2025 Urban Water Management Plan

Adopted June 18, 2026



PCWA

www.pcwa.net



2025 Urban Water Management Plan

ADOPTED JUNE 18, 2026

Prepared by Water Systems Consulting, Inc



ACKNOWLEDGEMENTS

The 2025 Urban Water Management Plan was prepared by Water Systems Consulting, Inc. The primary authors are listed below.

Jeroen Olthof

Stephanie Ard

Adrianna Lemanek

Water Systems Consulting, Inc. would like to acknowledge the significant contributions of Placer County Water Agency. The primary contributors are listed below.

Steve Bowman

Brian Rickards

Tony Brillante

Jeremy Shepard

Linda Higgins

TABLE OF CONTENTS

1 Introduction and Lay Description 1-1
1.1 Introduction for PCWA 1-2
1.2 California Water Code 1-2
1.3 UWMP Organization 1-3
1.4 Changes Since 2020 1-4
1.5 UWMPs in Relation to Other Efforts 1-5
1.6 UWMPs and Grant or Loan Eligibility 1-5
1.7 Consistency with the Delta Plan for Participants in Covered Actions 1-5
1.8 Lay Description 1-6
2 Plan Preparation 2-1
2.1 Basis for Preparing a Plan 2-2
2.2 Regional Planning 2-2
2.3 Coordination and Outreach 2-3
3 System Description 3-1
3.1 General Description 3-2
3.2 Classification of Water Usage 3-2
3.3 Service Area Boundary Maps 3-3
3.4 Service Area Climate 3-11
3.5 Climate Change 3-14
4 Water Use Characterization 4-1
4.1 Non-Potable Versus Potable Water Use 4-2
4.2 Western Area Water Use 4-2
4.3 Zone 3 Water Use 4-14
4.4 Total PCWA Water Use 4-16
4.5 Distribution System Water Losses 4-17
4.6 Worksheets and Reporting Tables 4-22
4.7 Water Use for Lower Income Households 4-22
4.8 Climate Change Considerations 4-23
5 SB X7-7 Baselines, Targets, and 2025 Compliance 5-1
5.1 SBX7-7 Forms and Tables 5-2
5.2 2025 Compliance Daily Per-Capita Water Use 5-2
6 Water Supply Characterization 6-1

6.1 Water Supply Analysis Overview 6-2
6.2 Water Supply Characterization 6-2
6.3 Energy Intensity 6-17
7 Water Service Reliability and Drought Risk Assessment 7-1
7.1 Introduction 7-2
7.2 Water Service Reliability Assessment 7-2
7.3 Drought Risk Assessment 7-8
8 Water Shortage Contingency Plan 8-1
8.0 Introduction 8-2
8.1 Overview of WSCP Components 8-2
9 Demand Management Measures 9-1
9.1 Demand Management Measures for Wholesale Suppliers 9-2
9.2 Existing Demand Management Measures for Retail 9-3
10 Plan Adoption, Submittal, and Implementation 10-1
10.1 Notice of Plan Preparation (60-Day Notice) 10-2
10.2 Notice of Public Hearing 10-2
10.3 Public Hearing and Adoption 10-2
10.4 Plan Submittal 10-2
10.5 Public Availability 10-3
10.6 Amending an adopted UWMP or WSCP 10-3
References REF-1
Appendix A Notification to Agencies ..... A
Appendix B DWR Tables ..... B
Appendix C DWR Checklist C
Appendix D SBX7-7 Forms ..... D
Appendix E AWWA Water Audits ..... E
Appendix F Land Use Exhibits ..... F
Appendix G North American Subbasin Groundwater Sustainability Plan 2021 ..... G
Appendix H Water Shortage Contingency Plan ..... H
Appendix I Adoption Documentation I

LIST OF FIGURES

Figure 3-1: PCWA's Service Area 3-4
Figure 3-2: PCWA's Service Area – Zone Boundaries 3-5
Figure 3-3: Zone 1 Canals 3-8
Figure 3-4: Zone 3 Canals 3-10
Figure 3-5: Annual Precipitation in Auburn from 2005-2025 3-12
Figure 3-6: Annual Precipitation in Colfax from 2005-2025 3-12
Figure 3-7: American River Basin Study 3-15
Figure 3-8: Projected Changes in July Temperature between Historical and End of Century Under Central Tendency Climate Change 3-17
Figure 3-9: Distribution of Average Monthly Runoff for Historical Record (1922-2015) and Future Projections Under Central Tendency Climate Scenario 3-19
Figure 3-10: Exceedance Plot of Folsom Reservoir Storage (end of September) Under Future Climate Change 3-20
Figure 3-11: Placer County Land Use Map 3-22
Figure 4-1: Planning Subareas 4-4
Figure 4-2: Water Supply Summary Map 4-10
Figure 6-1: Western Placer County Groundwater Management Plan Area 6-4

LIST OF TABLES

Table 2-1: Public and Agency Coordination 2-4
Table 3-1. Historical Climate for Roseville 3-13
Table 3-2. Historical Climate for Auburn 3-13
Table 3-3. Historical Climate for Colfax 3-14
Table 3-4: Projected Changes in Precipitation and Temperature Over the ARBS's Study Area Between Historical and End of Century 3-17
Table 3-5: Change in Hydrologic Indicators Between Historical Observations and Projected Future Hydrology 3-19
Table 3-6: Current and Projected Population 3-21
Table 4-1: PCWA Approved Land Use Plans 4-5
Table 4-2: Placer County Approved Land Use Plans 4-5
Table 4-3: PCWA Available Untreated Supply to Wholesale Agencies 4-9
Table 4-4: Western Area Historical Water Use, AFY 4-11
Table 4-5: Western Area Treated Retail Demand Factors 4-12
Table 4-6: Western Area Projected Water Use, AFY 4-13
Table 4-7: Zone 3 Historic Water Use, AFY 4-15
Table 4-8: Zone 3 Projected Water Use, AFY 4-16
Table 4-9: Summary of PCWA Historical Total Customer Demands, AFY 4-16
Table 4-10: Summary of PCWA Total Customer Demand Projections, AFY 4-17
Table 4-11: Progress Toward 2028 Water Loss Standard 4-19
Table 4-12: Water Loss Audit Reporting 4-20
Table 4-13: Future Distribution System Water Losses 4-21
Table 4-14: Low-Income Water Use, AFY 4-23
Table 5-1: 2020 GPCD 5-2
Table 6-1: PCWA Surface Water Supply Summary 6-5
Table 6-2: Buildout Treated Water Demands 6-12
Table 6-3: Planned Water Treatment Plant (WTP) Capacity 6-13

Table 6-4: DWR 6-4R Recycled Water Direct Beneficial Uses Within Service Area (in AF)... 6-14
Table 6-5: DWR 6-5R 2020 UWMP Recycled Water Use Projection Compared to 2025 Actual (in AF)... 6-14
Table 6-6: Existing and Planned Supplies, AFY ... 6-16
Table 6-7: Energy Estimate (in KW-Hours) for Extraction or Diversion of Water Supplies ... 6-17
Table 6-8: Energy Estimate (in Kw-Hours) for Conveying Supplies to WTPs or Distribution Systems ... 6-18
Table 6-9: Energy Estimate (in KW-Hours) to Treat Water Supplies ... 6-18
Table 6-10: Energy Estimate (in KW-Hours) to Distribute Water Supplies ... 6-18
Table 7-1: Water Supply Constraints ... 7-3
Table 7-2: Normal Year Supplies ... 7-4
Table 7-3: Single Dry Year Supplies ... 7-5
Table 7-4: Five Consecutive Year Drought ... 7-6
Table 7-5: Average Year Supply and Demand Comparison ... 7-6
Table 7-6: Single Dry Year Supply and Demand Comparison ... 7-7
Table 7-7: Multiple Dry Years Supply and Demand Comparison ... 7-7
Table 7-8: Five-Year Drought Risk Assessment (AFY) ... 7-9
Table 9-1: Online Advertising Summary ... 9-4
Table 9-2: WEP Advertising Summary ... 9-6
Table 9-3: Regional Rebates and Installation from 2021-2025 ... 9-7

ACRONYMS & ABBREVIATIONS

°F	Degrees Fahrenheit
%	Percent
AB	Assembly Bill
AF	Acre Foot
AFY	Acre Feet per Year
AMI	Advanced Metering Infrastructure
ARBS	American River Basin Society
ARPS	American River Pump Station
AWWA	American Water Works Association
Basin	American River Basin
BCM	Basin Characterization Model
Cal-Am	California American Water Company
CASGEM	California Statewide Groundwater Elevation Monitoring
CFS	Cubic Feet per Second
CII	Commercial, Industrial, and Institutional
CIMIS	California Irrigation Management Irrigation System
CMMS	Computerized Maintenance Management System
Co.	Company
CPUC	California Public Utilities Commission
CSD	Community Service District
CVP	Central Valley Project
CWC	California Water Code
DMM	Demand Management Measure
DPWM	Distributed Parameter Watershed Model
DRA	Drought Risk Assessment
DWR	California Department of Water Resources
EIR	Environmental Impact Report

EPA	United States Environmental Protection Agency
ETo	Reference Evapotranspiration
GIS	Geographic Information System
GPCD	Gallons per Capita per Day
GPSCD	Gallons per Service Connection per Day
GPF	Gallons Per Flush
GSP	Groundwater Sustainability Plan
LINCOLN	City of Lincoln
M&I WSP	Municipal and Industrial Water Shortage Policy
MFP	Middle Fork American River Project
MG	Million Gallons
MGD	Million Gallons per Day
MHCWD	Midway Heights Community Water District
MWELO	Model Water Efficient Landscape Ordinance
NID	Nevada Irrigation District
NCSD	Northstar Community Services District
PCWA	Placer County Water Agency
PET	Potential evapotranspiration
PG&E	Pacific Gas and Electric Company
PSAS	Public Service Announcements
ROSEVILLE	City of Roseville
RWA	Regional Water Authority
SBX7-7	Senate Bill 7 of Special Extended Session 7
SF	Square Feet
SJWD	San Juan Water District
SODU	Statements of Water Diversion and Use
SPMUD	South Placer Municipal Utility District
SSWD	Sacramento Suburban Water District
SVI	Sacramento Valley Index
SWE	Snow water equivalent
TAF	Thousand acre-feet

UIFR	Unimpaired Inflow into Folsom Reservoir
USBR	United States Bureau of Reclamation
UWMP	Urban Water Management Plan
UWMP ACT	Urban Water Management Planning Act
UWUO	Urban Water Use Objective
WEP	Water Efficiency Program
WFA	Water Forum Agreement
WSCP	Water Shortage Contingency Plan
WPCGMP	Western Placer County Groundwater Management Plan
WPGSA	West Placer Groundwater Sustainability Agency
WRCC	Western Regional Climate Center
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1 Introduction and Lay Description

This section provides a brief overview of Placer County Water Agency (PCWA) and the purpose of this 2025 Urban Water Management Plan (UWMP). It also describes how the UWMP is organized and its relationship with local and regional planning efforts in which PCWA is involved.

IN THIS SECTION

- Introduction for Placer County Water Agency
- California Water Code
- UWMP Organization
- Changes Since 2020
- UWMPs in Relation to Other Efforts
- UWMPs and Grant or Loan Eligibility
- Consistency with the Delta Plan for Participants in Covered Actions
- Lay Description

1.1 Introduction for PCWA

PCWA was created in 1957 by a special act of the California Legislature known as the Placer County Water Agency Act. PCWA has a five-member board of directors elected by district voters for four-year terms. The boundaries of PCWA are coterminous with the boundaries of Placer County.

PCWA carries out a broad range of responsibilities including water resource planning and management, wholesale and retail supply of water, and hydroelectric energy production. PCWA has existing surface water appropriative rights as well as contract entitlements of approximately 300,000 acre-feet per year (AFY). PCWA also has access to sustainably managed regional groundwater resources to manage emergency conditions.

PCWA currently delivers approximately 100,000 AFY of treated and untreated water to retail customers, providing treated drinking water for nearly 130,000 people and untreated water for about 10,000 people. In addition, PCWA provides approximately 64,000 AFY of treated and untreated wholesale water to neighboring water suppliers for resale,. In total, the agency's water deliveries support close to 350,000 people based on current estimates. These values reflect updated demand projections since the 2020 UWMP. Changes are attributable to updated population projections, conservation program performance, and revised wholesale delivery assumptions. In addition, PCWA regularly makes surface water available for transfer to other purveyors in the state and to assist fishery protection goals in the lower American River during periods of drought.

PCWA has prepared this UWMP to comply with the Urban Water Management Planning Act (UWMP Act) requirements for urban water suppliers. This UWMP addresses PCWA's water management planning efforts to ensure adequate water supply to meet retail and wholesale demands over the next 25 years. The 2025 UWMP specifically assesses the availability of supplies to meet future demands during normal, single-dry, and multiple dry years. Verification that future demands will not exceed supplies and assuring the availability of supplies in dry-year conditions are critical outcomes of this UWMP. This UWMP also provides verification that future demands, represented by existing General Plans within the land use jurisdictions served by PCWA, will not exceed PCWA's available water supplies.

1.2 California Water Code

In 1983, the State of California Legislature (Legislature) enacted the UWMP Act. The law requires an urban water supplier providing water for municipal purposes to more than 3,000 customers or serving more than 3,000 AFY to adopt a UWMP every five years. This UWMP must demonstrate water supply reliability under both normal and drought conditions. The UWMP Act applies to wholesale and retail water suppliers.

Since the original UWMP Act was passed, it has undergone significant expansion. Prolonged droughts, groundwater overdraft, regulatory revisions, and changing climatic conditions affect the reliability of each water supplier as well as statewide water reliability overseen by California

Department of Water Resources (DWR), the State Water Resources Control Board (SWRCB), and the Legislature. Accordingly, the UWMP Act has grown to address changing conditions. The current requirements are found in Sections 10610-10656 and 10608 of the California Water Code (CWC).

DWR provides guidance for urban water suppliers by preparing an Urban Water Management Plan Guidebook 2025 (Guidebook), conducting workshops, developing tools, and providing program staff to help water suppliers prepare comprehensive and useful water management plans, implement water conservation programs, and understand the requirements of the CWC. Suppliers prepare their own UWMPs and submit them to DWR. DWR then reviews the plans to make sure they have addressed the requirements; DWR submits a report to the Legislature summarizing the status of the plans for each five-year cycle.

This 2025 UWMP was developed using the Guidebook, finalized in 2026. Its purpose is to aid PCWA's evaluation of long-term resource planning and establish management measures to ensure adequate water supplies are available to meet existing and future demands. The UWMP provides a framework to help water suppliers maintain efficient use of urban water supplies, promote conservation programs and policies, ensure that sufficient water supplies are available for future beneficial use, and provide a response mechanism during drought conditions or other water supply shortages.

The UWMP is a valuable planning tool used for multiple purposes, including:

- Providing a standardized methodology for water utilities to assess their water resource needs and availability.
- Serving as a resource to the community and other interested parties regarding water supply and demand, conservation, and other water-related information.
- Providing a key source of information for cities and counties when considering approval of proposed new developments and preparing long-range regional planning documents, such as city and county General Plans.
- Informing other regional and statewide water planning efforts, such as Integrated Regional Water Management Plans and the California Water Plan.

CWC 10632 also includes requirements for suppliers to prepare a Water Shortage Contingency Plan (WSCP). The WSCP documents a supplier's plans to manage and mitigate an actual water shortage condition, should one occur because of drought or other impacts on water supplies. The WSCP is a standalone document that can be updated independently of the UWMP but is referenced and attached to the 2025 UWMP. The WSCP is provided in Appendix H.

1.3 UWMP Organization

The 2025 UWMP is organized as follows:

Section 1 – Introduction and Lay Description

This section provides background information on the UWMP process, new regulatory requirements, and an overview of the information covered throughout the remaining sections.

Section 2 – Plan Preparation

This section provides information on the processes used to develop the UWMP, including coordination and outreach efforts.

Section 3 – System Description

This section describes PCWA's water system, service area, population demographics, local climate, and land uses.

Section 4 – System Water Use

This section describes and quantifies the current and projected water uses through 2050 within the water service area.

Section 5 – SBX7-7 Baseline, Targets and Compliance

This section demonstrates PCWA's compliance with the SBX7-7 water use targets.

Section 6 – System Supplies

This section describes and quantifies the current and projected potable and non-potable water supplies.

Section 7 – Water Supply Reliability

This section describes the water service reliability through 2050 and includes the Drought Risk Assessment (DRA) for the next five years.

Section 8 – Water Shortage Contingency Plan

This section includes an overview of the standalone WSCP. The complete WSCP is included as Appendix H.

Section 9 – Demand Management Measures

This section describes efforts to promote conservation and reduce water demand, including discussions of specific demand management measures.

Section 10 – Plan Adoption, Submittal, and Implementation

This section describes steps taken to adopt and submit the UWMP and to make it publicly available.

1.4 Changes Since 2020

Since the 2020 UWMP cycle, DWR has updated the UWMP Guidebook to reflect revisions to the CWC and to provide additional clarification and guidance for plan preparation. The 2025 Guidebook refines reporting expectations for water demand and supply characterization, treatment and capacity accounting, climate change considerations, and related planning elements, and it includes updated submittal tables to improve consistency and comparability statewide. These guidebook updates have been used in preparation of this UWMP to ensure

consistency with current DWR guidance while maintaining continuity with the planning approach established in the 2020 UWMP.

1.5 UWMPs in Relation to Other Efforts

This UWMP characterizes water use, estimates future demands and supply sources, and evaluates supply reliability for normal, single-dry, and five consecutive dry years. The UWMP also requires a standalone WSCP, which is provided in Appendix H.

In addition to the 2025 UWMP, PCWA is involved in several internal and external planning efforts. It collaborates with a variety of stakeholders to achieve consistency between various planning documents locally and regionally.

Documents that were leveraged in preparation of this UWMP are:

- 2007 Western Placer County Groundwater Management Plan
- 2013 Placer County General Plan and the 2024 General Plan Annual Progress Report;
- 2014 Sacramento Groundwater Authority, Groundwater Management Plan
- 2018 Regional Water Authority Integrated Regional Water Management
- 2020 PCWA UWMP
- 2020 PCWA Water Shortage Contingency Plan
- 2022 American River Basin Study
- 2025 Placer County Economic and Demographic Profile
- DWR's Urban Water Management Plan Guidebook 2025

1.6 UWMPs and Grant or Loan Eligibility

For a water supplier to be eligible for a grant or loan administered by DWR, the supplier must have a current UWMP on file that meets the requirements set forth by the CWC. A current UWMP must also be maintained by the supplier throughout the term of any grants or loans received. PCWA has prepared the 2025 UWMP using guidance from DWR's 2025 UWMP Guidebook.

1.7 Consistency with the Delta Plan for Participants in Covered Actions

Pursuant to guidance from the DWR, an urban water supplier that anticipates participating in or receiving water from a proposed project (or "covered action") such as a multi-year water transfer, conveyance facility, or new diversion involving the Sacramento–San Joaquin Delta, should provide information in its UWMP to demonstrate consistency with Delta Plan Policy WR P1, "Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance."

PCWA's water supply portfolio is primarily sourced from local surface water and groundwater within the American River watershed, supplemented by contract deliveries from the Central Valley Project. PCWA does not directly rely on imported water supplies conveyed through the

Delta for normal or emergency operations. PCWA actively implements programs to enhance regional self-reliance, including conservation, groundwater management, and drought preparedness, and does not anticipate participating in or benefiting from any Delta-related covered actions during the 2025 UWMP planning horizon.

Accordingly, this section is not applicable to PCWA. However, PCWA remains committed to supporting statewide goals for water efficiency and regional sustainability through its ongoing resource management strategies.

1.8 Lay Description

This UWMP explains how PCWA plans to meet water demands over the next 25 years under normal and drought conditions and describes actions to ensure reliable water supplies for the communities that it serves.

The UWMP is prepared in accordance with California State requirements and updated every five years to reflect new data, regulatory changes, and evolving water-management priorities. Adoption of the UWMP demonstrates PCWA's compliance with State law and provides transparency to the public on how water resources are managed to support long-term reliability, sustainability, and community resilience.

2 Plan Preparation

This section provides information on the processes used to develop the UWMP, including efforts in coordination and outreach.

IN THIS SECTION

- Basis for Preparing a Plan
- Regional Planning
- Coordination and Outreach
- Water Forum Agreement
- Regional Water Authority
- Additional Entities

2.1 Basis for Preparing a Plan

The UWMP Act requires every urban water supplier to prepare an UWMP pursuant to CWC § 10610 et seq. Because PCWA is an urban water supplier, it is preparing its 2025 UWMP consistent with the UWMP Act. The plan provides a framework for water planning to minimize the negative effects of potential water shortages and provides useful information to the public about PCWA and its water management programs.

Specifically, the 2025 UWMP describes and evaluates the reliability of PCWA's existing and planned water supplies to meet forecasted near-term and long-term customer demands. The plan assesses the availability and sufficiency of surface, groundwater, and recycled water assets and the vulnerability of these supplies to seasonal, climactic, seismic, and regulatory conditions.

The 2025 UWMP also demonstrates compliance with the target conservation values as presented in PCWA's 2020 UWMP. This UMWP includes narratives describing water demand management measures (DMMs), PCWA's long-term plan for efficient water use, and estimated future water savings based on water use projections, where available. Consideration of distribution system water loss, climate change, seismic risk, and recycled water potential use as a water source is included. The 2025 UWMP also provides a comprehensive water shortage contingency analysis, which details stages of action to be undertaken by PCWA in response to water supply shortages.

2.2 Regional Planning

The CWC indicates that both urban wholesale and retail water suppliers are required to prepare UWMPs. Wholesale and retail suppliers are also to coordinate and provide water use and supply information to each other during preparation of their respective UWMPs. There are several instances within the UWMP Act where the requirements for wholesale and retail urban water suppliers differ. These include:

- **Past Water Use and Water Loss** – Only retail urban water suppliers are required to report past water use and water loss. Wholesale urban water suppliers can include information if desired.
- **SBX7-7 Baselines and Targets** – Only retail urban water suppliers are required to provide a baseline and urban water use target and identify if the SB X7-7 water use target was met.
- **Water Use Reduction** – Wholesale suppliers are to provide "an assessment of their present and proposed future measures, programs, and policies to help achieve the water use reductions."
- **DMMs** – Wholesale suppliers provide documentation for DMMs as required under CWC 10631(e)(1)(B). Retail suppliers provide documentation for each DMM as required under CWC 10631(e)(1)(A).
- **Lower Income Household** – Only retail urban water suppliers are required to address the lower income water supply projections required by CWC 10631.1.

Since PCWA meets the CWC definition of a retail and wholesale urban water supplier, this 2025 UWMP will address both the retail and wholesale requirements of the UWMP Act.

2.3 Coordination and Outreach

The UWMP Act requires a water purveyor to coordinate the preparation of its UWMP with other appropriate agencies in and around its service area. PCWA coordinated with wholesale and retail agencies in accordance with California Water Code Section 10631. This includes other water suppliers that share a common source, water management agencies, and relevant public agencies. PCWA has prepared this UWMP in coordination with water utilities that receive wholesale water from PCWA, as well as other appropriate local government agencies, as listed Table 2-1. All relevant entities and adjacent water suppliers were sent 60-day notices and encouraged to attend the public hearing prior to the adoption of the 2025 UWMP. Copies of the letters and other correspondence are provided in Appendix A. PCWA is also a part of local partnerships that enhance water resources and the environment. These partnerships are discussed in further detail in the following section.

Table 2-1: Public and Agency Coordination

AGENCY	DEMAND COORDINATION	SENT 60-DAY NOTICE	NOTICE OF PUBLIC HEARING
WHOLESALE CUSTOMERS FROM FOLSOM LAKE			
City of Roseville	X	X	X
San Juan Water District	X	X	X
Sacramento Suburban Water District	X	X	X
TREATED WATER WHOLESALE CUSTOMERS - URBAN WATER SUPPLIERS			
City of Lincoln	X	X	X
California American Water Company	X	X	X
TREATED WATER WHOLESALE CUSTOMERS - NOT URBAN WATER SUPPLIERS			
Heather Glen Community Service District (CSD)		X	X
Meadow Vista County Water District		X	X
Willow-Glen Water Co.		X	X
Midway Heights County Water District		X	X
Christian Valley Park CSD		X	X
Folsom Lake Mutual Water Co.		X	X
Golden Hills Mutual Water Co.		X	X
Hidden Valley Community Association		X	X
Lakeview Hills Community Association		X	X
LAND USE ENTITIES AND INTERESTED PARTIES			
General Public			X
Placer County		X	X
Sacramento County		X	X
Nevada Irrigation District		X	X
City of Rocklin		X	X
Town of Loomis		X	X
City of Auburn		X	X
City of Colfax		X	X
United States Bureau of Reclamation		X	X
Pacific Gas & Electric		X	X
Water Forum			X

2.3.1 Water Forum Agreement

Businesses, environmental entities, citizen groups, public interests, community leaders, along with water purveyors in Sacramento, Placer, and El Dorado counties negotiated the Water Forum Agreement (WFA). The WFA is a comprehensive package of linked actions that will achieve two coequal objectives: (1) Provide a reliable and safe water supply for the Sacramento region's long-term growth and economic health; and (2) Preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River. PCWA is a signatory to the WFA. As one of the signatories, PCWA has agreed to specific water management actions under a range of hydrologic conditions that are linked primarily to the American River Basin and Folsom Reservoir. The water management actions impact the operation of PCWA's Middle Fork American River Project (MFP) reservoirs as replacement water to benefit the Lower American River. Pursuant to the WFA provisions, PCWA has also developed best management practices that are consistent with the DMMs in the 2025 UWMP.

2.3.2 Regional Water Authority

The Regional Water Authority (RWA) is a joint powers authority that serves and represents the interests of 20 water providers in the greater Sacramento, Placer, El Dorado, and Yolo County regions. The Authority's primary mission is to help its members protect and enhance the reliability, availability, affordability, and quality of water resources. RWA has launched significant programs and services on a regional scale, including: (1) A water efficiency program designed to help local purveyors implement best management practices on a regional basis; (2) implementation of the American River Basin Regional Conjunctive Use Program to build and upgrade water facilities throughout the region to better manage surface and groundwater resources; and (3) development of an Integrated Regional Water Management Planning Program to continually identify the regional projects and partnerships that will help the region best meet its future water needs. PCWA is an active member of RWA and holds executive positions on the RWA Board.

2.3.3 Additional Entities

PCWA has shared water interests with numerous local and regional water purveyors. The list of these purveyors is incorporated in Table 2-1. Specifically, PCWA provides surface water to San Juan Water District (SJWD), the City of Roseville (Roseville), the City of Lincoln (Lincoln), Sacramento Suburban Water District (SSWD), California American Water Company (Cal-Am) and other local purveyors within Placer County. Moreover, PCWA accesses groundwater from the Sacramento North American Groundwater Basin (described in more detail in Section 6) that also overlaps with numerous water agency boundaries.

3 System Description

PCWA provides treated and untreated water to its wholesale and retail customers. PCWA's treated retail system serves a current population of 126,633. PCWA's service area consists of mixed land use including residential, commercial and agriculture. This section describes PCWA's water system, service area, population demographics, local climate, and land uses.

IN THIS SECTION

- General Description
- Classification of Water Usage
- Service Area Boundary Map
- Service Area Climate
- Climate Change
- Service Area Population and Demographics
- Land Uses with Service Area

3.1 General Description

PCWA is a public water agency that provides treated and untreated water both directly and indirectly to wholesale and retail customers throughout Placer County. Historically, water use in the region began in the 1850's, and was primarily utilized for mining, agricultural, and residential purposes. This disaggregated usage lasted through the 1950's. In 1957, the Placer County Water Agency Act was signed by Governor Goodwin Knight, creating the Placer County Water Agency. Shortly thereafter, PCWA constructed the Middle Fork American River Hydroelectric Project on the Middle Fork American River and selected tributaries, securing a reliable water and energy source for the county.

PCWA's service area encompasses the entirety of Placer County, extending from the community of Alta on the east, westward along the Interstate 80 corridor, and bounded by Sutter County to the west, Sacramento and El Dorado Counties to the south, and Nevada County to the north. Within this area, PCWA provides retail treated water service to the communities of Alta, Monte Vista, Applegate, Colfax, Auburn, Loomis, Rocklin, and many of the surrounding unincorporated areas within Placer County. PCWA also provides wholesale treated water to Lincoln, Cal-Am for use in their franchise area west of Roseville and south of Baseline Road, and to various smaller mutual water companies and towns throughout the service area.

In addition to treated water service, PCWA provides untreated water through its extensive canal system to individual customers, and untreated water for treatment and resale by other retail water purveyors. Untreated water comprises approximately 70 percent (%) of PCWA's deliveries.

The service area is composed of four distinct systems, each acquired or developed over time and designated as a PCWA Zone: numbered 1, 2, 3 and 5, or aggregately together as Zone 6. Zone 4 (Martis Valley) is no longer part of PCWA's operations; it was detached and transferred to Northstar Community Services District (NCSD) in 2015 and remains outside PCWA's service area. These four active zones are described in greater detail in Section 3.3.

PCWA also provides untreated water under its North Fork American River water rights into Folsom Lake for delivery to the SJWD, Roseville, and SSWD, each of which are required to prepare their own UWMPs. As a result, the place of use for PCWA's water rights extends beyond the agency's district boundaries.

3.2 Classification of Water Usage

PCWA is both a retail water purveyor and a wholesale water purveyor that provides treated and untreated water to a diverse customer base. Because of this customer diversity, PCWA classifies its customers into four categories for purposes of assessing existing and future demands:

- **Treated Retail Water** – Potable water that is directly served to PCWA's customers for potable water use.

- **Untreated Retail Water** – Untreated water directly serviced to PCWA's customers from PCWA's non-potable surface water system for commercial agriculture and rural residential outdoor use.
- **Treated Wholesale Water** – Potable water treated at PCWA-owned water treatment facilities and sold to other water suppliers who then deliver to customers. (PCWA does not directly serve the end-user).
- **Untreated Wholesale Water** – Untreated water sold to other water suppliers who treat and deliver purchased water to their customers (PCWA does not directly serve the end-user).

These categories are discussed in more depth in Section 4.

3.3 Service Area Boundary Maps

Figure 3-1 and Figure 3-2 illustrate PCWA Service area boundary and surrounding region. These maps depict the full extent of the Agency's retail and wholesale service areas, divided into Upper and Lower Zone 6 based on elevation and system configuration, and identify adjacent jurisdictions, wholesale customers, and nearby water service providers.

3.3.1 Zone 6

Zone 6 represents the consolidated Western Water System encompassing all treated and untreated water service areas previously administered as Zones 1, 2, 3, and 5. Although each zone maintains distinct operational characteristics, water supply sources, and infrastructure, they are collectively managed within Zone 6 for planning, system integration, and long-term investment purposes.

For the purposes of this UWMP:

- Zone 1, Zone 2, and Zone 5 function as the Western Area (Lower Zone 6).
- Zone 3 functions as Upper Zone 6 due to its elevation, distribution hydraulics, and unique supply contract.

The following subsections maintain full detail on each legacy zone while placing them within the unified Zone 6 structure.

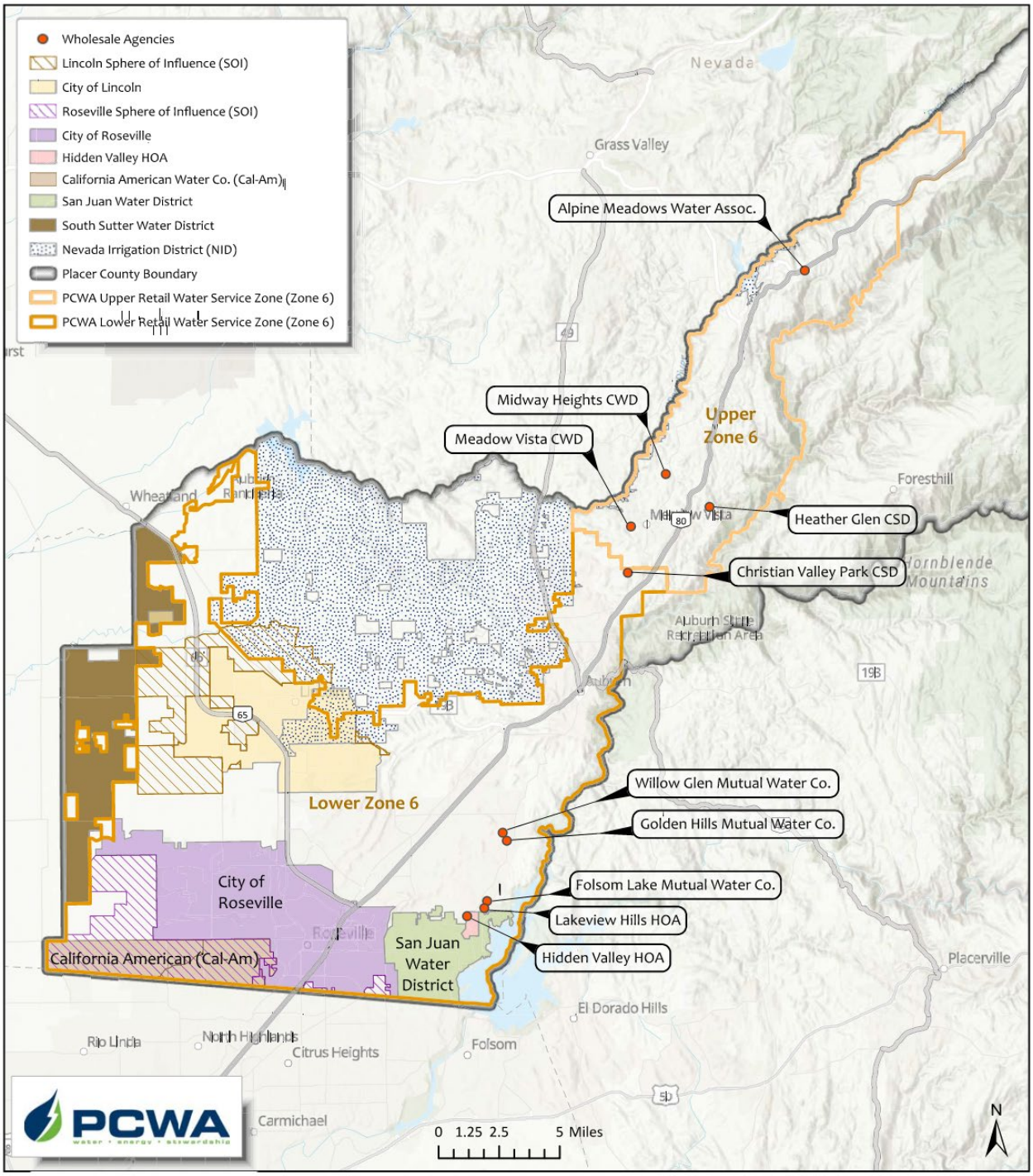


Figure 3-1: PCWA's Service Area

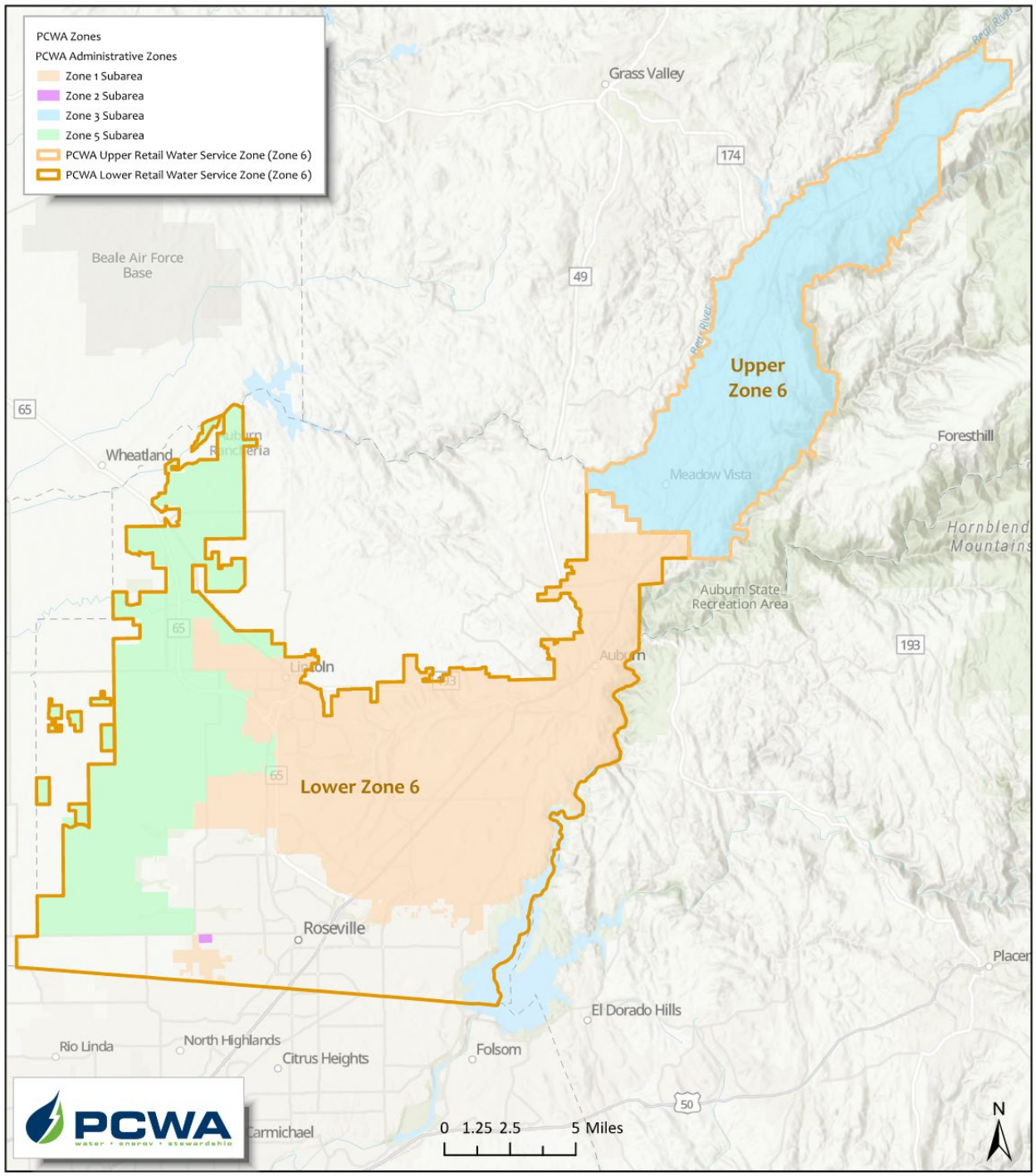


Figure 3-2: PCWA's Service Area – Zone Boundaries

3.3.2 Zone 6 - Zone 1 Subarea

Zone 1 is the largest component of Zone 6, stretching from the City of Auburn north to City of Lincoln and south to the Sacramento County line. PCWA provides retail treated water, wholesale treated water (to the City of Lincoln, Cal-Am, and smaller purveyors), and untreated irrigation water. Christian Valley Park CSD receives raw water and operates its own water treatment plant (WTP).

Zone 1 receives water from two primary supply systems:

- PG&E's Drum-Spaulding system, conveying Bear and Yuba River water via the Bear River Canal, Wise Canal, and South Canal.
- PCWA's Middle Fork Project (MFP), where American River water from Hell Hole and French Meadows Reservoirs is pumped into the system at Auburn as needed.

Zone 1 includes four PCWA WTPs, 18 treated water storage tanks totaling approximately 63 MG, and 643 miles of treated water pipeline. Figure 3-3 provides a map of the Zone 1 canal and supply infrastructure.

3.3.2.1 Upper Zone 1 Subarea

Upper Zone 1 encompasses Auburn and nearby communities, which must be supplied exclusively with PG&E contract water due to elevation constraints that preclude direct delivery of pumped MFP supply. PG&E conveys water through the Bear River Canal and Wise/South Canal system to PCWA's Auburn WTP (8 MGD) and Bowman WTP (7 MGD).

After treatment, water is distributed by gravity to customers in Auburn, Bowman, Newcastle, and surrounding areas. PCWA also conveys untreated water from Upper Zone 1 to treatment plants in Lower Zone 1, including Christian Valley Park CSD.

Upper Zone 1 consists of five service subareas:

- Auburn/Bowman
- City of Auburn
- City of Auburn Airport
- Newcastle/Ophir
  Unincorporated Newcastle

3.3.2.2 Lower Zone 1 Subarea

Lower Zone 1 includes Horseshoe Bar/Penryn, the Loomis Basin (Town of Loomis and unincorporated areas), Bickford Ranch, Granite Bay, Rocklin, Whitney Ranch, Lincoln, Roseville, and the Sunset Industrial Area.

The primary source is PG&E contract water from the Drum-Spaulding system, with supplemental American River supply from the MFP. MFP water is pumped into the Auburn Tunnel and routed into the Zone 1 network, where it may serve:

- Zone 5 agricultural customers, or
- Foothill WTP or the future Ophir WTP via the Ophir Pump Station.

Lower Zone 1 treatment facilities include:

- Foothill WTP: 60 MGD
- Sunset WTP: 5 MGD

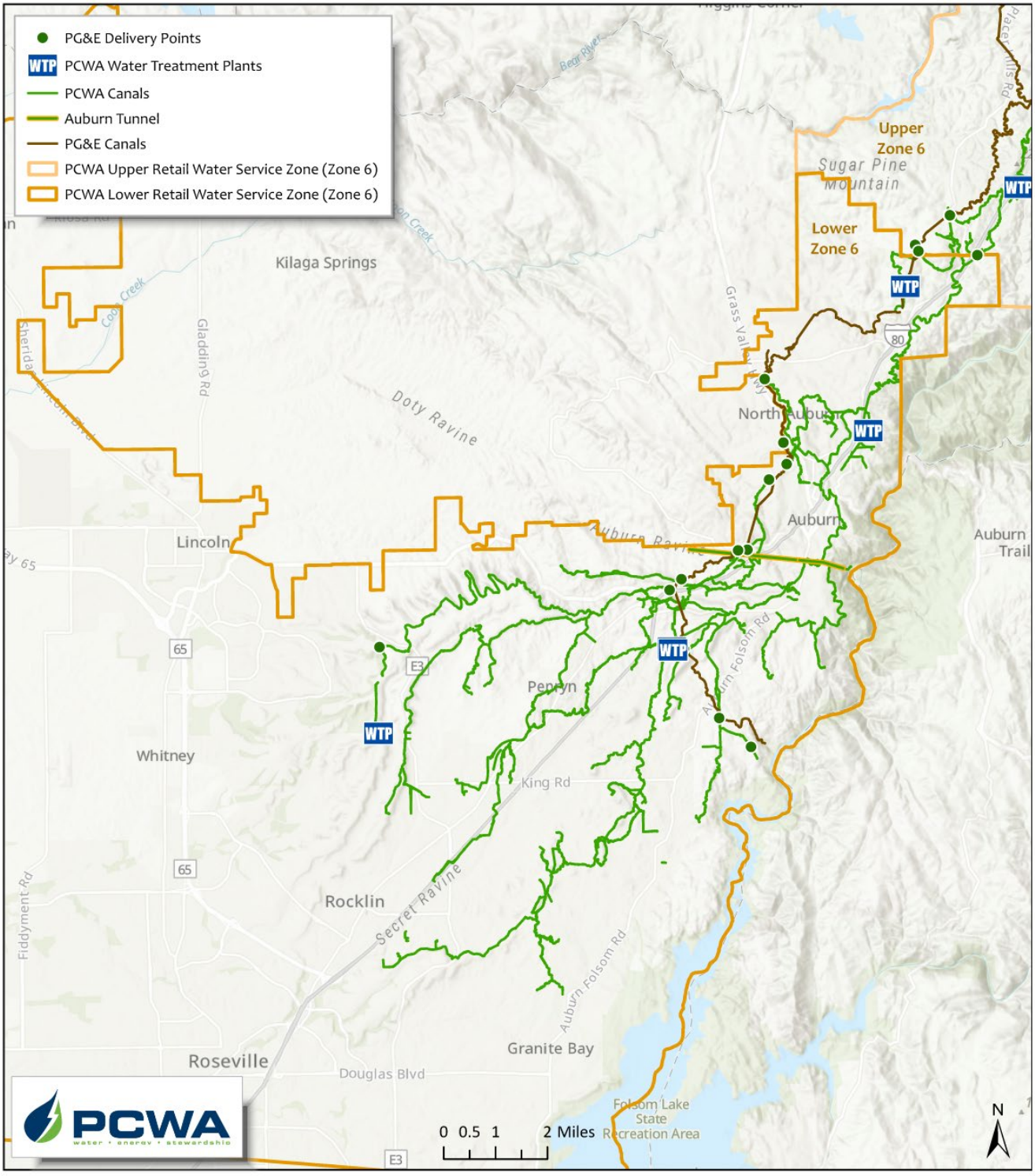


Figure 3-3: Zone 1 Canals

3.3.3 Zone 6 - Zone 2 Subarea

Zone 2 contains 39 active residential connections in Bianchi Estates south of Roseville. Formerly served by groundwater, the system was converted to surface water in 2003. Treated water is conveyed through the City of Roseville's distribution system under a wheeling agreement.

Because Zone 2 now relies entirely on Zone 1's infrastructure and treated supplies, it is integrated into Lower Zone 6 for UWMP analysis, consistent with the 2020 UWMP.

3.3.4 Zone 6 - Zone 3 Subarea

Zone 3, also known as Upper Zone 6, includes Applegate, Weimar, Meadow Vista, Colfax, Gold Run, Monte Vista, Dutch Flat, and Alta. Water is delivered under a 1982 PG&E contract via the Boardman Canal, beginning near Alta, paralleling Interstate 80, and eventually connecting to Zone 1 infrastructure.

PCWA operates five Zone 3 WTPs:

- Alta WTP – 0.512 MGD
- Monte Vista WTP – 0.102 MGD
- Colfax WTP – 1.244 MGD (scheduled replacement to 2–3 MGD)
- Weimar WTP – 1.0 MGD
- Applegate WTP – 0.071 MGD

Zone 3 operates approximately 56 miles of treated water piping and 3.7 MG of storage. Its unique reliance on the Boardman Canal and multiple small WTPs distinguishes it as Upper Zone 6. A graphical depiction of Zone 3 canals and supply infrastructure can be found in Figure 3-4.

3.3.5 Zone 6 - Zone 5 Subarea

Zone 5 was established in 2000 to serve commercial agricultural lands west of Lincoln. Untreated water is conveyed using Zone 1 infrastructure and sourced from both PG&E's Drum-Spaulding system and PCWA's MFP.

Zone 5 serves approximately 3,800 acres of irrigated agricultural land. It does not receive treated water and is analyzed as part of Lower Zone 6 for UWMP purposes.

3.3.6 Western Area (Lower Zone 6)

Zone 1, Zone 2, and Zone 5 will be referred to as the "Western Area" or "Lower Zone 6" in this UWMP, due to geographic overlap and operational integration of supplies and infrastructure. All water demands in these zones, including the treated wholesale demands, will be grouped under the term "Western Area Water Demands." Zone 3 remains distinct in both geography and supply characteristics and will continue to be referred to as "Zone 3" in this UWMP.

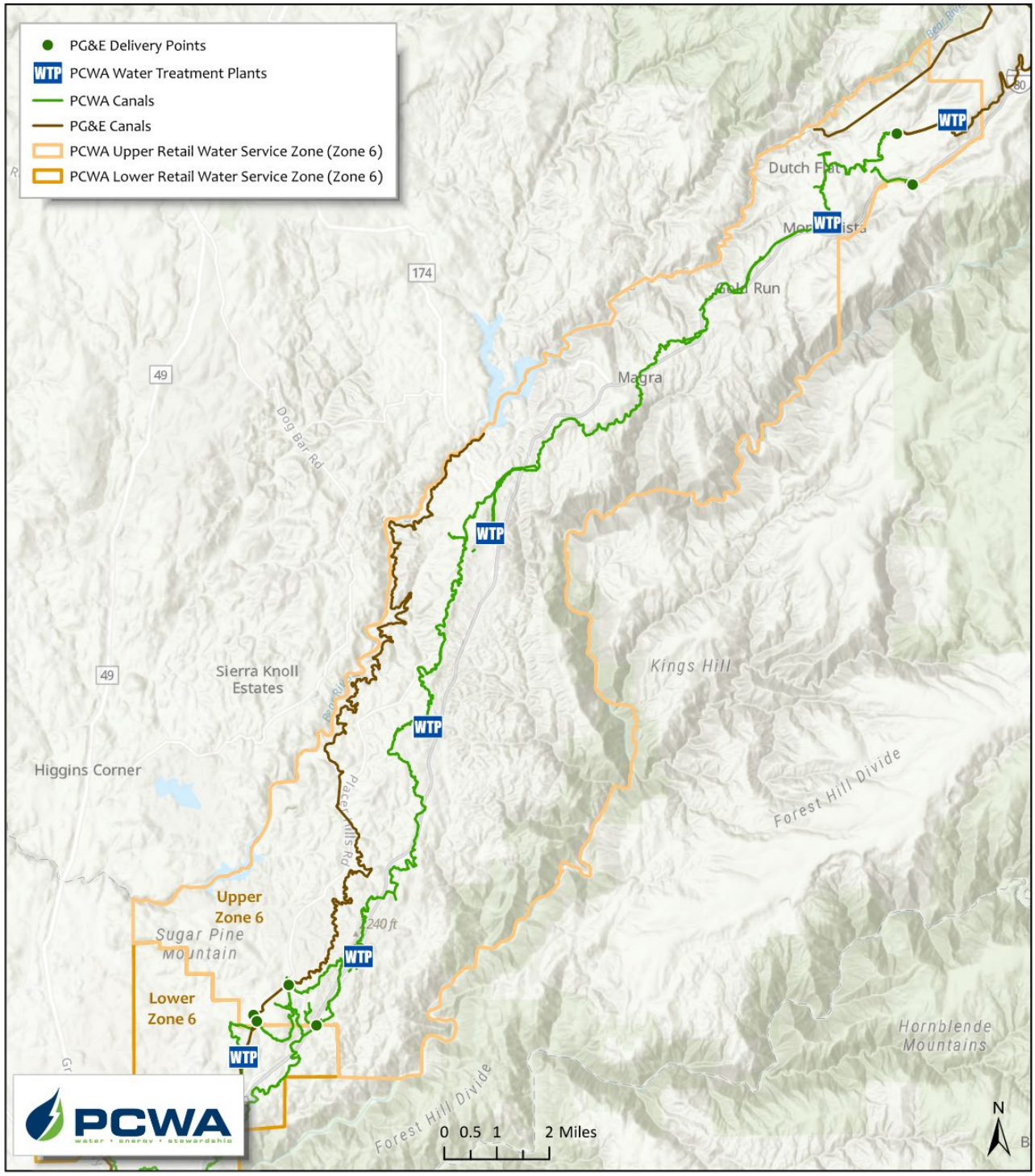


Figure 3-4: Zone 3 Canals

3.4 Service Area Climate

Climate across PCWA's service area varies widely due to significant differences in topography, elevation, and related climatological characteristics. This unique variation includes elevation ranges from about 150 feet in the west to nearly 4,000 feet in the east. There are significant climate variations even within PCWA's designated service zones. This section describes conditions across multiple distinct locations to represent the diversity of the service area climate.

The lower portion of Zone 1 (Lower Zone 1), Zone 2 and Zone 5 are in the western portion of Placer County. These zones have weather typical of California's Central Valley with hot dry summers and cool wet winters. The upper portion of Zone 1 (Upper Zone 1) consists of rolling foothills and associated large landscape development as well as climate variations associated with elevations up to 1,600 feet. The climate follows the pattern stated above and additionally includes evening temperatures cooling below areas further west as well as increased precipitation amounts caused by orographic uplift.

PCWA's Zone 3 extends from Zone 1 to elevations near 4,000 feet and is characterized by Sierra forest climate with warm summers, cold wet winters, and occasional snow. Precipitation at these elevations is significant. Spring runoff from higher elevations, above 4,000 feet, is the backbone of PCWA's water supply system.

Table 3-1 and Table 3-2 present average reference evapotranspiration (ETo), precipitation, and temperature for selected locations in the PCWA service area. Auburn and Roseville represent climate in two distinct areas of the PCWA Zone 1 service area: Upper and Lower, respectively. Colfax is representative of the climate in PCWA's Zone 3.

Roseville and Auburn include an additional column for ETo data from local California Irrigation Management Information System (CIMIS) stations. CIMIS data is not available for Colfax, though historical climate data for the region is available from the National Oceanic and Atmospheric Administration (NOAA) for the period 1905 through October 2025. Average snowfall values are included for Colfax in Table 3-3 in addition to precipitation data since this area receives significant annual snowfall. Temperature values are provided as monthly averages, and average maximum and minimum temperatures in degrees Fahrenheit (°F).

Figure 3-5 shows the annual precipitation from 2005 through 2025 in Auburn, representing Upper Zone 1, and illustrates which years had above or below the annual average precipitation. For comparison, Figure 3-6 presents average annual precipitation for Zone 3 over the same period. As shown by both figures, 2020 was the driest year since 2015, underscoring the importance of proactive water management to prepare for future droughts.

Future climate projections for the American River Basin indicate warmer temperatures (up to +7.2°F by 2100), reduced snowpack (50–85% decline), and more variable precipitation patterns. These changes will affect runoff timing and water supply reliability, reinforcing the need for adaptive management strategies in PCWA's planning efforts.

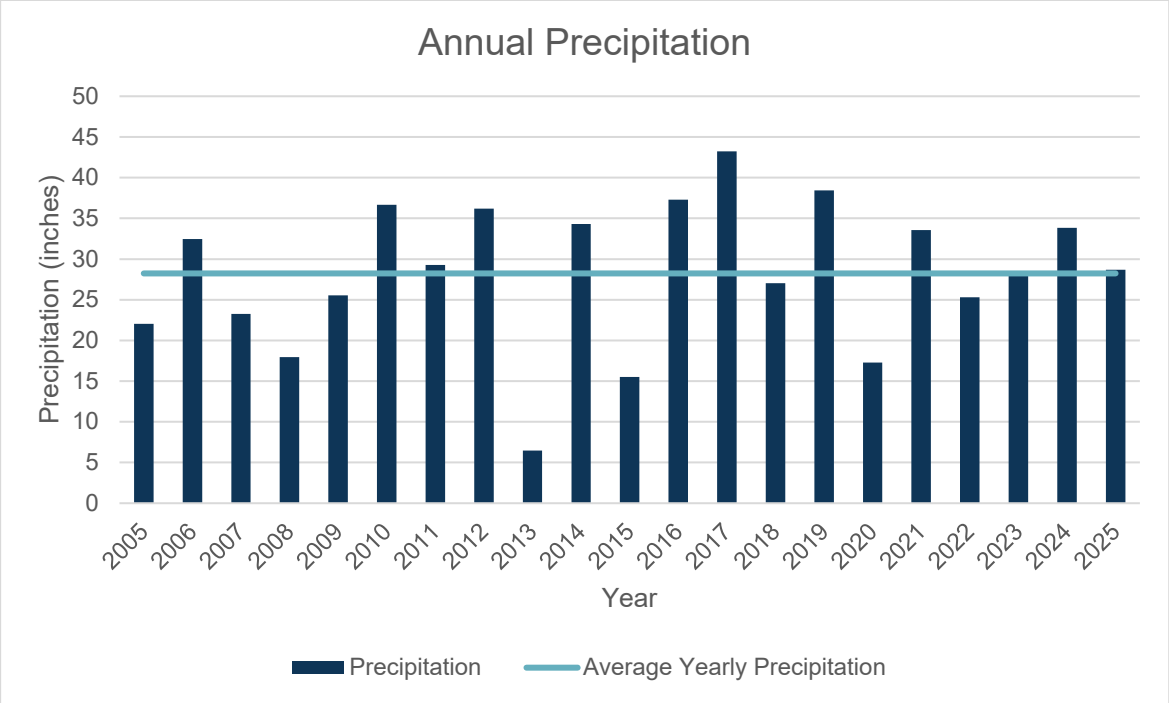


Figure 3-5: Annual Precipitation in Auburn from 2005-2025[1]

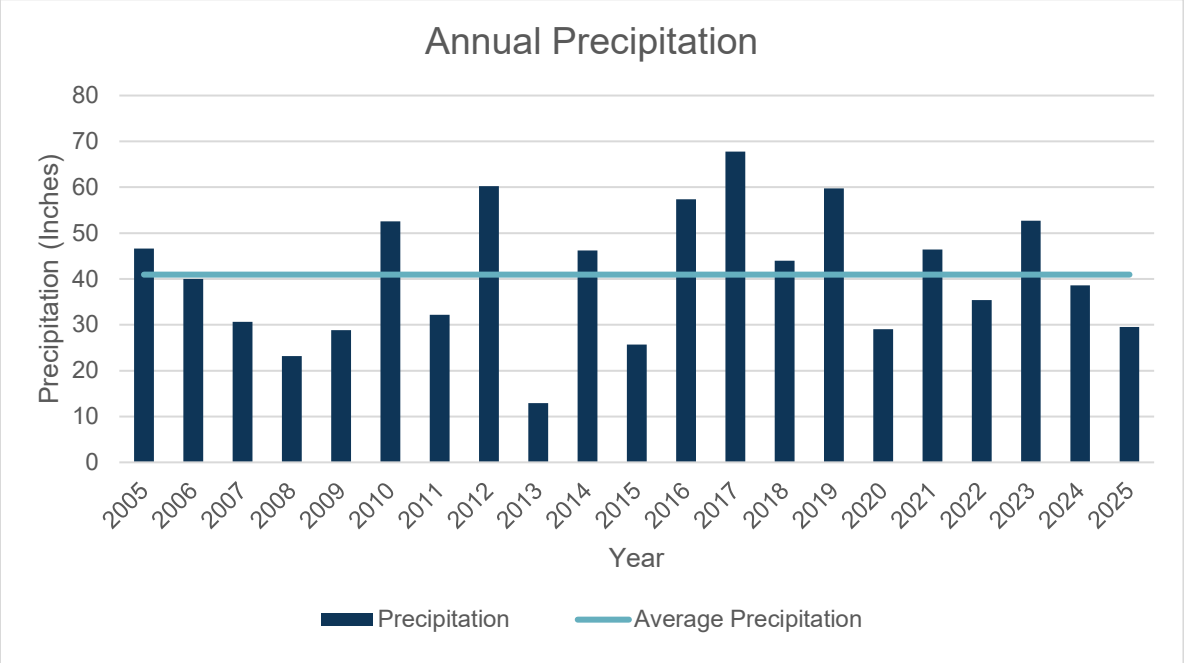


Figure 3-6: Annual Precipitation in Colfax from 2005-2025[2]

[1] California Irrigation Management Information System (CIMIS). (n.d.). *Monthly report for precipitation data (Station 195, Auburn; Placer County; status: Active).* California Department of Water Resources. https://cimis.water.ca.gov/WSNReportCriteria.aspx

Table 3-1. Historical Climate for Roseville

MONTH	CIMIS AVERAGE ETO (INCHES)	AVERAGE PRECIP. (INCHES)	AVERAGE TEMP. (°F)	AVERAGE MAX TEMP. (°F)	AVERAGE MIN TEMP. (°F)
January	1.19	3.51	47.79	57.60	39.51
February	1.83	3.83	50.73	61.74	40.92
March	3.23	2.79	54.73	66.31	43.78
April	4.58	1.72	58.95	71.93	46.47
May	6.42	0.90	65.40	80.09	51.09
June	7.48	0.05	72.38	88.58	56.76
July	8.01	0.03	76.68	94.15	60.02
August	7.48	0.01	75.38	92.76	59.48
September	5.17	0.16	71.77	88.56	57.14
October	3.44	1.28	63.19	78.33	50.15
November	1.65	2.24	53.03	65.15	43.14
December	1.03	4.18	47.30	57.06	39.16

Source: ETo, precipitation and temperature values from CIMIS Fair Oaks data (1998-2025).

Table 3-2. Historical Climate for Auburn

MONTH	CIMIS AVERAGE ETO (INCHES)	AVERAGE PRECIP. (INCHES)	AVERAGE TEMP. (°F)	AVERAGE MAX TEMP. (°F)	AVERAGE MIN TEMP. (°F)
January	1.22	4.18	48.56	57.69	40.53
February	1.90	4.58	50.08	61.01	41.34
March	3.10	4.41	53.10	64.11	43.77
April	4.78	2.19	58.09	70.41	46.71
May	6.40	1.06	64.82	78.63	51.78
June	7.51	0.28	73.42	88.37	59.05
July	8.30	0.02	79.18	95.11	64.68
August	7.55	0.03	77.93	93.49	63.88
September	5.62	0.26	72.65	87.36	60.29
October	3.77	1.87	62.24	76.46	52.67
November	1.73	3.23	53.24	64.46	44.91
December	0.96	6.13	46.60	56.05	39.39

Source: ETo, precipitation and temperature values from CIMIS Auburn data (2005-2025).

[2] National Centers for Environmental Information. (n.d.). *Monthly precipitation and temperature data (Colfax, CA; Station USC00041912)*. National Oceanic and Atmospheric Administration. https://www.ncei.noaa.gov

Table 3-3. Historical Climate for Colfax

MONTH	AVERAGE PRECIP. (INCHES)	AVERAGE SNOWFALL (INCHES)	AVERAGE TEMP. (°F)	AVERAGE MAX TEMP. (°F)	AVERAGE MIN TEMP. (°F)
January	8.01	6.34	44.63	54.23	35.01
February	7.48	3.66	46.45	56.41	36.47
March	6.85	4.00	49.04	59.74	38.34
April	3.53	0.79	54.13	66.08	42.21
May	1.74	0.05	60.89	73.63	48.17
June	0.58	0.00	69.18	83.03	55.30
July	0.08	0.00	76.76	91.33	62.20
August	0.12	0.00	75.34	90.24	60.46
September	0.64	0.00	70.15	84.56	55.82
October	2.46	0.00	61.30	74.52	48.05
November	5.54	0.52	51.24	62.29	40.13
December	7.90	2.63	45.15	54.78	35.37

Source: ETo, precipitation and temperature values from NOAA data for Colfax (1905-2016).

3.5 Climate Change

Finalized in 2022, the American River Basin (Basin) region conducted a climate change study in partnership with local water purveyors and the U.S. Department of the Interior, Bureau of Reclamation. The purpose of the American River Basin Study (ARBS) was to identify and develop data, tools, analyses, supply-demand imbalances, and climate change adaptation strategies specific to the Basin. Under the “new normal” of a changing climate, the ARBS aims to improve the resolution of regional climate change data and to develop regionally specific mitigation and adaptation strategies.

The ARBS’s study area is bounded by the Sierra Nevada mountain range to the east, the Feather and Sacramento rivers to the west, the Bear River to the north, and the Cosumnes River to the south (Figure 3-7). In addition to the American River Watershed, the study area encompasses the North and South American Groundwater Subbasins, and Non-Federal Partners’ service areas outside of the American River Watershed.

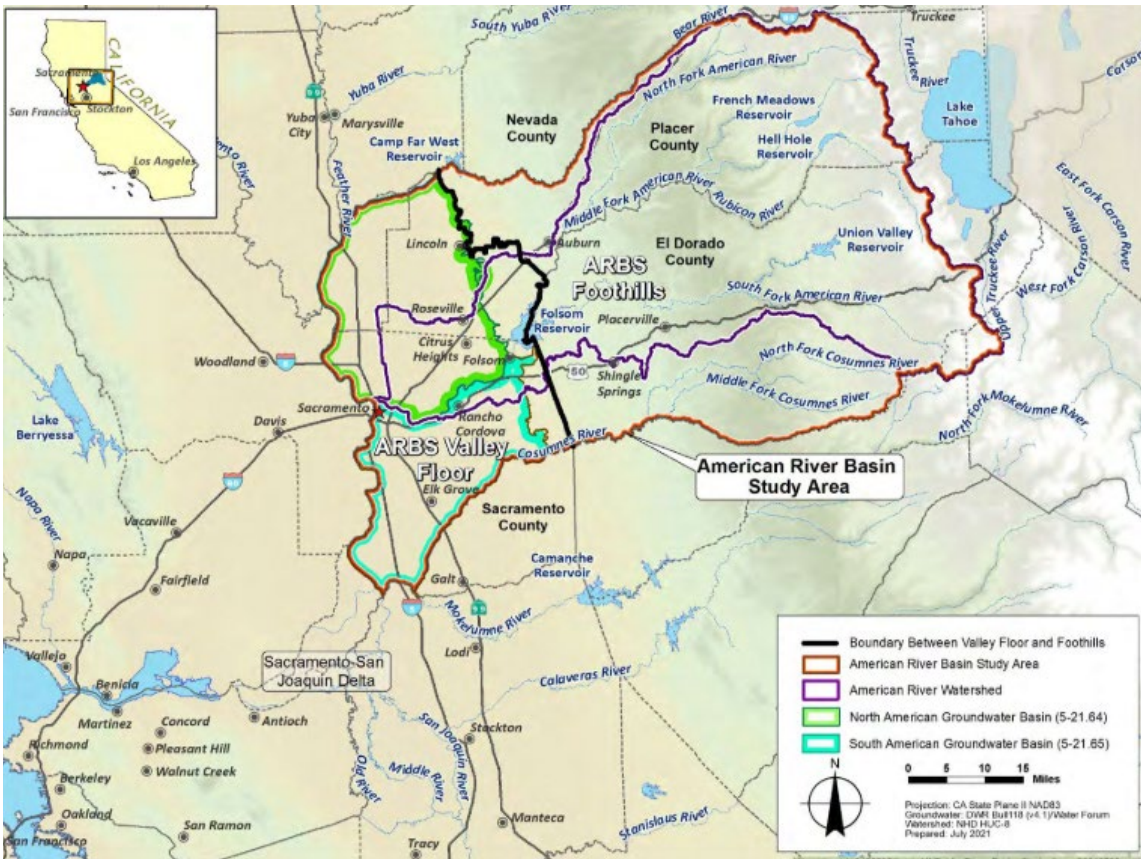


Figure 3-7: American River Basin Study

The following sections summarize climate change findings from the ARBS[3].

3.5.1 Projected Future Conditions

Projected climate conditions for the Basin and development of ARBS climate scenarios were based on an ensemble of bias-corrected, spatially downscaled climate projections. The ARBS assessed several adaptation portfolios for addressing the range of vulnerabilities and future supply-demand imbalances for the Study Area for regional benefits.

[3] More detail and approved study can be found at www.pcwa.net/planning/arbs.

Portfolios analyzed were:

- Future Operations Baseline
- Importance of Long-Term CVP Water Contracts
- Alder Creek Reservoir and Conservation Project
- Sacramento River Diversion Project
- Federally Recognized Groundwater Bank (North and South Basin)
- Folsom Dam Raise with Groundwater Banking (South Basin)
- Modified Flow Management Standard (2019)

The seven formulated adaptation portfolios were quantitatively evaluated using CalSim 3 to served as the primary basis for evaluating future climate conditions and to alleviate supply-demand imbalances and evaluate benefits to the region. Climate change considerations are incorporated into supply reliability and demand projections as described in Sections 6 and 7.

Hydrology scenarios derived from these projections provided streamflow inputs to the CalSim 3.0 model. CalSims 3.0 was then used to evaluate changes in water supplies, demands, and management throughout the Central Valley Project (CVP) and State Water Project, including the study area. Demand projections for individual water purveyors primarily relied on information from the Regional Drought Contingency Plan/Regional Water Reliability Plan (Regional Water Authority, 2017) and 2015 UWMPs.

3.5.1.1 Temperature

Surface air temperatures are projected to increase steadily, with average summer temperatures increasing by approximately 7.2°F by the end of the 21st century, and winter temperatures increasing by 4.9°F. Projections of daily maximum and minimum temperatures suggest similar warming trends during all seasons, with maximum temperatures projected to increase as much as 7.3°F during the summer months. Projected change in temperature for the study area between historical (1980-2009) and end of century (2070-2099) is presented in Table 3-4.

3.5.1.2 Precipitation

Annual precipitation projections show no significant trend in the median of change over the 21st century. Many of the available global climate model projections show change in precipitation, but there is no consistency in the magnitude and direction of projected change between models. Approximately half of the projections indicate a minor increase in annual precipitation and half indicate a minor decrease, highlighting the large uncertainty in future precipitation over this region. Although lacking a clear trend in projected annual precipitation, by the end of the 21st century the average fall and spring precipitation is expected to decrease, with winter and summer precipitation increasing. Increasing variability is also projected in winter and fall precipitation. Projected change in precipitation for the study area between historical and end of century is presented in Table 3-4.

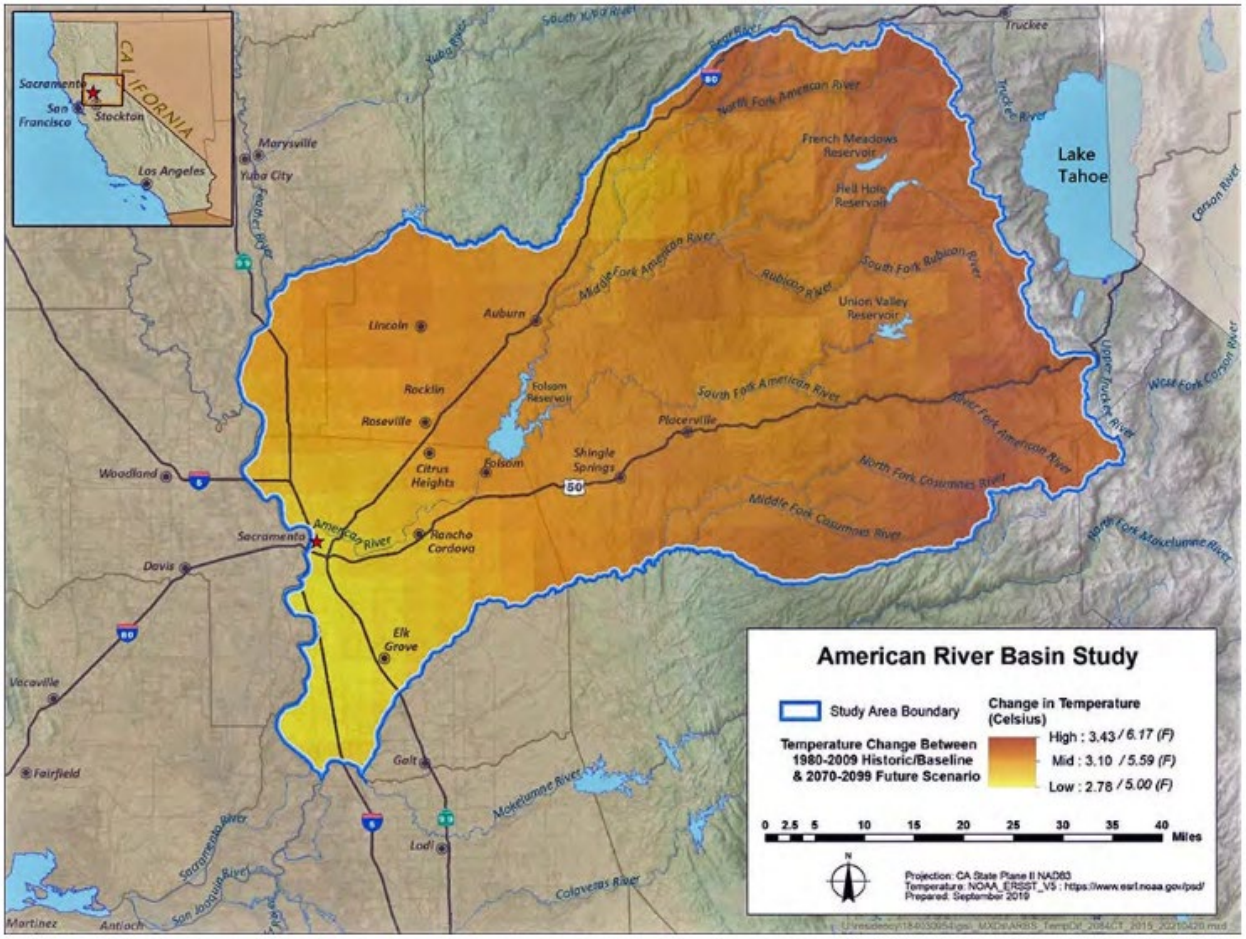


Figure 3-8: Projected Changes in July Temperature between Historical and End of Century Under Central Tendency Climate Change

Table 3-4: Projected Changes in Precipitation and Temperature Over the ARBS's Study Area Between Historical and End of Century

	Percent Change in Basin-Averaged Annual Mean Precipitation (%)	Change in Basin-Averaged Annual Mean Daily Air Temperature (°F)	Change in Annual Mean of Daily Maximum Air Temperature (°F)	Change in Annual Mean of Daily Minimum Air Temperature (°F)
Fall	-6.0	5.8	6.1	5.5
Winter	4.7	4.9	5.0	4.8
Spring	-11.9	5.8	6.3	5.1
Summer	10.4	7.2	7.3	7.0

3.5.1.3 Snowpack

Snow water equivalent (SWE) is a key indicator of water supplies in this region, where runoff is largely influenced by snowmelt. The increasing variability in precipitation combined with increases in surface air temperatures are key drivers in projections of a reduction in annual average SWE. Average SWE is forecasted to decrease by 50-85% across all climate scenarios and future time periods. In addition, areas that accumulate snow above Folsom Reservoir are also projected to have up to a 4.3-inch decrease in maximum snowpack by end of the century.

3.5.1.4 Evapotranspiration

Potential evapotranspiration (PET) serves as a key indicator of landscape water demands, including consumptive use by evaporation and transpiration from bare soil, water surfaces, native vegetation, and crops. Average annual PET is expected to increase 1.2 to 6.2 inches across all climate scenarios and future time periods. PET is strongly correlated with air temperature and thus expected to increase more under the hot scenarios (Hot-Dry, Hot-Wet) than under the warm scenarios (Warm-Dry, Warm-Wet).

3.5.1.5 Runoff

Watershed runoff is a direct indicator of local water supply available, as well as to the statewide CVP-SWP system. Climate change projections indicate a pronounced shift in the distribution of runoff from May and June to earlier in the season (December to March), implying a transition in precipitation from snow to rainfall and/or earlier snowmelt and increasing the amount of runoff during the winter months. Peak runoff is expected to shift by more than a month earlier by mid to late century, as shown in Figure 3-9. Spring runoff will decrease due to reduced winter snowpack. Similar to the precipitation scenarios, there is large uncertainty in projected runoff where the ‘wet’ scenarios suggest an increase in annual runoff and the ‘dry’ scenarios suggest a decrease in annual runoff. The projected changes in basin wide runoff range from an increase of 486 thousand acre-feet (TAF) under the warm-wet scenario to a decrease of 203 TAF under the hot-dry scenario by the end of the century.

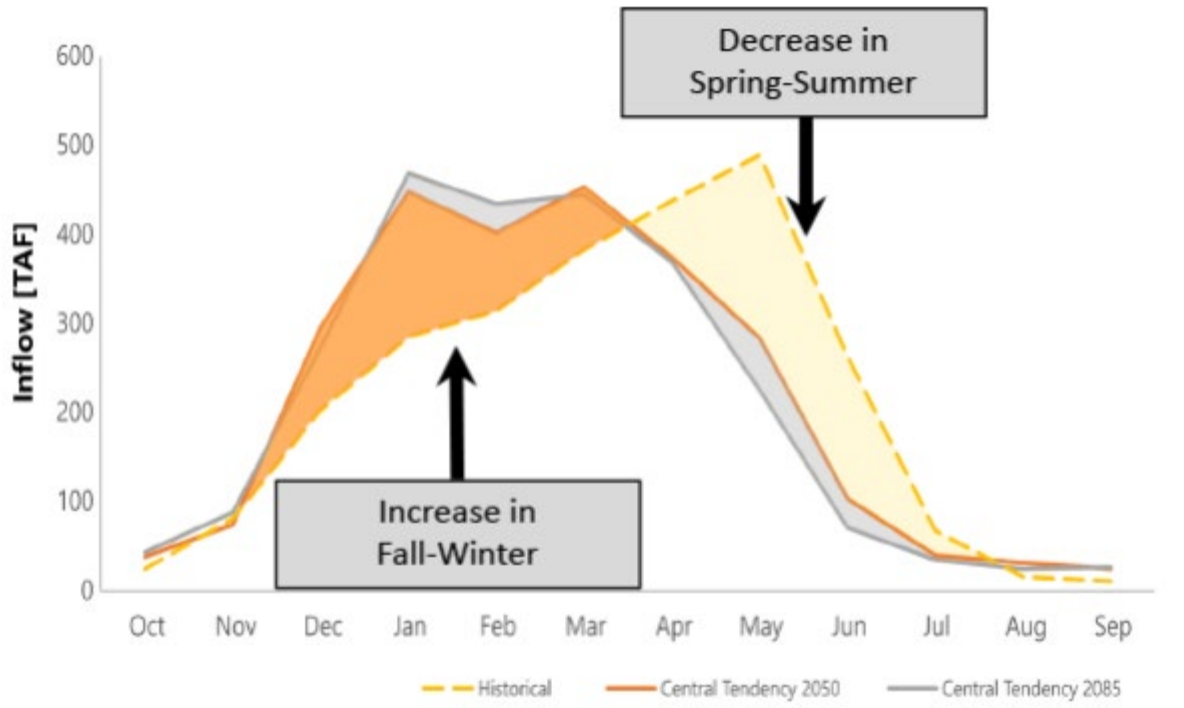


Figure 3-9: Distribution of Average Monthly Runoff for Historical Record (1922-2015) and Future Projections Under Central Tendency Climate Scenario

Table 3-5 presents the change in annual climatic and hydrologic indicators between historical baseline observations (1915 to 2015) and projected future conditions for the ARBS's study area.

Table 3-5: Change in Hydrologic Indicators Between Historical Observations and Projected Future Hydrology

Time Period	Climate Scenario	Precip (in)	T avg (°F)	T max (°F)	T min (°F)	PET (in)	SWE avg (in)	SWE max (in)	Runoff (TAF)
1915 -2015	Historical Observations	38.2	54.8	67.8	35.6	42.8	1.5	5.7	1,458
2040 -2069	Warm-Wet	1.9	4	6.2	1.6	1.6	-0.7	-2.3	701
	Central Tendency	0.1	5	8.1	2.1	2.7	-0.9	-2.8	-2
	Hot-Dry	-2.8	6.2	10.4	2.7	3.7	-1.1	-3.4	-206
2055 -2084	Warm-Wet	3.8	4.7	7.4	2	2	-0.8	-2.5	199
	Central Tendency	-1.1	6.3	11.1	2.6	4.1	-1.08	-3.5	-93
	Hot-Dry	-3.4	7.9	13.3	3.7	5	-1.2	-3.8	-185
2070 -2099	Warm-Wet	7	5.4	8.3	2.5	1.8	-0.9	-2.9	486
	Central Tendency	-0.6	6.5	11	2.8	3.9	-1	-3.3	-54
	Hot-Dry	-4.6	8.9	15.7	4.1	6.2	-1.3	-4.3	-203

3.5.2 Water Supply Reliability

Changing climate conditions in the Sierra Nevada Mountains threaten the volume of w ater stored as snowpack and the timing of runoff entering Folsom Reservoir. Consequently, they can also affect the critical role of Folsom Reservoir in the CVP Operations. Reliance on Folsom Reservoir is expected to increase commensurate with the impact of sea level rise on salinity in the Delta. Modeling indicates that, without operational adjustments, Folsom Reservoir is projected to reach lower end-of-September storage levels and approach dead pool more frequently under most future climate scenarios, as shown in Figure 3-10. Similarly, increased early season runoff would increase flood risks along the Lower American River, leaving less water in the upper watershed available during water supply operations.

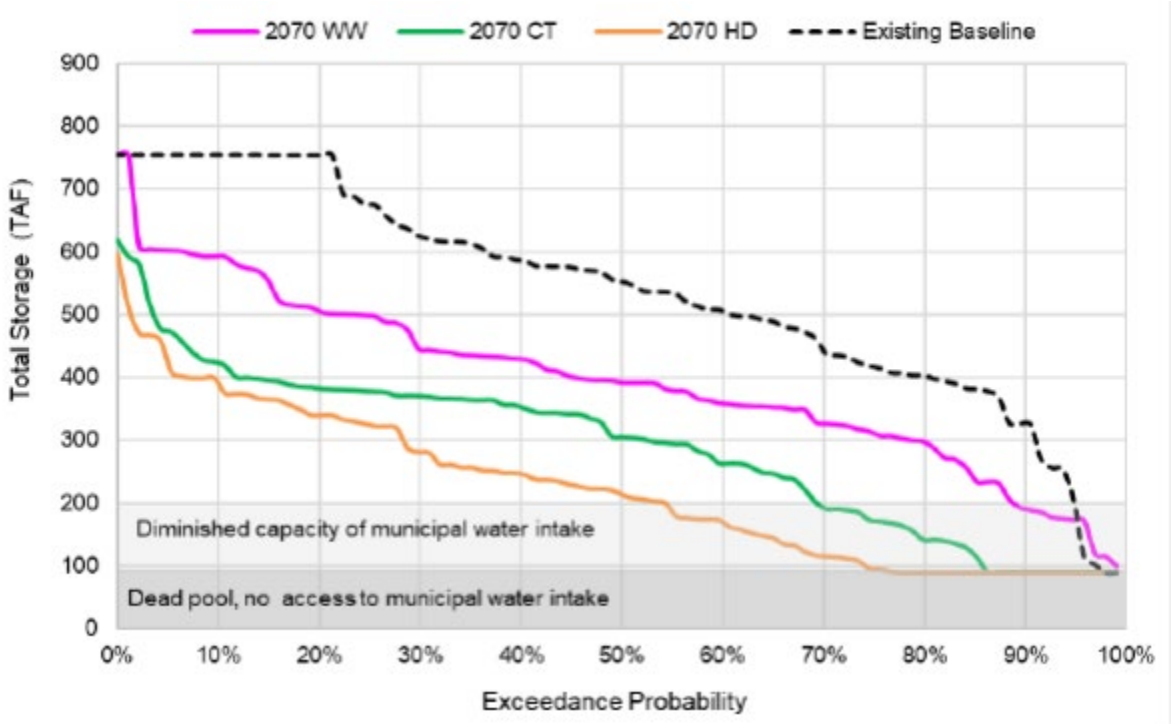


Figure 3-10: Exceedance Plot of Folsom Reservoir Storage (end of September) Under Future Climate Change

Under the 2070 level of development, the ARBS projects a supply-demand imbalance of 63 to 78 TAF/year in the Upper Basin (or Foothills Area) without further conservation or management actions. In the Lower Basin, groundwater extraction is expected to increase by 62 to 155 TAF/year to offset the projected imbalance, which would affect groundwater sustainability.

Based on the water supply and demand imbalance results, the region's water supply reliability has vulnerabilities. ARBS's intent was not focused on individual water-supplier's portfolio, but rather how the region could plan to increase regional reliability. The precise composition, scale, operations, partnerships, funding, and governance to advance these project concepts will require further evaluations and coordination among American River Basin interests, including

the United States Bureau of Reclamation (USBR), DWR, and State Water Resources Control Board.

3.6 Service Area Population and Demographics

3.6.1 Service Area Population

The population served by PCWA represents a highly varied mix of users and user classes. This is due to the size of the treated retail service area, which includes a broad mix of residential population densities, as well as commercial, public, and industrial water use customers. Population projections are based on the PCWA 2025 Annual Report and are consistent with land use assumptions used in demand projections. Due to the size of the treated retail service area, it is difficult to determine when and where growth can occur. However, PCWA anticipates growth in the treated retail service area will be similar to the growth over the past 20 years. Therefore, an annual growth of 2.9% was used to estimate projected population through 2050.

Table 3-6: Current and Projected Population

POPULATION SERVED	2025	2030	2035	2040	2045	2050
TOTAL	126,633	146,091	168,539	194,436	224,313	258,780

3.6.2 Other Social, Economic, and Demographic Factors

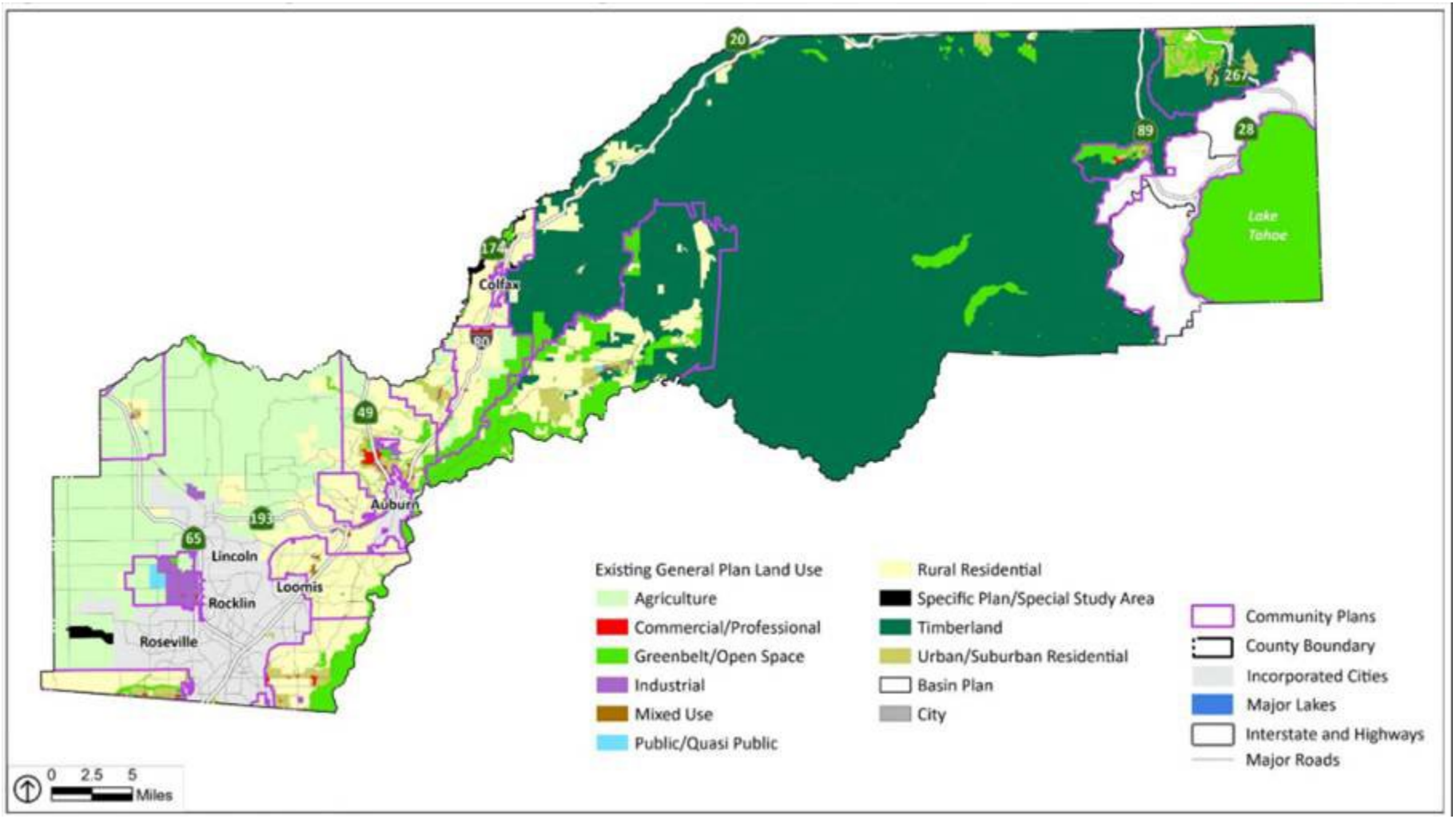
Placer County provides demographic reports for each of its supervisorial districts along with a county-wide report. Based on the 2024 report, the median household income is $107,851 with the per capita income of $55,843 and an unemployment rate of 3.4% The most recent Placer County Demographics can be found at Demographics | Placer County, CA.

Housing characteristics also reveal notable distinctions between urban and rural areas. The Western Area consists of approximately 90% urban housing, with the remaining 10% classified as urbanized clusters or rural housing. In contrast, Zone 3, located in the Sierra Nevada foothills, has a more rural demographic profile, with roughly 55% rural housing and 44% urbanized clusters. These differences highlight the county's mixed development pattern, ranging from newer, suburbanized communities in the west to more rural, dispersed populations in the foothill regions.

3.7 Land Uses within Service Area

Land use within PCWA's service area consists of Agriculture, Greenbelt/Open Space, Rural Residential, Commercial/Professional, Industrial, Mixed-Use, Public, Specific Plan Area and Urban/Suburban Residential.

Figure 3-11 illustrates the land use within Placer County per the 2050 Placer County. Appendix F contains land use exhibits for City of Rocklin, Town of Loomis, and City of Auburn.



Source: Placer County Open Data and Applications; PlaceWorks;Esri;2025

Figure 3-11: Placer County Land Use Map

4 Water Use Characterization

This section describes and quantifies PCWA's past, current, and future water use through 2050. PCWA's current treated and untreated retail demands are 105,625 AFY and are projected to increase to 125,629 AFY by 2050. PCWA's current treated and untreated wholesale demands are 25,078 AFY and are projected to increase to 117,815 AFY by 2050.

IN THIS SECTION

- Non-Potable Versus Potable Water Use
- Western Area Water Use
- Zone 3 Water Use
- Total PCWA Water Use
- Distribution System Water Losses
- Worksheets and Reporting Tables
- Water Use for Lower Income Households
- Climate Change Considerations

4.1 Non-Potable Versus Potable Water Use

As previously stated, PCWA's system is broken down into the Western Area and Zone 3 for this UWMP. However, PCWA's system wide water use is summarized in Section 4.4.

PCWA's water use is broken down in four classifications:

- Retail Treated
- Retail Untreated
- Wholesale Treated
- Wholesale Untreated

PCWA currently does not have recycled water demands. There is a potential for recycled water to be available to PCWA's retail system in the future.

Consistent with the 2020 UWMP, water demand projections were developed based on a review of historical water consumption data. For this update, the analysis was performed using the most recent five years of available consumption data, applying the same demand estimation approach used in the prior UWMP to ensure consistency across planning cycles.

4.2 Western Area Water Use

This section presents the historical, current, and projected water use for the Western Area. The Western Area consists of several classifications of water use which include treated retail, untreated retail, treated wholesale and untreated wholesale.

4.2.1 Western Area Classifications of Water Use

4.2.1.1 Western Area Treated Retail Water Use

Retail treated water use is a significant component of PCWA's long-term planning. Treated retail customer classifications include single family residential, multi-family residential, commercial, industrial, municipal, landscape and "other." The "other" customer classification includes water used for commercial fire and fire protection and customers involuntarily deprived of untreated service.

Although currently representing less than a quarter of PCWA's Western Area water use, treated retail water use is expected to see a large increase in water use over the next several decades as a result of anticipated growth of urban areas within Placer County. Large amounts of growth are expected in various large urban areas of Placer County. The location and rate of this growth is difficult to predict for the treated retail system. Given these conditions, PCWA has projected that treated retail water use will increase on average at a similar rate of growth seen during the past 20 years. PCWA's service area 20-year annual population growth rate is 2.9%. This growth rate was applied to the 2025 Western Area treated retail water use through 2050 for all customer classifications except industrial.

Demand projections are based on the unit demand factors shown in Table 4-5, with no conservation assumed for existing customers; new customers are assumed to be 11% more

efficient than existing customers due to new construction and plumbing requirements. PCWA currently has one industrial customer and does not expect a large growth of industrial water use within its service area. Therefore, it is assumed one additional industrial customer will connect to the Western Area system every five years. The 2025 demand for the current industrial customer will be applied to each new industrial customer.

The 2.9% population growth rate assumption covers growth and projected water use within the following Placer County area, cities, and existing/future developments:

- Auburn/Bowman
- City of Auburn
- City of Auburn (Airport)
- Newcastle/Ophir
- Unincorporated County Area C (Newcastle)
- Bickford Ranch
- Horseshoe Bar/Penryn
- Unincorporated County Area B (Loomis Basin)
- Town of Loomis
- Granite Bay
- City of Rocklin
- Whitney Ranch
- City of Roseville (area served by PCWA)
- Sunset Area
- Regional University Area

These planning subareas are shown in Figure 4-1.

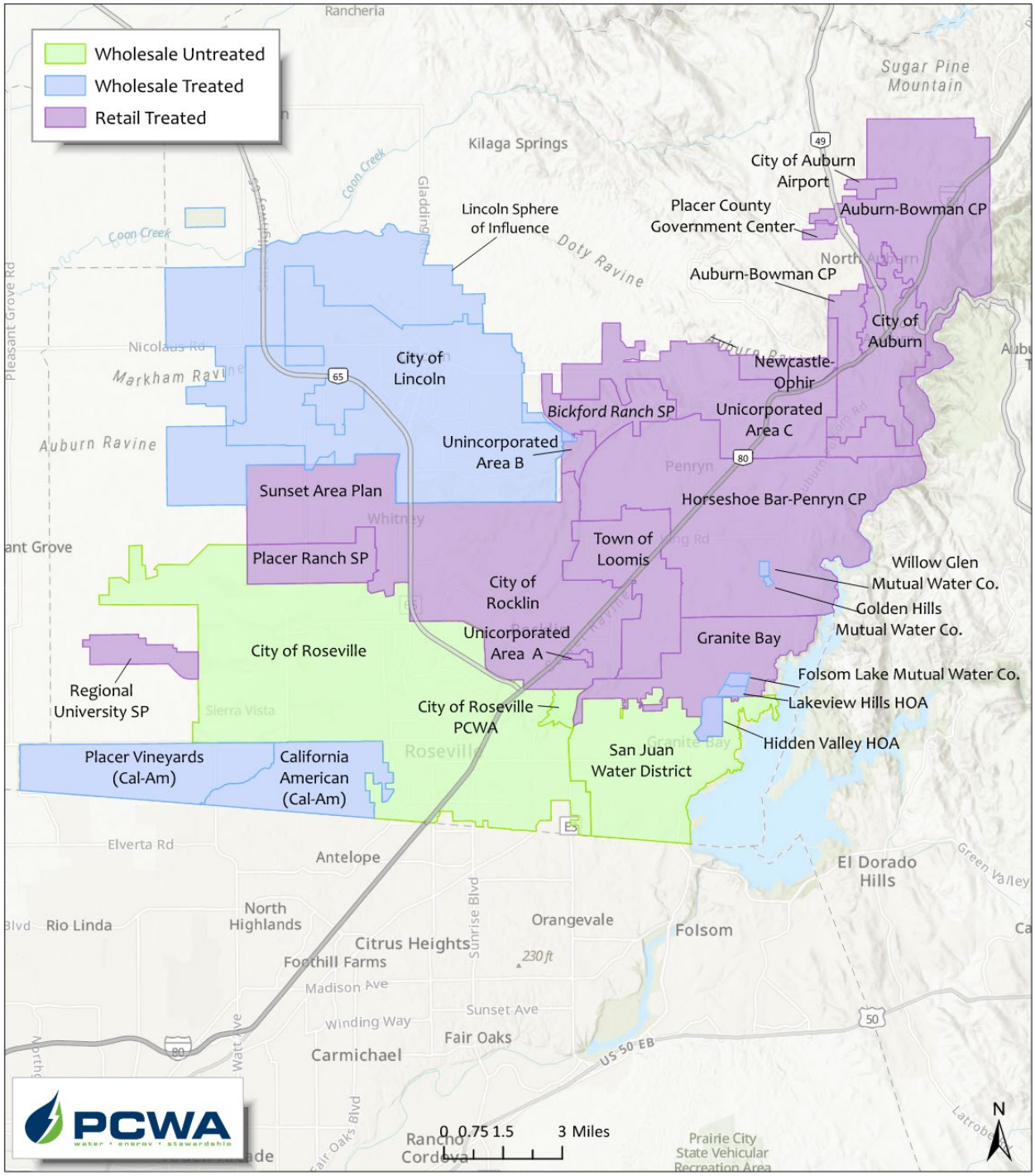


Figure 4-1: Planning Subareas

Table 4-1 and Table 4-2 summarize approved land use plans and community planning documents applicable to planned development areas within PCWA's service area. City planning documents are maintained by the respective jurisdictions and are available on their official websites. Additional community plans governing unincorporated areas are available through the County of Placer.

Table 4-1: PCWA Approved Land Use Plans

SPECIFIC PLAN	GENERAL LOCATION	PRIMARY LAND USE	PROJECTED WATER USE (AFY)	YEAR AMENDED
Bickford Ranch	Lower Zone 1	Residential/Mixed Use	1,320	2015
Placer Ranch	Lower Zone 1	Residential/Commercial	4,386	2022
Placer Vineyards	Roseville (SOI)	Residential	6,789[1]	2015
Regional University	Roseville (SOI)	Educational/ Mixed Use	3,220	2019
Placer County Government Center Master Plan	All Zones	Government/Civic	Not specified[2]	2019

1. Per the Placer Vineyards 2026 Update Water Demands Technical Memorandum, dated January 8, 2026.
2. For UWMP purposes, Specific Plans that do not include a quantified projected water use at buildout are accounted for within the City's aggregate land use-based demand projections rather than as plan-specific entitlements.

Table 4-2: Placer County Approved Land Use Plans

SPECIFIC PLAN	GENERAL LOCATION	PRIMARY LAND USE	YEAR AMENDED
Auburn/Bowman Community Plan	Upper Zone 1	Residential/Mixed Use	2024 (Draft)
Granite Bay Community Plan	Lower Zone 1	Residential/Commercial	2019
Horseshoe Bar/Penryn Community Plan	Lower Zone 1	Residential	2005
Sunset Plan	Lower Zone 1	Residential	2022

To accommodate a potential additional demand, PCWA established a regional buffer. The assumed buffer of 2,000 AF in 2050 is the approximate difference between PCWA's prior estimate of the Curry Creek area, which included the Regional University Area, and the current estimate of only the Regional University area. The assumed buffer of 8,000 AF at buildout accounts for consolidation of existing homes; this value is based on an estimated 10,000 parcels within the service area that are currently not served treated water from PCWA and assumes 50% of homes convert to treated water at 0.80 AFY per parcel.

4.2.1.2 Western Area Untreated Retail Water Use

Western Area untreated retail water use is a non-potable water use generally for commercial agriculture, irrigation customers, landscape greenbelts, and metered irrigation. The information presented below provides further details about these customers.

Commercial Agriculture - There are approximately 330 commercial agriculture accounts in Zone 1 and Zone 5. With planned growth by the City of Lincoln westward into Zone 5, PCWA expects the Zone 5 water use to decrease over the next twenty to thirty years. In contrast to Zone 5, the water use for the Zone 1 commercial agricultural customers is expected to remain consistent with current water use through this UWMP's planning horizon.

Irrigation - There are over 3,400 irrigation customers, including many rural residences within Zone 1 that receive irrigation canal water for use in gardens, for landscaping, for small pastures, to maintain stock water sources and storage, and for other rural residential needs. For purposes

of long-term planning, PCWA anticipates irrigation water use to remain consistent with current water use, with expected annual variations depending on the length of the irrigation season.

Landscape - With only 24 active accounts, the landscape designation is used by PCWA to represent greenbelts irrigated with untreated retail water supplies. For purposes of long-term planning, PCWA anticipates landscape water use to remain consistent with current water use.

Metered - This classification of untreated retail water use has insignificant water use, reflecting less than 1% of recent untreated annual retail deliveries. PCWA anticipates this water use will remain consistent in the future.

4.2.1.3 Western Area Treated Wholesale Water Use

PCWA wholesales treated water to several retail water systems located within Zone 1. This section presents the current and projected water use associated with these wholesale arrangements, and the basis for those projections.

City of Lincoln

The City of Lincoln (Lincoln) is the largest customer of treated wholesale water from PCWA, receiving about 90 percent of the wholesale treated water currently sold by PCWA. Lincoln has a renewable contract with PCWA for treated surface water. Based on Lincoln's current General Plan, PCWA will supply the volume of potable surface water required to meet maximum day demands for buildout of Lincoln contract limits on a "first-come first-served" basis. During 2025 UWMP preparation, PCWA coordinated with Lincoln to understand its most recent forecast for future demands. Lincoln's Water Master Plan, dated January 21, 2026, provides demands at 5-year intervals, and includes a buildout forecast.

With significant growth occurring over the last decade, Lincoln anticipates total potential demands estimates to grow from approximately 10,500 acre-feet in 2025 to about 22,000 acre-feet annually by 2045, and 37,400 acre-feet at buildout. While some of this demand may be met with other Lincoln water assets under some circumstances, Lincoln primarily plans for this demand to be served by PCWA supplies.

California American Water

With multiple retail service areas around greater Sacramento, California American (Cal-Am) specifically receives wholesale treated supplies from PCWA for its West Placer community (located in western Placer County just southwest of Roseville). Currently, this Cal-Am service area receives about 12 percent (about 1,500 acre-feet) of the PCWA wholesale treated supplies. The general area of Cal-Am's West Placer service area is anticipated to grow, resulting in an expanded wholesale agreement with Cal-Am. For purposes of PCWA's long-term planning, the anticipated growth in this general area is represented within this category of PCWA customers and is subdivided into two growth areas: (1) Placer Vineyards and (2) Cal-Am Remainder.

Cal-Am (Remainder): This area is comprised of the Riolo Vineyards Specific Plan and other large developments. Historical use of Cal-Am's water supply has predominantly been within this

area; however, over the last several years, Placer Vineyards has been developing and adding to the current water demands. Future demand in this area is expected to evolve as a result of customer conservation, redevelopment, and new growth as well as combined with Placer Vineyards demands. Combined, PCWA anticipates that total Cal-Am demand within this category will increase to nearly 2,400 acre-feet.

Small Community Retail Systems

Several small community retail water systems exist within Zone 1 (there are no retail suppliers in Zone 5). Generally organized as homeowner associations, these small retail systems include Folsom Lake Mutual Water Company, Golden Hills Mutual Water Company, Hidden Valley Community Association, Lakeview Hills Community Association, and Willow-Glen Water Company.

With most of these small retail systems serving communities that are built-out or are nearly built-out, PCWA does not anticipate growth within this category of treated wholesale water and assumes demands will remain constant through 2050.

4.2.1.4 Western Area Untreated Wholesale Water Use

In addition to being a retail purveyor of treated and untreated water suppliers, PCWA also wholesales untreated water to several retail water systems located within Zone 1. PCWA has contracts with SJWD, SSWD, and Roseville to provide each with untreated water supplies up to quantities as defined in each contract. This section presents the current and projected water use associated with these wholesale arrangements, and the basis for those projections.

Regional hydrology plays an important role in shaping untreated wholesale supply conditions, as surface water availability varies substantially across wet, dry, and multi-dry year scenarios.

San Juan Water District

PCWA's current contract with the SJWD includes an annual entitlement of 25,000 acre-feet of water from the MFP. Since that time, PCWA and the District have amended the 2000 contract three times. The most recent amendment, April 17, 2025, reduced the "take or pay" obligation from 25,000 acre-feet to 10,000 acre-feet, while maintaining the availability of up to 25,000 acre-feet upon SJWD request. SJWD's available surface water supply from the MFP is subject to terms in its PCWA contract, combined with Water Forum Agreement (WFA) restrictions that limit the amount of water that SJWD is able to divert from the American River.

According to SJWD's Water Forum Purveyor Specific Agreement, SJWD's American River diversion restrictions are dependent upon the projected March through November Unimpaired Inflow into Folsom Reservoir (UIFR). Inclusive of the PCWA supply, SJWD can divert its full 82,200 acre-feet per year from the American River in wet years (when projected March through November UIFR is greater than 950,000 acre-feet). This would include the 25,000 acre-feet MFP supply from PCWA. During drier years when the UIFR is between 950,000 and 400,000 acre-feet, SJWD will proportionately decrease its diversion amounts from 82,200 acre-feet per year to 54,200 acre-feet per year, which includes a proportional reduction of the MFP supply to 10,000 acre-feet. During the driest years, when projected March through November UIFR is less

than 400,000 acre-feet, SJWD's American River diversions are limited to 54,200 AF, equivalent to its baseline diversion amount. During these years, SJWD will further reduce demand through additional conservation (up to 15 percent) and use groundwater as needed. If unimpaired inflows are insufficient to meet the dry-year quantities specified in the WFA, and/or to provide expected flows to the mouth of the American River, the Water Forum signatories have agreed to meet and confer to develop a plan for water use.

The MFP supply will be delivered to SJWD pursuant to its contract with PCWA and Water Forum Agreement commitments, as described above. PCWA intends to meet all obligations of its contract with SJWD as future conditions and contract terms evolve.

Based on coordination with SJWD during preparation of each purveyor's 2020 UWMP, and SJWD 25 Year Demand Forecast Report (dated May 2020), SJWD forecasts through 2045 an estimated total retail demand of 11,500 acre-feet, and a total wholesale customer agencies of 27,600 acre-feet. PCWA's interpretation of SJWD's demand for MFP water is that SJWD prioritizes the use of MFP water within its Placer County retail service area, which anticipates a buildout demand of up to 10,000 acre-feet, matching the current take-or-pay contract. Based on historical conditions, the MFP supply to SJWD is estimated to remain at 10,000 acre-feet under all year types; however, may be increased up to 25,000 upon approval of the Agency,

City of Roseville

PCWA's current contract with the City of Roseville (Roseville) includes an annual entitlement of up to 30,000 acre-feet of water from the MFP in Drier Years and 44,000 acre-feet in Most Years. "Drier Years" and "Most Years" are currently defined in the Roseville and PCWA Water Forum Purveyor Specific Agreements tied to the amount of unimpaired inflow to the Lower American River in any given year. Roseville's surface water supply from the MFP is governed by both the terms of its contract with PCWA and the diversion limitations established through the Water Forum Agreement, which restrict the volume of water Roseville may divert from the American River under varying hydrologic conditions.

According to Roseville's Water Forum Purveyor Specific Agreement, Roseville's American River diversion restrictions are dependent upon the projected March-November UIFR. Inclusive of the PCWA supply, Roseville can divert up to 54,900 acre-feet per year from the American River in most years (when projected March through November UIFR is greater than 950,000 acre-feet). During drier years when the UIFR is between 950,000 and 400,000 acre-feet, Roseville decreases its diversion amounts from 54,900 acre-feet per year down to 39,800 acre-feet per year. During the driest periods, when UIFR drops below 400,000 acre-feet, Water Forum signatories must convene to determine an appropriate plan for water use.

The MFP supply will be delivered to Roseville pursuant to its contract with PCWA and Water Forum Agreement commitments, as described above. PCWA intends to meet all obligations of its contract with Roseville as future conditions and contract terms evolve. PCWA's interpretation of Roseville's contractual demand for MFP water is based on the amended Water Supply Contract dated May 18, 2023.

Sacramento Suburban Water District

PCWA's current contract with SSWD includes an annual entitlement of 29,000 acre-feet of water from the MFP. Delivery of this supply is governed by the terms of SSWD's contract with PCWA as well as the diversion limitations established through the Water Forum Agreement, which restrict the volume of American River water SSWD may divert under various hydrologic conditions, and PCWA's water rights conditions that limit delivery of MFP water supplies to Northern Sacramento County to wetter years.

According to SSWD's Water Forum Purveyor Specific Agreement, SSWD's American River diversion restrictions are dependent upon the projected March–November Unimpaired Inflow into Folsom Reservoir (UIFR). SSWD can divert 29,000 acre-feet per year of MFP water from Folsom Reservoir in wet years (when projected March through November UIFR is greater than 1,600,000 acre-feet). During drier years when the UIFR is less than 1,600,000 acre-feet, SSWD does not receive MFP water from PCWA.

MFP water will be delivered pursuant to SSWD's contract with PCWA and Water Forum Agreement commitments, as described above. PCWA intends to meet all obligations of its contract with SSWD as future conditions and contract terms evolve. PCWA's interpretation of SSWD's build-out demand for MFP water in normal years is 29,000 acre-feet, reducing to zero acre-feet in single dry and multiple dry years

For purposes of demand forecasting, PCWA is assuming the full demand will occur by 2030 and continue to exist throughout PCWA's 2025 UWMP planning horizon:

Table 4-3 summarizes PCWA's untreated water supply that is contractually available to the Wholesale agencies during average, single dry year, and five-consecutive year drought.

Table 4-3: PCWA Available Untreated Supply to Wholesale Agencies

WHOLESALE AGENCY	AVERAGE	SINGLE DRY YEAR	FIVE-CONSECUTIVE YEAR DROUGHT
SJWD	25,000	10,000	25,000
Roseville	44,000	30,000	30,000
SSWD	29,000	0	0
TOTAL AVAILABLE PCWA SUPPLY	**84,000**	**40,000**	**55,000**

Figure 4-2 presents PCWA's water supplies and the places of use. PCWA's supplies are described in further detail in Chapter 6.

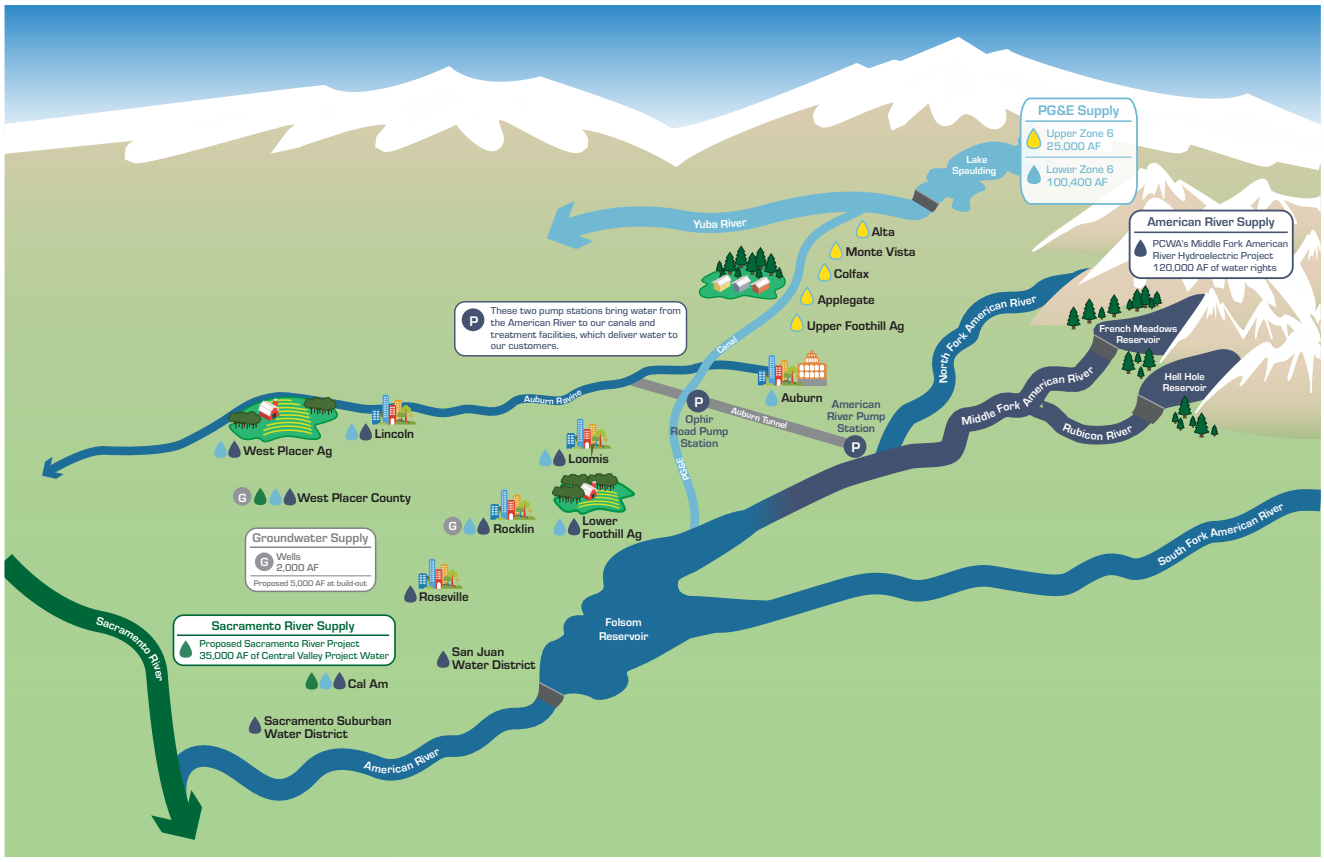


Figure 4-2: Water Supply Summary Map

4.2.2 Western Area Historical and Current Water Use

Based on available records for water production, water sales, and deliveries, Table 4-4 summarizes the historical water use for the different classes of water usage in the Western Area.

Table 4-4: Western Area Historical Water Use, AFY

CLASSIFICATION OF WATER USE	2021	2022	2023	2024	2025
Treated Retail Water	26,021	25,642	23,667	25,202	24,869
Treated Retail Water Loss	1,953	1,989	1,354	2,244	2,559
Untreated Retail Water	61,430	64,541	57,467	55,536	67,619
RETAIL SUBTOTAL	**89,404**	**92,172**	**82,487**	**82,982**	**95,046**
Treated Wholesale Water	11,872	11,973	11,631	13,281	12,390
Untreated Wholesale Water	24,781	37,450	13,490	22,463	11,171
WHOLESALE SUBTOTAL	**36,654**	**49,423**	**25,121**	**35,743**	**23,561**
WESTERN AREA TOTAL WATER USE	**126,058**	**141,595**	**107,608**	**118,725**	**118,607**

4.2.2.1 Treated Retail Demand Factors for Western Area

While preparing this UWMP, PCWA developed demand factors for the Western Area Treated Retail Water customers. These demand factors were not used in the development of the water use projections for this 2025 UWMP; but are made available for PCWA to use in evaluating future proposed projects. Using 2025 account information and meter data, PCWA used GIS to link the lot size designations with 2025 customer meter data, generating average demand factors for each lot-size for both the upper and lower portions of Zone 1. Table 4-5 presents the 2025 demand factors for each customer classification. Demand factors are presented by residential lot size for upper Zone 1 customers and lower Zone 1 customers, since these areas have varied climates and demographics, as described previously.

PCWA expects that demand factors to remain roughly consistent into the future as conservation for existing customers and new customers assumed to be 11% more efficient than existing customers due to new construction and plumbing requirements.

Table 4-5: Western Area Treated Retail Demand Factors

CUSTOMER TYPE		LOT SIZE	DEMAND FACTOR	
SINGLE-FAMILY RESIDENTIAL				
UPPER ZONE 1				
	Upper SF 1	<2.9k	0.13	AFY/unit
	Upper SF 2	2.9k-4.1k	0.19	AFY/unit
	Upper SF 3	4.1k-4.7k	0.21	AFY/unit
	Upper SF 4	4.7k-5.5k	0.21	AFY/unit
	Upper SF 5	5.5k-7k	0.25	AFY/unit
	Upper SF 6	7k-10k	0.32	AFY/unit
	Upper SF 7	10k-17k	0.43	AFY/unit
	Upper SF 8	17k-35k	0.53	AFY/unit
	Upper SF 9	>35k	0.5	AFY/unit
LOWER ZONE 1				
	Lower SF 1	<2.9k	0.19	AFY/unit
	Lower SF 2	2.9k-4.1k	0.22	AFY/unit
	Lower SF 3	4.1k-4.7k	0.26	AFY/unit
	Lower SF 4	4.7k-5.5k	0.31	AFY/unit
	Lower SF 5	5.5k-7k	0.36	AFY/unit
	Lower SF 6	7k-10k	0.42	AFY/unit
	Lower SF 7	10k-17k	0.53	AFY/unit
	Lower SF 8	17k-35k	0.73	AFY/unit
	Lower SF 9	>35k	1.03	AFY/unit
MULTI-FAMILY RESIDENTIAL			**0.2**	**AFY/UNIT**
COMMERCIAL [2]			**0.81**	**AFY/ACRE**
INDUSTRIAL[1]			**7.30**	**AFY/ACRE**
PUBLIC /MUNICIPAL[2]			**2.70**	**AFY/ACRE**
LANDSCAPE			**1.63**	**AFY/ACRE**

1. PCWA currently has one industrial account. The industrial demand factor is shown for informational purposes. New industrial development demand factors shall be determined on a case-by-case basis.

2. These unit demand factors are representative values used for UWMP demand projections across commercial and public/municipal customers; actual site demands vary and may differ significantly based on site-specific conditions.

SF- square feet

Public/municipal and industrial water demands vary widely by region, customer mix, and hydrologic conditions, and can fluctuate significantly from year to year. As a result, the demand factors presented here represent a generalized snapshot based on 2023 conditions and are intended for planning-level analysis only.

4.2.2.2 Western Area Projected Water Use

Assumptions described in Section 4.2.1 were used in developing the projected water use for the Western Area. Table 4-6 presents the expected water use for each 5-year increment through 2050.

Table 4-6: Western Area Projected Water Use, AFY

CLASSIFICATION OF WATER USE		2025	2030	2035	2040	2045	2050
TREATED RETAIL	Single Family Residential	15,992	18,172	20,773	23,772	27,235	31,228
	Multi-Family Residential	1,847	2,306	2,632	3,010	3,444	3,946
	Commercial	2,760	3,435	3,916	4,471	5,112	5,851
	Industrial[1]	381	371	378	384	391	397
	Municipal	884	2,652	3,025	3,455	3,952	4,525
	Landscape	2,658	3,309	3,773	4,307	4,926	5,638
	Other	346	628	715	817	933	1,067
	Water Loss	2,559	1,852	2,113	2,413	2,760	3,159
	Regional Buffer	0	0	0	0	2,000	5,000
	TREATED RETAIL SUBTOTAL	**27,428**	**32,724**	**37,324**	**42,628**	**50,751**	**60,811**
UNTREATED RETAIL	Zone 1 Canal Customers	48,629	44,000	44,000	44,000	44,000	44,000
	Zone 5 Agriculture	13,981	11,776	10,024	8,542	7,288	4,856
	Water Loss	5,009	3,347	3,241	3,153	3,077	2,931
	UNTREATED RETAIL SUBTOTAL	**67,619**	**59,123**	**57,265**	**55,695**	**54,365**	**51,787**
RETAIL SUBTOTAL		**95,046**	**91,847**	**94,590**	**98,323**	**105,117**	**112,598**
TREATED WHOLESALE	City of Lincoln	10,586	13,376	16,588	19,809	22,032	25,392
	Small Wholesale Purveyors	276	324	324	324	324	324
	Cal-Am Water Company	1,527	2,263	2,991	3,663	4,335	5,131
	Water Loss	-[2]	958	1,194	1,428	1,601	1,851
	TREATED WHOLESALE SUBTOTAL	**12,390**	**16,921**	**21,097**	**25,224**	**28,292**	**32,698**
UNTREATED WHOLESALE	San Juan Water District	9,484	10,000	10,000	10,000	10,000	10,000
	Sacramento Suburban Water District	882	29,000	29,000	29,000	29,000	29,000
	City of Roseville	419	39,000	44,000	44,000	44,000	44,000
	Christian Valley Park, CSD	387	418	418	418	418	418
	UNTREATED WHOLESALE SUBTOTAL	**11,171**	**78,418**	**83,418**	**83,418**	**83,418**	**83,418**
WHOLESALE SUBTOTAL		**23,561**	**95,339**	**104,515**	**108,642**	**111,710**	**116,116**
WESTERN AREA TOTAL WATER USE		**118,607**	**187,186**	**199,105**	**206,965**	**216,827**	**228,714**

Note: Western Zone projections are based on 2023 water year demands; 2024–2025 data reflect irregular water use patterns not representative of baseline conditions.

1. It is assumed one industrial customer will connect to the Western Area system every five years.
2. Water Loss was incorporated in 2025 Consumption Data

4.3 Zone 3 Water Use

This section presents the historical, current, and projected water use for Zone 3. Zone 3 is the second largest zone in the PCWA system and extends through Applegate, Weimer, Meadow Vista, Colfax, Gold Run, Monte Vista, Dutch Flat, and Alta. Water supply for Zone 3 is provided primarily under a long-term contract with PG&E, which delivers surface water from the Drum–Spaulding hydroelectric system into PCWA's Boardman Canal. Zone 3 consists of several classifications of water use which include treated retail, untreated retail, and untreated wholesale.

4.3.1 Zone 3 Classifications of Water Use

4.3.1.1 Zone 3 Treated Retail Water Use

Retail treated water uses in Zone 3 represent a relatively small fraction of PCWA's current water use and will increase slightly over the next several decades as a result of nominal growth (approximately 1%) of mountain communities within Placer County. Zone 3 treated retail demands are served by five small water treatment plants (Alta, Monte Vista, Weimar, Colfax, and Applegate), which are scaled to community size and seasonal demand. Changes in this zone are unlikely to have significant impacts on the expected increase in total water use served by PCWA. The planned replacement of the Colfax Water Treatment Plant by the end of Winter 2027 will increase treatment capacity but is not expected to induce additional demand.

4.3.1.2 Zone 3 Untreated Retail Water Use

Zone 3 untreated retail water use is a non-potable water use generally for commercial agriculture, irrigation customers, landscape greenbelts, and metered irrigation. The information presented below provides further details about these customers.

Commercial Agriculture - There are currently only 15 commercial agriculture accounts in Zone 3. Zone 3 commercial agricultural water use is expected to remain consistent though the UWMP planning horizon.

Irrigation - Approximately 300 irrigation customer accounts include the many rural residences within Zone 3 that receive irrigation canal water for use in gardens, for landscaping, for small pastures, to maintain stock water sources and small ponds, and for other rural residential needs. For purposes of long-term planning, PCWA anticipates the untreated retail water use will remain consistent with existing water use, with expected annual variations depending on the length of the irrigation season.

Metered - This classification of untreated retail water use has very insignificant water use, reflecting less than 1% of recent annual untreated retail deliveries in Zone 3. PCWA anticipates water use will remain consistent in the future.

4.3.1.3 Zone 3 Untreated Wholesale Water Use

This section presents the existing and anticipated future water use of five small water purveyors that purchase untreated wholesale water from PCWA for treatment and delivery. These purveyors include Alpine Meadows Water Association, Heather Glen CSD, and Meadow Vista County Water District. The Agency historically sold water to Dutch Flat Water Association but consolidated with them on July 17, 2024. Additionally, the Agency sold water to Weimar Water Company, but acquired the water system on October 1, 2023, as part of future consolidation efforts. Recent water sales to these retail agencies have remained consistent. For purposes of long-term planning, PCWA anticipates the untreated wholesale water use to remain consistent with recent sales. This assumption aligns with Countywide utilities planning, which identifies no planned expansions in wholesale service areas within Zone 3.

4.3.1.4 Zone 3 Treated Wholesale Water Use

Zone 3 treated wholesale water use consists of potable water deliveries provided by PCWA to MHCWD for retail distribution within its service area. Treated wholesale water to Midway Heights is supplied through the Weimar Water Treatment Plant. The delivery was formalized following PCWA's acquisition of the Weimar Water Company in October 2023, which established PCWA as MHCWD's treated wholesale water provider.

MHCWD and PCWA have evaluated consolidation of the District to address long-term operational and regulatory challenges. A feasibility study completed in March 2025 concluded that consolidation was not viable under the evaluated scenarios due to the cost required.[4] Treated wholesale water deliveries to MHCWD are expected to continue under the existing wholesale service arrangement. For purposes of long-term planning, PCWA anticipates that Zone 3 treated wholesale water use will remain generally consistent throughout the UWMP planning horizon, consistent with the absence of planned service area expansions.

4.3.2 Zone 3 Historical and Current Water Use

Based on available records for water production, water sales, and deliveries, Table 4-7 summarizes the historical water use for the different classifications of water usage in Zone 3.

Table 4-7: Zone 3 Historic Water Use, AFY

CLASSIFICATION OF WATER USE	2021	2022	2023	2024	2025
Treated Retail Water	555	503	500	721	717
Treated Retail Water Loss	214	175	339	279	108
Untreated Retail Water	6,756	8,104	7,892	8,179	8,366
RETAIL SUBTOTAL	**7,525**	**8,783**	**8,732**	**9,180**	**9,190**

[4] **Placer County Water Agency & Midway Heights County Water District.** (2025). *Exploration of consolidation of the district with Placer County Water Agency (PCWA).* Midway Heights County Water District. https://www.mhcwd.org/exploration-of-consolidation-of-the-district-with-placer-county-water-agency-pcwa

Wholesale Untreated Water[1]	2,230	2,178	2,154	2,110	1,411
Wholesale Treated Water	0	22	103	106	106
WHOLESALE SUBTOTAL	**2,230**	**2,178**	**2,176**	**2,213**	**1,517**
ZONE 3 TOTAL WATER USE	**9,756**	**10,961**	**10,908**	**11,393**	**10,708**

1. Dutch Flat Mutual and Weimar Water company were included in wholesale deliveries prior to 2024 and 2023, respectively.

4.3.3 Zone 3 Projected Water Use

Assumptions described in Section 4.3.1 were used in developing the projected water use for Zone 3. Table 4-8 presents the expected water use for each 5-year increment through 2045 and buildout conditions.

Table 4-8: Zone 3 Projected Water Use, AFY

	Classification of Water Use	2025	2030	2035	2040	2045	2050
Treated Retail	Single Family Residential	479	529	555	583	613	637
	Multi-Family Residential	50	55	58	61	64	67
	Commercial	142	152	157	163	169	174
	Municipal	23	25	27	28	30	31
	Landscape	20	22	23	24	26	27
	Other	3	4	4	4	4	3
	Water Loss	108	118	124	130	136	141
	Treated Water Total	**825**	**905**	**948**	**993**	**1,041**	**1,079**
Untreated Retail		8,366	8,847	8,847	8,847	8,847	8,847
Retail Subtotal		**9,190**	**9,752**	**9,795**	**9,841**	**9,888**	**9,926**
Untreated Wholesale		1,411	1,715	1,715	1,715	1,715	1,715
Treated Wholesale		106	106	106	106	106	106
Regional Buffer[1]		0	0	0	0	0	250
Wholesale Subtotal		**1,517**	**1,821**	**1,821**	**1,821**	**1,821**	**2,071**
Zone 3 Total Water Use		**10,708**	**11,573**	**11,616**	**11,662**	**11,709**	**11,997**

1. Regional Buffer includes future consolidation and groundwater substitutions within Zone 3.

4.4 Total PCWA Water Use

Table 4-9 provides the historical demand summary for the entire PCWA system.

Table 4-9: Summary of PCWA Historical Total Customer Demands, AFY

CLASSIFICATION OF WATER USE	2021	2022	2023	2024	2025
Treated Retail Water	26,579	26,616	23,337	26,598	25,586
Treated Retail Water Loss	2,167	2,164	1,693	2,523	2,667
Untreated Retail Water	68,186	72,645	65,359	63,715	75,984

RETAIL SUBTOTAL	**96,930**	**100,955**	**91,219**	**92,162**	**104,237**
Treated Wholesale Water	11,872	11,973	11,675	13,487	12,496
Untreated Wholesale Water	27,012	39,629	15,644	24,391	12,582
WHOLESALE SUBTOTAL	**38,884**	**51,602**	**27,297**	**37,775**	**25,078**
PCWA TOTAL WATER USE	**135,813**	**152,557**	**118,516**	**129,937**	**129,314**

As detailed in the previous sections, PCWA has many different customer types with different projected growth representations. Table 4-10 provides the total PCWA customer demand summary for the 5-year increments through 2045 and buildout conditions.

Table 4-10: Summary of PCWA Total Customer Demand Projections, AFY

CLASSIFICATION OF WATER USE	2025	2030	2035	2040	2045	2050
Treated Retail Water	28,252	33,629	38,272	43,622	51,792	61,890
Untreated Retail Water	75,984	67,970	66,113	64,542	63,213	60,635
RETAIL SUBTOTAL	**104,237**	**101,599**	**104,385**	**108,163**	**115,005**	**122,524**
Treated Wholesale Water	12,496	16,921	21,097	25,224	28,292	32,698
Untreated Wholesale Water	12,582	80,133	85,133	85,133	85,133	85,133
WHOLESALE SUBTOTAL	**25,078**	**97,054**	**106,230**	**110,357**	**113,425**	**117,831**
PCWA TOTAL WATER USE	**129,314**	**198,653**	**210,615**	**218,520**	**228,430**	**240,355**

4.4.1 Buildout

Buildout of the PCWA's retail and wholesale area varies; however, buildout is intended to be beyond 2050, the duration of the 2025 UWMP. The overall buildout demand of PCWA's water system is 252,074 acre-feet. Section 6.2.3.4 has a summary of buildout WTP needs, including all planned/approved developments.

4.4.2 Exchanges

PCWA maintains an on-demand treated water system that is used for municipal and industrial purposes. Additionally, PCWA maintains direct treated water interties with five surrounding jurisdictions, as described in Section 6.2.7. PCWA can transfer water between jurisdictions through these interties or access water to supplement its distribution system. These facilities are designed to be used for wheeling water through the service area or for demand shortage assistance.

4.5 Distribution System Water Losses

Distribution system water losses are the potable water losses from the point of water entry to the distribution system to the point of delivery to the customer's system. Water loss can result from aging infrastructure, leaks, seepage, theft, metering inaccuracies, data handling errors, and other causes. Addressing water losses can increase water supplies and recover revenue. Section 9 discusses PCWA's programs to assess and manage distribution system real loss.

PCWA, like all water agencies, does have some water loss. For the purposes of this UWMP, water loss is defined as the difference between the amount of water produced and the amount of water billed to customers. PCWA has conducted annual water audits for its Western Area and Zone 3 retail water distribution systems using the methodology described in the American Water Works Association (AWWA) Manual M36 – Water Audits and Loss Control Programs since 2016. The audits quantify PCWA's real losses (water physically lost from the system through leaks, breaks, theft, and other means) as well as apparent losses (water lost through meter under registration and data handling errors).

Zone 3 has AWWA Water Audits from 2020 to 2024. Although the Zone 3 system has less than 3,000 connections and supplies less than 3,000 acre-feet (AF) of treated water, DWR clarified in early 2020 that urban water suppliers with 3,000 or more connections or deliveries of over 3,000 AF, were required to provide water audits for each system that the supplier operates even if individual systems did not meet the regulatory threshold. Since DWR already reviewed and accepted the 2015-2017 AWWA Water Audits, PCWA has provided audits of all systems from 2018 onward.

CWC Section 10631 (d)(3)(C) requires water suppliers to provide data to determine if the supplier will meet its State Water Board water loss performance standard. Table 4-11 summarizes PCWA's progress toward meeting the State Water Resources Control Board calculated water loss performance standard by 2028, as determined through AWWA Water Audit results for each applicable retail distribution system. Suppliers must quantify past, current, and projected water use by sector, including distribution system water loss, with projections reported in five-year increments consistent with the planning horizon. Distribution system water losses constitute a distinct water use sector and are integrated into the historic and projected demand tables in this section.

Table 4-11: Progress Toward 2028 Water Loss Standard

		REAL WATER LOSS					APPARENT WATER LOSS				
PUBLIC WATER SYSTEM	WATER BOARD - WATER LOSS STANDARD	2028 REAL WATER LOSS STANDARD1	UNITS FOR REAL WATER LOSS	NUMBER OF UNITS	VOLUME OF TOTAL REAL LOSS	2023 REAL WATER LOSS1	2028 APPARENT WATER LOSS STANDARD1	UNITS FOR APPARENT WATER LOSS	NUMBER OF CONNECTIONS	UNITS FOR APPARENT WATER LOSS	2023 APPARENT WATER LOSS[1]
Alta	No[2]	-	-	-	-	-	-	-	-	-	-
Apple-gate	No	-	-	-	-	-	-	-	-	-	-
Auburn-Bowman	Yes	42	GPSCD	9,031	48	4.7	20.1	GPSCD	9,031	197	19.5
Bianchi	No	-	-	-	-	-	-	-	-	-	-
Colfax	No[3]	-	-	-	-	-	-	-	-	-	-
Foothill-Sunset	Yes	46	GPSCD	28,978	381	11.7	23.8	GPSCD	28,978	726	22.4
Monte-Vista	No	-	-	-	-	-	-	-	-	-	-
Weimar	No[4]	-	-	-	-	-	-	-	-	-	-

1. Per Unit Per Day
2. The system went through a consolidation and the new target will be established using data from 2025 - 2028 ___
3. The system went through a consolidation and the new target will be established using data from 2024 - 2027 ___
4. The system went through an acquisition and the new target will be established using data from 2024 - 2027_+_.

The 2020 to 2024 reporting worksheets can be found in Appendix E and losses are summarized in Table 4-12 by retail distribution system.

Table 4-12: Water Loss Audit Reporting

PUBLIC WATER SYSTEM	REPORTING PERIOD	SUBMITTED TO DWR WATER LOSS AUDIT PROGRAM
Report all five years for each Public Water System as available.		
Alta	2020	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
Applegate	2020	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
Auburn-Bowman	2020	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
Bianchi	2020	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
Colfax	2020	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
Foothill-Sunset	2020	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
Monte-Vista	2020	Yes
	2021	Yes

PUBLIC WATER SYSTEM	REPORTING PERIOD	SUBMITTED TO DWR WATER LOSS AUDIT PROGRAM
	2022	Yes
	2023	Yes
	2024	Yes
Weimar	2020	No
	2021	No
	2022	No
	2023	Yes
	2024	Yes

4.5.1 Future Distribution Water Losses

Based on the latest DWR Economic Water Loss Performance Standard Model (Version 4) available at the time this UWMP was prepared, the compliance water loss standard for the entire PCWA service area was estimated to be 6% or less by 2028. Table 4-13 summarizes the estimated distribution system water loss for the Western Area system and the Zone 3 system for 2025 through buildout. These future distribution system water loss estimates were used in the future water use projections.

Projected distribution system water loss assumptions were developed based on review of historical water audit results, recent system performance, and system-specific characteristics. Separate water loss percentages were applied to Zone 1 and Zone 3 to reflect differences in system size, infrastructure condition, water loss performance standard, and observed loss variability.

Table 4-13: Future Distribution System Water Losses

		CURRENT 2023	2030	2035	2040	2045	2050
Western Area System	**Percentage of Losses**	8%	6%	6%	6%	6%	6%
Zone 3 System	**Percentage of Losses**	16%	15%	15%	15%	15%	15%

For Zone 1, a lower projected water loss percentage was applied based on recent AWWA audit results and water loss standards set by the Water Loss Performance Standard. For Zone 3, a higher projected water loss percentage was applied to reflect the characteristics of smaller mountain systems with older infrastructure, greater relative real losses, and higher year-to-year variability observed in past audits. As detailed in Table 4-11, these systems don't have water loss standards at the moment due to ongoing consolidations efforts in the Zone 3 area, therefore, a theoretical reduction was applied to superseded historical audits. These assumptions are used for long-range UWMP planning purposes only and are intended to represent expected system performance.

4.6 Worksheets and Reporting Tables

This section summarizes the worksheets and reporting tables prepared to support PCWA's 2025 UWMP. DWR provides standardized templates and tools to ensure consistent reporting across all urban water suppliers. These resources guide the development of demand projections, supply assessments, water shortage planning, and other required submittal elements. PCWA has prepared all required tables using DWR's 2025 formats and incorporated optional tools where they supported the analysis.

4.6.1 DWR 2025 UWMP Submittal Tables

DWR requires that all UWMP data be submitted using standardized 2025 UWMP Submittal Tables. These tables capture quantitative information on water use, water supply characterization, demand management, and reliability evaluations. PCWA has prepared each required table consistent with the 2025 Guidebook and will submit the complete table set through DWR's online reporting system as part of the final UWMP package. The full set of completed submittal tables is provided in Appendix B.

4.7 Water Use for Lower Income Households

CWC Section 10631.1 requires demand projections to include projected water use associated with lower-income residential housing. Lower-income households were identified using the American Community Survey (ACS) definition of families living below 200 percent of the federal poverty level. Based on the ACS 2019–2023 five-year estimates, approximately 12.1 percent of families in Placer County fall below this threshold.[5]

The estimated lower-income share of the population was applied to PCWA's population projections to develop corresponding lower-income population and housing unit estimates. In the absence of long-term income distribution forecasts, this proportion is assumed to remain constant over the UWMP's 20-year planning horizon.

Projected water demands for lower-income households were calculated using the estimated lower-income population (12.1 percent), the countywide persons-per-household (PPH) factor (2.62), and representative residential unit demand factors consistent with the overall demand-forecasting methodology (0.43 AFY/unit).

Table 4-14 summarizes the estimated lower-income population, housing units, and associated water demands for the planning period.

[5] U.S. Census Bureau. American Community Survey 2019–2023 Five-Year Estimates, Table S1702 (Ratio of Income to Poverty Level)

Table 4-14: Low-Income Water Use, AFY

	2030	2035	2040	2045	2050
Projected Population	146,829	169,391	195,419	225,447	260,088
Low-Income Population	17,766	20,496	23,646	27,279	31,471
Low-Income Units Needed	6,781	7,823	9,025	10,412	12,012
LOW-INCOME WATER USE, AFY	**2,916**	**3,364**	**3,881**	**4,477**	**5,165**

4.8 Climate Change Considerations

As discussed in Section 3.5, the Basin region prepared the ARBS. The ARBS found that while climate change currently does have an impact on the basin, impacts are largely seen closer to the end of the century, and not within the timeline of the UWMP. Through proactive adaptation management actions, the ARBS highlights ways for the region to alleviate climate change impacts by the end of century; therefore, in consideration of the timeline of the UWMP, PCWA did not include climate change impacts in supply and demand scenarios within this UWMP.

5 SB X7-7 Baselines, Targets, and 2025 Compliance

This section describes the Water Conservation Act of 2009, also known as SBX7-7, Baseline, Targets, and 2020 compliance. The goal of this section is to demonstrate compliance with the 2020 targeted water-use reduction of 20%.

IN THIS SECTION

- SBX7-7 Forms and Tables
- 2025 Compliance Daily Per Capita Water Use

5.1 SBX7-7 Forms and Tables

Senate Bill 7 of Special Extended Session 7 (SBX7-7) was incorporated into the UWMP Act in 2009 and requires that all water suppliers increase water use efficiency with the overall goal of decreasing per-capita water consumption within the state by 20% by the year 2020. SBX7-7 required DWR to develop certain criteria, methods, and standard reporting forms, through a public process, that water suppliers could use to establish their baseline water use and determine their water conservation targets. SBX7-7 and DWR's *Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use* (State of California Department of Water Resources, February 2016) specify methodologies for determining the baseline water demand, 2015 interim urban water use target, and the 2020 urban water use target for the Agency. The SBX7-7 Verification and Compliance Forms, which were required to be submitted to DWR to demonstrate compliance with the SBX7-7 requirements, are presented in Appendix D. This section also demonstrates that the Agency achieved its 2020 water use target in 2020 and 2025.

5.2 2025 Compliance Daily Per-Capita Water Use

The Agency submitted its SBX7-7 Verification Form as part of the 2015 and 2020 UWMP, establishing the Agency's baseline daily per capita water use and 2020 water use target. Because the Agency has had no changes to its service area boundaries, these baseline and target values remain valid for the 2025 UWMP reporting cycle.

As part of the 2025 UWMP, the Agency must demonstrate compliance with its 2020 water use target by completing Submittal Table 5-1 R. Because the Agency met its 2020 target of 261 GPCD in 2020 with an Actual GPCD of 240 GPCD, SBX7-7 2025 Compliance Form completion is not required. Table 5-1 R includes the City's 2020 Target and Actual GPCD to verify compliance. A summary of the 2020 information is shown in Table 5-1.

Table 5-1: 2020 GPCD

YEAR	TARGET GPCD	ACTUAL GPCD	DID SUPPLIER ACHIEVE TARGETED REDUCTION
2020	261	240	Yes

Pursuant to CWC Section 10608.40, the Agency must report whether it met the 2020 Target as part of its 2025 UWMP. The Agency achieved the target, completing its SBX7-7 compliance obligations, and no additional calculations are required.

While SB X7-7 compliance is reported for historical purposes, PCWA acknowledges the transition toward Urban Water Use Objectives under current regulatory frameworks. Future planning efforts will incorporate UWUO compliance requirements as guidance becomes finalized.

6 Water Supply Characterization

This section describes and quantifies PCWA's current and projected potable and non-potable water supplies. It provides a narrative description of each supply source and quantifies the supply availability for each supply source identified.

IN THIS SECTION

- Water Supply Analysis Overview
- Water Supply Characterization
- Energy Intensity

6.1 Water Supply Analysis Overview

This section characterizes water supplies under normal, single-dry, and multiple dry year conditions consistent with California Water Code requirements. PCWA uses surface water from the American River and Yuba River watersheds as its primary water supply and delivers this supply to its wholesale and retail customers as described in Section 4. PCWA can also use groundwater in dry hydrologic conditions to meet demands in the Zone 1 service area. While groundwater use has previously been limited, it remains an important supplemental source for drought resiliency and emergency supply. The agency also anticipates future opportunities to incorporate recycled water produced by the cities of Roseville and Lincoln, to meet demands in the future.

PCWA's groundwater, surface water and recycled water supplies are discussed in the following subsections.

6.2 Water Supply Characterization

This section provides further guidance on the water supply availability and narrative required under the Water Code.

6.2.1 Purchased or Imported Water

PCWA utilizes purchased water supplies through two long-term contractual agreements with PG&E. This supply is presented in Section 6.2.3.1.

6.2.2 Groundwater

PCWA has historically produced a limited quantity of groundwater, primarily as a supplemental source during dry years. Pumping in the Western Area occurs from the North American Subbasin of the Sacramento Valley Groundwater Basin (DWR Sub-basin 5-021.64) which is bounded by the Bear River to the north, American River to the south, Feather and Sacramento Rivers to the west and the Sierra Nevada foothills to the east. This subbasin is not adjudicated. Historical pumping by PCWA in the Western Area was limited to pumping for Bianchi Estates (Zone 2) and for the Sunset Industrial area. Pumping for Bianchi estates ceased in 2004 when PCWA began serving the area with surface water. PCWA maintains the Sunset Industrial area wells, which are available only for dry year supplies.

6.2.2.1 West Placer Groundwater Sustainability Agency

PCWA, along with Placer County, Roseville, Lincoln, and Cal-Am make up the West Placer Groundwater Sustainability Agency (WPGSA), an organization that manages groundwater resources within the North American Subbasin (NASb) of the Sacramento Valley Groundwater Basin (DWR Subbasin 5-021.64). The WPGSA was formed in 2017 to implement the Sustainable Groundwater Management Act (SGMA) passed in 2014. This agency implements activities that preserve and enhance the current state of groundwater for the local cities, communities, agriculture, and the environment. More specifically, the locally controlled effort will

protect the basin from overdraft, create sustainable water supplies for current and future agricultural development, support a stable and growing local economy, and contribute to land and habitat conservation.

The North American Subbasin was designated as a high priority subbasin under SGMA, requiring the development and implementation of groundwater sustainability agencies and completion of a Groundwater Sustainability Plan (GSP). This subbasin contains five partners (including WPGSA) that together have developed the North American Subbasin GSP. The coordinated GSP for the Subbasin was finalized and adopted by all five GSAs in late 2021 following extensive stakeholder engagement, and is provided in Appendix G. The plan establishes sustainability criteria, monitoring networks, and management actions intended to maintain groundwater levels, prevent undesirable results, and protect groundwater-dependent ecosystems. Implementation is underway and includes annual reporting, five-year evaluations, and adaptive management to address climate variability and future demands. Groundwater use by PCWA is subject to SGMA requirements and the sustainability criteria established in the NASb GSP, which may limit groundwater production to avoid undesirable results and ensure long-term basin sustainability. The WPGSA and its partners are also exploring conjunctive use and groundwater banking opportunities as part of regional adaptation strategies, which will inform the next GSP update anticipated in 2026. The North American Subbasin along with the subbasin partners are shown in Figure 6-1.

6.2.2.2 Groundwater Supply System

PCWA does not anticipate utilizing groundwater to support its normal year water deliveries. Specifically, PCWA currently has two wells – the Sunset Well and the Tinker Well – each with a production capacity of 1,000 AFY. These wells are used primarily for backup and dry-year supplies but remain available in all scenarios. Groundwater supplies are intended to provide short-term operational flexibility during dry years and emergency conditions and are not assumed to be continuously available at full capacity during extended droughts.

PCWA's last use of groundwater was in August 2014. The proposed Regional University and Placer One developments plan to construct one new well within each specific plan area. Therefore, PCWA is anticipating an increase of groundwater supply for a single-dry year between 2025-2040 from 2,000 GPM to 5,000 GPM.

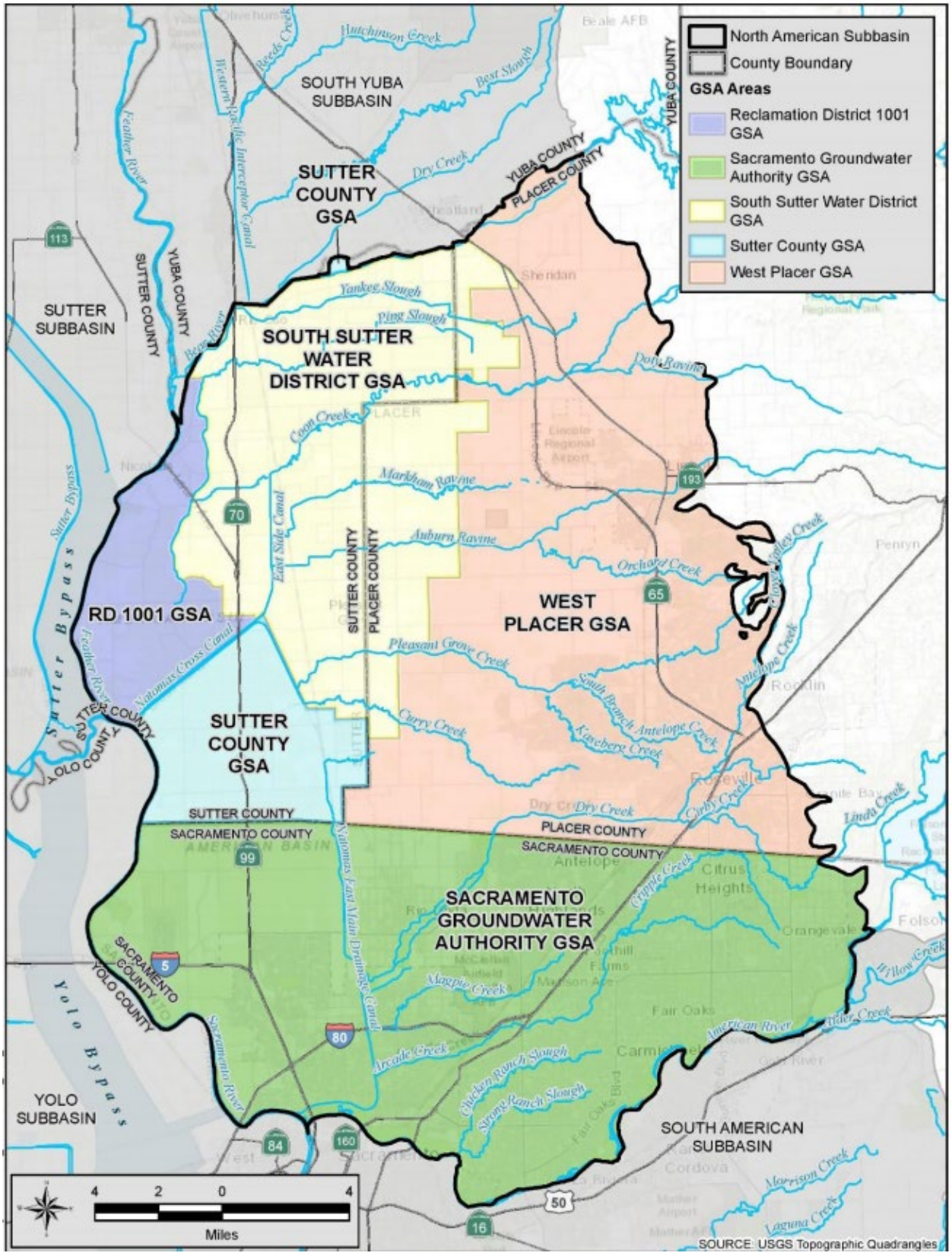


Figure 6-1: Western Placer County Groundwater Management Plan Area

6.2.3 Surface Water

PCWA's surface water supplies consist of water diverted from the Yuba, Bear, and North Fork American River and its tributaries which includes:

- Water purchased from PG&E from the Yuba and Bear Rivers under the 1982 Zone 3 Contract Purchase Agreement and the February 27, 2015 Water Supply Agreement.
- Water stored in its MFP under water rights permits 13856 and 13858.
- CVP water under CVP Repayment Contract 14-06-200-5082A-IR1-P from the American River; and
- Surface water from various small creeks under pre-1914 water rights.

A summary of PCWA's existing surface water supplies is provided in the following subsections. Table 6-1 lists each source and contract by water right, showing the maximum available quantity, purpose of use, and place of use for each water asset. If a supply may be used in multiple zones, the total use cannot exceed the maximum quantity available under the water rights or contract. Greater use of a given quantity of a supply in one zone precludes the use of the same water in another zone.

Table 6-1: PCWA Surface Water Supply Summary

SUPPLY	SOURCE	PURPOSE OF USE	MAX USE AFY	PLACE OF USE
Permits 13856-13858	American River	Irrigation, Domestic, Municipal, and Industrial, Recreation	120,000	Western Area; Portions of Sacramento County, including SJWD, SSWS and Rio Linda Water District service area
Central Valley Project Contract	American River	Municipal and Industrial	35,000	Zone 1
PG&E Water Supply Agreement (2015)	Yuba and Bear Rivers	Irrigation and Domestic	100,400	Western Area
PG&E (Zone 3) Purchase Agreement (1982)	Yuba and Bear Rivers	Irrigation and Domestic	25,000	Zone 3
Pre-1914 Appropriative Right (S000959)	Canyon Creek	Irrigation and Domestic	40 cfs (Max.)	Alta, Colfax, Monte Vista, and rural areas (Not limited to Zone 3)
Pre-1914 Appropriative Right (S000967)	Tributary to Auburn Ravine	Irrigation and Stock Watering	Not Stated	"Boardman Canal" Area
Pre-1914 Appropriative Right (S010397)	South Fork Dry Creek Tributary to Coon Creek	Irrigation	Not Stated	Localized Irrigation Just East of Auburn
Pre-1914 Appropriative Right (S010398)	North Fork Dry Creek Tributary to Coon Creek	Irrigation	Not Stated	Localized Irrigation Just East of Auburn

6.2.3.1 PG&E Contracts

PCWA has two water supply contracts with PG&E that provide the opportunity to purchase up to 125,400 AFY for irrigation and domestic purposes: 100,400 AFY under one agreement for Zone 1 and 25,000 AFY under another agreement for Zone 3. The underlying rights for the PG&E supply are PG&E's pre-1914 appropriative rights to water in the Yuba and Bear Rivers, which were established prior to the time that PG&E developed hydroelectric facilities throughout the Yuba and Bear River watersheds. The water supply that PCWA purchases from PG&E is used to meet both untreated and treated water demands within PCWA's service area.

In 1968, PCWA purchased PG&E's lower Placer Water System, including its distribution canals, treated water systems, and rights to delivery of 100,400 AFY of water from PG&E's Drum-Spaulding Project to serve PCWA customers in Western Placer County (also referred to as the Western Area in this UWMP). The Drum-Spaulding Project consists of 29 reservoirs, 6 major water conduits, 11 powerhouses as well as other water, power, and recreation related facilities. In 2014, the Drum-Spaulding Project was divided into three distinct projects for purposes of Federal Energy Regulatory Commission (FERC) compliance: Upper Drum-Spaulding, Lower Drum, and Deer Creek hydroelectric projects. The Deer Creek hydroelectric project was recently sold to NID, though this does not affect PCWAs supplies from PG&E.

The systems are currently operating on annual FERC license renewals; final issued FERC licenses have a term between 30 and 50 years. Since the Upper Drum-Spaulding and Lower Drum hydroelectric projects are FERC licensed facilities, they are subject to the terms and conditions of the FERC Licenses affecting their operations. In concert with the terms of these licenses, PG&E provides wholesale water to PCWA for consumptive uses in PCWA's service area. While federal law allows FERC to adopt permit conditions that mandate minimum flows and reservoir levels or set water temperature limitations related to operation of a hydroelectric facility, these provisions should not affect the appropriation and distribution of water for consumptive purposes at this time. Future conditions in the FERC License renewal process could impact deliveries for consumptive purposes.

In 1982, PCWA purchased the remainder of PG&E's Upper Placer Water System, securing delivery of up to 25,000 AF per year from PG&E's Drum Spaulding Project as part of the Upper Placer Water System conveyance. PCWA typically acquires the full amount during average years. PCWA purchases water from PG&E at various buy points, and untreated water is diverted into PCWA's Boardman Canal which begins near Alta and extends southwest along the Interstate 80 corridor by Lake Theodore. From the Boardman Canal, PCWA delivers water to its four water treatment plant facilities located within Zone 3, multiple community water districts, and its untreated water customers. The purchase agreement has no termination date but limits availability under certain conditions, such as maintenance or regulatory actions beyond PG&E's control.

PCWA and PG&E entered a new Water Supply Agreement on February 29, 2015, and later amended on April 21, 2025. In Article II of the Agreement, PG&E will continue to deliver 100,400 AF of water to PCWA from the Drum-Spaulding Project. PCWA will purchase this water during a

water contract year. PCWA is also entitled to purchase additional water if made available by PG&E. The 2015 Water Supply Agreement terminates upon "the expiration date of the New FERC License…."

PG&E's pre-1914 water rights and supplies delivered through its system under these water rights are highly reliable during normal, single-dry, and multiple-dry year periods. PG&E relies on the Sacramento Valley Index (SVI) to determine contract availability for Drum Spaulding supply. During the 1987-1992 drought, PCWA had a full Yuba/Bear River supply from PG&E each year. In 2015, one of California's driest years, PG&E reduced deliveries by only 40%, compared to much steeper reductions for other statewide sources. PCWA conservatively estimates that it will experience a 50% reduction in its PG&E supply in a single dry year and a 0% reduction in multiple dry years. PCWA has developed an untreated water allocation strategy in the Western Placer System for dry-year shortage conditions, which relies on agricultural customers switching to groundwater during shortages.

PCWA's projected reliance on PG&E contract water is reduced relative to prior UWMP cycles. This is due to the increased availability and planned utilization of other elements of the Agency's diversified water supply portfolio, particularly MFP supplies. PG&E water continues to provide an important flexible and supplemental supply; however, future demand projections do not assume full reliance on this source where alternative supplies are available and operationally preferred. This approach is consistent with the 2020 UWMP and reflects updated assumptions regarding the sequencing and utilization of PCWA's available water supplies.

Section 6.2.10 shows PG&E supplies through 2050.

6.2.3.2 Middle Fork Project (Permit 13856 and 13858)

PCWA owns and operates the MFP and holds appropriative North Fork American River water rights for the MFP pursuant to Permits 13856 and 13858 through the California State Water Resource Control Board (State Water Board), Division of Water Rights. This includes direct diversion rights from the North Fork American River, Folsom Dam, and other locations within PCWA's MFP including storage rights in MFP reservoirs and subsequent re-diversion rights of the stored water for irrigation, domestic, municipal, industrial, and recreational purposes. PCWA may divert water directly from the North Fork American River and Folsom Dam from November through June and must re-divert stored reservoir water for remainder of the year.

In 2014 and 2015, two of the driest years on record, PCWA's water rights were additionally curtailed from direct diversion or diversion to storage. The curtailments were from May 27 to November 19 in 2014 and from May 1 to November 6 in 2015, reducing the permitted diversion to storage season by 54 days in 2014 and 67 days in 2015. In 2014 and 2015, PCWA used 77,496 and 42,346 AF, respectively, of MFP water in Zone 1 and in raw water deliveries primarily to Roseville, SJWD, and SSWD. In 2014, a 40,736 AF out of county transfer was made to East Bay Municipal Utilities District/Westlands Water District. This out of county transfer accounted for the water use differential in the water for these two years.

During the latter years of the 2020–2022 statewide drought, PG&E Drum–Spaulding deliveries to Zone 1 remained below the full 100,400 AF contractual volume, totaling 88,611 AF in WY 2021–2022 and 83,516 AF in WY 2022–2023, leaving unused entitlement of approximately 11,789 AF and 16,884 AF, respectively. In Calendar Year 2022, PCWA used 71,167 AF of MFP entitlement to support Zone 1 demands, wholesale deliveries from Folsom Reservoir, and other raw water needs. MFP use declined to 26,223 AF in 2023 as operational priorities shifted and less MFP water was required. PCWA also completed a 21,053 AF out-of-county transfer to East Bay Municipal Utility District in 2022 under existing transfer arrangements; no comparable transfer occurred in 2023, accounting for a substantial portion of the year-to-year difference in MFP use. These operational patterns occurred within the broader context of statewide drought response and annual shortage reporting, including DWR's 2022 Annual Water Supply and Demand Assessment and associated urban conservation actions.

The two water rights permits provide water supplies to PCWA's treated and irrigation water customers from the American River Pump Station (ARPS) and to PCWA's wholesale customers from Folsom Dam. PCWA may use water under its permitted water rights in western Placer County, as well as portions of northern Sacramento County, including SJWD, SSWD, and Rio Linda/Elverta Community Water District service areas. PCWA's wholesale customers include Roseville, SJWD, and SSWD.

PCWA's total volume of water rights through these permits is greater than 300,000 AFY. However, PCWA has signed an interim agreement with USBR limiting its diversions under PCWA's permitted rights to 120,000 AFY off the North Fork American River for use within the existing PCWA place of use.

Section 6.2.10 below shows the MFP supply through 2050.

Permit Extension of Time

The State Water Board-governed water rights system consists of a three-stage water rights process – application, permit and then licensing of the water put to beneficial use at the end of the permit term. PCWA's water rights are in the permit stage, meaning that PCWA has not yet put the water supplies under its permit to full beneficial use. The water rights system allows for an extension of time to the permit term.

PCWA's North Fork American River Water Rights Permit Nos. 13856 and 13858 state that the complete application of the water to the proposed use was to be made on or before December 1, 2007. PCWA did not fully utilize the water supply entitlements described in Water Rights Permits 13856 and 13858 prior to the specified date. PCWA judiciously filed petitions for a 36-year extension of time in which to put water allocated under these permits to full beneficial use. The petitions were accepted by the State Water Board in January 2008 and are undergoing formal administrative review. To support State Water Board's decision on the petitions for extension of time, PCWA is preparing an Environmental Impact Report (EIR) to assess potential environmental impacts of diverting the full 120,000 AFY under interim USBR agreement as compared to the baseline diversion quantity it put to beneficial use prior to December 1, 2007

(41,991 AFY). Although PCWA anticipates approval of its petition by the State Water Board, the ultimate outcome of the process is yet to be determined.

ARPS Capacity

The ARPS, completed in 2008, has a current capacity of 189 cfs. PCWA has used the ARPS (and its predecessor pumping stations) to meet agriculture and treated water demands within its Zone 1 and Zone 5 service areas. In 2020, PCWA diverted 14,577 AF of water from the ARPS. In 2025, a year where PCWA lost access to PG&E supply, PCWA diverted 35,500 AF of water from the ARPS.

The ARPS EIR, completed in June of 2002, analyzed diversion of up to 35,500 AFY of North Fork American River water rights water. Future diversions above 35,500 AFY, if needed, would require additional environmental review. The EIR anticipated that PCWA may need to divert up to a total of 70,500 AFY at ARPS to fulfill future demand. In order to meet these projected demands in Zone 1, PCWA anticipates that it will need to expand the use of the ARPS.

Water Forum Agreement

The Water Forum is a regional collaborative established to implement the WFA that advances two co-equal objectives:

1. Provide a reliable and safe water supply for the region's economic and planned development,
2. Preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River.

The WFA was executed in 2000 following negotiations among four stakeholder caucuses: water purveyors, environmental organizations, business interests, and public interests. The foundation of the WFA is commitment towards water operations balanced with support for projects. Additionally, the agreement also includes construction of fish spawning and rearing habitat enhancements in the Lower American River. The WFA has provided a coordinated framework for successfully balancing regional water supply for the region's growing economy and for the environment, making it a model for water management in California, and leading to significant federal, state, and regional investment in multi-benefit water supply and environmental restoration projects in the region.

For PCWA, the WFA has played a central role in:

1. Securing the American River Water Rights Extension,
2. Supporting construction and operation of the American River Pump Station,
3. Advancing the RiverArc project,
4. Establishing PCWA's commitment to environmental flow releases resulting from reservoir re-operation and downstream water transfers, and
5. Selling environmental release flows downstream of the Sacramento region has provided revenue for PCWA's participation in a variety of stewardship programs.

The existing WFA sunsets in 2030. Renegotiation of a successor agreement, referred to as Water Forum 2050 (WF2050) Agreement, began in 2020. Renewal and extension of the WFA was sought early due to increasing ecological pressures on the Lower American River resulting from contemporary droughts. The American River Basin Study, prepared in coordination with the U.S. Bureau of Reclamation, served as a technical foundation for this effort.

Water Forum 2050 Agreement Overview

Water Forum members signed and adopted the WF2050 Agreement in May 2026.The WF2050 Agreement covers a 25-year planning horizon and consists of the following elements:

1) WF2050 Agreement:
    a) Memorandum of Understanding (MOU) for WF2050 – signed by all Water Forum members.
    b) Program Areas:
        i) American River Flows and Operations
        ii) American River Corridor Health
        iii) Regional Water Supply Sustainability
        iv) Science, Monitoring, and Decision Support
        v) Governance, Funding, and Administration
    c) Purveyor -Specific Agreements (PSAs) – commitments and descriptions unique to each water purveyor, including PCWA.
2) Third Interagency Agreement for Administration and Management of the Water Forum – executed by funding members only to define administrative authority, budgeting procedures, and liability provisions.
3) Interagency Agreement for Cost-Sharing of Water Forum Successor Effort and Habitat Management Elements – outlining annual fiscal commitments, executed each year by funding members only.

The WF2050 Agreement is structured as an MOU and does not create enforceable contractual rights or obligations. As with the original WFA, implementation relies on voluntary commitments and collaborative regional engagement.

PCWA's Purveyor Specific Agreement

1. Each water purveyor participating in the Water Forum prepares a PSA describing its system characteristics, management strategies, and commitments under the WF2050 framework. PCWA's PSA includes the following components: Purveyor background (service area, customer characteristics, available water supplies, system infrastructure). This section details the relationship between PCWA's two supplies on the American River: 1) Middle Fork Project appropriative rights and 2) Central Valley Project contract rights.
2. Water supply management approach, including supply portfolio balancing and planning for buildout demand conditions.
3. Drier-year and critically dry-year management strategies, including provisions for PCWA's environmental flow releases.

4. Compliance approach for California's water use efficiency regulations.

PCWA projects that support the Water Forum's co-equal objectives.

PCWA's PSA is more complex than most due to its reservoir re-operation and environmental release program, which enables up to 47,000 AF of flow that would not otherwise be released to support the health of the American River. The environmental flow releases and subsequent downstream transfer program is an uncommon capability within the watershed that provides substantial aquatic habitat benefits. This provision is the cornerstone of PCWA's WFA commitment. PCWA Central Valley Project Contract

PCWA has a CVP water contract with USBR for delivery of up to 35,000 AFY for municipal and industrial purposes, including groundwater recharge programs that are consistent with applicable State law. The CVP Repayment Contract 14-06-200-5082A-IR1-P (dated February 28, 2020) remains in effect in perpetuity with no expiration date.

PCWA's point of delivery for CVP water under the CVP Contract is Folsom Dam, but the contract also includes potential for other points of delivery, including the Sacramento River, if the points of delivery are mutually agreeable to the Contracting Officer. PCWA does not currently own or control facilities that are capable of conveying CVP water from Folsom Dam to the PCWA service area. As such, the availability of the water supply is limited by these physical constraints. PCWA is engaged in negotiations with the City of Roseville and other regional entities to potentially utilize existing facilities to divert and deliver PCWA's CVP project water supplies.

The CVP contract identifies only a portion of PCWA's Zone 1 service area as the area available for water deliveries from CVP Project supplies. Some sections of PCWA's current Zone 1 service area are not identified as delivery areas in the CVP Contract map. The contract, however, specifies a procedure for administratively modifying the service area with USBR approval.

Article 3(b) of the CVP Contract indicates that the amount of water that would likely be delivered in normal years is 32,000 AFY. USBR reserves the right to apportion the available CVP water supply among PCWA and other CVP water contractors under USBR's Municipal and Industrial Water Shortage Policy (M&I WSP). The M&I WSP generally defines water service terms and conditions under drought conditions. The M&I WSP is valid through 2030. Generally, reductions in municipal and industrial deliveries should not exceed 25%, unless conditions are severe. In 2015, M&I WSP allocations on the American River watershed were 25% of the historical use, meaning 25% of the last three normal years' average use was adjusted with identified variables. At present, PCWA uses only a very small amount of CVP water. In the future, PCWA will need to demonstrate a record of CVP water use in normal years to have access to water in drought years.

Several issues related to CVP water, including diversion facilities, the service area identified in the CVP Contract, and M&I WSP drought year allocations will need to be addressed if the CVP Contract water is to be utilized in PCWA's service area effectively.

Section 6.2.10 below shows the CVP supply through 2050.

6.2.3.3 Pre- 1914 Appropriative Rights

PCWA holds four pre-1914 appropriative water rights for diversion of water from various small creeks and their tributaries in western Placer County. PCWA has filed Statements of Water Diversion and Use (SODU) with the State Water Board for each water right: S000959, S000967, S010397 and S010398. These rights are generally for agricultural purposes, including irrigation and stock watering. The pre-1914 appropriative water rights in Zone 1 are used to convey contract water, any diversions are incidental, and it is the goal of the canal operators to only divert the same amount of water that entered the natural water course from the PCWA's canals. Generally, water for diversion is only present during times of significant precipitation when availability exceeds PCWA's demands. Other water that may be present outside of precipitation events is generally return flows from customer irrigation activities.

In 2014 and 2015, back-to-back dry years, the combined diversion from pre-1914 water rights were 2,687 AF and 3,792 AF, respectively. The most recent drought had combined diversion of 1,991 AF in 2021 and 2,218 AF in 2022. In recent years 2023 through 2024 that are more representative of a normal PCWA water year, the combined diversion from pre-1914 water rights were 4,209 AF and 2,937 AF, respectively. The diversion data demonstrate a declining trend in water utilization, with combined pre-1914 water right diversions decreasing between the 2014–2015 and 2021–2022 drought periods and remaining comparatively lower during recent water years representative of normal hydrologic conditions.

Section 6.2.10 shows the pre-1914 appropriative rights estimated supply through 2050.

6.2.3.4 Water Treatment Plant Capacity

Surface water supplies are treated at multiple water treatment plants (WTPs) located throughout the PCWA Zone 1 service area. Projected treated water demands include both Zone 1 retail and wholesale service components.

Table 6-2 summarizes total buildout treated water demands and the corresponding equivalent maximum-day demand used for comparison with treatment capacity.

Table 6-2: Buildout Treated Water Demands

	BUILDOUT DEMAND (MGD)	BUILDOUT DEMAND (AFY)
Zone 1 Retail	56	63,000
Zone 1 Wholesale	45	50,700
Total Treated Demand	**102**	**113,700**
Equivalent Maximum Day Demand	**203**	-

Table 6-3 summarizes existing and planned WTP capacity by facility and primary surface water supply source. Capacities reflect rated, sustained treatment capability under normal operating conditions and are intended for long-term planning evaluation.

Table 6-3: Planned Water Treatment Plant (WTP) Capacity

Water Treatment Plant	PLANNED CAPACITY (MGD)	PRIMARY SUPPLY DESCRIPTION
Foothill WTP	60	PG&E and MFP
Sunset WTP	5	PG&E and MFP
Ophir WTP	60	30 MGD from expanded MFP use; 30 MGD from raw water conversion and/or MFP
Auburn/Bowman WTP	15	PG&E
Sacramento River-Associated Supply	65	CVP supply plus groundwater banking / conjunctive use
Total Planned Treatment Capacity	**205 MGD**	

At buildout, total planned treatment capacity is sufficient to meet projected maximum-day treated water demands at the system level. Treatment capacity will continue to be monitored and evaluated through PCWA's ongoing planning and capital improvement processes to maintain consistency with projected demands over the UWMP planning horizon.

6.2.4 Stormwater

There are currently no plans to develop stormwater supplies within the PCWA service area.

6.2.5 Wastewater and Recycled Water

6.2.5.1 Wastewater System

PCWA does not collect, treat, or discharge municipal wastewater. Wastewater generated within PCWA's service area is conveyed to and treated by other local municipalities, including South Placer Municipal Utility District (SPMUD) and Placer County. A summary of sewer flows for SPMUD and Placer County for 2025 are provided in Appendix B, Submittal Tables 6-2R and 6-3R. Data was sourced from the agencies for the 2025 calendar year.

6.2.5.2 Recycled Water System

PCWA anticipates recycled water will be developed and potentially available as a supply in its retail service area. These supplies would be provided through agreements with Lincoln and Roseville as a potential user for each city's established recycled water program.

PCWA anticipates that recycled water will be available to meet a portion of customer demands, including retail and wholesale customers adjacent to these cities, beginning around 2030. These supplies will help offset potable water use for non-potable applications such as landscape irrigation and industrial processes, improving overall system reliability and supporting regional sustainability goals. Specific quantities and delivery mechanisms are being refined through ongoing regional planning efforts and will align with the projections presented in Section 6.2.10.

The anticipated future use of recycled water is shown in Table 6-4.

Table 6-4: DWR 6-4R Recycled Water Direct Beneficial Uses Within Service Area (in AF)

BENEFICIAL USE TYPE	2025	2030	2035	2040	2045	2050	POTENTIAL RECYCLED WATER USE (VOLUME)
Other (Unknown)	0	2,500	5,000	7,000	9,000	9,000	
TOTAL	**0**	**2,500**	**5,000**	**7,000**	**9,000**	**9,000**	**0**

A comparison of actual 2025 recycled water use and the projection for 2025 that was included in the 2020 UWMP is shown in Table 6-5.

Table 6-5: DWR 6-5R 2020 UWMP Recycled Water Use Projection Compared to 2025 Actual (in AF)

BENEFICIAL USE TYPE	2020 PROJECTION FOR 2025	2025 ACTUAL USE
Other (Unknown)	0	0
Total	0	0

6.2.6 Desalinated Water

There are currently no plans to develop desalinated supplies within the PCWA service area.

6.2.7 Water Exchanges and Transfers

PCWA holds water rights and is party to contracts entitling it to water supplies that are adequate to meet its current and future projected needs. PCWA has historically transferred water outside of its service area to Placer and Sacramento Counties.

These transfers have been conducted pursuant to commitments under the WFA as well as from water made available through reservoir reoperations. Such transfers have supported areas experiencing water deficits and have provided additional water to Folsom Reservoir benefitting flows to the lower American River.

PCWA may engage in future water transfers to benefit areas with water supply deficits and to meet its commitments under the WFA. These transfer opportunities may include reservoir reoperation transfers, groundwater substitution transfers, conserved water transfers, or any other transfer or exchange opportunity allowed by law.

Beginning in the year 2045, PCWA anticipates its CVP contract will yield at least 35,000 AFY. However, access to the full contract amount may be limited by infrastructure in place. Also, PCWA's pre-1914 appropriative rights are available for deliveries in portions of Zone 3 and in Zone 1 and the estimated yield is 3,400 AFY. Recycled water supplies are projected to be available in the PCWA retail service area starting in 2030 and will be sourced from Lincoln and Roseville to meet regional demands.

6.2.8 Interties

To supplement supplies and enhance system reliability, PCWA maintains treated-water interties with neighboring agencies that can be used to transfer or receive water to support distribution

system operations and facilitate wheeling. These interties provide redundancy for emergency conditions and for outages associated with maintenance or construction activities, but they are not typically relied upon as a long-term supply and, depending on conditions and operational constraints, the amount available through interties may not be reliably quantified. PCWA maintains interties with Nevada Irrigation District (NID), Roseville, SJWD, and California American Water Company (Cal-Am).

6.2.8.1 Nevada Irrigation District

PCWA and NID maintain several interties for treated water emergency use. Additionally, the parties exchange water for operational purposes pursuant to a temporary water sale agreement. For each of the past five years, the water exchanged has been approximately 1,400 AFY to benefit areas within Lincoln. These exchanges are operational in nature and do not represent a net increase in Zone 1 demand.

NID shares capacity in South Canal with PG&E to transport and release water into Auburn Ravine, below PG&E's Wise Powerhouse. Until NID constructs and operates a WTP for their service area in Lincoln, NID will wheel water through PCWA and Lincoln to NID's service area. NID uses a portion of their capacity in the South Canal to deliver NID raw water to PCWA's Foothill WTP without affecting the maximum PCWA Zone 1 flow diversion. This water is treated at the Foothill WTP and delivered to Lincoln through the Lincoln Metering Station near the PCWA Sunset WTP. Lincoln then delivers this treated water to the NID service area.

6.2.8.2 City of Roseville

PCWA and the Roseville exchange treated water for operational purposes and have several emergency interties. In 2024 and 2025, PCWA lost access to PG&E raw water supply for an extended duration, Roseville treated PCWA supplies to serve PCWA retail customers in the east Roseville area and wholesale to Cal-Am on behalf of PCWA. These interties provides a critical redundancy for PCWA's treated water system and supports service continuity during outages or supply interruptions.

6.2.8.3 San Juan Water District

PCWA and San Juan Water District maintain treated-water interties to facilitate bidirectional transfers for emergency response, planned maintenance, and other operational needs. The primary connection is the Barton Road Intertie, which links the agencies' treated-water systems and provides mutual redundancy by allowing either system to supplement the other during supply disruptions, outages, or constrained operations. Additional connections at pump station facilities provide supplemental connectivity between the service areas. These facilities are operated on an as-needed basis and are not a consistent source of supply.

6.2.8.4 California American Water

Cal-Am receives water from PCWA as a wholesale purveyor. In normal operations, PCWA provides water to Roseville at Tinker Road Intertie, which is then wheeled through their service area and provided to California American Water Company through three interties. This wheeling

arrangement allows PCWA to utilize existing regional infrastructure to deliver supplies to wholesale customers and supports the conveyance of treated water between adjacent service areas to manage operational needs and available system capacity.

6.2.8.5 City of Lincoln

Lincoln receives water from PCWA as a wholesale purveyor. In normal operations, PCWA provides water to Roseville at Lincoln Metering Station and Twelve Bridges Metering Station. While Lincoln does not have the ability at this time to send water back to PCWA, Lincoln does have additional supplies that they are able to utilize to offset demands in time of need.

6.2.9 Future Water Projects

PCWA is investing in a series of renewal, replacement, and expansion projects to enhance system reliability and meet future demand. Near-term infrastructure improvements total approximately $18 million annually. For a comprehensive list of projects over the next five (5) years, visit Financial Reports | pcwa.net

Looking ahead, PCWA is advancing major capital projects that will transform regional water service capacity. The Ophir Water Treatment Plant, PCWA's first new treatment facility in over 30 years, will begin construction in 2026 and will add 10 million gallons per day of new capacity. Additional future projects include the Placer Parkway Pipeline and the Duncan Hill Treated Water Improvements Project, which will strengthen treated water delivery and system resilience. Together, these investments position PCWA to serve a growing population while maintaining high standards of water quality and reliability. For a comprehensive list of projects, refer to the Agency's Water Connection Charge (WCC) program at Financial Reports | pcwa.net

6.2.10 Summary of Existing and Planned Sources of Water

Table 6-6 summarizes PCWA's existing and projected water supplies through 2050.

Table 6-6: Existing and Planned Supplies, AFY

SUPPLY SOURCE	2025	2030	2035	2040	2045	2050
MFP	120,000	120,000	120,000	120,000	120,000	120,000
CVP	2,000	2,000	5,000	10,000	35,000	35,000
PG&E	125,400	125,400	125,400	125,400	125,400	125,400
Pre 1914 Appropriative Rights	3,400	3,400	3,400	3,400	3,400	3,400
Recycled Water	0	0	2,500	5,000	7,000	9,000
Groundwater	2,000	2,000	4,000	4,000	5,000	5,000
Total Supply	**252,800**	**252,800**	**260,300**	**267,800**	**295,800**	**297,800**

6.2.11 Special Conditions: Climate Change Impacts, Regulatory Conditions, Other Locally Applicable Criteria

PCWA's future water supply availability is influenced by evolving hydrologic conditions in the American River watershed. Warmer temperatures, reduced snowpack, and earlier runoff may shift the timing and reliability of inflows to the MFP system, which in turn affects storage operations and the seasonal availability of water to support customer demands. Increasingly frequent dry periods and greater watershed sensitivity towards wildfire may also contribute to short-term water quality impacts, creating operational challenges during peak demand months when the system is most constrained.

PCWA must also operate within an evolving regulatory environment. Requirements under the Water Forum Agreement limit MFP water availability in certain dry years to support Lower American River flow and habitat objectives. Access to CVP supplies similarly depends on annual allocations set by Reclamation, which are influenced by statewide hydrology, Delta regulatory constraints, and upstream temperature management needs at Folsom Reservoir. Regional groundwater management under SGMA, while not central to PCWA's own supply portfolio, affects the availability of supplemental or emergency supplies in neighboring basins during prolonged droughts. In parallel, statewide efficiency requirements under SB 606 and AB 1668 may reduce long term customer demand, shaping future supply operations.

Collectively, these climate, regulatory, and regional factors underscore the need for continued monitoring, interagency coordination, and adaptive management to maintain reliable service over the planning horizon.

6.3 Energy Intensity

Table 6-7 through Table 6-10 provides the available estimated energy information used to extract or divert water supplies, convey water supplies to treatment plants and distribution systems, treat water supplies, and distribute water supplies based on energy accounting data provided by PCWA. Information related to energy usage for treated water supplies in comparison to the energy use for nontreated water supplies, the amount of energy to place water into or withdraw water from storage, or any other energy related information that is available.

Table 6-7: Energy Estimate (in KW-Hours) for Extraction or Diversion of Water Supplies

YEAR	AMERICAN RIVER PUMP STATION	OPHIR ROAD PUMP STATION 1	OPHIR ROAD PUMP STATION 2
2020	3,424,973	2,095,972	163,601
2021	11,029,491	5,522,007	3,108,445
2022	4,027,300	1,616,466	771,966
2023	4,346,237	3,846,856	587,579
2024	11,370,279	5,788,081	2,010,867

Table 6-8: Energy Estimate (in Kw-Hours) for Conveying Supplies to WTPs or Distribution Systems

YEAR	WHITNEY PUMP STATION
2020	112,455
2021	90,723
2022	88,194
2023	31,336
2024	21,553

Table 6-9: Energy Estimate (in KW-Hours) to Treat Water Supplies

YEAR	ALTA WTP	APPLEGATE WTP	AUBURN WTP[1]	BOWMAN WTP	COLFAX WTP	FOOTHILL WTP	MONTE VISTA WTP	WEIMAR WTP	SUNSET WTP
2020	141,530	85,281	*502,000*	365,260	225,841	1,113,304	41,081	-	114,436
2021	168,696	80,001	*502,000*	343,090	249,175	1,262,551	38,639	-	113,940
2022	160,173	76,658	*502,000*	343,334	221,540	1,374,587	42,183	-	121,927
2023	178,957	82,020	*502,000*	357,781	198,934	1,251,247	38,170	41,427	90,302
2024	168,530	76,542	*502,000*	361,550	211,491	1,323,026	47,863	210,582	50,995

1. Gray italic text indicates sites with on-site solar generation; values shown are estimated based on historical usage.

Table 6-10: Energy Estimate (in KW-Hours) to Distribute Water Supplies

YEAR	TINKER[1]	BICKFORD PS	MIDAS PS	NORTH STAR PUMP STATION	STONERIDGE PUMP STATION	SKYRIDGE PUMP STATION	SUNSET WTP 10MG/PRS
2020	*680,000*	-	-	12,119	201,484	81,713	33,153
2021	*680,000*	-	-	10,548	308,282	79,215	20,300
2022	*680,000*	-	-	10,101	264,139	76,125	12,671
2023	*680,000*	-	-	7,859	336,700	69,059	22,969
2024	*680,000*	67,153	20,322	8,629	426,942	78,896	16,637

1. Gray italic text indicates sites with on-site solar generation; values shown are estimated based on historical usage.

7 Water Service Reliability and Drought Risk Assessment

This section describes water service reliability through 2050. As required by the UWMP Act, the assessment must compare total projected water supply and demands over the next 20 years in five-year increments under normal, single dry water years, and multiple dry water years. This section also includes the DRA, which provides a snapshot of the anticipated surplus or deficit if a drought were to occur in the next five years.

IN THIS SECTION

- Water Service Reliability Assessment
- Drought Risk Assessment

7.1 Introduction

Water service reliability is determined based on the security of water supply and water infrastructure security. The supply reliability assessment discusses factors (i.e., climatic, environmental, water quality and legal) that could potentially limit the expected quantity of water available from PCWA's current and projected sources of supply through 2050. Multiple drought scenarios are considered and the quantitative impacts of the aforementioned factors on water supply and demand are discussed, as well as possible methods for addressing these issues.

Evaluating the water service reliability is critical for water management as it can help identify potential problems before these happen. Water managers can then take proactive steps to mitigate shortages by encouraging water use efficiency, securing new water supplies and/or investing in infrastructure.

7.2 Water Service Reliability Assessment

PCWA's 2025 UWMP water service reliability assessment and DRA results indicate that no water shortages are anticipated within the next 25-years under normal, single dry water years, and multiple dry water years.

PCWA's 2025 UWMP water service reliability assessment compares total projected water supply and demands over the next 25 years in five-year increments under normal, single dry water year, and five-year consecutive dry period. The approach for the analysis and results is discussed in this section.

7.2.1 Service Reliability - Constraints on Water Sources

Impacts from climatic, legal, environment or water quality constraints on PCWA's water sources are summarized in Table 7-1 and are discussed in further detail in Section 6.

Climatic constraints include hydrological circumstances, like a drought. Legal constraints include contractual relationships, like the WFA, and terms and conditions for FERC licensed supply facilities. Environmental constraints include issues like species protection in the Sacramento-San Joaquin Bay Delta and maintaining flows in Placer County creeks. Water quality constraints would include issues with groundwater or surface water sources.

Table 7-1: Water Supply Constraints

WATER SUPPLY SOURCES	SPECIFIC SOURCE NAME	CLIMATIC CONSTRAINTS	LEGAL CONSTRAINTS	ENVIRONMENTAL CONSTRAINTS	WATER QUALITY CONSTRAINTS
Surface Water	PG&E Contracts	➲	➲	➲	-
	MFP	-	➲	➲	-
	CVP Contract	➲	➲	➲	-
	Pre-1914 Appropriative Rights	➲	➲	➲	-
Groundwater		➲	➲	➲	➲

7.2.2 Service Reliability – Year Type Characterization

In accordance with CWC Section 10635(a), every urban water supplier must provide their expected water service reliability for a normal year, single dry year, and five consecutive dry years for 2030, 2035, 2040, 2045, and optionally 2050.

7.2.2.1 Types of Years

DWR defines these years as:

- **Normal Year:** This condition represents a single year or an averaged range of years that most closely represents the average water supply available. An average was used for this analysis.
- **Single Dry Year:** The single dry year is recommended to be the year that represents the lowest water supply available.
- **Five-Consecutive Year Drought:** The driest five-year historical sequence for the supplier, which may be the lowest average water supply available for five years in a row.

These year types reflect increasing levels of hydrologic stress and provide a framework for understanding how individual water supply sources perform under varying conditions.

PCWA's water supply portfolio includes a combination of surface water supplies, contractual deliveries, recycled water, and groundwater resources. The availability of each supply varies by year type based on hydrologic conditions, operational constraints, and contractual provisions. Senior water rights and local supplies tend to provide greater reliability during dry conditions, while imported and hydrology-dependent supplies may experience reductions.

Table 7-2 through Table 7-4 summarize PCWA's available water supplies by year type and form the basis for the water supply reliability assessment presented in this chapter. Additional detail regarding the characteristics and reliability of individual water supply sources are provided in Section 6.

7.2.3 Supply Reliability

The factors affecting the reliability of PCWA's water supplies are discussed in Section 6. The average year or normal year is based on typical supplies available to PCWA in most years. The single dry year and five-consecutive year drought events are based on UIFR for MFP, pre-1914, and CVP supplies and SVI for PG&E supplies. The single dry year supply is based on the single driest year period in PCWA's recent history (1977). The five-consecutive year drought supply values were based on the 1988 to 1992 multi-year dry period. Each supplies' reliability for average year, single dry year and five-consecutive year drought are described below.

7.2.3.1 Normal Year

Under average conditions, PCWA estimates availability of the following supplies:

- **PG&E**– PG&E supply will be 125,400 AFY.
- **MFP** – PCWA's modeling over an 82-year hydrologic record indicates that 120,000 AFY will be available from the MFP supply.
- **CVP**– Based on availability estimates documented in PCWA's CVP contract and projected demand needs, with full 35,000 AFY of supply availability contingent on completion of required infrastructure.
- **Pre-1914**– The pre-1914 appropriative rights will provide approximately 3,400 AFY.
- **Recycled water**– As buildout of Lincoln and the planning areas west of Roseville occurs, recycled water should be available in both average and dry years.
- **Groundwater**– It is anticipated that groundwater will be available in average years.

Table 7-2 summarizes the available supplies under average conditions from 2030-2045 and buildout conditions.

Table 7-2: Normal Year Supplies

WATER SUPPLY SOURCES	2030	2035	2040	2045	2050	% REDUCTION
PG&E	125,400	125,400	125,400	125,400	125,400	0%
MFP	120,000	120,000	120,000	120,000	120,000	0%
CVP	2,000	5,000	10,000	35,000	35,000	0%
Pre-1914 Appropriative Rights	3,400	3,400	3,400	3,400	3,400	0%
Recycled Water	0	2,500	5,000	7,000	9,000	0%
Groundwater	2,000	4,000	4,000	5,000	5,000	0%
TOTAL SUPPLY	**252,800**	**260,300**	**267,800**	**295,800**	**297,800**	

7.2.3.2 Single-Dry Year

If hydrologic conditions were similar to those experienced during the 1977 drought year (PCWAs worst drought year on record), PCWA estimates that single dry year supplies would reduce as follows:

- **PG&E** – PG&E supply is assumed to reduce by 50%.
- **MFP** – Due to the ability to store and deliver supplies under this permit, MFP supply will not see a reduction.
- **CVP** – CVP supply is assumed to reduce by 75% of normal usage based on the Reclamation's current M&I shortage policy.
- **Pre-1914** – The pre-1914 appropriative right supply is assumed to reduce by 75%, given that the creeks from which PCWA diverts are runoff dependent.
- **Recycled water**– It is assumed recycled water supplies will not be reduced.
- **Groundwater** – Any potential shortfall in supply that may occur in Zone 1 in a dry year will be addressed through groundwater production. Groundwater may be produced by overlying users and/or appropriators to meet demands, consistent with the GSP discussed in Section 6.2.2.1. It is assumed groundwater supplies will not be reduced.

Table 7-3 summarizes the available supplies under single dry year conditions from 2030-2045 and buildout conditions.

Table 7-3: Single Dry Year Supplies

WATER SUPPLY SOURCES	2030	2035	2040	2045	2050	% REDUCTION
PG&E	62,700	62,700	62,700	62,700	62,700	50%
MFP	120,000	120,000	120,000	120,000	120,000	0%
CVP	500	1,250	2,500	8,750	8,750	75%
Pre-1914 Appropriative Rights	850	850	850	850	850	75%
Recycled Water	0	2,500	5,000	7,000	9,000	0%
Groundwater	2,000	4,000	4,000	5,000	5,000	0%
TOTAL SUPPLY	**186,050**	**191,300**	**195,050**	**204,300**	**206,300**	

7.2.3.3 Five Consecutive Dry Years

During a five-consecutive year drought, PCWA anticipates supplies to reduce as follows:

- **PG&E**– Based on historical five-year periods, it is assumed PG&E supply will not be reduced.
- **MFP** – Due to the ability to store and deliver supplies under this permit, MFP supply will not see a reduction.
- **CVP** – CVP supply is assumed to reduce by 50% of normal usage for all five years.
- **Pre-1914** – The pre-1914 appropriative right supply is assumed to reduce by 50% for all five years.
- **Recycled water** – It is assumed recycled water supplies will not be reduced.

- **Groundwater** – Any potential shortfall in supply that may occur in Zone 1 in dry years will be addressed through groundwater production. Groundwater may be produced by overlying users and/or appropriators to meet demands, consistent with the GSP discussed in Section 6.2.2.1. It is assumed groundwater supplies will not be reduced.

Table 7-4 summarizes the available supplies under five-consecutive years drought conditions from 2030-2045 and buildout conditions. The supply reduction will be the same for each of the five years.

Table 7-4: Five Consecutive Year Drought

WATER SUPPLY SOURCES	2030	2035	2040	2045	2050	% REDUCTION
PG&E	125,400	125,400	125,400	125,400	125,400	0%
MFP	120,000	120,000	120,000	120,000	120,000	0%
CVP	1,000	2,500	5,000	17,500	17,500	50%
Pre-1914 Appropriative Rights	1,700	1,700	1,700	1,700	1,700	50%
Recycled Water	0	2,500	5,000	7,000	9,000	0%
Groundwater	2,000	4,000	4,000	5,000	5,000	0%
TOTAL SUPPLY	**250,100**	**256,100**	**261,100**	**276,600**	**278,600**	

7.2.4 Water Service Reliability – Supply and Demand Comparison

This section compares projected supplies and demands for an average year, single-dry year, and five-year consecutive drought for the entire PCWA system.

7.2.4.1 Water Service Reliability – Normal Year

Under an average year, PCWA anticipates receiving full supplies as described in Section 7.2.3.1. Demands during an average year conditions are assumed as projected in Table 4-10. The supply and demand comparison for the average year is presented in Table 7-5.

Table 7-5: Average Year Supply and Demand Comparison

	2030	2035	2040	2045	2050
Supply Totals	252,800	260,300	267,800	295,800	297,800
Demand Totals	198,653	210,615	218,520	228,430	240,355
Difference	**54,147**	**49,685**	**49,280**	**67,370**	**57,445**

7.2.4.2 Water Service Reliability – Single-Dry Year

For a single dry year, PCWA anticipates receiving reduced supplies as described in Section 7.2.3.2. Demands presented in Table 4-10 were used; however, the untreated wholesale demands were updated to reflect PCWA's supply available during a single dry year per wholesale contracts, as presented in Table 4-3. The supply and demand comparison for the single-dry year is presented in
Table 7-6.

Table 7-6: Single Dry Year Supply and Demand Comparison

	2030	2035	2040	2045	2050
Supply Totals	186,050	191,300	195,050	204,300	206,300
Demand Totals[1]	160,653	167,615	175,520	185,430	197,355
Difference	**25,397**	**23,685**	**19,530**	**18,870**	**8,945**

1. Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.

7.2.4.3 Water Service Reliability – Five Consecutive Dry Years

For purposes of this UMWP, PCWA has assessed a five-year series of dry conditions that mimic supply conditions from 1988 through 1992. The supplies available during this series of multiple dry years were not as constrained as during the representative single dry year condition. Although, as experienced with the 2012-2016 and 2020-22 drought periods, actual water supply availability over multiple years is dependent on many factors that will require flexibility for PCWA to manage supplies and implementation of its WSCP stages accordingly.

The supply assumptions for the five-consecutive year drought conditions are described in Section 7.2.3.3. Demands presented in Table 4-10 were used; however, the untreated wholesale demands were updated to reflect PCWA's supply available during a five-consecutive year drought per wholesale contracts, as presented in Table 4-3. The supply and demand comparison for the five-consecutive year drought is presented in Table 7-7.

Table 7-7: Multiple Dry Years Supply and Demand Comparison

		2030	2035	2040	2045	2050
First Year	Supply Totals	250,100	256,100	261,100	276,600	278,600
	Demand Totals[1]	160,653	167,615	175,520	185,430	197,355
DIFFERENCE		**89,447**	**84,935**	**88,485**	**85,580**	**91,170**
Second Year	Supply Totals	250,100	256,100	261,100	276,600	278,600
	Demand Totals[1]	160,653	167,615	175,520	185,430	197,355
DIFFERENCE		**85,810**	**89,447**	**84,935**	**88,485**	**85,580**
Third Year	Supply Totals	250,100	256,100	261,100	276,600	278,600
	Demand Totals[1]	160,653	167,615	175,520	185,430	197,355
DIFFERENCE		**85,810**	**89,447**	**84,935**	**88,485**	**85,580**
Fourth Year	Supply Totals	250,100	256,100	261,100	276,600	278,600
	Demand Totals[1]	160,653	167,615	175,520	185,430	197,355
DIFFERENCE		**85,810**	**89,447**	**84,935**	**88,485**	**85,580**
Fifth Year	Supply Totals	250,100	256,100	261,100	276,600	278,600
	Demand Totals[1]	160,653	167,615	175,520	185,430	197,355
DIFFERENCE		**85,810**	**89,447**	**84,935**	**88,485**	**85,580**

1. Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.

7.2.5 Description of Management Tools and Options

PCWA employs a combination of water management tools and options designed to maximize the use of locally developed water supplies and minimize reliance on water imported from other regions, consistent with California Water Code Section 10620(f). PCWA's water supply portfolio is primarily based on local surface water resources managed through an integrated system of reservoirs, conveyance, and treatment facilities, with operations designed to provide reliability under a range of hydrologic conditions while meeting environmental and regulatory requirements. Groundwater resources are used where appropriate, primarily during dry year and emergency conditions, and are managed in coordination with local and regional groundwater sustainability efforts.

PCWA also supports demand management measures, including water conservation programs, public education, and coordination with retail water purveyors to improve water use efficiency and reduce overall demand. Where feasible, PCWA coordinates with wastewater agencies and retail providers to support the potential future use of recycled water for non-potable purposes, thereby reducing demand on potable supplies. Ongoing efforts to improve system efficiency, including evaluation of distribution system performance and reduction of water losses, further enhance the effective use of available resources. Additionally, PCWA participates in regional water management and planning efforts to improve coordination, share resources, and enhance long-term water supply reliability. Together, these management tools and options support PCWA's ability to meet current and projected demands while prioritizing local water resources and adapting to evolving hydrologic, climatic, and regulatory conditions.

7.3 Drought Risk Assessment

CWC Section 10635 (b) requires a DRA. The DRA provides a quick snapshot of the anticipated surplus or deficit if a five-consecutive year drought were to occur in the next five years. The DRA can be modified or updated outside of the UWMP five-year plan cycle, so a description of the data, methodology, and basis for shortage conditions must be included in this 2025 UWMP. The DRA evaluates each water supply's reliability and compares available water supplies and projected demands during a five-consecutive dry years scenario. This short-term analysis can help water suppliers foresee undesired risks, such as upcoming shortages, and provide time to evaluate and implement the necessary response actions needed to mitigate shortages in a less impactful manner to the community and environment.

The reliability of supplies over a five-consecutive year drought is described in Section 7.2.4.3. Demands presented in Table 4-10 were used; however, the untreated wholesale demands were updated to reflect PCWA's supply available during a five-consecutive year drought per wholesale contracts, as presented in Table 4-3. Table 7-8 compares the total projected supply and demand for the 5-year DRA for 2021 through 2025. As shown, PCWA does not expect to enact its WSCP for a 5-year consecutive year drought based on the 2021-2025 unrestricted potable demand projections and the current supply portfolio and reliability.

7.3.1 Data, Methods, and Basis for Water Shortage Condition

The DRA builds on the water service reliability analysis from Section 7.2, which incorporated assessment of historical consumption data by customer class, populated from billing records, and historical supply data by source from production reports. Based on this data, historical demand has never exceeded available supply. For this DRA analysis, normal year demand conditions and five consecutive year drought supply conditions were considered for 2026-2030.

As described in Section 4, demands were estimated using the same methodology applied in the 2020 UWMP. The analysis was updated using the most recent five years of available water consumption data to reflect current demand conditions while maintaining methodological continuity. As described in Section 7.2.3, the groundwater supply is reliable under normal, single dry, and five-consecutive dry years.

Table 7-8: Five-Year Drought Risk Assessment (AFY)

2026	Gross Water Use	135,582
	Total Supplies	250,100
	Surplus/Shortfall without WSCP Action	114,518
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	0
	WSCP (Use Reduction Savings Benefit)	0
	Revised Surplus/Shortfall	114,518
	Resulting Percent Use Reduction from WSCP Action	0%
2027	Gross Water Use	141,850
	Total Supplies	250,100
	Surplus/Shortfall without WSCP Action	108,250
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	0
	WSCP (Use Reduction Savings Benefit)	0
	Revised Surplus/Shortfall	108,250
	Resulting Percent Use Reduction from WSCP Action	0%
2028	Gross Water Use	148,117
	Total Supplies	250,100
	Surplus/Shortfall without WSCP Action	101,983
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	0
	WSCP (Use Reduction Savings Benefit)	0
	Revised Surplus/Shortfall	101,983
	Resulting Percent Use Reduction from WSCP Action	0%
2029	Gross Water Use	154,385
	Total Supplies	250,100
	Surplus/Shortfall without WSCP Action	95,715
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	0
	WSCP (Use Reduction Savings Benefit)	0
	Revised Surplus/Shortfall	95,715
	Resulting Percent Use Reduction from WSCP Action	0%

2030	Gross Water Use	160,653
	Total Supplies	250,100
	Surplus/Shortfall without WSCP Action	89,447
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	0
	WSCP (Use Reduction Savings Benefit)	0
	Revised Surplus/Shortfall	89,447
	Resulting Percent Use Reduction from WSCP Action	0%

7.3.2 DRA Individual Water Source Reliability

PCWA's principal supply sources include American River diversions, MFP supplies conveyed from Folsom Reservoir, contractual deliveries, and locally available surface water rights. In calendar year 2025, these sources collectively supported total service area water use of approximately 130,700 AF, including both treated and untreated deliveries. Operational flexibility is further provided through system interties, water exchanges, and the ability to adjust the proportion of treated and untreated deliveries based on demand and hydrologic conditions.

As shown in Table 7-3, MFP provides a substantial and stable share of total supplies across the planning horizon, particularly as availability from other surface water sources is reduced under dry and multiple-dry-year conditions. Coordinated operation of MFP supplies with PG&E contract water, American River sources, and other surface water and groundwater supplies supports balanced system operations and sustainable management of long-term supply variability.

Based on existing water rights, contractual arrangements, and recent operating experience, PCWA does not anticipate reliability constraints associated with the loss or curtailment of any individual water source during the five-year DRA planning horizon. Each identified water source is considered reliable for the DRA period when operated as part of PCWA's integrated water supply system.

7.3.3 Total Water Supply and Use Comparison

PCWA evaluated total available water supply relative to projected water use to assess near-term drought risk over the five-year DRA planning horizon. This evaluation is conducted on an aggregate, service-area basis and includes both treated and untreated retail water use, consistent with the methodology applied in the 2020 UWMP and described in Section 6.

Total water use for calendar year 2025 is estimated at approximately 130,700 AF, reflecting combined treated and untreated water deliveries across all PCWA service zones. This total represents end use within the PCWA service area and excludes wholesale exports and pass-through transfers that do not contribute to local demand.

Wastewater inflows summarized in Section 6 provide a complementary indicator of indoor water use within the service area. As shown in DWR Tables 6-2R and 6-3R in Appendix B,

wastewater generated within the PCWA service area totaled approximately 2,200 million gallons in 2025, based on flows reported by South Placer Municipal Utility District and Placer County sewer agencies. Because wastewater flows are not tracked by PCWA water-supply zone, total service-area water use is used for comparison purposes.

The comparison of total available supply to projected water use indicates that existing supplies are sufficient to meet service-area demands under normal operating conditions. Based on this assessment, PCWA does not anticipate any supply shortages within the next five years, as shown in Table 7-8. The Agency's diversified supply portfolio, combined with operational flexibility and multiple delivery pathways, provides sufficient reliability to meet projected demands during the DRA planning period.

8 Water Shortage Contingency Plan

The Water Shortage Contingency Plan (WSCP) is a detailed plan for how the Agency intends to act in the case of an actual water shortage condition. This allows for management of a shortage with predictability and accountability. This section provides an overview of the contents of PCWA's WSCP. The standalone WSCP is included in Appendix H.

IN THIS SECTION

- Overview of WSCP Components

8.0 Introduction

The California Water Code (CWC) Section 10632 requires that every urban water supplier shall prepare and adopt a standard-alone Water Shortage Contingency Plan (WSCP) as part of its UWMP.

PCWA's WSCP is included as Appendix H and will be separately submitted to DWR. The WSCP is developed independently of PCWA's 2025 UWMP and can be amended, as needed, without amending the UWMP. While PCWA's WSCP dated May 20, 2021 meets all applicable requirements of California Water Code Section 10632. It was amended and resubmitted to the Board and accepted on June 18, 2026.

The WSCP is a strategic plan that PCWA uses to prepare for and respond to foreseeable and unforeseeable water shortages. A water shortage occurs when the water supply available is insufficient to meet the normally expected customer water use at a given point in time. A shortage may occur due to a number of reasons, such as water supply quality changes, climate change, drought, regional power outage, and catastrophic events (e.g., earthquake). Additionally, the State may declare a statewide drought emergency and mandate that water suppliers reduce demands, as occurred in 2014 and again during the 2021 drought emergency. The 2021 declaration was prompted by severe and prolonged dry conditions, requiring agencies across California to implement demand reduction measures and enhance conservation efforts. The WSCP serves as the operating manual that will be used to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of water shortages.

The WSCP provides a process for an annual water supply and demand assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation provides accountability and predictability and will help maintain reliable supplies and reduce the impacts of any supply shortages and/or interruptions.

8.1 Overview of WSCP Components

The Water Code establishes several prescriptive elements that must be included in a retail water supplier's WSCP. Each element and its location within the WSCP is described below.

8.1 Water Supply Reliability Analysis: Summarizes PCWA's water supply analysis and reliability and identifies any key issues that may trigger a shortage condition.

8.2 Annual Water Supply and Demand Assessment Procedures: Describes the key data inputs, evaluation criteria, and methodology for assessing the system's reliability for the coming year and the steps to formally declare any water shortage levels and response actions.

8.3 Six Standard Water Shortage Stages: Establishes water shortage levels to clearly identify and prepare for shortages.

8.4 Shortage Response Actions: Describes the response actions that may be implemented or considered for each stage to reduce gaps between supply and demand.

8.5 Communication Protocols: Describes communication protocols under each stage to ensure customers, the public, and government agencies are informed of shortage conditions and requirements.

8.6 Compliance and Enforcement: Defines compliance and enforcement actions available to administer demand reductions.

8.7 Legal Authorities: Lists the legal documents that grant the authority to declare a water shortage and implement and enforce response actions.

8.8 Financial Consequences of WSCP Activation: Describes the anticipated financial impact of implementing water shortage stages and identifies mitigation strategies to offset financial burdens.

8.9 Monitoring and Reporting: Summarizes the monitoring and reporting techniques to evaluate the effectiveness of shortage response actions and overall WSCP implementation. Results are used to determine if additional shortage response actions should be activated or if efforts are successful and response actions should be reduced.

8.10 WSCP Refinement Procedures: Describes the factors that may trigger updates to the WSCP and outlines how to complete an update.

8.11 Special Water Feature Distinctions: Identifies exemptions for decorative features aside from pools and spas.

8.12 Plan Adoption, Submittal, and Availability: Describes the process for the WSCP adoption, submittal, and availability after each revision.

The WSCP was prepared in conjunction with PCWA's 2025 UWMP and is a standalone document that can be modified as needed. The document is compliant with the CWC Section 10632 and incorporates guidance from the DWR UWMP Guidebook.

9 Demand Management Measures

Consistent with the requirements of the CWC, this section describes the wholesale and retail systems' demand measurement measures (DMM) that have been implemented in the past five years and will continue to be implemented by PCWA.

IN THIS SECTION

- Existing Demand Management
- Reporting Implementation
- Water Use Objectives

9.1 Demand Management Measures for Wholesale Suppliers

PCWA's wholesale system DMMs and implementation over the past five years are discussed in the following sections.

9.1.1 Metering

PCWA's wholesale system is fully metered. Meters are read monthly and tested as needed per the annual Water Loss Audit. Meters are tested at low, medium, and high thresholds based on meter size. Meters are rebuilt, recalibrated or replaced based on test results or age.

9.1.2 Public Education/Outreach and Wholesale Supplier Assistance

PCWA participates in variety of outreach events to promote water conservation, sustainable landscaping, and efficient irrigation. These events are discussed in Section 9.2.4. PCWA also coordinates with their retail purveyors during a declared WSCP stage. During a declared WSCP stage, PCWA will provide messaging and informational material for their retail purveyors, as well as other interested stakeholders, to help reduce demands.

9.1.3 Water Conservation Program Coordination and Staffing

When mutually agreeable and beneficial, PCWA provides assistance to wholesale customers' water conservation programs. PCWA may include technical support for program development, regional partnerships, presenting and sharing information on water conservation programs.

9.1.4 Asset Management

PCWA's asset management program is made up of several systems and processes. Typically, all horizontal assets of the distribution system including meters, valves, pipelines are maintained in GIS. GIS contains attributes of the various infrastructure including installation date and material type. While vertical assets, such as pump stations, storage tanks, and water treatment plants are also in GIS, PCWA utilizes a computerized maintenance management system (CMMS) to store information on the various components of these facilities and implement a preventative maintenance schedule. Crews are scheduled to fix and repair mains and services. Information regarding leaks is then stored in the GIS system and utilized to prioritize treated water main replacement projects. Large replacement projects as well as major upgrades and/or rehabilitation projects of the facilities are identified and prioritized in PCWA's capital improvement program, which identifies projects for the next five years. The 5-year capital improvement program is updated annually. PCWA also conducted a 25-year renewal and replacement study to support long range planning efforts.

9.2 Existing Demand Management Measures for Retail

PCWA's retail system DMMs and implementation over the past five years are discussed in the following sections.

9.2.1 Water Waste Prevention Ordinances

PCWA actively enforces prohibitions against wasteful use of water in PCWA's Rules and Regulations. Water waste prevention actions are addressed in PCWA's WSCP. PCWA enforces these actions regardless of the availability of water.

9.2.2 Metering

PCWA's retail system is fully metered, allowing them to understand customer usage patterns. To assist with this understanding, PCWA maintains a database of meter use information, categorized by land-use classification. Existing customers are categorized into classifications in the customer enterprise system, CentralSquare including but not limited to single family residential, multi-family residential, commercial, industrial, municipal, and landscape.

9.2.3 Conservation Pricing

Conservation pricing is designed to discourage wasteful water habits and encourage conservation. PCWA has increasing block water rate structure for all customer classes except for fire lines, which is uniform.

9.2.4 Public Education and Outreach

PCWA has made water efficiency one of the core focuses of its communications outreach to its customers and utilized a variety of innovative ways of incorporating traditional and new media, public events, and partnerships with local businesses.

PCWA participates in a variety of outreach events to promote water conservation, sustainable landscaping, and efficient irrigation. From 2020 through 2025, PCWA participated in a minimum of 25 community events, approximately 5 per year. These events include Run Rocklin, Mulch Mayhem, Wildfire Preparedness Events, the UC Master Gardener's Garden Faire and Open Garden days, and the City of Rocklin's Hot Chili Cool Cars.

In 2023, PCWA partnered with the Town of Loomis and UC Master Gardeners of Placer County to transform 11,000 square feet of turf at the Loomis Library into a waterwise garden showcasing California natives, pollinators, and edible plants. PCWA invested more than $22,000 in rebates and sponsorship to help fund the makeover. PCWA won the Award of Distinction from the California Association of Public Information Officers (CAPIO) for creating a marketing video promoting the garden. The California Water Efficiency Partnership (CalWEP) features the Loomis Demonstration garden as a case study in its statewide toolkit on nonfunctional turf resources for water providers. PCWA launched its Summer Strong plant campaign in 2023, featuring a new flower, shrub or tree each month that is water-wise, and well-

suited to Placer County's environment. The plants are promoted on social media, E-blasts and the newsletter.

Online Advertising

In 2020, PCWA began an extensive online geo-targeted advertising campaign on news and weather websites and Facebook. The advertising campaign has been on the news and weather websites including AccuWeather, New York Times, Sacramento Bee, San Francisco Chronicle, USA Today, Weather.com, and the Washington Post. The ads have promoted PCWA's rebates for sprinkler system upgrades, weather-based sprinkler controllers, water-wise house calls, the benefits of fall planting, leak detection, low-water use gardens, WaterSense, and more.

Some ads titles are below with total number of Impressions for all the ads by year:

Table 9-1: Online Advertising Summary

YEAR	TOTAL IMPRESSIONS	EXAMPLE AD TITLES
2021	5,147,014	Fire-Wise, Water-Wise Webinar, Fix a Leak Week Challenge
2022	5,147,014	Bucket Band Tree Watering, Compost
2023	1975,815	Compost, Hot Chili Cool Cars
2024	1639,247	Corgi Leak Ad, Do More Video
2025	2,629,109	Bench Your Old Toilet, Jack LaPlant Fall Planting

School Outreach

PCWA offers a fun, interactive educational program for 3rd to 5th grade that teaches students about where their water comes from and trains them to be "Leak Detectives" at home and school. The curriculum, can be customized to suit teacher needs, and includes: a map that shows local water sources, a quiz to get students thinking about fixtures and activities that use the most water, a specially created demonstration toilet that will show students how to check for toilet leaks at home, a goodie bag with water -saving resources and some schools received a visit from Les Leaky, the water drop mascot. Over 300 3rd- 5th graders have participated in the presentations from 4 schools.

Strategic Partnerships

In 2023, PCWA partnered with the Town of Loomis and UC Master Gardeners of Placer County to transform 11,000 square feet of turf at the Loomis Library into a waterwise garden showcasing California natives, pollinators, and edible plants. PCWA invested more than $22,000 in rebates and sponsorship to help fund the makeover. PCWA won the Award of Distinction from the California Association of Public Information Officers (CAPIO) for creating a marketing video promoting the garden. The California Water Efficiency Partnership (CalWEP) features the Loomis Demonstration garden as a case study in its statewide toolkit on nonfunctional turf resources for water providers. PCWA launched its Summer Strong plant campaign in 2023, featuring a new flower, shrub or tree each month that is water-wise, and well-suited to Placer County's environment. The plants are promoted on social media, E-blasts and the newsletter.

Regional Public Education and Outreach Programs

In addition to local public education and outreach programs, PCWA also participates in a regional public education and outreach program through the Regional Water Authority. In collaboration with 17 water supplier members and other wastewater, stormwater and energy partners, RWA formed the Water Efficiency Program (WEP) in 2001 to bring cost effectiveness through economies of scale to public education and outreach activities.

The WEP operates on an average annual budget of $610,000 funded by participating local water suppliers and is supplemented by grant funding. Since 2003, the Program has been awarded $19.9 million in grant funding for public outreach and education as well as a variety of rebate programs, fixture direct install programs, system water loss, individualized customer usage reports, large landscape budgets and more. Of those funds, $6.7 million was awarded between 2021 and 2025.

The Program distributes water efficiency messages on a regional scale through regional media and advertising buys and was honored with the United States Environmental Protection Agency WaterSense Partner of the Year award in 2021 along with three Public Relations Society of America (PRSA), California Capital Chapter awards in 2023/2024 for WEP's public outreach and school education programs. From 2021-2025, the WEP created a series of public outreach campaigns. Below is a summary of each campaign and highlighted achievements.

RWA's RWEP began 2021 with a focus on household leaks and then transitioned to the fourth year of an award-winning outreach campaign focused on tackling the landscape overwatering problem by encouraging residents to check soil moisture before turning on sprinklers (Check & Save). With the sudden emergence of drought in May 2021, the program introduced new creative and tools for RWEP participants. The goal: Help provide consistent and actionable tips region-wide while providing flexibility for RWA members to customize materials to reflect their unique water supply situation and call to action.

As the drought grew more serious through late 2021 and into 2022, the WEP updated messaging again and ramped up outreach, asking residents to reduce lawn watering while continuing to water trees (Stress Your Lawn, Save Your Trees), understanding that lawns can handle less water but that drought-stressed trees can be lost forever. This messaging supported the Governor's request of water suppliers to voluntarily reduce water use by 15 percent. Additionally, the WEP continued to partner with the Sacramento Tree Foundation to help educate residents and business on how to maintain and expand the region's healthy tree canopy and included a series of co-branded educational videos and materials.

From 2021-2025, the WEP public outreach campaigns produced:

Table 9-2: WEP Advertising Summary

WEP PUBLIC OUTREACH CAMPAIGNS PRODUCED (2021- 2025)	ADVERTISEMENTS	IMPRESSIONS	CLICKS	EARNED VALUE	SOCIAL MEDIA POSTS
Television Advertising	3,926	23,212,700			
Streaming Video Advertising	3,532,621	3,532,621			
Radio Advertising	5,273	19,994,200			
Digital Advertising		29,472,602	297,870		
Billboard Advertising	2,037,102	62,807,653			
Public Service Announcements		24,248,000		$683,400	
Facebook					300

Finally, WEP partners with professional sports teams in the region to expand the Be Water Smart advertising to new and captive audiences. WEP partnered with the Sacramento River Cats (local Triple – A affiliate of the San Francisco Giants) in 2021, which included our long standing water savings advertisements on all bathroom stall doors as well as 30-second Check & Save spots broadcast on KMAX Channel 31 during each Saturday game and multiple 30-second radio spots broadcast during every game via their streaming radio coverage. In 2023, RWEP launched a new partnership with Sacramento Republic FC (local USL professional soccer team), displaying water-wise messages at games to promote "Summer Strong" yards. The partnership continued through 2025 and included the following activities: a 30-second LED ad, messaging on water refill stations, and giveaways booths at events/games.

To support public outreach messaging and promote water savings tips, the Program also coordinated several regional rebate programs, which were partially or fully funded by state, federal and private foundation grants. A variety of high efficiency rebate options were provided including toilets, clothes washers and irrigation efficiencies (full summary in Table 9-3). Additionally, from August 2023 - November 2025, RWA managed a regional direct installation program, in which a contractor was hired to replace old high use fixtures in multifamily and commercial/institutional properties in disadvantaged communities in the region. Collectively these rebates and direct installations will produce an estimated lifetime (10 years) savings of 7.4 billion gallons of water and 7.9 million kilowatt hours of energy.

Table 9-3: Regional Rebates and Installation from 2021-2025

Rebate/Installation Type	2021	2022	2023	2024	2025	Lifetime Water Savings 2021-2025 (MG)	Lifetime Energy Savings 2021-2025 (kWh)**
High Efficiency Clothes Washer Rebates	359	265	307	321	298	74.7	79,309
High Efficiency Toilet Rebates	767	1,275	602	423	326	137.5	145,990
Smart Irrigation Controller Rebates	686	1,049	3,051	556	464	1,190.2	1,264,024
Irrigation Efficiences Rebates*	5,941	7,153	13,327	11,160	10,321	5,269.2	5,595,912
Turf Replacement Rebates (square feet)	153,880	239,645	135,607	300,152	266,840	405.6	430,711
Toilet Direct Installation	NA	NA	584	2,183	1,688	141.9	150,671
Showerhead Direct Installation	NA	NA	562	1,766	1,532	197.2	209,475
Faucet Aerators Direct Installation	NA	NA	884	3,215	2,343	20.6	21,850
Urinal Direct Installation	NA	NA	-	19	40	1.3	1,348
Total Water Savings (MG)						**7,438.1**	
Total Energy Savings (kWh)**							**7,899,291**
*Includes: pressure regulator equipment, pipe and pipe fittings, drip or low volume equipment, and sprinkler heads or nozzles.							
**Regional average of 1,062 kilowatt-hours per MG							
kWh = kilowatt-hour							
MG = million gallons							
NA = no funding available							
Lifetime = 10 years							

In addition to public outreach, the Program also coordinates regional school education activities. The RWA-sponsored water efficiency exhibits ($500,000 sponsorship) opened for viewing in 2021 at the new SMUD Museum of Science and Curiosity (MOSAC) in downtown Sacramento, reflecting years of input by RWA Water Efficiency Program Manager, Amy Talbot, who helped shape the exhibits. MOSAC currently welcomes around 150,000 visitors a year from all over the region.

9.2.5 Programs to Assess and Manage Distribution System Real Losses

PCWA uses the AWWA Water Audits to perform and validate water audits in compliance with Senate Bill 555. PCWA tests its 3” to 8” meters with testing intervals set at AWWA standard and then updated based on testing results, throughput and age of the meter. PCWA will continue to utilize water audits and validations to assess areas for water loss improvements.

9.2.6 Water Conservation Program Coordination and Staffing Support

PCWA’s Water Efficiency Division is comprised of a Deputy Director and Supervisor, seven Water Efficiency Specialists, a Customer Service Specialist and 6 temporary staff. Each full-time team member splits their time among metering and water efficiency programs. The Deputy Director and Supervisor coordinate to manage both the team and water efficiency programs that is implemented by the entire Division.

Contact: Deputy Director of Customer Services – Linda Higgins, (lhiggins@pcwa.net)

10 Plan Adoption, Submittal, and Implementation

This section describes the complete steps taken to make the UWMP publicly available as well as adopt and submit the UWMP in accordance with the Water Code.

IN THIS SECTION

- Completed Steps for UWMP and WSCP

10.1 Notice of Plan Preparation (60-Day Notice)

In accordance with Water Code Section 10621(b), PCWA issued 60-day notifications to all cities and counties within its service area prior to holding public hearings on the UWMP. These notifications informed agencies that PCWA was preparing and updating its 2025 UWMP and invited their participation in the process.

Table 2-1 provides a summary of the notifications that were issued as a part of the development of PCWA's UWMP. Submittal Table 10-1, Notifications to Cities and Counties, is located in Appendix B and includes this information. Supporting correspondence, including mailed notices, is provided in Appendix A.

10.2 Notice of Public Hearing

Prior to adoption of the WSCP and 2025 UWMP, PCWA held a public hearing regarding its 2025 UWMP on June 18, 2026. In advance of the hearings, PCWA made a draft of the 2025 UWMP available for public inspection at PCWA's office and on the PCWA website. Pursuant to CWC Section 10642, general notice of the public hearings were provided through publication of the hearing date and time, with additional notification of the hearing provided at PCWA's office.

10.3 Public Hearing and Adoption

PCWA notified the public within its service area of the opportunity to provide input regarding the Plan. A copy of the public outreach materials, including newspaper notices and invitation letters, is included in Appendix A.

Both drafts were publicly reviewed during their 2026 hearing. This provided the cities, counties, and other members of the public a chance to review the staff report and provide comments. The public hearing took place before adoption, ensuring an opportunity for the report to be modified in response to public input.

Following completion of the public hearing, the 2025 UWMP and WSCP were adopted by the PCWA Board of Directors on June 18, 2026, by resolution.

A copy of the Resolution of Plan Adoption signed by the PCWA board of directors and attached cover letter addressed to DWR is included as Appendix I of the UWMP. The UWMP includes all applicable information necessary to meet the requirements of California Water Code. The 2025 UWMP and WSCP were submitted to the DWR within 30 days of adoption.

10.4 Plan Submittal

A hard copy of the Final 2025 UWMP and WSCP were sent to the California State Library and electronical copies to DWR (electronically using the WUEdata reporting tool), and electronical copies to all cities and counties within PCWA's service area within 30 days of adoption.

PCWA will retain copies of the adopted documents for future reference and compliance verification.

10.5 Public Availability

To fulfill the requirements of Water Code Section 10642 of the UWMP Act, PCWA made the 2025 UWMP and WSCP available online (see below) and at the main PCWA office located at 144 Ferguson Road, Auburn, CA 95603, between the hours of 8:00 am and 5:00 pm, for public review within 30 days of adoption.

10.6 Amending an adopted UWMP or WSCP

Following submittal, DWR will conduct a completeness review of the 2025 UWMP. If additional information or clarification is required, PCWA will respond promptly and provide any necessary amendments or supporting documentation to ensure the UWMP meets all requirements of the California Water Code.

DWR's final review determination will confirm whether the UWMP satisfies eligibility criteria for State water-related grants and loans.

Amendments to the PCWA's 2025 UWMP and WSCP will be made on an as needed basis. Should PCWA need to amend the adopted 2025 UWMP or WSCP in the future, PCWA will hold a public hearing for review of the proposed amendments to the document and send a 60-day notification letter to all cities and counties within their service area and notify the public in same manner as set forth in this UWMP. Once the amended document is adopted, a copy of the finalized version will be distributed to the California State Library, DWR (electronically using the WUEdata reporting tool), and all cities and counties within PCWA's service area within 30 days of adoption. The finalized version will also be made available to the public both online on PCWA's website and in person at PCWA's main office during normal business hours.

References

Meter Upgrade Project. (2023). Retrieved from City of Roseville California: https://www.roseville.ca.us/government/departments/electric_utility/utility_billing/meter_upgrade_project

State of California Department of Water Resources. (February 2016). *Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use.*

Appendix A Notification to Agencies

A

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 25, 2026

Audie Foster
California American Water Co.
4701 Beloit Drive
Sacramento, CA 95838

Subject: PCWA's 2025 UWMP Notification Letter

Dear Audie Foster,

PCWA is preparing its 2025 Urban Water Management Plan (UWMP) for submittal to the Department of Water Resources (DWR) by July 1, 2026. As a Placer County Water Agency (PCWA) wholesale water customer, we want to officially notify you of PCWA's 2025 UWMP efforts, pursuant to California Water Code Section 10621(b).

In addition to this notification, this letter is to initiate coordination of our water projections in accordance with Water Code Section 10631(j). The following is a modified summary of our 2020 UWMP that we intend to include in our 2025 UWMP. The table below provides our current representation of your future demands on our water system.

In addition to being a retail purveyor of treated and raw water suppliers, PCWA also wholesales treated water to a number of retail water systems located within Zone 1. This section presents the current and projected demands associated with these wholesale arrangements, and the basis for those projections.

- *California American Water – With multiple retail service areas around greater Sacramento, California American (Cal-Am) specifically receives wholesale treated supplies from PCWA for its West Placer community (located in western Placer County just southwest of the City of Roseville). Currently, this Cal-Am service area receives about 15 percent of the PCWA wholesale treated supplies. The general area of Cal-Am's West Placer service area is anticipated to grow, resulting in an expanded wholesale agreement with Cal-Am. For purposes of PCWA's long-term planning, the anticipated growth in this general area is represented within this category of PCWA customers, and is subdivided into two growth areas: (1) Placer Vineyards and (2) Cal-Am Remainder.*

    1. *Placer Vineyards: This project, approved in July 2007, covers 5,230 acres in southwestern Placer County and is planned as a mixed-use community with 14,132 homes, commercial areas, parks, and public facilities. The first development phase was approved in June 2017 and includes about one-third of the planned area, spanning 1,535 acres and up to 5,266 homes. Supply will come from PCWA's unused American River Middle Fork Project water, treated at the Foothill Water Treatment Plant and delivered through existing systems. Long-term supply may transition to a new regional Sacramento River diversion*

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

led by PCWA.[1] Recycled water will also be used for irrigating parks, schools, and landscaped areas. PCWA originally estimated water demand at 11,400 acre-feet based on a 2006 study; this has been reduced to 6,460 acre-feet per the Placer Vineyards 2026 Update Water Demands Technical Memorandum, dated January 8, 2026.

2. *Cal-Am (Remainder): This area is comprised of the Riolo Vineyards Specific Plan and other large developments. Historical use of Cal-Am's water supply has predominantly been within this area; however, over the last several years, Placer Vineyards has been developing and adding to the current water demands. Future demand in this area is expected to evolve as a result of customer conservation, redevelopment, and new growth as well as combined with Placer Vineyards demands. Combined, PCWA anticipates that total Cal-Am demand within this category will increase to nearly 2,400 acre-feet.*

The table below provides a preliminary representation of Cal-Am's future demands on PCWA's water system based on current demands and projections used in the 2020 UWMP.

Table 1. Current and Projected Water Demands, AFY

	Current (2025)	2030	2035	2040	2045	BO
Cal-Am (Remainder)	1,528	1,404	1,684	1,965	2,385	2,385
Placer Vineyards		1,292	2,584	3,876	5,168	6,460
Total	1,528	2,696	4,268	5,841	7,553	8,845

If any of these values or the accompanying explanation do not align with Cal-Am's current projections, please contact us at your earliest convenience so that we may refine the characterization together. The values and explanation may be adjusted throughout the UWMP process based on your input and PCWA's UWMP analysis. Following this initial coordination, we will provide you with our draft UWMP analysis for your input and review in April of 2026.

Notification (including date, time, and location) for a public hearing to adopt our 2025 UWMP will be given at a later date. Access to a copy of the draft UWMP for review will be given at that time.

If you have any questions or concerns regarding our current representation of your demands, please contact me at (530) 823-4845. We appreciate your on-going efforts to help us incorporate the most representative information in our respective UWMPs.

Sincerely,

Brian Rickards, P.E.
Planning & Development Services Manager

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 24, 2026

Chris Nelson
City of Lincoln
600 Sixth Street
Lincoln, CA 95648

Subject: PCWA's 2025 UWMP Notification Letter

Dear Chris Nelson,

PCWA is preparing its 2025 Urban Water Management Plan (UWMP) for submittal to the Department of Water Resources (DWR) by July 1, 2026. As a Placer County Water Agency (PCWA) wholesale treated water customer, we want to officially notify you of PCWA's 2025 UWMP efforts, pursuant to California Water Code Section 10621(b).

In addition to this notification, this letter is to initiate coordination of our water projections in accordance with Water Code Section 10631(j). The following is a modified summary of our 2020 UWMP that we intend to include in our 2025 UWMP. The table below provides our current representation of your future demands on our water system.

> *In addition to being a retail purveyor of treated and raw water suppliers, PCWA also wholesales treated water to a number of retail water systems located within Zone 1. This section presents the current and projected demands associated with these wholesale arrangements, and the basis for those projections.*

- *City of Lincoln – The City of Lincoln is the largest retail customer of wholesale treated water from PCWA, receiving about 90 percent of the wholesale treated water currently sold by PCWA. The City has a renewable contract with the PCWA for treated surface water. Based on the City's current General Plan, PCWA will supply to the City Limits, on a "first-come-first served" basis, the volume of potable surface water required to meet maximum day demands for build-out of the City limits. With significant growth occurring over the last decade, the City anticipates total potential demands estimates to be about 37,400 acre-feet annually by 2045 to serve the entire City's projected population. While some of this demand may be met with other City water assets under some circumstances, the City primarily plans for this demand to be served by PCWA supplies. The table below provides a preliminary representation of the City's future demands on PCWA's water system based on current demands and projections used in the 2020 UWMP and data from Table ES-1 of the 2025 City of Lincoln Water Masterplan.*

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

Table 1. Current and Projected Water Demands, AFY

	Current	2030	2035	2040	2045	BO
Lincoln	10,542	12,770	16,400	19,800	22,140	37,400

If any of these values or the accompanying explanation do not align with the City's current projections, please contact us at your earliest convenience so that we may refine the characterization together. The values and explanation may be adjusted throughout the UWMP process based on your input and PCWA's UWMP analysis. Following this initial coordination, we will provide you with our draft UWMP analysis for your input and review in April of 2026.

Notification (including date, time, and location) for a public hearing to adopt our 2025 UWMP will be given at a later date. Access to a copy of the draft UWMP for review will be given at that time.

If you have any questions or concerns regarding our current representation of your demands, please contact me at (530) 823-4845. We appreciate your on-going efforts to help us incorporate the most representative information in our respective UWMPs.

Sincerely,

Brian Rickards, P.E.
Planning & Development Services Manager

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 25, 2026

George Hanson
City of Roseville
2005 Hilltop Circle
Roseville, CA 95747

Subject: PCWA's 2025 UWMP Notification Letter

Dear George Hanson,

PCWA is preparing its 2025 Urban Water Management Plan (UWMP) for submittal to the Department of Water Resources (DWR) by July 1, 2026. As a Placer County Water Agency (PCWA) wholesale raw water customer, we want to officially notify you of PCWA's 2025 UWMP efforts, pursuant to California Water Code Section 10621(b).

In addition to this notification, this letter is to initiate coordination of our water projections in accordance with Water Code Section 10631(j). The following is a modified summary of our 2020 UWMP that we intend to include in our 2025 UWMP. The table below provides our current representation of your future demands on our water system.

> *PCWA's current contract with the City of Roseville (Roseville) includes an annual entitlement of up to 30,000 acre-feet of water from the Middle Fork Project (MFP) in Drier Years and 44,000 acre-feet in Most Years. "Drier Years" and "Most Years" are currently defined in the Roseville and PCWA Water Forum Purveyor Specific Agreements tied to the amount of unimpaired inflow to the Lower American River in any given year. Roseville's surface water supply from the MFP is governed by both the terms of its contract with PCWA and the diversion limitations established through the Water Forum Agreement, which restrict the volume of water Roseville may divert from the American River under varying hydrologic conditions.*
>
> *According to Roseville's Water Forum Purveyor Specific Agreement, Roseville's American River diversion restrictions are dependent upon the projected March-November Unimpaired Inflow into Folsom Reservoir (UIFR). Inclusive of the PCWA supply, Roseville can divert up to 54,900 acre-feet per year from the American River in most years (when projected March through November UIFR is greater than 950,000 acre-feet). During drier years when the UIFR is between 950,000 and 400,000 acre-feet, Roseville decreases its diversion amounts from 54,900 acre-feet per year down to 39,800 acre-feet per year. During the driest periods, when UIFR drops below 400,000 acre-feet, Water Forum signatories must convene to determine an appropriate plan for water use.*
>
> *The MFP supply will be delivered to Roseville pursuant to its contract with PCWA and Water Forum Agreement commitments, as described above. PCWA intends to meet all obligations of its contract with Roseville as future conditions and contract terms evolve. PCWA's interpretation of*

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

Roseville's contractual demand for MFP water is based on the amended Water Supply Contract dated May 18, 2023, as follows:

Table 1. Current and Projected Water Demands, AFY

	Current (2022)	Year-Type	2030	2035	2040	2045	BO
Roseville	27,490	Average	39,000	44,000	44,000	44,000	44,000
		Multi-Dry	30,000	30,000	30,000	30,000	30,000
		Single-Dry	30,000	30,000	30,000	30,000	30,000

If any of these values or the accompanying explanation do not align with the City's current projections, please contact us at your earliest convenience so that we may refine the characterization together. The values and explanation may be adjusted throughout the UWMP process based on your input and PCWA's UWMP analysis. Following this initial coordination, we will provide you with our draft UWMP analysis for your input and review in April of 2026.

Notification (including date, time, and location) for a public hearing to adopt our 2025 UWMP will be given at a later date. Access to a copy of the draft UWMP for review will be given at that time.

If you have any questions or concerns regarding our current representation of your demands, please contact me at (530) 823-4845. We appreciate your on-going efforts to help us incorporate the most representative information in our respective UWMPs.

Sincerely,

Brian Rickards, P.E.
Planning & Development Services Manager

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 25, 2026

Adam Larsen
San Juan Water District
9935 Auburn Folsom Road
Granite Bay, CA 95746

Subject: PCWA's 2025 UWMP Notification Letter

Dear Adam Larsen,

PCWA is preparing its 2025 Urban Water Management Plan (UWMP) for submittal to the Department of Water Resources (DWR) by July 1, 2026. As a Placer County Water Agency (PCWA) wholesale raw water customer, we want to officially notify you of PCWA's 2025 UWMP efforts, pursuant to California Water Code Section 10621(b).

In addition to this notification, this letter is to initiate coordination of our water projections in accordance with Water Code Section 10631(j). The following is a modified summary of our 2020 UWMP that we intend to include in our 2025 UWMP. The table below provides our current representation of your future demands on our water system.

> *PCWA's current contract with the San Juan Water District (SJWD) includes an annual entitlement of 25,000 acre-feet of water from the Middle Fork Project (MFP). Since that time, PCWA and the District have amended the 2000 contract three times. The most recent amendment, January 1, 2025, reduced the "take or pay" obligation from 25,000 acre-feet to 10,000 acre-feet, while maintaining the availability of up to 25,000 acre-feet upon SJWD request. SJWD's available surface water supply from the MFP is subject to terms in its PCWA contract, combined with Water Forum Agreement (WFA) restrictions that limit the amount of water that SJWD is able to divert from the American River.*
>
> *According to SJWD's Water Forum Purveyor Specific Agreement, SJWD's American River diversion restrictions are dependent upon the projected March through November Unimpaired Inflow into Folsom Reservoir (UIFR). Inclusive of the PCWA supply, SJWD can divert its full 82,200 acre-feet per year from the American River in wet years (when projected March through November UIFR is greater than 950,000 acre-feet). This would include the 25,000 acre-feet MFP supply from PCWA. During drier years when the UIFR is between 950,000 and 400,000 acre-feet, SJWD decreases its diversion amounts from 82,200 acre-feet per year to 54,200 acre-feet per year, which includes a reduction of the MFP supply to 10,000 acre-feet. During the driest years when projected March through November UIFR is less than 400,000 acre-feet, the Water Forum signatories have agreed to meet and confer to develop a plan for water use.*

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

The MFP supply will be delivered to SJWD pursuant to its contract with PCWA and Water Forum Agreement commitments, as described above. PCWA intends to meet all obligations of its contract with SJWD as future conditions and contract terms evolve.

Based on coordination with SJWD during preparation of each purveyor's 2020 UWMP, and SJWD 25 Year Demand Forecast Report (dated May 2020), SJWD forecasts through 2045 an estimated total retail demand of 11,500 acre-feet, and a total wholesale customer agencies of 27,600 acre-feet . PCWA's interpretation of SJWD's demand for MFP water is that SJWD prioritizes the use of MFP water within its Placer County retail service area, which anticipates a buildout demand of up to 10,000 acre-feet, matching the current take-or-pay contract. Based on historical conditions, the MFP supply to SJWD is estimated to remain at 10,000 acre-feet under all year types; however, may be increased up to 25,000 upon approval of the Agency, as depicted in the table below:

Table 1. Current and Projected Water Demands, AFY

	Current (2025)	Year-Type	2030	2035	2040	2045	BO
San Juan Water District	9,843	Average	10,000	10,000	10,000	10,000	10,000
		Multi-Dry	10,000	10,000	10,000	10,000	10,000
		Single-Dry	10,000	10,000	10,000	10,000	10,000

Note: In any year during the term of the Water Supply Agreement, the District may request that the Agency make available up to a total of 25,000 acre-feet of water, inclusive of the District's Annual Entitlement, which, if approved by the Agency, would be made available to the District under the applicable provisions of the Water Supply Agreement.

If any of these values or the accompanying explanation do not align with the District's current projections, please contact us at your earliest convenience so that we may refine the characterization together. The values and explanation may be adjusted throughout the UWMP process based on your input and PCWA's UWMP analysis. Following this initial coordination, we will provide you with our draft UWMP analysis for your input and review in April of 2026.

Notification (including date, time, and location) for a public hearing to adopt our 2025 UWMP will be given at a later date. Access to a copy of the draft UWMP for review will be given at that time.

If you have any questions or concerns regarding our current representation of your demands, please contact me at (530) 823-4845. We appreciate your on-going efforts to help us incorporate the most representative information in our respective UWMPs.

Sincerely,

Brian Rickards, P.E.
Planning & Development Services Manager

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 25, 2026

Dan York
Sacramento Suburban Water District
3701 Marconi Ave, #100
Sacramento, CA 95821

Subject: PCWA's 2025 UWMP Notification Letter

Dear Dan York,

PCWA is preparing its 2025 Urban Water Management Plan (UWMP) for submittal to the Department of Water Resources (DWR) by July 1, 2026. As a Placer County Water Agency (PCWA) wholesale raw water customer, we want to officially notify you of PCWA's 2025 UWMP efforts, pursuant to California Water Code Section 10621(b).

In addition to this notification, this letter is to initiate coordination of our water projections in accordance with Water Code Section 10631(j). The following is a modified summary of our 2020 UWMP that we intend to include in our 2025 UWMP. The table below provides our current representation of your future demands on our water system.

> *PCWA's current contract with Sacramento Suburban Water District (SSWD) includes an annual entitlement of 29,000 acre-feet of water from the Middle Fork Project (MFP). Delivery of this supply is governed by the terms of SSWD's contract with PCWA as well as the diversion limitations established through the Water Forum Agreement, which restrict the volume of American River water SSWD may divert under various hydrologic conditions, and PCWA's water rights conditions that limit delivery of MFP water supplies to Northern Sacramento County to wetter years.*
>
> *According to SSWD's Water Forum Purveyor Specific Agreement, SSWD's American River diversion restrictions are dependent upon the projected March–November Unimpaired Inflow into Folsom Reservoir (UIFR). SSWD can divert 29,000 acre-feet per year of MFP water from Folsom Reservoir in wet years (when projected March through November UIFR is greater than 1,600,000 acre-feet). During drier years when the UIFR is less than 1,600,000 acre-feet, SSWD does not receive MFP water from PCWA.*
>
> *MFP water will be delivered pursuant to SSWD's contract with PCWA and Water Forum Agreement commitments, as described above. PCWA intends to meet all obligations of its contract with SSWD as future conditions and contract terms evolve. PCWA's interpretation of SSWD's build-out demand for MFP water in normal years is 29,000 acre-feet, reducing to zero acre-feet in single dry and multiple dry years*

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

For purposes of demand forecasting, PCWA is assuming the full demand will occur by 2030 and continue to exist throughout PCWA's 2025 UWMP planning horizon:

Table 1. Current and Projected Water Demands, AFY

	Current	*Year-Type*	*2030*	*2035*	*2040*	*2045*	*BO*
Sacramento Suburban Water District	*Varies*	*Average*	29,000	29,000	29,000	29,000	29,000
		Multi-Dry	0	0	0	0	0
		Single-Dry	0	0	0	0	0

If any of these values or the accompanying explanation do not align with the City's current projections, please contact us at your earliest convenience so that we may refine the characterization together. The values and explanation may be adjusted throughout the UWMP process based on your input and PCWA's UWMP analysis. Following this initial coordination, we will provide you with our draft UWMP analysis for your input and review in April of 2026.

Notification (including date, time, and location) for a public hearing to adopt our 2025 UWMP will be given at a later date. Access to a copy of the draft UWMP for review will be given at that time.

If you have any questions or concerns regarding our current representation of your demands, please contact me at (530) 823-4845. We appreciate your on-going efforts to help us incorporate the most representative information in our respective UWMPs.

Sincerely,

Brian Rickards, P.E.
Planning & Development Services Manager

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Mengil Deane
City of Auburn
1225 Lincoln Way
Auburn, CA 95603

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Mengil Deane,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Don Elias
Christian Valley Park CSD
PO Box 3138
Auburn, CA 95604

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Don Elias,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Ron Walker
City of Colfax
PO Box 702
Colfax, CA 95713

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Ron Walker,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Alan Johnston
Folsom Lake Mutual Water Company
PO Box 2945
Granite Bay, CA 95746

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Alan Johnston,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

David Muscarella
Golden Hills Mutual Water Co.
4061 Miners Drive
Loomis, CA 95650

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear David Muscarella,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Cheryl Madden
Heather Glen CSD
PO Box 715
Applegate, CA 95703

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Cheryl Madden,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Paul Schmidt
Hidden Valley Community Association
7072 Pine Gate Way
Granite Bay, CA 95746

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Paul Schmidt,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Ed Holt
Meadow Vista County Water District
17000 Placer Hills Road
Meadow Vista, CA 95722

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Ed Holt,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Town Manager
Town of Loomis
3665 Taylor Road
Loomis, CA 95650

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Town Manager,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Ed Holt
Meadow Vista County Water District
17000 Placer Hills Road
Meadow Vista, CA 95722

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Ed Holt,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Gerry LaBudde
Midway Heights County Water District
PO Box 596
Meadow Vista, CA 95722

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Gerry LaBudde,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Jennifer Hanson
Nevada Irrigation District
1036 West Main Street
Grass Valley, CA 95945

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Jennifer Hanson,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Pacific Gas and Electric Company
Dave Gabbard
Vice President, Power Generation
12840 Bill Clark Way
Auburn, CA 95602

Subject: Notification of Intent to Use PG&E Water Contract Supplies in Support of 2025 Urban Water Management Plan

Dear Dave Gabbard:

Placer County Water Agency (PCWA) hereby provides formal notification of its intent to continue exercising and relying upon its existing water supply contracts with Pacific Gas and Electric Company (PG&E) during the 25-year planning horizon of the 2025 Urban Water Management Plan (UWMP). This notice is provided to support coordination and ensure that PCWA's projected water supplies are appropriately reflected in planning documents and interagency communications.

As described in Section 6 (Water Supply Characterization) of PCWA's adopted 2020 Urban Water Management Plan, including Section 6.1.2.1 (PG&E Contracts), PCWA's water supply portfolio includes long-standing contractual arrangements with PG&E for delivery of surface water supplies from the Drum-Spaulding hydroelectric system. These supplies are conveyed through the Bear River, Wise, and South Canal systems and are integral to service within PCWA's Western Area and Zone 3 systems. PG&E contract water supports both treated and untreated retail deliveries, as well as wholesale deliveries within PCWA's service area in Placer County.

PG&E contract supplies represent a foundational component of PCWA's diversified water supply portfolio, which also includes Middle Fork Project water rights, federal Central Valley Project contract supplies, and access to regional groundwater resources for reliability purposes. As documented in the 2020 UWMP, these combined sources are evaluated for average, single-dry, and multiple-dry year reliability consistent with the requirements of the Urban Water Management Planning Act (California Water Code §10610 et seq.).,400

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

Table 1. Current and Projected Water Demands, AFY

	Current (2022)	2030	2035	2040	2045	BO
PCWA	101,607	125,400	125,400	125,400	125,400	125,400

PCWA intends to continue using its PG&E contract supplies in accordance with the terms and conditions of its existing agreements throughout the 2025 UWMP planning horizon. These supplies will remain integrated into PCWA's long-term supply reliability framework to meet projected retail and wholesale demands within its Placer County service area under a range of hydrologic conditions.

This notification is provided solely for planning and coordination purposes and is intended to support preparation of the 2025 UWMP and related agency planning efforts. Nothing in this letter is intended to expand, modify, supersede, or otherwise alter the legal rights, obligations, or operational terms established under existing water supply contracts between PCWA and PG&E. All rights and responsibilities remain governed exclusively by the applicable contractual agreements and governing law.

PCWA appreciates its longstanding partnership with PG&E and looks forward to continued coordination to support reliable water supplies within Placer County. Please feel free to contact PCWA if additional information would assist with your planning or documentation needs.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Daniel Chatigny
Placer County CEO
175 Fulweiler Avenue
Auburn, CA 95603

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Daniel Chatigny,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Aly Zimmerman
City of Rocklin
3970 Rocklin Road
Rocklin, CA 95677

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear Aly Zimmerman,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

David Villanueva
Sacramento County CEO
700 H Street, Room 7650
Sacramento, CA 95814

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear David Villanueva,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

Drew Lassard
CCAO Area Manager
United States Bureau of Reclamation
7794 Folsom Dam Road
Folsom, CA 95630

Subject: Notification of Intent to Use Central Valley Project (CVP) Contract Supplies in Support of 2025 Urban Water Management Plan

Dear Drew Lassard:

Placer County Water Agency (PCWA) hereby provides formal notification of its intent to continue exercising and relying upon its existing Central Valley Project (CVP) contractual supplies and related federal water supply arrangements during the 2025 Urban Water Management Plan (UWMP) planning horizon. This notice is provided to support coordination with the United States Bureau of Reclamation (USBR) and to ensure that PCWA's projected water supplies are appropriately reflected in federal and regional planning efforts.

As described in Section 6 (Water Supply Characterization) of PCWA's adopted 2020 Urban Water Management Plan, PCWA's water supply portfolio consists of a diversified combination of surface water appropriative rights, contractual entitlements, and access to sustainably managed regional groundwater resources. Surface water supplies include PCWA's Middle Fork Project supplies, Pacific Gas and Electric Company contract water, and federal CVP contract supplies administered by USBR. These CVP supplies form an integral component of PCWA's long-term water supply reliability strategy and are incorporated into PCWA's planning for average, single-dry, and multiple-dry year conditions pursuant to the Urban Water Management Planning Act (California Water Code § 10610 et seq.).

PCWA intends to rely upon and use its CVP contract supplies consistent with the terms and conditions of its existing agreements with USBR during the 25-year planning horizon addressed in the 2025 UWMP. These supplies are planned for use within PCWA's service area in Placer County and are integrated with PCWA's broader portfolio of surface water and groundwater resources to meet projected retail and wholesale demands. PCWA's demand projections and

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

supply reliability analyses for the 2025 UWMP cycle will reflect continued access to CVP supplies consistent with historical operations, applicable hydrologic conditions, and federal regulatory requirements.

Table 1. Current and Projected Water Demands, AFY

	Current	2030	2035	2040	2045	BO
PCWA - CVP	0	0	10,000	35,000	35,000	35,000

This notification is provided solely for planning coordination purposes and to support preparation of federal and regional planning documents. Nothing in this letter is intended to expand, modify, supersede, or otherwise alter the terms, conditions, or legal status of any existing CVP contract, water right, exchange, or other agreement between PCWA and USBR. PCWA's rights and obligations remain governed exclusively by applicable contracts, federal and state law, and regulatory requirements.

PCWA values its longstanding coordination with the United States Bureau of Reclamation and looks forward to continued collaboration to support reliable water supplies for Placer County and the broader American River watershed. Should you require additional information to support USBR planning efforts, PCWA staff would welcome the opportunity to coordinate further.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Chris Wilson, District 3
Robert Dugan, District 4
Joshua Alpine, District 5

Andrew Fecko, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

March 26, 2026

President
Willo-Glen Water Co.
PO Box 659
Loomis, CA 95650

Subject: Placer County Water Agency 2025 UWMP Notification Letter

Dear President,

The Placer County Water Agency (PCWA) is reviewing and updating its Urban Water Management Plan (UWMP) as required by the California Water Code (CWC). This effort must be completed by July 1, 2026. Pursuant to CWC Section 10621(b), PCWA must notify any city, county, and other interested parties within which it delivers water at least sixty days prior to a public hearing on the updated UWMP. This letter provides that notification. You will also be notified as to the hearing date, time, and location (anticipated to be held in May); and will have access to a copy of the draft UWMP for review. The public hearing will allow: (1) community input regarding PCWA's implementation plan, and (2) PCWA to adopt a method, pursuant to subdivision (b) of Section 10608.26, for determining its urban water use target compliance.

If you have any questions regarding this notification for PCWA's UWMP process, please contact me at (530)823-4845.

Sincerely,

Brian Rickards, P.E.
Planning and Development Services Manager

BR:nn

Appendix B DWR Tables

B

Submittal Table 2-1 Retail: Public Water Systems			
Public Water System Number	Public Water System Name	Number of Municipal Connections 2025	Volume of Water Supplied 2025 (AF)
Add additional rows as needed			
CA3110024	Alta	270	159
CA3110050	Applegate	68	24
CA3110005	Auburn-Bowman	8,539	6,089
CA3110040	Bianchi	39	29
CA3110006	Colfax	955	468
CA3110025	Foothill-Sunset	27,693	33,728
CA3110124	Monte Vista	17	26
CA3110035	Weimar	613	357
	Total	38,194	40,881
DWR NOTES: **Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.			
NOTES: Municipal Connections data collected from Water Board.			

Submittal Table 2-2: Plan Identification		
Select One	**Type of Plan**	**Name of Regional Alliance or RUWMP** (Drop Down List)
☑	**Individual UWMP**	
	If Water Supplier is also a member of a SB X7-7 Regional Alliance, select name from the drop-down.	
☐	**Regional Urban Water Management Plan (RUWMP)**	
	If Supplier selected RUWMP, select name from the drop-down.	
NOTES:		

Submittal Table 2-3: Supplier Identification	
Type of Supplier (select one or both)	
☑	Supplier is a wholesale supplier
☑	Supplier is a retail supplier
Fiscal or Calendar Year (select one)	
☑	UWMP Tables are in calendar years
☐	UWMP Tables are in fiscal years
If using fiscal years provide month and date that the fiscal year begins (mm/dd)	
Units of measure used in UWMP (Select from the drop down list).	
Unit	AF
DWR NOTES: **Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3.	
NOTES:	

Submittal Table 2-4 Retail: Water Supplier Information Exchange **Water Code Section 10631(h)**
The retail Supplier has informed the following wholesale supplier(s) of projected water use.
Wholesale Water Supplier Name
Add additional rows as needed
NOTES: PCWA does not receive purchased water from a wholesaler.

Submittal Table 2-4 Wholesale: Water Supplier Information Exchange Water Code Section 10631(h)	
☐	Check the box if the Supplier has informed more than 10 other water suppliers of water supplies available. **Completion of the table below is optional. If not completed, include a list of the water suppliers that were informed.**
Page 2-4	Provide page number for location of the list.
☑	Check the box if the Supplier has informed 10 or fewer other water suppliers of water supplies available. **Complete the table below.**

Water Supplier Name
Add additional rows as needed
City of Roseville
San Juan Water District
Sacramento Suburban Water District
City of Lincoln
California American Water Company
NOTES:

Submittal Table 3-1 Retail: Population - Current and Projected Water Code Section 10631(a)						
Population Served	2025	2030	2035	2040	2045	2050(opt)
	126,633	146,091	168,539	194,436	224,313	258,780
NOTES: See Section 3. Population shown is for the treated retail service. These values are the same as reported on Table 3-1W.						

Submittal Table 3-1 Wholesale: Population - Current and Projected Water Code Section 10631(a)						
Population Served	2025	2030	2035	2040	2045	2050(opt)
	126,633	146,091	168,539	194,436	224,313	258,780
NOTES: These values are the same as reported on Table 3-1R.						

Submittal Table 4-1 Retail: Total Uses for Potable and Non-Potable Water — Actual Water Code Section 10631(d)(1)			
Use Type	Additional Description (as needed)	2025 Actual Water Use	
Drop down list May select each use multiple times These are the only use types that will be recognized by the WUEdata online submittal tool		**Potable or Non-Potable** (OPTIONAL) Drop down list	Volume (AF)
Add additional rows as needed			
Single Family		Potable	16,472
Multi-Family		Potable	1,897
Commercial		Potable	2,902
Industrial		Potable	381
Institutional/Governmental	Municipal	Potable	907
Landscape		Non-Potable	2,678
Other (optional)	See Note 1	Potable	350
Distribution System Water Loss		Potable	2,667
Other (optional)	See Note 2	Non-Potable	75,984
		Subtotal Potable	25,574
		Subtotal Non-Potable	78,662
		Total	104,237
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.			
NOTES: **1."Other" classification included water used for commerical fire and fire protection and customers involuntarily deprived of untreated service.** **2. Commercial agriculture, irrigation, landscape and meter uses, including losses.**			

Optional **Submittal Table 4-1 Wholesale: Total Uses for Potable and Non-Potable Water — Actual** **Water Code Section 10631(d)(1)**			
Use Type	Additional Description (as needed)	2025 Actual Water Use	
Drop down list May select each use multiple times These are the only use types that will be recognized by the WUEdata online submittal tool		**Potable or Non-Potable** (OPTIONAL) Drop down list	Volume (AF)
Add additional rows as needed			
Sales to other agencies		Potable	12,602
Sales to other agencies		Non-Potable	12,582
		Subtotal Potable	12,602
		Subtotal Non-Potable	12,582
		Total	25,184
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.			
NOTES:			

Submittal Table 4-2 Retail: Total Uses for Potable, and Non-PotableWater — Projected Water Code Section 10631(d)(1)							
Use Type	Additional Description (as needed)	**Projected Water Use** (Report To the Extent that Records are Available)					
Drop down list May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool		**Potable or Non-Potable** (OPTIONAL) Drop down list	**2030 (AF)**	**2035 (AF)**	**2040 (AF)**	**2045 (AF)**	**2050 opt (AF)**
Add additional rows as needed.							
Single Family		Potable	18,701	21,328	24,355	27,848	31,864
Multi-Family		Potable	2,361	2,690	3,071	3,508	4,012
Commercial		Potable	3,587	4,074	4,634	5,281	6,025
Industrial		Potable	371	378	384	391	397
Institutional/Governmental	Municipal	Potable	2,677	3,051	3,483	3,981	4,556
Landscape		Non-Potable	3,331	3,796	4,332	4,951	5,665
Other (optional)	See Note 1	Potable	631	719	821	938	1,071
Distribution System Water Loss		Potable	1,970	2,236	2,542	2,895	3,300
Other (optional)	See Note 2	Non-Potable	59,123	57,265	55,695	54,365	51,787
Other (optional)	Regional Buffer	Potable	0	0	0	2,000	5,000
		Subtotal Potable	30,298	34,476	39,290	46,841	56,225
		Subtotal Non-Potable	62,453	61,061	60,026	59,317	57,452
		Total	92,752	95,538	99,316	106,157	113,677

DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.

NOTES:

1."Other" classification included water used for commerical fire and fire protection and customers involuntarily deprived of untreated service.

2. Commercial agriculture, irrigation, landscape and meter uses, including losses.

Optional **Submittal Table 4-2 Wholesale: Total Uses for Potable and Non-Potable Water — Projected** **Water Code Section 10631(d)(1)**							
Use Type		**Projected Water Use** (Report To the Extent that Records are Available)					
Drop down list May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool.	Additional Description (as needed)	**Potable or Non-Potable** (OPTIONAL) Drop down list	**2030 (AF)**	**2035 (AF)**	**2040 (AF)**	**2045 (AF)**	**2050 opt (AF)**
Add additional rows as needed							
Sales to other agencies		Potable	16,921	21,097	25,224	28,292	32,698
Sales to other agencies		Non-Potable	80,133	85,133	85,133	85,133	85,133
		Subtotal Potable	16,921	21,097	25,224	28,292	32,698
		Subtotal Non-Potable	80,133	85,133	85,133	85,133	85,133
		Total	97,054	106,230	110,357	113,425	117,831
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.							
NOTES:							

Submittal Table 4-3 Retail: Inclusion in Water Use Projections Water Code Section 10631 (a), 10631 (d)(4)(A), and 10631 (d)(4)(B)	
Are Future Water Savings Included in Projections? **Drop down list (y/n)**	No
If "Yes" to above, **state the section or page number**, in the cell to the right, where citations of the codes, ordinances, or otherwise are utilized in demand projections are found. ***Optional*** Suppliers may complete Optional Submittal Table 4-4 R to quantify the expected savings.	Page 4-23 Section 4.7
Are Lower Income Residential Demands Included In Projections? **Drop down list (y/n)**	Yes
Optional If the method for accounting Lower Income Residential Demands has been included, provide page number where this accounting can be found.	
DWR NOTES: Additional guidance is provided in Appendix K.	
NOTES:	

Submittal Table 4-5 Retail: Water Loss Audit Reporting Water Code Section 10631(d)(3)(A)		
Public Water System ID # Reported in Table 2-1 R	Reporting Period	Submitted to DWR Water Loss Audit Program (yes/no)
Report submittal status for all five years for each Public Water System as available. Add rows as needed		
CA3110024	**2020**	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
CA3110050	**2020**	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
CA3110005	**2020**	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
CA3110040	**2020**	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
CA3110006	**2020**	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
CA3110025	**2020**	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
CA3110124	**2020**	Yes
	2021	Yes
	2022	Yes
	2023	Yes
	2024	Yes
CA3110035	**2020**	No
	2021	No
	2022	No
	2023	Yes
	2024	Yes
DWR NOTES: Suppliers will provide a link to the WUEdata submittals of their Water		
NOTES:		

Submittal Table 4-6 Retail: Progress Towards 2028 Water Loss Standard
Water Code Section 10631(d)(3)(C)

Public Water System ID # Reported in Submittal Table 2-1 R	Did the Water Board Calculate a Water Loss Standard for this Public Water System? (y/n) If no, Supplier will not complete this row.	Real Water Loss					Apparent Water Loss				
		State Water Board Standard		Most Recent AWWA Water Loss Audit			State Water Board Standard		Most Recent AWWA Water Loss Audit		
		2028 Real Water Loss Standard per Unit per day	Units for Real Water Loss Drop down list	Number of Units (Connections or Miles corresponding with units selected)	Volume of Total Real Loss (from AWWA Water Loss Audit) (AF)	Real Water Loss Per Unit per Day	2028 Apparent Water Loss Standard per Unit per Day	Units for Apparent Water Loss	Number of Connections	Volume of Total Apparent Loss (from AWWA Water Loss Audit) (AF)	Apparent Water Loss Per Unit per Day
Add additional rows as needed.											
CA3110024	No										
CA3110050	No										
CA3110005	Yes	42.6	Gallons per Service Connection per Day (GPSCD)	9031	47.8	4.7	20.1	Gallons per Service Connection per Day (GPSCD)	9031	197.5	19.5
CA3110040	No										
CA3110006	No										
CA3110025	Yes	46.0	Gallons per Service Connection per Day (GPSCD)	28978	381.3	11.7	23.8	Gallons per Service Connection per Day (GPSCD)	28978	726.1	22.4
CA3110124	No										
CA3110035	No										

Water Board's Calculated Water Loss Standards

DWR NOTES: Units of measure (AF, CCF, MG) for Water Loss **MUST** remain consistent with units reported in Submittal Table 2-3. The units reported in Submittal Table 2-3 are used in this table's calculations.

NOTES:

1.The system went through a consolidation and the new target will be established using data from 2025 - 2028 ___

2.The system went through a consolidation and the new target will be established using data from 2024 - 2027 ___

3.The system went through an acquisition and the new target will be established using data from 2024 - 2027_+_.

Submittal Table 5-1 Retail: SB X7-7 2020 Target Progress Water Code Section 10608.40						
☐	Check the box if the Supplier was not an Urban Water Supplier during or before the 2020 UWMP reporting cycle. Proceed to the next table.					
Was Supplier part of a merger or consolidation since 2020?	Regional Alliance Target or Individual Target? Drop down list	2020 Target	Actual 2020 GPCD	Did Supplier Achieve Targeted Reduction for 2020?	Only for suppliers that did not meet the Target in 2020 See DWR NOTES below. Actual 2025 GPCD (From SB X7-7 Compliance Form)	Did Supplier meet the 2020 Target in 2025?
Yes	Individual Target	261	240	Yes		NA

DWR NOTES:
Suppliers calculating a 2025 GPCD will need to complete and submit SB X 7-7 Compliance Tables to verify the use of SB X7-7 Methodologies.
Suppliers that were part of a merger or consolidation since 2020 see Chapter 5 and Appendix P for guidance.
NA=Not Applicable

NOTES:

Submittal Table 6-1 Retail: Groundwater Volume Pumped
Water Code Section 10631(4) and 10631(4)(c)

☑	Check the box if the Supplier does not pump groundwater. Proceed to the next table.
☐	Check the box if all or part of the groundwater described below is desalinated. (OPTIONAL)

Groundwater Type **Drop Down List** May use each category multiple times	Potable or Non-Potable (OPTIONAL) **Drop down list**	Location or Basin Name	2021 (AF)	2022 (AF)	2023 (AF)	2024 (AF)	2025 (AF)
Add additional rows as needed							
Alluvial Basin	Potable	North American Subbasin	0	0	0	0	0
		Total	0	0	0	0	0

DWR NOTES:
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.

NOTES: See Chapter 6

Submittal Table 6-1 Wholesale: Groundwater Volume Pumped							
☑	Check the box if the Supplier does not pump groundwater. Proceed to the next table.						
☐	Check the box if all or part of the groundwater described below is desalinated. (OPTIONAL)						
Groundwater Type **Drop Down List** May use each category multiple times	Potable or Non-Potable (OPTIONAL) Drop down list	Location or Basin Name	2021 (AF)	2022 (AF)	2023 (AF)	2024 (AF)	2025 (AF)
Add additional rows as needed							
Alluvial Basin	Potable	North American Subbasin	-	-	-	-	-
		Total	0	0	0	0	0
DWR NOTES:							
NOTES: See Chapter 6							

Submittal Table 6-2 Retail: Wastewater Collected Within Service Area
Water Code Section 10633(a)

☐	Check the box if there is no wastewater collection system. Proceed to the next table.
	Percentage of 2025 service area served by wastewater collection system (OPTIONAL)
	Percentage of 2025 service area population served by wastewater collection system (OPTIONAL)

Wastewater Collection			Recipient of Collected Wastewater	
Name of Wastewater Collection Agency	Wastewater Volume Metered or Estimated? OPTIONAL **Drop Down List**	Volume of Wastewater Collected from UWMP Service Area 2025 (AF)	Name of Wastewater Treatment Plant (WWTP) and Place ID Number **Drop down list**	Is WWTP Located Within UWMP Area? **Drop Down List**
Add additional rows as needed				
South Placer Municipal Utility District		2,604	Other (provide name and ID in "NOTES" field)	No
South Placer Municipal Utility District		2,862	Other (provide name and ID in "NOTES" field)	No
Placer County		2,059	Lincoln City WWTF, Place ID 238365	No
Placer County		4,655	Other (provide name and ID in "NOTES" field)	No
Placer County		97	Other (provide name and ID in "NOTES" field)	No
Total Wastewater Received from UWMP Service Area in 2025:		12,277		

DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
Additional Guidance: See Appendix M, Section M.21 for detailed guidance on this table.

NOTES:
1. Dry Creek WWTP, 220768
2. Pleasant Grove WWTP, 248706

Submittal Table 6-3 Retail: Wastewater Treatment and Outcomes Within UWMP Service Area
Water Code Section 10633(b)

☑	**Check the box if no wastewater is treated or disposed of within the UWMP service area.** Proceed to the next table.

Wastewater Treatment Plant Name and Place ID Number **Drop down list**	Does This Plant Treat Wastewater Generated Outside the UWMP Service Area? (OPTIONAL) **Drop down list**	2025 Volume of Wastewater Received from UWMP Service Area (As Reported in Submittal Table 6-2 R) (AF)	Total 2025 Volume of Water Treated (AF)	**2025 Outcomes of Treated Wastewater**										
				Water Recycled Within UWMP Service Area (enter data as applicable)		**Water Recycled Outside of UWMP Service Area** (enter data as applicable)		**Effluent Discharge that is not a Permitted Recycled Water Use** (enter data as applicable)		**Required Discharge for Instream Flow** (enter data as applicable)		**Delivered to Another Entity for Additional Treatment** (enter data as applicable)		
				Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Name of other entity
Add additional rows as needed														
					-									
					-									
					-									
Total		0	-		0		0		0		0		0	

DWR NOTES:
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
IPR: Indirect Potable Reuse would have the treatment level of its end use requirement in the Level of Treatment drop-down.
Additional Guidance: See Appendix M, Section M.21 for detailed guidance on this table.

NOTES:

Submittal Table 6-3 Wholesale: Wastewater Treatment and Discharge Within Service Area
Water Code Section 10633(b)

☑ Check the box if the Wholesale Supplier neither distributes nor provides supplemental treatment to recycled water. Proceed to the next table.

Wastewater Treatment Plant Name and Place ID Number **Drop down list**	Does This Plant Treat Wastewater Generated Outside the UWMP Service Area? (OPTIONAL) **Drop down list**	2025 Volume of Wastewater Received from UWMP Service Area (AF)	Total 2025 Volume of Water Treated (AF)	**2025 Outcomes of Treated Wastewater**										
				Water Recycled Within UWMP Service Area (enter data as applicable)		**Water Recycled Outside of UWMP Service Area** (enter data as applicable)		**Effluent Discharge that is not a Permitted Recycled Water Use** (enter data as applicable)		**Required Discharge for Instream Flow** (enter data as applicable)		**Delivered to Another Entity for Additional Treatment** (enter data as applicable)		
				Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Treatment Level **Drop down list**	Volume (AF)	Name of other entity
Add additional rows as needed.														
Total		0	0		0		0		0		0		0	

DWR NOTES:
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
IPR: Indirect Potable Reuse would have the treatment level of its end use requirement in the Level of Treatment drop-down.
Additional Guidance: See Appendix M, Section M.21 for detailed guidance on this table.

NOTES:

Submittal Table 6-4 Retail: Recycled Water Direct Beneficial Uses Within Service Area
Water Code Section 10633 (c),(d),(e)

☐	Check box if recycled water is not used and is not planned for use within the service area of the supplier. The supplier will only complete the column on "Potential Recycled Water Use" and submit an accompanying narrative on the feasibility of that potential recycled water use.
Name(s) of Facility/ies Producing (Treating) the Recycled Water (OPTIONAL) :	
Name of Supplier Operating the Recycled Water Distribution System (OPTIONAL) :	
Volume of Supplemental Water Added in 2025 (OPTIONAL) :	
Source of 2025 Supplemental Water (OPTIONAL) :	

Use Type **Drop down list**	**Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop down list	Additional Information (as needed)	2025 (AF)	2030 (AF)	2035 (AF)	2040 (AF)	2045 (AF)	2050 (AF)	**Potential Recycled Water Use**	
									Volume	Narrative page number (OPTIONAL)
Add additional rows as needed										
Other (Description Required)	Non-Potable	Landscape Irrigation and Industrial Processes	0	0	2500	5000	7000	9000		
Subtotal Potable			0	0	0	0	0	0	0	
Subtotal Non-Potable			0	0	2,500	5,000	7,000	9,000	0	
Total			0	0	2500	5000	7000	9000	0	

DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
Additional Guidance: See Appendix M, Section M.21 for detailed guidance on this table.
Potential recycled water use: a description of the feasibility of these uses must be included in the narrative.
Multiple Producers: If you have multiple recycled water producers, submit a separate table for each.

NOTES: Recycled water is projected for availability by 2035. Supply will be provided by City of Lincoln and Roseville. These values are the same as reported on Table 6-4W.

Submittal Table 6-4 Wholesale: Current and Projected Recycled Water Uses
Water Code Section 10633(c),(d),(e)

☐	Check box if recycled water is not used and is not planned for use within the service area of the supplier. The supplier will only complete the column on "Potential Recycled Water Use" and submit an accompanying narrative on the feasibility of that potential recycled water use.

Name(s) of Facility/ies Producing (Treating) the Recycled Water (OPTIONAL) :	
Name of Supplier Operating the Recycled Water Distribution System (OPTIONAL) :	
Volume of Supplemental Water Added in 2025 (OPTIONAL) :	
Source of 2025 Supplemental Water (OPTIONAL) :	

Name of Receiving Supplier or Direct Use by Wholesale Supplier	Potable or Non-Potable (after treatment if treated) (OPTIONAL) Drop down list	Additional Information (as needed)	2025 (AF)	2030 (AF)	2035 (AF)	2040 (AF)	2045 (AF)	2050 (AF)	Potential Recycled Water Use	
									Volume (AF)	Narrative page number (OPTIONAL)
Add additional rows as needed										
Other (Description Required)	Non-Potable	Landscape Irrigati	0	0	2500	5000	7000	9000		
		Subtotal Potable	0	0	0	0	0	0	0	
		Subtotal Non-Potable	0	0	2,500	5,000	7,000	9,000	0	
		Total	0	0	2500	5000	7000	9000	0	

DWR NOTES:
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table reports the unit of measure selected in Submittal Table 2-3.
Additional Guidance: See Appendix M, Section M.21 for detailed guidance on this table.
Potential recycled water use: a description of the feasibility of these uses must be included in the narrative.
Multiple Producers: If you have multiple recycled water producers, submit a separate table for each.

NOTES: Recycled water is projected for availability by 2035. Supply will be provided by City of Lincoln and Roseville. These values are the same as reported on Table 6-4R.

Submittal Table 6-5 Retail: 2020 UWMP Recycled Water Use Projection Compared to 2025 Actual
Water Code Section 10633(e)

☑	Check the box if recycled water was not used in 2025 nor previously projected for use in 2020. Proceed to the next table.

Use Type Drop Down list	2020 Projection for 2025 (AF)	2025 Actual Use (AF)
Add additional rows as needed		
Total	0	0

DWR NOTES:
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure reported in Submittal Table 2-3
Additional Guidance: See Appendix M, Section M.21 for detailed guidance on this table.

NOTES:

Submittal Table 6-5 Wholesale: 2020 UWMP Recycled Water Use Projection Compared to 2025 Actual
Water Code Section 10633(e)

☑	Check the box if recycled water was not used or distributed by the supplier in 2025, nor projected for use or distribution in 2020. Proceed to the next table.

Name of Receiving Supplier or Direct Use by Wholesale Supplier	2020 Projection for 2025 (AF)	2025 Actual Use (AF)
Add additional rows as needed		
Total	0	0

DWR NOTES:

Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.

Additional Guidance: See Appendix M, Section M.21 for detailed guidance on this table.

NOTES:

Submittal Table 6-6 Retail: Methods to Encourage Future Recycled Water Use Water Code Section 10633(f)			
☑	Check the box if the Supplier does not plan to expand recycled water use in the future. Supplier will not complete the table below but will provide narrative explanation.		
Page 6-13 Section 6.2.5	Provide page location of narrative in the UWMP		
Name of Action	Description	Planned Implementation Year	Expected Increase in Recycled Water Use (AF)
Add additional rows as needed			
		Total (AF)	0
		Unit Conversion to AF	0

DWR NOTES:

Units of measure (AF, CCF, MG) MUST remain consistent with units reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.

The unit conversion to Acre Feet addresses the Water Code's requirement that this value be provided in acre-feet.

NOTES:

Submittal Table 6-7 Retail: Expected Future Water Supply Projects or Programs Water Code Section 10631(f)							
☑	Check the box if there are no expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Proceed to the next table.						
☐	Check the box if some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format.						
	Provide page location of narrative in the UWMP						
Name of Future Projects or Programs	Joint Project with other suppliers?		Additional Description (as needed)	**Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop Down list	Planned Implementation Year	Planned for Use in Year Type **Drop Down List**	Expected Increase in Water Supply to Supplier (This may be a range) (AF)
	Drop Down List (yes/no)	If Yes, Supplier Name					
Add additional rows as needed							
DWR NOTES: **Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure reported in Submittal Table 2-3.							
NOTES:							

Submittal Table 6-7 Wholesale: Expected Future Water Supply Projects or Programs Water Code Section 10631(f)							
☑	Check the box if there are no expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Proceed to the next table.						
☐	Check the box if some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format.						
	Provide page location of narrative in the UWMP						
Name of Future Projects or Programs	Joint Project with other suppliers?		Additional Description (as needed)	Potable or Non-Potable (after treatment if treated) (OPTIONAL) Drop down list	Planned Implementation Year	Planned for Use in Year Type **Drop Down list**	Expected Increase in Water Supply to Supplier (This may be a range) (AF)
	Drop Down List (yes/no)	If Yes, Supplier Name					
Add additional rows as needed							
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure reported in Submittal Table 2-3.							
NOTES:							

Submittal Table 6-8 Retail: Water Supplies — Actual
Water Code Section 10631(b)

Water Supply		2025		
Drop down list May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool	Additional Description (as needed)	**Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop Down list	Actual Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)
Add additional rows as needed				
Surface water (not desalinated)	MFP	Potable	44,925	
Purchased or Imported Water	CVP Contract	Potable	0	
Purchased or Imported Water	PG&E Agreement	Potable	67,108	
Surface water (not desalinated)	Pre-1914 Appropriations	Potable	4,485	
Recycled Water	From City of Lincoln/Roseville	Non-Potable	0	
Groundwater (not desalinated)		Potable	0	
		Subtotal Potable	116,518	0
		Subtotal Non-Potable	0	0
		Total	116,518	0

DWR NOTES:
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
Total Entitlement: e.g. Water Right, Groundwater Allocation, Contracted Amount.

NOTES: See Chapter 6. These values are managed dynamically as PCWA's overall supply to meeti it's treated retail, untreated retail, treated wholesale and untreated wholesale customer demands. These values are the same as reported on Table 6-8W.

Submittal Table 6-8 Wholesale: Water Supplies — Actual
Water Code Section 10631(b)

Water Supply	Additional Description (as needed)	2025		
Drop down list May use each category multiple times.These are the only water supply categories that will be recognized by the WUEdata online submittal tool		**Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop Down list	Actual Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)
Add additional rows as needed				
Surface water (not desalinated)	MFP	Potable	44,925	
Purchased or Imported Water	CVP Contract	Potable	0	
Purchased or Imported Water	PG&E Agreement	Potable	67,108	
Surface water (not desalinated)	Pre-1914 Appropriations	Potable	4,485	
Recycled Water	From City of Lincoln/Roseville	Non-Potable	0	
Groundwater (not desalinated)		Potable	0	
		Subtotal Potable	116,518	0
		Subtotal Non-Potable	0	0
		Total	116,518	0

DWR NOTES:

Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.

Total Entitlement: e.g. Water Right, Groundwater Allocation, Contracted Amount.

NOTES: See Chapter 6. These values are managed dynamically as PCWA's overall supply to meet it's treated retail, untreated retail, treated wholesale and untreated wholesale customer demands. These values are the same as reported on Table 6-8R.

Submittal Table 6-9 Retail: Water Supplies — Projected
Water Code Section 10631 (b)

Water Supply			Projected Water Supply (Report to the Extent Practicable)									
			2030		2035		2040		2045		2050 (opt)	
Drop down list May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool	Additional Detail on Water Supply	**Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop Down list	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)
Add additional rows as needed												
Surface water (not desalinated)	MFP	Potable	120,000		120,000		120,000		120,000		120,000	
Purchased or Imported Water	CVP Contract	Potable	2,000		5,000		10,000		35,000		35,000	
Purchased or Imported Water	PG&E Agreement	Potable	125,400		125,400		125,400		125,400		125,400	
Surface water (not desalinated)	Pre-1914 Appropriations	Potable	3,400		3,400		3,400		3,400		3,400	
Recycled Water	From City of	Non-Potable	0		2,500		5,000		7,000		9,000	
Groundwater (not desalinated)		Potable	2,000		4,000		4,000		5,000		5,000	
		Subtotal Potable	252,800	0	257,800	0	262,800	0	288,800	0	288,800	0
		Subtotal Non-Potable	0	0	2,500	0	5,000	0	7,000	0	9,000	0
		Total	252,800	0	260,300	0	267,800	0	295,800	0	297,800	0

DWR NOTES:

Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.

Total Entitlement: e.g. Water Right, Groundwater Allocation, Contracted Amount.

NOTES: CVP Supply is currently not available due to physical limitaitons. Supply from CVP is 0 AFY until infrastructure is in place to access this supply, which is assumed to be in 2030.

These values are managed dynamically as PCWA's overall supply to meet it's treated retail, untreatd retail, treated wholesae and untreated whole customer demands. These values are the same as reported on Table 6-9W.

Submittal Table 6-9 Wholesale: Water Supplies — Projected
Water Code Section 10631 (b)

Water Supply			Projected Water Supply (Report to the Extent Practicable)									
			2030		2035		2040		2045		2050 (opt)	
Drop down list May use each category multiple times.These are the only water supply categories that will be recognized by the WUEdata online submittal tool	Additional Detail on Water Supply	**Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop Down list	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)	Reasonably Available Volume (AF)	Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF)
Add additional rows as needed												
Surface water (not desalinated)	MFP	Potable	120,000		120,000		120,000		120,000		120,000	
Purchased or Imported Water	CVP Contract	Potable	2,000		5,000		10,000		35,000		35,000	
Purchased or Imported Water	PG&E Agreement	Potable	125,400		125,400		125,400		125,400		125,400	
Surface water (not desalinated)	Pre-1914 Appropriations	Potable	3,400		3,400		3,400		3,400		3,400	
Recycled Water	From City of Lincoln/Roseville	Non-Potable	0		2,500		5,000		7,000		9,000	
Groundwater (not desalinated)		Potable	2,000		4,000		4,000		5,000		5,000	
		Subtotal Potable	252,800	0	257,800	0	262,800	0	288,800	0	288,800	0
		Subtotal Non-Potable	0	0	2,500	0	5,000	0	7,000	0	9,000	0
		Total	252,800	0	260,300	0	267,800	0	295,800	0	297,800	0

DWR NOTES:

Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in a Submittal Table 2-3.

Total Entitlement: e.g. Water Right, Groundwater Allocation, Contracted Amount.

NOTES: CVP Supply is currently not available due to physical limitaitons. Supply from CVP is 0 AFY until infrastructure is in place to access this supply, which is assumed to be in 2030.

These values are managed dynamically as PCWA's overall supply to meet it's treated retail, untreatd retail, treated wholesae and untreated whole customer demands. These values are the same as reported on Table 6-9R.

Optional Submittal Table O-1A: Recommended Energy Reporting - SINGLE DELIVERY PRODUCT - WATER SUPPLY PROCESS APPROACH

Water Delivery Product drop down list (If delivering more than one type of product recommend using Table O-1C)	Multiple Products (if unable to use table O-1C)	**Only for Water Delivery Products Under the Urban Water Supplier's Operational Control**								
Start Date of Reporting Period	1/1/2024	**Water Management Process**							**Non-Consequential Hydropower (if applicable)**	
End Date of Reporting Period	12/31/2024									
Is upstream embedded energy included in the values reported?	No									
		Units for Water Volume	Extract and Divert	Place into Storage	Conveyance	Treatment	Distribution	**Total Utility** See DWR NOTES	Hydropower	Net Utility
Volume of Water Entering Process		AF	108,759		108759.4	42977.76	42977.764	108759.4		108759.4
Energy Consumed (kWh)		N/A	19,169,227	0	21553.2	2952579	1299579	23442939		23442939
Energy Intensity (kWh/vol. converted to MG)		N/A	540.9	0.0	0.6	210.8	92.8	661.5	0.0	661.50

DWR NOTES: Total Utility: The volume of water entered in the "Total Utility" column should equal the volume of water entering the distribution system (excluding recycled water); in most cases, this is the total volume calculated in UWMP Table 4-1: 2025 Actual Total Uses for Potable and Non-Potable Water. Note if recycled water is included in your Submittal Table 4-1, you must exclude it from your volume in this table.

Quantity of Self-Generated Renewable Energy

0 kWh

Data Quality (Estimate, Metered Data, Combination of Estimates and Metered Data)

Combination of Estimates and Metered Data

Data Quality Narrative:

Treatment volumes were compiled from PCWA-provided annual WTP flow data for the reporting period. Energy consumption values were obtained from PCWA utility and facility energy records; where on-site solar generation affects net utility usage, energy values for select pump stations and water treatment plants were estimated to best represent net utility consumption. PCWA reported no recycled water deliveries and no non-consequential hydropower for the reporting period. Overall data quality is a combination of metered data and estimates.

Narrative:

Reported values reflect energy that PCWA can readily obtain for its operations and are intended to support UWMP energy reporting under Water Code Section 10631.2(a), with additional methodology and assumptions documented in UWMP Section 6.3.

NOTES:

Optional Submittal Table 7-1 Retail: Basis of Water Year Data (Reliability Assessment)

Year Type	Base Year If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 2024-2025, use 2025	Available Supplies if Year Type Repeats	
		☑	Check the box if quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. **Location:** Section 7.2.3 (Pages 7-4 to 7-6)
		Quantification of available supplies is provided in this table as either volume only, percent only, or both.	
		Volume Available (AF)	**% of Average Supply**
Average Year			
Single-Dry Year			
Consecutive Dry Years 1st Year			
Consecutive Dry Years 2nd Year			
Consecutive Dry Years 3rd Year			
Consecutive Dry Years 4th Year			
Consecutive Dry Years 5th Year			

DWR NOTES: Supplier may use multiple versions of Submittal Table 7-1 R if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If a Supplier uses multiple versions of Submittal Table 7-1 R, in the "Note" section of each submittal table, state that multiple versions of Submittal Table 7-1 R are being used and identify the particular water source that is being reported in each submittal table.
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table reports the units of measure reported in Submittal Table 2-3.

NOTES:

OPTIONAL Submittal Table 7-1 Wholesale: Basis of Water Year Data (Reliability Assessment)

Year Type	Base Year If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 2024-2025, use 2025	Available Supplies if Year Type Repeats	
		☑	Check the box if quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. **Location:** Section 7.2.3 (Pages 7-4 to 7-6)
		Quantification of available supplies is provided in this table as either volume only, percent only, or both.	
		Volume Available (AF)	**% of Average Supply**
Average Year			
Single-Dry Year			
Consecutive Dry Years 1st Year			
Consecutive Dry Years 2nd Year			
Consecutive Dry Years 3rd Year			
Consecutive Dry Years 4th Year			
Consecutive Dry Years 5th Year			

DWR NOTES: Supplier may use multiple versions of Submittal Table 7-1 W if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If a Supplier uses multiple versions of Submittal Table 7-1 W, in the "Note" section of each submittal table, state that multiple versions of Submittal Table 7-1 W are being used and identify the particular water source that is being reported in each submittal table.
Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table reports the unit of measure selected in Submittal Table 2-3.

NOTES:

Submittal Table 7-2 Retail: Normal Year Supply and Use Comparison Water Code Section 10635 (a)					
	2030 (AF)	**2035 (AF)**	**2040 (AF)**	**2045 (AF)**	**2050 (AF)**
Supply totals (autofill from Submittal Table 6-9 R)	252,800	260,300	267,800	295,800	297,800
Use totals (autofill from Submittal Table 4-2 R)	198,653	210,615	218,520	228,430	240,355
Surplus/(shortfall)	54,147	49,685	49,280	67,370	57,445
OPTIONAL Planned WSCP Actions					
WSCP - supply augmentation benefit	0	0	0	0	0
WSCP - use reduction savings benefit	0	0	0	0	0
Revised Surplus/(shortfall)	54,147	49,685	49,280	67,370	57,445
DWR NOTES : Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.					
NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-2W.					

Submittal Table 7-2 Wholesale: Normal Year Supply and Use Comparison Water Code Section 10635 (a)					
	2030 (AF)	**2035 (AF)**	**2040 (AF)**	**2045 (AF)**	**2050 (AF)**
Supply totals (autofill from Submittal Table 6-9 W)	252,800	260,300	267,800	295,800	297,800
Use totals (see OPTIONAL Submittal Table 4-2 W)	198,653	210,615	218,520	228,430	240,355
Surplus/(shortfall)	54,147	49,685	49,280	67,370	57,445
OPTIONAL Planned WSCP Actions					
WSCP - supply augmentation benefit	0	0	0	0	0
WSCP - use reduction savings benefit	0	0	0	0	0
Revised Surplus/(shortfall)	54,147	49,685	49,280	67,370	57,445
DWR NOTES : Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.					
NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-2R.					

Submittal Table 7-3 Retail: Single Dry Year Supply and Use Comparison Water Code Section 10635(a)					
	2030 (AF)	**2035 (AF)**	**2040 (AF)**	**2045 (AF)**	**2050 (AF)**
Supply totals	186,050	191,300	195,050	204,300	206,300
Use totals*	160,653	167,615	175,520	185,430	197,355
Surplus/(shortfall)	25,397	23,685	19,530	18,870	8,945
OPTIONAL Planned WSCP Actions					
WSCP - supply augmentation benefit	0	0	0	0	0
WSCP - use reduction savings benefit	0	0	0	0	0
Revised Surplus/(shortfall)	25,397	23,685	19,530	18,870	8,945
DWR NOTES : Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.					
NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-3W. ***Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.**					

Submittal Table 7-3 Wholesale: Single Dry Year Supply and Use Comparison Water Code Section 10635(a)					
	2030 (AF)	**2035 (AF)**	**2040 (AF)**	**2045 (AF)**	**2050 (AF)**
Supply totals	186,050	191,300	195,050	204,300	206,300
Use totals*	160,653	167,615	175,520	185,430	197,355
Surplus/(shortfall)	25,397	23,685	19,530	18,870	8,945
OPTIONAL Planned WSCP Actions					
WSCP - supply augmentation benefit	0	0	0	0	0
WSCP - use reduction savings benefit	0	0	0	0	0
Revised Surplus/(shortfall)	25,397	23,685	19,530	18,870	8,945
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.					
NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-3R. ***Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.**					

Submittal Table 7-4 Retail: Multiple Dry Years Supply and Use Comparison
Water Code Section 10635(a)

		2030 (AF)	2035 (AF)	2040 (AF)	2045 (AF)	2050 (AF)
First year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Second year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Third year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Fourth year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Fifth year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245

DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.

NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-4W.

***Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.**

Submittal Table 7-4 Wholesale: Multiple Dry Years Supply and Use Comparison Water Code Section 10635(a)						
		2030 (AF)	2035 (AF)	2040 (AF)	2045 (AF)	2050 (AF)
First year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Second year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Third year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Fourth year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
Fifth year	Supply totals	250,100	256,100	261,100	276,600	278,600
	Use totals	160,653	167,615	175,520	185,430	197,355
	Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245
	OPTIONAL Planned WSCP Actions					
	WSCP - supply augmentation benefit	0	0	0	0	0
	WSCP - use reduction savings benefit	0	0	0	0	0
	Revised Surplus/(shortfall)	89,447	88,485	85,580	91,170	81,245

DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.

NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-4R.

***Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.**

Submittal Table 7-5 Retail: Five-Year Drought Risk Assessment Water Code Section 10635(b)(3)	
2026	**Total**
Total Water Use (AF)	135,582
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	114,518
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	114,518
2027	**Total**
Total Water Use (AF)	141,850
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	108,250
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	108,250
2028	**Total**
Total Water Use (AF)	148,117
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	101,983
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	101,983
2029	**Total**
Total Water Use (AF)	154,385
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	95,715
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	95,715
2030	**Total**
Total Water Use (AF)	160,653
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	89,447
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	89,447
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.	
NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-5W. ***Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.**	

Submittal Table 7-5 Wholesale: Five-Year Drought Risk Assessment Water Code Section 10635(b)(3)	
2026	**Total**
Total Water Use (AF)	135,582
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	114,518
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	114,518
2027	**Total**
Total Water Use (AF)	141,850
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	108,250
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	108,250
2028	**Total**
Total Water Use (AF)	148,117
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	101,983
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	101,983
2029	**Total**
Total Water Use (AF)	154,385
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	95,715
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	95,715
2030	**Total**
Total Water Use (AF)	160,653
Total Supplies (AF)	250,100
Surplus/Shortfall w/o WSCP Action	89,447
OPTIONAL Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit (AF)	0
WSCP - use reduction savings benefit (AF)	0
Revised Surplus/(shortfall)	89,447
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.	
NOTES: Since PCWA manages its supplies, wholesale demands and retail demands collectively, these values are the same as reported on Table 7-5R. ***Lower drought-year demands reflect reduced wholesale deliveries to Roseville and SSWD.**	

Submittal Table 8-1: Cross-reference for Standard vs Supplier Shortage Levels Water Code Section 10632(a)(3)(B)			
☑	Check the box if the Supplier uses the Standard six levels of water shortage. Proceed to the next table.		
Standard Shortage Levels	**Percent Shortage Range**	**Suppliers Shortage Levels**	**Percent Shortage Range**
1	Up to 10%		
2	Up to 20%		
3	Up to 30%		
4	Up to 40%		
5	Up to 50%		
6	>50%		
NOTES:			

Submittal Table 8-2 Retail: Supply Augmentation and Other Actions Water Code Section 10632(a)(4)(A),(C) and (E)				
Yes	Is the Supplier completing this table using the standard six levels? (yes/no)			
Shortage Level	Supply Augmentation Methods and Other Actions by Water Supplier **Drop down list** These are the only categories that will be accepted by the WUEdata online submittal tool	How much is this going to reduce the shortage gap?		Additional Explanation or Reference (OPTIONAL)
		Volume or Percentage Drop down	Shortage Gap Reduction Value (May be a range) (AF)	
Add additional rows as needed				
All	Transfers	Percentage	0-15%	Transfers with neighboring agencies - Nevada Irrigation District, San Juan Water District, City of Lincoln and the City of Roseville through interties
All	Other Actions (describe)	Percentage	0-15%	Through contracts with treated water wholesale customers (Cal Am and City of Lincoln), PCWA can request these customers transfer to their groundwater supply
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.				
NOTES: These augmentation actions are the same as reported on Table 8-2W.				

Submittal Table 8-2 Wholesale: Supply Augmentation and Other Actions Water Code Section 10632(a)(4)(A),(C) and (E)				
Yes	Is the Supplier completing this table using the standard six levels? (yes/no)			
Shortage Level	Supply Augmentation Methods and Other Actions by Water Supplier **Drop down list** These are the only categories that will be accepted by the WUEdata online submittal tool	How much is this going to reduce the shortage gap?		Additional Explanation or Reference (OPTIONAL)
		Volume or Percentage Drop down	Shortage Gap Reduction Value (May be a range) (AF)	
Add additional rows as needed				
All	Transfers	Percentage	0-15%	Transfers with neighboring agencies - Nevada Irrigation District, San Juan Water District, City of Lincoln and the City of Roseville through interties
All	Other Actions (describe)	Percentage	0-15%	Through contracts with treated water wholesale customers (Cal Am and City of Lincoln), PCWA can request these customers transfer to their groundwater supply
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.				
NOTES: These augmentation actions are the same as reported on Table 8-2R.				

Submittal Table 8-3 Retail: Demand Reduction Actions Water Code Section 10632(a)(4)(B),(D), and (E)					
Yes	Is the Supplier completing this table using the standard six levels? (yes/no)				
Shortage Level	Demand Reduction Actions **Drop down list** These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.	How much is this going to reduce the shortage gap?		Additional Explanation or Reference (OPTIONAL)	Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List
		Volume or Percentage Drop down	Shortage Gap Reduction Value (May be a range) (AF)		
Add additional rows as needed					
1	CII - Lodging establishment must offer opt out of linen service	Percentage	0-1%		No
1	CII - Other CII restriction or prohibition	Percentage	0-1%		No
1	Decrease Line Flushing	Percentage	0-1%		No
1	Expand Public Information Campaign	Percentage	0-1%		No
1	Landscape - Other landscape restriction or prohibition	Percentage	0-6%		No
1	Landscape - Restrict or prohibit runoff from landscape irrigation	Percentage	0-15%		No
1	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	Percentage	0-12%		No
1	Other - Require automatic shut of hoses	Percentage	0-1%		No
1	Water Features - Restrict water use for decorative water features, such as fountains	Percentage	0-1%		No
1	Pools and Spas - Require covers for pools and spas	Percentage	0-1%		No
1	CII - Restaurants may only serve water upon request	Percentage	0-1%		No
2	Decrease Line Flushing	Percentage	5-15%		No
2	Landscape - Limit landscape irrigation to specific times	Percentage	5-10%		No
2	Landscape - Limit landscape irrigation to specific days	Percentage	5-10%		No
2	Other - Prohibit use of potable water for washing hard surfaces	Percentage	0-1%		No
2	Other	Percentage	0-10%		No
3	CII - Other CII restriction or prohibition	Percentage	0-5%		No
3	Landscape - Limit landscape irrigation to specific days	Percentage	10-25%		No
3	Landscape - Other landscape restriction or prohibition	Percentage	0-1%		No
3	Other - Prohibit use of potable water for construction and dust control	Percentage	0-1%		No
3	Other water feature or swimming pool restriction	Percentage	0-1%		No
4	Landscape - Limit landscape irrigation to specific days	Percentage	5-20%		No
4	Landscape - Other landscape restriction or prohibition	Percentage	0-3%		No
4	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	Percentage	0-1%		No
4	Other water feature or swimming pool restriction	Percentage	0-1%		No
4	Other	Percentage	0-1%		No
5	Landscape - Other landscape restriction or prohibition	Percentage	0-50%	Water use for public heatg and safety purposes only.	Yes
6	Landscape - Other landscape restriction or prohibition	Percentage	0-70%	Water use for public health and safety purposes only. Customer rationing may be implemented.	Yes
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.					
NOTES:					

Submittal Table 8-3 Wholesale: Demand Reduction Actions Water Code Section 10632(a)(4)(B) and (E)				
Yes	Is the Supplier completing this table using the standard six levels? (yes/no)			
Shortage Level	Demand Reduction Actions **Drop down list** These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.	How much is this going to reduce the shortage gap?		Additional Explanation or Reference (OPTIONAL)
		Volume or Percentage Drop down	Shortage Gap Reduction Value (May be a range) (AF)	
Add additional rows as needed				
DWR NOTES: Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Submittal Table 2-3.				
NOTES: See Table 8-3R for demand reduction actions. Receiving agencies oversee wholesale demand reduction actions and will have them shown in their respective UWMPs.				

Submittal Table 10-1 Retail: Notification to Cities and Counties Water Code Section 10621(b) and 10642		
City Name	60 Day Notice **Drop Down (yes/no)**	Notice of Public Hearing **Drop Down (yes/no)**
Add additional rows as needed		
City of Auburn	Yes	Yes
City of Colfax	Yes	Yes
City of Rocklin	Yes	Yes
Town of Loomis	Yes	Yes
County Name **Drop Down List**	60 Day Notice **Drop Down (yes/no)**	Notice of Public Hearing **Drop Down (yes/no)**
Add additional rows as needed		
Placer County	Yes	Yes
Sacramento County	Yes	Yes
Other	60 Day Notice **Drop Down (yes/no)**	Notice of Public Hearing **Drop Down (yes/no)**
Add additional rows as needed		
Nevada Irrigation District	Yes	Yes
General Public	Yes	Yes
NOTES:		

Submittal Table 10-1 Wholesale: Notification to Cities and Counties Water Code Section 10621(b) and 10642		
☐	Check the box if the Supplier has notified more than 10 cities or counties. **Completion of the table below is not required. Provide a separate list of the cities and counties that were notified.**	
Page 2-4 Section 2.3	Provide the page or location of this list in the UWMP.	
☑	Check the box if the Supplier has notified 10 or fewer cities or counties. **Complete the table below.**	
City Name	60 Day Notice **Drop Down (yes/no)**	Notice of Public Hearing **Drop Down (yes/no)**
Add additional rows as needed		
City of Lincoln	Yes	Yes
City of Roseville	Yes	Yes
County Name **Drop Down List**	60 Day Notice **Drop Down (yes/no)**	Notice of Public Hearing **Drop Down (yes/no)**
Add additional rows as needed		
Other	60 Day Notice **Drop Down (yes/no)**	Notice of Public Hearing **Drop Down (yes/no)**
Add additional rows as needed		
Heather Glen Community Service	Yes	Yes
Meadow Vista County Water District	Yes	Yes
Willow-Glen Water Co.	Yes	Yes
Midway Heights County Water District	Yes	Yes
Christian Valley Park CSD	Yes	Yes
Folsom Lake Mutual Water Co.	Yes	Yes
Golden Hills Mutual Water Co.	Yes	Yes
San Juan Water District	Yes	Yes
Sacramento Suburban Water District	Yes	Yes
Hidden Valley Community Association	Yes	Yes
Lakeview Hills Community Association	Yes	Yes
NOTES:		

Appendix C DWR Checklist

C

Retail (x = required)	Wholesale (x = required)	Order	2025 Guidebook Location	Water Code Section	Summary as Applies to UWMP	Subject	Relevant Submittal Table	2025 UWMP Location
x	x	1	Chapter 1	10615	A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities.	Introduction and overview	n/a	Section 1
x	x	1	Chapter 1	10630.5	Each plan shall include a simple description of the Supplier's plan including water availability, future requirements, a strategy for meeting needs, and other pertinent information. Additionally, a Supplier may also choose to include a simple description at the beginning of each chapter.	Plan preparation	n/a	Section 1.1-1.8
x	x	2.1	Section 2.1	10620(b)	Every person that becomes a Supplier shall adopt UWMP within one year after it has become a Supplier.	Plan preparation	n/a	Section 2.1
x	n/a	2.5	Section 2.5	10644	Supplier shall report the Public Water Systems number, volume of delivered water, and number of connections that are included in this UWMP.	Plan preparation	2-1	Appendix E
x	x	2.5	Section 2.5	10644	Supplier shall report if this UWMP is an individual UWMP and whether the Supplier belongs to a regional UWMP or regional alliance.	Plan preparation	2-2	Section 2.3, Appendix B
x	x	2.5	Section 2.5	10644	Supplier shall report whether the data is in fiscal or calendar years and the units of measure used for reporting water volumes.	Plan preparation	2-3	Appendix B
x	x	2.4	Section 2.4	10642	Provide supporting documentation that the Supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan and contingency plan.	Plan preparation	n/a	Sections 2.3, 10.3
x	x	2.4	Section 2.4.2	10620(d)(3)	Coordinate the preparation of its plan with other appropriate agencies in the area, including other Suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.	Plan preparation	n/a	Section 2.3
x	n/a	2.4	Section 2.4.1	10631(h)	Retail Suppliers will include documentation that they have provided their Wholesale Supplier(s)—if any—with water use projections from that source.	Plan preparation	2-4 R	Appendix A
n/a	x	2.4	Section 2.4.1	10631(h)	Wholesale Suppliers will provide their Suppliers with identification and quantification of the existing and planned sources of water available from the Wholesale Supplier to the Supplier during various water year types.	Plan preparation	2-4 W	Appendix A
x	x	3	Chapter 3.0	10631(a)	Describe the Supplier service area.	System description	n/a	Sections 3.1-3.3
x	x	3.3	Section 3.3	10631(a)	Describe the climate of the Supplier's service area.	System description	n/a	Sections 3.4, 3.5
x	x	3.4	Section 3.4.1	10631(a)	Provide the current and projected service area populations for 2030, 2035, 2040, 2045 and optionally 2050.	System description	3-1	Section 3.6.1, Table 3-6
x	x	3.4	Section 3.4.2	10631(a)	Describe other social, economic, and demographic factors affecting the Supplier's water management planning.	System description	n/a	Section 3.6.2
x	x	3.5	Section 3.5	10631(a)	Describe the land uses within the service area… include the current and projected land uses within the existing or anticipated service area affecting the Supplier's water management planning. Describe the land uses within the service area.	System description and baselines	n/a	Section 3.7, Appendix F
x	Optional	4.2	Sections 4.2.3 and 4.2.4	10631(d)(1)	Quantify past, current, and projected water use, identifying the uses among water use sectors.	System water use	4-1 and 4-2	Sections 4.2-4.4
x	Optional	4.3	Section 4.3.1	10631(d)(3)(A)	Report the distribution system water loss for each of the five years preceding the plan update.	System water use	4-5	Section 4.5, Appendix E
x	n/a	4.3	Section 4.3.2	10631(d)(3)(C)	Retail Suppliers shall provide data to show the distribution loss standards were met.	System water use	4-6	Section 4.5, Table 4-11
x	n/a	4.2	Section 4.2.5.4	10631.1(a)	Include projected water use needed for lower income housing projected in the service area of the Supplier.	System water use	4-3	Section 4.7
x	n/a	4.2	Section 4.2.5.3	10631(d)(4)(A)	In projected water use, include estimates of water savings from adopted codes, plans, and other policies or laws.	System water use	4-3	Sections 9.2.4
x	n/a	4.2	Section 4.2.5.3	10631(d)(4)(B)	Provide citations of codes, standards, ordinances, or plans used to make water use projections.	System water use	4-3	Section 4.2.1
x	n/a	4.2	Section 4.2.5.3	10631(d)(4)(B)(ii)	To the extent that a Supplier reports the information described in subparagraph (A), an urban water Supplier shall… Indicate the extent that the water use projections consider savings from codes, standards, ordinances, or transportation and land use plans. Water use projections that do not account for these water savings shall be noted of that fact.	System water use	4-3	Sections 4.1, 4.2
x	x	4.2	Section 4.2.5.6	10635(b)	Demands under climate change considerations must be included as part of the drought risk assessment.	System water use	n/a	Sections 4.8, 7.3
n/a	x	5.1	Section 5.1	10608.36	Wholesale Suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their Retail Suppliers achieve targeted water use reductions.	Baselines and targets	n/a	Section 9.1
x	n/a	5.2	Section 5.2	10608.4	Retail Suppliers shall report on their compliance in meeting their water use targets. Reporting requirements will vary depending on whether the Supplier: - Was considered an urban retail water supplier in 2020, - Met its 2020 target in 2020, or - Was part of a merger or consolidation since 2020. Chapter 5 Subsections 5.2.1, 5.2.2, and 5.2.3 address each of these situations.	Baselines and targets	5-1	Section 5.2
x	x	6.1	Section 6.1	10631(b)(2)	When multiple sources of water supply are identified, describe the management of each supply in relationship to other identified supplies.	System supplies	n/a	Sections 6.1, 6.2
x	x	6.1	Sections 6.1 and 6.2	10631(b)(1)	Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought, including changes in supply due to climate change.	System supplies	n/a	Section 7.2
x	x	6.2	Section 6.2.2	10631(b)(4)(C)	Indicate whether groundwater is an existing or planned source of water available to the Supplier. If groundwater is identified as an existing or planned source of water… (include) a detailed description and analysis of the location, amount and sufficiency of groundwater pumped by the Supplier for the past five years.	Water supplies and recycled water	6-1	Section 6.2

x	x	6.2	Section 6.2.2	10631(b)(4)(A)	Indicate whether a groundwater sustainability plan or groundwater management plan has been adopted by the Supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization.	System supplies	n/a	Section 6.2, Appendix G
x	x	6.2	Section 6.2.2	10631(b)(4)(B)	Describe the groundwater basin.	System supplies	n/a	Section 6.2.2
x	x	6.2	Section 6.2.2	10631(b)(4)(B)	Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the Supplier has the legal right to pump.	System supplies	n/a	N/A
x	x	6.2	Section 6.2.2	10631(b)(4)(B)	For unadjudicated basins… (include) information as to whether DWR has identified the basin as a high- or medium-priority basin in the most current official departmental bulletin…	Water supplies and recycled water	n/a	Section 6.2.2.1
x	x	6.2	Section 6.2.2	10631(b)(4)(B)	For unadjudicated basins… describe efforts by the Supplier to coordinate with sustainability or groundwater agencies to achieve sustainable groundwater conditions.	Water supplies and recycled water	n/a	Section 6.2.2.1
x	x	6.2	Section 6.2.2.	10631(b)(4)(C)	If groundwater is identified as an existing or planned source of water… (include) a detailed description and analysis of the location, amount and sufficiency of groundwater pumped by the Supplier for the past five years.	System supplies	n/a	Section 6.2.2.2
x	x	6.2	Section 6.2.2	10631(b)(4)(D)	Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped.	System supplies	6-9	Section 6.2.2.2
x	x	6.1	Section 6.1	10631(b)	Identify and quantify the existing and planned sources of water available for 2025, 2030, 2035, 2040, 2045 and optionally 2050.	System supplies	6-8 and 6-9	Section 6.2.9
x	x	6.2	Section 6.2.7	10631(c)	Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.	System supplies	n/a	Section 6.2.7
x	n/a	6.2	Section 6.2.5	10633(a)	Describe the wastewater collection and treatment systems in the Supplier's service area with quantified amount of collection and treatment and the disposal methods.	System supplies (recycled water)	6-2	Section 6.2.5, Appendix B
x	x	6.2	Section 6.2.5	10633(b)	Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.	System supplies (recycled water)	6-3	N/A
x	x	6.2	Section 6.2.5	10633(c)	Describe the recycled water currently being used in the Supplier's service area.	System supplies (recycled water)	6-4	Section 6.2.5.2
x	x	6.2	Section 6.2.5	10633(d)	Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses.	System supplies (recycled water)	6-4	Section 6.2.5.2
x	x	6.2	Section 6.2.5	10633(e)	Describe the projected use of recycled water within the Supplier's service area at the end of 5, 10, 15, and 20 years, and describe the actual use of recycled water in comparison to uses previously projected.	System supplies (recycled water)	6-4 and 6-5	Section 6.2.5.2
x	x	6.2	Section 6.2.5	10633(f)	Describe the actions that may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year.	System supplies (recycled water)	6-6	N/A
x	x	6.2	Section 6.2.5	10633(g)	Provide a plan for optimizing the use of recycled water in the Supplier's service area.	System supplies (recycled water)	n/a	6.2.5.2
x	x	6.2	Section 6.2.6	10631(g)	Describe desalinated water project opportunities for long-term supply.	System supplies	6-7	Section 6.2.6
x	x	6.2	Section 6.2.10	10631(f)	Describe the expected future water supply projects and programs that may be undertaken by the water Supplier to address water supply reliability in average, single-dry, and for a period of drought lasting five consecutive water years.	System supplies	6-7	Section 6.2.8
x	x	6.3	Section 6.3 and Appendix O	10631.2(a)	The UWMP must include energy information, as stated in the code, that a Supplier can readily obtain.	System suppliers, energy intensity	O-1A, O-1B, O-1C, and O-2	Section 6.3
x		7.1	Section 7.1	10634	Provide information on the quality of existing sources of water available to the Supplier and the manner in which water quality affects water management strategies and supply reliability.	Water supply reliability assessment	n/a	Section 7.2.1
x	x	7.2	Section 7.2	10635(a)	Service Reliability Assessment: Assess the water supply reliability during normal, dry, and a drought lasting five consecutive water years by comparing the total water supply sources available to the Supplier with the total projected water use over the next 20 years.	Water supply reliability assessment	7-2, 7-3, and 7-4	Sections 7.2.3, 7.2.4
x	x	7.2	Section 7.2.3	10620(f)	Describe water management tools and options to maximize resources and minimize the need to import water from other regions.	Water supply reliability assessment	n/a	Section 7.2.5
x	x	7.3	Section 7.3	10635(b)	Provide a drought risk assessment as part of information considered in developing the demand management measures and water supply projects.	Water supply reliability assessment	n/a	Section 7.3
x	x	7.3	Section 7.3	10635(b)(1)	Include a description of the data, methodology, and basis for one or more supply shortage conditions that are necessary to conduct a drought risk assessment for a drought period that lasts five consecutive years.	Water supply reliability assessment	n/a	Section 7.3.1
x	x	7.3	Section 7.3	10635(b)(2)	Include a determination of the reliability of each source of supply under a variety of water shortage conditions.	Water supply reliability assessment	n/a	Sections 7.2.1-7.2.3
x	x	7.3	Section 7.3	10635(b)(3)	Include a comparison of the total water supply sources available to the Supplier with the total projected water use for the drought period.	Water supply reliability assessment	7-5	Section 7.3.1
x	x	7.3	Section 7.3	10635(b)(4)	Include considerations of the historical drought hydrology, plausible changes on projected supplies and demands under climate change conditions, anticipated regulatory changes, and other locally applicable criteria.	Water supply reliability assessment	n/a	Section 7.3.2
x	x	8	Chapter 8	10632(a)	Provide a water shortage contingency plan (WSCP) with specified elements below.	Water shortage contingency planning	n/a	Section 8, Appendix H
x	x	8	Chapter 8	10632(a)(1)	Provide an analysis of water supply reliability (from Guidebook Chapter 7) in the WSCP.	Water shortage contingency planning	n/a	Appendix H
x	x	8.2	Section 8.2	10632(a)(2)(A)	Provide the written decision-making process and other methods that the Supplier will use each year to determine its water reliability.	Water shortage contingency planning	n/a	Appendix H
x	x	8.2	Section 8.2	10632(a)(2)(B)	Provide data and methodology to evaluate the Supplier's water reliability for the current year and one dry year pursuant to factors in the code.	Water shortage contingency planning	n/a	Appendix H

x	x	8.3	Section 8.3	10632(a)(3)(A)	Define six standard water shortage levels of 10%, 20%, 30%, 40%, 50% shortage, and greater than 50% shortage. These levels shall be based on supply conditions, including percent reductions in supply, changes in groundwater levels, changes in surface elevation, or other conditions. The shortage levels shall also apply to a catastrophic interruption of supply.	Water shortage contingency planning	n/a	Appendix H
x	x	8.3	Section 8.3	10632(a)(3)(B)	Suppliers with an existing WSCP that uses different water shortage levels must cross reference their categories with the six standard categories.	Water shortage contingency planning	8-1	Appendix H
x	x	8.4	Section 8.4	10632(a)(4)(A)	Suppliers with WSCPs that align with the defined shortage levels must specify locally appropriate supply augmentation actions.	Water shortage contingency planning	8-2	Appendix H
x	x	8.4	Section 8.4	10632(a)(4)(B)	Specify locally appropriate demand reduction actions to adequately respond to shortages.	Water shortage contingency planning	8-3	Appendix H
x	x	8.4	Section 8.4	10632(a)(4)(C)	Specify locally appropriate operational changes.	Water shortage contingency planning	8-2	Appendix H
x	x	8.4	Section 8.4	10632(a)(4)(D)	Specify additional mandatory prohibitions against specific water use practices that are in addition to State-mandated prohibitions are appropriate to local conditions.	Water shortage contingency planning	Table 8-3	Appendix H
x	x	8.4	Section 8.4	10632(a)(4)(E)	Estimate the extent to which the gap between supplies and demand will be reduced by implementation of the action.	Water shortage contingency planning	8-2 and 8-3	Appendix H
x	x	8.4	Section 8.4.6	10632.5	The UWMP shall include a seismic risk assessment and mitigation plan.	Water shortage contingency plan	n/a	Appendix H
x	x	8.5	Section 8.5	10632(a)(5)(A)	Suppliers must describe that they will inform customers, the public and others regarding any current or predicted water shortages.	Water shortage contingency planning	n/a	Appendix H
x	x	8.5	Section 8.5	10632(a)(5)(B), 10632(a)(5)(C)	Suppliers must describe that they will inform customers, the public and others regarding any shortage response actions triggered or anticipated to be triggered and other relevant communications.	Water shortage contingency planning	n/a	Appendix H
x	n/a	8.6	Section 8.6	10632(a)(6)	Retail Supplier must describe how it will ensure compliance with and enforce provisions of the WSCP.	Water shortage contingency planning	n/a	Appendix H
x	x	8.7	Section 8.7	10632(a)(7)(A)	Describe the legal authority that empowers the Supplier to enforce shortage response actions.	Water shortage contingency planning	n/a	Appendix H
x	x	8.7	Section 8.7	10632(a)(7)(B)	Provide a statement that the Supplier will declare a water shortage emergency per Water Code Chapter 3. *Water Shortage Emergencies* .	Water shortage contingency planning	n/a	Appendix H
x	x	8.7	Section 8.7	10632(a)(7)(C)	Provide a statement that the Supplier will coordinate with any city or county within which it provides water for the possible proclamation of a local emergency.	Water shortage contingency planning	n/a	Appendix H
x	x	8.8	Section 8.8	10632(a)(8)(A)	Describe the potential revenue reductions and expense increases associated with activated shortage response actions.	Water shortage contingency planning	n/a	Appendix H
x	x	8.8	Section 8.8	10632(a)(8)(B)	Provide a description of mitigation actions needed to address revenue reductions and expense increases associated with activated shortage response actions.	Water shortage contingency planning	n/a	Appendix H
x	n/a	8.8	Section 8.8	10632(a)(8)(C)	Retail Suppliers must describe the cost of compliance with Water Code Chapter 3.3, *Excessive Residential Water Use During Drought* .	Water shortage contingency planning	n/a	Appendix H
x	n/a	8.9	Section 8.9	10632(a)(9)	Retail Suppliers must describe the monitoring and reporting requirements and procedures that ensure appropriate data are collected, tracked, and analyzed for purposes of monitoring customer compliance.	Water shortage contingency planning	n/a	Appendix H
x	x	8.10	Section 8.10	10632(a)(10)	Describe reevaluation and improvement procedures for monitoring and evaluation the WSCP to ensure risk tolerance is adequate and appropriate water shortage mitigation strategies are implemented.	Water shortage contingency planning	n/a	Appendix H
x	n/a	8.11	Section 8.11	10632(b)	Analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas.	Water shortage contingency planning	n/a	Appendix H
x	x	8.12	Section 8.12	10632(c)	Make available the WSCP to customers and any city or county where it provides water within 30 days after adoption of the plan.	Water shortage contingency planning	n/a	Section 10.5, Appendix I
x	n/a	9.1	Sections 9.1	10631(e)(1)	Retail Suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code.	Demand management measures	n/a	Section 9.2
n/a	x	9.2	Sections 9.2	10631(e)(2)	Wholesale Suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and Supplier assistance program.	Demand management measures	n/a	Section 9.1
x	n/a	10	Chapter 10	10608.26(a)	Retail Suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets (recommended to discuss compliance).	Plan adoption, submittal, and implementation	n/a	Section 10.3
x	x	10.2	Section 10.2.1	10621(b)	Notify, at least 60 days prior to the public hearing, any city or county within which the Supplier provides water that the Supplier will be reviewing the UWMP and considering amendments or changes to the plan.	Plan adoption, submittal, and implementation	10-1	Section 10.1, Appendix A
x	x	10.4	Section 10.4	10621(f)	Each urban water Supplier shall update and submit its 2025 plan to DWR by July 1, 2026.	Plan adoption, submittal, and implementation	n/a	Appendix I
x	x	10.2	Sections 10.2.2, 10.3, and 10.5	10642	Provide supporting documentation that the Supplier made the UWMP and WSCP available for public inspection, published notice of the public hearing, and held a public hearing about the UWMP and WSCP.	Plan adoption, submittal, and implementation	n/a	Sections 10.3, 10.5
x	x	10.2	Section 10.2.2	10642	The Supplier is to provide the time and place of the hearing to any city or county within which the Supplier provides water.	Plan adoption, submittal, and implementation	10-1	Section 10.2, Appendix A
x	x	10.3	Section 10.3.2	10642	Provide supporting documentation that the UWMP and WSCP has been adopted as prepared or modified.	Plan adoption, submittal, and implementation	n/a	Appendix I
x	x	10.4	Section 10.4	10644(a)	Provide supporting documentation that the Supplier has submitted their UWMP to the California State Library.	Plan adoption, submittal, and implementation	n/a	Section 10.4, Appendix I

x	x	10.4	Section 10.4	10644(a)(1)	Provide supporting documentation that the Supplier has submitted their UWMP to any city or county within which the Supplier provides water no later than 30 days after adoption.	Plan adoption, submittal, and implementation	n/a	Section 10.4
x	x	10.4	Sections 10.4.1 and 10.4.2	10644(a)(2)	The UWMP, or amendments to the UWMP, submitted to DWR shall be submitted electronically.	Plan adoption, submittal, and implementation	n/a	Section 10.6
x	x	10.7	Section 10.7.2	10644(b)	If revised, submit a copy of the WSCP to DWR within 30 days of adoption.	Plan adoption, submittal, and implementation	n/a	Section 10.6
x	x	10.5	Section 10.5	10645(a)	Provide supporting documentation that, not later than 30 days after filing a copy of its UWMP with DWR, the Supplier has or will make the plan available for public review during normal business hours.	Plan adoption, submittal, and implementation	n/a	Section 10.5
x	x	10.5	Section 10.5	10645(b)	Provide supporting documentation that, not later than 30 days after filing a copy of its WSCP with DWR, the Supplier has or will make the plan available for public review during normal business hours.	Plan adoption, submittal, and implementation	n/a	Section 10.5
x	x	10.6	Section 10.6	10621(c)	If Supplier is regulated by the Public Utilities Commission, include its plan and contingency plan as part of its general rate case filings.	Plan adoption, submittal, and implementation	n/a	N/A

Appendix D SBX7-7 Forms

D

SBX7-7 2020 Compliance Forms

SB X7-7 Table 0: Units of Measure Used in 2020 UWMP* *(select one from the drop down list)*
Acre Feet
**The unit of measure must be consistent throughout the UWMP, as reported in Submittal Table 2-3.*
NOTES:

SB X7-7 Table 2: Method for 2020 Population Estimate	
Method Used to Determine 2020 Population (may check more than one)	
☐	**1. Department of Finance** (DOF) or **American Community Survey** (ACS)
☑	**2. Persons-per-Connection Method**
☐	**3. DWR Population Tool**
☐	**4. Other** DWR recommends pre-review
NOTES:	

SB X7-7 Table 3: 2020 Service Area Population	
2020 Compliance Year Population	
2020	108,225
NOTES:	

SB X7-7 Table 4: 2020 Gross Water Use							
		2020 Deductions					
Compliance Year 2020	**2020 Volume Into Distribution System** *This column will remain blank until SB X7-7 Table 4-A is completed.*	**Exported Water ***	**Change in Dist. System Storage*** (+/-)	**Indirect Recycled Water** *This column will remain blank until SB X7-7 Table 4-B is completed.*	**Water Delivered for Agricultural Use***	**Process Water** *This column will remain blank until SB X7-7 Table 4-D is completed.*	**2020 Gross Water Use**
	29,065			-		-	**29,065**
*** Units of measure (AF, MG , or CCF)** must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.							
NOTES:							

SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment

Complete one table for each source.

Name of Source	Surface Water
This water source is *(check one)* **:**	
☑	The supplier's own water source
☐	A purchased or imported source

Compliance Year 2020	Volume Entering Distribution System [1]	Meter Error Adjustment [2] *Optional (+/-)*	Corrected Volume Entering Distribution System
	29,065	-	29,065

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.*

[2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES

SB X7-7 Table 5: 2020 Gallons Per Capita Per Day (GPCD)		
2020 Gross Water *Fm SB X7-7 Table 4*	**2020 Population** *Fm SB X7-7 Table 3*	**2020 GPCD**
29,065	108,225	**240**
NOTES:		

SB X7-7 Table 9: 2020 Compliance

Actual 2020 GPCD[1]	Optional Adjustments to 2020 GPCD (Enter "0" if Adjustment Not Used)			TOTAL Adjustments[1]	Adjusted 2020 GPCD [1] *(Adjusted if applicable)*	2020 Confirmed Target GPCD [1, 2]	**Did Supplier Achieve Targeted Reduction for 2020?**
	Extraordinary Events[1]	Weather Normalization[1]	Economic Adjustment[1]				
240	-	-	-	-	240	261	**YES**

[1] *All values are reported in GPCD*

[2] ***2020 Confirmed Target GPCD*** *is taken from the Supplier's SB X7-7 Verification Form Table SB X7-7, 7-F.*

NOTES:

Appendix E AWWA Water Audits

E

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency (CA3110024)
Reporting Year: 2020 (1/2020 - 12/2020)

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

				Pcnt:	Value:	
Volume from own sources:	3	131.040	acre-ft/yr	4	-1.00%	acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr			acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr			acre-ft/yr
WATER SUPPLIED:		**132.364**	acre-ft/yr			

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	93.380	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	3	0.100	acre-ft/yr			
Unbilled unmetered:	5	0.233	acre-ft/yr		0.233	acre-ft/yr
AUTHORIZED CONSUMPTION:		**93.713**	acre-ft/yr			

Use buttons to select percentage of water supplied **OR** value

WATER LOSSES (Water Supplied - Authorized Consumption)

38.651 acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:		0.331	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	3	3.390	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr
Apparent Losses:		**3.722**	acre-ft/yr			

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **34.928** acre-ft/yr

WATER LOSSES: **38.651** acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: **38.984** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	7	8.0	miles
Number of active AND inactive service connections:	7	287	
Service connection density:		36	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	4	93.0	psi

COST DATA

Total annual cost of operating water system:	10	$187,730	$/Year	
Customer retail unit cost (applied to Apparent Losses):	6	$1.73	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$154.50	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 48 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Unbilled metered
3: Customer metering inaccuracies

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency (CA3110050)
Reporting Year: 2020 (1/2020 - 12/2020)

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	2	24.110	acre-ft/yr	3	-3.00%		acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr				acre-ft/yr
WATER SUPPLIED:		**24.856**	acre-ft/yr				

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	23.410	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	n/a	0.000	acre-ft/yr			
Unbilled unmetered:	5	0.059	acre-ft/yr		0.059	acre-ft/yr
AUTHORIZED CONSUMPTION:		**23.469**	acre-ft/yr			

Use buttons to select percentage of water supplied **OR** value

WATER LOSSES (Water Supplied - Authorized Consumption) **1.387** acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:		0.062	acre-ft/yr	0.25%		acre-ft/yr
Customer metering inaccuracies:	3	0.849	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr
Apparent Losses:		**0.912**	acre-ft/yr			

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses:	**0.474**	acre-ft/yr
WATER LOSSES:	**1.387**	acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER:	**1.446**	acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	7	1.7	miles
Number of active AND inactive service connections:	7	69	
Service connection density:		42	conn./mile main
Are customer meters typically located at the curbstop or property line?		Yes	
Average length of customer service line:			(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	4	82.0	psi

COST DATA

Total annual cost of operating water system:	10	$35,199	$/Year	
Customer retail unit cost (applied to Apparent Losses):	6	$1.73	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$154.50	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 47 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency (CA3110005)
Reporting Year: 2020 | 1/2020 - 12/2020

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

Volume from own sources:	3	5,701.260	acre-ft/yr	6	-7.60%			acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr					acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr					acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 6,170.195 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	5,341.080	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	3	134.380	acre-ft/yr			
Unbilled unmetered:	5	13.350	acre-ft/yr		13.350	acre-ft/yr

Use buttons to select percentage of water supplied **OR** value

AUTHORIZED CONSUMPTION: 5,488.810 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption)

681.385 acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:		15.425	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	4	198.592	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr

Apparent Losses: 214.018 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 467.367 acre-ft/yr

WATER LOSSES: 681.385 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: 829.115 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	7	164.3	miles
Number of active AND inactive service connections:	7	8,934	
Service connection density:		54	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	6	82.0	psi

COST DATA

Total annual cost of operating water system:	10	$9,415,852	$/Year
Customer retail unit cost (applied to Apparent Losses):	7	$1.73	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	5	$154.50	$/acre-ft

☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 50 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Unbilled metered
3: Customer metering inaccuracies

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0
American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Bianchi (CA3110040)
Reporting Year: 2020 | 1/2020 - 12/2020

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

					Pcnt:	Value:	
Volume from own sources:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water imported:	3	32.250	acre-ft/yr	n/a			acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr				acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 32.250 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

			Pcnt:	Value:	
Billed metered:	5	28.500	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	n/a	0.000	acre-ft/yr			
Unbilled unmetered:	5	0.081	acre-ft/yr		0.081	acre-ft/yr

Use buttons to select percentage of water supplied OR value

AUTHORIZED CONSUMPTION: ? 28.581 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption) 3.669 acre-ft/yr

Apparent Losses

			Pcnt:	Value:	
Unauthorized consumption:		0.081	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	3	0.288	acre-ft/yr	1.00%	acre-ft/yr
Systematic data handling errors:		0.071	acre-ft/yr	0.25%	acre-ft/yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: ? 0.440 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ? 3.230 acre-ft/yr

WATER LOSSES: 3.669 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: ? 3.750 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	1.3	miles
Number of active AND inactive service connections:	9	38	
Service connection density:		30	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line:

(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	5	62.0	psi

COST DATA

Total annual cost of operating water system:	10	$46,933	$/Year	
Customer retail unit cost (applied to Apparent Losses):	9	$1.67	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$154.50	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 51 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported
2: Customer metering inaccuracies
3: Billed metered

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency (CA3110006)
Reporting Year: 2020 | 1/2020 - 12/2020

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ----------> | Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	3	529.860	acre-ft/yr	4	-1.00%		acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr				acre-ft/yr
WATER SUPPLIED:		**535.212**	acre-ft/yr				

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	401.710	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	3	0.140	acre-ft/yr			
Unbilled unmetered:	5	1.000	acre-ft/yr		1.000	acre-ft/yr
AUTHORIZED CONSUMPTION:		**402.850**	acre-ft/yr			

Use buttons to select percentage of water supplied **OR** value

WATER LOSSES (Water Supplied - Authorized Consumption) **132.362** acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:		1.338	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	3	14.575	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr
Apparent Losses:		**15.914**	acre-ft/yr			

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **116.448** acre-ft/yr

WATER LOSSES: **132.362** acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: **133.502** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	7	19.8	miles
Number of active AND inactive service connections:	7	1,013	
Service connection density:		51	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line:

(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	4	78.0	psi

COST DATA

Total annual cost of operating water system:	10	$745,055	$/Year	
Customer retail unit cost (applied to Apparent Losses):	6	$1.73	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$154.50	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 48 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Unbilled metered
3: Customer metering inaccuracies

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency (CA3110025)
Reporting Year: 2020 | 1/2020 - 12/2020

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ----------> | Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	3	32,183.060	acre-ft/yr	6	-1.10%		acre-ft/yr
Water imported:	3	1,724.510	acre-ft/yr	1	-1.00%		acre-ft/yr
Water exported:	2	11,528.010	acre-ft/yr	1	-1.00%		acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 22,638.486 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	20,232.430	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	8	17.010	acre-ft/yr			
Unbilled unmetered:	5	50.581	acre-ft/yr		50.581	acre-ft/yr

Use buttons to select percentage of water supplied OR value

AUTHORIZED CONSUMPTION: 20,300.021 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption) 2,338.465 acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:		56.596	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	4	734.436	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr

Apparent Losses: 791.033 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 1,547.432 acre-ft/yr

WATER LOSSES: 2,338.465 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: 2,406.056 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	7	451.9	miles
Number of active AND inactive service connections:	7	28,269	
Service connection density:		63	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line:

(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	6	78.0	psi	

COST DATA

Total annual cost of operating water system:	10	$48,234,973	$/Year	
Customer retail unit cost (applied to Apparent Losses):	7	$1.73	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$154.50	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 52 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Water exported
3: Customer metering inaccuracies

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency (CA3110124)
Reporting Year: 2020 (1/2020 - 12/2020)

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	3	28.490	acre-ft/yr	4	-1.00%		acre-ft/yr
Water imported:	n/a		acre-ft/yr				acre-ft/yr
Water exported:	n/a		acre-ft/yr				acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 28.778 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	22.080	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	3	1.143	acre-ft/yr			
Unbilled unmetered:	5	0.055	acre-ft/yr		0.055	acre-ft/yr

Use buttons to select percentage of water supplied OR value

AUTHORIZED CONSUMPTION: ? 23.278 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption) 5.500 acre-ft/yr

Apparent Losses

			Pcnt:	Value:	
Unauthorized consumption:	0.072	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	3	0.842	acre-ft/yr	3.50%	acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr	0.001	acre-ft/yr

Apparent Losses: ? 0.915 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ? 4.585 acre-ft/yr

WATER LOSSES: 5.500 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: ? 6.698 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	7	0.8	miles
Number of active AND inactive service connections:	7	20	
Service connection density:		24	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line:

(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 4 82.0 psi

COST DATA

Total annual cost of operating water system:	10	$41,066	$/Year	
Customer retail unit cost (applied to Apparent Losses):	6	$1.73	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$154.50	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 48 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Unbilled metered
3: Customer metering inaccuracies

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Alta (CA3110024)
Reporting Year: 2021 1/2021 - 12/2021

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	3	164.230	acre-ft/yr	3			acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water exported:	3	0.100	acre-ft/yr	1			acre-ft/yr
WATER SUPPLIED:		**164.130**	acre-ft/yr				

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	86.190	acre-ft/yr			
Billed unmetered:	n/a		acre-ft/yr			
Unbilled metered:	9	15.410	acre-ft/yr			
Unbilled unmetered:	5	0.410	acre-ft/yr		0.410	acre-ft/yr
AUTHORIZED CONSUMPTION:		**102.010**	acre-ft/yr			

Use buttons to select percentage of water supplied **OR** value

WATER LOSSES (Water Supplied - Authorized Consumption) **62.120** acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:	3	1.641	acre-ft/yr		1.641	acre-ft/yr

Unauthorized consumption volume entered is greater than the recommended default value

Customer metering inaccuracies:	3	3.685	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr
Apparent Losses:		**5.327**	acre-ft/yr			

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **56.792** acre-ft/yr

WATER LOSSES: **62.120** acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: **77.940** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	8.0	miles
Number of active AND inactive service connections:	9	290	
Service connection density:		36	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 5 109.0 psi

COST DATA

Total annual cost of operating water system:	10	$239,452	$/Year	
Customer retail unit cost (applied to Apparent Losses):	9	$1.28	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$158.24	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 54 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Applegate (CA3110050)
Reporting Year: 2021 1/2021 - 12/2021

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	3	24.010	acre-ft/yr	3			acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr				acre-ft/yr
WATER SUPPLIED:		**24.010**	acre-ft/yr				

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons

				Pcnt:	Value:	
Billed metered:	7	23.200	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	n/a	0.000	acre-ft/yr			
Unbilled unmetered:	5	0.060	acre-ft/yr		0.060	acre-ft/yr
AUTHORIZED CONSUMPTION:		**23.260**	acre-ft/yr			

Use buttons to select percentage of water supplied **OR** value

WATER LOSSES (Water Supplied - Authorized Consumption)

0.750 acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:		0.060	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	3	0.656	acre-ft/yr	2.75%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr
Apparent Losses:		**0.717**	acre-ft/yr			

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **0.033** acre-ft/yr

WATER LOSSES: **0.750** acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: **0.810** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	1.6	miles
Number of active AND inactive service connections:	9	68	
Service connection density:		44	conn./mile main
Are customer meters typically located at the curbstop or property line?		Yes	
Average length of customer service line:			(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	5	82.0	psi

COST DATA

Total annual cost of operating water system:	10	$35,042	$/Year	
Customer retail unit cost (applied to Apparent Losses):	9	$1.28	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$158.24	$/acre-ft	☐ Use Customer Retail Unit Cost to value real

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 53 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Auburn/Bowman (CA3110005)
Reporting Year: 2021 | 1/2021 - 12/2021

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

Volume from own sources:	+ ?	3	6,229.540	acre-ft/yr	+ ?	8	Pcnt:	Value: -13.000	acre-ft/yr
Water imported:	+ ?	3	2.760	acre-ft/yr	+ ?	n/a			acre-ft/yr
Water exported:	+ ?	3	33.060	acre-ft/yr	+ ?	n/a			acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 6,212.240 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

					Pcnt:	Value:	
Billed metered:	+ ?	7	5,369.240	acre-ft/yr			
Billed unmetered:	+ ?	n/a	0.000	acre-ft/yr			
Unbilled metered:	+ ?	9	245.060	acre-ft/yr			
Unbilled unmetered:	+ ?	5	15.767	acre-ft/yr		15.767	acre-ft/yr

Use buttons to select percentage of water supplied **OR** value

AUTHORIZED CONSUMPTION: ? 5,630.067 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption)

582.173 acre-ft/yr

Apparent Losses

					Pcnt:	Value:	
Unauthorized consumption:	+ ?		15.531	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	+ ?	3	203.627	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	+ ?	5	0.001	acre-ft/yr		0.001	acre-ft/yr

Apparent Losses: ? 219.159 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ? 363.014 acre-ft/yr

WATER LOSSES: 582.173 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: ? 843.000 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	+ ?	9	164.5	miles
Number of active AND inactive service connections:	+ ?	9	8,975	
Service connection density:	?		55	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: + ? (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	+ ?	5	82.0	psi

COST DATA

Total annual cost of operating water system:	+ ?	10	$8,912,271	$/Year
Customer retail unit cost (applied to Apparent Losses):	+ ?	9	$1.28	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	+ ?	5	$158.24	$/acre-ft

☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 55 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0
American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Bianchi (CA3110040)
Reporting Year: 2021 | 1/2021 - 12/2021

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water imported:	3	32.250	acre-ft/yr	n/a			acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr				acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 32.250 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

			Pcnt:	Value:	
Billed metered:	5	30.730	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	n/a	0.000	acre-ft/yr			
Unbilled unmetered:	5	0.081	acre-ft/yr		0.081	acre-ft/yr

Use buttons to select percentage of water supplied OR value

AUTHORIZED CONSUMPTION: ? 30.811 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption) 1.439 acre-ft/yr

Apparent Losses

			Pcnt:	Value:	
Unauthorized consumption:		0.081	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	3	0.310	acre-ft/yr	1.00%	acre-ft/yr
Systematic data handling errors:		0.077	acre-ft/yr	0.25%	acre-ft/yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: ? 0.468 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ? 0.972 acre-ft/yr

WATER LOSSES: 1.439 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: ? 1.520 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	1.3	miles
Number of active AND inactive service connections:	9	38	
Service connection density:		30	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line:

(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	5	62.0	psi

COST DATA

Total annual cost of operating water system:	10	$46,722	$/Year	
Customer retail unit cost (applied to Apparent Losses):	9	$1.67	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$158.24	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 51 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported
2: Customer metering inaccuracies
3: Billed metered

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0
American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
\+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Colfax (CA3110006)
Reporting Year: 2021 1/2021 - 12/2021

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

					Pcnt:	Value:	
Volume from own sources:	3	553.640	acre-ft/yr	8		-0.100	acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr				acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 553.740 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

			Pcnt:	Value:	
Billed metered:	7	401.040	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	n/a	0.000	acre-ft/yr			
Unbilled unmetered:	5	5.760	acre-ft/yr		5.760	acre-ft/yr

Use buttons to select percentage of water supplied OR value

AUTHORIZED CONSUMPTION: ? 406.800 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption) 146.940 acre-ft/yr

Apparent Losses

			Pcnt:	Value:	
Unauthorized consumption:	3	5.537	acre-ft/yr		5.537	acre-ft/yr

Unauthorized consumption volume entered is greater than the recommended default value

Customer metering inaccuracies:	3	14.545	acre-ft/yr	3.50%	acre-ft/yr
Systematic data handling errors:	7	0.001	acre-ft/yr	0.001	acre-ft/yr

Apparent Losses: ? 20.084 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ? 126.856 acre-ft/yr

WATER LOSSES: 146.940 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: ? 152.700 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	19.8	miles
Number of active AND inactive service connections:	9	1,019	
Service connection density:		52	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 5 78.0 psi

COST DATA

Total annual cost of operating water system:	10	$671,632	$/Year	
Customer retail unit cost (applied to Apparent Losses):	9	$1.28	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$158.24	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 53 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Foothill/Sunset (CA3110025)
Reporting Year: 2021 1/2021 - 12/2021

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

						Pcnt:	Value:	
Volume from own sources:	3	32,705.170	acre-ft/yr	8	-0.100		-0.100	acre-ft/yr
Water imported:	3	1,317.460	acre-ft/yr	n/a				acre-ft/yr
Water exported:	3	12,215.410	acre-ft/yr	n/a				acre-ft/yr
WATER SUPPLIED:		**21,807.320**	acre-ft/yr					

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	20,428.590	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	9	3.310	acre-ft/yr			
Unbilled unmetered:	3	6.460	acre-ft/yr		6.460	acre-ft/yr
AUTHORIZED CONSUMPTION:		**20,438.360**	acre-ft/yr			

Use buttons to select percentage of water supplied OR value

WATER LOSSES (Water Supplied - Authorized Consumption) **1,368.960** acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:		54.518	acre-ft/yr	0.25%		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	3	741.053	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr
Apparent Losses:		**795.573**	acre-ft/yr			

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **573.387** acre-ft/yr

WATER LOSSES: **1,368.960** acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: **1,378.730** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	457.9	miles
Number of active AND inactive service connections:	9	29,013	
Service connection density:		63	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line:

(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 5 78.0 psi

COST DATA

Total annual cost of operating water system:	10	$48,503,545	$/Year	
Customer retail unit cost (applied to Apparent Losses):	9	$1.28	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$158.24	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 55 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Water exported
3: Customer metering inaccuracies

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
\+ Click to add a comment

Water Audit Report for: Placer County Water Agency - Monte Vista (CA3110124)
Reporting Year: 2021 1/2021 - 12/2021

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

				Pcnt:	Value:	
Volume from own sources:	3	29.260	acre-ft/yr	-3.33%		acre-ft/yr
Water imported:	n/a		acre-ft/yr			acre-ft/yr
Water exported:	n/a		acre-ft/yr			acre-ft/yr
WATER SUPPLIED:		**30.268**	acre-ft/yr			

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	23.680	acre-ft/yr			
Billed unmetered:	n/a	0.000	acre-ft/yr			
Unbilled metered:	9	0.920	acre-ft/yr			
Unbilled unmetered:	9	1.210	acre-ft/yr		1.210	acre-ft/yr
AUTHORIZED CONSUMPTION:		**25.810**	acre-ft/yr			

Unbilled Unmetered volume entered is greater than the recommended default value

Use buttons to select percentage of water supplied OR value

WATER LOSSES (Water Supplied - Authorized Consumption)

4.458 acre-ft/yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:	3	0.303	acre-ft/yr		0.303	acre-ft/yr
Customer metering inaccuracies:	3	0.892	acre-ft/yr	3.50%		acre-ft/yr
Systematic data handling errors:	5	0.001	acre-ft/yr		0.001	acre-ft/yr
Apparent Losses:		**1.196**	acre-ft/yr			

Unauthorized consumption volume entered is greater than the recommended default value

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **3.262** acre-ft/yr

WATER LOSSES: **4.458** acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: **6.588** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	0.8	miles
Number of active AND inactive service connections:	9	19	
Service connection density:		23	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	5	82.0	psi

COST DATA

Total annual cost of operating water system:	10	$40,882	$/Year	
Customer retail unit cost (applied to Apparent Losses):	9	$1.28	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	5	$158.24	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 55 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency - Alta
Audit Year: 2022 | Jan 01 2022 - Dec 31 2022 | Calendar Year

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	6	127.710	Acre-ft/Yr	n	g	8		acre-ft/yr	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA
	WATER SUPPLIED:				127.710	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	86.610	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	10	7.550	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.217	Acre-ft/Yr	0.25%	Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 94.377 Acre-ft/Yr

WATER LOSSES

33.333 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	3.415	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.217	Acre-ft/Yr	0.25%	Default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 3.633 Acre-ft/Yr

Real Losses

Real Losses: 29.701 Acre-ft/Yr

WATER LOSSES: 33.333 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 41.100 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	8.0	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	283		(active *and* inactive)
	Service connection density:				35	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP: Average Operating Pressure: n g 6 109.0 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$1.77	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$182.43	$/acre-ft	$275,879	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency - Applegate
Audit Year: 2022 | Jan 01 2022 - Dec 31 2022 | Calendar Year

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	6	21.460	Acre-ft/Yr	n	g	8		acre-ft/yr	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA
	WATER SUPPLIED:				21.460	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	19.430	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.049	Acre-ft/Yr	0.25%	Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 19.479 Acre-ft/Yr

WATER LOSSES

1.981 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	0.705	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.049	Acre-ft/Yr	0.25%	Default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.754 Acre-ft/Yr

Real Losses

Real Losses: 1.227 Acre-ft/Yr

WATER LOSSES: 1.981 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 2.030 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	1.6	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	70		(active *and* inactive)
	Service connection density:				45	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP: Average Operating Pressure: n g 6 82.0 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$1.77	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$182.43	$/acre-ft	$46,358	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency - Auburn/Bowman
Audit Year: 2022 | Jan 01 2022 - Dec 31 2022 | Calendar Year

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

			n	g				n	g				
VOS	Volume from Own Sources:		n	g	6	5,231.652	Acre-ft/Yr	n	g	8	volume 318.587	acre-ft/yr	under-registration VOSEA
WI	Water Imported:		n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:		n	g	n/a	0.000	Acre-ft/Yr						WEEA
	WATER SUPPLIED:					5,550.239	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

			n	g						
BMAC	Billed Metered:		n	g	9	5,221.370	Acre-ft/Yr			
BUAC	Billed Unmetered:		n	g	n/a	0.000	Acre-ft/Yr			
UMAC	Unbilled Metered:		n	g	10	84.950	Acre-ft/Yr			
UUAC	Unbilled Unmetered:		n	g	8	0.181	Acre-ft/Yr	Custom 0.181	acre-ft/yr	
	AUTHORIZED CONSUMPTION:					5,306.501	Acre-ft/Yr			

WATER LOSSES

243.738 Acre-ft/Yr

Apparent Losses

choose entry option:

			n	g						
SDHE	Systematic Data Handling Errors:		n	g	6	0.001	Acre-ft/Yr	custom 0.001	acre-ft/yr	
CMI	Customer Metering Inaccuracies:		n	g	3	192.457	Acre-ft/Yr	3.50% percent		under-registration
UC	Unauthorized Consumption:		n	g	3	13.053	Acre-ft/Yr	0.25% Default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 205.512 Acre-ft/Yr

Real Losses

Real Losses: 38.227 Acre-ft/Yr

WATER LOSSES: 243.738 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 328.869 Acre-ft/Yr

SYSTEM DATA

			n	g				
Lm	Length of mains:		n	g	10	175.4	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:		n	g	5	8,971		(active *and* inactive)
	Service connection density:					51	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

			n	g			
AOP	Average Operating Pressure:		n	g	6	90.0	psi

COST DATA

			n	g					
CRUC	Customer Retail Unit Charge:		n	g	9	$1.77	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:		n	g	9	$182.43	$/acre-ft	$11,301,411	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency - Bianchi
Audit Year: 2022 | Jan 01 2022 - Dec 31 2022 | Calendar Year

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g								
VOS	Volume from Own Sources:	n	g	n/a	0.000	Acre-ft/Yr					VOSEA
WI	Water Imported:	n	g	3	31.850	Acre-ft/Yr	n	g	4	acre-ft/yr	WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr					WEEA

WATER SUPPLIED: 31.850 Acre-ft/Yr

AUTHORIZED CONSUMPTION

BMAC	Billed Metered:	n	g	9	30.350	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.076	Acre-ft/Yr	0.25%	Default

choose entry option:

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 30.426 Acre-ft/Yr

WATER LOSSES

1.424 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	0.307	Acre-ft/Yr	1.00%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.076	Acre-ft/Yr	0.25%	Default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.383 Acre-ft/Yr

Real Losses

Real Losses: 1.041 Acre-ft/Yr

WATER LOSSES: 1.424 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1.500 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	1.3	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	38		(active *and* inactive)
	Service connection density:				30	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP: Average Operating Pressure: n g 6 62.0 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$1.77	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$182.43	$/acre-ft	$68,802	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Water Imported (WI)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency - Colfax
Audit Year: 2022 | Jan 01 2022 - Dec 31 2022 | Calendar Year

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	6	508.621	Acre-ft/Yr	n	g	8		acre-ft/yr	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA
	WATER SUPPLIED:				508.621	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	367.230	Acre-ft/Yr			
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr			
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr			
UUAC	Unbilled Unmetered:	n	g	8	2.190	Acre-ft/Yr	Custom	2.190	acre-ft/yr
	AUTHORIZED CONSUMPTION:				369.420	Acre-ft/Yr			

WATER LOSSES

139.201 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr	custom	0.001	acre-ft/yr	
CMI	Customer Metering Inaccuracies:	n	g	3	13.319	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.918	Acre-ft/Yr	0.25%	Default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 14.238 Acre-ft/Yr

Real Losses

Real Losses: 124.963 Acre-ft/Yr

WATER LOSSES: 139.201 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 141.391 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	21.0	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	1,008		(active *and* inactive)
	Service connection density:				48	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp	n	g	10	

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP	Average Operating Pressure:	n	g	6	78.0	psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$1.77	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$182.43	$/acre-ft	$1,098,723	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency - Foothill/Sunset
Audit Year: 2022 | Jan 01 2022 - Dec 31 2022 | Calendar Year

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

VOS	Volume from Own Sources:	n	g	6	32,595.190	Acre-ft/Yr	n	g	8			acre-ft/yr	VOSEA
WI	Water Imported:	n	g	3	1,249.900	Acre-ft/Yr	n	g	4			acre-ft/yr	WIEA
WE	Water Exported:	n	g	3	12,257.428	Acre-ft/Yr	n	g	4			acre-ft/yr	WEEA
	WATER SUPPLIED:				21,587.662	Acre-ft/Yr							

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	19,833.636	Acre-ft/Yr				
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr				
UMAC	Unbilled Metered:	n	g	10	5.014	Acre-ft/Yr				
UUAC	Unbilled Unmetered:	n	g	8	4.840	Acre-ft/Yr	Custom	4.840	acre-ft/yr	
	AUTHORIZED CONSUMPTION:				19,843.490	Acre-ft/Yr				

WATER LOSSES

1,744.172 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr	custom	0.001	acre-ft/yr	
CMI	Customer Metering Inaccuracies:	n	g	3	719.537	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	49.584	Acre-ft/Yr	0.25%	Default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 769.122 Acre-ft/Yr

Real Losses

Real Losses: 975.050 Acre-ft/Yr

WATER LOSSES: 1,744.172 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1,754.026 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	481.2	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	28,857		(active *and* inactive)
	Service connection density:				60	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 6 78.0 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$1.77	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$182.43	$/acre-ft	$46,633,652	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Water Exported (WE)
3: Customer Metering Inaccuracies (CMI)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency - Monte Vista
Audit Year: 2022 | Jan 01 2022 - Dec 31 2022 | Calendar Year

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	6	28.200	Acre-ft/Yr	n	g	8		acre-ft/yr	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA
	WATER SUPPLIED:				28.200	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	26.310	Acre-ft/Yr			
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr			
UMAC	Unbilled Metered:	n	g	10	0.930	Acre-ft/Yr			
UUAC	Unbilled Unmetered:	n	g	8	0.066	Acre-ft/Yr	Custom	0.066	acre-ft/yr
	AUTHORIZED CONSUMPTION:				27.306	Acre-ft/Yr			

WATER LOSSES

0.894 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	0.770	Acre-ft/Yr	2.75%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.066	Acre-ft/Yr	0.25%	Default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.837 Acre-ft/Yr

Real Losses

Real Losses: 0.057 Acre-ft/Yr

WATER LOSSES: 0.894 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1.890 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	0.9	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	19		(active *and* inactive)
	Service connection density:				22	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 7 82.0 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$1.77	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$182.43	$/acre-ft	$59,617	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Alta
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	4	121.250	Acre-ft/Yr	n	g	8		percent	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA
	WATER SUPPLIED:				121.250	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

		n	g					
BMAC	Billed Metered:	n	g	9	78.650	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	4	4.678	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.197	Acre-ft/Yr	0.25%	default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 83.525 Acre-ft/Yr

WATER LOSSES

37.725 Acre-ft/Yr

Apparent Losses

choose entry option:

		n	g							
SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	3.022	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.197	Acre-ft/Yr	0.25%	default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 3.220 Acre-ft/Yr

Real Losses

Real Losses: 34.505 Acre-ft/Yr

WATER LOSSES: 37.725 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 42.600 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	8.0	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	393		(active *and* inactive)
	Service connection density:				49	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp		n	g	10			

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP	Average Operating Pressure:	n	g	6	109.0	psi	

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$2.03	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$250,042	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Applegate
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

		n	g				choose entry option:			
VOS	Volume from Own Sources:	n	g	4	20.530	Acre-ft/Yr	n g 8		percent	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr				WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr				WEEA
	WATER SUPPLIED:				20.530	Acre-ft/Yr				

AUTHORIZED CONSUMPTION

							choose entry option:		
BMAC	Billed Metered:	n	g	9	19.540	Acre-ft/Yr			
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr			
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr			
UUAC	Unbilled Unmetered:	n	g	3	0.049	Acre-ft/Yr	0.25%	default	

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 19.589 Acre-ft/Yr

WATER LOSSES

0.941 Acre-ft/Yr

Apparent Losses

							choose entry option:			
SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	0.709	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.049	Acre-ft/Yr	0.25%	default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.759 Acre-ft/Yr

Real Losses

Real Losses: 0.183 Acre-ft/Yr

WATER LOSSES: 0.941 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 0.990 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	1.6	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	69		(active *and* inactive)
	Service connection density:				44	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP	Average Operating Pressure:	n	g	6	82.0	psi	

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$2.00	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$42,337	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Auburn/Bowman
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

VOS	Volume from Own Sources:	n	g	4	5,097.411	Acre-ft/Yr	n	g	8	volume 303.985	acre-ft/yr	under-registration VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	3	44.884	Acre-ft/Yr	n	g		percent		WEEA
	WATER SUPPLIED:				5,356.512	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	5,013.900	Acre-ft/Yr			
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr			
UMAC	Unbilled Metered:	n	g	4	84.773	Acre-ft/Yr			
UUAC	Unbilled Unmetered:	n	g	3	12.535	Acre-ft/Yr	0.25%	default	

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 5,111.208 Acre-ft/Yr

WATER LOSSES

245.304 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr	
CMI	Customer Metering Inaccuracies:	n	g	3	184.926	Acre-ft/Yr	3.50%	percent			under-registration
UC	Unauthorized Consumption:	n	g	3	12.535	Acre-ft/Yr	0.25%	default			

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 197.462 Acre-ft/Yr

Real Losses

Real Losses: 47.842 Acre-ft/Yr

WATER LOSSES: 245.304 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 342.612 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	176.1	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	9,031		(active *and* inactive)
	Service connection density:				51	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP	Average Operating Pressure:	n	g	6	90.0	psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$2.02	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$11,046,197	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Bianchi
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g									
VOS	Volume from Own Sources:	n	g	n/a		Acre-ft/Yr						VOSEA
WI	Water Imported:	n	g	3	27.020	Acre-ft/Yr	n	g	5	volume 1.086	acre-ft/yr	under-registration WIEA
WE	Water Exported:	n	g	n/a		Acre-ft/Yr						WEEA

WATER SUPPLIED: 28.106 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

		n	g					
BMAC	Billed Metered:	n	g	9	26.810	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.067	Acre-ft/Yr	0.25%	default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 26.877 Acre-ft/Yr

WATER LOSSES

1.229 Acre-ft/Yr

Apparent Losses

choose entry option:

		n	g						
SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr	custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	0.271	Acre-ft/Yr	1.00%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.067	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.339 Acre-ft/Yr

Real Losses

Real Losses: 0.890 Acre-ft/Yr

WATER LOSSES: 1.229 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1.296 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	1.3	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	43		(active *and* inactive)
	Service connection density:				34	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp		n	g	10	

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP	Average Operating Pressure:	n	g	6	78.0	psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$2.18	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$57,959	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Water Imported (WI)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Colfax
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	4	469.250	Acre-ft/Yr	n	g	8		percent	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA
	WATER SUPPLIED:				469.250	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	339.550	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.849	Acre-ft/Yr	0.25%	default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 340.399 Acre-ft/Yr

WATER LOSSES

128.851 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	12.315	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.849	Acre-ft/Yr	0.25%	default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 13.165 Acre-ft/Yr

Real Losses

Real Losses: 115.686 Acre-ft/Yr

WATER LOSSES: 128.851 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 129.700 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	20.8	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	1,004		(active *and* inactive)
	Service connection density:				48	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP	Average Operating Pressure:	n	g	6	78.0	psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$1.96	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$967,687	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Foothill/Sunset
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

		n	g				n	g		choose entry option:		
VOS	Volume from Own Sources:	n	g	4	31,115.526	Acre-ft/Yr	n	g	8		percent	VOSEA
WI	Water Imported:	n	g	3	1,099.784	Acre-ft/Yr	n	g	4		percent	WIEA
WE	Water Exported:	n	g	3	12,329.522	Acre-ft/Yr	n	g	4		percent	WEEA

WATER SUPPLIED: 19,885.788 Acre-ft/Yr

AUTHORIZED CONSUMPTION

		n	g				choose entry option:	
BMAC	Billed Metered:	n	g	9	18,677.250	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	4	54.470	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	46.693	Acre-ft/Yr	0.25%	default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 18,778.413 Acre-ft/Yr

WATER LOSSES

1,107.375 Acre-ft/Yr

Apparent Losses

		n	g				choose entry option:			
SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr	custom	0.001	acre-ft/yr	
CMI	Customer Metering Inaccuracies:	n	g	3	679.389	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	46.693	Acre-ft/Yr	0.25%	default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 726.083 Acre-ft/Yr

Real Losses

Real Losses: 381.292 Acre-ft/Yr

WATER LOSSES: 1,107.375 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1,208.538 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	484.2	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	28,978		(active *and* inactive)
	Service connection density:				60	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

		n	g			
AOP	Average Operating Pressure:	n	g	6	78.0	psi

COST DATA

		n	g				Total Annual Operating Cost	
CRUC	Customer Retail Unit Charge:	n	g	9	$2.03	$/100 cubic feet (ccf)		
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$41,008,462	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Water Exported (WE)
3: Customer Metering Inaccuracies (CMI)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Monte Vista
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	4	26.354	Acre-ft/Yr	n	g	8		percent	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA

WATER SUPPLIED: 26.354 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	25.070	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	4	1.120	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.063	Acre-ft/Yr	0.25%	default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 26.253 Acre-ft/Yr

WATER LOSSES

0.101 Acre-ft/Yr

Apparent Losses

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr		custom	0.001	acre-ft/yr
CMI	Customer Metering Inaccuracies:	n	g	3	0.265	Acre-ft/Yr	1.00%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.063	Acre-ft/Yr	0.25%	default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.328 Acre-ft/Yr

Check input values; APPARENT LOSSES should be less than WATER LOSSES

Real Losses

Real Losses: -0.227 Acre-ft/Yr

WATER LOSSES: 0.101 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1.284 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	0.9	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	19		(active *and* inactive)
	Service connection density:				22	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n | g | 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP	Average Operating Pressure:	n	g	6	82.0	psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$2.12	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$54,347	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Weimar
Audit Year: 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	4	405.940	Acre-ft/Yr	n	g	8		percent	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	3	104.992	Acre-ft/Yr	n	g	3		percent	WEEA
	WATER SUPPLIED:				300.948	Acre-ft/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

		n	g							
BMAC	Billed Metered:	n	g	9	216.891	Acre-ft/Yr				
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr				
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr				
UUAC	Unbilled Unmetered:	n	g	8	3.508	Acre-ft/Yr	custom	3.508	acre-ft/yr	
	AUTHORIZED CONSUMPTION:				220.399	Acre-ft/Yr				

WATER LOSSES

80.549 Acre-ft/Yr

Apparent Losses

choose entry option:

		n	g							
SDHE	Systematic Data Handling Errors:	n	g	6	0.001	Acre-ft/Yr	custom	0.001	acre-ft/yr	
CMI	Customer Metering Inaccuracies:	n	g	3	7.867	Acre-ft/Yr	3.50%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	0.542	Acre-ft/Yr	0.25%	default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 8.410 Acre-ft/Yr

Real Losses

Real Losses: 72.139 Acre-ft/Yr

WATER LOSSES: 80.549 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 84.057 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	19.9	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	621		(active *and* inactive)
	Service connection density:				31	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

		n	g			
AOP	Average Operating Pressure:	n	g	5	106.0	psi

COST DATA

		n	g				
CRUC	Customer Retail Unit Charge:	n	g	9	$1.56	$/100 cubic feet (ccf)	Total Annual Operating Cost
VPC	Variable Production Cost:	n	g	9	$196.27	$/acre-ft	$620,615 $/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Water Exported (WE)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Alta
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

WATER SUPPLIED

Water Supplied Error Adjustments
choose entry option:

VOS	Volume from Own Sources:	n	g	4	142.019	Acre-ft/Yr	n g 8	volume	0.000	acre-ft/yr	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr					WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr					WEEA
	WATER SUPPLIED:				142.019	Acre-ft/Yr					

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	104.063	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	4	5.273	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.260	Acre-ft/Yr	0.25%	Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 109.596 Acre-ft/Yr

WATER LOSSES

32.422 Acre-ft/Yr

Apparent Losses

choose entry option:

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

SDHE	Systematic Data Handling Errors:	n	g	3	0.260	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	3	3.966	Acre-ft/Yr	3.50%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.260	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 4.486 Acre-ft/Yr

Real Losses

Real Losses: 27.936 Acre-ft/Yr

WATER LOSSES: 32.422 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 37.956 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	9.8	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	405		(active *and* inactive)
	Service connection density:				41	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 5 109.0 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$2.19	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$335,727	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses^:		gal/conn/day
Unit Real Losses^:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0
American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Applegate
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g			
VOS	Volume from Own Sources:	n	g	1	24.562	Acre-ft/Yr	n	g	8	volume 0.000	acre-ft/yr
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr					
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr					

WATER SUPPLIED: 24.562 Acre-ft/Yr

AUTHORIZED CONSUMPTION

		n	g				
BMAC	Billed Metered:	n	g	9	21.465	Acre-ft/Yr	
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr	
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr	choose entry option:
UUAC	Unbilled Unmetered:	n	g	3	0.054	Acre-ft/Yr	0.25% Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 21.519 Acre-ft/Yr

WATER LOSSES

3.043 Acre-ft/Yr

Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

		n	g				choose entry option:		
SDHE	Systematic Data Handling Errors:	n	g	3	0.054	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	3	0.779	Acre-ft/Yr	3.50%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.054	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.886 Acre-ft/Yr

Real Losses

Real Losses: 2.157 Acre-ft/Yr

WATER LOSSES: 3.043 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 3.096 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	1.6	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	71		(active *and* inactive)
	Service connection density:				45	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

		n	g			
AOP	Average Operating Pressure:	n	g	5	82.0	psi

COST DATA

		n	g					
CRUC	Customer Retail Unit Charge:	n	g	9	$2.22	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$58,063	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier II (26-50). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[P]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Auburn Bowman
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g					
VOS	Volume from Own Sources:	n	g	4	5,383.082	Acre-ft/Yr	n	g	10	volume	1.423	acre-ft/yr	over-registration VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr							WIEA
WE	Water Exported:	n	g	3	3.446	Acre-ft/Yr	n	g	4			acre-ft/yr	WEEA

WATER SUPPLIED: 5,378.212 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

		n	g					
BMAC	Billed Metered:	n	g	9	5,105.611	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	4	29.599	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	12.764	Acre-ft/Yr	0.25%	Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 5,147.974 Acre-ft/Yr

WATER LOSSES

230.238 Acre-ft/Yr

Apparent Losses

choose entry option:

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

		n	g						
SDHE	Systematic Data Handling Errors:	n	g	3	12.764	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	3	186.251	Acre-ft/Yr	3.50%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	12.764	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 211.779 Acre-ft/Yr

Real Losses

Real Losses: 18.459 Acre-ft/Yr

WATER LOSSES: 230.238 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 272.601 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	174.7	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	9,349		(active *and* inactive)
	Service connection density:				54	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 5 90.0 psi

COST DATA

		n	g					
CRUC	Customer Retail Unit Charge:	n	g	9	$2.13	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$12,713,893	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Bianchi
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

WATER SUPPLIED

Water Supplied Error Adjustments
choose entry option:

VOS	Volume from Own Sources:	n	g	n/a	0.000	Acre-ft/Yr				VOSEA
WI	Water Imported:	n	g	3	29.921	Acre-ft/Yr	n g 4	volume 1.098	acre-ft/yr	under-registration WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr				WEEA
	WATER SUPPLIED:				31.019	Acre-ft/Yr				

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	9	29.731	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.074	Acre-ft/Yr	0.25% Default	

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 29.805 Acre-ft/Yr

WATER LOSSES

1.214 Acre-ft/Yr

Apparent Losses

choose entry option:

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

SDHE	Systematic Data Handling Errors:	n	g	3	0.074	Acre-ft/Yr	0.25% default	
CMI	Customer Metering Inaccuracies:	n	g	3	0.300	Acre-ft/Yr	1.00% percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.074	Acre-ft/Yr	0.25% default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.449 Acre-ft/Yr

Real Losses

Real Losses: 0.765 Acre-ft/Yr

WATER LOSSES: 1.214 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1.288 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	10	1.3	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	43		(active *and* inactive)
	Service connection density:				34	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP: Average Operating Pressure: n g 5 — 78.0 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$2.37	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$73,327	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Water Imported (WI)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses^:		gal/conn/day
Unit Real Losses^:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Colfax
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	4	512.055	Acre-ft/Yr	n	g	10	volume 0.348	acre-ft/yr	over-registration VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr						WEEA

WATER SUPPLIED: 511.707 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

		n	g					
BMAC	Billed Metered:	n	g	9	350.024	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.875	Acre-ft/Yr	0.25%	Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 350.899 Acre-ft/Yr

WATER LOSSES

160.808 Acre-ft/Yr

Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

		n	g						
SDHE	Systematic Data Handling Errors:	n	g	3	0.875	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	3	12.695	Acre-ft/Yr	3.50%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.875	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 14.445 Acre-ft/Yr

Real Losses

Real Losses: 146.363 Acre-ft/Yr

WATER LOSSES: 160.808 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 161.683 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	20.7	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	1,051		(active *and* inactive)
	Service connection density:				51	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP: Average Operating Pressure: n g 5 — 78.0 psi

COST DATA

		n	g					
CRUC	Customer Retail Unit Charge:	n	g	9	$2.12	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$1,209,656	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Foothill Sunset
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g					
VOS	Volume from Own Sources:	n	g	4	33,196.442	Acre-ft/Yr	n	g	10	volume	1.221	acre-ft/yr	under-registration VOSEA
WI	Water Imported:	n	g	3	2,568.331	Acre-ft/Yr	n	g	4		0.000	acre-ft/yr	WIEA
WE	Water Exported:	n	g	3	13,163.102	Acre-ft/Yr	n	g	4			acre-ft/yr	WEEA

WATER SUPPLIED: 22,602.892 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

		n	g					
BMAC	Billed Metered:	n	g	9	20,495.499	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	4	43.845	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	51.239	Acre-ft/Yr	0.25%	Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 20,590.584 Acre-ft/Yr

WATER LOSSES

2,012.309 Acre-ft/Yr

Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

		n	g						
SDHE	Systematic Data Handling Errors:	n	g	3	51.239	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	3	744.950	Acre-ft/Yr	3.50%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	51.239	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 847.428 Acre-ft/Yr

Real Losses

Real Losses: 1,164.881 Acre-ft/Yr

WATER LOSSES: 2,012.309 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 2,107.393 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	485.0	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	29,531		(active *and* inactive)
	Service connection density:				61	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 5 78.0 psi

COST DATA

		n	g					
CRUC	Customer Retail Unit Charge:	n	g	9	$2.18	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$53,432,392	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Water Exported (WE)
3: Customer Metering Inaccuracies (CMI)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Monte Vista
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g			
VOS	Volume from Own Sources:	n	g	4	27.250	Acre-ft/Yr	n	g	8	volume 0.000	acre-ft/yr
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr					
WE	Water Exported:	n	g	n/a	0.000	Acre-ft/Yr					

VOSEA
WIEA
WEEA

WATER SUPPLIED: 27.250 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

		n	g					
BMAC	Billed Metered:	n	g	9	27.034	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	4	1.096	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.068	Acre-ft/Yr	0.25%	Default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 28.198 Acre-ft/Yr

Check input values; WATER SUPPLIED should be greater than AUTHORIZED CONSUMPTION

WATER LOSSES

-0.948 Acre-ft/Yr

Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

		n	g						
SDHE	Systematic Data Handling Errors:	n	g	3	0.068	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	3	0.284	Acre-ft/Yr	1.00%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.068	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 0.419 Acre-ft/Yr

Check input values; APPARENT LOSSES should be less than WATER LOSSES

Real Losses

Real Losses: -1.367 Acre-ft/Yr

WATER LOSSES: -0.948 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 0.216 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	0.9	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	20		(active *and* inactive)
	Service connection density:				23	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp — n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

		n	g			
AOP	Average Operating Pressure:	n	g	5	82.0	psi

COST DATA

		n	g					
CRUC	Customer Retail Unit Charge:	n	g	9	$2.34	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$64,418	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Number of Service Connections (Nc)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses[A]:		gal/conn/day
Unit Real Losses[B]:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
Copyright © 2020, All Rights Reserved.

Water Audit Report for: Placer County Water Agency Weimar
Audit Year: 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	4	441.084	Acre-ft/Yr	n	g	4	volume 0.000	acre-ft/yr	VOSEA
WI	Water Imported:	n	g	n/a	0.000	Acre-ft/Yr						WIEA
WE	Water Exported:	n	g	3	102.768	Acre-ft/Yr	n	g	4		acre-ft/yr	WEEA

WATER SUPPLIED: 338.316 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

		n	g					
BMAC	Billed Metered:	n	g	9	246.684	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	8	7.681	Acre-ft/Yr	Custom 7.681	acre-ft/yr

AUTHORIZED CONSUMPTION: 254.365 Acre-ft/Yr

WATER LOSSES

83.951 Acre-ft/Yr

Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

		n	g						
SDHE	Systematic Data Handling Errors:	n	g	3	0.617	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	3	8.947	Acre-ft/Yr	3.50%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.617	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 10.181 Acre-ft/Yr

Real Losses

Real Losses: 73.771 Acre-ft/Yr

WATER LOSSES: 83.951 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 91.632 Acre-ft/Yr

SYSTEM DATA

		n	g				
Lm	Length of mains:	n	g	10	21.5	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	621		(active *and* inactive)
	Service connection density:				29	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

		n	g			
AOP	Average Operating Pressure:	n	g	6	106.0	psi

COST DATA

		n	g					
CRUC	Customer Retail Unit Charge:	n	g	9	$2.19	$/100 cubic feet (ccf)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	9	$209.93	$/acre-ft	$799,767	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Water Exported (WE)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

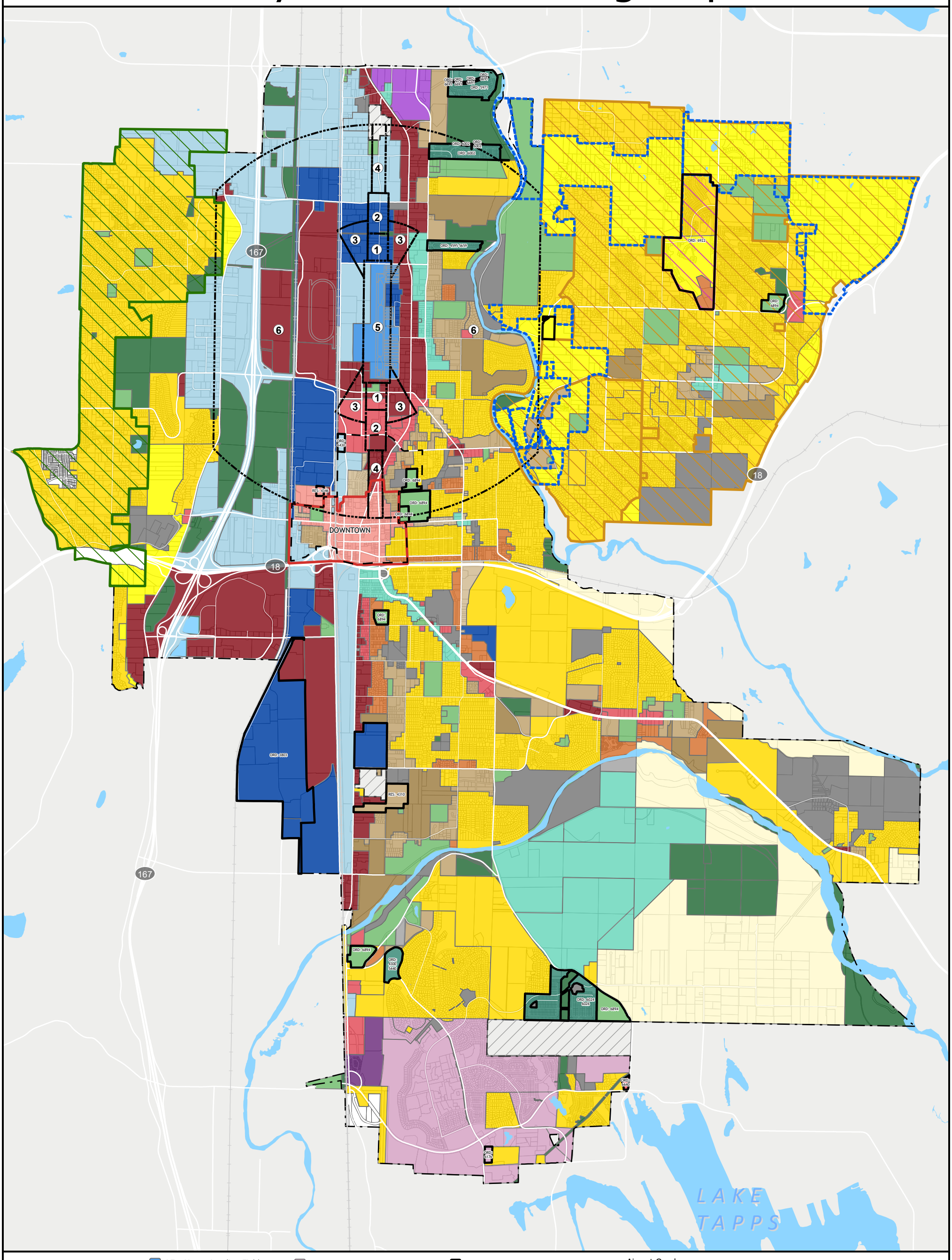
Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses^:		gal/conn/day
Unit Real Losses^:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

Appendix F Land Use Exhibits

F

City of Auburn Zoning Map



Zoning

- DOWNTOWN URBAN CENTER
- C-AG - AUBURN GATEWAY
- C-1 LIGHT COMMERCIAL
- C-2 HEAVY COMMERCIAL
- I - INSTITUTIONAL
- M-1 LIGHT INDUSTRIAL
- M-2 HEAVY INDUSTRIAL
- LF - Airport Landing Field
- OS - OPEN SPACE
- P-1 PUBLIC USE
- PLANNED UNIT DEVELOPMENT DISTRICT
- R1 RESIDENTIAL 1 DU/ACRE
- R2 - Residential Low
- R3 - Residential Moderate
- R4 - Residential High
- Lakeland Hills PUD
- R-MHC RESIDENTIAL MANUFACTURED/MOBILE HOME COMMUNITY
- R-NM NEIGHBORHOOD MIXED-USE
- RC RESIDENTIAL CONSERVANCY
- RF - Residential-Flex
- TERRACE VIEW DISTRICT
- UNCLASSIFIED USE DISTRICT

- Special Zoning Ordinances & Resolution
- Downtown Urban Center
- Expanded Downtown Urban Center
- Potential Annexation Areas
- Urban Separators Overlay
- Lea Hill Overlay (Ordinance: 5346 & 6121)
- Bridges Overlay (Ordinance: 6922)
- West Hill Overlay (Ordinance: 6122)

Airport Overlays

- Runway Overlay Zone 1
- Inner Safety Zone 2
- Inner Turning Zone 3
- Outer Safety Zone 4
- Sideline Safety Zone 5
- Airport Operations Zone 6

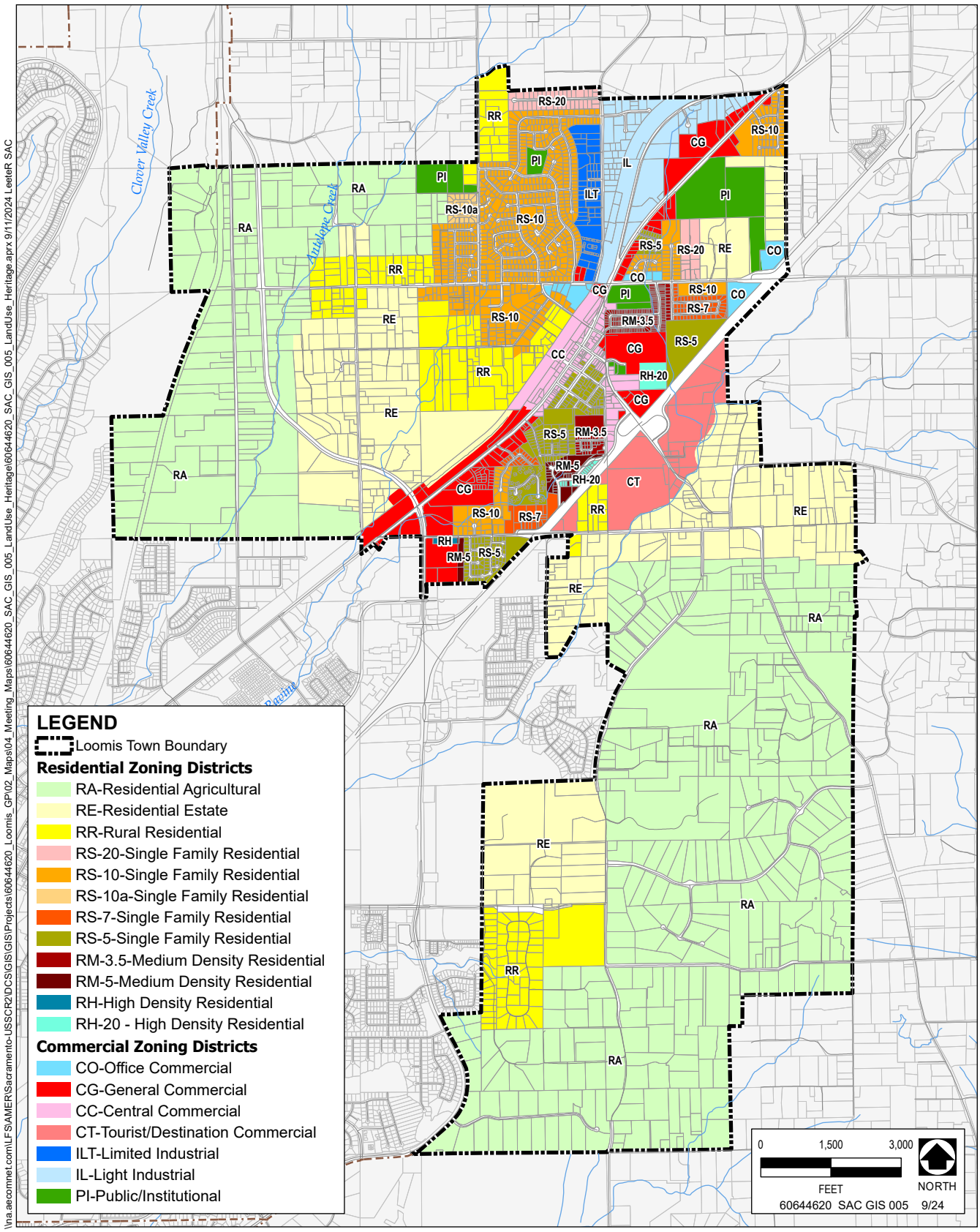
0 0.25 0.5 0.75 1
MILES

Updated On: 12/26/2024

Printed On: 1/2/2025

Map ID: 1016

Information shown is for general reference purposes only and does not necessarily represent exact geographic or cartographic data as mapped. The City of Auburn makes no warranty as to its accuracy.



LEGEND

Loomis Town Boundary

Residential Zoning Districts

- RA-Residential Agricultural
- RE-Residential Estate
- RR-Rural Residential
- RS-20-Single Family Residential
- RS-10-Single Family Residential
- RS-10a-Single Family Residential
- RS-7-Single Family Residential
- RS-5-Single Family Residential
- RM-3.5-Medium Density Residential
- RM-5-Medium Density Residential
- RH-High Density Residential
- RH-20 - High Density Residential

Commercial Zoning Districts

- CO-Office Commercial
- CG-General Commercial
- CC-Central Commercial
- CT-Tourist/Destination Commercial
- ILT-Limited Industrial
- IL-Light Industrial
- PI-Public/Institutional

\\na.aecomnet.com\LFS\AMER\Sacramento-USSCR2\DCS\GIS\GIS\Projects\60644620_Loomis_GP\02_Maps\04_Meeting_Maps\60644620_SAC_GIS_005_LandUse_Heritage\60644620_SAC_GIS_005_LandUse_Heritage aprx 9/11/2024 LeeteR SAC

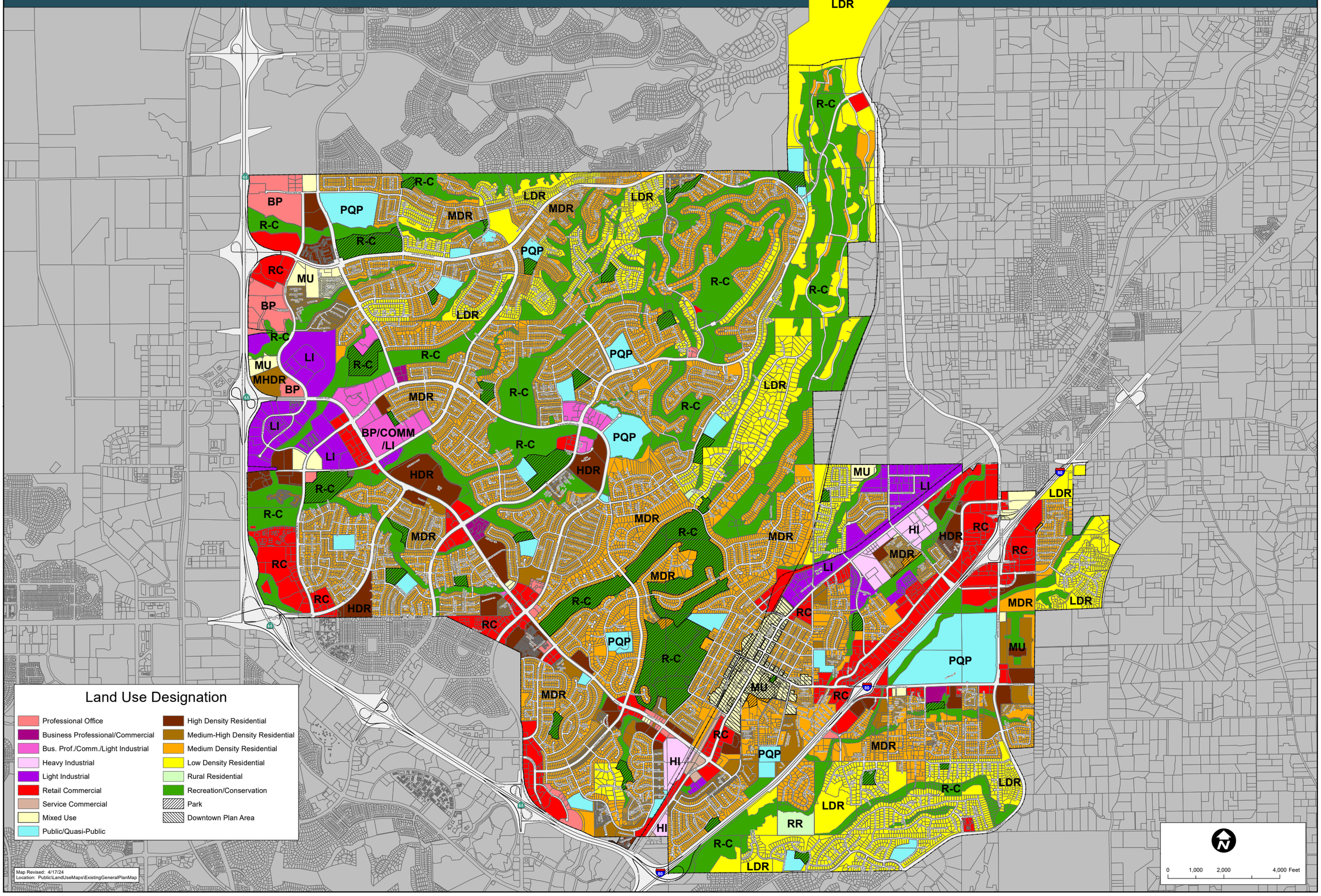
Source: Placer County 2024, AECOM 2024

Zoning Map

Town of Loomis

General Plan Land Use

ROCKLIN
CALIFORNIA



Land Use Designation

- Professional Office
- Business Professional/Commercial
- Bus. Prof./Comm./Light Industrial
- Heavy Industrial
- Light Industrial
- Retail Commercial
- Service Commercial
- Mixed Use
- Public/Quasi-Public
- High Density Residential
- Medium-High Density Residential
- Medium Density Residential
- Low Density Residential
- Rural Residential
- Recreation/Conservation
- Park
- Downtown Plan Area

Map Revised: 4/17/24
Location: Public\LandUseMaps\ExistingGeneralPlanMap

Appendix G North American Subbasin Groundwater Sustainability Plan 2021

G



NORTH AMERICAN SUBBASIN
Groundwater Sustainability Plan

PREPARED FOR:

RD1001 GSA
Sacramento Groundwater Authority GSA
South Sutter Water District GSA
Sutter County GSA
West Placer County GSA

DECEMBER 2021

This page left intentionally blank

North American Subbasin Groundwater Sustainability Plan

Prepared for:

Sacramento Groundwater Authority GSA
Reclamation District 1001 GSA
South Sutter Water District GSA
Sutter County GSA
West Placer GSA

Prepared by:

GEI Consultants
2868 Prospect Park Drive, Suite 400
Sacramento, CA 95670

December 2021

This page left intentionally blank

Table of Contents

Table of Contents i

Acronyms and Abbreviations x

Executive Summary 1

1. Introduction 1-1

2. Agency Information 2-1
- 2.1 GSA Organization and Management Structure 2-1
  - 2.1.1 Sacramento Groundwater Authority GSA 2-1
  - 2.1.2 RD 1001 GSA 2-3
  - 2.1.3 South Sutter Water District GSA 2-3
  - 2.1.4 Sutter County GSA 2-3
  - 2.1.5 West Placer GSA 2-3
- 2.2 Plan Manager Contact Information 2-4
- 2.3 Implementation Authority 2-4

3. Description of Plan Area 3-1
- 3.1 GSP Plan Area 3-1
- 3.2 Adjudicated Areas 3-1
- 3.3 Jurisdictional Areas 3-3
  - 3.3.1 Federal 3-3
  - 3.3.2 State of California 3-3
  - 3.3.3 California Native American Tribes 3-4
  - 3.3.4 County 3-6
  - 3.3.5 City 3-6
  - 3.3.6 Water Agencies 3-6
  - 3.3.7 Small Community Water Systems 3-7
  - 3.3.8 Agricultural Water Providers 3-9
  - 3.3.9 Reclamation Districts 3-9
- 3.4 Land Use Designations 3-9
- 3.5 Habitat Preserves and Easements 3-14
- 3.6 Disadvantaged Communities 3-14
- 3.7 Water Use Sectors 3-17
  - 3.7.1 Urban 3-17
  - 3.7.2 Domestic 3-17
  - 3.7.3 Agriculture 3-17
  - 3.7.4 Environmental 3-19
  - 3.7.5 Groundwater Remediation 3-19
- 3.8 Water Source Types 3-21
  - 3.8.1 Groundwater 3-21
  - 3.8.2 Surface Water Sources 3-23
  - 3.8.3 Recycled Water 3-24
  - 3.8.4 Water Reuse 3-28
- 3.9 Density of Wells 3-28
- 3.10 Existing Water Resources Management Plans 3-32
  - 3.10.1 Groundwater Management Plans 3-32
  - 3.10.2 Water Forum Agreement 3-32
  - 3.10.3 American River Basin Integrated Regional Water Management Plan 3-33

3.10.4 North Sacramento Valley Integrated Regional Water Management Plan 3-33
3.10.5 Urban Water Management Plans 3-34
3.10.6 Urban Water Use Efficiency Program 3-34
3.10.7 Agricultural Water Management Plans 3-35
3.10.8 Salt/Nutrient Management Plan 3-36
3.10.9 Water Quality Control Plan for the Sacramento River Basin 3-36
3.11 Existing Water Resources Monitoring Programs 3-37
3.11.1 Groundwater Level Monitoring Programs and Networks 3-37
3.11.2 Groundwater Quality Monitoring Programs and Network 3-40
3.11.3 Surface Water Monitoring Networks 3-42
3.11.4 Precipitation Monitoring Network 3-42
3.11.5 Subsidence Monitoring Network 3-44
3.12 Limits to Operational Flexibility 3-46
3.13 Conjunctive Use Programs 3-46
3.14 Land Use Plans 3-47
3.15 GSP Implementation Effects on Land Use 3-48
3.16 GSP Implementation Effects on Water Supply 3-48
3.16.1 Urban Water Supply 3-49
3.16.2 Agricultural Water Supply 3-49
3.16.3 Domestic Water Supply 3-49
3.16.4 Environmental Water Supply 3-49
3.17 Well Permitting 3-49
3.18 Land Use Plans Outside of the NASb 3-51

4. Hydrogeologic Setting 4-1
4.1 Basin Boundaries 4-1
4.2 Topography 4-3
4.3 Surface Water Bodies 4-3
4.4 Soils 4-5
4.5 Regional Geology 4-8
4.6 Geologic Structure 4-8
4.7 Fresh Water-Bearing Formations 4-9
4.7.1 Quaternary Alluvium 4-9
4.7.2 Modesto and Riverbank Formations 4-11
4.7.3 Turlock Lake and Laguna Formations 4-11
4.7.4 Mehrten Formation 4-11
4.8 Non-Water or Non-Fresh Water Bearing Formations 4-12
4.8.1 Valley Springs Formation 4-12
4.8.2 Ione Formation 4-12
4.8.3 Central Valley Formation 4-13
4.8.4 Basement Rocks 4-15
4.9 Regional Geologic Sections 4-15
4.9.1 Section A-A' 4-18
4.9.2 Section B-B' 4-21
4.9.3 Section C-C' 4-25
4.9.4 Geotechnical Investigations Sections 4-29
4.10 General Water Quality 4-31
4.11 Principal Aquifers 4-35
4.12 Groundwater Recharge and Discharge Areas 4-36
4.12.1 Recharge Areas Inside of the Subbasin 4-36
4.12.2 Recharge Areas Outside of the Subbasin 4-37
4.12.3 Groundwater Discharge Areas 4-37
4.13 Imported Water Supplies 4-39
4.14 Data Gaps 4-39

5. Groundwater Conditions 5-1

5.1 General 5-1
5.2 Groundwater Levels 5-2
5.2.1 Western Area 5-3
5.2.2 Central Area 5-9
5.2.3 Eastern Area 5-9
5.3 Historic Groundwater Contours 5-10
5.4 Current Groundwater Contours 5-17
5.5 Hydraulic Gradients Between Aquifers 5-20
5.6 Hydraulic Gradients Between Fresh and Non-Fresh Water Formations 5-22
5.7 Change in Groundwater Storage 5-22
5.8 Groundwater Quality 5-24
5.8.1 Occurrence of Commonly Evaluated Constituents in Groundwater 5-24
5.8.2 Groundwater Quality Trends 5-35
5.8.3 Groundwater Contamination Sites and Plumes 5-45
5.9 Seawater Intrusion 5-47
5.10 Land Subsidence 5-48
5.11 Interconnected Surface Water 5-57
5.12 Groundwater-Dependent Ecosystems 5-61
5.13 Data Gaps 5-65

6. Water Budgets 6-1
6.1 Water Budget Information 6-1
6.2 Identification of Hydrologic Periods 6-2
6.3 Usage of the CoSANA Model and Associated Data in Water Budget Development 6-4
6.4 Water Budget Definitions and Assumptions 6-4
6.4.1 Historical Water Budget 6-5
6.4.2 Current Water Budget 6-5
6.4.3 Projected Water Budget 6-6
6.4.4 Water Budget Estimates 6-7
6.5 Historical Water Budget 6-15
6.6 Current Water Budget 6-19
6.7 Projected Water Budget 6-22
6.8 Projected Water Budget with Climate Change 6-26
6.9 Sustainable Yield Estimate 6-29

7. Monitoring Networks 7-1
7.1 Objectives 7-1
7.2 Monitoring Network 7-2
7.3 Representative Monitoring Network 7-8
7.4 Chronic Lowering of Groundwater Levels 7-13
7.4.1 GDE Representative Monitoring Network 7-13
7.4.2 Domestic Well Representative Monitoring Network 7-14
7.4.3 Groundwater Only Area Representative Monitoring Network 7-14
7.4.4 Groundwater Level Monitoring Frequency 7-21
7.4.5 Groundwater Level Monitoring Spatial Density 7-22
7.4.6 Data Gaps 7-22
7.5 Reduction in Groundwater Storage 7-22
7.6 Seawater Intrusion 7-23
7.7 Groundwater Quality 7-23
7.7.1 Monitoring Network 7-24
7.7.2 Representative Monitoring Wells 7-27
7.7.3 Groundwater Quality Monitoring Frequency 7-31
7.7.4 Groundwater Quality Monitoring Spatial Density 7-31
7.7.5 Data Gaps 7-32
7.8 Land Subsidence 7-32
7.8.1 Land Subsidence Monitoring Network 7-32

7.8.2 Representative Monitoring Locations 7-32
7.8.3 Land Subsidence Monitoring Frequency 7-36
7.8.4 Land Subsidence Monitoring Spatial Density 7-36
7.8.5 Data Gaps 7-37
7.9 Surface Water Depletion 7-37
7.9.1 Monitoring Network 7-37
7.9.2 Surface Water Representative Monitoring Locations 7-37
7.9.3 Monitoring Frequency 7-42
7.10 Groundwater Well Monitoring Spatial Density 7-42
7.10.1 Data Gaps 7-42
7.11 Monitoring Protocols 7-42
7.11.1 Groundwater Levels 7-42
7.11.2 Water Quality 7-45
7.12 Data Reporting 7-47
7.13 Monitoring Network Improvements 7-47

8. Sustainable Management Criteria 8-1
8.1 Sustainability Goal 8-1
8.1.1 Supporting Sustainability Goal Information 8-2
8.2 Process of Developing SMC 8-4
8.3 Sustainability Indicators 8-8
8.3.1 NASb SMC Approach - Sustainability Indicator Grouping 8-8
8.4 Sustainability Indicator #1 - Chronic Lowering of Groundwater Levels 8-9
8.4.1 Undesirable Results – Chronic Lowering of Groundwater Levels 8-9
8.4.2 Minimum Thresholds - Chronic Lowering of Groundwater Levels 8-11
8.4.3 Measurable Objectives – Chronic Lowering of Groundwater Levels 8-21
8.5 Sustainability Indicator #2 - Reduction of Storage 8-24
8.5.1 Undesirable Results – Reduction of Storage 8-25
8.5.2 Minimum Thresholds – Reduction of Storage 8-25
8.5.3 Measurable Objectives – Reduction of Storage 8-26
8.6 Sustainability Indicator #3 - Seawater Intrusion 8-26
8.7 Sustainability Indicator #4 - Degraded Water Quality 8-26
8.7.2 Minimum Thresholds – Degraded Water Quality 8-29
8.7.3 Measurable Objectives – Degraded Water Quality 8-32
8.8 Sustainability Indicator #5 - Land Subsidence 8-34
8.8.1 Undesirable Results – Land Subsidence 8-34
8.8.2 Minimum Thresholds – Land Subsidence 8-35
8.8.3 Measurable Objectives – Land Subsidence 8-39
8.9 Sustainability Indicator #6 - Depletion of Surface Water 8-39
8.9.1 Undesirable Results – Depletion of Surface Water 8-43
8.9.2 Minimum Thresholds – Depletion of Surface Water 8-44
8.9.3 Measurable Objectives – Depletion of Surface Water 8-47

9. Projects and Management Actions 9-1
9.1 Current Groundwater Management Activities 9-1
9.2 Projects and Management Actions 9-2
9.2.1 Project #1 - Regional Conjunctive Use Expansion – Phase 1 9-2
9.2.2 Project #2 - Natomas Cross Canal Stability Berm and Channel Habitat Enhancements Project 9-7
9.2.3 Management Action #1 - Complete Planning for Sacramento Regional Water Bank 9-10
9.2.4 Management Action #2 - Explore Improvements with NASb Well Permitting Programs 9-12
9.2.5 Management Action #3 - Proactive Coordination with Land Use Agencies 9-13
9.2.6 Management Action #4 - Domestic/Shallow Well – Data Collection and Communication Program 9-15

9.2.7 Management Action #5 - GDE Assessment Program 9-16
9.3 Supplemental Projects 9-17

10. Plan Implementation 10-1
10.1 Plan Implementation Staffing 10-1
10.2 Implementation Costs and Funding 10-1
10.3 Implementation Activities 10-2

11. Notice and Communications 11-1
11.1 Public Engagement and Active Involvement 11-1
11.2 Groundwater Beneficial Uses and Users 11-2
11.2.1 Agriculture 11-3
11.2.2 Non-municipal Domestic Well Users 11-6
11.2.3 Small Water Systems 11-7
11.2.4 Environmental Users of Groundwater 11-7
11.2.5 Disadvantaged Communities 11-8
11.2.6 Tribes 11-9
11.3 List of Public Meetings 11-9
11.3.1 Draft GSP 11-10
11.3.2 GSP Hearings and Adoption 11-11
11.4 GSP Comments and Responses 11-11
11.5 Interbasin Communications and Agreements 11-13
11.6 GSAs Decision Making Process 11-14
11.6.1 GSA Formation 11-15
11.6.2 GSP Initial Notification 11-15
11.6.3 GSP Adoption and Submittal to DWR 11-15
11.6.4 GSP Review and Evaluation 11-16
11.6.5 GSP Implementation MOA 11-16
11.7 Informing the Public During GSP Implementation 11-16

12. References 12-1

List of Figures

Figure ES-1. North American Subbasin, GSAs and Adjacent Subbasins 2
Figure ES-2. Water Use Sectors 4
Figure ES-3. Geologic Section 5
Figure 1-1. North American Subbasin 1-3
Figure 2-1. GSP Plan Area and GSAs 2-2
Figure 3-1. Area Covered by GSP 3-2
Figure 3-2. City, County, State, and Federal Jurisdictional Areas and Lands. 3-5
Figure 3-3. Water Districts and Systems Areas 3-8
Figure 3-4. Reclamation Districts Jurisdictional Areas 3-10
Figure 3-5. Existing Land Use Designations 3-12
Figure 3-6. Planned Development Areas and Planned Water Source Types 3-13
Figure 3-7. Habitat Conservation Preserves and Easements 3-15
Figure 3-8. Disadvantaged and Severely Disadvantaged Communities 3-16
Figure 3-9. Water Use Sectors 3-18
Figure 3-10. Natural Communities Commonly Associated with Groundwater 3-20
Figure 3-11. Water Source Types 3-22
Figure 3-12. Wastewater Treatment Plants 3-27
Figure 3-13. Density of Domestic Wells Per Square Mile 3-29
Figure 3-14. Density of Production Wells Per Square Mile 3-30
Figure 3-15. Density of Municipal Wells Per Square Mile 3-31
Figure 3-16. Groundwater Level Monitoring Network 3-39
Figure 3-17. Groundwater Quality Monitoring Network 3-41

Figure 3-18. River Gages and Precipitation Stations 3-43
Figure 3-20. Subsidence Monitoring Network 3-45
Figure 4-1. Base of Fresh Water 4-2
Figure 4-2. Topography 4-4
Figure 4-3. Hydrologic Soils Classification 4-6
Figure 4-4. SAGBI Soils 4-7
Figure 4-5. Surface Geology 4-10
Figure 4-6. Natural Gas Wells 4-14
Figure 4-7. Geologic Section Locations 4-16
Figure 4-8. Stream Channel Deposits 4-17
Figure 4-9. Geologic Section A-A' 4-19
Figure 4-10. Geologic Section B-B' 4-23
Figure 4-11. Geologic Section C-C' 4-27
Figure 4-12. Detailed Geologic Sections - Slurry Cut Off Walls 4-30
Figure 4-13. General Water Quality Types and Distribution 4-32
Figure 4-14. General Water Quality Types 4-33
Figure 4-15. Recharge and Discharge Areas 4-38
Figure 5-1. Groundwater Level Monitoring Wells 5-4
Figure 5-2. Depth to Groundwater – Spring 2019 5-5
Figure 5-3. Representative Groundwater Level Hydrographs 5-7
Figure 5-4. Groundwater Contours – Early 1900s 5-13
Figure 5-5. Groundwater Contours – 1970 through 2004 5-15
Figure 5-6. Groundwater Contours – Spring 2019 5-18
Figure 5-7. Groundwater Contours – Fall 2019 5-19
Figure 5-8. Vertical Gradients Upper to Lower Portions of the Aquifer – Fall 2019 5-21
Figure 5-9. Annual and Cumulative Change in Storage 5-23
Figure 5-10. Distribution of TDS Concentrations 5-26
Figure 5-11. Distribution of Nitrate as Nitrogen Concentrations 5-27
Figure 5-12. Distribution of Arsenic Concentrations 5-28
Figure 5-13. Distribution of Boron Concentrations 5-29
Figure 5-14. Distribution of Iron Concentrations 5-30
Figure 5-15. Distribution of Manganese Concentrations 5-31
Figure 5-16. Distribution of Hexavalent Chromium Concentrations 5-32
Figure 5-17. TDS Trends 5-38
Figure 5-18. Nitrate as Nitrogen Trends 5-39
Figure 5-19. Arsenic Trends 5-40
Figure 5-20. Boron Trends 5-41
Figure 5-21. Iron Trends 5-42
Figure 5-22. Manganese Trend 5-43
Figure 5-23. Hexavalent Chromium Trend 5-44
Figure 5-24. Groundwater Contamination Sites and Plumes 5-46
Figure 5-25. Land Subsidence and Groundwater Level Decline Correlation 5-51
Figure 5-26. Extensometer versus Groundwater Levels 5-52
Figure 5-27. CGPS Station LCN1 versus Groundwater Levels 5-53
Figure 5-28. CGPS Station LCN2 versus Groundwater Levels 5-54
Figure 5-29. Benchmark Differences 2008-2017 (in Feet) 5-55
Figure 5-30. InSAR Subsidence 2015-2020 (in Feet) 5-56
Figure 5-31. Interconnected Surface Water 5-59
Figure 5-32. Likely Groundwater Dependent Ecosystems 5-62
Figure 5-33. Rankings of Likely and Less Likely GDE Areas 5-63
Figure 5-34. Occurrence of Quercus Lobata (Valley Oak) 5-64
Figure 6-1. Generalized Water Budget Diagram 6-2
Figure 6-2. 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation in the North American Groundwater Basin 6-3
Figure 6-3. Historical Average Annual Water Budget – Stream and Canal Systems, North American Subbasin 6-16

Figure 6-4. Historical Average Annual Water Budget – Land Surface System, North American Subbasin 6-17
Figure 6-5. Historical Average Annual Water Budget – Groundwater System, North American Subbasin 6-18
Figure 6-6. Average Annual Current Water Budget – Stream and Canal Systems, North American Subbasin 6-20
Figure 6-7. Average Annual Current Water Budget – Land Surface System, North American Subbasin 6-21
Figure 6-8. Average Annual Current Water Budget – Groundwater System, North American Subbasin 6-22
Figure 6-9. Average Annual Projected Water Budget – Stream and Canal Systems, North American Subbasin 6-23
Figure 6-10. Average Annual Projected Water Budget – Land Surface System, North American Subbasin 6-24
Figure 6-11. Average Annual Projected Water Budget – Groundwater System, North American Subbasin 6-26
Figure 6-12. Average Annual Projected with Climate Change Water Budget – Stream and Canal Systems, North American Subbasin 6-27
Figure 6-13. Average Annual Projected with Climate Change Water Budget – Land Surface System, North American Subbasin 6-28
Figure 6-14. Average Annual Projected with Climate Change Water Budget – Groundwater System, North American Subbasin 6-29
Figure 7-1. Groundwater Level Monitoring Network Wells 7-4
Figure 7-2. Representative Groundwater Level Monitoring Wells 7-9
Figure 7-3. Representative Groundwater Level Monitoring Wells for GDEs 7-15
Figure 7-4. Representative Monitoring Wells Selection for Domestic Wells 7-16
Figure 7-5. Depth to Domestic Well Top of Screens and Representative Monitoring Wells 7-17
Figure 7-6. Comparison of Domestic Well Minimum Depths to Agricultural and Municipal Well Depths 7-18
Figure 7-7. Representative Monitoring Wells for Areas Solely Dependent on Groundwater 7-19
Figure 7-8. Representative Monitoring Wells for Chronic Lowering of Groundwater 7-20
Figure 7-9. Sentry Monitoring Well Network 7-26
Figure 7-10. Shallow Aquifer Water Quality Representative Monitoring Wells 7-29
Figure 7-11. Deep Aquifer Groundwater Quality Representative Monitoring Network 7-30
Figure 7-12. Land Subsidence Monitoring Network 7-34
Figure 7-13. Land Subsidence Representative Monitoring Network 7-35
Figure 7-14 Surface Water Depletion Monitoring Network 7-39
Figure 8-1. Processing of Sustainability Indicators 8-3
Figure 8-2. Depiction of Key SGMA Compliance Elements 8-5
Figure 8-3. NASb Applicable Sustainability Indicators 8-6
Figure 8-4. MO and MT Relationship 8-7
Figure 8-5. Projected Groundwater Elevation Changes at RMS Locations 8-13
Figure 8-6. Projected Groundwater Elevation MTs at RMS Locations 8-16
Figure 8-7. Projected Groundwater Elevation MOs at RMS Locations 8-22
Figure 8-7. Projected Long-Term Average Annual Water Budget Change along the Sacramento River 8-41
Figure 9-1. Groundwater Level Hydrographs, PMA Scenario and Associated Baselines 9-6
Figure 9-2. Cumulative Storage Change for the PMA Scenarios and Associated Baselines 9-7

List of Tables

Table ES-1. Estimated Groundwater Change in Storage 7
Table ES-2. NASb Undesirable Results 9
Table 3-1. Land Use Summary 3-11
Table 3-2. Well Type Summary 3-21
Table 3-4. Water Supply Sources 3-26
Table 3-5. Groundwater Management Plans 3-32
Table 4-1. Criteria Evaluated for Two Principal Aquifers 4-36
Table 5-1. Groundwater Gradients Toward the Central Area 5-17

Table 5-2. Summary of Annual Extraction and Change in Storage 5-23
Table 5-3. General Water Quality Summary 5-33
Table 5-4. Water Quality Trend Summary 5-37
Table 6-1. Current Water Budget Conditions Summary 6-6
Table 6-2. Projected Water Budget Conditions Summary 6-6
Table 6-3. Summary of Groundwater Budget Assumptions 6-7
Table 6-4. Average Annual Water Budget – American River (AFY) 6-10
Table 6-5. Average Annual Water Budget – Bear River (AFY) 6-10
Table 6-6. Average Annual Water Budget – Sacramento River (AFY) 6-11
Table 6-7. Average Annual Water Budget – Feather River (AFY) 6-11
Table 6-8. Average Annual Water Budget – Composite of All Major Rivers (AFY) 6-12
Table 6-9. Total Inflows to the Subbasin 6-12
Table 6-10. Average Annual Water Budget – Land Surface System, North American Subbasin (AFY) 6-13
Table 6-11. Average Annual Water Budget – Groundwater System, North American Subbasin (AFY) 6-14
Table 6-12. Average Annual Values for Key Components of Water Budget by Year Type (AFY) 6-19
Table 7-1. Summary of Groundwater Level Well Types 7-3
Table 7-2. Groundwater Level Monitoring Well Types and Distribution 7-5
Table 7-3. Representative Groundwater Level Monitoring Wells 7-11
Table 7-4. Sentry Monitoring Wells 7-25
Table 7-5. Shallow Aquifer Water Quality Representative Monitoring Wells 7-28
Table 7-6. Land Subsidence Representative Monitoring Wells 7-36
Table 7-7. Surface Water Gaging Stations 7-40
Table 7-8. Paired Monitoring Wells and Gages for Gradients 7-41
Table 8-1. Chronic Lowering of Groundwater Level Minimum Thresholds 8-15
Table 8-2. Groundwater Flow with Neighboring Subbasins 8-19
Table 8-3. Chronic Lowering of Groundwater Level Measurable Objectives and Interim Milestones 8-23
Table 8-4. Projected Groundwater Change in Storage 8-24
Table 8-5. Measurable Objective (Public Supply Well – Average Nitrate and TDS Concentrations) 8-33
Table 8-6. Measurable Objective (Domestic/Self-supplied – RMS Nitrate and TDS Concentrations) 8-33
Table 8-7. Minimum Thresholds for Land Subsidence RMS 8-36
Table 8-8. Seepage Changes in Interconnected Surface Waters that Support Critical Aquatic Species 8-42
Table 8-9. MTs, MOs, and Interim Milestones for Depletion of Surface Water 8-45
Table 9-1. CoSANA Regional Conjunctive Use Scenario Specifications 9-5
Table 9-2. Supplemental Projects 9-18
Table 10-1. Five-year Budget and Funding Sources 10-2
Table 10-2. Summary of Implementation Actions 10-3
Table 11-1. Beneficial Uses and Users 11-5

List of Appendices

Appendix A: Implementation MOA
Appendix B: Domestic Well Assessment
Appendix C: Monitoring Construction Details
Appendix D: Geologic Section Well Logs
Appendix E: Levee Geologic Sections
Appendix F: Assessment of Assessment of Principal Aquifers
Appendix G: Western Area Hydrographs
Appendix H: Central Well Hydrographs
Appendix I: Eastern Area Hydrographs
Appendix J: Vertical Gradients
Appendix K: Ione Well Hydrographs
Appendix L: Summary of Water Quality Detections
Appendix M: Water Quality Trend Analysis Results
Appendix N: Surface Water Interactions
Appendix O: GDE Analysis

Appendix P: Groundwater Model Documentation
Appendix Q: SMC Hydrographs
Appendix R: List of Public Meetings
Appendix S: Public Comments
Appendix T: Interbasin Coordination Communications

Acronyms and Abbreviations

Act (or SGMA)	Sustainable Groundwater Management Act
AB	Assembly Bill
AFB	Air Force Base
AF	acre-feet
AFY	acre-feet per year
APN	assessor parcel number
As	arsenic
ASR	Aquifer Storage and Recovery
AWMP	Agricultural Water Management Plan
Basin Plan	Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin
bgs	below ground surface
BMP	Best Management Practice
CASGEM	California Statewide Groundwater Elevation Monitoring
CCBL	Current Conditions Baseline
CCR	California Code of Regulations
CDEC	California Data Exchange Center
CEQA	California Environmental Quality Act
CFWID	Camp Far West Irrigation District
cfs	cubic feet per second
CGPS	continuous global positioning stations
CrVI	hexavalent chromium
CoSANA	Cosumnes-South American-North American groundwater model
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DAC	Disadvantaged Community
DDW	Division of Drinking Water
DMS	data management system
DWR	California Department of Water Resources
EC	electrical conductivity
EPA	U.S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
Fe	iron
Ft	feet
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	groundwater dependent ecosystem
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
ILRP	Irrigated Lands Regulatory Program
InSAR	interferometric synthetic aperture radar
IRWMP	Integrated Regional Water Management Program
JPA	Joint Powers Authority
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
Mn	manganese
M&I	municipal and industrial
MO	measurable objective

MOA	Memorandum of Agreement
msl	mean sea level
MT	minimum threshold
MW	monitoring well
N	nitrogen
NASb or Subbasin	North American Subbasin
NAVD88	North American Vertical Datum of 1988
NAWQA	National Water-Quality Assessment Program
NBCHCP	Natomas Basin Conservancy Habitat Conservation Plan
NCC	Natomas Cross Canal
NCCAG	Natural Communities Commonly Associated with Groundwater
NDMA	N-Nitrosodimethylamine
NDVI	Normalized Difference Vegetation Index
NEPA	National Environmental Policy Act
NID	Nevada Irrigation District
NM	no measurement code
NULE	Non-Urban Levee Evaluation
NMWC	Natomas Mutual Water Company
NWIS	National Water Information System
OWHD	Omochumne-Hartnell Water District
PCBL	Projected Conditions Baseline
PCBL+CC	Projected Conditions Baseline with Climate Change
PCE	perchloroethylene
PCWA	Placer County Water Agency
PFAS	per- and poly-fluoroalkyl substances
Plan	Groundwater Sustainability Plan
PMA	Projects and Management Actions
PWS	public water system
RCIC	Regional Contamination Issues Committee
RD	Reclamation District
RD 1001	Reclamation District 1001
RP	reference point
RPWS	reference point to water surface
RMS	representative monitoring site
RWA	Regional Water Authority
RWRP	Regional Water Reliability Plan
SAFCA	Sacramento Area Flood Control Agency
SAFER	Safe and Affordable Fund for Equity and Resilience
SAGBI	Soil Agricultural Groundwater Banking Index
SASb	South American Subbasin
SB	Senate Bill
SB X7-7	Water Conservation Act of 2009
SCEHD	Sutter County Environmental Health Division
SCEMD	Sacramento County Environmental Management Department
SCWA	Sacramento County Water Agency
SDAC	Severely Disadvantaged Community
SGA	Sacramento Groundwater Authority
SGMA	Sustainable Groundwater Management Act
Sierra Nevada	Sierra Nevada Mountain range
SJWD	San Juan Water District
SMC	Sustainable Management Criteria

SMCL	Secondary Maximum Contaminant Level
SSWD	South Sutter Water District
State Water Board	California State Water Resources Control Board
Subbasin	North American Subbasin
SWRCB	State Water Resources Control Board
TCE	Trichloroethylene
TDS	total dissolved solids
TSS	Technical Support Services Program
U.S.	United States of America
UAIC	United Auburn Indian Community
USBR	United States Bureau of Reclamation
USGS	United States Geologic Survey
UWMP	Urban Water Management Plan
WAF	Water Accounting Framework
Water Code	California Water Code
WCR	well completion report
WD	Water District
WDR	Waste Discharge Requirements
WEP	Water Efficiency Program
WFA	Water Forum Agreement
WPGSA	West Placer Groundwater Sustainability Agency
WSCP	Water Shortage Contingency Plan
WWTP	wastewater treatment plant

Executive Summary

Overview

In 2014, the California Legislature passed the Sustainable Groundwater Management Act (SGMA), which became effective on January 1, 2015. SGMA requires local Groundwater Sustainability Agencies (GSAs) to develop Groundwater Sustainability Plans (GSPs) that, among other things, explain how the basin will be managed sustainably over a 20-year timeframe. SGMA provides authorities to support locally controlled sustainable management of groundwater – meaning in a way that does not produce undesirable results such as chronic lowering of groundwater levels, causing subsidence or degrading water quality.

The North American Subbasin (NASb or Subbasin) includes five GSAs that have worked cooperatively to develop this single GSP covering the 535 square-mile subbasin that includes portions of Placer, Sacramento, and Sutter counties. The GSAs include: Reclamation District 1001 (RD 1001) GSA; Sacramento Groundwater Authority (SGA) GSA; South Sutter Water District (SSWD) GSA; Sutter County GSA; and West Placer GSA.

SGMA requires certain information be included in every GSP. This includes, among other things, the subbasin setting, a hydrogeological conceptual model, a comprehensive water budget, a basin-wide monitoring network, sustainable management criteria, and projects and management actions necessary to ensure the Subbasin's sustainability. A summary of each of the primary NASb GSP sections is provided below.

ES 1 – Introduction

SGMA effectively prescribes four basic steps to the management process: 1) form a GSA; 2) develop and adopt a GSP; 3) implement the GSP to achieve a sustainability goal and avoid undesirable results within 20 years; and 4) report the implementation activities to DWR to document whether progress towards the sustainability goal and the avoidance of undesirable results are being achieved.

Ultimately, five GSAs were formed to manage groundwater in the NASb, completing Step 1. Figure ES-1 shows the location of the Subbasin and the GSAs. This GSP and adoption by each GSA will complete Step 2. The GSP will be assessed every 5 years as additional information becomes available. Steps 3 and 4 will be implemented over the next 20 years.

The NASb is bounded by four adjacent subbasins. Figure ES-1 shows the location of the NASb along with the adjacent subbasin names and locations. The NASb is closely coordinating with these subbasins.

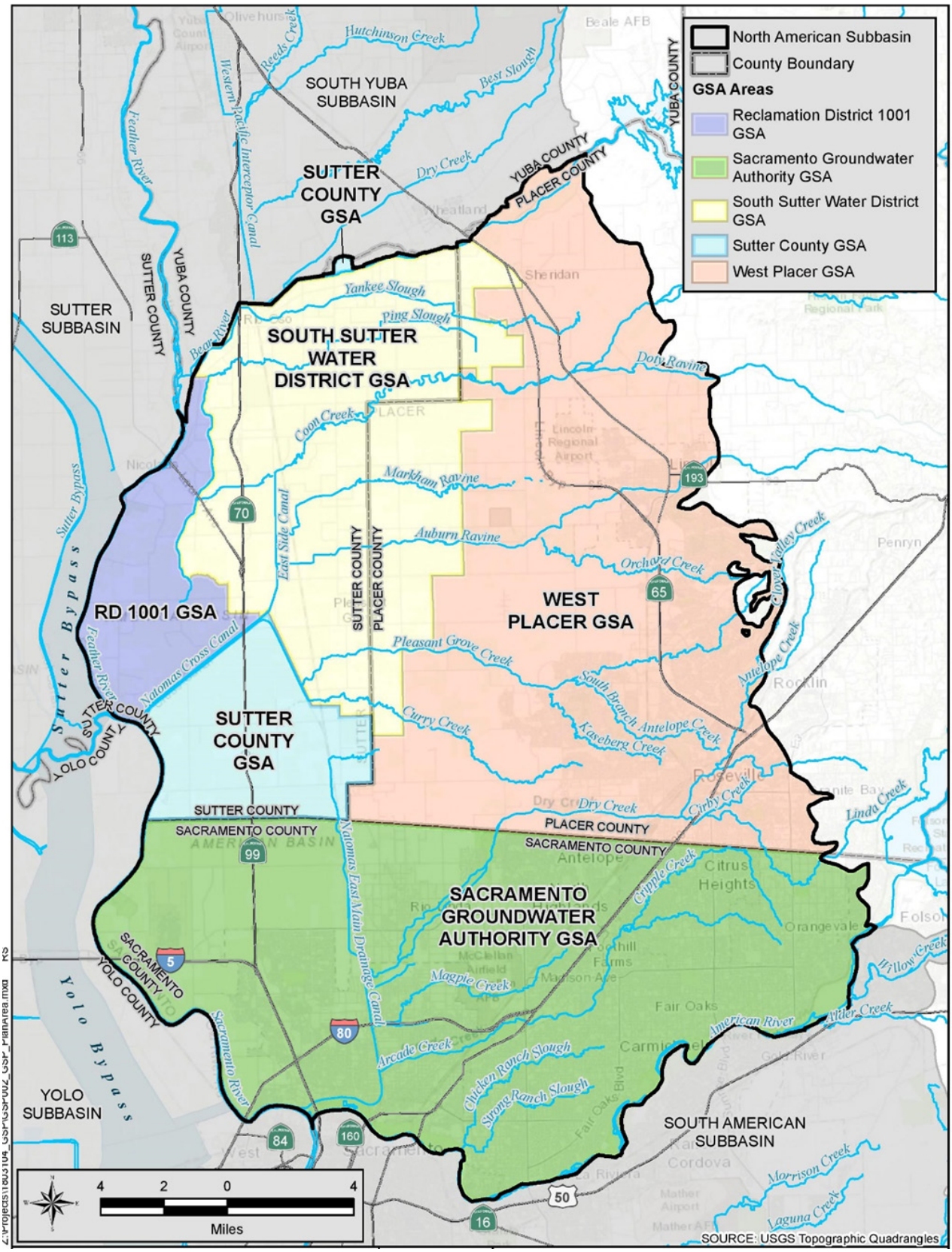


Figure ES-1. North American Subbasin, GSAs and Adjacent Subbasins

ES 2 – Agency Information

The five GSAs, by mutual agreement, selected the SGA GSA to be the Plan manager and lead agency for the preparation and implementation of the NASb GSP. The GSAs have entered into a Memorandum of Agreement (MOA) for the implementation of this GSP, which includes monitoring and reporting in the Subbasin along with projects and management actions.

ES 3 – Plan Area

The NASb encompasses about 342,000 acres in Sutter, Placer, and Sacramento counties and is bounded by the American, Bear, Feather, and Sacramento rivers. The Sierra Nevada foothills form the eastern boundary of the Subbasin. The NASb is about 40 percent urban, 30 percent farmland (mostly in Placer and Sutter counties), and less than 1 percent riparian vegetation. About 30 percent of the land is either native vegetation or fallowed farmland that could not be fully characterized. Most of the urban area is in Sacramento County and the southeastern portion of Placer County. Currently, the NASb has about 16,900 acres of habitat conservation preserves and easements, of which about 1,700 acres is riparian habitat. Figure ES-2 shows the general locations of these water use sectors.

Within the NASb, there are federal, state, county, and tribal agencies with land use jurisdiction. Within Placer and Sacramento counties, there are 20 water agencies, water districts, city/county water departments and water wholesalers that provide water to residents in the cities and towns. There are also over 40 small community water and non-community non-transient water systems, that are overseen by the counties and the state, whose water supply is from groundwater. Irrigation districts are also present that provide surface water for agriculture. Within many of the irrigation districts and cities are reclamation districts that are responsible for managing and maintaining the levees, freshwater channels, or sloughs, canals, pumps, and other flood protection structures in the area.

Surface water is available to most areas of the Subbasin and is supplemented with groundwater. There are about 3,800 water supply wells present in the Subbasin (about 2,600 domestic, 800 agricultural, 400 municipal and industrial wells).

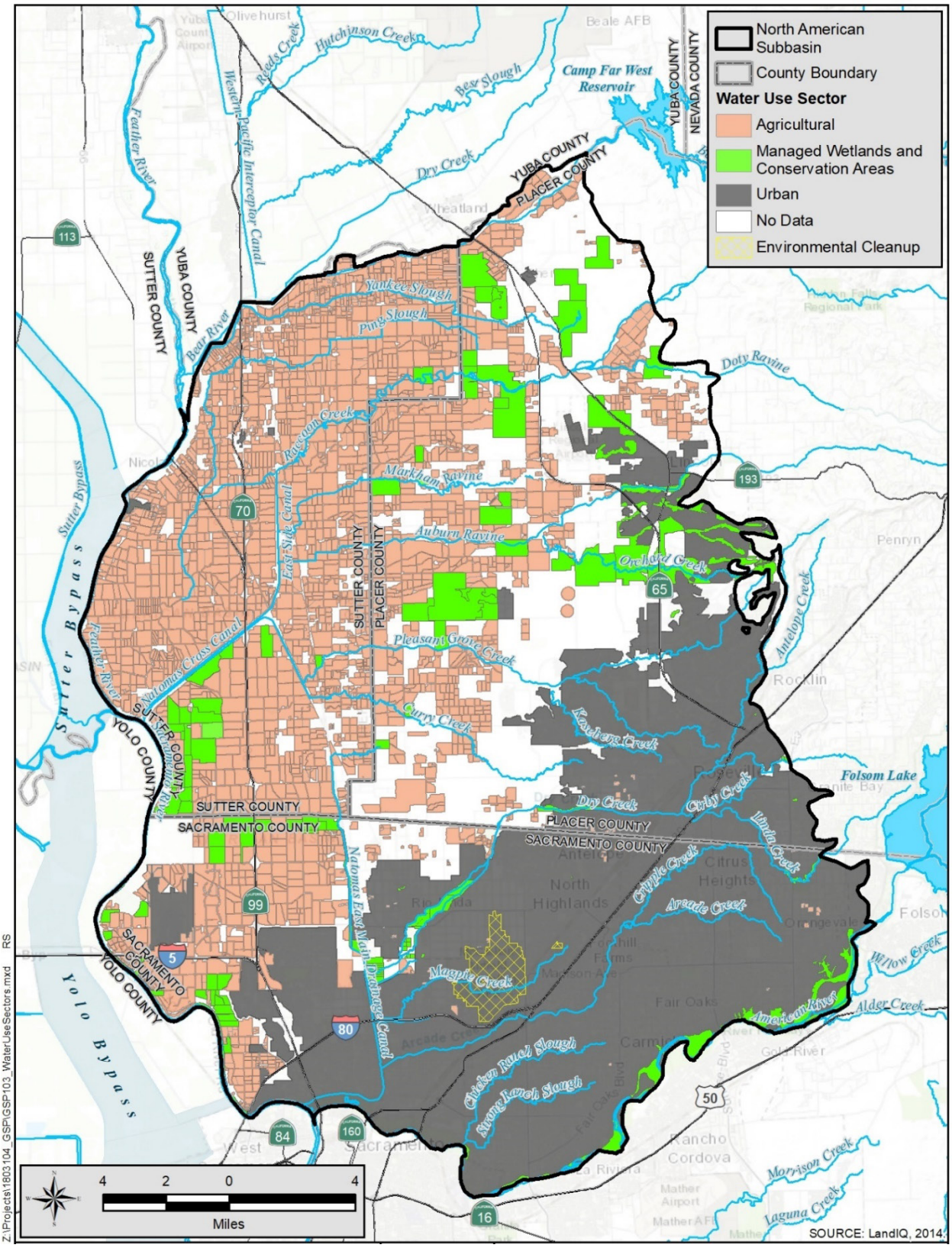


Figure ES-2. Water Use Sectors

ES 4 – Hydrogeologic Setting

The NASb is in the Sacramento Valley and is filled largely with sediments derived from the adjacent Sierra Nevada foothills, which contain fresh water. In general, these fresh-water bearing sediments beneath the NASb are thinnest to the east and thicken up to 2,000 feet to the west (see Figure ES-3). The sediments consist of alternating layers of clays, silts, sand and gravel. The sand and gravels layers into which wells are constructed are referred to as aquifers. These sand and gravel layers were deposited by meandering rivers and creeks, so they are not continuous across the entire Subbasin. Although the sediments are not present as continuous layers, they are interconnected. This was demonstrated by observing that groundwater levels in the various sand and gravel layers have similar levels and trends. Based on this information, the NASb is interpreted as having one principal aquifer.

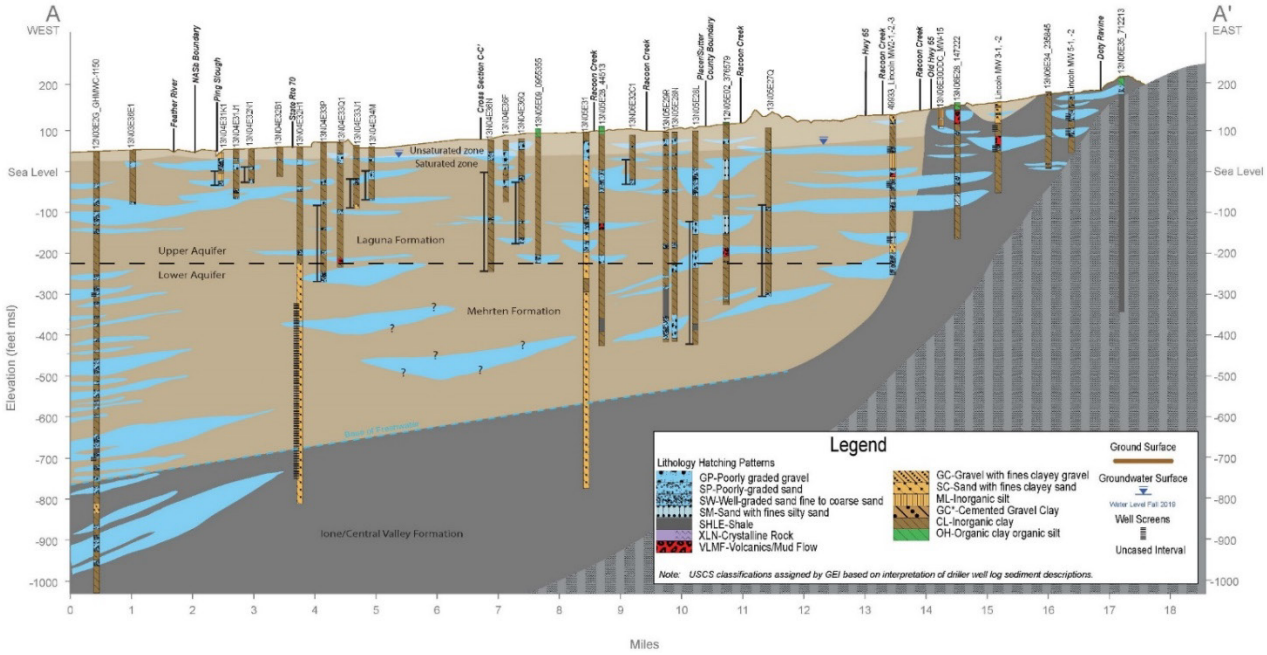


Figure ES-3. Geologic Section

Groundwater is recharged from throughout the surface of the Subbasin and from groundwater inflow from adjacent subbasins. No geologic sediments are impermeable, so some recharge occurs in all areas that are not covered by impermeable surfaces (such as asphalt or concrete). This is particularly important in agricultural areas where, even though there are low permeability soils, there are more than one hundred thousand acres of land that have applied or ponded water throughout the growing season, which results in large volumes of recharge to the Subbasin.

ES 5 – Groundwater Conditions

Groundwater levels in the western portion of the Subbasin are generally stable through time dating back to early in the 20th century. Groundwater levels in the central part of the Subbasin showed long-term declines in the north-central portion until the mid-1960s and in the south-central portion until the mid-1990s, when conjunctive use programs arrested these declines and allowed groundwater levels to begin to recover. Groundwater levels in the eastern portion of the subbasin have been generally stable since the 1970s, but they do show declines during dry periods with recovery during wet periods.

The groundwater contours show a pumping depression in the center of the Subbasin that is currently about 30 feet below mean sea level. Groundwater flows radially toward this depression, from the fringes of the Subbasin toward the center. The depression has been stabilized, with groundwater levels generally declining during dry periods and recovering during wet periods.

Limited land subsidence due to groundwater pumping was documented up to the early 1990s, but there were no documented impacts associated with the subsidence. Since then, the subsidence has been negligible.

Areas with surface water that is interconnected with groundwater were identified along portions of the American, Bear, Feather, and Sacramento rivers, along with creeks primarily in the western part of the Subbasin.

Potential groundwater dependent ecosystems (GDEs) identified in the natural communities commonly associated with groundwater dataset were evaluated using groundwater levels and the types of vegetation to classify them as *Likely*, *Less Likely* or *Unlikely* GDEs. Classifications of the species types and diversity of vegetation were used to further prioritize these areas. In many cases, GDEs were identified along canals and natural waterways that are used to convey surface water to agricultural users. In some cases, GDEs were identified in areas that could be supported by groundwater, but it appears their primary source of supply is groundwater pumped from wells.

Generally, the quality of groundwater in the Subbasin is suitable for nearly all uses, with the exception of contamination plumes and localized, naturally-occurring and human-caused quality issues, which may affect the supply, beneficial uses, and potential management of groundwater in the Subbasin if not properly managed. Total dissolved solids (TDS) and nitrate were identified as constituents that represent general conditions in the Subbasin, with some wells displaying upward trends. Nitrate is below the drinking water standards for all wells in the Subbasin. TDS exceeds the drinking water standards in some wells, predominantly in the western and eastern portions of the Subbasin. The higher salinity concentrations are generally considered to be present due to natural sources.

In the NASb, there are a few large groundwater contamination sites and multiple smaller sites that could affect supply and beneficial uses of groundwater in the Subbasin. The most significant

of these sites are the former McClellan Air Force Base (AFB) and the Aerojet Superfund Site (outside of the Subbasin). Cleanup activities, as overseen by U.S. Environmental Protection Agency, SWRCB, and the California Department of Toxic Substances Control, have been in progress for years and contaminants appear to be contained. SGA and interested water agencies meet with regulators on a quarterly basis to discuss the plumes' containment and how groundwater management activities may affect the remediation.

ES 6 – Water Budgets

Water budgets were created utilizing the Cosumnes-South American-North American (CoSANA) model, a fully integrated surface and groundwater numerical flow model that covers the entire NASb as well as the adjacent South American and the Cosumnes subbasins. CoSANA integrates the groundwater aquifer with the surface hydrologic system and land surface processes and operations. CoSANA was used to preform analyses of hydrogeologic conditions, agricultural and urban water demands, agricultural and urban water supplies and an evaluation of current and projected future regional conditions, including climate change, for the NASb. Because the model is integrated with the adjacent subbasins to the south, future projected conditions, along with climate change and projects, were assessed for the entire region.

The water budget for current conditions in the NASb showed the Subbasin has a current surplus of water, which was confirmed by groundwater levels rising in the central portions of the Subbasin. This surplus continues into the future, but in lesser amounts. The future conditions modeling included planned new developments, along with changes in agriculture and projected changes in water supply. When the future conditions were modeled with a central tendency climate change scenario, the Subbasin has an estimated future deficit of about 3,500 acre-feet per year. Table ES-1 shows the average annual estimated change in groundwater storage under each of these conditions.

Table ES-1. Estimated Groundwater Change in Storage

Model Baseline Condition	Average Annual Groundwater Storage Change (acre-feet)
Historical (water years 2009 through 2018)	31,900
Current (water years 1970 through 2019)	14,900
Projected Future Demands over 50 years (using 1970 through 2019 hydrology)	5,400
Projected Future Demands over 50 years with Climate Change (using 1970 through 2019 hydrology)	-3,500

ES 7 – Monitoring Networks

Groundwater levels and water quality are currently being monitored by the GSAs, local agencies, counties, DWR and federal entities in over 160 wells, not including those present near contamination sites. Representative monitoring wells were selected from this larger network that

are spatially distributed, actively being monitored, and have construction details to prove which portion of the aquifer they are monitoring. A total of 41 representative monitoring wells for groundwater levels (to monitor for chronic lowering of groundwater levels, reduction of storage, the potential for subsidence, and surface water depletion) were selected. The monitoring locations were developed to protect beneficial uses and users including, domestic well owners, GDEs and interconnected surface water.

Separate representative groundwater quality monitoring networks were developed. Sixteen shallow groundwater monitoring wells were selected to monitor water quality in the shallow portions of the aquifer in areas that are used by domestic well owners. The deeper portions of the aquifer, commonly used by public water systems, will be monitored by over 200 public supply wells that are required to monitor and report the analyses to state agencies.

There are instances of poorer water quality along the westerly and eastern edges of the Subbasin, so a separate sentry well monitoring network was developed to track the potential movement of these waters into the Subbasin. This sentry well network is not designated as being representative monitoring wells where minimum thresholds and measurable objectives would have been established.

ES 8 – Sustainable Management Criteria (SMC)

The NASb sustainability goal is to:

> *Manage groundwater resources sustainably for beneficial uses and users to support the lasting health of the Subbasin's community, economy, and environment. This will be achieved through:*
>
> - *The monitoring and management of established SMC;*
> - *Continued expansion of conjunctive management of groundwater and surface water;*
> - *Proactively working with local well permitting and land use planning agencies on effective groundwater policies and practices;*
> - *Continued GSA coordination and stakeholder engagement; and*
> - *Continued improvement of our understanding of the Subbasin.*

Undesirable results, minimum thresholds, and measurable objectives were developed for five of the six SGMA sustainability indicators: chronic lowering of groundwater levels, reduction of storage, land subsidence, degradation of water quality, and surface water depletion. Seawater intrusion has not occurred in the past and is unlikely to occur in the future and, therefore, sustainability criteria were not established for this sustainability indicator. As allowed under SGMA, the NASb uses groundwater elevations as a proxy for minimum thresholds and measurable objectives for its applicable sustainability indicators, with the exception of degradation of water quality. Undesirable results are summarized in Table ES-2 below.

Table ES-2. NASb Undesirable Results

Sustainability Indicator	Undesirable Result Definition
Chronic lowering of groundwater levels	*20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41 wells)*
Reduction of storage	*20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41 wells)*
Degraded groundwater quality	For public water system wells • *The basin wide average TDS concentrations of all public water system wells exceeds 400 mg/l* *OR* • *The basin wide average nitrate (as N) concentration of all public water system wells exceeds 8 mg/l* For the shallow aquifer (i.e. domestic and self-supplied) wells • *25% of the representative monitoring sites' (RMS) TDS or nitrate (as N) concentrations exceed state maximum contaminant levels (MCLs)*
Land Subsidence	*The rate of inelastic subsidence exceeds 0.5 feet over a five-year period over an area covering approximately five or more square miles*
Depletion of surface water	*20% or more of the NASb interconnected surface water (ISW) representative monitoring sites (RMSs) have minimum threshold exceedances for 2 consecutive Fall measurements (5 out of 21)*

ES 9 – Projects and Management Actions

Because the water budget estimated that the Subbasin may be about 3,500 AFY in deficit with future demands and with climate change, the NASb evaluated a conjunctive use project that can resolve the deficit and has a net benefit of reducing groundwater pumping by 5,000 AFY. The project uses, for the most part, existing infrastructure, so project costs are minimal and are to be funded by the public water suppliers participating in the program.

A second planned project will make improve flood protection and habitat for aquatic species in the Natomas Cross Canal. As part of the continued water resources management of the NASb, six supplemental projects that are in the conceptual or planning level stages are also identified in the event projected conditions are worse than expected.

Five management actions are identified. The first management action is to continue development of the Sacramento Regional Water Bank, which will expand conjunctive use to further ensure basin sustainability. The second action is to explore potential revisions to Placer, Sacramento, and Sutter counties' and the City of Roseville's well permitting programs to assess whether the permitting ordinances can be improved to be more protective of domestic wells, GDEs and

interconnected surface water, along with reducing potential impacts to designated representative wells. The third action is to proactively coordinate with land use agencies on their development of plans and approvals of new developments, to improve communications with the agencies and inform them of findings of this GSP, annual report findings, and whether groundwater can be relied upon for future growth without causing undesirable results. The fourth action will improve data collection and communication with domestic and other shallow well owners to protect these beneficial users of groundwater in the NASb. The fifth action will continue monitoring and assessment of the NASb's GDEs to better understand these ecosystems to help protect them.

ES 10 – Plan Implementation

The NASb GSAs estimate a budget of $1.15 million over the next five years for monitoring, reporting, GSP assessment and update, data management, coordination, outreach, and management actions. The budget also includes a 20 percent contingency for unanticipated expenses. The GSAs have also identified a funding plan in an MOA for GSP implementation. The budget does not include estimates of the costs for conjunctive use or development of the Sacramento Regional Water Bank, which already have funding through individual participating agencies. The budget also does not include the value of the in-kind time being provided by the participating GSAs.

The GSP identifies 28 specific implementation actions with associated schedules, where applicable. These actions are organized into the following categories: monitoring; data management; data analysis; coordination and outreach; and other management activities.

ES 11 – Notice and Communications

The GSAs reached out to the public by developing a website (nasbgroundwater.org) and a list of more than 300 interested parties. The GSAs sought input from small community water systems by notifying them through direct mailer post cards. The GSAs developed informational materials and held over 40 public meetings (both at board and city councils and monthly technical committee meetings) and four NASb-wide public workshops.

The public had opportunities to comment directly on this GSP during releases of draft chapters, through workshops and on the Public Draft GSP. If a comment was specific to an individual section of the GSP, the GSP text was revised. General comments that raised substantial technical or policy issues may have resulted in changes to multiple GSP sections. Comments that were general in nature or that did not raise substantial issues were noted, but no changes were made. The GSAs plan to continue public outreach and stakeholder engagement through the GSP implementation phase through various activities, including an annual public meeting to release the results of the Annual Report and the status of projects and management actions.

1. Introduction

In 2014, the Sustainable Groundwater Management Act (SGMA) was signed by the Governor of the state of California, setting the framework for local agencies to sustainably manage California's groundwater basins. To avoid potential State intervention, SGMA requires groundwater basins/subbasins designated by the California Department of Water Resources (DWR) as medium- or high-priority to follow four basic steps: 1) form a Groundwater Sustainability Agency (GSA); 2) develop and adopt a Groundwater Sustainability Plan (GSP or Plan); 3) implement the Plan to achieve a sustainability goal and avoid undesirable results within 20 years; and 4) report the implementation activities to the DWR to document whether the sustainability goal and the avoidance of undesirable results is being achieved. Ultimately, five GSAs were formed to manage groundwater in the North American Subbasin (NASb or Subbasin), completing Step 1. This GSP and adoption by each GSA will complete Step 2. This GSP will be assessed every 5 years, with amendments as needed to ensure the Plan is meeting its sustainability goal.

This GSP is a framework to provide for the sustainability of the NASb of the Sacramento Valley Groundwater Basin for the next 20 years. The NASb, designated as subbasin No. 5-021.64 by the DWR, is bounded on the north by the Bear River, on the south by the American River, to the west by the Feather and Sacramento rivers, and on the east by the Sierra Nevada foothills (*see* **Figure 1-1**). The NASb was designated by DWR as a high priority subbasin and therefore the formation of GSAs and the completion of a GSP is required to avoid potential State Water Resources Control Board (SWRCB) intervention. Surrounding subbasins were also designated as medium- or high-priority and are required to comply with SGMA. Groundwater is a critical resource to the Subbasin's community, economy, and environment by providing an average of 280,000 acre-feet per year (AFY) for public and agricultural supply or just under 50 percent of total water supply.

Agencies in the NASb have been actively managing groundwater for decades and have achieved positive groundwater management results. Groundwater levels within the Subbasin have been relatively stable for decades and have shown the ability to recover after periods of prolonged pumping and droughts. The passage of SGMA created an opportunity for a cooperative endeavor to develop a single GSP for the entire NASb. Beginning in January 2017, representatives of local agencies began coordination meetings that ultimately led to agreement to form five GSAs to cover the entirety of the Subbasin, while ensuring broad representation of the various stakeholder interests throughout the parts of the three counties comprising the NASb.

This GSP is organized into the following sections:

> Section 1 – Introduction – Provides an overview of SGMA and associated requirements and introduces the contents of the Plan.

Section 2 – Agency Information – Provides a description of each GSA, contact information, implementation authority, and estimated costs for Plan implementation.

Section 3 – Plan Area – Describes the geography, historical and projected land uses, jurisdictional areas, water use sectors and water sources, existing water resources management plans, existing monitoring networks, and conjunctive use programs. The section also assesses the potential effects of implementing the Plan on water supplies.

Section 4 – Basin Setting – Describes the geologic conditions that control how groundwater moves in the Subbasin, recharge and discharge areas, general water quality, and principal aquifers.

Section 5 – Groundwater Conditions – Describes historical and current groundwater levels, changes in groundwater storage, water quality, subsidence, change in storage, and identification of interconnected surface water and groundwater dependent ecosystems.

Section 6 – Water Budgets – Provides a historical water budget and forecasts future groundwater use for the next 50-years to assess whether groundwater conditions will remain sustainable including the influence of climate change.

Section 7 – Monitoring Networks – Describes the monitoring networks to be used to assess sustainability indicators and monitoring protocols. Establishes an annual reporting mechanism to assess the management performance and for 5-year assessments of this GSP to maintain the Subbasin's sustainability.

Section 8 – Sustainable Management Criteria – Describes locally defined sustainability goals and undesirable results for the SGMA groundwater sustainability indicators. Establishes management criteria, the operating range in which groundwater levels will be maintained, in the form of minimum thresholds and measurable objectives.

Section 9 – Projects and Management Actions – Identifies current, planned, and supplemental projects and management actions to maintain groundwater sustainability.

Section 10 – Plan Implementation – Provides an overview of how the GSAs will regularly perform the activities needed to manage the Subbasin.

Section 11 – Notice and Communications – Provides a summary of GSA activities with interested parties.

Section 12 – References – List of materials used to develop this Plan.

This Plan was developed cooperatively by the GSAs in the NASb along with input from stakeholders and in coordination with the adjacent South Yuba, Sutter, Yolo, and South American subbasins.



Figure 1-1. North American Subbasin

This page intentionally left blank

2. Agency Information

This section provides a description of GSAs in the NASb and their legal authority to implement the GSP, along with contact information for the Plan manager. A cost estimate for implementing the GSP is provided along with a general description of how the GSAs plan to fund these expenses.

2.1 GSA Organization and Management Structure

Five agencies in the NASb filed with DWR to become GSAs to cover the entire NASb. DWR designated them as exclusive in 2016 and 2017. The five GSAs are listed below:

- Sacramento Groundwater Authority GSA
- Reclamation District 1001 (RD 1001) GSA
- South Sutter Water District (SSWD) GSA
- Sutter County GSA
- West Placer GSA

Figure 2-1 shows the areas covered by each GSA. All the GSAs have the legal authority to implement this GSP. A brief description of each GSA is provided below.

2.1.1 Sacramento Groundwater Authority GSA

The Sacramento Groundwater Authority (SGA) is a Joint Powers Authority formed in 1998 to manage the groundwater basin in Sacramento County north of the American River. In January 2016, SGA became the exclusive GSA in conformance with SGMA for its portion of the North American Subbasin.

The SGA draws its authority from a joint powers agreement executed by the cities of Citrus Heights, Folsom, and Sacramento and the county of Sacramento utilizing their common police powers. The signatories chose to manage the basin cooperatively by creating a governing board of directors comprised of representatives of 14 water agencies and other water users within their jurisdiction:

- California American Water
- Carmichael Water District
- Citrus Heights Water District
- City of Folsom
- City of Sacramento
- County of Sacramento
- Del Paso Manor Water District
- Fair Oaks Water District
- Golden State Water Company
- Natomas Central Mutual Water Company
- Orange Vale Water Company
- Rio Linda/Elverta Community Water District
- Sacramento Suburban Water District
- San Juan Water District
- Agricultural Representative
- Commercial/Industrial Self-supplied Representative

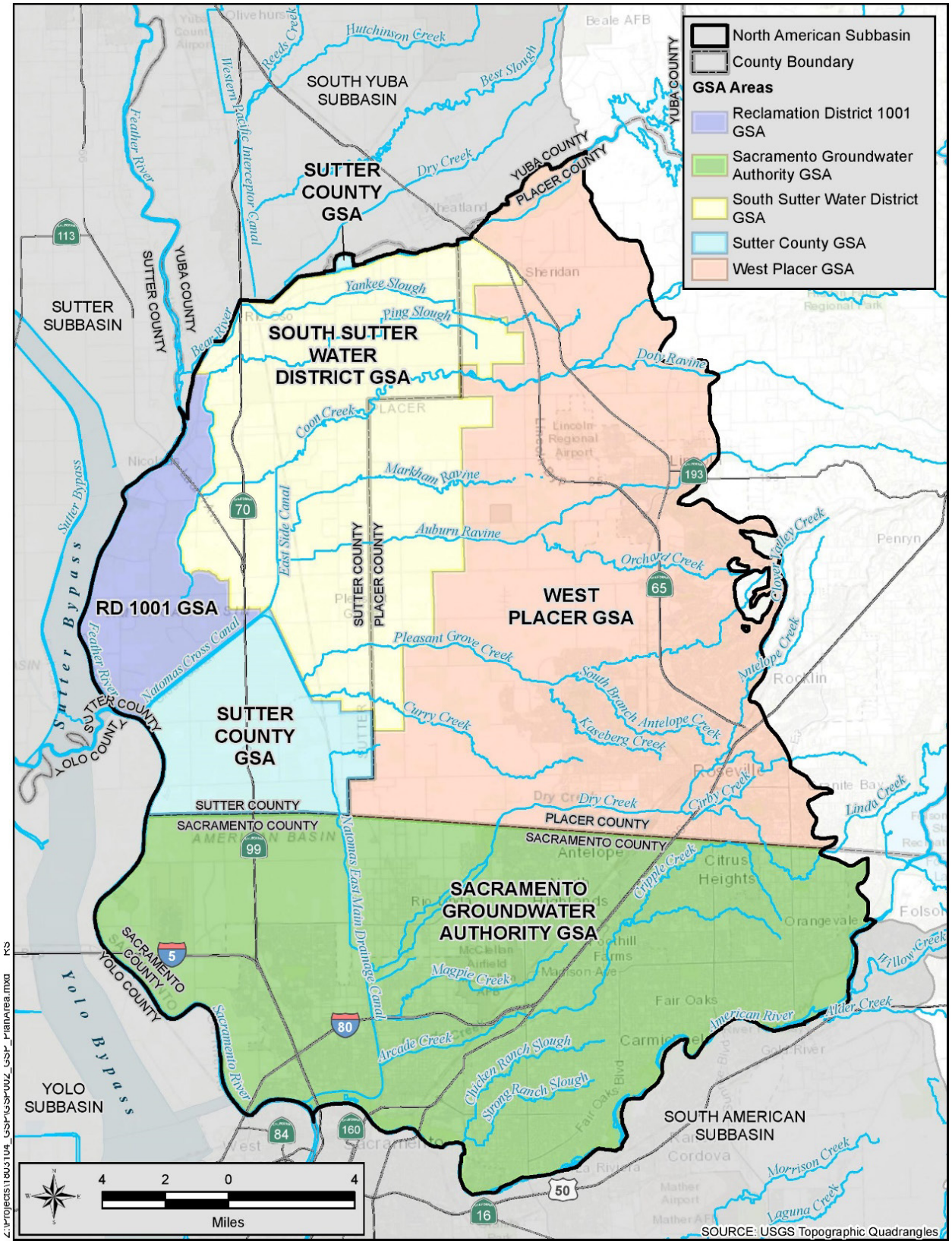


Figure 2-1. GSP Plan Area and GSAs

2.1.2 RD 1001 GSA

RD 1001 is a special-purpose district that provides flood protection for approximately 43,395 acres, including the communities of East Nicolaus, Nicolaus, Pleasant Grove, Rio Oso, Trowbridge, and Verona. The Reclamation District (RD) is governed by elected board members who own property or work on land in RD 1001.

RD 1001 is delegating certain activities regarding the implementation of SGMA to the Pleasant Grove-Verona Mutual Water Company, which is located within its service area, through a separate MOA.

2.1.3 South Sutter Water District GSA

SSWD is a California water district organized, existing, and operating under the provisions of the California Water District Law, California Water Code Section 34000 et seq., and is thus a local agency authorized to exercise powers related to groundwater management under California Water Code Section 10721. SSWD was established in May 1954 to develop, store, and distribute surface water to reverse the effects groundwater pumping was having on the declining groundwater levels. The SSWD GSA covers some area within Placer County that is in the SSWD boundary. Placer County and SSWD have signed a MOA describing the management of shared lands to ensure that all areas are managed appropriately.

2.1.4 Sutter County GSA

The Sutter County Board of Supervisors serves as the legislative body for Sutter County and provides policy direction for all branches of county government. The Board of Supervisors authorized the Development Services Department to submit the necessary documents to form the Sutter County GSA and oversee the preparation of the GSP and its implementation in the NASb within Sutter County that is not represented by another GSA.

Sutter County is delegating certain activities regarding the implementation of SGMA to the Natomas Central Mutual Water Company, which is located within its service area, through a separate MOA.

2.1.5 West Placer GSA

The West Placer GSA consists of four public agencies with water management or land use authority in a portion of the NASb located within Placer County. The member agencies are Placer County, the cities of Roseville and Lincoln, and Placer County Water Agency, all of which are water purveyors. In addition, through a separate participation agreement, the GSAs will allow for California American Water (an investor-owned utility) to participate in the West Placer GSA since they are a water supplier within the West Placer GSA portion of the Subbasin. The agencies have entered into an MOA to manage the groundwater within West Placer County.

Other local agencies that provide water to areas of the West Placer GSA portion of the Subbasin including San Juan Water District, Camp Far West Irrigation District, Citrus Heights Water District, Nevada Irrigation District, RD 1001, and a land-use agency, the City of Rocklin. These agencies do not supply groundwater within the West Placer GSA area and have not requested to be part of the GSA. Nevada Irrigation District was a GSA participant, but elected to withdraw in November 2021.

2.2 Plan Manager Contact Information

The five GSAs, by mutual agreement, selected SGA to be the Plan manager and lead agency for the preparation and implementation of the NASb GSP. SGA contact information is provided below:

Agency Name:	Sacramento Groundwater Authority	Contact person:	Rob Swartz
Agency Address:	5620 Birdcage Street, Suite 180 Citrus Heights, CA 95610	Phone Number:	(916) 967-7692
Agency Website:	https://www.sgah2o.org	Email:	rswartz@rwah2o.org

2.3 Implementation Authority

Any local public agency that has water supply, water management, or land use responsibilities in a basin can become a GSA under SGMA. All five of the NASb GSAs meets at least one of these criteria and has legal authority to jointly prepare, adopt, and implement a GSP. Each GSA in the NASb has the legal authorities granted to a GSA under the California Water Code (Water Code) to manage groundwater in their area.

All five of the GSAs have entered into an MOA for the implementation of this GSP, which will include management of the Subbasin along with projects and management actions. The GSAs have designated SGA as the lead agency. **Appendix A** provides a copy of the GSP Implementation MOA.

3. Description of Plan Area

3.1 GSP Plan Area

The NASb encompasses about 342,000 acres in Sutter, Placer, and Sacramento counties bounded by the American, Bear, Feather, and Sacramento rivers. The Sierra Nevada foothills form the eastern boundary of the Subbasin. **Figure 3-1** shows the plan area. The eastern portion of the Subbasin is characterized by low rolling dissected uplands, while the western part is a nearly flat flood basin for the Bear, Feather, Sacramento, and American rivers. Between the rivers are several small tributaries that have low elevation and small watersheds. Most of the small tributaries drain to the Natomas Cross Canal, East Side Canal, and the Natomas East Main Drain Canal, which convey runoff to the Feather and Sacramento rivers. Some of the tributaries are used by irrigation and RDs to convey water to their customers. Several miles of agricultural drains are used by the RDs to control flooding and are also used to recapture excess applied water for reuse.

Water uses in the Subbasin include agricultural, municipal, industrial, domestic, and native vegetation and aquatic species. Some water purveyors rely exclusively on either groundwater or surface water, but most rely on a combination of surface water and groundwater.

Urban areas dominate in Sacramento County and the southeastern portion of Placer County, while the rest of the Subbasin is predominately agriculture and undeveloped land. Permanent crops dominate the western, eastern, and northern edges of the Subbasin and along the rivers, while rice and other non-permanent crops dominate the central and western portions of the Subbasin.

3.2 Adjudicated Areas

The Subbasin is not adjudicated, nor are any of the surrounding subbasins.

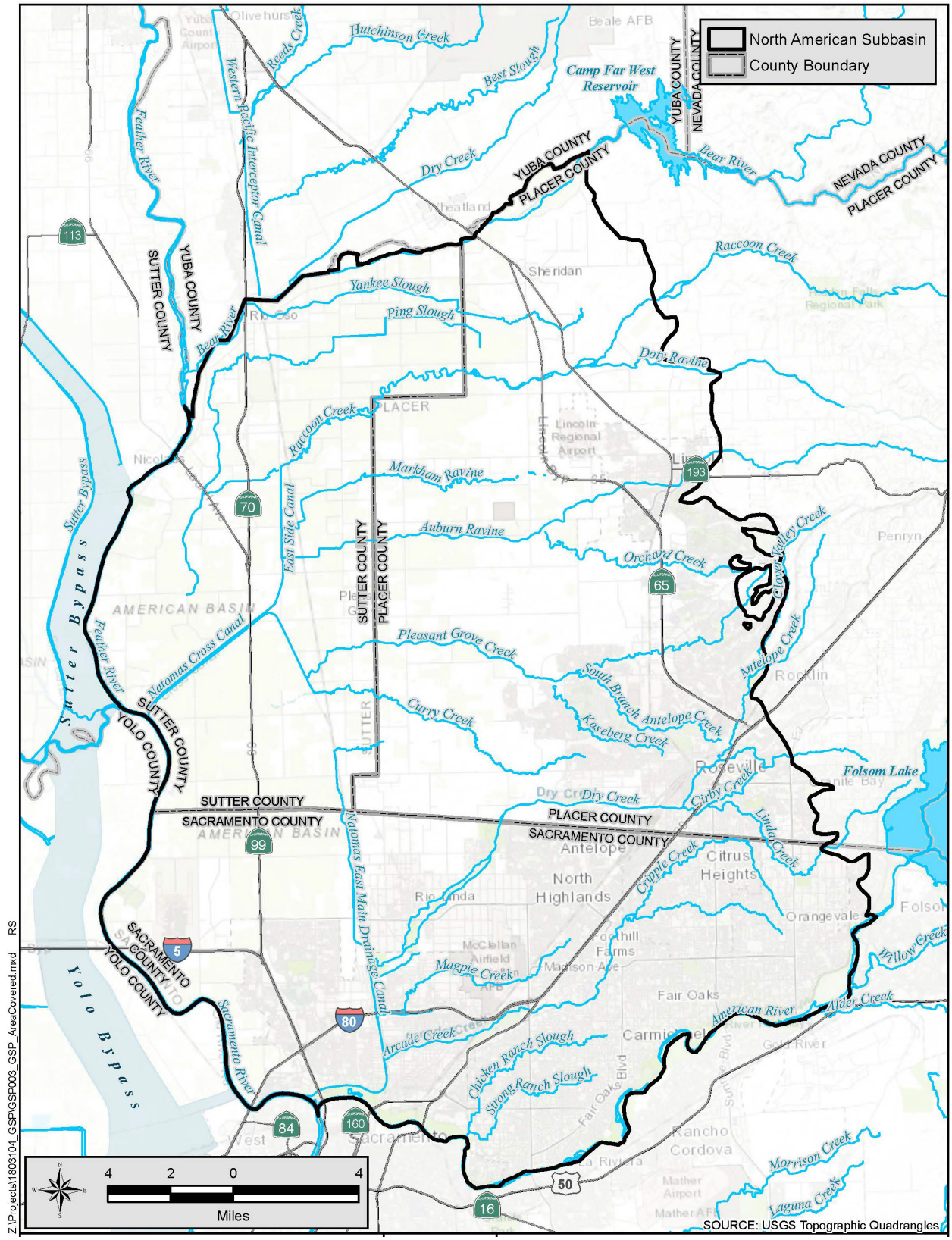


Figure 3-1. Area Covered by GSP

3.3 Jurisdictional Areas

Within the NASb, there are federal, state, county, and tribal agencies with land use jurisdictional responsibilities. Within each county, there are cities with land-use authorities and water agencies that serve water within the Subbasin. Irrigation districts are also present that provide surface water for agriculture. Within many of the irrigation districts and cities are RDs that are responsible for managing and maintaining the levees, freshwater channels, or sloughs, canals, pumps, and other flood protection structures in the area. The following sections describe the jurisdictional areas and agencies within the Subbasin. **Figures 3-2 through 3-4** show these jurisdictional areas.

3.3.1 Federal

The United States (U.S.) Army Corps of Engineers has jurisdictional authorities on all navigable waterways in the Subbasin. The U.S. Bureau of Reclamation (Bureau of Reclamation) contracts to deliver Central Valley Project and settlement agreement surface water through diversions from the Sacramento and American rivers.

The federal government (Air Force) retroceded jurisdiction for all portions of the former McClellan Air Force Base during post-closure of the base. This means that the U.S. Government no longer has "federal legislative jurisdiction" over any portion of the former base, i.e., the U.S. Government does not make or enforce laws/regulations for/on this land area any longer. The Air Force Real Property Agency still owns some of the parcels overlying contaminated areas, but will ultimately transfer those properties as cleanup is achieved.

The federal government also owns a small parcel (less than 1 acre) that is managed by Beale Air Force Base west of the city of Lincoln.

Figure 3-2 shows the federal lands in the Subbasin where the federal government may voluntarily agree to participate in administration of a GSP. Federal government officials have been invited to participate in the development of this GSP.

3.3.2 State of California

The California State Department of Transportation has authority for lands occupied by freeways and highways and maintenance yards. The State Department of Parks and Recreation has authority over the Folsom State Recreational Area, which extends along a portion of the American River west of Folsom Dam. The California State Lands Commission has authority over the Natomas Basin Conservancy area, located in the western portion of Sutter and Sacramento counties. The state also has authority over some small specific conservation land and preserves. DWR has jurisdictional authority for maintaining State Plan of Flood Control levees along the Sacramento and Feather rivers. **Figure 3-2** shows the state-owned lands in the

Subbasin where SGMA does not apply, but the state government officials have been invited to assist in the development of this GSP.

3.3.3 California Native American Tribes

United Auburn Indian Community has jurisdiction over land in Placer County southeast of the city of Lincoln and northeast of the town of Sheridan, within the Subbasin. Similar to the federal government, any federally recognized Indian tribe may voluntarily agree to participate in administration of a GSP.

Tribal community members have been invited to participate in the development of this GSP and were sent public outreach information about SGMA and GSP development. **Figure 3-2** shows the tribal lands in the Subbasin.

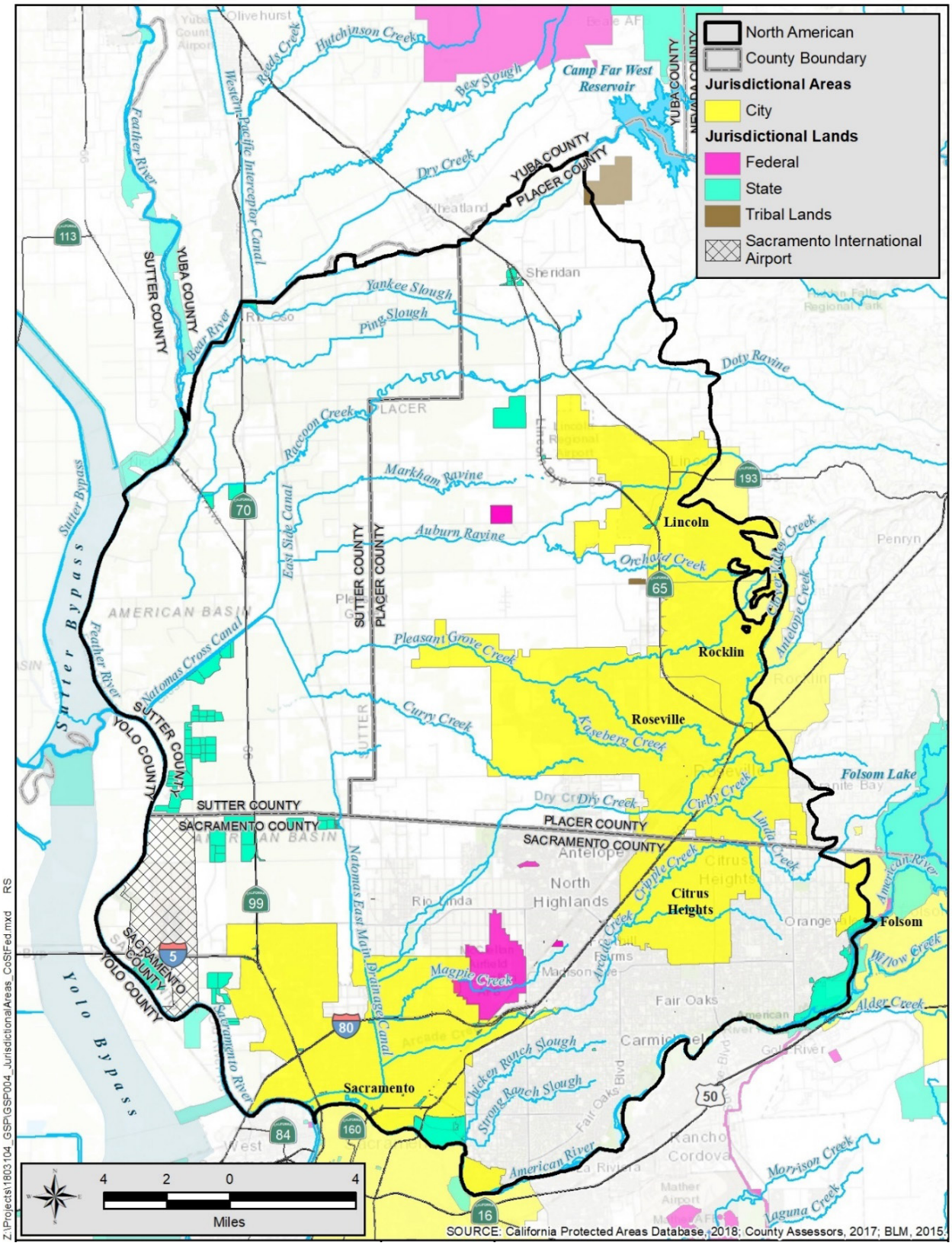


Figure 3-2. City, County, State, and Federal Jurisdictional Areas and Lands.

3.3.4 County

Placer, Sacramento, and Sutter counties each cover about one-third of the NASb. **Figure 3-2** shows the county boundaries. Each of the counties has a general planning and land use authorities. Sacramento County also has land-use management authority along the American River Parkway and along Dry Creek and lands associated with Sacramento International Airport.

3.3.5 City

There are six incorporated cities within the NASb (**Figure 3-3**), including Citrus Heights, Folsom (just a small portion located within the NASb), Lincoln, Rocklin, Roseville, and Sacramento. Each of the cities has land use management and planning authority granted through the state of California, which is derivative of the city or county general police power. This power allows cities and counties to establish land use and zoning laws that govern development.

3.3.6 Water Agencies

The following water agencies, water districts, city/county water departments and irrigation districts (classified as community water systems) are located within the Subbasin and provide potable water to residents (DWR, 2019). **Figure 3-3** shows the location of the water entities. Some are public entities, while others are private water companies. Their water supplies are derived from surface and groundwater or a combination of both.

- California American Water
- Carmichael Water District
- Citrus Heights Water District
- City of Folsom
- City of Lincoln
- City of Roseville
- City of Sacramento
- County of Sacramento
- Del Paso Manor Water District
- Fair Oaks Water District
- Golden State Water Company
- Orange Vale Water Company
- Rio Linda/Elverta Community Water District
- Sacramento Suburban Water District
- Sacramento County Water Agency
- San Juan Water District
- Placer County Water Agency
- Nevada Irrigation District
- Placer County (Area of Sheridan)

San Juan Water District (SJWD) is also a water wholesaler and provides treated surface water to Fair Oaks Water District, Orange Vale Water Company, and Citrus Heights Water District. SJWD also has interties to provide water to California American Water and the city of Roseville and a small portion of the city of Folsom (north of the American River) and periodically to another 171,000 customers in the Sacramento Suburban Water District.

Figure 3-3 also shows the relationship of disadvantaged and severely disadvantaged communities (DAC and SDAC) to the water agencies. Most DACs in Sacramento County and in the southern portion of Placer County are provided drinking water by water agencies. Some

portions of northwest Placer County do not have water service provided by water agencies and would rely on domestic wells.

3.3.7 Small Community Water Systems

There are multiple small community water and non-community non-transient water systems, in the Subbasin, that are overseen by the counties and the state. Their water supplies are from groundwater. **Figure 3-3** shows the location of some of these small community water systems and also their relationship to DACs and SDACs.

Water System Name
American River College
Antelope Springs
Brown's Elementary School
Building Trades Association
Burton and Kathryn Lauppe
California State Fair
Caltrans (Elkhorn I-5 Rest Area)
Csp Labs & Micro Paradox
E. L. H. Sutter Properties
East Nicolaus Joint Union High
East Nicolaus MWC
Edwin A. and Marjorie E. Willey
Eleven Oaks Mobile Home
Grant Union High School
Holt Of California
Huppe Moore Landscape
I B E W Training Center
Imperial Manor Mobile Home
Javed and Amna Siddiqui
Lincoln High School Farm
Marcum Illinois Elementary School
McClellan Mobile Home Park
National American Corp. Lp-Lak

Water System Name
Natomas Basin Conservancy
Odysseus Farms Partnership
On The Y
Pape Machinery
Pleasant Grove Elementry School
Rio Oso
Rio Ramaza CSD
River Oaks Golf Club
Rosecrest Mutual
Sacramento County
Sacramento County (Boat Launch)
Sacramento County (Discovery Park)
Sacramento County International Airport
Stafford Meat Company
Sysco Food Services of Sacramento
Teal Bend Golf Course
Trowbridge
Valley Hi Country Club
Verona Marina Launch & R.V.
Verona Village River Resort
Virgin Sturgeon
William S. Cummings

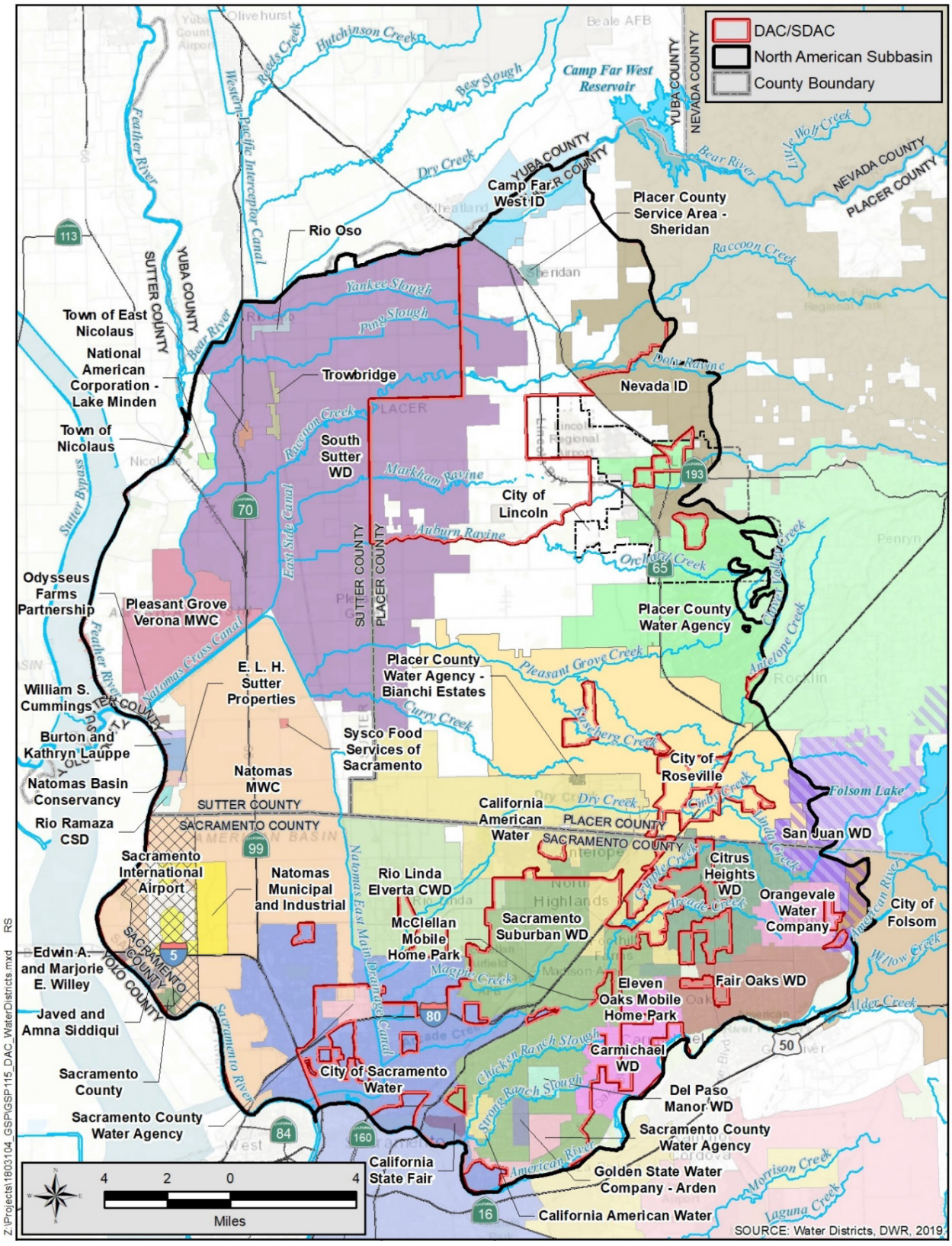


Figure 3-3. Water Districts and Systems Areas

3.3.8 Agricultural Water Providers

The Sutter County area of the NASb is almost entirely agricultural, Placer County is about 60 percent agricultural, and Sacramento County is about 20 percent agricultural. Surface water is supplied to agriculture by:

- Camp Far West Irrigation District
- Natomas Mutual Water Company
- Nevada Irrigation District
- Pleasant Grove-Verona Mutual Water Company
- South Sutter Water District

The water companies typically only supply a portion of the water supplies for agricultural use. The unmet demand is provided by privately owned wells.

3.3.9 Reclamation Districts

RDs are a form of special-purpose districts in the United States that are responsible for reclaiming and/or maintaining land for agricultural, residential, commercial, or industrial use that is threatened by permanent or temporary flooding. Within the NASb are RD 1000 along the Sacramento River and RD 1001 along the Bear, Feather and Sacramento rivers. Along the Bear River, RD 817 and RD 2103 have small areas within the NASb. Some of the RD areas overlie other water and irrigation district areas. **Figure 3-4** shows the RDs in the NASb.

3.4 Land Use Designations

In 2014, the NASb was roughly about 40 percent urban, 30 percent farmland, and less than 1 percent riparian vegetation (Land IQ, 2017). About 30 percent of the land was not classified. The total acres by each significant land use category and crops are summarized in **Table 3-1**. **Figure 3-5** shows the 2014 land use in the Subbasin.

Most of the urban development is in Sacramento County and the southeastern portion of Placer County. The population is projected to increase by about 200,000 people by 2030 (DWR, 2019), with an increase in urban development extending the urban areas to the north and west. **Figure 3-6** shows the locations of approved urban development areas in the Subbasin as identified from Placer, Sacramento, and Sutter counties, and each city's General Plans.

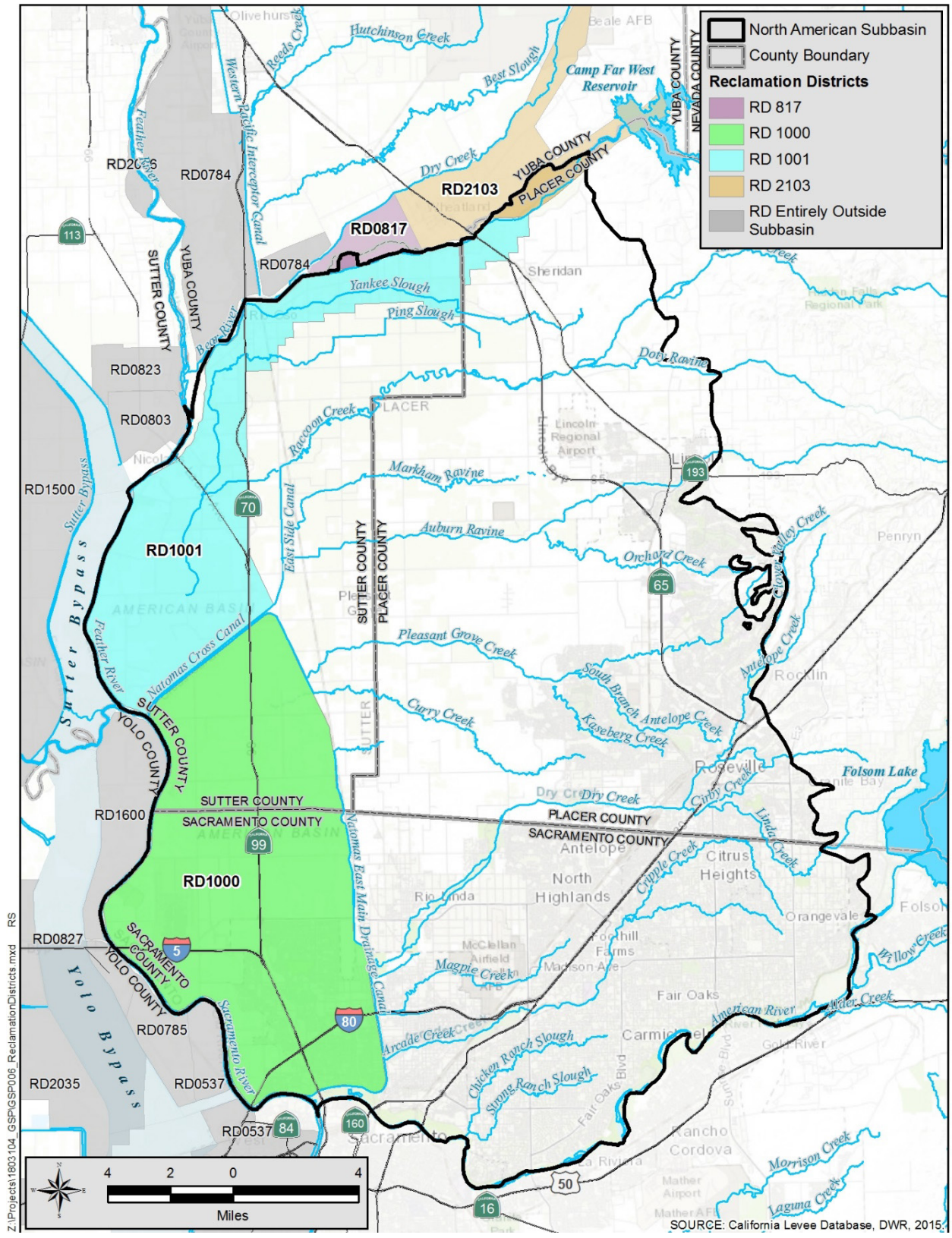


Figure 3-4. Reclamation Districts Jurisdictional Areas

Table 3-1. Land Use Summary

Land Use	Acres	Percent
Urban	**131,504**	**38.39%**
Urban	131,504	38.39%
Agriculture	**115,446**	**33.71%**
Citrus and Subtropical	99	0.03%
Deciduous Fruits and Nuts	11,529	3.37%
Field Crops	2,867	0.84%
Grain and Hay Crops	2,242	0.65%
Idle	30,083	8.78%
Pasture	11,331	3.31%
Rice	56,316	16.44%
Truck Nursery and Berry Crops	660	0.19%
Vineyard	45	0.01%
Young Perennial	275	0.08%
Managed Wetlands	**1,745**	**0.51%**
Riparian Vegetation	1,745	0.51%
Not Classified	**93,821**	**27.39%**
No Data	93,821	27.39%
Total	**342,516**	**100%**

Source: Land IQ, 2014

The Subbasin is a significant producer of pears, prunes, rice, tomatoes for processing, walnuts, peaches, beans, row crops, corn, and grapes. Agriculture uses about 50 percent of its acreage for growing rice and 10 percent for permanent crops, including orchards and vineyards. About 10 percent of the total farmland acreage is idle.

Urban development is projected to continue to increase, which will decrease agricultural lands. This has the potential to shift surface water use on permeable land to groundwater use on non-permeable ground thus, having a negative impact on the groundwater basin. **Figure 3-6** shows the locations of future urban development areas in the Subbasin as identified in Placer, Sacramento, and Sutter counties General and Specific Plans and their proposed water sources. Planned development areas will likely use groundwater as their initial sources of supply and ultimately plan to use both surface water and groundwater as their source of supply.

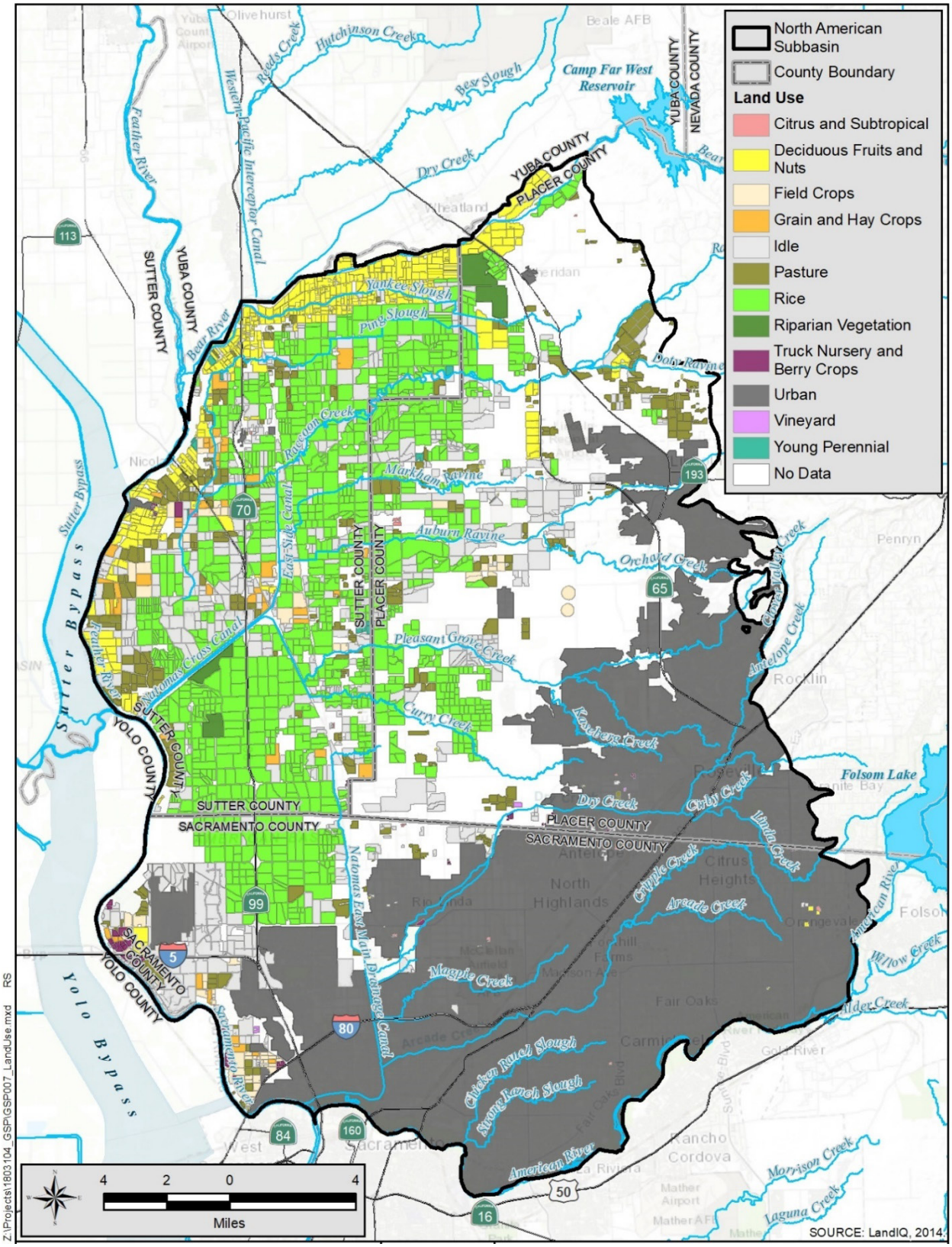


Figure 3-5. Existing Land Use Designations

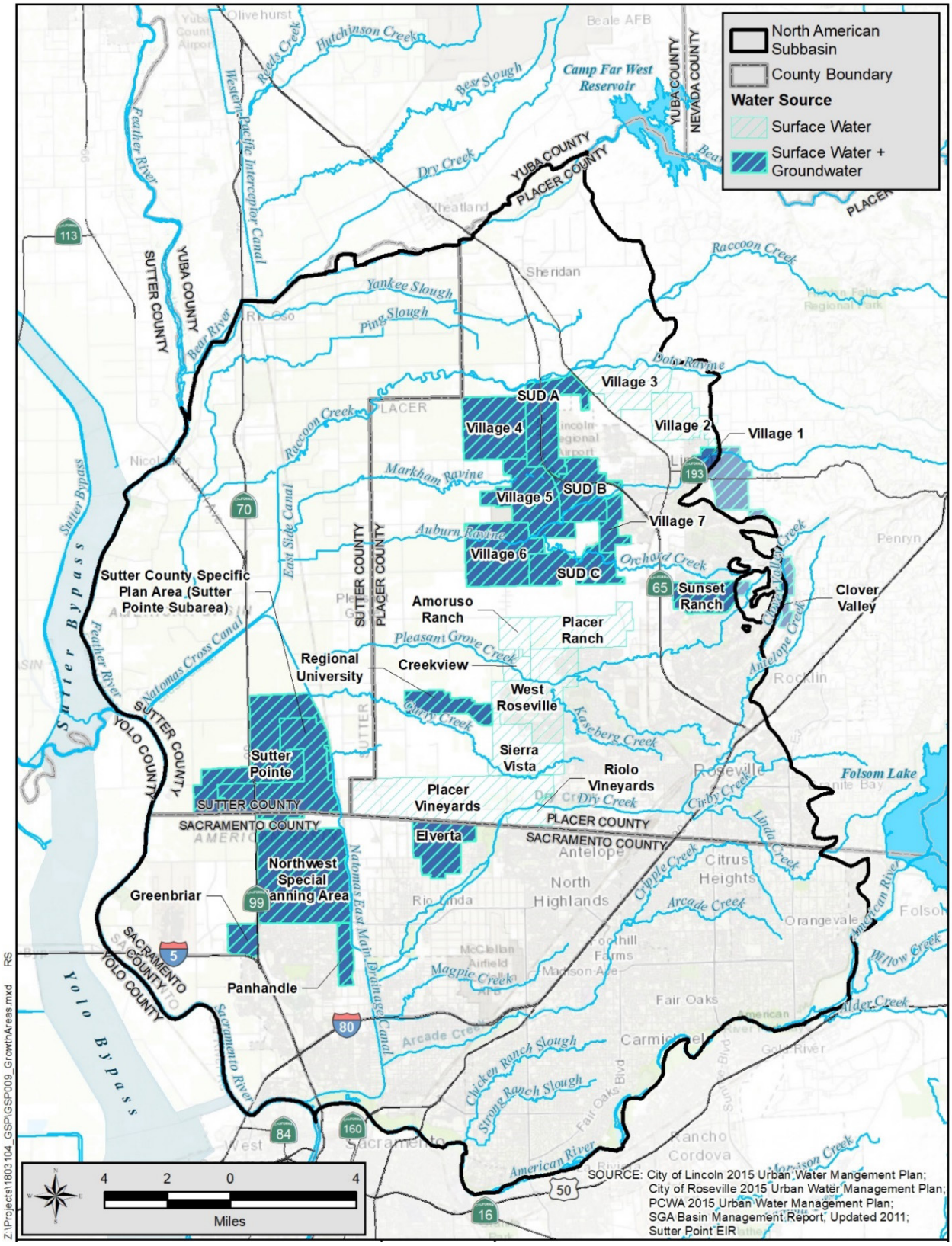


Figure 3-6. Planned Development Areas and Planned Water Source Types

3.5 Habitat Preserves and Easements

The counties in the NASb have each prepared conservation and habitat plans to assess current preserves and easements and provide goals and plans for the next 50 years to continue to increase these areas (Placer County Conservation Plan 2020, Natomas Basin Habitat Conservation Plan 2003). The Placer County Conservation Plan was jointly developed by the County of Placer, the City of Lincoln, the Placer County Water Agency and the South Placer Transportation Authority. The Natomas Basin Habitat Conservation Plan was jointly developed by Sutter and Sacramento counties along with other parties. Currently, the NASb has about 16,900 acres of habitat conservation preserves and easements. **Figure 3-7** shows the locations of existing reserves, preserves, and easements. Some of the preserves do not have water supplies and rely on precipitation while others have access to surface water and groundwater.

Riparian vegetation typically occurs along the fringes of the rivers, canals, and tributaries. Natural marsh habitats are generally present near the Feather and Sacramento rivers in the area, generally known as the Natomas Basin. Key natural marsh areas include Pritchard Lake north of Sacramento International Airport and the area adjacent to Natomas Mutual Water Company's Elkhorn Pumping Plant, which also contains riparian habitat. Other natural marsh areas are scattered in approximately five small areas throughout unincorporated Sacramento County. In unincorporated western Placer County, some fresh emergent marsh habitats are created by irrigation runoff and many of the wetland habitats are fed by leakage or runoff from irrigation canals or irrigated pastures. Riparian habitat occurs on the American and Bear River corridors and along Raccoon Creek, lower Auburn Ravine, and lower Dry Creek. Other habitat types include scattered pasture, idle, and ruderal lands, and include about 290 acres of grassland habitat adjacent to Natomas East Main Drainage Canal.

3.6 Disadvantaged Communities

Disadvantaged and severely disadvantaged communities are present in the Subbasin (DWR, 2018). **Figure 3-8** show their locations. Most are located within Placer and Sacramento Counties. Those within Sacramento County are located within urban areas, while those in Placer County are located in rural areas.

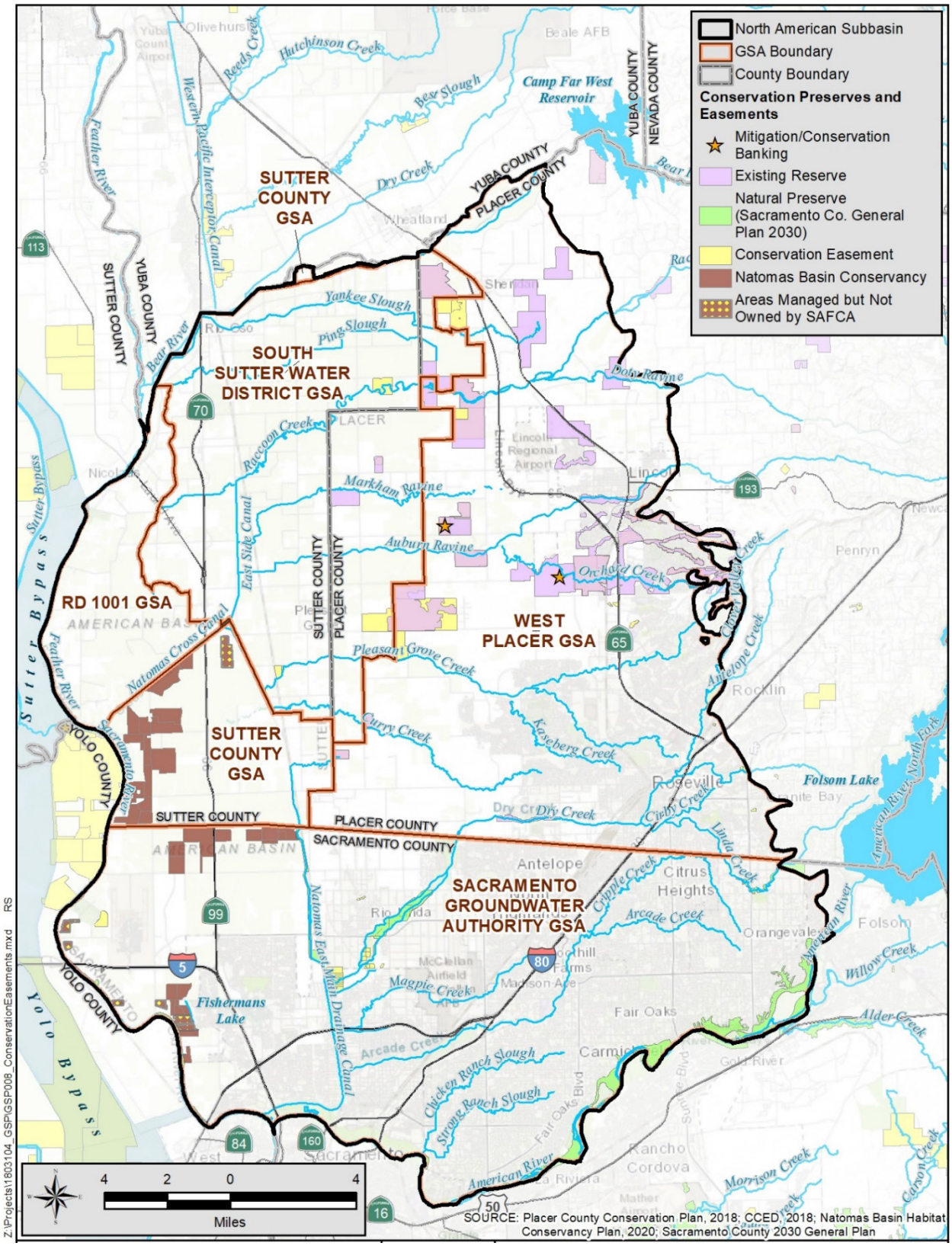


Figure 3-7. Habitat Conservation Preserves and Easements

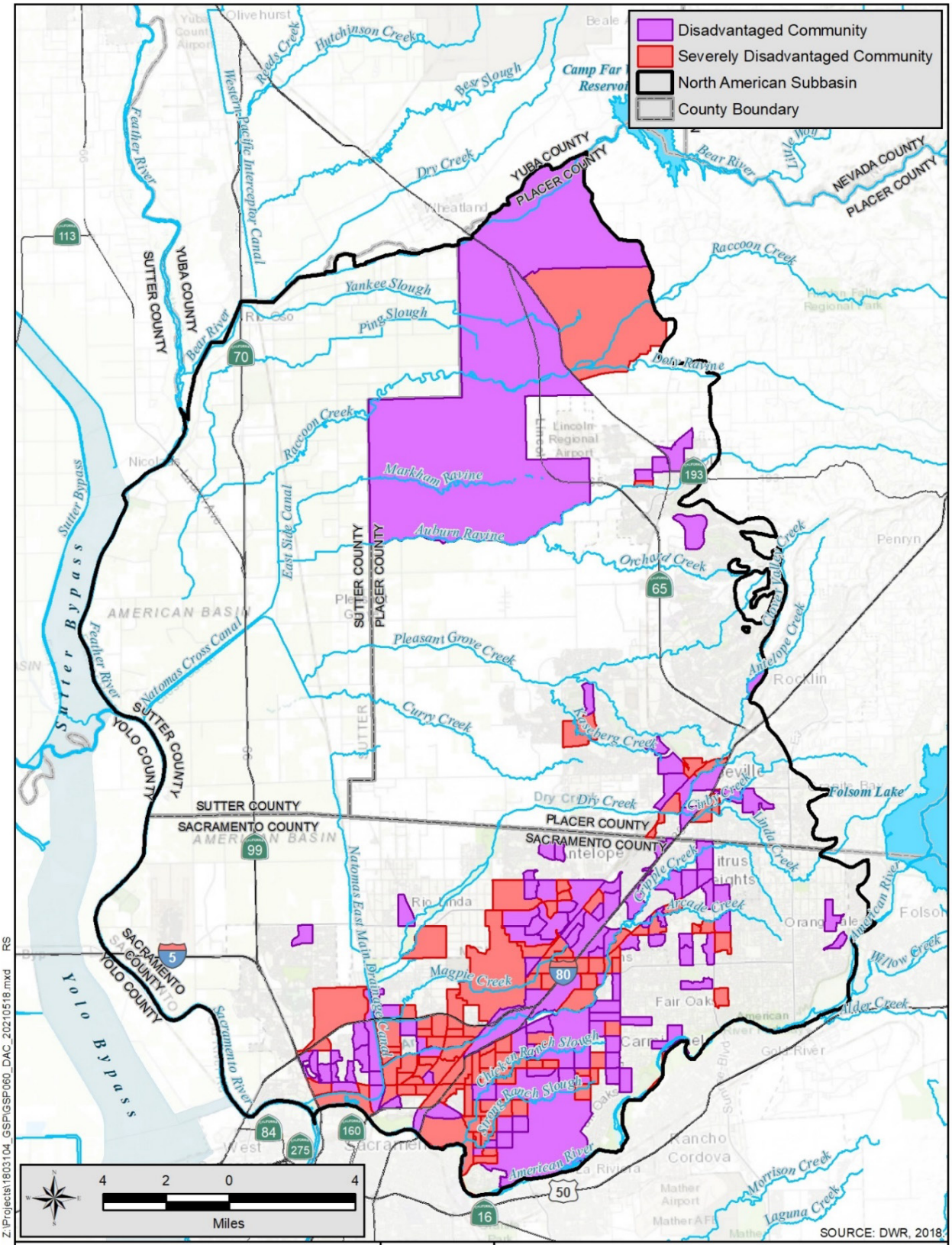


Figure 3-8. Disadvantaged and Severely Disadvantaged Communities

3.7 Water Use Sectors

Water use sectors in the Subbasin are urban (industrial included in this category), domestic, agriculture, environmental (native habitat, managed wetlands, and conservation areas) and groundwater remediation sites. **Figure 3-9** shows the water use sectors in the Subbasin, except for domestic users. Some of the water use sector areas may change with time as urbanization continues (*refer to* **Figure 3-6**).

Environmental cleanup is in progress in the Subbasin and some sites pump and treat groundwater to remove contaminants. Some of the water is used for municipal purposes while at other facilities the treated water is discharged to surface water.

3.7.1 Urban

Land in the southern and eastern portions of the Subbasin is primarily urban and is served by groundwater and surface water, for the most part by multiple agencies, as shown on **Figure 3-9**. This widespread urban development initially used groundwater, and by the 1960s, a significant groundwater depression had developed in the Sacramento County portion of the Subbasin. By the 1980s, urban water supplies were augmented by surface water. In 1993, the Water Forum (*see* Section 3.9.2 for details) began a collaborative process among stakeholders to develop a regional approach to ensuring a reliable water supply for the Sacramento region, including work to develop conjunctive use projects in the area, which expanded the option to use surface water. Currently, only the communities of Rio Linda, Arden, and Del Paso Manor rely solely on groundwater. **Figure 3-9** shows the water sources for urban areas.

3.7.2 Domestic

Domestic wells are used to supply groundwater to households in both urban and rural areas. They are scattered through the Subbasin.

3.7.3 Agriculture

Land in the northern and western portions of the Subbasin are predominately agriculture. A significant amount of surface water irrigates pastures, orchards, rice fields, and farms. Farmers in the Subbasin receive surface water from federal and local projects. Many also pump groundwater to augment their surface water supplies. During the dry year of 2014, surface water deliveries fell, causing farmers to rely more heavily on groundwater. Water districts, companies and irrigation districts manage surface water and encourage surface water use and basin recharge during wet years and groundwater use during dry years. **Figure 3-9** shows the availability of water sources for these agricultural areas.

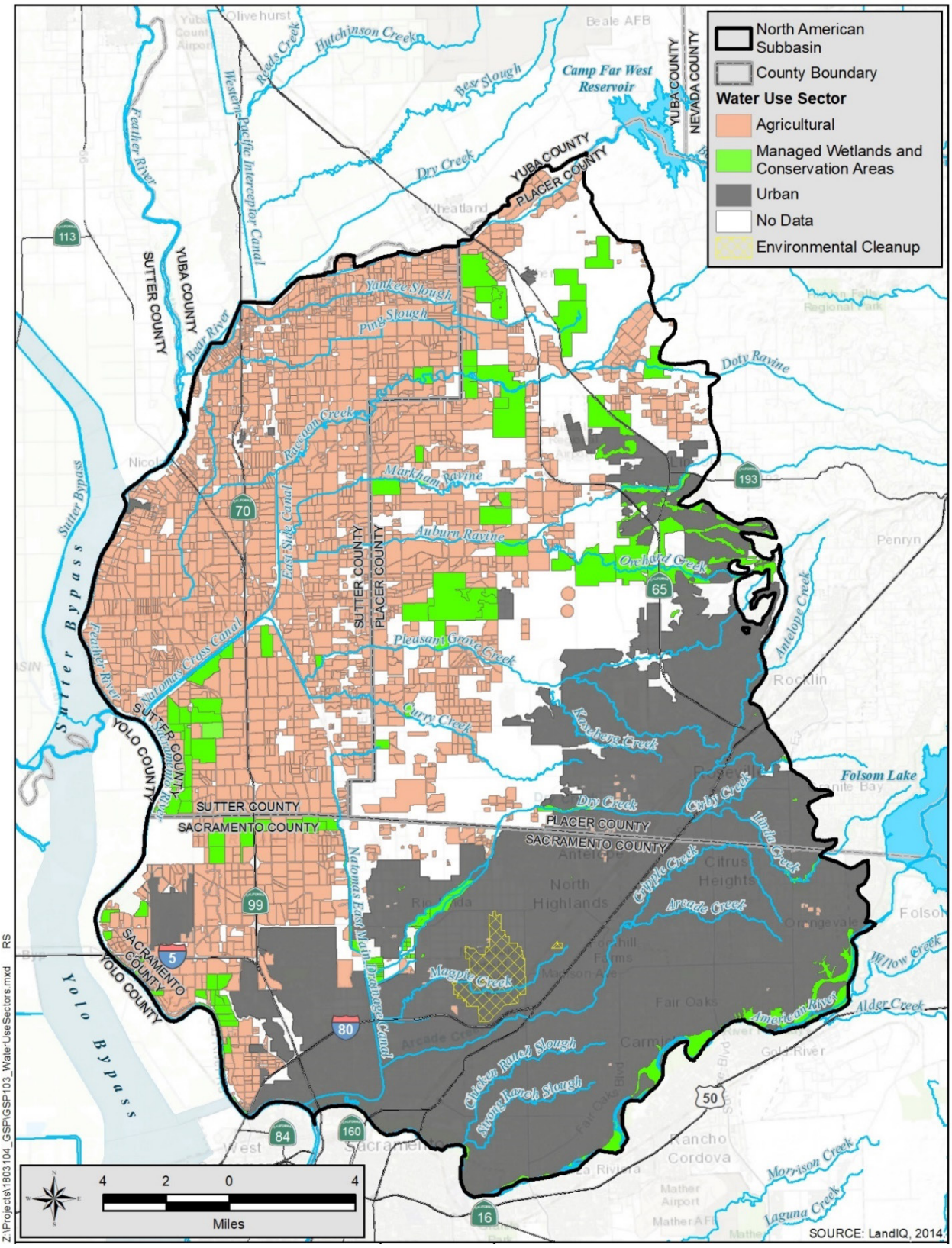


Figure 3-9. Water Use Sectors

3.7.4 Environmental

Rivers and streams in the Subbasin support more than 40 species of native and nonnative fish, including naturally spawning fall-run Chinook salmon, steelhead, and American shad. Several of these species are of primary management concern because of their declining numbers or their importance to recreational/commercial fisheries. Auburn Ravine in Placer County is also a habitat area for Chinook salmon and steelhead. The banks of the many rivers and streams within the Subbasin provide riparian habitat, both scrub and forest consisting of cottonwood, valley oak, and willow, with occasional white alder, box elder, and Oregon ash. Emergent marsh habitat is found in still or slow-moving shallow water located on the edges of the rivers and on the banks of open water areas. These areas constitute about three percent of the total NASb area. **Figure 3-10** shows vegetation and wetlands (NCCAG, 2018). Groundwater pumped and used to support some of the habitat preserves in Sutter and Sacramento counties is shown on **Figure 3-7**.

3.7.5 Groundwater Remediation

The federal government is in the process of remediating groundwater contamination beneath and near the former McClellan Air Force Base. Some of the cleanup involves pumping, treating, and discharging the treated groundwater to surface water. Pumping of the groundwater for cleanup of contaminants is relatively small, on the order of about 2,000 AFY and is expected to continue for about 30 to 200 years.

Aerojet also is performing groundwater remediation and is pumping wells north of the American River, in the vicinity of Fair Oaks and Carmichael and extracts about 3,000 AFY.

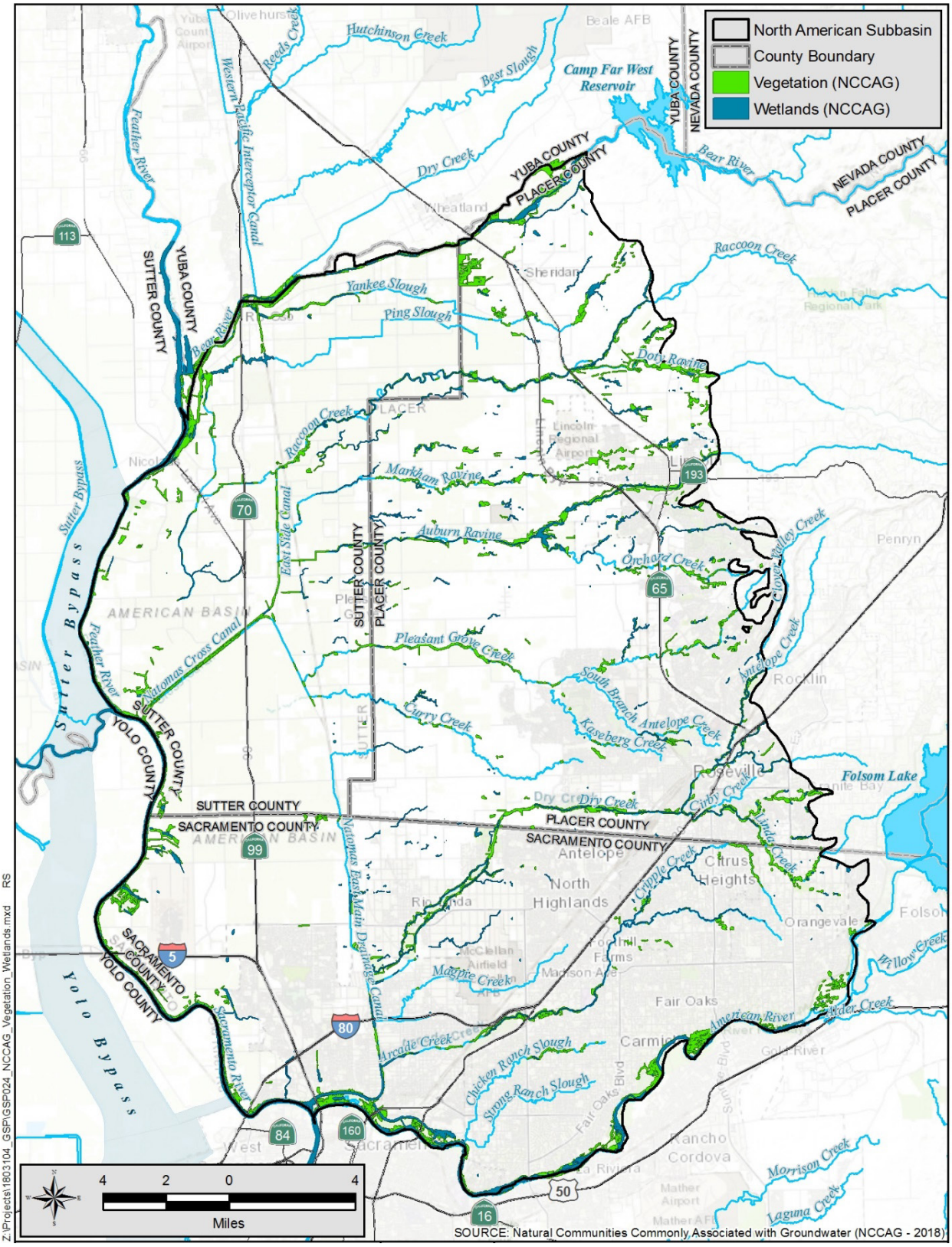


Figure 3-10. Natural Communities Commonly Associated with Groundwater

3.8 Water Source Types

In general, water agencies in the NASb meet water demands with a mixture of surface water and groundwater. Groundwater is used to supply about 40 percent of the water needs in the Subbasin, with about 60 percent being surface water (DWR, 2019). Both the cities of Roseville and Lincoln are using recycled water and are planning to increase this use. Irrigation and RDs also reuse runoff from agricultural fields.

Water source types in the Subbasin are groundwater and surface water, with limited recycled water (treated wastewater) use at this time. Excess applied water to agricultural lands is reused by the irrigation and RDs. **Figure 3-11** shows the areas and water supply source types in the Subbasin. Due to the limited recycled water use and the extensive water reuse in the Subbasin, areas with these sources are not shown on **Figure 3-11** but are described in the following text. Most urban areas in Placer County, other than for the city of Lincoln, utilize surface water for their primary needs and only use groundwater during emergency, drought or other conditions. In Sacramento, most urban areas conjunctively use groundwater during dry periods and use surface water when abundant. **Figure 3-11** shows where groundwater is the sole source of water in the Subbasin. Some of the water source type areas shown on **Figure 3-11** may change as areas are developed as shown (*refer to* **Figure 3-6**). Most of the agricultural areas have groundwater and surface water sources and, therefore, can conjunctively use these resources to manage groundwater in those areas.

3.8.1 Groundwater

There are about 13,600 wells in the Subbasin, of which about 3,800 are production wells and include domestic, agricultural, and municipal water supply wells (DWR WCR, 2019). Wells were classified by DWR as production wells if the well casing was greater than or equal to 4 inches, and the total depth was greater than or equal to 22 feet. Most of the production wells in the Subbasin are domestic wells, which may be classified as de-minimis extractors that pump less than 2 AFY. **Table 3-2** summarizes the types of well categories.

Table 3-2. Well Type Summary

Well Type	Count	Percent
Production - Domestic	2,563	19%
Production - Agriculture	847	6%
Production - Municipal	372	3%
Production Well Total	**3,782**	**28%**
Monitoring	2,558	19%
Remediation	809	6%
Other/Abandoned/Unknown	6,471	48%
TOTAL	**13,620**	**100%**

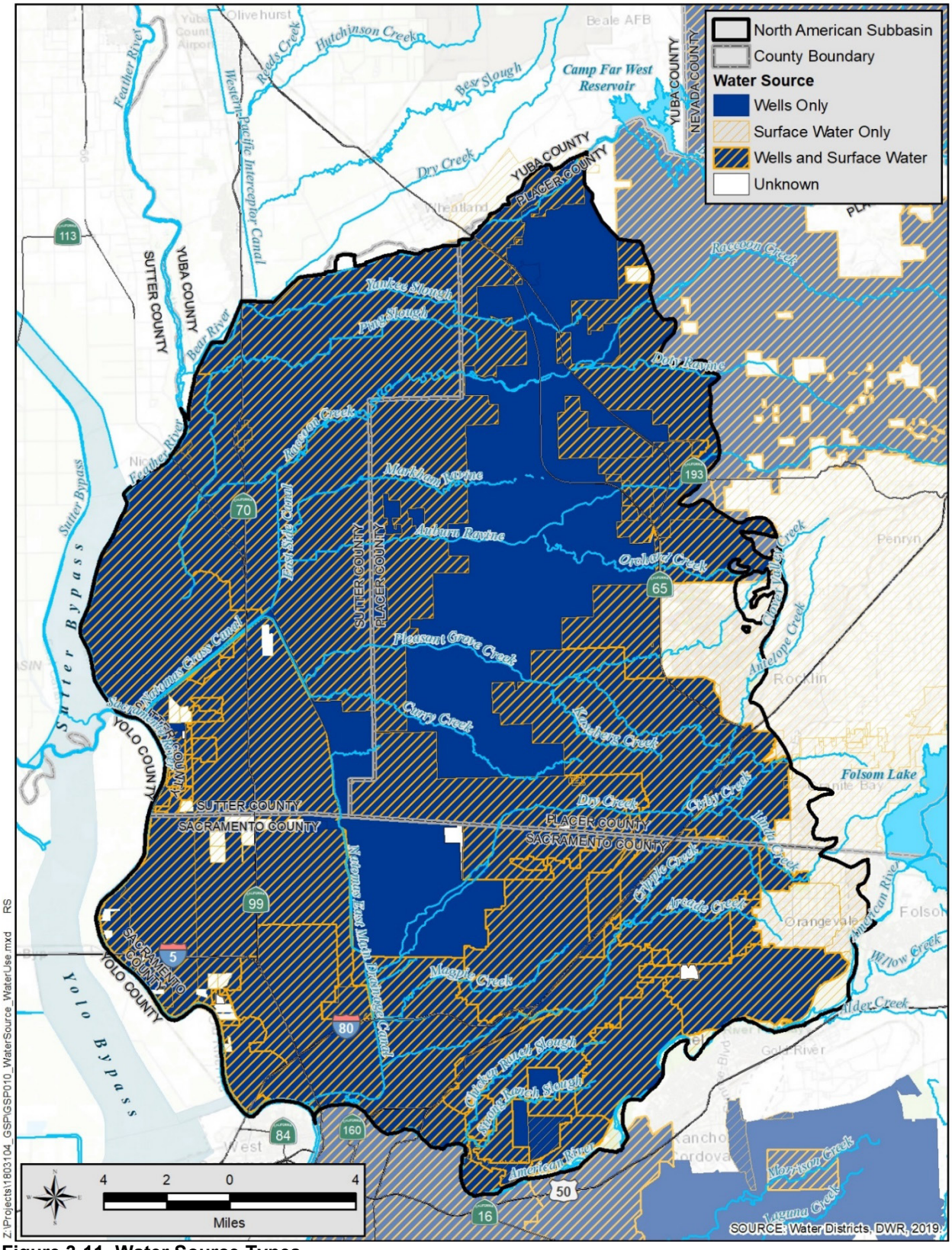


Figure 3-11. Water Source Types

3.8.2 Surface Water Sources

The SGA area of the NASb derives most of its surface water from the American and Sacramento rivers. The eastern two-thirds of the SGA region lies within the lower American watershed, and surface water served to that area typically comes from the American River. Four agencies within the SGA boundaries identified in **Table 3-3** have water rights on the American River—Carmichael Water District, City of Folsom, City of Sacramento, and San Juan Water District (SGA, 2014).

Within the SGA GSA, Natomas Mutual Water Company (NMWC) has been using mostly surface water for many years, pursuant to riparian claims and water rights dating back to 1916 on the Sacramento River. In 1964, NMWC executed a settlement agreement with the Bureau of Reclamation to accommodate the development and operation of the Central Valley Project. The settlement agreement provided a supplemental supply (Project Water: previously stored water from Shasta Reservoir) during times determined by the parties that the water rights were deficient. The senior water rights of NMWC and the security of the settlement contract have provided for a secure surface water supply for agricultural use which incidentally provides recharge to the groundwater basin. Water is diverted from the Sacramento River system at four points within the NASb: two diversions from Natomas Cross Canal, and two from the Sacramento River near the Sutter-Sacramento county line and near Elkhorn Road. About 75 percent of the water demand in the service area is met with surface water while groundwater makes up the remaining portion of the demand.

Within RD 1001 GSA, Pleasant Grove-Verona Mutual Water Company has a similar settlement agreement as NMWC identified above except the quantities are less and the specific details of the water rights are slightly different. Surface water is diverted from the Sacramento River through the Natomas Cross Canal.

South Sutter Water District (SSWD) holds post-1914 appropriative water rights to store up to 102,100 AFY of water in the Camp Far West Reservoir located approximately six miles east-northeast of the city of Wheatland (*refer to* **Figure 3-3**), as well as direct diversion rights for the diversion and use of water from the Bear River and other small streams transecting the District. Pursuant to an agreement between Camp Far West Irrigation District (CFWID) and SSWD during the construction and enlargement of the reservoir, CFWID is entitled to the first 13,000 AF released from the reservoir each year to satisfy its senior water rights along the Bear River. CFWID also holds direct diversion water right licenses for small streams transecting the district service area. SSWD only provides surface water to agricultural users to meet about one-third of water demand, with the remaining two-thirds being met from private groundwater wells.

In addition to its rights and licenses on the Bear River and small streams, SSWD receives supplemental sources of surface water from Nevada Irrigation District (NID) via releases to Auburn Ravine except during the driest years. The amount of water received from NID ranges

from zero to 20,000 AFY. The principal raw water delivery outside of the NID has been to SSWD.

Surface water is brought into the Placer County portion of the NASb by the city of Roseville, NID, Placer County Water Agency (PCWA), and San Juan Water District. The city of Roseville and San Juan Water District divert water from the American River from Folsom reservoir. PCWA's surface water supply sources consist of water purchased from PG&E from the Yuba and Bear rivers, Middle Fork Project water from the upper American River, and Central Valley Project water from the American River (Brown & Caldwell 2006). NID's primary source of supply is local surface water derived principally from the Yuba River, Bear River, and Deer Creek watersheds that are diverted and stored under the NID's pre-1914 and post-1914 appropriative water rights. The water rights allow for a diversion of up to 450,000 AFY. NID has an extensive system of small storage reservoirs. Through PCWA water rights and an agreement with the city of Roseville, the city treats surface water and delivers potable water to the California American Water service area in Placer County. The city of Lincoln purchases treated surface water from PCWA. PCWA also treats NID surface water to potable standards for delivery to NID areas within the city of Lincoln.

There are other small diverters of surface water with riparian water rights in the NASb. No attempt was made to identify and locate their diversion for this GSP from the SWRCB databases.

3.8.3 Recycled Water

Wastewater from urban areas and new developments will be treated at one of six wastewater treatment plants (WWTPs). **Figure 3-12** shows the location of the WWTPs. Five of the WWTPs are in the NASb, while one, the Sacramento Regional WWTP, is located outside of the Subbasin, in the South American Subbasin, as shown on **Figure 3-12**. The Sacramento Regional treatment plant receives water from the SGA area as well as other areas in Sacramento County. Interior urban water use, which originated from both groundwater and surface water supplies, is exported outside of the Subbasin to the Sacramento Regional WWTP.

Treated wastewater from the five WWTPs in the Subbasin is reused for irrigation of beltways, golf courses, and some agriculture along with some water features at golf courses. In 2016, about 23,000 AF of wastewater was treated by the cities of Lincoln and Roseville, of which about 3,600 AF was reused. Excess treated water, about 6,000 AF, was discharged into Dry and Pleasant Grove Creeks and Auburn Ravine (GEI SBR, 2018). The city of Roseville's Dry Creek WWTP is required to release an average of 10,000 AF for environmental purposes. The Urban Water Management Plans for the cities of Lincoln and Roseville detail reuse of the water currently being discharged to the creeks, other than flows that are committed for environmental purposes. Placer County operates the Sheridan WWTP, which does not discharge to nearby creeks but uses the water for irrigation of pasture. Wastewater from the Auburn area, which is outside of the Subbasin, is treated and then discharged to Auburn Ravine and enters the Subbasin near the city of Lincoln. Water from the northern portions of Auburn are sent to the city of

Lincoln's WWTP and is discharged to Auburn Ravine via Orchard Creek. In 2016, about 1,300 AF was discharged and potentially entered the Subbasin from Auburn.

Table 3-3. Water Supply Sources

Individual Agencies by GSA	Groundwater	Surface Water					
		American River		Sacramento River		Bear River	
		Water Rights	Contracts and Agreements	Water Rights	Contracts and Agreements	Water Rights	Contracts and Agreements
SGA GSA							
Carmichael WD	x	x					
City of Folsom		x	x				
City of Sacramento North	x	x		x			
California American Water - Arden Area	x						
Del Paso Manor Water District	x		x				
Sacramento Suburban WD - Town & Country	x		x				
Golden State Water Company - Arden Town	x						
SCWA - Arden Park Vista	x						
Portion of Natomas MWC	x(1)			x	x		
Sacramento Suburban Water District – North Service Area	x		x				
California American Water - Antelope and Lincoln Oaks	x						
Rio Linda/Elverta Community Water District	x						
Sacramento International Airport	x			x	x		
SCWA - Northgate	x						
Citrus Heights Water District	x		x				
Fair Oaks Water District	x		x				
Orange Vale Water Company	x		x				
SJWD - Sacramento County		x	x				
WP GSA							
Placer County (Sheridan)	x	x					
City of Roseville	x		x				
Placer County Water Agency	x	x	x	x			
SJWD - Placer County Retail Area			x				
Nevada Irrigation District	x		x			x	x
Camp Far West Irrigation District						x	x
SSWD GSA							
SSWD	x(1)					x	x
RD1001 GSA							
Pleasant Grove-Verona Mutual Water Company	x(1)			x	x		
Sutter County GSA							
Portion of Natomas MWC	x(1)			x	x		

(1) Groundwater is used by landowners within company boundaries but is pumped from privately owned wells.
x = Existing available water supply

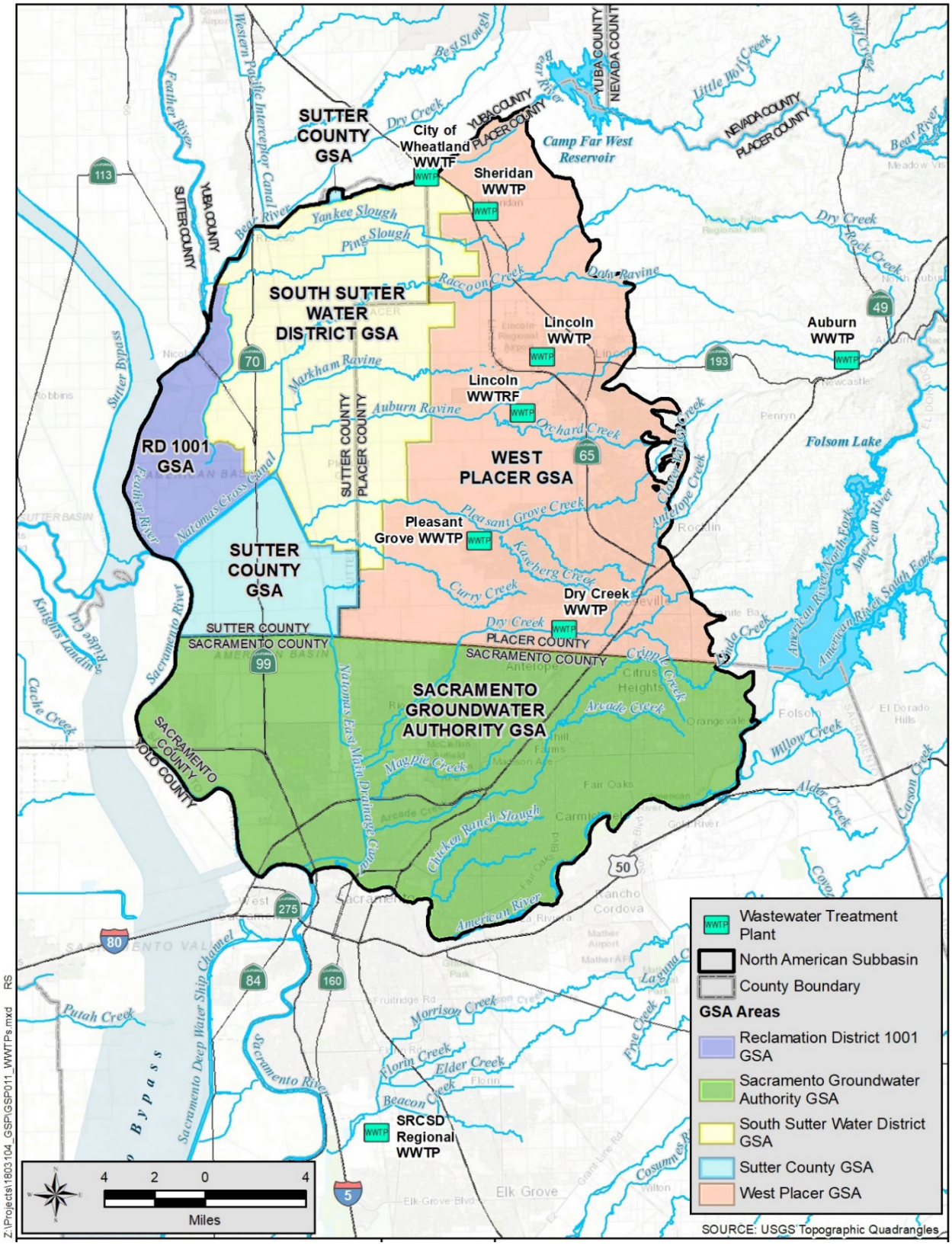


Figure 3-12. Wastewater Treatment Plants

3.8.4 Water Reuse

Excess applied surface water from agricultural fields either percolates into the soils or is returned to drains where it is recaptured by the RDs in the Subbasin. Shallow groundwater may also discharge to these drains, but only in areas where the groundwater surface is near the ground surface. In SSWD and RDs 1001 and 1000, excess applied surface water from agricultural fields is recaptured by drains and returned to the conveyance system to meet further water demands downstream.

Natomas Mutual Water Company has developed a complex closed system of unlined canals, laterals, drains, and lift pumps that circulate surface water around the service area. This system allows water users to take water from the system at any time during the irrigation season. The system also captures all return flow and recirculates it into the system for use by others. During a normal irrigation season, no agricultural drainage water returns to the Sacramento River until after October 15 each year.

3.9 Density of Wells

Groundwater in the Subbasin is used for municipal, industrial, irrigation, domestic, stock watering, frost protection, and other purposes. **Table 3-2** provides a summary of the number of wells by general type in the Subbasin. It should be noted that the number of wells is based on well logs filed and contained within DWR's Water Well Drillers Reports and may not reflect the actual number of active wells. Some wells contained in DWR files may have been destroyed, mis-located, mis-classified, constructed into granites beneath the Subbasin and are very old and may no longer be active.

Figures 3-13 through 3-15 show the density of domestic wells, as refined by GSP efforts, and production (agricultural and industrial) and municipal wells (from DWR database) per square mile. Outlines of DACs and SDACs are also shown on the domestic and municipal well density figures. They show that within northern Placer County these communities likely use domestic wells. There are many sections where disadvantage communities are designated but no domestic or municipal wells are present. **Appendix B** provides a description of the methods used to refine density and minimum depths of the domestic well database along with new figures illustrating the density and top of well screens.

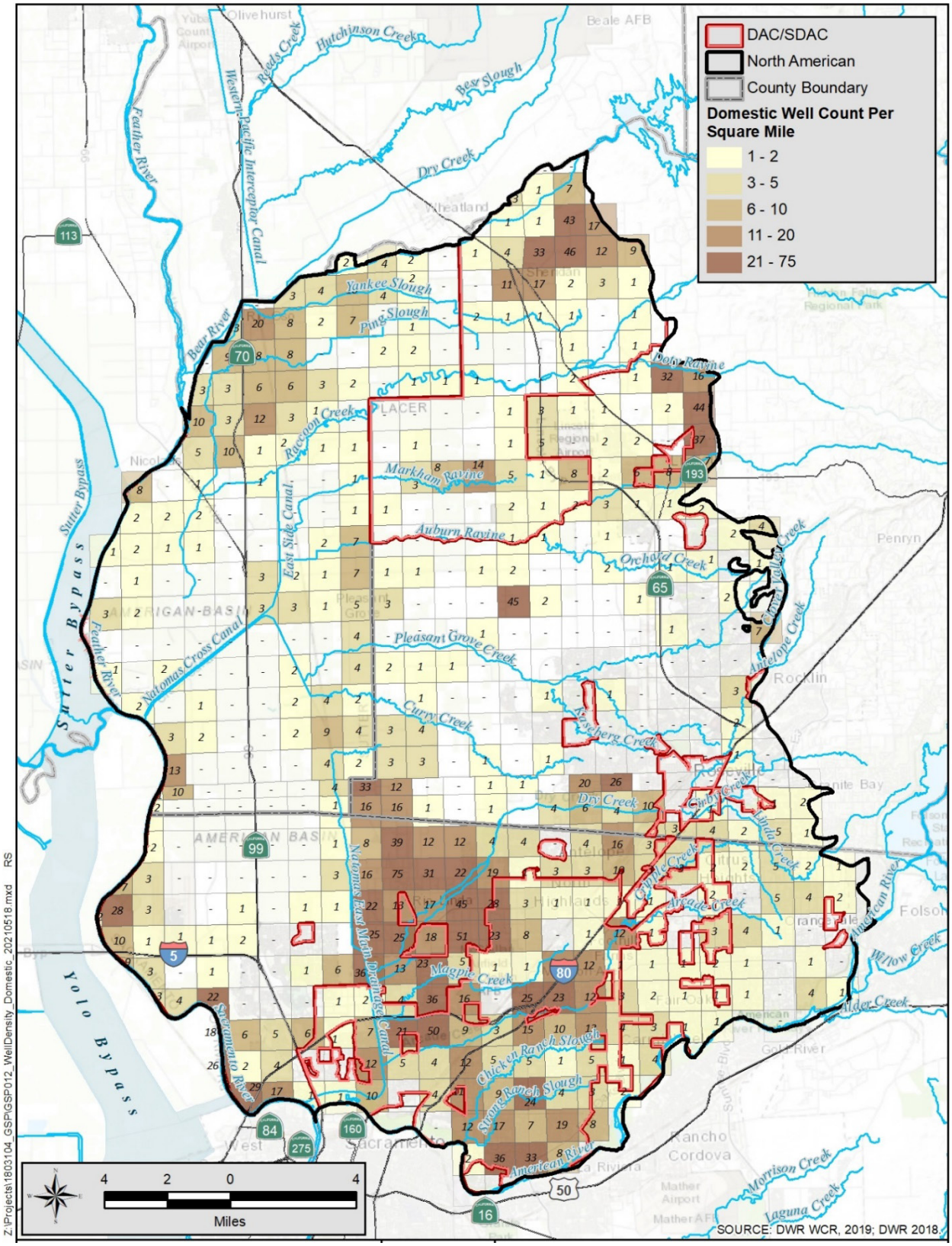


Figure 3-13. Density of Domestic Wells Per Square Mile

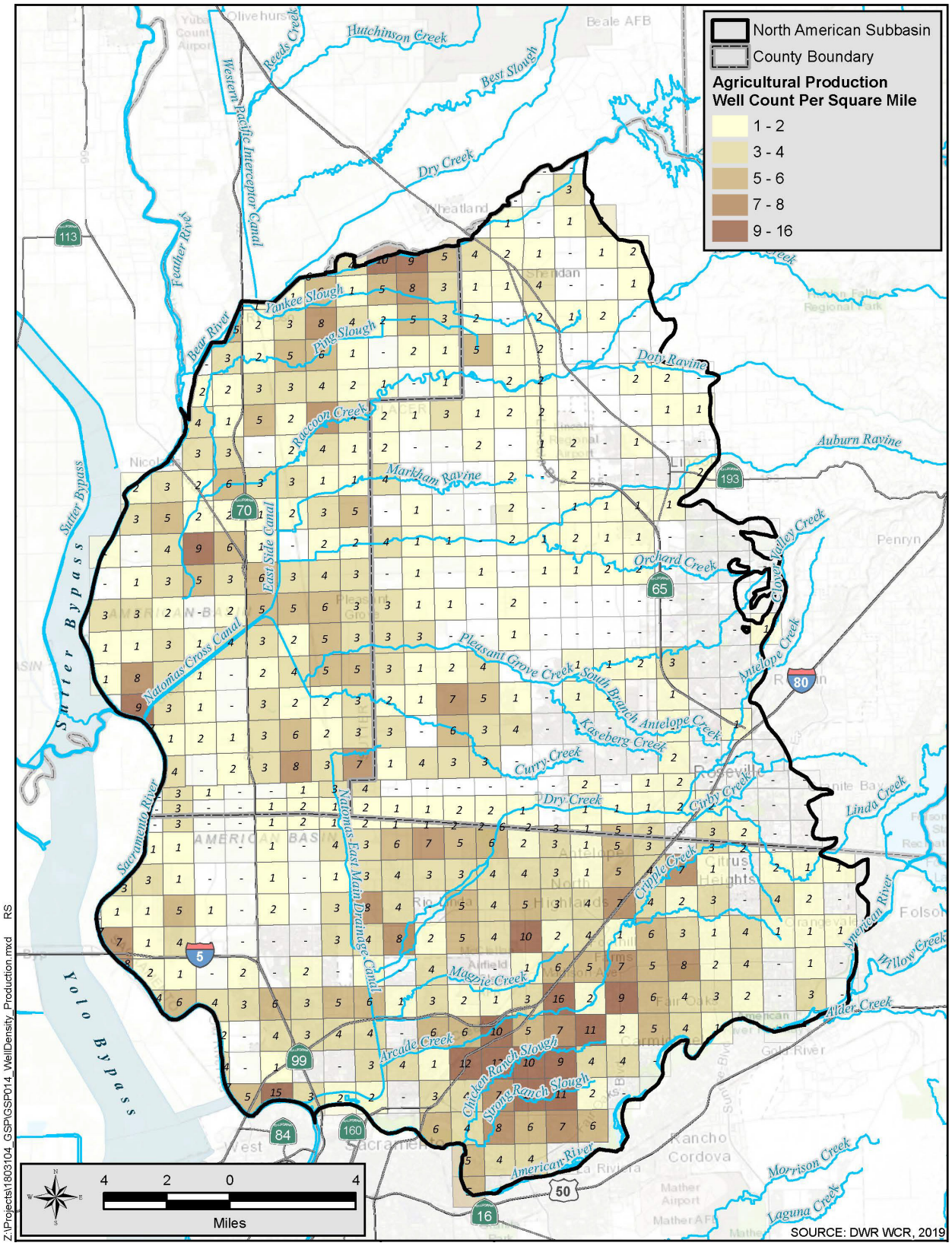


Figure 3-14. Density of Production Wells Per Square Mile

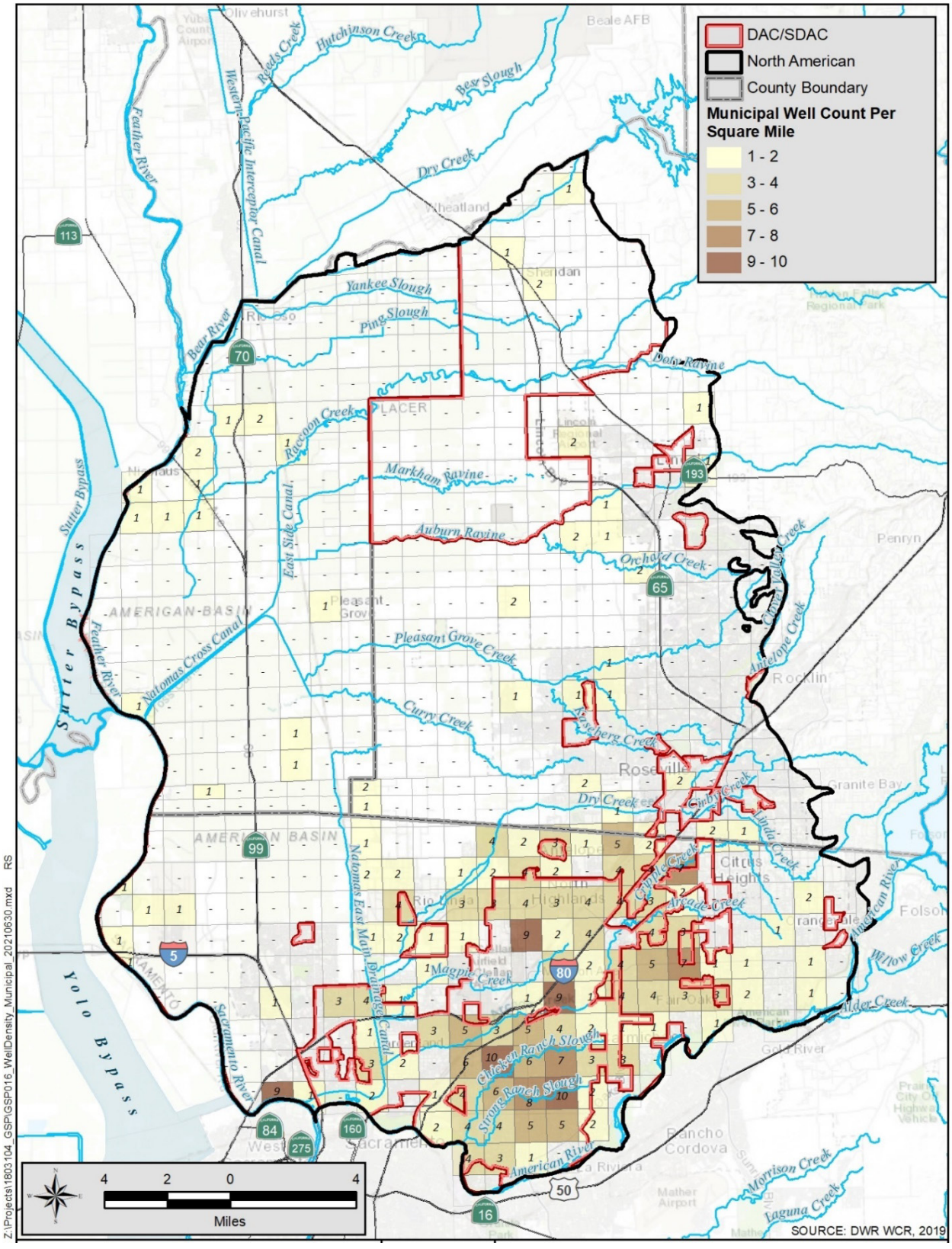


Figure 3-15. Density of Municipal Wells Per Square Mile

3.10 Existing Water Resources Management Plans

The Subbasin has many water resources management plans that cover activities that induces additional complexity to managing water resources. The following subsections provide a summary of other existing plans that the GSAs considered in the development of this GSP to manage groundwater resources in the Subbasin.

3.10.1 Groundwater Management Plans

In 1992, the California State Legislature enacted Assembly Bill (AB) 3030, and in 2002 the Legislature enacted Senate Bill (SB)1938. SB 1938 required adoption of a groundwater management plan as a prerequisite to obtaining funding assistance for groundwater projects from funds administered by DWR. These two pieces of legislation were incorporated into the California Water Code, Section 10753, to encourage local public agencies/water purveyors to voluntarily adopt formal plans to manage groundwater resources within their jurisdictions. **Table 3-4** provides a list of these groundwater management plans that separately covered the entire NASb. These existing groundwater management plans will be replaced with this GSP. Natomas Mutual Water Company has also prepared a groundwater management plan for its service area.

Table 3-4. Groundwater Management Plans

Groundwater Management Plan	AB3030	SB1938
SGA GMP 2014	x	x
Sutter County GMP 2012	x	x
WPC GMP 2007	x	x
SSWD GMP 2009	x	x

3.10.2 Water Forum Agreement

Representatives of water suppliers, local governments, citizens groups, environmental organizations, and businesses began the Water Forum in 1993 with the goal of developing a plan to ensure reliable long-term water supplies while protecting the lower American River. Following more than six years of analysis, professionally facilitated discussion, and negotiations, 40 diverse stakeholder groups signed the Sacramento Water Forum Agreement (WFA) in April 2000 (Water Education Foundation, 2002). An Environmental Impact Report for the WFA was completed in October 1999. The WFA included the following co-equal objectives:

- Provide a reliable and safe water supply for the region's economic health and planned development through the year 2030
- Preserve the fishery, wildlife, recreational, and aesthetic values of the lower American River

To achieve its objectives, WFA signatories approved an integrated package of seven elements:

- Increased surface water diversions
- Actions to meet customer needs while reducing diversion impacts in drier years
- Support for improved pattern of fishery flow releases from Folsom Reservoir
- Lower American River habitat management
- Water conservation
- Groundwater management
- Water Forum Successor Effort

The Water Forum effort continues today, with many successes and some ongoing challenges to meeting its objectives. Most importantly, a majority of the signatory stakeholder groups are still focused on supporting and achieving the WFA's objectives more than 20 years after its execution. While each of the elements of the WFA is critical to achieving its co-equal objectives, the groundwater management element is most relevant to local groundwater management efforts and to this GSP. The groundwater management element provides a framework for protecting and using groundwater in a sustainable manner. The WFA is currently being updated and will reflect the enactment of SGMA and implementation requirements of this GSP.

3.10.3 American River Basin Integrated Regional Water Management Plan

The greater Sacramento area has been involved in integrated water planning and implementation for two decades. In 2001, water suppliers in the Sacramento area formed the Regional Water Authority (RWA) as a joint powers authority to help implement elements of the Water Forum Agreement. RWA developed the first American River Basin Integrated Regional Water Management Plan (IRWMP) in 2006, with updates in 2013 and 2018. The IRWMP area includes SGA and West Placer GSAs.

Integrated Regional Water Management is an effective way to address complex water resources challenges and is driven by stakeholders that identify major water and related resource management issues and their proposed solutions. It maximizes economic and societal benefits in an equitable manner while maintaining the ecosystem critical to water resource sustainability.

The IRWMP identifies specific projects and implementation programs and agreements between different affected agencies to identify projects to put conjunctive use in place. The intended purpose of the IRWMP is to provide and encourage regional opportunities for water resources planning and project development.

3.10.4 North Sacramento Valley Integrated Regional Water Management Plan

The North Sacramento Valley IRWMP covers a large planning area and includes the Sutter County portion of the NASb and RD 1001, Sutter County, and portions of the SSWD GSA areas.

The IRWMP also includes specific projects and implementation programs and agreements between different affected agencies to identify projects to put conjunctive use in place.

3.10.5 Urban Water Management Plans

The Urban Water Management Planning (UWMP) Act was developed in response to the state's water shortages, droughts, and other factors. Every urban water supplier that provides over 3,000 AF of water annually or serves more than 3,000 service connections is required to submit a UWMP. UWMP requirements include updating water shortage contingency plans (WSCP), extended drought risk assessments, and energy intensity reporting. Required elements of an UWMP include a report on the progress that urban water suppliers are making in meeting their water use efficiency targets, current and projected water demands, current and projected water sources, water management actions to improve supply reliability, and an evaluation of the sufficiency of supplies to meet the forecasted demands under both normal and drought conditions. Entities within the NASb with UWMPs include:

California American Water	Nevada Irrigation District
Carmichael Water District	Orangevale Water Company
Citrus Heights Water District	Placer County Water Agency
City of Folsom	Rio Linda/Elverta Community Water District
City of Lincoln	Sacramento County Water Agency
City of Roseville	Sacramento Suburban Water District
City of Sacramento	San Juan Water District
Fair Oaks Water District	

Within UWMPs, the WSCPs are an important temporary demand management tool. WSCPs have required water shortage stages that allow local agencies to call for temporary demand reductions during periods of constrained supply. These reductions are an important management action to adapt to dry conditions.

3.10.6 Urban Water Use Efficiency Program

The RWA has managed a Regional Water Efficiency Program (WEP) since 2002. The WEP has 19 urban water suppliers participating throughout the greater Sacramento region, with 14 of those agencies being in the NASb. The Program's primary focus is a regional public and education program with the goal of assisting urban water suppliers with informing customers on how to use water more efficiently. Program activities include a public facing educational website (https://bewatersmart.info/), development of an annual public outreach campaign, radio, television, online and social media advertising, and a public service announcement-focused video contest for students. In 2021, the U.S. Environmental Protection Agency (EPA) honored the RWA WEP with the national 2021 WaterSense® Partner of the Year Award for its

dedication to helping consumers and businesses save water, even with the challenges presented by the COVID-19 pandemic in 2020. This is the second WaterSense award for the Program (awarded WaterSense® Excellence in Education and Outreach Award in 2016).

In addition to public outreach and education, the WEP has been successful in securing grants to assist water suppliers in issuing rebates for water saving devices (e.g., toilets, showerheads, irrigation controllers). Since 2003, the program has secured nearly $14.7 million from highly competitive grant programs. In 2020, the WEP received $2.4 million in grant funding from Proposition 1 (The Water Quality, Supply, and Infrastructure Improvement Act of 2014) for several new multi-year programs and incentives focused on customer rebates and system water loss recovery and efficient irrigation practices and equipment.

As a result of the WEP's efforts over the last 20 years, the region's water use has remained steady even though the population grew 37 percent from 1.5 million to 2.1 million people. Additionally, every supplier in the region has successfully met and exceeded (by an average of 20%) the Water Conservation Act of 2009 (SB X7-7) requirements to increase water use efficiency by 20 percent by the year 2020. Looking forward, new water conservation regulations resulting from the passage of Senate Bill 606 and Assembly Bill 1668 (2018) are currently under development with implementation starting in 2023. These new regulations have a statute-defined goal of producing more savings than SB X7-7 and incorporate water efficiency standards for residential indoor use, residential outdoor use, commercial, industrial, and institutional landscape use and supplier system water loss.

3.10.7 Agricultural Water Management Plans

The Water Conservation Act of 2009 (SB X7-7) requires agricultural water suppliers serving more than 25,000 irrigated acres (excluding recycled water deliveries) to adopt and submit to DWR an Agricultural Water Management Plan (AWMP). These plans must include reports on the implementation status of specific Efficient Water Management Practices that were required under SB X7-7.

Required components of the plans include:

- Annual water budget
- Identification of water management objectives to improve system efficiency
- Quantification of water use efficiency with all water uses being accounted for including; crop water use, agronomic use, environmental use, and recoverable surface flows
- A Drought Plan for periods of limited water supplies that describes actions for drought preparedness

Districts within the NASb which have adopted AWMPs are:

- SSWD
- Natomas Mutual Water Company
- Nevada Irrigation District

3.10.8 Salt/Nutrient Management Plan

In February 2009, the SWRCB adopted Resolution No. 2009-011, which established a statewide Recycled Water Policy. Central to this Policy was the requirement that local water and wastewater entities, together with local salt- and nutrient-contributing stakeholders, develop a Salt and Nutrient Management Plan for specified groundwater basins and subbasins in California. The plans include management strategies, plans for stormwater and recycled water use, a monitoring program, and an antidegradation analysis. In response, the Sacramento Valley Water Quality Coalition was formed to perform studies and to represent growers in the Sacramento Valley, including the NASb. The Coalition developed a Groundwater Quality Assessment Report (CH2MHill, 2016) and a Comprehensive Groundwater Quality Management Plan. The Groundwater Quality Management Plan presents a baseline picture of groundwater quality, establishes a framework under which salt and nutrient issues can be managed, and streamlines the permitting process of new recycled water projects while meeting water quality objectives and protecting beneficial uses. This plan excluded areas where rice is grown.

The California Rice Commission also prepared a Groundwater Quality Assessment Report (CH2MHill, 2013). Rice is primarily grown in eight Sacramento Valley counties (Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Yolo, and Yuba). Rice lands overlie eleven subbasins in the Sacramento Valley Groundwater Basin, including the NASb. The California Rice Commission has issued rice-specific Waste Discharge Requirements (WDR), which requires groundwater trend monitoring and reporting at representative wells (one well is sampled in the NASb). Rice acreage has been identified as having a low vulnerability for nitrates.

3.10.9 Water Quality Control Plan for the Sacramento River Basin

The Central Valley Regional Water Quality Control Board (CVRWQCB) prepared a Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin (Basin Plan). The objective of the Basin Plan is to show how the quality of the surface water and groundwater in the Sacramento Region should be managed to provide the highest water quality reasonably possible. Water uses and water benefits vary depending upon the location in the basins. Water quality is an important factor in determining use and benefit. For example, drinking water must be of higher quality than the water used to irrigate pastures. Both are legitimate uses, but the quality requirements for irrigation are different from those for domestic use. The Basin Plan recognizes such variations.

The Basin Plan lists beneficial users, describes the water quality, which must be maintained to allow those uses, and contains an implementation plan, SWRCB, and CVRWQCB plans and policies to protect water quality, and statewide surveillance and monitoring as well as regional surveillance and monitoring programs.

Present and potential beneficial uses for inland waters in the basins are surface water and groundwater as municipal (water for community, military, or individual water supplies); agricultural; groundwater recharge; recreational water contact and non-contact; sport fishing; warm freshwater habitat; wildlife habitat; rare, threatened, or endangered species; and, spawning, reproduction, and/or early development of fish.

Water Quality Objectives for both groundwater (drinking water and irrigation) and surface water are provided.

3.11 Existing Water Resources Monitoring Programs

Existing management and monitoring plans in the NASb are described below. Some of the programs will be incorporated into the GSP monitoring network or were used to develop this GSP.

3.11.1 Groundwater Level Monitoring Programs and Networks

Historical groundwater level data measurements were made by DWR, SGA, local water districts, and the United States Geological Survey (USGS).

Groundwater level monitoring is being performed by designated monitoring entities in the NASb as part of the California Statewide Groundwater Elevation Monitoring (CASGEM) program. This network of groundwater level monitoring wells provides data that is the foundation for many groundwater management decisions. Designated monitoring entities include: SGA, Placer County, City of Roseville, SSWD, and Sutter County. DWR also continues to monitor groundwater levels in the Subbasin. The CASGEM groundwater level monitoring network and others are shown on **Figure 3-16**.

Appendix C provides the monitoring well construction details. Many of the wells are dedicated nested monitoring wells (small diameter wells that are screened opposite individual aquifers). The NASb GSAs rely upon these dedicated monitoring wells to assess the groundwater conditions in the basin since these wells are not affected by local pumping, as are the voluntary wells that are commonly active pumping wells. SSWD, RD 1001, and the Sutter County GSAs use more voluntary wells than dedicated monitoring wells.

Groundwater level monitoring is also performed as part of DWR and the Bureau of Reclamation's Water Transfer Program, which allows for three categories of transfers: 1) groundwater substitution, 2) cropland idling and crop shifting, and 3) reservoir storage releases. Groundwater substitution transfers make surface water available for transfer by reducing surface water diversions and replacing that water with groundwater pumping. The monitoring of groundwater levels is required as part of the transfer agreement. The monitoring networks developed for the water transfers include the groundwater production wells participating in the transfer and additional monitoring wells to assess the effects of the transfer. The monitoring

frequency varies from weekly to monthly. Monitoring begins just prior to the start of water transfer pumping and continues until groundwater levels have recovered to their seasonal highs the following spring.

The USGS monitors thousands of wells across the nation. The extensive water data, which includes manual measurements of depth to groundwater in wells throughout California, are stored in the National Water Information System (NWIS) online database (https://waterdata.usgs.gov/nwis). The database stores historical observations of active and discontinued sites in addition to current conditions with measurements transmitted hourly.

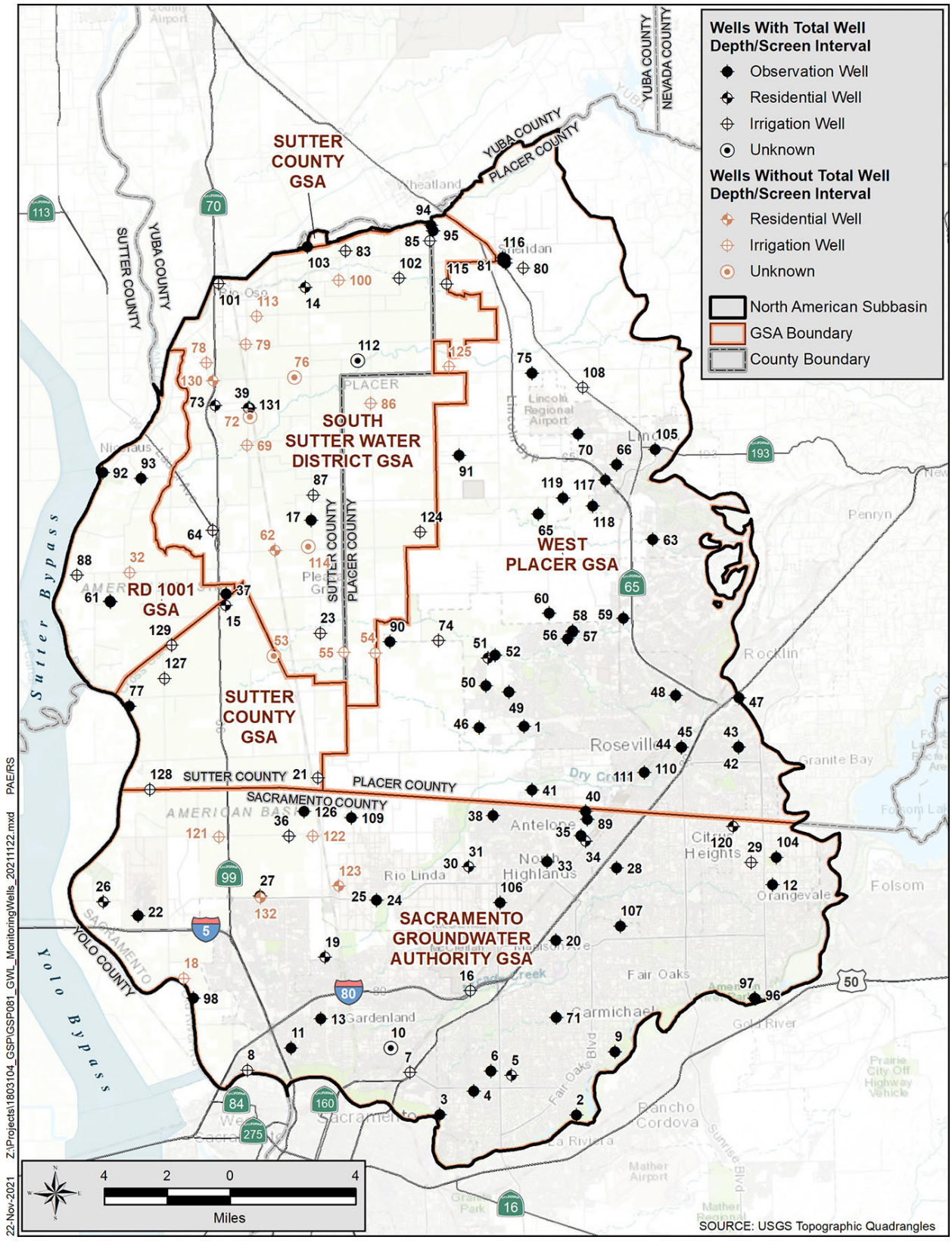


Figure 3-16. Groundwater Level Monitoring Network

Groundwater level measurements at these wells are taken approximately once per quarter. The USGS actively monitors 10 well sites within the NASb.

3.11.2 Groundwater Quality Monitoring Programs and Network

Groundwater quality is monitored under several different programs and by different agencies, as described below:

- Municipal and community water purveyors collect water quality samples on a routine basis for compliance monitoring and reporting to the SWRCB's Division of Drinking Water.
- The USGS collects water quality data under the Groundwater Ambient Monitoring and Assessment (GAMA) and National Water Quality Assessment programs.
- The Irrigated Lands Regulatory Program (ILRP) required the development of a Salt Nutrient Management Plan and, more recently, the development of a Groundwater Trend Monitoring Work Plan to identify wells for sampling and a groundwater quality monitoring protocol. Only one well has been designated in the Subbasin.
- West Placer selectively monitors 16 dedicated monitoring wells on an annual basis to assess water quality trends in wells that are approaching or have exceeded the maximum contaminant levels (MCLs) and for select water quality constituents with pending MCLs.

Figure 3-17 shows the locations of the water quality monitoring wells used for the programs described above.

In addition to these monitoring programs, there are multiple sites groundwater quality samples are collected and analyzed as part of investigation or compliance monitoring programs through the Central Valley Regional Water Quality Control Board.

The SWRCB, under the California's Safe and Affordable Fund for Equity and Resilience (SAFER) Program is evaluating on an annual basis water quality and risks to domestic wells and state small water systems. An aquifer risk map has been developed with the intent to help prioritize areas where domestic wells and state small water systems may be accessing groundwater that does not meet primary drinking water standards (maximum contaminant level or MCL). The combined risk layer combines the water quality risk ranking with the domestic well and state small system density of an area to calculate the overall risk to domestic well and state small systems. By combining these two data elements, areas with a relatively high density of reported domestic wells or state small water systems, and a high relative risk to water quality, are assigned the highest combined risk. The risk map will be used by SWRCB staff to help prioritize areas for available SAFER funding. Water quality results for the past 20 years from each well were analyzed. Of the 43 small community water systems within the NASb, only seven water systems were considered to be potentially at risk.

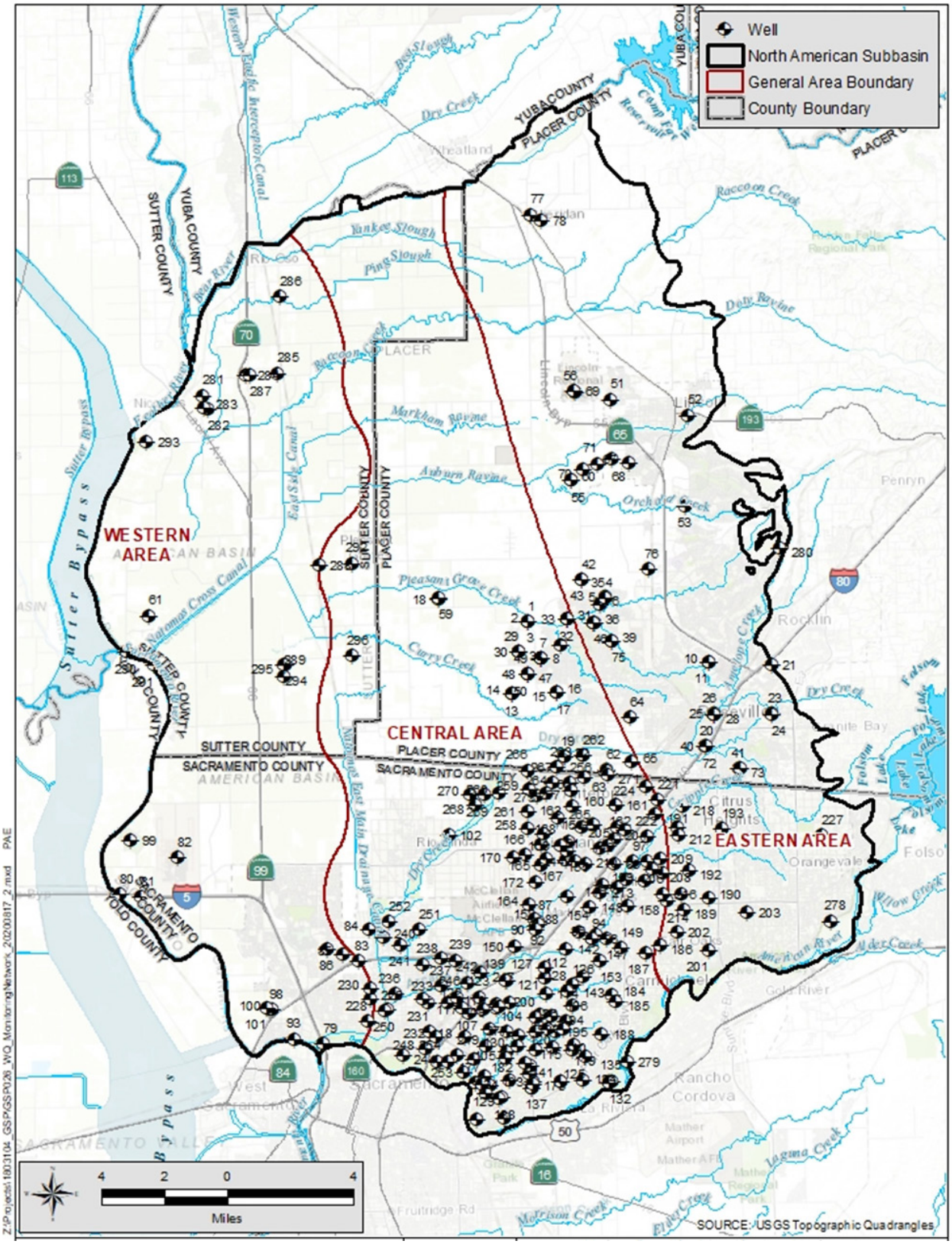


Figure 3-17. Groundwater Quality Monitoring Network

3.11.3 Surface Water Monitoring Networks

DWR, USGS, Placer County, and Sacramento County maintain surface water gages along the rivers, creeks, and sloughs in the NASb with publicly available data online. Depending on the station, they may measure only the level of water (stage) or the discharge. **Figure 3-18** shows the location of these gages. Note that the figure only shows a subset of the gages monitored by Sacramento County. This GSP uses the data collected by these agencies from some of these gages.

Surface water diversions into the Subbasin are also monitored by SSWD, NMWC, Pleasant Grove-Verona Mutual Water Company, Nevada Irrigation District, and Placer County Water Agency, cities of Sacramento and Roseville, San Juan Water District, and Carmichael Water District.

3.11.4 Precipitation Monitoring Network

Precipitation is measured at 29 stations located in the NASb, although many of the stations do not have a long period of record. **Figure 3-17** shows the location of these stations. This GSP uses the data collected by various agencies that maintain and report the data.

The closest station to the NASb with a long period of record, dating back into the 1880s, is the Sacramento 5ESE station, which is just south of the Subbasin but is likely representative due to its geographic location. The average precipitation, using the state climatologist definition of a recent representative period of years, water year 1988-89 through 2008-09 is 18.65 inches, at this location. **Figure 3-19** shows the precipitation by water year (October 1–September 30 of any given year).

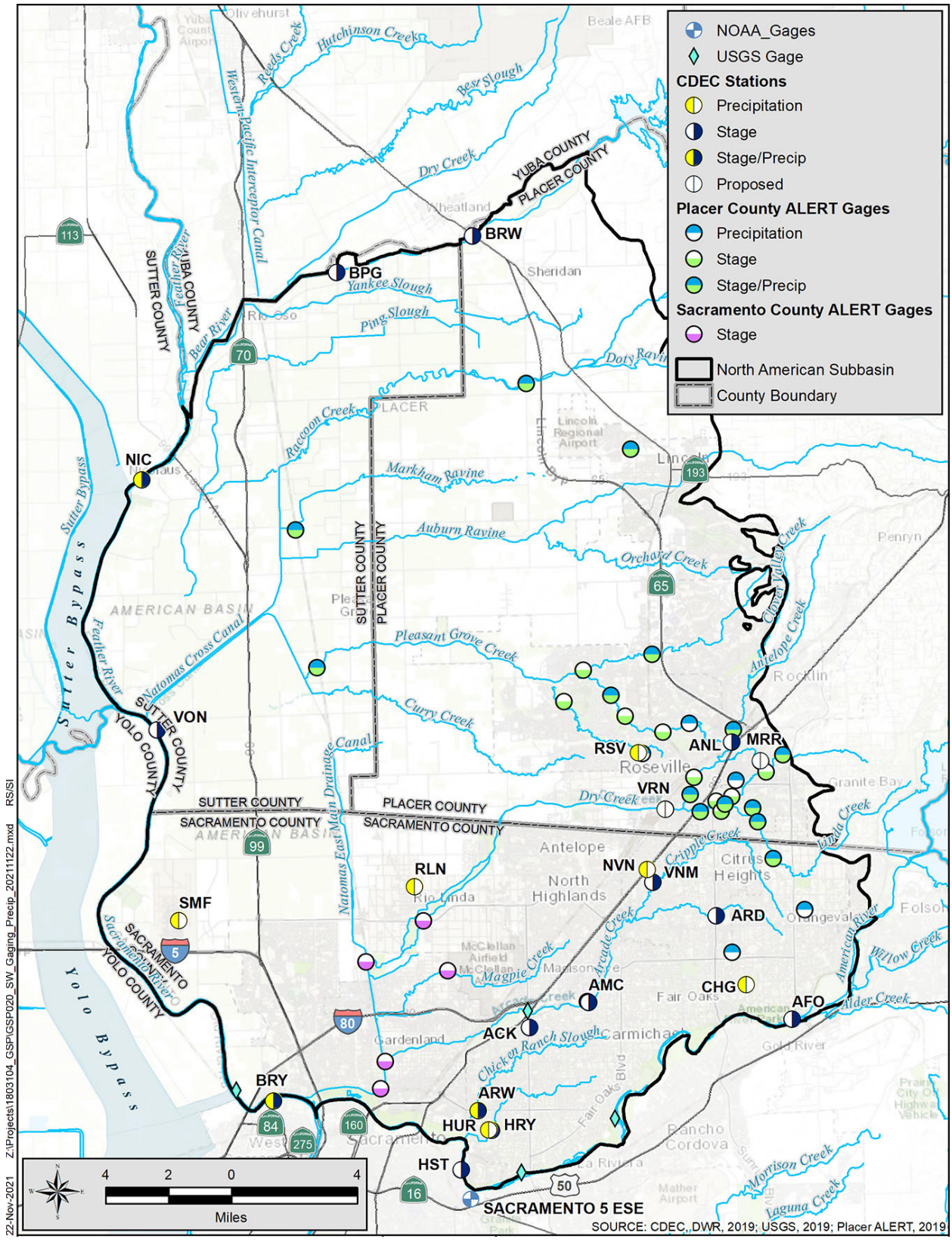


Figure 3-18. River Gages and Precipitation Stations

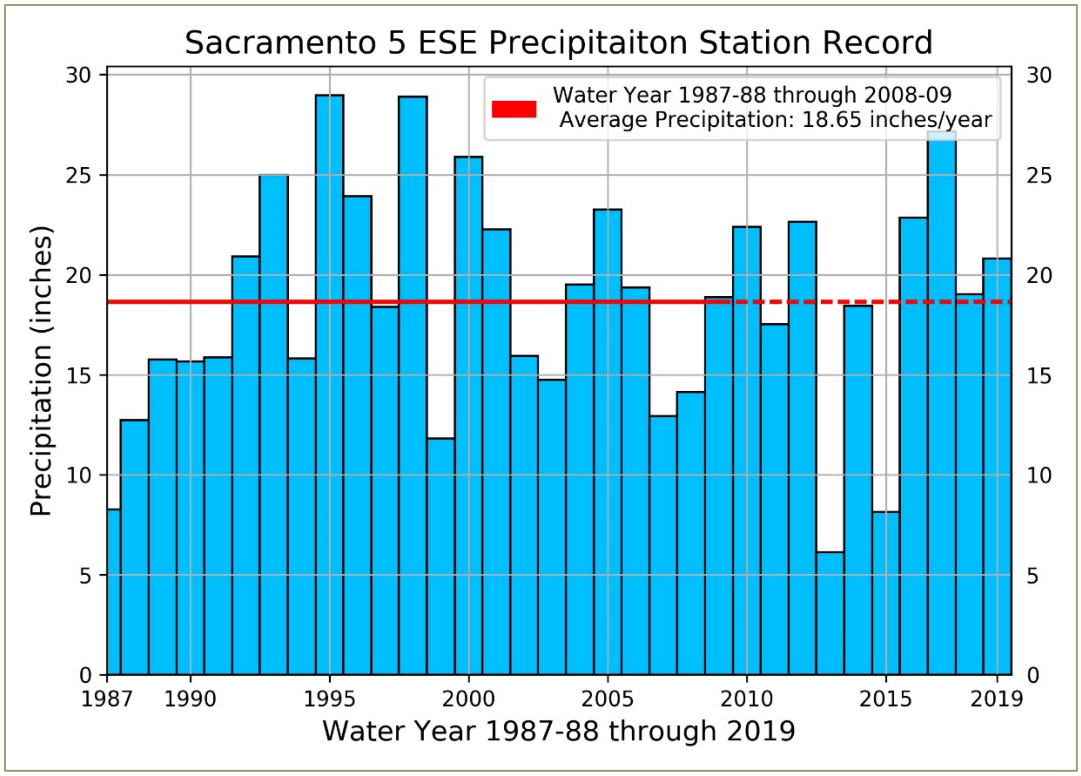


Figure 3-19. Water Year Precipitation

3.11.5 Subsidence Monitoring Network

DWR established a Sacramento Valley-wide benchmark network in 2008 and then resurveyed the benchmarks in 2017 to assess if and where subsidence occurred (DWR, 2018). DWR plans to resurvey this benchmark network about every 5 years or as funding is appropriated.

DWR constructed and monitors for subsidence at the Sutter extensometer (SUT Ext), located near the western edge of the Subbasin, near the Natomas Cross Canal at Highway 99 as shown on **Figure 3-20**. A nearby monitoring well SUT-P (11N04E04N005M) provides groundwater levels to assess if subsidence is related to changes in groundwater levels.

This GSP relies on data from these benchmarks and the extensometer and plans to incorporate them as part of the monitoring network for the NASb, as measured or coordinated by DWR. **Figure 3-20** shows the location of these benchmarks and the extensometer.

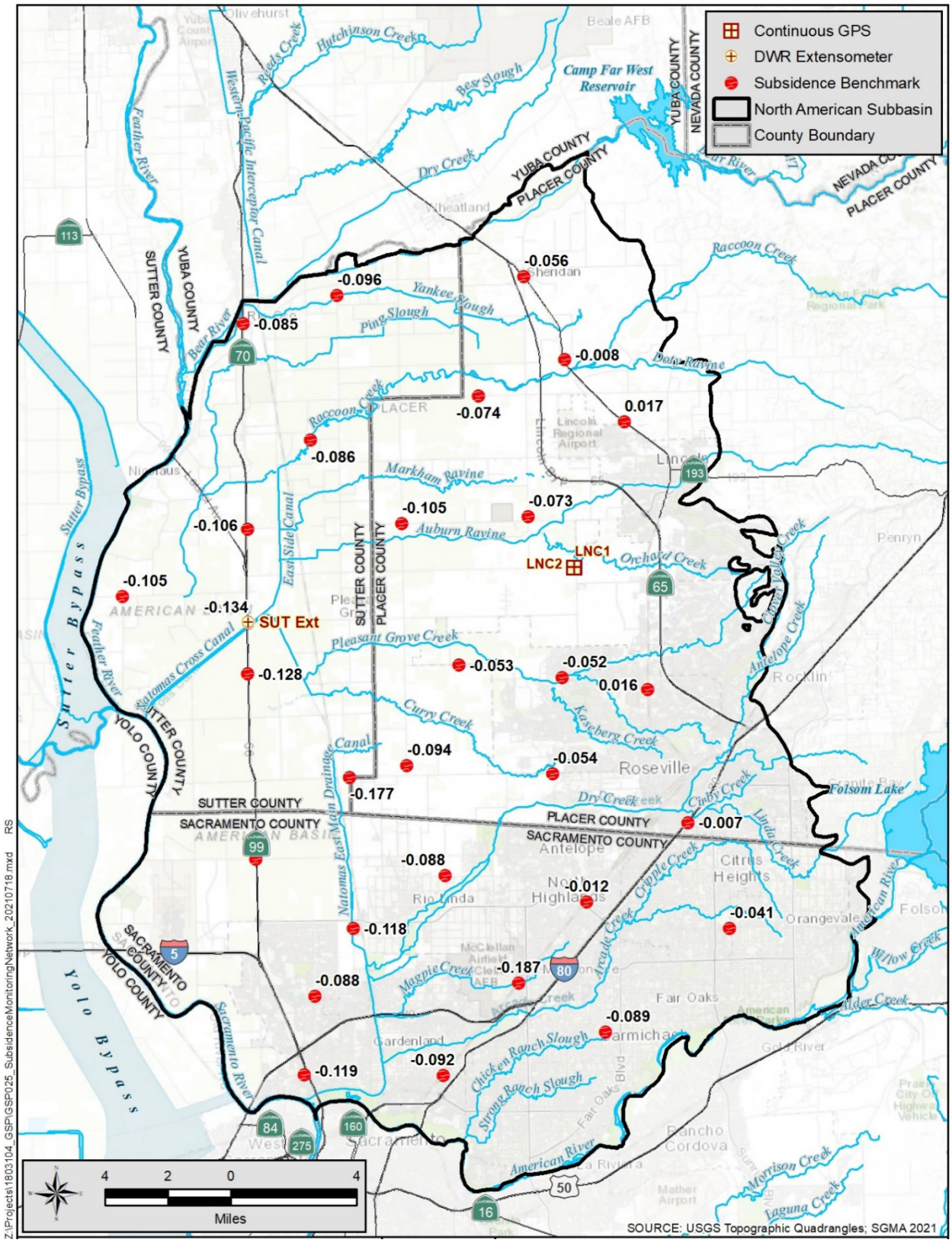


Figure 3-20. Subsidence Monitoring Network

3.12 Limits to Operational Flexibility

None of the existing water resources management or monitoring programs are expected to limit operational flexibility in the basin. Rather, they are seen as complementary to groundwater sustainability. They promote integrated management of water resources, water demand management, and water quality management. These are all fundamental to groundwater sustainability.

3.13 Conjunctive Use Programs

Conjunctive use is the planned, coordinated use of groundwater and surface water to optimize available water supplies. Surface water is used when it is available, and groundwater is used when surface water supplies are reduced or not available. The aquifer is utilized as a storage reservoir that can be recharged from precipitation, subsurface inflow, applied surface water, or injection wells. This stored water is then available when needed.

In 1993, the Water Forum began a process to develop a plan to ensure a reliable water supply for the Sacramento region, including work to develop conjunctive use projects in the area. This resulted in the formation of SGA in 1998. SGA focused the effort started by earlier agencies to manage groundwater in the Sacramento County portion of the NASb. Since the 1990s, SGA and its member agencies have managed groundwater and implemented conjunctive use projects, thereby reversing the decline of groundwater levels in the North Basin.

Currently, public water supplier agencies in the NASb meet water demands with a mixture of a little more than half surface water and a little less than half groundwater. To the extent practicable, the agencies maximize the use of surface water in wet years to maximize the amount of groundwater stored in the basin. The SGA and Regional Water Authority (with member agencies in the NASb and also in the South American and Consumes subbasins and surrounding watersheds) are committed to expanded conjunctive use operations and are investigating a variety of ways to recharge water into the available storage space in the NASb. Most of the recharge occurring through current conjunctive use is from in-lieu recharge (i.e., this is recharge that occurs naturally from rivers, streams, and surface percolation by simply reducing groundwater extractions).

The SGA has developed a Water Accounting Framework (WAF) that has been used by SGA member agencies in the Sacramento County portion of the Subbasin to ensure a safe and sustainable water supply for the greater Sacramento region by encouraging water purveyors to “bank” water in the basin, when available, for use during dry periods. This includes the establishment of a WAF that supports groundwater banking programs by setting forth rules for operating a model groundwater bank and monitoring the basin to ensure its sustainability as the program is implemented. Since 2012, SGA has maintained an accounting of groundwater “deposits” and “withdrawals” associated with implementing their conjunctive use program.

Well ahead of any formal conjunctive use programs, SSWD was formed for the purpose of providing surface water supplies to offset the decline of groundwater levels. The first year of operation of Camp Far West Reservoir and associated facilities was 1964. The operation of these facilities was successful in reversing the decline of groundwater levels such that by 1970 the potential of drainage problems were identified if greater quantities of groundwater were not put to use.

Although not a formal program, water and irrigation districts and mutual water companies that provide surface water for agricultural use in the NASb also provide conjunctive use by increasing their deliveries of surface water during times of surplus, thereby reducing the amount of groundwater pumped by private well owners.

In addition to the active conjunctive use programs described above, Sacramento County has an existing General Plan Conservation Element, Policy C-01 that states to "Support conjunctive use water supply for development." This will help ensure that conjunctive use continues in developing areas of the County.

3.14 Land Use Plans

Land use management and planning authority is granted through the state of California and is derivative of a city's or county's general police power. This power allows cities and counties to establish land use and zoning laws that govern development. Agencies with land use authority in the NASb are the cities of Citrus Heights, Folsom, Lincoln, Rocklin, Roseville, and Sacramento along with counties of Placer, Sacramento, and Sutter. The cities of Roseville and Sacramento are considered charter cities, which provides them with additional constitutional freedoms to govern municipal affairs even if a conflict with state law exists.

General Plans and UWMPs have been developed by the cities of Citrus Heights, Folsom, Lincoln, Roseville, and Sacramento along with Sutter, Placer, and Sacramento counties. Their planning horizons (out to 2030 or 2035) include the anticipated planned growth in the region.

Water purveyors also have a voice in land use planning, but not necessarily an authority. Because they provide water supply, any new development is required to prove adequate water supply will be made available to serve the project and, therefore, may affect land use. Proof of adequate water supplies is required under SB 610 and SB 221, which are intended to assist water suppliers, cities, and counties with integrating water and land use planning. SB 221 prohibits a city or county from approving a residential subdivision of more than 500 units unless there is written verification that sufficient water supply for 20 years is, or will be, available. SB 610 requires retail water agencies with responsibility under prescribed circumstances to prepare water supply assessments for the purpose of predicting and ensuring long-term (20-year) water supply reliability for those projects that are subject to the California Environmental Quality Act (CEQA).

It should be noted that California American Water and Golden State Water Company, although not public water agencies, have similar authority to the public water agencies for the determination of adequate water supplies for new developments.

Water supplies for new developments (*refer to* **Figure 3-6**) will be a mixture of surface water and groundwater. Placer County, Policy 4.C.2, requires for approval that new urban and suburban developments should rely on public water systems using surface water supply. In Placer County, the development near and south of Pleasant Grove Creek will be provided with surface water. Those in the Lincoln area will be a mixture of surface water and groundwater. The early phases of the Sutter Pointe development in Sutter County will rely on groundwater and ultimate planned combination of groundwater and surface water to meet the needs of the community. Surface water would be obtained from NMWC. Planned development areas within Sacramento County will likely use groundwater as their initial sources of supply and ultimately plan to use both surface water and groundwater as their source of supply.

3.15 GSP Implementation Effects on Land Use

The General Plans in the Subbasin provide guidelines to facilitate anticipated growth within the sustainable capacity of existing resources. Successful land use planning promotes sustainable water supply and use within the region. Due to the complementary nature of the General Plans and the GSP, the goals and policies in the General Plans support the ability of the GSAs to achieve sustainability.

Implementation of the GSP, including changes in groundwater management, may influence the type of land use and location of future development. The result will depend on the level of changes set forth by the GSP such as enacted programs, plans, and policies. While General Plan implementation may result in land use changes and changes in water consumption, minimal change in water demand is expected from GSP implementation. The potential for future management actions, which could impact water supplies and development, is discussed in **Section 9 – Projects and Management Actions**.

Most of the land within the Subbasin is currently developed to some use, and conversion from agricultural uses to urban uses is not anticipated to increase water demand. However, conversion from agriculture to urban use may have an effect on water source, depending on the location in the Subbasin, and may shift supply from groundwater to surface water.

3.16 GSP Implementation Effects on Water Supply

The water budgets for the Subbasin show that it is currently within balance and that projected conditions with climate change results in only a slight imbalance. One project is planned that can bring the water budget into balance and within its sustainable yield. The GSAs have also six long-term Supplemental Projects, as discussed in **Section 9 – Projects and Management**

Actions, that are in process of being developed that should groundwater level measurements indicate there is an imbalance the GSAs can easily rectify any short fall. Therefore, with these conditions this GSP does not intend to curtail groundwater use.

3.16.1 Urban Water Supply

The reliability of urban suppliers is expected to improve with implementation of this GSP through expansion of their conjunctive use programs (*see* **Section 9 – Projects and Management Actions**). These conjunctive use programs benefit the entire Subbasin.

3.16.2 Agricultural Water Supply

Agriculture uses about 50 percent groundwater to grow crops (*see* **Section 6 – Water Budgets)**. Conversion of fallow land and rice lands to orchards were included in the modeling assumptions for the projected future with climate change. The model is showing that even with these changes groundwater sustainability indicators will not be adversely affected. Therefore, implementation of this GSP is not expected to affect agricultural water supply.

3.16.3 Domestic Water Supply

Groundwater levels are expected to remain near their current levels (*see* **Section 8 – Sustainable Management Criteria**) and, therefore, no domestic wells are projected to go dry. Because agriculture and municipal wells are typically deeper than domestic wells, implementation of this GSP is not expected to affect these water supplies.

3.16.4 Environmental Water Supply

Groundwater dependent ecosystems are predominately located near the rivers which will continue to maintain shallow groundwater levels (*see* **Section 8 – Sustainable Management Criteria**). Groundwater levels are expected to remain near their current levels and, therefore, groundwater supply to potential groundwater dependent ecosystems is not expected to be lowered or reduced during implementation of this GSP. During drought periods groundwater levels are expected to decrease, which will mimic the natural cycle of wet and dry periods.

Surface water depletion may increase from the Sacramento River with construction of an already approved development (Sutter Pointe). However, the increase in surface water depletion will be offset by the reduction of surface water diversions as the land is converted from agriculture to urban.

3.17 Well Permitting

DWR has responsibility for developing standards for wells for the protection of water quality under California Water Code Section 231. All counties and cities and water agencies, where

appropriate, were required to adopt a well ordinance that meets or exceeds DWR's Water Resources Bulletin 74-81, "Water Standards: State of California" and Bulletin 74-90. Four agencies have well-permitting authority in the NASb for both new and replacement wells and well destruction.

- The **Placer County Water Well Construction Ordinance** provides the minimum requirements for construction, repair, and destruction of water wells, cathodic protection wells, and monitoring wells. Whoever wishes to drill a well within the county's boundaries, except for those within the city of Roseville, must first obtain a County Environmental Health permit. Placer County administers the well permitting program for the entire county, except for lands within the city of Roseville. Any wells planned within the city of Lincoln must first be approved by the city prior to the issuance of a County Environmental Health permit.

- **Roseville's Environmental Utilities Engineering Division** is the permitting agency for wells located within Roseville's city limits. To permit a well in Roseville, a Well Construction Application and Permit Form must be filed with the Environmental Utilities Department.

- The **Sacramento County Environmental Management Department (SCEMD)** approves permit applications for a new well or to deepen, reconstruct, recondition, or destroy a well. Any well that is constructed in Sacramento County must have a permit from the Environmental Management Department prior to the start of construction unless it is specifically exempted in the Sacramento County Code. The conditions and process for obtaining well permits are governed under Sacramento County Code, Title 6, Chapter 6.28.

    - Section 6.28.025 defined a "prohibition area" as that portion of the unincorporated territory of the county bounded on the east and south by the former McClellan Air Force Base, on the south by Sacramento city limits, on the west by Dry Creek Road, and on the north by I Street. No permits shall be issued for, and no person shall dig or drill a new water well within the prohibition area.

    - The permit requires that any applicant shall contact the CVRWQCB to assess the potential for groundwater contamination in the vicinity of the well and can require special sanitary seal requirements to prevent the spread of contaminants.

    - SCEMD also, when required, requests copies of CEQA documentation prior to the approval of the permits.

- **Sutter County Environmental Health Division (SCEHD)** is the well-permitting agency for Sutter County. One permit application is used for a new well or to deepen, reconstruct, recondition, or destroy a well. The permit application requires a site plan showing the location of the well and the accessor's parcel number. The design and construction of the well shall be in conformance with the California Department of Water Resources Bulletin

74-81, “Water Standards: State of California” as outlined in the County of Sutter Department of Public Works Improvement Standards (2005, rev. 2010).

All of the permitting agencies have requirements for wellhead protection including minimum well heights, well seals and concrete pads to surround the well and to promote drainage away for the wells.

None of the well permitting agencies coordinates with county or city land developers. There are no setbacks or special investigation requirements for construction of supply wells near the rivers or tributaries.

3.18 Land Use Plans Outside of the NASb

During coordination with the Yuba, Sutter, and Yolo subbasins, representative GSAs disclosed that there were no planned developments or land use changes near our common boundaries that would affect the NASb’s ability to maintain sustainable groundwater management to our north and west. To the south, the NASb has closely coordinated on development of a groundwater model with the South American Subbasin. While there are planned changes in land use and conjunctive management practices to our south, modeling indicates that these changes would not affect our ability to maintain sustainable groundwater management. This modeling is documented in **Section 9.2.1 - Project #1 - Regional Conjunctive Use Expansion** of this GSP.

This page intentionally left blank

4. Hydrogeologic Setting

This section describes the geologic conditions that control how groundwater moves in the NASb, the Subbasin extent, recharge and discharge areas, general water quality, and defines the principal aquifers.

4.1 Basin Boundaries

The NASb lies in the eastern central portion of the Sacramento Valley Groundwater Basin. A subbasin designation indicates that aquifers beneath the NASb may extend into the adjacent South American, South Yuba, Sutter, and Yolo subbasins.
The NASb is surrounded on three sides by rivers and on one side by bedrock; the Bear River is its northern boundary, the Feather and Sacramento rivers are its western boundary, and the American River is its southern boundary. The eastern boundary, a roughly north-south line extending from the Bear River south to the American River, represents the approximate edge of the alluvial basin, where little or no groundwater flows into or out of the groundwater basin from the bedrock of the Sierra Nevada mountain range (Sierra Nevada) (DWR, 1997).

The bottom of the Subbasin is defined as either bedrock (igneous and metamorphic) that can be found cropping out in the foothills east portion of the Subbasin or the top of the marine sediments (base of fresh water). Fresh water is defined as water having salts that result in an electrical conductivity measurement of less than 3,000 micromhos (Berkstresser, 1973). The base of fresh water occurs near ground surface in the eastern portions of the Subbasin and deepens westward to more than 2,000 feet below mean sea level (msl) near the southwestern corner of the Subbasin. **Figure 4-1** shows the base of fresh water.

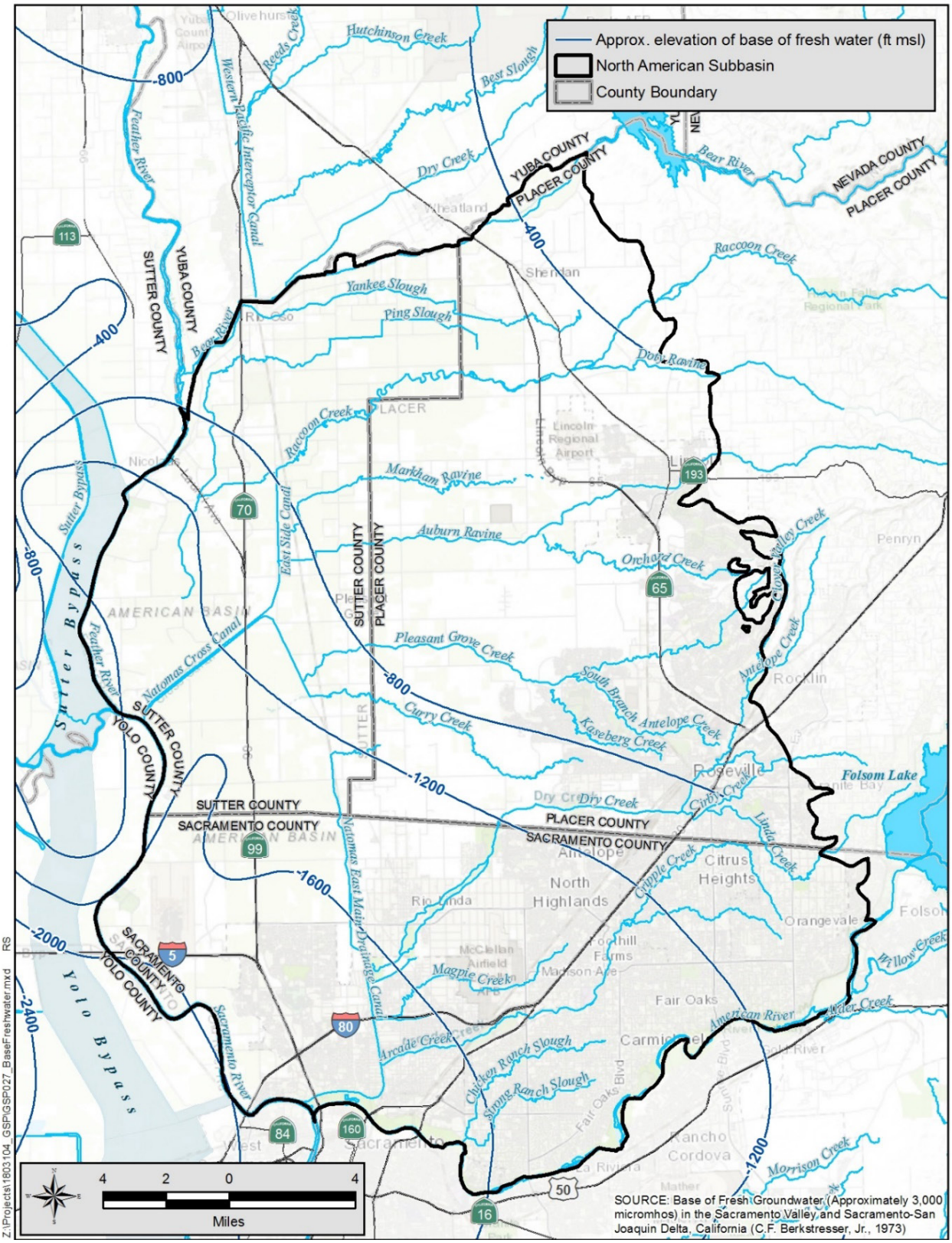


Figure 4-1. Base of Fresh Water

4.2 Topography

The topography in the NASb is irregular in the eastern portion of the Subbasin whereas the western portion of the Subbasin is nearly flat. The elevation in the Subbasin ranges from about 20 to 300 feet above msl. In the eastern portion of the NASb, ground surface is characterized by low rolling dissected uplands. The western half of the Subbasin is nearly flat, with elevations ranging from 20 feet above msl near the Feather and Sacramento rivers to about 50 feet above msl in the central portion of the Subbasin. The lowest land elevations are located near the southwestern corner of the Subbasin, near the confluence of the Sacramento and American rivers. The topography of the Subbasin is shown in **Figure 4-2**.

4.3 Surface Water Bodies

There are no large lakes or reservoirs in the NASb. There are numerous lakes and reservoirs within the Bear and American watersheds that contribute water to the NASb. The lowest elevation reservoirs in the watershed are Folsom and Camp Far West, which control flows in the American River and the Bear River, respectively. There are numerous smaller reservoirs above both Folsom and Camp Far West reservoirs.

Below Folsom Reservoir and within the NASb is Lake Natoma, which is a small lake that ponds water and may provide some recharge to the Subbasin. Outside of the Subbasin and watershed, to the north, are Lake Oroville and Shasta reservoirs, which regulate flow to the Feather and Sacramento rivers, respectively. Flows in these rivers, especially during the summer months, are predominantly due to regulated releases through dams that created these reservoirs and lakes.

The Subbasin is drained by numerous creeks and ravines that are tributary to the American, Bear, Feather, and Sacramento rivers (**Figure 4-2)**. Most of the creeks and ravines drain either to the East Side Canal and Natomas Cross Canal or the Natomas East Main Drainage Canal. These canals were constructed to reclaim and provide flood protection for lands west of the canals.

Water in the tributaries is present due to rain (winter months), tailwater from Placer County Water Agency and Nevada Irrigation District canal systems, conveyance of transferred water, and treated water from wastewater treatment plants. In the western portion of the Subbasin, groundwater may discharge seasonally to drainage canals and the Feather and Sacramento rivers.

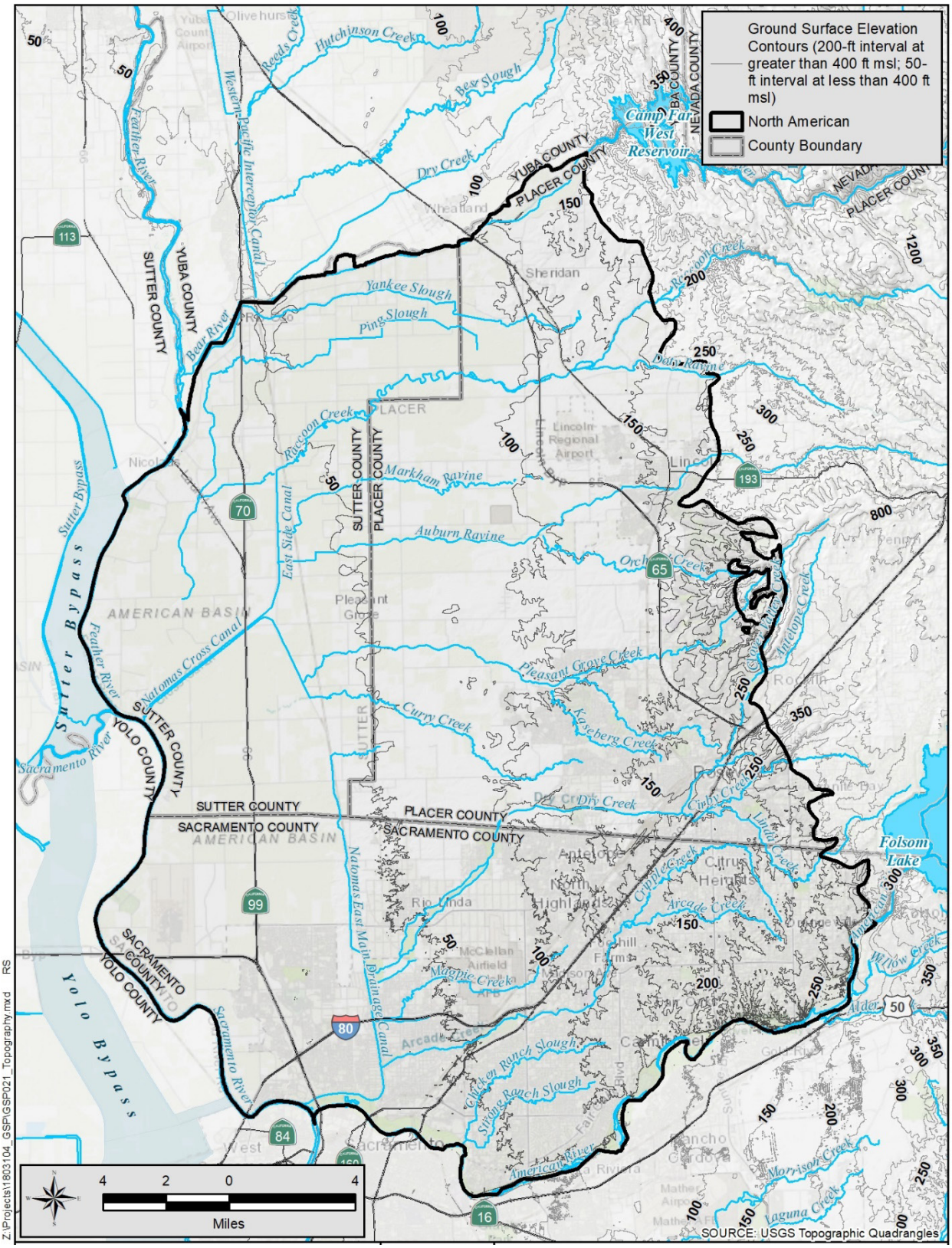


Figure 4-2. Topography

4.4 Soils

The NASb is covered by soils whose age, in general, corresponds with the relative age of the geologic units. The oldest soils lie along the eastern margin of the study area, with progressively younger soils toward the west. Most of the soils in the eastern three-fourths of the study area have well-developed profiles, usually with claypans and hardpans (U.S. Soil Conservation Service, 1980 and 1987). The dense subsoil in these areas may limit deep percolation of precipitation and applied irrigation water.

Soil permeability provides an initial indication of where recharge to the underlying aquifers may occur. Soil types and attributes have been mapped in the NASb by the U.S. Department of Agriculture's Natural Resources Conservation Service and are contained in a database (SSURGO, 2019). The Hydrologic Soils Grouping describes the soil's drainage characteristics. The groups range from Type A soils, which are well drained (high infiltration rates), Type B that are moderately drained, Type C that are poorly drained, and Type D soils that are very poorly drained (very slow infiltration rates). **Figure 4-3** shows the soil types by hydrologic groupings in the Subbasin. Much of the Subbasin is covered with poorly drained Type C and D soils. While these poor infiltration rate soils often inhibit flow to the subsurface, these soils classifications are generalizations of soil types and localized windows of connection to the underlying aquifers can exist, particularly when streams are incised through the soil profile. Most of the coarse-grained, well-drained soils occur along rivers and major stream channels and some along the eastern margins of the Subbasin.

While the Hydrologic Soils groups shown on **Figure 4-3** indicate the hydrologic characteristics of the soils, the Soil Agricultural Groundwater Banking Index (SAGBI), developed by researchers at UC Davis (O'Green, et al., 2015), also considers factors that affect the suitability of active agricultural lands for groundwater recharge, including root zone residence time, topography, chemical limitations, and soil surface condition. The UC Davis researchers developed an index that ignores restrictive layers in the first 6 feet. This "modified SAGBI" is shown on **Figure 4-4** and assumes that tillage practices could break up the shallow restrictive layers. These kinds of tillage (or ripping) practices may already have been used in certain areas that may have greatly enhanced the soil's hydrologic characteristics and increased their permeability. **Figure 4-4** shows a much larger area of more permeable soils than shown on the SSURGO soils map in **Figure 4-3**. Note that the white/gray areas do not contain the data necessary to calculate the SAGBI.

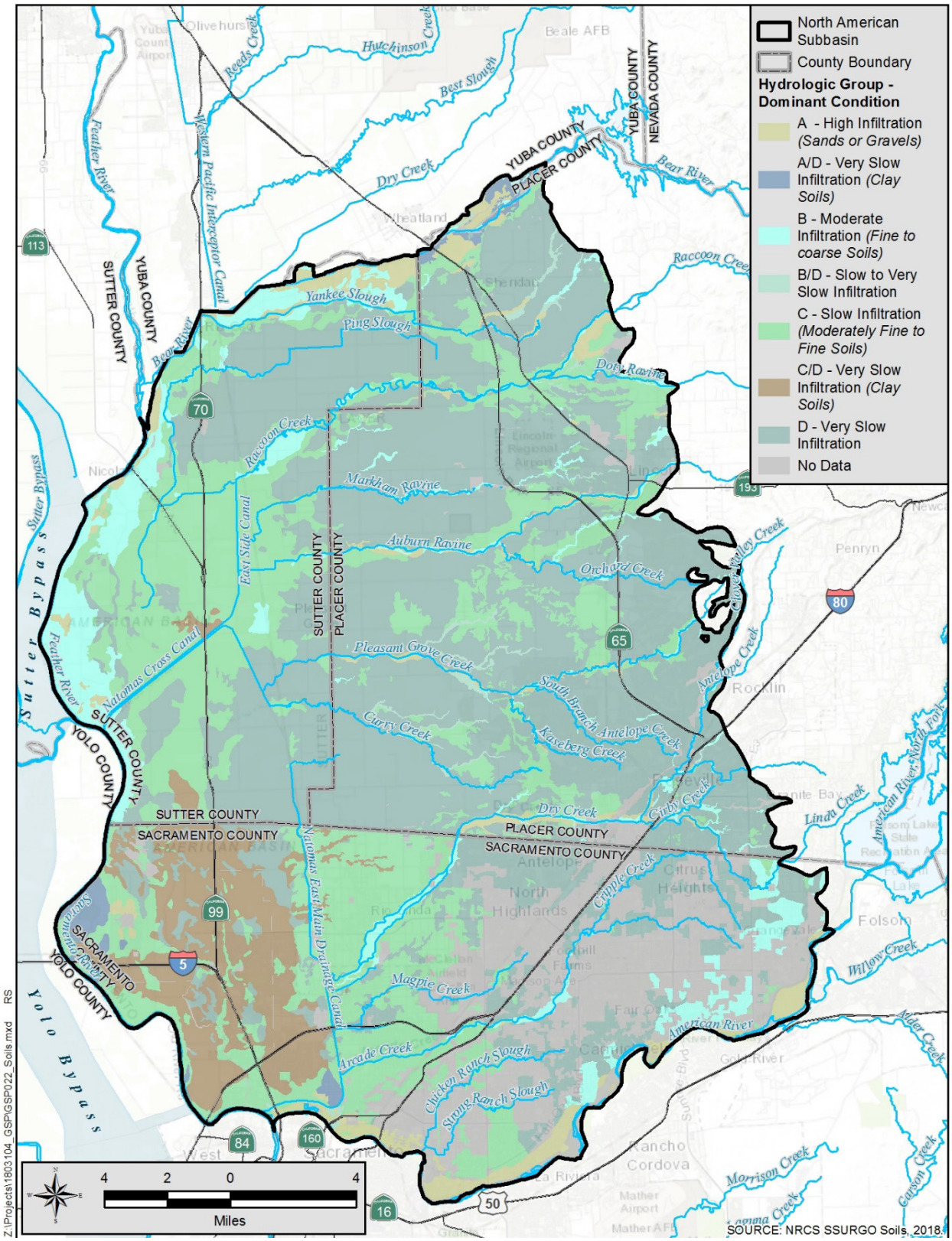


Figure 4-3. Hydrologic Soils Classification

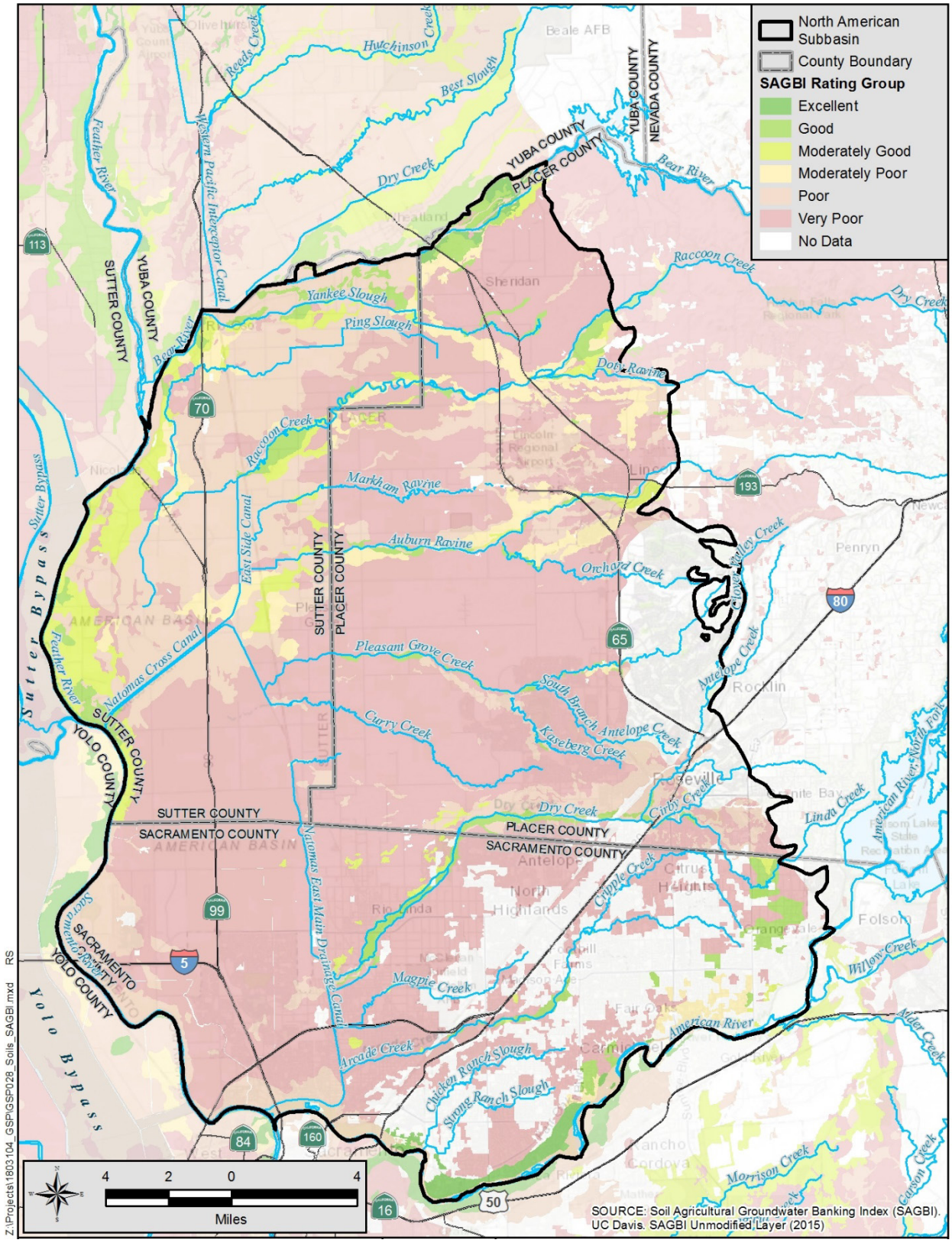


Figure 4-4. SAGBI Soils

4.5 Regional Geology

The Sacramento Valley is a large depression bounded on the east by the Sierra Nevada, a block mountain range faulted upward on the east and dipping westward beneath the Sacramento Valley. The Sierra Nevada consists of metamorphic rocks intruded by igneous rocks. The Sacramento Valley is bounded on the west by the Coast Range mountains.

Younger river and creek-lain deposits comprise the major portion of the freshwater aquifer system in the Sacramento Valley. The sediments beneath the NASb depict a regional change in the environments, from one previously dominated by marine sedimentary processes to one with continental sedimentary processes. The Sacramento Valley, including the NASb, is filled with marine sedimentary rocks that contain ancient seawater and traps of natural gases. The Valley Springs and Ione formations were deposited during the conversion from marine to continental environments. These formations contain both fresh and brackish water (having salts that result in an electrical conductivity measurement of greater than 3,000 micromhos). Both formations are overlain by younger, continentally derived sediments that have been grouped into the Younger Alluvium and the Modesto, Riverbank, Turlock Lake, Laguna, and Mehrten formations. **Figure 4-5** shows the distribution of these sediments in the Subbasin at ground surface. These formations contain fresh, mostly potable water. Clear distinctions and confining layers that separate formations often do not exist and water movement between formations can occur.

4.6 Geologic Structure

During the deposition of sediments, the valley has been gently down-warped due to tectonic activities and consolidation of the sediments. Sediments generally dip toward the center of the valley at about a 4-degree dip. Therefore, near the eastern edge of the Subbasin, older sediments such as the Mehrten Formation are exposed at the ground surface while to the west these sediments occur as deep as 2,000 feet below ground surface.

Faults may affect groundwater flow by bringing geologic materials with different hydraulic properties into contact across the fault plane or by fracturing the sediments, which could either increase or decrease permeability. Faults might, therefore, act as a boundary or barrier affecting the lateral flow of groundwater between adjacent areas and could act as a conduit allowing vertical upward flow within the fault zone. There are no known active faults within the Subbasin (DWR, 1997), but there are older inactive faults that may affect groundwater quality. One of these older faults is the Willows Fault, which is a northwest-southeast trending reverse fault that dips 74 degrees to the east and extends from the Stockton area through the NASb and to the north end of the Sacramento Valley (Harwood and Helley, 1987). **Figure 4-5** shows the location of the fault. Displacement along the Willows Fault is approximately 1,600 feet and displaces older marine sediments up to the time of deposition of the Ione Formation (Harwood and Helley, 1987). It does not continue into the fresh water-bearing sediments and therefore is not a barrier to groundwater flow. Although the fault is not designated by the state as active, the fault does

appear to have some movement. The slip rate on the Willows Fault is very small, estimated to be 0.00055 inches per year (McPherson and Garven, 1999, referenced in DWR, 2014), but still suggests some activity.

4.7 Fresh Water-Bearing Formations

Fresh water-bearing sediments in the NASb from shallow/youngest to deepest/oldest sediments include the Quaternary Alluvium and the Modesto, Riverbank, Turlock Lake, Laguna, and Mehrten formations. These formations are of similar ages and have been grouped together for discussion purposes below. Surface outcrop locations of the formations are shown in **Figure 4-5**.

4.7.1 Quaternary Alluvium

Quaternary Alluvium is the youngest geologic unit (current to 10,000 years old) in the Subbasin. Laterally extensive outcrops of the Quaternary Alluvium deposits occur along the American, Bear, Feather, and Sacramento rivers. The alluvium is separated into three types: those associated with stream channels, with flood basins, and with alluvial fans (sediments deposited by streams as they emerge onto the valley floor).

The stream channel deposits originate in the channels of active streams and as overbank deposits of those streams, terraces, and local dredge tailings. Alluvium consists of sand, gravel, silt, and minor clay. The most extensive deposits occur along the American, Bear, Feather, and Sacramento rivers. Near the junction of the Bear and Feather rivers, coarse-grained sediments are present at depths up to 140 feet. However, the deeper sediments probably belong to the Modesto and Riverbank formations. Along the Bear River, the thickness of the alluvium is estimated to be 25 to 60 feet thick (Olmstead and Davis, 1961). The alluvium is also exposed along the smaller streams draining the Subbasin and is probably only a few tens of feet thick.

Flood basin deposits consist primarily of poorly drained silts and clays, although local lenses of sand and gravel may occur from the deposition of migrating ancestral river channels. The thickness of each of these units may be up to 100 feet (Olmstead and Davis, 1961). Flood basin deposits crop out on the western margin of the Subbasin, immediately east of the Sacramento River.

Alluvial fan deposits are derived from the Sierra Nevada and are generally coarse-grained. They are present along the eastern edge of the Sacramento Valley where they overlie the Mehrten, Ione, and Valley Springs formations.

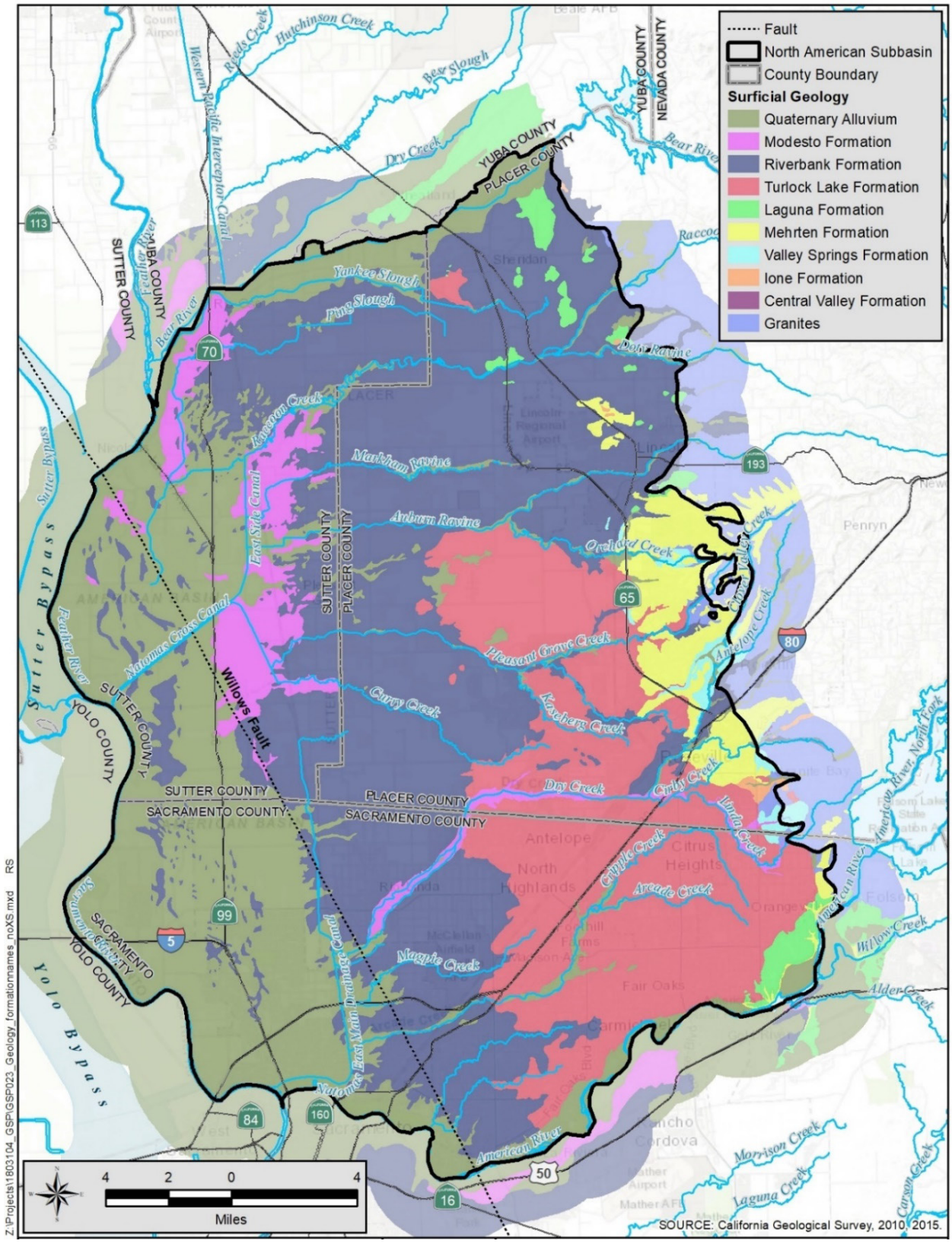


Figure 4-5. Surface Geology

4.7.2 Modesto and Riverbank Formations

The Pleistocene-age (10,000 to 2 million years) Modesto and Riverbank formations are the most widely exposed geologic units in the study area. They unconformably overlie the Turlock Lake, Laguna, and Mehrten formations and the metamorphic and igneous rocks near the eastern margin of the Subbasin. The Modesto and Riverbank formations were derived from similar parent rocks and are indistinguishable (lithologically) in the subsurface, composed of mixtures of silt, sand, gravel, and clay that are very heterogeneous both laterally and vertically. The combined thickness of these two formations can be up to 75 feet. These two formations are moderately permeable but include highly permeable coarse zones (Olmstead and Davis 1961).

4.7.3 Turlock Lake and Laguna Formations

Underlying the Modesto and Riverbank formations are the early Pleistocene-age (2 to 10 million years) Turlock Lake Formation and Pliocene-age Laguna Formation. The Turlock Lake and Laguna formations unconformably overlie the Mehrten Formation. The units underlie dissected uplands along the eastern margin of the study area and dip westward beneath the land surface toward the axis of the valley. The exposures of the Laguna Formation are small and discontinuous, generally less than a few square miles in area, and limited to the northeastern corner of the NASb. The Turlock Lake Formation is exposed on ground surface in a wide band near the southeastern corner of the NASb.

The Turlock Lake and Laguna formations are lithologically indistinguishable. They are differentiated in outcrop by the presence of a preserved clay soil horizon in the Turlock Lake Formation (Helley and Harwood, 1985). The Turlock Lake and Laguna formations consist of a heterogeneous mixture of tan to brown interbedded silt, clay, and sand. Gravel lenses are scarce and, where present, are poorly sorted and have low permeability. Pebbles and cobbles of quartz and metamorphic rocks generally dominate the gravels (DWR, 1974; Olmstead and Davis, 1961). The combined thickness of the two units is probably less than 200 feet.

Due to the predominantly fine-grained character of these two formations, wells completed in them reportedly have low to moderate yields, usually less than 1,000 gallons per minute.

4.7.4 Mehrten Formation

The Mehrten Formation is early to mid-Pliocene age and crops out along the southeastern Sacramento and Northern San Joaquin valleys and within the NASb. It is exposed only on the eastern side of the Subbasin near the City of Lincoln and south toward the City of Roseville and has been penetrated by wells as far west as the town of Nicolaus. The Mehrten Formation was deposited on an irregular eroded surface (unconformable) of marine sediments of the Valley Springs and Ione formations (Olmstead and Davis, 1961).

Depending on location, the Mehrten Formation is between 200 and 1,200 feet thick (DWR, 2003). It is thinnest in the eastern portion of the NASb and thickens towards the west. The

thickness of the Mehrten Formation in the Sacramento Valley is about 200 feet where exposed and ranges between 400 and 500 feet in thickness in the subsurface (Page, 1986). Black sands are characteristic of the Mehrten Formation.

Two distinct units in the Mehrten Formation have been described in the Sacramento Valley—an upper unit composed of unconsolidated black sands interbedded with blue-to-brown clay, and a lower unit composed of hard, angular rock fragments in a fine grained matric (breccia), which is sometimes reported by well drillers as "lava" (DWR, 1978; Page, 1986). This breccia may act as a confining layer in the subsurface. The volcanic source material is from the Sierra Nevada.

Wells completed in the sand and gravel units have reported pumping capacities of over 3,000 gallons per minute.

4.8 Non-Water or Non-Fresh Water Bearing Formations

Non-water or non-fresh water bearing formations in the NASb include the Tertiary-age Ione and Valley Springs formations and the Paleocene to Eocene Central Valley Formation. These strata are underlain by crystalline igneous and metamorphic basement rock like those exposed in the foothills east of the Subbasin. The Ione and Valley Springs formations exist beneath the Mehrten Formation and are thought to be a transitional system that contains a mixture of saline and fresh groundwater.

4.8.1 Valley Springs Formation

The Valley Springs Formation is a sequence of mostly fluvial sediments that unconformably overlies the Ione Formation, and is composed of sandy clay, sand, rhyolitic ash, and siliceous gravel (Davis and Hall, 1959). Well-log information and outcrop exposure in the Sacramento Valley indicated that the Valley Springs Formation is estimated to be up to 200 feet thick (Piper and others, 1939; DWR, 1978). Fine ash and clay in the Valley Springs Formation limit the quantity of water produced by wells (Page and Balding, 1973). The Valley Springs Formation is exposed along Antelope Creek and in the community of Granite Bay.

4.8.2 Ione Formation

The Ione Formation was deposited on eroded surfaces (unconformably) of the Central Valley Formation and crystalline and metamorphic rocks near the eastern portion of the Subbasin. The formation is near the surface in most of the Placer County portion of the Subbasin generally east of Highway 65 and the foothills. The western extent of the Ione Formation is characterized by shallow marine deposition in the remnants of the inland sea, while the eastern extent of the formation is characterized by non-marine deltaic deposition (Redwine, 1984; Springhorn, 2008). It is exposed in the clay pit area near the city of Lincoln. The thickness of the formation varies because the top is eroded. The formation is about 200 to 300 feet thick in the vicinity of the city

of Roseville, 500 to 600 feet thick in the vicinity of the city of Lincoln and thickens to about 1,000 feet at the western margin of Placer County. There are also small exposures in the Granite Bay area.

Clean sands of the Ione Formation are partially and erratically flushed by fresh waters in the area between the foothills and Highway 65. However, there is very little movement of groundwater in this formation, and due to low yields and poor water quality, it is not considered an economical source of groundwater for irrigation. Owing to the degree of consolidation and clay content, the Ione Formation yields a limited quantity of water to wells (DWR, 1978; Page, 1986).

4.8.3 Central Valley Formation

Overlapping the granite and metamorphic crystalline bedrock are the Upper Cretaceous marine sedimentary rocks that compose the Central Valley Formation. The strata form a wedge thickening generally westward beneath the Subbasin. Water contained in these sediments is generally saline and of very low yield to wells. The total thickness of the Central Valley Formation near the eastern portion of the Subbasin where it overlaps on the bedrock is only a few hundred feet thick, but it increases to several thousand feet thick near the western boundary of the Subbasin.

The Central Valley Formation and other marine formations contain economic quantities of natural gases. Several small gas fields are located primarily along the western border of the Subbasin, near the Willows Fault. Drilling and operation of natural gas wells are highly regulated by the California Geologic Energy Management Division (commonly known as “CalGEM”), formerly known as Division of Oil, Gas, and Geothermal Resources, which was formed in 1913. However, exploration holes and abandoned wells drilled prior to 1913 and not properly sealed could affect freshwater quality. At this time, no water quality problems in the Subbasin can be directly attributed to these holes or wells. **Figure 4-6** shows the locations of the natural gas wells in the Subbasin, illustrating potential areas where old exploration holes may have been improperly abandoned but could provide vertical conduits for brackish water to intrude the freshwater aquifers.

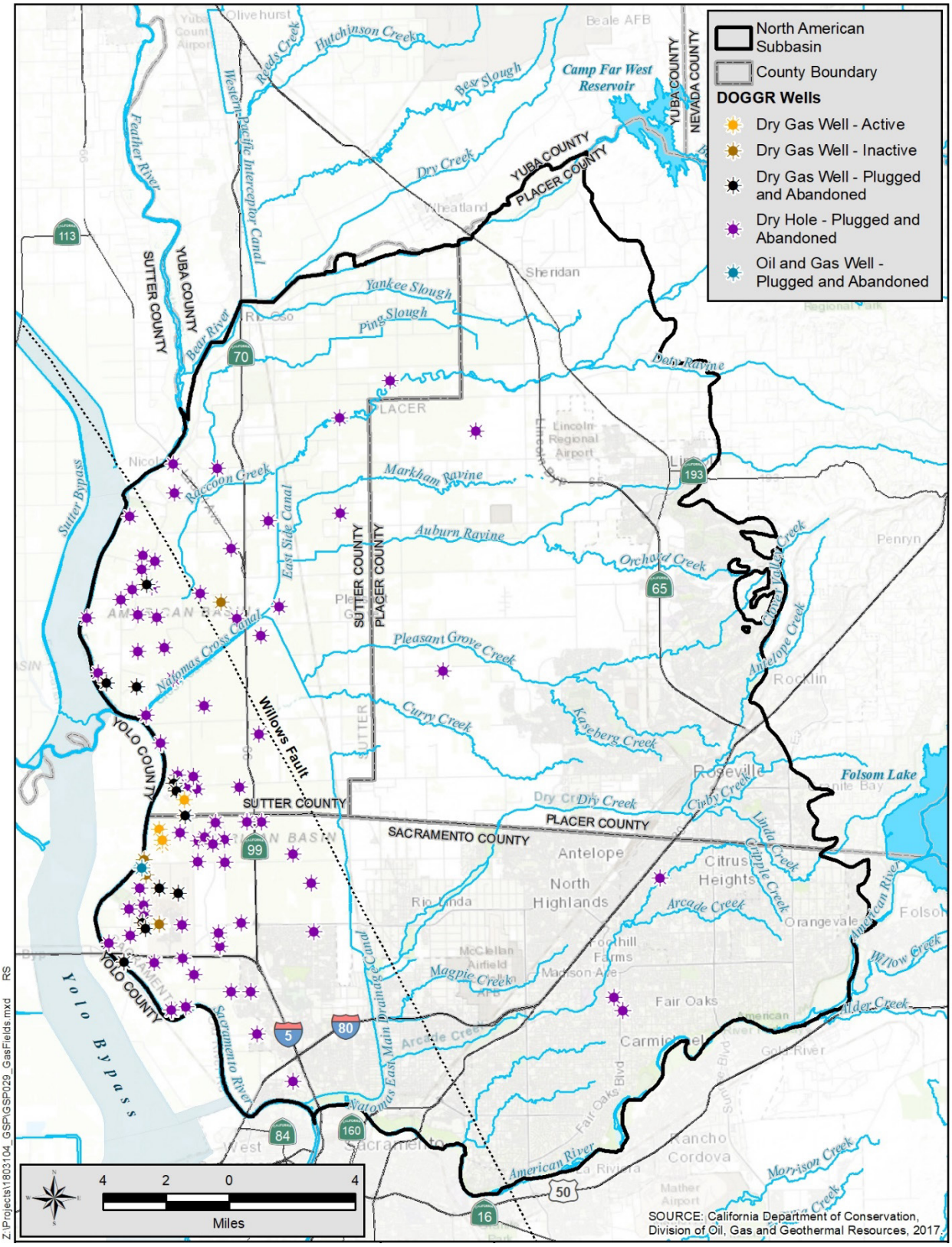


Figure 4-6. Natural Gas Wells

4.8.4 Basement Rocks

All of the formations and sediments mentioned above are underlain by igneous and metamorphic rocks, potentially similar to those exposed in the Coast Ranges and in the Sierra Nevada. Along the eastern margin of the Subbasin where the Ione and Central Valley formations are present at shallow depths, generally north of the city of Lincoln, domestic and agricultural well owners have constructed wells into the basement rocks, due to the low yielding and poor-quality water in the marine sediments, to obtain fresh water.

4.9 Regional Geologic Sections

Three geologic sections were created for this Groundwater Sustainability Plan (GSP) using previous sections developed by DWR (1997) and are straight lines through the Subbasin as shown on **Figure 4-7**. The coarse-grained sediments (sands and gravels) that are aquifers were deposited as stream or river channels that meandered through the Subbasin in a sinusoidal (snake like) pattern and therefore a straight profile may not show their full extent or their inter-connectedness. **Figure 4-8** illustrates these channel deposits and how they wander and may be stacked upon each other (DWR, 1974).

Geologic sections of the Subbasin exist from multiple sources, but historical sections did not cross the entire Subbasin. The longest and most detailed sections were prepared by DWR (1997). The DWR sections were used as a starting point and modified to extend across the entire Subbasin for this GSP effort. Lithologic information from well logs was normalized and digitized to generally conform with the Unified Soil Classification System. Lithology and well screens from dedicated groundwater monitoring wells, constructed after the DWR sections were created, were also added to the geologic sections for this GSP effort. The profiles are presented to illustrate the subsurface relationships and distribution of the formations and coarse-grained sediments that constitute principal aquifers. The profile locations are shown on **Figure 4-7**. **Figures 4-9, 4-10, and 4-11** illustrate the subsurface with sediment types, saturated sediments, and the base of fresh water. These figures were created from the well driller's reports attached in **Appendix D**.

The profiles show the general contact between the Mehrten Formation and younger formations. The profiles also show different dips of the aquifers respecting the unconformities previously documented.

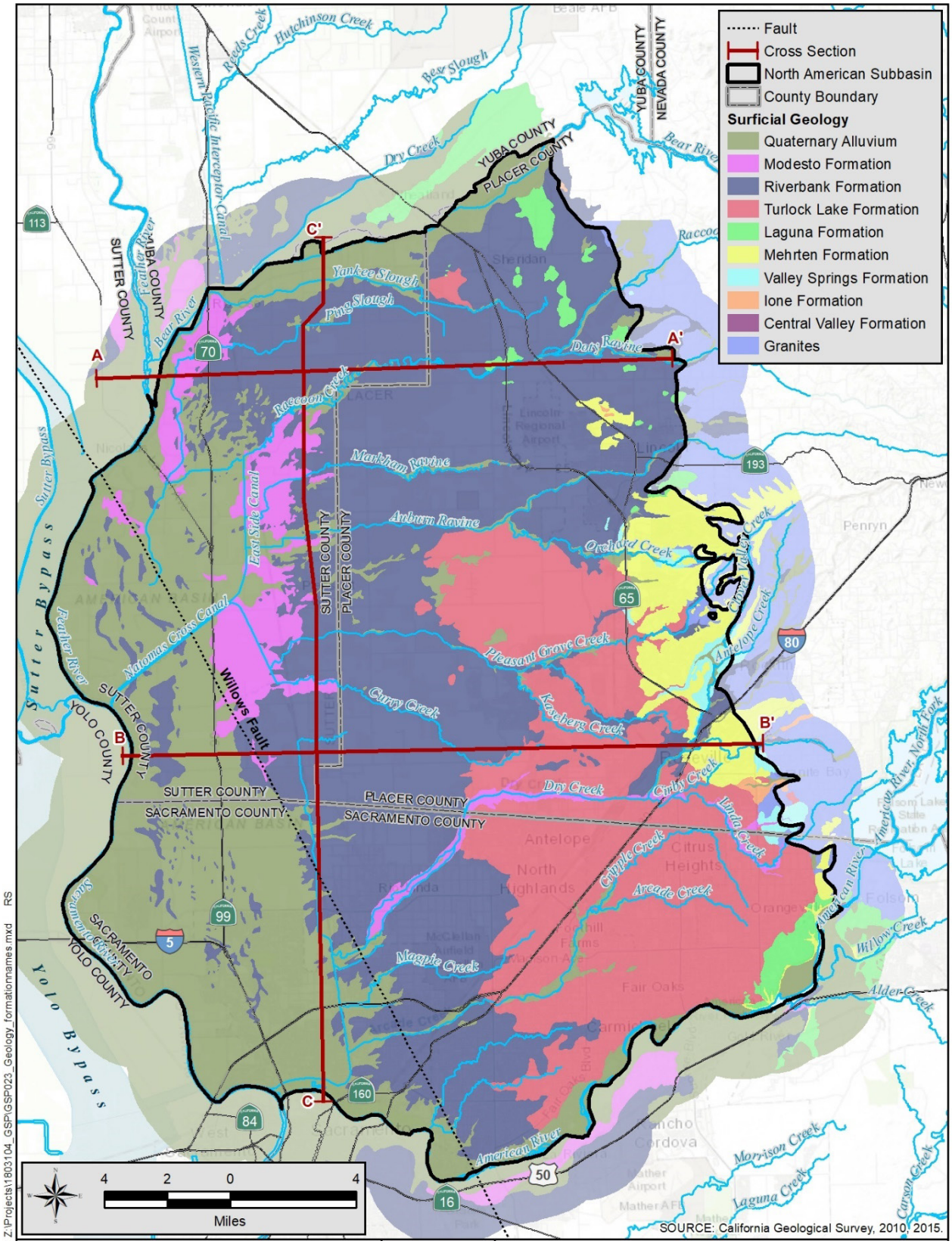


Figure 4-7. Geologic Section Locations

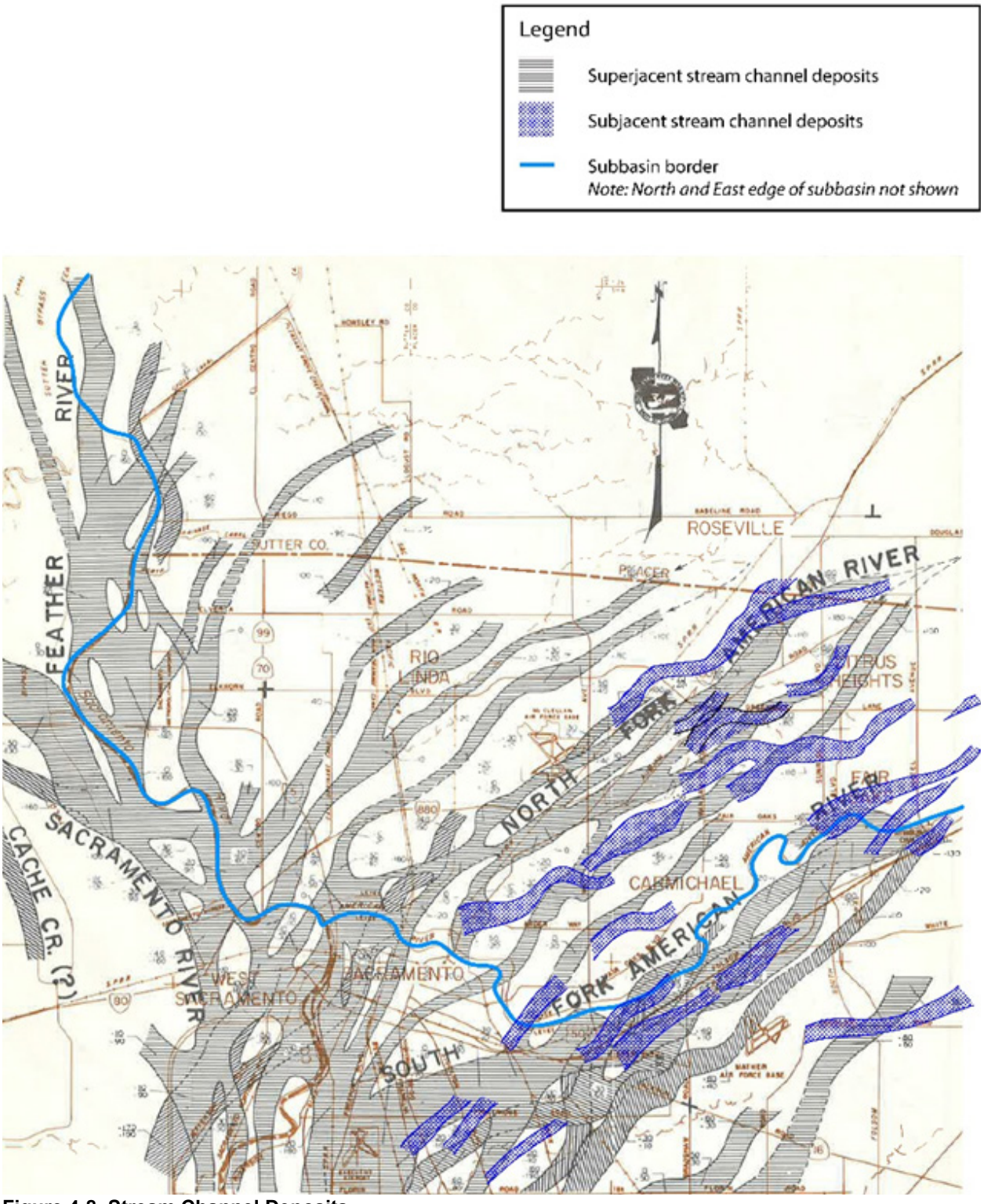


Figure 4-8. Stream Channel Deposits

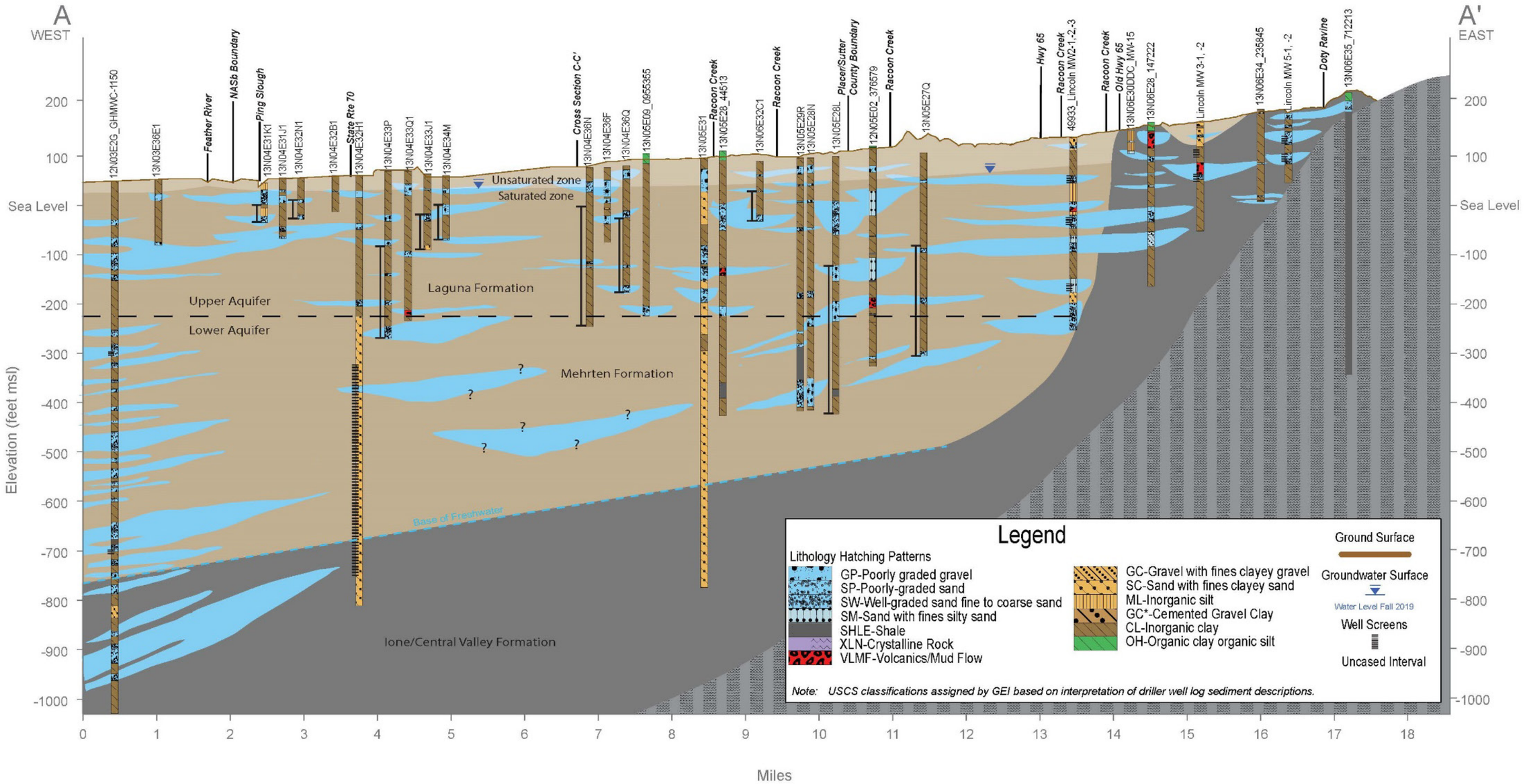
4.9.1 Section A-A'

Figure 4-9 shows Geologic Section A-A', a regional east-west profile through the northern portion of the Subbasin. Section A-A' generally runs parallel to the direction of groundwater flow.

Section A-A' shows that the eastern area generally has clays and silts (shown in brown color), low permeability sediments near surface, and permeable sediments (sands and gravels shown in light blue) throughout the depth profile. Continuous layers of sand and gravels are not identified likely due the sinusoidal nature of the river channels associated with these types of sediments.

In the western portion of the Subbasin, fine-grained sediments are more prevalent and, supported by groundwater levels and water quality information, suggest that the shallow aquifer is unconfined and separate from the deeper semi-confined to confined aquifers in the Mehrten Formation.

Cross sections A-A' and B-B' show the general shape of the groundwater gradient at the northern end of the Subbasin where water levels are highest in the east and decrease to the west. The Ione Formation, or the base of fresh water, is at or near surface in the eastern portions of the Subbasin and has multiple permeable sediment layers that could contribute brackish water to the fresh-water-bearing aquifers in the Laguna and Mehrten formations. The top of the Ione Formation and the base of fresh water is relatively shallow in this portion of the Subbasin.



Source: DWR, 1995. Modified by GEI 2019. Berkstresser, 1973.

Figure 4-9. Geologic Section A-A'

This page left intentionally blank

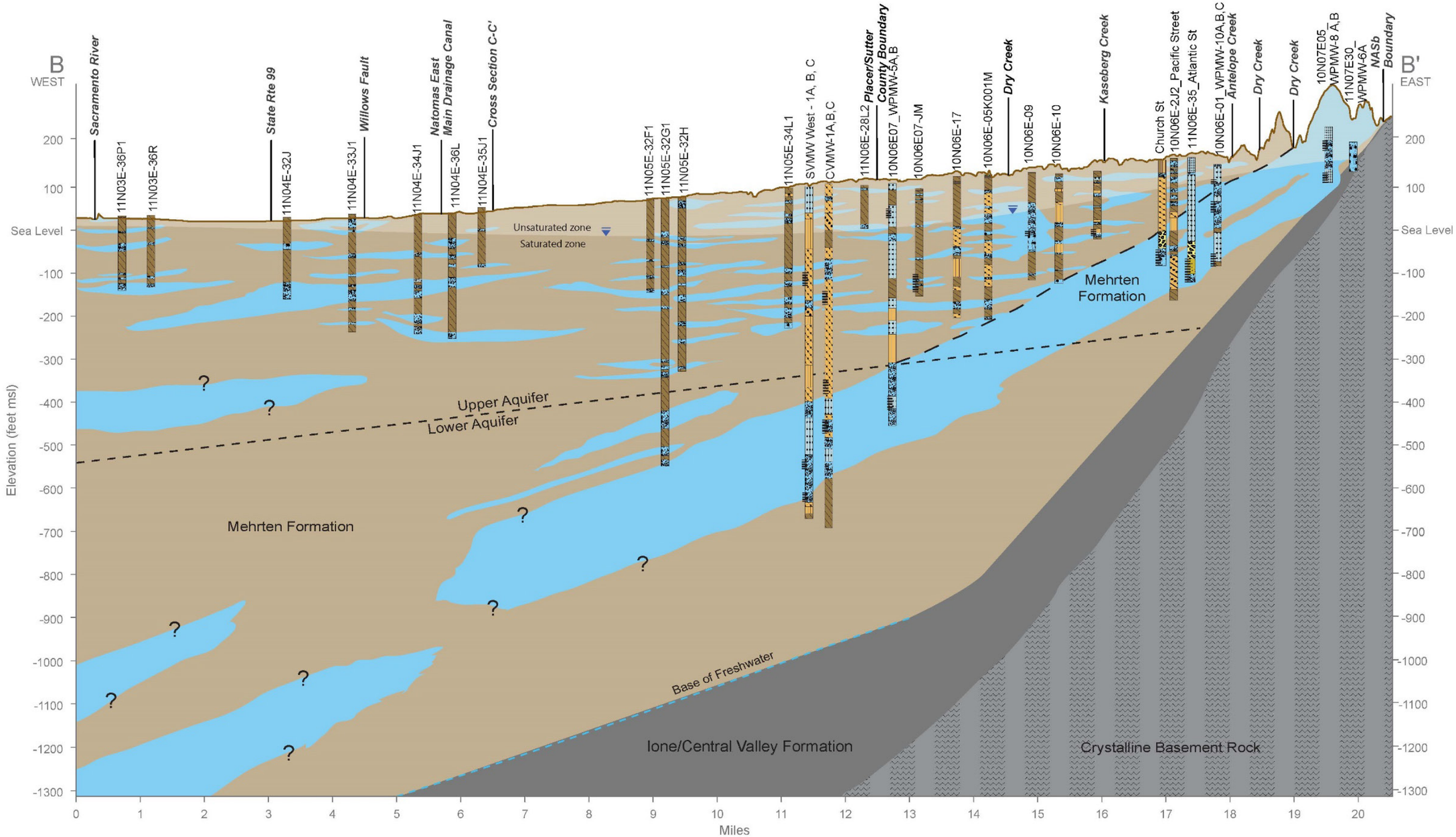
4.9.2 Section B-B'

Figure 4-10 shows Geologic Section B-B', an east-west profile located near the Sacramento, Placer, and Sutter County lines. Section B-B' generally runs parallel to the direction of groundwater flow.

Section B-B' shows the layering of Laguna, Mehrten, and Ione formations. The Mehrten Formation and its permeable sand and gravel are exposed at ground surface in the eastern portion of the Subbasin, near the city of Roseville, and can be traced to the west indicating this area can allow surface water to recharge the aquifers to the west. Toward the west, the Mehrten Formation thickens and deepens.

Section B-B' shows the groundwater levels across the central area of the Subbasin. Water levels are highest in the east, where recharge from the Sierra Nevada originates. To the west, water levels are depressed at the center of the Subbasin and are shallower further to the west. The base of fresh water is much deeper in this area than to the north as is shown on Section A-A'.

This page left intentionally blank



Source: DWR, 1995. Modified by GEI 2019. Berkstresser, 1973.

Figure 4-10. Geologic Section B-B'

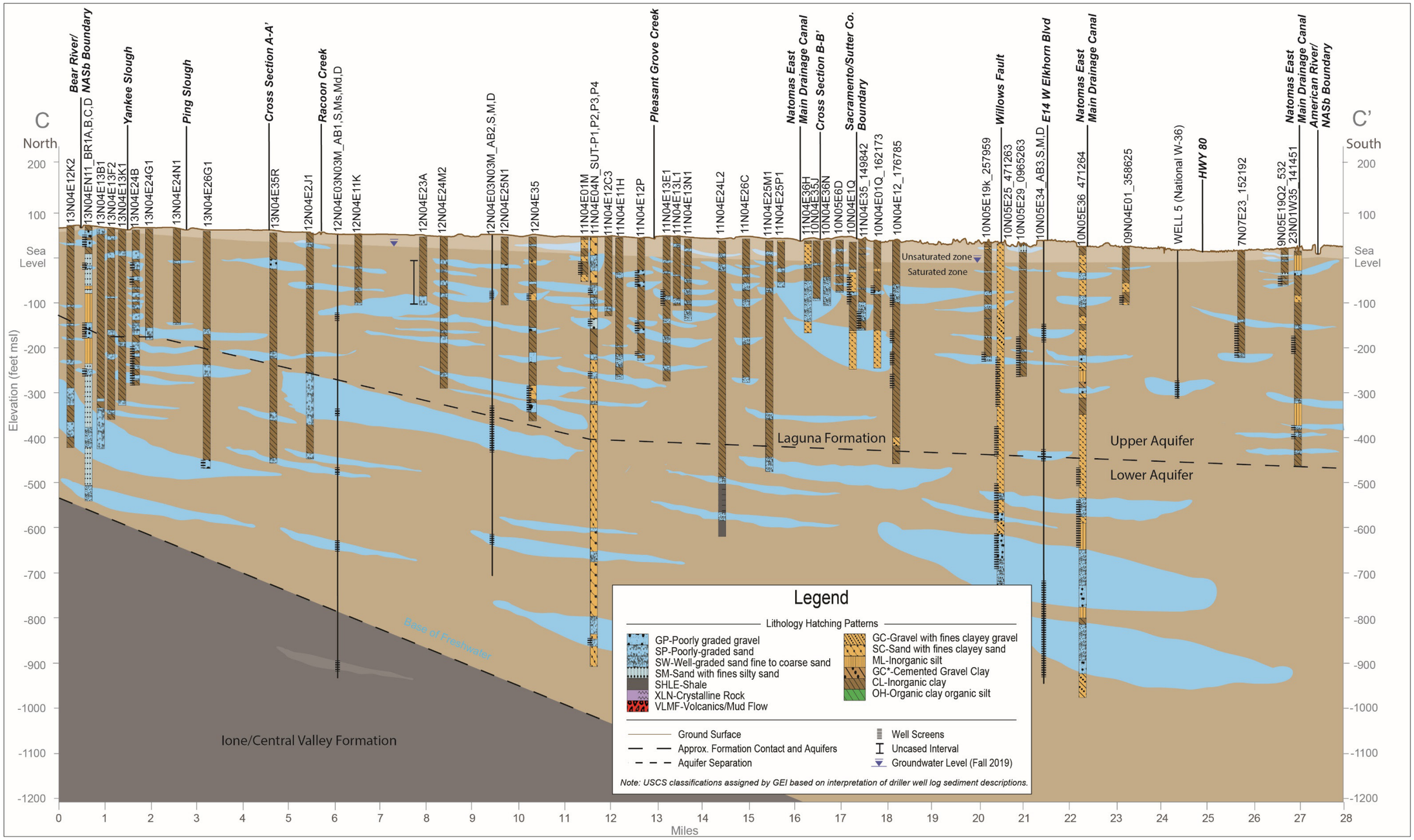
This page left intentionally blank.

4.9.3 Section C-C'

Figure 4-11 shows Geologic Section C-C', a north-south profile that extends the length of the Subbasin. Section C-C' is generally perpendicular to the direction of the deposition of the sediments (bedding dip).

Fine-grained sediments appear to be more prevalent in the northern portion of the Subbasin, while more interconnected aquifers exist along the southern portions of the section. The base of fresh water is shallower in the northern portions of the Subbasin and dips steeply to the south before projecting below the depth profile.

This page left intentionally blank



Source: DWR, 1995. Modified by GEI 2019. Berkstresser, 1973.

Figure 4-11. Geologic Section C-C'

This page left intentionally blank

4.9.4 Geotechnical Investigations Sections

In addition to these regional geologic sections, geotechnical investigations (to depths of up to 140 feet) have been performed along portions of the American, Bear, Feather, and Sacramento River levees. These studies provided subsurface information to design levee improvements to reduce seeps that could de-stabilize the levees during flood events. Profiles (geologic sections) were developed as part of these investigations. The investigations show sediment types where groundwater and surface water interactions occur, and where the Sacramento River (bathymetric elevations) has cut partially or entirely through coarse-grained sediments that are part of the shallow aquifer. They also show where man-made slurry walls were constructed that have reduced or eliminated this connectedness and where they are planned to be built. **Figure 4-12** shows the areas where slurry walls have been constructed. **Appendix E** provides these geologic profiles along the rivers. The sections do not contain a breakout of the geologic formations but, in general, dependent upon the location, would include Alluvium, Flood Basin Deposits, and Modesto and Riverbank formations.

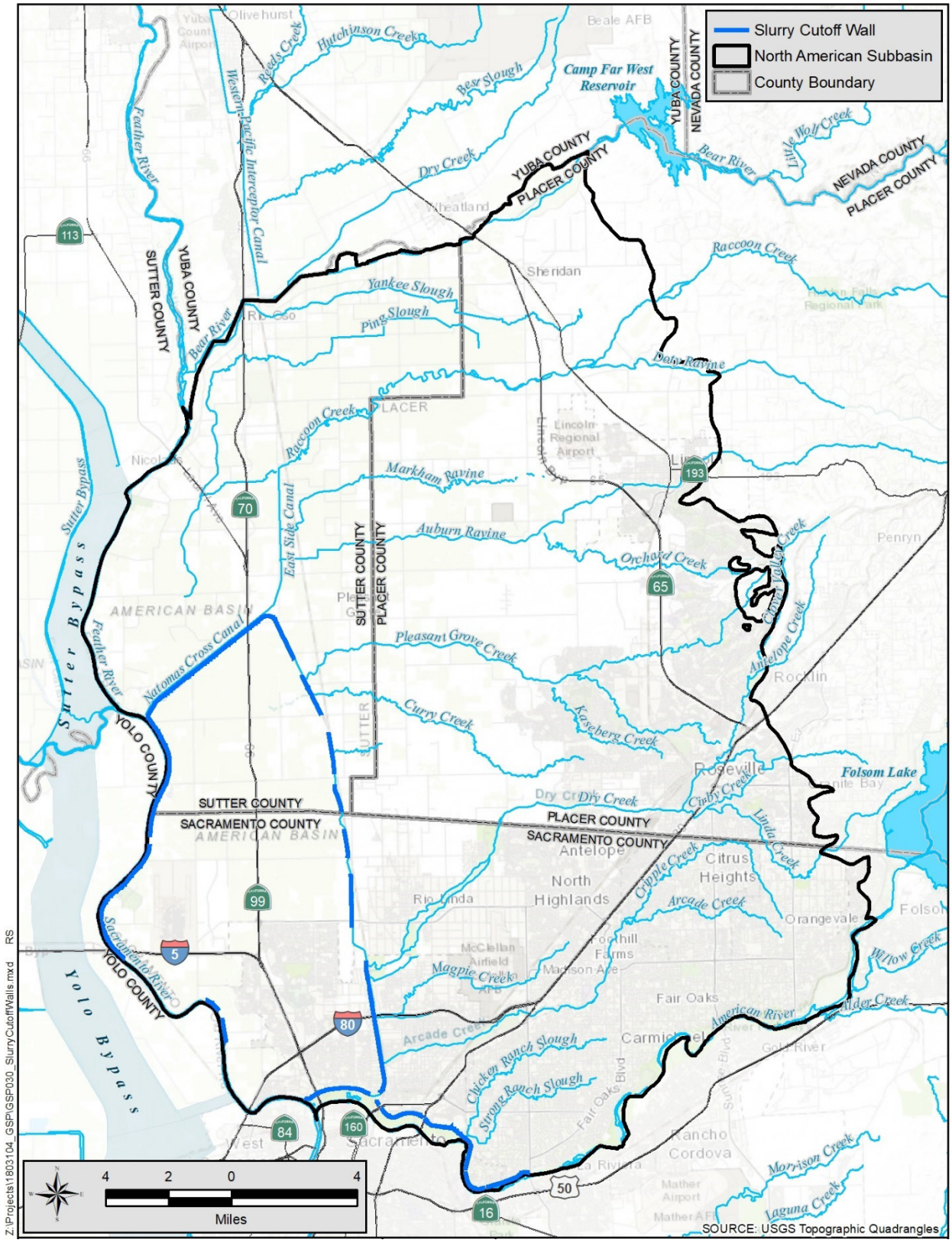


Figure 4-12. Detailed Geologic Sections - Slurry Cut Off Walls

4.10 General Water Quality

Most of the groundwater in the Subbasin can be grouped into two general types based on which minerals[1] are present at highest concentrations. If no one anion or cation are predominant, multiple names may be listed. Water Type 1 is a magnesium-calcium bicarbonate and is present in the shallowest aquifer zones sampled with one exception. Water Type 2 is a sodium bicarbonate water and is typically found at the intermediate depths (up to about 850 feet). Type1 resembles Type 2 except that the percentage of cations changes (sodium is becoming more dominant). **Figure 4-13** shows the distribution of the water types in the Subbasin. The relative percentages of anions are similar for both water types. This may support the idea of cation exchange as a major factor in the evolution of chemistry of the groundwater (DWR, 1997).

Monitoring wells have been installed to provide information on discrete changes in water chemistry with depth. Although the data are limited, there appears to be a trend in the water chemistry with depth (DWR, 1997) changing from calcium-dominated water to magnesium and from bicarbonate to sodium with depth.

In the deepest monitored zone (well AB-1 deep, located in South Sutter Water District's corporate yard), the chemistry changes significantly and is characterized as sodium chloride water. The chemistry of well AB-1 deep (screened below the base of fresh water) is considered to be water that was deposited at the time of deposition of the sediments (connate water) in the Sacramento Valley. This well has groundwater with an electrical conductivity of about 1,800 micromhos per centimeter and is considered to be brackish water. Because of the regional southwestern dip of formations in the area these waters are closer to ground surface in the eastern portions of the Subbasin. Sodium chloride water is known to occur near the Bear River and Highway 65 where the Ione Formation is near the ground surface (**Figure 4-13**). Water quality evaluations in the eastern portions of the Subbasin, north of the city of Lincoln, have not been able to distinguish any significant effects of connate water discharging to freshwater (GEI, 2019).

There are multiple wells with chloride as the predominant anion, which suggests there may be mixing of connate water with fresh water (DWR, 1997). **Figure 4-14** shows the types of water in some of the monitoring wells in the Subbasin. Sodium chloride water may also be present due to evaporation of water as seen in some localized areas.

[1] cations which are calcium, magnesium, and sodium; and anions which are bicarbonate, sulfate, and chloride

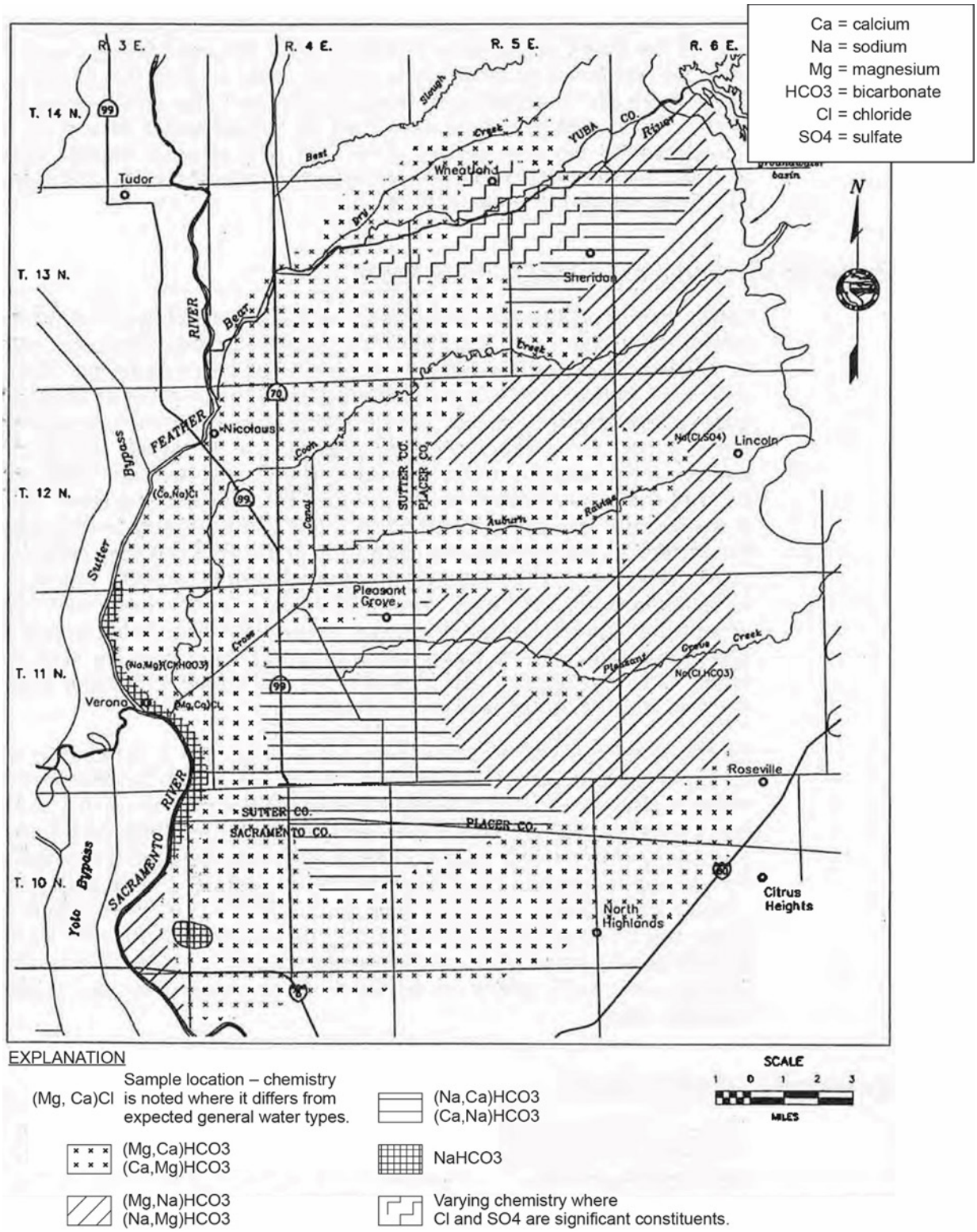


Figure 4-13. General Water Quality Types and Distribution

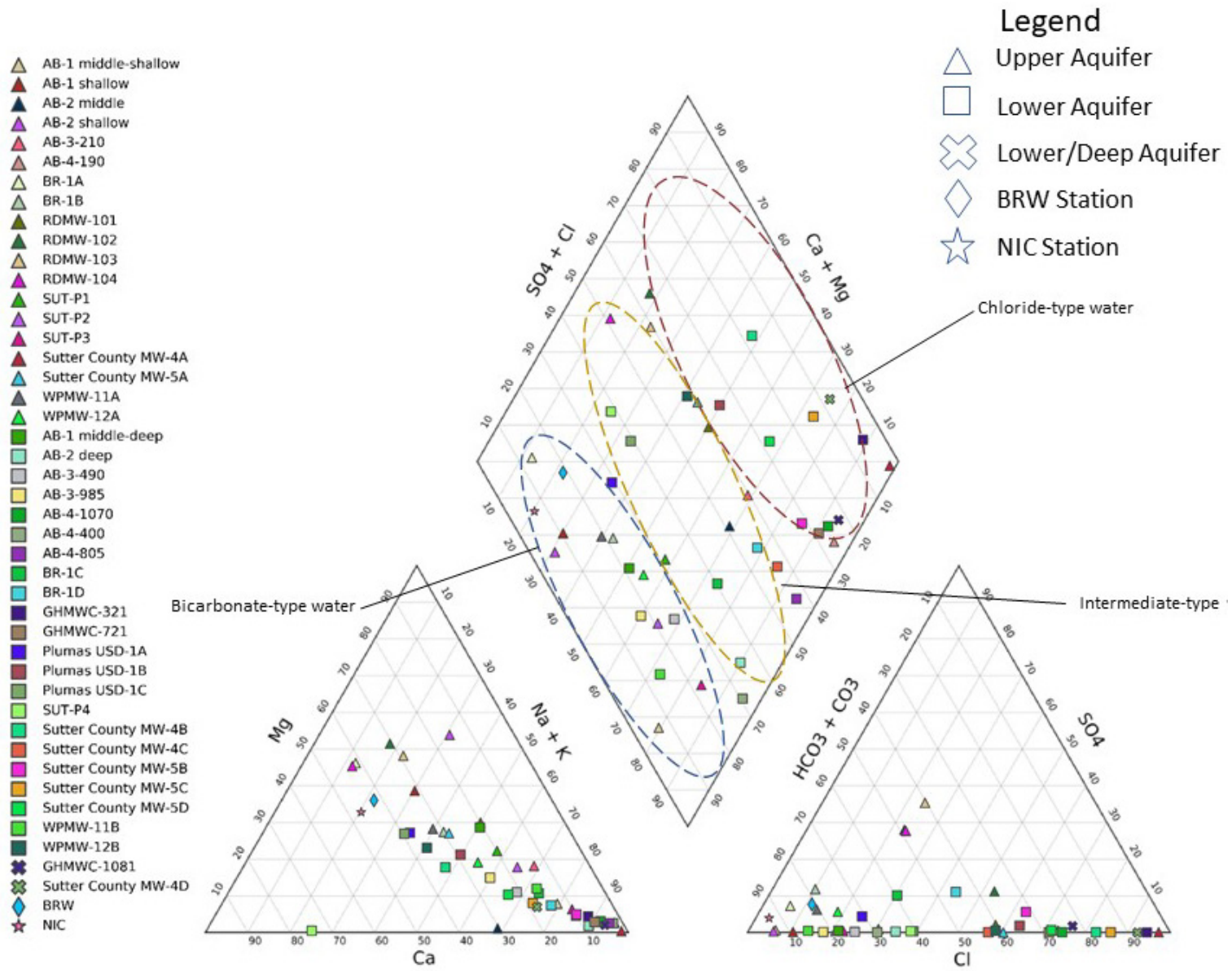


Figure 4-14. General Water Quality Types

This page left intentionally blank

4.11 Principal Aquifers

All sediments, to some extent, contain groundwater in the pores between particles. Near ground surface sediment pores are filled with mostly air but have some moisture. This moisture will gradually migrate down to the groundwater surface where the sediment pores will be entirely filled with water. At times there are low permeability sediment layers with a limited horizontal extent, where the moisture accumulates and fully fills the sediment pores, but the underlying sediments and pores are not filled with water. These occurrences are called ”perched” water and do not constitute a principal aquifer. At the edges of these low permeability sediments, the water may then resume its vertical path to the groundwater surface. Aquifers are those coarse-grained sediment layers whose pores are completely filled with water and can be managed.

The aquifers underlying NASb are composed of cobbles, gravel, and sand, which are interspersed with deposits of silt and clay. Those interspersed layers are deposited in stream channels, alluvial fans, or floodplains by rivers draining the Sierra Nevada and the upper Sacramento Valley. DWR’s Bulletin 118-3 describes the aquifers as “…a number of now-buried stream channel deposits. These deposits, which are composed of permeable sand and gravel, are enclosed by less permeable silt and clay. This has resulted in a network of meandering tabular aquifers.” A graphic interpretation of the location of those ancestral channels is shown on **Figure 4-8** (DWR, 1974) for portions of the NASb. This complex system of intertwined and interbedded, fine and coarse-grained sediments interconnects shallow and deeper aquifers (DWR, 1997).

The geologic units described above were grouped and separated into two aquifers, an upper and lower aquifer system, by DWR in its evaluation of a proposed conjunctive use program in the NASb in the mid-1990s (DWR, 1997). The upper aquifer was defined as the upper 200 to 300 feet of the aquifer system. The lower aquifer was defined as extending from about 200 to 300 feet below ground surface to the base of fresh water. “The division between the two aquifers is inexact, due to the difficulty in accurately determining the formation contacts.” The aquifer systems were, in part, defined by differences in groundwater levels. Since this was over 20 years ago, the geologic and groundwater information was re-evaluated to assess whether the aquifers should be divided into one or two principal aquifers. **Table 4-1** provides a summary of criteria used to determine if there is enough evidence to define two principal aquifers for the purposes of this GSP. Details of this analysis are provided in **Appendix F**. In addition to the hydrogeologic evidence a comparison of adjacent subbasin definitions of principal aquifers was made.

Table 4-1. Criteria Evaluated for Two Principal Aquifers

Criteria	Two Principal Aquifers?			Comments / Evidence
	Yes	No	Maybe	
Depth and Extent of Confining Bed		X		No regionally extensive clay layer defined.
Groundwater Level Difference				
• *Vertical Head Difference*			X	Up to 20 feet difference in western portion suggesting semi-confined to confined conditions but similar in eastern portion, suggesting unconfined.
• *Response to Stress Difference*		X		Similar trends in both aquifers but slight lag time in Lower aquifer.
• *Groundwater Contour Difference*			X	Similar groundwater flow directions. Lower aquifer not showing influence from rivers.
Aquifer Hydraulic Characteristics	-	-	-	No high-quality, multi-well aquifer tests available.
Water Quality Difference		X		Nothing distinct within NASb, Yuba, or Sutter subbasins.
Adjacent Subbasins Approach				
• *Yuba*		X		GSP submitted
• *South American*		X		Alternative Submittal
• *Yolo*	-	-	-	Unknown
• *Sutter*	X			Alternative Submittal

There is not enough evidence to define multiple principal aquifers in the NASb; therefore, for this GSP, only one principal aquifer is present in the Subbasin. This definition corresponds with adjacent subbasins both north and south of the NASb.

4.12 Groundwater Recharge and Discharge Areas

Groundwater recharge occurs throughout the Subbasin in varying amounts based on the SAGBI hydrologic classification for soils, *refer to* **Figure 4-4**. The soil's ability to allow water to migrate to the aquifers is significantly reduced if the soils have been covered by impermeable surfaces such as roads and houses. In some cases, although the soils may be classified as being more permeable, recharge may be limited due to underlying low permeability sediments (clays), especially along the rivers and creeks.

4.12.1 Recharge Areas Inside of the Subbasin

Recharge areas in the Subbasin have been defined based on the soils' hydrologic classifications along with a variety of techniques including water quality, isotopes, well logs indicating coarse-grained sediments are present near ground surface, and crop types. Overall, no geologic sediments are impermeable, so some recharge occurs in all areas that are not covered by impermeable surfaces such as asphalt or concrete. This is particularly important in agricultural areas where even though there are low permeability soils, in excess of a hundred thousand acres

of land that have applied or ponded water throughout the growing season that aggregate to a large volume of recharge.

Investigations conducted along the river levees provide detailed profiles that allow for assessment of where coarse-grained sediments are present and where they are connected to the rivers (*see* **Appendix E**). **Figure 4-15** shows the combination of these studies, referenced sources, and recharge areas, including reaches of the rivers and some creeks. **Figure 4-15** also shows a rather broad potential recharge area, between the eastern edge of the Subbasin and a dashed line approximating the western edge where water could infiltrate from ground surface through coarse-grained soils and sediments directly into the underlying aquifers. Generally, the rate of movement is ten times higher when water moves horizontally along aquifer beds rather than percolating vertically through the sediments. As shown, this is a broad band parallel to the eastern side of the Subbasin.

4.12.2 Recharge Areas Outside of the Subbasin

Aquifers in the NASb extend beyond the Subbasin boundary and into adjacent subbasins. Dependent upon the groundwater gradients, groundwater may flow into or leave the Subbasin. Therefore, recharge to the NASb may occur from adjacent subbasins or even beyond these subbasins. The recharge areas in adjacent subbasins will be identified in their respective GSPs, once completed.

4.12.3 Groundwater Discharge Areas

Groundwater discharge occurs along some of the creeks, canals, and rivers. The conditions may change seasonally from recharge to discharge conditions. **Figure 4-15** shows these potential areas, which are typically along the rivers as they represent topographic lows where the groundwater surface may intersect the ground surface.

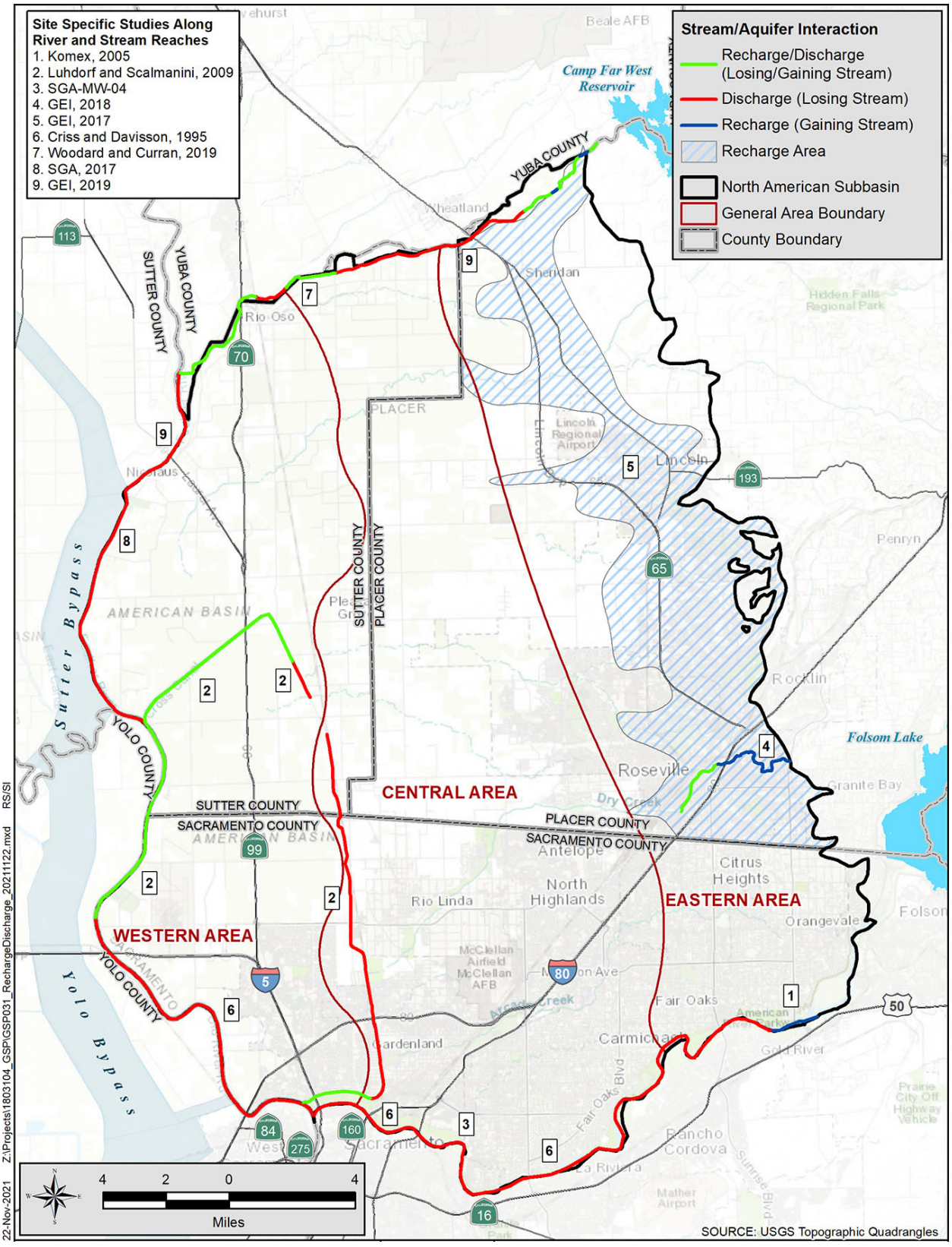


Figure 4-15. Recharge and Discharge Areas

4.13 Imported Water Supplies

For purposes of this GSP, imported water is defined as water that is brought in from areas outside of the Subbasin or its watershed. Diversions are defined as water that is diverted from rivers or tributaries within and adjacent to the Subbasin. For example, even though water in the Sacramento River may have originated from as far away as Lake Shasta, water diverted from the river is not considered to be imported because the river is adjacent to the Subbasin. The Subbasin does not have imported water other than water imported from the Yuba watershed into the Nevada Irrigation District and Placer County Water Agency service areas.

4.14 Data Gaps

The hydrogeologic conditions in the NASb have been investigated and documented since 1912 and continue through the present. Most of the recent improvements to data gathering have been construction of new monitoring wells to replace voluntary wells to improve the quality of groundwater levels. At this time, there are no data gaps that would affect the ability to sustainably manage the Subbasin within the next 5 years.

This page left intentionally blank

5. Groundwater Conditions

This section provides a description of historical and current groundwater conditions in the Subbasin. The North American Subbasin (NASb or Subbasin) can be divided into three areas (Eastern, Central, and Western) from a water resources standpoint based on the differences in groundwater conditions. Groundwater conditions between areas vary for several reasons, the primary reason being the extent to which surface water is accessible as a source in a given area. In order to understand how and why conditions vary, it is helpful to consider the historical development of water resources in the basin.

5.1 General

Current groundwater conditions are the result of both historical and current availability of surface water. Historically, where surface water was not available groundwater was used for agricultural, industrial, and urban growth.

In the Eastern and Western areas of the Subbasin, surface water has been available and delivered for agricultural and urban development. Today, both the Eastern and Western areas of the Subbasin continue to be served primarily with surface water, with some urban areas (city of Sacramento) in the Western area being served both groundwater and surface water. As a result of surface water availability, groundwater levels in the Eastern and Western areas of the Subbasin have remained relatively stable.

In the Central area of the Subbasin, a groundwater pumping depression (a lowering of groundwater levels as a result of pumping) developed by the mid-1960s. This was largely due to widespread agricultural and urban development and the lack of available surface water to this part of the basin. The pumping depression started in Sutter County, moving to the east and south.

Agricultural development in the 1950s relied exclusively on groundwater to meet crop demands and resulted in groundwater level declines through 1960. As a result of these declining water levels SSWD constructed Camp Far West Reservoir in 1964 and began supplying a portion of the crop demands with surface water. This action reversed the overall decline in water levels.

Demand on groundwater in the Central area also increased markedly around the 1950s as military and industrial facilities, such as McClellan AFB, were established accompanied by rapid suburban development. Groundwater wells provided water for the industrial and urban development. Falling groundwater levels moved the Sacramento County Board of Supervisors to take management actions and initiated the Water Forum Agreement and Sacramento Groundwater Authority (SGA).

Since the mid-1990s, water suppliers in the northern Sacramento County portion of the Central area implemented conjunctive use projects, thereby reversing the decline of groundwater levels, but the pumping depression still remains in the Central area of the Subbasin and extends into Placer and Sutter counties.

5.2 Groundwater Levels

Groundwater levels are used to track the use and recharge of groundwater in the Subbasin to avoid long-term lowering of groundwater levels. Historically, when downward trending groundwater levels have been observed in the Subbasin, management actions have been taken.

Groundwater levels are recorded at more than 160 wells in the Subbasin and reported to the CASGEM system. Groundwater levels were historically measured twice per year (Spring and Fall), but the frequency of the measurement in some wells has been increased to monthly or more frequently where wells have been instrumented with continuous recorders (transducers). Wells that were only measured a few times or where measurements were discontinued many years ago were not evaluated to establish groundwater conditions.

Figure 5-1 shows the location of 91 wells in the Subbasin evaluated to illustrate the groundwater conditions for this GSP. All of these wells have long-term records or are dedicated monitoring wells with shorter-term records. The dedicated monitoring wells with shorter-term records are used in place of CASGEM "voluntary wells" (privately owned domestic or agricultural wells) where groundwater levels may be affected by pumping at the well or construction details are not available. Due to the number of wells and the long CASGEM identification numbers, each well was provided with a unique number (**Figure 5-1**). A table correlating the unique numbers to CASGEM identification numbers is provided in **Appendix G** with well construction details and the DWR-defined aquifer being monitored. For those wells with known construction details there is a high degree of certainty that the groundwater levels are representative of the principal aquifer, other than for two wells that monitored perched water levels (water that has percolated from ground surface, but has yet to reach the principal aquifer). Where the well construction details (mostly voluntary wells) are unknown there is less certainty, but the hydrographs are provided to provide a long-term condition of the groundwater levels. **Appendices G through I** contain time-series groundwater level measurements (hydrographs) for wells in the Western, Central, and Eastern areas. All of the hydrographs, have consistent date ranges (1950 to present or 2004 to present) and vertical scales were attempted to be maintained at a consistent range unless otherwise noted.

All sediments, to some extent, contain groundwater in the pores between particles. Near ground surface sediment pores are filled with mostly air but have some moisture. This moisture will gradually migrate down to the groundwater surface where the sediment pores will be entirely filled with water. At times there are low permeability sediment layers with a limited horizontal extent, where the moisture accumulates and fully fills the sediment pores, but the underlying sediments and pores are not filled with water. These occurrences are called perched water and do

not constitute a principal aquifer. Evidence to support that the groundwater levels in these areas is perched are that the groundwater levels are higher than in underlying aquifers (principal aquifers) and that the groundwater levels in the principal aquifers never rise to the levels of the perched water, showing they are disconnected.

The following sections include a description of the depth to groundwater and trends by area. **Figure 5-2** shows the depth to groundwater in the Subbasin. **Figure 5-3** shows representative time series graphs of groundwater levels (hydrographs) to show general trends in groundwater levels for each of the areas. **Appendices G through I** contain time-series groundwater level measurements (hydrographs) for wells by the Western, Central, and Eastern areas.

5.2.1 Western Area

The Western area of the Subbasin is bounded by the Feather and Sacramento rivers on the west and approximately by the Sutter/Placer County Line and Natomas East Main Drainage Canal on the east (**Figure 5-1)**. The Western area has surface water deliveries, but groundwater is used to supplement the surface water supplies. In general, groundwater levels in this area are stable and have historically been near the surface.

Groundwater levels in the Western area in shallow wells typically range from near ground surface to 20 feet below ground surface (bgs) (**Figure 5-2**). The shallow groundwater levels are due to the area being at the topographic bottom of the Subbasin and potentially from the adjacent rivers. Groundwater levels in deep wells in this area have slightly deeper groundwater levels, ranging from about 15 to 40 feet bgs.

Figure 5-3 shows the trends in groundwater levels in some wells in the Subbasin to illustrate the differences in groundwater levels and general trends in different portions of the Subbasin. The wells typically experience seasonal fluctuations. During the most recent drought, 2012 through 2016, groundwater was relied upon more heavily and the groundwater levels declined in response to increased pumping, but then recovered to pre-drought levels as of 2019, although a few wells have not fully recovered. **Appendix G** provides hydrographs for wells in this area.

Perched groundwater has not been documented in this area.

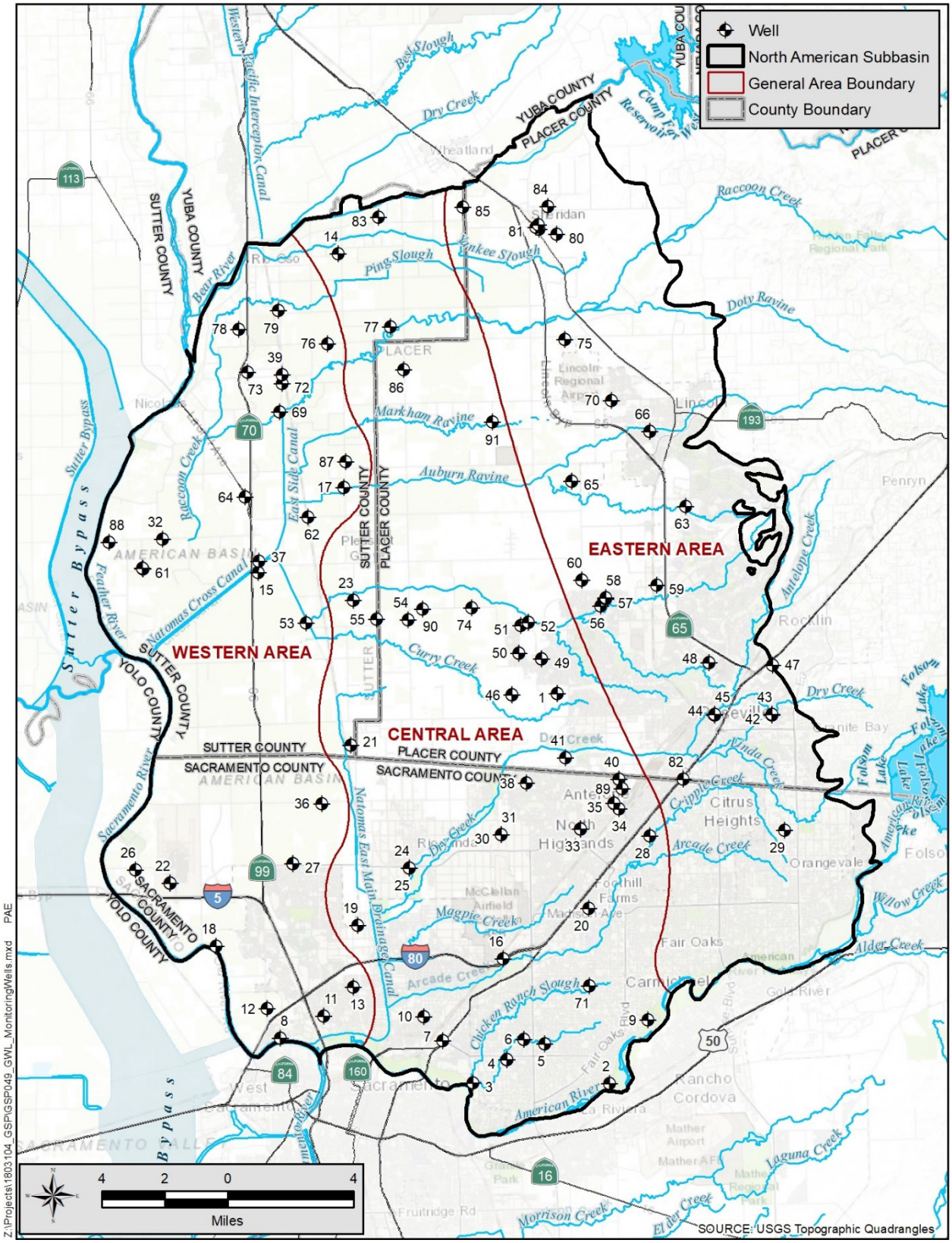


Figure 5-1. Groundwater Level Monitoring Wells

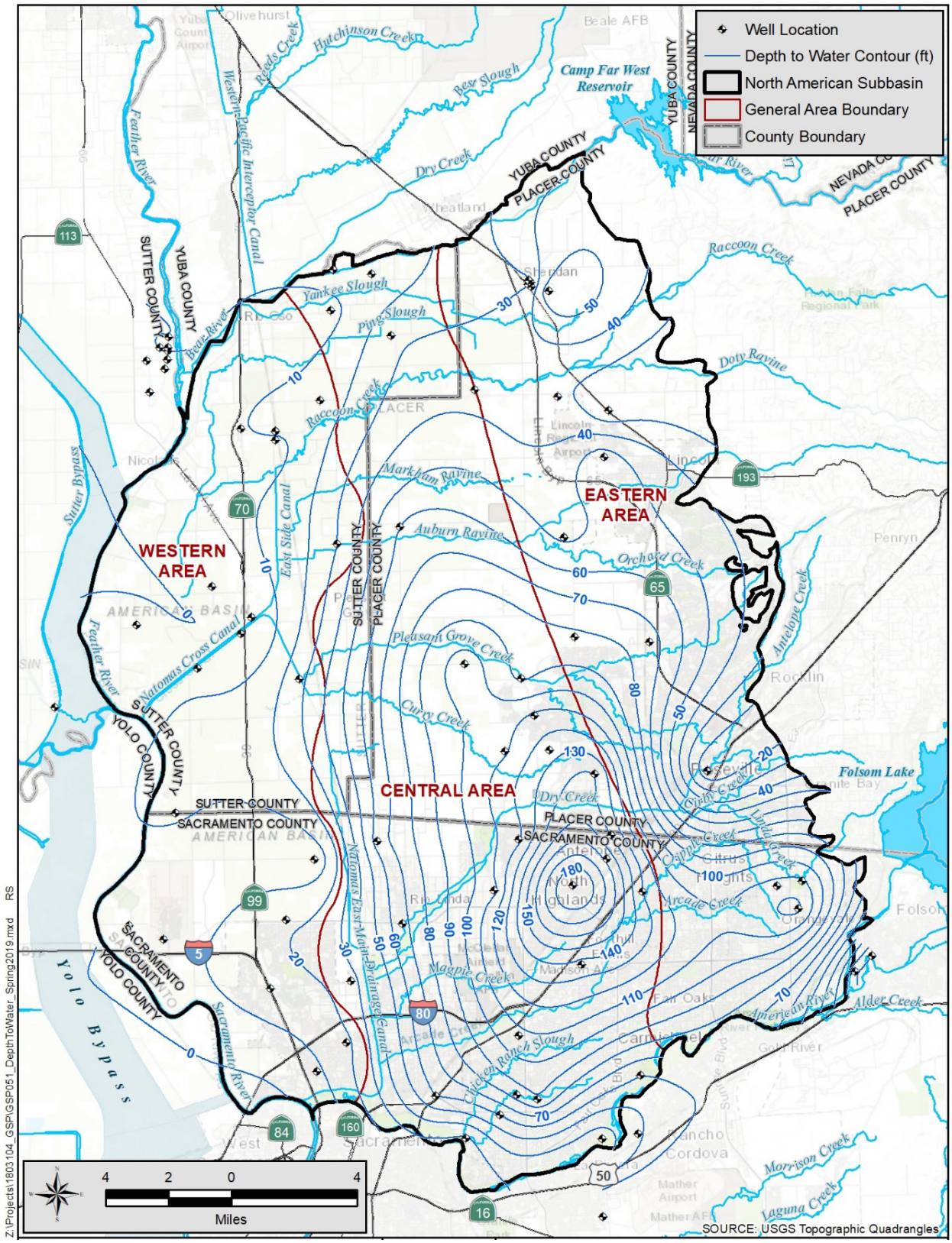


Figure 5-2. Depth to Groundwater – Spring 2019

This page left intentionally blank

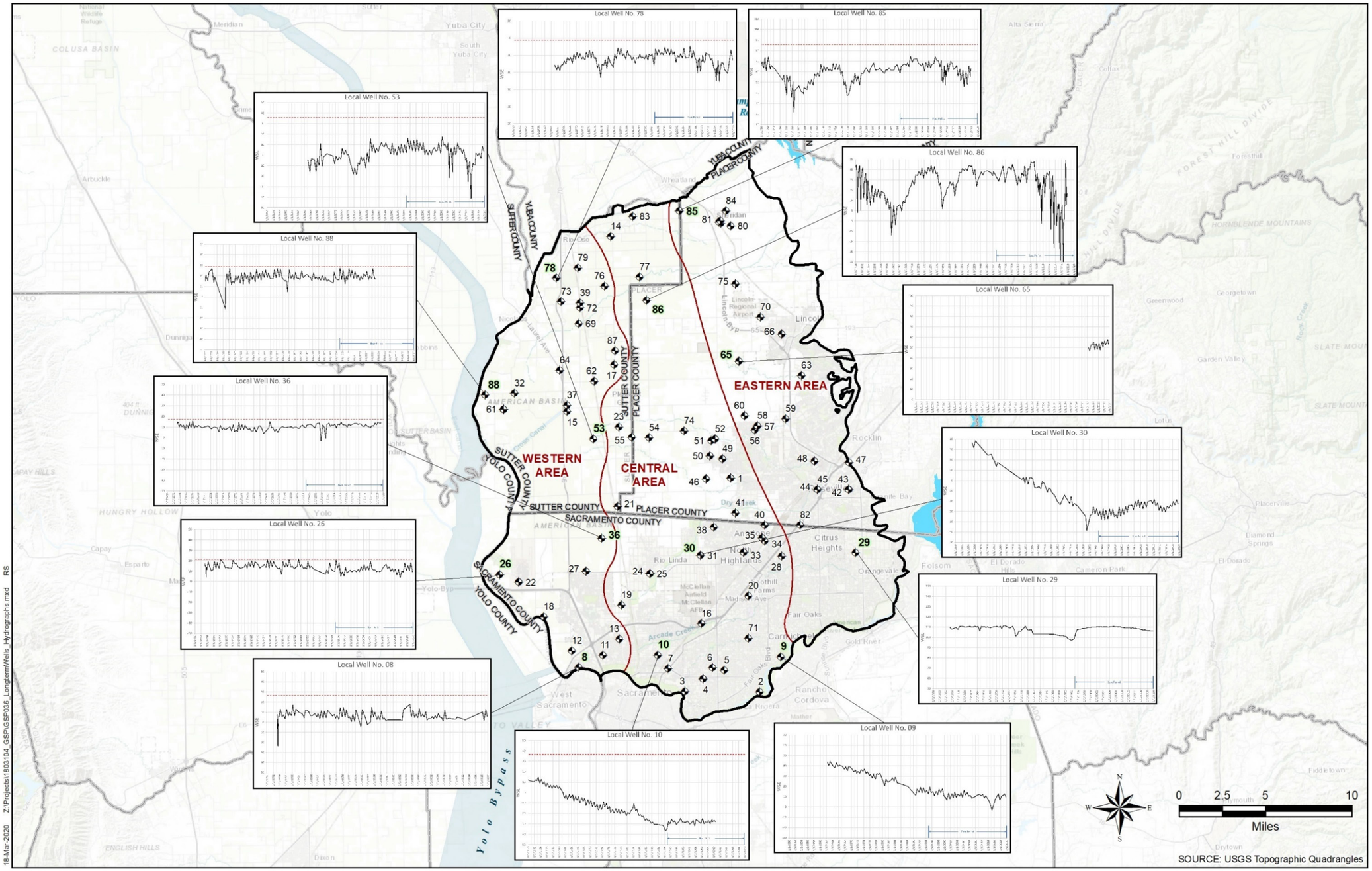


Figure 5-3. Representative Groundwater Level Hydrographs

[This page intentionally left blank.]

5.2.2 Central Area

The Central area of the Subbasin is bounded generally on the west by the Sutter/Placer County Line and the Natomas East Main Drainage Canal and extends east to about Citrus Heights and the city of Lincoln (*refer to* **Figure 5-1**). **Appendix H** provides hydrographs for the Central area. This area historically relied predominantly on groundwater. Groundwater levels in this area have shown a wide range of fluctuations but since the mid-1990s are relatively stable and sometimes rising. Currently the groundwater levels are between 0 and 15 feet bgs near the American and Bear rivers with as much as 150 feet bgs within the Sacramento County portion of the area (*refer to* **Figure 5-2**).

Two groundwater level trend patterns are present in the northern (Placer and Sutter counties) and southern (Sacramento County) portions of the Central area (*refer to* **Figure 5-3**).

In the Placer and Sutter counties portion of the Central area, groundwater levels declined by about 30 to 40 feet between the early 1950s and 1960s, until Camp Far West Reservoir was completed in 1964 (MBK, 2016). Groundwater levels rose in response to decreased groundwater use but still vary in response to climatic conditions when surface water availability decreases and groundwater pumping increases. Seasonal fluctuations in this portion of the Central area are greater than those seen in Sacramento County. Groundwater levels declined noticeably during the 2012 to 2016 drought, but began to recover following the end of that drought. However, they have not generally fully recovered to pre-drought levels.

In the Sacramento County portion of the Central area, groundwater levels declined at a rate of nearly 1.5 feet per year from around the 1950s through the mid-1990s, with groundwater levels being lowered by up to 60 feet. Groundwater levels stabilized in the mid-1990s due, in substantial part, to expanded conjunctive-use operations, making surface water available to this area. Groundwater levels have continued to rise overall since that time, with slight declines from 2007 through 2009 when dry conditions were experienced throughout California. During the most recent drought conditions of 2012 to 2016 groundwater levels declined slightly, but recovered following the end of that drought as of 2019, except for a few wells.

Perched water can be present in the Central area. Perched water was observed during the construction of a nested monitoring well (*refer to* **Figure 5-**1, monitoring well number 91) at a depth of 4 feet bgs, while the depth-to-water in monitoring well 91 was 70 feet bgs. Several contamination site investigations within the Roseville area also show perched groundwater levels.

5.2.3 Eastern Area

The Eastern area extends roughly from Citrus Heights and the City of Lincoln east to the edge of the Subbasin. There are only a few wells in the Eastern area with long-term historic measurements because this area primarily utilizes surface water. **Appendix I** provides

hydrographs for the Eastern area. With urbanization of the area and development of groundwater management organizations, over 40 monitoring wells have been constructed since 2003.

The depth to groundwater in the Eastern area ranges from about 5 to 70 feet bgs and groundwater levels are generally stable (*refer to* **Figures 5-2 and 5-3**). Shallower groundwater levels are typically seen in monitoring wells near the foothills and near streams or where perched water is present. Long-term groundwater level trends are limited in this area, with most monitoring wells in this area being constructed in about 2003. **Appendix I** provides hydrographs for these shorter-term groundwater levels and show that for the most part groundwater levels are rising in this area, but a few did not recover completely since the 2012 to 2016 drought as of 2019.

A small pumping depression is present near the City of Lincoln and varies in depth seasonally by about 5- to 10-feet and based on the water year type. The depression was first identified in 2012, but may have been present in earlier years. Monitoring wells 65, 66, 70 and 75 provide the hydrographs for this area. Groundwater levels in these wells rose between 2003 and 2011. At well 65, groundwater levels recovered and are currently at or about 2 feet higher than in 2011. Groundwater levels in wells 66, 70 and 75 are still about 3 feet lower than pre-drought conditions as of 2019.

Perched groundwater is present locally in the Eastern area. Perched water has been found in MW 1-4 (monitoring well number 65) located near Auburn Ravine and at multiple locations within the city of Roseville, generally in the area north and south of Dry Creek (GEI, 2018). Perched water may also be present in the area north of Lincoln and east of old Highway 65 on top of the Ione Formation (GEI, 2019).

5.3 Historic Groundwater Contours

Groundwater contours reflect the historical groundwater use in the Subbasin. In general, groundwater conditions from the early 1900s through the 1950s essentially remained unchanged because there was little groundwater use. From the 1950s through the 1990s, pumping created a depression. After 1990 the groundwater levels stabilized or rebounded. Snapshots of the changes in groundwater contours during these periods are provided in **Figures 5-4 and 5-5**.

Contours representing little to no use of groundwater in the Subbasin were developed for the early 1900s (Bryan, 1923), as shown on **Figure 5-4**. The contours show groundwater entering the Subbasin from the east moving toward the west. The Eastern area of the Subbasin has depths to groundwater greater than 50 feet bgs, while the Western area has groundwater levels of about 15 feet bgs, similar to current conditions.

Groundwater contours did not change until about 1960 when a small depression, due to pumping, began to form near the junction of the Sutter/Placer/Sacramento County lines and extended up to Pleasant Grove (DWR, 1997). By 1970, the pumping depression was established as shown on **Figure 5-5** (MWH, 2005). Gradually over the years the depth of the central pumping depression

became deeper and shifted to the east and south, extending from Placer County to almost the American River. By 1995, the pumping depression reached its maximum depth, to more than 40 feet below mean sea level, as shown on **Figure 5-5**. Between 1995 and 2004, groundwater elevations stabilized, as shown on **Figure 5-5**. From 2004 to 2019, significant recoveries of groundwater elevations have been observed within the main pumping depression in Sacramento County. As shown on **Figure 5-**6, groundwater elevations in the main depression have recovered from 10 to 20 feet. This stabilization and subsequent improvement is primarily due to groundwater management activities stemming from the Sacramento Suburban Water District's in-lieu groundwater recharge program in combination with regional water efficiency measures decreasing overall public water supply demand.

This page left intentionally blank

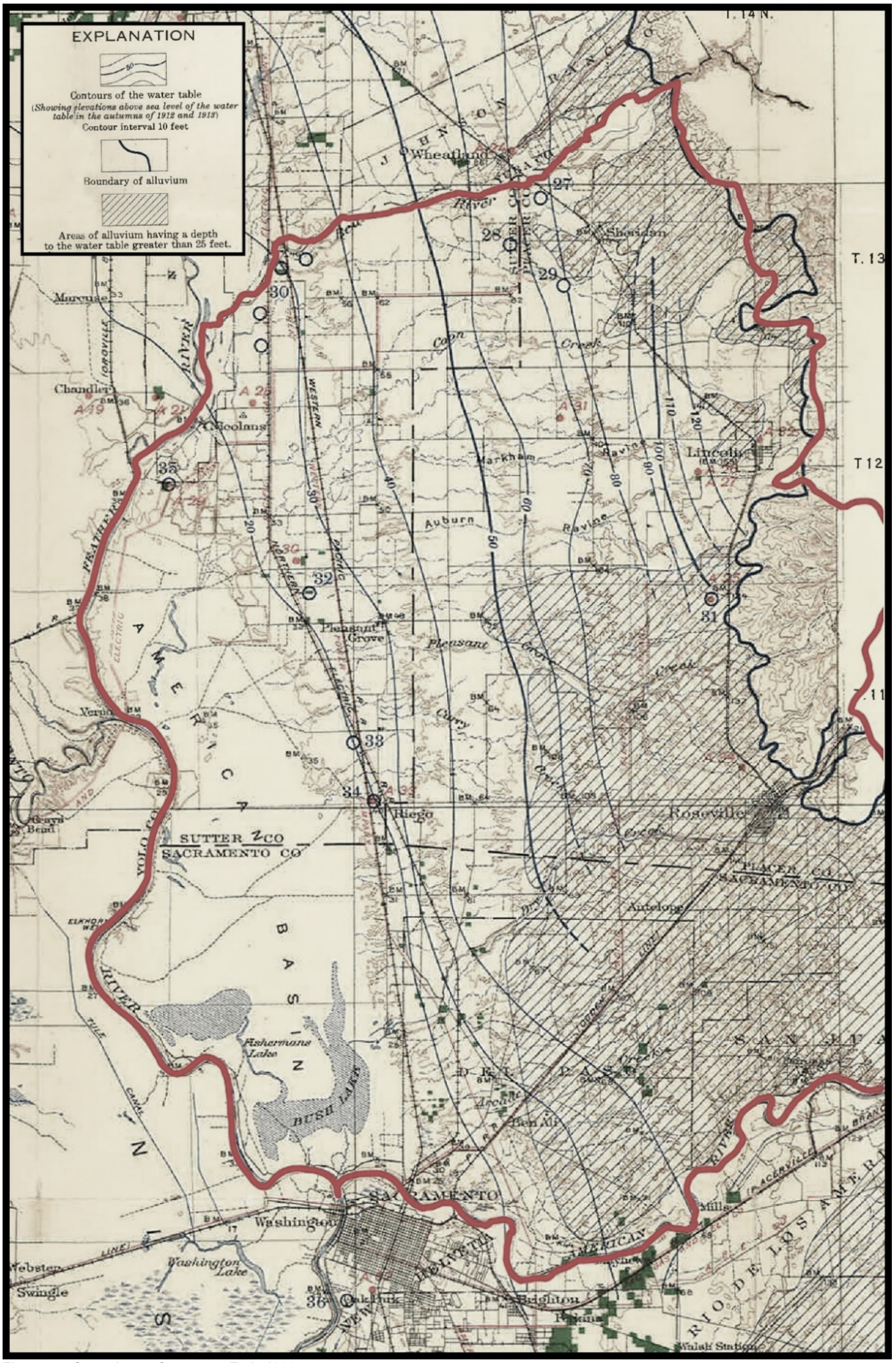


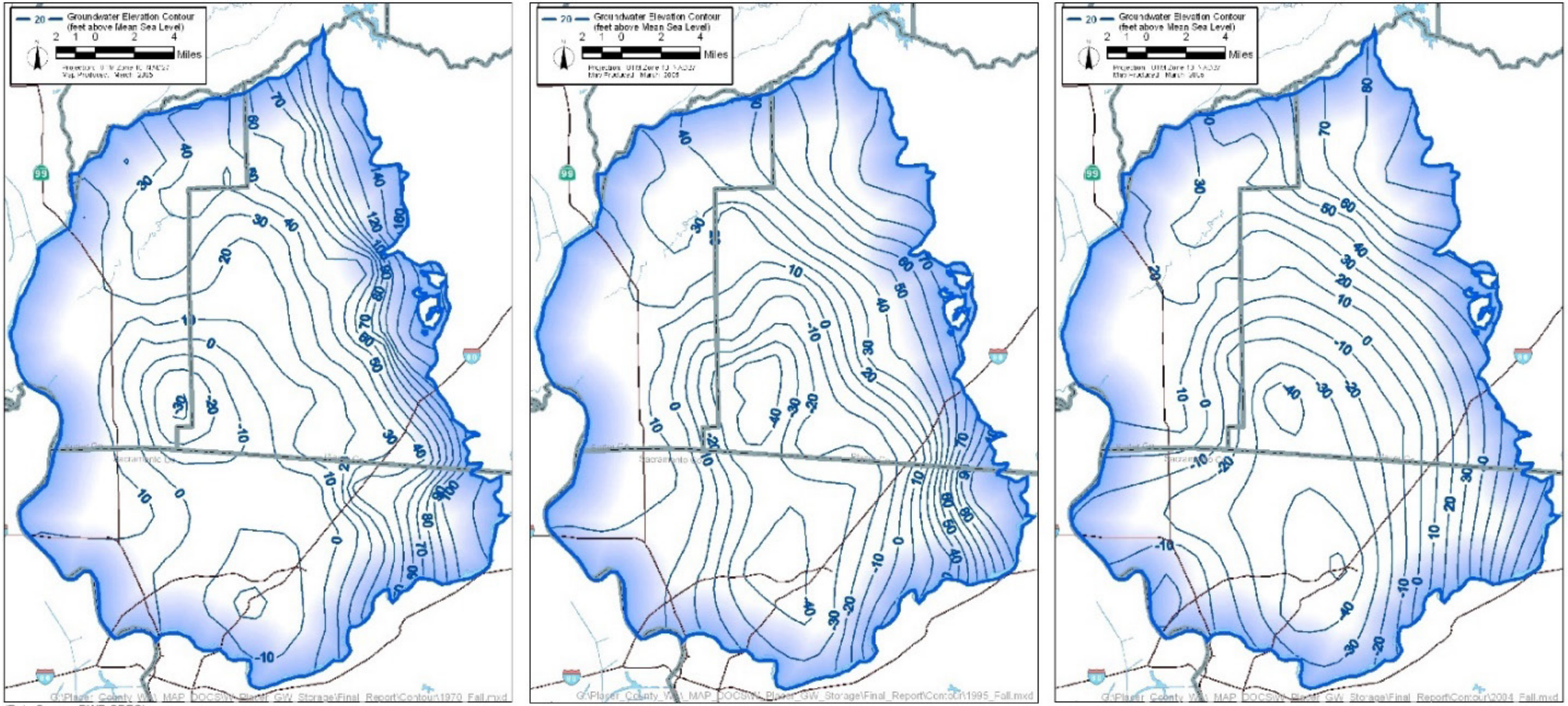
Figure 5-4. Groundwater Contours – Early 1900s

[This page intentionally left blank.]

(a) 1970 Fall

(b) 1995 Fall

(c) 2004 Fall



(Data Source: DWR CDEC)

Figure 5-5. Groundwater Contours – 1970 through 2004

This page intentionally left blank

5.4 Current Groundwater Contours

Current groundwater surface elevation contours were developed to show the seasonal high and low water levels, groundwater flow directions, and regional pumping effects. These contours were based on Spring and Fall of 2019 groundwater levels using shallow wells (less than 300 feet total depth) as shown on **Figures 5-6 and 5-7,** respectively**.**

The current groundwater contours show a pumping depression in the center of the Subbasin that is about 20 feet below mean sea level. Groundwater flows radially toward this depression, from the fringes of the Subbasin toward the center. The depression extends from the American River but stops before reaching the Bear and Feather rivers. The depression extends westward toward the Sacramento River. This depression was created when groundwater pumping exceeded the natural recharge. The depression has been stabilized, with groundwater levels remaining similar or rising, by reducing pumping so that it is equal to or less than recharge. When a long-term pumping depression such as this one is created, sediments that previously contained groundwater are dewatered and there is groundwater-in-storage depletion. This condition is beneficial for management of the Subbasin by allowing for conjunctive use.

In the northern portions of the NASb, near the Bear River, the groundwater flow direction is perpendicular to the river, the contours do not show that the aquifer is receiving significant recharge from the river, and there is little inflow from the South Yuba Subbasin. Near the Feather and Sacramento rivers, the groundwater flow direction is parallel to the rivers, suggesting there is recharge from the rivers and potentially subsurface inflow from adjacent subbasins (Yolo and Sutter). Slight changes in the contours along the eastern side of the basin suggest recharge is occurring along the upper reaches of Dry Creek, Auburn Ravine, and Racoon Creek. The groundwater contours concur with the assessment of groundwater recharge and discharge areas discussed presented in **Section 4.12 – Groundwater Recharge and Discharge Areas**. The contours, along with the depths-to-water, provide an indication of areas where groundwater and surface water may be interconnected.

The groundwater gradients near the pumping depression are similar except from the east where they are steeper, potentially due to groundwater recharge effects. **Table 5-1** provides the gradients for Fall 2019.

Table 5-1. Groundwater Gradients Toward the Central Area

Groundwater Gradients (ft/ft)			
West	**East**	**North**	**South**
0.001	0.06	0.001	0.002

The current seasonal changes in groundwater levels were assessed for Spring and Fall of 2019, a wet water year. Changes in groundwater levels in the upper aquifer vary across the Subbasin. In the upper aquifer the seasonal changes from Spring to Fall range from about +2 to -14 feet.

These seasonal changes do not account for pumping levels at individual wells and may be greater in exceptionally dry years when reliance on groundwater is greater due to the reduction of surface water supplies.

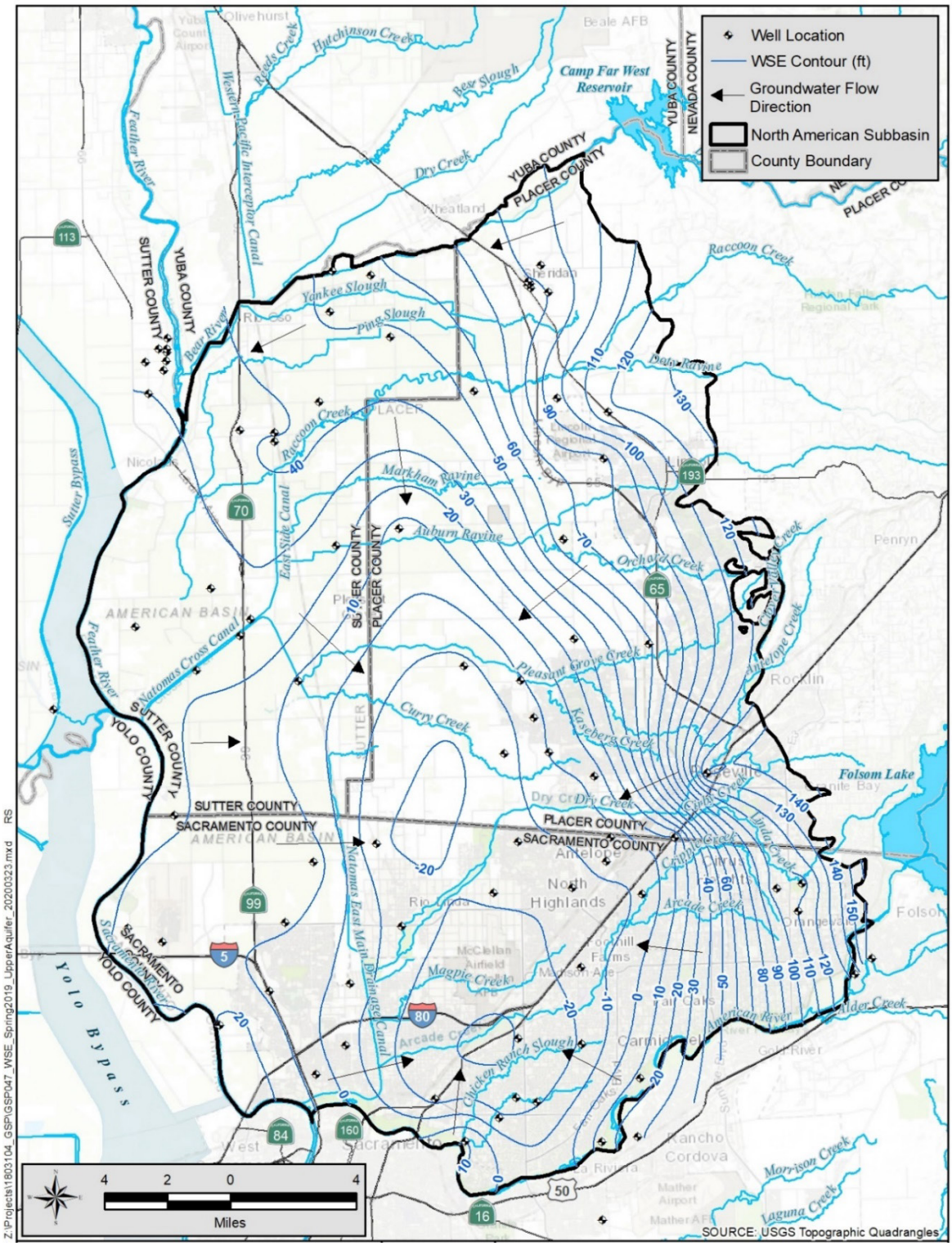


Figure 5-6. Groundwater Contours – Spring 2019

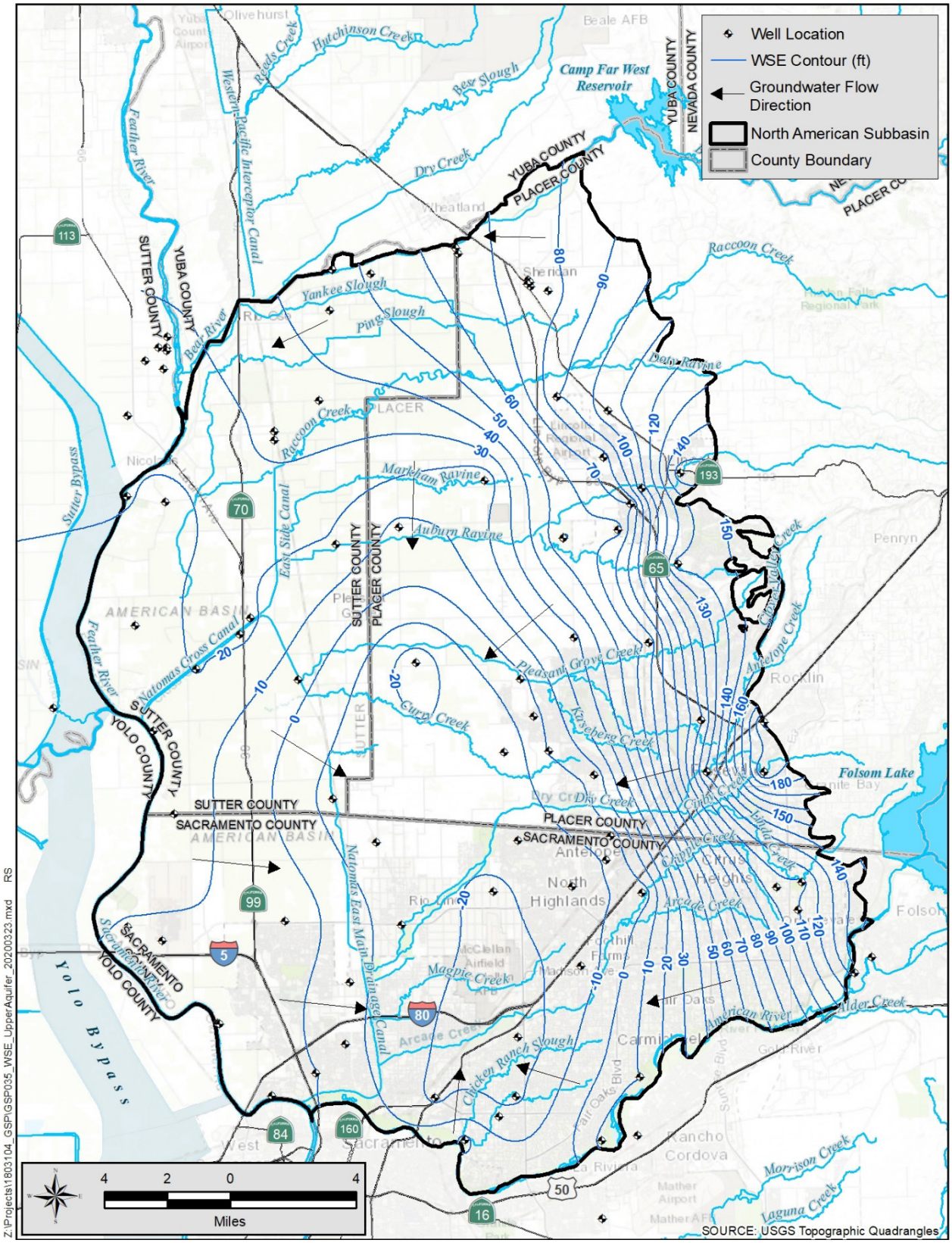


Figure 5-7. Groundwater Contours – Fall 2019

5.5 Hydraulic Gradients Between Aquifers

Since the mid-1970s dedicated monitoring wells have been constructed to monitor discrete intervals within the aquifer. When multiple monitoring wells are constructed in the same hole they are referred to as nested wells. Monitoring wells that are closely located but monitor different discrete intervals are called clustered wells. Nested and clustered monitoring wells were used to evaluate vertical groundwater gradients at varying depths of the aquifers, as sorted by the formation in which the aquifer occurs. There are 31 nested and clustered monitoring well locations in the Subbasin with up to five multiple-completion monitoring wells at each location (**Figure 5-8)**. **Appendix J** contains the hydrographs for each set of nested or clustered wells. In some cases, the nested or clustered wells are all in the same aquifer or a monitoring well has been constructed below the base of fresh water into the marine formations (monitoring well number 39), potentially the Central Valley Formation.

Generally, the aquifer in the Tulare Lake and Laguna formations has been found to exhibit unconfined aquifer characteristics. Confinement has been found to increase with depth and to the west in the deeper portions of the aquifer (DWR, 1997). The deeper portions of the aquifer (Mehrten Formation) typically exhibit delayed responses to pumping and recharge effects imposed in the shallower portions of the aquifer, confirming hydraulic interconnection.

Figure 5-8 provides a graphic representation of vertical groundwater gradients (heads) between the shallower and deeper portions of the aquifer (in Fall 2019), just after high groundwater use in the summer months, when the difference in groundwater levels should be the greatest:

- In the Western area, the vertical gradients are all downward and the greatest groundwater level differences in the Subbasin, downward by 23 feet, occurs at AB-4. The head differences are less near the rivers and greater toward the east. The head differences in this area are likely due to the deeper portion of the aquifer being more confined allowing for greater differences in groundwater levels.
- In the Central area, the vertical gradients are not consistent and have both upward and downward heads, ranging from about +7 to -7 feet. This suggests unconfined to semi-confined conditions with increasing depth in the aquifer may be present.
- In the Eastern area, the groundwater head differences are small suggesting unconfined conditions.

Although there are head differences, hydrographs show that groundwater levels in the different depths of the aquifer have similar trends, indicating the interconnectedness and a similar recharge area.

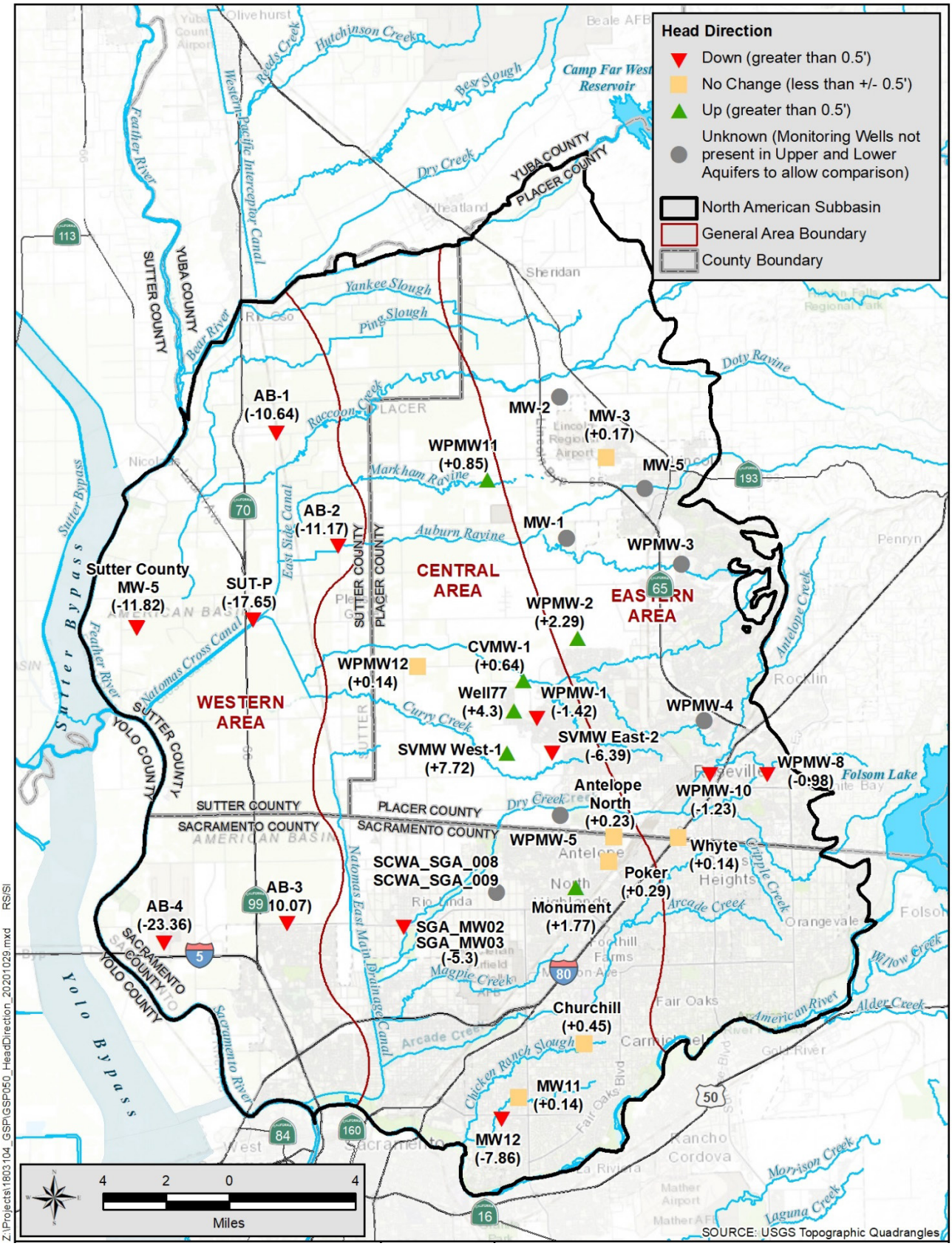


Figure 5-8. Vertical Gradients Upper to Lower Portions of the Aquifer – Fall 2019

5.6 Hydraulic Gradients Between Fresh and Non-Fresh Water Formations

Three of the deeper nested monitoring wells (monitoring wells 48, 63, 66, or wells MW5-2, WPMW-3B, and WPMW-4B) were constructed into the Ione Formation in the Eastern area of the Subbasin. These wells consistently have higher heads in the marine Ione Formation than in the other aquifers, indicating an upward head and suggesting the groundwater in the Ione Formation could discharge to the fresh-water aquifers. **Appendix K** provides these hydrographs which show the head differences are up to 50 feet upward at monitoring well 48.

One monitoring well (monitoring well 39 or AB-1 deep) was constructed below the base of fresh water, potentially into the Valley Springs or Central Valley Formation, in the Western area of the Subbasin. Groundwater levels (piezometric) in the formation in comparison to the fresh-water aquifers change seasonally, apparently due to pumping influences. During the winter months groundwater levels in the fresh water-bearing aquifers are higher than in the formation. During the summer months the groundwater levels are higher in the formation than in the fresh water. During the summer months the water in the formation could up-well into the fresh water-bearing formations. Historically, prior to 2006, the head differences during the summer months were only a few feet, but since then up to 15 feet of head differences have occurred. The greater head differences suggest an increase in groundwater pumping occurred locally in this area.

5.7 Change in Groundwater Storage

The amount of groundwater in storage changes annually and seasonally depending on the amount of groundwater use and recharge. The change in storage provides an indication of how much groundwater is in storage for dry years when there is more reliance on groundwater. The change in groundwater storage was estimated for the entire NASb using the calibrated groundwater model. The model includes actual groundwater pumping from municipal water purveyors and estimated groundwater pumping for agricultural areas from the NASb.

Table 5-2 shows the NASb-wide groundwater pumping for water years 2009 through 2018. **Figure 5-9** shows both the annual and cumulative changes in groundwater in storage in the Subbasin. The cumulative change in storage during this period, increased by about 300,000 acre-feet (AFY) which included the recent drought, or on average by about 30,000 AFY.

Table 5-2. Summary of Annual Extraction and Change in Storage

Water Year	Groundwater Extraction (acre-feet)	Change in Storage (acre-feet)	Water Year Classification
2009	313,120	9,395	Dry
2010	273,566	72,314	Below Normal
2011	252,800	152,057	Wet
2012	293,862	-9,524	Below Normal
2013	298,785	-13,615	Dry
2014	301,847	-32,603	Critical
2015	357,224	-71,725	Critical
2016	279,422	54,642	Below Normal
2017	279,942	168,082	Wet
2018	306,763	-10,024	Below Normal

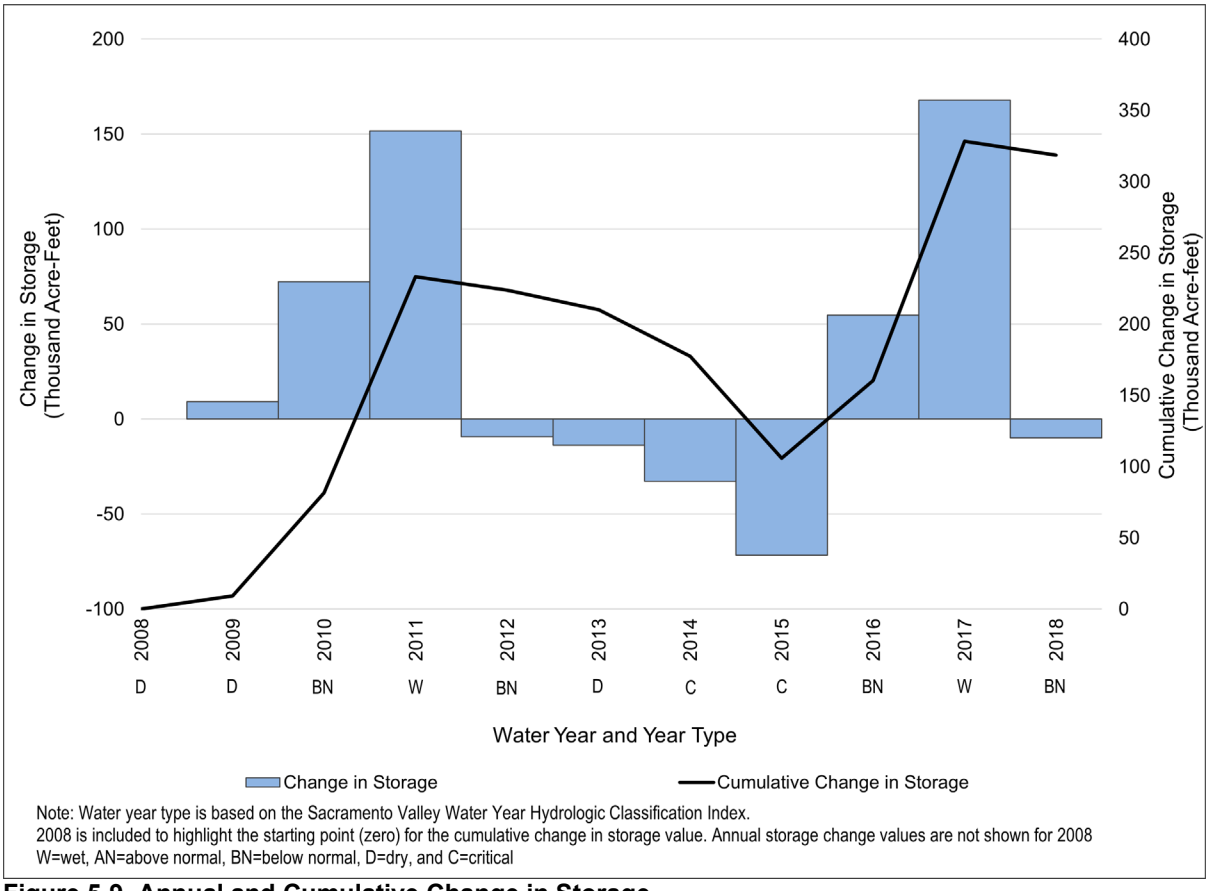


Figure 5-9. Annual and Cumulative Change in Storage

5.8 Groundwater Quality

Generally, the quality of groundwater in the Subbasin is suitable for nearly all uses, with the exception of contamination plumes and localized, naturally-occurring and human-caused quality issues, which may affect the supply, beneficial uses, and potential management of groundwater in the Subbasin. This section describes the distribution, concentration and trends of the more commonly encountered and primarily naturally-occurring dissolved constituents in groundwater, along with human-caused water quality contamination issues.

5.8.1 Occurrence of Commonly Evaluated Constituents in Groundwater

While there are over 50 elements (general minerals and metals) with established drinking water and agricultural standards, only a few elements typically occur in the Sacramento Valley at levels that warrant evaluation and tracking to assess their occurrence and distribution. The concentration and depth of the elements varies widely over the NASb and at any given location. Various studies have been performed and each has evaluated similar elements, and a few have evaluated additional elements. A Groundwater Quality Vulnerability Assessment of the SGA portion of the Subbasin identified seven elements (arsenic, chromium (total and hexavalent), iron, manganese, nitrate, total dissolved solids, and radon) that provide a general condition of the groundwater quality (SGA, 2011). It should be noted that some of these naturally-occurring elements may be either sourced from, or increased by, human activities. This GSP evaluates six of these seven elements (not radon), which were also identified and analyzed in other studies, plus boron because its presence can affect agriculture.

The groundwater quality presented in this GSP was developed using information from the California State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW), which maintains a database of public water systems' water quality analyses. DDW requires each public water system to analyze water quality for over 300 elements at intervals ranging from weekly to every 3 years. Because large portions of Placer and Sutter counties are agricultural, public water systems are scarce within those areas. Therefore, data from the DDW was supplemented with data from one well (monitoring well 61, *refer to* **Figure 3-15**) monitored for the Irrigated Lands Regulatory Program Sacramento Valley Water Quality Coalition Groundwater Quality Trend Monitoring program and data from domestic wells used by the USGS for their *Groundwater Quality Data in the Southern Sacramento Valley, California, 2005 – Results from the California Groundwater Ambient Monitoring and Assessment (GAMA) Program* (Milby, et. al. 2005 and 2018) and water quality from local programs.

Water quality samples were collected from 24 domestic wells, between 2013 and 2017, with an average screen interval 129 to 178 feet bgs. The results showed TDS ranged between 70 and 459 mg/L. Nitrate (as nitrogen) ranged between 0.1 and 1.4 mg/L (Bennett, 2019). The concentrations indicate the water is suitable for drinking water with all concentrations below the secondary and primary drinking water standards (California Code of Regulations (CCR)-Title

22, 2021). However, about 15 percent of the wells had arsenic and manganese above their respective MCLs (Bennett, 2019).

Figures 5-10 through 5-16 show the most recent analyses and distribution of the selected elements in the Subbasin. The analyses dates range from 1967 to 2019. These figures also show where monitoring wells are located that could be used to supplement the data set. **Appendix L** provides a detailed list of the water quality analysis and wells used to create the figures. **Table 5-3** provides a list of the constituents, the number of samples analyzed, their minimum and maximum concentrations, and the average and percent of samples exceeding the MCL or Notification Level.

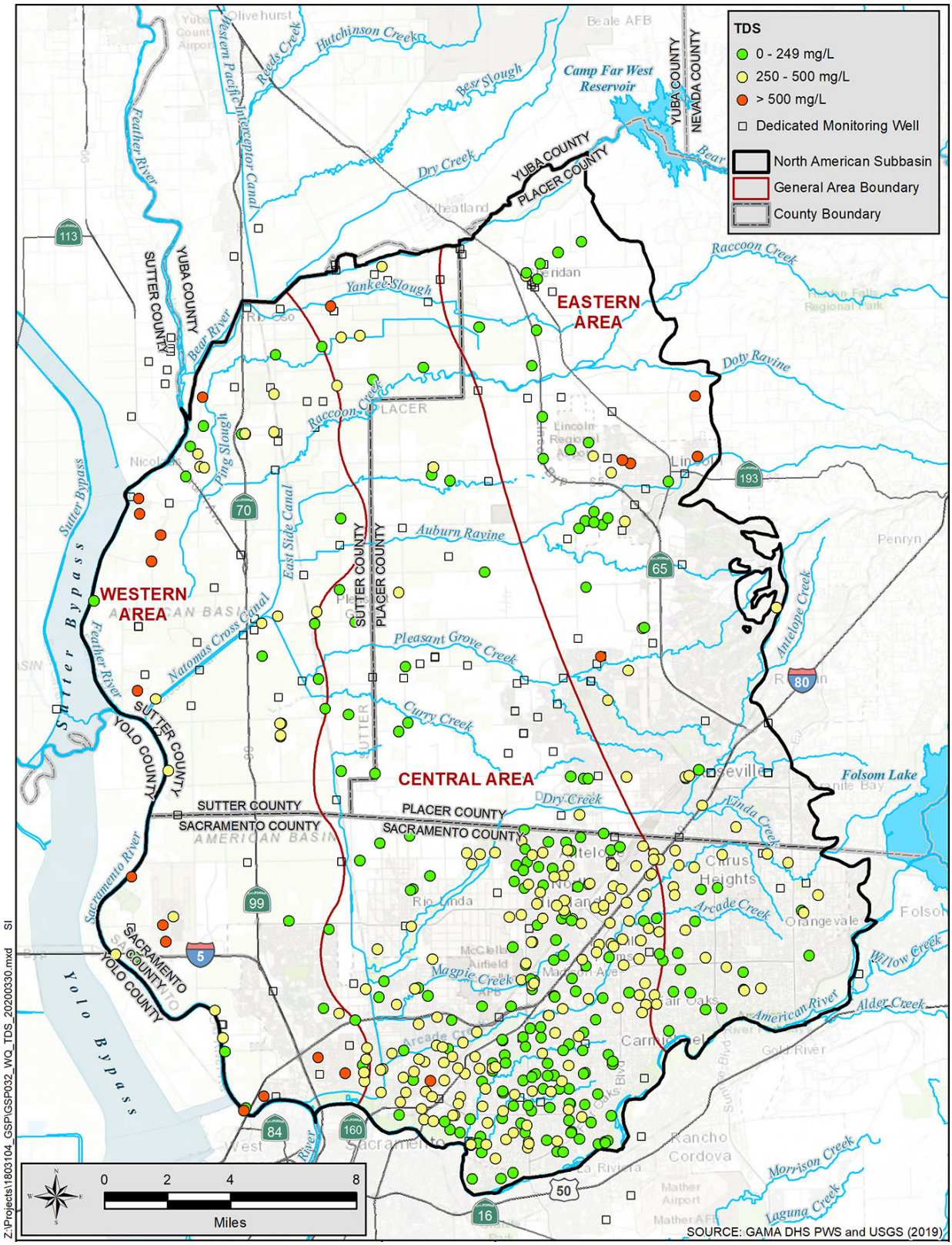


Figure 5-10. Distribution of TDS Concentrations

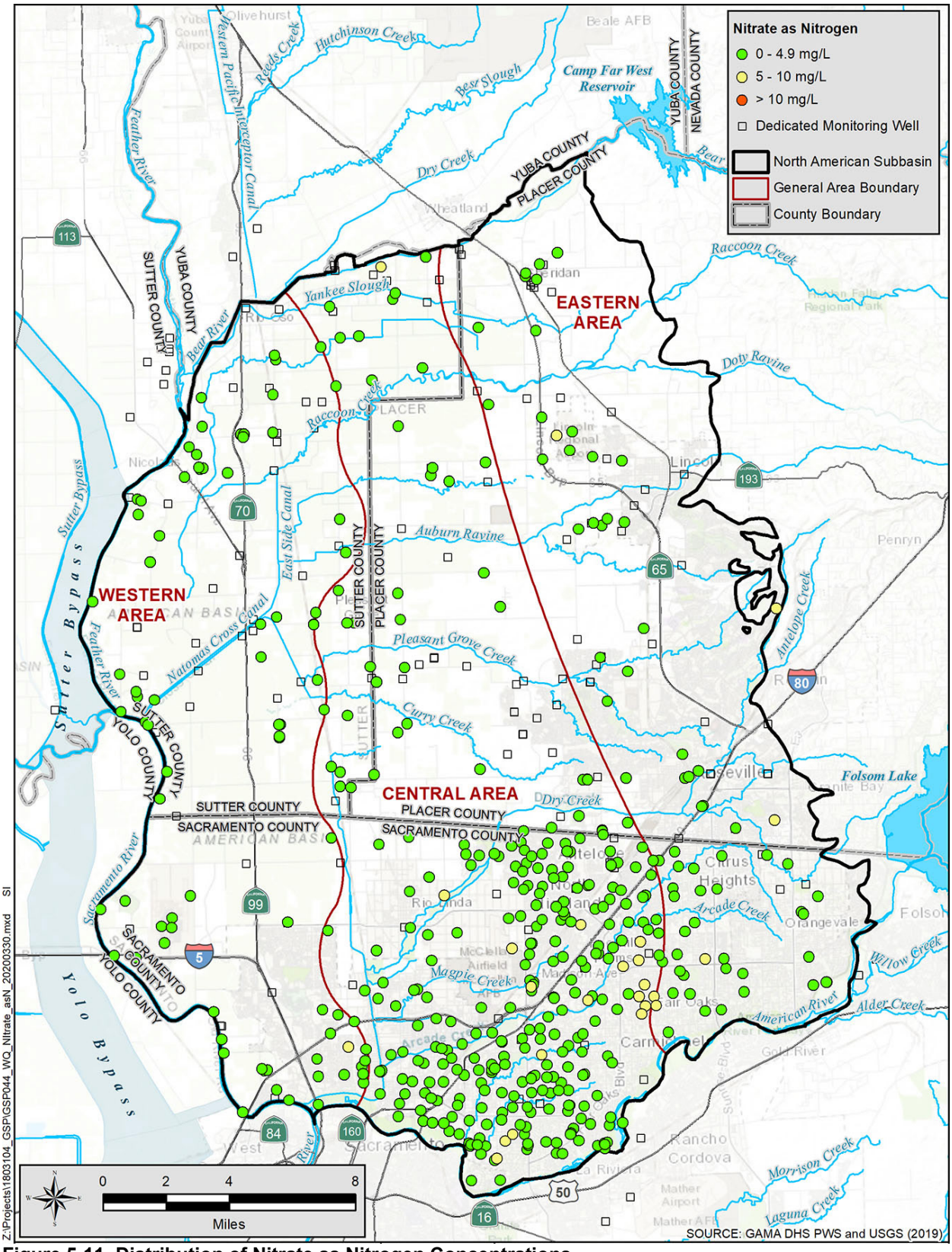


Figure 5-11. Distribution of Nitrate as Nitrogen Concentrations

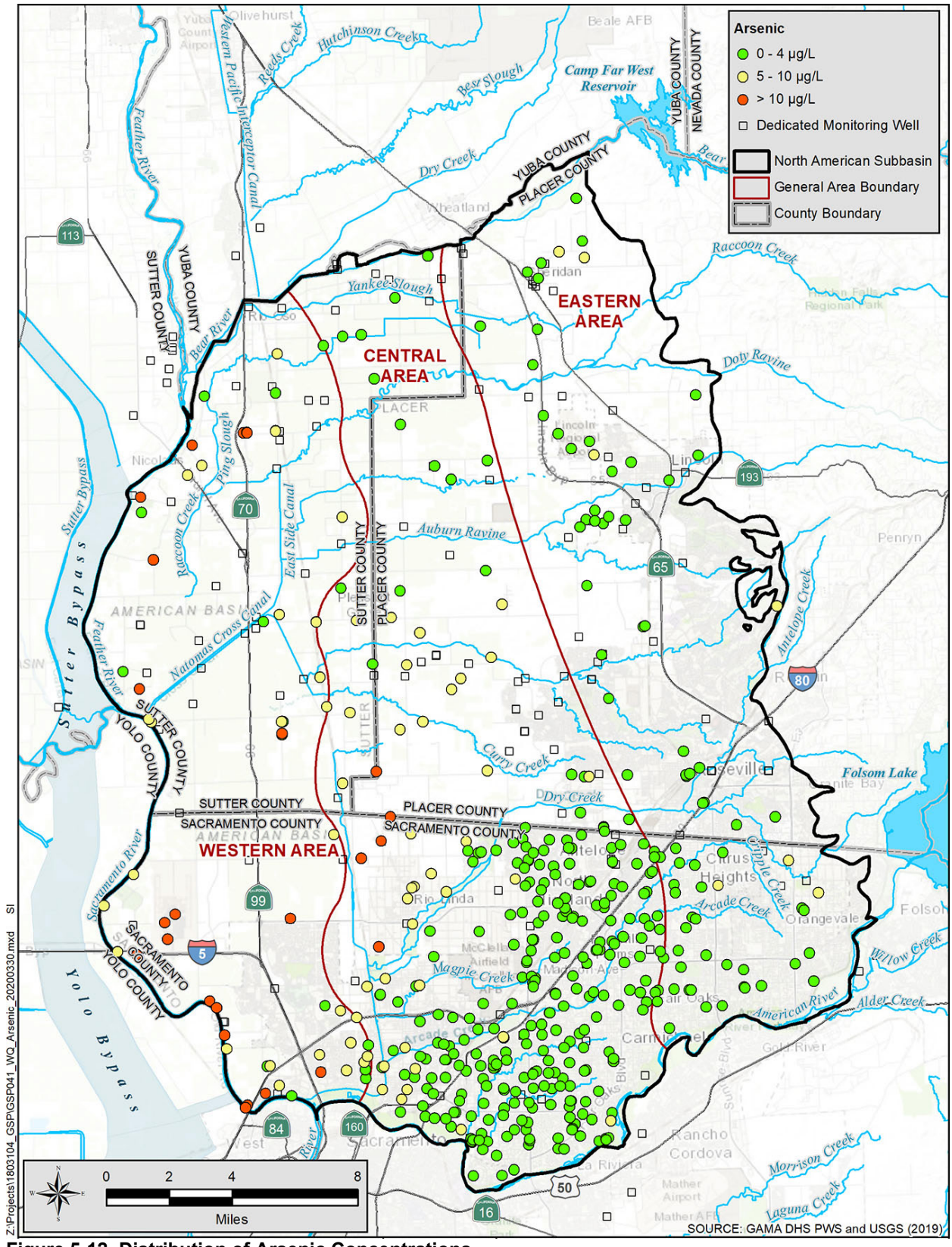


Figure 5-12. Distribution of Arsenic Concentrations

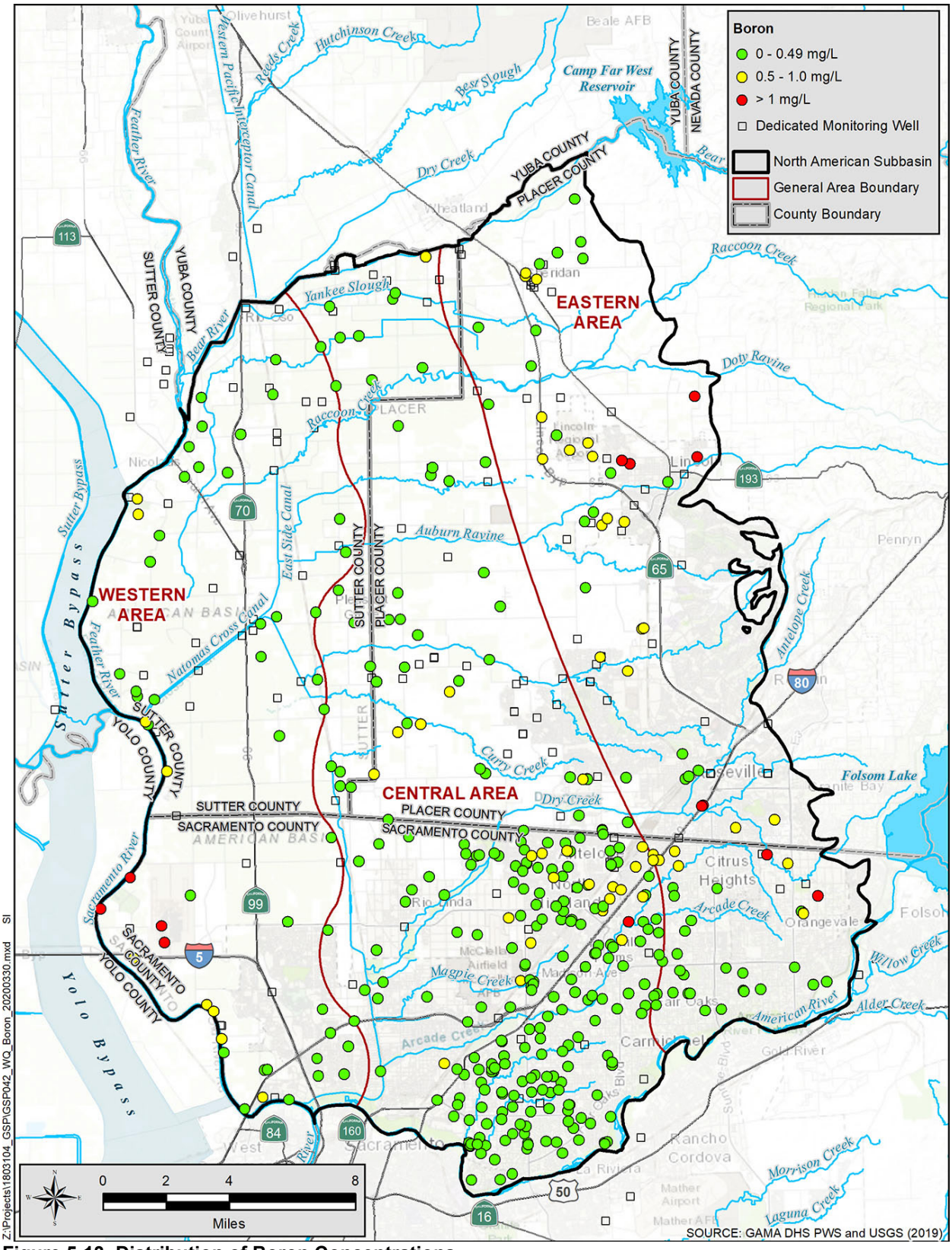


Figure 5-13. Distribution of Boron Concentrations

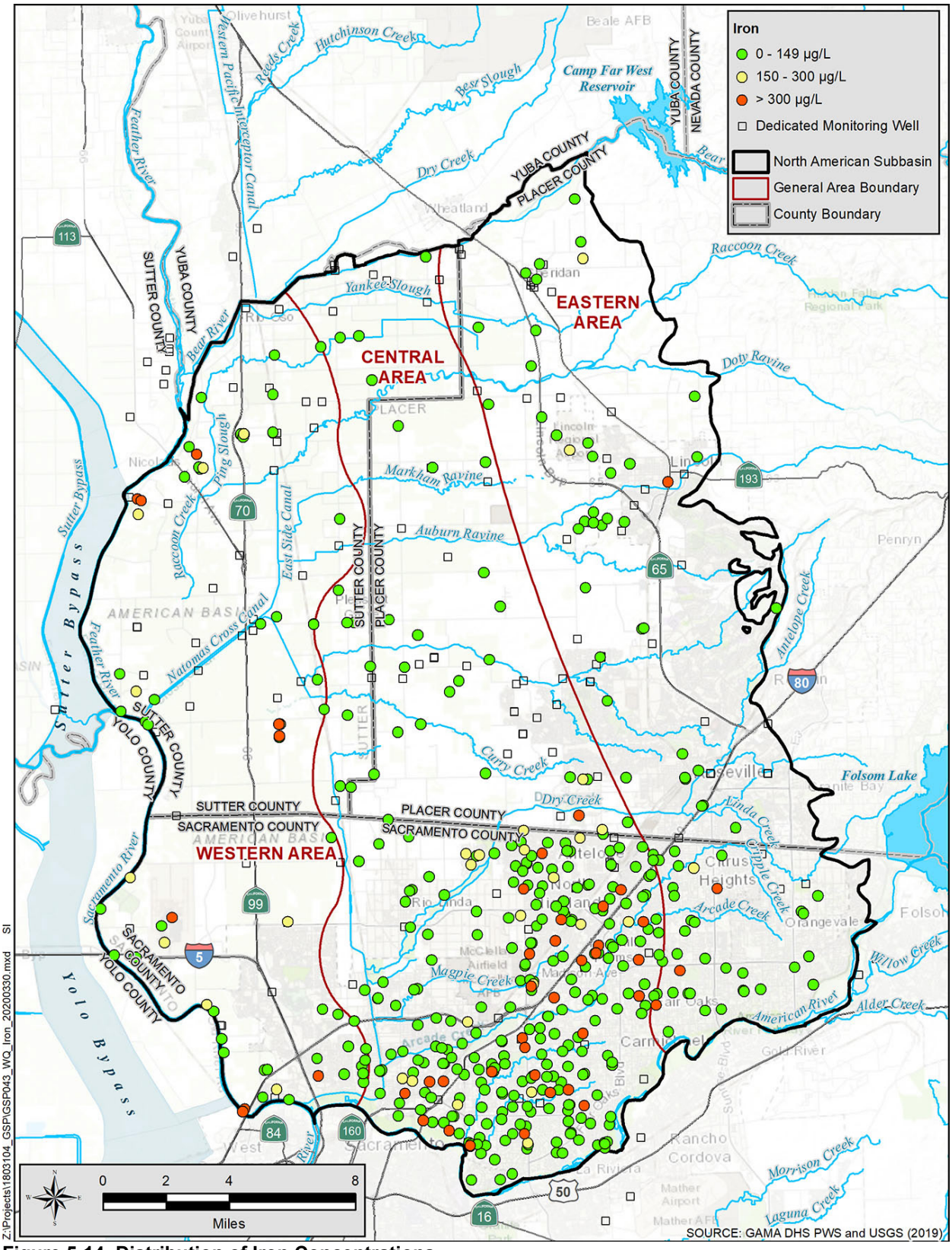


Figure 5-14. Distribution of Iron Concentrations

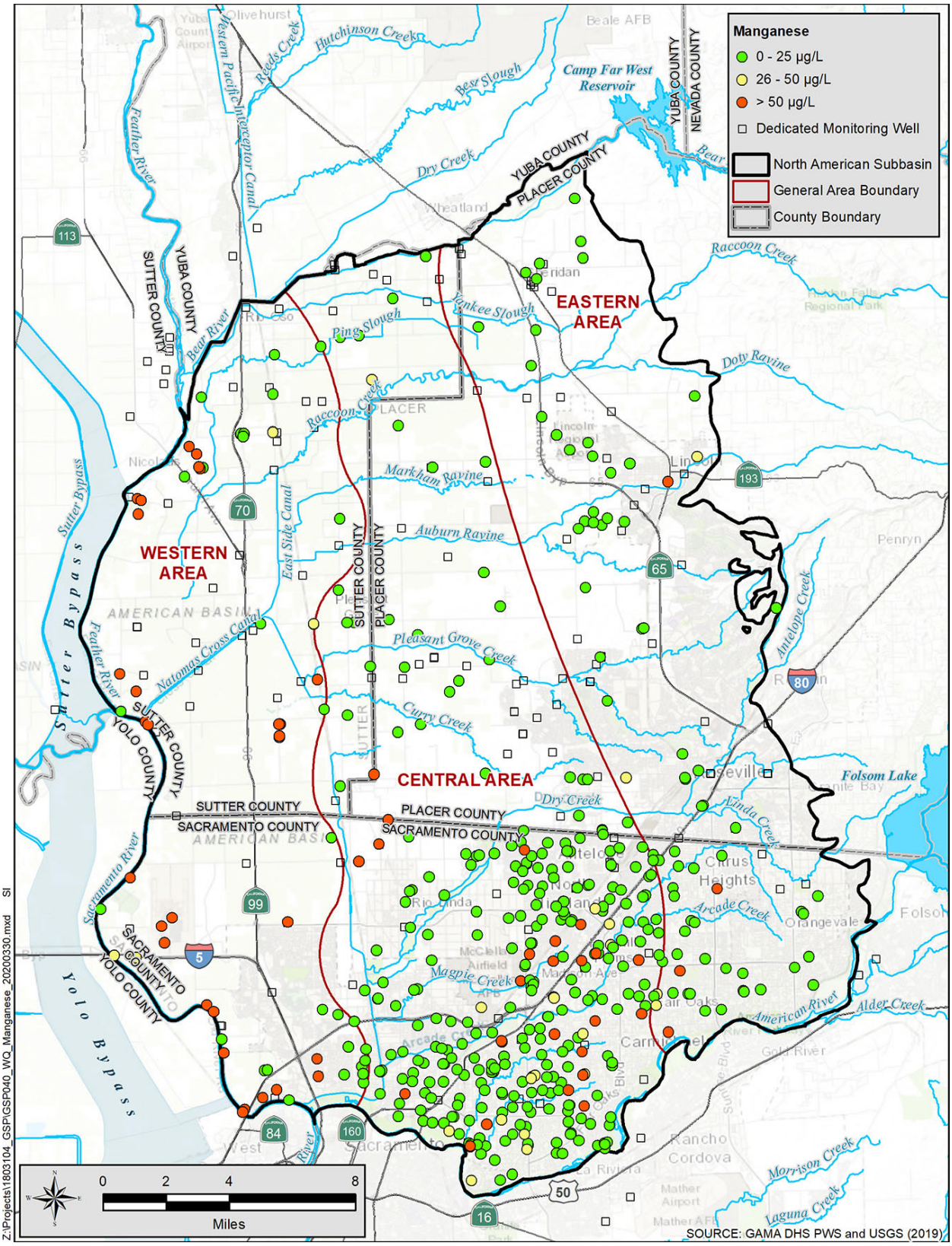


Figure 5-15. Distribution of Manganese Concentrations

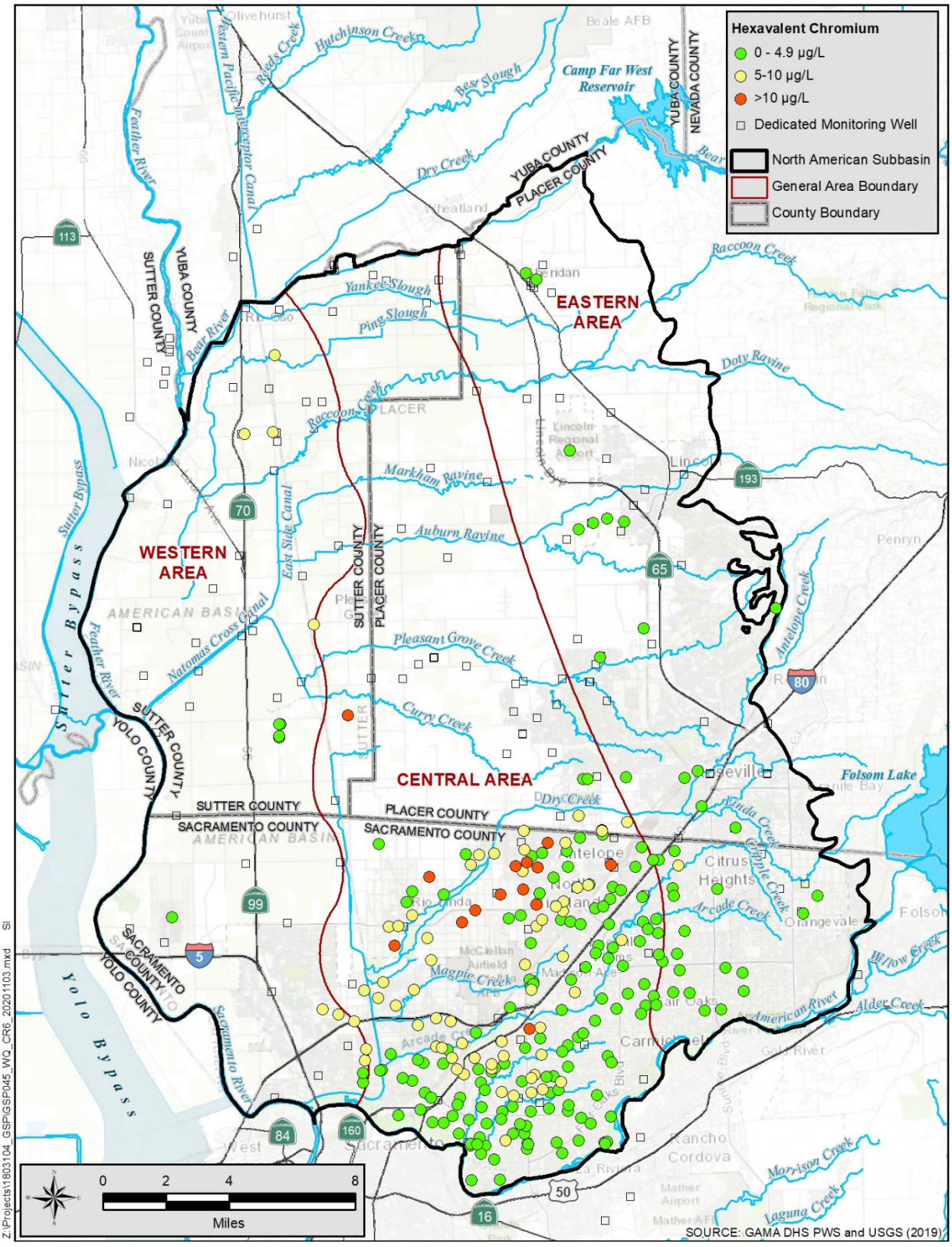


Figure 5-16. Distribution of Hexavalent Chromium Concentrations

Table 5-3. General Water Quality Summary

Constituents	Units	MCL or Notification Level	Number of wells with analytical results	Minimum Concentration[4]	Maximum Concentration	Average	Number of wells with most recent analysis exceeding MCL	Range of analysis (years)
Arsenic	ug/L	10	482	<2.0	78.1	4.09	29	1967-2019
Boron	mg/L	1[1]	410	<0.1	6.8	0.2	14	1969-2018
Hexavalent Chromium	ug/L	10[2]	252	<0.05	14	4.17	-	2001-2019
Iron	mg/L	0.3	488	<0.03	5.5	0.16	44	1957-2019
Manganese	mg/L	0.05	488	<0.01	3.6	0.05	62	1970-2019
Nitrate as Nitrogen	mg/L	10	494	<0.023	10	1.7	0	1964-2019
TDS	mg/L	500[3]	451	97	1,360	268.7	22	1969-2019

Notes: 1 = Notification level, no MCL
2 = No MCL, previous MCL shown
3 = Secondary standard, recommended level shown
4 = Reporting limit, may vary with historic analysis

This page left intentionally blank

Water quality in each of the areas varies and some elements with elevated levels are only present in a one or more areas while not in others. These findings align with previous studies in the Subbasin. Where concentrations are elevated, wells are often constructed into different aquifers where the water quality is better. In summary:

- In the Western area, elevated concentrations of arsenic, boron, and TDS are present near the Feather and Sacramento rivers. Studies in the area show variable water quality in the aquifers. Poor-quality water is present in the adjacent Sutter Subbasin. It is unknown if the poor-quality water is present in the Yolo Subbasin.
- In the Central area, elevated levels of arsenic and hexavalent chromium are generally found in the western portion of this area, in the vicinity of Rio Linda (SGA, 2011) with scattered occurrences elsewhere in the Subbasin. The areas of biggest concern for hexavalent chromium appear to be north of Interstate 80 near the communities of Rio Linda, Antelope, and North Highlands.
- In the Eastern area, scattered locations near Sheridan, Lincoln, and Roseville have elevated boron and TDS levels. High TDS concentrations are commonly associated with sodium chloride types of water and may be related to connate water from the marine Ione Formation. The effects of the Ione Formation water in this area appear to be of limited extent. Sodium chloride types of water are also present in deeper wells in the Subbasin near or below the base of fresh water.

Nitrate concentrations are typically below the MCL for drinking water in all three areas; however, nitrate concentrations are trending upward in many parts of the Subbasin. Elevated levels of boron appear to be present in most areas with some concentrated areas in the Western area south of Highway 5 and in the SGA area. Elevated iron and manganese levels (**Figures 5-15 and 5-16**) could be encountered in any of the three areas. Elevated levels of hexavalent chromium appear to be more concentrated in the SGA area, but this could in part be due to SGA having a greater number of wells with analyses.

5.8.2 Groundwater Quality Trends

Groundwater quality trends are evaluated to assess trends and where management actions may be required to reduce future degradation and keep the water potable. Water quality sampling in the Subbasin has been conducted for over 40 years as part of state and federal efforts to evaluate water quality throughout the state and nation and where future studies may be needed to maintain potable water supplies. Although many of the elements are naturally occurring, human activities may result in increased concentrations of elements and produce upward trends. In general, water quality trends in the NASb are not showing rising concentrations and are remaining in a consistent range with a few exceptions.

5.8.2.1 Previous Analyses

Water quality trends for TDS (a primary indicator of naturally occurring water quality) and nitrates (a primary indicator of human activities) were analyzed in historical reports and concluded the following trends.

In the SGA area, a Water Quality Vulnerability Assessment in 2011 using just public water supply wells found:

- TDS trends are, for the most part, stable and not increasing (SGA, 2014).
- In 19 wells, nitrate concentrations were rising somewhat over the period of record (earliest records in the database are generally from the mid-1980s or later) (SGA, 2014). In 10 wells, nitrate concentrations were trending downward. SGA concluded that there was no discernible overall trend in the data at that time. Regardless, SGA concluded there were no trends that would constitute a health concern with respect to nitrates in the SGA area.

In the West Placer GSA area:

- TDS levels are generally stable or decreasing but are increasing at one water supply well (GEI, 2020).
- Nitrate trends were not evaluated.

A Groundwater Assessment Report for most of the Sacramento Valley was performed as part of the Irrigated Lands Regulatory Program, which used all wells in the GAMA data files (CH2MHill, 2014). This report provides water quality covering the SGA, West Placer, SSWD, RD 1001 and Sutter GSA areas. It used a modified Mann-Kendall statistical approach. In the NASb:

- TDS levels trends were consistent.
- Nitrate concentrations are increasing at seven out of 20 wells, in the agricultural areas of west Placer County and Sutter County.

A Groundwater Assessment Report for rice areas in the Sacramento Valley, including in part some portion of all of the GSAs, was also performed as part of the Irrigated Lands Regulatory Program. No rigorous trend analysis was performed but graphs were provided for some wells. This analysis only used 12 wells in the NASb (CH2MHill, 2013). In the NASb:

- TDS concentrations were very consistent.
- Data was only sufficient at one well to evaluate nitrate trends (decreasing).

5.8.2.2 Current Analyses

Groundwater quality trends for this GSP were developed using data from public water supply wells, and USGS and DWR wells were used to develop the water quality distribution (*refer to* **Figures 5-10 through 5-16**). A statistical trend analysis of the data was performed using the Mann-Kendall method when a well had more than five samples for a given element. This method is a non-parametric (for example, does not assume a distribution in the data) test for identifying trends in time-series data. **Appendix M** provides the analysis and trend graphs for each constituent**. Figures 5-17 through 5-23** show the trends for each element. **Table 5-4** provides a summary of the analysis.

Table 5-4. Water Quality Trend Summary

Element	Units	Number of Wells with Greater Than Five Samples	Increasing Trends	Decreasing or Flat Trends
Arsenic	ug/L	245	7	238
Boron	mg/L	71	3	68
Hexavalent Chromium	ug/L	115	1	114
Iron	mg/L	241	9	232
Manganese	mg/L	241	2	239
Nitrate as Nitrogen	mg/L	316	69	247
TDS	mg/L	267	8	259

Similar to historical assessments, this GSP finds that groundwater quality is stable with the exception of nitrate. Although nitrate has the greatest number of wells with upward trends, and these upward trends are present in all areas, nitrate concentrations are well below the safe drinking water standard throughout the Subbasin. The nitrate is likely present due to historical agricultural fertilization practices, septic systems, and leaky sewers.

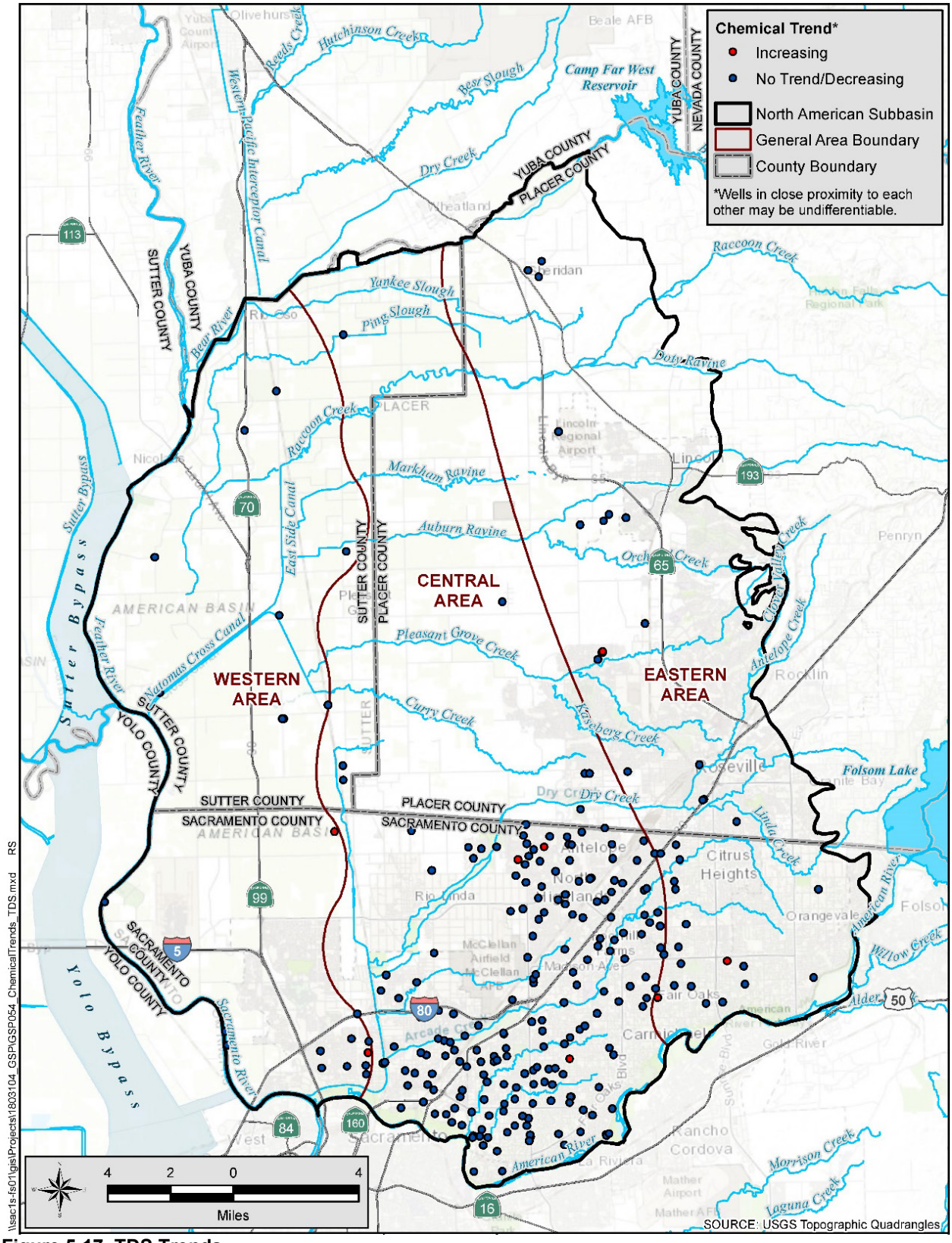


Figure 5-17. TDS Trends

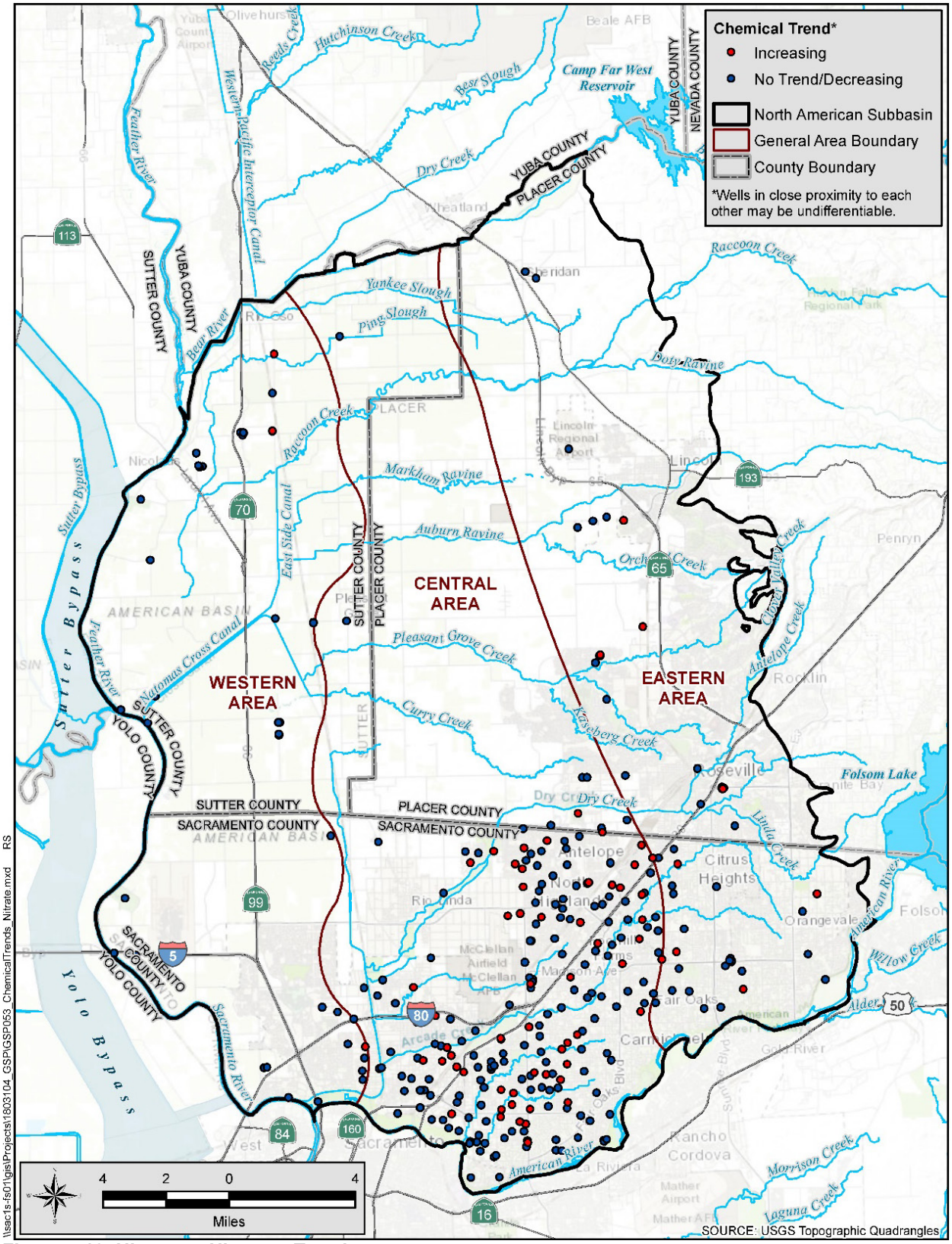


Figure 5-18. Nitrate as Nitrogen Trends

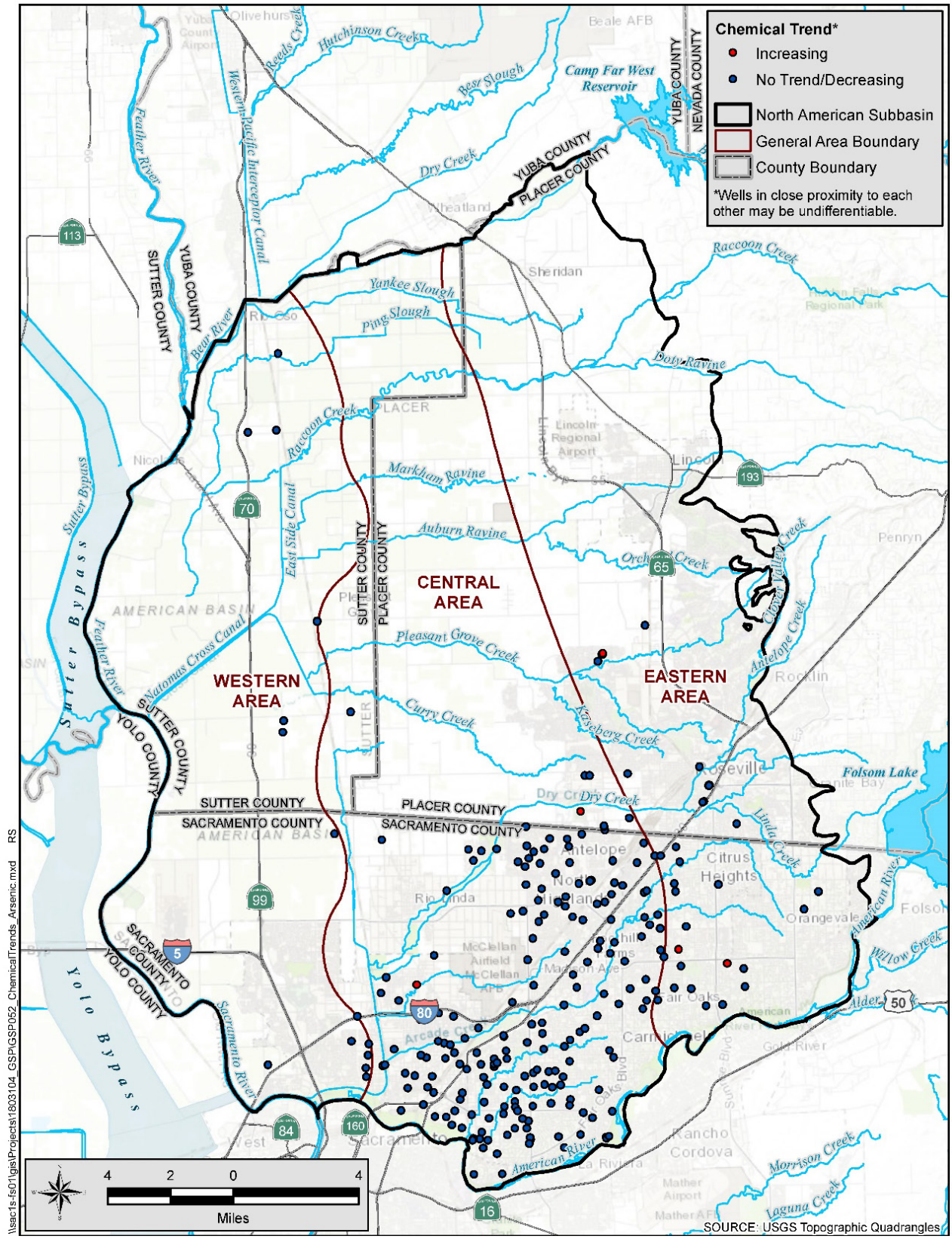


Figure 5-19. Arsenic Trends

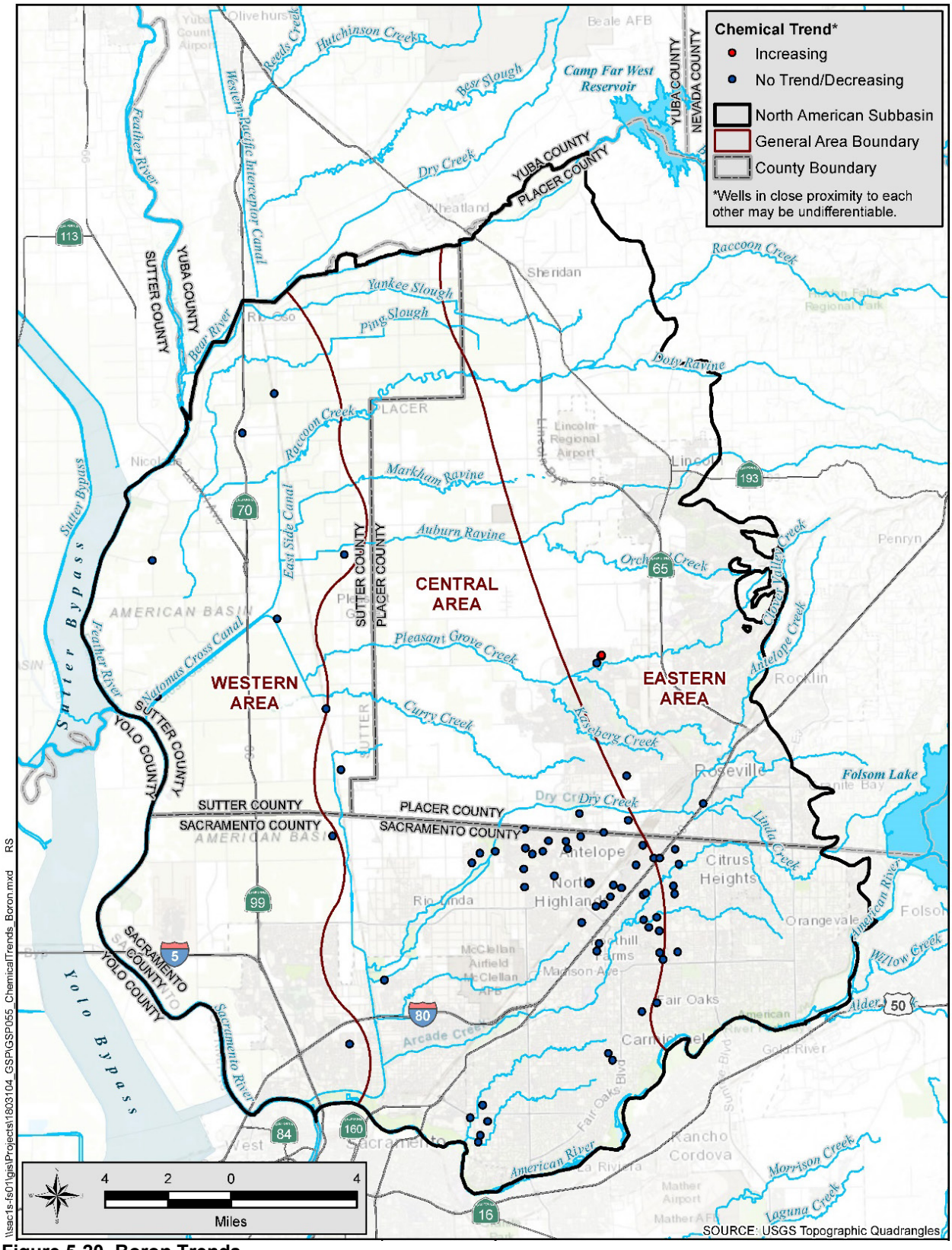


Figure 5-20. Boron Trends

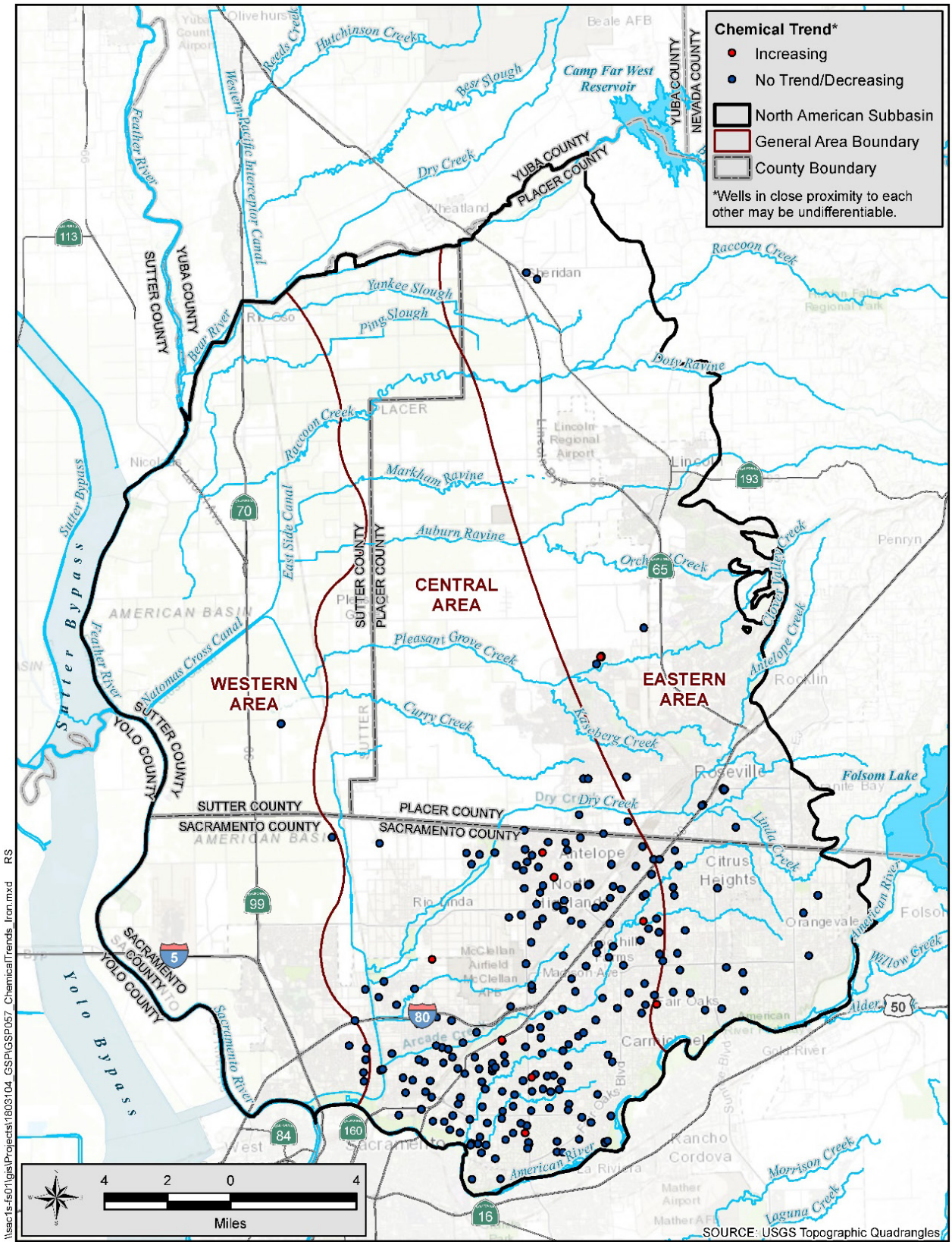


Figure 5-21. Iron Trends

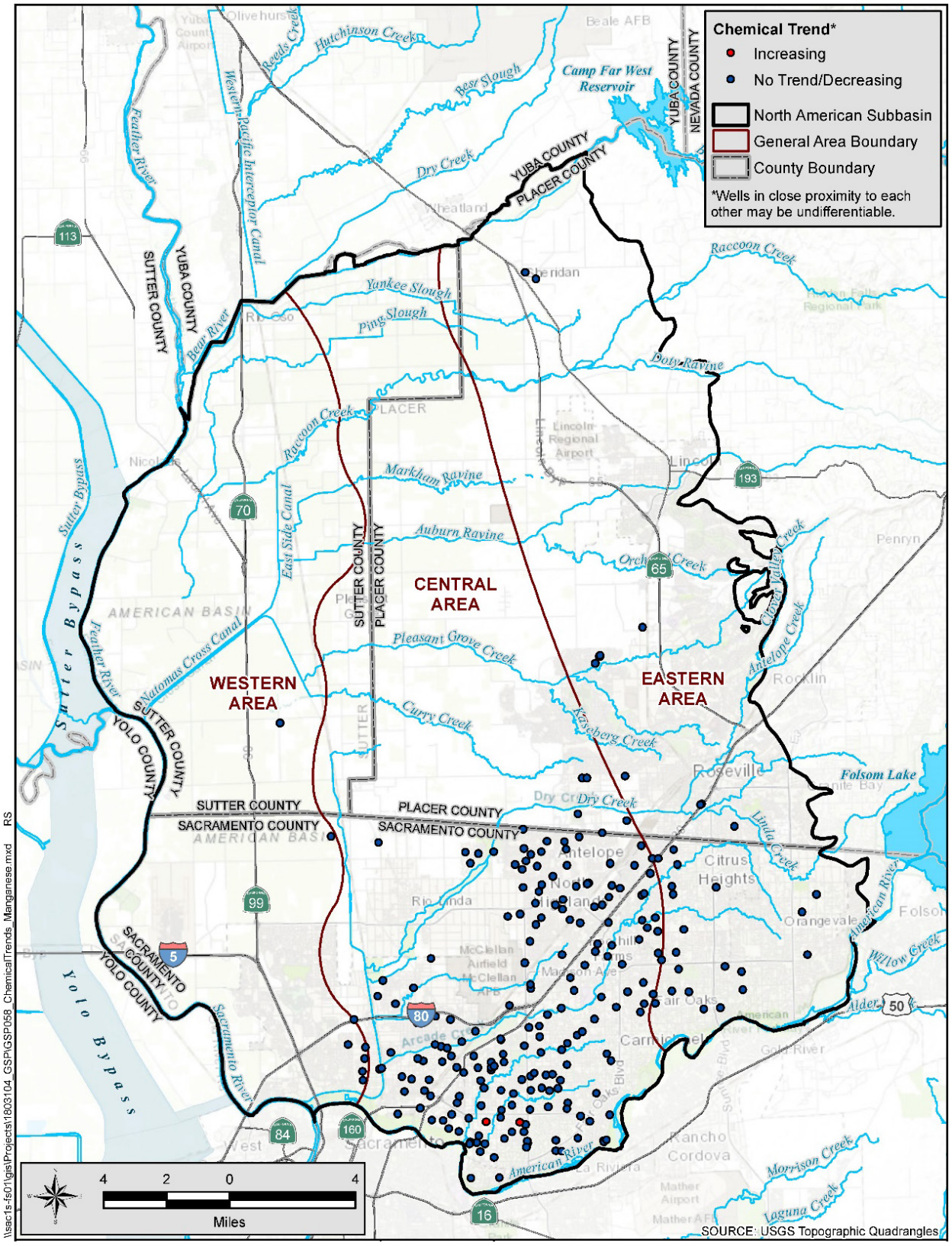


Figure 5-22. Manganese Trend

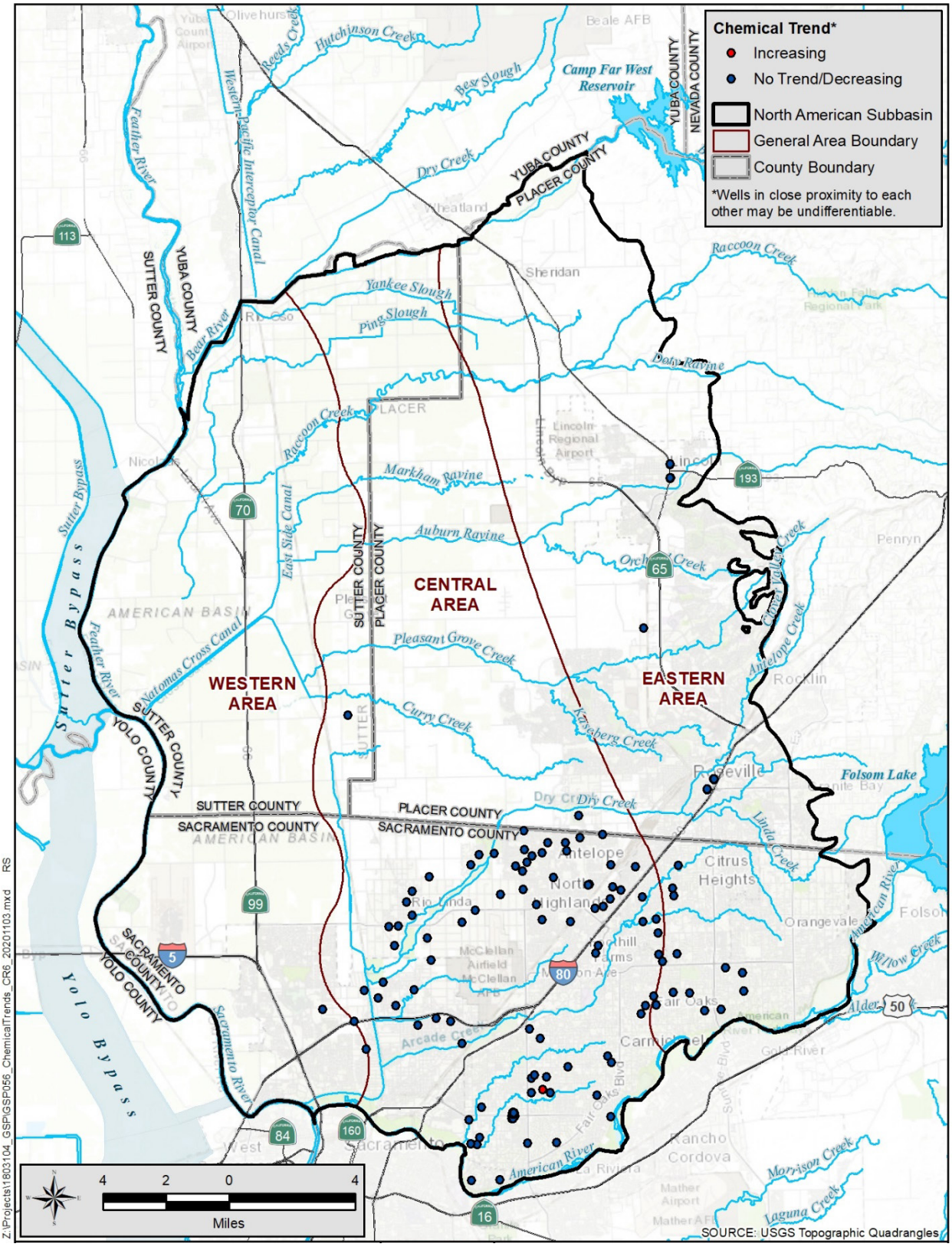


Figure 5-23. Hexavalent Chromium Trend

5.8.3 Groundwater Contamination Sites and Plumes

In the NASb, there are a few large and known groundwater contamination sites that could affect supply and beneficial uses of groundwater in the Subbasin. The most significant of these sites are the former McClellan AFB and the Aerojet Superfund Site (adjacent to the NASb to the south). **Figure 5-24** shows the extent of the plumes at these sites. Cleanup activities, as overseen by the U.S. Environmental Protection Agency, SWRCB, and the California Department of Toxic Substances Control, have been in progress for multiple years and contaminants appear to be contained. As described in the SGMA, the GSAs are required to manage the groundwater basin to avoid significant and unreasonable degradation of water quality. However, GSA's authorities under SGMA do not limit or supersede the authorities of the State Water Resources Control Board (SWRCB), the Regional Water Quality Control Boards to order investigations or remediation activities.

At the former McClellan AFB, one of the cleanup methods in use is air-sparging, which injects air up to depths of 106 feet bgs and requires groundwater levels to remain below this depth for the clean-up to be effective. The former McClellan AFB is within the Central area of the NASb and is part of the reason the pumping depression remains in this area. Their groundwater cleanup program is well established; mandated by Comprehensive Environmental Response, Compensation, and Liability Act and is not discretionary; and their pumping is relatively small, on the order of 2,000 acre-feet per year and will likely remain the same for years if not decades.

Although the Aerojet site is in the South American Subbasin, a contaminant plume (including perchlorate, trichloroethene or TCE, tetrachloroethene or PCE, and N-Nitrosodimethylamine or NDMA) extends north from Aerojet, under the American River, and into the NASb into the communities of Carmichael and Fair Oaks. The plumes are being remediated by Aerojet by pumping and treating the water to remove the contaminants.

There are other localized areas of groundwater contamination in the Subbasin that are generally smaller in size and the extent of contamination is typically localized near the properties and is being remediated (*refer to* **Figure 5-24)**.

PCE contamination is present near Interstate 80 and the Sacramento and Placer counties boundaries (Roseville, Citrus Heights, and Lincoln Oaks areas), but the source(s) has not been defined. A study by the SGA defined the extent of the plume. Currently, there are no active cleanup activities.

The Union Pacific Railroad site is located near Roseville Road and Vernon Street in Roseville. The primary constituents of concern are total petroleum hydrocarbons (including diesel, oil, and gasoline), volatile organic compounds (TCE, PCE, and others), semi-volatile organic compounds, dissolved arsenic, nickel and lead. Groundwater contamination assessment and remediation is in progress.

Remedial activities are occurring at two landfills in West Placer County along with cleanup activities of nitrate and perchlorate at the Alpha Explosives facility.

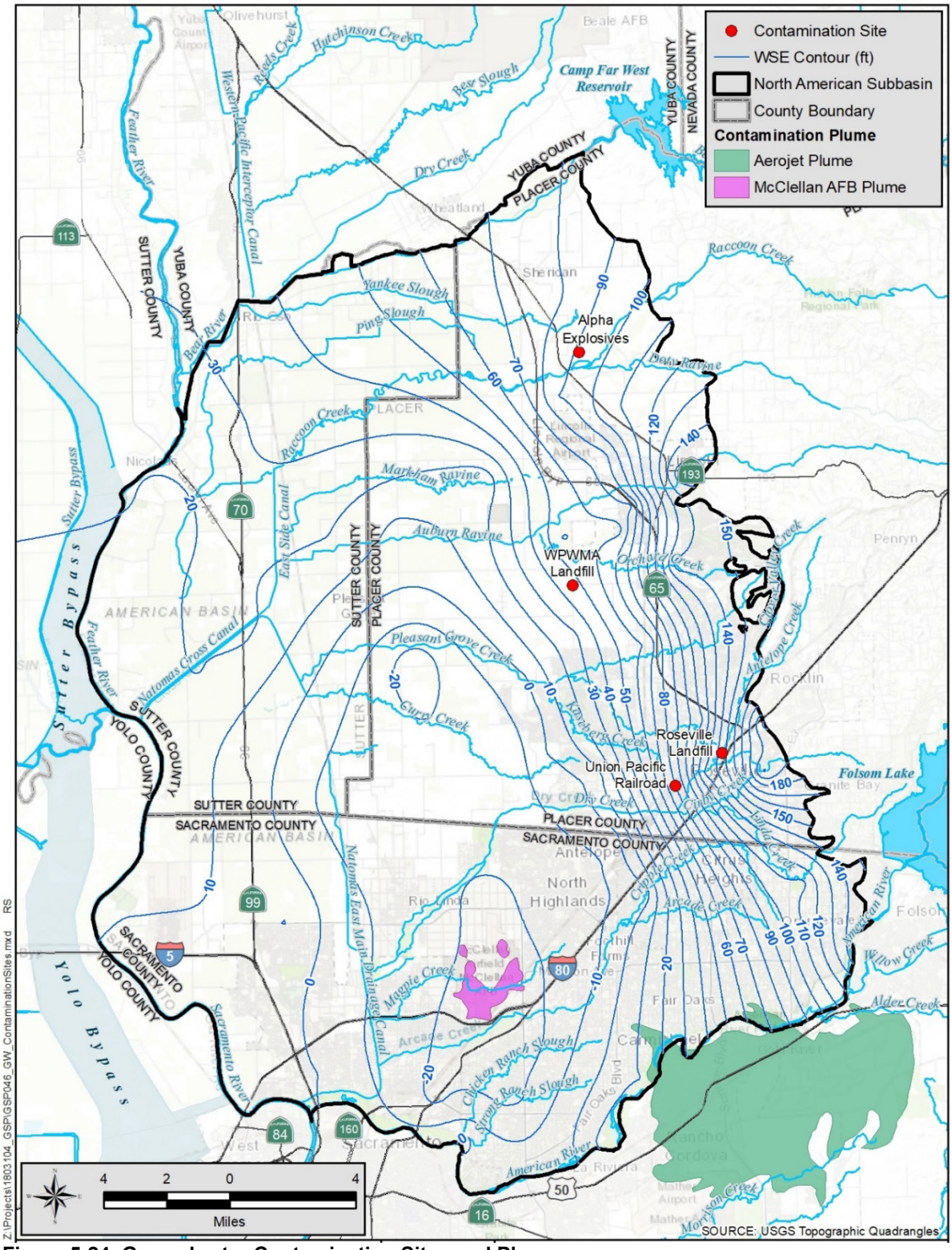


Figure 5-24. Groundwater Contamination Sites and Plumes

The presence of groundwater contamination plumes associated with defense-related and other industrial activities has been an issue of particular interest to the SGA. This contamination is known to limit local water purveyors' access to groundwater in a significant portion of the basin due to an exclusion zone for wells enforced by Sacramento County around the former McClellan Air Force Base. The SGA concern has been that if groundwater contamination is not managed properly, the region could potentially increase its reliance on surface water. This could in turn threaten the region's ability to implement the Water Forum Agreement.

In February 2004, SGA learned that NDMA associated with a contaminant plume from the Aerojet facility near Rancho Cordova had been detected in a monitoring well within Carmichael Water District north of the American River within the SGA area (see **Figure 5-24**). In response, SGA joined forces with the Sacramento Water Forum to establish what is now known as the Regional Contamination Issues Committee (RCIC) in June 2004. The RCIC is a forum for water purveyors, regulators and responsible parties to raise issues and discuss solutions for dealing with groundwater contamination issues that impact the region. The group has met continually since that time. Standing meetings are scheduled on a quarterly basis. State agencies represented include the Central Valley Regional Water Quality Control Board, the Department of Toxic Substances Control, and the SWRCB Division of Drinking Water. The federal government has been represented by the United States Environmental Protection Agency. The group has been very successful at collaborating on solutions that have kept these plumes from mobilizing, while progress on remediation has been made. There is active consultation and evaluation process established to understand the potential effects of new proposed municipal production as it relates to wells to ensure prevention of plume mobilization. Continued monitoring around the perimeter of the plumes shows that concentrations of contaminants are not increasing.

In 2011, an analysis of the capture effectiveness of the McClellan and Aerojet contamination was completed for the SGA (RMC, 2011). The study evaluated expanded conjunctive use operations by municipal water suppliers in the SGA area. Based on the analysis results, SGA concluded that the facilities each had effective capture of contaminants within the SGA area.

Finally, it is worth noting that Per- and poly-fluoroalkyl substances (PFAS) are a groundwater contaminant of emerging concern nationwide. Preliminary testing is being conducted under order of the State Water Resources Control Board to assess the extent of PFAS in groundwater. The NASb GSAs will closely monitor as results become available and consider appropriate actions to the extent that contamination could cause water quality concerns related to future use or management actions resulting from this GSP.

5.9 Seawater Intrusion

The NASb is more than 80 miles inland from the Pacific Ocean. However, tidal action and Delta outflow work to create a long and gradual salinity gradient from the ocean up the Sacramento River. Before Shasta Dam was constructed in 1943, seawater (defined as chloride concentration greater than 1,000 mg/L or about 5% seawater) had intruded up-river beyond Courtland (DWR,

1995), about 20 miles from the NASb. Since 1943, seawater intrusion into the river has remained below Isleton, about 40 miles from the NASb. Therefore, seawater intrusion is unlikely to occur in the vicinity of or in the Subbasin.

5.10 Land Subsidence

Substantial land subsidence could interfere with storm water drainage, canal delivery systems and transportation infrastructure. Subsidence monitoring in the NASb consists of one extensometer, two continuous positioning ground stations (CGPS) stations and benchmark surveys. The amount of subsidence is small with the maximum displacement, in a very small portion of the Subbasin, within the last 20 years being -0.25 foot or an average of -0.05 feet per year. **Figures 5-25 through 5-29** present the different surveys and stations results.

Historically, benchmark surveys showed about 0.3 feet of subsidence most likely due to groundwater levels declining by about 30 feet from the 1950s through 1970s or about 0.01 foot of land subsidence per foot of groundwater level decline (MWH, 2002); **Figure 5-25** shows this correlation. The location of the well that was used for this correlation is shown on **Figure 5-29**.

In 1994, DWR constructed the Sutter extensometer (SUT-Ext) and a nested monitoring well (SUT-P) in the Western area of the Subbasin, their locations are shown on **Figure 5-29**. **Figure 5-27** shows the changes in ground surface as they relate to the maximum change in groundwater levels at this location. Since 1994, the groundwater levels have remained stable, with Fall lows only changing by about 20 feet between 1994 and 2019, a 26-year period. The ground surface shows elastic response and potentially some inelastic subsidence of up to 0.04 foot (about one-half inch) or an average rate of -0.002 feet per year. The inelastic response during this time period is less than that predicted from earlier benchmark survey data.

The Subbasin also has two CGPS stations (LCN1 and LCN2) but both stations appear to be at the same location. They are located about the center of the Subbasin in Placer County. **Figure 5-29** show their locations as a single point. **Figures 5-27 and 5-28** show the changes in ground surface as they relate to the maximum change in groundwater levels at this location. Vertical displacements range from -0.01 to -0.025 feet depending upon the evaluation period, from the last 1 to 10 years. The total displacement for the period of record (Oct 2004 through September 2019) was -0.026 feet or an average of -0.002 feet per year. The rate of vertical displacement ranges from -0.001 to -0.005 feet per year depending upon the evaluation period, from the last 1 to 10 years.

DWR performed a regional subsidence assessment by surveying benchmarks in the Sacramento Valley in 2008 and then again in 2017. **Figure 5-29** shows subsidence throughout the Subbasin over this 10-year period (DWR, 2018). The least amount of change has occurred in the Eastern area of the Subbasin with the greatest changes, -0.177 foot or 2 inches, in the south-Central and Western areas of the Subbasin. With any type of survey, there is some amount of error and uncertainty, which for this survey was approximately 0.17 foot. Therefore, any change less than

0.17 foot is not considered statistically significant (DWR, 2018). This uncertainty helps explain an inconsistency between the data from the DWR benchmark survey data report and the extensometer data, the report indicating 0.134 foot of subsidence whereas the more accurate extensometer only shows about -0.04 foot, so the subsidence in the Western portion may be less.

DWR's SGMA Data Viewer (DWR 2021) provides land subsidence based on satellite-based imagery (InSAR). The estimated error in the InSAR data is 0.1 foot. The interpretation of the results do not indicate whether the subsidence is elastic or inelastic subsidence. The InSAR data (**Figure 5-30**) from January 2015 through October 2020, shows land subsidence ranged from 0 to -0.25 feet with most of the area with less than -0.05 foot and just a small area in the western portion of the Subbasin where the subsidence is greater than -0.15 foot. In the northern portion of the Subbasin there are areas with subsidence up to -0.1 foot. The maximum average rate of displacement would be -0.05 feet per year.

This page left intentionally blank

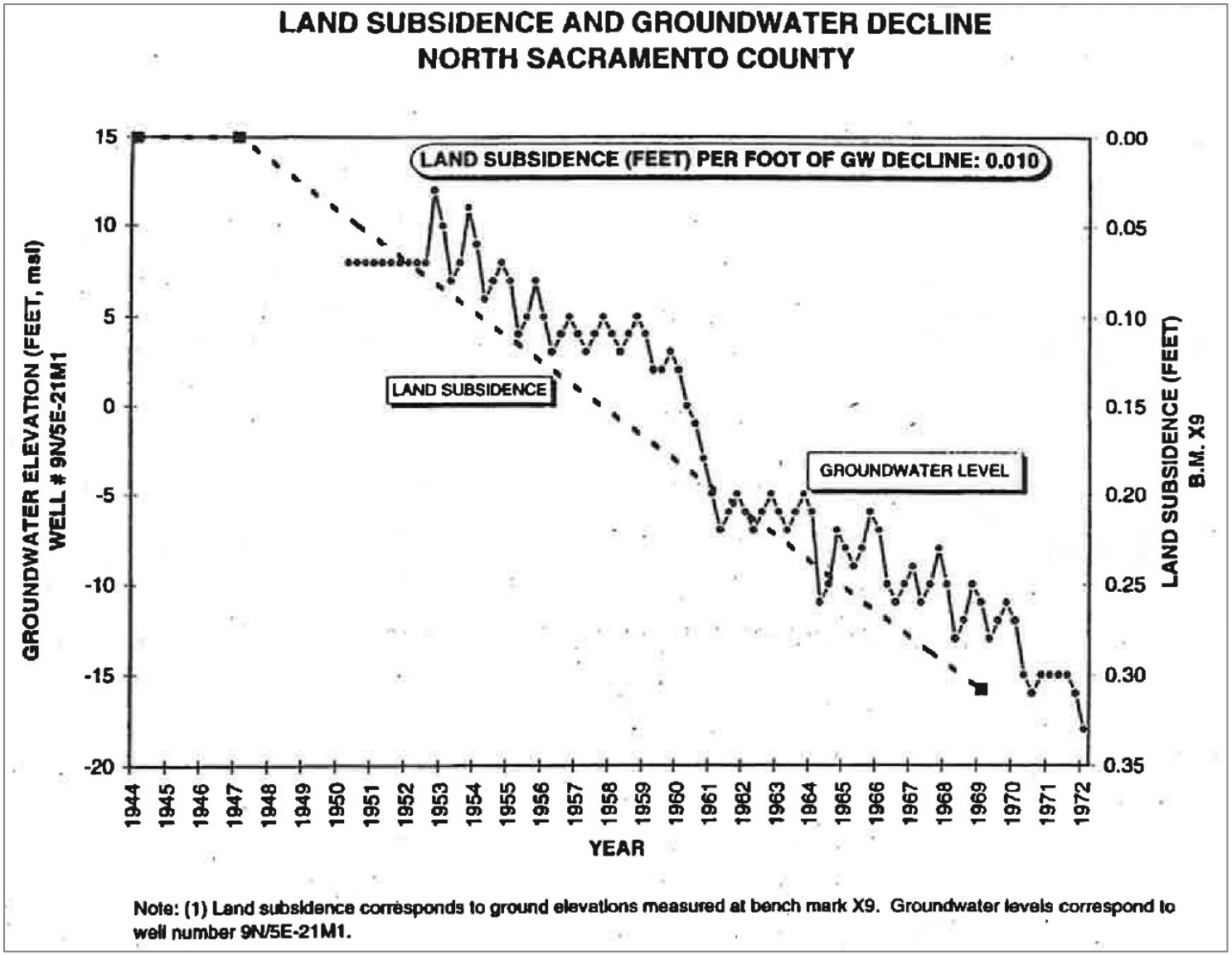


Figure 5-25. Land Subsidence and Groundwater Level Decline Correlation

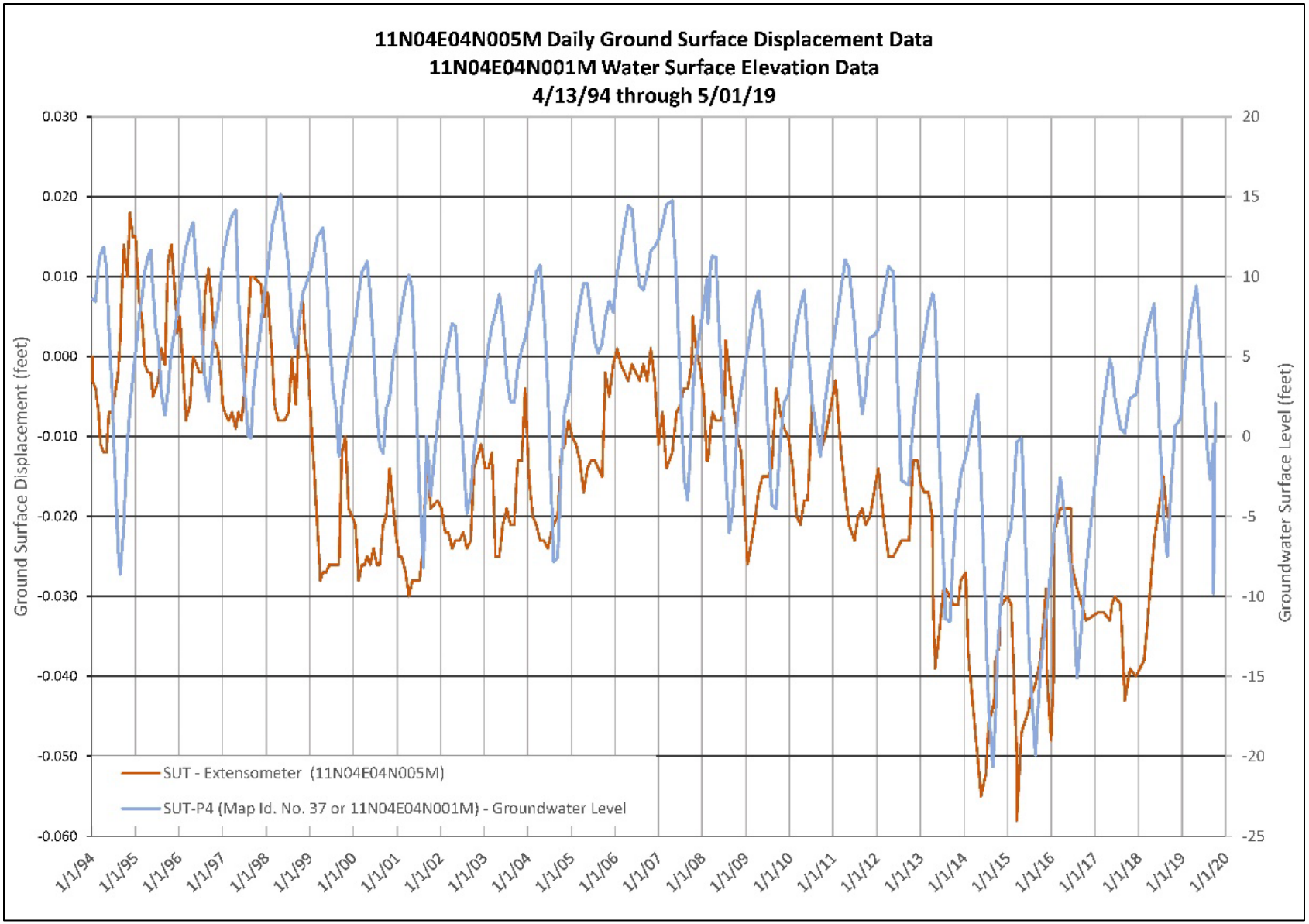


Figure 5-26. Extensometer versus Groundwater Levels

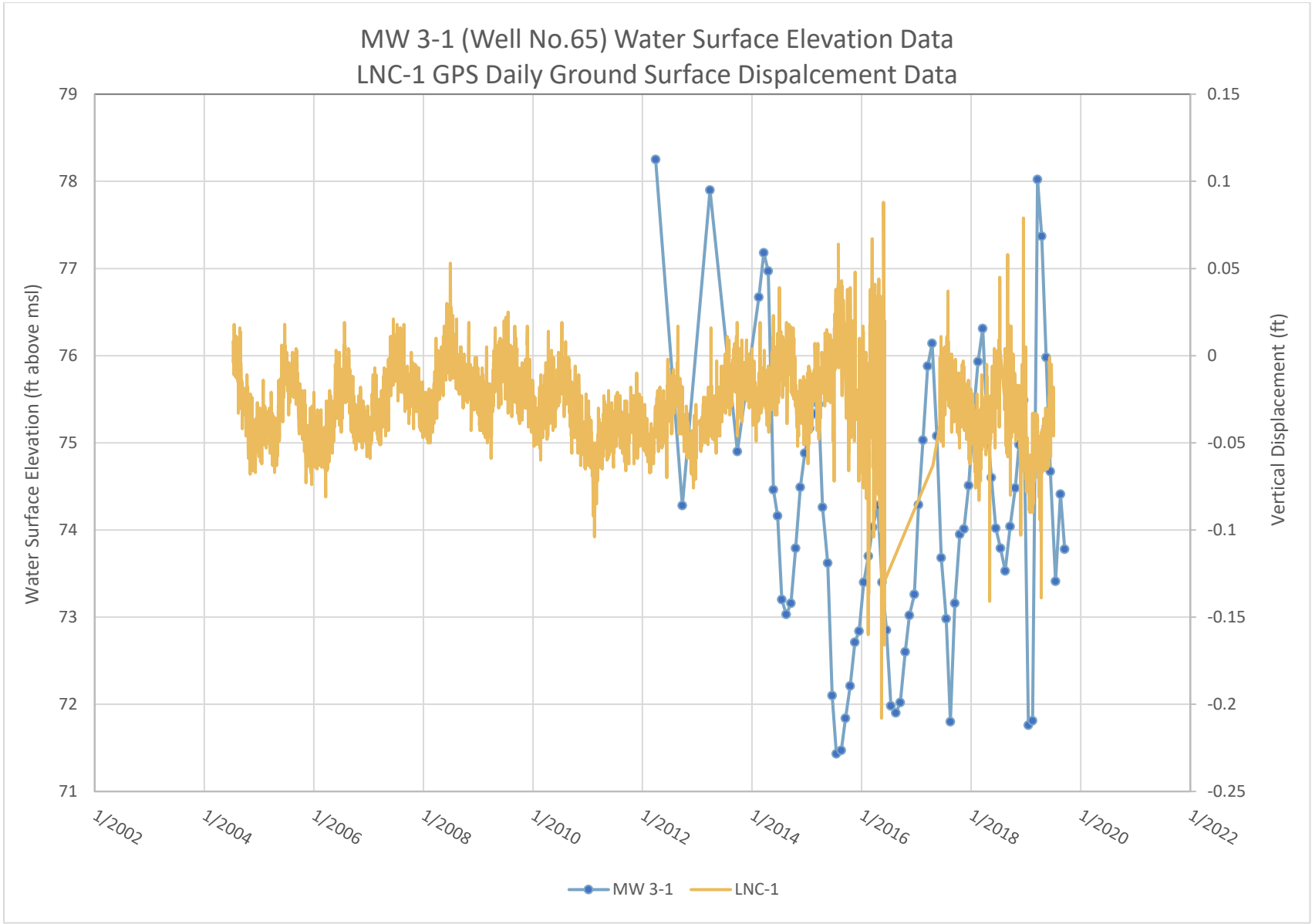


Figure 5-27. CGPS Station LCN1 versus Groundwater Levels

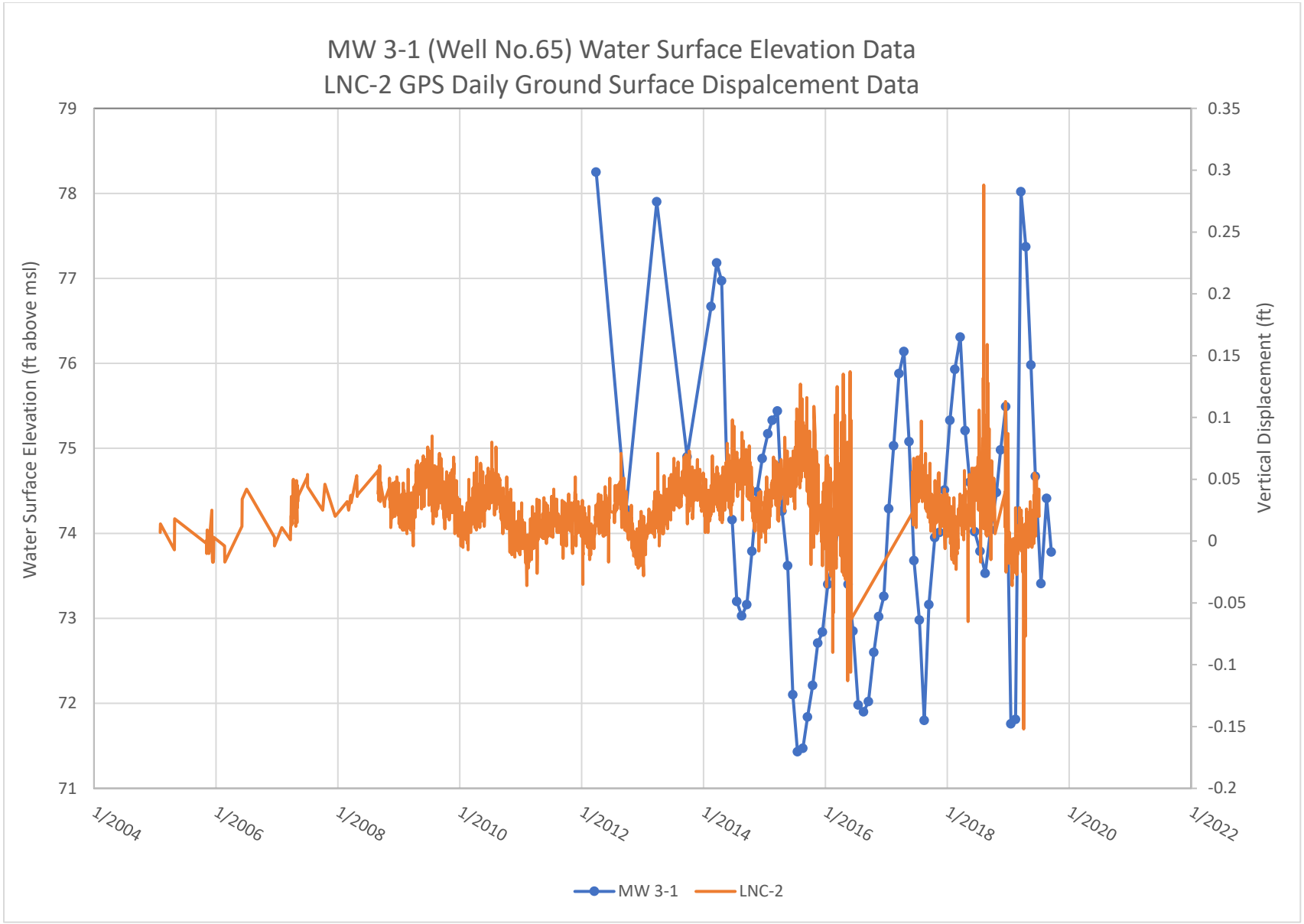


Figure 5-28. CGPS Station LCN2 versus Groundwater Levels

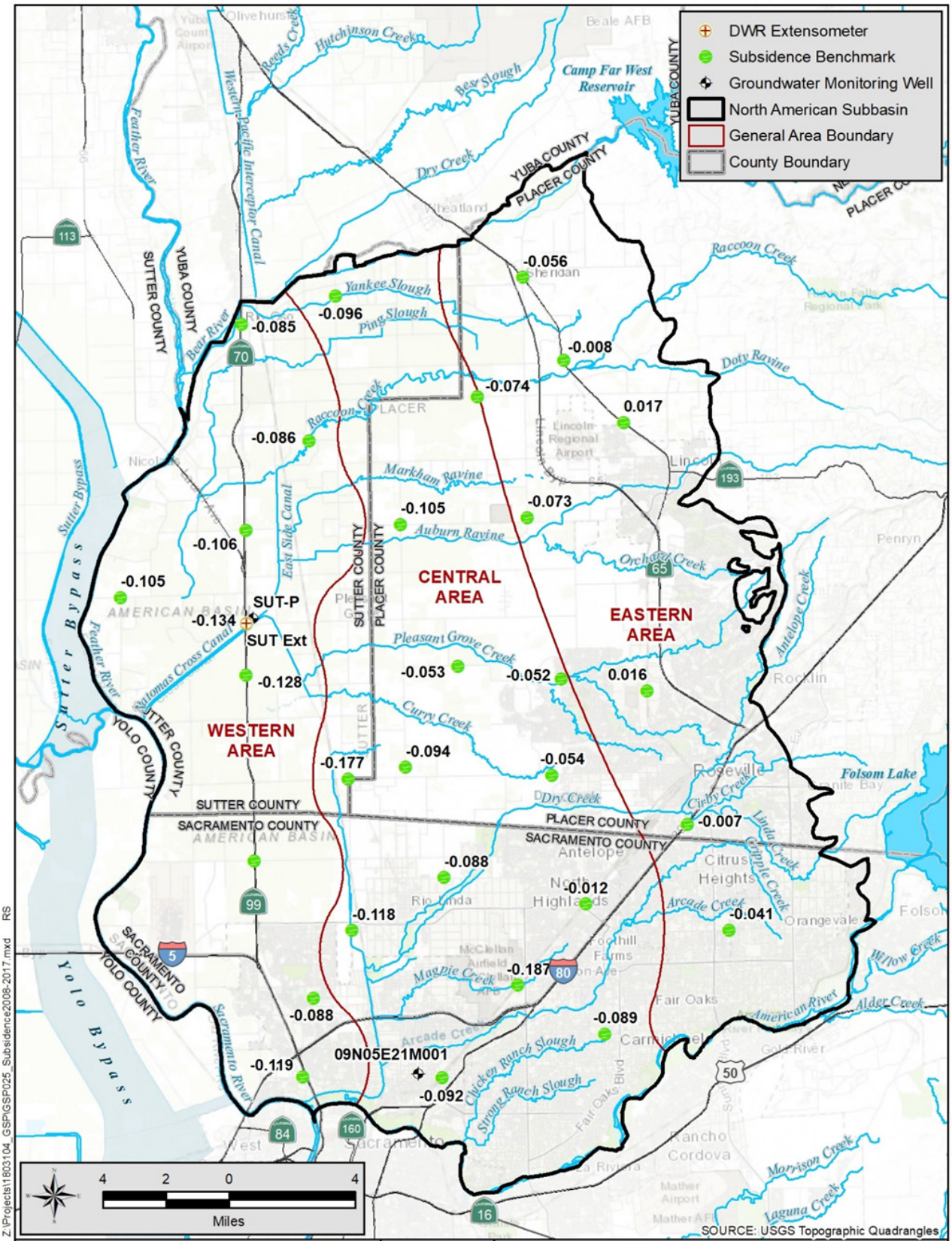


Figure 5-29. Benchmark Differences 2008-2017 (in Feet)

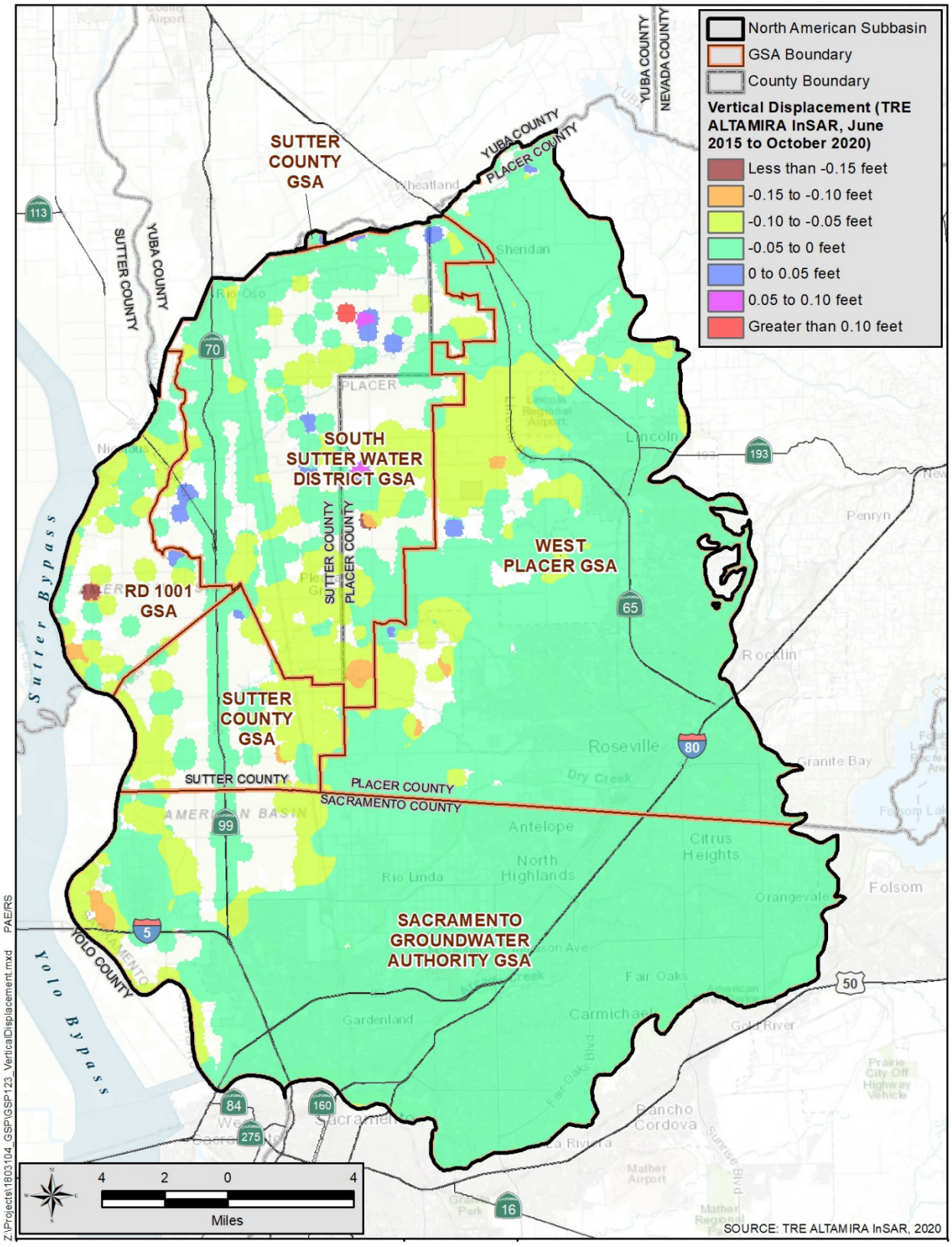


Figure 5-30. InSAR Subsidence 2015-2020 (in Feet)

5.11 Interconnected Surface Water

Interconnected surface water refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted (DWR, 2016). In other words, all of the sediment pores in the area are filled with water, from ground surface to the groundwater table. The depth-to-water map provides an initial indication of whether the rivers and creeks are interconnected or disconnected. For purposes of this GSP, the rivers and creeks were assumed to be interconnected when the depth to water is less than 30 feet bgs (*see* **Appendix O** for description of methods used to determine depth to groundwater). In general, surface water and groundwater are considered interconnected along portions of the American, Bear, Feather, and Sacramento rivers.

Understanding interconnected surface water is important, because where this occurs lowering of groundwater levels regionally or by local pumping of groundwater has the potential to deplete surface water (to an extreme case of rivers or creeks going dry) and affect habitat and species dependent on surface water. In the NASb, California Department of Fish and Wildlife RareFind5 database, Central Valley Steelhead and Chinook Salmon are important aquatic species known to use the American, Sacramento, and Feather rivers for either spawning or migration. The species are not noted in the Bear River. Interior to the NASb, Central Valley Steelhead are noted in the Dry Creek system in western Placer County, and in Auburn Ravine in western Placer County. To get into these systems, fish migrate through Steelhead Creek and the Natomas Cross Canal, respectively, from the Sacramento River.

Monitoring wells have been constructed in the Subbasin at various locations along the rivers and creeks to evaluate the interconnectedness of surface water and groundwater based on groundwater levels and in some cases supported by water quality (stable isotopes; *refer to* **Figure 5-1** for monitoring well locations). Monitoring wells were also constructed along the Sacramento River to evaluate the levees and the effects of installation of man-made slurry walls. **Appendix N** contains the hydrographs from the wells along with surface water elevations and additional hydrographs from the levee studies.

Two patterns emerge from evaluating the groundwater level hydrographs and water quality parameters – groundwater levels that respond to changes in surface water (interconnected) and those that do not (disconnected). For example, at monitoring wells 94 and 95 (RDMW-103 and -104), groundwater levels do not respond to changes in water levels in the Bear River, and stable isotopes indicate the groundwater is from local origin and not from higher elevations in the watershed that flow through the river. The conclusion is that the river is not interconnected with groundwater at this location. Conversely, along the Feather River, at RDMW-101, the groundwater levels track similarly to water levels in the river and the stable isotopes show the influence of surface water in the groundwater (GEI, 2020).

With this documented relationship, groundwater levels in the monitoring wells adjacent to the rivers and creeks were evaluated for interconnectedness. **Figure 5-31** shows the locations where the hydrographs show the rivers and creeks are interconnected.

- In the Western area, groundwater is connected with the Sacramento and Feather rivers. Even within short distances this condition may change, as shown along the Sacramento River in studies performed for SAFCA (*see* Kleinfelder report in **Appendix N**).
- In the Central area, as described in **Section 5.2.2**, most groundwater levels are over 100 feet bgs and there is no continuous saturated zone as proven along lower Dry Creek at WPMW-5A (monitoring well number 41) where the shallow monitoring well constructed into the first sand and gravel layer is dry (the well has a screen interval from 80 to 100 feet bgs). The newly constructed WMPW-11A (monitoring well number 91), which is adjacent to Markham Ravine, also encountered groundwater during hand-auguring at about 4 feet bgs while the depth to groundwater at this location is over 70 feet bgs indicating a continuous saturated interval is not present (disconnected from the underlying aquifer). Along portions of the American and Bear rivers, the groundwater is interconnected with the rivers.
- In the Eastern area, there is interconnection along upper portions of Dry Creek and its tributaries, potentially along Auburn Ravine as it enters the Subbasin and Raccoon Creek west of Highway 65 as indicated by shallow depths to water. Studies along the upper reaches of Raccoon Creek, generally east of Highway 65, show the area is underlain by the Ione Formation and, due to its low permeability, would tend to perch water. Therefore, the surface water is not connected to the principal aquifer. East of Highway 65, near Raccoon Creek, groundwater levels decrease rapidly so the creek is not interconnected with groundwater. Groundwater levels are generally interconnected along the American River, with the exception of a segment that is disconnected near Rancho Cordova. Groundwater levels are generally interconnected along the Bear River, with the exception of a segment near well RDMW-103.

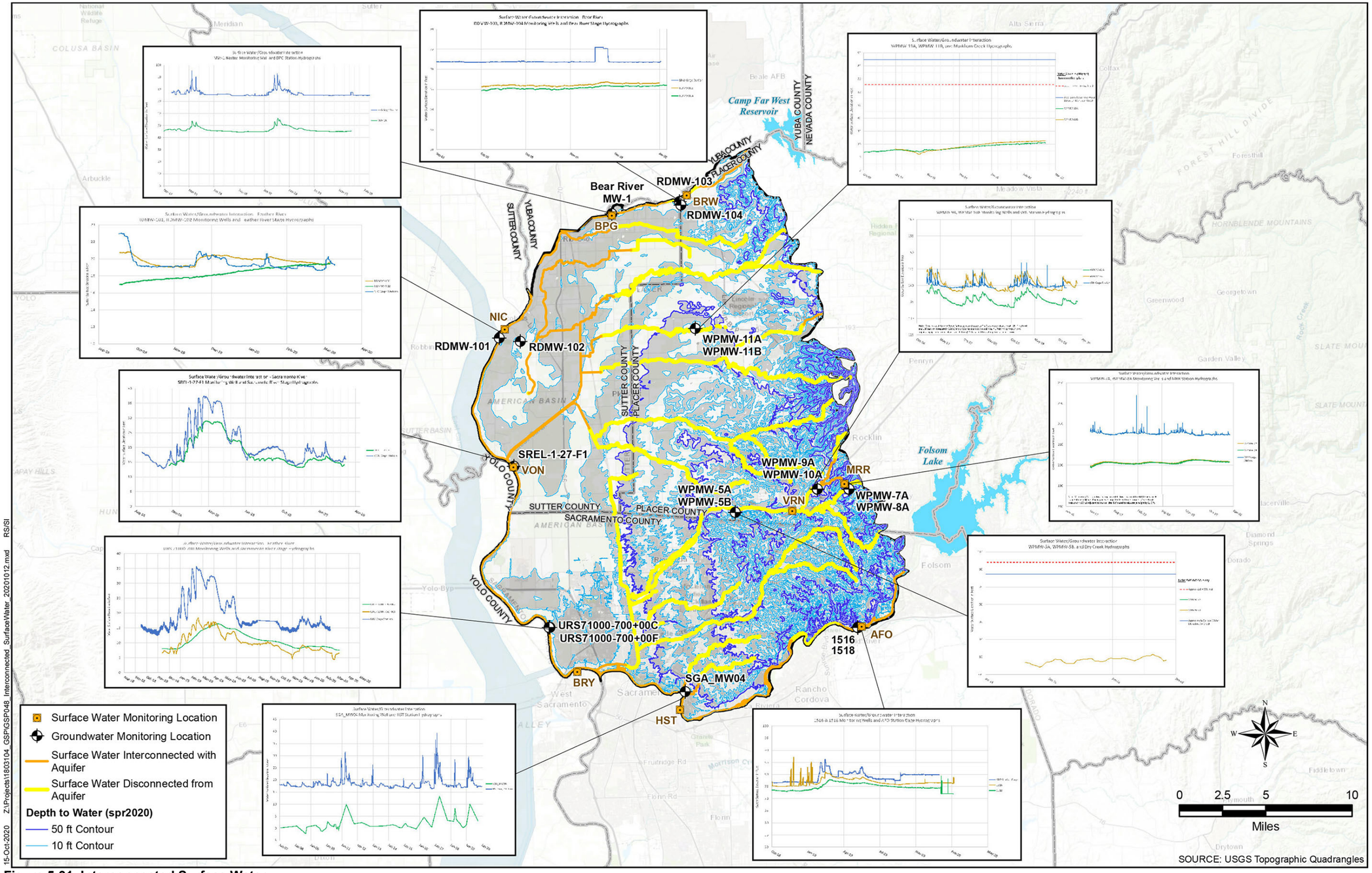


Figure 5-31. Interconnected Surface Water

This page intentionally left blank

5.12 Groundwater-Dependent Ecosystems

The Natural Communities Commonly Associated with Groundwater dataset (NCCAG, 2018) was used to provide the locations of potential GDEs. Likely GDEs were developed by plotting the depth to groundwater developed from shallow monitoring wells, those with screen intervals between 20 and 300 feet bgs along with ground surface elevations from the National Elevation Dataset and elevations of the bottom of the rivers and slough channels. Water surface elevations were then subtracted from ground surface elevations to obtain the depth to water throughout the Subbasin. Areas where groundwater levels are less than 30 feet bgs are areas where likely GDEs are present. All of the potential GDEs were then evaluated for the types of vegetation or species present to further refine whether the potential GDEs are likely, less likely or not likely to be present. **Figure 5-32** shows the results of this classification efforts. The likely and less likely GDE areas were then evaluated further based on whether critical species, diverse vegetation or a combination of both were present to prioritize those areas. **Figure 5-33** shows the results of this ranking. **Appendix O** contains a detailed description of the approach used.

The 30-foot bgs interval was used to identify GDEs, because it is associated with the overwhelming majority of GDE plant species' maximum rooting depths, and thus would most likely contain groundwater-supported priority habitat. While some Valley Oak (Quercus lobata) has been noted at rooting depths of up to 80 feet, the optimal depth is more in the vicinity of 33 feet (Howard, 1992). To better assess whether using 30 feet bgs would represent a meaningful difference in terms of identifying or protecting GDEs, a map of the occurrence of Valley Oak from the NCCAG dataset was prepared using depth intervals of less than 30 feet bgs, from 30 to 80 feet bgs, and greater than 80 feet bgs. The resulting map is shown on **Figure 5-34**. In the NASb, there are 4,335 acres identified as having Valley Oak. Of those, about 37 percent (1,618 acres) are at depths of less than 30 feet and about 44 percent (1,925 acres) are at depths between 30 and 80 feet bgs. Additionally, 18 percent (792) of Valley Oak are noted in the same channels where depth to groundwater is greater than 80 feet bgs, which would not be supported by groundwater.

For the areas that are between 30 and 80 feet bgs (shown in orange on **Figure 5-34),** note that almost all Valley Oak is located along creeks, ravines, and rivers. Auburn Ravine, Pleasant Grove Creek, and Dry Creek all receive year-round flows from wastewater treatment plants (see **Figure 3-12**) and other urban runoff, Arcade Creek has year-round flow associated with urban runoff based on records from the Sacramento County stormwater monitoring program, and the American River has year-round flow as managed by the Bureau of Reclamation. Based on this occurrence data, the NASb GSAs believe that the Valley Oak occurring at greater than 30 feet bgs is maintained by surface water flow and is not groundwater supported.

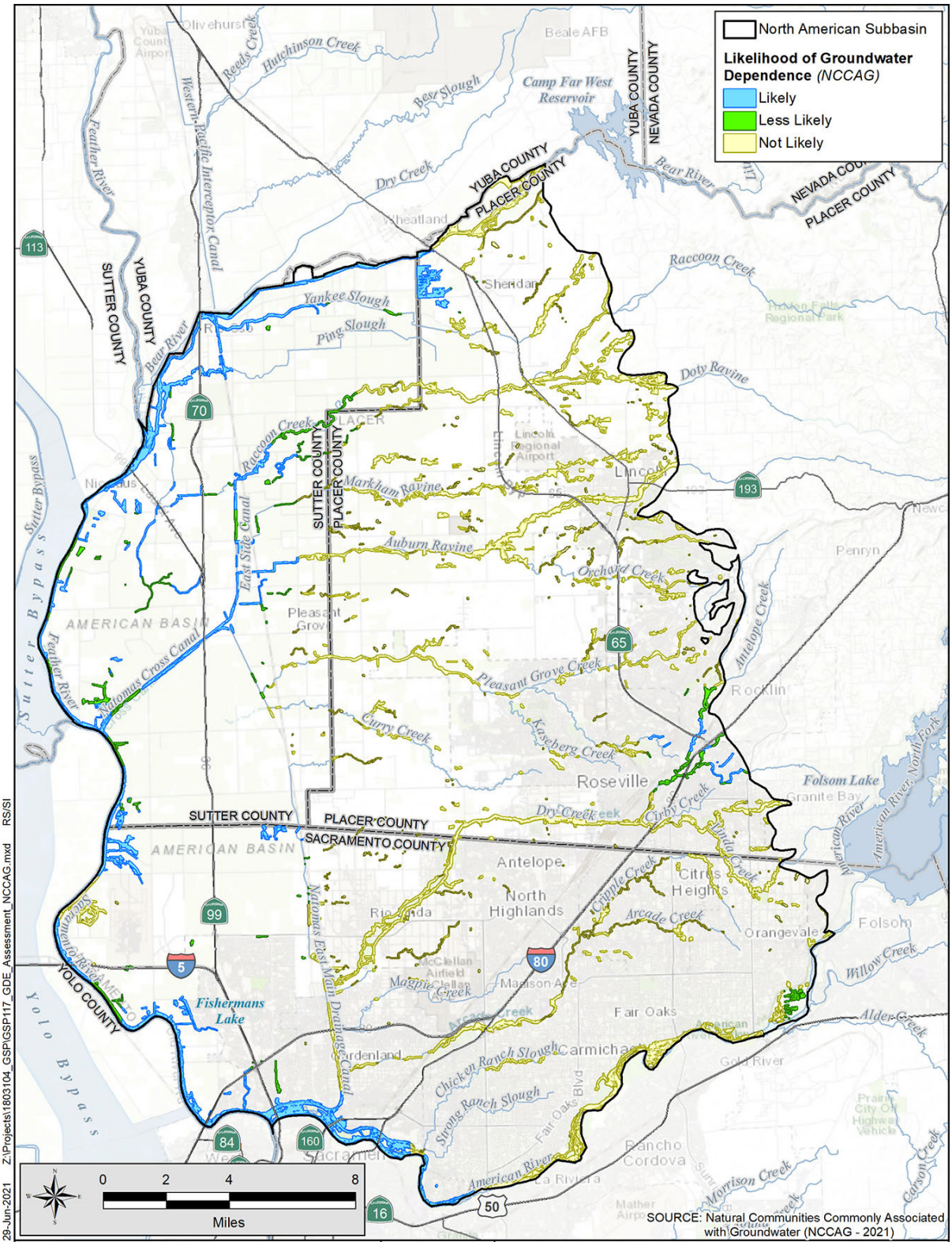


Figure 5-32. Likely Groundwater Dependent Ecosystems

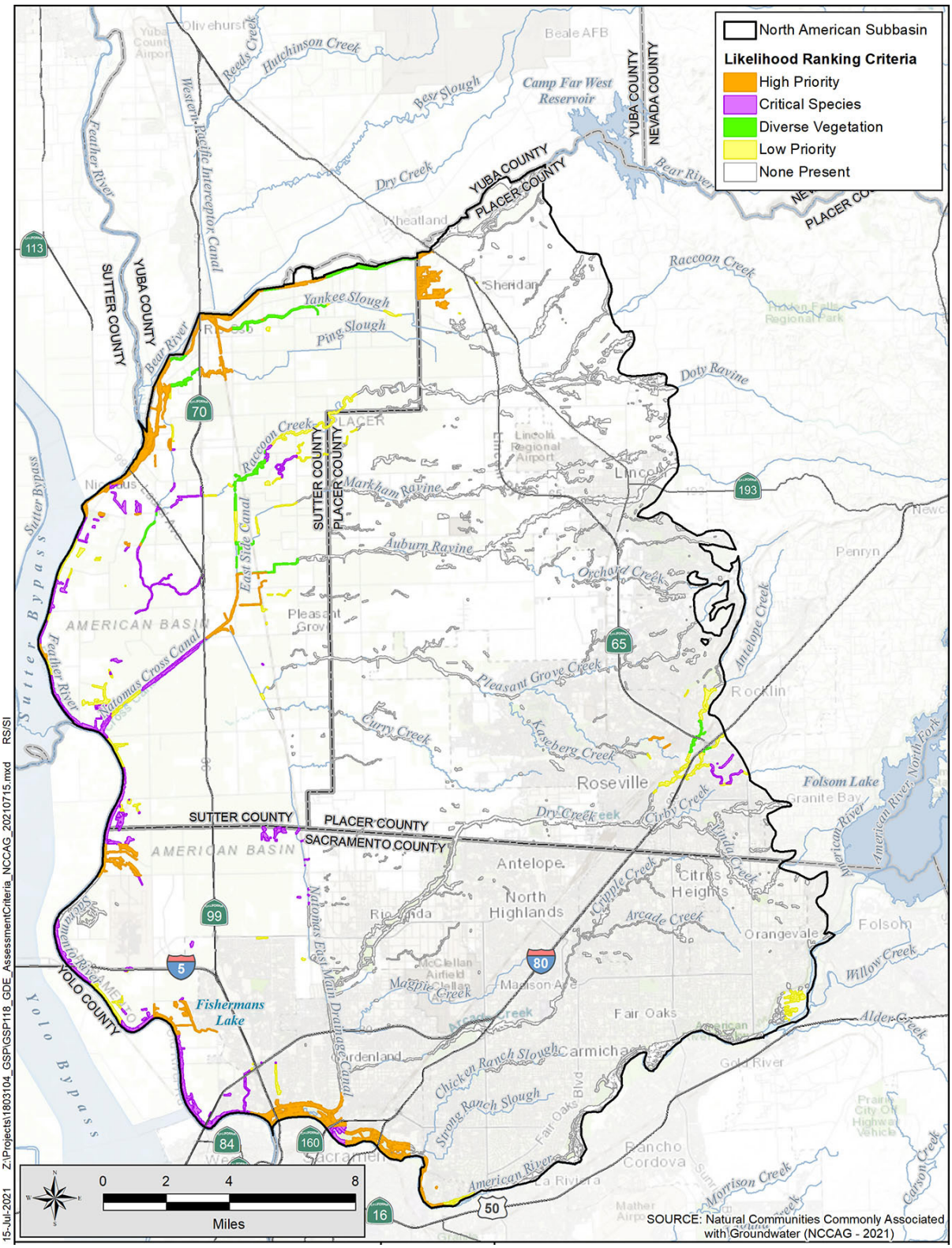


Figure 5-33. Rankings of Likely and Less Likely GDE Areas

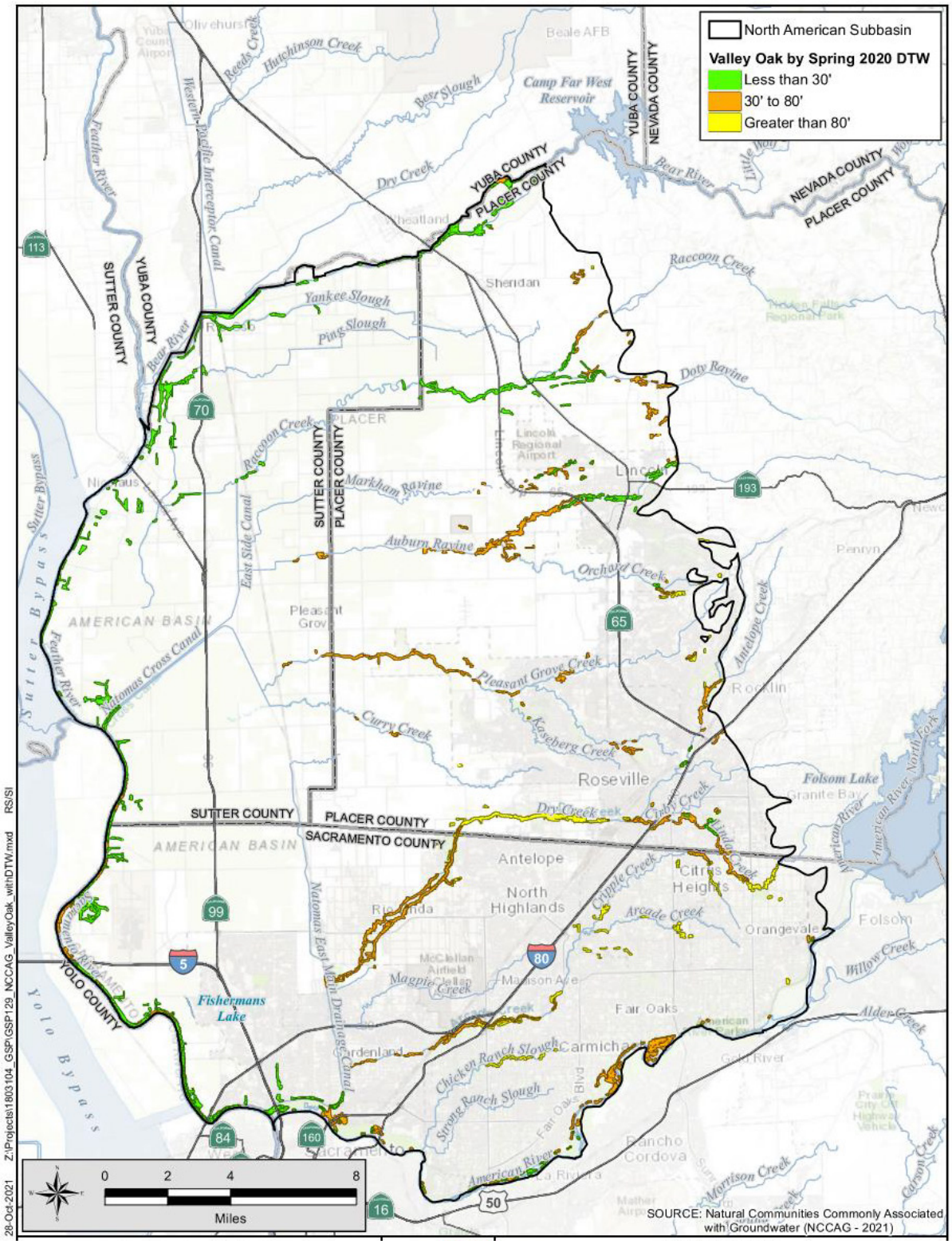


Figure 5-34. Occurrence of Quercus Lobata (Valley Oak)

5.13 Data Gaps

The groundwater conditions in the NASb have been investigated and documented since at least 1912 through present. Most of the recent improvements to data gathering were the construction of new monitoring wells to replace voluntary wells to improve the quality of groundwater level data. At this time, there are no data gaps in the understanding of groundwater conditions that would affect the ability to sustainably manage the Subbasin.

Information that would improve the overall knowledge of groundwater conditions in the Subbasin are:

- **Water Quality** – continued water quality sampling should provide enough water quality data to further assess water quality trends in the northern portions of the Subbasin.
- **Aquifers Assessment** – groundwater levels in the aquifers are stable as shown by the hydrographs but warrant further assessment in the Western area because groundwater levels in deeper nested monitoring wells in the Mehrten Formation are up to 23 feet deeper than groundwater levels in the Laguna Formation as seen in most monitoring wells in the Central and Eastern areas. Further evaluation could include the following:
    - groundwater pumping in adjacent Subbasins in the deeper aquifers
    - relation of the Willows Fault to the affected aquifers
    - use of new geophysical tools to map the extent of aquifers (statewide program proposed by DWR)
- **Interconnected Surface Water –** confirmation of areas likely to be interconnected.

This page left intentionally blank

6. Water Budgets

6.1 Water Budget Information

Water budgets were developed to provide a quantitative account of water entering and leaving the NASb. Water entering the Subbasin includes water entering at the surface and through the subsurface. Similarly, water leaving the Subbasin leaves at the surface and through the subsurface. Water enters and leaves naturally, such as precipitation and streamflow, and through human activities, such as pumping and recharge from irrigation or outdoor water use. As in the California Department of Water Resources' (DWR's) Water Budget BMP (DWR 2016c), water budgets are presented separately for the land surface system, stream and canal system, and groundwater system. The different frame of reference for each of these systems provides insight into how the overall system behaves, which is critical for successful management. **Figure 6-1** highlights the interconnectivity of stream, surface, and groundwater components of the natural and human related hydrologic system used in this analysis.

The values presented in the water budget provide information on historical, current, and projected conditions as they relate to hydrology, water demand, water supply, land use, population, climate conditions, such as climate change, groundwater and surface water interaction, and subsurface groundwater flow. This information can assist in management of the Subbasin groundwater and surface water resources, by identifying the scale of different uses, highlighting potential risks, and identifying potential opportunities to improve water supply conditions, among others.

Water budgets can be developed on different scales. In agricultural use, water budgets may be limited to the root zone, improving irrigation techniques by estimating the inflows and outflows of water from the upper portion of the soil accessible to plants through their roots. In a pure groundwater study, water budgets may be limited to water flow within the subsurface, aiding in understanding how water flows beneath the surface. Global climate models simulate water budgets that incorporate atmospheric water, allowing for simulation of climate change conditions. In this document, consistent with the Regulations (CCR, Title 23), the water budgets investigate the combined land surface, stream, and groundwater systems for the NASb.

Water budgets can also be developed at different temporal scales. Daily water budgets may be used to demonstrate how evaporation and transpiration increase during the day and decrease at night. Monthly water budgets may be used to demonstrate how groundwater pumping increases in the dry, hot summer months and decreases in the cool, wet winter months. The water budget analyses are performed on a monthly basis using the CoSANA model and are aggregated to annual budgets. However, for the purposes of this Groundwater Sustainability Plan (GSP), the

water budgets are presented on a long-term average annual basis, as well by hydrologic year type.

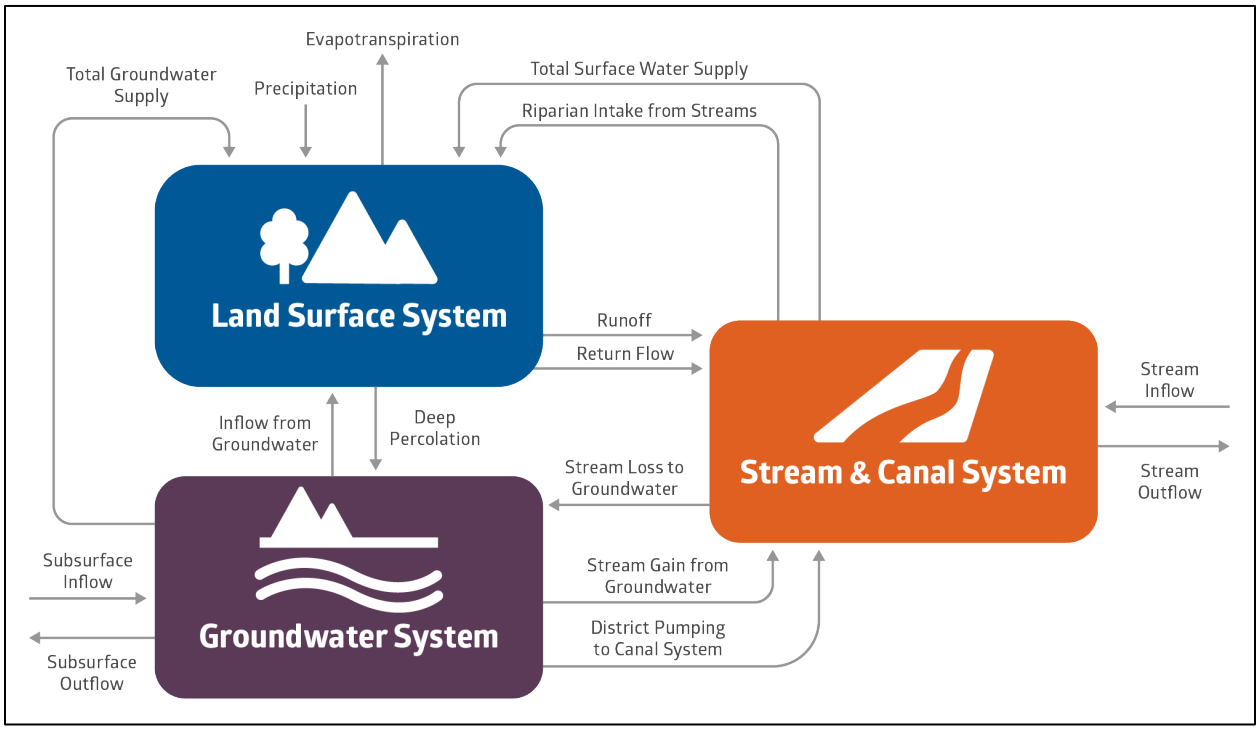


Figure 6-1. Generalized Water Budget Diagram

The Regulations require the annual water budgets to be based on three different levels of development: historical, current, and projected conditions. Budgets are developed to capture typical conditions during these time periods. Typical conditions are developed through averaging hydrologic conditions that incorporate droughts, wet periods, and normal periods. By incorporating these varied conditions within the budgets, analysis of the system under certain hydrologic conditions, such as drought, can be performed along with analysis of long-term averages. Information is provided in the following subsections on the hydrology dataset used to identify time periods for budget analysis; the usage of the CoSANA model and associated data in water budget development; and on the budget estimates.

6.2 Identification of Hydrologic Periods

Hydrologic periods were selected to meet the needs of developing historical, current, and projected water budgets. The Regulations require that the projected water budget incorporate a 50-year hydrologic period in order to reflect long-term average hydrologic conditions. Precipitation data for the Subbasin is derived from the PRISM (Precipitation-Elevation Regressions on Independent Slopes Model) dataset of DWR's California Simulation of Evapotranspiration of Applied Water model. Precipitation for the NASb was used to identify hydrologic periods that would provide a representation of wet and dry periods and long-term average conditions needed for water budget analyses.

Identification of periods with a balance of wet and dry periods was performed by evaluating the cumulative departure from mean precipitation. Under this method, the long-term average precipitation is subtracted from annual precipitation within each water year to develop the departure from mean precipitation for each water year. Wet years have a positive departure and dry years have a negative departure; a year with exactly average precipitation would have zero departure. Starting at the first year analyzed, the departures are added cumulatively for each year. So, if the departure for Year 1 is 5 inches and the departure for Year 2 is -2 inches, the cumulative departure would be 5 inches for Year 1 and 3 inches (5 plus -2) for Year 2. A chart is used to graphically illustrate the cumulative departure of the spatially averaged rainfall within the Subbasin (**Figure 6-2**). The chart includes bars displaying annual precipitation for each water year from 1970 through 2019 and a horizontal line representing the mean precipitation of 20.2 inches. This is less than 1 inch per year greater than the long-term (1922-2019) average of 19.3 inches. The cumulative departure from mean precipitation is based on these data sets and is displayed as a line that starts at zero and highlights wet periods with upward slopes and dry periods with downward slopes. More severe events are shown by steeper slopes and greater changes. Thus, the period from 1976 to 1977 illustrates a short period with dramatically dry conditions (23-inch decline in cumulative departure over 2 years). In addition to the 1976-1977 drought, the 1970-2019 period also includes the extended drought periods of 1987-1992 and 2012-2016 and the historical wet periods of 1982-1983 and 1995-1998.

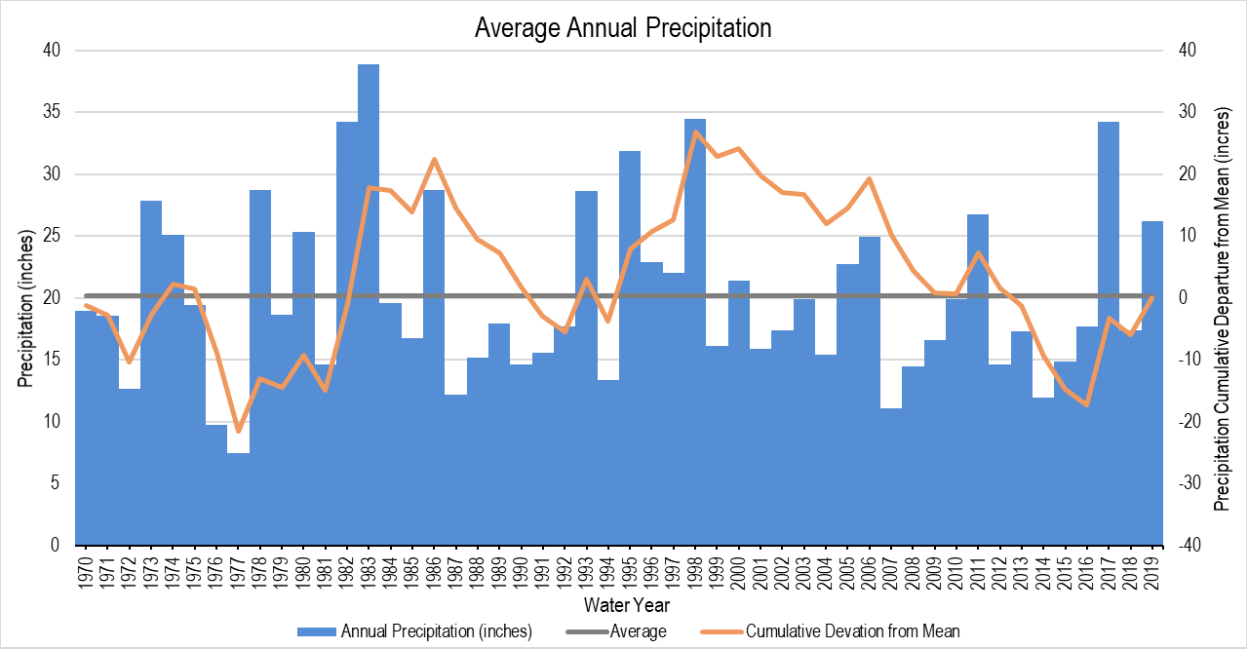


Figure 6-2. 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation in the North American Groundwater Basin

6.3 Usage of the CoSANA Model and Associated Data in Water Budget Development

Water budgets were developed utilizing the CoSANA model, a fully integrated surface and groundwater flow model that covers the entire NASb as well as the adjoining South American and Cosumnes Subbasins. CoSANA was developed with the RWA as the lead agency with collaboration by GSAs in each respective Subbasin. CoSANA is a quasi-three-dimensional finite element model that was developed using the Integrated Water Flow Model 2015 software package to simulate the relevant hydrologic processes prevailing in the region. CoSANA integrates the groundwater aquifer with the surface hydrologic system and land surface processes and operations. Using data from federal, state, and local resources, CoSANA was calibrated for the hydrologic period of October 1994 to September 2018 by comparing simulated evapotranspiration, groundwater levels, and streamflow records with historical observed records. Development of the model involved the study and analyses of hydrogeologic conditions, agricultural and urban water demands, agricultural and urban water supplies, and an evaluation of regional water quality conditions. Two baseline models were developed reflecting the current and projected levels of development for each Subbasin to support GSP development.

Additional information on the data and assumptions used to develop the CoSANA model is included in **Appendix P**.

With the CoSANA model as the underlying framework, model simulations were developed to allow for the estimation of water budgets. Four model simulations were used to develop the water budgets for historical, current, projected and projected with climate change conditions, which are discussed in detail below:

- The **historical water budget** is based on a simulation of historical conditions in the NASb.
- The **current water budget** is based on a simulation of current land and water use over historical hydrologic conditions, assuming no other changes in population, water demands, land use, or other conditions.
- The **projected water budget** is based on a simulation of future land and water use over historical hydrologic conditions.
- The **projected with climate change water budget** is based on a simulation of future land and water use over hydrologic conditions modified to reflect future climate.

6.4 Water Budget Definitions and Assumptions

Definitions and assumptions for the historical, current, and projected water budgets are provided below.

6.4.1 Historical Water Budget

The historical water budget is intended to evaluate availability and reliability of past surface water supply deliveries, aquifer response to water supply, and demand trends relative to water year type. The hydrologic period of WY 2009 through 2018 was analyzed to provide a period of representative hydrology while capturing recent operations in the Subbasin. The period WY 2009 through 2018 has an average annual precipitation of approximately 19.0 inches, compared to the long-term (1970 - 2019) average of 20.2 inches and includes wet and dry periods as follows, according to the Sacramento Valley Index:

- Critical: 2014, 2015
- Dry: 2009, 2013
- Below normal: 2010, 2012, 2016, 2018
- Above normal: none
- Wet: 2011, 2017

6.4.2 Current Water Budget

While a budget indicative of current conditions could be developed using the most recent historical conditions, like the historical water budget, such an analysis would be difficult to interpret due to the extreme weather conditions of the past several years and its effect on local water system operations. Instead, to analyze the long-term effects of current land and water use on groundwater conditions and to accurately estimate current inflows and outflows for the basin, a Current Conditions Baseline scenario is developed using the CoSANA model. This baseline applies current land and water use conditions to historical hydrology.

The Current Conditions Baseline includes the conditions described in **Table 6-1**.

Table 6-3. Current Water Budget Conditions Summary

Component	Description
Hydrologic Period	Water years 1970-2019 (50-year hydrology)
River Flow	Historical records from the United States Geological Survey (USGS) and California Data Exchange Center (CDEC), and the simulation of small-stream watersheds
Land Use	2014 statewide California crop mapping
	2015 Sacramento County land use survey
	Local ground truthing and refinement
Urban Water Demand	2015 demands as reported in the 2015 Urban Water Management Plan (UWMP)
	Municipal pumping records
Agricultural Water Demand	2015 land use and cropping conditions, adjusted for urban growth areas based on General Plans
	Irrigation practices are assumed to be similar to those in 2019

6.4.3 Projected Water Budget

The projected water budget is intended to assess the conditions of the Subbasin under projected conditions of land use; water supply; and agricultural and urban demand. The Projected Conditions Baseline applies future land and water use conditions and uses a 50-year hydrologic period of WY 1970-2019. The Projected Conditions Baseline is analyzed with and without climate change.

The Projected Conditions Baseline includes the conditions described in **Table 6-2**

Table 6-4. Projected Water Budget Conditions Summary

Component	Description
Hydrologic Period	Water Years 1970-2019 (50-year hydrology)
River Flow	Historical records from the USGS and CDEC, and the simulation of small-stream watersheds
Land Use	2014 statewide California crop mapping
	2015 Sacramento County land use survey
	Agricultural Water Management Plan projections
	Direct communication on future projections with local agencies
Urban Water Demand	Decadal population projections from 2015 UWMPs for most users
Agricultural Water Demand	2015 land use and cropping conditions, adjusted for urban growth areas based on General Plans
	Irrigation practices are assumed to be similar to those in 2019

Table 6-3 provides a summary of the groundwater budget assumptions for each of the three water budget types.

Table 6-5. Summary of Groundwater Budget Assumptions

Water Budget Type	Historical	Current	Projected
Scenario	Historical Simulation	Current Conditions Baseline	Projected Conditions Baseline
Hydrologic Years	WY 2009-2018	WY 1970-2019	WY 1970-2019
Level of Development	Historical	Current	General Plan buildout
Agricultural Demand	Historical Records	Current Conditions	Projected based on projected land use changes
Urban Demand	Historical Records	Current Conditions	Projected based on local UWMP data
Water Supplies	Historical Records	Current Conditions	Projected based on local UWMP data

6.4.4 Water Budget Estimates

For each baseline condition, water budgets have been developed for the stream and canal system, the land surface system, and for the groundwater system.

The water budget components for the stream and canal system are shown separately for the following river reaches:

- American River from Folsom Lake to the confluence with Sacramento River (**Table 6-4**)
- Bear River starting at the boundary of the groundwater subbasin, approximately 1.5 miles downstream from Camp Far West Dam, to the confluence with Feather River (**Table 6-5**)
- Sacramento River from the Feather River confluence to the American River confluence (**Table 6-6**)
- Feather River from Bear River confluence to the Sacramento River confluence (**Table 6-7**)

A composite water budget for these stream reaches is shown in **Table 6-8**. The primary components that are reported in each of these tables are:

- Inflows:
    - Upstream inflows
    - Tributary inflows
    - Stream gain from the groundwater system
    - Surface runoff to the stream system
    - Return flow to stream system

- Outflows:
    - Stream losses to groundwater system
    - Surface water deliveries
    - Stream outflows

Total inflows to the subbasin are summarized in **Table 6-9**. Note that **Tables 6-4 through 6-8** include upstream inflows, which are the inflows of the four major rivers into the Subbasin, and tributary inflows, which are inflows from the tributaries into the major rivers. As such, **Tables 6-4 through 6-8** do not include total inflows entering the subbasin, values which are provided in **Table 6-9**.

The primary components of the land surface system in the NASb (**Table 6-10**) are:

- Inflows:
    - Precipitation
    - Surface water supplies
    - Groundwater supplies
    - Recycled water supplies
    - Riparian intake from streams
- Outflows:
    - Evapotranspiration
    - Surface runoff to the stream system
    - Return flow to the stream system
    - Deep percolation

The primary components of the groundwater system in the NASb (**Table 6-11**) are:

- Inflows:
    - Deep percolation
    - Infiltration from the stream system
    - Subsurface inflow
- Outflows:

    - Discharge to the stream system
    - Groundwater production
    - Subsurface outflow
- Change in groundwater storage

The estimated water budgets are provided below for the historical, current, and projected water budgets in AFY in the tables below.

Table 6-6. Average Annual Water Budget – American River (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Inflow	2,524,600	2,688,100	2,688,100	2,337,800
Tributary Inflows[1]	57,400	58,400	66,800	69,100
Groundwater Discharge	24,200	29,400	26,100	24,900
Surface Runoff	-	-	-	-
Direct Return Flow to Streams	15,800	17,800	17,800	17,800
Total Inflow	2,622,100	2,793,700	2,798,700	2,449,500
Outflows				
Infiltration to Groundwater	46,300	43,900	52,500	53,700
Surface Water Diversions	46,000	43,000	62,900	62,900
Outflow to Sacramento River	2,529,800	2,706,800	2,683,400	2,333,000
Total Outflow	2,622,100	2,793,700	2,798,700	2,449,500

Notes:

[1]Local Tributaries include Alder Creek, Buffalo Creek, and small watersheds for unmodeled streams. Alder Creek and Buffalo Creek are both within the South American Subbasin

Table 6-7. Average Annual Water Budget – Bear River (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Bear River Inflow	305,800	257,100	257,100	251,200
Tributary Inflows[1]	1,300	1,700	1,700	1,700
Groundwater Discharge	12,800	15,500	14,300	7,700
Surface Runoff	3,400	3,700	3,700	3,800
Direct Return Flow to Streams	12,900	15,400	15,200	15,600
Total Inflow	*336,200*	*293,400*	*292,000*	*280,000*
Outflows				
Infiltration to Groundwater	-	-	-	-
Surface Water Diversions[2]	-	-	-	-
Outflow to Feather River	336,200	293,400	292,000	280,000
Total Outflow	*336,200*	*293,400*	*292,000*	*280,000*

Notes:

[1]Local Tributaries include small watersheds for unmodelled streams

[2]Diversions incorporated within CoSANA from the Bear River occur upstream of the groundwater subbasin

Table 6-8. Average Annual Water Budget – Sacramento River (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	**WY 2009-2018**	**WY 1970 - 2019**	**WY 1970 - 2019**	**WY 1970 – 2019**
Inflows				
Upstream Feather River & Sacramento River Inflow	12,161,000	14,330,700	14,330,700	12,111,200
Tributary Inflows[1]	292,000	327,900	367,000	361,400
Groundwater Discharge	29,200	30,500	24,500	22,800
Surface Runoff	8,800	8,600	13,700	13,800
Direct Return Flow to Streams	28,900	32,800	34,800	35,100
Total Inflow	12,519,800	14,730,400	14,770,700	12,544,200
Outflows				
Infiltration to Groundwater	-	-	-	-
Surface Water Diversions	90,400	89,400	64,100	66,700
Outflow Downstream of American River Confluence	12,429,500	14,641,000	14,706,600	12,477,500
Total Outflow	12,519,800	14,730,400	14,770,700	12,544,200

Notes:

[1]Local Tributaries include Natomas East Drain and Natomas Cross Canal

Table 6-9. Average Annual Water Budget – Feather River (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Bear River Inflow	336,200	293,400	292,000	280,000
Upstream Feather River Inflow	4,563,200	5,860,300	5,860,300	4,679,600
Tributary Inflows	-	-	-	-
Groundwater Discharge	-	-	-	-
Surface Runoff	-	1	-	-
Direct Return Flow to Streams	-	-	-	-
Total Inflow	*4,899,400*	*6,153,700*	*6,152,300*	*4,959,600*
Outflows				
Infiltration to Groundwater	25,900	30,700	30,800	27,300
Surface Water Diversions	11,000	11,000	11,000	11,000
Outflow to Sacramento River	4,862,400	6,112,000	6,110,500	4,921,400
Total Outflow	*4,899,400*	*6,153,700*	*6,152,300*	*4,959,600*

Table 6-10. Average Annual Water Budget – Composite of All Major Rivers (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Inflow[1]	14,681,100	17,013,200	17,014,700	14,447,500
Tributary Inflows[2]	350,700	388,000	435,500	432,200
Groundwater Discharge	66,200	75,400	64,800	55,300
Surface Runoff	12,200	12,200	17,400	17,600
Direct Return Flow to Streams	57,600	66,000	67,700	68,400
Total Inflow	15,167,800	17,554,800	17,600,200	15,021,000
Outflows				
Infiltration to Groundwater	72,200	74,600	83,300	80,900
Surface Water Diversions	147,400	143,400	138,000	140,600
Outflow from Sacramento and American Rivers	14,948,300	17,336,800	17,379,000	14,799,500
Total Outflow	15,167,800	17,554,800	17,600,200	15,021,000

Notes:

[1]Upstream inflows include Bear River, Feather River, Sacramento River, and American River flows into the North American Subbasin

[2]Local Tributaries include Racoon Creek, East Side Canal, Auburn Ravine, Pleasant Grove Creek, Pleasant Grove Creek Canal, Cross Canal. Natomas East Drain, Dry Creek, Magpie Creek, Arcade Creek, Buffalo Creek, and Alder Creek inflow into major rivers. Note that this list includes simulated tributaries within the South American Subbasin as well.

Table 6-11. Total Inflows to the Subbasin

Component	Historical Calibration (AFY)	Current Conditions (AFY)	Projected Conditions (AFY)	Projected Conditions with Climate Change (AFY)
Hydrologic Period	WY 2009 - 2018	50-Year Period	50-Year Period	50-Year Period
Auburn Ravine Upstream Flow	14,600	16,600	16,600	16,600
Pleasant Grove Creek Upstream Flow	22,100	25,200	25,200	25,200
Dry Creek Upstream Flow	29,600	33,500	33,500	34,000
Bear River Upstream Flow	305,800	257,100	257,100	251,200
Feather River Upstream Flow	4,563,200	5,860,300	5,860,300	4,679,600
Sacramento River Upstream Flow	7,287,600	8,207,700	8,209,200	7,178,800
American River Upstream Flows	2,524,600	2,688,100	2,688,100	2,337,800
Total Inflows	*14,747,500*	*17,088,400*	*17,090,000*	*14,523,300*
Outflow to Sacramento River	*14,948,300*	*17,336,800*	*17,379,000*	*14,799,500*

Table 6-12. Average Annual Water Budget – Land Surface System, North American Subbasin (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Precipitation	551,000	590,800	590,800	592,800
Total Surface Water Supply				
Municipal and Industrial	117,900	117,600	220,200	220,200
Agricultural	189,900	189,000	149,900	152,500
Total Groundwater Supply				
Municipal and Industrial	66,600	69,000	102,400	102,400
Agricultural	200,300	206,100	200,500	*220,400*
Ag Residential	20,600	20,600	14,600	14,600
Total Recycled Water Supply				
Remediated Municipal and Industrial	-	-	-	-
Recycled Water	-	-	-	-
Total Inflow	*1,146,300*	*1,193,000*	*1,278,400*	*1,302,900*
Outflows				
Evapotranspiration				
Municipal and Domestic	127,200	128,900	203,600	207,700
Agricultural	299,200	297,900	270,400	293,600
Refuge, Native, and Riparian	68,500	69,900	42,000	43,300
Runoff to the Stream System	297,000	328,400	356,300	358,400
Return Flow to the Stream System				
Agricultural	68,600	73,300	59,400	59,800
Municipal and Domestic	102,900	104,800	171,900	171,900
Deep Percolation				
Precipitation	53,100	55,700	42,600	39,900
Applied Surface Water				
Urban and Industrial	24,600	25,000	40,000	37,500
Agricultural	39,700	40,100	27,200	26,000
Applied Groundwater				
Urban and Industrial	13,900	14,600	18,600	17,500
Agricultural	41,900	43,700	36,400	37,600
Ag Residential	4,300	4,400	2,700	2,500
Applied Recycled Water				
Urban and Industrial	-	-	-	-
Applied Remediated Water				
Urban	-	-	-	-
Other Flows[1]	5,500	6,300	7,300	7,200
Total Outflow	*1,146,300*	*1,193,000*	*1,278,400*	*1,302,900*

Notes: [1] "Other Flows" is a closure term that captures the gains and losses due to land expansion and temporary seasonal storage in the root-zone.

Table 6-13. Average Annual Water Budget – Groundwater System, North American Subbasin (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Deep Percolation				
Precipitation	53,100	55,700	42,600	39,900
Applied Surface Water				
Urban and Industrial	24,600	25,000	40,000	37,500
Agricultural	39,700	40,100	27,200	26,000
Applied Groundwater				
Urban and Industrial	13,900	14,600	18,600	17,500
Agricultural	41,900	43,700	36,400	37,600
Ag Residential	4,300	4,400	2,700	2,500
Applied Recycled Water				
Urban and Industrial	-	-	-	-
Applied Remediated Water				
Urban	-	-	-	-
Infiltration from Streams				
American River	23,500	21,700	27,100	28,100
Bear River	3,300	2,700	3,000	5,000
Feather River	10,900	12,300	12,400	13,500
Sacramento River	3,700	6,100	7,600	8,400
Local Tributaries[1]	92,600	91,700	104,200	108,600
Groundwater Injection (from ASR and Remediation)	300	200	2,100	2,100
Other Recharge[2]	16,700	16,700	16,400	16,400
Subsurface Inflow				
South American Subbasin	21,800	16,600	18,300	18,400
Sutter Subbasin	1,400	1,400	1,400	2,100
Yolo Subbasin	10,200	9,000	10,800	11,800
Yuba Subbasin	6,500	6,700	6,800	7,600
Foothills	12,100	13,600	13,600	13,200
Outside B118 Subbasin	2,600	2,600	2,700	3,200
Total Inflow	*383,000*	*384,700*	*393,800*	*399,500*
Outflows				
Discharge to Streams				
American River	6,100	7,100	6,600	6,500
Bear River	9,500	10,000	9,100	6,400
Feather River	4,300	4,900	4,800	5,300
Sacramento River	16,300	20,300	15,800	16,200

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Local Tributaries[1]	8,200	10,700	10,000	7,200
Groundwater Pumping				
Urban and Industrial	66,600	69,000	102,400	102,400
Ag Residential	20,600	20,600	14,600	14,600
Agricultural	200,300	206,100	200,500	220,400
Remediation	8,900	7,700	7,700	7,700
Subsurface Outflow				
South American Subbasin	7,700	9,700	13,000	13,200
Sutter Subbasin	1,400	2,000	2,000	1,400
Yolo Subbasin	400	500	400	400
Yuba Subbasin	100	100	100	100
Outside B118 Subbasin	900	1,400	1,300	1,100
Other Flows[3]	-	-	-	100
Total Outflow	*351,100*	*369,900*	*388,400*	*403,000*
Change in Groundwater Storage	*31,900*	*14,900*	*5,400*	*(3,500)*

Notes:

[1]Local Tributaries include Racoon Creek, East Side Canal, Auburn Ravine, Pleasant Grove Creek, Pleasant Grove Creek Canal, Cross Canal. Natomas East Drain, Dry Creek, Magpie Creek, and Arcade Creek.

[2]Other Recharge includes primarily unlined canals seepage.

[3] Other Flows is a closure term to help balance the model in the projected conditions with climate change scenario only.

6.5 Historical Water Budget

The historical water budget is a quantitative evaluation of the historical surface and groundwater supply covering the 10-year period from WY 2009 to 2018. This period was selected as the most recent, modeled, representative hydrologic period to represent recent historical conditions in the subbasin and as a subset of the CoSANA model calibration period of WY 1995 to 2018. The goal of the historical water budget analysis is to characterize the supply and demand, while summarizing the hydrologic flow within the Subbasin, including the movement of all primary sources of water such as rainfall, irrigation, streamflow, and subsurface flows.

The existing stream and canal network supplies multiple water users and agencies in the NASb, including the City of Sacramento, Carmichael Water District (WD), Natomas MWC, and Pleasant Grove Verona MWC. In addition to these entities, South Sutter WD, City of Roseville, City of Lincoln, San Juan WD, Orange Vale WC, Citrus Heights WD, California American WC, Sacramento Suburban WD, Fair Oaks WD, and Placer County WA supplied areas receive surface water that originates outside of the model boundaries.

When analyzing the stream and canal system, it is important to note potentially significant effects resulting from the natural interactions and managed operations of adjacent groundwater

subbasins. Because the CoSANA model covers multiple subbasins, it is not always possible to distinguish between stream system inflows and outflows by subbasin. Because of this, the water budgets in **Tables 6-4 through Table 6-7** quantify budgets based on the major rivers and their associated tributaries. **Figure 6-3** below shows the composite inflows and outflows for portions of the American, Feather, Bear, and Sacramento Rivers that are adjacent to the NASb.

During the historical period, average annual surface water inflows of about 14,681,100 acre-feet (AF) enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (350,700 AFY), gain from groundwater (66,200 AFY), runoff (12,200 AFY), and direct return flows (57,600 AFY). These are offset by an equal quantity of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American Rivers (14,948,300 AFY). However, additional water exits the stream system as seepage to groundwater (72,200 AFY) and surface water diversions (147,400 AFY).

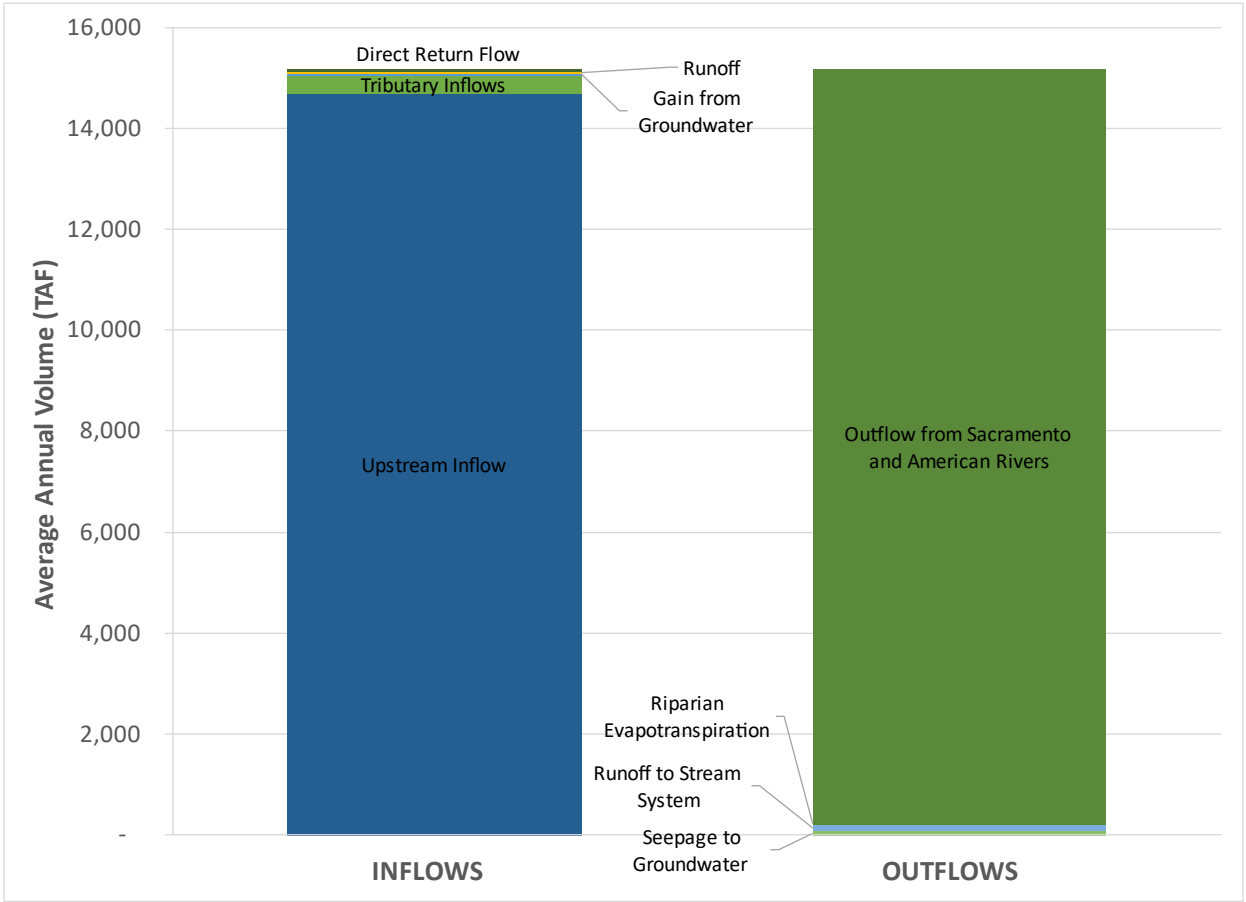


Figure 6-3. Historical Average Annual Water Budget – Stream and Canal Systems, North American Subbasin

The NASb land surface system water budget, shown below in **Figure 6-4**, includes approximately 1,146,300 AF of inflows each year, a combination of precipitation (551,000 AFY), surface water deliveries (307,800 AFY), and groundwater supplies (287,500 AFY). These

inflows are balances with the outflows, which are comprised of evapotranspiration (494,900 AFY), surface runoff (297,000 AFY), return flow (171,500 AFY) to the stream and canal system, deep percolation (177,500 AFY), and other flows (5,500 AFY).



Figure 6-4. Historical Average Annual Water Budget – Land Surface System, North American Subbasin

The groundwater system of the NASb experiences approximately 383,000 AF of inflows each year, of which 177,500 AF is deep percolation. Additional inflows include infiltration from the stream system (134,000 AFY), injection of remediated water to the groundwater system (300 AFY), subsurface inflows (54,600 AFY) from the Sierra Nevada foothills and the neighboring subbasins (primarily Yolo and Yuba), and other recharge (16,700 AFY) which is primarily seepage from irrigation water canal system.

On average, the inflows exceed the groundwater outflows. The primary components of outflow from the groundwater system are groundwater pumping (296,400 AFY), followed by groundwater discharge to streams (44,400 AYF) and subsurface outflow to neighboring subbasins (10,400 AFY).

The NASb average historical groundwater budget has greater inflows than outflows, leading to an average annual increase in groundwater storage of approximately 31,900 AFY. **Figure 6-5** summarizes the average historical groundwater inflows and outflows in the NASb.

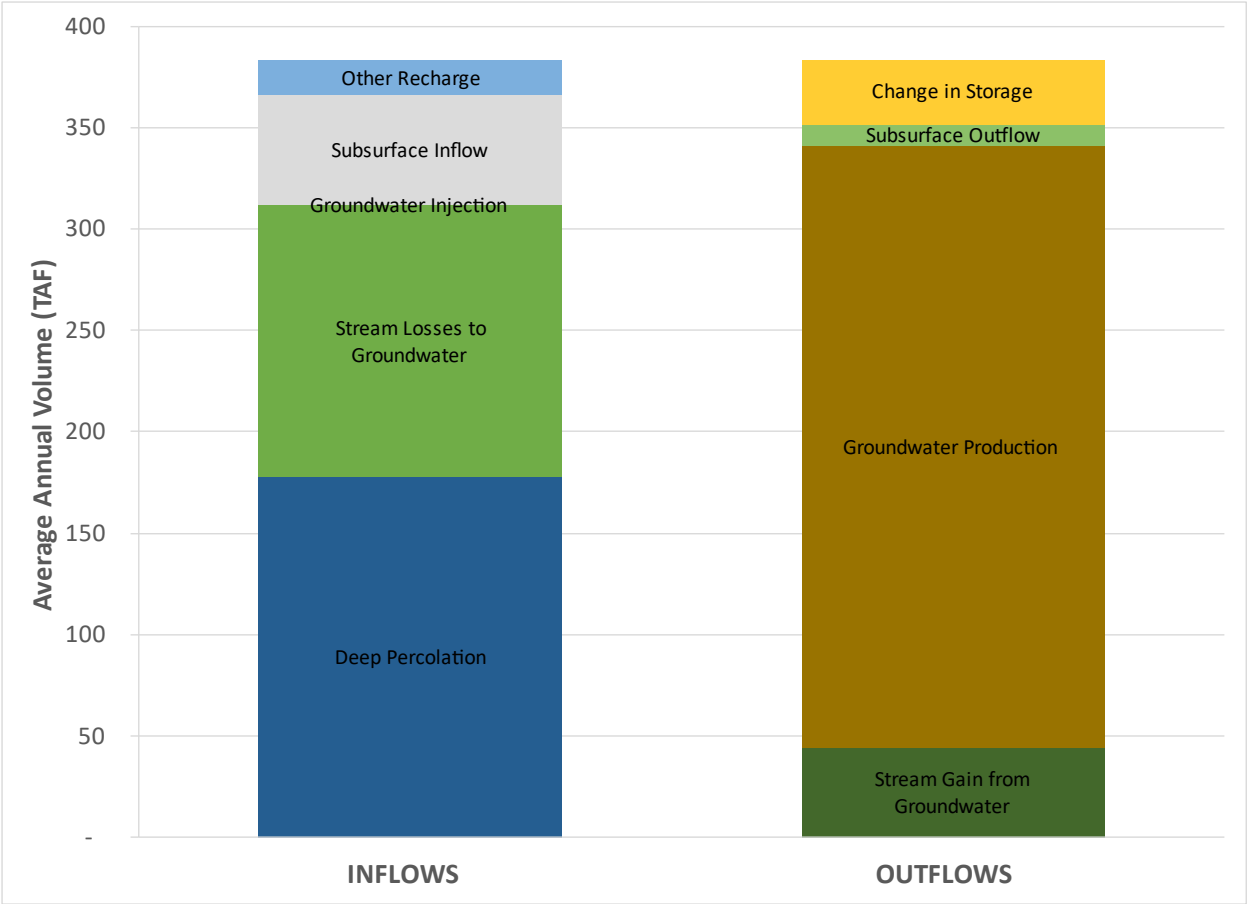


Figure 6-5. Historical Average Annual Water Budget – Groundwater System, North American Subbasin

Historical inflows and outflows change by water year type. In wet years, precipitation meets more of the water demand and greater recharge occurs from precipitation and streams. In dry years, more groundwater is pumped to meet the agricultural demand not met by precipitation and less recharge occurs from precipitation and streamflows. This contributes to an increase in groundwater storage in wet years and a decrease in dry years. Further, many urban water users practice conjunctive use, using more surface water in wet years and more groundwater in dry years to optimize these water supplies. While agricultural demand for applied water increases in dry years due to lack of precipitation, agricultural surface water supplies remain relatively consistent in most non-critical years. Note the agricultural surface water supply in this water budget is reflective of the volume available to the grower, and thus does not include operational spills, canal seepage, or evaporative losses. **Table 6-12** breaks down the average historical water supply and demand, by water year type, from the CoSANA simulated 29-year period of 1990 through 2018. Also shown are the average annual values for the 2009-2018 period.

During the 2009-2018 historical period, the availability of surface water supplies were largely reliable. During the period, the only water right curtailment experienced by an urban water user was to a post-1914 water right permit held by Carmichael Water District on the lower American River. This occurred in parts of 2014 and 2015.

Table 6-14. Average Annual Values for Key Components of Water Budget by Year Type (AFY)

Component	Water Year Type (Sacramento River Index)					
	Wet	Above Normal	Below Normal	Dry	Critical	10-Year Average WY 2009-2018
Water Demand						
Ag Demand	417,300	413,800	434,300	449,600	436,000	410,800
Urban Demand	212,600	223,800	213,900	218,900	197,300	184,500
Total Demand	*633,400*	*659,100*	*653,900*	*672,800*	*637,400*	*602,800*
Water Supply						
Total Surface Water Supply						
Agricultural	215,500	233,900	211,300	213,100	181,900	189,900
Urban	116,500	126,400	126,600	133,800	110,700	117,900
Total Groundwater Supply						
Agricultural	181,200	177,300	202,400	215,900	233,500	200,300
Ag Residential	20,600	20,600	20,600	20,600	20,600	20,600
Urban	96,100	97,400	87,300	85,100	86,600	66,600
Remediation	3,500	3,500	5,700	4,300	4,100	7,500
Total Supply	*633,400*	*659,100*	*653,900*	*672,800*	*637,400*	*602,800*
Change in GW Storage	*102,300*	*29,300*	*12,600*	*(7,300)*	*(66,400)*	*31,800*

Note:
Information is presented here to show variability in historical conditions based on water year type. However, as these data are based on historical conditions, other differences are present beyond water year type that influence the values shown. For instance, the Above Normal year of 1991 will have different conditions and results than the Critical year of 2015 due to level of development, changes in management, nuances of the water year, and a variety of other factors. In some cases, these distinctions may be more significant than the impact of the water year type, resulting in some results and trends in this table that may seem nonintuitive.

6.6 Current Water Budget

The current water budget quantifies inflows to and outflows from the basin using 50-years of hydrology in conjunction with water supply, demand, and land use information reflecting the current level of development. Current level of development for most of the entities in the NASb is defined as the average demand and supply conditions during the most recent 10 years (approx. 2009-2018). The only exception is the supply mix for the current level of development for the City of Sacramento, which is defined per the city's Groundwater Master Plan. These conditions are incorporated in the Current Conditions Baseline simulation of the CoSANA model.

In the Current Conditions Baseline, average annual surface water inflows of approximately 17,013,200 AFY enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (388,000 AFY), gain

from groundwater (75,400 AFY), runoff (12,200 AFY), and direct return flows (66,000 AFY). These are offset by an equal quantity of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American Rivers (17,336,900 AFY). However, additional water exits the stream system as seepage to groundwater (74,600 AFY) and surface water diversions (143,400 AFY).

Figure 6-6 summarizes the average annual current conditions inflows and outflows in the NASb surface water network.

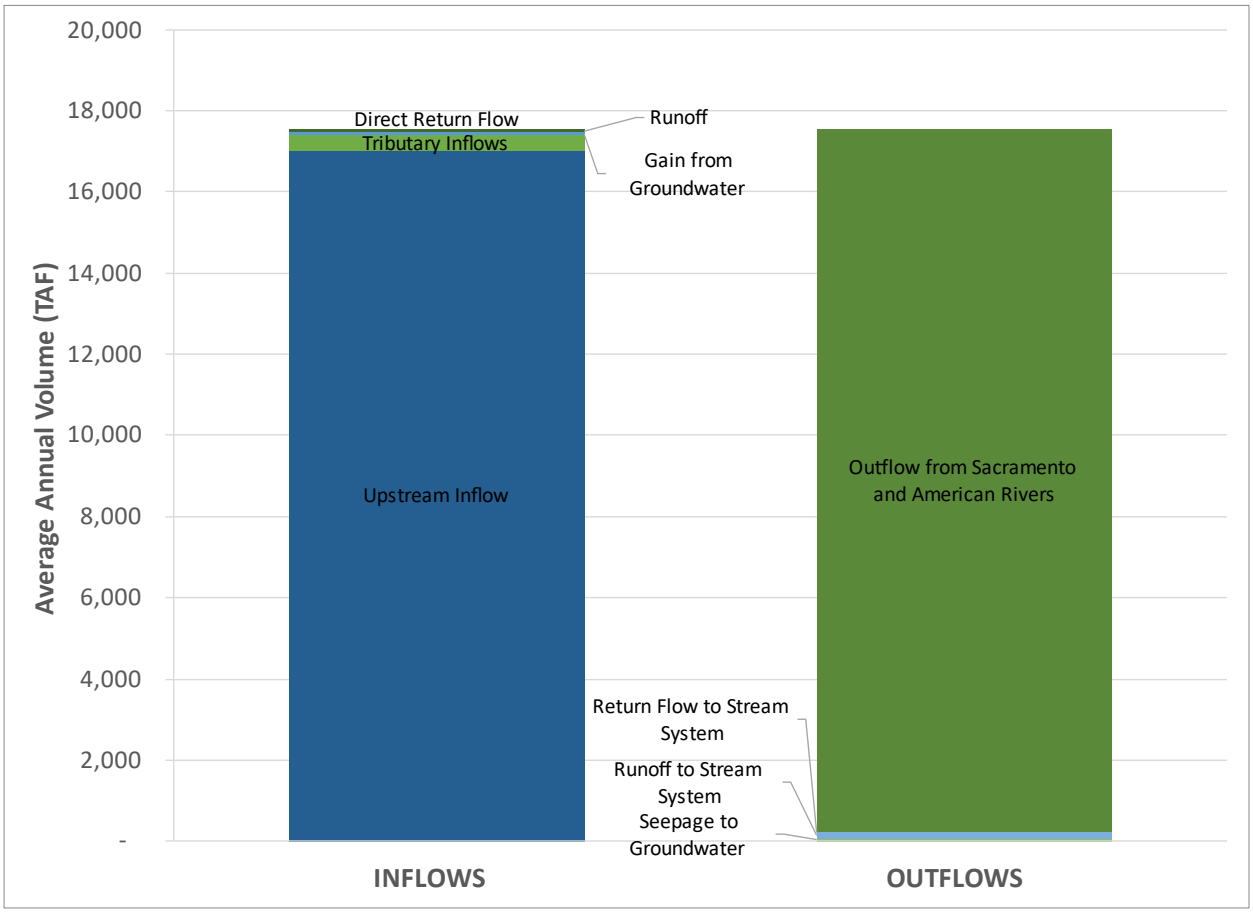


Figure 6-6. Average Annual Current Water Budget – Stream and Canal Systems, North American Subbasin

The current land surface water budget simulates annual inflows of 1,193,000 AFY, including 590,800 AFY of precipitation and 602,200 AFY of applied water (306,600 AFY of surface water and 295,600 AFY of groundwater). Balancing the current land surface water budget, the 1,193,000 AFY of outflows include evapotranspiration (496,700 AFY), surface runoff to the stream system (328,400 AFY), return flow to the stream system (178,100 AFY), deep percolation (183,500 AFY), and other flows (6,300 AFY). **Figure 6-7** summarizes the average annual current inflows and outflows in the NASb land surface water budget.

There are small but important differences between the historical and current conditions land surface system water budget. The Current Conditions Baseline uses a 50-year hydrology that is more similar to long-term average precipitation conditions in the NASb, while the 2009-2018 recent historical period is slightly drier. The more normal conditions are shown as slightly higher precipitation inflows under the Current Conditions Baseline as well as higher runoff to streams.

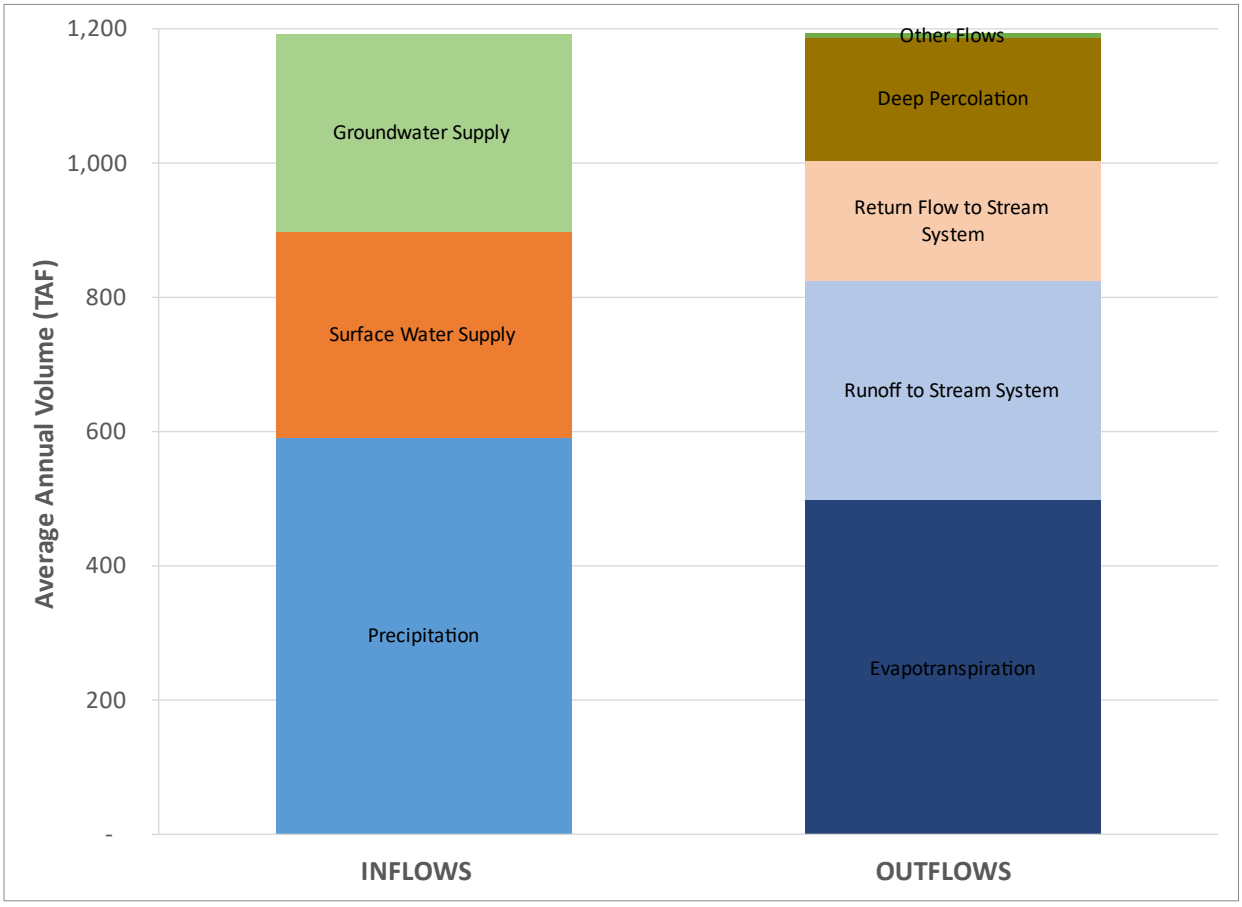


Figure 6-7. Average Annual Current Water Budget – Land Surface System, North American Subbasin

Over the simulation period, the current groundwater budget simulates annual inflows of 384,700 AFY, including 183,500 AFY of deep percolation, 134,500 AFY of stream seepage, subsurface inflows totaling 49,900 AFY, groundwater injection of 200 AFY, and 16,700 AFY of other recharge (which is primarily canal system seepage).

Similar to the historical groundwater budget, average aquifer inflows exceed the outflows under the current water budget. Groundwater production (303,300 AFY) remains the largest component of aquifer discharge, with losses to the local stream system (53,000 AFY) and subsurface outflows (13,600 AFY) bringing the total system outflows to 369,900 AFY annually.

The NASb current groundwater budget has an average annual increase in groundwater storage of about 14,900 AFY. **Figure 6-8** summarizes the average current conditions groundwater inflows and outflows in the NASb. It should be noted that groundwater conditions are variable across the

NASb, with some areas showing greater increases in groundwater storage and some areas showing lower increases or declines in groundwater storage.

Similar to the land surface system water budget, the groundwater system budget shows the influences of slightly different hydrologic conditions, but also shows influences of slightly higher groundwater levels. Higher average groundwater level conditions under current conditions, due to positive change in groundwater storage in historical conditions, results in generally lower stream seepage, higher outflow to streams, higher subsurface outflows, and lower subsurface inflows. Otherwise, the values in the historical and current groundwater budgets are generally similar.

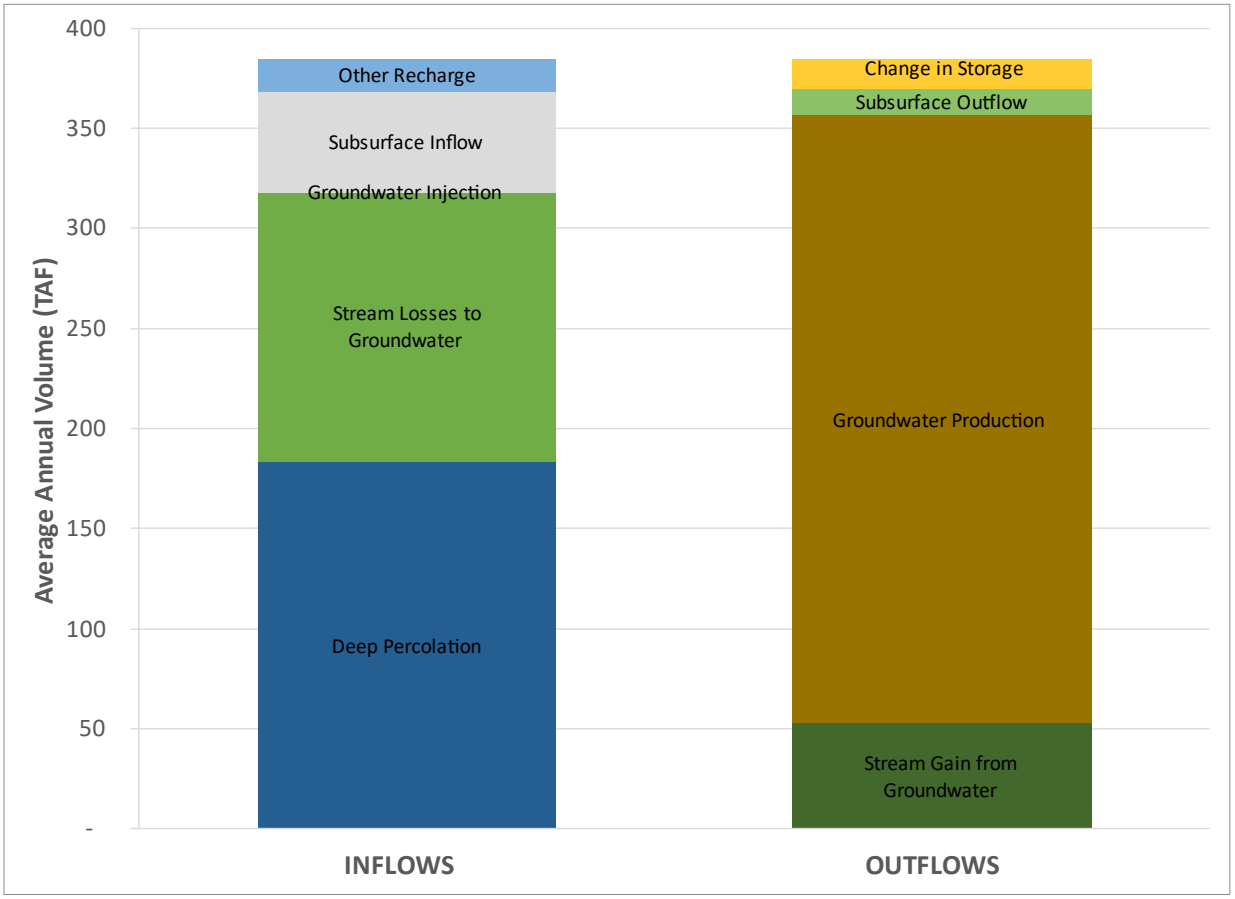


Figure 6-8. Average Annual Current Water Budget – Groundwater System, North American Subbasin

6.7 Projected Water Budget

The projected water budget is used to estimate future baseline conditions of supply, demand, and aquifer response to plan implementation. The Projected Conditions Baseline simulation of the CoSANA model is used to evaluate the projected water budget using the historical hydrology from 1970 to 2019. As previously discussed, this represents a hydrologic period of at least 50 years and has average precipitation similar to the long-term average. Development of the projected water demand is based on information reported in 2015 UWMPs, general plans, and

other planning documents, or information provided by purveyors. The projected water budget then reflects the water supply and demand conditions at the projected level of development, which is set at the 2040 projections for most entities, other than the supply mix for the City of Sacramento, which is based on the city's Groundwater Master Plan.

In the Projected Conditions Baseline, average annual surface water inflows of approximately 17,014,700 AFY enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (435,500 AFY), gain from groundwater (64,800 AFY), runoff (17,400 AFY), and direct return flows (67,700 AFY). These are offset by an equal volume of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American Rivers (17,379,000 AFY). However, additional water exits the stream system as seepage to groundwater (83,300 AFY) and surface water diversions (138,000 AFY).

Figure 6-9 summarizes the average projected inflows and outflows in the NASb surface water network.

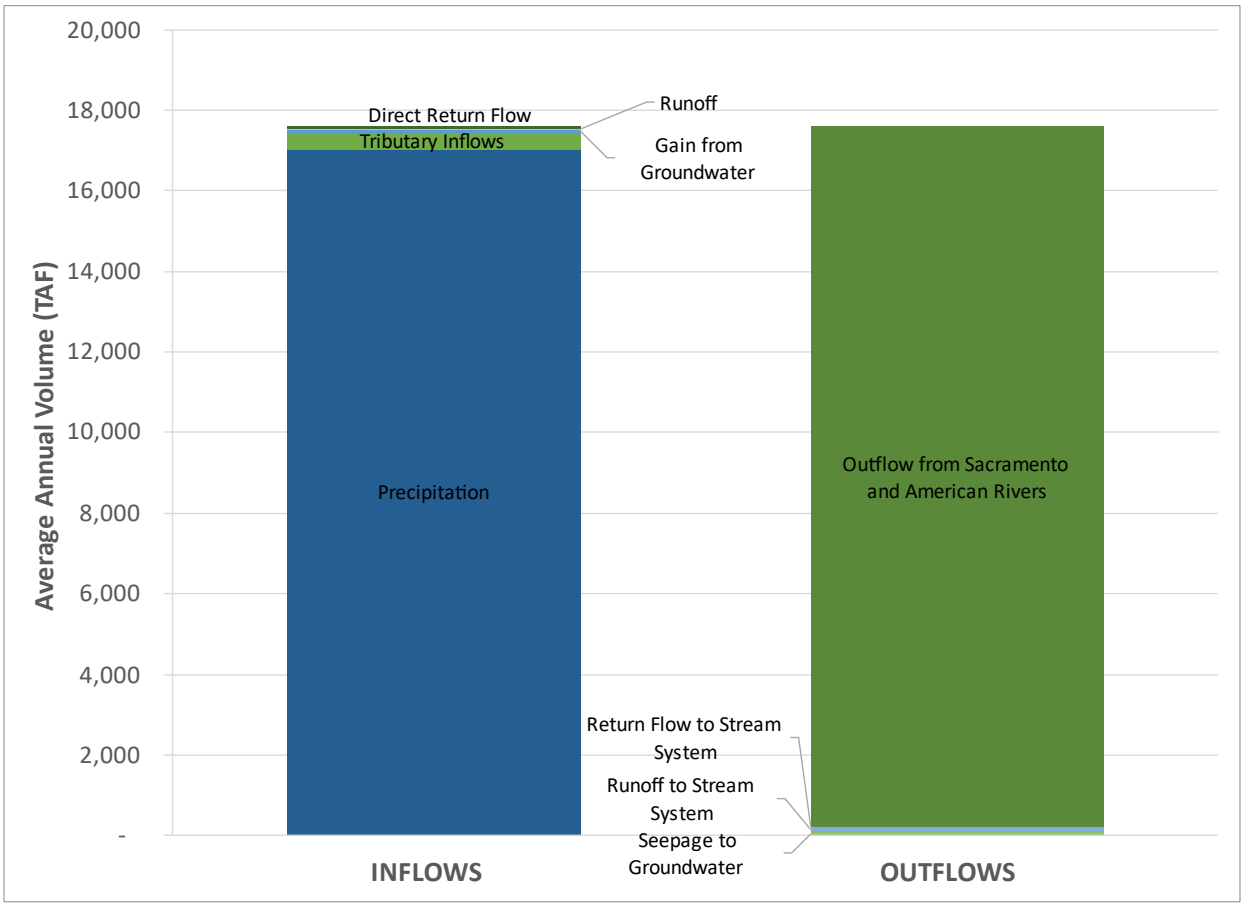


Figure 6-9. Average Annual Projected Water Budget – Stream and Canal Systems, North American Subbasin

The projected land surface water budget shows annual inflows of 1,278,400 AFY, including 590,800 AFY of precipitation and 687,600 AFY of applied water (370,000 AFY of surface water

and 317,600 AFY of groundwater). Balancing the projected land surface water budget are 1,278,400 AFY of outflows, including evapotranspiration (516,100 AFY), surface runoff to the stream system (356,300 AFY), return flow to the stream system (231,300 AFY), deep percolation (167,400 AFY), and other flows (7,300 AFY). A summary of these flows can be seen below in **Figure 6-10**.

There are several key differences between the current and projected land surface system water budget. The current and projected conditions use the same hydrologic period, and as such, the rainfall amounts are same. However, runoff and percolation conditions are different due to the impact of land conversion from agricultural and native to urban land uses. The urban growth also results in increases in demand and urban water supplies. Both groundwater and surface water urban supplies increase, with the bulk of increased surface water use the result of increased supply for new developments within Placer County. Agricultural water supplies decline due to reduced irrigated acreage. These changes in inflows are also reflected in the outflows, with increased urban land and water use resulting in increased urban evapotranspiration, urban return flow, and runoff. Conversely, reduced agricultural uses and native lands results in lower levels of evapotranspiration and return flow from these areas.

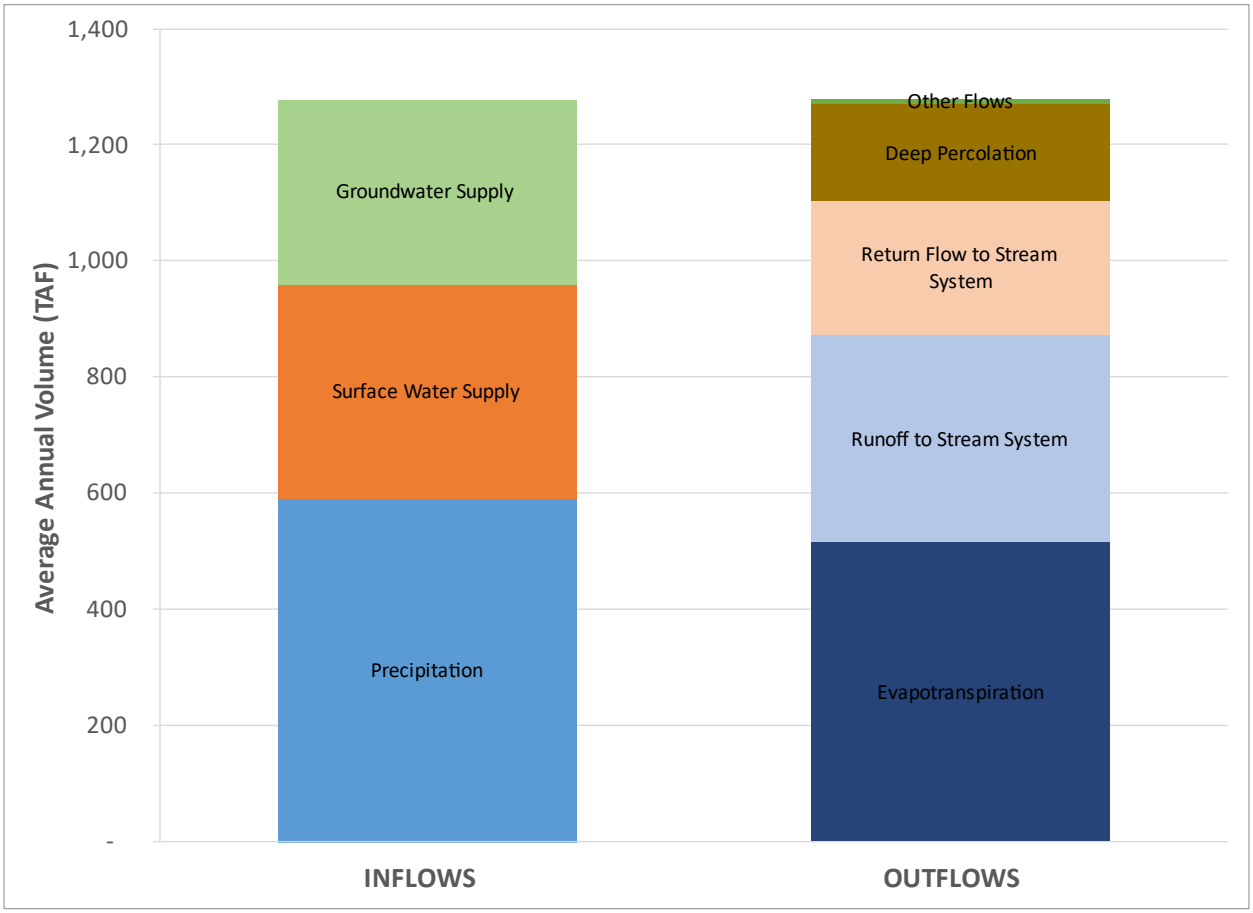


Figure 6-10. Average Annual Projected Water Budget – Land Surface System, North American Subbasin

Over the simulation period, the projected groundwater budget shows annual inflows of 393,800 AFY, including 167,400 AFY of deep percolation, 154,300 AFY of stream seepage, subsurface inflows totaling 53,600 AFY, groundwater injection of 2,100 AFY, and other recharge of 16,400 AFY (which is primarily canal system seepage).

Similar to the current and historical conditions groundwater budgets, average aquifer inflows exceed the outflows in the projected groundwater budget. Groundwater production (325,300 AFY) remains the largest point of aquifer discharge, with losses to the local stream system (46,400 AFY), and subsurface outflows (16,800 AFY) bringing the total system outflows to 388,400 AFY.

The NASb projected groundwater budget has an average annual surplus in groundwater storage of about 5,400 AFY. **Figure 6-11** summarizes the average projected groundwater inflows and outflows in the NASb.

Similar to the land surface system water budget, the groundwater system water budget shows the influences of land conversion and changes to water supplies when compared to the current water budget. Deep percolation from precipitation is lower in the Projected Conditions Baseline compared to current conditions largely due to the changes in land use and increase in impervious surfaces that comes with urban development. Changes in deep percolation of applied water are largely the result of changes in volumes of water supplies, as noted within the land surface system water budget. Stream losses increase in the Projected Conditions Baseline in comparison to the Current Conditions Baseline due to lower groundwater levels caused largely by increases in pumping for urban uses and increases in runoff from urban land.

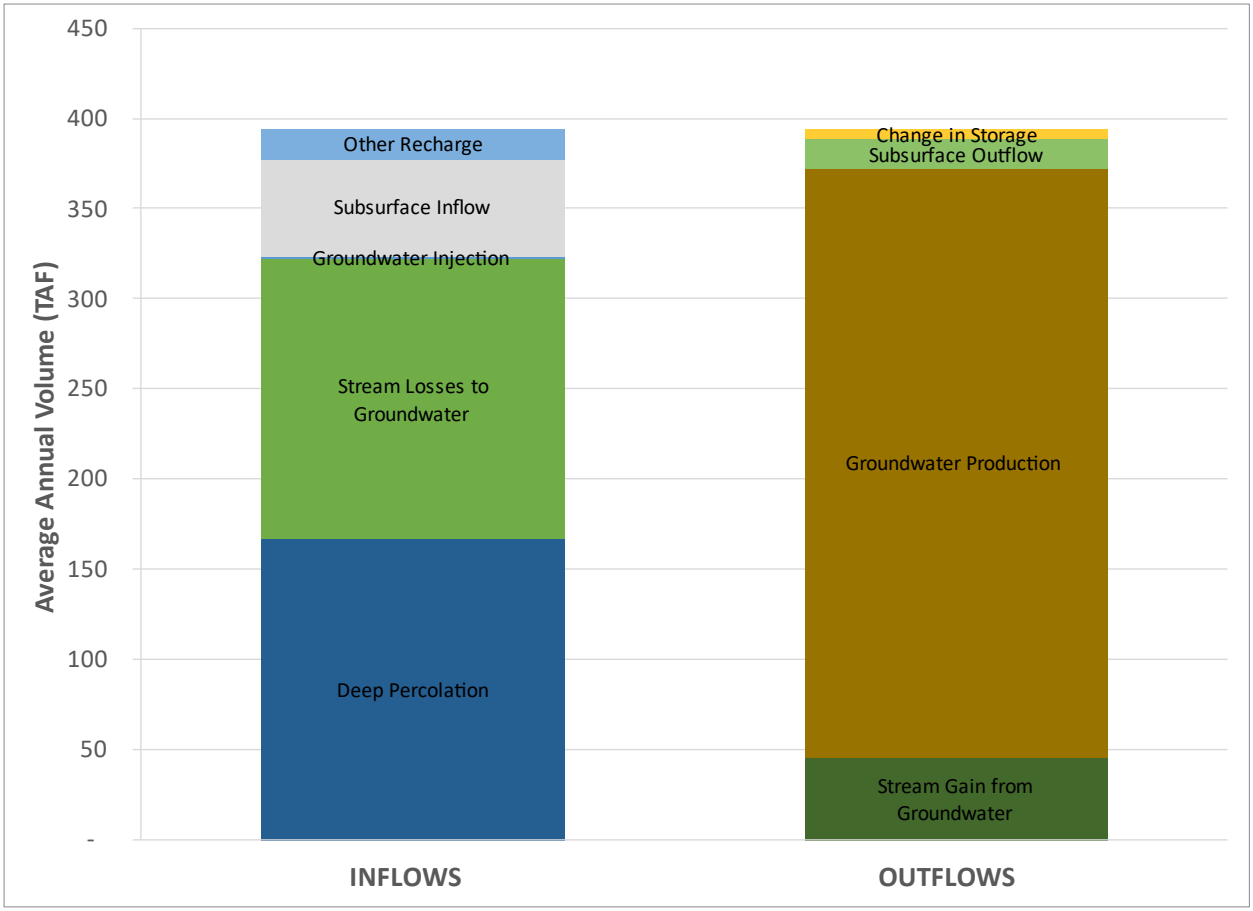


Figure 6-11. Average Annual Projected Water Budget – Groundwater System, North American Subbasin

6.8 Projected Water Budget with Climate Change

The Projected Conditions Baseline with Climate Change is used to estimate future conditions of supply, demand, and aquifer response to plan implementation with consideration of climate impacts. The Projected Conditions Baseline with Climate Change simulation of the CoSANA model is used to evaluate the Projected Conditions Baseline with Climate Change water budget using hydrology from 1970 to 2019, adjusted for projected climate change. As previously discussed, this represents a hydrologic period of at least 50 years and has average precipitation similar to the long-term average. To account for climate change, model inputs for precipitation, evapotranspiration and stream inflow were adjusted using data developed for the American River Basin Study. Additional discussion of the climate change analysis approach, including a description of a sensitivity analysis under a more extreme climate change scenario, can be found in **Appendix P**. Other model data remained the same as the Projected Conditions Baseline.

In the Projected Conditions Baseline with Climate Change water budget, average annual surface water inflows of about 14,447,500 AFY enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (432,200 AFY), gain from groundwater (55,300 AFY), runoff (17,600 AFY), and direct return

flows (68,400 AFY). These are offset by an equal quantity of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American rivers (14,799,500 AFY). However, additional water exits the stream system as seepage to groundwater (80,900 AFY) and surface water diversions (140,600 AFY).

Figure 6-12 summarizes the average projected inflows and outflows in the NASb surface water network.

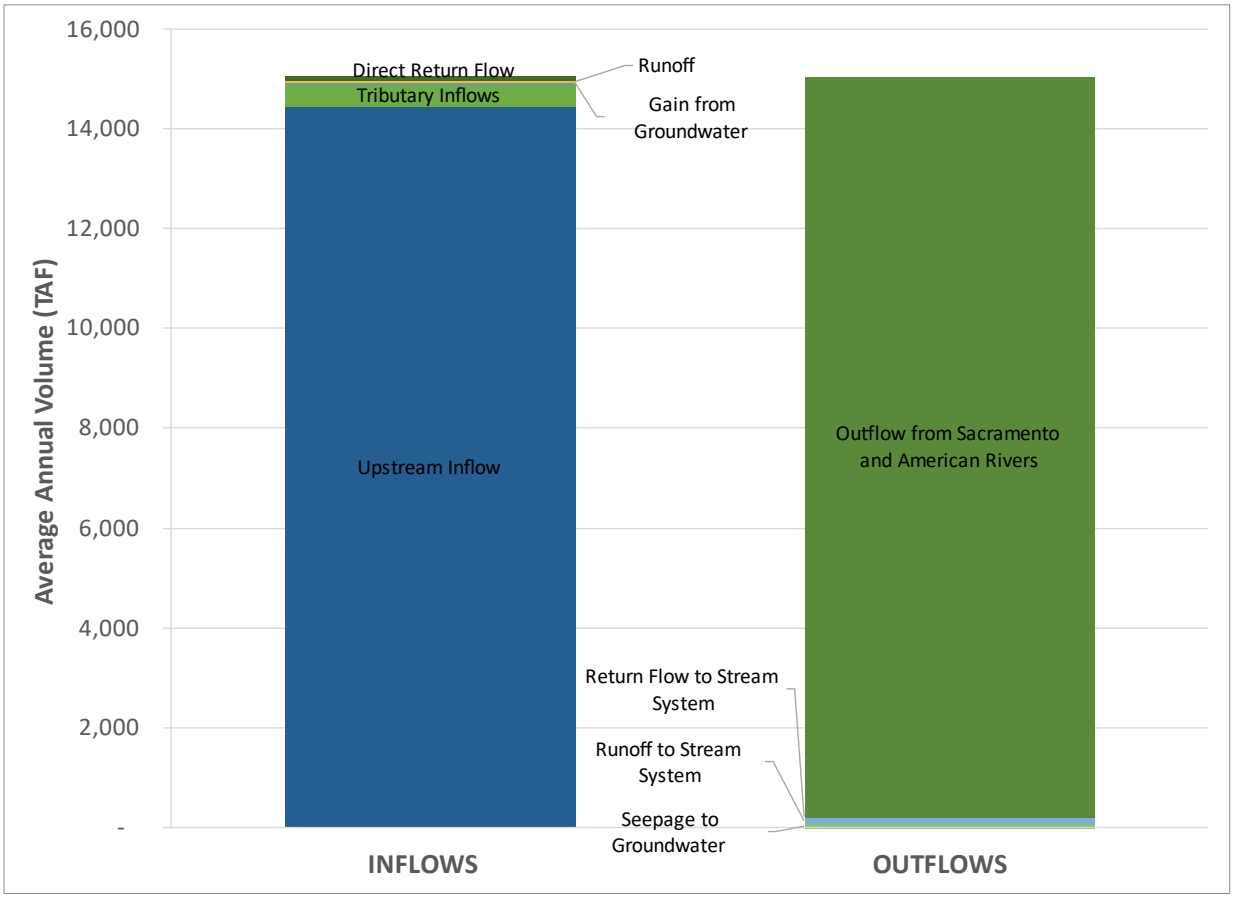


Figure 6-12. Average Annual Projected with Climate Change Water Budget – Stream and Canal Systems, North American Subbasin

The Projected Conditions Baseline with Climate Change land surface water budget shows annual inflows of 1,302,900 AFY, including 592,800 AFY of precipitation and 710,100 AFY of applied water (372,700 AFY of surface water and 337,400 AFY of groundwater). Balancing the projected land surface water budget is 1,302,900 AFY of outflows including evapotranspiration (544,600 AFY), surface runoff to the stream system (358,400 AFY), return flow to the stream system (231,700 AFY), deep percolation (161,000 AFY), and other flows (7,200 AFY). A summary of these flows can be seen below in **Figure 6-13**.

With land use conditions the same between the Projected Conditions Baseline and the Projected Conditions Baseline with Climate Change, the differences between the two associated land surface systems water budgets are the result of climate change hydrology. The substantial change

in the budget is an increase in agricultural evapotranspiration. This results in an increase in irrigation needs for agricultural lands and an associated increase in agricultural groundwater production.

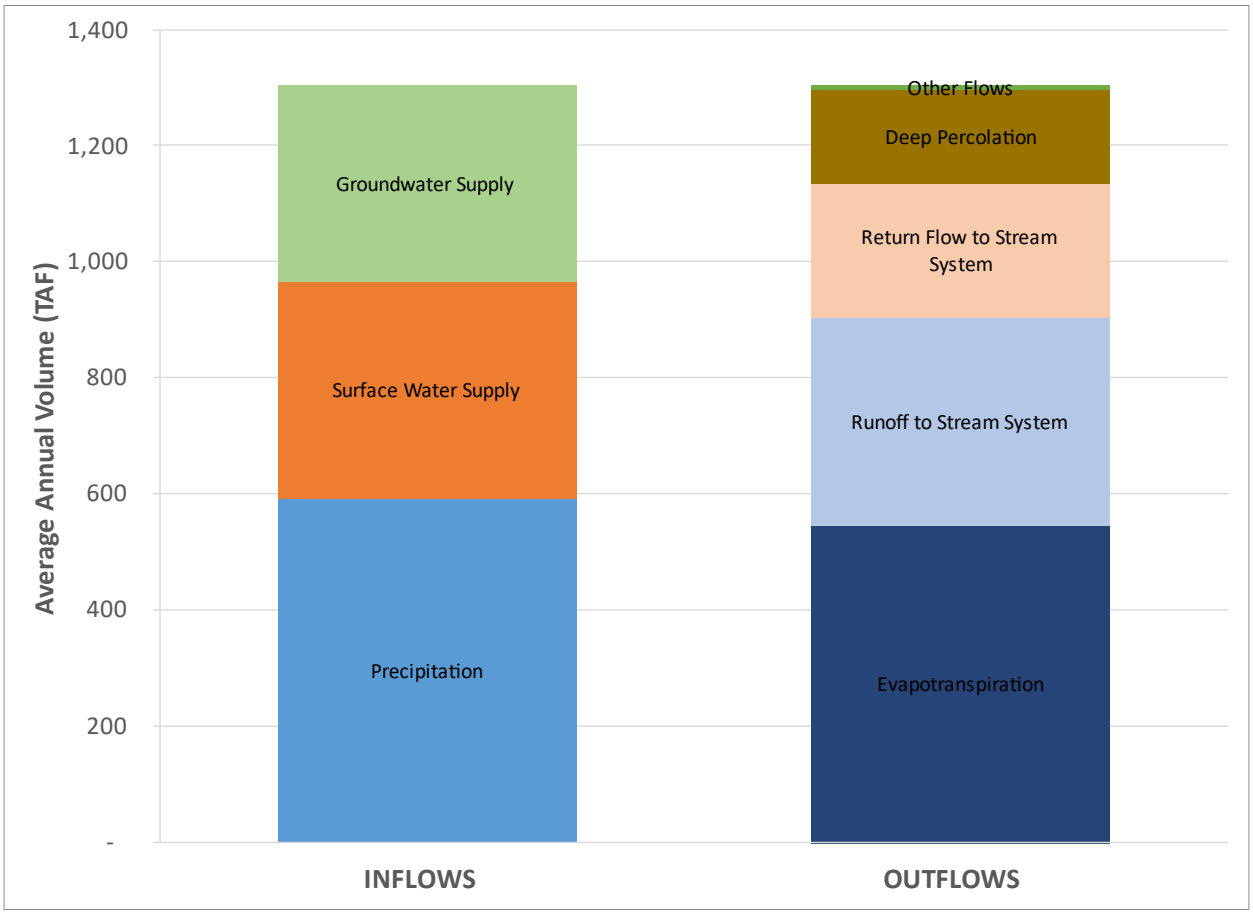


Figure 6-13. Average Annual Projected with Climate Change Water Budget – Land Surface System, North American Subbasin

Over the simulation period, the Projected Conditions Baseline with Climate Change groundwater budget simulates annual inflows of 399,500 AFY, including 161,000 AFY of deep percolation, 163,700 AFY of stream seepage, subsurface inflows totaling 56,300 AFY, groundwater injection of 2,100 AFY, and other recharge of 16,400 AFY (which is primarily canal system seepage).

In contrast to the projected, current, and historical water budgets, average aquifer outflows exceed the inflows in the Projected Conditions Baseline with Climate Change water budget. Groundwater production (345,100 AFY) remains the largest point of aquifer discharge, with losses to the local stream system (41,500 AFY), and subsurface outflows (16,300 AFY) bringing the total system outflows to 403,000 AFY.

The NASb Projected Conditions Baseline with Climate Change water budget has an average annual decline in groundwater storage of about 3,500 AFY. **Figure 6-14** summarizes the average

groundwater inflows and outflows in the NASb in the projected with climate change water budget.

Similar to the land surface system water budget, the groundwater system budget shows the influences of climate change when compared to the projected groundwater budget. Changes are largely the result of increased agricultural pumping resulting from climate-related increases in evapotranspiration and associated demand. This increase in outflow is a large component of increased stream losses, which is the largest change to inflows and is primarily the result of lowered groundwater levels near the rivers and streams due primarily to increased pumping and decreased deep percolation.

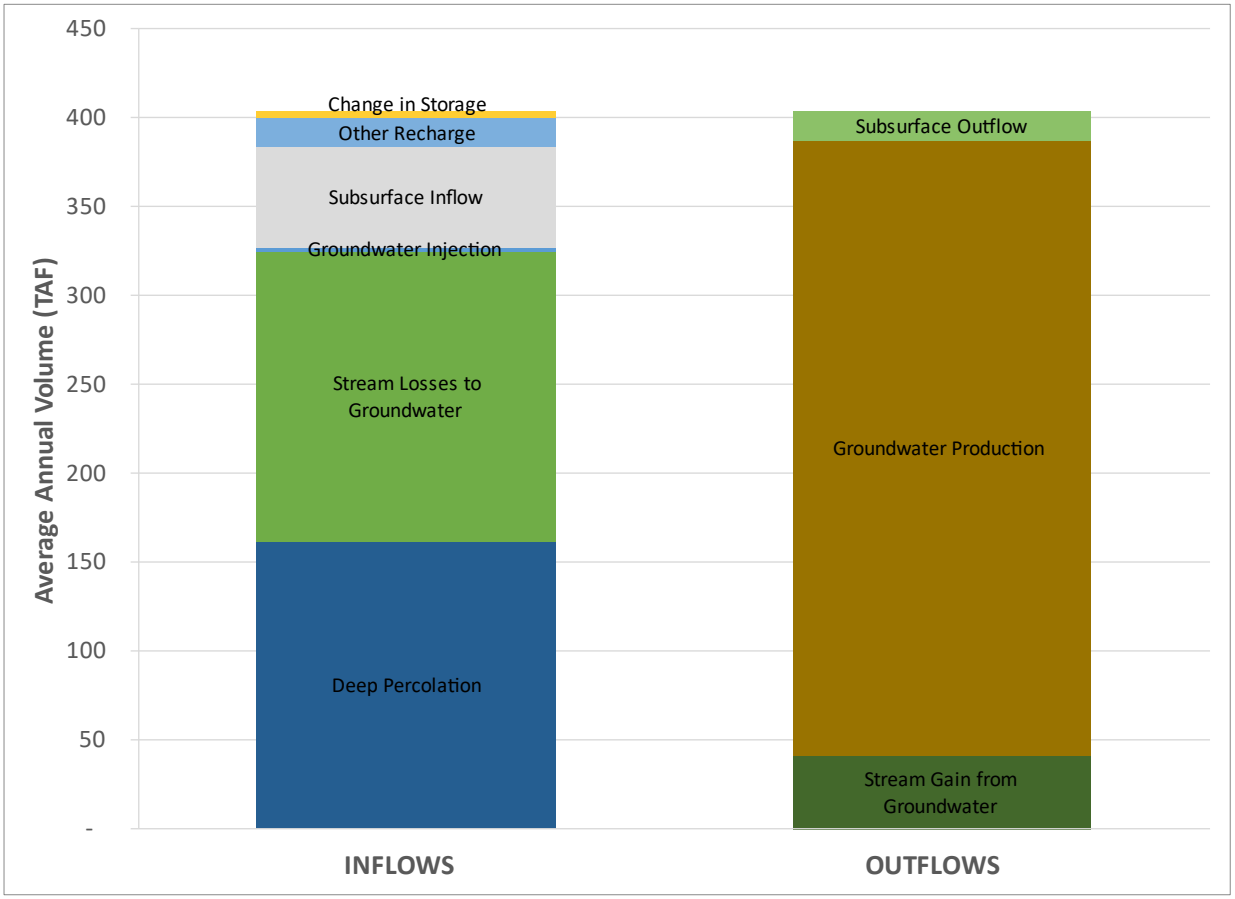


Figure 6-14. Average Annual Projected with Climate Change Water Budget – Groundwater System, North American Subbasin

6.9 Sustainable Yield Estimate

Sustainable yield is defined by the SGMA as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result." (California Water Code Section 10721(w)) In short, sustainable yield is the amount of groundwater that can be withdrawn on a long-term average basis without causing

undesirable results. The value is intended to assist in identifying projects and management actions needed to achieve sustainability, if any. Note that SGMA does not incorporate sustainable yield estimates directly into the sustainable management criteria, which are the regulatory drivers of SGMA. Basinwide pumping within the sustainable yield estimate is neither a measure of, nor proof of, sustainability. Sustainability under SGMA is only demonstrated by avoiding undesirable results for the sustainability indicators (DWR, 2017).

For the NASb, the sustainable yield was estimated by identifying a level of pumping that would result in no long-term change in groundwater in storage and then verifying that this level of pumping would avoid undesirable results. This approach was selected for two primary reasons:

- Current levels of storage and current groundwater levels are broadly considered satisfactory by stakeholders and are not known to have caused significant and unreasonable conditions. Thus, maintenance of these conditions, on a subbasin scale, is a desired outcome.

- Minimum thresholds for groundwater levels and depletions of interconnected surface water, discussed later in **Section 8 – Sustainable Management Criteria**, are defined based wholly or partly on CoSANA-simulated conditions using the same modeling simulation showing zero change in storage. Simulated groundwater levels do not go below the minimum thresholds. Thus, management of pumping using the long-term sustainable yield volume is expected to prevent undesirable results for these sustainability indicators.

Pumping that achieves zero change in storage can be estimated through the sum of pumping and change in storage. A positive change in storage suggests that more pumping is possible to achieve zero change in groundwater in storage, while a negative change in storage suggests that less pumping is necessary to achieve zero groundwater in storage. Due to the complexities of groundwater systems, this method is most accurate when change in storage is small, as the relationship between change in storage and additional pumping is not one-to-one. Modeling of projected conditions with both climate change and projects and management actions estimated total NASB groundwater pumping as 336,000 AFY and an associated change in groundwater in storage of 0 AFY. With simulated zero change in storage, no additions or subtractions for storage change are necessary from the 336,000 AFY of pumping, which is thus the estimated volume of pumping that would result in zero change in storage. This value, like others in the GSP, may be updated in the future based on new information or new conditions in the Subbasin.

7. Monitoring Networks

The Subbasin has a well-established groundwater-level monitoring program that consists of dedicated monitoring, irrigation, and residential wells. Wells in the monitoring network include CASGEM program wells, ILRP-designated wells along with monitoring wells constructed by SAFCA and a few wells constructed by agencies and private entities to assess water quality near areas with releases of contaminants to the environment. They are monitored by various agencies including each of the GSAs, DWR, USGS, and consultants. Groundwater quality is monitored as part of compliance with drinking water standards and the ILRP.

Representative monitoring wells were selected from these monitoring networks to assess groundwater levels and water quality as related to the SGMA sustainability indicators. The representative monitoring well network includes those wells that will be used to track changes for each of the sustainability indicators in the Subbasin to assess short- and long-term trends for lowering of groundwater levels, reduction in storage, depletion of interconnected surface water, subsidence and water quality degradation. A monitoring network was not selected for sea water intrusion, as it is not likely to occur in the future (*refer to* **Section 5.9 – Seawater Intrusion** for further details).

Representative monitoring wells are discussed for each of the sustainability indicators in the following sections along with evidence that the wells are reflective of conditions in the principal aquifer.

7.1 Objectives

The objectives of the monitoring networks are to provide access to measure groundwater conditions that are representative of conditions throughout the Subbasin. The objectives of the monitoring well network is to:

- Have monitoring wells distributed throughout the Subbasin to assess changes in conditions and to determine if management actions are required
- Use dedicated monitoring wells, with known construction details, that will be present for the next 20 years and beyond, and that will provide measurements that are reflective of regional conditions
- Provide measurements of the groundwater conditions to demonstrate if the Subbasin is being sustainably managed within the locally established minimum thresholds and measurable objectives

- Provide measurements for future refinements of the groundwater model and water budgets
- Assess whether the pumping depression in the central area is deepening or expanding
- Track groundwater levels near surface water bodies to limit depletion and effects on groundwater dependent ecosystems (GDEs)
- Track and reduce the potential for land subsidence to occur
- Monitor groundwater quality to ensure it is not being degraded due to use of groundwater, projects, or management actions

To meet the monitoring objectives, groundwater levels and quality will be measured and compared to established minimum thresholds and measurable objectives to assess the groundwater conditions in the Subbasin and monitor progress toward achieving sustainable conditions. Monitoring protocols are provided, in detail, and that when followed, will ensure accurate and repeatable measurements.

The following sections provide a description of the 1) entire monitoring network, 2) selected representative monitoring well network along with its justification, and 3) frequency of measurement for each of the sustainability indicators.

7.2 Monitoring Network

The groundwater level monitoring network has changed over the years with a reduction in the number of production wells used for monitoring and movement towards dedicated monitoring wells.

The Subbasin has about 160 wells that are currently used to monitor groundwater levels, and most have known well construction details or at least the total constructed depth. **Table 7-1** summarizes the types of wells. Most of the 160 wells are dedicated monitoring wells. The locations of these wells are shown on **Figure 7-1.** There are over 100 nested and clustered monitoring wells that can be used to assess vertical groundwater gradients. These nested and clustered wells are located at over 30 sites distributed throughout the Subbasin and have been assigned a single map number to simplify the plotting of wells (**Figure 7-1** and subsequent figures). **Table 7-2** contains monitoring well attributes, well type, monitoring frequency, and other pertinent details. The table also lists wells currently being monitored and those that are no longer being monitored or are not recommended for monitoring. The monitoring well network is sufficient to monitor and demonstrate groundwater occurrence and flow directions, both horizontal and vertical gradients, and water table levels near surface water.

There are over 80 wells are constructed to shallow depths that are suitable to monitor unconfined groundwater conditions and can be used to evaluate surface water depletion, and groundwater levels near GDEs and domestic wells.

Table 7-1. Summary of Groundwater Level Well Types

Groundwater Level Types of Wells [1]	Number of Wells
Observation (dedicated monitoring wells)	125
Residential	14
Irrigation	20
Additional Information	**Number of Wells**
Nested or Clustered Monitoring Wells (at 33 sites) [2]	101
Wells with Unknow Construction Details [3]	5
Number of Shallow Wells (<200 feet) [4]	80

Notes: 1 = Only wells actively monitored
2 = Part of observation wells listed above
3 = Part of residential or irrigation wells listed above
4 = Extracted from monitoring, residential, and irrigation wells listed above

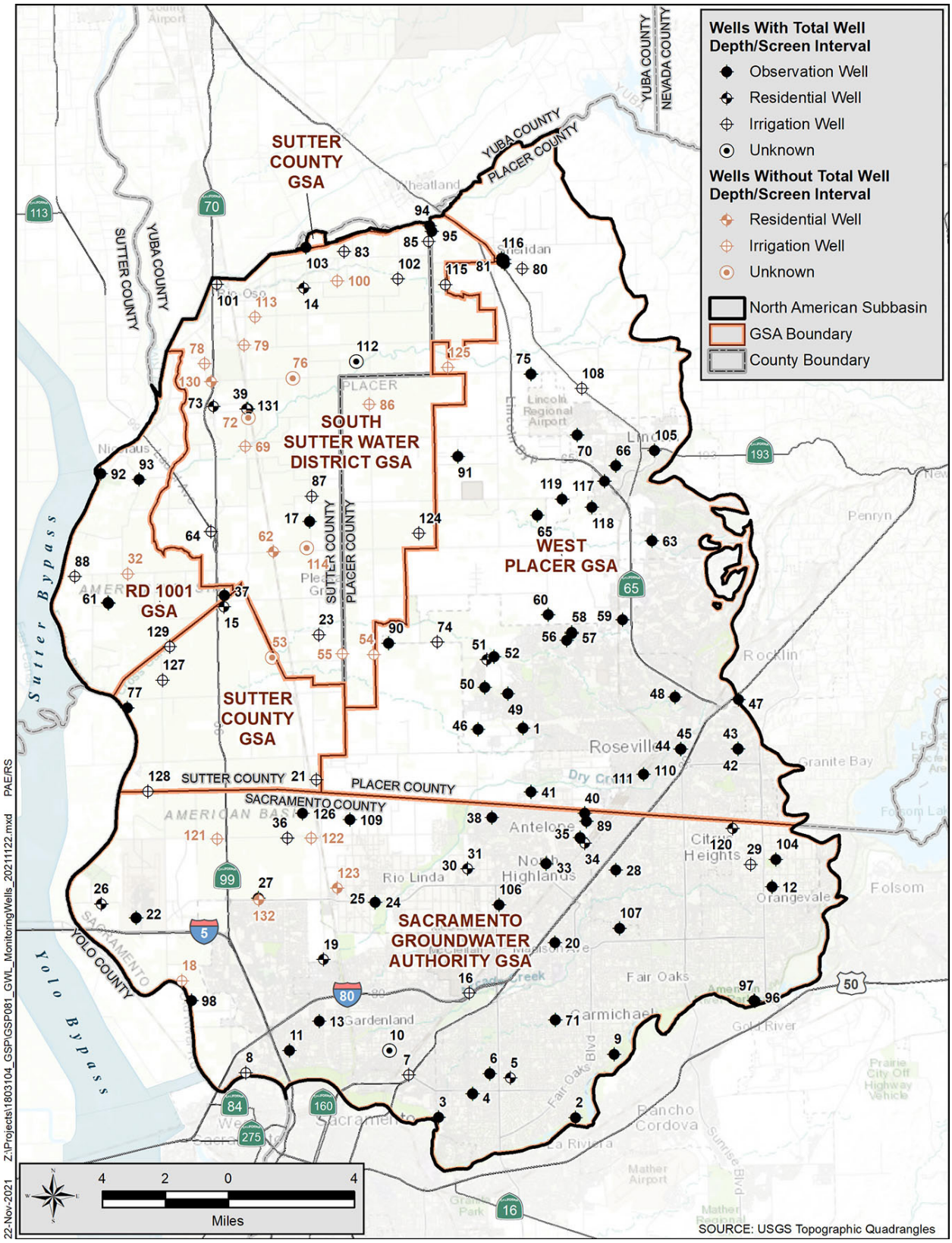


Figure 7-1. Groundwater Level Monitoring Network Wells

Table 7-2. Groundwater Level Monitoring Well Types and Distribution

Map No.	CASGEM ID	Local Name	State Well Numb	Latitud	Longitud	Reference Point Elevation (ft	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Ty	Frequency of Monitorin
1	387626N1213651W001	SVMW East-2A		38.76263	-121.3651	126.02	125-135	140	M	Monthly
1	381626N1213651W001	SVMW East-2B		38.76263	-121.3651	125.83	510-520	525	M	Monthly
1	387626N1213651W002	SVMW East-2C		38.76263	-121.3651	125.75	655-665	670	M	Monthly
2	385828N1213385W001	SGA_MW06		38.58281	-121.33846	49.49	62-72	72	M	Monthly
3	385841N1214185W001	SGA_MW04		38.58414	-121.41852	38.69	55-65	65	M	Monthly
4	385947N1213985W001	MW12A		38.59472	-121.39847	41.8	200-280	285	M	Monthly
4	385947N1213985W002	MW12B		38.59472	-121.39847	41.84	360-380	385	M	Monthly
4	385947N1213985W003	MW12C		38.59472	-121.39847	41.82	590-610	615	M	Monthly
4	385947N1213985W004	MW12D		38.59472	-121.39847	41.82	810-840	845	M	Monthly
4	385947N1213985W005	MW12E		38.59472	-121.39847	41.77	960-1000	1005	M	Monthly
5	386016N1213761W001	DWR_SGA_004	09N05E25J001M	38.6016	-121.3761	66.7	Unknown	238	R	Monthly
6	386038N1213882W001	MW11A		38.6038	-121.38815	59.45	167-177	187	M	Monthly
6	386038N1213882W002	MW11B		38.6038	-121.38815	59.41	258-268	278	M	Monthly
6	386038N1213882W003	MW11C		38.6038	-121.38815	59.25	332-365	375	M	Monthly
7	386038N1214357W001	DWR_SGA_005	09N05E28K001M	38.6038	-121.4357	36.84	Unknown	250	I	
8	386061N1215313W001	SCWA_SGA_003	09N04E27F001M	38.6061	-121.5313	27.04	Unknown	320	I	Monthly
9	386117N1213150W001	SCWA_SGA_004	09N06E27D001M	38.6117	-121.315	73.5	Unknown	200	M	Monthly
10	386151N1214467W001	DWR_SGA_003	09N05E21M001M	38.6151	-121.4467	37.14	Unknown	89	U	
11	386160N1215054W001	Bannon Creek Park	09N04E23R002M	38.61603	-121.5054	13.76	33-48	48	M	Monthly
12	386874N1212206W001	SGA_MW09		38.68739	-121.22058	231.27	150-160	160	M	Monthly
13	386292N1214877W001	Chuckwagon Park	09N04E13R001M	38.62921	-121.4877	11.71	27-37	52	M	Monthly
14	389669N1214897W001	13N04E23A002M	13N04E23A002M	38.9669	-121.4897	59.28	56-83	83	R	Monthly
15	388208N1215397W001	11N04E09D002M	11N04E09D002M	38.8208	-121.5397	30.87	Unknown	100	R	
16	386410N1213995W001	DWR_SGA_002	09N05E14B001M	38.641	-121.3995	68.53	Unknown	550	I	Monthly
17	388593N1214885W003	AB-2 shallow	12N04E26J004M	38.8593	-121.4885	52.76	135-145	155	M	Continuous
17	388593N1214885W001	AB-2 deep	12N04E26J002M	38.8593	-121.4885	52.3	670-690	700	M	Continuous
17	388593N1214885W002	AB-2 middle	12N04E26J003M	38.8593	-121.4885	52.63	380-490	500	M	Continuous
18	386489N1215679W001	SCWA_SGA_002	09N04E08L001M	38.6489	-121.5679	27.51	Unknown	Unknown	I	Monthly
19	386576N1214846W001	SCWA_SGA_001	09N04E01R001M	38.6576	-121.4846	22.72	Unknown	17	R	Monthly
20	386635N1213486W001	SGA_MW05		38.66347	-121.34859	121.87	205-215	215	M	Monthly
21	387404N1214870W001		10N04E12A001M	38.7404	-121.487	45.54	Unknown	290	I	Semi-Ann
22	386782N1215943W004	AB-4 shallow	10N04E31M004M	38.6782	-121.5943	18.53	170-190	200	M	Continuous
22	386782N1215943W001	AB-4 deep	10N04E31M001M	38.6782	-121.5943	19.28	1060-1070	1080	M	Continuous
22	386782N1215943W002	AB-4 middle-deep	10N04E31M002M	38.6782	-121.5943	17.51	795-805	815	M	Continuous
22	386782N1215943W003	AB-4 middle-shallow	10N04E31M003M	38.6782	-121.5943	17.98	380-400	410	M	Continuous
23	388072N1214842W001		11N04E13D001M	38.8072	-121.4842	49.96	Unknown	535	I	Semi-Ann
24	386836N1214536W001	SGA_MW02		38.68362	-121.45363	52.39	100-110	110	M	Monthly
25	386836N1214536W002	SGA_MW03		38.68356	-121.45362	51.82	285-305	305	M	Monthly
26	386848N1216146W001	SCWA_SGA_005	10N03E35A001M	38.6848	-121.6146	23.09	Unknown	96	R	Monthly
27	386864N1215222W003	AB-3 shallow	10N04E27R004M	38.6864	-121.5222	28.31	190-210	220	M	Continuous
27	386864N1215222W001	AB-3 deep	10N04E27R002M	38.6864	-121.5222	27.84	745-995	995	M	Continuous
27	386864N1215222W002	AB-3 middle	10N04E27R003M	38.6864	-121.5222	28.09	470-500	500	M	Continuous
28	386964N1213120W001	Twin Creeks Park	10N06E27F001M	38.6964	-121.31203	121.8	183-193	193	M	Monthly
29	386979N1212329W001	SCWA_SGA_012	10N07E29G001M	38.6979	-121.2329	219.57	150-240	240	I	Monthly
30	386982N1213992W001	SCWA_SGA_008	10N05E14Q002M	38.6982	-121.3992	88.51	116-227	227	R	Monthly
31	386982N1213992W002	SCWA_SGA_009	10N05E26B002M	38.6982	-121.3992	83.81	Unknown	150	R	Monthly
32	388361N1215959W001	MLF Well #1	11N03E01D001M	38.83664	-121.59591	24.45	Unknown	Unknown	I	Monthly
33	387000N1213529W001	Monument (A)		38.70005	-121.35288	173.39	226-274	274	M	
33	387000N1213529W002	Monument (B)		38.70005	-121.35288	173.26	324-334	334	M	
33	387000N1213529W003	Monument (C)		38.70005	-121.35288	173.26	380-450	450	M	
33	387000N1213529W004	Monument (D)		38.70005	-121.35288	173.24	498-544	544	M	
34	387092N1213300W001	SCWA_SGA_010	10N06E21F002M	38.7092	-121.33	161.51	Unknown	144	R	Monthly
35	387117N1213327W001	Poker (A)		38.71174	-121.33271	151.74	104-124	134	M	
35	387117N1213327W002	Poker (B)		38.71174	-121.33271	151.77	156-166	176	M	
35	387117N1213327W003	Poker (C)		38.71174	-121.33271	151.76	274-310	320	M	
35	387117N1213327W004	Poker (D)		38.71174	-121.33271	151.75	370-460	470	M	
36	387138N1215047W001	SCWA_SGA_006	10N04E23A001M	38.7138	-121.5047	17.97	Unknown	85	I	Monthly
37	388260N1215394W004	SUT-P1	11N04E04N004M	38.826	-121.5394	32.31	110-120	120	M	Continuous
37	388260N1215394W001	SUT-P4	11N04E04N001M	38.826	-121.5394	31.81	880-890	890	M	Continuous
37	388260N1215394W002	SUT-P3	11N04E04N002M	38.826	-121.5394	31.95	295-305	305	M	Continuous
37	388260N1215394W003	SUT-P2	11N04E04N003M	38.826	-121.5394	32.13	185-195	195	M	Continuous
38	387216N1213842W001	Lone Oak Park	10N05E13F001M	38.72163	-121.38417	105.77	151-161	166	M	Monthly
39	389116N1215238W003	AB-1 shallow	12N04E03N004M	38.9116	-121.5238	50.58	170-180	190	M	Continuous
39	389116N1215238W001	AB-1 deep	12N04E03N001M	38.9116	-121.5238	49.83	950-970	980	M	Continuous
39	389116N1215238W002	AB-1 middle-deep	12N04E03N002M	38.9116	-121.5238	50.23	680-700	710	M	Continuous
39	389117N1215238W001	AB-1 middle-shallow	12N04E03N003M	38.9116	-121.5238	50.37	390-520	530	M	Continuous
40	387228N1213298W001	Antelope North (A)		38.7228	-121.32976	133.68	253-273	283	M	
40	387228N1213298W002	Antelope North (B)		38.7228	-121.32976	133.71	328-468	473	M	
41	387331N1213610W001	WPMW-5A		38.73311	-121.36099	100.42	80-100	100	O	Continuous
41	387331N1213610W002	WPMW-5B		38.73311	-121.36099	100.35	630-650	650	O	Continuous
42	387510N1212390W001	WPMW-8A		38.75099	-121.23895	234.17	30-50	50	O	Continuous
42	387510N1212390W002	WPMW-8B		38.75099	-121.23895	234.09	95-115	115	O	Continuous
43	387512N1212390W001	WPMW-7A		38.75119	-121.239	225.97	35-45	45	O	Continuous
44	387515N1212725W001	WPMW-10A		38.75149	-121.27251	153.21	26-36	36	O	Continuous
44	387515N1212725W002	WPMW-10B		38.75149	-121.27251	153.18	80-100	100	O	Continuous

Map N	CASGEM ID	Local Name	State Well Numb	Latitud	Longitud	Reference Point Elevation (ft	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Ty	Frequency of Monitorin
44	387515N1212725W003	WPMW-10C		38.75149	-121.27251	153.12	240-260	260	O	Continuous
45	387517N1212727W001	WPMW-9A		38.75167	-121.27266	154.66	26-36	36	O	Continuous
46	387623N1213915W001	SVMW West - 1A		38.76232	-121.39153	94.25	120-140	145	O	Monthly
46	387623N1213915W002	SVMW West - 1B		38.76233	-121.39153	94.17	535-555	560	O	Monthly
46	387623N1213915W003	SVMW West - 1C		38.76233	-121.39153	94.05	725-745	750	O	Monthly
47	387739N1212382W001	WPMW-6A		38.7739	-121.23818	207.61	35-65	65	O	Continuous
48	387755N1212753W001	WPMW-4A		38.77554	-121.27525	181.67	120-140	145	O	Monthly
48	387755N1212753W002	WPMW-4B		38.77554	-121.27526	181.52	275-295	300	O	Monthly
49	387786N1213737W002	WPMW-1B	11N05E25	38.7786	-121.3737	107.31	460-480	480	O	Monthly
49	387786N1213737W001	WPMW-1A		38.7786	-121.3737	107.83	110-120	120	O	Monthly
49	387786N1213737W003	WPMW-1C		38.7786	-121.3737	106.75	535-545	545	O	Monthly
50	387816N1213870W001	W-77MW-A		38.78158	-121.38702	97.2	486-506	516	O	Monthly
50	387816N1213870W002	W-77MW-B		38.78158	-121.38702	97.2	584-594	604	O	Monthly
51	387943N1213856W001	O'Brien well	11N05E23B001M	38.7943	-121.3856	90.86	Unknown	195	R	
52	387957N1213813W001	CVMW-1A		38.79566	-121.38126	87.11	260-280	285	O	Monthly
52	387957N1213813W002	CVMW-1B		38.79565	-121.38126	86.95	460-490	495	O	Monthly
52	387957N1213813W003	CVMW-1C		38.79566	-121.38126	86.84	565-585	590	O	Monthly
53	387971N1215119W001		11N04E15Q001M	38.7971	-121.5119	35.98	Unknown	Unknown	U	
54	387977N1214521W001		11N05E18R001M	38.7977	-121.4521	64.37	Unknown	Unknown	I	
55	387982N1214704W001		11N04E13R001M	38.7982	-121.4704	53.37	Unknown	Unknown	I	
56	388027N1213384W001	DCMW-3		38.80271	-121.33843	99.82	400-515	520	O	Monthly
57	388058N1213355W001	DCMW-1		38.80576	-121.3355	119.94	320-450	455	O	Monthly
58	388063N1213354W001	DCMW-2		38.80629	-121.33542	120.22	322-432	437	O	Monthly
59	388116N1213054W001	Tinker MW		38.81159	-121.30539	132.2	117-177	177	O	Monthly
60	388145N1213491W001	WPMW-2A		38.8145	-121.34914	108.2	215-225	230	O	Monthly
60	388145N1213491W002	WPMW-2B		38.8145	-121.34914	108.09	400-420	425	O	Monthly
61	388235N1216079W001	Sutter County MW-5A	11N03E02Q002M	38.82324	-121.60763	26.45	130-160	170	O	Continuous
61	388235N1216079W002	Sutter County MW-5B	11N03E02Q003M	38.82324	-121.60763	26.28	655-675	675	O	Continuous
61	388235N1216079W003	Sutter County MW-5C	11N03E02Q004M	38.82324	-121.60763	26.22	910-920	930	O	Continuous
61	388235N1216079W004	Sutter County MW-5D	11N03E02Q005M	38.8235	-121.6079	26.12	1205-1215	1225	O	Continuous
62	388458N1215100W001		12N04E34H001M	38.8458	-121.51	42.83	Unknown	Unknown	R	
63	388476N1212872W001	WPMW-3A		38.84761	-121.28719	150.95	48-53	53	O	Monthly
63	388476N1212872W002	WPMW-3B		38.84761	-121.28719	150.34	130-140	140	O	Monthly
64	388555N1215468W001		12N04E29J001M	38.8555	-121.5468	34.84	Unknown	285	I	
65	388604N1213544W003	MW 1-3		38.86038	-121.35438	113.81	184-204	204	O	Monthly
65	388604N1213544W001	MW 1-1		38.86038	-121.35438	113.6	378-398	398	O	Monthly
65	388604N1213544W002	MW 1-2		38.86038	-121.35438	113.76	298-318	318	O	Monthly
65	388604N1213544W004	MW 1-4		38.86038	-121.35438	113.61	82-92	92	O	Monthly
66	388826N1213078W001	MW 5-1		38.88258	-121.30775	148.7	80-100	100	O	Monthly
66	388826N1213078W002	MW 5-2		38.88258	-121.30775	148.65	52-62	62	O	Monthly
69	388944N1215257W001		12N04E16A004M	38.8944	-121.5257	42.82	Unknown	Unknown	I	
70	388971N1213301W001	MW 3-1		38.89713	-121.33008	130.5	118-133	133	O	Monthly
70	388971N1213301W002	MW 3-2		38.89713	-121.33008	130.5	65-75	75	O	Monthly
71	386280N1213493W001	WCMSS		38.62799	-121.34925	90.74	130-150	170	O	Monthly
71	386280N1213493W002	WCMSM		38.62799	-121.34925	90.53	230-270	290	O	Monthly
71	386280N1213493W003	WCMSD		38.62799	-121.34925	90.23	490-510	530	O	Monthly
72	389075N1215237W001		12N04E10D002M	38.9075	-121.5237	51.32	Unknown	Unknown	U	
73	389130N1215441W001		12N04E05R004M	38.913	-121.5441	44.32	Unknown	90	R	Semi-Ann
74	388029N1214145W001		11N05E16H001M	38.8029	-121.4145	90.36	135-460	460	I	Semi-Ann
75	389255N1213566W003	MW 2-3		38.92547	-121.35663	127.67	75-85	85	O	Monthly
75	389255N1213566W002	MW 2-2		38.92547	-121.35663	127.67	160-170	170	O	Monthly
75	389255N1213566W001	MW 2-1		38.92547	-121.35663	127.7	290-310	310	O	Monthly
76	389255N1214969W001		13N04E35Q002M	38.9255	-121.4969	57.9	Unknown	Unknown	U	
77		SREL-1-27-F1		38.77491	-121.59754		Unknown	46.32	O	Continuous
78	389328N1215489W001		13N04E32G001M	38.9328	-121.5489	48.32	Unknown	Unknown	I	
79	389410N1215254W001		13N04E28R001M	38.941	-121.5254	51.31	Unknown	Unknown	I	
80	389740N1213606W001	Cemetery		38.97403	-121.36062	135.28	70-111	111	I	Monthly
81	387432N1215588W001	MW 1		38.97846	-121.37132	109.71	30-40	40	O	Monthly
81	389764N1213710W001	MW-2		38.97643	-121.371	113.69	24.3-44.3	45	O	Monthly
81	389774N1213728W001	MW-3		38.97741	-121.37284	103.41	19.5-34.5	35	O	Monthly
82	387222N1212920W001	Whyte A		38.722168	-121.29196	167.31	200-220	226	O	Monthly
82	387222N1212920W002	Whyte B		38.722168	-121.29196	167.35	280-300	306	O	Monthly
83	389834N1214655W001	South Sutter WD	13N05E18C001M	38.9834	-121.4655	71.85	Unknown	210	I	Semi-Ann
84	389867N1213654W002	Spencer (SVWQC00008)		38.986724	-121.36542	134.5	96-107	107	R	Monthly
85	389873N1214156W001	13N05E09R001M	13N05E09R001M	38.9873	-121.4156	86	Unknown	150	I	Semi-Ann
86	389128N1214522W001		12N05E06R001M	38.9128	-121.4522	71.3	Unknown	Unknown	I	
87	388710N1214870W001		12N04E24M002M	38.871	-121.487	54.32	Unknown	340	I	Semi-Ann
88	388357N1216273W001		11N03E03C002M	38.8357	-121.6273	28.79	Unknown	97	I	Semi-Ann
89		Roseview Park - 315		38.71912	-121.32879	156.84	295-305	315	O	Monthly
89		Roseview Park - 370		38.71912	-121.32879		350-360	370	O	Monthly
89		Roseview Park - 465		38.71912	-121.32879	156.76	445-455	465	O	Monthly
90	388026N1214432W002	WPMW-12A	11N05E17	38.80264	-121.44322	69.62	260-280	300	O	Continuous
90	388026N1214432W004	WPMW-12B	11N05E17	38.80264	-121.44322	69.57	508-528	550	O	Continuous
91	388882N1214005W002	WPMW-11A	12N05E15	38.88816	-121.40046	92.07	132-152	162	O	Continuous
91	388882N1214005W004	WPMW-11B		38.88816	-121.40046	91.7	264-304	309	O	Continuous
92		RDMW-101		38.88294	-121.61105	30.18	28-43	48	O	Continuous

Map No.	CASGEM ID	Local Name	State Well Number	Latitude	Longitude	Reference Point Elevation (ft)	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Frequency of Monitoring
92		RDMW-101		38.88294	-121.61105	30.18	28-43	48	O	Continuous
93		RDMW-102		38.87987	-121.58853	30.47	28-43	48	O	Continuous
94	389950N1214148W002	RDMW-103	13N05E10	38.99461	-121.41479	89.38	28-43	48	O	Continuous
95	389919N1214141W002	RDMW-104	13N05E10	38.99195	-121.4135	87.68	28-43	48	O	Continuous
96		1516		38.63487	-121.23192	88.38	13-33	40	O	Continuous
97		1518		38.63513	-121.23231	130.71	55-75	80	O	Continuous
98		URS71000-700+00C		38.6397	-121.56244	41.7	Unknown	45.24	O	Continuous
99		URS71000-700+00F		38.63954	-121.56154	24.2	Unknown	45.14	O	
100		13N04E13R001M	13N04E13R001M	38.97	-121.4697	71.57	Unknown	Unknown	I	
101		13N04E16N001M	13N04E16N001M	38.9692	-121.5408		Unknown	500	I	Semi-Ann
102	389704N1214340W001	13N05E17R001M	13N05E17R001M	38.9704	-121.434		Unknown	480	I	Semi-Ann
103	389857N1214880W001	BR-1B	13N04E11R002M	38.9857	-121.488		78-98	98	O	Continuous
103	389857N1214880W004	BR-1A	13N04E11R005M	38.9857	-121.488		28-48	48	O	Continuous
103	389857N1214880W002	BR-1C	13N04E11R003M	38.9857	-121.488		215-245	245	O	Continuous
103	389857N1214880W003	BR-1D	13N04E11R004M	38.9857	-121.488		320-331	331	O	Continuous
104	387000N1212180W001	SGA_MW08		38.69998	-121.21795	218.06	130-140	140	O	Monthly
105	388893N1212847W001	MW 4		38.88928	-121.28468	183.87	15-25	25	O	Monthly
106	386814N1213809W001	MW-15	09N06E06A001M	38.68144	-121.38093		205-481	486	O	Monthly
107	386697N1213106W001	MW-N28	09N06E03C001M	38.66967	-121.31058		170-452	454	O	Monthly
108	389185N1213268W001	Swainson		38.91846	-121.32684	140.65	44.1-91.9	92	I	Monthly
109	387218N1214677W001	SGA_MW01		38.72178	-121.46771	47.59	100-110	110	O	Monthly
110		Dpool A		38.74034	-121.29462		190-210	245	O	Monthly
111		Dpool B		38.74034	-121.29462		310-330	336	O	Monthly
112	389327N1214594W001		13N05E31K001M	38.9327	-121.4594	70.29	Unknown	393	U	
113	389539N1215186W001		13N04E27C003M	38.9539	-121.5186	54.47	Unknown	Unknown	I	
114	388473N1214905W001	12N04E35H001M	12N04E35H001M	38.8473	-121.4905	50.73	Unknown	Unknown	U	
115	389674N1214063W001		13N05E22C003M	38.9674	-121.4063		Unknown	400	I	
116	389791N1213727W001	Old Well #2	13N05E13D003M	38.97913	-121.37269	107	144-209	209	O	Monthly
117	388755N1213144W001	SLC-1		38.87548	-121.3144	145	142-249	249	O	Monthly
118	388637N1213222W001	SLC-2		38.86373	-121.32218	126.47	144-293	293	O	Monthly
119	388677N1213397W001	SLC-3		38.86768	-121.33973	117.98	132-311	311	O	Monthly
120	387141N1212431W001	SCWA_SGA_011	10N07E20D001M	38.71469	-121.2431	207.57	Unknown	185	R	Monthly
121	387139N1215459W001	10N04E21B002M	10N04E21B002M	38.7139	-121.5459	18.97	Unknown	Unknown	I	Semi-Ann
122	387137N1214906W001	SCWA_SGA_007	10N04E24B001M	38.7137	-121.4906	30.17	Unknown	Unknown	I	Monthly
123	386904N1214757W001	10N05E30L001M	10N05E30L001M	38.6904	-121.4757	38.99	Unknown	Unknown	R	Semi-Ann
124	388531N1214244W001		12N05E33C001M	38.8531	-121.4244	69.33	Unknown	610	I	
125	389292N1214056W001	35633	13N05E34P001M	38.9292	-121.4056	89.3	Unknown	Unknown	I	
126	384330121293901		10N04E13F001M	38.72512	-121.49544	22	Unknown	50	O	Monthly
127	387874N1215764W001	Spangler		38.7874	-121.5764	27	150-170	252	I	Monthly
128	387363N1215862W001	TNBC Atkinson		38.73631	-121.5862	31.39	110-288	288	I	Semi-Ann
129	388028N1215720W001	TNBC Lucich North		38.8028	-121.57205	28.91	150-160	226	I	Semi-Ann
129	388028N1215720W001	TNBC Lucich North		38.8028	-121.57205	28.91	150-160	226	I	Semi-Ann

Notes: Wells destroyed, no longer monitored or not recommended for monitoring
O = observation well (dedicated monitoring well)
I = irrigation well
R = residential well
U = unknown

7.3 Representative Monitoring Network

Representative monitoring wells were selected to represent general conditions for areas within the Subbasin for each of the sustainability indicators and where minimum thresholds and measurable objectives will be established. Monitoring will continue at the monitoring network wells for a more thorough analysis of conditions and groundwater contour development. Representative monitoring networks are discussed by sustainability indicators in the following sections along with evidence that the locations reflect general conditions in the areas.

The entire monitoring well network (*refer to* **Figure 7-1**) was evaluated and a subset of the monitoring sites were selected to be representative of the groundwater level conditions in the Subbasin.

Criteria considered for selecting representative monitoring wells included:

- Dedicated monitoring wells were selected over voluntary wells which may be being used for water supply and measurements may be affected by pumping.
- Wells with known construction details or at least the total depth.
- Wells near sensitive beneficial users (e.g., GDEs, domestic wells, and wells in areas solely supplied by groundwater). Protection of these sensitive beneficial users would then be protective of agriculture and municipal beneficial users as their wells are typically deeper.
- Ability to monitor the pumping depression depth and extent.
- Wells that are constructed to similar depths as beneficial users.
- A geographic distribution of monitoring wells over the entire Subbasin.

The selection criteria were used to select a representative monitoring network. **Figure 7-2** illustrates the selected groundwater level representative monitoring wells for chronic lowering of groundwater levels, reduction in groundwater storage and for surface water depletion and their geographic distribution in the Subbasin. Monitoring wells were not selected in the area north or Lincoln and east of Old Highway 65 because this area has perched groundwater resting on top of marine deposits. Table 7-3 provides a list of the representative monitoring wells, their construction details and their purpose for monitoring.

Representative monitoring wells for chronic lowering of groundwater levels were selected based on sensitive beneficial users (GDEs and domestic wells), areas that rely on groundwater and a few supplemental wells to provide complete coverage over the Subbasin. Figures 7-3 through 7-7 illustrate the distribution of the groundwater level representative monitoring wells as they relate to these beneficial users and are discussed in more detail in the following sections.

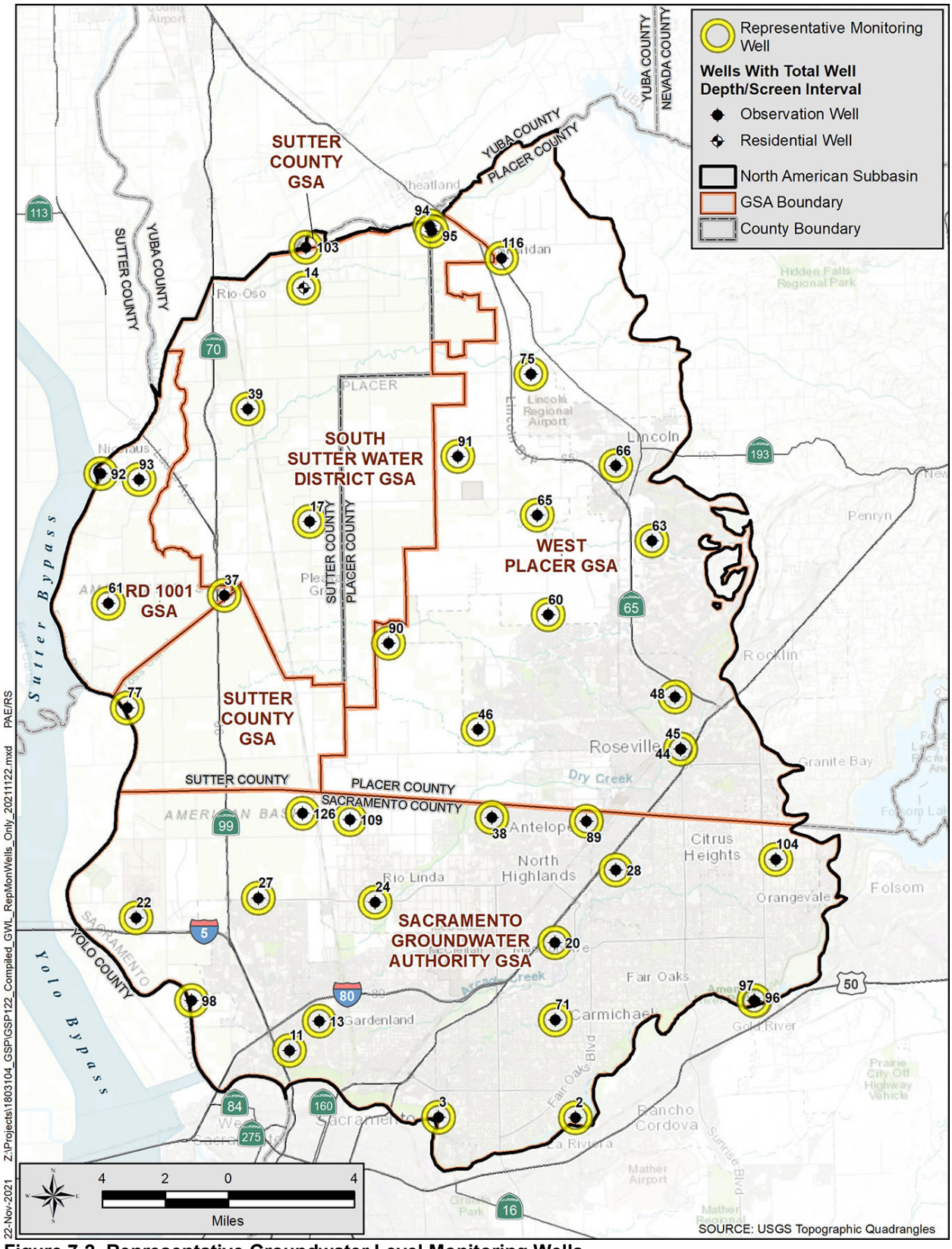


Figure 7-2. Representative Groundwater Level Monitoring Wells

This page left intentionally blank

Table 7-3. Representative Groundwater Level Monitoring Wells

Map No.	CASGEM ID	Local Name	State Well Number	Latitude	Longitude	Reference Point Elevation (ft)	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Frequency of Monitoring	GDE Representative Wells	Domestic Well Density Representative Wells	Areas Solely Reliant on Groundwater Representative Wells	Surface Water Depletion
2	385828N1213385W001	SGA_MW06		38.58281	-121.33846	49.49	62-72	72	O	Monthly		X		X
3	385841N1214185W001	SGA_MW04		38.58414	-121.41852	38.69	55-65	65	O	Daily	X	X		X
11	386160N1215054W001	Bannon Creek Park	09N04E23R002M	38.61603	-121.5054	13.76	33-48	48	O	Monthly	X	X		X
13	386292N1214877W001	Chuckwagon Park	09N04E13R001M	38.62921	-121.4877	11.71	27-37	52	O	Monthly		X		X
14	389669N1214897W001	13N04E23A002M	13N04E23A002M	38.9669	-121.4897	59.28	56-83	83	R	Semi-Annual	X			X
17	388593N1214885W003	AB-2 shallow	12N04E26J004M	38.8593	-121.4885	52.76	135-145	155	O	Daily		X		
20	386635N1213486W001	SGA_MW05		38.66347	-121.34859	121.87	205-215	215	O	Semi-Annual		X		
22	386782N1215943W004	AB-4 shallow	10N04E31M004M	38.6782	-121.5943	18.53	170-190	200	O	Daily	X	X		X
24	386836N1214536W001	SGA_MW02		38.68362	-121.45363	52.39	100-110	110	O	Monthly		X	X	
27	386864N1215222W003	AB-3 shallow	10N04E27R004M	38.6864	-121.5222	28.31	190-210	220	O	Daily				X
28	386964N1213120W001	Twin Creeks Park	10N06E27F001M	38.6964	-121.31203	121.8	183-193	193	O	Monthly		X		
37	388260N1215394W004	SUT-P1	11N04E04N004M	38.826	-121.5394	32.31	110-120	120	O	Daily	X			X
38	387216N1213842W001	Lone Oak Park	10N05E13F001M	38.72163	-121.38417	105.77	151-161	166	O	Monthly		X		
39	389116N1215238W003	AB-1 shallow	12N04E03N004M	38.9116	-121.5238	50.58	170-180	190	O	Daily	X	X	X	X
44	387515N1212725W001	WPMW-10A		38.75149	-121.27251	153.21	26-36	36	O	Daily	X			X
45	387517N1212727W001	WPMW-9A		38.75167	-121.27266	154.66	26-36	36	O	Daily				X
46	387623N1213915W001	SVMW West - 1A		38.76232	-121.39153	94.25	120-140	145	O	Monthly			X	
48	387755N1212753W001	WPMW-4A		38.77554	-121.27525	181.67	120-140	145	O	Monthly	X			
60	388145N1213491W001	WPMW-2A		38.8145	-121.34914	108.2	215-225	230	O	Monthly			X	
61	388235N1216079W001	Sutter County MW-5A	11N03E02Q002M	38.82324	-121.60763	26.45	130-160	170	O	Daily	X			X
63	388476N1212872W001	WPMW-3A		38.84761	-121.28719	150.95	48-53	53	O	Monthly				X
65	388604N1213544W003	MW 1-3		38.86038	-121.35438	113.81	184-204	204	O	Monthly		X	X	
66	388826N1213078W002	MW 5-2		38.88258	-121.30775	148.65	52-62	62	O	Monthly		X		X
71	386280N1213493W001	WCMSS		38.62799	-121.34925	90.74	130-150	170	O	Monthly		X		
75	389255N1213566W003	MW 2-3		38.92547	-121.35663	127.67	75-85	85	O	Monthly			X	X
77		SREL-1-27-F1		38.77491	-121.59754		Unknown	46	O	Daily	X			X
89		Roseview Park - 315		38.71912	-121.32879	156.84	295-305	315	O	Monthly		X		
90	388026N1214432W002	WPMW-12A	11N05E17	38.80264	-121.44322	69.62	260-280	300	O	Daily			X	
91	388882N1214005W002	WPMW-11A	12N05E15	38.88816	-121.40046	92.07	132-152	162	O	Daily		X	X	
92		RDMW-101		38.88294	-121.61105	30.18	28-43	48	O	Daily				X
93		RDMW-102		38.87987	-121.58853	30.47	28-43	48	O	Daily	X			X
94	389950N1214148W002	RDMW-103	13N05E10	38.99461	-121.41479	89.38	28-43	48	O	Daily				X
95	389919N1214141W002	RDMW-104	13N05E10	38.99195	-121.4135	87.68	28-43	48	O	Daily	X			X
96		1516		38.63487	-121.23192	88.38	13-33	40	O	Daily				X
97		1518		38.63513	-121.23231	130.71	55-75	80	O	Daily				X
98		URS71000-700+00C		38.6397	-121.56244	41.7	Unknown	45	O	Daily				X
103	389857N1214880W001	BR-1B	13N04E11R002M	38.9857	-121.488	65.57	78-98	98	O	Daily	X	X		X
104	387000N1212180W001	SGA_MW08		38.69998	-121.21795	218.06	130-140	140	O	Semi-Annual		X		
109	387218N1214677W001	SGA_MW01		38.72178	-121.46771	47.59	100-110	110	O	Semi-Annual		X	X	
116	389791N1213727W001	Old Well #2	13N05E13D003M	38.97913	-121.37269	107	144-209	209	O	Semi-Annual		X	X	
126	384330121293901	10N04E13F001M	10N04E13F001M	38.72512	-121.49544	22	Unknown	50	O	Monthly	X			

Notes: O = Monitoring well
R = Residential well

This page intentionally left blank

7.4 Chronic Lowering of Groundwater Levels

The Subbasin has a long history of groundwater management and has developed an extensive groundwater monitoring network capable of collecting data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the Subbasin and to evaluate changing conditions. Representative wells have been selected to demonstrate groundwater occurrence, flow directions, and hydraulic gradients within the Subbasin.

Declining groundwater levels in the Subbasin have been a concern for local water resource managers for decades. Groundwater levels were dropping on a long-term average of about 3 feet per year for several decades prior to 1980 (refer to Section 5.2 – Groundwater Levels). A cone of depression formed in the center of the Subbasin that, although it is smaller than it once was, it still remains. The current state of this depression is a substantial improvement over the situation in the mid-1990s when the depth to groundwater at the center of the depression was about 20 feet deeper than it is now. This improvement is largely the result of local groundwater management, especially conjunctive use operations. Groundwater levels along the western and eastern portions of the Subbasin have remained stable for nearly 100 years.

Currently, the groundwater depression is being managed to benefit the groundwater cleanup efforts associated with groundwater contamination at the former McClellan AFB. The depression has benefits to water resources management as it can be used to store groundwater (groundwater banking). In general, the remainder of the Subbasin does not show distinctive regional groundwater elevation patterns other than to mimic the local topography. This results in groundwater generally flowing from the edges of the Subbasin from the east and west towards the central groundwater depression.

7.4.1 GDE Representative Monitoring Network

Representative groundwater level monitoring wells were selected to be protective of GDEs. **Section 5.12 – Groundwater Dependent Ecosystems** provide details of the evaluation of the process to refine potential GDEs to those that are likely to be supported by groundwater from the principal aquifer. Since GDEs in the Subbasin typically have shallow rooting depths (less than 30 feet), representative monitoring wells were selected near likely GDEs that monitor water table conditions (wells with depths less than 200 feet). **Figure 7-3** show the locations of likely and less likely GDEs and selected representative shallow monitoring wells in the Subbasin. A 3-mile radius around each well is also shown to approximate a minimum density of about three monitoring wells per 100 square miles, to illustrate whether there is sufficient monitoring coverage. **Table 7-3** provides a list of the representative monitoring wells, their screen intervals, and well depths.

7.4.2 Domestic Well Representative Monitoring Network

Representative groundwater level monitoring wells were also selected to be protective of domestic well owners. Selected representative monitoring wells have similar or shallower depths as the domestic wells and are located near high densities of domestic wells. Representative wells were also selected to provide coverage throughout the Subbasin where lower densities of domestic wells are present. **Figure 7-4** shows the density of the domestic wells in the Subbasin and locations of selected representative monitoring wells. A 3-mile radius around each monitoring well is shown to illustrate the Subbasin has an adequate monitoring network for this beneficial user. Representative monitoring wells listed in **Table 7-3** were selected with similar or shallower depths as the shallowest top of well screens in domestic wells. **Figure 7-5** provides the top of domestic well screen depths and the locations of the representative monitoring wells, which along with **Table 7-3** illustrates the selected monitoring wells are representative for domestic wells.

Figure 7-6 shows domestic well minimum depths (DWR, 2019) in comparison to both agriculture and municipal well depths using DWR's database to illustrate that selection of representative monitoring wells for domestic wells would be protective of municipal and agricultural wells, which are typically deeper than domestic wells.

7.4.3 Groundwater Only Area Representative Monitoring Network

Some portions of the Subbasin rely solely on groundwater as their source of water (**Figure 7-7)**. **Table 7-3** lists these selected representative wells. Representative monitoring wells were selected in these areas to be protective of domestic and irrigation wells owners. The approach to select representative monitoring wells for these areas was the same as used for selection of representative monitoring wells for domestic well owners.

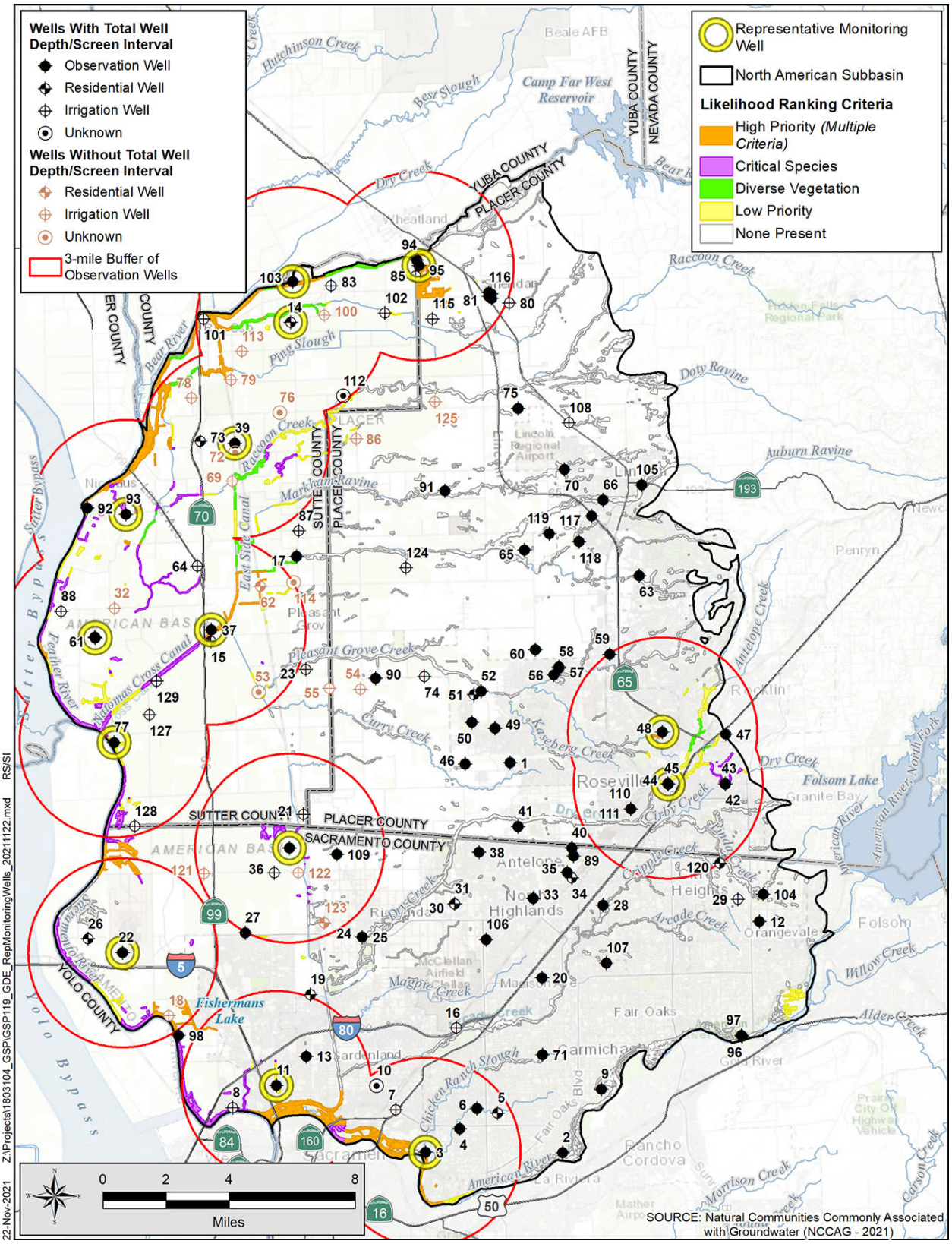


Figure 7-3. Representative Groundwater Level Monitoring Wells for GDEs

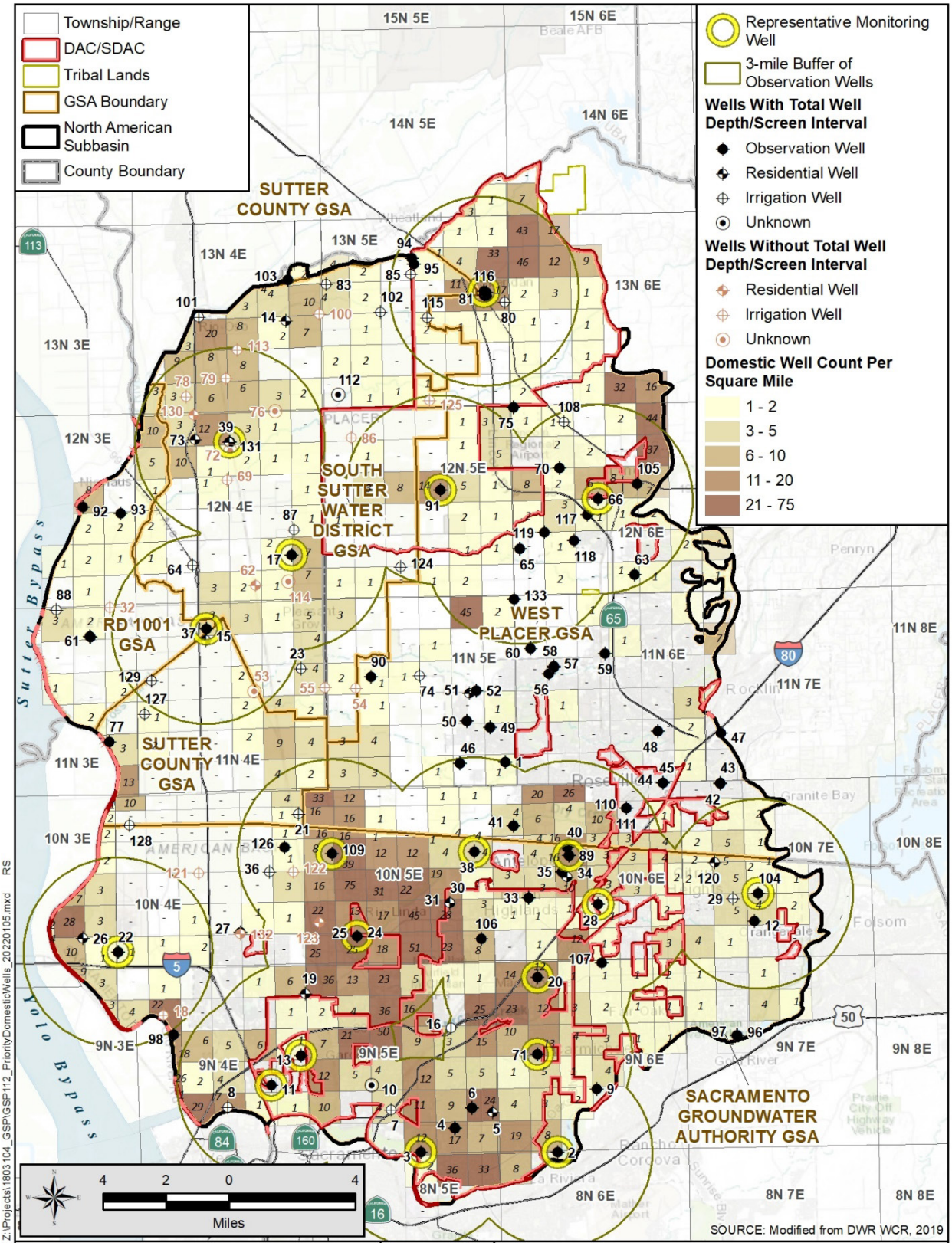


Figure 7-4. Representative Monitoring Wells Selection for Domestic Wells

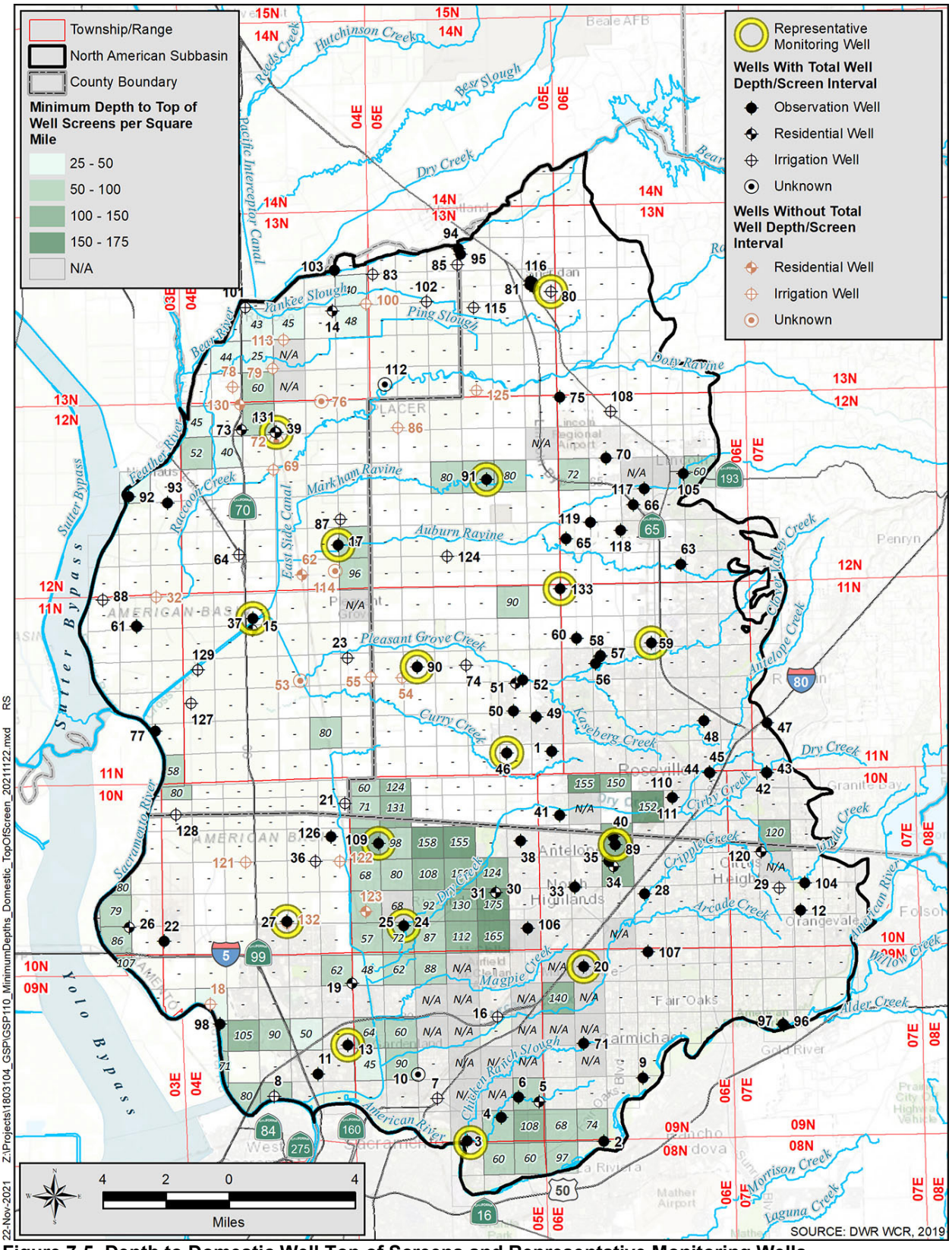


Figure 7-5. Depth to Domestic Well Top of Screens and Representative Monitoring Wells

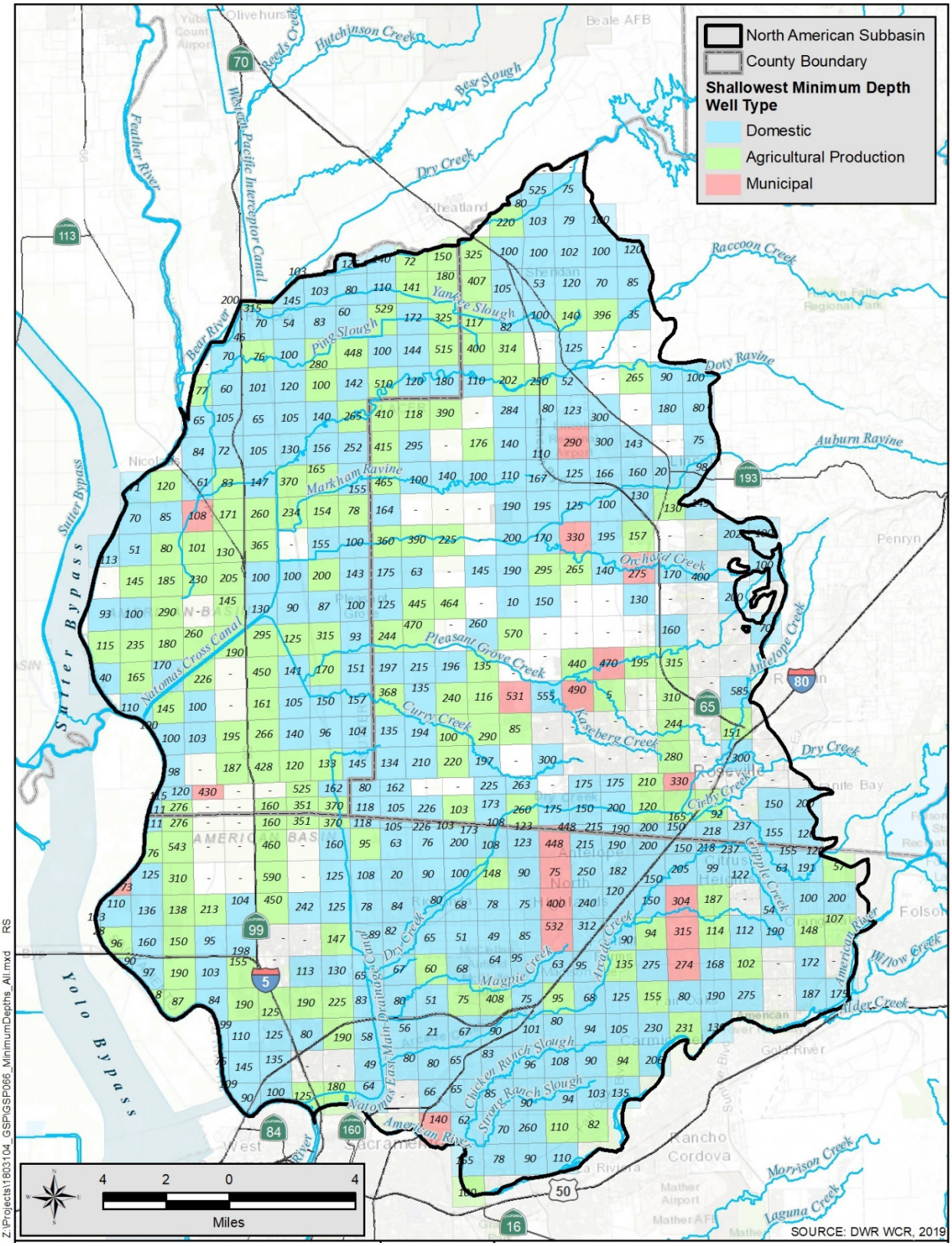


Figure 7-6. Comparison of Domestic Well Minimum Depths to Agricultural and Municipal Well Depths

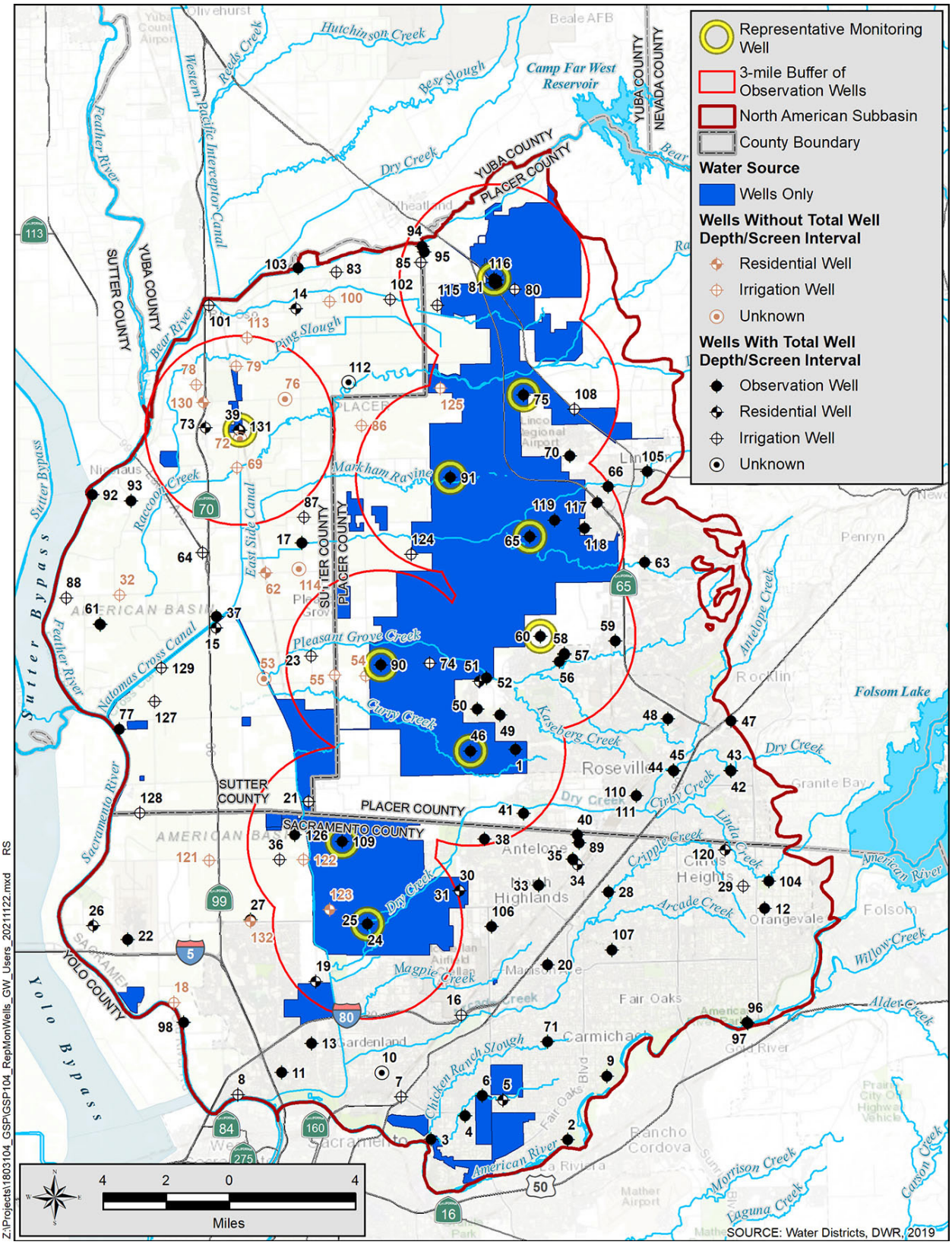


Figure 7-7. Representative Monitoring Wells for Areas Solely Dependent on Groundwater

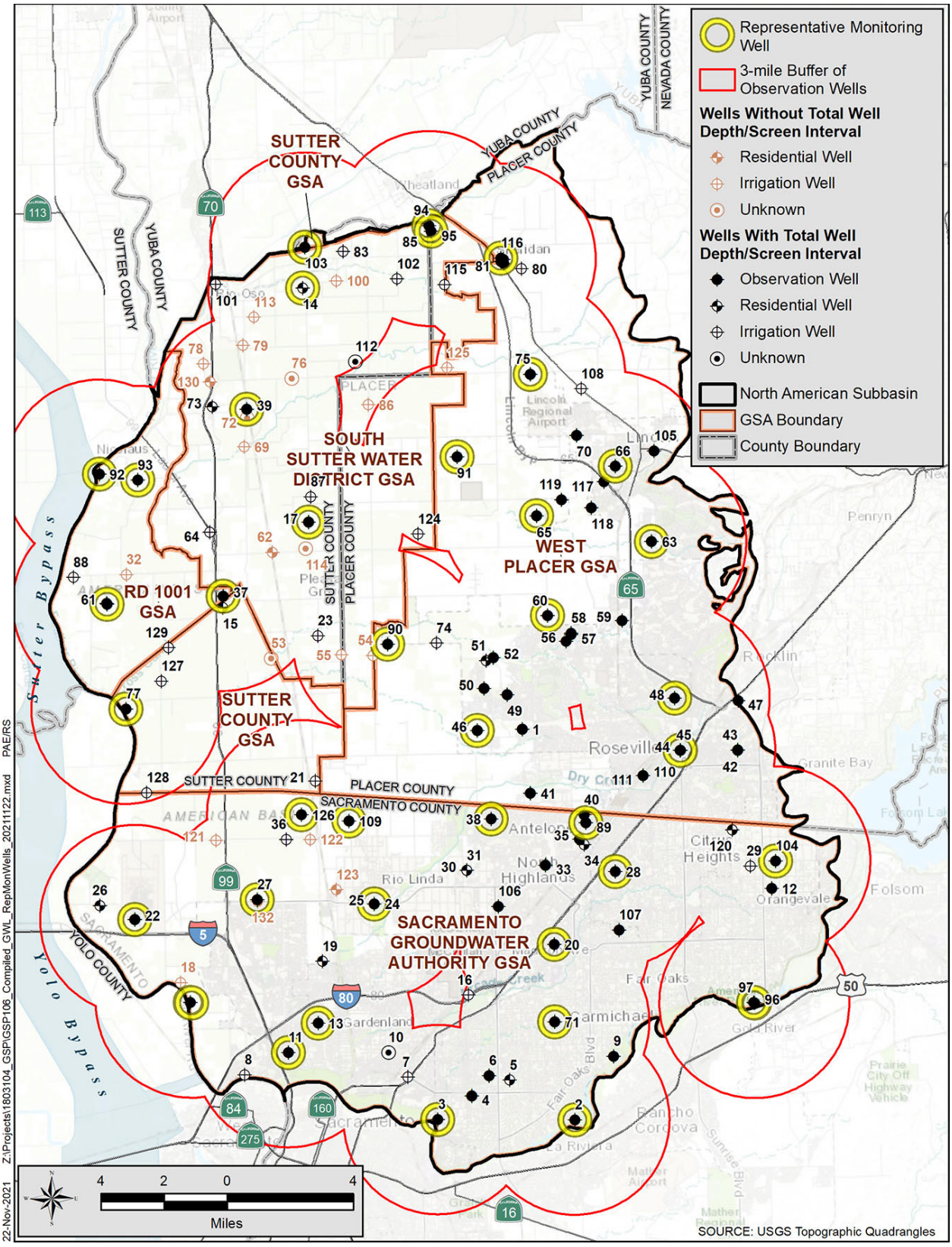


Figure 7-8. Representative Monitoring Wells for Chronic Lowering of Groundwater

7.4.4 Groundwater Level Monitoring Frequency

Frequency of groundwater level monitoring is cited in the Draft Monitoring Networks and Identification of Data Gaps Best Management Practice (DWR, 2016a), which presents guidance on monitoring frequency based on the type of monitoring, aquifer type, confinement, recharge rate, hydraulic conductivity, and withdrawal rate. Historically, DWR has monitored groundwater levels on a semi-annual basis. Because groundwater levels are being used to assess sustainability indicators, more frequent monitoring at some locations is warranted. Sampling frequencies were developed based on this guidance in combination with a consideration of monitoring costs.

Based on the analysis of groundwater level monitoring data in the Subbasin, dating back several decades, the GSA's have determined that semi-annual groundwater level measurements are sufficient to identify groundwater level trends in the Subbasin**.** However, at some representative wells, the frequency of monitoring has been increased to monthly or daily near areas with groundwater dependent ecosystems and surface water depletion to better define seasonal variations. **Table 7-3** provides the monitoring schedule for each representative monitoring well (note that where daily is listed as the frequency the well is equipped with a pressure transducer that can be set at daily or to match the measurement frequency at nearby surface water gaging stations).

Semi-annual groundwater levels will be collected in the Spring and Fall at all wells (*refer to* **Figure 7-2**). In the Spring, groundwater levels are typically higher than any other time of the year and groundwater pumping stresses are usually minimal. The Spring levels are reflective of regional high groundwater levels after recharge to the aquifer from winter rains. Fall measurements are taken after the heaviest pumping has occurred during the summer months and before substantial recharge has occurred from precipitation. The fall measurement is considered to be the regional minimum groundwater level for a given year. The work will be completed during a 2-week window on either side of target dates (April 15 and October 15) to accommodate for inclement weather and scheduling conflicts. This frequency of monitoring is more than sufficient to demonstrate seasonal, short-term (1-5 years), and long-term (5-10 years) trends in groundwater and related surface conditions and yield representative information about groundwater conditions.

Under some conditions, groundwater level measurements may be increased. For example, if agencies are participating in water transfers, groundwater level measurements are required to be collected weekly to monthly, from the beginning of the water transfer pumping until groundwater levels recovered to their seasonal highs the following Spring.

The monitoring frequency at representative monitoring wells have been adjusted to better track the groundwater levels near sensitive beneficial users that may be more effected by short-term groundwater level fluctuations. Wells monitoring more sensitive areas, such as GDE's and surface water interaction areas, have been increased to monthly (when measurements are made

manually) or daily (using pressure transducers) to track groundwater levels that semi-annual monitoring would not capture.

7.4.5 Groundwater Level Monitoring Spatial Density

The Subbasin extends over an area of about 535 square miles (342,000 acres) and supplies about 208,000 acre-feet of groundwater annually for drinking water and irrigation (DWR, BMP 2019). This equates to about 39,000 AFY per 100 square miles.

A groundwater level well monitoring density goal ranges from 0.2 to 10 wells per 100 square miles (DWR, 2016a). The monitoring well density goals can also be based on the amount of groundwater use. For basins were groundwater pumping more than 10,000 AFY per 100 square miles, four wells per 100 square miles is recommended. Professional judgement is also essential to determining an adequate level of monitoring, frequency, and density based on the need to observe aquifer response near high pumping areas, cones of depression, significant recharge areas, and specific projects.

There are 37 representative monitoring wells selected to monitor for chronic lowering of groundwater levels in the Subbasin, equating to a density of about seven wells per 100 square miles. **Figure 7-8** shows the distribution of representative wells in the Subbasin. Of these 37 representative monitoring wells, 16 were selected to monitor areas with GDEs, which are present in about a 200-square-mile area, equating to a density of about eight wells per 100 square miles. The density of these representative monitoring wells exceeds the recommended density goals of four wells per 100 square miles and are therefore sufficient to provide representative groundwater levels throughout the Subbasin to assess groundwater lowering.

7.4.6 Data Gaps

As illustrated on **Figures 7-3 through 7-8**, there is an adequate density of representative monitoring wells in most of the Subbasin. However, two additional dedicated shallow monitoring wells are needed near high priority GDEs close to the Sacramento River (near well 128) and near the junction of the Bear and Feather rivers (near well 78) (*refer to* **Figure 7-3**). Alternatively, surface water observation stations may be established along Ping Slough at road crossings as groundwater and surface water are interconnected in this area. Another data gap area is present near well 112, (*refer to* **Figure 7-8**). A new monitoring well should be constructed in this vicinity.

7.5 Reduction in Groundwater Storage

Change in groundwater storage will use the same wells as designated for the representative groundwater level monitoring network (*refer to* **Section 7.3 – Representative Monitoring Network**), for the chronic lowering of groundwater levels. For decades, DWR has utilized changes in groundwater elevations, along with specific yield, to estimate changes in storage.

The Subbasin will use groundwater levels as a proxy for the change in groundwater storage. Groundwater storage changes will be calculated by evaluating the volumetric difference between changes in groundwater surfaces created based on groundwater level data collected in the Spring of each year.

Because groundwater levels will be used as a proxy for groundwater storage changes, discussions of monitoring frequency and spatial density will be the same as for chronic lowering of groundwater levels (*refer to* **Section 7.4.4 – Groundwater Level Monitoring Frequency** and **Section 7.4.5 – Groundwater Level Monitoring Spatial Density**.

7.6 Seawater Intrusion

As stated previously, in **Section 5.9 – Seawater Intrusion**, the Subbasin is more than 80 miles inland from the Pacific Ocean which precludes the consideration of seawater intrusion as a sustainability indicator. Saline water intrusion into waterways is more than 40 miles south of the Subbasin. Therefore, seawater intrusion is not likely to occur in the vicinity of the Subbasin and a representative monitoring network and monitoring is not required for this sustainability indicator.

7.7 Groundwater Quality

The groundwater quality in the Subbasin is good and meets the needs of urban, municipal, industrial, and agricultural uses based on salinity and nitrate concentrations. The concentrations of salinity and nitrate, for the most part, are below drinking water standards and agricultural water quality objectives. Poorer groundwater quality (higher salinity) has been noted in a few wells:

- In the western portion of the Subbasin, adjacent to the Sacramento and Feather rivers, due to this area historically being a slough and a salt sink or due to migration groundwater from adjacent subbasins
- Along the eastern portion of the Subbasin, near Lincoln, Roseville and Lincoln, due to shallow marine sediments

Between 2013 and 2017, water quality samples were collected by the USGS from 24 domestic wells with screen intervals ranging from 129 to 178 feet below ground surface (bgs). The results showed TDS ranged between 70 and 459 milligrams per liter (mg/L). Nitrate (as nitrogen) ranged between 0.1 and 1.4 mg/L (Bennett, 2019). The concentrations indicate the water is suitable for drinking water with all concentrations below the primary and recommended secondary drinking water standards. However, about 15 percent of the wells had arsenic and manganese above the MCL (Bennett, 2019). The locations and owners of these wells are confidential and cannot be released to the GSAs so they cannot be used as part of the monitoring network.

7.7.1 Monitoring Network

Groundwater quality in the Subbasin is monitored in 247 public water supply wells (PWS) and in one well designated for the ILRP water quality trend monitoring program. Groundwater quality is also monitored by agencies and private entities to assess water quality near areas with releases of contaminants to the environment. Groundwater quality monitoring is also required during water transfers.

An extensive record of water quality data from the PWS wells, dating from as far back as 1964 to the present, is available. Every PWS well is required by the California DDW to collect and analyze water quality samples. However, wells used by the small community systems are only required to collect samples for nitrate, with infrequent electrical conductivity measurements or TDS. A list of the PWS locations and attributes is not provided due to them being critical infrastructure.

As part of ILRP Water Quality Trend monitoring program, the Sacramento Valley Water Quality Coalition, collects samples from one monitoring well to be representative of water quality in the Subbasin. The well is screened in the upper portions of the aquifer to provide a regional representation of groundwater quality within a time frame that enables the evaluation of trends in groundwater quality resulting from the effects of agricultural practices and changes in land use practices. The well is required to be sampled annually for TDS and nitrate. The California Rice Commission has no monitoring wells in the Subbasin.

The USGS, National Water-Quality Assessment Program (NAWQA) has one well (monitoring well number 126) in the Subbasin that was sampled to assess groundwater quality near rice growing areas. This well has historically been sampled 10 times since 1997 and was last sampled in 2017. The next time the well is to be sampled is unknown. As part of the NAWQA, 25 domestic wells were sampled. The USGS attempts to resample wells about once every 5 years dependent upon funding. The USGS does not release domestic well location information to allow sampling of these wells by the GSAs.

As described in **Section 7.2 – Monitoring Network**, dedicated groundwater monitoring wells have been constructed in the Subbasin by the GSAs, DWR, and the USGS. These monitoring wells are used to measure groundwater levels but can be used to collect water quality samples, but at a higher cost as they are not equipped with pumps. The location of these wells is shown on **Figure 7-1**.

Additional dedicated monitoring wells have been constructed by agencies and private entities to assess water quality near areas with releases of contaminants to the environment. These monitoring wells were not considered during preparation of this GSP as water quality from these wells is reported to regulatory agencies who manage investigation and cleanup of groundwater.

There are a couple of areas of poorer quality groundwater with TDS greater than the drinking water MCL of 500 mg/L, in the western and eastern portions of the Subbasin. A groundwater

quality sentry monitoring network was developed using selected groundwater level monitoring wells that are downgradient of these occurrences of poorer quality water. They were selected to assess if the poorer quality groundwater is migrating into the Subbasin and affecting water quality. Some of the sentry wells were also selected to monitor near the base-of-fresh water to assess for the potential upwelling of saline water from underlying marine sediments. These sentry wells are not being designated as representative wells. **Figure 7-9** shows the location of the sentry wells, with several of the wells being nested monitoring wells which can monitor various depths in the aquifer. **Table 7-4** lists the sentry monitoring well construction details. Sentry wells are planned to be sampled once every 2 years, in the fall.

Table 7-4. Sentry Monitoring Wells

Map No.	CASGEM or PWS ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Monitoring Frequency
Monitoring Wells								
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155	O	Biennial
17	388593N1214885W002	AB-2 middle	38.8593	-121.4885	380-490	500	O	Biennial
17	388593N1214885W001	AB-2 deep	38.8593	-121.4885	670-690	700	O	Biennial
27	386864N1215222W002	AB-3 middle	38.6864	-121.5222	470-500	500	O	Biennial
37	388260N1215394W004	SUT-P1	38.826	-121.5394	110-120	120	O	Biennial
37	388260N1215394W003	SUT-P2	38.826	-121.5394	185-195	195	O	Biennial
37	388260N1215394W002	SUT-P3	38.826	-121.5394	295-305	305	O	Biennial
65	388604N1213544W001	MW 1-1	38.86038	-121.35438	378-398	398	O	Biennial
65	388604N1213544W002	MW 1-2	38.86038	-121.35438	298-318	318	O	Biennial
65	388604N1213544W003	MW 1-3	38.86038	-121.35438	184-204	204	O	Biennial
65	388604N1213544W004	MW 1-4	38.86038	-121.35438	82-92	92	O	Biennial
75	389255N1213566W002	MW 2-2	38.92547	-121.35663	160-170	170	O	Biennial
75	389255N1213566W003	MW 2-3	38.92547	-121.35663	75-85	85	O	Biennial
90	388026N1214432W002	WPMW-12A	38.80264	-121.44322	260-280	300	O	Biennial
90	388026N1214432W004	WPMW-12B	38.80264	-121.44322	508-528	550	O	Biennial
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162	O	Biennial
91	388882N1214005W004	WPMW-11B	38.88816	-121.40046	264-304	309	O	Biennial
131		SSWD- supply	38.91158	-121.52438	85-140	140	R	Biennial
132		NCMWC - supply	38.68561	-121.52211	Unknown	Unknown	R	Biennial

Notes: O = Monitoring well
R = Residential well

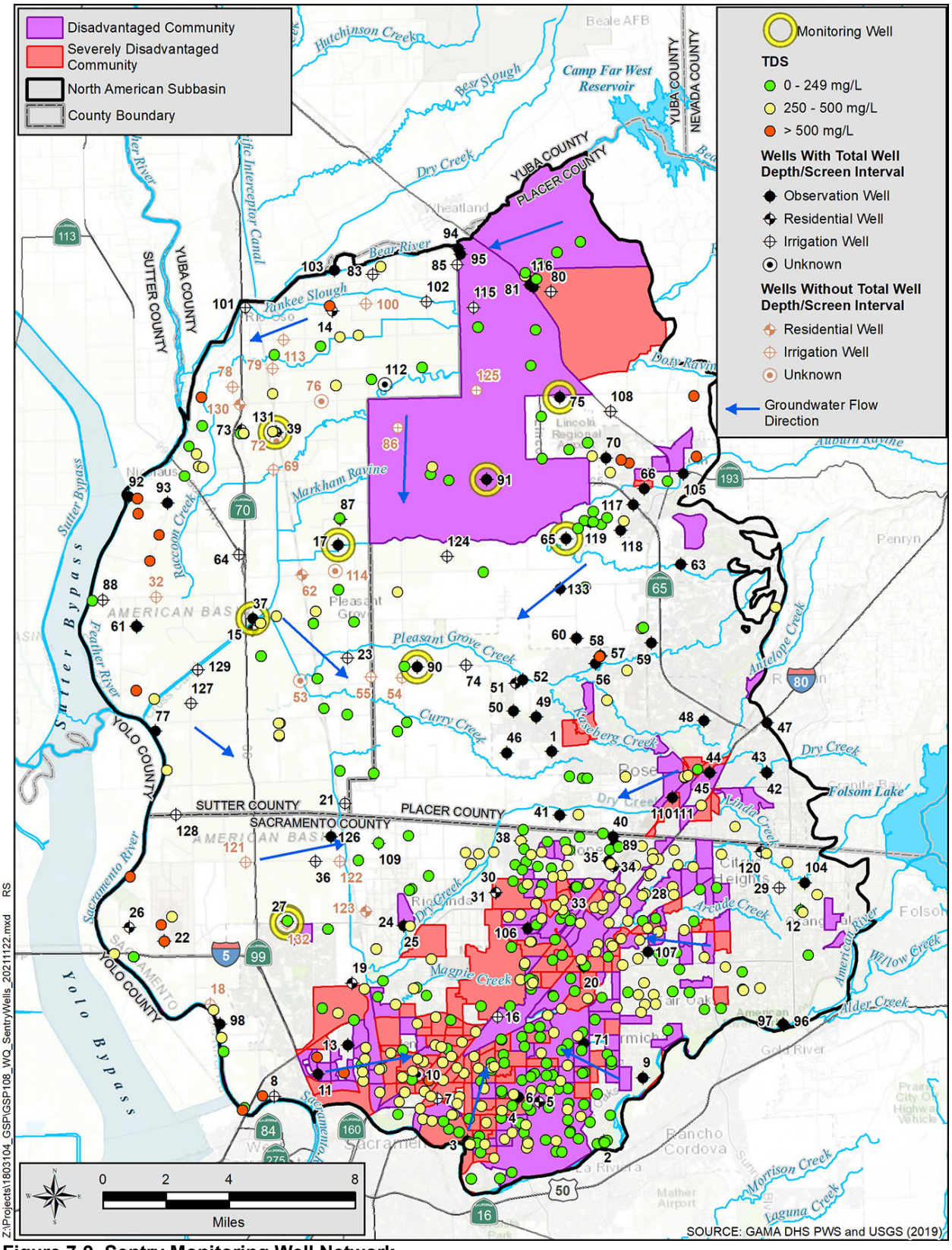


Figure 7-9. Sentry Monitoring Well Network

7.7.2 Representative Monitoring Wells

Representative monitoring wells were selected for groundwater quality degradation in the Subbasin where minimum thresholds and measurable objectives will be established to be protective of domestic, agricultural, and municipal well beneficial users.

The entire groundwater level monitoring well network and PWS wells were evaluated and a subset of the monitoring and PWS wells were selected to be representative of the groundwater quality conditions in the Subbasin.

Criteria used to select the representative monitoring well network for the Subbasin is based on:

- Wells with construction details
- Whether the wells are part of another regulatory program that requires sampling, reducing the overall costs
- The distribution of wells throughout the Subbasin
- Whether they are representative of beneficial users
- Whether the wells are located near or downgradient of known areas of poorer quality groundwater to assess degradation of water quality

Based on these considerations two representative monitoring networks were selected one for the shallow portions of the aquifer and one for the deeper portions of the aquifer.

The shallow portion of the aquifer is used by domestic wells. **Figure 7-10** shows the location of representative monitoring wells selected in relation to areas where high densities of domestic wells are present and for distribution across the entire Subbasin. Monitoring wells and a few shallow PWS wells with well screen intervals at depths at about the average depth of domestic wells (about 175 feet bgs; *refer to* **Appendix B**), were selected to be representative wells for the shallow portion of the aquifer. **Table 7-5** provides the attributes for these shallow aquifer representative wells.

There are 247 PWS wells in the Subbasin and construction details have been acquired for 205 of the wells. The details show that the average well depth is about 420 feet bgs, deeper than the average domestic wells depths. There are some PWS wells, about 20, with known well construction details and up to 42 wells with unknown details, with total well depths about the same as the domestic wells, but overall, the PWS wells are mostly reflective of the deeper portions of the aquifer. As illustrated on **Figure 7-11**, there is a high density of PWS in the southern portion of the Subbasin with lesser density in the northern portion of the Subbasin. All of the PWS wells will be used as a representative monitoring network.

Table 7-5. Shallow Aquifer Water Quality Representative Monitoring Wells

Map No.	CASGEM or PWS ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Monitoring Frequency
Monitoring Wells								
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155	O	Biennial
20	386635N1213486W001	SGA_MW05	38.66347	-121.34859	205-215	215	O	Biennial
24	386836N1214536W001	SGA_MW02	38.68362	-121.45363	100-110	110	O	Biennial
27	386864N1215222W003	AB-3 shallow	38.6864	-121.5222	190-210	220	O	Biennial
37	388260N1215394W004	SUT-P1	38.826	-121.5394	110-120	120	O	Biennial
39	389116N1215238W003	AB-1 shallow	38.9116	-121.5238	170-180	190	O	Biennial
46	387623N1213915W001	SVMW West - 1A	38.76232	-121.39153	120-140	145	O	Biennial
80	389740N1213606W001	Cemetery (IRLP)	38.97403	-121.36062	70-111	111	O	Annual
89		Roseview Park - 315	38.71912	-121.32879	295-305	315	O	Biennial
90	388026N1214432W002	WPMW-12A	38.80264	-121.44322	260-280	300	O	Biennial
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162	O	Biennial
109	387218N1214677W001	SGA_MW01	38.72178	-121.46771	100-110	110	O	Biennial
133		LW-1	38.83731	-121.35831	68-108	108	O	Annual
Public Water Supply Wells								
298	3110025-014	Tinker Road Well			117-177	177	M	Tri annial
99	3400396-001	Main Well			53-71	73	M	Tri annial
177	3410002-013	Well 22 - Northrop			113-225	265	M	Tri annial

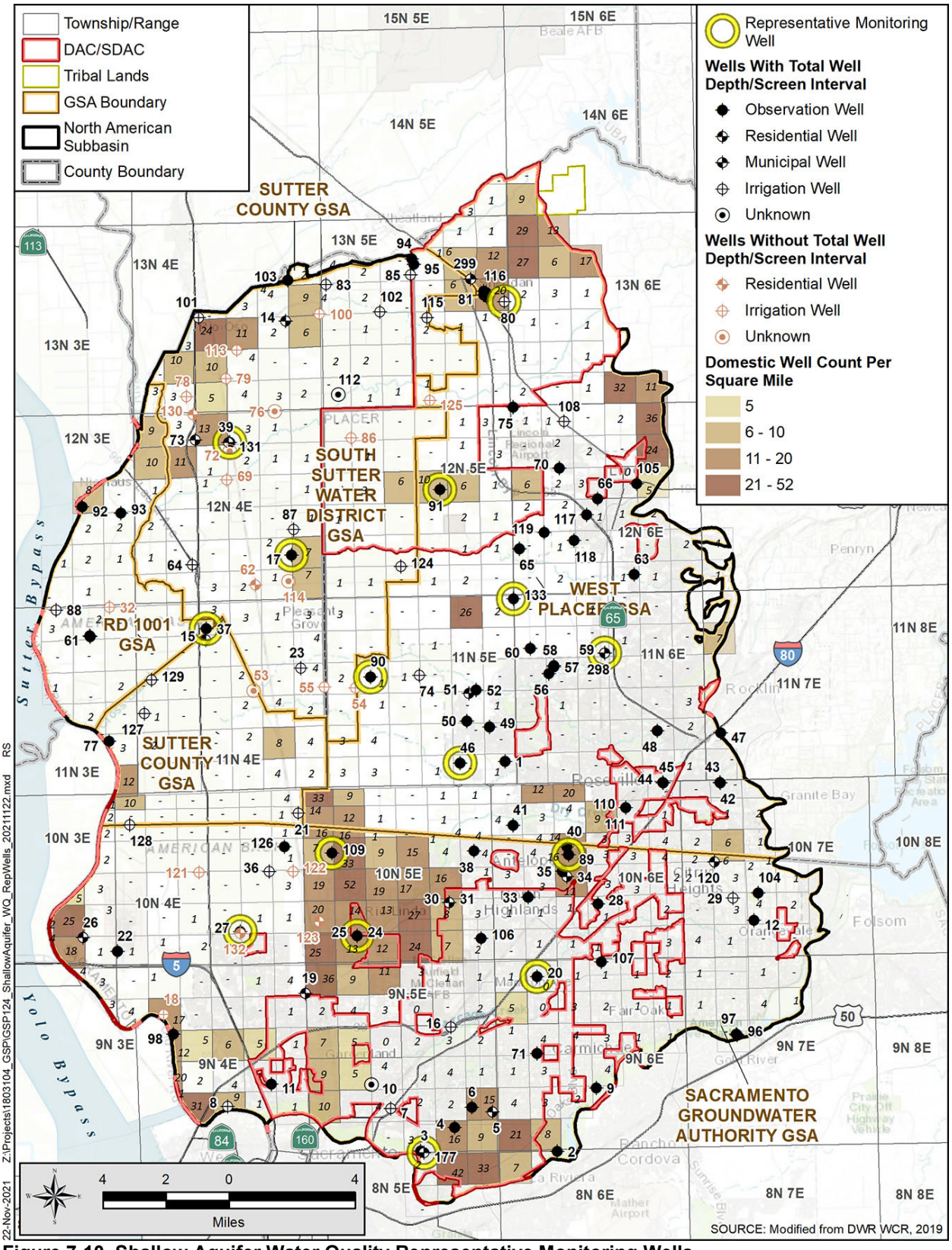


Figure 7-10. Shallow Aquifer Water Quality Representative Monitoring Wells

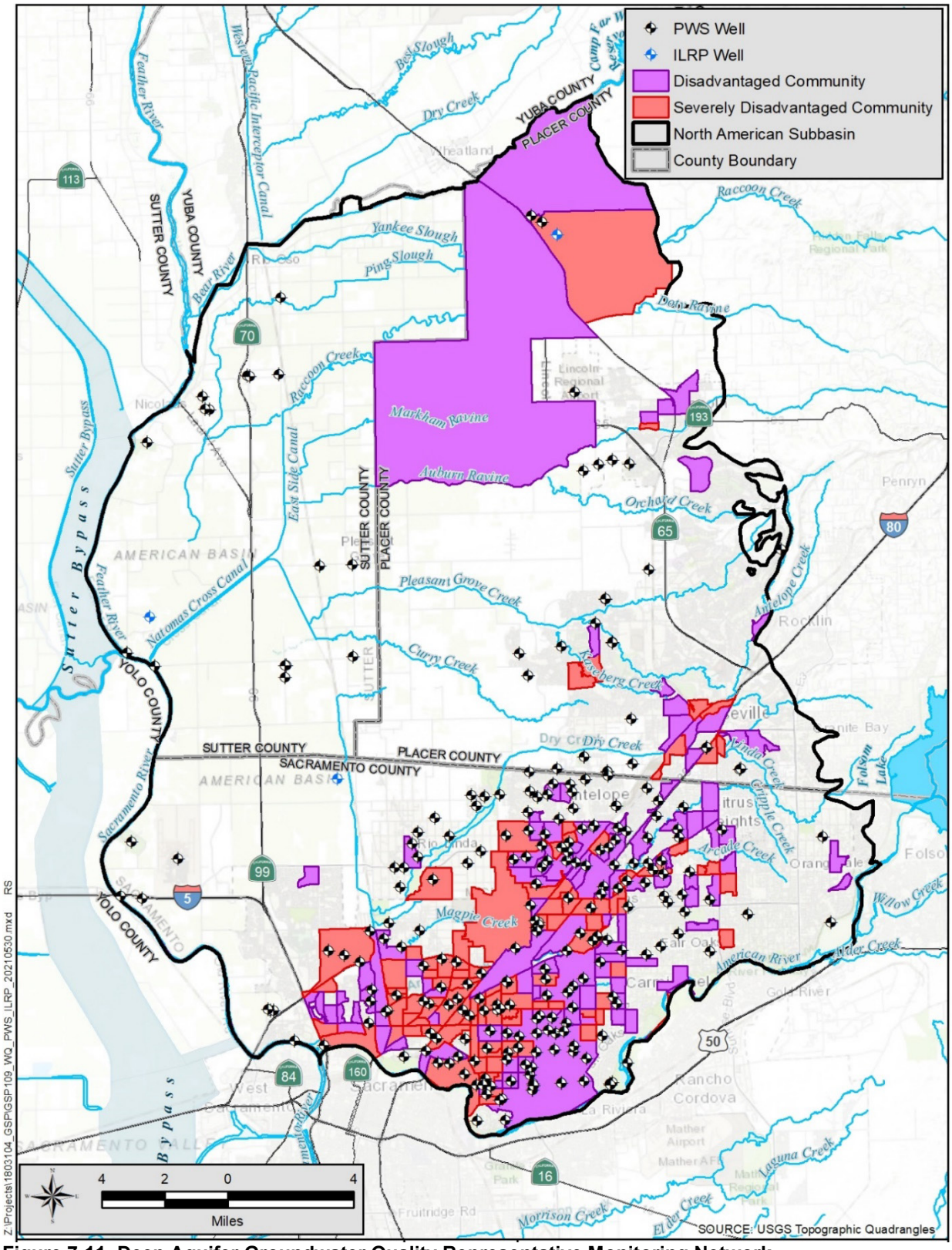


Figure 7-11. Deep Aquifer Groundwater Quality Representative Monitoring Network

7.7.3 Groundwater Quality Monitoring Frequency

The water quality monitoring frequency will vary based on the type of well.
DDW requires monitoring of community PWS wells for Title 22 requirements (such as organic and inorganic compounds, metals, microbial, and radiological analytes). Salinity (TDS) is typically required to only be monitored once every 3 years. Nitrate sampling frequency varies from monthly to annually. For small community water systems, the frequency and the list of analytes is typically different than community PWS wells. The sampling schedule varies by PWS and well and does not occur in all wells in a single year.

ILRP wells are monitored on an annual basis, typically in the fall of each year. Well LW-1 is part of a water quality compliance program and is sampled in the fall of each year.

Shallow aquifer monitoring wells are planned to be sampled once every 2 years, in the fall. The frequency of monitoring is provided in **Table 7-5**.

7.7.4 Groundwater Quality Monitoring Spatial Density

DWR's Monitoring Networks and Identification of Data Gaps BMP identifies different sources and calculations for establishing water quality monitoring network densities (DWR, 2016a). A specific density of water quality monitoring wells per 100 square miles was not provided by DWR, but methods are available to assess an adequate density by performing a water quality needs assessment. The Groundwater Assessment Reports prepared for the ILRP and subsequent Water Quality Trends Monitoring Programs designated one monitoring well in the Subbasin, or one well per 535 square miles.

As demonstrate in **Table 7-4**, the 17 designated shallow representative monitoring wells has a density of about three wells per 100 square miles. As demonstrated on Figure 7-10, the monitoring wells are located specifically near areas with high densities of domestic wells and for distribution across the Subbasin and therefore is sufficient to assess trends for water quality degradation.

This GSP is proposing to use 247 PWS representative monitoring wells, or about 70 wells per 100 square miles, for monitoring the deeper portion of the aquifer. This is higher than the density recommended for groundwater level monitoring well densities. The water quality well density for the deeper portions of the aquifer in the Subbasin, is sufficient to assess trends for water quality degradation.

7.7.5 Data Gaps

At this time there is abundant water quality data through DDW, IRLP, and other regulatory compliance programs to assess water quality in the shallow and deeper portions of the aquifer and along with the sentry wells to detect movement of poorer quality water in the Subbasin. Construction details will be acquired for well 132 in the near future using a video survey. There are no data gaps for the water quality monitoring network.

7.8 Land Subsidence

The subsidence monitoring network will consist of using groundwater levels as a proxy for the rate of land subsidence. **Section 5.10, Land Subsidence** provided hydrographs in comparison to benchmark surveys and an extensometer. A historical analysis showed about 0.01 foot of subsidence per foot of groundwater level decline occurred between 1950s and 1970s during the development of the pumping depression beneath the central portion of the Subbasin. Benchmark surveys that include the period during the 2012 to 2016 drought did not detect subsidence exceeding the instrumentation accuracy.

7.8.1 Land Subsidence Monitoring Network

Subsidence has been monitored using benchmarks established by DWR in 2007. The benchmark network is shown on **Figure 7-12** along with the difference in elevations (in feet) from 2007 to 2018.

DWR constructed the Sutter extensometer (SUT-Ext) and nested monitoring wells (SUT-P1 through SUT-P4) in the western area of the Subbasin and is shown on **Figure 7-12**. DWR is also using satellite-based data (InSAR) to assess subsidence throughout the Central Valley.

The Subbasin has a network of groundwater level monitoring wells that can be used as a proxy to subsidence rates, as listed in **Table 7-1** and shown on **Figure 7-1**.

7.8.2 Representative Monitoring Locations

The subsidence representative monitoring network will consist of using groundwater levels as a proxy to limit the potential for subsidence. Groundwater levels will be made on a monthly basis and provide greater assurance in a timely manner that land subsidence will not create undesirable results. The rate of land subsidence will be tracked at an existing extensometer (SUT-Ext) which is located near nested representative monitoring wells (SUT-P1 through SUT-P4).

Criteria used to select representative monitoring wells were selected based on their proximity to:

- Major transportation infrastructure (highways and freeways)
- Sacramento Metropolitan International Airport

- Levees near rivers
- The existing groundwater depression
- Proximity to the SUT-Ext extensometer

Twelve representative monitoring wells were selected to monitor groundwater levels to be used to avoid the undesirable result of land subsidence associated with groundwater pumping. **Figure 7-13** shows the representative monitoring well locations, infrastructure and the pumping depression (a groundwater surface topographic map). **Tables 7-3** and **7-6** lists the representative groundwater level monitoring wells to be used to assess subsidence. **Table 7-6** lists their purpose and relation to major infrastructure in the area. All wells other wells are positioned to assess the potential for deepening or expansion of the pumping depression and increasing the potential for subsidence.

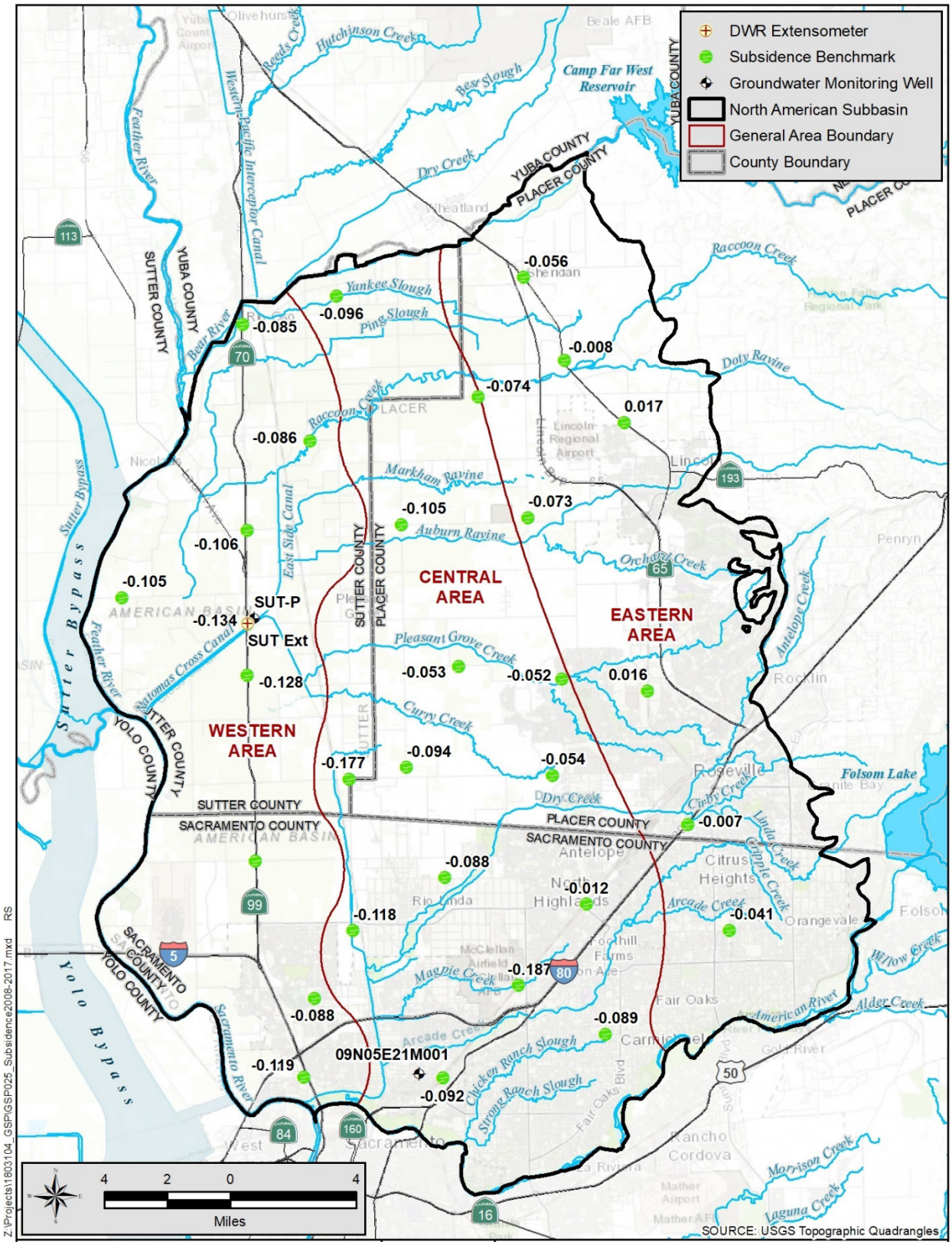


Figure 7-12. Land Subsidence Monitoring Network

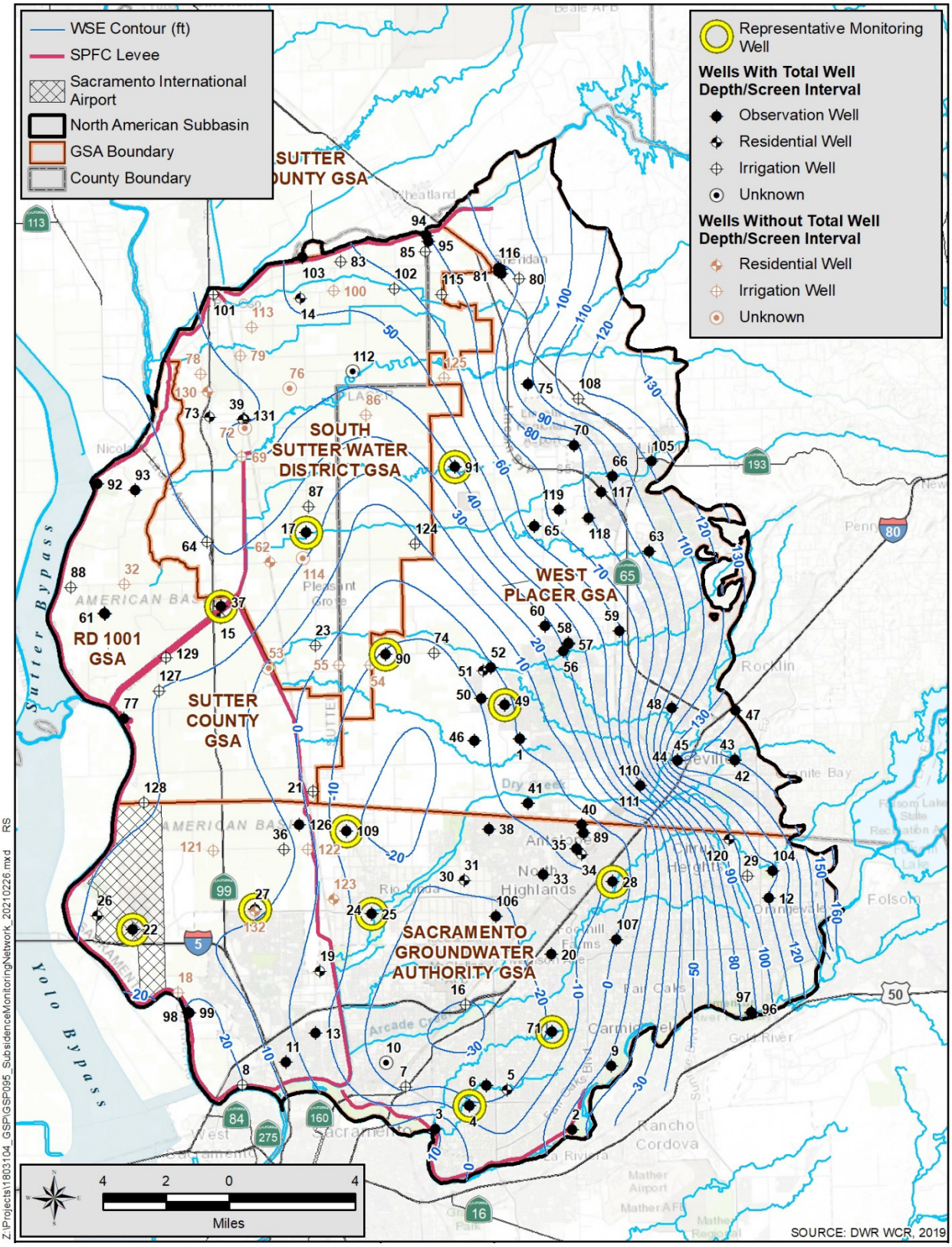


Figure 7-13. Land Subsidence Representative Monitoring Network

Table 7-6. Land Subsidence Representative Monitoring Wells

Map No.	CASGEM ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Near Infrastructure	Frequency of Monitoring
4	385947N1213985W001	MW12A	38.59472	-121.39847	200-280	285	O	B80	Monthly
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155	O		Continuous
22	386782N1215943W002	AB-4 middle-deep	38.6782	-121.5943	795-805	815	O	SIA, I5, L	Continuous
24	386836N1214536W001	SGA_MW02	38.68362	-121.45363	100-110	110	O		Monthly
27	386864N1215222W003	AB-3 shallow	38.6864	-121.5222	190-210	220	O	Hwy 99, L	Continuous
28	386964N1213120W001	Twin Creeks Park	38.6964	-121.31203	183-193	193	O	I80	Monthly
37	388260N1215394W001	SUT-P4	38.826	-121.5394	880-890	890	O	Hwy 70, L	Continuous
49	387786N1213737W002	WPMW-1B	38.7786	-121.3737	460-480	480	O		Monthly
71	386280N1213493W001	WCMSS	38.62799	-121.34925	130-150	170	O	I80	Monthly
90	388026N1214432W004	WPMW-12B	38.80264	-121.44322	508-528	550	O		Monthly
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162	O		Monthly
109	387218N1214677W001	SGA_MW01	38.72178	-121.46771	100-110	110	O		Monthly

Notes: O = monitoring well; I5 = Interstate 5; Hwy 70 = Highway 70
B80 = Business 80; I80 = Interstate 80; L = Levees
SIA = Sacramento International Airport; Hwy 99 = Highway 99

The GSAs intend to use these representative monitoring wells in the Subbasin to track the potential for subsidence. Should groundwater levels indicate levels have gone below the historical lows, the GSAs would then implement land surveys of the nearest surrounding benchmarks as shown on **Figure 7-12**.

The GSAs will review annual satellite-based (InSAR) subsidence results when it is made available. This program is currently funded by DWR. Subsidence will also be tracked on a semi-annual basis at the SUT-Ext and compare the subsidence to SUT-P4. Its location is shown on **Figure 7-12**.

7.8.3 Land Subsidence Monitoring Frequency

Groundwater levels in the representative monitoring wells will be made either on a monthly or daily basis. Continuous measuring stations will be downloaded in the Spring and Fall of each year. The groundwater levels will be plotted annually with benchmark survey results or from other sources to assess subsidence.

7.8.4 Land Subsidence Monitoring Spatial Density

Figure 7-13 provides the distribution of the 12 representative groundwater level monitoring wells. The density of the stations is 2 wells per 100 square miles.

A groundwater level well monitoring density goal ranges from 0.2 to 10 wells per 100 square miles (DWR, 2016a). The monitoring well density goals can also be based on the amount of groundwater use. For basins were groundwater pumping more than 10,000 AFY per 100 square miles, four wells per 100 square miles is recommended. Professional judgement will be essential to determining an adequate level of monitoring cones of depression, significant recharge areas, and specific projects. Based on professional judgement the subsidence network has sufficient density.

7.8.5 Data Gaps

At this time there are no data gaps. As necessary, the subsidence monitoring network may be adjusted.

7.9 Surface Water Depletion

Temporal changes in river flows volumes from gaging stations cannot be used to assess surface water depletion due to the relatively small volumes of groundwater gains and losses in comparison to the volume of water in the rivers. The uncertainty in the accuracy of the volume increases due to the complex nature of merging rivers, ungagged small tributaries, wastewater discharges, and tail water return.

As described and illustrated in **Section 5.11 – Interconnected Surface Water**, groundwater levels in monitoring wells in the aquifer near rivers and creeks correlate to changes in elevations of surface water at river gages. Increasing the depth to groundwater will increase groundwater gradient away from the rivers and increase the amount of surface water depletions. Therefore, use of groundwater levels and gradients as a proxy for surface water depletion is appropriate.

As describe in **Section 5.3 – Historic Groundwater Levels**, groundwater levels near the rivers have been stable along the Bear, Feather and Sacramento rivers since the early 1900s. Changes have occurred in the groundwater levels along the American River and portions of the Sacramento River near its confluence with the American River indicating surface water depletion along these portions increased between 1950 and 1990. Since 1990, levels have stabilized and risen reducing the depletion.

7.9.1 Monitoring Network

The Subbasin has monitoring wells placed near river and creek stage gages to assess if the groundwater gradient changes outside of its historic range, indicating greater surface water depletion. The monitoring wells have a short period of record due to most wells being recently constructed. **Figure 7-1** shows the locations of the monitoring wells.

7.9.2 Surface Water Representative Monitoring Locations

Twenty-four shallow monitoring wells are located along the American, Bear, Feather and Sacramento rivers and various creeks and also near surface water gages to track surface water/groundwater interaction in the Subbasin. All wells have construction details. Eighteen wells are less than 80 feet while the other six wells are deeper but still reflect the unconfined aquifer conditions in the Subbasin. **Table 7-3** provides the well construction details and attributes. **Figure 7-14** shows the surface water depletion monitoring wells which in most cases are paired with river or creek gaging stations. At all gage and monitoring well locations, except Bear River Near Wheatland (BRW) gage, observations of water surface/groundwater elevations

trend closely during high flow/stage events in the rivers, demonstrating a hydrologic connection between the groundwater in the shallow portion of the aquifer and surface water. The wells are suitable for monitoring surface water depletion.

Table 7-7 lists the river stage gages that will be used as part of the representative monitoring network, the type and frequency of the measurements, responsible monitoring agency along with the associated monitoring wells. **Table 7-8** list the wells that can be used to assess gradients from the surface water and also those wells where only levels will be used to assess surface water depletion.

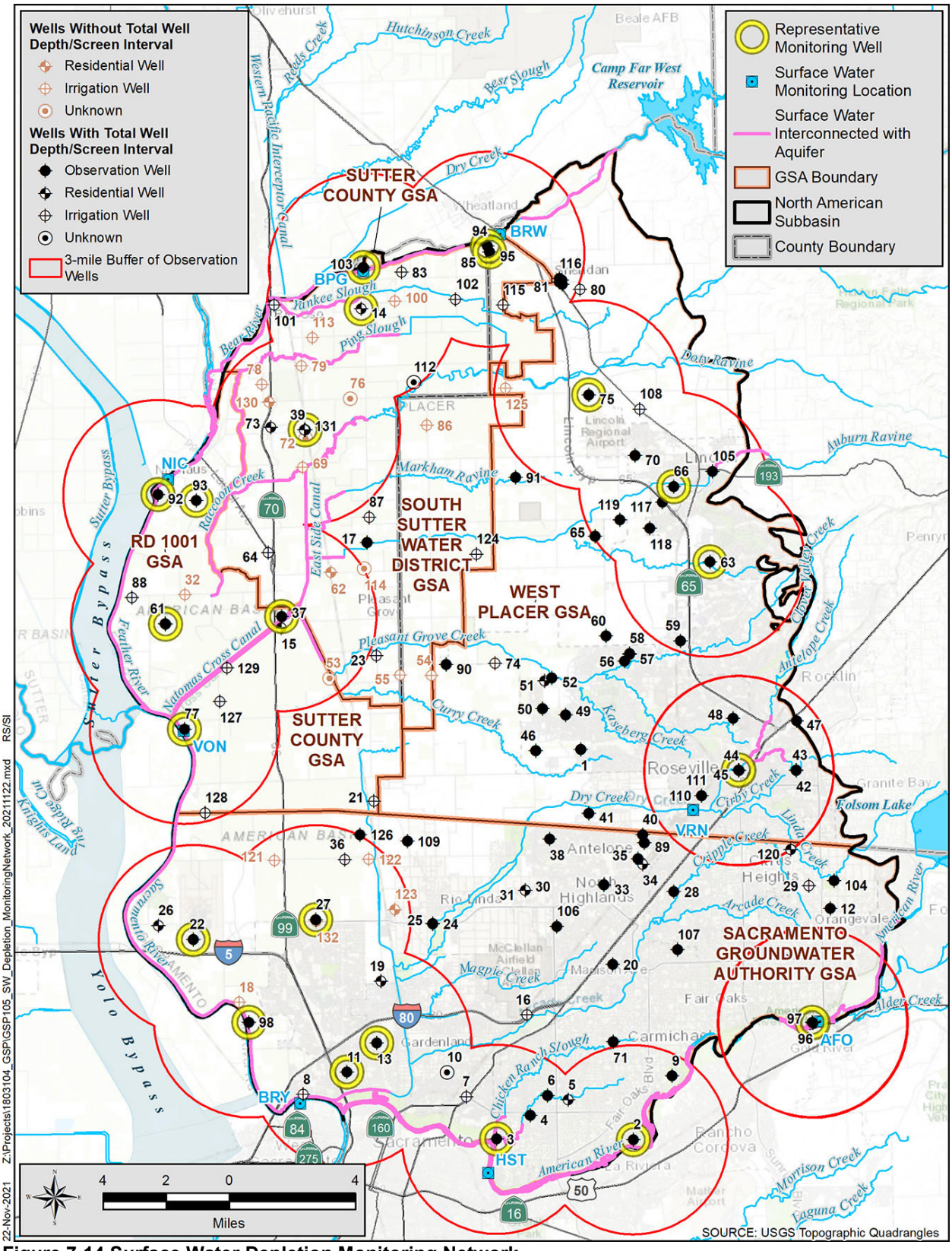


Figure 7-14 Surface Water Depletion Monitoring Network

Table 7-7. Surface Water Gaging Stations

Abbreviation	Name	Operating Agency	Type	Frequency of Measurements	Associated Representative Monitoring Wells (Map No.)
AFO	American River at Fair Oaks	USGS	River Stage (feet [ft]), Flow River Discharge (cubic feet per second [cfs])	15 minutes	96, 97
HST	American River at H Street Bridge	CA Dept of Water Resources/Operations and Maintenance	River Stage (ft)	Hourly	3
BPG	Bear River at Pleasant Grove Road	CA Dept of Water Resources/North Region Office	River Stage (ft), Flow River Discharge (cfs)	Hourly	103
BRY	Sacramento River at Bryce Maintenance Yard	CA Dept of Water Resources/North Region Office	River Stage (ft)	Hourly	98, 99
VRN	Dry Creek @ Vernon St.	City of Roseville	River Stage (ft)	Hourly	44, 45
NIC	Feather River at Nicolaus	CA Dept of Water Resources/Flood Management	River Stage (ft)	Hourly	92, 93
BRW	Bear River Near Wheatland	USGS and DWR	River Stage (ft), Flow River Discharge (cfs)	15 minutes	94, 95
VON	Sacramento River at Verona	DWR & USGS	River Stage (ft), Flow River Discharge (cfs)	Hourly	77

Table 7-8. Paired Monitoring Wells and Gages for Gradients

Map No. or Gage Name	CASGEM ID	Local Name	Latitude	Longitude	River or Creek
Gradient Wells and Gages					
AFO			38.63546	-121.228	Am
96		1516	38.63487	-121.232	Am
97		1518	38.63513	-121.232	Am
BRY		Sacramento River At BRYTE	38.602	-121.533	Sac
11	386160N1215054W001	Bannon Creek Park	38.61603	-121.505	Am
13	386292N1214877W001	Chuckwagon Park	38.62921	-121.488	Am
BPG			38.9841	-121.488	Br
103	389857N1214880W004	BR-1A	38.9857	-121.488	Br
14	389669N1214897W001	13N04E23A002M	38.9669	-121.49	Br
BRW			38.99993	-121.407	Br
94	389950N1214148W002	RDMW-103	38.99461	-121.415	Br
95	389919N1214141W002	RDMW-104	38.99195	-121.414	Br
NIC			38.88984	-121.605	Fr
61	388235N1216079W001	Sutter County MW-5A	38.82324	-121.608	Fr
37	388260N1215394W004	SUT-P1	38.826	-121.539	Fr
NIC			38.88984	-121.605	Fr
92		RDMW-101	38.88294	-121.611	Fr
93		RDMW-102	38.87987	-121.589	Fr
VON			38.77416	-121.598	Sac
77		SREL-1-27-F1	38.77491	-121.598	Sac
22	386782N1215943W004	AB-4 shallow	38.6782	-121.594	Sac
27	386864N1215222W003	AB-3 shallow	38.6864	-121.522	Sac
VRN			38.734	-121.301	Dry
44	387515N1212725W001	WPMW-10A	38.75149	-121.273	Dry
45	387517N1212727W001	WPMW-9A	38.75167	-121.273	Dry
Groundwater Levels Only					
2	385828N1213385W001	SGA_MW06	38.58281	-121.338	Am
3	385841N1214185W001	SGA_MW04	38.58414	-121.419	Am
63	388476N1212872W001	WPMW-3A	38.84761	-121.287	Or
66	388826N1213078W002	MW 5-2	38.88258	-121.308	Ab
75	389255N1213566W003	MW 2-3	38.92547	-121.357	Ra
98		URS71000-700+00C	38.6397	-121.562	Sac
105	388893N1212847W001	MW 4	38.88928	-121.285	Ab

Notes:
Ab = Auburn Ravine
Am = American River
Br = Bear River
Dry = Dry Creek
Fr = Feather River
Or = Orchard Creek
Ra = Raccoon Creek
Sac = Sacramento River

7.9.3 Monitoring Frequency

The stage in the rivers and creeks are monitored on a minimum of 15-minute intervals. The measurements are reported either to the CDEC) database or to the city of Roseville, where the measurements are archived.

Groundwater levels in the monitoring wells are being monitored with transducers that obtain measurements at the same frequency of measurements as the gaging stations, but no less than once every 15 minutes. Groundwater levels will be measured, using water level sounders twice per year, in the Spring (March) and Fall (October) of each year to confirm the accuracy of the transducers. **Table 7-3** provides the frequency of measurements (designated as continuous because they are outfitted with transducers) in groundwater monitoring wells which will correspond with the frequency of measurements at the surface water gaging stations listed in **Table 7-7**.

The frequency of the groundwater measurements may be reduced to daily after further assessment of the data.

7.10 Groundwater Well Monitoring Spatial Density

No specific density of monitoring well spatial density guidance has been provided by DWR for wells associated with surface water depletion. Using a radius of 3-miles (*see* **Figure 7-14**) which is equal to about five wells per 100 square miles illustrates the Subbasin has sufficient density along the rivers.

7.10.1 Data Gaps

Two monitoring wells noted under **Section 7.4.6** as gaps for chronic lowering of groundwater levels would improve the surface water monitoring network.

7.11 Monitoring Protocols

The following technical protocols provide guidance based upon existing professional standards and are commonly adopted in various groundwater-related programs. The protocols provide clear techniques to yield quality data for use in the various components of this GSP. The following monitoring protocol were developed using DWR's Best Management Practices for Monitoring Protocols, Standards and Sites (DWR, 2016b) with additions from other existing programs.

7.11.1 Groundwater Levels

The following monitoring protocols were developed for the CASGEM monitoring programs by the GSAs and will be used to measure groundwater levels in the monitoring wells using a water level sounder or pressure transducers.

7.11.1.1 Water Level Sounders

Groundwater level measurements must be collected with consistency and with sufficient additional data that those who use the data understand its usefulness and limitations. Field notes which document the data collection are therefore required.

To assure that the same well is being measured each time, the monitoring entity will create a Well Identification Sheet, which will be used to track the monitoring at each well site. The following information will be recorded on the Well Identification Sheet: well number, date of survey, latitude and longitude, reference point (RP) elevation and description, location description and map, well type and use, well completion type, and, if available, total depth, screened intervals, and well completion report number. A close-up photo of the well showing the access port for measuring groundwater levels and a photo of the well from a distance should be included for confirmation that the correct well is being monitored and that measurements are made consistently at the same locations.

The following data is collected on standard forms in the field to establish a dependable groundwater level measurement:

- Name of person collecting data and agency association
- Well name/identification
- Date and time of measurement
- Type of equipment used to measure the depth to water
- RP used at each well
- Nearby conditions which confirm (or not) that measurement is static water level and are noted by a Questionable Measurement Code
- Measurement from the RP to the water surface (RPWS)
- Weather and other conditions that may affect the ability to obtain a good measurement
- If a measurement cannot be made information is provided using a No Measurement Code (NM)

Additional steps are taken in the field to:

- Ensure the safety of staff collecting the data
- Ensure the integrity of the data collection process
- Maintain hygienic conditions in the wells
- Maintain good relations with property owners

Groundwater level measurements will be made using the following protocol (DWR, 2016b):

- Depth to groundwater will be measured from an established RP on the well casing. The RP will be identified with a permanent marker, paint spot, or a notch in the lip of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing.
- The sampler will remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a pressure release is evident, the measurement will be delayed for a short period of time to allow the water level to equilibrate.
- Measurements of depth to groundwater and land surface will be measured and reported in feet to an accuracy of at least 0.01 feet and the method of measurement will be noted on the record (i.e., electric sounder, steel tape, acoustic sounder).
- The sampler will replace any well caps or plugs and lock any well buildings or covers after taking a measurement.
- The water level probe should be cleaned after measuring each well.
- All data will be entered into the North American Subbasin data management system (DMS) as soon as possible. Care will be taken to avoid data entry mistakes and the entries will be checked by a second person for accuracy.

By following these monitoring protocols, the GSAs ensure that its groundwater level measurements are appropriate for use in conjunction with other groundwater level data from other groundwater management entities. Monitoring protocols shall be reviewed at least every 5 years as part of the periodic evaluation and update of this Plan and modified as necessary.

7.11.1.2 Pressure Transducers

Groundwater levels may be measured using pressure transducers. When relying on pressure transducers and data loggers, manual measurements of groundwater levels will be taken during installation to synchronize the transducer system and, periodically (semi-annually), to ensure monitoring equipment does not allow a "drift" in the actual values.

The following protocols from DWR *Monitoring Protocols* BMP, 2016 will be followed when installing a pressure transducer in a monitoring well and during routine monitoring and downloads:

- The sampler will use an electronic sounder or chalked steel tape to measure the depth to groundwater level from the RP. The groundwater elevation will be calculated by subtracting the depth to groundwater from the RP elevation. These values will be used as references to synchronize the transducer system in the monitoring well.

- The sampler will record the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and other pertinent information in the log.
- The sampler will record whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented cables are acceptable if the transducer data are properly corrected for natural fluctuations in barometric pressure, which requires commensurate logging of barometric pressures.
- Transducers will be able to record groundwater levels with an accuracy of at least 0.1 feet. Various factors will be considered in the selection of the transducer system, including battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers.
- Follow manufacturer specifications for installation, calibration, battery life, correction procedure (for non-vented cables), and anticipated life expectancy to ensure optimal use of the equipment.
- Secure the cable to the wellhead with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker to allow estimates of future cable slippage.
- The transducer data will be checked periodically against hand-measured groundwater levels to monitor electronic drift or cable movement. This check will not occur during routine site visits, but at least annually.
- The data will be downloaded regularly to ensure data are not lost and entered into the DMS following the QA/QC program established for the GSP. Data from non-vented cables will be corrected for atmospheric barometric pressure changes, as appropriate. After ensuring the transducer data have been downloaded and stored in the DMS, the data will be deleted from the data logger to ensure that adequate data logger memory remains for future measurements.

7.11.2 Water Quality

Water quality samples will be collected from PWS, ILRP wells, shallow monitoring wells and sentry wells. The samples will be collected by various agencies.

All designated water quality monitoring wells are part of public water supply systems. The state of California requires that public water systems maintain a level of water quality monitoring that ensures the public is provided with a safe, reliable drinking water supply. Specifically, system operators must collect and analyze samples from their producing wells to determine the concentration of a broad range of constituents on a scheduled basis as detailed in Title 22 of the California Code of Regulations. The sampling events are carried out under detailed sampling plans which comply with state requirements. Wells are typically pumped for about 15 minutes prior to acquiring water quality samples to ensure the wells are adequately purged.

All public water system operators have been trained for water quality sampling to obtain certifications. PWS wells are required to be pumped for a minimum of 15 minutes prior to collection of samples, the samples are collected from dedicated sampling ports near the well head, the samples will be collected directly into laboratory prepared bottles, cooled to 4° degrees Celsius and then transported (shipped) to a state Environmental Laboratory Accreditation Program (ELAP) certified laboratory under standard chain of custody.

Water quality samples collected from selected ILRP wells will be performed using protocol described in their Water Quality Trends Monitoring Programs.

Water quality samples collected from dedicated monitoring wells will be collected using the following protocol obtained from DWR's Groundwater Monitoring Protocols, Standards, and Sites BMP, 2016 and as modified for the well types to be sampled:

- Prior to sampling, the sampler must contact the laboratory to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- Each well has a unique identifier as contained in **Table 7-4** and will be used to record field measurements and on the sample bottles.
- Laboratory bottles labels will be filled out prior to collection of the samples. The labels are to include: the well name, sampler initials, date, and time of collection of the samples, preservative used, and the type of analysis to be performed.
- The groundwater elevation in the well will be measured prior to being purging of the wells using following appropriate protocols described above in the groundwater level measuring protocols.
- The sampler must decontaminate sampling equipment between sampling locations or wells to avoid cross-contamination between samples. The sampler should clean the sampling port and/or sampling equipment and the sampling port and/or sampling equipment must be free of any contaminants.
- In the NASb most sentry wells are not equipped with sampling pumps and therefore a temporary sampling pump will be installed to purge the wells. The purge time will be calculated using the well construction details and the depth to water. Three well volumes will be purged prior to collection of a sample.
- While purging the wells: pH, temperature, and electrical conductivity (EC) will be monitored at select intervals using a calibrated multi-parameter meter and noted on the field groundwater sampling records.
- In the case of wells with dedicated pumps, samples will be collected at or near the wellhead. Samples should not be collected from storage tanks, at the end of long pipe runs, or after any water treatment.

- All samples will be collected from the pump discharge or sampling port directly into laboratory prepared bottles, cooled to 4 degrees Celsius and then transported (shipped) to an ELAP certified laboratory under standard chain of custody.
- All analyses will be performed by a California State certified ELAP laboratory.

7.12 Data Reporting

All of the groundwater level measurements collected will either be reported to CASGEM and or stored in the DMS developed for the Subbasin. Water quality data will be reported to the GAMA database.

A DMS has been developed for the Subbasin that access publicly available data (DWR, CASGEM, GAMA, and USGS databases) and to store historic and future local data including water supply information. All data is recorded in standard units for water volumes and flow and depths and elevations (NAVD88). All measurement locations are geographic referenced.

The data will be analyzed and reported in annual reports and shared with Stakeholders. The data will be used to provide annual updates and to support revisions to the groundwater model.

7.13 Monitoring Network Improvements

An assessment of the existing monitoring network and representative monitoring wells shows the monitoring network is sufficient for assessment of the sustainability indicators.

Monitoring well network improvements, to be completed within the next 5-years, include:

- Two additional dedicated shallow monitoring wells are needed near high priority GDEs close to the Sacramento River (near the Sutter and Sacramento counties lines) and near the junction of the Bear and Feather rivers (along Ping Slough). Alternatively, surface water observation stations may be established along Ping Slough at road crossings as groundwater and surface water are interconnected in this area.
- Construct a new monitoring well near in the vicinity of monitoring well 112 to improve the monitoring network for chronic lowering of groundwater levels.

This page left intentionally blank

8. Sustainable Management Criteria

This section describes the criteria and the approach by which the NASb GSAs established what are collectively referred to as the Sustainable Management Criteria (SMC). As required by SGMA GSP regulations, this section describes the groundwater conditions that constitute SMC and the process by which the NASb GSAs characterize each element of the SMC.

The SMC include a sustainability goal for the entire NASb and for each sustainability indicator, as wells as locally defined undesirable results, minimum thresholds (MTs), and measurable objectives (MOs) with interim milestones. The sustainability goal and measurable objectives define conditions within the NASb that the GSAs plan to achieve while the minimum thresholds define what constitutes NASb wide undesirable results that GSAs hope to avoid. Defining SMC requires sound data, significant analysis, meticulous planning, and effective coordination and communication.

Provided within this section are the qualitative and quantitative defined conditions that make up each element of the SMC, an explanation of how each element of the SMC were developed, and how each element influences all beneficial uses and users of groundwater.

8.1 Sustainability Goal

As required by the SGMA regulations, the NASb GSAs developed a sustainability goal for the North American Subbasin which is to:

Manage groundwater resources sustainably for beneficial uses and users to support the lasting health of the Subbasin's community, economy, and environment. This will be achieved through:

- The monitoring and management of established SMC;
- Continued expansion of conjunctive management of groundwater and surface water;
- Proactively working with local well permitting and land use planning agencies on effective groundwater policies and practices;
- Continued GSA coordination and stakeholder engagement; and
- Continued improvement of our understanding of the Subbasin.

8.1.1 Supporting Sustainability Goal Information

The sustainability goal was developed by the NASb GSAs based on knowledge gained from actively managing groundwater in the NASb for decades.

Measures implemented to manage the NASb within the Sustainable Yield. To support the sustainability goal, the GSAs will continue to implement measures that will result in sustainable groundwater elevations over time. This includes continued and expanded conjunctive use practices.

Measures to be implemented in the Subbasin to ensure its sustainability include:

- Continued integrated management and adaptive management of water resources.
- Routine monitoring and analysis of groundwater levels and quality along with a comparison to established minimum thresholds and measurable objectives.
- Regular meetings with GSAs to discuss monitoring findings and, as necessary, adaptively adjust management activities to address and resolve adverse trends effecting groundwater conditions.
- Ongoing communication and engagement with stakeholders to build on understanding of how groundwater management activities potentially effect beneficial uses and users (*see* **Section 11 – Notice and Communication**).
- Implementation of projects and management actions (*see* **Section 9 - Projects and Management Actions**), as necessary, based on physical measurements of groundwater conditions at representative monitoring wells.

Information from Basin Setting and Groundwater Conditions used to establish Sustainability Goal. The GSAs established the sustainability goal through a comprehensive understanding of groundwater conditions based on technical information as previously documented in **Section 4 – Hydrogeologic Setting and Section 5 – Groundwater Conditions**. This understanding of the Subbasin setting and groundwater conditions provides a strong foundation for evaluating the sustainability indicators[2] through the SMC and by tracking progress through a detailed monitoring network. The process is defined below.

The process of defining the SMC, specifically minimum thresholds and undesirable results, is heavily dependent on evaluating the applicable sustainability indicators through the specific regulatory sections in three separate parts of the GSP regulations. These three sections include the specific sustainability indicator in the Groundwater Conditions section of the Basin Setting

[2] Sustainability indicators are defined and described in greater detail in sections 8.2 and 8.3.

sub article (§354.16), the minimum thresholds section of the SMC sub article (§354.28), and the monitoring network section of the Monitoring Network sub article (§354.34).

There are specific and separate instructions for the GSA to follow for each of the six sustainability indicators, which is carried through in three separate sub articles of the GSP regulations (i.e., the Basin Setting, SMC, and Monitoring Network). The specific information and purpose of these requirements for each sustainability indicator is illustrated in **Figure 8-1** and described below.

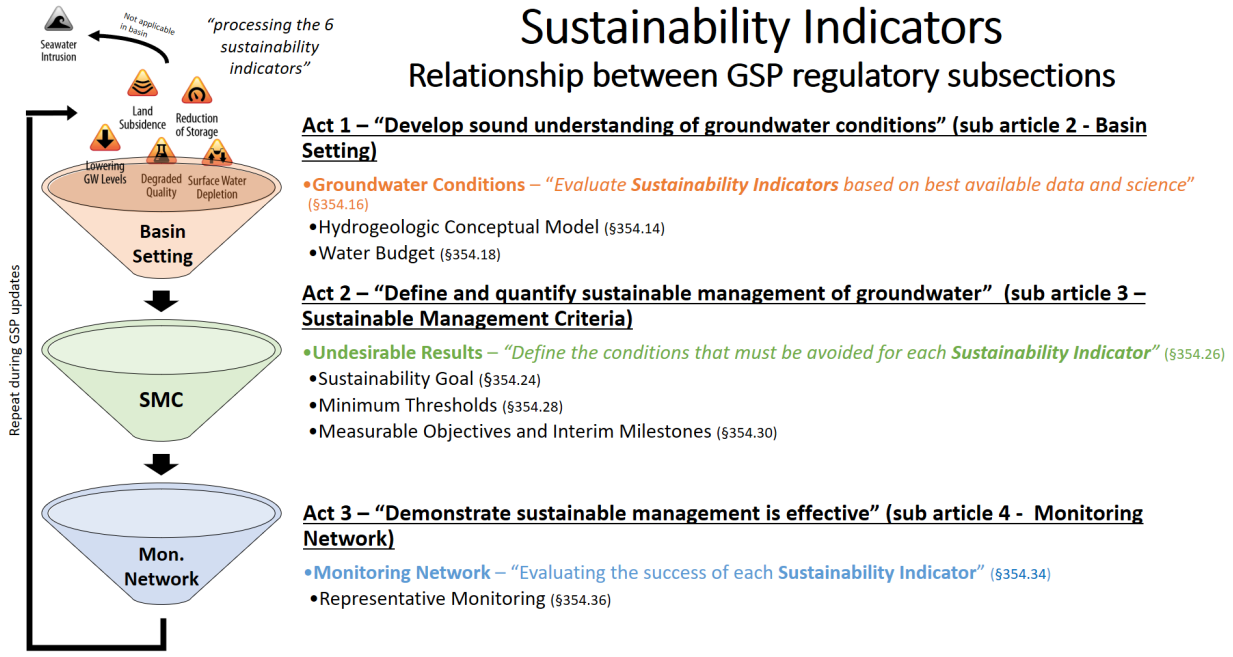


Figure 8-1. Processing of Sustainability Indicators

As illustrated in **Figure 8-1**, the NASb GSAs followed the process of carrying the applicable sustainability indicators for the NASb basin through this process. This process is also referred to as the "three act play" in reference to specific instructions provided for each of the six sustainability indicators that are located in each of three of the GSP regulation sub articles. The general intent of these instructions and how it resulted in NASb GSP development is paraphrased below.

- Basin Setting (GSP regulations - sub article 2) "Act 1" - Within the subsection Groundwater Conditions (§354.16), the current and historical conditions for each sustainability indicator must be evaluated based on best available data and science. This evaluation provides a baseline for each sustainability indicator in the basin and is foundational for the next GSP regulation requirement that applies to each sustainability indicator, the SMC. For the NASb GSP, this foundational baseline information can specifically be found in **Section 5 (Groundwater Conditions)**, but also **Section 4 (Hydrogeologic Setting)** and **Section 6 (Water Budget)**.

- SMC (GSP regulations - sub article 3) “Act 2” – Within the subsection Minimum Thresholds (§354.28), the GSA shall define and quantify the condition that must be avoided for each sustainability indicator. This is done at a site-specific scale through the use of minimum thresholds, and then again defined for each sustainability indictor at a basin scale through the quantifiable definition of undesirable results. These defined conditions provide the State, stakeholders, and GSAs clarity as to what constitutes sustainable groundwater management in the NASb. For the NASb GSP, this information can specifically be found in this section on the SMC.

- Monitoring Network (GSP regulations - sub article 4) “Act 3” - Within the subsection Monitoring Network (§354.34), the GSA shall demonstrate that sustainable groundwater management is effective. Essentially, the GSP defines specific monitoring locations and metrics to adequately evaluate success for each sustainability indicator. For the NASb GSP, this information is in **Section 7 - Monitoring Networks**.

Activities to achieve the sustainability goal for the next 20 years and beyond. The NASb GSAs believe the sustainability goal is currently being met, based on the absence of undesirable results, and plan to continue and expand on activities to maintain the sustainability goal for the next 20 years and beyond. Through the use of empirical data and modeling, the GSAs have evaluated: current groundwater conditions; projected groundwater conditions based on planned land use changes; and projected conditions as a result of planned land use changes with climate change. This evaluation indicates that by managing to the Subbasin’s SMC and through implementing planned projects and management actions, the NASb will remain sustainable as defined by the absence of undesirable results.

8.2 Process of Developing SMC

As provided in **Section 8.1**, the sustainability goal defines and summarizes the conditions in this GSP that constitute sustainable groundwater management for the NASb at the highest level. The remaining process of developing the SMCs is focused on the next levels of defined conditions in the NASb, including establishing undesirable results, minimum thresholds and measurable objectives. Remaining SGMA terminology as depicted on **Figure 8-2** such as *Sustainable Yield* is defined in **Section 6 - Water Budgets**.

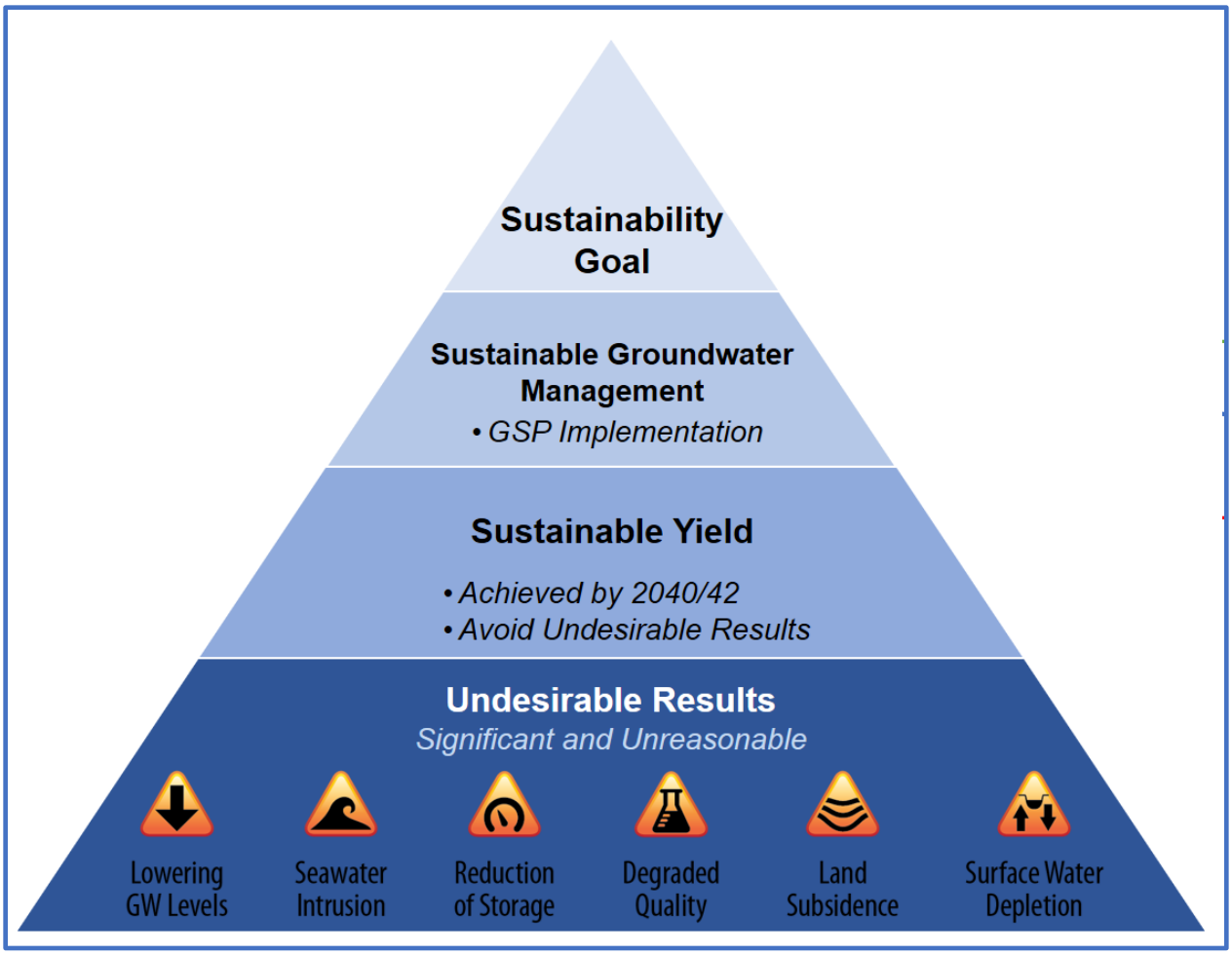


Figure 8-2. Depiction of Key SGMA Compliance Elements

This SMC section of the GSP was developed based on the application of technical information as is documented in:

- Section 4 – Hydrogeologic Setting
- Section 5 – Groundwater Conditions
- Section 6 – Water Budget
- Section 7 – Monitoring Network

The NASb GSAs completed a process during SMC development based on a comprehensive and strong foundational technical understanding of each applicable sustainability indicator. This process then included the development of proposed values that quantified Subbasin conditions that considered beneficial uses and users of groundwater. This process is summarized and illustrated on **Figure 8-3**.

- **Applicability of Sustainability Indicators.** Initially GSAs were required to complete the somewhat simple determination of which sustainability indicators were applicable in the NASb. Sustainability indicators are the effects caused by groundwater conditions

occurring throughout the basin that, when significant and unreasonable, become undesirable results. As described in **Section 4 – Hydrogeologic Setting** and **Section 5 – Groundwater Conditions** of this GSP, seawater intrusion is not an applicable sustainability indicator in the NASb. A specific description of how undesirable results, minimum thresholds, and measurable objectives were established for the five applicable sustainability indicators is provided in **Section 8.3**.

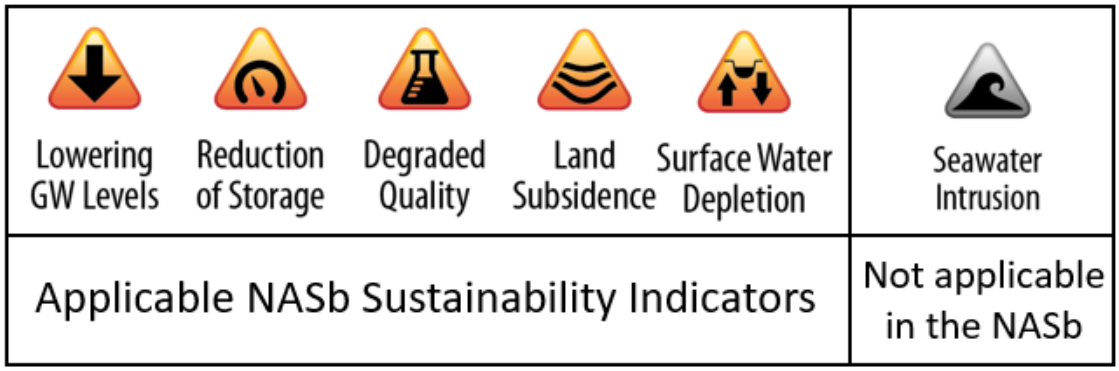


Figure 8-3. NASb Applicable Sustainability Indicators

- **Development of Measurable Objectives (MOs), Minimum Thresholds (MTs) and Undesirable Results.** This process consisted of developing proposed values for the key State regulatory required metrics that define conditions within the NASb that GSAs plan to achieve and also the conditions that GSAs plan to avoid. These include determining the MOs, MTs, and undesirable results for the NASb for each applicable sustainability indicator. **Figure 8-4** illustrates the relationship between the MOs and MTs. The GSAs used consistent methodology in development of the quantitative values for each of these as defined in subsequent sections below. These metrics include:
    - For the MOs, GSAs focused on developing target water levels and water quality that represent optimum water level and quality conditions in the NASb.
    - For the MTs, water levels and water quality values were set that if exceeded, could result in negative effects to beneficial uses and users in the NASb.
    - For the undesirable results, GSAs focused on defining for each sustainability indicator what combination of minimum threshold exceedances may constitute significant and unreasonable groundwater conditions that in turn would mean the NASb groundwater use is unsustainable.

Prior to discussing the proposed values for MOs, MTs, and URs for each sustainability indicator with stakeholders, the GSAs provided stakeholders background information on the status of each indicator in the NASb. This information was provided both in the form of draft GSP technical sections **(Sections 1 through 5)** and summarized in written form and included in presentations at public meetings. Discussion during these public meetings facilitated additional information sharing and clarity for the GSAs. Once GSAs felt that they had an understanding of stakeholder

input on the material provided to the public, the GSAs were able to advance the proposed MTs, MOs and undesirable results values for each of the sustainability indicators as provided in the sections below:

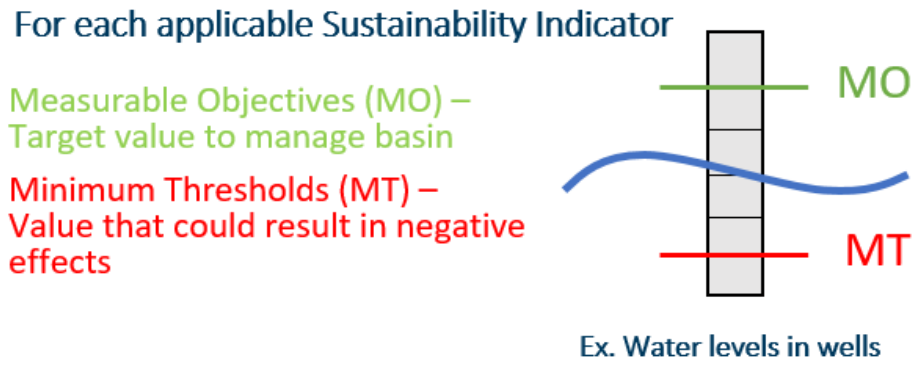


Figure 8-4. MO and MT Relationship

- **Consideration of beneficial uses and users.** This process consisted of identifying all the beneficial uses and users in the NASb and then evaluating the proposed MOs, MTs and undesirable results values based the interests of each beneficial uses and users of groundwater. These beneficial uses and users are listed below:
    - Agricultural
    - Domestic
    - Municipal
    - Public Water Systems
    - Environmental
    - Federal Government
    - Tribes
    - Disadvantaged Communities (DACs)
    - Surface Water Users
    - Parks
    - State Government
    - Local Land Use Planning Agencies
    - Conservancies

Stakeholders provided feedback individually, during public meetings or workshops, or as written comments, which enabled GSAs to fine-tune the quantitative values used for MOs, MTs, and undesirable results as defined below in this section. This approach was taken so that the SMCs would have a strong level of support among stakeholders and the GSAs responsible for implementing this GSP.

8.3 Sustainability Indicators

Sustainability indicators are the effects caused by groundwater conditions occurring throughout the Subbasin that, when significant and unreasonable, become undesirable results. Undesirable results are defined in the SGMA as one or more of the following effects:

1. *Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods*

2. *Significant and unreasonable reduction of groundwater storage*

3. *Significant and unreasonable seawater intrusion*

4. *Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies*

5. *Significant and unreasonable land subsidence that substantially interferes with surface land uses*

6. *Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water*

SGMA requires that GSAs demonstrate sustainability through the avoidance of undesirable results. The presence of significant and unreasonable effects for any of these indicators, if left uncorrected, could result in State intervention in the management of groundwater in the Subbasin.

8.3.1 NASb SMC Approach - Sustainability Indicator Grouping

The following sections of the SMC are grouped by sustainability indicator to not only retain an organized approach but to also ensure all of the GSP regulation requirements regarding SMC have been addressed. Each subsection of the NASb GSP follows a consistent format that contains the information required by Section §354.22 et. seq of the SGMA regulations and outlined in the Sustainable Management Criteria BMP (DWR, 2017). Each Sustainable Management Criteria section includes a description of:

- How locally defined significant and unreasonable conditions were developed.
- How undesirable results were developed, including:

- The criteria defining when and where the effects of the groundwater conditions cause undesirable results based on a quantitative description of the combination of minimum threshold exceedances (§354.26 (b)(2)).
- The potential causes of undesirable results (§354.26 (b)(1)).
- The effects of these undesirable results on the beneficial users and uses (§354.26 (b)(3)).

- How minimum thresholds were developed, including:
  - The information and criteria used to develop minimum thresholds (§354.28 (b)(1)).
  - The relationship between minimum thresholds and the relationship of these minimum thresholds to other sustainability indicators (§354.28 (b)(2)).
  - The effect of minimum thresholds on neighboring basins (§354.28 (b)(3)).
  - The effect of minimum thresholds on beneficial uses and users (§354.28 (b)(4))
  - How minimum thresholds relate to relevant Federal, State, or local standards (§354.28 (b)(5)).
  - The method for quantitatively measuring minimum thresholds (§354.28 (b)(6)).
- How measurable objectives were developed, including:
  - The methodology for setting measurable objectives (§354.30).
  - Interim milestones (§354.30 (a), §354.30 (e), §354.34 (g)(3)).

8.4 Sustainability Indicator #1 - Chronic Lowering of Groundwater Levels

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #1 – chronic lowering of groundwater levels.

8.4.1 Undesirable Results – Chronic Lowering of Groundwater Levels

Chronic lowering of groundwater levels is considered significant and unreasonable when:

- *20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41 wells).*

The NASb GSAs believe that this criterion would constitute an undesirable result, because it would indicate that about 20% of the area of the Subbasin would be experiencing an MT

exceedance (based on relatively even spacing of the representative monitoring wells). As described further below, MTs were established by detailed modeling of expected future conditions that was then compared to beneficial uses and users to ensure that potential negative impacts would be avoided.

The use of 20% of the wells would help early detection of potential impacts of a regional nature. This is based on past experience in the Subbasin. For example, cones of depression emerged over time in both the agricultural areas in the northern part of the NASb and in urban areas in the southern part of the NASb (*refer to* **Section 5.3 – Historic Groundwater Contours**). These cones of depression represented overdraft conditions in relatively small portions of the subbasin that were significant enough for local agencies to take actions to correct them. For years, these local agency groundwater management activities have led to the stabilization and even some recovery of groundwater levels in the South Sutter Water District area since the mid-1960s and in Sacramento County since the mid-1990s.

Overall, the GSAs intend that groundwater elevations remain sustainable over time, which includes allowing for certain planned and managed areas of declining groundwater levels to support the future needs of the region. However, exceedances of MTs at more than 20% of the representative monitoring sites could be an indication that undesirable results are emerging from conditions that exceed the currently assumed future conditions, which could impact beneficial uses and users.

8.4.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for chronic lowering of groundwater levels is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of:

- Domestic and irrigation wells going dry (i.e., cost to deepen existing or construct new wells).
- Municipal wells decrease in capacity or go dry.
- Increased costs associated with lowering or replacement of pumps.
- Surface water is depleted such that creek flows are significantly reduced over time.
- Groundwater supported vegetation die or cannot repopulate, thereby reducing or eliminating GDEs.
- Significant increase in subsurface inflow from adjacent subbasins could impede adjacent basins from meeting their sustainability goals.
- Delaying contamination cleanup by potentially mobilizing existing plumes at existing remediation sites.

8.4.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for chronic lowering of groundwater level results are:

- A significant increase in NASb pumping distribution and volumes, most likely due to changing land use practices such as an increase or concentration of new agricultural and/or municipal pumping.
- A significant reduction in natural recharge as a result of changing surface water hydrology or land use (conversion to impermeable surfaces such as concrete, asphalt or homes).
- An increase in outside of basin demand for surface water (e.g., exports) that could result decreased surface water available for use in the NASb or decreasing natural recharge.

8.4.1.3 Effects on Beneficial Users and Land Use

If undesirable results occur, the likely effects will be experienced by domestic (i.e., shallow well) users. Shallow domestic wells would tend to be impacted first as groundwater levels decline, and rural residents may be faced with the financial burden of well deepening or replacement. If groundwater levels continued to decline causing a much greater percent of MT exceedances, a significant number of deeper domestic and ultimately agricultural and municipal production wells could be challenged to meet their water demands from groundwater.

The effects of undesirable results could also cause GDEs to be cut off from groundwater. GDEs are "ecological communities or species that depend on groundwater emerging from aquifer or on groundwater occurring near the ground surface" (23 CCR §354.24(m)). Undesirable results could include the disconnection of GDEs from saturated groundwater or reduced base flow to streams that depend on groundwater base flow, thereby impacting riparian ecosystems and aquatic species associated with GDEs.

8.4.2 Minimum Thresholds - Chronic Lowering of Groundwater Levels

The MTs used to support the undesirable results definition of the chronic lowering of groundwater levels are provided within this section.

8.4.2.1 Information and Criteria Used to Establish Minimum Thresholds

The GSP regulations require a description of the information and criteria used for establishing the chronic lowering of groundwater levels MTs (§354.28 (b)(1)). To develop proposed MTs, information was derived from detailed modeling analysis. The GSAs identified what conditions would look like at groundwater elevations at representative monitoring site (RMS) locations throughout the NASb under a scenario that included a 50-year simulation with projected demands, climate change, and an urban conjunctive use program. The scenario is described in

Section 9.2.1 – Project #1 Regional Conjunctive Use Expansion – Phase 1, and the CoSANA model is documented in **Appendix P – Groundwater Model Documentation**. The scenario is intended to provide a reasonable approximation of what groundwater conditions could look like over a 50-year hydrologic sequence if all of the demand, climate, and conjunctive use operations projections were realized.

As described in **Section 6 – Water Budget**, the NASb is currently under its estimated sustainable yield by more than 10 percent. Therefore, the NASb is in position to support additional development and land use changes that will result in increased groundwater use. With these land use changes and projected climate change, some portions of the basin could expect to experience lower groundwater elevations in the future. **Figure 8-5** shows the 50-year simulation projected water level changes from baseline conditions at each groundwater RMS location in the NASb.

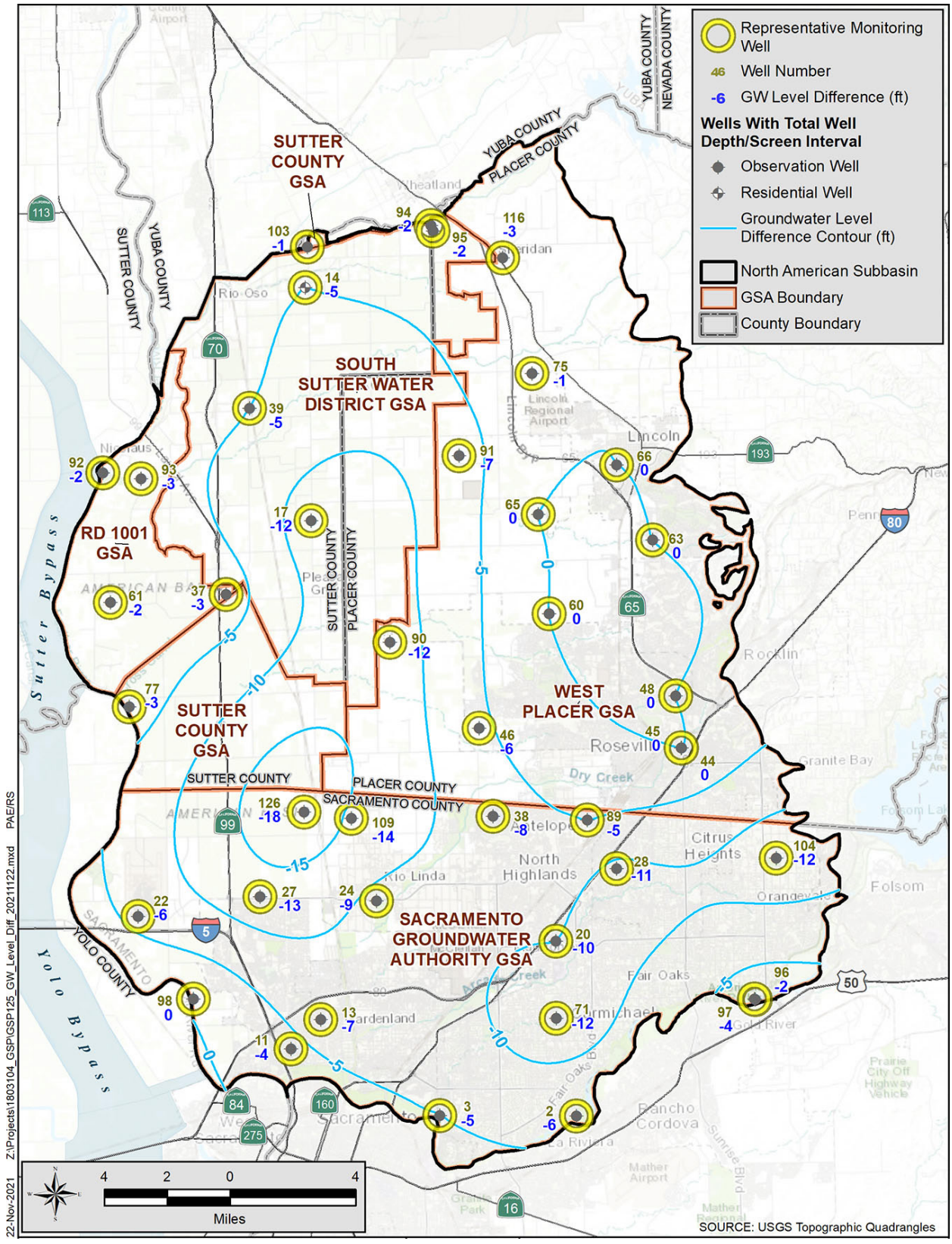


Figure 8-5. Projected Groundwater Elevation Changes at RMS Locations

The elevations in **Figure 8-5** are relative changes to groundwater levels projected at the end of the 50-year groundwater modeling simulation. The methodology used to develop MTs included subtracting the projected groundwater level elevations from baseline elevations. The average of Fall 2014 and Fall 2015 elevations were used for the baseline at each RMS, except in cases where the RMS wells were constructed after that time (data from 2018 through 2020 was used for these recent wells). The NASb GSAs believe this baseline approach is appropriate for the following reasons:

- It is consistent with the conditions present at the time of the passage of SGMA.
- It uses data from the most recent decade, which better reflects current hydrology and regional land use development conditions.
- It represents a period when relatively low levels of groundwater elevations were observed in the basin in which negative effects to beneficial uses and users were not reported or observed.
- As described in **Sections 3.13 and 5.2 through 5.4**, conjunctive use programs in the NASb have been implemented that have resulted in improved groundwater elevations relative to their historical lows in many parts of the subbasin (also see **Figure 5-3**). Using average 2014/2015 levels as the baseline for establishing MTs recognizes the benefit of those conjunctive use programs.

The final MT was then calculated by subtracting the relative change resulting from the 50-year modeled projections at each RMS (as shown in **Figure 8-5**) from the average Fall baseline. Following the calculations of the MTs, the resulting values were evaluated relative to beneficial uses and users and adjacent subbasins (see **Sections 8.4.2.4 and 8.4.2.5** below) to determine whether significant and unreasonable undesirable results would be experienced from those future groundwater elevations.

8.4.2.2 Chronic Lowering of Groundwater Levels Minimum Threshold

Table 8-1 shows the Fall baseline groundwater elevation, the model projected change from baseline, and the final selected MT at each RMS. The final MTs at the RMS locations for chronic lowering of groundwater are shown on **Figure 8-6**. Hydrographs for each RMS showing actual groundwater elevations in comparison to the average Fall condition baseline and model adjusted projected MTs are in **Appendix Q – SMC Hydrographs**.

Table 8-1. Chronic Lowering of Groundwater Level Minimum Thresholds

Representative Monitoring Site		Fall Baseline (ft msl)	Model Projected Water Level Change (ft)	Selected MT (ft msl)
Map No.	Local Name			
2	SGA_MW06	7	-6	1
3	SGA_MW04	0	-5	-5
11	Bannon Creek Park	-1	-4	-5
13	Chuckwagon Park	-8	-7	-15
14	13N04E23A002M	31	-5	26
17	AB-2 shallow	-5	-12	-17
20	SGA_MW05	-27	-10	-37
22	AB-4 shallow	5	-6	-1
24	SGA_MW02	-18	-9	-27
27	AB-3 shallow	9	-13	-4
28	Twin Creeks Park	-17	-11	-28
37	SUT-P1	13	-3	10
38	Lone Oak Park	-19	-8	-27
39	AB-1 shallow	8	-5	3
44	WPMW-10A	133	0	133
45	WPMW-9A	135	0	135
46	SVMW West - 1A	-26	-6	-32
48	WPMW-4A	75	0	75
60	WPMW-2A	22	0	22
61	Sutter County MW-5A	12	-2	10
63	WPMW-3A	145	0	145
65	MW 1-3	49	0	49
66	MW 5-1	108	0	108
71	WCMSS	-28	-12	-40
75	MW 2-3	90	-1	89
77	SREL-1-27-F1	12	-3	9
89	Roseview Park - 315	-17	-5	-22
90	WPMW-12A	-33	-12	-45
91	WPMW-11A	10	-7	3
92	RDMW-101	17	-2	15
93	RDMW-102	15	-3	12
94	RDMW-103	60	-2	58
95	RDMW-104	59	-2	57
96	1516	69	-2	67
97	1518	61	-4	57
98	URS71000-700+00C	7	0	7
103	BR-1B	37	-1	36
104	SGA_MW08	109	-12	97
109	SGA_MW01	-19	-14	-33
116	Old Well #2	71	-3	68
126	DeWit	-7	-18	-25

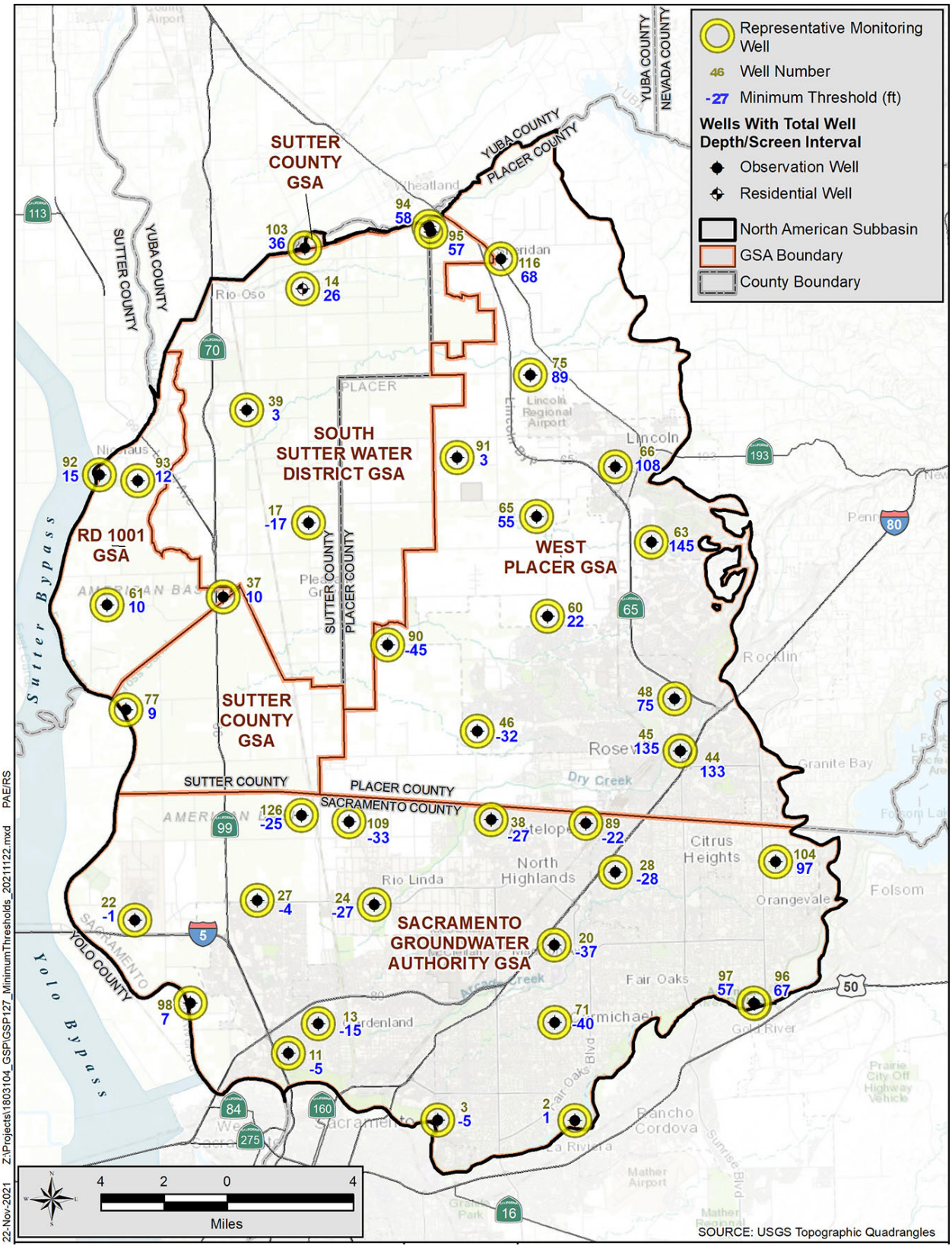


Figure 8-6. Projected Groundwater Elevation MTs at RMS Locations

As described in the groundwater storage, land subsidence, and depletion of interconnected surface water sustainability indicator sections below, groundwater levels were used as a reasonable proxy for defining quantitative thresholds per GSP regulations (§354.28 (d)).

8.4.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

Assessing the relationship between the MTs for each sustainability indicator is a requirement of the GSP regulations (§354.28 (b)(2)). MTs are often established for multiple sustainability indicators at a single RMS. If the same RMS was used for multiple sustainability indicators that use groundwater elevation as a metric, the shallowest (or most protective) groundwater elevation will be used to evaluate potential negative effects at that location.

The relationship between the MT for chronic lowering of groundwater levels and those for other sustainability indicators are discussed below.

Reduction of groundwater in storage. There are different metrics identified in the GSP regulations for reduction of groundwater in storage (volume of groundwater extracted). However, as supported in the GSP regulations (§354.28 (d)), groundwater levels can serve as a reasonable proxy for defining quantitative thresholds for other sustainability indicators. For this reason, since the reduction of groundwater in storage MTs are dependent on avoiding undesirable results pursuant to the NASb's other sustainability indicators, maintaining the MTs for chronic lowering of groundwater levels equates to preventing an undesirable reduction of groundwater in storage.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

Degraded groundwater quality. The MTs are not expected to have a significant impact on groundwater quality. As shown in **Figure 8-5**, the areas of greatest drawdown are in the vicinity of the junction between Sacramento, Sutter, and Placer counties and trending to the north and south. To the north, there are no known areas of contaminants that could be mobilized from these changes in water levels. On the Sacramento County side of the junction, contamination at the former McClellan Air Force Base is actively managed and is expected to be largely remediated in the next two decades; there is very little risk of mobilization of the contaminant plume based on a study by the SGA as discussed in **Section 5.8.3**. Also as shown in **Figure 8-5**, despite some projected declines in groundwater elevations, these are not appreciable in the Subbasin over a 50-year period. This would not be expected to alter conditions in the aquifer to such a degree that significant mobilization or geochemical reactions related to the presence naturally-occurring constituents (e.g., arsenic) would be of concern.

Land subsidence. The MTs are not expected to have a significant impact on land subsidence. **Section 5.10 – Land Subsidence** documents that land subsidence has been negligible in the NASb since the 1990s. The historical rate of subsidence has been approximately 0.01 feet per 1 foot of groundwater level decline. The maximum MT decline is projected at 18 feet, which would equate to approximately 0.18 feet of subsidence over the next 50 years.

Depletion of interconnected surface water. There are different metrics identified in the GSP regulations for depletion of interconnected surface water (rate or volume of surface water depletion caused by groundwater use). As supported by the GSP regulations (354.28 (d)), groundwater levels can serve as a reasonable proxy for defining quantitative thresholds for this sustainability indicator. The NASb GSAs believe that the use of groundwater levels as a proxy is appropriate because:

- The relationship between groundwater elevations and surface water flows has been analyzed and well-established during preparation of this GSP (see **Section 5.11 – Interconnected Surface Water**) and has been analyzed extensively associated with flood control planning efforts in the region (see Luhdorff and Scalmanini 2009).
- An appropriate surface water depletion monitoring network has been established in the NASb (see **Section 7.9 – Surface Water Depletion**).

Similar to the reduction of storage, since depletion of interconnected surface water is dependent on avoiding undesirable results for the NASb's other sustainability indicators, maintaining the MT for chronic lowering of groundwater levels equates to preventing a significant and unreasonable undesirable result with respect to depletion of interconnected surface water. The highest projected future change in gradient associated with the MTs is along the Sacramento River (*see* **Figure 8-5**). As part of the modeling analysis, a review of additional seepage associated with the increased gradient away from the Sacramento River and changes to diversions from the river associated with land use changes reveals that there is an expected net increase in flows in the river. This is described further under **Section 8.9** below. Additional discussion of seepage associated with other interconnected surface waters is also discussed under **Section 8.9** below.

8.4.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The NASb shares boundaries with four groundwater subbasins: the South Yuba Subbasin to the north; the Sutter Subbasin to the northwest; the Yolo Subbasin to the southwest; and the South American Subbasin to the south. The NASb MTs would have negligible effect on adjacent subbasins. This is demonstrated by the modeling conducted to establish the MTs. The first line of evidence is in the limited lowering of average groundwater levels at the boundaries, which range from 0 to 6 feet (see Figure 8-3). These changes in groundwater levels ultimately translate to groundwater gradients, which drive groundwater flow across the boundaries. **Table 8-2** shows the subsurface flows under current and projected conditions used to establish the MTs. The difference in boundary flows associated with implementing the MTs is negligible. Representatives of the NASb met and discussed the boundary conditions with representatives from each subbasin, and the agencies agree that the proposed MTs will not impact their ability to sustainably manage their respective subbasins. This coordination is documented in **Section 11 – Notices and Communications**.

Table 8-2. Groundwater Flow with Neighboring Subbasins

Subsurface Groundwater Flow Across Boundaries with Neighboring Subbasins	Current Conditions (AFY)	Projected with Climate Change and Project Implementation (AFY)	Future Scenario Difference from Current Conditions (AFY)
Inflows			
South American Subbasin	16,600	18,000	1,400
Sutter Subbasin	1,400	2,100	700
Yolo Subbasin	9,000	11,600	2,600
Yuba Subbasin	6,700	7,600	900
Outflows			
South American Subbasin	9,700	11,800	2,100
Sutter Subbasin	2,000	1,400	(600)
Yolo Subbasin	500	400	(100)
Yuba Subbasin	100	100	-
Net Boundary Flows			
South American Subbasin	6,900	6,200	(700)
Sutter Subbasin	(600)	700	1,300
Yolo Subbasin	8,500	11,200	2,700
Yuba Subbasin	6,600	7,500	900

8.4.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The potential effects of MTs to specific applicable beneficial uses and users of groundwater in the NASb are described below.

Rural residential land uses and users. The chronic lowering of groundwater level MTs is protective of domestic well users' ability to access groundwater. As documented in **Appendix B**, domestic well construction was analyzed in the vicinity of each RMS location with a projected decline of 5 feet or more. The evaluation looked at the total depth and first open interval 1,331 potentially existing domestic wells. Note that there are an estimated 2,412 domestic wells NASb-wide. Based on the analysis, no domestic wells of up to 50 years old would go dry (e.g., drop below their total depth). Of wells that are greater than 50 years old, only 2 percent (26 wells) could potentially drop below their total depth; many of these may no longer in use. In terms of maintaining groundwater levels above their first open interval, domestic users are also protected. Of wells that are up to 50 years old, less than 1 percent (9 wells) could potentially drop below the

first open interval. Of wells greater than 50 years old, less than 5 percent (65 wells) would potentially drop below their first open interval. Again, many of the wells are over 50 years old and may longer be in use. Confirmation of the status of these domestic wells is a management action in this GSP (see **Section 9.2.6**). MTs could result in slightly higher energy costs associated with greater pumping lifts in limited areas.

Agricultural land uses and users. Similar to rural residential users and users, MTs for chronic lowering of groundwater levels protect agricultural users of groundwater by protecting their ability to meet their typical demands. Most agricultural wells are constructed to deeper depths than domestic wells as shown on **Figure 7-6**. As MTs are set higher to protect other users like rural residences and GDEs, they will also be protective of agricultural beneficial uses of groundwater unless declines continue or are not stabilized. MT exceedances could also increase agricultural land users' energy costs associated with greater pumping lifts.

Urban land uses and users. The MTs for chronic lowering of groundwater levels are set so that all users, including municipal groundwater pumpers can still meet their typical water demands. Similar to the agricultural users, municipal wells are typically deeper, and as MTs are set higher to protect other users such as rural residential and GDEs, if MTs for chronic lowering of groundwater level are exceeded in many areas the exceedance will likely not limit urban beneficial use of groundwater unless declines continue or are not stabilized. MT exceedances could also increase urban land users' energy costs associated with greater pumping lifts.

Ecological land uses and users. The chronic lowering of groundwater level MTs protect Avoid undesirable results with respect to GDEs in the NASb. As described in **Appendix O**, a comparison of existing GDE areas under current conditions compared to conditions at the Subbasin MTs results in only a 2 percent decrease in vegetation and less than a 1 percent decrease in wetland areas. Of those potentially impacted areas, more than 70 percent of the vegetation was classified as low priority (meaning that neither critical species nor diverse vegetation was present) and all of the wetland areas that are potentially impacted were classified as low priority. The MTs are also protective of aquatic ecosystems, which is discussed further under **Section 8.9** below.

8.4.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for chronic lowering of groundwater elevations.

8.4.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater levels in RMS wells will be directly measured to determine where groundwater elevations are in relation to MTs and MOs. Groundwater level monitoring will be conducted in accordance with the monitoring protocols outlined in **Section 7.10 – Monitoring Protocols**. Many RMS wells are equipped with continuous data loggers to observe data in between the semi-annual MT and MO monitoring.

After the initial detection of an MT exceedance, the GSAs will:

- Take confirmation measurements.
- If the exceedance is confirmed, initiate an investigation to assess the cause of the exceedance.
- Identify if there are impacts as a result of the MT exceedance and possible mitigation measures, if impacts are noted.

8.4.3 Measurable Objectives – Chronic Lowering of Groundwater Levels

The MOs used to define preferred sustainable groundwater level conditions in the NASb are provided within this section.

8.4.3.1 Measurable Objectives

Groundwater level MOs were set above the MTs to allow for groundwater use for beneficial uses and users in the NASb. The MOs were established based on the approximate average historical Spring groundwater levels from 2010 through 2019 to reflect current conditions and because at these levels there were no reported negative impacts on beneficial uses and users. **Table 8-3** provides a listing of the selected MOs at each RMS.

8.4.3.2 Interim Milestones

Groundwater levels were established as interim milestones at all RMS on a 5-year frequency for the next 20 years as documented in **Table 8-3**. Groundwater levels in the NASb are currently above MTs at all RMS. Minor groundwater level declines in parts of the Subbasin are projected over the next 20 years based on modeling simulations. The 20-year interim milestone groundwater elevation coincides with the MO for each RMS. All of the values provided in **Table 8-3** will be periodically reevaluated as empirical data from monitoring is analyzed. For this reason, the values identified in **Table 8-3** will be evaluated and modified in accordance with the GSP regulatory requirements. The MOs at the RMS locations for chronic lowering of groundwater are shown on **Figure 8-7**.

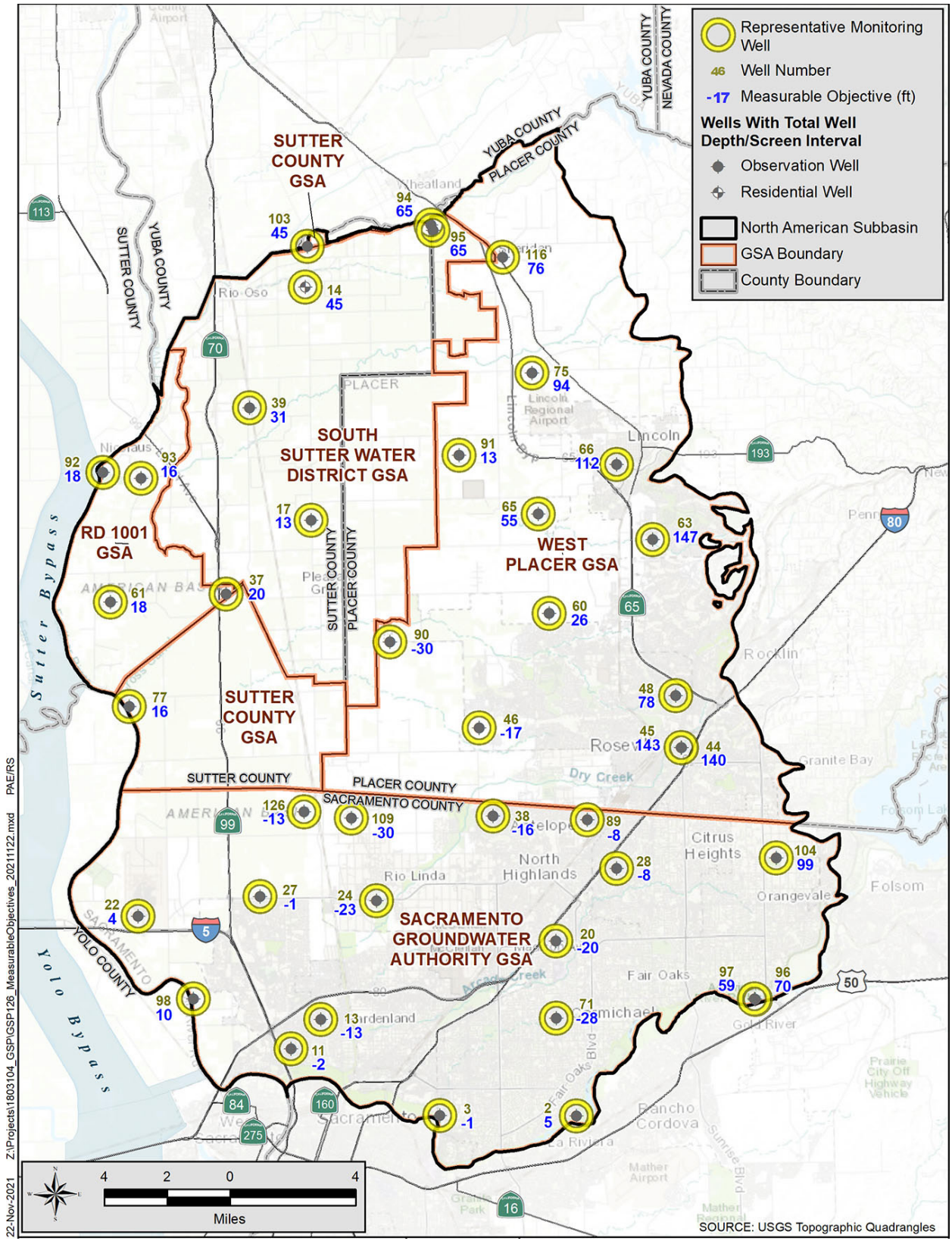


Figure 8-7. Projected Groundwater Elevation MOs at RMS Locations

Table 8-3. Chronic Lowering of Groundwater Level Measurable Objectives and Interim Milestones

Representative Monitoring Site		Selected MO (ft msl)	Interim Milestones (ft msl)			
Map No.	Local Name		Year 5 (ft msl)	Year 10 (ft msl)	Year 15 (ft msl)	Year 20 (ft msl)
2	SGA_MW06	5	9	7	6	5
3	SGA_MW04	-1	3	1	-1	-1
11	Bannon Creek Park	-2	1	0	-2	-2
13	Chuckwagon Park	-13	-8	-10	-12	-13
14	13N04E23A002M	45	49	47	46	45
17	AB-2 shallow	13	21	18	14	13
20	SGA_MW05	-25	-18	-21	-24	-25
22	AB-4 shallow	4	8	6	5	4
24	SGA_MW02	-23	-17	-19	-22	-23
27	AB-3 shallow	-1	8	4	0	-1
28	Twin Creeks Park	-19	-11	-15	-18	-19
37	SUT-P1	20	22	21	20	20
38	Lone Oak Park	-21	-15	-18	-20	-21
39	AB-1 shallow	31	35	33	32	31
44	WPMW-10A	140	140	140	140	140
45	WPMW-9A	143	143	143	143	143
46	SVMW West - 1A	-22	-18	-20	-21	-22
48	WPMW-4A	78	78	78	78	78
60	WPMW-2A	26	26	26	26	26
61	Sutter County MW-5A	18	19	19	18	18
63	WPMW-3A	147	147	147	147	147
65	MW 1-3	55	55	55	55	55
66	MW 5-1	112	112	112	112	112
71	WCMSS	-32	-24	-27	-31	-32
75	MW 2-3	94	95	94	94	94
77	SREL-1-27-F1	16	18	17	16	16
89	Roseview Park - 315	-13	-10	-11	-13	-13
90	WPMW-12A	-30	-22	-25	-29	-30
91	WPMW-11A	13	18	16	14	13
92	RDMW-101	18	19	19	18	18
93	RDMW-102	16	18	17	16	16
94	RDMW-103	65	66	66	65	65
95	RDMW-104	65	66	66	65	65
96	1516	70	71	71	70	70
97	1518	59	62	61	59	59
98	URS71000-700+00C	10	10	10	10	10
103	BR-1B	45	45	45	45	45
104	SGA_MW08	99	107	104	100	99
109	SGA_MW01	-30	-20	-24	-29	-30
116	Old Well #2	76	78	77	76	76
126	DeWit	-13	0	-6	-11	-13

8.5 Sustainability Indicator #2 - Reduction of Storage

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #2 – reduction of storage. Because chronic lowering of groundwater levels can be directly correlated to reduction of storage, groundwater levels will be used as a suitable proxy for reduction of storage.

Using the same modeling scenario for Sustainability Indicator #1 described above, results showed the basin's future projected inflows are balanced with projected outflows (*see* **Table 8-4)**. This would indicate that using the same MTs and MOs as the chronic lowering of groundwater levels MTs and MOs would also result in meeting this sustainability indicator.

Table 8-4. Projected Groundwater Change in Storage

Groundwater Budget Component	Current Conditions (AFY)	Projected with Climate Change and Project Implementation (AFY)
Inflows		
Deep Percolation	183,500	161,000
Stream Seepage	134,500	160,700
GW Injection (from ASR Operations)	200	2,100
Other Recharge	16,700	16,400
Subsurface Inflow	49,900	55,600
Total Inflow	***384,700***	***395,800***
Outflows		
Groundwater Outflow to Streams	53,000	42,400
Groundwater Pumping	303,300	338,500
Subsurface Outflow	13,600	14,900
Other Flows	-	100
Total Outflow	**369,900**	**395,800**
Change in Groundwater Storage	**14,900**	**-**

8.5.1 Undesirable Results – Reduction of Storage

The reduction of storage is considered significant and unreasonable when the following occurs:

- *20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41).*

8.5.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for reduction of storage are the same as used for chronic lowering of groundwater levels.

8.5.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for reduction of storage are the same as for chronic lowering of groundwater levels.

8.5.1.3 Effects on Beneficial Users and Land Use

The effects on beneficial users and land use are the same as used for chronic lowering of groundwater levels.

8.5.2 Minimum Thresholds – Reduction of Storage

8.5.2.1 Reduction of Storage Minimum Threshold

The GSAs used groundwater levels, which can serve as a reasonable proxy for defining quantitative thresholds for this sustainability indicator as supported in the GSP regulations (§354.28 (d)).

8.5.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

The information and criteria used are the same as used for chronic lowering of groundwater levels.

8.5.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between MTs for each sustainability indicator is the same as used for chronic lowering of groundwater levels.

8.5.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The effects of MTs on adjacent subbasins is the same as used for chronic lowering of groundwater levels.

8.5.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The effects of MTs on beneficial uses and users is the same as used for chronic lowering of groundwater levels.

8.5.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for reduction of storage.

8.5.2.7 Method for Quantitative Measurement of Minimum Threshold

The method for quantitative measurement is the same as used for chronic lowering of groundwater levels.

8.5.3 Measurable Objectives – Reduction of Storage

The measurable objectives used to define reduction of storage conditions in the NASb are provided within this section.

8.5.3.1 Measurable Objectives

MOs for reduction in storage are the same as used for chronic lowering of groundwater levels.

8.5.3.2 Interim Milestones

The interim milestones for MOs for reduction in storage are the same as used for chronic lowering of groundwater levels.

8.6 Sustainability Indicator #3 - Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator because the nearest occurrence of saline water intrusion into waterways, the Sacramento-San Joaquin River Delta, is about 40 miles west of the Subbasin boundary. The location of the saline front in the rivers has been maintained in the Delta in a similar location for nearly 80 years due to construction and operation of dams tributary to the Delta. Seawater intrusion is unlikely to occur during the planning horizon of this GSP.

8.7 Sustainability Indicator #4 - Degraded Water Quality

Although the concentration of constituents varies widely over the NASb and with depth at any given location, the quality of groundwater in the NASb has been suitable for nearly all beneficial uses and users. As described in **Section 5 – Groundwater Conditions**, there are some areas of elevated total dissolved solids (TDS), arsenic (As), hexavalent chromium (CrVI), iron (Fe), and

manganese (Mn). Additionally, while not having any concentrations exceeding water quality standards, nitrates are an element of concern in the Subbasin. For the most part, constituent trends have remained stable and concentrations have not significantly changed over many decades, with the exception of nitrate, which has an upward trend in about 20 percent of the wells sampled (*refer to* **Table 5-4**). With scattered to very few possibly increasing trends in As, CrVI, Fe, and Mn observed to date and no significant changes in the planned use or management activities in the Subbasin, the NASb is not setting SMCs for these constituents. Rather, the GSAs will continue to monitor these constituents to observe if consistent increasing trends emerge. Because increases in TDS and nitrate can be associated with human activities, and, therefore, subject to some form of management if needed, the NASb is establishing SMC for these two constituents.

It is also worth noting that in the Sacramento County portion of the NASb, there are well-documented larger areas of contamination as described in **Section 5.8.3**. As also described in that section, the NASb has analyzed expanded groundwater use around the plumes relative to the ongoing remediation operations and found that the plumes have effective capture. Representatives of the NASb have also maintained active coordination with regulators and responsible parties to address effective remediation of these contaminants. For that reason, there are no SMC for the contaminants in groundwater.

Based on the above information, degraded water quality is considered significant and unreasonable in the NASb when either of the following occur:

For public water system wells

- *The basin wide average total dissolved solids (TDS) concentrations of <u>all</u> public water system wells exceeds 400 mg/l.*

OR

- *The basin wide average nitrate (as N) concentration of <u>all</u> public water system wells exceeds 8 mg/l.*

For the shallow aquifer (i.e. domestic and self-supplied) wells

- *25% of the representative monitoring sites (RMS)[3] total dissolved solids (TDS) or nitrate (as N) concentrations exceed state maximum contaminant levels (MCLs).*

[3] Representative monitoring sites (RMSs) are interchangeably referred to as representative monitoring wells (RMWs)

8.7.1.1 Criteria for Defining Undesirable Results

The criteria used to define undesirable results for degraded water quality is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of:

- Groundwater that fails to meet state drinking water standards for domestic and self-supplied wells which are located predominantly in the shallow aquifer.
- Groundwater that fails to meet state drinking water standards for public water systems (i.e., municipal wells).
- Groundwater exceeding agricultural water quality goals for TDS resulting in lesser crop yields.

8.7.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for degraded water quality are:

- Changes in NASb pumping distribution and volumes. This would be most likely due to changing land use practices such as an increase or concentration of new agricultural and/or municipal pumping. This pumping could alter hydraulic gradients and cause movement of poor-quality groundwater towards municipal or domestic wells, causing concentrations to exceed state drinking water standards or agricultural water quality goals.
- Changing land use practices that contaminate the quality of the groundwater basin or cause an increase in recharge of poor-quality water. Groundwater quality could become degraded by increasing the salt content (i.e., lowering of groundwater levels increases and changes in pressure allows saline water from underlying marine sediments to intrude into freshwater aquifers).

8.7.1.3 Effects on Beneficial Users and Land Use

If undesirable results were to occur, the effect may be groundwater quality that does not meet state drinking water standards or agricultural water quality goals. This would result in either potentially expensive treatment or may trigger increased use of an alternative water supply (e.g., surface water) to meet demands. An alternative water supply may be economically or physically infeasible for certain beneficial users.

This undesirable result does not apply to groundwater quality changes that are outside the control of the GSAs. Multiple federal, state, and local regulatory requirements regarding the protection of groundwater quality exist that will be enforced by these agencies.

8.7.2 Minimum Thresholds – Degraded Water Quality

The MTs used to support the undesirable results definition of the degradation of water quality are provide within this section.

8.7.2.1 Degraded Water Quality Minimum Threshold

The MTs are state drinking water standards for constituents of concern monitored in all public water system wells (i.e., municipal wells) and in the RMS locations for domestic/self-supplied wells for degraded groundwater quality. These MTs include:

- *Individual well total dissolved solids (TDS) concentrations that exceed the state secondary recommended maximum contaminant level (MCL).*
- *Individual well nitrate (as N) concentrations that exceed the state primary maximum contaminant level (MCL).*

As defined by the State Water Resources Control Board (SWRCB) the MCL for nitrate (as N) is a primary MCL and for TDS is a secondary aesthetic "taste and odor" MCL. State regulations allow public water systems to serve water that exceeds secondary aesthetic MCL standards under certain conditions and there are no public health goals for secondary MCLs, whereas primary MCL standards are more strictly observed.

8.7.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

Information used to establish the degraded groundwater quality MTs included:

- Historical and current groundwater quality data from municipal and monitoring wells in the NASb.
- Federal and State drinking water standards.
- Agricultural water quality goals.
- Depths, location, and geologic information from well logs throughout the NASb.
- Evaluation and organization of different well type construction data (i.e., domestic, municipal, and irrigation).

The criteria used to establish MTs consisted of analyzing the historical and current groundwater quality data as discussed in **Section 5 – Groundwater Conditions**. Based on a review of the information identified above, the GSAs determined that state drinking water standards are the most appropriate values to define as the MTs.

For public water system, or municipal wells, the SWRCB Division of Drinking Water (DDW) requires all active municipal wells be periodically sampled and analyzed in accordance with California Water Code Title 22 constituent standards. Results from this analysis is provided directly to the Division of Drinking Water through the Electronic Data Transfer site.

For domestic/self-supplied wells, special care was taken to evaluate the density and known well construction details of domestic wells by section in the NASb. As illustrated on **Figure 7-10**, RMSs were strategically located in areas throughout the Subbasin where the greatest density of domestic/self-supplied wells occur, along with additional wells to provide regional coverage in areas with lesser densities.

8.7.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The NASb projects and management actions (*refer to* **Section 9 – Projects and Management Actions**) are focused on ensuring the sustainability of the Subbasin from chronic lowering of groundwater levels, reduction of storage, land subsidence, and depletions of interconnected streams. The NASb groundwater quality generally meets all beneficial uses and users and is currently sustainable. From a GSP project and management action perspective, there are no projects and management actions in the NASb GSP focused on groundwater quality and, therefore, no direct relationship to other sustainability indicators. However, the prevention of migration of poorer quality groundwater, as a result largely of chronic lowering of groundwater levels, is the main relationship between the degraded water quality and other sustainability indicators.

In theory the degraded water quality MT could influence the **chronic lowering of groundwater levels, reduction of groundwater in storage, land subsidence,** and **depletion of interconnected surface water** MTs in a positive way, if groundwater pumping is reduced as a result of domestic and municipal users being unable to pump groundwater to meet demands. However, GSAs will be managing the groundwater to avoid this theoretical situation, so that groundwater can continue to be used for beneficial uses.

The metric of using state standards has been applied to define MTs for the degraded groundwater quality sustainability indicator. The remaining sustainability indicators' minimum thresholds are based on other metrics (i.e. all others use groundwater). For this reason, there is no conflict between the degraded groundwater quality and other MTs.

8.7.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The anticipated negative effects of exceeding the degraded groundwater quality MTs to each of the neighboring basins is very negligible to potentially nonexistent. If NASb degraded groundwater quality MTs were to be exceeded, it would likely be a result of significant groundwater level declines within the NASb that would result in potentially changing the direction or increasing the slope of the hydraulic gradient of groundwater from adjacent basins towards the NASb. This could result in a potential of increased rate and volume of subsurface

flow into the NASb. For this reason, any groundwater quality degradation would likely be contained within the NASb. However, the flow dynamics associated with groundwater level declines, which may change the direction or increase the gradient across basin boundaries are also possible in the other subbasins, meaning if adjacent subbasin groundwater quality was significantly degraded it could impact the NASb.

8.7.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

Degraded groundwater quality minimum thresholds (if exceeded) may have effects on beneficial uses and users of groundwater in the NASb.

Rural residential land uses and users. The degraded groundwater quality MTs protect domestic users of groundwater in the basin as the MTs coincide with state drinking water standards. If the MT was exceeded for nitrate (as N) water would not meet primary MCL state standards. If the MT was exceeded for TDS, water would not meet secondary aesthetic MCL state standards. However, for TDS, domestic users would still be able to use groundwater in excess of the taste and odor thresholds.

Agricultural land uses and users. The degraded groundwater quality MTs generally benefit agricultural water users of groundwater in the basin as the MTs for the agricultural water quality goal of 450 mg/L to obtain 90 percent crop production for TDS is close to the drinking water standard of 500 mg/L. For this reason, groundwater quality approaching the MT will likely not negatively affect known agricultural land uses.

Urban land uses and users. The degraded groundwater quality MTs protect urban water users of groundwater in the basin as the MT coincides with state drinking water standards. Preventing groundwater used for drinking water from exceeding the state drinking water standards provides adequate water quality of groundwater for municipal uses.

Ecological land uses and users. The groundwater quality MTs would benefit ecological users by preventing poor quality groundwater from migrating to GDEs.

8.7.2.6 Relevant State, Federal, and Local Standards

The degraded groundwater quality MTs specifically incorporate state drinking water standards.

8.7.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater samples will be taken in accordance with the monitoring network description provided in **Section 7 – Monitoring Networks**. Results from these samples will enable GSAs to make a direct correlation between current groundwater quality concentrations and state water quality standards.

The GSAs also intend to monitor groundwater quality with the use of "Sentry Wells". A Sentry Well is not an RMS as defined by the GSP regulations for degraded water quality. The GSAs

have identified Sentry Wells for the specific purpose of providing early warning of groundwater quality changes (spatially or vertically) due to shifting changes in groundwater use in the NASb. The GSAs will sample, analyze, and report on water quality concentrations for TDS and nitrate (as N) at Sentry Wells to determine if water quality changes related to groundwater level changes that could result in MT exceedances could occur.

Many constituents that are routinely sampled and analyzed from groundwater wells (e.g., general minerals and metals) are often observed to have significant fluctuations in concentrations over time. Due to these fluctuations, multiple groundwater samples need to be collected over many years to establish trends and a true and accurate understanding of groundwater quality conditions. It is good practice to sample at the same time of year when collecting and analyzing groundwater quality samples from wells. TDS concentrations from groundwater samples are often more susceptible than many other constituents to fluctuating concentrations over time.

Furthermore, although the GSAs will strive to collect samples in accordance with best management practices, the practice of obtaining water quality samples in the field is done so in an uncontrolled environment and, therefore, can lead to erroneous data. For this reason, if MT exceedances are reported, GSAs may resample to verify measurements to ensure accurate readings are reported. Data determined to be erroneous by the GSA and not representative of actual conditions will not be used for the purposes of defining sustainability.

8.7.3 Measurable Objectives – Degraded Water Quality

The MOs used to define optimal water quality conditions in the NASb are provided within this section.

8.7.3.1 Measurable Objectives

The MO for public water system wells will be 300 mg/l for TDS and 3 mg/l for nitrate (as N). These MO concentrations are slightly higher than average concentrations observed in public supply wells from more than 300 samples of TDS and nitrate (as N) as summarized on **Table 8-5**. Slightly higher average MO concentrations were established based on the understanding that projected groundwater levels might be slightly lower in 2042, possibly increasing concentrations. A list of known public system wells and a summary of water quality detections is provided in **Appendix L – Summary of Water Quality Detections**. The average values for TDS and nitrate (as N) have been calculated based on the most recent sample result from each well as summarized in **Table 8-5**.

Table 8-5. Measurable Objective (Public Supply Well – Average Nitrate and TDS Concentrations)

Public Supply Well Statistic	Nitrate (as N)	TDS
Units	mg/l	mg/l
Date Range	4/9/1987 10/1/2019	4/9/1987 9/12/2019
Minimum Concentrations[1]	0	0
Maximum Concentrations	10	720
Maximum Contaminant Level (MCL)	10	500
Number of reported concentrations observed above MCL during date range	0	3
Number of wells with analytical results during date range	354	313
Average concentrations reported during date range[2]	**1.8**	**258.4**
Measurable Objective (Estimated concentration based on projected groundwater levels in year 2042)	**3**	**300**

[1] For purposes of averaging concentration, less than the reporting limit is calculated as 0.
[2] Concentrations are calculated based on the average of the most recent sample result from each well.

The MOs for the domestic/self-supplied wells is approximately 10 percent higher than recent concentrations for Nitrate (as N) and TDS reported at each RMS as illustrated in **Table 8-6**. Similar to the methodology used to establish MO concentrations for public supply wells, the MOs for domestic/self-supplied wells are slightly higher than average concentrations observed in RMS as summarized on **Table 8-6**. Slightly higher average MO concentrations were established based on the understanding that projected groundwater levels might be slightly lower in 2042 possibly increasing concentrations. If an RMS does not have groundwater quality data during this period, an MO will be established prior to the next 5-year GSP update.

Table 8-6. Measurable Objective (Domestic/Self-supplied – RMS Nitrate and TDS Concentrations)

Map No.	Local Name	TDS (Secondary MCL = 500 mg/L)			Nitrate (Primary MCL = 10 mg/L)			Interim Milestones (mg/l)
		Reported Concentration (mg/L)	Selected MTs (mg/L)	Selected MOs (mg/L)	Reported Concentration (mg/L)	Selected MTs (mg/L)	Selected MOs (mg/L)	Year 5, 10, 15, & 20 (mg/L)
17	AB-2 shallow	200	500	220	ND	10	ND	ND
20	SGA_MW05	274	500	300	1.5	10	1.7	1.7
24	SGA_MW02	270	500	300	4.1	10	4.5	4.5
27	AB-3 shallow	150	500	170	ND	10	ND	ND
37	SUT-P1	110	500	120	ND	10	ND	ND
39	AB-1 shallow	140	500	150	ND	10	ND	ND
46	SVMWWest1A	unknown	500	TBD	unknown	10	TBD	TBD
80	Cemetery (IRLP)	268	500	290	unknown	10	TBD	TBD
89	Roseview Park - 315	190	500	210	unknown	10	TBD	TBD
90	WPMW-12A	210	500	230	0.58	10	0.64	0.64
91	WPMW-11A	220	500	240	1.0	10	1.1	1.1
99	Main Well	unknown	500	TBD	ND	10	ND	ND
109	SGA_MW01	330	500	360	0.9	10	1.0	1.0
133	LW-1	200	500	220	3.6	10	4.0	4.0
177	Well 22 - Northrop	110	500	120	ND	10	ND	ND
298	Tinker Road Well	220	500	240	3.87	10	4.26	4.26

8.7.3.2 Interim Milestones

Groundwater quality in the NASb is currently below the respective MTs for public supply wells and domestic/self-supplied wells, with no change in quality expected from projects and management actions implemented to maintain sustainability. Since the MOs effectively represent current conditions, interim milestones for the RMS wells are set as the same concentrations as MOs shown on **Table 8-6**.

8.8 Sustainability Indicator #5 - Land Subsidence

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #5 – land subsidence.

8.8.1 Undesirable Results – Land Subsidence

As described in **Section 5.10 – Land Subsidence**, past land surface subsidence has been very limited and has been gradual through time. As a result, no significant impacts have been documented in the NASb from subsidence. Additionally, the geologic setting (*see* **Section 4.9 - Geologic Sections**) does not indicate the presence of thick, laterally extensive clay deposits that generally create conditions for subsidence to occur. Based on these conditions, significant and unreasonable land surface subsidence could occur when:

The rate of inelastic subsidence exceeds 0.5 feet over a five-year period over an area covering approximately five or more square miles.

8.8.1.1 Criteria for Defining Undesirable Results

Based on past limited subsidence documented in the Subbasin, there have been no undesirable results encountered. Based on the hydrogeologic setting (*see* **Section 4 – Hydrogeologic Setting**) and projected conditions (*see* **Section 6.4.3 – Projected Water Budget**), the Subbasin would not expect to experience undesirable results associated with subsidence. Therefore, the criteria used would indicate exceeding past rates of subsidence. The area of five square miles was selected because it represents one percent of the total area of the Subbasin. An area covering less than that would be a highly localized phenomenon (or potentially based on erroneous data) that would not impact overall basin sustainability.

8.8.1.2 Potential Causes of Undesirable Results

Potential causes that may create these undesirable results could be from groundwater pumping causing groundwater levels to drop below historic lows which may result in inelastic land subsidence.

8.8.1.3 Effects on Beneficial Users and Land Use

As stated above, historically the Subbasin has not experienced undesirable results based on existing land subsidence data. For this reason, the extent and magnitude of how an undesirable result for land subsidence might impact beneficial users of groundwater and land uses can only be theorized. Therefore, should undesirable results for subsidence due to groundwater extractions occur, possible impacts to beneficial users' land use could include:

- Shifting of land gradients causing problems for crops that rely on precise irrigation depths (e.g., rice).
- Damage to pipelines and wells.
- Shifting of grades to sewer and storm drains preventing proper drainage.
- Damage to pavement on local roads and highways or structural damage to buildings.
- Lowering of levee crowns adjacent to rivers increasing flood risk.

8.8.2 Minimum Thresholds – Land Subsidence

8.8.2.1 Land Subsidence Minimum Thresholds

Groundwater levels are being used as a proxy for minimum thresholds. At each groundwater level RMS, either the minimum recorded low water level elevation or the projected low groundwater elevation, whichever is lower, is being used. In the case of historical lows, subsidence would not be expected until the level exceeded the minimum threshold. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (*refer to* **Section 5.10 – Land Subsidence**). As the maximum projected long-term drawdown within the Subbasin is about 18 feet, that would equate to approximately 0.18 feet of subsidence. That would not result in a demonstrable impact in the Subbasin (i.e., no infrastructure damage or loss of surface water conveyance capacity would be expected). **Table 8-7** shows the RMS locations used for land subsidence. The table also shows the MT as determined by the modeled projected conditions, for chronic lowering of groundwater levels and the minimum measured groundwater elevation near each location. Where the minimum elevation is lower than the modeled MT, the lower value is used for the subsidence MT.

Table 8-7. Minimum Thresholds for Land Subsidence RMS

Map No.	Local Name	Model Projected MT (ft msl)	Subsidence Historic Low Groundwater Levels	Selected MT (ft MSL)
2	SGA_MW06	1	7	1
3	SGA_MW04	-5	-2	-5
11	Bannon Creek Park	-5	-2	-5
13	Chuckwagon Park	-15	-10	-15
14	13N04E23A002M	26	15	15
17	AB-2 shallow	-17	-21	-21
20	SGA_MW05	-37	-35	-37
22	AB-4 shallow	-1	4	-1
24	SGA_MW02	-27	-19	-27
27	AB-3 shallow	-4	5	-4
28	Twin Creeks Park	-28	-15	-28
37	SUT-P1	10	8	8
38	Lone Oak Park	-27	-19	-27
39	AB-1 shallow	3	-5	-5
44	WPMW-10A	133	133	133
45	WPMW-9A	135	131	131
46	SVMW West - 1A	-32	-28	-32
48	WPMW-4A	75	72	72
60	WPMW-2A	22	21	21
61	Sutter County MW-5A	10	-1	-1
63	WPMW-3A	145	146	145
65	MW 1-3	49	38	38
66	MW 5-1	108	104	104
71	WCMSS	-40	-26	-40
75	MW 2-3	89	86	86
77	SREL-1-27-F1	9	13	9
89	Roseview Park - 315	-22	-17	-22
90	WPMW-12A	-45	-65	-65
91	WPMW-11A	3	-18	-18
92	RDMW-101	15	14	14
93	RDMW-102	12	8	8
94	RDMW-103	58	36	36
95	RDMW-104	57	36	36
96	1516	67	69	67
97	1518	57	61	57
98	URS71000-700+00C	7	6	6
103	BR-1B	36	36	36
104	SGA_MW08	97	107	97
109	SGA_MW01	-33	-20	-33
116	Old Well #2	68	72	68
126	DeWit	-25	12	-25

The Department of Water Resources (DWR) is advancing statewide understanding of land subsidence through the use of InSAR technology[4]. DWR has recently extended the use of InSAR technology first utilized in the San Joaquin Valley to evaluate the extent of subsidence to the Sacramento Valley. As data from InSAR has only recently become available, the GSAs did not have the time to thoroughly evaluate the use of InSAR collected data at the time of the preparation of this GSP in comparison to the process described above relating to understanding land subsidence in the NASb. For this reason, the NASb GSAs are establishing MTs using the accepted practice of utilizing historic land subsidence data and correlating it to groundwater levels. However, the NASb GSAs may incorporate DWR-provided InSAR data into how the GSAs evaluate compliance with the SMC.

8.8.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

Information used in establishing thresholds and objectives includes multiple lines of directly measured subsidence (*refer to* **Section 5.10 – Land Subsidence**), direct measurements of historic water levels (see **Section 5.2 – Groundwater Levels and Appendices G through I**), and modeled simulation of projected groundwater elevations based on future land use changes and future climate conditions (see **Section 8.4.2.2**).

8.8.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between land subsidence MTs for other sustainability indicators are discussed below.

Chronic lowering of groundwater levels. These are closely related in that the subsidence MTs will be measured at the same locations as for groundwater levels. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater levels are declining below their groundwater level MT, even though subsidence would likely not be occurring.

Reduction of groundwater in storage. These are closely related in that the subsidence MTs will be measured at the same locations as for groundwater levels. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater in storage is being reduced, with some minor projected subsidence.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

[4] InSAR (Interferometric Synthetic Aperture Radar) is a technique for mapping land subsidence with very precise accuracy using radar images of the Earth's surface that are collected from orbiting satellites.

Degraded groundwater quality. There is no relationship between subsidence and groundwater quality.

Depletion of interconnected surface water. These are closely related in that the subsidence MTs will be measured at the same locations as for interconnected surface water groundwater level locations. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater levels are declining that induces additional seepage of surface water, even though subsidence would likely not be occurring.

8.8.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The MTs are not expected to effect adjacent subbasins because they are established at historical or projected low groundwater levels in the representative groundwater level monitoring network, whichever is lower. In the case of historical lows, subsidence would not be expected until the level exceeded the MT. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (see **Section 5.10 – Land Subsidence**). As the maximum projected long-term drawdown at RMS locations to an adjacent subbasin is about 6 feet, that would equate to approximately 0.06 feet of subsidence. That would not result in a demonstrable impact on an adjacent subbasins.

8.8.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The MTs are not expected to effect beneficial uses and users because they are established at historical or projected low groundwater levels in the representative groundwater level monitoring network, whichever is lower. In the case of historical lows, subsidence would not be expected until the level exceeded the MT. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (see Section 5.10). As the maximum projected long-term drawdown within the subbasin is about 18 feet, that would equate to approximately 0.18 feet of subsidence. That would not result in a demonstrable impact on a beneficial user in the subbasin (i.e., no infrastructure damage or loss of surface water conveyance capacity would be expected).

8.8.2.6 Relevant State, Federal, and Local Standards

There are no established state, federal, or local standards for subsidence-related thresholds.

8.8.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater levels are being used as a proxy for MTs. While many of the groundwater elevation monitoring network wells are equipped with pressure transducers to collect at least daily water levels, the minimum standard for quantitative water elevation measurements will be through a manually collected field measurement taken twice annually (Fall and Spring). The Fall water level measurement will be used to compare against the MT.

8.8.3 Measurable Objectives – Land Subsidence

8.8.3.1 Measurable Objectives

Given the well-established relationship between groundwater levels and subsidence, groundwater levels are used as a proxy for MOs for land subsidence. Because the MOs established for chronic lowering of groundwater levels and reduction of groundwater in storage represent the desired state for a sustainable groundwater basin, those same values apply to land subsidence as shown in **Table 8-7**.

8.8.3.2 Interim Milestones

Because the MO interim milestones established for chronic lowering of groundwater levels and reduction of groundwater in storage represent the desired state for a sustainable groundwater basin, those same values apply to land subsidence as shown in **Table 8-7**.

8.9 Sustainability Indicator #6 - Depletion of Surface Water

The following description addresses SGMA GSP regulatory requirements related to sustainability indicator #6 – depletion of surface water. Because the depletion of interconnected surface water is directly related to the gradient between the surface water system at the groundwater interface and the groundwater Subbasin, groundwater levels are a suitable proxy for this sustainability indicator. Because surface water is not interconnected with the groundwater Subbasin over its entire area (*see* **Section 5.11**), only a subset (24 wells) of the RMS for groundwater elevations is used, which is shown in **Figure 7-13** in **Section 7.3 – Representative Monitoring Network**. Of those wells, some are monitoring different depths at the same location. As a result, there are 21 locations that will be used for evaluation purposes.

Using the same modeling scenario for Sustainability Indicator #1 described above, the effects on surface water flows resulting from land use changes and coincident additional use of groundwater can be observed. This would indicate that using the same MTs and MOs as those for the chronic lowering of groundwater levels would also result in meeting this sustainability indicator.

The results of the modeled scenario, which is described further in **Section 9.2.1 – Project #1 – Regional Conjunctive Use Extension – Phase 1**, indicate that NASb-wide groundwater extractions are projected to increase from their Current Conditions Baseline (CCBL) by some 40,000 AFY under the Projected Conditions Baseline with Climate Change (PCBL+CC). As shown in **Figure 8-5** above, the most significant drawdown of groundwater elevations under these conditions is near the Sacramento River. A detailed analysis of seepage along the Sacramento River from the modeling results indicates that the river will lose about 5,800 AFY over the 50-year simulation to the groundwater basin. However, as the municipal development

occurs near the river, it will take some agricultural land out of production that currently diverts water from the river. As a result, Sacramento River flows will experience a net increase of about 17,200 AFY. This trend has already been observed by NMWC, which is in the area of proposed land use conversion. NMWC has observed surface water deliveries decline from an average of more than 80,000 AFY in the 1990s down to less than 65,000 AFY in the 2010s.

Figure 8-7 depicts the long-term projected changes along the Sacramento River on a monthly basis. Since the new groundwater demand is for public water supply, there is a baseline demand all year long (rather than a typical 6-month growing season). Additionally, some of the new public water supply will come from surface water, so there is a decrease in streamflow from January through March from diversions to meet that demand. The river will see its greatest increase in streamflow from May through August; this would have otherwise been diverted to meet agricultural demand. There is a net decrease in streamflow for the month of September, because there are still relatively high public supply demands in that month due to high air temperature and lack of precipitation. The net change is partially offset by the fact that many agricultural lands have reduced water applications in September. Overall, the projected land use changes would represent a net improvement to Sacramento River flows on an annual basis.

As described in **Section 5.11**, Central Valley Steelhead and Chinook Salmon are known to rely on the Sacramento, Feather, and American rivers, and Central Valley Steelhead are known to enter western Placer County creeks through the Natomas Cross Canal and the westernmost segment of Steelhead Creek. To evaluate whether there would be potential impacts to these aquatic species, additional seepage from each reach of these systems resulting from the modeled scenario described above was evaluated in comparison to total flow in the interconnected reach on a monthly basis. **Table 8-8** shows the projected average monthly flows in each reach, the projected future seepage from each reach to the groundwater system (value is negative when there is a net contribution from groundwater to surface water), and the percentage of surface water flow that seepage represents for any given month. As can be seen in the table, the seepage at all times represents less than 1 percent, generally substantially less, of flow in the rivers and the Natomas Cross Canal. In Steelhead Creek (aka Natomas East Main Drain), additional projected seepage is greater than 2 percent in a few months. However, that occurs in summer months when the fish species would not be migrating. Finally, it is worth noting that at no time do any of these reaches go dry. The Cross Canal and Steelhead Creek are constantly fed by urban runoff and wastewater treatment plants, and that condition is projected to increase with future development.

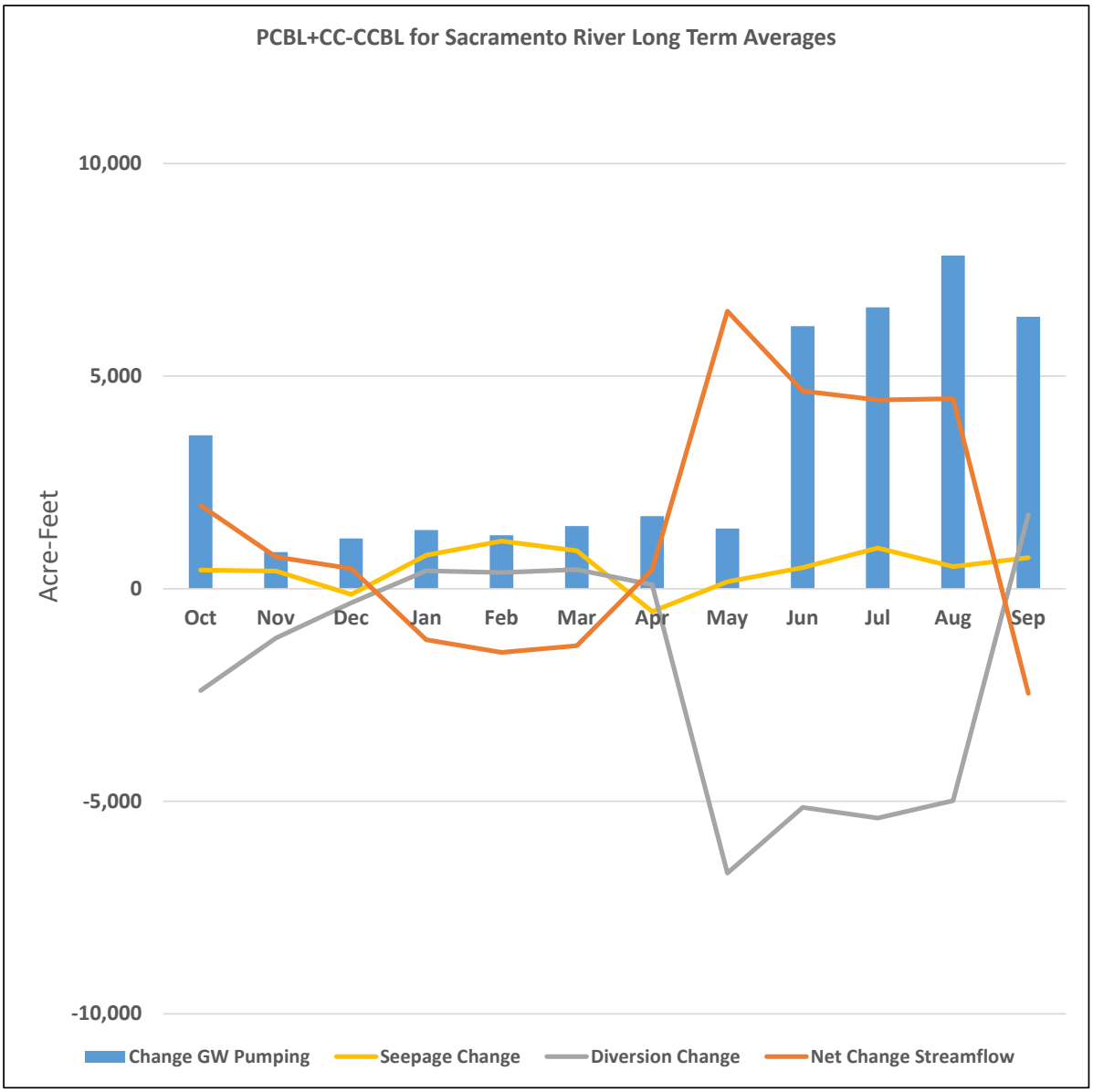


Figure 8-7. Projected Long-Term Average Annual Water Budget Change along the Sacramento River

Table 8-8. Seepage Changes in Interconnected Surface Waters that Support Critical Aquatic Species

Reach	Flow (acre-feet)	Seepage (acre-feet)	Seepage as Percent of Flow
Feather River			
Oct	166,572	156	0.09%
Nov	195,798	56	0.03%
Dec	354,140	369	0.10%
Jan	623,738	234	0.04%
Feb	814,007	422	0.05%
Mar	979,384	583	0.06%
Apr	449,412	-607	0.14%
May	208,164	-631	0.30%
Jun	212,331	87	0.04%
Jul	354,998	604	0.17%
Aug	274,013	-7	0.00%
Sep	288,837	336	0.12%
Annual Total	4,921,394	1,602	0.03%
Sacramento River			
Oct	509,583	485	0.10%
Nov	638,065	463	0.07%
Dec	1,078,974	-70	0.01%
Jan	1,718,596	862	0.05%
Feb	1,932,039	1,163	0.06%
Mar	2,021,789	871	0.04%
Apr	1,027,100	-493	0.05%
May	593,809	240	0.04%
Jun	559,450	568	0.10%
Jul	843,658	1,020	0.12%
Aug	723,319	574	0.08%
Sep	831,110	784	0.09%
Annual Total	12,477,492	6,467	0.05%
American River			
Oct	70,127	410	0.58%
Nov	92,426	517	0.56%
Dec	166,509	524	0.31%
Jan	305,324	784	0.26%
Feb	352,172	710	0.20%
Mar	378,339	918	0.24%
Apr	207,264	293	0.14%
May	104,031	17	0.02%
Jun	209,435	950	0.45%
Jul	221,909	764	0.34%
Aug	107,981	402	0.37%
Sep	117,452	749	0.64%
Annual Total	2,332,969	7,038	0.30%

Reach	Flow (acre-feet)	Seepage (acre-feet)	Seepage as Percent of Flow
Natomas Cross Canal			
Oct	7,156	41	0.57%
Nov	14,695	47	0.32%
Dec	30,120	40	0.13%
Jan	39,131	40	0.10%
Feb	37,100	49	0.13%
Mar	38,076	45	0.12%
Apr	11,913	31	0.26%
May	6,582	29	0.44%
Jun	5,123	21	0.41%
Jul	6,239	32	0.51%
Aug	5,227	30	0.57%
Sep	4,752	31	0.65%
Annual Total	206,114	436	0.21%
Steelhead Creek			
Oct	7,799	109	1.40%
Nov	13,522	75	0.55%
Dec	20,461	95	0.46%
Jan	26,383	92	0.35%
Feb	24,197	113	0.47%
Mar	24,097	133	0.55%
Apr	9,657	69	0.71%
May	6,465	101	1.56%
Jun	5,400	129	2.39%
Jul	6,194	163	2.63%
Aug	5,626	136	2.42%
Sep	5,510	125	2.27%
Annual Total	155,311	1,340	0.86%

8.9.1 Undesirable Results – Depletion of Surface Water

Depletion of surface water is considered significant and unreasonable when the following occurs:

- *20% or more of the NASb interconnected surface water (ISW) representative monitoring sites (RMS) have minimum threshold exceedances for 2 consecutive Fall measurements (5 out of 21).*

8.9.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for depletion of surface water is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of drawing down of groundwater levels such that a gradient is induced that results in significant

and unreasonable depletion of surface water that could impact downstream users, riparian and aquatic habitat and species in the river corridor, or adjacent GDEs dependent on shallow groundwater.

8.9.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for depletion of surface water are increased groundwater extractions that could induce additional seepage from local rivers and tributaries.

8.9.1.3 Effects on Beneficial Users and Land Use

If undesirable results were to occur, this could reduce the availability of surface water for downstream and in-basin diverters, riparian and aquatic habitat and species in the river corridor, or adjacent GDEs. Reduced surface water availability could limit land use if reliable water supply is determined to not be available.

8.9.2 Minimum Thresholds – Depletion of Surface Water

Groundwater levels were used as a proxy metric for this sustainability indicator.

8.9.2.1 Depletion of Surface Water Minimum Threshold

The MTs for depletion of surface water are the same as for chronic lowering of groundwater levels, with the exception that only a subset of the RMS locations are considered interconnected with the surface water system. These are shown in **Table 8-9**.

Table 8-9. MTs, MOs, and Interim Milestones for Depletion of Surface Water

Representative Monitoring Sites (i.e. Wells)		Final Selection		Interim Milestones (ft msl)			
Map No.	Local Name	(ft msl)	(ft msl)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
2	SGA_MW06	5	1	9	7	6	5
3	SGA_MW04	-1	-5	3	1	-1	-1
11	Bannon Creek Park	-2	-5	1	0	-2	-2
13	Chuckwagon Park	-13	-15	-8	-10	-12	-13
14	13N04E23A002M	45	26	49	47	46	45
22	AB-4 shallow	4	-1	8	6	5	4
27	AB-3 shallow	-1	-4	8	4	0	-1
28	Twin Creeks Park	-8	-17	-8	-8	-8	-8
37	SUT-P1	20	10	22	21	20	20
44	WPMW-10A	140	133	140	140	140	140
45	WPMW-9A	143	135	143	143	143	143
61	Sutter County MW-5A	18	10	19	19	18	18
63	WPMW-3A	147	145	147	147	147	147
66	MW 5-1	112	108	112	112	112	112
75	MW 2-3	94	89	95	94	94	94
77	SREL-1-27-F1	16	9	18	17	16	16
92	RDMW-101	18	15	19	19	18	18
93	RDMW-102	16	12	18	17	16	16
94	RDMW-103	65	58	66	66	65	65
95	RDMW-104	65	57	66	66	65	65
96	1516	70	67	71	71	70	70
97	1518	59	57	62	61	59	59
98	URS71000-700+00C	10	7	10	10	10	10
103	BR-1B	45	36	49	47	46	45

8.9.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

The criteria used to define significant and undesirable results for depletion of surface water are the same as used for chronic lowering of groundwater levels, with an additional analysis of changes in streamflow as described above.

8.9.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between depletion of surface water MTs and other sustainability indicators are discussed below:

Chronic lowering of groundwater levels. These are closely related in that the MT values are the same. However, the MTs for depletion of surface water are only applicable at a subset of the overall groundwater level network, because only those locations with likely interconnected surface water are being monitored. Based on modeling results, maintaining groundwater levels above the MTs for surface water depletion will also result in not experiencing chronic lowering of groundwater levels.

Reduction of groundwater in storage. These are closely related in that the MT values are the same. However, the MTs for depletion of surface water are a subset of the overall groundwater level network, because only those locations with likely interconnected surface water are being monitored for that MT. Based on modeling results, maintaining above the MTs for surface water depletion will also result in not experiencing reduction of groundwater in storage.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

Degraded groundwater quality. There would not be expected degradation of groundwater quality as surface water is of generally higher quality.

Land Subsidence. The MTs are not expected to have a significant impact on land subsidence. The rate of subsidence been approximately 0.01 feet per 1 foot of groundwater level decline. The maximum MT decline for the depletion of surface water RMS location is projected at 13 feet, which would equate to approximately 0.13 feet of subsidence.

8.9.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

As described under the chronic lowering of groundwater levels, modeling results demonstrate that there are no significant impacts to adjacent basins from those MTs for the NASb.

8.9.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The MTs for interconnected surface water use the same elevations as the MTs for chronic lowering of groundwater levels. As described under the chronic lowering of groundwater levels, the MTs protect rural residential, agricultural, and urban users, as well as GDEs. Also as described above, there is no net decrease in surface water outflow from the NASb resulting from the use of groundwater or management actions under this GSP, so downstream uses would not be impacted. The MTs would result in minimal increases in seepage and rivers and their tributaries, and there are projected circumstances in which these systems would go dry; therefore, there are no expected significant and unreasonable undesirable results to aquatic species. As an additional protection to migrating fish species, the RD1001 GSA has a planned project on the Natomas Cross Canal to improve flood protection and improve channel habitat (see **Section 9.2.2**).

8.9.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for depletion of surface water.

8.9.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater elevations in RMS wells will be directly measured to determine where groundwater levels are in relation to MTs and MOs. Groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in **Section 7 – Monitoring Network**. Many RMS wells are equipped with continuous data loggers to observe data in between the semi-annual MT and MO monitoring.

Because of the sensitivity of the beneficial uses near the interconnected surface water systems, additional data analysis would begin if measurements were nearing an MT exceedance. After the initial detection of an MT exceedance, the GSAs will:

- Take confirmation measurements.
- Assess the groundwater gradients.
- If the exceedance is confirmed, initiate an investigation to assess the cause of the exceedance.
- Identify if there are impacts as a result of the MT exceedance and possible mitigation measures, if impacts are noted.

8.9.3 Measurable Objectives – Depletion of Surface Water

The measurable objectives used to define optimal management of groundwater and surface water conditions in the NASb are provided within this section.

8.9.3.1 Measurable Objectives

The process for establishing depletion of surface water MOs is the same as for chronic lowering of groundwater level MOs. These MOs are shown in **Table 8-9**.

8.9.3.2 Interim Milestones

Interim milestones are shown in **Table 8-9**.

This page left intentionally blank

9. Projects and Management Actions

SGMA requires that a GSP establish a sustainability goal that results in the absence of undesirable results within 20 years, with 2042 being the applicable deadline in the NASb. As described in previous sections of this GSP, the NASb is not experiencing any undesirable results and it does not project to experience any in the 2042 planning horizon. This projection includes planned growth and land use changes. However, the NASb GSAs recognize that some sustainability risk in the form of modest groundwater overdraft of about 3,500 AFY may present itself when climate change is considered in the 50-year planning horizon. To avoid future potential undesirable results related to lowering of groundwater levels and depletion of groundwater storage, additional conjunctive use opportunities in the urban municipal supply distribution systems were identified as a combined project. As a result, urban water purveyors under the Regional Water Authority (RWA) have been planning for the completion of a Federally-recognized groundwater bank, which will increase the use of the Subbasin as a storage reservoir as surface water reservoirs and the snowpack evolve under climate change. Further development of the Sacramento Regional Water Bank is presented as a management action below.

A description of current groundwater management activities, planned projects and management actions, and supplemental projects is provided below. Current groundwater management activities are those that are already ongoing and anticipated to continue. Planned projects and management activities (PMAs) are those that are intended to begin implementation within the first 5-year horizon of this GSP and that the NASb GSAs believe will aid in the achievement of the sustainability goal of the Subbasin, while allowing effective responses to changing conditions in the Subbasin. Supplemental projects are those that are still generally at a feasibility level of planning, so detailed information is not presented in this GSP.

9.1 Current Groundwater Management Activities

The NASb GSAs recognize that groundwater sustainability is not guaranteed without active management. As noted in **Section 5 – Groundwater Conditions**, the northern portion of the NASb experienced significant decline in groundwater levels until surface water was introduced to practice conjunctive use in agricultural areas. In the southern portion of the NASb, groundwater declines continued into the 1990s until a conjunctive use program was introduced into the more urban areas of the Subbasin. These and other PMAs that have brought the NASb to a point of sustainability are ongoing and warrant listing here. Additional information can be found at the referenced sections in this GSP.

- Continued conjunctive use in urban and agricultural areas (*see* **Section 3.13 – Conjunctive Use Programs**)

- Continued demand management through:
    - Temporary conservation measures consistent with water shortage contingency plans in Urban Water Management Plans that allow for water use reductions during periods of constrained supply (*see* **Section 3.10.5 – Urban Water Management Plans**)
    - Urban water use efficiency program (*see* **Section 3.10.6 – Urban Water Use Efficiency Program**)
    - Agricultural specific Efficient Water Management Practices (*see* **Section 3.10.7- Agricultural Water Management Plans**)

- Continued agricultural water reuse (*see* **Section 3.8.4 – Water Reuse**)
- Continued recycled water use (*see* **Section 3.8.3 - Recycled Water**)

9.2 Projects and Management Actions

Two projects and five management activities are described below that will help aid in reaching the NASb sustainability goal. For each PMA, SGMA-required detail is provided.

9.2.1 Project #1 - Regional Conjunctive Use Expansion – Phase 1

For more than two decades, municipal and industrial (M&I) water purveyors in the NASb have expanded conjunctive use operations that arrested past overdraft conditions and have resulted in generally increasing groundwater levels in the urban area. Additionally, M&I water purveyors in the South American Subbasin (SASb) have been expanding conjunctive use for the past decade that has also improved conditions south of the American River. In 2019, the Regional Water Authority completed a Regional Water Reliability Plan (RWRP) that identified additional conjunctive use operations that could be achieved with both existing facilities and with future water facilities improvements to expand upon successful conjunctive use.

Project Description:

This project identified additional conjunctive use that could be implemented in the near-term by reoperating existing water treatment and distribution facilities[5]. The conjunctive use program was closely coordinated with the SASb and was evaluated as part of a single modeling evaluation. The project will provide additional surface water during wet years to reduce existing demand on groundwater. Some additional groundwater would be utilized during dry years, but

[5] One exception is in the Rio Linda/Elverta Community Water District. Future demand projections are associated with the Elverta Specific Plan area, which is conditioned by Sacramento County to essentially implement a conjunctive use program if the development occurs. The model analysis assumed that the new demand would receive surface water in wet years and use groundwater in dry years to assess the long-term effects on the subbasin. If the assumed growth does not occur, the projected demand will not increase.

average annual operations would result in a net decrease of groundwater extraction, resolving the deficit of 3,500 AF of projected overdraft with climate change. Agencies expected to participate by altering their groundwater extraction patterns to increase conjunctive use include California American Water, Citrus Heights Water District, City of Lincoln, City of Sacramento, Golden State Water Company, Rio Linda/Elverta Community Water District, Sacramento County Water Agency, and Sacramento Suburban Water District.

Hydrologic conditions serve as the trigger criteria for implementing the project. For example, when wet conditions existed in 2019, M&I purveyors in the region preferentially used surface water as a percentage of supply. As dry conditions emerged in 2020 and continued into 2021, M&I purveyors have increasingly used groundwater as a percentage of supply.

Measurable Objectives Expected to Benefit: The net reduction in groundwater extraction will benefit the measurable objectives for groundwater levels and, by extension, groundwater storage, and depletion of interconnected surface waters.

Project Status: The project is capable of proceeding immediately as hydrologic conditions warrant. Dry conditions in 2021 necessitate the preferential use of groundwater. Additional surface water use as a percentage of supply would increase when wet conditions return.

Permitting and Regulatory Process: The operations are within existing water rights, contracts, and authorized places of use, so no additional permitting or regulatory requirements are anticipated.

Public Noticing: The operations are within existing water rights, contracts, and authorized places of use, so no additional public noticing requirements are anticipated.

Expected Benefits: The project is expected to reduce long-term average pumping from the M&I area of in the NASb. This will fully mitigate the projected deficit of 3,500 AFY in average annual storage projected under future climate conditions described in **Section 6 – Water Budgets**.

How the Project will be Accomplished: The M&I purveyors involved have a history of working cooperatively together. While the project can already be implemented in the near-term, long-term operations of the conjunctive use program will likely require completion of planning of the Sacramento Regional Water Bank (described below), which will also establish a framework for accounting of the storage and recovery of water from the groundwater subbasin.

Legal Authority: Each of the M&I purveyors have the legal authority to operate the public water systems needed to implement the project.

Estimated Costs and Funding Plan: Because of the complexity of variable water costs among the participants, an estimated operations cost cannot be determined. However, each of the M&I purveyors will fund the shifting of supplies between groundwater and surface water from their

existing operations and maintenance programs. Most of the infrastructure needed to implement the program is already in place. The only capital costs may be in some areas that will experience growth, which will primarily be funded through development fees.

Management of Groundwater Extractions and Recharge: The M&I purveyors have demonstrated a past ability to manage extractions and recharge to sustainably manage the Subbasin. Additionally, The Sacramento Regional Water Bank (Management Action #1, described below) will establish when extractions and recharge should occur and a framework for accounting for the storage and recovery of water from the groundwater subbasin.

Project Evaluation: To evaluate the potential effects of proposed projects and management actions in meeting the sustainability goals of the NASb GSP, the regional conjunctive use program has been analyzed using the groundwater model developed jointly for the CoSANA subbasins. The CoSANA model is described in greater detail in the water budget section of GSP **Section 6 – Water Budgets**.

For consistency and to support more accurate effects of project implementation, including subsurface groundwater flow estimates between the subbasins, modeling included projects proposed for both the NASb and SASb. Near-term projects and management actions simulated in the SASb include the portion of the Regional Conjunctive Use Program within that subbasin, Sacramento Regional County Sanitation District's Harvest Water Program, which delivers recycled water for in-lieu recharge and for habitat use, and a groundwater recharge project proposed by Omochumne-Hartnell Water District (OHWD) near the Cosumnes River. Both the Harvest Water Program and the OHWD recharge project are on the opposite side of the SASb from the NASb and, while beneficial to the SASb, are expected to provide very limited benefits to the NASb. Because those two projects have limited effect on the NASb, they are not described further in this GSP.

The analysis below considers the proposed projects using the Projected Conditions Baseline (PCBL) in CoSANA with climate change. The Projected Conditions Baseline applies future land and water use conditions and uses the 50-year hydrologic period of WY 1970-2019, with modifications for the climate change analysis.

Specific assumptions used for the effects of implementing the NASb project modeling scenario include:

- The program is a comprehensive regional conjunctive use program, with participation by both NASb and SASb urban purveyors
- The program will be integrated with the Regional Water Reliability Plan (RWA, 2019)
- Project operations include delivery of wet year surface water supplies to reduce groundwater use and dry year groundwater pump back operations to move water between distribution systems to meet demands

- A summary of the regional conjunctive use scenario assumptions is shown in **Table 9-1**

The results of modeling the projects in both the NASb and SASb are shown on **Figure 9-1.** The figure shows the changes in groundwater level hydrographs in the NASb compared to the PCBL with and without climate change. The benefits of the project are seen primarily in the Sacramento County portions of the NASb, as that is the area where most of the increased conjunctive use occurs. Groundwater levels in these areas are typically improved to approximately 3 to 5 feet above the comparable baseline.

Table 9-1. CoSANA Regional Conjunctive Use Scenario Specifications

Entity	Projected Demand (AFY)	Wet Year Additional SW Supply (AFY)	Wet Year GW Pumping Reduction (AFY)	Long Term (50-Yr) Avg. Annual Pumping Reduction (AFY)	Dry Year GW Pump Back (AFY)
Cal Am - Antelope	5,225	2,174	2,174	739	0
Cal Am - Arden	1,606	0	0	0	0
Cal Am - Lincoln Oaks	6,213	4,681	4,375	1,487	0
Citrus Heights Water District	17,172	719	653	222	0
City of Sacramento - North	62,922	1,000	1,000	340	0
Rio Linda/Elverta CWD	7,745	5,000	5,000	2,400	0
Sac. Suburban WD - North	24,848	2,000	2,000	680	0
Sac. Suburban WD - South	16,456	4,800	4,800	1,632	4,000
City of Lincoln	20,568	1,013	762	259	0
Subtotal NASb	***162,755***	***21,388***	***20,764***	***7,760***	***4,000***
Cal Am - Parkway	16,604	5,351	5,351	1,819	0
Cal Am - Suburban Rosemont	13,227	6,902	6,885	2,341	0
Golden State WC - Cordova	19,752	6,177	6,108	2,077	0
City of Sacramento - South	101,306	1,000	1,000	340	0
Sac County WA - Laguna Vineyard	72,423	1,000	1,000	612	0
Subtotal SASb	***223,312***	***20,431***	***20,344***	***7,189***	***0***

Figure 9-2 shows the cumulative change in storage compared to the PCBL both with and without climate change over the 50-year simulation period. While the PCBL has an average annual change in storage of 5,400 AFY (increasing) without climate change, the PCBL with climate change has an average annual reduction in storage of about 3,500 AFY. Implementing this project results in an average annual change in storage of approximately 0 AFY. Therefore, this project provides an average annual benefit to the subbasin of about 3,500 AFY, in addition to the benefits provided to the surface water bodies and the neighboring subbasins.

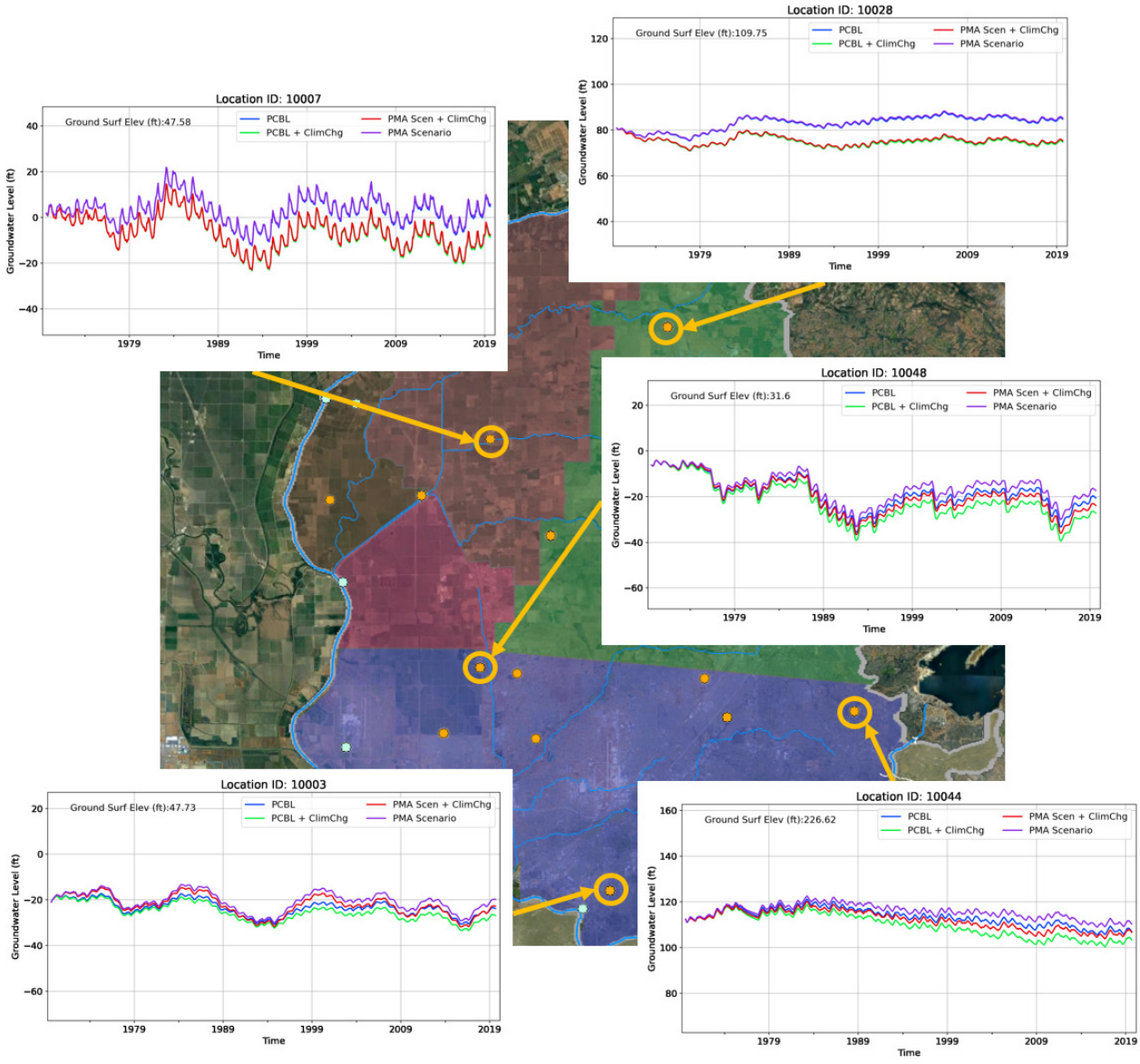


Figure 9-1. Groundwater Level Hydrographs, PMA Scenario and Associated Baselines

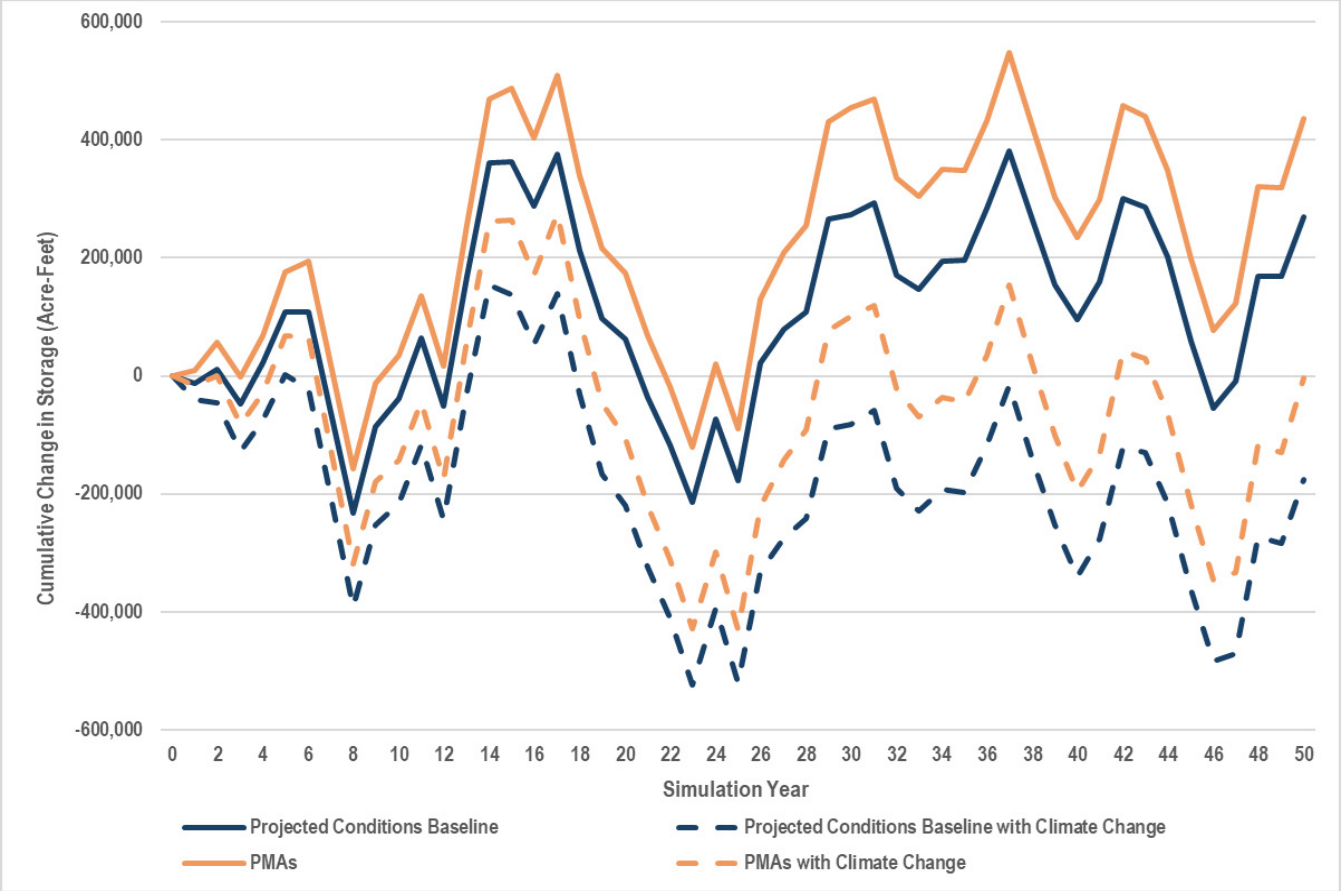


Figure 9-2. Cumulative Storage Change for the PMA Scenarios and Associated Baselines

9.2.2 Project #2 - Natomas Cross Canal Stability Berm and Channel Habitat Enhancements Project

Reclamation District 1001 (RD 1001) is proposing to design and implement the Natomas Cross Canal Stability Berm and Channel Habitat Enhancements Project (NCC SB & CHE Project) that will drastically improve flood protection through strengthening of the Natomas Cross Canal (NCC) north levee and enhance the aquatic and riparian habitat within the NCC channel.

The NCC is a man-made flood control feature, originally constructed in 1912, through use of a dragline excavator to excavate a canal and the placement of spoils to act as levees, offset from the channel on both sides of the canal. The NCC is intended to act as conveyance for numerous small tributaries that were intercepted by the flood control system to outflow into the Sacramento River. Four watersheds, including the Auburn Ravine, the Markham Ravine, Raccoon Creek and the Pleasant Grove Creek converge and flow into the Sacramento River through the NCC. These four watersheds are located north of the American River watershed and northeast of Sacramento, California. The original construction excavated and placed existing materials, predominately composed of variable lean-to-fat clay and silty materials, throughout the levee, which are subject to shrink-swell cycles that result in decreased stability over time. These stability issues were

evaluated in 1987 and again in the DWR's Non-Urban Levee Evaluation (NULE) Program (Segment 284).

In addition to embankment stability issues, the NCC north bank levee has also had historical issues with wind-induced wave erosion. This erosion results from high winds pushing waves against levee embankments, resulting in erosion of the embankment material. The NCC north bank levee1 experiences prevailing southern winds during storm events which pushes the wave action towards the north levee. Observations from the most recent flood fight of wind-wave erosion, which occurred during the January 2006 flood event, indicate that the areas most susceptible to damage are those lacking adequate tree cover in the channel. The riparian forest acts as a buffer to break wind-induced wave action before it reaches the north bank levee.

The NCC was listed as the top priority for RD 1001 in the 2014 Feather River Regional Flood Management Plan (FRRFMP), due to "Potential overtopping, recurrent wave wash erosion, slumps, and cracking of the Natomas Cross Canal north levee." The highest priority project for RD 1001, as listed in the FRRFMP, was to "[r]aise, buttress, and provide erosion protection for the Natomas Cross Canal levee."

The primary purpose of the NCC SB & CHE Project will be to construct a stability berm along 11,000 feet of the NCC levee, in areas that have not been previously repaired, and to plant additional riparian vegetation to act as a natural wind-induced wave defense. The project will also enhance local aquatic and riparian habitat through vegetation management; terracing and grading the in-channel geometry, near the NCC and Sacramento River confluence; and reconfigure downstream portions of the NCC into a more meandering channel. This effort will utilize waterside berm plantings of varietal native understory and native plant species; thus, providing a natural wind-wave buffer that will also provide shaded riverine aquatic habitat over an additional 2,400 linear feet, along the channel edge. These habitat enhancements and channel modifications will benefit water quality, improve water flow along the channel, as well as provide more non-natal rearing habitat for juvenile salmon – particularly winter-run salmon and other commercially important fishes (including fall-run Chinook, steelhead, and green sturgeon). In addition, the habitat enhancements and channel modifications will also provide an additional flood control conveyance and natural erosion protection feature. Fish screens will also be installed on existing intakes to protect the fish within their new environment.

Construction of the proposed in-channel habitat improvements will yield a large enough quantity of borrow to construct up to a 11,000 linear feet of stability berm. The NCC SB & CHE Project plans to add riprap, soil, and plants on another 3,600 linear feet of the north NCC levee between RD 1001's main pumping plant, the NCC, and the Sacramento River confluence, to correct channel scour that is encroaching into the levee prism. These features will also provide adequate waterside berm to allow riparian habitat between the levee toe and the channel.

These various improvements the NCC SB & CHE Project will support many of the Central Valley Protection Plan's Conservation Strategy, and at the same time reduce flood risk, provide

significant fish and wildlife habitat benefits, maintain the existing high-water quality within the NCC, protect local agricultural, and forested landscapes. These actions and benefits are also consistent with the State of California's planning priorities.

Measurable Objectives Expected to Benefit: This project is not expected to directly benefit a current measurable objective; however, it will improve flood protection and enhance aquatic and riparian habitat within the NCC channel, which are designed to help sensitive aquatic species (a beneficial use and user) to migrate into western Placer County creeks.

Project Status: As of November 2021, the project is currently at 65% design and is preparing submittals for CEQA and National Environmental Policy Act (NEPA) compliance, Central Valley Flood Protection Board encroachment permit, US Army Corps Sections 404 and 408 permissions, ESA consultation, CDFW Section 1600 Lake and Streambed Alteration Agreement, and Section 401 Water Quality Certification. Construction is expected to be completed in 2023.

Permitting and Regulatory Process: The project is preparing applications for regulatory permits as stated above. The operations are within existing water rights, contracts, and authorized places of use, so no additional permitting or regulatory requirements are anticipated.

Public Noticing: Public Noticing will occur for both CEQA and NEPA. The operations are within existing water rights, contracts, and authorized places of use, so no additional public noticing requirements are anticipated.

Expected Benefits: The project is expected to improve flood protection and enhance riparian habitat within the NCC channel.

How the Project will be Accomplished: RD 1001 has a history of successful project implementation and has a grant in place to fund the project. The RD also exists to operate and maintain flood control and drainage features and project operations and maintenance will fit within existing RD activities.

Legal Authority: RD 1001 has the legal authority to implement and operate the project as proposed.

Estimated Costs and Funding Plan: Project costs are estimated at $6,042,500. RD 1001 has a grant agreement in place with DWR utilizing funding from the Water Quality, Supply, and Infrastructure Improvement Act of 2014 to fund 100% of the Project pursuant to Water Code, section 79780.

Management of Groundwater Extractions and Recharge: This project is not intended to manage groundwater extractions and recharge.

Project Evaluation: RD 1001 will be implementing a monitoring program prior to, during and following project completion to evaluate the project. Details of this monitoring program are currently under development.

9.2.3 Management Action #1 - Complete Planning for Sacramento Regional Water Bank

Management Action Description: As envisioned, the Sacramento Regional Water Bank (Water Bank) will consist of an institutional and legal framework for operating a sustainable storage and recovery program in the North American and South American subbasins. Participation in the Water Bank will be voluntary, but it is intended to provide an incentive for participants to expand conjunctive use operations in the subbasins that would also allow for future groundwater substitution transfers, which can provide funding to maintain, replace and improve water supply infrastructure. The primary goal of the Water Bank is to manage the groundwater subbasins sustainably and to enhance climate change resilience through expanded conjunctive use, while protecting all beneficial uses and users in the subbasins. To achieve this, banking and recovery operations will need to be developed and evaluated using the regional CoSANA model, which will assist in accounting for stored water including losses through groundwater outflow from the subbasins over time. A fundamental principle of the Water Bank is that water must be stored before it can be recovered and losses must be accounted for, so that operations will contribute to enhancement of subbasin conditions; operations of the Water Bank will not operate in a deficit manner. It should be noted that a groundwater bank is already operating in the NASb in that the SGA GSA has accounted for actions to increase conjunctive use since 2012. The planning for the Sacramento Regional Water Bank will expand upon the program by seeking Federal recognition and will assess existing accounting consistent with SGMA requirements. Operations of the Water Bank will require monitoring and mitigation specifically designed to aid in the protection of beneficial users of groundwater in the Subbasin.

Measurable Objectives Expected to Benefit: The net increase in storage in the NASb will benefit the measurable objectives for chronic lowering of groundwater levels and, by extension, groundwater storage by raising groundwater levels and reducing depletion of interconnected surface waters.

Project Status: As of mid-2021, the planning for the project has entered its second and final phase. With development of GSPs and ongoing drought conditions in 2021, the majority of the planning effort is expected to commence in 2022 and take up to two years to complete.

Permitting and Regulatory Process: Initial operations of the Water Bank include the use of existing water rights and contracts within the existing public water supply distribution system of the subbasins. For these existing water rights, where appropriate the Water Bank would rely on the Department of Water Resources and United States Bureau of Reclamation (USBR) Water Transfer White Paper (2019) for transfer criteria and the State Water Board to approve temporary transfer of post-1914 water rights to enable groundwater substitution transfers for recovery

operations. Most groundwater substitution transfers occurring in Sacramento County would also require a county permit. A county permit is not required in Placer or Sutter counties. GSA approval of substitution transfers is required in all counties. Additionally, the Water Bank will seek to be able to store and recover Central Valley Project (CVP) contract water for those agencies with federal contracts. For the federal component, the Water Bank would comply with the USBR Groundwater Banking Guidelines for CVP Water (2019). Operations of the Water Bank that result in groundwater substitution transfers would require concurrence of the GSAs in which such activities would occur in each year that a transfer is proposed.

Public Noticing: Completion of the Water Bank will include CEQA and NEPA environmental documentation and analysis and will be appropriately publicly noticed. In addition, RWA as the project lead to complete Water Bank planning, has conducted extensive stakeholder outreach for the project and will continue to provide notice and input opportunities to local stakeholder interests as the Water Bank is developed. Among other means, RWA will provide notice to GSAs and caucuses of the Sacramento Water Forum.

Expected Benefits and Evaluation: The 2019 RWA RWRP identified the potential to increase surface water use in the existing interconnected urban distribution systems in the region by up to about 60,000 AF as a means of storing water in the Water Bank. In dry years, the RWRP estimated the ability to increase groundwater extraction by about 60,000 AF to recover stored water. The operations would be roughly split in half between the NASb and the South American Subbasin. With system improvements (described under Supplemental PMA below), the RWRP estimated that both storage and recovery could be increased to about 90,000 AF in any given year, after completion of Phase 2 (refer to **Section 9.3 – Supplemental Projects**). Operations will be determined during the development of the Water Bank and evaluated using the CoSANA model used to develop the GSP. The evaluation will include determination of the volumes of water that will need to remain in storage in the subbasins to sustainably manage the Subbasin. Evaluation will include an analysis of future climate that will include consideration of the risks of changing hydrology and temperatures.

How the Project will be Accomplished: Development of the Water Bank is being coordinated by RWA. RWA has developed a scope of work to complete planning and has launched a Sacramento Regional Water Bank Program to complete the effort. The participants will work cooperatively to develop and operate the Water Bank in a way that results in improved groundwater subbasin sustainability. Most of the current participants have worked together since the 1990s through the Sacramento Water Forum, so they have demonstrated their intent and ability to achieve outcomes that benefit the region's community and environment.

Legal Authority: The Water Bank participants possess the water rights and contracts and have the legal authority to operate the water systems required to store and recover water under the program.

Estimated Costs and Funding Plan: Estimated remaining planning costs are about $2.5 million. Of this, local participants have committed $1.4 million through the Water Bank Program under RWA, and USBR is providing $1.1 million in technical funding support for the Water Bank, which will include a feasibility determination.

Management of Groundwater Extractions and Recharge: The Water Bank itself provides in part an institutional framework for the management of the storage and recovery of water. It includes an accounting to track storage and recoverable volumes of water and requires an extensive monitoring and mitigation program. Participants will agree to restrict operations as needed to maintain proper accounting balances overall, while adjusting operations in real-time if monitoring exceeds parameters that will be established during Water Bank planning.

9.2.4 Management Action #2 - Explore Improvements with NASb Well Permitting Programs

Management Action Description: This management action will consist of exploring potential revisions to Placer, Sacramento, and Sutter counties' and the City of Roseville's well permitting programs. Areas of improvement to explore include:

- Minimum screen depth requirements to limit high-capacity wells from impacting shallow aquifers directly connected to surface water or groundwater that may support GDEs.
- Minimum spacing requirements for high-capacity wells to limit impacts to existing groundwater wells in the NASb.
- Consultations for new wells to be constructed near groundwater level representative monitoring wells to optimize effective future monitoring for the NASb.

The project will require development of technical information to support proposed modifications to existing well programs.

Measurable Objectives Expected to Benefit: This project is expected to benefit the water level objective associated with interconnected surface water by limiting direct connection of wells to rivers, canals, and creeks.

Project Status: The project is expected to commence upon submittal of the NASb GSP. Technical analysis and coordination with the respective well permitting programs are expected to take about two years to complete.

Permitting and Regulatory Process: Each well permitting agency would determine the necessary and appropriate permitting and regulatory requirements from any modifications that may result from this management action.

Public Noticing: Each well permitting agency is a public agency and will determine the necessary public noticing requirements from any modifications that may result from this

management action. The GSAs will notice interested parties when the management action commences and will provide regular updates on any progress through nasbgroundwater.org.

Expected Benefits and Evaluation: The management action is intended to protect the most sensitive of the beneficial uses and users of the NASb, including, interconnected surface water, shallow domestic well owners, and GDEs. Benefits are expected to be evaluated using groundwater drawdown software and potentially field testing of drawdown and recovery.

How the Project will be Accomplished: The NASb GSAs intend to work cooperatively with their respective well permitting agencies by proactively communicating the management needs of the beneficial uses and users of the subbasin and performing an appropriate technical analysis.

Legal Authority: The counties and city have land use management and planning authority granted through the State of California. This power allows cities and counties to establish land use and zoning laws that govern development. The well permitting agencies are authorized under California Water Code Section 13801.

Estimated Costs and Funding Plan: Costs to the local well permitting agencies to modify existing Code or Ordinances is unknown. The NASb GSAs have estimated $25,000 to conduct an analysis of well drawdowns and pumping spheres of influence at various capacities in an alluvial system. This will help inform recommended minimum screen depths in areas most sensitive to drawdown (e.g., interconnected surface water, GDEs) and to recommend spacing requirements for future wells to avoid impacts to existing groundwater users. The GSAs have committed to funding this activity in the Implementation Agreement in this GSP (*refer to* **Appendix A – MOA and Fiscal Budget**).

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction. Rather, it is intended to put into place prudent practices to limit mostly localized impacts to beneficial uses and users in the Subbasin.

9.2.5 Management Action #3 - Proactive Coordination with Land Use Agencies

Management Action Description: This management action will help aid GSAs and land use planners and decision makers coordinate land use planning and GSP implementation consistent with the requirements under the SGMA. This GSP relied heavily on existing information from land use planning decisions that have already been made. The technical analysis performed for this GSP indicates that those planned land use practices have maintained sustainable conditions in the Subbasin. However, the analysis indicates that the system is only just in balance with current land use and approved development along with implemented GSP projects. Significant changes in land use from these assumptions could represent a potential risk to the Subbasin's sustainability. Therefore, the NASb GSAs desire to coordinate with respective city or county

land use planning agencies so they are aware of GSP analysis and implementation as General Plans or other land use permitting updated occur in the future. Areas for coordination include:

- Sharing groundwater modeling results specific to the areas covered by the respective land use planning agencies.
- Sharing of annual GSP implementation reports with monitoring results that are relevant to the area of each land use planning agency.
- Holding an annual meeting with each land use planning agency to share information on trends, upcoming projects, and upcoming planning efforts (e.g., General Plan update).

Measurable Objectives Expected to Benefit: This management action is not expected to directly benefit a current measurable objective because the objectives were established based on the land use planning decisions that have already been made. Rather, the intent of the action is to aid in coordinated land use planning so land use decisions do not impede the GSAs' ability to sustainably manage the Subbasin.

Project Status: The project is expected to commence upon submittal of the NASb GSP and will be an ongoing annual activity.

Permitting and Regulatory Process: There are no permitting or regulatory processes required for this coordination.

Public Noticing: There is no public noticing requirement for this coordination. Land use planning agencies will follow their respective public noticing requirements for future land use planning and General Plan updates.

Expected Benefits and Evaluation: The expected benefit is that the Subbasin will continue to be managed sustainably and locally to promote continued healthy economic growth in the region.

How the Project will be Accomplished: The project will be accomplished by regular, cooperative coordination between NASb GSAs and local land use planning agencies.

Legal Authority: GSAs have legal authority to share information proactively with land use planning agencies. Land use planning agencies will maintain their authority for ultimately making land use planning decisions.

Estimated Costs and Funding Plan: There is no expected direct cost for this management action. The GSAs will participate with their in-kind time for meetings.

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction. Rather, it is intended to proactively work with local land use planning agencies so the Subbasin continues to be sustainable into the future.

9.2.6 Management Action #4 - Domestic/Shallow Well – Data Collection and Communication Program

Management Action Description: This program will focus on the collection, sharing, and distribution of water level and water quality data and information for GSAs and domestic well owners to make informed decisions regarding land owners design and construction of wells and GSAs the management of groundwater. The ultimate goal of this program will be to safeguard land owners use of domestic/shallow wells for their deminimus supply while enabling other beneficial users of groundwater in the basin to maintain use of this resource.

The analysis of domestic wells consisted of detailed review of known construction information of every known well completion report (WCR) from DWR. While the NASb GSAs' analysis and established SMC was done carefully with the best available data and information to consider these beneficial users of groundwater, we recognize that DWR has not historically received full compliance in submission of WCRs. This is particularly likely in the case of well abandonment or destruction. Additionally, the NASb GSAs believe that one of the best ways to protect shallow well owners is through knowledge and information gained through two-way communication. This program is expected to include:

- Using assessor parcel number (APN) data provided by DWR, send direct mailings to high concentration areas of domestic and other shallow wells to confirm the presence of a well.
- Establish a group of willing, voluntary domestic well owners interested in monitoring groundwater conditions in their local areas.
- Provide regular information to interested domestic well owners and to NASb well permitting agencies on groundwater elevation and groundwater quality conditions to help protect existing owners and allow proposed new well owners to make informed decisions when constructing new wells.

Measurable Objectives Expected to Benefit: This management action is not expected to directly benefit a current measurable objective because the objectives were established based on the land use planning decisions that have already been made. Rather, the intent of the action is to aid in the management of groundwater levels to allow for current and continued use of groundwater for existing and prospective shallow well owners.

Project Status: The project is expected to commence upon submittal of the NASb GSP.

Permitting and Regulatory Process: There are no permitting or regulatory processes required for this coordination.

Public Noticing: There is no public noticing requirement for this coordination. However, the NASb GSAs will use direct mailings and other electronic means (NASb website, social media, etc.) to reach out to domestic and other shallow well owners.

Expected Benefits and Evaluation: The expected benefit is that the subbasin will continue to be managed sustainably and locally to protect shallow and domestic well users.

How the Project will be Accomplished: The project will be accomplished by regular, cooperative coordination between NASb GSAs, local well owners, and local well permitting agencies.

Legal Authority: GSAs have legal authority to share information proactively with well owners and well permitting agencies.

Estimated Costs and Funding Plan: The NASb GSAs have budgeted $25,000 in direct expenses for this management action. The GSAs will also participate with their in-kind time in implementing the program.

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction. Rather, it is intended to proactively work with local well owners and well permitting agencies to protect shallow uses of groundwater in the NASb.

9.2.7 Management Action #5 - GDE Assessment Program

Management Action Description: This management action will improve the NASb GSAs' understanding of GDEs in the NASb to informing potential future protective measures for this beneficial use of groundwater. As described in **Appendix O** of the GSP, the GSAs used a conservative approach by using the 30-foot depth to water interval to identify potential GDEs, and up to an 80-foot depth to water interval to identify potential Valley Oak that could be supported by groundwater. To further inform the understanding of potential GDEs and their relative health, the program will include:

- Using the Normalized Difference Vegetation Index (NDVI) during implementation of the GSP to track vegetative health and confirm the likelihood that the vegetation is groundwater-supported. We will achieve this by monitoring a year-to-year index for longer-term. For the first part of the program, we will also review intra-year data to confirm whether the vegetation is more likely supported by surface water or groundwater.

- Continue to monitor flows in small tributary systems to better understand the source of flow in these channels (e.g., urban runoff, treated wastewater discharges, groundwater baseflow).

Measurable Objectives Expected to Benefit: This management action is not expected to directly benefit a current measurable objective because the objectives were established based on the land use planning decisions that have already been made. Rather, the intent of the action is to aid in the management of groundwater in the Subbasin through the improved understanding and monitoring of GDEs.

Project Status: The project is expected to commence upon submittal of the NASb GSP.

Permitting and Regulatory Process: There are no permitting or regulatory processes required for this coordination.

Public Noticing: There is no public noticing requirement for this program.

Expected Benefits and Evaluation: The expected benefit is that the subbasin will demonstrate that GDEs are protected under the adopted SMC.

How the Project will be Accomplished: The project will be accomplished by developing the methodology and completing the NDVI analysis and by regular monitoring of flows in NASb tributary areas associated with GDEs.

Legal Authority: GSAs have legal authority to conduct the NDVI monitoring and surface water monitoring.

Estimated Costs and Funding Plan: for the GSAs have budgeted up to $55,000 this management action. The GSAs will also participate with their in-kind time contributions for monitoring.

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction.

9.3 Supplemental Projects

Groundwater management is a continuous ongoing process in the NASb whether SGMA is mandating sustainable management or not. The NASb GSAs have additional projects that are at a feasibility level and over the next several years many will likely be ready for implementation. **Table 9-2** provides a list of these supplemental projects that are in an ongoing planning process.

Table 9-2. Supplemental Projects

Supplemental Project No.	Project Sponsor	Project Description	Potential Benefit (AFY)	Potential Capital Cost ($ million)
1	Regional Water Authority	Expansion of the Sacramento Regional Water Bank – Phase 2 - implementation of the expanded conjunctive use program by constructing various system interties and booster pumps to increase in-lieu recharge; install aquifer storage and recovery (ASR) for direct recharge; install additional production wells to recover groundwater in dry years. The recharge potential and cost are “up to” amounts because the program is fully scalable.	30,000	250
2	Placer County Water Agency	RiverArc – a new treatment plant and pipeline would be constructed to bring Sacramento River water for municipal and industrial water supplies. Improves water supply security by having a water source from a different watershed and expands in-lieu conjunctive use by offsetting existing groundwater demands.	30,000	1,400
3	South Sutter Water District	Water System Conveyance System Improvements – enlarging of district laterals to allow greater surface water deliveries during wet years and a reduction of groundwater pumping to achieve in-lieu recharge.	TBD	TBD
4	Natomas Mutual Water Company	Service Area Expansion – annexation of about 2,300 acres and supplying the area with surface water reducing groundwater pumping. This area has previously been solely dependent on groundwater.	4,600	TBD
5	City of Lincoln	Conjunctive Use – expand use of recycled water to offset existing groundwater demand.	1,000	TBD
6	Placer County	Sustainable Agricultural Groundwater Recharge Program – this program will fund construction of recharge facilities in western Placer County. A funding mechanism has been established through developer fees.	TBD	TBD

10. Plan Implementation

This section describes in general how the NASb GSAs will implement our GSP. Successful implementation requires committed human resources, sufficient and sustained funding, and specific actions to be undertaken in appropriate timeframes.

10.1 Plan Implementation Staffing

The NASb GSAs have entered into an MOA for the implementation of this GSP, which will include management of the Subbasin along with projects and management actions. The GSAs have designated the SGA GSA as the lead agency with DWR and as the GSA Coordinator. The role of the coordinator includes ensuring that all required submittals to the State are provided in a timely fashion, that the GSAs meet and coordinate on a regular basis for successful GSP implementation and coordinate activities and findings with adjacent subbasins. SGA has been an ongoing groundwater management agency with permanent staffing since 1998, so it is well-positioned to serve in this role. The GSAs have designated the West Placer GSA as the GSA Administrator. The administrator will serve in an important coordination and documentation role for the GSAs as well as to ensure that effective outreach continues during GSP implementation. Placer County has assigned a senior-level planner to serve in this role. Each GSA is committed to actively serving on the GSA Committee and will provide either in-kind staffing or consulting support services to implement the GSP. **Appendix A** provides a copy of the GSP Implementation MOA.

10.2 Implementation Costs and Funding

Table 10-1 provides an estimate of the shared common expenses over the first five years of GSP implementation, which is subject to change. Note that these expenses do not include the in-kind time that each GSA will contribute or other expenses related to groundwater management that each GSA may perform that is unique to its area. The estimate also does include expenses that other agencies will provide for projects and management actions. For example, the conjunctive use expansion expenses will be borne by participating agencies developing the Sacramento Regional Water Bank. Finally, the budget below does not include the small number of new monitoring wells needed that were identified as potential data gaps. At this time, the NASb GSAs are pursuing assistance through the DWR Technical Support Services Program (TSS) to construct new monitoring wells that were identified as data gaps. The TSS will fund the construction of monitoring wells at no cost to GSAs, other than for local in-kind assistance in completing the project. In the event that support is not provided, the GSP Implementation MOA includes a 20 percent contingency budget of the total estimated budget that could be used for that purpose.

Table 10-1 also provides the funding contributions of each GSA to cover the five-year budget. The NASb GSAs have agreed to use their relative geographic areas within the NASb to determine the funding distribution for the first five years of implementation.

Table 10-1. Five-year Budget and Funding Sources

Budget Item Description/Year	2022	2023	2024	2025	2026
Regulatory Requirements					
Groundwater Level Monitoring	$7,300	$7,500	$7,700	$7,900	$8,100
Biennial Water Quality Monitoring	$0	$25,000	$0	$25,000	$0
Annual Reports	$65,000	$50,000	$40,000	$40,000	$40,000
5-Year GSP Assessment/Update	$0	$0	$0	$125,000	$125,000
Modeling Support and Update	$20,000	$20,000	$20,000	$150,000	$90,000
Data Management System Maintenance and Upgrades	$10,000	$10,000	$10,000	$10,000	$10,000
Program Management and Administrative Expenses					
NASb GSA Coordination Meetings	$3,800	$3,800	$3,800	$3,800	$3,800
Public Outreach	$1,000	$1,000	$1,000	$1,000	$1,000
Website Maintenance	$4,000	$4,500	$5,000	$5,500	$6,000
GIS Mapping Support	$3,800	$4,000	$4,200	$4,400	$5,000
Lead Agency Administration	$6,200	$6,500	$6,900	$14,800	$16,000
Projects and Management Actions					
Well Permit/Construction Practices	$12,500	$12,500			
Domestic/Shallow Well – Data/Communication Program	$12,500	$12,500			
GDE Assessment Program	$20,000	$10,000	$10,000	$ 7,500	$ 7,500
Total Shared Costs					
Annual Estimated Cost	**$166,100**	**$167,300**	**$108,600**	**$394,900**	**$312,400**
5-year Total Cost					$1,149,300
Average Annual 5-year Cost	$229,860	$229,860	$229,860	$229,860	$229,860
Estimated Average Annual Contribution by GSAs					
SGA	$83,171	$83,171	$83,171	$83,171	$83,171
West Placer	$76,912	$76,912	$76,912	$76,912	$76,912
SSWD	$44,521	$44,521	$44,521	$44,521	$44,521
Sutter County	$13,583	$13,583	$13,583	$13,583	$13,583
RD1001	$11,673	$11,673	$11,673	$11,673	$11,673

10.3 Implementation Activities

Groundwater management is a continuous ongoing process in the NASb. **Table 10-2** provides a partial list of the implementation actions needed for successful management of the Subbasin.

Table 10-2. Summary of Implementation Actions

Monitoring
Groundwater Elevation Monitoring
1. Continue ongoing semi-annual monitoring of the groundwater elevation monitoring network. 2. Conduct confirmation water level monitoring as needed. 3. Download transducer data semi-annually.
Groundwater Quality Monitoring
1. Download public supply well water quality monitoring data for TDS and Nitrates from the State DDW by December 31 of each year for MT and MO evaluation. 2. Download data for Arsenic, Hexavalent Chromium, Iron, and Manganese from DDW as it becomes available for individual public supply wells and observe for trends. If future upward trends emerge for these constituents, assess if establishing sustainable management criteria for them would be beneficial. 3. Collect water quality samples in the shallow water quality monitoring network in the Fall of odd numbered years (e.g., 2023).
Subsidence Monitoring
1. No current action required unless water level MT exceedances are occurring or if optional DWR InSAR monitoring indicates a potential undesirable result.
Other Monitoring
1. Collect additional monitoring data (e.g., surface water stages) from CDEC on an as-needed basis (e.g., during preparation of Annual Report).
Data Management
1. Upload groundwater elevation data on an ongoing basis to CASGEM (or other applicable State SGMA database) within one month after semi-annual monitoring. 2. Upload water quality data from shallow monitoring well network by December 31 of each year that it is collected. 3. Update NASb Data Management System with appropriate data by December 31 of each year.
Data Analysis
Sustainability Indicators
1. Review all representative groundwater levels in comparison to MOs and MTs by December 31 each year for potential emergence of undesirable results. 2. Calculate the public water supply wells TDS and N rolling averages to determine if the Subbasin in meeting MOs and MTs by January 31 each year. 3. Review shallow monitoring network TDS and N data to determine if the Subbasin in meeting MOs and MTs by January 31 of each year following its collection.
Annual Report
1. Complete the recurring Annual Report for review by GSAs by February 28 each year and submit to DWR by April 1 each year.
CoSANA Groundwater Model
1. In 2025, a comprehensive assessment and update of the CoSANA model will begin. This will be coordinated with the South American and Cosumnes subbasins. Update to the model will include the use of the most updated urban water supplier demand projections, the latest climate change projections (using multiple future projection scenarios), consideration of an extreme scenario, consideration of the model recommendations in Section 6 of the CoSANA model report included in Appendix P of the GSP.
Coordination and Outreach
1. Continue quarterly meetings of the NASb GSAs.

2. Hold at least one public meeting each year in which basin conditions will be presented and upcoming year activities will be described. The meeting will be scheduled when the Annual Report has been completed each year.
3. Meet with each adjacent subbasin at least annually. The meeting will be scheduled as the Annual Report is being prepared, so that any observations about potential concerns near common boundaries can be discussed.
4. Meet with County and City land use planning staff of respective counties once each year to share the results of the Annual Report and discuss any upcoming anticipated changes to land use designations or General Plans. The meetings will be scheduled shortly after the Annual Report is submitted.
5. Continue quarterly meetings of the Regional Contamination Issues Committee to identify and report on potential emerging issues of contamination or constituents of concern. The committee is facilitated by SGA staff and includes State and Federal regulatory agencies, local water agencies, responsible parties, and members of the public.

Other Management Activities

1. Fill the data gaps noted in the monitoring well network by December 31, 2024.
2. Track implementation of urban area conjunctive use program as part of Annual Report preparation. Identify if there are barriers to its planned expansion.
3. Work with the Regional Water Authority in its development of the Sacramento Regional Water Bank to ensure that it is consistent with achieving the sustainability goal of the NASb.
4. Begin technical work on well construction practices (e.g., depth and spacing) to protect the most sensitive beneficial uses and users of groundwater in the NASb. Work will commence in early 2022 and be completed by the end of 2023. This will require a cooperative effort with local permitting agencies.
5. Commence shallow/domestic well analysis in early 2022 and conclude by early 2024.
6. Commence GDE assessment management action in early 2022 and conclude major assessment by early 2024. Continue annual monitoring of GDE health.
7. Track progress on supplemental projects on an annual basis. Update progress and any information on newly proposed supplemental projects in the Annual Report.

11. Notice and Communications

This section describes the NASb GSA noticing and communication with stakeholders and interested parties during the development and then during implementation of this GSP. The regulatory requirements and additional State guidance were provided in DWR's GSP Guidance Document: Stakeholder Communication and Engagement (DWR 2018). Under the requirements of the SGMA, GSAs must consider interests of all beneficial uses and users of groundwater. Furthermore, the GSP Regulations require that GSAs document the opportunities provided for public engagement and active involvement of diverse social, cultural, and economic elements of the population within the Subbasin during develop of this GSP.

11.1 Public Engagement and Active Involvement

Early in the GSP development process, each GSA developed a Communication and Engagement Plan, or C&E Plan, that described how stakeholders would be engaged through outreach, education, and opportunities for input during development of the GSP. The C&E Plans included key elements such as:

- Goals and Desired Outcomes
- Stakeholder Identification
- Venues for Engaging
- Implementation Timeline

The GSAs established and maintained an Interested Parties list to receive notices regarding plan preparation. To comply with this section, the GSAs maintain an email notification database. The public is regularly informed through engagement activities on how they can request to be placed on the list and receive notifications. Currently the Interest Parties list has over 330 subscribers.

The GSAs used a variety of methods to communicate with the public and encourage participation throughout GSA formation and GSP development as outlined in the C&E Plans and summarized below. When COVID-19 restrictions went into effect in 2020, some adjustments had to be made, such as switching from in-person public meetings to virtual meetings, pursuant to Executive Order N-25-20. Other than that, the C&E Plans were implemented as written and included the following engagement methods:

- Notifications – The GSAs used multiple methods to keep stakeholders informed of the GSP development process and aware of opportunities to engage. These methods included email blasts, website postings, social media, mailers and other printed information such as a SGMA brochure for distribution at public counters and outreach events and postcard mailers announcing the public comment period. A NASb website was developed, which

included a communications portal where interested parties could sign up for notifications and from which email notifications could be sent. Ultimately, over 330 parties received GSP updates, public meeting notifications, invitations to comment, and other notices via email.

- Websites –The NASb website (nasbgroundwater.org) served as the main hub for information on the GSP, providing opportunities for the public to sign up for electronic notices, learn about SGMA, the GSAs, the GSP, how to attend events, access and comment on the draft GSP, and contact their GSA representative. In addition, the West Placer GSA formed an independent website (westplacergroundwater.com) to post information on GSP-specific activities. Finally, single-entity GSAs maintained information on SGMA and GSP development on their agency websites.

- Public Meetings – The GSAs held many public meetings during GSP development. These meetings included GSA agency board/council meetings, Agriculture Commission meetings, water agency meetings, and larger, multi-GSA coordinated events to discuss GSP development in depth. Public meetings are discussed in Section 10.3.

- Board, Neighborhood, or Community Meetings – Individual GSAs engaged the public through various other meetings opportunities where appropriate, such as board/council meetings, committee meetings, municipal advisory committees, and others.

- Targeted Engagement – Where appropriate, the GSAs conducted targeted engagement with specific groups. In the NASb, one of the primary beneficial users of groundwater is the agricultural community. Therefore, targeted meetings were held to engage the agricultural community through tailgate meetings and presentations at public venues such as Agriculture Commission meetings. The NASb also has an engaged environmental community. One such group, the Sacramento Water Forum's Environmental Caucus was actively targeted to participate in public meetings and to comment on GSP components.

Stakeholder input received through these methods helped the GSAs guide development of the draft GSP. In the early development, most input was in the form of questions or concerns regarding how the GSP might affect them. As input was received, the GSAs acknowledged the input and/or concerns, answered the questions, and strived to keep the public informed of how their input influenced the GSP development.

11.2 Groundwater Beneficial Uses and Users

SGMA requires the GSAs consider the interests of beneficial users and uses of groundwater in the Subbasin. As a result, the GSP development process needed to consider effects to other stakeholder groups in and around the groundwater Subbasin with overlapping interests including holders of overlying groundwater rights, including, but not limited to, the following:

1. Agricultural users, including farmers, ranchers, and dairy professionals.

2. Domestic well owners.
3. Municipal well operators.
4. Public water systems.
5. Local land use planning agencies.
6. Environmental users of groundwater.
7. Surface water users, if there is a hydrologic connection between surface and groundwater bodies.
8. The federal government, including, but not limited to, the military and managers of federal lands.
9. California Native American tribes.
10. Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems.
11. Entities that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.

Early in GSP development, the GSAs worked to identify the individuals and groups in their areas that would have interest in groundwater. A broad list of potential beneficial uses and users and parties representing those interests is shown in Table 11-1.

The categories referenced above are broad examples; the GSAs considered each of the interest groups named to determine if they were present within the NASb. Below is a discussion of some of the beneficial users and uses of groundwater that were considered and contacted during development of the GSP. More detailed information regarding how they were considered specifically during development of sustainable management criteria is described in **Section 8 – Sustainable Management Criteria.**

11.2.1 Agriculture

Through preliminary stakeholder identification and engagement efforts the agriculture community was identified as a major beneficial user of groundwater in the Subbasin. Although Sacramento County and the southeastern portion of Placer County contain mostly urban areas, the rest of the Subbasin is predominately agriculture and undeveloped land. Permanent crops dominate the western, eastern, and northern edges of the Subbasin and along the rivers, while rice and other non-permanent crops dominate the central and western portions of the Subbasin. While much of the agriculture community relies on surface water to irrigate pastures, orchards, rice fields, and farms, many also pump groundwater to augment their surface water supplies, particularly in dry years. Therefore, the NASb GSAs included the agriculture community in their

engagement plans early in GSP development – e.g. included agriculture representatives such as Farm Bureaus, Farm Advisors, and Agriculture Commissioners in their stakeholder lists and identified and added members of the agriculture community to interested parties lists.

In 2016, during the formation of the WPGSA, a stakeholder assessment was conducted for the purposes of guiding communication strategies and tactics associated with the formation process. Agriculture was identified as having a key interest in groundwater, so West Placer GSA agencies immediately engaged these stakeholders, holding 12 interviews with members of the agricultural

Table 11-1. Beneficial Uses and Users

Category of Interest	Parties Representing Interests	Engagement Purpose
General Public	Citizen Groups Community Leaders Municipal Advisory Committees	Inform to improve public awareness of sustainable groundwater management
Land Use	Municipalities (City/County Planning Regional Land Use Agencies	Consult and involve to promote land use policies that support GSPs
Private / Domestic Users	Private / Rural Pumpers Domestic Users	Inform and involve to minimize negative impact to these users
Urban / Agricultural Users	Water Agencies Irrigation Districts Mutual Water Companies Resource Conservation Districts Farm Bureaus	Collaborate to promote sustainable management of groundwater
Industrial Users	Commercial and Industrial Self Suppliers Local Trade Associations or Groups	Inform and involve to avoid negative impact to these users
Environmental	Federal and State Agencies Environmental Groups Wetland Managers Conservation Plans, Districts Resource Conservation Districts Land Trusts School Farm Departments	Inform and involve to avoid negative impact to the environment
Economic Development	Chambers of Commerce Business Groups / Associations Elected Officials State Senators and Assembly Members	Inform and involve to support a stable economy
Human Right to Water	Disadvantaged Communities Small Water/Community Systems Environmental Justice Groups	Inform and involve to provide a safe and secure groundwater supplies to all communities reliant on groundwater
Tribes	Federally Recognized Tribes Other Tribes with Land Interest	Inform, involve and consult with tribal government
Federal Lands	Federal Governments Military	Inform, involve and collaborate to ensure basin sustainability
Integrated Water	Flood Agencies Regional Water Management Groups	Inform, involve and collaborate to improve regional sustainability

community to hear their concerns and input. In addition, the Agricultural Commissioner was brought in as a member of the West Placer GSA technical working group. Throughout development of the GSP, the agricultural community was engaged through email notifications, postcard mailings, updates at Agriculture Commission and Farm Bureau meetings and focused in-person tailgate meetings with local farmers and ranchers. The West Placer GSA will continue to inform and engage the agricultural community throughout the GSP implementation.

Similarly, within the SSWD GSA boundaries agriculture accounts for the vast majority of water use. SSWD is a conjunctive use agricultural water district. Approximately one-third of water used by landowners in the district comes from stored surface water with the remaining two-thirds being pumped groundwater. Throughout the GSP development process, SSWD engaged its stakeholders via newspaper announcements, postcard notifications, and public meetings; both in-person and virtual. The SSWD Board of Directors, all of which are landowners and water users within the SSWD GSA, are updated on GSP activity regularly at monthly board meetings. SSWD will continue to actively engage with stakeholders moving forward.

The other GSAs engaged agricultural users as appropriate for their GSA, and consistent with their C&E plans, through public meetings, board updates, online information, letters, direct mailers, and other methods.

11.2.2 Non-municipal Domestic Well Users

Domestic wells are used to supply groundwater to households in both urban and rural areas, and are scattered through the Subbasin **Figure 3-13** show the density of domestic wells per square mile (outlines of DAC and SDAC communities are also shown on the domestic well density figure). The GSAs reached out to and consulted with domestic users through the activities described in their C&E Plans. Additionally, the monitoring network was developed with consideration of the locations of domestic wells (*refer to* **Section 7.4.2 – Domestic Well Representative Monitoring Network**) and sustainable management criteria were specifically developed to be protective of domestic wells; see **Section 8 – Sustainable Management Criteria** for details.

In Placer County, many of the areas with high domestic well density are in the rural Sheridan and Lincoln areas (domestic users within the City of Lincoln and community of Sheridan are on public water supplies). Outreach to DACs in the more rural areas was done through social media, community meetings, municipal advisory meetings, and direct mailers. In addition, multiple community meetings were held in locations near them – e.g. in rural Lincoln (including at Western Placer Waste Management Authority meeting room and Rural Lincoln Municipal Advisory Committee meetings), downtown Lincoln, and community of Sheridan (Sheridan MAC meetings). The meetings were held during after-work hours (as well as not during the busy farming season) to ensure adequate opportunity to participate. See **Appendix R** for a full list of public meetings. Local community Facebook pages were also utilized to post notices, including Lincoln Country Neighbors and Sheridan Happenings pages. In addition, direct mailers were sent

to the rural areas in Lincoln and Sheridan (including the community of Sheridan) announcing the public comment period for the draft GSP.

11.2.3 Small Water Systems

As noted in **Section 3.3.7 – Small Community Water Systems**, there are multiple small community water and non-community non-transient water systems in the Subbasin that are overseen by the counties and the state. Their water supplies are from groundwater. These systems and the local permitting agencies were identified as stakeholders early in the process through direct mailings. Most recently, postcard mailers with information on how to review and comment on or participate in the GSP were sent directly to the small public water system operators.

11.2.4 Environmental Users of Groundwater

As described in **Section 3.7.4 – Environmental**, the Subbasin includes several creeks, streams, ponds and marshes support more than 40 species of native and nonnative fish, including naturally spawning fall-run Chinook salmon, steelhead, and American shad. The banks of the many rivers and streams within the Subbasin provide riparian habitat, both scrub and forest consisting of cottonwood, valley oak, and willow, with occasional white alder, box elder, and Oregon ash. To ensure environmental users, including groundwater dependent ecosystems (GDEs), were adequately considered, a thorough evaluation was performed for GDEs as documented in **Appendix O**.

During this GSP development process, GSA staff engaged environmental interests. GSA staff engaged with the Sacramento Water Forum's Environmental Caucus and met with representatives of the Environmental Council of Sacramento (ECOS) and Habitat 2020, two organizations that have been actively engaged in the NASb GSP, including attending numerous NASb public meetings. Member organizations of ECOS include: 350 Sacramento, Breathe California Sacramento Region, Environmental Democrats of Sacramento, Friends of Stone Lakes National Wildlife Refuge, International Dark-Sky Association, Physicians for Social Responsibility Sacramento Chapter, Sacramento Audubon Society, Sacramento Citizens' Climate Lobby, Sacramento Electric Vehicle Association, Sacramento Housing Alliance, Sacramento Natural Foods Coop, Sacramento Valley Chapter of the California Native Plant Society, Sacramento Vegetarian Society, Save Our Sandhill Cranes, Save the American River Association and Sierra Club Sacramento Group. Member organizations of Habitat 2020 include: Friends of Stone Lakes National Wildlife Refuge, Friends of Swainson's Hawk, International Dark-Sky Association, Sacramento Area Creeks Council, Sacramento Audubon Society, Sacramento Heron and Egret Rescue, Sacramento Valley Chapter of the California Native Plant Society, Save Our Sandhill Cranes, Save the American River Association and Sierra Club Sacramento Group.

In Placer County, WPGSA staff engaged early on with the Administrator of the Placer County Conservation Plan - a multi-component program comprised of a Habitat Conservation Plan / Natural Community Conservation Plan and County Aquatic Resources Plan – to coordinate in the common goal to support long-term conservation and management of natural resources, including groundwater. Both agencies will be collaborating on joint groundwater recharge projects that will be part of the Sustainable Agriculture Groundwater Recharge Project (Supplemental Project) and will utilize joint funding where appropriate to benefit agriculture, GDE's, groundwater levels and the preservation of local habitat. As implementation of both the PCCP and GSP moves forward, these agencies will continue to collaborate.

In Sacramento and Sutter counties, SGA GSA staff have been actively engaged with Natomas Basin Conservancy. The Conservancy is implementing the Natomas Basin Conservancy Habitat Conservation Plan (NBCHCP), which covers approximately 54,000 acres in the Natomas Basin. The purpose of the NBCHCP is to promote biological conservation along with economic development and the continuation of agriculture within the Natomas Basin. Both agriculture and habitat rely on groundwater in the Natomas Basin. The SGA GSA has communicated with the Conservancy on the development of sustainable management criteria and is coordinating on locations for additional groundwater monitoring during GSP implementation.

These groups were added to the Interested Parties notification list and the fact that some of them commented on the draft GSP demonstrates that they were sufficiently informed.

11.2.5 Disadvantaged Communities

As mentioned in **Section 3.6 – Disadvantaged Communities**, there are disadvantaged communities (DACs and SDACs) in the Subbasin that were identified using DWR's DAC mapping tool. **Figure 3-8** shows their locations. Most are located within Placer and Sacramento counties. Those within Sacramento County are located within urban areas, while those in Placer County are primarily in the rural areas around the communities of Sheridan and Lincoln. Those disadvantaged communities in Sacramento County and in the southern portion of Placer County are mostly provided drinking water by water agencies, but some still rely on domestic wells. Water delivered to these customers by water agencies is regularly sampled and tested to ensure it meets or exceeds all state and federal drinking water standards. Outreach to these communities was provided through water agency board meetings, notices, and/or direct mailers and other methods.

In the Sacramento area, the water supply and water quality needs of DACs in the Subbasin are generally served effectively by water agency efforts to provide high-quality water supplies to their entire service area. Customers are represented by the water agencies that serve them and have received information on the GSP process through those agencies. Some DACs or individuals that would be considered disadvantaged reside in very small pockets of the region, served by a small water system. As mentioned above, direct mail outreach was sent to small water system operators.

Most DAC areas in the northern portion of Placer County do not have water service and rely on domestic wells - other than those communities near City of Lincoln, which have water service from the City of Lincoln. The community of Sheridan is also served by a community water system. As mentioned in Section 11.2.2 above, outreach to DACs in the more rural areas was done through social media, community meetings, municipal advisory meetings, and direct mailers. In addition, multiple community meetings were held in locations near them – e.g. in rural Lincoln (including at Western Placer Waste Management Authority meeting room and Rural Lincoln Municipal Advisory Committee meetings), Lincoln City Hall, and community of Sheridan (Sheridan MAC meetings). The meetings were held during after-work hours (as well as not during the busy farming season) to ensure adequate opportunity to participate. An additional in person meeting targeted at area farmers and ranchers was held at the Wise Road Placer County Fire Station in rural Lincoln. See **Appendix R** for a full list of public meetings. Local community Facebook pages were also utilized to post notices, including Lincoln Country Neighbors and Sheridan Happenings pages. In addition, direct mailers were sent to the DAC areas in Lincoln and Sheridan announcing the public comment period for the draft GSP.

Those DACs in the Roseville area of Placer County are served by the City of Roseville Environmental Utilities and were automatically covered by outreach conducted to customers.

11.2.6 Tribes

The United Auburn Indian Community (UAIC) has jurisdiction over land in Placer County southeast of Lincoln and northeast of Sheridan (See Section 3.3). These lands are exempt from SGMA. **Figure 3-2** in **Section 3 – Plan Area** shows the tribal lands in the Subbasin. The West Placer GSA reached out to the UAIC prior to GSP development by coordinating with the Placer County Environmental Coordinator to attend the joint Placer County / UAIC annual meeting. Staff gave an update on SGMA and the GSP development process and offered to attend future UAIC meetings. Staff obtained the contact information of key tribal staff and added them to the Stakeholders and Interested Parties lists, touching base periodically to ensure contact information was up to date (most recently with Anna Starkey, UAIC, in July 2021) and to repeat the standing offer to present at future meetings. To date, the UAIC has received notification of all GSP development activities. The UAIC's properties in Lincoln and Auburn are provided surface water by Placer County Water Agency.

11.3 List of Public Meetings

The individual GSAs conducted numerous public meetings during GSA formation and throughout GSP development to explain the requirements of SGMA, discuss the GSP regulations and proposed content, and solicit input from the public. This section focuses primarily on the public meetings that were held once key information for the GSP became available, such as the results of the groundwater modeling and water budget, and proposed sustainable management criteria, and projects and management actions.

A full list of public engagement activities, including all public meetings, are included in **Appendix R**. It should be noted that this is not an exhaustive list, as many of the water agency GSAs have standing agenda items to report on SGMA-related updates to their boards or various committees.

11.3.1 Draft GSP

The GSAs conducted public meetings at various times throughout GSP development, culminating in a three-meeting virtual series of coordinated, Subbasin-wide public meetings in spring of 2021 prior to the Public Draft GSP release and one Subbasin-wide public meeting during the Public Draft GSP review period on September 8, 2021. At each meeting, GSA representatives gave a general overview of SGMA and GSP requirements, GSP development and content, as well as an overview of the GSP development timeline, before focusing on the specific meeting topic. Representatives from each GSA in the basin were present to answer questions. Notices were provided through a variety of methods and consistent with C&E Plans, including email blasts to over 330 stakeholders and interested parties. Prior to these meetings, in November 2020, draft GSP Sections 1 through 5 were posted for public comment on the NASb website along with a recorded PowerPoint presentation and a written overview of the sections' contents to guide the reader. Comments to the sections were accepted via the online portal at nasbgroundwater.org or by mail.

Below is a summary of the four basin-wide public meetings in 2021, which were all held via Zoom.

- **Workshop #1 - SGMA and Sustainable Management Criteria (February 10, 2021)** – In this first meeting, the GSAs provided an overview of SGMA, the draft sections (1 through 5) recently completed and released for public review and comment, and the GSAs' efforts to define groundwater levels and other criteria to measure sustainability in the basin. This event had 69 attendees.

- **Workshop #2 - Water Budget (March 10, 2021)** – In this second meeting, the GSAs presented the results of the Subbasin wide groundwater model and groundwater budget, explaining how the water budget will provide stakeholders a good understanding of the Subbasin, assist the GSAs in long range planning as well as fine-tuning of sustainable management criteria, and help determine how much water can be safely pumped from the Subbasin while remaining sustainable. This event had 72 attendees.

- **Workshop #3 - Projects and Management Actions (May 12, 2021)** - In this third meeting, the GSAs discussed refinements to the sustainable management criteria, approach to defining undesirable results, and the proposed projects and management actions that will potentially be included in the GSP and that could be implemented should the Subbasin become unsustainable, or at risk of becoming unsustainable, as indicated by the results of the above-mentioned monitoring of water groundwater conditions. This event had 47 attendees.

The two-hour meetings allotted time for questions and comments from the public. All workshops were recorded, and the videos were posted online at nasbgroundwater.org. Additionally, the Q&A and Chat questions were downloaded, and transcripts were compiled to document verbal comments. Around this time, many of the GSAs brought updates to their boards and councils and at other community venues to inform them of the GSP status, GSP content, and the public review process.

A final public meeting was held on Zoom shortly after the Public Draft GSP was released for public review on August 31, 2021:

- **Workshop #4 – Draft GSP (September 15, 2021)** - In this final meeting, the GSAs gave an overview of the GSP, reviewed updates to the GSP since Workshop #3, and how and when the public may comment on the plan.

11.3.2 GSP Hearings and Adoption

Each GSA, including individual GSA member agencies where required (when GSA is not a JPA), adopted the GSP at a public meeting and after a public hearing, pursuant to California Water Code Section 10728.4.

11.4 GSP Comments and Responses

GSP regulations require GSAs to consider stakeholder input and DWR must, in their evaluations, consider whether GSAs have adequately responded to comments that raise credible technical or policy issues with the GSP. Pursuant to SGMA, the five GSAs solicited and responded to comments from the public on the Public Draft GSP. On numerous occasions prior to and during development of the GSP, information about the GSP was released to the public and comments were solicited. With each release of information, public notices were sent through a variety of methods, consistent with C&E Plans, and public meetings were held. Comments were accepted both electronically via the website, emails and during public meetings. This section discusses comments received during key points in GSP development.

In November 2020, partial drafts of Sections 1 through 5 were released to the public on the NASb website and a 30-day comment period was provided. Comments were accepted online via the comment portal at nasbgroundwater.org and by email. A list of comments and how they were considered can be found in **Appendix S**. Copies of the public letters or emails are also provided in **Appendix S**.

A Public Draft of the GSP, with previous public comments incorporated was prepared and released on the NASb website on August 31, 2021, and a 60-day comment period was provided. The Public Draft GSP was noticed on the website, through social media, mailers, print outreach, and an e-mail blast was sent to over 300 stakeholders and interested parties notifying them of the document availability. Comments were accepted online via the comment portal at

nasbgroundwater.org and by email. A list of comments and how they were considered can be found in **Appendix S**. Copies of the public letters or emails are also provided in **Appendix S**.

Prior to adoption, and in accordance with California Water Code Section 10728.4, the GSAs filed a Public Notice of Proposed GSP Adoption to notify cities and counties in the NASb plan area. GSAs must review and consider comments from any city or county that receives notice pursuant to this section and shall consult with a city or county that requests consultation within 30 days of receipt of the notice. No cities or counties requested consultation.

It should be noted that in addition to the formal comment periods mentioned above, input from the public was sought and received in various ways throughout GSP development, including verbally at public meetings. All public outreach informed the public how they could reach their GSA representatives to ask questions or provide input by phone, email, or in writing.

Input from the public on the GSP was handled in three different ways depending on how the information was submitted. It should be noted that most comments during public meetings were in the form of questions or requests for clarification.

- **Verbal Comments** – If the input was received in a broad context, changes to the GSP were made if they were they were specific or relevant to a section of the GSP and if they raised credible technical or policy issues. If received in the form of questions, various portions of the GSP may have been changed to provide better clarification.
- **Website Comments** – If the input was submitted via the website, raised credible technical or policy issues, and provided specific sections, paragraph and line, these comments were downloaded into a table format and a response placed opposite each comment that indicates if the change was made to the GSP. If a similar comment raised the same issue and/or was previously addressed in a different section of the GSP, or if the comment was too general in nature or not required by SGMA, the comment was noted but no changes were made.
- **Written Comments** – If the input was received in letter or email format, the comments were dissected and placed into the table format described for Website Comments, along with if and how the GSP was modified or clarified. If a similar comment raised the same issue and/or was previously addressed in a different section of the GSP, or if the comment was too general in nature, the comment was noted but no changes were made.

As mentioned, **Appendix S** provides a table listing the public comments received on the draft GSP Sections 1 through 5 (November 2020) and those to the Public Draft GSP and how the comments were addressed. Responses focused on those comments that pertained to the GSAs responsibilities and obligations under the SGMA and that raised credible technical or policy issues with the GSP pursuant to GSP regulations (23 CCR 55.4).

11.5 Interbasin Communications and Agreements

During development of this GSP the GSAs reached out to adjacent subbasin GSAs (South American, Sutter, Yolo and Yuba South) to share information, technical approaches, findings and whether implementation of the NASb GSP would adversely affect adjacent subbasins's ability to achieve sustainability. Coordination meetings were held that discussed:

- Groundwater model types and coordination
- Groundwater flow across common boundaries
- Projected land use changes along common boundaries
- Monitoring networks along common boundaries
- Minimum thresholds along common boundaries

Based on this coordination, the NASb GSAs and adjacent subbasin GSAs concluded:

- Current and projected groundwater flow, projected land use changes, and MTs near common boundaries do not appear to impede their respective abilities to achieve each subbasin's sustainability goals.
- The monitoring network along common boundaries is sufficient to detect significant changes that could impact their respective GSPs and that each GSA will actively share monitoring information along common boundaries.
- The GSAs would meet for annual coordination meetings after the completion of each GSP annual report to share information on monitoring results and other implementation activities and to identify and address any emerging trends that may be of concern along common boundaries
- It is currently preferrable to document our coordination through this correspondence rather than through a more formal interbasin agreement. Interbasin letters are provided in **Appendix T**.

As a result of the above coordination, the GSAs shared information to the mutual benefit of each subbasin's GSP development effort and have confirmed that the implementation of each respective GSPs will not adversely impact the attainment of sustainability goals. The GSAs examined findings in each GSP along their respective boundaries and either confirmed consistency or have agreed to work together during GSP implementation to resolve differences, to the extent they merit such effort.

11.6 GSAs Decision Making Process

The Subbasin is managed by five GSAs that have jointly developed this coordinated GSP. A description of each GSA's organization and management structure can be found in **Section 2.1 – GSA Organization and Structure**. All GSAs are comprised of local agencies authorized to exercise powers related to groundwater management under California Water Code Section 10721.

- **Sacramento Groundwater Authority GSA** - This SGA is a Joint-Powers Authority that manages groundwater in Sacramento County north of the American River. The joint-powers agreement signatories chose to manage the basin cooperatively by creating a governing board of directors comprised of representatives of 14 water agencies and other water users within their jurisdiction. GSA decisions must be approved by a majority of this board.

- **Reclamation District 1001 GSA** - The Reclamation District (RD) is a special-purpose district governed by elected board members who own property or work on land in RD 1001. RD 1001 has delegated certain activities regarding the implementation of SGMA to the Pleasant Grove Verona Mutual Water Company through a separate MOA. GSA decisions must be approved by a majority of this board.

- **SSWD GSA** - South Sutter Water District (SSWD) is a public agency governed by an elected board of directors who are landowners within the district. GSA decisions must be approved by majority vote of the SSWD Board.

- **Sutter County GSA** - The Sutter County Board of Supervisors serves as the legislative body for Sutter County and is responsible for GSP preparation and implementation in the County; however, Sutter County has delegated certain activities regarding the implementation of SGMA to the Natomas Central Mutual Water Company through a separate MOA. GSA decisions must be approved by a majority of the Sutter County board.

- **West Placer GSA** - The West Placer GSA has no authority of its own. Placer County, the cities of Roseville and Lincoln, and Placer County Water Agency formed the WPGSA through a MOA (with participation by the California American Water through a separate participation agreement). Each member agency assigned representatives to serve on the technical working group with certain decision-making abilities. However, certain actions, such as approval of the GSP, require the approval of the governing body of each WPGSA member agency.

This section provides a summary of their decision-making processes and key decisions made leading up to adoption of the GSP, including how the public was engaged.

11.6.1 GSA Formation

All five NASb GSAs began coordinating in January 2017 and executed a MOA in April 2019 to fund development of a single GSP for the NASb. During GSA formation, and as the GSAs began to meet to develop this GSP, the GSAs offered numerous opportunities for public engagement:

- GSA Formation Public Notice – Each public agency desiring to form a GSA published a notice of public hearing.
- GSA Formation Public Hearing – Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant, the local agencies each held a public hearing in the county or counties overlying the Subbasin.

In addition to these two mandatory activities, the GSAs engaged the public prior to and during the GSA formation process through various activities such as public workshops and other public venues (e.g. Municipal Advisory Committees, City Councils, County Board of Supervisors, Water Agency Directors, Agricultural Commission and others) to inform groundwater users and other interested parties of GSA formation and SGMA requirements, as well as to identify potential participants and other stakeholders to engage during the GSP development phase.

11.6.2 GSP Initial Notification

GSP regulations require GSAs to submit an Initial Notification to DWR prior to GSP development. SGA, as the lead agency for the NASb, and pursuant to the above-mentioned MOA, filed the Initial Notification on behalf of the five NASb GSAs on September 24, 2018. While there are no formal adoption requirements for Initial Notification, the GSAs notified the public through various methods, including public meetings, of the Initial Notification and opportunity to comment to DWR. The public was engaged during this process via notifications prior to and after filing of the Initial Notification.

11.6.3 GSP Adoption and Submittal to DWR

The GSAs offered numerous opportunities for public engagement, including but not limited to the following key decision points pursuant to California Water Code Section 10728.4:

- Public Notice of Proposed Adoption – *Prior to adopting a GSP, GSAs must provide notice to a city or county within the area of the proposed plan or amendment. Notices were sent on September 1, 2021.*
- GSP Adoption Public Hearing – *A GSA may adopt a Final GSP after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment.*

Following the required notifications and public hearings, and after consideration of public comments, the GSA agencies adopted the GSP at public meetings held in December and January 2021. Specific dates of public hearings can be found in **Appendix R**.

11.6.4 GSP Review and Evaluation

Once the Final GSP is submitted, any person may provide comments to DWR via the SGMA Portal. The GSA's will inform stakeholders of the GSP submittal and DWR's public comment process and online public comment portal during the workshop on September 8, 2021.

11.6.5 GSP Implementation MOA

At the time the GSAs adopt the GSP, they will also agree to the Implementation MOA to fund and coordinate GSP implementation activities, including ongoing outreach and stakeholder engagement. In general, each of the GSAs in the Subbasin will be responsible for sustainably managing their portion of the Subbasin and contributing funds for GSP implementation, including basin-wide management activities, public engagement, annual reports, and five-year GSP updates. Each GSA approved the MOA at a publicly noticed meeting.

11.7 Informing the Public During GSP Implementation

The GSAs plan to continue public outreach and stakeholder engagement through the GSP implementation phase through various activities, including an annual public meeting to release the results of the Annual Report and the status of projects and management actions. As mentioned, the NASb agencies agreed to coordinate and fund GSP implementation activities through a MOA. The MOA also contains provisions for funding and implementing outreach activities, and the GSAs agreed to, at a minimum:

1. Provide for the consideration of all interests of legal users of groundwater within the NASb. To that end, the GSAs intend to update and seek input from the public and other interested stakeholders as part of GSP implementation and overall SGMA compliance.

2. Hold at least one annual NASb public meeting to inform and update stakeholders on NASb activities and basin wide conditions.

3. Develop public outreach materials and maintain and update the public website (nasbgroundwater.org). The website will be used to inform the public about NASb activities and meetings, provide a portal for the public to provide comments to the NASb GSAs, and include information for each GSA.

In addition, the GSP commits to a Domestic/Shallow Well Data Collection and Communication Program that will focus on increased outreach and collection, sharing, and distribution of water

level and water quality data and information with domestic well owners, enabling informed decisions regarding land owners' design and construction of wells and GSAs' management of groundwater.

The GSAs will work to ensure DAC areas are notified at least annually through a variety of methods, such as water agency notices, direct mail, social media, and/or community meetings (e.g. annual notices or updates at Municipal Advisory Committee meetings in DAC areas).

The UAIC will continue to be notified of all activities and invited to the NASb annual public meetings.

With adoption of this GSP and the MOA, public involvement will continue through activities in the GSA individual C&E Plans along with Subbasin-wide public meetings. Nothing within the MOA precludes the individual NASb GSAs from holding additional public stakeholder meetings or conducting their own public engagement activities, consistent with their C&E Plans.

In addition, to comply with the statutory requirements for public engagement during implementation of this GSP, the GSAs will engage the public through:

- Public Notices and Meetings
    - Before amending a GSP
    - Prior to imposing or increasing a fee
- Encouraging Active Involvement

The GSAs will continue to maintain and update their Stakeholder and Interested Parties lists.

This page left intentionally blank

12. References

Berkstresser, C.F., Jr. 1973. Base of Fresh Ground-Water – Approximately 3,000 micromhos - in the Sacramento Valley and Sacramento-San Joaquin Delta, California. U.S. https://pubs.er.usgs.gov/publication/wri7340

Bennett, G.L., V, Fram, M.S., and Belitz, Kenneth. 2011. Status of groundwater quality in the Southern, Middle, and Northern Sacramento Valley study units, 2005–08—California GAMA Priority Basin Project. USGS Scientific Investigations Report 2011–5002. https://pubs.usgs.gov/sir/2011/5002/

Bennett, G.L., 2019. Groundwater quality in the Sacramento Metropolitan Shallow Aquifer, California. USGS Open-File Report 2019-1047. https://pubs.er.usgs.gov/publication/ofr20191047

Brown & Caldwell. 2006. Placer County Water Agency Integrated Water Resources Plan. Rancho Cordova, CA. http://www.pcwa.net/

Bryan, K. 1923. Geology and Ground-Water Resources of the Sacramento Valley, California. U.S. Geological Survey Water-Supply Paper 495. https://pubs.er.usgs.gov/publication/wsp495

California Code of Regulations (CCR), Title 23, Division 2, Chapter 1.5, Subchapter 2 Groundwater Sustainability Plans. 2016. https://cawaterlibrary.net/document/california-code-of-regulations-title-23-waters-division-2-department-of-water-resources-chapter-1-5-groundwater-management-subchapter-2-groundwater-sustainability-plans/

California Code of Regulations (CCR), Title 22, Division 4, Chapter 15, Domestic Water Quality and Monitoring, accessed 2021. https://casetext.com/regulation/california-code-of-regulations/title-22-social-security/division-4-environmental-health/chapter-15-domestic-water-quality-and-monitoring-regulations

California Department of Water Resources (DWR), July 1974. Evaluation of Ground Water Resources: Sacramento County. Department of Water Resources Bulletin 118-3. https://www.csus.edu/indiv/h/hornert/Geologic%20maps%20and%20references/DWR_Bull_118-3_text.pdf

California Department of Water Resources (DWR), July 1978. Evaluation of Ground Water Resources: Sacramento Valley. Department of Water Resources Bulletin 118-6.

California Department of Water Resources (DWR), 1981. Bulletin 74-81 Water Well Standards: State of California. https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Standards/Combined-Well-Standards

California Department of Water Resources (DWR), 1991. Bulletin 74-90. California Well Standards. https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Standards/Combined-Well-Standards

California Department of Water Resources (DWR), 1995. Sacramento Delta San Joaquin Atlas. Reprinted July 1995. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/nmfs/spprt_docs/nmfs_exh4_dwr_1995.pdf

California Department of Water Resources (DWR), 1995. *Draft Feasibility Report, American Basin Conjunctive Use Project*. Sacramento, CA.

California Department of Water Resources (DWR), 1997. *Feasibility Report, American Basin Conjunctive Use Project*. Sacramento, CA.

California Department of Water Resources, 2003. "California's Groundwater," Bulletin 118 – Update 2003, North American Subbasin, last update February 27, 2004. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/Statewide-Reports/Bulletin_118_Update_2003.pdf

California Department of Water Resources, 2014. Geology of the Northern Sacramento Valley, California. https://cawaterlibrary.net/document/geology-of-the-northern-sacramento-valley-california/

California Department of Water Resources, 2016a. Best Management Practices for the Sustainable Management of Groundwater, Monitoring Networks and Identification of Data Gaps. https://groundwaterexchange.org/wp-content/uploads/2020/09/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps_ay_19.pdf

California Department of Water Resources, 2016b. Best Management Practices for the Sustainable Management of Groundwater, Monitoring Protocols, Standards and Sites. December 2016. https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents

California Department of Water Resources, 2016c. *Best Management Practices for the Sustainable Management of Groundwater: Water Budget*. December. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

California Department of Water Resources, 2017. Best management Practices for the Sustainable Management of Groundwater, Sustainable Management Criteria DRAFT. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf

California Department of Water Resources, 2018a. Disadvantaged Communities Mapping Tool. Accessed May 2021. https://gis.water.ca.gov/app/dacs/

California Department of Water Resources, 2018. 2017 GPS Survey of the Sacramento Valley Subsidence Network. https://scgah2o.saccounty.net/Documents/2017_GPS_Survey_of_the_Sacramento_Valley_Subsidence_Network.pdf

California Department of Water Resources, 2018. Guidance Documentation for Groundwater Sustainability Plan, Stakeholder Communication and Engagement. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Assistance-and-Engagement/Files/Guidance-Doc-for-GSP---Stakeholder-Communication-and-Engagement.pdf

California Department of Water Resources, 2019. SGMA Basin Prioritization, Phase 2. https://gis.water.ca.gov/app/bp-dashboard/final/

California Department of Water Resources, 2019. Well Completion Reports, https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports

California Department of Water Resources. 2020. SGMA Data Viewer https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub

California Department of Water Resources. 2021. California's Groundwater Update 2020, Bulletin 118. CalGW Online datasets, water level trend data (Groundwater Level Estimated Trends Dashboard (arcgis.com)

Central Valley Regional Water Quality Control Board (CVRWQCB). 2007. *The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region, Fourth Edition, Revised October 2007 (with Approved Amendments), The Sacramento River Basin & The San Joaquin River Basin, California Regional Water Quality Control Board Central Valley Region.* http://www.swrcb.ca.gov/rwqcb5/water_issues/basin_plans/ (accessed 10/2008).

Central Valley Region Regional Water Quality Control Board (CVRWQCB). 2018. Water Quality Control Plan for the Sacramento and San Joaquin Rivers. https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

CH2MHill, 2013. Rice Specific - Groundwater Assessment Report. https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/california_rice_commission/ground_water/2013_07_rice_gar.pdf

CH2M, 2016. Groundwater Quality Assessment Report on behalf of the Northern California Water Agencies and the Sacramento Valley Water Quality Coalition. https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/sacramento_valley/ground_water/2016_0128_sacvalley_gar_rev.pdf

CH2M, 2016. Groundwater Trend Monitoring Workplan and Data Gap Assessment Plan on behalf of the California Rice Commission.

https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/california_rice_commission/ground_water/2016_03_rice_gar.pdf

County of Sacramento. Chapter 6.28 Wells and Pumps. https://qcode.us/codes/sacramentocounty/view.php?topic=6-6_28

Davis and Hall, 1959. Davis, S. N., and Hall, F. R., 1959, Water quality of eastern Stanislaus and northern Merced Counties, California: Stanford Univ. Pubs., Geol. Sci., v. 6, no. 1, 112 p. Davis and Hall, 1959. Davis, S. N., and Hall, F. R., 1959, Water quality of eastern Stanislaus and northern Merced Counties, California: Stanford Univ. Pubs., Geol. Sci., v. 6, no. 1, 112 p. https://ngmdb.usgs.gov/Prodesc/proddesc_91644.htm

Department of Water Resources and United States Bureau of Reclamation (USBR) Water Transfer White Paper (2019) https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Water-Transfers/Files/Draft_WTWhitePaper_20191203.pdf

Harwood and Helley, 1987. Late Tectonism of the Sacramento Valley, California, U.S. Geologic Survey Professional Paper 1359. https://pubs.usgs.gov/pp/1359/report.pdf

Helley and Harwood, 1985. Geologic Map of Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California, U.S. Geological Survey, Miscellaneous Field Studies Map MF-1790. https://pubs.usgs.gov/mf/1985/1790/

Howard, Janet L. 1992. Quercus lobata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). https://www.fs.fed.us/database/feis/plants/tree/quelob/all.html

GEI, March 2018 (GEI SBR). State of the Basin Report 2013 through 2016 West Placer County.

GEI, November 2, 2018. Technical Memorandum, Initial GSP Development Activities.

GEI, June 21, 2019. Technical Memorandum, Brackish Water Affected Areas Study.

GEI, March 11, 2020. Water Quality Sampling.

Kleinfelder, 2019, Piezometer Reading Summary, 2018-2019 Flood Season Natomas Cross Canal Sacramento and American Rivers. Sacramento and Sutter Counties, CA. File No.: 20161893.005A.

Komex H20 Science, Inc, 2005. Summary of Studies Regarding Surface Water-Groundwater Interaction Along the American River Downstream of Nimbus Dam, Sacramento County, California. Technical Memorandum. Prepared for Sacramento Groundwater Authority.

Land IQ, 2017. Draft report-2014 statewide land use mapping. In. Sacramento, California, USA. https://gis.water.ca.gov/app/CADWRLandUseViewer/images/2014%20Statewide%20Land%20Use%20Mapping%20-%20Report%20-%2020170727.pdf

MBK, 2016. South Sutter Water District Agricultural Water Management Plan.

Milby, Barbara J, and George L. Bennett V, and Kenneth Belitz, 2005. Ground-Water Quality Data in the Southern Sacramento Valley, California, 2005—Results from the California GAMA Program. https://pubs.er.usgs.gov/publication/ds285

Milby, Barbara J, and George L. Bennett V, and Kenneth Belitz, 2018. Ground-Water Quality Data in the Southern Sacramento Valley, California, 2005—Results from the California GAMA Program. https://pubs.usgs.gov/ds/285/

Montgomery Watson Harza (MWH), 2002. Sacramento Groundwater Authority Data Management System, Summary of Basin Conditions.

Montgomery Watson Harza (MWH), December 2005. Western Placer County, Groundwater Storage Study Final Report.

Natomas Basin Habitat Conservation Plan, 2003. https://www.natomasbasin.org/helpful-documents/2003-nbhcp-related-documents/

Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset, accessed 2018. https://gis.water.ca.gov/app/NCDatasetViewer/sitedocs/

O'Green, M Saal, H Dahlke, D Doll, R Elkins. 2015. Soil suitability index identifies potential areas for groundwater banking on agricultural lands. http://calag.ucanr.edu/archive/?article=ca.v069n02p75

Olmstead, F.H., and Davis, G.H., 1961, Geologic features and ground-water storage capacity of the Sacramento Valley, California. vi, 241. DOI 10.3133/wsp1497 https://pubs.usgs.gov/wsp/1497/report.pdf

Page, R. W. and Balding 1973. Geology and quality of water in the Modesto-Merced area, San Joaquin Valley, California. Water-Resources Investigations Report 73-6. https://pubs.usgs.gov/wri/1973/0006/report.pdf

Page. 1986. Geology of the Fresh Ground-Water Basin of the Central Valley, California, with Texture Maps and Sections. USGS Professional Paper 1401-C. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C38&as_vis=1&q=Page.+1971&btnG=

Piper, A. M., Gale, H. S., Thomas, H. E., and Robinson, T. W., 1939, Geology and ground-water hydrology of the Mokelumne area, California: U.S. Geol. Survey Water-Supply Paper 780, 230 p. https://pubs.er.usgs.gov/publication/wsp780

Placer County, 1990. Water Well Construction Ordinance. https://www.placer.ca.gov/DocumentCenter/View/8877/County-Water-Well-Construction-Ordinance-PDF

Placer County, 2020. Placer County Conservation Plan. https://www.placer.ca.gov/3362/Placer-County-Conservation-Program

Redwine, L.E., 1984, The Tertiary Princeton Submarine Valley System Beneath the Sacramento Valley, California: American Association of Petroleum Geologists publication Paleogene Submarine Canyons of the Sacramento Valley, California, pp. 53-80. http://archives.datapages.com/data/pacific/data/069/069001/53_ps0690053.htm?q=%2BtextStrip%3Ala+textStrip%3Aluna+textStrip%3Aformation+textStrip%3Amiddle+textStrip%3Amagdalena+textStrip%3Abasin+textStrip%3Acolombia

Regional Water Authority, 2018. American River Basin Integrated Water Management Plan 2018. https://rwah2o.org/programs/integrated-regional-water-management/american-river-basin-irwmp-2018-update/

RMC, 2011. Groundwater Quality Sustainability Report, Integrated Hydrologic Modeling, prepared for Sacramento Groundwater Authority.

Sacramento Groundwater Authority (SGA), October 2011. Groundwater Quality Vulnerability Assessment. Prepared by Kennedy/Jenks Consultants.

Sacramento Groundwater Authority (SGA), 2014. Groundwater Management Plan Sacramento County – North Basin. http://www.sgah2o.org/wp-content/uploads/2016/06/GMP_SGA_2014_Final.pdf

Springhorn, S.T., 2008, Stratigraphic Analysis and Hydrogeologic Characterization of Cenozoic Strata in the Sacramento Valley near the Sutter Buttes: Master of Science Dissertation, California State University, Chico, 2008. https://www.worldcat.org/title/stratigraphic-analysis-and-hydrogeologic-characterization-of-cenozoic-strata-in-the-sacramento-valley-near-the-sutter-buttes/oclc/636057707

Soil Survey Survey Geographic Database (SSURGO), Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. https://websoilsurvey.nrcs.usda.gov/ . Accessed [11/4/2019].

State Water Resources Control Board, 2021. SAFER Drinking Water Systems with Violations Tool. https://www.waterboards.ca.gov/safer/dw_systems_violations_tool.html

State Water Resources Control Board, 2021. Drinking Water Needs Assessment. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

State Water Resources Control Board, 2021. SAFER Aquifer Risk Tool. https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=17825b2b791d4004b547d316af7ac5cb

Sutter County, 2005. County of Sutter Department of Public Works Improvement Standards. 2005, rev. 2010. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKE

wjr0MWthr7yAhWFW80KHWZNBiEQFnoECAMQAQ&url=https%3A%2F%2Fwww.suttercounty.org%2Fhome%2Fshowpublisheddocument%2F2600%2F637554857279900000&usg=AOvVaw0A8jRi6vM4em5_rtL6YahS

U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Interior Region. 2020. American River Basin Study. https://www.pcwa.net/planning/arbs

U.S. Soil Conservation Service, 1987. Soil Survey of Sacramento County, California. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/CA067/0/sacramento.pdf

U.S. Soil Conservation Service, 1980. Soil Survey of Placer County, California, Western Part. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/placerCA1980/placerCA1980.pdf

USBR Groundwater Banking Guidelines for CVP Water (2019). https://www.usbr.gov/mp/waterbanking/docs/groundwater-banking-guidelines-11-2014.pdf

USGS, 2005. Groundwater Quality Data in the Southern Sacramento Valley, California, 2005 – Results from the California Groundwater Ambient Monitoring and Assessment (GAMA) Program.

USGS, accessed 2019. National Water Information System. https://waterdata.usgs.gov/nwis

Water Education Foundation, 2002, The Water Forum Agreement: A model for collaborative problem solving. https://www.watereducation.org/publication/water-forum-agreement-model-collaborative-problem-solving

Water Forum. 2000. Water Forum Agreement. Updated October 2015. https://waterforum.org/wp-content/uploads/2014/08/Water-Forum-Agreement-Update-2015-FINAL-FOR-PRINT2.pdf

This page left intentionally blank

Appendix A: Implementation MOA

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX A
Implementation Memorandum of Agreement

December 2021

MEMORANDUM OF AGREEMENT
REGARDING COORDINATION BETWEEN GROUNDWATER SUSTAINABILITY AGENCIES AND IMPLEMENTATION OF THE GROUNDWATER SUSTAINABILITY PLAN FOR THE NORTH AMERICAN SUBBASIN

THIS MEMORANDUM OF AGREEMENT (MOA or Agreement) is entered into and effective this 11th day of January, 2022 (Effective Date) by and among the City of Lincoln, the City of Roseville, the County of Placer, the County of Sutter, the Natomas Central Mutual Water Company, the Placer County Water Agency, the Reclamation District 1001, the Sacramento Groundwater Authority, and the South Sutter Water District (all hereafter known individually as a "Party" and collectively as "Parties").

RECITALS

Whereas, on August 29, 2014, the California Legislature passed comprehensive groundwater legislation contained in SB 1168, SB 1319, and AB 1739. Collectively, those bills, as subsequently amended in later years, enacted the Sustainable Groundwater Management Act (SGMA). Governor Brown signed the legislation on September 16, 2014 and it became effective on January 1, 2015; and

Whereas, SGMA requires "sustainable groundwater management "for all groundwater basins and requires “sustainable groundwater management” via a Groundwater Sustainability Plan (GSP) for all groundwater basins or subbasins that are designated as high-priority or medium- priority basins by the California Department of Water Resources (DWR) in its' report entitled "California's Groundwater: Bulletin 118”; and

Whereas, the North American Subbasin (NASb) of the Sacramento Valley Groundwater Basin, DWR Basin No. 5-21.64, has been designated as a high priority subbasin in Bulletin 118; and

Whereas, the following Groundwater Sustainability Agencies (GSAs) collectively cover under their respective jurisdictions, the entire NASb; Reclamation District 1001; Sacramento Groundwater Authority; South Sutter Water District; County of Sutter (consisting of the County of Sutter and the Natomas Central Mutual Water Company); and West Placer GSA (consisting of the City of Lincoln, the City of

Roseville, the County of Placer, the Nevada Irrigation District and the Placer County Water Agency); and

Whereas, the Nevada Irrigation District Board of Directors took action on November 10, 2021] to formally withdraw from the West Placer GSA thereby removing them as a Party to this Agreement; and

Whereas, the California American Water Company and the Golden State Water Company are participants, as defined by SGMA, in certain GSAs overlying the NASb; and

Whereas, the GSAs overlying the NASb have jointly prepared a single Groundwater Sustainability Plan (GSP) to cover the entire NASb, and each Party plans to adopt the GSP to ensure continued sustainable management of the basin; and

Whereas, it is the desire of the Parties to coordinate on the development and long-term implementation of the GSP for the NASb; and

Whereas, the Parties seek to memorialize the terms and conditions of the development and long-term coordination of the GSP and long term SGMA coordination through this Memorandum of Agreement.

THEREFORE, in consideration of the mutual promises, covenants and conditions herein set forth, the Parties agree as follows:

I. **DEFINITIONS.** As used in this Agreement, the meaning of the terms hereinafter set forth shall be as follows:

A. **"Agreement"** shall mean this Memorandum of Agreement Regarding Coordination Between Groundwater Sustainability Agencies and Implementation of the Groundwater Sustainability Plan for the North American Subbasin.

B. **"Annual Budget" or "Budget"** means the budget provided for in this Agreement.

C. **“California Public Records Act”** shall mean California Government Code section 6250, *et seq*.

D. **“Contracting Entity”** shall mean the Party appointed from time to time by agreement of a majority of the NASb GSA Representatives in the manner set forth in this Agreement, who is authorized to collect funds annually from the approved budgets from each Party and contract with service providers for common GSP activities, including monitoring, analysis, and reporting, as well as implementation of Projects and Management Actions.

E. **“Coordination Committee”** shall mean, the five-member committee organized to oversee GSP implementation and SGMA compliance for the NASb.

F. **“Data Management System” or “DMS”** shall mean a system that is capable of storing and reporting information relevant to the development or implementation of the GSP and monitoring of the subbasin as defined by the GSP Regulations (California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2).

G. **"Day” or “Days”** shall mean calendar day.

H. **"Fiscal and Contracting Entity”** shall mean either the GSP Administrator or GSP Coordinator while acting from their home agency to perform financial accounting and contracting duties on behalf of the NASb GSAs.

I. **"Fiscal Year”** shall mean the term to which the Annual Budget applies from July 1 through June 30.

J. **"Funds"** means funds received by the Fiscal and Contracting Entity from the Parties, or any other source for use in carrying out the purposes of this Agreement.

K. **"Groundwater Sustainability Agency" or "GSA"** shall mean an agency or combination of local agencies authorized by SGMA to regulate a portion of

a groundwater subbasin cooperatively with all other Groundwater Sustainability Agencies formed in a subbasin, in compliancewith SGMA.

L. **"Groundwater Sustainability Plan" or "GSP"** shall have the definition set forth in SGMA.

M. **"GSP Coordinator"** shall mean a Coordination Committee Primary or Alternate Representative appointed from time to time by agreement of a majority of the NASb GSA Representatives, in the manner set forth in this Agreement, who is authorized to administer the activities contemplated by this Agreement. Generally, the nature of this position is technical coordination.

N. **"GSP Administrator"** shall mean a Coordination Committee Primary Representative appointed from time to time by agreement of a majority of the NASb GSA Representatives, in the manner set forth in this Agreement, who is authorized to coordinate the activities contemplated by this Agreement. Generally, the nature of this position is administrative including meeting coordination and documentation.

O. **"GSP Managers"** shall mean, collectively, the GSP Coordinator and the GSP Administrator.

P. **"GSP Plan Manager"** shall mean a Coordination Committee Primary or Alternate Representative appointed as GSP Plan Manager, as defined in SGMA, as part of this MOA and by the NASb GSAs from time to time by agreement of a majority of the NASb GSA Representatives. The GSP Plan Manager may also serve as the GSP Coordinator or the GSP Administrator. Generally, the duty of this position is to submit required documents to and be the point of contact with the DWR.

Q. **"Management Action"** shall have the definition set forth in SGMA.

R. **"NASb" or "Subbasin"** as used in this Agreement shall mean the North American Subbasin of the Sacramento Valley Groundwater Basin, DWR Basin No. 5-21.64 as its boundaries may be modified from time to time in accordance with California Water Code section 10722.2.

S. **"NASb GSAs"** as used in this Agreement shall mean the GSAs formed in the North American Subbasin consisting of the Reclamation District 1001 GSA; the Sacramento Groundwater Authority GSA; the South Sutter Water District GSA; the Sutter County GSA; and the West Placer GSA.

T. **"NASb GSA Representative" or "Representative"** shall mean the staff member (and/or alternates), designated from time to time by each NASb GSA, who is authorized to take actions under this Agreement to the extent permitted, until such time as the NASb GSA notifies the GSP Administrator and the other Parties of a change in its NASb GSA Representative.

U. **"Party" or "Parties"** shall mean the entities listed in the Preamble to this Agreement.

V. **"Project"** shall mean projects defined in the GSP and projects proposed by the Parties to this Agreement following adoption of the GSP.

W. **"SGMA"** shall mean the Sustainable Groundwater Management Act and all regulations adopted under the legislation (SB 1168, SB 1319 and AB 1739) that collectively comprise the Act, as that legislation and those regulations may be amended from time to time.

X. **"Super Majority"** shall mean a vote of four-fifths (4/5) of the Coordination Committee representatives voting on an item.

Y. **"Undesirable Results"** shall mean one or more of the following effects as defined in SGMA, caused by groundwater conditions occurring throughout the basin: (NASb specific measures can be found in the GSP):

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

II. PURPOSE AND TERM

A. **Compliance with SGMA.** The purpose of this Agreement is to ensure that: (i) the NASb GSAs, including the members of each NASb GSA, are appropriately coordinated to achieve sustainable management of the basin; (ii) the NASb remains under the coordinated local management of the GSAs and does not become a "probationary" basin as defined by SGMA; and (iii) the NASb GSAs consistently implement the NASb GSP and any subsequent amendments or updates to the GSP as required by SGMA or as otherwise made by the NASb GSAs.

B. **Responsibilities of Parties.** The Parties agree that by executing this Agreement, they are committing to the other Parties to carry out the actions specified in this Agreement in good faith, and in a manner consistent with their individual responsibilities to comply with the California Sustainable Groundwater Management Act of 2014 ("SGMA").

C. **Agreement Term.** This Agreement shall remain in effect until amended or terminated by the Parties as provided herein.

III. ORGANIZING PRINCIPLES

A. **Obligation to Coordinate.**
1. The Parties shall strive to provide for, in addition to the interests of GSAs, the interests of all legal users and stakeholders of groundwater within the NASb. To that end, the Parties intend to update and seek input from the public and other interested stakeholders as part of the NASb GSP implementation and SGMA compliance.

2. The Parties shall consider the interests of all beneficial users and uses of groundwater within the NASb, GSA member agencies, and members of the general public. To that end, the Parties intend to update and seek input from the public and other interested stakeholders as part of the NASb GSP implementation and SGMA compliance.

3. Those Parties with land use authorities shall communicate with and inform other Parties of potential land use decisions as they may relate to the GSP and the intended objectives of SGMA.

4. The Parties will share with each other information that is relevant to GSP implementation and SGMA compliance as provide herein.

B. **Obligation to Fund Common Activities, Projects, and Management Actions**.

The Parties agree to fund common activities that are approved in accordance with this Agreement, to achieve the sustainability goals for the NASb, as may be amended from time to time, and to meet the requirements of SGMA. Common activities include, but are not limited to, monitoring, analysis, and reporting of groundwater conditions and implementation of projects or actions determined necessary for sustainability. For planning and budgeting purposes, anticipated common activities will be estimated over a five-year period for each five-year period leading up to the required GSP updates due to DWR by January 31 of, 2027, 2032, 2037 and 2042. The Parties agree that this Agreement constitutes a binding commitment to fund the approved five-year costs presented and approved, by all Parties, at the beginning of each five-year period.

Individual NASb GSAs will have an obligation to fund approved and required projects or management actions determined necessary by actual measured "Undesirable Results" conditions to mitigate Undesirable Results from discretionary projects or actions (or inactions) taken by them or by their GSA members to ensure the sustainable management criteria are met in compliance with SGMA.

C. **Duties of Individual Parties**.

1. Each Party agrees to individually undertake activities and actions to carry out SGMA, in accordance with the terms of the GSP, within their respective GSA boundaries in the NASb. Each Party, or the GSA that Party is a member of, is individually responsible to make decisions consistent with the GSP and to fund and implement activities, plans, or decisions necessary to prevent Undesirable Results within their respective GSA.

2. Each Party shall appoint and authorize one Primary Representative and one Alternate to participate in coordination functions as described herein, and to facilitate reasonably timely and informed input and direction to the Coordination Committee and the GSP Managers.

3. By execution of this Agreement, each Party confirms the authority of its Primary Representative or Alternate to provide input and direction to the Coordination Committee and the GSP Managers on behalf of that Party, and each Party understands that the Coordination Committee and the GSP Managers may undertake further consideration or conduct further analysis on the basis of that input and direction.

4. Each Party shall work cooperatively and in good faith with other Parties within their respective GSA boundaries to manage local groundwater to meet Sustainability Criteria as established and defined within the NASb GSP and to investigate, and address if applicable, Undesirable Results as defined within the NASb GSP.

5. Parties with land use authorities shall work in good faith when making land use decisions to do so in a manner consistent with the GSP and shall seek to achieve the intended objectives of SGMA within the NASb.

IV. GOVERNANCE

A. NASb Coordination Committee.

1. **Purpose.** The purpose of the NASb Coordination Committee is to oversee GSP implementation and SGMA compliance for the NASb.

2. **Representatives.** Each GSA a shall appoint a Primary representative from the staff level to the Coordination Committee. Each GSA shall also appoint an Alternate representative, from the staff level, to serve in the place of Primary representative should the Primary representative be unavailable to attend a Coordination Committee meeting(s). Each NASb GSA Representative and Alternate will serve at the pleasure of the appointing Party. There will be no limit on the term of participation.

3. **Engagement** Each GSA agrees to use best efforts to ensure at least one of its NASb GSA Representatives attend Coordination Committee meetings. If a NASb GSA is not represented by at least one of its NASb GSA representatives at more than two consecutive meetings, the GSP Administrator may request the GSA appoint a new representative(s).

4. **Meeting Frequency.** The NASb Coordination Committee will strive to meet at least quarterly of each calendar year but may meet more or less frequently as otherwise determined by the Coordination Committee. Meetings of the Coordination Committee are not public meetings unless specifically advertised as public by the Coordination Committee and as provided below.

   The NASb Coordination Committee will hold at least one annual public meeting to inform and update stakeholders on NASb activities and basin wide conditions. Nothing within this Agreement precludes the Coordination Committee or individual NASb GSAs from holding additional public stakeholder meetings regarding GSP activities. NASb GSAs shall provide reasonable notice to the Coordination Committee of any planned public meetings regarding GSP activities that they intend to hold regarding NASb GSP activities.

   If a NASb GSA holds a public meeting for their stakeholders regarding GSP activities, the GSA shall provide the Coordination Committee with documentation of the meeting for posting on the NASb website. Acceptable documentation includes but is not limited to presentation recording (if recorded), presentation materials, and meeting agenda/minutes.

5. **Designation of Fiscal and Contracting Entity.** The Coordination Committee shall designate either the GSP Administrator or GSP Coordinator to serve as the Fiscal and Contracting Entity for the Coordination Committee.

6. **Responsibilities.** The Coordination Committee will have the responsibility and authority to act on or otherwise manage the following, on its own account, or through the Fiscal and Contracting Entity, as the case may be:

    i. Selection of the GSP Plan Manager, GSP Coordinator, GSP Administrator, and the Contracting Entity, if not otherwise identified herein.

    ii. Development and adoption of an annual work plan and associated annual budget.

    iii. Approval of service providers, scope of work, fee, and schedule for contracted work.

    iv. Review, comment, and approval of technical work, including monitoring, analysis, and reporting.

    v. Selection of Projects and Management Actions.

    vi. Reporting back to their respective NASb GSAs on GSP implementation.

7. **Quorum.** A majority (three of five – 3/5) of NASb GSA Representatives (one from each GSA) on the Coordination Committee will constitute a Quorum. A Quorum is required for the Coordination Committee to meet.

8. **Meeting Location.** The Coordination Committee may meet in a virtual setting or in person at locations agreed to by the Coordination Committee.

9. **Agenda.** An Agenda will be developed by the GSP Coordinator or GSP Administrator in advance of each Coordination Committee meeting.

B. **GSP Coordinator, GSP Administrator, GSP Plan Manager, and Fiscal and Contracting Entity.**

1. **Selection.** The Parties hereby appoint the Primary or Alternate Representative from the Sacramento Groundwater Authority GSA to be the GSP Coordinator and GSP Plan Manager. The Parties hereby appoint the Primary Representative from the West Placer GSA to be the GSP Administrator. The Fiscal and Contracting Entity shall be selected by the Coordination Committee.

2. **Term.** The Coordination Committee will reaffirm the GSP Managers and the Fiscal and Contracting Entity at the first meeting of the Coordination Committee of each calendar year and they will also be reevaluated at the time of each GSP Update as required by SGMA. If the GSP Coordinator and/or the GSP Administrator or the Fiscal and Contracting Entity is unable to fulfill the required responsibilities as set forth herein, the Coordination Committee shall, by a Super Majority vote, reassign the role to another NASb GSA Representative, or, through the Fiscal and Contracting Entity, retain Consultant services. If the Fiscal and Contracting Entity is unable to fulfil the required responsibilities as set forth herein, the Coordinating Committee shall reassign the role to another Party to fulfill the responsibilities.

3. **Responsibilities.**

   i. The GSP Coordinator will be responsible for the following:

      a. Coordinate the preparation and submittal of Annual Reports as required by SGMA.

      b. Coordinate the preparation and submittal of GSP Updates as required by SGMA.

   ii. The GSP Administrator will be responsible to:

      a. Plan and facilitate Coordination Committee meetings and action items.

   iii. The GSP Plan Manager will be responsible to:
      a. To submit required documents to and be the point of contact with the DWR.

iv. The Fiscal and Contracting Entity will be responsible to:

a. Collect the established contributions to the annual budget at the beginning of each budget year.

b. Contract with service providers, including professional consultants and construction contractors, to implement common GSP activities.

v. The GSP Managers, if requested by the Coordination Committee shall:

a. Prepare grant applications and administration of grants.

b. Contract for consulting services after review and recommendation of the Coordination Committee.

c. Manage projects.

vi. The Fiscal and Contracting Entity shall comply with the procurement and contracting requirements of their respective entity, as well as state and federal laws as applicable.

vii. The GSP Managers shall be designated to fulfill, or provide direction to the Fiscal and Contracting Entity for the following actions upon and after prior approval by the Coordination Committee:

a. To undertake or arrange for approved activities in accordance with the provisions of this Agreement consistent with the approved budget and approving action by the Coordinating Committee.

b. To apply for, accept and expend Funds for use in carrying out the purposes of this Agreement consistent with the approved budget and approving action by the Coordinating Committee.

c. To hold Funds for the purposes herein mentioned provided such Funds are not presently needed to pay costs related to the authorized uses of such Funds under this Agreement consistent with the approved budget and approving action by the Coordinating Committee.

d. To make and enter into contracts reasonably necessary to carry out the purpose of this Agreement, consistent with the approved budget,

recommended action and scope of activities by the Coordinating Committee and within that agency's procurement rules and regulations.

viii. Fiscal and Contracting Entity shall have the following responsibilities:

a. Serve as the contracting counterparty for engagement of third-party service providers, including consultants and contractors as the Coordination Committee directs, be engaged through approved contracts.

b. Establish separate accounts, and receive, hold, manage, and provide strict accounting for funds contributed by the members, or obtained from other sources such as grant proceeds, in furtherance of this Agreement. The Fiscal and Contracting Entity shall perform these functions as a fiduciary for the Committee.

V. INFORMATION SHARING

A. **Obligation to Share Information.** The Parties acknowledge and recognize pursuant to this Agreement that the Parties will need to exchange information amongst and between the Parties. The Parties agree that each NASb GSA shall provide the data reasonably required to implement the GSP, develop the Annual Report and update the GSP as required by SGMA.

B. **Procedure for Exchange of Information.**

1. The Parties shall exchange relevant public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. However, to the extent it is necessary to make a written request for information to another Party, each Party shall designate arepresentative to respond to information requests and provide the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, email, or other electronic means to the designated representative. The designated representative shall respond in a reasonably timely manner.

2. Nothing in this Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Coordination Committee.

3. The Parties agree that the Coordination Committee is not a public agency and shall take reasonable steps to refer any data requests made under the Public Records Act or otherwise to the appropriate NASb GSA or public entity.

4. To the extent that a court order, subpoena, or the California Public Records Act is applicable to a Party and applicable or relevant to the GSP, such Party in responding to a request made pursuant to any such authority for release of information exchanged from another Party or Parties shall notify each Party in writing of its proposed release of information within a reasonable time prior to disclosure to allow the appropriate entity the ability to seek a court order restricting such disclosure.

C. **Disclosures.** The Parties agree to disclose to the other Parties non-privileged information that is reasonably relevant to GSP implementation and SGMA compliance. Information that is not time sensitive (e.g., groundwater quality results) shall be disclosed through the NASb GSA representative at the next Coordination Committee meeting or to the GSP Managers. Information that is deemed time sensitive (e.g., groundwater substitution request with timelines attached) shall be disclosed within 5 business days in writing, via mail, email, or other electronic means, to each NASb GSA Coordination Committee Primary or Alternate Representative and to the GSP Managers.

VI. FUNDING PROVISIONS

A. **Budget.**

1. The Coordination Committee shall create, approve, and recommend an Annual Budget aligned to the fiscal year, which will run from July 1 through June 30. The initial annual budget shall be prepared and agreed to within ninety (90) days of the effective date of this Agreement and include a five-year look ahead and budget estimate for the period leading up to the first required GSP update. Thereafter, a Budget shall be agreed upon no later than February 1 of the preceding fiscal year or other such date as approved

by the Coordination Committee. The Budget must be approved by unanimous vote of the Coordinating Committee and recommended for approval to and subsequently approved by the governing body of each Party to this Agreement.

a. Where the Annual Budget anticipates expenditures attributable to multiple NASb GSAs, the Fiscal and Contracting Entity, as approved by the Coordination Committee, will be responsible for handling funds and reporting on financial accounts as otherwise described in Section III, herein. Funds collected but not used in a fiscal year will roll over as a contribution for the following year.

   The Annual Budget shall identify the activities, costs, and cost share to each NASb GSA associated with common expenses required to meet SGMA / GSP compliance. The first year annual Draft Budget is contained in Exhibit 1. Also included in Exhibit 1 is a five-year projection of total costs required to submit the first required NASb GSP update by January 31, 2027.

B. **Coordination Expenses.** Each NASb GSA shall share in the general operating and administrative costs of complying with SGMA and implementing the GSP as approved in the Annual Budget. Approved budgeted costs shall be shared in accordance with the percentages set forth in Exhibit 2 attached hereto and incorporated herein. The cost share formula shall remain in effect for the five-year projected expenses in Exhibit 1 at which time the formula will be reviewed for equity.

C. **Alternative Funding Sources.** The Coordination Committee may pursue State of California, federal, local, or private company grants, but shall not create any indebtedness without prior approval of all Parties to this Agreement.

D. **Accounting of Funds**. The Fiscal and Contracting Entity shall maintain a strict accounting of funds collected, spent, and maintained on behalf of the Coordinating Committee, and shall provide fiscal statements not less frequently than Annually. The books and records of the Fiscal Agent shall be open to inspection by any Party upon reasonable notice.

E. **Individual Party Resources**. Each Party shall bear its own costs associated with activities performed under this Agreement. No Party shall incur debt, liabilities, or obligations on behalf of any other Party unless provided for in a separate agreement.

VII. DECISION-MAKING

A. **Voting.**

1. In the event a vote of the Coordination Committee is necessary, each GSA Representative shall be entitled to one vote. Said vote may be cast by either the Primary or Alternate Representative.

2. The GSA Representative (or, if applicable, GSA Alternate Representative) must be in attendance at a meeting to vote.

3. Prior to voting, the Coordination Committee shall endeavor in good faith to reach consensus on the matters to be determined such that any subsequent vote shall be to confirm the consensus of the Coordination Committee. If any NASb GSA Representative objects to a consensus-based decision prior to a vote being cast, the Representative shall work in good faith to reasonably resolve such objection, and, if the same is not resolved collaboratively, then the matter will proceed to a vote for final resolution.

B. **Unanimous vote Requirements for Certain Actions**. Coordination Committee recommendation of the Annual Budget will require a unanimous vote.

C. **Super Majority Vote Requirements for Certain Actions.** All actions not considered as general business, as determined by the Coordination Committee, shall require a Super Majority vote of the Coordination Committee.

VIII. GROUNDWATER MONITORING NETWORK

A. **Obligation to Develop and Maintain a Groundwater Monitoring Network.** In accordance with SGMA, the Parties hereby agree to coordinate in the development, information sharing, and maintenance of a Groundwater Monitoring Network at the Subbasin level and as established pursuant to the

NASb GSP. This may include but not be limited to the addition of monitoring wells if determined necessary to assess basin conditions in accordance with the GSP and/or SGMA, making repairs to and taking measurements at monitoring network facilities, and collection and analysis of water quality samples.

IX. DATA MANAGEMENT SYSTEM

A. **Obligation to Develop and Maintain a Data Management System.** In accordance with SGMA, the Parties hereby agree to coordinate in the development, information sharing and maintenance of a Data Management System capable of storing and reporting information relevant to the reporting requirements established pursuant to the GSP and SGMA. Data shall be provided in the format required by the Data Management System.

X. REQUEST TO JOIN, WITHDRAW AND TERMINATION

A. **Request to Join.** Requests to join this Agreement shall be considered by the Coordination Committee and per the provisions of Section XIII, Other Provisions/Modifications.

B. **Termination of Participation.**

1. Each Party may, in its sole discretion, unilaterally withdraw from and terminate its participation in this Agreement effective upon ninety (90) days prior written notice to the NASb GSA Representatives participating on the Coordination Committee and the GSP Managers, provided that the withdrawing Party will remain responsible for its proportionate share of any indebtedness incurred prior to the effective date of withdrawal. Such withdrawal by a Party will not cause a termination of this Agreement as to the remaining Parties.

2. Upon withdrawal, the withdrawing Party acknowledges it has a continuing obligation to comply with SGMA and any coordination guidelines or regulations issued by the Department of Water Resources or the State Water Resources Control Board. The Withdrawing Party also acknowledges the need to coordinate with all NASb GSAs in accordance

with applicable law. This obligation shall survive the withdrawal from this Agreement and is for the express benefit of the remaining Parties.

3. Subject to the requirements of Section XI, Procedures for Resolving Conflict, nothing in this section shall be construed as a limitation on the right of a Party to seek legal remedies against a Withdrawing Party.

4. Upon withdrawal, any Party shall be entitled to use any data or other information developed under this Agreement during its time as a Party to this Agreement. After withdrawal, a Party shall be entitled to utilize the NASb GSP for future implementation of SGMA compliance within its legal boundary. Should the Withdrawing Party have an obligation under State law to comply with SGMA, the Withdrawing Party agrees to comply with the coordination requirements set forth in SGMA allowing multiple GSPs over a basin.

C. **Termination.** The Agreement shall terminate if the requirements of SGMA are no longer applicable. This Agreement may be terminated by a unanimous vote of the Parties. However, in the event of termination, each of the Parties will remain responsible for its proportionate share of all debts, liabilities and obligations incurred prior to the effective date of termination.

XI. PROCEDURES FOR RESOLVING CONFLICT

A. Procedures for Resolving Conflict

1. If any dispute arises among the Parties relating to this Agreement or the rights and obligations arising from this Agreement, the aggrieved Party or Parties shall provide written notice to the GSP Managers of the dispute. Within 20 days after receipt of such written notice, the GSP Administrator and/or GSP Coordinator shall call a meeting of the Coordination Committee. Members of the Coordination Committee shall attempt in good faith to resolve the dispute through informal means for a period of 60 days. If the Parties, through the Coordination Committee, cannot agree upon resolution of the dispute within 60 days from the date of the first meeting of the Coordination Committee on the issue in dispute, the Parties shall submit the dispute to non-binding mediation prior to commencement of any legal action. The cost of mediation shall be paid in equal proportion

amongst Parties involved in the dispute. Upon completion of mediation, if the controversy has not been resolved, any Party may exercise any and all rights to bring a legal action relating to the dispute.

2. In the event a dispute or claim is not resolved by a mutually agreeable settlement through negotiation or mediation, the aggrieved Party may file suit in Placer County Superior Court, Sacramento County Superior Court, or Sutter County Superior Court.

XII. OTHER PROVISIONS

A. **Agreement Limitations.** The Parties expressly intend that this Agreement shall not limit or interfere with the respective Parties' rights and authorities over their own internal matters, including, but not limited to, a Party's legal rights to surface water supplies and assets, groundwater supplies and assets, facilities, operations, water management and water supply matters. The Parties make no commitments by entering into this Agreement to share or otherwise contribute their water supply assets as part of the development or implementation of a GSP.

B. **Amendment of Agreement.** The Parties agree this Agreement may be amended from time to time by a written amendment approved by unanimous vote of the Coordination Committee and subsequent approval by all Parties.

C. **Non-Indemnification.** No Party to this Agreement, nor any director, officer or employee of a Party, shall be responsible for any damage or liability occurring by reason of anything done or omitted to be done by another Party under or in connection with this Agreement.

D. **Good Faith.** The Parties agree to exercise their best efforts and good faith to effectuate all terms and conditions of the Agreement and, to take appropriate, expedient, or proper actions reasonably necessary to carry out the intent and purposes of this Agreement.

E. **Governing Law.** The validity and interpretation of this Agreement will be governed by the laws of the State of California.

F. **Counterparts.** This Agreement may be executed in any number of counterparts, each of which will be an original, but all of which will constitute one and the same agreement.

G. **Construction and Interpretation.** The Agreement has been developed through negotiation and each of the Parties has had a full and fair opportunity to review and to make suggestions to revise the terms of this Agreement. As a result, the normal rule of construction that any ambiguities are to be resolved amongst the drafting Parties shall not apply in the construction or interpretation of this Agreement.

H. **Severability.** If any term, provision, covenant, or condition of this Agreement is determined to be unenforceable by a court of competent jurisdiction, it is the Parties' intent that the remaining provisions of this Agreement will remain in full force and effect and will not be affected, impaired, or in validated by such a determination.

I. **Authority of Signers.** The individuals executing this Agreement represent and warrant that they have the authority to enter into this Agreement and to legally bind the Party for whom they are signing to the terms and conditions of this Agreement.

IN WITNESS WHEREOF, the Parties have executed this Agreement on the day and year first above-written.

CITY OF LINCOLN

By: Mark Scott

Printed Name/Title: Mark Scott, Interim City Manager

Date: 1-13-22

Approved As to Form: K Mollenkopf

[Title]

Date: 1/12/21 Kristine Mollenkopf, City Attorney

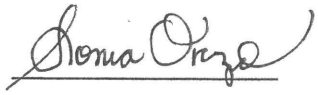
CITY OF ROSEVILLE

By:



Dominick Casey
City Manager

ATTEST:



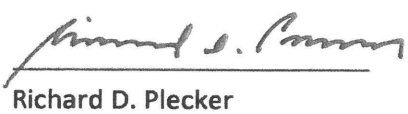
Sonia Orozco
City Clerk

APPROVED AS TO FORM:



Michelle Sheidenberger
City Attorney

APPROVED AS TO SUBSTANCE:



Richard D. Plecker
Environmental Utilities Director

EMORAN TION

TH

Attachment D

COUNTY OF PLACER

By: Ken Grehm

Ken Grehm, Director of Public Works

Date: 1/18/2022

Approved As to Form: Robert Sandman

[Title] Assistant County Counsel

Date: 1/18/22

COUNTY OF SUTTER

By: DAN FLORES

Dan Flores, Chairman:

Date: 12.14.21

Approved As to Form:

County Counsel's Office

Date: 12/10/21

NATOMAS CENTRAL MUTUAL WATER COMPANY

By: _____

Printed Name/Title: Brett Gray, General Manager

Date: 1-7-22

Approved As to Form: _____

Date: January 19, 2022

PLACER COUNTY WATER AGENCY

By: _____

Printed Name/Title: Andrew Fecko, General Manager

Date: January 6, 2022

Approved As to Form: _____

Date: 1/10/22

RECLAMATION DISTRICT 1001

By: 

Printed Name/Title: Kimberly Reese/General Manager

Date: December 22, 2021

Approved As to Form: _____

[Title]

Date: _____

SACRAMENTO GROUNDWATER AUTHORITY

By: 

Jim Peifer, Executive Director

Date: 1/10/2022

SOUTH SUTTER WATER DISTRICT

By: _____

Printed Name/Title: Dennis Michel, Acting President

Date: December 16, 2021

Approved As to Form: _____

[Title] Brad Arnold, General Manager

Date: December 16, 2021

ATTACHMENTS:

Exhibit 1: 2022 Annual Budget and Four-Year Projection Summary

Exhibit 2: Cost Sharing Acreage Summary

Exhibit 1

2022 ANNUAL BUDGET AND FOUR-YEAR PROJECTION SUMMARY					
GSA Name	**Estimated Annual Contribution by GSAs (a)**				
	2022	**2023**	**2024**	**2025**	**2026**
Reclamation District 1001	11,673	11,673	11,673	11,673	11,673
Sacramento Groundwater Authority	83,171	83,171	83,171	83,171	83,171
South Sutter Water District	44,521	44,521	44,521	44,521	44,521
Sutter County	13,583	13,583	13,583	13,583	13,583
West Placer Groundwater Sustainability Agency	76,912	76,912	76,912	76,912	76,912
TOTAL	**$229,860**	**$229,860**	**$229,860**	**$229,860**	**$229,860**
FIVE-YEAR TOTAL	**$1,149,300**				

NOTES:

a. The Parties acknowledge the need to establish an aggregate contingency budget of up to 20%. Any future use of any portion of the contingency budget shall be provided to each GSA for review and approved by a unanimous vote of the Parties at a GSA Basin Coordination Meeting before implementation. Upon approval of the use of the contingency budget, SGA will invoice the Parties to collect the agreed upon contingency amount.

Exhibit 2

COST SHARING SUMMARY		
GSA Name	**Total Acreage**	**Percent Share**
Reclamation District 1001	17,394.5	5.08%
Sacramento Groundwater Authority	123,933.3	36.18%
South Sutter Water District	66,340.6	19.37%
Sutter County	20,240.2	5.91%
West Placer Groundwater Sustainability Agency	114,607.8	33.46%
TOTAL	**342,516.4**	**100%**

Appendix B: Domestic Well Assessment

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX B
Domestic Well Assessment

December 2021

APPENDIX B –DOMESTIC WELL ASSESSMENT

This appendix provides a description of the approach used to assess the potential impacts to domestic well users in the North American Subbasin (NASb or Subbasin) resulting from minimum threshold sustainable management criteria (SMC) developed for the NASb groundwater sustainability plan (GSP). The assessment consisted of five steps. The first step was to verify to the degree possible the presence of domestic wells as provided by the California Department of Water resources (DWR) (see https://data.ca.gov/dataset/well-completion-reports/resource/90ef01cc-b057-413c-8110-3e02a9db28eb). The second step was to identify domestic wells in the vicinity of where groundwater elevations are expected to decline by five feet or more. The third step was to estimate the projected groundwater levels at these nearby domestic wells. The fourth step was to compare projected groundwater levels in these domestic wells to their construction information. These steps and the assessment results are described below.

Step 1 –Verification of Potential Domestic Wells in NASb

Domestic well information for each Public Land Survey System (PLSS) section in the Subbasin was downloaded from the SGMA database. Figure B-1 shows the well densities as originally downloaded from the database. The database information includes well location (address, coordinates, and/or Assessor's Parcel Number (APN)), and well construction information. Where good location information was available, well locations were verified to ensure that wells were assigned to the correct PLSS section. Based on the SGMA database, there were an estimated total of 2,412 potentially active domestic wells in the Subbasin. During the review, wells that had duplicate records, were mis-located or had been destroyed but not recorded (including well destructions verified by records from the former McClellan Air Force Base), were removed from the total number of wells (155 wells removed) leaving a revised estimate of 2,257 domestic wells within the Subbasin. In some cases, the verified number of wells in a PLSS section increased based on the review. A summary of this information by PLSS section is included in Table B-1.

Step 2 – Identify Domestic Wells in the NASb where Five Feet or Greater Groundwater Level Declines are Projected

Figure B-2 shows the projected changes at each Representative Monitoring Site (RMS) in the NASb for groundwater elevations. The RMS locations are where SMC are established in the NASb. For RMS locations that had a projected five feet or greater decrease in depth to groundwater, domestic wells nearby were identified. The RMS used in the evaluation, their estimated change in groundwater level, the nearby PLSS sections assessed, and the number of domestic wells assessed are shown in Table B-2. There were 1,331 domestic wells in the vicinity of RMS where projected groundwater levels could decline by five feet or more.

Step 3 – Estimate Projected Groundwater Levels in Domestic Wells based on Minimum Thresholds at RMS Locations

Using the known groundwater elevation and ground surface elevation at each RMS, a depth to groundwater was calculated to represent a "baseline" condition (i.e., conditions before modeled future projections). For most RMS locations, the average of Fall 2014 and Fall 2015 was used. Where RMS locations did not have data for that period, more recent data (typically 2018 or 2019) were used. The baseline depth to water for nearby domestic wells was then interpolated based on the characteristics of the Fall 2019 depth to water contour map, which is shown in Figure B-3. The projected depth to groundwater for each domestic well was then calculated by subtracting the projected decline at the nearest RMS from the domestic well baseline depth to water.

Step 4 – Comparison of Projected Groundwater Levels to Domestic Well Construction

With a projected depth to water at each of the 1,331 domestic wells along with construction information, an assessment of anticipated impacts to domestic users can be made. For each domestic well, the total depth, depth to first open interval, and year of construction were reviewed. Total depth was used because it represents the most extreme impact on a well if projected water levels are deeper (i.e., the well would go completely dry). The depth of first open interval was used because it represents a more conservative level of impact in that it would indicate that the open interval of the completed well is fully saturated with groundwater; maintaining groundwater above this interval preserves access to groundwater for the domestic users. Note that no domestic wells were eliminated from the NASb well database based on age. However, wells greater than 50 years old (1970 was used for this evaluation) are considerably less likely to be in service today. Destruction records are sporadic, so confirmation of destruction is difficult.

To compare the projected levels associated with NASb SMC to domestic well construction, graphs were prepared for each of the eighteen RMS locations with projected declines of five feet or more. On the graph, all nearby domestic wells with their projected depth to water, first open interval, and total depth are also plotted. Finally, the data are shown with reference to the year the well was constructed on the horizontal axis. Plotting by date helps observe where wells have been constructed deeper through time in areas that experienced groundwater declines.

The graphs are shown in Figures B-4 through B-21. The green markers represent the projected depth to groundwater at each domestic well. The orange markers represent the depth of the first open interval of each well. The solid black vertical lines represent the total depth of each well. Also shown on the graph is the RMS well with its Measurable Objective shown as a blue horizontal line and its Minimum Threshold shown as a red horizontal line. These are only included for reference and should not be applied to a domestic well on the graph. The most important consideration in evaluating the graphs is the relationship of the green marker to the orange marker. Where the green marker is above the orange marker, the

well is considered protected. Where the green marker is below the orange marker, the well may not be protected with respect to having continued access to groundwater.

Assessment Results

To assess the potential impacts to domestic wells from the NASb SMC, the baseline and projected depth to groundwater at each location were compared to the total depth (the point at which a well is dry) and the depth to first open interval (the point at which the well would experience operational difficulties). The baseline comparison is important because it helps isolate wells that may have already been impacted at the time of SGMA passage from those that could be impacted from future usage and management of the basin (the responsibility of GSAs under SGMA). The net difference then between the baseline condition and the projected condition is an indicator of the potential effects of the NASb SMC.

Table B-3 shows the results of the assessment with respect to whether domestic wells would go dry. In terms of maintaining groundwater levels above their total depth, domestic users are protected. Based on the analysis, no domestic wells of up to 50 years old would go dry (e.g., drop below their total depth). Of wells that are greater than 50 years old, only 2 percent (28 of the 1,331 wells assessed) could potentially drop below their total depth; many of these may no longer in use.

Table B-4 shows the assessment results with respect to whether domestic wells could see groundwater levels drop below their first open interval. In terms of maintaining groundwater levels above their first open interval, domestic users are also protected. Of wells that are up to 50 years old, less than 1 percent (9 wells of 1,331 wells) could potentially drop below the first open interval. Of wells greater than 50 years old, 5 percent (66 wells of 1,331 wells) could potentially drop below their first open interval. Again, many of the wells are over 50 years old and may longer be in use.

This assessment concludes that the NASb SMC will not lead to significant and unreasonable undesirable results with respect to domestic users. It is also important to remember that almost none of the projected changes to groundwater elevations in the NASb would occur within the next five years. Confirmation of the status of these domestic wells is a management action in the NASb GSP (see **Section 9.2.6** of the GSP). The results of implementing the management action to better understand the status of these wells will be considered when conducting the required five-year assessment of the GSP.

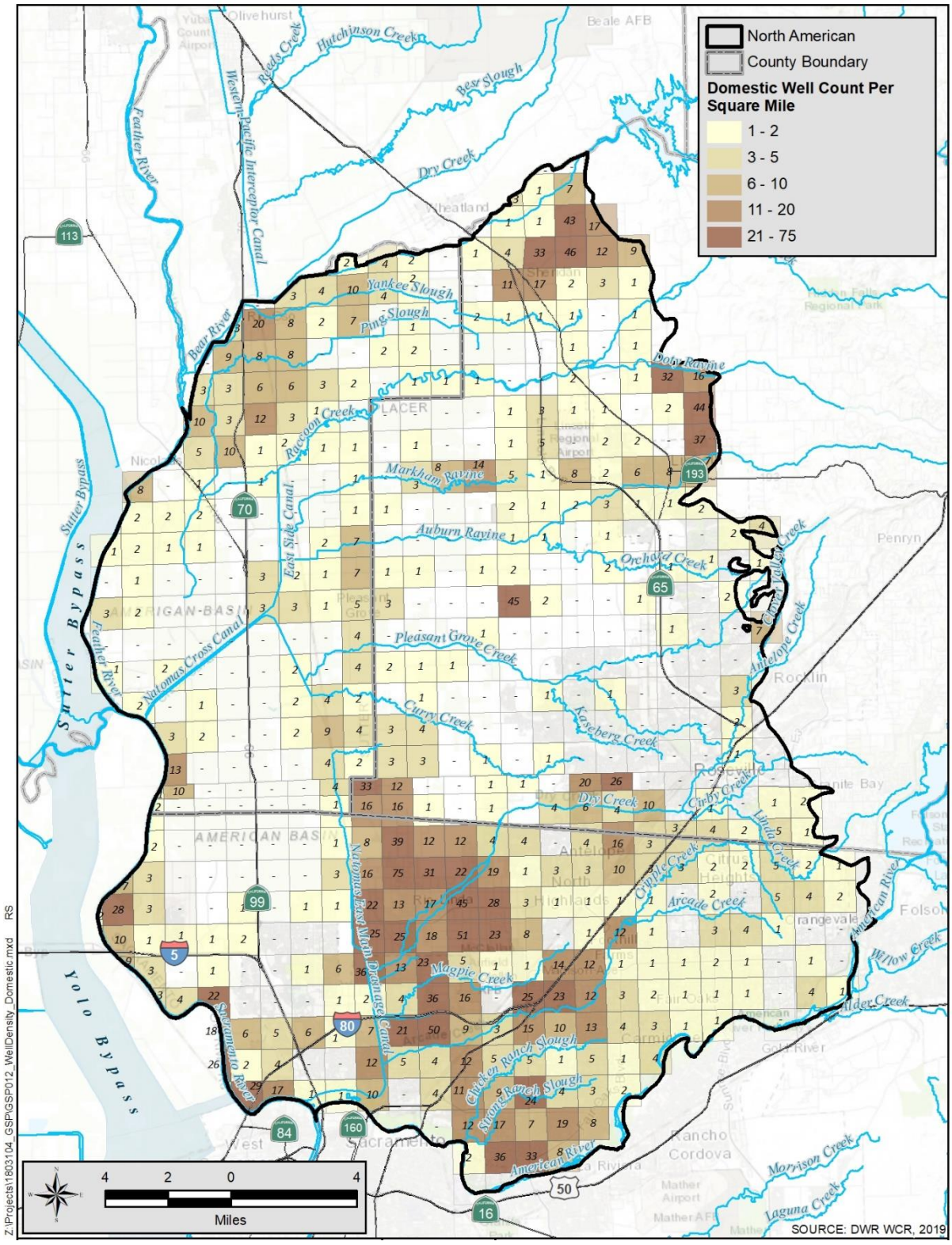


Figure B-1. Domestic Well Density from DWR SGMA database

Table B-1. Well Verification Data Summary

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
8	5	1	33	35
8	5	2	36	26
8	5	3	2	2
8	5	10	0	0
8	5	11	0	0
8	5	12	0	0
8	6	5	5	5
8	6	6	8	7
9	3	1	3	2
9	3	2	9	5
9	3	12	3	1
9	4	1	6	5
9	4	2	1	1
9	4	3	0	0
9	4	4	0	0
9	4	5	1	1
9	4	6	0	0
9	4	7	4	3
9	4	8	22	17
9	4	9	0	0
9	4	10	0	0
9	4	11	0	0
9	4	12	1	1
9	4	13	1	1
9	4	14	6	5
9	4	15	5	6
9	4	16	6	5
9	4	17	18	12
9	4	20	26	20
9	4	21	2	1
9	4	22	4	6
9	4	23	0	0
9	4	24	0	0
9	4	25	1	1
9	4	26	1	1
9	4	27	17	9
9	4	28	29	21
9	4	35	1	1
9	4	36	11	10
9	5	1	1	0
9	5	2	1	0
9	5	3	5	5
9	5	4	23	29
9	5	5	13	15
9	5	6	36	36
9	5	7	1	0
9	5	8	4	4
9	5	9	36	30
9	5	10	16	15
9	5	11	0	0

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
9	5	12	25	26
9	5	13	15	14
9	5	14	3	3
9	5	15	9	11
9	5	16	50	36
9	5	17	21	20
9	5	18	7	7
9	5	19	12	10
9	5	20	5	6
9	5	21	4	2
9	5	22	12	11
9	5	23	5	7
9	5	24	5	8
9	5	25	24	21
9	5	26	9	8
9	5	27	11	10
9	5	28	4	6
9	5	29	0	0
9	5	30	10	12
9	5	31	0	0
9	5	32	1	0
9	5	33	0	0
9	5	34	12	12
9	5	35	17	15
9	5	36	7	8
9	6	1	2	2
9	6	2	1	1
9	6	3	1	1
9	6	4	1	1
9	6	5	12	13
9	6	6	14	14
9	6	7	23	27
9	6	8	12	9
9	6	9	3	3
9	6	10	2	2
9	6	11	1	1
9	6	12	1	1
9	6	13	1	1
9	6	14	1	0
9	6	15	3	2
9	6	16	4	4
9	6	17	13	14
9	6	18	10	11
9	6	19	1	1
9	6	20	5	6
9	6	21	1	0
9	6	22	4	5
9	6	23	0	0
9	6	28	2	2
9	6	29	3	2
9	6	30	4	6
9	6	31	19	21

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
9	6	32	8	8
9	6	33	0	0
10	3	1	1	0
10	3	12	2	2
10	3	13	2	2
10	3	23	7	5
10	3	24	3	2
10	3	25	3	3
10	3	26	28	25
10	3	35	11	18
10	4	1	4	3
10	4	2	0	0
10	4	3	0	0
10	4	4	0	0
10	4	5	0	0
10	4	6	10	10
10	4	7	0	0
10	4	8	0	0
10	4	9	0	0
10	4	10	0	0
10	4	11	0	0
10	4	12	1	0
10	4	13	1	1
10	4	14	0	0
10	4	15	0	0
10	4	16	0	0
10	4	17	0	0
10	4	18	0	0
10	4	19	0	0
10	4	20	0	0
10	4	21	0	0
10	4	22	0	0
10	4	23	0	0
10	4	24	3	2
10	4	25	1	1
10	4	26	1	1
10	4	27	0	0
10	4	28	1	1
10	4	29	0	0
10	4	30	0	0
10	4	31	1	0
10	4	32	1	1
10	4	33	2	1
10	4	34	0	0
10	4	35	0	0
10	4	36	0	0
10	5	1	1	1
10	5	2	1	1
10	5	3	0	0
10	5	4	0	0
10	5	5	12	10
10	5	6	34	34

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
10	5	7	16	14
10	5	8	16	15
10	5	9	1	1
10	5	10	0	0
10	5	11	1	0
10	5	12	1	1
10	5	13	4	4
10	5	14	4	4
10	5	15	13	15
10	5	16	12	11
10	5	17	39	40
10	5	18	8	7
10	5	19	16	19
10	5	20	75	70
10	5	21	32	26
10	5	22	23	20
10	5	23	19	17
10	5	24	1	1
10	5	25	3	3
10	5	26	29	26
10	5	27	46	47
10	5	28	17	26
10	5	29	14	16
10	5	30	22	21
10	5	31	26	25
10	5	32	25	20
10	5	33	18	19
10	5	34	51	39
10	5	35	23	17
10	5	36	8	9
10	6	1	0	0
10	6	2	0	0
10	6	3	0	0
10	6	4	26	29
10	6	5	20	22
10	6	6	0	0
10	6	7	4	4
10	6	8	7	5
10	6	9	4	3
10	6	10	10	10
10	6	11	0	0
10	6	12	1	1
10	6	13	4	3
10	6	14	3	3
10	6	15	3	3
10	6	16	16	15
10	6	17	4	3
10	6	18	0	0
10	6	19	3	1
10	6	20	3	3
10	6	21	10	11
10	6	22	3	1

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
10	6	23	3	3
10	6	24	2	1
10	6	25	2	2
10	6	26	0	0
10	6	27	1	1
10	6	28	1	1
10	6	29	1	1
10	6	30	1	1
10	6	31	0	0
10	6	32	1	1
10	6	33	12	12
10	6	34	1	0
10	6	35	0	0
10	6	36	3	3
10	7	4	0	0
10	7	5	0	0
10	7	6	0	0
10	7	7	0	0
10	7	8	1	1
10	7	16	1	2
10	7	17	7	7
10	7	18	2	2
10	7	19	2	2
10	7	20	5	6
10	7	21	2	2
10	7	22	1	1
10	7	23	0	0
10	7	27	2	2
10	7	28	4	4
10	7	29	5	5
10	7	30	0	0
10	7	31	4	3
10	7	32	1	1
10	7	33	0	0
10	7	34	0	0
11	3	1	0	0
11	3	2	2	2
11	3	3	2	2
11	3	10	0	0
11	3	11	0	0
11	3	12	1	1
11	3	13	2	2
11	3	14	0	0
11	3	15	1	1
11	3	22	0	0
11	3	23	2	2
11	3	24	0	0
11	3	25	3	3
11	3	36	12	12
11	4	1	5	3
11	4	2	1	1
11	4	3	3	4

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
11	4	4	3	3
11	4	5	0	0
11	4	6	0	0
11	4	7	0	0
11	4	8	0	0
11	4	9	0	0
11	4	10	0	0
11	4	11	0	0
11	4	12	4	5
11	4	13	4	3
11	4	14	0	0
11	4	15	2	2
11	4	16	0	0
11	4	17	0	0
11	4	18	0	0
11	4	19	1	1
11	4	20	0	0
11	4	21	0	0
11	4	22	2	2
11	4	23	4	4
11	4	24	2	3
11	4	25	4	5
11	4	26	9	8
11	4	27	2	2
11	4	28	0	0
11	4	29	0	0
11	4	30	2	2
11	4	31	0	0
11	4	32	0	0
11	4	33	0	0
11	4	34	0	0
11	4	35	4	3
11	4	36	2	1
11	5	1	2	2
11	5	2	45	42
11	5	3	0	0
11	5	4	0	0
11	5	5	0	0
11	5	6	3	3
11	5	7	0	0
11	5	8	0	0
11	5	9	0	0
11	5	10	1	1
11	5	11	0	0
11	5	12	0	0
11	5	13	0	0
11	5	14	0	0
11	5	15	0	0
11	5	16	1	1
11	5	17	1	1
11	5	18	2	1
11	5	19	0	0

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
11	5	20	1	1
11	5	21	0	0
11	5	22	0	0
11	5	23	0	0
11	5	24	1	1
11	5	25	0	0
11	5	26	0	0
11	5	27	0	0
11	5	28	0	0
11	5	29	4	3
11	5	30	3	3
11	5	31	3	3
11	5	32	3	4
11	5	33	0	0
11	5	34	1	1
11	5	35	0	0
11	5	36	1	1
12	3	12	0	0
12	3	13	0	0
12	3	14	8	8
12	3	23	2	2
12	3	24	2	2
12	3	25	1	1
12	3	26	2	2
12	3	27	1	1
12	3	34	0	0
12	3	35	1	2
12	3	36	0	0
12	4	1	0	0
12	4	2	1	1
12	4	3	3	3
12	4	4	13	13
12	4	5	3	3
12	4	6	10	12
12	4	7	5	10
12	4	8	10	12
12	4	9	1	1
12	4	10	2	1
12	4	11	1	1
12	4	12	1	0
12	4	13	1	1
12	4	14	0	0
12	4	15	0	0
12	4	16	1	1
12	4	17	0	0
12	4	18	1	1
12	4	19	2	2
12	4	20	0	0
12	4	21	0	0
12	4	22	0	0
12	4	23	0	0
12	4	24	1	2

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
12	4	25	7	8
12	4	26	2	2
12	4	27	0	0
12	4	28	0	0
12	4	29	0	0
12	4	30	1	1
12	4	31	0	0
12	4	32	0	0
12	4	33	3	3
12	4	34	2	1
12	4	35	1	1
12	4	36	7	7
12	5	1	3	2
12	5	2	1	0
12	5	3	0	0
12	5	4	0	0
12	5	5	0	0
12	5	6	0	0
12	5	7	0	0
12	5	8	1	1
12	5	9	0	0
12	5	10	0	0
12	5	11	1	1
12	5	12	5	3
12	5	13	1	1
12	5	14	5	6
12	5	15	15	13
12	5	16	8	6
12	5	17	4	4
12	5	18	0	0
12	5	19	1	1
12	5	20	0	0
12	5	21	0	0
12	5	22	0	0
12	5	23	2	2
12	5	24	1	1
12	5	25	1	1
12	5	26	1	1
12	5	27	0	0
12	5	28	0	0
12	5	29	0	0
12	5	30	0	0
12	5	31	1	1
12	5	32	1	0
12	5	33	0	0
12	5	34	1	1
12	5	35	2	1
12	5	36	0	0
12	6	5	1	0
12	6	6	1	0
12	6	7	0	0
12	6	8	2	2

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
12	6	9	2	2
12	6	10	0	0
12	6	15	8	2
12	6	16	6	5
12	6	17	2	2
12	6	18	8	9
12	6	19	2	2
12	6	20	3	2
12	6	22	1	1
12	6	27	0	0
12	6	28	0	0
12	6	30	0	0
12	6	31	0	0
12	6	32	2	2
12	6	33	0	0
12	6	34	1	1
13	4	13	10	9
13	4	14	4	3
13	4	15	3	3
13	4	16	0	0
13	4	20	3	1
13	4	21	20	24
13	4	22	8	11
13	4	23	2	2
13	4	24	7	6
13	4	25	0	0
13	4	26	0	0
13	4	27	8	4
13	4	28	8	10
13	4	29	9	19
13	4	30	0	0
13	4	31	3	3
13	4	32	3	3
13	4	33	6	5
13	4	34	6	4
13	4	35	3	3
13	4	36	2	2
13	5	1	1	1
13	5	2	1	1
13	5	7	4	3
13	5	8	3	2
13	5	9	0	0
13	5	10	1	1
13	5	11	4	4
13	5	12	35	33
13	5	13	17	23
13	5	14	11	6
13	5	15	0	0
13	5	16	0	0
13	5	17	2	2
13	5	18	4	3
13	5	19	0	0

Township	Range	Section	Total Wells from DWR SGMA Database (Domestic)	Actual Total Domestic Wells after verification (removing mis-location, destruction or duplicates)
13	5	20	1	1
13	5	21	0	0
13	5	22	2	2
13	5	23	1	1
13	5	24	1	0
13	5	25	0	0
13	5	26	0	0
13	5	27	0	0
13	5	28	0	0
13	5	29	2	1
13	5	30	2	1
13	5	31	0	0
13	5	32	1	1
13	5	33	1	1
13	5	34	1	1
13	5	35	0	0
13	5	36	0	0
13	6	5	18	7
13	6	6	43	34
13	6	7	46	41
13	6	8	12	9
13	6	9	9	13
13	6	16	1	1
13	6	17	3	2
13	6	18	2	2
13	6	19	1	1
13	6	20	0	0
13	6	21	1	0
13	6	28	1	1
13	6	29	0	0
13	6	30	1	0
13	6	31	2	1
13	6	32	0	0
13	6	33	1	0
13	6	34	32	26
Totals:			**2,412**	**2,257**

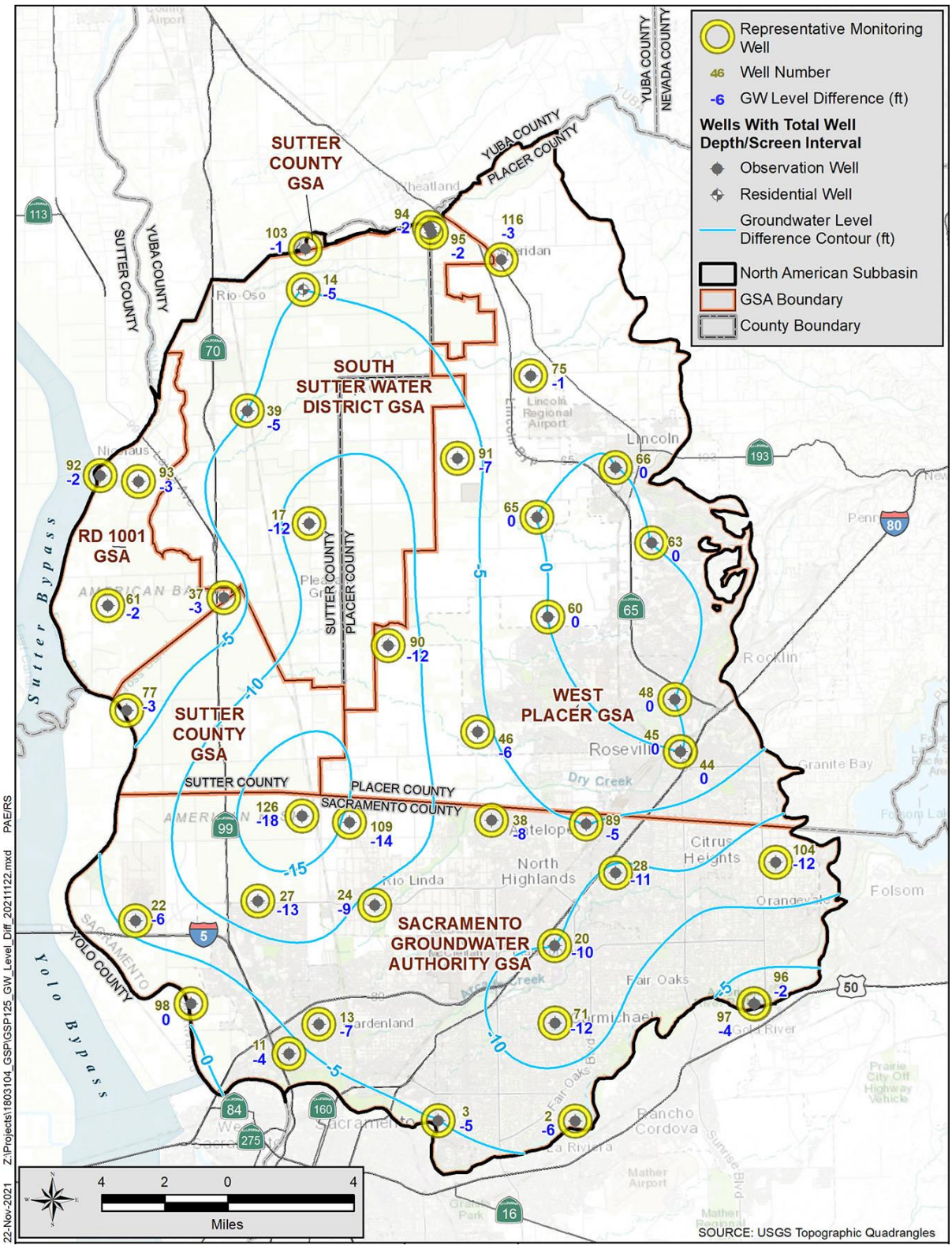


Figure B-2. Projected Groundwater Elevation Changes at RMS Location

Table B-2. NASb RMS Wells with Nearby Number of Domestic Wells

Local RMS Well No.	PLSS Section of RMS (Township/Range-Section)	Projected RMS Change (ft)	PLSS Sections in Vicinity of RMS	Number of Domestic Wells Evaluated
2	8/6-5	-6	8/5-1; 8/6-5, 6; 9/5-25, 31, 32, 36	105
3	9/5-34	-5	8/5-2;9/5-25, 26, 27, 28, 34, 35, 36	111
13	9/4-13	-7	9/4-1, 13, 14, 15, 22; 9/5-7, 8, 18, 19	50
14	13/4-23	-5	13/4-13, 21, 22, 23, 24; 13/5-18	63
17	12/4-26	-12	11/4-1, 3, 4, 12; 11/5-6; 12/4-13, 16, 25, 26, 33, 34, 36	38
20	9/6-5	-5	9/6-5, 6, 7, 8, 17, 18; 10/6-33	99
22	10/4-31	-6	9/3-2; 9/4-8; 10/3-23, 26, 35; 10/4-31	69
24	10/5-32	-9	9/5-6; 10/5-28, 29 ,31 32	130
27	10/4-27	-13	9/4-1; 10/4-27; 10/5-30	29
28	10/6-27	-11	10/6-10, 16, 17, 20, 21, 27, 33, 36	58
38	10/5-13	-8	10/5-13, 14, 15, 22, 23, 26; 10/6-8	89
39	12/04-3	-5	12/4-3, 4, 6, 7, 8; 13/4-27, 28, 29, 33, 34	89
71	9/6-17	-8	9/5-13; 9/6-5, 7, 8, 16, 17, 18, 20	77
90	11/5-17	-12	11/4-12, 13, 23, 25 11/5-6, 17, 29, 30	24
91	12/5-15	-7	12/5-14, 15, 16, 17, 23; 12/6-18	41
104	10/7-29	-12	10/7-17, 18, 20, 21, 28, 29, 31	29
109	10/5-18	-14	10/5-8, 16, 17, 18, 20	140
126	10/4-13	-18	10/4-1, 13; 10/5-6, 7, 19, 30	90
			Totals	1,331

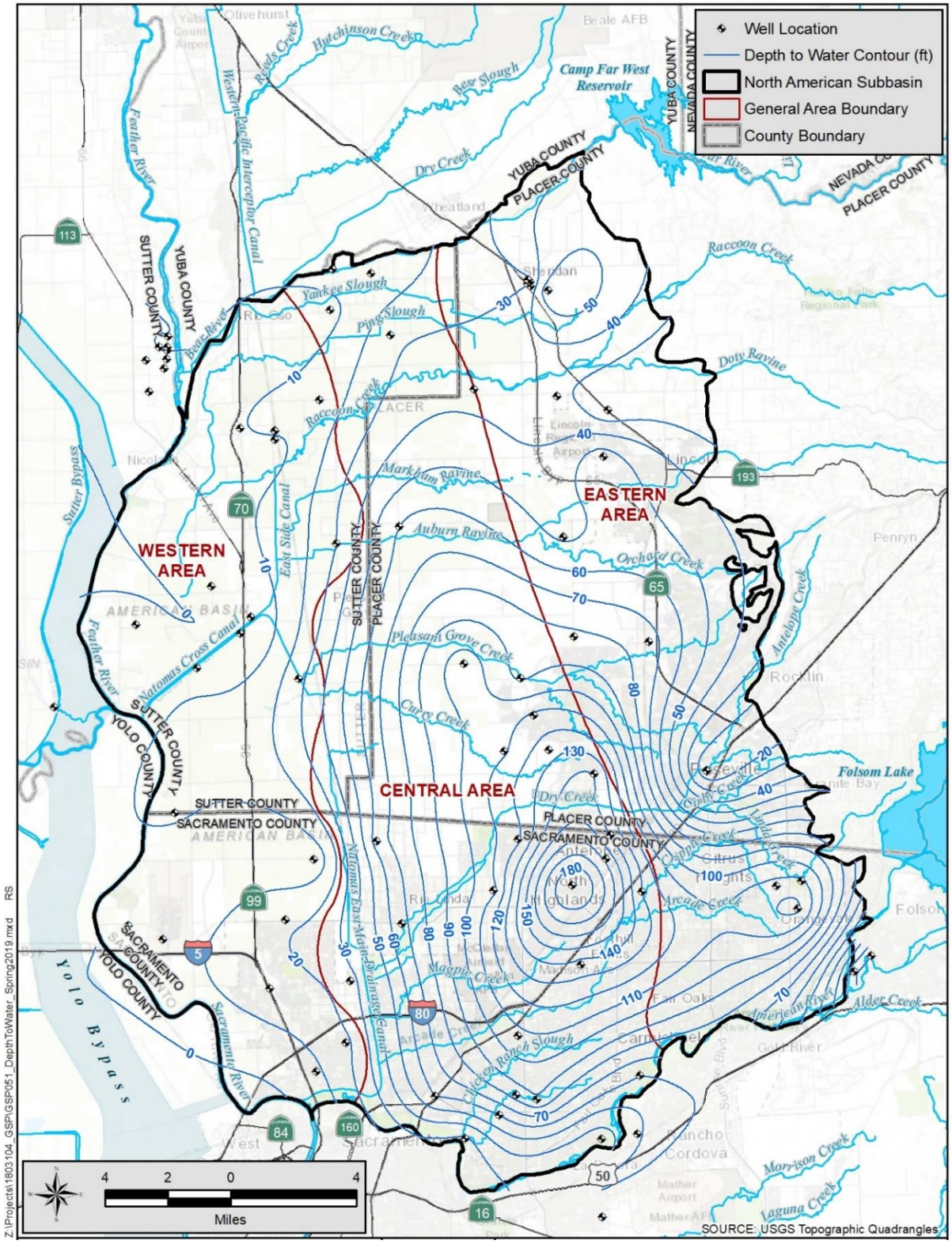


Figure B-3. Spring 2019 Depth to Water Contours

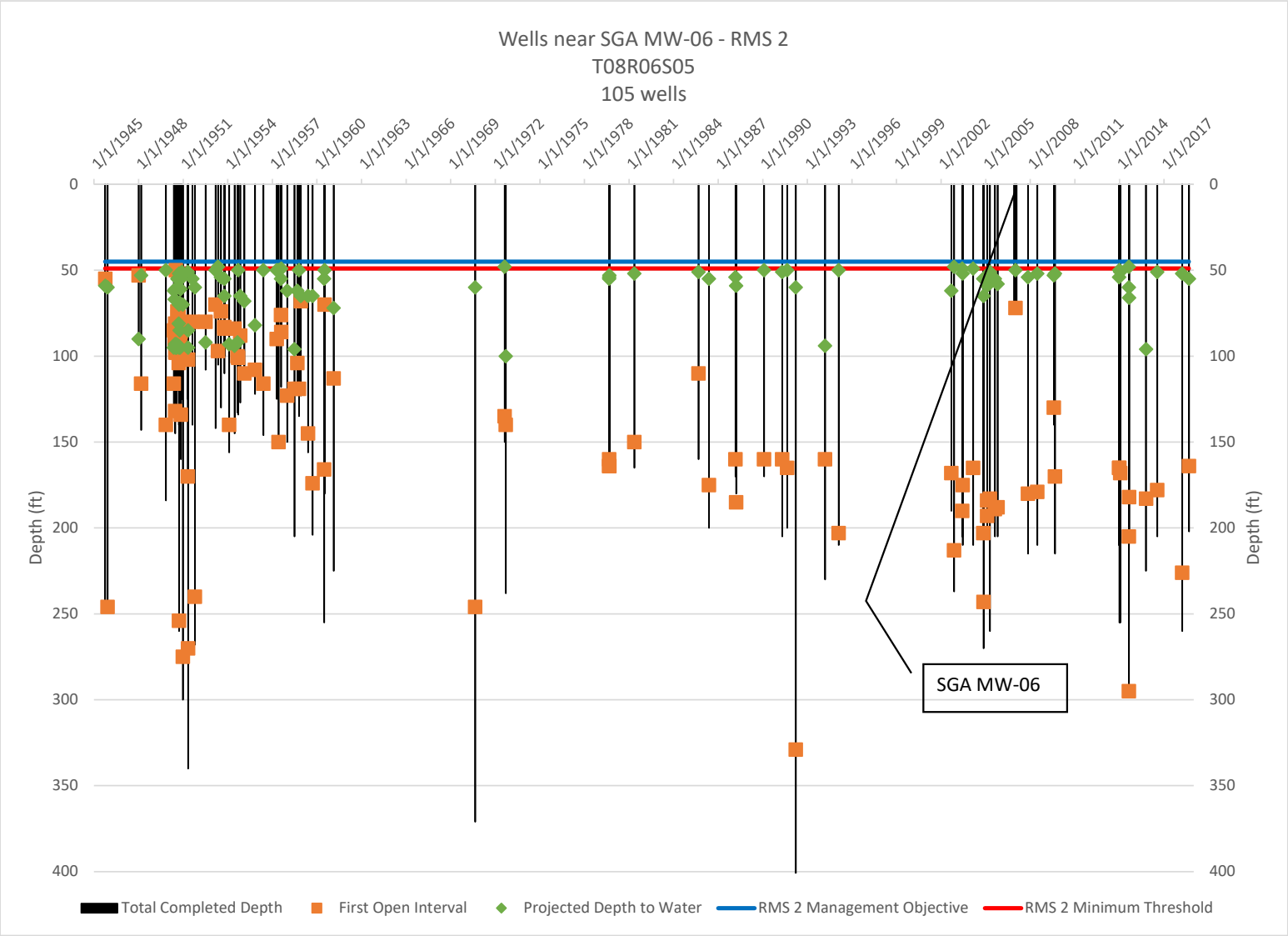


Figure B-4. Domestic Well Characteristics near RMS 2

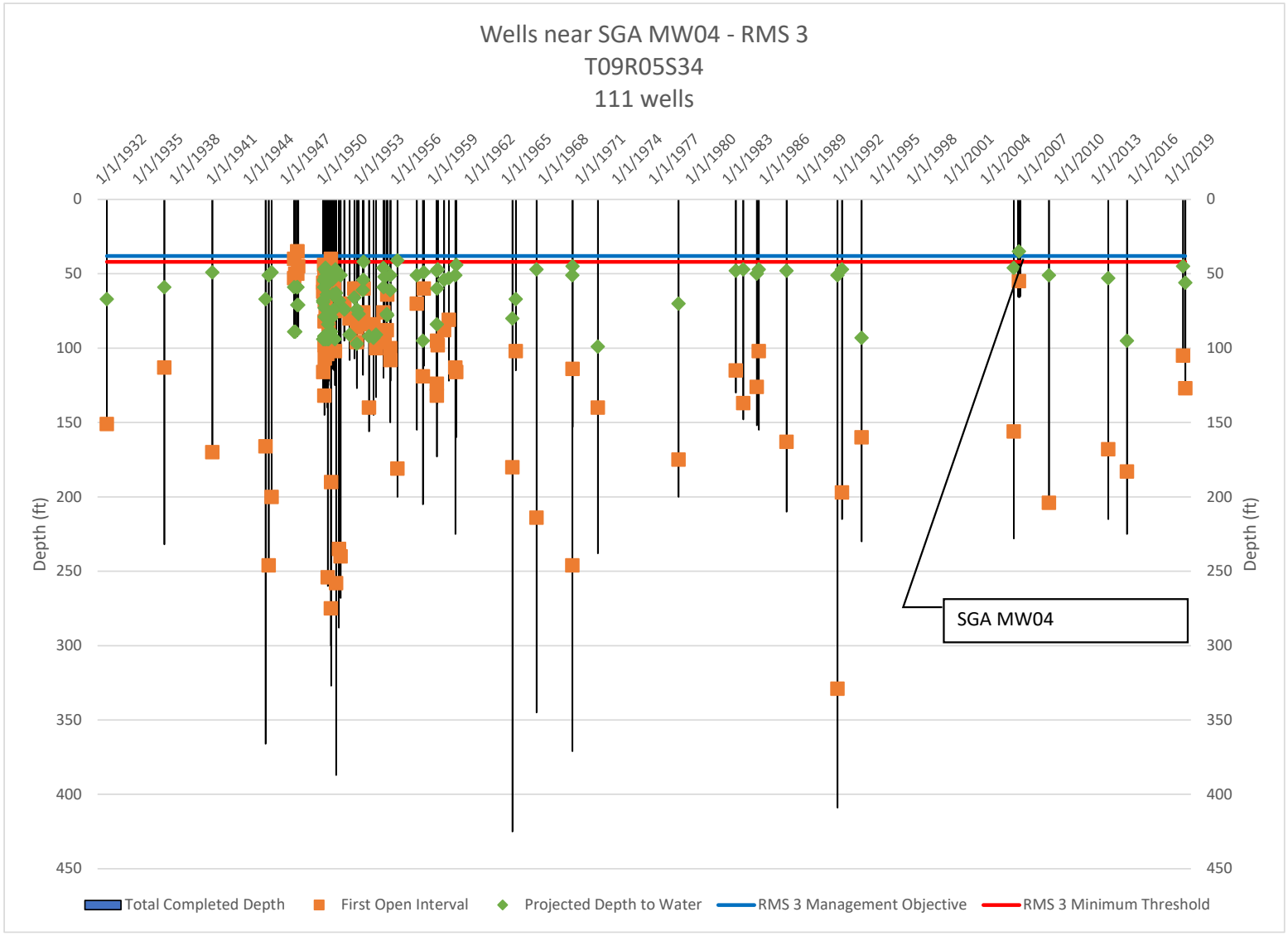


Figure B-5. Domestic Well Characteristics near RMS 3

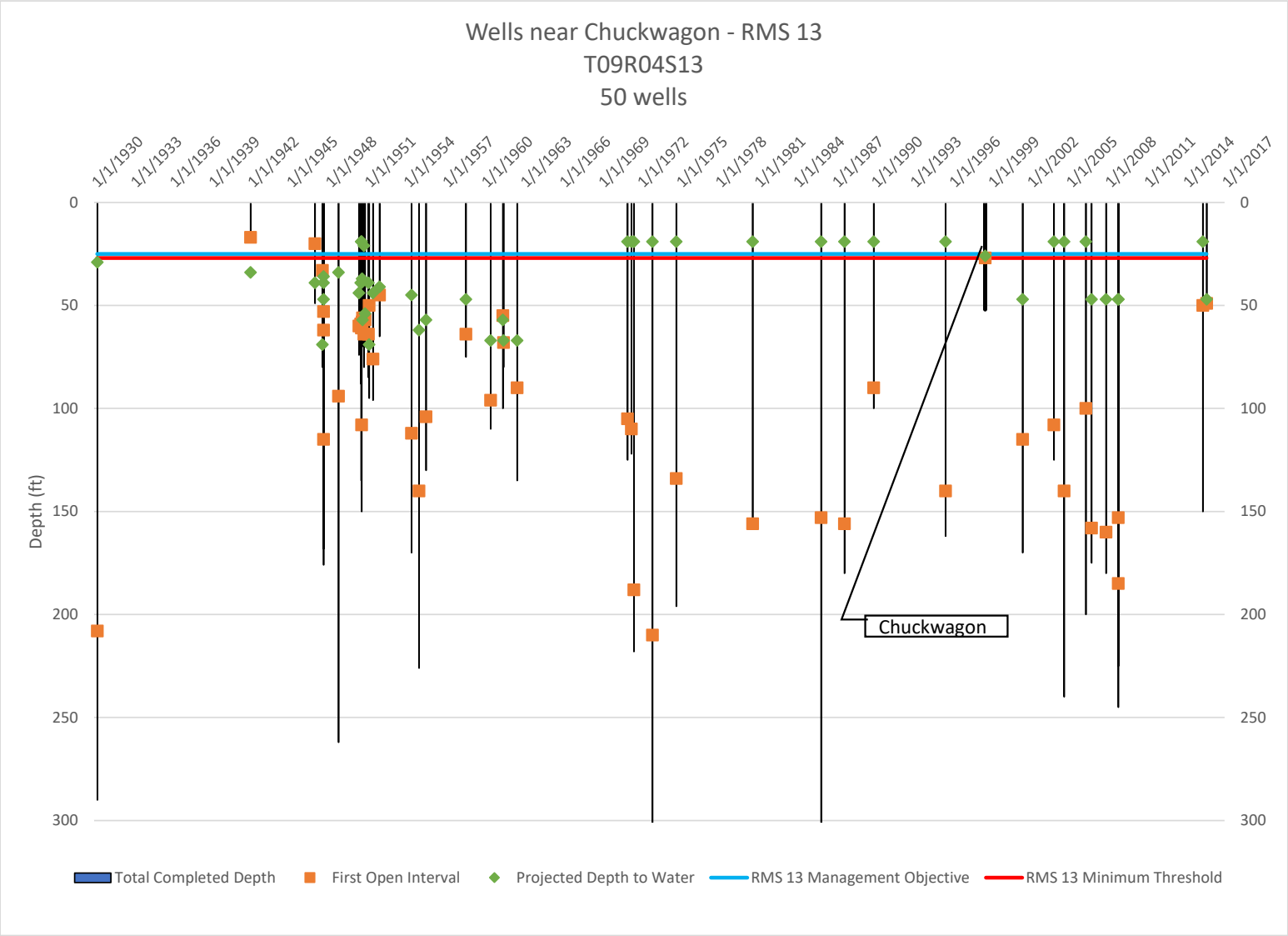


Figure B-6. Domestic Well Characteristics near RMS 13

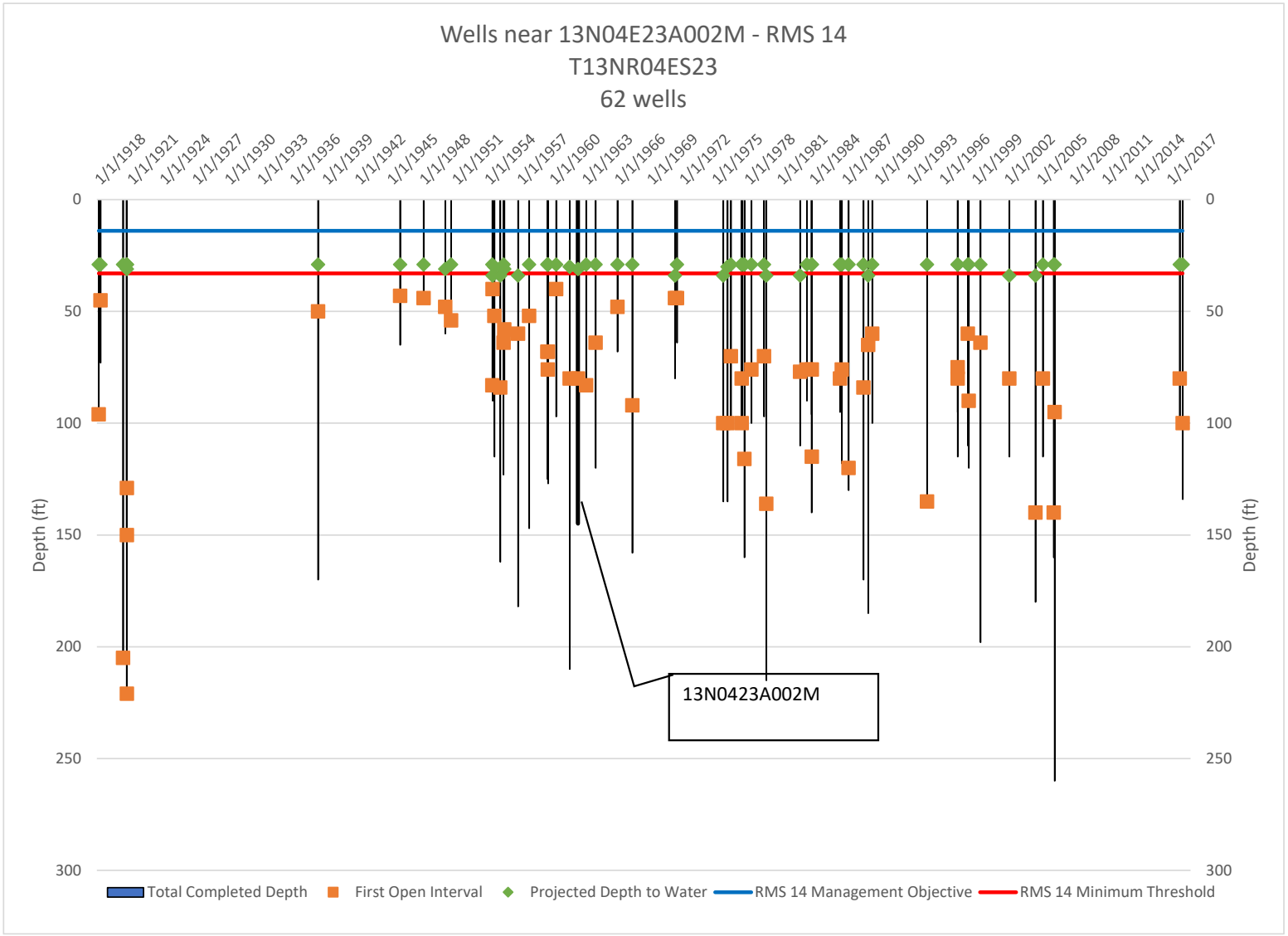


Figure B-7. Domestic Well Characteristics near RMS 14

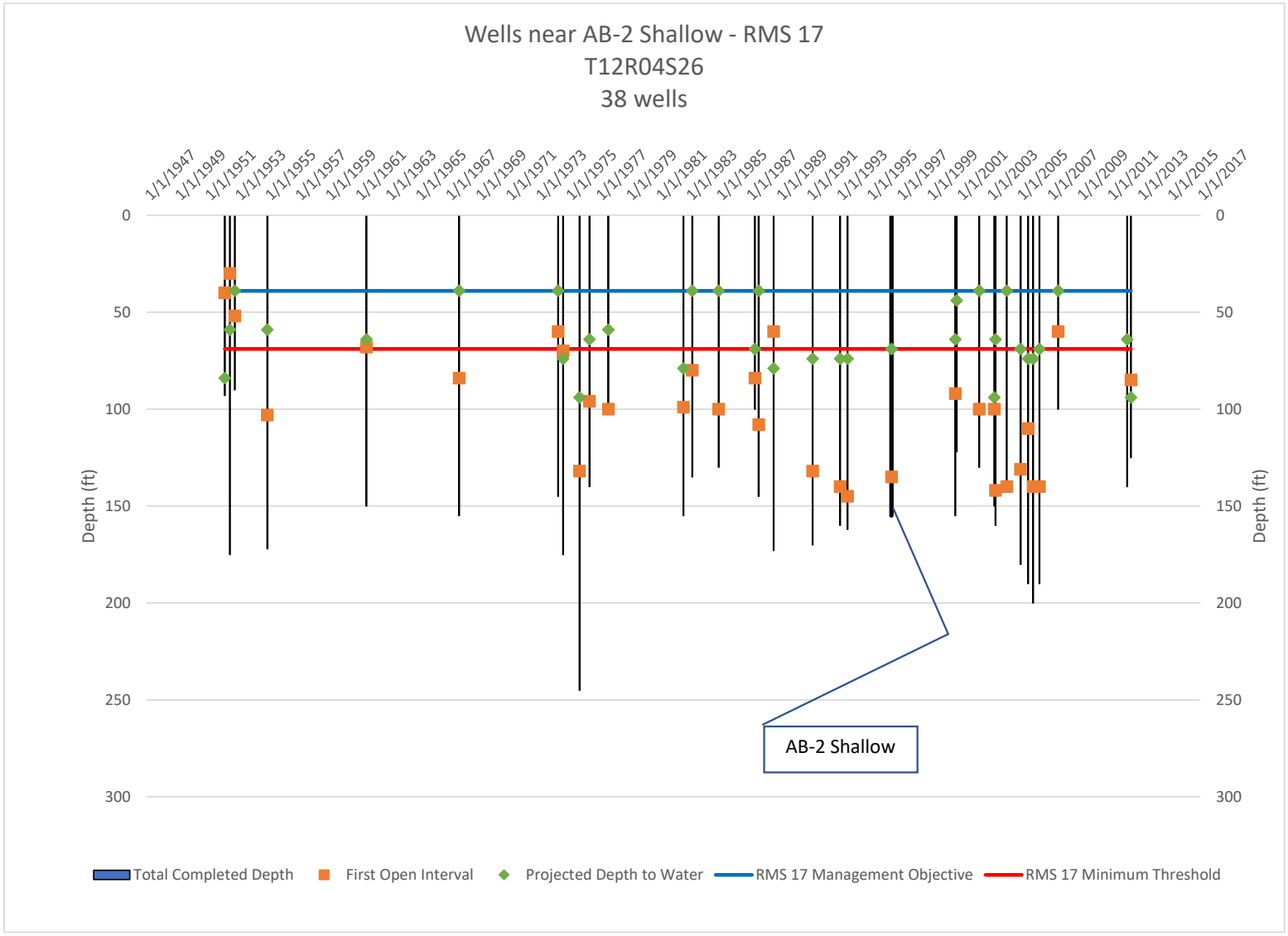


Figure B-8. Domestic Well Characteristics near RMS 17

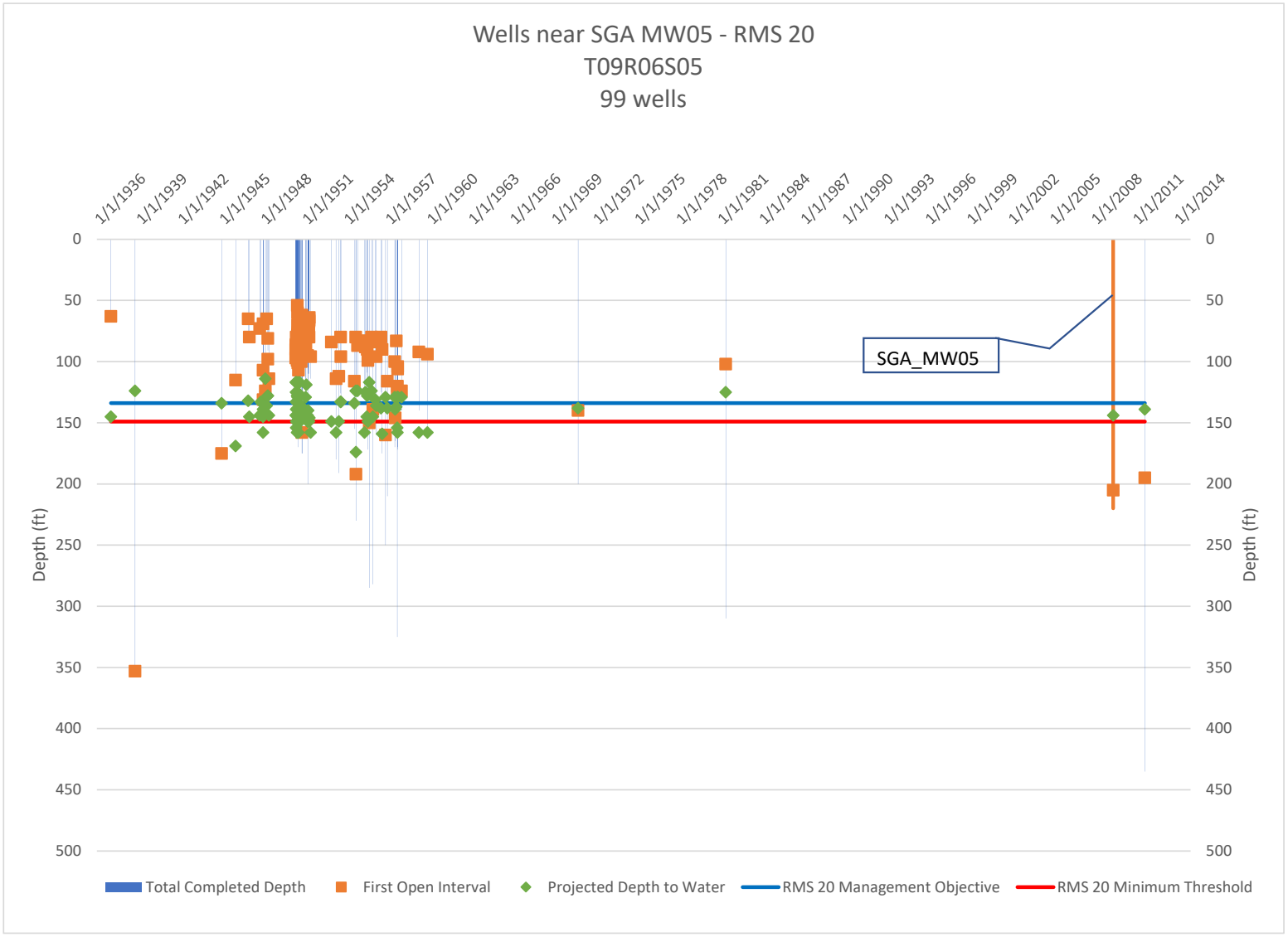


Figure B-9. Domestic Well Characteristics near RMS 20

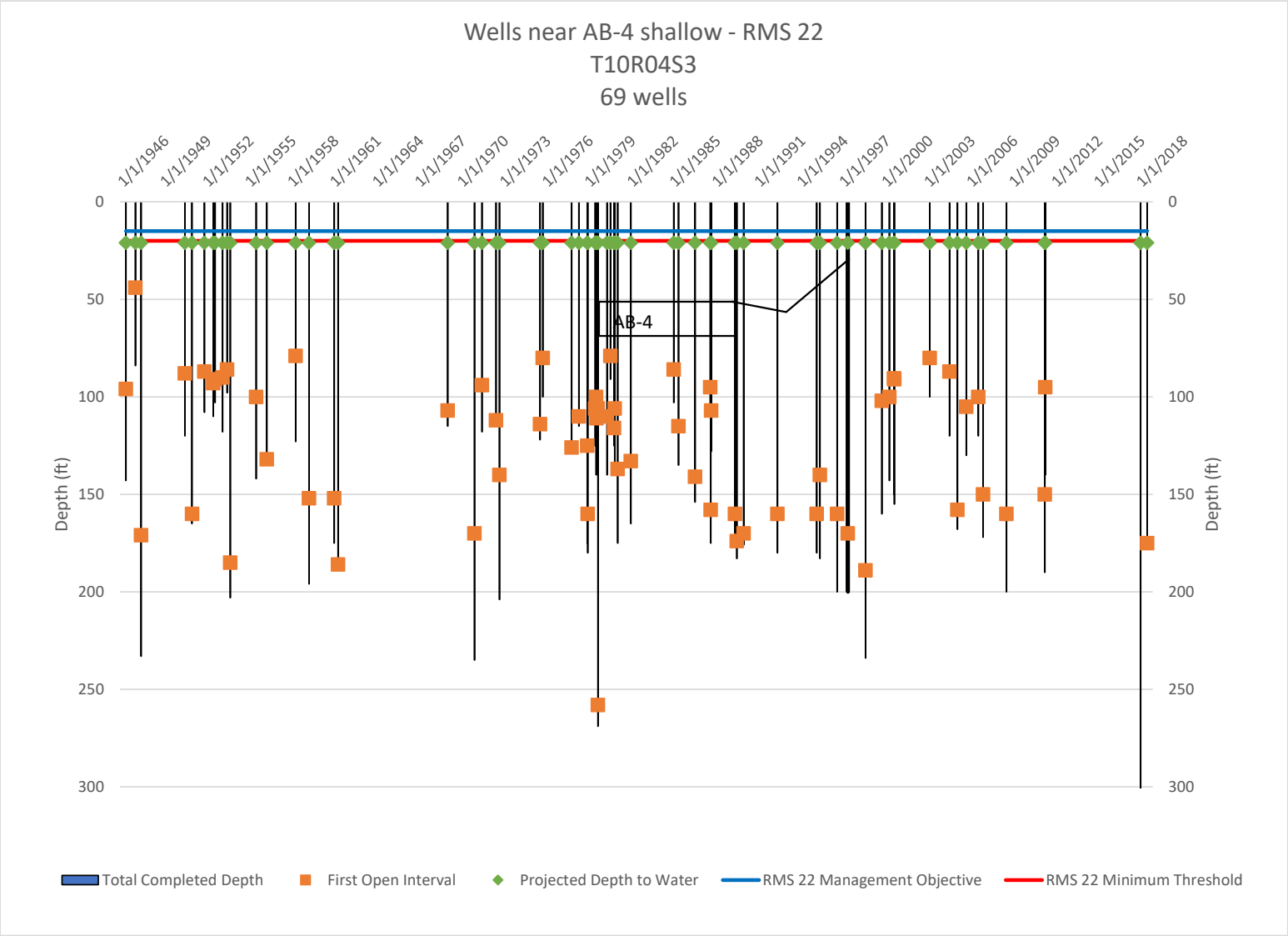


Figure B-10. Domestic Well Characteristics near RMS 22

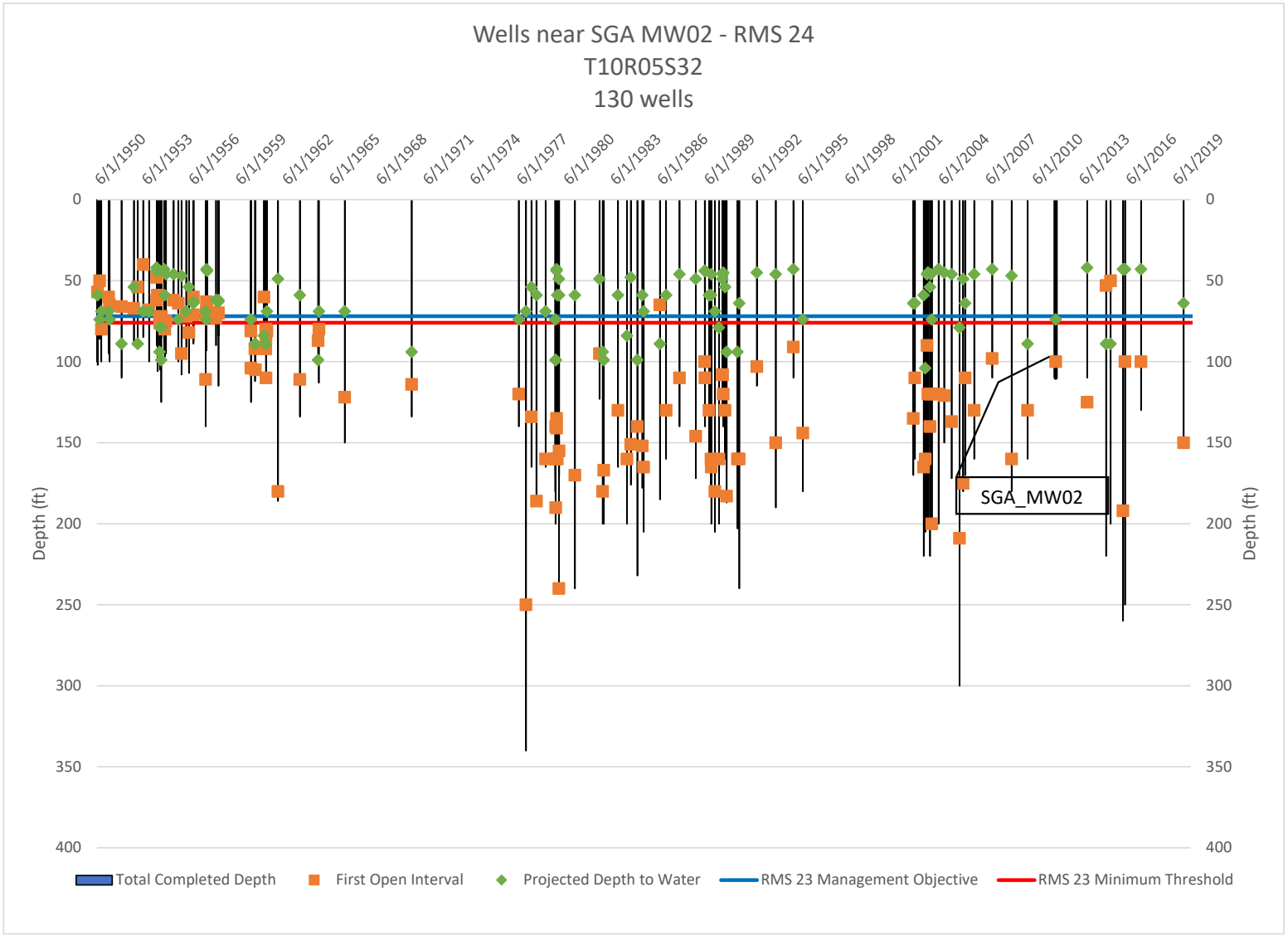


Figure B-11. Domestic Well Characteristics near RMS 24

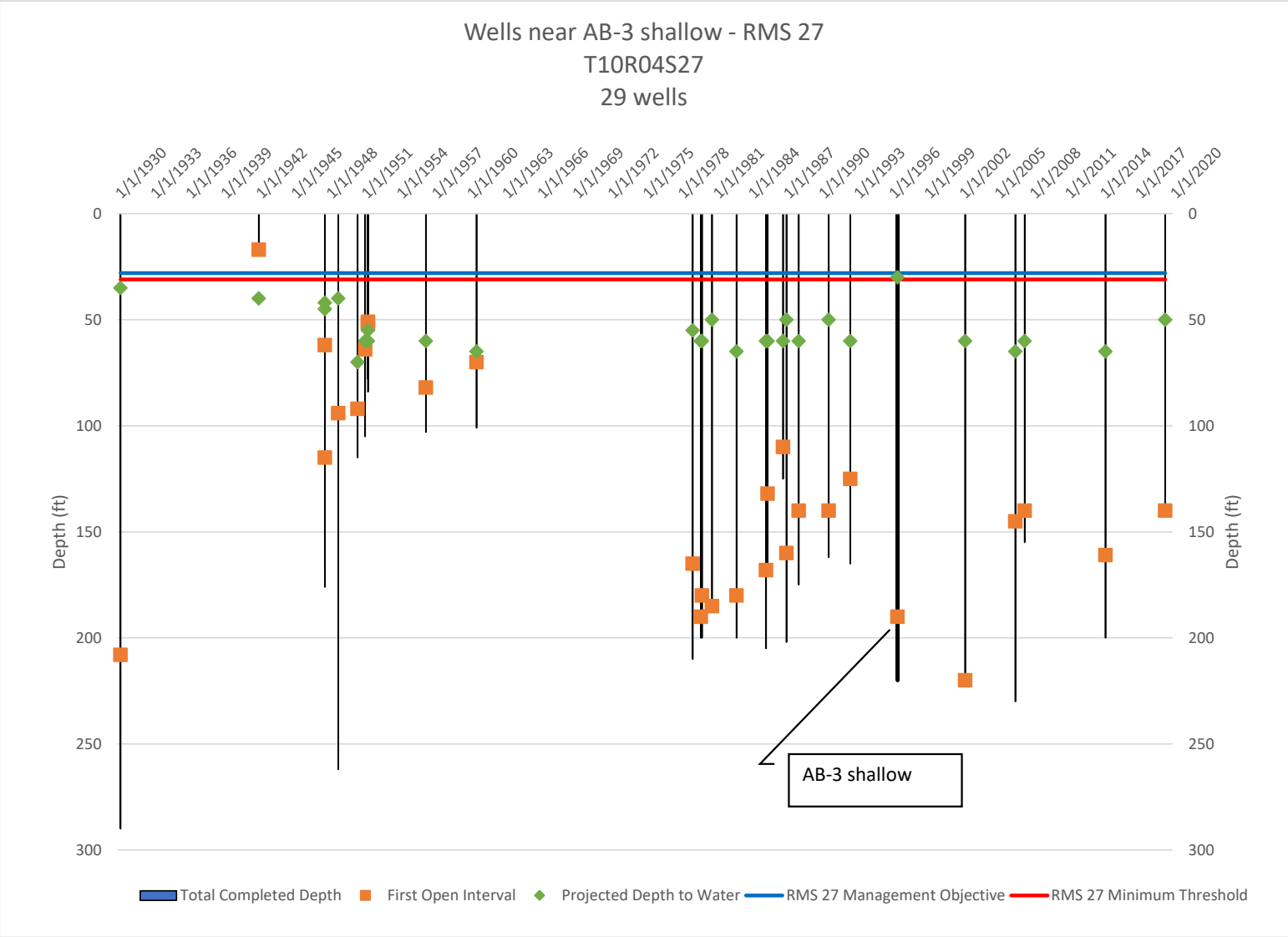


Figure B-12. Domestic Well Characteristics near RMS 27

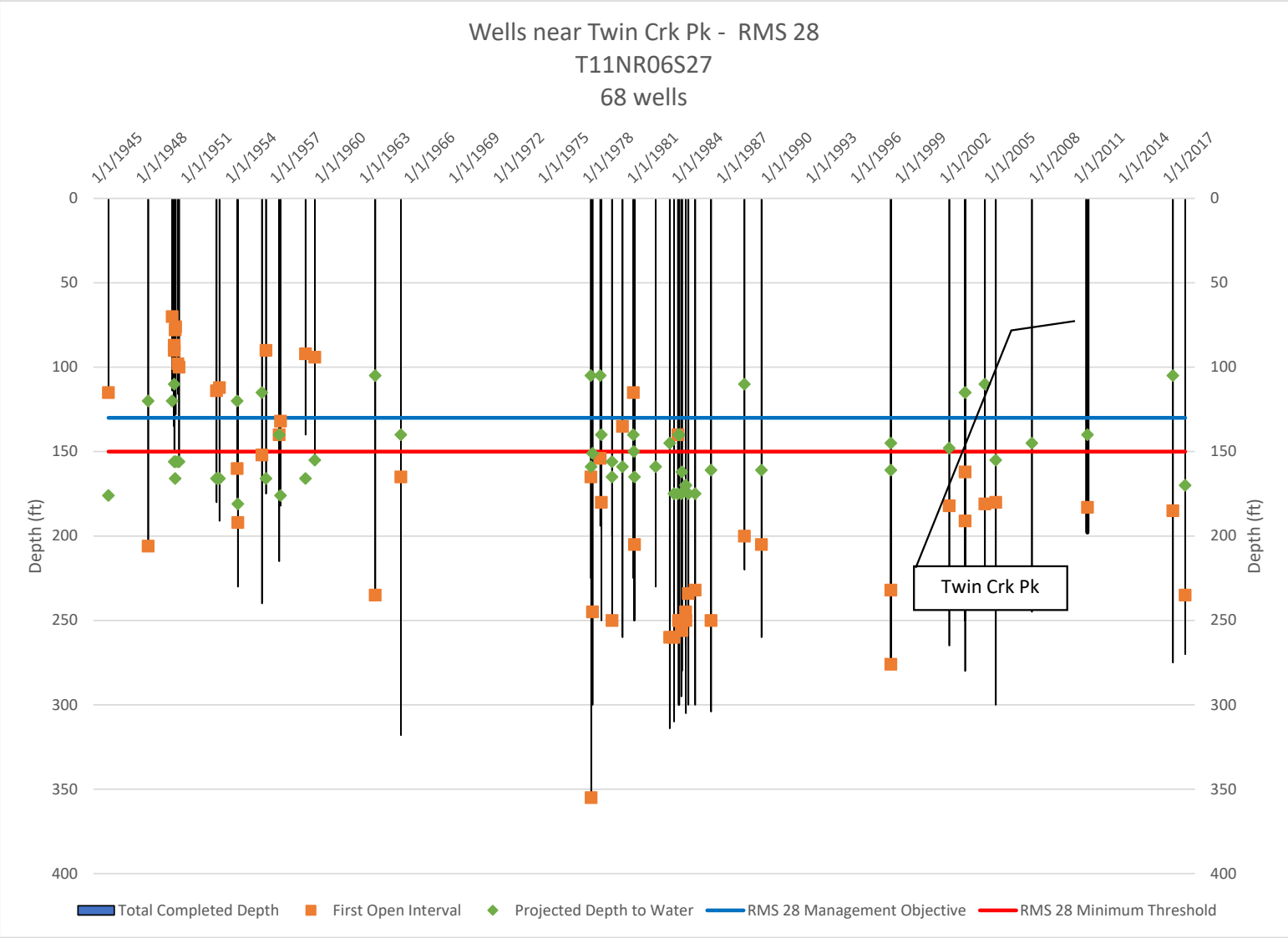


Figure B-13. Domestic Well Characteristics near RMS 28

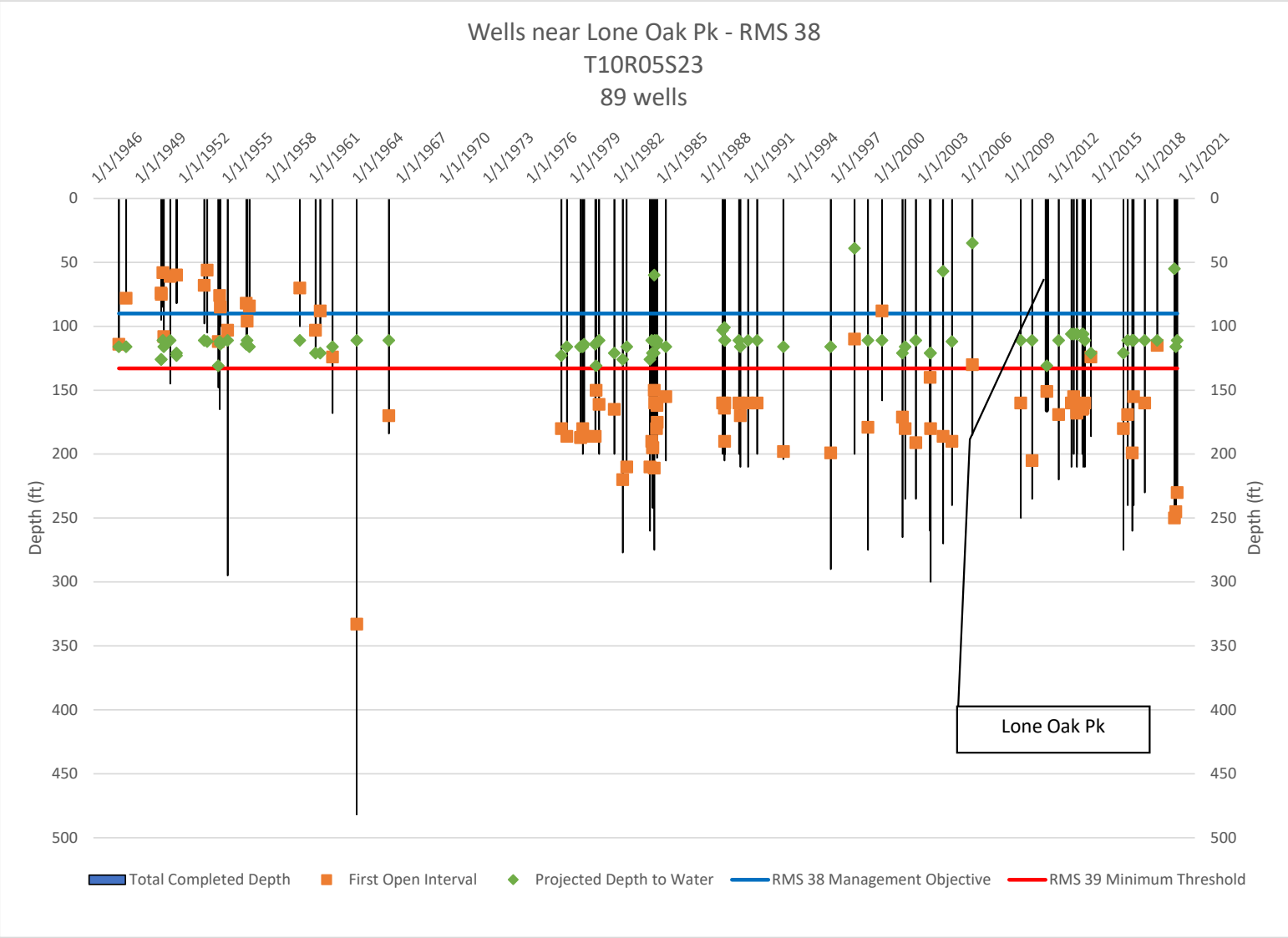


Figure B-14. Domestic Well Characteristics near RMS 38

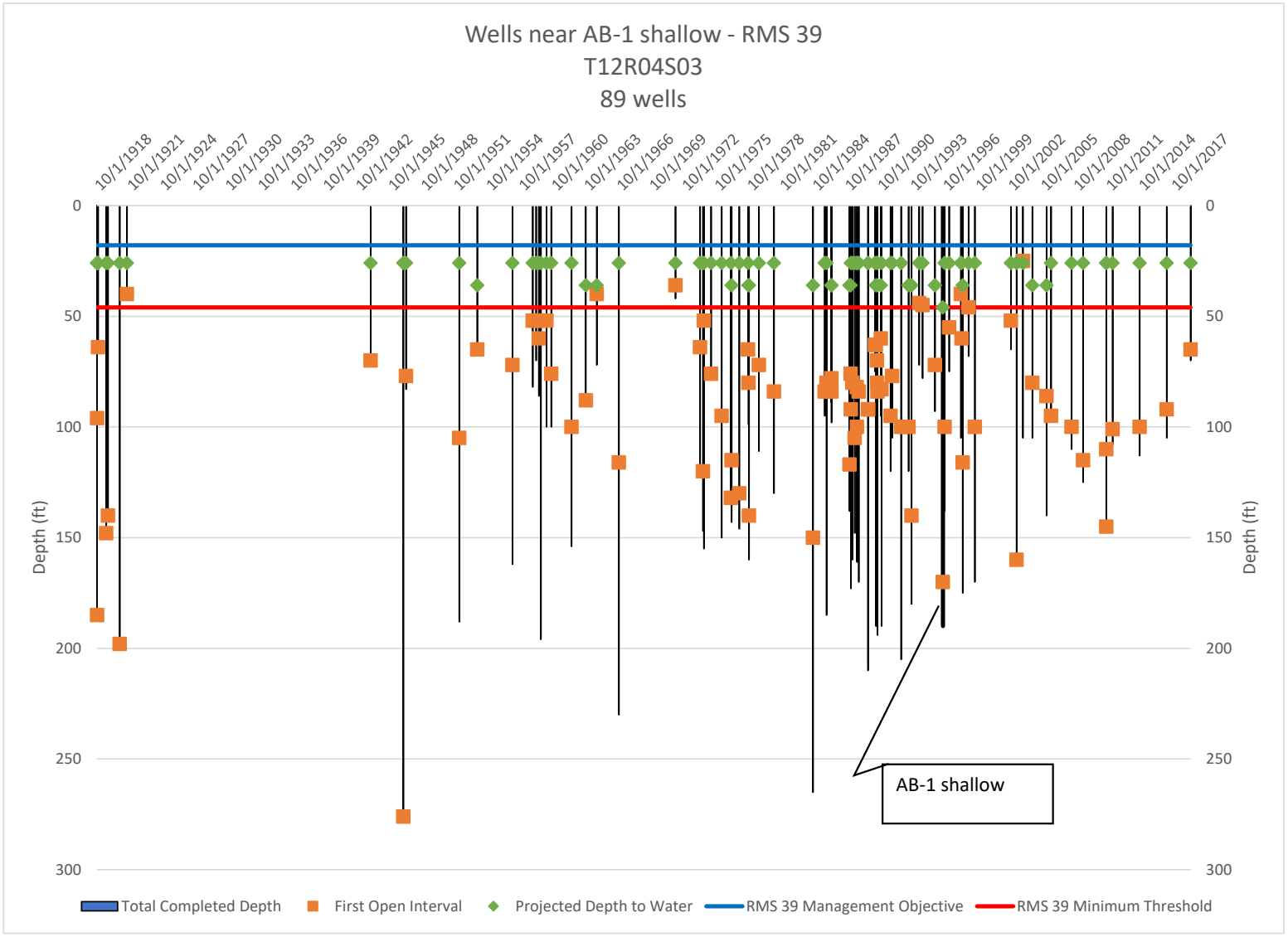


Figure B-15. Domestic Well Characteristics near RMS 39

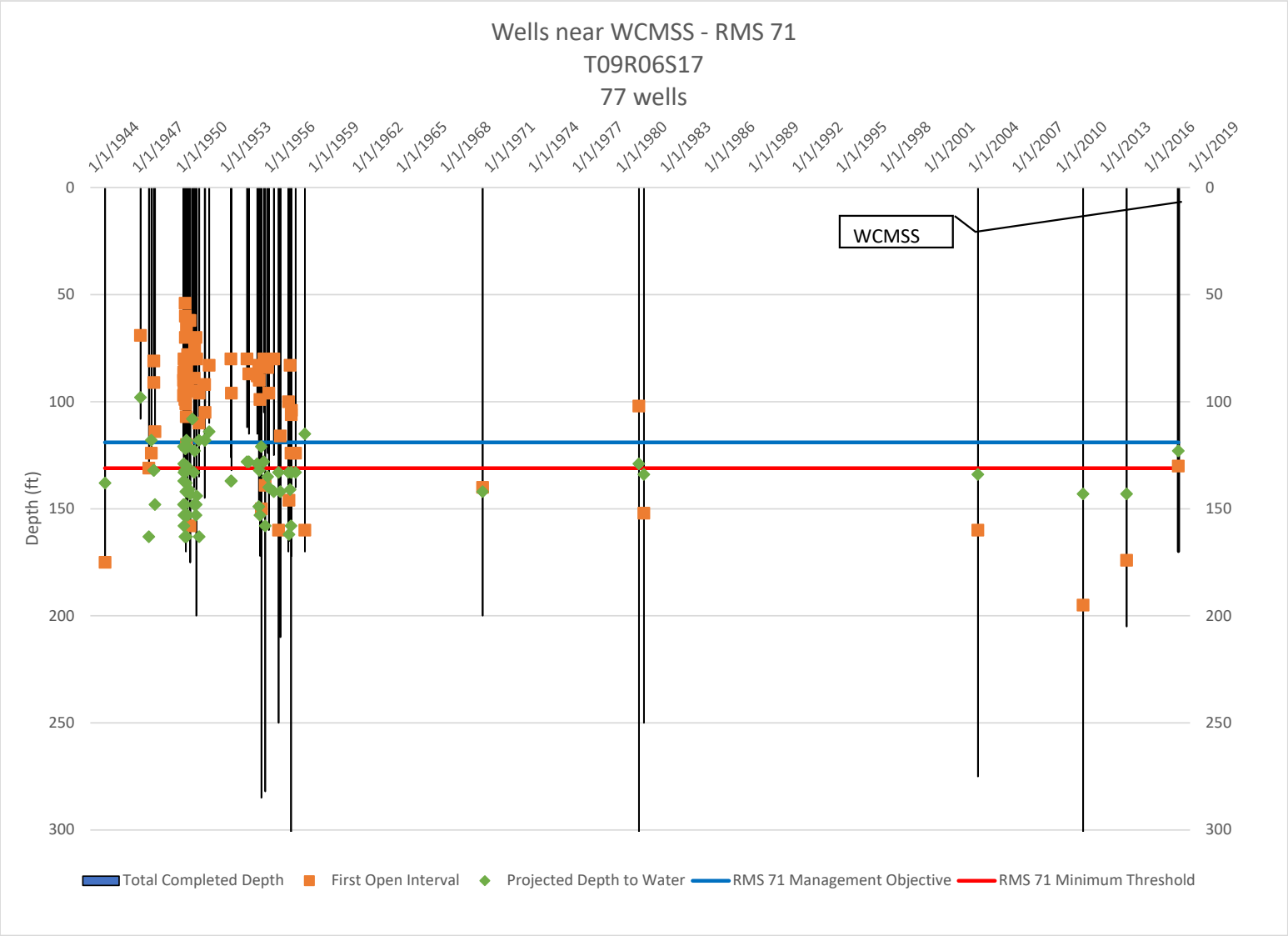


Figure B-16. Domestic Well Characteristics near RMS 71

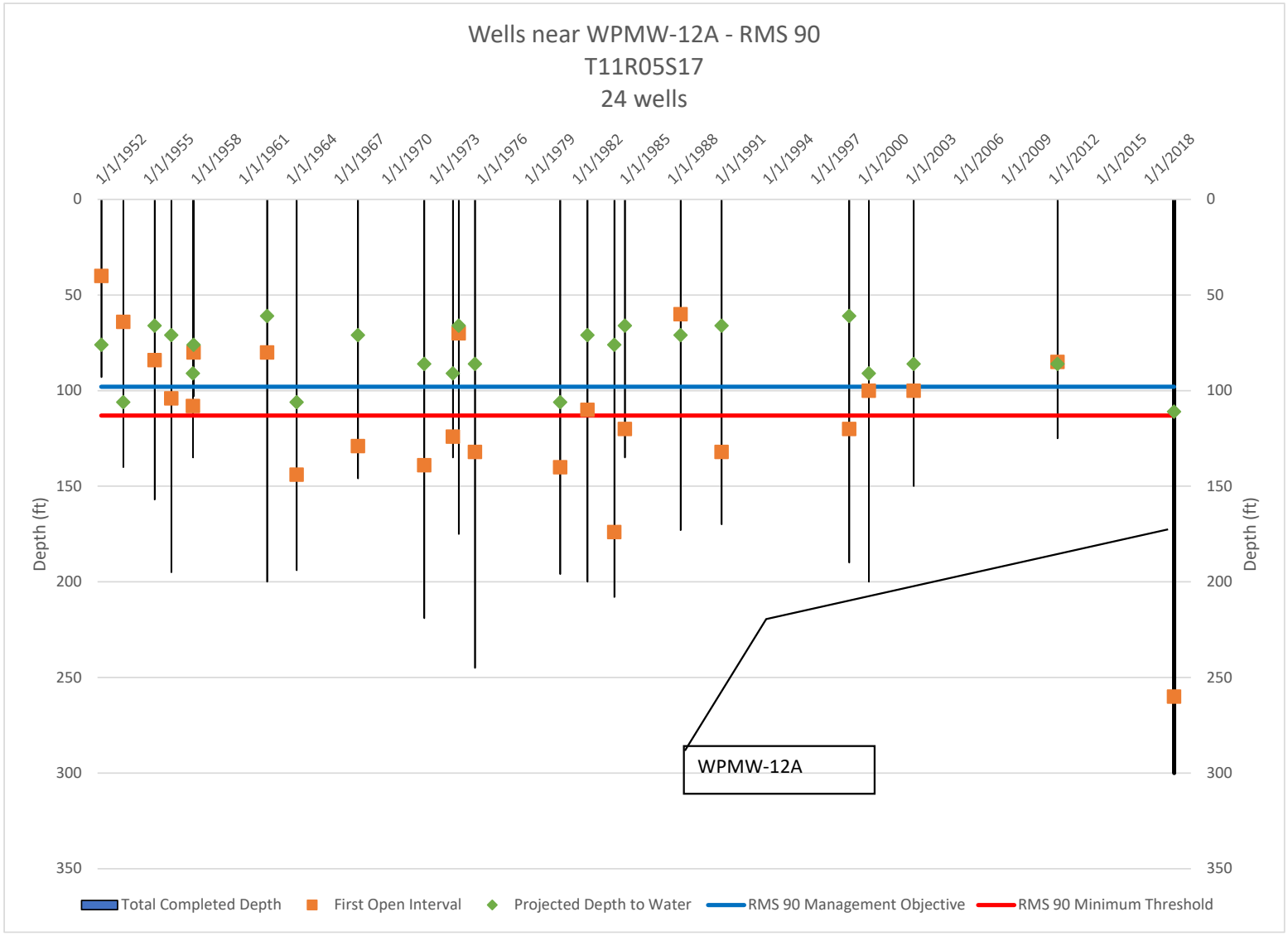


Figure B-17. Domestic Well Characteristics near RMS 90

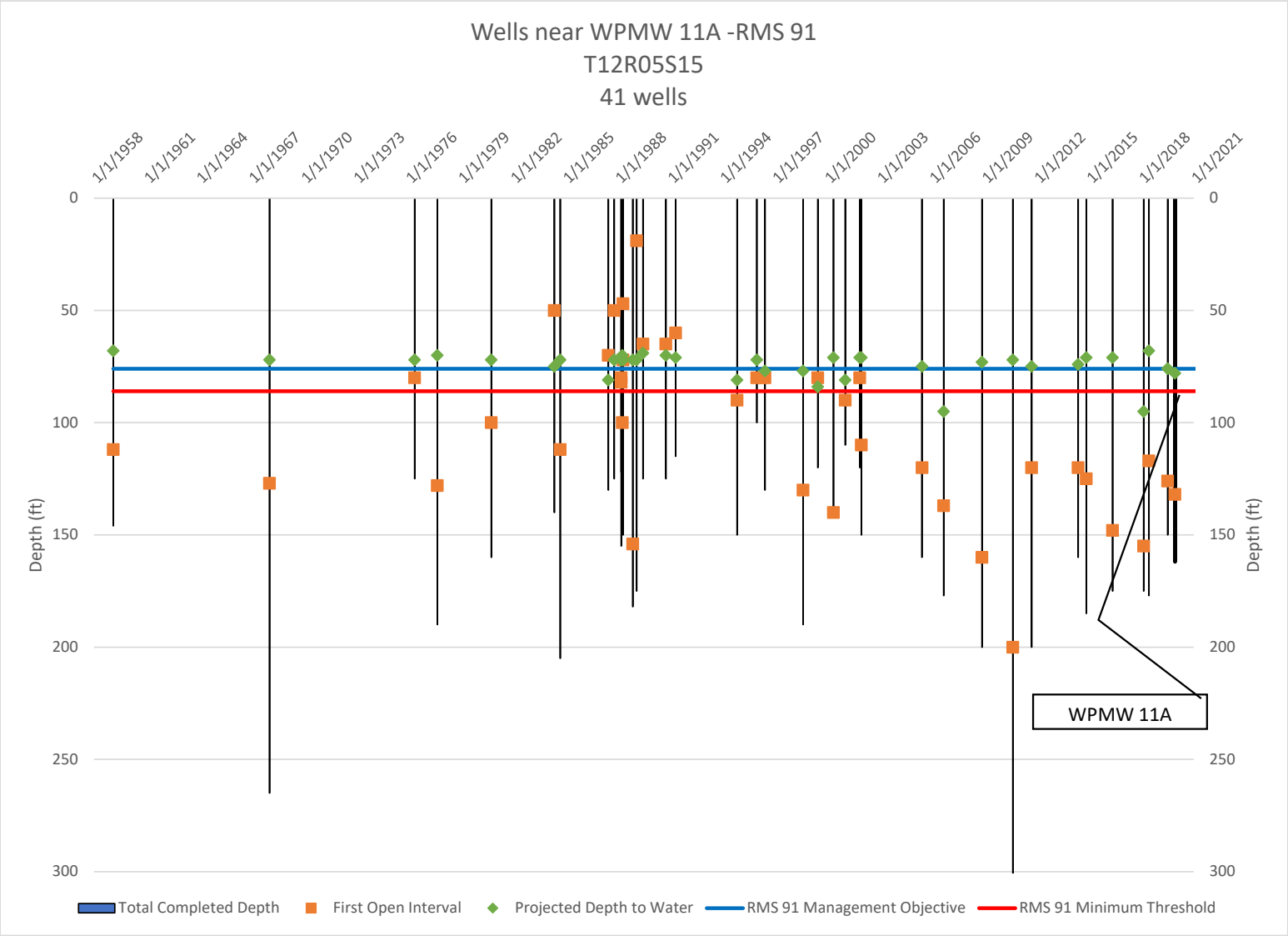


Figure B-18. Domestic Well Characteristics near RMS 91

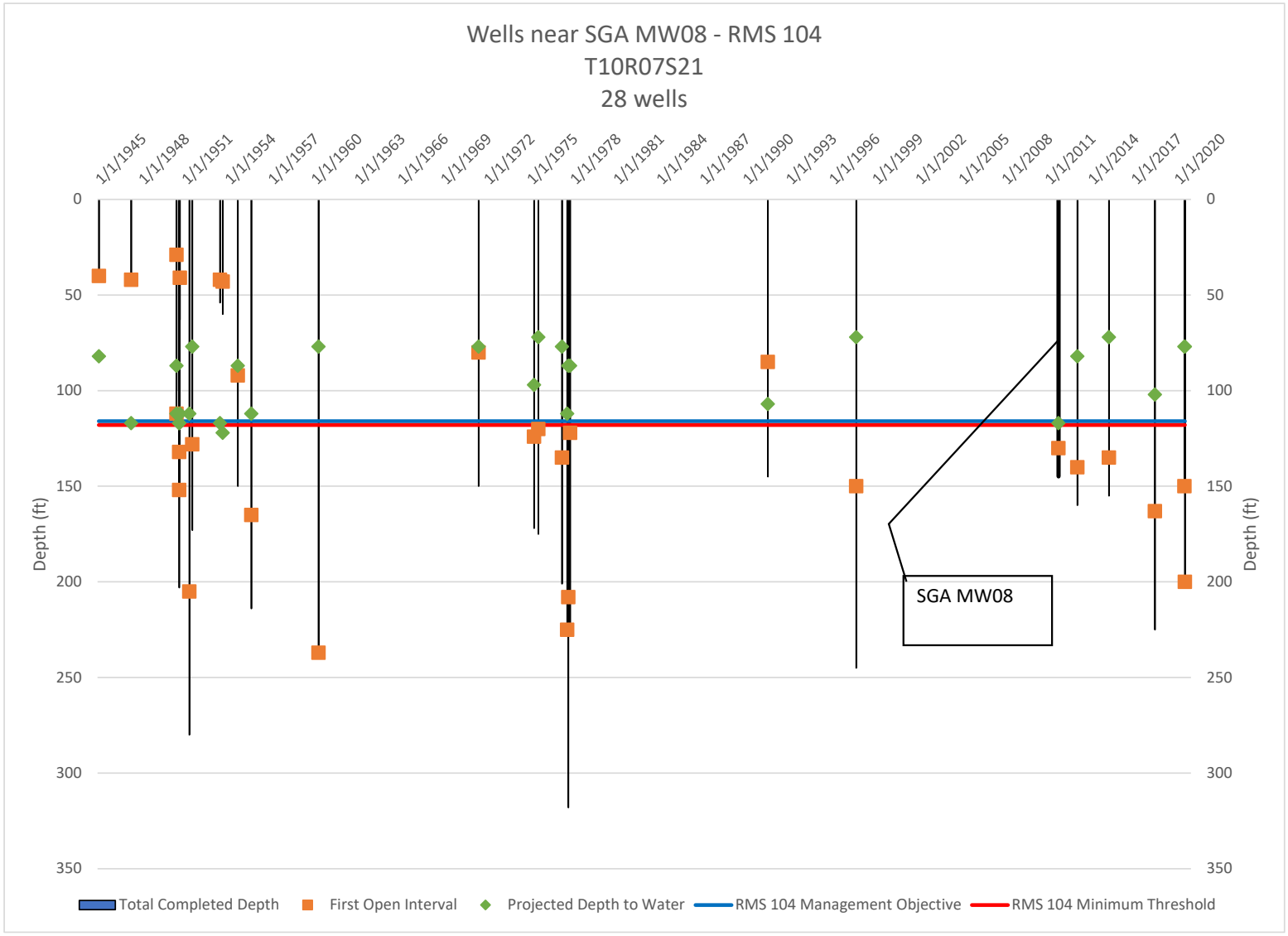


Figure B-19. Domestic Well Characteristics near RMS 104

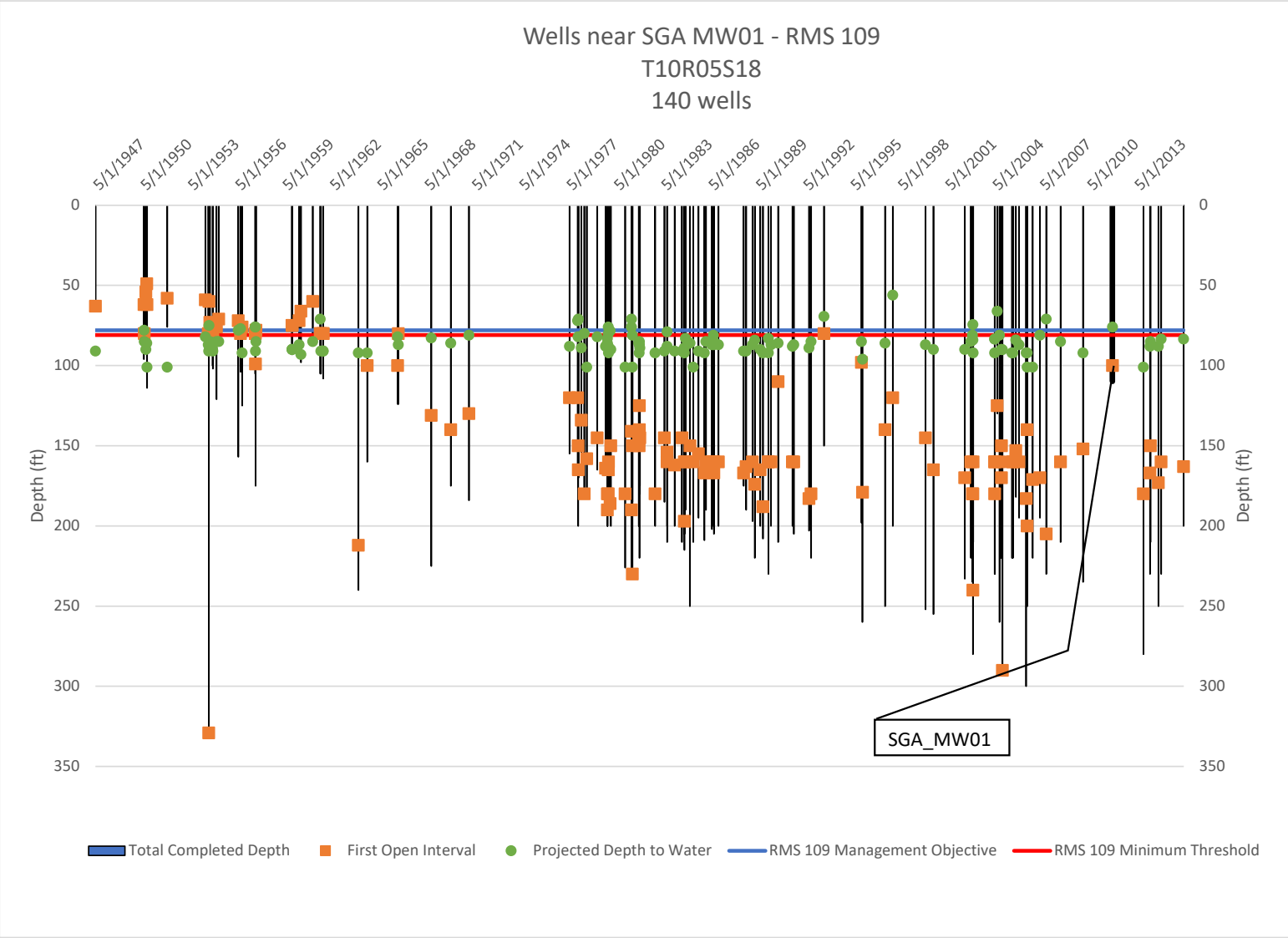


Figure B-20. Domestic Well Characteristics near RMS 109

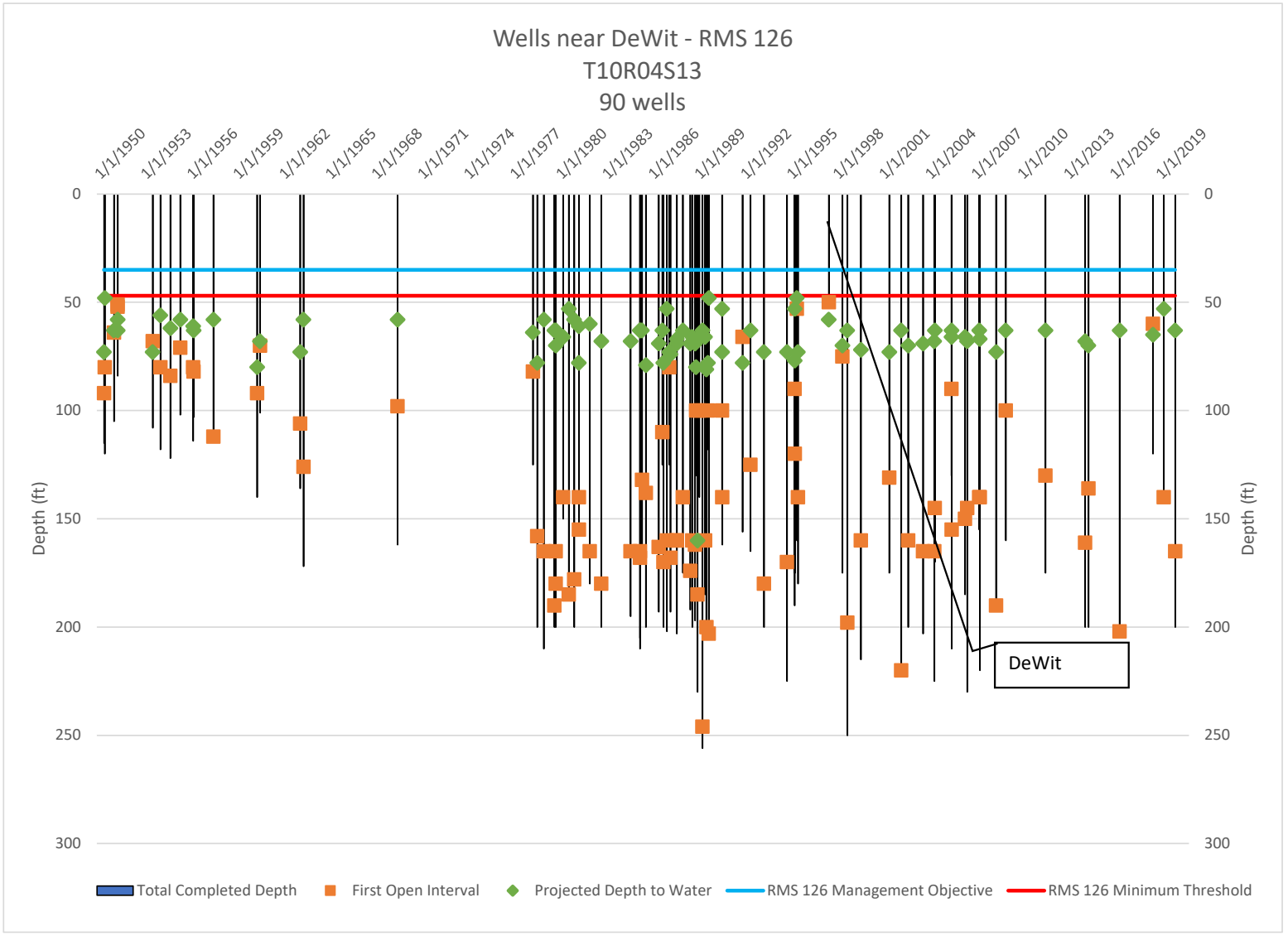


Figure B-21. Domestic Well Characteristics near RMS 126

Table B-3. Summary of Domestic Well Analysis with Respect to Total Depth

Well Information		Baseline Condition			Projected Condition			Net Difference (Baseline-Projected)	
Representative Monitoring Well	**Number of Domestic Wells Assessed**	**Number pre-1970 Wells Above Depth to Water**	**Number post-1970 Wells Above Depth to Water**	**Total Wells Above Depth to Water**	**Number pre-1970 Wells Above Depth to Water**	**Number post-1970 Wells Above Depth to Water**	**Total Wells Above Depth to Water**	**Pre-1970 Domestic Wells**	**Post-1970 Domestic Wells**
2	105	0	0	0	2	0	2	2	0
3	111	3	0	3	7	0	7	4	0
13	50	1	0	1	1	0	1	0	0
14	63	0	0	0	0	0	0	0	0
17	38	0	0	0	0	0	0	0	0
20	99	56	0	56	60	0	60	4	0
22	69	0	0	0	0	0	0	0	0
24	130	2	0	2	3	0	3	1	0
27	29	1	0	1	1	0	1	0	0
28	58	8	0	8	9	0	9	1	0
38	89	12	0	12	15	0	15	3	0
39	89	0	0	0	0	0	0	0	0
71	77	36	0	36	42	0	42	6	0
90	24	0	0	0	0	0	0	0	0
91	41	0	0	0	0	0	0	0	0
104	29	5	0	5	5	0	5	0	0
109	140	2	0	2	9	0	9	7	0
126	90	0	0	0	0	0	0	0	0
Total	**1331**	**126**	**0**	**126**	**154**	**0**	**154**	**28**	**0**

Table B-4. Summary of Domestic Well Analysis with Respect to First Open Interval

Well Information		Baseline Condition			Projected Condition			Net Difference (Baseline-Projected)	
Representative Monitoring Well	**Number of Domestic Wells Assessed**	**Number pre-1970 Wells Above Depth to Water**	**Number post-1970 Wells Above Depth to Water**	**Total Wells Above Depth to Water**	**Number pre-1970 Wells Above Depth to Water**	**Number post-1970 Wells Above Depth to Water**	**Total Wells Above Depth to Water**	**Pre-1970 Domestic Wells**	**Post-1970 Domestic Wells**
2	105	6	0	6	7	0	7	1	0
3	111	28	0	28	32	0	32	4	0
13	50	4	0	4	6	0	6	2	0
14	63	0	0	0	0	0	0	0	0
17	38	2	1	3	4	1	5	2	0
20	99	85	1	86	85	1	86	0	0
22	69	0	0	0	0	0	0	0	0
24	130	14	3	17	22	3	25	8	0
27	29	1	0	1	3	0	3	2	0
28	58	15	3	18	15	3	18	0	0
38	89	21	0	21	22	0	22	1	0
39	89	0	0	0	0	1	1	0	1
71	77	39	1	40	63	2	65	24	1
90	24	2	0	2	2	2	4	0	2
91	41	0	6	6	0	9	9	0	3
104	29	6	1	7	7	1	8	1	0
109	140	10	0	10	28	0	28	18	0
126	90	0	0	0	3	2	5	3	2
Total	**1331**	**233**	**16**	**249**	**299**	**25**	**324**	**66**	**9**

Appendix C: Monitoring Construction Details

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX C
Groundwater Level Monitoring Well Construction Details

December 2021

Appendix C
Groundwater Level Monitoring Well Construction Details

Map No.	CASGEM ID	Local Name	State Well Number	Latitude	Longitude	Reference Point Elevation (ft)	Monitoring Entity	Screened Interval (ft bgs)	Total Depth (ft bgs)	Period of Record	Well Type
1	387626N1213651W001	SVMW East-2A		38.762629	-121.3651	126.02	City of Roseville	125-135	140	2011-2020	O
1	381626N1213651W001	SVMW East-2B		38.762629	-121.3651	125.83	City of Roseville	510-520	525	2011-2020	O
1	387626N1213651W002	SVMW East-2C		38.76263	-121.3651	125.75	City of Roseville	655-665	670	2011-2020	O
2	385828N1213385W001	SGA_MW06		38.58281	-121.33846	49.49	DWR	62-72	72	2007-2019	O
3	385841N1214185W001	SGA_MW04		38.58414	-121.41852	38.69	DWR	55-65	65	2007-2019	O
4	385947N1213985W001	MW12A		38.59472	-121.39847	41.8	DWR	200-280	285	2010-2020	O
4	385947N1213985W002	MW12B		38.59472	-121.39847	41.84	DWR	360-380	385	2010-2020	O
4	385947N1213985W003	MW12C		38.59472	-121.39847	41.82	DWR	590-610	615	2010-2020	O
4	385947N1213985W004	MW12D		38.59472	-121.39847	41.82	DWR	810-840	845	2010-2020	O
4	385947N1213985W005	MW12E		38.59472	-121.39847	41.77	DWR	960-1000	1005	2010-2020	O
5	386016N1213761W001	DWR_SGA_004	09N05E25J001M	38.6016	-121.3761	66.7	DWR	Unknown	238	1977-2020	R
6	386038N1213882W001	MW11A		38.6038	-121.38815	59.45	DWR	167-177	187	2010-2017	O
6	386038N1213882W002	MW11B		38.6038	-121.38815	59.41	DWR	258-268	278	2010-2020	O
6	386038N1213882W003	MW11C		38.6038	-121.38815	59.25	DWR	332-365	375	2010-2020	O
7	386038N1214357W001	DWR_SGA_005	09N05E28K001M	38.6038	-121.4357	36.84	DWR	Unknown	250	1968-2020	I
8	386061N1215313W001	SCWA_SGA_003	09N04E27F001M	38.6061	-121.5313	27.04	SCWA	Unknown	320	1953-2029	I
9	386117N1213150W001	SCWA_SGA_004	09N06E27D001M	38.6117	-121.315	73.5	SCWA	Unknown	200	1962-2019	O
10	386151N1214467W001	DWR_SGA_003	09N05E21M001M	38.6151	-121.4467	37.14	DWR	Unknown	89	1948-2010	U
11	386160N1215054W001	Bannon Creek Park	09N04E23R002M	38.61603	-121.5054	13.76	SGA	33-48	48	2011-2012	O
12	386874N1212206W001	SGA_MW09		38.68739	-121.22058	231.27	DWR	150-160	160	2007-2019	O
13	386292N1214877W001	Chuckwagon Park	09N04E13R001M	38.62921	-121.4877	11.71	DWR	27-37	52	1998-2019	O
14	389669N1214897W001	13N04E23A002M	13N04E23A002M	38.9669	-121.4897	59.28	SSWD	Unknown	83	1963-2020	R
15	388208N1215397W001	11N04E09D002M	11N04E09D002M	38.8208	-121.5397	30.87	DWR	Unknown	100	1958-2020	R
16	386410N1213995W001	DWR_SGA_002	09N05E14B001M	38.641	-121.3995	68.53	DWR	Unknown	550	1980-2019	I
17	388593N1214885W003	AB-2 shallow	12N04E26J004M	38.8593	-121.4885	52.76	DWR	135-145	155	1996-2020	O
17	388593N1214885W001	AB-2 deep	12N04E26J002M	38.8593	-121.4885	52.3	DWR	670-690	700	1996-2020	O
17	388593N1214885W002	AB-2 middle	12N04E26J003M	38.8593	-121.4885	52.63	DWR	380-490	500	1996-2020	O
18	386489N1215679W001	SCWA_SGA_002	09N04E08L001M	38.6489	-121.5679	27.51	SCWA	Unknown	Unknown	1953-2010	I
19	386576N1214846W001	SCWA_SGA_001	09N04E01R001M	38.6576	-121.4846	22.72	SCWA	Unknown	17	1953-2019	R
20	386635N1213486W001	SGA_MW05		38.66347	-121.34859	121.87	DWR	205-215	215	2007-2019	O
21	387404N1214870W001		10N04E12A001M	38.7404	-121.487	45.54	DWR	Unknown	290	1947-2005	I
22	386782N1215943W004	AB-4 shallow	10N04E31M004M	38.6782	-121.5943	18.53	DWR	170-190	200	1997-2020	O
22	386782N1215943W001	AB-4 deep	10N04E31M001M	38.6782	-121.5943	19.28	DWR	1060-1070	1080	1997-2020	O
22	386782N1215943W002	AB-4 middle-deep	10N04E31M002M	38.6782	-121.5943	17.51	DWR	795-805	815	1997-2020	O
22	386782N1215943W003	AB-4 middle-shallow	10N04E31M003M	38.6782	-121.5943	17.98	DWR	380-400	410	1997-2020	O
23	388072N1214842W001		11N04E13D001M	38.8072	-121.4842	49.96	DWR	Unknown	535	1948-2008	I
24	386836N1214536W001	SGA_MW02		38.68362	-121.45363	52.39	DWR	100-110	110	2007-2019	O
25	386836N1214536W002	SGA_MW03		38.68356	-121.45362	51.82	DWR	285-305	305	2007-2019	O
26	386848N1216146W001	SCWA_SGA_005	10N03E35A001M	38.6848	-121.6146	23.09	SCWA	Unknown	96	1953-2019	R
27	386864N1215222W003	AB-3 shallow	10N04E27R004M	38.6864	-121.5222	28.31	DWR	190-210	220	1996-2019	O
27	386864N1215222W001	AB-3 deep	10N04E27R002M	38.6864	-121.5222	27.84	DWR	745-995	995	1996-2020	O
27	386864N1215222W002	AB-3 middle	10N04E27R003M	38.6864	-121.5222	28.09	DWR	470-500	500	1996-2020	O
28	386964N1213120W001	Twin Creeks Park	10N06E27F001M	38.6964	-121.31203	121.8	DWR	183-193	193	2011-2019	O
29	386979N1212329W001	SCWA_SGA_012	10N07E29G001M	38.6979	-121.2329	219.57	SCWA	150-240	240	1955-2019	I
30	386982N1213992W001	SCWA_SGA_008	10N05E14Q002M	38.6982	-121.3992	88.51	SCWA	116-227	227	1955-2019	R
31	386982N1213992W002	SCWA_SGA_009	10N05E26B002M	38.6982	-121.3992	83.81	SCWA	Unknown	150	1990-2019	R
32	388361N1215959W001	MLF Well #1	11N03E01D001M	38.83664	-121.59591	24.45	Sutter County	Unknown	Unknown	1949-2017	I
33	387000N1213529W001	Monument (A)		38.70005	-121.35288	173.39	Sac Suburban WD	226-274	274	2011-2020	O
33	387000N1213529W002	Monument (B)		38.70005	-121.35288	173.26	Sac Suburban WD	324-334	334	2011-2020	O
33	387000N1213529W003	Monument (C)		38.70005	-121.35288	173.26	Sac Suburban WD	380-450	450	2011-2020	O
33	387000N1213529W004	Monument (D)		38.70005	-121.35288	173.24	Sac Suburban WD	498-544	544	2011-2020	O
34	387092N1213300W001	SCWA_SGA_010	10N06E21F002M	38.7092	-121.33	161.51	SCWA	Unknown	144	1952-2019	R
35	387117N1213327W001	Poker (A)		38.71174	-121.33271	151.74	SGA	104-124	134	1994-2020	O
35	387117N1213327W002	Poker (B)		38.71174	-121.33271	151.77	SGA	156-166	176	1994-2020	O
35	387117N1213327W003	Poker (C)		38.71174	-121.33271	151.76	SGA	274-310	320	1994-2020	O
35	387117N1213327W004	Poker (D)		38.71174	-121.33271	151.75	SGA	370-460	470	1994-2020	O
36	387138N1215047W001	SCWA_SGA_006	10N04E23A001M	38.7138	-121.5047	17.97	SCWA	Unknown	85	1953-2019	I
37	388260N1215394W004	SUT-P1	11N04E04N004M	38.826	-121.5394	32.31	DWR	110-120	120	1994-2020	O
37	388260N1215394W001	SUT-P4	11N04E04N001M	38.826	-121.5394	31.81	DWR	880-890	890	1994-2020	O
37	388260N1215394W002	SUT-P3	11N04E04N002M	38.826	-121.5394	31.95	DWR	295-305	305	1994-2020	O
37	388260N1215394W003	SUT-P2	11N04E04N003M	38.826	-121.5394	32.13	DWR	185-195	195	1994-2020	O
38	387216N1213842W001	Lone Oak Park	10N05E13F001M	38.72163	-121.38417	105.77	DWR	151-161	166	2011-2019	O
39	389116N1215238W003	AB-1 shallow	12N04E03N004M	38.9116	-121.5238	50.58	DWR	170-180	190	1996-2020	O
39	389116N1215238W001	AB-1 deep	12N04E03N001M	38.9116	-121.5238	49.83	DWR	950-970	980	1996-2020	O
39	389116N1215238W002	AB-1 middle-deep	12N04E03N002M	38.9116	-121.5238	50.23	DWR	680-700	710	1996-2020	O
39	389117N1215238W001	AB-1 middle-shallow	12N04E03N003M	38.9116	-121.5238	50.37	DWR	390-520	530	1996-2020	O
40	387228N1213298W001	Antelope North (A)		38.722803	-121.32976	133.68	Sac Suburban WD	253-273	283	2011-2020	O
40	387228N1213298W002	Antelope North (B)		38.722803	-121.32976	133.71	Sac Suburban WD	328-468	473	2011-2020	O
41	387331N1213610W001	WPMW-5A		38.733106	-121.36099	100.42	City of Roseville	80-100	100	2015-2020	O
41	387331N1213610W002	WPMW-5B		38.733106	-121.36099	100.35	City of Roseville	630-650	650	2015-2020	O
42	387510N1212390W001	WPMW-8A		38.750989	-121.23895	234.17	City of Roseville	30-50	50	2015-2019	O
42	387510N1212390W002	WPMW-8B		38.750989	-121.23895	234.09	City of Roseville	95-115	115	2015-2020	O
43	387512N1212390W001	WPMW-7A		38.751194	-121.239	225.97	City of Roseville	35-45	45	2015-2019	O
44	387515N1212725W001	WPMW-10A		38.751494	-121.27251	153.21	City of Roseville	26-36	36	2015-2019	O
44	387515N1212725W002	WPMW-10B		38.751494	-121.27251	153.18	City of Roseville	80-100	100	2015-2020	O
44	387515N1212725W003	WPMW-10C		38.751494	-121.27251	153.12	City of Roseville	240-260	260	2015-2020	O
45	387517N1212727W001	WPMW-9A		38.751667	-121.27266	154.66	City of Roseville	26-36	36	2015-2020	O
46	387623N1213915W001	SVMW West - 1A		38.762324	-121.39153	94.25	City of Roseville	120-140	145	2015-2020	O
46	387623N1213915W002	SVMW West - 1B		38.762325	-121.39153	94.17	City of Roseville	535-555	560	2011-2020	O
46	387623N1213915W003	SVMW West - 1C		38.762325	-121.39153	94.05	City of Roseville	725-745	750	2011-2020	O
47	387739N1212382W001	WPMW-6A		38.7739	-121.238183	207.61	City of Roseville	35-65	65	2015-2020	O
48	387755N1212753W001	WPMW-4A		38.775536	-121.27525	181.67	City of Roseville	120-140	145	2011-2020	O
48	387755N1212753W002	WPMW-4B		38.775535	-121.275255	181.52	City of Roseville	275-295	300	2011-2020	O
49	387786N1213737W001	WPMW-1A		38.778603	-121.3737	107.83	City of Roseville	110-120	120	2011-2020	O
49	387786N1213737W002	WPMW-1B		38.778603	-121.3737	107.31	City of Roseville	460-480	480	2011-2020	O

Appendix C
Groundwater Level Monitoring Well Construction Details

49	387786N1213737W003	WPMW-1C		38.778602	-121.3737	106.75	City of Roseville	535-545	545	2011-2020	O
50	387816N1213870W001	W-77MW-A		38.781581	-121.38702	97.2	City of Roseville	486-506	516	2012-2020	O
50	387816N1213870W002	W-77MW-B		38.781581	-121.38702	97.2	City of Roseville	584-594	604	2012-2020	O
51	387943N1213856W001	O'Brien well	11N05E23B001M	38.7943	-121.3856	90.86	City of Roseville	Unknown	195	1972-2020	R
52	387957N1213813W001	CVMW-1A		38.795655	-121.38126	87.11	City of Roseville	260-280	285	2011-2020	O
52	387957N1213813W002	CVMW-1B		38.795654	-121.38126	86.95	City of Roseville	460-490	495	2011-2020	O
52	387957N1213813W003	CVMW-1C		38.795655	-121.38126	86.84	City of Roseville	565-585	590	2011-2020	O
53	387971N1215119W001		11N04E15Q001M	38.7971	-121.5119	35.98	DWR	Unknown	Unknown	1963-2020	U
54	387977N1214521W001		11N05E18R001M	38.7977	-121.4521	64.37	DWR	Unknown	Unknown	1963-2020	I
55	387982N1214704W001		11N04E13R001M	38.7982	-121.4704	53.37	DWR	Unknown	Unknown	1963-2020	I
56	388027N1213384W001	DCMW-3		38.80271	-121.33843	99.82	City of Roseville	400-515	520	2012-2020	O
57	388058N1213355W001	DCMW-1		38.805757	-121.3355	119.94	City of Roseville	320-450	455	2014-2020	O
58	388063N1213354W001	DCMW-2		38.806291	-121.33542	120.22	City of Roseville	322-432	437	2012-2020	O
59	388116N1213054W001	Tinker MW		38.811594	-121.30539	132.2	City of Roseville	117-177	177	2013-2020	O
60	388145N1213491W001	WPMW-2A		38.814497	-121.34914	108.2	City of Roseville	215-225	230	2011-2020	O
60	388145N1213491W002	WPMW-2B		38.814497	-121.34914	108.09	City of Roseville	400-420	425	2011-2020	O
61	388235N1216079W001	Sutter County MW-5A	11N03E02Q002M	38.823235	-121.60763	26.45	Sutter County	130-160	170	2012-2020	O
61	388235N1216079W002	Sutter County MW-5B	11N03E02Q003M	38.823235	-121.60763	26.28	Sutter County	655-675	675	2012-2020	O
61	388235N1216079W003	Sutter County MW-5C	11N03E02Q004M	38.823235	-121.60763	26.22	Sutter County	910-920	930	2012-2020	O
61	388235N1216079W004	Sutter County MW-5D	11N03E02Q005M	38.8235	-121.6079	26.12	Sutter County	1205-1215	1225	2012-2020	O
62	388458N1215100W001		12N04E34H001M	38.8458	-121.51	42.83	DWR	Unknown	Unknown	2011-2020	R
63	388476N1212872W001	WPMW-3A		38.847609	-121.28719	150.95	City of Roseville	48-53	53	2012-2019	O
63	388476N1212872W002	WPMW-3B		38.847609	-121.287187	150.34	City of Roseville	130-140	140	2012-2019	O
64	388555N1215468W001		12N04E29J001M	38.8555	-121.5468	34.84	DWR	Unknown	285	2005-2020	I
65	388604N1213544W003	MW 1-3		38.860383	-121.35438	113.81	City of Lincoln	184-204	204	2012-2020	O
65	388604N1213544W001	MW 1-1		38.860383	-121.35438	113.6	City of Lincoln	378-398	398	2012-2019	O
65	388604N1213544W002	MW 1-2		38.860383	-121.35438	113.76	City of Lincoln	298-318	318	2012-2020	O
65	388604N1213544W004	MW 1-4		38.860383	-121.35438	113.61	City of Lincoln	82-92	92	2012-2020	O
66	388826N1213078W001	MW 5-1		38.882583	-121.30775	148.7	City of Lincoln	80-100	100	2012-2019	O
66	388826N1213078W002	MW 5-2		38.882583	-121.30775	148.65	City of Lincoln	52-62	62	2012-2020	O
69	388944N1215257W001		12N04E16A004M	38.8944	-121.5257	42.82	DWR	Unknown	Unknown	1963-2020	I
70	388971N1213301W001	MW 3-1		38.897133	-121.33008	130.5	City of Lincoln	118-133	133	2012-2020	O
70	388971N1213301W002	MW 3-2		38.897133	-121.33008	130.5	City of Lincoln	65-75	75	2012-2019	O
71	386280N1213493W001	WCMSS		38.62799	-121.34925	90.74	SGA	130-150	170	2017-2019	O
71	386280N1213493W002	WCMSM		38.62799	-121.34925	90.53	SGA	230-270	290	2017-2019	O
71	386280N1213493W003	WCMSD		38.62799	-121.34925	90.23	SGA	490-510	530	2017-2019	O
72	389075N1215237W001		12N04E10D002M	38.9075	-121.5237	51.32	DWR	Unknown	Unknown	2011-2020	U
73	389130N1215441W001		12N04E05R004M	38.913	-121.5441	44.32	DWR	Unknown	90	1963-2019	R
74	388029N1214145W001		11N05E16H001M	38.8029	-121.4145	90.36	DWR	135-460	460	2011-2020	I
75	389255N1213566W003	MW 2-3		38.925467	-121.35663	127.67	City of Lincoln	75-85	85	2012-2020	O
75	389255N1213566W002	MW 2-2		38.925467	-121.35663	127.67	City of Lincoln	160-170	170	2012-2019	O
75	389255N1213566W001	MW 2-1		38.925467	-121.356633		City of Lincoln	290-310	310	2012-2019	O
76	389255N1214969W001		13N04E35Q002M	38.9255	-121.4969	57.9	DWR	Unknown	Unknown	1988-2020	U
77		SREL-1-27-F1		38.774911	-121.597535		SGA	Unknown	46.32		O
78	389328N1215489W001		13N04E32G001M	38.9328	-121.5489	48.32	DWR	Unknown	Unknown	1963-2020	I
79	389410N1215254W001		13N04E28R001M	38.941	-121.5254	51.31	DWR	Unknown	Unknown	1949-2013	I
80	389740N1213606W001	Cemetery		38.974027	-121.36062	135.28	DWR	70-111	111	2015-2019	I
81	387432N1215588W001	MW 1		38.74317	-121.55875	109.71	Placer County	30-40	40	2015-2016, 20	I
81	389764N1213710W001	MW-2		38.976427	-121.371	113.69	Placer County	24.3-44.3	45	2016-2020	O
81	389774N1213728W001	MW-3		38.977408	-121.37284	103.41	Placer County	19.5-34.5	35	2016-2020	O
82	387222N1212920W001	Whyte A		38.722168	-121.29196	167.31	SGA	200-220	226	2016-2019	O
82	387222N1212920W002	Whyte B		38.722168	-121.29196	167.35	SGA	280-300	306	2016-2019	O
83	387874N1215764W001	Spangler		38.7874	-121.5764	27	DWR	150-170	252	2014-2016, 20	I
84	389867N1213654W002	Spencer (SVWQC00008)		38.986724	-121.36542		Placer County	96-107	107	2016-2020	R
85	389873N1214156W001	13N05E09R001M	13N05E09R001M	38.9873	-121.4156	86	DWR	Unknown	150	1949-2020	I
86	389128N1214522W001		12N05E06R001M	38.9128	-121.4522	71.3	DWR	Unknown	Unknown		I
87	388710N1214870W001		12N04E24M002M	38.871	-121.487	54.32	DWR	Unknown	340	1952-2017	I
88	388357N1216273W001		11N03E03C002M	38.8357	-121.6273	28.79	DWR	Unknown	97	1948-2007	I
89		Roseview Park - 315		38.719118	-121.328786	156.84	SGA	295-305	315	2014-2019	O
89		Roseview Park - 370		38.719118	-121.328786		SGA	350-360	370	2014-2019	O
89		Roseview Park - 465		38.719118	-121.328786	156.76	SGA	445-455	465	2014-2019	O
90	388026N1214432W002	WPMW-12A		38.802639	-121.443216	69.62	City of Roseville	260-280	300	2019-2020	O
90	388026N1214432W004	WPMW-12B		38.802639	-121.443216	69.57	City of Roseville	508-528	550	2019-2020	O
91	388882N1214005W002	WPMW-11A		38.888164	-121.400463	92.07	Placer County	132-152	162	2019-2020	O
91	388882N1214005W004	WPMW-11B		38.888164	-121.400463	91.7	Placer County	264-304	309	2019-2020	O
92		RDMW-101		38.882937	-121.611051		Sutter County	28-43	48		O
93		RDMW-102		38.879869	-121.588533		Sutter County	28-43	48		O
94	389950N1214148W002	RDMW-103		38.99461	-121.414794		Placer County	28-43	48	2019-2020	O
95	389919N1214141W002	RDMW-104		38.99195	-121.413502		Placer County	28-43	48	2019-2020	O
96		1516		38.634871	-121.231917	88.38	Aerojet	13-33	40	2018-2019	O
97		1518		38.635131	-121.232312	130.71	Aerojet	55-75	80	2018-2019	O
98		URS71000-700+00C		38.639704	-121.562435	41.7	SGA	Unknown	45.24		O
99		URS71000-700+00F		38.639539	-121.561543	24.2	SGA	Unknown	45.14		O
100		13N04E13R001M	13N04E13R001M	38.97	-121.4697	71.57	DWR	Unknown	Unknown		I
101		13N04E16N001M	13N04E16N001M	38.9692	-121.5408		DWR	Unknown	500	1948-2020	I
102	389704N1214340W001	13N05E17R001M	13N05E17R001M	38.9704	-121.434		DWR	Unknown	480	1948-2020	I
103	389857N1214880W001	BR-1B	13N04E11R002M	38.9857	-121.488		DWR	78-98	98	2003-2020	O
103	389857N1214880W004	BR-1A	13N04E11R005M	38.9857	-121.488		DWR	28-48	48	2003-2020	O
103	389857N1214880W002	BR-1C	13N04E11R003M	38.9857	-121.488		DWR	215-245	245	2003-2020	O
103	389857N1214880W003	BR-1D	13N04E11R004M	38.9857	-121.488		DWR	320-331	331	2003-2020	O
104	387000N1212180W001	SGA_MW08		38.69998	-121.21795	218.06	DWR	130-140	140	2007-2019	O
105	388893N1212847W001	MW 4		38.889283	-121.28468	183.87	City of Lincoln	15-25	25	2012-2019	O
106	386814N1213809W001	MW-15	09N06E06A001M	38.68144	-121.38093		Sac Suburban WD	205-481	486	2011-2019	O
107	386697N1213106W001	MW-N28	09N06E03C001M	38.669665	-121.310578		Sac Suburban WD	170-452	454	2011-2019	O
108	389185N1213268W001	Swainson		38.918461	-121.32684	140.65	Placer County	44.1-91.9	92	2015-2019	I
109	387218N1214677W001	SGA_MW01		38.72178	-121.46771	47.59	DWR	100-110	110	2007-2019	O
110		Dpool A		38.7403376	-121.2946181		SGA	190-210	245		O
111		Dpool B		38.7403376	-121.2946181		SGA	310-330	336		O
112	389327N1214594W001		13N05E31K001M	38.9327	-121.4594	70.29	DWR	Unknown	393	1963-2020	U
113	389539N1215186W001		13N04E27C003M	38.9539	-121.5186	54.47	DWR	Unknown	Unknown	2008-2020	I
114	388473N1214905W001	12N04E35H001M	12N04E35H001M	38.8473	-121.4905	50.73	DWR	Unknown	Unknown	2012-2020	U

Appendix C
Groundwater Level Monitoring Well Construction Details

115	389674N1214063W001		13N05E22C003M	38.9674	-121.4063		DWR	Unknown	400	1961-2020	I
116	389791N1213727W001	Old Well #2	13N05E13D003M	38.979133	-121.37269	107	Placer County	144-209	209	2016-2020	O
117	388755N1213144W001	SLC-1	Not Available	38.875475	-121.3144	145	City of Lincoln	142-249	249	2012-2020	O
118	388637N1213222W001	SLC-2	Not Available	38.863733	-121.32218	126.47	City of Lincoln	144-293	293	2012-2020	O
119	388677N1213397W001	SLC-3	Not Available	38.867683	-121.33973	117.98	City of Lincoln	132-311	311	2012-2020	O
120	387141N1212431W001	SCWA_SGA_011	10N07E20D001M	38.714688	-121.2431	207.57	SCWA	Unknown	185	2011-2019	R
121	387139N1215459W001	10N04E21B002M	10N04E21B002M	38.7139	-121.5459	18.97	DWR	Unknown	Unknown	1990-2019	I
122	387137N1214906W001	SCWA_SGA_007	10N04E24B001M	38.7137	-121.4906	30.17	DWR	Unknown	Unknown	1990-2019	I
123	386904N1214757W001	10N05E30L001M	10N05E30L001M	38.6904	-121.4757	38.99	DWR	Unknown	Unknown	1990-2012	R
124	388531N1214244W001		12N05E33C001M	38.8531	-121.4244	69.33	DWR	Unknown	610	1961-2020	I
125	389292N1214056W001	35633	13N05E34P001M	38.9292	-121.4056	89.3	DWR	Unknown	Unknown	1961-2020	I

Appendix D: Geologic Section Well Logs

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX D
Geologic Section Well Logs

December 2021

Geologic Section A-A’

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

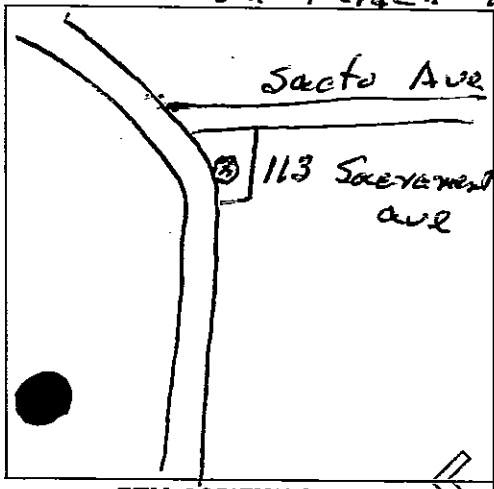
Do not fill in
No. 244954

[redacted] Intent No.
Local Permit No. or Date

State Well No.
Other Well No. 12N03E02F

(2) LOCATION OF WELL (See instructions):

County Sutter Owner's Well Number
Well address if different from above
Township Range Section
Distance from cities, roads, railroads, fences, etc.
18 mi South of Yuba City
On Garden Hyw



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic [X]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [ ]
Other [ ]

(5) EQUIPMENT:

Rotary [ ] Reverse [ ]
Cable [X] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:

Yes [ ] No [X] Size
Diameter of bore
Packed from ft. to ft.

(7) CASING INSTALLED:

Steel [ ] Plastic [ ] Concrete [ ]

From ft.	To ft.	Dia. in.	Gage or Wall
0	44	8"	10

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:

Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 38' ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval 0-44 ft.
Method of sealing Caesing Landed in Clay

(10) WATER LEVELS:

Depth of first water, if known ft.
Standing level after well completion ft.

(11) WELL TESTS:

Was well test made? Yes [ ] No [ ] If yes, by whom?
Type of test Pump [ ] Bailer [ ] Air lift [ ]
Depth to water at start of test ft. At end of test ft
D[redacted]ge gal/min after hours Water temperature
C[redacted]al analysis made? Yes [ ] No [ ] If yes, by whom?
Was electric log made? Yes [ ] No [ ] If yes, attach copy to this report

(12) WELL LOG:

Total depth ft. Depth of completed well ft.

from ft. to ft. Formation (Describe by color, character, size or material)

0 - 4 - Soil
4 - 12 - Hard Pan
12 - 42 - Soft Sandy Clay
42 - 60 - Bl Clay
60 - 72 - Sandy Bl Clay
72 - 80 - Bl Clay Sand & gravel in Bottom

Work started 3/8 19 85 Completed 3/12 19 85

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

SIGNED "Ed" Herr Inc (Well Driller)
NAME Henry E. Herr (Person, firm, or corporation) (Typed or printed)
Address 2410 Tuscan Rd
City Yuba City Zip 95991
License No. 431172 Date of this report 3/13/85

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

NOT FOR PUBLIC USE
WATER CODE SEC. 13752

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

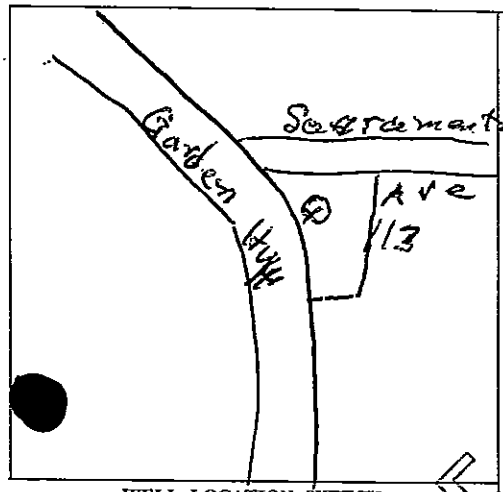
Do not fill in
No. 244968

[redacted] of Intent No.
Local Permit No. or Date

State Well No.
Other Well No. 12N03E02

(1) OWNER:
Address
City

(2) LOCATION OF WELL (See instructions):
County Sutter Owner's Well Number
Well address if different from above
Township Range Section
Distance from cities, roads, railroads, fences, etc.
18 mi. south of Yuba City on Garden Hiway



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [X]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [ ]
Other [ ]

(5) EQUIPMENT:
Rotary [ ] Reverse [ ]
Cable [X] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [ ] No [X] Size
Diameter of bore
Packed from to ft.

(7) CASING INSTALLED:
Steel [ ] Plastic [ ] Concrete [ ]

From ft.	To ft.	Dia. in.	Gage or Wall
0	54	8"	10

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 50 ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval 0'-54 ft.
Method of sealing Casing landed in clay

(10) WATER LEVELS:
Depth of first water, if known ft.
Standing level after well completion ft.

(11) WELL TESTS:
Was well test made? Yes [ ] No [ ] If yes, by whom?
Type of test Pump [ ] Bailer [ ] Air lift [ ]
Depth to water at start of test ft. At end of test ft
[redacted] charge gal/min after hours Water temperature
[redacted]cal analysis made? Yes [ ] No [ ] If yes, by whom?
Was electric log made? Yes [ ] No [ ] If yes, attach copy to this report

(12) WELL LOG: Total depth ft. Depth of completed well ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	4	Soil
4	12	Hardpan
12	42	Soft, sandy clay
42	60	Blue clay
60	72	Sandy, blue clay
72	80	Blue cemented sand, gravel in bottom

Work started 3/8 19 85 Completed 3/12 19 85

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
SIGNED Henry T. Herr (Well Driller)
NAME Henry T. Herr, Well-Drilling, Inc (Person, firm, or corporation) (Typed or printed)
Address 2410 Tuscan Rd.
City Yuba City Zip 95991
License No. 431172 Date of this report 5/15/85

NOT FOR PUBLIC USE
WATER CODE SEC. 13752

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

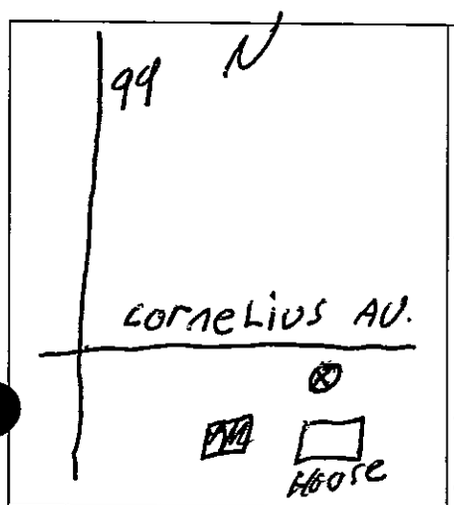
WATER WELL DRILLERS REPORT

Do not fill in
No. 340815

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. _____
Other Well No. 12N04E04B3

(2) LOCATION OF WELL (See instructions):
County Sutter Owner's Well Number _____
Well address if different from above _____
Township 13 Range 4E Section 4
Distance from cities, roads, railroads, fences, etc. _____



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☑ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☒

(5) EQUIPMENT:
Rotary ☐ Reverse ☐
Cable ☑ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☑ Size
Diameter of bore _____
Packed from _____ to _____ ft.

(7) CASING INSTALLED:
Steel ☑ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
0	84	6	10

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☑ No ☐ If yes, to depth 20 ft.
Were strata sealed against pollution? Yes ☑ No ☐ Interval 20 ft.
Method of sealing _____

(10) WATER LEVELS:
Depth of first water, if known _____ ft.
Standing level after well completion 30 ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☑ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? _____
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 194 ft. Completed depth 194 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	1	Top
1	17	Brown clay
17	19	Shell
19	34	Brown clay
34	36	Shell
36	41	Brown clay
41	45	Soft Brown clay
45	48	Sand
48	54	Brown clay
54	58	Sandy Brown clay
58	71	Brown clay
71	79	Sand
79	84	Brown clay
84	86	Shell
86	89	Brown clay
89	93	Shell
93	106	Hard Brown clay
106	109	Sandy Brown clay
109	115	Shell
115	128	Brown clay
128	130	Shell
130	136	Soft Brown clay
136	144	Brown clay
144	156	Soft Sandy Brown clay
156	158	Shell
158	162	Brown clay
162	164	Shell
164	168	Brown clay
168	172	Shell
172	176	Hard Brown clay
176	181	Sandy Brown clay
181	182	Shell
182	190	Sandy Brown clay
190	194	Shell

Work started 6/26 19 90 Completed 7/6 19 90

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief
Signed _____ (Well Driller)
NAME Superior Drilling Co. (Person, firm, or corporation) (Typed or printed)
Address 1146 Grand Ave
City Marysville CA ZIP 95901
License No. 466272 Date of this report 7-6-90

COPY NOT FOR PUBLIC WATER USE VOID

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 86 96355

? 1/0BA

MD-13N/3E-36E1

REGION

COUNTY Sutter

NEAR

DIVISION OF WATER RESOURCES

DEPARTMENT OF PUBLIC WORKS

STATE OF CALIFORNIA

WELL LOG

51-746

BASIN

DWR No. 16 B & M

OTHER Nos. #133 36 S 1

7-27B

119

LOCATION

OWNER

DRILLED BY Crandall and Herr ADDRESS

DRILLING METHOD GRAVEL PACKED DATE COMPLETED Nov. 1926

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION Driller

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICK-NESS	SP. YIELD %
8		Soil		
30		Clay, yellow		
31		Gravel and clay		
42		Dead gravel		
129		Variations of blue clay		
132		Sand and gravel		

Plotted and Coded

As Well 13N/3E-36E1

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE SHEET 1 OF

FORM 263. 47965 7-51 5M ② SPO

2/10BA

MD-13N/3E-36F1

REGION

COUNTY Sutter

NEAR

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

WELL LOG

BASIN 16

DWR No. 133 36 F 1 B & M

OTHER NOS.

51-458 180

LOCATION

OWNER ADDRESS

DRILLED BY Crandall and Herr ADDRESS

DRILLING METHOD GRAVEL PACKED DATE COMPLETED Feb. 1935

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION Driller

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICK-NESS	SP. YIELD %
2		Silt		
4		Sand		
22		Silt soil		
35		Brown clay		
39		Brown san (Perforated)		
44		Clay		
60		Sandy clay		
67		Sand		
		Water table 17'		

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE SHEET 1 OF

FORM 263. 47625 7-51 5M ② SPO

MD 13N/4E-31J1

REGION

COUNTY Sutter

NEAR

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

51-789

WELL LOG

BASIN

DWR No. 13N 31J1 ; B & M

R Nos. 16-33

167

LOCATION

OWNER

DRILLED BY Crandall and Herr ADDRESS

DRILLING METHOD GRAVEL PACKED DATE COMPLETED 3/39

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE 14" No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION Log book

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICK-NESS	SP. YIELD %
3		Soil		
13		Clay, brown		
15		Sand, brown		
36		Clay, brown		
40		Gravel		
50		Gravel, cemented		
68		Clay, brown		
74		Clay, brown, soft		
98		Clay, brown		
108		Sand, brown, cemented		
114		Clay, brown		
116		Sand, cemented		
120		Gravel and sand, caving at 105		

Noted and Coded As Well 13N/4E-31J1

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE SHEET 1 OF

FORM 263. 47865 7-51 5M ② SPO

13N/4E-31K1

ORIGINAL
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No. 5
(Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

751

LOCATION ~~NOT~~ CHECKED
Do Not Fill In
No. 54781
State Well No. 13N/4-31K1
Other Well No. ~~12N/4E-6~~

(1) OWNER:

Name
Address 6

(2) LOCATION OF WELL:

County Sutter Owner's number, if any—
R. F. D. or Street No. One Mile North of the East Nicolaus highway. ¼ Mile East of the Feather River

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:

SINGLE ☒ DOUBLE ☐

From ft.	to ft.	Diam.	Gage or Wall
1	45	14"	10 RD

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring 3/4x6
Size of gravel:
Describe joint ~~3/4x6~~ Butt Weld

(7) PERFORATIONS:

Type of perforator used None
Size of perforations in., length, by in.

From ft.	to ft.	Perf. per row	Rows per ft.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☐ Yes ☒ No To what depth ft.
Were any strata sealed against pollution? ☐ Yes ☐ No If yes, note depth of strata
From ft. to ft.
Method of Sealing

(9) WATER LEVELS:

Depth at which water was first found 16 ft.
Standing level before perforating ft.
Standing level after perforating ft.

(10) WELL TESTS:

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Star Well
Yield: 2300 gal./min. with 55 ft. draw down after 8 hrs.
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No
Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:

Total depth 82 ft. Depth of completed well 82 ft.
Formation: Describe by color, character, size of material, and structure.

ft.	to ft.	
0	16	Top Soil
16	43	Sand
43	53	Clay
53	70	Brown Silt Packed
70	82	Gravel & Sand

1 MI NO. OF E NICOLAUS ON EL CENTRO RD, W ON CORNELIUS AVE 1 MI TO WHITE GATE AT 90° TURN IN RD. 5 MI ALONG DIRT RD TO SMALL POND ADJACENT TO LEVEE, WELL IS WEST OF RD & NEXT TO POND

CONFIDENTIAL
Section 7076.1, Water Code

FOR OFFICIAL USE ONLY

Work started 1-25-60 19 . Completed 1-28 1960

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Star Well Drilling & Pump Co.
(Person, firm, or corporation) (Typed or printed)
Address Live Oak Highway
Yuba City, California
[SIGNED] [signature] Well Driller
License No. 121868 Dated 2-2, 1960

57025 6-57 50M QUIN △ SPO

DWR 188 (REV. 3-54)

N.B. location of this well may not agree with Hyde Forbes or Kirk Bryan. This location was obtained from Natomas Co. records and is believed to be correct.

Sheet 1

REGION

COUNTY Sutter

NEAR

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

51-791

WELL LOG

BASIN MD 13N/4E-32H1

DWR No. 13N 32H1 : B & M

WELL Nos. 16-35

165

LOCATION Lot 29, Subdivision 1, Bear River Garden, Subarea, Nicolas Quad
Rio Oso, California

OWNER

DRILLED BY Linscott Drilling Co. ADDRESS
Log 43

DRILLING METHOD GRAVEL PACKED DATE COMPLETED Aug. 6-Sept. 30, 1913

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION DWR - Hyde Forbes

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICK-NESS	SP. YIELD %
10		Top soil	10	
18		Hard pan	8	
30		Soft clay	12	
35		Fine gravel	5	
69		Clay	34	
73		Loose sand	4	
95		Clay	23	
120		Clay and fine gravel	25	
140		Yellow clay	20	
155		White clay	15	
170		Yellow clay	15	
207		All clay with small gravel	37	
210		Sand, gravel, and clay	3	
218		White clay	8	
272		Blue shale	54	
300		Shale and lava	28	
307		Shale	7	
315		Lava	8	
320		Shale	5	
330		Lava	10	
348		Lava sand	18	
395		Blue shale	47	
397		Gravel	2	
405		Shale	8	
430		Lava	25	
435		Shale	5	
450		Lava	15	
463		Blue shale	13	

Plotted and Coded As Well 13N 4E 32H1

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE SHEET 1 OF 2

FORM 263. 47695 7-51 5M ⓢ SPO

FORM 115-A
INVESTIGATION

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

51-791

SHEET 2

NUMBER 134 32H1

WELL LOG

LOCAL DESIGNATION 16-35

DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL	THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
475		Lava	12			
485		Blue shale, sloughing	10			
505		Lava	20			
510		Blue shale	5			
570		Lava	60			
580		Shale	10			
685		Lava	105			
690		Blue shale	5			
710		Lava	20			
735		Blue shale	25			
740		Lava ash	5			
768		Lava	28			
785		Loose lava	17			
795		Hard lava	10			
806		Loose lava	11			
		Casing - 11-5/8" casing 378 ft. deep				
		9-5/8" casing 806 ft. deep				
		Perforations:				
		Double slots from 500' up to 380'				
		600' up to 500'				
		800' up to 600'				
		Some casing pulled out.				
		Test with air line about 200 gals. per minute.				
		Water level 6 ft.				

FOR FIELD COPIES USE ALTERNATE LINES

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES

51-467

SHEET 1

SOUTH

Do Not Fill In
State Well No. 13N/4E-32N1
Other Well No.
Region

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

120

(1) **Driller:**
Name Frank P. Conley
Address 432 - Feather River Blvd
Marysville, Calif
License No. 105346 Classification C 57

Owner:
Name
Address

(2) **Proposed use or uses** *(check)*:
Domestic ☒ Municipal ☐
Irrigation ☐ Industrial ☐
Domestic and Irrigation ☐ Test well ☐
Other

(3) **Equipment used** *(check)*:
Rotary ☐
Cable ☒
Dug well ☐
Other

(4) **Type of work** *(check)*:
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(5) **Well log:**
Total depth of well 84 ft.

Depth From Ground Surface

Give details of formations penetrated, such as silt, peat, muck, sand, gravel, clay, shale, sandstone, hardpan, rock. Include size of gravel (diameter) and sand (fine, medium, coarse), color of material, structure (loose, packed, cemented, soft, hard, brittle).

	ft. to	4	ft.	top soil
4	" "	5	"	hard pan
5	" "	18	"	brown clay
18	" "	22	"	soft brown clay
22	" "	46	"	brown clay
46	" "	50	"	gray sand
50	" "	75	"	tough brown clay
75	" "	84	"	fine brown sand

Plotted and Coded As Well 13N/4E-32N1

FOR OFFICIAL USE ONLY

If additional space is required, continue on DWR Form No. 246—Supplement, and attach to respective report copies.

(6) **Casing left in well:**

LENGTH FT.	DIAMETER INCHES	SINGLE, DOUBLE, WELDED, OTHER	LBS. PER FOOT OR GAGE OF CASING	SEATING BELOW GROUND SURFACE, FT.
53	8"	welded	129	5-2½

Type and size of shoe or well ring 3 X 3/8 Welded joints ☒ Yes ☐ No

ORIGINAL
File Original, Duplicate and Triplicate with the
[redacted] OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

SHEET 2

5446

Do Not Fill In
State Well No. 13N/4E-32N1
Other Well No.
Region

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

(7) Perforations:

Type of perforator used

Perforated	ft. to	ft.	Hole size	No. of holes
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "
"	" "	"	" " "	" " "

(8) Water levels:

Depth at which water first encountered 18 ft.
Depth to water before perforating ft.
Depth to water after perforating ft.
Note any change in water level while drilling

(9) Well pumping test:

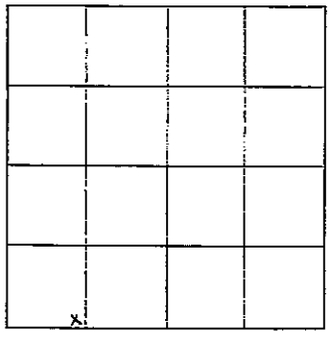
Date of test By whom
Depth to water when test started ft.
G.P.M. at beginning of test
Drawdown from standing level ft.
G.P.M. at completion of test
Drawdown at completion of test ft.
Length of time tested
Temperature of water
Was gas present in water? ☐ Yes ☐ No

(10) General:

Was well gravel packed? Yes Size of rock Thickness of pack
Was a surface sanitary seal provided? No
Were any strata sealed against pollution? ☒ Yes ☐ No If yes, attach detailed description.
Strata sealed 52½ ft. sealed casing driven into sandy clay
Was analysis made of water? ☐ Yes ☒ No If yes, attach copy.
Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
If well abandoned, was it plugged and sealed? FOR OFFICIAL USE ONLY
Method of plugging and sealing

(11) Location:

North



1 MILE

(N)

Section No. 32
Township 13 - North
Range 4 - East
Base & Meridian Mt. D
Show location of well in Section, thus (X)
Distances to section lines from well, N or S 75 ft. and E or W 4200 ft.
Show location of nearest known well, thus (O)
Distance to nearest known well ft.

(12) Time of work:

Work started date Aug 8 Completed date Aug 9
Date of this report Oct. 6, 1951

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Frank P. Conley
Well Driller
By Bernice Freeborn
License No. 105346 Classification C 57
Dated Oct. 6, 19 51

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY 23972 3-50 40M QUIN SPO

13N/4E-33J1 — WELL NOT CHECKED

ORIGINAL
File Original, Duplicate and Triplicate with the REGIONAL WATER POLLUTION CONTROL BOARD No. 5 (Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA 1105

Do Not Fill In
No. 73352
State Well No. 13N/4E-33J1
Other Well No.

(1) OWNER:

(2) LOCATION OF WELL:

County SUTTER Owner's number, if any— NONE

R. F. D. or Street No. 1 MILE NORTH OF NICALOUS ~~CORNER~~ AVE. ON PACIFIC AVE. HOUSE LOCATED 50 FT WEST OF PACIFIC AVE. - WELL LOCATED 30 FT. NORTH WEST OF GARAGE. (TROWBRIDGE AREA)

(3) TYPE OF WORK (check):

New well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [ ]
Cable [X]
Dug Well [ ]

(6) CASING INSTALLED:

SINGLE [X] DOUBLE [ ]

From 0 ft. to 100 ft. Diam. 12 Gage or Wall

Type and size of shoe or well ring 8 X 1/2 X 4

Describe joint BUTT WELDED

If gravel packed

Diameter of Bore	from ft.	to ft.
NONE		

Size of gravel:

(7) PERFORATIONS:

Type of perforator used NONE

Size of perforations — in., length, by — in.

From — ft. to — ft. — Perf. per row — Rows per ft.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? [X] Yes [ ] No To what depth 2 FT. ft.

Were any strata sealed against pollution? [X] Yes [ ] No If yes, note depth of strata

From 0 ft. to 100 ft.

Method of Sealing CASING DRIVEN IN CLAY

(9) WATER LEVELS:

Depth at which water was first found 65 FT. ft.

Standing level before perforating NO PERFORATING ft.

Standing level after perforating — — ft.

(10) WELL TESTS:

Was a pump test made? [ ] Yes [X] No If yes, by whom? —

Yield: — gal./min. with — ft. draw down after — hrs.

Temperature of water — Was a chemical analysis made? [ ] Yes [X] No

Was electric log made of well? [ ] Yes [X] No

(11) WELL LOG:

Total depth 155 ft. Depth of completed well 154 ft.

Formation: *Describe by color, character, size of material, and structure.*

ft. to	ft.	
0	3	TOP SOIL
3	30	RED CLAY
30	32	FINE BROWN SAND
32	80	SOFT BROWN CLAY
80	96	FINE BROWN SAND
96	145	HEPUY BROWN CLAY
145	155	BLUE CLAY & FINE SAND (BLUE)

FOR OFFICIAL USE ONLY

Work started MAY 13 1962 Completed MAY 14 1962

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME SUTTER PUMP WORKS
(Person, firm, or corporation) (Typed or printed)

Address 909 S WALTON

YUBA CITY CALIF.

[SIGNED] Earl L Lamb
Well Driller

License No. 154299 Dated JUNE 18, 1962

57025 6-57 50M QUIN △ SFO

DWR 188 (REV. 3-54)

ORIGINAL

File with DWR

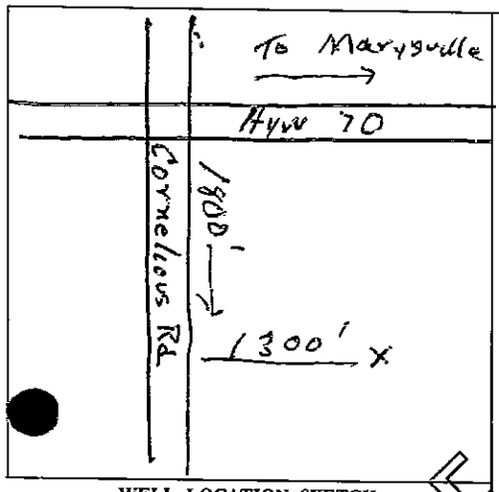
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do not fill in
No. 111753

Notice of Intent No.
Permit No. or Date
State Well No.
Other Well No 13N/4E-33P

(2) LOCATION OF WELL (See instructions):

County Sutter Owner's Well Number
Well address if different from above East Nicholas
Township Range Section
Distance from cities, roads, railroads, fences, etc. 1300' No of Cornelius Rd 1800' East of Hwy 70



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☐
Irrigation ☒
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other ☐

(5) EQUIPMENT:

Rotary ☐ Reverse ☐
Cable ☒ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☐ No ☐ Size
Diameter of bore
Packed from to ft.

(7) CASING INSTALLED:

Steel ☒ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
0	152	14	10

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 - 152' ft.
Method of sealing Casing Landed in Clay

(10) WATER LEVELS:

Depth of first water, if known 60 ft.
Standing level after well completion ft.

(11) WELL TESTS:

Was well test made? Yes ☐ No ☒ If yes, by whom?
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test ft. At end of test ft
Discharge gal/min after hours Water temperature
Chemical analysis made? Yes ☐ No ☐ If yes, by whom?
Was electric log made? Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG:

Total depth 336 ft. Depth of completed well 336 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	3	Soil
3	87	Br Clay
87	98	Fine Gravel
98	140	Br Clay
140	150	Cem Sand Gravel 2"
150	205	Br Clay
205	210	Cem Gravel Fine
210	260	Blue Clay
260	268	Cem Bl Sand
268	310	Blue Clay
310	336	Blue Cem Sand Gravel

Work started 9/5/ 1978 Completed 9/12 1978

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED Henry J. Herr (Well Driller)
NAME H T Henry (Person, firm, or corporation) (Typed or printed)
Address 2410 Tuscan Rd
City Yuba City Zip 95991
License No. 209184 Date of this report 9/20/78

DO NOT FILL IN
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES

SHEET 1
51-793

Do Not Fill In
State Well No. 13N-4E-33Q1
Other Well No. 27-27A
Region 5

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

17

(1) Driller:
Name William Flynn
Address Box 157 Sutter, Calif.
So. Butte Rd at York
License No. 97194 Classification SC 57

Owner:
Name
Address

(2) Proposed use or uses *(check)*:
Domestic ☐ Municipal ☐
Irrigation ☒ Industrial ☐
Domestic and Irrigation ☐ Test well ☐
Other

(3) Equipment used *(check)*:
Rotary ☐
Cable ☒
Dug well ☐
Other

(4) Type of work *(check)*:
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(5) Well log:
Total depth of well 300 ft.

Give details of formations penetrated, such as silt, peat, muck, sand, gravel, clay, shale, sandstone, hardpan, rock. Include size of gravel (diameter) and sand (fine, medium, coarse), color of material, structure (loose, packed, cemented, soft, hard, brittle).

Depth From Ground Surface				
0	ft. to	4	ft.	Top Soil
4	" "	27	"	Yellow Clay
27	" "	31	"	Sand and Decomposed Granite
31	" "	50	"	Yellow Clay and Decomposed Granite
50	" "	65	"	Sandy Yellow Clay
65	" "	120	"	Yellow Clay
120	" "	134	"	Sandy Yellow Clay
134	" "	161	"	Yellow Clay
161	" "	174	"	Hard Sand
174	" "	240	"	Yellow Clay
240	" "	280	"	Blue Clay
280	" "	290	"	Brown Lava Sand
290	" "	300	"	Blue Clay

Plotted and Coded
As Well 13N 1 4E 33G1

FOR OFFICIAL USE ONLY

If additional space is required, continue on DWR Form No. 246—Supplement, and attach to respective report copies.

(6) Casing left in well:

LENGTH FT.	DIAMETER INCHES	SINGLE, DOUBLE, WELDED, OTHER	LBS. PER FOOT OR GAGE OF CASING	SEATING BELOW GROUND SURFACE, FT.
70	14	3/16 welded	Steel	70

Type and size of shoe or well ring 14" X 5/8" X 4" Welded joints—☒ Yes ☐ No

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

SHEET 2

27-27A 51-793

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

Do Not Fill In
State Well No. 13N-4E-33Q1
Other Well No. 27-27A
Region 5

(7) Perforations:

Type of perforator used None

Perforated ____ ft. to ____ ft. Hole size ____ No. of holes ____

" " " " " " " " " " " "

(8) Water levels:

Depth at which water first encountered 40 ft.
Depth to water before perforating ____ ft.
Depth to water after perforating ____ ft.
Note any change in water level while drilling ____

(9) Well pumping test:

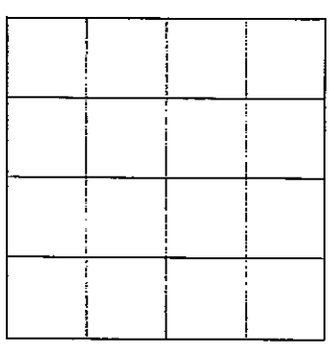
Date of test ____ By whom ____
Depth to water when test started ____ ft.
G.P.M. at beginning of test ____
Drawdown from standing level NO ft.
G.P.M. at completion of test ____
Drawdown at completion of test ____ ft.
Length of time tested ____
Temperature of water ____
Was gas present in water? ☐ Yes ☒ No

(10) General:

Was well gravel packed? no Size of rock ____ Thickness of pack ____
Was a surface sanitary seal provided? ____
Were any strata sealed against pollution? ☐ Yes ☐ No If yes, attach detailed description.
Strata sealed ____
Was analysis made of water? ☐ Yes ☐ No If yes, attach copy.
Was electric log made of well? NO ☐ Yes ☐ No If yes, attach copy.
If well abandoned, was it plugged and sealed? ____ FOR OFFICIAL USE ONLY
Method of plugging and sealing ____

(11) Location:

North



1 MILE

Section No. 33
Township Nicolas
Range Sutter County
Base & Meridian ____
Show location of well in Section, thus (X)
Distances to section lines from well, N or S 500 N ft. and E or W ____ ft.
Show location of nearest known well, thus (O)
Distance to nearest known well 500 ft.

1-Mile North & 1 Mile East of East Nicolas, 500 ft North of Road

(12) Time of work:

Work started date June 5 Completed date June 8 51
Date of this report June 25 51

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Wm G Lynn
Well Driller

By ____

License No. 97194 Classification 3057

Dated June 25, 1951

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY 23972 3-50 40M QUIN SPO

ORIGINAL
File with DWR

WATER WELL DRILLERS REPORT

(Sections 7079, 7080, 7081, 7082, Water Code)

THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

CONFIDENTIAL LOG
Water Code Sec. 13752

Do Not Fill In

Nº 16850

State Well No. 13N/4E-34M
Other Well No. 13N/4E-34

(2) LOCATION OF WELL:
County Sutter Owner's number, if any
Township, Range, and Section
Distance from cities, roads, railroads, etc.

(3) TYPE OF WORK *(check)*:
New Well ☑ Deepening ☐ Reconditioning ☐ Destroying ☐
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE *(check)*:
Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) EQUIPMENT:
Rotary ☐
Cable ☑
Other ☐

(6) CASING INSTALLED:
STEEL: OTHER:
SINGLE ☑ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	If gravel packed From ft.	To ft.
0	80	8"	12ga.			

Size of shoe or well ring: 1/2 x 4 x 8"
Size of gravel:
Describe joints: B/W

(7) PERFORATIONS OR SCREEN:
Type of perforation or name of screen

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.

(8) CONSTRUCTION:
Was a surface sanitary seal provided? Yes ☑ No ☐ To what depth ft.
Were any strata sealed against pollution? Yes ☐ No ☐ If yes, note depth of strata
From 6 ft. to ft.
From ft. to ft.
Method of sealing

(9) WATER LEVELS:
Depth at which water was first found, if known 35 ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing 35 ft.

(10) WELL TESTS:
Was pump test made? Yes ☐ No ☑ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Temperature of water Was a chemical analysis made? Yes ☐ No ☑
Was electric log made of well? Yes ☐ No ☑ If yes, attach copy

(11) WELL LOG:
Total depth 130 ft. Depth of completed well 130 ft.
Formation: *Describe by color, character, size of material, and structure*

ft.	to ft.	
0	2	top soil
2	25	Soft Clay
25	35	Dry Sand
35	60	soft Yellow Clay
60	78	sand & Gravel
78	125	Yellow Clay
125	130	Sand.

This Well is approx 2 miles South of Rio Ceo Rd on Pacific Ave. Approx 1/4 mi. East out in Pasture.

Plotted and Coded
As Well 13N/4E-34M SC

Work started 4/5 1971, Completed 4/6 1971

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Beaman & Son Pump Co.
(Person, firm, or corporation) (Typed or printed)
Address 470 N. Geo. Wash. Blvd
Yuba City Calif.
[SIGNED] J. N. Beaman
(Well Driller)
License No. 196093 Dated 4/13, 1971

SKETCH LOCATION OF WELL ON REVERSE SIDE

CONFIDENTIAL LOG
Water Code Sec. 13752

DWR 188 (REV. 9-65)

56391-950 10-65 50M TRIP ① △ OSP

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P.O. BOX 1079
SACRAMENTO 5, CALIFORNIA

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

51-469

CATION NOT CHECKED

DIVISION OF WATER RESOURCES

Do Not Fill In
State Well No.
Other Well No. 13N-4E-35H
Region 5

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

CONFIDENTIAL
Section 7076.1, Water Code

206

(1) **Driller:**
Name Chas E. Cranda
Address [illegible]
License No. 123196 Classification C57

(2) **Proposed use or uses** *(check)*:
Domestic ☐ Municipal ☐
Irrigation ☑ Industrial ☐
Domestic and Irrigation ☐ Test well ☐
Other

(3) **Equipment used** *(check)*:
Rotary ☐
Cable ☑
Dug well ☐
Other

Owr
Nam
Addr

(4) **Type of work** *(check)*:
New well ☐ Reconditioning of well ☑
Deepening existing well ☐

(5) **Well log:**
Total depth of well 544 ft.

Give details of formations penetrated, such as silt, peat, muck, sand, gravel, clay, shale, sandstone, hardpan, rock. Include size of gravel (diameter) and sand (fine, medium, coarse), color of material, structure (loose, packed, cemented, soft, hard, brittle).

Depth From Ground Surface ft.	to ft.	
0	372	Unknown
372	382	Gray Sand (med)
382	510	Ream & clean out - Clay Mud
510	544	Black Sand Cemented (Coarse)

Plotted and Coded
As Well 13N 14E - 35H80

FOR OFFICIAL USE ONLY

If additional space is required, continue on DWR Form No. 246—Supplement, and attach to respective report copies.

(6) **Casing left in well:**

LENGTH FT.	DIAMETER INCHES	SINGLE, DOUBLE, WELDED, OTHER	LBS. PER FOOT OR GAGE OF CASING	SEATING BELOW GROUND SURFACE, FT.
60	12	Single Welded	12 ga	360' to 390'

Type and size of shoe or well ring Welded joints ☑ Yes ☐ No

2 - 12 X 4 X 3/8 Steel Shoes

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY

23971 3-50 40M QUIN SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

51-469 SHEET 2 406
Sutter

Do Not Fill In
State Well No.
Other Well No. 13N-4E-35
Region 5

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

CONFIDENTIAL
Section 7076.1 Water Code

(7) Perforations:

Type of perforator used Torch

Perforated	ft. to	ft. Hole size	No. of holes
Top 30'	Slotted 1/8 X	8" Slots to the round	

(8) Water levels:

Depth at which water first encountered 28 ft.
Depth to water before perforating ft.
Depth to water after perforating ft.
Note any change in water level while drilling none

(9) Well pumping test:

Date of test By whom
Depth to water when test started ft.
G.P.M. at beginning of test
Drawdown from standing level ft.
G.P.M. at completion of test
Drawdown at completion of test ft.
Length of time tested
Temperature of water
Was gas present in water? ☐ Yes ☐ No

(10) General:

Was well gravel packed? no Size of rock Thickness of pack
Was a surface sanitary seal provided?
Were any strata sealed against pollution? ☐ Yes ☐ No If yes, attach detailed description.
Strata sealed
Was analysis made of water? ☐ Yes ☒ No If yes, attach copy.
Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
If well abandoned, was it plugged and sealed? FOR OFFICIAL USE ONLY
Method of plugging and sealing

(11) Location:

North

350' north Hicks Rd
100' West of Pleasant Grove Rd.

1 MILE

Section No.
Township
Range
Base & Meridian
Show location of well in Section, thus (X)
Distances to section lines from well, N or S ft. and E or W ft.
Show location of nearest known well, thus (O)
Distance to nearest known well ft.

(12) Time of work:

Work started date 4/20/53 Completed date 4/24/53
Date of this report 5/18/53

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Chas D. Candell
Well Driller

By

License No. 123192 Classification C57

Dated May 18, 1953

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY 23972 3-50 40M QUIN SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No._____
(Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA 356

Do Not Fill In
No 8627
State Well No._____
Other Well No. 13/4-36F

(1)
Nam
Addr

(2) LOCATION OF WELL:

County Sutter Owner's number, if any—
R. F. D. or Street No. Rio Oso Sub Station
½ mile East of Pleasant Grove Road
on Nicks Road, ½ mile North of Nicks Road

(3) TYPE OF WORK (*check*):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (*check*):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:

SINGLE ☒ DOUBLE ☐

From	ft. to		ft.	Diam.	Gage or Wall
0		91		8"	8

Type and size of shoe or well ring 8"x4"x5/8"
Describe joint

If gravel packed

Diameter of Bore	from ft.	to ft.

Size of gravel:

(7) PERFORATIONS: None

Type of perforator used
Size of perforations in., length, by in.

From	ft. to	ft.	Perf. per row	Rows per ft.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth 6 ft.
Were any strata sealed against pollution? ☐ Yes ☐ No If yes, note depth of strata

From	ft. to	ft.

Method of Sealing

(9) WATER LEVELS:

Depth at which water was first found 45 ft.
Standing level before perforating ft.
Standing level after perforating ft.

(10) WELL TESTS:

Was a pump test made? ☒ Yes ☐ No If yes, by whom? SWD & P Co.
Yield: 120 gal./min. with 12 ft. draw down after 8 hrs.
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No
Was electric log made of well? ☐ Yes ☐ No

(11) WELL LOG:

Total depth 150 ft. Depth of completed well 150 ft.
Formation: *Describe by color, character, size of material, and structure.*

	ft. to		ft.	
0	"	2	"	Sand
2	"	12	"	Red Clay
12	"	21	"	brown sandy clay
21	"	56	"	sand & gravel
56	"	59	"	brown sandy clay
59	"	67	"	sand & gravel
67	"	78	"	brown sandy clay
78	"	82	"	cemented sand
82	"	95	"	brown sandy clay
95	"	108	"	cemented sand
108	"	110	"	sand & pea gravel
110	"	150	"	brown sandy clay

Plotted and Coded
As Well 13N 1E-36F5C

FOR OFFICIAL USE ONLY

Work started 6/29/54 19 Completed 7/7/54 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Star Well Drilling & Pump Co.
(Person, firm, or corporation) *(Typed or printed)*
Address P.O. Box 689
Yuba City, Calif.
[SIGNED] Glenn R. Morey
Well Driller
License No. 121868 Dated 7/10/54, 19

95689 3-54 50M QUIN & SPO

DWR FORM NO. 246 (REV. 3-54)

ORIGINAL
File Original, Duplicate and Triplicate
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

51-471

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES 23 B

LOCATION NOT CHECKED
Do Not Fill In

State Well No. .....

Other Well No. 13N-4E-36N

Region .....

Section 7076, 7077, 7078 Water Code

(1) DRILLER: (person, firm, or corporation)

Name Frank P. Conley

Address 432 - Feather River Blvd. Marysville, Calif.

OWNER

Name

Address

(2) Proposed Use (Check)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other	☐

Equipment

Rotary	☐
Cable	☒
Dug Well	☐
Other	☐

(3) CASING:

84 ft. of 14 in 10 lb./ga. casing left in well

" " " " " " "

" " " " " " "

" " " " " " "

" " " " " " "

Type and size of shoe or well ring 14" 4. X 1/2

(4) PERFORATIONS:

Type of perforator used

Perforated	ft. to	ft.	holes per	in.
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"

Diameter of perforations in., length in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.

Depth at which water was first found 50 ft.

Standing level before perforating ft.

Standing level after perforating ft.

Note your observation of any change in water level while drilling 40

Was a surface sanitary seal provided? No

(6) WELL PUMPING TEST:

Capacity gal./min. ft. draw down

Was well gravel packed? No

Were any strata sealed against pollution? Casing driven into clay at 80'

Temperature Was a chemical analysis made? Attach copy

If abandoned was well capped?

(7) TYPE OF WORK (check):

New well ☒ Reconditioning of well ☐

Deepening existing well ☐

(8) LOCATION OF WELL:

County Sutter

R. F. D. or Street No. Pleasant Grove Rd. End of Cornelius Ave.

(9) WELL LOG:

Total depth of well 320 ft.

Formation: Mention size of water gravel—

0	ft. to 28	ft.	top soil
28	" 48	"	coarse sand
48	" 50	"	pea gravel
50	" 190	"	Brown clay
190	" 193	"	brown sand
193	" 198	"	crumbly brown clay
198	" 200	"	pea gravel &
200	" 260	"	Brown clay & gravel
260	" 265	"	Blue clay
265	" 295	"	Brown clay
295	" 319	"	Blue shale
319	" 320	"	clay

Plotted and Coded

As Well 13N 4E 36N80

FOR OFFICIAL USE ONLY

Work started July 3 1953. Completed July 10 1953

Date of Report Aug. 7, 1953

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Frank P. Conley
Well Driller

By [illegible]

License No. [illegible] Classification B-57

Dated Aug 7, 1953

46370 7-51 30M QUIN ① SB

ORIGINAL
File Original, Duplicate and Triplicate
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

51-472

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES 229

LOCATION NOT CHECKED

Do Not Fill In

State Well No.

Other Well No. 13N-4E-36Q

Region

(1) DRILLER: (person, firm, or corporation)

Name Frank P. Conley

Address 432 - Feather Rd. Box 1 Blvd
Marysville, Calif.

(2) Proposed Use (Check)

				Equipment	
Domestic	☐	Industrial	☐	Rotary	☐
Irrigation	☒	Test Well	☐	Cable	☒
Municipal	☐	Other	☐	Dug Well	☐
				Other	☐

(3) CASING:

108 ft. of 14 in 10 lb./ga. casing 107 1/2 left in well

Type and size of shoe or well ring 14" 4 X 1/2

(4) PERFORATIONS:

Type of perforator used

Perforated ft. to ft. holes per in.

Diameter of perforations in., length in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.

Depth at which water was first found 28 ft.

Standing level before perforating ft.

Standing level after perforating ft.

Note your observation of any change in water level while drilling

Was a surface sanitary seal provided? No

(6) WELL PUMPING TEST: Tested by Ludorf Pump Co. Woodland

Capacity gal./min. ft. draw down

Was well gravel packed? No

Were any strata sealed against pollution?

Temperature Was a chemical analysis made? Attach copy

If abandoned was well capped?

(7) TYPE OF WORK (check):

New well ☒ Reconditioning of well ☐

Deepening existing well ☐

(8) LOCATION OF WELL:

County Sutter

R. F. D. or Street No. 1/2 mile south of Hicks Rd. near drain ditch — 1/2 mile east of Pleasant Grove Rd. east of Gallagher home.

(9) WELL LOG:

Total depth of well 255 ft.

Formation: Mention size of water gravel—

ft. to	ft.	
0	6	top soil
6	30	gravel
30	90	brown clay
90	105	sand
105	200	brown clay
200	205	gravel
205	240	blue clay
240	255	blue sand

Plotted and Coded
As Well 13N/4E-36Q8E

FOR OFFICIAL USE ONLY

Work started Mar. 6 1953. Completed Mar. 16 1953

Date of Report July. 23, 1953

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Frank P. Conley
Well Driller

By Bernice Freeborn

License No. 105346 Classification C 57

Dated July 23, 1953

46370 7-51 30M 2 IN ① SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SHEET 1

45

LOCAT 31-113 ECKED

Do Not Fill In
State Well No.
Other Well No. 13N/5E-27Q
Region

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

45

(1) **Driller:**
Name William Flynn
Address Box 157 Sutter, Calif.

License No. 97194 Classification B-57

(2) **Proposed use or uses** *(check)*:
Domestic ☐ Municipal ☐
Irrigation ☒ Industrial ☐
Domestic and Irrigation ☐ Test well ☐
Other

(3) **Equipment used** *(check)*:
Rotary ☐
Cable ☒
Dug well ☐
Other

(4) **Type of work** *(check)*:
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(5) **Well log:**
Total depth of well 400 ft.

Give details of formations penetrated, such as silt, peat, muck, sand, gravel, clay, shale, sandstone, hardpan, rock. Include size of gravel (diameter) and sand (fine, medium, coarse), color of material, structure (loose, packed, cemented, soft, hard, brittle).

Depth From Ground Surface				
1	ft. to	3	ft.	top soil
3	" "	10	"	hard pan
10	" "	35	"	brown clay
35	" "	40	"	brown clay
40	" "	55	"	yellow clay
55	" "	58	"	packed gravel
58	" "	85	"	soft clay
85	" "	100	"	brown clay
100	" "	110	"	yellow hard clay
110	" "	120	"	soft yellow clay
120	" "	170	"	hard gray clay
170	" "	180	"	soft clay
180	" "	190	"	yellow clay
190	" "	200	"	hard sand
200	" "	250	"	tough clay
250	" "	290	"	gray clay
290	" "	300	"	hard sand
300	" "	360	"	yellow clay
360	" "	370	"	blue clay
370	" "	400	"	hard gray clay
400	" "	405	"	blue sand
405	" "		"	blue shale
	" "		"	
	" "		"	
	" "		"	

Plotted and Coded
As Well 13N 10SE 27Q

FOR OFFICIAL USE ONLY

CONFIDENTIAL
Section 7076.1, Water Code

If additional space is required, continue on DWR Form No. 246—Supplement, and attach to respective report copies.

(6) **Casing left in well:**

LENGTH FT.	DIAMETER INCHES	SINGLE, DOUBLE, WELDED, OTHER	LBS. PER FOOT OR GAGE OF CASING	SEATING BELOW GROUND SURFACE, FT.
132	14	single	10#	132

Type and size of shoe or well ring 14" x 5/8" x 4" Welded joints—☒ Yes ☐ No

SPO

ORIGINAL
File original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

91-113 45
SHEET 2
Placer

LOCATION NOT CHECKED
LOCATION NOT CHECKED
Do Not Fill In
State Well No.
Other Well No.
Region

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

(7) Perforations:

Type of perforator used Mills

Perforated 90 ft. to 124 ft. Hole size 1/2 X 2 No. of holes 180

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

" " " " " " " " " " " " " "

(8) Water levels:

Depth at which water first encountered 40 ft.

Depth to water before perforating 40 ft.

Depth to water after perforating 40 ft.

Note any change in water level while drilling

(9) Well pumping test:

Date of test None By whom

Depth to water when test started ft.

G.P.M. at beginning of test

Drawdown from standing level ft.

G.P.M. at completion of test

Drawdown at completion of test ft.

Length of time tested

Temperature of water

Was gas present in water? ☐ Yes ☐ No

(10) General:

Was well gravel packed? No Size of rock Thickness of gravel

FOR OFFICIAL USE ONLY

Was a surface sanitary seal provided?

Were any strata sealed against pollution? ☐ Yes ☐ No If yes, attach detailed description.

Strata sealed

Was analysis made of water? ☐ Yes ☐ No If yes, attach copy.

Was electric log made of well? ☐ Yes ☐ No If yes, attach copy.

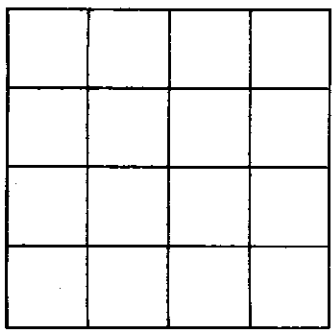
If well abandoned, was it plugged and sealed?

Method of plugging and sealing

CONFIDENTIAL
Section 7076.1, Water Code

(11) Location:

North



1 MILE

Section No. 27

Township 10 12

Range Placer County

Base & Meridian

Show location of well in Section, thus (X)

Distances to section lines from well, N or S ft. and E or W ft.

Show location of nearest known well, thus (O)

Distance to nearest known well 1800 ft.

(12) Time of work:

Work started date 11/30/51 Completed date 12/5/51

Date of this report 3/3/52

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Wm A Lyme
Well Driller

By

License No. 97194 Classification B057

Dated March 3, 1952

3rd road south of Sheridan on old Rosville road 11/2 miles west of old Rosville road, 1/4 mile past 1st set of buildings, 800 ft. north of road.

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY 23972 3-50 40M QUIN &PO

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 44513

Notice of Intent No. 135681

Local Permit No. or Date

State Well No.

Other Well No. 13N/5E-28L

(1) OWNER:
Name
Address
City

(2) LOCATION OF WELL (See instructions):
County Sutter Owner's Well Number
Well address if different from above Waltz Rd
Township 13N Range 5E Section 28
Distance from cities, roads, railroads, fences, etc. N/E quarter of s/e quarter of section 28 1½ miles East of Brewer Rd and ½ mile north of Waltz Rd.

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [ ]
Irrigation [X]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [ ]
Other [ ]

(5) EQUIPMENT:
Rotary [ ] Reverse [ ]
Cable [X] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [ ] No [X] Size
Diameter of bore
Packed from ft. to ft.

(7) CASING INSTALLED:
Steel [ ] Plastic [ ] Concrete [X]

(8) PERFORATIONS:
Type of perforation or size of screen Mills knife

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	304	16	3/16	130	190	

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [ ] No [X] If yes, to depth ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval ft.
Method of sealing Casing driven 31' into light brown clay

(10) WATER LEVELS:
Depth of first water, if known ft.
Standing level after well completion 72. ft.

(11) WELL TESTS:
Was well test made? Yes [X] No [ ] If yes, by whom? Valley Pump
Type of test Pump [X] Bailer [ ] Air lift [ ]
Depth to water at start of test 67 ft. At end of test 186 ft
Discharge 2950 gal/min after 21½ hours Water temperature
Chemical analysis made? Yes [ ] No [X] If yes, by whom?
Water quality log made? Yes [ ] No [X] If yes, attach copy to this report

(12) WELL LOG: Total depth 515 ft. Depth of completed well ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	4	top soil
4	6	red clay
6	37	Brown clay
37	91	Dark brown clay
91	93	quick sand
93	159	cemented sand
159	220	light brown clay
220	225	Black sand
225	250	Cemented gravel
250	296	Brown clay
296	331	cinders & gravel
331	465	Blue clay
465	480	blue shale
480	515	blue clay

Work started 9-26 19 77 Completed 11-15 19 77

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed (Well Driller)

NAME Valley Pump & Motor Works, Inc (Person, firm, or corporation) (Typed or printed)
Address 470 No Geo. Washington Blvd
City Yuba City Zip 95991
License No 256384 Class C-57 Date of this report 11-20-77

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 43816-950 7-76 50M QUAD OT OSP

NOT VALID FOR PUBLIC USE
WATER CODE SEC. 13752

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

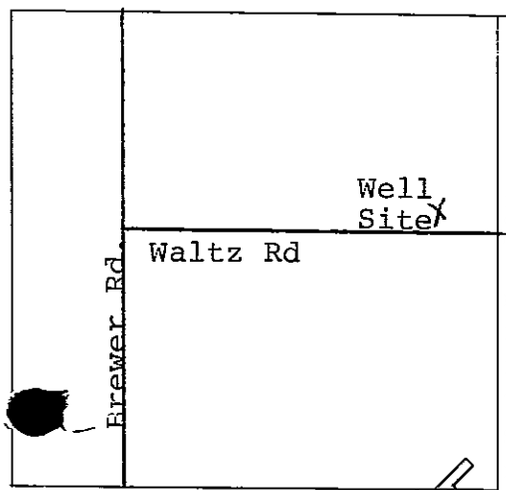
No. 123431

[redacted] of Intent No.
[redacted] Permit No. or Date

State Well No.
Other Well No. 13N/5E-29 R

(1)
Address
City

(2) LOCATION OF WELL (See instructions):
County Sutter Owner's Well Number A-14
Well address if different from above
Township 13 N Range 5E Section SW¼ 28
Distance from cities, roads, railroads, fences, etc. Approx 1 mi east of Brewer Rd on north side of Waltz Rd.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☒
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other ☐

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size Pea
Diameter of bore 26
Packed from 0 to 386 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS: Johnson Irrigator
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	233	16	1/4	233	253	100
253	278	16		278	338	100
338	368	16		368	378	100
378	386					

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.
Method of sealing

(10) WATER LEVELS:
Depth of first water, if known ft.
Standing level after well completion 46 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? EELCO
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 52 ft. At end of test 189 ft
Discharge 3000 gal/min after 2 hours Water temperature
[redacted] analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made? Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 505 ft. Depth of completed well 386 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	2	Red gravel, top soil
2	7	Hard pan
7	9	Gravel and clay mixed
9	14	Hard yellow clay
14	31	Rocks and gravel
31	40	Hard yellow clay
40	52	Hard pan
52	54	Coarse sand and gravel
54	65	Hard yellow clay
65	86	Brittle brown clay
86	89	Coarse sand and gravel
89	96	Yellow clay
96	99	Hard gray clay
99	137	Brown sandy clay
137	143	Coarse sand and gravel
143	152	Sandy brown clay
152	173	Green clay
173	180	Blue clay
180	190	Blue clay
190	239	Hard brown clay & cemented sand
239	267	Hard green clay
267	280	Brown cemented sand
280	285	Hard sand and brown hard pan
285	320	Hard shale and sandstone
320	340	Coarse sand and gravel shale
340	345	Hard sandy blue clay
345	350	Hard blue sand stone
350	370	Hard blue clay
370	377	Coarse sand and fine shale
377	400	Sandy blue clay & blue shale
400	441	Blue clay
441	444	Clay and gravel mixed
444	498	Coarse sand
498	500	Sandy blue clay
500	504	Clay and coarse sand
504	505	Hard blue clay
		-
		-
		-

Work started 2-22 19 77 Completed 2-26 19 77

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED (Well Driller)

NAME E.E. Luhdorff Co/Division of Layne Western
(Person, firm, or corporation) (Typed or printed)
Address P.O. Box 1326
City Woodland Zip 95695
License No. 334205 Date of this report 12-22-77

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

DO NOT PUBLISH
NOT FOR PUBLICATION
WATER QUALITY

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

SUTTER

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES

SHEET 1

13N 2E 32C1

51-123

37

Do Not Fill In
te Well No. 13N 2E-32 C 1
Other Well No.
Region 5

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

(1) **Driller:**
Name J B Breazeale
Address Route 1 Box 312 Live Oak Calif.
License No. Classification

Own
Nam
Addr

(2) **Proposed use or uses** *(check)*:
Domestic ☒ Municipal ☐
Irrigation ☐ Industrial ☐
Domestic and Irrigation ☐ Test well ☐
Other

(3) **Equipment used** *(check)*:
Rotary ☐
Cable ☒
Dug well ☐
Other

Type of work *(check)*:
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(5) **Well log:**
Total depth of well 120 ft.

Depth From Ground Surface

1	ft. to	30	ft.
30	" "	32	"
32	" "	60	"
60	" "	61	"
61	" "	109	"
109	" "	120	"

Give details of formations penetrated, such as silt, peat, muck, sand, gravel, clay, shale, sandstone, hardpan, rock. Include size of gravel (diameter) and sand (fine, medium, coarse), color of material, structure (loose, packed, cemented, soft, hard, brittle).

Clay - red
gravel size of an egg (no water)
clay - red
coarse grey sand. (loose)
clay red
sand, grey, coarse, (loose)

Plotted and Coded
As Well 13N 1E 32C1

FOR OFFICIAL USE ONLY

If additional space is required, continue on DWR Form No. 246—Supplement, and attach to respective report copies.

(6) **Casing left in well:**

LENGTH FT.	DIAMETER INCHES	SINGLE, DOUBLE, WELDED, OTHER	LBS. PER FOOT OR GAGE OF CASING	SEATING BELOW GROUND SURFACE, FT.
76 ft-	10		10	75 ft-

Type and size of shoe or well ring ½ x 4" Welded joints—☒ Yes ☐ No

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY

23971 3-53 40M QUIN SPO

ORIGINAL
Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

SHEET 2

51-123

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

27

Do Not Fill In
State Well No. 1N/5E-32C1
Other Well No. 51-123
Region 5

(7) Perforations:

Type of perforator used None

Perforated	ft. to	ft.	Hole size	No. of holes
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "
"	" "	" " "	" " "	" " "

(8) Water levels:

Depth at which water first encountered 40 ft.
Depth to water before perforating ft.
Depth to water after perforating ft.
Note any change in water level while drilling
went from 40 to 30

(9) Well pumping test:

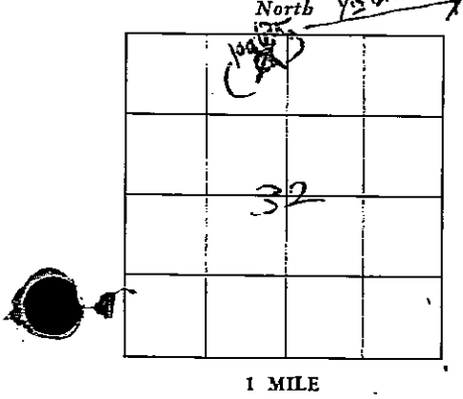
Date of test By whom
Depth to water when test started ft.
G.P.M. at beginning of test
Drawdown from standing level ft.
G.P.M. at completion of test
Drawdown at completion of test ft.
Length of time tested
Temperature of water
Was gas present in water? ☐ Yes ☒ No

(10) General:

Was well gravel packed? no Size of rock Thickness of pack
Was a surface sanitary seal provided?
Were any strata sealed against pollution? ☒ Yes ☐ No If yes, attach detailed description.
Strata sealed all sealed to 75' ft
Was analysis made of water? ☐ Yes ☒ No If yes, attach copy.
Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
If well abandoned, was it plugged and sealed?
Method of plugging and sealing

FOR OFFICIAL USE ONLY

(11) Location:



Section No. 32
Township 13 North
Range 5 East
Base & Meridian Diablo
Show location of well in Section, thus (X)
Distances to section lines from well, N or S 100 ft. and E or W ft.
Show location of nearest known well, thus (O)
Distance to nearest known well ½ mi east.

(12) Time of work:

Work started date May 9 Completed date May 28, 1952
Date of this report June 7, 1952

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] J B Broyles
Well Driller

By
License No. Classification
Dated , 19

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY 23972 3-50 40M SUIN SPO

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

CONFIDENTIAL LOG Water Code Sec. 13752

ORIGINAL File with DWR

Do Not Fill In

№ 113384

State Well No. _____

Other Well No. 13N/6E-35A

(2) LOCATION OF WELL:

County Placer Owner's number, if any

Township, Range, and Section

Distance from cities, roads, railroads, etc.

(3) TYPE OF WORK (check):

New Well ☐*** Deepening ☐ Reconditioning ☐ Destroying ☐

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐

Irrigation ☒** Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐

Cable ☒***

Other ☐

(6) CASING INSTALLED:

STEEL: OTHER:

SINGLE ☐ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
144'		14" x	3/16"	B/W Plate Casing		

If gravel packed

Size of shoe or well ring: 14"x6"x3/4" Size of gravel:

Describe joint

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☐ No ☐ To what depth ft.

Were any strata sealed against pollution? Yes ☐ No ☐ If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing

(9) WATER LEVELS:

Depth at which water was first found, if known 32 ft.

Standing level before perforating, if known 32 ft.

Standing level after perforating and developing ft.

(10) WELL TESTS:

Was pump test made? Yes ☐ No ☐ If yes, by whom?

gal./min. with ft. drawdown after hrs.

Temperature of water Was a chemical analysis made? Yes ☐ No ☐

Was electric log made of well? Yes ☐ No ☐ If yes, attach copy

(11) WELL LOG:

Total depth 0 ft. Depth of completed well 250 ft.

Formation: *Describe by color, character, size of material, and structure*

FROM: ft.	TO: ft.	
0'	05'	Top Soil
05'	10'	Red Clay
10'	18'	Sand & Gravel 2"
18'	80'	Red Clay & Streaks of Clay & Gravel
80'	85'	Gray Clay & Gravel
85'	95'	Brown Clay & Gravel
95'	97'	Sand & Gravel
97'	115'	Brown Clay With Traces of Gravel and Clay
115'	120'	Loose Sand & Clay
120'	134'	Gray Clay
134'	155'	Packed Sand
155'	167'	Brown Brittle Shale
167'	200'	Blue Clay & Streaks of Blue Shale
200'	207'	Brown Clay
207'	240'	Brown Shale
240'	250'	Blue Shale
250'	250'+	Blackish Packed Sand

CONFIDENTIAL LOG
Water Code Sec. 13752

Work started 2/2/ 19 77 , Completed 2/14/ 19 77

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Frank L. Cornwell & Son
(Person, firm, or corporation) (*Typed or printed*)

Address 521 3rd St. Marysville, California 95901

[SIGNED] _____
(Well Driller)

License No. _____ Dated _____, 19____

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-68)

67139-750 8-72 30M TRIP OT OSP

Geologic Section B-B’

DWR Log No: 51-014 9

USGS-CAL-T1
May 1948

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES BRANCH

No. 11/3E-2B1
Other Nos. 20-9
DWR J

WELL LOG

State California County Sutter Subarea Vernon

Owner

Location

Drilled by Coupe Address

Date Jan. 1932 Casing diam. 16 and 12" Land-surf. alt. 20

Source of data Matomes

(Enter type of well, perforations, yield, and drawdown at end of log)

Correlation	Material	Thickness (feet)	Depth (feet)
	Top soil		3
	Hard pan		6
	Brown clay		10
	Sand		12
	Brown clay		45
	Blue clay		98
	Blue sand		125
	Blue sand and gravel		138

Record by Date Sheet of

MD 11N/3E ~~20~~ 2C1

REGION

COUNTY Sutter

NEAR

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

WELL LOG

BASIN

DWR No. 113 ~~20~~ 2C1 B & M

OTHER Nos. 20-9A

24

DWR Log No: 51-015

LOCATION Feather River, NE. 1/4 Sec. 2, T. 11 N., R. 3 E., South Portion

OWNER ADDRESS

DRILLED BY Francis Coupe ADDRESS

DRILLING METHOD GRAVEL PACKED DATE COMPLETED March 13, 1932

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE 16, 12, and 10" No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION Natomas Co.

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICKNESS	SP. YIELD %
17		Brown clay		
19		Brown sand		
45		Brown clay		
80		Blue clay		
90		Fine Blue sand		
100		Blue sandy clay		
122		Blue sand		
125		Brown sandy clay		
128		Blue sand		

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY ok DATE 11-1-48 SHEET 1 OF 546

FORM 263. 47835 7-51 5M © SPO

DWR Log No: 51-018 MD 11N/3E-3C2

REGION

COUNTY Sutter

NEAR

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

WELL LOG

BASIN

DWR No. 113 3C2 : B & M

OTHER Nos. 20-8

21

LOCATION Natomas, Feather River, NE 1/4 Sec. 3, T. 11 N., R. 3 E., F-1 Property for F. R. Pump Unit No. 3

OWNI ADDRESS

DRILLED BY Vernon McGrew ADDRESS

DRILLING METHOD GRAVEL PACKED DATE COMPLETED May 1937

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE 14" No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION Natomas

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICK-NESS	SP. YIELD %
18		Soil and silt		
35		Sand ans small gravel		
87		Clay		
95		Hard sand		
110		Tight gravel		
		Loose gravel		

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY ok DATE 11-1-48 SHEET 1 OF 544

FORM 263. 47885 7-51 5M ② SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES 218

DWR Log No. 51-043
LOCATION CHECKED Do Not Fill In

State Well No. 11N/4E-3C1

Other Well No. ~~11N-4E-30~~

Region 5

CONFIDENTIAL Section 7076, Water Code

(1) DRILLER: (person, firm, or corporation)

Name Frank P. Conley

Address 432 - Feather River Blvd.
Marysville, Calif.

OWNER

Name

Address

(2) Proposed Use (Check)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other	☐

Equipment

Rotary	☐
Cable	☒
Dug Well	☐
Other	☐

(3) CASING:

80 ft. of 14" in 3/16 lb./ga. casing 79½ left in well

" " " " " " " "

" " " " " " " "

" " " " " " " "

" " " " " " " "

Type and size of shoe or well ring 14" 4 X ½

(4) PERFORATIONS:

Type of perforator used

Perforated	ft. to	ft.	holes per	in.
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"

Diameter of perforations in., length in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.

Depth at which water was first found 18 ft.

Standing level before perforating ft.

Standing level after perforating ft.

Note your observation of any change in water level while drilling

Was a surface sanitary seal provided? No

(6) WELL PUMPING TEST:

Capacity gal./min. ft. draw down

Was well gravel packed? No

Were any strata sealed against pollution?

Temperature Was a chemical analysis made? Attach copy

If abandoned was well capped?

(7) TYPE OF WORK (check):

New well ☒ Reconditioning of well ☐

Deepening existing well ☐

(8) LOCATION OF WELL:

County Sutter

R. F. D. or Street No.

Prairie Ave. — 1 mile North
& Hounslow Rd. — east of
Arthur Crescent home

(9) WELL LOG:

Total depth of well 250 ft.

Formation: Mention size of water gravel—

0	ft. to 15	ft.	Top soil	5
15	" 25	"	sand	20
25	" 50	"	clay	3
50	" 60	"	fine gravel	15
60	" 115	"	gray clay	3
115	" 140	"	sand, soft	20
140	" 200	"	brown clay	3
200	" 215	"	sandy	20
215	" 240	"	clay	3
240	" 250	"	brown sand	20

FOR OFFICIAL USE ONLY

Work started Nov. 8 19 52. Completed Nov. 15 19 52

Date of Report May 21, 1953

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Frank P. Conley
Well Driller

By Bernice Freeborn

License No. 105346 Classification C 57

Dated May 21, 1953

46370 7-51 30M QUIN ① SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES 253

DWR Log No: 51-050
LOCATION NOT CHECKED
Do Not Fill In

State Well No. .....
Other Well No. 11N-4E-4A
Region .....

CONFIDENTIAL Section 7076 Water Code

(1) DRILLER: (person, firm, or corporation)

Name Frank P. Conley
Address 432-Feather River Blvd.
Marysville, Calif.

OWNER:

Name
Address

(2) Proposed Use (*Check*)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other	☐

Equipment

Rotary	☐
Cable	☒
Dug Well	☐
Other	☐

(3) CASING:

Liner	48	ft. of	12	in	10	lb./ga. casing	48	left in well
"	40	"	10	"	12	" "	40	" " "
"	60	"	8	"	12	" "	60	" " "
		"		"		" "		" " "
		"		"		" "		" " "

Type and size of shoe or well ring 12" 3 x 3/8

(4) PERFORATIONS:

Type of perforator used Burnt with acetylene

12" liner	Perforated	180	ft. to 216	ft.	7	holes per	12	in.
10" liner		275	" 291	"	5	" "	12	"
8" liner		330	" 390	"	5	" "	12	"
			"	"		" "		"
			"	"		" "		"
			"	"		" "		"
			"	"		" "		"
			"	"		" "		"
			"	"		" "		"
			"	"		" "		"
			"	"		" "		"

Diameter of perforations 1/4 in., length 3 in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
Depth at which water was first found 20 ft.
Standing level before perforating 20 ft.
Standing level after perforating 20 ft.
Note your observation of any change in water level while drilling
Was a surface sanitary seal provided? No

(6) WELL PUMPING TEST: Tested by Mr. Wilson Woodland

Capacity 1700 gal./min. 85 ft. draw down

Was well gravel packed? No
Were any strata sealed against pollution? No
Temperature Was a chemical analysis made? Attach copy
If abandoned was well capped?

(7) TYPE OF WORK (*check*):

New well ☐ Reconditioning of well ☐
Deepening existing well ☒

(8) LOCATION OF WELL:

County Sutter
R. F. D. or Street No.
On levee road - 3/4 S mile
North of Howsley Rd.
Pleasant Grove, Calif.

(9) WELL LOG:

Total depth of well 400 ft.

Formation: Mention size of water gravel—

0	ft. to 207 ft.	old hole
207	" 280 "	sand, run-in
280	" 300 "	gravel
300	" 310 "	sand
310	" 355 "	brown clay
355	" 365 "	sand - water
365	" 385 "	gray clay
385	" 390 "	Tuscan Flute clay
390	" 400 "	blue sand

FOR OFFICIAL USE ONLY

Work started Nov 20 19 53 Completed Dec 10 19 53
Date of Report December 10, 19 53

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Frank P. Conley
Well Driller
By Bernice Freebarn
License No. 105346 Classification C 57
Dated December 10, 19 53

46370 7-51 30M QUIN ① SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES 186

LOCATION NOT CHECKED
Do Not Fill In
DWR Log No: 51-051
State Well No.
Other Well No. 11N - 4E - 5C
Region 5

CONFIDENTIAL
Section 7076, Water Code

(1) DRILLER: (person, firm, or corporation)

Name Frank P. Conley
Address 432 - Feather River Blvd.
Marysville, Calif.

OWNER:
Name
Address

(2) Proposed Use (Check)

				Equipment	
Domestic	☐	Industrial	☐	Rotary	☐
Irrigation	☒	Test Well	☐	Cable	☒
Municipal	☐	Other	☐	Dug Well	☐
				Other	☐

(3) CASING:

105 ft. of 14 in 3/16 lb./ga. casing 104½ left in well

Type and size of shoe or well ring 14" 4 X ½

(4) PERFORATIONS:

Type of perforator used

Perforated ft. to ft. holes per in.

Diameter of perforations in., length in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
Depth at which water was first found 14 ft.
Standing level before perforating ft.
Standing level after perforating ft.
Note your observation of any change in water level while drilling
Was a surface sanitary seal provided? No

(6) WELL PUMPING TEST:

Capacity 2000 gal./min. 50 ft. draw down

Was well gravel packed? No
Were any strata sealed against pollution?
Temperature Was a chemical analysis made? Attach copy
If abandoned was well capped?

(7) TYPE OF WORK (check):

New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(8) LOCATION OF WELL:

County Sutter
R. F. D. or Street No. South side of Catlett Rd. - approx 3/4 mile west of El Centro Rd.

(9) WELL LOG:

Total depth of well 145 ft.

Formation: Mention size of water gravel—

ft. to ft.	
0 - 16	tough clay
16 - 40	sand
40 - 75	brown clay
75 - 105	blue sand
105 - 120	dark clay
120 - 130	gravel
130 - 145	sand

FOR OFFICIAL USE ONLY

Work started Feb 4 1953 Completed Feb 9 1953
Date of Report Mar. 25, 1953

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Frank P. Conley
Well Driller
By Bernice Freeborn
License No. 105346 Classification C57
Dated Mar. 25, 1953

46370 7-51 30M QUIN ① SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES 228

DWR Log No: 51-172
LOCATION ~~NOT~~ CHECKED

State Well No. 12N/3E-36Q2
Other Well No. ~~12N 4E-31E~~
Region

(1) DRILLER: (person, firm, or corporation)
Name Frank P. Conley
Address 432-Feather River Blvd.
Marysville, Calif.

OWNER
Name
Addre

(2) Proposed Use (*Check*)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other	☐

Equipment

Rotary	☐
Cable	☒
Dug Well	☐
Other	☐

(3) CASING:
176 ft. of 14 in. 10 lb./ga. casing 175½ left in well
" " " " " " " "
" " " " " " " "
" " " " " " " "
" " " " " " " "
Type and size of shoe or well ring 14" 4 X ½

(4) PERFORATIONS:
Type of perforator used mills perforator
Perforated 125 ft. to 135 ft. 8 holes per 12 in.
" 153 " 165 " 8 " " 12 "
Diameter of perforations 3/4 in., length 3 in.

(5) WATER LEVELS:
Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
Depth at which water was first found 14 ft.
Standing level before perforating 17 ft.
Standing level after perforating 14 ft.
Note your observation of any change in water level while drilling
Was a surface sanitary seal provided? No

(6) WELL PUMPING TEST:
Capacity 1150 gal./min. 39 ft. draw down
Was well gravel packed? No
Were any strata sealed against pollution? No
Temperature Was a chemical analysis made? Attach copy
If abandoned was well capped?

(7) TYPE OF WORK (*check*):
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(8) LOCATION OF WELL:
County Sutter
R. F. D. or Street No. On Ukropina ranch
Catlett Rd. - 2 miles
west of El Centro Blvd. -
back of equipment shed
Pleasant Grove, Calif.

(9) WELL LOG:
Total depth of well 240 ft.
Formation: Mention size of water gravel—

0	ft. to 2	ft.	top soil
2	" 6	"	hardpan
6	" 18	"	sandy clay
18	" 40	"	gray clay
40	" 50	"	sand
50	" 80	"	blue clay
80	" 85	"	sand
85	" 130	"	blue sandy clay
130	" 140	"	blue sand
140	" 160	"	blue clay
160	" 172	"	gravel
172	" 200	"	blue clay
200	" 210	"	blue sand
210	" 240	"	blue clay

FOR OFFICIAL USE ONLY

Work started Sept. 19 1953. Completed Sept. 30 1953
Date of Report October 6, 1953

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
[SIGNED] Frank P. Conley
Well Driller
By Bernice Freeborn
License No. 105346 Classification C 57
Dated October 6, 1953

46370 7-51 30M QUIN ① SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES

51-349

SHEET

Do Not Fill In
State Well No. 12N/4E-33P1
Other Well No.
Region

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

119

(1) **Driller:**
Name Frank P. Conley
Address 432 - Feather River Blvd
Marysville, Calif.
License No. 105346 Classification C 57

Owne
Name
Addre

(2) **Proposed use or uses** *(check)*:
Domestic ☐ Municipal ☐
Irrigation ☒ Industrial ☐
Domestic and Irrigation ☐ Test well ☐
Other

(3) **Equipment used** *(check)*:
Rotary ☐
Cable ☒
Dug well ☐
Other

(4) **Type of work** *(check)*:
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(5) **Well log:**
Total depth of well 185 ft.

Depth From Ground Surface

Give details of formations penetrated, such as silt, peat, muck, sand, gravel, clay, shale, sandstone, hardpan, rock. Include size of gravel (diameter) and sand (fine, medium, coarse), color of material, structure (loose, packed, cemented, soft, hard, brittle).

	ft. to	6 ft.	top soil
6	" "	20 "	coarse, granulated sand X
20	" "	35 "	blue clay,
35	" "	45 "	sand & Gravel
45	" "	70 "	light grey clay
70	" "	80 "	red, bouldy
80	" "	88 "	red soft clay
88	" "	106 "	cemented granite X
106	" "	115 "	sandy
115	" "	185 "	gray clay
185	" "	200 "	

FOR OFFICIAL USE ONLY

If additional space is required, continue on DWR Form No. 246—Supplement, and attach to respective report copies.

(6) **Casing left in well:**

LENGTH FT.	DIAMETER INCHES	SINGLE, DOUBLE, WELDED, OTHER	LBS. PER FOOT OR GAGE OF CASING	SEATING BELOW GROUND SURFACE, FT.
91	14"	welded	10 g	90 1/2
24	12"	"	10 g	
	14" 3 X 1/2			

Type and size of shoe or well ring Welded joints—☒ Yes ☐ No

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

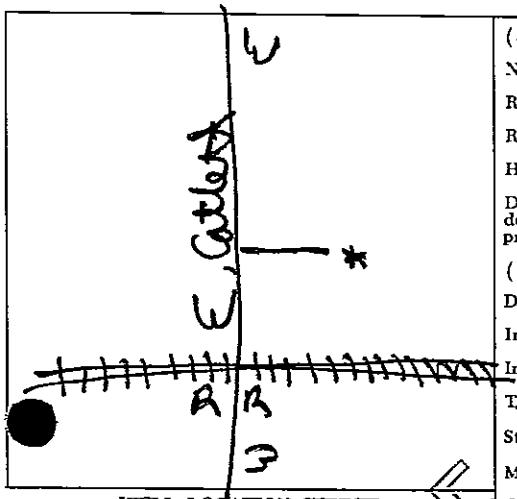
Do not fill in
No. 209372

Notice of Intent No.
Permit No. or Date 4/21/83

State Well No.
Other Well No. 12N04E34J

(1)
Addr
City

(2) LOCATION OF WELL (See instructions):
County Sutter Owner's Well Number
Well address if different from above same
Township Range Section
Distance from cities, roads, railroads, fences, etc. 45' west of house, between corner of garage and tree.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [X]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [ ]
Other [ ]

(5) EQUIPMENT:
Rotary [ ] Reverse [ ]
Cable [X] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [ ] No [X] Size
Diameter of bore
Packed from ft. to ft.

(7) CASING INSTALLED:
Steel [X] Plastic [ ] Concrete [ ]

From ft.	To ft.	Dia. in.	Gage or Wall
0	80	10	10ga

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [ ] No [X] If yes, to depth ft.
Were strata sealed against pollution? Yes [ ] No [X] Interval ft.
Method of sealing

(10) WATER LEVELS:
Depth of first water, if known 1 ft.
Standing level after well completion 9 ft.

(11) WELL TESTS:
Was well test made? Yes [ ] No [X] If yes, by whom?
Type of test Pump [ ] Bailer [ ] Air lift [ ]
Depth to water at start of test ft. At end of test ft.
Discharge gal/min after hours Water temperature
Chemical analysis made? Yes [ ] No [X] If yes, by whom?
Was electric log made? Yes [ ] No [X] If yes, attach copy to this report

(12) WELL LOG: Total depth 165 ft. Depth of completed well 135 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)	
0	1	top soil	
1	8	coarse granite sand	WB
8	17	yellow tough clay	
17	27	brown sandy clay	
27	37	coarse granite sand&sm. grav.	WB
37	52	brown tough clay	
52	61	red sandy clay	
61	64	yellow soft clay	
64	71	yellow tough clay	
71	77	brown sandy brittle clay	
77	81	yellow tough clay	
81	85	brown sandy brittle clay	
85	103	yellow silty clay	
103	106	yellow shale clay	
106	114	brown sandy clay	
114	119	gray fine packed sand	WB
119	130	yellow sandy clay	
130	137	yellow tough clay	
137	144	brown sandy brittle clay	
		155-165	
144	155	yellow tough clay/br.coarse loose	

Work started 4/8 19 83 Completed 4/19 19 83

WELL DRILLER'S STATEMENT: sand&sm.grav. WB
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
SIGNED John A. Beebe (Well Driller)
NAME John A. Beebe (Person, firm, or corporation) (Typed or printed)
Address 2574 16th St.
City Sacramento Zip 95818
License No. 392469 Date of this report 4/21/83

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

COPY NOT FOR PUBLIC USE
WATER QUALITY

CONFIDENTIAL LOG
Water Code Sec. 13752

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do Not Fill In

№ 115437

State Well No.
Other Well No. 12N/4E-35P

(1) OWNER:

Name
Addre

(2) LOCATION OF WELL:

County SUTTRR Owner's number, if any 75-1

Township, Range, and Section 12N, R4E, Sec. 35

Distance from cities, roads, railroads, etc. 2½mi. E. on Cattlet Rd., off Hwy. 99, 100' north.

(3) TYPE OF WORK *(check)*:

New Well XX Deepening ☐ Reconditioning ☐ Destroying ☐

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE *(check)*:

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation XX Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☒
Cable ☐
Other ☐

(6) CASING INSTALLED:

STEEL XX OTHER:
SINGLE ☐ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall
0	137	16"OD	¼"
157	191	"	"
278	326	"	"
390	400	"	"

Size of shoe or well ring:

Describe joint Collared Welded

If gravel packed

Diameter of Bore	From ft.	To ft.
26"	0	
"		
"		
"		

Size of gravel: MIX #31

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen Milled Slot & Fulflo louvered

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
137	157	16"OD	2½x.125	milled slot
191	278	"	"	"
326	350	"	.125	fulflo louvered
350	390	"	2½x.125	milled slot

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☐ No XX To what depth ft.

Were any strata sealed against pollution? Yes ☐ No ☐ If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing

(9) WATER LEVELS:

Depth at which water was first found, if known ft.

Standing level before perforating, if known ft.

Standing level after perforating and developing 18' ft.

(10) WELL TESTS:

Was pump test made? Yes ☒ No ☐ If yes, by whom? EELCOINC

Yield: 1200 gal./min. with 101 ft. drawdown after 2 hrs.

Temperature of water Was a chemical analysis made? Yes ☐ No ☒

Was electric log made of well? Yes ☒ No ☐ If yes, attach copy

(11) WELL LOG:

Total depth 410 ft. Depth of completed well 400 ft.

Formation: *Describe by color, character, size of material, and structure*

0	16	Hard pan & red clay
16	19	Loose course sand
19	29	Red clay & sand
29	53	Clay
53	57	Sand & clay stringers
57	64	Clay
64	69	Sandy clay stringers
69	100	Clay
100	105	Loose sand
105	125	Yellow clay
125	130	Course gravel & sand and shale
130	136	Yellow clay
136	143	Loose sand & layered shale
143	160	Hard yellow clay
160	182	Hard layer of shale
182	214	Hard yellow clay
214	221	Hard yellow clay with layer of hard shale
221	229	Loose sand and gravel
229	233	Hard yellow clay
233	242	Broken shale
242	259	Hard yellow clay
259	279	Loose sand & small gravel
279	312	Hard clay and shale
312	331	Hard sandy yellow shale
331	349	Sand gravel, layers of shale
349	354	Sandy blue clay
354	360	Sand, gravel and shale
360	370	Hard blue clay
370	390	Sand and gravel
390	410	Hard clay

Work started 12/2 19 75 Completed 12/9 19 75

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME E. E. LUHDORFF CO., INC.
(Person, firm, or corporation) *(Typed or printed)*

Address P. O. BOX 1326
WOODLAND, CALIFORNIA 95695

[SIGNED] (Well Driller)

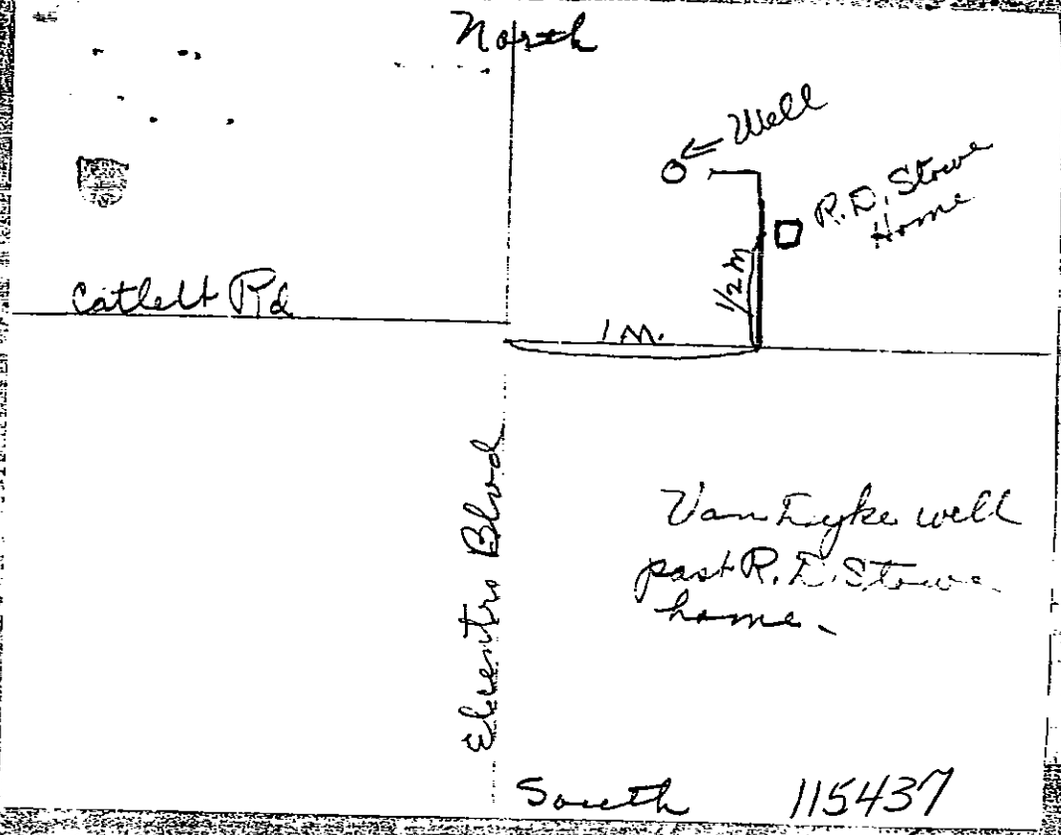
License No. 276625 Dated 1-9, 1976

SKETCH LOCATION OF WELL ON REVERSE SIDE

CONFIDENTIAL LOG
Water Code Sec. 13752

DWR 188 (REV. 9-68)

67139-750 8-72 30M TRIP ⓘT OSP



115437

RECEIVED
DIV. OF WATER RESOURCES
SACRAMENTO
1951 OCT 9 AM

51-831

USGS-CAL-T1
May 1948

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES BRANCH

No. 12/ AE - 3681

Other Nos.

WELL LOG

State California County Sutter Subarea Pleasant Grove

Owner

Location

Drilled by Kirchgater Address

Date 1947 Casing diam. 8" Land-surf. alt. 50

Source of data

(Enter type of well, perforations, yield, and drawdown at end of log)

Correlation	Material	Thickness (feet)	Depth (feet)
	Soil		1
	~~Adobe~~		~~2~~
	Hardpan		4
	~~Clay, yellow~~		~~17~~
	Clay, white		28
	~~Sandstone, soft~~		~~78~~
	Clay, yellow		114
	~~Sand and clay~~		~~119~~
	Clay		182
	~~Clay, hard and small gravel~~		~~200~~
	Clay, hard		275
	~~Coarse sand, small gravel and white clay~~		~~280~~
	Sand, fine		308
	~~Clay~~		~~310~~
	Sand and gravel, cemented		325
	~~Clay, blue~~		~~350~~
	Shale		372
	~~Shale, sand and blue clay~~		~~390~~
	Well began to sluff in from 360-390'		
	~~Water level 25'~~		

Record by Date Sheet of

DUPLICATE
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPO

51-832

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES

Do Not Fill In 120

State Well No.
Other Well No. 12/4-~~34~~
Region 5 (36 H)

CONFIDENTIAL

(1) DRILLER: (person, firm, or corporation)
Name Frank P. Conley
Address 432 - Feather River Blvd.
Marysville, Calif.

OWNE
Name
Address

(2) Proposed Use (*Check*)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other ✓	☐

Equipment

Rotary	☐
Cable	☒
Dug Well ✓	☐
Other	☐

(3) CASING: 1 - X
60 ft. of 12 in 10 lb./ga. casing 60 left in well
" " " " " " " "
" " (.34) " " " " "
" " " " " " " "
" " " " " " " "
Type and size of shoe or well ring 12" 3 X 3/8 1 - 0.25 0.5

(4) PERFORATIONS:
Type of perforator used burnt with acetylene
Perforated 155 ft. to 175 ft. 6 holes per 12 in.
" " " " " "
" " " " " "
" " " " " "
" " " " " "
" " " " " "
" " " " " "
" " " " " "
" " " " " "
" " " " " "
Diameter of perforations 1/8 in., length 3 in.

(5) WATER LEVELS:
Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
Depth at which water was first found 30 ft.
Standing level before perforating 30 ft.
Standing level after perforating 30 ft.
Note your observation of any change in water level while drilling
Was a surface sanitary seal provided? No

(6) WELL PUMPING TEST:
Capacity gal./min. ft. draw down
Was well gravel packed? No ✓
Were any strata sealed against pollution? Casing driven into clay
Temperature Was a chemical analysis made? Attach copy
If abandoned was well capped?

(7) TYPE OF WORK (*check*):
New well ☐ Reconditioning of well ☒
Deepening existing well ☐

(8) LOCATION OF WELL:
County Sutter
R. F. D. or Street No.
Catlett Rd. - 1 mile east of Pleasant Grove Rd.

(9) WELL LOG: Old well 215 ft
Total depth of well 380 Caved in to 160 ft.

Formation: Mention size of water gravel—

160 ft. to	215 ft.	sand
215 "	225 "	gray clay
225 "	270 "	decomposed granite
270 "	290 "	clay
290 "	300 "	fine shale
300 "	370 "	clay
370 "	380 "	sand

FOR OFFICIAL USE ONLY

Work started Nov. 24 19 , Completed Dec. 15 1952
Date of Report Jan. 2 , 1953

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Frank P. Conley 506
Well Driller
By Bernice Freeborn
License No. 105346 Classification C57
Dated Jan 2 , 1953

46370 7-51 30M QUIN SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPOR

31-045 N CHECKED
Do Not Fill In

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES 108

State Well No. 12N/5E-34H1
Other Well No. 12N-5E-~~35~~ 34 H1
Region

(1) DRILLER: (person, firm, or corporation)

Name William Flynn
Address Box 26 Sutter, Calif

OWNER:

Name
Address

(2) Proposed Use (*Check*)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other	☐

Equipment

Rotary	☐
Cable	☒
Dug Well	☐
Other	☐

(3) CASING:

150 ft. of 16 in 3/16 lb./ga. casing 150 left in well
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "

Type and size of shoe or well ring 16" X 3/4" X 6"

(4) PERFORATIONS:

Type of perforator used Mills

Perforated 140 ft. to ~~148~~ ft. 16 holes per ft. per in.
" " 148 " " " " "
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "

Diameter of perforations 1/2 in., length 2 in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
Depth at which water was first found 110 ft.
Standing level before perforating 48 ft.
Standing level after perforating 48 ft.
Note your observation of any change in water level while drilling
Was a surface sanitary seal provided?

(6) WELL PUMPING TEST:

Capacity 850 gal./min. 105 ft. draw down
Was well gravel packed? no
Were any strata sealed against pollution? no
Temperature Was a chemical analysis made? Attach copy
If abandoned was well capped?

(7) TYPE OF WORK (*check*):

New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(8) LOCATION OF WELL:

County Placer
R. F. D. or Street No. 7 1/2 mi. east of Pacific Ave. on Catlett Rd. and 1/8mi. north of Catlett Rd. (Pacific Ave is 1 mi. east of East Nicolaus)

(9) WELL LOG:

Total depth of well 470 ft.

Formation: Mention size of water gravel—

0	ft. to	4	ft.	top soil
4	"	110	"	yellow clay
110	"	140	"	red clay
140	"	145	"	packed sand & gravel
145	"	233	"	yellow clay
233	"	274	"	cemented gravel
274	"	331	"	blue clay
331	"	352	"	lava ash
352	"	403	"	blue clay
403	"	408	"	hard sand
408	"	420	"	white clay
420	"	427	"	packed gravel
427	"	465	"	white clay
465	"	470	"	sand and gravel

CONFIDENTIAL
Section 7076.1, Water Code

RECEIVED

FOR OFFICIAL USE ONLY

Work started 4/23/54 19 , Completed 5/29/54 19
Date of Report 6/5/54 , 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] Wm F Flynn
Well Driller

By
License No. 97194 Classification S.C.57
Dated 6/5/54 , 19

46370 7-51 30M QUIN ① SPO

12N/5E-34K1

JUL 20 1967

ORIGINAL
File with DWR

WATER WELL DRILLERS REPORT

(Sections 7079, 7080, 7081, 7082, Water Code)

THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

890

Do Not Fill In

No. 9468

State Well No. 12N/5E-34K1

Other Well No. 12N/SE-34K1

(1) OWNER:

Name

Address

(2) LOCATION OF WELL:

County Placer Owner's number, if any

Township, Range, and Section 12N/5E-34K1

Distance from cities, roads, railroads, etc. 2½ Mi. east of Brewer Rd. on Pleasant Grove Rd.

(3) TYPE OF WORK *(check)*:

New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE *(check)*:

Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [ ]
Cable [X]
Other [ ]

(6) CASING INSTALLED:

STEEL: OTHER:

SINGLE [X] DOUBLE [ ]

From ft.	To ft.	Diam.	Gage or Wall
0	100	10	10

If gravel packed

Diameter of Bore	From ft.	To ft.

Size of shoe or well ring: ½" X 6" X 10" Spun steel

Describe joint ark but welded

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen None

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes [ ] No [X] To what depth ft.

Were any strata sealed against pollution? Yes [ ] No [X] If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing

(9) WATER LEVELS:

Depth at which water was first found, if known 89 ft.

Standing level before perforating, if known 75 ft.

Standing level after perforating and developing ft.

(10) WELL TESTS:

Pump test made? Yes [ ] No [X] If yes, by whom?

gal./min. with ft. drawdown after hrs.

erature of water Was a chemical analysis made? Yes [ ] No [X]

Was electric log made of well? Yes [ ] No [X] If yes, attach copy

(11) WELL LOG:

Total depth 145 ft. Depth of completed well 145 ft.

Formation: *Describe by color, character, size of material, and structure*

0	to	1	top soil	ft.
1	"	3	hard pan	
3	"	22	red hard clay	
22	"	36	red silty clay	
36	"	62	yellow hard silty clay	
62	"	74	red tough clay	
74	"	78	yellow clay	
78	"	81	gravel & clay mix	W.B.
81	"	96	red silty clay	
96	"	104	red & yellow tough clay	
104	"	107	brown coarse cemented sand	W.B.
107	"	123	gray coarse tight sand	W.B.
123	"	138	Gray sand & small gravel	W.B.
138	"	145	tight med. & small gravel	W.B.

Plotted and Coded
As Well 12N/5E-34K80

FOR OFFICIAL USE ONLY

Work started May 29 19 67, Completed June 7, 19 67

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME LYLE W. CORNELIUS
Well Drilling Contractor
(Person, firm, or corporation) (Type or printed)

Address 1820 First Ave. GI 8-6410
~~Sacramento 18, Calif.~~

[SIGNED] Lyle W. Cornelius
(Well Driller)

License No. 142613 Dated June 10, 1967

SKETCH LOCATION OF WELL ON REVERSE SIDE

56391-950 10-65 50M TRIP ① △ OSP

Geologic Section C-C’

ORIGINAL
File with DWR

CONFIDENTAL LOG Water Code Sec. 7080

WATER WELL DRILLERS REPORT

(Sections 7079, 7080, 7081, 7082, Water Code)

THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Do Not Fill In

No. 9491

State Well No. 11N/3E-36P1

Other Well No. 11N/3E-36P1

(1) **OWNER:**

Name

Address

(2) **LOCATION OF WELL:**

County Sutter Owner's number, if any 483-7122

Township, Range, and Section T- R- S-

Distance from cities, roads, railroads, etc. 62' west of center Garden Highway & 100 ' north Rego Rd.

(3) **TYPE OF WORK** *(check):*

New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]

If destruction, describe material and procedure in Item 11.

(4) **PROPOSED USE** *(check):*

Domestic [XX] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

(5) **EQUIPMENT:**

Rotary [ ]
Cable [XX]
Other [ ]

(6) **CASING INSTALLED:**

STEEL: OTHER:
SINGLE [X] DOUBLE [ ]

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
minus 6'	157	8"	10			

If gravel packed

Size of shoe or well ring: 1/2" X 4" X 8" Size of plow steel

Describe joint Ark but welded

(7) **PERFORATIONS OR SCREEN:**

Type of perforation or name of screen none

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.

(8) **CONSTRUCTION:**

Was a surface sanitary seal provided? Yes [X] No [ ] To what depth 8 ft.

Were any strata sealed against pollution? Yes [ ] No [X] If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing

(9) **WATER LEVELS:**

Depth at which water was first found, if known 38 ft.

Standing level before perforating, if known 19 ft.

Standing level after perforating and developing ft.

(10) **WELL TESTS:**

Was pump test made? Yes [X] No [ ] If yes, by whom? Cornelius

Yield: 300 gal./min. with 11 ft. drawdown after 4 hrs.

Temperature of water Was a chemical analysis made? Yes [ ] No [X]

Was electric log made of well? Yes [ ] No [X] If yes, attach copy

(11) **WELL LOG:**

Total depth 171 ft. Depth of completed well 170 ft.

Formation: *Describe by color, character, size of material, and structure*

0' to 3 ft.	sandy top soil	
3 " 6'	fine sand	
6 " 19'	brown doby clay	
19 " 38'	blue silty clay	
38 " 40'	fine packed sand	W.B.
40 " 64'	blue doby clay	
64 " 70'	blue cemented sand	
70 " 83'	sand & small gravel	W.B.
83 " 126'	blue crumbly clay	
126 " 134'	blue stickey clay	
134 " 138'	blue packed sand	W.B.
138 " 143'	blue stickey clay	
143 " 148'	blue fine quick sand	W.B.
148 " 157'	blue tough sandy clay	
157 " 171'	dark sand & small gravel	W.B.
171 "	large gravel	W.B.

CONFIDENTAL LOG
Water Code Sec 7080

Work started 6 / 20 1969 , Completed 6 / 26 1969

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME LYLE W. CORNELIUS
Well Drilling Contractor
1820 First Ave. GI 8-6410
(Person, firm, or corporation) (Typed or printed)
Sacramento 18, Calif.

Address

[SIGNED] Lyle W. Cornelius
(Well Driller)

License No. 142613 Dated June 27, 1969

SKETCH LOCATION OF WELL ON REVERSE SIDE

56391-950 10-65 50M TRIP ① △ OSP

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

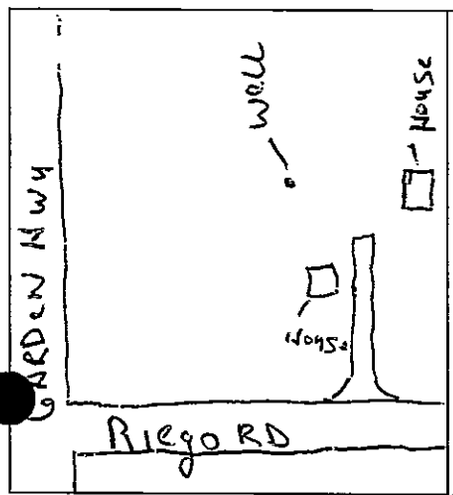
Do not fill in
No. 280943

Notice of Intent No. 246643
Local Permit No. or Date 35-030-015

State Well No.
Other Well No. 11N03E36R

(1)
A
C

(2) LOCATION OF WELL (See instructions):
County SUTTER Owner's Well Number
Well address if different from above 5341 W. Riego RD
Township 11N Range 4E Section 36
Distance from cities, roads, railroads, fences, etc.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☐
Cable ☒ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☒ Size
Diameter of bore
Packed from ft. to ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
0	145	8"	.156

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 21 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.
Method of sealing Bent Seal

(10) WATER LEVELS:
Depth of first water, if known ft.
Standing level after well completion 15' ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☐ If yes, by whom?
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test ft. At end of test ft.
Discharge gal/min after hours Water temperature
Chemical analysis made? Yes ☐ No ☐ If yes, by whom?
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 165 ft. Completed depth ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	3	TOP SOIL
3	15	BROWN STICKY CLAY
15	17	BLUE CLAY
17	28	BROWN CLAY
28	29	SAND W.B.
29	64	BROWN CLAY
64	65	SAND
65	99	BROWN CLAY
99	141	BLUE CLAY
141	143	SAND
143	158	BLUE CLAY
158	165	SAND & GRAVEL

Work started 1-10 1990 Completed 1-23 1990

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed (Well Driller)
NAME G. CAKIN Well Drilling (Person, firm, or corporation) (Typed or printed)
Address 10550 LOWELL ST.
City ELVERTA ZIP 95626
License No. 374391 Date of this report 1-24-90

ONLINE NOT FOR PUBLIC USE WATER CODE SEC. 13752

ORIGINAL
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No. _____
(Insert appropriate number)

WATER WELL DRILLERS REPORT
(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA 481

[redacted] LOCATION NOT CHECKED

Do Not Fill In
No. 32889

State Well No. _____
Other Well No. 11/4 32R3

(1) OWNER:
Name _____
Address _____

(2) LOCATION OF WELL:
County Sutter Owner's number, if any—
R. F. D. or Street No.
550' W of Marysville Rd.
1500' N of Base Line Road

(3) TYPE OF WORK (*check*):
New well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (*check*):
Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) EQUIPMENT:
Rotary [ ]
Cable [X]
Dug Well [ ]

(6) CASING INSTALLED:
SINGLE [X] DOUBLE [ ]

From ft.	to ft.	Diam.	Gage or Wall
0	76	12	12

Type and size of shoe or well ring 1/2x4x12
Describe joint Welded

If gravel packed

Diameter of Bore	from ft.	to ft.

Size of gravel:

(7) PERFORATIONS:
Type of perforator used
Size of perforations in., length, by in.

From ft.	to ft.	Perf. per row	Rows per ft.

(8) CONSTRUCTION:
Was a surface sanitary seal provided? [X] Yes [ ] No To what depth 76 ft.
Were any strata sealed against pollution? [ ] Yes [ ] No If yes, note depth of strata
From 0 ft. to 76 ft.
Method of Sealing Welded

(9) WATER LEVELS:
Depth at which water was first found 46 ft.
Standing level before perforating ft.
Standing level after perforating ft.

(10) WELL TESTS:
Was a pump test made? [ ] Yes [ ] No If yes, by whom?
Yield: gal./min. with ft. draw down after hrs.
Temperature of water Was a chemical analysis made? [ ] Yes [ ] No
Was electric log made of well? [ ] Yes [ ] No

(11) WELL LOG:
Total depth 187 ft. Depth of completed well 185 ft.
Formation: *Describe by color, character, size of material, and structure.*

0'	3'	Top Soil
3	10	Hardpan & Sand
10	23	Clay, gray
23	32	Clay, brown
32	64	Clay, gray
64	70	Sediment, gray
70	74	Sand
74	150	Clay, gray
150	165	Sandy
165	175	Sediment, blue
175	187	Sand, coarse

CONFIDENTIAL
Water Code
Section 7076.1.

FOR OFFICIAL USE ONLY

Work started April 19 56 Completed — 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME E. C. Keables, Well Drilling
(Person, firm, or corporation) (*Typed or printed*)
Address 1700 Glenrose Ave.
N. Sacramento 15, Calif.

[SIGNED] E C Keables
Well Driller
License No. 157234 Dated April, 1956

95689 3-54 50M QUIN ⑤ SPO

DWR FORM NO. 246 (REV. 3-54)

DWR Log No: 51-095 MD 11N/4E-33J1

REGION

COUNTY Sutter

NEAR State - California

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

WELL LOG

BASIN

DWR NO. ; B & M

OTHER Nos. 32-16
11N 3EJ1
11/4E-33 51

LOCATION

SUBAREA Vernon

OWNER ADDRESS

DRILLED BY Thomas J. Fulton ADDRESS Casing diam. 16, 14, and 12"

DRILLING METHOD GRAVEL PACKED DATE COMPLETED Sept. 1947

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION Owner

(Enter type of well, perforations, yield, and drawdown at end of log)

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICK-NESS	SP. YIELD %
13		Soft top soil		
16		Brown sand		
32		Gray with pieces brown clay		
39		Soft brown clay		
40		Pea gravel		
71		Hard dark brown clay		
91		Soft brown clay		
93		Black burnt sand		
96		Soft gray sand		
101		Hard gray sand		
139		Soft brown clay		
143		Hard black sand		
145		Black sand		
156		Hard gray clay		
163		Blue clay		
164		Gray sand		
175		Hard blue clay		
181		Soft gray sand		
183		Hard gray sand		
196		Cemented sand and gravel		
199		Hard yellow clay		
201		Gray sand		
219		Soft blue clay		
221		Black sand		
243		Soft blue clay		
247		Hard blue clay		
251		Soft blue clay		
252		Blue sand		
271		Hard blue clay		

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE SHEET 1 OF

FORM 263. 47655 7-51 5M ② SPC

DWR Log No: 51-095 MD 11N/4E-33J1

REGION

COUNTY

NEAR

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

WELL LOG

BASIN

DWR NO. : B & M

OTHER NOS. 32-16
114 33J1
11/4E-33 5/

LOCATION

OWNER ADDRESS

DRILLED BY ADDRESS

DRILLING METHOD GRAVEL PACKED DATE COMPLETED

SIZE OF CASING DEPTH STRUCK WATER AT

PERFORATIONS SIZE No.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD ANALYSIS

SURFACE ELEV. DATUM SOURCE OF INFORMATION

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICK-NESS	SP. YIELD %
283		Hard blue shale		
285		Hard blue sand and caving small pieces of clay		
		Perforated 82-102, 148-168'		

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE SHEET 1 OF

FORM 263. 47865 7-51 5M ® SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES 305

DWR Log No: 51-099
LOCATION ~~NOT~~ CHECKED
Do Not Fill In
State Well No. 11N/4E-34J1
Other Well No. 11N/4E-~~6~~ 34J1
Region

(1) DRILLER: (person, firm, or corporation)
Name E. C. Keables
Address 1700 Glenrose Ave.
Sacramento 15, Calif.

OWNER:
Name
Address

(2) Proposed Use (*Check*)

				Equipment	
Domestic	☐	Industrial	☐	Rotary	☐
Irrigation	☒	Test Well	☐	Cable	☒
Municipal	☐	Other	☐	Dug Well	☐
				Other	☐

(3) CASING:
100 ft. of 14 in. 12 lb./ga. casing 100 left in well
" " " " " "
50' 12" 12G Liner- perf. 30' " " "
40' 10" 12G Liner- perf 16' " " "
" " " " " "
Type and size of shoe or well ring 14"

(4) PERFORATIONS:
Type of perforator used

Perforated	ft. to	ft.	holes per	in.
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"

Diameter of perforations in., length in.

(5) WATER LEVELS:
Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
Depth at which water was first found 24 ft.
Standing level before perforating ft.
Standing level after perforating ft.
Note your observation of any change in water level while drilling
Was a surface sanitary seal provided? Yes

(6) WELL PUMPING TEST:
Capacity gal./min. ft. draw down
Was well gravel packed?
ere any strata sealed against pollution?
Temperature Was a chemical analysis made? Attach copy
If abandoned was well capped?

(7) TYPE OF WORK (*check*)**:**
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(8) LOCATION OF WELL ~~LOCATION~~ ~~QUESTIONABLE~~
County Sutter
R. F. D. or Street No.
2376 Ft. N. Riego Rd.
3840' W of Western Pacific RR

(9) WELL LOG:
Total depth of well 275 Ft. ft.
Formation: Mention size of water gravel—

1	ft. to	2	ft.	Top Soil
2	"	3	"	Hardpan
3	"	40	"	Clay & Granite Sand
40	"	90	"	Clay
90	"	98	"	Sand, hard
98	"	150	"	Clay
150	"	156	"	Sand, hard
156	"	165	"	Clay
165	"	171	"	Sand, soft
171	"	176	"	Clay
176	"	192	"	Sand
192	"	229	"	Clay
229	"	250	"	Sand
250	"	255	"	Clay
255	"	265	"	Sand, hard
265	"	275	"	Sand, soft
~~275~~	"		"	

FOR OFFICIAL USE ONLY

Work started Mar. 30, 1953 Completed 4/13/53 19
Date of Report April 30, 1953 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] E. C. Keables
Well Driller
By Owner
License No. 119760 Classification C-57
Dated June 9, 1954, 19

45270 7-51 30M QUIN ① SPO

~~LOCATION NOT CHECKED~~

ORIGINAL
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No._____
(Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

683

Do Not Fill In
No. 45210 35J1
State Well No. 11N/4E-[redacted]
Other Well No. 11N/4E-~~35R~~

(1) OWNER:

Name
Address

(2) LOCATION OF WELL:

County Sutter Owner's number, if any—
R. F. D. or Street No. (Pleasant Grove Rd
342' W Old Marysville Rd.
474' N. Riego Road

(3) TYPE OF WORK (*check*):

New well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (*check*):

Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [ ]
Cable [X]
Dug Well [ ]

(6) CASING INSTALLED:

SINGLE [X] DOUBLE [ ]

From ft.	to ft.	Diam.	Gage or Wall
1	20	12	12

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring none
Size of gravel:
Describe joint

(7) PERFORATIONS:

Type of perforator used
Size of perforations in., length, by in.

From ft.	to ft.	Perf. per row	Rows per ft.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? [X] Yes [ ] No To what depth 20 ft.
Were any strata sealed against pollution? [ ] Yes [ ] No If yes, note depth of strata

From ft.	to ft.	

Method of Sealing

(9) WATER LEVELS:

Depth at which water was first found 54 ft.
Standing level before perforating ft.
Standing level after perforating ft.

(10) WELL TESTS:

Was a pump test made? [ ] Yes [ ] No If yes, by whom?
Yield: gal./min. with ft. draw down after hrs.
Temperature of water Was a chemical analysis made? [ ] Yes [ ] No
Was electric log made of well? [ ] Yes [ ] No

(11) WELL LOG:

~~35R~~

Total depth 133 ft. Depth of completed well 133 ft.

Formation: *Describe by color, character, size of material, and structure.*

ft.	to ft.	
0	3	Top Soil
3	50	Clay
50	52	Sand
52	128	Clay
128	133	Sand

official NO. 11N/4E-35J1
plots in 35 RJ
plot .1 mi W of
P.G. Rd, .26 mi N of
Riego Rd

CONFIDENTIAL
Section 7076.1, Water Code

FOR OFFICIAL USE ONLY

Work started 6/2/58 19 , Completed 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME E. C. Keables, Well Drilling
(Person, firm, or corporation) (Typed or printed)
Address 1700 Glenrose Ave., N. Sacto., 15
California

[SIGNED] E C Keables
Well Driller

License No. 157234 Dated Jan., 19 59

95669 3-54 50M QUIN SPO DWR FORM NO. 246 (REV. 3-54)

DUPLICATE
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES

9168

DWR Log No: 51-199 / 1

Do Not Fill In

State Well No.

Other Well No. 11/-

Region

(1) DRILLER: (person, firm, or corporation) 101

Name E. C. Keables

Address 1700 Glenrose Ave., Sacramento, Calif.

OWNER

Name

Address

(2) Proposed Use (*Check*)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other 2	☐

Equipment

Rotary	☐
Cable	☒
Dug Well 2	☐
Other	☐

(3) CASING: 1-X

88 ft. of 14 in 12 X/ga. casing 88 left in well

122 " " " " " " "

34 Ft. Liner from 138' to 172' " " "

Type and size of shoe or well ring 14" 1-X

(4) PERFORATIONS: 0

Type of perforator used

Perforated	ft. to	ft.	holes per	in.
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"
"	"	"	" "	"

Diameter of perforations in., length in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.

Depth at which water was first found 34 ft.

Standing level before perforating ft.

Standing level after perforating ft.

Note your observation of any change in water level while drilling

Was a surface sanitary seal provided? Yes 1-3

(6) WELL PUMPING TEST:

Capacity gal./min. ft. draw down

Was well gravel packed? 2

Were any strata sealed against pollution? 2

Temperature Was a chemical analysis made? Attach copy

If abandoned was well capped?

(7) TYPE OF WORK (*check*):

New well ☒ Reconditioning of well ☐

Deepening existing well ☐

(8) LOCATION OF WELL:

County Sutter

R. F. D. or Street No.

2376' N Reigo Rd.
1200' W of W.P. Railroad

(9) WELL LOG:

Total depth of well 290 ft.

Formation: Mention size of water gravel—

ft. to	ft.	
1	3	Top Soil
3	21	Hardpan
21	60	Clay
60	85	Sand
85	99	Clay
99	106	Sand
106	120	Clay
120	125	Sand
125	150	Clay
150	172	Sand
172	275	Clay
275	290	Sand, Coarse

FOR OFFICIAL USE ONLY

Work started 4/5/51 19 , Completed 4-[illegible]/ 19

Date of Report July 1952 , 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] E. C. Keables / 1

Well Driller

By E C Keables

License No. 96347 Classification C-57

Dated , 19

46370 7-51 30M QUIN SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

31-010

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SHEET 1

11N 5E 26L2

Do Not Fill In
State Well No. 11N/5E-26L2
Other Well No.
Region 5

Placer
31

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

(1) Driller:
Name V. J. McGrew
Address 304 W. El Camino
North Sacramento, California
License No. 17425 Classification A

Ov
Na
Ad

(2) Proposed use or uses (check):
Domestic ☐ Municipal ☐
Irrigation ☐ Industrial ☐
Domestic and Irrigation ☐ Test well ☐
Other Stock Well

(3) Equipment used (check):
Rotary ☐
Cable ☒
Dug well ☐
Other

(4) Type of work (check):
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

(5) Well log:
Total depth of well 100' ft.

Give details of formations penetrated, such as silt, peat, muck, sand, gravel, clay, shale, sandstone, hardpan, rock. Include size of gravel (diameter) and sand (fine, medium, coarse), color of material, structure (loose, packed, cemented, soft, hard, brittle).

Depth From Ground Surface						
0	ft. to	3	ft.	Top Soil	Red	
3	" "	9	"	Hard Pan	Yellow	
9	" "	12	"	Sand	Grey	Fine
12	" "	50	"	Clay Sandy	Yellow	Soft
50	" "	93	"	Clay	White	Packed
93	" "	100	"	Sand	Brown	Soft

Plotted and Coded
As Well 11N 5E 26L2

FOR OFFICIAL USE ONLY

If additional space is required, continue on DWR Form No. 246—Supplement, and attach to respective report copies.

(6) Casing left in well:

LENGTH FT.	DIAMETER INCHES	SINGLE, DOUBLE, WELDED, OTHER	LBS. PER FOOT OR GAGE OF CASING	SEATING BELOW GROUND SURFACE, FT.
4	6	Single	12 ga	3

Type and size of shoe or well ring None Welded joints—☒ Yes ☐ No

D.W.R. FORM NO. 246 REGIONAL WATER POLLUTION CONTROL BOARD COPY

23971 3-50 40M QUIN SPC

ORIGINAL
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

31-016

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RESOURCES 3/4

11N/5E-32G1

Do Not Fill In

LOCATION ~~NOT~~ CHECKED

State Well No.

Other Well No. 11N-5E-32

Region G1

(1) DRILLER: (person, firm, or corporation)

Name E. C. Keables

Address 1700 Glenrose Ave.
Sacramento 15, Calif.

OWNER: (Well #2) '53

Name

Address

(2) Proposed Use (*Check*)

Domestic	☐	Industrial	☐
Irrigation	☒	Test Well	☐
Municipal	☐	Other	☐

Equipment

Rotary	☐
Cable	☒
Dug Well	☐
Other	☐

(3) CASING:

224 ft. of 14 in 12 lb./ga. casing 224 left in well

44', 12" 12 G. Liner

132' 10" 12 G. Liner

Type and size of shoe or well ring 14"

(4) PERFORATIONS:

Type of perforator used

Perforated ft. to ft. holes per in.

Plotted and Coded
As Well 11N/5E-32G80

Diameter of perforations in., length in.

(5) WATER LEVELS:

Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.

Depth at which water was first found 36 ft.

Standing level before perforating ft.

Standing level after perforating ft.

Note your observation of any change in water level while drilling

Was a surface sanitary seal provided? Yes

(6) WELL PUMPING TEST:

Capacity gal./min. ft. draw down

Was well gravel packed?

Were any strata sealed against pollution?

Temperature Was a chemical analysis made? Attach copy

If abandoned was well capped?

(7) TYPE OF WORK (*check*):

New well ☒ Reconditioning of well ☐

Deepening existing well ☐

(8) LOCATION OF WELL:

County Sutter

R. F. D. or Street No.

2670' N. Base Line Rd.
3660' E of Brewer Rd.

(9) WELL LOG:

Total depth of well 614 Ft. ft.

Formation: Mention size of water gravel—

ft. to	ft.	
0	3	Top Soil
3	5	Hardpan & Sand
5	80	Clay
80	90	Sand
90	100	Clay
100	110	Sand, cemented
110	157	Clay
157	159	Sandy
159	212	Clay
212	216	Sand, hard
216	222	Sand (loose)
222	250	Clay
250	255	Sand
255	372	Clay
372	376	Sand
376	385	Clay
385	393	Sand
393	400	Clay
400	410	Sand
410	490	Clay
490	528	Sand
528	570	Clay
570	590	Sand
590	600	Clay
600	614	Sand, blue (loose)

CONFIDENTIAL
Section 7076.1, Water Code

RECEIVED
JUN 10 1954
FOR OFFICIAL USE ONLY

Work started Oct. 16 1953. Completed 12/14/53 19

Date of Report Dec. 30, 1953 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

[SIGNED] E. C. Keables
Well Driller

By Owner

License No. 119760 Classification C-57

Dated June 9, 1954 19

46370 7-51 30M QUIN ① SPO

ORIGINAL
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No. 5
(Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

106

LOCATION NOT CHECKED
No. 1994
State Well No. 11N/5E-34L1
Other Well No. 11N/5E-34L1

(2) LOCATION OF WELL:

County Placer Owner's number, if any—

R. F. D. or Street No.

1500' N. of Base Line Rd.
Sec. 33, T 11 N, R-5 E
4½ miles E of Riego

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:

SINGLE ☒ DOUBLE ☐

From ft. to	ft.	Diam.	Gage or Wall
½ above	139½	14	12

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring 14" 4 X 5/8

Size of gravel:

Describe joint buttweld

(7) PERFORATIONS:

Type of perforator used

Size of perforations in., length, by in.

From ft. to	ft.	Perf. per row	Rows per ft.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☐ Yes ☒ No To what depth ft.

Were any strata sealed against pollution? ☐ Yes ☒ No If yes, note depth of strata

From ft. to ft.

Method of Sealing

(9) WATER LEVELS:

Depth at which water was first found 60 ft.

Standing level before perforating 65 ft.

Standing level after perforating ft.

(10) WELL TESTS:

Was a pump test made? ☐ Yes ☒ No If yes, by whom?

Yield: gal./min. with ft. draw down after hrs.

Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:

Total depth 320 ft. Depth of completed well ft.

Formation: *Describe by color, character, size of material, and structure.*

ft. to	ft.	
0	1	top soil
1	5	hard pan
5	20	granulated formations
20	30	clay
30	35	coarse sand
35	60	clay
60	65	sandy - 1st water
65	70	clay
70	80	soft + sandy
80	110	clay
110	120	sandy clay
120	185	hard clay
185	195	soft
195	215	clay
215	225	light sand
225	250	hard clay
250	265	sand
265	275	clay
275	297	coarse sand
297	310	red clay
310	320	black sand

Plotted and Coded
As Well 11N, 5E 34L80

FOR OFFICIAL USE ONLY

Work started July 7 1954. Completed July 13 1954

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Frank P. Conley (Person, firm, or corporation) (Typed or printed)

Address 432 Feather River Blvd
Marysville, Calif

[SIGNED] Frank P. Conley
Well Driller

License No. 105346 Dated , 19

95689 3-54 2M QUIN ② SPO DWR FORM NO. 246 (REV. 3-54)

Appendix E: Levee Geologic Sections

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX E
Levee Geologic Sections

December 2021

Evaluation of Potential Groundwater Impacts Due to Proposed Construction for Natomas Levee Improvement Program

prepared for:

Sacramento Area Flood Control Agency
(SAFCA)

prepared by:

Luhdorff & Scalmanini,
Consulting Engineers

May 4, 2009

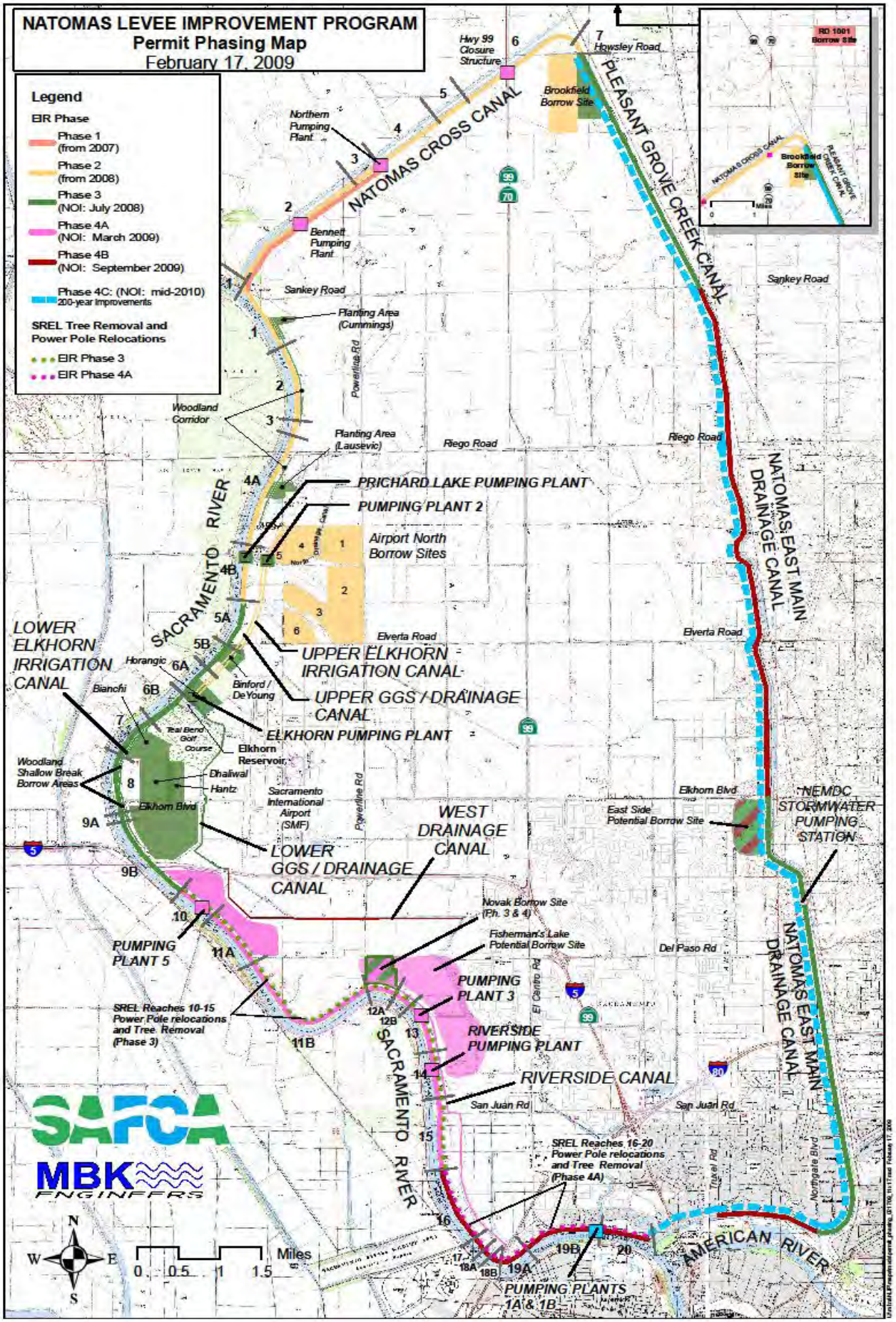
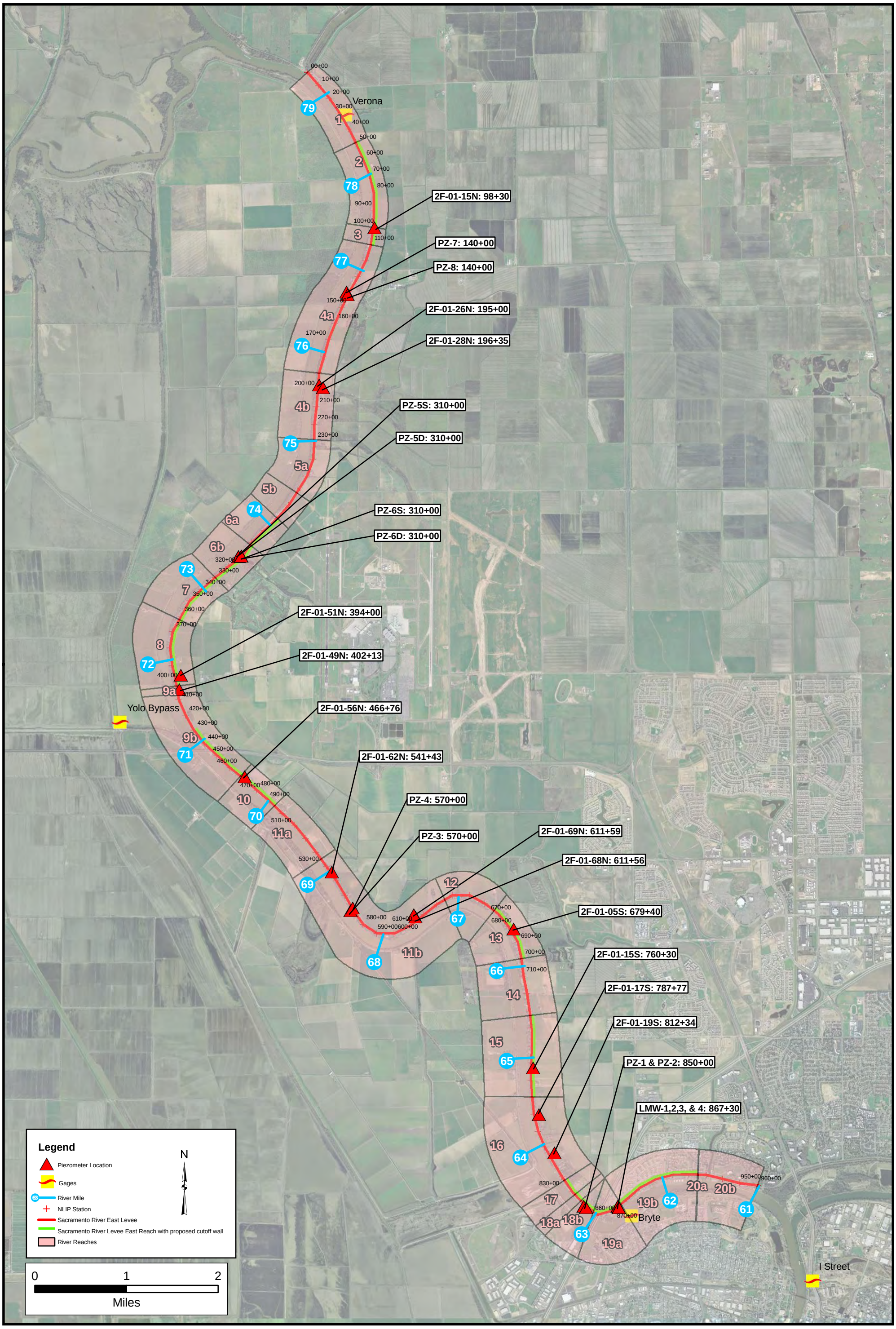


Figure 1-1
Proposed SAFCA Construction Locations for Natomas Levee Improvement Program



FILE: \public\SAFCA\GIS\Wells and Levee Location map.mxd

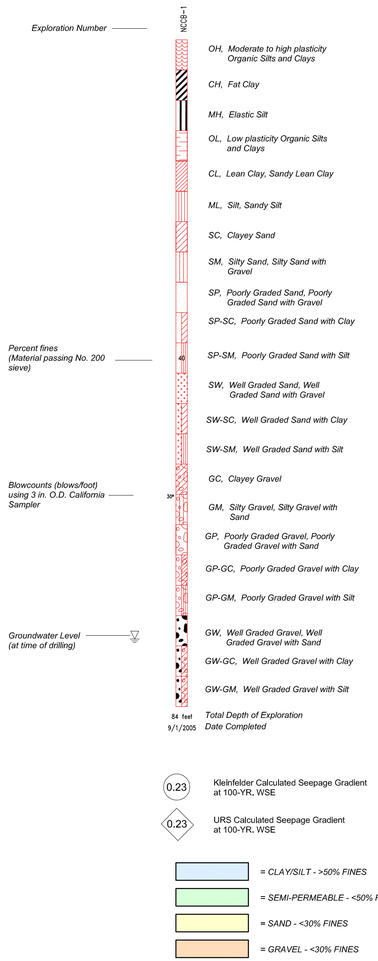
DATE: 1/30/2008 4:01:06 PM

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-1
Piezometer Locations Along Sacramento River East Levee in Natomas Basin

SUBSURFACE PROFILE
SACRAMENTO RIVER EAST LEVEE

LOG LEGEND



Notes:

1. Base drawings for these levee profiles, obtained in August 2005 from the Sacramento District U.S. Army Corps of Engineers (USACE) and used with their permission, include stick logs of previous explorations, a levee crown profile, a landside levee toe profile, notes regarding levee performance and completed levee improvements, and elevation scale based on the 1929 National Geodetic Vertical Datum (NGVD, 1929).

2. Logs of the following explorations were added to the USACE base drawings: Kleinfelder 2006 borings (SRE-06-XX); Kleinfelder 2005 borings (SRB-XX); Kleinfelder 2003/2004 Borings S-03-1, S-03-2, S-03-3, S-03-4.

3. Locations of explorations shown are approximate. See Plate 2A through 2E for approximate plan locations of explorations.

4. The log legend shown applies to Kleinfelder 2005 borings (SRB-XX) and Kleinfelder 2006 borings (SRE-06-XX). Caution is advised in using the legend for interpretation of other explorations.

5. Logs represent general soil conditions observed at the point of exploration on the date indicated. Refer to Kleinfelder's 2005 report and Kleinfelder's 2006 report for more detail on the Kleinfelder 2005 borings (SRB-XX) and 2006 borings (SRE-06-XX).

6. Lines separating strata on logs represent approximate boundaries only. Actual transitions may be gradual.

7. No warranty is provided as to the continuity of soil conditions between individual sample locations.

8. Approximate top of boring elevations for Kleinfelder 2006 borings (SRE-06-XX) were obtained using GPS equipment survey; Kleinfelder 2005 borings (SRB-XX) were estimated using topographic data obtained by USACE 1997.

9. The 1/100 AEP and 1/200 AEP water surface profiles shown were provided by MBK Engineerson August 18, 2006. See report for an explanation of these profiles and conditions.

10. Details regarding completed levee improvements have been added to those already on the USACE levee profile base drawings and were obtained from the USACE. Extents of completed levee improvements shown are approximate and are the same as indicated on the USACE profiles. Refer to USACE as-built drawings for actual extents.

KLEINFELDER

Drawn By: D. ROSS
Project No.: 72834AASRN
Date: 09/24/2007
Filename: 72834_P1.dwg

SACRAMENTO RIVER EAST LEVEE
Basis of Design Report
Sacramento River East Levee Reaches 1 through 4B
Natomas Basin Evaluation
Sacramento and Sutter Counties, California

PLATE
3A

© Kleinfelder, 2007

EXISTING STABILITY BERM

CUTOFF WALL TO BE CONSTRUCTED AS PART OF NATOMAS CROSS CANAL PROJECT

REACH 1
NONE

REACH 2
CUTOFF WALL TO ELEVATION -25 (65 FEET DEEP) OR 100-FOOT-WIDE SEEPAGE BERM

REACH 3
CUTOFF WALL TO ELEVATION -25 (65 FEET DEEP) OR 100-FOOT-WIDE SEEPAGE BERM

REACH 4A
DSM WALL TO ELEVATION -70 (110 FEET DEEP) OR 100-FOOT-WIDE SEEPAGE BERM OR RELIEF WELL 95 FEET DEEP (100 FOOT SPACING)

Natomas Cross Canal

EXISTING STABILITY BERM (TYP.)

Seepage Observed

LEVEE TOP ELEVATION (TYP.)

GROUND SURFACE ELEVATION NEAR LANDSIDE LEVEE TOE (TYP.)

RIEGO ROAD (2.36)

LEVEE MILES

1/200 AEP WATER SURFACE (200-YR WSE)

1/100 AEP WATER SURFACE (100-YR WSE)

ELEVATION, FEET

STATIONING, FEET

LEGEND

= CLAY/SILT - >50% FINES

= SEMI-PERMEABLE - <50% FINES

= SAND - <30% FINES

= GRAVEL - <30% FINES

URS 071000-168+00C

NOTE: SOME STICK LOGS HAVE BEEN MOVED IN ORDER FOR ALL DATA TO BE READABLE. REFER TO THE BORING LOCATION MAPS FOR ACCURATE STATIONING OF THESE EXPLORATIONS.

KLEINFELDER

Drawn By: D. ROSS
Project No.: 72834AASRN
Date: 09/24/2007
Filename: 72834_p1.dwg

SACRAMENTO RIVER EAST LEVEE PROFILE
Basis of Design Report
Sacramento River East Levee Reaches 1 through 4B
Natomas Basin Evaluation
Sacramento and Sutter Counties, California

PLATE 3B

© Kleinfelder, 2007

EXISTING CANAL

REACH 4A
DSM WALL TO ELEVATION -70 (110 FEET DEEP)
OR 100-FOOT-WIDE SEEPAGE BERM OR
RELIEF WELL 95 FEET DEEP (100 FEET SPACING)

REACH 4B
DSM WALL TO ELEVATION -70 (110 FEET DEEP) OR
100-FOOT-WIDE SEEPAGE BERM OR RELIEF WELL
95 FEET DEEP (100 FEET SPACING)

REACH 4C
DSM WALL TO ELEVATION -70
(110 FEET DEEP) OR 300-FOOT-WIDE
SEEPAGE BERM OR RELIEF WELL
95 FEET DEEP (100 FEET SPACING)

REACH 5A
CUTOFF WALL TO ELEVATION -30 (70 FEET DEEP)
OR 100-FOOT-WIDE SEEPAGE BERM

REACH 5B
CUTOFF WALL TO ELEVATION -30 (70 FEET DEEP)
OR 100-FOOT-WIDE SEEPAGE BERM

REACH 6
DSM WALL TO ELEVATION -70
(110 FEET DEEP) OR 300-FOOT-WIDE
SEEPAGE BERM OR RELIEF WELL
70 FEET DEEP (100 FEET SPACING)

RD 1000
PP #2
(3.77)

3

4 Landside Sloughing and
Seepage Boils in 1997

Landside Sloughing
1987

ELVERTA
ROAD
(4.9)

5

ELKHORN RESERVOIRS (5.74)

1/200 AEP
WATER SURFACE
(26.0 WSE)

1/100 AEP
WATER SURFACE
(10.0 WSE)

ELEVATION, FEET

STATIONING, FEET

URS 071000-168+00C

LEGEND

= CLAY/SILT - >50% FINES

= SEMI-PERMEABLE - <50% FINES

= SAND - <30% FINES

= GRAVEL - <30% FINES

NOTE: SOME STICK LOGS HAVE BEEN MOVED IN ORDER FOR ALL DATA TO BE READABLE. REFER TO THE BORING LOCATION MAPS FOR ACCURATE STATIONING OF THESE EXPLORATIONS.

KLEINFELDER

Drawn By: D. ROSS
Project No.: 72834AASRN
Date: 09/24/2007
Filename: 72834_p1.dwg

SACRAMENTO RIVER EAST LEVEE PROFILE
Basis of Design Report
Sacramento River East Levee Reaches 1 through 4B
Natomas Basin Evaluation
Sacramento and Sutter Counties, California

PLATE
3C

© Kleinfelder, 2007

Appendix F: Assessment of Assessment of Principal Aquifers

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX F
Assessment of Principal Aquifers

December 2021

APPENDIX F – ASSESSMENT OF PRINCIPAL AQUIFERS

This section provides a detailed hydrogeologic assessment of potential principal aquifers. It provides both historic definition of aquifers and current information to assess the number of principal aquifers.

The definition of principal aquifers must be supported by the geologic conditions, differences in groundwater levels, and water quality. The following sections provide a detailed discussion of aquifer conditions to demonstrate that the aquifers within the North American Subbasin can be considered to be one principal aquifer. Definitions of principal aquifers in adjacent subbasins are also included.

Historic Definition of Aquifers

The geologic units described above were grouped and separated into two aquifers, an Upper and Lower aquifer, by DWR for the North American Conjunctive Use Program (1997). "The division between the two aquifers is inexact, due to the difficulty in accurately determining the formation contacts". Figures 4-9 through 4-11 in Section 4.9 of the GSP show the extent of the principal aquifers on the geologic sections.

The Upper aquifer was defined as the upper 200 to 300 feet of the aquifer system. It includes the Quaternary Alluvium, Modesto, Riverbank, and Laguna Formations and consists of generally thin and laterally discontinuous sands and gravels separated by thick sequences of clay. Groundwater in the Upper aquifer occurs under generally unconfined conditions. It should be noted on the geologic sections that portions of the Mehrten Formation in the eastern portion of the Subbasin would also be included in the Upper aquifer.

The Lower aquifer was defined as extending from about 200 to 300 feet below ground surface to the base of freshwater. It consists of Mehrten Formation sediments. It should be noted that in the eastern portion of the Subbasin the Upper aquifer includes the Mehrten Formation as it raises to ground surface.

Geologic Conditions

There are no regionally extensive fine-grained layers in the subsurface that were identified by previous studies or during the development of the geologic profiles or by historic references that could be used to separate and define principal aquifers.

There may be a confining bed in the deeper portions of the Mehrten Formation that is not being used for water supply in the NASb. Groundwater under the confining bed typically has dissolved gases and manganese concentrations above the MCL. It was partially identified near Roseville, but only a few other wells in the area have been drilled deep enough, so the full extent is unknown.

Groundwater Levels

Nested monitoring wells provide some of the highest quality data and groundwater levels in the various penetrated aquifers. Figure F-1 shows the location of nested and clustered wells in the NASb along with selected wells to illustrate groundwater levels in the different aquifers. Appendix J contains hydrographs for all of the nested and clustered wells in the Subbasin and sorted by DWR's definition of the aquifers.

Figure F-1 shows that for the most part, groundwater levels in the DWR-defined aquifers are similar, with the maximum difference in levels being 23 feet and those wells only present in the western portion of the subbasin. In the western portion, groundwater levels in the upper portions of the Mehrten Formation track similar to those in the Laguna Formation. Greater groundwater level differences are present in the deeper portions of the Mehrten Formation. The amount of separation of water levels between some zones indicates increasing confinement and isolation with depth (DWR, 1977). Other than for the western portion of the Subbasin, there is not a significant difference in groundwater levels between the two aquifers and does not suggest two separate aquifers.

Although there are head differences between the aquifers, wells in the areas are responding in a similar manner, to pumping and effects of recharge. Figure F-2 shows the head differences across the subbasin at nested or clustered wells and illustrates the similar trends in the aquifers suggesting they are interconnected.

The hydrographs show that groundwater levels in the Upper and Lower aquifers have similar trends, indicating that the aquifers are connected and are not separate. There is a slight lag time of the responses in the Lower aquifer.

Groundwater Gradients

The groundwater gradients are similar between the Upper and Lower aquifers except for on the east side. The gradients in the Upper aquifer are steeper from the east than in the Lower aquifer potentially due to groundwater recharge effects being greater in the Upper aquifer than in the Lower aquifer. Table F-1 provides the gradients by aquifers.

Table F-1. Groundwater Gradients

	Groundwater gradients (ft/ft)			
Aquifers	West	East	North	South
Upper	0.001	0.06	0.001	0.002
Lower	0.002	0.002	0.001	ND

Aquifer Hydraulic Characteristics

Aquifer hydraulic characteristics can best be determined by pumping a well and measuring the drawdown in observation well(s), but this only provides information at a single location in a 342,000-acre basin. The basis of the aquifers are from DWR's SVSim model which uses textural classifications to estimate hydraulic characteristics to simulate groundwater

hydraulic characteristics on a basin wide scale. The principal aquifers defined by DWR were not based on hydraulic characteristics of sediments. Aquifer tests with this elevated level of testing could not be located.

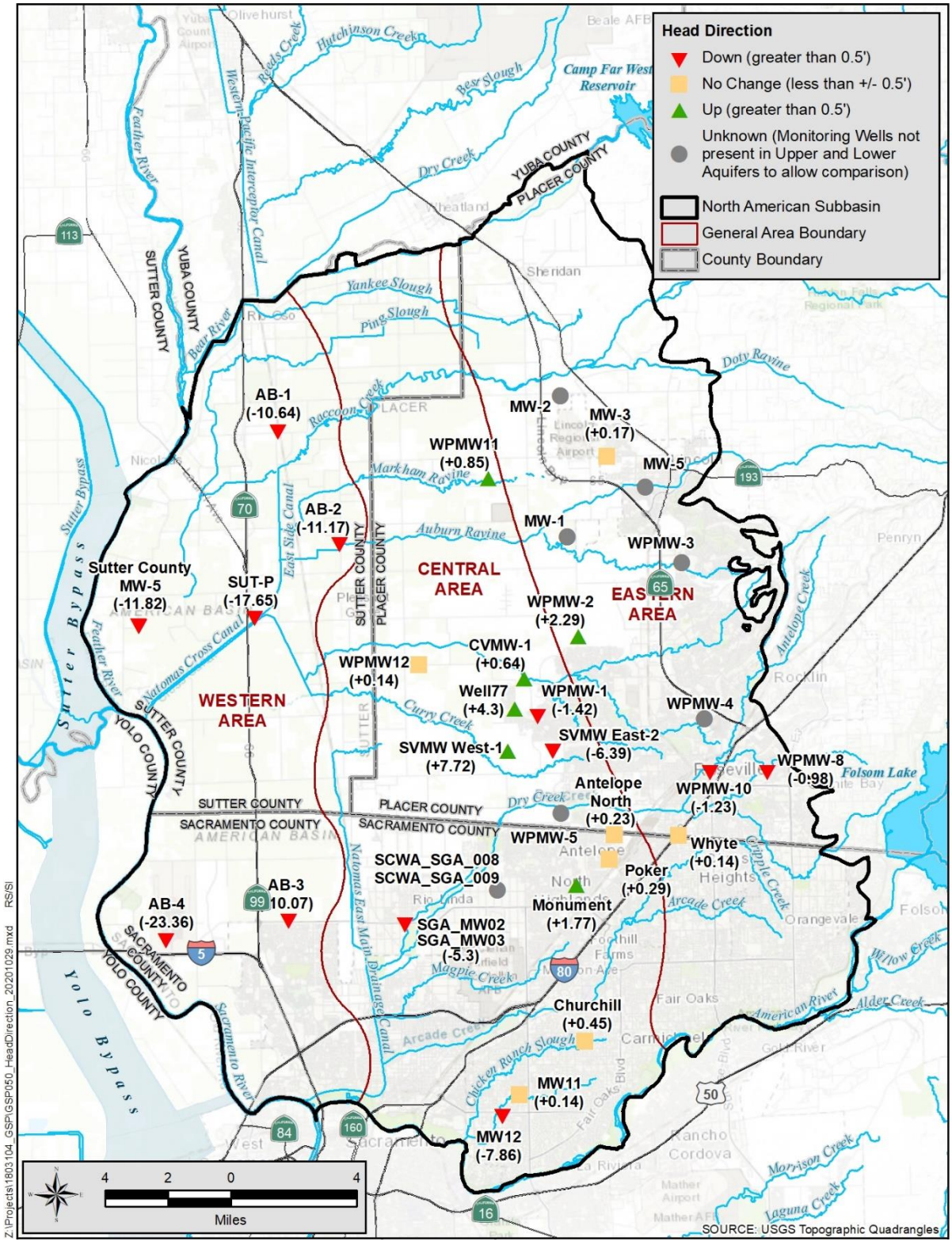


Figure F-1 Vertical Gradients Upper to Lower Aquifer – Fall 2019

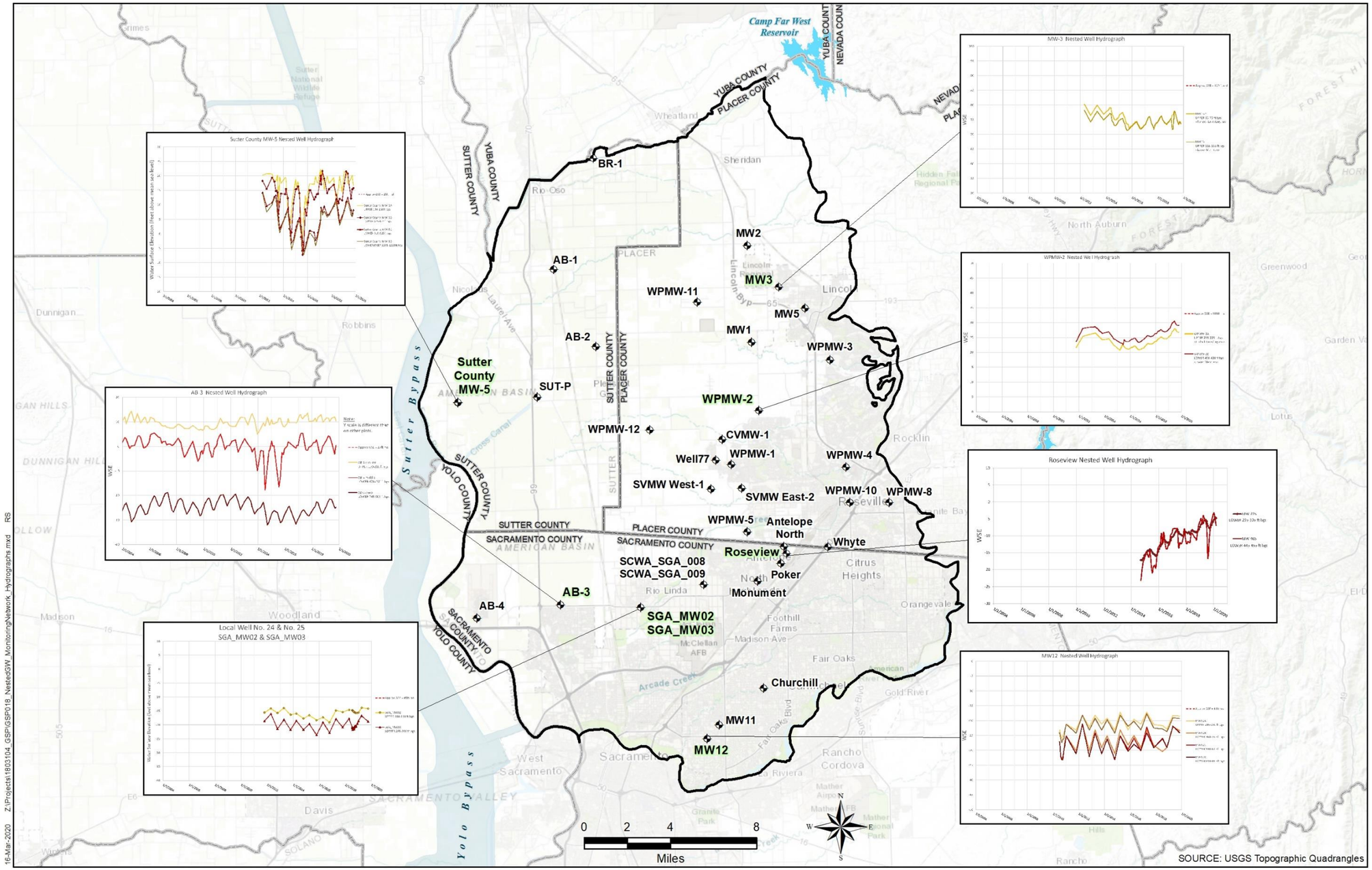


Figure F-2 Groundwater Level Trends

This page intentionally left blank.

General Water Quality

Figures F-3 and F-4 illustrate the distribution of total dissolved solids (TDS), a measure of the salt content, by the two DWR-identified aquifers in the central and western portion of the Subbasin and adjacent subbasins based on water quality sampling of depth-discrete monitoring wells that allowed vertical profiling of the groundwater quality in the various aquifers (GEI, 2020). The figures show that good quality water (green color and each ring representing one to three monitoring wells within the same aquifer) is present in the central portions of the Subbasin but poorer quality water (browns and reds) are present in the western portions of the Subbasin. Figure F-5 shows the distribution of the water quality in the subsurface by principal aquifers. The figure shows that water quality does not distinguish the DWR-defined principal aquifers.

Figures F-3 and F-4 show that high TDS groundwater is present along the western edge of the NASb. Figure F-5 shows the water quality in the western area is highly variable and not consistent by aquifer. Near surface groundwater, near the Feather River, contains high concentrations of TDS, along with elevated levels of chloride and nitrate, and its shallow depth suggests that it has been affected by agriculture. Underlying the near surface poor quality water is better quality water, but it also changes and varies with depth. There is also poor-quality water underlying the freshwater bearing aquifers, below the base of freshwater.

Number of Principal Aquifers

Based on the discussion above, there is not sufficient evidence to define two separate and distinct principal aquifers. Therefore, for the purposes of this GSP, the NASb only contains one principal aquifer.

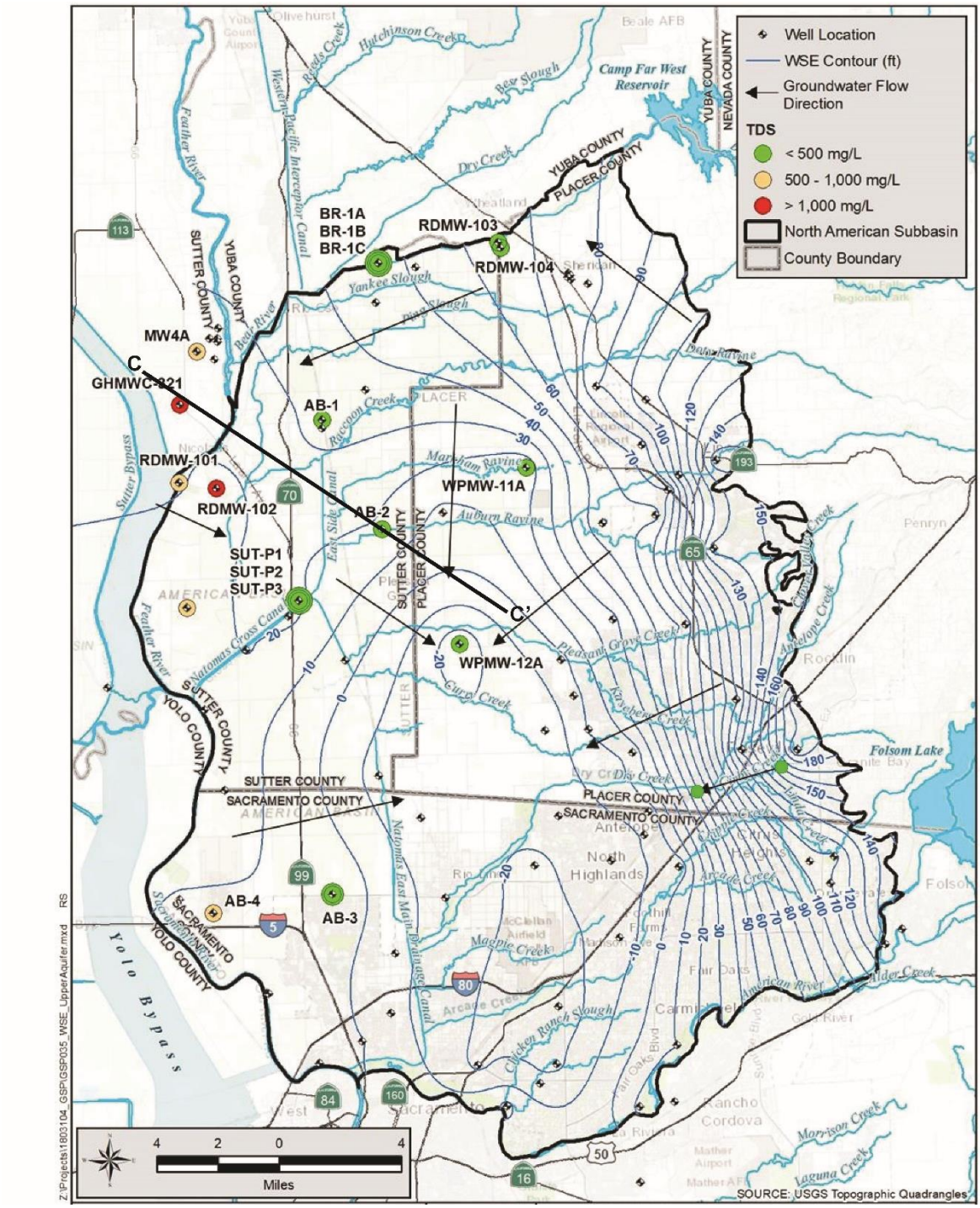


Figure F-3 Groundwater Quality Distribution Upper Aquifer

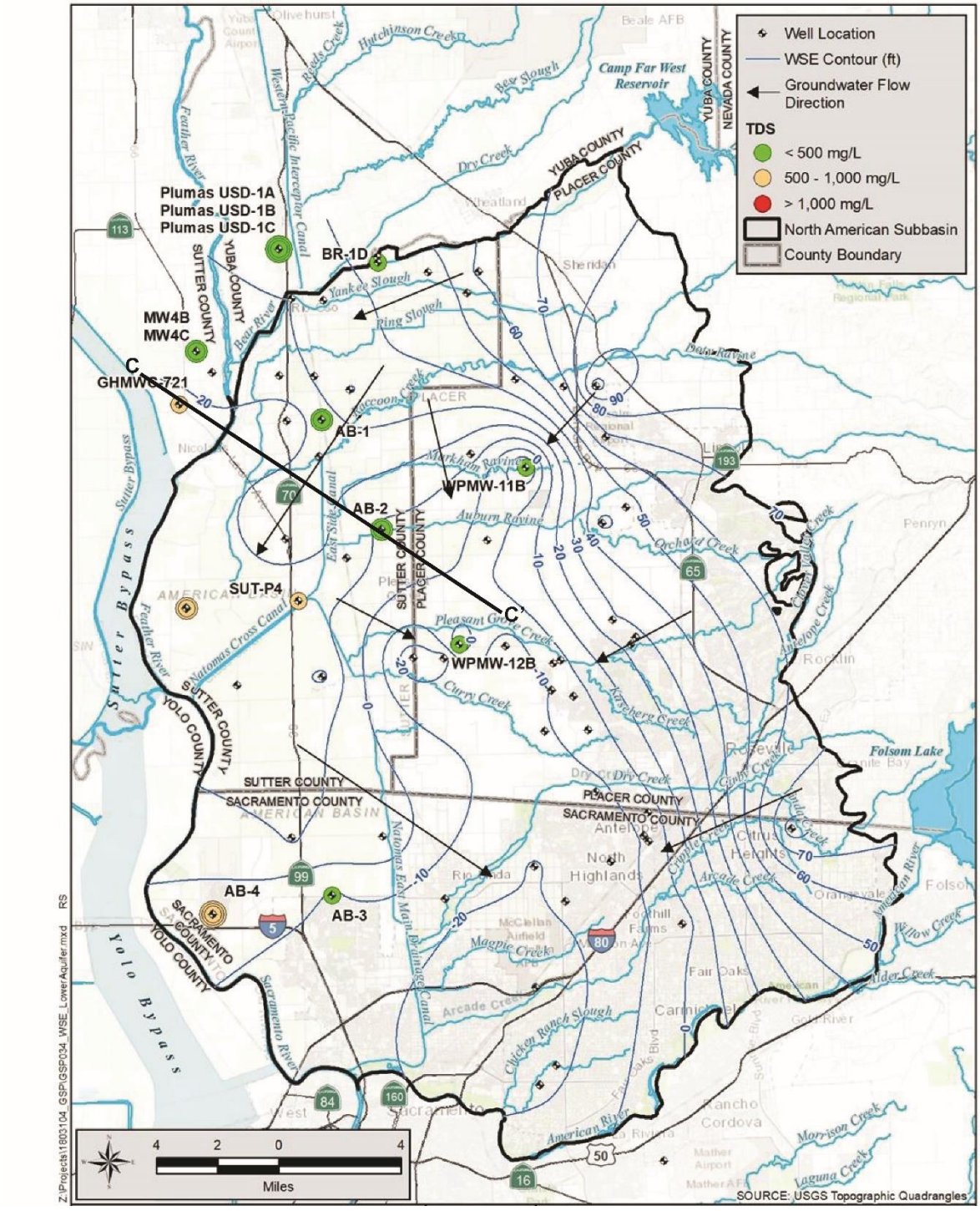


Figure F-4 Groundwater Quality Distribution Lower Aquifer

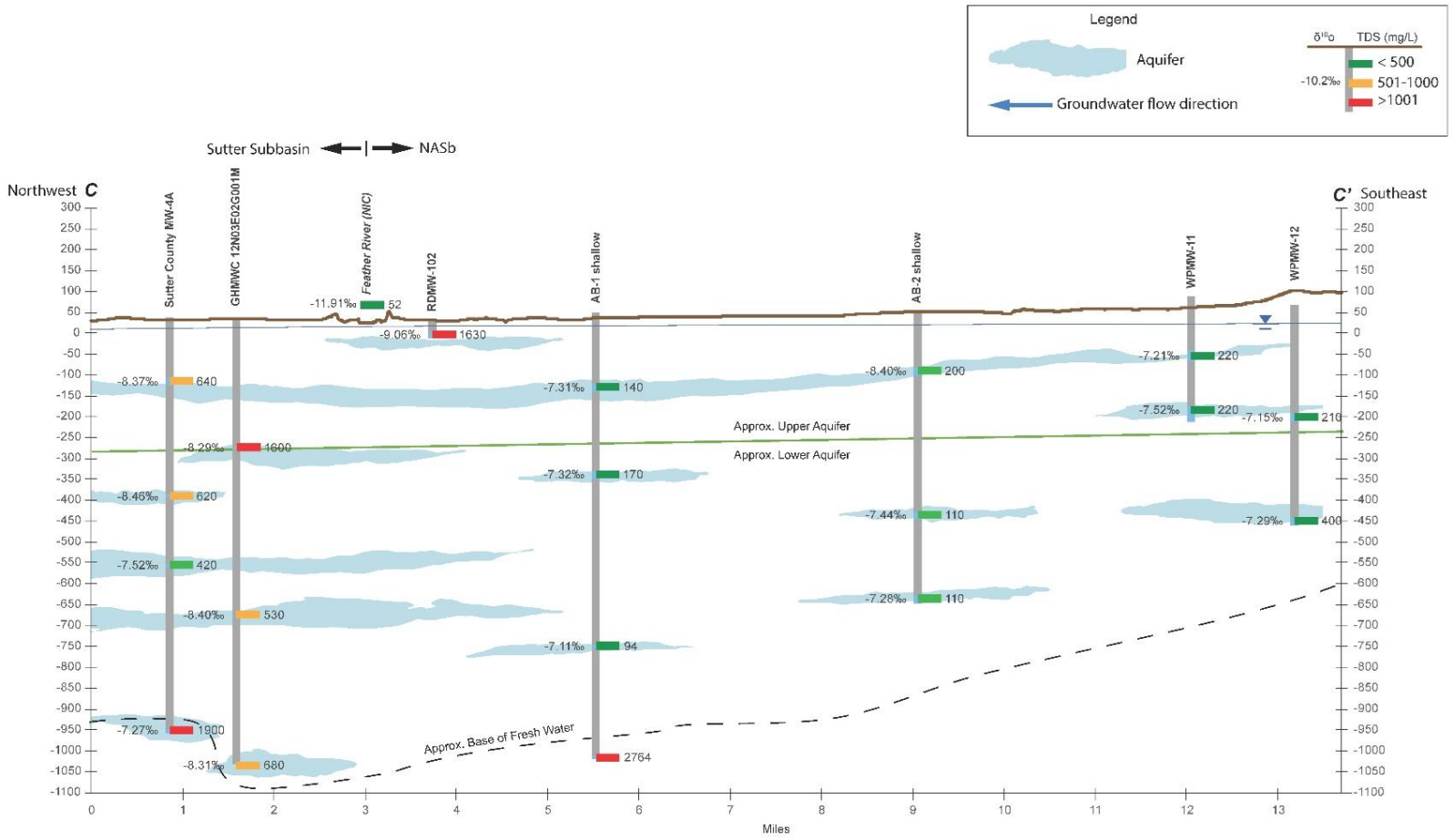


Figure F-5: Groundwater Quality Profile C-C'

Appendix G: Western Area Hydrographs

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX G
Western Area Wells with Hydrographs

December 2021

APPENDIX G

WESTERN AREA
WELLS WITH HYDROGRAPHS

LEGEND:

- Laguna Formation Wells
- Mehrten Formation Wells
- Wells with Unknown Construction Details
- Ione or Central Valley Fm. Wells

Long-Term Hydrographs

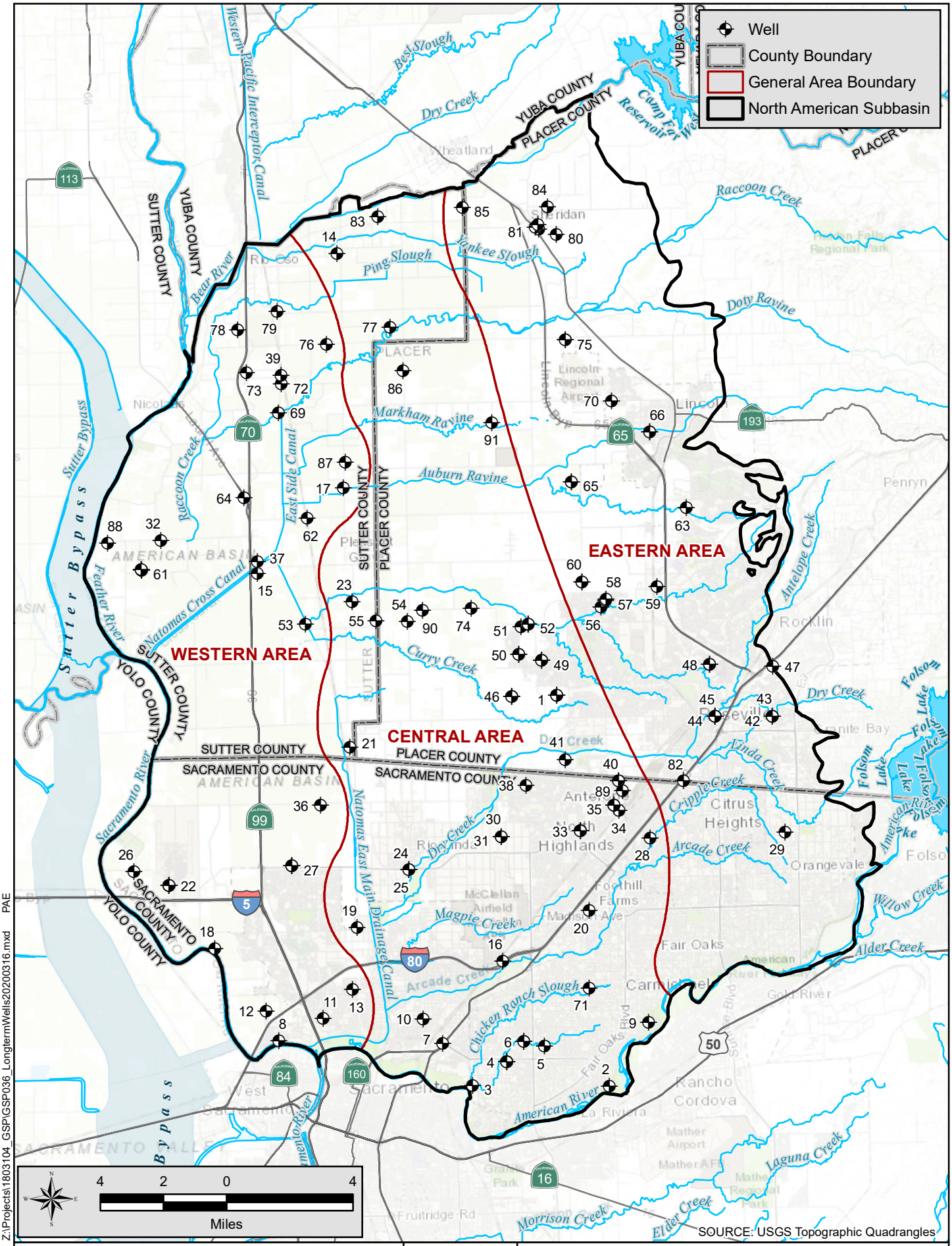
Years Displayed	1950 to 2019
Vertical Axis	50 feet

Unless otherwise noted

Short Term Hydrographs

Years Displayed	2004 to 2019
	Unless otherwise noted
Vertical Axis	50 feet
	Unless otherwise noted

Groundwater levels from multiple aquifers shown



Z:\Projects\1803104_GSP\GSP036_LongtermWells20200316.mxd PAE

18-Mar-2020

North American Subbasin
Sutter, Placer and Sacramento Counties

North American Subbasin

GEI Consultants

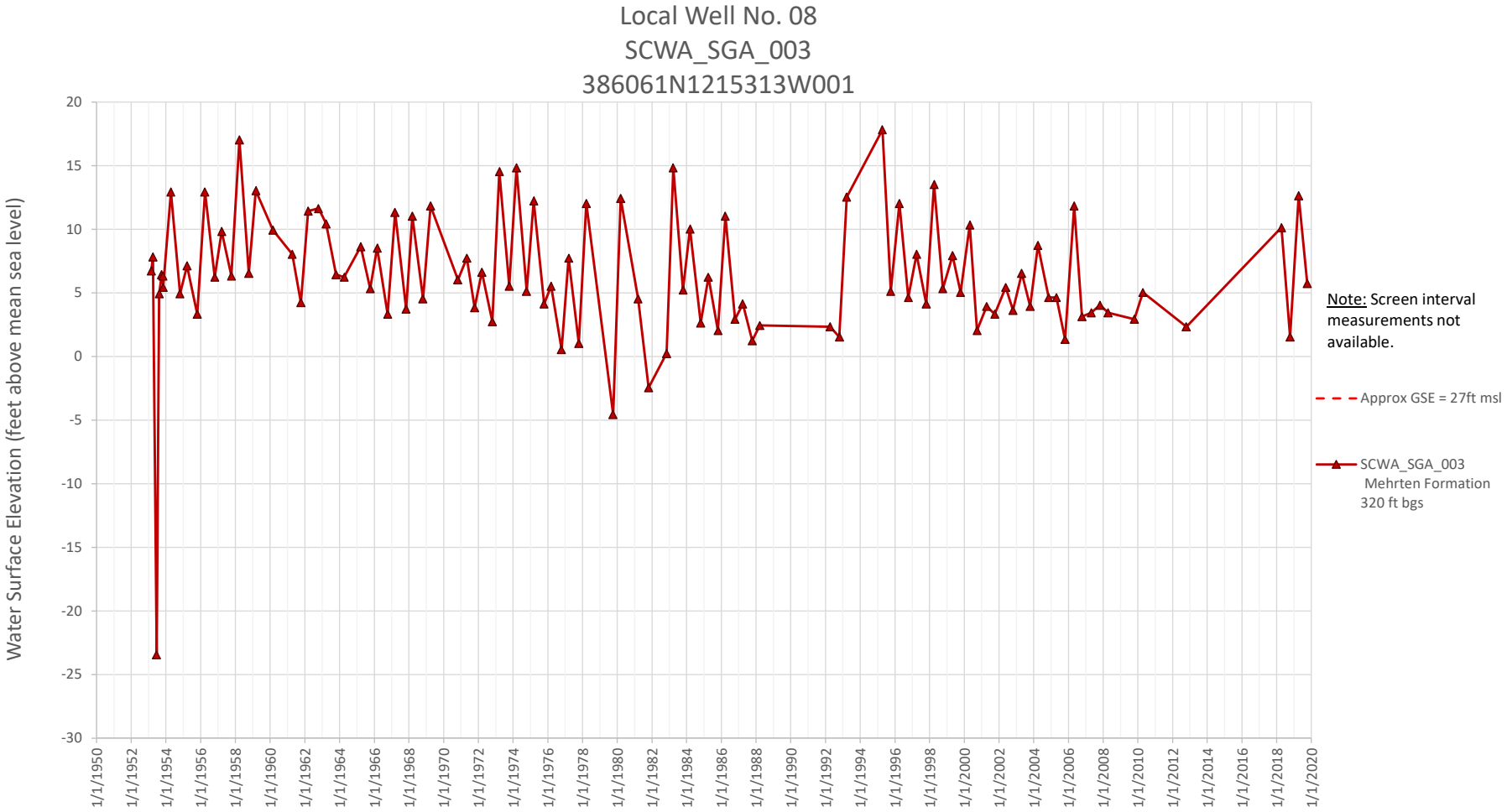
Long Term Wells

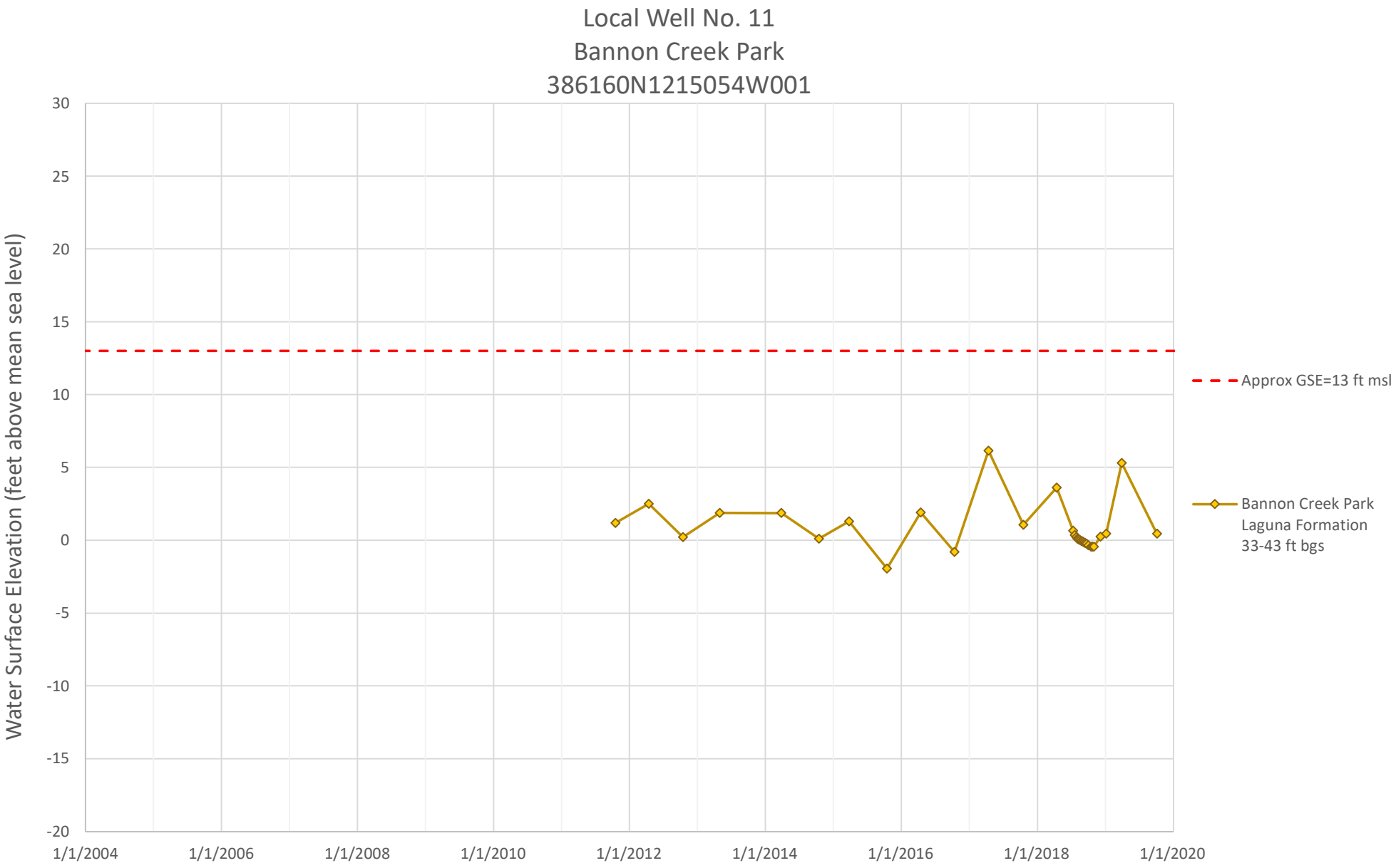
MARCH 2020

Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
1	SVMW East-2B	Not Available	48577	381626N1213651W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	525	Y	NOT AVAILABLE	Active	38.762629	-121.365097
1	SVMW East-2A	Not Available	48576	387626N1213651W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	140	Y	NOT AVAILABLE	Active	38.762629	-121.365099
1	SVMW East-2C	Not Available	48578	387626N1213651W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	670	Y	NOT AVAILABLE	Active	38.76263	-121.365098
2	SGA_MW06	Not Available	48014	385828N1213385W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	72	Y	e026069	Active	38.58281	-121.33846
3	SGA_MW04	Not Available	48012	385841N1214185W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	65	Y	e029066	Active	38.58414	-121.41852
4	MW12A	Not Available	48021	385947N1213985W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	285	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12B	Not Available	48022	385947N1213985W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	385	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12C	Not Available	48023	385947N1213985W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	615	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12D	Not Available	48024	385947N1213985W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	845	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12E	Not Available	48025	385947N1213985W005	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	1005	Y	NOT AVAILABLE	Active	38.59472	-121.39847
5	DWR_SGA_004	09N05E25J001M	9641	386016N1213761W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	238	N	94507	Active	38.6016	-121.3761
6	MW11A	Not Available	48018	386038N1213882W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	187	Y	NOT AVAILABLE	Active	38.6038	-121.38815
6	MW11B	Not Available	48019	386038N1213882W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	278	Y	NOT AVAILABLE	Active	38.6038	-121.38815
6	MW11C	Not Available	48020	386038N1213882W003	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	375	Y	NOT AVAILABLE	Active	38.6038	-121.38815
7	DWR_SGA_005	09N05E28K001M	9643	386038N1214357W001	Department of Water Resources	North American	5-021.64	Sacramento	Irrigation	No	250	N	NOT AVAILABLE	Active	38.6038	-121.4357
8	SCWA_SGA_003	09N04E27F001M	8944	386061N1215313W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	320	N	828	Active	38.6061	-121.5313
9	SCWA_SGA_004	09N06E27D001M	9648	386117N1213150W001	Sacramento Central Groundwater	North American	5-021.64	Sacramento	Observation	No	200	N	NOT AVAILABLE	Inactive	38.6117	-121.315
10	DWR_SGA_003	09N05E21M001M	31412	386151N1214467W001	Department of Water Resources	North American	5-021.64	Sacramento	Unknown	No	89	N	NOT AVAILABLE	Active	38.6151	-121.4467
11	Bannon Creek Park	09N04E23R002M	48041	386160N1215054W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	48	Y	NOT AVAILABLE	Active	38.61603	-121.5054
12	09N04E22E001M	09N04E22E001M	8943	386199N1215386W001	Department of Water Resources	North American	5-021.64	Sacramento	Residential	No	-	N	NOT AVAILABLE	Active	38.6199	-121.5386
13	Chuckwagon Park	09N04E13R001M	48040	386292N1214877W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	52	Y	NOT AVAILABLE	Active	38.62921	-121.4877
14	13N04E23A002M	13N04E23A002M		389669N1214897W001	Department of Water Resources	North American	5-021.64	Sutter	Residential		83				38.9669	-121.4897
15	11N04E09D002M	11N04E09D002M		388208N1215397W001	Department of Water Resources	North American	5-021.64	Sutter	Residential		100				38.8208	-121.5397
16	DWR_SGA_002	09N05E14B001M	40050	386410N1213995W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	550	N	49236	Active	38.641	-121.3995
17	AB-2 deep	12N04E26J002M		388593N1214885W001	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
17	AB-2 middle	12N04E26J003M		388593N1214885W002	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
17	AB-2 shallow	12N04E26J004M		388593N1214885W003	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
18	SCWA_SGA_002	09N04E08L001M	29914	386489N1215679W001	Department of Water Resources	North American	5-021.64	Sacramento	Irrigation	No	105	N	185	Active	38.6489	-121.5679
19	SCWA_SGA_001	09N04E01R001M	8921	386576N1214846W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	82	N	NOT AVAILABLE	Active	38.6576	-121.4846
20	SGA_MW05	Not Available	48013	386635N1213486W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	220	Y	e029068	Active	38.66347	-121.34859
21	10N04E12A001M	10N04E12A001M		387404N1214870W001	Department of Water Resources	North American	5-021.64		Irrigation					Active	38.7404	-121.487
22	AB-4 deep	10N04E31M001M	39756	386782N1215943W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	1080	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 middle-deep	10N04E31M002M	24319	386782N1215943W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	815	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 middle-shallow	10N04E31M003M	37857	386782N1215943W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	410	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 shallow	10N04E31M004M	24318	386782N1215943W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	200	Y	NOT AVAILABLE	Active	38.6782	-121.5943
23	South Sutter	11N04E13D001M		388072N1214842W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation		535				38.8072	-121.4842
24	SGA_MW02	Not Available	48010	386836N1214536W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	110	Y	e029062	Active	38.68362	-121.45363
25	SGA_MW03	Not Available	48011	386836N1214536W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	305	Y	e034123	Active	38.68356	-121.45362
26	SCWA_SGA_005	10N03E35A001M	40055	386848N1216146W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	96	N	221	Active	38.6848	-121.6146
27	AB-3 deep	10N04E27R002M	32581	386864N1215222W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	995	Y	NOT AVAILABLE	Active	38.6864	-121.5222
27	AB-3 middle	10N04E27R003M	15689	386864N1215222W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	500	Y	NOT AVAILABLE	Active	38.6864	-121.5222
27	AB-3 shallow	10N04E27R004M	15690	386864N1215222W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	220	Y	NOT AVAILABLE	Active	38.6864	-121.5222
28	Twin Creeks Park	10N06E27F001M	48042	386964N1213120W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	198	Y	NOT AVAILABLE	Active	38.6964	-121.31203
29	SCWA_SGA_012	10N07E29G001M	33380	386979N1212329W001	Sacramento County	North American	5-021.64	Sacramento	Irrigation	No	240	N	1037	Inactive	38.6979	-121.2329
30	SCWA_SGA_008	10N05E14Q002M	13652	386982N1213992W001	Department of Water Resources	North American	5-021.64	Sacramento	Residential	No	225	N	10678	Active	38.6982	-121.3992
31	SCWA_SGA_009	10N05E26B002M	13654	386982N1213992W002	Sacramento County	North American	5-021.64	Sacramento	Residential	No	150	N	NOT AVAILABLE	Active	38.6982	-121.3992
32	MLF Well #1	11N03E01D001M		388361N1215959W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.83664	-121.59591
33	Monument (A)	Not Available	48030	387000N1213529W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	274	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (B)	Not Available	48031	387000N1213529W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	334	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (C)	Not Available	48032	387000N1213529W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	450	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (D)	Not Available	48033	387000N1213529W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	544	Y	NOT AVAILABLE	Active	38.70005	-121.35288
34	SCWA_SGA_010	10N06E21F002M	33087	387092N1213300W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	144	N	NOT AVAILABLE	Active	38.7092	-121.33
35	Poker (A)	Not Available	48034	387117N1213327W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	134	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (B)	Not Available	48035	387117N1213327W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	176	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (C)	Not Available	48036	387117N1213327W003	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	320	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (D)	Not Available	48037	387117N1213327W004	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	470	Y	NOT AVAILABLE	Active	38.71174	-121.33271
36	SCWA_SGA_006	10N04E23A001M	32580	387138N1215047W001	Sacramento County	North American	5-021.64	Sacramento	Industrial	No	85	N	NOT AVAILABLE	Active	38.7138	-121.5047
37	SUT-P4	11N04E04N001M		388260N1215394W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		305				38.826	-121.5394
37	SUT-P3	11N04E04N002M		388260N1215394W002	Department of Water Resources	North American	5-021.64	Sutter	Observation		195				38.826	-121.5394
37	SUT-P2	11N04E04N003M		388260N1215394W003	Department of Water Resources	North American	5-021.64	Sutter	Observation		120				38.826	-121.5394
37	SUT-P1	11N04E04N004M		388260N1215394W004	Department of Water Resources	North American	5-021.64	Sutter	Observation		980				38.826	-121.5394
38	Lone Oak Park	10N05E13F001M	48043	387216N1213842W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	166	Y	NOT AVAILABLE	Active	38.72163	-121.38417
39	AB-1 deep	12N04E03N001M		389116N1215238W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		980				38.9116	-121.5238
39	AB-1 middle-deep	12N04E03N002M		389116N1215238W002	Department of Water Resources	North American	5-021.64	Sutter	Observation		710				38.9116	-121.5238
39	AB-1 shallow	12N04E03N004M		389116N1215238W003	Department of Water Resources	North American	5-021.64	Sutter	Observation		190				38.9116	-121.5238
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
39	AB-1 middle-shallow	12N04E03N003M		389117N1215238W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		530				38.9116	-121.5238
40	Antelope North (A)	Not Available	48038	387228N1213298W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	283	Y	NOT AVAILABLE	Active	38.722803	-121.329755
40	Antelope North (B)	Not Available	48039	387228N1213298W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	473	Y	NOT AVAILABLE	Active	38.722803	-121.329755
41	WPMW-5A	Not Available	51280	387331N1213610W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	100	Y	e0266541	Active	38.733106	-121.360994
41	WPMW-5B	Not Available	51281	387331N1213610W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	650	Y	e0266541	Active	38.733106	-121.360994
42	WPMW-7A	Not Available	51283	387512N1212390W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	45	Y	e0265730	Active	38.751194	-121.239
43	WPMW-8A	Not Available	51284	387510N1212390W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	50	Y	e0265733	Active	38.750989	-121.23895
43	WPMW-8B	Not Available	51285	387510N1212390W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	115	Y	e0265733	Active	38.750989	-121.23895
44	WPMW-9A	Not Available	51286	387517N1212727W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	36	Y	e0265735	Active	38.751667	-121.272656
45	WPMW-10A	Not Available	51287	387515N1212725W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	36	Y	e0265738	Active	38.751494	-121.272511
45	WPMW-10B	Not Available	51288	387515N1212725W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	100	Y	e0265738	Active	38.751494	-121.272511
45	WPMW-10C	Not Available	51289	387515N1212725W003	City of Roseville	North American	5-021.64	Placer	Observation	Yes	260	Y	e0265738	Active	38.751494	-121.272511

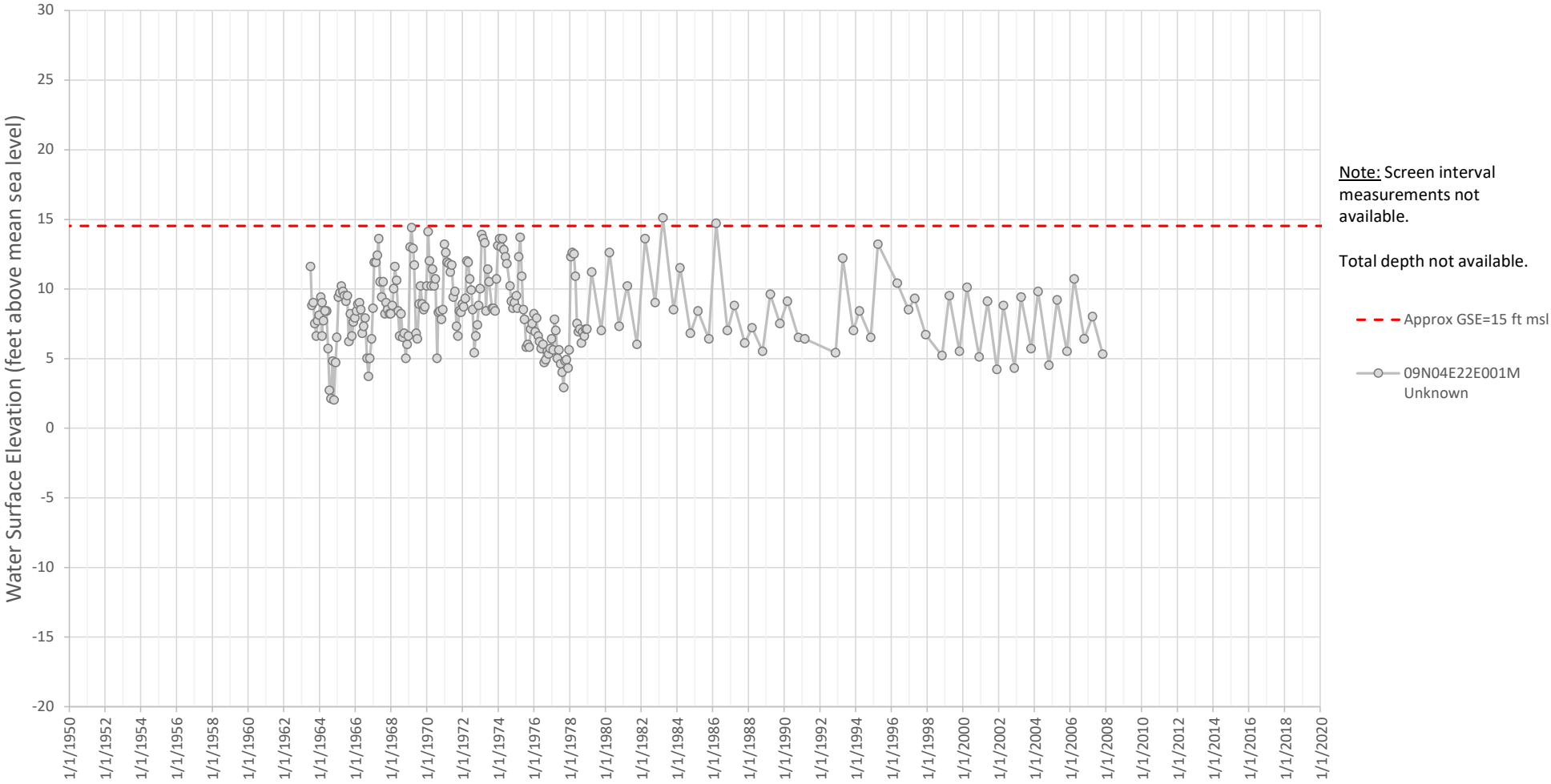
46	SVMW West - 1A	Not Available	48573	387623N1213915W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	145	Y	NOT AVAILABLE	Active	38.762324	-121.39153
46	SVMW West - 1B	Not Available	48574	387623N1213915W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	560	Y	NOT AVAILABLE	Active	38.762325	-121.39153
46	SVMW West - 1C	Not Available	48575	387623N1213915W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	750	Y	NOT AVAILABLE	Active	38.762325	-121.391529
48	WPMW-4A	Not Available	48567	387755N1212753W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	145	Y	NOT AVAILABLE	Active	38.775536	-121.275254
48	WPMW-4B	Not Available	48568	387755N1212753W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	300	Y	NOT AVAILABLE	Active	38.775535	-121.275255
49	WPMW-1A	Not Available	48560	387786N1213737W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	120	Y	NOT AVAILABLE	Active	38.778603	-121.373698
49	WPMW-1B	Not Available	48561	387786N1213737W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	480	Y	NOT AVAILABLE	Active	38.778603	-121.373697
49	WPMW-1C	Not Available	48562	387786N1213737W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	545	Y	NOT AVAILABLE	Active	38.778602	-121.373698
50	W-77MW-A	Not Available	51294	387816N1213870W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	516	Y	NOT AVAILABLE	Active	38.781581	-121.38702
50	W-77MW-B	Not Available	51295	387816N1213870W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	604	Y	NOT AVAILABLE	Active	38.781581	-121.38702
51	O'Brien well	11N05E23B001M	11223	387943N1213856W001	City of Roseville	North American	5-021.64	Placer	Residential	No	195	N	NOT AVAILABLE	Active	38.7943	-121.3856
52	CVMW-1A	Not Available	48569	387957N1213813W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	285	Y	NOT AVAILABLE	Active	38.795655	-121.38126
52	CVMW-1B	Not Available	48571	387957N1213813W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	495	Y	NOT AVAILABLE	Active	38.795654	-121.381258
52	CVMW-1C	Not Available	48572	387957N1213813W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	590	Y	NOT AVAILABLE	Active	38.795655	-121.381258
53	South Sutter WD	11N04E15Q001M	10508	387971N1215119W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.7971	-121.5119
54	South Sutter WD	11N05E18R001M	11221	387977N1214521W001	South Sutter Water District	North American	5-021.64	Placer	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.7977	-121.4521
55	South Sutter WD	11N04E13R001M	10507	387982N1214704W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.7982	-121.4704
56	DCMW-3	Not Available	51293	388027N1213384W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	520	Y	NOT AVAILABLE	Active	38.80271	-121.338432
57	DCMW-1	Not Available	51291	388058N1213355W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	455	Y	NOT AVAILABLE	Active	38.805757	-121.335503
58	DCMW-2	Not Available	51292	388063N1213354W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	437	Y	NOT AVAILABLE	Active	38.806291	-121.335415
59	Tinker MW	Not Available	51290	388116N1213054W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	177	Y	NOT AVAILABLE	Active	38.811594	-121.305387
60	WPMW-2A	Not Available	48563	388145N1213491W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	230	Y	NOT AVAILABLE	Active	38.814497	-121.349144
60	WPMW-2B	Not Available	48564	388145N1213491W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	425	Y	NOT AVAILABLE	Active	38.814497	-121.349143
61	Sutter County MW-5A	11N03E02Q002M	47776	388235N1216079W001	Sutter County	North American	5-021.64	Sutter	Observation	Yes	170	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5B	11N03E02Q003M	47777	388235N1216079W002	Sutter County	North American	5-021.64	Sutter	Observation	Yes	675	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5C	11N03E02Q004M	47778	388235N1216079W003	Sutter County	North American	5-021.64	Sutter	Observation	Yes	930	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5D	11N03E02Q005M	47779	388235N1216079W004	Sutter County	North American	5-021.64	Sutter	Observation	Yes	1225	Y	E0123539	Active	38.8235	-121.6079
62	South Sutter WD	12N04E34H001M	17037	388458N1215100W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Residential	Yes	-	N	NOT AVAILABLE	Active	38.8458	-121.51
63	WPMW-3A	Not Available	48565	388476N1212872W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	53	Y	NOT AVAILABLE	Active	38.847609	-121.287189
63	WPMW-3B	Not Available	48566	388476N1212872W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	140	Y	NOT AVAILABLE	Active	38.847609	-121.287187
64	South Sutter WD	12N04E29J001M	25784	388555N1215468W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.8555	-121.5468
65	MW 1-2	Not Available	49928	388604N1213544W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	318	Y	NOT AVAILABLE	Active	38.860383	-121.354383
65	MW 1-4	Not Available	49930	388604N1213544W004	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	92	Y	NOT AVAILABLE	Active	38.860383	-121.354383
66	MW 5-1	Not Available	49937	388826N1213078W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	100	Y	NOT AVAILABLE	Active	38.882583	-121.30775
66	MW 5-2	Not Available	49938	388826N1213078W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	62	Y	NOT AVAILABLE	Active	38.882583	-121.30775
69	South Sutter WD	12N04E16A004M	17031	388944N1215257W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.8944	-121.5257
70	MW 3-2	Not Available	49935	388971N1213301W002	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	75	Y	NOT AVAILABLE	Active	38.897133	-121.330083
71	WCMSS	Not Available	52461	386280N1213493W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	170	Y	WCR2016-005904	Active	38.62799	-121.34925
71	WCMSM	Not Available	52462	386280N1213493W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	290	Y	WCR2016-005902	Active	38.62799	-121.34925
71	WCMSD	Not Available	52463	386280N1213493W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	530	Y	WCR2016-005899	Active	38.62799	-121.34925
72	South Sutter WD	12N04E10D002M	17027	389075N1215237W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.9075	-121.5237
73	South Sutter WD	12N04E05R004M	17025	389130N1215441W001	South Sutter Water District	North American	5-021.64	Sutter	Residential	Yes	90	N	NOT AVAILABLE	Active	38.913	-121.5441
74	11N05E16H001M	11N05E16H001M		388029N1214145W001	Department of Water Resources	North American	5-021.64	Placer	Irrigation		460				38.8029	-121.4145
75	MW 2-1	Not Available	49931	389255N1213566W001	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	310	Y	NOT AVAILABLE	Active	38.925467	-121.356633
75	MW 2-2	Not Available	49932	389255N1213566W002	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	170	Y	NOT AVAILABLE	Active	38.925467	-121.356633
76	South Sutter WD	13N04E35Q002M	35624	389255N1214969W001	South Sutter Water District	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.9255	-121.4969
77	South Sutter WD	13N05E31K001M	40137	389327N1214594W001	Department of Water Resources	North American	5-021.64	Sutter	Unknown	Yes	393	N	NOT AVAILABLE	Active	38.9327	-121.4594
78	South Sutter WD	13N04E32G001M	35623	389328N1215489W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.9328	-121.5489
79	South Sutter WD	13N04E28R001M	17195	389410N1215254W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.941	-121.5254
80	Cemetery	Not Available	51328	389740N1213606W001	Placer County	North American	5-021.64	Placer	Irrigation	Yes	111	Y	NOT AVAILABLE	Active	38.974027	-121.360615
81	MW-2	Not Available	51331	389764N1213710W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	45	Y	NOT AVAILABLE	Active	38.976427	-121.371001
81	MW-3	Not Available	51332	389774N1213728W001	Placer County	North American	5-021.64	Placer	Observation	Yes	35	Y	NOT AVAILABLE	Active	38.977408	-121.372844
81	MW-1	Not Available	51330	389785N1213713W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	40	Y	NOT AVAILABLE	Active	38.97846	-121.37132

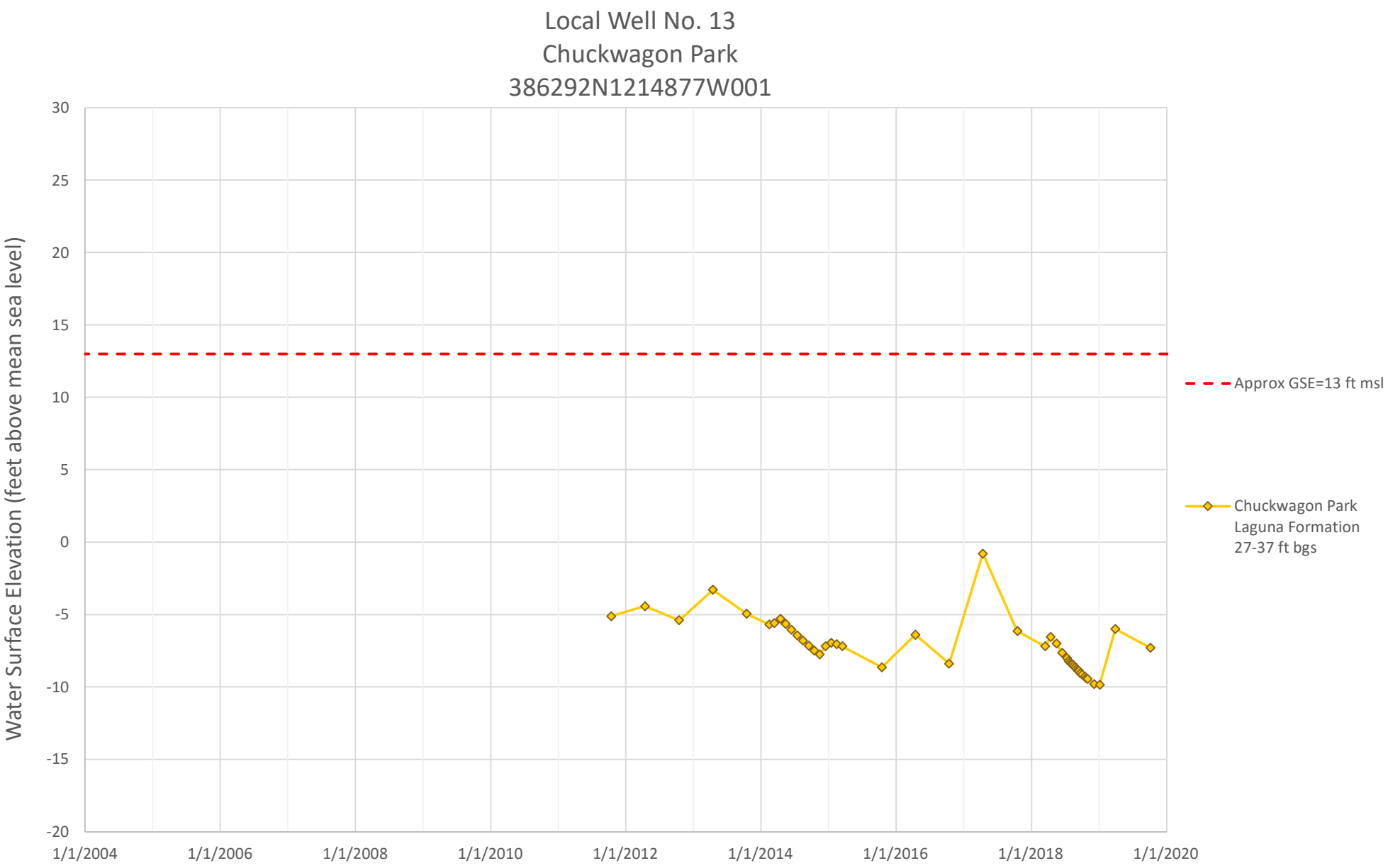
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
82	Whyte A	Not Available	52475	387222N1212920W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	226	Y	e0303799	Active	38.722168	-121.29196
82	Whyte B	Not Available	52476	387222N1212920W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	306	Y	e0303799	Active	38.722168	-121.29196
83	South Sutter WD	13N05E18C001M	17209	389834N1214655W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	210	N	NOT AVAILABLE	Active	38.9834	-121.4655
84	Spencer	Not Available	52555	389867N1213654W002	Department of Water Resources	North American	5-021.64	Placer	Residential	Yes	107	Y	101157	Active	38.986724	-121.36542
85	13N05E09R001M	13N05E09R001M		389873N1214156W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.9873	-121.4156
86	12N05E06R001M	12N05E06R001M		389128N1214522W001	Department of Water Resources	North American	5-021.64	Placer	Irrigation						38.9128	-121.4522
87	12N04E24M002M	12N04E24M002M		388710N1214870W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.871	-121.487
88	11N03E03C002M	11N03E03C002M		388357N1216273W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.8357	-121.6273
89	Roseview-MW315	Not Available			Sacramento Groundwater Authority	North American	5-021.64				315				38.718222	-121.327729
89	Roseview-MW465	Not Available			Sacramento Groundwater Authority	North American	5-021.64				465				38.718222	-121.327729
90	WPMW-11A	Not Available	54779	388882N1214005W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	162	Y	NOT AVAILABLE		38.888164	-121.400463
90	WPMW-11B	Not Available	54780	388882N1214005W004	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	309	Y	NOT AVAILABLE		38.888164	-121.400463
91	WPMW12-A	Not Available			Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	300	Y	NOT AVAILABLE		38.802639	-121.443216
91	WPMW12-B	Not Available			Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	550	Y	NOT AVAILABLE		38.802639	-121.443216

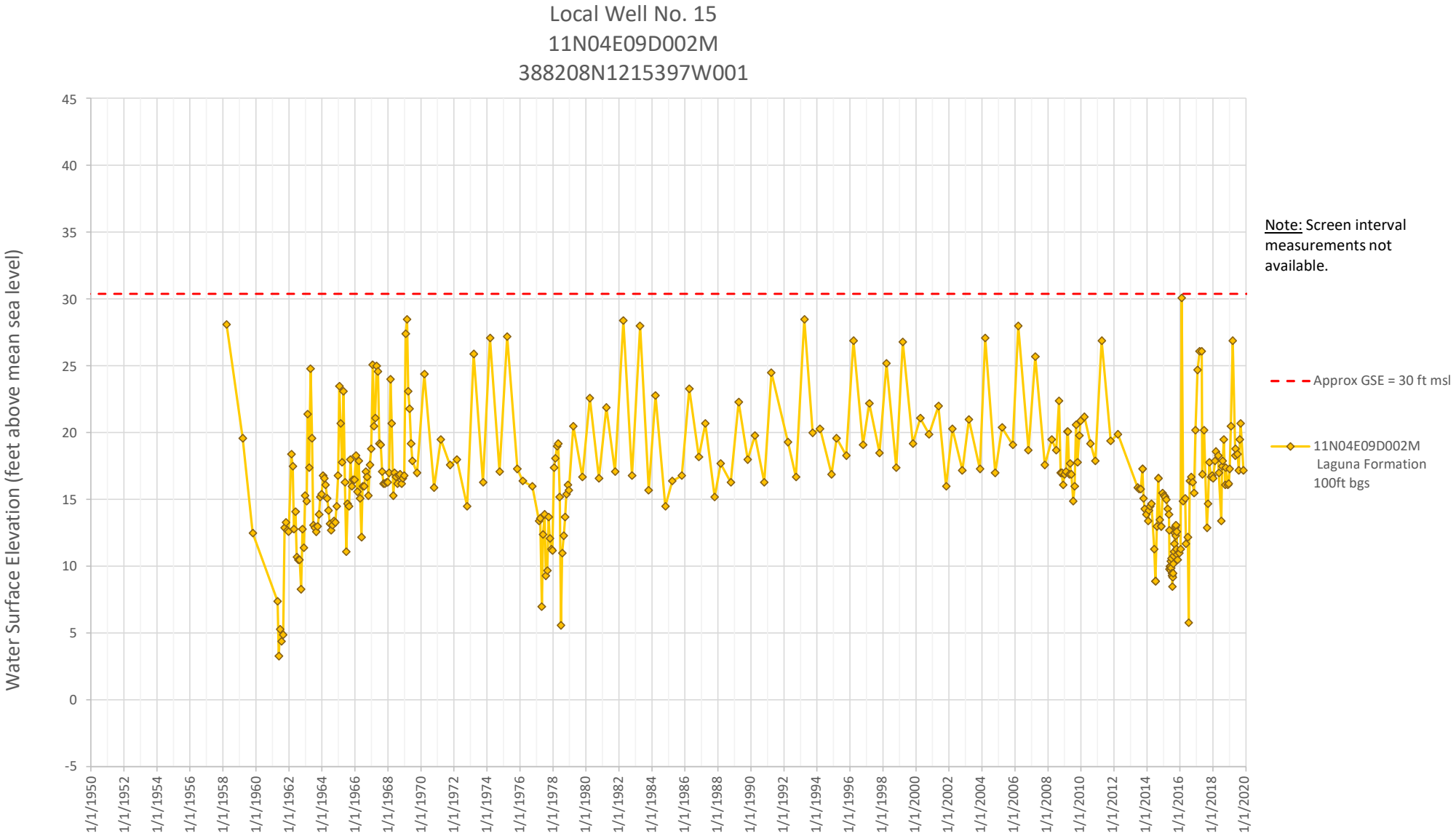

Local Well No. 08
SCWA_SGA_003
386061N1215313W001
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurements not available.
Approx GSE = 27ft msl
SCWA_SGA_003
Mehrten Formation
320 ft bgs

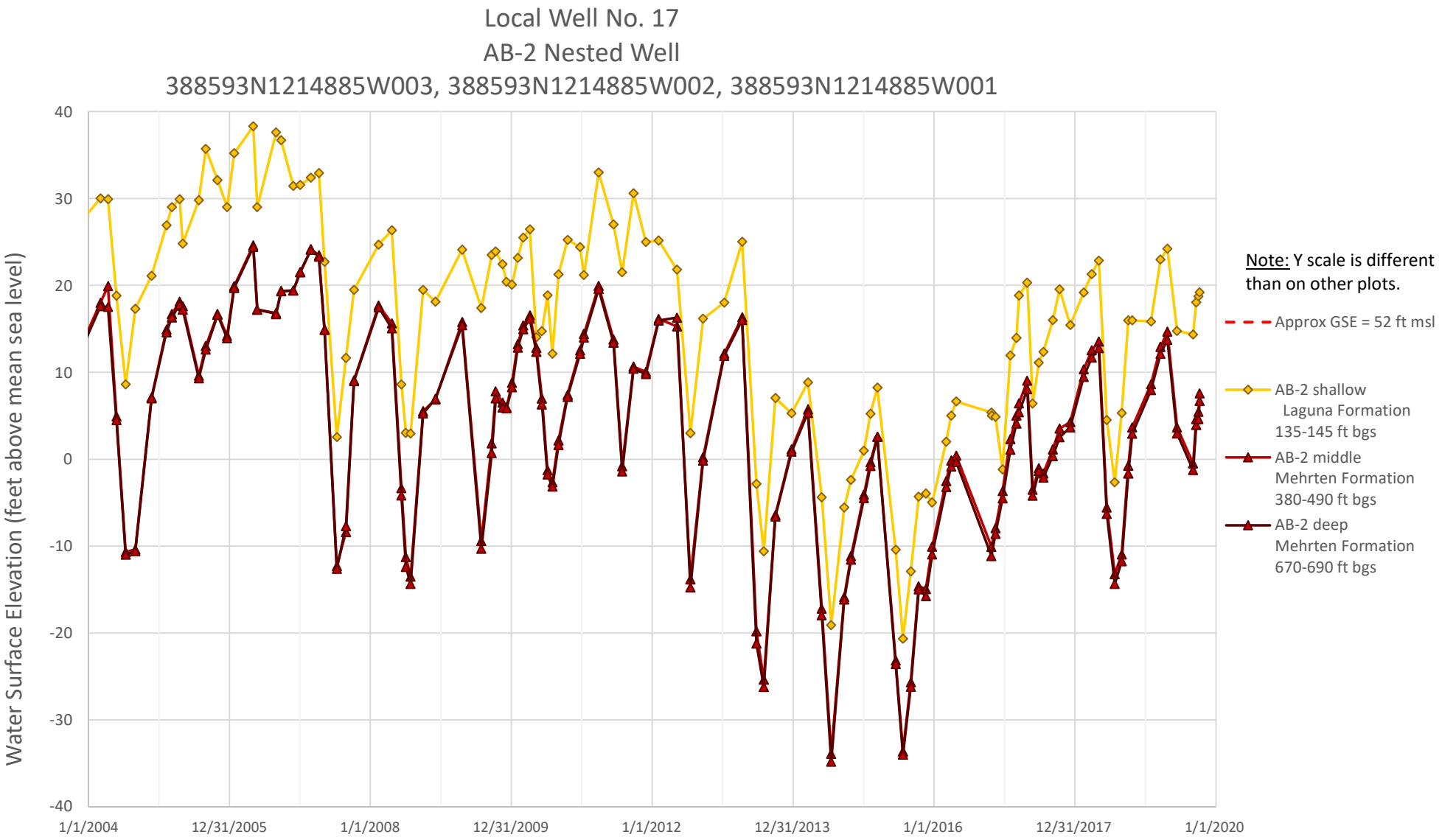

Local Well No. 11
Bannon Creek Park
386160N1215054W001
Water Surface Elevation (feet above mean sea level)
30
25
20
15
10
5
0
-5
-10
-15
-20
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE=13 ft msl
Bannon Creek Park
Laguna Formation
33-43 ft bgs

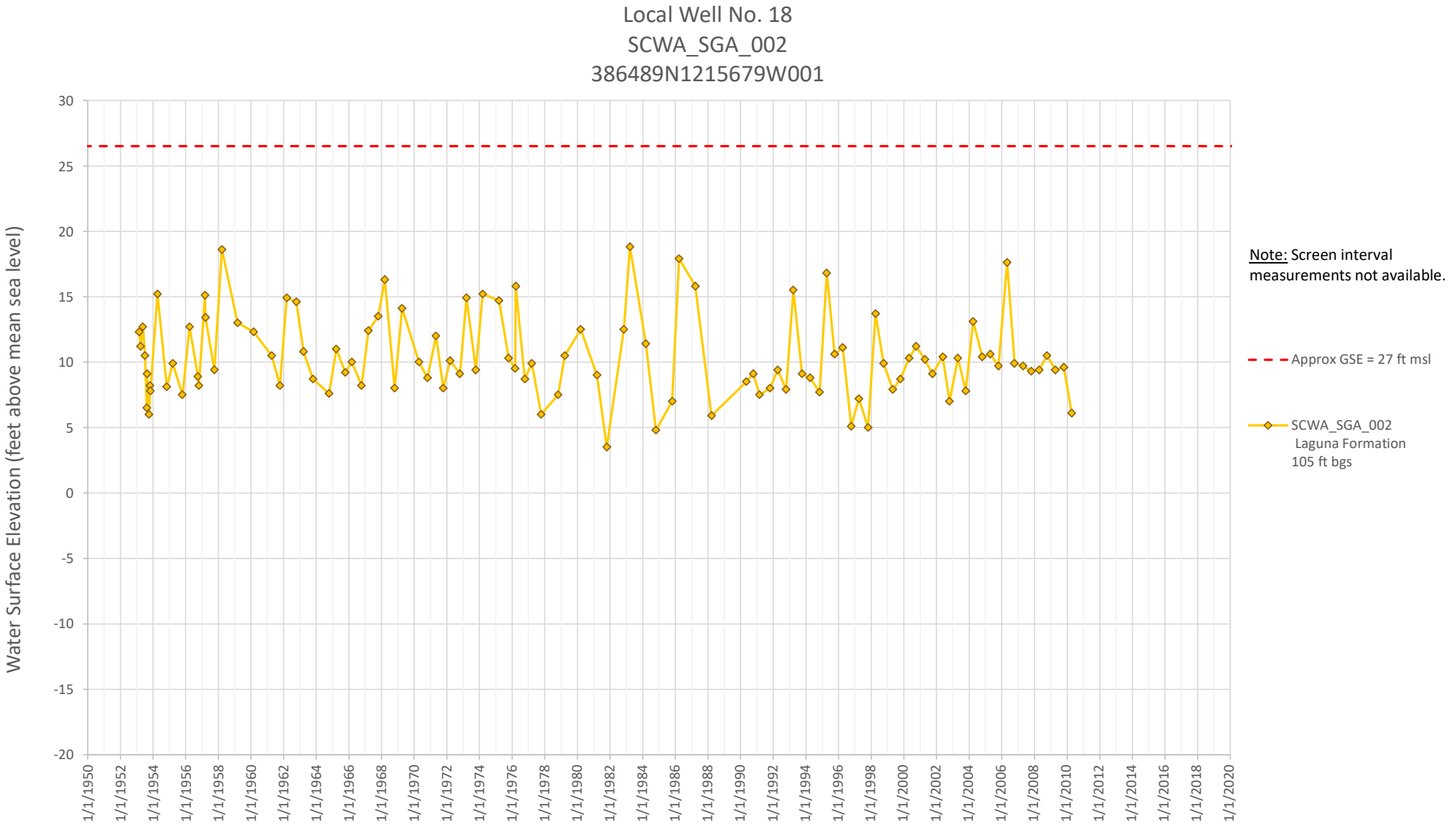
Local Well No. 12
09N04E22E001M
386199N1215386W001

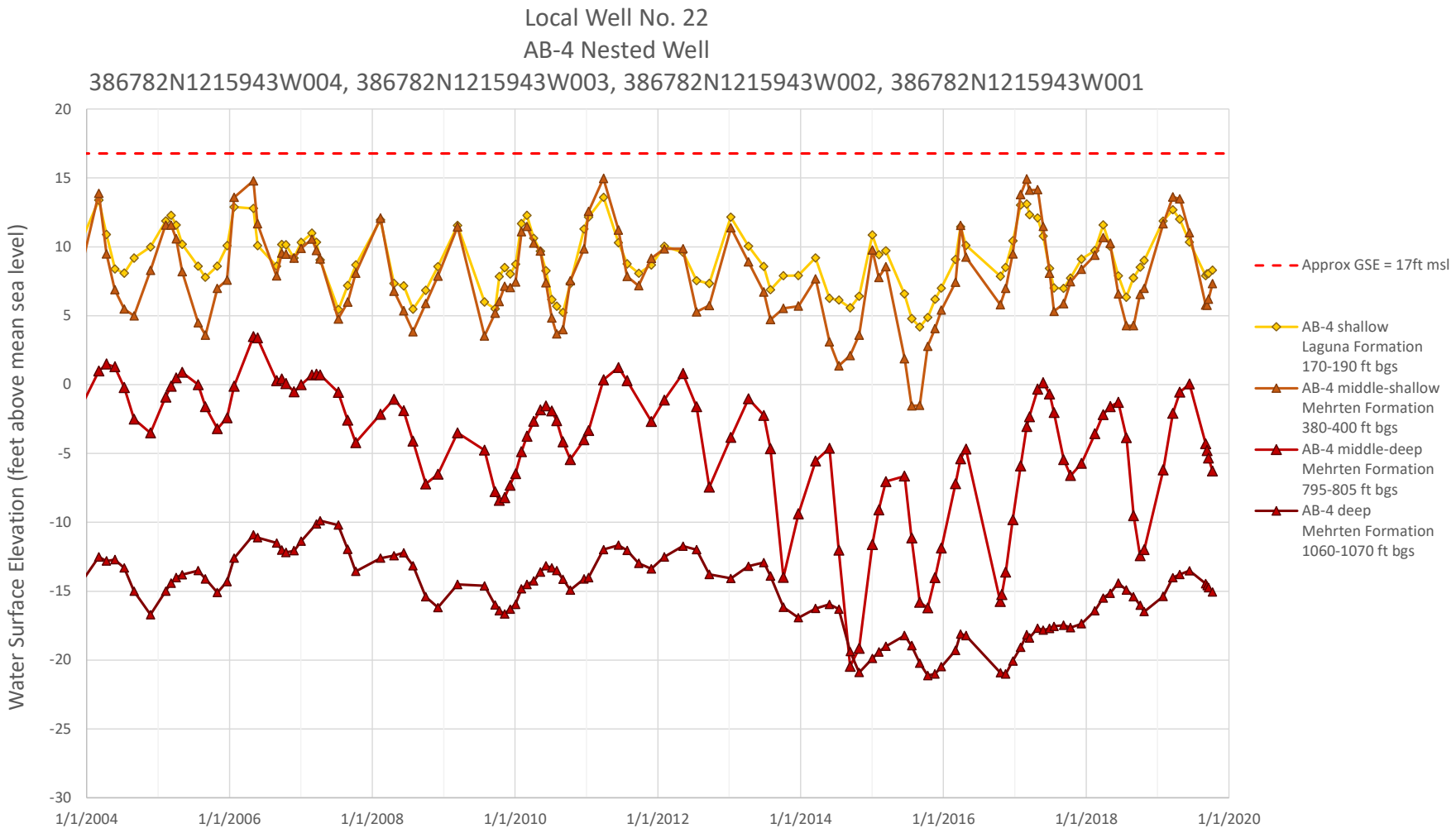


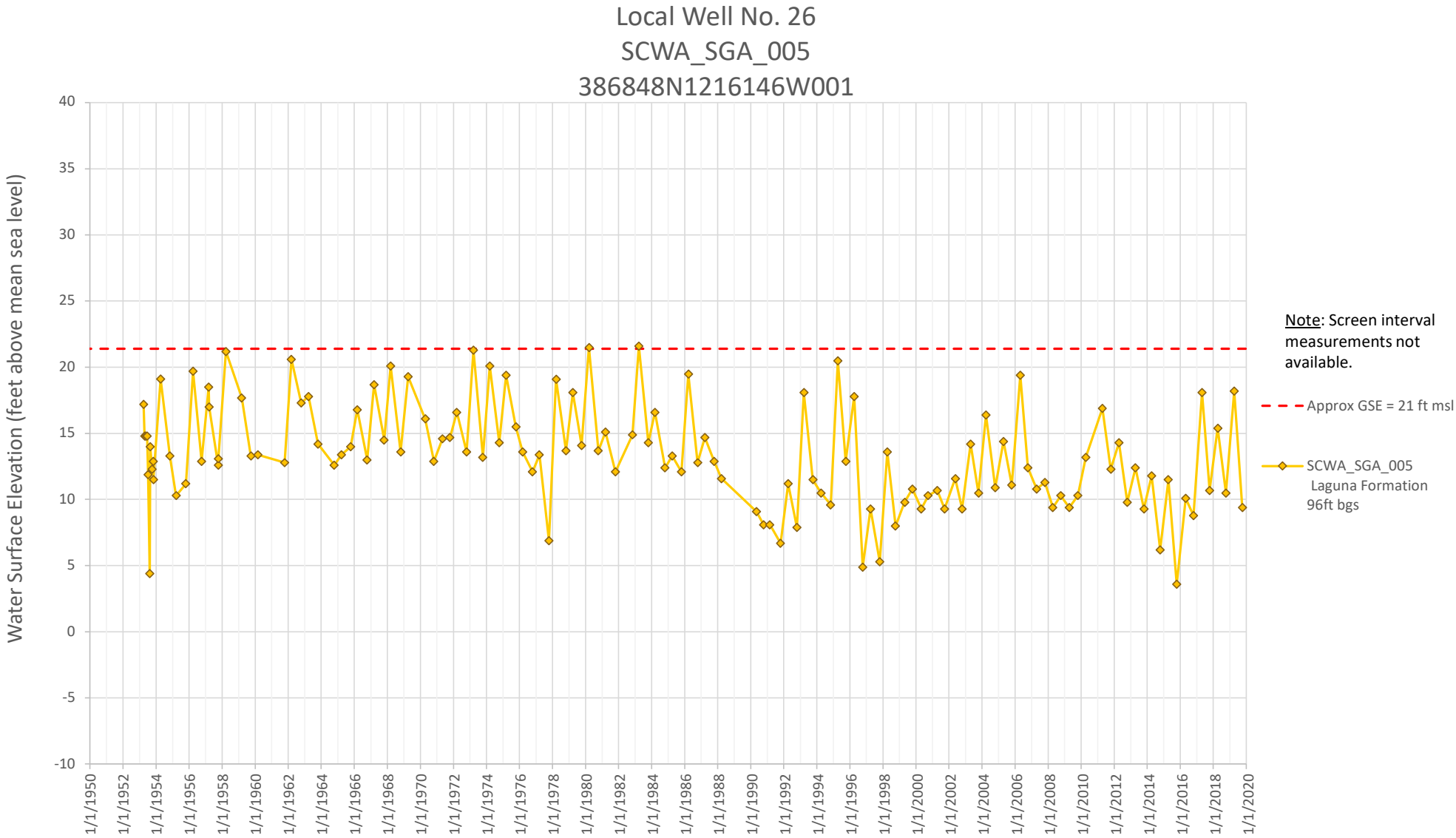

Local Well No. 13
Chuckwagon Park
386292N1214877W001
Water Surface Elevation (feet above mean sea level)
30
25
20
15
10
5
0
-5
-10
-15
-20
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE=13 ft msl
Chuckwagon Park
Laguna Formation
27-37 ft bgs

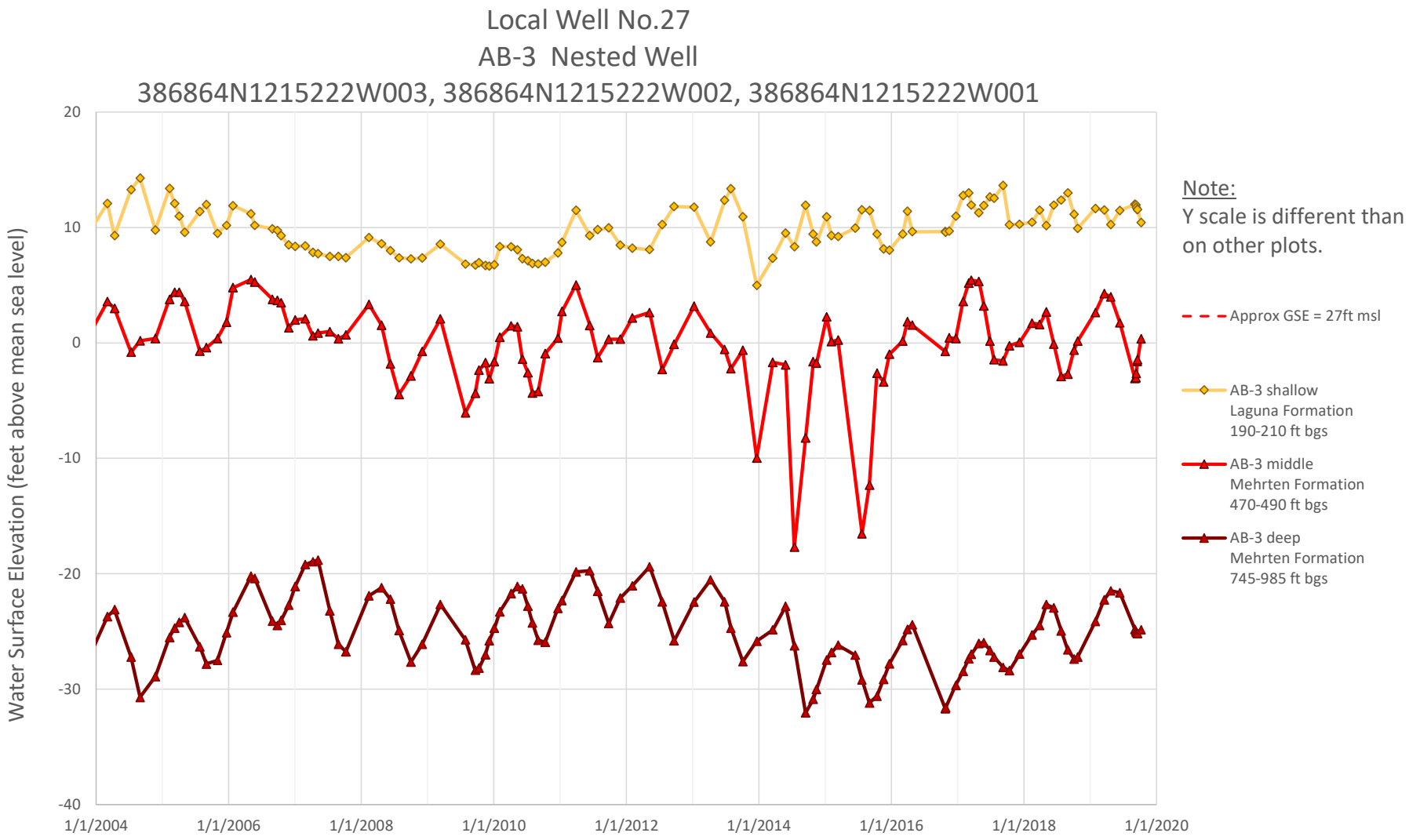

Local Well No. 15
11N04E09D002M
388208N1215397W001
Water Surface Elevation (feet above mean sea level)
45
40
35
30
25
20
15
10
5
0
-5
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurements not available.
Approx GSE = 30 ft msl
11N04E09D002M
Laguna Formation
100ft bgs


Local Well No. 17
AB-2 Nested Well
388593N1214885W003, 388593N1214885W002, 388593N1214885W001
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
-30
-40
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Note: Y scale is different than on other plots.
Approx GSE = 52 ft msl
AB-2 shallow
Laguna Formation
135-145 ft bgs
AB-2 middle
Mehrten Formation
380-490 ft bgs
AB-2 deep
Mehrten Formation
670-690 ft bgs

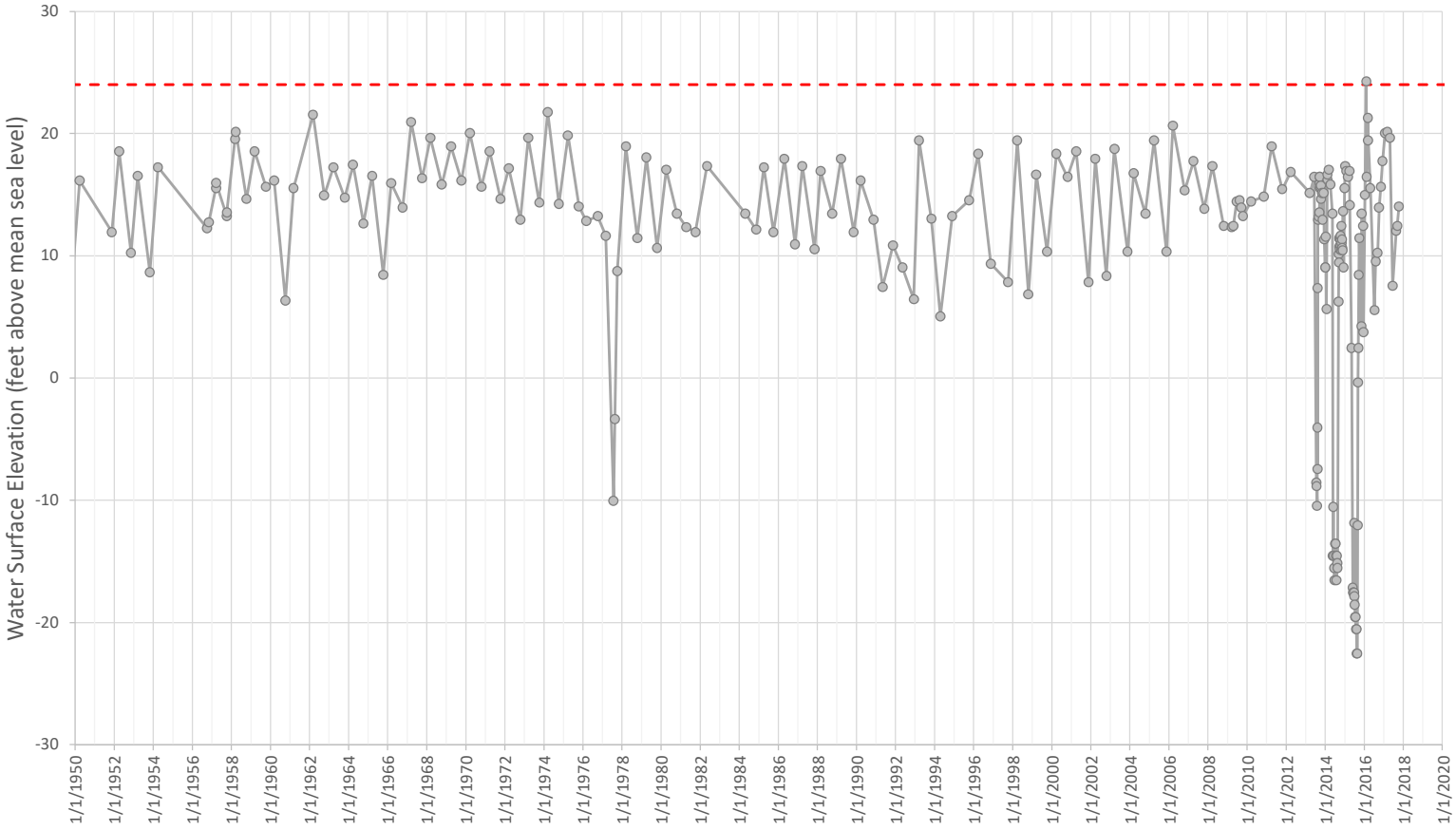

Local Well No. 18
SCWA_SGA_002
386489N1215679W001
Water Surface Elevation (feet above mean sea level)
30
25
20
15
10
5
0
-5
-10
-15
-20
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurements not available.
Approx GSE = 27 ft msl
SCWA_SGA_002
Laguna Formation
105 ft bgs


Local Well No. 22
AB-4 Nested Well
386782N1215943W004, 386782N1215943W003, 386782N1215943W002, 386782N1215943W001
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 17ft msl
AB-4 shallow
Laguna Formation
170-190 ft bgs
AB-4 middle-shallow
Mehrten Formation
380-400 ft bgs
AB-4 middle-deep
Mehrten Formation
795-805 ft bgs
AB-4 deep
Mehrten Formation
1060-1070 ft bgs


Local Well No. 26
SCWA_SGA_005
386848N1216146W001
Water Surface Elevation (feet above mean sea level)
40
35
30
25
20
15
10
5
0
-5
-10
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurements not available.
Approx GSE = 21 ft msl
SCWA_SGA_005
Laguna Formation
96ft bgs


Local Well No.27
AB-3 Nested Well
386864N1215222W003, 386864N1215222W002, 386864N1215222W001
Water Surface Elevation (feet above mean sea level)
20
10
0
-10
-20
-30
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note:
Y scale is different than on other plots.
Approx GSE = 27ft msl
AB-3 shallow
Laguna Formation
190-210 ft bgs
AB-3 middle
Mehrten Formation
470-490 ft bgs
AB-3 deep
Mehrten Formation
745-985 ft bgs

Local Well No. 32
MLF Well #1
388361N1215959W001



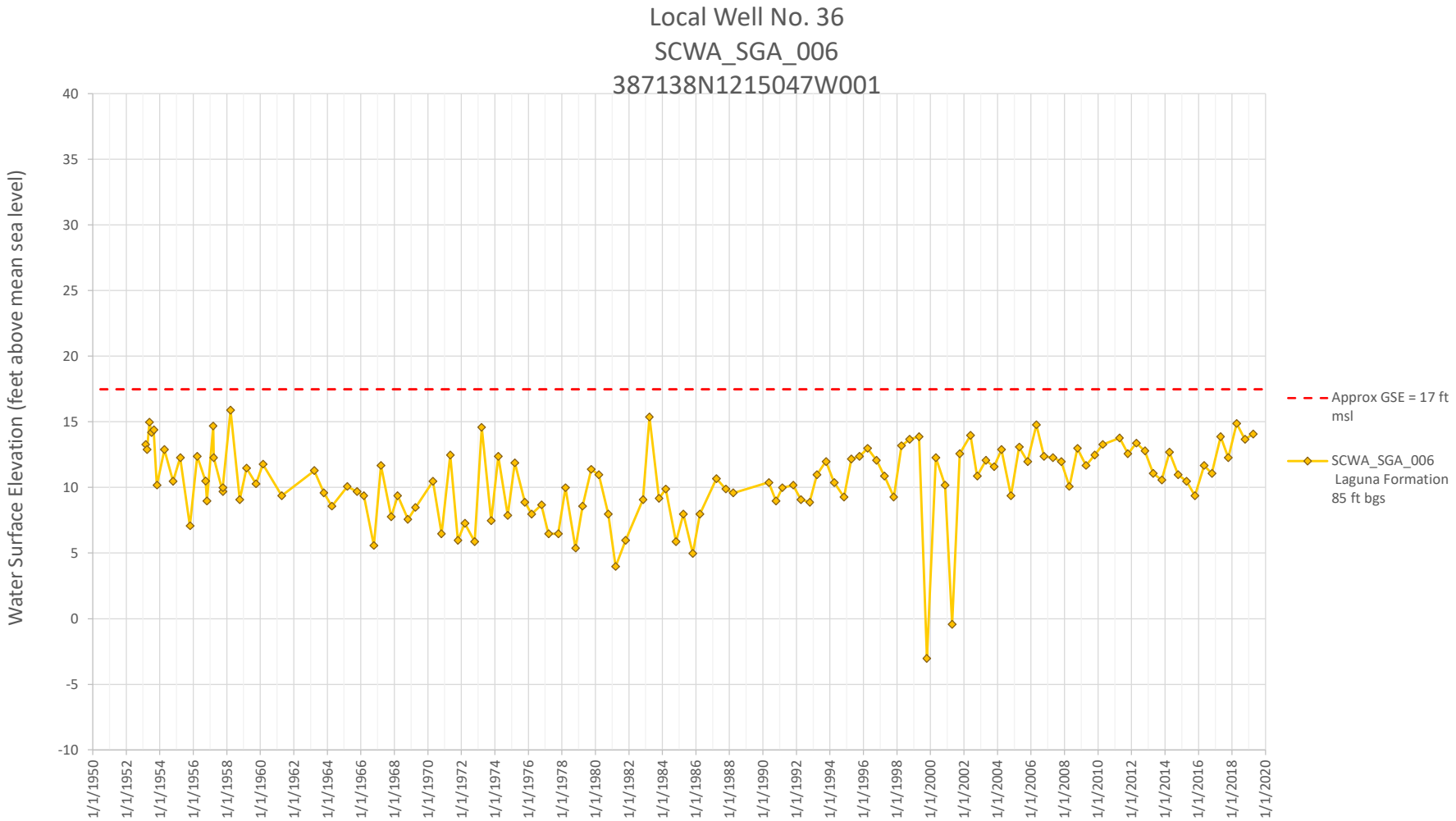
Note: Screen interval measurements not available.

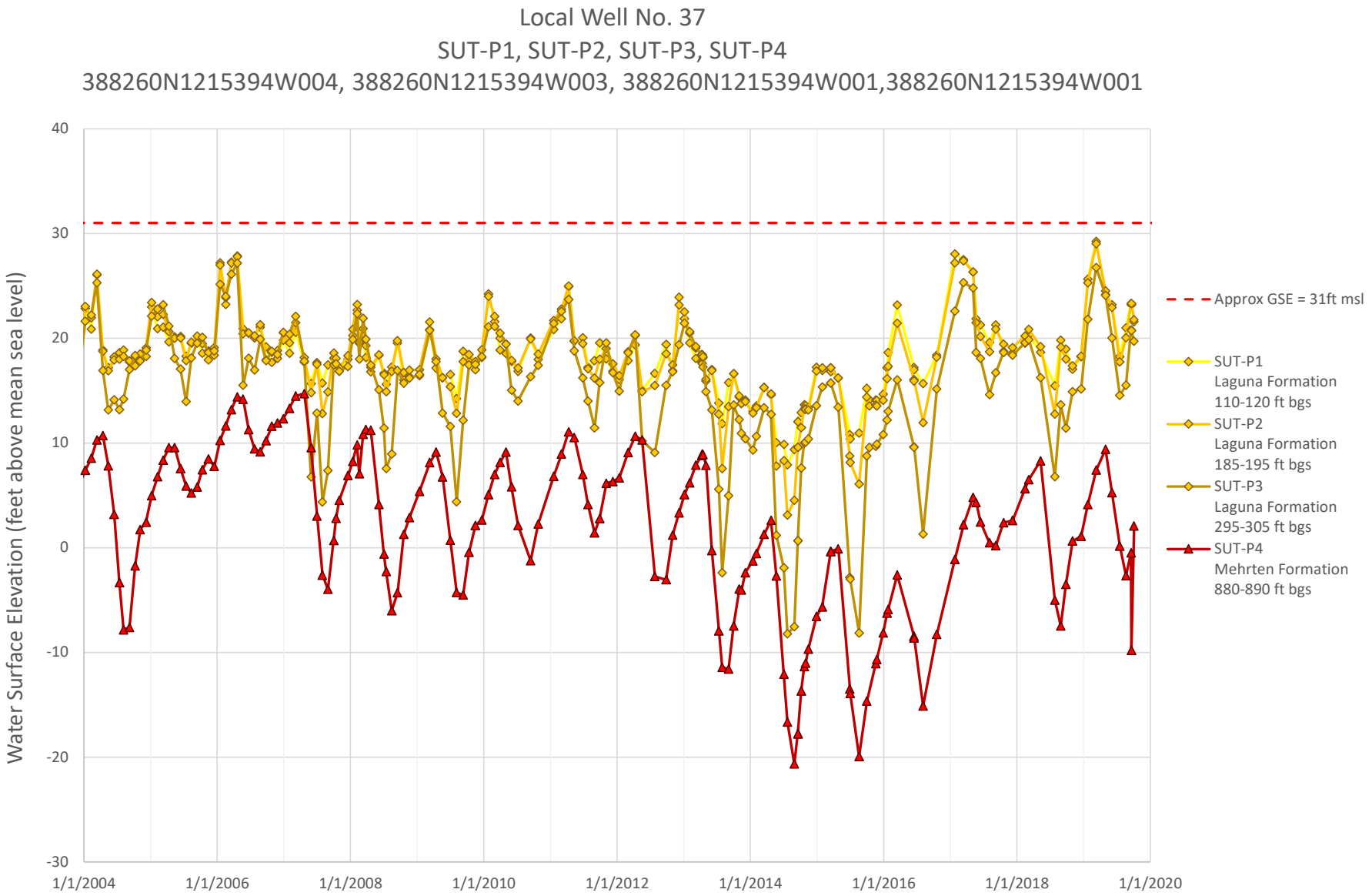
Total depth not available.

Y axis is different than on other plots

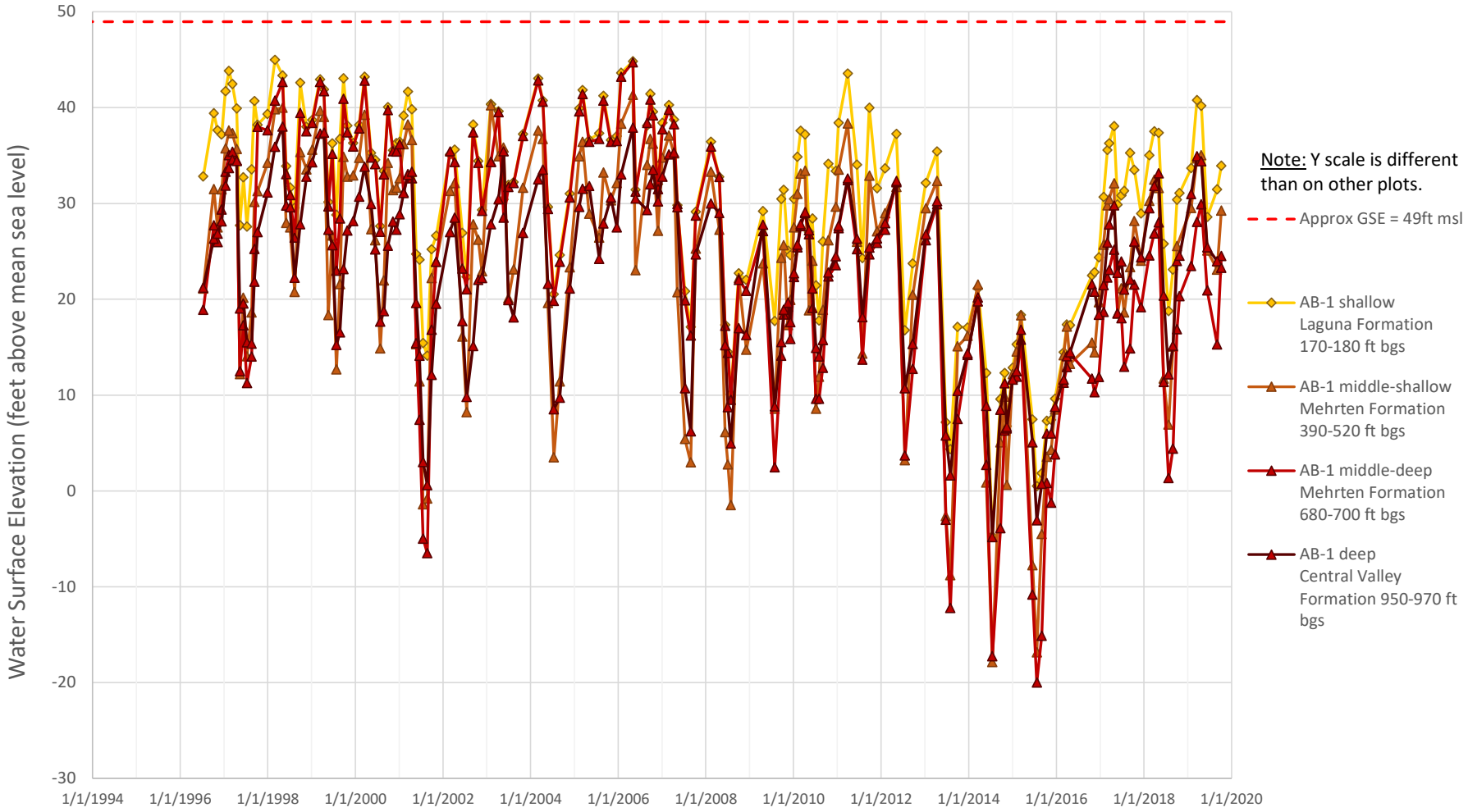
Approx GSE = 24ft msl

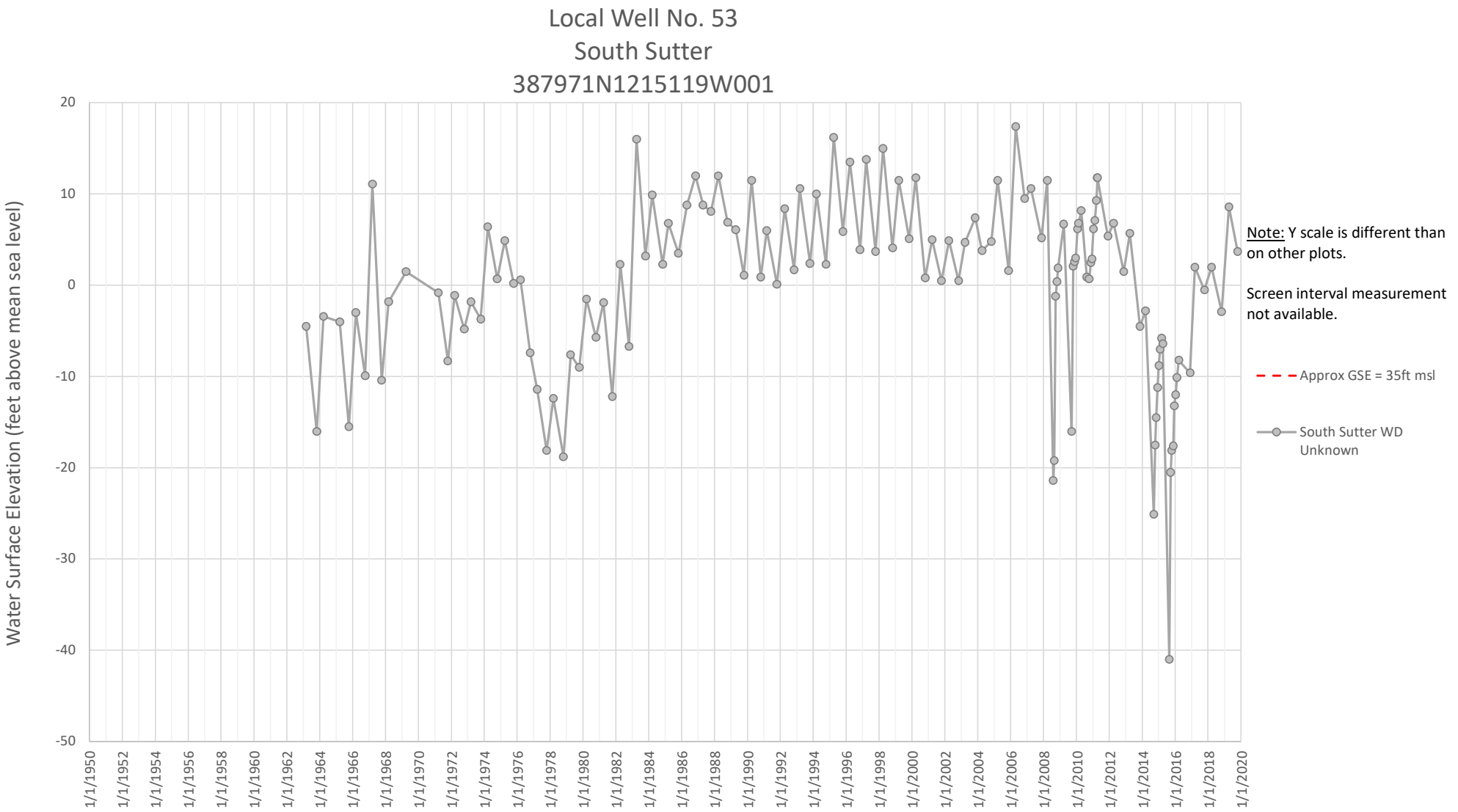
MLF Well #1


Local Well No. 36
SCWA_SGA_006
387138N1215047W001
Water Surface Elevation (feet above mean sea level)
40
35
30
25
20
15
10
5
0
-5
-10
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 17 ft msl
SCWA_SGA_006
Laguna Formation
85 ft bgs

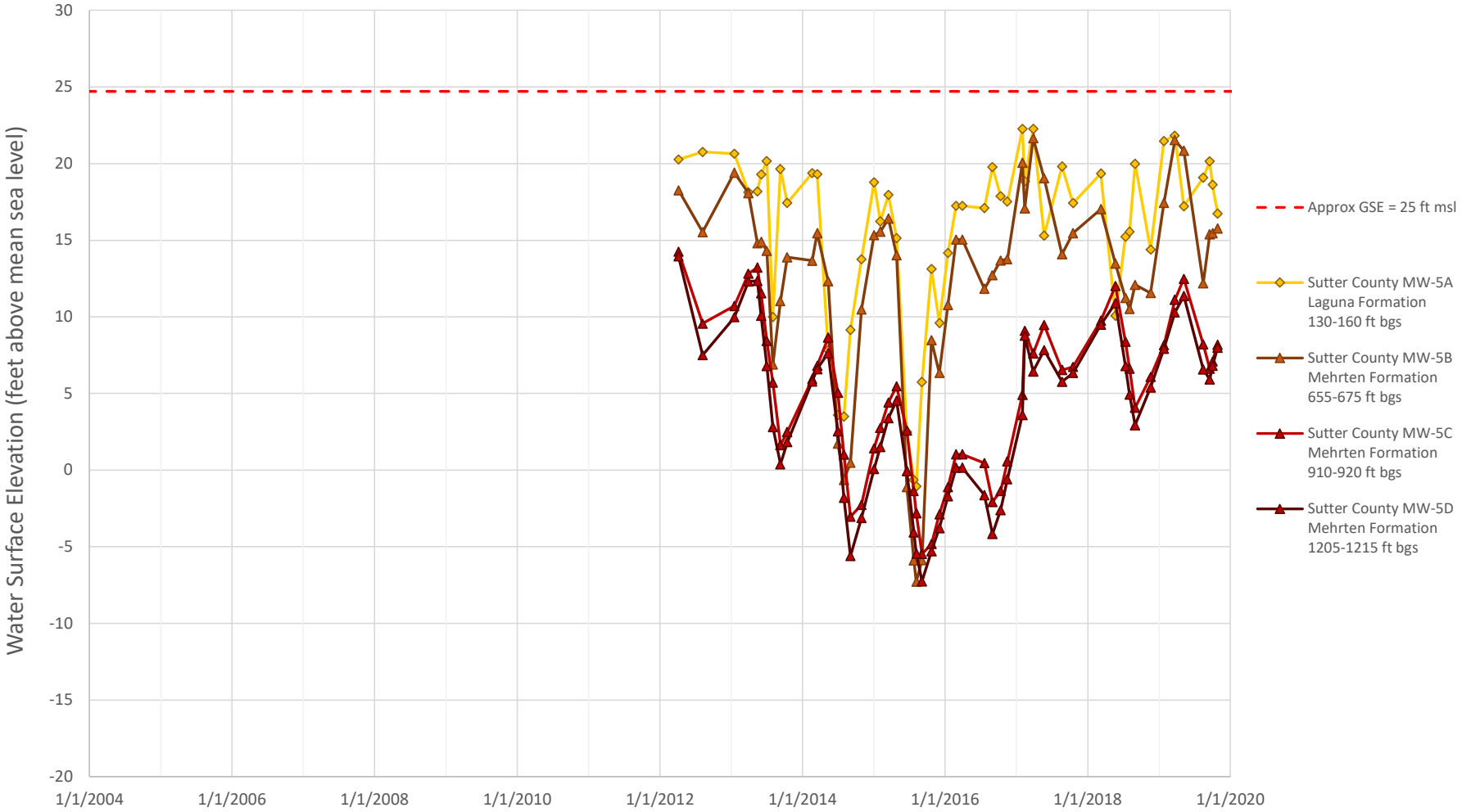

Local Well No. 37
SUT-P1, SUT-P2, SUT-P3, SUT-P4
388260N1215394W004, 388260N1215394W003, 388260N1215394W001,388260N1215394W001
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 31ft msl
SUT-P1
Laguna Formation
110-120 ft bgs
SUT-P2
Laguna Formation
185-195 ft bgs
SUT-P3
Laguna Formation
295-305 ft bgs
SUT-P4
Mehrten Formation
880-890 ft bgs

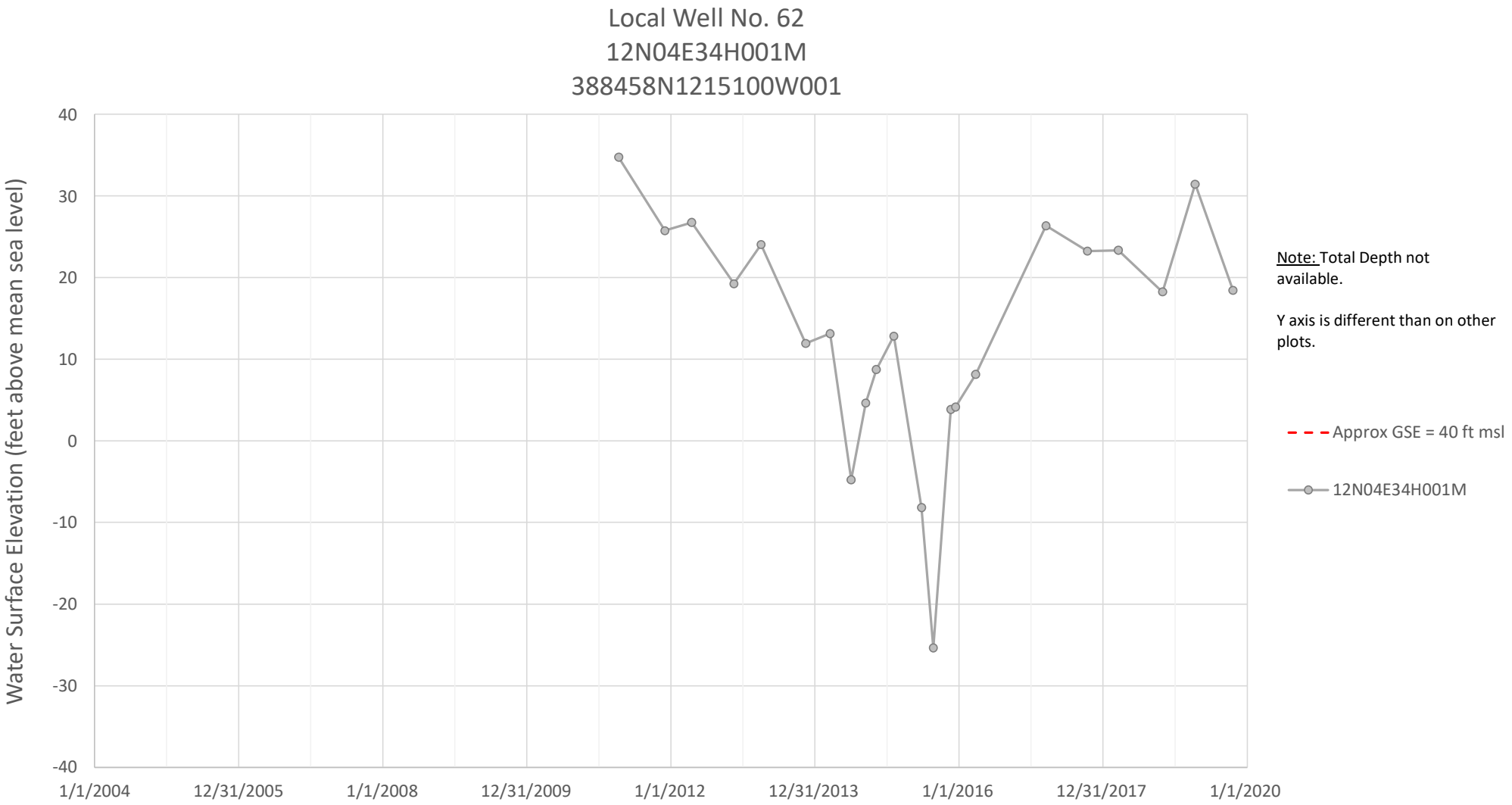
Local Well No. 39
AB-1 Nested Well
389116N1215238W003, 389117N1215238W001, 389116N1215238W002, 389116N1215238W001

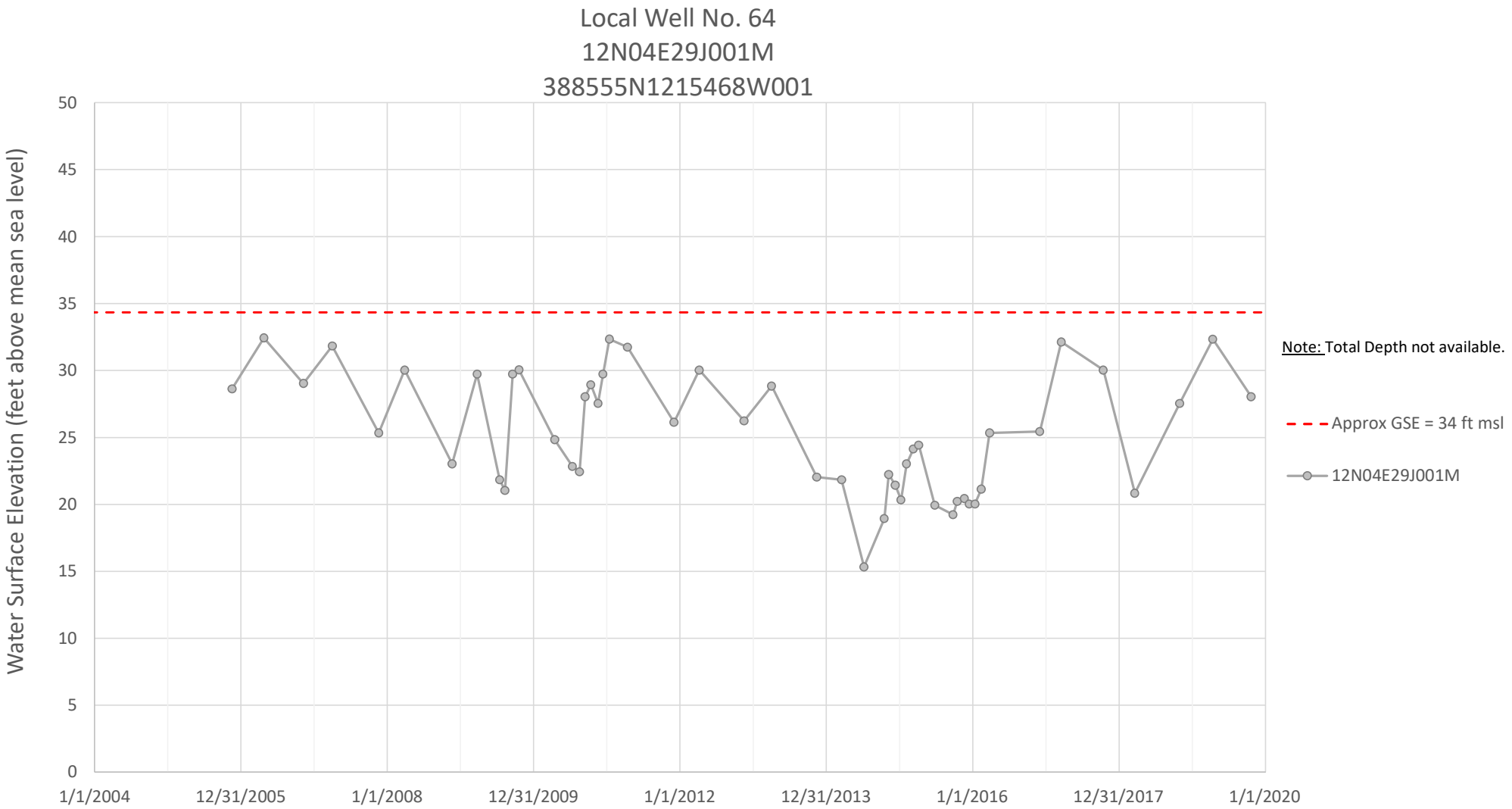


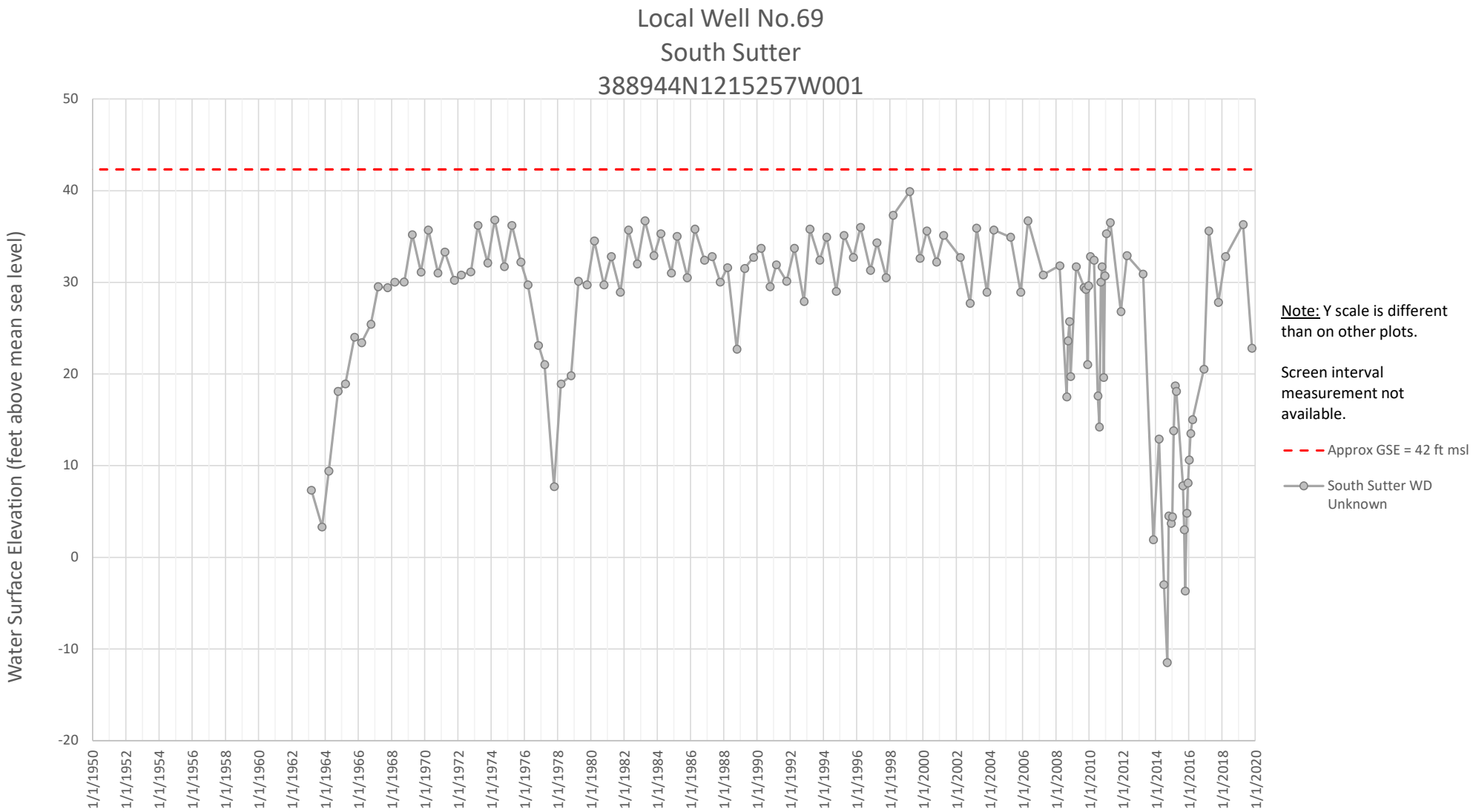

Local Well No. 53
South Sutter
387971N1215119W001
Water Surface Elevation (feet above mean sea level)
20
10
0
-10
-20
-30
-40
-50
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurement not available.
Approx GSE = 35ft msl
South Sutter WD Unknown

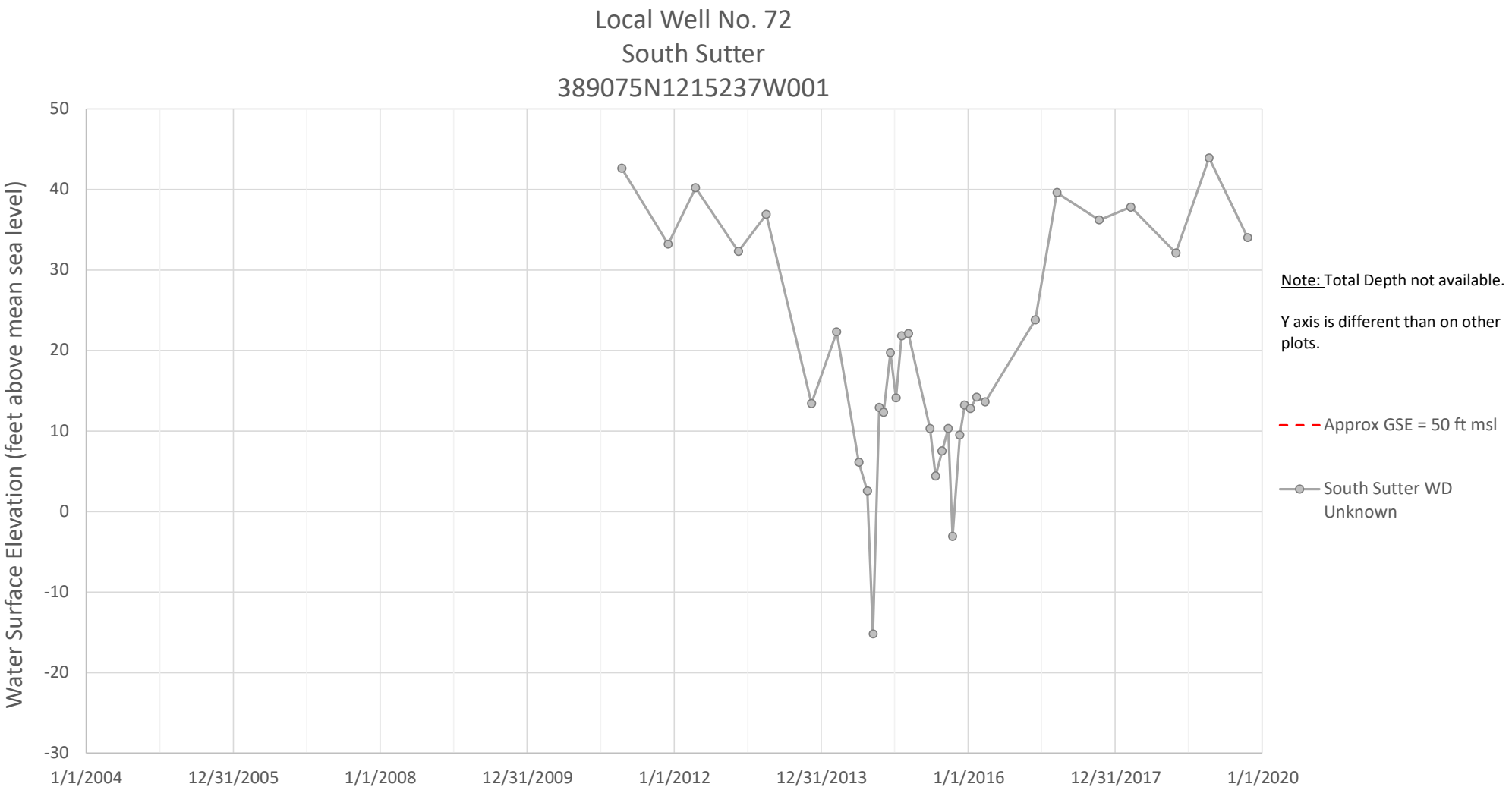
Local Well No. 61
Sutter County MW-5 Nested Well
388235N1216079W001, 388235N1216079W002, 388235N1216079W003, 388235N1216079W004

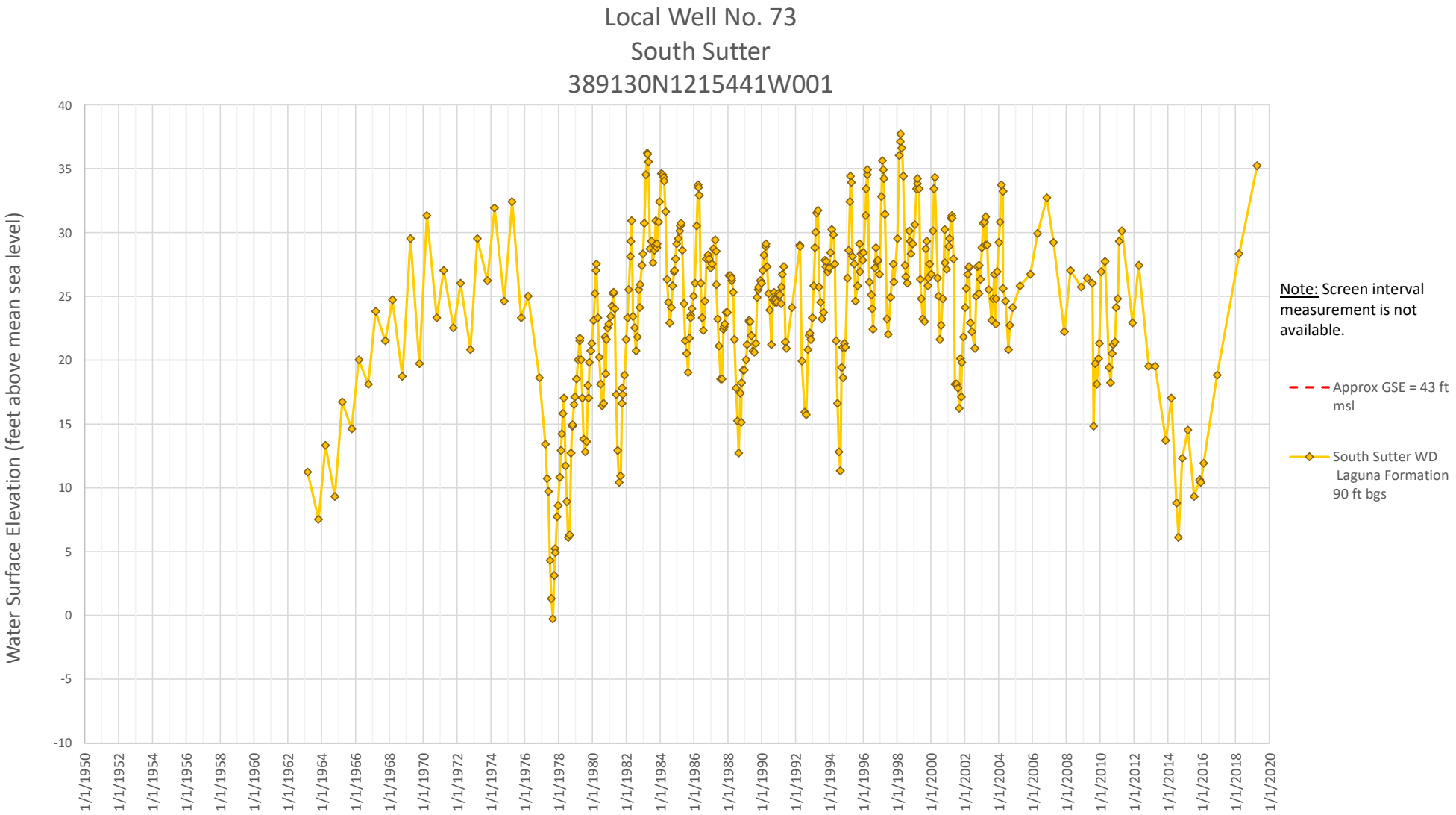


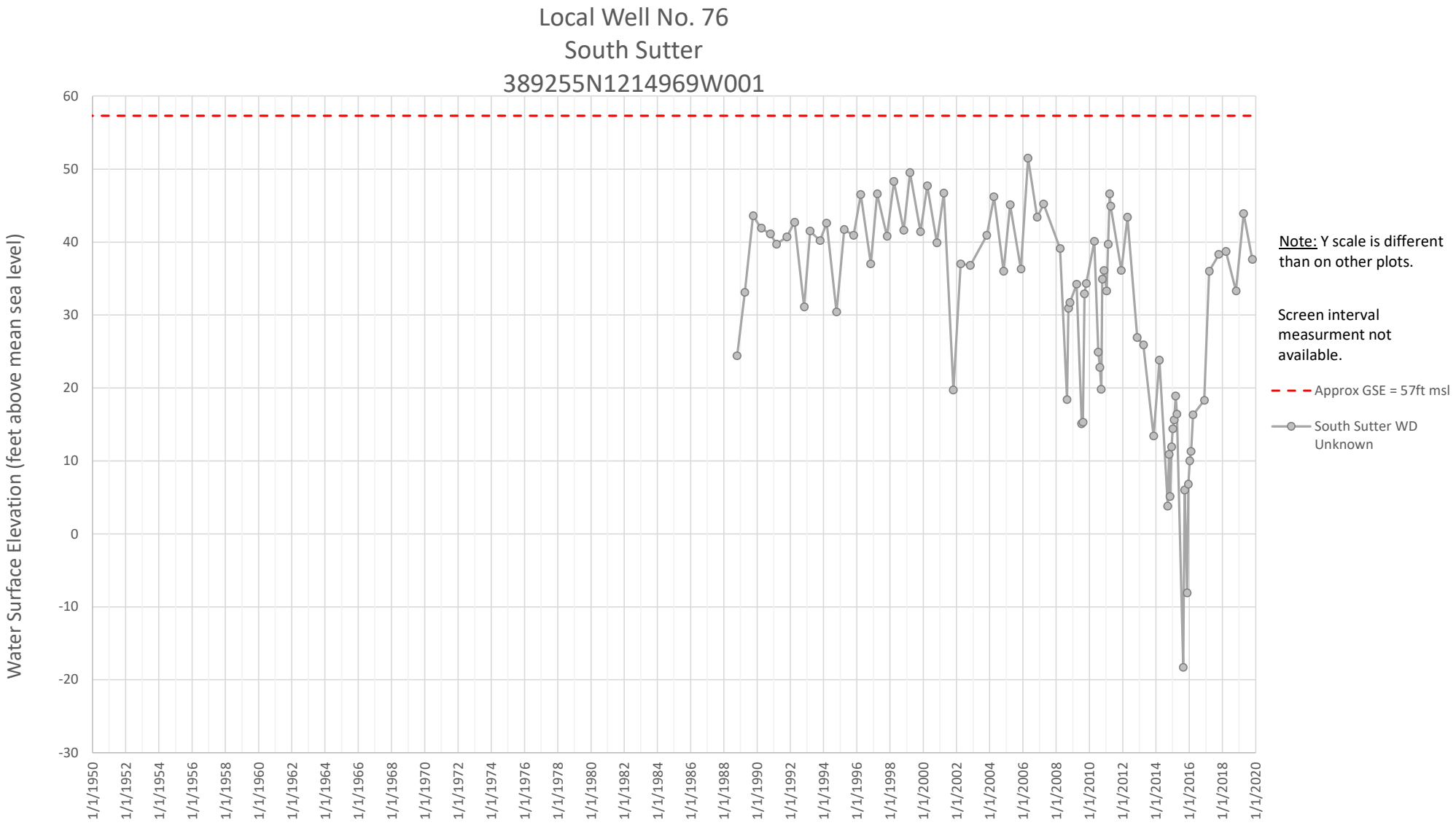

Local Well No. 62
12N04E34H001M
388458N1215100W001
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
-30
-40
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Note: Total Depth not available.
Y axis is different than on other plots.
Approx GSE = 40 ft msl
12N04E34H001M

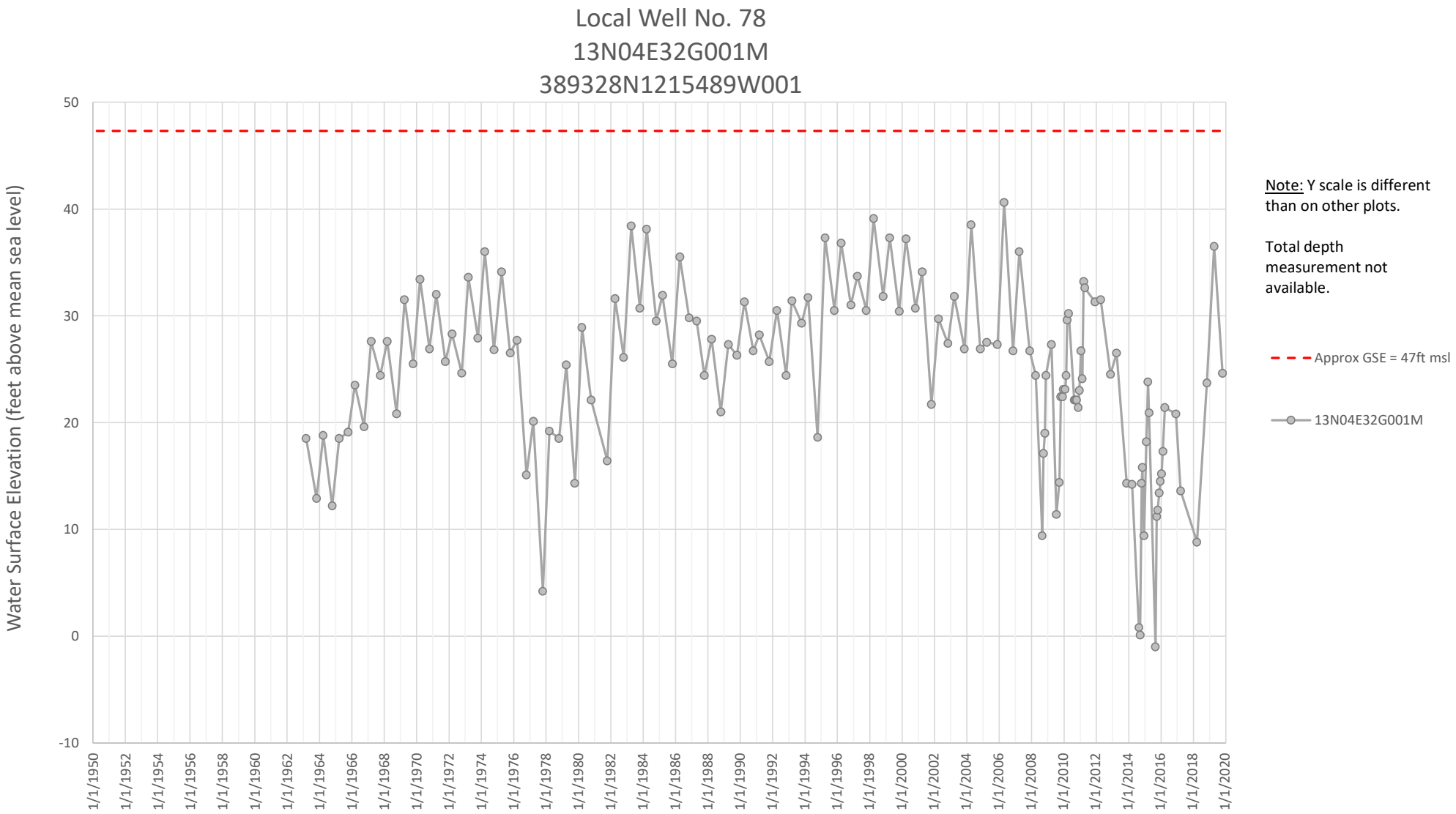

Local Well No. 64
12N04E29J001M
388555N1215468W001
Water Surface Elevation (feet above mean sea level)
50
45
40
35
30
25
20
15
10
5
0
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Note: Total Depth not available.
Approx GSE = 34 ft msl
12N04E29J001M

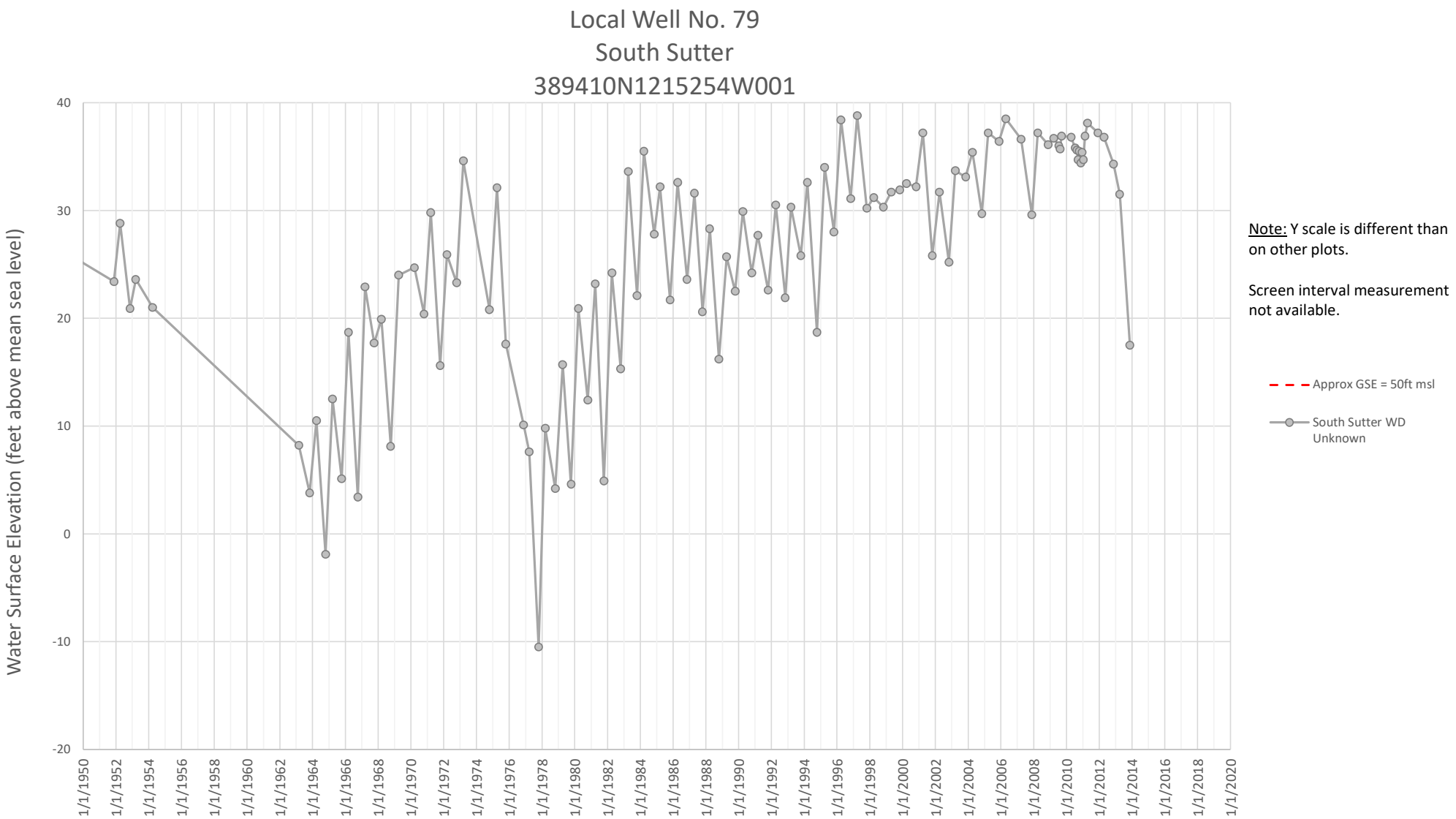

Local Well No.69
South Sutter
388944N1215257W001
Water Surface Elevation (feet above mean sea level)
50
40
30
20
10
0
-10
-20
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurement not available.
Approx GSE = 42 ft msl
South Sutter WD Unknown

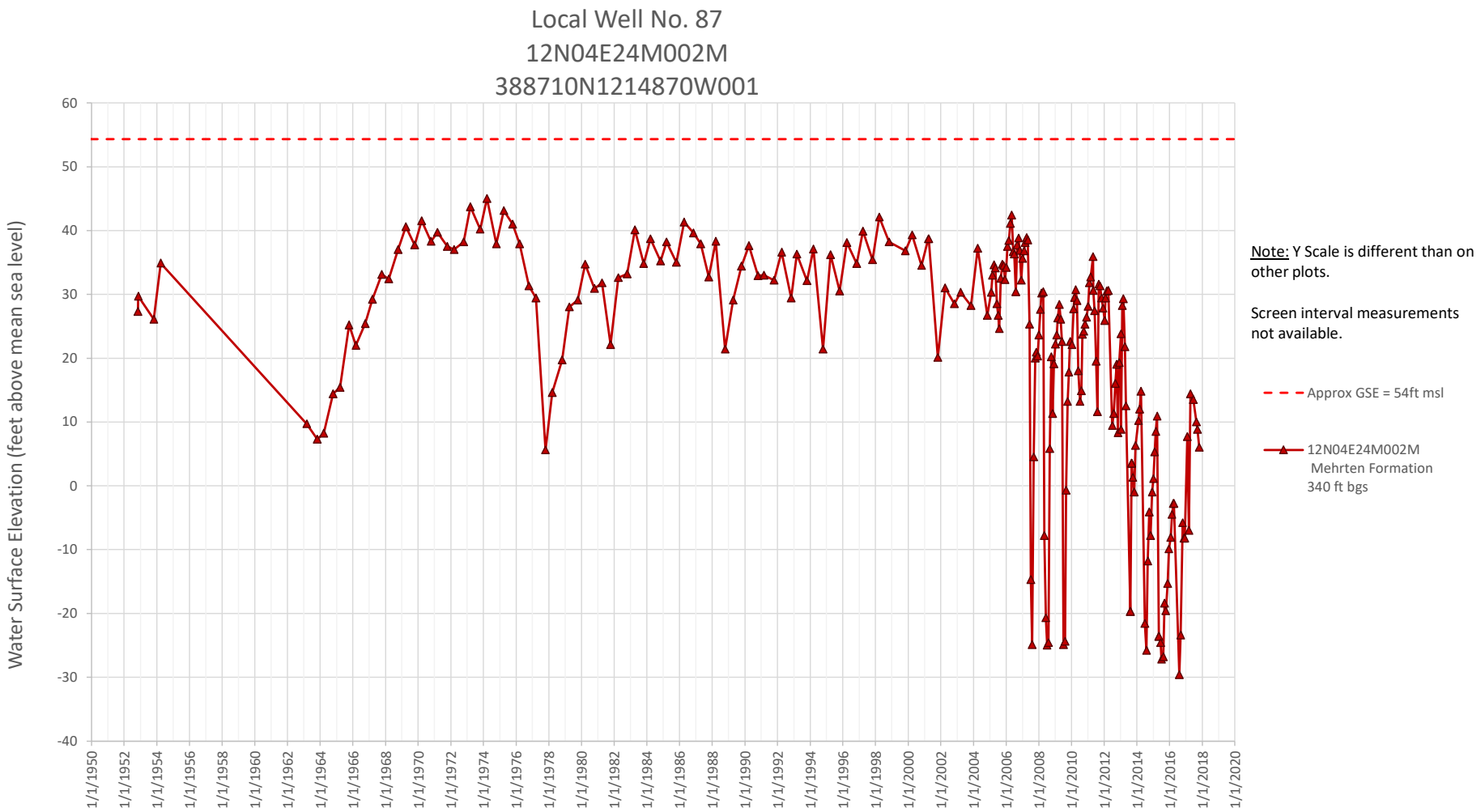

Local Well No. 72
South Sutter
389075N1215237W001
Water Surface Elevation (feet above mean sea level)
50
40
30
20
10
0
-10
-20
-30
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Note: Total Depth not available.
Y axis is different than on other plots.
Approx GSE = 50 ft msl
South Sutter WD
Unknown


Local Well No. 73
South Sutter
389130N1215441W001
Water Surface Elevation (feet above mean sea level)
40
35
30
25
20
15
10
5
0
-5
-10
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurement is not available.
Approx GSE = 43 ft msl
South Sutter WD Laguna Formation 90 ft bgs

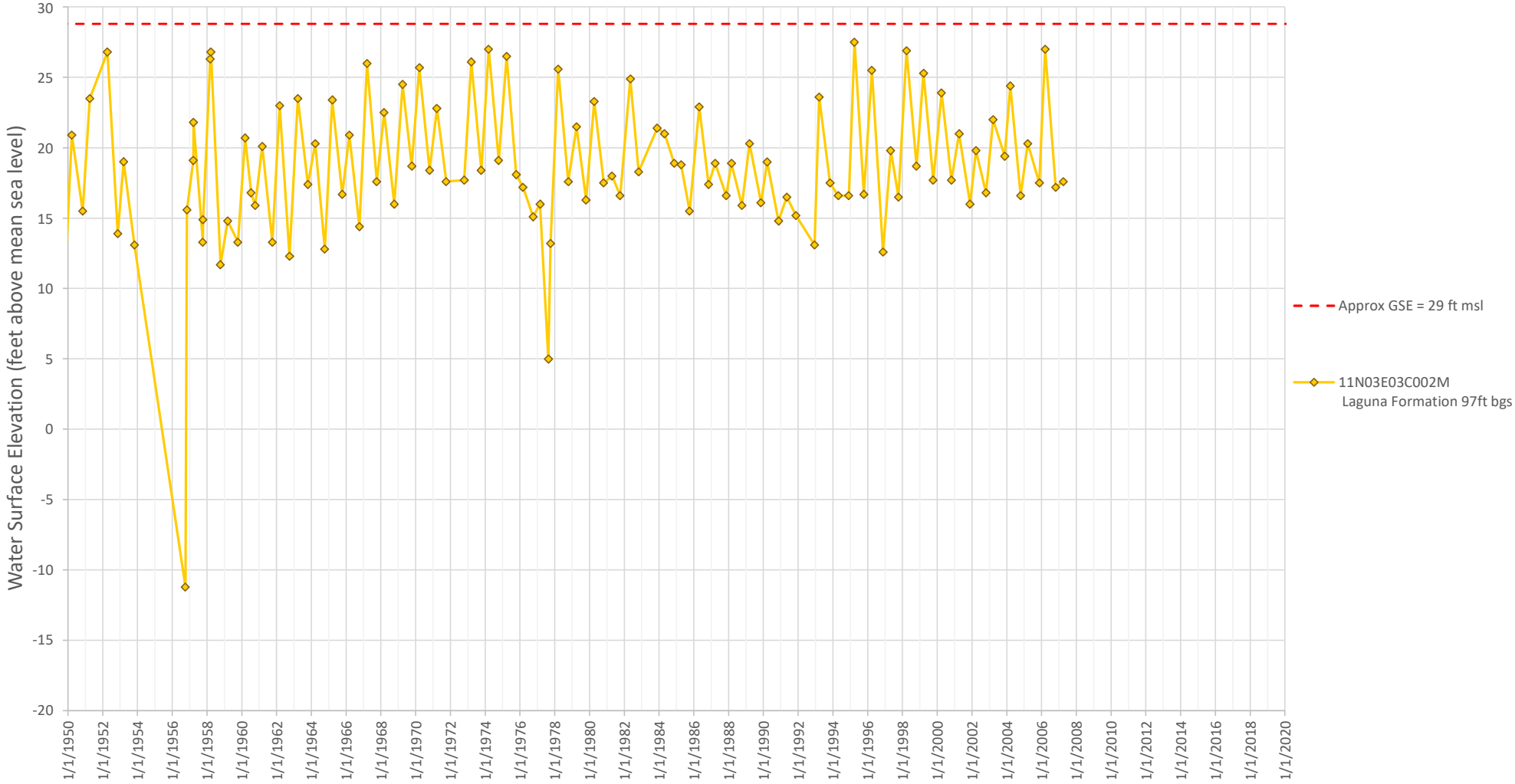

Local Well No. 76
South Sutter
389255N1214969W001
Water Surface Elevation (feet above mean sea level)
60
50
40
30
20
10
0
-10
-20
-30
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurment not available.
Approx GSE = 57ft msl
South Sutter WD Unknown


Local Well No. 78
13N04E32G001M
389328N1215489W001
Water Surface Elevation (feet above mean sea level)
50
40
30
20
10
0
-10
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Total depth measurement not available.
Approx GSE = 47ft msl
13N04E32G001M


Local Well No. 79
South Sutter
389410N1215254W001
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurement not available.
Approx GSE = 50ft msl
South Sutter WD Unknown


Local Well No. 87
12N04E24M002M
388710N1214870W001
Water Surface Elevation (feet above mean sea level)
60
50
40
30
20
10
0
-10
-20
-30
-40
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y Scale is different than on other plots.
Screen interval measurements not available.
Approx GSE = 54ft msl
12N04E24M002M
Mehrten Formation
340 ft bgs

Local Well No. 88
11N03E03C002M
388357N1216273W001



Appendix H: Central Well Hydrographs

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX H
Central Area Wells with Hydrographs

December 2021

APPENDIX H

CENTRAL AREA
WELLS WITH HYDROGRAPHS

LEGEND:

- Laguna Formation Wells
- Mehrten Formation Wells
- Wells with Unknown Construction Details
- Ione or Central Valley Fm. Wells

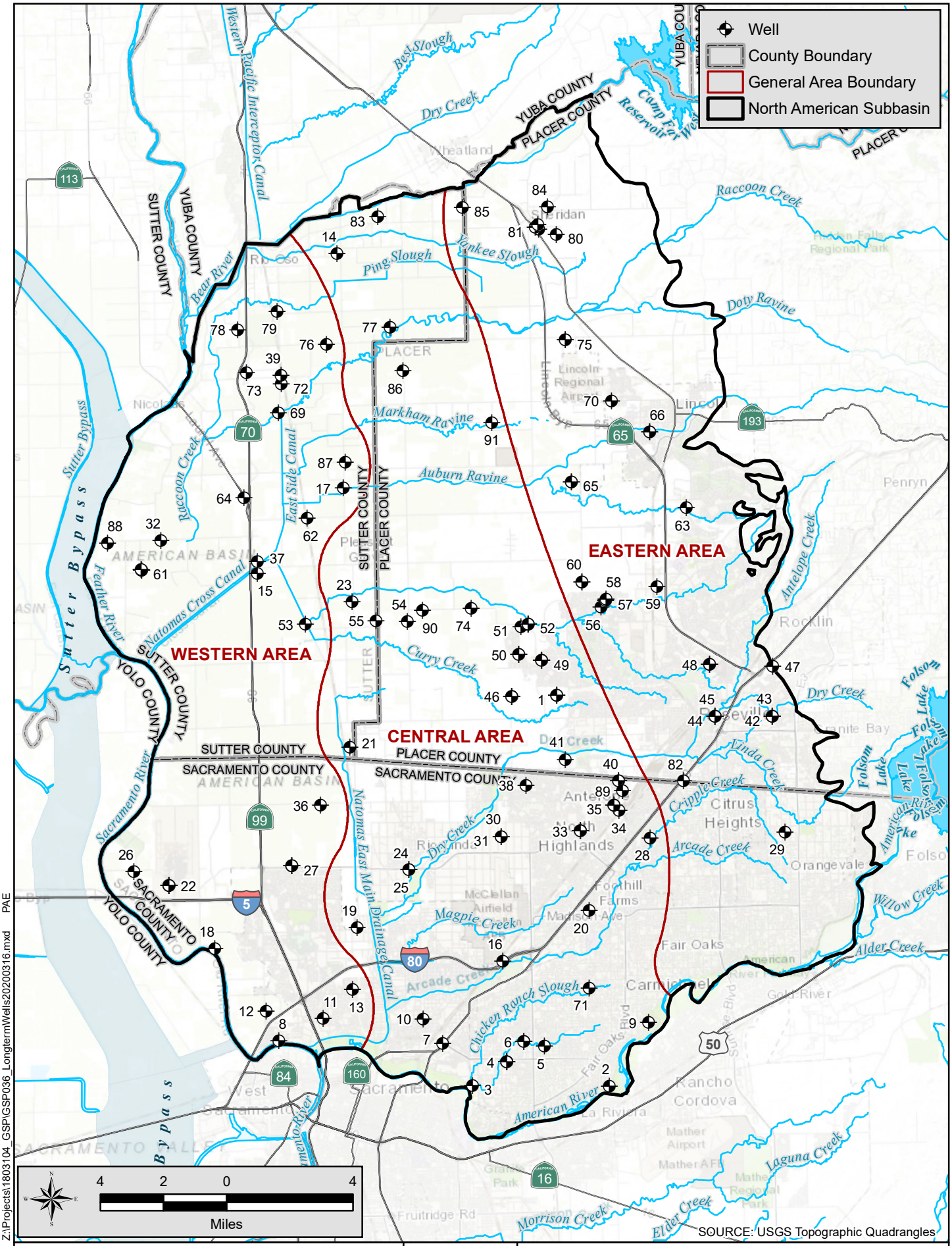
Long-Term Hydrographs

Years Displayed	1950 to 2019
Vertical Axis	50 feet
	Unless otherwise noted

Short Term Hydrographs

Years Displayed	2004 to 2019
	Unless otherwise noted
Vertical Axis	50 feet
	Unless otherwise noted

Groundwater levels from multiple aquifers shown



Z:\Projects\1803104_GSP\GSP036_LongtermWells20200316.mxd PAE

18-Mar-2020

North American Subbasin
Sutter, Placer and Sacramento Counties

North American Subbasin

GEI Consultants

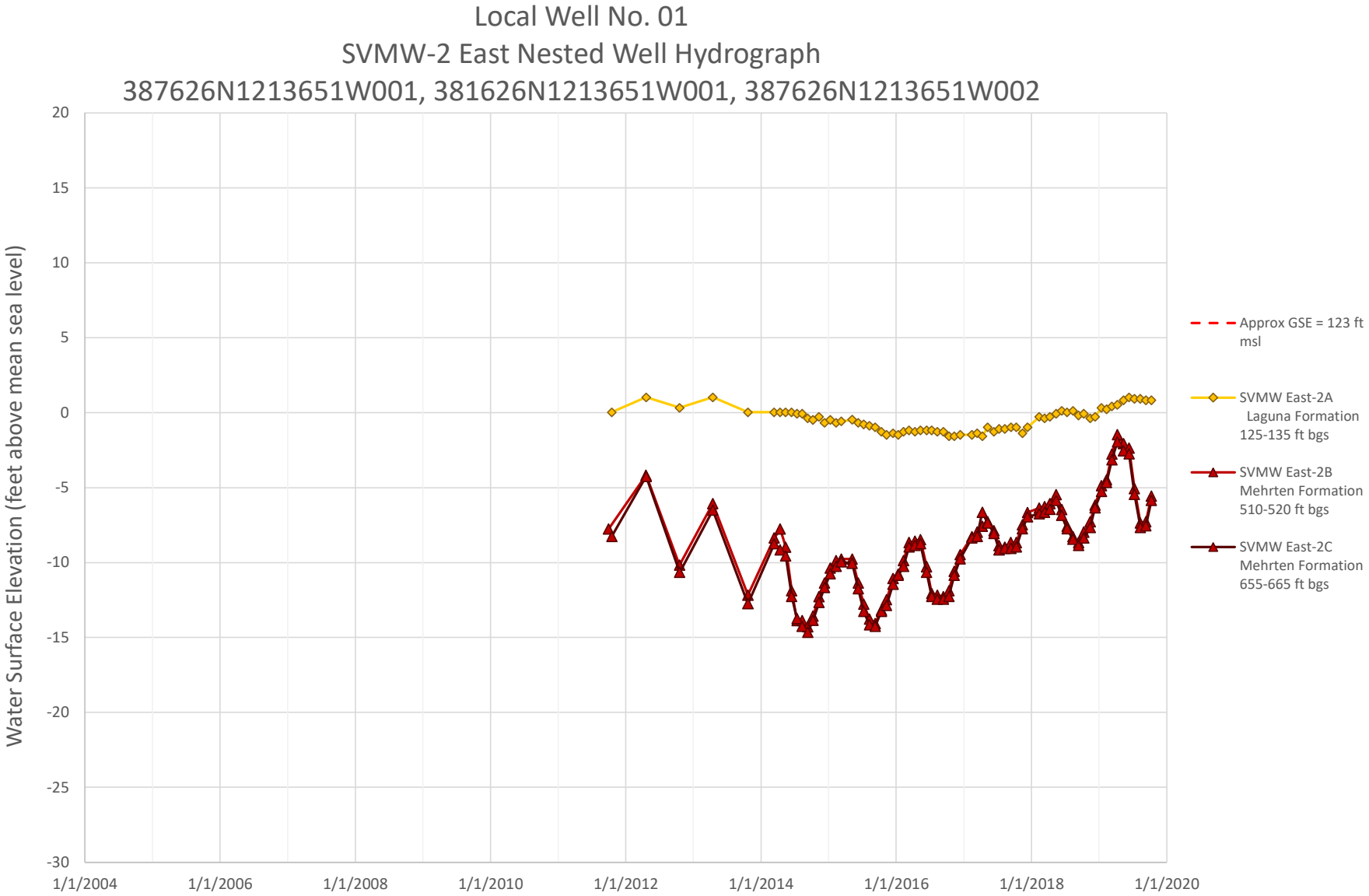
Long Term Wells

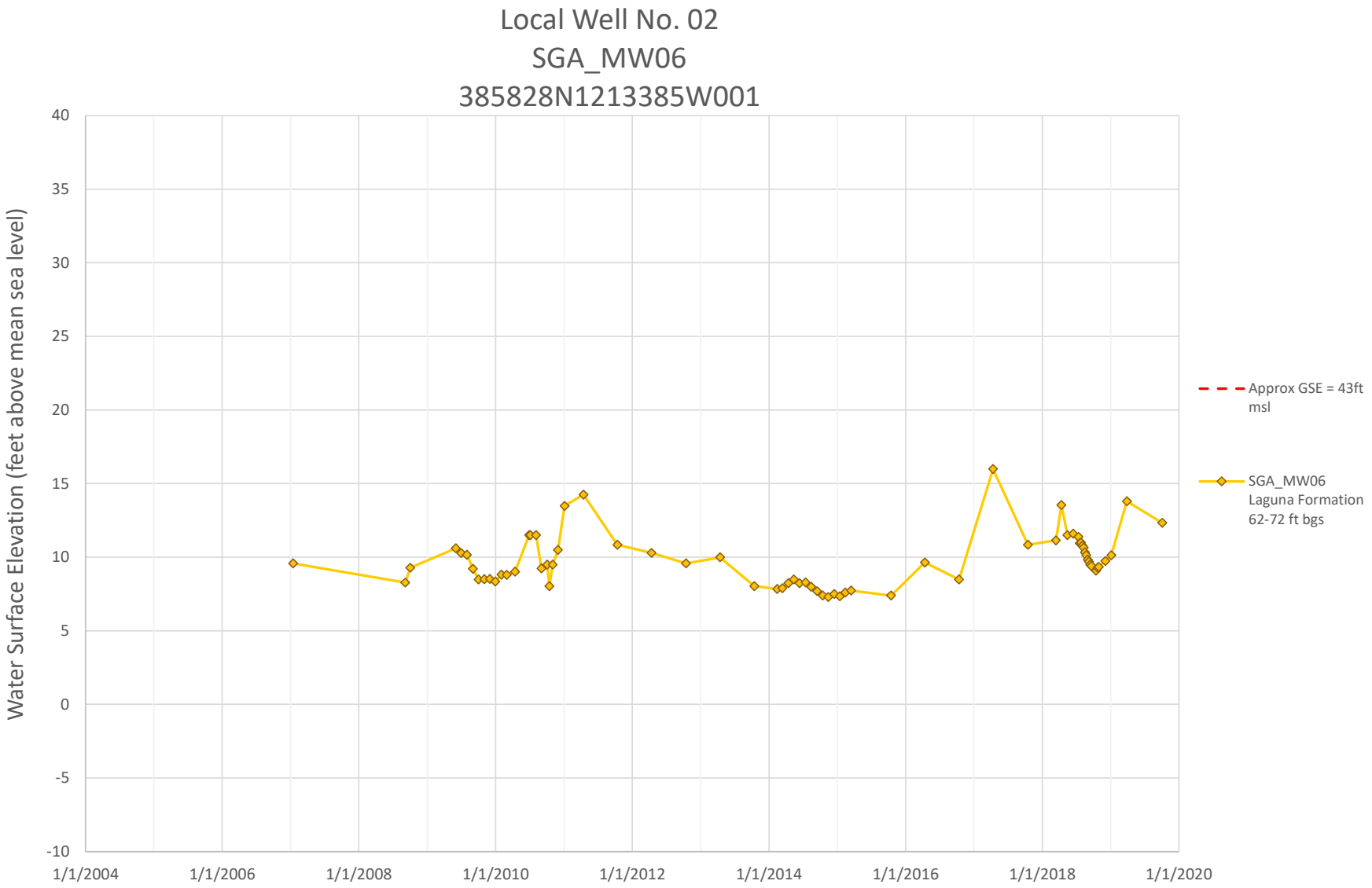
MARCH 2020

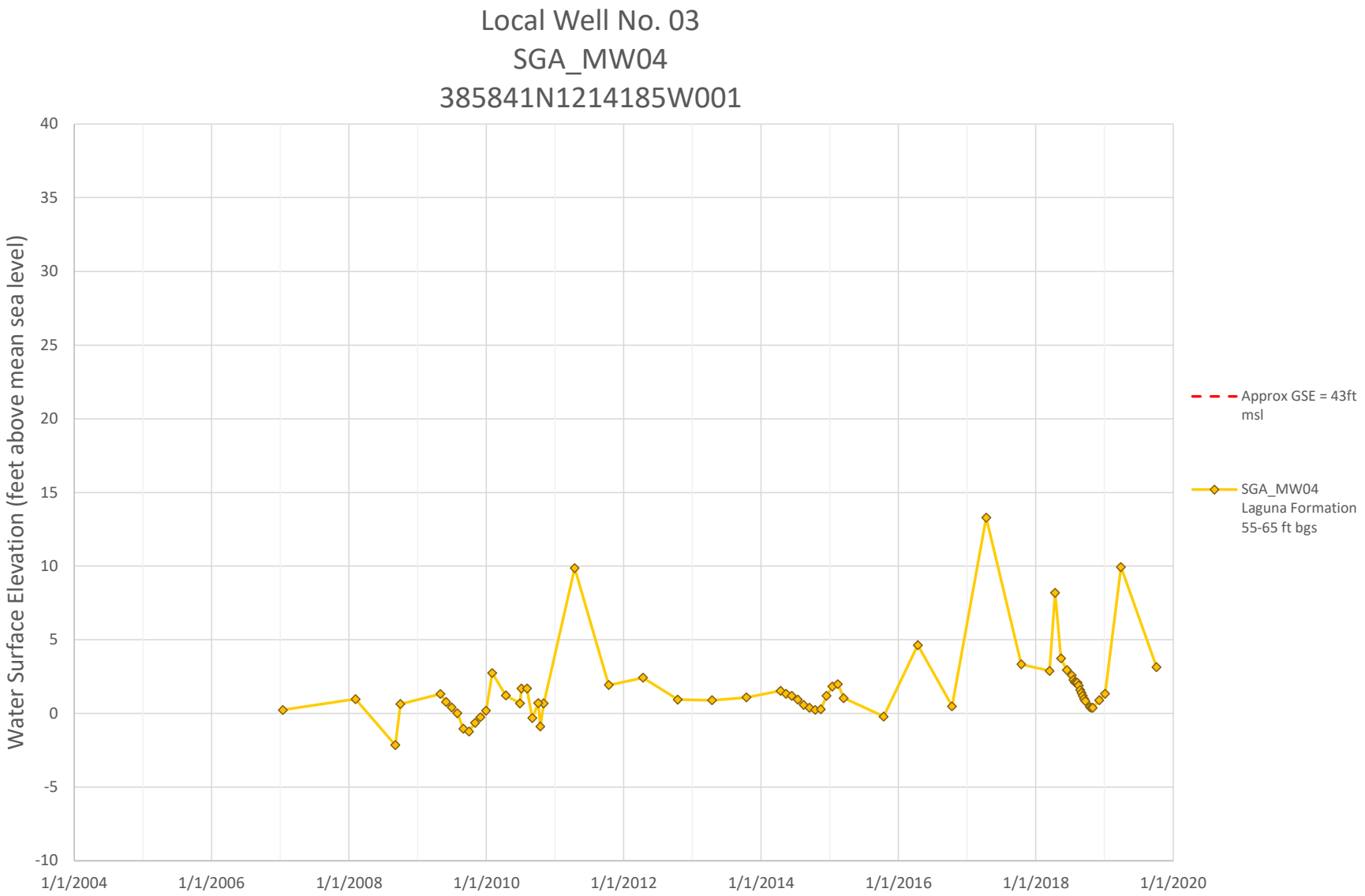
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
1	SVMW East-2B	Not Available	48577	381626N1213651W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	525	Y	NOT AVAILABLE	Active	38.762629	-121.365097
1	SVMW East-2A	Not Available	48576	387626N1213651W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	140	Y	NOT AVAILABLE	Active	38.762629	-121.365099
1	SVMW East-2C	Not Available	48578	387626N1213651W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	670	Y	NOT AVAILABLE	Active	38.76263	-121.365098
2	SGA_MW06	Not Available	48014	385828N1213385W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	72	Y	e026069	Active	38.58281	-121.33846
3	SGA_MW04	Not Available	48012	385841N1214185W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	65	Y	e029066	Active	38.58414	-121.41852
4	MW12A	Not Available	48021	385947N1213985W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	285	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12B	Not Available	48022	385947N1213985W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	385	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12C	Not Available	48023	385947N1213985W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	615	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12D	Not Available	48024	385947N1213985W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	845	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12E	Not Available	48025	385947N1213985W005	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	1005	Y	NOT AVAILABLE	Active	38.59472	-121.39847
5	DWR_SGA_004	09N05E25J001M	9641	386016N1213761W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	238	N	94507	Active	38.6016	-121.3761
6	MW11A	Not Available	48018	386038N1213882W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	187	Y	NOT AVAILABLE	Active	38.6038	-121.38815
6	MW11B	Not Available	48019	386038N1213882W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	278	Y	NOT AVAILABLE	Active	38.6038	-121.38815
6	MW11C	Not Available	48020	386038N1213882W003	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	375	Y	NOT AVAILABLE	Active	38.6038	-121.38815
7	DWR_SGA_005	09N05E28K001M	9643	386038N1214357W001	Department of Water Resources	North American	5-021.64	Sacramento	Irrigation	No	250	N	NOT AVAILABLE	Active	38.6038	-121.4357
8	SCWA_SGA_003	09N04E27F001M	8944	386061N1215313W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	320	N	828	Active	38.6061	-121.5313
9	SCWA_SGA_004	09N06E27D001M	9648	386117N1213150W001	Sacramento Central Groundwater	North American	5-021.64	Sacramento	Observation	No	200	N	NOT AVAILABLE	Inactive	38.6117	-121.315
10	DWR_SGA_003	09N05E21M001M	31412	386151N1214467W001	Department of Water Resources	North American	5-021.64	Sacramento	Unknown	No	89	N	NOT AVAILABLE	Active	38.6151	-121.4467
11	Bannon Creek Park	09N04E23R002M	48041	386160N1215054W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	48	Y	NOT AVAILABLE	Active	38.61603	-121.5054
12	09N04E22E001M	09N04E22E001M	8943	386199N1215386W001	Department of Water Resources	North American	5-021.64	Sacramento	Residential	No	-	N	NOT AVAILABLE	Active	38.6199	-121.5386
13	Chuckwagon Park	09N04E13R001M	48040	386292N1214877W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	52	Y	NOT AVAILABLE	Active	38.62921	-121.4877
14	13N04E23A002M	13N04E23A002M		389669N1214897W001	Department of Water Resources	North American	5-021.64	Sutter	Residential		83				38.9669	-121.4897
15	11N04E09D002M	11N04E09D002M		388208N1215397W001	Department of Water Resources	North American	5-021.64	Sutter	Residential		100				38.8208	-121.5397
16	DWR_SGA_002	09N05E14B001M	40050	386410N1213995W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	550	N	49236	Active	38.641	-121.3995
17	AB-2 deep	12N04E26J002M		388593N1214885W001	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
17	AB-2 middle	12N04E26J003M		388593N1214885W002	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
17	AB-2 shallow	12N04E26J004M		388593N1214885W003	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
18	SCWA_SGA_002	09N04E08L001M	29914	386489N1215679W001	Department of Water Resources	North American	5-021.64	Sacramento	Irrigation	No	105	N	185	Active	38.6489	-121.5679
19	SCWA_SGA_001	09N04E01R001M	8921	386576N1214846W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	82	N	NOT AVAILABLE	Active	38.6576	-121.4846
20	SGA_MW05	Not Available	48013	386635N1213486W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	220	Y	e029068	Active	38.66347	-121.34859
21	10N04E12A001M	10N04E12A001M		387404N1214870W001	Department of Water Resources	North American	5-021.64		Irrigation					Active	38.7404	-121.487
22	AB-4 deep	10N04E31M001M	39756	386782N1215943W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	1080	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 middle-deep	10N04E31M002M	24319	386782N1215943W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	815	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 middle-shallow	10N04E31M003M	37857	386782N1215943W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	410	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 shallow	10N04E31M004M	24318	386782N1215943W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	200	Y	NOT AVAILABLE	Active	38.6782	-121.5943
23	South Sutter	11N04E13D001M		388072N1214842W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation		535				38.8072	-121.4842
24	SGA_MW02	Not Available	48010	386836N1214536W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	110	Y	e029062	Active	38.68362	-121.45363
25	SGA_MW03	Not Available	48011	386836N1214536W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	305	Y	e034123	Active	38.68356	-121.45362
26	SCWA_SGA_005	10N03E35A001M	40055	386848N1216146W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	96	N	221	Active	38.6848	-121.6146
27	AB-3 deep	10N04E27R002M	32581	386864N1215222W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	995	Y	NOT AVAILABLE	Active	38.6864	-121.5222
27	AB-3 middle	10N04E27R003M	15689	386864N1215222W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	500	Y	NOT AVAILABLE	Active	38.6864	-121.5222
27	AB-3 shallow	10N04E27R004M	15690	386864N1215222W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	220	Y	NOT AVAILABLE	Active	38.6864	-121.5222
28	Twin Creeks Park	10N06E27F001M	48042	386964N1213120W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	198	Y	NOT AVAILABLE	Active	38.6964	-121.31203
29	SCWA_SGA_012	10N07E29G001M	33380	386979N1212329W001	Sacramento County	North American	5-021.64	Sacramento	Irrigation	No	240	N	1037	Inactive	38.6979	-121.2329
30	SCWA_SGA_008	10N05E14Q002M	13652	386982N1213992W001	Department of Water Resources	North American	5-021.64	Sacramento	Residential	No	225	N	10678	Active	38.6982	-121.3992
31	SCWA_SGA_009	10N05E26B002M	13654	386982N1213992W002	Sacramento County	North American	5-021.64	Sacramento	Residential	No	150	N	NOT AVAILABLE	Active	38.6982	-121.3992
32	MLF Well #1	11N03E01D001M		388361N1215959W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.83664	-121.59591
33	Monument (A)	Not Available	48030	387000N1213529W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	274	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (B)	Not Available	48031	387000N1213529W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	334	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (C)	Not Available	48032	387000N1213529W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	450	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (D)	Not Available	48033	387000N1213529W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	544	Y	NOT AVAILABLE	Active	38.70005	-121.35288
34	SCWA_SGA_010	10N06E21F002M	33087	387092N1213300W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	144	N	NOT AVAILABLE	Active	38.7092	-121.33
35	Poker (A)	Not Available	48034	387117N1213327W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	134	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (B)	Not Available	48035	387117N1213327W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	176	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (C)	Not Available	48036	387117N1213327W003	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	320	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (D)	Not Available	48037	387117N1213327W004	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	470	Y	NOT AVAILABLE	Active	38.71174	-121.33271
36	SCWA_SGA_006	10N04E23A001M	32580	387138N1215047W001	Sacramento County	North American	5-021.64	Sacramento	Industrial	No	85	N	NOT AVAILABLE	Active	38.7138	-121.5047
37	SUT-P4	11N04E04N001M		388260N1215394W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		305				38.826	-121.5394
37	SUT-P3	11N04E04N002M		388260N1215394W002	Department of Water Resources	North American	5-021.64	Sutter	Observation		195				38.826	-121.5394
37	SUT-P2	11N04E04N003M		388260N1215394W003	Department of Water Resources	North American	5-021.64	Sutter	Observation		120				38.826	-121.5394
37	SUT-P1	11N04E04N004M		388260N1215394W004	Department of Water Resources	North American	5-021.64	Sutter	Observation		980				38.826	-121.5394
38	Lone Oak Park	10N05E13F001M	48043	387216N1213842W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	166	Y	NOT AVAILABLE	Active	38.72163	-121.38417
39	AB-1 deep	12N04E03N001M		389116N1215238W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		980				38.9116	-121.5238
39	AB-1 middle-deep	12N04E03N002M		389116N1215238W002	Department of Water Resources	North American	5-021.64	Sutter	Observation		710				38.9116	-121.5238
39	AB-1 shallow	12N04E03N004M		389116N1215238W003	Department of Water Resources	North American	5-021.64	Sutter	Observation		190				38.9116	-121.5238
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
39	AB-1 middle-shallow	12N04E03N003M		389117N1215238W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		530				38.9116	-121.5238
40	Antelope North (A)	Not Available	48038	387228N1213298W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	283	Y	NOT AVAILABLE	Active	38.722803	-121.329755
40	Antelope North (B)	Not Available	48039	387228N1213298W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	473	Y	NOT AVAILABLE	Active	38.722803	-121.329755
41	WPMW-5A	Not Available	51280	387331N1213610W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	100	Y	e0266541	Active	38.733106	-121.360994
41	WPMW-5B	Not Available	51281	387331N1213610W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	650	Y	e0266541	Active	38.733106	-121.360994
42	WPMW-7A	Not Available	51283	387512N1212390W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	45	Y	e0265730	Active	38.751194	-121.239
43	WPMW-8A	Not Available	51284	387510N1212390W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	50	Y	e0265733	Active	38.750989	-121.23895
43	WPMW-8B	Not Available	51285	387510N1212390W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	115	Y	e0265733	Active	38.750989	-121.23895
44	WPMW-9A	Not Available	51286	387517N1212727W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	36	Y	e0265735	Active	38.751667	-121.272656
45	WPMW-10A	Not Available	51287	387515N1212725W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	36	Y	e0265738	Active	38.751494	-121.272511
45	WPMW-10B	Not Available	51288	387515N1212725W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	100	Y	e0265738	Active	38.751494	-121.272511
45	WPMW-10C	Not Available	51289	387515N1212725W003	City of Roseville	North American	5-021.64	Placer	Observation	Yes	260	Y	e0265738	Active	38.751494	-121.272511

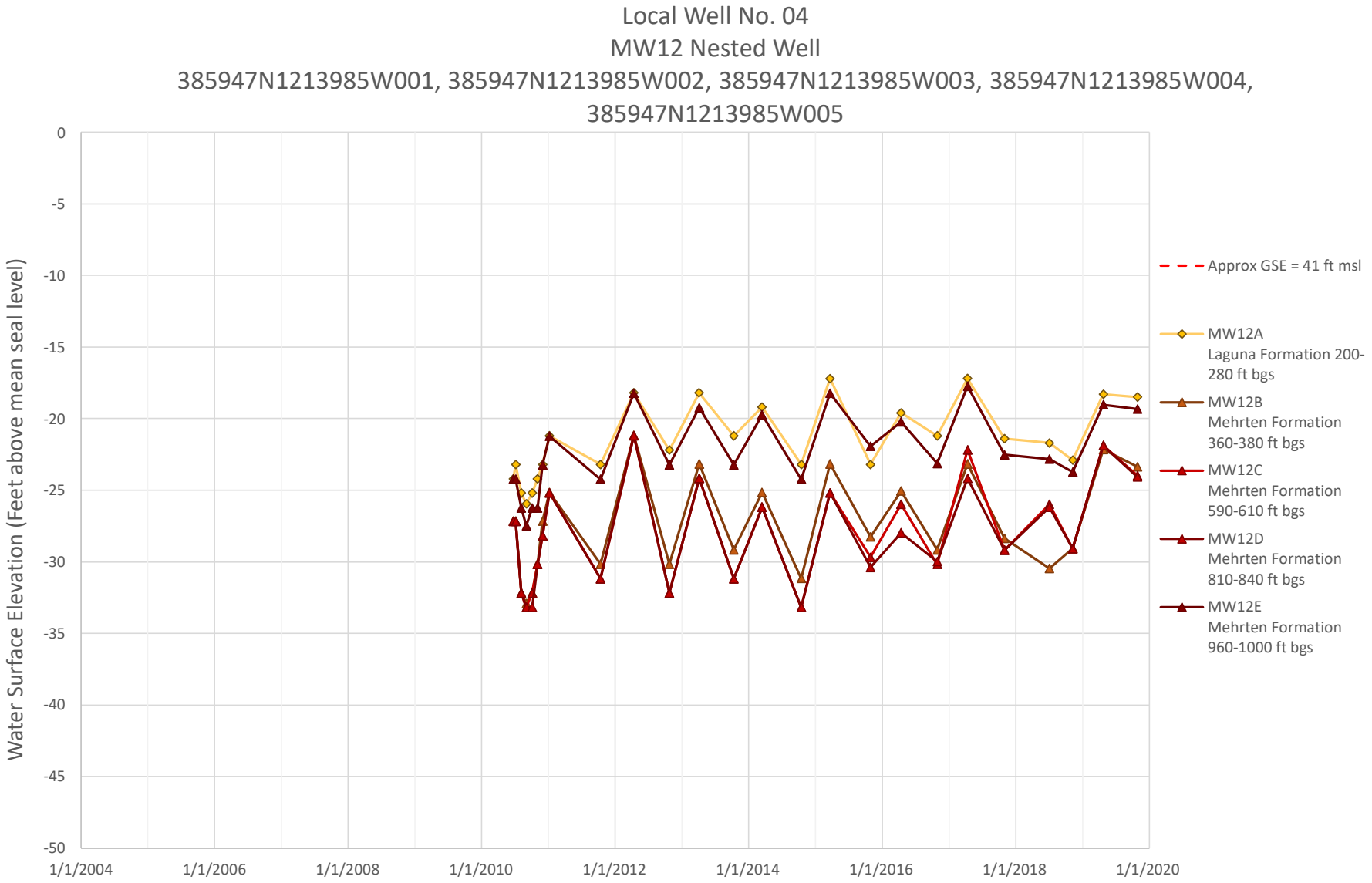
46	SVMW West - 1A	Not Available	48573	387623N1213915W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	145	Y	NOT AVAILABLE	Active	38.762324	-121.39153
46	SVMW West - 1B	Not Available	48574	387623N1213915W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	560	Y	NOT AVAILABLE	Active	38.762325	-121.39153
46	SVMW West - 1C	Not Available	48575	387623N1213915W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	750	Y	NOT AVAILABLE	Active	38.762325	-121.391529
48	WPMW-4A	Not Available	48567	387755N1212753W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	145	Y	NOT AVAILABLE	Active	38.775536	-121.275254
48	WPMW-4B	Not Available	48568	387755N1212753W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	300	Y	NOT AVAILABLE	Active	38.775535	-121.275255
49	WPMW-1A	Not Available	48560	387786N1213737W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	120	Y	NOT AVAILABLE	Active	38.778603	-121.373698
49	WPMW-1B	Not Available	48561	387786N1213737W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	480	Y	NOT AVAILABLE	Active	38.778603	-121.373697
49	WPMW-1C	Not Available	48562	387786N1213737W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	545	Y	NOT AVAILABLE	Active	38.778602	-121.373698
50	W-77MW-A	Not Available	51294	387816N1213870W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	516	Y	NOT AVAILABLE	Active	38.781581	-121.38702
50	W-77MW-B	Not Available	51295	387816N1213870W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	604	Y	NOT AVAILABLE	Active	38.781581	-121.38702
51	O'Brien well	11N05E23B001M	11223	387943N1213856W001	City of Roseville	North American	5-021.64	Placer	Residential	No	195	N	NOT AVAILABLE	Active	38.7943	-121.3856
52	CVMW-1A	Not Available	48569	387957N1213813W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	285	Y	NOT AVAILABLE	Active	38.795655	-121.38126
52	CVMW-1B	Not Available	48571	387957N1213813W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	495	Y	NOT AVAILABLE	Active	38.795654	-121.381258
52	CVMW-1C	Not Available	48572	387957N1213813W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	590	Y	NOT AVAILABLE	Active	38.795655	-121.381258
53	South Sutter WD	11N04E15Q001M	10508	387971N1215119W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.7971	-121.5119
54	South Sutter WD	11N05E18R001M	11221	387977N1214521W001	South Sutter Water District	North American	5-021.64	Placer	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.7977	-121.4521
55	South Sutter WD	11N04E13R001M	10507	387982N1214704W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.7982	-121.4704
56	DCMW-3	Not Available	51293	388027N1213384W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	520	Y	NOT AVAILABLE	Active	38.80271	-121.338432
57	DCMW-1	Not Available	51291	388058N1213355W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	455	Y	NOT AVAILABLE	Active	38.805757	-121.335503
58	DCMW-2	Not Available	51292	388063N1213354W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	437	Y	NOT AVAILABLE	Active	38.806291	-121.335415
59	Tinker MW	Not Available	51290	388116N1213054W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	177	Y	NOT AVAILABLE	Active	38.811594	-121.305387
60	WPMW-2A	Not Available	48563	388145N1213491W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	230	Y	NOT AVAILABLE	Active	38.814497	-121.349144
60	WPMW-2B	Not Available	48564	388145N1213491W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	425	Y	NOT AVAILABLE	Active	38.814497	-121.349143
61	Sutter County MW-5A	11N03E02Q002M	47776	388235N1216079W001	Sutter County	North American	5-021.64	Sutter	Observation	Yes	170	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5B	11N03E02Q003M	47777	388235N1216079W002	Sutter County	North American	5-021.64	Sutter	Observation	Yes	675	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5C	11N03E02Q004M	47778	388235N1216079W003	Sutter County	North American	5-021.64	Sutter	Observation	Yes	930	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5D	11N03E02Q005M	47779	388235N1216079W004	Sutter County	North American	5-021.64	Sutter	Observation	Yes	1225	Y	E0123539	Active	38.8235	-121.6079
62	South Sutter WD	12N04E34H001M	17037	388458N1215100W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Residential	Yes	-	N	NOT AVAILABLE	Active	38.8458	-121.51
63	WPMW-3A	Not Available	48565	388476N1212872W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	53	Y	NOT AVAILABLE	Active	38.847609	-121.287189
63	WPMW-3B	Not Available	48566	388476N1212872W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	140	Y	NOT AVAILABLE	Active	38.847609	-121.287187
64	South Sutter WD	12N04E29J001M	25784	388555N1215468W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.8555	-121.5468
65	MW 1-2	Not Available	49928	388604N1213544W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	318	Y	NOT AVAILABLE	Active	38.860383	-121.354383
65	MW 1-4	Not Available	49930	388604N1213544W004	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	92	Y	NOT AVAILABLE	Active	38.860383	-121.354383
66	MW 5-1	Not Available	49937	388826N1213078W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	100	Y	NOT AVAILABLE	Active	38.882583	-121.30775
66	MW 5-2	Not Available	49938	388826N1213078W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	62	Y	NOT AVAILABLE	Active	38.882583	-121.30775
69	South Sutter WD	12N04E16A004M	17031	388944N1215257W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.8944	-121.5257
70	MW 3-2	Not Available	49935	388971N1213301W002	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	75	Y	NOT AVAILABLE	Active	38.897133	-121.330083
71	WCMSS	Not Available	52461	386280N1213493W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	170	Y	WCR2016-005904	Active	38.62799	-121.34925
71	WCMSM	Not Available	52462	386280N1213493W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	290	Y	WCR2016-005902	Active	38.62799	-121.34925
71	WCMSD	Not Available	52463	386280N1213493W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	530	Y	WCR2016-005899	Active	38.62799	-121.34925
72	South Sutter WD	12N04E10D002M	17027	389075N1215237W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.9075	-121.5237
73	South Sutter WD	12N04E05R004M	17025	389130N1215441W001	South Sutter Water District	North American	5-021.64	Sutter	Residential	Yes	90	N	NOT AVAILABLE	Active	38.913	-121.5441
74	11N05E16H001M	11N05E16H001M		388029N1214145W001	Department of Water Resources	North American	5-021.64	Placer	Irrigation		460				38.8029	-121.4145
75	MW 2-1	Not Available	49931	389255N1213566W001	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	310	Y	NOT AVAILABLE	Active	38.925467	-121.356633
75	MW 2-2	Not Available	49932	389255N1213566W002	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	170	Y	NOT AVAILABLE	Active	38.925467	-121.356633
76	South Sutter WD	13N04E35Q002M	35624	389255N1214969W001	South Sutter Water District	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.9255	-121.4969
77	South Sutter WD	13N05E31K001M	40137	389327N1214594W001	Department of Water Resources	North American	5-021.64	Sutter	Unknown	Yes	393	N	NOT AVAILABLE	Active	38.9327	-121.4594
78	South Sutter WD	13N04E32G001M	35623	389328N1215489W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.9328	-121.5489
79	South Sutter WD	13N04E28R001M	17195	389410N1215254W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.941	-121.5254
80	Cemetery	Not Available	51328	389740N1213606W001	Placer County	North American	5-021.64	Placer	Irrigation	Yes	111	Y	NOT AVAILABLE	Active	38.974027	-121.360615
81	MW-2	Not Available	51331	389764N1213710W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	45	Y	NOT AVAILABLE	Active	38.976427	-121.371001
81	MW-3	Not Available	51332	389774N1213728W001	Placer County	North American	5-021.64	Placer	Observation	Yes	35	Y	NOT AVAILABLE	Active	38.977408	-121.372844
81	MW-1	Not Available	51330	389785N1213713W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	40	Y	NOT AVAILABLE	Active	38.97846	-121.37132

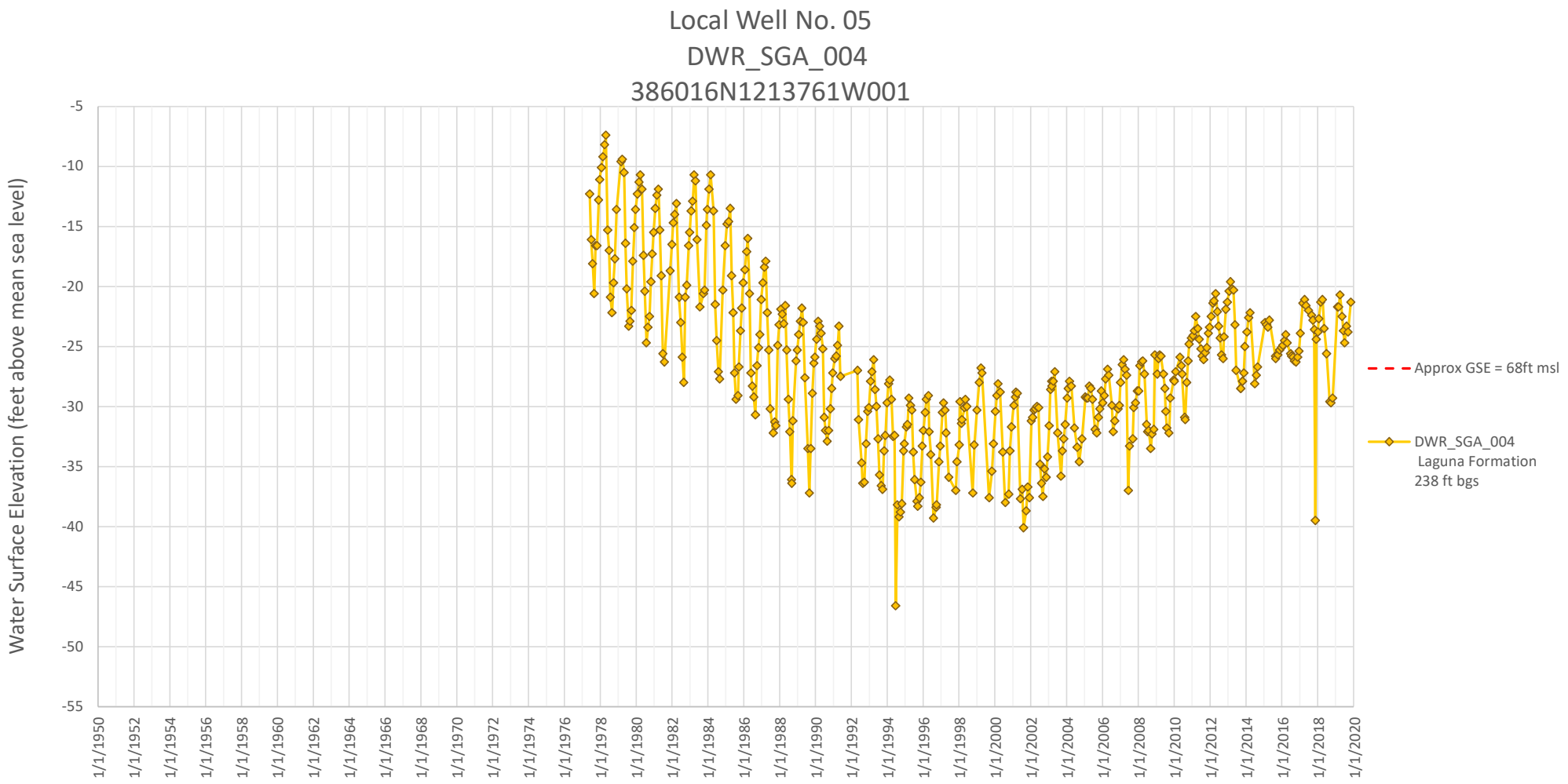
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
82	Whyte A	Not Available	52475	387222N1212920W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	226	Y	e0303799	Active	38.722168	-121.29196
82	Whyte B	Not Available	52476	387222N1212920W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	306	Y	e0303799	Active	38.722168	-121.29196
83	South Sutter WD	13N05E18C001M	17209	389834N1214655W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	210	N	NOT AVAILABLE	Active	38.9834	-121.4655
84	Spencer	Not Available	52555	389867N1213654W002	Department of Water Resources	North American	5-021.64	Placer	Residential	Yes	107	Y	101157	Active	38.986724	-121.36542
85	13N05E09R001M	13N05E09R001M		389873N1214156W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.9873	-121.4156
86	12N05E06R001M	12N05E06R001M		389128N1214522W001	Department of Water Resources	North American	5-021.64	Placer	Irrigation						38.9128	-121.4522
87	12N04E24M002M	12N04E24M002M		388710N1214870W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.871	-121.487
88	11N03E03C002M	11N03E03C002M		388357N1216273W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.8357	-121.6273
89	Roseview-MW315	Not Available			Sacramento Groundwater Authority	North American	5-021.64				315				38.718222	-121.327729
89	Roseview-MW465	Not Available			Sacramento Groundwater Authority	North American	5-021.64				465				38.718222	-121.327729
90	WPMW-11A	Not Available	54779	388882N1214005W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	162	Y	NOT AVAILABLE		38.888164	-121.400463
90	WPMW-11B	Not Available	54780	388882N1214005W004	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	309	Y	NOT AVAILABLE		38.888164	-121.400463
91	WPMW12-A	Not Available			Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	300	Y	NOT AVAILABLE		38.802639	-121.443216
91	WPMW12-B	Not Available			Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	550	Y	NOT AVAILABLE		38.802639	-121.443216

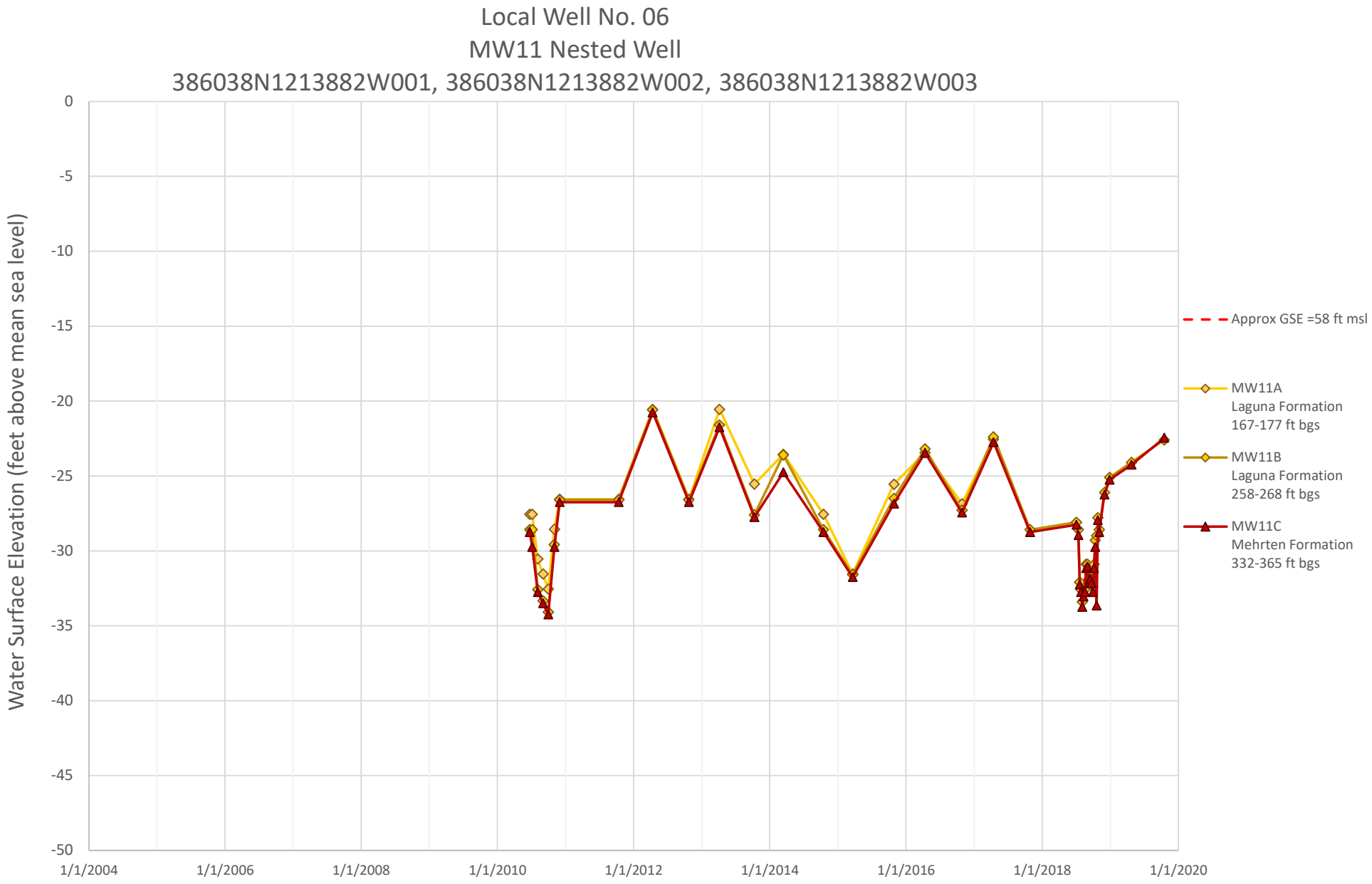

Local Well No. 01
SVMW-2 East Nested Well Hydrograph
387626N1213651W001, 381626N1213651W001, 387626N1213651W002
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 123 ft msl
SVMW East-2A Laguna Formation 125-135 ft bgs
SVMW East-2B Mehrten Formation 510-520 ft bgs
SVMW East-2C Mehrten Formation 655-665 ft bgs

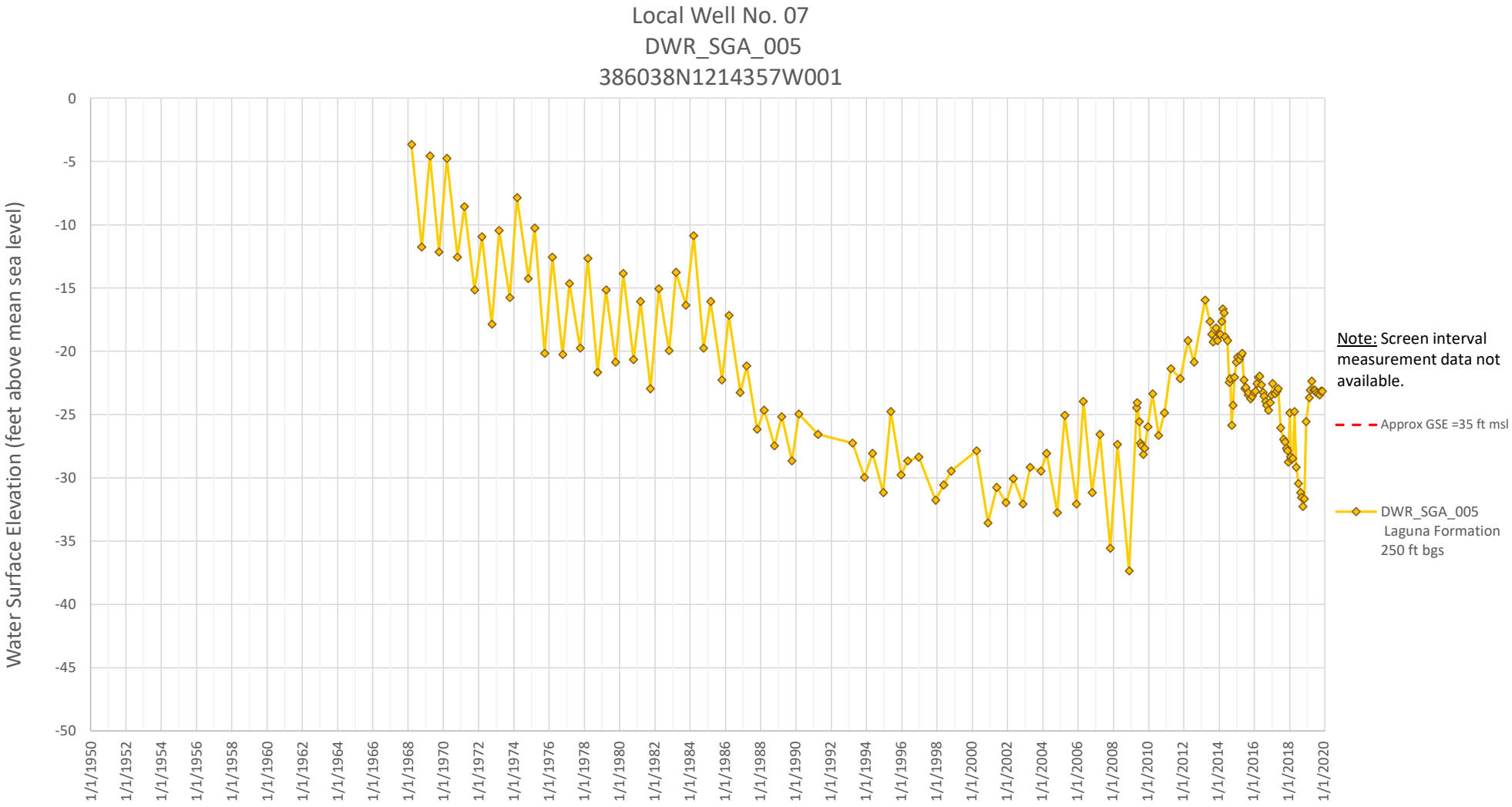

Local Well No. 02
SGA_MW06
385828N1213385W001
Water Surface Elevation (feet above mean sea level)
40
35
30
25
20
15
10
5
0
-5
-10
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 43ft msl
SGA_MW06
Laguna Formation
62-72 ft bgs

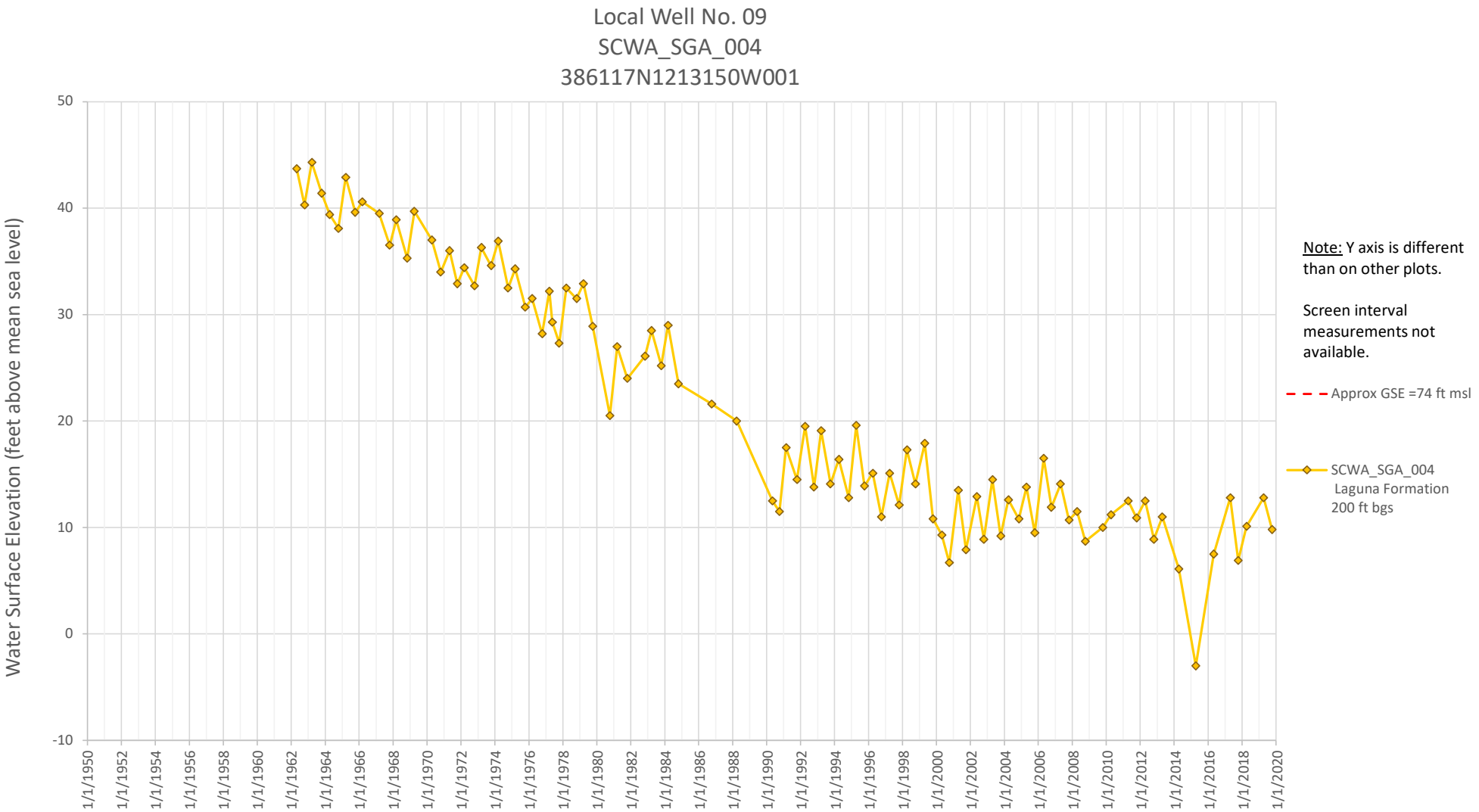

Local Well No. 03
SGA_MW04
385841N1214185W001
Water Surface Elevation (feet above mean sea level)
40
35
30
25
20
15
10
5
0
-5
-10
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 43ft msl
SGA_MW04
Laguna Formation
55-65 ft bgs

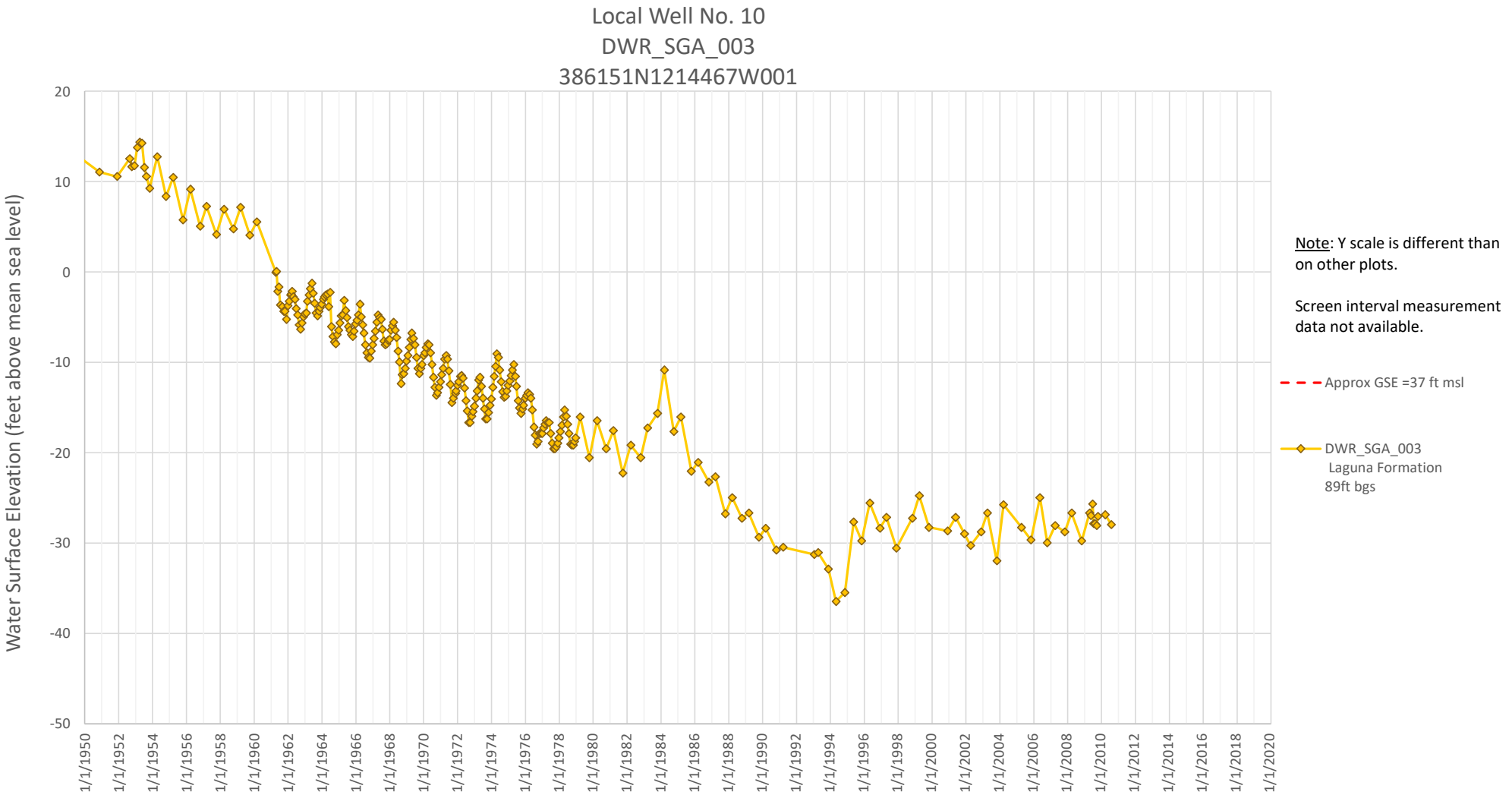

Local Well No. 04
MW12 Nested Well
385947N1213985W001, 385947N1213985W002, 385947N1213985W003, 385947N1213985W004, 385947N1213985W005
Water Surface Elevation (Feet above mean seal level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 41 ft msl
MW12A
Laguna Formation 200-280 ft bgs
MW12B
Mehrten Formation 360-380 ft bgs
MW12C
Mehrten Formation 590-610 ft bgs
MW12D
Mehrten Formation 810-840 ft bgs
MW12E
Mehrten Formation 960-1000 ft bgs


Local Well No. 05
DWR_SGA_004
386016N1213761W001
Water Surface Elevation (feet above mean sea level)
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 68ft msl
DWR_SGA_004
Laguna Formation
238 ft bgs

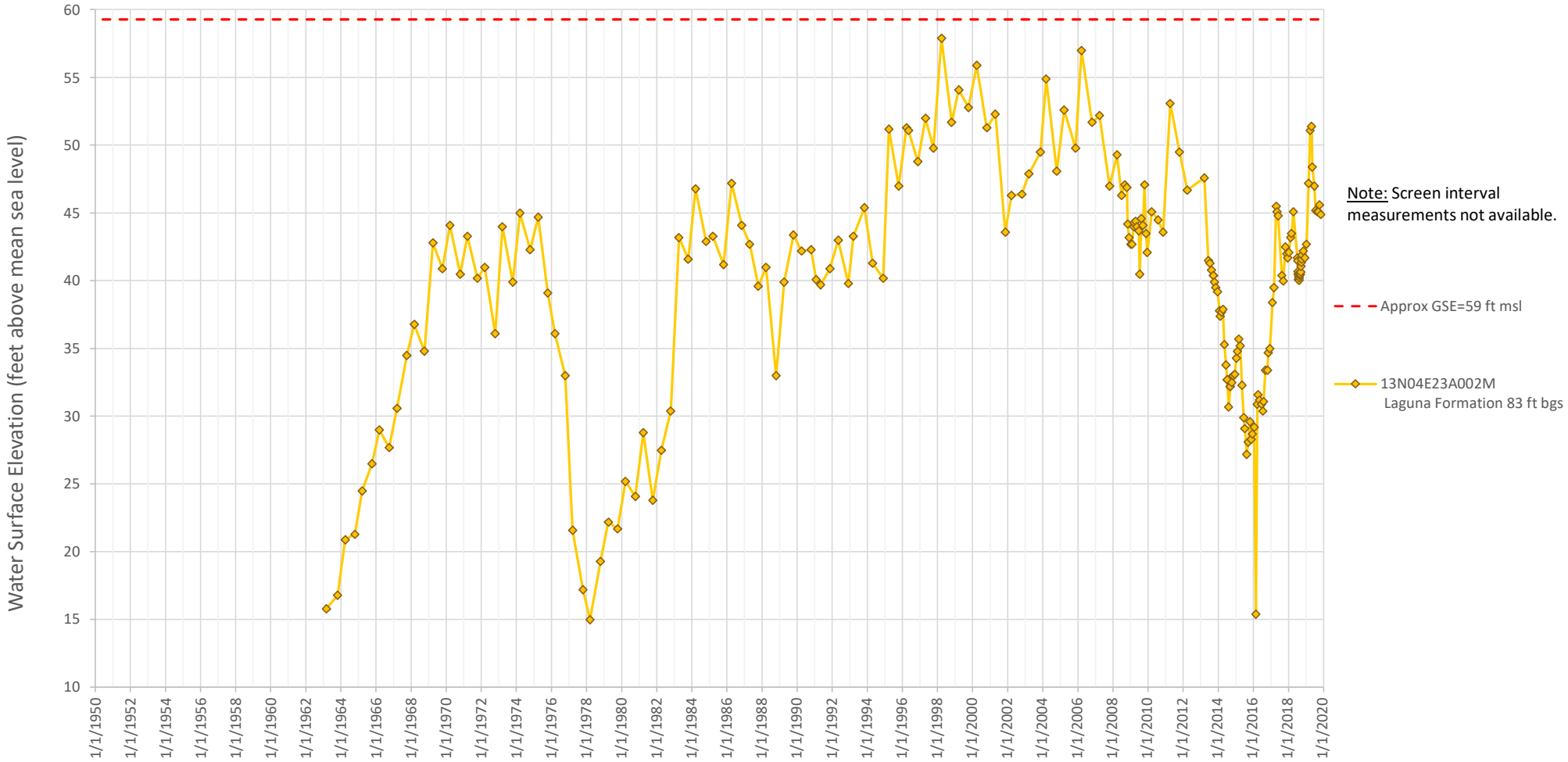

Local Well No. 06
MW11 Nested Well
386038N1213882W001, 386038N1213882W002, 386038N1213882W003
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE =58 ft msl
MW11A
Laguna Formation
167-177 ft bgs
MW11B
Laguna Formation
258-268 ft bgs
MW11C
Mehrten Formation
332-365 ft bgs

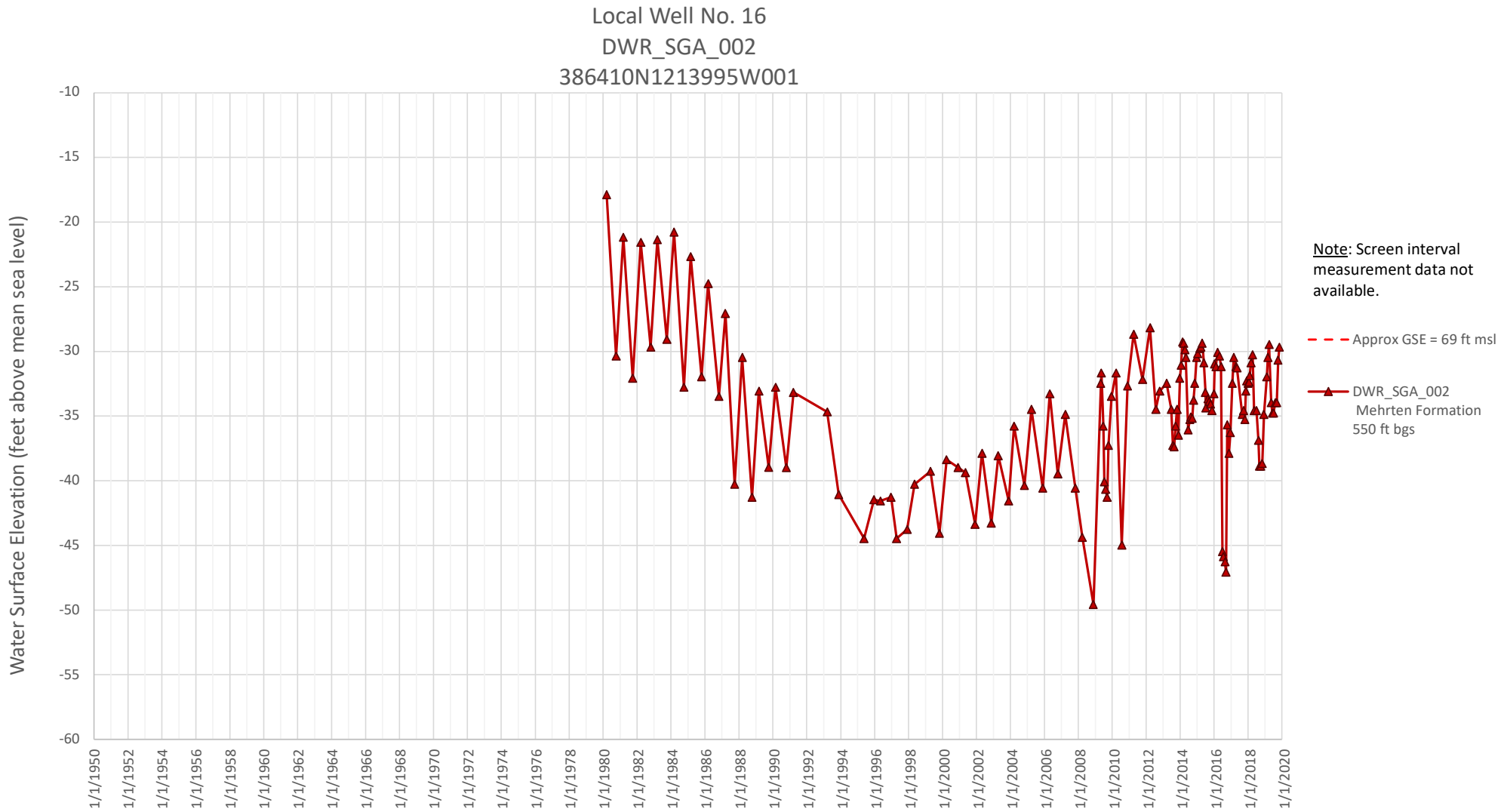

Local Well No. 07
DWR_SGA_005
386038N1214357W001
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurement data not available.
Approx GSE =35 ft msl
DWR_SGA_005
Laguna Formation
250 ft bgs


Local Well No. 09
SCWA_SGA_004
386117N1213150W001
Water Surface Elevation (feet above mean sea level)
50
40
30
20
10
0
-10
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y axis is different than on other plots.
Screen interval measurements not available.
Approx GSE =74 ft msl
SCWA_SGA_004
Laguna Formation
200 ft bgs

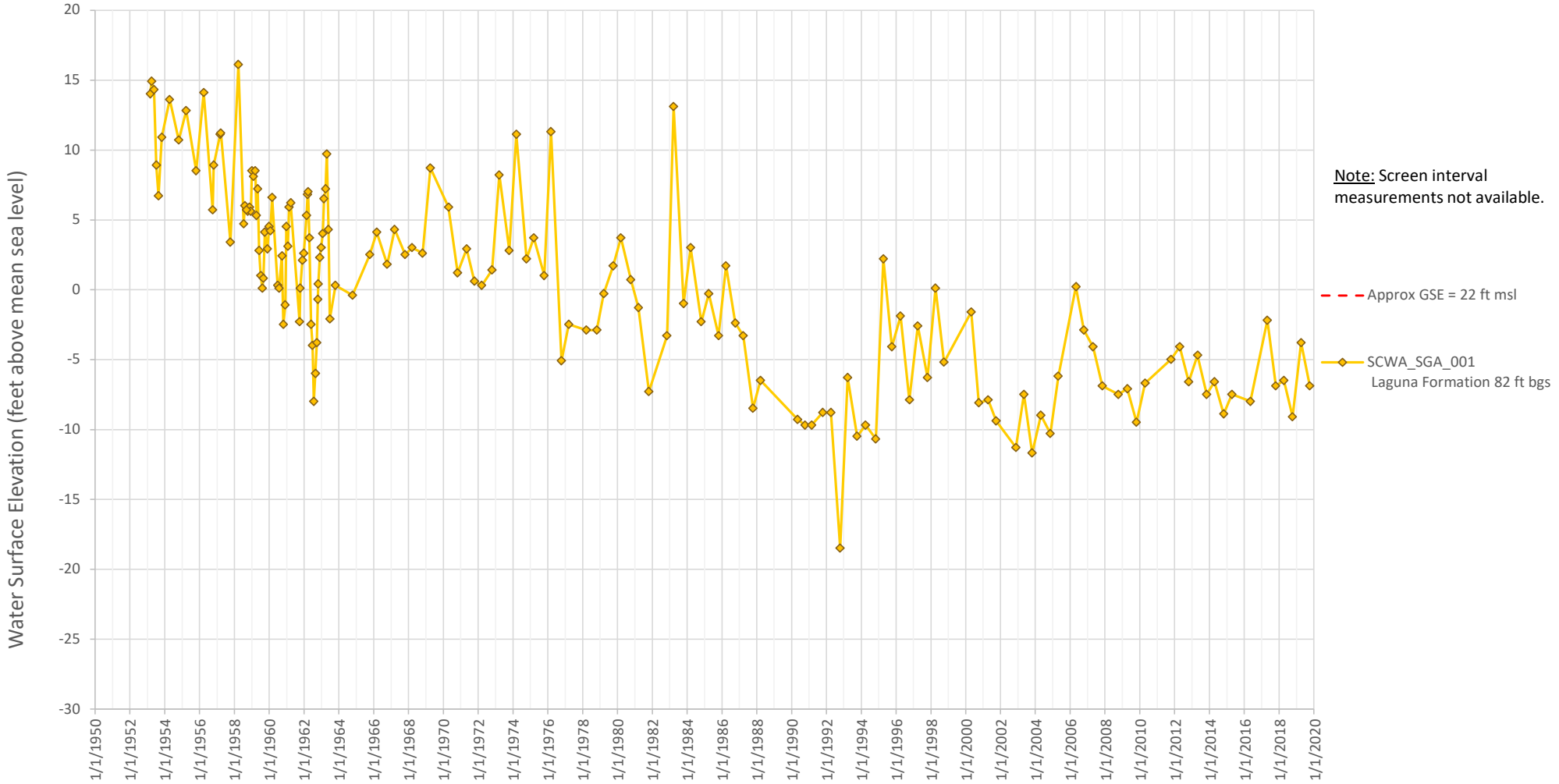

Local Well No. 10
DWR_SGA_003
386151N1214467W001
Water Surface Elevation (feet above mean sea level)
20
10
0
-10
-20
-30
-40
-50
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurement data not available.
Approx GSE =37 ft msl
DWR_SGA_003
Laguna Formation
89ft bgs

Local Well No. 14
13N04E23A002M
389669N1214897W001

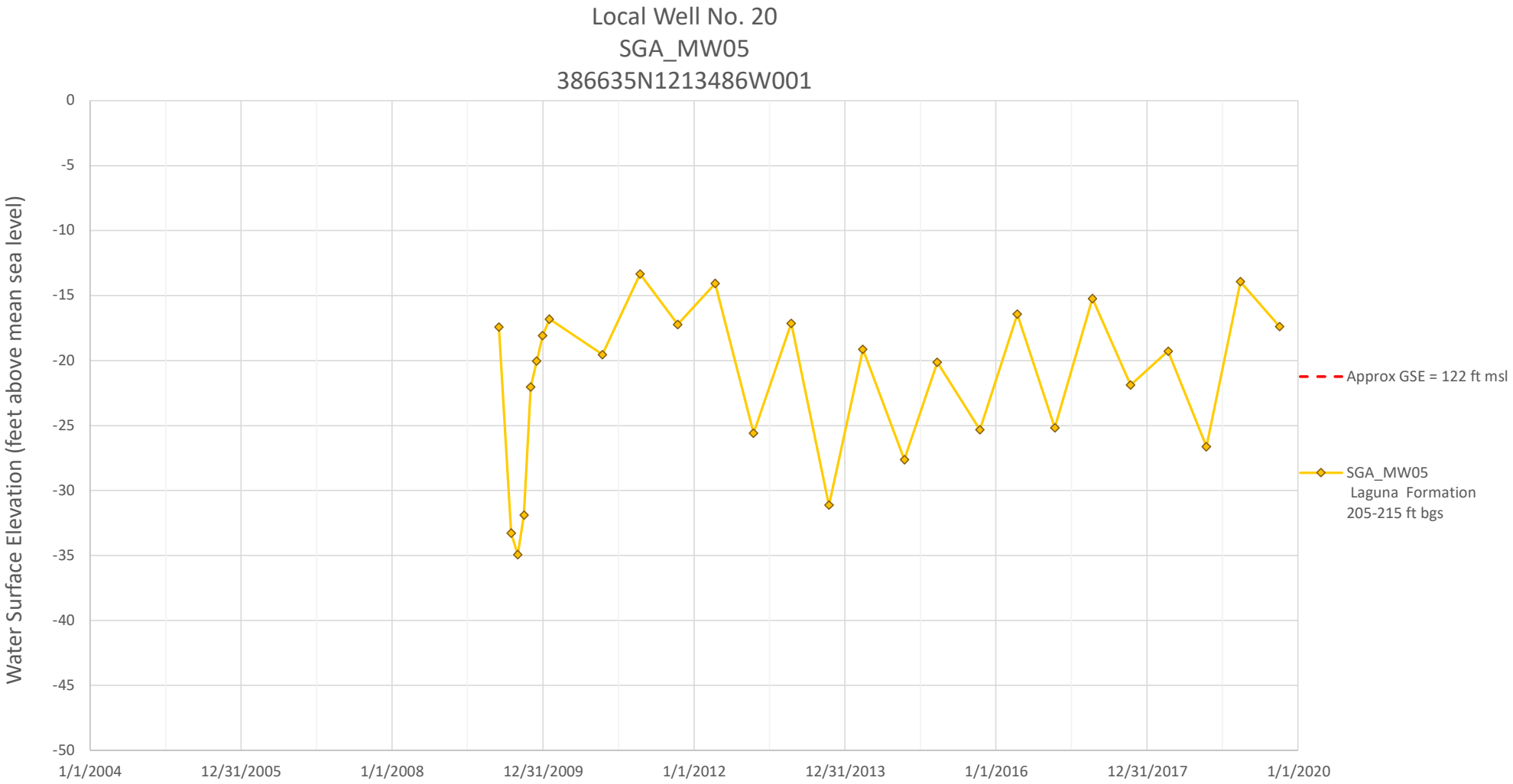



Local Well No. 16
DWR_SGA_002
386410N1213995W001
Water Surface Elevation (feet above mean sea level)
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurement data not available.
Approx GSE = 69 ft msl
DWR_SGA_002
Mehrten Formation
550 ft bgs

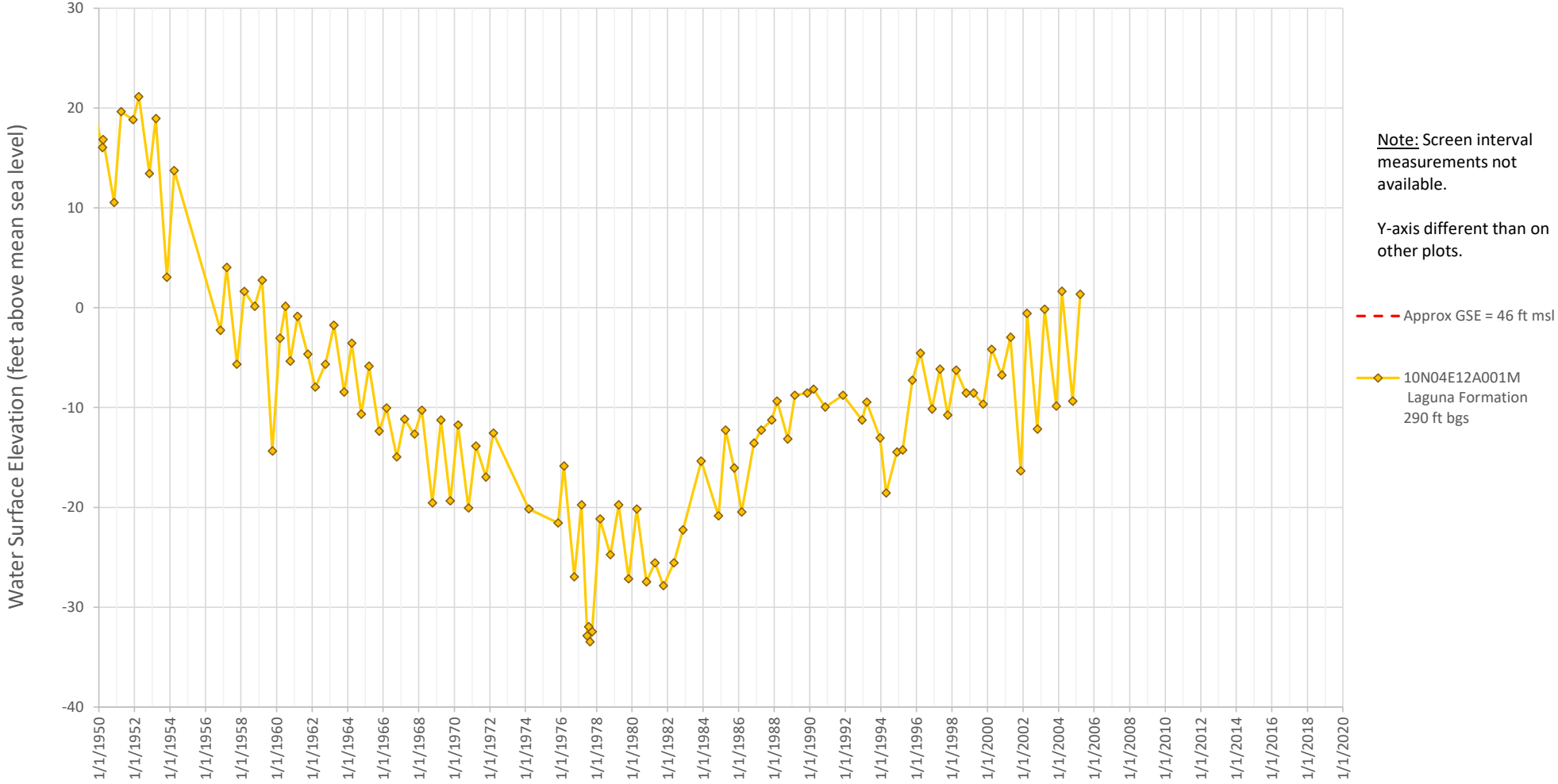
Local Well No. 19
SCWA_SGA_001
386576N1214846W001



Note: Screen interval measurements not available.


Local Well No. 20
SGA_MW05
386635N1213486W001
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 122 ft msl
SGA_MW05
Laguna Formation
205-215 ft bgs

Local Well No. 21
10N04E12A001M
387404N1214870W001

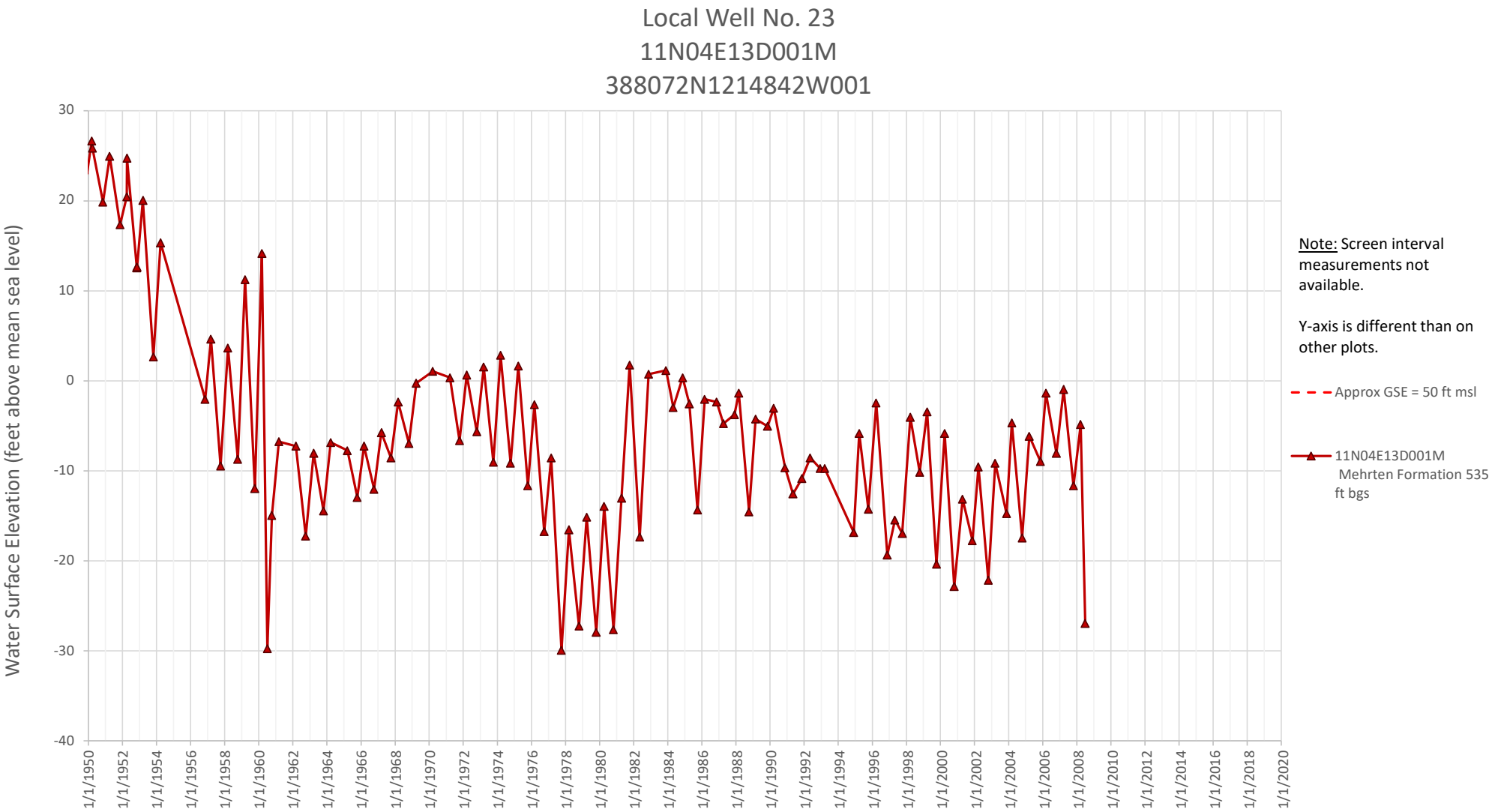


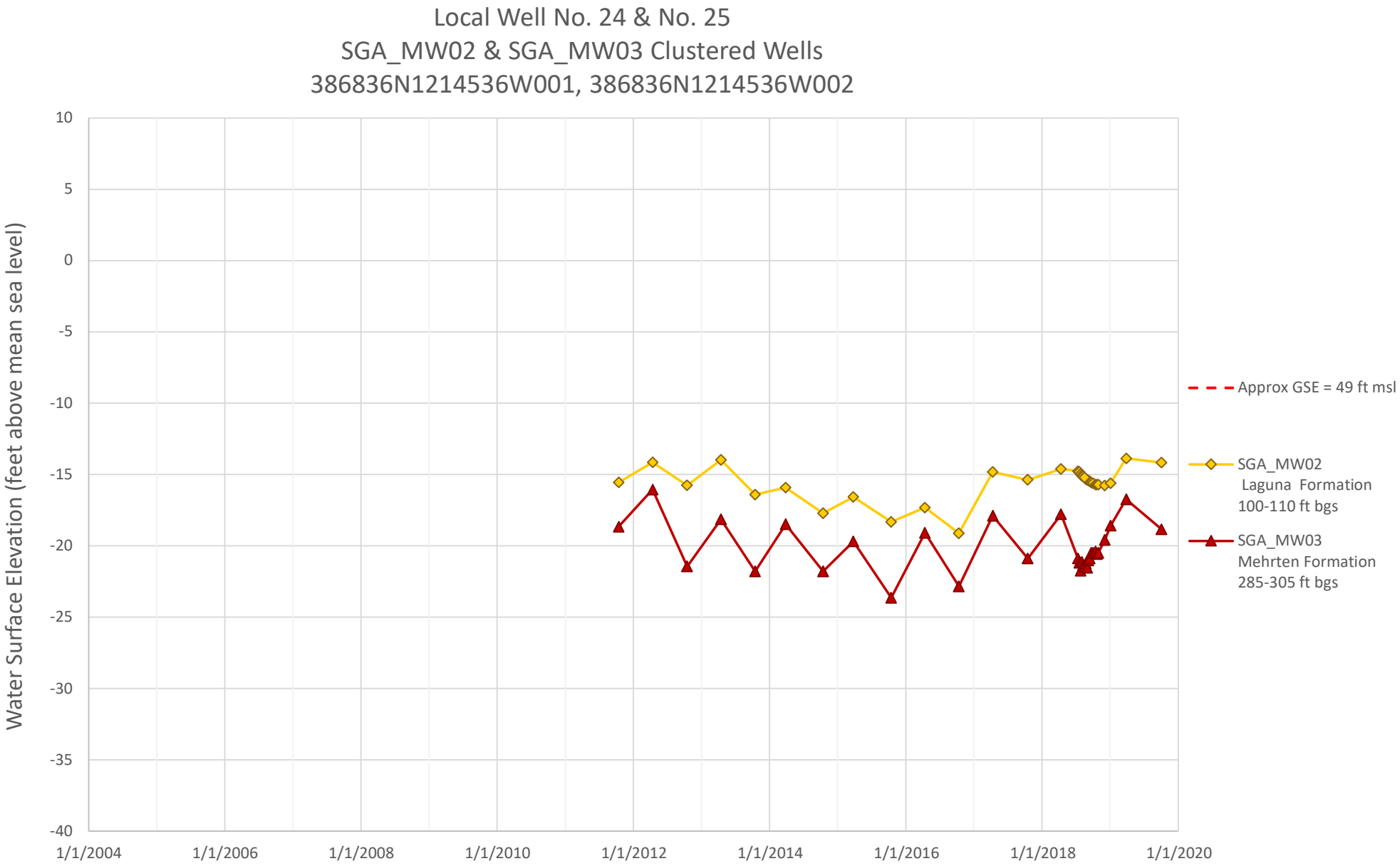
Note: Screen interval measurements not available.

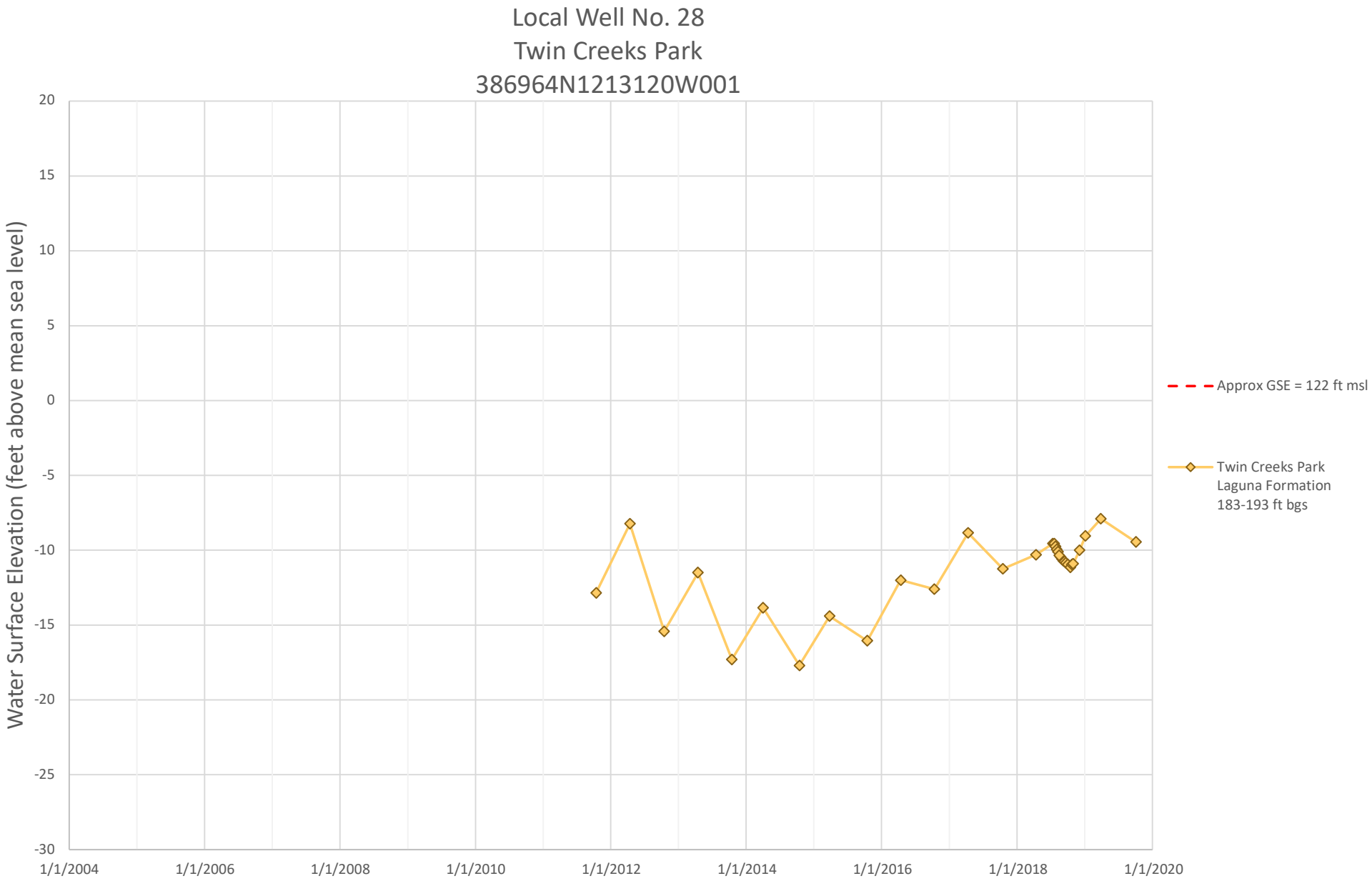
Y-axis different than on other plots.

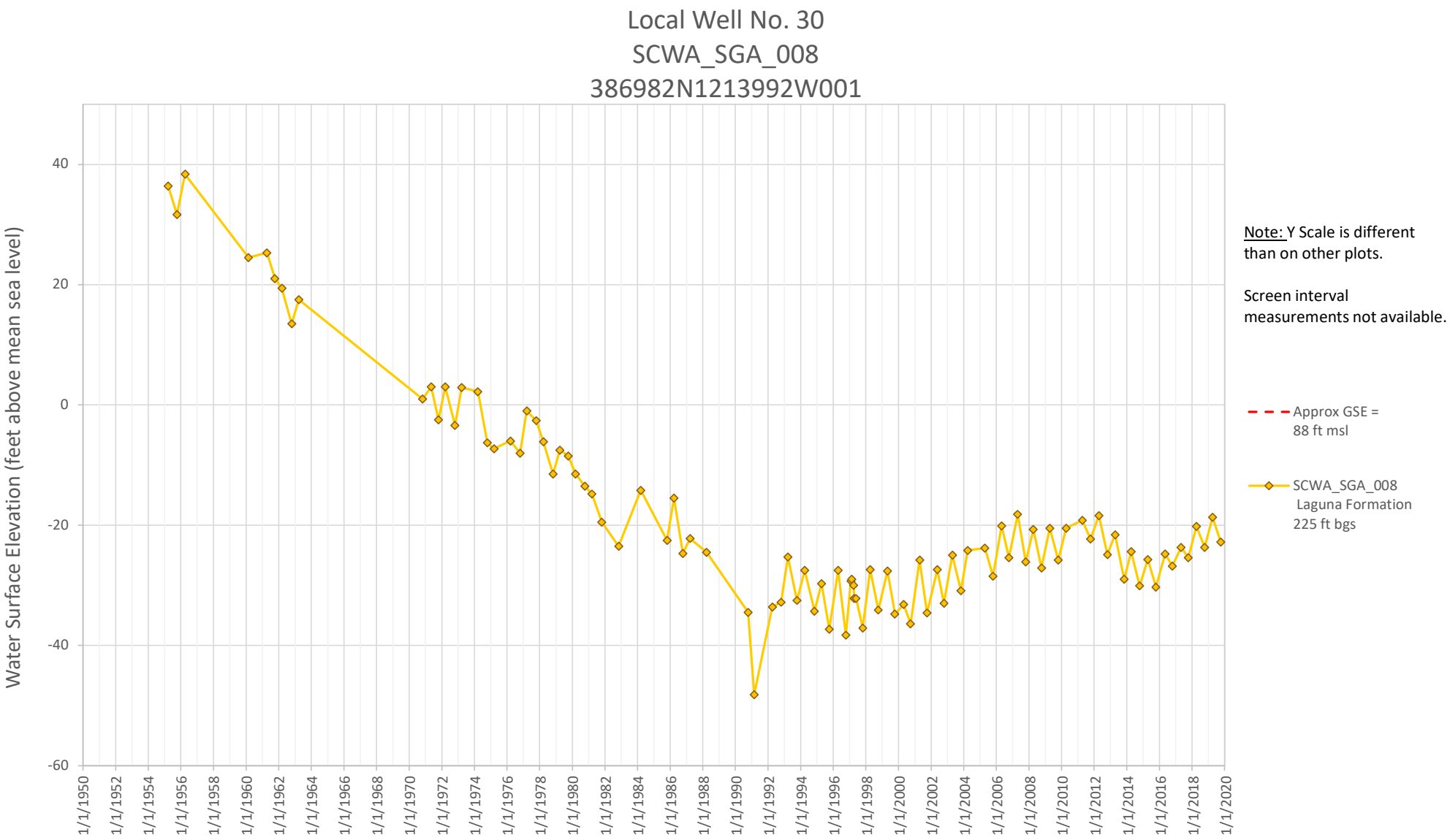
Approx GSE = 46 ft msl

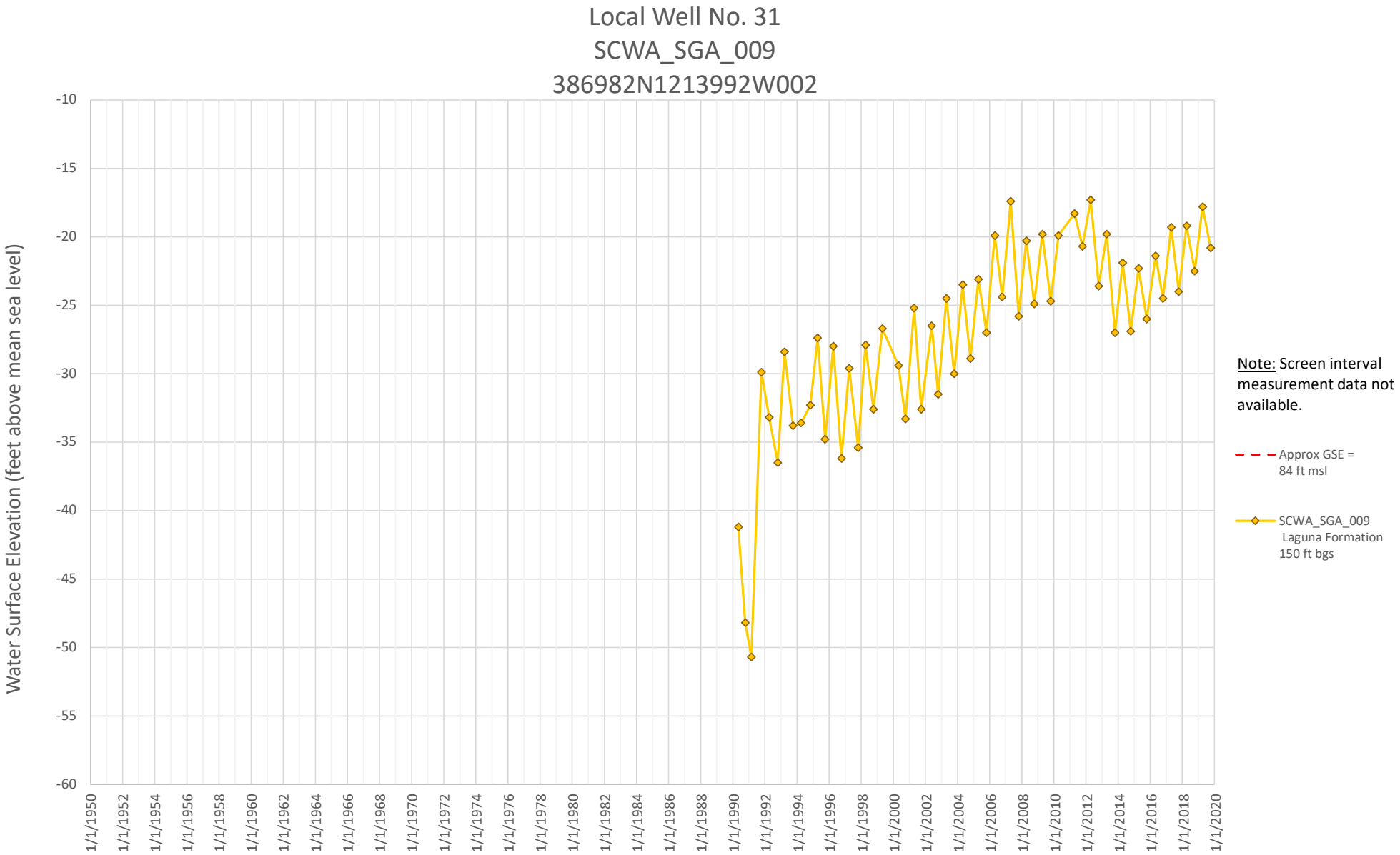
10N04E12A001M
Laguna Formation
290 ft bgs


Local Well No. 23
11N04E13D001M
388072N1214842W001
Water Surface Elevation (feet above mean sea level)
30
20
10
0
-10
-20
-30
-40
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurements not available.
Y-axis is different than on other plots.
Approx GSE = 50 ft msl
11N04E13D001M Mehrten Formation 535 ft bgs

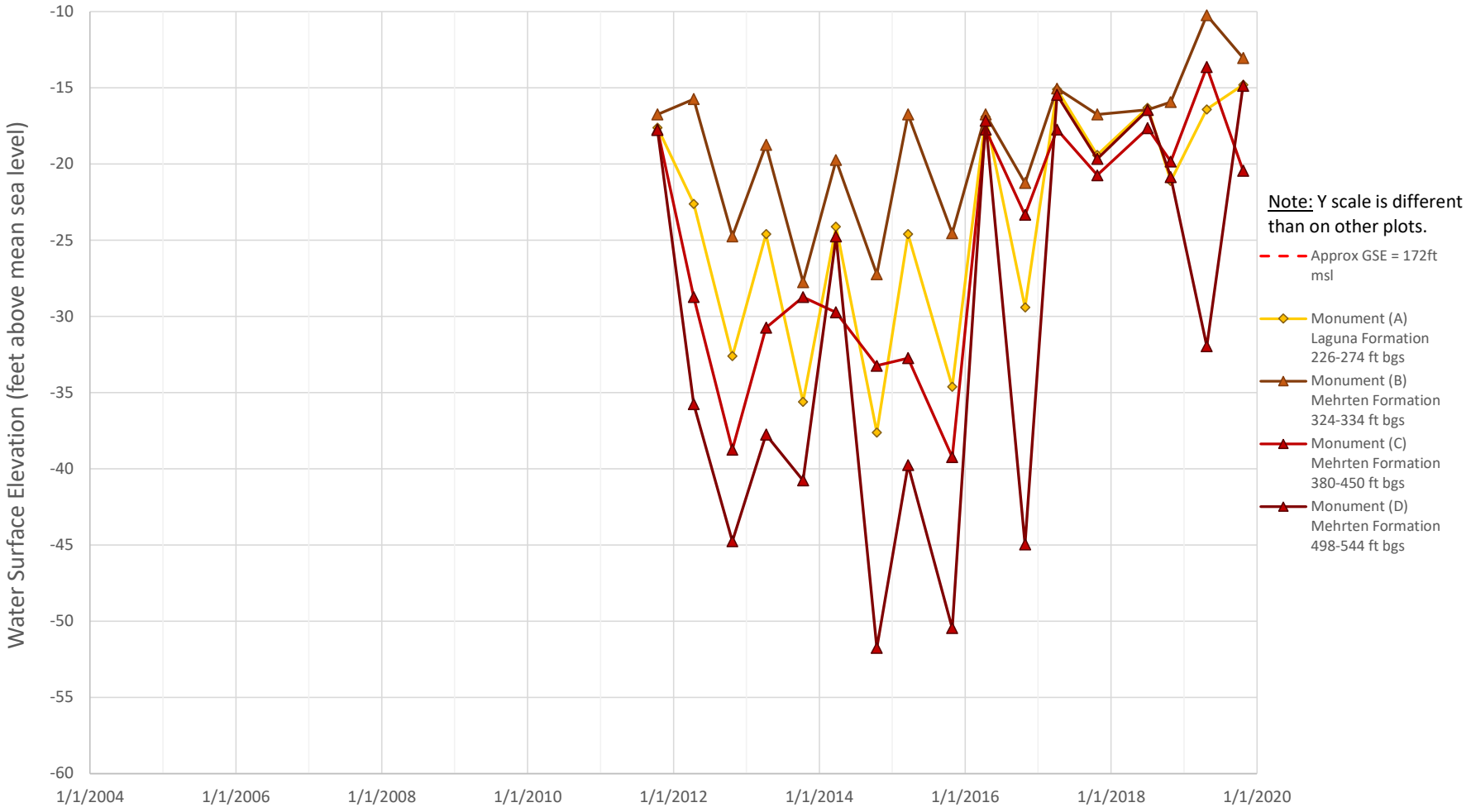

Local Well No. 24 & No. 25
SGA_MW02 & SGA_MW03 Clustered Wells
386836N1214536W001, 386836N1214536W002
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 49 ft msl
SGA_MW02
Laguna Formation
100-110 ft bgs
SGA_MW03
Mehrten Formation
285-305 ft bgs

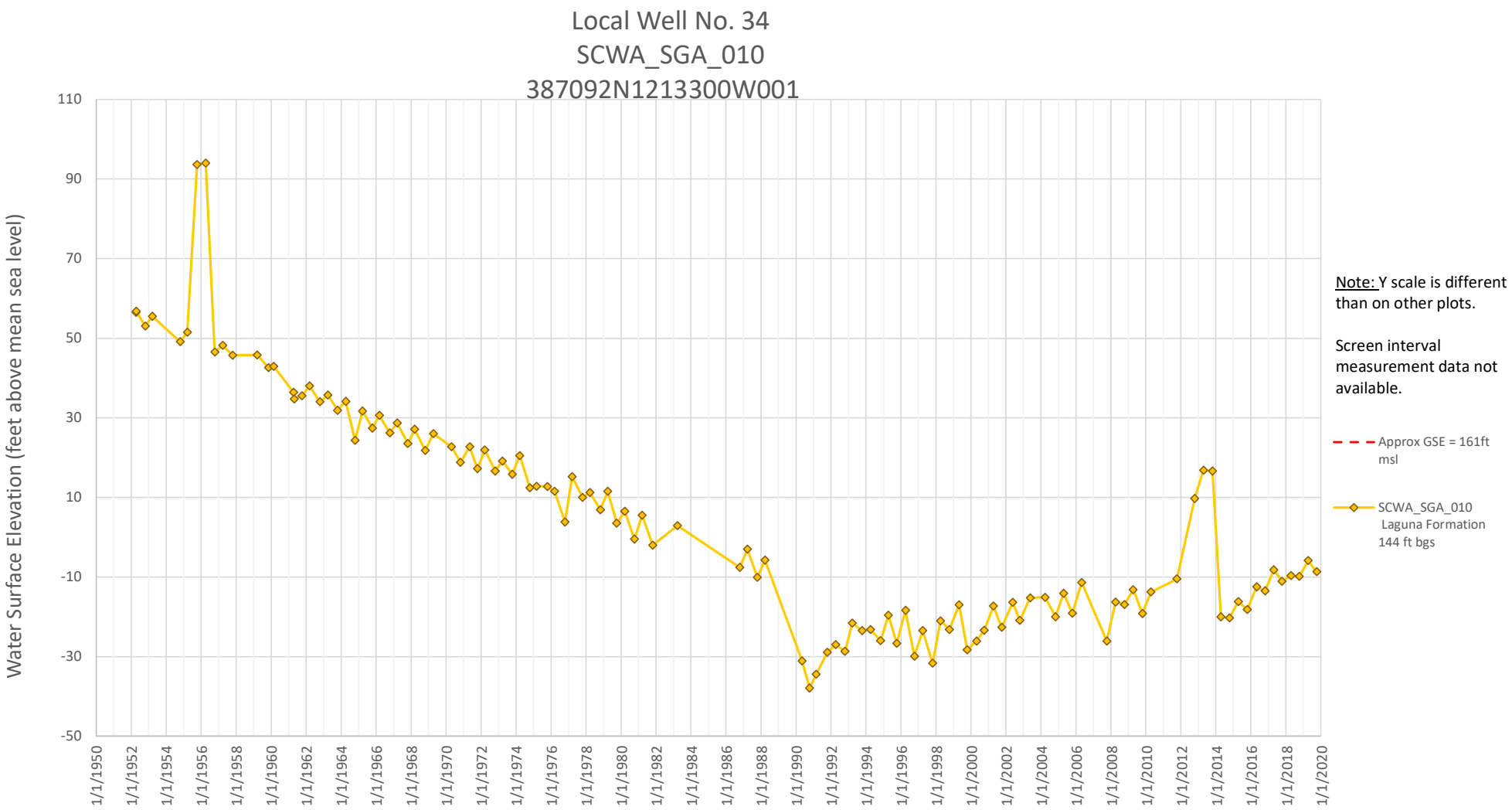

Local Well No. 28
Twin Creeks Park
386964N1213120W001
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 122 ft msl
Twin Creeks Park
Laguna Formation
183-193 ft bgs


Local Well No. 30
SCWA_SGA_008
386982N1213992W001
Water Surface Elevation (feet above mean sea level)
40
20
0
-20
-40
-60
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y Scale is different than on other plots.
Screen interval measurements not available.
Approx GSE = 88 ft msl
SCWA_SGA_008
Laguna Formation
225 ft bgs

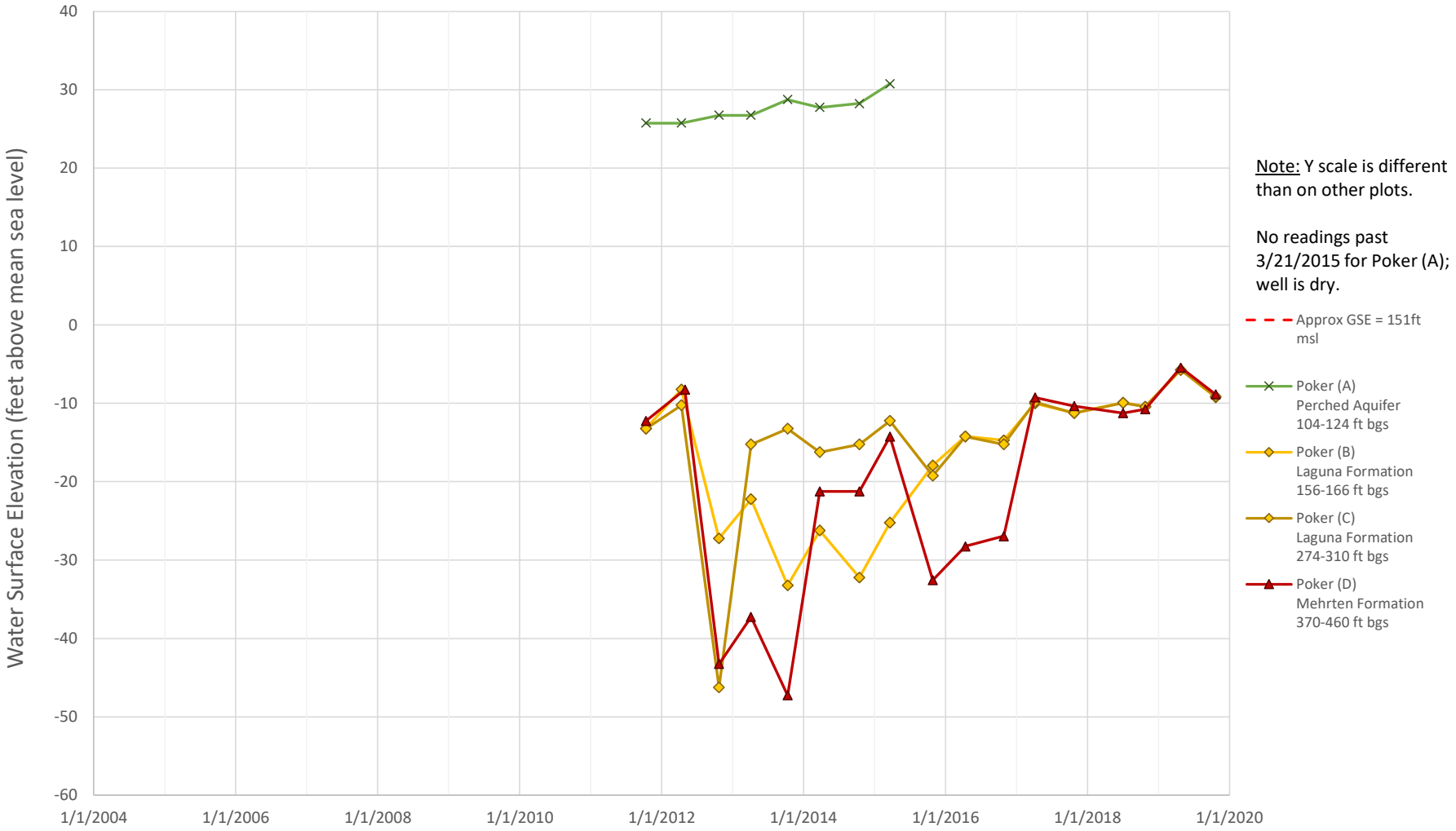

Local Well No. 31
SCWA_SGA_009
386982N1213992W002
Water Surface Elevation (feet above mean sea level)
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurement data not available.
Approx GSE = 84 ft msl
SCWA_SGA_009 Laguna Formation 150 ft bgs

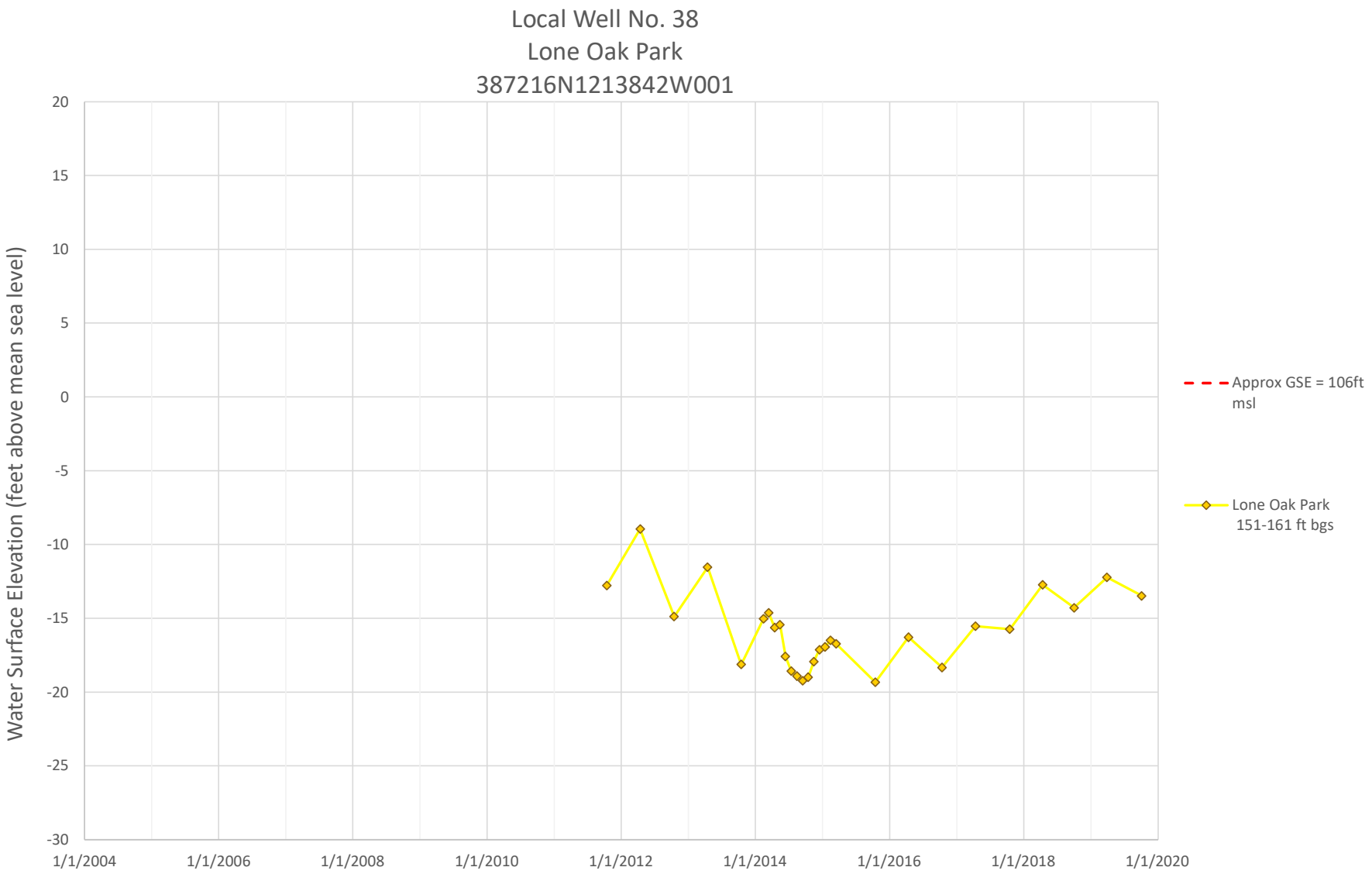
Local Well No. 33
Monument Nested Well
387000N1213529W001, 387000N1213529W002, 387000N1213529W003, 387000N1213529W004

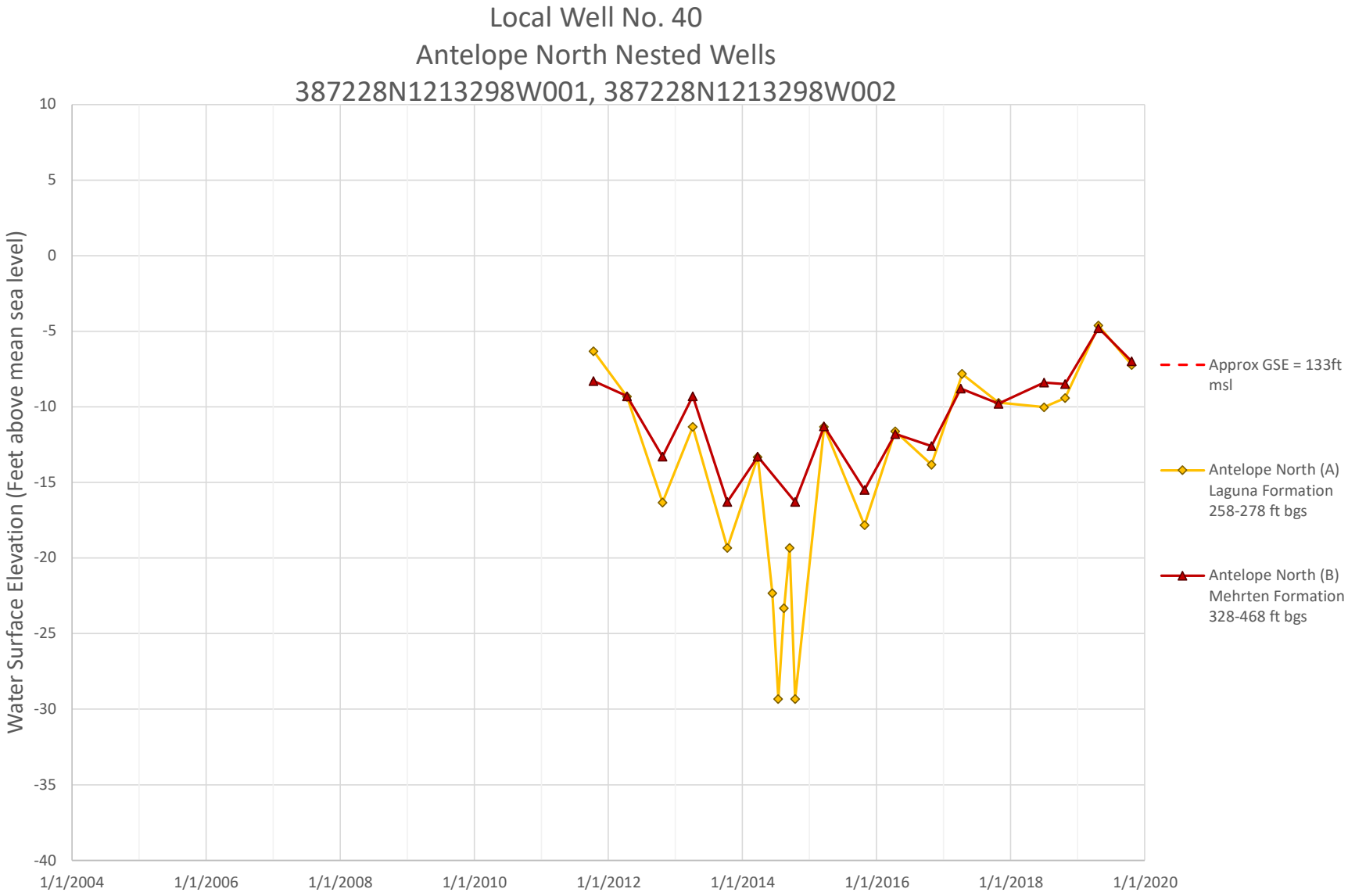



Local Well No. 34
SCWA_SGA_010
387092N1213300W001
Water Surface Elevation (feet above mean sea level)
110
90
70
50
30
10
-10
-30
-50
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurement data not available.
Approx GSE = 161ft msl
SCWA_SGA_010 Laguna Formation 144 ft bgs

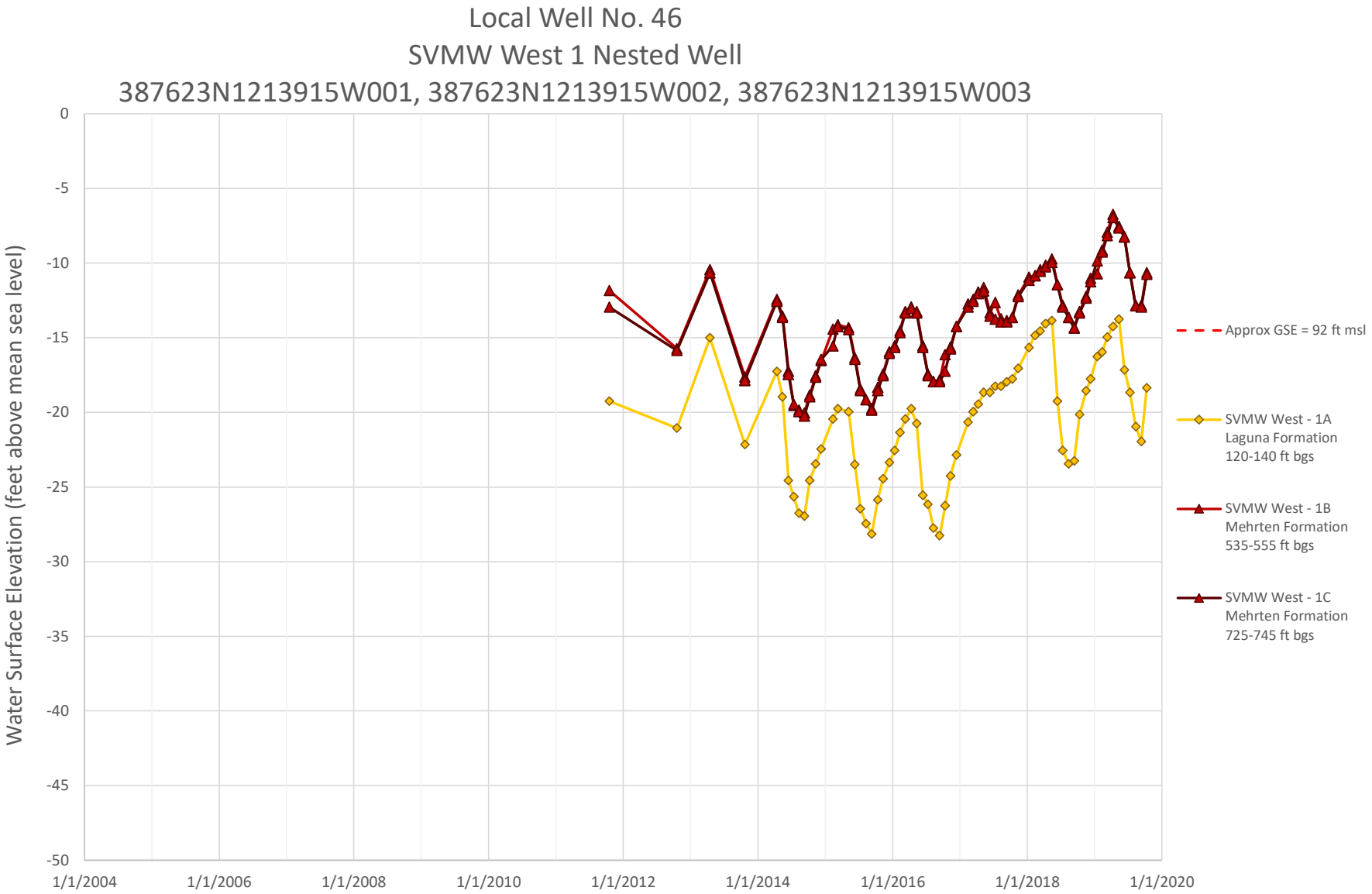
Local Well No. 35
Poker Nested Well
387117N1213327W001, 387117N1213327W002, 387117N1213327W003, 387117N1213327W004

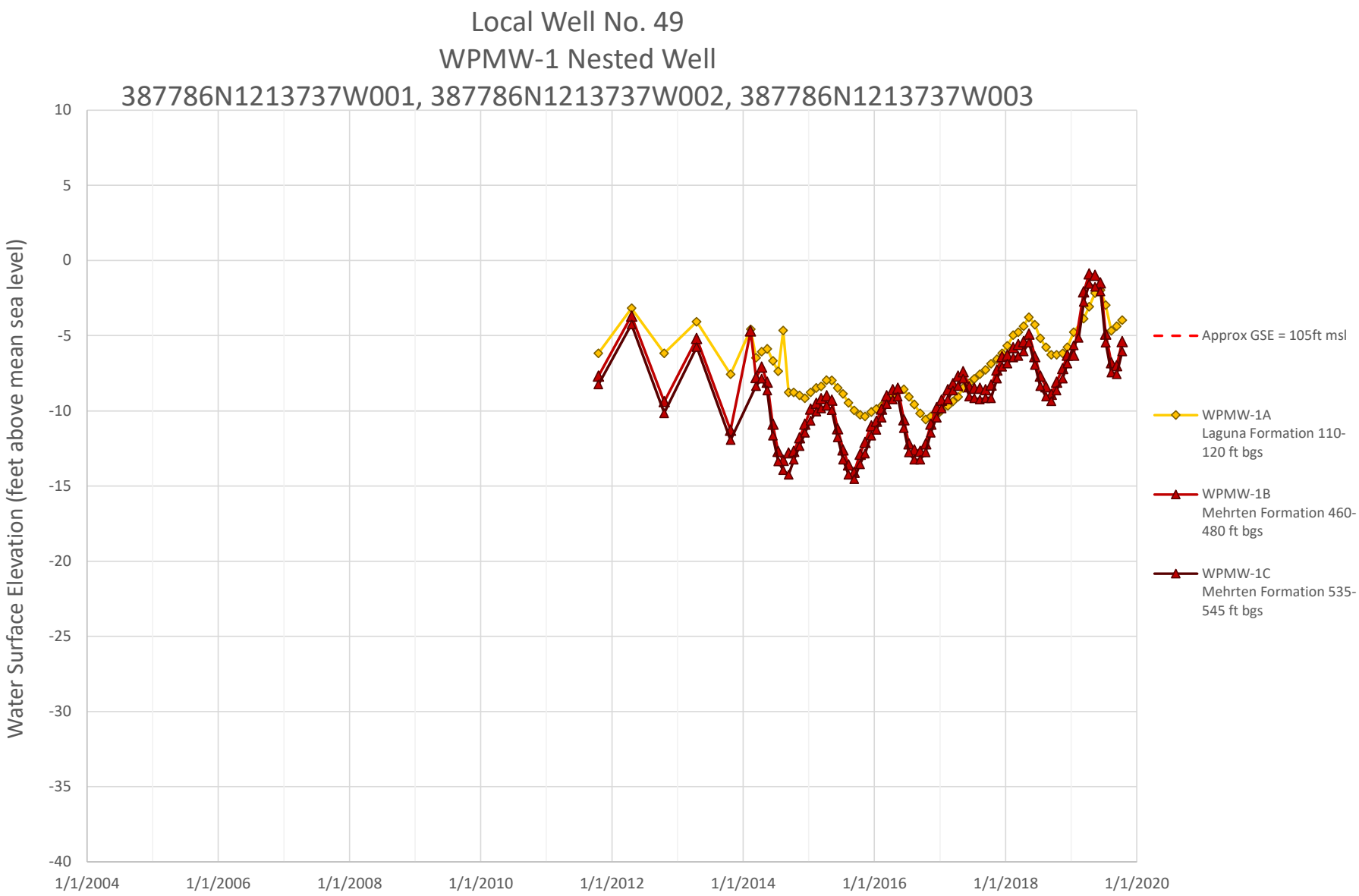


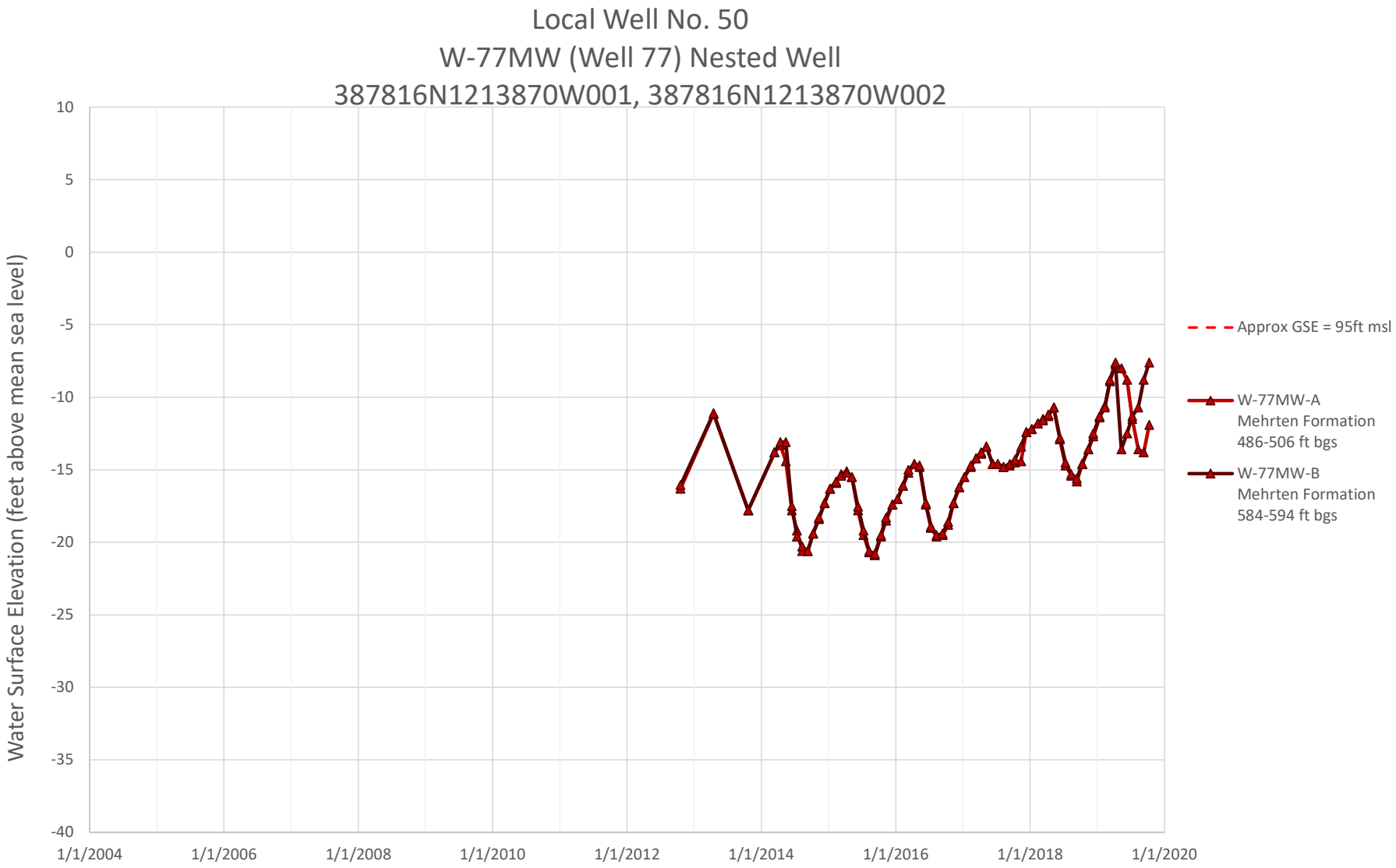

Local Well No. 38
Lone Oak Park
387216N1213842W001
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 106ft msl
Lone Oak Park 151-161 ft bgs

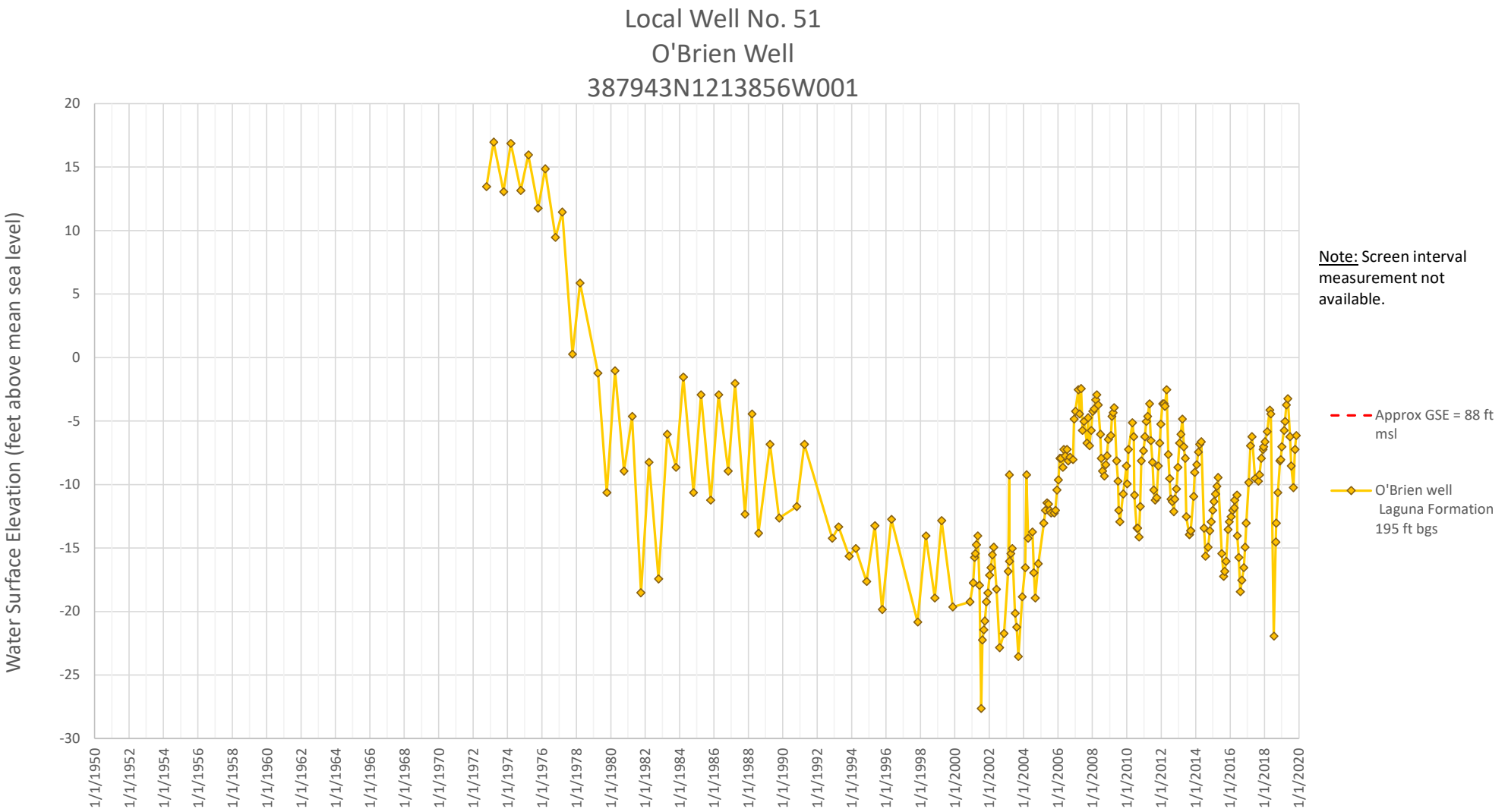

Local Well No. 40
Antelope North Nested Wells
387228N1213298W001, 387228N1213298W002
Water Surface Elevation (Feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 133ft msl
Antelope North (A) Laguna Formation 258-278 ft bgs
Antelope North (B) Mehrten Formation 328-468 ft bgs

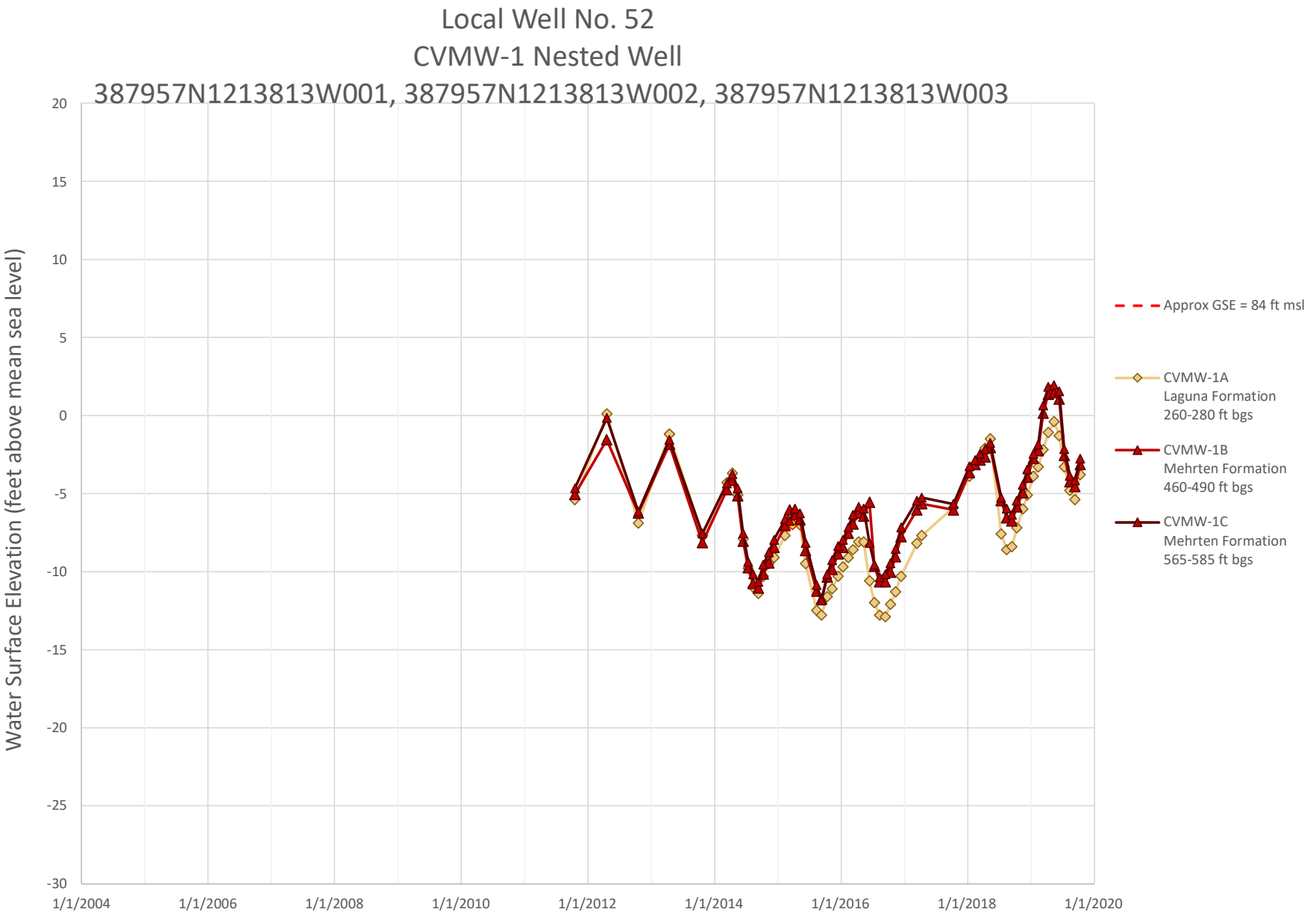

Local Well No. 41
WPMW-5 Nested Well
387331N1213610W001, 387331N1213610W002
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: WPMW-5A is dry.
Approx GSE = 98ft msl
WPMW-5A
Laguna Formation
80-100 ft bgs
WPMW-5B
Mehrten Formation
630-650 ft bgs

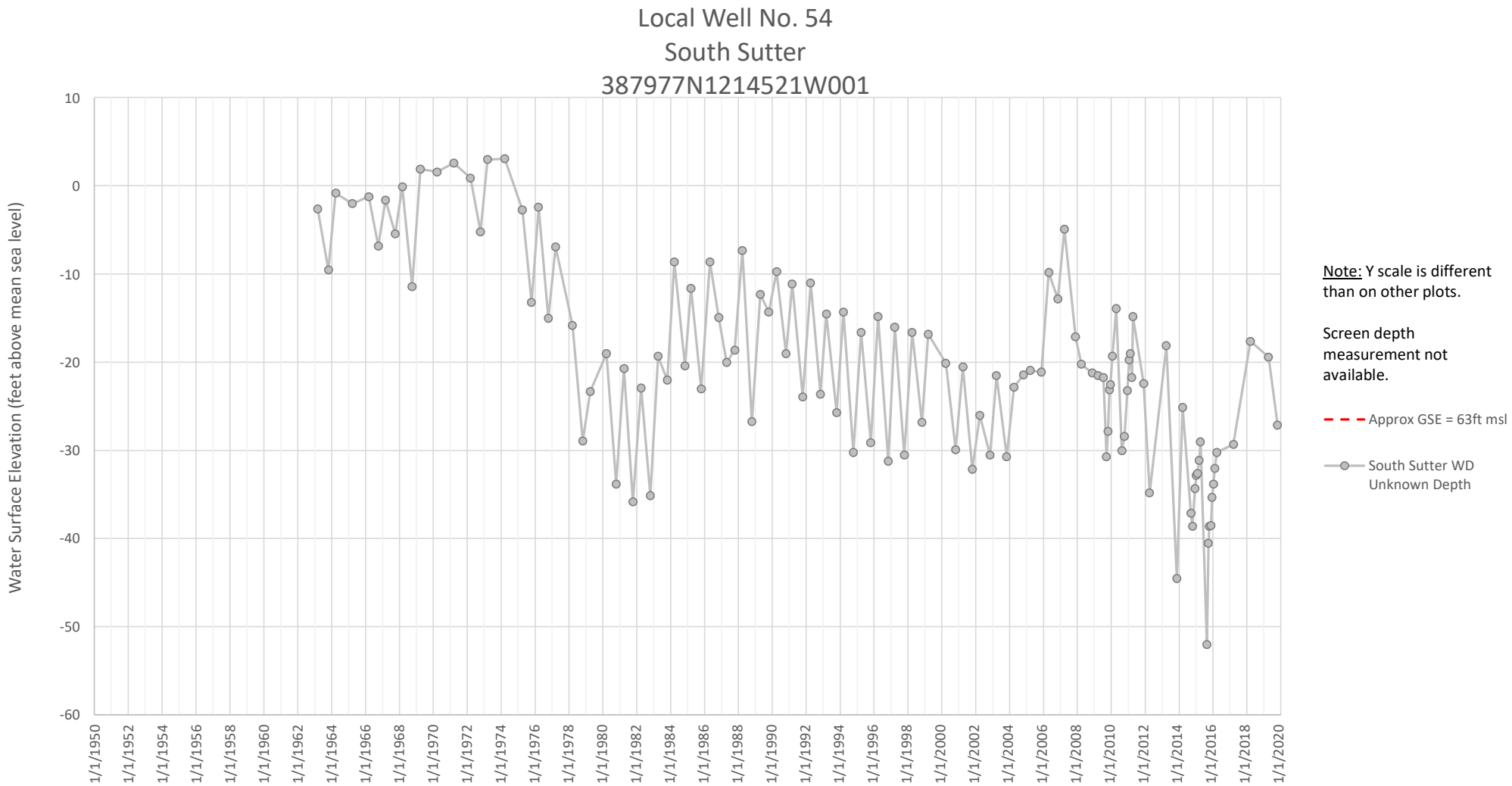

Local Well No. 46
SVMW West 1 Nested Well
387623N1213915W001, 387623N1213915W002, 387623N1213915W003
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 92 ft msl
SVMW West - 1A
Laguna Formation
120-140 ft bgs
SVMW West - 1B
Mehrten Formation
535-555 ft bgs
SVMW West - 1C
Mehrten Formation
725-745 ft bgs

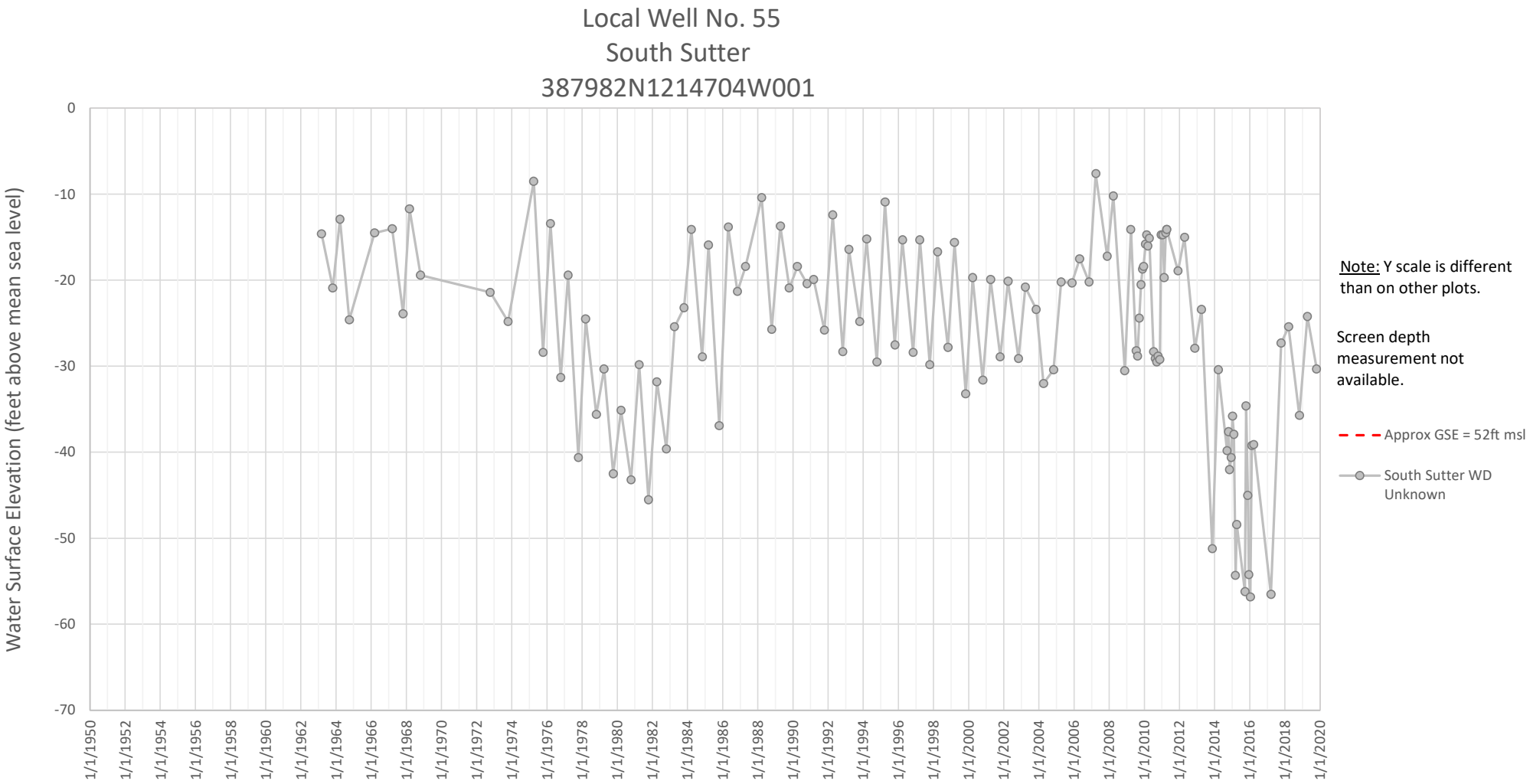

Local Well No. 49
WPMW-1 Nested Well
387786N1213737W001, 387786N1213737W002, 387786N1213737W003
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 105ft msl
WPMW-1A
Laguna Formation 110-120 ft bgs
WPMW-1B
Mehrten Formation 460-480 ft bgs
WPMW-1C
Mehrten Formation 535-545 ft bgs

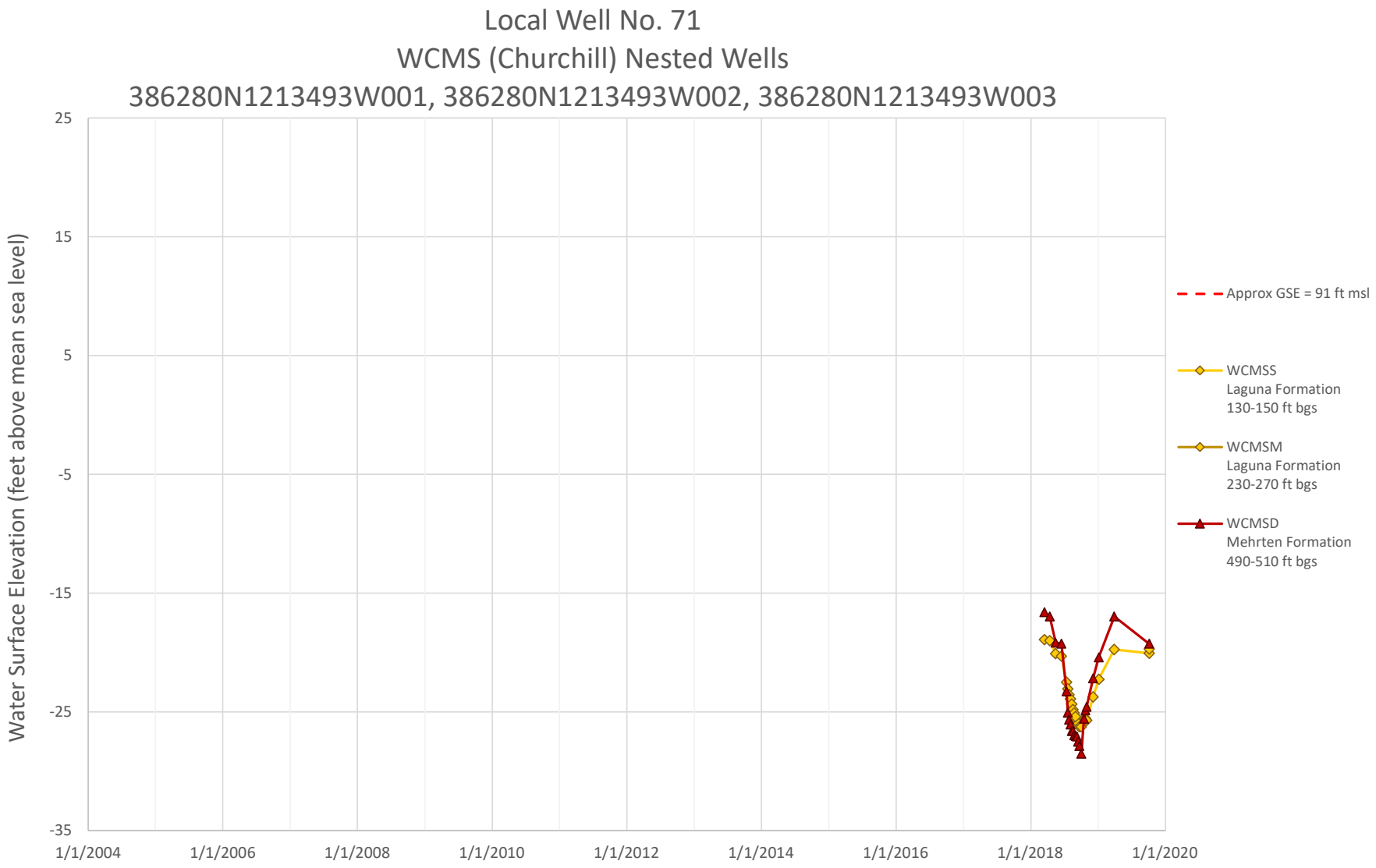

Local Well No. 50
W-77MW (Well 77) Nested Well
387816N1213870W001, 387816N1213870W002
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 95ft msl
W-77MW-A
Mehrten Formation
486-506 ft bgs
W-77MW-B
Mehrten Formation
584-594 ft bgs

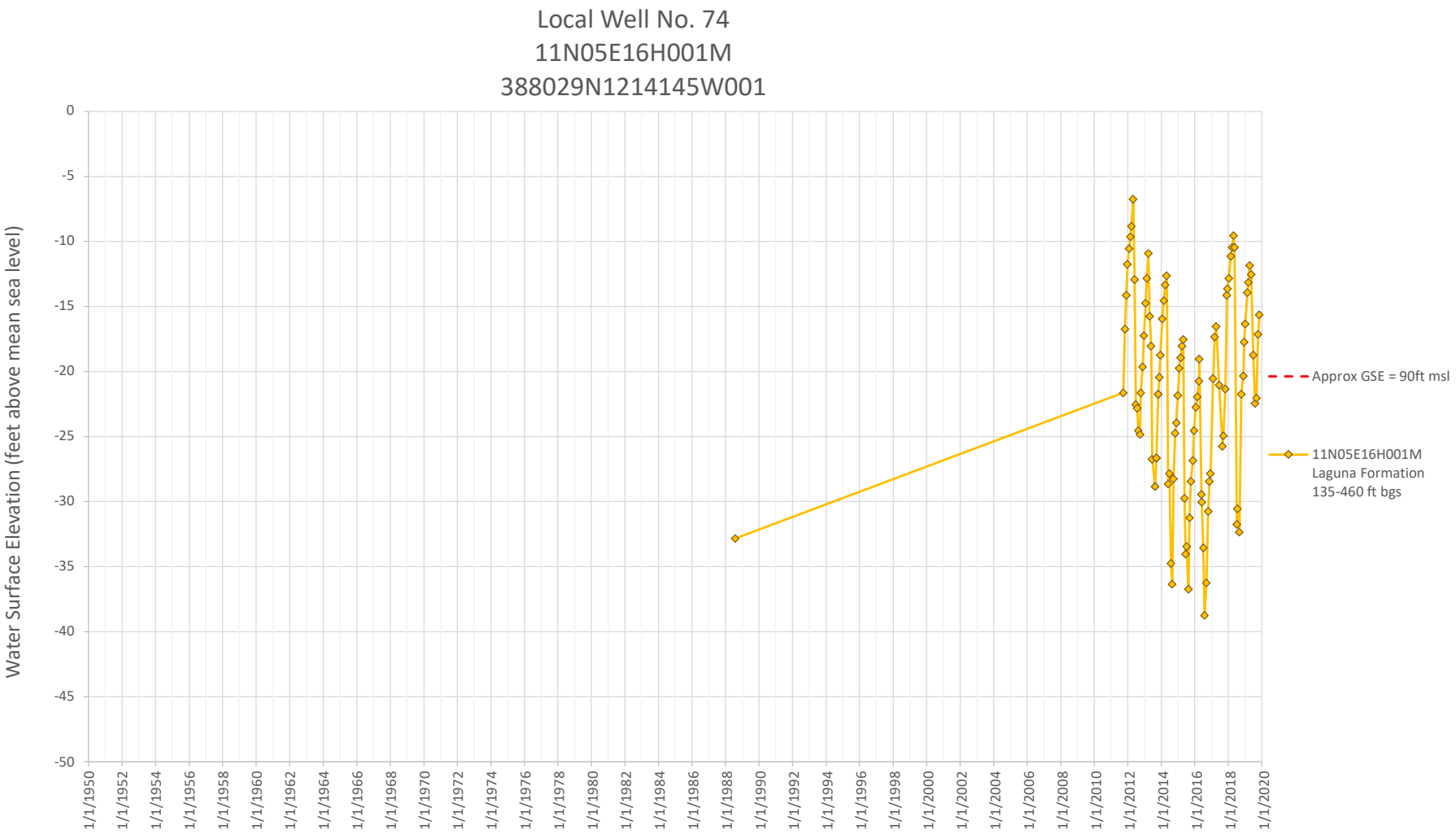

Local Well No. 51
O'Brien Well
387943N1213856W001
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurement not available.
Approx GSE = 88 ft msl
O'Brien well
Laguna Formation
195 ft bgs

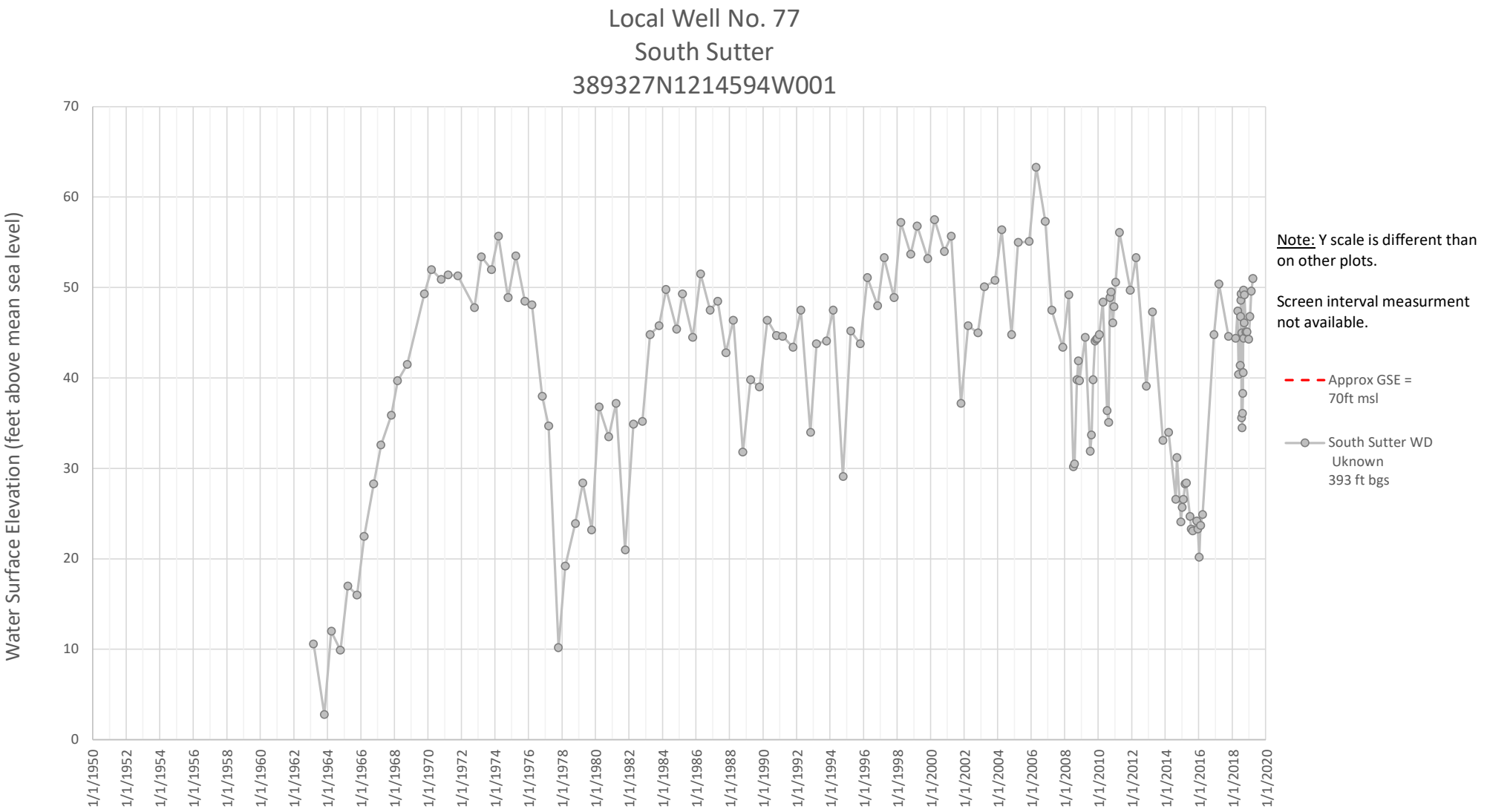

Local Well No. 52
CVMW-1 Nested Well
387957N1213813W001, 387957N1213813W002, 387957N1213813W003
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 84 ft msl
CVMW-1A
Laguna Formation
260-280 ft bgs
CVMW-1B
Mehrten Formation
460-490 ft bgs
CVMW-1C
Mehrten Formation
565-585 ft bgs

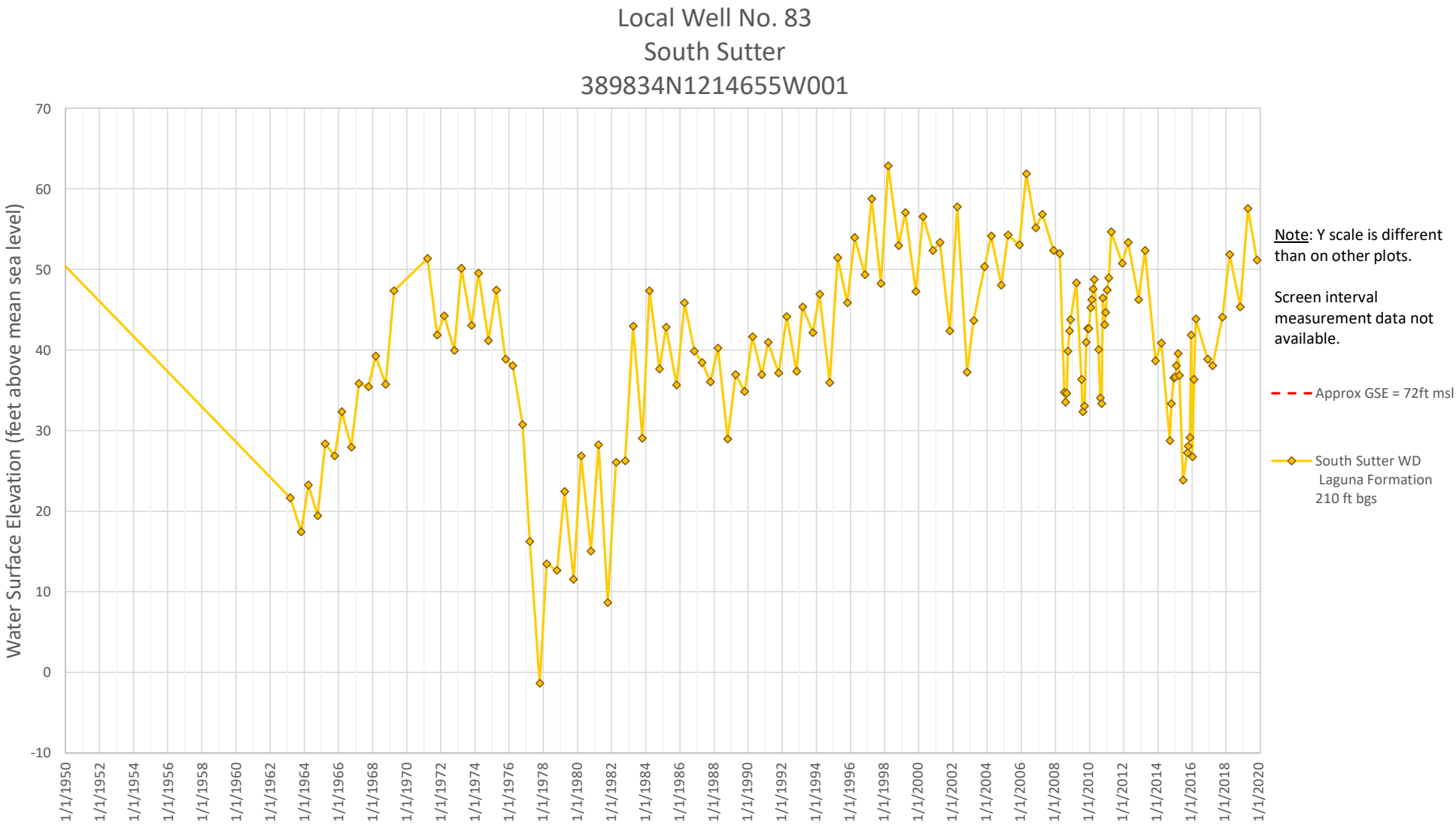

Local Well No. 54
South Sutter
387977N1214521W001
Water Surface Elevation (feet above mean sea level)
10
0
-10
-20
-30
-40
-50
-60
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen depth measurement not available.
Approx GSE = 63ft msl
South Sutter WD Unknown Depth

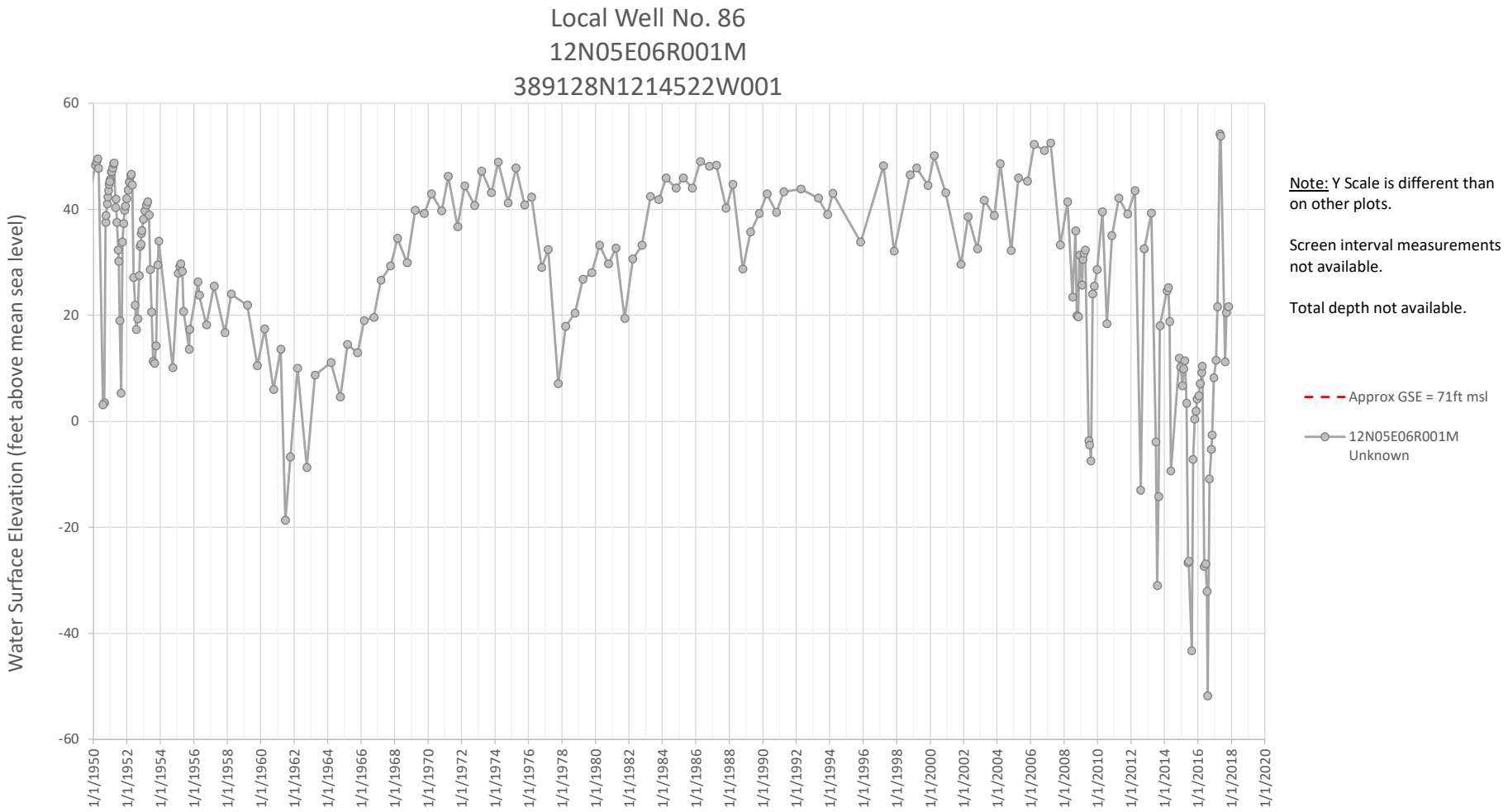

Local Well No. 55
South Sutter
387982N1214704W001
Water Surface Elevation (feet above mean sea level)
0
-10
-20
-30
-40
-50
-60
-70
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen depth measurement not available.
Approx GSE = 52ft msl
South Sutter WD Unknown

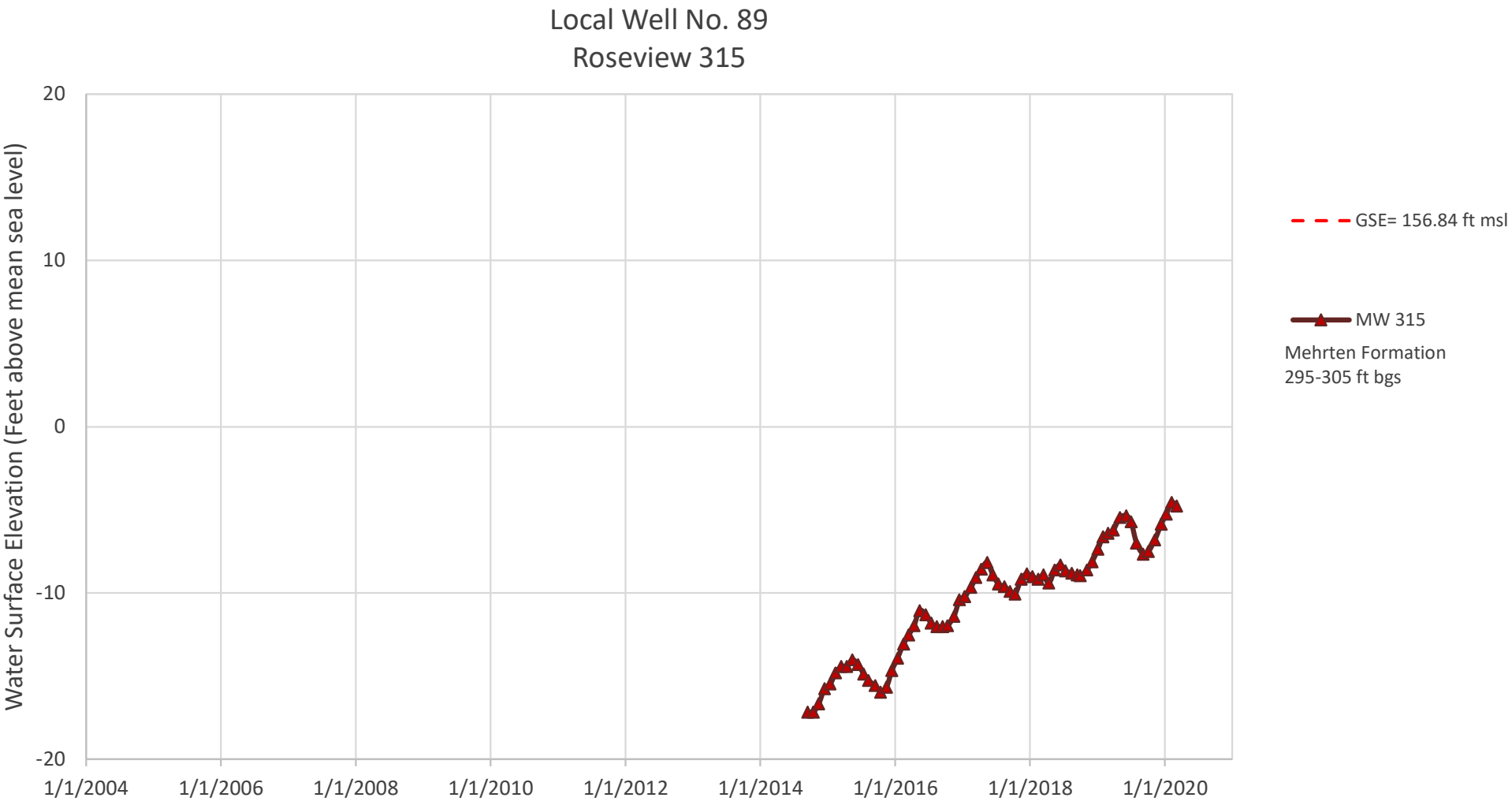

Local Well No. 71
WCMS (Churchill) Nested Wells
386280N1213493W001, 386280N1213493W002, 386280N1213493W003
Water Surface Elevation (feet above mean sea level)
25
15
5
-5
-15
-25
-35
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 91 ft msl
WCMSS
Laguna Formation
130-150 ft bgs
WCMSM
Laguna Formation
230-270 ft bgs
WCMSD
Mehrten Formation
490-510 ft bgs

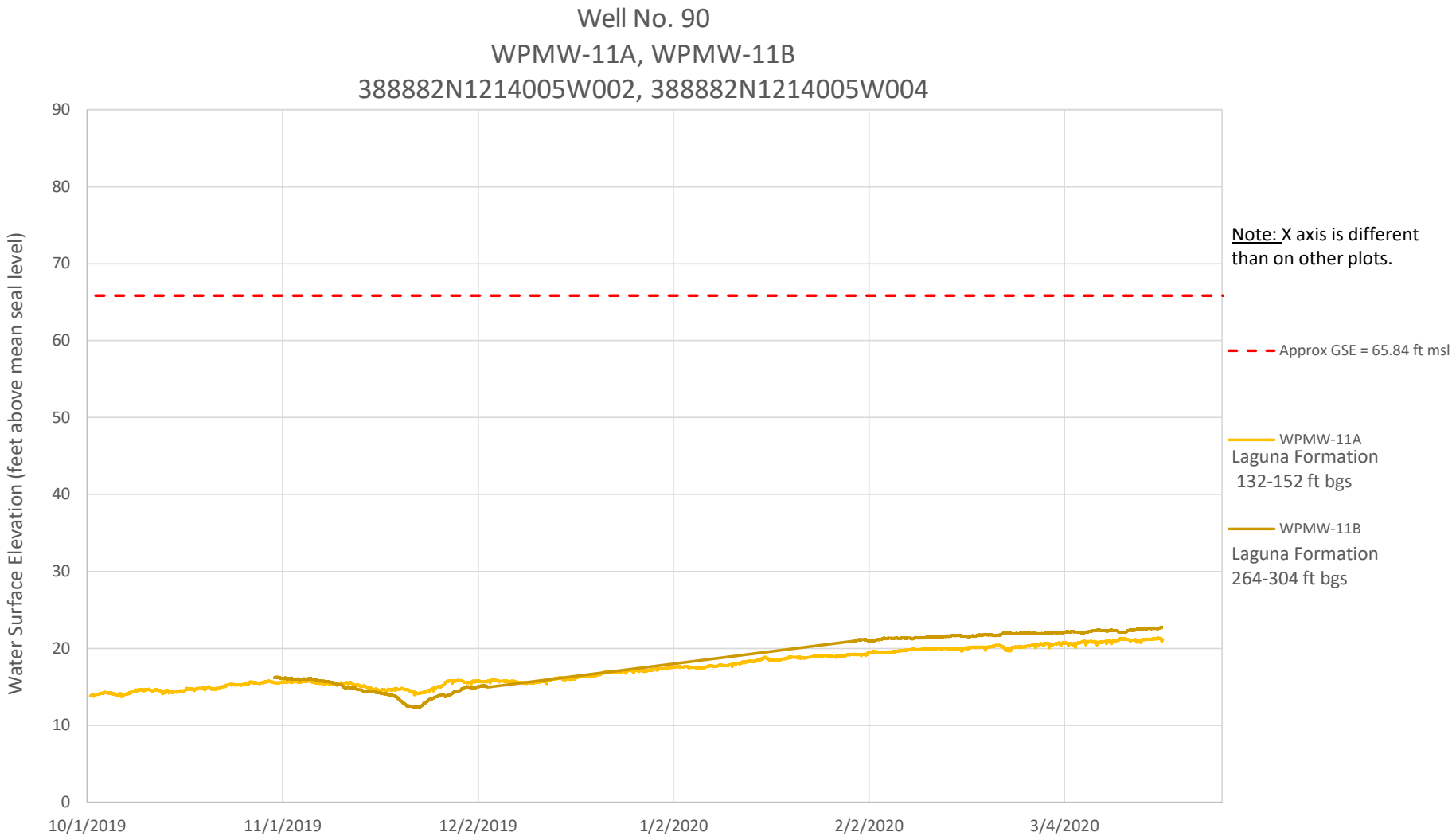

Local Well No. 74
11N05E16H001M
388029N1214145W001
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 90ft msl
11N05E16H001M
Laguna Formation
135-460 ft bgs

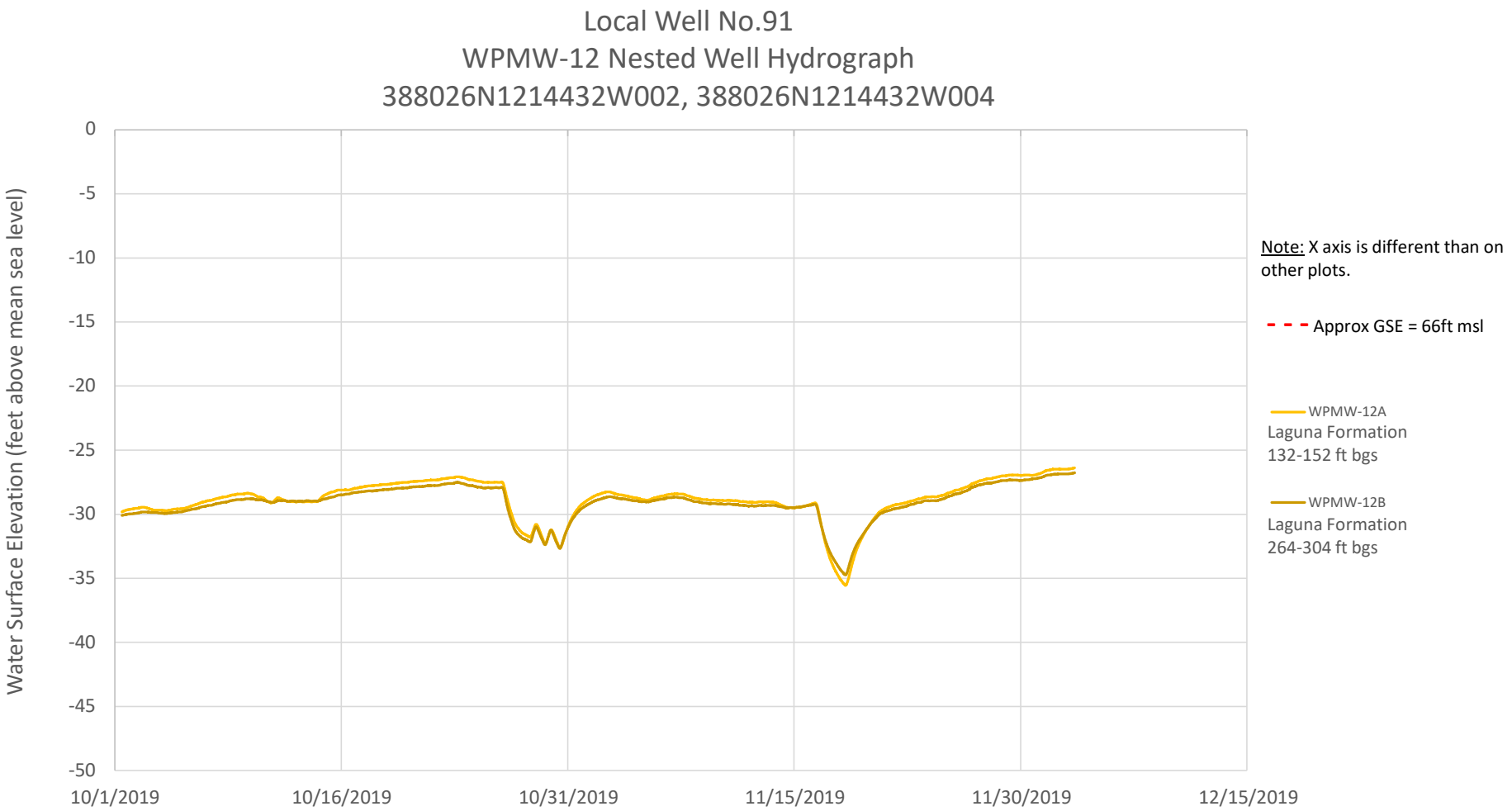

Local Well No. 77
South Sutter
389327N1214594W001
Water Surface Elevation (feet above mean sea level)
70
60
50
40
30
20
10
0
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurment not available.
Approx GSE = 70ft msl
South Sutter WD
Uknown
393 ft bgs

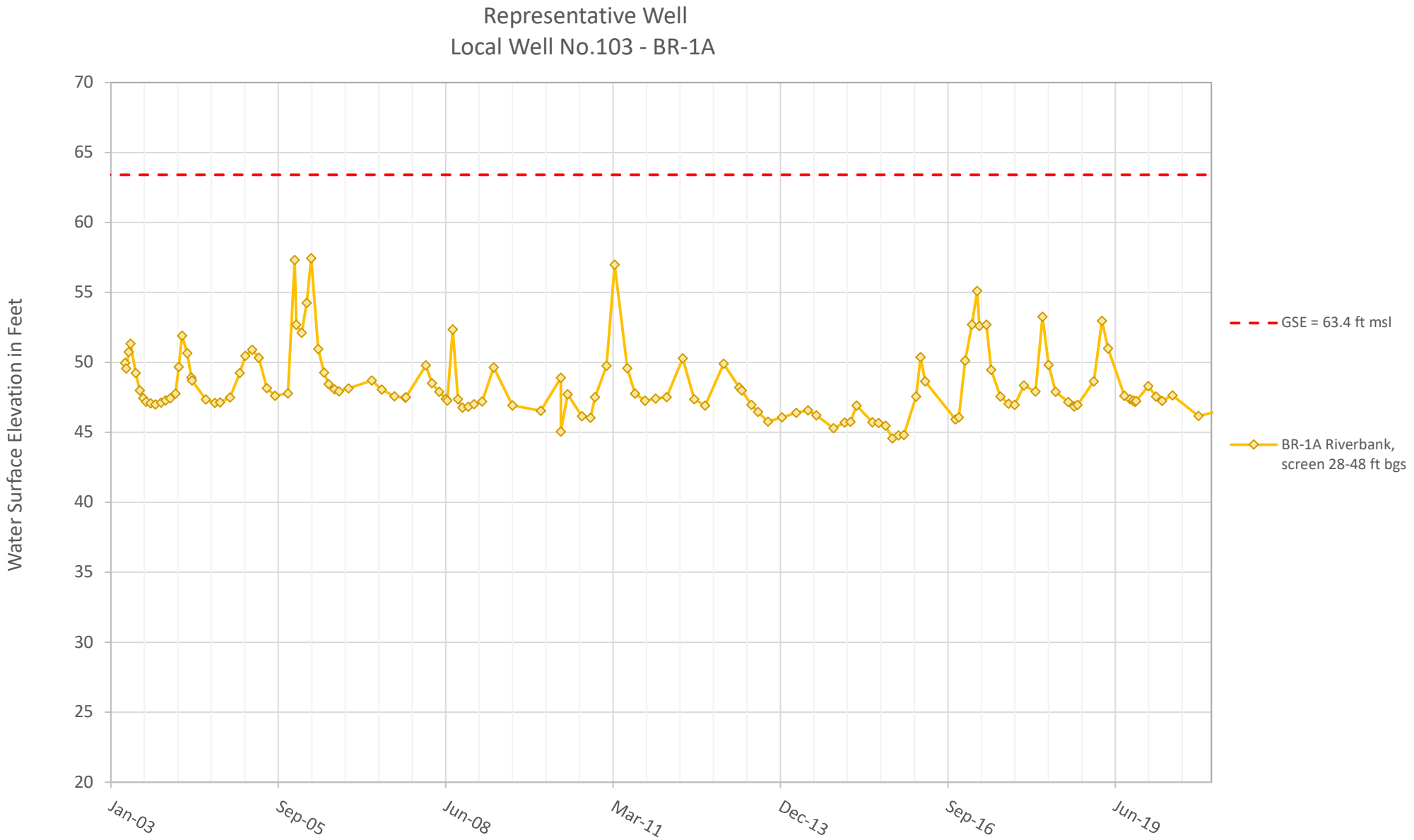

Local Well No. 83
South Sutter
389834N1214655W001
Water Surface Elevation (feet above mean sea level)
70
60
50
40
30
20
10
0
-10
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Screen interval measurement data not available.
Approx GSE = 72ft msl
South Sutter WD
Laguna Formation
210 ft bgs

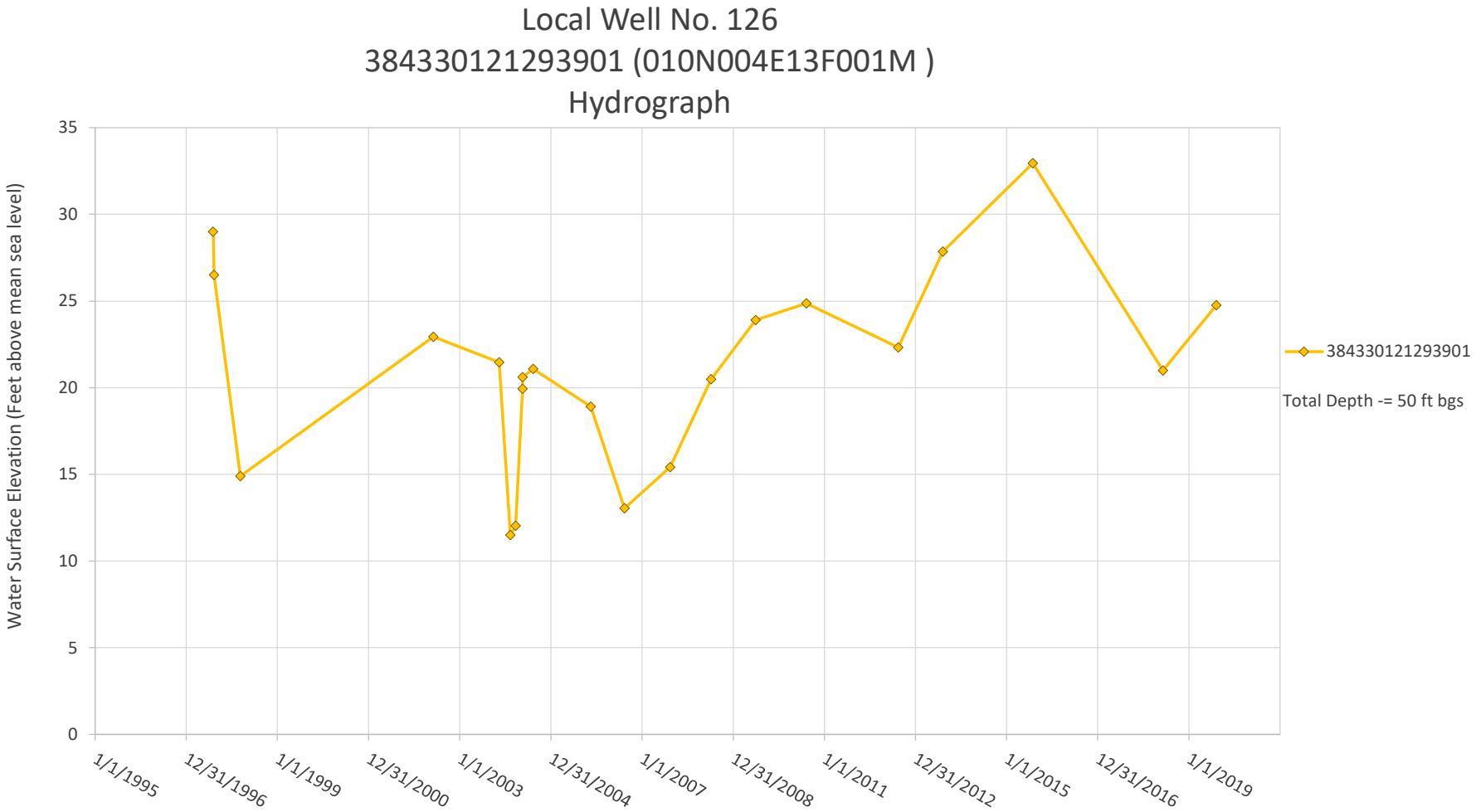

Local Well No. 86
12N05E06R001M
389128N1214522W001
Water Surface Elevation (feet above mean sea level)
60
40
20
0
-20
-40
-60
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y Scale is different than on other plots.
Screen interval measurements not available.
Total depth not available.
Approx GSE = 71ft msl
12N05E06R001M
Unknown


Local Well No. 89
Roseview 315
Water Surface Elevation (Feet above mean sea level)
20
10
0
-10
-20
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
GSE= 156.84 ft msl
MW 315
Mehrten Formation
295-305 ft bgs


Well No. 90
WPMW-11A, WPMW-11B
388882N1214005W002, 388882N1214005W004
Water Surface Elevation (feet above mean seal level)
90
80
70
60
50
40
30
20
10
0
10/1/2019
11/1/2019
12/2/2019
1/2/2020
2/2/2020
3/4/2020
Note: X axis is different than on other plots.
Approx GSE = 65.84 ft msl
WPMW-11A
Laguna Formation
132-152 ft bgs
WPMW-11B
Laguna Formation
264-304 ft bgs


Local Well No.91
WPMW-12 Nested Well Hydrograph
388026N1214432W002, 388026N1214432W004
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
10/1/2019
10/16/2019
10/31/2019
11/15/2019
11/30/2019
12/15/2019
Note: X axis is different than on other plots.
Approx GSE = 66ft msl
WPMW-12A
Laguna Formation
132-152 ft bgs
WPMW-12B
Laguna Formation
264-304 ft bgs


Representative Well
Local Well No.103 - BR-1A
Water Surface Elevation in Feet
70
65
60
55
50
45
40
35
30
25
20
Jan-03
Sep-05
Jun-08
Mar-11
Dec-13
Sep-16
Jun-19
GSE = 63.4 ft msl
BR-1A Riverbank,
screen 28-48 ft bgs


Local Well No. 126
384330121293901 (010N004E13F001M)
Hydrograph
Water Surface Elevation (Feet above mean sea level)
35
30
25
20
15
10
5
0
1/1/1995
12/31/1996
1/1/1999
12/31/2000
1/1/2003
12/31/2004
1/1/2007
12/31/2008
1/1/2011
12/31/2012
1/1/2015
12/31/2016
1/1/2019
384330121293901
Total Depth -= 50 ft bgs

Appendix I: Eastern Area Hydrographs

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX I
Eastern Area Wells with Hydrographs

December 2021

APPENDIX I

EASTERN AREA
WELLS WITH HYDROGRAPHS

LEGEND:



Perched Aquifer Wells
Laguna Formation Wells
Mehrten Formation Wells
Wells with Unknown Construction Details
Ione or Central Valley Fm. Wells

Long-Term Hydrographs

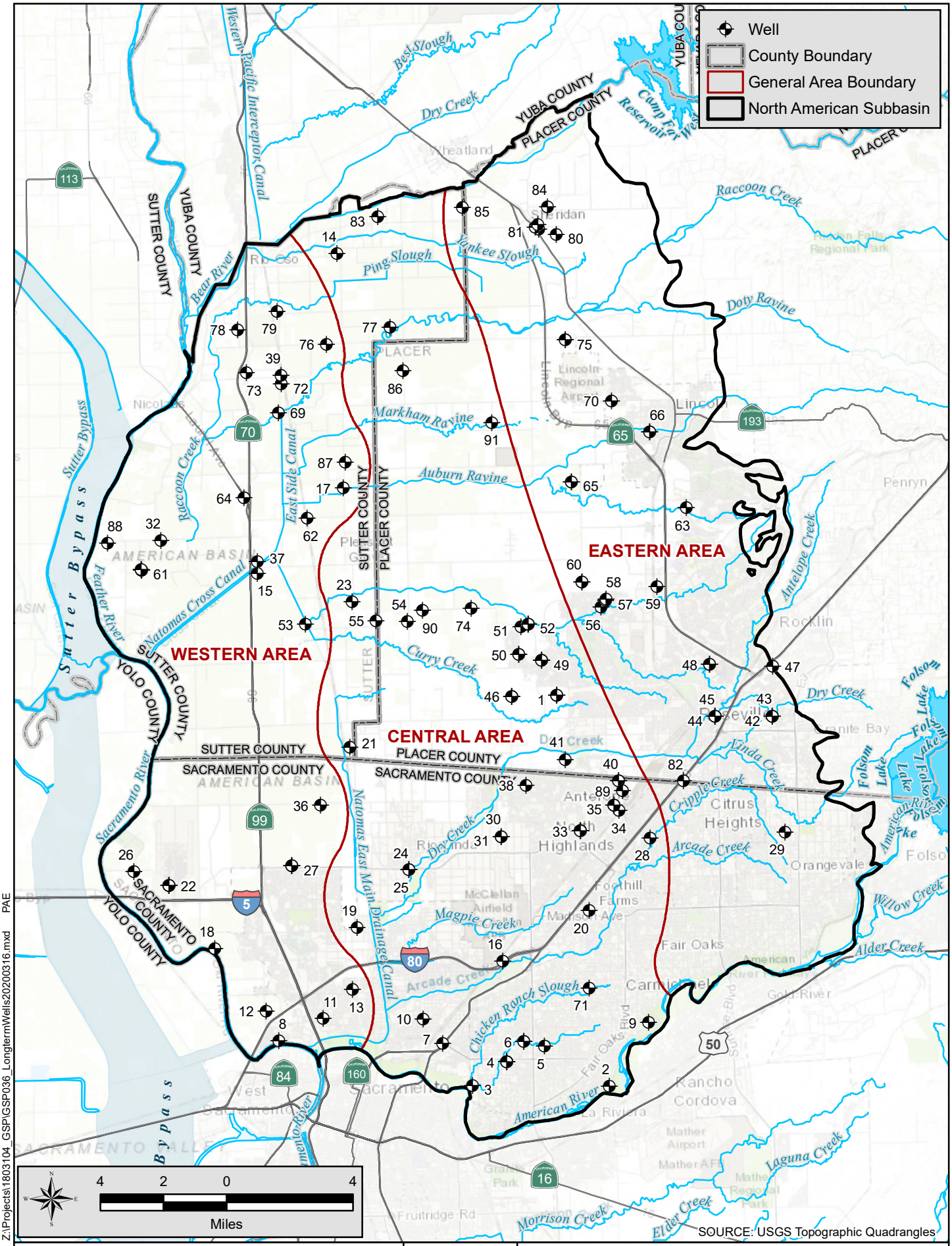
Years Displayed	1950 to 2019
Vertical Axis	50 feet

Unless otherwise noted

Short Term Hydrographs

Years Displayed	2004 to 2019
	Unless otherwise noted
Vertical Axis	50 feet
	Unless otherwise noted

Groundwater levels from multiple aquifers shown



Z:\Projects\1803104_GSP\GSP036_LongtermWells20200316.mxd PAE

18-Mar-2020

North American Subbasin
Sutter, Placer and Sacramento Counties

North American Subbasin

GEI Consultants

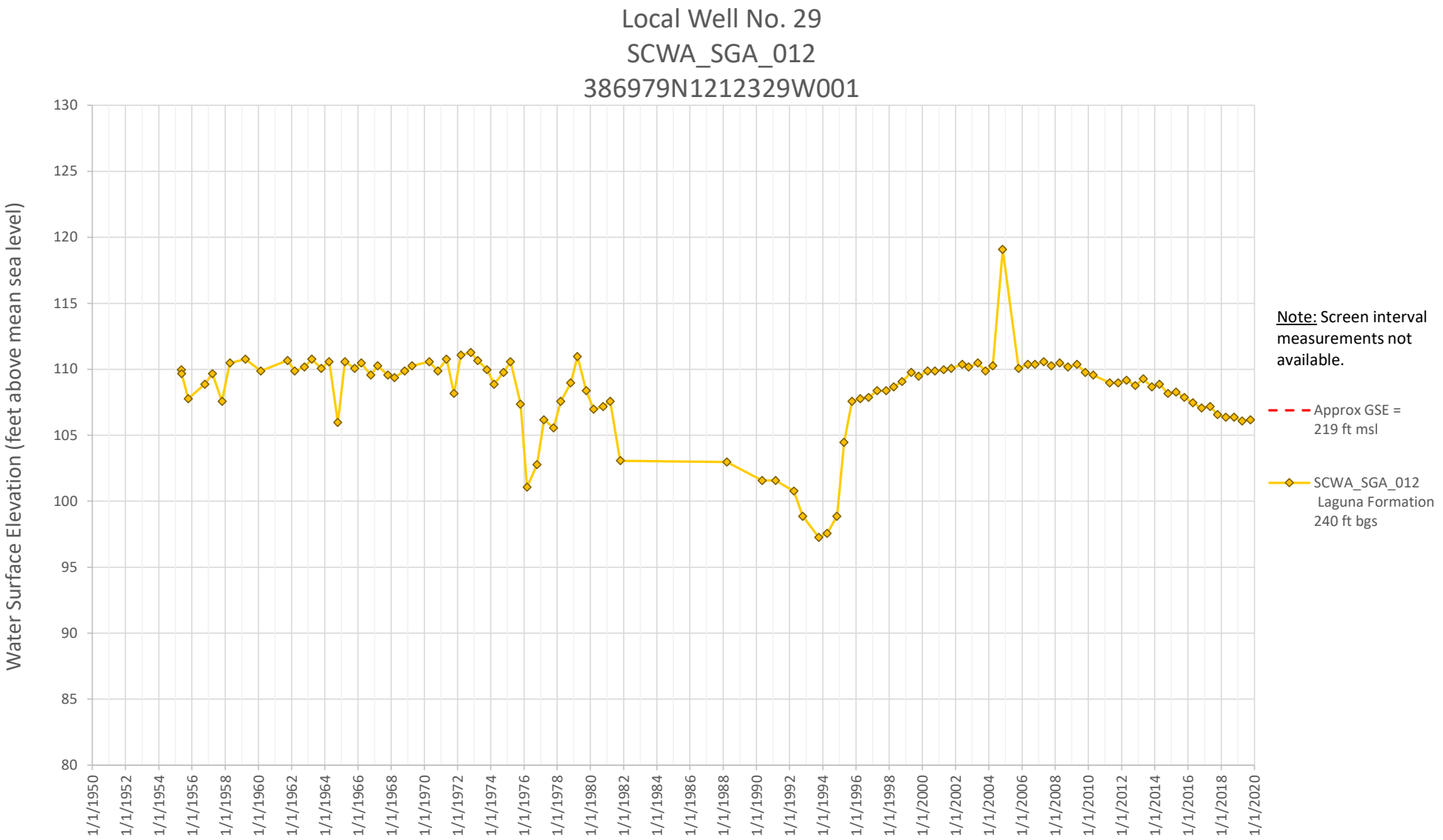
Long Term Wells

MARCH 2020

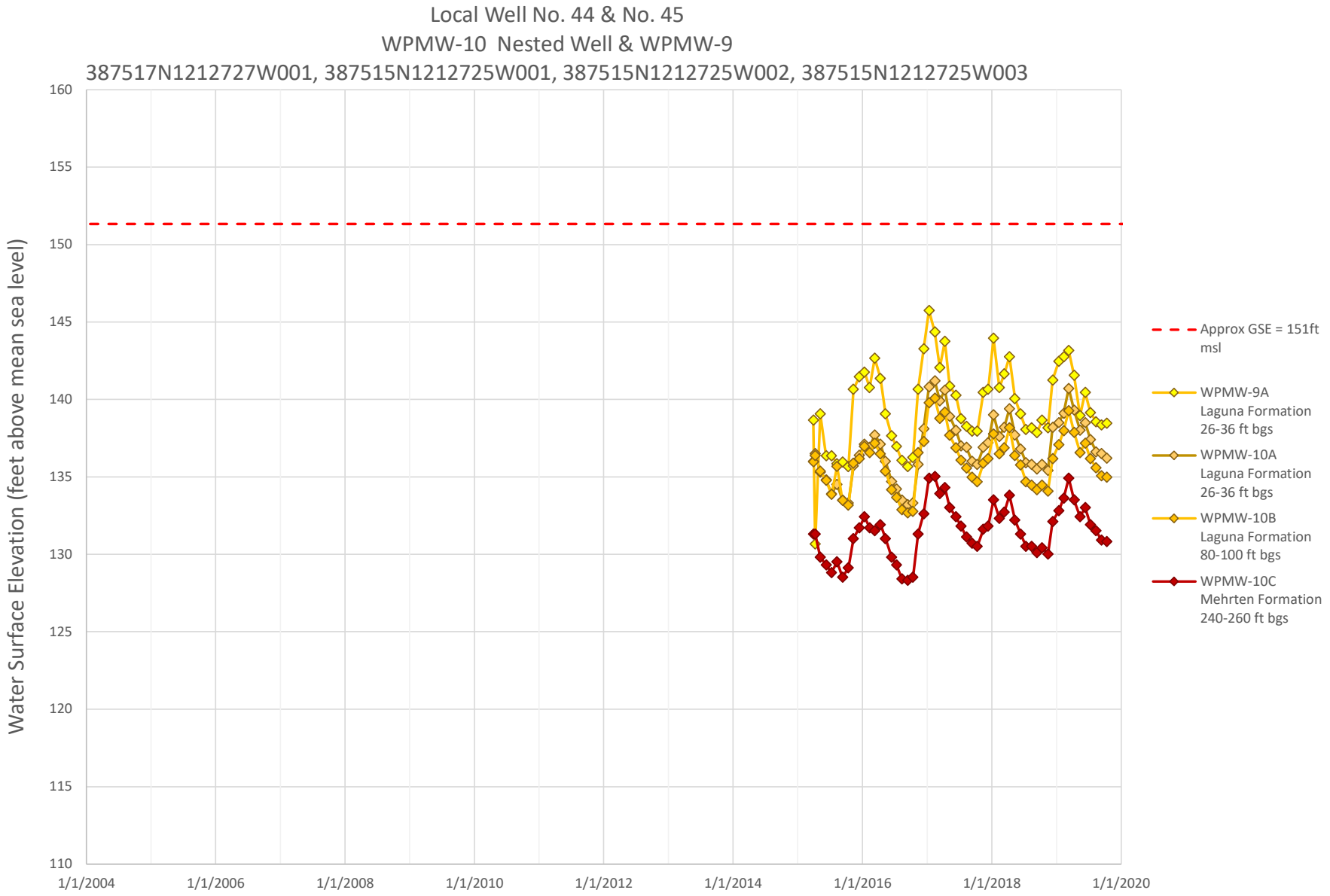
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
1	SVMW East-2B	Not Available	48577	381626N1213651W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	525	Y	NOT AVAILABLE	Active	38.762629	-121.365097
1	SVMW East-2A	Not Available	48576	387626N1213651W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	140	Y	NOT AVAILABLE	Active	38.762629	-121.365099
1	SVMW East-2C	Not Available	48578	387626N1213651W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	670	Y	NOT AVAILABLE	Active	38.76263	-121.365098
2	SGA_MW06	Not Available	48014	385828N1213385W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	72	Y	e026069	Active	38.58281	-121.33846
3	SGA_MW04	Not Available	48012	385841N1214185W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	65	Y	e029066	Active	38.58414	-121.41852
4	MW12A	Not Available	48021	385947N1213985W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	285	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12B	Not Available	48022	385947N1213985W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	385	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12C	Not Available	48023	385947N1213985W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	615	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12D	Not Available	48024	385947N1213985W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	845	Y	NOT AVAILABLE	Active	38.59472	-121.39847
4	MW12E	Not Available	48025	385947N1213985W005	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	1005	Y	NOT AVAILABLE	Active	38.59472	-121.39847
5	DWR_SGA_004	09N05E25J001M	9641	386016N1213761W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	238	N	94507	Active	38.6016	-121.3761
6	MW11A	Not Available	48018	386038N1213882W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	187	Y	NOT AVAILABLE	Active	38.6038	-121.38815
6	MW11B	Not Available	48019	386038N1213882W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	278	Y	NOT AVAILABLE	Active	38.6038	-121.38815
6	MW11C	Not Available	48020	386038N1213882W003	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	375	Y	NOT AVAILABLE	Active	38.6038	-121.38815
7	DWR_SGA_005	09N05E28K001M	9643	386038N1214357W001	Department of Water Resources	North American	5-021.64	Sacramento	Irrigation	No	250	N	NOT AVAILABLE	Active	38.6038	-121.4357
8	SCWA_SGA_003	09N04E27F001M	8944	386061N1215313W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	320	N	828	Active	38.6061	-121.5313
9	SCWA_SGA_004	09N06E27D001M	9648	386117N1213150W001	Sacramento Central Groundwater	North American	5-021.64	Sacramento	Observation	No	200	N	NOT AVAILABLE	Inactive	38.6117	-121.315
10	DWR_SGA_003	09N05E21M001M	31412	386151N1214467W001	Department of Water Resources	North American	5-021.64	Sacramento	Unknown	No	89	N	NOT AVAILABLE	Active	38.6151	-121.4467
11	Bannon Creek Park	09N04E23R002M	48041	386160N1215054W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	48	Y	NOT AVAILABLE	Active	38.61603	-121.5054
12	09N04E22E001M	09N04E22E001M	8943	386199N1215386W001	Department of Water Resources	North American	5-021.64	Sacramento	Residential	No	-	N	NOT AVAILABLE	Active	38.6199	-121.5386
13	Chuckwagon Park	09N04E13R001M	48040	386292N1214877W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	52	Y	NOT AVAILABLE	Active	38.62921	-121.4877
14	13N04E23A002M	13N04E23A002M		389669N1214897W001	Department of Water Resources	North American	5-021.64	Sutter	Residential		83				38.9669	-121.4897
15	11N04E09D002M	11N04E09D002M		388208N1215397W001	Department of Water Resources	North American	5-021.64	Sutter	Residential		100				38.8208	-121.5397
16	DWR_SGA_002	09N05E14B001M	40050	386410N1213995W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	550	N	49236	Active	38.641	-121.3995
17	AB-2 deep	12N04E26J002M		388593N1214885W001	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
17	AB-2 middle	12N04E26J003M		388593N1214885W002	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
17	AB-2 shallow	12N04E26J004M		388593N1214885W003	Department of Water Resources	North American	5-021.64	Sutter	Observation					Active	38.8593	-121.4885
18	SCWA_SGA_002	09N04E08L001M	29914	386489N1215679W001	Department of Water Resources	North American	5-021.64	Sacramento	Irrigation	No	105	N	185	Active	38.6489	-121.5679
19	SCWA_SGA_001	09N04E01R001M	8921	386576N1214846W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	82	N	NOT AVAILABLE	Active	38.6576	-121.4846
20	SGA_MW05	Not Available	48013	386635N1213486W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	220	Y	e029068	Active	38.66347	-121.34859
21	10N04E12A001M	10N04E12A001M		387404N1214870W001	Department of Water Resources	North American	5-021.64		Irrigation					Active	38.7404	-121.487
22	AB-4 deep	10N04E31M001M	39756	386782N1215943W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	1080	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 middle-deep	10N04E31M002M	24319	386782N1215943W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	815	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 middle-shallow	10N04E31M003M	37857	386782N1215943W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	410	Y	NOT AVAILABLE	Active	38.6782	-121.5943
22	AB-4 shallow	10N04E31M004M	24318	386782N1215943W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	200	Y	NOT AVAILABLE	Active	38.6782	-121.5943
23	South Sutter	11N04E13D001M		388072N1214842W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation		535				38.8072	-121.4842
24	SGA_MW02	Not Available	48010	386836N1214536W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	110	Y	e029062	Active	38.68362	-121.45363
25	SGA_MW03	Not Available	48011	386836N1214536W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	305	Y	e034123	Active	38.68356	-121.45362
26	SCWA_SGA_005	10N03E35A001M	40055	386848N1216146W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Irrigation	No	96	N	221	Active	38.6848	-121.6146
27	AB-3 deep	10N04E27R002M	32581	386864N1215222W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	995	Y	NOT AVAILABLE	Active	38.6864	-121.5222
27	AB-3 middle	10N04E27R003M	15689	386864N1215222W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	500	Y	NOT AVAILABLE	Active	38.6864	-121.5222
27	AB-3 shallow	10N04E27R004M	15690	386864N1215222W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	220	Y	NOT AVAILABLE	Active	38.6864	-121.5222
28	Twin Creeks Park	10N06E27F001M	48042	386964N1213120W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	198	Y	NOT AVAILABLE	Active	38.6964	-121.31203
29	SCWA_SGA_012	10N07E29G001M	33380	386979N1212329W001	Sacramento County	North American	5-021.64	Sacramento	Irrigation	No	240	N	1037	Inactive	38.6979	-121.2329
30	SCWA_SGA_008	10N05E14Q002M	13652	386982N1213992W001	Department of Water Resources	North American	5-021.64	Sacramento	Residential	No	225	N	10678	Active	38.6982	-121.3992
31	SCWA_SGA_009	10N05E26B002M	13654	386982N1213992W002	Sacramento County	North American	5-021.64	Sacramento	Residential	No	150	N	NOT AVAILABLE	Active	38.6982	-121.3992
32	MLF Well #1	11N03E01D001M		388361N1215959W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.83664	-121.59591
33	Monument (A)	Not Available	48030	387000N1213529W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	274	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (B)	Not Available	48031	387000N1213529W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	334	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (C)	Not Available	48032	387000N1213529W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	450	Y	NOT AVAILABLE	Active	38.70005	-121.35288
33	Monument (D)	Not Available	48033	387000N1213529W004	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	544	Y	NOT AVAILABLE	Active	38.70005	-121.35288
34	SCWA_SGA_010	10N06E21F002M	33087	387092N1213300W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Residential	No	144	N	NOT AVAILABLE	Active	38.7092	-121.33
35	Poker (A)	Not Available	48034	387117N1213327W001	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	134	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (B)	Not Available	48035	387117N1213327W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	176	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (C)	Not Available	48036	387117N1213327W003	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	320	Y	NOT AVAILABLE	Active	38.71174	-121.33271
35	Poker (D)	Not Available	48037	387117N1213327W004	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	470	Y	NOT AVAILABLE	Active	38.71174	-121.33271
36	SCWA_SGA_006	10N04E23A001M	32580	387138N1215047W001	Sacramento County	North American	5-021.64	Sacramento	Industrial	No	85	N	NOT AVAILABLE	Active	38.7138	-121.5047
37	SUT-P4	11N04E04N001M		388260N1215394W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		305				38.826	-121.5394
37	SUT-P3	11N04E04N002M		388260N1215394W002	Department of Water Resources	North American	5-021.64	Sutter	Observation		195				38.826	-121.5394
37	SUT-P2	11N04E04N003M		388260N1215394W003	Department of Water Resources	North American	5-021.64	Sutter	Observation		120				38.826	-121.5394
37	SUT-P1	11N04E04N004M		388260N1215394W004	Department of Water Resources	North American	5-021.64	Sutter	Observation		980				38.826	-121.5394
38	Lone Oak Park	10N05E13F001M	48043	387216N1213842W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	166	Y	NOT AVAILABLE	Active	38.72163	-121.38417
39	AB-1 deep	12N04E03N001M		389116N1215238W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		980				38.9116	-121.5238
39	AB-1 middle-deep	12N04E03N002M		389116N1215238W002	Department of Water Resources	North American	5-021.64	Sutter	Observation		710				38.9116	-121.5238
39	AB-1 shallow	12N04E03N004M		389116N1215238W003	Department of Water Resources	North American	5-021.64	Sutter	Observation		190				38.9116	-121.5238
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
39	AB-1 middle-shallow	12N04E03N003M		389117N1215238W001	Department of Water Resources	North American	5-021.64	Sutter	Observation		530				38.9116	-121.5238
40	Antelope North (A)	Not Available	48038	387228N1213298W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	283	Y	NOT AVAILABLE	Active	38.722803	-121.329755
40	Antelope North (B)	Not Available	48039	387228N1213298W002	Sacramento Groundwater Authority	North American	5-021.64	Sacramento	Observation	Yes	473	Y	NOT AVAILABLE	Active	38.722803	-121.329755
41	WPMW-5A	Not Available	51280	387331N1213610W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	100	Y	e0266541	Active	38.733106	-121.360994
41	WPMW-5B	Not Available	51281	387331N1213610W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	650	Y	e0266541	Active	38.733106	-121.360994
42	WPMW-7A	Not Available	51283	387512N1212390W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	45	Y	e0265730	Active	38.751194	-121.239
43	WPMW-8A	Not Available	51284	387510N1212390W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	50	Y	e0265733	Active	38.750989	-121.23895
43	WPMW-8B	Not Available	51285	387510N1212390W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	115	Y	e0265733	Active	38.750989	-121.23895
44	WPMW-9A	Not Available	51286	387517N1212727W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	36	Y	e0265735	Active	38.751667	-121.272656
45	WPMW-10A	Not Available	51287	387515N1212725W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	36	Y	e0265738	Active	38.751494	-121.272511
45	WPMW-10B	Not Available	51288	387515N1212725W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	100	Y	e0265738	Active	38.751494	-121.272511
45	WPMW-10C	Not Available	51289	387515N1212725W003	City of Roseville	North American	5-021.64	Placer	Observation	Yes	260	Y	e0265738	Active	38.751494	-121.272511

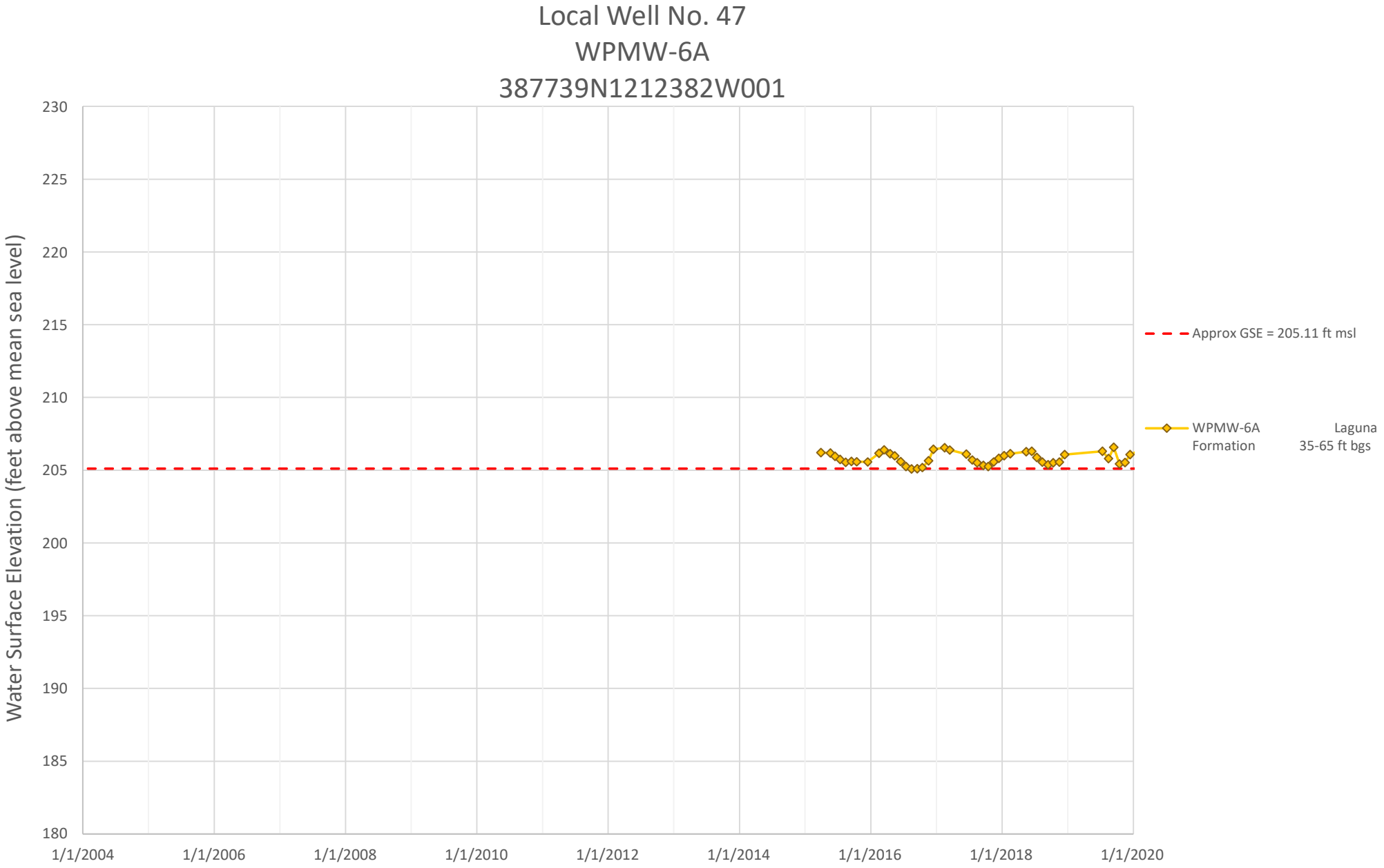
46	SVMW West - 1A	Not Available	48573	387623N1213915W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	145	Y	NOT AVAILABLE	Active	38.762324	-121.39153
46	SVMW West - 1B	Not Available	48574	387623N1213915W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	560	Y	NOT AVAILABLE	Active	38.762325	-121.39153
46	SVMW West - 1C	Not Available	48575	387623N1213915W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	750	Y	NOT AVAILABLE	Active	38.762325	-121.391529
48	WPMW-4A	Not Available	48567	387755N1212753W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	145	Y	NOT AVAILABLE	Active	38.775536	-121.275254
48	WPMW-4B	Not Available	48568	387755N1212753W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	300	Y	NOT AVAILABLE	Active	38.775535	-121.275255
49	WPMW-1A	Not Available	48560	387786N1213737W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	120	Y	NOT AVAILABLE	Active	38.778603	-121.373698
49	WPMW-1B	Not Available	48561	387786N1213737W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	480	Y	NOT AVAILABLE	Active	38.778603	-121.373697
49	WPMW-1C	Not Available	48562	387786N1213737W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	545	Y	NOT AVAILABLE	Active	38.778602	-121.373698
50	W-77MW-A	Not Available	51294	387816N1213870W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	516	Y	NOT AVAILABLE	Active	38.781581	-121.38702
50	W-77MW-B	Not Available	51295	387816N1213870W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	604	Y	NOT AVAILABLE	Active	38.781581	-121.38702
51	O'Brien well	11N05E23B001M	11223	387943N1213856W001	City of Roseville	North American	5-021.64	Placer	Residential	No	195	N	NOT AVAILABLE	Active	38.7943	-121.3856
52	CVMW-1A	Not Available	48569	387957N1213813W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	285	Y	NOT AVAILABLE	Active	38.795655	-121.38126
52	CVMW-1B	Not Available	48571	387957N1213813W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	495	Y	NOT AVAILABLE	Active	38.795654	-121.381258
52	CVMW-1C	Not Available	48572	387957N1213813W003	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	590	Y	NOT AVAILABLE	Active	38.795655	-121.381258
53	South Sutter WD	11N04E15Q001M	10508	387971N1215119W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.7971	-121.5119
54	South Sutter WD	11N05E18R001M	11221	387977N1214521W001	South Sutter Water District	North American	5-021.64	Placer	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.7977	-121.4521
55	South Sutter WD	11N04E13R001M	10507	387982N1214704W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.7982	-121.4704
56	DCMW-3	Not Available	51293	388027N1213384W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	520	Y	NOT AVAILABLE	Active	38.80271	-121.338432
57	DCMW-1	Not Available	51291	388058N1213355W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	455	Y	NOT AVAILABLE	Active	38.805757	-121.335503
58	DCMW-2	Not Available	51292	388063N1213354W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	437	Y	NOT AVAILABLE	Active	38.806291	-121.335415
59	Tinker MW	Not Available	51290	388116N1213054W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	177	Y	NOT AVAILABLE	Active	38.811594	-121.305387
60	WPMW-2A	Not Available	48563	388145N1213491W001	City of Roseville	North American	5-021.64	Placer	Observation	Yes	230	Y	NOT AVAILABLE	Active	38.814497	-121.349144
60	WPMW-2B	Not Available	48564	388145N1213491W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	425	Y	NOT AVAILABLE	Active	38.814497	-121.349143
61	Sutter County MW-5A	11N03E02Q002M	47776	388235N1216079W001	Sutter County	North American	5-021.64	Sutter	Observation	Yes	170	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5B	11N03E02Q003M	47777	388235N1216079W002	Sutter County	North American	5-021.64	Sutter	Observation	Yes	675	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5C	11N03E02Q004M	47778	388235N1216079W003	Sutter County	North American	5-021.64	Sutter	Observation	Yes	930	Y	E0123539	Active	38.823235	-121.60763
61	Sutter County MW-5D	11N03E02Q005M	47779	388235N1216079W004	Sutter County	North American	5-021.64	Sutter	Observation	Yes	1225	Y	E0123539	Active	38.8235	-121.6079
62	South Sutter WD	12N04E34H001M	17037	388458N1215100W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Residential	Yes	-	N	NOT AVAILABLE	Active	38.8458	-121.51
63	WPMW-3A	Not Available	48565	388476N1212872W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	53	Y	NOT AVAILABLE	Active	38.847609	-121.287189
63	WPMW-3B	Not Available	48566	388476N1212872W002	City of Roseville	North American	5-021.64	Placer	Observation	Yes	140	Y	NOT AVAILABLE	Active	38.847609	-121.287187
64	South Sutter WD	12N04E29J001M	25784	388555N1215468W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.8555	-121.5468
65	MW 1-2	Not Available	49928	388604N1213544W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	318	Y	NOT AVAILABLE	Active	38.860383	-121.354383
65	MW 1-4	Not Available	49930	388604N1213544W004	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	92	Y	NOT AVAILABLE	Active	38.860383	-121.354383
66	MW 5-1	Not Available	49937	388826N1213078W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	100	Y	NOT AVAILABLE	Active	38.882583	-121.30775
66	MW 5-2	Not Available	49938	388826N1213078W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	62	Y	NOT AVAILABLE	Active	38.882583	-121.30775
69	South Sutter WD	12N04E16A004M	17031	388944N1215257W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.8944	-121.5257
70	MW 3-2	Not Available	49935	388971N1213301W002	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	75	Y	NOT AVAILABLE	Active	38.897133	-121.330083
71	WCMSS	Not Available	52461	386280N1213493W001	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	170	Y	WCR2016-005904	Active	38.62799	-121.34925
71	WCMSM	Not Available	52462	386280N1213493W002	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	290	Y	WCR2016-005902	Active	38.62799	-121.34925
71	WCMSD	Not Available	52463	386280N1213493W003	Department of Water Resources	North American	5-021.64	Sacramento	Observation	Yes	530	Y	WCR2016-005899	Active	38.62799	-121.34925
72	South Sutter WD	12N04E10D002M	17027	389075N1215237W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.9075	-121.5237
73	South Sutter WD	12N04E05R004M	17025	389130N1215441W001	South Sutter Water District	North American	5-021.64	Sutter	Residential	Yes	90	N	NOT AVAILABLE	Active	38.913	-121.5441
74	11N05E16H001M	11N05E16H001M		388029N1214145W001	Department of Water Resources	North American	5-021.64	Placer	Irrigation		460				38.8029	-121.4145
75	MW 2-1	Not Available	49931	389255N1213566W001	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	310	Y	NOT AVAILABLE	Active	38.925467	-121.356633
75	MW 2-2	Not Available	49932	389255N1213566W002	City of Lincoln	North American	5-021.64	Placer	Observation	Yes	170	Y	NOT AVAILABLE	Active	38.925467	-121.356633
76	South Sutter WD	13N04E35Q002M	35624	389255N1214969W001	South Sutter Water District	North American	5-021.64	Sutter	Unknown	Yes	-	N	NOT AVAILABLE	Active	38.9255	-121.4969
77	South Sutter WD	13N05E31K001M	40137	389327N1214594W001	Department of Water Resources	North American	5-021.64	Sutter	Unknown	Yes	393	N	NOT AVAILABLE	Active	38.9327	-121.4594
78	South Sutter WD	13N04E32G001M	35623	389328N1215489W001	SUTTER, SOUTH, WATER DISTRICT	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.9328	-121.5489
79	South Sutter WD	13N04E28R001M	17195	389410N1215254W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation	Yes	-	N	NOT AVAILABLE	Active	38.941	-121.5254
80	Cemetery	Not Available	51328	389740N1213606W001	Placer County	North American	5-021.64	Placer	Irrigation	Yes	111	Y	NOT AVAILABLE	Active	38.974027	-121.360615
81	MW-2	Not Available	51331	389764N1213710W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	45	Y	NOT AVAILABLE	Active	38.976427	-121.371001
81	MW-3	Not Available	51332	389774N1213728W001	Placer County	North American	5-021.64	Placer	Observation	Yes	35	Y	NOT AVAILABLE	Active	38.977408	-121.372844
81	MW-1	Not Available	51330	389785N1213713W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	40	Y	NOT AVAILABLE	Active	38.97846	-121.37132

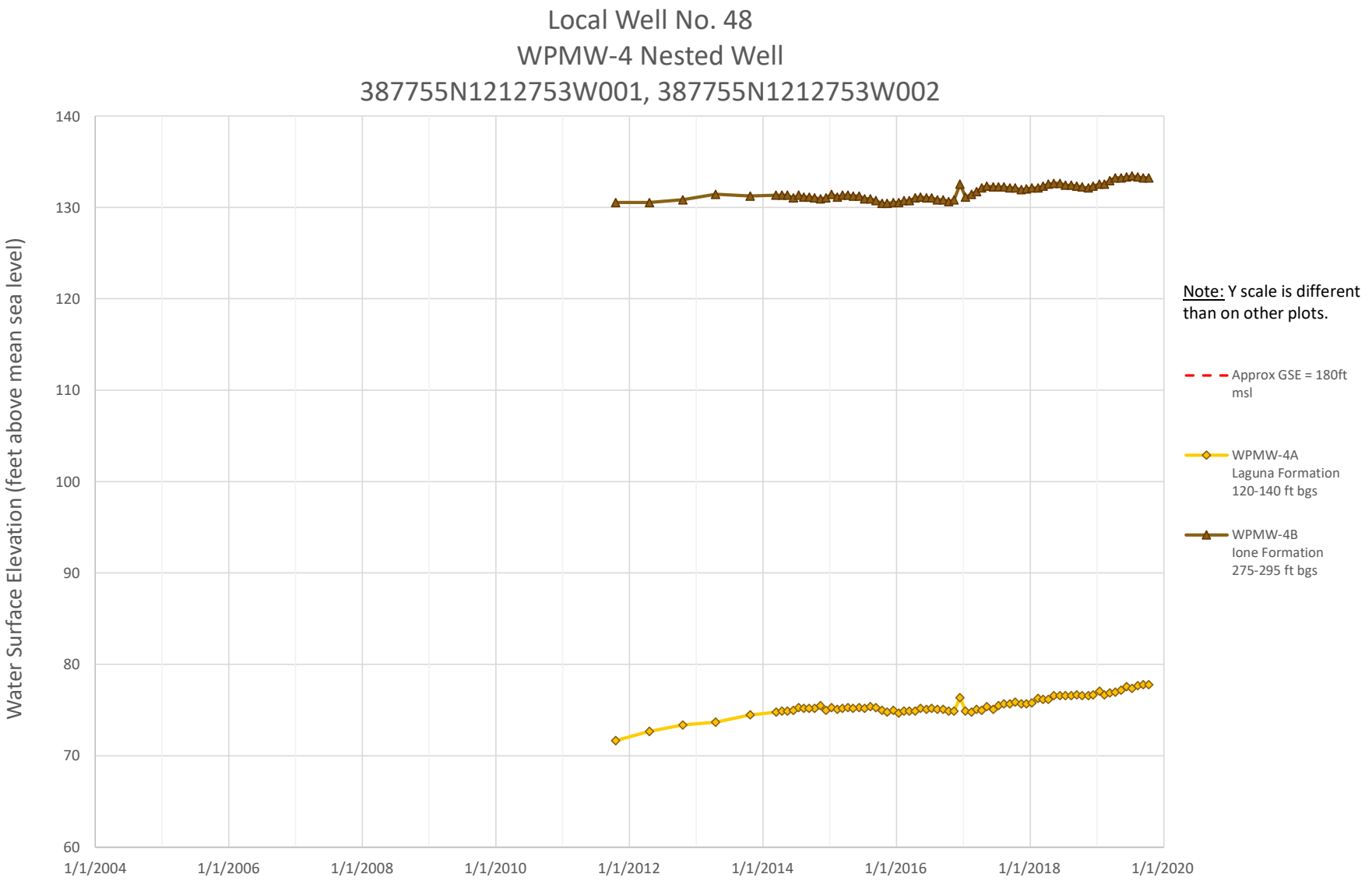
Sl No.	Local Well Number	State Well Number	CASGEM Well ID	CASGEM Station ID	Monitoring Entity	GW Basin Name	GW Basin Code	County	Well Use	CASGEM Well	Total Well Depth	Well Construction	Well Completion	Status	Latitude(Y)	Longitude(X)
82	Whyte A	Not Available	52475	387222N1212920W001	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	226	Y	e0303799	Active	38.722168	-121.29196
82	Whyte B	Not Available	52476	387222N1212920W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	306	Y	e0303799	Active	38.722168	-121.29196
83	South Sutter WD	13N05E18C001M	17209	389834N1214655W001	South Sutter Water District	North American	5-021.64	Sutter	Irrigation	Yes	210	N	NOT AVAILABLE	Active	38.9834	-121.4655
84	Spencer	Not Available	52555	389867N1213654W002	Department of Water Resources	North American	5-021.64	Placer	Residential	Yes	107	Y	101157	Active	38.986724	-121.36542
85	13N05E09R001M	13N05E09R001M		389873N1214156W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.9873	-121.4156
86	12N05E06R001M	12N05E06R001M		389128N1214522W001	Department of Water Resources	North American	5-021.64	Placer	Irrigation						38.9128	-121.4522
87	12N04E24M002M	12N04E24M002M		388710N1214870W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.871	-121.487
88	11N03E03C002M	11N03E03C002M		388357N1216273W001	Department of Water Resources	North American	5-021.64	Sutter	Irrigation						38.8357	-121.6273
89	Roseview-MW315	Not Available			Sacramento Groundwater Authority	North American	5-021.64				315				38.718222	-121.327729
89	Roseview-MW465	Not Available			Sacramento Groundwater Authority	North American	5-021.64				465				38.718222	-121.327729
90	WPMW-11A	Not Available	54779	388882N1214005W002	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	162	Y	NOT AVAILABLE		38.888164	-121.400463
90	WPMW-11B	Not Available	54780	388882N1214005W004	Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	309	Y	NOT AVAILABLE		38.888164	-121.400463
91	WPMW12-A	Not Available			Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	300	Y	NOT AVAILABLE		38.802639	-121.443216
91	WPMW12-B	Not Available			Department of Water Resources	North American	5-021.64	Placer	Observation	Yes	550	Y	NOT AVAILABLE		38.802639	-121.443216

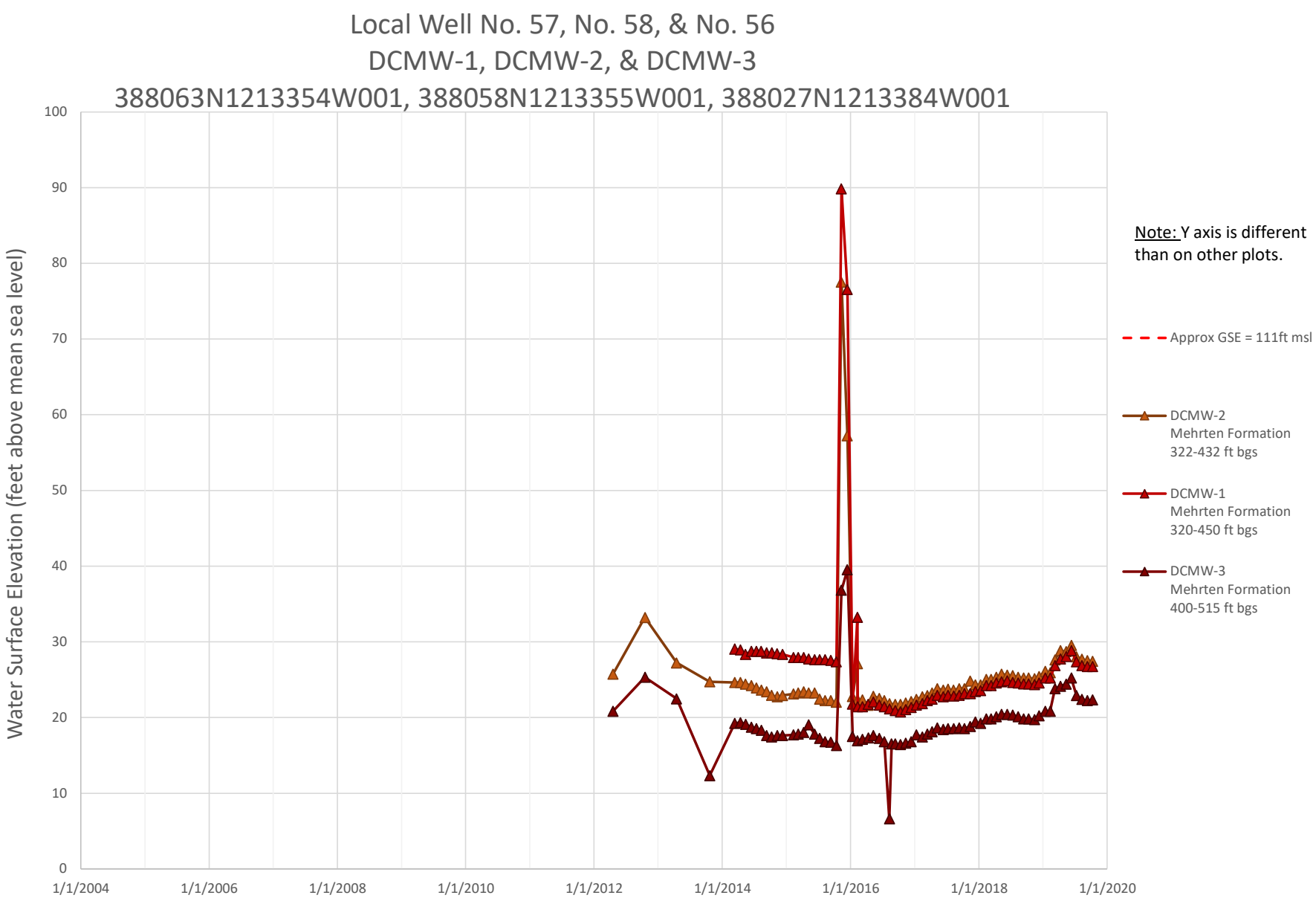

Local Well No. 29
SCWA_SGA_012
386979N1212329W001
Water Surface Elevation (feet above mean sea level)
130
125
120
115
110
105
100
95
90
85
80
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurements not available.
Approx GSE = 219 ft msl
SCWA_SGA_012
Laguna Formation
240 ft bgs

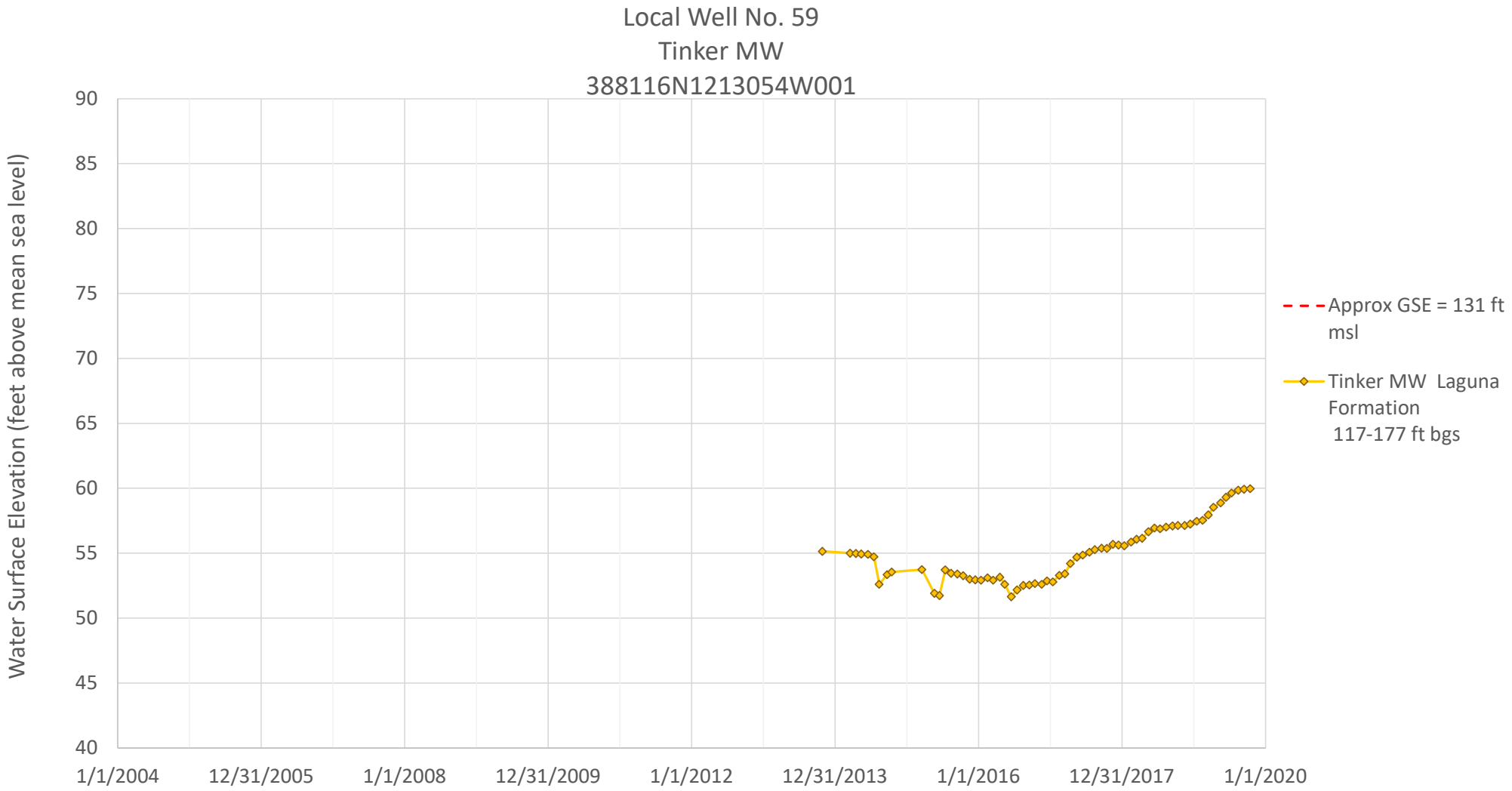

Local Well No.42 & No.43
387512N1212390W001, 387510N1212390W001, 387510N1212390W002
Water Surface Elevation (feet above mean sea level)
240
235
230
225
220
215
210
205
200
195
190
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 229ft msl
WPMW-7A Laguna Formation 35-45 ft bgs
WPMW-8A Laguna Formation 30-50 ft bgs
WPMW-8B Laguna Formation 95-115 ft bgs

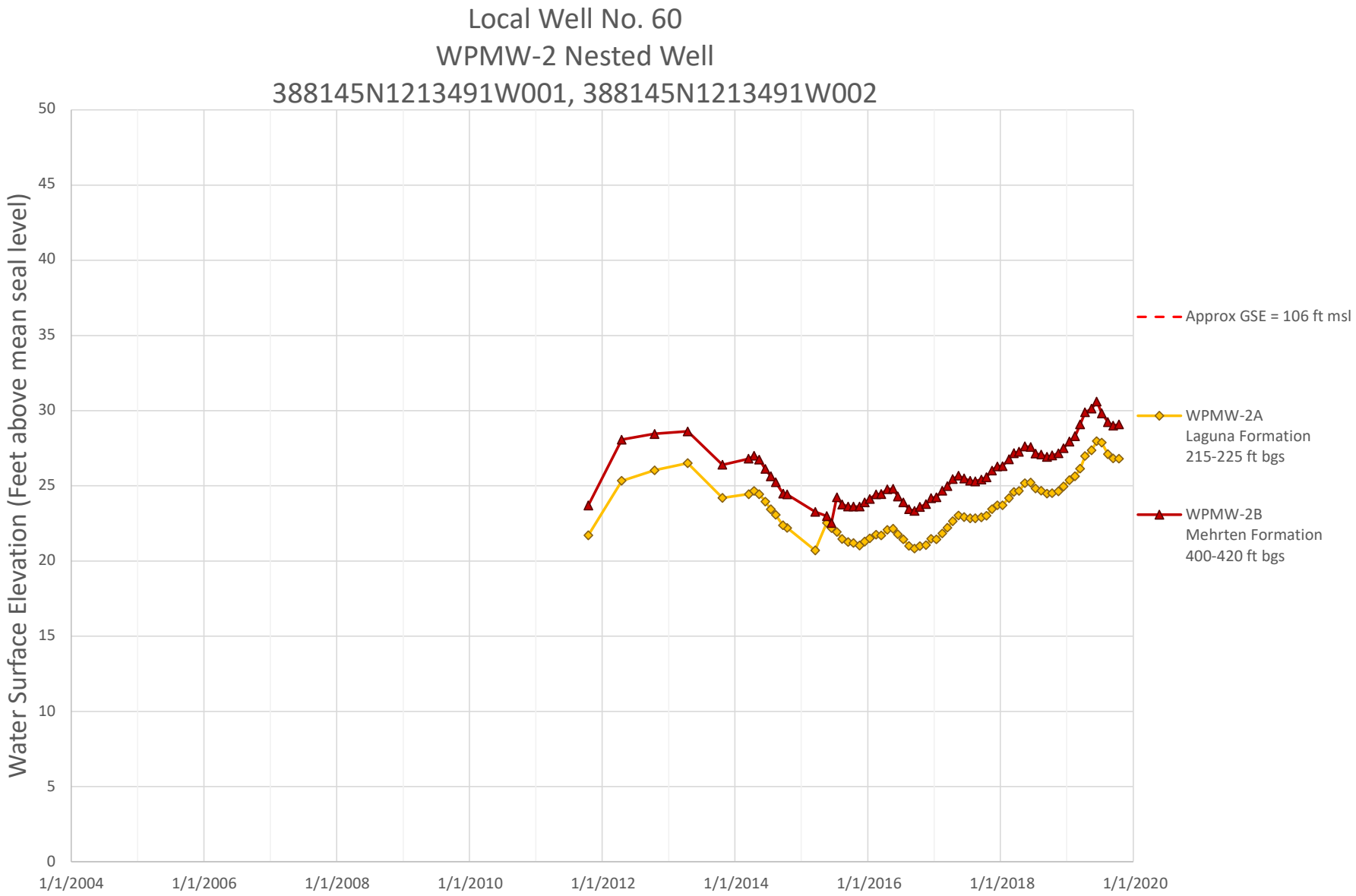

Local Well No. 44 & No. 45
WPMW-10 Nested Well & WPMW-9
387517N1212727W001, 387515N1212725W001, 387515N1212725W002, 387515N1212725W003
Water Surface Elevation (feet above mean sea level)
160
155
150
145
140
135
130
125
120
115
110
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 151ft msl
WPMW-9A Laguna Formation 26-36 ft bgs
WPMW-10A Laguna Formation 26-36 ft bgs
WPMW-10B Laguna Formation 80-100 ft bgs
WPMW-10C Mehrten Formation 240-260 ft bgs

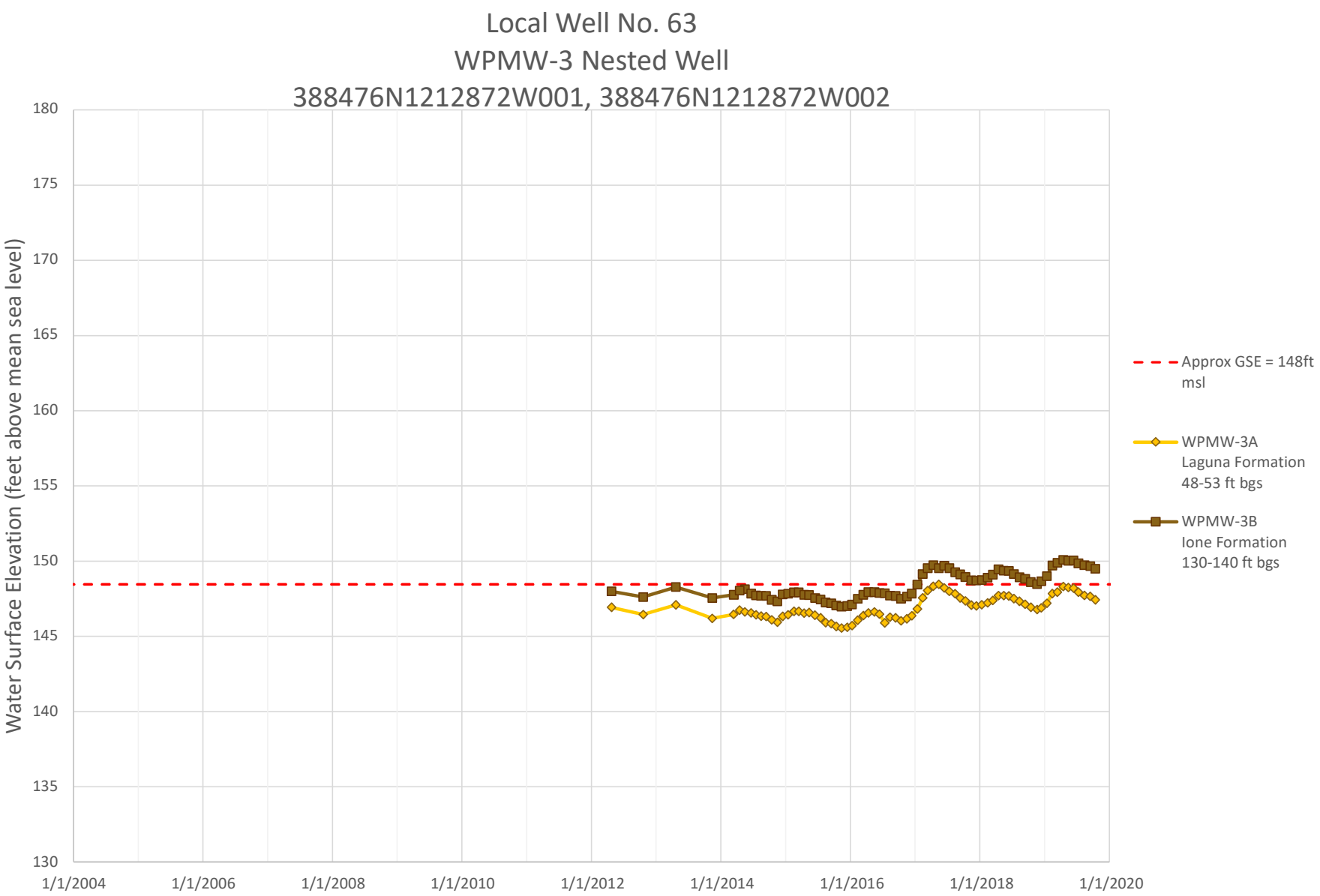

Local Well No. 47
WPMW-6A
387739N1212382W001
Water Surface Elevation (feet above mean sea level)
230
225
220
215
210
205
200
195
190
185
180
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 205.11 ft msl
WPMW-6A
Formation
Laguna
35-65 ft bgs

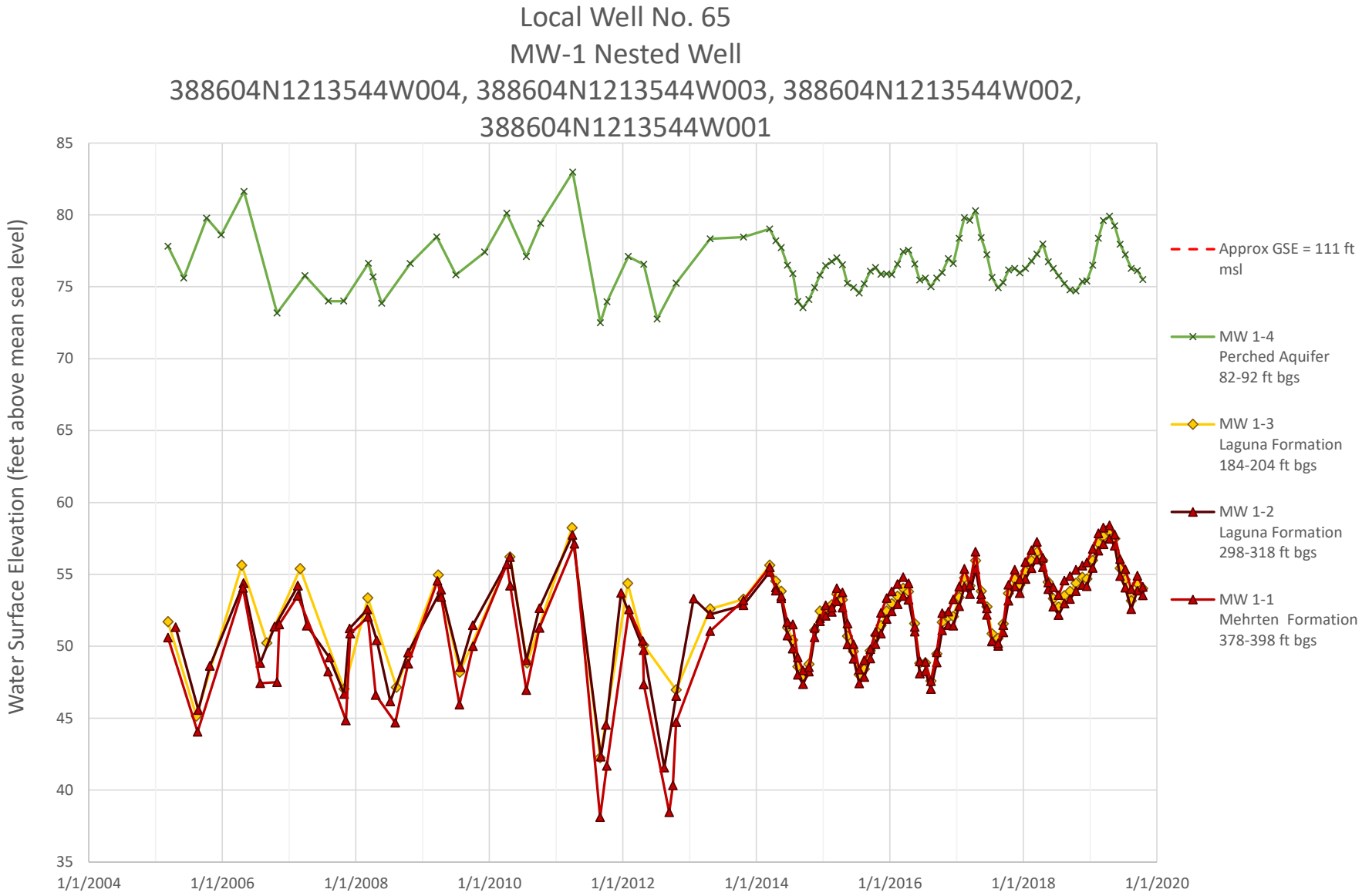

Local Well No. 48
WPMW-4 Nested Well
387755N1212753W001, 387755N1212753W002
Water Surface Elevation (feet above mean sea level)
140
130
120
110
100
90
80
70
60
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Approx GSE = 180ft msl
WPMW-4A
Laguna Formation
120-140 ft bgs
WPMW-4B
Ione Formation
275-295 ft bgs

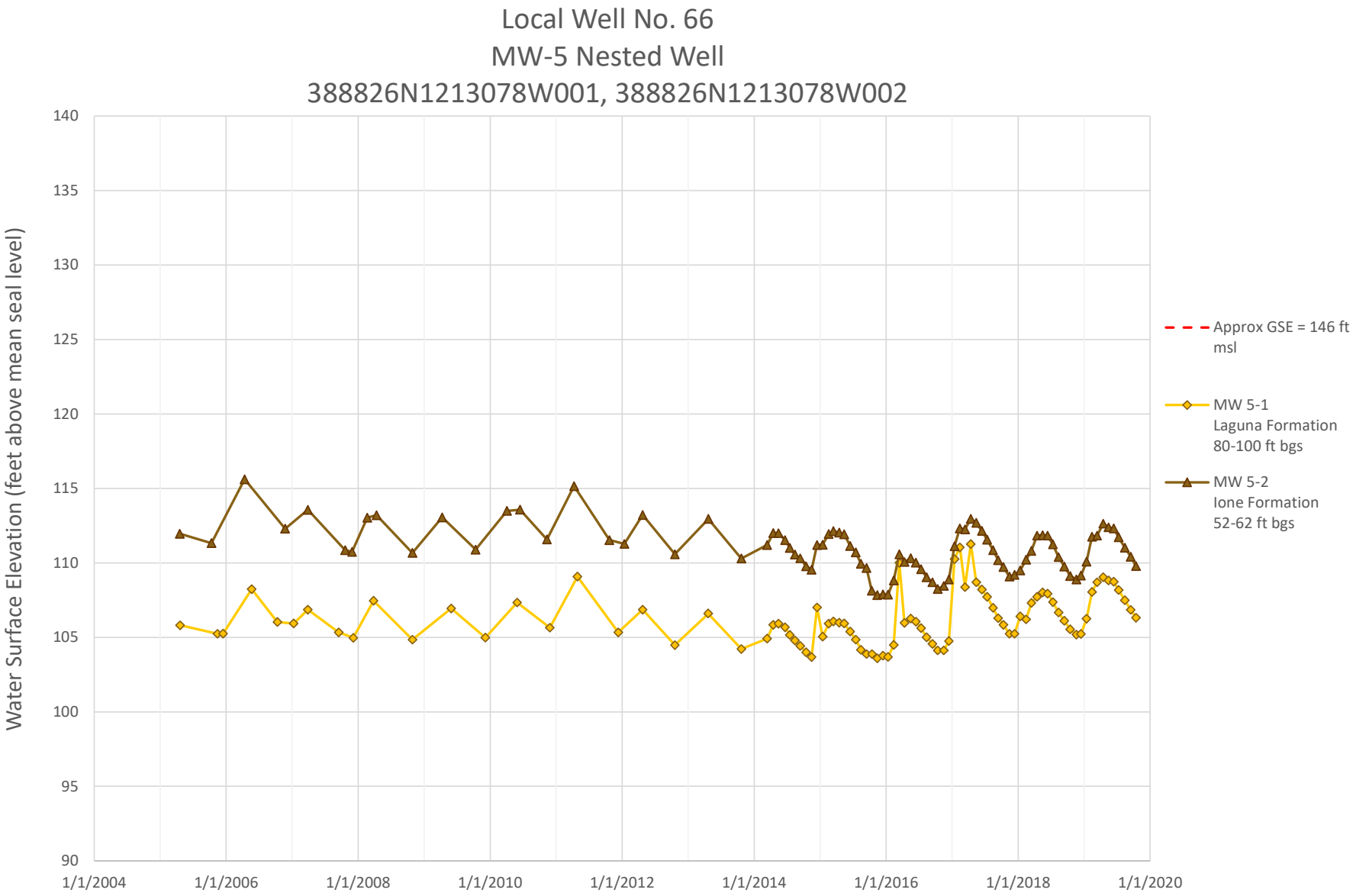

Local Well No. 57, No. 58, & No. 56
DCMW-1, DCMW-2, & DCMW-3
388063N1213354W001, 388058N1213355W001, 388027N1213384W001
Water Surface Elevation (feet above mean sea level)
100
90
80
70
60
50
40
30
20
10
0
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y axis is different than on other plots.
Approx GSE = 111ft msl
DCMW-2
Mehrten Formation
322-432 ft bgs
DCMW-1
Mehrten Formation
320-450 ft bgs
DCMW-3
Mehrten Formation
400-515 ft bgs

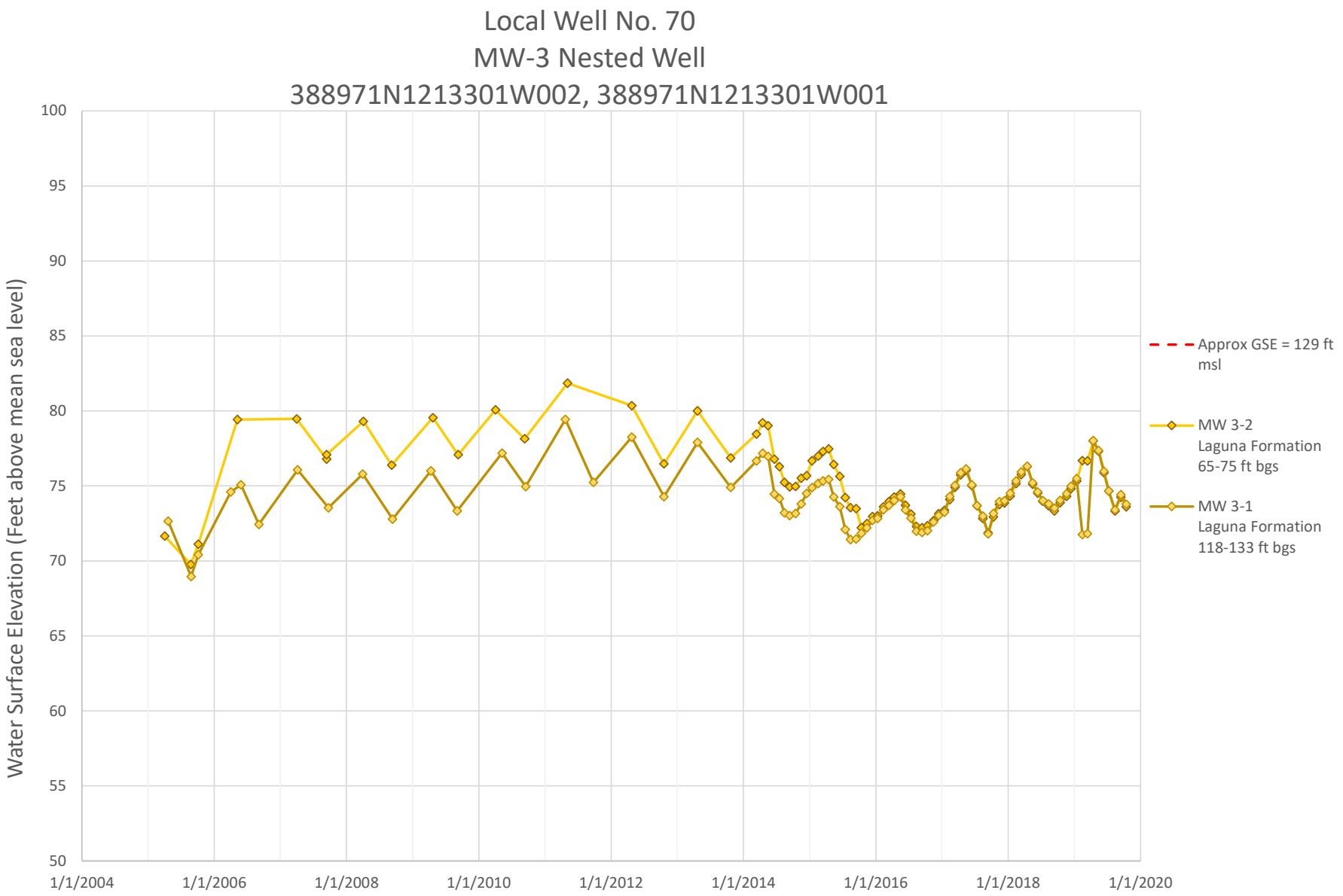

Local Well No. 59
Tinker MW
388116N1213054W001
Water Surface Elevation (feet above mean sea level)
90
85
80
75
70
65
60
55
50
45
40
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 131 ft msl
Tinker MW Laguna Formation
117-177 ft bgs

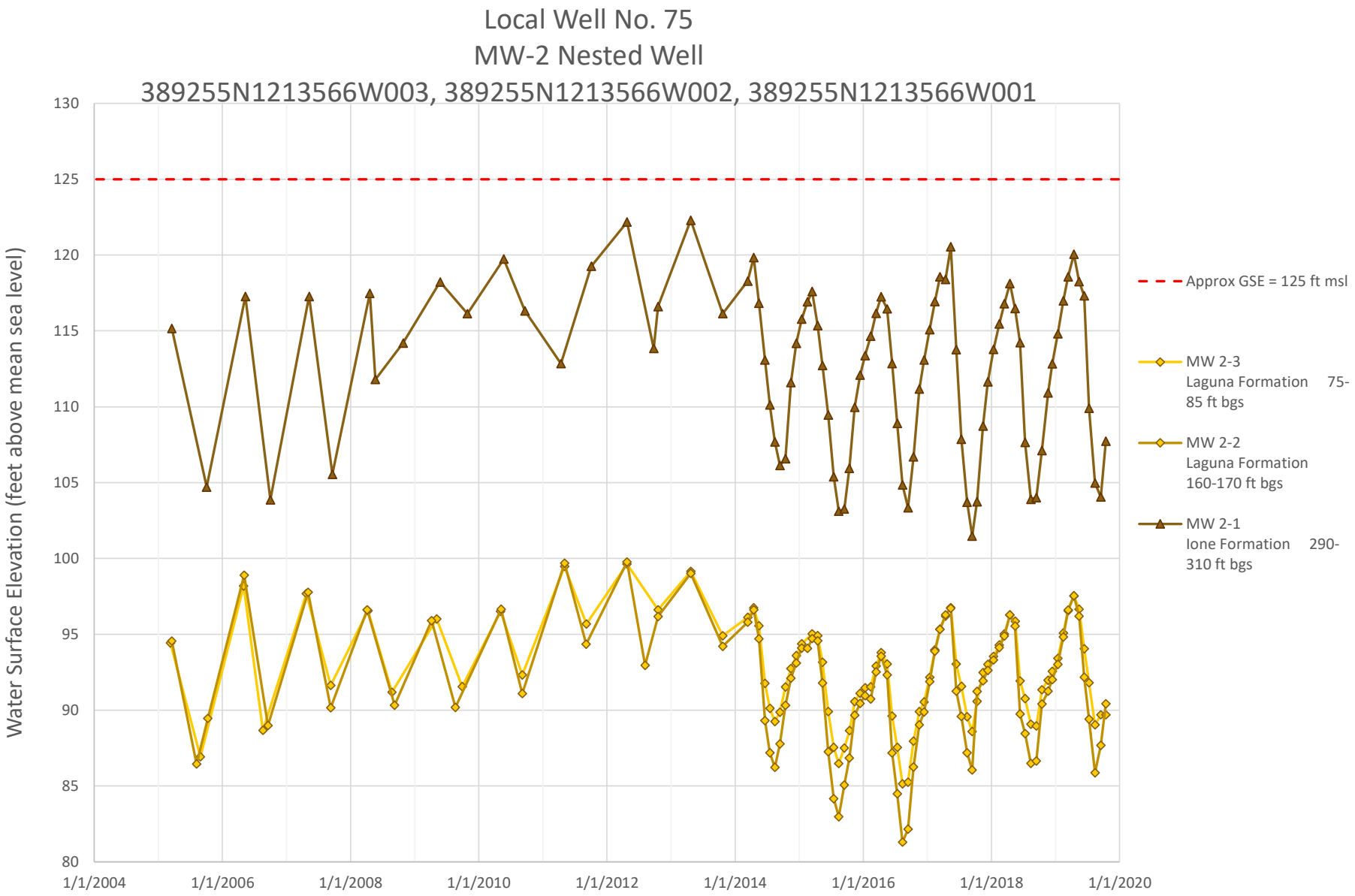

Local Well No. 60
WPMW-2 Nested Well
388145N1213491W001, 388145N1213491W002
Water Surface Elevation (Feet above mean seal level)
50
45
40
35
30
25
20
15
10
5
0
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 106 ft msl
WPMW-2A
Laguna Formation
215-225 ft bgs
WPMW-2B
Mehrten Formation
400-420 ft bgs

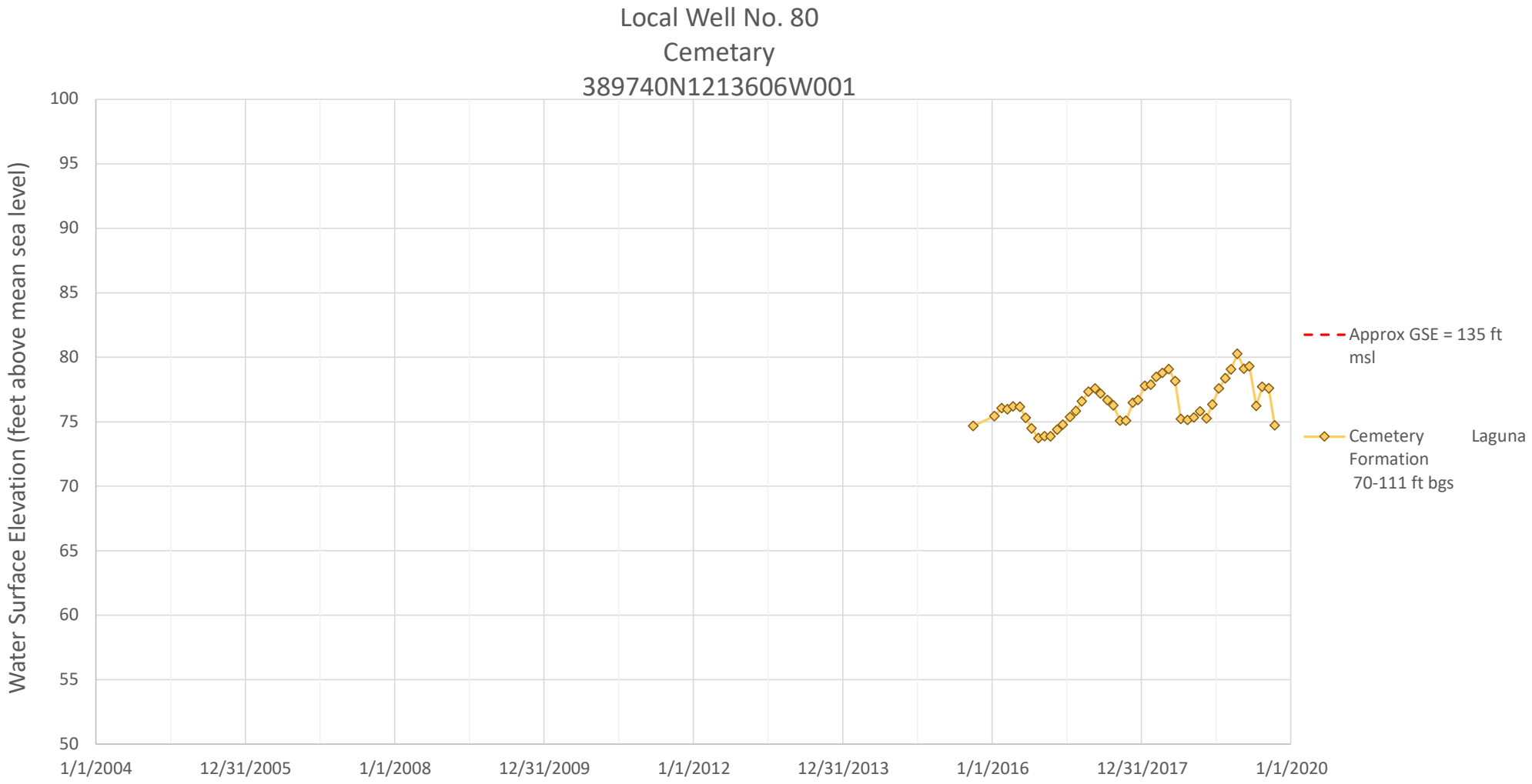

Local Well No. 63
WPMW-3 Nested Well
388476N1212872W001, 388476N1212872W002
Water Surface Elevation (feet above mean sea level)
180
175
170
165
160
155
150
145
140
135
130
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 148ft msl
WPMW-3A Laguna Formation 48-53 ft bgs
WPMW-3B Ione Formation 130-140 ft bgs

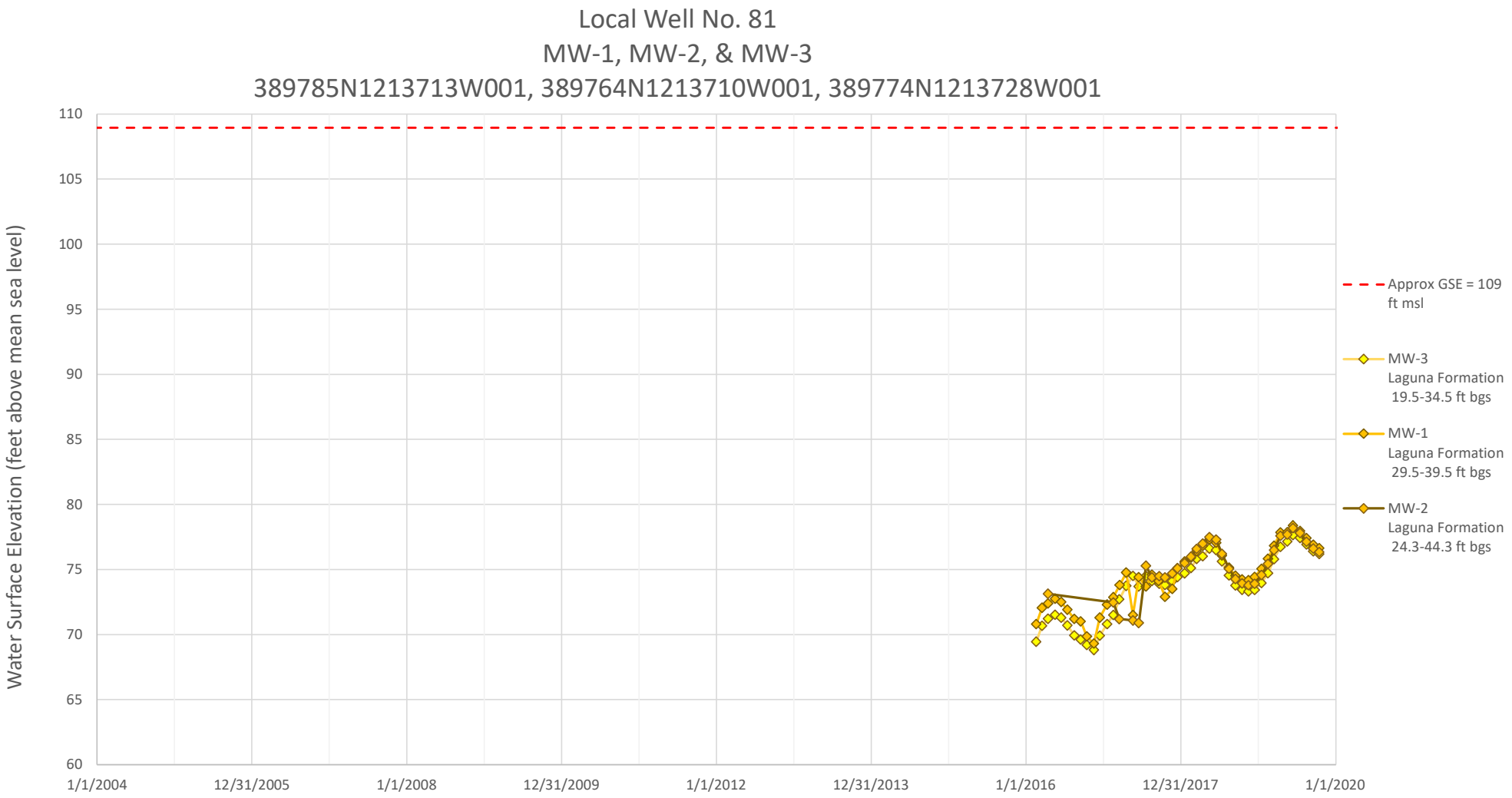

Local Well No. 65
MW-1 Nested Well
388604N1213544W004, 388604N1213544W003, 388604N1213544W002,
388604N1213544W001
Water Surface Elevation (feet above mean sea level)
85
80
75
70
65
60
55
50
45
40
35
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 111 ft msl
MW 1-4
Perched Aquifer
82-92 ft bgs
MW 1-3
Laguna Formation
184-204 ft bgs
MW 1-2
Laguna Formation
298-318 ft bgs
MW 1-1
Mehrten Formation
378-398 ft bgs

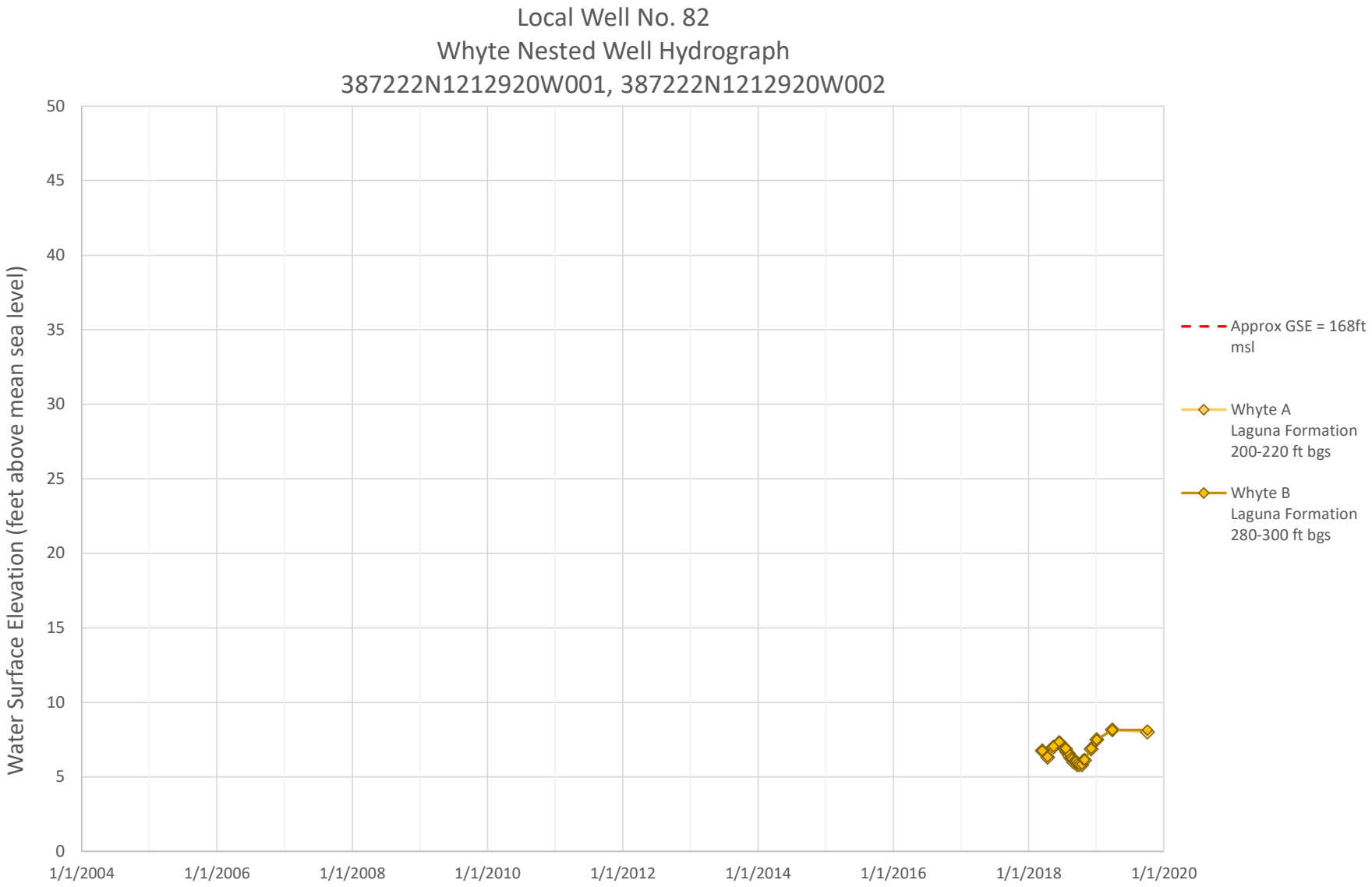

Local Well No. 66
MW-5 Nested Well
388826N1213078W001, 388826N1213078W002
Water Surface Elevation (feet above mean seal level)
140
135
130
125
120
115
110
105
100
95
90
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 146 ft msl
MW 5-1
Laguna Formation
80-100 ft bgs
MW 5-2
Ione Formation
52-62 ft bgs


Local Well No. 70
MW-3 Nested Well
388971N1213301W002, 388971N1213301W001
Water Surface Elevation (Feet above mean sea level)
100
95
90
85
80
75
70
65
60
55
50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 129 ft msl
MW 3-2
Laguna Formation
65-75 ft bgs
MW 3-1
Laguna Formation
118-133 ft bgs

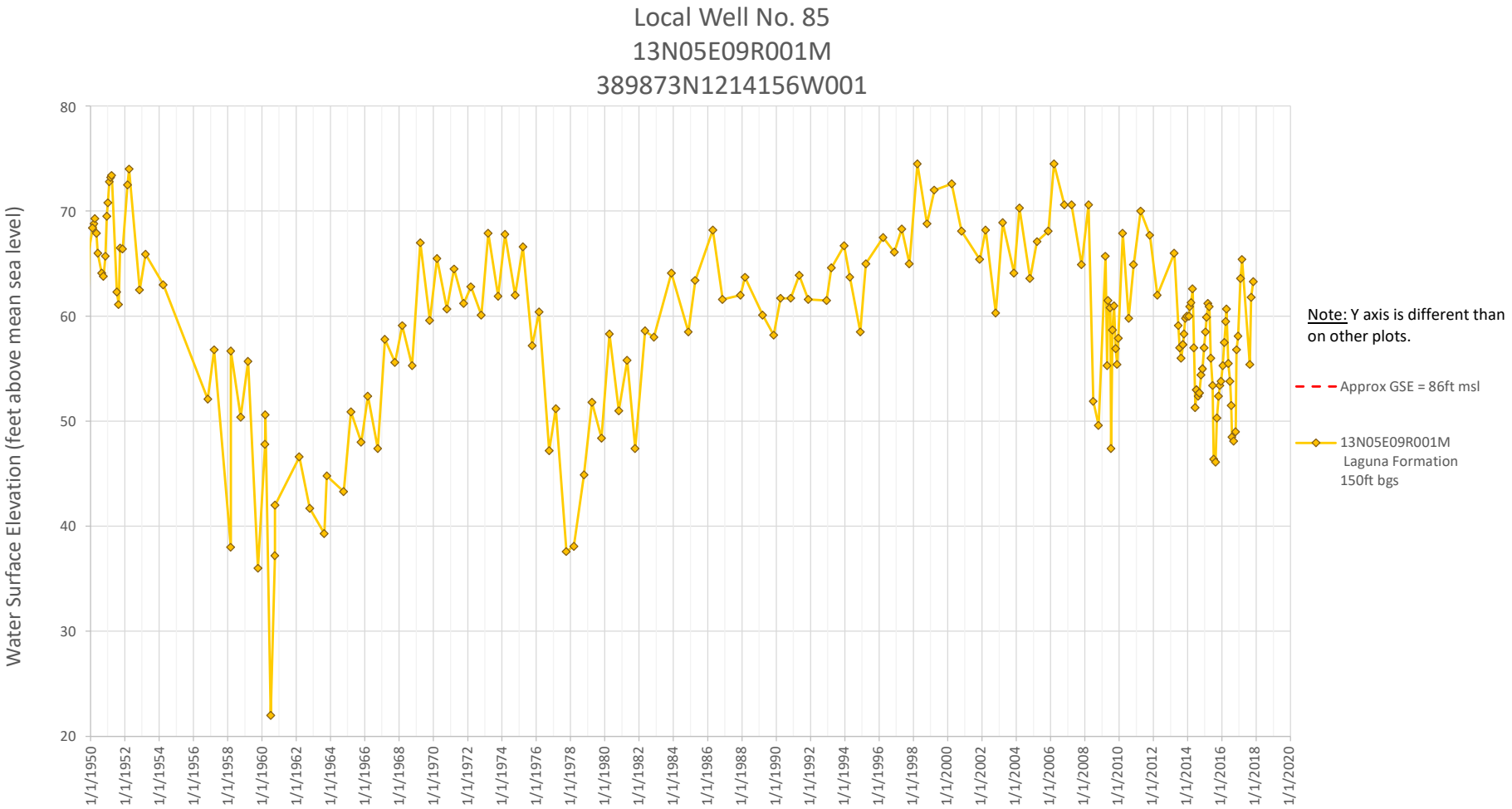

Local Well No. 75
MW-2 Nested Well
389255N1213566W003, 389255N1213566W002, 389255N1213566W001
Water Surface Elevation (feet above mean sea level)
130
125
120
115
110
105
100
95
90
85
80
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 125 ft msl
MW 2-3
Laguna Formation 75-85 ft bgs
MW 2-2
Laguna Formation
160-170 ft bgs
MW 2-1
Ione Formation 290-310 ft bgs


Local Well No. 80
Cemetary
389740N1213606W001
Water Surface Elevation (feet above mean sea level)
100
95
90
85
80
75
70
65
60
55
50
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 135 ft msl
Cemetery Laguna Formation 70-111 ft bgs


Local Well No. 81
MW-1, MW-2, & MW-3
389785N1213713W001, 389764N1213710W001, 389774N1213728W001
Water Surface Elevation (feet above mean sea level)
110
105
100
95
90
85
80
75
70
65
60
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 109 ft msl
MW-3 Laguna Formation 19.5-34.5 ft bgs
MW-1 Laguna Formation 29.5-39.5 ft bgs
MW-2 Laguna Formation 24.3-44.3 ft bgs


Local Well No. 82
Whyte Nested Well Hydrograph
387222N1212920W001, 387222N1212920W002
Water Surface Elevation (feet above mean sea level)
50
45
40
35
30
25
20
15
10
5
0
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 168ft msl
Whyte A
Laguna Formation
200-220 ft bgs
Whyte B
Laguna Formation
280-300 ft bgs


Local Well No. 84
Spencer
389867N1213654W002
Water Surface Elevation (feet above mean sea level)
100
95
90
85
80
75
70
65
60
55
50
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 134 ft msl
Spencer Laguna Formation 96-107 ft bgs


Local Well No. 85
13N05E09R001M
389873N1214156W001
Water Surface Elevation (feet above mean sea level)
80
70
60
50
40
30
20
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y axis is different than on other plots.
Approx GSE = 86ft msl
13N05E09R001M
Laguna Formation
150ft bgs

Appendix J: Vertical Gradients

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX J
Vertical Gradient Hydrographs

December 2021

APPENDIX J

VERTICAL GRADIENTS
HYDROGRAPHS

LEGEND:

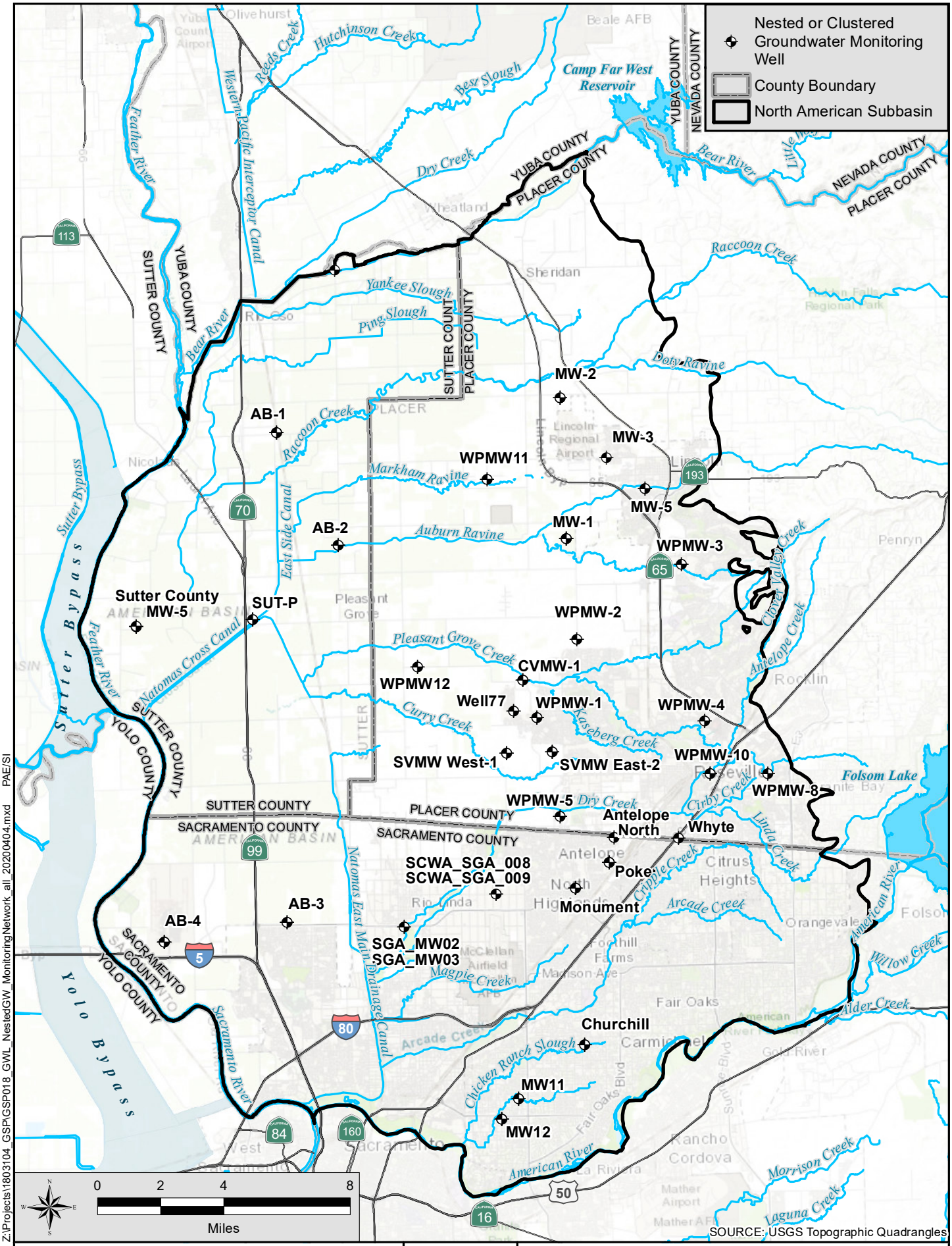


Laguna Formation Wells
Mehrten Formation Wells
Ione or Central Valley Fm. Wells

Short Term Hydrographs

Years Displayed	2004 to 2019
	Unless otherwise noted
Vertical Axis	50 feet
	Unless otherwise noted

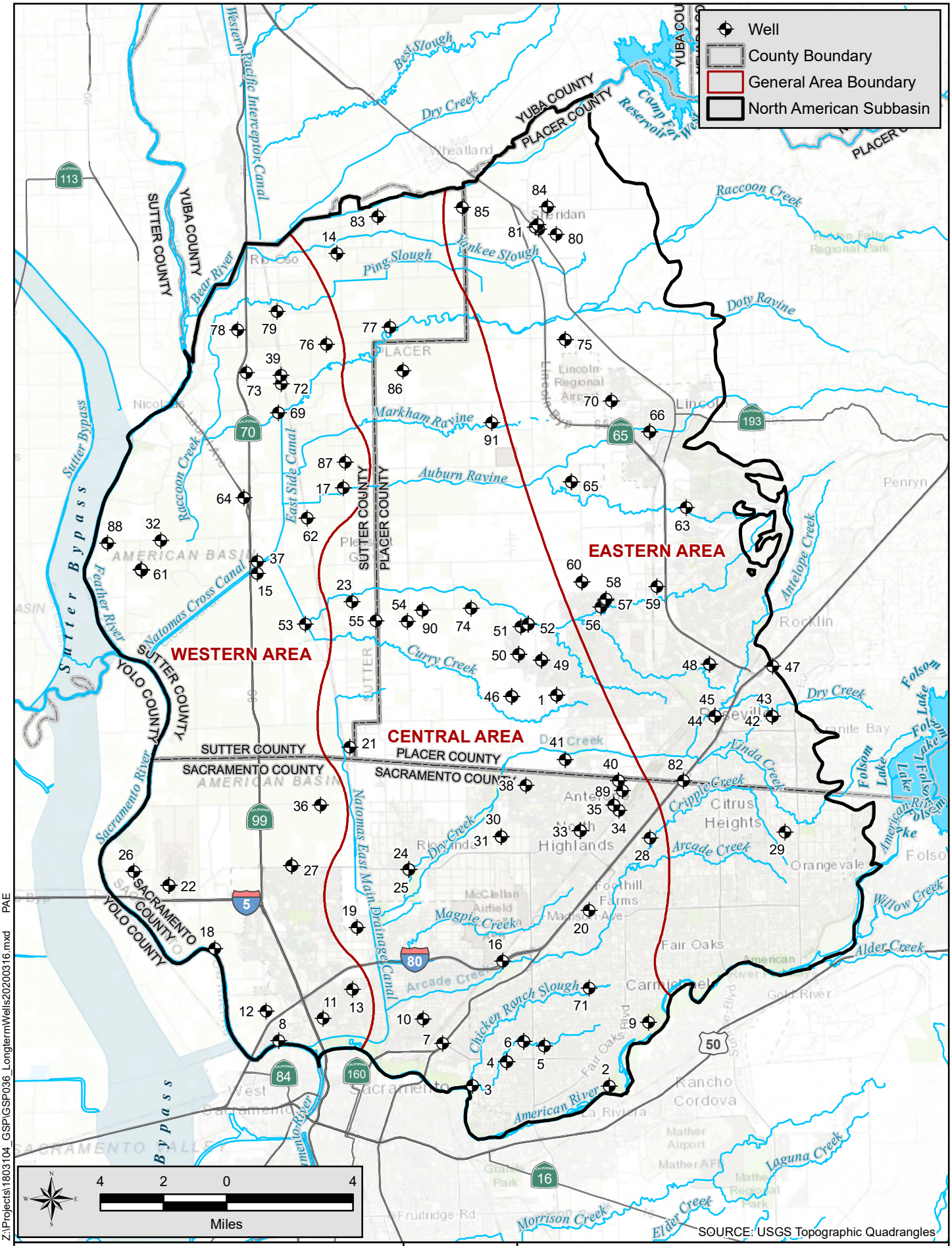
Groundwater levels from multiple aquifers shown



Z:\Projects\1803104_GSP\GSP018_GWL_NestedGW_MonitoringNetwork_all_20200404.mxd PAE/SI

04-Apr-2020

North American Subbasin Sutter, Placer and Sacramento Counties	GEI Consultants	Nested and Clustered Groundwater Monitoring Wells
North American Subbasin	APRIL 2020	FIGURE 4



Z:\Projects\1803104_GSP\GSP036_LongtermWells20200316.mxd PAE

18-Mar-2020

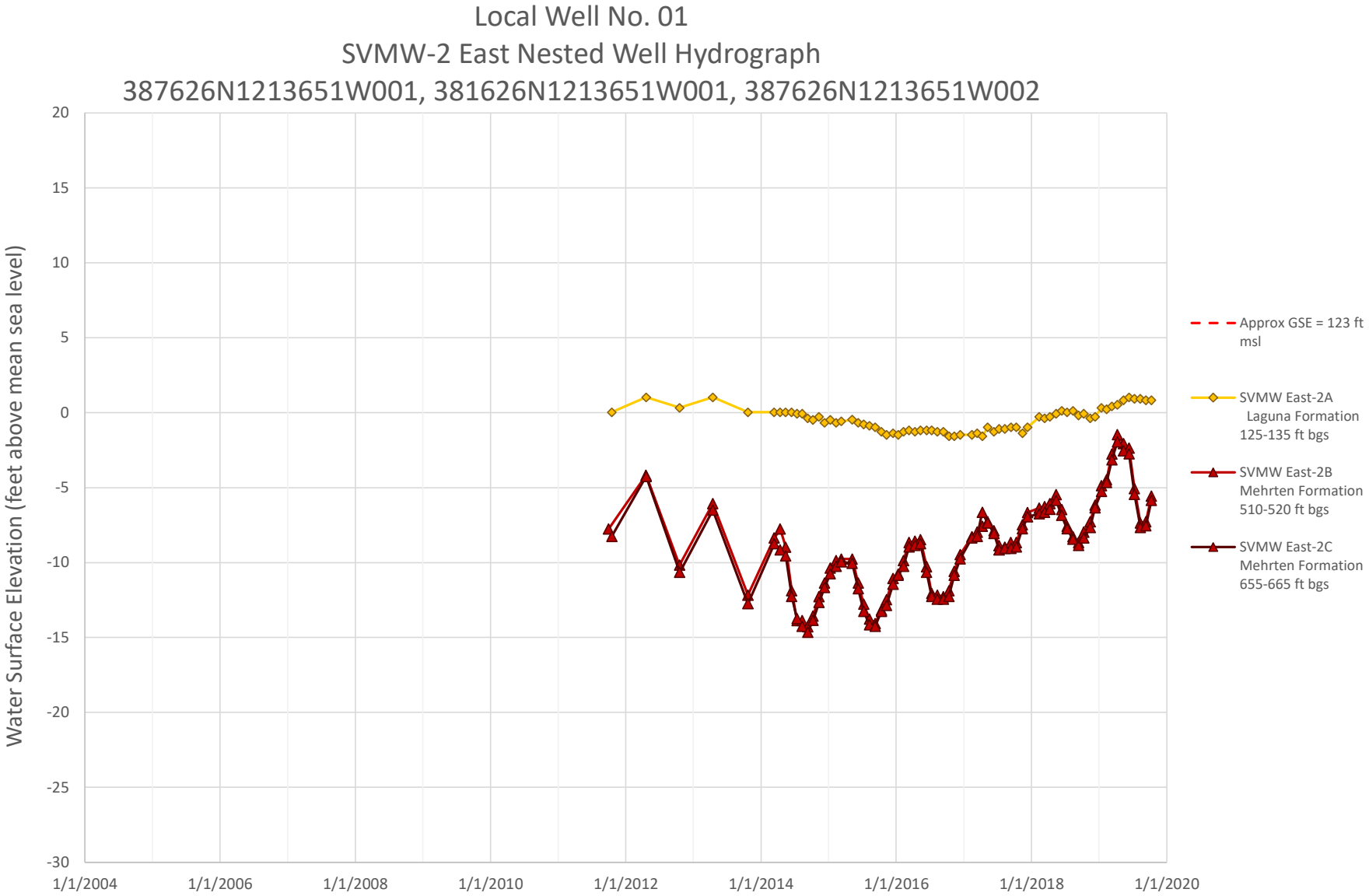
North American Subbasin
Sutter, Placer and Sacramento Counties

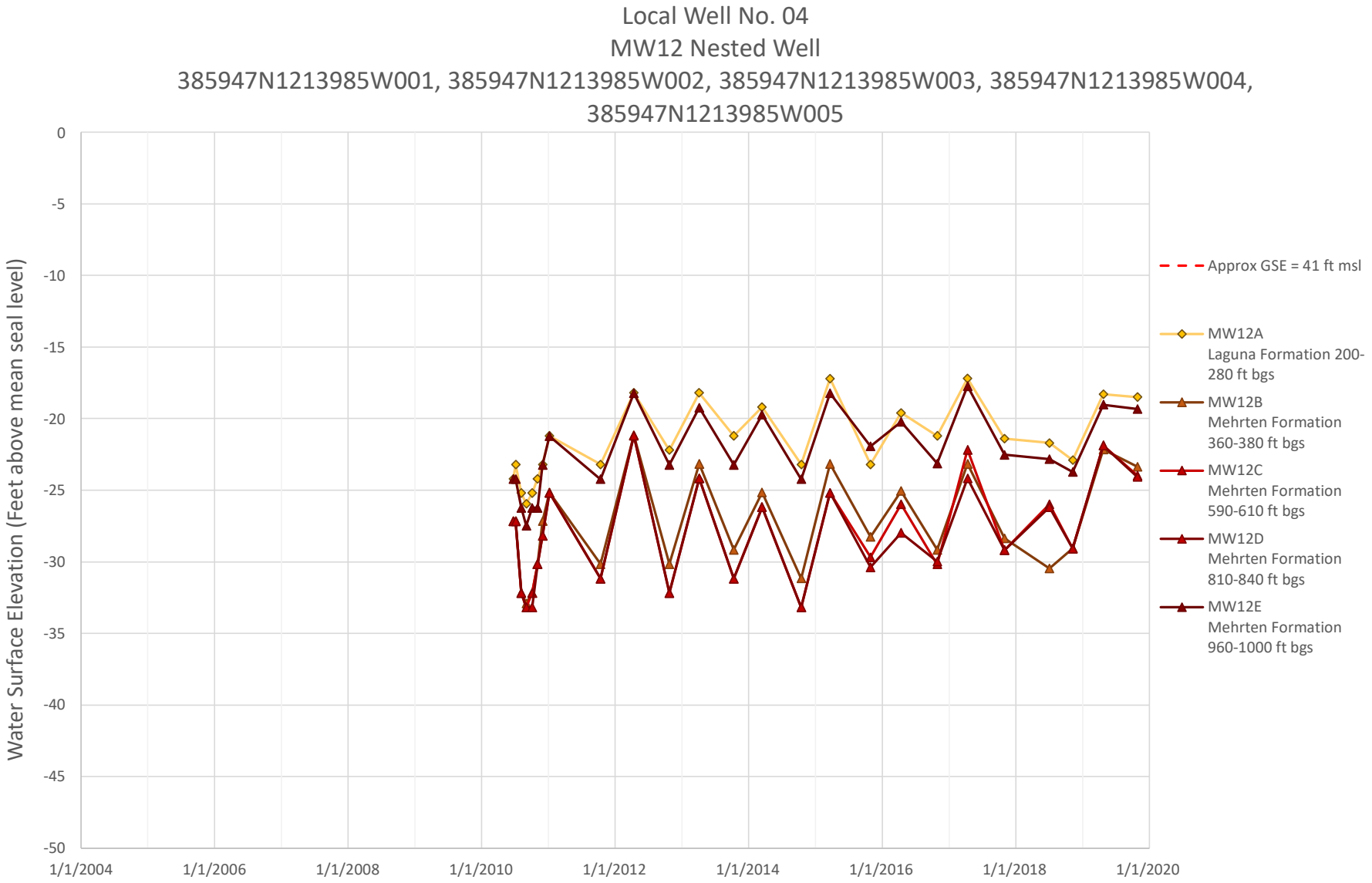
North American Subbasin

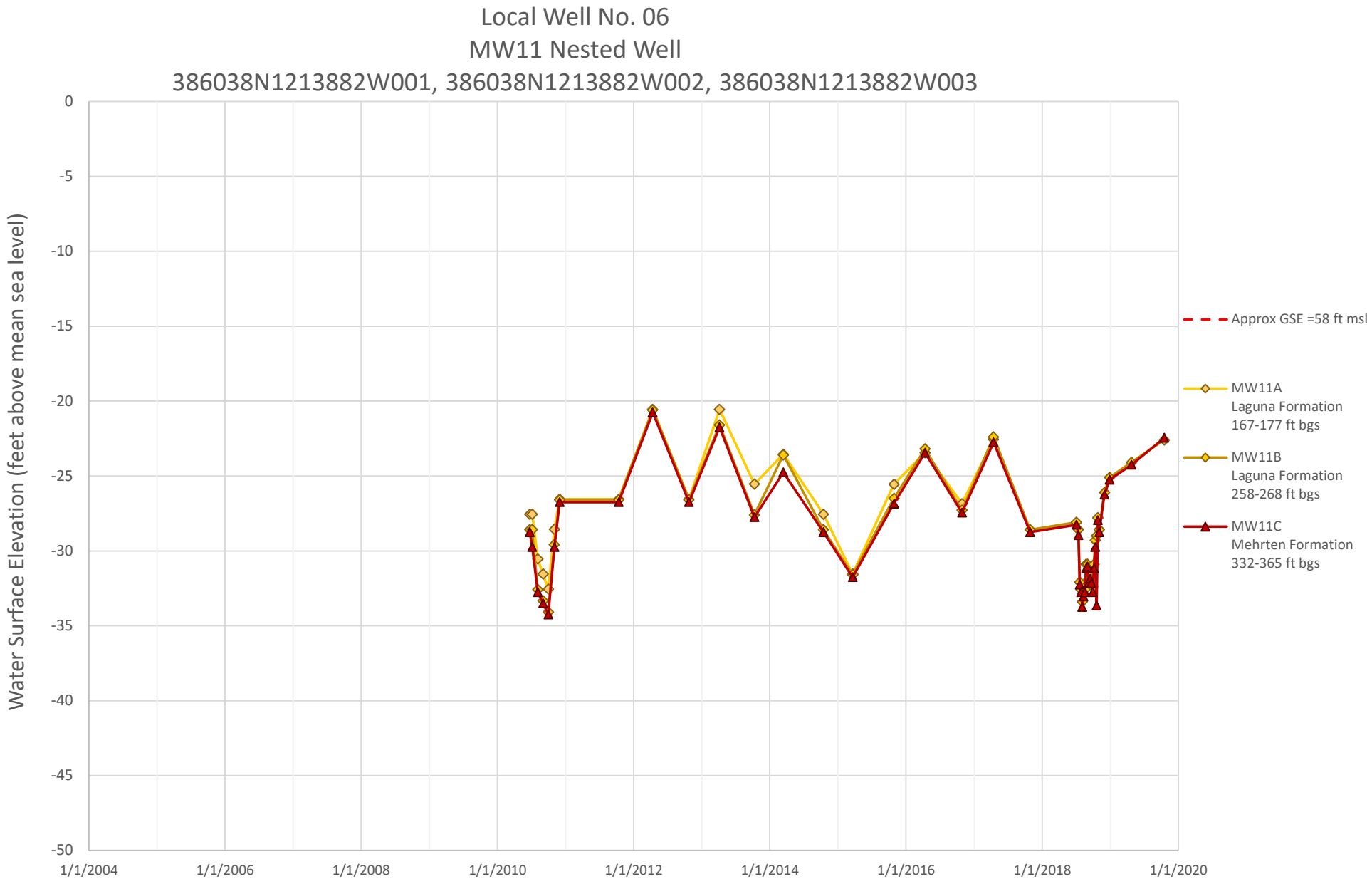
GEI Consultants

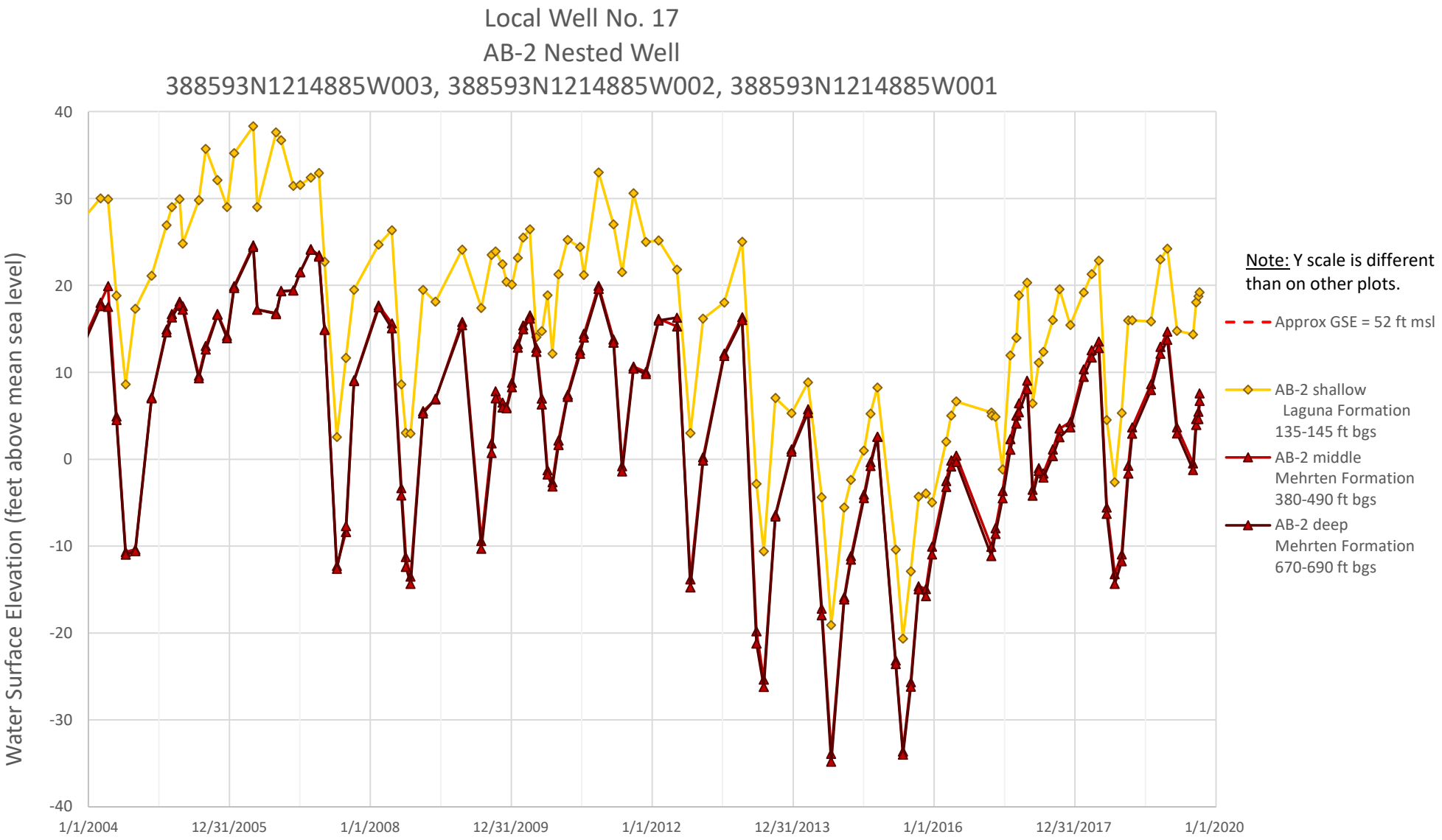
Long Term Wells

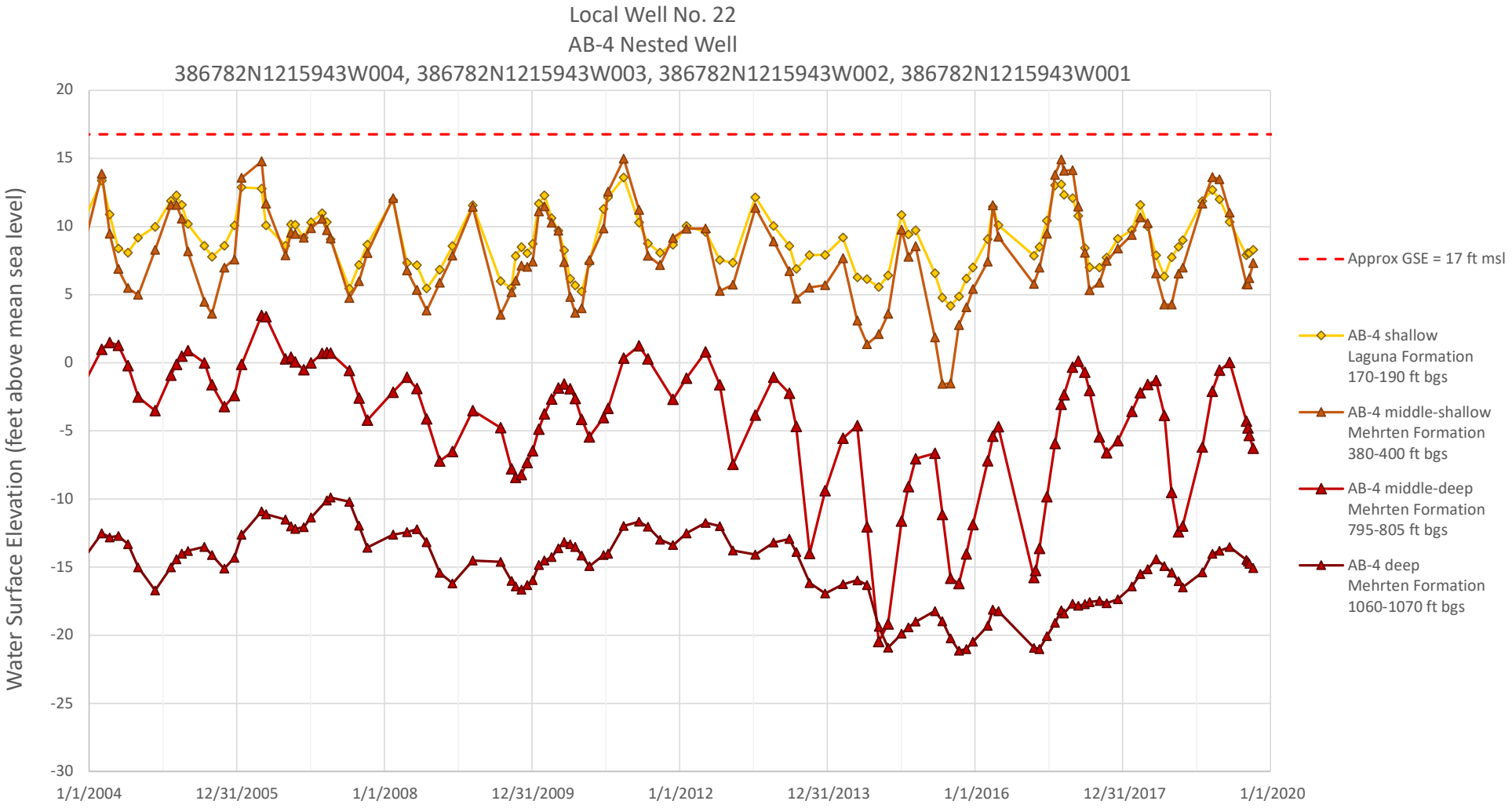
MARCH 2020

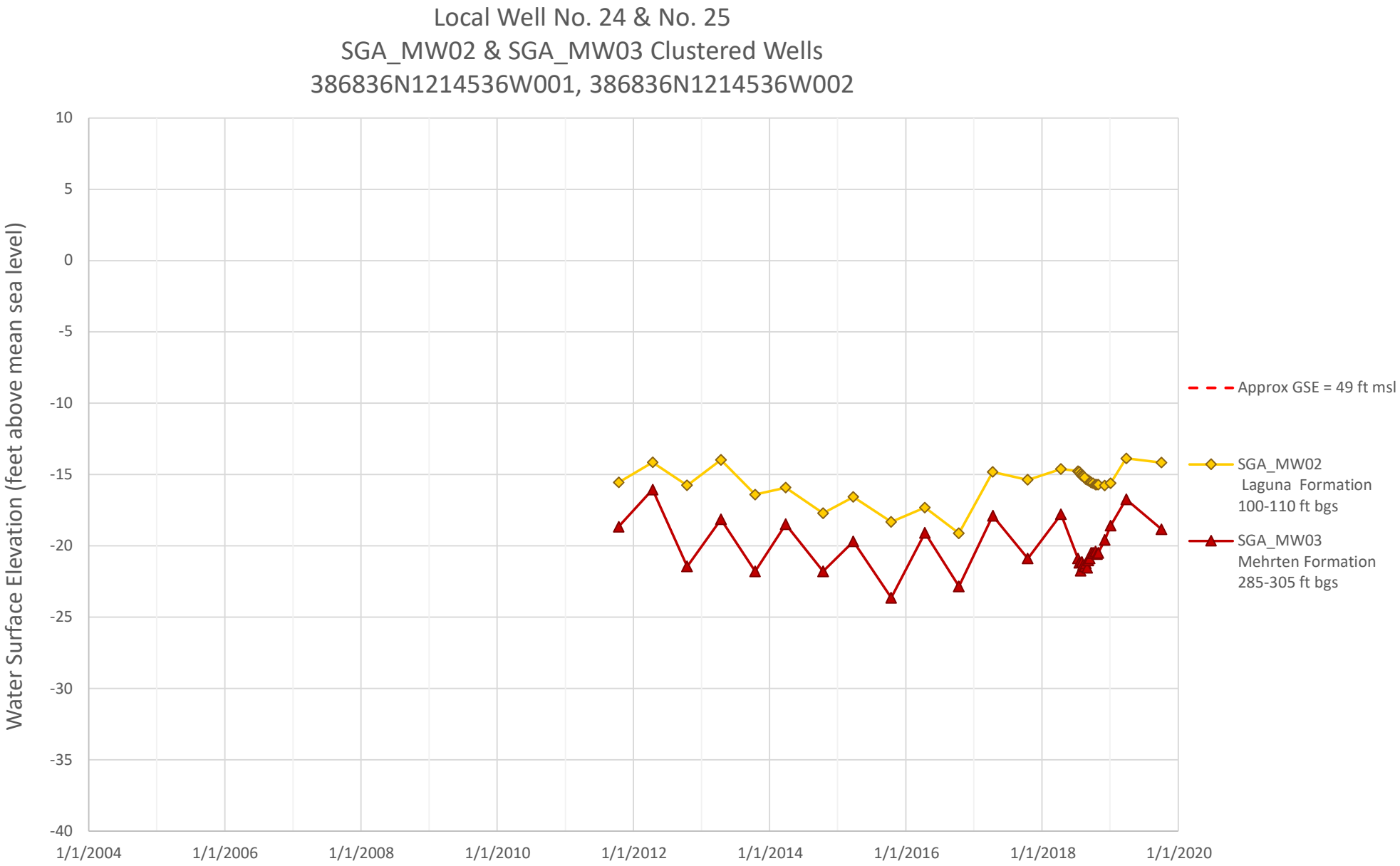

Local Well No. 01
SVMW-2 East Nested Well Hydrograph
387626N1213651W001, 381626N1213651W001, 387626N1213651W002
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 123 ft msl
SVMW East-2A Laguna Formation 125-135 ft bgs
SVMW East-2B Mehrten Formation 510-520 ft bgs
SVMW East-2C Mehrten Formation 655-665 ft bgs

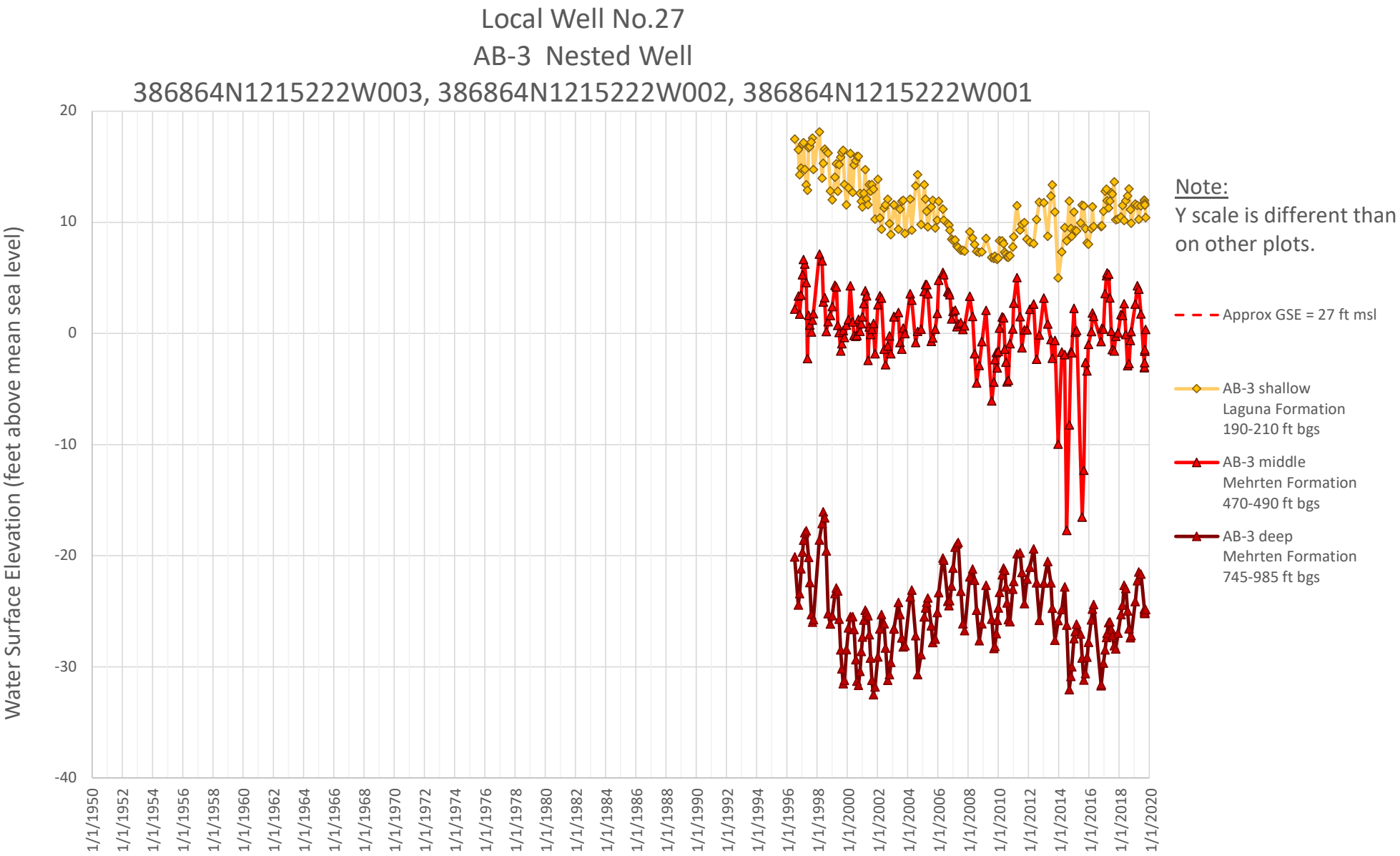

Local Well No. 04
MW12 Nested Well
385947N1213985W001, 385947N1213985W002, 385947N1213985W003, 385947N1213985W004, 385947N1213985W005
Water Surface Elevation (Feet above mean seal level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 41 ft msl
MW12A
Laguna Formation 200-280 ft bgs
MW12B
Mehrten Formation 360-380 ft bgs
MW12C
Mehrten Formation 590-610 ft bgs
MW12D
Mehrten Formation 810-840 ft bgs
MW12E
Mehrten Formation 960-1000 ft bgs

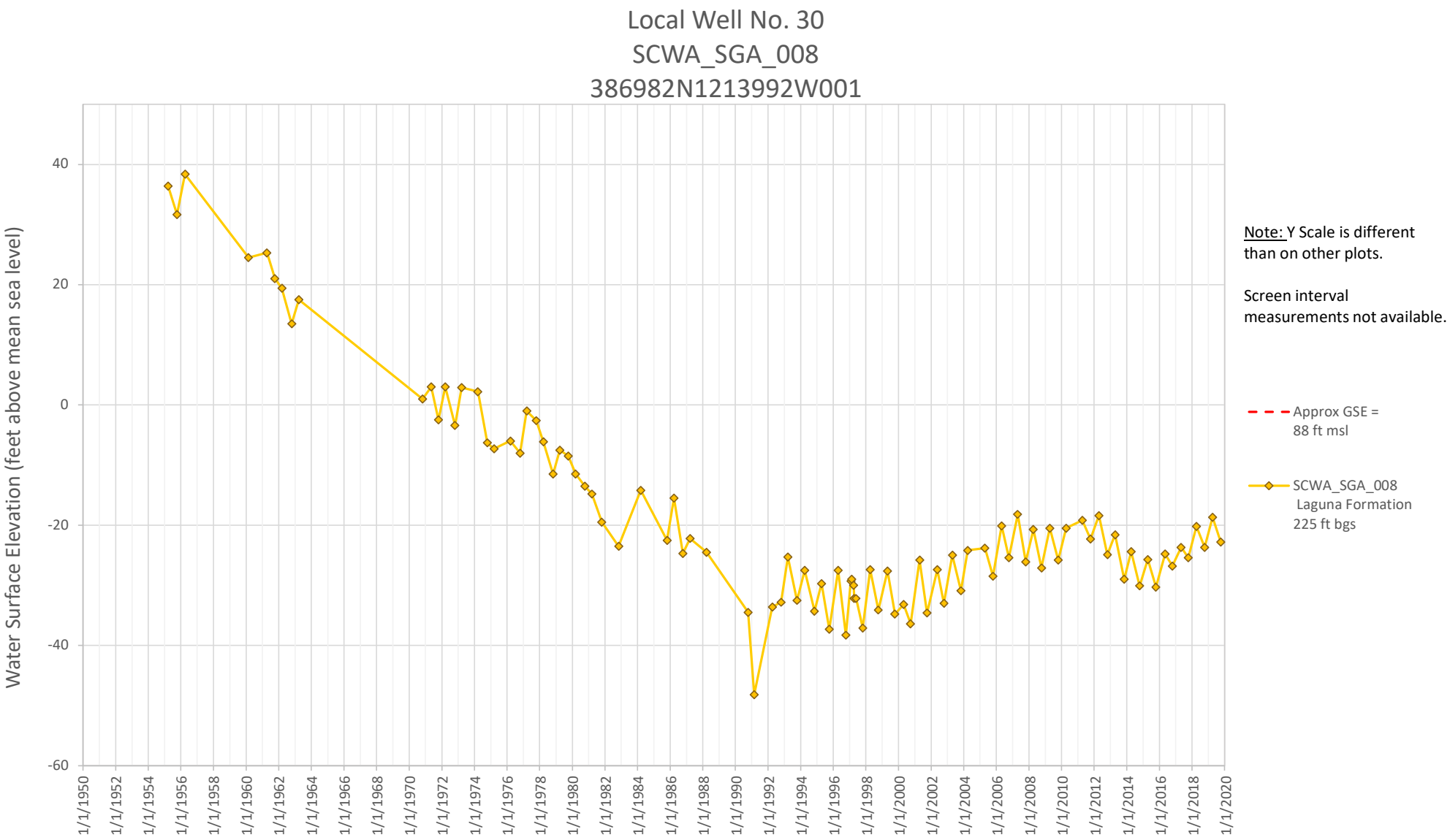

Local Well No. 06
MW11 Nested Well
386038N1213882W001, 386038N1213882W002, 386038N1213882W003
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE =58 ft msl
MW11A
Laguna Formation
167-177 ft bgs
MW11B
Laguna Formation
258-268 ft bgs
MW11C
Mehrten Formation
332-365 ft bgs

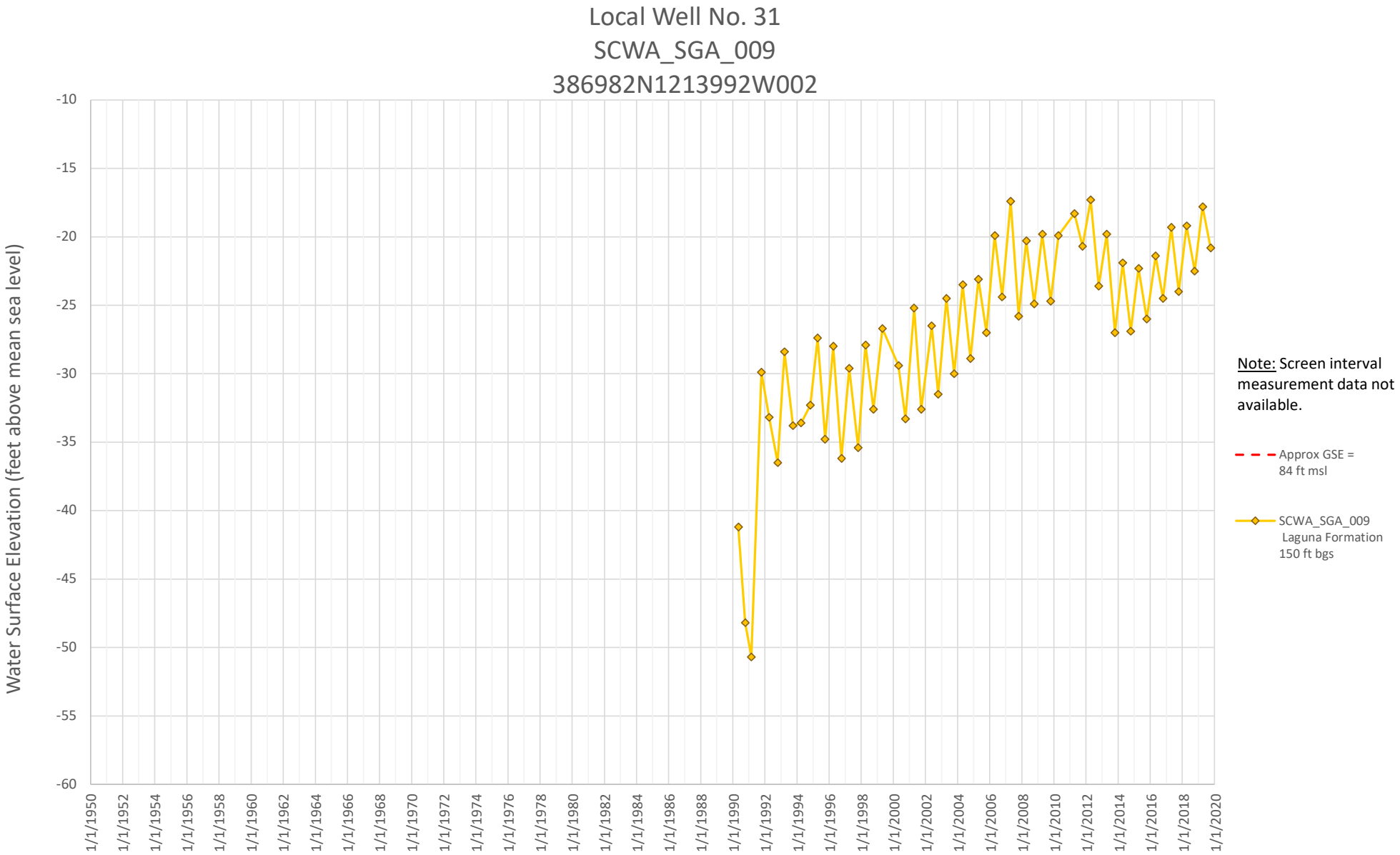

Local Well No. 17
AB-2 Nested Well
388593N1214885W003, 388593N1214885W002, 388593N1214885W001
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
-30
-40
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Note: Y scale is different than on other plots.
Approx GSE = 52 ft msl
AB-2 shallow
Laguna Formation
135-145 ft bgs
AB-2 middle
Mehrten Formation
380-490 ft bgs
AB-2 deep
Mehrten Formation
670-690 ft bgs


Local Well No. 22
AB-4 Nested Well
386782N1215943W004, 386782N1215943W003, 386782N1215943W002, 386782N1215943W001
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 17 ft msl
AB-4 shallow
Laguna Formation
170-190 ft bgs
AB-4 middle-shallow
Mehrten Formation
380-400 ft bgs
AB-4 middle-deep
Mehrten Formation
795-805 ft bgs
AB-4 deep
Mehrten Formation
1060-1070 ft bgs

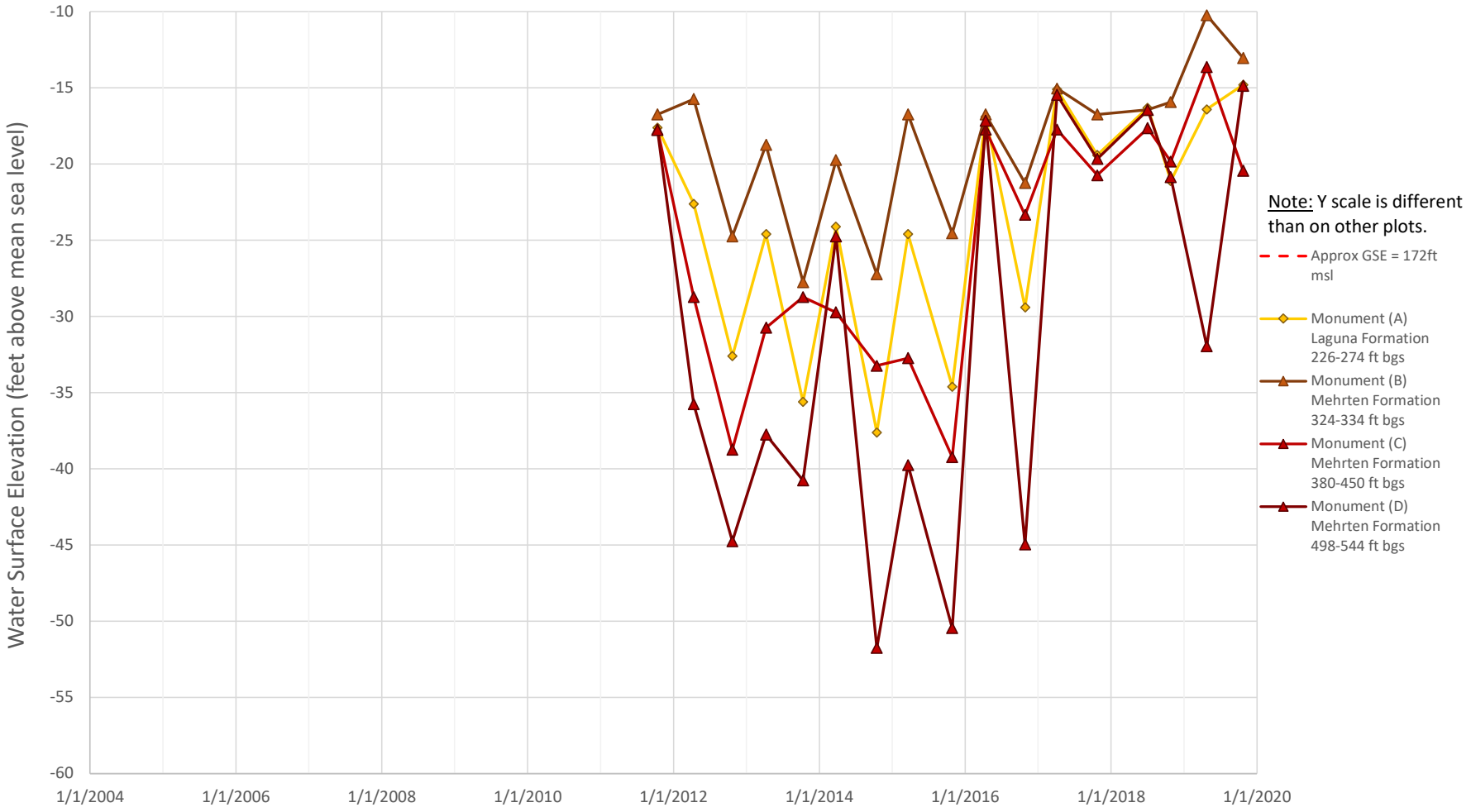

Local Well No. 24 & No. 25
SGA_MW02 & SGA_MW03 Clustered Wells
386836N1214536W001, 386836N1214536W002
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 49 ft msl
SGA_MW02
Laguna Formation
100-110 ft bgs
SGA_MW03
Mehrten Formation
285-305 ft bgs


Local Well No.27
AB-3 Nested Well
386864N1215222W003, 386864N1215222W002, 386864N1215222W001
Water Surface Elevation (feet above mean sea level)
20
10
0
-10
-20
-30
-40
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note:
Y scale is different than on other plots.
Approx GSE = 27 ft msl
AB-3 shallow
Laguna Formation
190-210 ft bgs
AB-3 middle
Mehrten Formation
470-490 ft bgs
AB-3 deep
Mehrten Formation
745-985 ft bgs

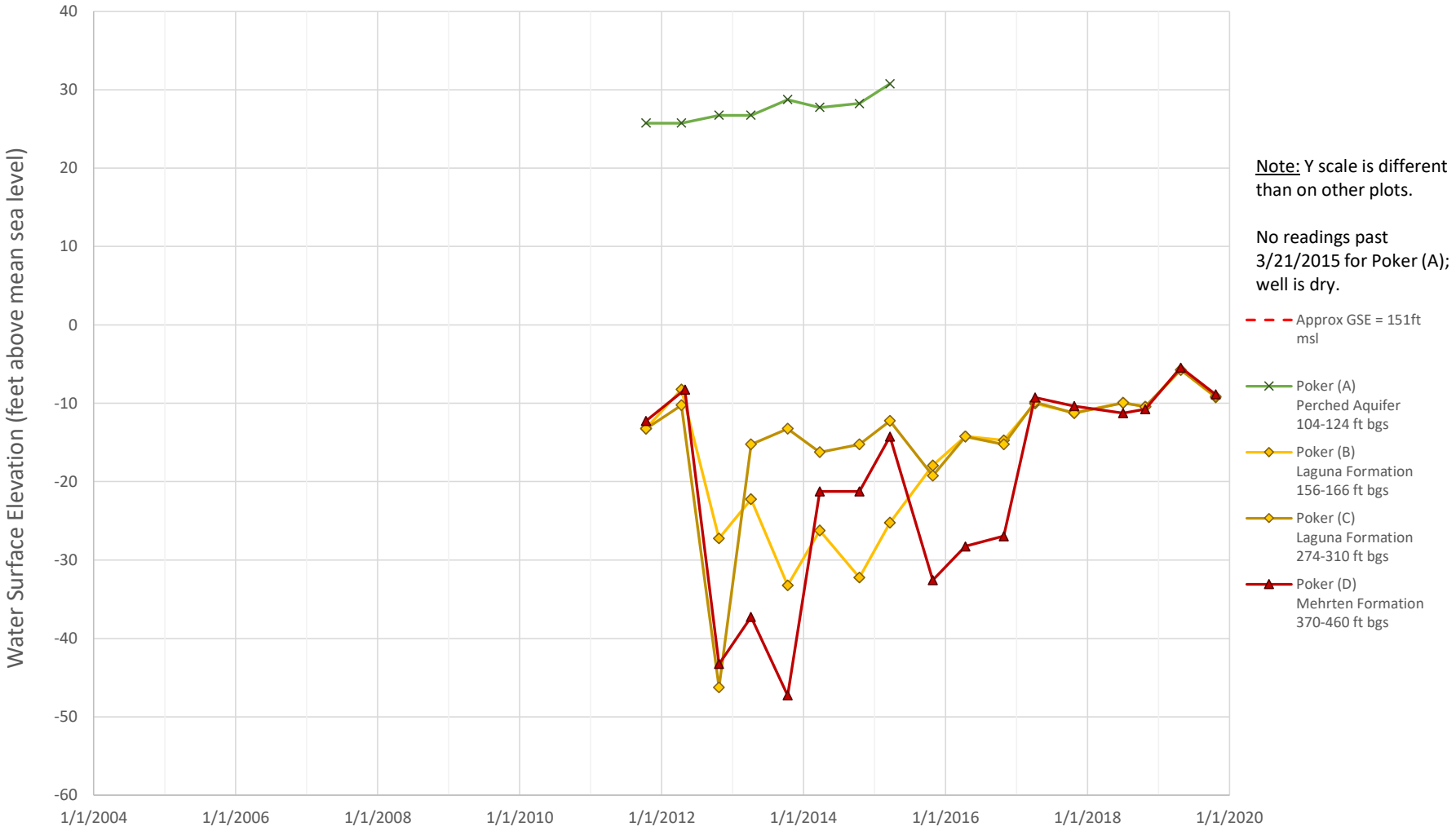

Local Well No. 30
SCWA_SGA_008
386982N1213992W001
Water Surface Elevation (feet above mean sea level)
40
20
0
-20
-40
-60
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y Scale is different than on other plots.
Screen interval measurements not available.
Approx GSE = 88 ft msl
SCWA_SGA_008
Laguna Formation
225 ft bgs


Local Well No. 31
SCWA_SGA_009
386982N1213992W002
Water Surface Elevation (feet above mean sea level)
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Screen interval measurement data not available.
Approx GSE = 84 ft msl
SCWA_SGA_009 Laguna Formation 150 ft bgs

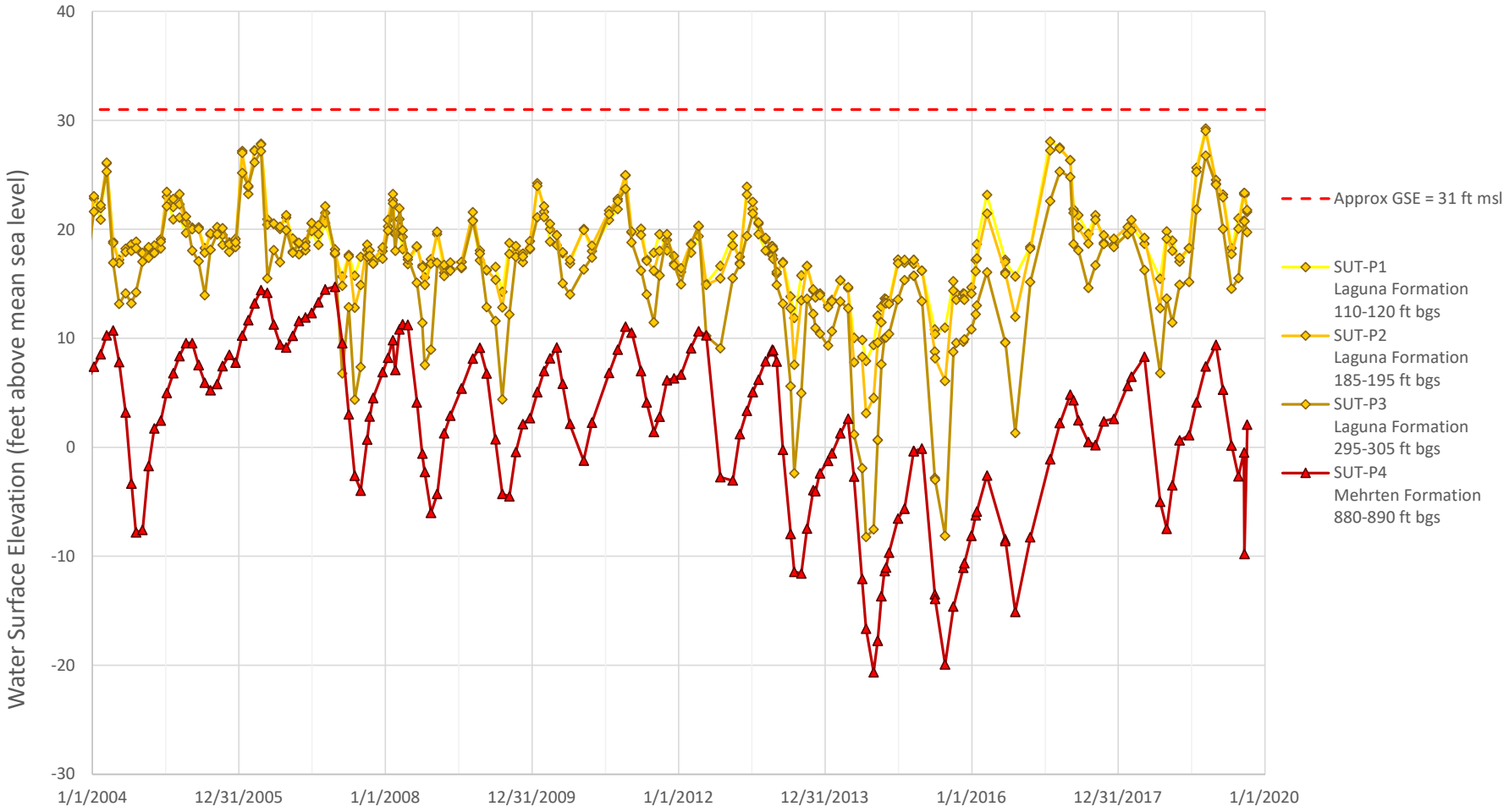
Local Well No. 33
Monument Nested Well
387000N1213529W001, 387000N1213529W002, 387000N1213529W003, 387000N1213529W004



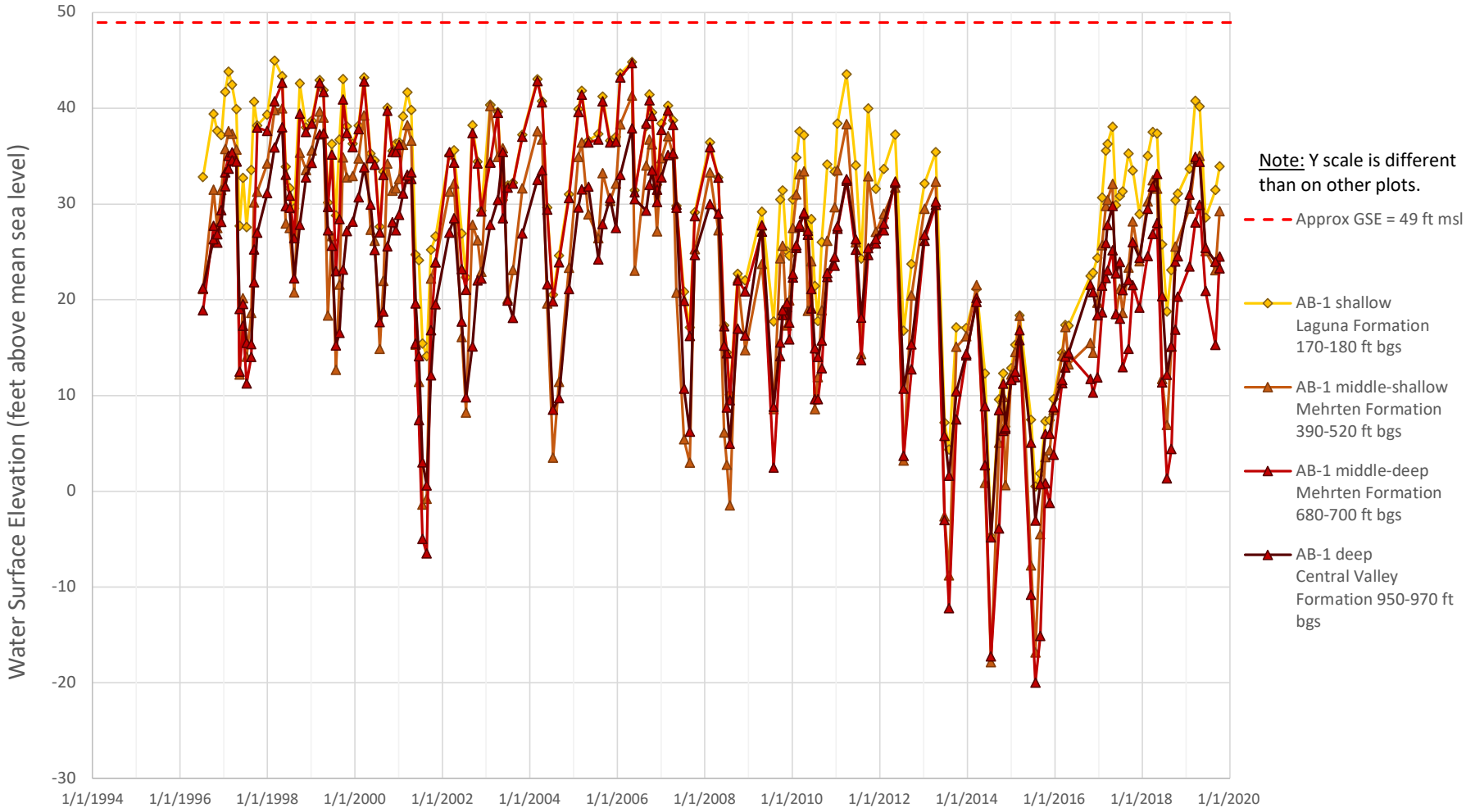
Local Well No. 35
Poker Nested Well
387117N1213327W001, 387117N1213327W002, 387117N1213327W003, 387117N1213327W004

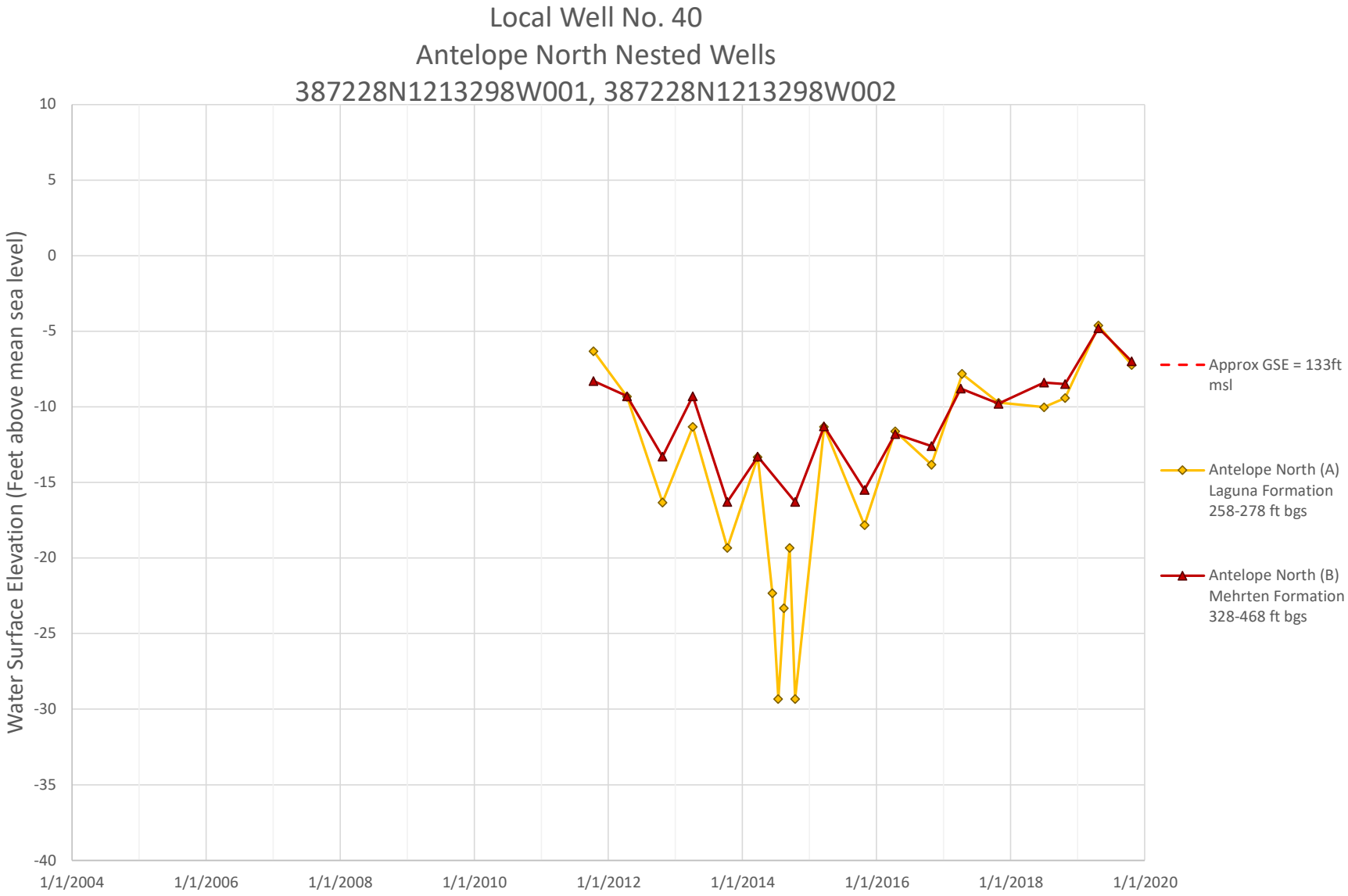


Local Well No. 37
SUT-P1, SUT-P2, SUT-P3, SUT-P4
388260N1215394W004, 388260N1215394W003, 388260N1215394W001,388260N1215394W001



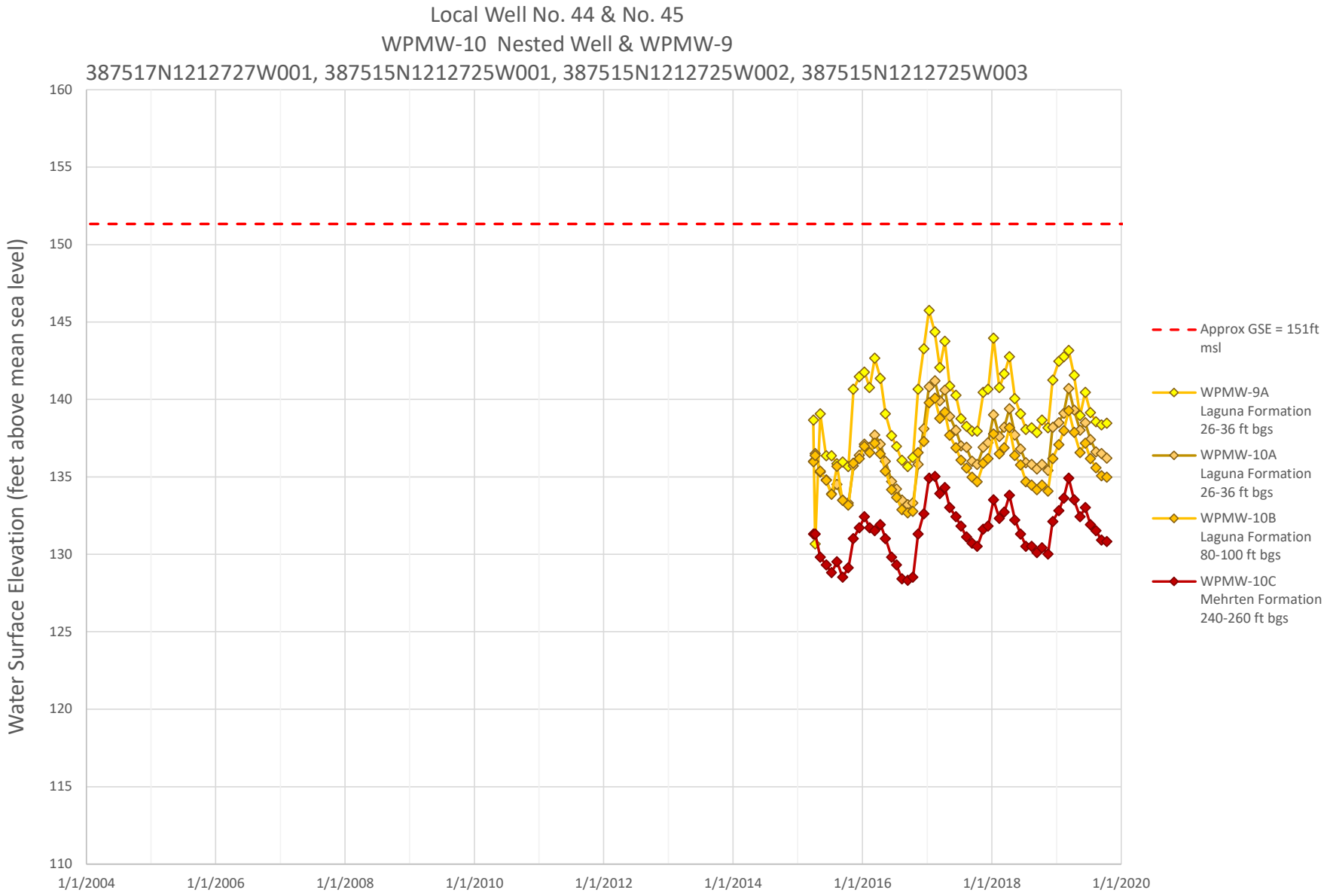
Local Well No. 39
AB-1 Nested Well
389116N1215238W003, 389117N1215238W001, 389116N1215238W002, 389116N1215238W001

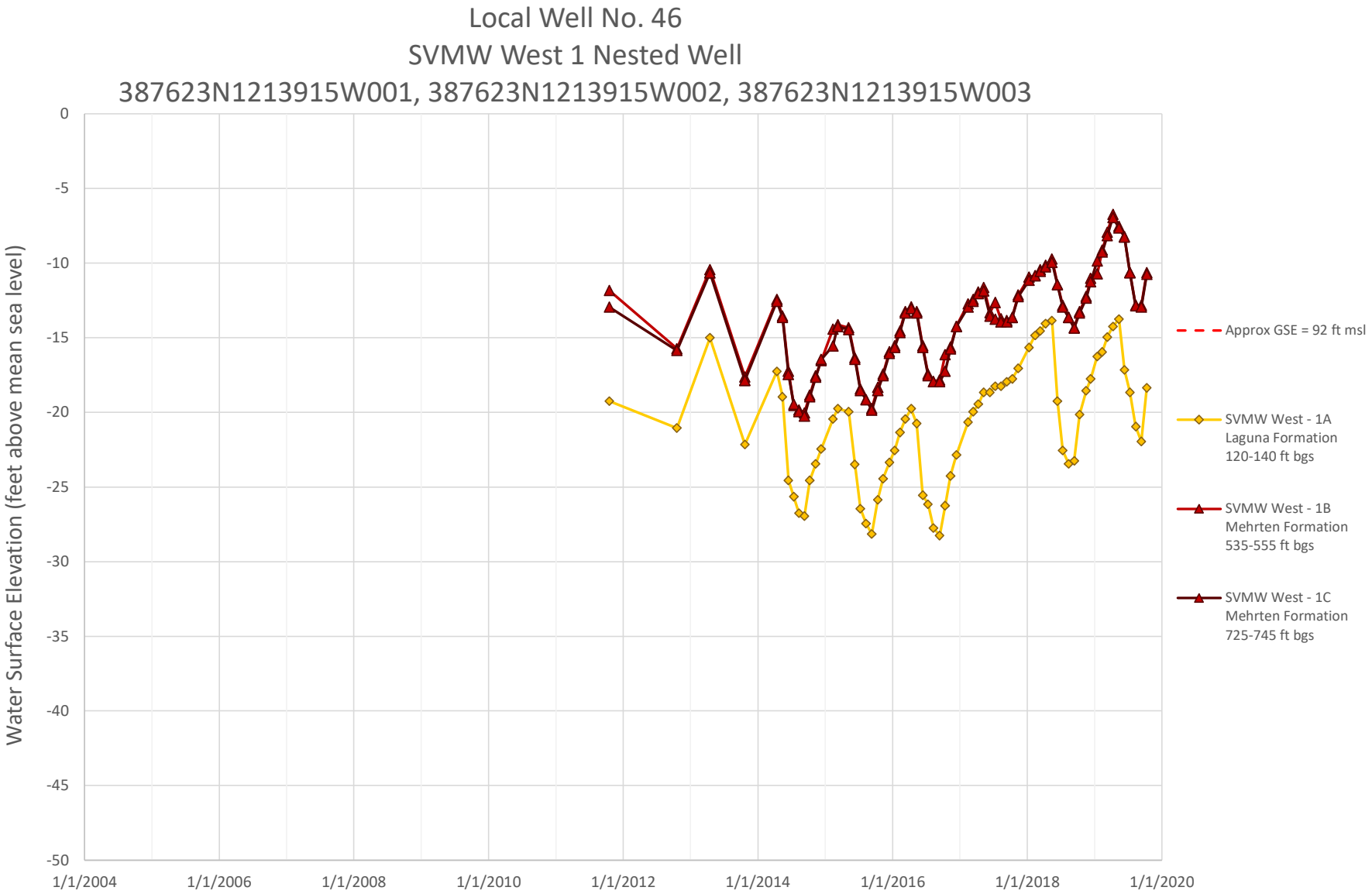


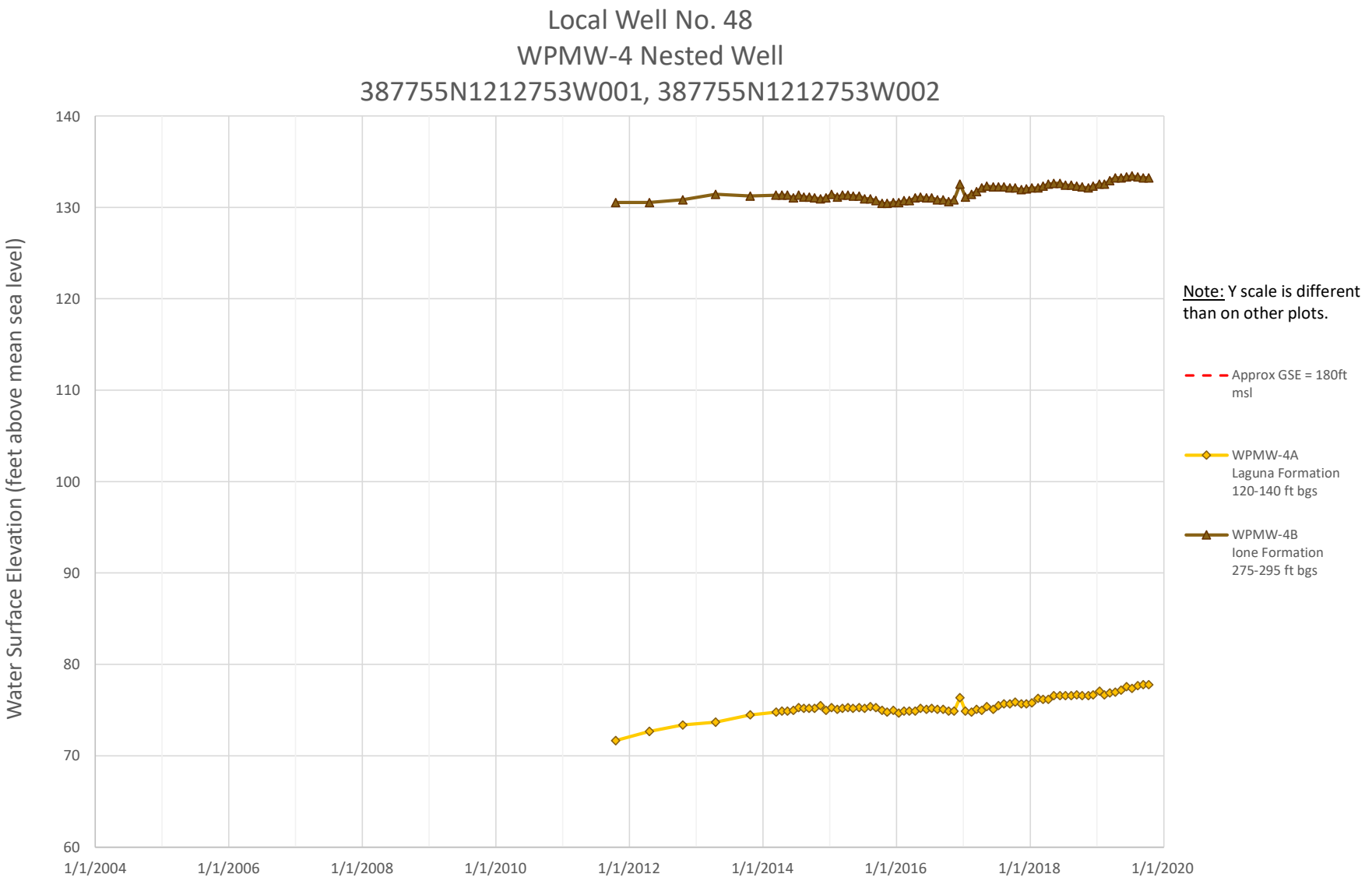

Local Well No. 40
Antelope North Nested Wells
387228N1213298W001, 387228N1213298W002
Water Surface Elevation (Feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 133ft msl
Antelope North (A) Laguna Formation 258-278 ft bgs
Antelope North (B) Mehrten Formation 328-468 ft bgs

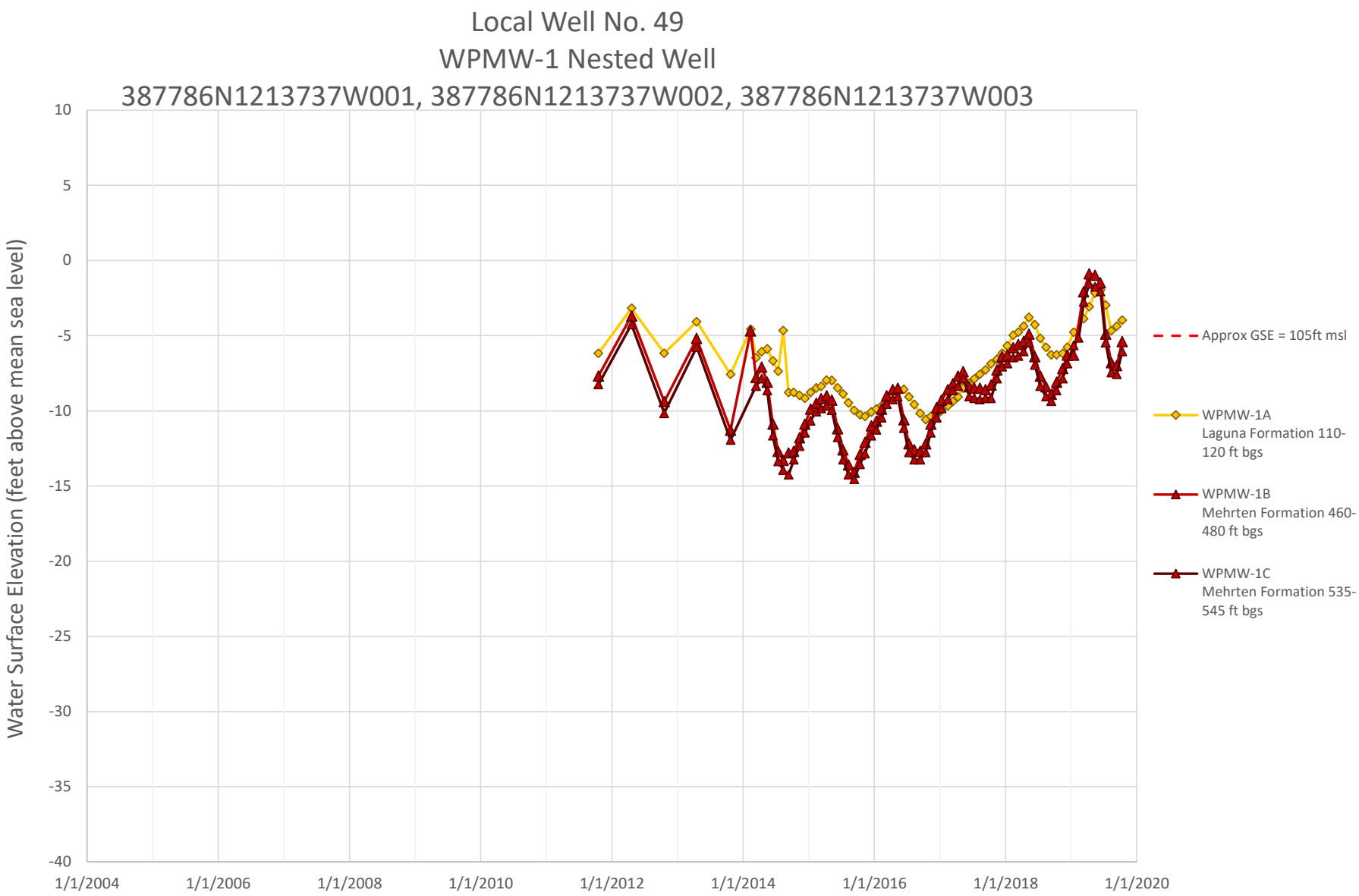

Local Well No. 41
WPMW-5 Nested Well
387331N1213610W001, 387331N1213610W002
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: WPMW-5A is dry.
Approx GSE = 98ft msl
WPMW-5A
Laguna Formation
80-100 ft bgs
WPMW-5B
Mehrten Formation
630-650 ft bgs

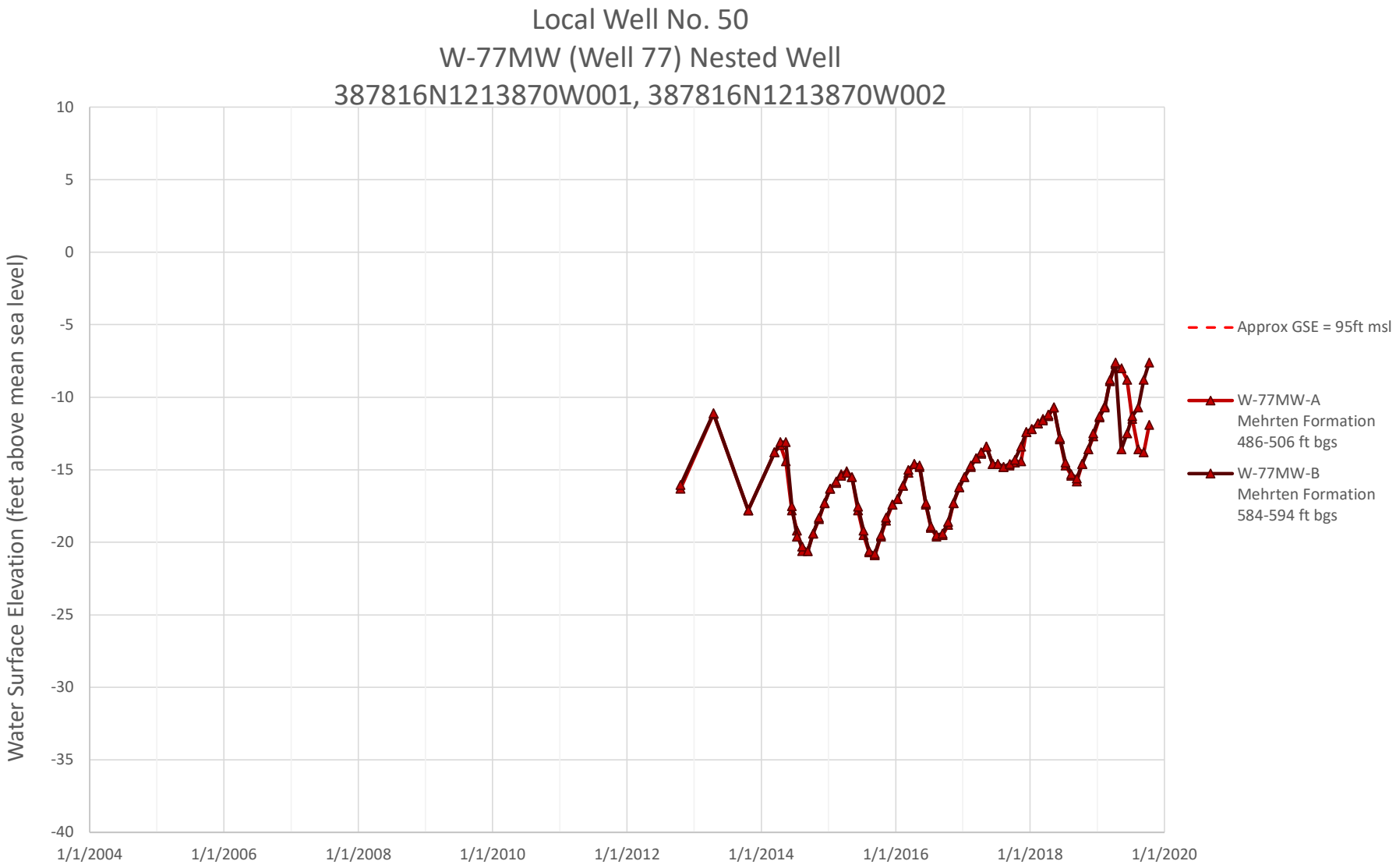

Local Well No.42 & No.43
387512N1212390W001, 387510N1212390W001, 387510N1212390W002
Water Surface Elevation (feet above mean sea level)
240
235
230
225
220
215
210
205
200
195
190
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 229ft msl
WPMW-7A Laguna Formation 35-45 ft bgs
WPMW-8A Laguna Formation 30-50 ft bgs
WPMW-8B Laguna Formation 95-115 ft bgs

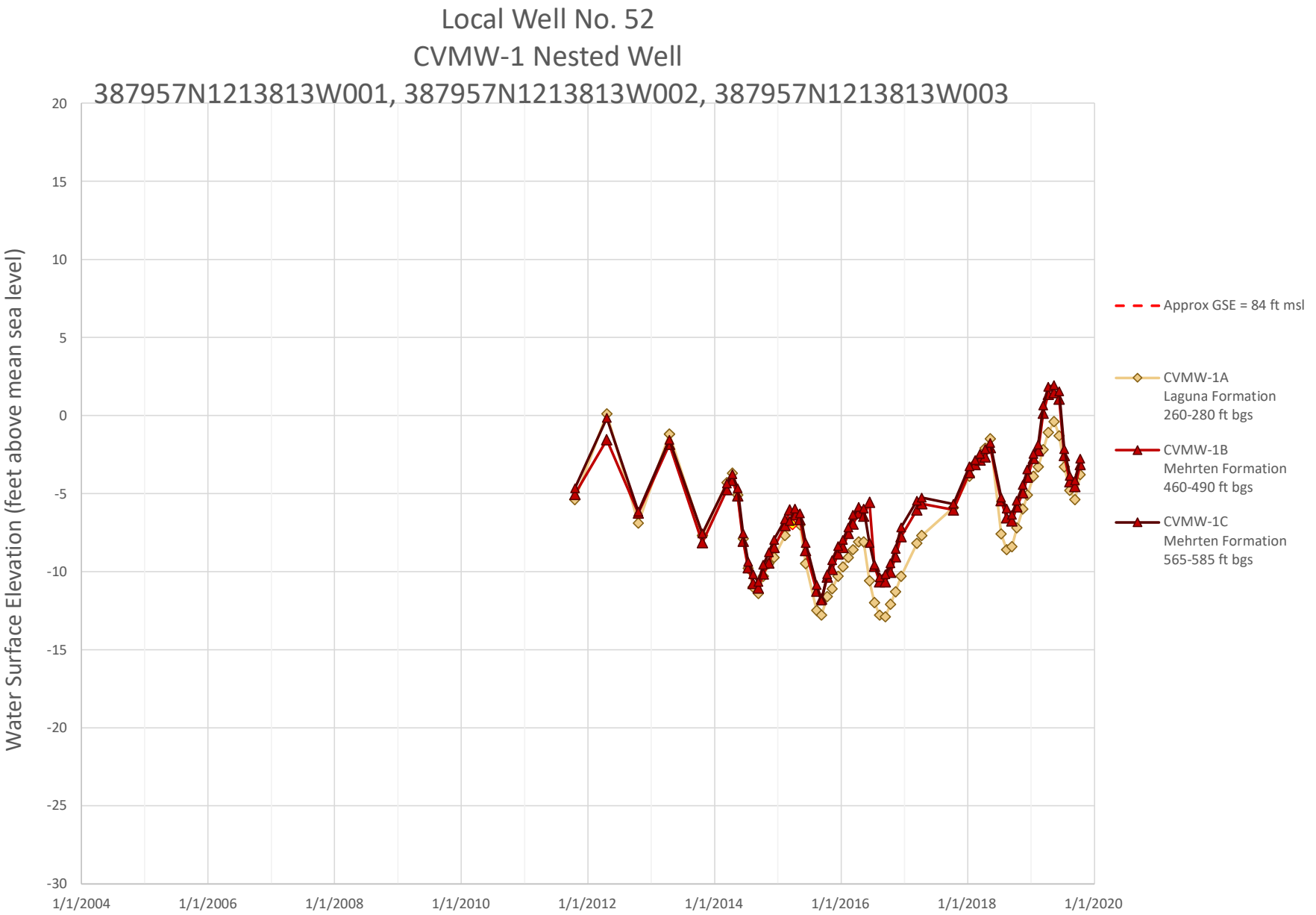

Local Well No. 44 & No. 45
WPMW-10 Nested Well & WPMW-9
387517N1212727W001, 387515N1212725W001, 387515N1212725W002, 387515N1212725W003
Water Surface Elevation (feet above mean sea level)
160
155
150
145
140
135
130
125
120
115
110
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 151ft msl
WPMW-9A Laguna Formation 26-36 ft bgs
WPMW-10A Laguna Formation 26-36 ft bgs
WPMW-10B Laguna Formation 80-100 ft bgs
WPMW-10C Mehrten Formation 240-260 ft bgs

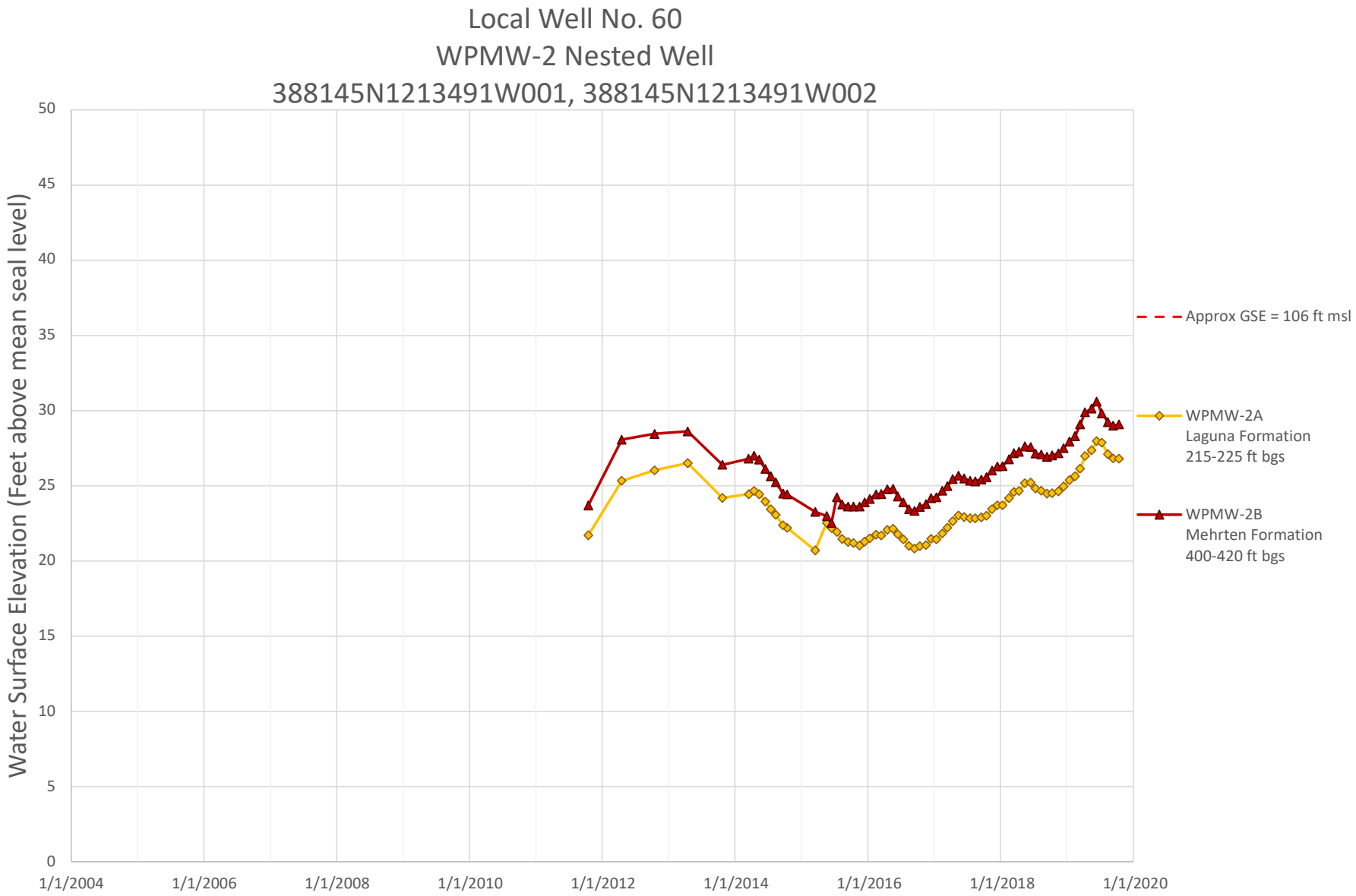

Local Well No. 46
SVMW West 1 Nested Well
387623N1213915W001, 387623N1213915W002, 387623N1213915W003
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 92 ft msl
SVMW West - 1A
Laguna Formation
120-140 ft bgs
SVMW West - 1B
Mehrten Formation
535-555 ft bgs
SVMW West - 1C
Mehrten Formation
725-745 ft bgs


Local Well No. 48
WPMW-4 Nested Well
387755N1212753W001, 387755N1212753W002
Water Surface Elevation (feet above mean sea level)
140
130
120
110
100
90
80
70
60
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Y scale is different than on other plots.
Approx GSE = 180ft msl
WPMW-4A
Laguna Formation
120-140 ft bgs
WPMW-4B
Ione Formation
275-295 ft bgs

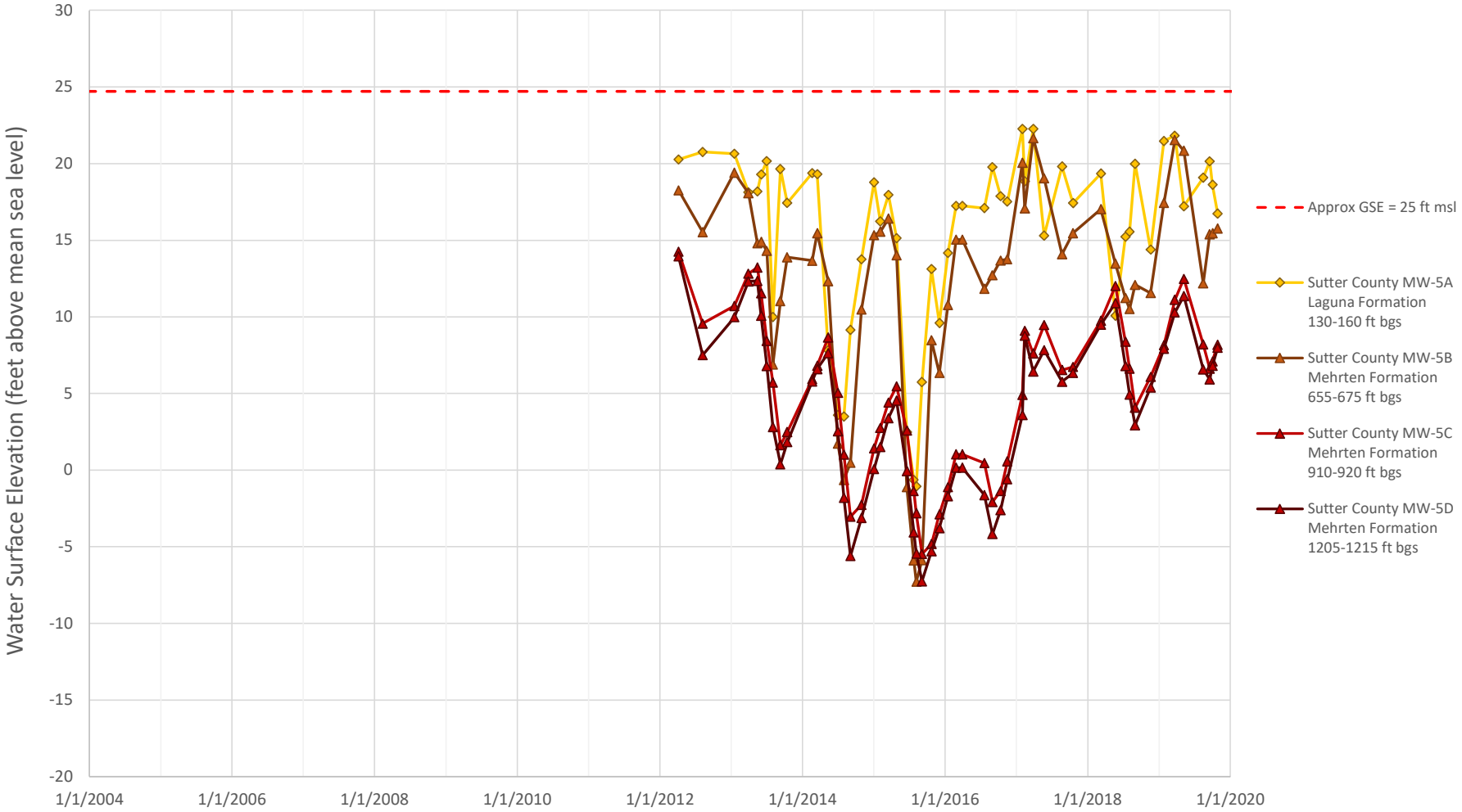

Local Well No. 49
WPMW-1 Nested Well
387786N1213737W001, 387786N1213737W002, 387786N1213737W003
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 105ft msl
WPMW-1A
Laguna Formation 110-120 ft bgs
WPMW-1B
Mehrten Formation 460-480 ft bgs
WPMW-1C
Mehrten Formation 535-545 ft bgs

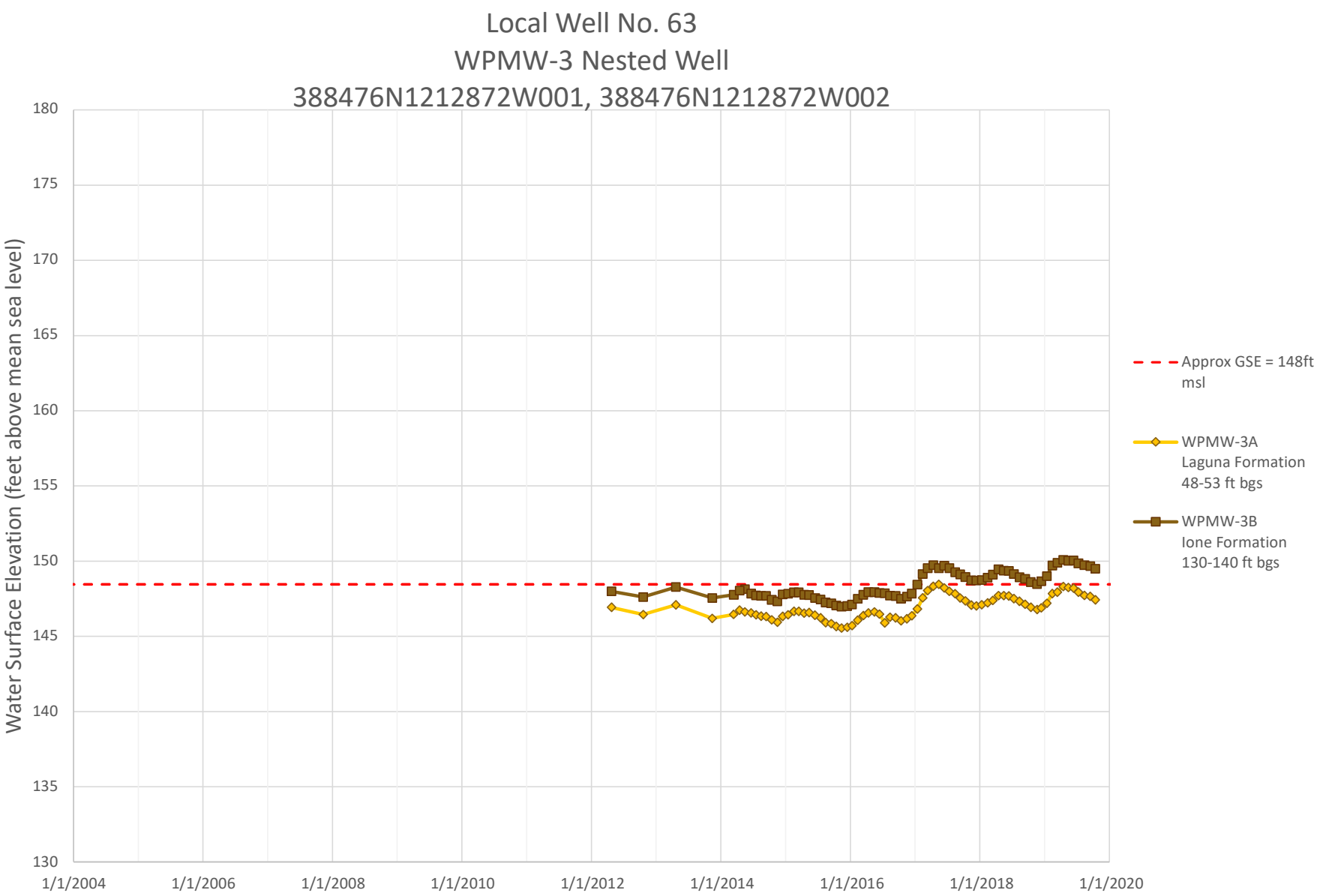

Local Well No. 50
W-77MW (Well 77) Nested Well
387816N1213870W001, 387816N1213870W002
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 95ft msl
W-77MW-A
Mehrten Formation
486-506 ft bgs
W-77MW-B
Mehrten Formation
584-594 ft bgs

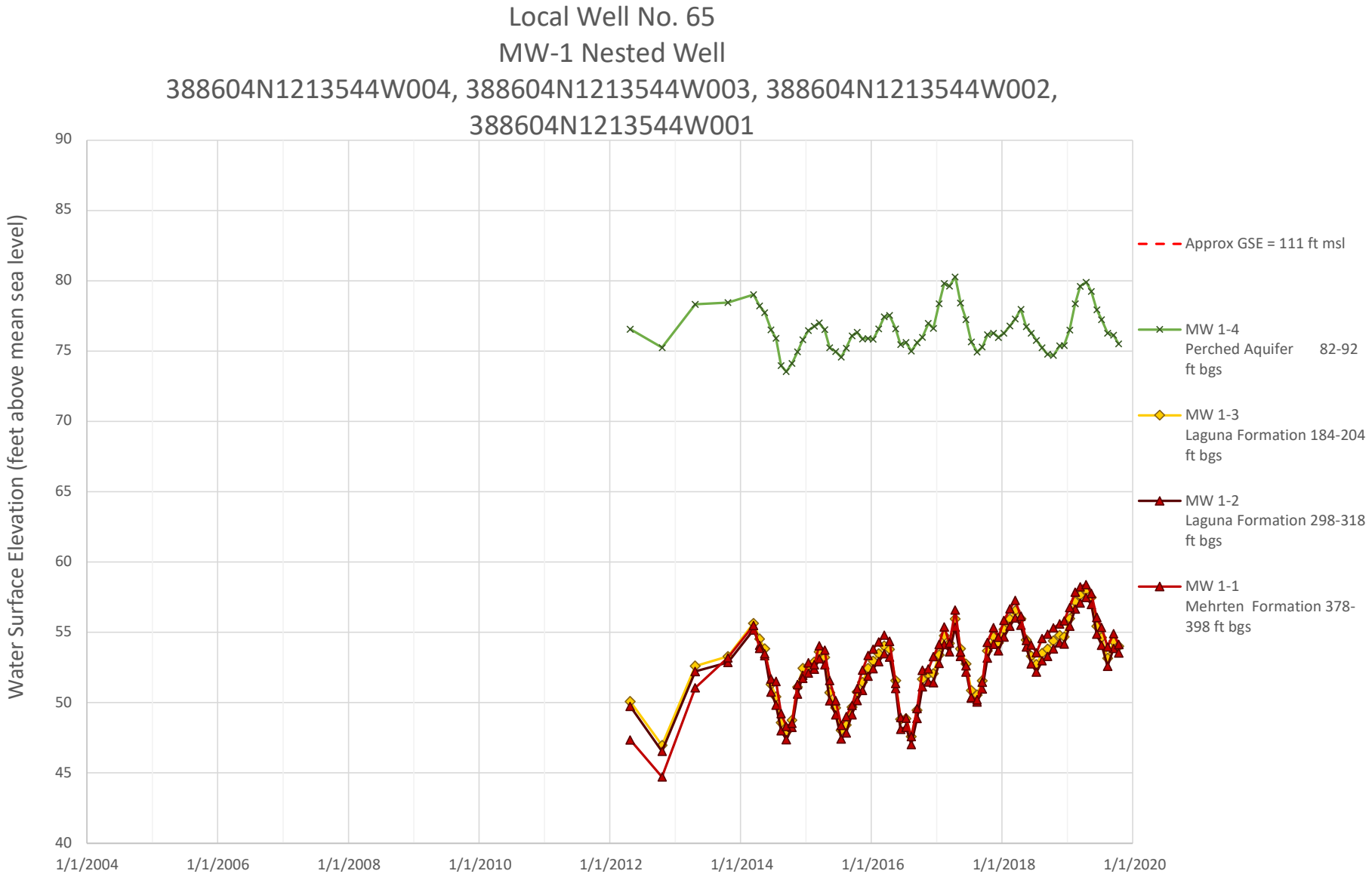

Local Well No. 52
CVMW-1 Nested Well
387957N1213813W001, 387957N1213813W002, 387957N1213813W003
Water Surface Elevation (feet above mean sea level)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 84 ft msl
CVMW-1A
Laguna Formation
260-280 ft bgs
CVMW-1B
Mehrten Formation
460-490 ft bgs
CVMW-1C
Mehrten Formation
565-585 ft bgs

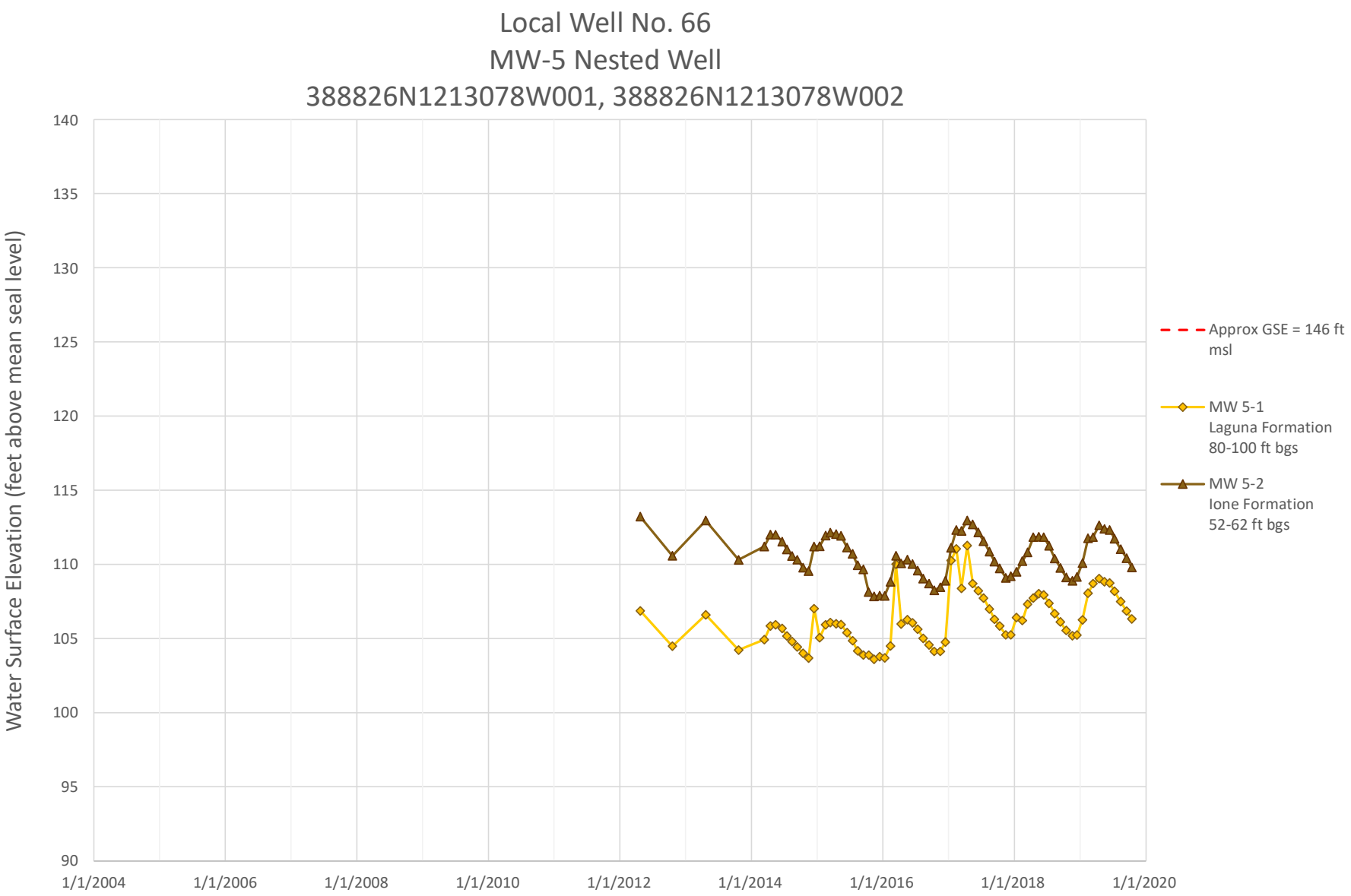

Local Well No. 60
WPMW-2 Nested Well
388145N1213491W001, 388145N1213491W002
Water Surface Elevation (Feet above mean seal level)
50
45
40
35
30
25
20
15
10
5
0
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 106 ft msl
WPMW-2A
Laguna Formation
215-225 ft bgs
WPMW-2B
Mehrten Formation
400-420 ft bgs

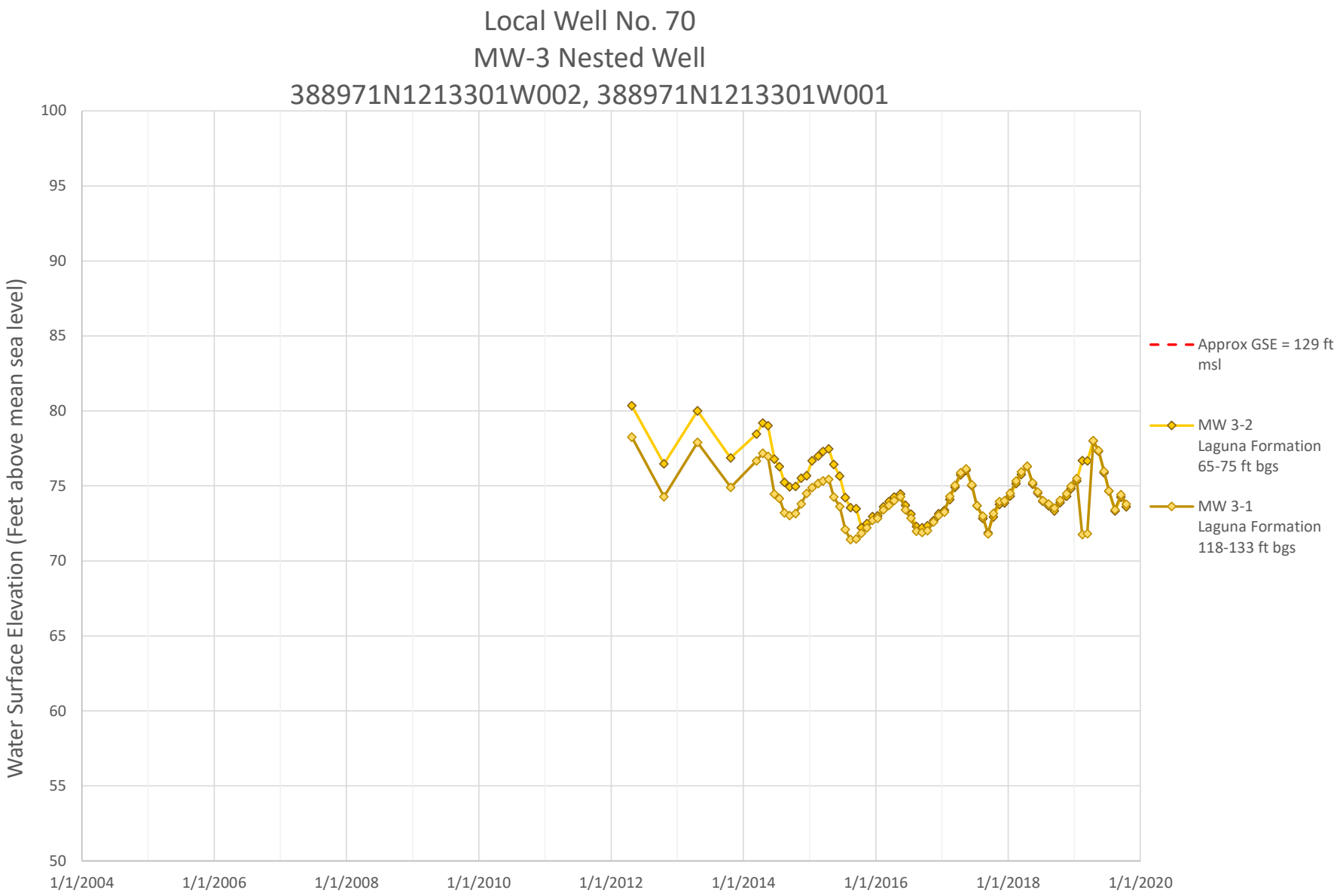
Local Well No. 61
Sutter County MW-5 Nested Well
388235N1216079W001, 388235N1216079W002, 388235N1216079W003, 388235N1216079W004

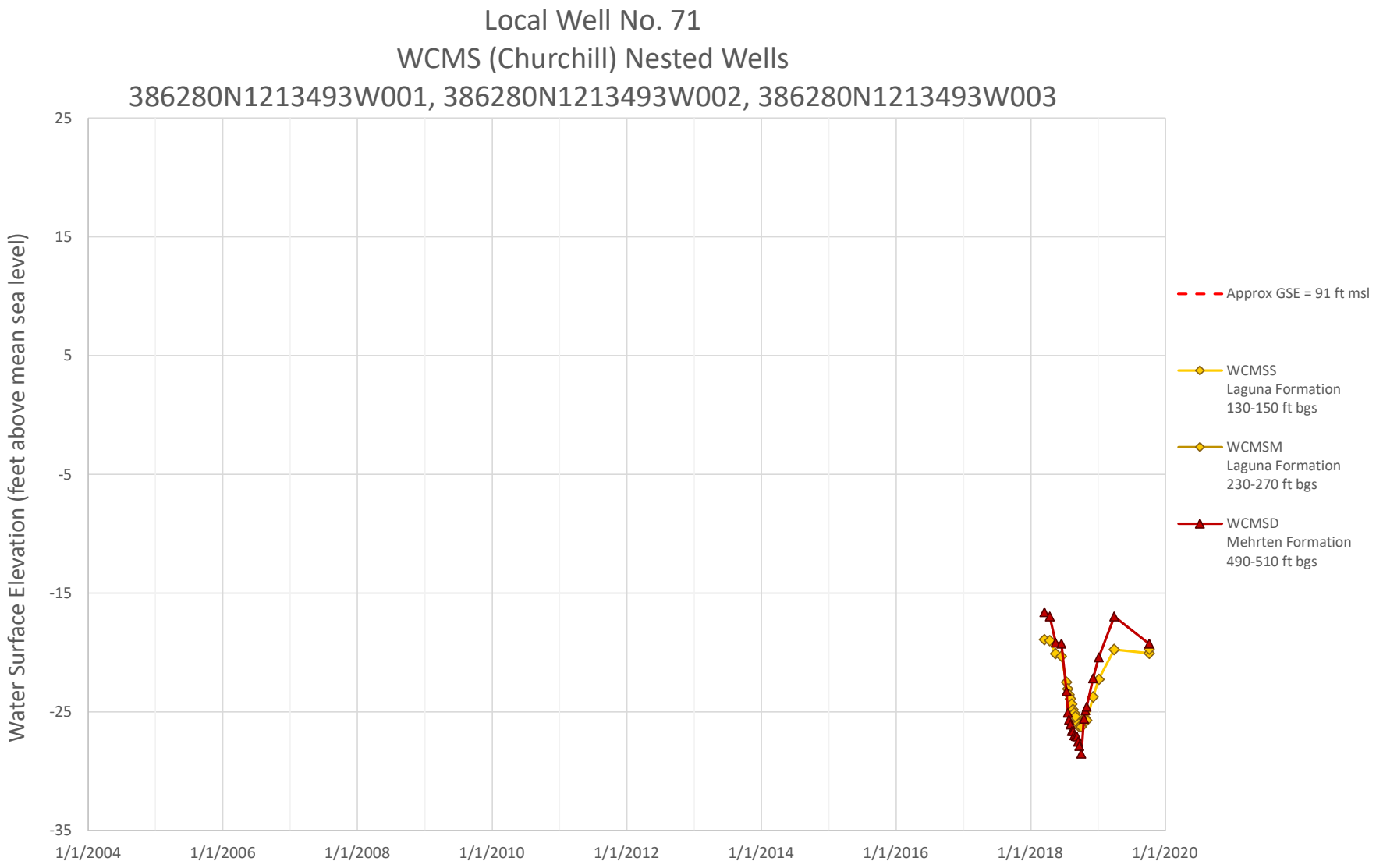


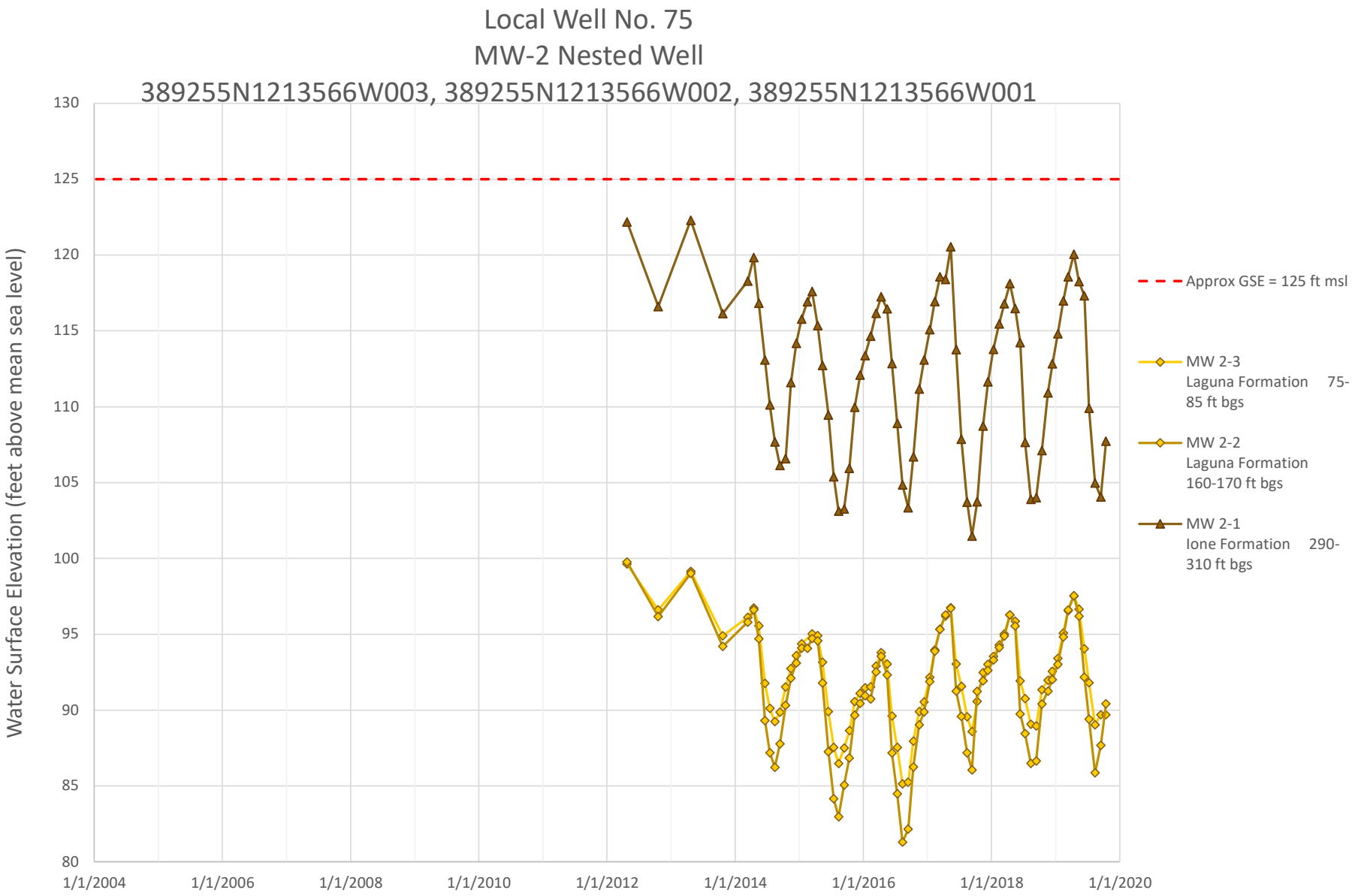

Local Well No. 63
WPMW-3 Nested Well
388476N1212872W001, 388476N1212872W002
Water Surface Elevation (feet above mean sea level)
180
175
170
165
160
155
150
145
140
135
130
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 148ft msl
WPMW-3A Laguna Formation 48-53 ft bgs
WPMW-3B Ione Formation 130-140 ft bgs

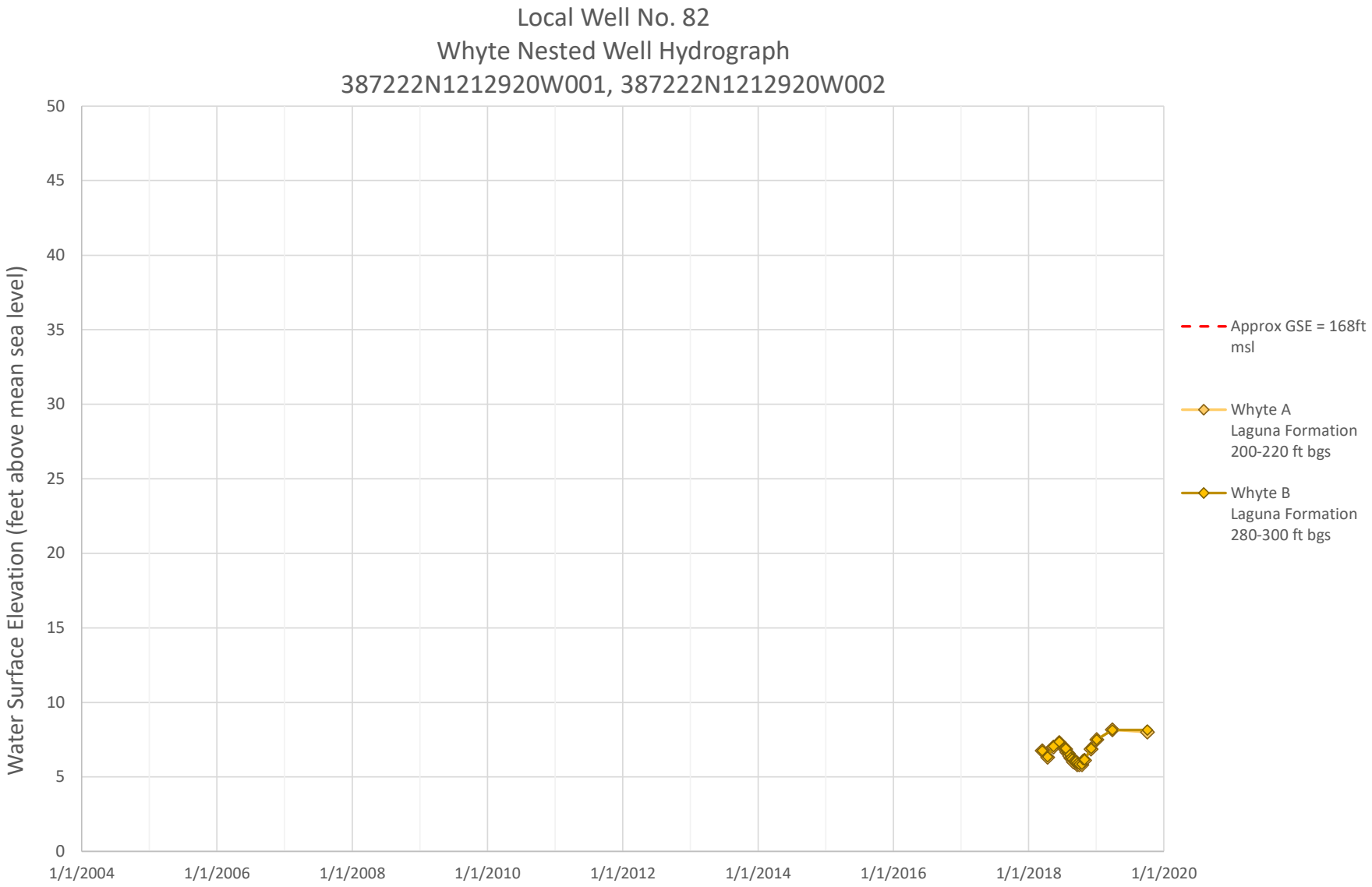

Local Well No. 65
MW-1 Nested Well
388604N1213544W004, 388604N1213544W003, 388604N1213544W002,
388604N1213544W001
Water Surface Elevation (feet above mean sea level)
90
85
80
75
70
65
60
55
50
45
40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 111 ft msl
MW 1-4
Perched Aquifer 82-92
ft bgs
MW 1-3
Laguna Formation 184-204
ft bgs
MW 1-2
Laguna Formation 298-318
ft bgs
MW 1-1
Mehrten Formation 378-
398 ft bgs

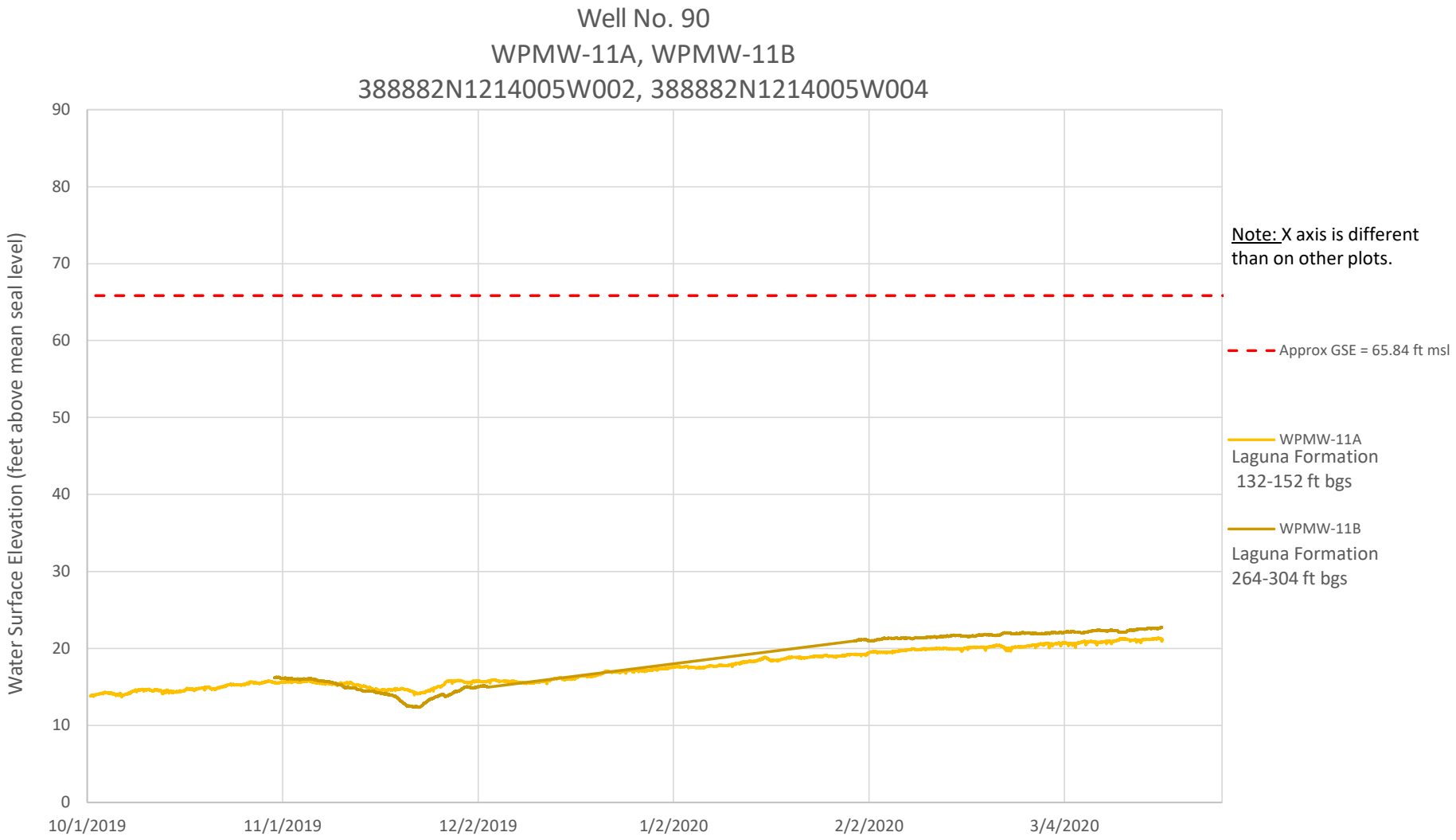

Local Well No. 66
MW-5 Nested Well
388826N1213078W001, 388826N1213078W002
Water Surface Elevation (feet above mean seal level)
140
135
130
125
120
115
110
105
100
95
90
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 146 ft msl
MW 5-1
Laguna Formation
80-100 ft bgs
MW 5-2
Ione Formation
52-62 ft bgs

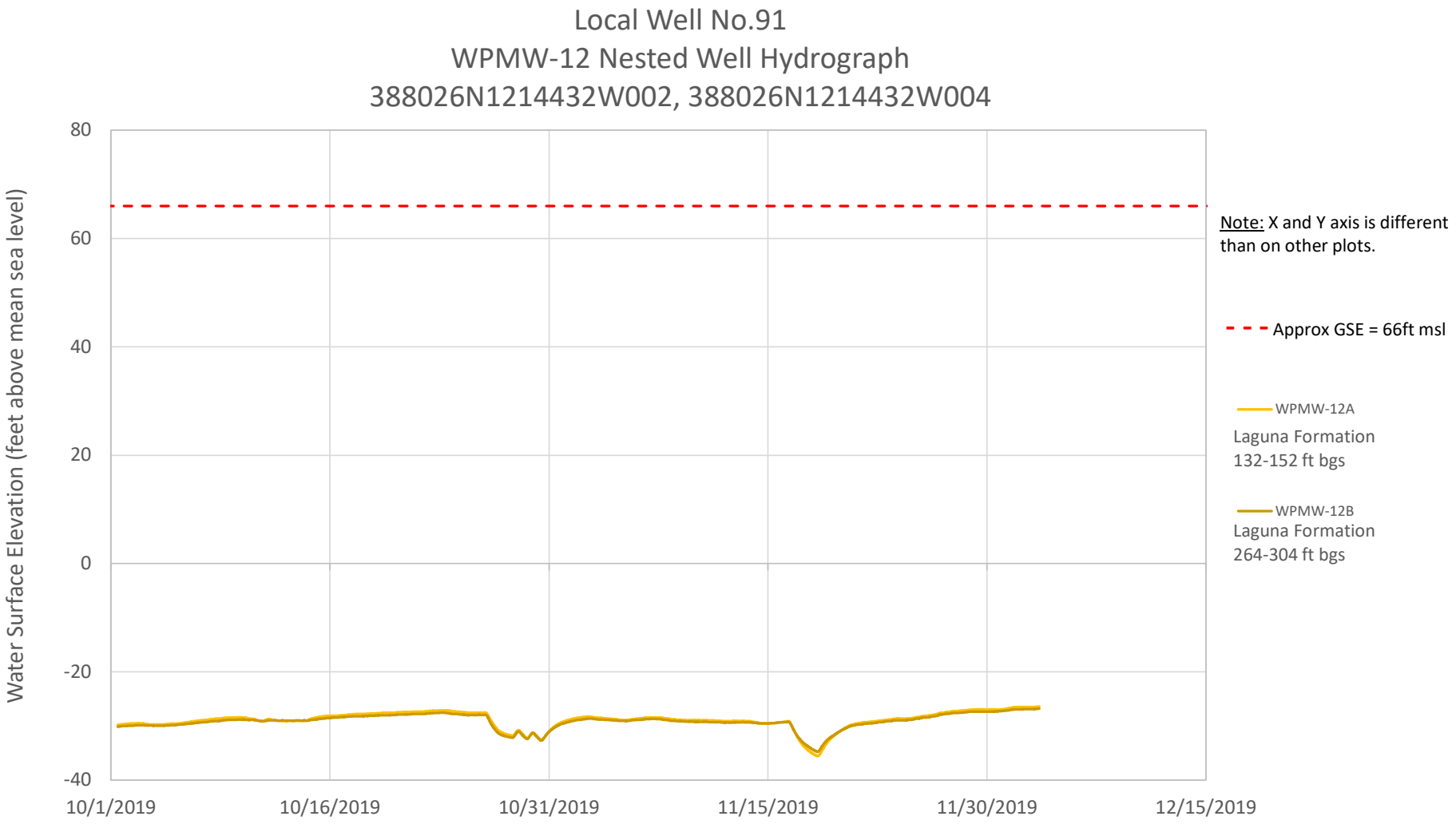

Local Well No. 70
MW-3 Nested Well
388971N1213301W002, 388971N1213301W001
Water Surface Elevation (Feet above mean sea level)
100
95
90
85
80
75
70
65
60
55
50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 129 ft msl
MW 3-2
Laguna Formation
65-75 ft bgs
MW 3-1
Laguna Formation
118-133 ft bgs

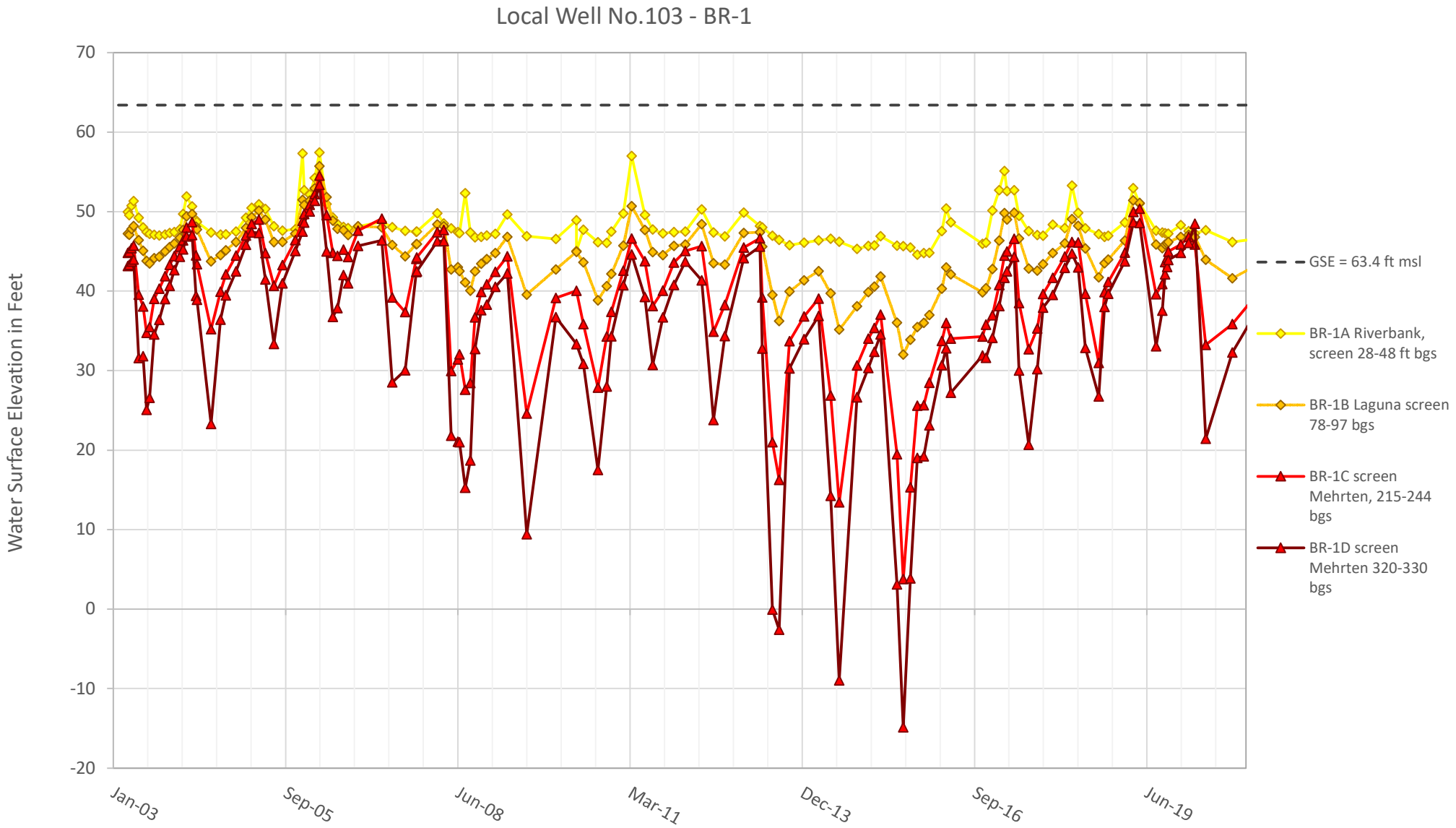

Local Well No. 71
WCMS (Churchill) Nested Wells
386280N1213493W001, 386280N1213493W002, 386280N1213493W003
Water Surface Elevation (feet above mean sea level)
25
15
5
-5
-15
-25
-35
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 91 ft msl
WCMSS
Laguna Formation
130-150 ft bgs
WCMSM
Laguna Formation
230-270 ft bgs
WCMSD
Mehrten Formation
490-510 ft bgs


Local Well No. 75
MW-2 Nested Well
389255N1213566W003, 389255N1213566W002, 389255N1213566W001
Water Surface Elevation (feet above mean sea level)
130
125
120
115
110
105
100
95
90
85
80
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 125 ft msl
MW 2-3
Laguna Formation 75-85 ft bgs
MW 2-2
Laguna Formation
160-170 ft bgs
MW 2-1
Ione Formation 290-310 ft bgs


Local Well No. 82
Whyte Nested Well Hydrograph
387222N1212920W001, 387222N1212920W002
Water Surface Elevation (feet above mean sea level)
50
45
40
35
30
25
20
15
10
5
0
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 168ft msl
Whyte A
Laguna Formation
200-220 ft bgs
Whyte B
Laguna Formation
280-300 ft bgs


Well No. 90
WPMW-11A, WPMW-11B
388882N1214005W002, 388882N1214005W004
Water Surface Elevation (feet above mean seal level)
90
80
70
60
50
40
30
20
10
0
10/1/2019
11/1/2019
12/2/2019
1/2/2020
2/2/2020
3/4/2020
Note: X axis is different than on other plots.
Approx GSE = 65.84 ft msl
WPMW-11A
Laguna Formation
132-152 ft bgs
WPMW-11B
Laguna Formation
264-304 ft bgs


Local Well No.91
WPMW-12 Nested Well Hydrograph
388026N1214432W002, 388026N1214432W004
Water Surface Elevation (feet above mean sea level)
80
60
40
20
0
-20
-40
10/1/2019
10/16/2019
10/31/2019
11/15/2019
11/30/2019
12/15/2019
Note: X and Y axis is different than on other plots.
Approx GSE = 66ft msl
WPMW-12A
Laguna Formation
132-152 ft bgs
WPMW-12B
Laguna Formation
264-304 ft bgs


Local Well No.103 - BR-1
Water Surface Elevation in Feet
70
60
50
40
30
20
10
0
-10
-20
Jan-03
Sep-05
Jun-08
Mar-11
Dec-13
Sep-16
Jun-19
GSE = 63.4 ft msl
BR-1A Riverbank, screen 28-48 ft bgs
BR-1B Laguna screen 78-97 bgs
BR-1C screen Mehrten, 215-244 bgs
BR-1D screen Mehrten 320-330 bgs

Appendix K: Ione Well Hydrographs

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX K
Ione or Central Valley Formation Well Hydrographs

December 2021

APPENDIX K

IONE OR CENTRAL VALLEY FORMATION WELLS WITH HYDROGRAPHS

LEGEND:

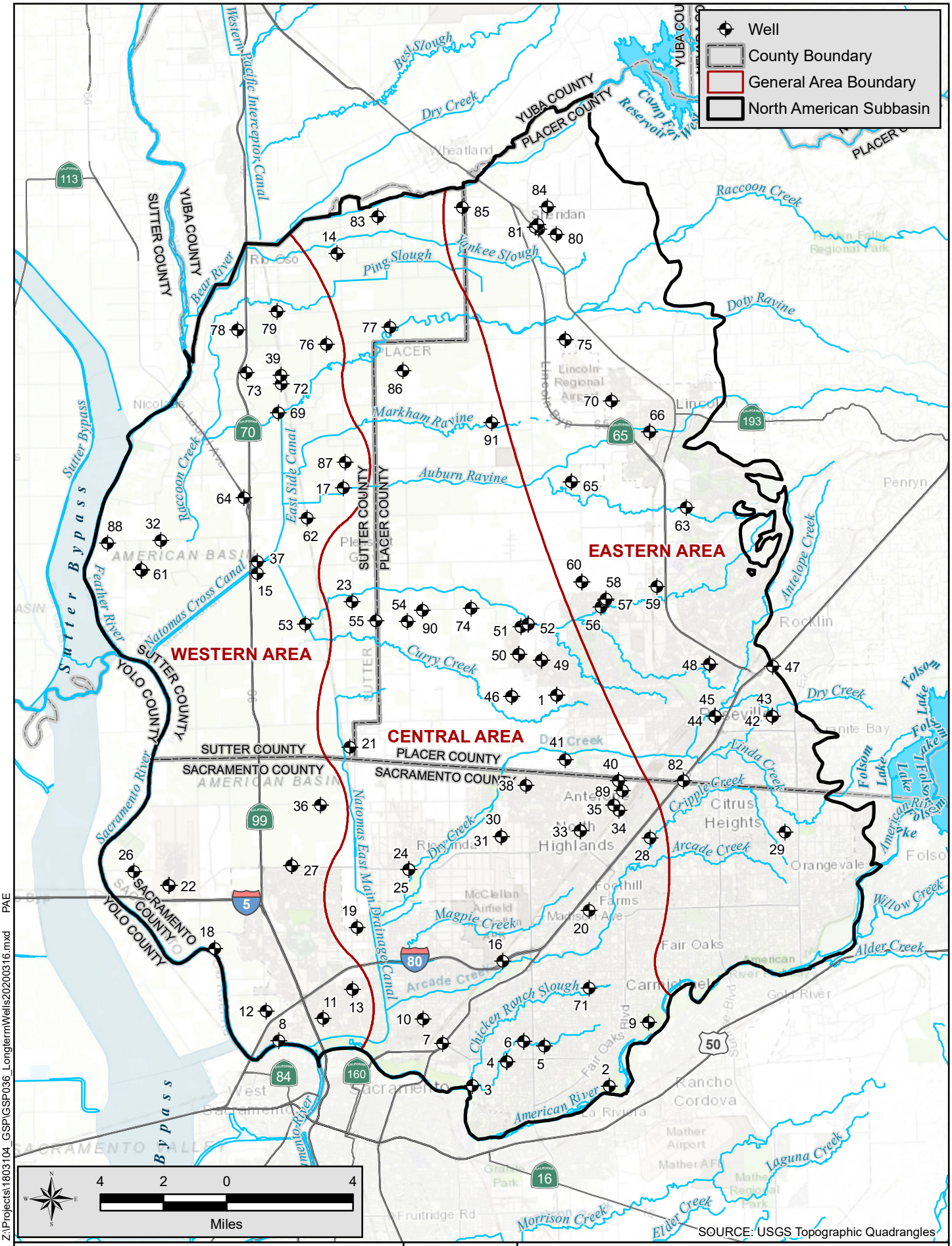


Laguna Formation Wells
Mehrten Formation Wells
Ione or Central Valley Fm. Wells

Short Term Hydrographs

Years Displayed	2004 to 2019
	Unless otherwise noted
Vertical Axis	50 feet
	Unless otherwise noted

Groundwater levels from multiple aquifers shown



Z:\Projects\1803104_GSP\GSP036_LongtermWells20200316.mxd PAE

18-Mar-2020

North American Subbasin
Sutter, Placer and Sacramento Counties

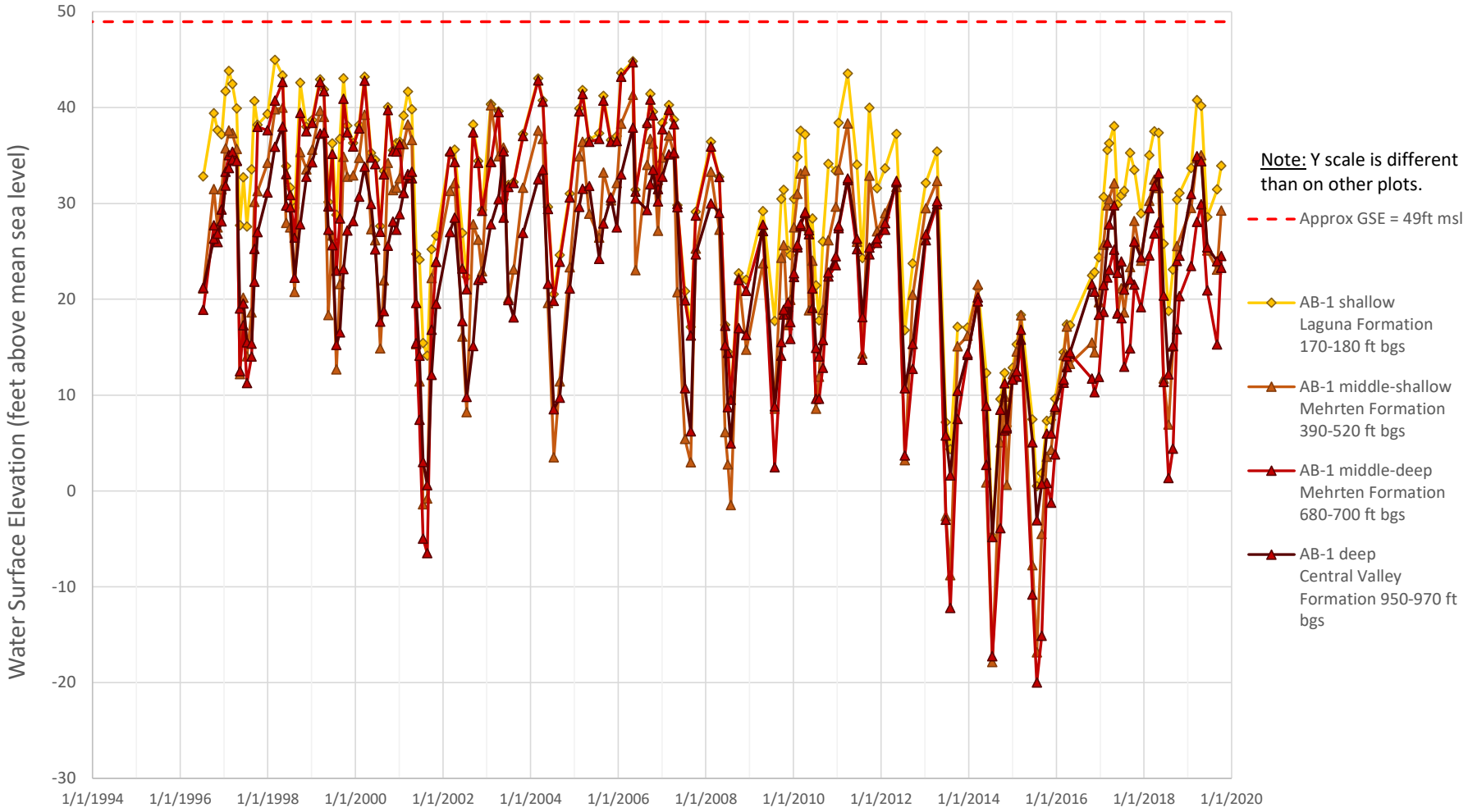
North American Subbasin

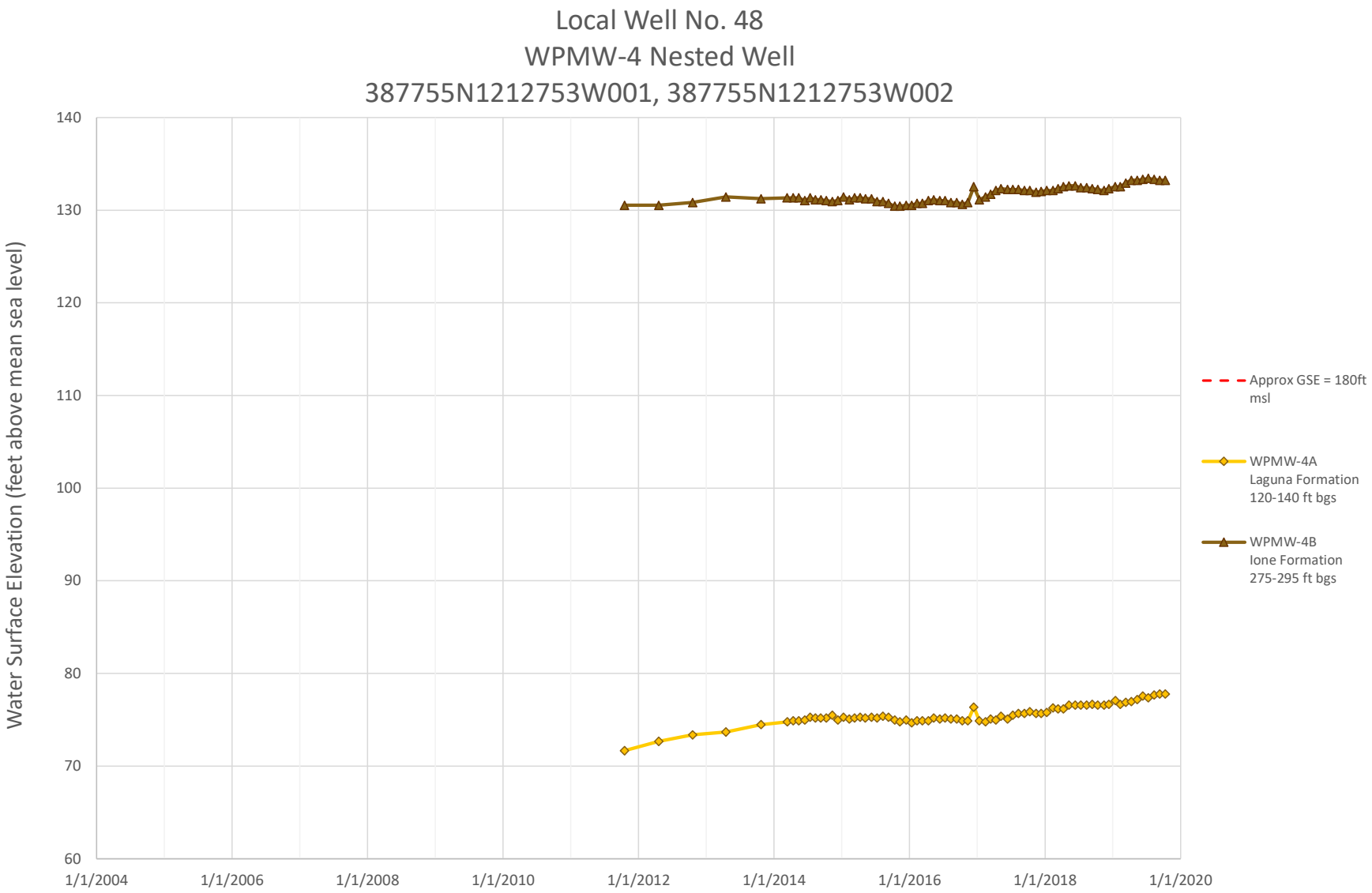
GEI Consultants

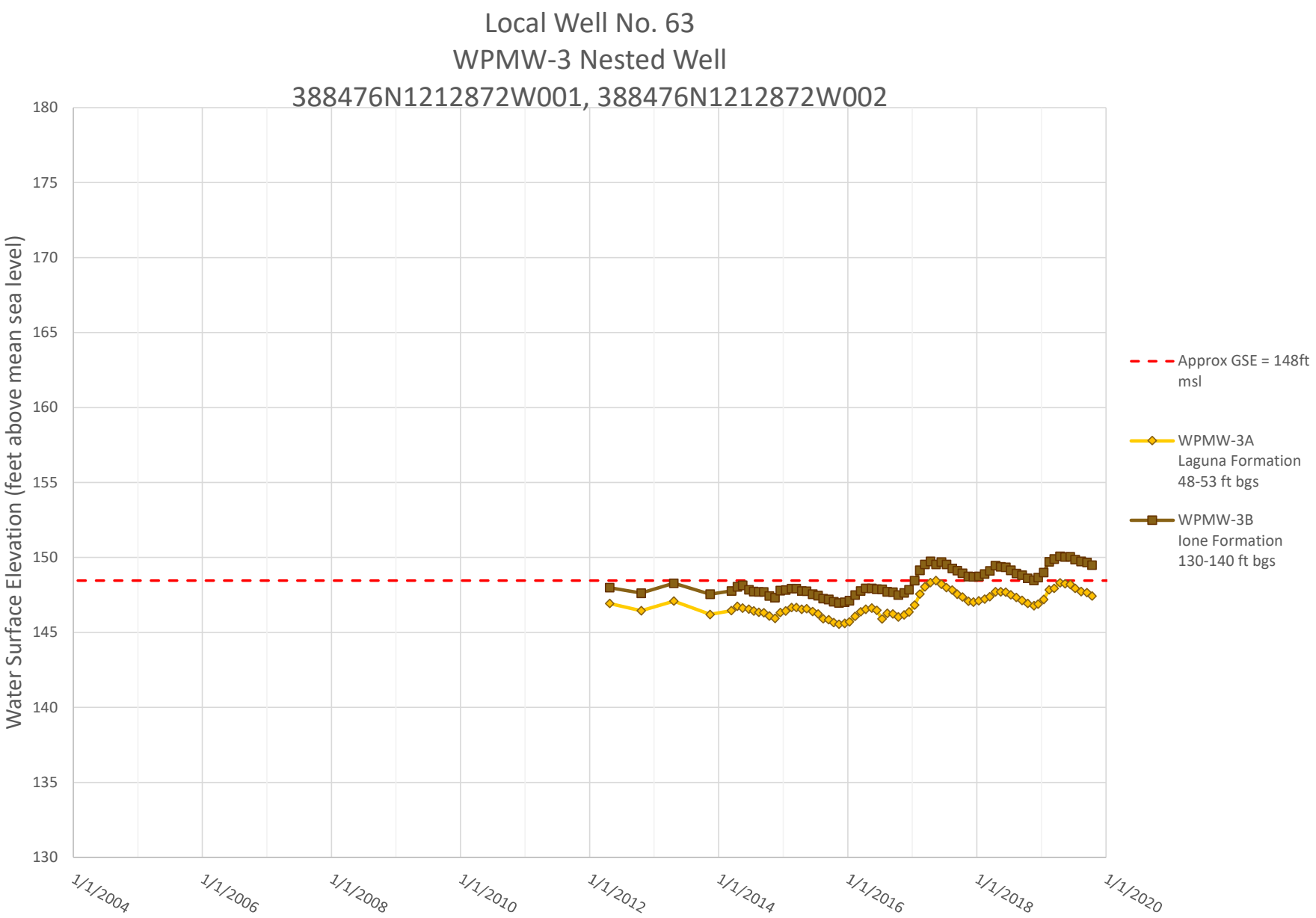
Long Term Wells

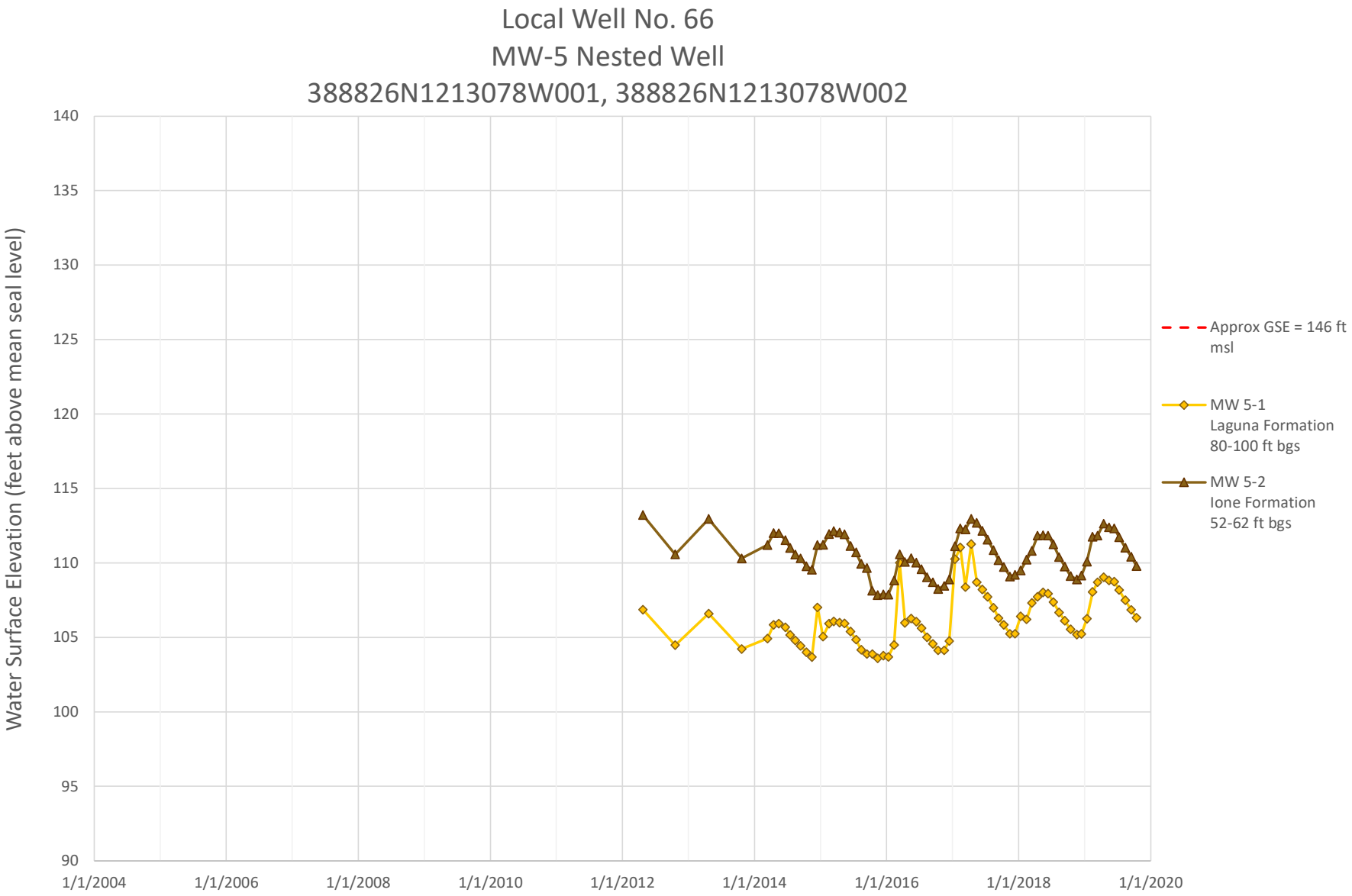
MARCH 2020

Local Well No. 39
AB-1 Nested Well
389116N1215238W003, 389117N1215238W001, 389116N1215238W002, 389116N1215238W001




Local Well No. 48
WPMW-4 Nested Well
387755N1212753W001, 387755N1212753W002
Water Surface Elevation (feet above mean sea level)
140
130
120
110
100
90
80
70
60
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 180ft msl
WPMW-4A
Laguna Formation
120-140 ft bgs
WPMW-4B
Ione Formation
275-295 ft bgs


Local Well No. 63
WPMW-3 Nested Well
388476N1212872W001, 388476N1212872W002
Water Surface Elevation (feet above mean sea level)
180
175
170
165
160
155
150
145
140
135
130
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 148ft msl
WPMW-3A Laguna Formation 48-53 ft bgs
WPMW-3B Ione Formation 130-140 ft bgs


Local Well No. 66
MW-5 Nested Well
388826N1213078W001, 388826N1213078W002
Water Surface Elevation (feet above mean seal level)
140
135
130
125
120
115
110
105
100
95
90
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 146 ft msl
MW 5-1
Laguna Formation
80-100 ft bgs
MW 5-2
Ione Formation
52-62 ft bgs

Appendix L: Summary of Water Quality Detections

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX L
Summary of Water Quality Detections

December 2021

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
3100077-003	38.726602	-121.336563	7/10/2017	0	6/17/2010	0.1	8/14/2017	7.7	6/17/2010	280	6/17/2010	0	7/10/2017	0.76		
3100077-004	38.726284	-121.336527	7/10/2017	0	7/1/2010	0.1	8/14/2017	5.6	7/1/2010	100	7/1/2010	0	7/10/2017	1.66		
3100538-001	38.7505	-121.321972	3/23/2018	3.2	3/23/2018	0	4/20/2017	3	6/12/2019	130	3/23/2018	48	6/12/2019	2.5	3/23/2018	350
3104508-001	38.729952	-121.321616	4/20/2017	2.7	4/20/2017	0	4/20/2017	6.2	4/20/2017	0	4/20/2017	0	3/21/2019	1.2		
3105886-001	38.728166	-121.366194											3/21/2019	2.2		
3107126-001	38.91	-121.35											6/11/2004	2.2		
3110004-002	38.868006	-121.320358	1/9/2014	2.2	1/13/2003	0.5	11/20/2014	1.5	1/9/2014	100	1/9/2014	20	2/26/2019	3.6	1/15/2015	310
3110004-003	38.86973	-121.330213	4/27/2017	0	1/13/2003	0.3	11/20/2014	3.8	4/27/2017	0	4/27/2017	0	2/26/2019	1.5	4/27/2017	240
3110004-007	38.901373	-121.351602	5/8/2015	0	1/13/2003	0.4	1/13/2003	3.1	5/8/2015	150	5/8/2015	0	2/26/2019	4	5/8/2015	220
3110004-011	38.865086	-121.347261	11/16/2011	2.9			11/20/2014	4.4	11/16/2011	100	11/16/2011	0	3/1/2018	1.2	1/15/2015	200
3110004-012	38.867769	-121.338461	12/27/2011	2.7			4/27/2017	4.6	12/27/2011	0	12/27/2011	0	2/26/2019	2	1/15/2015	210
3110008-003	38.753022	-121.279492	1/8/2010	2	3/15/2005	0.11	11/20/2003	1	1/8/2010	100	1/8/2010	20	1/8/2010	2.5	1/8/2010	230
3110008-004	38.749947	-121.287425	11/20/2003	0			11/20/2003	1.7	11/20/2003	0	11/20/2003	0	11/20/2003	2.882	11/20/2003	260
3110008-005	38.750569	-121.285216	10/17/1995	0	8/24/2004	0.0006							8/24/2004	0.9	10/27/1992	460
3110008-006	38.736633	-121.277875	8/25/2016	0	3/15/2005	1.3	11/20/2003	3.2	8/25/2016	140	8/25/2016	0	8/23/2018	1.6	9/5/2013	400
3110008-007	38.726493	-121.258205	8/25/2016	0	3/15/2005	0.57	11/20/2003	3.7	8/25/2016	0	8/25/2016	0	8/23/2018	0.69	9/5/2013	310
3110008-008	38.805938	-121.33588	8/23/2018	0	3/15/2005	0.71	10/22/2002	3.5	8/23/2018	120	8/23/2018	0	8/23/2018	1.1	8/23/2018	720
3110008-015	38.785813	-121.332225	8/25/2016	0					8/25/2016	0	8/25/2016	0	8/23/2018	1.2	8/23/2018	350
3110025-005	38.818889	-121.31	9/12/2019	3.513	10/22/2003	0.81	8/21/2017	4.2	9/12/2019	0	9/12/2019	0	9/12/2019	2.98	9/12/2019	220
3110030-001	38.898247	-121.338122	6/20/1990	5	8/14/2002	0.4			6/20/1990	15	6/20/1990	5	6/20/1990	3	6/20/1990	252
3110040-001	38.75	-121.34722	7/9/2002	3.6	5/16/2001	0.33	12/12/2001	0	7/9/2002	170	7/9/2002	0	7/9/2002	1.1	7/9/2002	220
3110040-002	38.75	-121.34444	7/9/2002	4.1	5/16/2001	0	12/12/2001	0	7/9/2002	0	7/9/2002	0	7/9/2002	1.6	7/9/2002	200
3110048-001	38.983062	-121.375659	4/9/2018	2.1	4/22/2009	0.34	7/13/2016	2.2	4/9/2018	97.1	4/9/2018	3.71	7/18/2019	2.76	4/9/2018	247
3110048-002	38.980075	-121.369185	4/9/2018	2.54	4/22/2009	0.61	7/13/2016	2.1	4/9/2018	0	4/9/2018	1.47	4/9/2018	1.29	4/9/2018	249
3400117-001	38.602797	-121.50572											8/12/2019	0		
3400123-001	38.672825	-121.623796	11/27/2006	7					8/23/2007	100	8/23/2007	40	5/6/2019	0	8/23/2007	250
3400124-001	38.66	-121.33														
3400131-001	38.671667	-121.611111							6/15/1995	113	6/15/1995	32	11/28/2018	3.58		
3400139-002	38.689662	-121.589795	5/13/2019	40			5/13/2019	0	8/12/2019	330	8/12/2019	250	5/24/2007	0.5	8/12/2019	460
3400139-003	38.685083	-121.59011											5/24/2007	0.5		
3400139-004	38.643894	-121.493168											2/3/2005	0.5		
3400171-001	38.64	-121.53														
3400173-002	38.640638	-121.483861	2/14/2017	5.2	2/20/2002	0.16	2/14/2017	8.4	2/14/2017	0	2/14/2017	0	2/4/2019	2.1	2/14/2017	230
3400173-003	38.654819	-121.477561	2/15/2017	4.6	2/20/2002	0.16	2/15/2017	6.2	2/15/2017	100	2/15/2017	0	2/4/2019	0.63	2/15/2017	310
3400173-004	38.643894	-121.493168	2/4/2019	4.3			2/4/2019	5.5	5/21/2018	0	5/21/2018	0	2/4/2019	4.3	5/21/2018	450
3400173-005	38.646271	-121.502342	2/15/2017	3.8	2/20/2002	0.16	2/15/2017	8.7	2/15/2017	0	2/15/2017	0	2/15/2017	0.48	2/15/2017	200
3400179-001	38.6575	-121.378333	3/15/2018	0	3/15/2018	0.21	10/16/2014	3.6	3/15/2018	0	3/15/2018	0	3/20/2019	0.46	3/20/2019	190
3400179-002	38.658333	-121.380555	4/20/2017	0	4/20/2017	0	10/16/2014	4.5	4/20/2017	0	4/20/2017	0	3/20/2019	0.47	4/20/2017	190
3400190-001	38.675861	-121.326329	6/20/2013	0	6/20/2013	0.29	10/16/2014	5.7	6/20/2013	0	6/20/2013	0	3/20/2019	2.8	3/20/2019	340
3400191-001	38.65525	-121.379888	3/23/2018	2.6	3/23/2018	0	10/29/2014	0	3/23/2018	510	3/23/2018	0	3/20/2019	6.6	3/20/2019	300
3400191-002	38.685618	-121.361651	3/23/2018	2.1	3/23/2018	0	10/29/2014	0	3/23/2018	730	3/23/2018	0	3/20/2019	4.4	3/23/2018	230
3400191-003	38.656327	-121.378432	3/23/2018	0	3/23/2018	0	10/29/2014	0	3/23/2018	300	3/23/2018	0	3/20/2019	4.4	3/23/2018	250
3400196-001	38.62	-121.44														
3400225-001	38.61	-121.53	8/7/2001	9.1					8/7/2001	200	8/7/2001	350	8/7/2001	0		
3400226-001	38.605089	-121.522873	7/23/2004	0	7/23/2004	0			7/23/2004	0	7/23/2004	0	3/20/2019	0		
3400258-001	38.67	-121.37														
3400260-001	38.688055	-121.359444	2/28/2008	2.1					2/28/2008	0	2/28/2008	0	2/28/2008	0.54	2/28/2008	210
3400261-001	38.67	-121.34	8/20/2003	2					8/20/2003	0	8/20/2003	0	9/23/2004	2.7		
3400262-001	38.68	-121.44	4/28/2003	4					4/28/2003	0	4/28/2003	0	4/28/2003	0.9		
3400263-001	38.62	-121.48	2/28/2008	5.8					2/28/2008	0	2/28/2008	0	2/28/2008	0.5	2/28/2008	230
3400264-001	38.72	-121.39	10/2/2001	0					10/2/2001	0	10/2/2001	0	10/2/2001	0.5		
3400265-001	38.7	-121.36														
3400276-001	38.65	-121.54														
3400278-001	38.648694	-121.346694	8/10/2004	3.6	8/10/2004	0			8/10/2004	0	8/10/2004	0	12/18/2018	1.8		
3400278-002	38.650597	-121.344144	8/10/2004	3.6	8/10/2004	0			8/10/2004	0	8/10/2004	0	6/22/2017	0		
3400281-002	38.634611	-121.403111	3/12/2012	2.8							3/12/2012	20	3/12/2012	0.5		

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
3400283-001	38.648694	-121.346694							3/15/2010	0	3/15/2010	0	4/30/2018	7	3/15/2010	460
3400284-001	38.692607	-121.32344							7/28/2008	0	7/28/2008	0	4/16/2008	1.7	7/28/2008	300
3400298-001	38.592112	-121.327685											2/11/2009	0		
3400347-001	38.684099	-121.322031	6/17/2010	3.6	6/17/2010	3.1			6/17/2010	250	6/17/2010	10	6/24/2010	0	6/21/2007	290
3400356-001	38.684099	-121.322031											5/13/2019	0.4		
3400368-001	38.67	-121.23														
3400371-001	38.72	-121.39											7/20/2000	0.93		
3400372-001	38.72	-121.38														
3400383-001	38.618983	-121.536935	7/24/2008	3.1	6/28/2007	0			6/28/2007	0	6/28/2007	0	3/20/2019	0		
3400385-001	38.72	-121.39	10/2/2001	0					10/2/2001	0	10/2/2001	0	10/2/2001	0.93		
3400396-001	38.697778	-121.616944											3/20/2019	0		
3400406-001	38.619087	-121.53506	6/22/2007	5.8	6/3/2004	0			6/3/2004	0	6/3/2004	0	3/20/2019	0		
3400416-001	38.619722	-121.538333											11/29/2017	0		
3400456-001	38.698055	-121.43	9/18/2019	5	5/12/2016	0	12/30/2014	0	5/12/2016	0	5/12/2016	0	8/15/2019	5.5		
3400459-001	38.576666	-121.401666											8/2/2019	6.3		
3410001-001	38.606839	-121.3982	9/5/2017	2.2	10/23/2002	0	4/23/2014	6.5	9/5/2017	100	9/5/2017	20	7/15/2019	2.5	9/5/2017	230
3410001-002	38.59783	-121.398024	7/18/2017	0	10/23/2002	0	12/17/2013	4.8	10/18/2017	100	10/18/2017	20	7/15/2019	3.9	7/18/2017	320
3410001-003	38.6175	-121.411389							4/14/1987	30	4/14/1987	10				
3410001-004	38.611483	-121.410107	6/19/2014	2.1	5/6/2002	0	4/17/2014	4.4	6/19/2014	0	6/19/2014	0	8/10/2015	0.52	6/19/2014	210
3410001-005	38.623478	-121.396638	6/8/2011	2.3	11/17/2004	0	7/8/2002	6.3	6/8/2011	0	6/8/2011	0	7/30/2013	2.5	6/8/2011	190
3410001-006	38.613889	-121.38	1/11/1993	4					1/11/1993	71	1/11/1993	10	1/11/1993	0.79	1/11/1993	190
3410001-007	38.610999	-121.363391	9/27/2017	2	10/23/2002	0	11/12/2014	5.4	9/27/2017	100	9/27/2017	20	9/16/2019	3.9	9/27/2017	250
3410001-008	38.631667	-121.385556	10/11/1995	3					10/11/1995	490	10/11/1995	0	1/8/1997	0.54	2/25/1991	200
3410001-009	38.616331	-121.403703	12/15/2005	2	10/21/2002	0	10/21/2002	0	3/3/2005	1600	3/3/2005	20	1/23/2006	0.7	3/3/2005	190
3410001-010	38.608099	-121.408153	9/12/2017	2.5	10/21/2002	0	4/17/2014	4.4	9/12/2017	100	9/12/2017	20	6/13/2018	1.7	9/12/2017	290
3410001-011	38.619863	-121.396184	9/14/2017	2.7	10/21/2002	0	10/21/2002	0	9/14/2017	100	9/14/2017	20	7/30/2019	1.4	9/14/2017	230
3410001-012	38.617662	-121.403695	12/12/2017	2.1	10/21/2002	0	4/17/2014	7	2/6/2018	100	12/12/2017	20	4/10/2018	2.1	12/12/2017	340
3410001-013	38.598939	-121.370714	9/26/2017	2.9	6/23/2004	0	4/16/2014	3	9/26/2017	100	9/26/2017	20	7/11/2019	1.3	9/26/2017	180
3410001-014	38.61171	-121.386048	6/27/2006	2.8	10/21/2002	0	10/21/2002	3.7	9/14/2006	0	9/14/2006	0	3/12/2009	1.3	9/26/2006	220
3410001-015	38.59781	-121.381308	9/19/2017	2.6	10/17/2002	0	4/23/2014	4.5	9/19/2017	100	9/19/2017	20	7/11/2019	2.7	9/19/2017	170
3410001-016	38.631327	-121.37485	9/4/2014	0	10/21/2002	0	4/14/2014	3.2	9/4/2014	0	9/4/2014	0	7/12/2016	0	9/4/2014	190
3410001-017	38.61981	-121.403732	8/27/2014	0	10/21/2002	0	11/17/2014	5.2	8/27/2014	0	8/27/2014	0	2/8/2016	0.53	8/27/2014	160
3410001-018	38.623854	-121.374359	9/19/2017	2	10/17/2002	0	11/6/2014	6.6	9/19/2017	100	9/19/2017	20	7/11/2019	5.4	9/19/2017	350
3410001-019	38.597831	-121.359623	9/25/2017	2	10/23/2002	0	4/16/2014	3.1	9/25/2017	100	9/25/2017	20	7/11/2019	2.1	9/25/2017	270
3410001-020	38.618079	-121.359205	9/19/2017	2	10/15/2002	0	4/14/2014	4.8	9/19/2017	100	9/19/2017	20	7/10/2019	3.4	9/19/2017	340
3410001-021	38.615256	-121.419986	9/12/2017	2.6	10/17/2002	0	4/21/2014	7.9	9/12/2017	100	9/12/2017	20	7/29/2019	2.1	9/12/2017	250
3410001-022	38.604549	-121.42274	9/11/2017	2.5	10/17/2002	0	4/21/2014	2.1	9/11/2017	100	9/11/2017	20	7/25/2019	0.71	9/11/2017	300
3410001-023	38.614722	-121.349444	2/5/1998	0					2/5/1998	0	2/5/1998	40	5/16/2000	1	2/5/1998	240
3410001-024	38.641255	-121.370271	2/19/2001	0					2/19/2001	0	2/19/2001	0	2/19/2001	2.3	2/19/2001	280
3410001-025	38.60046	-121.359118	9/19/2017	2.7	10/21/2002	0	11/7/2013	1.4	9/19/2017	100	9/19/2017	20	7/26/2018	1	9/19/2017	130
3410001-026	38.627091	-121.384097	2/23/2005	2	10/21/2002	0	10/21/2002	0	2/23/2005	540	2/23/2005	20	2/23/2005	2	2/23/2005	220
3410001-027	38.605146	-121.390988	9/27/2017	2.5	11/7/2002	0	4/21/2014	7.1	9/27/2017	100	9/27/2017	20	7/17/2018	4.2	9/27/2017	260
3410001-028	38.63562	-121.381097	8/21/2014	0	11/17/2004	0	2/11/2015	11	8/21/2014	0	8/21/2014	0	8/21/2014	2.2	8/21/2014	240
3410001-029	38.630252	-121.397575	10/3/2017	2.3	10/7/2002	0.2	4/16/2014	6.6	10/3/2017	100	10/3/2017	20	10/3/2017	1.8	10/3/2017	230
3410001-030	38.617802	-121.424022	9/26/2017	2.4	11/17/2004	0	4/17/2014	7.3	9/26/2017	100	9/26/2017	20	7/9/2018	2.5	9/26/2017	260
3410001-031	38.61919	-121.371454	11/20/2007	2.2					11/20/2007	0	11/20/2007	0	11/20/2007	3.6	11/20/2007	240
3410001-032	38.622918	-121.413817	9/19/2017	2.3	10/15/2002	0	4/17/2014	6.6	9/19/2017	100	9/19/2017	20	7/9/2018	2.3	9/19/2017	250
3410001-033	38.601378	-121.424	7/10/2014	0	11/7/2002	0	4/23/2014	2.7	7/10/2014	290	7/10/2014	0	7/10/2014	1.5	7/10/2014	290
3410001-034	38.584674	-121.396539	9/11/2017	2	6/23/2004	0	4/16/2014	6.4	9/11/2017	100	9/11/2017	20	7/16/2019	5	9/11/2017	500
3410001-035	38.594464	-121.351844	9/28/2017	2	10/15/2002	0	4/16/2014	0	9/28/2017	100	9/28/2017	20	7/26/2018	2.3	9/28/2017	260
3410001-036	38.59115	-121.335446	7/25/1989	5.5					7/25/1989	22	7/25/1989	5.1	1/9/1997	0		
3410001-037	38.578611	-121.366667	2/5/1998	0					2/5/1998	0	2/5/1998	0	6/13/2000	2.5	2/5/1998	160
3410001-038	38.578371	-121.363395	6/9/2011	0	10/17/2002	0	10/17/2002	0	6/9/2011	0	6/9/2011	0	7/25/2012	0.5	6/9/2011	130
3410001-039	38.591742	-121.346413	6/20/2006	2.6	10/17/2002	0	10/17/2002	0	9/18/2006	0	9/18/2006	0	6/16/2010	0.32	9/18/2006	110
3410001-040	38.624895	-121.35055	6/8/1999	0					6/8/1999	0	6/8/1999	230	6/13/2000	0	6/8/1999	190
3410001-041	38.587778	-121.358056	2/4/1998	0					2/4/1998	0	2/4/1998	0	2/4/1998	1	2/4/1998	140

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
3410001-042	38.628014	-121.358648	9/12/2017	2.6	10/15/2002	0	4/10/2014	3.4	9/12/2017	100	9/12/2017	20	7/11/2019	2	9/12/2017	240
3410001-043	38.580278	-121.338333							1/11/1993	30	1/11/1993	10	8/19/1997	0		
3410001-051	38.636187	-121.375067	9/11/2017	2	10/17/2002	0	4/16/2014	7.6	9/11/2017	100	9/11/2017	20	7/10/2019	2.4	9/11/2017	220
3410001-052	38.625054	-121.362252	9/11/2017	2.4	6/22/2004	0	4/17/2014	3.1	9/11/2017	100	9/11/2017	20	7/10/2019	1.9	9/11/2017	190
3410001-053	38.6075	-121.359167	7/26/1995	1					7/26/1995	310	1/13/1999	120	7/26/1995	3.8	7/26/1995	230
3410001-054	38.582422	-121.408379	9/13/2017	2.7	11/7/2002	0	4/16/2014	2.1	9/13/2017	100	8/8/2019	22	7/16/2019	2.7	9/13/2017	320
3410001-055	38.594474	-121.39864	12/13/2017	2.9	11/7/2002	0	4/23/2014	3.8	12/13/2017	100	12/13/2017	40	12/13/2017	1.8	12/13/2017	220
3410001-056	38.578749	-121.41096	9/13/2017	2.3	10/17/2002	0	4/16/2014	1.7	9/13/2017	100	9/13/2017	20	7/9/2018	1.1	9/13/2017	220
3410001-057	38.581667	-121.3425	10/13/1995	0					10/13/1995	0	10/13/1995	0	5/1/1996	0	10/13/1995	39
3410001-061	38.582786	-121.338489	3/20/2018	2.5	10/7/2002	0	4/17/2014	2.6	3/20/2018	100	9/26/2017	20	7/18/2019	0.82	9/26/2017	110
3410001-062	38.618056	-121.401944	9/5/2017	2	10/7/2002	0	4/10/2014	2.6	9/5/2017	100	9/5/2017	20	7/25/2019	0.86	9/5/2017	290
3410001-063	38.587249	-121.358393	7/28/1999	0					7/28/1999	0	7/28/1999	0	11/27/2001	2	7/28/1999	150
3410001-064	38.584121	-121.353432	9/12/2017	2.3	10/17/2002	0	4/10/2014	2.2	9/12/2017	100	9/12/2017	20	7/11/2019	0.73	9/12/2017	160
3410001-065	38.583196	-121.33679	9/21/2017	2.7	10/7/2002	0	4/23/2014	3.2	9/21/2017	100	9/21/2017	20	7/18/2019	1.1	9/21/2017	130
3410001-066	38.582214	-121.338203	9/12/2017	2.3	10/7/2002	0	4/17/2014	3.3	9/12/2017	100	9/12/2017	20	7/18/2019	0.91	9/12/2017	130
3410001-067	38.582481	-121.417169	10/1/2014	2.5	7/8/2002	0	4/21/2014	0	1/8/2015	430	1/8/2015	750	10/1/2014	0	10/1/2014	410
3410001-068	38.614258	-121.350454	9/17/1999	3					9/17/1999	0	9/17/1999	110	9/17/1999	0	9/17/1999	160
3410001-069	38.580609	-121.384004	9/28/2017	2	11/7/2002	0	4/10/2014	1.4	9/28/2017	100	9/28/2017	20	7/16/2019	3.4	9/28/2017	290
3410001-070	38.576006	-121.403088	9/12/2017	2.2	11/7/2002	0	4/10/2014	4.2	9/12/2017	100	9/12/2017	20	7/16/2019	2.6	9/12/2017	340
3410001-071	38.63056	-121.397787	9/14/2017	4.8	10/15/2002	0	4/10/2014	1.1	9/12/2019	100	9/12/2019	120	7/10/2019	0.73	9/14/2017	190
3410001-072	38.61744	-121.411527	9/12/2017	2	10/7/2002	0	4/10/2014	4.7	9/12/2017	100	9/12/2017	20	7/25/2019	2.4	9/12/2017	260
3410001-073	38.58058	-121.383962	9/7/2017	2	10/7/2002	0	4/21/2014	0	7/25/2019	100	7/25/2019	39	7/25/2019	0.4	9/7/2017	250
3410001-076	38.644265	-121.362069	7/10/2019	2	11/22/2001	0	4/15/2014	1.9	7/10/2019	100	7/10/2019	20	7/10/2019	2.2	7/10/2019	260
3410001-077	38.631522	-121.352911	7/10/2019	2.3	11/27/2001	0	4/17/2014	4.8	7/10/2019	100	7/10/2019	20	7/10/2019	3.8	7/10/2019	260
3410001-078	38.684818	-121.355931	7/9/2019	2.1	10/7/2002	0	4/16/2014	4.1	7/9/2019	100	7/9/2019	20	7/9/2019	0.95	7/9/2019	240
3410001-079	38.667577	-121.334161	7/24/2013	0	12/4/2001	0	12/13/2001	2	7/24/2013	0	7/24/2013	0	7/24/2013	0.88	7/24/2013	240
3410001-080	38.672567	-121.331573	7/17/2019	2	11/22/2001	0	4/10/2014	3.8	7/17/2019	100	7/17/2019	20	7/17/2019	4.8	7/17/2019	450
3410001-081	38.683333	-121.333333	7/22/2019	2			4/16/2014	1.8	7/22/2019	100	7/22/2019	41	7/22/2019	0.87	7/22/2019	340
3410001-082	38.648929	-121.338368	7/21/2016	0	11/30/2004	0	4/17/2014	2.1	7/21/2016	0	7/21/2016	0	7/18/2018	1.3	7/21/2016	180
3410001-083	38.663692	-121.347786	7/9/2019	2	11/27/2001	0	4/10/2014	4.4	7/9/2019	100	7/9/2019	20	7/9/2019	1.7	7/9/2019	220
3410001-084	38.666667	-121.35	7/28/1988	4					7/28/1988	630	7/28/1988	730	7/28/1988	0.2	7/28/1988	400
3410001-085	38.644208	-121.329841	7/17/2019	2	11/22/2001	0	4/17/2014	4.2	7/17/2019	100	7/17/2019	20	10/1/2019	4.7	7/17/2019	280
3410001-086	38.666667	-121.366667	4/29/1988	4					4/29/1988	60	4/29/1988	290	4/29/1988	0.7	4/29/1988	240
3410001-087	38.645858	-121.392317	7/11/2019	2.1	11/27/2001	0	4/10/2014	4	7/11/2019	100	7/11/2019	20	7/11/2019	0.43	7/11/2019	240
3410001-088	38.668746	-121.361	7/11/2013	0	11/27/2001	0	4/16/2014	7.4	6/4/2014	0	6/4/2014	0	10/19/2015	0.72	7/11/2013	210
3410001-089	38.653579	-121.379692	7/9/2019	2	6/22/2004	0	4/16/2014	5.1	7/9/2019	100	7/9/2019	20	7/9/2019	1.1	7/9/2019	240
3410001-090	38.683333	-121.35	6/30/1988	4					2/26/1991	180	2/26/1991	100	6/30/1988	0.2	6/30/1988	280
3410001-091	38.633333	-121.366667	2/1/1993	4					2/1/1993	30	2/1/1993	140	2/1/1993	0.2	2/1/1993	270
3410001-092	38.63889	-121.342759	7/20/2016	2.4	11/22/2001	0	4/16/2014	0	7/24/2018	100	7/24/2018	52	7/24/2018	0.4	7/20/2016	180
3410001-093	38.65	-121.366667	10/31/1996	4					10/31/1996	2300	10/31/1996	40	10/31/1996	0	10/31/1996	240
3410001-094	38.652299	-121.354305	7/10/2019	2	11/22/2001	0	4/16/2014	5.5	7/10/2019	100	7/10/2019	20	7/10/2019	0.85	7/10/2019	180
3410001-095	38.658062	-121.356402	6/21/2007	0	11/27/2001	0	12/13/2001	0	6/21/2007	0	6/21/2007	0	5/28/2009	1.3	6/21/2007	200
3410001-096	38.689669	-121.360198	7/9/2019	2.4	11/27/2001	0	4/10/2014	6.2	7/9/2019	100	7/9/2019	20	7/9/2019	3.3	7/9/2019	290
3410001-097	38.694158	-121.360024	7/11/2019	2.4	11/27/2001	0	4/16/2014	7.9	7/11/2019	100	7/11/2019	20	7/11/2019	3.1	7/11/2019	310
3410001-098	38.700217	-121.351805	7/9/2019	2.5	12/4/2001	0	11/14/2013	8.2	7/9/2019	100	7/9/2019	20	7/9/2019	1.5	7/9/2019	240
3410001-099	38.655401	-121.313482	6/21/2007	0	11/27/2001	0	12/13/2001	0	6/21/2007	0	6/21/2007	0	4/8/2010	5	6/21/2007	310
3410001-100	38.666667	-121.316667	10/12/1995	0					10/31/1996	780	10/31/1996	70	1/27/1998	7.7	10/31/1996	370
3410001-101	38.663926	-121.32579	7/7/2016	0	11/22/2001	0	4/17/2014	4.6	7/7/2016	0	7/7/2016	0	4/15/2019	5.9	7/7/2016	380
3410001-102	38.675049	-121.315501	7/15/2019	2	11/22/2001	0	4/16/2014	4.1	7/15/2019	100	7/15/2019	20	10/1/2019	5.7	7/15/2019	320
3410001-103	38.651225	-121.32298	11/13/2013	0	11/27/2001	0	11/14/2013	1.7	1/13/2014	0	1/13/2014	0	11/13/2013	0.84	11/13/2013	170
3410001-104	38.710442	-121.331662	7/10/2019	2	12/4/2001	0	4/10/2014	3.7	7/10/2019	100	7/10/2019	20	7/10/2019	1.4	7/10/2019	300
3410001-105	38.710528	-121.331667	7/10/2019	2	12/4/2001	0	4/10/2014	3	7/10/2019	100	7/10/2019	20	7/10/2019	1.3	7/10/2019	310
3410001-106	38.710517	-121.331659	7/8/2013	0	12/4/2001	0	2/19/2015	11	6/4/2014	0	6/4/2014	0	8/21/2014	3.4	7/8/2013	330
3410001-107	38.709903	-121.357066	7/14/2016	2.5	12/4/2001	0	4/16/2014	2.2	7/14/2016	0	7/14/2016	0	7/18/2018	0.52	7/14/2016	340
3410001-110	38.657778	-121.385278														
3410001-111	38.665363	-121.383099	7/11/2019	2.3	12/13/1995	0.1	4/24/2014	8.5	7/11/2019	100	7/11/2019	20	7/11/2019	3.4	7/11/2019	320

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
3410001-112	38.651944	-121.3825														
3410001-114	38.646389	-121.4025														
3410001-116	38.646111	-121.409444	12/13/1995	3.1	12/13/1995	0.1			12/13/1995	50	12/13/1995	30	12/13/1995	1.4	12/13/1995	208
3410001-117	38.646111	-121.409444														
3410001-118	38.646111	-121.409444														
3410001-119	38.646111	-121.409444														
3410001-120	38.646111	-121.409444														
3410001-121	38.646111	-121.409444	12/13/1995	2.5	12/13/1995	0.1			12/13/1995	50	12/13/1995	30	12/13/1995	1.5	12/13/1995	209
3410001-122	38.646111	-121.409444														
3410001-124	38.671944	-121.404444														
3410001-125	38.673056	-121.390833	12/21/1998	0	12/13/1995	0.1			12/21/1998	0	12/21/1998	0	7/1/2002	5	12/21/1998	157
3410001-126	38.869722	-121.390278														
3410001-127	38.712268	-121.381099	7/29/2013	2.6	12/4/2001	0	11/11/2014	12	7/29/2013	0	7/29/2013	0	8/21/2014	2	7/29/2013	220
3410001-128	38.709783	-121.374669	6/17/2010	3.4	12/4/2001	0	12/13/2001	11	6/17/2010	110	6/17/2010	0	6/17/2010	1.8	6/17/2010	230
3410001-129	38.710651	-121.387666	7/29/2013	2.9	12/4/2001	0	2/26/2015	13	7/29/2013	0	7/29/2013	0	10/15/2014	2.1	7/29/2013	230
3410001-132	38.670226	-121.380503	10/11/1995	0					10/11/1995	1100	10/11/1995	130	4/30/1996	2		
3410001-133	38.682932	-121.376063	7/22/2019	2.1	11/4/2002	0.1	4/21/2014	6.2	7/22/2019	100	7/22/2019	20	7/22/2019	0.56	7/22/2019	240
3410001-135	38.68794	-121.385107	11/7/2016	0	11/4/2002	0.2	12/19/2013	2.9	11/7/2016	160	3/13/2018	24	3/13/2018	2.9	11/7/2016	270
3410001-136	38.685899	-121.372701	3/27/2018	3	11/4/2002	0	3/27/2018	9.5	3/27/2018	100	3/27/2018	20	3/27/2018	2.6	3/27/2018	280
3410001-137	38.692847	-121.375953	7/29/2013	0	11/4/2002	0	2/19/2015	12	6/30/2014	0	6/30/2014	0	8/21/2014	2.1	7/29/2013	260
3410001-138	38.676018	-121.36531	3/8/2005	3					4/23/2002	2800	4/23/2002	180	1/28/2004	2	4/23/2002	220
3410001-139	38.69191	-121.364477	7/19/2016	2.4	11/4/2002	0	11/4/2002	8.4	7/19/2016	0	7/19/2016	0	7/12/2018	0.84	7/19/2016	270
3410001-140	38.675278	-121.378889	2/5/1998	0					2/5/1998	0	2/5/1998	0	5/16/2000	1	2/5/1998	280
3410001-141	38.70172	-121.380618	10/11/1995	3.3					10/11/1995	0	10/11/1995	0	1/26/1995	0.54	1/29/1992	269
3410001-142	38.686782	-121.392424	7/11/2016	0	7/15/2002	0.3	4/21/2014	4.3	7/11/2016	0	7/11/2016	0	9/13/2017	1	7/11/2016	250
3410001-143	38.701228	-121.371968	2/4/1998	2					2/4/1998	0	2/4/1998	0	5/16/2000	0.7	2/4/1998	220
3410001-144	38.69798	-121.373877	7/23/2019	2.1	11/4/2002	0	11/21/2013	2.5	7/23/2019	100	7/23/2019	20	7/23/2019	0.52	7/23/2019	310
3410001-145	38.67526	-121.379573	7/10/2019	2	11/4/2002	0.4	4/10/2014	3.3	7/10/2019	100	7/10/2019	20	7/10/2019	0.51	7/10/2019	360
3410002-001	38.583333	-121.383333	2/8/2017	0	2/20/2002	0	2/8/2017	1.8	2/8/2017	0	2/8/2017	0	2/5/2019	2.7	2/8/2017	270
3410002-002	38.583333	-121.366667	2/8/2017	0	2/20/2002	0	2/8/2017	2.5	2/8/2017	0	2/8/2017	0	8/13/2019	1.5	2/8/2017	260
3410002-007	38.566667	-121.4	2/14/2017	0	2/20/2002	0	2/14/2017	1.4	2/14/2017	0	2/14/2017	0	2/4/2019	0.45	2/14/2017	140
3410002-009	38.566667	-121.4	2/10/1998	0					2/10/1998	0	2/10/1998	0	6/17/1999	0	2/10/1998	140
3410002-012	38.566667	-121.416667	5/8/2017	0	2/20/2002	0	11/14/2017	0	5/8/2017	0	5/8/2017	38	8/13/2019	0	5/8/2017	180
3410002-013	38.583333	-121.416667	2/14/2017	3.5	2/20/2002	0	2/14/2017	0	2/14/2017	0	2/14/2017	0	2/4/2019	0	2/14/2017	94
3410002-014	38.583333	-121.366667	5/8/2017	0	2/20/2002	0	11/14/2017	2.3	5/8/2017	0	5/8/2017	0	5/13/2019	1.1	5/8/2017	180
3410003-001	38.587545	-121.385145	2/6/2019	2	12/17/2002	0	11/18/2014	3.4	2/6/2019	440	2/6/2019	27	2/6/2019	0.4	2/6/2019	180
3410003-002	38.582537	-121.383219	2/28/2017	2	12/17/2002	0	11/18/2014	2.6	2/28/2017	100	2/28/2017	20	1/8/2019	3	2/28/2017	250
3410003-003	38.583333	-121.383333	4/15/1998	2.4					4/15/1998	200	6/17/1998	0	4/15/1998	1.3	4/15/1998	220
3410003-004	38.587611	-121.392074	1/25/2005	2.5	7/31/2003	0	7/31/2003	4.2	1/25/2005	40	1/25/2005	2	7/11/2007	5.2	1/25/2005	250
3410003-005	38.591017	-121.384139	7/11/2017	2.2	12/17/2002	0	11/18/2014	4.5	7/11/2017	100	7/11/2017	20	1/8/2019	4.2	7/11/2017	310
3410003-006	38.59211	-121.387633	2/28/2017	2.5	12/17/2002	0	11/18/2014	4.5	2/28/2017	100	2/28/2017	20	1/8/2019	2.6	2/28/2017	230
3410003-007	38.6	-121.383333	4/15/1998	3					4/15/1998	0	4/15/1998	0	2/1/1999	4.3	4/15/1998	240
3410003-008	38.600074	-121.391973	2/28/2017	2.8	12/17/2002	0	11/18/2014	4.6	2/28/2017	100	2/28/2017	20	1/8/2019	2.1	2/28/2017	190
3410004-001	38.645432	-121.313067	2/3/2004	0	1/29/2003	0	1/29/2003	3.5	2/3/2004	100	2/3/2004	0	2/3/2004	7.355	2/3/2004	340
3410004-002	38.6	-121.35	10/18/1995	3.1					10/18/1995	1300	10/18/1995	78	2/7/1995	0.5	3/1/1991	140
3410004-004	38.64988	-121.30798	1/28/2010	0	4/30/2003	0	7/23/2003	1.5	1/28/2010	0	1/28/2010	0	7/28/2011	5.9	1/28/2010	370
3410004-005	38.633333	-121.35	10/4/2001	0			10/3/2001	0	10/4/2001	380	10/4/2001	44	10/4/2001	0	10/4/2001	150
3410004-006	38.622744	-121.335704	6/1/2017	0	11/4/2003	0	6/4/2015	1.5	6/1/2017	0	6/1/2017	0	3/7/2019	1.4	6/1/2017	180
3410004-007	38.594673	-121.334606	10/23/2002	0	10/23/2002	0	10/23/2002	1.4	10/23/2002	0	10/23/2002	0	10/23/2002	0	10/23/2002	110
3410004-008	38.65	-121.316667	8/1/1990	4					8/1/1990	580	8/1/1990	14	2/7/1995	0.38	8/1/1990	240
3410004-009	38.619652	-121.333354	6/1/2017	0	10/23/2003	0	6/4/2015	1.3	6/1/2017	0	6/1/2017	0	3/7/2019	1.2	6/1/2017	170
3410004-012	38.633333	-121.3	4/13/1995	0					4/13/1995	0	4/13/1995	0	5/2/1996	0.5	4/13/1995	45
3410004-014	38.633333	-121.3							1/28/1993	74	1/28/1993	130				
3410004-015	38.65	-121.316667	10/18/1995	0					10/18/1995	0	10/18/1995	0	2/7/1995	6.1	2/19/1991	250
3410004-016	38.645576	-121.306819	6/1/2017	3.6	4/30/2003	0	6/4/2015	3	6/1/2017	4700	6/1/2017	35	6/7/2018	5.1	6/1/2017	360
3410004-020	38.641845	-121.315446	6/1/2017	0	10/21/2003	0	6/4/2015	3.2	6/1/2017	110	6/1/2017	60	6/7/2018	5.6	6/1/2017	320

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
3410004-021	38.604804	-121.342252	6/1/2017	0	10/23/2003	0	6/4/2015	0	6/1/2017	0	6/1/2017	0	3/7/2019	0.48	6/1/2017	120
3410006-001	38.661305	-121.292607	5/30/2019	0	10/21/2004	0	5/30/2019	0	5/30/2019	310	5/30/2019	290	11/14/2018	0.99	2/20/2013	190
3410006-002	38.713889	-121.266667	1/21/1998	2					1/21/1998	0	1/21/1998	0	1/21/1998	0.9	1/21/1998	360
3410006-003	38.708333	-121.283333	8/2/1990	4					10/5/1990	180	10/5/1990	12	10/5/1990	4.3	10/5/1990	390
3410006-005	38.683333	-121.283333	10/5/1990	4					1/26/1993	30	1/26/1993	10	10/5/1990	2.3	10/5/1990	210
3410006-006	38.666667	-121.277778	4/10/1987	4					4/10/1987	30	4/10/1987	10	10/25/2016	7.3	4/10/1987	250
3410006-007	38.705556	-121.308333	1/21/1998	0					1/21/1998	0	1/21/1998	0	1/21/1998	2.3	1/21/1998	300
3410006-008	38.679425	-121.289154	2/20/2013	0	10/21/2004	0.11	1/24/2019	1.8	2/20/2013	0	2/20/2013	0	1/24/2019	2.9	2/20/2013	260
3410006-010	38.698638	-121.269673	6/6/2018	4.6	10/21/2004	0	8/17/2016	2	6/6/2018	2900	6/6/2018	680	4/12/2018	0.92	2/20/2013	220
3410007-001	38.613787	-121.367811	6/24/2010	2.2	9/5/2002	0	9/25/2002	3.4	6/24/2010	0	6/24/2010	0	6/24/2010	1	6/24/2010	180
3410007-002	38.613607	-121.371676	8/18/2016	0	9/5/2002	0	8/13/2018	3.5	8/7/2019	0	8/7/2019	0	8/7/2019	1.1	8/7/2019	190
3410007-003	38.606352	-121.369707	8/22/2016	0	2/3/2003	0	8/5/2015	2.1	12/11/2018	940	8/22/2016	21	9/11/2018	2.6	8/22/2016	330
3410007-004	38.607768	-121.374083	8/17/2016	2.2	9/5/2002	0	8/13/2018	6.8	8/6/2019	0	8/6/2019	0	8/6/2019	0.87	8/6/2019	170
3410007-005	38.61458	-121.378552	8/18/2016	2.1	9/5/2002	0	8/13/2018	8.7	8/6/2019	410	8/6/2019	29	8/6/2019	1.8	8/6/2019	220
3410007-006	38.60731	-121.364767	6/28/2010	0	9/5/2002	0	8/5/2015	3.8	1/20/2012	0	1/20/2012	0	3/8/2012	0	6/28/2010	160
3410007-007	38.606531	-121.380719	6/21/2018	2.4	9/5/2002	0	8/14/2018	5.2	8/6/2019	230	8/6/2019	0	8/6/2019	3.5	8/6/2019	280
3410007-008	38.613172	-121.380739	8/16/2016	3	9/5/2002	0	8/14/2018	8.8	8/13/2019	130	8/13/2019	39	8/13/2019	1.5	8/13/2019	210
3410009-001	38.643048	-121.268528	6/26/2003	0	12/17/2003	0	12/17/2003	0	6/16/2004	0	6/16/2004	0	6/16/2004	0	6/16/2004	100
3410009-003	38.666667	-121.216667	2/8/2000	0					2/8/2000	0	2/8/2000	0	2/8/2000	0.9	2/8/2000	180
3410009-004	38.651282	-121.255173	6/6/2006	0	12/17/2003	0	12/17/2003	0	6/6/2006	0	6/6/2006	0	12/6/2007	2.5	6/6/2006	270
3410009-005	38.650805	-121.286999	6/26/2003	0	12/17/2003	0	12/17/2003	0	6/16/2004	0	6/16/2004	0	3/17/2005	0.5	6/16/2004	140
3410009-006	38.642768	-121.278261	5/10/2012	0	12/17/2003	0	11/8/2018	0	6/14/2012	0	6/14/2012	0	5/2/2019	0.45	6/14/2012	110
3410009-007	38.651297	-121.296666	5/10/2012	0	12/17/2003	0	11/8/2018	0	6/14/2012	0	6/14/2012	0	5/2/2019	0.56	6/14/2012	150
3410009-008	38.662066	-121.265396	6/6/2006	2.2	12/17/2003	0	12/17/2003	0	6/6/2006	0	6/6/2006	0	6/29/2007	0.5	6/6/2006	400
3410009-009	38.666667	-121.266667											1/22/1997	0.5		
3410009-010	38.659628	-121.25556	3/28/2019	0	12/17/2003	0	3/28/2019	0	6/14/2012	0	6/14/2012	0	5/2/2019	1.3	6/14/2012	150
3410013-001	38.694922	-121.332628	8/13/2018	0	8/13/2018	0.29	5/17/2017	1.57	8/13/2018	0	8/13/2018	0	8/6/2019	1.25	8/13/2018	280
3410013-002	38.69054	-121.34151	8/13/2018	0	8/13/2018	0.2	5/17/2017	1	8/13/2018	0	8/6/2019	43	8/6/2019	0.22	8/13/2018	260
3410013-003	38.683982	-121.31348	8/16/2018	0	8/16/2018	0	12/19/2017	2.14	8/29/2018	5500	8/16/2018	0	8/8/2019	1.71	8/16/2018	230
3410013-004	38.699328	-121.295627	8/7/2018	0	8/7/2018	0.24	5/9/2017	4.11	8/7/2018	0	8/7/2018	0	8/7/2018	3.1	8/7/2018	300
3410013-005	38.669042	-121.293798	8/7/2018	0	8/7/2018	0	5/9/2017	1.91	8/7/2018	0	8/7/2018	0	8/6/2019	2.82	8/7/2018	220
3410013-006	38.685052	-121.305855	8/8/2018	0	8/8/2018	0	5/9/2017	1	8/8/2018	0	8/8/2018	0	8/7/2019	1.67	8/8/2018	210
3410013-007	38.691478	-121.336784	8/19/2015	2	8/19/2015	0.1	5/9/2017	2.15	11/16/2016	480	8/19/2015	20	2/19/2018	1.79	8/19/2015	270
3410013-008	38.673506	-121.340002	8/16/2018	0	8/16/2018	0	9/19/2018	3.9	8/29/2018	960	8/16/2018	22	8/6/2019	2.38	8/16/2018	310
3410013-009	38.695662	-121.29509	8/7/2018	0	8/7/2018	0	5/9/2017	3.63	8/7/2018	0	8/7/2018	0	8/6/2019	4.41	8/7/2018	390
3410013-010	38.670117	-121.341406	8/15/2018	0	8/15/2018	0	5/10/2017	1	8/15/2018	570	8/15/2018	59	8/6/2019	1.44	8/15/2018	380
3410013-012	38.66565	-121.302524	8/13/2018	0	8/13/2018	0	5/8/2017	1.62	8/13/2018	0	8/13/2018	0	8/7/2019	2.89	8/13/2018	230
3410013-013	38.678824	-121.304628	8/13/2018	0	8/13/2018	0	5/8/2017	3.63	8/13/2018	100	8/13/2018	0	8/7/2019	3.58	8/13/2018	290
3410013-014	38.668822	-121.304482	8/8/2018	0	8/8/2018	0	5/8/2017	2.25	8/8/2018	0	8/8/2018	0	8/6/2019	2.02	8/8/2018	180
3410013-015	38.70124	-121.345319	8/6/2018	0	8/6/2018	0	5/8/2017	7.29	8/6/2018	0	8/6/2018	0	8/6/2019	1.21	8/6/2018	220
3410013-016	38.709473	-121.292244	8/13/2018	0	8/13/2018	0.61	2/13/2018	5.2	8/13/2018	0	8/13/2018	0	9/10/2019	1.89	8/13/2018	310
3410013-017	38.712243	-121.303547	8/24/2006	2	8/24/2006	0.539	9/17/2002	0	8/24/2006	0	8/24/2006	0	8/24/2006	2.1	8/24/2006	370
3410013-019	38.700287	-121.330955	8/6/2018	0	8/6/2018	0.35	10/19/2017	4.58	8/6/2018	0	8/6/2018	0	8/6/2019	1.85	8/6/2018	290
3410013-020	38.716217	-121.294262	8/24/2006	2	8/24/2006	0.85	9/5/2002	2.6	8/24/2006	0	8/24/2006	0	8/24/2006	2	8/24/2006	380
3410013-021	38.683333	-121.35	8/8/2018	0	8/8/2018	0	5/8/2017	2.43	8/8/2018	0	8/8/2018	0	8/6/2019	6.99	8/8/2018	390
3410013-022	38.7124	-121.306829	9/11/2012	2	9/11/2012	0.761	5/9/2017	1.86	9/11/2012	100	9/11/2012	10	4/5/2017	1.79	9/11/2012	340
3410013-023	38.695536	-121.313454	8/7/2018	0	8/7/2018	0.26	5/8/2017	3.66	8/7/2018	120	8/7/2018	0	8/7/2019	1.58	8/7/2018	250
3410013-024	38.680539	-121.31067	8/7/2018	0	8/7/2018	0	5/7/2019	3.51	8/7/2018	0	8/7/2018	0	8/6/2019	2.82	8/7/2018	260
3410013-025	38.718426	-121.313299	8/13/2018	0	8/13/2018	0.5	5/17/2017	4.09	8/13/2018	0	8/13/2018	0	8/13/2018	0.72	8/13/2018	290
3410013-026	38.701667	-121.344722	8/6/2018	0	8/6/2018	0.35	5/8/2017	4.56	8/6/2018	0	8/6/2018	0	8/6/2019	0.9	8/6/2018	260
3410013-027	38.709413	-121.317252	9/18/2012	1	9/18/2012	0.569	5/7/2014	3.5	9/18/2012	100	9/18/2012	10	5/5/2015	1.64	9/18/2012	320
3410013-028	38.698857	-121.32618	8/13/2018	0	8/13/2018	0.33	5/8/2017	2.52	8/13/2018	1100	8/13/2018	0	8/6/2019	1.38	8/13/2018	280
3410016-001	38.686538	-121.219546	12/3/2007	2	12/4/2001	0.3	9/25/2002	2.2	12/21/2004	0	12/21/2004	0	3/22/2007	2.5	12/21/2004	280
3410016-002	38.694541	-121.210813	1/17/2013	7.5	12/4/2001	1.5	9/25/2002	1.1	1/17/2013	130	1/17/2013	0	12/14/2016	2.5	1/17/2013	450
3410018-001	38.683333	-121.45	4/9/1987	8					4/9/1987	100	4/9/1987	10	4/9/1987	2.7	4/9/1987	280
3410018-002	38.7	-121.45	2/28/1991	7					2/28/1991	30	2/28/1991	10	2/28/1991	2	2/28/1991	200

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
3410018-005	38.721801	-121.46774	3/5/2002	13	12/19/2002	0.2	12/19/2002	3.7	3/5/2002	0	3/5/2002	90	3/3/2005	0.5	3/5/2002	200
3410018-008	38.690277	-121.41111							2/28/1991	30	2/28/1991	10				
3410020-011	38.616667	-121.45	6/30/1990	5					6/30/1990	10	6/30/1990	10			6/30/1990	252
3410020-015	38.6125	-121.479167	4/3/2017	3.3			4/3/2017	0	4/3/2017	100	4/3/2017	20	4/3/2017	0.4	4/3/2017	252
3410020-016	38.616667	-121.479167	1/20/2015	3.5			2/19/2015	3.3	1/20/2015	100	1/20/2015	20	1/20/2015	2	1/20/2015	420
3410020-017	38.62266	-121.477813	8/24/2017	4.2			7/20/2017	6	8/24/2017	0	8/24/2017	20	7/8/2019	3.4	10/9/2017	466
3410020-018	38.627831	-121.477227	5/8/2017	2.6			7/10/2017	5.8	5/8/2017	0	5/8/2017	20	2/4/2019	2.4	5/8/2017	340
3410020-020	38.602689	-121.457994	1/11/1994	5					1/11/1994	120	1/11/1994	10	1/11/1994	1.2	1/11/1994	420
3410020-021	38.607083	-121.454779	10/12/2011	4.3					10/12/2011	4400	10/12/2011	122	10/10/2012	2.1	10/12/2011	446
3410020-022	38.607305	-121.443097	3/20/2017	2.3			3/20/2017	3.1	3/20/2017	100	3/20/2017	20	4/27/2018	1	3/20/2017	332
3410020-023	38.604956	-121.439486	3/7/2017	2			3/7/2017	3.1	3/7/2017	100	3/7/2017	20	4/20/2018	0.7	3/7/2017	418
3410020-024	38.612801	-121.450505	10/10/2011	3.2			12/3/2002	4.3	10/10/2011	184	10/10/2011	20	10/10/2012	1.5	10/10/2011	202
3410020-025	38.612294	-121.440456	10/9/2008	2					10/9/2008	334	10/9/2008	20	10/9/2008	4.1	10/9/2008	613
3410020-026	38.612369	-121.4322	12/3/2002	2					12/3/2002	360	12/3/2002	20	12/3/2002	0.5	12/3/2002	258
3410020-027	38.620988	-121.443553	5/8/2017	2			5/8/2017	3.1	5/8/2017	0	5/8/2017	20	2/4/2019	1	5/8/2017	294
3410020-028	38.62044	-121.432285	5/8/2017	2			5/8/2017	3.8	5/8/2017	0	5/8/2017	20	2/26/2018	1.4	5/8/2017	293
3410020-029	38.618056	-121.468056	10/8/2018	4.6			3/20/2017	1.8	3/20/2017	100	3/20/2017	20	4/20/2018	2	3/20/2017	328
3410020-030	38.625119	-121.462605	5/8/2017	2			5/8/2017	3.7	5/8/2017	0	5/8/2017	20	2/4/2019	1.5	5/8/2017	321
3410020-031	38.626389	-121.455556	11/30/1988	5					11/30/1988	10	11/30/1988	10	11/30/1988	1	11/30/1988	225
3410020-032	38.628503	-121.43627	8/24/2017	3			8/24/2017	5.1	8/24/2017	0	8/24/2017	20	2/4/2019	1.3	10/9/2017	286
3410020-033	38.626808	-121.42959	10/10/2011	2.6			12/4/2002	2.3	10/10/2011	100	10/10/2011	20	10/10/2012	1.2	10/10/2011	178
3410020-034	38.638412	-121.446721	2/27/2018	2.4			7/10/2017	6.8	2/27/2018	100	2/27/2018	20	2/4/2019	2.9	3/12/2018	284
3410020-035	38.639934	-121.427293	2/27/2018	2.4			7/10/2017	6.5	2/27/2018	100	2/27/2018	20	2/4/2019	0.6	3/12/2018	226
3410020-036	38.639352	-121.417132														
3410020-037	38.651207	-121.469509	5/8/2017	3.7			7/10/2017	7.1	5/8/2017	0	5/8/2017	21.8	2/4/2019	1.2	5/8/2017	244
3410020-038	38.647475	-121.459256	5/8/2017	2.6			7/10/2017	7.7	7/8/2019	100	5/8/2017	20	2/4/2019	1.4	5/8/2017	250
3410020-039	38.627595	-121.432917	10/8/2003	2			12/3/2002	5	10/8/2003	100	10/8/2003	20	11/9/2004	2.7	10/8/2003	261
3410020-040	38.629597	-121.420726	5/9/2017	2.5			7/10/2017	6.4	5/9/2017	0	5/9/2017	20	2/4/2019	2.3	5/9/2017	271
3410020-041	38.641387	-121.435795	5/9/2017	2.2			7/10/2017	7.6	5/9/2017	0	5/9/2017	20	2/4/2019	2.9	5/9/2017	260
3410020-042	38.596923	-121.458973	3/7/2017	3.3			3/7/2017	0	7/8/2019	100	3/7/2017	20	3/5/2019	0.4	3/7/2017	234
3410020-044	38.613996	-121.456155	10/10/2011	2.5			12/3/2002	2.9	10/10/2011	194	10/10/2011	20	10/10/2012	3.7	10/10/2011	427
3410020-045	38.622276	-121.446858	5/9/2017	2			5/9/2017	4.5	5/9/2017	0	5/9/2017	20	2/4/2019	1.9	5/9/2017	334
3410020-046	38.623116	-121.427024	9/22/2014	2.5			4/6/2016	5	9/22/2014	100	9/22/2014	20	3/24/2016	1.4	9/22/2014	287
3410020-047	38.645833	-121.415278														
3410020-048	38.607222	-121.469444	3/9/1993	5					3/9/1993	10	3/9/1993	10	3/9/1993	0.5	3/9/1993	295
3410020-049	38.655	-121.446667	10/22/1990	5					10/22/1990	10	10/22/1990	10	10/22/1990	0.77	10/22/1990	228
3410020-050	38.668053	-121.438012	3/25/2014	3.9			11/3/2015	9.5	3/25/2014	100	3/25/2014	20	10/15/2015	1.6	3/25/2014	260
3410020-051	38.634413	-121.412516	2/27/2018	2.3			4/19/2016	2.2	2/27/2018	100	2/27/2018	20	2/4/2019	0.6	3/12/2018	260
3410020-052	38.599341	-121.445804	5/9/2017	3.7			5/9/2017	0	5/9/2017	0	5/9/2017	20	2/4/2019	0.4	5/9/2017	287
3410020-053	38.594444	-121.444444	5/22/1995	2					5/22/1995	740	5/22/1995	10	5/22/1995	0.036	5/22/1995	257
3410020-054	38.596324	-121.427308	8/24/2017	2.7			8/24/2017	1	8/24/2017	0	8/24/2017	20	2/4/2019	0.5	10/9/2017	286
3410020-055	38.617636	-121.469304	5/9/2017	2.4			5/9/2017	3.6	5/9/2017	0	5/9/2017	20	5/9/2017	1	5/9/2017	329
3410020-056	38.654657	-121.448564	5/9/2017	3.5			7/10/2017	6.5	5/9/2017	0	5/9/2017	20	2/4/2019	0.9	5/9/2017	251
3410020-057	38.658482	-121.466415	12/19/2018	5.2			7/10/2017	5.8	12/19/2018	100	12/19/2018	20	12/27/2018	0.72	12/19/2018	180
3410026-001	38.58961	-121.429343	5/31/2012	0					5/31/2012	600	5/31/2012	49	5/31/2012	0	5/31/2012	220
3410026-002	38.588266	-121.423478	5/3/2018	4.9			4/1/2015	0	5/3/2018	0	5/3/2018	0	3/7/2019	0	5/3/2018	110
3410026-003	38.593617	-121.439154	5/3/2018	2.4			4/1/2015	2.5	5/3/2018	0	5/3/2018	0	3/7/2019	0	5/3/2018	270
3410026-004	38.593339	-121.432431	5/3/2018	2.4			4/1/2015	0	5/3/2018	0	5/3/2018	0	3/7/2019	0	5/3/2018	230
3410031-001	38.720833	-121.358333	5/16/2019	2	8/11/2015	0.1	5/9/2017	8.18	5/16/2019	120	5/16/2019	20	8/7/2019	2.08	8/11/2015	240
3410031-002	38.717222	-121.3575	8/8/2018	2.1	8/8/2018	0.27	5/8/2017	1	8/8/2018	0	8/8/2018	0	8/6/2019	0.8	8/8/2018	310
3410031-003	38.7	-121.383333	8/14/2018	2.6	8/14/2018	0	8/6/2019	14	8/30/2018	420	8/14/2018	0	8/6/2019	1.6	8/14/2018	190
3410031-004	38.718056	-121.382222	8/14/2018	2.5	8/14/2018	0	8/17/2017	6.31	8/14/2018	220	8/14/2018	210	8/8/2019	1.06	8/14/2018	210
3410031-005	38.716667	-121.4	8/5/2015	4	8/5/2015	0.1	5/2/2018	9.55	8/5/2015	110	8/5/2015	20	8/24/2016	3.86	8/5/2015	260
3410031-006	38.708333	-121.383611	8/14/2018	2.6	8/14/2018	0	8/6/2019	10	8/14/2018	0	8/14/2018	0	8/6/2019	1	8/14/2018	190
3410031-007	38.733333	-121.35	8/9/2018	3.1	8/9/2018	0.22	5/11/2017	4.41	8/9/2018	600	8/9/2018	0	8/8/2019	1.09	8/9/2018	160
3410031-008	38.733333	-121.35	8/9/2018	2.5	8/9/2018	0	5/11/2017	8.48	8/9/2018	0	8/9/2018	0	8/8/2019	3.8	8/9/2018	310

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
3410031-009	38.715278	-121.378056	8/7/2018	2.1	8/7/2018	0.47	5/8/2017	1.72	8/7/2018	0	8/7/2018	0	8/6/2019	0.51	8/7/2018	250
3410031-010	38.705	-121.365556	8/7/2018	2.7	8/7/2018	0.47	5/9/2017	1.93	8/21/2018	260	8/8/2019	20	8/8/2019	0.42	8/7/2018	270
3410031-011	38.726944	-121.3825	8/7/2018	2.6	8/7/2018	0.24	11/5/2018	9.28	8/7/2018	180	3/4/2019	20	8/7/2018	1.3	8/7/2018	230
3410031-012	38.721111	-121.368611	8/7/2018	3.4	8/7/2018	0	8/8/2019	10.19	8/7/2018	0	8/7/2018	0	8/8/2019	1.51	8/7/2018	210
3410031-013	38.711667	-121.413889	8/14/2018	3.8	8/14/2018	0	5/8/2017	5.74	8/14/2018	150	8/14/2018	25	8/8/2019	2.2	8/14/2018	250
3410031-014	38.716111	-121.408889	8/14/2018	3.1	8/14/2018	0	5/8/2017	5	8/14/2018	210	8/14/2018	0	8/6/2019	1.93	8/14/2018	300
3410031-015	38.716667	-121.416667	8/14/2018	2.2	8/14/2018	0	5/8/2017	2.02	8/14/2018	180	8/14/2018	0	8/12/2019	2.61	8/14/2018	330
3410031-016	38.724444	-121.336111	8/8/2018	0	8/8/2018	0.21	5/8/2017	2.98	8/8/2018	0	8/8/2018	0	8/6/2019	1.03	8/8/2018	220
3410031-017	38.723056	-121.349722	8/8/2018	2.3	8/8/2018	0	5/8/2017	1.51	8/8/2018	180	8/8/2018	0	8/7/2019	0.95	8/8/2018	220
3410031-018	38.716389	-121.371944	8/7/2018	2.4	8/7/2018	0.26	5/9/2017	1.99	8/7/2018	610	8/7/2018	21	8/8/2019	0.5	8/7/2018	260
3410045-001	38.586137	-121.411513	8/7/2018	2.4	8/7/2018	0	5/9/2017	1.33	8/7/2018	0	8/7/2018	0	8/7/2019	1.12	8/7/2018	210
3410045-002	38.583085	-121.413054	8/7/2018	3.4	8/7/2018	0	5/9/2017	1	8/7/2018	0	8/7/2018	0	8/7/2019	0.28	8/7/2018	140
3410045-003	38.594423	-121.417465	8/7/2018	3.1	8/7/2018	0	5/9/2017	1.52	8/7/2018	0	8/7/2018	0	8/7/2019	1.28	8/7/2018	150
3410045-004	38.592566	-121.407256	7/12/2012	3	7/12/2012	0.05	5/6/2014	2.2	7/12/2012	100	8/11/2014	2831	8/11/2014	2.905	7/24/2012	250
3410045-005	38.600025	-121.410183	8/7/2018	2.5	8/7/2018	0	5/9/2017	4.02	8/7/2018	0	8/7/2018	0	8/7/2019	3.92	8/7/2018	270
3410301-001	38.655029	-121.206869											3/20/2019	0.41		
3901176-001	38.592112	-121.327685											5/16/2019	2.9		
3910005-049	38.8271	-121.232	6/12/2018	6.9			12/9/2014	3.9	6/12/2018	0	6/12/2018	0	8/6/2019	10	6/12/2018	400
5100106-001	38.744444	-121.595833											11/7/2000	0.1		
5100117-001	38.89568	-121.56893							5/1/1995	130	5/1/1995	54	12/20/2000	0.5		
5100117-002	38.902331	-121.570943							12/10/2008	1710	12/10/2008	85	6/21/2017	0	12/10/2008	280
5100117-003	38.896068	-121.567281							12/10/2008	165	12/10/2008	0	6/20/2018	0.12	12/10/2008	309
5100117-004	38.896379	-121.56981							8/18/1999	130	8/18/1999	54	6/20/2018	0		
5100135-001	38.911394	-121.544681							1/15/2003	100	1/15/2003	20	7/24/2019	0.83		
5100136-001	38.911667	-121.525833	11/12/1997	5.9					11/12/1997	100	11/12/1997	30	11/17/1999	2.3	11/12/1997	250
5100136-002	38.911927	-121.526004	4/11/2018	2.16			5/13/2015	6.8	3/14/2012	0	3/14/2012	0	4/17/2019	3.47	3/14/2012	352
5100138-001	38.947299	-121.524183	1/3/2017	8.7			9/9/2014	7.9	10/20/1999	100	10/20/1999	20	1/8/2019	1.33	5/12/2004	153
5100140-001	38.911233	-121.542832	5/19/2010	12.8					5/21/2008	0	5/21/2008	0	5/19/2010	0.581	5/21/2008	101
5100140-002	38.911269	-121.542936	7/20/2016	4			10/10/2014	8.9	7/6/2010	194	7/6/2010	0	7/24/2019	1.88	7/6/2010	288
5100143-001	38.823397	-121.503832	5/18/2005	4.2					11/12/1997	100	11/12/1997	30	5/18/2005	2.1	11/12/1997	240
5100143-002	38.823303	-121.503779	8/21/2019	5.64			8/27/2015	6.5	5/17/2006	100	5/17/2006	20	5/15/2019	2.31	5/17/2006	214
5100153-001	38.771748	-121.5251	4/21/2004	7.7			4/27/2004	1.9	1/17/2001	100	1/17/2001	30	4/20/2005	3.4	4/5/2002	415
5100153-002	38.772313	-121.525061	7/7/2019	21	3/8/2005	0.15	9/11/2017	0	3/8/2005	4900	3/8/2005	270	1/8/2019	0	3/8/2005	300
5100159-001	38.784649	-121.617807							4/23/1996	30	4/23/1996	5	1/8/2019	0		
5100160-002	38.778461	-121.601924							12/30/2002	100	12/30/2002	130	1/8/2019	0		
5101205-001	38.909988	-121.543625							11/23/2005	100	11/23/2005	20	7/19/2006	1.45		
5103002-001	38.82383	-121.48433							10/20/1999	100	10/20/1999	20	1/12/2017	4.55		
5105002-001	38.881393	-121.60408							11/19/2003	799	11/29/2004	435	7/24/2019	0		
5105004-001	38.777769	-121.52437	5/17/2017	0			4/29/2015	0	10/16/2013	300	10/16/2013	182	6/19/2019	0	12/14/2016	28
5105004-002	38.777766	-121.525116	11/16/2016	5.9			6/19/2015	0	10/16/2013	542	10/16/2013	218	6/19/2019	0	12/14/2016	277
5105013-001	38.781319	-121.484797	7/7/2019	9.2			10/9/2017	12	2/29/2016	0	2/29/2016	0	1/8/2019	1.06	3/16/2016	200
5710003-024	38.6	-121.55	11/27/1990	12					11/27/1990	520	11/27/1990	290	11/27/1990	0.2	11/27/1990	580
USGS-383410121233001	38.5693503	-121.3927303	9/22/1982	2	9/22/1982	0.02			9/22/1982	30	9/22/1982	0			9/22/1982	153
USGS-383456121245801	38.5821277	-121.4171754	9/22/1982	4	9/22/1982	0.01			9/22/1982	0	9/22/1982	0			9/22/1982	109
USGS-383457121225601	38.5824055	-121.3832856	9/23/1982	2	9/23/1982	0.03			9/23/1982	10	9/23/1982	0			9/23/1982	186
USGS-383502121221801	38.5837944	-121.3727298			8/4/1971	0							8/4/1971	1.2	8/4/1971	165
USGS-383502121250301	38.5838333	-121.41775	9/14/2006	1.5	9/14/2006	0.01			9/14/2006	0	9/14/2006	0.83	9/14/2006	0.559	9/14/2006	NA
USGS-383524121212401	38.5898611	-121.356611	8/23/2017	2.1	8/23/2017	0.009							8/23/2017	0.593	8/23/2017	NA
USGS-383531121231101	38.5918497	-121.3874524	9/23/1982	1	9/23/1982	0.01			9/23/1982	0	9/23/1982	0			9/23/1982	209
USGS-383535121213001	38.5929609	-121.3593962	9/22/1982	2	9/22/1982	0.01			9/22/1982	0	9/22/1982	0			9/22/1982	153
USGS-383547121253101	38.5962939	-121.4263424	9/21/1982	2	9/21/1982	0.02			9/21/1982	0	9/21/1982	0			9/21/1982	402
USGS-383602121212701	38.6004607	-121.3585628	3/22/2005	2.7	3/22/2005	0.006			3/22/2005	0	3/22/2005	0	3/22/2005	0.832	3/22/2005	155
USGS-383604121325201	38.601016	-121.5488456	9/10/1982	12	9/10/1982	0.23			9/10/1982	350	9/10/1982	110			9/10/1982	176
USGS-383614121260601	38.6037937	-121.4360649			8/7/1970	0.1							8/7/1970	0.429	8/7/1970	NA
USGS-383622121234901	38.606016	-121.3980083	9/10/1982	3	9/10/1982	0.02			9/10/1982	0	9/10/1982	0			9/10/1982	167
USGS-383623121321301	38.6062936	-121.538012	9/10/1982	14	9/10/1982	0.3			9/10/1982	90	9/10/1982	550			9/10/1982	607

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
USGS-383655121301601	38.6157528	-121.5054028	8/7/2017	77	8/7/2017	0.125			8/7/2017	1060	8/7/2017	3660	8/7/2017	0	8/7/2017	NA
USGS-383659121292201	38.6164833	-121.4903694	8/8/2017	4.2	8/8/2017	0.215			8/17/2005	0	8/17/2005	0.3	8/8/2017	3.83	8/8/2017	656
USGS-383700121241001	38.6166667	-121.4027778	9/29/1982	2	9/29/1982	0.02			9/29/1982	0	9/29/1982	0			9/29/1982	0
USGS-383703121280701	38.6175	-121.4688889	5/15/2014	3.3	5/15/2014	0.221			5/15/2014	0	5/15/2014	0	5/15/2014	2.07	5/15/2014	NA
USGS-383706121195601	38.6182381	-121.3332844	9/27/1982	1	9/27/1982	0.01			9/27/1982	0	9/27/1982	0			9/27/1982	173
USGS-383714121255001	38.62046	-121.4316204	9/21/1982	3	9/21/1982	0.26			9/21/1982	0	9/21/1982	0			9/21/1982	NA
USGS-383727121301801	38.6237972	-121.5060556	8/7/2017	4.6	8/7/2017	0.119			8/17/2005	0	8/7/2017	245	8/7/2017	0.661	8/7/2017	524
USGS-383738121333401	38.6271266	-121.5605127	9/14/2017	6.9	9/14/2017	0.048			9/14/2017	88.6	9/14/2017	394	9/14/2017	0	9/14/2017	152
USGS-383746121291101	38.6292139	-121.4877028	8/8/2017	5.9	8/8/2017	0.175			9/4/2012	8.4	8/8/2017	0.72	8/8/2017	6.07	8/8/2017	NA
USGS-383801121333801	38.6335154	-121.5616239	5/13/2008	24.6	5/13/2008	0.385			5/13/2008	14.9	5/13/2008	2.38	5/13/2008	0.182	5/13/2008	325
USGS-383808121294801	38.6354595	-121.4977332			8/11/1970	0.2							8/11/1970	0.497	8/11/1970	NA
USGS-383822121245901	38.6393485	-121.4174534	9/21/1982	4	9/21/1982	0.02			9/21/1982	280	9/21/1982	20			9/21/1982	0
USGS-383829121221001	38.641293	-121.3705077	9/29/1982	1	9/29/1982	0.02			9/29/1982	30	9/29/1982	0			9/29/1982	249
USGS-383846121335801	38.6462222	-121.5661944	10/18/2017	39.2	10/18/2017	0.697			10/18/2017	19.2	10/18/2017	289	10/18/2017	0	10/18/2017	420
USGS-383858121340801	38.6493484	-121.5699576	9/10/1982	27	9/10/1982	0.25			9/10/1982	220	9/10/1982	700			9/10/1982	NA
USGS-383900121270001	38.6585	-121.4664722	6/15/2005	4.2	6/15/2005	0.14			6/15/2005	6.9	6/15/2005	3.8	6/15/2005	0.34	6/15/2005	198
USGS-383901121220001	38.6503611	-121.3667778	10/2/2017	3.1	10/2/2017	0.015					10/2/2017	1.48	10/2/2017	1.06	10/2/2017	192
USGS-383903121171301	38.6507374	-121.2880056	9/27/1982	1	9/27/1982	0.02			9/27/1982	10	9/27/1982	0			9/27/1982	NA
USGS-383903121181801	38.6507373	-121.3060616	9/27/1982	1	9/27/1982	0.06			9/27/1982	0	9/27/1982	30			9/27/1982	0
USGS-383904121280801	38.6510147	-121.4699548	9/21/1982	6	9/21/1982	0.12			9/21/1982	0	9/21/1982	0			9/21/1982	NA
USGS-383905121262401	38.6512926	-121.4410651			7/24/1969	0							7/24/1969	0.745	7/24/1969	201
USGS-383906121151601	38.6515707	-121.2555047	9/27/1982	2	9/27/1982	0.09			9/27/1982	20	9/27/1982	0			9/27/1982	178
USGS-383908121144001	38.6521263	-121.2455045	9/27/1982	1	9/27/1982	0			9/27/1982	10	9/27/1982	0			9/27/1982	253
USGS-383914121124901	38.653793	-121.2146703	6/17/2008	0.54	6/17/2008	0.009			6/17/2008	0	6/17/2008	0	6/17/2008	0.527	6/17/2008	NA
USGS-383918121122001	38.6549041	-121.2066146			7/25/1969	0							7/25/1969	0	7/25/1969	NA
USGS-383929121230501	38.6579592	-121.3857859	9/21/1982	1	9/21/1982	0.51			9/21/1982	0	9/21/1982	70			9/21/1982	312
USGS-383934121172201	38.6593482	-121.2905057			8/7/1970	0							8/7/1970	2.17	8/7/1970	NA
USGS-383943121132701	38.6618483	-121.2252262	9/27/1982	1	9/27/1982	0.05			9/27/1982	0	9/27/1982	0			9/27/1982	NA
USGS-383953121225601	38.6646257	-121.3832859	9/21/1982	2	9/21/1982	0.1			9/21/1982	0	9/21/1982	0			9/21/1982	226
USGS-384000121350001	38.67825	-121.5942778	4/5/2005	25.3	4/5/2005	0.496			4/5/2005	65.6	4/5/2005	120	4/5/2005	0	4/5/2005	632
USGS-384000121350002	38.67825	-121.5944167	4/6/2005	78.1	4/6/2005	0.985			4/6/2005	223	4/6/2005	82.7	4/6/2005	0	4/6/2005	0
USGS-384000121350003	38.67825	-121.5944167	4/7/2005	42.2	4/7/2005	2.2			4/7/2005	68.6	4/7/2005	55.6	4/7/2005	0	4/7/2005	501
USGS-384000121350004	38.67825	-121.5944167	4/7/2005	16.9	4/7/2005	1.43			4/7/2005	254	4/7/2005	254	4/7/2005	0	4/7/2005	656
USGS-384012121202801	38.6699034	-121.3421737	9/16/1982	2	9/16/1982	0.02			9/16/1982	0	9/16/1982	0			9/16/1982	NA
USGS-384017121364101	38.6712927	-121.612459	9/10/1982	20	9/10/1982	0.26			9/10/1982	0	9/10/1982	30			9/10/1982	231
USGS-384024121281301	38.67325	-121.4701944	8/22/2017	11.3	8/22/2017	0.038					8/22/2017	0.66	8/22/2017	1.49	8/22/2017	299
USGS-384026121195401	38.6737922	-121.332729	9/17/1982	1	9/17/1982	0.22			9/17/1982	0	9/17/1982	40			9/17/1982	302
USGS-384046121243501	38.6793475	-121.4107866	9/30/1982	3	9/30/1982	0.07			9/30/1982	0	9/30/1982	0			9/30/1982	NA
USGS-384051121251801	38.6807363	-121.4227314			8/13/1974	0							8/13/1974	1.4	8/13/1974	NA
USGS-384058121295001	38.6826806	-121.4982889			8/10/1970	0							8/10/1970	0.836	8/10/1970	192
USGS-384100121210001	38.6941667	-121.3600278	3/11/2014	2.2	3/11/2014	0.135			3/11/2014	4.5	3/11/2014	0	3/11/2014	1.34	3/11/2014	NA
USGS-384100121230001	38.6879167	-121.3851667	4/10/2008	2.2	4/10/2008	0.394			4/10/2008	7.2	4/10/2008	0.47	4/10/2008	0.851	4/10/2008	281
USGS-384100121310002	38.6867778	-121.5219444	4/13/2005	25.3	4/13/2005	0.234			4/13/2005	293	4/13/2005	146	4/13/2005	0	4/13/2005	246
USGS-384100121310003	38.6867778	-121.5219444	4/14/2005	16.9	4/14/2005	0.196			4/14/2005	101	4/14/2005	16.5	4/14/2005	0	4/14/2005	242
USGS-384100121310004	38.6867778	-121.5219444	4/18/2005	46.5	4/18/2005	0.098			4/18/2005	44.4	4/18/2005	156	4/18/2005	0	4/18/2005	0
USGS-384100121350001	38.6857778	-121.5960556	3/28/2005	21.1	3/28/2005	1.53			3/28/2005	149	3/28/2005	145	3/28/2005	0	3/28/2005	654
USGS-384103121170401	38.6840698	-121.2855056	9/17/1982	1	9/17/1982	0.04			9/17/1982	0	9/17/1982	0			9/17/1982	NA
USGS-384108121211601	38.6854585	-121.3555074	9/17/1982	2	9/17/1982	0.07			9/17/1982	0	9/17/1982	0			9/17/1982	336
USGS-384112121130601	38.6865699	-121.2193928	3/16/2005	1.6	3/16/2005	0.379			3/16/2005	0	3/16/2005	0.62	3/16/2005	2.57	3/16/2005	259
USGS-384114121131401	38.6874167	-121.220611	9/14/2006	1.3	9/14/2006	0.014			9/14/2006	8.2	9/14/2006	5.65	9/14/2006	1.81	9/14/2006	230
USGS-384123121201001	38.6896251	-121.3371736	9/16/1982	2	9/16/1982	0.36			9/16/1982	20	9/16/1982	0			9/16/1982	263
USGS-384140121375001	38.6940833	-121.6316389	10/4/2017	9.5	10/4/2017	1.13			10/4/2017	37.3	10/4/2017	0.99	10/4/2017	0	10/4/2017	NA
USGS-384143121270601	38.6951803	-121.4527322	9/22/1982	6	9/22/1982	0.07			9/22/1982	0	9/22/1982	0			9/22/1982	0
USGS-384145121184101	38.6964	-121.3120389	9/4/2012	1.8	9/4/2012	0.032			9/4/2012	3.9	9/4/2012	1.33	9/4/2012	1.53	9/4/2012	261
USGS-384153121164601	38.698	-121.2795278	9/12/2017	0.08									9/12/2017	0	9/12/2017	70
USGS-384159121343901	38.6996252	-121.5785692			7/24/1969	0.1							7/24/1969	0.361	7/24/1969	NA

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
USGS-384200121190001	38.7104722	-121.331611	4/1/2005	1.8	4/1/2005	0.563			4/1/2005	0	4/1/2005	1.11	4/1/2005	1.14	4/1/2005	306
USGS-384200121190002	38.7105	-121.3316944	4/1/2005	2.2	4/1/2005	0.096			4/1/2005	8.3	4/1/2005	1.36	4/1/2005	1.52	4/1/2005	209
USGS-384200121190003	38.7105556	-121.3316667	3/29/2005	1.7	3/29/2005	0.648			3/29/2005	0	3/29/2005	0.99	3/29/2005	1.26	3/29/2005	315
USGS-384200121190004	38.7105556	-121.3316667	3/30/2005	2.3	3/30/2005	0.058			3/30/2005	0	3/30/2005	0.49	3/30/2005	2.15	3/30/2005	222
USGS-384202121265201	38.700458	-121.4488432	9/22/1982	7	9/22/1982	0.18			9/22/1982	0	9/22/1982	0			9/22/1982	236
USGS-384211121232001	38.7031944	-121.389	8/22/2017	4.3	8/22/2017	0.014			8/22/2017	18.5	8/22/2017	0.92	8/22/2017	3.61	8/22/2017	223
USGS-384218121183101	38.7049026	-121.309673	9/17/1982	1	9/17/1982	0.08			9/17/1982	20	9/17/1982	0			9/17/1982	281
USGS-384220121213401	38.705458	-121.3605076			8/13/1974	0							8/13/1974	2.1	8/13/1974	269
USGS-384224121261401	38.7064722	-121.4384722	3/12/2014	4.5	3/12/2014	0.167			3/12/2014	0	3/12/2014	0	3/12/2014	1.54	3/12/2014	233
USGS-384230121364601	38.7082365	-121.6138482	9/30/1982	9	9/30/1982	1.6			9/30/1982	250	9/30/1982	260			9/30/1982	511
USGS-384234121134101	38.7095556	-121.2280278	9/11/2017	4.4	9/11/2017	0.483							9/11/2017	1.02	9/11/2017	340
USGS-384234121215601	38.7088167	-121.3664944	8/20/1998	3	8/20/1998	0.022			8/20/1998	0	8/20/1998	0	8/20/1998	2.2	8/20/1998	224
USGS-384242121193701	38.711569	-121.3280068			7/23/1969	0							7/23/1969	1.76	7/23/1969	NA
USGS-384243121224801	38.7118467	-121.3810637	9/21/1982	4	9/21/1982	0.02			9/21/1982	0	9/21/1982	0			9/21/1982	NA
USGS-384250121142101	38.7137913	-121.2402267			8/7/1970	1.4							8/7/1970	0.248	8/7/1970	353
USGS-384251121284301	38.7140687	-121.4796774	9/30/1982	16	9/30/1982	0.13			9/30/1982	30	9/30/1982	90			9/30/1982	171
USGS-384254121182101	38.7149023	-121.3068951	9/16/1982	1	9/16/1982	0.61			9/16/1982	10	9/16/1982	0			9/16/1982	302
USGS-384256121234801	38.7154577	-121.3977308			8/10/1970	0							8/10/1970	1.08	8/10/1970	NA
USGS-384257121243401	38.7157355	-121.410509	9/16/1982	3	9/16/1982	0.06			9/16/1982	0	9/16/1982	0			9/16/1982	NA
USGS-384301121195101	38.717	-121.3320278	10/2/2017	2.3	10/2/2017	0.018			5/22/2008	0	5/22/2008	0.14	10/2/2017	1.24	10/2/2017	239
USGS-384303121211701	38.7169944	-121.3556528	9/21/2005	3.1	9/21/2005	0.013			9/21/2005	0	9/21/2005	0.56	9/21/2005	1.88	9/21/2005	203
USGS-384306121193301	38.7182355	-121.3268957	9/17/1982	3	9/17/1982	0.05			9/17/1982	0	9/17/1982	0			9/17/1982	160
USGS-384316121250301	38.7210556	-121.4175278	10/16/2017	5.3	10/16/2017	0.036							10/16/2017	0.925	10/16/2017	NA
USGS-384318121230001	38.7216389	-121.3841778	8/21/2017	3.8	8/21/2017	0.014			8/21/2017	17.7	8/21/2017	1.43	9/20/2005	3.62	8/21/2017	287
USGS-384330121265601	38.7249018	-121.4499544	5/14/2008	6.9	5/14/2008	0.188			5/14/2008	0	5/14/2008	0.14	5/14/2008	1.2	5/14/2008	230
USGS-384330121293901	38.7251167	-121.4954417	7/10/2017	4.8	7/10/2017	0.06			8/16/2012	4.2	8/16/2012	0.53	7/10/2017	4.84	7/10/2017	NA
USGS-384347121140801	38.7298333	-121.2355	10/16/2017	1.4	10/16/2017	0.467							10/16/2017	6.4	10/16/2017	NA
USGS-384359121273901	38.7329572	-121.4618992	9/30/1982	18	9/30/1982	0.19			9/30/1982	0	9/30/1982	80			9/30/1982	0
USGS-384413121163801	38.7369444	-121.2772222	3/10/2014	2.3	3/10/2014	1.06			3/10/2014	12	3/10/2014	1.17	3/10/2014	2.16	3/10/2014	NA
USGS-384454121285701	38.7482346	-121.4835665			6/24/1974	0.1			7/15/1957	10			6/24/1974	2.26	6/24/1974	NA
USGS-384455121292101	38.7487778	-121.4898889	9/12/2017	8.1	9/12/2017	0.1			5/14/2008	0	5/14/2008	0	9/12/2017	3.48	9/12/2017	NA
USGS-384458121171001	38.7493458	-121.2871725	9/24/1982	2	9/24/1982	0.15			9/24/1982	0	9/24/1982	0			9/24/1982	240
USGS-384501121203701	38.7501791	-121.344674			7/23/1969	0							7/23/1969	1.24	7/23/1969	NA
USGS-384504121211401	38.7510124	-121.354952	9/17/1982	4	9/17/1982	0.07			9/17/1982	10	9/17/1982	0			9/17/1982	183
USGS-384510121242301	38.7535	-121.4045	9/14/1982	7	9/14/1982	0.21			9/14/1982	0	9/14/1982	0			9/14/1982	NA
USGS-384515121280801	38.7540678	-121.469955	8/2/1976	22	8/2/1976	0.39			8/2/1976	40	8/2/1976	110	8/2/1976	0.16	8/2/1976	189
USGS-384520121291901	38.7554566	-121.4896778			8/13/1971	0.2							8/13/1971	0.723	8/13/1971	194
USGS-384521121242401	38.7557345	-121.4077313			8/3/1976	0.17							8/3/1976	1.49	8/3/1976	NA
USGS-384525121352501	38.7568463	-121.5913478			8/2/1976	0.41							8/2/1976	0.12	8/2/1976	397
USGS-384529121293701	38.7579565	-121.494678			8/3/1976	0.18							8/3/1976	0.994	8/3/1976	NA
USGS-384539121171601	38.7607345	-121.2888394	6/4/1975	0	6/4/1975	0.1			6/4/1975	40	6/4/1975	0	6/4/1975	0.678	6/4/1975	NA
USGS-384624121271601	38.7732339	-121.4555106	8/3/1976	9	8/3/1976	0.28			8/3/1976	0	8/3/1976	0	8/3/1976	1.2	8/3/1976	201
USGS-384636121262701	38.7765672	-121.4418992	9/14/1982	8	9/14/1982	0.27			9/14/1982	0	9/14/1982	0			9/14/1982	NA
USGS-384638121265601	38.7771227	-121.4499549			8/12/1970	0.2							8/12/1970	0.971	8/12/1970	183
USGS-384643121360701	38.7785	-121.6019167	10/4/2017	8.2	10/4/2017	0.235			10/4/2017	55.2	10/4/2017	226	10/4/2017	0	10/4/2017	NA
USGS-384648121360901	38.7799013	-121.6035708	8/2/1976	7	8/2/1976	0.26			8/2/1976	0	8/2/1976	70	8/2/1976	0.061	8/2/1976	NA
USGS-384703121295001	38.7840669	-121.4982896	8/2/1976	7	8/2/1976	0.1			8/2/1976	0	8/2/1976	0	8/2/1976	2.19	8/2/1976	222
USGS-384724121354901	38.7899009	-121.5980152			7/23/1974	0.1			7/21/1964	40			7/23/1974	0.068	7/23/1974	370
USGS-384729121252501	38.7912891	-121.4246767	9/14/1982	6	9/14/1982	0.32			9/14/1982	0	9/14/1982	10			9/14/1982	NA
USGS-384730121362501	38.7915676	-121.6080156			8/2/1976	0.06							8/2/1976	0.61	8/2/1976	NA
USGS-384738121362701	38.7937898	-121.6085712	7/23/1974	20	7/23/1974	0.2			7/23/1974	150	7/23/1974	170	7/23/1974	0	7/23/1974	618
USGS-384747121250501	38.796289	-121.419121	9/14/1982	6	9/14/1982	0.18			9/14/1982	0	9/14/1982	0			9/14/1982	0
USGS-384748121275901	38.7965666	-121.4674557			8/3/1976	0.11							8/3/1976	2.48	8/3/1976	NA
USGS-384753121300401	38.7979554	-121.5021789	8/2/1976	8	8/2/1976	0.13			8/2/1976	0	8/2/1976	70	8/2/1976	2.48	8/2/1976	233
USGS-384758121190801	38.7993447	-121.3199518			6/25/1974	0.7							6/25/1974	3.61	6/25/1974	265
USGS-384807121370101	38.8018451	-121.618016	8/2/1976	1	8/2/1976	0.13			8/2/1976	20	8/2/1976	410	8/2/1976	0.655	8/2/1976	NA

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
USGS-384809121201801	38.8026944	-121.3384444											8/9/2007	1.26		
USGS-384811121265901	38.8029554	-121.4507887	8/3/1976	10	8/3/1976	0.09			8/3/1976	20	8/3/1976	0	8/3/1976	2.1	8/3/1976	172
USGS-384813121281201	38.8035109	-121.471067	9/24/1970	0	7/9/1976	0.1			9/24/1970	0	9/24/1970	0	7/9/1976	1.31	7/9/1976	NA
USGS-384820121200701	38.80575	-121.3355278											8/7/2007	0.73		
USGS-384821121200801	38.8058333	-121.33575											2/28/2008	1.31		
USGS-384821121240001	38.8057332	-121.4010652	9/14/1982	5	9/14/1982	0.17			9/14/1982	10	9/14/1982	10			9/14/1982	0
USGS-384822121200701	38.8063056	-121.3353889											8/8/2007	1.25		
USGS-384832121320201	38.8087887	-121.5349579			8/2/1976	0.12							8/2/1976	0.791	8/2/1976	239
USGS-384904121263001	38.8176772	-121.4427331	9/14/1982	5	9/14/1982	0.23			9/14/1982	0	9/14/1982	0			9/14/1982	NA
USGS-384907121183601	38.8185109	-121.311063	9/17/1982	4	9/17/1982	0.83			9/17/1982	0	9/17/1982	0			9/17/1982	285
USGS-384926121284401	38.8237881	-121.4799565	8/3/1976	7	8/3/1976	0.07			8/3/1976	0	8/3/1976	0	8/3/1976	2.94	8/3/1976	217
USGS-384926121320201	38.8237883	-121.534958	8/2/1976	3	8/2/1976	0.08			8/2/1976	0	8/2/1976	0	8/2/1976	0.881	8/2/1976	492
USGS-384930121270601	38.8248992	-121.4527335			8/3/1976	0.09							8/3/1976	2.01	8/3/1976	NA
USGS-384930121273001	38.8248992	-121.4594004	9/14/1982	6	9/14/1982	0.16			9/14/1982	0	9/14/1982	0			9/14/1982	NA
USGS-384938121312801	38.8271214	-121.5255134	10/3/2017	4.7	10/3/2017	0.049			5/2/1968	140			10/3/2017	3.54	10/3/2017	435
USGS-384944121300501	38.8287879	-121.5024571			8/2/1976	0.03							8/2/1976	4.29	8/2/1976	314
USGS-384949121233501	38.8301771	-121.3941209	10/3/2017	4.6	10/3/2017	0.06			5/21/2008	0	5/21/2008	0	10/3/2017	1.22	10/3/2017	NA
USGS-385008121375701	38.8354552	-121.6335726			8/2/1976	0.09							8/2/1976	0.02	8/2/1976	97
USGS-385014121271501	38.8371389	-121.4540833	10/30/2017	2.9	10/30/2017	0.045							10/30/2017	3.47	10/30/2017	340
USGS-385017121203401	38.8379548	-121.3438419	9/14/1982	3	9/14/1982	0.24			9/14/1982	0	9/14/1982	0			9/14/1982	229
USGS-385020121291601	38.8387876	-121.4888458	8/3/1976	3	8/3/1976	0.06			8/3/1976	0	8/3/1976	0	8/3/1976	1.49	8/3/1976	218
USGS-385045121240801	38.8457322	-121.403288	8/5/1976	2	8/5/1976	0.03			8/5/1976	0	8/5/1976	0	8/5/1976	1.11	8/5/1976	205
USGS-385112121355401	38.8532322	-121.599405	8/11/1967	40	8/13/1974	0.2							8/13/1974	0	8/13/1974	507
USGS-385123121290001	38.8562872	-121.4844015			8/4/1976	0.04							8/4/1976	1.4	8/4/1976	NA
USGS-385155121353301	38.8651762	-121.5935717			8/4/1976	0.06							8/4/1976	0.099	8/4/1976	569
USGS-385200121195701	38.8666944	-121.3334167	9/13/2017	3	9/13/2017	0.332			9/13/2017	13	9/9/1982	0	9/13/2017	1.37	9/13/2017	212
USGS-385207121203301	38.8685097	-121.3435645	9/9/1982	2	9/9/1982	0.13			9/9/1982	0	9/9/1982	0			9/9/1982	226
USGS-385218121291101	38.8715645	-121.4874574	8/4/1976	5	8/4/1976	0.06			8/4/1976	0	8/4/1976	0	8/4/1976	2.1	8/4/1976	221
USGS-385222121201401	38.8726763	-121.3382867	9/9/1982	2	9/9/1982	0.17			9/9/1982	0	9/9/1982	0			9/9/1982	217
USGS-385231121361701	38.875176	-121.6057945	8/4/1976	2	8/4/1976	0.35			8/4/1976	150	8/4/1976	1400	8/4/1976	0.655	8/4/1976	1360
USGS-385256121362201	38.8822222	-121.606111	10/17/2017	37.1	10/17/2017	0.249			10/17/2017	1640	10/17/2017	307	10/17/2017	0	10/17/2017	913
USGS-385300121340001	38.8963889	-121.5698333	3/18/2014	6	3/18/2014	0.029			3/18/2014	5.5	3/18/2014	0	3/18/2014	0.194	3/18/2014	288
USGS-385310121173501	38.8860095	-121.294119	9/8/1982	0	9/8/1982	0.15			9/8/1982	3400	9/8/1982	300			9/8/1982	223
USGS-385318121252201	38.8881944	-121.4227778	10/31/2017	2.5	10/31/2017	0.051							10/31/2017	2.29	10/31/2017	189
USGS-385326121193601	38.8904537	-121.327731	9/8/1982	1	9/8/1982	0.17			9/8/1982	0	9/8/1982	0			9/8/1982	305
USGS-385328121255701	38.8910087	-121.4335673			8/5/1976	0.05							8/5/1976	1.11	8/5/1976	158
USGS-385332121343801	38.8921197	-121.5782939	8/4/1976	8	8/4/1976	0.03			8/4/1976	0	8/4/1976	0	8/4/1976	0.407	8/4/1976	241
USGS-385338121330701	38.8937863	-121.5530153			8/4/1976	0.04							8/4/1976	1.11	8/4/1976	NA
USGS-385340121255701	38.8944444	-121.4325	5/4/2005	1.4	5/4/2005	0.022			5/4/2005	0	5/4/2005	0	5/4/2005	3.27	5/4/2005	359
USGS-385341121185501	38.8946203	-121.3163419	9/8/1982	3	9/8/1982	1.1			9/8/1982	0	9/8/1982	0			9/8/1982	598
USGS-385347121191201	38.8962869	-121.3210643			6/25/1974	1.4							7/8/1964	4.07	6/25/1974	584
USGS-385348121240101	38.8965643	-121.4013443	8/5/1976	2	8/5/1976	0.14			8/5/1976	0	8/5/1976	0	8/5/1976	0.61	8/5/1976	NA
USGS-385350121163301	38.8971205	-121.2768964	9/8/1982	1	9/8/1982	6.8			9/8/1982	80	9/8/1982	40			9/8/1982	1100
USGS-385351121220001	38.8973978	-121.3677323			8/5/1976	0.28							8/5/1976	1.31	8/5/1976	202
USGS-385416121202301	38.9043422	-121.3407872	9/8/1982	2	9/8/1982	0.54			9/8/1982	0	9/8/1982	0			9/8/1982	222
USGS-385423121342701	38.9057222	-121.57525	10/17/2017	14.8	10/17/2017	0.067			10/17/2017	14.5	10/17/2017	61.8	10/17/2017	0	10/17/2017	190
USGS-385432121213001	38.9084167	-121.3590833	10/18/2017	1.2	10/18/2017	0.015			5/21/2008	0	5/21/2008	0	10/18/2017	4.94	10/18/2017	NA
USGS-385441121323801	38.9112857	-121.5449598	8/4/1976	12	8/4/1976	0.08			8/4/1976	0	8/4/1976	0	8/4/1976	0.768	8/4/1976	165
USGS-385450121270401	38.9137858	-121.4521793	8/5/1976	3	8/5/1976	0.07			8/5/1976	0	8/5/1976	0	8/5/1976	1.11	8/5/1976	NA
USGS-385455121335901	38.9151745	-121.5674606			8/4/1976	0.1							8/4/1976	0.16	8/4/1976	249
USGS-385501121220001	38.9168417	-121.3677326	8/5/1976	2	8/5/1976	0.27			8/5/1976	0	8/5/1976	0	8/5/1976	1.31	8/5/1976	197
USGS-385523121235201	38.9229525	-121.3988446			8/5/1971	0.1			8/4/1958	0			8/5/1971	0.068	8/5/1971	NA
USGS-385530121163601	38.9248976	-121.2777301	9/8/1982	1	9/8/1982	5.6			9/8/1982	10	9/8/1982	0			9/8/1982	505
USGS-385542121340001	38.9282297	-121.5677385	8/9/1976	2	8/9/1976	0.19			8/9/1976	0	8/9/1976	0	8/9/1976	0.768	8/9/1976	549
USGS-385546121312801	38.92925	-121.5254444	10/5/2017	3.4	10/5/2017	0.019			5/20/2008	0	5/20/2008	0.3	10/5/2017	2.3	10/5/2017	454
USGS-385558121291401	38.9326739	-121.4882917			8/9/1976	0							8/9/1976	2.71	8/9/1976	353

WELL_ID	LATITUDE	LONGITUDE	AS_Date	AS	B_Date	B	CR6_Date	CR6	FE_Date	FE	MN_Date	MN	NO3N_Date	NO3N	TDS_Date	TDS
USGS-385607121275801	38.935174	-121.46718	8/9/1976	0	8/9/1976	0			8/9/1976	0	8/9/1976	30	8/9/1976	1.69	8/9/1976	184
USGS-385625121222401	38.9402778	-121.3733333	9/24/1982	2	9/24/1982	0.05			9/24/1982	50	9/24/1982	0			9/24/1982	192
USGS-385626121261101	38.9404518	-121.437457			8/9/1976	0							8/9/1976	2.48	8/9/1976	228
USGS-385643121312101	38.9451735	-121.5235708			8/9/1976	0							8/9/1976	1.81	8/9/1976	NA
USGS-385703121294501	38.9507289	-121.4969034	8/9/1976	2	8/9/1976	0.18			8/9/1976	0	8/9/1976	0	8/9/1976	0.226	8/9/1976	181
USGS-385718121290401	38.9548956	-121.4855142	5/20/2008	1.8	5/20/2008	0.02			5/20/2008	0	5/20/2008	3.83	5/20/2008	2.11	5/20/2008	310
USGS-385720121282401	38.9554512	-121.4744028	10/2/1997	1	10/2/1997	0.032			10/2/1997	0	10/2/1997	1.76	10/2/1997	1.13	10/2/1997	303
USGS-385724121220901	38.956563	-121.3702332	8/12/1970	0	6/4/1975	0.1			6/4/1975	20	6/4/1975	0	6/4/1975	0.542	6/4/1975	195
USGS-385731121241101	38.9585071	-121.404123	8/9/1976	1	8/9/1976	0.07			8/9/1976	0	8/9/1976	0	8/9/1976	1.11	8/9/1976	178
USGS-385810121292501	38.9693396	-121.491348			8/9/1976	0							8/9/1976	4.52	8/9/1976	574
USGS-385820121271401	38.9723056	-121.4540278	10/5/2017	0.69	10/5/2017	0.016					10/5/2017	0.55	10/5/2017	4.75	10/5/2017	NA
USGS-385830121270501	38.9748953	-121.452458			8/5/1976	0.03							8/5/1976	3.39	8/5/1976	NA
USGS-385854121222901	38.9815623	-121.3757893			7/22/1969	0.4							7/22/1969	1.54	7/22/1969	323
USGS-385856121222501	38.9830833	-121.3756389	4/6/2005	1.7	4/6/2005	0.357			4/6/2005	0	4/6/2005	0	4/6/2005	3.31	4/6/2005	286
USGS-385914121215801	38.9871178	-121.367178	6/2/2008	2.1	6/2/2008	0.084			6/2/2008	0	6/2/2008	0.17	6/2/2008	1.63	6/2/2008	192
USGS-385914121273501	38.9871171	-121.4607918											7/25/1970	6.78	7/25/1970	462
USGS-385922121202601	38.9893402	-121.3416217	9/7/1982	5	9/7/1982	0.14			9/7/1982	220	9/7/1982	20			9/7/1982	NA
USGS-385929121260001	38.9912839	-121.4344022	8/5/1976	3	8/5/1976	0.36			8/5/1976	0	8/5/1976	0	8/5/1976	0.994	8/5/1976	NA
USGS-385932121212401	38.9922778	-121.3566944	10/31/2017	4.6	10/31/2017	0.092							10/31/2017	2.43	10/31/2017	172
USGS-385949121203001	38.99684	-121.342733	9/7/1982	4	9/7/1982	0.14			9/7/1982	20	9/7/1982	0			9/7/1982	145
USGS-390100121204201	39.0165619	-121.3460669	9/8/1982	2	9/8/1982	0.13			9/8/1982	0	9/8/1982	0			9/8/1982	NA
1.USGS and Public Supply Wells																
Min			8/11/1967	0	7/22/1969	0	10/3/2001	0	7/15/1957	0	9/24/1970	0	7/8/1964	0	7/22/1969	0
Max			9/18/2019	78.1	8/16/2018	6.8	8/8/2019	14	9/12/2019	5500	9/12/2019	3660	10/1/2019	10	9/12/2019	1360
Units in Raw Data				**ug/l**		**mg/l**		**ug/l**		**ug/l**		**ug/l**		**mg/l**		**mg/l**
MCL				10		1		10		300		50		10		500
Above MCL				29		14		9		44		62		0		22
# of wells with analytical results				482		410		252		488		488		494		451
Average				3.93		0.18		3.76		158.02		49.31		1.68		266.36
2.Public Supply Wells																
Min			4/9/1987	0	12/13/1995	0	10/3/2001	0	4/9/1987	0	4/9/1987	0	4/9/1987	0	4/9/1987	0
Max			9/18/2019	40	8/16/2018	3.1	8/8/2019	14	9/12/2019	5500	9/12/2019	2831	10/1/2019	10	9/12/2019	720
Units in Raw Data				**ug/l**		**mg/l**		**ug/l**		**ug/l**		**ug/l**		**mg/l**		**mg/l**
MCL				10		1		10		300		50		10		500
Above MCL				5		3		9		40		34		0		3
# of wells with analytical results				326		213		252		341		342		354		313
Average				2.4		0.1		3.8		196.3		38.3		1.8		258.4

Appendix M: Water Quality Trend Analysis Results

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX M
Water Quality Trend Analysis Results

December 2021

Graphs can be made available by request using contact information on nasbgroundwater.org

APPENDIX M – WATER QUALITY TRENDS

METHODS AND APPROACH

A statistical trend analysis of the data was performed using the Mann-Kendall method when the well had more than five samples for a given element. This method is a nonparametric (for example, does not assume a distribution in the data) test for identifying trends in time-series data. The Mann-Kendall test for trend detection assumes that the sample data are serially independent since the presence of positive serial correlation increases the probability that the Mann-Kendall test detects trend even though no such trend exists. The accepted approach is to remove the serial correlation from the time series before application of the test. This process is called the pre-whitening (Zhang et al. 2001; Burn and Elnur 2002). After removing the effect of serial correlation from the respective time series by pre-whitening, the Mann-Kendall test compares the relative magnitudes of sample data rather than the data values themselves. The initial value of the Mann-Kendall statistic, S, was assumed to be 0 (that is, no trend). If a concentration from a later sampling event is higher than a concentration from an earlier sampling event, S is incremented by 1. Conversely, if the concentration from a later sampling event is lower than a concentration sampled earlier, S is decremented by 1. Then the Mann-Kendall statistic (S) is given by

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^{n} Sign(x_j - x_k)$$

Where:

$$Sign(x_j - x_k) = 1, if\ x_j - x_k > 0$$

$$= 0, if\ x_j - x_k = 0$$

$$= -1, if\ x_j - x_k < 0$$

The net result of all such increments and decrements yields the final value of S. A very high positive value of S is an indicator of an increasing trend, and a very low negative value indicates a decreasing trend. However, it is necessary to compute the probability associated with S and the sample size, n, to statistically quantify the significance of the trend. Kendall (1975) describes a normal-approximation test statistic Z as follows:

$$Z = \frac{S-1}{[VAR(S)]^{\frac{1}{2}}} \; if \; S > 0$$

$$= 0, if \; S = 0$$

$$= \frac{S-1}{[VAR(S)]^{\frac{1}{2}}} \; if \; S < 0$$

Probability value (P) is then computed with the normalized test statistic Z. The probability density function for a normal distribution with a mean of 0 and a standard deviation of 1 is given by the following equation:

$$f(z) = \frac{1}{\sqrt{2\pi}} e^{\frac{z^2}{2}}$$

A P-value less than 0.05 (typically ≤ 0.05) is statistically significant. It indicates strong evidence against the null hypothesis (If the null hypothesis is true, the results are random). The trend is said to be decreasing if Z is negative and the computed probability P is less than the level of significance. The trend is said to be increasing if the Z is positive and the computed probability is less than the level of significance. If the computed probability is greater than the level of significance, there is no trend.

Total Dissolved Solids

Local_ID	Well_Info_ID	chemical	h	p	s	tau	trend	var_s	z	datemin	datemax	Latitude_NAD83	Longitude_NAD83
2934	11N03E24D001M	TDS	FALSE	0.368	7	0.333	no trend	44.3	0.9	7/21/1964	8/18/2004	38.7906	-121.5973
2940	11N04E04R002M	TDS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	8/12/1971	8/24/2005	38.8255	-121.5259
2957	11N04E23P002M	TDS	FALSE	0.133	9	0.6	no trend	28.3	1.5	4/15/1965	8/18/2004	38.7837	-121.4982
2943	11N04E35J001M	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	8/13/1971	8/24/2005	38.7556	-121.4898
2083	11N06E17D001M	TDS	TRUE	0.001	584	0.281	increasing	31200	3.3	5/5/2004	3/26/2008	38.8064	-121.3353
2081	11N06E17D002M	TDS	FALSE	0.111	-363	-0.124	no trend	51691.7	-1.59	5/6/2004	3/26/2008	38.8027	-121.3384
2080	11N06E17D003M	TDS	FALSE	0.623	65	0.047	no trend	16994.3	0.49	5/5/2004	3/26/2008	38.8059	-121.3358
2082	11N06E17E001M	TDS	TRUE	0	564	0.353	increasing	21102.7	3.88	5/5/2004	3/26/2008	38.8058	-121.3354
2953	12N03E26R001M	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	6/13/1963	8/18/2004	38.8533	-121.5991
2967	12N04E05R005M	TDS	FALSE	0.26	7	0.467	no trend	28.3	1.13	8/25/1970	8/18/2004	38.9114	-121.5447
2956	12N04E25N001M	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	6/12/1969	8/25/2005	38.8546	-121.4859
2059	3100538-001	TDS	FALSE	0.089	6	1	no trend	8.7	1.7	3/18/2004	3/23/2018	38.7505	-121.321972
2057	3110004-002	TDS	FALSE	0.133	-9	-0.6	no trend	28.3	-1.5	4/24/2001	1/15/2015	38.868006	-121.320358
2068	3110004-003	TDS	FALSE	0.452	5	0.333	no trend	28.3	0.75	11/9/2004	4/27/2017	38.86973	-121.330213
2061	3110004-011	TDS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	12/7/2005	1/15/2015	38.865086	-121.347261
2069	3110008-003	TDS	FALSE	0.47	3	0.5	no trend	7.7	0.72	10/26/1992	1/8/2010	38.753022	-121.279492
2071	3110008-006	TDS	FALSE	0.221	6	0.6	no trend	16.7	1.22	10/27/1992	9/5/2013	38.736633	-121.277875
2066	3110008-007	TDS	FALSE	0.462	4	0.4	no trend	16.7	0.73	10/26/1992	9/5/2013	38.726493	-121.258205
2050	3110008-008	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	10/22/2002	8/23/2018	38.805938	-121.33588
2064	3110025-005	TDS	FALSE	0.181	-28	-0.267	no trend	407.3	-1.34	7/26/1989	9/12/2019	38.818889	-121.31
2063	3110040-001	TDS	FALSE	0.085	23	0.418	no trend	163	1.72	9/27/1988	7/9/2002	38.75	-121.34722
2067	3110040-002	TDS	FALSE	0.154	14	0.389	no trend	83.3	1.42	8/31/1989	7/9/2002	38.75	-121.34444
2054	3110048-001	TDS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	3/31/2004	4/9/2018	38.983062	-121.375659
2058	3110048-002	TDS	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	3/31/2004	4/9/2018	38.980075	-121.369185
145	3400173-002	TDS	FALSE	0.734	2	0.333	no trend	8.7	0.34	5/24/2001	2/14/2017	38.640638	-121.483861
79	3400179-001	TDS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	6/21/2007	3/20/2019	38.6575	-121.378333
57	3400190-001	TDS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	6/21/2007	3/20/2019	38.675861	-121.326329
272	3400191-001	TDS	FALSE	0.734	2	0.333	no trend	8.7	0.34	6/28/2007	3/20/2019	38.65525	-121.379888
193	3410001-001	TDS	FALSE	0.452	5	0.333	no trend	28.3	0.75	1/12/1993	9/5/2017	38.606839	-121.3982
242	3410001-002	TDS	FALSE	1	1	0.067	no trend	28.3	0	2/5/1998	7/18/2017	38.59783	-121.398024
258	3410001-004	TDS	FALSE	0.085	-10	-0.667	no trend	27.3	-1.72	1/12/1993	6/19/2014	38.611483	-121.410107
284	3410001-005	TDS	FALSE	0.452	5	0.333	no trend	28.3	0.75	2/25/1991	6/8/2011	38.623478	-121.396638
203	3410001-007	TDS	FALSE	0.548	5	0.238	no trend	44.3	0.6	7/9/1990	9/27/2017	38.610999	-121.363391
212	3410001-010	TDS	FALSE	0.23	9	0.429	no trend	44.3	1.2	7/10/1990	9/12/2017	38.608099	-121.408153
158	3410001-011	TDS	FALSE	0.902	-2	-0.071	no trend	65.3	-0.12	1/30/1992	9/14/2017	38.619863	-121.396184
228	3410001-012	TDS	FALSE	0.386	8	0.286	no trend	65.3	0.87	2/25/1991	12/12/2017	38.617662	-121.403695
82	3410001-013	TDS	FALSE	1	0	0	no trend	43.3	0	1/28/1992	9/26/2017	38.598939	-121.370714
146	3410001-014	TDS	FALSE	0.221	6	0.6	no trend	16.7	1.22	7/10/1990	9/26/2006	38.61171	-121.386048
260	3410001-015	TDS	FALSE	0.879	-2	-0.095	no trend	43.3	-0.15	11/1/1988	9/19/2017	38.59781	-121.381308
191	3410001-016	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	2/22/1991	9/4/2014	38.631327	-121.37485
124	3410001-017	TDS	FALSE	0.06	-11	-0.733	no trend	28.3	-1.88	1/30/1992	8/27/2014	38.61981	-121.403732
211	3410001-018	TDS	FALSE	0.764	3	0.143	no trend	44.3	0.3	2/22/1991	9/19/2017	38.623854	-121.374359
209	3410001-019	TDS	FALSE	0.072	13	0.619	no trend	44.3	1.8	1/27/1992	9/25/2017	38.597831	-121.359623
114	3410001-020	TDS	TRUE	0.035	15	0.714	increasing	44.3	2.1	1/27/1992	9/19/2017	38.618079	-121.359205
210	3410001-021	TDS	FALSE	0.095	12	0.571	no trend	43.3	1.67	7/9/1990	9/12/2017	38.615256	-121.419986
161	3410001-022	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	2/5/1998	9/11/2017	38.604549	-121.42274
222	3410001-025	TDS	FALSE	0.879	2	0.095	no trend	43.3	0.15	2/22/1991	9/19/2017	38.60046	-121.359118
113	3410001-027	TDS	FALSE	0.072	13	0.619	no trend	44.3	1.8	1/30/1992	9/27/2017	38.605146	-121.390988
244	3410001-028	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	1/30/1992	8/21/2014	38.63562	-121.381097
227	3410001-029	TDS	FALSE	0.848	2	0.133	no trend	27.3	0.19	1/30/1992	10/3/2017	38.630252	-121.397575
236	3410001-030	TDS	FALSE	1	1	0.067	no trend	28.3	0	1/29/1992	9/26/2017	38.617802	-121.424022
81	3410001-032	TDS	FALSE	0.26	-7	-0.467	no trend	28.3	-1.13	7/9/1990	9/19/2017	38.622918	-121.413817
104	3410001-033	TDS	FALSE	0.06	11	0.733	no trend	28.3	1.88	1/29/1992	7/10/2014	38.601378	-121.424
173	3410001-034	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	7/9/1990	9/11/2017	38.584674	-121.396539
169	3410001-035	TDS	FALSE	0.23	9	0.429	no trend	44.3	1.2	7/9/1990	9/28/2017	38.594464	-121.351844
19	3410001-038	TDS	FALSE	0.086	8	0.8	no trend	16.7	1.71	1/28/1992	6/9/2011	38.578371	-121.363395
20	3410001-039	TDS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	2/22/1991	9/18/2006	38.591742	-121.346413
168	3410001-042	TDS	FALSE	0.548	5	0.238	no trend	44.3	0.6	2/22/1991	9/12/2017	38.628014	-121.358648
184	3410001-051	TDS	FALSE	0.548	5	0.238	no trend	44.3	0.6	7/9/1990	9/11/2017	38.636187	-121.375067
111	3410001-052	TDS	FALSE	0.848	-2	-0.133	no trend	27.3	-0.19	7/9/1990	9/11/2017	38.625054	-121.362252
287	3410001-054	TDS	FALSE	1	1	0.048	no trend	44.3	0	2/11/1991	9/13/2017	38.582422	-121.408379
122	3410001-055	TDS	FALSE	0.133	11	0.524	no trend	44.3	1.5	11/1/1988	12/13/2017	38.594474	-121.39864
26	3410001-056	TDS	FALSE	0.23	-9	-0.429	no trend	44.3	-1.2	1/12/1993	9/13/2017	38.578749	-121.41096
3	3410001-061	TDS	FALSE	0.133	-11	-0.524	no trend	44.3	-1.5	5/7/1998	9/26/2017	38.582786	-121.338489
176	3410001-062	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	8/22/2000	9/5/2017	38.618056	-121.401944
12	3410001-064	TDS	FALSE	0.221	6	0.6	no trend	16.7	1.22	4/23/2002	9/12/2017	38.584121	-121.353432
13	3410001-065	TDS	TRUE	0.027	-10	-1	decreasing	16.7	-2.2	4/22/2002	9/21/2017	38.583196	-121.33679
4	3410001-066	TDS	FALSE	0.221	-6	-0.6	no trend	16.7	-1.22	4/23/2002	9/12/2017	38.582214	-121.338203
2	3410001-067	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	6/3/1999	10/1/2014	38.582481	-121.417169
225	3410001-069	TDS	FALSE	0.23	9	0.429	no trend	44.3	1.2	2/26/1992	9/28/2017	38.580609	-121.384004
255	3410001-070	TDS	FALSE	0.875	2	0.095	no trend	40.7	0.16	2/12/1991	9/12/2017	38.576006	-121.403088

205	3410001-071	TDS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	4/17/2002	9/14/2017	38.63056	-121.397787
106	3410001-072	TDS	FALSE	0.806	2	0.2	no trend	16.7	0.24	4/17/2002	9/12/2017	38.61744	-121.411527
252	3410001-073	TDS	FALSE	0.462	-4	-0.4	no trend	16.7	-0.73	4/17/2002	9/7/2017	38.58058	-121.383962
58	3410001-076	TDS	FALSE	1	0	0	no trend	65.3	0	4/29/1988	7/10/2019	38.644265	-121.362069
69	3410001-077	TDS	FALSE	0.295	11	0.306	no trend	91	1.05	4/20/1988	7/10/2019	38.631522	-121.352911
86	3410001-078	TDS	FALSE	0.529	7	0.194	no trend	91	0.63	4/29/1988	7/9/2019	38.684818	-121.355931
259	3410001-079	TDS	FALSE	1	1	0.067	no trend	28.3	0	6/30/1988	7/24/2013	38.667577	-121.334161
110	3410001-080	TDS	FALSE	0.917	-2	-0.056	no trend	92	-0.1	6/23/1988	7/17/2019	38.672567	-121.331573
174	3410001-081	TDS	TRUE	0.049	-23	-0.511	decreasing	125	-1.97	6/30/1988	7/22/2019	38.683333	-121.333333
71	3410001-082	TDS	FALSE	0.142	15	0.417	no trend	91	1.47	10/19/1988	7/21/2016	38.648929	-121.338368
246	3410001-083	TDS	FALSE	0.454	7	0.25	no trend	64.3	0.75	4/29/1988	7/9/2019	38.663692	-121.347786
239	3410001-085	TDS	FALSE	0.474	-9	-0.2	no trend	125	-0.72	6/23/1988	7/17/2019	38.644208	-121.329841
49	3410001-087	TDS	FALSE	0.175	14	0.389	no trend	92	1.36	7/28/1988	7/11/2019	38.645858	-121.392317
218	3410001-088	TDS	FALSE	0.368	7	0.333	no trend	44.3	0.9	4/9/1987	7/11/2013	38.668746	-121.361
89	3410001-089	TDS	FALSE	0.419	-10	-0.222	no trend	124	-0.81	4/20/1988	7/9/2019	38.653579	-121.379692
132	3410001-092	TDS	FALSE	0.118	16	0.444	no trend	92	1.56	6/23/1988	7/20/2016	38.63889	-121.342759
185	3410001-094	TDS	FALSE	0.076	18	0.5	no trend	92	1.77	6/23/1988	7/10/2019	38.652299	-121.354305
196	3410001-095	TDS	FALSE	0.089	6	1	no trend	8.7	1.7	6/30/1988	6/21/2007	38.658062	-121.356402
297	3410001-096	TDS	FALSE	0.105	19	0.422	no trend	123	1.62	6/30/1988	7/9/2019	38.689669	-121.360198
102	3410001-097	TDS	FALSE	0.178	16	0.356	no trend	124	1.35	4/20/1988	7/11/2019	38.694158	-121.360024
256	3410001-098	TDS	FALSE	0.785	4	0.089	no trend	121.3	0.27	4/29/1988	7/9/2019	38.700217	-121.351805
295	3410001-099	TDS	FALSE	1	0	0	no trend	8.7	0	10/20/1988	6/21/2007	38.655401	-121.313482
46	3410001-101	TDS	FALSE	0.754	4	0.111	no trend	92	0.31	10/27/1988	7/7/2016	38.663926	-121.32579
231	3410001-102	TDS	FALSE	0.711	4	0.143	no trend	65.3	0.37	10/20/1988	7/15/2019	38.675049	-121.315501
101	3410001-103	TDS	FALSE	1	0	0	no trend	12	0	10/25/1988	11/13/2013	38.651225	-121.32298
163	3410001-104	TDS	FALSE	0.395	9	0.25	no trend	88.3	0.85	2/1/1993	7/10/2019	38.710442	-121.331662
180	3410001-105	TDS	FALSE	1	0	0	no trend	65.3	0	11/4/1996	7/10/2019	38.710528	-121.331667
262	3410001-106	TDS	FALSE	0.089	6	1	no trend	8.7	1.7	6/28/2001	7/8/2013	38.710517	-121.331659
85	3410001-107	TDS	FALSE	0.339	6	0.4	no trend	27.3	0.96	11/4/1996	7/14/2016	38.709903	-121.357066
127	3410001-111	TDS	FALSE	0.386	8	0.286	no trend	65.3	0.87	12/13/1995	7/11/2019	38.665363	-121.383099
254	3410001-127	TDS	FALSE	0.26	7	0.467	no trend	28.3	1.13	12/13/1995	7/29/2013	38.712268	-121.381099
283	3410001-128	TDS	FALSE	0.221	6	0.6	no trend	16.7	1.22	12/13/1995	6/17/2010	38.709783	-121.374669
149	3410001-129	TDS	TRUE	0.009	15	1	increasing	28.3	2.63	12/13/1995	7/29/2013	38.710651	-121.387666
118	3410001-133	TDS	FALSE	0.445	-7	-0.25	no trend	61.7	-0.76	2/25/1991	7/22/2019	38.682932	-121.376063
182	3410001-135	TDS	FALSE	0.06	-11	-0.733	no trend	28.3	-1.88	2/5/1998	11/7/2016	38.68794	-121.385107
99	3410001-136	TDS	FALSE	0.072	13	0.619	no trend	44.3	1.8	2/25/1991	3/27/2018	38.685899	-121.372701
141	3410001-137	TDS	FALSE	0.707	3	0.2	no trend	28.3	0.38	2/25/1991	7/29/2013	38.692847	-121.375953
183	3410001-139	TDS	FALSE	0.764	3	0.143	no trend	44.3	0.3	6/30/1988	7/19/2016	38.69191	-121.364477
280	3410001-142	TDS	FALSE	0.764	3	0.143	no trend	44.3	0.3	7/20/1989	7/11/2016	38.686782	-121.392424
197	3410001-144	TDS	FALSE	0.135	13	0.464	no trend	64.3	1.5	2/25/1991	7/23/2019	38.69798	-121.373877
213	3410001-145	TDS	FALSE	0.133	9	0.6	no trend	28.3	1.5	4/22/2002	7/10/2019	38.67526	-121.379573
315	3410002-001	TDS	FALSE	0.142	15	0.417	no trend	91	1.47	2/20/1991	2/8/2017	38.583333	-121.383333
117	3410002-002	TDS	FALSE	0.386	8	0.286	no trend	65.3	0.87	7/17/1990	2/8/2017	38.583333	-121.366667
28	3410002-007	TDS	FALSE	0.23	9	0.429	no trend	44.3	1.2	7/17/1990	2/14/2017	38.566667	-121.4
10	3410002-012	TDS	FALSE	1	1	0.067	no trend	28.3	0	7/17/1990	5/8/2017	38.566667	-121.416667
17	3410002-013	TDS	FALSE	0.902	-2	-0.071	no trend	65.3	-0.12	7/17/1990	2/14/2017	38.583333	-121.416667
249	3410002-014	TDS	FALSE	1	0	0	no trend	65.3	0	1/19/1993	5/8/2017	38.583333	-121.366667
152	3410003-001	TDS	FALSE	0.622	10	0.11	no trend	332.7	0.49	9/5/1990	2/6/2019	38.587545	-121.385145
153	3410003-002	TDS	FALSE	0.15	22	0.333	no trend	212.7	1.44	4/11/1986	2/28/2017	38.582537	-121.383219
245	3410003-004	TDS	FALSE	0.221	6	0.6	no trend	16.7	1.22	9/19/1990	1/25/2005	38.587611	-121.392074
162	3410003-005	TDS	FALSE	0.276	15	0.273	no trend	165	1.09	4/2/1987	7/11/2017	38.591017	-121.384139
251	3410003-006	TDS	FALSE	0.21	15	0.333	no trend	125	1.25	4/2/1987	2/28/2017	38.59211	-121.387633
238	3410003-008	TDS	FALSE	0.276	15	0.273	no trend	165	1.09	4/2/1987	2/28/2017	38.600074	-121.391973
74	3410004-001	TDS	FALSE	0.371	11	0.244	no trend	125	0.89	1/29/1998	2/3/2004	38.645432	-121.313067
83	3410004-004	TDS	FALSE	0.276	23	0.219	no trend	408.3	1.09	2/19/1991	1/28/2010	38.64988	-121.30798
175	3410004-005	TDS	FALSE	1	-1	-0.067	no trend	28.3	0	3/1/1991	10/4/2001	38.633333	-121.35
172	3410004-006	TDS	FALSE	0.323	-36	-0.156	no trend	1254.7	-0.99	8/1/1990	6/1/2017	38.622744	-121.335704
6	3410004-007	TDS	FALSE	0.928	2	0.044	no trend	124	0.09	8/1/1990	10/23/2002	38.594673	-121.334606
150	3410004-009	TDS	FALSE	0.494	-24	-0.104	no trend	1132.7	-0.68	2/19/1991	6/1/2017	38.619652	-121.333354
261	3410004-016	TDS	TRUE	0.037	80	0.316	increasing	1432.7	2.09	5/8/1987	6/1/2017	38.645576	-121.306819
248	3410004-020	TDS	FALSE	0.139	28	0.308	no trend	332.7	1.48	4/25/2002	6/1/2017	38.641845	-121.315446
139	3410004-021	TDS	FALSE	1	-1	-0.015	no trend	211.7	0	4/23/2002	6/1/2017	38.604804	-121.342252
290	3410006-001	TDS	FALSE	1	0	0	no trend	43.3	0	12/20/1990	2/20/2013	38.661305	-121.292607
198	3410006-008	TDS	FALSE	1	-1	-0.067	no trend	28.3	0	12/6/1990	2/20/2013	38.679425	-121.289154
130	3410007-001	TDS	FALSE	1	0	0	no trend	8.7	0	4/10/1992	6/24/2010	38.613787	-121.367811
229	3410007-002	TDS	FALSE	0.181	8	0.533	no trend	27.3	1.34	1/25/2001	8/7/2019	38.613607	-121.371676
216	3410007-003	TDS	FALSE	1	1	0.067	no trend	28.3	0	2/19/1991	8/22/2016	38.606352	-121.369707
269	3410007-004	TDS	FALSE	0.566	4	0.267	no trend	27.3	0.57	1/25/2001	8/6/2019	38.607768	-121.374083
77	3410007-005	TDS	FALSE	0.566	4	0.267	no trend	27.3	0.57	1/25/2001	8/6/2019	38.61458	-121.378552
195	3410007-007	TDS	FALSE	0.452	5	0.333	no trend	28.3	0.75	1/25/2001	8/6/2019	38.606531	-121.380719
253	3410007-008	TDS	FALSE	0.356	7	0.333	no trend	42.3	0.92	1/26/1993	8/13/2019	38.613172	-121.380739
166	3410009-001	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	1/28/1993	6/16/2004	38.643048	-121.268528

105	3410009-004	TDS	FALSE	0.06	11	0.733	no trend	28.3	1.88	8/2/1990	6/6/2006	38.651282	-121.255173
78	3410009-005	TDS	FALSE	0.221	6	0.6	no trend	16.7	1.22	2/28/1991	6/16/2004	38.650805	-121.286999
201	3410009-006	TDS	TRUE	0.048	-20	-0.556	decreasing	92	-1.98	2/28/1991	6/14/2012	38.642768	-121.278261
234	3410009-007	TDS	FALSE	0.915	2	0.056	no trend	87.3	0.11	7/19/1989	6/14/2012	38.651297	-121.296666
217	3410009-008	TDS	TRUE	0.009	15	1	increasing	28.3	2.63	8/16/1990	6/6/2006	38.662066	-121.265396
164	3410009-010	TDS	TRUE	0.009	-26	-0.722	decreasing	92	-2.61	11/7/1991	6/14/2012	38.659628	-121.25556
93	3410013-001	TDS	FALSE	0.945	2	0.03	no trend	212.7	0.07	10/7/1992	8/13/2018	38.694922	-121.332628
159	3410013-002	TDS	FALSE	0.283	13	0.289	no trend	125	1.07	2/18/1992	8/13/2018	38.69054	-121.34151
51	3410013-003	TDS	FALSE	0.858	3	0.067	no trend	125	0.18	11/2/1988	8/16/2018	38.683982	-121.31348
240	3410013-004	TDS	FALSE	0.582	-9	-0.136	no trend	211.7	-0.55	7/2/1990	8/7/2018	38.699328	-121.295627
178	3410013-005	TDS	FALSE	0.679	7	0.106	no trend	209.7	0.41	7/2/1990	8/7/2018	38.669042	-121.293798
63	3410013-006	TDS	FALSE	0.099	-25	-0.379	no trend	211.7	-1.65	2/11/1992	8/8/2018	38.685052	-121.305855
156	3410013-007	TDS	FALSE	0.144	12	0.429	no trend	56.7	1.46	7/2/1990	8/19/2015	38.691478	-121.336784
270	3410013-008	TDS	FALSE	0.184	18	0.327	no trend	164	1.33	2/13/1991	8/16/2018	38.673506	-121.340002
224	3410013-009	TDS	FALSE	0.371	11	0.244	no trend	125	0.89	2/11/1992	8/7/2018	38.695662	-121.29509
92	3410013-010	TDS	FALSE	0.088	20	0.444	no trend	124	1.71	2/11/1992	8/15/2018	38.670117	-121.341406
237	3410013-012	TDS	FALSE	0.631	8	0.121	no trend	212.7	0.48	7/2/1990	8/13/2018	38.66565	-121.302524
223	3410013-013	TDS	FALSE	0.283	-13	-0.289	no trend	125	-1.07	2/12/1991	8/13/2018	38.678824	-121.304628
144	3410013-014	TDS	FALSE	0.858	3	0.067	no trend	125	0.18	2/12/1991	8/8/2018	38.668822	-121.304482
112	3410013-015	TDS	FALSE	0.531	9	0.164	no trend	163	0.63	2/18/1992	8/6/2018	38.70124	-121.345319
233	3410013-016	TDS	FALSE	0.938	-2	-0.036	no trend	164	-0.08	2/11/1993	8/13/2018	38.709473	-121.292244
265	3410013-017	TDS	FALSE	0.072	13	0.619	no trend	44.3	1.8	2/11/1992	8/24/2006	38.712243	-121.303547
247	3410013-019	TDS	FALSE	0.161	19	0.345	no trend	165	1.4	7/2/1990	8/6/2018	38.700287	-121.330955
226	3410013-020	TDS	FALSE	0.452	5	0.333	no trend	28.3	0.75	2/12/1991	8/24/2006	38.716217	-121.294262
88	3410013-021	TDS	FALSE	0.721	5	0.111	no trend	125	0.36	2/13/1991	8/8/2018	38.683333	-121.35
232	3410013-022	TDS	FALSE	0.445	7	0.25	no trend	61.7	0.76	2/18/1992	9/11/2012	38.7124	-121.306829
189	3410013-023	TDS	FALSE	0.917	-2	-0.056	no trend	92	-0.1	2/11/1992	8/7/2018	38.695536	-121.313454
66	3410013-024	TDS	FALSE	0.244	18	0.273	no trend	212.7	1.17	2/11/1992	8/7/2018	38.680539	-121.31067
220	3410013-025	TDS	FALSE	0.585	8	0.145	no trend	164	0.55	2/18/1992	8/13/2018	38.718426	-121.313299
188	3410013-026	TDS	FALSE	0.528	9	0.164	no trend	160.3	0.63	7/2/1990	8/6/2018	38.701667	-121.344722
119	3410013-027	TDS	FALSE	0.107	19	0.422	no trend	125	1.61	2/18/1992	9/18/2012	38.709413	-121.317252
165	3410013-028	TDS	FALSE	1	0	0	no trend	43.3	0	4/21/1997	8/13/2018	38.698857	-121.32618
147	3410016-002	TDS	FALSE	0.312	5	0.5	no trend	15.7	1.01	4/18/1991	1/17/2013	38.694541	-121.210813
24	3410020-015	TDS	FALSE	1	0	0	no trend	65.3	0	1/17/1992	4/3/2017	38.6125	-121.479167
11	3410020-016	TDS	FALSE	0.711	4	0.143	no trend	65.3	0.37	1/17/1992	1/20/2015	38.616667	-121.479167
293	3410020-017	TDS	TRUE	0.043	27	0.491	increasing	165	2.02	11/18/1988	10/9/2017	38.62266	-121.477813
84	3410020-018	TDS	FALSE	0.107	19	0.422	no trend	125	1.61	1/17/1992	5/8/2017	38.627831	-121.477227
292	3410020-021	TDS	FALSE	0.452	-5	-0.333	no trend	28.3	-0.75	1/21/1992	10/12/2011	38.607083	-121.454779
97	3410020-022	TDS	FALSE	0.592	7	0.156	no trend	125	0.54	11/18/1988	3/20/2017	38.607305	-121.443097
136	3410020-023	TDS	FALSE	0.536	-6	-0.214	no trend	65.3	-0.62	1/21/1992	3/7/2017	38.604956	-121.439486
314	3410020-024	TDS	FALSE	0.152	17	0.378	no trend	125	1.43	11/18/1988	10/10/2011	38.612801	-121.450505
129	3410020-025	TDS	FALSE	0.086	8	0.8	no trend	16.7	1.71	1/21/1992	10/9/2008	38.612294	-121.440456
215	3410020-027	TDS	FALSE	0.592	7	0.156	no trend	125	0.54	1/22/1992	5/8/2017	38.620988	-121.443553
279	3410020-028	TDS	FALSE	0.68	7	0.106	no trend	211.7	0.41	11/18/1988	5/8/2017	38.62044	-121.432285
108	3410020-029	TDS	FALSE	0.251	12	0.333	no trend	92	1.15	1/17/1992	3/20/2017	38.618056	-121.468056
107	3410020-030	TDS	FALSE	0.348	-10	-0.278	no trend	92	-0.94	1/17/1992	5/8/2017	38.625119	-121.462605
59	3410020-032	TDS	FALSE	0.21	-15	-0.333	no trend	125	-1.25	1/16/1991	10/9/2017	38.628503	-121.43627
55	3410020-033	TDS	FALSE	0.754	4	0.111	no trend	92	0.31	11/16/1988	10/10/2011	38.626808	-121.42959
171	3410020-034	TDS	FALSE	0.436	11	0.2	no trend	165	0.78	1/16/1991	3/12/2018	38.638412	-121.446721
73	3410020-035	TDS	FALSE	0.35	-13	-0.236	no trend	165	-0.93	1/16/1991	3/12/2018	38.639934	-121.427293
133	3410020-037	TDS	FALSE	1	-1	-0.018	no trend	165	0	1/16/1991	5/8/2017	38.651207	-121.469509
264	3410020-038	TDS	FALSE	0.436	11	0.2	no trend	165	0.78	1/16/1991	5/8/2017	38.647475	-121.459256
50	3410020-039	TDS	FALSE	0.221	-6	-0.6	no trend	16.7	-1.22	1/22/1992	10/8/2003	38.627595	-121.432917
56	3410020-040	TDS	FALSE	1	1	0.018	no trend	165	0	10/22/1990	5/9/2017	38.629597	-121.420726
278	3410020-041	TDS	FALSE	0.39	12	0.218	no trend	164	0.86	1/16/1991	5/9/2017	38.641387	-121.435795
22	3410020-042	TDS	FALSE	0.063	-16	-0.571	no trend	65.3	-1.86	1/21/1992	3/7/2017	38.596923	-121.458973
294	3410020-044	TDS	FALSE	0.266	10	0.357	no trend	65.3	1.11	10/16/1990	10/10/2011	38.613996	-121.456155
194	3410020-045	TDS	FALSE	0.161	19	0.345	no trend	165	1.4	10/19/1990	5/9/2017	38.622276	-121.446858
134	3410020-046	TDS	TRUE	0.005	-28	-0.778	decreasing	92	-2.81	1/22/1992	9/22/2014	38.623116	-121.427024
157	3410020-050	TDS	FALSE	0.474	-9	-0.2	no trend	125	-0.72	1/16/1991	3/25/2014	38.668053	-121.438012
42	3410020-051	TDS	FALSE	0.64	-7	-0.127	no trend	165	-0.47	1/16/1991	3/12/2018	38.634413	-121.412516
296	3410020-052	TDS	FALSE	0.592	-7	-0.156	no trend	125	-0.54	3/8/1993	5/9/2017	38.599341	-121.445804
214	3410020-054	TDS	FALSE	0.533	-9	-0.164	no trend	165	-0.62	1/21/1992	10/9/2017	38.596324	-121.427308
33	3410020-055	TDS	FALSE	0.35	-13	-0.236	no trend	165	-0.93	1/17/1992	5/9/2017	38.617636	-121.469304
91	3410020-056	TDS	FALSE	0.466	-8	-0.222	no trend	92	-0.73	1/12/1994	5/9/2017	38.654657	-121.448564
291	3410020-057	TDS	FALSE	0.386	-8	-0.286	no trend	65.3	-0.87	1/18/1995	12/19/2018	38.658482	-121.466415
30	3410026-001	TDS	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	2/21/1991	5/31/2012	38.58961	-121.429343
7	3410026-002	TDS	FALSE	0.806	2	0.2	no trend	16.7	0.24	2/21/1991	5/3/2018	38.588266	-121.423478
31	3410026-003	TDS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	2/21/1991	5/3/2018	38.593617	-121.439154
18	3410026-004	TDS	FALSE	0.221	-6	-0.6	no trend	16.7	-1.22	2/21/1991	5/3/2018	38.593339	-121.432431
206	3410031-001	TDS	FALSE	1	0	0	no trend	161.3	0	3/24/1988	8/11/2015	38.720833	-121.358333
190	3410031-002	TDS	FALSE	0.323	12	0.267	no trend	124	0.99	9/10/1993	8/8/2018	38.717222	-121.3575

94	3410031-003	TDS	FALSE	0.928	2	0.044	no trend	121.3	0.09	2/12/1991	8/14/2018	38.7	-121.383333
221	3410031-004	TDS	FALSE	0.584	11	0.121	no trend	333.7	0.55	10/29/1987	8/14/2018	38.718056	-121.382222
61	3410031-005	TDS	FALSE	0.592	7	0.156	no trend	125	0.54	2/26/1992	8/5/2015	38.716667	-121.4
160	3410031-006	TDS	FALSE	0.113	24	0.364	no trend	210.7	1.58	11/2/1988	8/14/2018	38.708333	-121.383611
2073	3410031-007	TDS	TRUE	0.035	-28	-0.509	decreasing	164	-2.11	2/12/1991	8/9/2018	38.733333	-121.35
2056	3410031-008	TDS	FALSE	0.39	12	0.218	no trend	164	0.86	10/7/1992	8/9/2018	38.733333	-121.35
208	3410031-009	TDS	FALSE	0.471	-9	-0.2	no trend	123	-0.72	1/15/1992	8/7/2018	38.715278	-121.378056
72	3410031-010	TDS	FALSE	0.343	-10	-0.278	no trend	90	-0.95	8/29/1995	8/7/2018	38.705	-121.365556
289	3410031-011	TDS	FALSE	0.207	34	0.222	no trend	684.7	1.26	6/21/1990	8/7/2018	38.726944	-121.3825
135	3410031-012	TDS	FALSE	0.858	-3	-0.067	no trend	125	-0.18	6/12/1992	8/7/2018	38.721111	-121.368611
45	3410031-013	TDS	FALSE	0.471	9	0.2	no trend	123	0.72	2/25/1992	8/14/2018	38.711667	-121.413889
54	3410031-014	TDS	FALSE	0.213	17	0.309	no trend	165	1.25	4/15/1987	8/14/2018	38.716111	-121.408889
95	3410031-015	TDS	FALSE	0.221	6	0.6	no trend	16.7	1.22	2/11/1993	8/14/2018	38.716667	-121.416667
241	3410031-016	TDS	FALSE	0.246	-12	-0.333	no trend	90	-1.16	7/16/1996	8/8/2018	38.724444	-121.336111
80	3410031-017	TDS	FALSE	0.386	8	0.286	no trend	65.3	0.87	4/30/1998	8/8/2018	38.723056	-121.349722
257	3410031-018	TDS	TRUE	0.039	24	0.533	increasing	124	2.07	1/9/1996	8/7/2018	38.716389	-121.371944
288	3410045-001	TDS	FALSE	0.436	11	0.2	no trend	165	0.78	2/25/1992	8/7/2018	38.586137	-121.411513
138	3410045-002	TDS	FALSE	0.718	-5	-0.111	no trend	123	-0.36	2/25/1992	8/7/2018	38.583085	-121.413054
116	3410045-003	TDS	FALSE	0.371	-11	-0.244	no trend	125	-0.89	1/21/1993	8/7/2018	38.594423	-121.417465
243	3410045-004	TDS	FALSE	0.348	-10	-0.278	no trend	92	-0.94	7/3/1990	7/24/2012	38.592566	-121.407256
96	3410045-005	TDS	FALSE	0.64	7	0.127	no trend	165	0.47	2/12/1991	8/7/2018	38.600025	-121.410183
2907	5105004-001	TDS	FALSE	0.53	-8	-0.178	no trend	124	-0.63	11/29/2000	12/14/2016	38.777769	-121.52437
2906	5105004-002	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	10/21/2009	12/14/2016	38.777766	-121.525116
1880	USGS-383655121301601	TDS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	8/3/1998	8/7/2017	38.6157528	-121.5054028
1894	USGS-383659121292201	TDS	FALSE	1	0	0	no trend	8.7	0	8/5/1998	8/8/2017	38.6164833	-121.4903694
1835	USGS-383703121280701	TDS	FALSE	1	1	0.067	no trend	28.3	0	9/21/1982	5/15/2014	38.6175	-121.4688889
1876	USGS-383727121301801	TDS	FALSE	1	0	0	no trend	8.7	0	8/6/1998	8/7/2017	38.6237972	-121.5060556
1859	USGS-383746121291101	TDS	FALSE	0.063	-67	-0.29	no trend	1257.7	-1.86	8/4/1998	8/8/2017	38.6292139	-121.4877028
1855	USGS-383900121270001	TDS	FALSE	0.368	-7	-0.333	no trend	44.3	-0.9	6/14/2005	6/15/2005	38.6585	-121.4664722
1860	USGS-384145121184101	TDS	FALSE	0.284	34	0.179	no trend	950	1.07	8/17/1998	9/4/2012	38.6964	-121.3120389
1869	USGS-384224121261401	TDS	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	9/22/1982	3/12/2014	38.7064722	-121.4384722
1866	USGS-384301121195101	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	6/5/1996	10/2/2017	38.717	-121.3320278
1902	USGS-384318121230001	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	8/19/1998	8/21/2017	38.7216389	-121.3841778
1882	USGS-384330121265601	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	7/24/1969	5/14/2008	38.7249018	-121.4499544
1882	USGS-384330121265601	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	7/24/1969	5/14/2008	38.7249018	-121.4499544
1868	USGS-384330121293901	TDS	TRUE	0.041	64	0.337	increasing	950	2.04	8/11/1997	7/10/2017	38.7251167	-121.4954417
2806	USGS-384413121163801	TDS	FALSE	1	1	0.048	no trend	44.3	0	9/24/1982	3/10/2014	38.7369444	-121.2772222
3035	USGS-384455121292101	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	8/7/1996	9/12/2017	38.7487778	-121.4898889
3035	USGS-384455121292101	TDS	FALSE	0.308	4	0.667	no trend	8.7	1.02	8/7/1996	9/12/2017	38.7487778	-121.4898889
2812	USGS-384949121233501	TDS	FALSE	1	0	0	no trend	8.7	0	8/7/1996	10/3/2017	38.8301771	-121.3941209
2812	USGS-384949121233501	TDS	FALSE	1	0	0	no trend	8.7	0	8/7/1996	10/3/2017	38.8301771	-121.3941209
2813	USGS-385432121213001	TDS	FALSE	1	0	0	no trend	8.7	0	6/3/1996	10/18/2017	38.9084167	-121.3590833
2813	USGS-385432121213001	TDS	FALSE	1	0	0	no trend	8.7	0	6/3/1996	10/18/2017	38.9084167	-121.3590833
3034	USGS-385546121312801	TDS	FALSE	0.368	7	0.333	no trend	44.3	0.9	6/3/1965	10/5/2017	38.92925	-121.5254444
3034	USGS-385546121312801	TDS	FALSE	0.368	7	0.333	no trend	44.3	0.9	6/3/1965	10/5/2017	38.92925	-121.5254444
3042	USGS-385718121290401	TDS	FALSE	0.133	9	0.6	no trend	28.3	1.5	5/19/1965	5/20/2008	38.9548956	-121.4855142
3042	USGS-385718121290401	TDS	FALSE	0.133	9	0.6	no trend	28.3	1.5	5/19/1965	5/20/2008	38.9548956	-121.4855142
2857	USGS-385914121215801	TDS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	9/7/1982	6/2/2008	38.9871178	-121.367178
2857	USGS-385914121215801	TDS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	9/7/1982	6/2/2008	38.9871178	-121.367178

Arsenic

Local_ID	Well_Info_ID	chemical	h	p	s	tau	trend	var_s	z	datemin	datemax	Latitude_NAD83	Longitude_NAD83
2083	11N06E17D001M	AS	TRUE	0.027	37	0.407	increasing	266.3	2.21	12/13/2005	3/26/2008	38.8064	-121.3353
2081	11N06E17D002M	AS	FALSE	0.205	-109	-0.133	no trend	7253.7	-1.27	12/13/2005	3/26/2008	38.8027	-121.3384
2080	11N06E17D003M	AS	TRUE	0.028	36	0.462	increasing	255.3	2.19	12/13/2005	3/26/2008	38.8059	-121.3358
2082	11N06E17E001M	AS	TRUE	0.003	53	0.582	increasing	301.7	2.99	12/13/2005	3/26/2008	38.8058	-121.3354
2065	3100077-003	AS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	2/26/2004	7/10/2017	38.726602	-121.336563
2062	3100077-004	AS	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	2/26/2004	7/10/2017	38.726284	-121.336527
2059	3100538-001	AS	FALSE	1	0	0	no trend	16.7	0	8/19/1999	3/23/2018	38.7505	-121.321972
2060	3104508-001	AS	FALSE	0.47	3	0.5	no trend	7.7	0.72	2/19/2004	4/20/2017	38.729952	-121.321616
2069	3110008-003	AS	FALSE	0.211	6	0.286	no trend	16	1.25	10/26/1992	1/8/2010	38.753022	-121.279492
2071	3110008-006	AS	FALSE	0.61	5	0.179	no trend	61.7	0.51	10/26/1992	8/25/2016	38.736633	-121.277875
2066	3110008-007	AS	FALSE	0.507	6	0.214	no trend	56.7	0.66	10/26/1992	8/25/2016	38.726493	-121.258205
2050	3110008-008	AS	FALSE	0.452	-5	-0.333	no trend	28.3	-0.75	10/22/2002	8/23/2018	38.805938	-121.33588
2064	3110025-005	AS	FALSE	0.82	-7	-0.046	no trend	695	-0.23	7/26/1989	9/12/2019	38.818889	-121.31
2063	3110040-001	AS	FALSE	0.729	-8	-0.076	no trend	407.3	-0.35	9/27/1988	7/9/2002	38.75	-121.34722
2067	3110040-002	AS	FALSE	0.625	-9	-0.115	no trend	267.7	-0.49	8/31/1989	7/9/2002	38.75	-121.34444
145	3400173-002	AS	FALSE	0.089	6	1	no trend	8.7	1.7	5/24/2001	2/14/2017	38.640638	-121.483861
8	3400383-001	AS	FALSE	0.26	7	0.467	no trend	28.3	1.13	8/23/2001	7/24/2008	38.618983	-121.536935
60	3400456-001	AS	FALSE	0.402	39	0.12	no trend	2058.3	0.84	6/27/2013	9/18/2019	38.698055	-121.43
193	3410001-001	AS	FALSE	1	1	0.022	no trend	116.3	0	1/12/1993	9/5/2017	38.606839	-121.3982
242	3410001-002	AS	FALSE	0.105	-19	-0.422	no trend	123	-1.62	10/13/1995	7/18/2017	38.59783	-121.398024
258	3410001-004	AS	FALSE	1	-1	-0.036	no trend	64.3	0	1/12/1993	6/19/2014	38.611483	-121.410107
284	3410001-005	AS	FALSE	0.402	-9	-0.25	no trend	91	-0.84	2/25/1991	6/8/2011	38.623478	-121.396638
203	3410001-007	AS	FALSE	1	-1	-0.018	no trend	163	0	7/9/1990	9/27/2017	38.610999	-121.363391
128	3410001-009	AS	FALSE	0.242	-5	-0.333	no trend	11.7	-1.17	2/2/1993	12/15/2005	38.616331	-121.403703
212	3410001-010	AS	FALSE	0.754	-5	-0.091	no trend	163	-0.31	7/10/1990	9/12/2017	38.608099	-121.408153
158	3410001-011	AS	FALSE	0.876	-3	-0.055	no trend	163	-0.16	1/30/1992	9/14/2017	38.619863	-121.396184
228	3410001-012	AS	FALSE	0.752	-5	-0.091	no trend	160.3	-0.32	2/25/1991	12/12/2017	38.617662	-121.403695
82	3410001-013	AS	FALSE	1	-1	-0.018	no trend	148.3	0	1/28/1992	9/26/2017	38.598939	-121.370714
146	3410001-014	AS	FALSE	0.316	8	0.286	no trend	48.7	1	7/10/1990	6/27/2006	38.61171	-121.386048
260	3410001-015	AS	FALSE	0.934	2	0.036	no trend	147.3	0.08	11/1/1988	9/19/2017	38.59781	-121.381308
191	3410001-016	AS	FALSE	0.385	-10	-0.222	no trend	107.3	-0.87	2/22/1991	9/4/2014	38.631327	-121.37485
124	3410001-017	AS	FALSE	0.367	-11	-0.244	no trend	123	-0.9	1/30/1992	8/27/2014	38.61981	-121.403732
211	3410001-018	AS	FALSE	0.75	-5	-0.091	no trend	157.7	-0.32	2/22/1991	9/19/2017	38.623854	-121.374359
209	3410001-019	AS	FALSE	0.672	7	0.106	no trend	200.3	0.42	1/27/1992	9/25/2017	38.597831	-121.359623
114	3410001-020	AS	FALSE	1	1	0.018	no trend	156.3	0	1/27/1992	9/19/2017	38.618079	-121.359205
210	3410001-021	AS	FALSE	1	-1	-0.018	no trend	163	0	7/9/1990	9/12/2017	38.615256	-121.419986
161	3410001-022	AS	FALSE	0.419	-10	-0.222	no trend	124	-0.81	10/13/1995	9/11/2017	38.604549	-121.42274
222	3410001-025	AS	FALSE	0.636	-7	-0.127	no trend	160.3	-0.47	2/22/1991	9/19/2017	38.60046	-121.359118
148	3410001-026	AS	FALSE	0.308	4	0.667	no trend	8.7	1.02	7/10/1990	2/23/2005	38.627091	-121.384097
113	3410001-027	AS	FALSE	0.788	-4	-0.089	no trend	124	-0.27	1/30/1992	9/27/2017	38.605146	-121.390988
244	3410001-028	AS	FALSE	0.853	3	0.067	no trend	116.3	0.19	1/30/1992	8/21/2014	38.63562	-121.381097
227	3410001-029	AS	FALSE	0.522	9	0.164	no trend	156.3	0.64	1/30/1992	10/3/2017	38.630252	-121.397575
236	3410001-030	AS	FALSE	0.266	-13	-0.289	no trend	116.3	-1.11	1/29/1992	9/26/2017	38.617802	-121.424022
81	3410001-032	AS	FALSE	0.578	7	0.156	no trend	116.3	0.56	7/9/1990	9/19/2017	38.622918	-121.413817
104	3410001-033	AS	FALSE	0.395	-9	-0.25	no trend	88.3	-0.85	1/29/1992	7/10/2014	38.601378	-121.424
173	3410001-034	AS	FALSE	0.584	7	0.156	no trend	120.3	0.55	7/9/1990	9/11/2017	38.584674	-121.396539
169	3410001-035	AS	FALSE	0.856	-3	-0.067	no trend	121	-0.18	7/9/1990	9/28/2017	38.594464	-121.351844
19	3410001-038	AS	FALSE	0.461	-8	-0.222	no trend	90	-0.74	1/28/1992	6/9/2011	38.578371	-121.363395
20	3410001-039	AS	FALSE	0.834	-3	-0.083	no trend	91	-0.21	2/22/1991	6/20/2006	38.591742	-121.346413
168	3410001-042	AS	FALSE	0.696	-6	-0.109	no trend	164	-0.39	2/22/1991	9/12/2017	38.628014	-121.358648
184	3410001-051	AS	FALSE	0.936	2	0.036	no trend	156.7	0.08	7/9/1990	9/11/2017	38.636187	-121.375067
111	3410001-052	AS	FALSE	0.651	-6	-0.133	no trend	122	-0.45	7/9/1990	9/11/2017	38.625054	-121.362252
287	3410001-054	AS	FALSE	0.937	-2	-0.036	no trend	161.3	-0.08	2/11/1991	9/13/2017	38.582422	-121.408379
122	3410001-055	AS	FALSE	0.848	-3	-0.067	no trend	108.3	-0.19	11/1/1988	12/13/2017	38.594474	-121.39864
26	3410001-056	AS	FALSE	0.564	7	0.156	no trend	108.3	0.58	1/12/1993	9/13/2017	38.578749	-121.41096
3	3410001-061	AS	FALSE	0.979	-2	-0.008	no trend	1416	-0.03	5/7/1998	3/20/2018	38.582786	-121.338489
176	3410001-062	AS	FALSE	0.295	-11	-0.306	no trend	91	-1.05	8/22/2000	9/5/2017	38.618056	-121.401944
12	3410001-064	AS	FALSE	0.886	-2	-0.071	no trend	48.7	-0.14	4/23/2002	9/12/2017	38.584121	-121.353432
13	3410001-065	AS	FALSE	1	1	0.028	no trend	74.3	0	4/22/2002	9/21/2017	38.583196	-121.33679
4	3410001-066	AS	FALSE	0.378	-9	-0.25	no trend	82.3	-0.88	4/23/2002	9/12/2017	38.582214	-121.338203
2	3410001-067	AS	FALSE	0.466	-8	-0.222	no trend	92	-0.73	6/3/1999	10/1/2014	38.582481	-121.417169
225	3410001-069	AS	FALSE	0.578	9	0.136	no trend	207	0.56	2/26/1992	9/28/2017	38.580609	-121.384004
255	3410001-070	AS	FALSE	0.327	15	0.227	no trend	204.3	0.98	2/12/1991	9/12/2017	38.576006	-121.403088
205	3410001-071	AS	FALSE	0.23	-9	-0.429	no trend	44.3	-1.2	4/17/2002	9/14/2017	38.63056	-121.397787
106	3410001-072	AS	FALSE	0.19	7	0.25	no trend	21	1.31	4/17/2002	9/12/2017	38.61744	-121.411527
252	3410001-073	AS	FALSE	0.19	7	0.25	no trend	21	1.31	4/17/2002	9/7/2017	38.58058	-121.383962
58	3410001-076	AS	FALSE	0.949	2	0.026	no trend	244.7	0.06	6/5/1984	7/10/2019	38.644265	-121.362069
69	3410001-077	AS	FALSE	0.442	-15	-0.165	no trend	331.7	-0.77	3/7/1984	7/10/2019	38.631522	-121.352911
86	3410001-078	AS	FALSE	1	1	0.015	no trend	211.7	0	6/5/1984	7/9/2019	38.684818	-121.355931
259	3410001-079	AS	FALSE	0.797	-4	-0.073	no trend	136.7	-0.26	6/4/1984	7/24/2013	38.667577	-121.334161
110	3410001-080	AS	FALSE	0.956	-2	-0.022	no trend	328	-0.06	6/4/1984	7/17/2019	38.672567	-121.331573
174	3410001-081	AS	FALSE	0.699	-7	-0.09	no trend	240.3	-0.39	6/5/1984	7/22/2019	38.683333	-121.333333
71	3410001-082	AS	FALSE	1	-1	-0.008	no trend	279.7	0	6/4/1984	7/21/2016	38.648929	-121.338368
246	3410001-083	AS	FALSE	0.614	9	0.115	no trend	251	0.5	5/17/1984	7/9/2019	38.663692	-121.347786

239	3410001-085	AS	FALSE	0.881	-4	-0.038	no trend	402.7	-0.15	6/4/1984	7/17/2019	38.644208	-121.329841
49	3410001-087	AS	FALSE	0.868	-4	-0.044	no trend	328	-0.17	6/5/1984	7/11/2019	38.645858	-121.392317
218	3410001-088	AS	FALSE	0.712	-7	-0.09	no trend	265	-0.37	5/17/1984	7/11/2013	38.668746	-121.361
89	3410001-089	AS	FALSE	0.252	-24	-0.229	no trend	402.7	-1.15	3/7/1984	7/9/2019	38.653579	-121.379692
132	3410001-092	AS	FALSE	1	1	0.011	no trend	268.3	0	6/4/1984	7/20/2016	38.63889	-121.342759
185	3410001-094	AS	FALSE	0.52	11	0.121	no trend	241.7	0.64	5/17/1984	7/10/2019	38.652299	-121.354305
196	3410001-095	AS	FALSE	1	-1	-0.022	no trend	59.7	0	5/17/1984	6/21/2007	38.658062	-121.356402
297	3410001-096	AS	FALSE	0.298	-22	-0.21	no trend	407.3	-1.04	6/30/1988	7/9/2019	38.689669	-121.360198
102	3410001-097	AS	FALSE	0.07	-34	-0.374	no trend	330.7	-1.81	12/13/1984	7/11/2019	38.694158	-121.360024
256	3410001-098	AS	FALSE	0.659	9	0.075	no trend	328.3	0.44	5/9/1984	7/9/2019	38.700217	-121.351805
295	3410001-099	AS	FALSE	0.19	-7	-0.25	no trend	21	-1.31	10/20/1988	6/21/2007	38.655401	-121.313482
46	3410001-101	AS	FALSE	0.142	-12	-0.154	no trend	56	-1.47	10/27/1988	7/7/2016	38.663926	-121.32579
231	3410001-102	AS	FALSE	0.741	5	0.076	no trend	146.3	0.33	10/20/1988	7/15/2019	38.675049	-121.315501
101	3410001-103	AS	FALSE	0.175	-8	-0.222	no trend	26.7	-1.36	10/25/1988	11/13/2013	38.651225	-121.32298
163	3410001-104	AS	FALSE	0.573	-10	-0.128	no trend	255.3	-0.56	2/1/1993	7/10/2019	38.710442	-121.331662
180	3410001-105	AS	FALSE	0.755	-5	-0.076	no trend	163.7	-0.31	10/12/1995	7/10/2019	38.710528	-121.331667
262	3410001-106	AS	FALSE	0.799	-3	-0.107	no trend	61.7	-0.25	6/28/2001	7/8/2013	38.710517	-121.331659
85	3410001-107	AS	FALSE	0.701	5	0.111	no trend	108.3	0.38	11/4/1996	7/14/2016	38.709903	-121.357066
127	3410001-111	AS	FALSE	1	1	0.018	no trend	160.3	0	12/13/1995	7/11/2019	38.665363	-121.383099
254	3410001-127	AS	FALSE	0.433	11	0.2	no trend	163	0.78	12/13/1995	7/29/2013	38.712268	-121.381099
283	3410001-128	AS	FALSE	0.343	10	0.278	no trend	90	0.95	12/13/1995	6/17/2010	38.709783	-121.374669
149	3410001-129	AS	FALSE	0.582	-8	-0.145	no trend	161.3	-0.55	12/13/1995	7/29/2013	38.710651	-121.387666
118	3410001-133	AS	FALSE	1	1	0.015	no trend	209	0	2/25/1991	7/22/2019	38.682932	-121.376063
182	3410001-135	AS	FALSE	0.138	-17	-0.378	no trend	116.3	-1.48	2/5/1998	11/7/2016	38.68794	-121.385107
99	3410001-136	AS	FALSE	0.189	-17	-0.309	no trend	148.3	-1.31	2/25/1991	3/27/2018	38.685899	-121.372701
141	3410001-137	AS	FALSE	0.145	-17	-0.378	no trend	120.3	-1.46	2/25/1991	7/29/2013	38.692847	-121.375953
183	3410001-139	AS	FALSE	0.35	-13	-0.236	no trend	165	-0.93	5/17/1984	7/19/2016	38.69191	-121.364477
280	3410001-142	AS	FALSE	0.241	-16	-0.291	no trend	164	-1.17	7/20/1989	7/11/2016	38.686782	-121.392424
197	3410001-144	AS	FALSE	0.358	-16	-0.205	no trend	266.7	-0.92	2/25/1991	7/23/2019	38.69798	-121.373877
213	3410001-145	AS	FALSE	0.659	5	0.139	no trend	82.3	0.44	4/22/2002	7/10/2019	38.67526	-121.379573
315	3410002-001	AS	FALSE	0.936	-2	-0.036	no trend	155.3	-0.08	2/20/1991	2/8/2017	38.583333	-121.383333
117	3410002-002	AS	FALSE	0.799	-3	-0.107	no trend	61.7	-0.25	7/17/1990	2/8/2017	38.583333	-121.366667
28	3410002-007	AS	FALSE	0.212	-11	-0.393	no trend	64.3	-1.25	7/17/1990	2/14/2017	38.566667	-121.4
10	3410002-012	AS	FALSE	0.368	-7	-0.333	no trend	44.3	-0.9	7/17/1990	5/8/2017	38.566667	-121.416667
17	3410002-013	AS	FALSE	0.902	2	0.071	no trend	65.3	0.12	7/17/1990	2/14/2017	38.583333	-121.416667
249	3410002-014	AS	FALSE	0.799	-3	-0.107	no trend	61.7	-0.25	1/19/1993	5/8/2017	38.583333	-121.366667
152	3410003-001	AS	FALSE	1	1	0.013	no trend	265	0	9/5/1990	2/6/2019	38.587545	-121.385145
153	3410003-002	AS	FALSE	0.813	-4	-0.073	no trend	161.3	-0.24	4/11/1986	2/28/2017	38.582537	-121.383219
245	3410003-004	AS	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	9/19/1990	1/25/2005	38.587611	-121.392074
162	3410003-005	AS	FALSE	0.592	-7	-0.156	no trend	125	-0.54	4/2/1987	7/11/2017	38.591017	-121.384139
251	3410003-006	AS	FALSE	0.348	10	0.278	no trend	92	0.94	4/2/1987	2/28/2017	38.59211	-121.387633
238	3410003-008	AS	FALSE	0.788	-4	-0.089	no trend	124	-0.27	4/2/1987	2/28/2017	38.600074	-121.391973
74	3410004-001	AS	FALSE	1	1	0.022	no trend	106.3	0	10/24/1995	2/3/2004	38.645432	-121.313067
83	3410004-004	AS	FALSE	0.257	20	0.19	no trend	281.3	1.13	2/19/1991	1/28/2010	38.64988	-121.30798
175	3410004-005	AS	FALSE	0.242	-5	-0.333	no trend	11.7	-1.17	3/1/1991	10/4/2001	38.633333	-121.35
172	3410004-006	AS	FALSE	0.158	-49	-0.194	no trend	1157.7	-1.41	8/1/1990	6/1/2017	38.622744	-121.335704
6	3410004-007	AS	FALSE	1	-1	-0.018	no trend	73	0	8/1/1990	10/23/2002	38.594673	-121.334606
150	3410004-009	AS	FALSE	0.832	-8	-0.032	no trend	1092.7	-0.21	2/19/1991	6/1/2017	38.619652	-121.333354
261	3410004-016	AS	FALSE	0.151	55	0.199	no trend	1411.7	1.44	5/8/1987	6/1/2017	38.645576	-121.306819
248	3410004-020	AS	FALSE	0.585	7	0.077	no trend	121	0.55	4/25/2002	6/1/2017	38.641845	-121.315446
139	3410004-021	AS	FALSE	0.373	-14	-0.212	no trend	212.7	-0.89	4/23/2002	6/1/2017	38.604804	-121.342252
290	3410006-001	AS	FALSE	1	-1	-0.036	no trend	37	0	12/20/1990	5/30/2019	38.661305	-121.292607
198	3410006-008	AS	FALSE	0.242	-5	-0.333	no trend	11.7	-1.17	12/6/1990	2/20/2013	38.679425	-121.289154
98	3410006-010	AS	FALSE	0.308	4	0.667	no trend	8.7	1.02	10/21/2004	6/6/2018	38.698638	-121.269673
130	3410007-001	AS	FALSE	0.221	-6	-0.6	no trend	16.7	-1.22	4/10/1992	6/24/2010	38.613787	-121.367811
229	3410007-002	AS	FALSE	0.133	-9	-0.6	no trend	28.3	-1.5	10/2/1995	8/18/2016	38.613607	-121.371676
216	3410007-003	AS	FALSE	0.368	-7	-0.333	no trend	44.3	-0.9	2/19/1991	8/22/2016	38.606352	-121.369707
269	3410007-004	AS	FALSE	0.707	3	0.2	no trend	28.3	0.38	10/2/1995	8/17/2016	38.607768	-121.374083
77	3410007-005	AS	FALSE	0.133	-9	-0.6	no trend	28.3	-1.5	10/2/1995	8/18/2016	38.61458	-121.378552
142	3410007-006	AS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	10/2/1995	6/28/2010	38.60731	-121.364767
195	3410007-007	AS	FALSE	0.707	-3	-0.2	no trend	28.3	-0.38	10/2/1995	6/21/2018	38.606531	-121.380719
253	3410007-008	AS	FALSE	0.707	3	0.2	no trend	28.3	0.38	1/26/1993	8/16/2016	38.613172	-121.380739
166	3410009-001	AS	FALSE	0.211	-6	-0.286	no trend	16	-1.25	1/28/1993	6/26/2003	38.643048	-121.268528
105	3410009-004	AS	FALSE	0.857	-3	-0.067	no trend	123	-0.18	8/2/1990	6/6/2006	38.651282	-121.255173
78	3410009-005	AS	FALSE	0.19	-7	-0.25	no trend	21	-1.31	2/28/1991	6/26/2003	38.650805	-121.286999
201	3410009-006	AS	FALSE	0.524	8	0.121	no trend	120.7	0.64	2/28/1991	5/10/2012	38.642768	-121.278261
234	3410009-007	AS	FALSE	0.155	-10	-0.182	no trend	40	-1.42	7/19/1989	5/10/2012	38.651297	-121.296666
217	3410009-008	AS	TRUE	0.012	24	0.667	increasing	83.3	2.52	8/16/1990	6/6/2006	38.662066	-121.265396
164	3410009-010	AS	FALSE	0.141	22	0.282	no trend	203.3	1.47	11/7/1991	3/28/2019	38.659628	-121.25556
93	3410013-001	AS	FALSE	0.838	-3	-0.067	no trend	95.7	-0.2	10/7/1992	8/13/2018	38.694922	-121.332628
159	3410013-002	AS	FALSE	0.524	-8	-0.145	no trend	120.7	-0.64	2/18/1992	8/13/2018	38.69054	-121.34151
51	3410013-003	AS	FALSE	0.239	14	0.311	no trend	122	1.18	11/2/1988	8/16/2018	38.683982	-121.31348
240	3410013-004	AS	FALSE	0.265	15	0.273	no trend	157.7	1.11	7/2/1990	8/7/2018	38.699328	-121.295627
178	3410013-005	AS	TRUE	0.043	26	0.473	increasing	152.7	2.02	7/2/1990	8/7/2018	38.669042	-121.293798
63	3410013-006	AS	FALSE	0.132	20	0.364	no trend	159.3	1.51	2/11/1992	8/8/2018	38.685052	-121.305855

156	3410013-007	AS	FALSE	0.081	10	0.476	no trend	26.7	1.74	7/2/1990	8/19/2015	38.691478	-121.336784
270	3410013-008	AS	FALSE	0.235	16	0.291	no trend	159.3	1.19	2/13/1991	8/16/2018	38.673506	-121.340002
224	3410013-009	AS	FALSE	0.363	11	0.244	no trend	121	0.91	2/11/1992	8/7/2018	38.695662	-121.29509
92	3410013-010	AS	FALSE	0.235	16	0.291	no trend	159.3	1.19	2/11/1992	8/15/2018	38.670117	-121.341406
237	3410013-012	AS	FALSE	0.068	27	0.409	no trend	203	1.82	7/2/1990	8/13/2018	38.66565	-121.302524
223	3410013-013	AS	FALSE	0.306	-12	-0.267	no trend	115.3	-1.02	2/12/1991	8/13/2018	38.678824	-121.304628
144	3410013-014	AS	FALSE	0.239	14	0.311	no trend	122	1.18	2/12/1991	8/8/2018	38.668822	-121.304482
112	3410013-015	AS	FALSE	0.772	4	0.089	no trend	107.3	0.29	2/18/1992	8/6/2018	38.70124	-121.345319
233	3410013-016	AS	FALSE	0.466	10	0.182	no trend	152.7	0.73	2/11/1993	8/13/2018	38.709473	-121.292244
265	3410013-017	AS	FALSE	0.119	9	0.6	no trend	26.3	1.56	2/11/1992	8/24/2006	38.712243	-121.303547
247	3410013-019	AS	FALSE	0.098	21	0.382	no trend	146.3	1.65	7/2/1990	8/6/2018	38.700287	-121.330955
226	3410013-020	AS	FALSE	0.558	3	0.2	no trend	11.7	0.59	2/12/1991	8/24/2006	38.716217	-121.294262
88	3410013-021	AS	FALSE	0.28	14	0.255	no trend	144.7	1.08	2/13/1991	8/8/2018	38.683333	-121.35
232	3410013-022	AS	FALSE	0.319	9	0.321	no trend	64.3	1	2/18/1992	9/11/2012	38.7124	-121.306829
189	3410013-023	AS	TRUE	0.006	-28	-0.622	decreasing	96.7	-2.75	2/11/1992	8/7/2018	38.695536	-121.313454
66	3410013-024	AS	FALSE	0.636	7	0.127	no trend	161	0.47	2/11/1992	8/7/2018	38.680539	-121.31067
220	3410013-025	AS	FALSE	0.888	-3	-0.045	no trend	201	-0.14	2/18/1992	8/13/2018	38.718426	-121.313299
188	3410013-026	AS	FALSE	0.186	17	0.309	no trend	146.3	1.32	7/2/1990	8/6/2018	38.701667	-121.344722
119	3410013-027	AS	FALSE	0.098	22	0.4	no trend	161.3	1.65	2/18/1992	9/18/2012	38.709413	-121.317252
165	3410013-028	AS	FALSE	0.211	-6	-0.286	no trend	16	-1.25	4/21/1997	8/13/2018	38.698857	-121.32618
125	3410016-001	AS	FALSE	1	1	0.167	no trend	7.7	0	1/28/1993	12/3/2007	38.686538	-121.219546
147	3410016-002	AS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	4/18/1991	1/17/2013	38.694541	-121.210813
126	3410018-005	AS	FALSE	0.089	-6	-1	no trend	8.7	-1.7	2/28/1991	3/5/2002	38.721801	-121.46774
24	3410020-015	AS	FALSE	0.902	2	0.071	no trend	65.3	0.12	1/17/1992	4/3/2017	38.6125	-121.479167
11	3410020-016	AS	FALSE	0.536	6	0.214	no trend	65.3	0.62	1/17/1992	1/20/2015	38.616667	-121.479167
293	3410020-017	AS	FALSE	1	0	0	no trend	164	0	11/18/1988	8/24/2017	38.62266	-121.477813
84	3410020-018	AS	FALSE	0.858	-3	-0.067	no trend	125	-0.18	1/17/1992	5/8/2017	38.627831	-121.477227
292	3410020-021	AS	FALSE	0.566	4	0.267	no trend	27.3	0.57	1/21/1992	10/12/2011	38.607083	-121.454779
97	3410020-022	AS	FALSE	0.419	-10	-0.222	no trend	124	-0.81	11/18/1988	3/20/2017	38.607305	-121.443097
136	3410020-023	AS	FALSE	0.799	-3	-0.107	no trend	61.7	-0.25	1/21/1992	3/7/2017	38.604956	-121.439486
314	3410020-024	AS	FALSE	0.718	-5	-0.111	no trend	123	-0.36	11/18/1988	10/10/2011	38.612801	-121.450505
129	3410020-025	AS	FALSE	1	-1	-0.1	no trend	13	0	1/21/1992	10/9/2008	38.612294	-121.440456
215	3410020-027	AS	FALSE	0.578	-7	-0.156	no trend	116.3	-0.56	1/22/1992	5/8/2017	38.620988	-121.443553
279	3410020-028	AS	FALSE	0.37	-14	-0.212	no trend	210.7	-0.9	11/18/1988	5/8/2017	38.62044	-121.432285
108	3410020-029	AS	FALSE	0.428	17	0.162	no trend	408.3	0.79	1/17/1992	10/8/2018	38.618056	-121.468056
107	3410020-030	AS	FALSE	0.602	-6	-0.167	no trend	92	-0.52	1/17/1992	5/8/2017	38.625119	-121.462605
59	3410020-032	AS	FALSE	0.696	-6	-0.109	no trend	164	-0.39	1/16/1991	8/24/2017	38.628503	-121.43627
55	3410020-033	AS	FALSE	1	1	0.028	no trend	82.3	0	11/16/1988	10/10/2011	38.626808	-121.42959
171	3410020-034	AS	FALSE	0.696	-6	-0.109	no trend	164	-0.39	1/16/1991	2/27/2018	38.638412	-121.446721
73	3410020-035	AS	FALSE	1	1	0.018	no trend	163	0	1/16/1991	2/27/2018	38.639934	-121.427293
133	3410020-037	AS	FALSE	0.938	-2	-0.036	no trend	164	-0.08	1/16/1991	5/8/2017	38.651207	-121.469509
264	3410020-038	AS	FALSE	0.638	-7	-0.127	no trend	163	-0.47	1/16/1991	5/8/2017	38.647475	-121.459256
50	3410020-039	AS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	1/22/1992	10/8/2003	38.627595	-121.432917
56	3410020-040	AS	FALSE	0.585	8	0.145	no trend	164	0.55	10/22/1990	5/9/2017	38.629597	-121.420726
278	3410020-041	AS	FALSE	0.271	-17	-0.258	no trend	211.7	-1.1	1/16/1991	5/9/2017	38.641387	-121.435795
22	3410020-042	AS	FALSE	0.902	2	0.071	no trend	65.3	0.12	1/21/1992	3/7/2017	38.596923	-121.458973
294	3410020-044	AS	FALSE	0.799	3	0.107	no trend	61.7	0.25	10/16/1990	10/10/2011	38.613996	-121.456155
194	3410020-045	AS	FALSE	0.815	-4	-0.073	no trend	164	-0.23	10/19/1990	5/9/2017	38.622276	-121.446858
134	3410020-046	AS	FALSE	0.834	3	0.083	no trend	91	0.21	1/22/1992	9/22/2014	38.623116	-121.427024
157	3410020-050	AS	FALSE	0.474	9	0.2	no trend	125	0.72	1/16/1991	3/25/2014	38.668053	-121.438012
42	3410020-051	AS	FALSE	0.81	-4	-0.073	no trend	155.3	-0.24	1/16/1991	2/27/2018	38.634413	-121.412516
296	3410020-052	AS	FALSE	0.283	13	0.289	no trend	125	1.07	3/8/1993	5/9/2017	38.599341	-121.445804
214	3410020-054	AS	FALSE	0.533	9	0.164	no trend	165	0.62	1/21/1992	8/24/2017	38.596324	-121.427308
33	3410020-055	AS	FALSE	0.537	-10	-0.152	no trend	212.7	-0.62	1/17/1992	5/9/2017	38.617636	-121.469304
91	3410020-056	AS	TRUE	0.012	29	0.644	increasing	125	2.5	1/12/1994	5/9/2017	38.654657	-121.448564
291	3410020-057	AS	FALSE	0.651	16	0.076	no trend	1096.7	0.45	1/18/1995	12/19/2018	38.658482	-121.466415
30	3410026-001	AS	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	2/21/1991	5/31/2012	38.58961	-121.429343
7	3410026-002	AS	FALSE	0.806	2	0.2	no trend	16.7	0.24	2/21/1991	5/3/2018	38.588266	-121.423478
31	3410026-003	AS	FALSE	1	0	0	no trend	16.7	0	2/21/1991	5/3/2018	38.593617	-121.439154
18	3410026-004	AS	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	2/21/1991	5/3/2018	38.593339	-121.432431
206	3410031-001	AS	FALSE	1	-1	-0.018	no trend	160.3	0	3/24/1988	5/16/2019	38.720833	-121.358333
190	3410031-002	AS	FALSE	0.711	-5	-0.111	no trend	116.3	-0.37	9/10/1993	8/8/2018	38.717222	-121.3575
94	3410031-003	AS	TRUE	0.008	-30	-0.545	decreasing	120.7	-2.64	2/12/1991	8/14/2018	38.7	-121.383333
221	3410031-004	AS	FALSE	0.453	-16	-0.152	no trend	398.7	-0.75	10/29/1987	8/14/2018	38.718056	-121.382222
61	3410031-005	AS	FALSE	0.442	-9	-0.2	no trend	108.3	-0.77	2/26/1992	8/5/2015	38.716667	-121.4
160	3410031-006	AS	TRUE	0.021	-31	-0.47	decreasing	168.3	-2.31	11/2/1988	8/14/2018	38.708333	-121.383611
2073	3410031-007	AS	TRUE	0.001	41	0.745	increasing	148.3	3.28	2/12/1991	8/9/2018	38.733333	-121.35
2056	3410031-008	AS	FALSE	0.235	-16	-0.291	no trend	159.3	-1.19	10/7/1992	8/9/2018	38.733333	-121.35
208	3410031-009	AS	FALSE	0.611	6	0.133	no trend	96.7	0.51	1/15/1992	8/7/2018	38.715278	-121.378056
72	3410031-010	AS	FALSE	0.667	5	0.139	no trend	86.3	0.43	8/29/1995	8/7/2018	38.705	-121.365556
289	3410031-011	AS	FALSE	1	1	0.008	no trend	483.7	0	6/21/1990	8/7/2018	38.726944	-121.3825
135	3410031-012	AS	FALSE	0.203	11	0.393	no trend	61.7	1.27	6/12/1992	8/7/2018	38.721111	-121.368611
45	3410031-013	AS	FALSE	0.651	-6	-0.133	no trend	122	-0.45	2/25/1992	8/14/2018	38.711667	-121.413889
54	3410031-014	AS	FALSE	0.631	-7	-0.127	no trend	156.3	-0.48	4/15/1987	8/14/2018	38.716111	-121.408889
95	3410031-015	AS	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	2/11/1993	8/14/2018	38.716667	-121.416667

241	3410031-016	AS	TRUE	0.047	-19	-0.528	decreasing	82.3	-1.98	7/16/1996	8/8/2018	38.724444	-121.336111
80	3410031-017	AS	FALSE	0.521	-6	-0.214	no trend	60.7	-0.64	4/30/1998	8/8/2018	38.723056	-121.349722
257	3410031-018	AS	FALSE	0.854	-3	-0.067	no trend	118.3	-0.18	1/9/1996	8/7/2018	38.716389	-121.371944
288	3410045-001	AS	FALSE	0.43	-11	-0.2	no trend	160.3	-0.79	2/25/1992	8/7/2018	38.586137	-121.411513
138	3410045-002	AS	FALSE	0.113	18	0.4	no trend	115.3	1.58	2/25/1992	8/7/2018	38.583085	-121.413054
116	3410045-003	AS	FALSE	0.711	5	0.111	no trend	116.3	0.37	1/21/1993	8/7/2018	38.594423	-121.417465
243	3410045-004	AS	FALSE	0.175	14	0.389	no trend	92	1.36	7/3/1990	7/12/2012	38.592566	-121.407256
96	3410045-005	AS	FALSE	0.636	7	0.127	no trend	160.3	0.47	2/12/1991	8/7/2018	38.600025	-121.410183
2074	3910005-049	AS	FALSE	0.602	-6	-0.167	no trend	92	-0.52	6/9/2009	6/12/2018	38.8271	-121.232
2908	5100136-002	AS	FALSE	0.221	6	0.6	no trend	16.7	1.22	3/12/2003	4/11/2018	38.911927	-121.526004
2901	5100138-001	AS	FALSE	0.764	3	0.143	no trend	44.3	0.3	2/11/1991	1/3/2017	38.947299	-121.524183
2902	5100140-001	AS	FALSE	0.537	-16	-0.118	no trend	589.3	-0.62	2/11/1991	5/19/2010	38.911233	-121.542832
2900	5100143-001	AS	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	2/11/1991	5/18/2005	38.823397	-121.503832
2905	5100143-002	AS	FALSE	0.451	-12	-0.182	no trend	212.7	-0.75	9/21/2005	8/21/2019	38.823303	-121.503779
2904	5100153-002	AS	FALSE	0.051	262	0.183	no trend	17963	1.95	3/8/2005	7/7/2019	38.772313	-121.525061
2907	5105004-001	AS	FALSE	0.063	-16	-0.571	no trend	65.3	-1.86	11/29/2000	5/17/2017	38.777769	-121.52437
2909	5105013-001	AS	FALSE	0.38	17	0.187	no trend	331.7	0.88	2/29/2016	7/7/2019	38.781319	-121.484797
1859	USGS-383746121291101	AS	FALSE	0.711	-4	-0.143	no trend	65.3	-0.37	8/4/1998	8/8/2017	38.6292139	-121.4877028
1860	USGS-384145121184101	AS	FALSE	0.368	7	0.333	no trend	44.3	0.9	8/17/1998	9/4/2012	38.6964	-121.3120389
1868	USGS-384330121293901	AS	FALSE	1	1	0.048	no trend	44.3	0	8/11/1997	7/10/2017	38.7251167	-121.4954417
2806	USGS-384413121163801	AS	FALSE	0.308	4	0.667	no trend	8.7	1.02	9/24/1982	3/10/2014	38.7369444	-121.2772222

Nitrate as Nitrogen

Local_ID	Well_Info_ID	chemical	h	p	s	tau	trend	var_s	z	datemin	datemax	Latitude_NAD83	Longitude_NAD83
2934	11N03E24D001M	NO3N	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	7/21/1964	8/18/2004	38.7906	-121.5973
2940	11N04E04R002M	NO3N	FALSE	0.089	-6	-1	no trend	8.7	-1.7	5/2/1968	8/24/2005	38.8255	-121.5259
2083	11N06E17D001M	NO3N	TRUE	0	567	0.368	increasing	20007.7	4	5/5/2004	3/26/2008	38.8064	-121.3353
2081	11N06E17D002M	NO3N	FALSE	0.301	-137	-0.092	no trend	17276.3	-1.03	5/6/2004	3/26/2008	38.8027	-121.3384
2080	11N06E17D003M	NO3N	FALSE	0.099	175	0.169	no trend	11151	1.65	5/5/2004	3/26/2008	38.8059	-121.3358
2082	11N06E17E001M	NO3N	TRUE	0	515	0.334	increasing	20015	3.63	5/5/2004	3/26/2008	38.8058	-121.3354
2953	12N03E26R001M	NO3N	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	6/13/1963	8/18/2004	38.8533	-121.5991
2967	12N04E05R005M	NO3N	FALSE	1	0	0	no trend	8.7	0	8/25/1970	8/18/2004	38.9114	-121.5447
2065	3100077-003	NO3N	FALSE	0.074	-21	-0.467	no trend	125	-1.79	2/26/2004	7/10/2017	38.726602	-121.336563
2062	3100077-004	NO3N	TRUE	0.029	-22	-0.611	decreasing	92	-2.19	2/26/2004	7/10/2017	38.726284	-121.336527
2059	3100538-001	NO3N	FALSE	0.065	42	0.35	no trend	493.3	1.85	3/18/2004	6/12/2019	38.7505	-121.321972
2060	3104508-001	NO3N	FALSE	0.098	-52	-0.274	no trend	950	-1.65	7/17/2003	3/21/2019	38.729952	-121.321616
2077	3105886-001	NO3N	FALSE	0.086	26	0.394	no trend	212.7	1.71	6/21/2007	3/21/2019	38.728166	-121.366194
2057	3110004-002	NO3N	TRUE	0.034	76	0.329	increasing	1254.7	2.12	4/24/2001	2/26/2019	38.868006	-121.320358
2068	3110004-003	NO3N	FALSE	0.156	51	0.221	no trend	1244.3	1.42	12/30/2002	2/26/2019	38.86973	-121.330213
2070	3110004-007	NO3N	FALSE	0.308	4	0.667	no trend	8.7	1.02	4/24/2001	2/26/2019	38.901373	-121.351602
2061	3110004-011	NO3N	FALSE	0.432	20	0.147	no trend	585.3	0.79	12/7/2005	3/1/2018	38.865086	-121.347261
2072	3110004-012	NO3N	FALSE	0.075	37	0.352	no trend	408.3	1.78	6/14/2005	2/26/2019	38.867769	-121.338461
2069	3110008-003	NO3N	FALSE	0.347	13	0.236	no trend	163	0.94	10/26/1992	1/8/2010	38.753022	-121.279492
2071	3110008-006	NO3N	FALSE	0.398	-18	-0.171	no trend	405.3	-0.84	10/27/1992	8/23/2018	38.736633	-121.277875
2066	3110008-007	NO3N	TRUE	0.003	-55	-0.604	decreasing	333.7	-2.96	10/26/1992	8/23/2018	38.726493	-121.258205
2050	3110008-008	NO3N	FALSE	1	-1	-0.048	no trend	44.3	0	8/24/2004	8/23/2018	38.805938	-121.33588
2051	3110008-015	NO3N	FALSE	0.086	8	0.8	no trend	16.7	1.71	1/8/2010	8/23/2018	38.785813	-121.332225
2064	3110025-005	NO3N	TRUE	0.031	53	0.39	increasing	581	2.16	7/26/1989	9/12/2019	38.818889	-121.31
2063	3110040-001	NO3N	FALSE	0.351	18	0.198	no trend	332.7	0.93	9/27/1988	7/9/2002	38.75	-121.34722
2067	3110040-002	NO3N	FALSE	0.193	20	0.303	no trend	212.7	1.3	8/31/1989	7/9/2002	38.75	-121.34444
2054	3110048-001	NO3N	FALSE	0.324	-19	-0.209	no trend	333.7	-0.99	4/21/2004	7/18/2019	38.983062	-121.375659
2058	3110048-002	NO3N	FALSE	0.087	-23	-0.418	no trend	165	-1.71	4/21/2004	4/9/2018	38.980075	-121.369185
40	3400117-001	NO3N	FALSE	1	-1	-0.013	no trend	103.7	0	2/14/2005	8/12/2019	38.602797	-121.50572
15	3400123-001	NO3N	TRUE	0.049	-31	-0.341	decreasing	233	-1.97	2/3/2005	5/6/2019	38.672825	-121.623796
38	3400131-001	NO3N	FALSE	1	1	0.167	no trend	7.7	0	6/15/1995	11/28/2018	38.671667	-121.611111
145	3400173-002	NO3N	FALSE	0.381	-26	-0.152	no trend	813.3	-0.88	7/26/2001	2/4/2019	38.640638	-121.483861
235	3400173-003	NO3N	FALSE	0.537	16	0.118	no trend	589.3	0.62	10/25/2001	2/4/2019	38.654819	-121.477561
316	3400173-004	NO3N	FALSE	0.118	16	0.444	no trend	92	1.56	4/6/2009	2/4/2019	38.643894	-121.493168
167	3400173-005	NO3N	FALSE	0.171	-37	-0.242	no trend	692.3	-1.37	7/26/2001	2/15/2017	38.646271	-121.502342
79	3400179-001	NO3N	FALSE	0.599	16	0.094	no trend	813.3	0.53	8/17/2001	3/20/2019	38.6575	-121.378333
199	3400179-002	NO3N	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	4/28/2008	3/20/2019	38.658333	-121.380555
57	3400190-001	NO3N	FALSE	0.195	47	0.203	no trend	1257.7	1.3	10/2/2001	3/20/2019	38.675861	-121.326329
272	3400191-001	NO3N	TRUE	0.019	84	0.364	increasing	1256.7	2.34	8/17/2001	3/20/2019	38.65525	-121.379888
285	3400191-002	NO3N	FALSE	0.118	16	0.444	no trend	92	1.56	7/30/2009	3/20/2019	38.685618	-121.361651
121	3400191-003	NO3N	FALSE	1	0	0	no trend	92	0	7/30/2009	3/20/2019	38.656327	-121.378432
36	3400226-001	NO3N	FALSE	0.939	3	0.02	no trend	681	0.08	7/6/2000	3/20/2019	38.605089	-121.522873
44	3400278-001	NO3N	FALSE	0.869	-4	-0.044	no trend	330.7	-0.16	7/10/2000	12/18/2018	38.648694	-121.346694
43	3400278-002	NO3N	FALSE	0.631	8	0.121	no trend	212.7	0.48	8/22/2001	6/22/2017	38.650597	-121.344144
67	3400283-001	NO3N	FALSE	0.371	11	0.244	no trend	125	0.89	8/12/2009	4/30/2018	38.648694	-121.346694
302	3400284-001	NO3N	TRUE	0.023	-34	-0.515	decreasing	210.7	-2.27	3/15/2001	4/16/2008	38.692607	-121.32344
48	3400347-001	NO3N	FALSE	0.178	-16	-0.356	no trend	124	-1.35	7/17/2003	6/24/2010	38.684099	-121.322031
65	3400356-001	NO3N	FALSE	0.396	25	0.146	no trend	798.3	0.85	7/12/2000	5/13/2019	38.684099	-121.322031
8	3400383-001	NO3N	FALSE	0.429	-34	-0.113	no trend	1741.3	-0.79	7/20/2000	3/20/2019	38.618983	-121.536935
39	3400396-001	NO3N	FALSE	0.062	-46	-0.338	no trend	580.7	-1.87	9/5/2002	3/20/2019	38.697778	-121.616944
23	3400406-001	NO3N	FALSE	0.175	-77	-0.177	no trend	3133	-1.36	8/7/2001	3/20/2019	38.619087	-121.53506
60	3400456-001	NO3N	FALSE	0.284	-34	-0.179	no trend	950	-1.07	6/20/2012	8/15/2019	38.698055	-121.43
309	3400459-001	NO3N	TRUE	0.011	-91	-0.394	decreasing	1257.7	-2.54	2/18/2010	8/2/2019	38.576666	-121.401666
193	3410001-001	NO3N	TRUE	0.014	112	0.345	increasing	2057.3	2.45	1/12/1993	7/15/2019	38.606839	-121.3982
242	3410001-002	NO3N	TRUE	0.037	80	0.316	increasing	1432.7	2.09	1/25/1995	7/15/2019	38.59783	-121.398024
258	3410001-004	NO3N	FALSE	0.739	12	0.057	no trend	1090	0.33	1/12/1993	8/10/2015	38.611483	-121.410107
284	3410001-005	NO3N	FALSE	0.107	47	0.275	no trend	812.3	1.61	2/25/1991	7/30/2013	38.623478	-121.396638
203	3410001-007	NO3N	TRUE	0.008	129	0.368	increasing	2299	2.67	7/9/1990	9/16/2019	38.610999	-121.363391
128	3410001-009	NO3N	FALSE	0.807	-5	-0.064	no trend	267.7	-0.24	2/2/1993	1/23/2006	38.616331	-121.403703
212	3410001-010	NO3N	FALSE	0.118	72	0.222	no trend	2057.3	1.57	7/10/1990	6/13/2018	38.608099	-121.408153
158	3410001-011	NO3N	FALSE	0.127	66	0.22	no trend	1814	1.53	1/30/1992	7/30/2019	38.619863	-121.396184
228	3410001-012	NO3N	FALSE	0.174	154	0.137	no trend	12656.7	1.36	2/25/1991	4/10/2018	38.617662	-121.403695
82	3410001-013	NO3N	FALSE	0.409	-34	-0.123	no trend	1596	-0.83	1/28/1992	7/11/2019	38.598939	-121.370714
146	3410001-014	NO3N	FALSE	0.24	27	0.225	no trend	490.3	1.17	7/10/1990	3/12/2009	38.61171	-121.386048
260	3410001-015	NO3N	TRUE	0.002	136	0.453	increasing	1831.3	3.15	11/1/1988	7/11/2019	38.59781	-121.381308
191	3410001-016	NO3N	FALSE	0.428	-29	-0.126	no trend	1249	-0.79	2/22/1991	7/12/2016	38.631327	-121.37485
124	3410001-017	NO3N	FALSE	0.865	7	0.03	no trend	1253	0.17	1/30/1992	2/8/2016	38.61981	-121.403732
211	3410001-018	NO3N	FALSE	0.972	7	0.003	no trend	29784.3	0.03	2/22/1991	7/11/2019	38.623854	-121.374359
209	3410001-019	NO3N	FALSE	0.366	42	0.129	no trend	2057.3	0.9	1/27/1992	7/11/2019	38.597831	-121.359623
114	3410001-020	NO3N	TRUE	0.037	236	0.209	increasing	12656.7	2.09	1/27/1992	7/10/2019	38.618079	-121.359205

210	3410001-021	NO3N	TRUE	0.026	102	0.314	increasing	2048.7	2.23	7/9/1990	7/29/2019	38.615256	-121.419986
161	3410001-022	NO3N	FALSE	0.636	20	0.072	no trend	1614.7	0.47	1/26/1995	7/25/2019	38.604549	-121.42274
123	3410001-023	NO3N	FALSE	0.764	-3	-0.143	no trend	44.3	-0.3	4/13/1987	5/16/2000	38.614722	-121.349444
64	3410001-024	NO3N	FALSE	0.707	3	0.2	no trend	28.3	0.38	1/27/1992	2/19/2001	38.641255	-121.370271
222	3410001-025	NO3N	TRUE	0.027	101	0.311	increasing	2053.7	2.21	2/22/1991	7/26/2018	38.60046	-121.359118
148	3410001-026	NO3N	FALSE	0.185	19	0.288	no trend	184.3	1.33	7/10/1990	2/23/2005	38.627091	-121.384097
113	3410001-027	NO3N	TRUE	0.032	87	0.315	increasing	1607.7	2.14	1/30/1992	7/17/2018	38.605146	-121.390988
244	3410001-028	NO3N	TRUE	0.027	74	0.352	increasing	1088	2.21	1/30/1992	8/21/2014	38.63562	-121.381097
227	3410001-029	NO3N	TRUE	0.048	71	0.307	increasing	1249	1.98	1/30/1992	10/3/2017	38.630252	-121.397575
236	3410001-030	NO3N	TRUE	0.009	81	0.426	increasing	944.3	2.6	1/29/1992	7/9/2018	38.617802	-121.424022
170	3410001-031	NO3N	FALSE	0.548	5	0.238	no trend	44.3	0.6	1/28/1992	11/20/2007	38.61919	-121.371454
81	3410001-032	NO3N	FALSE	0.139	50	0.238	no trend	1094.7	1.48	7/9/1990	7/9/2018	38.622918	-121.413817
104	3410001-033	NO3N	FALSE	0.113	46	0.269	no trend	807.3	1.58	1/29/1992	7/10/2014	38.601378	-121.424
173	3410001-034	NO3N	TRUE	0	-1179	-0.449	decreasing	43973	-5.62	7/9/1990	7/16/2019	38.584674	-121.396539
169	3410001-035	NO3N	FALSE	0.441	32	0.116	no trend	1616.7	0.77	7/9/1990	7/26/2018	38.594464	-121.351844
25	3410001-037	NO3N	FALSE	0.072	13	0.619	no trend	44.3	1.8	1/27/1992	6/13/2000	38.578611	-121.366667
19	3410001-038	NO3N	FALSE	0.069	-52	-0.304	no trend	786.7	-1.82	1/28/1992	7/25/2012	38.578371	-121.363395
20	3410001-039	NO3N	FALSE	0.797	-7	-0.051	no trend	545	-0.26	2/22/1991	6/16/2010	38.591742	-121.346413
90	3410001-040	NO3N	FALSE	1	-1	-0.1	no trend	13	0	1/27/1992	6/13/2000	38.624895	-121.35055
168	3410001-042	NO3N	TRUE	0.027	90	0.326	increasing	1623.3	2.21	2/22/1991	7/11/2019	38.628014	-121.358648
184	3410001-051	NO3N	FALSE	0.153	147	0.148	no trend	10449	1.43	7/9/1990	7/10/2019	38.636187	-121.375067
111	3410001-052	NO3N	TRUE	0.039	79	0.312	increasing	1431.7	2.06	7/9/1990	7/10/2019	38.625054	-121.362252
287	3410001-054	NO3N	FALSE	0.107	-70	-0.233	no trend	1831.3	-1.61	2/11/1991	7/16/2019	38.582422	-121.408379
122	3410001-055	NO3N	TRUE	0.004	117	0.424	increasing	1621.7	2.88	11/1/1988	12/13/2017	38.594474	-121.39864
26	3410001-056	NO3N	FALSE	0.122	-71	-0.218	no trend	2049.7	-1.55	1/12/1993	7/9/2018	38.578749	-121.41096
3	3410001-061	NO3N	FALSE	0.195	-47	-0.203	no trend	1257.7	-1.3	5/7/1998	7/18/2019	38.582786	-121.338489
176	3410001-062	NO3N	FALSE	0.489	22	0.116	no trend	920.7	0.69	8/22/2000	7/25/2019	38.618056	-121.401944
12	3410001-064	NO3N	FALSE	0.904	5	0.024	no trend	1095.7	0.12	5/31/2000	7/11/2019	38.584121	-121.353432
13	3410001-065	NO3N	FALSE	0.319	-34	-0.162	no trend	1094.7	-1	2/22/2000	7/18/2019	38.583196	-121.33679
4	3410001-066	NO3N	FALSE	0.974	-2	-0.011	no trend	945.3	-0.03	2/22/2000	7/18/2019	38.582214	-121.338203
2	3410001-067	NO3N	FALSE	0.211	-6	-0.286	no trend	16	-1.25	6/3/1999	10/1/2014	38.582481	-121.417169
225	3410001-069	NO3N	FALSE	0.506	-69	-0.07	no trend	10449	-0.67	2/26/1992	7/16/2019	38.580609	-121.384004
255	3410001-070	NO3N	TRUE	0.018	-226	-0.25	decreasing	9122.7	-2.36	2/12/1991	7/16/2019	38.576006	-121.403088
205	3410001-071	NO3N	TRUE	0.026	59	0.386	increasing	680.3	2.22	3/21/2002	7/10/2019	38.63056	-121.397787
106	3410001-072	NO3N	FALSE	0.183	33	0.243	no trend	577	1.33	3/21/2002	7/25/2019	38.61744	-121.411527
252	3410001-073	NO3N	FALSE	0.43	-21	-0.137	no trend	643	-0.79	3/21/2002	7/25/2019	38.58058	-121.383962
58	3410001-076	NO3N	FALSE	0.402	37	0.114	no trend	1843.7	0.84	6/5/1984	7/10/2019	38.644265	-121.362069
69	3410001-077	NO3N	TRUE	0.036	155	0.246	increasing	5389	2.1	3/7/1984	7/10/2019	38.631522	-121.352911
86	3410001-078	NO3N	FALSE	0.196	63	0.179	no trend	2301	1.29	6/5/1984	7/9/2019	38.684818	-121.355931
259	3410001-079	NO3N	FALSE	0.532	-36	-0.083	no trend	3138.7	-0.62	6/4/1984	7/24/2013	38.667577	-121.334161
110	3410001-080	NO3N	FALSE	0.54	37	0.08	no trend	3457	0.61	6/4/1984	7/17/2019	38.672567	-121.331573
174	3410001-081	NO3N	FALSE	0.897	5	0.026	no trend	946.3	0.13	6/5/1984	7/22/2019	38.683333	-121.333333
71	3410001-082	NO3N	FALSE	1	0	0	no trend	4165.3	0	6/4/1984	7/18/2018	38.648929	-121.338368
246	3410001-083	NO3N	FALSE	0.215	51	0.185	no trend	1624.3	1.24	5/17/1984	7/9/2019	38.663692	-121.347786
239	3410001-085	NO3N	FALSE	0.868	38	0.013	no trend	49707.3	0.17	6/4/1984	10/1/2019	38.644208	-121.329841
49	3410001-087	NO3N	FALSE	0.537	-32	-0.085	no trend	2516.7	-0.62	6/5/1984	7/11/2019	38.645858	-121.392317
218	3410001-088	NO3N	FALSE	1	1	0.004	no trend	1624.3	0	5/17/1984	10/19/2015	38.668746	-121.361
89	3410001-089	NO3N	FALSE	0.985	2	0.005	no trend	2842	0.02	3/7/1984	7/9/2019	38.653579	-121.379692
132	3410001-092	NO3N	FALSE	0.605	29	0.067	no trend	2929	0.52	6/4/1984	7/24/2018	38.63889	-121.342759
185	3410001-094	NO3N	FALSE	0.06	91	0.259	no trend	2290.3	1.88	5/17/1984	7/10/2019	38.652299	-121.354305
196	3410001-095	NO3N	TRUE	0.039	51	0.375	increasing	586.3	2.06	5/17/1984	5/28/2009	38.658062	-121.356402
297	3410001-096	NO3N	FALSE	0.659	21	0.065	no trend	2058.3	0.44	6/30/1988	7/9/2019	38.689669	-121.360198
102	3410001-097	NO3N	FALSE	0.791	13	0.04	no trend	2056.3	0.26	12/13/1984	7/11/2019	38.694158	-121.360024
256	3410001-098	NO3N	FALSE	0.185	68	0.18	no trend	2553.3	1.33	5/9/1984	7/9/2019	38.700217	-121.351805
295	3410001-099	NO3N	FALSE	0.313	75	0.119	no trend	5387	1.01	10/20/1988	4/8/2010	38.655401	-121.313482
46	3410001-101	NO3N	TRUE	0	800	0.296	increasing	45911.3	3.73	10/27/1988	4/15/2019	38.663926	-121.32579
231	3410001-102	NO3N	TRUE	0.011	408	0.223	increasing	25821.3	2.53	10/20/1988	10/1/2019	38.675049	-121.315501
101	3410001-103	NO3N	FALSE	0.063	46	0.338	no trend	584.7	1.86	10/25/1988	11/13/2013	38.651225	-121.32298
163	3410001-104	NO3N	FALSE	0.763	13	0.047	no trend	1579	0.3	2/1/1993	7/10/2019	38.710442	-121.331662
180	3410001-105	NO3N	FALSE	0.821	9	0.039	no trend	1253	0.23	1/18/1995	7/10/2019	38.710528	-121.331667
262	3410001-106	NO3N	FALSE	0.053	29	0.439	no trend	209	1.94	6/28/2001	8/21/2014	38.710517	-121.331659
85	3410001-107	NO3N	FALSE	0.228	-38	-0.2	no trend	942.7	-1.21	11/4/1996	7/18/2018	38.709903	-121.357066
127	3410001-111	NO3N	FALSE	0.553	22	0.095	no trend	1254.7	0.59	12/13/1995	7/11/2019	38.665363	-121.383099
254	3410001-127	NO3N	FALSE	0.652	11	0.092	no trend	492.3	0.45	12/13/1995	8/21/2014	38.712268	-121.381099
283	3410001-128	NO3N	FALSE	0.441	15	0.165	no trend	329.7	0.77	12/13/1995	6/17/2010	38.709783	-121.374669
149	3410001-129	NO3N	TRUE	0.01	74	0.433	increasing	804.7	2.57	12/13/1995	10/15/2014	38.710651	-121.387666
118	3410001-133	NO3N	FALSE	0.146	63	0.21	no trend	1815.7	1.46	2/25/1991	7/22/2019	38.682932	-121.376063
182	3410001-135	NO3N	TRUE	0.004	95	0.452	increasing	1084.3	2.85	1/26/1995	3/13/2018	38.68794	-121.385107
99	3410001-136	NO3N	TRUE	0.042	67	0.319	increasing	1050.3	2.04	2/25/1991	3/27/2018	38.685899	-121.372701
141	3410001-137	NO3N	FALSE	0.312	34	0.162	no trend	1065.3	1.01	2/25/1991	8/21/2014	38.692847	-121.375953
230	3410001-138	NO3N	FALSE	0.085	10	0.667	no trend	27.3	1.72	8/19/1997	1/28/2004	38.676018	-121.36531

183	3410001-139	NO3N	FALSE	0.579	22	0.087	no trend	1432.7	0.55	5/17/1984	7/12/2018	38.69191	-121.364477
200	3410001-140	NO3N	FALSE	0.462	4	0.4	no trend	16.7	0.73	1/26/1995	5/16/2000	38.675278	-121.378889
280	3410001-142	NO3N	TRUE	0.001	120	0.519	increasing	1256.7	3.36	7/20/1989	9/13/2017	38.686782	-121.392424
267	3410001-143	NO3N	FALSE	0.452	5	0.333	no trend	28.3	0.75	7/9/1990	5/16/2000	38.701228	-121.371968
197	3410001-144	NO3N	FALSE	0.441	34	0.113	no trend	1833.3	0.77	2/25/1991	7/23/2019	38.69798	-121.373877
213	3410001-145	NO3N	FALSE	0.879	5	0.033	no trend	695	0.15	3/25/2002	7/10/2019	38.67526	-121.379573
315	3410002-001	NO3N	FALSE	0.104	92	0.211	no trend	3133.3	1.63	2/20/1991	2/5/2019	38.583333	-121.383333
117	3410002-002	NO3N	TRUE	0.028	-95	-0.317	decreasing	1832.3	-2.2	7/17/1990	8/13/2019	38.583333	-121.366667
28	3410002-007	NO3N	FALSE	0.884	8	0.023	no trend	2300	0.15	7/17/1990	2/4/2019	38.566667	-121.4
9	3410002-009	NO3N	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	8/2/1989	6/17/1999	38.566667	-121.4
10	3410002-012	NO3N	FALSE	0.429	-37	-0.105	no trend	2071.7	-0.79	7/17/1990	8/13/2019	38.566667	-121.416667
17	3410002-013	NO3N	FALSE	0.313	-47	-0.134	no trend	2079.7	-1.01	7/17/1990	2/4/2019	38.583333	-121.416667
249	3410002-014	NO3N	TRUE	0.002	-150	-0.427	decreasing	2300	-3.11	1/19/1993	5/13/2019	38.583333	-121.366667
152	3410003-001	NO3N	FALSE	0.877	11	0.021	no trend	4155	0.16	9/5/1990	2/6/2019	38.587545	-121.385145
153	3410003-002	NO3N	TRUE	0.022	111	0.316	increasing	2299	2.29	4/11/1986	1/8/2019	38.582537	-121.383219
245	3410003-004	NO3N	FALSE	0.166	29	0.276	no trend	408.3	1.39	9/19/1990	7/11/2007	38.587611	-121.392074
162	3410003-005	NO3N	TRUE	0.028	95	0.317	increasing	1832.3	2.2	4/2/1987	1/8/2019	38.591017	-121.384139
251	3410003-006	NO3N	TRUE	0.002	126	0.457	increasing	1623.3	3.1	4/2/1987	1/8/2019	38.59211	-121.387633
238	3410003-008	NO3N	TRUE	0	189	0.582	increasing	2058.3	4.14	4/2/1987	1/8/2019	38.600074	-121.391973
74	3410004-001	NO3N	FALSE	0.1	28	0.359	no trend	268.7	1.65	2/7/1995	2/3/2004	38.645432	-121.313067
83	3410004-004	NO3N	FALSE	0.082	89	0.235	no trend	2561	1.74	2/19/1991	7/28/2011	38.64988	-121.30798
175	3410004-005	NO3N	FALSE	1	-1	-0.036	no trend	64.3	0	3/1/1991	10/4/2001	38.633333	-121.35
172	3410004-006	NO3N	TRUE	0.044	-317	-0.179	decreasing	24568.3	-2.02	8/1/1990	3/7/2019	38.622744	-121.335704
6	3410004-007	NO3N	FALSE	0.495	12	0.154	no trend	260	0.68	8/1/1990	10/23/2002	38.594673	-121.334606
150	3410004-009	NO3N	FALSE	0.773	44	0.027	no trend	22182	0.29	2/19/1991	3/7/2019	38.619652	-121.333354
261	3410004-016	NO3N	FALSE	0.142	161	0.149	no trend	11883.7	1.47	5/8/1987	6/7/2018	38.645576	-121.306819
248	3410004-020	NO3N	TRUE	0	214	0.46	increasing	3460.7	3.62	4/25/2002	6/7/2018	38.641845	-121.315446
139	3410004-021	NO3N	FALSE	0.776	-32	-0.03	no trend	11885.3	-0.28	4/23/2002	3/7/2019	38.604804	-121.342252
290	3410006-001	NO3N	FALSE	1	0	0	no trend	948	0	12/20/1990	11/14/2018	38.661305	-121.292607
207	3410006-007	NO3N	FALSE	1	0	0	no trend	8.7	0	8/2/1990	1/21/1998	38.705556	-121.308333
198	3410006-008	NO3N	FALSE	0.383	34	0.134	no trend	1430.7	0.87	12/6/1990	1/24/2019	38.679425	-121.289154
98	3410006-010	NO3N	FALSE	0.868	4	0.044	no trend	324	0.17	6/24/2004	4/12/2018	38.698638	-121.269673
130	3410007-001	NO3N	FALSE	0.102	34	0.324	no trend	407.3	1.64	4/10/1992	6/24/2010	38.613787	-121.367811
229	3410007-002	NO3N	TRUE	0.006	111	0.402	increasing	1619.7	2.73	1/23/1995	8/7/2019	38.613607	-121.371676
216	3410007-003	NO3N	FALSE	0.367	33	0.143	no trend	1257.7	0.9	2/19/1991	9/11/2018	38.606352	-121.369707
269	3410007-004	NO3N	FALSE	0.073	73	0.264	no trend	1607.7	1.8	1/23/1995	8/6/2019	38.607768	-121.374083
77	3410007-005	NO3N	TRUE	0.004	116	0.42	increasing	1620.7	2.86	1/23/1995	8/6/2019	38.61458	-121.378552
142	3410007-006	NO3N	FALSE	0.68	11	0.081	no trend	588.3	0.41	1/23/1995	3/8/2012	38.60731	-121.364767
195	3410007-007	NO3N	FALSE	0.068	70	0.277	no trend	1430	1.82	1/23/1995	8/6/2019	38.606531	-121.380719
253	3410007-008	NO3N	FALSE	0.08	76	0.253	no trend	1831.3	1.75	1/26/1993	8/13/2019	38.613172	-121.380739
166	3410009-001	NO3N	FALSE	0.436	-8	-0.178	no trend	80.7	-0.78	1/28/1993	6/16/2004	38.643048	-121.268528
100	3410009-003	NO3N	FALSE	0.707	3	0.2	no trend	28.3	0.38	11/9/1988	2/8/2000	38.666667	-121.216667
105	3410009-004	NO3N	TRUE	0.009	81	0.426	increasing	935.7	2.62	8/2/1990	12/6/2007	38.651282	-121.255173
78	3410009-005	NO3N	FALSE	0.449	13	0.167	no trend	251	0.76	2/28/1991	3/17/2005	38.650805	-121.286999
201	3410009-006	NO3N	FALSE	0.119	-144	-0.167	no trend	8419.3	-1.56	2/28/1991	5/2/2019	38.642768	-121.278261
234	3410009-007	NO3N	FALSE	0.054	-172	-0.21	no trend	7886	-1.93	7/19/1989	5/2/2019	38.651297	-121.296666
217	3410009-008	NO3N	FALSE	0.337	52	0.128	no trend	2818	0.96	8/16/1990	6/29/2007	38.662066	-121.265396
164	3410009-010	NO3N	TRUE	0	-589	-0.322	decreasing	25779	-3.66	11/7/1991	5/2/2019	38.659628	-121.25556
93	3410013-001	NO3N	FALSE	0.358	50	0.123	no trend	2842	0.92	10/7/1992	8/6/2019	38.694922	-121.332628
159	3410013-002	NO3N	FALSE	0.117	84	0.207	no trend	2804	1.57	2/18/1992	8/6/2019	38.69054	-121.34151
51	3410013-003	NO3N	TRUE	0.002	136	0.453	increasing	1831.3	3.15	11/2/1988	8/8/2019	38.683982	-121.31348
240	3410013-004	NO3N	FALSE	0.051	-181	-0.21	no trend	8512.3	-1.95	7/2/1990	8/7/2018	38.699328	-121.295627
178	3410013-005	NO3N	TRUE	0.023	122	0.3	increasing	2838	2.27	7/2/1990	8/6/2019	38.669042	-121.293798
63	3410013-006	NO3N	FALSE	0.227	72	0.155	no trend	3450	1.21	2/11/1992	8/7/2019	38.685052	-121.305855
156	3410013-007	NO3N	FALSE	0.195	50	0.198	no trend	1432.7	1.29	7/2/1990	2/19/2018	38.691478	-121.336784
270	3410013-008	NO3N	TRUE	0.008	128	0.365	increasing	2292.7	2.65	2/13/1991	8/6/2019	38.673506	-121.340002
224	3410013-009	NO3N	FALSE	0.499	-115	-0.059	no trend	28425	-0.68	2/11/1992	8/6/2019	38.695662	-121.29509
92	3410013-010	NO3N	TRUE	0.011	-543	-0.201	decreasing	45915	-2.53	2/11/1992	8/6/2019	38.670117	-121.341406
237	3410013-012	NO3N	TRUE	0.024	127	0.292	increasing	3137	2.25	7/2/1990	8/7/2019	38.66565	-121.302524
223	3410013-013	NO3N	TRUE	0.005	-269	-0.298	decreasing	9126.3	-2.81	2/12/1991	8/7/2019	38.678824	-121.304628
144	3410013-014	NO3N	FALSE	0.117	76	0.217	no trend	2291.3	1.57	2/12/1991	8/6/2019	38.668822	-121.304482
112	3410013-015	NO3N	FALSE	0.295	54	0.143	no trend	2562	1.05	2/18/1992	8/6/2019	38.70124	-121.345319
233	3410013-016	NO3N	TRUE	0	7337	0.413	increasing	755319.7	8.44	2/11/1993	9/10/2019	38.709473	-121.292244
265	3410013-017	NO3N	FALSE	0.054	36	0.396	no trend	330	1.93	2/11/1992	8/24/2006	38.712243	-121.303547
247	3410013-019	NO3N	TRUE	0.001	164	0.434	increasing	2545.3	3.23	7/2/1990	8/6/2019	38.700287	-121.330955
226	3410013-020	NO3N	FALSE	0.533	10	0.11	no trend	208.7	0.62	2/12/1991	8/24/2006	38.716217	-121.294262
88	3410013-021	NO3N	TRUE	0	910	0.366	increasing	40585.3	4.51	2/13/1991	8/6/2019	38.683333	-121.35
232	3410013-022	NO3N	TRUE	0	4775	0.536	increasing	269178.3	9.2	2/18/1992	4/5/2017	38.7124	-121.306829
189	3410013-023	NO3N	TRUE	0	212	0.487	increasing	3140.7	3.77	2/11/1992	8/7/2019	38.695536	-121.313454
66	3410013-024	NO3N	FALSE	0.051	116	0.249	no trend	3460.7	1.95	2/11/1992	8/6/2019	38.680539	-121.31067
220	3410013-025	NO3N	TRUE	0.004	123	0.41	increasing	1832.3	2.85	2/18/1992	8/13/2018	38.718426	-121.313299

188	3410013-026	NO3N	TRUE	0.046	102	0.27	increasing	2560	2	7/2/1990	8/6/2019	38.701667	-121.344722
119	3410013-027	NO3N	TRUE	0	1514	0.627	increasing	38714	7.69	2/18/1992	5/5/2015	38.709413	-121.317252
165	3410013-028	NO3N	TRUE	0.003	115	0.455	increasing	1429	3.02	6/19/1995	8/6/2019	38.698857	-121.32618
125	3410016-001	NO3N	FALSE	0.099	25	0.379	no trend	211.7	1.65	1/28/1993	3/22/2007	38.686538	-121.219546
147	3410016-002	NO3N	TRUE	0.023	56	0.412	increasing	584.7	2.27	4/18/1991	12/14/2016	38.694541	-121.210813
126	3410018-005	NO3N	FALSE	0.297	14	0.255	no trend	155.3	1.04	2/28/1991	3/3/2005	38.721801	-121.46774
24	3410020-015	NO3N	FALSE	0.156	32	0.267	no trend	476.7	1.42	1/17/1992	4/3/2017	38.6125	-121.479167
11	3410020-016	NO3N	FALSE	0.139	-28	-0.308	no trend	332.7	-1.48	1/17/1992	1/20/2015	38.616667	-121.479167
293	3410020-017	NO3N	FALSE	0.607	-27	-0.071	no trend	2558.3	-0.51	11/18/1988	7/8/2019	38.62266	-121.477813
84	3410020-018	NO3N	TRUE	0.024	92	0.333	increasing	1623.3	2.26	1/17/1992	2/4/2019	38.627831	-121.477227
292	3410020-021	NO3N	FALSE	0.36	16	0.205	no trend	268.7	0.92	1/21/1992	10/10/2012	38.607083	-121.454779
97	3410020-022	NO3N	FALSE	0.405	23	0.15	no trend	697	0.83	11/18/1988	4/27/2018	38.607305	-121.443097
136	3410020-023	NO3N	FALSE	0.692	-9	-0.086	no trend	408.3	-0.4	1/21/1992	4/20/2018	38.604956	-121.439486
314	3410020-024	NO3N	FALSE	0.234	35	0.205	no trend	815	1.19	11/18/1988	10/10/2012	38.612801	-121.450505
129	3410020-025	NO3N	FALSE	0.076	18	0.5	no trend	92	1.77	1/21/1992	10/9/2008	38.612294	-121.440456
215	3410020-027	NO3N	TRUE	0.022	93	0.337	increasing	1624.3	2.28	1/22/1992	2/4/2019	38.620988	-121.443553
279	3410020-028	NO3N	TRUE	0	231	0.77	increasing	1829.7	5.38	11/18/1988	2/26/2018	38.62044	-121.432285
108	3410020-029	NO3N	FALSE	0.484	18	0.132	no trend	589.3	0.7	1/17/1992	4/20/2018	38.618056	-121.468056
107	3410020-030	NO3N	FALSE	0.894	-6	-0.024	no trend	1396	-0.13	1/17/1992	2/4/2019	38.625119	-121.462605
59	3410020-032	NO3N	FALSE	0.543	-24	-0.095	no trend	1430.7	-0.61	1/16/1991	2/4/2019	38.628503	-121.43627
55	3410020-033	NO3N	TRUE	0.012	73	0.427	increasing	817	2.52	11/16/1988	10/10/2012	38.626808	-121.42959
171	3410020-034	NO3N	TRUE	0.016	104	0.347	increasing	1833.3	2.41	1/16/1991	2/4/2019	38.638412	-121.446721
73	3410020-035	NO3N	FALSE	0.157	58	0.21	no trend	1623.3	1.41	1/16/1991	2/4/2019	38.639934	-121.427293
133	3410020-037	NO3N	FALSE	0.181	58	0.193	no trend	1815.3	1.34	1/16/1991	2/4/2019	38.651207	-121.469509
264	3410020-038	NO3N	FALSE	0.206	52	0.188	no trend	1625.3	1.27	1/16/1991	2/4/2019	38.647475	-121.459256
50	3410020-039	NO3N	FALSE	0.118	16	0.444	no trend	92	1.56	1/22/1992	11/9/2004	38.627595	-121.432917
56	3410020-040	NO3N	FALSE	1	-1	-0.003	no trend	2294.3	0	10/22/1990	2/4/2019	38.629597	-121.420726
278	3410020-041	NO3N	TRUE	0	170	0.523	increasing	2057.3	3.73	1/16/1991	2/4/2019	38.641387	-121.435795
22	3410020-042	NO3N	FALSE	0.893	4	0.033	no trend	493.3	0.14	1/21/1992	3/5/2019	38.596923	-121.458973
294	3410020-044	NO3N	FALSE	0.3	24	0.2	no trend	493.3	1.04	10/16/1990	10/10/2012	38.613996	-121.456155
194	3410020-045	NO3N	FALSE	0.161	61	0.203	no trend	1832.3	1.4	10/19/1990	2/4/2019	38.622276	-121.446858
134	3410020-046	NO3N	TRUE	0.003	98	0.467	increasing	1096.7	2.93	1/22/1992	3/24/2016	38.623116	-121.427024
157	3410020-050	NO3N	FALSE	0.79	8	0.052	no trend	693.3	0.27	1/16/1991	10/15/2015	38.668053	-121.438012
42	3410020-051	NO3N	FALSE	0.432	-27	-0.129	no trend	1093.7	-0.79	1/16/1991	2/4/2019	38.634413	-121.412516
296	3410020-052	NO3N	FALSE	0.795	10	0.043	no trend	1204.7	0.26	3/8/1993	2/4/2019	38.599341	-121.445804
214	3410020-054	NO3N	TRUE	0.013	95	0.375	increasing	1429	2.49	1/21/1992	2/4/2019	38.596324	-121.427308
33	3410020-055	NO3N	FALSE	0.065	-62	-0.295	no trend	1096.7	-1.84	1/17/1992	5/9/2017	38.617636	-121.469304
91	3410020-056	NO3N	TRUE	0.014	100	0.362	increasing	1614.7	2.46	1/12/1994	2/4/2019	38.654657	-121.448564
291	3410020-057	NO3N	FALSE	0.921	-3	-0.029	no trend	403.7	-0.1	1/18/1995	12/27/2018	38.658482	-121.466415
30	3410026-001	NO3N	FALSE	0.242	-5	-0.333	no trend	11.7	-1.17	2/21/1991	5/31/2012	38.58961	-121.429343
7	3410026-002	NO3N	FALSE	0.737	7	0.051	no trend	319.7	0.34	2/21/1991	3/7/2019	38.588266	-121.423478
31	3410026-003	NO3N	FALSE	0.161	-22	-0.183	no trend	224.7	-1.4	2/21/1991	3/7/2019	38.593617	-121.439154
18	3410026-004	NO3N	FALSE	0.132	-14	-0.133	no trend	74.7	-1.5	2/21/1991	3/7/2019	38.593339	-121.432431
206	3410031-001	NO3N	FALSE	0.081	94	0.232	no trend	2831.3	1.75	3/24/1988	8/7/2019	38.720833	-121.358333
190	3410031-002	NO3N	FALSE	0.44	38	0.108	no trend	2300	0.77	9/10/1993	8/6/2019	38.717222	-121.3575
94	3410031-003	NO3N	TRUE	0.014	99	0.359	increasing	1597	2.45	2/12/1991	8/6/2019	38.7	-121.383333
221	3410031-004	NO3N	TRUE	0.004	161	0.37	increasing	3124.3	2.86	10/29/1987	8/8/2019	38.718056	-121.382222
61	3410031-005	NO3N	TRUE	0	159	0.53	increasing	1805	3.72	2/26/1992	8/24/2016	38.716667	-121.4
160	3410031-006	NO3N	TRUE	0.001	162	0.429	increasing	2557.3	3.18	11/2/1988	8/6/2019	38.708333	-121.383611
2073	3410031-007	NO3N	TRUE	0.003	158	0.389	increasing	2834.7	2.95	2/12/1991	8/8/2019	38.733333	-121.35
2056	3410031-008	NO3N	FALSE	0.53	76	0.062	no trend	14288	0.63	10/7/1992	8/8/2019	38.733333	-121.35
208	3410031-009	NO3N	FALSE	0.089	-87	-0.23	no trend	2549.7	-1.7	1/15/1992	8/6/2019	38.715278	-121.378056
72	3410031-010	NO3N	FALSE	0.104	-79	-0.225	no trend	2297	-1.63	9/10/1993	8/8/2019	38.705	-121.365556
289	3410031-011	NO3N	FALSE	0.154	89	0.179	no trend	3801.7	1.43	6/21/1990	8/7/2018	38.726944	-121.3825
135	3410031-012	NO3N	TRUE	0.027	74	0.352	increasing	1096.7	2.2	6/12/1992	8/8/2019	38.721111	-121.368611
45	3410031-013	NO3N	TRUE	0.007	151	0.347	increasing	3125	2.68	2/25/1992	8/8/2019	38.711667	-121.413889
54	3410031-014	NO3N	FALSE	0.056	108	0.248	no trend	3138.7	1.91	4/15/1987	8/6/2019	38.716111	-121.408889
95	3410031-015	NO3N	FALSE	0.3	24	0.2	no trend	493.3	1.04	2/11/1993	8/12/2019	38.716667	-121.416667
241	3410031-016	NO3N	TRUE	0	189	0.582	increasing	2013	4.19	7/16/1996	8/6/2019	38.724444	-121.336111
80	3410031-017	NO3N	FALSE	0.396	31	0.134	no trend	1247	0.85	4/30/1998	8/7/2019	38.723056	-121.349722
257	3410031-018	NO3N	TRUE	0.006	-111	-0.402	decreasing	1599	-2.75	1/9/1996	8/8/2019	38.716389	-121.371944
288	3410045-001	NO3N	FALSE	0.293	75	0.126	no trend	4954.3	1.05	2/25/1992	8/7/2019	38.586137	-121.411513
138	3410045-002	NO3N	FALSE	0.403	41	0.117	no trend	2291.7	0.84	2/25/1992	8/7/2019	38.583085	-121.413054
116	3410045-003	NO3N	FALSE	0.617	-25	-0.071	no trend	2299	-0.5	1/21/1993	8/7/2019	38.594423	-121.417465
243	3410045-004	NO3N	FALSE	0.98	-2	-0.007	no trend	1623.3	-0.02	7/3/1990	8/11/2014	38.592566	-121.407256
96	3410045-005	NO3N	FALSE	0.066	94	0.249	no trend	2560	1.84	2/12/1991	8/7/2019	38.600025	-121.410183
35	3410301-001	NO3N	FALSE	0.462	-4	-0.4	no trend	16.7	-0.73	3/9/2005	3/20/2019	38.655029	-121.206869
2074	3910005-049	NO3N	FALSE	0.881	79	0.009	no trend	270133	0.15	6/9/2009	8/6/2019	38.8271	-121.232
2894	5100117-001	NO3N	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	5/1/1995	12/20/2000	38.89568	-121.56893
2893	5100117-002	NO3N	TRUE	0.011	-68	-0.398	decreasing	696.7	-2.54	5/1/1995	6/21/2017	38.902331	-121.570943
2897	5100117-003	NO3N	TRUE	0.026	-65	-0.342	decreasing	829.7	-2.22	5/1/1995	6/20/2018	38.896068	-121.567281

2896	5100117-004	NO3N	FALSE	0.121	-38	-0.279	no trend	568	-1.55	11/5/2002	6/20/2018	38.896379	-121.56981
2913	5100135-001	NO3N	FALSE	0.207	55	0.183	no trend	1829.7	1.26	7/5/1995	7/24/2019	38.911394	-121.544681
2915	5100136-001	NO3N	FALSE	1	0	0	no trend	8.7	0	12/15/1994	11/17/1999	38.911667	-121.525833
2908	5100136-002	NO3N	TRUE	0.028	59	0.386	increasing	697	2.2	11/13/2002	4/17/2019	38.911927	-121.526004
2901	5100138-001	NO3N	TRUE	0.033	109	0.288	increasing	2561	2.13	9/5/1989	1/8/2019	38.947299	-121.524183
2902	5100140-001	NO3N	FALSE	0.651	-11	-0.092	no trend	489.7	-0.45	2/11/1991	5/19/2010	38.911233	-121.542832
2910	5100140-002	NO3N	FALSE	1	0	0	no trend	92	0	7/6/2010	7/24/2019	38.911269	-121.542936
2900	5100143-001	NO3N	FALSE	0.837	4	0.061	no trend	212.7	0.21	2/11/1991	5/18/2005	38.823397	-121.503832
2905	5100143-002	NO3N	FALSE	0.592	-14	-0.103	no trend	589.3	-0.54	9/21/2005	5/15/2019	38.823303	-121.503779
2903	5100153-001	NO3N	FALSE	0.597	21	0.083	no trend	1433.7	0.53	11/21/1994	4/20/2005	38.771748	-121.5251
2904	5100153-002	NO3N	TRUE	0.009	-81	-0.426	decreasing	949	-2.6	3/8/2005	1/8/2019	38.772313	-121.525061
2911	5100159-001	NO3N	FALSE	1	-1	-0.007	no trend	181	0	3/29/1996	1/8/2019	38.784649	-121.617807
2898	5100160-002	NO3N	FALSE	0.798	-7	-0.041	no trend	548.3	-0.26	2/28/2002	1/8/2019	38.778461	-121.601924
2914	5101205-001	NO3N	FALSE	1	-1	-0.018	no trend	165	0	7/5/1995	7/19/2006	38.909988	-121.543625
2912	5103002-001	NO3N	FALSE	0.149	78	0.192	no trend	2842	1.44	7/5/1995	1/12/2017	38.82383	-121.48433
2895	5105002-001	NO3N	TRUE	0.029	-25	-0.275	decreasing	121	-2.18	11/19/2003	7/24/2019	38.881393	-121.60408
2907	5105004-001	NO3N	TRUE	0.003	-121	-0.372	decreasing	1603.7	-3	11/29/2000	6/19/2019	38.777769	-121.52437
2906	5105004-002	NO3N	FALSE	1	0	0	no trend	125	0	10/21/2009	6/19/2019	38.777766	-121.525116
847	T0606700736-U-1	NO3N	FALSE	0.73	4	0.111	no trend	75.3	0.35	4/13/2012	7/24/2014	38.6643785	-121.2619887
1263	T0606700736-U-2	NO3N	FALSE	1	0	0	no trend	92	0	4/13/2012	7/24/2014	38.6644124	-121.2616867
1581	T0606700736-U-3	NO3N	FALSE	0.063	-18	-0.5	no trend	83.3	-1.86	4/13/2012	7/24/2014	38.6643082	-121.261563
775	T0606700736-U-4	NO3N	FALSE	1	0	0	no trend	92	0	4/13/2012	7/24/2014	38.6645843	-121.261931
1237	T0606700736-U-7	NO3N	FALSE	0.142	-15	-0.417	no trend	91	-1.47	4/13/2012	7/24/2014	38.6639123	-121.2616611
1510	T0606700736-U-8	NO3N	FALSE	0.443	8	0.222	no trend	83.3	0.77	4/13/2012	7/24/2014	38.6644205	-121.2623142
1457	T0606700736-U-9	NO3N	FALSE	1	0	0	no trend	92	0	4/13/2012	7/24/2014	38.6651105	-121.2622752
1859	USGS-383746121291101	NO3N	FALSE	0.21	-15	-0.333	no trend	125	-1.25	8/4/1998	8/8/2017	38.6292139	-121.4877028
1860	USGS-384145121184101	NO3N	FALSE	0.754	4	0.111	no trend	92	0.31	8/17/1998	9/4/2012	38.6964	-121.3120389
1868	USGS-384330121293901	NO3N	FALSE	0.592	-7	-0.156	no trend	125	-0.54	8/11/1997	7/10/2017	38.7251167	-121.4954417
2803	USGS-384820121200701	NO3N	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	7/8/2007	8/7/2007	38.80575	-121.3355278
2804	USGS-384821121200801	NO3N	FALSE	0.466	8	0.222	no trend	92	0.73	8/6/2007	2/28/2008	38.8058333	-121.33575
2802	USGS-384822121200701	NO3N	FALSE	0.308	4	0.667	no trend	8.7	1.02	8/8/2007	8/8/2007	38.8063056	-121.3353889
3034	USGS-385546121312801	NO3N	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	6/3/1965	10/5/2017	38.92925	-121.5254444
3034	USGS-385546121312801	NO3N	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	6/3/1965	10/5/2017	38.92925	-121.5254444
3042	USGS-385718121290401	NO3N	FALSE	0.308	4	0.667	no trend	8.7	1.02	5/19/1965	5/20/2008	38.9548956	-121.4855142
3042	USGS-385718121290401	NO3N	FALSE	0.308	4	0.667	no trend	8.7	1.02	5/19/1965	5/20/2008	38.9548956	-121.4855142

Boron

Local_ID	Well_Info_ID	chemical	h	p	s	tau	trend	var_s	z	datemin	datemax	Latitude_NAD83	Longitude_NAD83
2934	11N03E24D001M	B	FALSE	0.242	7	0.467	no trend	26.3	1.17	7/21/1964	8/18/2004	38.7906	-121.5973
2940	11N04E04R002M	B	FALSE	0.371	-3	-0.5	no trend	5	-0.89	8/12/1971	8/24/2005	38.8255	-121.5259
2957	11N04E23P002M	B	FALSE	1	0	0	no trend	0	0	4/15/1965	8/18/2004	38.7837	-121.4982
2943	11N04E35J001M	B	FALSE	1	0	0	no trend	0	0	6/19/1968	8/24/2005	38.7556	-121.4898
2083	11N06E17D001M	B	TRUE	0	642	0.417	increasing	19908	4.54	5/5/2004	3/26/2008	38.8064	-121.3353
2081	11N06E17D002M	B	FALSE	0.884	-15	-0.01	no trend	9182.3	-0.15	5/6/2004	3/26/2008	38.8027	-121.3384
2080	11N06E17D003M	B	TRUE	0.031	228	0.22	increasing	11019.3	2.16	5/5/2004	3/26/2008	38.8059	-121.3358
2082	11N06E17E001M	B	TRUE	0	622	0.404	increasing	19728	4.42	5/5/2004	3/26/2008	38.8058	-121.3354
2953	12N03E26R001M	B	FALSE	0.149	5	0.833	no trend	7.7	1.44	6/13/1963	8/18/2004	38.8533	-121.5991
2967	12N04E05R005M	B	FALSE	0.26	-7	-0.467	no trend	28.3	-1.13	8/25/1970	8/18/2004	38.9114	-121.5447
2956	12N04E25N001M	B	FALSE	0.181	-8	-0.533	no trend	27.3	-1.34	6/12/1969	8/25/2005	38.8546	-121.4859
2059	3100538-001	B	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	3/18/2004	3/23/2018	38.7505	-121.321972
2060	3104508-001	B	FALSE	1	-1	-0.167	no trend	7.7	0	2/19/2004	4/20/2017	38.729952	-121.321616
172	3410004-006	B	FALSE	1	1	0.1	no trend	13	0	1/29/2002	11/4/2003	38.622744	-121.335704
150	3410004-009	B	FALSE	1	1	0.1	no trend	13	0	1/29/2002	10/23/2003	38.619652	-121.333354
261	3410004-016	B	FALSE	1	0	0	no trend	8.7	0	1/29/2002	4/30/2003	38.645576	-121.306819
248	3410004-020	B	FALSE	1	0	0	no trend	16.7	0	4/25/2002	10/21/2003	38.641845	-121.315446
93	3410013-001	B	FALSE	0.386	-8	-0.286	no trend	65.3	-0.87	3/18/2003	8/13/2018	38.694922	-121.332628
159	3410013-002	B	FALSE	0.536	-6	-0.214	no trend	65.3	-0.62	3/18/2003	8/13/2018	38.69054	-121.34151
51	3410013-003	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	6/18/2002	8/16/2018	38.683982	-121.31348
240	3410013-004	B	FALSE	0.063	16	0.571	no trend	65.3	1.86	6/20/2001	8/7/2018	38.699328	-121.295627
178	3410013-005	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	6/19/2002	8/7/2018	38.669042	-121.293798
63	3410013-006	B	FALSE	0.706	4	0.143	no trend	63.3	0.38	6/20/2001	8/8/2018	38.685052	-121.305855
156	3410013-007	B	FALSE	1	-1	-0.067	no trend	28.3	0	7/22/2003	8/19/2015	38.691478	-121.336784
270	3410013-008	B	FALSE	0.826	3	0.083	no trend	82.3	0.22	9/17/2002	8/16/2018	38.673506	-121.340002
224	3410013-009	B	FALSE	0.352	8	0.286	no trend	56.7	0.93	3/18/2003	8/7/2018	38.695662	-121.29509
92	3410013-010	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	6/19/2002	8/15/2018	38.670117	-121.341406
237	3410013-012	B	FALSE	0.618	5	0.179	no trend	64.3	0.5	6/20/2001	8/13/2018	38.66565	-121.302524
223	3410013-013	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	6/18/2002	8/13/2018	38.678824	-121.304628
144	3410013-014	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	6/19/2002	8/8/2018	38.668822	-121.304482
112	3410013-015	B	FALSE	0.352	8	0.286	no trend	56.7	0.93	3/19/2003	8/6/2018	38.70124	-121.345319
233	3410013-016	B	TRUE	0.035	-18	-0.643	decreasing	65.3	-2.1	6/18/2002	8/13/2018	38.709473	-121.292244
265	3410013-017	B	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	6/18/2002	8/24/2006	38.712243	-121.303547
247	3410013-019	B	FALSE	0.536	-6	-0.214	no trend	65.3	-0.62	6/20/2001	8/6/2018	38.700287	-121.330955
226	3410013-020	B	FALSE	0.221	-6	-0.6	no trend	16.7	-1.22	6/20/2001	8/24/2006	38.716217	-121.294262
88	3410013-021	B	FALSE	0.8	3	0.107	no trend	62.3	0.25	6/20/2001	8/8/2018	38.683333	-121.35
232	3410013-022	B	FALSE	0.339	6	0.4	no trend	27.3	0.96	6/18/2002	9/11/2012	38.7124	-121.306829
189	3410013-023	B	FALSE	1	0	0	no trend	65.3	0	6/20/2001	8/7/2018	38.695536	-121.313454
66	3410013-024	B	FALSE	0.8	3	0.107	no trend	62.3	0.25	6/20/2001	8/7/2018	38.680539	-121.31067
220	3410013-025	B	FALSE	1	1	0.048	no trend	44.3	0	6/18/2002	8/13/2018	38.718426	-121.313299
188	3410013-026	B	FALSE	0.711	-4	-0.143	no trend	65.3	-0.37	6/20/2001	8/6/2018	38.701667	-121.344722
119	3410013-027	B	FALSE	0.707	3	0.2	no trend	28.3	0.38	6/18/2002	9/18/2012	38.709413	-121.317252
165	3410013-028	B	FALSE	0.711	4	0.143	no trend	65.3	0.37	6/20/2001	8/13/2018	38.698857	-121.32618
206	3410031-001	B	FALSE	0.181	8	0.533	no trend	27.3	1.34	6/25/2001	8/11/2015	38.720833	-121.358333
190	3410031-002	B	FALSE	0.266	10	0.357	no trend	65.3	1.11	6/19/2002	8/8/2018	38.717222	-121.3575
94	3410031-003	B	FALSE	0.879	2	0.095	no trend	43.3	0.15	6/25/2001	8/14/2018	38.7	-121.383333
221	3410031-004	B	FALSE	0.266	-10	-0.357	no trend	65.3	-1.11	6/19/2002	8/14/2018	38.718056	-121.382222
61	3410031-005	B	FALSE	0.759	3	0.143	no trend	42.3	0.31	6/25/2001	8/5/2015	38.716667	-121.4
160	3410031-006	B	FALSE	0.618	5	0.179	no trend	64.3	0.5	6/25/2001	8/14/2018	38.708333	-121.383611
2073	3410031-007	B	FALSE	0.548	5	0.238	no trend	44.3	0.6	6/25/2001	8/9/2018	38.733333	-121.35
2056	3410031-008	B	FALSE	0.518	7	0.194	no trend	86.3	0.65	6/25/2001	8/9/2018	38.733333	-121.35
208	3410031-009	B	FALSE	0.063	-16	-0.571	no trend	65.3	-1.86	6/19/2002	8/7/2018	38.715278	-121.378056
72	3410031-010	B	FALSE	0.174	12	0.429	no trend	65.3	1.36	6/19/2002	8/7/2018	38.705	-121.365556
289	3410031-011	B	FALSE	1	0	0	no trend	65.3	0	6/19/2002	8/7/2018	38.726944	-121.3825
135	3410031-012	B	FALSE	0.806	-2	-0.2	no trend	16.7	-0.24	6/25/2001	8/7/2018	38.721111	-121.368611
45	3410031-013	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	6/19/2002	8/14/2018	38.711667	-121.413889
54	3410031-014	B	FALSE	0.548	5	0.238	no trend	44.3	0.6	6/25/2001	8/14/2018	38.716111	-121.408889
241	3410031-016	B	FALSE	0.902	2	0.071	no trend	65.3	0.12	6/19/2002	8/8/2018	38.724444	-121.336111
80	3410031-017	B	FALSE	0.902	-2	-0.071	no trend	65.3	-0.12	6/19/2002	8/8/2018	38.723056	-121.349722
257	3410031-018	B	FALSE	0.23	9	0.429	no trend	44.3	1.2	6/25/2001	8/7/2018	38.716389	-121.371944
288	3410045-001	B	FALSE	0.8	3	0.107	no trend	62.3	0.25	6/26/2001	8/7/2018	38.586137	-121.411513
138	3410045-002	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	2/27/2002	8/7/2018	38.583085	-121.413054
116	3410045-003	B	FALSE	0.8	3	0.107	no trend	62.3	0.25	6/26/2001	8/7/2018	38.594423	-121.417465
243	3410045-004	B	FALSE	0.697	-3	-0.2	no trend	26.3	-0.39	6/26/2001	7/12/2012	38.592566	-121.407256
96	3410045-005	B	FALSE	0.898	2	0.071	no trend	60.7	0.13	2/27/2002	8/7/2018	38.600025	-121.410183
1859	USGS-383746121291101	B	FALSE	0.902	-2	-0.071	no trend	65.3	-0.12	8/4/1998	8/8/2017	38.6292139	-121.4877028
1855	USGS-383900121270001	B	FALSE	0.734	2	0.333	no trend	8.7	0.34	6/14/2005	6/15/2005	38.6585	-121.4664722
1860	USGS-384145121184101	B	FALSE	0.368	7	0.333	no trend	44.3	0.9	8/17/1998	9/4/2012	38.6964	-121.3120389
1868	USGS-384330121293901	B	FALSE	0.23	9	0.429	no trend	44.3	1.2	8/11/1997	7/10/2017	38.7251167	-121.4954417
2806	USGS-384413121163801	B	FALSE	1	0	0	no trend	8.7	0	9/24/1982	3/10/2014	38.7369444	-121.2772222

3034	USGS-385546121312801	B	FALSE	0.613	3	0.3	no trend	15.7	0.51	6/3/1965	10/5/2017	38.92925	-121.5254444
3034	USGS-385546121312801	B	FALSE	0.613	3	0.3	no trend	15.7	0.51	6/3/1965	10/5/2017	38.92925	-121.5254444

Iron

Local_ID	Well_Info_ID	chemical	h	p	s	tau	trend	var_s	z	datemin	datemax	Latitude_NAD83	Longitude_NAD83
2083	11N06E17D001M	FE	FALSE	0.357	24	0.074	no trend	624.7	0.92	5/5/2004	3/26/2008	38.8064	-121.3353
2081	11N06E17D002M	FE	FALSE	0.341	69	0.05	no trend	5104.3	0.95	5/6/2004	3/26/2008	38.8027	-121.3384
2080	11N06E17D003M	FE	TRUE	0.047	78	0.283	increasing	1499.3	1.99	5/5/2004	3/26/2008	38.8059	-121.3358
2082	11N06E17E001M	FE	FALSE	0.663	-17	-0.048	no trend	1351	-0.44	5/5/2004	3/26/2008	38.8058	-121.3354
2059	3100538-001	FE	TRUE	0.008	25	0.694	increasing	82.3	2.64	8/19/1999	6/12/2019	38.7505	-121.321972
2060	3104508-001	FE	FALSE	0.613	-3	-0.3	no trend	15.7	-0.51	2/19/2004	4/20/2017	38.729952	-121.321616
2071	3110008-006	FE	FALSE	0.707	-3	-0.2	no trend	28.3	-0.38	10/31/1995	8/25/2016	38.736633	-121.277875
2066	3110008-007	FE	FALSE	0.794	-2	-0.2	no trend	14.7	-0.26	10/31/1995	8/25/2016	38.726493	-121.258205
2050	3110008-008	FE	FALSE	0.411	5	0.333	no trend	23.7	0.82	10/22/2002	8/23/2018	38.805938	-121.33588
2064	3110025-005	FE	FALSE	0.536	-13	-0.096	no trend	375.7	-0.62	7/26/1989	9/12/2019	38.818889	-121.31
2063	3110040-001	FE	FALSE	0.324	13	0.236	no trend	148.3	0.99	9/27/1988	7/9/2002	38.75	-121.34722
2067	3110040-002	FE	FALSE	0.078	-17	-0.472	no trend	82.3	-1.76	8/31/1989	7/9/2002	38.75	-121.34444
2054	3110048-001	FE	FALSE	0.089	6	1	no trend	8.7	1.7	2/5/2003	4/9/2018	38.983062	-121.375659
2058	3110048-002	FE	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	2/5/2003	4/9/2018	38.980075	-121.369185
145	3400173-002	FE	FALSE	1	-1	-0.167	no trend	7.7	0	5/24/2001	2/14/2017	38.640638	-121.483861
235	3400173-003	FE	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	10/25/2001	2/15/2017	38.654819	-121.477561
272	3400191-001	FE	FALSE	0.149	5	0.833	no trend	7.7	1.44	8/17/2001	3/23/2018	38.65525	-121.379888
193	3410001-001	FE	FALSE	1	-1	-0.018	no trend	156.3	0	4/14/1987	9/5/2017	38.606839	-121.3982
242	3410001-002	FE	FALSE	0.522	-9	-0.164	no trend	156.3	-0.64	4/14/1987	10/18/2017	38.59783	-121.398024
258	3410001-004	FE	FALSE	0.675	5	0.139	no trend	91	0.42	10/31/1988	6/19/2014	38.611483	-121.410107
284	3410001-005	FE	FALSE	0.445	-7	-0.25	no trend	61.7	-0.76	10/31/1988	6/8/2011	38.623478	-121.396638
203	3410001-007	FE	FALSE	0.522	-9	-0.164	no trend	156.3	-0.64	7/24/1989	9/27/2017	38.610999	-121.363391
128	3410001-009	FE	FALSE	0.734	2	0.333	no trend	8.7	0.34	4/14/1987	3/3/2005	38.616331	-121.403703
212	3410001-010	FE	FALSE	0.326	15	0.227	no trend	203	0.98	4/14/1987	9/12/2017	38.608099	-121.408153
158	3410001-011	FE	FALSE	0.266	-13	-0.289	no trend	116.3	-1.11	10/31/1988	9/14/2017	38.619863	-121.396184
228	3410001-012	FE	FALSE	0.439	-29	-0.115	no trend	1307.7	-0.77	5/7/1987	2/6/2018	38.617662	-121.403695
82	3410001-013	FE	FALSE	0.068	-21	-0.467	no trend	120.3	-1.82	7/25/1989	9/26/2017	38.598939	-121.370714
146	3410001-014	FE	FALSE	0.396	-6	-0.286	no trend	34.7	-0.85	11/1/1988	9/14/2006	38.61171	-121.386048
260	3410001-015	FE	FALSE	0.441	-10	-0.182	no trend	136.7	-0.77	11/1/1988	9/19/2017	38.59781	-121.381308
191	3410001-016	FE	FALSE	0.205	-12	-0.333	no trend	75.3	-1.27	11/1/1988	9/4/2014	38.631327	-121.37485
124	3410001-017	FE	FALSE	0.67	-5	-0.139	no trend	88.3	-0.43	7/24/1989	8/27/2014	38.61981	-121.403732
211	3410001-018	FE	FALSE	0.324	-13	-0.236	no trend	148.3	-0.99	11/1/1988	9/19/2017	38.623854	-121.374359
209	3410001-019	FE	FALSE	0.436	-8	-0.178	no trend	80.7	-0.78	11/1/1988	9/25/2017	38.597831	-121.359623
114	3410001-020	FE	FALSE	1	1	0.028	no trend	47.7	0	1/27/1992	9/19/2017	38.618079	-121.359205
210	3410001-021	FE	FALSE	0.743	-5	-0.091	no trend	148.3	-0.33	4/14/1987	9/12/2017	38.615256	-121.419986
161	3410001-022	FE	FALSE	0.853	3	0.067	no trend	116.3	0.19	10/31/1988	9/11/2017	38.604549	-121.42274
64	3410001-024	FE	FALSE	0.149	-5	-0.833	no trend	7.7	-1.44	7/24/1989	2/19/2001	38.641255	-121.370271
222	3410001-025	FE	FALSE	1	1	0.022	no trend	95.7	0	4/13/1987	9/19/2017	38.60046	-121.359118
148	3410001-026	FE	FALSE	0.452	5	0.333	no trend	28.3	0.75	10/31/1988	2/23/2005	38.627091	-121.384097
113	3410001-027	FE	FALSE	0.602	-6	-0.167	no trend	92	-0.52	1/30/1992	9/27/2017	38.605146	-121.390988
244	3410001-028	FE	FALSE	1	1	0.022	no trend	125	0	7/24/1989	8/21/2014	38.63562	-121.381097
227	3410001-029	FE	FALSE	0.667	-4	-0.143	no trend	48.7	-0.43	1/30/1992	10/3/2017	38.630252	-121.397575
236	3410001-030	FE	FALSE	1	0	0	no trend	75.3	0	7/21/1989	9/26/2017	38.617802	-121.424022
81	3410001-032	FE	FALSE	0.458	-10	-0.182	no trend	147.3	-0.74	10/31/1988	9/19/2017	38.622918	-121.413817
104	3410001-033	FE	FALSE	0.803	3	0.107	no trend	64.3	0.25	7/21/1989	7/10/2014	38.601378	-121.424
173	3410001-034	FE	FALSE	0.522	-9	-0.164	no trend	156.3	-0.64	5/7/1987	9/11/2017	38.584674	-121.396539
169	3410001-035	FE	FALSE	0.436	8	0.178	no trend	80.7	0.78	7/9/1990	9/28/2017	38.594464	-121.351844
25	3410001-037	FE	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	4/13/1987	2/5/1998	38.578611	-121.366667
19	3410001-038	FE	TRUE	0.022	-34	-0.374	decreasing	208.7	-2.28	7/25/1989	6/9/2011	38.578371	-121.363395
20	3410001-039	FE	FALSE	1	-1	-0.067	no trend	19.7	0	10/31/1988	9/18/2006	38.591742	-121.346413
168	3410001-042	FE	FALSE	0.564	-7	-0.156	no trend	108.3	-0.58	11/1/1988	9/12/2017	38.628014	-121.358648
184	3410001-051	FE	FALSE	1	1	0.018	no trend	119.7	0	4/13/1987	9/11/2017	38.636187	-121.375067
111	3410001-052	FE	FALSE	1	1	0.022	no trend	95.7	0	4/13/1987	9/11/2017	38.625054	-121.362252
287	3410001-054	FE	FALSE	0.442	-9	-0.2	no trend	108.3	-0.77	2/11/1991	9/13/2017	38.582422	-121.408379
122	3410001-055	FE	FALSE	0.452	7	0.194	no trend	63.7	0.75	11/1/1988	12/13/2017	38.594474	-121.39864
26	3410001-056	FE	FALSE	0.452	7	0.194	no trend	63.7	0.75	11/1/1988	9/13/2017	38.578749	-121.41096
3	3410001-061	FE	FALSE	0.662	15	0.059	no trend	1024.3	0.44	5/7/1998	3/20/2018	38.582786	-121.338489
176	3410001-062	FE	FALSE	0.211	6	0.286	no trend	16	1.25	8/22/2000	9/5/2017	38.618056	-121.401944
12	3410001-064	FE	FALSE	0.211	6	0.286	no trend	16	1.25	4/23/2002	9/12/2017	38.584121	-121.353432
13	3410001-065	FE	FALSE	1	-1	-0.048	no trend	35.7	0	4/22/2002	9/21/2017	38.583196	-121.33679
4	3410001-066	FE	FALSE	1	1	0.048	no trend	27.7	0	4/23/2002	9/12/2017	38.582214	-121.338203
2	3410001-067	FE	FALSE	0.321	23	0.192	no trend	492.3	0.99	6/3/1999	1/8/2015	38.582481	-121.417169
225	3410001-069	FE	FALSE	0.505	14	0.133	no trend	380	0.67	7/27/1989	9/28/2017	38.580609	-121.384004
255	3410001-070	FE	FALSE	0.919	-2	-0.044	no trend	96.7	-0.1	2/12/1991	9/12/2017	38.576006	-121.403088
205	3410001-071	FE	TRUE	0	666	0.403	increasing	15307.3	5.37	4/17/2002	9/12/2019	38.63056	-121.397787
106	3410001-072	FE	FALSE	0.68	-8	-0.052	no trend	288.7	-0.41	4/17/2002	9/12/2017	38.61744	-121.411527
252	3410001-073	FE	FALSE	0.148	44	0.21	no trend	884	1.45	4/17/2002	7/25/2019	38.58058	-121.383962
58	3410001-076	FE	FALSE	0.927	2	0.036	no trend	120.7	0.09	6/5/1984	7/10/2019	38.644265	-121.362069
69	3410001-077	FE	FALSE	0.94	2	0.026	no trend	176.7	0.08	3/7/1984	7/10/2019	38.631522	-121.352911
86	3410001-078	FE	FALSE	0.747	-6	-0.066	no trend	240.7	-0.32	6/5/1984	7/9/2019	38.684818	-121.355931

259	3410001-079	FE	FALSE	0.454	-7	-0.25	no trend	64.3	-0.75	6/4/1984	7/24/2013	38.667577	-121.334161
110	3410001-080	FE	TRUE	0.019	-66	-0.314	decreasing	762	-2.35	6/4/1984	7/17/2019	38.672567	-121.331573
174	3410001-081	FE	FALSE	0.292	-18	-0.231	no trend	260	-1.05	6/5/1984	7/22/2019	38.683333	-121.333333
71	3410001-082	FE	FALSE	0.126	-27	-0.297	no trend	288.3	-1.53	6/4/1984	7/21/2016	38.648929	-121.338368
246	3410001-083	FE	FALSE	1	0	0	no trend	147.3	0	5/17/1984	7/9/2019	38.663692	-121.347786
239	3410001-085	FE	FALSE	0.407	-15	-0.165	no trend	285.7	-0.83	6/4/1984	7/17/2019	38.644208	-121.329841
49	3410001-087	FE	FALSE	0.94	2	0.026	no trend	176.7	0.08	6/5/1984	7/11/2019	38.645858	-121.392317
218	3410001-088	FE	FALSE	0.102	-17	-0.378	no trend	95.7	-1.64	5/17/1984	6/4/2014	38.668746	-121.361
89	3410001-089	FE	FALSE	0.499	-12	-0.132	no trend	264.7	-0.68	3/7/1984	7/9/2019	38.653579	-121.379692
132	3410001-092	FE	FALSE	0.549	52	0.06	no trend	7256.7	0.6	6/4/1984	7/24/2018	38.63889	-121.342759
185	3410001-094	FE	FALSE	0.457	-14	-0.154	no trend	305.3	-0.74	5/17/1984	7/10/2019	38.652299	-121.354305
196	3410001-095	FE	FALSE	1	0	0	no trend	43.3	0	5/17/1984	6/21/2007	38.658062	-121.356402
297	3410001-096	FE	FALSE	0.175	-22	-0.282	no trend	239.3	-1.36	6/30/1988	7/9/2019	38.689669	-121.360198
102	3410001-097	FE	FALSE	0.726	-6	-0.077	no trend	203.3	-0.35	12/13/1984	7/11/2019	38.694158	-121.360024
256	3410001-098	FE	FALSE	0.912	-3	-0.033	no trend	329	-0.11	5/9/1984	7/9/2019	38.700217	-121.351805
295	3410001-099	FE	FALSE	1	-1	-0.067	no trend	19.7	0	10/20/1988	6/21/2007	38.655401	-121.313482
46	3410001-101	FE	FALSE	0.833	-4	-0.051	no trend	203.3	-0.21	10/27/1988	7/7/2016	38.663926	-121.32579
231	3410001-102	FE	FALSE	0.207	-35	-0.205	no trend	725	-1.26	10/20/1988	7/15/2019	38.675049	-121.315501
101	3410001-103	FE	FALSE	1	-1	-0.048	no trend	27.7	0	10/25/1988	1/13/2014	38.651225	-121.32298
163	3410001-104	FE	FALSE	0.237	-14	-0.255	no trend	120.7	-1.18	2/26/1991	7/10/2019	38.710442	-121.331662
180	3410001-105	FE	FALSE	0.919	-2	-0.044	no trend	96.7	-0.1	10/12/1995	7/10/2019	38.710528	-121.331667
262	3410001-106	FE	FALSE	0.096	-7	-0.7	no trend	13	-1.66	6/28/2001	6/4/2014	38.710517	-121.331659
85	3410001-107	FE	FALSE	1	0	0	no trend	44.3	0	11/4/1996	7/14/2016	38.709903	-121.357066
127	3410001-111	FE	FALSE	0.919	-2	-0.044	no trend	96.7	-0.1	12/13/1995	7/11/2019	38.665363	-121.383099
254	3410001-127	FE	FALSE	0.288	-8	-0.381	no trend	43.3	-1.06	12/13/1995	7/29/2013	38.712268	-121.381099
283	3410001-128	FE	FALSE	1	1	0.067	no trend	19.7	0	12/13/1995	6/17/2010	38.709783	-121.374669
149	3410001-129	FE	FALSE	0.211	-6	-0.286	no trend	16	-1.25	12/13/1995	7/29/2013	38.710651	-121.387666
118	3410001-133	FE	FALSE	0.249	-13	-0.289	no trend	108.3	-1.15	7/9/1990	7/22/2019	38.682932	-121.376063
182	3410001-135	FE	FALSE	0.064	21	0.467	no trend	116.3	1.85	11/1/1988	11/7/2016	38.68794	-121.385107
99	3410001-136	FE	FALSE	0.497	16	0.133	no trend	488.7	0.68	5/7/1987	3/27/2018	38.685899	-121.372701
141	3410001-137	FE	FALSE	0.287	-11	-0.306	no trend	88.3	-1.06	11/1/1988	6/30/2014	38.692847	-121.375953
183	3410001-139	FE	FALSE	0.365	-12	-0.218	no trend	147.3	-0.91	5/17/1984	7/19/2016	38.69191	-121.364477
280	3410001-142	FE	FALSE	0.089	-17	-0.472	no trend	88.3	-1.7	7/20/1989	7/11/2016	38.686782	-121.392424
267	3410001-143	FE	FALSE	0.47	-3	-0.5	no trend	7.7	-0.72	4/13/1987	2/4/1998	38.701228	-121.371968
197	3410001-144	FE	FALSE	1	1	0.018	no trend	119.7	0	4/13/1987	7/23/2019	38.69798	-121.373877
213	3410001-145	FE	FALSE	0.242	5	0.333	no trend	11.7	1.17	4/22/2002	7/10/2019	38.67526	-121.379573
315	3410002-001	FE	FALSE	0.688	-6	-0.109	no trend	155.3	-0.4	2/20/1991	2/8/2017	38.583333	-121.383333
117	3410002-002	FE	FALSE	0.926	-2	-0.044	no trend	115.3	-0.09	7/17/1990	2/8/2017	38.583333	-121.366667
28	3410002-007	FE	FALSE	0.853	-3	-0.067	no trend	116.3	-0.19	8/2/1989	2/14/2017	38.566667	-121.4
10	3410002-012	FE	FALSE	0.67	-5	-0.139	no trend	88.3	-0.43	8/2/1989	5/8/2017	38.566667	-121.416667
17	3410002-013	FE	FALSE	0.602	-22	-0.073	no trend	1620.7	-0.52	7/17/1990	2/14/2017	38.583333	-121.416667
249	3410002-014	FE	FALSE	0.228	-12	-0.333	no trend	83.3	-1.2	7/17/1990	5/8/2017	38.583333	-121.366667
152	3410003-001	FE	TRUE	0.007	65	0.478	increasing	571.7	2.68	7/20/1989	2/6/2019	38.587545	-121.385145
153	3410003-002	FE	FALSE	0.124	26	0.333	no trend	264	1.54	4/11/1986	2/28/2017	38.582537	-121.383219
245	3410003-004	FE	FALSE	0.602	-6	-0.167	no trend	92	-0.52	7/20/1989	1/25/2005	38.587611	-121.392074
162	3410003-005	FE	TRUE	0.034	48	0.4	increasing	491.3	2.12	4/2/1987	7/11/2017	38.591017	-121.384139
251	3410003-006	FE	FALSE	0.694	6	0.109	no trend	161.3	0.39	4/2/1987	2/28/2017	38.59211	-121.387633
238	3410003-008	FE	FALSE	0.211	26	0.248	no trend	400	1.25	4/2/1987	2/28/2017	38.600074	-121.391973
74	3410004-001	FE	FALSE	0.36	10	0.222	no trend	96.7	0.92	10/24/1995	2/3/2004	38.645432	-121.313067
83	3410004-004	FE	FALSE	0.914	3	0.029	no trend	341	0.11	2/19/1991	1/28/2010	38.64988	-121.30798
175	3410004-005	FE	FALSE	0.466	8	0.222	no trend	92	0.73	11/9/1988	10/4/2001	38.633333	-121.35
172	3410004-006	FE	FALSE	0.245	-43	-0.17	no trend	1307.7	-1.16	8/1/1990	6/1/2017	38.622744	-121.335704
6	3410004-007	FE	TRUE	0.035	-19	-0.345	decreasing	73	-2.11	8/1/1990	10/23/2002	38.594673	-121.334606
150	3410004-009	FE	FALSE	0.912	4	0.016	no trend	734.7	0.11	2/19/1991	6/1/2017	38.619652	-121.333354
261	3410004-016	FE	FALSE	0.982	-2	-0.006	no trend	2014	-0.02	5/8/1987	6/1/2017	38.645576	-121.306819
248	3410004-020	FE	FALSE	0.094	27	0.297	no trend	241.7	1.67	4/25/2002	6/1/2017	38.641845	-121.315446
139	3410004-021	FE	FALSE	1	-1	-0.015	no trend	87.7	0	4/23/2002	6/1/2017	38.604804	-121.342252
290	3410006-001	FE	FALSE	0.631	-7	-0.127	no trend	156.3	-0.48	7/19/1989	5/30/2019	38.661305	-121.292607
207	3410006-007	FE	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	7/19/1989	1/21/1998	38.705556	-121.308333
198	3410006-008	FE	FALSE	1	-1	-0.048	no trend	27.7	0	12/6/1990	2/20/2013	38.679425	-121.289154
98	3410006-010	FE	FALSE	0.371	3	0.5	no trend	5	0.89	10/21/2004	6/6/2018	38.698638	-121.269673
130	3410007-001	FE	FALSE	1	-1	-0.1	no trend	15.7	0	4/10/1992	6/24/2010	38.613787	-121.367811
229	3410007-002	FE	FALSE	0.586	12	0.114	no trend	407.3	0.55	11/7/1988	8/7/2019	38.613607	-121.371676
216	3410007-003	FE	FALSE	0.917	2	0.056	no trend	92	0.1	7/19/1989	12/11/2018	38.606352	-121.369707
269	3410007-004	FE	FALSE	1	0	0	no trend	407.3	0	7/19/1989	8/6/2019	38.607768	-121.374083
77	3410007-005	FE	FALSE	0.214	26	0.248	no trend	404.7	1.24	11/7/1988	8/6/2019	38.61458	-121.378552
142	3410007-006	FE	TRUE	0.012	-29	-0.644	decreasing	125	-2.5	7/19/1989	1/20/2012	38.60731	-121.364767
195	3410007-007	FE	FALSE	1	-1	-0.028	no trend	91	0	7/19/1989	8/6/2019	38.606531	-121.380719
253	3410007-008	FE	TRUE	0.032	16	0.571	increasing	48.7	2.15	1/26/1993	8/13/2019	38.613172	-121.380739
166	3410009-001	FE	FALSE	1	-1	-0.1	no trend	13	0	2/28/1991	6/16/2004	38.643048	-121.268528
100	3410009-003	FE	FALSE	1	-1	-0.167	no trend	7.7	0	11/9/1988	2/8/2000	38.666667	-121.216667

105	3410009-004	FE	FALSE	0.3	-10	-0.278	no trend	75.3	-1.04	8/2/1990	6/6/2006	38.651282	-121.255173
78	3410009-005	FE	FALSE	1	-1	-0.067	no trend	19.7	0	11/9/1988	6/16/2004	38.650805	-121.286999
201	3410009-006	FE	FALSE	0.161	-18	-0.273	no trend	147.3	-1.4	7/19/1989	6/14/2012	38.642768	-121.278261
234	3410009-007	FE	FALSE	0.175	-8	-0.222	no trend	26.7	-1.36	7/19/1989	6/14/2012	38.651297	-121.296666
217	3410009-008	FE	FALSE	1	-1	-0.048	no trend	27.7	0	8/16/1990	6/6/2006	38.662066	-121.265396
164	3410009-010	FE	TRUE	0.019	-24	-0.533	decreasing	96.7	-2.34	11/7/1991	6/14/2012	38.659628	-121.25556
93	3410013-001	FE	FALSE	0.943	2	0.03	no trend	194	0.07	10/7/1992	8/13/2018	38.694922	-121.332628
159	3410013-002	FE	FALSE	0.407	-13	-0.197	no trend	209	-0.83	2/18/1992	8/13/2018	38.69054	-121.34151
51	3410013-003	FE	FALSE	0.622	10	0.11	no trend	332.7	0.49	11/2/1988	8/29/2018	38.683982	-121.31348
240	3410013-004	FE	FALSE	0.841	5	0.048	no trend	397.7	0.2	4/15/1987	8/7/2018	38.699328	-121.295627
178	3410013-005	FE	FALSE	0.954	-2	-0.022	no trend	303.3	-0.06	4/15/1987	8/7/2018	38.669042	-121.293798
63	3410013-006	FE	FALSE	0.852	-4	-0.051	no trend	260	-0.19	2/11/1992	8/8/2018	38.685052	-121.305855
156	3410013-007	FE	FALSE	0.086	50	0.292	no trend	813.3	1.72	4/15/1987	11/16/2016	38.691478	-121.336784
270	3410013-008	FE	FALSE	0.804	6	0.057	no trend	404.7	0.25	11/2/1988	8/29/2018	38.673506	-121.340002
224	3410013-009	FE	FALSE	0.725	-6	-0.091	no trend	202	-0.35	4/15/1987	8/7/2018	38.695662	-121.29509
92	3410013-010	FE	FALSE	0.675	13	0.076	no trend	817	0.42	4/14/1989	8/15/2018	38.670117	-121.341406
237	3410013-012	FE	FALSE	0.66	-9	-0.099	no trend	331.7	-0.44	7/2/1990	8/13/2018	38.66565	-121.302524
223	3410013-013	FE	FALSE	0.161	38	0.248	no trend	696	1.4	4/15/1987	8/13/2018	38.678824	-121.304628
144	3410013-014	FE	FALSE	0.85	-4	-0.051	no trend	250	-0.19	11/2/1988	8/8/2018	38.668822	-121.304482
112	3410013-015	FE	FALSE	0.296	15	0.227	no trend	179.7	1.04	2/18/1992	8/6/2018	38.70124	-121.345319
233	3410013-016	FE	FALSE	0.374	13	0.197	no trend	182.3	0.89	2/11/1993	8/13/2018	38.709473	-121.292244
265	3410013-017	FE	FALSE	0.751	3	0.143	no trend	39.7	0.32	2/11/1992	8/24/2006	38.712243	-121.303547
247	3410013-019	FE	FALSE	0.738	-7	-0.077	no trend	323	-0.33	4/15/1987	8/6/2018	38.700287	-121.330955
226	3410013-020	FE	TRUE	0.033	-18	-0.643	decreasing	63.3	-2.14	11/2/1988	8/24/2006	38.716217	-121.294262
88	3410013-021	FE	FALSE	0.954	-2	-0.022	no trend	303.3	-0.06	11/2/1988	8/8/2018	38.683333	-121.35
232	3410013-022	FE	FALSE	0.336	-10	-0.278	no trend	87.3	-0.96	2/18/1992	9/11/2012	38.7124	-121.306829
189	3410013-023	FE	FALSE	0.349	18	0.198	no trend	330	0.94	7/28/1989	8/7/2018	38.695536	-121.313454
66	3410013-024	FE	FALSE	0.729	6	0.091	no trend	208	0.35	2/11/1992	8/7/2018	38.680539	-121.31067
220	3410013-025	FE	FALSE	0.363	-25	-0.163	no trend	697	-0.91	8/15/1989	8/13/2018	38.718426	-121.313299
188	3410013-026	FE	FALSE	1	-1	-0.011	no trend	304.3	0	4/15/1987	8/6/2018	38.701667	-121.344722
119	3410013-027	FE	FALSE	0.938	-2	-0.03	no trend	167.3	-0.08	2/18/1992	9/18/2012	38.709413	-121.317252
165	3410013-028	FE	FALSE	0.369	8	0.286	no trend	60.7	0.9	4/21/1997	8/13/2018	38.698857	-121.32618
125	3410016-001	FE	FALSE	1	-1	-0.167	no trend	7.7	0	8/2/1990	12/21/2004	38.686538	-121.219546
147	3410016-002	FE	FALSE	1	1	0.1	no trend	13	0	4/18/1991	1/17/2013	38.694541	-121.210813
126	3410018-005	FE	FALSE	0.13	-7	-0.7	no trend	15.7	-1.52	7/28/1989	3/5/2002	38.721801	-121.46774
24	3410020-015	FE	FALSE	0.618	5	0.179	no trend	64.3	0.5	1/17/1992	4/3/2017	38.6125	-121.479167
11	3410020-016	FE	FALSE	0.902	2	0.071	no trend	65.3	0.12	1/17/1992	1/20/2015	38.616667	-121.479167
293	3410020-017	FE	FALSE	1	0	0	no trend	121.3	0	11/18/1988	8/24/2017	38.62266	-121.477813
84	3410020-018	FE	FALSE	0.564	-7	-0.156	no trend	108.3	-0.58	1/17/1992	5/8/2017	38.627831	-121.477227
292	3410020-021	FE	FALSE	0.452	-5	-0.333	no trend	28.3	-0.75	1/21/1992	10/12/2011	38.607083	-121.454779
97	3410020-022	FE	FALSE	0.65	6	0.133	no trend	121.3	0.45	11/18/1988	3/20/2017	38.607305	-121.443097
136	3410020-023	FE	FALSE	0.174	-12	-0.429	no trend	65.3	-1.36	1/21/1992	3/7/2017	38.604956	-121.439486
314	3410020-024	FE	FALSE	0.067	20	0.444	no trend	107.3	1.83	11/18/1988	10/10/2011	38.612801	-121.450505
129	3410020-025	FE	FALSE	0.089	6	1	no trend	8.7	1.7	1/21/1992	10/9/2008	38.612294	-121.440456
215	3410020-027	FE	FALSE	0.578	6	0.133	no trend	80.7	0.56	1/22/1992	5/8/2017	38.620988	-121.443553
279	3410020-028	FE	FALSE	0.697	6	0.091	no trend	164.7	0.39	11/18/1988	5/8/2017	38.62044	-121.432285
108	3410020-029	FE	FALSE	0.638	4	0.19	no trend	40.7	0.47	1/17/1992	3/20/2017	38.618056	-121.468056
107	3410020-030	FE	FALSE	0.136	-15	-0.417	no trend	88.3	-1.49	1/17/1992	5/8/2017	38.625119	-121.462605
59	3410020-032	FE	FALSE	0.295	-41	-0.149	no trend	1460.3	-1.05	1/16/1991	8/24/2017	38.628503	-121.43627
55	3410020-033	FE	FALSE	0.894	-2	-0.071	no trend	56.7	-0.13	11/16/1988	10/10/2011	38.626808	-121.42959
171	3410020-034	FE	FALSE	0.365	10	0.182	no trend	98.7	0.91	1/16/1991	2/27/2018	38.638412	-121.446721
73	3410020-035	FE	FALSE	0.365	10	0.182	no trend	98.7	0.91	1/16/1991	2/27/2018	38.639934	-121.427293
133	3410020-037	FE	FALSE	0.926	-2	-0.044	no trend	115.3	-0.09	1/16/1991	5/8/2017	38.651207	-121.469509
264	3410020-038	FE	FALSE	0.546	14	0.103	no trend	463.3	0.6	1/16/1991	7/8/2019	38.647475	-121.459256
50	3410020-039	FE	FALSE	1	1	0.1	no trend	13	0	1/22/1992	10/8/2003	38.627595	-121.432917
56	3410020-040	FE	FALSE	0.934	-2	-0.036	no trend	147.3	-0.08	10/22/1990	5/9/2017	38.629597	-121.420726
278	3410020-041	FE	FALSE	1	-1	-0.015	no trend	146.3	0	1/16/1991	5/9/2017	38.641387	-121.435795
22	3410020-042	FE	TRUE	0.027	-32	-0.485	decreasing	196	-2.21	1/21/1992	7/8/2019	38.596923	-121.458973
294	3410020-044	FE	FALSE	0.144	12	0.429	no trend	56.7	1.46	10/16/1990	10/10/2011	38.613996	-121.456155
194	3410020-045	FE	FALSE	0.87	-3	-0.055	no trend	148.3	-0.16	10/19/1990	5/9/2017	38.622276	-121.446858
134	3410020-046	FE	FALSE	1	1	0.028	no trend	47.7	0	1/22/1992	9/22/2014	38.623116	-121.427024
157	3410020-050	FE	FALSE	0.499	8	0.178	no trend	107.3	0.68	1/16/1991	3/25/2014	38.668053	-121.438012
42	3410020-051	FE	FALSE	0.927	2	0.036	no trend	120.7	0.09	1/16/1991	2/27/2018	38.634413	-121.412516
296	3410020-052	FE	FALSE	0.564	-7	-0.156	no trend	108.3	-0.58	3/8/1993	5/9/2017	38.599341	-121.445804
214	3410020-054	FE	FALSE	0.146	-18	-0.327	no trend	136.7	-1.45	1/21/1992	8/24/2017	38.596324	-121.427308
33	3410020-055	FE	FALSE	0.071	-23	-0.418	no trend	148.3	-1.81	1/17/1992	5/9/2017	38.617636	-121.469304
91	3410020-056	FE	FALSE	0.689	10	0.048	no trend	507.3	0.4	1/12/1994	5/9/2017	38.654657	-121.448564
291	3410020-057	FE	FALSE	0.669	5	0.076	no trend	87.7	0.43	1/18/1995	12/19/2018	38.658482	-121.466415
30	3410026-001	FE	FALSE	0.089	6	1	no trend	8.7	1.7	2/21/1991	5/31/2012	38.58961	-121.429343
7	3410026-002	FE	FALSE	1	-1	-0.1	no trend	13	0	2/21/1991	5/3/2018	38.588266	-121.423478
31	3410026-003	FE	FALSE	0.289	-4	-0.4	no trend	8	-1.06	2/21/1991	5/3/2018	38.593617	-121.439154

18	3410026-004	FE	FALSE	0.13	-7	-0.7	no trend	15.7	-1.52	2/21/1991	5/3/2018	38.593339	-121.432431
206	3410031-001	FE	FALSE	0.055	60	0.316	no trend	945.3	1.92	3/24/1988	5/16/2019	38.720833	-121.358333
190	3410031-002	FE	FALSE	0.731	5	0.091	no trend	135.7	0.34	9/10/1993	8/8/2018	38.717222	-121.3575
94	3410031-003	FE	TRUE	0.048	62	0.326	increasing	950	1.98	4/14/1989	8/30/2018	38.7	-121.383333
221	3410031-004	FE	FALSE	0.052	68	0.294	no trend	1188.7	1.94	10/29/1987	8/14/2018	38.718056	-121.382222
61	3410031-005	FE	FALSE	0.241	-16	-0.291	no trend	164	-1.17	2/26/1992	8/5/2015	38.716667	-121.4
160	3410031-006	FE	FALSE	0.781	-6	-0.066	no trend	324	-0.28	11/2/1988	8/14/2018	38.708333	-121.383611
2073	3410031-007	FE	FALSE	0.458	19	0.14	no trend	588.3	0.74	11/2/1988	8/9/2018	38.733333	-121.35
2056	3410031-008	FE	FALSE	0.404	13	0.197	no trend	207	0.83	10/7/1992	8/9/2018	38.733333	-121.35
208	3410031-009	FE	FALSE	0.62	7	0.127	no trend	146.3	0.5	1/15/1992	8/7/2018	38.715278	-121.378056
72	3410031-010	FE	TRUE	0.026	28	0.509	increasing	147.3	2.22	8/29/1995	8/21/2018	38.705	-121.365556
289	3410031-011	FE	FALSE	0.082	141	0.172	no trend	6493	1.74	6/21/1990	8/7/2018	38.726944	-121.3825
135	3410031-012	FE	FALSE	0.783	6	0.066	no trend	330	0.28	6/12/1992	8/7/2018	38.721111	-121.368611
45	3410031-013	FE	FALSE	0.31	19	0.209	no trend	315	1.01	11/2/1988	8/14/2018	38.711667	-121.413889
54	3410031-014	FE	FALSE	0.115	23	0.348	no trend	195	1.58	4/15/1987	8/14/2018	38.716111	-121.408889
95	3410031-015	FE	FALSE	0.089	6	1	no trend	8.7	1.7	2/11/1993	8/14/2018	38.716667	-121.416667
241	3410031-016	FE	FALSE	1	1	0.022	no trend	106.3	0	7/16/1996	8/8/2018	38.724444	-121.336111
80	3410031-017	FE	FALSE	0.1	16	0.444	no trend	83.3	1.64	4/30/1998	8/8/2018	38.723056	-121.349722
257	3410031-018	FE	TRUE	0.026	28	0.509	increasing	147.3	2.22	1/9/1996	8/7/2018	38.716389	-121.371944
288	3410045-001	FE	FALSE	0.95	2	0.026	no trend	250	0.06	11/3/1988	8/7/2018	38.586137	-121.411513
138	3410045-002	FE	FALSE	0.344	11	0.244	no trend	111.7	0.95	2/25/1992	8/7/2018	38.583085	-121.413054
116	3410045-003	FE	FALSE	1	-1	-0.018	no trend	158.3	0	2/25/1992	8/7/2018	38.594423	-121.417465
243	3410045-004	FE	FALSE	0.53	-16	-0.118	no trend	570.7	-0.63	4/20/1987	7/12/2012	38.592566	-121.407256
96	3410045-005	FE	FALSE	0.943	2	0.03	no trend	194	0.07	11/2/1988	8/7/2018	38.600025	-121.410183
2907	5105004-001	FE	FALSE	0.902	2	0.071	no trend	65.3	0.12	11/29/2000	10/16/2013	38.777769	-121.52437
1859	USGS-383746121291101	FE	FALSE	0.064	-21	-0.467	no trend	116.3	-1.85	8/4/1998	9/4/2012	38.6292139	-121.4877028
1860	USGS-384145121184101	FE	FALSE	0.178	-16	-0.356	no trend	124	-1.35	8/17/1998	9/4/2012	38.6964	-121.3120389
1868	USGS-384330121293901	FE	FALSE	0.917	2	0.056	no trend	92	0.1	8/11/1997	8/16/2012	38.7251167	-121.4954417
2806	USGS-384413121163801	FE	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	9/24/1982	3/10/2014	38.7369444	-121.2772222

Manganese

Local_ID	Well_Info_ID	chemical	h	p	s	tau	trend	var_s	z	datemin	datemax	Latitude_NAD83	Longitude_NAD83
2083	11N06E17D001M	MN	FALSE	1	0	0	no trend	1625.3	0	5/5/2004	3/26/2008	38.8064	-121.3353
2081	11N06E17D002M	MN	FALSE	1	0	0	no trend	15158	0	5/6/2004	3/26/2008	38.8027	-121.3384
2080	11N06E17D003M	MN	FALSE	1	0	0	no trend	817	0	5/5/2004	3/26/2008	38.8059	-121.3358
2082	11N06E17E001M	MN	FALSE	1	0	0	no trend	1625.3	0	5/5/2004	3/26/2008	38.8058	-121.3354
2059	3100538-001	MN	FALSE	0.613	3	0.3	no trend	15.7	0.51	8/19/1999	3/23/2018	38.7505	-121.321972
2060	3104508-001	MN	FALSE	1	1	0.1	no trend	13	0	2/19/2004	4/20/2017	38.729952	-121.321616
2071	3110008-006	MN	FALSE	0.652	3	0.2	no trend	19.7	0.45	10/31/1995	8/25/2016	38.736633	-121.277875
2066	3110008-007	MN	FALSE	0.613	-3	-0.3	no trend	15.7	-0.51	10/31/1995	8/25/2016	38.726493	-121.258205
2050	3110008-008	MN	FALSE	0.411	-5	-0.333	no trend	23.7	-0.82	10/22/2002	8/23/2018	38.805938	-121.33588
2064	3110025-005	MN	FALSE	0.516	-15	-0.11	no trend	464.3	-0.65	7/26/1989	9/12/2019	38.818889	-121.31
2063	3110040-001	MN	TRUE	0.029	-28	-0.509	decreasing	152.7	-2.19	9/27/1988	7/9/2002	38.75	-121.34722
2067	3110040-002	MN	FALSE	0.078	-17	-0.472	no trend	82.3	-1.76	8/31/1989	7/9/2002	38.75	-121.34444
2054	3110048-001	MN	FALSE	0.734	2	0.333	no trend	8.7	0.34	2/5/2003	4/9/2018	38.983062	-121.375659
2058	3110048-002	MN	FALSE	0.734	2	0.333	no trend	8.7	0.34	2/5/2003	4/9/2018	38.980075	-121.369185
145	3400173-002	MN	FALSE	1	-1	-0.167	no trend	7.7	0	5/24/2001	2/14/2017	38.640638	-121.483861
272	3400191-001	MN	FALSE	1	0	0	no trend	8.7	0	8/17/2001	3/23/2018	38.65525	-121.379888
193	3410001-001	MN	FALSE	0.482	-10	-0.182	no trend	164	-0.7	4/14/1987	9/5/2017	38.606839	-121.3982
242	3410001-002	MN	FALSE	0.436	-11	-0.2	no trend	165	-0.78	4/14/1987	10/18/2017	38.59783	-121.398024
258	3410001-004	MN	FALSE	0.377	-8	-0.222	no trend	62.7	-0.88	10/31/1988	6/19/2014	38.611483	-121.410107
284	3410001-005	MN	FALSE	0.352	-8	-0.286	no trend	56.7	-0.93	10/31/1988	6/8/2011	38.623478	-121.396638
203	3410001-007	MN	FALSE	0.669	-6	-0.109	no trend	136.7	-0.43	7/24/1989	9/27/2017	38.610999	-121.363391
128	3410001-009	MN	FALSE	1	0	0	no trend	8.7	0	4/14/1987	3/3/2005	38.616331	-121.403703
212	3410001-010	MN	FALSE	0.374	-13	-0.197	no trend	182.3	-0.89	4/14/1987	9/12/2017	38.608099	-121.408153
158	3410001-011	MN	FALSE	0.263	-12	-0.267	no trend	96.7	-1.12	10/31/1988	9/14/2017	38.619863	-121.396184
228	3410001-012	MN	FALSE	0.886	-3	-0.045	no trend	195	-0.14	5/7/1987	12/12/2017	38.617662	-121.403695
82	3410001-013	MN	FALSE	0.564	-7	-0.156	no trend	108.3	-0.58	7/25/1989	9/26/2017	38.598939	-121.370714
146	3410001-014	MN	FALSE	0.396	-6	-0.286	no trend	34.7	-0.85	11/1/1988	9/14/2006	38.61171	-121.386048
260	3410001-015	MN	FALSE	0.391	-11	-0.2	no trend	135.7	-0.86	11/1/1988	9/19/2017	38.59781	-121.381308
191	3410001-016	MN	FALSE	1	-1	-0.028	no trend	47.7	0	11/1/1988	9/4/2014	38.631327	-121.37485
124	3410001-017	MN	FALSE	0.316	-9	-0.25	no trend	63.7	-1	7/24/1989	8/27/2014	38.61981	-121.403732
211	3410001-018	MN	FALSE	0.436	8	0.178	no trend	80.7	0.78	11/1/1988	9/19/2017	38.623854	-121.374359
209	3410001-019	MN	FALSE	0.578	6	0.133	no trend	80.7	0.56	11/1/1988	9/25/2017	38.597831	-121.359623
114	3410001-020	MN	FALSE	1	1	0.028	no trend	47.7	0	1/27/1992	9/19/2017	38.618079	-121.359205
210	3410001-021	MN	FALSE	1	1	0.018	no trend	119.7	0	4/14/1987	9/12/2017	38.615256	-121.419986
161	3410001-022	MN	FALSE	0.436	8	0.178	no trend	80.7	0.78	10/31/1988	9/11/2017	38.604549	-121.42274
64	3410001-024	MN	FALSE	1	-1	-0.167	no trend	7.7	0	7/24/1989	2/19/2001	38.641255	-121.370271
222	3410001-025	MN	FALSE	1	1	0.022	no trend	95.7	0	4/13/1987	9/19/2017	38.60046	-121.359118
148	3410001-026	MN	FALSE	0.848	2	0.133	no trend	27.3	0.19	10/31/1988	2/23/2005	38.627091	-121.384097
113	3410001-027	MN	FALSE	0.817	-3	-0.083	no trend	74.3	-0.23	1/30/1992	9/27/2017	38.605146	-121.390988
244	3410001-028	MN	TRUE	0.021	-25	-0.556	decreasing	108.3	-2.31	7/24/1989	8/21/2014	38.63562	-121.381097
227	3410001-029	MN	FALSE	0.474	-6	-0.214	no trend	48.7	-0.72	1/30/1992	10/3/2017	38.630252	-121.397575
236	3410001-030	MN	FALSE	1	0	0	no trend	75.3	0	7/21/1989	9/26/2017	38.617802	-121.424022
81	3410001-032	MN	FALSE	0.321	-13	-0.236	no trend	146.3	-0.99	10/31/1988	9/19/2017	38.622918	-121.413817
104	3410001-033	MN	FALSE	1	-1	-0.048	no trend	27.7	0	7/21/1989	7/10/2014	38.601378	-121.424
173	3410001-034	MN	FALSE	0.873	3	0.055	no trend	156.3	0.16	5/7/1987	9/11/2017	38.584674	-121.396539
169	3410001-035	MN	FALSE	0.436	8	0.178	no trend	80.7	0.78	7/9/1990	9/28/2017	38.594464	-121.351844
25	3410001-037	MN	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	4/13/1987	2/5/1998	38.578611	-121.366667
19	3410001-038	MN	FALSE	0.084	-24	-0.308	no trend	176.7	-1.73	7/25/1989	6/9/2011	38.578371	-121.363395
20	3410001-039	MN	FALSE	1	-1	-0.067	no trend	19.7	0	10/31/1988	9/18/2006	38.591742	-121.346413
168	3410001-042	MN	FALSE	0.436	8	0.178	no trend	80.7	0.78	11/1/1988	9/12/2017	38.628014	-121.358648
184	3410001-051	MN	FALSE	1	1	0.018	no trend	119.7	0	4/13/1987	9/11/2017	38.636187	-121.375067
111	3410001-052	MN	FALSE	1	1	0.022	no trend	95.7	0	4/13/1987	9/11/2017	38.625054	-121.362252
287	3410001-054	MN	TRUE	0.002	-196	-0.395	decreasing	3794	-3.17	2/11/1991	8/8/2019	38.582422	-121.408379
122	3410001-055	MN	FALSE	0.324	-10	-0.278	no trend	83.3	-0.99	11/1/1988	12/13/2017	38.594474	-121.39864
26	3410001-056	MN	FALSE	0.443	-8	-0.222	no trend	83.3	-0.77	11/1/1988	9/13/2017	38.578749	-121.41096
3	3410001-061	MN	FALSE	0.937	2	0.036	no trend	161.3	0.08	5/7/1998	9/26/2017	38.582786	-121.338489
176	3410001-062	MN	FALSE	0.211	6	0.286	no trend	16	1.25	8/22/2000	9/5/2017	38.618056	-121.401944
12	3410001-064	MN	FALSE	0.211	6	0.286	no trend	16	1.25	4/23/2002	9/12/2017	38.584121	-121.353432
13	3410001-065	MN	FALSE	0.61	-4	-0.19	no trend	34.7	-0.51	4/22/2002	9/21/2017	38.583196	-121.33679
4	3410001-066	MN	FALSE	0.211	6	0.286	no trend	16	1.25	4/23/2002	9/12/2017	38.582214	-121.338203
2	3410001-067	MN	FALSE	0.685	10	0.083	no trend	493.3	0.41	6/3/1999	1/8/2015	38.582481	-121.417169
225	3410001-069	MN	FALSE	0.089	-37	-0.308	no trend	449	-1.7	7/27/1989	9/28/2017	38.580609	-121.384004
255	3410001-070	MN	FALSE	1	1	0.022	no trend	59.7	0	2/12/1991	9/12/2017	38.576006	-121.403088
205	3410001-071	MN	FALSE	0.979	5	0.003	no trend	22174	0.03	4/17/2002	9/12/2019	38.63056	-121.397787
106	3410001-072	MN	FALSE	0.123	17	0.111	no trend	107.7	1.54	4/17/2002	9/12/2017	38.61744	-121.411527
252	3410001-073	MN	FALSE	0.975	2	0.01	no trend	1031.3	0.03	4/17/2002	7/25/2019	38.58058	-121.383962
58	3410001-076	MN	FALSE	0.927	2	0.036	no trend	120.7	0.09	6/5/1984	7/10/2019	38.644265	-121.362069
69	3410001-077	MN	FALSE	1	1	0.013	no trend	175.7	0	3/7/1984	7/10/2019	38.631522	-121.352911
86	3410001-078	MN	FALSE	0.747	-6	-0.066	no trend	240.7	-0.32	6/5/1984	7/9/2019	38.684818	-121.355931
259	3410001-079	MN	TRUE	0.042	-17	-0.607	decreasing	61.7	-2.04	6/4/1984	7/24/2013	38.667577	-121.334161
110	3410001-080	MN	FALSE	0.974	2	0.01	no trend	930.7	0.03	6/4/1984	7/17/2019	38.672567	-121.331573
174	3410001-081	MN	FALSE	1	-1	-0.013	no trend	224.3	0	6/5/1984	7/22/2019	38.683333	-121.333333
71	3410001-082	MN	TRUE	0.006	-48	-0.527	decreasing	289.3	-2.76	6/4/1984	7/21/2016	38.648929	-121.338368
246	3410001-083	MN	FALSE	0.934	2	0.03	no trend	147.3	0.08	5/17/1984	7/9/2019	38.663692	-121.347786

239	3410001-085	MN	FALSE	0.464	-13	-0.143	no trend	268.3	-0.73	6/4/1984	7/17/2019	38.644208	-121.329841
49	3410001-087	MN	FALSE	0.94	2	0.026	no trend	176.7	0.08	6/5/1984	7/11/2019	38.645858	-121.392317
218	3410001-088	MN	FALSE	1	-1	-0.022	no trend	95.7	0	5/17/1984	6/4/2014	38.668746	-121.361
89	3410001-089	MN	FALSE	0.385	-15	-0.165	no trend	259.7	-0.87	3/7/1984	7/9/2019	38.653579	-121.379692
132	3410001-092	MN	TRUE	0.039	-324	-0.183	decreasing	24491	-2.06	6/4/1984	7/24/2018	38.63889	-121.342759
185	3410001-094	MN	FALSE	0.94	2	0.026	no trend	176.7	0.08	5/17/1984	7/10/2019	38.652299	-121.354305
196	3410001-095	MN	FALSE	1	1	0.048	no trend	44.3	0	5/17/1984	6/21/2007	38.658062	-121.356402
297	3410001-096	MN	FALSE	0.671	-7	-0.09	no trend	199.7	-0.42	6/30/1988	7/9/2019	38.689669	-121.360198
102	3410001-097	MN	FALSE	0.404	11	0.141	no trend	143.7	0.83	12/13/1984	7/11/2019	38.694158	-121.360024
256	3410001-098	MN	FALSE	0.651	-10	-0.095	no trend	396	-0.45	5/9/1984	7/9/2019	38.700217	-121.351805
295	3410001-099	MN	FALSE	0.462	-4	-0.4	no trend	16.7	-0.73	10/20/1988	6/21/2007	38.655401	-121.313482
46	3410001-101	MN	FALSE	0.219	-21	-0.269	no trend	265	-1.23	10/27/1988	7/7/2016	38.663926	-121.32579
231	3410001-102	MN	TRUE	0.01	-38	-0.576	decreasing	204	-2.59	10/20/1988	7/15/2019	38.675049	-121.315501
101	3410001-103	MN	FALSE	0.875	2	0.095	no trend	40.7	0.16	10/25/1988	1/13/2014	38.651225	-121.32298
163	3410001-104	MN	FALSE	0.423	9	0.164	no trend	99.7	0.8	2/26/1991	7/10/2019	38.710442	-121.331662
180	3410001-105	MN	FALSE	0.505	23	0.11	no trend	1087	0.67	10/12/1995	7/10/2019	38.710528	-121.331667
262	3410001-106	MN	FALSE	1	0	0	no trend	16.7	0	6/28/2001	6/4/2014	38.710517	-121.331659
85	3410001-107	MN	FALSE	1	0	0	no trend	44.3	0	11/4/1996	7/14/2016	38.709903	-121.357066
127	3410001-111	MN	FALSE	1	1	0.028	no trend	47.7	0	12/13/1995	7/11/2019	38.665363	-121.383099
254	3410001-127	MN	FALSE	0.314	-6	-0.4	no trend	24.7	-1.01	12/13/1995	7/29/2013	38.712268	-121.381099
283	3410001-128	MN	FALSE	0.289	-4	-0.4	no trend	8	-1.06	12/13/1995	6/17/2010	38.709783	-121.374669
149	3410001-129	MN	FALSE	0.242	-5	-0.333	no trend	11.7	-1.17	12/13/1995	7/29/2013	38.710651	-121.387666
118	3410001-133	MN	FALSE	1	0	0	no trend	96.7	0	7/9/1990	7/22/2019	38.682932	-121.376063
182	3410001-135	MN	FALSE	0.694	13	0.062	no trend	931.7	0.39	11/1/1988	3/13/2018	38.68794	-121.385107
99	3410001-136	MN	FALSE	0.486	16	0.133	no trend	464	0.7	5/7/1987	3/27/2018	38.685899	-121.372701
141	3410001-137	MN	FALSE	1	-1	-0.036	no trend	37	0	11/1/1988	6/30/2014	38.692847	-121.375953
183	3410001-139	MN	FALSE	0.397	-11	-0.2	no trend	139.7	-0.85	5/17/1984	7/19/2016	38.69191	-121.364477
280	3410001-142	MN	FALSE	1	-1	-0.028	no trend	47.7	0	7/20/1989	7/11/2016	38.686782	-121.392424
267	3410001-143	MN	FALSE	0.47	-3	-0.5	no trend	7.7	-0.72	4/13/1987	2/4/1998	38.701228	-121.371968
197	3410001-144	MN	FALSE	0.805	4	0.073	no trend	147.3	0.25	4/13/1987	7/23/2019	38.69798	-121.373877
213	3410001-145	MN	FALSE	0.242	5	0.333	no trend	11.7	1.17	4/22/2002	7/10/2019	38.67526	-121.379573
315	3410002-001	MN	FALSE	0.606	7	0.127	no trend	135.7	0.52	2/20/1991	2/8/2017	38.583333	-121.383333
117	3410002-002	MN	FALSE	0.926	-2	-0.044	no trend	115.3	-0.09	7/17/1990	2/8/2017	38.583333	-121.366667
28	3410002-007	MN	FALSE	0.711	-5	-0.111	no trend	116.3	-0.37	8/2/1989	2/14/2017	38.566667	-121.4
10	3410002-012	MN	FALSE	0.834	3	0.083	no trend	91	0.21	8/2/1989	5/8/2017	38.566667	-121.416667
17	3410002-013	MN	FALSE	0.941	2	0.03	no trend	183.3	0.07	7/17/1990	2/14/2017	38.583333	-121.416667
249	3410002-014	MN	FALSE	0.913	-2	-0.056	no trend	83.3	-0.11	7/17/1990	5/8/2017	38.583333	-121.366667
152	3410003-001	MN	FALSE	0.103	30	0.33	no trend	316	1.63	7/20/1989	2/6/2019	38.587545	-121.385145
153	3410003-002	MN	FALSE	0.056	32	0.41	no trend	264	1.91	4/11/1986	2/28/2017	38.582537	-121.383219
245	3410003-004	MN	FALSE	1	1	0.048	no trend	44.3	0	7/20/1989	1/25/2005	38.587611	-121.392074
162	3410003-005	MN	FALSE	0.126	23	0.348	no trend	207	1.53	4/2/1987	7/11/2017	38.591017	-121.384139
251	3410003-006	MN	TRUE	0.04	27	0.491	increasing	160.3	2.05	4/2/1987	2/28/2017	38.59211	-121.387633
238	3410003-008	MN	FALSE	0.346	20	0.19	no trend	407.3	0.94	4/2/1987	2/28/2017	38.600074	-121.391973
74	3410004-001	MN	TRUE	0.036	-24	-0.436	decreasing	120.7	-2.09	10/24/1995	2/3/2004	38.645432	-121.313067
83	3410004-004	MN	FALSE	0.424	17	0.162	no trend	399.7	0.8	2/19/1991	1/28/2010	38.64988	-121.30798
175	3410004-005	MN	FALSE	0.754	4	0.111	no trend	92	0.31	11/9/1988	10/4/2001	38.633333	-121.35
172	3410004-006	MN	TRUE	0	-152	-0.551	decreasing	1596	-3.78	5/8/1987	6/1/2017	38.622744	-121.335704
6	3410004-007	MN	FALSE	0.155	-10	-0.182	no trend	40	-1.42	8/1/1990	10/23/2002	38.594673	-121.334606
150	3410004-009	MN	FALSE	0.912	4	0.016	no trend	734.7	0.11	2/19/1991	6/1/2017	38.619652	-121.333354
261	3410004-016	MN	FALSE	0.298	45	0.15	no trend	1787	1.04	5/8/1987	6/1/2017	38.645576	-121.306819
248	3410004-020	MN	FALSE	0.207	24	0.264	no trend	332.7	1.26	4/25/2002	6/1/2017	38.641845	-121.315446
139	3410004-021	MN	FALSE	1	-1	-0.015	no trend	87.7	0	4/23/2002	6/1/2017	38.604804	-121.342252
290	3410006-001	MN	FALSE	0.213	17	0.309	no trend	165	1.25	7/19/1989	5/30/2019	38.661305	-121.292607
207	3410006-007	MN	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	7/19/1989	1/21/1998	38.705556	-121.308333
198	3410006-008	MN	FALSE	1	-1	-0.048	no trend	27.7	0	12/6/1990	2/20/2013	38.679425	-121.289154
98	3410006-010	MN	FALSE	1	0	0	no trend	8.7	0	10/21/2004	6/6/2018	38.698638	-121.269673
130	3410007-001	MN	FALSE	0.707	-3	-0.2	no trend	28.3	-0.38	4/10/1992	6/24/2010	38.613787	-121.367811
229	3410007-002	MN	FALSE	0.084	-16	-0.444	no trend	75.3	-1.73	11/7/1988	8/7/2019	38.613607	-121.371676
216	3410007-003	MN	FALSE	0.711	-4	-0.143	no trend	65.3	-0.37	7/19/1989	8/22/2016	38.606352	-121.369707
269	3410007-004	MN	FALSE	1	-1	-0.028	no trend	47.7	0	7/19/1989	8/6/2019	38.607768	-121.374083
77	3410007-005	MN	FALSE	0.205	12	0.333	no trend	75.3	1.27	11/7/1988	8/6/2019	38.61458	-121.378552
142	3410007-006	MN	FALSE	0.537	-10	-0.152	no trend	212.7	-0.62	7/19/1989	1/20/2012	38.60731	-121.364767
195	3410007-007	MN	FALSE	0.084	-16	-0.444	no trend	75.3	-1.73	7/19/1989	8/6/2019	38.606531	-121.380719
253	3410007-008	MN	FALSE	1	1	0.048	no trend	27.7	0	1/26/1993	8/13/2019	38.613172	-121.380739
166	3410009-001	MN	FALSE	1	-1	-0.1	no trend	13	0	2/28/1991	6/16/2004	38.643048	-121.268528
100	3410009-003	MN	FALSE	1	-1	-0.167	no trend	7.7	0	11/9/1988	2/8/2000	38.666667	-121.216667
105	3410009-004	MN	FALSE	1	-1	-0.036	no trend	37	0	8/2/1990	6/6/2006	38.651282	-121.255173
78	3410009-005	MN	FALSE	1	-1	-0.067	no trend	19.7	0	11/9/1988	6/16/2004	38.650805	-121.286999
201	3410009-006	MN	FALSE	1	-1	-0.018	no trend	73	0	7/19/1989	6/14/2012	38.642768	-121.278261
234	3410009-007	MN	FALSE	0.175	-8	-0.222	no trend	26.7	-1.36	7/19/1989	6/14/2012	38.651297	-121.296666
217	3410009-008	MN	FALSE	0.548	5	0.238	no trend	44.3	0.6	8/16/1990	6/6/2006	38.662066	-121.265396
164	3410009-010	MN	FALSE	0.611	6	0.133	no trend	96.7	0.51	11/7/1991	6/14/2012	38.659628	-121.25556
93	3410013-001	MN	FALSE	0.889	3	0.045	no trend	204.3	0.14	10/7/1992	8/13/2018	38.694922	-121.332628
159	3410013-002	MN	FALSE	0.816	-16	-0.03	no trend	4163.3	-0.23	2/18/1992	8/6/2019	38.69054	-121.34151
51	3410013-003	MN	FALSE	0.408	11	0.2	no trend	146.3	0.83	11/2/1988	8/16/2018	38.683982	-121.31348

240	3410013-004	MN	FALSE	1	1	0.01	no trend	361	0	4/15/1987	8/7/2018	38.699328	-121.295627
178	3410013-005	MN	FALSE	1	1	0.011	no trend	302.3	0	4/15/1987	8/7/2018	38.669042	-121.293798
63	3410013-006	MN	FALSE	1	-1	-0.015	no trend	211.7	0	2/11/1992	8/8/2018	38.685052	-121.305855
156	3410013-007	MN	FALSE	0.508	7	0.194	no trend	82.3	0.66	4/15/1987	8/19/2015	38.691478	-121.336784
270	3410013-008	MN	FALSE	0.07	29	0.372	no trend	238.3	1.81	11/2/1988	8/16/2018	38.673506	-121.340002
224	3410013-009	MN	FALSE	0.72	6	0.091	no trend	194	0.36	4/15/1987	8/7/2018	38.695662	-121.29509
92	3410013-010	MN	FALSE	0.064	58	0.305	no trend	948	1.85	4/14/1989	8/15/2018	38.670117	-121.341406
237	3410013-012	MN	FALSE	0.503	13	0.143	no trend	320.3	0.67	7/2/1990	8/13/2018	38.66565	-121.302524
223	3410013-013	MN	FALSE	0.683	-10	-0.083	no trend	484.7	-0.41	4/15/1987	8/13/2018	38.678824	-121.304628
144	3410013-014	MN	FALSE	0.72	6	0.091	no trend	194	0.36	11/2/1988	8/8/2018	38.668822	-121.304482
112	3410013-015	MN	FALSE	1	1	0.015	no trend	201	0	2/18/1992	8/6/2018	38.70124	-121.345319
233	3410013-016	MN	FALSE	0.699	6	0.091	no trend	167.3	0.39	2/11/1993	8/13/2018	38.709473	-121.292244
265	3410013-017	MN	FALSE	0.61	-4	-0.19	no trend	34.7	-0.51	2/11/1992	8/24/2006	38.712243	-121.303547
247	3410013-019	MN	FALSE	1	1	0.011	no trend	302.3	0	4/15/1987	8/6/2018	38.700287	-121.330955
226	3410013-020	MN	FALSE	1	-1	-0.036	no trend	55.7	0	11/2/1988	8/24/2006	38.716217	-121.294262
88	3410013-021	MN	FALSE	0.698	7	0.09	no trend	238.3	0.39	11/2/1988	8/8/2018	38.683333	-121.35
232	3410013-022	MN	FALSE	0.726	4	0.111	no trend	73.3	0.35	2/18/1992	9/11/2012	38.7124	-121.306829
189	3410013-023	MN	FALSE	0.298	-20	-0.22	no trend	332.7	-1.04	7/28/1989	8/7/2018	38.695536	-121.313454
66	3410013-024	MN	FALSE	0.833	-4	-0.061	no trend	202	-0.21	2/11/1992	8/7/2018	38.680539	-121.31067
220	3410013-025	MN	FALSE	0.363	-25	-0.163	no trend	697	-0.91	8/15/1989	8/13/2018	38.718426	-121.313299
188	3410013-026	MN	FALSE	1	1	0.011	no trend	302.3	0	4/15/1987	8/6/2018	38.701667	-121.344722
119	3410013-027	MN	FALSE	0.699	6	0.091	no trend	167.3	0.39	2/18/1992	9/18/2012	38.709413	-121.317252
165	3410013-028	MN	FALSE	1	-1	-0.036	no trend	64.3	0	4/21/1997	8/13/2018	38.698857	-121.32618
125	3410016-001	MN	FALSE	1	-1	-0.167	no trend	7.7	0	8/2/1990	12/21/2004	38.686538	-121.219546
147	3410016-002	MN	FALSE	0.289	-4	-0.4	no trend	8	-1.06	4/18/1991	1/17/2013	38.694541	-121.210813
126	3410018-005	MN	FALSE	0.26	7	0.467	no trend	28.3	1.13	7/28/1989	3/5/2002	38.721801	-121.46774
24	3410020-015	MN	FALSE	0.203	-11	-0.393	no trend	61.7	-1.27	1/17/1992	4/3/2017	38.6125	-121.479167
11	3410020-016	MN	FALSE	1	0	0	no trend	56.7	0	1/17/1992	1/20/2015	38.616667	-121.479167
293	3410020-017	MN	FALSE	0.203	17	0.309	no trend	157.7	1.27	11/18/1988	8/24/2017	38.62266	-121.477813
84	3410020-018	MN	FALSE	0.36	-10	-0.222	no trend	96.7	-0.92	1/17/1992	5/8/2017	38.627831	-121.477227
292	3410020-021	MN	FALSE	1	1	0.067	no trend	28.3	0	1/21/1992	10/12/2011	38.607083	-121.454779
97	3410020-022	MN	FALSE	0.788	-4	-0.089	no trend	124	-0.27	11/18/1988	3/20/2017	38.607305	-121.443097
136	3410020-023	MN	FALSE	1	1	0.036	no trend	64.3	0	1/21/1992	3/7/2017	38.604956	-121.439486
314	3410020-024	MN	FALSE	0.78	4	0.089	no trend	115.3	0.28	11/18/1988	10/10/2011	38.612801	-121.450505
129	3410020-025	MN	FALSE	0.613	-3	-0.3	no trend	15.7	-0.51	1/21/1992	10/9/2008	38.612294	-121.440456
215	3410020-027	MN	FALSE	1	0	0	no trend	96.7	0	1/22/1992	5/8/2017	38.620988	-121.443553
279	3410020-028	MN	FALSE	0.206	18	0.273	no trend	180.7	1.26	11/18/1988	5/8/2017	38.62044	-121.432285
108	3410020-029	MN	FALSE	1	-1	-0.028	no trend	91	0	1/17/1992	3/20/2017	38.618056	-121.468056
107	3410020-030	MN	FALSE	0.629	-6	-0.133	no trend	107.3	-0.48	1/17/1992	5/8/2017	38.625119	-121.462605
59	3410020-032	MN	FALSE	0.211	-26	-0.217	no trend	399.3	-1.25	1/16/1991	8/24/2017	38.628503	-121.43627
55	3410020-033	MN	FALSE	0.073	17	0.472	no trend	79.7	1.79	11/16/1988	10/10/2011	38.626808	-121.42959
171	3410020-034	MN	FALSE	1	1	0.018	no trend	143.7	0	1/16/1991	2/27/2018	38.638412	-121.446721
73	3410020-035	MN	FALSE	1	1	0.018	no trend	143.7	0	1/16/1991	2/27/2018	38.639934	-121.427293
133	3410020-037	MN	FALSE	0.629	7	0.127	no trend	154.3	0.48	1/16/1991	5/8/2017	38.651207	-121.469509
264	3410020-038	MN	FALSE	0.144	17	0.309	no trend	119.7	1.46	1/16/1991	5/8/2017	38.647475	-121.459256
50	3410020-039	MN	FALSE	1	-1	-0.1	no trend	15.7	0	1/22/1992	10/8/2003	38.627595	-121.432917
56	3410020-040	MN	FALSE	0.492	9	0.164	no trend	135.7	0.69	10/22/1990	5/9/2017	38.629597	-121.420726
278	3410020-041	MN	FALSE	1	1	0.015	no trend	179.7	0	1/16/1991	5/9/2017	38.641387	-121.435795
22	3410020-042	MN	FALSE	0.659	-5	-0.139	no trend	82.3	-0.44	1/21/1992	3/7/2017	38.596923	-121.458973
294	3410020-044	MN	FALSE	0.521	6	0.214	no trend	60.7	0.64	10/16/1990	10/10/2011	38.613996	-121.456155
194	3410020-045	MN	FALSE	0.492	9	0.164	no trend	135.7	0.69	10/19/1990	5/9/2017	38.622276	-121.446858
134	3410020-046	MN	FALSE	0.659	-5	-0.139	no trend	82.3	-0.44	1/22/1992	9/22/2014	38.623116	-121.427024
157	3410020-050	MN	FALSE	0.145	17	0.378	no trend	120.3	1.46	1/16/1991	3/25/2014	38.668053	-121.438012
42	3410020-051	MN	FALSE	0.203	17	0.309	no trend	157.7	1.27	1/16/1991	2/27/2018	38.634413	-121.412516
296	3410020-052	MN	FALSE	0.853	-3	-0.067	no trend	116.3	-0.19	3/8/1993	5/9/2017	38.599341	-121.445804
214	3410020-054	MN	FALSE	0.629	-6	-0.133	no trend	107.3	-0.48	1/21/1992	8/24/2017	38.596324	-121.427308
33	3410020-055	MN	FALSE	0.941	2	0.03	no trend	183.3	0.07	1/17/1992	5/9/2017	38.617636	-121.469304
91	3410020-056	MN	TRUE	0.002	-82	-0.39	decreasing	687.3	-3.09	1/12/1994	5/9/2017	38.654657	-121.448564
291	3410020-057	MN	TRUE	0.027	-31	-0.47	decreasing	184.3	-2.21	1/18/1995	12/19/2018	38.658482	-121.466415
30	3410026-001	MN	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	2/21/1991	5/31/2012	38.58961	-121.429343
7	3410026-002	MN	FALSE	0.289	-4	-0.4	no trend	8	-1.06	2/21/1991	5/3/2018	38.588266	-121.423478
31	3410026-003	MN	FALSE	0.289	-4	-0.4	no trend	8	-1.06	2/21/1991	5/3/2018	38.593617	-121.439154
18	3410026-004	MN	FALSE	1	1	0.1	no trend	15.7	0	2/21/1991	5/3/2018	38.593339	-121.432431
206	3410031-001	MN	FALSE	0.944	3	0.018	no trend	808.3	0.07	3/24/1988	5/16/2019	38.720833	-121.358333
190	3410031-002	MN	FALSE	0.731	5	0.091	no trend	135.7	0.34	9/10/1993	8/8/2018	38.717222	-121.3575
94	3410031-003	MN	FALSE	0.552	-13	-0.124	no trend	406.3	-0.6	4/14/1989	8/14/2018	38.7	-121.383333
221	3410031-004	MN	FALSE	0.071	65	0.281	no trend	1255.7	1.81	10/29/1987	8/14/2018	38.718056	-121.382222
61	3410031-005	MN	FALSE	1	-1	-0.018	no trend	154.3	0	2/26/1992	8/5/2015	38.716667	-121.4
160	3410031-006	MN	FALSE	1	1	0.011	no trend	302.3	0	11/2/1988	8/14/2018	38.708333	-121.383611
2073	3410031-007	MN	FALSE	0.225	-23	-0.253	no trend	329	-1.21	11/2/1988	8/9/2018	38.733333	-121.35
2056	3410031-008	MN	FALSE	0.72	6	0.091	no trend	194	0.36	10/7/1992	8/9/2018	38.733333	-121.35
208	3410031-009	MN	FALSE	0.408	11	0.2	no trend	146.3	0.83	1/15/1992	8/7/2018	38.715278	-121.378056
72	3410031-010	MN	FALSE	0.146	24	0.308	no trend	250	1.45	8/29/1995	8/8/2019	38.705	-121.365556
289	3410031-011	MN	FALSE	0.056	-215	-0.191	no trend	12534	-1.91	6/21/1990	3/4/2019	38.726944	-121.3825
135	3410031-012	MN	FALSE	1	0	0	no trend	407.3	0	6/12/1992	8/7/2018	38.721111	-121.368611

45	3410031-013	MN	FALSE	0.073	26	0.394	no trend	194	1.79	11/2/1988	8/14/2018	38.711667	-121.413889
54	3410031-014	MN	FALSE	0.72	6	0.091	no trend	194	0.36	4/15/1987	8/14/2018	38.716111	-121.408889
95	3410031-015	MN	FALSE	0.734	2	0.333	no trend	8.7	0.34	2/11/1993	8/14/2018	38.716667	-121.416667
241	3410031-016	MN	FALSE	0.772	4	0.089	no trend	107.3	0.29	7/16/1996	8/8/2018	38.724444	-121.336111
80	3410031-017	MN	FALSE	0.826	3	0.083	no trend	82.3	0.22	4/30/1998	8/8/2018	38.723056	-121.349722
257	3410031-018	MN	FALSE	0.059	23	0.418	no trend	135.7	1.89	1/9/1996	8/7/2018	38.716389	-121.371944
288	3410045-001	MN	FALSE	1	1	0.013	no trend	249	0	11/3/1988	8/7/2018	38.586137	-121.411513
138	3410045-002	MN	FALSE	0.262	13	0.289	no trend	114.3	1.12	2/25/1992	8/7/2018	38.583085	-121.413054
116	3410045-003	MN	FALSE	0.747	5	0.091	no trend	154.3	0.32	2/25/1992	8/7/2018	38.594423	-121.417465
243	3410045-004	MN	TRUE	0.022	93	0.337	increasing	1624.3	2.28	4/20/1987	8/11/2014	38.592566	-121.407256
96	3410045-005	MN	FALSE	0.72	6	0.091	no trend	194	0.36	11/2/1988	8/7/2018	38.600025	-121.410183
2907	5105004-001	MN	FALSE	0.386	-8	-0.286	no trend	65.3	-0.87	11/29/2000	10/16/2013	38.777769	-121.52437
1859	USGS-383746121291101	MN	FALSE	0.64	-7	-0.127	no trend	165	-0.47	8/4/1998	8/8/2017	38.6292139	-121.4877028
1855	USGS-383900121270001	MN	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	6/14/2005	6/15/2005	38.6585	-121.4664722
1860	USGS-384145121184101	MN	TRUE	0.049	-23	-0.511	decreasing	125	-1.97	8/17/1998	9/4/2012	38.6964	-121.3120389
1868	USGS-384330121293901	MN	FALSE	0.251	-12	-0.333	no trend	92	-1.15	8/11/1997	8/16/2012	38.7251167	-121.4954417
2806	USGS-384413121163801	MN	FALSE	0.734	2	0.333	no trend	8.7	0.34	9/24/1982	3/10/2014	38.7369444	-121.2772222

Hexavalent Chromium

Local_ID	Well_Info_ID	chemical	h	p	s	tau	trend	var_s	z	datemin	datemax	Latitude_NAD83	Longitude_NAD83
2064	3110025-005	CR6	FALSE	1	-1	-0.167	no trend	7.7	0	12/12/2001	8/21/2017	38.818889	-121.31
145	3400173-002	CR6	FALSE	1	0	0	no trend	16.7	0	7/26/2001	2/14/2017	38.640638	-121.483861
235	3400173-003	CR6	FALSE	0.089	-6	-1	no trend	8.7	-1.7	2/20/2002	2/15/2017	38.654819	-121.477561
167	3400173-005	CR6	FALSE	0.089	-6	-1	no trend	8.7	-1.7	7/26/2001	2/15/2017	38.646271	-121.502342
191	3410001-016	CR6	FALSE	0.462	-4	-0.4	no trend	16.7	-0.73	6/6/2002	4/14/2014	38.631327	-121.37485
114	3410001-020	CR6	FALSE	1	0	0	no trend	8.7	0	5/9/2002	4/14/2014	38.618079	-121.359205
244	3410001-028	CR6	FALSE	1	1	0.167	no trend	7.7	0	7/15/2002	2/11/2015	38.63562	-121.381097
86	3410001-078	CR6	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	7/19/2001	4/16/2014	38.684818	-121.355931
262	3410001-106	CR6	FALSE	0.707	-3	-0.2	no trend	28.3	-0.38	7/19/2001	2/19/2015	38.710517	-121.331659
254	3410001-127	CR6	FALSE	1	1	0.167	no trend	7.7	0	7/19/2001	11/11/2014	38.712268	-121.381099
149	3410001-129	CR6	FALSE	0.312	5	0.5	no trend	15.7	1.01	7/19/2001	2/26/2015	38.710651	-121.387666
99	3410001-136	CR6	FALSE	0.848	-2	-0.133	no trend	27.3	-0.19	7/18/2002	3/27/2018	38.685899	-121.372701
141	3410001-137	CR6	FALSE	0.613	-3	-0.3	no trend	15.7	-0.51	7/11/2002	2/19/2015	38.692847	-121.375953
315	3410002-001	CR6	FALSE	0.707	-3	-0.2	no trend	28.3	-0.38	3/20/2001	2/8/2017	38.583333	-121.383333
117	3410002-002	CR6	FALSE	0.452	-5	-0.333	no trend	28.3	-0.75	3/20/2001	2/8/2017	38.583333	-121.366667
28	3410002-007	CR6	FALSE	1	-1	-0.067	no trend	28.3	0	3/20/2001	2/14/2017	38.566667	-121.4
10	3410002-012	CR6	FALSE	0.579	-3	-0.3	no trend	13	-0.55	3/20/2001	11/14/2017	38.566667	-121.416667
17	3410002-013	CR6	FALSE	1	0	0	no trend	28.3	0	3/20/2001	2/14/2017	38.583333	-121.416667
249	3410002-014	CR6	FALSE	1	0	0	no trend	27.3	0	3/20/2001	11/14/2017	38.583333	-121.366667
74	3410004-001	CR6	FALSE	0.312	5	0.5	no trend	15.7	1.01	6/12/2001	1/29/2003	38.645432	-121.313067
83	3410004-004	CR6	FALSE	0.266	10	0.357	no trend	65.3	1.11	6/12/2001	7/23/2003	38.64988	-121.30798
172	3410004-006	CR6	FALSE	1	0	0	no trend	268.7	0	6/12/2001	6/4/2015	38.622744	-121.335704
6	3410004-007	CR6	FALSE	0.433	6	0.286	no trend	40.7	0.78	4/11/2001	10/23/2002	38.594673	-121.334606
150	3410004-009	CR6	FALSE	0.951	-2	-0.026	no trend	266.7	-0.06	6/12/2001	6/4/2015	38.619652	-121.333354
261	3410004-016	CR6	FALSE	1	1	0.022	no trend	120.3	0	6/12/2001	6/4/2015	38.645576	-121.306819
248	3410004-020	CR6	FALSE	0.902	2	0.071	no trend	65.3	0.12	4/25/2002	6/4/2015	38.641845	-121.315446
139	3410004-021	CR6	FALSE	0.272	-8	-0.381	no trend	40.7	-1.1	4/23/2002	6/4/2015	38.604804	-121.342252
229	3410007-002	CR6	FALSE	0.462	4	0.4	no trend	16.7	0.73	3/12/2002	8/13/2018	38.613607	-121.371676
216	3410007-003	CR6	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	6/13/2002	8/5/2015	38.606352	-121.369707
269	3410007-004	CR6	TRUE	0.027	10	1	increasing	16.7	2.2	3/12/2002	8/13/2018	38.607768	-121.374083
77	3410007-005	CR6	FALSE	0.462	4	0.4	no trend	16.7	0.73	3/12/2002	8/13/2018	38.61458	-121.378552
195	3410007-007	CR6	FALSE	0.707	3	0.2	no trend	28.3	0.38	3/12/2002	8/14/2018	38.606531	-121.380719
253	3410007-008	CR6	FALSE	1	0	0	no trend	8.7	0	3/12/2002	8/14/2018	38.613172	-121.380739
166	3410009-001	CR6	FALSE	1	0	0	no trend	8.7	0	6/27/2001	12/17/2003	38.643048	-121.268528
105	3410009-004	CR6	FALSE	1	0	0	no trend	8.7	0	6/27/2001	12/17/2003	38.651282	-121.255173
78	3410009-005	CR6	FALSE	0.371	-3	-0.5	no trend	5	-0.89	6/27/2001	12/17/2003	38.650805	-121.286999
201	3410009-006	CR6	FALSE	0.148	-11	-0.306	no trend	47.7	-1.45	6/27/2001	11/8/2018	38.642768	-121.278261
234	3410009-007	CR6	FALSE	1	0	0	no trend	92	0	6/27/2001	11/8/2018	38.651297	-121.296666
217	3410009-008	CR6	FALSE	1	0	0	no trend	8.7	0	6/27/2001	12/17/2003	38.662066	-121.265396
164	3410009-010	CR6	FALSE	0.544	-25	-0.077	no trend	1565	-0.61	6/27/2001	3/28/2019	38.659628	-121.25556
93	3410013-001	CR6	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	3/25/2002	5/17/2017	38.694922	-121.332628
159	3410013-002	CR6	FALSE	1	1	0.167	no trend	7.7	0	6/5/2002	5/17/2017	38.69054	-121.34151
51	3410013-003	CR6	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	6/5/2002	12/19/2017	38.683982	-121.31348
240	3410013-004	CR6	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	3/25/2002	5/9/2017	38.699328	-121.295627
178	3410013-005	CR6	FALSE	0.734	2	0.333	no trend	8.7	0.34	3/25/2002	5/9/2017	38.669042	-121.293798
63	3410013-006	CR6	FALSE	0.308	4	0.667	no trend	8.7	1.02	7/25/2002	5/9/2017	38.685052	-121.305855
156	3410013-007	CR6	FALSE	0.734	2	0.333	no trend	8.7	0.34	7/28/2003	5/9/2017	38.691478	-121.336784
270	3410013-008	CR6	FALSE	1	0	0	no trend	16.7	0	6/5/2002	9/19/2018	38.673506	-121.340002
224	3410013-009	CR6	FALSE	0.308	4	0.667	no trend	8.7	1.02	3/25/2002	5/9/2017	38.695662	-121.29509
92	3410013-010	CR6	FALSE	1	0	0	no trend	8.7	0	3/25/2002	5/10/2017	38.670117	-121.341406
237	3410013-012	CR6	FALSE	0.308	4	0.667	no trend	8.7	1.02	3/25/2002	5/8/2017	38.66565	-121.302524
223	3410013-013	CR6	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	3/25/2002	5/8/2017	38.678824	-121.304628
144	3410013-014	CR6	FALSE	0.221	6	0.6	no trend	16.7	1.22	6/5/2002	5/8/2017	38.668822	-121.304482
112	3410013-015	CR6	FALSE	0.734	2	0.333	no trend	8.7	0.34	3/25/2002	5/8/2017	38.70124	-121.345319
233	3410013-016	CR6	FALSE	0.308	4	0.667	no trend	8.7	1.02	3/25/2002	2/13/2018	38.709473	-121.292244
247	3410013-019	CR6	FALSE	0.089	-6	-1	no trend	8.7	-1.7	3/25/2002	10/19/2017	38.700287	-121.330955
189	3410013-023	CR6	FALSE	0.221	6	0.6	no trend	16.7	1.22	6/5/2002	5/8/2017	38.695536	-121.313454
188	3410013-026	CR6	FALSE	0.462	-4	-0.4	no trend	16.7	-0.73	3/25/2002	5/8/2017	38.701667	-121.344722
119	3410013-027	CR6	FALSE	1	0	0	no trend	8.7	0	3/25/2002	5/7/2014	38.709413	-121.317252
165	3410013-028	CR6	FALSE	1	0	0	no trend	8.7	0	6/5/2002	5/8/2017	38.698857	-121.32618
3103	3410018-016	CR6	FALSE	0.617	-8	-0.121	no trend	196	-0.5	1/28/2014	6/27/2019	38.67821521	-121.4400672
3104	3410018-017	CR6	FALSE	1	-1	-0.018	no trend	148.3	0	4/16/2014	6/27/2019	38.70652939	-121.4385374
3105	3410018-018	CR6	FALSE	0.221	-6	-0.6	no trend	16.7	-1.22	4/16/2014	3/13/2018	38.699946	-121.448704
3106	3410018-019	CR6	FALSE	0.331	-15	-0.227	no trend	207	-0.97	1/28/2014	6/27/2019	38.6908207	-121.4118831

3107	3410018-020	CR6	FALSE	0.221	-6	-0.6	no trend	16.7	-1.22	4/16/2014	3/14/2018	38.683913	-121.457232
3108	3410018-021	CR6	FALSE	0.65	6	0.133	no trend	121.3	0.45	4/16/2014	6/27/2019	38.67497323	-121.459362
3109	3410018-022	CR6	FALSE	1	0	0	no trend	124	0	1/28/2014	6/27/2019	38.68524743	-121.4196703
3110	3410018-023	CR6	FALSE	1	0	0	no trend	16.7	0	1/28/2014	3/14/2018	38.6887253	-121.4487616
3111	3410018-025	CR6	FALSE	0.346	-32	-0.152	no trend	1084	-0.94	5/2/2011	6/27/2019	38.697725	-121.39672
3101	3410018-031	CR6	FALSE	0.328	-17	-0.218	no trend	267.7	-0.98	4/16/2014	6/27/2019	38.69494633	-121.4521593
3102	3410018-033	CR6	FALSE	0.462	-4	-0.4	no trend	16.7	-0.73	4/16/2014	3/26/2019	38.683947	-121.462511
84	3410020-018	CR6	FALSE	0.755	-5	-0.091	no trend	165	-0.31	7/8/2002	7/10/2017	38.627831	-121.477227
171	3410020-034	CR6	FALSE	0.917	2	0.056	no trend	92	0.1	7/9/2002	7/10/2017	38.638412	-121.446721
73	3410020-035	CR6	FALSE	0.649	4	0.19	no trend	43.3	0.46	7/9/2002	7/10/2017	38.639934	-121.427293
133	3410020-037	CR6	FALSE	0.213	-17	-0.309	no trend	165	-1.25	7/8/2002	7/10/2017	38.651207	-121.469509
264	3410020-038	CR6	FALSE	0.276	15	0.273	no trend	165	1.09	7/10/2002	7/10/2017	38.647475	-121.459256
56	3410020-040	CR6	FALSE	1	-1	-0.028	no trend	91	0	7/9/2002	7/10/2017	38.629597	-121.420726
278	3410020-041	CR6	FALSE	0.876	-3	-0.055	no trend	165	-0.16	7/9/2002	7/10/2017	38.641387	-121.435795
157	3410020-050	CR6	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	7/10/2002	11/3/2015	38.668053	-121.438012
91	3410020-056	CR6	FALSE	0.902	-2	-0.071	no trend	65.3	-0.12	7/10/2002	7/10/2017	38.654657	-121.448564
291	3410020-057	CR6	FALSE	0.673	14	0.074	no trend	950	0.42	12/2/2002	7/10/2017	38.658482	-121.466415
206	3410031-001	CR6	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	3/25/2002	5/9/2017	38.720833	-121.358333
190	3410031-002	CR6	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	6/4/2002	5/8/2017	38.717222	-121.3575
94	3410031-003	CR6	FALSE	0.183	42	0.221	no trend	950	1.33	3/25/2002	8/6/2019	38.7	-121.383333
221	3410031-004	CR6	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	3/25/2002	8/17/2017	38.718056	-121.382222
61	3410031-005	CR6	FALSE	0.064	-46	-0.338	no trend	589.3	-1.85	3/25/2002	5/2/2018	38.716667	-121.4
160	3410031-006	CR6	FALSE	0.401	-25	-0.146	no trend	815	-0.84	3/25/2002	8/6/2019	38.708333	-121.383611
2073	3410031-007	CR6	FALSE	1	0	0	no trend	8.7	0	3/25/2002	5/11/2017	38.733333	-121.35
2056	3410031-008	CR6	FALSE	0.734	2	0.333	no trend	8.7	0.34	6/5/2002	5/11/2017	38.733333	-121.35
208	3410031-009	CR6	FALSE	1	0	0	no trend	8.7	0	6/4/2002	5/8/2017	38.715278	-121.378056
72	3410031-010	CR6	FALSE	1	0	0	no trend	8.7	0	6/4/2002	5/9/2017	38.705	-121.365556
289	3410031-011	CR6	FALSE	0.755	-5	-0.091	no trend	165	-0.31	6/4/2002	11/5/2018	38.726944	-121.3825
135	3410031-012	CR6	FALSE	0.732	6	0.091	no trend	212.7	0.34	6/4/2002	8/8/2019	38.721111	-121.368611
45	3410031-013	CR6	FALSE	0.089	-6	-1	no trend	8.7	-1.7	3/25/2002	5/8/2017	38.711667	-121.413889
54	3410031-014	CR6	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	6/4/2002	5/8/2017	38.716111	-121.408889
241	3410031-016	CR6	FALSE	0.734	-2	-0.333	no trend	8.7	-0.34	6/4/2002	5/8/2017	38.724444	-121.336111
80	3410031-017	CR6	FALSE	1	0	0	no trend	8.7	0	6/4/2002	5/8/2017	38.723056	-121.349722
257	3410031-018	CR6	FALSE	0.308	-4	-0.667	no trend	8.7	-1.02	3/25/2002	5/9/2017	38.716389	-121.371944
288	3410045-001	CR6	FALSE	1	0	0	no trend	8.7	0	6/5/2002	5/9/2017	38.586137	-121.411513
138	3410045-002	CR6	FALSE	1	0	0	no trend	8.7	0	6/4/2002	5/9/2017	38.583085	-121.413054
116	3410045-003	CR6	FALSE	0.089	6	1	no trend	8.7	1.7	6/4/2002	5/9/2017	38.594423	-121.417465
96	3410045-005	CR6	FALSE	1	0	0	no trend	8.7	0	6/4/2002	5/9/2017	38.600025	-121.410183
2909	5105013-001	CR6	FALSE	0.128	-9	-0.429	no trend	27.7	-1.52	2/29/2016	10/9/2017	38.781319	-121.484797
1075	SL185602928-EX-1	CR6	FALSE	0.692	-9	-0.086	no trend	408.3	-0.4	3/21/2006	6/24/2010	38.5948499	-121.3917114
1374	SL185602928-F-1	CR6	FALSE	0.06	-39	-0.371	no trend	408.3	-1.88	6/27/2007	9/19/2012	38.5967632	-121.3919666
935	SL185602928-F-10	CR6	FALSE	0.124	-35	-0.292	no trend	489.7	-1.54	3/22/2007	9/20/2012	38.5972826	-121.3912015
1345	SL185602928-F-2	CR6	FALSE	0.107	19	0.422	no trend	125	1.61	6/27/2007	6/25/2010	38.5967632	-121.3917771
846	SL185602928-F-3	CR6	FALSE	0.876	3	0.055	no trend	165	0.16	3/22/2007	6/25/2010	38.5967603	-121.3915766
1385	SL185602928-F-4	CR6	FALSE	0.161	-19	-0.345	no trend	165	-1.4	3/22/2007	6/25/2010	38.5967465	-121.3913754
1470	SL185602928-F-5	CR6	FALSE	0.834	7	0.041	no trend	817	0.21	3/22/2007	9/20/2012	38.5967608	-121.3911558
1422	SL185602928-F-6	CR6	TRUE	0	-82	-0.683	decreasing	493.3	-3.65	3/22/2007	9/19/2012	38.5972848	-121.3920357
971	SL185602928-F-7	CR6	FALSE	1	1	0.018	no trend	165	0	3/22/2007	6/28/2010	38.5972856	-121.3918353
1580	SL185602928-F-8	CR6	FALSE	0.913	3	0.033	no trend	333.7	0.11	3/22/2007	9/20/2012	38.5972826	-121.3916167
1298	SL185602928-F-9	CR6	FALSE	0.544	-17	-0.111	no trend	697	-0.61	3/22/2007	9/20/2012	38.5972862	-121.3913874
1369	SL185602928-SP-1A	CR6	FALSE	0.079	-40	-0.333	no trend	493.3	-1.76	3/21/2006	6/24/2010	38.594695	-121.3918783

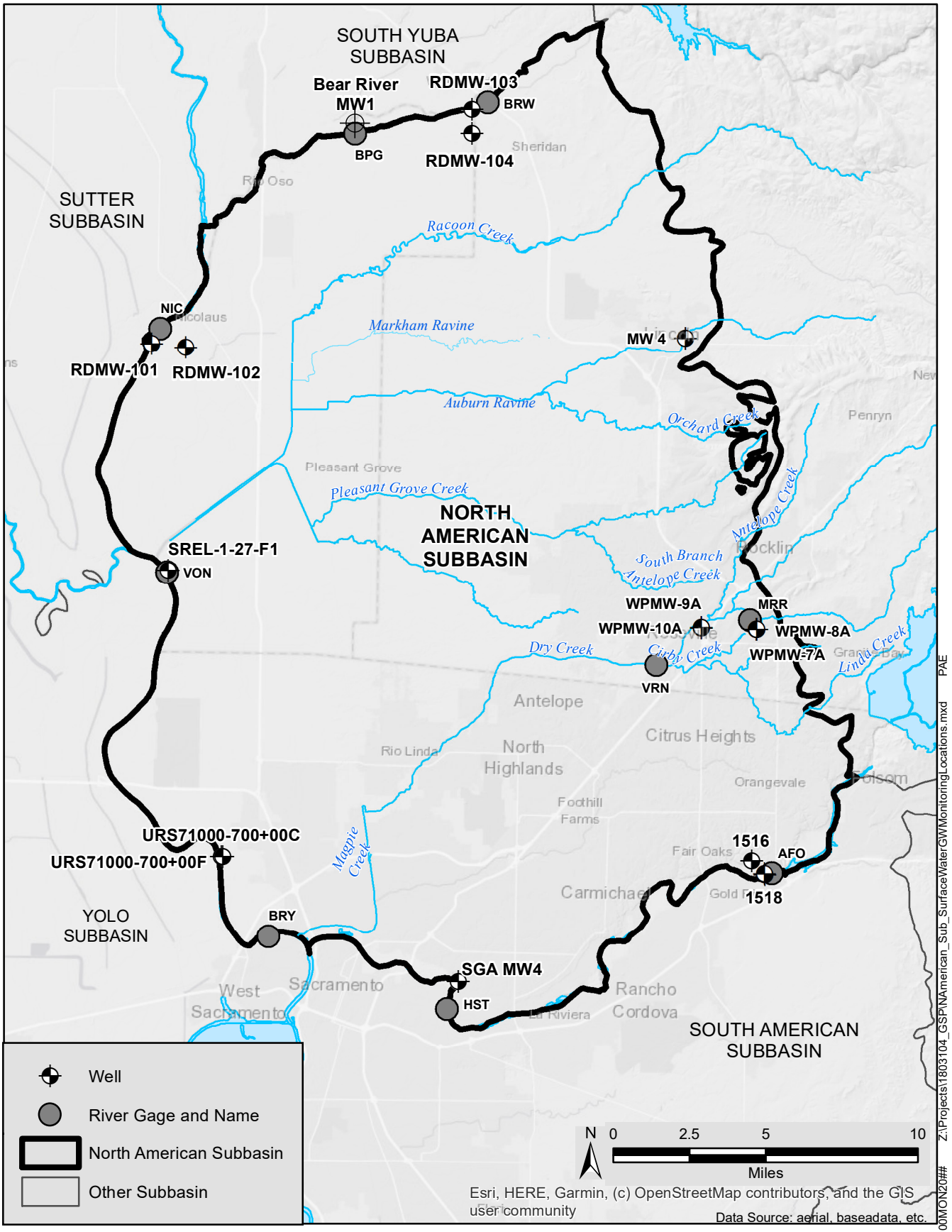
Appendix N: Surface Water Interactions

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX N
Surface Water/Groundwater Interaction Hydrographs

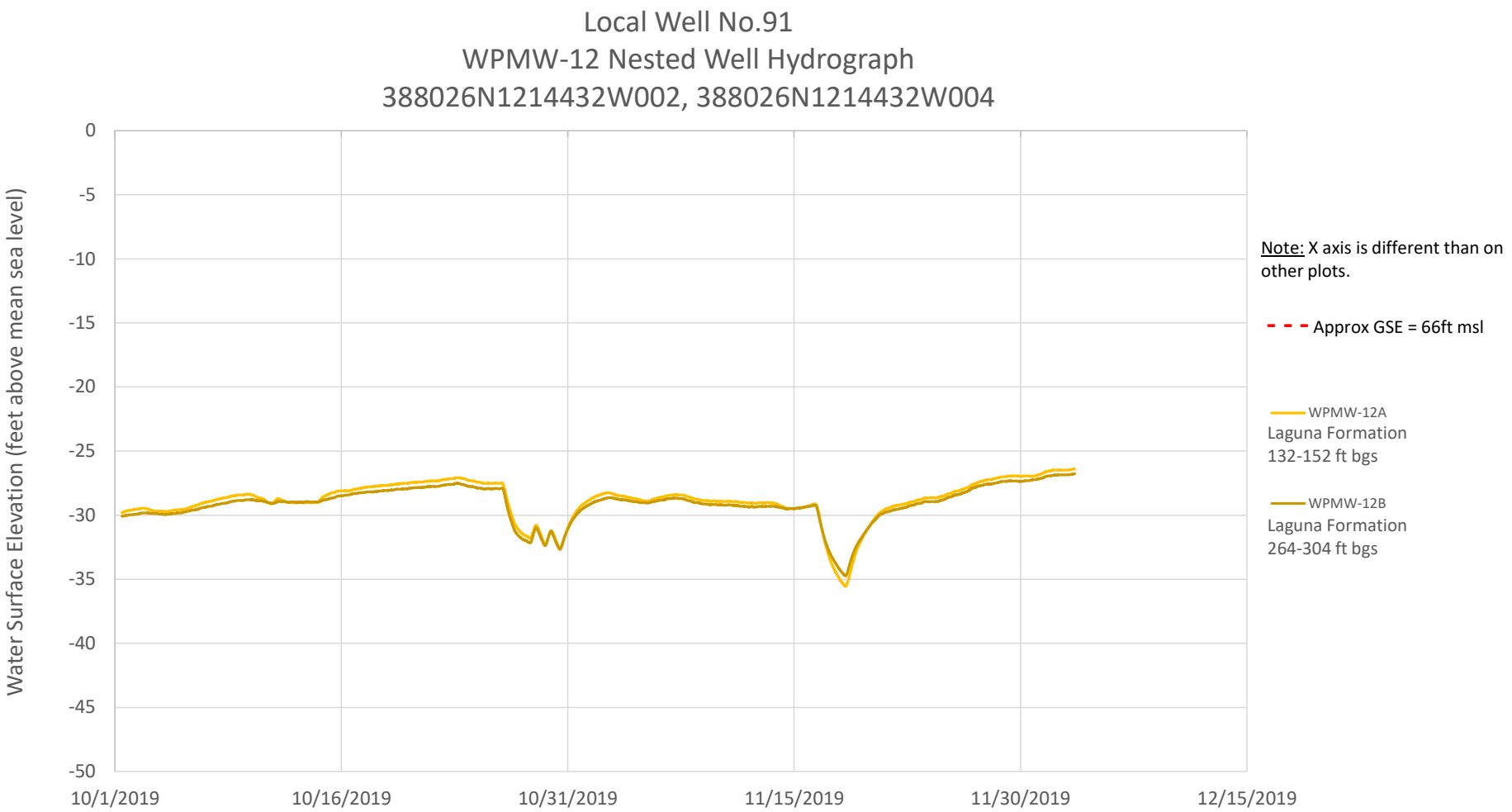
December 2021

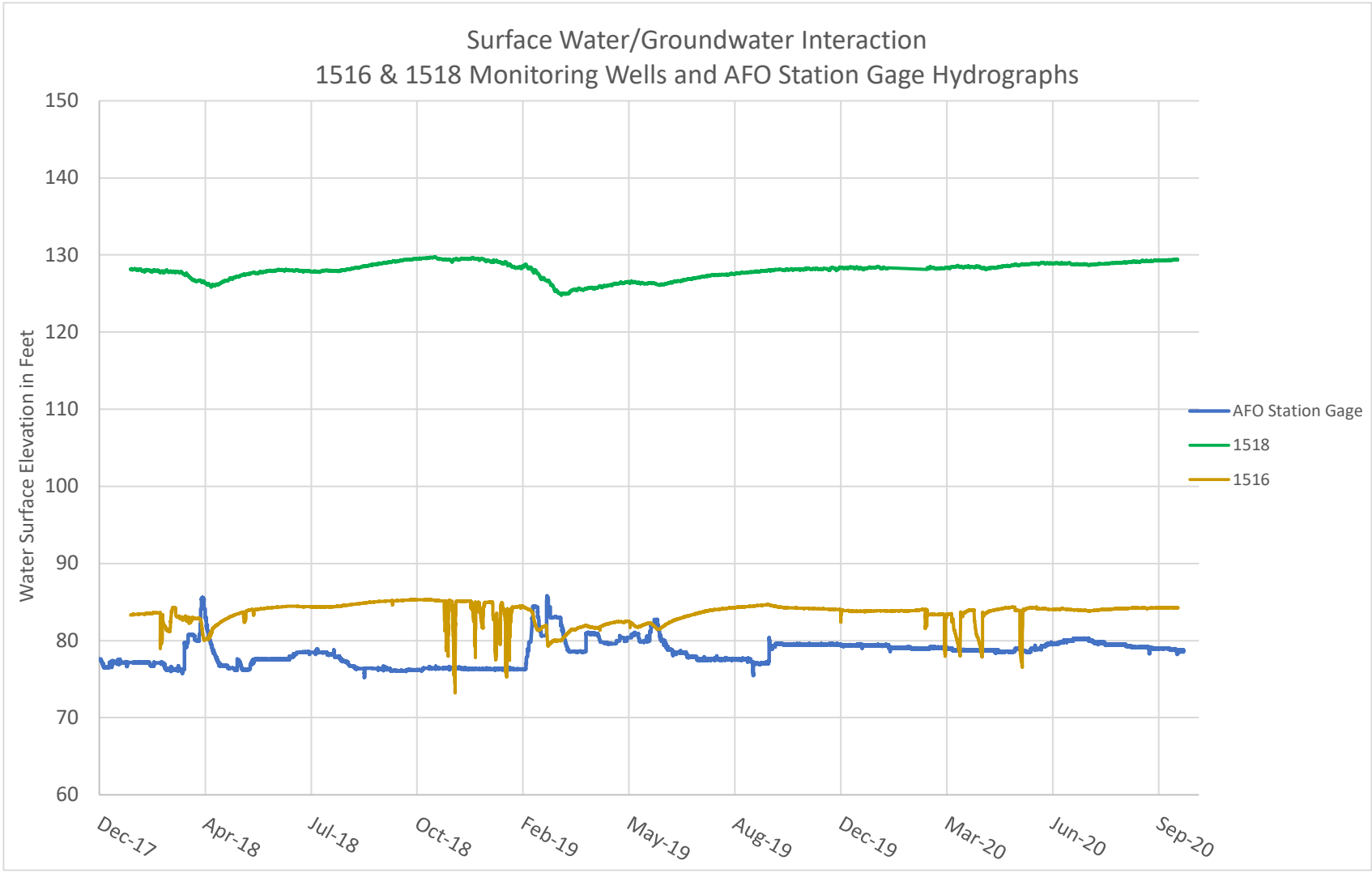
APPENDIX N
SURFACE WATER/GROUNDWATER INTERACTION HYDROGRAPHS

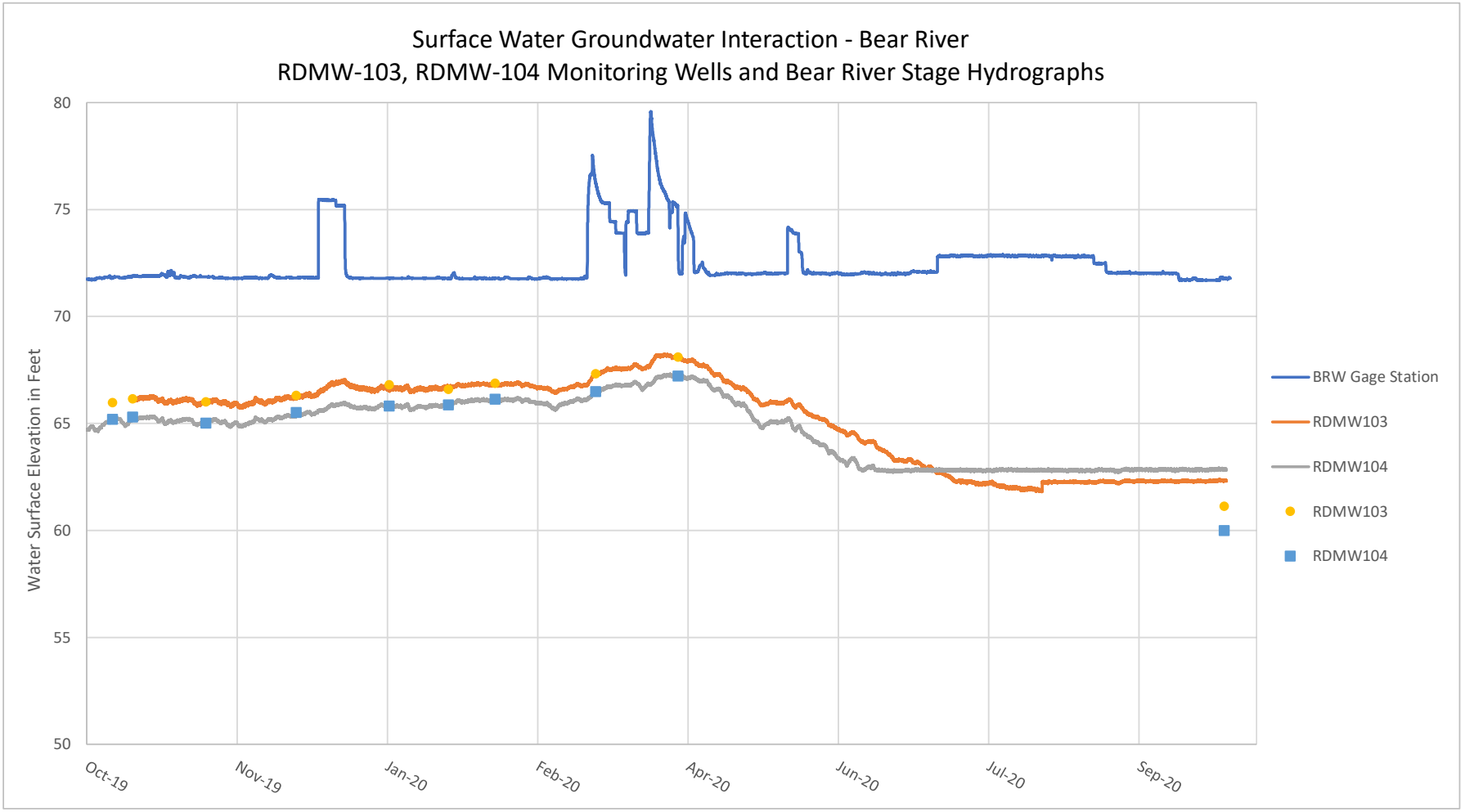


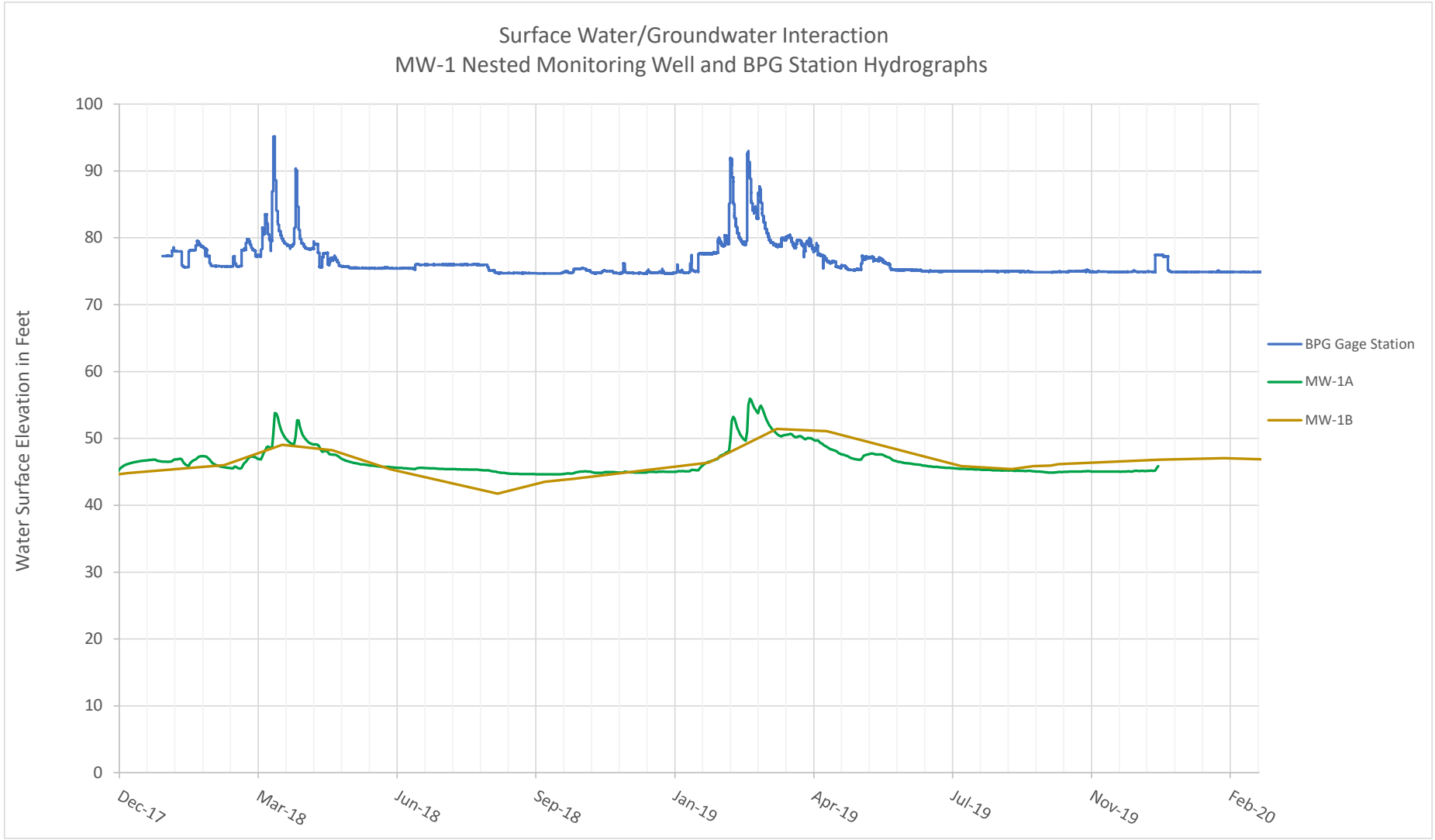
North American Subbasin	GEI Consultants	Surface Water/Groundwater Monitoring Locations
North American Subbasin	MARCH 2020	FIGURE K-1

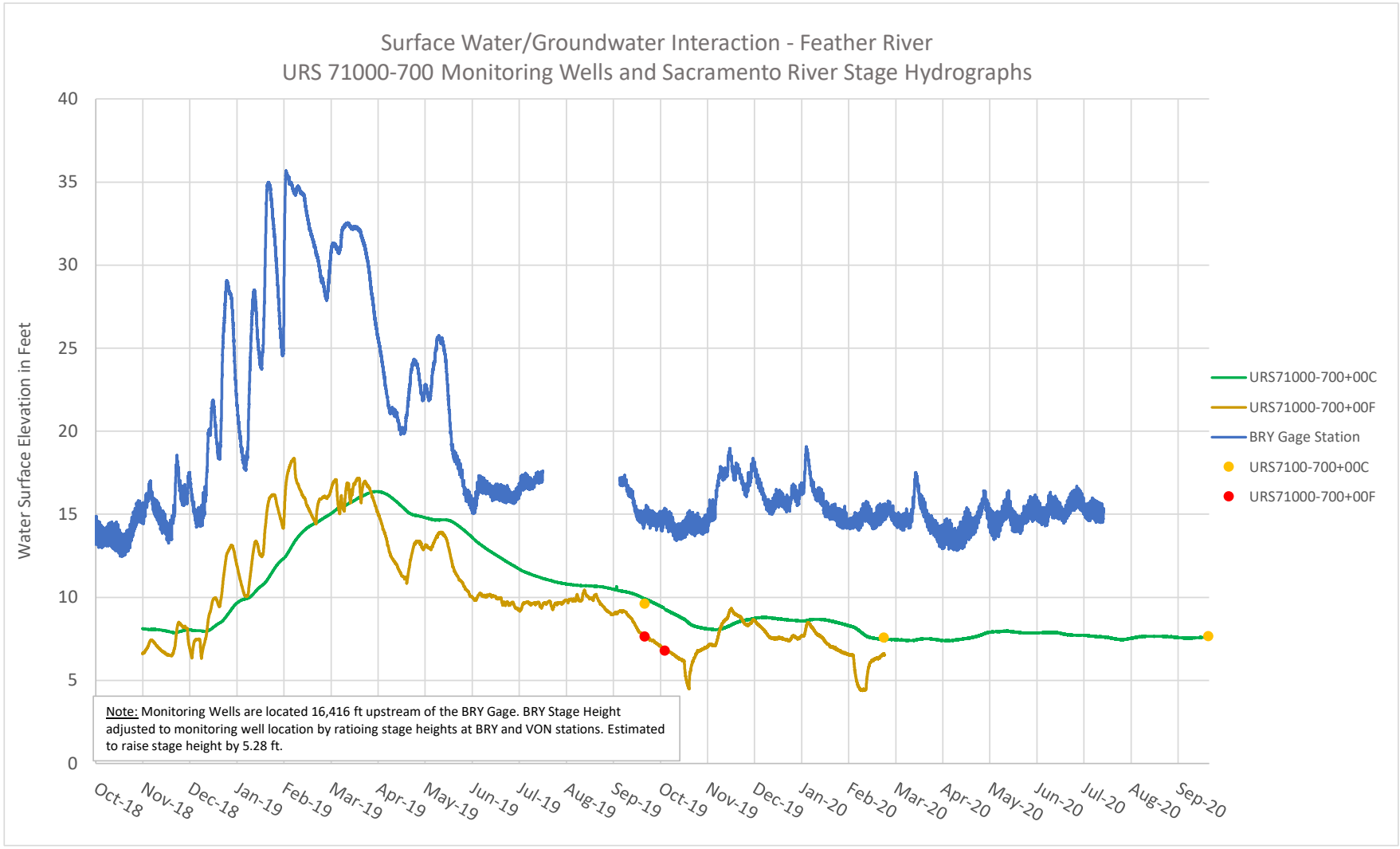

Local Well No. 41
WPMW-5 Nested Well
387331N1213610W001, 387331N1213610W002
Water Surface Elevation (feet above mean sea level)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: WPMW-5A is dry.
Approx GSE = 98ft msl
WPMW-5A
Laguna Formation
80-100 ft bgs
WPMW-5B
Mehrten Formation
630-650 ft bgs

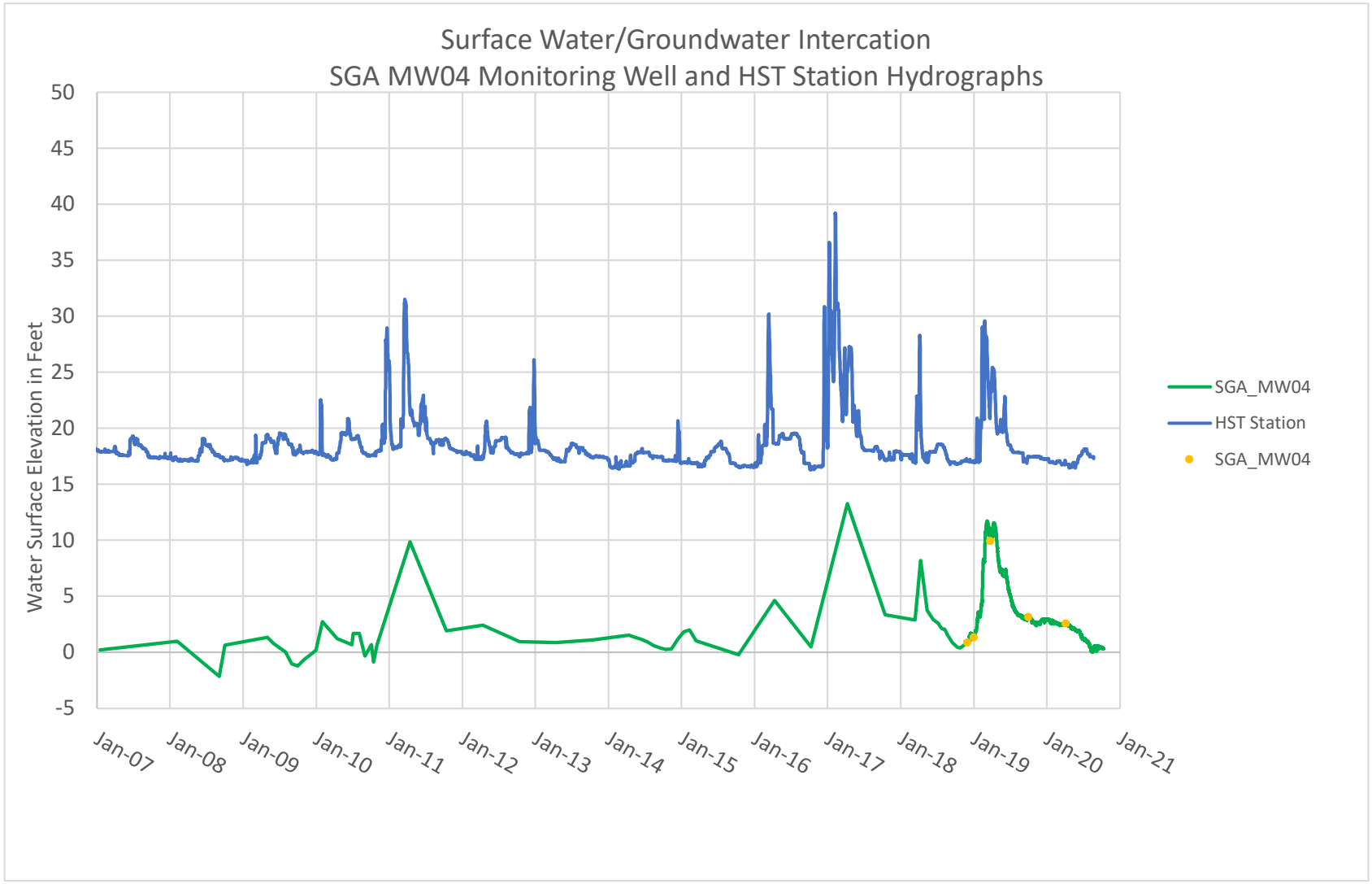

Local Well No.91
WPMW-12 Nested Well Hydrograph
388026N1214432W002, 388026N1214432W004
Water Surface Elevation (feet above mean sea level)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
10/1/2019
10/16/2019
10/31/2019
11/15/2019
11/30/2019
12/15/2019
Note: X axis is different than on other plots.
Approx GSE = 66ft msl
WPMW-12A
Laguna Formation
132-152 ft bgs
WPMW-12B
Laguna Formation
264-304 ft bgs

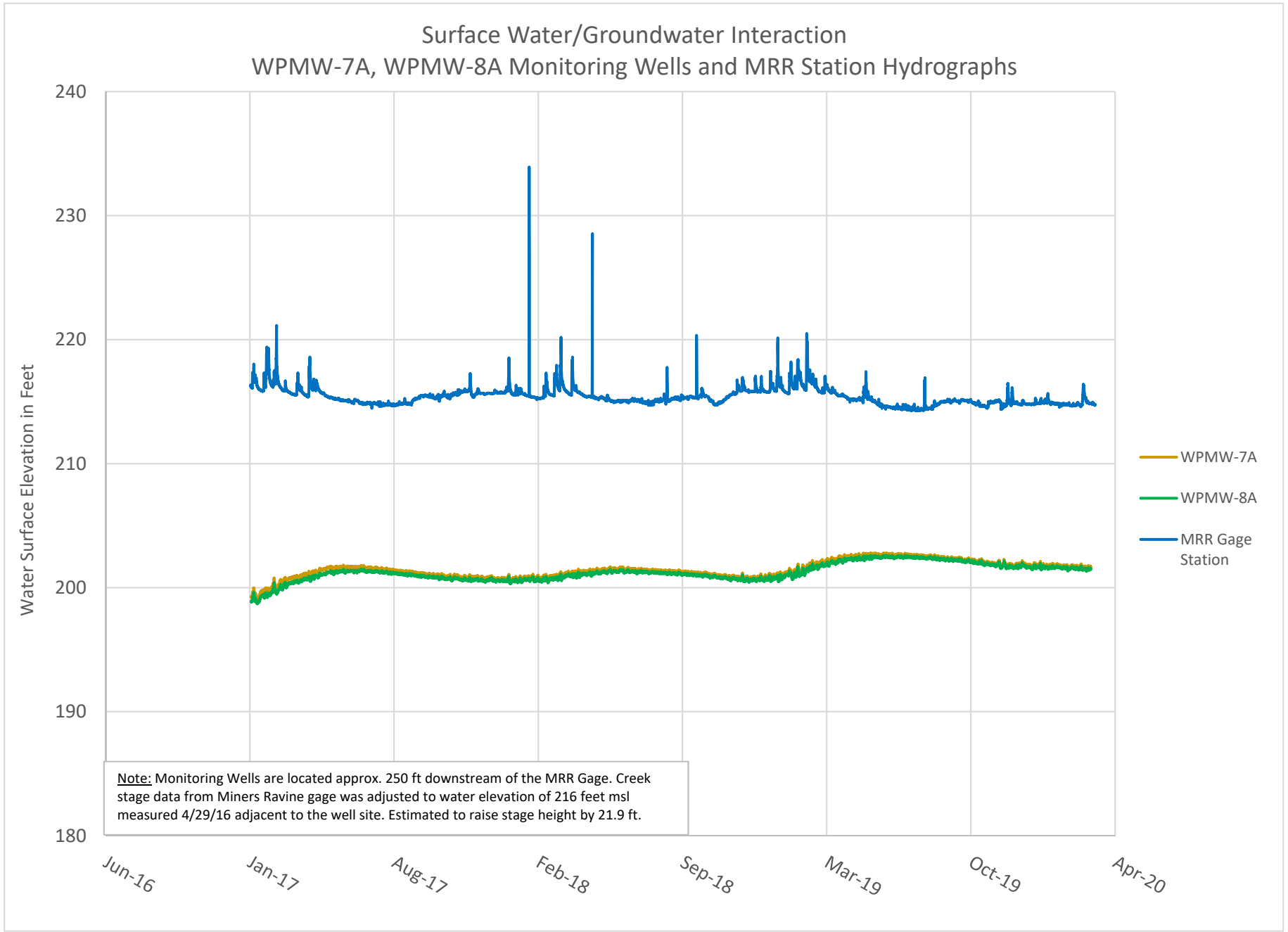

Surface Water/Groundwater Interaction
1516 & 1518 Monitoring Wells and AFO Station Gage Hydrographs
Water Surface Elevation in Feet
150
140
130
120
110
100
90
80
70
60
Dec-17
Apr-18
Jul-18
Oct-18
Feb-19
May-19
Aug-19
Dec-19
Mar-20
Jun-20
Sep-20
AFO Station Gage
1518
1516

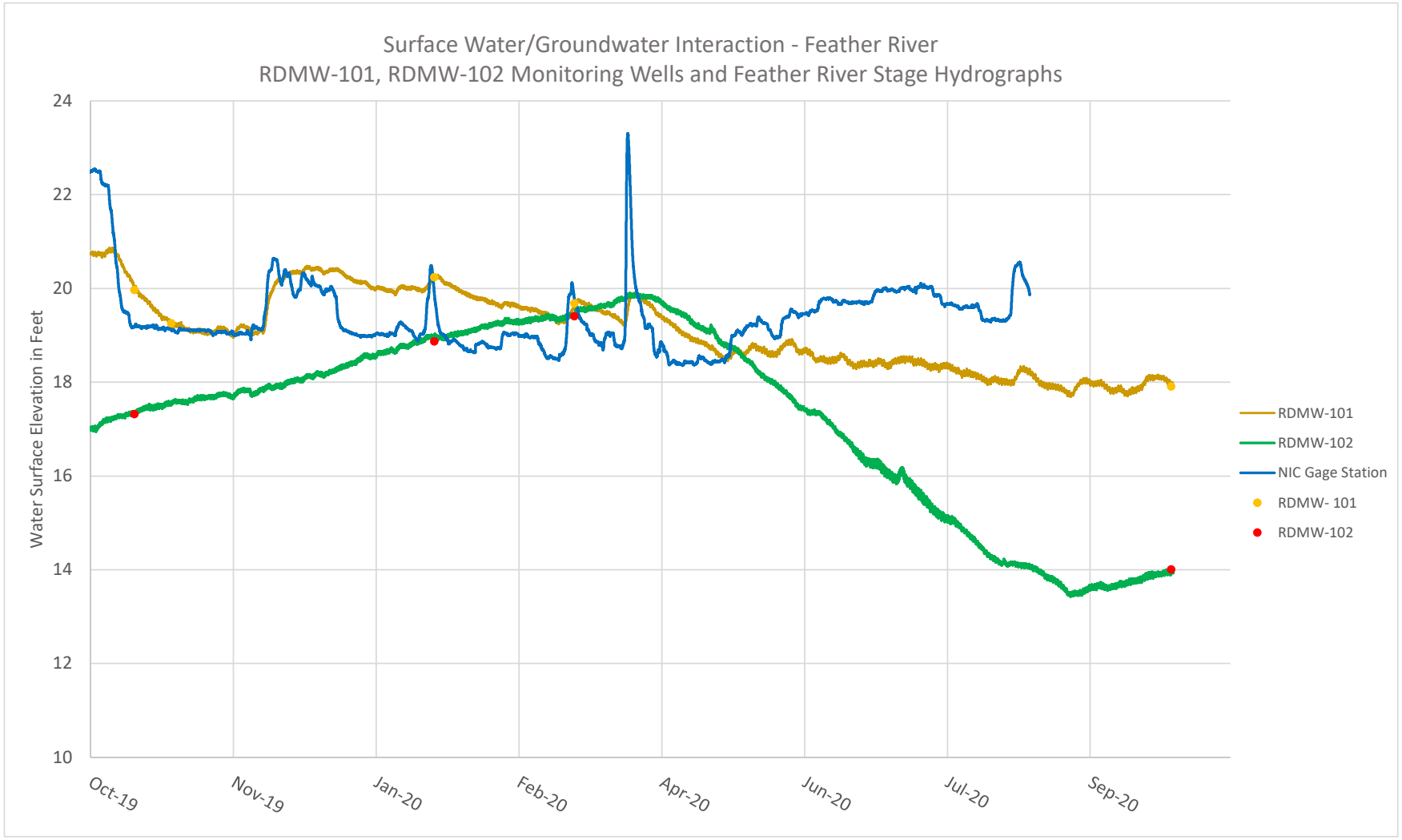

Surface Water Groundwater Interaction - Bear River
RDMW-103, RDMW-104 Monitoring Wells and Bear River Stage Hydrographs
Water Surface Elevation in Feet
80
75
70
65
60
55
50
Oct-19
Nov-19
Jan-20
Feb-20
Apr-20
Jun-20
Jul-20
Sep-20
BRW Gage Station
RDMW103
RDMW104
RDMW103
RDMW104

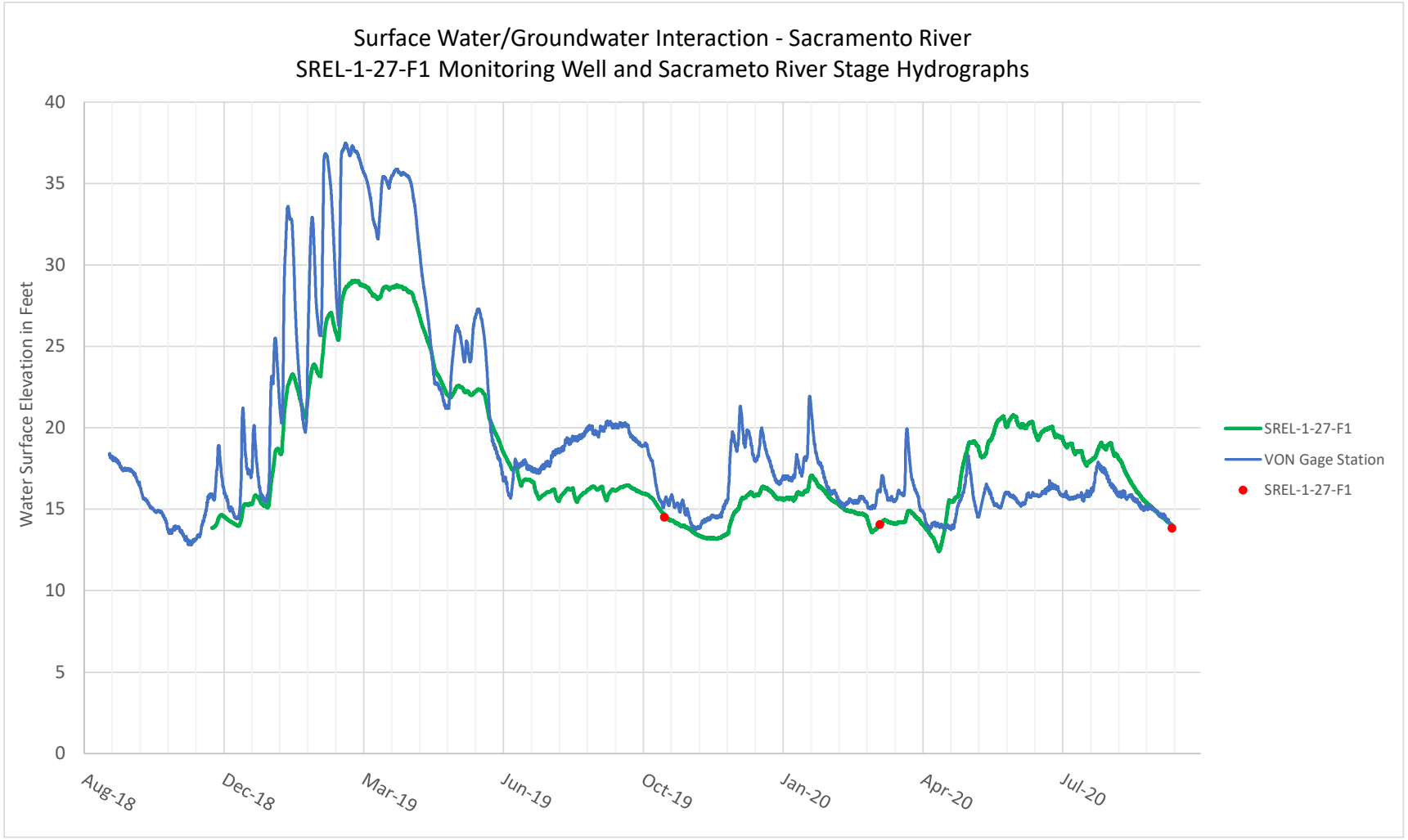

Surface Water/Groundwater Interaction
MW-1 Nested Monitoring Well and BPG Station Hydrographs
Water Surface Elevation in Feet
100
90
80
70
60
50
40
30
20
10
0
Dec-17
Mar-18
Jun-18
Sep-18
Jan-19
Apr-19
Jul-19
Nov-19
Feb-20
BPG Gage Station
MW-1A
MW-1B

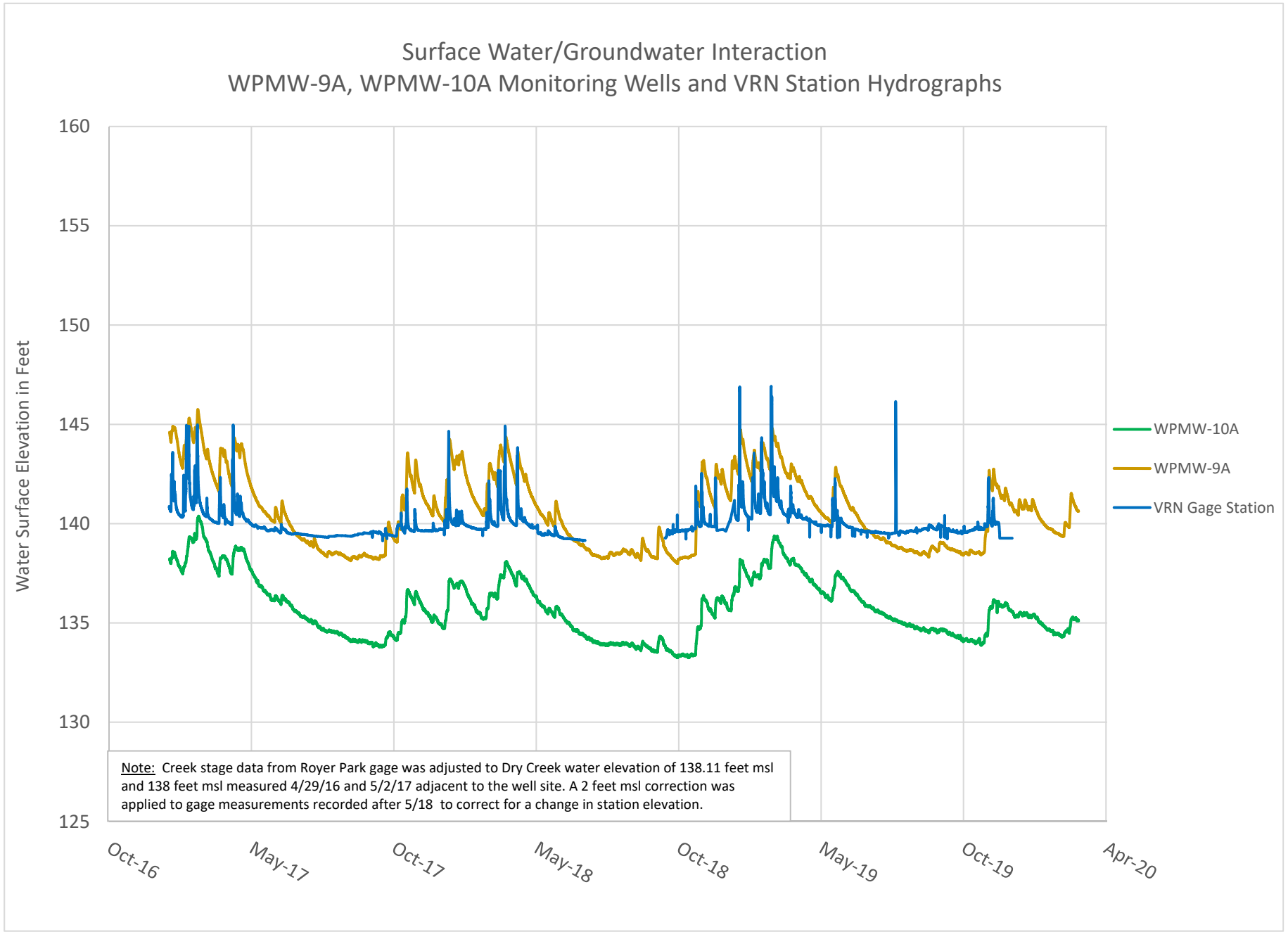

Surface Water/Groundwater Interaction - Feather River
URS 71000-700 Monitoring Wells and Sacramento River Stage Hydrographs
Water Surface Elevation in Feet
40
35
30
25
20
15
10
5
0
Oct-18
Nov-18
Dec-18
Jan-19
Feb-19
Mar-19
Apr-19
May-19
Jun-19
Jul-19
Aug-19
Sep-19
Oct-19
Nov-19
Dec-19
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
URS71000-700+00C
URS71000-700+00F
BRY Gage Station
URS7100-700+00C
URS71000-700+00F
Note: Monitoring Wells are located 16,416 ft upstream of the BRY Gage. BRY Stage Height adjusted to monitoring well location by ratioing stage heights at BRY and VON stations. Estimated to raise stage height by 5.28 ft.


Surface Water/Groundwater Intercation
SGA MW04 Monitoring Well and HST Station Hydrographs
Water Surface Elevation in Feet
50
45
40
35
30
25
20
15
10
5
0
-5
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
SGA_MW04
HST Station
SGA_MW04

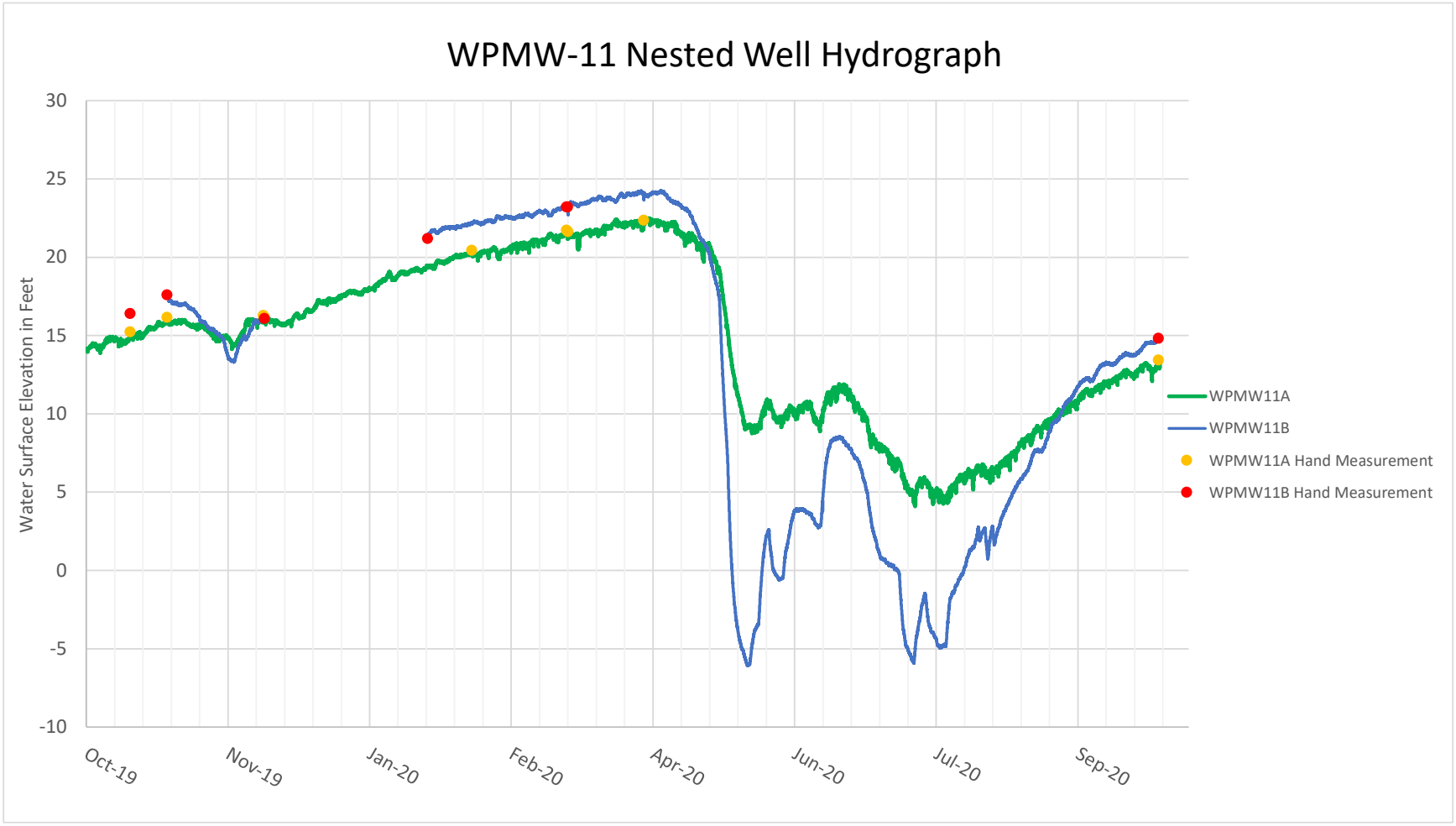

Surface Water/Groundwater Interaction
WPMW-7A, WPMW-8A Monitoring Wells and MRR Station Hydrographs
Water Surface Elevation in Feet
240
230
220
210
200
190
180
Jun-16
Jan-17
Aug-17
Feb-18
Sep-18
Mar-19
Oct-19
Apr-20
WPMW-7A
WPMW-8A
MRR Gage Station
Note: Monitoring Wells are located approx. 250 ft downstream of the MRR Gage. Creek stage data from Miners Ravine gage was adjusted to water elevation of 216 feet msl measured 4/29/16 adjacent to the well site. Estimated to raise stage height by 21.9 ft.

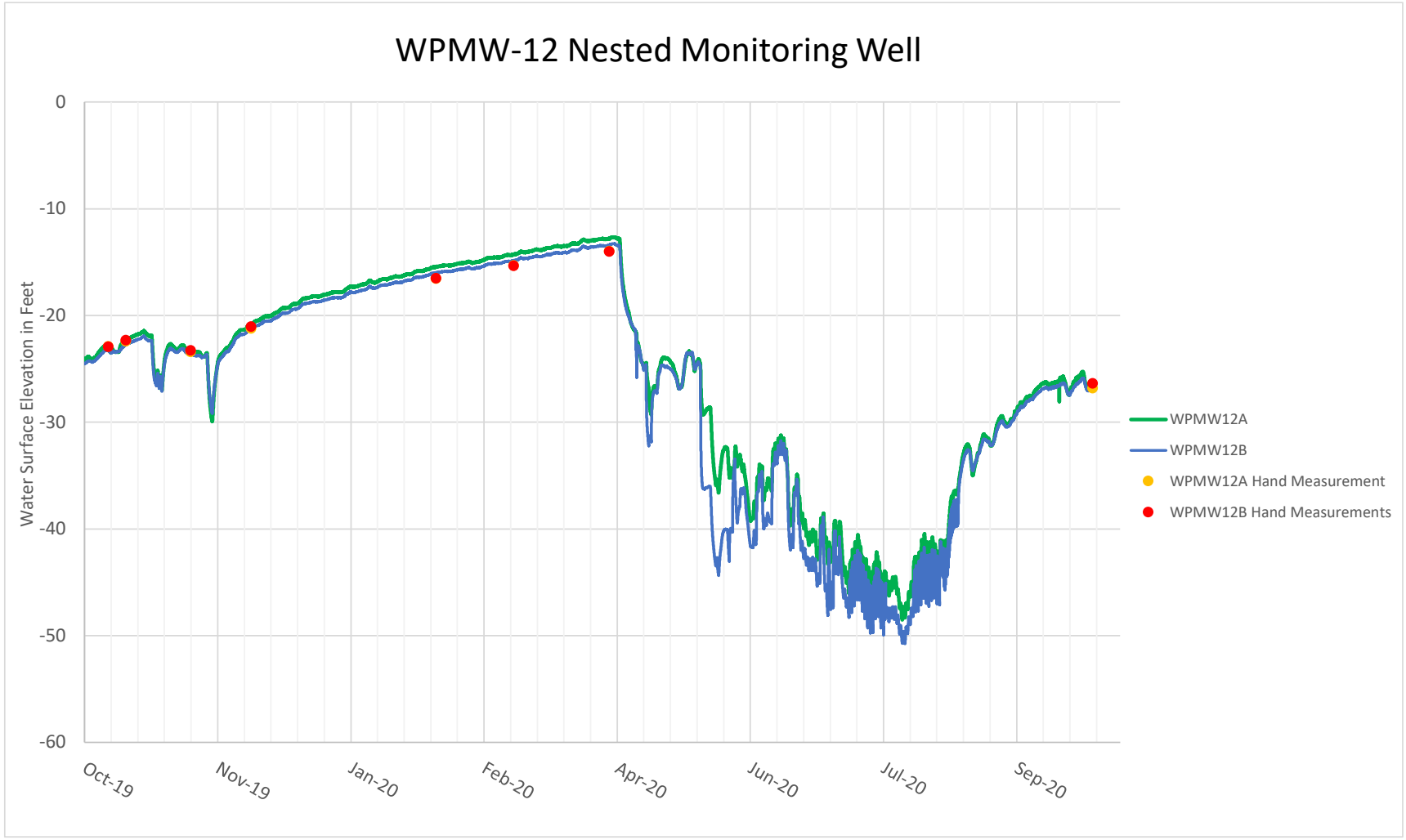

Surface Water/Groundwater Interaction - Feather River
RDMW-101, RDMW-102 Monitoring Wells and Feather River Stage Hydrographs
Water Surface Elevation in Feet
24
22
20
18
16
14
12
10
Oct-19
Nov-19
Jan-20
Feb-20
Apr-20
Jun-20
Jul-20
Sep-20
RDMW-101
RDMW-102
NIC Gage Station
RDMW- 101
RDMW-102


Surface Water/Groundwater Interaction - Sacramento River
SREL-1-27-F1 Monitoring Well and Sacrameto River Stage Hydrographs
Water Surface Elevation in Feet
40
35
30
25
20
15
10
5
0
Aug-18
Dec-18
Mar-19
Jun-19
Oct-19
Jan-20
Apr-20
Jul-20
SREL-1-27-F1
VON Gage Station
SREL-1-27-F1


Surface Water/Groundwater Interaction
WPMW-9A, WPMW-10A Monitoring Wells and VRN Station Hydrographs
Water Surface Elevation in Feet
160
155
150
145
140
135
130
125
Oct-16
May-17
Oct-17
May-18
Oct-18
May-19
Oct-19
Apr-20
WPMW-10A
WPMW-9A
VRN Gage Station
Note: Creek stage data from Royer Park gage was adjusted to Dry Creek water elevation of 138.11 feet msl and 138 feet msl measured 4/29/16 and 5/2/17 adjacent to the well site. A 2 feet msl correction was applied to gage measurements recorded after 5/18 to correct for a change in station elevation.


Surface Water/Groundwater Interaction
WPMW-5A, WPMW-5B, and Dry Creek Hydrographs
Water Surface Elevation in Feet
110
90
70
50
30
10
-10
-30
Jan-14
Jan-16
Jan-18
Jan-20
Note: WPMW-5A is dry.
Approx GSE = 98ft msl
WPMW-5A
WPMW-5B
Approximate Surface Water Elevation Dry Creek


WPMW-11 Nested Well Hydrograph
Water Surface Elevation in Feet
30
25
20
15
10
5
0
-5
-10
Oct-19
Nov-19
Jan-20
Feb-20
Apr-20
Jun-20
Jul-20
Sep-20
WPMW11A
WPMW11B
WPMW11A Hand Measurement
WPMW11B Hand Measurement


WPMW-12 Nested Monitoring Well
Water Surface Elevation in Feet
0
-10
-20
-30
-40
-50
-60
Oct-19
Nov-19
Jan-20
Feb-20
Apr-20
Jun-20
Jul-20
Sep-20
WPMW12A
WPMW12B
WPMW12A Hand Measurement
WPMW12B Hand Measurements

July 8, 2019
File No.: 20161893.005A

Mr. John Bassett, PE
SAFCA
1007 7th Street, 7th Floor
Sacramento, California 95814

Subject: Piezometer Reading Summary, 2018-2019 Flood Season
Natomas Cross Canal
Sacramento and American Rivers
Sacramento and Sutter Counties, California

Dear Mr. Bassett:

Kleinfelder is pleased to present this Piezometer Reading Summary Report for the 2018-2019 flood season based upon piezometer readings taken along the Natomas Cross Canal South Levee (NCCSL), Sacramento River East Levee (SREL), and American River North Levee (ARNL) see Figure 1-1, located in Sacramento and Sutter Counties, California. This report provides groundwater level data at specific locations along the NCCSL, SREL, and ARNL and a compilation of piezometer readings from a series of measurements completed during the 2018-2019 flood season. The purpose of this report is to present the measurements taken in piezometers installed by Kleinfelder and previously installed by others.

Piezometer locations are shown on Figures 2-1 through 2-9. Plots of piezometer readings showing groundwater elevation, approximate piezometer station, location, and levee improvement are shown on Figures 3-1 through 3-39. The stage of the Sacramento and American rivers, as appropriate, are shown on the piezometer reading plots along with the referenced gauge station.

BACKGROUND

Piezometers have been installed by Kleinfelder and others between approximately 2001 and 2009. Elevation references in this report are in feet and are based on the North American Vertical Datum of 1988 (NAVD88). Elevations may be converted to the previously used National Geodetic Vertical Datum of 1929 (NGVD29) by using the conversion factor Elevation 0 NGVD29 = Elevation +2.28 NAVD88 (Psomas 2009).

Kleinfelder published a report summarizing groundwater levels and piezometer readings taken between December 2017 and April 2018 for the 2017-2018 flood season entitled “Piezometer Reading Summary, 2017-2018 Flood Season, Natomas Cross Canal, Sacramento and American Rivers, Sacramento and Sutter Counties, California,” dated June 11, 2018.

Kleinfelder previously published a report summarizing groundwater levels and piezometer readings taken between November 2016 and June 2017 for the 2016-2017 flood season for the Natomas Cross Canals entitled “Piezometer Reading Summary, 2016-2017 Flood Season, Natomas Cross Canals, Sacramento and American Rivers, Sacramento and Sutter Counties, California,” dated February 22, 2018.

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Kleinfelder published a report summarizing groundwater levels and piezometer readings taken in March 2016 for the 2015-2016 flood season for the Natomas Cross Canals entitled "Piezometer Reading Summary, 2015-2016 Flood Season, Natomas Cross Canals, Sacramento and American Rivers, Sacramento and Sutter Counties, California," dated December 22, 2016.

Kleinfelder published a report summarizing groundwater levels and piezometer readings taken between October 2011 and April 2016 for the Natomas Cross Canal entitled "Groundwater Level Data Report, Natomas Cross Canal South Levee, Natomas Levee Improvement Program, Sutter County, California," dated August 8, 2016.

Kleinfelder published a report summarizing groundwater levels and piezometer readings taken between May 2009 and August 2011 for the subject project titled "Groundwater Level Data Report, Natomas Cross Canal South Levee, Natomas Levee Improvement Program, Sutter County, California," dated August 25, 2011.

Piezometers are read based on the following table.

Table 1: Current RD1000 Levee Patrol Criteria and Activation WSE for Piezometer Reading [3]

Locations	Stage Forecast	RD1000 Patrol Frequency Interval	Comments
American River / NEMDC / Sacramento River (downstream of Sacramento Weir)		24-48 hours	Activation WSE at I Street Gage for Piezometer Readings El. 15 (NAVD88) Reading intervals twice a week as the river is rising or falling between El. 15 and 24.3 (NAVD88). Every other day readings at WSE above El. 24.3 (NAVD88)
	I Street 25.5[1]	6 hours	
	I Street 27.3[1]	3 hours	
	I Street 29.3[1]	2 hours	
	I Street 29.8[1]	1 hour	
	I Street 30.8[1]	30 minutes	
Sacramento River (upstream of Sacramento Weir) / NCC / PGCC		24-48 hours	Activation WSE at Verona Gage for Piezometer Readings El. 27 (NAVD88) El. 27.7 (USED) Reading intervals twice a week as the river is rising or falling between El. 27.7 and 31 (USED) [El. 27 and 30.3 NAVD88]. Every other day readings at WSE above El. 31 (USED) [El. 30.3 NAVD88)
	I Street 27.3[1] and/or Verona 32.0[2]	6 hours	
	I Street 29.3[1] and/or Verona 37.0 (36.3)[2]	3 hours	
	I Street 31.3[1] and/or Verona 40.0 (39.3)[2]	2 hours	
	I Street 33.3[1] and/or Verona 41.0 (40.3)[2]	1 hour	
	I Street 34.3[1] and/or Verona 42.0 (41.3)[2]	30 minutes	

Notes:

[1] WSEs were converted to elevation at I Street Gaging Station, NAVD88, in feet.

[2] WSEs were converted to elevation at Verona Gaging Station, USED, in feet with a conversion to NAVD88 provided in parenthesis.

[3] The water surface elevations and levee patrol frequencies included in this table are used as guidelines for levee patrol staffing and flood fight readiness. Actual patrol frequency will be based on site specific observed conditions. Any signs of levee distress including, but not limited to, seepage carrying soil material, boils, sloughing, or erosion should be addressed with more frequent patrols and/or flood fight activities as appropriate.

© 2018 Kleinfelder

OBSERVATIONS

Recent piezometer readings were taken between January and April 2019 during periods of high water levels in the Natomas Cross Canal, Sacramento River, and American River. Piezometer readings from this period are graphically shown on Figures 3-1 through 3-39. These readings were made to record the response of groundwater levels along the Natomas Cross Canal, Sacramento River, and American River to the fluctuation in these bodies of water. Tables 2, 3, and 4 summarize the piezometer readings located along the NCCSL, SREL, and ARNL, respectively. All elevations provided are referenced to NAVD88. Table 5 summarizes the name, station, and figure showing each of the piezometers.

Table 2: Natomas Cross Canal South Levee
Piezometer Groundwater Surface Elevations

Date	NCC-3-T1 El. +32.4	NCC-21-C1 El. +49.1	NCC-21-F1 El. +21.5	NCC-21-R1 El. +45.2		
1/22/19	15.1	19.4	18.9	25.2		
1/25/19	20.4	19.2	18.7	23.7		
2/5/19	21.0	19.4	19.1	23.9		
2/8/19	21.8	19.7	19.2	25.8		
2/15/19	24.0	20.4	19.8	29.6		
2/18/19	24.9	20.5	19.8	30.8		
2/20/19	25.2	20.4	19.7	29.6		
2/22/19	24.9	20.1	19.4	27.0		
2/27/19	25.2	20.7	20.5	29.6		
3/1/19	--[2]	20.9	20.1	31.7		
3/4/19	26.0	21.0	20.1	31.8		
3/6/19	26.2	21.2	20.6	31.6		
3/8/19	26.2	21.6	20.2	31.9		
3/11/19	26.2	20.9	20.0	31.5		
3/13/19	26.0	20.7	19.8	31.0		
3/15/19	26.1	20.6	19.8	30.5		
3/19/19	26.0	20.5	19.7	29.6		
3/22/19	25.7	20.4	19.6	28.2		
3/26/19	25.8	20.5	19.9	27.2		
3/29/19	26.0	20.9	20.2	30.1		

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 2: Natomas Cross Canal South Levee
Piezometer Groundwater Surface Elevations

Date	NCC-3-T1 El. +32.4	NCC-21-C1 El. +49.1	NCC-21-F1 El. +21.5	NCC-21-R1 El. +45.2		
4/1/19	26.1	20.8	20.0	30.0		
4/8/19	26.1	20.8	19.9	30.6		
4/10/19	26.1	20.7	19.8	30.4		
4/12/19	26.1	20.7	19.8	30.9		
4/16/19	25.6	20.4	19.6	30.2		
4/19/19	25.8	20.3	19.5	29.6		
4/22/19	25.4	20.1	19.2	28.1		
4/25/19	24.9	19.8	19.1	26.0		
Date	NCC-53-T1 El. +27.1	NCC-56-T1 El. +28.3	NCC-58-T1 El. +33.2	NCC-61-T1 El. +28.1	NCC-63-T1 El. +26.4	
1/22/19	18.9	17.7	19.4	19.2	18.5	
1/25/19	18.7	17.5	19.1	19.0	18.4	
2/5/19	18.8	17.5	18.8	19.0	18.5	
2/8/19	19.1	17.8	19.5	19.4	18.7	
2/15/19	20.0	18.6	20.3	20.4	19.6	
2/18/19	20.0	18.5	20.7	20.6	19.5	
2/20/19	19.9	18.4	20.7	20.4	19.4	
2/22/19	19.5	18.1	20.0	19.9	19.2	
2/27/19	18.7	19.6	19.9	20.9	20.1	
3/1/19	20.5	19.0	21.4	21.2	20.1	
3/4/19	20.6	18.9	21.5	21.2	20.0	
3/6/19	20.8	19.3	21.7	21.3	20.2	
3/8/19	20.6	19.0	21.8	21.4	20.2	
3/11/19	20.3	18.6	21.4	21.0	19.7	
3/13/19	20.1	18.5	21.2	20.7	19.5	
3/15/19	--[2]	18.5	21.1	20.6	19.4	
3/19/19	19.8	18.3	--[2]	20.3	19.2	
3/22/19	19.6	18.1	20.4	20.0	--[2]	
3/26/19	19.8	18.3	--[2]	20.0	19.2	
3/29/19	20.2	18.6	--[2]	20.5	19.6	
4/1/19	--[2]	18.5	20.9	20.5	19.5	
4/8/19	19.9	18.4	20.8	20.4	19.2	
4/10/19	19.8	18.3	20.8	20.3	19.1	
4/12/19	20.3	18.3	20.8	20.2	19.1	
4/16/19	19.5	18.2	20.6	20.0	18.9	
4/19/19	19.5	18.2	20.6	20.0	18.9	
4/22/19	19.2	17.9	20.2	19.6	18.6	

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 2: Natomas Cross Canal South Levee
Piezometer Groundwater Surface Elevations

Date	NCC-53-T1 El. +27.1	NCC-56-T1 El. +28.3	NCC-58-T1 El. +33.2	NCC-61-T1 El. +28.1	NCC-63-T1 El. +26.4	
4/25/19	19.0	17.7	19.6	19.2	18.5	
Date	NCC-116-T1 El. +26.1	NCC-116-C1 El. +49.0	NCC-116-C2 El. +49.1	NCC-118-T1 El. +26.3	NCC-121-T1 El. +32.3	
1/22/19	21.4	21.8	--[5]	21.9	22.5	
1/25/19	21.2	21.6	--[5]	21.5	22.0	
2/5/19	20.5	20.9	--[5]	21.2	22.0	
2/8/19	21.2	21.4	--[5]	21.6	22.3	
2/15/19	21.8	22.2	--[5]	22.5	23.4	
2/18/19	22.3	22.7	--[5]	22.6	23.4	
2/20/19	22.4	22.8	--[5]	22.5	23.2	
2/22/19	22.1	22.5	--[5]	22.2	22.7	
2/27/19	22.3	22.7	--[5]	23.0	24.0	
3/1/19	22.8	23.1	--[5]	23.2	24.0	
3/4/19	23.1	23.6	--[5]	23.3	24.0	
3/6/19	23.3	23.7	--[5]	23.4	24.1	
3/8/19	23.3	23.7	--[5]	23.5	24.2	
3/11/19	23.3	23.7	--[5]	23.3	24.0	
3/13/19	23.1	23.6	--[5]	23.2	23.8	
3/15/19	24.1	23.5	--[5]	23.1	23.7	
3/19/19	22.9	23.3	--[5]	23.0	23.6	
3/22/19	22.7	23.2	--[5]	22.8	23.4	
3/26/19	22.6	23.0	--[5]	22.9	23.4	
3/29/19	22.9	23.4	--[5]	23.3	23.9	
4/1/19	23.1	23.4	--[5]	23.5	24.0	
4/8/19	22.6	23.0	--[5]	23.8	24.6	
4/10/19	22.2	22.5	--[5]	23.3	24.1	
4/12/19	22.0	22.3	--[5]	23.4	24.3	
4/16/19	22.1	22.4	--[5]	23.1	23.9	
4/19/19	22.4	22.9	--[5]	23.5	24.2	
4/22/19	22.5	23.0	--[5]	23.2	23.8	
4/25/19	22.4	22.8	--[5]	22.9	23.5	

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 2: Natomas Cross Canal South Levee
Piezometer Groundwater Surface Elevations

Date	NCC-123-T1 El. +29.4	NCC-125-T1 El. +29.7	NCC-135-C1 El. +49.1	NCC-135-C2 El. +48.8		
1/22/19	22.2	22.6	23.8	23.8		
1/25/19	21.9	22.4	23.6	23.6		
2/5/19	22.0	22.6	23.7	23.7		
2/8/19	22.0	22.4	23.5	23.5		
2/15/19	22.9	23.2	24.1	24.2		
2/18/19	22.6	22.9	23.8	23.9		
2/20/19	22.5	22.7	23.6	23.8		
2/22/19	22.3	22.5	23.5	22.5		
2/27/19	23.4	23.8	24.6	24.4		
3/1/19	23.2	23.4	24.3	24.4		
3/4/19	23.2	23.4	24.3	24.4		
3/6/19	23.4	23.8	24.6	24.6		
3/8/19	23.3	23.5	24.4	24.5		
3/11/19	23.1	23.2	24.2	24.2		
3/13/19	23.0	23.2	24.1	24.1		
3/15/19	23.0	23.1	24.0	24.0		
3/19/19	22.9	23.0	23.8	23.9		
3/22/19	22.8	23.0	23.8	23.8		
3/26/19	23.0	23.2	23.7	24.0		
3/29/19	23.3	23.4	24.2	24.2		
4/1/19	23.3	23.4	23.9	24.0		
4/8/19	24.0	24.1	24.4	24.6		
4/10/19	23.6	23.9	24.6	24.6		
4/12/19	23.8	24.0	24.5	24.7		
4/16/19	23.4	23.7	24.5	24.5		
4/19/19	23.7	24.0	24.7	24.7		
4/22/19	23.4	23.6	24.4	24.4		
4/25/19	23.2	23.5	24.2	24.2		
Date	NCC-183-C1 El. +49.0	NCC-183-T1 El. +29.2	NCC-221-C1 El. +49.2	NCC-221-C2 El. +49.1	NCC-221-T1 El. +30.6	
1/22/19	23.1	--[2]	25.3	28.5	24.9	
1/25/19	22.9	23.3	25.0	25.7	24.8	
2/5/19	23.0	23.4	24.8	25.7	23.8	
2/8/19	23.1	23.5	25.7	27.6	24.6	
2/15/19	24.0	24.4	26.7	31.3	26.3	
2/18/19	23.9	24.4	27.4	31.9	27.0	
2/20/19	23.7	22.2	27.3	30.6	27.0	

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 2: Natomas Cross Canal South Levee
Piezometer Groundwater Surface Elevations

Date	NCC-183-C1 El. +49.0	NCC-183-T1 El. +29.2	NCC-221-C1 El. +49.2	NCC-221-C2 El. +49.1	NCC-221-T1 El. +30.6	
2/22/19	23.5	23.8	26.4	27.9	26.3	
2/27/19	24.1	24.7	26.8	30.2	25.7	
3/1/19	24.3	24.8	28.0	32.8	27.4	
3/4/19	24.2	24.7	28.1	32.7	27.8	
3/6/19	24.3	24.8	28.3	32.3	27.8	
3/8/19	24.3	24.7	28.2	32.7	27.9	
3/11/19	24.0	24.4	28.0	32.3	27.7	
3/13/19	23.8	24.2	27.7	31.8	27.6	
3/15/19	23.7	24.2	27.5	31.3	27.4	
3/19/19	23.4	--[2]	27.3	30.5	27.2	
3/22/19	23.6	23.7	26.8	29.0	26.9	
3/26/19	23.3	23.8	26.7	27.9	26.7	
3/29/19	23.7	24.1	27.4	30.8	26.8	
4/1/19	23.6	24.1	27.6	30.9	26.8	
4/8/19	23.4	23.9	27.3	31.4	26.9	
4/10/19	23.3	23.8	27.2	31.3	26.9	
4/12/19	23.2	23.7	27.3	31.2	26.8	
4/16/19	23.1	23.6	26.8	31.0	26.7	
4/19/19	23.1	23.6	26.6	30.5	26.5	
4/22/19	23.1	23.5	26.1	29.0	26.2	
4/25/19	22.8	23.2	25.4	26.8	25.3	
Date	NCC-223-C1 El. +49.5	NCC-223-T1 El. +28.1	NCC-228-F1 El. +31.5	NCC-228-T1 El. +30.5	NCC-228-C1 El. +46.4	
1/22/19	28.5	22.4	25.8	26.5	27.4	
1/25/19	25.4	21.8	25.0	25.2	25.4	
2/5/19	25.6	20.8	24.4	24.7	25.2	
2/8/19	27.3	21.5	26.0	26.4	26.9	
2/15/19	31.6	23.7	27.5	28.5	29.9	
2/18/19	31.9	24.0	28.5	29.4	30.6	
2/20/19	30.5	23.9	28.2	28.9	29.6	
2/22/19	27.6	23.5	26.9	27.6	27.5	
2/27/19	30.4	23.0	27.5	28.4	29.4	
3/1/19	33.0	23.6	29.3	30.1	31.5	
3/4/19	32.8	24.0	29.4	30.1	31.5	
3/6/19	32.4	24.4	29.5	30.1	31.2	
3/8/19	32.8	24.5	29.5	30.1	31.6	
3/11/19	32.4	24.5	29.3	30.1	31.2	

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 2: Natomas Cross Canal South Levee
Piezometer Groundwater Surface Elevations

Date	NCC-223-C1 El. +49.5	NCC-223-T1 El. +28.1	NCC-228-F1 El. +31.5	NCC-228-T1 El. +30.5	NCC-228-C1 El. +46.0	
3/13/19	31.9	24.4	28.9	29.8	30.7	
3/15/19	31.4	24.3	28.7	29.4	30.4	
3/19/19	30.4	24.1	28.3	29.0	29.7	
3/22/19	28.9	23.9	27.5	27.9	28.5	
3/26/19	27.7	23.6	27.2	27.4	27.7	
3/29/19	31.0	23.7	28.4	--[2]	30.0	
4/1/19	30.9	23.7	--[2]	29.2	30.1	
4/8/19	31.5	24.1	28.6	29.3	30.4	
4/10/19	31.4	24.1	28.4	29.2	30.2	
4/12/19	31.4	24.1	28.5	29.2	30.2	
4/16/19	31.2	24.1	28.1	29.0	30.0	
4/19/19	30.6	23.8	27.9	28.6	29.5	
4/22/19	28.9	23.4	27.0	27.6	28.2	
4/25/19	26.8	22.6	26.0	26.1	26.4	
Date	NCC-231-T1 El. +31.1	NCC-233-T1 El. +31.9	NCC-240-C1 El. +49.1	NCC-240-C2 El. +49.3	NCC-240-T1 El. +31.4	NCC-240-F1 El. +32.4
1/22/19	25.8	25.4	24.4	29.2	24.4	24.4
1/25/19	25.1	25.0	24.5	25.9	24.5	24.5
2/5/19	24.5	24.2	24.0	26.8	24.0	24.0
2/8/19	26.0	25.9	25.4	27.9	25.3	25.3
2/15/19	27.6	27.0	26.2	32.7	26.2	26.1
2/18/19	28.7	28.2	27.4	32.7	27.4	27.4
2/20/19	28.4	28.2	27.7	31.2	27.6	27.6
2/22/19	26.9	27.1	27.0	28.2	26.9	26.9
2/27/19	27.7	27.4	27.2	31.6	27.1	27.1
3/1/19	29.6	29.2	28.5	33.8	28.4	28.4
3/4/19	29.7	29.4	28.9	33.5	28.9	28.9
3/6/19	29.8	29.5	29.2	33.1	29.2	29.0
3/8/19	29.9	29.6	29.2	33.6	29.2	29.2
3/11/19	29.6	29.3	29.1	33.1	29.1	29.1
3/13/19	29.3	29.0	28.8	32.6	28.8	28.8
3/15/19	29.0	28.8	28.6	32.0	28.6	28.6
3/19/19	28.6	28.5	28.4	31.1	28.4	28.4
3/22/19	27.9	27.8	--[7]	--[7]	27.9	27.9
3/26/19	27.5	27.7	27.9	28.3	27.8	27.8
3/29/19	28.7	28.4	28.4	31.6	29.0	28.3
4/1/19	29.0	28.8	28.8	31.5	28.8	28.8

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 2: Natomas Cross Canal South Levee
Piezometer Groundwater Surface Elevations

Date	NCC-231-T1 El. +31.1	NCC-233-T1 El. +31.9	NCC-240-C1 El. +49.1	NCC-240-C2 El. +49.3	NCC-240-T1 El. +31.4	NCC-240-F1 El. +32.4
4/8/19	28.9	28.6	28.4	32.1	28.4	28.4
4/10/19	28.8	28.5	28.3	32.0	28.3	28.3
4/12/19	28.8	28.6	28.4	31.9	28.4	28.4
4/16/19	28.4	28.1	27.9	31.7	27.9	27.9
4/19/19	28.2	28.0	27.8	31.1	27.7	27.8
4/22/19	27.3	27.2	27.2	29.4	27.2	27.2
4/25/19	26.3	26.3	26.6	27.0	26.6	26.6

Notes:

1. “El.” = ground surface elevation at piezometer location.
2. “ -- “ = Not measured.
3. Groundwater elevation in feet (NAVD88)
4. Piezometer water levels measured at top of casing
5. Well is dry.
6. Well is flooded.
7. Erroneous data point removed

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 3: Sacramento River East Levee
Piezometer Groundwater Surface Elevations

Date	SREL 1-27-F1 El. +27.4	SREL-27-R1 El. +44.9	SREL1-27-C1 El. +48.2	SREL1-27-C2 El. +48.7	SREL1-27-T1 El. +32.2
1/22/19	15.5	24.1	23.6	--[5]	23.3
1/25/19	19.7	23.7	23.6	--[5]	23.3
2/5/19	19.5	22.8	22.7	--[5]	22.8
2/8/19	20.5	24.9	24.5	--[5]	24.2
2/15/19	--[6]	26.5	25.7	--[5]	25.6
2/18/19	--[6]	28.5	27.7	--[5]	27.2
2/20/19	23.7	28.4	27.9	--[5]	27.4
2/22/19	23.0	27.2	27.0	--[5]	26.6
2/27/19	--[6]	27.2	25.9	--[5]	27.0
3/1/19	--[6]	32.8	29.1	--[5]	28.6
3/4/19	--[6]	30.7	30.1	--[5]	29.3
3/6/19	--[6]	30.9	30.3	--[5]	29.6
3/8/19	--[6]	31.2	30.6	--[5]	29.7
3/11/19	--[6]	31.2	30.5	--[5]	29.7
3/13/19	--[6]	30.8	30.4	--[5]	29.5
3/15/19	--[6]	30.5	30.1	--[5]	29.4
3/19/19	--[6]	30.0	29.5	--[5]	29.1
3/22/19	--[6]	29.5	29.0	--[5]	28.5
3/26/19	--[6]	28.4	28.3	--[5]	28.2
3/29/19	--[6]	29.7	29.2	--[5]	28.9
4/1/19	--[6]	30.1	29.6	--[5]	29.1
4/8/19	--[6]	30.4	30.0	--[5]	29.4
4/10/19	--[6]	30.4	30.0	--[5]	29.3
4/12/19	--[6]	30.4	30.0	--[5]	29.3
4/16/19	--[6]	29.0	29.7	--[5]	29.0
4/19/19	--[6]	29.8	--[2]	--[5]	28.9
4/22/19	--[6]	28.8	28.7	--[5]	28.0
4/25/19	--[6]	27.4	27.6	--[5]	27.0
Date	SREL 1B-72-R1 El. +44.6	SREL 1B-84-R1 El. +44.2	SREL 1B-168-R2 El. +44.3	SREL 1B-195-R1 El. +43.0	
1/22/19	28.2	25.9	14.0	24.5	
1/25/19	25.1	24.8	16.5	21.9	

© 2018 Kleinfelder

Table 3: Sacramento River East Levee
Piezometer Groundwater Surface Elevations

Date	SREL 1B-72-R1 El. +44.6	SREL 1B-84-R1 El. +44.2	SREL 1B-168-R2 El. +44.3	SREL 1B-195-R1 El. +43.0	
2/5/19	25.2	23.2	17.4	22.2	
2/8/19	27.1	26.2	18.7	23.6	
2/15/19	30.5	28.1	20.7	27.3	
2/18/19	32.0	30.0	30.0	27.4	
2/20/19	30.8	29.8	29.3	26.5	
2/22/19	28.0	27.9	28.4	24.3	
2/27/19	29.2	--[6]	19.2	26.6	
3/1/19	32.5	--[6]	18.2	28.3	
3/4/19	33.0	32.1	31.8	28.2	
3/6/19	32.7	32.3	32.0	27.9	
3/8/19	33.1	32.6	32.4	28.2	
3/11/19	32.8	--[7]	32.1	27.9	
3/13/19	32.3	--[7]	31.7	27.5	
3/15/19	31.8	--[7]	31.3	27.1	
3/19/19	30.8	30.9	30.6	26.4	
3/22/19	29.2	29.6	29.9	25.2	
3/26/19	27.9	28.3	29.2	24.3	
3/29/19	30.8	30.4	29.6	26.7	
4/1/19	31.0	30.7	30.0	26.6	
4/8/19	31.7	31.4	30.7	27.0	
4/10/19	31.6	31.3	30.7	27.1	
4/12/19	31.5	31.3	30.7	26.9	
4/16/19	31.5	31.2	30.6	27.0	
4/19/19	30.8	30.7	30.2	26.6	
4/22/19	29.2	29.4	29.6	25.5	
4/25/19	26.8	27.4	28.8	24.5	
Date	I-5 Well El. +26.4	SREL 9-423-T1 El. +44.2			
1/22/19	12.2	14.1			
1/25/19	12.9	14.2			
2/5/19	13.4	15.0			
2/8/19	14.4	15.6			
2/15/19	16.9	17.4			
2/18/19	18.9	17.8			
2/20/19	19.8	17.9			

© 2018 Kleinfelder

Table 3: Sacramento River East Levee
Piezometer Groundwater Surface Elevations

Date	I-5 Well El. +26.4	SREL 9-423-T1 El. +44.2			
2/22/19	19.9	17.6			
2/27/19	20.3	18.9			
3/1/19	21.5	19.3			
3/4/19	22.5	19.6			
3/6/19	23.6	20.0			
3/8/19	23.2	20.0			
3/11/19	23.0	19.8			
3/13/19	22.8	19.6			
3/15/19	22.7	19.5			
3/19/19	22.3	19.2			
3/22/19	21.8	18.9			
3/26/19	21.8	19.1			
3/29/19	22.0	19.5			
4/1/19	22.2	19.4			
4/8/19	22.2	19.4			
4/10/19	22.2	19.3			
4/12/19	22.2	19.4			
4/16/19	22.0	19.2			
4/19/19	21.8	19.0			
4/22/19	21.3	18.6			
4/25/19	20.6	--			
Date	DH-7-1 (shallow) El. +41.4	DH-7-1 (deep) El. +41.4	2F-01-05 El. +24.1	2F-01-15 El. +28.4	2F-01-15 El. +23.0
1/22/19	--[5]	--[5]	14.4	--[8]	16.3
1/25/19	--[5]	12.3	13.9	--[8]	14.5
2/5/19	--[5]	13.8	13.7	--[8]	14.6
2/8/19	--[5]	14.4	14.4	--[8]	16.2
2/15/19	--[5]	16.6	15.8	--[8]	20.4
2/18/19	--[5]	17.8	15.8	--[8]	20.6
2/20/19	--[5]	18.9	15.6	--[8]	19.4
2/22/19	--[5]	19.0	15.0	--[8]	18.5
2/27/19	--[5]	18.9	16.4	--[8]	20.9
3/1/19	--[5]	19.9	16.4	--[8]	21.6
3/4/19	--[5]	21.3	16.5	--[8]	21.2

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 3: Sacramento River East Levee
Piezometer Groundwater Surface Elevations

Date	DH-7-1 (shallow) El. +41.4	DH-7-1 (deep) El. +41.4	2F-01-05 El. +24.1	2F-01-15 El. +28.4	2F-01-15 El. +23.0
3/6/19	--[5]	21.9	16.3	--[8]	21.2
3/8/19	23.2	22.2	16.1	--[8]	21.3
3/11/19	24.2	22.8	15.6	--[8]	21.0
3/13/19	24.6	23.1	15.9	--[8]	20.3
3/15/19	24.6	23.1	15.7	--[8]	19.7
3/19/19	24.3	22.9	15.4	--[8]	18.9
3/22/19	23.9	22.4	15.4	--[8]	14.4
3/26/19	23.4	22.3	15.5	--[8]	17.3
3/29/19	23.1	21.9	15.9	--[8]	19.2
4/1/19	23.3	22.3	15.9	--[8]	19.2
4/8/19	23.7	22.6	15.8	--[8]	20.0
4/10/19	23.8	22.8	15.2	--[8]	19.8
4/12/19	24.0	22.9	15.5	--[8]	19.8
4/16/19	24.0	22.8	15.5	--[8]	19.7
4/19/19	23.9	22.8	15.8	--[8]	19.2
4/22/19	23.6	22.4	15.5	--[8]	18.2
4/25/19	23.2	21.9	15.0	--[8]	16.7
Date	URS071000_ 700+00C El. +41.7	URS071000_ 700+00F El. +24.2	URS071000_ 700+00T El. +26.5		
1/22/19	10.7	12.6	12.4		
1/25/19	11.1	12.4	12.2		
2/5/19	11.6	11.4	11.1		
2/8/19	11.5	13.0	12.8		
2/15/19	12.6	14.7	14.6		
2/18/19	13.0	15.7	15.6		
2/20/19	13.4	15.8	15.7		
2/22/19	13.6	15.1	14.9		
2/27/19	14.0	15.9	15.7		
3/1/19	14.3	17.2	17.2		
3/4/19	14.9	18.1	17.9		
3/6/19	15.2	16.9	16.7		
3/8/19	15.3	16.6	16.2		

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 3: Sacramento River East Levee
Piezometer Groundwater Surface Elevations

Date	URS071000_ 700+00C El. +41.7	URS071000_ 700+00F El. +24.2	URS071000_ 700+00T El. +26.5		
3/11/19	15.6	15.5	15.6		
3/13/19	15.7	15.1	15.2		
3/15/19	15.8	14.7	14.7		
3/19/19	16.0	--[2]	14.2		
3/22/19	16.2	15.5	15.4		
3/26/19	16.4	15.6	15.4		
3/29/19	16.6	16.2	16.1		
4/1/19	16.8	16.6	16.5		
4/8/19	17.2	16.2	16.1		
4/10/19	17.2	15.4	15.3		
4/12/19	17.4	15.4	16.3		
4/16/19	17.7	16.7	16.3		
4/19/19	17.7	16.6	16.4		
4/22/19	17.8	16.2	16.1		
4/25/19	17.9	15.4	15.2		

Notes:

1. "El." = ground surface elevation at piezometer location.
2. " -- " = Not measured.
3. Groundwater elevation in feet (NAVD88)
4. Piezometer water levels measured at top of casing
5. Well is dry.
6. Well is flooded.
7. Well is buried.
8. Well not located.

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 4: American River North Levee
Piezometer Groundwater Surface Elevations

Date	MW-1 El. +52.0	MW-2 El. +38.6
1/22/19	12.4	5.8
1/25/19	12.3	6.0
2/5/19	11.5	5.9
2/8/19	12.4	6.1
2/15/19	16.0	7.1
2/18/19	18.1	8.0
2/20/19	18.0	8.4
2/22/19	17.2	8.6
2/27/19	18.2	--[6]
3/1/19	19.5	--[6]
3/4/19	19.9	10.0
3/6/19	20.1	--[6]
3/8/19	20.3	10.4
3/11/19	20.5	10.8
3/13/19	19.9	11.0
3/15/19	19.4	11.0
3/19/19	18.4	10.9
3/22/19	17.6	10.7
3/26/19	16.7	10.5
3/29/19	16.9	10.4
4/1/19	17.2	10.6
4/8/19	18.3	10.9
4/10/19	18.5	11.0
4/12/19	18.7	11.1
4/16/19	18.7	11.2
4/19/19	18.3	11.3
4/22/19	17.8	11.2
4/25/19	17.2	11.0

Notes:

1. “El.” = ground surface elevation at piezometer location.
2. “ -- “ = Not measured.
3. Groundwater elevation in feet (NAVD88)
4. Piezometer water levels measured at top of casing
5. Well is dry.
6. Well is flooded.

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Table 5: Summary of Piezometer Locations

Levee Segment	Approximate Station	Piezometer Name	Figure No.
NCC	3+00	NCC-3-T1	2-1
NCC	21+00	NCC-21-R1, NCC-21-C1, NCC-21-F1	2-1
NCC	53+00	NCC-53-T1	2-2
NCC	56+00	NCC-56-T1	2-2
NCC	58+00	NCC-58-T1	2-2
NCC	61+00	NCC-61-T1	2-2
NCC	63+00	NCC-63-T1	2-2
NCC	116+00	NCC-116-C1, NCC-116-C2, NCC-116-T1	2-3
NCC	118+00	NCC-118-T1	2-3
NCC	121+00	NCC-121-T1	2-3
NCC	123+00	NCC-123-T1	2-3
NCC	125+00	NCC-125-T1	2-3
NCC	135+00	NCC-135-C1, NCC-135-C2, NCC-135-F1	2-3
NCC	183+00	NCC-183-C1, NCC-183-T1	2-4
NCC	221+00	NCC-221-C1, NCC-221-C2, NCC-221-T1	2-4
NCC	223+00	NCC-223-C1, NCC-223-T1	2-4
NCC	228+00	NCC-228-C1, NCC-228-T1, NCC-228-F1	2-4
NCC	231+00	NCC-231-T1	2-4
NCC	233+00	NCC-233-T1	2-4
NCC	240+00	NCC-240-C1, NCC-240-C2, NCC-240-T1, NCC-240-F1	2-5
SREL	27+00	SREL 1-27-R1, SREL 1-27-C1, SREL 1-27-C2, SREL 1-27-T1, SREL 1-27-F1	2-6
SREL	72+00	SREL 1B-72-R1	2-6
SREL	84+00	SREL 1B-84-R1	2-6
SREL	168+00	SREL 1B-168-R2	2-6
SREL	195+00	SREL 1B-195-R1	2-6
SREL	336+00	SREL 7-336-T1	2-7
SREL	423+00	SREL 9-423-T1	2-7
SREL	449+00	I-5 Well	2-7
SREL	678+00	2F-01-05	2-8
SREL	700+00	URS71000_700-00C, URS71000_700+00T, URS71000_700+00F	2-8
SREL	715+00	DH-7-1 (shallow), DH-7-1 (deep)	2-8
SREL	758+00	2F-01-15	2-8
SREL	810+00	2F-01-19	2-8
ARNL	3339+50	MW-1, MW-2	2-9

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

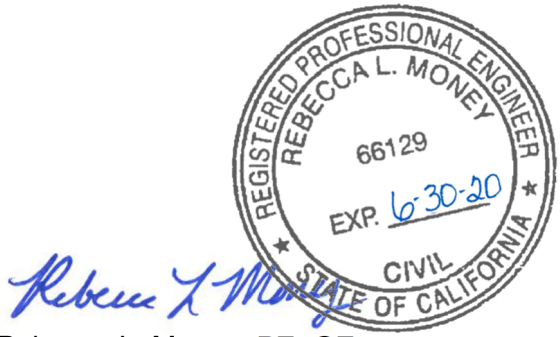
The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.
stacy
We appreciate the opportunity to work with you on this project. If you have any questions regarding this report, please contact us.

Respectfully submitted,

KLEINFELDER, INC.



Stacy Mann
Staff Toxicologist



Rebecca L. Money, PE, GE
Senior Geotechnical Engineer

Reviewed By:



Timothy A. Williams, PE, GE
Project Manager

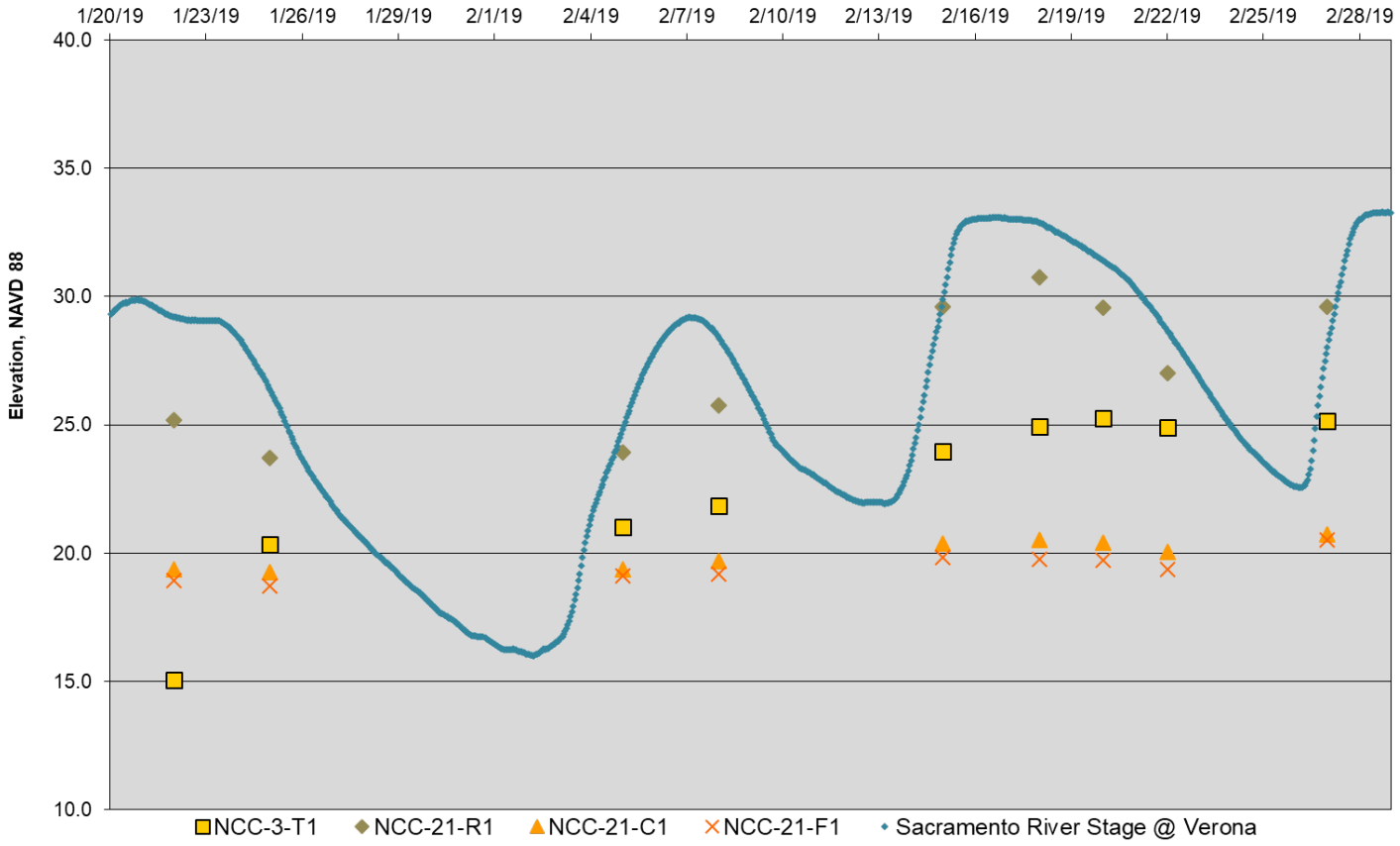
ATTACHMENTS
Figure 1-1: Site Location Map
Figures 2-1 through 2-9: Piezometer Location Maps
Figures 3-1 through 3-39: Groundwater Data

© 2018 Kleinfelder
KLEINFELDER 2882 Prospect Park Dr., Suite 200, Rancho Cordova, CA 95670 p | 916.366-1701 f | 916.366-7013

Note: Piezometers match locations on FIGURE 2-1

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Natomas Cross Canal Groundwater Level Elevations - Stations 0+00 to 30+00



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	3+00	Landside Toe	32.4	NCC-3-T1	Cutoff Wall
	21+00	Riverside	43	NCC-21-R1	
		Crown	49.1	NCC-21-C1	
		Field	21.5	NCC-21-F1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

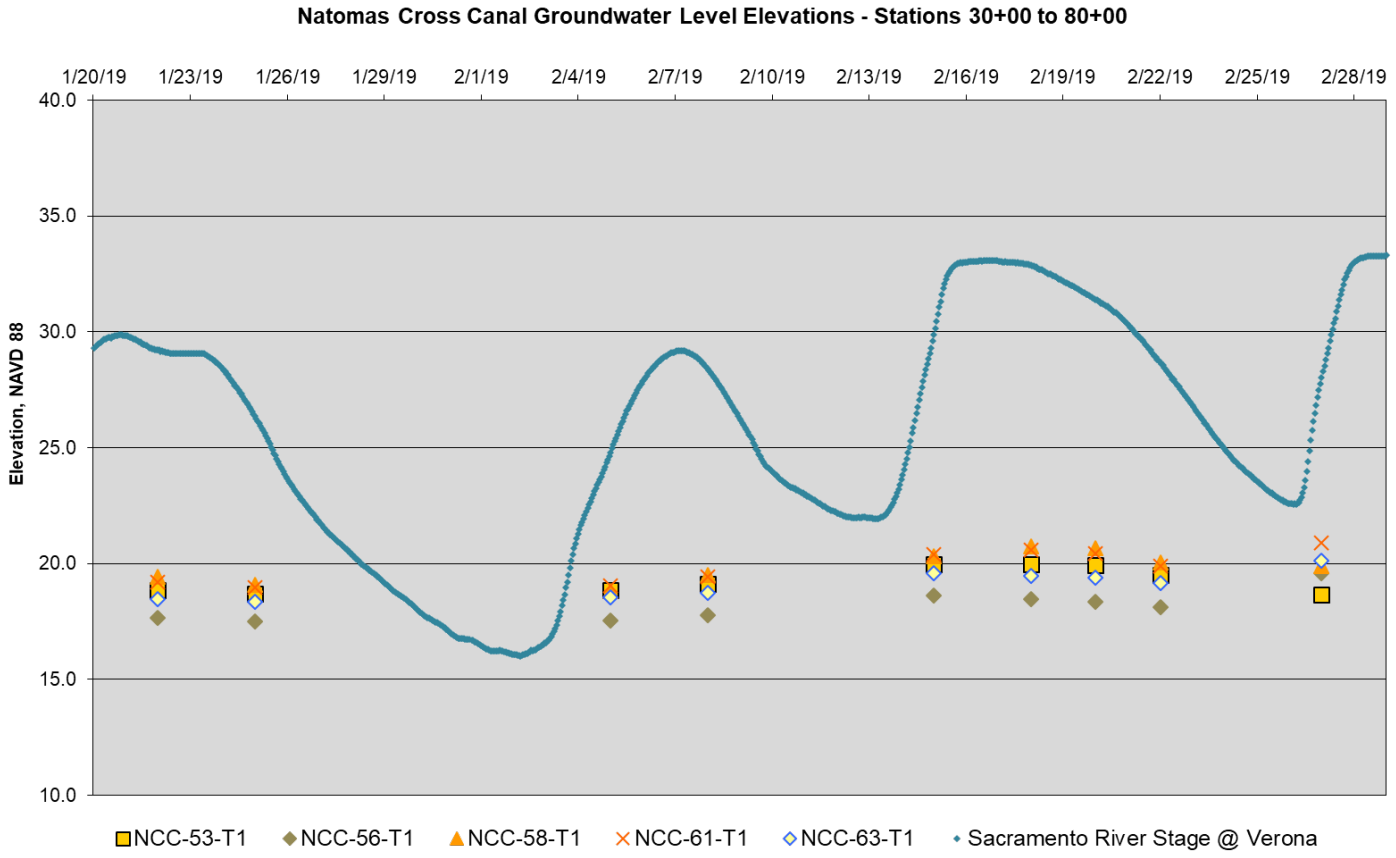
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 0+00 TO 30+00
JANUARY AND FEBRUARY 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-1

Note: Piezometers match locations on FIGURE 2-2

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	53+00	Landside Toe	27.1	NCC-53-T1	Cutoff Wall
	56+00		28.3	NCC-56-T1	Pumping Plant + Window
	58+00		33.2	NCC-58-T1	Pumping Plant + Window
	61+00		28.1	NCC-61-T1	Cutoff Wall
	63+00		26.4	NCC-63-T1	Cutoff Wall

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

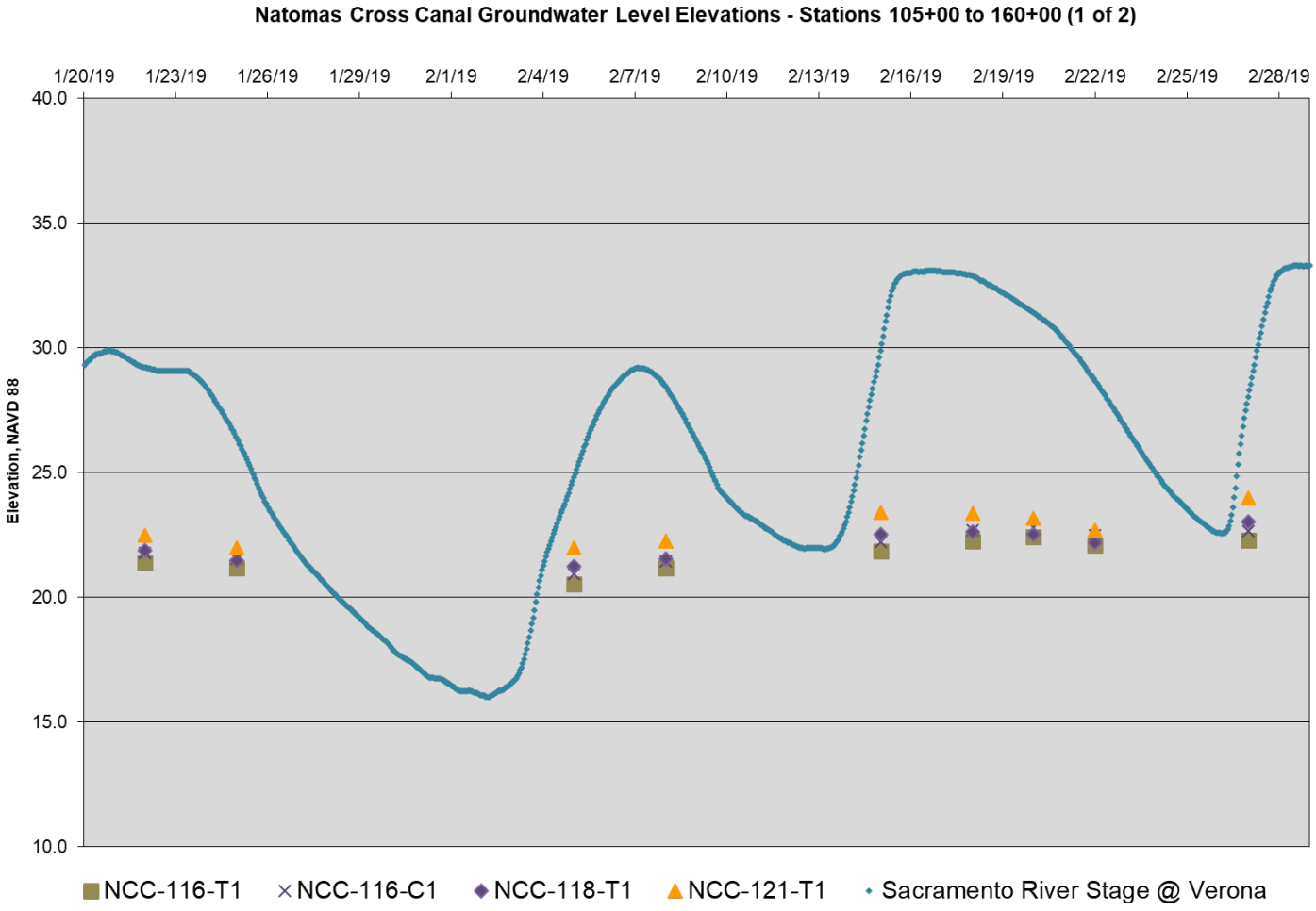
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 30+00 TO 80+00
JANUARY AND FEBRUARY 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-2

Note: Piezometers match locations on FIGURE 2-3

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC Note: NCC-116-C2 dry.	116+00	Waterside of COW	49	NCC-116-C1	Cutoff Wall
		Landside of COW	49.1	NCC-116-C2	
		Landside Toe	26.1	NCC-116-T1	
	118+00	Landside Toe	26.3	NCC-118-T1	Cutoff Wall
	121+00	Landside Toe	32.3	NCC-121-T1	Pumping Plant + Window

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 105+00 TO 160+00 (1 of 2)
JANUARY AND FEBRUARY 2019

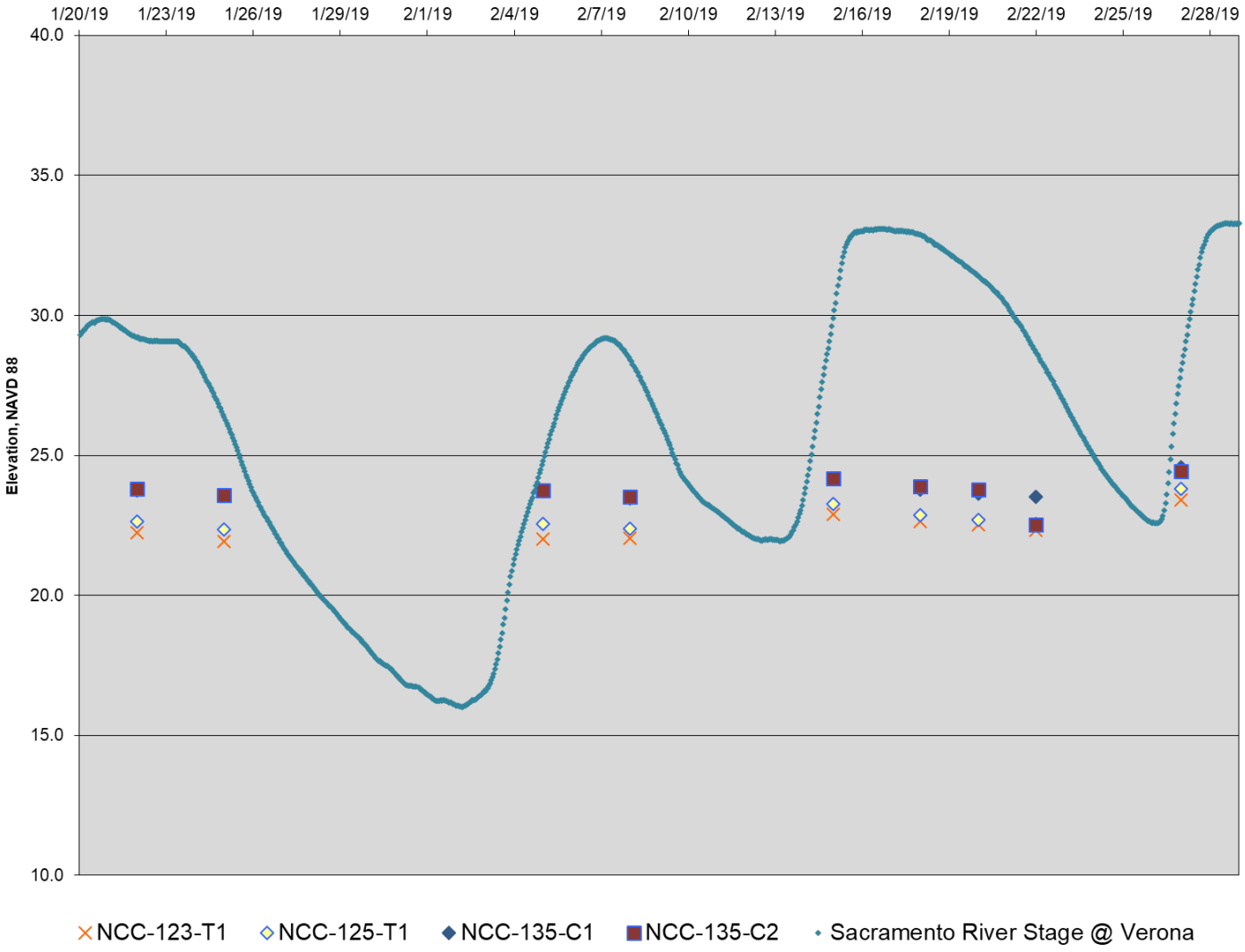
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-3

Note: Piezometers match locations on FIGURE 2-3

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Natomas Cross Canal Groundwater Level Elevations - Stations 105+00 to 160+00 (2 of 2)



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	123+00	Landside Toe	49	NCC-123-T1	Cutoff Wall
	125+00	Landside Toe	49.1	NCC-125-T1	
	135+00	Landside of COW	26.1	NCC-135-C1	
		Waterside of COW	26.3	NCC-135-C2	
		Field	32.3	NCC-135-F1	

Note: NCC-135-F1 destroyed and not measured.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B .MONEY
FILE NAME:	GW_Plots.pub

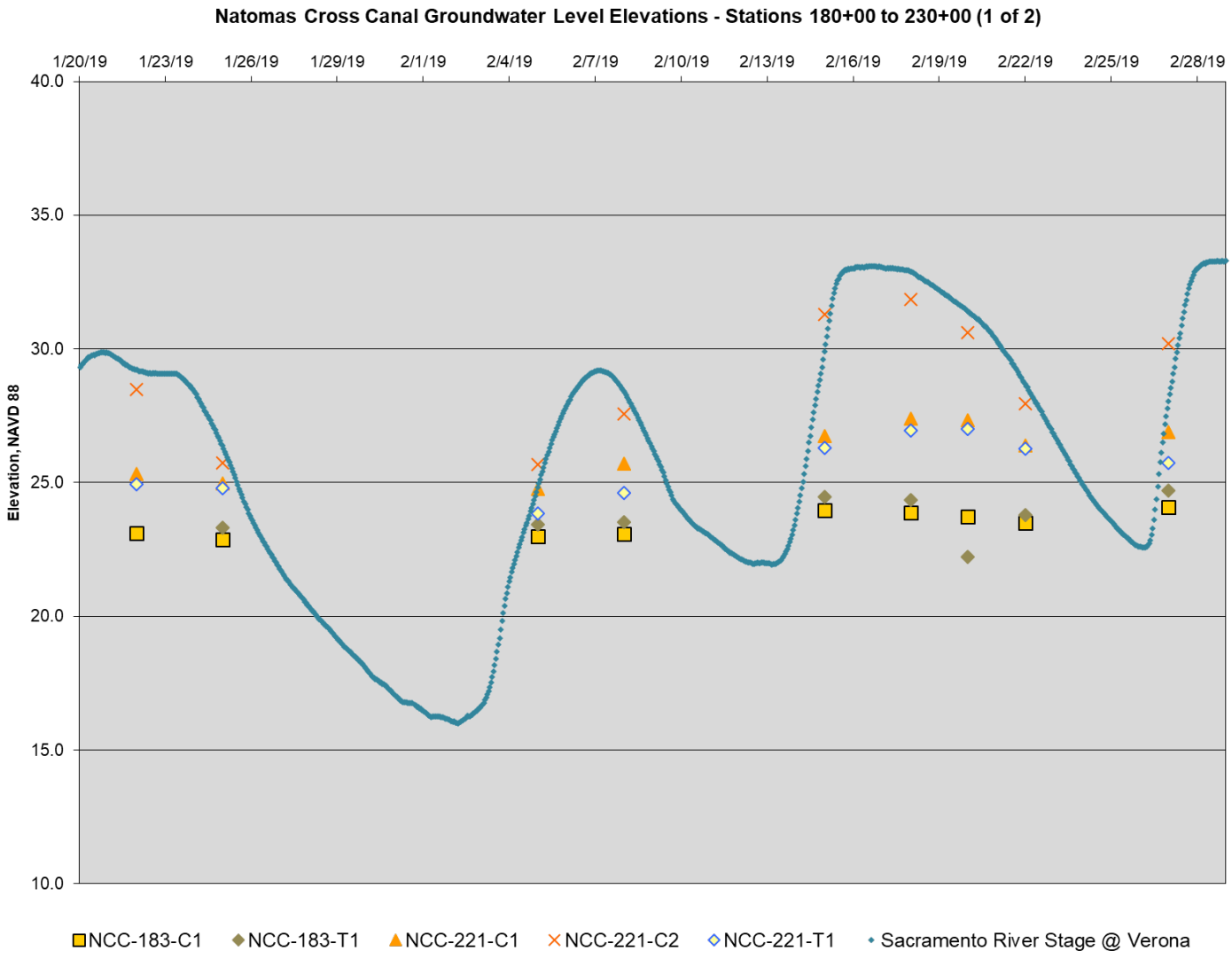
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 105+00 TO 160+00 (2 of 2)
JANUARY AND FEBRUARY 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-4

Note: Piezometers match locations on FIGURE 2-4

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	183+00	Crown	49	NCC-183-C1	Cutoff Wall
		Landside Toe	29.2	NCC-183-T1	
	221+00	Landside of COW	49.2	NCC-221-C1	
		Waterside of COW	49.1	NCC-221-C2	
		Landside Toe	30.6	NCC-221-T1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

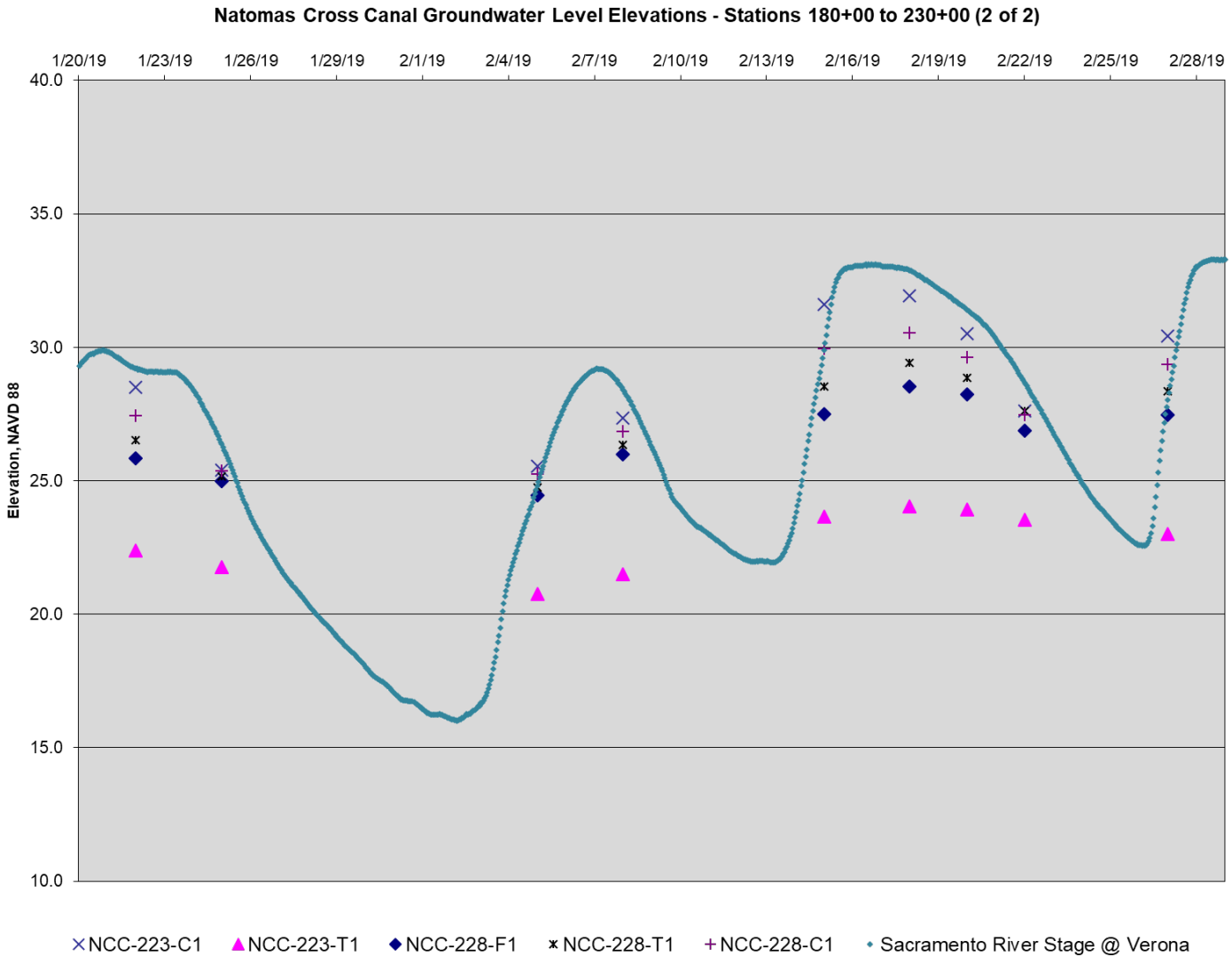
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 180+00 TO 230+00 (1 of 2)
JANUARY AND FEBRUARY 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-5

Note: Piezometers match locations on FIGURE 2-4

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	223+00	Crown	49.5	NCC-223-C1	Highway 99/70 Window
		Landside Toe	28.1	NCC-223-T1	
	228+00	Field	31.5	NCC-228-F1	
		Landside Toe	30.5	NCC-228-T1	
		Crown	46.4	NCC-228-CA	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

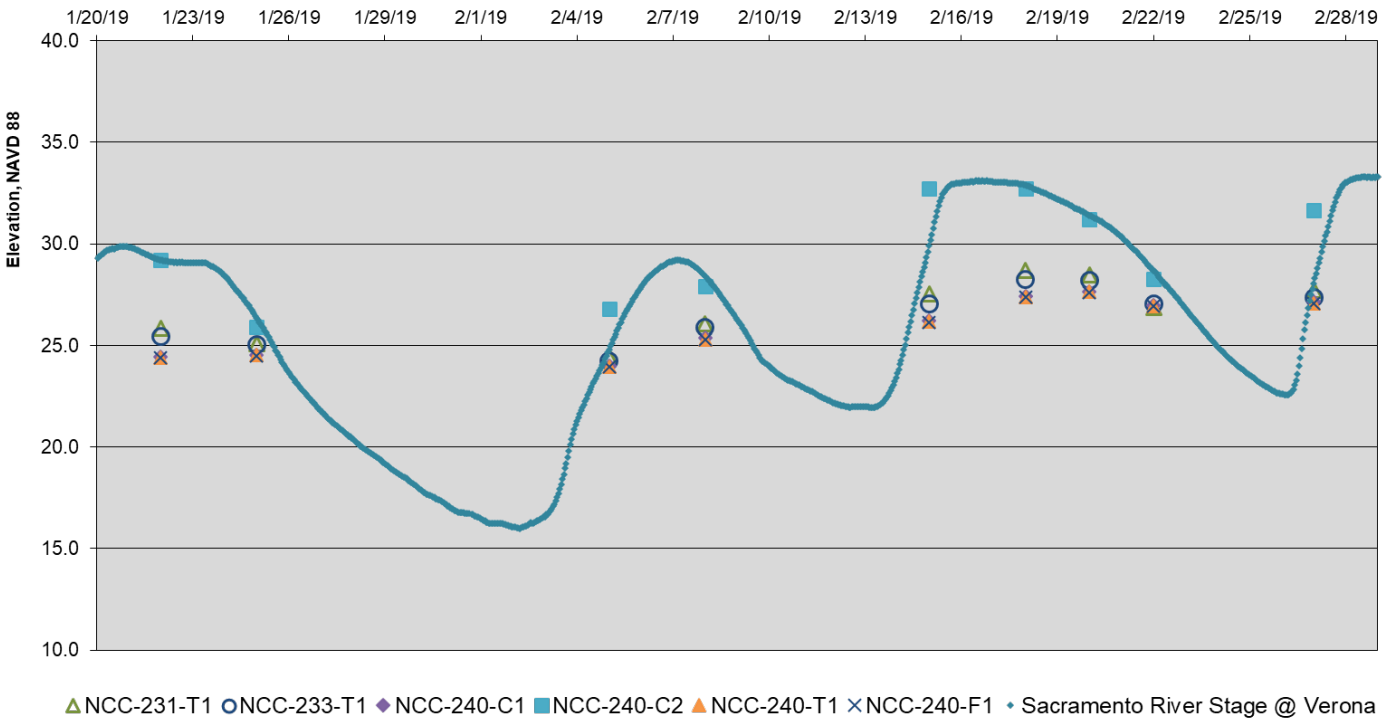
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 180+00 TO 230+00 (2 of 2)
JANUARY AND FEBRUARY 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-6

Note: Piezometers match locations on FIGURE 2-5

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	231+00	Landside Toe	31.1	NCC-231-T1	Highway 99/70
	233+00	Landside Toe	31.9	NCC-233-T1	Cutoff Wall
	240+00	Landside of COW	49.1	NCC-240-C1	Cutoff Wall
		Waterside of COW	49.3	NCC-240-C2	
		Landside Toe	31.4	NCC-240-T1	
		Field	32.4	NCC-240-F1	

Note:
224+00 to 231+00 Hwy 99/70 Window
231+00 to 253+00 Full Cutoff Wall

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

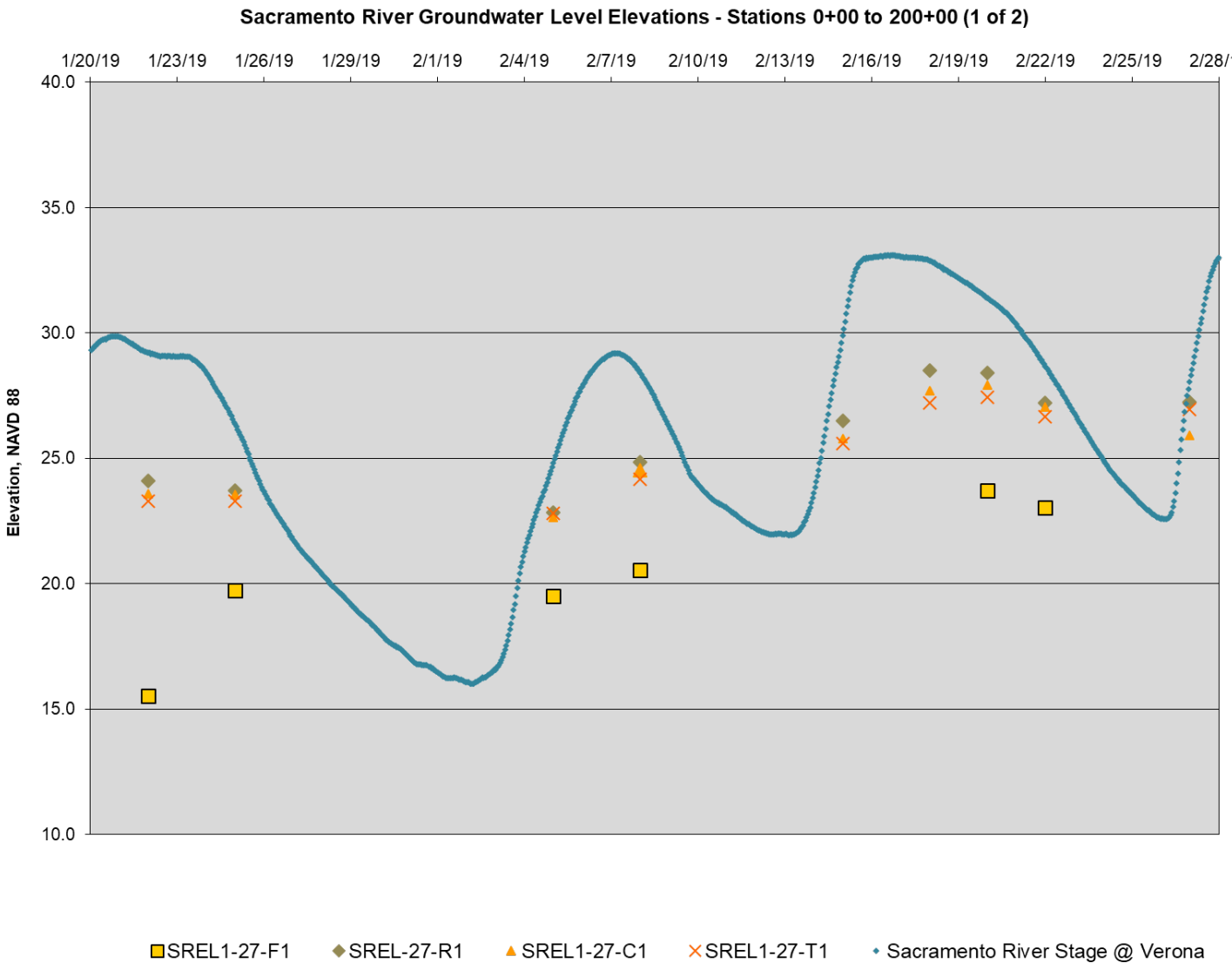
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 230+00 TO 240+00
JANUARY AND FEBRUARY 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-7

Note: Piezometers match locations on FIGURE 2-6

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	27+00	Field	27.4	SREL-1-27-F1	Cutoff Wall
		Riverside	44.9	SREL-1-27-R1	
		Waterside of	48.2	SREL-1-27-C1	
		Landside of COW	48.7	SREL-1-27-C2	
		Landside Toe	32.2	SREL-1-27-T1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 0+00 TO 200+00 (1 of 2)
JANUARY AND FEBRUARY 2019

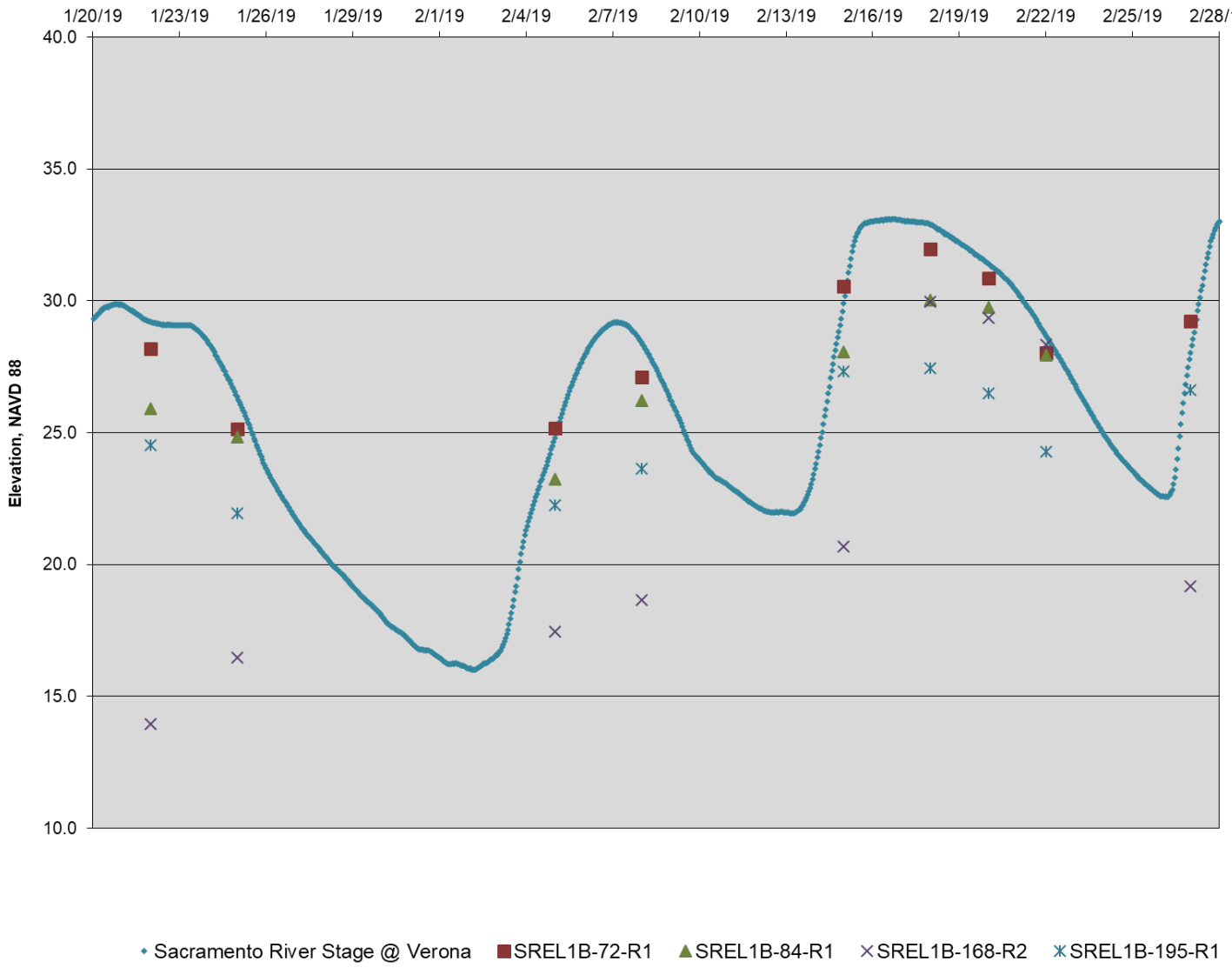
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-8

Note: Piezometers match locations on FIGURE 2-6

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Level Elevations - Stations 0+00 to 200+00 (2 of 2)



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	72+00	Riverside	44.6	SREL1B-72-R1	Cutoff Wall
SREL	84+00		44.2	SREL1B-84-R1	
SREL	168+00		44.3	SREL1B-168-R2	
SREL	195+00		43	SREL1B-195-R1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 0+00 TO 200+00 (2 of 2)
JANUARY AND FEBRUARY 2019

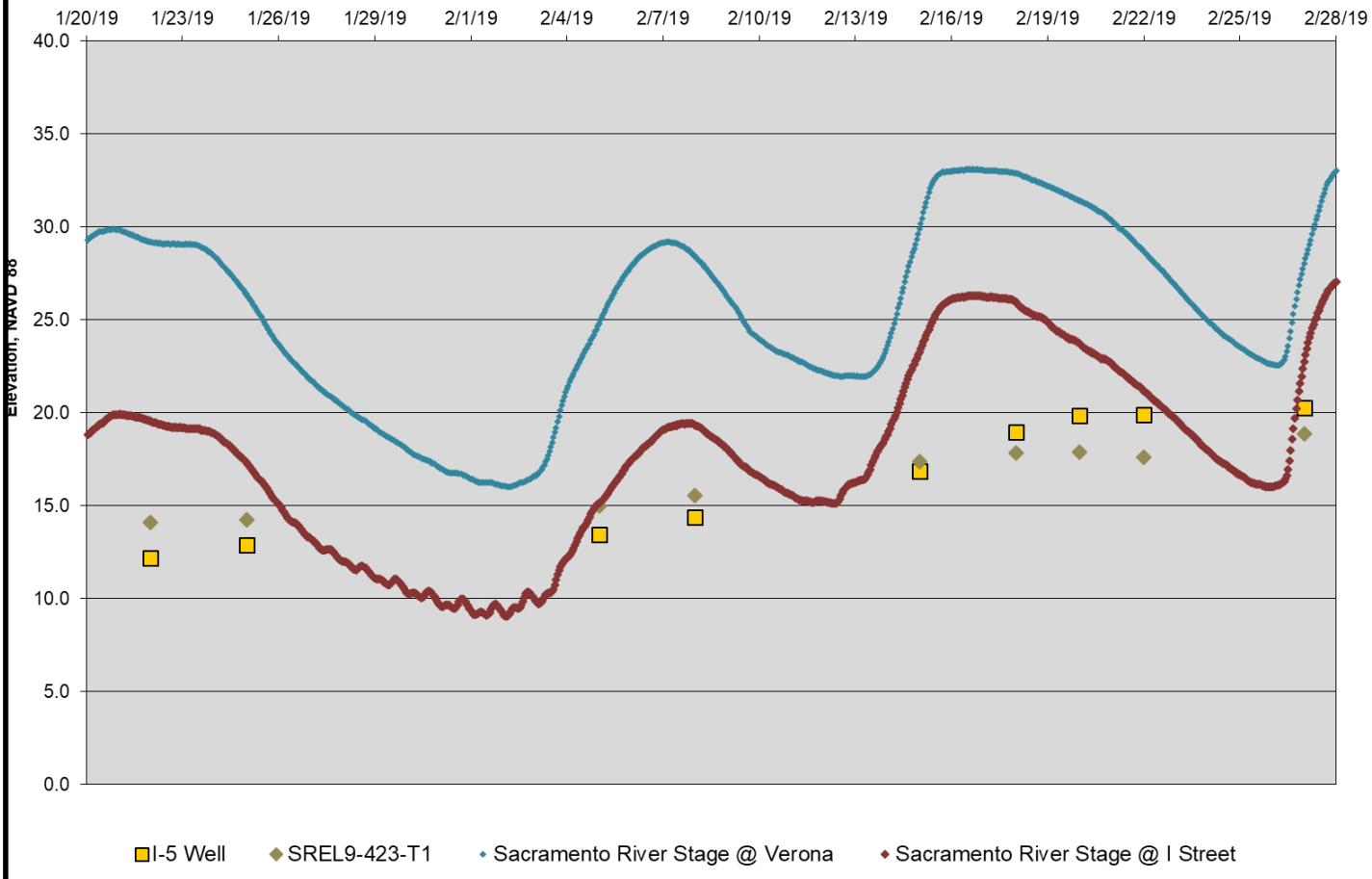
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-9

Note: Piezometers match locations on FIGURE 2-7

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Elevation Stations - 330+00 to 450+00



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	336+00	Landside Toe	34.4	SREL7-336-T1	Cutoff Wall
SREL	423+00	Landside Toe	30.1	SREL9-423-T1	
SREL	449+00	Landside Toe	26.45	I-5 Well	Window

Note:
SREL 7-336-T1 damaged.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 330+00 TO 450+00
JANUARY AND FEBRUARY 2019

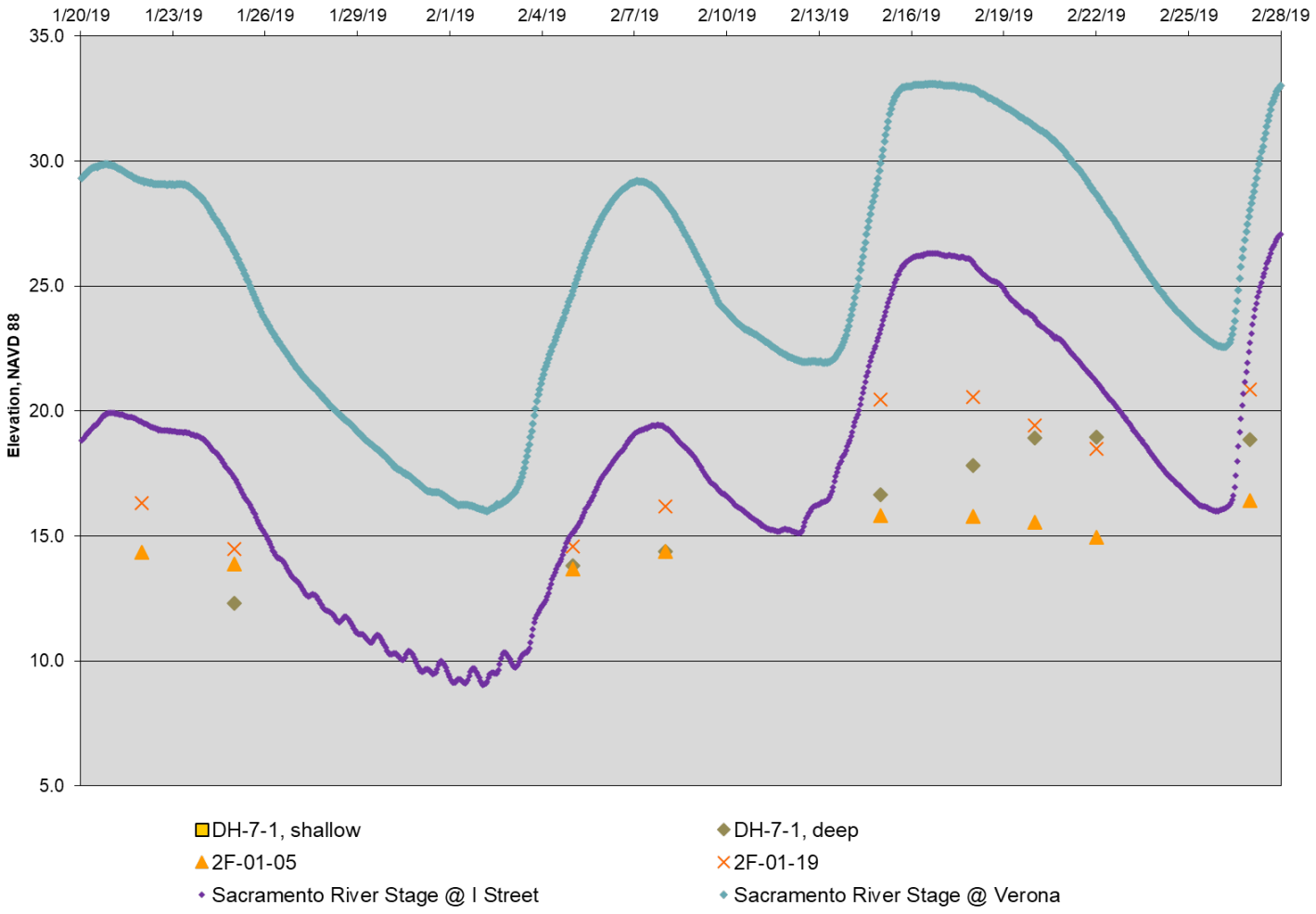
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-10

Note: Piezometers match locations on FIGURE 2-8

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Elevations - Stations 670+00 to 830+00 (1 of 2)



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	678+00	Landside Toe	24.1	2F-01-05	No Improvement
	715+00	Crown	41.4	DH-7-1 (shallow), DH-7-1 (deep)	
	758+00	Landside Toe	27.5	2F-01-15	
	810+00	Field	23.0	2F-01-19	

Note:
DH-7-1 Shallow was encountered to be dry.
2F-01-15 could not be located.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 670+00 TO 830+00 (1 of 2)
JANUARY AND FEBRUARY 2019

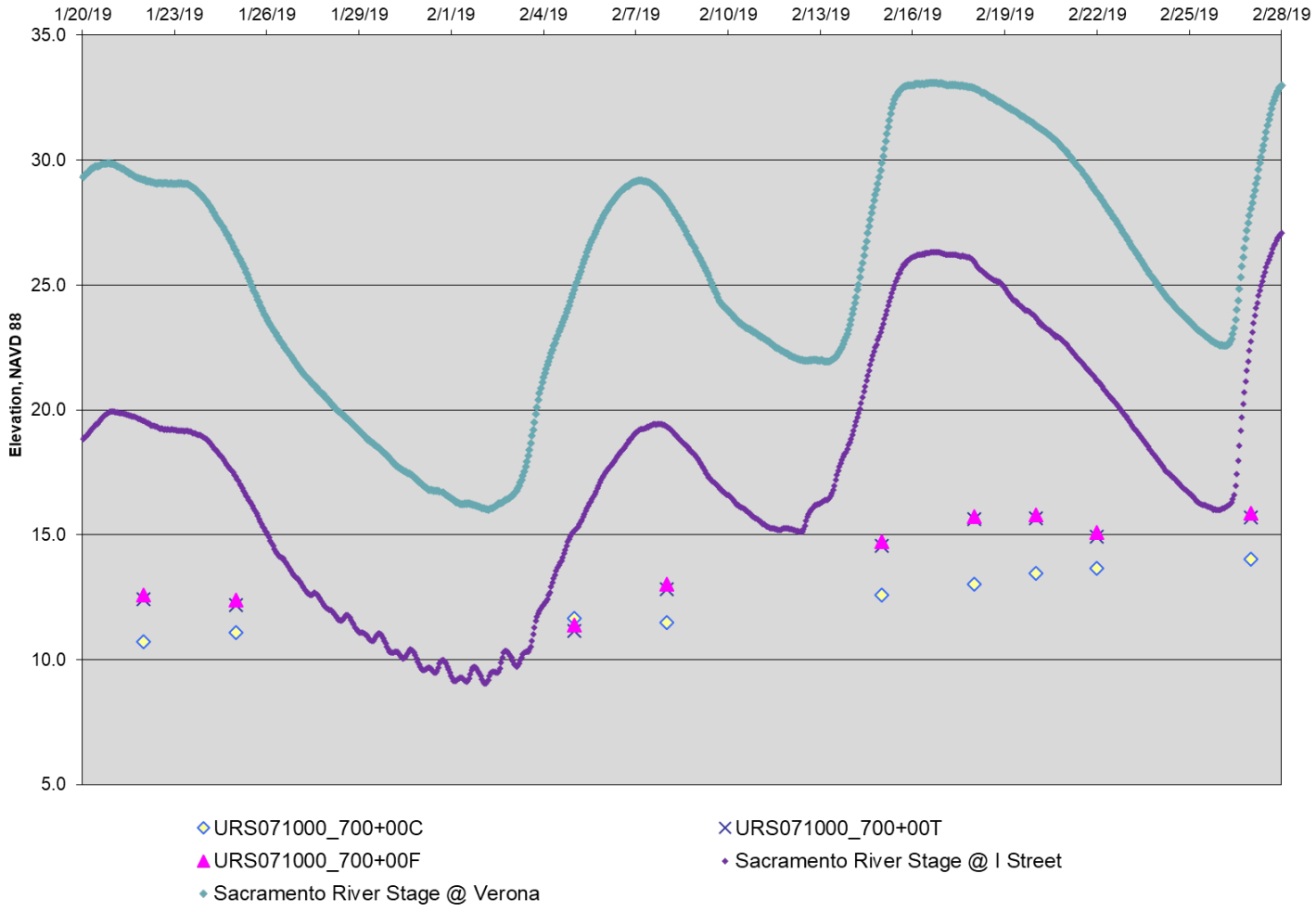
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-11

Note: Piezometers match locations on FIGURE 2-8

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Elevations - Stations 670+00 to 830+00 (2 of 2)



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	700+00	Crown	41.7	URS71000_700+00C	No Improvement
		Landside Toe	26.5	URS71000_700+00T	
		Field	24.2	URS71000_700+00F	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 670+00 TO 830+00 (2 of 2)
JANUARY AND FEBRUARY 2019

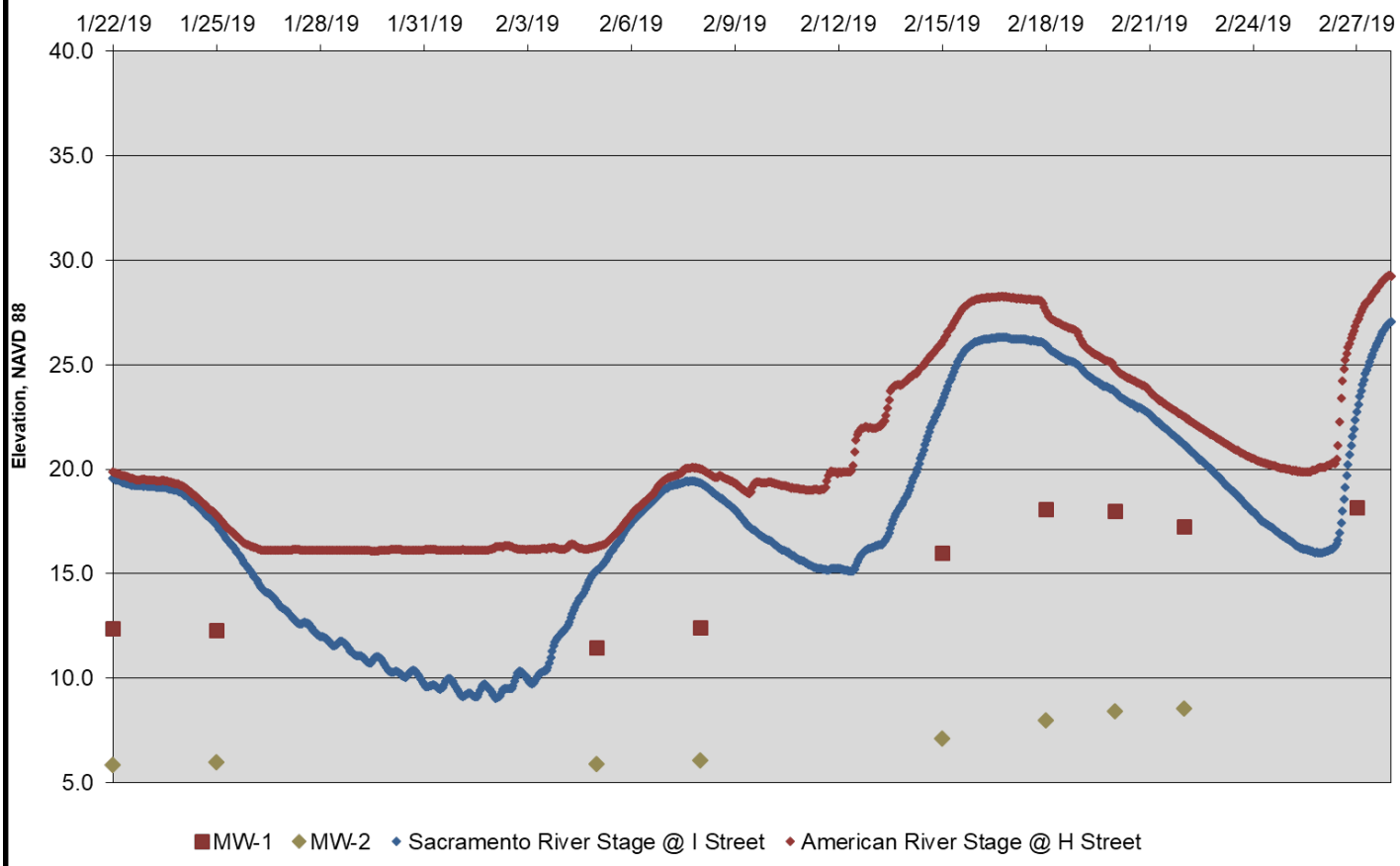
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-12

Note: Piezometers match locations on FIGURE 2-9

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

American River Groundwater Level Elevations



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
ARNL	3339+50	Landside of COW	52.0	MW-1	Cutoff Wall
		Landside Toe	38.6	MW-2	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
AMERICAN RIVER NORTH LEVEE
STATION 3330+00 to 3350+00
JANUARY AND FEBRUARY 2019

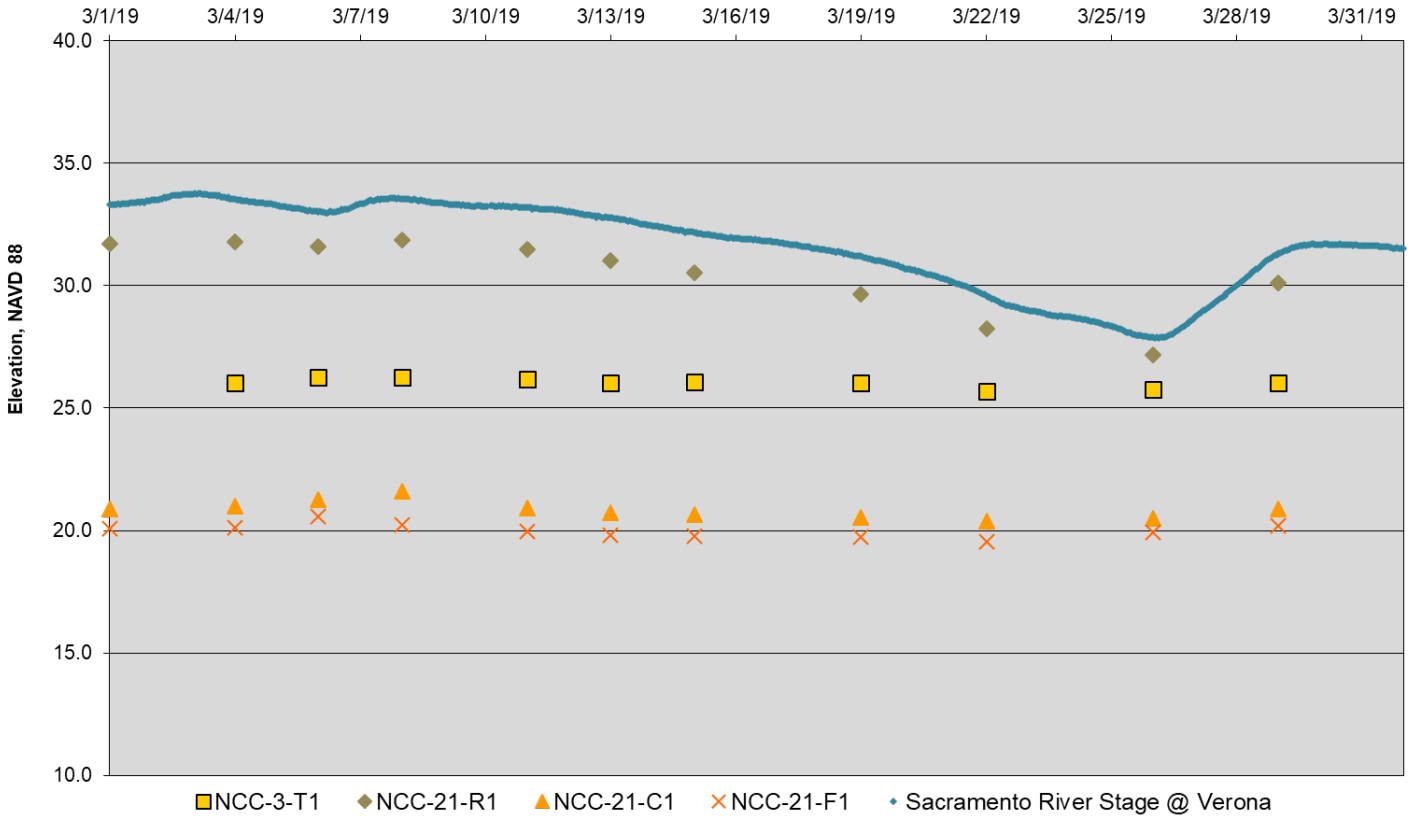
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-13

Note: Piezometers match locations on FIGURE 2-1

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Natomas Cross Canal Groundwater Level Elevations - Stations 0+00 to 30+00



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	3+00	Landside Toe	32.4	NCC-3-T1	Cutoff Wall
	21+00	Riverside	43	NCC-21-R1	
		Crown	49.1	NCC-21-C1	
		Field	21.5	NCC-21-F1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

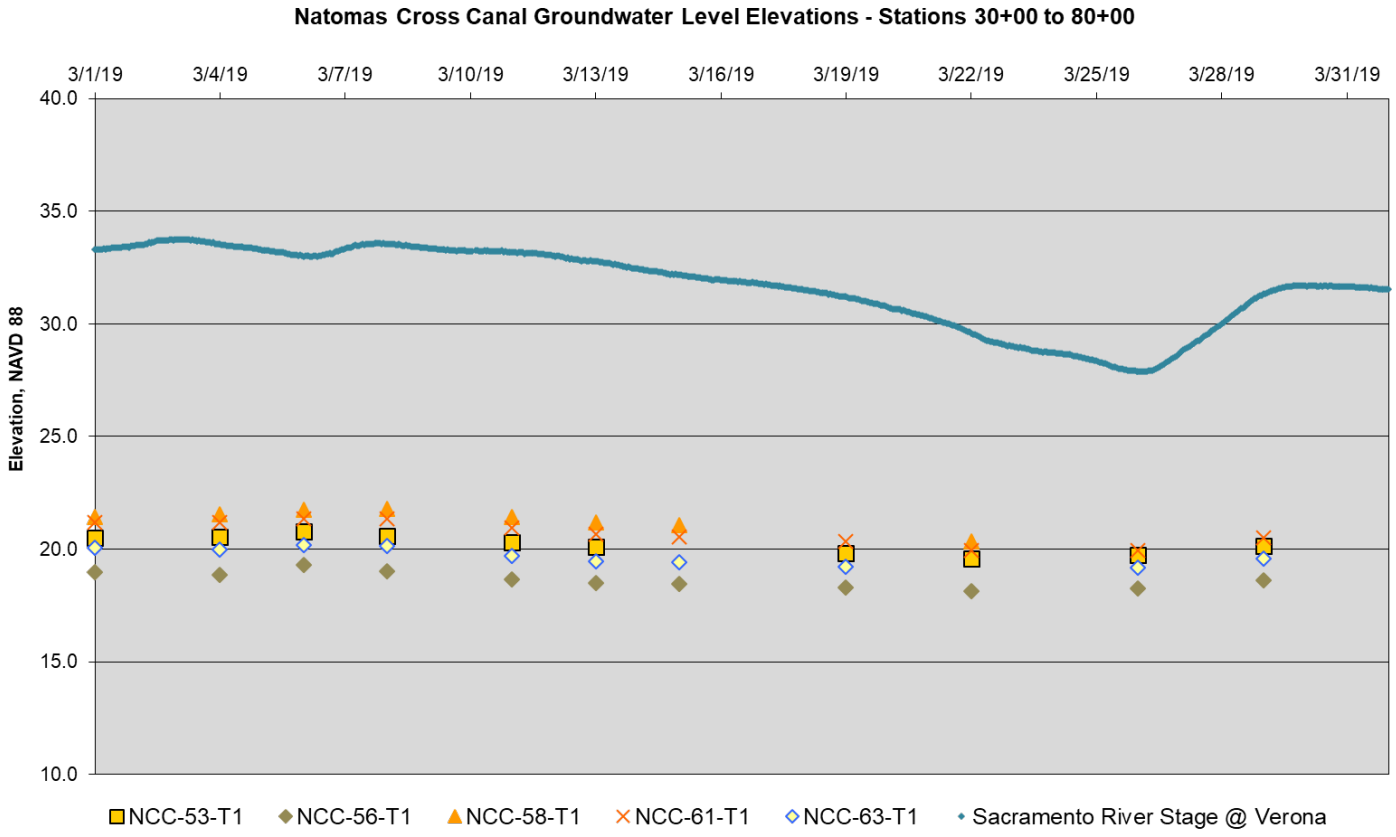
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 0+00 TO 30+00
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-14

Note: Piezometers match locations on FIGURE 2-2

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	53+00	Landside Toe	27.1	NCC-53-T1	Cutoff Wall
	56+00		28.3	NCC-56-T1	Pumping Plant + Window
	58+00		33.2	NCC-58-T1	Pumping Plant + Window
	61+00		28.1	NCC-61-T1	Cutoff Wall
	63+00		26.4	NCC-63-T1	Cutoff Wall

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

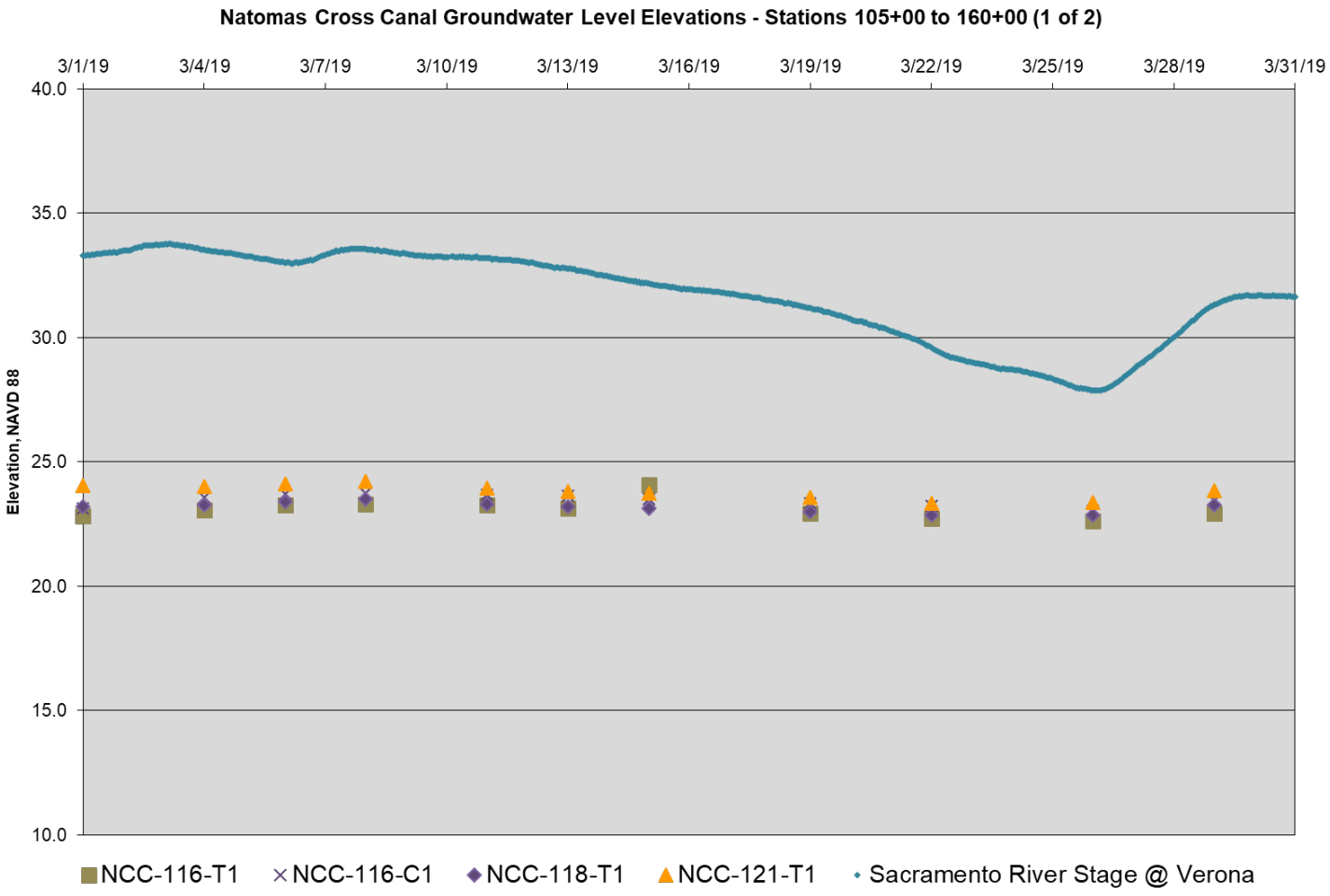
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 30+00 TO 80+00
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-15

Note: Piezometers match locations on FIGURE 2-3

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	116+00	Waterside of COW	49	NCC-116-C1	Cutoff Wall
		Landside of COW	49.1	NCC-116-C2	
		Landside Toe	26.1	NCC-116-T1	
	118+00	Landside Toe	26.3	NCC-118-T1	Cutoff Wall
	121+00	Landside Toe	32.3	NCC-121-T1	Pumping Plant + Window

Note: NCC-116-C2 dry.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

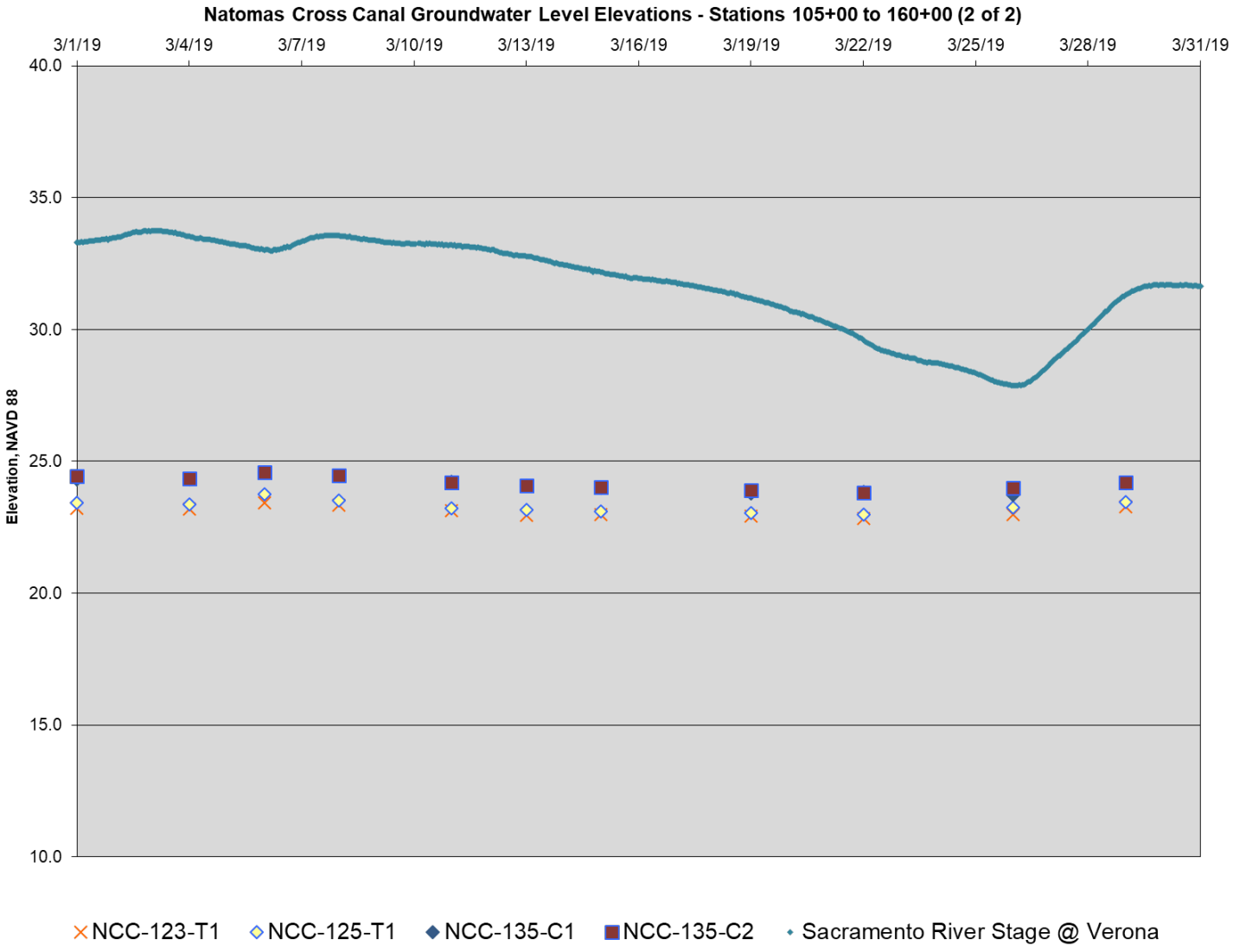
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 105+00 TO 160+00 (1 of 2)
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-16

Note: Piezometers match locations on FIGURE 2-3

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	123+00	Landside Toe	49	NCC-123-T1	Cutoff Wall
	125+00	Landside Toe	49.1	NCC-125-T1	
	135+00	Landside of COW	26.1	NCC-135-C1	
		Waterside of COW	26.3	NCC-135-C2	
		Field	32.3	NCC-135-F1	

Note: NCC-135-F1 destroyed and not measured.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B .MONEY
FILE NAME:	GW_Plots.pub

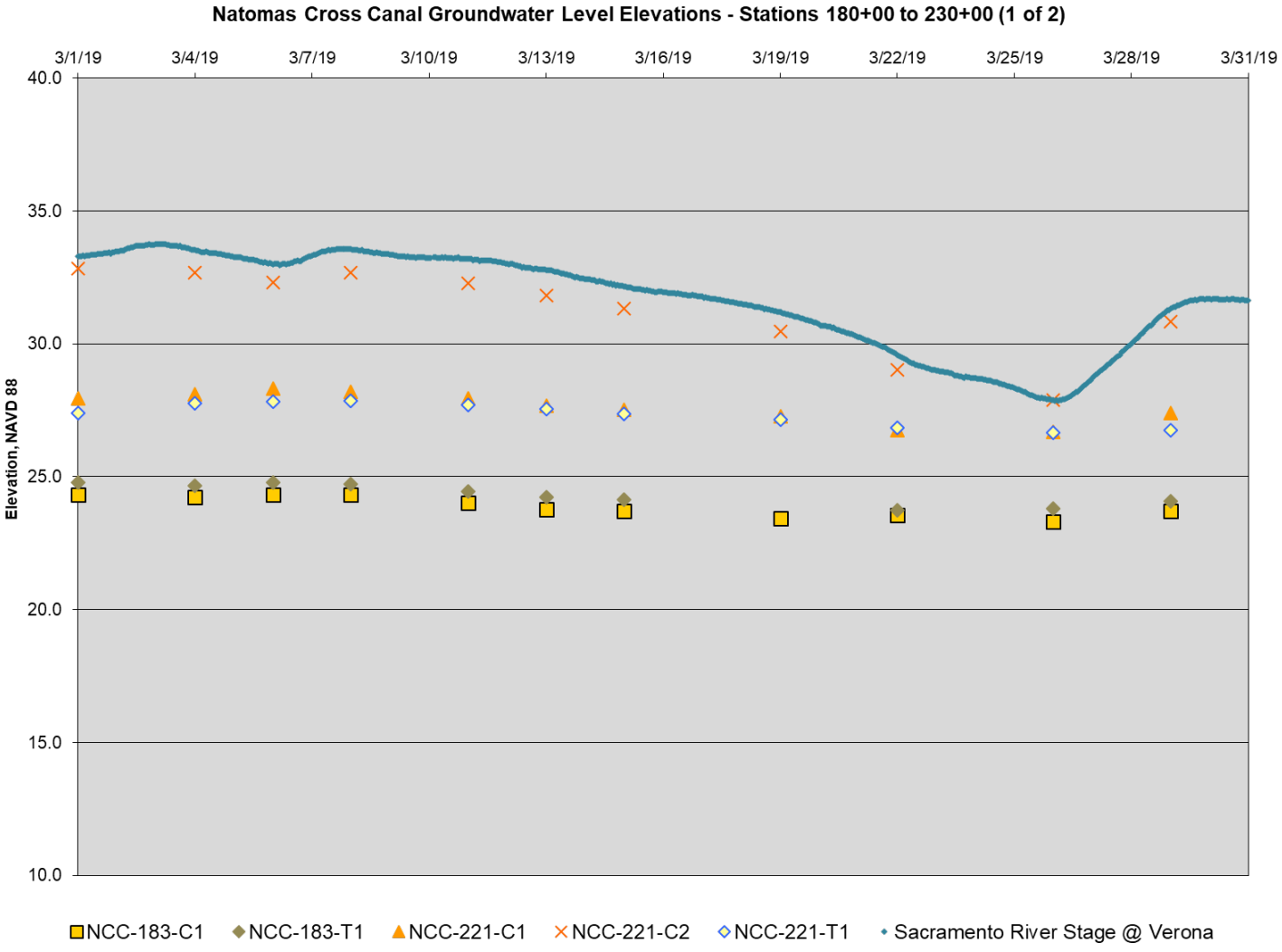
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 105+00 TO 160+00 (2 of 2)
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-17

Note: Piezometers match locations on FIGURE 2-4

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	183+00	Crown	49	NCC-183-C1	Cutoff Wall
		Landside Toe	29.2	NCC-183-T1	
	221+00	Landside of COW	49.2	NCC-221-C1	
		Waterside of COW	49.1	NCC-221-C2	
		Landside Toe	30.6	NCC-221-T1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

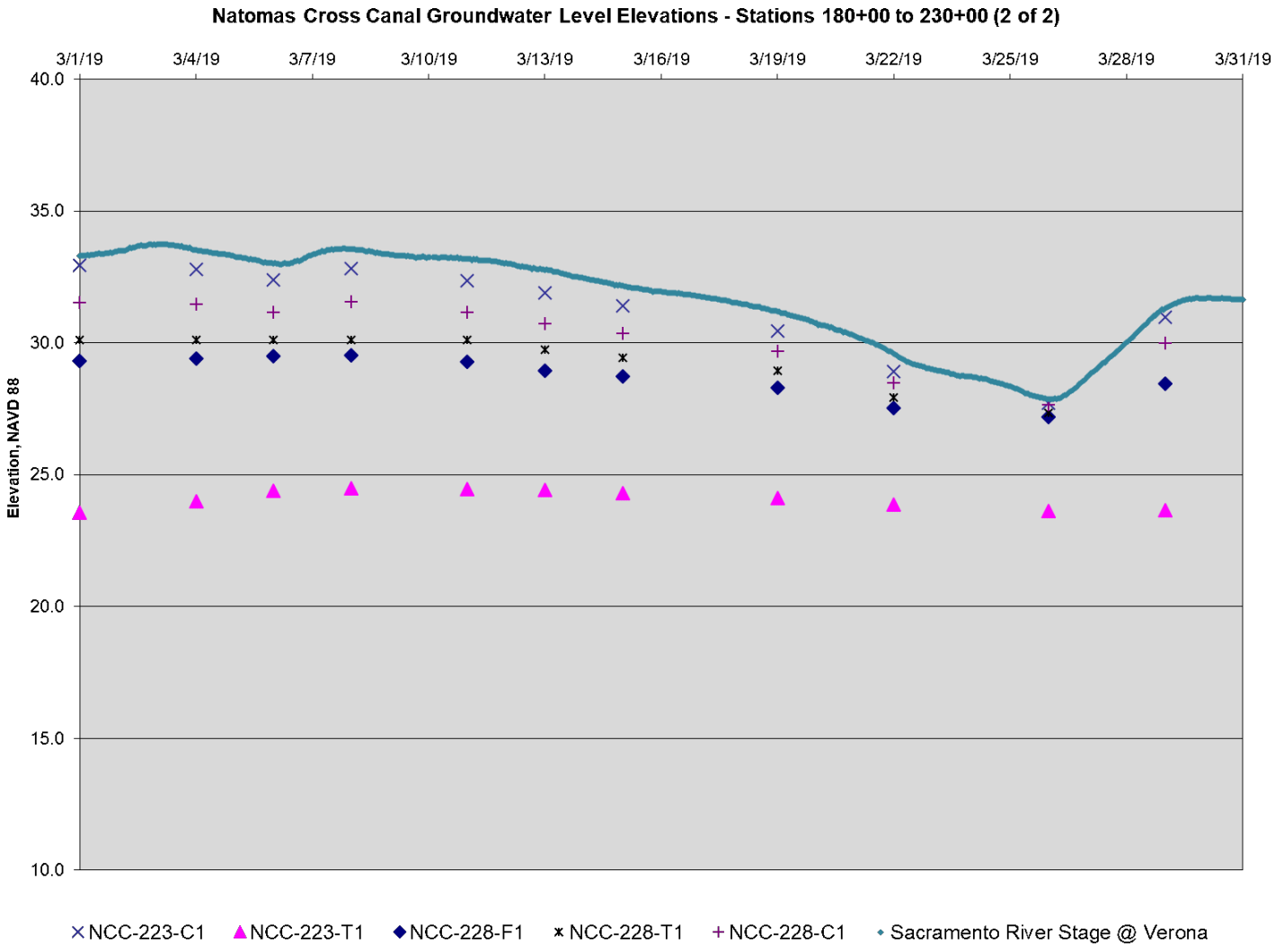
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 180+00 TO 230+00 (1 of 2)
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-18

Note: Piezometers match locations on FIGURE 2-4

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	223+00	Crown	49.5	NCC-223-C1	Highway 99/70 Window
		Landside Toe	28.1	NCC-223-T1	
	228+00	Field	31.5	NCC-228-F1	
		Landside Toe	30.5	NCC-228-T1	
		Crown	46.4	NCC-228-CA	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

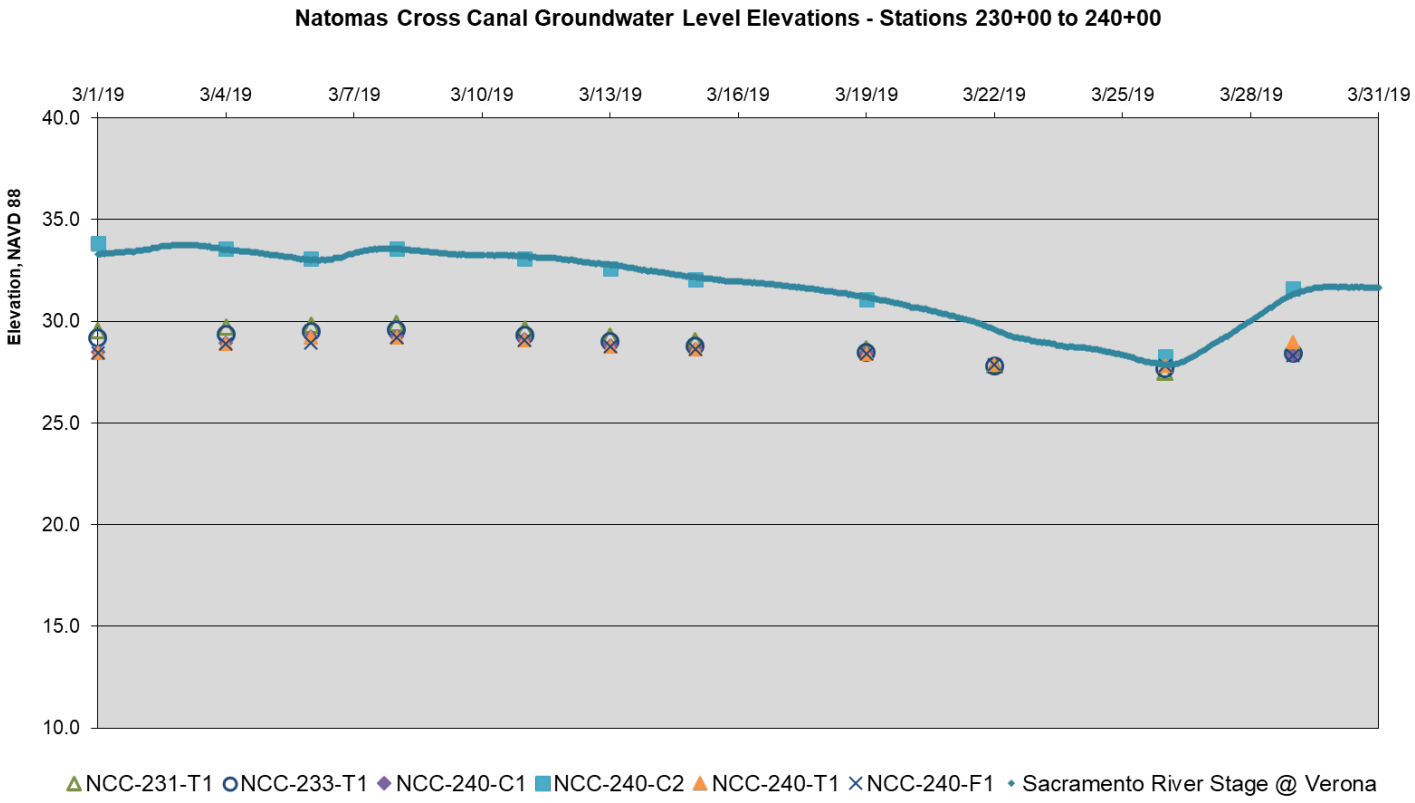
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 180+00 TO 230+00 (2 of 2)
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-19

Note: Piezometers match locations on FIGURE 2-5

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	231+00	Landside Toe	31.1	NCC-231-T1	Highway 99/70
	233+00	Landside Toe	31.9	NCC-233-T1	Cutoff Wall
	240+00	Landside of COW	49.1	NCC-240-C1	Cutoff Wall
		Waterside of COW	49.3	NCC-240-C2	
		Landside Toe	31.4	NCC-240-T1	
		Field	32.4	NCC-240-F1	

Note:
224+00 to 231+00 Hwy 99/70 Window
231+00 to 253+00 Full Cutoff Wall

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

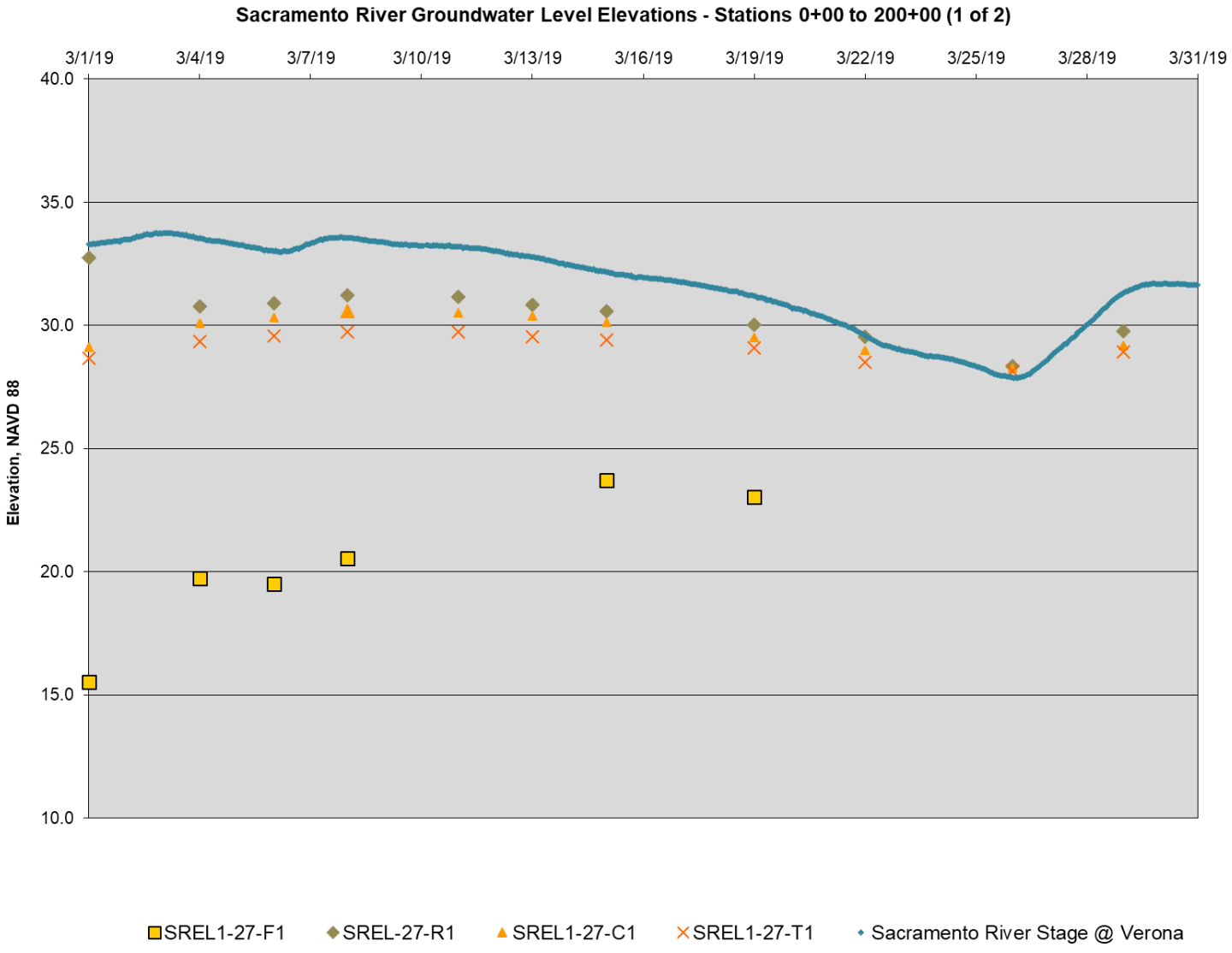
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 230+00 TO 240+00
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-20

Note: Piezometers match locations on FIGURE 2-6

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	27+00	Field	27.4	SREL-1-27-F1	Cutoff Wall
		Riverside	44.9	SREL-1-27-R1	
		Waterside of	48.2	SREL-1-27-C1	
		Landside of COW	48.7	SREL-1-27-C2	
		Landside Toe	32.2	SREL-1-27-T1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

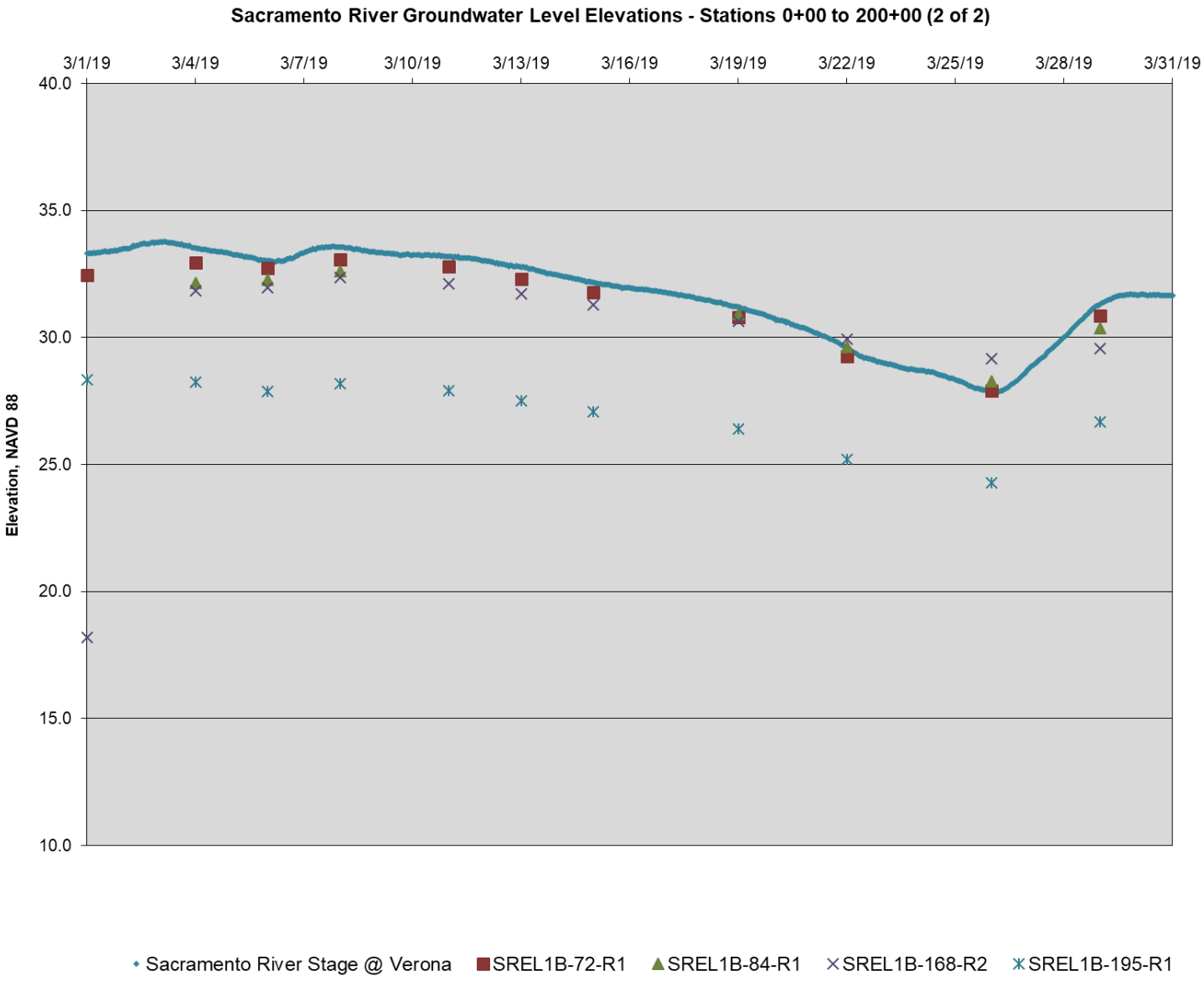
GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 0+00 TO 200+00 (1 of 2)
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-21

Note: Piezometers match locations on FIGURE 2-6

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	72+00	Riverside	44.6	SREL1B-72-R1	Cutoff Wall
SREL	84+00		44.2	SREL1B-84-R1	
SREL	168+00		44.3	SREL1B-168-R2	
SREL	195+00		43	SREL1B-195-R1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 0+00 TO 200+00 (2 of 2)
MARCH 2019

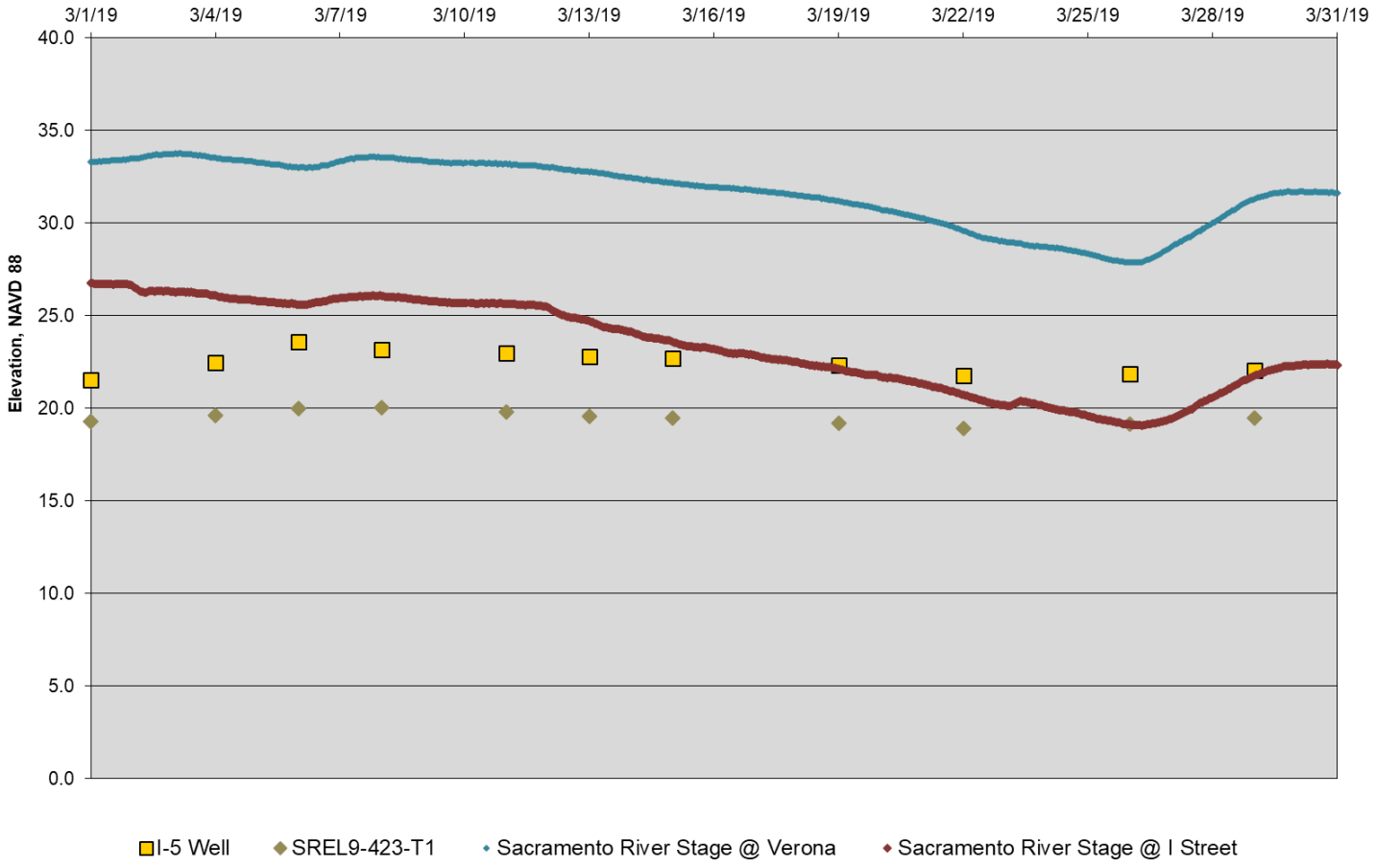
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-22

Note: Piezometers match locations on FIGURE 2-7

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Elevation Stations - 330+00 to 450+00



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	336+00	Landside Toe	34.4	SREL7-336-T1	Cutoff Wall
SREL	423+00	Landside Toe	30.1	SREL9-423-T1	
SREL	449+00	Landside Toe	26.45	I-5 Well	Window

Note:
SREL 7-336-T1 damaged.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

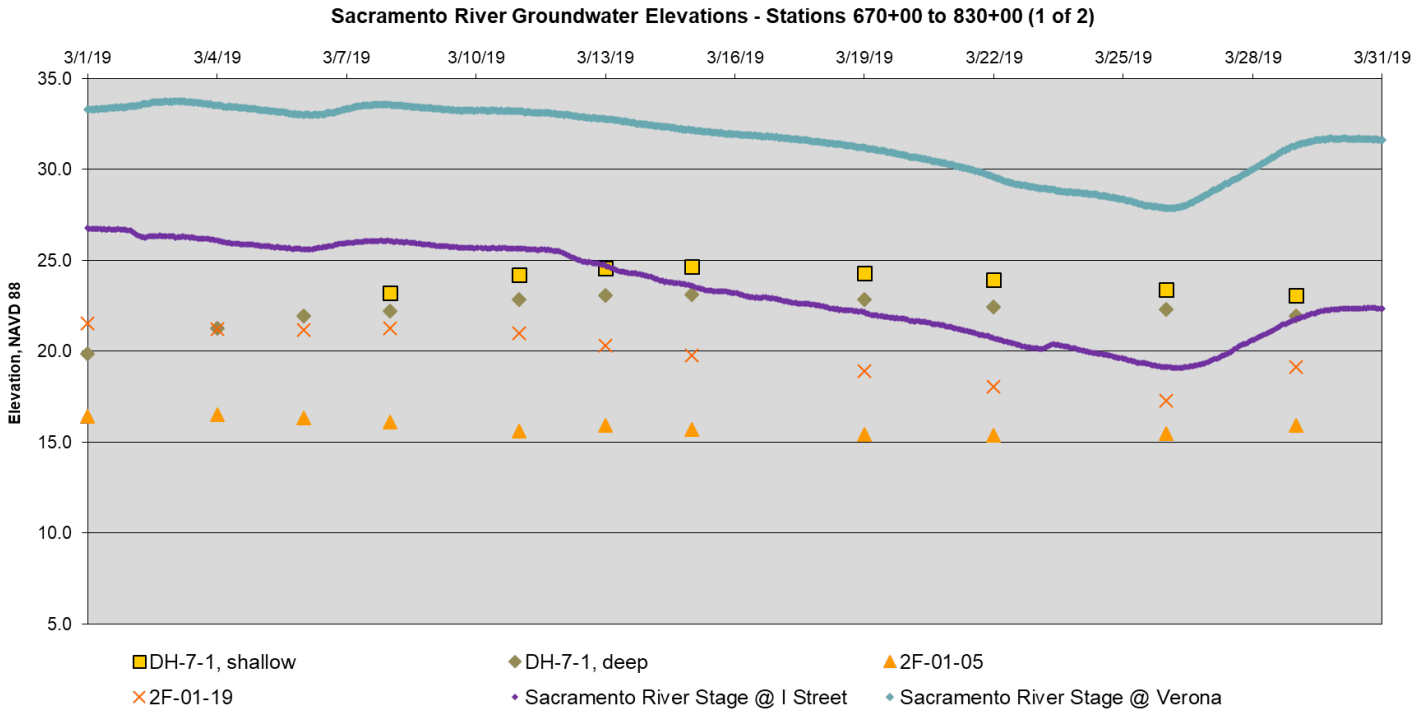
GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 330+00 TO 450+00
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-23

Note: Piezometers match locations on FIGURE 2-8

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	678+00	Landside Toe	24.1	2F-01-05	No Improvement
	715+00	Crown	41.4	DH-7-1 (shallow), DH-7-1 (deep)	
	758+00	Landside Toe	27.5	2F-01-15	
	810+00	Field	23.0	2F-01-19	

Note:
DH-7-1 Shallow was encountered to be dry.
2F-01-15 could not be located.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

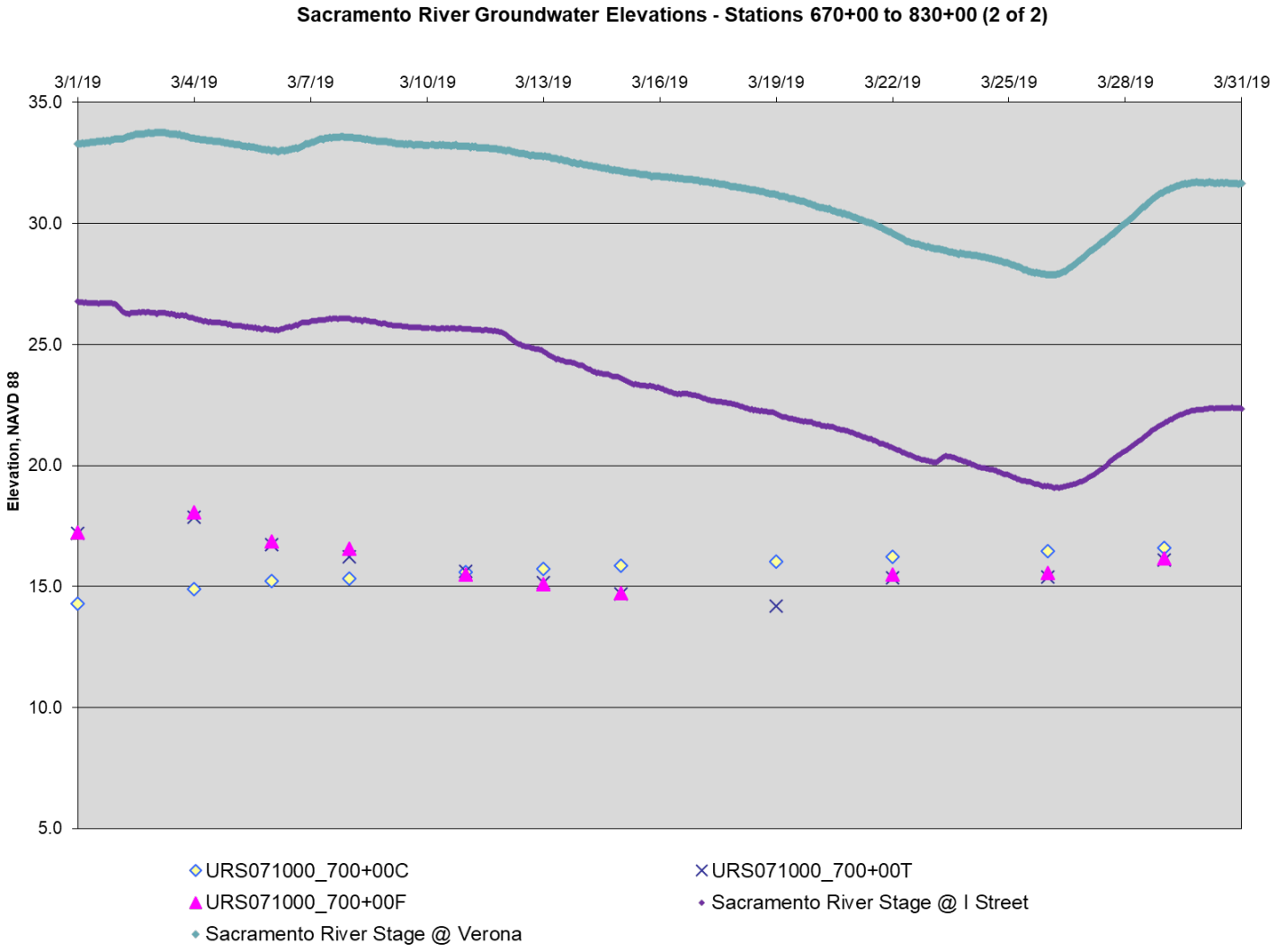
GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 670+00 TO 830+00 (1 of 2)
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-24

Note: Piezometers match locations on FIGURE 2-8

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	700+00	Crown	41.7	URS71000_700+00C	No Improvement
		Landside Toe	26.5	URS71000_700+00T	
		Field	24.2	URS71000_700+00F	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

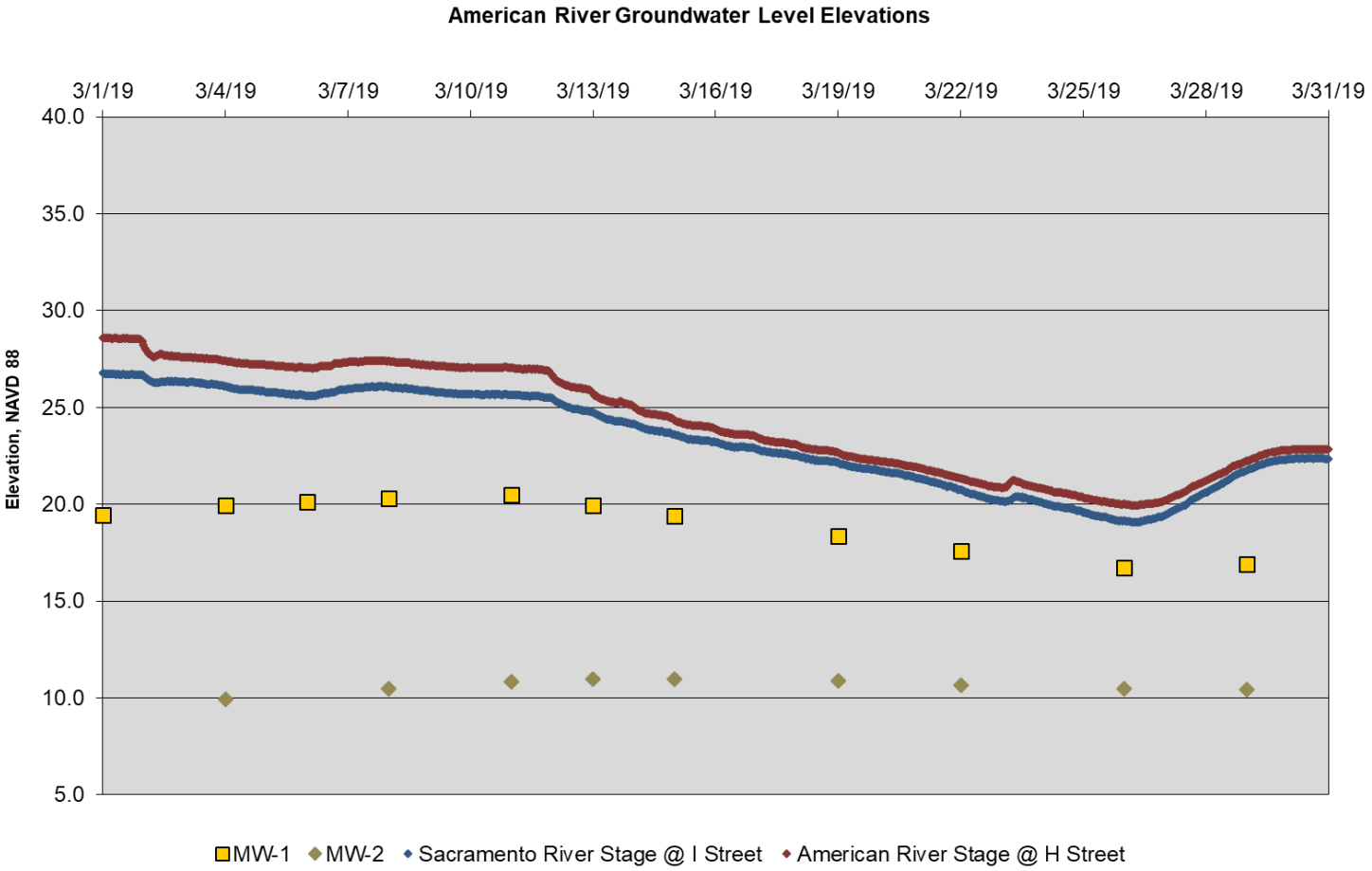
GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 670+00 TO 830+00 (2 of 2)
MARCH 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-25

Note: Piezometers match locations on FIGURE 2-9

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
ARNL	3339+50	Landside of COW	52.0	MW-1	Cutoff Wall
		Landside Toe	38.6	MW-2	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
AMERICAN RIVER NORTH LEVEE
STATION 3330+00 to 3350+00
MARCH 2019

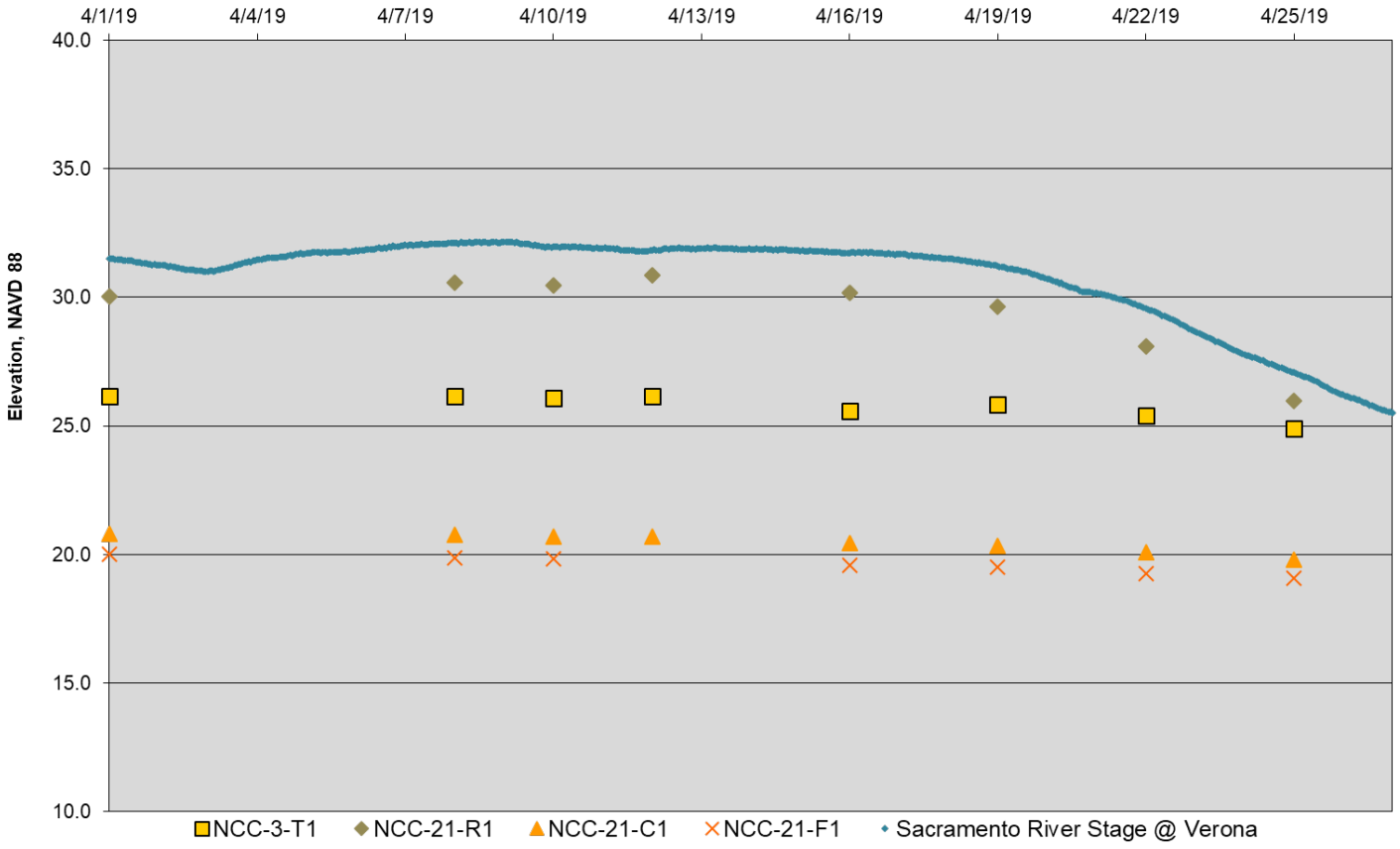
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-26

Note: Piezometers match locations on FIGURE 2-1

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Natomas Cross Canal Groundwater Level Elevations - Stations 0+00 to 30+00



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	3+00	Landside Toe	32.4	NCC-3-T1	Cutoff Wall
	21+00	Riverside	43	NCC-21-R1	
		Crown	49.1	NCC-21-C1	
		Field	21.5	NCC-21-F1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

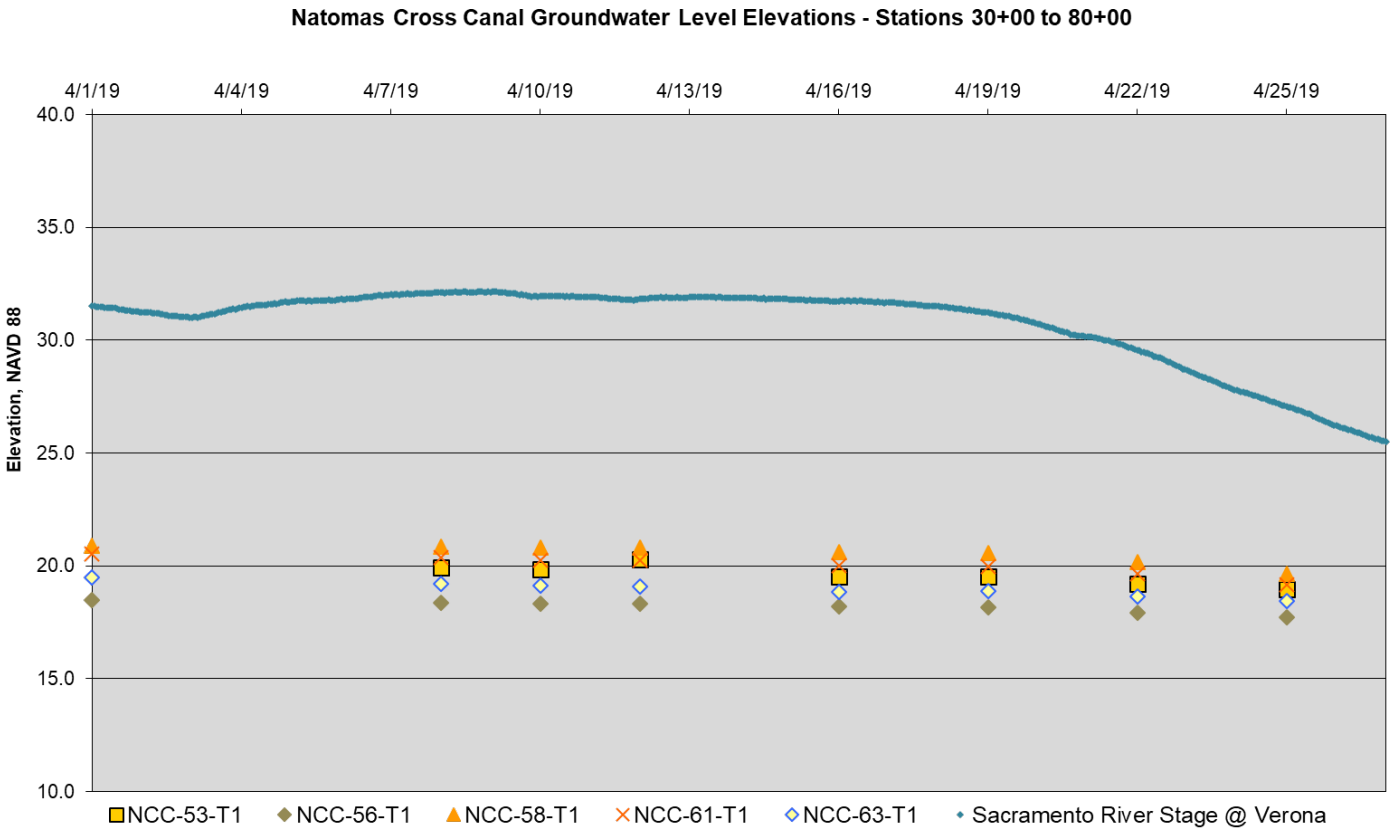
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 0+00 TO 30+00
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-27

Note: Piezometers match locations on FIGURE 2-2

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	53+00	Landside Toe	27.1	NCC-53-T1	Cutoff Wall
	56+00		28.3	NCC-56-T1	Pumping Plant + Window
	58+00		33.2	NCC-58-T1	Pumping Plant + Window
	61+00		28.1	NCC-61-T1	Cutoff Wall
	63+00		26.4	NCC-63-T1	Cutoff Wall

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

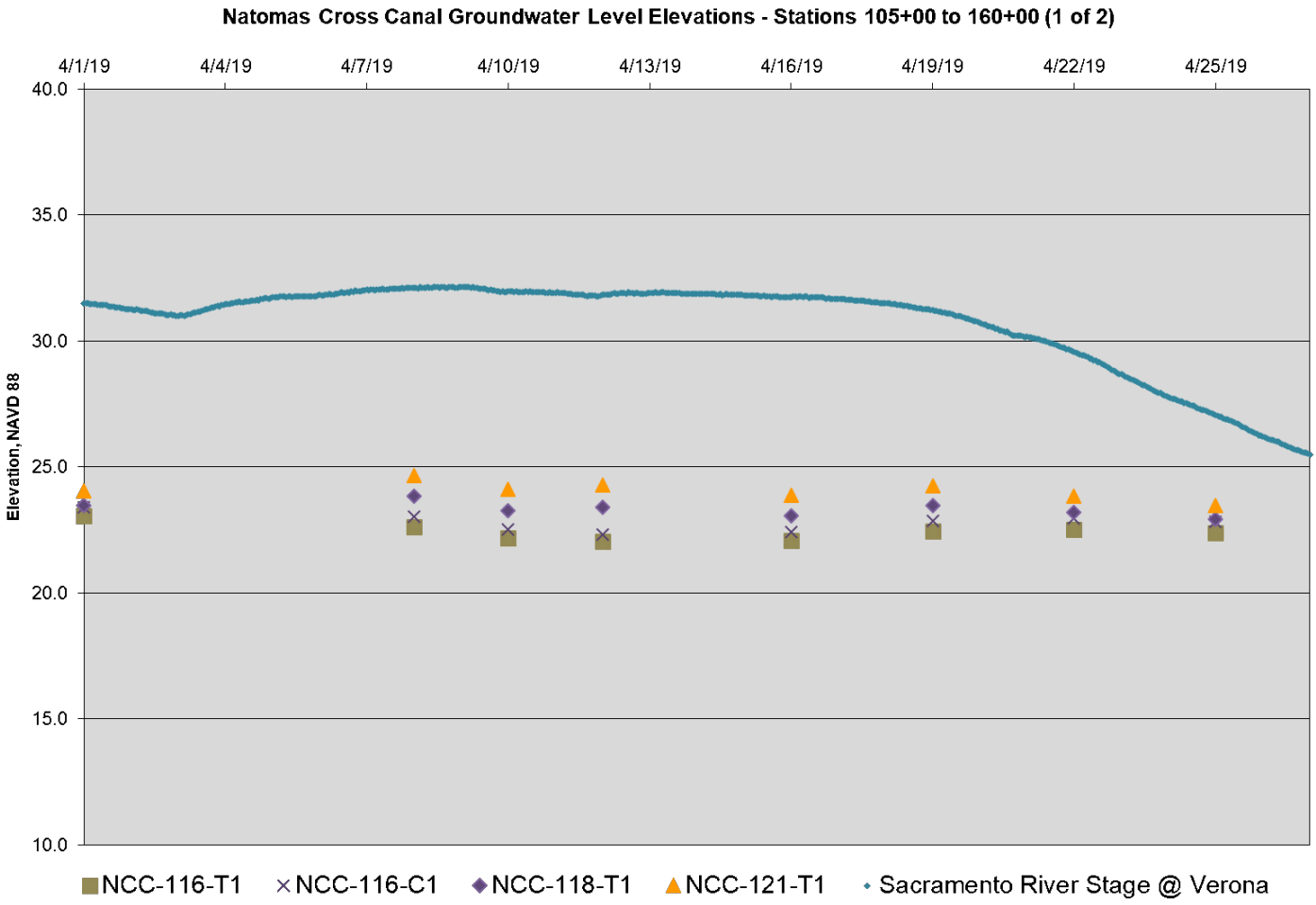
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 30+00 TO 80+00
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-28

Note: Piezometers match locations on FIGURE 2-3

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	116+00	Waterside of COW	49	NCC-116-C1	Cutoff Wall
		Landside of COW	49.1	NCC-116-C2	
		Landside Toe	26.1	NCC-116-T1	
	118+00	Landside Toe	26.3	NCC-118-T1	Cutoff Wall
	121+00	Landside Toe	32.3	NCC-121-T1	Pumping Plant + Window

Note: NCC-116-C2 dry.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

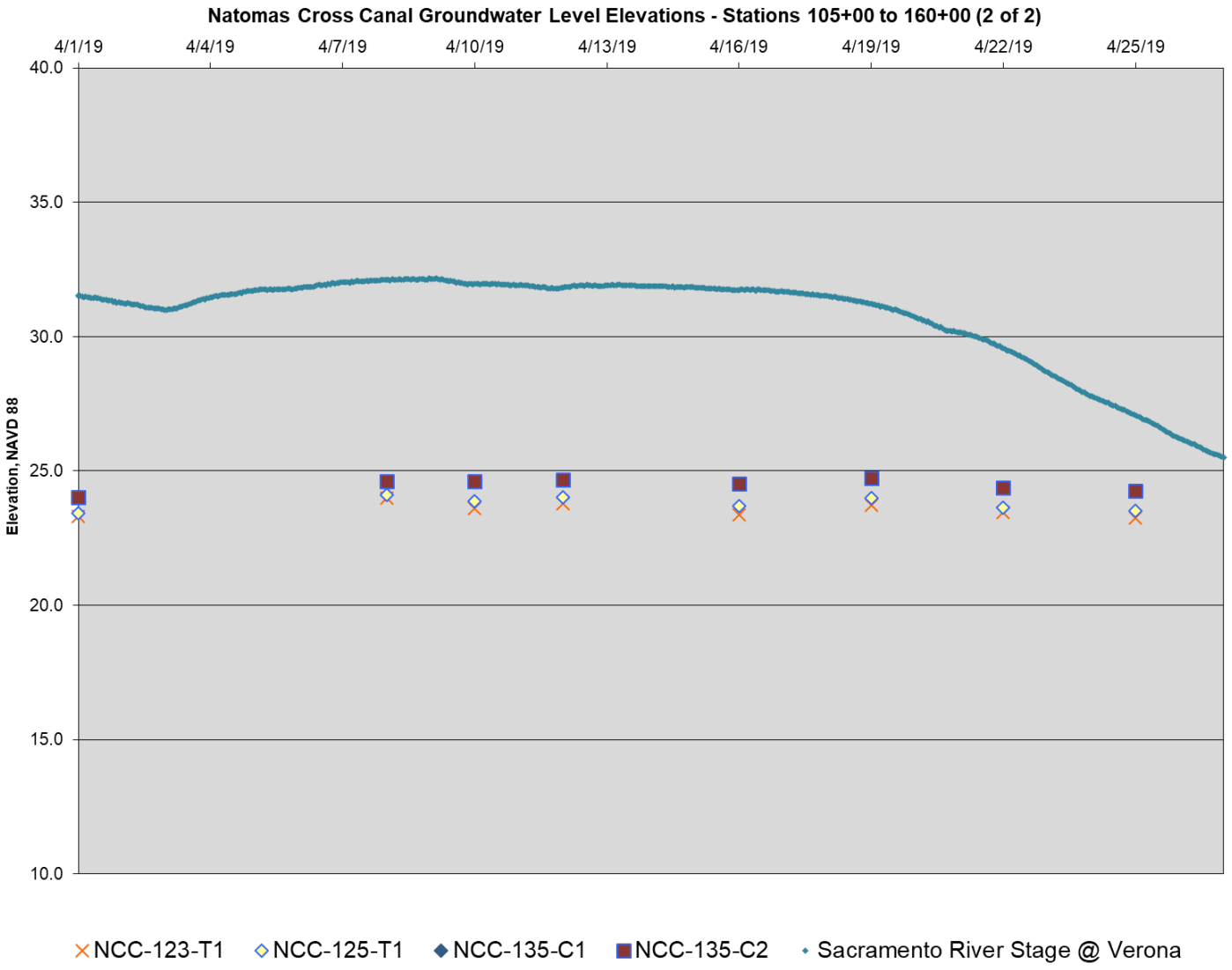
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 105+00 TO 160+00 (1 of 2)
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-29

Note: Piezometers match locations on FIGURE 2-3

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	123+00	Landside Toe	49	NCC-123-T1	Cutoff Wall
	125+00	Landside Toe	49.1	NCC-125-T1	
	135+00	Landside of COW	26.1	NCC-135-C1	
		Waterside of COW	26.3	NCC-135-C2	
		Field	32.3	NCC-135-F1	

Note: NCC-135-F1 destroyed and not measured.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B .MONEY
FILE NAME:	GW_Plots.pub

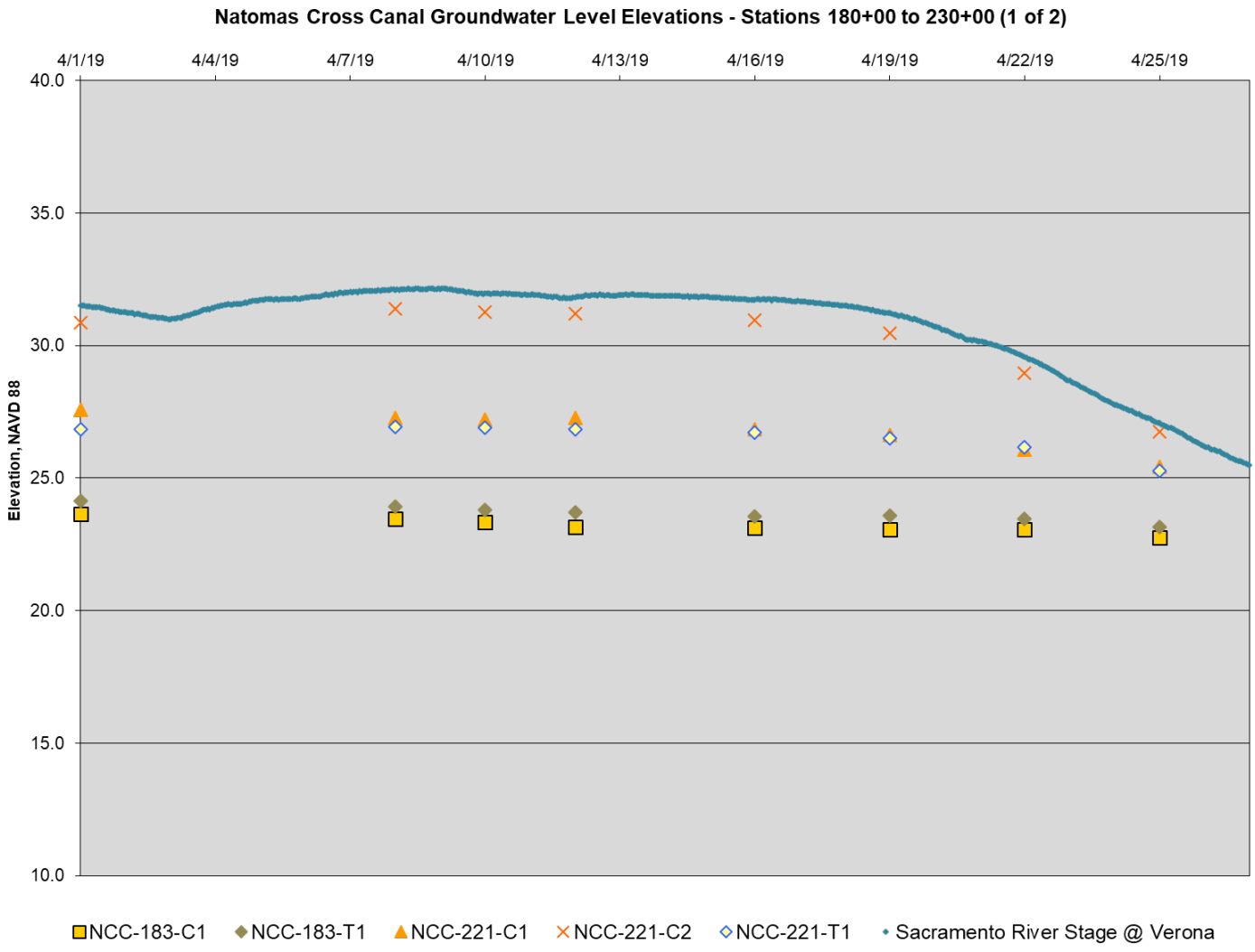
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 105+00 TO 160+00 (2 of 2)
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-30

Note: Piezometers match locations on FIGURE 2-4

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	183+00	Crown	49	NCC-183-C1	Cutoff Wall
		Landside Toe	29.2	NCC-183-T1	
	221+00	Landside of COW	49.2	NCC-221-C1	
		Waterside of COW	49.1	NCC-221-C2	
		Landside Toe	30.6	NCC-221-T1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

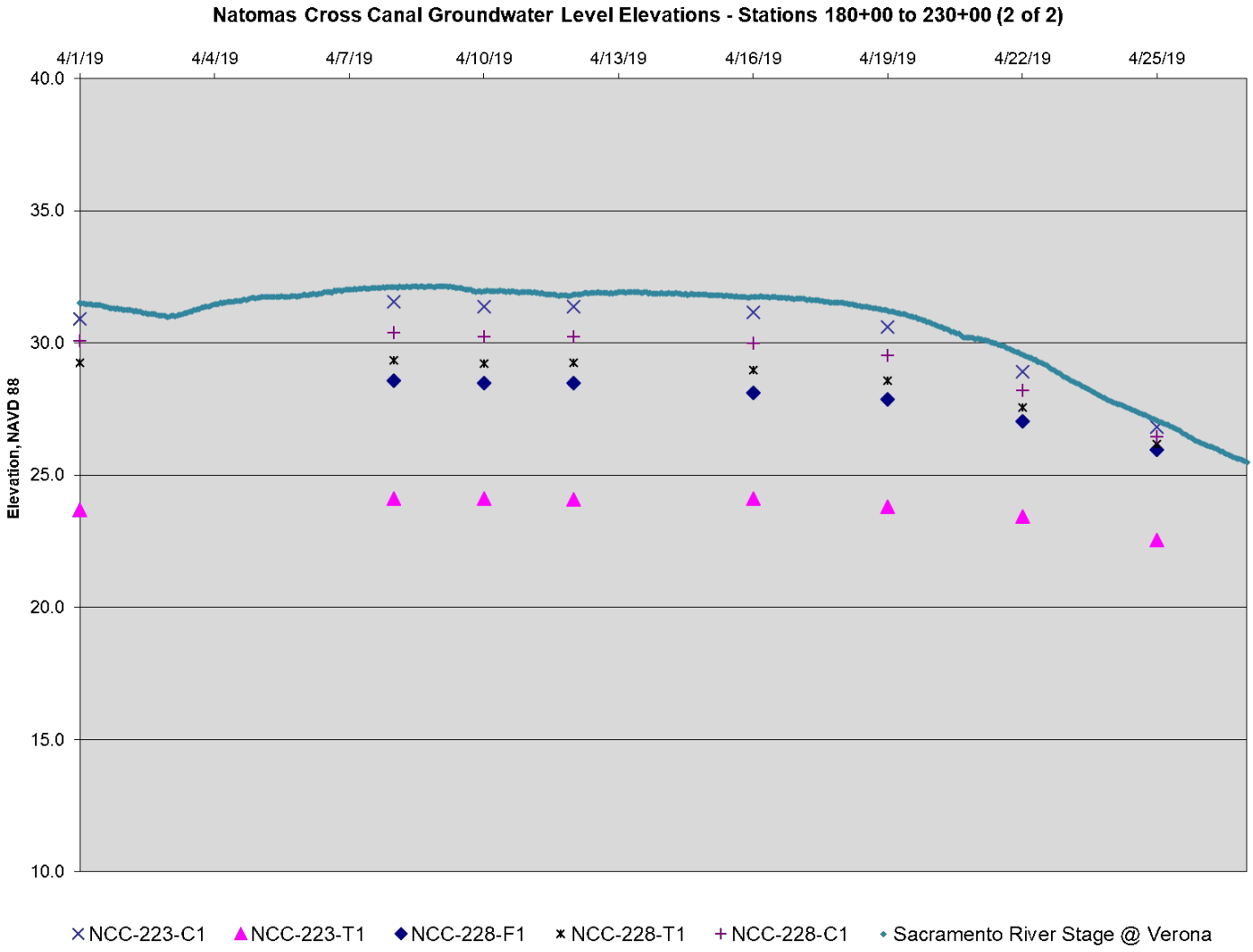
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 180+00 TO 230+00 (1 of 2)
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-31

Note: Piezometers match locations on FIGURE 2-4

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	223+00	Crown	49.5	NCC-223-C1	Highway 99/70 Window
		Landside Toe	28.1	NCC-223-T1	
	228+00	Field	31.5	NCC-228-F1	
		Landside Toe	30.5	NCC-228-T1	
		Crown	46.4	NCC-228-CA	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

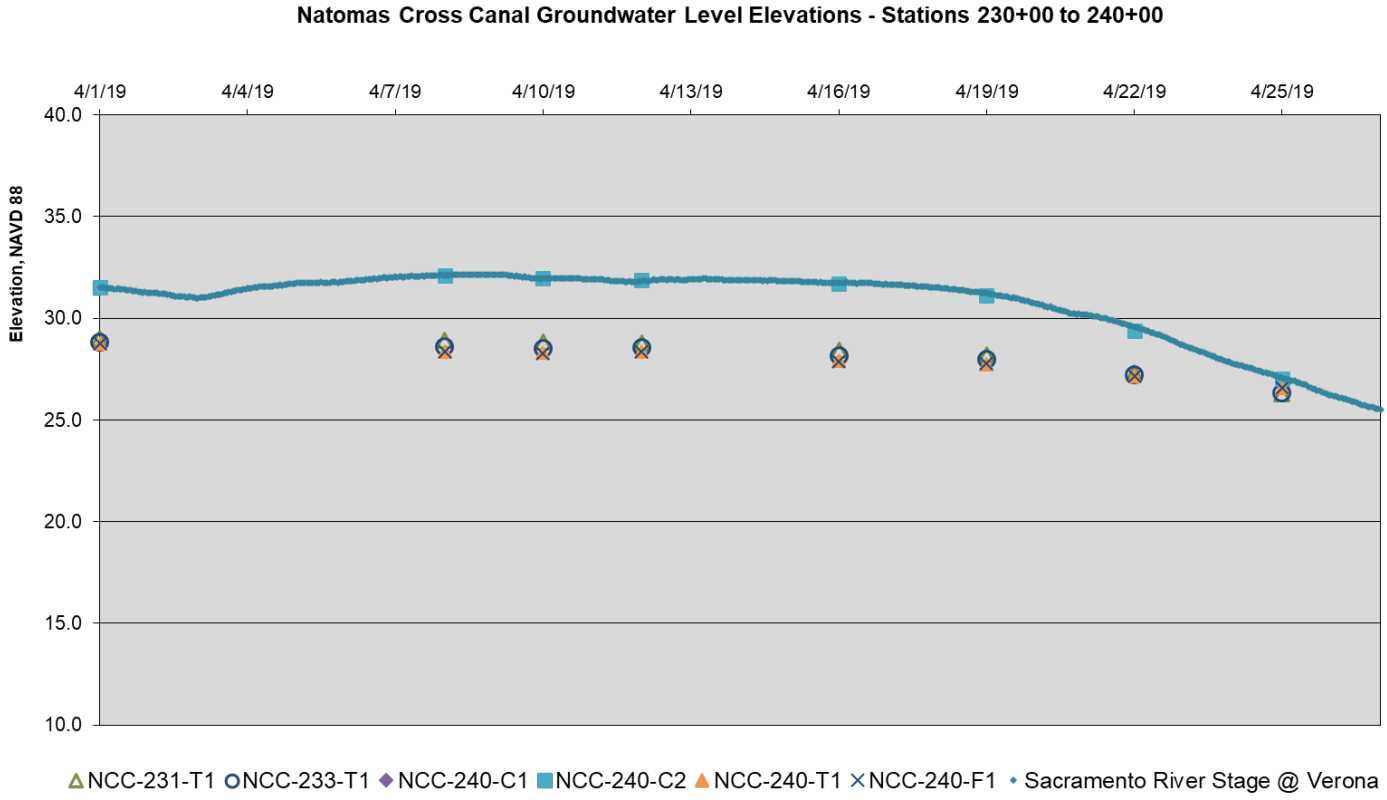
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 180+00 TO 230+00 (2 of 2)
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-32

Note: Piezometers match locations on FIGURE 2-5

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
NCC	231+00	Landside Toe	31.1	NCC-231-T1	Highway 99/70
	233+00	Landside Toe	31.9	NCC-233-T1	Cutoff Wall
	240+00	Landside of COW	49.1	NCC-240-C1	Cutoff Wall
		Waterside of COW	49.3	NCC-240-C2	
		Landside Toe	31.4	NCC-240-T1	
		Field	32.4	NCC-240-F1	

Note:
224+00 to 231+00 Hwy 99/70 Window
231+00 to 253+00 Full Cutoff Wall

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

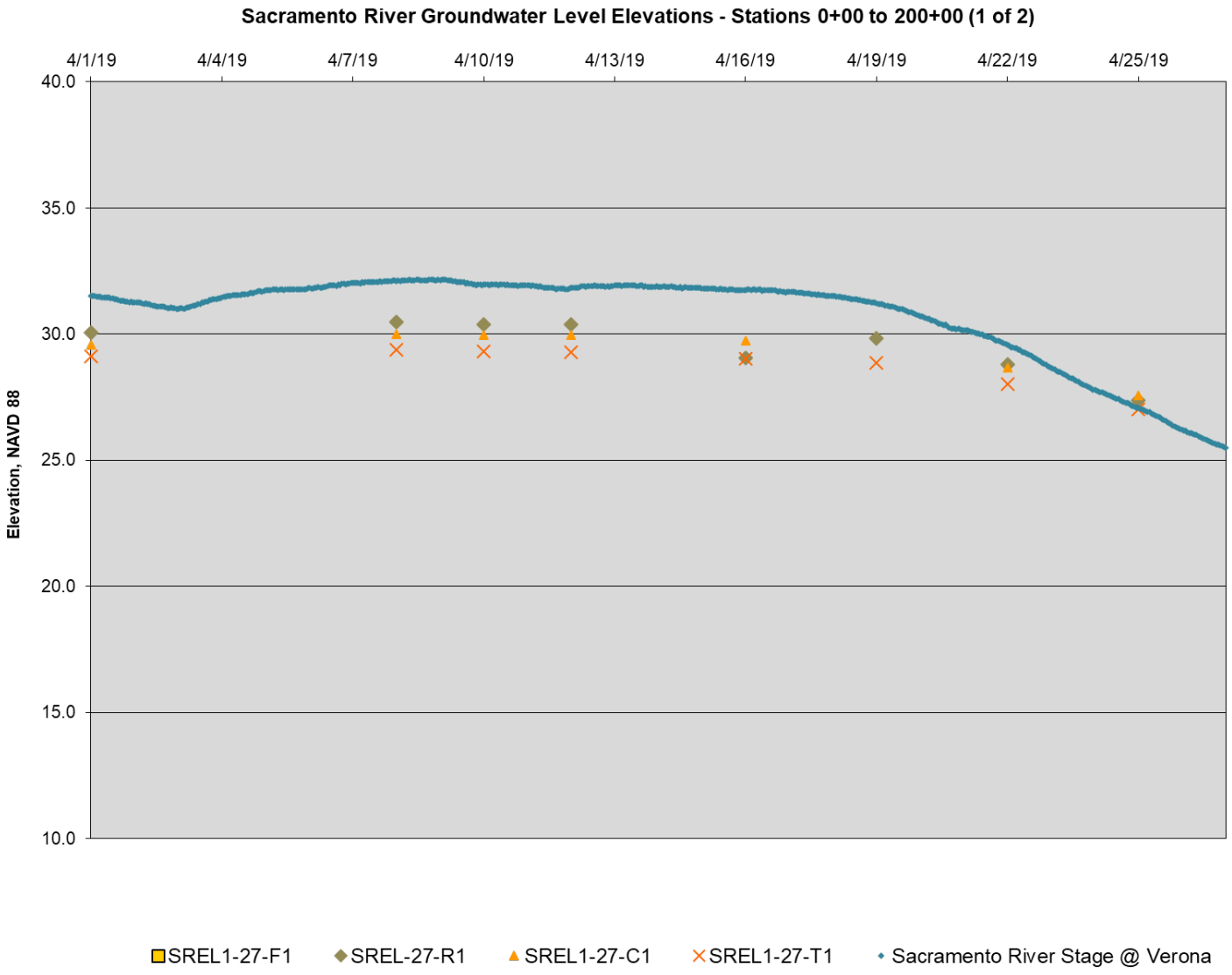
GROUNDWATER DATA
NATOMAS CROSS CANAL SOUTH LEVEE
STATIONS 230+00 TO 240+00
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-33

Note: Piezometers match locations on FIGURE 2-6

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	27+00	Field	27.4	SREL-1-27-F1	Cutoff Wall
		Riverside	44.9	SREL-1-27-R1	
		Waterside of	48.2	SREL-1-27-C1	
		Landside of COW	48.7	SREL-1-27-C2	
		Landside Toe	32.2	SREL-1-27-T1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 0+00 TO 200+00 (1 of 2)
APRIL 2019

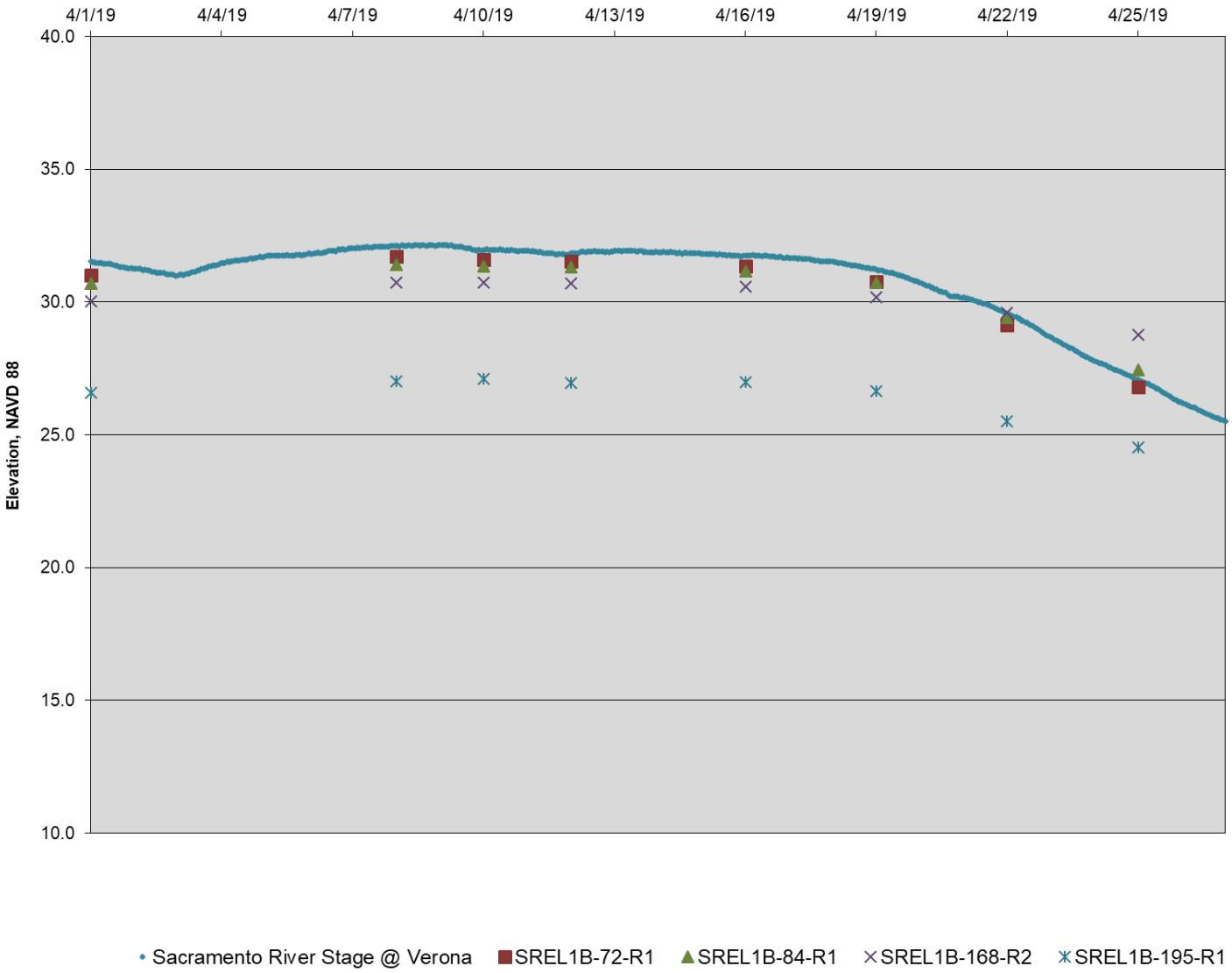
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-34

Note: Piezometers match locations on FIGURE 2-6

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Level Elevations - Stations 0+00 to 200+00 (2 of 2)



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	72+00	Riverside	44.6	SREL1B-72-R1	Cutoff Wall
SREL	84+00		44.2	SREL1B-84-R1	
SREL	168+00		44.3	SREL1B-168-R2	
SREL	195+00		43	SREL1B-195-R1	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 0+00 TO 200+00 (2 of 2)
APRIL 2019

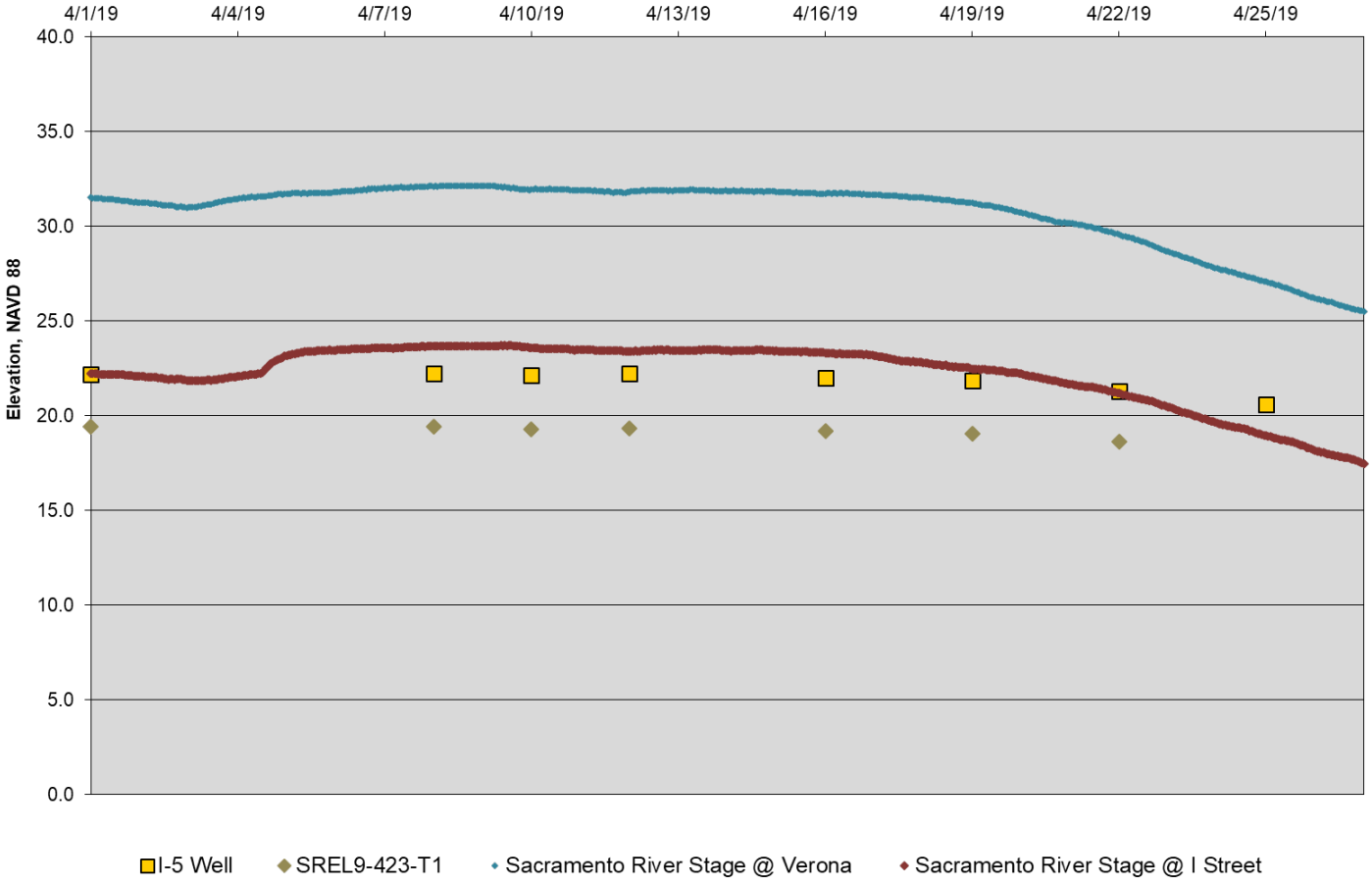
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-35

Note: Piezometers match locations on FIGURE 2-7

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Elevation Stations - 330+00 to 450+00



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	336+00	Landside Toe	34.4	SREL7-336-T1	Cutoff Wall
SREL	423+00	Landside Toe	30.1	SREL9-423-T1	
SREL	449+00	Landside Toe	26.45	I-5 Well	Window

Note:
SREL 7-336-T1 damaged.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 330+00 TO 450+00
APRIL 2019

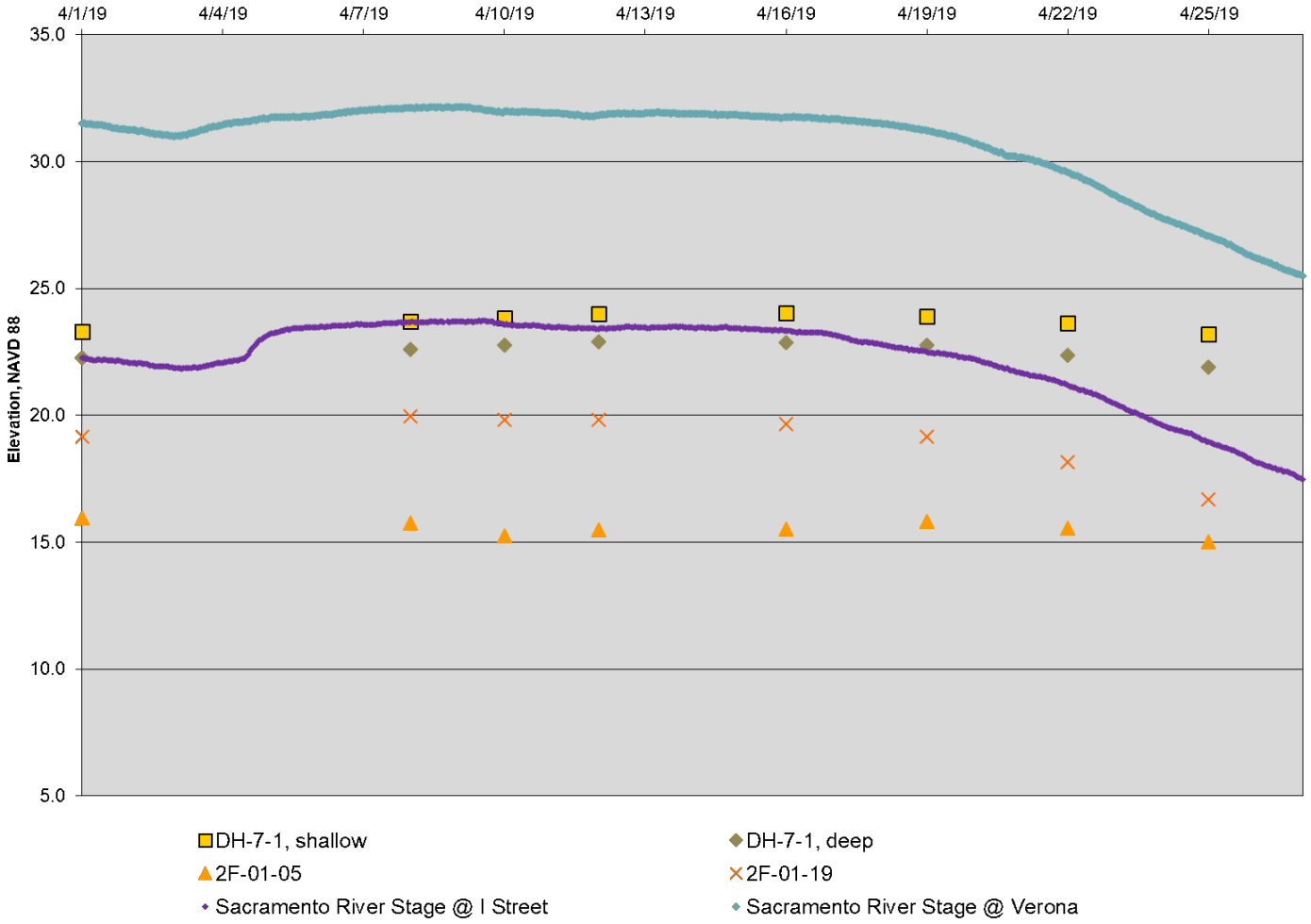
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-36

Note: Piezometers match locations on FIGURE 2-8

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Elevations - Stations 670+00 to 830+00 (1 of 2)



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	678+00	Landside Toe	24.1	2F-01-05	No Improvement
	715+00	Crown	41.4	DH-7-1 (shallow), DH-7-1 (deep)	
	758+00	Landside Toe	27.5	2F-01-15	
	810+00	Field	23.0	2F-01-19	

Note:
DH-7-1 Shallow was encountered to be dry.
2F-01-15 could not be located.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 670+00 TO 830+00 (1 of 2)
APRIL 2019

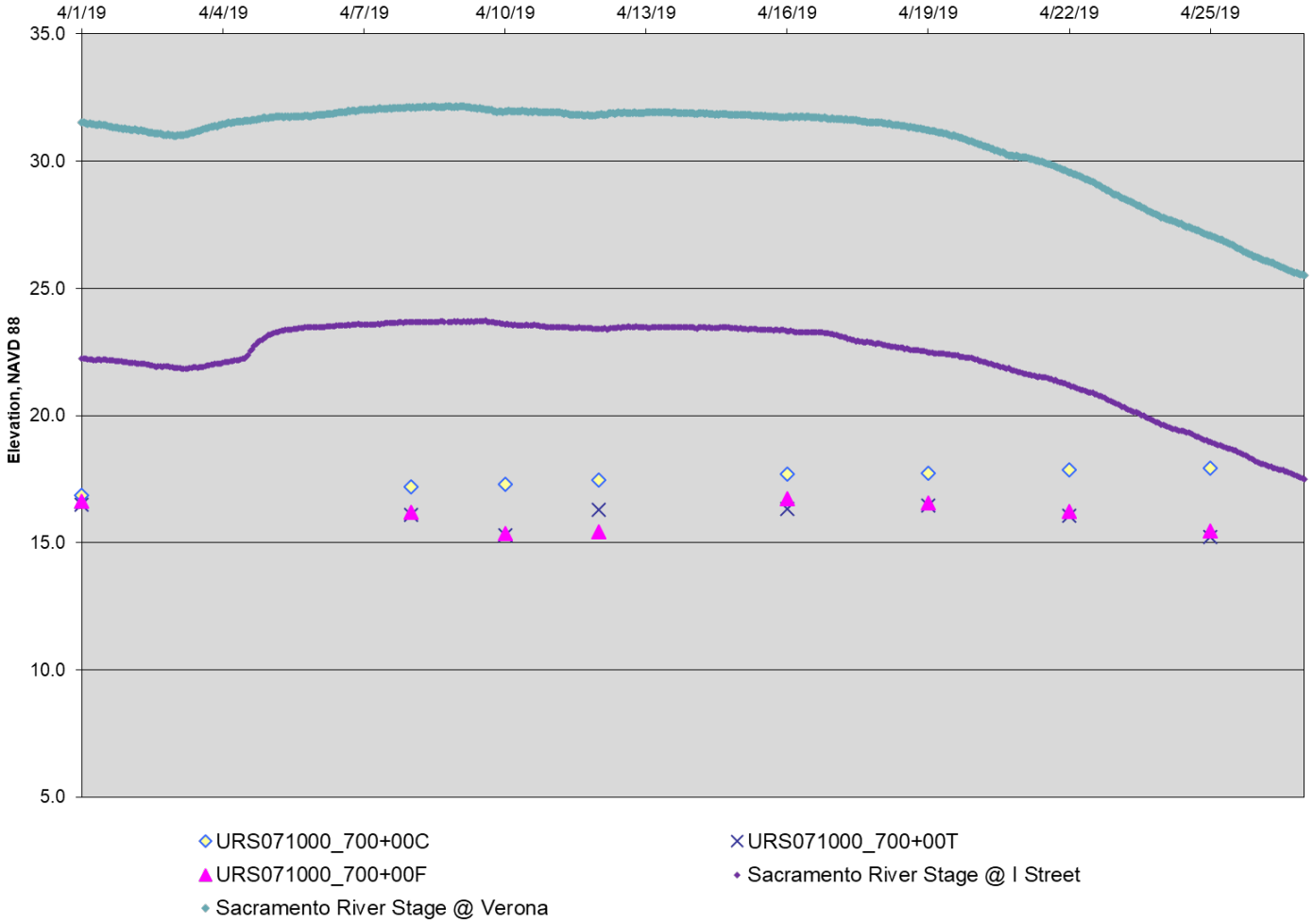
GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-37

Note: Piezometers match locations on FIGURE 2-8

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Sacramento River Groundwater Elevations - Stations 670+00 to 830+00 (2 of 2)



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
SREL	700+00	Crown	41.7	URS71000_700+00C	No Improvement
		Landside Toe	26.5	URS71000_700+00T	
		Field	24.2	URS71000_700+00F	

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

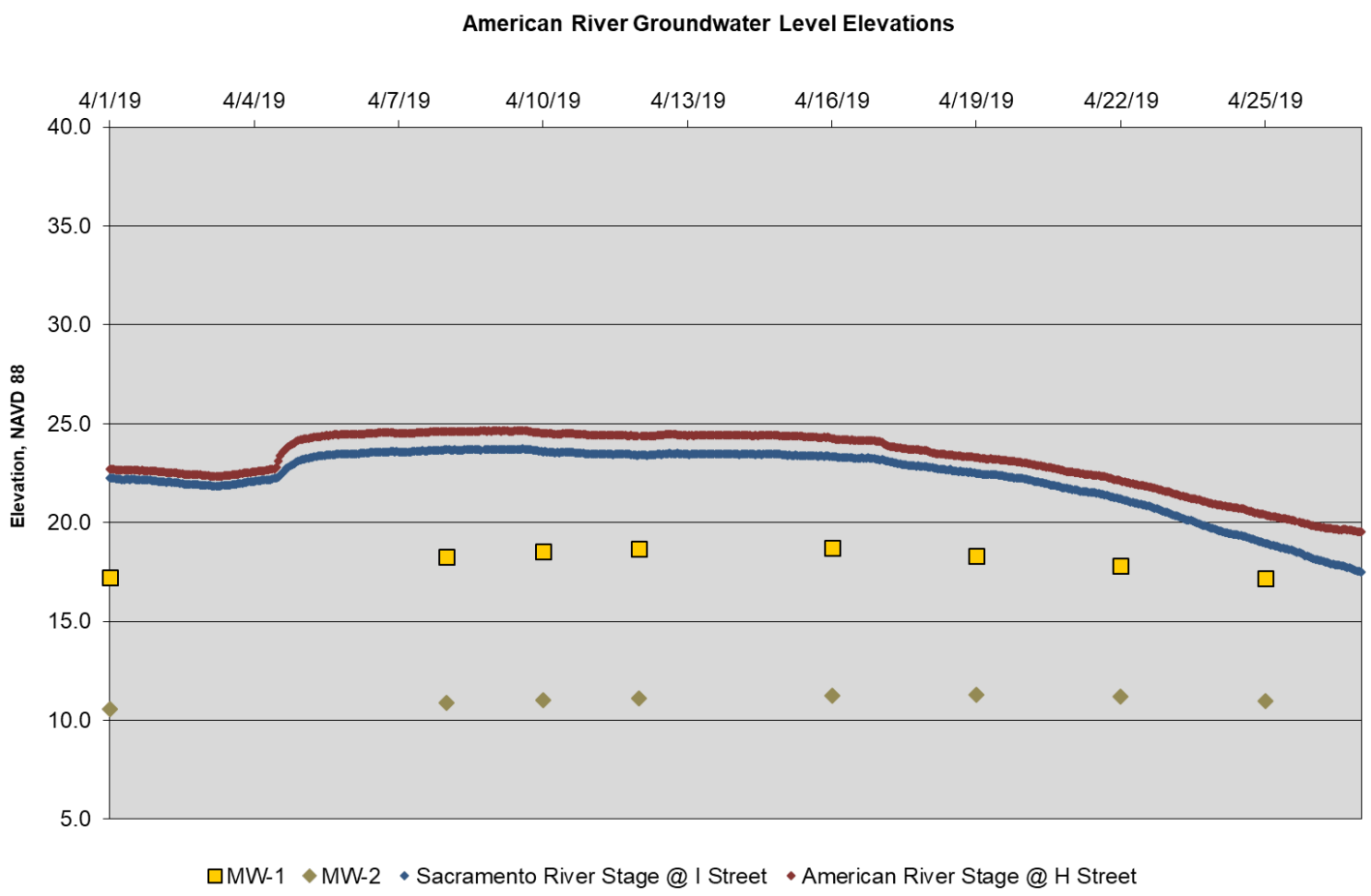
GROUNDWATER DATA
SACRAMENTO RIVER EAST LEVEE
STATIONS 670+00 TO 830+00 (2 of 2)
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-38

Note: Piezometers match locations on FIGURE 2-9

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



Levee Segment	Approximate Station	Location(s)	Elevation	Piezometer Name	Comments
ARNL	3339+50	Landside of COW	52.0	MW-1	Cutoff Wall
		Landside Toe	38.6	MW-2	

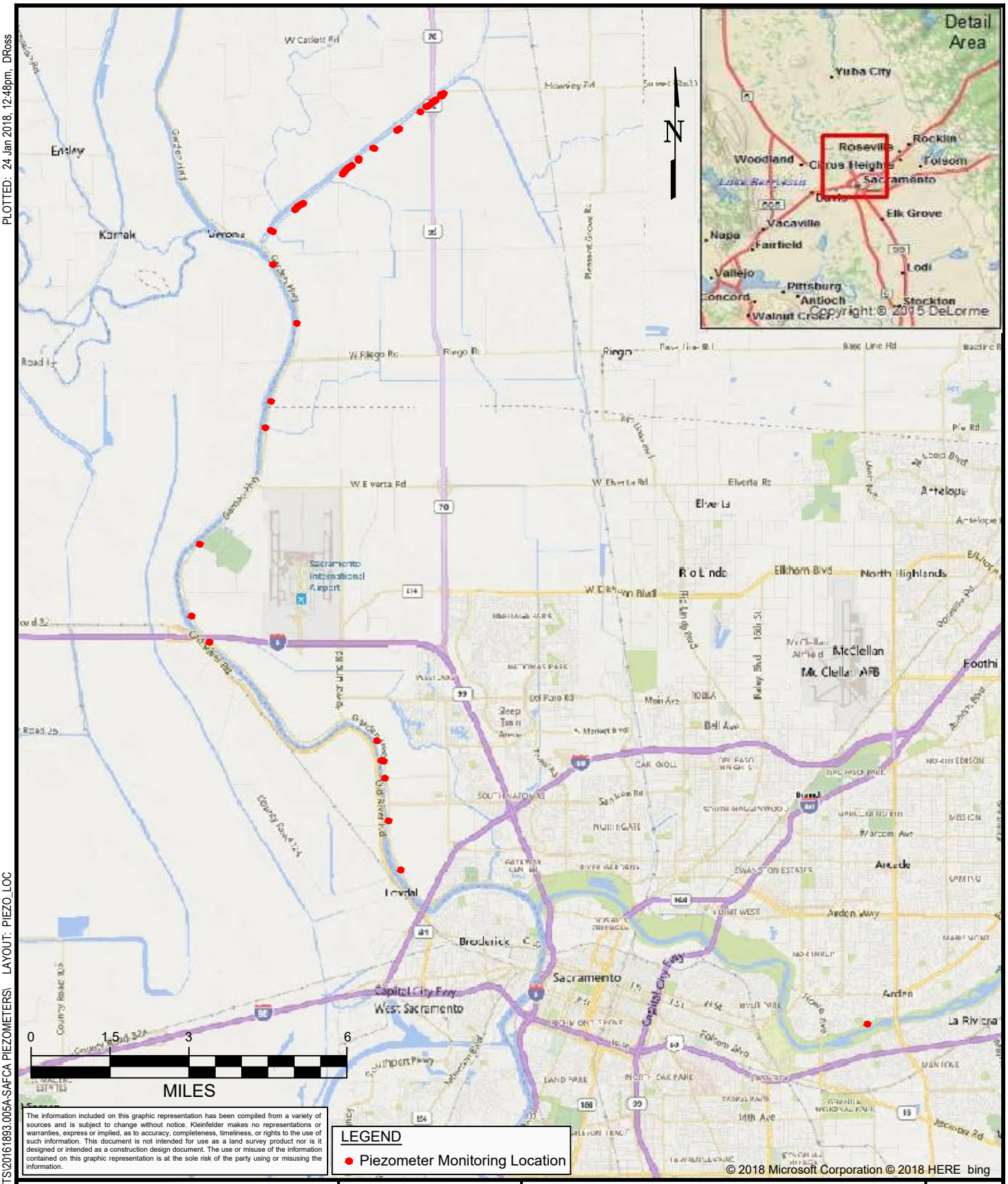
KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	20161893
DRAWN:	6/6/2019
DRAWN BY:	S. MANN
CHECKED BY:	B. MONEY
FILE NAME:	GW_Plots.pub

GROUNDWATER DATA
AMERICAN RIVER NORTH LEVEE
STATION 3330+00 to 3350+00
APRIL 2019

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL AND
SACRAMENTO AND AMERICAN RIVERS
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
3-39



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions
www.kleinfelder.com

PROJECT NO.	20161893.005A
DRAWN:	01/23/2018
DRAWN BY:	D. Ross
CHECKED BY:	B. Money
FILE NAME:	20161893_1.dwg

SITE LOCATION MAP

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTIES, CALIFORNIA

FIGURE
1-1

PLOTTED: 24 Jan 2018, 12:48pm, DRoss
CAD FILE: K:\2018_PROJECTS\20161893.005A-SAFCA PIEZOMETERS\ LAYOUT: PIEZO_LOC



File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps

0 1 2 4 6 8 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location — Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP
STATION 0+00 TO 30+00
NATOMAS CROSS CANAL
SOUTH LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-1



File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps

0 1.25 2.5 5 7.5 10 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location — Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP STATION 30+00 TO 80+00 NATOMAS CROSS CANAL SOUTH LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-2



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

0 1 2 4 6 8 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location — Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP
STATION 105+00 TO 160+00
NATOMAS CROSS CANAL
SOUTH LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-3

File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps



File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps

0 1.25 2.5 5 7.5 10 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location

Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP STATION 180+00 TO 230+00 NATOMAS CROSS CANAL SOUTH LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-4



File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps

0 1.25 2.5 5 7.5 10 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location

Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP
STATION 230+00 TO 240+00
NATOMAS CROSS CANAL
SOUTH LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-5


0+00
100+00
200+00
300+00
400+00
500+00
600+00
700+00
800+00
Powerline Rd
Powerline Rd
Powerline Rd
Power Line Rd
Sankey Rd
Sankey Rd
Garden Hwy
Garden Hwy
Garden Hwy



File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps

0 1.5 3 6 9 12 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location

Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP STATION 330+00 TO 450+00 SACRAMENTO RIVER EAST LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-7



File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps

0 1.25 2.5 5 7.5 10 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location — Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP STATION 630+00 TO 830+00 SACRAMENTO RIVER EAST LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-8



File Path: Sacramento/U/GIS/SAFCA/Piezo and Inclin Permit Maps/ Maps

0 0.75 1.5 3 4.5 6 Miles

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Legend

Approximate Well Location — Levee Centerline

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	94582
DRAWN:	Dec-2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Money
FILE NAME:	Wells2016.MXD

PIEZOMETER LOCATION MAP
STATION 3330+00 TO 3350+00
AMERICAN RIVER
NORTH LEVEE

GROUNDWATER LEVEL DATA REPORT
NATOMAS CROSS CANAL,
SACRAMENTO RIVER AND AMERICAN RIVER
SACRAMENTO AND SUTTER COUNTY, CALIFORNIA

FIGURE
2-9

Appendix O: GDE Analysis

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX O
Groundwater Dependent Ecosystems Analysis

December 2021

APPENDIX O –GROUNDWATER DEPENDENT ECOSYSTEMS ANALYSIS

This section provides a description of the approach used to refine potential groundwater dependent ecosystems (GDEs) in the North American Subbasin (Subbasin) based on depth to groundwater, groundwater dependent vegetation and potential presence of critical fauna (endangered or threatened species). Using this approach potential GDEs initially identified in the Natural Communities Commonly Associated with Groundwater (NCCAG) database were classified as "Likely", "Less Likely" or "Not Likely".

1.0 Evaluation of Plant Species and Rooting Zone Depths

An evaluation was performed to assess the types of potential groundwater dependent vegetation (vegetation) in the Subbasin to identify their rooting zone depths and where groundwater levels in the principal aquifer could be shallow enough to support them. The Natural Communities Commonly Associated with Groundwater (NCCAG) database (https://gis.water.ca.gov/app/NCDatasetViewer/) was reviewed to identify the types of native plant communities that may be considered to be groundwater dependent in the Subbasin for each section referenced in the Public Land Survey System (PLSS) (https://gis.conservation.ca.gov/server/rest/services/Base/BASE_PLSS/MapServer/1. **Table O-1**, located at the end of this document, provides the details of the types of native plant communities by township, range and section for the entire Subbasin.

Each plant species shown on the NCCAG database was compared to those listed on the Plant Rooting Depth database, developed by The Nature Conservancy (TNC), that includes spreadsheets with California Phreatophyte Rooting information and a Comprehensive Root Depth List. These two spreadsheets provided rooting depth references for many of the species listed in the NCCAG database. The following species were identified in the NCCAG database as being present in the Subbasin and were included in the TNC California Phreatophyte Rooting list database:

Scientific Name	Common Name	Max Rooting Depth (feet)
Acer negundo	Box-elder	13.12
Alnus rhombifolia	White Alder	Not cited
Plantanus racemosa	California Sycamore	Not cited
Populus fremontii	Fremont Cottonwood	6.89
Quercus lobata	Valley Oak	(1)
Salix exigua	Narrowleaf Willow	Not cited
Salix gooddingii	Goodding's Willow	6.89
Salix lasiolepis	Arroyo Willow	Not cited
Sambucus nigra	Common Elderberry	Not cited

(1) While some Valley Oak (Quercus lobata) has been noted at rooting depths of up to 80 feet, the optimal depth is more in the vicinity of 33 feet (Howard, 1992).

The following species were identified on the NCCAG database, but not included on the California Phreatophyte Rooting list, but were included on the TNC Comprehensive Root Depth List:

Scientific Name	Common Name	Max Rooting Depth (feet)
Juglans hindsii	Northern California Black Walnut	Not cited
Fraximus latifolia	Oregon Ash	Not cited
Typha augustifolia	Narrowleaf Cattail	Not cited
Schoenoplectus acutus	Hardstem Bulrush	1.97
Vitus californica	California Grape	Not cited
Persicaria lapathifolia	Curly-topped knotweed	Not cited

Arundo donax (Giant Reed) was identified on NCCAG database, but not included on the Plant Rooting Depth database.

The average depth of California phreatophytes is about 30 feet. Therefore, the depth to groundwater of less than 30 feet below ground surface groundwater was assumed to potentially being capable of supporting dependent ecosystems.

1.1 Identification of Critical Species

Using the California Department of Fish and Wildlife RareFind5 database (https://wildlife.ca.gov/Data/CNDDB/Maps-and-Data), an evaluation of aquatic critical fauna that may be present in the Subbasin was conducted to determine location of species by section using the PLSS. A query using RareFind5 included species that are "endangered", "threatened" or "candidate" under the Federal Listing Status or "endangered", "threatened", "rare", "candidate threatened" or "candidate endangered" under the California State Listing Status. The following species within these categories were identified within the NASb:

Scientific Name	Common Name
Riparia riparia	Bank Swallow
Laterallus jamaicensis coturniculus	California Black Rail
Branchinecta conservatio	Conservation Fairy Shrimp
Thamnophis gigas	Giant Gartersnake
Buteo Swainsoni	Swainson's Hawk
Agelaius tricolor	Tricolored Blackbird
Desmocerus californicus dimorphus	Valley Elderberry Longhorned Beetle
Branchinecta lynchi	Vernal Pool Fairy Shrimp
Lepidurus packardi	Vernal Pool Tadpole Shrimp
Coccyzus americanus	Yellow Billed Cuckoo
Onocorhynchus mykissirideus	Steelhead
Oncorhynchus tshawytscha	Chinook Salmon

1.2 Depth to Groundwater

Groundwater contours were developed using 61 wells and groundwater level measurements from Spring 2020. Spring 2020 was selected as having the most complete set of measurements, that include measurements from four new shallow monitoring wells (RDMW-101 through RDMW-104) constructed along the Bear and Feather Rivers early 2020 along with additional monitoring wells from various sources. Monitoring wells selected for contouring had screen intervals between 20 and 300 feet below ground surface (bgs), with only one exception, to represent the water table surface that could be accessed by vegetation. Deeper wells were incorporated into the contouring in the Central area where a large pumping depression has lowered the groundwater surface to more than 150 bgs. **Table O-2** provides the list of wells and their total depths and screen intervals. **Figure O-1** shows the location of the wells and the groundwater elevation contours.

Invert elevations within rivers and canals were obtained from the Central Valley Floodplain Evaluation and Delineation Program. Feather River, Bear River, Yankee Slough and Natomas Cross Canal were based on minimum values from selected cross section surveys. Sacramento River and American River values were derived from Urban Levee Evaluation Program multibeam SONAR surveys at approximately 1mile intervals within survey extents.

Ground surface elevations from National Elevation Dataset (NED) 1/3 arc-second (approximately 10 meter) elevation grids were obtained from United States Geological Survey via the National Map.

Water surface elevations were then subtracted from ground surface elevations to obtain the depth to water throughout the Subbasin. **Figure O-2** shows the depth to groundwater contours along with potential GDEs. **Figure O-3** highlights the areas where groundwater levels are less than 30 feet bgs.

1.3 GDE Classification

GDEs were prioritized by assigning a point system based on depth to groundwater using 2019 depth to groundwater contours for the Subbasin, vegetation diversity (NCCAG database) and the potential presence of critical species (RareFind5) for each section in the PLSS:

Criteria	Assigned Points
Depth to groundwater less than 30 ft bgs	2
Critical species identified	1
Diverse vegetation (3 or more plant species identified by NCCAG)	1
Depth to groundwater greater than or equal to 30 ft bgs	0
Lack of diverse vegetation (less than 3 plant species identified by NCCAG)	0
No vegetation identified (NCCAG)	-1
Diverse vegetation with rooting depths less than depth to water	0

The scoring system was used to simplify classification of GDEs as "Likely", "Less Likely" or "Not Likely" as follows:

Priority	Points Assigned
Likely GDE	3-4
Less Likely GDE	2
Not Likely GDE	0-1

Figure O-4 provides the priority classification of potential GDEs by section. **Figure O-5** provides a simplified summary of the results for the potential GDEs using this approach. Additional details describing the approach are provided below.

Figure O-6 provides the additional details for those Likely and Less Likely GDEs, by illustrating:

- high priority areas, where diverse and critical species are present,
- those areas where just diverse vegetation is present, and
- those areas where just critical species are present
- low priority areas, where depth to groundwater is less than 30 feet bgs but diverse vegetation or critical species are not present

Prioritizing GDEs by these criteria was performed to assist in selection of representative groundwater monitoring wells and identification of data gaps in the monitoring network. This approach will help to prioritize limited funding to fill monitoring gaps.

1.4.1 Likely GDEs

Sections that had depth to groundwater of less than 30 feet bgs, diverse vegetation and critical species identified received as score of 4. Sections that had depth to groundwater of less than 30 feet bgs, diverse vegetation, but no critical species received as score of 3. Likewise, sections with depth to groundwater of less than 30 feet bgs, critical species identified, but no diverse vegetation also received a score of 3. Sections with scores of 3 or 4 were considered "Likely" GDEs. Likely GDEs consisted of approximately 14% of all sections evaluated.

Exceptions occurred where land uses were identified based on historical aerial photos that showed that these vegetative species did not exist at these locations in the past, but do presently due to artificial sources of surface water, for example an NCCAG identified at a golf course that did not exist prior to the course being constructed.

1.4.2 Less Likely GDEs

Sections that had depth to groundwater of less than 30 feet bgs, critical species identified, but no groundwater dependent vegetation received a score of 2. Sections that had depth to groundwater of less than 30 feet bgs, vegetation identified, but no critical species identified also received a score of 2. Sections with scores of 2 were considered "Less Likely" GDEs. "Less likely" GDEs consisted of approximately 15 percent of the sections evaluated.

1.4.3 Not Likely GDEs

Sections that were classified as "Not Likely" GDEs generally had depth to groundwater equal to or greater than 30 feet bgs. If no critical species were identified a score of 0 was assigned. If critical species were identified, a score of 1 was assigned. Diverse vegetation was noted, but because groundwater dependent species in the Subbasin have rooting depths of less than 30 feet it was not considered in scoring.

There were "Not Likely" GDEs identified in sections that had depth to groundwater less than 30 feet bgs. These sections lacked the presence of critical species and there was no groundwater dependent vegetation identified. These received a score of 1. "Not Likely" GDEs consisted of 71 percent of all sections evaluated.

Further evaluation of some of the potential GDE areas with depths to groundwater greater than 30 feet bgs was performed to assess why the potential GDEs were present and their source of water. Most of the potential GDEs were present along creeks in these areas. Sources of surface water to portions of Dry, Raccoon, and Pleasant Grove Creeks and Auburn Ravines are from wastewater treatment plants both in the Subbasin and in watershed. Water in the creeks is also present due to releases from Nevada Irrigation District (NID) and Placer County Water Agency (PCWA) canals to Doty Ravine, Raccoon Creek, Antelope Creek and Miners Ravine. The amount of surface water in these waterways can be influenced by return flows from customer purchases, leakage, and end of canal losses, but cannot be quantified and is highly variable. Another waterway that benefits from return flows is Markham Ravine but NID does not currently use it for conveyance. Historically, NID had

supplied South Sutter Water District (SSWD) through Auburn Ravine but SSWD has not purchased water for a number of years. Currently, PCWA supplies surface water to a few agricultural customers in the Subbasin along Auburn Ravine. SSWD also uses the creeks and ravines within its boundaries for conveyance and to receive return water. Water in these creeks and ravines from these sources are not mandated, except for Dry Creek where 10,000 AFY is required to be released from Roseville's Dry Creek treatment plant, and may vary from year to year and may be reduced in the future due to recycling of treated water for use for irrigation and other uses.

It is important to note that many of the areas retained as Likely and Less Likely GDEs in Sutter County are supported through surface water, regardless of whether they or not they are groundwater-dependent. SSWD delivers surface water into several channels from April into October each year. From north to south, SSWD has documented deliveries into the following: Yankee Slough, Raccoon Creek, Bunkham Slough, Markham Ravine, Auburn Ravine, King Slough, and Pleasant Grove Creek. Deliveries to the East Side Canal are also documented. Also, conservation and preserves with potential GDEs, in areas with depth to groundwater less than 30 feet bgs, were also retained as Likely or Less Likely even though some of these areas are being supported by groundwater from wells.

Perched water is present beneath and adjacent to several creeks in the eastern portion of the Subbasin where potential GDEs were identified by NCCAG, even within areas designated as being less than 30 feet depth to groundwater. These perched water areas cannot be managed and are not part of the principal aquifer as illustrated below.

- Some of the potential GDEs along Markham Ravine in the area where the depth to groundwater is greater than 30 feet bgs, may be supported by perched groundwater which cannot be managed and is not part of the principal aquifer. Perched water was encounter during construction of monitoring well 90, located on the north side of the creek in Placer County. Perched water was encountered at a depth of about 5 feet below ground surface while the monitoring well shows the depth to water in the principal aquifer is over 40 feet bgs (see **Appendix H**).
- Studies along the foothills, northeast of Lincoln and east of Highway 65, along Raccoon Creek and Doty Ravine have shown groundwater is perched in thin alluvium resting on the low permeability sediments of the marine Ione Formation. **Figures O-7 through O-10** and provide a location map and geologic profiles (cross sections) showing the types of sediments in the subsurface. All three profiles paint a consistent picture that the Ione Formation is present at or near the ground surface east of the old Highway 65 and that thin alluvium rests on top of the Ione Formation where groundwater may be perched. The principal aquifer in the Subbasin starts to the west of old Highway 65 where the sediments are thicker.
- A fairly large area of perched water is present near the upper reaches of Dry Creek where potential GDEs were identified by NCCAG. Case files for releases of contaminants to the environment (leaky underground storage tanks, Roseville Railyard) were reviewed for groundwater levels and plotted with groundwater levels from dedicated groundwater monitoring wells. **Figure O-11** shows the locations of

the monitoring wells from these contaminant evaluation studies, dedicated monitoring wells, and cross sections drawn to illustrate the perched water occurrences and the potential path of the water to the saturated zone. **Figures O-12 through O-14** cross sections show groundwater levels and sediment types. **Figure O-12** was drawn generally parallel to Dry Creek and shows the principal aquifer (saturated zone) groundwater levels and other groundwater occurrences (inverted triangles) of groundwater levels from the various monitoring wells. There are four wells along this section that have perched groundwater levels up to 100 feet above the saturated zone. **Figure O-13** shows the same occurrences. The hydrograph for monitoring well 35 (see **Appendix H**) illustrates the long-term groundwater level occurrences along Dry Creek just north of the railyards and that even seasonal highs in the principal aquifer do rise high enough to connect with the perched water. These multiple perched groundwater levels extend north of the railyards to the Placer County Fair Grounds and south of Highway 80. **Figure O-14**, close to the foothills, does not show perched water but a continuous saturated interval with the principal aquifer.

- Areas around Auburn Ravine also have documented perched water but the extent is unknown. Evidence to support that the groundwater levels in this area are perched is because groundwater levels are higher (by about 20 feet) than in underlying principal aquifer and that the groundwater levels in the principal aquifer never rise to the levels of the perched water, showing they are disconnected. Monitoring well 65 (see **Appendix I**) illustrates the long-term groundwater level occurrences along Auburn Ravine and the perched water.

Potential GDEs along these creeks and in areas with depths to groundwater greater than 30 feet were removed as likely GDEs.

1.5 Summary of NCCAG Dataset Review

The NCCAG vegetation dataset covers 9,197 acres in the NASb. Of that amount, only 4,229 acres (46 percent) were present in areas with a depth to groundwater of 30 feet or less. Of the 4,229 acres, 1,679 acres (40 percent) was excluded as having no vegetation capable of being supported by groundwater at 30 feet bgs (e.g., Valley Oak), having no critical species, or having man-made features (e.g., irrigated golf course). The remaining 2,550 acres that remain as likely GDEs can be classified as follows:

Vegetation Priority	Acres	Percent of Area
High Priority	1,334	52
Critical Species	524	21
Diverse Vegetation	305	12
Low Priority	387	15
Total	2,550	100

The NCCAG dataset also has identified wetlands. Some of these are coincident with mapped vegetation areas, so the total acres of vegetation and wetlands are not additive. The NCCAG dataset identifies 3,298 acre in the NASb. Of that amount, 2,133 acres (65 percent) are in areas where the depth to groundwater 30 feet or less. Of the 2,133 acres, 686 acres (32 percent) were excluded based on supporting no species or being man-made features. The remaining 1,447 acres that remain as likely GDEs can be classified as follows:

Wetlands Priority	Acres	Percent of Area
High Priority	656	45
Critical Species	520	36
Diverse Vegetation	50	4
Low Priority	221	15
Total	1,447	100

1.6 Effects of Sustainable Management Criteria on GDEs

The NASb sustainable management criteria (SMC) were developed based on modeling of future demand projections with climate change and a limited urban area expanded conjunctive use program. This modeling produced estimated future Spring groundwater levels resulting from a 50-year simulation period. The future projected water levels were used to create a future conditions Spring groundwater elevation map. The projected Spring water levels were intersected with the NASb NCCAG vegetation and wetlands dataset in the same manner as was done for the Spring 2020 groundwater levels as described in Section 1.2 above. This had only a limited effect on the likely GDE areas as shown below:

Vegetation Priority	Spring 2020 Acres	Future Projected Spring Acres	Percent Reduction
High Priority	1,334	1,327	0.5
Critical Species	524	521	0.6
Diverse Vegetation	305	300	1.6
Low Priority	387	346	10.6
Total	2,550	2,496	2

Wetlands Priority	Spring 2020 Acres	Future Projected Spring Acres	Percent Reduction
High Priority	656	656	0
Critical Species	520	520	0
Diverse Vegetation	50	50	0
Low Priority	221	208	5.9
Total	1,447	1,434	0.9

The table above shows that only about 54 acres of vegetation GDE could be lost under the NASb SMC, which is only 2 percent of the area. Of the 54 acre reduction, nearly all can be

accounted for by low priority GDEs. For the wetlands areas, only a 13 acre reduction is projected. The entire reduced area is within wetlands that are classified as low priority based on having no critical species and lacking diverse vegetation.

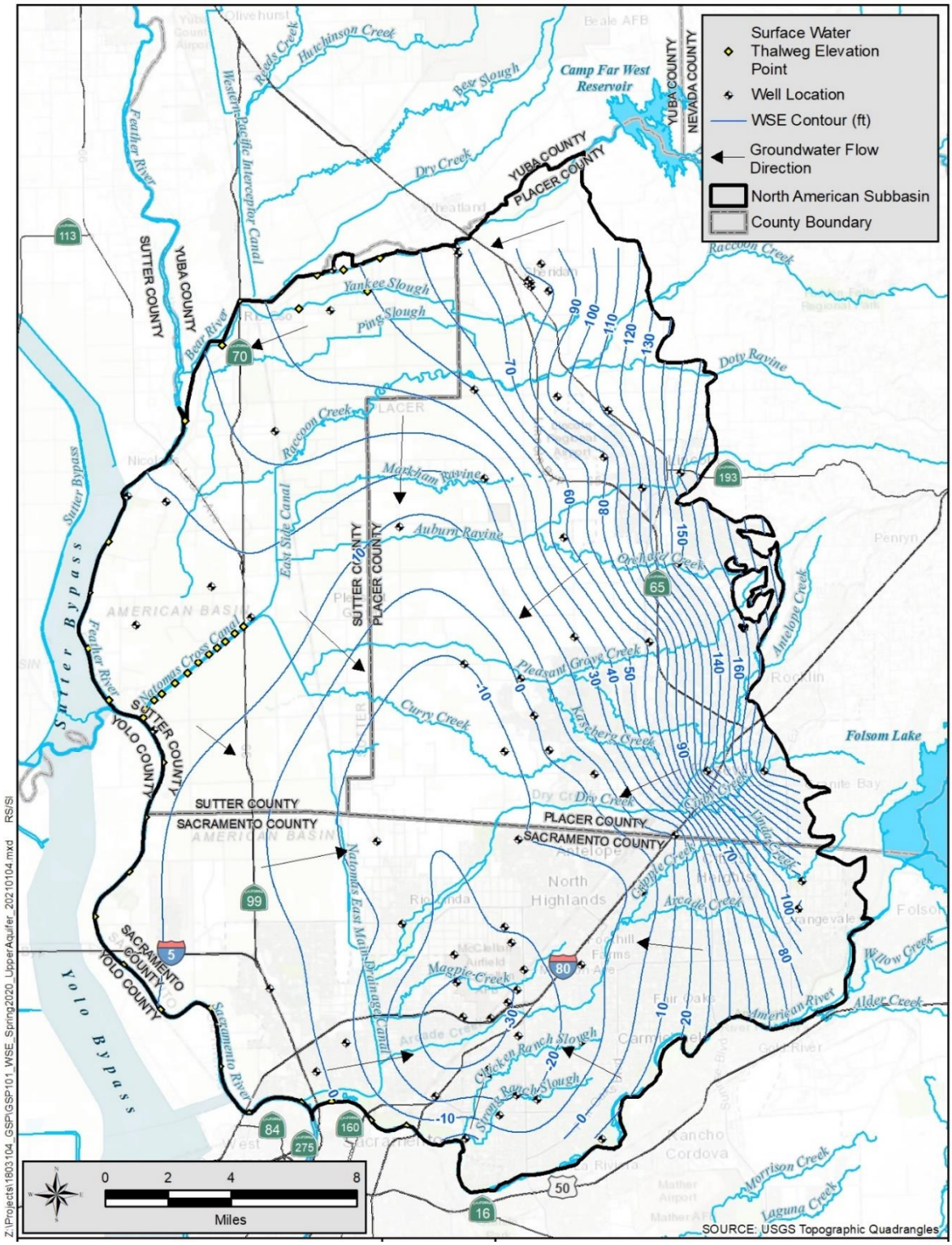


Figure O-1 Regional Groundwater Contours – Spring 2020

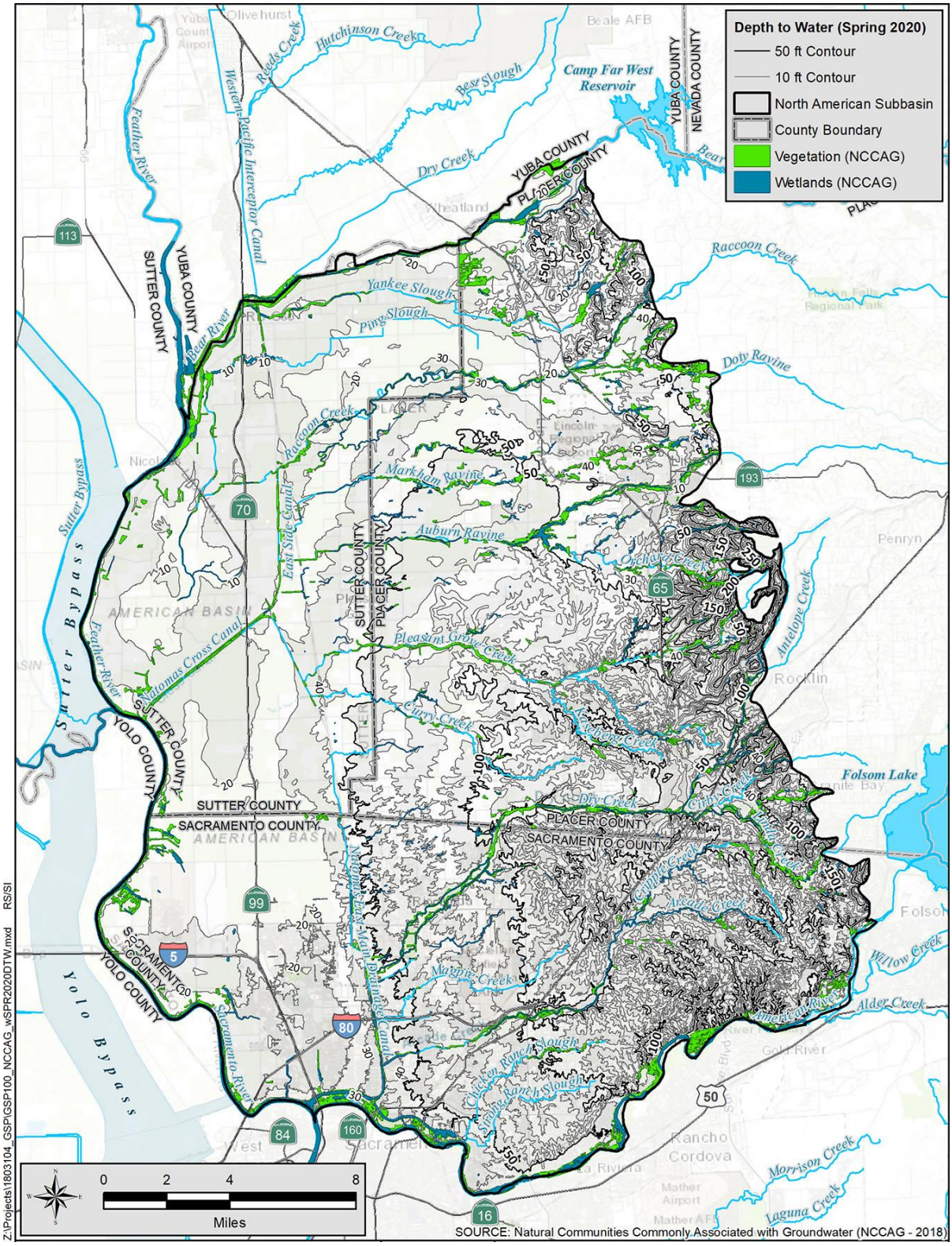


Figure O-2 Depth to Groundwater – Spring 2020

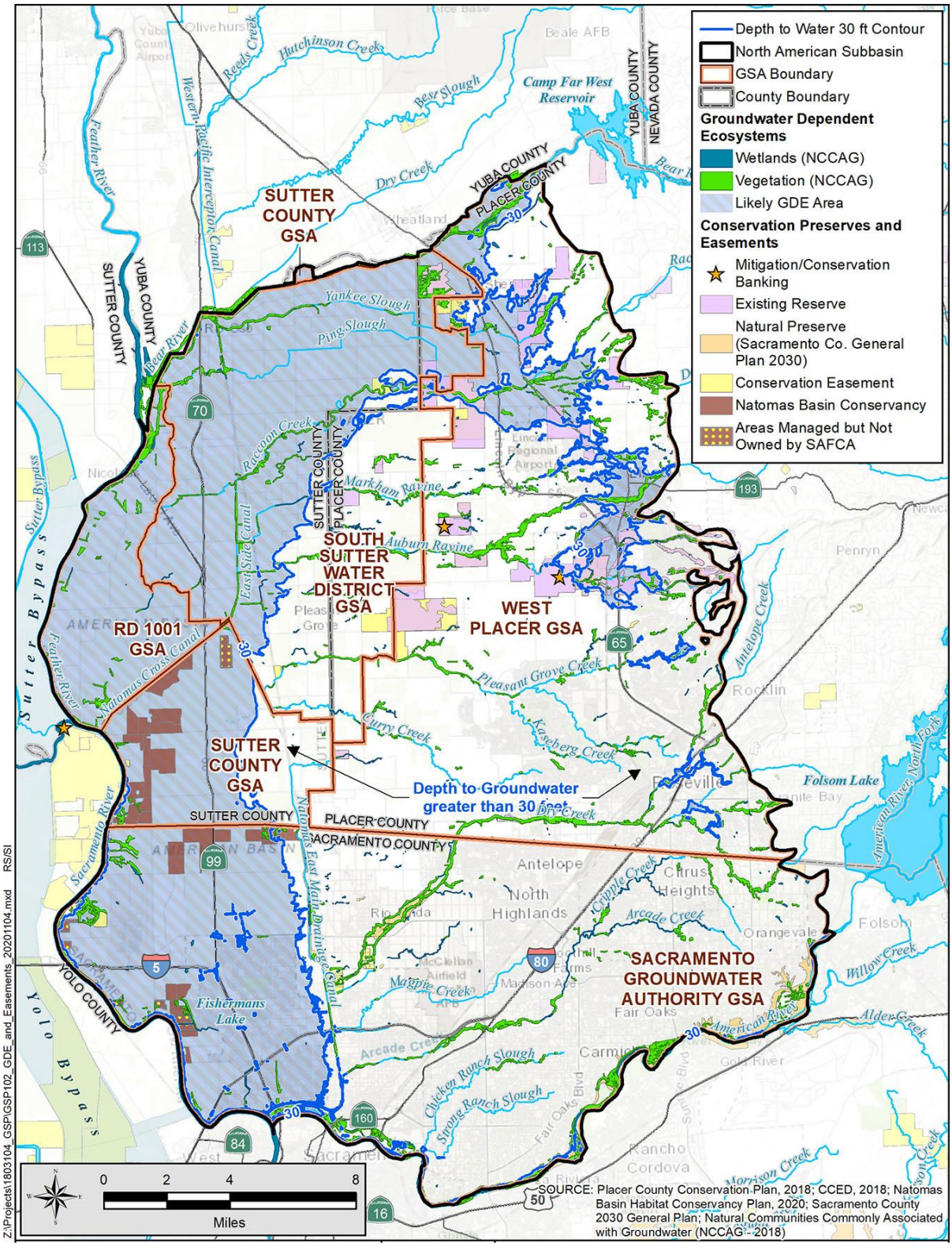


Figure O-3 Areas with Likely GDEs – Groundwater Less Than 30 Feet

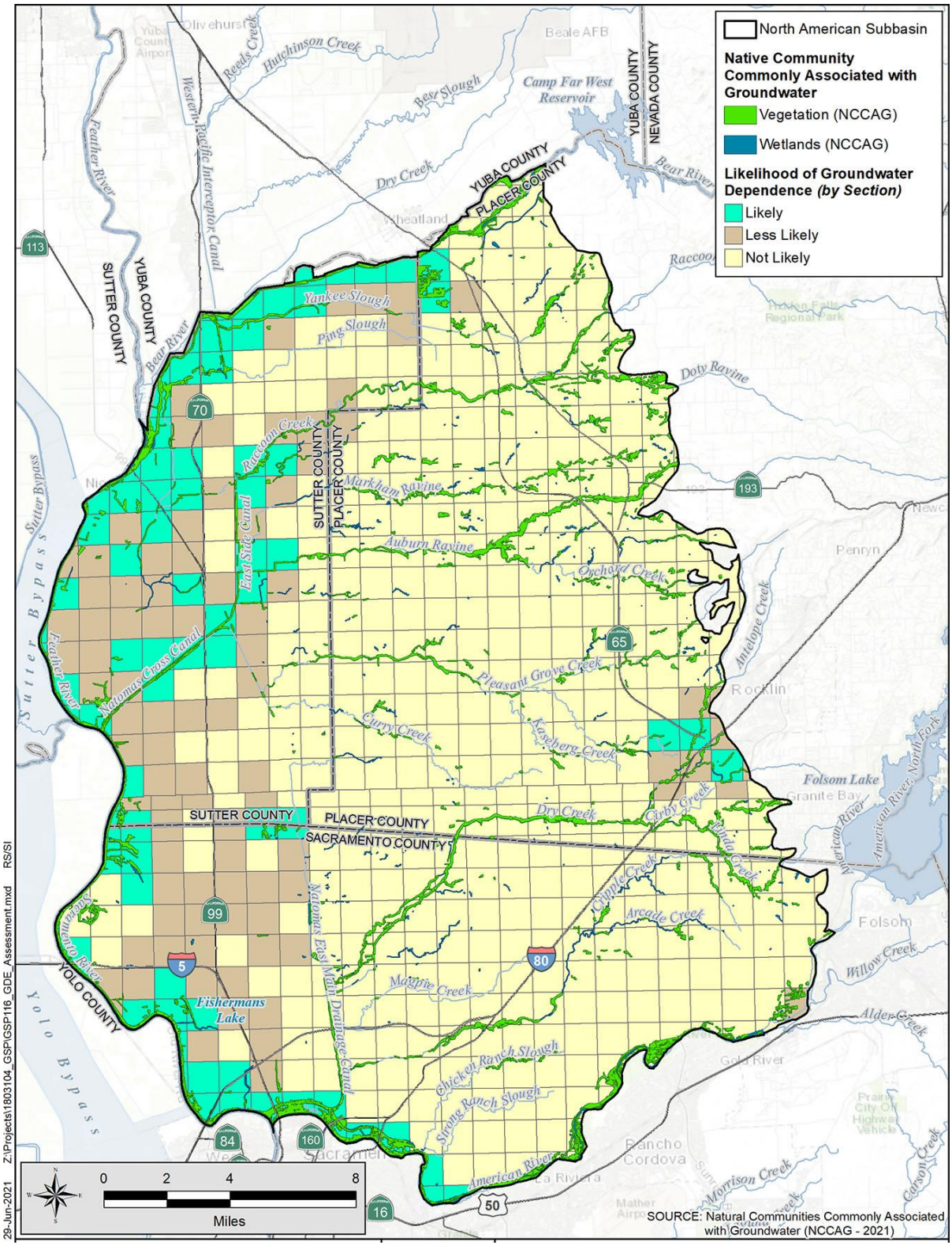


Figure O-4 Characterization of GDEs by Section

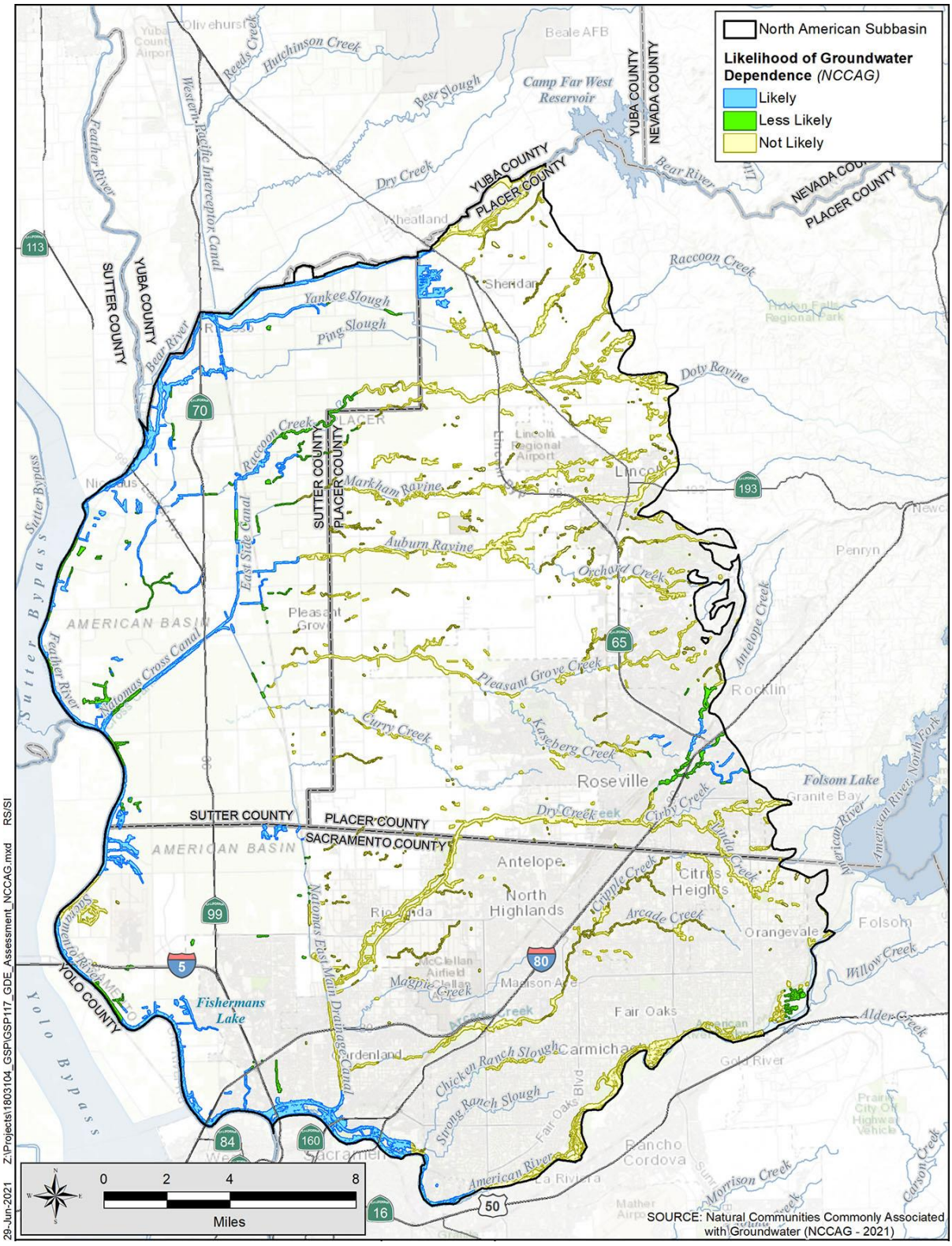


Figure O-5 Classification of Potential GDEs

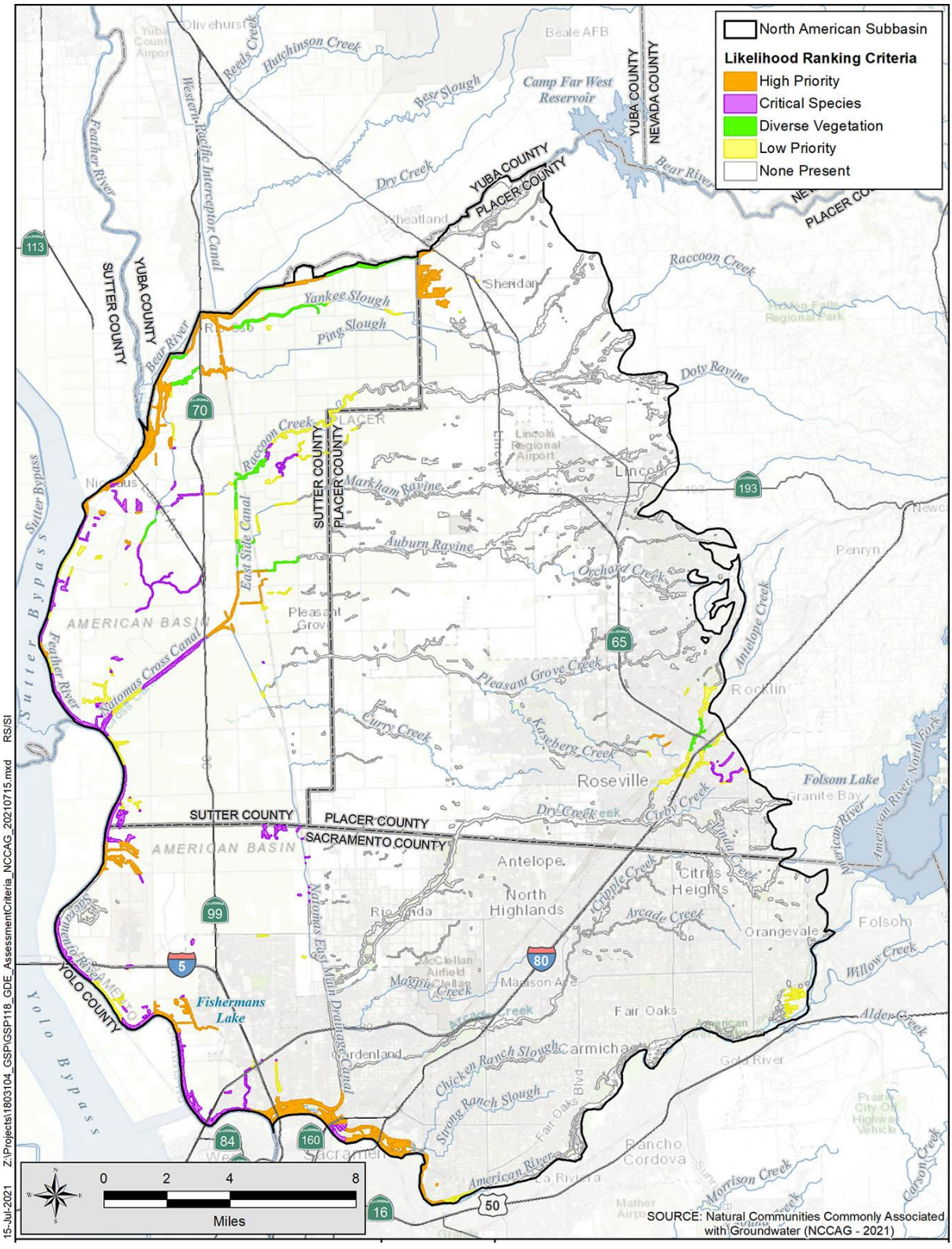


Figure O-6 Rankings of Likely and Less Likely GDE Areas

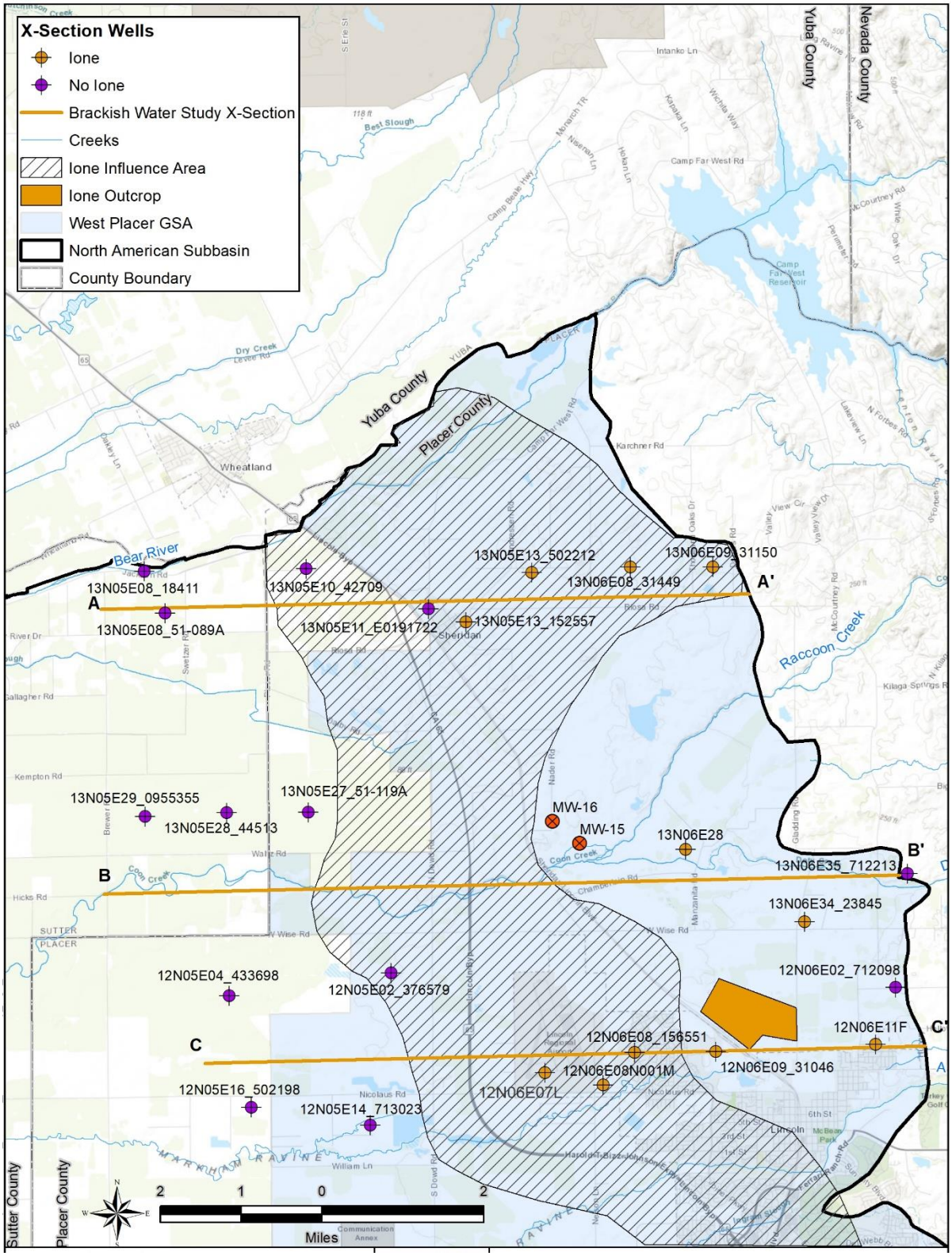
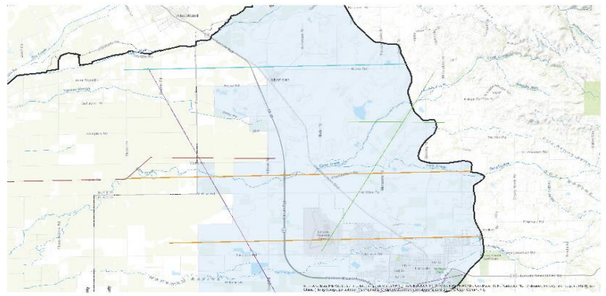


Figure O-7 Locations of Geologic Sections North of Lincoln



Legend

Ground Surface

Lithology Hatching Patterns

- GP-Poorly graded gravel
- SP-Poorly-graded sand
- SW-Well-graded sand fine to coarse sand
- GC-Gravel with fines clayey gravel
- SM-Sand with fines silty sand
- SC-Sand with fines clayey sand
- ML-Inorganic silt
- OH-Ogranic clay organic silt
- CL-Inorganic clay
- SHLE-Shale
- HP-Hardpan
- XLN-Crystalline Rock
- VLBA-Volcanic Basalt
- WS-White Sand
- WC-White Clay
- L/C-Lignite/Coal

NOTES: 1. USCS classifications assigned by GEI based on interpretation of driller well log sediment descriptions.
2. Ione indicated by white sand/clay, lignite, or coal.
3. Recent Total Dissolved Solids values shown beneath wells where applicable.
4. mg/L = milligrams per liter

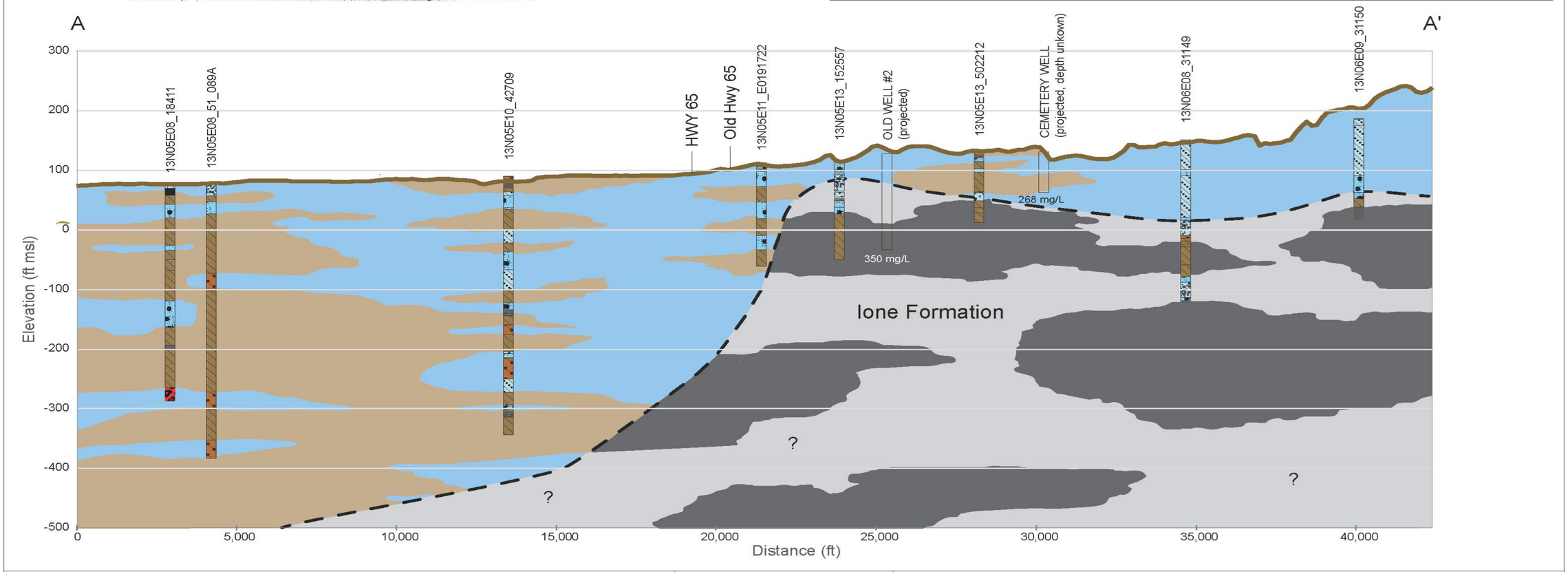
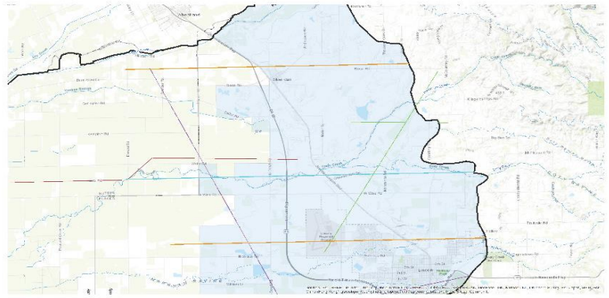


Figure O-8 Geologic Sections A-A' North of Lincoln

<this page intentionally left blank>



Legend

Ground Surface

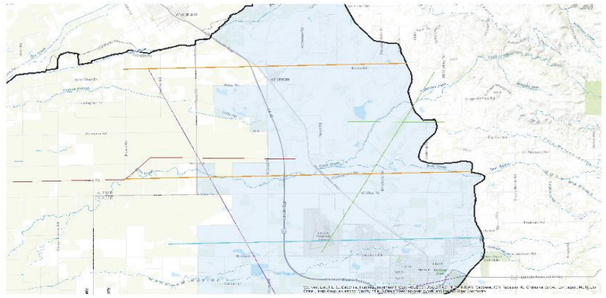
Lithology Hatching Patterns

- GP-Poorly graded gravel
- SP-Poorly-graded sand
- SW-Well-graded sand fine to coarse sand
- GC-Gravel with fines clayey gravel
- SM-Sand with fines silty sand
- SC-Sand with fines clayey sand
- ML-Inorganic silt
- OH-Ogranic clay organic silt
- CL-Inorganic clay
- SHLE-Shale
- HP-Hardpan
- XLN-Crystalline Rock
- VLBA-Volcanic Basalt
- WS-White Sand
- WC-White Clay
- L/C-Lignite/Coal

NOTES: 1. USCS classifications assigned by GEI based on interpretation of driller well log sediment descriptions.
2. Ione indicated by white sand/clay, lignite, or coal.
3. Recent Total Dissolved Solids values shown beneath wells where applicable.
4. mg/L = milligrams per liter

Figure O-9 Geologic Section B-B'

<this page intentionally left blank>



Legend

Ground Surface

Lithology Hatching Patterns

- GP-Poorly graded gravel
- SP-Poorly-graded sand
- SW-Well-graded sand fine to coarse sand
- GC-Gravel with fines clayey gravel
- SM-Sand with fines silty sand
- SC-Sand with fines clayey sand
- ML-Inorganic silt
- OH-Ogranic clay organic silt
- CL-Inorganic clay
- SHLE-Shale
- HP-Hardpan
- XLN-Crystalline Rock
- VLBA-Volcanic Basalt
- WS-White Sand
- WC-White Clay
- L/C-Lignite/Coal

NOTES:
1. *USCS classifications assigned by GEI based on interpretation of driller well log sediment descriptions.*
2. *Ione indicated by white sand/clay, lignite, or coal.*
3. *Recent Total Dissolved Solids values shown beneath wells where applicable.*
4. *mg/L = milligrams per liter*

Figure O-10 Geologic Section C-C' North of Lincoln

<this page intentionally left blank>

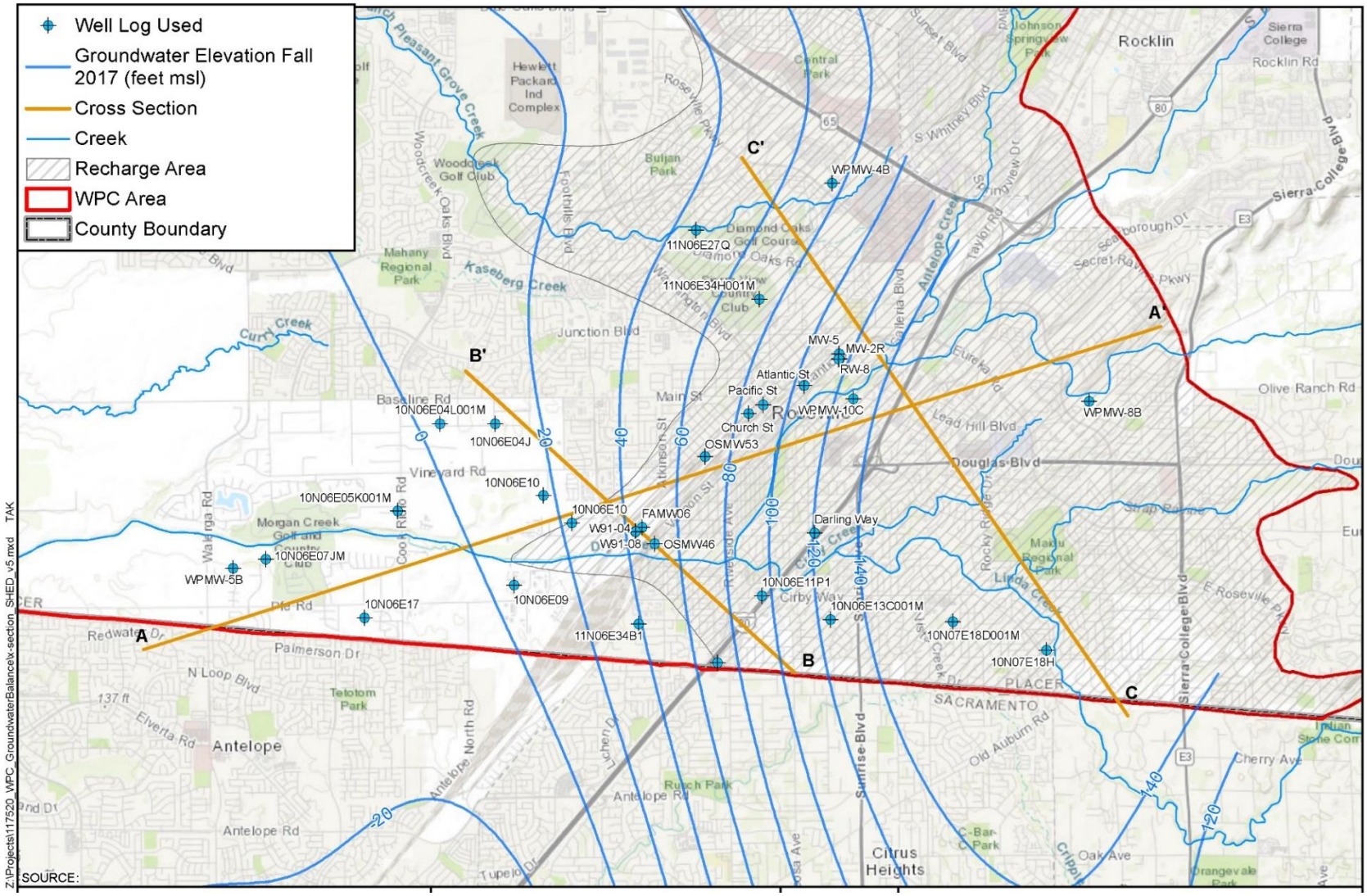


Figure O-11 Locations of Geologic Sections Dry Creek Area

Cross Section A-A'

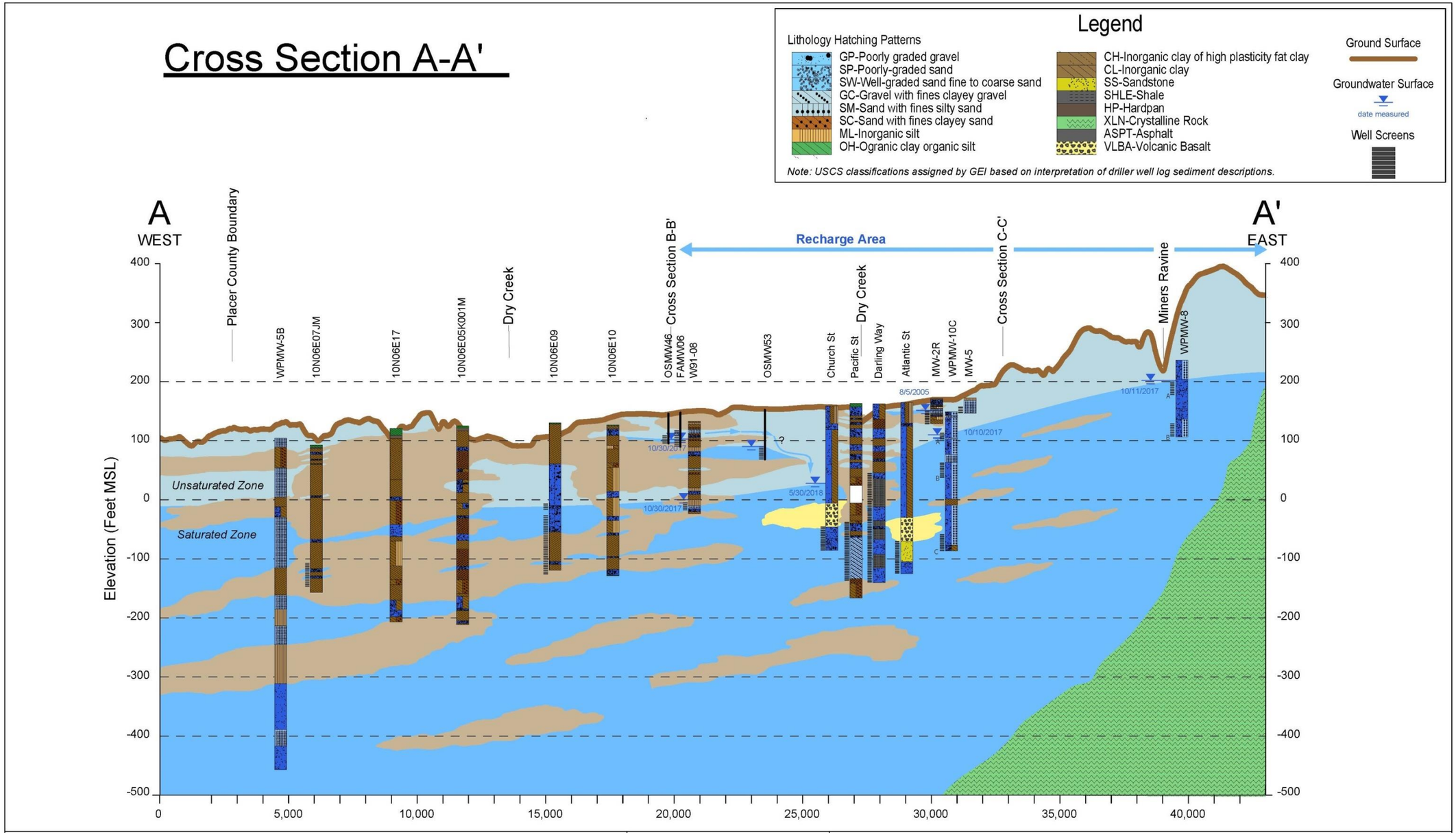


Figure O-12 Geologic Section A-A' Dry Creek Area

< this page intentionally left blank>

Cross Section B-B'

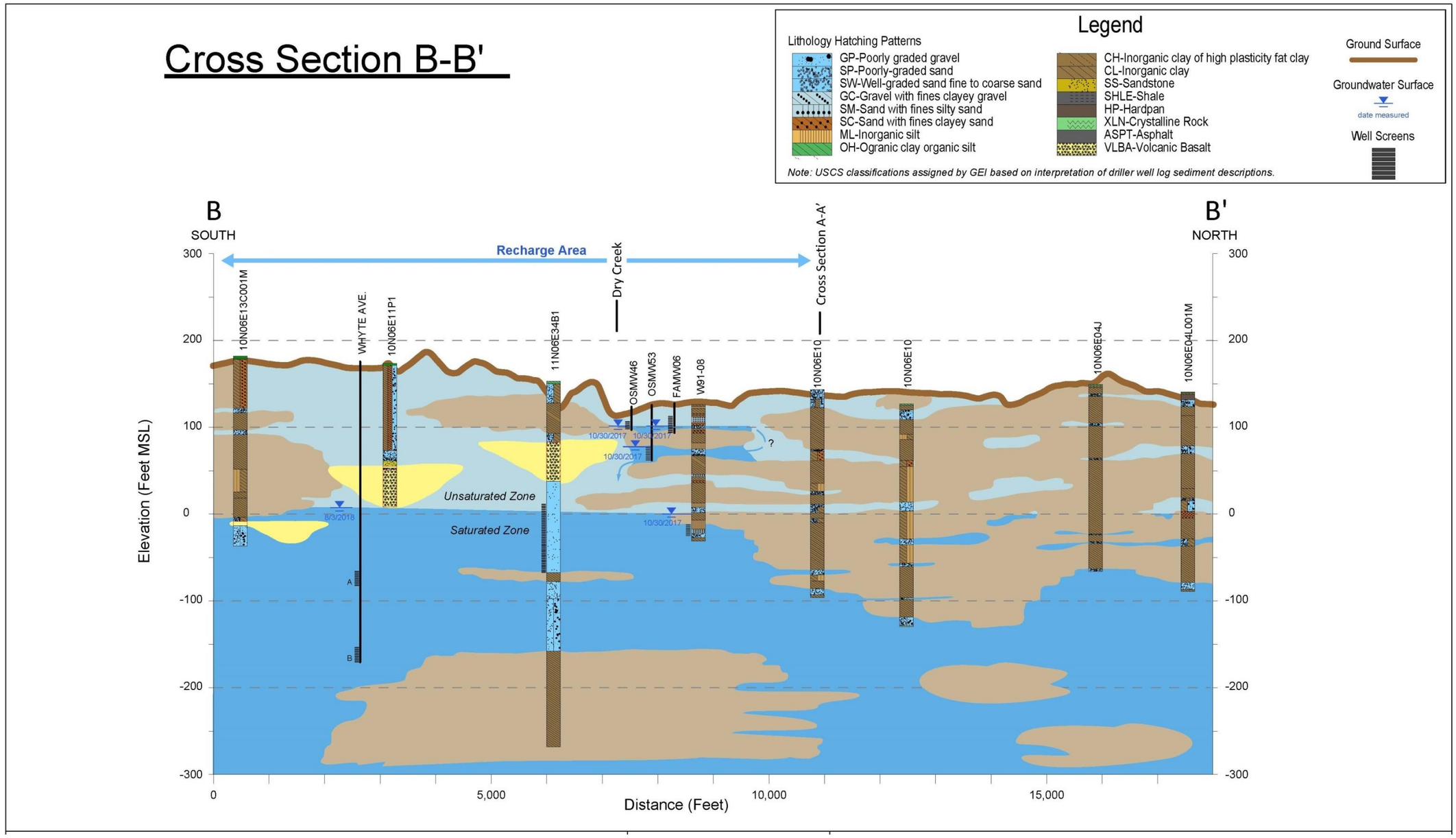


Figure O-13 Geologic Section B-B' Dry Creek Area

< this page intentionally left blank>

Cross Section C-C'

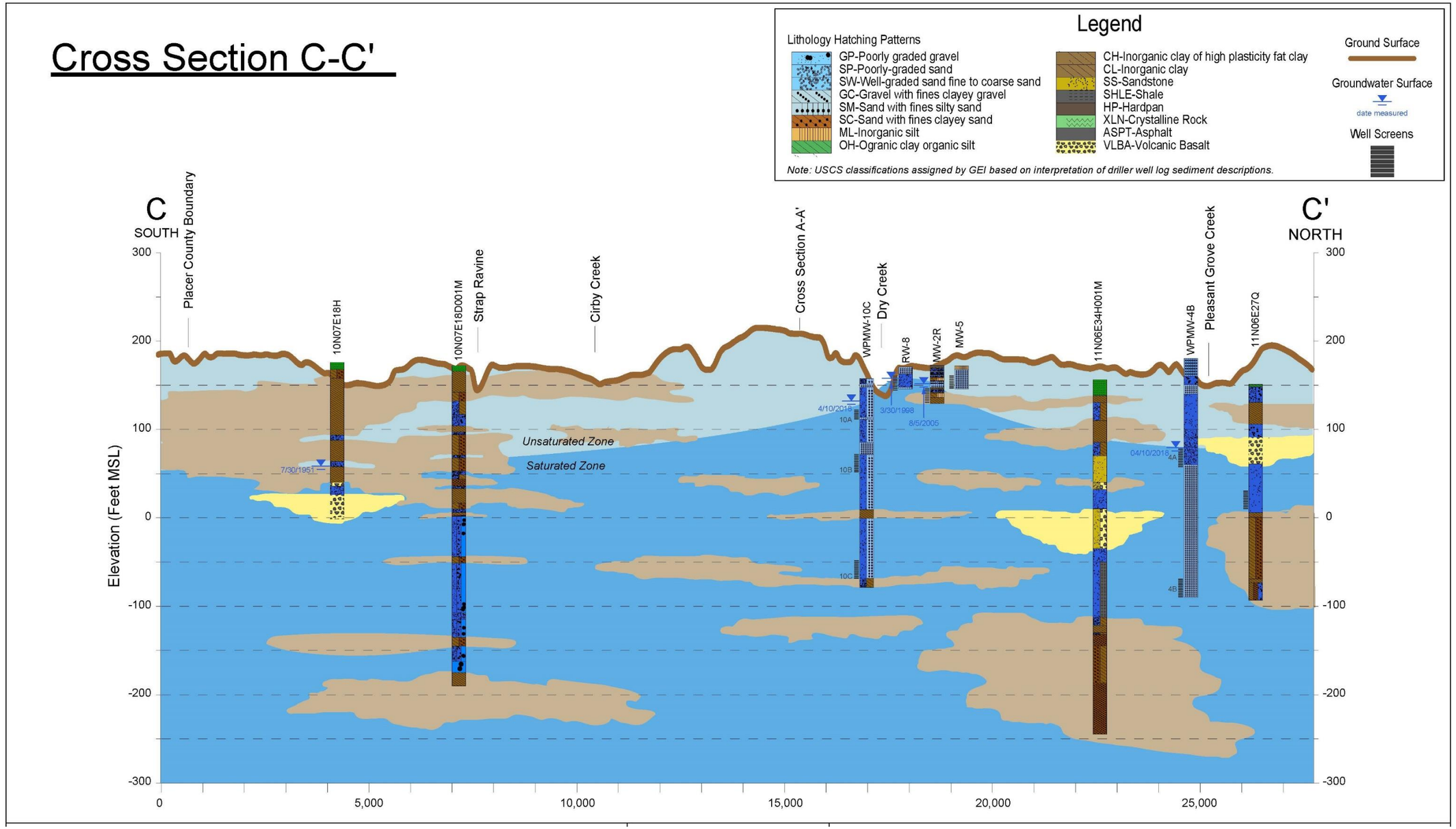


Figure O-14 Geologic Section C-C' Dry Creek Area

< this page intentionally left blank>

Table O-1. Likely GDE Analyses

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
8	5	1	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata requires a DTW of 24.31 ft[1] and the polygon is located between the 30 ft and 40 ft DTW contour interval. Species is likely dependent on the American River, not groundwater, at this location.	40	none	Flat	N/Flat	N- CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020) N - CASGEM Well 48014 (SGA_MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	none	Quercus lobata	Valley Oak														
8	5	2	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	No GDEs	30-45	none	Flat	N/Flat	N- CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020) N - CASGEM Well 48014 (SGA_MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	none																
8	5	3	American River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Quercus lobata occupies 0.18 acre of the section. (Refer to T8, R5, Section 10). All other species present have root depths that are shallow[1,3] and therefore not dependent on groundwater at this location. Species are likely dependent on the American River.	20-30	Valley Elderberry Longhorned Beetle	Flat	N/Flat	N- CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020) N - CASGEM Well 48014 (SGA_MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Emergent, Nonpersistent, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Acer negundo	Box-elder	Salix exigua	Narrowleaf Willow	Quercus lobata	Valley Oak	Alnus rhombifolia	White Alder						
8	5	4	American River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	All species present have shallow root depths[1,3] and therefore not dependent on groundwater at this location. Species are likely dependent on the American River.	20-30	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	N	N- CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow	Salix gooddingii	Goodding's Willow	Alnus rhombifolia	White Alder								
8	5	10	American River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Quercus lobata requires a DTW of 24.31 ft[1] and the polygon is located between the 20 ft and 30 ft DTW contour interval. All other species present have root depths that are shallow[1] and therefore not dependent on groundwater at this location. Species are likely dependent on the American River.	20-30	none w/in NASb boundary	Flat	N/Flat	N- CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020) N - CASGEM Well 48014 (SGA_MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow	Acer negundo	Box-elder						

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
8	5	11	American River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation Species have rooting depths less than DTW	Quercus lobata is located where DTW is greater than 30 ft. Species are likely dependent on the American River. Can be eliminated because DTW is greater than 30 ft.	25-35	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	N/Flat	N- CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020) N - CASGEM Well 48014 (SGA_MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Scrub-Shrub, Emergent, Persistent, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
8	5	12	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Location of species has DTW at greater than 30 ft. Species are likely dependent on the continuous flow of the American River, not groundwater at this location.	30-40	none	Flat	N/Flat	N- CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020) N - CASGEM Well 48014 (SGA_MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
8	6	4	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40	none	Flat	N	N - CASGEM Well 9649 (SCGA #24, 09N06E33R001M) avg DTW = 51 (29 points; 2000-2020) N - CASGEM Well 48014 (SGA MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow	Quercus lobata	Valley Oak	Alnus rhombifolia	White Alder						
8	6	5	American River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40	Valley Elderberry Longhorned Beetle	Flat	N	N - CASGEM Well 9649 (SCGA #24, 09N06E33R001M) avg DTW = 51 (29 points; 2000-2020) N - CASGEM Well 48014 (SGA MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Acer negundo	Box-elder	Sambucus nigra	Common Elderberry	Juglans hindsii and hybrids*	No Cal Black Walnut						
8	6	6	American River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40	Valley Elderberry Longhorned Beetle	Flat	N	N - CASGEM Well 9649 (SCGA #24, 09N06E33R001M) avg DTW = 51 (29 points; 2000-2020) N - CASGEM Well 48014 (SGA MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Alnus rhombifolia	White Alder	Acer negundo	Box-elder						

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
8	6	7	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40	none	Flat	N	N - CASGEM Well 9649 (SCGA #24, 09N06E33R001M) avg DTW = 51 (29 points; 2000-2020) N - CASGEM Well 48014 (SGA MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
9	3	1	Sacramento River	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Juglans hindsii and hybrids*	No California Black Walnut										
9	3	2	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak												
9	3	12	Sacramento River	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none w/in NASb boundary	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak												
9	4	1	Residential	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	20-30	none	Flat	Flat	Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001M) avg DTW = 29 (34 points; 2000-2020)	none														
9	4	2	Residential	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10-20	none	Flat	Flat	Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001M) avg DTW = 29 (34 points; 2000-2020)	none														
9	4	3	Residential	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	15-25	Swainson's Hawk Giant Gartersnake	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004M) avg DTW =17 (164 points; 2000-2020)	none														
9	4	4	Residential	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake (possibly extirpated) - area has been developed since sighted in 1986	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004M) avg DTW =17 (164 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
9	4	5	West Drainage Canal	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Salix gooddingii has a rooting depth of 6.89[1]. DTW is deeper than rooting depth. Less than 1.5 acres	10-20	Swainson's Hawk Giant Gartersnake	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow												
9	4	6	Unspecified area	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	DTW is less than 30 ft.	<10	none	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Palustrine, Unconsolidated Shore, Seasonally Flooded	Quercus lobata	Valley Oak												
9	4	7	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 29915 (09N04E10C001M) avg DTW = 15 (82 points; 2000-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
						diverse vegetation																					
9	4	8	Sacramento River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 29915 (09N04E10C001M) avg DTW = 15 (82 points; 2000-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Schoenoplectus acutus*	Hardstem Bullrush	Typha angustifolia*	Narrowleaf Cattail	Platanus racemosa	California Sycamore								
9	4	9	Artificial surface water in subdivision?	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft. However, appears to be man-made lake/pond in development	10	Swainson's Hawk Giant Gartersnake	Flat	Flat	Y - CASGEM Well 29915 (09N04E10C001M) avg DTW = 15 (82 points; 2000-2021)	Palustrine, Forested, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Salix gooddingii	Goodding's Willow	Schoenoplectus acutus*	Hardstem Bullrush										
9	4	10	Residential/Commercial	2	Less likely	DTW < 30 ft Critical Species not likely present (possibly extirpated) No vegetation	No GDEs	10-15	Giant Gartersnake (possibly extirpated) - area has been developed since sighted in 1986	Flat	Flat	Y - CASGEM Well 29915 (09N04E10C001M) avg DTW = 15 (82 points; 2000-2021)	none																
9	4	11	Residential/Commercial	2	Less likely	DTW < 30 ft Critical Species not likely present (possibly extirpated) No vegetation	No GDEs	15-20	Giant Gartersnake (possibly extirpated) - area has been developed since sighted in 1987	Flat	Flat	Y - CASGEM Well 29915 (09N04E10C001M) avg DTW = 15 (82 points; 2000-2021)	none																
9	4	12	Residential/Commercial	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-25	none	Flat	Flat	Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001M) avg DTW = 29 (34 points; 2000-2020)	none																
9	4	13	Residential/Commercial	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-25	none	Flat	Flat	Y - CASGEM Well 48040 (Chuckwagon, 09N04E13R001M) avg DTW = 19 (49 points; 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
9	4	14	Residential/Commercial	2	Less likely	DTW < 30 ft Critical Species not likely present (possibly extirpated) No vegetation	No GDEs	10-15	Swainson's Hawk (possible extirpated) last sighted 2003	Flat	Flat	Y - CASGEM Well 48040 (Chuckwagon, 09N04E13R001M) avg DTW = 19 (49 points; 2011-2020)	none																
9	4	15	Residential/Commercial	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	0-10	none	Flat	Flat	Y - CASGEM Well 48041 (Bannon Ck, 09N04E23R002M) avg DTW = 13 (34 points, 2011-2020)	none																
9	4	16	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 29915 (09N04E10C001M) avg DTW = 15 (82 points; 2000-2021)	none																
9	4	17	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Valley Elderberry Longhorned Beetle	Flat	Flat	Y - CASGEM Well 29915 (09N04E10C001M) avg DTW = 15 (82 points; 2000-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Platanus racemosa	California Sycamore												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	4	20	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	Insufficient data	Y - CASGEM Well 8944 (SCWA_SGA_003, 09N04E27F001M) avg DTW = 21 (25 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak																
9	4	21	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	Insufficient data	Y - CASGEM Well 8944 (SCWA_SGA_003, 09N04E27F001M) avg DTW = 21 (25 points; 2000-2020)	none	Quercus lobata	Valley Oak																
9	4	22	Residential	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft. However, appears to be in a developed area	0-10	Swainson's Hawk	Flat	Insufficient data	Y - CASGEM Well 8944 (SCWA_SGA_003, 09N04E27F001M) avg DTW = 21 (25 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Juglans hindsii and hybrids*	No Cal Black Walnut												
9	4	23	Residential	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft. However, vegetation may be part of landscaping	0-10	none	Flat	Flat	Y - CASGEM Well 48041 (Bannon Ck, 09N04E23R002M) avg DTW = 13 (34 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak	Juglans hindsii and hybrids*	No Cal Black Walnut												
9	4	24	Residential	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10-20	none	Flat	Flat	Y - CASGEM Well 48041 (Bannon Ck, 09N04E23R002M) avg DTW = 13 (34 points, 2011-2020)	none																
9	4	25	American River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	5-20	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Flat	Y - CASGEM Well 48041 (Bannon Ck, 09N04E23R002M) avg DTW = 13 (34 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Acer negundo	Box-elder	Vitis californica*	California Grape	Salix exigua	Narrowleaf Willow	Artemisia douglasiana**	Douglas' Wormwood				
9	4	26	Sacramento/American River Confluence	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Flat	Y - CASGEM Well 48041 (Bannon Ck, 09N04E23R002M) avg DTW = 13 (34 points, 2011-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix lasiolepis	Arroyo Willow										
9	4	27	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Insufficient data	Y - CASGEM Well 8944 (SCWA_SGA_003, 09N04E27F001M) avg DTW = 21 (25 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
9	4	28	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Insufficient data	Y - CASGEM Well 8944 (SCWA_SGA_003, 09N04E27F001M) avg DTW = 21 (25 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore,	Quercus lobata	Valley Oak														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
													Seasonally Flooded															
9	4	29	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	10	Swainson's Hawk	Flat	Insufficient data	Y - CASGEM Well 8944 (SCWA_SGA_003, 09N04E27F001M) avg DTW = 21 (25 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow												
9	4	33	Mostly outside NASb boundary (Yolo) Boundary line within river	0	Not likely	DTW < 30 ft No Critical Species w/in NASb boundary No vegetation w/in NASb boundary	No GDEs	10	none			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded																
9	4	35	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4[1].	20-30	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Insufficient data	Y - CASGEM Well 8944 (SCWA_SGA_003, 09N04E27F001M) avg DTW = 21 (25 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood														
9	5	1	McClellan AFB	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	125-135	none	Flat	N	N - CASGEM Well 48013 (SGA_MW-5, 09N06E05) avg DTW = 144 (29 points; 2009-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
9	5	2	McClellan AFB	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	105-125	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded																
9	5	3	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-100	Tri-Colored Blackbird Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix exigua	Narrowleaf Willow	Acer negundo	Box-elder												
9	5	4	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-85	none	Flat	N/Flat	N - CASGEM Well 48010 (SGA_MW02, 10N05E32) avg DTW = 65 (35 points; 2011-2020) N - CASGEM Well 48011 (SGA_MW03, 10N05E32) avg DTW = 70 (35 points; 2011-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak														
9	5	5	Dry Creek	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	45-70	Swainson's Hawk Vernal Pool Fairy Shrimp	Flat	N/Flat	N - CASGEM Well 48010 (SGA_MW02, 10N05E32) avg DTW = 65 (35 points; 2011-2020) N - CASGEM Well 48011 (SGA_MW03, 10N05E32) avg DTW = 70 (35 points; 2011-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus Lobata	Valley Oak	Juglans hindsii and hybrids*	No California Black Walnut								

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	5	6	Dry Ck/Steelhead Ck confluence	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Location of species has DTW at greater than 30 ft. Species are likely dependent on surface water from Dry Ck/Steelhead Ck, not groundwater, at this location.	35-45	Swainson's Hawk	Flat	N/Flat/Flat	N - CASGEM Well 48010 (SGA_MW02, 10N05E32) avg DTW = 65 (35 points; 2011-2020) N - CASGEM Well 48011 (SGA_MW03, 10N05E32) avg DTW = 70 (35 points; 2011-2020) Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001M) avg DTW = 29 (34 points; 2000-2020)	Palustrine, Unconsolidated Shore, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail												
9	5	7	Steelhead Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Location of Salix exigua has DTW greater than 30 ft[1]. Species is likely dependent on surface water from Steelhead Ck, not groundwater, at this location.	30-40	none	Flat	Flat	Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001M) avg DTW = 29 (34 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded	Salix exigua	Narrowleaf Willow														
9	5	8	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40-60	none			no representative hydrographs within contour interval	none																
9	5	9	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	60-80	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded, California Warm Temperate Marsh/Seep																
9	5	10	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	80-100	none	Flat	Flat	N - CASGEM Well 40050 (DWR_SGA_002, 09N05E14B001M) avg DTW = 103 (125 points; 2000-2021)	none																
9	5	11	McClellan AFB	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	100-120	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 40050 (DWR_SGA_002, 09N05E14B001M) avg DTW = 103 (125 points; 2000-2021)	none																

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	5	12	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW is greater than 30 ft	110-130	none	Flat	Flat/Y	N - CASGEM Well 40050 (DRW_SGA_002, 09N05E14B001M) avg DTW = 103 (125 points; 2000-2021) N - CASGEM Well 48017 (Well 10, 09N05E13L002M) avg DTW = 106 (47 points; 2010-2020)	none	Quercus lobata	Valley Oak												
9	5	13	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW is greater than 100 ft	100-120	none	Flat	Flat/Y	N - CASGEM Well 40050 (DRW_SGA_002, 09N05E14B001M) avg DTW = 103 (125 points; 2000-2021) N - CASGEM Well 48017 (Well 10, 09N05E13L002M) avg DTW = 106 (47 points; 2010-2020)	none	Quercus lobata	Valley Oak												
9	5	14	Arcade Ck - Haggin Oaks Golf Complex	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated DTW is greater than 30 ft	90-110	Vernal Pool Fairy Shrimp	Flat	Flat/Y	N - CASGEM Well 40050 (DRW_SGA_002, 09N05E14B001M) avg DTW = 103 (125 points; 2000-2021) N - CASGEM Well 48017 (Well 10, 09N05E13L002M) avg DTW = 106 (47 points; 2010-2020)	none	Quercus lobata	Valley Oak												
9	5	15	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW is greater than 30 ft	85-90	none	Flat	Flat	N - CASGEM Well 40050 (DWR_SGA_002, 09N05E14B001M) avg DTW = 103 (125 points; 2000-2021)	none	Quercus lobata	Valley Oak												
9	5	16	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	No GDEs	60-80	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak												
9	5	17	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40-60	none			no representative hydrographs within contour interval	none														
9	5	18	Steelhead Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Location has DTW greater than 30 ft. Species are likely dependent on surface water from Steelhead Ck, not groundwater, at this location.	35	none	Flat	Flat	Y - CASGEM Well 48040 (Chuckwagon, 09N04E13R001M) avg DTW = 19 (49 points; 2011-2020)	Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Typha angustifolia*	Narrowleaf Cattail										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	5	19	Steelhead Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Location has DTW greater than 30 ft. Species are likely dependent on surface water from Steelhead Ck, not groundwater, at this location.	35	Vernal Pool Tadpole Shrimp	Flat	Y/Flat	N - CASGEM Well 9643 (DWR_SGA_005, 09N05E28K001M) avg DTW = 60 (115 points, 2000-2020) Y - CASGEM Well 48040 (Chuckwagon, 09N04E13R001M) avg DTW = 19 (49 points; 2011-2020)	Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail										
9	5	20	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW is greater than 30 ft	40-60	none	Flat	Y	N - CASGEM Well 9643 (DWR_SGA_005, 09N05E28K001M) avg DTW = 60 (115 points, 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
9	5	21	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-75	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak												
9	5	22	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	75-80	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak												
9	5	23	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	55-90	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	none														
9	5	24	Del Paso Country Club	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW is greater than 30 ft	90-105	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak												
9	5	25	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	70-95	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	none														
9	5	26	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	60-90	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	none														
9	5	27	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	55-75	none	Flat	Y	N - CASGEM Well 9643 (DWR_SGA_005, 09N05E28K001M) avg DTW = 60 (115 points, 2000-2020)	none														
9	5	28	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	45-70	none	Flat	Y	N - CASGEM Well 9643 (DWR_SGA_005, 09N05E28K001M) avg DTW = 60 (115 points, 2000-2020)	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	5	29	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-55	none	Flat	Y	N - CASGEM Well 9643 (DWR_SGA_005, 09N05E28K001M) avg DTW = 60 (115 points, 2000-2020)	none															
9	5	30	American River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Quercus lobata requires a DTW of 24.31 ft[1]. All other species present (except Juglans hindsii and hybrids) have root depths that are shallow and therefore not dependent on groundwater at this location[1].	20-30	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Flat	Y - CASGEM Well 48041 (Bannon Ck, 09N04E23R002M) avg DTW = 13 (34 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow	Juglans hindsii and hybrids*	No Cal Black Walnut								
9	5	31	American River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	20-30	Valley Elderberry Longhorned Beetle Vernal Pool Fairy Shrimp	Flat	Flat	Y - CASGEM Well 48041 (Bannon Ck, 09N04E23R002M) avg DTW = 13 (34 points, 2011-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Forested, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
9	5	32	American River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Quercus lobata requires a DTW of 24.31 ft.[1] The polygon for Quercus lobata is at the 30 ft contour. All other species present have root depths that are shallow[1,5] and therefore not dependent on groundwater at this location.	20-40	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Flat	N - CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Forested, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Platanus racemosa	California Sycamore								
9	5	33	American River next to Cal Expo	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Location Quercus lobata is between the 30 ft and 40 ft DTW contour interval. All other species present have root depths that are shallow[1,3] and therefore not dependent on groundwater at this location. Species are likely dependent on the American River.	25-50	Bank Swallow Valley Elderberry Longhorned Beetle	Flat	Flat	N - CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Emergent, Persistent, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow	Juglans hindsii and hybrids*	No Cal Black Walnut	Salix gooddingii	Goodding's Willow	Acer negundo	Box-elder	Alnus rhombifolia	White Alder	Salix lasiolepis	Arroyo Willow	Sambucus nigra	Common Elderberry

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	5	34	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata requires a DTW of 24.31 ft[1]. The polygon for Quercus lobata is at the 30 ft DTW contour. All other species present have root depths that are shallow[1] and therefore not dependent on groundwater at this location. Species are likely dependent on the American River.	30-50	none	Flat	Flat	N - CASGEM Well 48012 (SGA_MW04, 09N05E34) avg DTW = 35 (69 points; 2007-2020)	Palustrine, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Juglans hindsii and hybrids*	No Cal Black Walnut	Quercus lobata	Valley Oak	Acer negundo	Box-elder	Populus fremontii	Fremont Cottonwood								
9	5	35	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-70	none	Flat	Flat	N - CASGEM Well 48021 (MW12A, 09N05E35) avg DTW = 62 (27 points, 2010-2020	none																
9	5	36	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40-80	none	Flat	Flat	N - CASGEM Well 48021 (MW12A, 09N05E35) avg DTW = 62 (27 points, 2010-2020	none																
9	6	1	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	95-110	none			no representative hydrographs within contour interval	none																
9	6	2	North Ridge Country Club	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	105-120	none	Flat	Flat	N - CASGEM Well 48029 (Well N28, 09N06E03C001M) avg DTW = 134 (43 points, 2011-2020)	none																
9	6	3	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	110-130	none	Flat	Flat	N - CASGEM Well 48029 (Well N28, 09N06E03C001M) avg DTW = 134 (43 points, 2011-2020)	none																
9	6	4	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	120-140	none	Flat	N	N - CASGEM Well 48013 (SGA_MW-5, 09N06E05) avg DTW = 144 (29 points; 2009-2020)	none	Populus fremontii	Fremont Cottonwood														
9	6	5	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	130-150	none	Flat	N	N - CASGEM Well 48013 (SGA_MW-5, 09N06E05) avg DTW = 144 (29 points; 2009-2020)	none																
9	6	6	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	130-150	none	Flat	N	N - CASGEM Well 48013 (SGA_MW-5, 09N06E05) avg DTW = 144 (29 points; 2009-2020)	none																
9	6	7	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	120-130	none	Flat	N	N - CASGEM Well 48013 (SGA_MW-5, 09N06E05) avg DTW = 144 (29 points; 2009-2020)	none	Quercus lobata	Valley Oak														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	6	8	Arcade Ck - American River College	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	110-130	none	Flat	N	N - CASGEM Well 48013 (SGA_MW-5, 09N06E05) avg DTW = 144 (29 points; 2009-2020)	none	Quercus lobata	Valley Oak														
9	6	9	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	105-125	none			no representative hydrographs within contour interval	none																
9	6	10	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	100-120	none			no representative hydrographs within contour interval	none																
9	6	11	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-110	none			no representative hydrographs within contour interval	none																
9	6	12	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	no GDEs	85-100	none			no representative hydrographs within contour interval	none																
9	6	13	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-90	none			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
9	6	14	American River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	75-85	Bank Swallow			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix lasiolepis	Arroyo Willow	Salix exigua	Narrowleaf Willow	Acer negundo	Box-elder						
9	6	15	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	80-100	none			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak														
9	6	16	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	85-110	none			no representative hydrographs within contour interval	none																
9	6	17	Chicken Ranch Slough	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	95-115	none	Flat	Y	N - CASGEM Well 48017 (Well 10, 09N05E13L002M) avg DTW = 106 (47 points; 2010-2020)	none	Quercus lobata	Valley Oak														
9	6	18	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	100-120	none	Flat	Y	N - CASGEM Well 48017 (Well 10, 09N05E13L002M) avg DTW = 106 (47 points; 2010-2020)	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	6	19	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-105	none	Flat	Y	N - CASGEM Well 48017 (Well 10, 09N05E13L002M) avg DTW = 106 (47 points; 2010-2020)	none	Quercus lobata	Valley Oak														
9	6	20	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	75-100	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	none	Quercus lobata	Valley Oak														
9	6	21	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	No GDEs	65-100	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	none	Quercus lobata	Valley Oak														
9	6	22	American River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	60-80	Swainson's Hawk			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Heterotheca oregona*	Oregon Goldenaster	Acer negundo	Box-elder	Juglans hindsii and hybrids*	No California Black Walnut								
9	6	23	American River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	70-80	Valley Elderberry Longhorn Beetle, Bank Swallow			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Heterotheca oregona*	Oregon Goldenaster	Salix exigua	Narrowleaf Willow								
9	6	24	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70	none			no representative hydrographs within contour interval	Palustrine, Forested, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Acer negundo	Box-elder												
9	6	27	American River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	55-65	Valley Elderberry Longhorned Beetle	Flat	N	N - CASGEM Well 9649 (SCGA #24, 09N06E33R001M) avg DTW = 51 (29 points; 2000-2020) N - CASGEM Well 48014 (SGA MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Quercus lobata	Valley Oak	Heterotheca oregona*	Oregon Goldenaster	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow								
9	6	28	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	55-70	none	Flat	N	N - CASGEM Well 9649 (SCGA #24, 09N06E33R001M) avg DTW = 51 (29 points; 2000-2020) N - CASGEM Well 48014 (SGA MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Heterotheca oregona*	Oregon Goldenaster	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Alnus rhombifolia	White Alder	Salix gooddingii	Goodding's willow						
9	6	29	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	55-85	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	none																

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
9	6	30	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-95	none	N	Flat	N - CASGEM Well 9641 (DWR_SGA_004, 09N05E25J001M) avg DTW = 95 (213 points, 2000-2021)	none																	
9	6	31	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40-80	none	Flat	Flat	N - CASGEM Well 48021 (MW12A, 09N05E35) avg DTW = 62 (27 points, 2010-2020	none																	
9	6	32	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40-60	none			no representative hydrographs within contour interval	none																	
9	6	33	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	45-55	none	Flat	N	N - CASGEM Well 9649 (SCGA #24, 09N06E33R001M) avg DTW = 51 (29 points; 2000-2020) N - CASGEM Well 48014 (SGA MW06, 08N06E05) avg DTW = 40 (72 points; 2007-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow	Quercus lobata	Valley Oak	Acer negundo	Box-elder	Alnus rhombifolia	White Alder						
9	7	3	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata is located where DTW is greater than 30 ft (50 ft)[1]. Populus fremontii has a maximum rooting depth of 16.4[1]. Salix gooddingii and Salix exigua (using rooting depth for S. gooddingii of 6.89 ft) requires surface water and elevated water table[1].	30-50	none			no representative hydrographs within contour interval	Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow												
9	7	4	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	50-100	none			no representative hydrographs within contour interval	none																	
9	7	5	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-105	none			no representative hydrographs within contour interval	none																	
9	7	6	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-105	none			no representative hydrographs within contour interval	none																	
9	7	7	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-95	none			no representative hydrographs within contour interval	none																	
9	7	8	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	60-90	none			no representative hydrographs within contour interval	none																	
9	7	9	American River/Folsom Lake Rec Area	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting	Can be eliminated as DTW is greater than 30 ft	40-50	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	Palustrine, Forested, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Schoenoplectus acutus*	Hardstem Bullrush	Salix gooddingii	Goodding's Willow									

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
						depths less than DTW																					
9	7	10	American River/Folsom Lake Rec Area	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation Species has rooting depth less than DTW	Populus fremontii has a maximum rooting depth of 16.4[1].	25-45	none			no representative hydrographs within contour interval	Palustrine, Scrub-Shrub, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
9	7	15	Alder Creek Development	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation w/in NASb boundary	No GDEs within NASb boundary	30	none			no representative hydrographs within contour interval	none														
9	7	16	American River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40-50	Valley Elderberry Longhorn Beetle			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
9	7	17	American River/Sailor Bar	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	55-70	Vernal Pool Fairy Shrimp, Valley Elderberry Longhorn Beetle			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Juglans hindsii and hybrids*	Northern Cal Black Walnut	Alnus rhombifolia	White Alder						
9	7	18	American River Parkway	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-80	none			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
10	3	1	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	10-20	Valley Elderberry Longhorn Beetle	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	3	12	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	10-20	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
10	3	13	Sacramento River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant garter snake Swainson's Hawk	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow										
10	3	23	Teal Bend Golf Course	1	Not likely	Vegetation species location on golf course likely supported by irrigation. Critical Species may be present Lack of diverse vegetation	Teal Bend GC was built in 1997. The current growth pattern of Q. lobata and P. fremontii do not follow the pattern of same species in the area. Vegetation on the golf course is likely supported by artificial irrigation. Aerial photos from 1993 show that the area was used for agriculture.	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Palustrine, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
10	3	24	Teal Bend Golf Course/Sac International Airport	1	Not likely	Vegetation species location on golf course likely supported by irrigation. No Critical Species Lack of diverse vegetation	Teal Bend GC was built in 1997. The current growth pattern of Q. lobata and P. fremontii do not follow the pattern of same species in the area. Vegetation on the golf course is likely supported by artificial irrigation. Aerial photos from 1993 show that the area was used for agriculture.	0-10	none	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Aquatic Bed, Permanently Flooded	Quercus lobata	Valley Oak												
10	3	25	Teal Bend Golf Course/Sac International Airport	1	Not likely	Vegetation species location on golf course likely supported by irrigation. Critical Species may be present Lack of diverse vegetation	Teal Bend GC was built in 1997. The current growth pattern of Q. lobata and P. fremontii do not follow the pattern of same species in the area. Vegetation on the golf course is likely supported by artificial irrigation. Aerial photos from 1993 show that the area was used for agriculture.	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow												
10	3	26	Teal Bend Golf Course/Sacramento River	1	Not likely	Vegetation species location on golf course likely supported by irrigation. No Critical Species Lack of diverse vegetation	Teal Bend GC was built in 1997. The current growth pattern of Q. lobata and P. fremontii do not follow the pattern of same species in the area. Vegetation on the golf course is likely supported by artificial	0-10	none	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Platanus racemosa	California Sycamore												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
							irrigation. Aerial photos from 1993 show that the area was used for agriculture.																					
10	3	27	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
10	3	34	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
10	3	35	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Platanus racemosa	California Sycamore												
10	3	36	Sacramento International Airport	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	<10	none	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004M) avg DTW =9 (162 points; 2000-2020)	none																
10	4	1	Steelhead Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	30-45	Swainson's Hawk	N	N	N - CASGEM Well 50874 (L-5, 10N04E01) avg DTW = 58 (87 points, 2014-2021)	none																
10	4	2	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	15-30	Giant Gartersnake			no representative hydrographs within contour interval	none																
10	4	3	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15	none	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	none																
10	4	4	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	none																
10	4	5	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	none																

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	4	6	Unnamed drainage	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	1952 Aerial photo shows little native vegetation, ag land predominates. 1981 Aerial photo shows area was a mobile home park surrounded by farm land. Quercus are also located along what appears to be an artificial drainage associated with nearby ag	0-10	none	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	none	Quercus lobata	Valley Oak																
10	4	7	Unnamed drainage	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4[1]. Typha angustifolia habitat is marshy with shallow surface water[2]. Species are located adjacent to a canal and are likely supported by surface water.	10-20	Giant garter snake	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood														
10	4	8	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	none																
10	4	9	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10	none	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	none																
10	4	10	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none																
10	4	11	Aquaculture (Sterling Caviar)/Natomas Basin Preserve	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Species have shallow rooting depth and are located on and adjacent to aquiculture facility and are likely dependent on artificial surface water sources.	10-20	Giant garter snake	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	Palustrine, Unconsolidated Shore, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Schoenoplectus acutus*	Hardstem Bullrush												
10	4	12	Aquaculture (Sterling Caviar)/Natomas Basin Preserve	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Species have shallow rooting depth and are located on and adjacent to aquiculture facility and are likely dependent on artificial surface water sources.	20-40	Tri-Colored Blackbird	Flat	Flat	Y - CASGEM Well 15688 (SCWA_SGA_007, 10N04E24B001M) avg DTW = 18 (35 points, 2000-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Schoenoplectus acutus*	Hardstem Bullrush														
10	4	13	Steelhead Ck	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-30	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 15688 (SCWA_SGA_007, 10N04E24B001M) avg DTW = 18 (35 points, 2000-2020)	none																
10	4	14	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10	none	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none																

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	4	15	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none														
10	4	16	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10	none	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none														
10	4	17	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	none														
10	4	18	Unnamed drainage	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant garter snake	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak							
10	4	19	Sacramento International Airport	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	No GDEs	<10	Giant garter snake	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix exigua	Narrowleaf Willow												
10	4	20	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant garter snake	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none														
10	4	21	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant garter snake	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none														
10	4	22	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant garter snake	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none														
10	4	23	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant garter snake	Flat	Flat	Y - CASGEM Well 32580 (SCWA_SGA_006, 10N04E23A001M) avg DTW = 6 (42 points, 2000-2020)	none														
10	4	24	Steelhead Ck	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-30	Giant garter snake	Flat	Flat	Y - CASGEM Well 15688 (SCWA_SGA_007, 10N04E24B001M) avg DTW = 18 (35 points, 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	4	25	Steelhead Ck	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-35	none	Flat	Flat	Y - CASGEM Well 15688 (SCWA_SGA_007, 10N04E24B001M) avg DTW = 18 (35 points, 2000-2020)	Palustrine, Emergent, Persistent, Semipermanently Flooded														
10	4	26	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-25	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004M) avg DTW =17 (164 points; 2000-2020)	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	4	27	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004 M) avg DTW =17 (164 points; 2000-2020)	none																
10	4	28	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004 M) avg DTW =17 (164 points; 2000-2020)	none																
10	4	29	East of Sacramento International Airport	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004 M) avg DTW =9 (162 points; 2000-2020)	none																
10	4	30	Sacramento International Airport	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	<10	none	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004 M) avg DTW =9 (162 points; 2000-2020)	none																
10	4	31	Sacramento International Airport	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	<10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004 M) avg DTW =9 (162 points; 2000-2020)	Palustrine, Unconsolidated Shore, Seasonally Flooded																
10	4	32	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 24318 (AB-4 shallow, 10N04E31M004 M) avg DTW =9 (162 points; 2000-2020)	none																
10	4	33	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004 M) avg DTW =17 (164 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
10	4	34	Residential/Commercial	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDE's	15-25	none	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004 M) avg DTW =17 (164 points; 2000-2020)	none																
10	4	35	Residential/Commercial	2	Less likely	DTW < 30 ft Critical Species likely extirpated Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft[1].	20-30	Giant Gartersnake (possibly extirpated) - area has been developed	Flat	Flat	Y - CASGEM Well 15690 (AB-3 shallow, 10N04E27R004 M) avg DTW =17 (164 points; 2000-2020)	none	Populus fremontii	Fremont Cottonwood														
10	4	36	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	25-30	Giant garter snake Swainson's Hawk	Flat	Flat	Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001 M) avg DTW = 29 (34 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
10	5	1	Curry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	115-130	none	N	N	N - CASGEM Well 48573 (SVMW West - 1A, 11N05E35) avg DTW = 111 (85 points, 2011-2021	none																
10	5	2	Curry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation		105-115	none	N	N	N - CASGEM Well 48573 (SVMW West - 1A, 11N05E35) avg DTW = 111 (85 points, 2011-2021	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus	Hardstem Bullrush														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	5	3	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	95-105	none	N	N	N - CASGEM Well 48573 (SVMW West - 1A, 11N05E35) avg DTW = 111 (85 points, 2011-2021	none														
10	5	4	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	80-90	none			no representative hydrographs within contour interval	none														
10	5	5	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	70-80	none	Flat	Flat	N - CASGEM Well 48009 (SGA_MW01, 10N05E17) avg DTW = 62 (19 points, 2011-2021)	none														
10	5	6	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	45-60	none	Flat	Flat	N - CASGEM Well 48009 (SGA_MW01, 10N05E17) avg DTW = 62 (19 points, 2011-2021)	none														
10	5	7	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	40-60	Swainson's Hawk	Flat	Flat	N - CASGEM Well 48009 (SGA_MW01, 10N05E17) avg DTW = 62 (19 points, 2011-2021)	none														
10	5	8	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	70-80	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 48009 (SGA_MW01, 10N05E17) avg DTW = 62 (19 points, 2011-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	9	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	80-90	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	10	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-100	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	11	Dry Creek	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	110-120	Swainson's Hawk	N	Flat	N - CASGEM Well 48043 (Lone Oak Park, 10N05E13F001M) avg DTW = 122 (30 points, 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak												
10	5	12	Dry Creek	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	115-130	none	N	Flat	N - CASGEM Well 48043 (Lone Oak Park, 10N05E13F001M) avg DTW = 122 (30 points, 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak												
10	5	13	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	125-140	none	N	Flat	N - CASGEM Well 48043 (Lone Oak Park, 10N05E13F001M) avg DTW = 122 (30 points, 2011-2020)	none														
10	5	14	Antelope Greens Golf Course/Gibson Ranch County Park	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	100-110	none	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002M) avg DTW = 107 (40 points, 2000-2021)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	5	15	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	90-100	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002 M) avg DTW = 107 (40 points, 2000-2021)	none														
10	5	16	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	80-90	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	17	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	60-80	none	Flat	Flat	N - CASGEM Well 48009 (SGA_MW01, 10N05E17) avg DTW = 62 (19 points, 2011-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	18	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-65	none	Flat	Flat	N - CASGEM Well 48009 (SGA_MW01, 10N05E17) avg DTW = 62 (19 points, 2011-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	19	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	30-55	Vernal Pool Fairy Shrimp	Flat	N/Flat	N - CASGEM Well 48010 (SGA_MW02, 10N05E32) avg DTW = 64 (35 points, 2011-2020 Y - CASGEM Well 15688 (SCWA_SGA_007, 10N04E24B001 M) avg DTW = 18 (35 points, 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	20	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	55-75	none	Flat	N	N - CASGEM Well 48010 (SGA_MW02, 10N05E32) avg DTW = 64 (35 points, 2011-2020	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	21	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-90	none			no representative hydrographs within contour interval	none														
10	5	22	Dry Creek	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-100	none	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002 M) avg DTW = 107 (40 points, 2000-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus Fremontii	Fremont Cottonwood										
10	5	23	Cherry Island Golf Course/Soccer Complex	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	100-115	none	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002 M) avg DTW = 107 (40 points, 2000-2021)	Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Acer negundo	Box-elder										
10	5	24	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	120-155	none	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002 M) avg DTW = 107 (40 points, 2000-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Persicaria lapathifolia*	Curly-topped knotweed										
10	5	25	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	130-160	none	N	N	N - CASGEM Well 48026 (Well 15, 09N06E06A001 M) avg DTW = 119 (23 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	5	26	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	100-130	none	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002 M) avg DTW = 107 (40 points, 2000-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	5	27	Dry Creek Parkway	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-100	none	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002 M) avg DTW = 107 (40 points, 2000-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow												
10	5	28	Dry Creek	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-80	none	Flat	Flat	N - CASGEM Well 13654 (SCWA_SGA_009, 10N05E26B002 M) avg DTW = 107 (40 points, 2000-2021)	Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak														
10	5	29	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	55-70	none	Flat	Flat	N - CASGEM Well 48011 (SGA_MW03, 10N05E32) avg DTW = 70 (35 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
10	5	30	East of Steelhead Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	30-40	none	Flat	Flat	Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001 M) avg DTW = 29 (34 points; 2000-2020)	Palustrine, Scrub-Shrub, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Semipermanently Flooded	Persicaria lapathifolia*	Curlytop Knotweed														
10	5	31	East of Steelhead Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4[1]. DTW is greater than 30 ft. Species is likely dependent on surface water from Steelhead Ck., not groundwater.	30-40	Vernal Pool Fairy Shrimp	Flat	Flat	Y - CASGEM Well 8921 (SCWA_SGA_001, 09N04E01R001 M) avg DTW = 29 (34 points; 2000-2020)	none	Populus fremontii	Fremont Cottonwood														
10	5	32	Dry Creek Parkway	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-70	Swainson's Hawk	Flat	Flat	N - CASGEM Well 48011 (SGA_MW03, 10N05E32) avg DTW = 70 (35 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak														
10	5	33	Central Park/Central Park Horse Area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-90	none	Flat	Flat	N - CASGEM Well 48011 (SGA_MW03, 10N05E32) avg DTW = 70 (35 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak														
10	5	34	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-110	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded																
10	5	35	McClellan AFB	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	110-120	none	N	N	N - CASGEM Well 48026 (Well 15, 09N06E06A001 M) avg DTW = 119 (23 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood														
10	5	36	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	130-160	none	N	N	N - CASGEM Well 48026 (Well 15, 09N06E06A001 M) avg DTW = 119 (23 points, 2011-2020)	none																
10	6	1	Dry Ck	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation Species has rooting depth less than DTW	Populus fremontii has a maximum rooting depth of 16.4[1].	20-35	none	Flat	Flat	Y - CASGEM Well 51287 (WPMW-10A, 10N06E01) avg DTW = 14 (69 points; 2015-2020) Y - CASGEM Well 51286 (WPMW-9A, 10N06E01) avg DTW = 13 (69 points; 2015-2020)	none	Populus fremontii	Fremont Cottonwood														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	6	2	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4[1].	30-65	none			no representative hydrographs within contour interval	none	Populus fremontii	Fremont Cottonwood												
10	6	3	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	65-105	none			no representative hydrographs within contour interval	none														
10	6	4	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	110-140	none	N	N	N - CASGEM Well 13659 (10N06E05H001M) avg DTW = 148 (229 points, 2000-2020)	none														
10	6	5	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	140	none	N	N	N - CASGEM Well 13659 (10N06E05H001M) avg DTW = 148 (229 points, 2000-2020)	none														
10	6	6	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	130-140	none	N	Flat	N - CASGEM Well 48043 (Lone Oak Park, 10N05E13F001M) avg DTW = 122 (30 points, 2011-2020)	none														
10	6	7	Lower Dry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	130-145	none	N	Flat	N - CASGEM Well 48043 (Lone Oak Park, 10N05E13F001M) avg DTW = 122 (30 points, 2011-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak												
10	6	8	Lower Dry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	140-150	none	N	N	N - CASGEM Well 48038 (Antelope North (A), 10N06E16) avg DTW = 147 (23 points; 2011-2020) N - CASGEM Well 13659 (10N06E05H001M) avg DTW = 148 (229 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak												
10	6	9	Lower Dry Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	110-140	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 48038 (Antelope North (A), 10N06E16) avg DTW = 147 (23 points; 2011-2020) N - CASGEM Well 13659 (10N06E05H001M) avg DTW = 148 (229 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Juglans hindsii and hybrids*	No California Black Walnut	Salix lasiolepis	Arroyo Willow	Populus fremontii	Fremont Cottonwood						
10	6	10	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-120	none	N	N	N - CASGEM Well 48038 (Antelope North (A), 10N06E16) avg DTW = 147 (23 points; 2011-2020) N - CASGEM Well 13659 (10N06E05H001M) avg DTW = 148 (229 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	6	11	Cirby Ck/Dry Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40-80	none	Flat	Flat	Y - CASGEM Well 51287 (WPMW-10A, 10N06E01) avg DTW = 14 (69 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Fraxinus latifolia*	Oregon Ash										
10	6	12	Cirby Ck/Linda Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	30-60	none	Flat	Flat	Y - CASGEM Well 51287 (WPMW-10A, 10N06E01) avg DTW = 14 (69 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak														
10	6	13	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-85	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak														
10	6	14	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	65-105	none			no representative hydrographs within contour interval	none																
10	6	15	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-130	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded																
10	6	16	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	120-160	none	N	N	N - CASGEM Well 48038 (Antelope North (A), 10N06E16) avg DTW = 147 (23 points, 2011-2020)	none																
10	6	17	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	150-170	none	N	N	N - CASGEM Well 48038 (Antelope North (A), 10N06E16) avg DTW = 147 (23 points, 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded																
10	6	18	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	130-165	none			no representative hydrographs within contour interval	none																
10	6	19	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	145-185	none	N	N	N - CASGEM Well 33087 (SCWA_SGA_010, 10N06E21F002M) avg DTW = 174 (36 points, 2000-2021)	none																

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	6	20	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	165-185	none	N	N	N - CASGEM Well 48030 (Monument A, 10N06E20) avg DTW = 195 (19 points, 2011-2020)	none																
10	6	21	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	135-170	none	N	N	N - CASGEM Well 33087 (SCWA_SGA_010, 10N06E21F002M) avg DTW = 174 (36 points, 2000-2021)	none																
10	6	22	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	105-140	none	N	N	N - CASGEM Well 48042 (Twin Creeks Park, 10N06E27F001M) avg DTW = 133 (25 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded																
10	6	23	Cripple Ck	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-115	none	N	N	N - CASGEM Well 48042 (Twin Creeks Park, 10N06E27F001M) avg DTW = 133 (25 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded																
10	6	24	Madera Park	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	80-90	none	Flat	Flat	N - CASGEM Well 13803 (SGWA_SGA_11, 10N07E20) avg DTW = 117 (19 points, 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak														
10	6	25	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	No GDEs	105-125	none	Flat	Flat	N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	6	26	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	110-120	none	N	N	N - CASGEM Well 48042 (Twin Creeks Park, 10N06E27F001 M) avg DTW = 133 (25 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak														
10	6	27	Cripple Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	120-140	none	N	N	N - CASGEM Well 48042 (Twin Creeks Park, 10N06E27F001 M) avg DTW = 133 (25 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak														
10	6	28	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	140-170	none	N	N	N - CASGEM Well 48042 (Twin Creeks Park, 10N06E27F001 M) avg DTW = 133 (25 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak														
10	6	29	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	170-180	none	N	N	N - CASGEM Well 48030 (Monument A, 10N06E20) avg DTW = 195 (19 points, 2011-2020)	none																
10	6	30	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	160-180	none	N	N	N - CASGEM Well 48030 (Monument A, 10N06E20) avg DTW = 195 (19 points, 2011-2020)	none																
10	6	31	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	150-175	none	N	N	N - CASGEM Well 48026 (Well 15, 09N06E06A001 M) avg DTW = 119 (23 points, 2011-2020)	none																
10	6	32	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	145-175	none	Flat	N	N - CASGEM Well 48013 (SGA_MW-5, 09N06E05) avg DTW = 144 (29 points; 2009-2020)	none																
10	6	33	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	135-160	none	Flat	Flat	N - CASGEM Well 48029 (Well N28, 09N06E03C001 M) avg DTW = 134 (43 points, 2011-2020)	none	Quercus lobata	Valley Oak														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	6	34	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	125-140	none	Flat	Flat	N - CASGEM Well 48029 (Well N28, 09N06E03C001M) avg DTW = 134 (43 points, 2011-2020)	none	Quercus lobata	Valley Oak												
10	6	35	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	115-125	none	Flat	Flat	N - CASGEM Well 48029 (Well N28, 09N06E03C001M) avg DTW = 134 (43 points, 2011-2020)	none	Quercus lobata	Valley Oak												
10	6	36	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	110	none	N	N	N - CASGEM Well 48042 (Twin Creeks Park, 10N06E27F001M) avg DTW = 133 (25 points, 2011-2020)	none	Quercus lobata	Valley Oak												
10	7	4	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-50	none	N	N	Y - CASGEM Well 51283 (WPMW-7A, 10N07E05) avg DTW = 21 (69 points; 2015-2020) Y - CASGEM Well 51284 (WPMW-8A, 10N07E05) avg DTW = 29 (69 points; 2015-2020)	none														
10	7	5	Miner's Ravine	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation Species has rooting depth less than DTW	Salix exigua has shallow rooting depth and generally occurs near surface water	20-30	none	N	N	Y - CASGEM Well 51283 (WPMW-7A, 10N07E05) avg DTW = 21 (69 points; 2015-2020) Y - CASGEM Well 51284 (WPMW-8A, 10N07E05) avg DTW = 29 (69 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Salix exigua	Narrowleaf Willow												
10	7	6	Residential/Commercial	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	20-30	none	N	N	Y - CASGEM Well 51283 (WPMW-7A, 10N07E05) avg DTW = 21 (69 points; 2015-2020) Y - CASGEM Well 51284 (WPMW-8A, 10N07E05) avg DTW = 29 (69 points; 2015-2020)	none														
10	7	7	Linda Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	40-60	none	N	N	no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak												
10	7	8	Strap Ravine/Maidu Regional Park	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40-60	none	Y/N	Y/N	no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail	Quercus lobata	Valley Oak	Schoenoplectus acutus*	Hardstem Bullrush						

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	7	9	Strap Ravine	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	55-65	Valley Elderberry Longhorn Beetle Tricolored Blackbird	Y/N	Y/N	no representative hydrographs within contour interval	Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow										
10	7	10	Strap Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	50-60	none	Y/N	Y/N	no representative hydrographs within contour interval	none	Populus fremontii	Fremont Cottonwood														
10	7	15	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	75-100	Valley Elderberry Longhorn Beetle	Flat	Flat	N - CASGEM Well 13803 (SGWA_SGA_11, 10N07E20) avg DTW = 117 (19 points, 2011-2020)	none																
10	7	16	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	70-90	none	Flat	Flat	N - CASGEM Well 13803 (SGWA_SGA_11, 10N07E20) avg DTW = 117 (19 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Salix lasiolepis	Arroyo Willow										
10	7	17	Linda Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-90	none	Flat	Flat	N - CASGEM Well 13803 (SGWA_SGA_11, 10N07E20) avg DTW = 117 (19 points, 2011-2020)	Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak														
10	7	18	Cripple Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	55-85	none	Flat	Flat	N - CASGEM Well 13803 (SGWA_SGA_11, 10N07E20) avg DTW = 117 (19 points, 2011-2020)	none	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	7	19	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	85-105	none	Flat	Flat	N - CASGEM Well 13803 (SGWA_SGA_11, 10N07E20) avg DTW = 117 (19 points, 2011-2020)	none	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
10	7	20	Linda Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-110	none	Flat	Flat	N - CASGEM Well 13803 (SGWA_SGA_11, 10N07E20) avg DTW = 117 (19 points, 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
10	7	21	Linda Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-110	none	Flat	Flat	N - CASGEM Well 33380 (SCWA_SGA_012, 10N07E29G001M) avg DTW = 109 (39 points, 2000-2020) N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak										
10	7	22	Bud and Artie Davis Park	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	Can be eliminated as DTW is greater than 30 ft	85-100	none	Flat	Flat	N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
10	7	23	Adjacent to Folsom Lk	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-80	none			no representative hydrographs within contour interval	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	7	26	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	50-70	none			no representative hydrographs within contour interval	none														
10	7	27	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	80-100	none	Flat/Y	Flat	N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020) N - CASGEM Well 48016 (SGA_MW09, 10N07E28) avg DTW = 115 (35 points; 2011-2020)	Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Populus fremontii	Fremont Cottonwood										
10	7	28	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	100-120	none	Flat/Y	Flat	N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020) N - CASGEM Well 48016 (SGA_MW09, 10N07E28) avg DTW = 115 (35 points; 2011-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow	Populus Fremontii	Fremont Cottonwood						
10	7	29	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation		110-120	none	Flat	Flat	N - CASGEM Well 33380 (SCWA_SGA_012, 10N07E29G001M) avg DTW = 109 (39 points, 2000-2020) N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak										
10	7	30	Arcade Ck	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	105-115	none	Flat	Flat	N - CASGEM Well 33380 (SCWA_SGA_012, 10N07E29G001M) avg DTW = 109 (39 points, 2000-2020) N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020)	Palustrine, Forested, Seasonally Flooded												
10	7	31	Sunrise Golf Course/Tempo Park	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	110	none	Flat	Flat	N - CASGEM Well 33380 (SCWA_SGA_012, 10N07E29) avg DTW = 109 (41 points, 2000-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
10	7	32	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-120	none	Flat	Flat	N - CASGEM Well 33380 (SCWA_SGA_012, 10N07E29) avg DTW = 109 (41 points, 2000-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded																		
10	7	33	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-120	none	Flat/Y	Flat	N - CASGEM Well 48015 (SGA_MW08, 10N07E21) avg DTW = 106 (19 points, 2011-2020) N - CASGEM Well 48016 (SGA_MW09, 10N07E28) avg DTW = 115 (35 points; 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
10	7	34	American River/Negro Bar	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	50-60	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
10	7	35	American River	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40-60	none			no representative hydrographs within contour interval	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak	Alnus rhombifolia	White Alder	Populus Fremontii	Fremont Cottonwood										
11	3	1	Main Canal	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0	Giant Gartersnake	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded, California Warm Temperate Marsh/Seep																
11	3	2	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0	Giant Gartersnake	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	none																

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	3	3	Sacramento River	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0	none	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak														
11	3	4	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0	Giant Gartersnake	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak														
11	3	9	Feather River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat/N	N*/N	Y - CASGEM Well 12777 (11N03E15C001M) avg DTW = 15 (135 points, 2000-2017) Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (61 points; 2012-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Unconsolidated Bottom, Permanently Flooded	Platanus racemosa	California Sycamore	Salix Gooding	Goodding's Willow	Quercus lobata	Valley Oak										
11	3	10	Feather River	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Flat	N*/N	Y - CASGEM Well 12777 (11N03E15C001M) avg DTW = 15 (135 points, 2000-2017) Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (61 points; 2012-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus Fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
11	3	11	Unspecified area	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation		<10	none	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	none	Salix exigua	Narrowleaf Cattail														
11	3	12	Main Canal	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant garter snake	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	none	Typha angustifolia*	Narrowleaf Cattail														
11	3	13	Cross Canal	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	none	Salix gooddingii	Goodding's Willow														
11	3	14	Main Canal and adjacent undisturbed area	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	none	Quercus lobata	Valley Oak														
11	3	15	Feather River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Populus Fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	3	22	Feather River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Bank Swallow Swainson's Hawk Tri-Colored Blackbird Valley Elderberry Longhorned Beetle	Flat	N*	Y - CASGEM Well 12777 (11N03E15C001M) avg DTW = 15 (135 points, 2000-2017)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus Fremontii	Fremont Cottonwood														
11	3	23	Feather River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft and Salix gooddingii has a maximum rooting depth of 6.89[1]. Location of species in on the riparian corridor. Quercus is pre-dominantly located along the Cross Canal and the Main Canal. Salix gooddingii is located an area that appears to be undisturbed as it remains the same in 2020 as aerial photos indicate in 1952	10-20	Swainson's Hawk	Flat	N*	Y - CASGEM Well 12777 (11N03E15C001M) avg DTW = 15 (135 points, 2000-2017)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Unconsolidated Shore, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded	Populus Fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow										
11	3	24	Cross Canal	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	5-15	none	Flat	N*	Y - CASGEM Well 12777 (11N03E15C001M) avg DTW = 15 (135 points, 2000-2017)	none	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow										
11	3	25	Sacramento River	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	10-20	none	Flat	N	Y - CASGEM Well 10509 (11N04E19E002M) avg DTW = 16 (145 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
11	3	26	Sacramento River	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft	10	none	Flat	N	Y - CASGEM Well 10509 (11N04E19E002M) avg DTW = 16 (145 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood												
11	3	36	Sacramento River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	10-20	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 51223 (TNBC Atkinson, 10N04E07) avg DTW = 16 (46 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak												
11	4	1	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-55	none	Y	N*/N	N - CASGEM Well 10503 (11N04E01M002M) avg DTW = 46 (177 points; 2000-2018) N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	none														
11	4	2	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	20-40	none	Flat	N	Y - CASGEM Well 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	4	3	King's Slough, unnamed drainage	2	Less likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Salix exigua are typically located at sites that have a generally high water table, and most stands are adjacent to flowing water[1]. Typha angustifolia habitat is marshy with shallow surface water[2].	10-20	none	Flat	Flat	Y - CASGEM Well 25773 (SUT-P1, 11N04E04N004M) avg DTW = 13 (59 points; 2015-2020)	Palustrine, Emergent, Persistent, Seasonally	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow												
11	4	4	Cross Canal	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	Flat	Y - CASGEM Well 25773 (SUT-P1, 11N04E04N004M) avg DTW = 13 (59 points; 2015-2020)	Palustrine, Forested, Seasonally Flooded	Salix gooddingii	Goodding's Willow	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail	Populus Fremontii	Fremont Cottonwood								
11	4	5	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Swainson's Hawk, Giant Gartersnake	Flat	Flat	Y - CASGEM Well 25773 (SUT-P1, 11N04E04N004M) avg DTW = 13 (59 points; 2015-2020)	none																
11	4	6	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Giant Gartersnake	Flat	Flat	Y - CASGEM Well 25773 (SUT-P1, 11N04E04N004M) avg DTW = 13 (59 points; 2015-2020)	none																
11	4	7	Cross Canal	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant garter snake	Flat	Flat	Y - CASGEM Well 25773 (SUT-P1, 11N04E04N004M) avg DTW = 13 (59 points; 2015-2020)	none	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood												
11	4	8	Cross Canal	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant garter snake Swainson's Hawk	Flat	Flat	Y - CASGEM Well 25773 (SUT-P1, 11N04E04N004M) avg DTW = 13 (59 points; 2015-2020)	none	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood												
11	4	9	Unspecified area	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Surface water species < .89 ac, predominantly in Section 4	0-10	Giant garter snake	Flat	N	Y - CASGEM Well 39806 (11N04E09D002M) avg DTW = 14 (172 points; 2000-2020)	none	Salix gooddingii	Goodding's Willow														
11	4	10	Pleasant Grove Creek Canal	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-25	Swainson's Hawk	Flat	N	Y - CASGEM Well 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded																
11	4	11	Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Populus fremontii has a maximum rooting depth of 16.4[1]. Quercus lobata has a maximum rooting depth of 24.02[1]. DTW is greater than 30 ft. Species is likely dependent on surface water from Pleasant Grove Ck., not groundwater. Can be eliminated because DTW is grater than 30 ft.	35-40	Vernal Pool Tadpole Shrimp	Y	N*/N	N - CASGEM Well 10503 (11N04E01M002M) avg DTW = 46 (177 points; 2000-2018) N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	4	12	on Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	50-60	Swainson's Hawk	Y	N*/N	N - CASGEM Well 10503 (11N04E01M002M) avg DTW = 46 (177 points; 2000-2018) N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow										
11	4	13	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	45-65	none	Y	N	N - CASGEM Well 10507 (So Sut WD, 11N04E13R001M) avg DTW = 81 (76 points; 2000-2020)	none														
11	4	14	Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Salix gooddingii has a rooting depth of 6.89[1]. DTW is deeper than rooting depth. Typha angustifolia habitat is marshy with shallow surface water[2].	30-45	Swainson's Hawk	Y	N*/N	N - CASGEM Well 10503 (11N04E01M002M) avg DTW = 46 (177 points; 2000-2018) N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	none	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow								
11	4	15	Pleasant Grove Ck Canal	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Salix gooddingii has a rooting depth of 6.89[1]. DTW is deeper than rooting depth. Typha angustifolia habitat is marshy with shallow surface water[2].	15-30	none	Y	N*/N	N - CASGEM Well 10503 (11N04E01M002M) avg DTW = 46 (177 points; 2000-2018) N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	none	Salix gooddingii	Goodding's Willow	Typha angustifolia*	Narrowleaf Cattail										
11	4	16	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	5-20	none	Flat	N	Y - CASGEM Well 39806 (11N04E09D002M) avg DTW = 14 (172 points; 2000-2020)	none														
11	4	17	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	0-10	none	Flat	N	Y - CASGEM Well 39806 (11N04E09D002M) avg DTW = 14 (172 points; 2000-2020)	none														
11	4	18	Cross Canal	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant garter snake Swainson's Hawk	Flat	N	Y - CASGEM Well 10509 (11N04E19E002M) avg DTW = 16 (145 points; 2000-2020)	none	Salix gooddingii	Goodding's Willow	Salix exigua	Narrowleaf Willow										
11	4	19	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake	Flat	N	Y - CASGEM Well 10509 (11N04E19E002M) avg DTW = 16 (145 points; 2000-2020)	none														
11	4	20	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake	Flat	N	Y - CASGEM Well 10509 (11N04E19E002M) avg DTW = 16 (145 points; 2000-2020)	none														
11	4	21	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	15-20	Giant Gartersnake	Flat	N	Y - CASGEM Well 10509 (11N04E19E002M) avg DTW = 16 (145 points; 2000-2020)	none														
11	4	22	Curry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	DTW is greater than 30 ft. Schoenoplectus acutus has rooting depth between 0.33 and 5 ft[3].	20-35	none	Y	N	N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	none	Schoenoplectus acutus*	Hardstem Bulrush												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	4	23	Pleasant Grove Ck Canal and Curry Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	DTW is greater than 30 ft. Schoenoplectus acutus has rooting depth between 0.33 and 5 ft[3].	30-40	Swainson's Hawk	Y	N	N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	none	Schoenoplectus acutus*	Hardstem Bulrush	Typha angustifolia*	Narrowleaf Cattail										
11	4	24	Curry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	50-65	none	Y	N	N - CASGEM Well 10507 (So Sut WD, 11N04E13R001M) avg DTW = 81 (76 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded														
11	4	25	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Salix gooddingii has a rooting depth of 6.89[3]. DTW is deeper than rooting depth.	60	none	Y	N	N - CASGEM Well 10507 (So Sut WD, 11N04E13R001M) avg DTW = 81 (76 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow												
11	4	26	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	DTW is greater than 30 ft. Schoenoplectus acutus has rooting depth between 0.33 and 5 ft[3].	40-45	Vernal Pool Fairy Shrimp Vernal Pool Tadpole Shrimp	Y	N	N - CASGEM Well 10507 (So Sut WD, 11N04E13R001M) avg DTW = 81 (76 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Schoenoplectus acutus*	Hardstem Bullrush												
11	4	27	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	20-30	none	Y	N	N - CASGEM Well 10508 (So Sut WD, 11N04E15Q001M) avg DTW = 36 (68 points; 2000-2020)	none														
11	4	28	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-20	none			no representative hydrographs within contour interval	none														
11	4	29	North Drainage Canal	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15	none			no representative hydrographs within contour interval	none														
11	4	30	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake			no representative hydrographs within contour interval	none														
11	4	31	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10-15	Giant Gartersnake Tricolored Blackbird			no representative hydrographs within contour interval	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	4	32	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	15	Giant Gartersnake			no representative hydrographs within contour interval	none																
11	4	33	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-20	none			no representative hydrographs within contour interval	none																
11	4	34	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	20-30	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	none																
11	4	35	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-45	none			no representative hydrographs within contour interval	none																
11	4	36	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	45-60	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	none																
11	5	1	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	65-80	none			no representative hydrographs within contour interval	none																
11	5	2	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	70-85	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded																
11	5	3	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-90	none	Flat	N	N - CASGEM Well 48569 (CVMW-1A, 11N05E14) avg DTW = 90 (81 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
11	5	4	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	75-90	Vernal Pool Fairy Shrimp	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	none																
11	5	5	King Slough	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-70	Swainson's Hawk Vernal Pool Fairy Shrimp	Flat/Y	Insufficient data/N	N - CASGEM Well 11217 (11N05E06H001M) avg DTW = 61 (39 points; 2000-2015) N - CASGEM Well 32067 (12N05E33C001M) avg DTW = 77 (119 points; 2000-2020)	none	Populus fremontii	Fremont Cottonwood														
11	5	6	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-70	none	Y	Insufficient data/N	N - CASGEM Well 11217 (11N05E06H001M) avg DTW = 61 (39 points; 2000-2015) N - CASGEM Well 32067 (12N05E33C001M) avg DTW = 77 (119 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	5	7	Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-70	Vernal Pool Fairy Shrimp	Y	Insufficient data/Y*	N - CASGEM Well 11217 (11N05E06H001M) avg DTW = 61 (39 points; 2000-2015) N - CASGEM Well 11220 (11N05E17A004M) avg DTW = 99 (107 points; 2000-2019)	Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak												
11	5	8	Pleasant Grove Ck & unnamed drainage ditch	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	80-90	Vernal Pool Fairy Shrimp	Y	Insufficient data/Y*	N - CASGEM Well 11217 (11N05E06H001M) avg DTW = 61 (39 points; 2000-2015) N - CASGEM Well 11220 (11N05E17A004M) avg DTW = 99 (107 points; 2000-2019)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak												
11	5	9	Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-100	Vernal Pool Fairy Shrimp	Y	Insufficient data/Y*	N - CASGEM Well 11217 (11N05E06H001M) avg DTW = 61 (39 points; 2000-2015) N - CASGEM Well 11220 (11N05E17A004M) avg DTW = 99 (107 points; 2000-2019)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
11	5	10	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	90-100	Tricolored Blackbird	N	N	N - CASGEM Well 48563 (WPMW-2A, 11N06E07) avg DTW = 81 (86 points, 2011-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail	Salix gooddingii	Goodding's Willow								
11	5	11	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 48563 (WPMW-2A, 11N06E07) avg DTW = 81 (86 points, 2011-2021)	California Warm Temperate Marsh/Seep	Quercus lobata	Valley Oak												
11	5	12	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	80-95	none	N	N	N - CASGEM Well 48563 (WPMW-2A, 11N06E07) avg DTW = 81 (86 points, 2011-2021)	none														
11	5	13	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	85-90	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 54798 (Well 14 MW-A, 11N06E18) avg DTW = 103 (74 points, 2013-2021)	none														
11	5	14	Pleasant Grove Ck and unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-100	none	Flat	N	N - CASGEM Well 48569 (CVMW-1A, 11N05E14) avg DTW = 90 (81 points, 2011-2020)	none	Quercus lobata	Valley Oak												
11	5	15	Pleasant Grove Dk	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	90-100	none	Flat	N	N - CASGEM Well 48569 (CVMW-1A, 11N05E14) avg DTW = 90 (81 points, 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow	Typha angustifolia*	Narrowleaf Cattail								
11	5	16	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-100	none	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	5	17	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata requires a DTW of 24.31 ft.[1]	80-90	none	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak																
11	5	18	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	60-80	none	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	none																		
11	5	19	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-80	none	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak																
11	5	20	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	80-90	Vernal Pool Fairy Shrimp, Swainson's Hawk	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bulrush	Salix gooddingii	Goodding's Willow												
11	5	21	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	95-100	none	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	none																		
11	5	22	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	100	none	Flat	N	N - CASGEM Well 48569 (CVMW-1A, 11N05E14) avg DTW = 90 (81 points, 2011-2020)	none																		
11	5	23	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-105	none	Flat	N	N - CASGEM Well 48569 (CVMW-1A, 11N05E14) avg DTW = 90 (81 points, 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded																		
11	5	24	Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-100	Vernal Pool Fairy Shrimp	Flat	N	N - CASGEM Well 48569 (CVMW-1A, 11N05E14) avg DTW = 90 (81 points, 2011-2020)	none	Quercus lobata	Valley Oak																
11	5	25	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	110-125	none	N	N	N - CASGEM Well 48560 (WPMW-1A, 11N05E25) avg DTW = 111 (91 points, 2011-2020)	none																		
11	5	26	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	105-115	none	N	N	N - CASGEM Well 48560 (WPMW-1A, 11N05E25) avg DTW = 111 (91 points, 2011-2020)	none																		
11	5	27	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	100-105	none	N	N	N - CASGEM Well 48560 (WPMW-1A, 11N05E25) avg DTW = 111 (91 points, 2011-2020)	California Warm Temperate Marsh/Seep																		

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	5	28	Curry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	90-100	none	Flat	N	N - CASGEM Well 48569 (CVMW-1A, 11N05E14) avg DTW = 90 (81 points, 2011-2020)	none	Populus fremontii	Fremont Cottonwood												
11	5	29	Curry Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	80-90	Swainson's Hawk	Y	N	N - CASGEM Well 10507 (So Sut WD, 11N04E13R001M) avg DTW = 81 (76 points; 2000-2020)	none	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow										
11	5	30	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-70	Vernal Pool Fairy Shrimp, Swainson's Hawk	Y	N	N - CASGEM Well 10507 (So Sut WD, 11N04E13R001M) avg DTW = 81 (76 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
11	5	31	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	60-80	none	Flat	Flat	N - CASGEM Well 48009 (SGA_MW01, 10N05E17) avg DTW = 62 (19 points, 2011-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded														
11	5	32	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	80-90	Swainson's Hawk	Y	N	N - CASGEM Well 11221 (So Sut WD, 11N05E18R001M) avg DTW = 90 (66 points, 2000-2021	Palustrine, Emergent, Persistent, Seasonally Flooded														
11	5	33	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	90-100	none	N	N	N - CASGEM Well 48573 (SVMW West - 1A, 11N05E35) avg DTW = 111 (85 points, 2011-2021	none														
11	5	34	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	105-110	none	N	N	N - CASGEM Well 48573 (SVMW West - 1A, 11N05E35) avg DTW = 111 (85 points, 2011-2021	Palustrine, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Platanus racemosa	California Sycamore										
11	5	35	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	100-110	none	N	N	N - CASGEM Well 48573 (SVMW West - 1A, 11N05E35) avg DTW = 111 (85 points, 2011-2021	none	Quercus lobata	Valley Oak												
11	5	36	Curry Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	130	none	N	N	N - CASGEM Well 48573 (SVMW West - 1A, 11N05E35) avg DTW = 111 (85 points, 2011-2021	none	Typha angustifolia*	Narrowleaf Cattail												
11	6	1	Pleasant Grove Ck w/in residential area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40-50	none			no representative hydrographs within contour interval	none	Populus fremontii	Fremont Cottonwood												
11	6	2	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40-50	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak												
11	6	3	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	55-65	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	6	4	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	60-70	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none														
11	6	5	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	65-75	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none														
11	6	6	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	65-75	none	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none														
11	6	7	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-85	none	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none														
11	6	8	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	75-85	none	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none														
11	6	9	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-80	none	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Quercus lobata	Valley Oak										
11	6	10	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	60-70	none	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none	Salix goodddingii	Goodding's Willow	Typha angustifolia*	Narrowleaf Cattail										
11	6	11	Pleasant Grove Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	50-60	none	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bulrush	Salix exigua	Narrowleaf Willow	Salix goodddingii	Goodding's Willow									
11	6	12	Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40-50	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix goodddingii	Goodding's Willow	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow									
11	6	13	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40-45	none			no representative hydrographs within contour interval	Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak												
11	6	14	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40-55	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Schoenoplectus acutus*	Hardstem Bulrush										
11	6	15	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	60-70	none	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none	Schoenoplectus acutus*	Hardstem Bulrush	Salix exigua	Narrowleaf Willow	Populus fremontii	Fremont Cottonwood									

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	6	16	Residential/Commercial	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	70-80	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	none	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail										
11	6	17	Pleasant Grove Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	80-90	Swainson's Hawk	N	N	N - CASGEM Well 54798 (Well 14 MW-A, 11N06E18) avg DTW = 103 (74 points, 2013-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak												
11	6	18	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	85-95	none	N	N	N - CASGEM Well 54798 (Well 14 MW-A, 11N06E18) avg DTW = 103 (74 points, 2013-2021)	none														
11	6	19	Multiple Parks and Golf Courses	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	100	Vernal Pool Fairy Shrimp, Swainson's Hawk	N	N	N - CASGEM Well 54798 (Well 14 MW-A, 11N06E18) avg DTW = 103 (74 points, 2013-2021)	none	Quercus lobata	Valley Oak												
11	6	20	So Branch Pleasant Grove Ck/located in open space adjacent to residential area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	85-100	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 54798 (Well 14 MW-A, 11N06E18) avg DTW = 103 (74 points, 2013-2021)	none														
11	6	21	Commercial	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	70-90	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 51290 (Tinker MW, 11N06E09) avg DTW = 75 (82 points, 2013-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded														
11	6	22	Residential/Commercial	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	50-70	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	none														
11	6	23	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-55	none			no representative hydrographs within contour interval	none														
11	6	24	Antelope Ck	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated as DTW is less than 30 ft	20-30	none			no representative hydrographs within contour interval	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak												
11	6	25	Antelope Ck	3	Likely	DTW < 30 ft No Critical Species Diverse vegetation	Quercus lobata requires a DTW of 24.31 ft.[1] The polygon for Quercus lobata is at the 30 ft contour. All other species present have root depths that are shallow[1,5] and therefore not dependent on groundwater at this location.	20-30	none	Flat	Flat	Y - CASGEM Well 51287 (WPMW-10A, 10N06E01) avg DTW = 14 (69 points; 2015-2020)	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Typha angustifolia	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow						
11	6	26	Residential/Commercial	3	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Populus fremontii has a maximum rooting depth of 16.4[1]. Salix gooddingii and Salix exigua (using rooting depth for S. gooddingii of 6.89 ft) requires surface water	25-40	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	none	Salix exigua	Narrowleaf Willow	Salix lasiolepis	Arroyo Willow	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood						

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
							and elevated water table[1].																					
11	6	27	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	40-65	none			no representative hydrographs within contour interval	Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow										
11	6	28	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated as DTW is greater than 30 ft	65-90	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow	Populus fremontii	Fremont Cottonwood										
11	6	29	Bear Dog and Mahany Regional Park	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	100-120	Vernal Pool Tadpole Shrimp			no representative hydrographs within contour interval	none	Salix exigua	Narrowleaf Willow														
11	6	30	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	120	Swainson's Hawk	N	N	N - CASGEM Well 48560 (WPMW-1A, 11N05E25) avg DTW = 111 (91 points, 2011-2020)	none	Salix lasiolepsis	Arroyo Willow	Salix exigua	Narrowleaf Willow												
11	6	31	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	120-140	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 48560 (WPMW-1A, 11N05E25) avg DTW = 111 (91 points, 2011-2020)	none																
11	6	32	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	110-120	Vernal Pool Fairy Shrimp	Flat	N	N - CASGEM Well 48576 (SVMW East-2A, 11N05E36) avg DTW = 123 (88 points, 2011-2021)	none	Salix exigua	Narrowleaf Willow														
11	6	33	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	No GDEs	65-100	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	none	Populus fremontii	Fremont Cottonwood														
11	6	34	Sierra View Country Club	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	35-65	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak														
11	6	35	Roseville Public Cemetery	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft	20	none	Flat	Flat	Y - CASGEM Well 51287 (WPMW-10A, 10N06E01) avg DTW = 14 (69 points; 2015-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Populus fremontii	Fremont Cottonwood														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
11	6	36	Miner's Ravine	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft	20	none	Flat	Flat	Y - CASGEM Well 51287 (WPMW-10A, 10N06E01) avg DTW = 14 (69 points; 2015-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak												
11	7	5	Clover Valley Ck	0	Not likely	DTW ≥ 30 ft No Critical Species w/in NASb boundary No vegetation	No GDEs	30-40	California Black Rail (located outside NASb boundary)			no representative hydrographs within contour interval	none															
11	7	6	Clover Valley Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40	none			no representative hydrographs within contour interval	Palustrine, Forested, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak												
11	7	7	Clover Valley Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated as DTW is greater than 30 ft	40	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak													
11	7	18	Antelope Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata has a maximum rooting depth of 24.02[1]. Species is likely dependent on surface water from Pleasant Grove Ck., not groundwater. Can be eliminated because DTW is grater than 30 ft.	30	none			no representative hydrographs within contour interval	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak													
11	7	19	Antelope Ck	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated as DTW is less than 30 ft	20-30	none			no representative hydrographs within contour interval	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood											
11	7	30	Secret Ravine	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated as DTW is less than 30 ft	<20	none	Flat	Flat	Y - CASGEM Well 51282 (WPMW-6A, 11N07E30) avg DTW = -0.77 (57 points, 2015-2021)	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak													
11	7	31	Unnamed drainage	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	20-30	Vernal Pool Fairy Shrimp	N	N	Y - CASGEM Well 51283 (WPMW-7A, 10N07E05) avg DTW = 21 (69 points; 2015-2020) Y - CASGEM Well 51284 (WPMW-8A, 10N07E05) avg DTW = 29 (69 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow											
11	7	32	Unnamed drainage	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated as DTW is less than 30 ft	20-30	none	N	N	Y - CASGEM Well 51283 (WPMW-7A, 10N07E05) avg DTW = 21 (69 points; 2015-2020) Y - CASGEM Well 51284 (WPMW-8A, 10N07E05) avg DTW = 29 (69 points; 2015-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood													
12	3	1	NASb - Sutter boundary	1	Not likely	DTW < 30 ft No Critical Species w/in NASb boundary No vegetation w/in NASb boundary	Cannot be eliminated as DTW is less than 30 ft	0-10	Swainson's Hawk (outside NASb boundary)	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded															

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	3	11	Mostly outside NASb boundary (Sutter) Boundary line within river	0	Not likely	DTW < 30 ft No Critical Species w/in NASb boundary No vegetation w/in NASb boundary	No GDEs	0	none w/in NASb boundary	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004 M) avg DTW = 19 (104 points, 2000-2019)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded																	
12	3	12	Feather River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	Bank Swallow Swainson's Hawk Western Yellow-Billed Cuckoo	Y	N*	Y - CASGEM Well 17033 (12N04E18D001 M) avg DTW = 18 (92 points; 2000-2017	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Acer negundo	Box-elder	Platanus racemosa	California Sycamore	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's willow								
12	3	13	Unnamed drainage	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	Swainson's Hawk	Y	N*	Y - CASGEM Well 17033 (12N04E18D001 M) avg DTW = 18 (92 points; 2000-2017	none	Quercus lobata	Valley Oak																
12	3	14	Feather River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	Bank Swallow	Flat	N*	Y - CASGEM Well 17012 (12N03E23N001 M) avg DTW = 12 (157 points; 2000-2017)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow										
12	3	22	Feather River	2	Less Likely	DTW < 30 ft No Critical Species w/in NASb boundary Lack of diverse vegetation	Quercus lobata present is likely dependent on surface water	0-10	Bank Swallow (outside NASb boundary)	Flat	N*	Y - CASGEM Well 17012 (12N03E23N001 M) avg DTW = 12 (157 points; 2000-2017)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak														
12	3	23	Feather River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	Swainson's Hawk	Flat	N*	Y - CASGEM Well 17012 (12N03E23N001 M) avg DTW = 12 (157 points; 2000-2017)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak														
12	3	24	Developed Parcel	2	Less Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation Plant Species on developed parcel	Quercus lobata appears to be on private land; may be irrigated	0-10	Swainson's Hawk	Flat	N*	Y - CASGEM Well 17012 (12N03E23N001 M) avg DTW = 12 (157 points; 2000-2017)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak														
12	3	25	Unnamed drainage	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	Giant Gartersnake	Flat	N*	Y - CASGEM Well 17012 (12N03E23N001 M) avg DTW = 12 (157 points; 2000-2017)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix exigua	Narrowleaf Willow														
12	3	26	Feather River	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	none	Flat	N*	Y - CASGEM Well 17012 (12N03E23N001 M) avg DTW = 12 (157 points; 2000-2017)	none	Quercus lobata	Valley Oak														
12	3	27	Feather River	2	Less Likely	DTW < 30 ft Critical Species outside NASb boundary Lack of diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	Bank Swallow (outside NASb boundary)	Flat	N*	Y - CASGEM Well 17012 (12N03E23N001 M) avg DTW = 12 (157 points; 2000-2017)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	3	34	Feather River	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated as DTW is less than 30 ft	0-10	Swainson's Hawk	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
12	3	35	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Giant Gartersnake	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	none																
12	3	36	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0	Giant Gartersnake	Flat	N	Y - CASGEM Well 47776 (Sut Co MW-5A, 11N03E02Q002M) avg DTW = 9 (62 points; 2012-2021)	none																
12	4	1	Raccoon Ck	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft[1]. Similar species to Fraxinus latifolia (F. velutina) has rooting depth of 7 ft[1]	20-30	none	Y	N	Y - CASGEM Well 17019 (12N04E02P001M) avg DTW = 27 (136 points; 2000-2020) Y - CASGEM Well 35624 (So Sut WD, 13N04E35Q002M) avg DTW = 29 (63 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Populus fremontii	Fremont Cottonwood	Fraxinus latifolia*	Oregon Ash										
12	4	2	Raccoon Ck	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Similar species to Fraxinus latifolia (F. velutina) has rooting depth of 7 ft[1].	10-20	none	Y	N	Y - CASGEM Well 17019 (12N04E02P001M) avg DTW = 27 (136 points; 2000-2020) Y - CASGEM Well 35624 (So Sut WD, 13N04E35Q002M) avg DTW = 29 (63 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded	Fraxinus latifolia*	Oregon Ash												
12	4	3	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-20	none	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	none																
12	4	4	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	10	Swainson's Hawk	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	none																
12	4	5	Unnamed Drainage	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	none	Quercus lobata	Valley Oak														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	4	6	Feather River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Bank Swallow Swainson's Hawk	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Juglans hindsii and hybrids*	No Cal Black Walnut										
12	4	7	Feather River & unnamed drainage canal	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	none w/in NASb boundary	Populus fremontii	Fremont Cottonwood	Acer negundo	Box-elder	Salix gooddingii	Goodding's Willow	Platanus racemosa	California Sycamore	Quercus lobata	Valley Oak						
12	4	8	Unspecified area	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Vernal Pool Tadpole Shrimp Giant Gartersnake	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	none	Quercus lobata	Valley Oak														
12	4	9	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	0-10	none	Y	N*	Y - CASGEM Well 17025 (So Sut WD 12N04E05R004M) avg DTW = 19 (104 points, 2000-2019)	none																
12	4	10	Raccoon Ck	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	10-20	none	Y/Flat	N	N - CASGEM Well 17027 (So Sut WD, 12N04E10D002M) avg DTW = 30 (35 points; 2011-2020) Y - CASGEM Well 17023 (AB-1 shallow, 12N04E03N004M) avg DTW = 21 (154 points; 2000-2020)	none	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Platanus racemosa	California Sycamore	Salix exigua	Narrowleaf Willow								
12	4	11	Raccoon Ck & Buckham Slough	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Salix gooddingii has a maximum rooting depth of 6.89 ft and Populus fremontii has a maximum rooting depths of 16.4[1]. Similar species to Fraxinus latifolia (F. velutina) has rooting depth of 7 ft[1]. Typha angustifolia habitat is marshy with shallow surface water[2].	10-20	Swainson's Hawk	Y	N	Y - CASGEM Well 17019 (12N04E02P001M) avg DTW = 27 (136 points; 2000-2020) Y - CASGEM Well 35624 (So Sut WD, 13N04E35Q002M) avg DTW = 29 (63 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Fraxinus latifolia*	Oregon Ash	Typha angustifolia*	Narrowleaf Cattail	Salix gooddingii	Goodding's Willow								
12	4	12	Unnamed drainage	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Populus fremontii has a maximum rooting depth of 16.4[1]. Valley Oak has a maximum rooting depth of 24.02[1]. Species is likely dependent on surface water from drainage	25-35	none	Y	N	Y - CASGEM Well 17019 (12N04E02P001M) avg DTW = 27 (136 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	4	13	Unnamed drainage	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	25-40	none	Y	N	N - CASGEM Well 39691 (AB-2 Shal, 12N04E26J004M) avg DTW = 34 (157 points, 2000-2020) N - CASGEM Well 24495 (12N04E25N001M) avg DTW = 37 (155 points; 2005-2018)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded														
12	4	14	Buckham Slough/Markham Ravine	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Can be eliminated as Typha angustifolia requires marshy conditions and shallow surface water[2].	20-30	none	Y/N	N	Y - CASGEM Well 17031 (So Sut WD, 12N04E16A004M) avg DTW = 20 (67 points; 2000-2020) N - CASGEM 17027 (So Sut WD, 12N04E10D002M) avg DTW = 30 (35 points; 2011-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Typha angustifolia*	Narrowleaf Cattail												
12	4	15	Raccoon Ck & Eastside Canal	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	10-20	none	Y/N	N	Y - CASGEM Well 17031 (So Sut WD, 12N04E16A004M) avg DTW = 20 (67 points; 2000-2020) N - CASGEM 17027 (12N04E10D002M) avg DTW = 30 (35 points; 2011-2020)	none	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow	Salix gooddingii	Goodding's Willow								
12	4	16	Raccoon Ck	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Can be eliminated as Typha angustifolia requires marshy conditions and shallow surface water[2].	0-10	none	Y/N	N	Y - CASGEM Well 17031 (So Sut WD, 12N04E16A004M) avg DTW = 20 (67 points; 2000-2020) N - CASGEM 17027 (So Sut WD, 12N04E10D002M) avg DTW = 30 (35 points; 2011-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Typha angustifolia*	Narrowleaf Cattail												
12	4	17	Racoon Ck & Ping Slough	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Y/N	N	Y - CASGEM Well 17031 (So Sut WD, 12N04E16A004M) avg DTW = 20 (67 points; 2000-2020) N - CASGEM 17027 (12N04E10D002M) avg DTW = 30 (35 points; 2011-2020)	none	Quercus lobata	Valley Oak												
12	4	18	Raccoon Ck & Ping Slough Confluence	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Diminimis Oaks	0-10	Swainson's Hawk	Flat	N*	Y - CASGEM Well 17033 (12N04E18D001M) avg DTW = 18 (92 points; 2000-2017	none	Quercus lobata	Valley Oak												
12	4	19	Main Canal	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant Gartersnake Swainson Hawk	Flat	N*	Y - CASGEM Well 17033 (12N04E18D001M) avg DTW = 18 (92 points; 2000-2017	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix exigua	Narrowleaf Willow	Salix gooddingii	Goodding's Willow	Quercus lobata	Valley Oak								
12	4	20	Unspecified area	2	Less likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Vernal Pool Tadpole Shrimp	Flat	N*	Y - CASGEM Well 17033 (12N04E18D001M) avg DTW = 18 (92 points; 2000-2017	none												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	4	21	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	5-15	none	Flat	N*	Y - CASGEM Well 17033 (12N04E18D001M) avg DTW = 18 (92 points; 2000-2017	none														
12	4	22	East Side Canal	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Might be eliminated as Salix exigua and Typha angustifolia require surface water or elevated water table[1,2].	10-20	none	Y	N*	N - CASGEM Well 17035 (12N04E24M002M) avg DTW = 34 (142 points 2000-2017)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail										
12	4	23	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	20-30	none	Y	N*	N - CASGEM Well 17035 (12N04E24M002M) avg DTW = 34 (142 points 2000-2017)	none														
12	4	24	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-40	none	Y	N*	N - CASGEM Well 17035 (12N04E24M002M) avg DTW = 34 (142 points 2000-2017)	none														
12	4	25	Auburn Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4[1]. Quercus lobata has a maximum rooting depth of 24.02[1]. DTW is greater than 30 ft. Species is likely dependent on surface water from Auburn Ravine, not groundwater.	30-45	none	Y	N	N - CASGEM Well 39691 (AB-2 Shal, 12N04E26J004M) avg DTW = 34 (157 points, 2000-2020) N - CASGEM Well 24495 (12N04E25N001M) avg DTW = 37 (155 points; 2005-2018)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
12	4	26	Unspecified area	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Populus fremontii has a maximum rooting depth of 16.4[1]. Salix exigua (using rooting depth for S. gooddingii of 6.89 ft) requires surface water and elevated water table. Quercus lobata may be reliant on groundwater in this area.	20-30	none	Y	N	N - CASGEM Well 39691 (AB-2 Shal, 12N04E26J004M) avg DTW = 34 (157 points, 2000-2020) N - CASGEM Well 24495 (12N04E25N001M) avg DTW = 37 (155 points; 2005-2018)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow	Quercus lobata	Valley Oak									
12	4	27	East Side Canal	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Location of Salix exigua appears artificial. 1962 aerial photo does not have this feature. Populus fremontii has a maximum rooting depth of 16.4[1] and is probably dependent on surface water from the Auburn Ravine.	10-20	none	Flat	N	Y - CASGEM Well 25784 (So Sut WD, 12N04E29J001M) avg DTW = 9 (61 points; 2005-2020) Y - CASGEM 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow	Schoenoplectus acutus*	Hardstem Bullrush									
12	4	28	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10	none	Flat	N	Y - CASGEM Well 25784 (So Sut WD, 12N04E29J001M) avg DTW = 9 (61 points; 2005-2020) Y - CASGEM 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	4	29	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Swainson's Hawk	Flat	N	Y - CASGEM Well 25784 (So Sut WD, 12N04E29J001M) avg DTW = 9 (61 points; 2005-2020) Y - CASGEM 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	none																
12	4	30	Unspecified area	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Swainson's Hawk, Giant Gartersnake	Flat	N	Y - CASGEM Well 25784 (So Sut WD, 12N04E29J001M) avg DTW = 9 (61 points; 2005-2020)	none																
12	4	31	Unnamed drainage	2	Less Likely	DTW < 30 ft Critical Species may be present No vegetation	No GDEs	0-10	Giant Gartersnake	Flat	N	Y - CASGEM Well 25784 (So Sut WD, 12N04E29J001M) avg DTW = 9 (61 points; 2005-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded																
12	4	32	Unspecified area	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Salix gooddingii may be dependent on groundwater. However, vegetation appears to be sparse and located in agricultural drainage. Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	N	Y - CASGEM Well 25784 (So Sut WD, 12N04E29J001M) avg DTW = 9 (61 points; 2005-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Salix gooddingii	Goodding's Willow												
12	4	33	Unspecified area	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Salix exigua is located along the East Side Canal and likely dependent on surface water	0-10	none	Flat	N	Y - CASGEM Well 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	none	Salix exigua	Narrowleaf Willow														
12	4	34	East Side Canal	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Species present have shallow rooting depths (less than 10 ft)[1,2].	10-20	Swainson's Hawk	Flat	N	Y - CASGEM Well 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow	Salix exigua	Narrowleaf Willow	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail								
12	4	35	King Slough	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Species present have shallow rooting depths (less than 10 ft)[1,2].	20-30	none	Flat	N	Y - CASGEM Well 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow														
12	4	36	King Slough	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Species present have shallow rooting depths (less than 10 ft)[1,2].	35-50	none	Flat	N	Y - CASGEM Well 17037 (So Sut WD, 12N04E34H001M) avg DTW = 26 (23 points; 2011-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow														
12	5	1	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	35-40	none	Flat	Flat	N - CASGEM Well 32899 (12N05E01D002M) avg DTW = 32 (113 points; 2000-2020) N - CASGEM Well 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	none	Quercus lobata	Valley Oak														
12	5	2	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	35-40	Swainson's Hawk	Flat	Flat	N - CASGEM Well 32899 (12N05E01D002M) avg DTW = 32 (113 points; 2000-2020) N - CASGEM Well 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	5	3	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-45	none	Flat	Flat	N - CASGEM Well 32899 (12N05E01D002M) avg DTW = 32 (113 points; 2000-2020) N - CASGEM Well 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded														
12	5	4	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-45	none	Flat	Flat	N - CASGEM Well 32899 (12N05E01D002M) avg DTW = 32 (113 points; 2000-2020) N - CASGEM Well 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	none														
12	5	5	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft. Populus fremontii has a maximum rooting depth of 16.4[1].	35-40	none	Y	N	N - CASGEM Well 17043 (12N05E06R001M) avg DTW = 53 (84 points; 2000-2020) Y - CASGEM Well 40137 (So Sut WD, 13N05E31K001M) avg DTW = 27 (94 points, 2000-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
12	5	6	Raccoon Ck	2	Less Likely	DTW < 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft. Populus fremontii has a maximum rooting depth of 16.4[1]. Typha angustifolia requires shallow surface water[2].	25-35	none	Y	N	N - CASGEM Well 17043 (12N05E06R001M) avg DTW = 53 (84 points; 2000-2020) Y - CASGEM Well 40137 (So Sut WD, 13N05E31K001M) avg DTW = 27 (94 points, 2000-2020)	Palustrine, Forested, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail										
12	5	7	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because Typha angustifolia requires shallow surface water[2].	30-40	none	Y	N	N - CASGEM Well 17043 (12N05E06R001M) avg DTW = 53 (84 points; 2000-2020) Y - CASGEM Well 40137 (So Sut WD, 13N05E31K001M) avg DTW = 27 (94 points, 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail												
12	5	8	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	35-45	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Typha angustifolia*	Narrowleaf Cattail	Schoenoplectus acutus*	Hardstem Bullrush	Populus fremontii	Fremont Cottonwood								
12	5	9	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	45-50	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail												
12	5	10	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	40-50	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Salix gooddingii	Goodding's Willow										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	5	11	Dammed unnamed drainages	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	40-51	Conservancy Fairy Shrimp Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Salix gooddingii	Goodding's Willow												
12	5	12	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-40	none	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
12	5	13	Markham Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	40-50	none	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail	Schoenoplectus acutus*	Hardstem Bullrush	Populus fremontii	Fremont Cottonwood						
12	5	14	Markham Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	45-50	none	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Unconsolidated Shore, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak						
12	5	15	Markham Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	45-55	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Typha angustifolia*	Narrowleaf Cattail	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood						
12	5	16	Markham Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	45-55	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Scrub-Shrub, Seasonally Flooded	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail	Salix gooddingii	Goodding's Willow						
12	5	17	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	45-55	Tricolored Blackbird	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail						
12	5	18	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	40-50	Tricolored Blackbird	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow												
12	5	19	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	50	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush												
12	5	20	Unspecified area	0	Not Likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	50-65	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	5	21	Unspecified area	0	Not Likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	55-65	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	none														
12	5	22	Unspecified area	0	Not Likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	60-70	none	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush												
12	5	23	Lincoln Communication Annex	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	50-55	Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp	Y	N	N - CASGEM Well 32903 (12N05E17A002M) avg DTW = 58 (254 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak												
12	5	24	Unspecified area	0	Not Likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	50	none	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	none	Quercus lobata	Valley Oak												
12	5	25	Auburn Ravine	1	Not Likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	50-60	Swainson's Hawk Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Unconsolidated Shore, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow						
12	5	26	Auburn Ravine	1	Not Likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	55-65	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail						
12	5	27	Auburn Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	60-70	none	Y	N	N - CASGEM Well 32067 (12N05E33C001M) avg DTW = 77 (119 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail										
12	5	28	Auburn Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	60-70	none	Y	N	N - CASGEM Well 32066 (12N05E29D001M) avg DTW = 57 (122 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	5	29	Auburn Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	60-70	none	Y	N	N - CASGEM Well 32066 (12N05E29D001M) avg DTW = 57 (122 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
12	5	30	Auburn Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	55-65	none	Y	N	N - CASGEM Well 32066 (12N05E29D001M) avg DTW = 57 (122 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood												
12	5	31	King Slough	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	50-65	none	Y	N	N - CASGEM Well 32066 (12N05E29D001M) avg DTW = 57 (122 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
12	5	32	King Slough	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	65-75	none	Y	N	N - CASGEM Well 32066 (12N05E29D001M) avg DTW = 57 (122 points; 2000-2020)	none														
12	5	33	King Slough	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	70-80	none	Y	N	N - CASGEM Well 32067 (12N05E33C001M) avg DTW = 77 (119 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
12	5	34	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Typha angustifolia is dependent on shallow groundwater[2]	65-75	none	Y	N	N - CASGEM Well 32067 (12N05E33C001M) avg DTW = 77 (119 points; 2000-2020)	none	Typha angustifolia*	Narrowleaf Cattail												
12	5	35	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	60-75	none	Y	N	N - CASGEM Well 32067 (12N05E33C001M) avg DTW = 77 (119 points; 2000-2020)	none														
12	5	36	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	55-70	none	Y	N	N - CASGEM Well 32067 (12N05E33C001M) avg DTW = 77 (119 points; 2000-2020)	none														
12	6	2	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft. Quercus lobata has a rooting depth of 24.02[1].	30	none	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020)	Palustrine, Unconsolidated Shore, Seasonally Flooded, Californian Warm Temperate Marsh/Seep Group	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
12	6	3	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30	none	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020)	none														
12	6	4	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	All species present have root depths that are shallow[1,2,3]. Species are likely dependent on the seeps and seasonal flooding, not groundwater.	30	Tri-Colored Blackbird	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020) N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Emergent, Persistent, Semipermanently Flooded, California Warm Temperate Marsh/Seep	Typha angustifolia*	Narrowleaf Cattail	Schoenoplectus acutus*	Hardstem Bullrush	Populus fremontii	Fremont Cottonwood								

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	6	5	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Quercus lobata (less than 3 acres) is located along W. Wise Rd and likely not dependent on groundwater, but on irrigation from adjacent ag operation (alfalfa). GDEs in this section are sparse.	30	Tri-Colored Blackbird Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020) N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Quercus lobata	Valley Oak												
12	6	6	Lincoln Regional Airpark	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-35	none	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020) N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
12	6	7	Lincoln Regional Airpark	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-40	none	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
12	6	8	Residential/Commercial	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	35-40	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	California Warm Temperate Marsh/Seep	Typha angustifolia*	Narrowleaf Cattail	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood						
12	6	9	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	35-50	Swainson's Hawk	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	California Warm Temperate Marsh/Seep	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow	Quercus lobata	Valley Oak						
12	6	10	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	35-40	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020)	California Warm Temperate Marsh/Seep, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Emergent, Persistent, Semipermanently Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood								

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	6	11	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Quercus lobata has a rooting depth of 24.02[1]. Species in northern portion of the section may be dependent on groundwater. The southern portion of the section has DTW greater than 30 ft	30-35	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Arid West freshwater emergent marsh, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
12	6	12	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata has a rooting depth of 24.02[1].	30-35	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	none	Quercus lobata	Valley Oak												
12	6	13	Turkey Creek Golf Club	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata has a rooting depth of 24.02[1].	35	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	none	Quercus lobata	Valley Oak												
12	6	14	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata has a rooting depth of 24.02[1]. Can be eliminated because DTW is greater than 30 ft.	35-40	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail								
12	6	15	Residential/Commercial	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata has a rooting depth of 24.02[1].	40-50	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Schoenoplectus acutus*	Hardstem Bullrush								
12	6	16	Residential	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata has a rooting depth of 24.02[1]. Can be eliminated because DTW is greater than 30 ft.	45-55	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, California Warm Temperate Marsh/Seep	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow								
12	6	17	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	50	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 49934 (MW 3-1, 12N06E17) avg DTW = 55 (85 points; 2012 - 2020)	Palustrine, Unconsolidated Bottom, Permanently Flooded, California Warm Temperate Marsh/Seep	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow	Typha angustifolia*	Narrowleaf Cattail						
12	6	18	Markham Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	40-50	none	Flat	Flat	N - CASGEM Well 49942 (Airport 4 MW, 12N06E07) avg DTW = 45 (86 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, California Warm Temperate Marsh/Seep	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail	Juglans hindsii and hybrids*	No Cal Black Walnut	Populus fremontii	Fremont Cottonwood						

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	6	19	Auburn Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	50	none	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, California Warm Temperate Marsh/Seep	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow								
12	6	20	Auburn Ravine	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft	50	Tri-Colored Blackbird Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 49941 (SLC - 3, 12N06E29) avg DTW = 65 (70 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak												
12	6	21	Auburn Ravine	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	50	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	California Warm Temperate Marsh/Seep, Palustrine, Emergent, Persistent, Seasonally Flooded	Juglans hindsii*	No Cal Black Walnut	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow								
12	6	22	Residential/Commercial	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	45-50	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Acer negundo	Box-elder	Populus fremontii	Fremont Cottonwood								
12	6	23	Ingram Slough	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft.	40	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail												
12	6	24	Ingram Slough	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft.	40	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Typha angustifolia*	Narrowleaf Cattail												
12	6	25	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft.	40	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	California Warm Temperate Marsh/Seep, Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail	Salix gooddingii	Goodding's Willow								

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	6	26	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft.	45-50	none	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, California Warm Temperate Marsh/Seep	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow	Salix gooddingii	Goodding's Willow										
12	6	27	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft.	50	Tricolored Blackbird, Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 49937 (MW 5-1, 12N06E21) avg DTW = 40 (85 points; 2012-2020) N - CASGEM Well 49938 (MW 5-2, 12N06E21) avg DTW = 36 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail												
12	6	28	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	55	Tricolored Blackbird, Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp	N	N	N - CASGEM Well 49941 (SLC - 3, 12N06E29) avg DTW = 65 (70 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
12	6	29	Ingram Slough	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft	55-60	Tri-Colored Blackbird	N	N	N - CASGEM Well 49941 (SLC - 3, 12N06E29) avg DTW = 65 (70 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush												
12	6	30	Orchard Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	50	none	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow								
12	6	31	Orchard Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft	55-65	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
12	6	32	Orchard Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft	55-65	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
12	6	33	Orchard Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft	55-65	Tri-Colored Blackbird Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 49927 (MW 1-1, 12N06E30) avg DTW = 57 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix exigua	Narrowleaf Willow												
12	6	34	Orchard Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	50-60	Tri-Colored Blackbird	N	N	N - CASGEM Well 49941 (SLC - 3, 12N06E29) avg DTW = 65 (70 points; 2012-2020)	none	Salix exigua	Narrowleaf Willow	Salix gooddingii	Goodding's Willow	Typha angustifolia*	Narrowleaf Cattail								

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
12	6	35	Residential	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	45-55	Tri-Colored Blackbird Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 49940 (SLC - 2, 12N06E29) avg DTW = 72 (79 points, 2012-2020	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
12	6	36	Residential	0	Not Likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated DTW greater than 30 ft	40-45	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow	Quercus lobata	Quercus lobata								
12	7	19	Unspecified area	0	Not Likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs within NASb boundary	40	none			no representative hydrographs within contour interval	none																
12	7	29	Most of section is outside NASb boundary - Foothills	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs within NASb boundary	40	none			no representative hydrographs within contour interval	none																
12	7	30	Unspecified area	0	Not Likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft	40	none			no representative hydrographs within contour interval	Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak														
12	7	31	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated DTW greater than 30 ft	40	none			no representative hydrographs within contour interval	none	Quercus lobata	Valley Oak														
12	7	32	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40	none			no representative hydrographs within contour interval	none																
13	4	11	Bear River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk Valley Elderberry Longhorned Beetle	Flat	Flat	Y - CASGEM Well 38351 (BR-1A, 13N04E11R005M) avg DTW = 14 (131 points; 2003-2020)	none w/in NASb boundary	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow	Salix exigua	Narrowleaf Willow										
13	4	12	Bear River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Valley Elderberry Longhorned Beetle	Flat	Flat	Y - CASGEM Well 38351 (BR-1A, 13N04E11R005M) avg DTW = 14 (131 points; 2003-2020)	none w/in NASb boundary	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood	Salix lasiolepis	Arroyo Willow								
13	4	13	Yankee Slough	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Flat	Flat	Y - CASGEM Well 38351 (BR-1A, 13N04E11R005M) avg DTW = 14 (131 points; 2003-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow	Quercus lobata	Valley Oak										
13	4	14	Yankee Slough	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Flat	Flat	Y - CASGEM Well 38351 (BR-1A, 13N04E11R005M) avg DTW = 14 (131 points; 2003-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Juglans hindsii and hybrids*	No Cal Black Walnut	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow	Populus fremontii	Fremont Cottonwood						
13	4	15	Bear River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Y	N	Y - CASGEM Well 17191 (So Sut WD, 13N04E22D001M) avg DTW = 22 (76 points; 2000-2020)	none w/in NASb boundary	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix lasiolepis	Arroyo Willow	Acer negundo	Box-elder								
13	4	16	Bear River	4	Likely	DTW < 30 ft Critical Species may be present	Cannot be eliminated because DTW is less than 30 ft.	0-10	Giant garter snake Swainson's Hawk	Flat	N	Y - CASGEM Well 17188 (13N04E16N001M) avg DTW = 17 (164 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
						Diverse vegetation																					
13	4	17	Bear River - NASb - So Yuba boundary	3	Likely	DTW < 30 ft Critical Species may be present Lack of diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	N	Y - CASGEM Well 17188 (13N04E16N001M) avg DTW = 17 (164 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak											
13	4	20	Bear River - NASb - So Yuba boundary	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	N	Y - CASGEM Well 17188 (13N04E16N001M) avg DTW = 17 (164 points; 2000-2020)	none	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow									
13	4	21	Yankee Slough	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	N	Y - CASGEM Well 17188 (13N04E16N001M) avg DTW = 17 (164 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow	Salix exigua	Narrowleaf Willow	Populus fremontii	Fremont Cottonwood							
13	4	22	Yankee Slough	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Y	N	Y - CASGEM Well 17191 (So Sut WD, 13N04E22D001M) avg DTW = 22 (76 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Juglans hindsii and hybrids*	Northern California Black Walnut	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail									
13	4	23	Unspecified area	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Flat	N	Y - CASGEM Well 17193 (13N04E23A002M) avg DTW = 18 (152 points; 2000-2021)	Palustrine, Emergent, Persistent, Seasonally Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Salix exigua	Narrowleaf Willow											
13	4	24	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10-20	none	Flat	N	Y - CASGEM Well 17193 (13N04E23A002M) avg DTW = 18 (152 points; 2000-2021)	none															
13	4	25	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10-20	none	Flat	N	Y - CASGEM Well 17193 (13N04E23A002M) avg DTW = 18 (152 points; 2000-2021)	none															
13	4	26	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	5-15	none	Flat	N	Y - CASGEM Well 17193 (13N04E23A002M) avg DTW = 18 (152 points; 2000-2021)	none															
13	4	27	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	0-10	none	Flat	N	N - CASGEM Well 24452 (So Sut, 13N04E33J002M) avg DTW = 33 (46 points, 2008-2020)	Palustrine, Emergent, Persistent, Semipermanently Flooded															
13	4	28	Ping Slough	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Flat	N	N - CASGEM Well 24452 (So Sut, 13N04E33J002M) avg DTW = 33 (46 points, 2008-2020)	Palustrine, Emergent, Persistent, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Broad-Leaved-Evergreen, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Typha angustifolia*	Narrowleaf Cattail	Quercus lobata	Valley Oak	Schoenoplectus acutus*	Hardstem Bullrush	Salix gooddingii	Goodding's Willow							

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
13	4	29	Yankee and Ping Sloughs	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Y	N	Y - CASGEM Well 35623 (13N04E32G001M) avg DTW = 25 (71 points; 2000-2020)	Palustrine, Forested, Broad-Leaved-Evergreen, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow								
13	4	30	Feather River/Yankee and Ping Sloughs	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk	Y	N	Y - CASGEM Well 35623 (13N04E32G001M) avg DTW = 25 (71 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow										
13	4	31	Yankee & Ping Sloughs	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	Swainson's Hawk Tricolored Blackbird (possibly extirpated)	Y	N	Y - CASGEM Well 35623 (13N04E32G001M) avg DTW = 25 (71 points; 2000-2020)	Palustrine, Aquatic Bed, Semipermanently Flooded, Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Juglans hindsii and hybrids*	No Cal Black Walnut										
13	4	32	Unspecified area	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminate as DTW is less than 30 ft	0-10	none	Y	N	Y - CASGEM Well 35623 (13N04E32G001M) avg DTW = 25 (71 points; 2000-2020)	none	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												
13	4	33	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	0-10	none	Flat	N	N - CASGEM Well 24452 (So Sut, 13N04E33J002M) avg DTW = 33 (46 points, 2008-2020)	none																
13	4	34	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	5-15	none	Flat	N	N - CASGEM Well 24452 (So Sut, 13N04E33J002M) avg DTW = 33 (46 points, 2008-2020)	none																
13	4	35	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	10-20	none	Y	N	Y - CASGEM Well 35624 (So Sut WD, 13N04E35Q002M) avg DTW = 29 (63 points, 2000-2020)	none																
13	4	36	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-25	none	Y	N	Y - CASGEM Well 35624 (So Sut WD, 13N04E35Q002M) avg DTW = 29 (63 points, 2000-2020)	none																
13	5	1	Bear River	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	35-45	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak												
13	5	2	Bear River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of	Can be eliminated because DTW is greater than 30 ft	30-35	none	N	N	N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points, 2016-2020)	none	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
						diverse vegetation																					
13	5	3	Bear River - no GDEs within NASb boundary	1	Not likely	DTW < 30 ft No Critical Species w/in NASb boundary No vegetation w/in NASb boundary	No GDEs within NASb boundary	20-30	none	N	N	N - CASGEM Well 47857 (PMW-27, 14N05E34F003 M) avg DTW = 59 (2765 points; 2007-2020) N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020)	none														
13	5	7	Bear River	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	All species present have root depths that are shallow[1]. Based on average DTW in nearby wells DTW is greater than 30 ft.	10-20	none	Flat/Y	N	Y - CASGEM Well 35627 (YCWA-13, 13N05E06R004 M) avg DTW = 29 (107 points; 2011-2020) Y - CASGEM Well 17209 (So Sut WD, 13N05E18C001 M) avg DTW = 28 (73 points; 2000-2020)	none	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow	Salix exigua	Narrowleaf Willow								
13	5	8	Bear River	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft	10-20	none	Flat/Y	N	Y - CASGEM Well 35627 (YCWA-13, 13N05E06R004 M) avg DTW = 29 (107 points; 2011-2020) Y - CASGEM Well 17209 (So Sut WD, 13N05E18C001 M) avg DTW = 28 (73 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow	Arundo donax**	Giant Reed	Salix exigua	Narrowleaf Willow						
13	5	9	Bear River	3	Likely	DTW < 30 ft No Critical Species Diverse Vegetation	Quercus lobata maximum rooting depth is 24.31[1]; cannot be eliminated	20-25	none	Flat/Y	N	Y - CASGEM Well 35627 (YCWA-13, 13N05E06R004 M) avg DTW = 29 (107 points; 2011-2020) Y - CASGEM Well 17209 (So Sut WD, 13N05E18C001 M) avg DTW = 28 (73 points; 2000-2020)	none	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood	Arundo donax**	Giant Reed						
13	5	10	Bear River	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Quercus lobata maximum rooting depth is 24.31[1]; cannot be eliminated.	25-30	Swainson's Hawk Vernal Pool Fairy Shrimp Valley Elderberry Longhorned Beetle	Y	N*/N	Y - CASGEM Well 17206 (13N05E09R001 M) avg DTW = 27 (87 points; 2000-2017) Y - CASGEM 17209 (So Sut WD, 13N05E18C001 M) avg DTW = 28 (73 points; 2000-2020)	California Warm Temperate Marsh/Seep, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Salix gooddingii	Goodding's Willow	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak						
13	5	11	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft[1].	30-45	none	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	California Warm Temperate Marsh/Seep	Populus fremontii	Fremont Cottonwood												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
13	5	12	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	35-45	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
13	5	13	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-50	none	N	N	N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points, 2016-2020)	none														
13	5	14	Unspecified area	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Populus fremontii has a maximum rooting depth of 6.89[1].	25-30	none	N	N	N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points, 2016-2020)	none	Populus fremontii	Fremont Cottonwood												
13	5	15	Unspecified area	4	Likely	DTW < 30 ft Critical Species may be present Diverse vegetation	Populus fremontii has a maximum rooting depth of 6.89[1]. All other species have shallow rooting depth[1,2].	25	Vernal Pool Fairy Shrimp	Y	N/N*	Y - CASGEM Well 17210 (13N05E22C003 M) avg DTW = 27 (78 points; 2000-2020) Y - CASGEM Well 17206 (13N05E09R001 M) avg DTW = 27 (87 points; 2000-2017)	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, California Warm Temperate Marsh/Seep	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow								
13	5	16	Yankee Slough	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft[1].	20-25	none	Y	N/N*	Y - CASGEM Well 17210 (13N05E22C003 M) avg DTW = 27 (78 points; 2000-2020) Y - CASGEM Well 17206 (13N05E09R001 M) avg DTW = 27 (87 points; 2000-2017)	none	Populus fremontii	Fremont Cottonwood												
13	5	17	Yankee Slough	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft[1].	25	none	Flat	N	N - CASGEM Well 17208 (13N05E17R001 M) avg DTW = 31 (135 points, 2000-2021)	none	Populus fremontii	Fremont Cottonwood												
13	5	18	Yankee Slough	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Cannot be eliminated because DTW is less than 30 ft.	0-10	none	Y	N	Y - CASGEM Well 17209 (So Sut WD, 13N05E18C001 M) avg DTW = 28 (73 points; 2000-2020)	none	Salix exigua	Narrowleaf Willow												
13	5	19	Unspecified area	1	Not Likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	15-25	none	Y	N	Y - CASGEM Well 17209 (So Sut WD, 13N05E18C001 M) avg DTW = 28 (73 points; 2000-2020)	California Warm Temperate Marsh/Seep														
13	5	20	Unspecified area	1	Not Likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	20-30	none	Flat	N	N - CASGEM Well 17208 (13N05E17R001 M) avg DTW = 31 (135 points, 2000-2021)	none														
13	5	21	Yankee Slough	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft[1].	25	none	Flat	N	Y - CASGEM Well 24451 (13N05E16F001 M) avg DTW = 27 (36 points; 2008-2020) N - CASGEM Well 17208 (13N05E17R001 M) avg DTW = 31 (135 points; 2000-2021)	none	Populus fremontii	Fremont Cottonwood												

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
13	5	22	Yankee Slough	0	Not Likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Populus fremontii has a maximum rooting depth of 16.4 ft[1].	30-35	none	Y	N	Y - CASGEM Well 17210 (13N05E22C003 M) avg DTW = 27 (78 points; 2000-2020) N - CASGEM Well 17208 (13N05E17R001 M) avg DTW = 31 (135 points; 2000-2021)	none	Populus fremontii	Fremont Cottonwood												
13	5	23	Surface water ponds?	0	Not Likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Populus fremontii has a maximum maximum rooting depth of 16.4 ft and Salix gooddingii has a maximum rooting depth of 6.89[1].	30-35	none	N	N	N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points, 2016-2020)	none	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood	Schoenoplectus acutus*	Hardstem Bullrush	Salix gooddingii	Goodding's Willow						
13	5	24	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can eliminate because DTW is greater than 30 ft.	35-40	Tri-Colored Blackbird	N	N	N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points, 2016-2020)	California Warm Temperate Marsh/Seep, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Emergent, Persistent, Semipermanently Flooded	Schoenoplectus acutus*	Hardstem Bullrush	Populus fremontii	Fremont Cottonwood										
13	5	25	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40	none	N	N	N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points, 2016-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
13	5	26	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35-40	none	Flat	Flat	N - CASGEM Well 32899 (12N05E01D002 M) avg DTW =32 (84 points, 2000-2020	California Warm Temperate Marsh/Seep														
13	5	27	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	35	none	Y	N	N - CASGEM Well 35633 (13N 05E34P001M) avg DTW =49 (95 points, 2000-2020)	none														
13	5	28	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	30-35	none	Y	N	N - CASGEM Well 35633 (13N 05E34P001M) avg DTW =49 (95 points, 2000-2020)	none														
13	5	29	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	25-35	none	Flat	N	N - CASGEM Well 17208 (13N05E17R001 M) avg DTW = 31 (135 points, 2000-2021)	none														
13	5	30	Unspecified area	1	Not likely	DTW < 30 ft No Critical Species No vegetation	No GDEs	20-30	none	Y	N	Y - CASGEM Well 40137 (So Sut WD, 13N05E31K001 M) avg DTW = 29 (94 points; 2000-2020)	none														
13	5	31	Raccoon Ck	2	Less Likely	DTW < 30 ft No Critical Species Lack of Diverse Vegetation	Salix gooddingii has a maximum rooting depth of 6.89[1]	25-30	none	Y	N/N*	Y- CASGEM Well 40137 (So Sut WD, 13N05E31K001 M) avg DTW = 29 (94 points; 2000-2020) N- CASGEM Well 35632 (13N05E30A001 M) avg DTW = 43 (100 points, 2000-2019)	Palustrine, Forested, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Salix gooddingii	Goodding's Willow										

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
13	5	32	Raccoon Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	30-35	none	Y	N	Y - CASGEM Well 40137 (So Sut WD, 13N05E31K001M) avg DTW = 29 (94 points; 2000-2020) N - CASGEM Well 35633 (13N05E34P001M) avg DTW = 49 (97 points; 2000-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood												
13	5	33	Raccoon Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft	35	none	Y	N	Y - CASGEM Well 40137 (So Sut WD, 13N05E31K001M) avg DTW = 29 (94 points; 2000-2020) N - CASGEM Well 35633 (13N05E34P001M) avg DTW = 49 (97 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail	Platanus racemosa	California Sycamore	Salix gooddingii	Goodding's Willow								
13	5	34	Raccoon Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	35	none	Y/Flat	N/Flat	N - CASGEM Well 35633 (13N05E34P001M) avg DTW = 41 (97 points; 2000-2020) N - CASGEM Well 32899 (12N05E01D002M) avg DTW = 32 (115 points; 2000-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow												
13	5	35	Raccoon Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	35	none	Y/Flat	N/Flat	N - CASGEM Well 35633 (13N05E34P001M) avg DTW = 41 (97 points; 2000-2020) N - CASGEM Well 32899 (12N05E01D002M) avg DTW = 32 (115 points; 2000-2020)	Palustrine, Forested, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak														
13	5	36	Raccoon Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	35	none	Flat	Flat	N - CASGEM Well 32899 (12N05E01D002M) avg DTW =32 (84 points, 2000-2020	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Quercus lobata	Valley Oak														
13	6	5	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	45	none	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	California Warm Temperate Marsh/Seep														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
13	6	6	Unspecified area	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	45	none	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	none														
13	6	7	appears to be artificial pond - no nearby drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	45	none	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Salix gooddingii	Goodding's Willow												
13	6	8	Racoon Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	50	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak												
13	6	9	Racoon Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	45	none	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow										
13	6	10	Most of section is outside NASb boundary - Foothills	0	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs (Himalayan Blackberry)	40	none			no representative hydrographs within contour interval	none														
13	6	15	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs - Himalayan Blackberry	40	Tricolored Blackbird			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded														
13	6	16	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	40	none	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	California Warm Temperate Marsh/Seep, Palustrine, Emergent, Persistent, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
13	6	17	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft	50	California Black Rail Tri-Colored Blackbird	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Palustrine, Emergent, Persistent, Semipermanently Flooded, Palustrine, Scrub-Shrub, Seasonally Flooded, Palustrine, Forested, Seasonally Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded, California Warm	Schoenoplectus acutus*	Hardstem Bullrush	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak								

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
													Temperate Marsh/Seep															
13	6	18	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	50	Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Palustrine, Emergent, Persistent, Seasonally	Schoenoplectus acutus*	Hardstem Bullrush												
13	6	19	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft	50	Tri-Colored Blackbird Vernal Pool Fairy Shrimp	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	California Warm Temperate Marsh/Seep	Schoenoplectus acutus*	Hardstem Bullrush	Salix exigua	Narrowleaf Willow	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail						
13	6	20	Unnamed drainage	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	40-55	Vernal Pool Fairy Shrimp Swainson's Hawk	N	N	N - CASGEM Well 52555 (Spencer, 13N05E12) avg DTW = 52 (59 points; 2016-2020) N - CASGEM Well 51330 (MW-1, 13N05E13) avg DTW = 35 (58 points; 2016-2020)	Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
13	6	21	Raccoon Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft	40	Swainson's Hawk			no representative hydrographs within contour interval	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Salix gooddingii	Goodding's Willow								
13	6	22	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata has a rooting depth of 24.31[1]. Other species required shallower DTW. Species likely dependent on surface water[1,2].	30-35	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow	Quercus lobata	Valley Oak	Salix gooddingii	Goodding's Willow						
13	6	26	Most of section is outside NASb boundary - Foothills	0	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	30	none			no representative hydrographs within contour interval	none														

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
13	6	27	Unnamed drainage	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata has a rooting depth of 24.31[1]. Other species required shallower DTW. Species likely dependent on surface water[1,2].	30	none			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Salix exigua	Narrowleaf Willow	Quercus lobata	Valley Oak								
13	6	28	Unnamed drainage & Doty Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Quercus lobata has a rooting depth of 24.31[1]. Other species required shallower DTW. Species likely dependent on surface water[1,2].	30-40	Tricolored Blackbird	Flat	Flat	N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) Y - CASGEM Well 49931 (MW 2-1, 12N06E06) avg DTW = 13 (85 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail	Salix exigua	Narrowleaf Willow							
13	6	29	Raccoon Ck	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata has a rooting depth of 24.31[1]. Populus fremontii has a maximum rooting depth of 16.4[1]. Species likely dependent on surface water.	30-35	none	Flat	Flat	N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
13	6	30	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present No vegetation	No GDEs	35-45	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded														
13	6	31	Raccoon Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Quercus lobata maximum rooting depth is 24.31[1]	30-35	none	Flat	Flat	N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Juglans hindsii and hybrids*	California Walnut							
13	6	32	Raccoon Ck & Doty Ck	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Quercus lobata maximum rooting depth is 24.31[1]	30-35	none	Flat	Flat	N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Palustrine, Forested, Seasonally Flooded	Quercus lobata	Valley Oak	Typha angustifolia*	Narrowleaf Cattail	Populus fremontii	Fremont Cottonwood							

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[9]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
13	6	33	Doty Ravine	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Quercus lobata maximum rooting depth is 24.312	30	Vernal Pool Fairy Shrimp	Flat	Flat	N - CASGEM Well 13162 (12N06E06A001M) avg DTW = 32 (75 points; 2012-2020) N - CASGEM 49933 (MW 2-3, 12N06E06) avg DTW = 33 (84 points; 2012-2020)	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Emergent, Persistent, Semipermanently Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Typha angustifolia*	Narrowleaf Cattail								
13	6	34	Doty Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Quercus lobata maximum rooting depth is 24.313	30	none	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020)	California Warm Temperate Marsh/Seep, Palustrine, Emergent, Persistent, Seasonally Flooded	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood	Platanus racemosa	California Sycamore								
13	6	35	Doty Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata maximum rooting depth is 24.314	30	none	Flat	Flat	N - CASGEM Well 51329 (Swainson, 12N06E05) avg DTW = 30 (60 points; 2015-2020)	California Warm Temperate Marsh/Seep, Palustrine, Emergent, Persistent, Semipermanently Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
13	6	36	Doty Ravine	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Quercus lobata maximum rooting depth is 24.315	30	none			no representative hydrographs within contour interval	none	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
14	5	25	Bear River - NASb - So Yuba boundary	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	35-40	none	N	N	N - CASGEM Well 47857 (PMW-27 14N05E34F003M) avg DTW = 59 (2765 points; 2007-2020)	none	Quercus lobata	Valley Oak	Populus fremontii	Fremont Cottonwood										
14	5	35	Bear River - NASb - So Yuba boundary	0	Not likely	DTW ≥ 30 ft No Critical Species No vegetation	No GDEs	40	none	N	N	N - CASGEM Well 47857 (PMW-27 14N05E34F003M) avg DTW = 59 (2765 points; 2007-2020)	none														
14	5	36	Bear River w/in NASb boundary	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	40	none	N	N	N - CASGEM Well 47857 (PMW-27 14N05E34F003M) avg DTW = 59 (2765 points; 2007-2020)	Palustrine, Scrub-Shrub, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood												
14	6	29	Bear River	0	Not likely	DTW ≥ 30 ft No Critical Species Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft	40	none			no representative hydrographs within contour interval	California Warm Temperate Marsh/Seep, Palustrine, Scrub-Shrub, Emergent, Persistent, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak										
14	6	30	Dammed section of Bear River & adjacent to Camp Far West Resv	0	Not likely	DTW ≥ 30 ft No Critical Species Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft	40	none			no representative hydrographs within contour interval	California Warm Temperate Marsh/Seep, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded, Palustrine, Emergent, Persistent, Unconsolidated Shore, Seasonally Flooded	Quercus lobata	Valley Oak	Salix exigua	Narrowleaf Willow	Salix gooddingii	Goodding's Willow	Populus fremontii	Fremont Cottonwood	Salix lasiolepis	Arroyo Willow	Sambucus Nigra	Common Elderberry		

T	R	Sec	Location	Score	GDE - Likely, Not Likely, Less likely	Rationale	Rationale Comments	DTW Contour Interval (ft)[7]	Critical species[8]	Water Levels Declining (all data points)	Water Levels Declining (2015-2020/2021)	GW - SW Connection (verified by Hydrograph within 3.1 mi)	Wetland Designation[9]	Plants-dominant[0]		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant		Plants-sub-dominant	
14	6	31	Dammed section of Bear River & adjacent to Camp Far West Resv	1	Not likely	DTW ≥ 30 ft Critical Species may be present Diverse vegetation have rooting depths less than DTW	Can be eliminated because DTW is greater than 30 ft.	40	Bank Swallow			no representative hydrographs within contour interval	Palustrine, Emergent, Persistent, Seasonally Flooded, Palustrine, Emergent, Persistent, Unconsolidated Shore, Seasonally Flooded, Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	Populus fremontii	Fremont Cottonwood	Quercus lobata	Valley Oak	Salix lasiolepis	Arroyo Willow	Schoenoplectus acutus*	Hardstem Bulrush	Salix exigua	Narrowleaf Willow						
14	6	32	Unspecified area	1	Not likely	DTW ≥ 30 ft Critical Species may be present Lack of diverse vegetation	Can be eliminated because DTW is greater than 30 ft.	40	Vernal Pool Fairy Shrimp			no representative hydrographs within contour interval	none	Schoenoplectus acutus*	Hardstem Bulrush														

Scoring:

DTW < 30 ft = 2

Critical Species Identified = 1

Diverse vegetation (3 or more plant species) = 1

DTW ≥ 30 ft = 0

No vegetation present = -1

Lack of diverse vegetation = 0

Diverse vegetation with rooting depths less than DTW = 0

"Vegetation" = vegetation listed in the NCCAG dataset

*Data does not extend to 2020/2021

Used avg static DTW

Proposed GSP monitoring wells

May not be dependent on groundwater

May be dependent on groundwater

*Not on TNC CA Phreatophyte Rooting List; on Comprehensive Root Depth List

**Not on TNC CA Phreatophyte Rooting List or Comprehensive Root Depth List

[1] TNC Plant Rooting Depth Database (Acer negundo, Fraxinus latifolia (used F.velutin), Populus fremontii, Quercus lobata, Salix gooddingii, Salix exigua (used rooting depth for S. gooddingii, Salix lasiolepis)

[2] CalFlora.org (Heterotheca oregona, Typha angustifolia)

[3] USDA FEIS Database (Alnus rhombifolia, Sambucus nigra, Schoenoplectus acutus, Vitas californica)

[4] https://www.fws.gov/sacramento/es_species/Accounts/Invertebrates/valley_elderberry_longhorn_beetle/

[5] https://plants.usda.gov (Platanus racemosa)

[6] https://www.habitatmatters.org/narrow-leaf-cattail.html)

[7] NASb Spring 2019 DTW

[8] https://wildlife.ca.gov/Data/CNDDB/Maps-and-Data - RareFind 5

[9] https://gis.water.ca.gov/app/NCDatasetViewer/

This page intentionally left blank

Table O-2. Groundwater Contouring Monitoring Well Construction Details

CASGEM SITE_CODE	LATITUDE	LONGITUDE	CommonName	MSMT_DATE	WSE	WLM_ORG_NAME	Screened Interval (ft bgs)	Total Depth (ft bgs)
388893N1212847W001	38.889283	-121.28468	MW 4	4/15/2020 7:57	162.28	Sacramento Groundwater Authority	15-25	25
389774N1213728W001	38.977408	-121.372844	MW-3	4/15/2020 8:56	76.69	Placer County	19.5-34.5	35
387515N1212725W001	38.751494	-121.272511	WPMW-10A	4/15/2020 12:05	137.21	City of Roseville	26-36	36
387517N1212727W001	38.751667	-121.272656	WPMW-9A	4/15/2020 12:05	140.66	City of Roseville	26-36	36
389785N1213713W001	38.97846	-121.37132	MW-1	4/15/2020 8:36	77.47	Placer County	30-40	40
389764N1213710W001	38.976427	-121.371001	MW-2	4/15/2020 8:42	77.17	Placer County	24.3-44.3	45
	38.639539	-121.561543	URS71000-700+00F	3/19/2020 9:30	6.53	Sacramento Groundwater Authority	Unknown	45
	38.639704	-121.562435	URS71000-700+00C	3/19/2020 9:15	7.47	Sacramento Groundwater Authority	Unknown	45
	38.774911	-121.597535	SREL-1-27-F1	3/19/2020 8:00	14.06	Sacramento Groundwater Authority	Unknown	46
389950N1214148W002	38.994987	-121.414793	RDMW-103	3/19/2020 12:00	68.09	Placer County	28-43	48
389919N1214141W002	38.991944	-121.414066	RDMW-104	3/19/2020 12:00	67.2	Placer County	28-43	48
386160N1215054W001	38.61603	-121.5054	Bannon Creek Park	4/8/2020 9:54	1.66	Sacramento Groundwater Authority	33-48	48
389857N1214880W004	38.9857	-121.488	BR-1A	3/11/2020 11:05	47.25	Yuba County Water Agency	28-48	48
	38.882937	-121.611051	RDMW-101	3/19/2020	19.65	Sutter County	28-43	48
	38.879869	-121.588533	RDMW-102	3/19/2020	19.43	Sutter County	28-43	48
387510N1212390W001	38.750989	-121.23895	WPMW-8A	4/15/2020 12:52	203.57	City of Roseville	30-50	50
386292N1214877W001	38.62921	-121.4877	Chuckwagon Park	4/8/2020 10:11	-7.19	Sacramento Groundwater Authority	27-37	52
388476N1212872W001	38.847609	-121.28719	WPMW-3A	4/15/2020 10:13	147.57	City of Roseville	48-53	53
388826N1213078W002	38.882583	-121.30775	MW 5-2	4/15/2020 8:19	110.51	City of Lincoln	52-62	62
385841N1214185W001	38.58414	-121.41852	SGA_MW04	4/8/2020 9:11	2.59	Sacramento Groundwater Authority	55-65	65
385841N1214185W001	38.58414	-121.41852	SGA_MW04	4/8/2020 9:11	2.59	Sacramento Groundwater Authority	55-65	65
385828N1213385W001	38.58281	-121.33846	SGA_MW06	4/8/2020 8:36	12.59	Sacramento Groundwater Authority	62-72	72
388971N1213301W002	38.897133	-121.330083	MW 3-2	4/15/2020 7:46	77.25	City of Lincoln	65-75	75
389669N1214897W001	38.9669	-121.4897	13N04E23A002M	3/2/2020 0:00	45.28	Department of Water Resources	Unknown	83
389255N1213566W003	38.925467	-121.356633	MW 2-3	4/15/2020 7:19	95.19	City of Lincoln	75-85	85
388604N1213544W004	38.860383	-121.354383	MW 1-4	4/15/2020 10:00	58.17	City of Lincoln	82-92	92
389185N1213268W001	38.918461	-121.326842	Swainson	4/15/2020 9:58	112.59	Placer County	44.1-91.9	92
389867N1213654W002	38.9867	-121.365	Spencer	4/15/2020 9:36	84.66	Placer County	96-107	107
387218N1214677W001	38.72178	-121.46771	SGA_MW01	4/8/2020 10:52	-15.66	Sacramento Groundwater Authority	100-110	110
386836N1214536W001	38.68362	-121.45363	SGA_MW02	4/8/2020 10:40	-13.36	Sacramento Groundwater Authority	100-110	110
389740N1213606W001	38.974027	-121.360615	Cemetery	4/15/2020 9:17	78.66	Placer County	70-111	111
387786N1213737W001	38.778603	-121.373698	WPMW-1A	4/15/2020 9:27	-0.07	City of Roseville	110-120	120
388260N1215394W004	38.826	-121.5394	SUT-P1	3/10/2020 10:49	19.23	Sutter County	110-120	120
387626N1213651W001	38.762629	-121.365099	SVMW East-2A	4/15/2020 9:44	2.02	City of Roseville	125-135	140
387000N1212180W001	38.69998	-121.21795	SGA_MW08	4/8/2020 14:17	107.21	Sacramento Groundwater Authority	130-140	140
387623N1213915W001	38.762324	-121.39153	SVMW West - 1A	4/15/2020 8:36	-12.35	City of Roseville	120-140	145
388235N1216079W001	38.823235	-121.60763	Sutter County MW-5A	4/23/2020 8:20	17.15	Department of Water Resources	130-160	160
386874N1212206W001	38.68739	-121.22058	SGA_MW09	4/8/2020 14:26	109.92	Sacramento Groundwater Authority	150-160	160
388882N1214005W002	38.888164	-121.400463	WPMW-11A	4/15/2020 7:31	22.47	Placer County	132-152	162
387216N1213842W001	38.72163	-121.38417	Lone Oak Park	4/8/2020 11:12	-10.53	Sacramento Groundwater Authority	151-161	166
386280N1213493W001	38.628	-121.349	WCMSS	4/8/2020 8:15	-15.26	Sacramento Groundwater Authority	130-150	170
388116N1213054W001	38.811594	-121.305387	Tinker MW	4/15/2020 9:40	61.14	City of Roseville	117-177	177
389116N1215238W003	38.9116	-121.5238	AB-1 shallow	3/11/2020 11:45	34.32	Department of Water Resources	170-180	190
386964N1213120W001	38.6964	-121.31203	Twin Creeks Park	4/8/2020 13:37	-6.4	Sacramento Groundwater Authority	183-193	193
386547N1215320W001	38.6547	-121.532	386547N1215320W001	3/2/2020 0:00	4.21	Department of Water Resources	140-200	200
389791N1213727W001	38.979133	-121.372694	Old Well #2	4/15/2020 8:24	78.3	Placer County	144-209	209
386635N1213486W001	38.66347	-121.34859	SGA_MW05	4/8/2020 12:01	-13.68	Sacramento Groundwater Authority	205-215	215
388145N1213491W001	38.814497	-121.349144	WPMW-2A	4/15/2020 10:15	29.25	City of Roseville	215-225	225
387222N1212920W001	38.7222	-121.292	Whyte A	4/8/2020 13:21	10.21	Sacramento Groundwater Authority	200-220	226
386016N1213761W001	38.6016	-121.3761	DWR_SGA_004	3/5/2020 0:00	-19.10	Department of Water Resources	Unknown	238
388406N1215627W001	38.840601	-121.562699	S&O #17	4/25/2020 0:00	18.17	Sutter County	152-240	240
386038N1214357W001	38.6038	-121.4357	DWR_SGA_005	3/5/2020 0:00	-21.86	Department of Water Resources	Unknown	250
387511N1213389W001	38.7511	-121.3389		3/4/2020 0:00	5.02	Department of Water Resources	150-256	256
386310N1213864W001	38.63101	-121.38641	Well 10	4/28/2020 9:00	-25.91	Sacramento Groundwater Authority	210-262	265
386038N1213882W002	38.6038	-121.38815	MW11B	4/3/2020 12:30	-20.09	Sacramento Groundwater Authority	258-268	278
387957N1213813W001	38.795655	-121.38126	CVMW-1A	4/15/2020 9:14	1.61	City of Roseville	260-280	285
385947N1213985W001	38.59472	-121.39847	WPMW12A	4/3/2020 9:20	-16.3	Sacramento Groundwater Authority	260-280	300
388029N1214145W001	38.8029	-121.4145		3/4/2020 0:00	-10.04	Department of Water Resources	135-460	460
389292N1214056W001	38.9292	-121.4056		3/2/2020 0:00	50.50	Department of Water Resources	NA	NA
388667N1214513W001	38.8667	-121.4513	12N05E29D001M	3/4/2020 0:00	8.52	Department of Water Resources	NA	NA
387859N1216565W001	38.7859	-121.6565	RD 1500 Karnak	3/10/2020 0:00	17.03	Department of Water Resources	Unknown	Unknown

Appendix P: Groundwater Model Documentation

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX P
CoSANA Groundwater Model Documentation

December 2021

CoSANA

An Integrated Water Resources Model of the Cosumnes, South American, and North American Groundwater Subbasins

NOVEMBER 2021













WOODARD &CURRAN

CoSANA:
An Integrated Water Resources Model
of the
Cosumnes, South American, and North American
Groundwater Subbasins

November 2021

801 T Street
Sacramento, CA 95811
916.999-8700

woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD &CURRAN

TABLE OF CONTENTS

SECTION **PAGE NO.**

EXECUTIVE SUMMARY **ES-1**

1. INTRODUCTION **1-1**

1.1 Goals of Model Development 1-1
1.2 Cosumnes, South American, and North American Subbasins 1-2
1.3 Collaborative and Open Environment 1-6
1.4 Model Platform and Historical Modeling of the Region 1-6
1.5 Report Organization 1-8

2. MODEL DEVELOPMENT **2-1**

2.1 Model Input Data 2-1
2.2 Simulation Period and Temporal Discretization 2-2
2.3 Model Grid and Subregions 2-2
2.4 Stream Configuration and Inflow 2-10
2.5 Surface Drainage Pattern 2-15
2.6 Precipitation 2-17
2.7 Land Use and Cropping Patterns 2-19
2.8 Evapotranspiration 2-29
2.9 Root Zone Soil Parameters 2-31
2.10 Geologic Structure and Model Layering 2-33
2.10.1 Model Layer Development and Approach 2-33
2.10.2 Model Layer Definition 2-34
2.11 Tributary Watersheds 2-45
2.12 Boundary Conditions 2-46
2.12.1 General Head 2-46
2.12.2 Small Watersheds 2-46
2.12.3 Constrained Head 2-46
2.13 Initial Conditions 2-46

3. WATER SUPPLY AND DEMAND DATA **3-1**

3.1 Water Supply 3-1
3.1.1 Surface Water Supply 3-1
3.1.2 Groundwater Pumping 3-5
3.2 Urban Water Demand and Supply 3-5
3.2.1 North American Subbasin 3-7
3.2.1.1 California American Water Company (Antelope) 3-7
3.2.1.2 California American Water Company (Arden) 3-7
3.2.1.3 California American Water Company (Lincoln Oaks) 3-7
3.2.1.4 California American Water Company (West Placer) 3-7
3.2.1.5 Carmichael Water District 3-7
3.2.1.6 Citrus Heights Water District 3-7
3.2.1.7 Del Paso Manor Water District 3-7
3.2.1.8 Fair Oaks Water District 3-7
3.2.1.9 Golden State Water Company (Arden) 3-8
3.2.1.10 City of Lincoln 3-8
3.2.1.11 Orange Vale Water Company 3-8
3.2.1.12 Placer County Water Agency (City of Rocklin Retail Service Area) 3-8

3.2.1.13 Rio Linda / Elverta Community Water District....3-8
3.2.1.14 City of Roseville....3-8
3.2.1.15 Sacramento Suburban Water District....3-8
3.2.1.16 City of Sacramento....3-8
3.2.1.17 Sacramento International Airport....3-9
3.2.1.18 San Juan Water District....3-9
3.2.1.19 Sacramento County Water Agency (Arden Park Vista)....3-9
3.2.1.20 Sacramento County Water Agency (Northgate)....3-9
3.2.2 South American Subbasin....3-9
3.2.2.1 California American Water Company (Fruitridge - formerly Fruitridge Vista Water Company)....3-9
3.2.2.2 California American Water Company (Parkway)....3-9
3.2.2.3 California American Water Company (Security Park)....3-9
3.2.2.4 California American Water Company (Suburban Rosemont)....3-9
3.2.2.5 Elk Grove Water District (Service Area 1)....3-10
3.2.2.6 Florin County Water District....3-10
3.2.2.7 City of Folsom....3-10
3.2.2.8 Golden State Water Company (Cordova)....3-10
3.2.2.9 Rancho Murieta Community Service District....3-10
3.2.2.10 City of Sacramento....3-10
3.2.2.11 Sacramento County Water Agency (Hood)....3-10
3.2.2.12 Sacramento County Water Agency (Laguna Vineyard)....3-10
3.2.2.13 Sacramento County Water Agency (Mather)....3-10
3.2.3 Cosumnes Subbasin....3-10
3.2.3.1 Amador County Water Agency (Camanche Village)....3-11
3.2.3.2 Amador County Water Agency (Ione)....3-11
3.2.3.3 City of Galt....3-11
3.2.3.4 Rancho Murieta Community Service District....3-11
3.2.4 Fish Farms....3-11
3.2.5 Galt Wastewater Treatment Plant Effluent....3-11
3.3 Agricultural Water Demand and Supply....3-11
3.3.1 Rural-Residential Pumping....3-12
3.3.2 Agricultural Pumping....3-12
3.3.3 Agricultural Groundwater Substitution Transfers....3-12
3.4 Remediation Pumping....3-15

4. MODEL CALIBRATION AND SENSITIVITY ANALYSIS....4-1

4.1 Calibration Goals....4-1
4.2 Calibration Process....4-2
4.2.1 Water Budget Calibration....4-3
4.2.1.1 Land and Water Use Budget....4-3
4.2.1.2 Groundwater Budget....4-13
4.2.2 Groundwater Level Calibration....4-16
4.2.3 Streamflow Calibration....4-36
4.2.4 Small Watershed Calibration....4-42
4.3 Calibration Statistics and Goodness of Fit....4-42
4.4 Final Calibration Parameters....4-44
4.5 Model Features, Strengths, and Limitations....4-50
4.5.1 Spatial Extent and Resolution....4-50
4.5.2 Temporal Scale....4-50
4.5.3 Geology and Hydrogeology....4-50

4.5.4 Land Use Data 4-50
4.5.5 Water Demand Estimates 4-50
4.5.6 Water Supply Data 4-51
4.5.7 Groundwater Pumping Estimates 4-51
4.5.8 Water Budgets 4-51
4.5.9 Groundwater Flow and Levels 4-51
4.5.10 Streamflows 4-52
4.6 Modeling Uncertainties 4-52
4.6.1 Structural Uncertainties 4-52
4.6.2 Data Uncertainties 4-53
4.6.3 Calibration Uncertainties 4-53
4.6.4 Application Uncertainties 4-53
4.7 Sensitivity Analysis 4-54
4.7.1 Metrics of the Sensitivity Analysis 4-54
4.7.2 Results of the Sensitivity Analysis 4-54

5. BASELINE CONDITIONS 5-1

5.1 Current Conditions Baseline 5-1
5.1.1 Hydrology 5-1
5.1.1.1 Precipitation 5-1
5.1.1.2 Evapotranspiration 5-2
5.1.1.3 Stream Inflow 5-2
5.1.1.4 Hydrologic Year Types 5-2
5.1.2 Initial Conditions 5-3
5.1.3 Boundary Conditions 5-5
5.1.4 Land Use 5-5
5.1.5 Urban Demand and Supply 5-11
5.1.5.1 North American Subbasin 5-11
5.1.5.2 South American Subbasin 5-12
5.1.5.3 Cosumnes Subbasin 5-12
5.1.5.4 Fish Farms 5-12
5.1.6 Agricultural Demand and Supply 5-13
5.1.6.1 Rural-Residential Pumping 5-13
5.1.6.2 Galt Wastewater Treatment Plant Effluent 5-13
5.1.6.3 Agricultural Groundwater Substitution Transfers 5-13
5.1.7 Remediation Operations 5-13
5.1.8 Results 5-13
5.1.8.1 Land and Water Use Budget 5-14
5.1.8.2 Groundwater Budget 5-17
5.2 Projected Conditions Baseline 5-19
5.2.1 Hydrologic Period 5-19
5.2.2 Land Use 5-19
5.2.3 Urban Demand and Supply 5-27
5.2.3.1 North American Subbasin 5-27
5.2.3.2 South American Subbasin 5-31
5.2.3.3 Cosumnes Subbasin 5-33
5.2.3.4 Fish Farms 5-33
5.2.4 Agricultural Demand and Supply 5-34
5.2.4.1 Galt Wastewater Treatment Plant Effluent 5-34
5.2.4.2 Rural Residential 5-34
5.2.4.3 Agricultural Groundwater Substitution Transfers 5-34

5.2.5 Remediation Operations 5-34
5.2.6 Results 5-34
5.2.6.1 Land and Water Use Budget 5-34
5.2.6.2 Groundwater Budget 5-38
5.3 Projected Conditions Baseline with Climate Change 5-40
5.3.1 Hydrologic Period 5-40
5.3.1.1 Methodology 5-40
5.3.1.2 Precipitation 5-41
5.3.1.3 Stream Inflow 5-45
5.3.1.4 Evapotranspiration 5-47
5.3.2 Land Use 5-48
5.3.3 Urban Demand and Supply 5-48
5.3.4 Agricultural Demand and Supply 5-48
5.3.5 Remediation Operations 5-48
5.3.6 Results 5-49
5.3.6.1 Land and Water Use Budget 5-49
5.3.6.2 Groundwater Budget 5-51
5.3.7 Sensitivity Analysis: Hot-Dry Scenario 5-53
6. SUMMARY AND RECOMMENDATIONS 6-1
6.1 Summary 6-1
6.2 Recommendations 6-1
7. REFERENCES 7-1

TABLES

Table 1-1: Groundwater Sustainability Agencies by Subbasin 1-2
Table 1-2: SacIWRM History and Application 1-7
Table 2-1: CoSANA Input Data 2-1
Table 2-2: CoSANA Subregions 2-4
Table 2-3: CoSANA Streams and Tiers 2-11
Table 2-4: Stream Inflows 2-13
Table 2-5: Land Use Categories 2-20
Table 2-6: Sources of Data for Land Use Coverages 2-21
Table 3-1: Summary of CoSANA Well Pumping by Urban Purveyor 3-5
Table 3-2: Summary of Agricultural Groundwater Substitution Transfer Pumping 3-15
Table 3-3: Summary of CoSANA Remediation Operations: 3-15
Table 4-1: Land and Water Use Budget Demand and Supply Mix (Average Annual for the Period WY 1995-2018) 4-9
Table 4-2: Summary of CoSANA Groundwater Budget (Average Annual for the Period WY 1995-2018) 4-14
Table 4-3: Summary of CoSANA Stream Calibration Gages 4-37
Table 4-4: Range of Aquifer Parameter Values 4-44
Table 5-1: Hydrologic Water Year Types 5-3
Table 5-2: CCBL Average Annual Land and Water Use Budget 5-14
Table 5-3: CCBL Average Annual Groundwater Budget 5-17
Table 5-4: Proposed New Developments 5-21
Table 5-5: PCBL Average Annual Land and Water Use Budget 5-35
Table 5-6: PCBL Average Annual Groundwater Budget 5-38
Table 5-7: Percent Change in Annual Climatic and Hydrologic Indicators in the American River Basin Study* 5-41
Table 5-8: PCBL with Climate Change Average Annual Land and Water Use Budget 5-49
Table 5-9: PCBL with Climate Change Average Annual Groundwater Budget 5-51

Table 5-10: Comparison Groundwater Budgets of CoSANA Climate Change Models to the Projected Conditions Baseline 5-53

FIGURES

Figure 1-1: Model Area and Groundwater Subbasin Boundaries 1-3
Figure 1-2: Major Water Purveyors 1-4
Figure 1-3: Groundwater Sustainability Agencies 1-5
Figure 2-1: Features Used to Create Model Grid 2-3
Figure 2-2: CoSANA Model Grid 2-7
Figure 2-3: Alignment with Neighboring Model Grids 2-8
Figure 2-4: CoSANA Subregions 2-9
Figure 2-5: CoSANA Streams 2-12
Figure 2-6: CoSANA Stream Inflow Gage Locations 2-14
Figure 2-7: CoSANA Drainage Network 2-16
Figure 2-8: CoSANA Average Annual Precipitation 2-18
Figure 2-9: CoSANA Average Annual Precipitation with Statistics 2-19
Figure 2-10: 1995 Land Use Coverage 2-22
Figure 2-11: 2005 Land Use Coverage 2-23
Figure 2-12: 2015 Land Use Coverage 2-24
Figure 2-13: Annual Land Use for CoSANA 2-25
Figure 2-14: Annual Land Use for North American Subbasin 2-26
Figure 2-15: Annual Land Use for South American Subbasin 2-27
Figure 2-16: Annual Land Use for Cosumnes Subbasin 2-28
Figure 2-17: Average Monthly Evapotranspiration by Land Use Type, Major Field and Row Crops 2-30
Figure 2-18: Average Monthly Evapotranspiration by Land Use Type, Orchards and Vineyards 2-30
Figure 2-19: Average Monthly Evapotranspiration by Land Use Type, Urban, Native, and Riparian 2-31
Figure 2-20: USDA Hydrologic Soil Groups 2-32
Figure 2-21: Thickness of Layer 1 2-35
Figure 2-22: Thickness of Layer 2 2-36
Figure 2-23: Thickness of Layer 3 2-37
Figure 2-24: Thickness of Layer 4 2-38
Figure 2-25: Thickness of Layer 5 2-39
Figure 2-26: CoSANA Cross Sections 2-40
Figure 2-27: CoSANA Cross Section A-A' 2-41
Figure 2-28: CoSANA Cross Section B-B' 2-41
Figure 2-29: CoSANA Cross Section C-C' 2-41
Figure 2-30: CoSANA Cross Section D-D' 2-42
Figure 2-31: CoSANA Cross Section E-E' 2-42
Figure 2-32: CoSANA Cross Section F-F' 2-42
Figure 2-33: CoSANA Cross Section G-G' 2-43
Figure 2-34: CoSANA Cross Section H-H' 2-43
Figure 2-35: CoSANA Cross Section I-I' 2-43
Figure 2-36: CoSANA Cross Section J-J' 2-44
Figure 2-37: CoSANA Cross Section K-K' 2-44
Figure 2-38: CoSANA Cross Section L-L' 2-44
Figure 2-39: Tributary Watersheds 2-45
Figure 2-40: Initial Conditions, Groundwater Heads, Fall 1989 2-47
Figure 3-1: CoSANA NASb Surface Water Delivery Schematic 3-2
Figure 3-2: CoSANA SASb Surface Water Delivery Schematic 3-3
Figure 3-3: CoSANA CoSb Surface Water Delivery Schematic 3-4

Figure 3-4: Locations of Urban Groundwater Production Wells 3-6
Figure 3-5: Locations of Agricultural Groundwater Substitution Transfer Pumping Wells 3-14
Figure 3-6: Locations of Remediation Pumping Wells 3-16
Figure 4-1: CoSANA Calibration Process 4-2
Figure 4-2: CoSANA Field Capacity 4-4
Figure 4-3: CoSANA Wilting Point 4-5
Figure 4-4: CoSANA Total Porosity 4-6
Figure 4-5: CoSANA Saturated Soil Hydraulic Conductivity 4-7
Figure 4-6: CoSANA Ponded Crop Saturated Soil Hydraulic Conductivity 4-8
Figure 4-7: CoSANA Agricultural Land and Water Use Budget 4-9
Figure 4-8: NASb Agricultural Land and Water Use Budget 4-10
Figure 4-9: SASb Agricultural Land and Water Use Budget 4-10
Figure 4-10: CoSb Agricultural Land and Water Use Budget 4-11
Figure 4-11: CoSANA Model Urban Land and Water Use Budget 4-11
Figure 4-12: NASb Urban Land and Water Use Budget 4-12
Figure 4-13: SASb Urban Land and Water Use Budget 4-12
Figure 4-14: CoSb Urban Land and Water Use Budget 4-13
Figure 4-15: CoSANA Groundwater Budget 4-14
Figure 4-16: NASb Groundwater Budget 4-15
Figure 4-17: SASb Groundwater Budget 4-15
Figure 4-18: CoSb Groundwater Budget 4-16
Figure 4-19: Number of Observations for Calibration Wells 4-17
Figure 4-20: Period of Record for Calibration Wells 4-18
Figure 4-21: CoSANA Groundwater Level Contours – Spring 1998 (End of Wet Period) 4-20
Figure 4-22: CoSANA Groundwater Level Contours – Fall 2015 (End of Drought Period) 4-21
Figure 4-23: CoSANA Groundwater Level Contours – Fall 2018 (End of Simulation) 4-22
Figure 4-24: Location of Sample Hydrographs 4-23
Figure 4-25: CoSANA Groundwater Level Hydrograph – Hydrograph #1 4-24
Figure 4-26: CoSANA Groundwater Level Hydrograph – Hydrograph #2 4-24
Figure 4-27: CoSANA Groundwater Level Hydrograph – Hydrograph #3 4-25
Figure 4-28: CoSANA Groundwater Level Hydrograph – Hydrograph #4 4-25
Figure 4-29: CoSANA Groundwater Level Hydrograph – Hydrograph #5 4-26
Figure 4-30: CoSANA Groundwater Level Hydrograph – Hydrograph #6 4-26
Figure 4-31: CoSANA Groundwater Level Hydrograph – Hydrograph #7 4-27
Figure 4-32: CoSANA Groundwater Level Hydrograph – Hydrograph #8 4-27
Figure 4-33: CoSANA Groundwater Level Hydrograph – Hydrograph #9 4-28
Figure 4-34: CoSANA Groundwater Level Hydrograph – Hydrograph #10 4-28
Figure 4-35: CoSANA Groundwater Level Hydrograph – Hydrograph #11 4-29
Figure 4-36: CoSANA Groundwater Level Hydrograph – Hydrograph #12 4-29
Figure 4-37: CoSANA Groundwater Level Hydrograph – Hydrograph #13 4-30
Figure 4-38: CoSANA Groundwater Level Hydrograph – Hydrograph #14 4-30
Figure 4-39: CoSANA Groundwater Level Hydrograph – Hydrograph #15 4-31
Figure 4-40: CoSANA Groundwater Level Hydrograph – Hydrograph #16 4-31
Figure 4-41: CoSANA Groundwater Level Hydrograph – Hydrograph #17 4-32
Figure 4-42: CoSANA Groundwater Level Hydrograph – Hydrograph #18 4-32
Figure 4-43: CoSANA Groundwater Level Hydrograph – Hydrograph #19 4-33
Figure 4-44: CoSANA Groundwater Level Hydrograph – Hydrograph #20 4-33
Figure 4-45: CoSANA Groundwater Level Hydrograph – Hydrograph #21 4-34
Figure 4-46: CoSANA Groundwater Level Hydrograph – Hydrograph #22 4-34
Figure 4-47: CoSANA Groundwater Level Hydrograph – Hydrograph #23 4-35
Figure 4-48: CoSANA Groundwater Level Hydrograph – Hydrograph #24 4-35

Figure 4-49: CoSANA Groundwater Level Hydrograph – Hydrograph #25 4-36
Figure 4-50: Stream Gage Locations 4-38
Figure 4-51: CoSANA Streambed Hydraulic Conductivity 4-39
Figure 4-52: Streamflow Hydrograph for Sacramento River at Freeport, Simulated and Observed 4-40
Figure 4-53: Sacramento River at Freeport Streamflow Exceedance, Simulated and Observed 4-40
Figure 4-54: Stage for Cosumnes River at McConnell, Simulated and Observed 4-41
Figure 4-55: Cosumnes River at McConnell Stage Exceedance, Simulated and Observed 4-41
Figure 4-56: Residual histogram for the CoSANA Model 4-43
Figure 4-57: Scatter Plot of CoSANA Simulated versus Observed Values 4-43
Figure 4-58: Distribution of CoSANA Layer 1 Horizontal Hydraulic Conductivity (K_H) 4-45
Figure 4-59: Distribution of CoSANA Layer 2 Horizontal Hydraulic Conductivity (K_H) 4-46
Figure 4-60: Distribution of CoSANA Layer 3 Horizontal Hydraulic Conductivity (K_H) 4-47
Figure 4-61: Distribution of CoSANA Layer 4 Horizontal Hydraulic Conductivity (K_H) 4-48
Figure 4-62: Distribution of CoSANA Layer 5 Horizontal Hydraulic Conductivity (K_H) 4-49
Figure 4-63: Sensitivity of Groundwater Level Residual Statistics in NASb 4-55
Figure 4-64: Sensitivity of Groundwater Level Residual Statistics in SASb 4-55
Figure 4-65: Sensitivity of Groundwater Level Residual Statistics in CoSb 4-56
Figure 5-1: 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation 5-2
Figure 5-2: Initial Groundwater Levels for CoSANA Baseline Models 5-4
Figure 5-3: Current Conditions Baseline Land Use 5-6
Figure 5-4: Current Conditions Baseline Land Use for CoSANA 5-7
Figure 5-5: Current Conditions Baseline Land Use for North American Subbasin 5-8
Figure 5-6: Current Conditions Baseline Land Use for South American Subbasin 5-9
Figure 5-7: Current Conditions Baseline Land Use for Cosumnes Subbasin 5-10
Figure 5-8: Annual Agricultural Water Demand and Supply – North American Subbasin, Current Conditions Baseline 5-14
Figure 5-9: Annual Agricultural Water Demand and Supply – South American Subbasin, Current Conditions Baseline 5-15
Figure 5-10: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Current Conditions Baseline 5-15
Figure 5-11: Annual Urban Water Demand and Supply – North American Subbasin, Current Conditions Baseline 5-16
Figure 5-12: Annual Urban Water Demand and Supply – South American Subbasin, Current Conditions Baseline 5-16
Figure 5-13: Annual Urban Water Demand and Supply – Cosumnes Subbasin, Current Conditions Baseline 5-17
Figure 5-14: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Current Conditions Baseline 5-18
Figure 5-15: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Current Conditions Baseline 5-18
Figure 5-16: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Current Conditions Baseline 5-19
Figure 5-17: Projected Land Use and Proposed New Developments 5-22
Figure 5-18: Projected Conditions Baseline Land Use for CoSANA 5-23
Figure 5-19: Projected Conditions Baseline Land Use for North American Subbasin 5-24
Figure 5-20: Projected Conditions Baseline Land Use for South American Subbasin 5-25
Figure 5-21: Projected Conditions Baseline Land Use for Cosumnes Subbasin 5-26
Figure 5-22: Annual Agricultural Water Demand and Supply – North American Subbasin, Projected Conditions Baseline 5-35
Figure 5-23: Annual Agricultural Water Demand and Supply – South American Subbasin, Projected Conditions Baseline 5-36
Figure 5-24: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline 5-36
Figure 5-25: Annual Urban Water Demand and Supply – North American Subbasin, Projected Conditions Baseline 5-37

Figure 5-26: Annual Urban Water Demand and Supply – South American Subbasin, Projected Conditions Baseline.... 5-37
Figure 5-27: Annual Urban Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline 5-38
Figure 5-28: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Projected Conditions Baseline 5-39
Figure 5-29: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Projected Conditions Baseline 5-39
Figure 5-30: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Projected Conditions Baseline 5-40
Figure 5-31: Annual Precipitation with and without Climate Change 5-43
Figure 5-32: Average Monthly Precipitation with and without Climate Change 5-44
Figure 5-33: Annual Folsom Reservoir Releases to American River with and without Climate Change 5-45
Figure 5-34: Monthly Average Folsom Reservoir Releases to American River 5-46
Figure 5-35: Exceedance Chart for the Monthly Folsom Reservoir Releases to American River 5-46
Figure 5-36: Annual Potential Evapotranspiration for Pasture 5-47
Figure 5-37: Monthly Average Potential Evapotranspiration for Pasture 5-48
Figure 5-38: Annual Agricultural Water Demand and Supply – North American Subbasin, Projected Conditions Baseline with Climate Change 5-49
Figure 5-39: Annual Agricultural Water Demand and Supply – South American Subbasin, Projected Conditions Baseline with Climate Change 5-50
Figure 5-40: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline with Climate Change 5-50
Figure 5-41: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Projected Conditions Baseline with Climate Change 5-51
Figure 5-42: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Projected Conditions Baseline with Climate Change 5-52
Figure 5-43: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Projected Conditions Baseline with Climate Change 5-52

APPENDICES

Appendix A: Model Surface Water Deliveries
Appendix B: Remediation Pumping by Entity
Appendix C: Subregion Land and Water Use Budgets
Appendix D: Stream Reach Budgets
Appendix E: Subregion Groundwater Budgets
Appendix F: Calibration Hydrographs
Appendix G: Baseline Conditions Demand and Supply Tables
Appendix H: Baseline Conditions Land and Water Use Budgets
Appendix I: Baseline Conditions Groundwater Budgets
Appendix J: Baseline Conditions Sample Hydrographs

ABBREVIATIONS

2070CT	2070 Central Tendency
2070HD	2070 Hot and Dry
AFY	acre-feet per year
ARBS	American River Basin Study
ASR	aquifer storage and recovery
ASTM	American Standard Testing Method
AWMP	Agricultural Water Management Plan
C2VSimFG	California Central Valley Groundwater-Surface Water Simulation Model
Cal Am	California American Water Company
CalSIMETAW	California Simulation of Evapotranspiration of Applied Water
CASGEM	California Statewide Groundwater Elevation Monitoring
CDEC	California Data Exchange Center
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CoSANA	Cosumnes-South American-North American Integrated Water Resources Model
CoSb	Cosumnes Subbasin
CSD	Community Services District
CWD	community water district
DEM	digital elevation model
DWR	California Department of Water Resources
ESJ	Eastern San Joaquin Groundwater Subbasin
ET	evapotranspiration
ET_o	reference ET
ET_c	crop coefficient
GSA	groundwater sustainability agency
GSP	groundwater sustainability plan
GWMP	City of Sacramento's 2017 Groundwater Master Plan
ID	irrigation district; identifier
IDC	IWFM Demand Calculator
IGSM	Integrated Groundwater and Surface Water Model
IWFM	Integrated Water Flow Model
JVID	Jackson Valley Irrigation District
METRIC	Mapping Evapotranspiration at High Resolution with Internalized Calibration
NASb	North American Subbasin
NRCS	Natural Resource Conservation Service
PCWA	Placer County Water Agency
PRISM	Precipitation-Elevation Regressions on Independent Slopes Model
Reclamation	United States Bureau of Reclamation
RMCSD	Rancho Murieta Community Services District
RMSE	root mean square error
RWA	Regional Water Authority
SacIWRM	Sacramento Area Integrated Water Resources Model
SAFCA	Sacramento Area Flood Control Agency
SASb	South American Subbasin
SCGA	Sacramento Central Groundwater Authority
SCWA	Sacramento County Water Agency
SGA	Sacramento Groundwater Authority
SGMA	Sustainable Groundwater Management Act

SMUD	Sacramento Municipal Utility District
SSCAWA	Southeast Sacramento County Agricultural Water Authority
SSURGO	Soil Survey Geographic Database
STATSGO2	Digital General Soil Map of the United States
SVSim	Sacramento Valley Groundwater-Surface Water Simulation Model
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WA	water agency
WC	water company
WD	water district
WDL	Water Data Library
WY	water year
YGM	Yuba Groundwater Model

ACKNOWLEDGEMENTS

The Cosumnes-South American-North American Integrated Water Resources Model (CoSANA) was developed in a collaborative effort with representatives of the North American Subbasin (NASb), South American Subbasin (SASb), and the Cosumnes Subbasin (CoSb). This collaborative approach spanning three subbasins improves the ability for local water managers and stakeholders to use CoSANA to for a range of regional planning efforts.

Funding of the CoSANA model was also a collaborative effort, with contributions from the Sacramento Groundwater Authority (SGA), Regional Water Authority (RWA), Sacramento Central Groundwater Authority (SCGA), Sacramento Area Flood Control District (SAFCA), and Southeast Sacramento County Agricultural Water Authority (SSCAWA). Contributions from SGA, SSCAWA, Sacramento Water Forum, Sacramento County, and the seven groundwater sustainability agencies (GSAs) represented by the Cosumnes Subbasin Sustainable Groundwater Management Act (SGMA) Working Group supported by grants from the California Department of Water Resources' Proposition 1, Round 2 Sustainable Groundwater Planning Grant Program

A technical committee consisting of working groups from each of the three subbasins provided technical support and quality assurance throughout the model development. Working groups included agencies and consultant teams representing the NASb, SASb, and CoSb with knowledge of the area. Participation by representatives of regional water agencies and GSA representatives, including SGA, RWA, SCGA, SAFCA, SSCAWA and the Sacramento Water Forum, allowed for incorporation of information related to stakeholders within those organizations and beyond. Further progress was shared at meetings associated with development of groundwater sustainability plans (GSPs) to gain additional input and information.

Model development was led by RWA and supported by input and efforts of many entities and their consultants, including:

- RWA/SGA
  - Rob Swartz
  - Monica Garcia
- SCGA
  - John Woodling
  - Ramon Roybal
  - Bob Gardner
- The Sacramento Water Forum
  - Tom Gohring
- SAFCA
  - Gary Bardini
- Department of Water Resources
  - Can Dogrul
  - Tyler Hatch
  - Tariq Kadir
- Each GSA within the North American, South American, and Cosumnes Subbasins and their representatives
- Many other water purveyor and remediation site representatives that provided information to better simulate their areas and operations.

Woodard & Curran was the lead consultant for development of the CoSANA model with substantial assistance from stakeholders, subbasin representatives, and their consultants. The Woodard & Curran project team included:

- Ali Taghavi
- Jim Blanke
- Sebastien Poore
- Sara Miller
- Sevim Onsoy
- Brian Van Lienden
- Sercan Ceyhan
- Mesut Cayar

Other consultants who contributed to the model development included:

- EKI Environment and Water
  - John Fio
  - Dave Leighton
  - Christina Lucero
- GEI Consultants
  - Jonathan Goetz
  - Richard Shatz
- Larry Walker Associates
  - Laura Foglia
  - Rich Pauloo
- MBK Engineers
  - Lee Bergfeld
  - Angela Bezzone
  - Kyle Knutson

The CoSANA team is grateful for the many entities that provided assistance or data to characterize the groundwater and surface water systems in the greater Sacramento region, including many urban water purveyors, agricultural entities, environmental groups, GSA representatives, managers of contamination remediation operations, project proponents, private domestic and rural residential well owners. The team is also appreciative of the California Department of Water Resources for their assistance in implementing the CoSANA model on the Integrated Water Flow Model (IWFM) platform.

EXECUTIVE SUMMARY

CoSANA, the Cosumnes-South American-North American, Integrated Water Resources Model, is a regional integrated water resources model developed as an upgrade and enhancement of the existing Sacramento Area Integrated Water Resources Model (SacIWRM). The enhanced integrated groundwater and surface water simulation capabilities afforded by CoSANA are intended to assist in a broad range of water management activities in the Sacramento Region. CoSANA is built on the Integrated Water Flow Model (IWFM) framework, which is specifically designated in Sustainable Groundwater Management Act (SGMA) Groundwater Sustainability Plans (GSP) regulations as being supported by the California Department of Water Resources for water budget development within GSPs. The model is developed with specific features to support development of sustainable groundwater management strategies and policies and compliance with SGMA, as well as to support the planning and implementation of regional conjunctive use and water banking efforts and other water management activities.

CoSANA at a Glance

Model area: North American, South American, and Cosumnes Groundwater Subbasins

Modeling Platform: IWFM

Layering: 5 layers representing major formations to the base of fresh water

Elements: 24,171 elements with an average element area of 37 acres

Stream system: 27 simulated streams with 51 reaches

Land Use: 24 land use types, including 20 agricultural crops

Water Supply: Surface water, groundwater, and recycled water supply to agricultural and urban water purveyors

Remediation Pumping: Groundwater extraction and cleanup at 4 remediation sites

Hydrologic period: Water Years 1970-2019 on a monthly time step

Stakeholder participation was a key component in the development of CoSANA, which enabled the model development team to work in a collaborative and transparent environment and to obtain the local data necessary to develop a detailed model, gain input and insight from those most knowledgeable about the subbasins, and to gain stakeholder buy-in, which is necessary for broad regional acceptance. Outreach activities included coordination with representatives of regional water agencies and groundwater sustainability agencies, including the Regional Water Authority, Sacramento Groundwater Authority, Sacramento Central Groundwater Authority, Sacramento Area Flood Control Agency, Southeast Sacramento County Agricultural Water Authority, and the Sacramento Water Forum. Further, progress was shared at meetings associated with development of GSPs for each of the three subbasins to gain additional input and information.

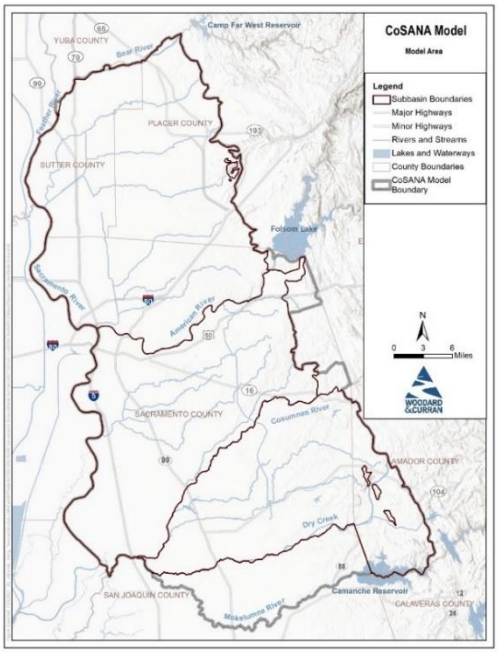


Figure ES-1: Model Area

ES.1 Model Area

The model area covers nearly 900,000 acres (approximately 1,400 square miles) and is bounded in the north by the Bear River, in the south by the Mokelumne River, in the west by the Sacramento River, and in the east by the Sierra Nevada foothills. This area includes the entirety of the North American, South American, and Cosumnes Groundwater Subbasins. Portions of the Eastern San Joaquin Subbasin are included for consistency with past efforts but are not updated or calibrated to the same level as the North American, South American, and Cosumnes Subbasins. The physical model boundaries are shown in Figure ES-1.

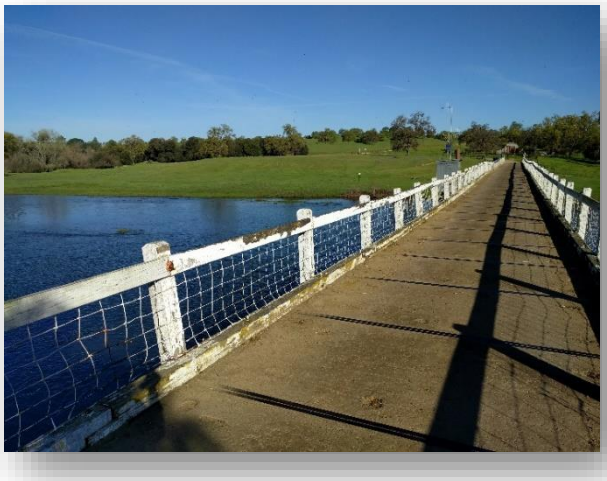
CoSANA performs calculations related to water flow by breaking down the model area into smaller areas both horizontally and with depth. This is known as discretization. Smaller areas and more layers allow for more detailed modeling, but optimal discretization is found by weighing these benefits against limitations of data availability and computational power. The CoSANA model grid contains 24,171 finite elements and 22,274 nodes with an average element area of 37 acres. The overall node spacing is 1,170 feet on average with a maximum of 2,210 feet and a minimum of 300 feet. Smaller node spacing is present near streams and near areas of significant groundwater contamination, where more accurate calculations are called for. The subsurface is characterized by five model layers representing the different geologic conditions from the ground surface to the shallower of the bedrock or base of fresh water. These layers represent:



- Layer 1: Recent alluvium and the Riverbank Formation
- Layer 2: Laguna Formation
- Layer 3 Mehrten Formation
- Layer 4: Valley Springs Formation
- Layer 5: Ione Formation

The development of CoSANA included collection and compilation of a broad range of data related to land use, water use, hydrologic conditions, and hydrogeologic conditions, including:

- Geologic stratification
- Aquifer parameters
- Stream configuration
- Stream flows
- Small watersheds
- Precipitation
- Land use
- Evapotranspiration
- Soil properties
- Population
- Per capita water use
- Groundwater pumping
- Groundwater levels
- Surface water deliveries
- Boundary conditions
- Initial conditions



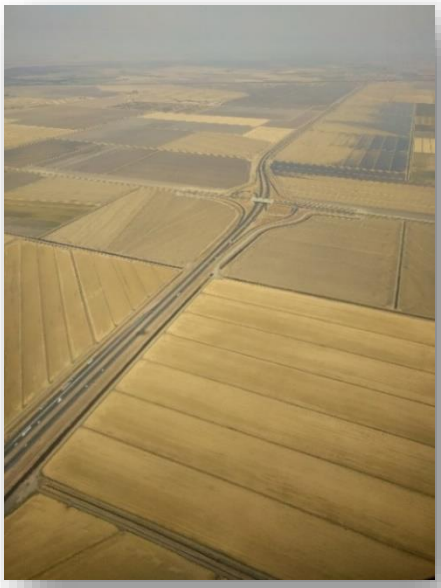
These and other datasets were developed based on local data, state databases, and federal databases and provided as input to CoSANA, on a monthly time step.

ES.2 Historical Simulation and Model Calibration

The CoSANA model simulates historical conditions in the basin for the period of water years 1970 through 2018 (October 1, 1969 through September 30, 2018). While the modeling time period begins in water year 1970, consistent with the SacIWRM, the focus of this modeling effort was water years 1990 – 2018, which includes substantially more refined data than the earlier years. Water years 1990 – 1994 are used as a warm-up period for the model, and water years 1995-2018 are used for model calibration. Additionally, the entire period of water year 1970-2018 is then used to perform a verification of the model performance over longer hydrologic period.

The simulation of historical conditions is intended to both help better understand and quantify the groundwater flow system and to calibrate the overall groundwater model. The calibration process involves comparison of simulated and observed data combined with adjustments to certain parameters. Data related to groundwater levels, streamflows, and water budgets were incorporated into the calibration process. Parameter adjustments were made within certain tolerance ranges that are reflective of the uncertainties associated with each parameter. The calibration process included both manual calibration by reviewing results and making appropriate adjustments as needed to reflect the long-term trends and short-term seasonal changes in observed data. Additionally, the PEST software package was employed to refine the calibration results by adjusting the soil, aquifer, and stream parameters within a reasonable range and distribution to achieve a better match between observed and simulated data. In this manner, the model is able to improve estimates for parameters lacking comprehensive data, such as agricultural groundwater production or certain aquifer parameters, resulting in better overall model performance.

ES.3 Baseline Simulations



Baseline simulations were developed to represent a set of pre-established hydrologic, land and water use, water demand, water supply, and basin operational conditions. In addition to providing valuable information on the groundwater flow system, these baselines can be implemented to evaluate effects of particular projects or management actions. The baselines incorporate 50 years of hydrology (water years 1970 – 2019) to meet SGMA requirements and to provide climatic variability necessary to assess future projects and management actions. Baseline simulations were developed for four different conditions:

- **Current Conditions:** The CoSANA Current Conditions Baseline (CCBL) is a representation of long-term average conditions assuming that a recent level of development and water demand persists over a long-term period of hydrologic conditions.
- **Projected Conditions:** The CoSANA Projected Conditions Baseline (PCBL) is a representation of the projected land and water use conditions of 2040, applied to the same long-term hydrologic conditions. Projected conditions are generally based on information from land use agencies and from Urban Water Management Plans or other planning documents from water purveyors.
- **Projected Conditions with Climate Change:** The CoSANA Projected Conditions Baseline with Climate Change (PCBL with Climate Change) shares many of the same inputs as the PCBL, but with additional factors to incorporate potential climate change conditions. Climate change conditions are represented through incorporation of information on 2070 Central Tendency (2070CT) conditions as documented by the US Bureau of Reclamation in the American River Basin Study (ARBS). In addition to the 2070CT, sensitivity of the model results and groundwater levels and storage was evaluated using a 2070 Hot and Dry (2070HD) climate scenario from the ARBS.

ES.4 Simulated Groundwater Conditions

Groundwater conditions associated with the historical simulation and the baseline simulations are presented in the report as contour maps, hydrographs, and water budgets. A summary-level groundwater budget for the three groundwater subbasins in the model area is presented in Table ES-1, below. This groundwater budget shows positive change in storage for the historical conditions, Current Conditions Baseline, and Projected Conditions Baseline, and a negative change in storage for the Projected Conditions with Climate Change Baseline (based on 2070CT). Generally, positive change in storage is associated with rising groundwater levels as the system seeks a new equilibrium with the surface water system and surrounding subbasins, while negative change in storage is associated with declining groundwater levels.

Table ES-1: Groundwater Budgets for the Combined North American, South American, and Cosumnes Subbasins

Model Version	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
Historical (1995–2018)	667,460	428,359	206,837	18,335	7,003*	11,302	26,702
CCBL	643,595	413,447	188,397	16,758	33,656	8,147	16,768
PCBL	685,501	396,714	230,109	16,402	36,561	8,726	2,969
PCBL+ Climate Change	726,028	377,207	261,089	16,427	40,481	11,378	-19,486

Note: all values presented in acre-feet per year (AFY)

CoSANA provides substantial detail that can allow for disaggregating these results spatially and temporally. For instance, as shown in Table ES-2, the North American Subbasin shows the most positive change in storage and the Cosumnes Subbasin shows the most negative change in storage, with values for the South American Subbasin in the middle. Similar differences exist within the subbasins as well, with areas receiving surface water and/or using little groundwater having generally more positive change in storage and groundwater levels and areas using more groundwater and/or receiving little surface water having generally more negative change in storage and groundwater levels. Groundwater conditions and model output are complex, and substantial detail is presented in the main report.

Table ES-2: Estimates of Average Change in Groundwater Storage by Subbasin

Model Version	North American Subbasin (AFY)	South American Subbasin (AFY)	Cosumnes Subbasin (AFY)	Total (AFY)
Historical (1995–2018)	26,661	5,551	-5,510	26,702
CCBL	14,843	2,158	-233	16,768
PCBL	5,390	-1,128	-1,293	2,969
PCBL+ Climate Change	-3,502	-6,222	-9,762	-19,486

ES.5 Recommendations

Like the SacIWRM before it, the CoSANA model is intended to be a living model, with refinements and updates occurring over time to meet the changing needs of the region and to incorporate the latest conditions, data, and modeling platforms. During the development of the model, several items were identified for future refinements to improve the capability of CoSANA to be a long-term defensible and reliable water resources model for the area, as listed below with additional detail in the main report.

- Continue collaboration and engagement with local GSAs, water purveyors, groundwater users, and water managers
- Collaborate with DWR
- Develop a model update schedule
- Enhance representation of variability of potential evapotranspiration
- Map Soil Survey Geographic Database (SSURGO) rootzone parameters directly to CoSANA
- Refine surface water deliveries in the North American and South American Subbasins
- Improve inflow estimates for tributary streams
- Improve return flow routing within IFWM and CoSANA
- Improve data and simulation of Auburn Ravine flows
- Develop improved rating tables for major streams
- Improve simulation of complex water systems
- Improve data for Mather AFB remediation operations
- Improve model information and data sets on the eastern areas

ES.6 Summary

The CoSANA model is built upon the previous SacIWRM by migrating to the IWFM platform, providing finer resolution spatially and with depth, and by refining and extending the data incorporated into the model. CoSANA provides a robust, comprehensive, defensible model for assessing water resources conditions in the Sacramento Region through integrated modeling of land surface, groundwater, and surface water conditions using detailed local and regional data and the most widely accepted modeling platform. This includes simulation under historical, current, projected, and projected with climate change conditions. The tool is well calibrated and ready to be used in various water supply and management studies and is flexible enough to be updated and refined to meet future needs of the region, including implementation of sustainable groundwater management strategies, regional water accounting and allocation frameworks, evaluation of well protection plans and programs, and regional conjunctive use and projects assessments, including the regional water bank.



1. INTRODUCTION

The North American, South American, and Cosumnes Groundwater Subbasins are simulated under a unified model to provide a regional integrated water resources model suitable for a variety of regional water management needs. With a comprehensive long-term hydrologic period, robust and accurate water supply and use data for urban water purveyors, land use and cropping patterns based on the latest statewide and regional land use surveys, geologic and hydrogeologic information based on the statewide numerical and texture models, and surface water hydrologic data, The Cosumnes-South American-North American Integrated Water Resource Model, or CoSANA, is a comprehensive integrated water resources model to serve the North and South American and Cosumnes groundwater subbasins. CoSANA incorporates all relevant data from the Sacramento Area Integrated Water Resources Model (SacIWRM).

1.1 Goals of Model Development

The primary goal of development of CoSANA is to have a robust, technically sound, publicly accepted analytical computer tool that simulates the details of the integrated land surface system; stream and river system; and groundwater hydrologic and hydrogeologic system in the model area for use in regional water management.

This goal represents continuation of successful use of the SacIWRM, which was implemented for numerous diverse water management efforts over three decades. Updating, refining, and modernizing SacIWRM into the new state-of-the-art CoSANA platform has a goal of providing a technical and analytical tool through conducting the work in a collaborative and open environment to gain regional acceptance in the water community of the greater Sacramento region. Together, the tool and regional acceptance can allow for a broad, regional, consistent modeling approach that can provide defensible, robust, consistent results in a more efficient manner.

While CoSANA is intended to assist in a broad range of water management activities in the area, the model is developed with specific features to support development of sustainable groundwater management strategies and policies and compliance with the Sustainable Groundwater Management Act (SGMA), as well as to support the planning and implementation of regional conjunctive use and water banking efforts.

CoSANA is used for the development of the groundwater sustainability plans (GSPs) for North American Subbasin (NASb), South American Subbasin (SASb), and Cosumnes Subbasin (CoSb), including work related to:

- Hydrogeologic conceptual model
- Sustainable management criteria
- Water budgets and sustainable yield
- Monitoring networks
- Projects and management actions to achieve sustainability
- Outreach, reporting, and ongoing analysis

CoSANA is also intended to support work associated with a Sacramento regional water bank, including:

- Identification of benefits and impacts
- Water bank accounting
- Quantification of losses
- Integration with surface water reservoir operations models
- FloodMAR opportunities assessment and design
- Outreach, reporting, and ongoing analysis

CoSANA is developed to support analysis of a broad range of regional water management efforts.

1.2 Cosumnes, South American, and North American Subbasins

CoSANA simulates the North American (5-021.64), South American (5-021.65), and Cosumnes (5-022.16) Groundwater Subbasins, along with a small portion of the Eastern San Joaquin (ESJ) (5-022.01) Groundwater Subbasin. The focus of the model is the NASb, SASb, and CoSb subbasins, with less detail provided for the ESJ Subbasin. Figure 1-1 shows the model domain and the boundaries of the associated subbasins. Portions outside of the groundwater subbasins were included in the model area to avoid breaking up larger urban areas, including the City of Folsom and Rancho Murieta Community Services District (RMCSD). The model area includes portions of Amador, Placer, Sacramento, San Joaquin, and Sutter Counties. The CoSANA model domain is similar to the SacIWRM model domain, with some differences due to changes in groundwater subbasin boundaries.

NASb and SASb are categorized as high priority groundwater subbasins and CoSb is categorized as a medium priority groundwater subbasin under the California Statewide Groundwater Elevation Monitoring (CASGEM) program. None of these three subbasins are identified by the California Department of Water Resources (DWR) as critically overdrafted. As such, groundwater sustainability agencies (GSAs) in these three subbasins must develop GSPs by January 31, 2022 that detail how each subbasin will be managed in a sustainable manner by 2042. CoSANA is developed to assist in that process.

Table 1-1 lists 17 GSAs covering the NASb, SASb, and CoSb Subbasins. The GSAs include the major urban water purveyors, agricultural water purveyors, or other agencies which supply water or have land use authority within the subbasin. The water purveyors are shown in Figure 1-2 and the GSAs are shown in Figure 1-3.

Table 1-1: Groundwater Sustainability Agencies by Subbasin

Subbasin	GSA
North American Subbasin	Reclamation District 1001
	Sacramento Groundwater Authority
	South Sutter Water District
	Sutter County
	West Placer County
South American Subbasin	Sacramento County
	Northern Delta
	Omochumne-Hartnell Water District
	Sacramento Central Groundwater Authority
	Sloughhouse Resource Conservation District
Cosumnes Subbasin	Amador County Groundwater Management Authority
	City of Galt
	Clay Irrigation District
	Galt Irrigation District
	Omochumne-Hartnell Water District
	Sacramento County
	Sloughhouse Resource Conservation District

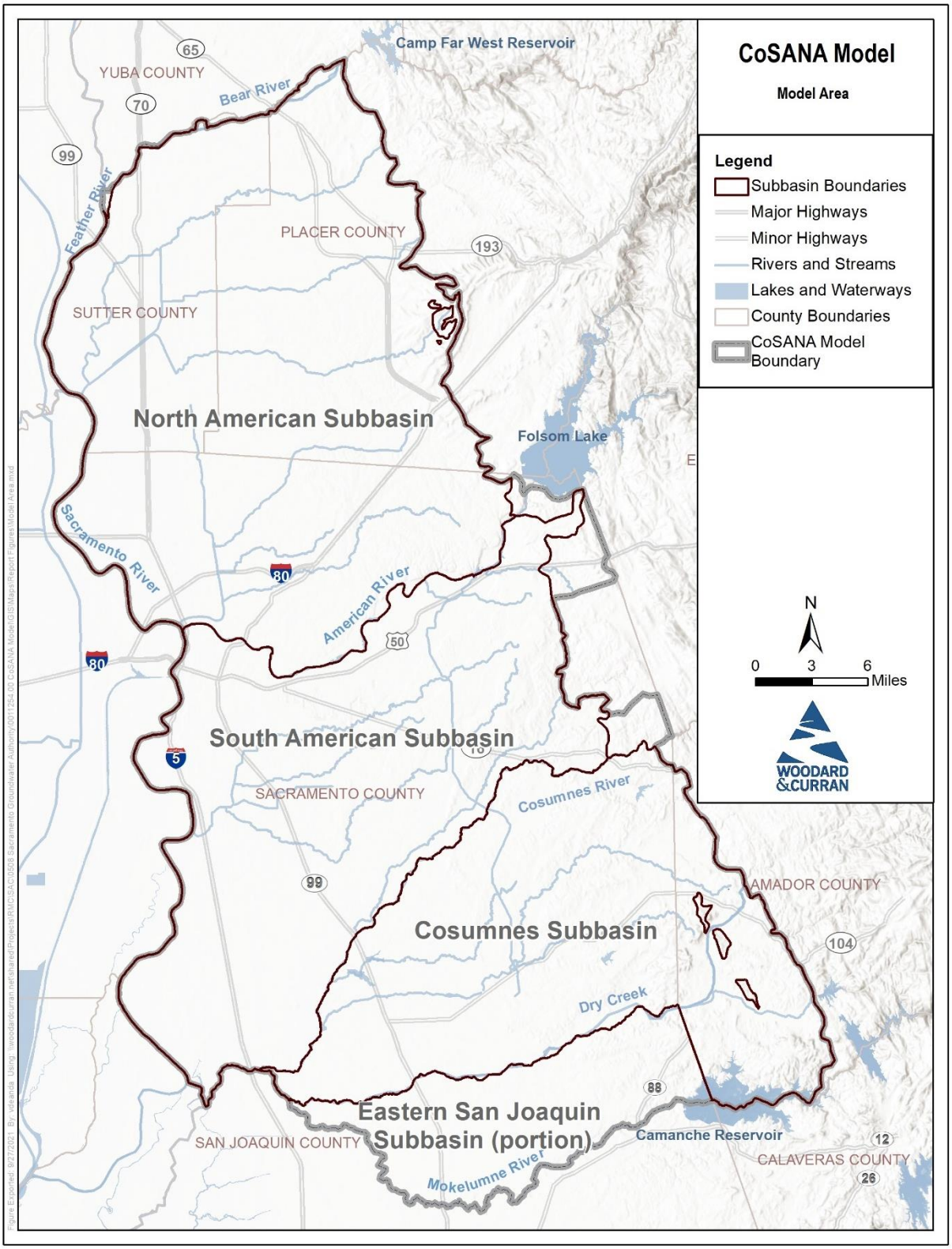


Figure 1-1: Model Area and Groundwater Subbasin Boundaries

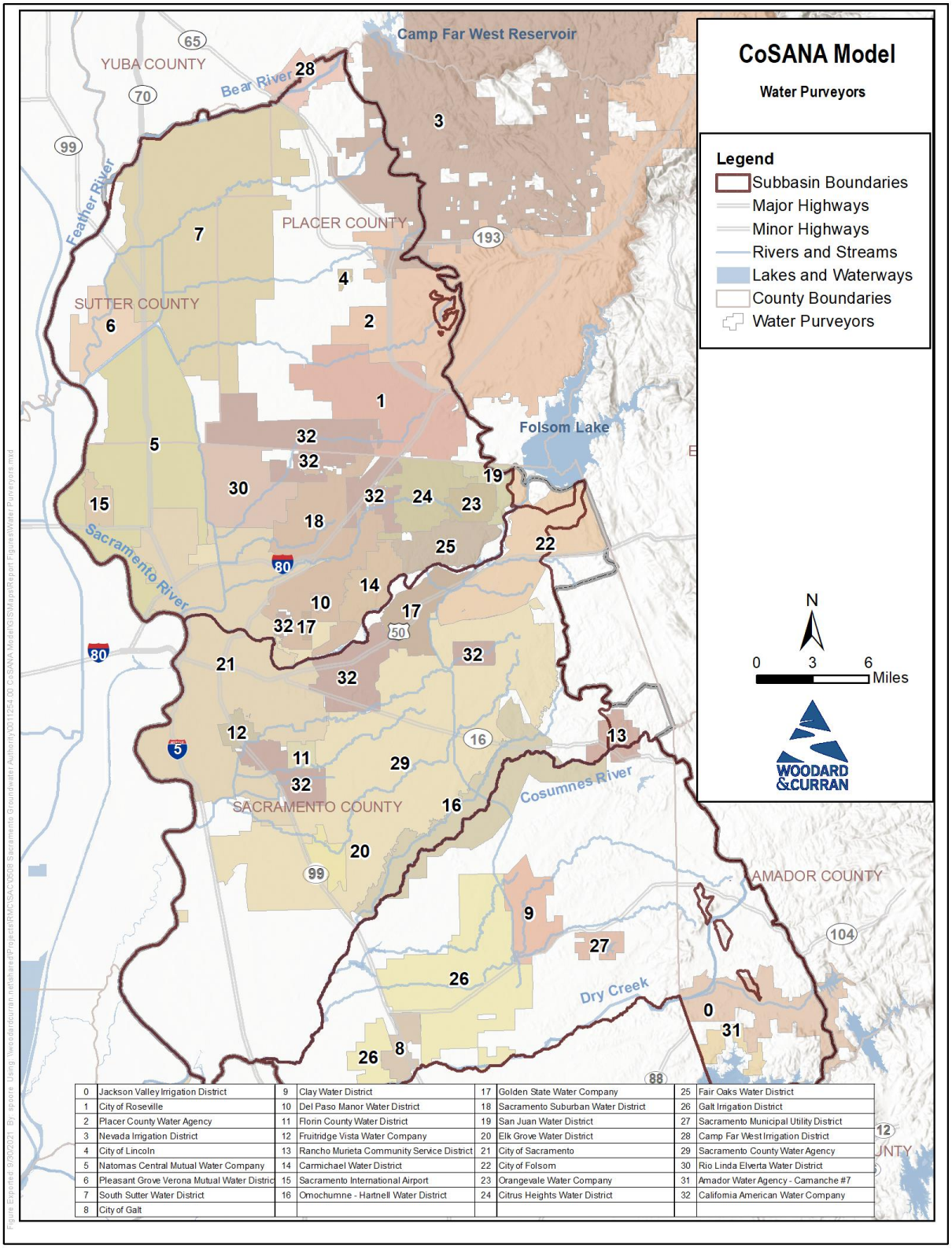


Figure 1-2: Major Water Purveyors

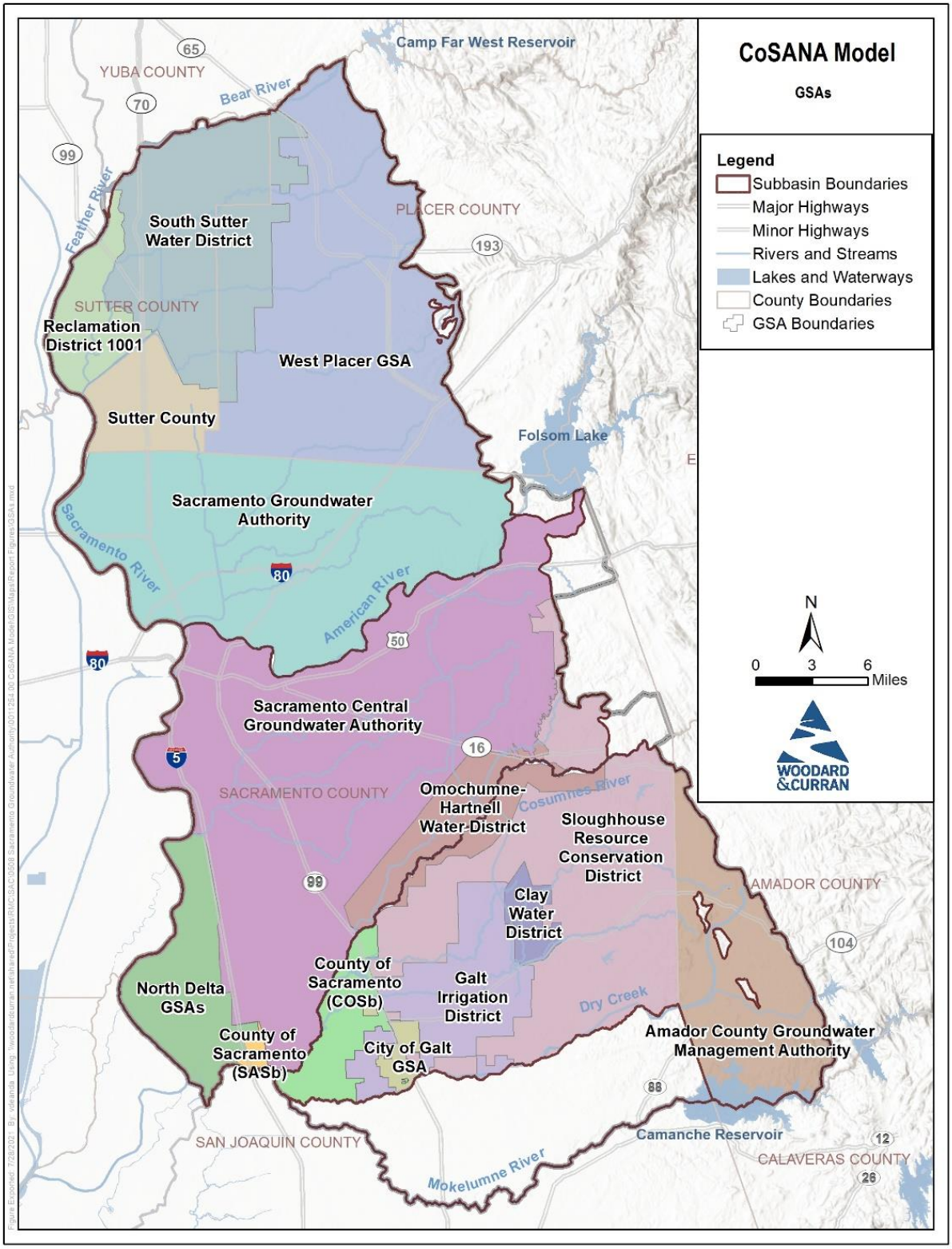


Figure 1-3: Groundwater Sustainability Agencies

1.3 Collaborative and Open Environment

Model development was conducted in a collaborative and open environment and was coordinated with various entities representing the three groundwater subbasins, including Sacramento Groundwater Authority (SGA), Sacramento Central Groundwater Authority (SCGA), Sacramento Area Flood Control Agency (SAFCA), Sacramento County, Regional Water Authority (RWA), the Sacramento Water Forum, the Cosumnes Subbasin SGMA Working Group (referred to as the "Working Group"), GSAs, and associated consultants.

The development of CoSANA took place in an open and transparent process and in a collaborative environment, with regular meetings between technical and working group members discussing model technical specifics and sharing model data, assumptions, data analysis and development, calibration approach and process, as well as interim and final results. The modeling team additionally met with local agencies individually to review model data and gather additional information to support refining model and data assumptions during model development.

Participation by representatives of regional water agencies and GSA representatives, including SGA, RWA, SCGA, SAFCA, Southeast Sacramento County Agricultural Water Authority (SSCAWA), the Sacramento Water Forum, and the Cosumnes Subbasin Working Group allowed for incorporation of information related to stakeholders within those organizations and associated subbasins. Further, progress was shared at meetings associated with development of GSPs for each of the three subbasins to gain additional input and information. These presentations provided details on the goals and progress of CoSANA development and also served as a method to request information and data from stakeholders.

In addition to coordination activities during development of the CoSANA model, the completed model was compared to models in the surrounding subbasins to assess consistency. The assessment focused primarily on subsurface flows, although other components, including stream seepage, were also reviewed. The assessment included meetings with modeling representatives from surrounding subbasins, including the Yolo, Yuba, and Solano Subbasins. Subsurface flows were found to be similar in magnitude, although in some cases in opposite directions. These differences were not considered substantial enough to impact the ability to use model results for management purposes within the GSP. This is due to the relatively small differences in comparison to other components of the groundwater budget and due to the calibrated nature of the models, where small differences in subsurface flows may be balanced out by similar differences in other calibrated components of the model. Coordination is expected to continue in the future, where information gained by recent modeling in the various subbasins can be incorporated into future refinements of CoSANA and the neighboring models to reduce the differences and improve model performance.

1.4 Model Platform and Historical Modeling of the Region

SacIWRM and predecessor models have been used to simulate and analyze the North American, South American, and Cosumnes Subbasins since 1992. The models have contributed to many regional and local studies, including supporting the Water Forum Agreement and implementation of groundwater management plans (Table 1-2). SacIWRM was developed based on the Integrated Groundwater and Surface Water Model (IGSM) code, developed in the early 1990s by DWR and the United States Bureau of Reclamation (Reclamation) to simulate Central Valley operations. SacIWRM underwent six major upgrades since first being developed, with the last major update to the northern portion of the model in 2007 and to the central portion in 2016. SacIWRM includes data from 1970 through 2011 and is still in active use for various projects.

CoSANA is developed by porting and refining the data from the older model SacIWRM into the newer DWR code that replaced IGSM in the early 2000s, called Integrated Water Flow Model (IWFM). IWFM is an open-source, finite element simulation code that supports triangular and quadrilateral elements (Dogrul et al., 2017a). It is specifically designated in the GSP regulations as being supported by DWR for water budget development within GSPs. It is also the code used for DWR's California Central Valley Groundwater-Surface Water Simulation Model (C2VSimFG), which supports SGMA activities throughout the Central Valley at the regional scale (Brush et al., 2013; DWR, 2020). The IWFM Demand Calculator (IDC) is the stand-alone root zone component of IWFM that simulates land surface and root zone

flow processes (Dogrul et al., 2017b). It calculates agricultural and urban water demands using inputs including climate conditions, soil parameters, and land use types and distribution. It can be run separately or combined with IWFM. IDC was run combined with IWFM, and data development and results in this documentation are included as part of overall IWFM datasets and results.

The model area covers 888,548 acres and is bounded in the north by the Bear River, in the south by the Mokelumne River, in the west by the Sacramento River, and in the east by the Sierra Nevada foothills. The physical model boundaries are shown in Figure 1-1.

Table 1-2: SacIWRM History and Application

Year	Study
1992	City-wide Model
1993	County-wide Model
1996	American River Water Resources Investigation
1996	Northridge Conjunctive Use Study
1996	Rio Linda Water Supply Analysis
1996	Hydrology Update
1996	Water Forum- Basin Yield
1999	Sunrise Douglas Water Supply Analysis
1999	Zone 40 (North Vineyard Well Field)
2000	American River Basin Cooperating Agencies Studies
2002	Aerojet Surface Water Discharge Permit
2004	Zone 40 Water Supply Master Plan Update
2005	Natomas Central Mutual Water Company Impacts Assessment
2005	Rio Del Oro Impacts Study
2007	Sutter Measure M Impact Study
2007	Sun Creek Development
2008	Model Comprehensive Update
2009	SCGA Well Protection Program
2009	Cosumnes River Hydrologic Study
2010	RWA Water Accounting Framework
2011	The Nature Conservancy (TNC) Reservoir Re-Operation Study
2012	South County Recycled Water Feasibility Study
2012	TNC Conjunctive Use Study
2012	TNC/California Water Foundation Central Valley Hydrologic Study
2014	TNC Groundwater Banking Feasibility
2015	SCGA Biennial Groundwater Management Plan Report
2016	Sacramento Regional County Sanitation District Climate Change Assessment & Environmental Impact Report Support
2017	Harvest Water, Water Storage Investment Program, City of Sacramento Groundwater Master Plan
2018	Dynamic linkage with the Yolo IGSM
2020	Grandpark Specific Plan Development

1.5 Report Organization

The remainder of this report is organized as follows:

- Chapter 1 is this introductory chapter.
- Chapter 2 describes the historical model development, including the design of the model grid, layering, and input data for the root zone, groundwater, surface water, and land surface modules.
- Chapter 3 describes model input data for water supply and demand. Assumptions associated with agricultural and urban water use are described in this chapter.
- Chapter 4 describes the methodology used for the calibration of model parameters. Final parameters used in the model are provided along with model results and comparisons to observed data. This chapter also includes a sensitivity analysis of model results with perturbed input parameters.
- Chapter 5 describes the baseline conditions. The Current Conditions Baseline (including the input data for water supply and demand and the model results), Projected Conditions Baseline (including the land use, water supply and demand data used and the model results), and Projected Conditions with Climate Change Baseline (including the hydrologic data used and the model results) are described in this chapter.
- Chapter 6 presents a summary of the report and provides recommendations for future activities.
- Chapter 7 presents a list of references used in this report.

2. MODEL DEVELOPMENT

This section presents the source and analysis of input data used in the development of CoSANA. This includes spatial and temporal information for hydrologic, hydrogeologic, water use, water supply, and operations data sets included in the model, as well as physical settings, parameters, and assumptions.

2.1 Model Input Data

IWFM model files and corresponding major data sources used in the development of CoSANA are presented in Table 2-1 along with the report sections where the model data and data sources are described.

Table 2-1: CoSANA Input Data

Major Data Category	Minor Data Category	Data Source	Report Section
Hydrogeological Data	Geologic Stratification	Local information	2.10
	Aquifer Parameters	USGS texture model	4.5.3
Stream Data	Stream Configuration	C2VSim SVSim SacIWRM Local information	2.4
	Stream Inflow	USGS & CDEC stream gages Local information	2.4
	Calibration Gages	USGS & CDEC stream gages	4.2.3
Hydrological Data	Precipitation	PRISM & CalSIMETAW	2.6
Agricultural Water Demand	Land Use	DWR county surveys CropScape DWR statewide mapping Local information	2.7
	Evapotranspiration	C2VSim METRIC Local information	2.8
	Soil Properties	SSURGO STATSGO2	2.9
Urban Water Demand	Population	U.S. Census Bureau tract data	3.3.1
	Per Capita Water Use	Local information California Water Plan	3.2
Water Supply	Groundwater Pumping	Local information SacIWRM	3.1.2
	Surface Water Deliveries	Local information SacIWRM	3.1.1
Other	Boundary Conditions	C2VSim Local information	2.12
	Initial Conditions	Water Data Library	2.13
	Small Watersheds	C2VSim	2.11
	Calibration Wells	DWR Local information	4.2.2

Abbreviations: C2VSim: California Central Valley Groundwater-Surface Water Simulation Model; CalSIMETAW: California Simulation of Evapotranspiration of Applied Water; CDEC: California Data Exchange Center; DWR: California Department of Water Resources; METRIC: Mapping Evapotranspiration at High Resolution with Internalized Calibration; SacIWRM: Sacramento Integrated Water Resources Mode; PRISM: Precipitation-Elevation Regressions on Independent Slopes Model; SSURGO: Soil Survey Geographic Database; STATSGO2:Digital General Soil Map of the United States; SVSim: Sacramento Valley Groundwater-Surface Water Simulation Model; USGS: United States Geological Survey

2.2 Simulation Period and Temporal Discretization

The CoSANA model simulates the historical conditions in the basin for the period of water years (WY) 1970 through 2018 (October 1, 1969 through September 30, 2018). Monthly data was used as model input, and the model simulation uses a monthly time step. Model output can be reported on a monthly or annual time increment, as needed.

Model data development efforts were divided into two periods, as follows:

- WY 1970-1989 – The data for this period is primarily mapped over from SacIWRM. As such, CoSANA inherits the spatial and temporal resolution of SacIWRM. As much of the source data for land use, water use, and water supply are not readily available in digital form, the mapped data from SacIWRM was used without substantial refinement. However, the hydrologic data sets, including rainfall and streamflows, are refined based on the latest sources of data.
- WY 1990-2018 – The data for this period is much more refined, as digital source data are used in development of the model input data. Additionally, the groundwater level and streamflow observation data are available in a more consistent quality and format. Therefore, this period is used for the WY 1995-2018 model calibration period, plus a WY 1990-1994 warm up period. Further discussion on calibration period selection is provided in the model calibration section of the report.

Beyond the two time periods, the entirely of the WY 1970-2018 period is used for verification of consistency of model simulation, long-term water budgets, long-term trends in groundwater levels and stream-aquifer interaction, and long-term trends in the groundwater storage changes. WY 2019 is added to the baselines to achieve 50 years of hydrology as required by SGMA (see Section 5).

2.3 Model Grid and Subregions

A model grid provides a discrete geographic representation of the physical, hydrologic, hydrogeologic, jurisdictional, land use, water use, and water supply features at a small enough size to support the basis for robust mathematical representation of the features and the inter-relationship between various components of the system.

A grid network was developed for the CoSANA model, based on principles of finite element numerical analysis, to reflect hydrological, hydrogeological, physical, jurisdictional, and operational conditions in the groundwater subbasins represented in CoSANA. The finite element grid for CoSANA was developed using Aquaveo's GMS-Groundwater Modeling System software with spatial processing using Esri's ArcGIS. The grid includes quadrilateral and triangular elements based on selected input lines and control points. Features included in the development of the model grid are shown in Figure 2-1 and include:

- Streams
- GSA boundaries
- Water purveyor boundaries
- County boundaries
- Areas of groundwater contamination
- Geological features
- Model grids in neighboring subbasins

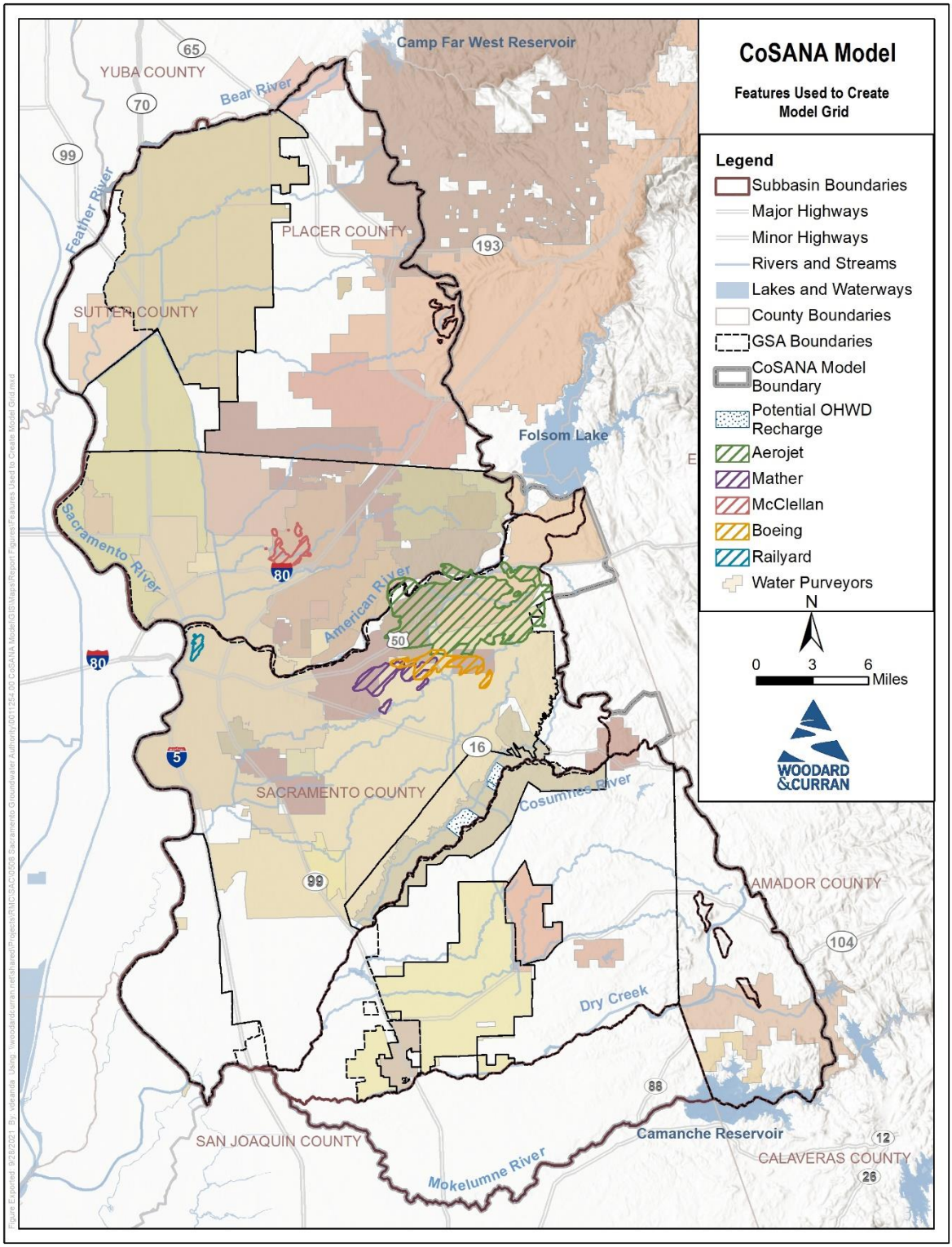


Figure 2-1: Features Used to Create Model Grid

The CoSANA model grid contains 24,171 elements and 22,274 nodes with an average element area of 37 acres (Figure 2-2). The node discretization interval for most features was set at 2,000 feet with more refined spacing in specific areas, such as near streams (described below) and areas of significant groundwater contamination (1,000 feet spacing for the Mather, Aerojet, and McClellan areas). The overall node spacing was 1,170 feet on average with a maximum of 2,210 feet and a minimum of 300 feet.

Streams in the model domain were separated into three tiers, described further in Section 2.4. The first two tiers are simulated in the model. Tier 3 streams are minor streams that are included in the model grid for drainage routes but are not directly modeled in CoSANA.

Border model nodes were aligned with the model grids for the Yuba Groundwater Model (YGM), which is directly adjacent and also uses the IWFM platform, to improve the potential for future direct interaction with this model (Figure 2-3). Node spacing along other boundaries for other neighboring models, including the Yolo and Eastern San Joaquin models were used as guidelines, however, CoSANA provides smaller node spacing along these boundaries compared to the neighboring models. There was no direct coordination on node spacing along the boundaries bordering the Solano or Sutter Subbasins.

The southern boundary of CoSANA is the Mokelumne River, which provides coverage for the Cosumnes Subbasin and a portion of the Eastern San Joaquin Subbasin, as well as a hydrologic boundary. The Cosumnes Subbasin is covered by both CoSANA and the Eastern San Joaquin Subbasin model (Eastern San Joaquin Water Resources Model). Generally, the CoSANA model has limited focus on the Eastern San Joaquin Subbasin, and the Eastern San Joaquin model has limited focus on the Cosumnes Subbasin. The CoSANA node spacing is refined along the Mokelumne River and the data and information in CoSANA's representation of the Cosumnes Subbasin is refined by the Cosumnes Subbasin GSAs and consultants. The Cosumnes Subbasin GSAs used CoSANA in development of their GSP.

The model elements are grouped into 87 model subregions (Figure 2-4) that are used to organize input data and to report standard model water budget output. Subregions were delineated using boundaries of cities, water agencies, GSAs, subbasins, and counties. A listing of model subregions, including the associated subbasin and the number of model elements they contain, is provided in Table 2-2.

Table 2-2: CoSANA Subregions

Subregion Number	Subregion Name	Groundwater Subbasin	Number of Elements
1	Camp Far West ID	North American	142
2	Sutter Co. 1	North American	12
3	South Sutter WD GSA	North American	1296
4	Placer County WA	North American	997
5	Nevada ID	North American	161
6	Lincoln	North American	235
7	RD1001	North American	359
8	Pleasant Grove Verona MWC	North American	162
9	Sutter Co. 2	North American	60
10	Natomas MWC (Sutter Co.)	North American	252
11	Sutter Co. 3	North American	76
12	Roseville SOI	North American	42
13	City of Roseville	North American	478
14	Cal Am (West Placer)	North American	166
15	Natomas MWC (Sacramento Co.)	North American	423

Subregion Number	Subregion Name	Groundwater Subbasin	Number of Elements
16	Sacramento International Airport	North American	48
17	Metro Air Park	North American	26
18	Sac Co. 1	North American	63
19	Sac Co. 2	North American	27
20	Sac County WA (Northgate 880)	North American	13
21	Rio Linda Elverta	North American	221
22	Sac Co. 3	North American	16
23	Cal Am (Antelope)	North American	55
24	Cal Am (Lincoln Oaks)	North American	92
25	Citrus Heights WD	North American	171
26	San Juan WD (Placer Co.)	North American	29
27	San Juan WD (Sacramento Co.)	North American	88
28	Orange Vale WC	North American	73
29	Lake Natoma/Mississippi Bar	North American	116
30	Fair Oaks WD	North American	354
31	Carmichael WD	North American	297
32	Sacramento Suburban WD (North)	North American	471
33	Sacramento Suburban WD (South)	North American	293
34	Del Paso Manor WD	North American	18
35	Golden State WC Arden	North American	21
36	Cal Am (Arden)	North American	27
37	Sac County WA (Arden Park Vista)	North American	76
38	City of Sacramento (North)	North American	777
39	City of Sacramento (South)	South American	1212
40	Cal Am (Suburban Rosemont)	South American	410
41	Sac Co. 4	South American	33
42	Golden State WC (Cordova)	South American	548
43	Sac Co. 5	South American	111
44	City of Folsom	South American (partial)	869
45	Cal Am (Security Park)	South American	76
46	Fruitridge Vista WC	South American	46
47	Florin County WD	South American	31
48	Cal Am (Parkway)	South American	98
49	Sac Co. 6	South American	104
50	Sac County WA (North/Central)	South American	1451
51	Sac County WA (South)	South American	240
52	Elk Grove WD (Service Area 2 - Intertie)	South American	97
53	Elk Grove WD (Service Area 1 - GW)	South American	62
54	Cosumnes River West	South American	734
55	RD744	South American	76
56	Franklin Drainage District	South American	197

Subregion Number	Subregion Name	Groundwater Subbasin	Number of Elements
57	RD813	South American	70
58	RD755	South American	22
59	RD1002	South American	94
60	RD551	South American	272
61	RD369	South American	36
62	RD2110	South American	88
63	Sac Co. 7	South American	54
64	Rancho Murieta (North)	South American (partial)	244
65	Sloughhouse RCD (North)	South American	422
66	OHWD (South American Subbasin)	South American	990
67	OHWD (Cosumnes Subbasin)	Cosumnes	601
68	Rancho Murieta (South)	Cosumnes	87
69	Sloughhouse RCD (East)	Cosumnes	1219
70	Wilton	Cosumnes	255
71	Sloughhouse RCD (West)	Cosumnes	254
72	Galt ID (East)	Cosumnes	615
73	Clay WD	Cosumnes	125
74	Clay	Cosumnes	67
75	SMUD Rancho Seco	Cosumnes	50
76	Cosumnes River South	Cosumnes	308
77	Galt ID (West)	Cosumnes	78
78	Sac Co. 8	Cosumnes	408
79	City of Galt	Cosumnes	86
80	Sloughhouse RCD (South)	Cosumnes	35
81	Amador Co. 1	Cosumnes	443
82	Ione	Cosumnes	44
83	Jackson ID	Cosumnes	213
84	Camanche	Cosumnes	355
85	Amador County WA	Cosumnes	57
86	Mokelumne	Eastern San Joaquin	1944
87	City of Galt WWTP	Cosumnes	7

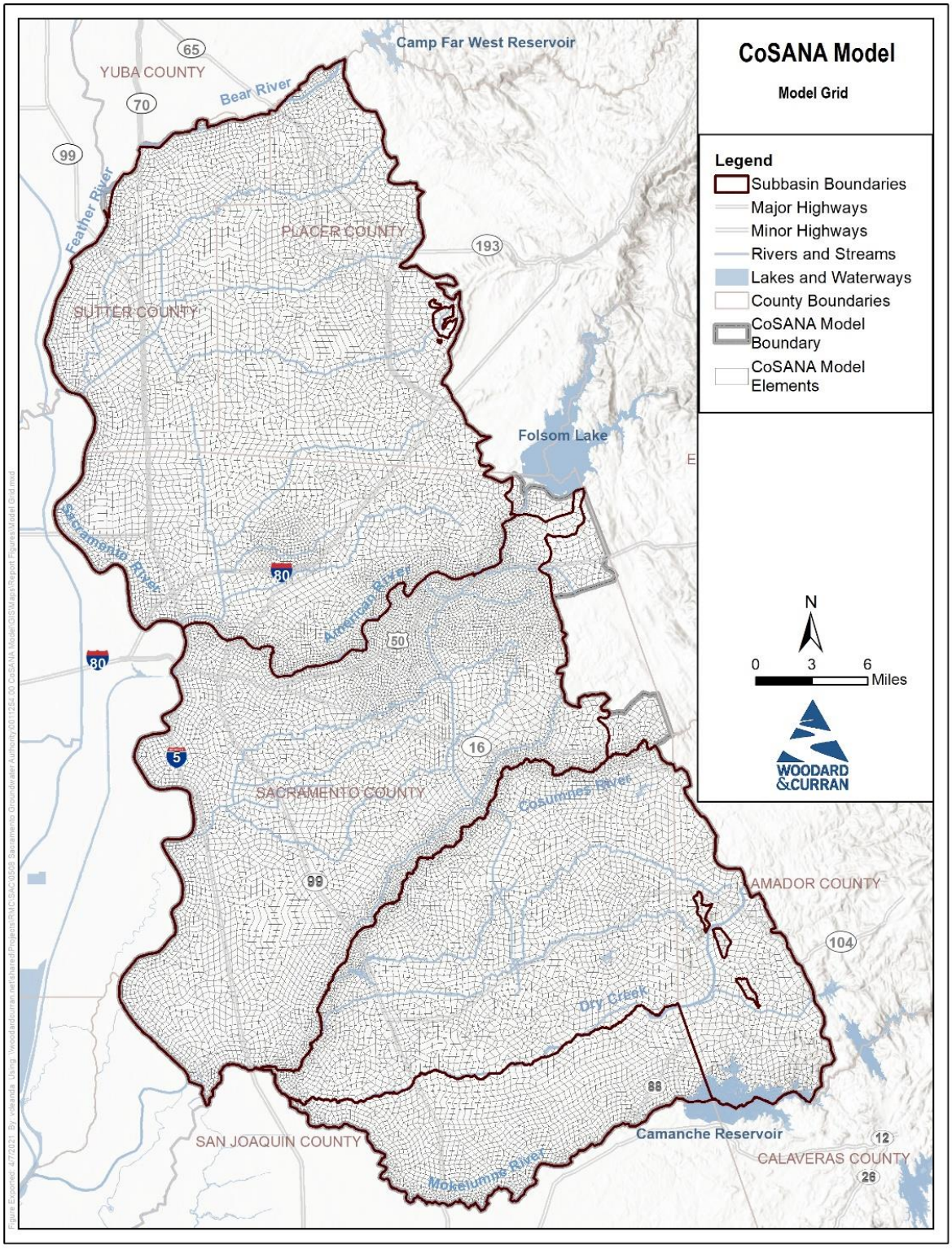


Figure 2-2: CoSANA Model Grid

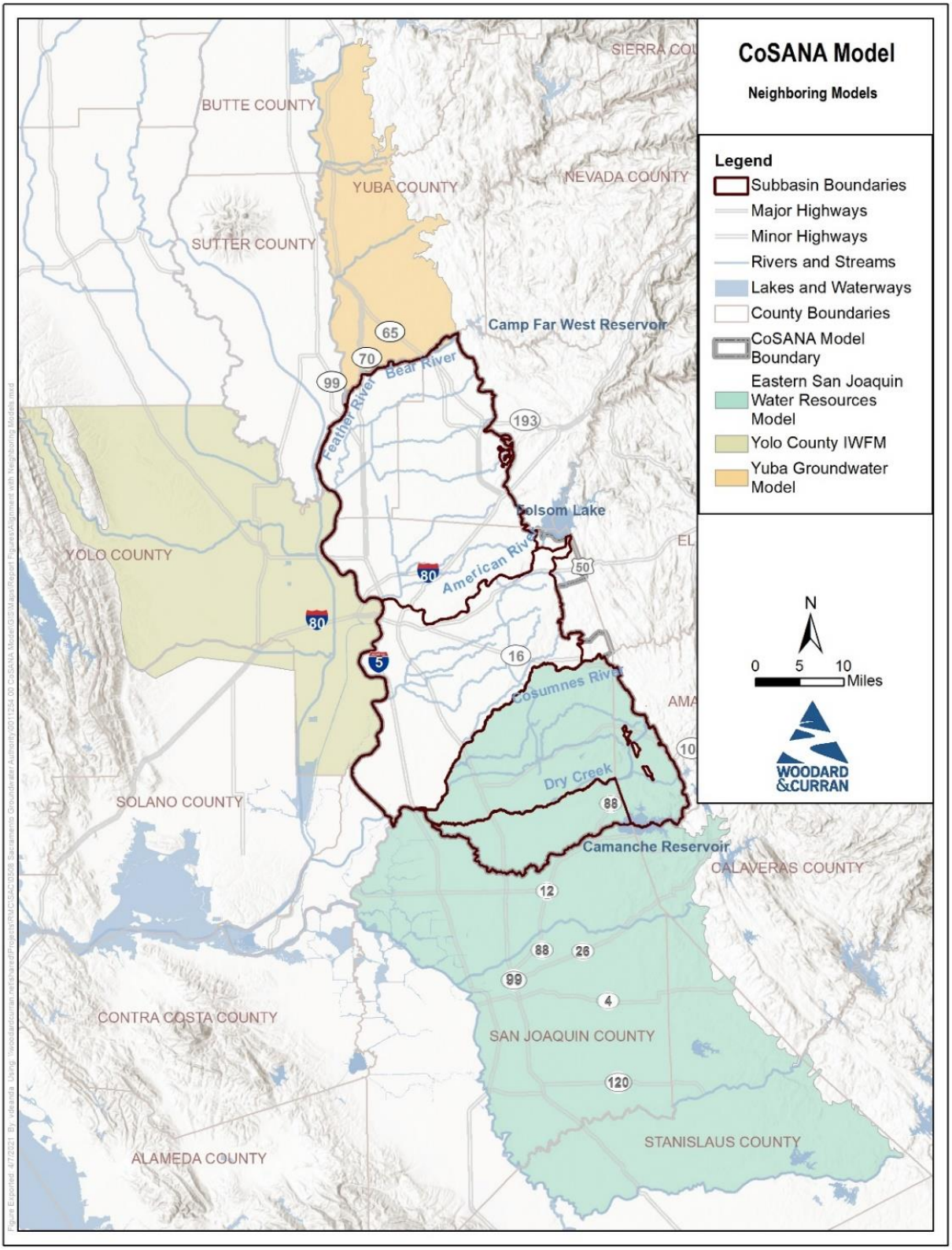


Figure 2-3: Alignment with Neighboring Model Grids

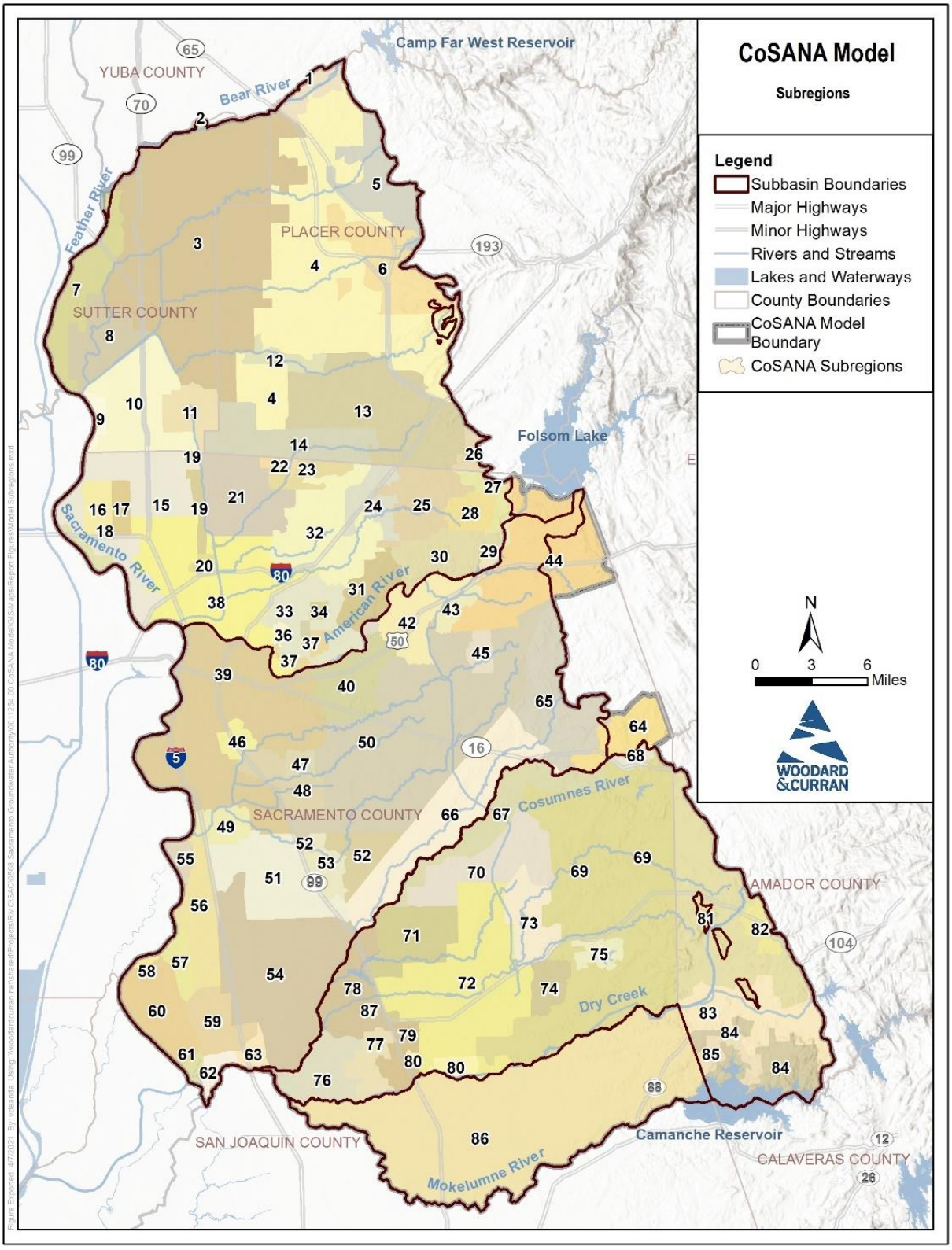


Figure 2-4: CoSANA Subregions

2.4 Stream Configuration and Inflow

Model hydrology is represented by 51 modeled stream reaches representing 27 streams, rivers, and canals, which are largely defined to start and/or end at confluences. Streams in the model domain are separated into three tiers, as shown in Table 2-3 and Figure 2-5. The discretization interval for stream node spacing and buffers included around the streams to transition from the finer to coarser node spacing vary based on the tier, as follows:

- Tier 1 includes major streams and were discretized to 750 feet (Cosumnes and American Rivers) or 1,000 feet (Sacramento, Feather, Bear, and Mokelumne Rivers). The fine level of discretization allows for better representation of surface water-groundwater interaction. A buffer, the distance within which the finer discretization is applied, of 5,280 feet (1 mile) was applied.
- Tier 2 represents important streams with standard feature discretization intervals (largely 2,000 feet). Exceptions included Deer Creek with discretization of 1,250 feet and a 2,640 feet (0.5 mile) buffer and Folsom South Canal with discretization of 1,500 feet and a 5,280 feet (1 mile) buffer.
- Tier 3 includes minor streams and drainages, and were not simulated as streams, but included for drainage routes (discussed further in section 2.5). Discretization for these streams was standard (largely 2,000 feet). While these hydrologic features represent drainage and conveyance water courses in the model, they are not directly used as simulated streams in the model due to lack of sufficient information such as channel geometry and streamflow records.

The streams and creeks are represented in the model by 2,388 stream nodes. The number of stream nodes and their refined resolution provide an increased level of accuracy when depicting stream-groundwater interaction. Physical channel characteristics, including the stream invert elevation, channel width, and stream flow rating tables, were obtained from the closest C2VSimFG stream nodes, SacIWRM, and United States Geological Survey (USGS) digital elevation models (DEM).

Time series of stream inflow data is available from 7 USGS gaging stations, additionally several tier 2 streams in the NASb use inflows developed by MBK Engineers or model derived flows from C2VSimFG or YGM. Table 2-4 presents stream input data and Figure 2-6 shows available stream gage locations.

Table 2-3: CoSANA Streams and Tiers

Stream	Groundwater Subbasin	Stream Tier
American River	North American	1
Arcade Creek	North American	2
Auburn Ravine	North American	2
Bear River	North American	1
Cross Canal	North American	2
Curry Creek	North American	3
Dry Creek	North American	2
East Side Canal	North American	2
Feather River	North American	1
Magpie Creek	North American	2
Natomas East Drain	North American	2
Ping Slough	North American	3
Pleasant Grove Creek	North American	2
Racoon Creek	North American	2
Sacramento River	North American	1
South Branch Pleasant Grove Creek	North American	3
Alder Creek	South American	2
American River	South American	1
Beacon Creek	South American	2
Buffalo Creek	South American	2
Cosumnes River	South American	1
Deer Creek	South American	2
Elder Creek	South American	2
Folsom South Canal	South American	2
Laguna Creek	South American	2
Morrison Creek	South American	2
Sacramento River	South American	1
Arkansas Creek	Cosumnes	3
Badger Creek	Cosumnes	2
Brown's Creek	Cosumnes	3
Cosumnes River	Cosumnes	1
Deadman Gulch	Cosumnes	3
Dry Creek	Cosumnes	2
Folsom South Canal	Cosumnes	2
Griffith Creek	Cosumnes	3
Hadselville Creek	Cosumnes	2
Jackson Creek	Cosumnes	2
Laguna Creek	Cosumnes	2
Mokelumne River	Cosumnes	1
North Fork Badger Creek	Cosumnes	3
Rolling Draw	Cosumnes	3
Skunk Creek	Cosumnes	3
Sutter Creek	Cosumnes	3
Willow Creek	Cosumnes	3
Windmill Draw	Cosumnes	3

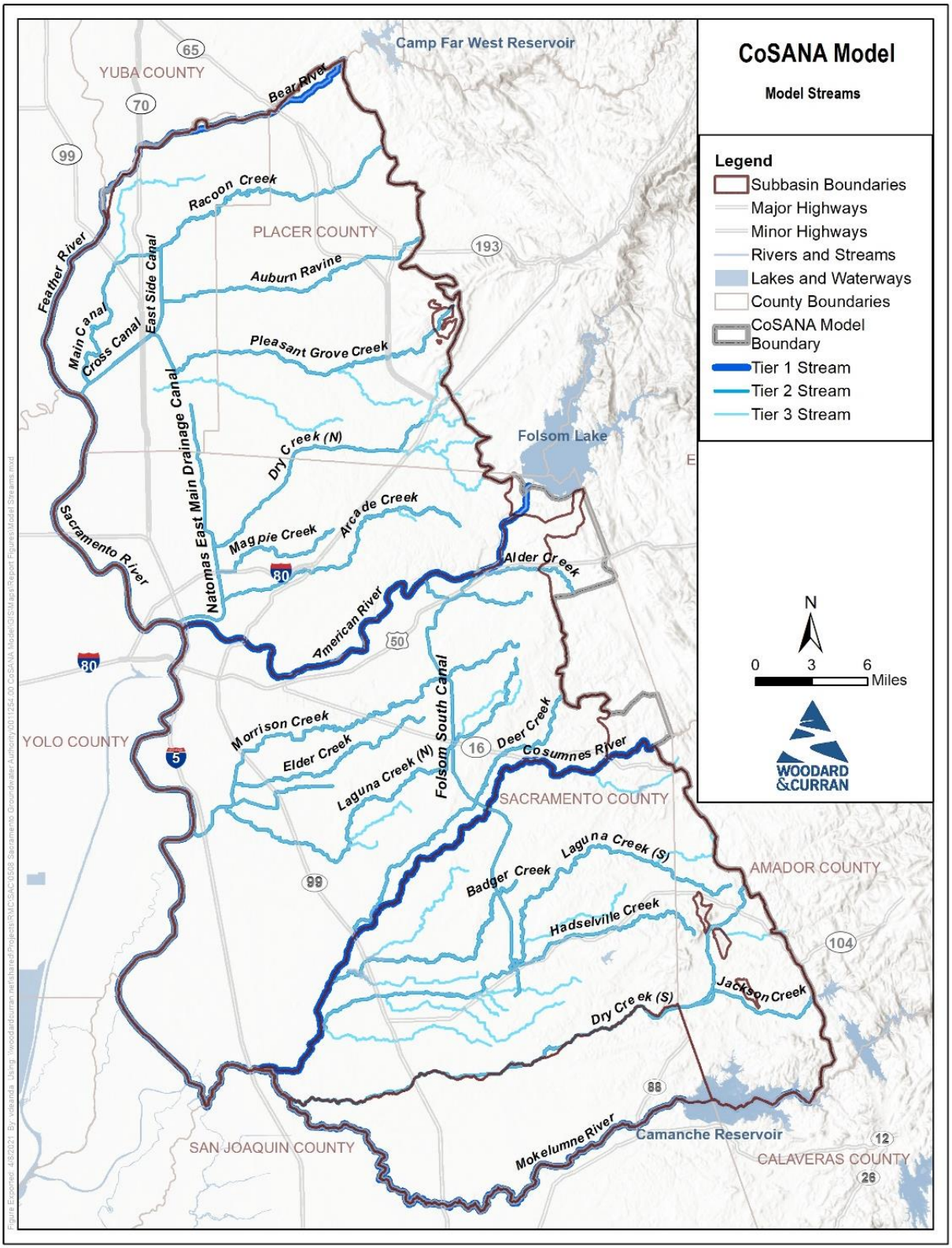


Figure 2-5: CoSANA Streams

Table 2-4: Stream Inflows

Stream	Stream Node	Source	Gage Name	Period of Record (WY)	Average Annual Streamflow (acre-feet)
Sacramento River	155	USGS	Sacramento River near Verona (USGS Gage 11425500)	1929 - 2021	14,461,848
American River	734	USGS	American River at Fair Oaks (USGS Gage 11446500)	1904 - 2021	2,745,469
Cosumnes River	1490	USGS	Cosumnes River at Michigan Bar (USGS Gage 11335000)	1907 - 2021	396,807
Mokelumne River	2080	USGS	Mokelumne River below Camanche Dam (USGS Gage 11323500)	1905 - 2020	568,754
Bear River	1	USGS	Bear River near Wheatland (USGS Gage 11424000)	1928 - 2021	325,546
Raccoon Creek	158	MBK Engineers	Raccoon Creek	1976 - 2018	28,848
Auburn Ravine	248	MBK Engineers	Auburn Ravine	1976 - 2018	19,353
Pleasant Grove Creek	301	MBK Engineers	Pleasant Grove Creek	1976 - 2018	28,827
Dry Creek[1]	502	MBK Engineers	Dry Creek (North American Subbasin)	1976 - 2018	35,944
Feather River	86	YGM	Feather River	1987 - 2015	5,314,464
Dry Creek[1]	1911	C2VSimFG	Dry Creek (Cosumnes Subbasin)	1970 - 2015	30,020
Jackson Creek	1936	JVID	Jackson Creek below Lake Amador Dam	1980 – 2009, 2017 – 2019	7,198
Morrison Creek	1024	USGS	Morrison Cr near Sacramento	1997 - 2017	15,158
Laguna Creek (SASb)	1169	USGS	Laguna Cr. near Elk Grove	1995 - 2018	8,336

C2VSimFG = California Central Valley Groundwater-Surface Water Simulation Fine Grid Model
JVID = Jackson Valley Irrigation District
USGS = United States Geological Survey
YGM = Yuba Groundwater Model
[1] There are two distinct streams named "Dry Creek" within the model domain: one in the North American Subbasin, and one in the Cosumnes Subbasin

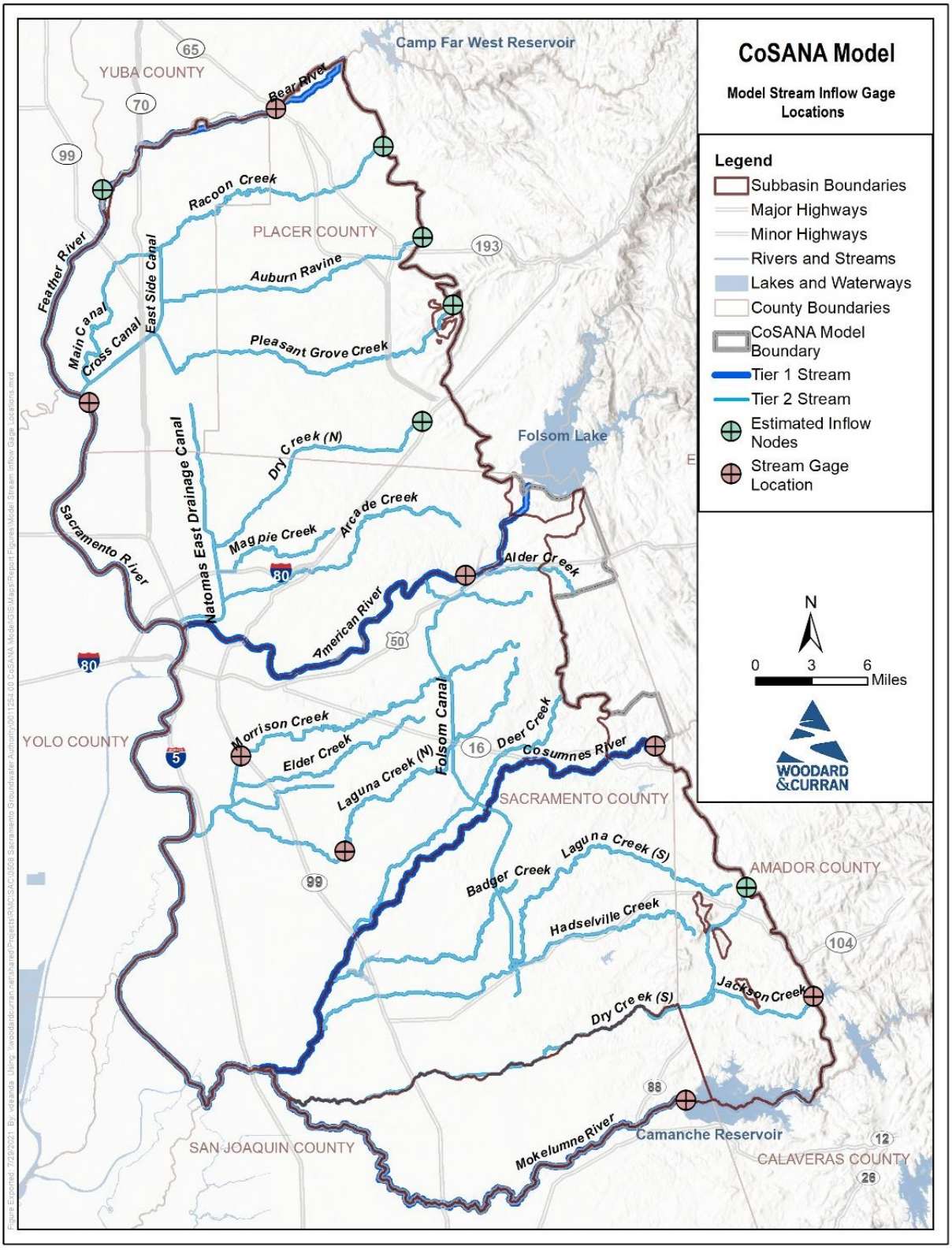


Figure 2-6: CoSANA Stream Inflow Gage Locations

2.5 Surface Drainage Pattern

Surface water drainage (e.g., runoff from rainfall and excess applied water) for each model element is assigned to a stream node representing where the drainage ultimately flows to. These drainage patterns were delineated using the USGS Watershed Boundary Dataset for 12-digit hydrologic units, also called subwatersheds. Each 12-digit hydrologic unit located within the model boundaries was associated with the model stream node it ultimately drained into through both visual analysis as well as information provided on the subwatersheds. Elements falling within the hydrologic units were assigned to the model stream node indicating the ultimate surface water drainage direction. Additional refinement was done along the Cosumnes River to simulate where agricultural return flow would return to the stream with more precision. A total of 62 unique stream nodes receive surface water drainage in CoSANA from 58 subwatersheds. Figure 2-7 shows these stream nodes and the subwatersheds mapped to the model elements.

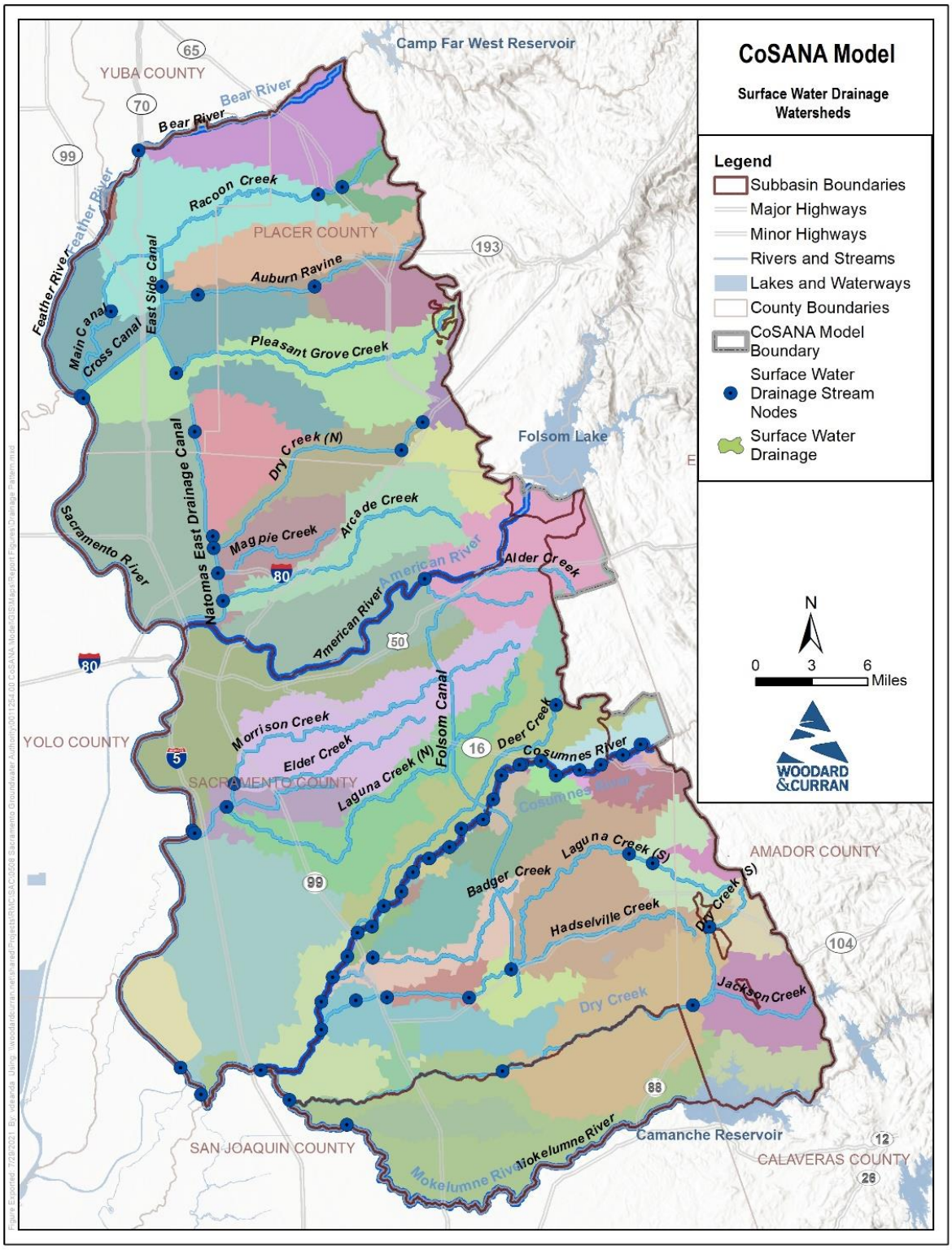


Figure 2-7: CoSANA Drainage Network

2.6 Precipitation

Rainfall data for the model area was derived from the PRISM (Precipitation-Elevation Regressions on Independent Slopes Model) database used in the DWR's CALSIMETAW (California Simulation of Evapotranspiration of Applied Water) model. The database contains daily precipitation data from October 1, 1921, to September 30, 2018, on an 800-meter grid throughout the model area. CoSANA has monthly rainfall data defined for every model element in order to preserve the spatial distribution of the monthly rainfall. Each of the model elements was mapped to the nearest PRISM reference node and the resulting average annual precipitation is shown in Figure 2-8.

Figure 2-9 shows the annual rainfall in the model area and the cumulative departure from mean, which is an indication of long-term rainfall trends in the area. For the 1995-2018 calibration period, the minimum precipitation was in 2007 with 11.0 inches, while the maximum occurred in 1998 with 34.4 inches, the average annual precipitation over this period was 20.1 inches. Based on the Sacramento Valley Water Year Index, there were 3 critical, 5 dry, 5 below normal, 3 above normal, and 8 wet years.

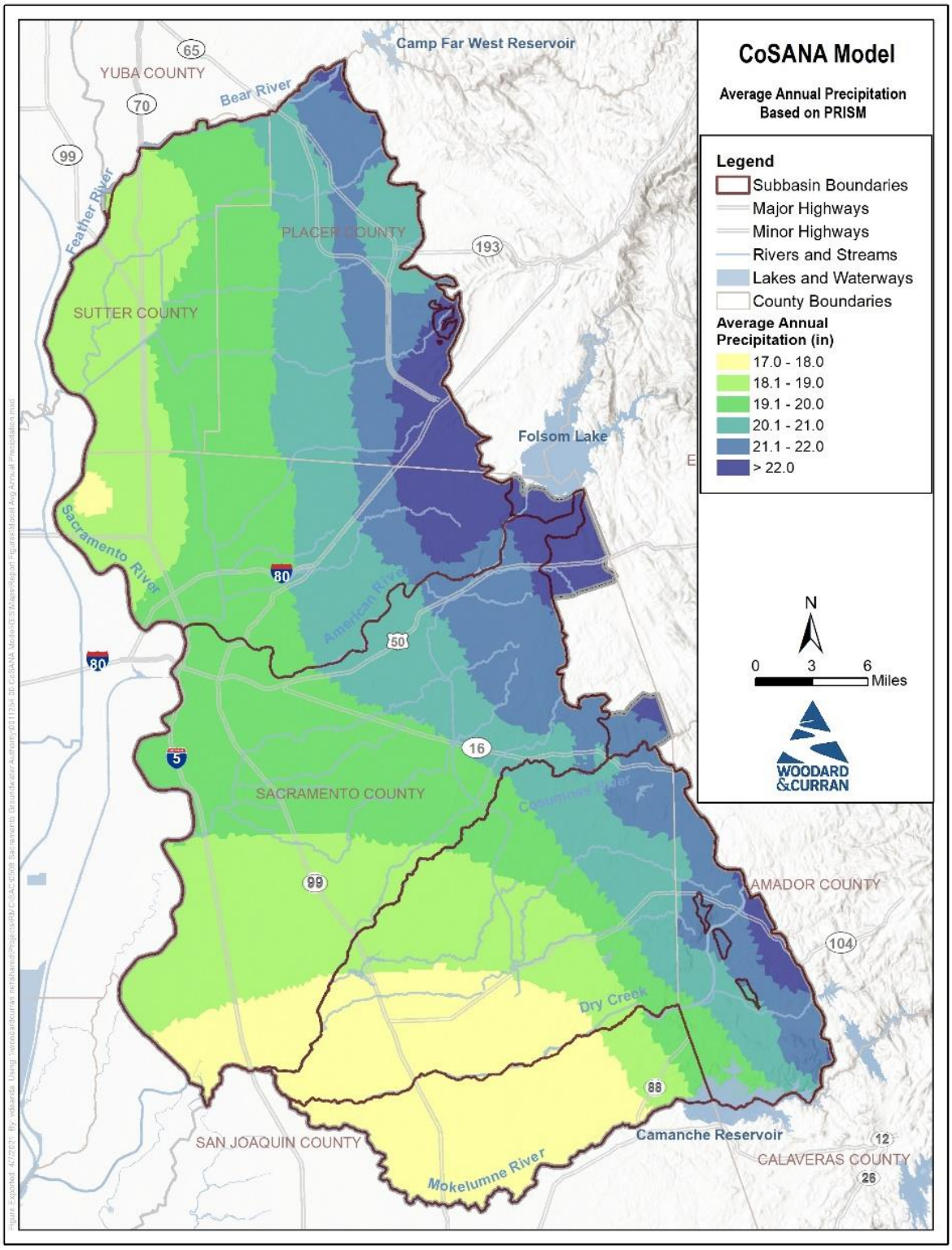


Figure 2-8: CoSANA Average Annual Precipitation

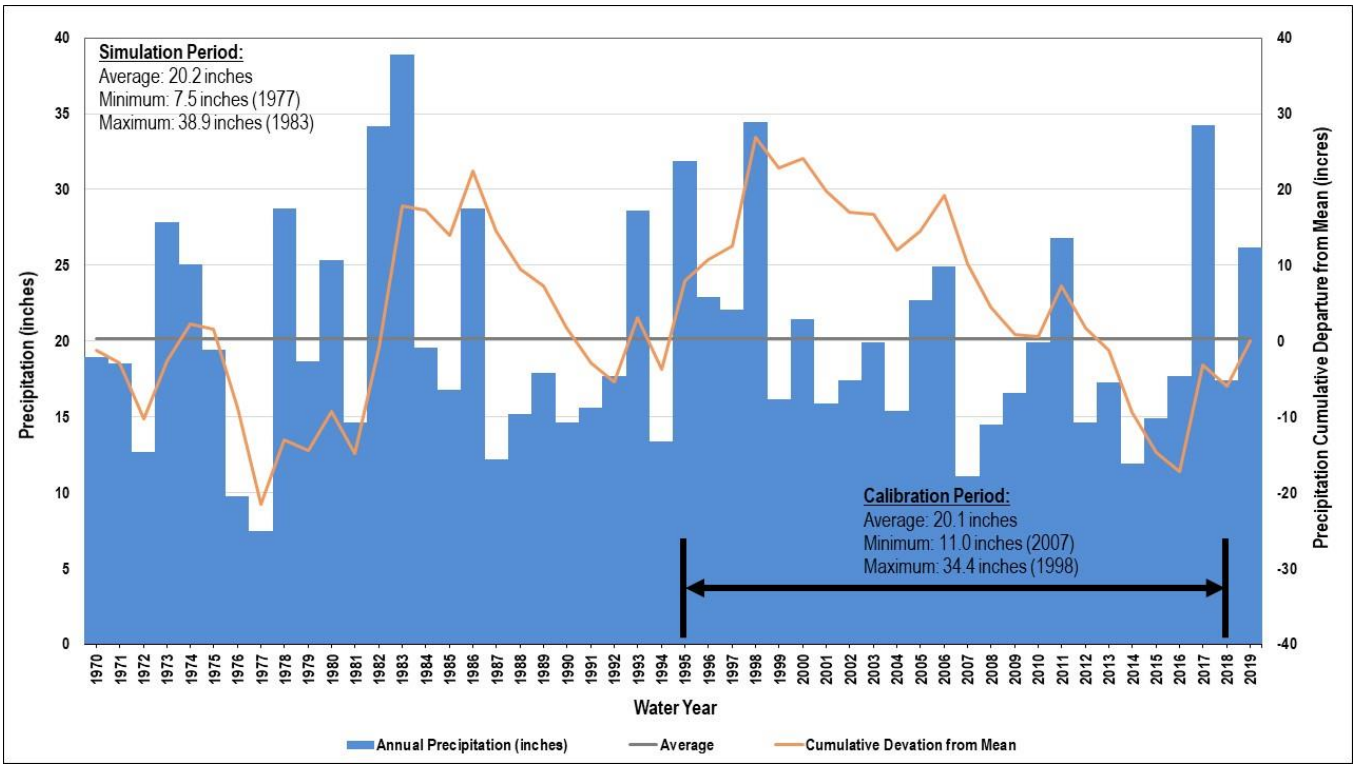


Figure 2-9: CoSANA Average Annual Precipitation with Statistics

2.7 Land Use and Cropping Patterns

Land use and cropping patterns are major data sets that drive the estimation of water demand for agricultural water use as well as rainfall runoff and deep percolation conditions throughout the model area. Land use surveys were used to map the agricultural crops into 4 general land use types and 20 irrigated crop categories, consistent with C2VSimFG, and as shown in Table 2-5. The digital land use surveys were mapped to each of the model elements, so as each model element contains all information to estimate the agricultural, native, and riparian water demand on a monthly time step. All irrigated crop categories except for rice are simulated as non-ponded crops, meaning they are grown without standing water. Rice is simulated as both no decomposition and flooded decomposition to represent the current understanding of local rice growing practices. Assumptions of rice decomposition practices were based on local information and estimated as proportion of rice acreage each year that underwent no decomposition or flooded decomposition. This information aligns with rice practices simulated in other models, including the Yuba Groundwater Model and C2VSimFG. Table 2-5 lists the land use categories. The crop categories are nearly identical to those in C2VSimFG, the only difference being CoSANA has one category of tomatoes, whereas C2VSimFG has two.

Table 2-5: Land Use Categories

Land Use Type	Model Category
Irrigated Crops	Grain
	Cotton
	Sugar Beets
	Corn
	Dry Beans
	Safflower
	Other Field Crops
	Alfalfa
	Pasture
	Tomato
	Cucurbits
	Onions & Garlic
	Potatoes
	Other Truck Crops
	Almonds & Pistachios
	Other Deciduous
	Citrus & Subtropical
	Vineyards
	Idle
	Rice
Other Land Use	Urban Landscape Water Surface Riparian Vegetation Native Vegetation

Spatial land use data were used to specify land use types and crop acreages for each model element for each year. The three major reference sources include DWR county land use surveys, DWR Statewide Crop Mapping, and CropScape. As crop categories were not consistent across all the land use data sources, individual mappings matched up each crop type to the appropriate model land use category. These data were available for different years for different counties. To approximate the land use across the entire model area, digital land use coverages were created from multiple datasets covering different years. These three snapshot years of land use coverage are assumed to represent conditions for 1995, 2005, and 2015 using data from a year close to that snapshot year (see Table 2-6). Linear interpolation was used represent land use for years between snapshot years. As no land use data for 2005 was available for Amador and San Joaquin Counties, land use in elements in those areas was linearly interpolated between 1995 and 2015.

Table 2-6: Sources of Data for Land Use Coverages

Data Source	Coverage Area	Year
1995 Land Use Coverage		
DWR Land Use Survey	Sutter County	1998
DWR Land Use Survey	Placer County	1994
DWR Land Use Survey	Sacramento County	1993
DWR Land Use Survey	San Joaquin County	1996
DWR Land Use Survey	Amador County	1997
2005 Land Use Coverage		
DWR Land Use Survey	Sutter County	2004
Local Information	Placer County	2009
DWR Land Use Survey	Sacramento County	2000
2015 Land Use Coverage		
DWR Statewide Crop Mapping	Sutter and Placer Counties (except for urban in Placer County)	2014
CropScape	Urban extent for Roseville-Lincoln	2015
DWR Land Use Survey	Sacramento County	2015
DWR Statewide Crop Mapping	San Joaquin and Amador Counties	2014

Land use development methodologies differed between DWR county land use surveys and DWR statewide crop mapping for 2014. Because the 2014 survey focused only on irrigated and urban areas, areas such as roads or strips between fields or buildings were assumed to be undeveloped or unirrigated land. This created issues in interpolation where longstanding rice fields would be shown as growing smaller and developed urban footprints were decreasing in acreage. In order to preserve the accuracy and refinement of the 2014 dataset, a reduction of 5% was applied to land use acreages developed from DWR county surveys assumed to represent 1995 and 2005. This 5% was estimated based on analysis of differences in estimated crop acreages for parcels known to be cultivated in both 1995 and 2015. Additionally, interpolation in dense urban areas was adjusted to have urban acreage remain the same or increase over time, to avoid erroneous reductions in urban land due to survey methodologies. Further refinement was also performed in the Elk Grove area to more accurately capture the timing of some of the large-scale agricultural-to-urban land use conversions in that area.

Refinement was also performed to capture drought-period fallowing. Growers indicated they fallowed fields in areas of Sutter and Placer Counties during 2014 in response to drought; these same fields were mostly returned to crops after the drought. The 2014 statewide survey categories for these idle plots were overwritten with 2016 and 2017 CropScape data to better reflect the total crop acreage in Sutter and Placer Counties for interpolation purposes. The idled acreage was added back in for the year 2014 after interpolation between the compositive areas was performed.

Figure 2-10, Figure 2-11, and Figure 2-12 show the spatial distribution of the land use coverages for CoSANA for 1995, 2005, and 2015. Figure 2-13 through Figure 2-16 show the annual cropping patterns for the entire CoSANA and individual subbasins.

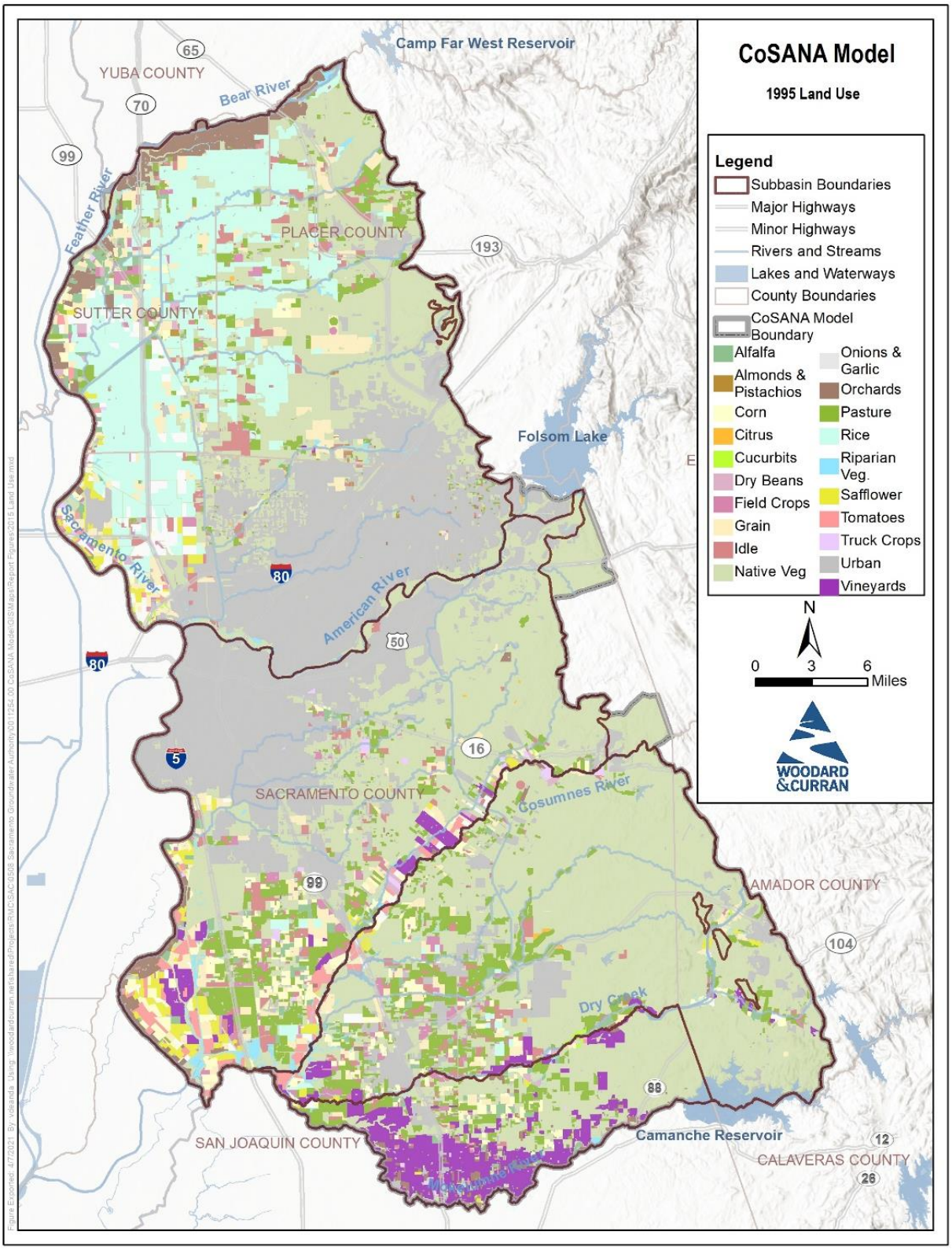


Figure 2-10: 1995 Land Use Coverage

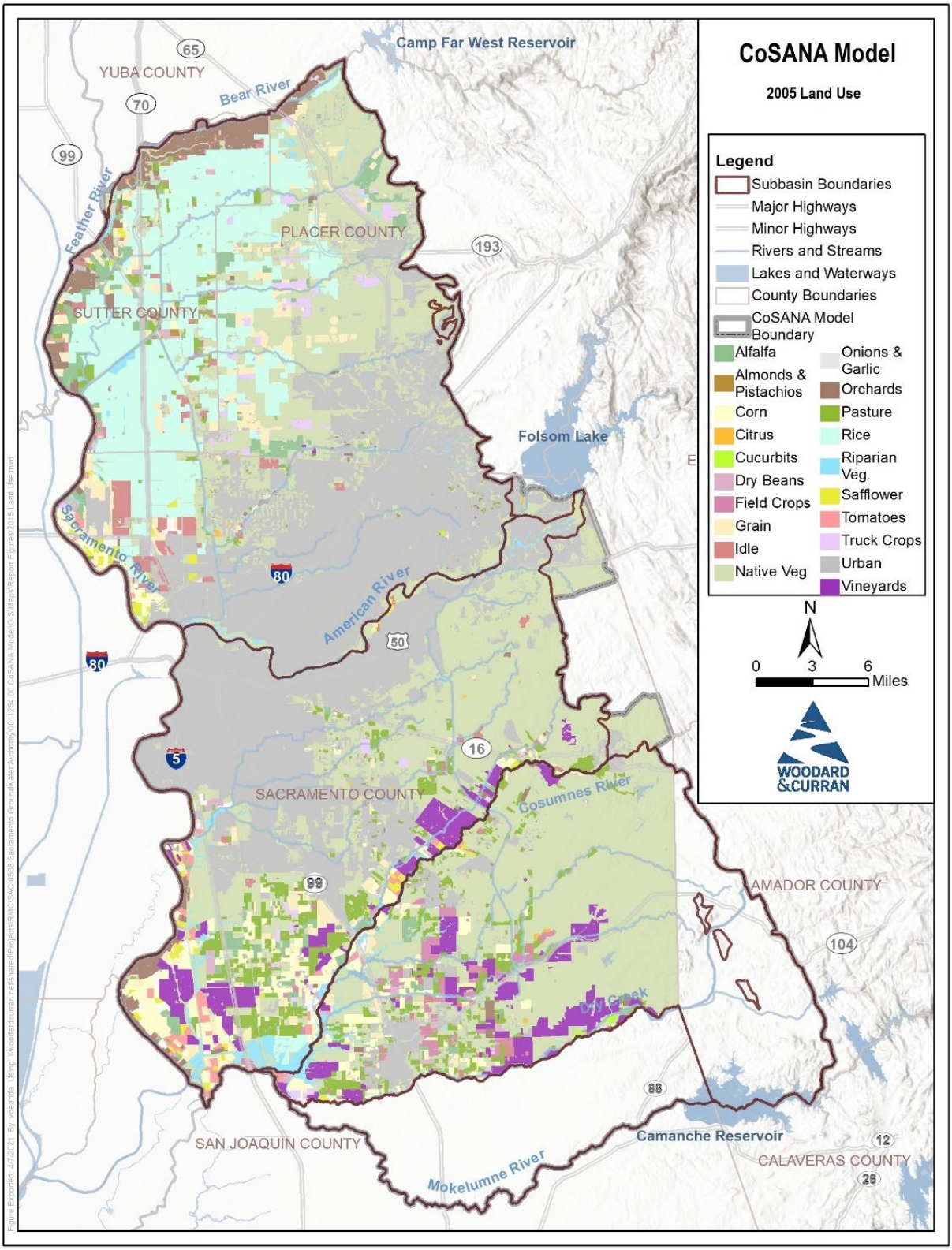


Figure 2-11: 2005 Land Use Coverage

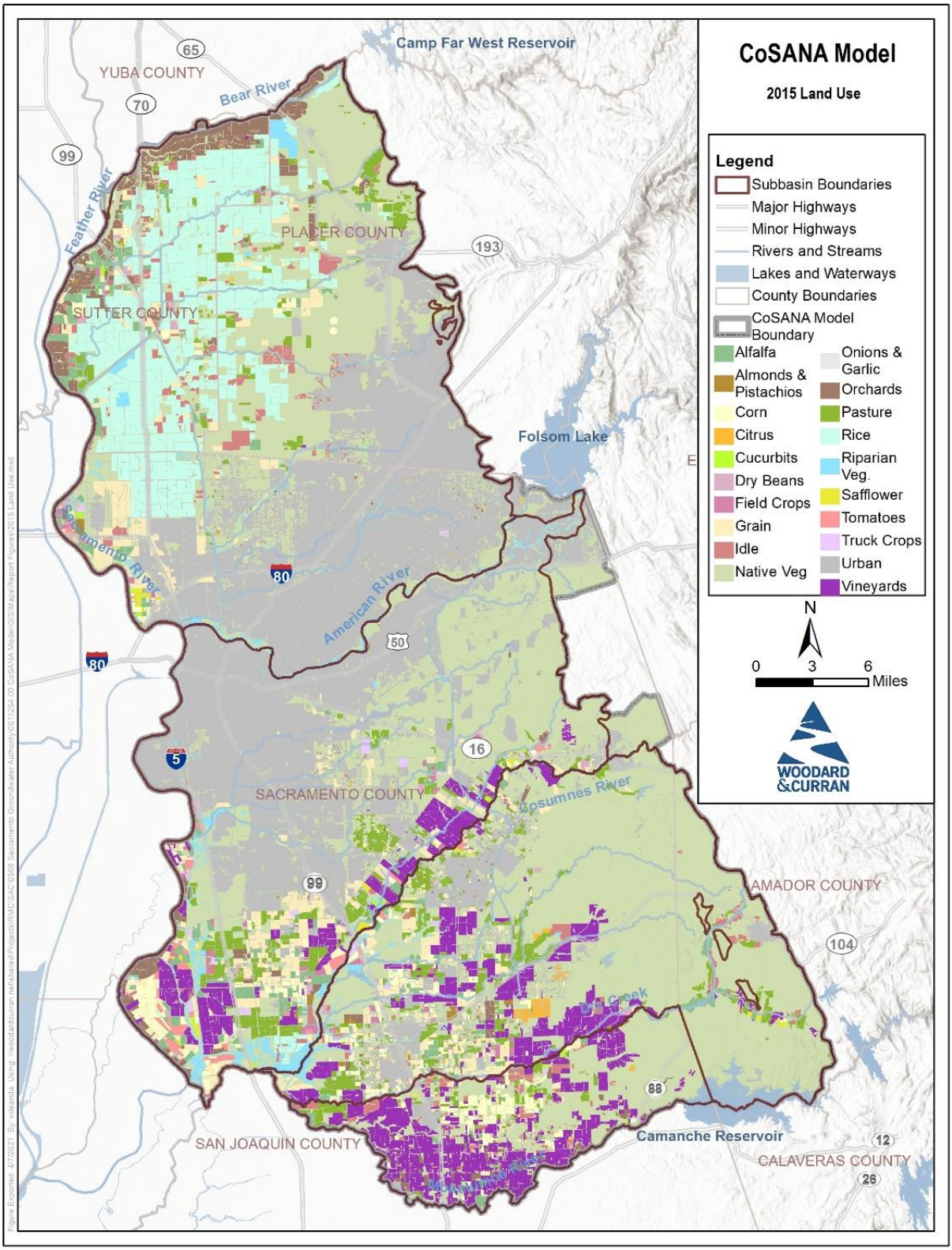


Figure 2-12: 2015 Land Use Coverage

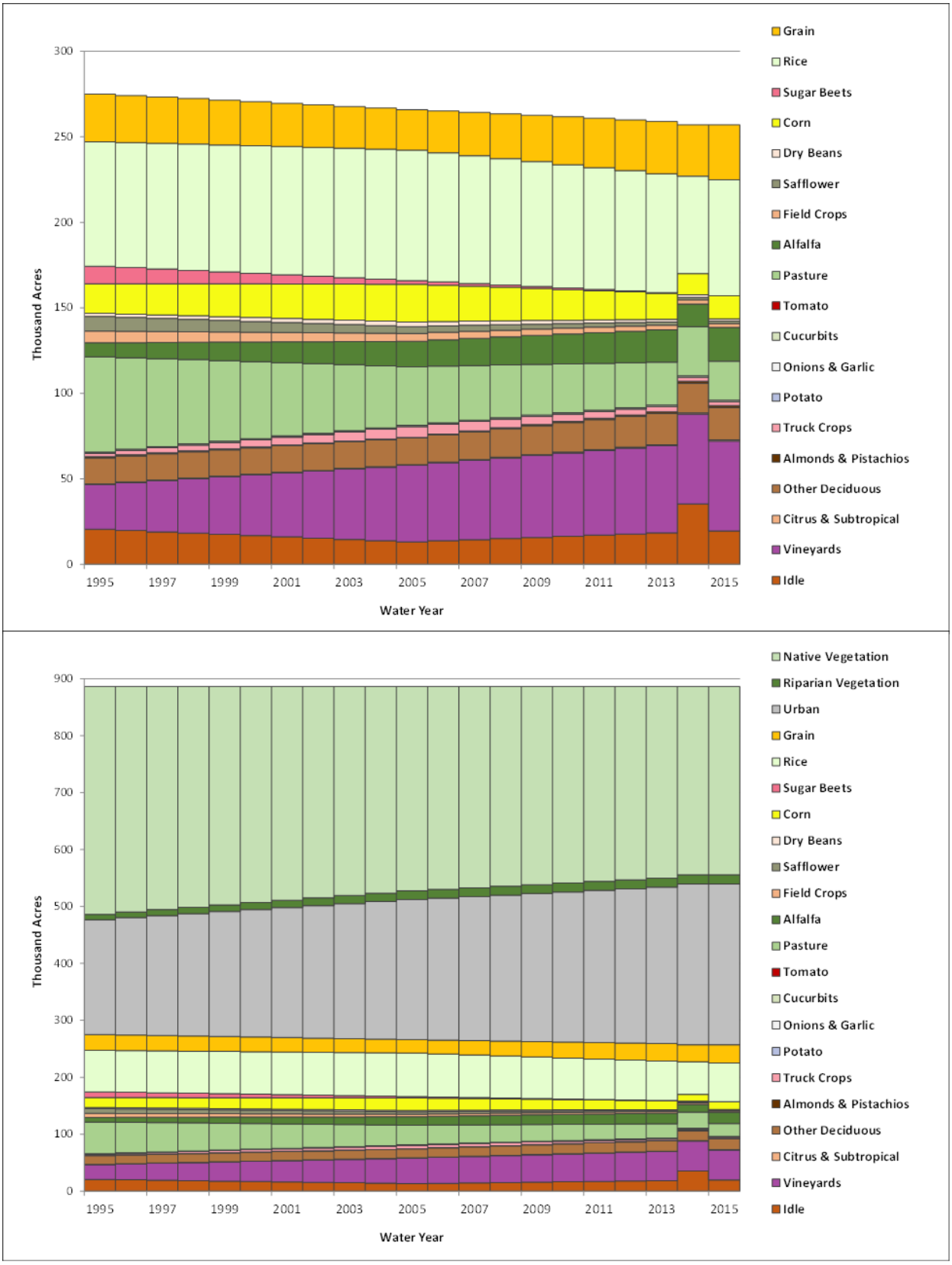


Figure 2-13: Annual Land Use for CoSANA

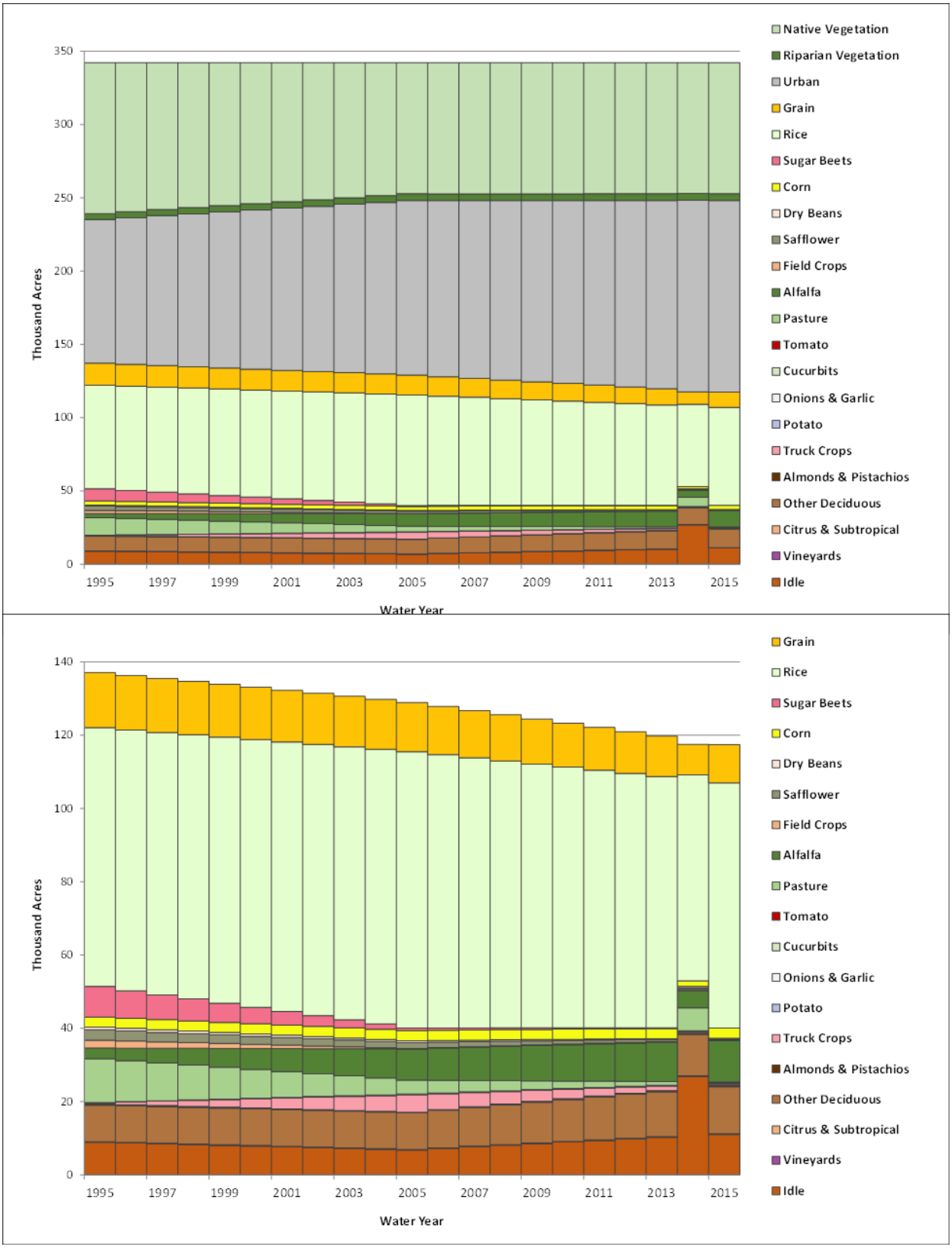


Figure 2-14: Annual Land Use for North American Subbasin

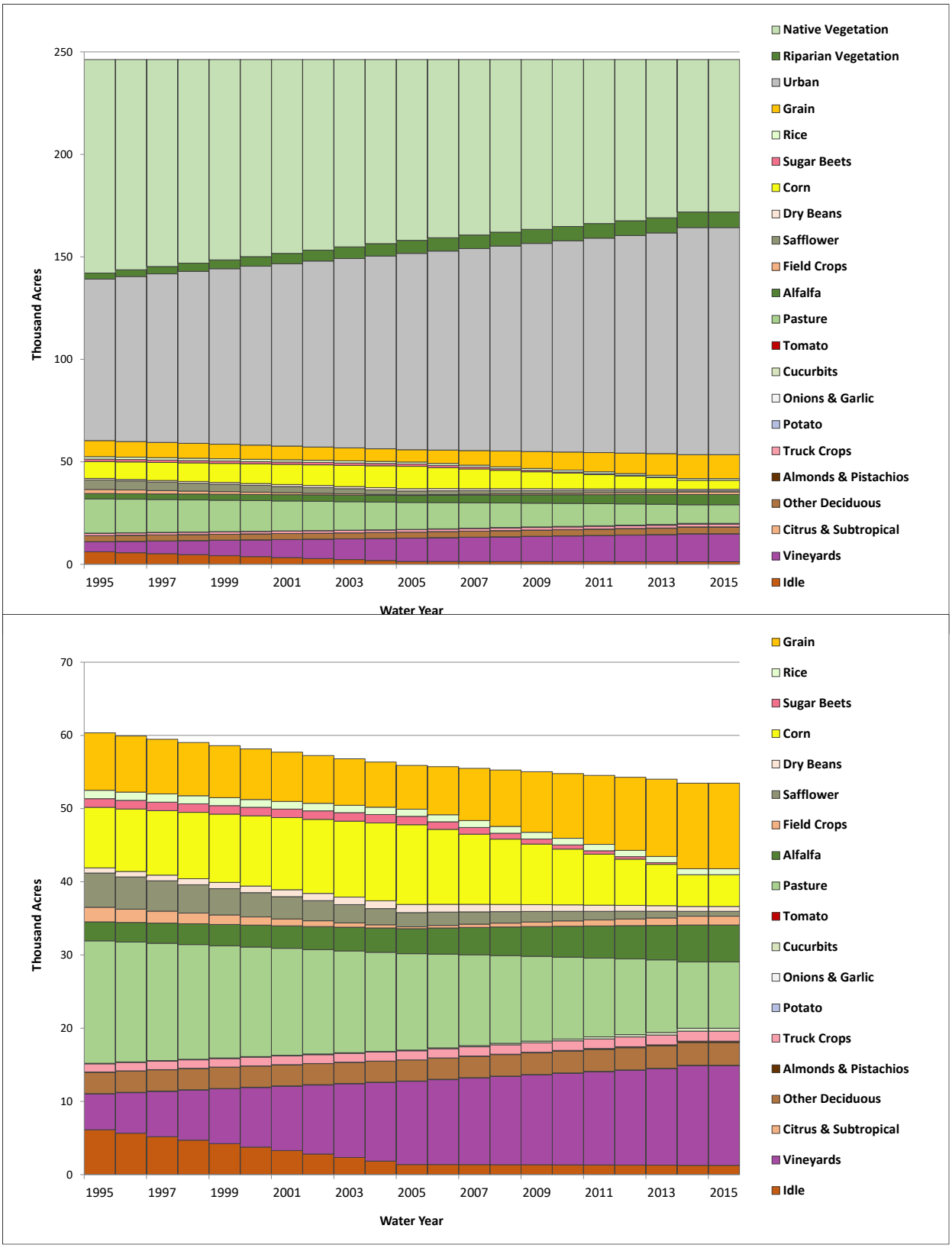


Figure 2-15: Annual Land Use for South American Subbasin

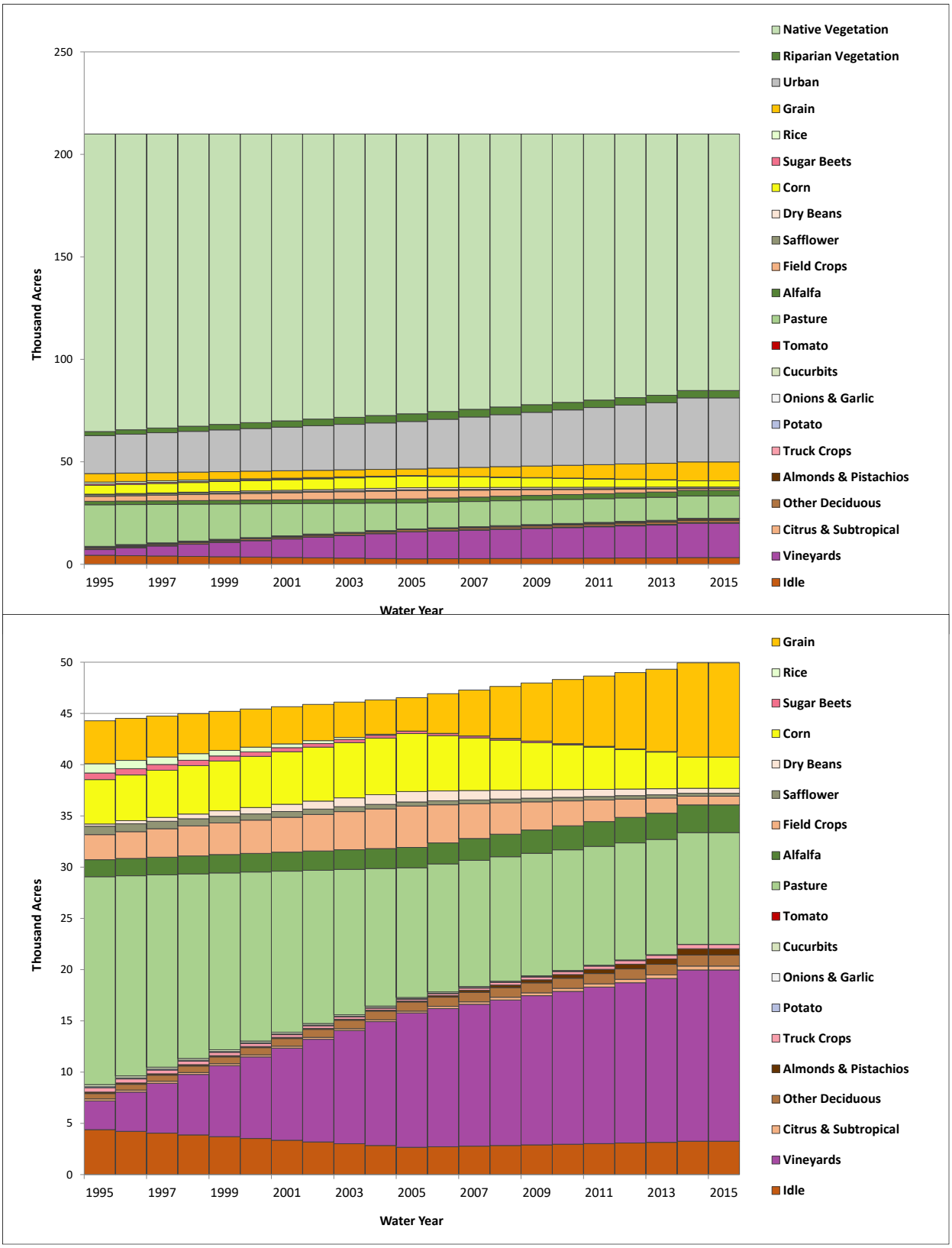


Figure 2-16: Annual Land Use for Cosumnes Subbasin

Land use trends in the North American Subbasin for 1995 through 2015 show decreases in total and irrigated agricultural acreage, with about 137,900 irrigated acres in 1995 and about 117,700 acres in 2015. During this same period, urban area increases from about 98,000 acres to about 130,800 acres. The increased urban area is due to both conversion of agricultural lands to urban areas, as well as conversion of native vegetation areas to urban. Most of the urban growth occurs in the Placer County area of the subbasin. In terms of irrigated acreages, decreases are observed in grain, rice, sugar beets, safflower, other field crops, and alfalfa/pasture. These decreases are due to urbanization and grower crop choices. The only irrigated crop showing substantial increases in acreage are orchards.

Land use trends in the South American Subbasin for 1995 through 2015 show decreases in total and irrigated agricultural acreage, with about 65,000 irrigated acres in 1995 and about 55,800 acres in 2015. During this same period, urban area increases from about 78,800 acres to about 110,800 acres. Increased urban area is due to both conversion of agricultural lands to urban areas, as well as conversion of native vegetation areas to urban. Most urban growth is observed to occur in the Elk Grove and Rancho Cordova areas. In terms of irrigated acreage, decreases are observed in corn, safflower, alfalfa/pasture, and tomatoes. These decreases are due to urbanization and grower crop choices. The largest increases in agricultural acreage are seen with the growth of grain and vineyards.

Land use trends in the Cosumnes Subbasin for 1995 through 2015 show increases in total and irrigated agricultural acreage, with about 45,200 irrigated acres in 1995 and about 50,200 acres in 2015. During this same period, urban area increases from about 18,500 acres to about 31,300 acres. Both urban and agricultural growth occur largely as a result of conversion of native vegetation areas. The majority of urban growth occurs as rural residential development in the Wilton area. In terms of irrigated acreage, decreases are observed in field crops (sugar beets, corn, safflower, and other field crops), and alfalfa/pasture. These decreases are due to urbanization and grower crop choices. Increases are observed in grain and permanent crops such as orchards and vineyards.

2.8 Evapotranspiration

Evapotranspiration (ET) is an important factor in demand estimation for crops and native vegetation. Every CoSANA land use type and crop category, as well as the small-stream watersheds, are assigned monthly values for the entire simulation period, which provides the monthly and annual hydrologic variability in ET estimates for the period of simulation.

The starting ET values through September 2015 were derived from C2VSimFG values for the C2VSimFG Subregion 7, which represents the NASb and was chosen as being most representative of the agricultural practices of the greater Sacramento region as modeled in CoSANA. Additional modifications were made during model calibration to the rice ET based on local information. Also, grain, vineyards, field crops, and safflower ET was updated using typical year monthly crop evapotranspiration information developed by the Irrigation Training and Research Center (ITRC) at California Polytechnic State University, San Luis Obispo by DWR's CIMIS (California Irrigation Management Information System) Zone. CIMIS zones represent areas with similar long-term average reference ET (ET_o) values, there are in total 18 zones to represent ET variability across California (https://cimis.water.ca.gov/App_Themes/images/ etozonemap.jpg). CoSANA uses average data for both Zone 12 and Zone 14.

To extend this data to 2018, ET_o data were downloaded for CIMIS station 131 (Fair Oaks). Monthly crop coefficient (ET_c) data for the extended period were estimated using the ratio of ET_o between annual data and the 2015 data.

Of 20 agricultural land uses in CoSANA, 7 crop types account for nearly 95% of irrigated cropland (for the 2015 land use survey). The monthly ET requirements of these crops are shown in Figure 2-17, Figure 2-18, and Figure 2-19, as well as for urban, riparian vegetation, and native vegetation land use types. Annual ET demands for the major land use types are 19.0 inches/year for grain, 29.7 inches/year for corn, 47.6 inches/year for alfalfa, 49.8 inches/year for pasture, 45.6 inches/year for orchards, 30.4 inches/year for vineyards, 32.3 inches/year for rice, 42.9 inches/year for urban, 18.2 inches/year for native vegetation, and 63.4 inches/year for riparian vegetation.

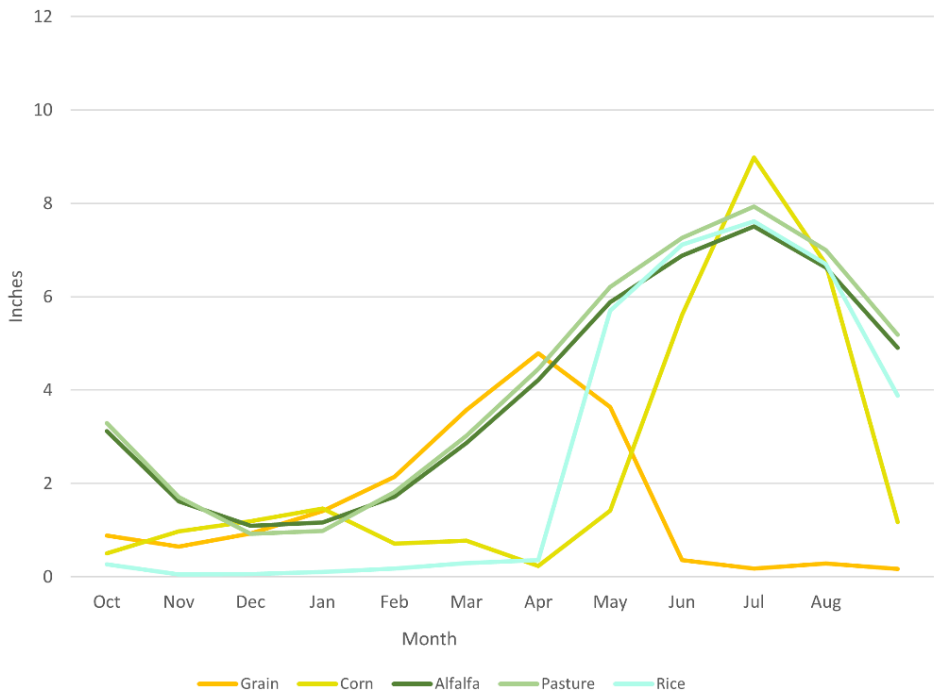


Figure 2-17: Average Monthly Evapotranspiration by Land Use Type, Major Field and Row Crops

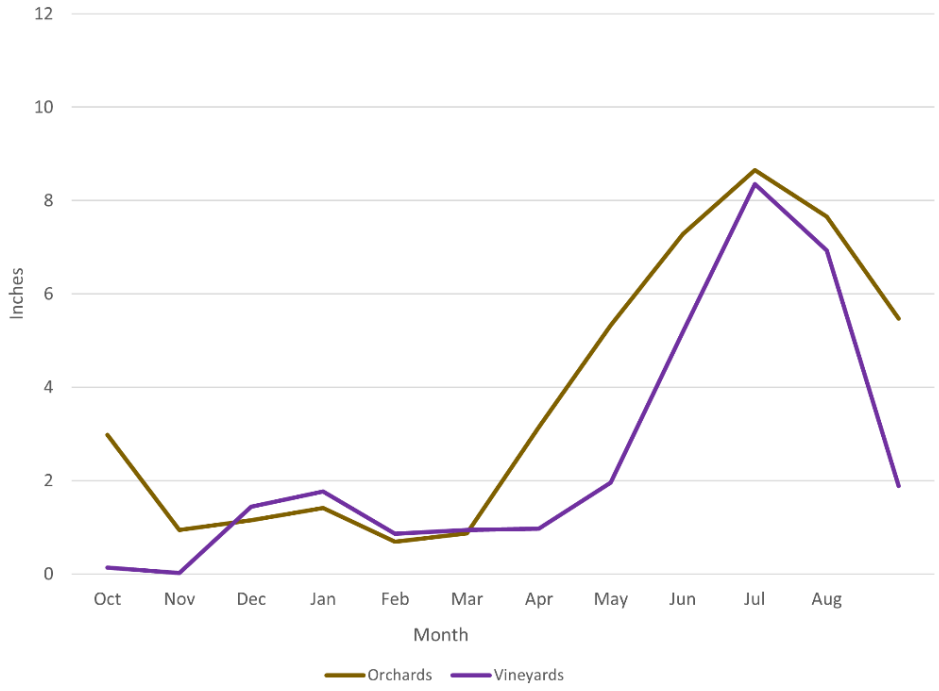


Figure 2-18: Average Monthly Evapotranspiration by Land Use Type, Orchards and Vineyards

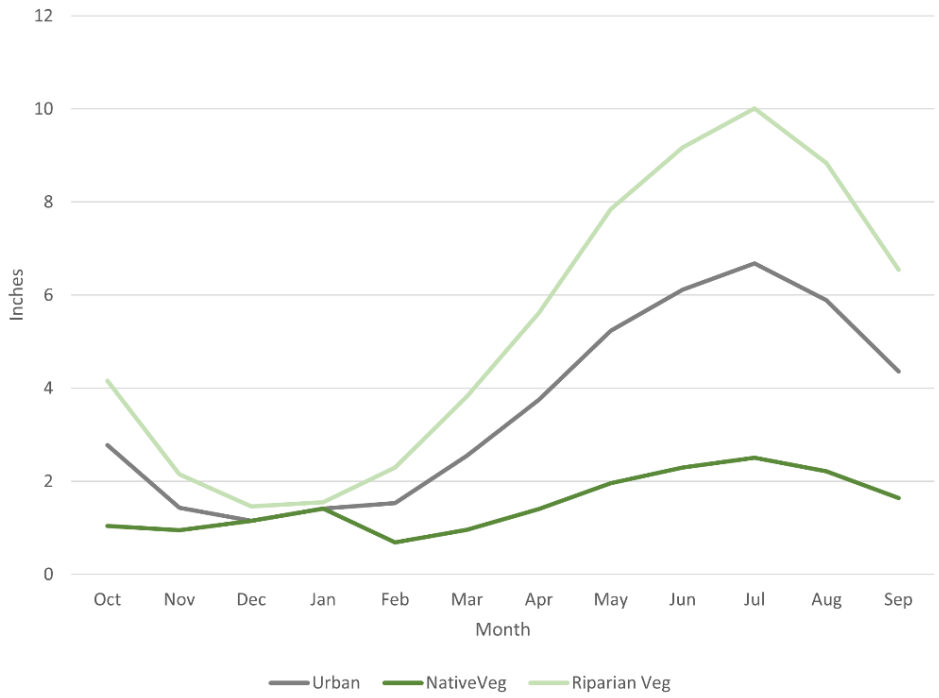


Figure 2-19: Average Monthly Evapotranspiration by Land Use Type, Urban, Native, and Riparian

2.9 Root Zone Soil Parameters

The soil properties specified in CoSANA are field capacity, wilting point, total porosity, saturated hydraulic conductivity, and pore size distribution index. The soil properties are used to calculate rainfall runoff and infiltration through the soil zone for each model element. Data from C2VSimFG was used to populate the five soil properties for each model element. The soil parameters were modified during the calibration process; the final soil parameter values and their spatial distributions are discussed and shown in figures in Section 0.

Model elements are also associated with the four hydrologic soil groups according to their runoff potential and infiltration characteristics. CoSANA elements with their corresponding hydrologic soil group are shown in Figure 2-20. The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS; USDA NRCS, 2007) defines these hydrological soil groups as follows:

- Soils in Group A have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Some soils having loamy sand, sandy loam, loam, or silt loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
- Soils in Group B have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. Some soils having loam, silt loam, silt, or sandy clay loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

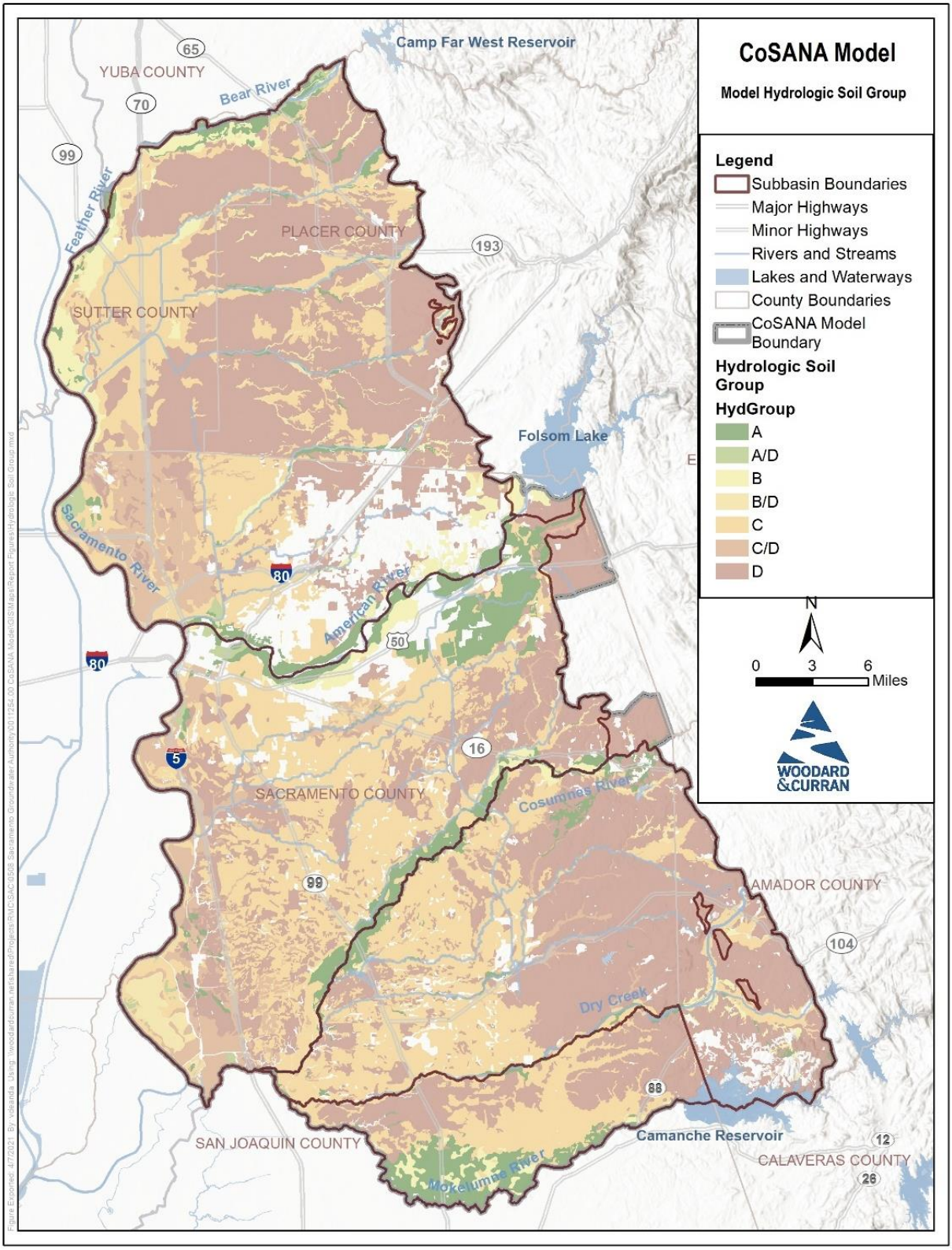


Figure 2-20: USDA Hydrologic Soil Groups

- Soils in Group C have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
- Soils in Group D have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

2.10 Geologic Structure and Model Layering

The following section highlights development and refinement of CoSANA stratigraphy.

2.10.1 Model Layer Development and Approach

Layering for a groundwater model is guided by many factors, several of which are described as follows:

- Hydrostratigraphy of the study area. The thickness and extent of model layers and the overall extent and depth of the model was developed based on available geologic and hydrogeologic reports, including available maps and cross-sections, to reflect the physical system being simulated. Information from neighboring subbasins was also considered for consistency with the modeling efforts in those areas.
- Stream-aquifer interaction. CoSANA will support the investigation of stream-aquifer interaction in the modeled subbasins, notably for the American, Sacramento, and Cosumnes Rivers. This requires a realistic and accurate representation of the aquifer, pumping volumes, and pumping locations and a grid that is discretized sufficiently fine horizontally and vertically. Representing the recent alluvium and Riverbank Formation as a separate layer provided a finer vertical discretization underneath and around the streams.
- Available information on screen/perforation depths for monitoring and production wells. If available, information on the vertical distribution of pumping is used to layer the model such that it corresponds to the depths at which those stresses occur. At present, there is limited information on the vertical distribution of well screens and perforations in the study area, particularly for private agricultural and domestic wells. Furthermore, many wells in the area were constructed with long sections of perforation or open boring, making it difficult to determine the elevations of greatest groundwater production.
- Importance of vertical gradients and the availability of vertically distributed head data. There are several multi-completion monitoring wells installed in the study area. At the most there are only five completions in an individual well cluster. Vertical discretization beyond that level would require estimation of parameters that control vertical movement of water (e.g., vertical hydraulic conductivity) that could not be evaluated by comparison of simulated and observed data.
- Model run time. All other considerations being equal, model run times will increase with the number of layers that are used. Run time was identified as an important consideration early in the planning process for CoSANA due to the benefits seen from faster model run time for SacIWRM. The ability to perform many model runs quickly is a desired outcome in the model development, particularly when iterative modeling scenarios are performed.

The selection of the number of layers and their elevations requires balancing these factors and the overall objectives of the project.

2.10.2 Model Layer Definition

The subsurface is characterized in CoSANA by five model layers representing the different geology from the ground surface to the shallower of bedrock or the base of fresh water. The ground surface elevation, the upper boundary of the topmost layer, is based on the USGS DEM at a resolution of 30 meters. Descriptions of each of the model layers are listed below, from top to bottom. DWR's Bulletin 118-3 (1974) and data from the Western Placer County Groundwater Management Plan (Roseville, City of, et al., 2007) provided cross sections that were used to support development of all layers, while surficial geology maps (California Geological Survey 2009, 2011) were used primarily to support the extent of layers at the surface. Figures 23-27 show the extent and thickness of each model layer as described below.

- Layer 1 represents the recent alluvium and Riverbank Formation. Layer 1 is up to 188 feet thick and is generally constrained to be at least 30 feet thick. This layer was developed using California Geological Survey (2009; 2011), DWR's Bulletin 118-3 (1974), and data from the Western Placer County Groundwater Management Plan (Roseville, City of, et al., 2007) (Figure 2-21).
- Layer 2 corresponds to the Laguna Formation. Layer 2 is up to 502 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-22).
- Layer 3 corresponds to the Mehrten Formation. Layer 3 is up to 1,487 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-23).
- Layer 4 corresponds to the Valley Springs Formation. Layer 4 is up to 824 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-24). The bottom of the Valley Springs Formation was supported by the work of Page (1974) in addition to the sources described earlier.
- Layer 5 corresponds to the portion of the Ione Formation that is above the base of fresh groundwater. Base of fresh water is defined based on Berkstresser (1973) and represents the depth where electrical conductivity is approximately 3,000 microsiemens per centimeter. Very few borings penetrate far below the base of freshwater, and it is expected that very little pumping occurs from this depth. Layer 5 is up to 795 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-25).

A set of cross-sections were developed to show model stratigraphy in various locations and are presented as an overview map and 12 cross sections in Figure 2-26 through Figure 2-38.

Within each model layer, CoSANA aquifer parameters were estimated based on the texture dataset of the Sacramento Valley (DWR, 2018a). Aquifer parameters assigned to pilot point locations covering the model domain were distributed to model nodes using the sediment-based texture information to provide the spatial variability of parameters.

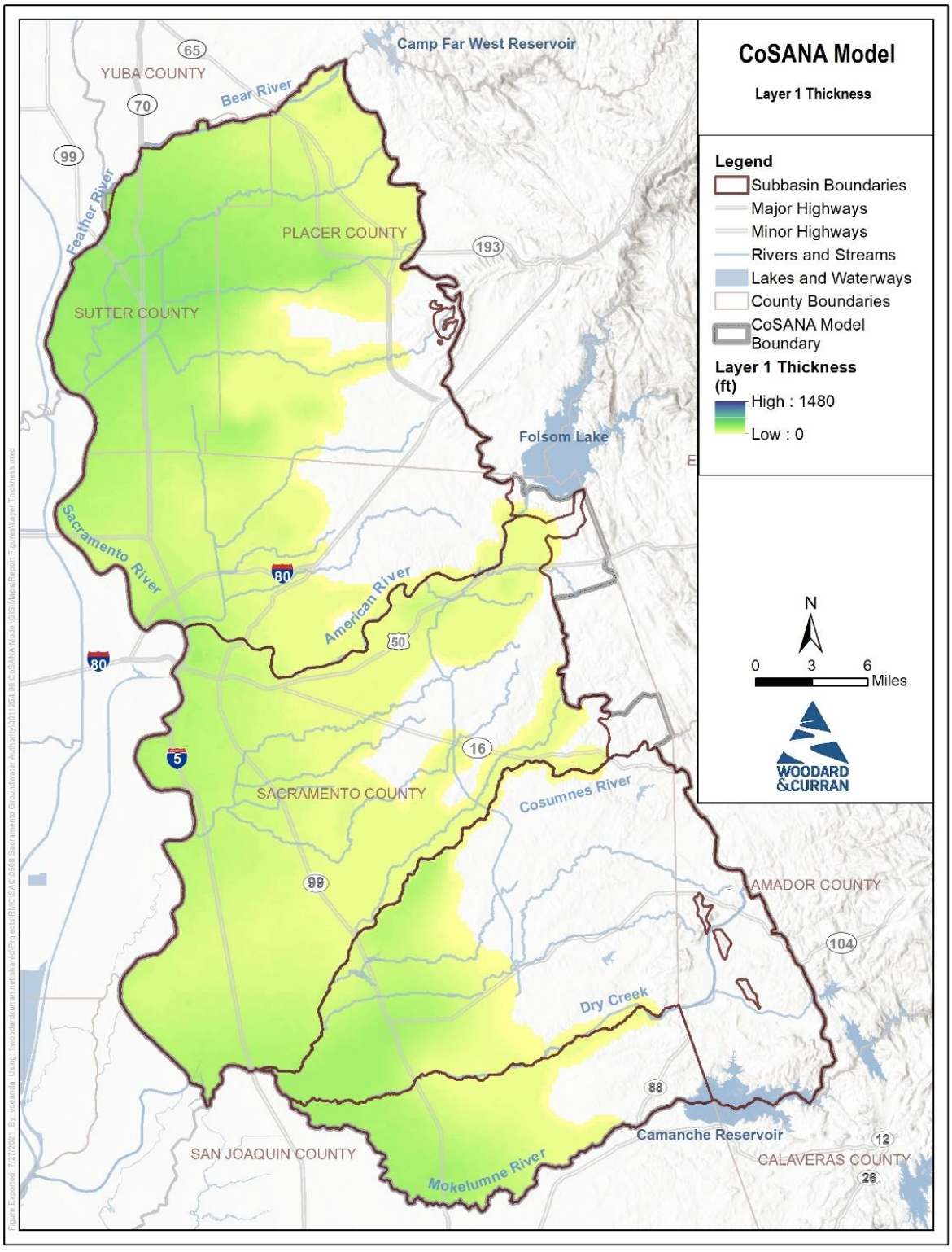


Figure 2-21: Thickness of Layer 1

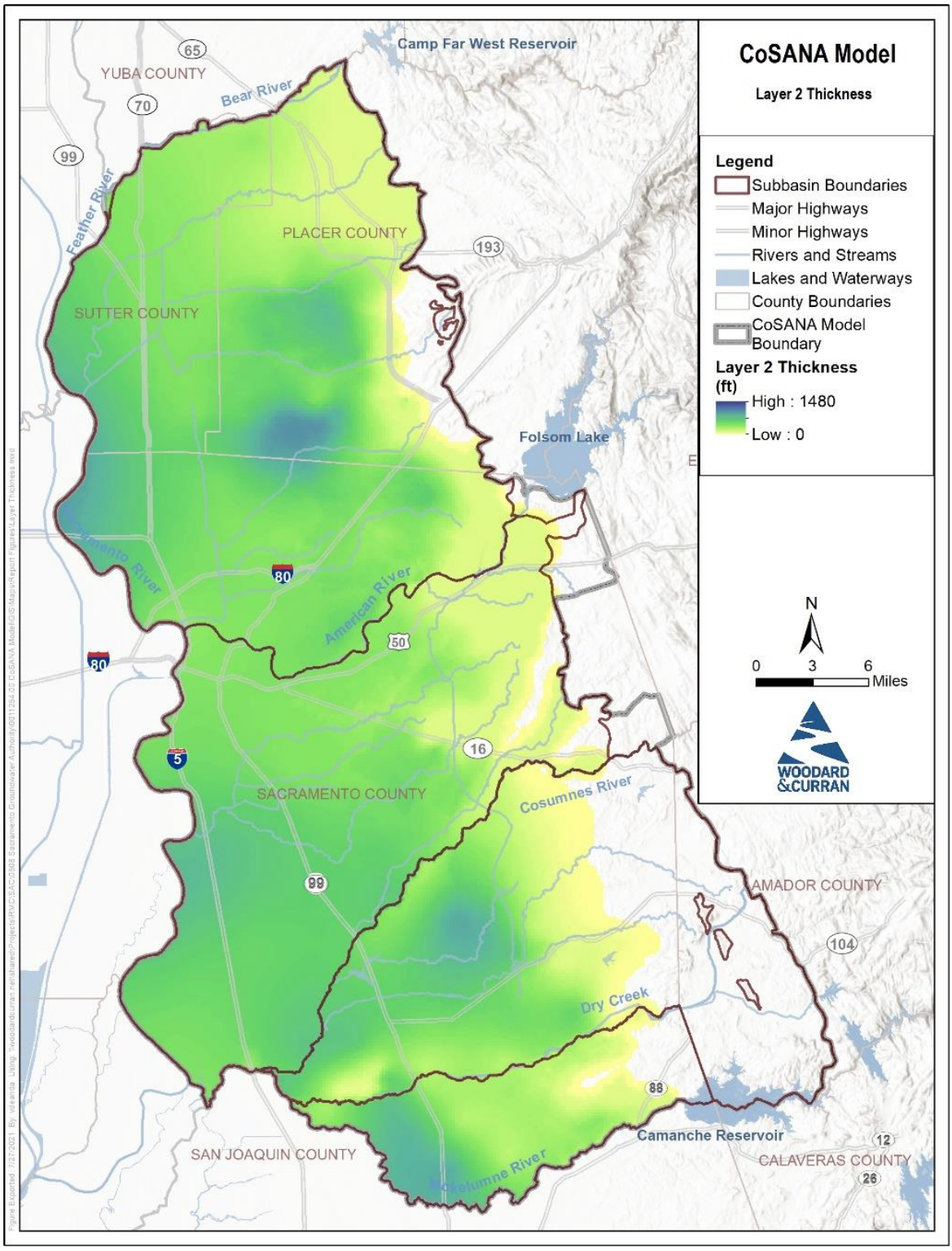


Figure 2-22: Thickness of Layer 2

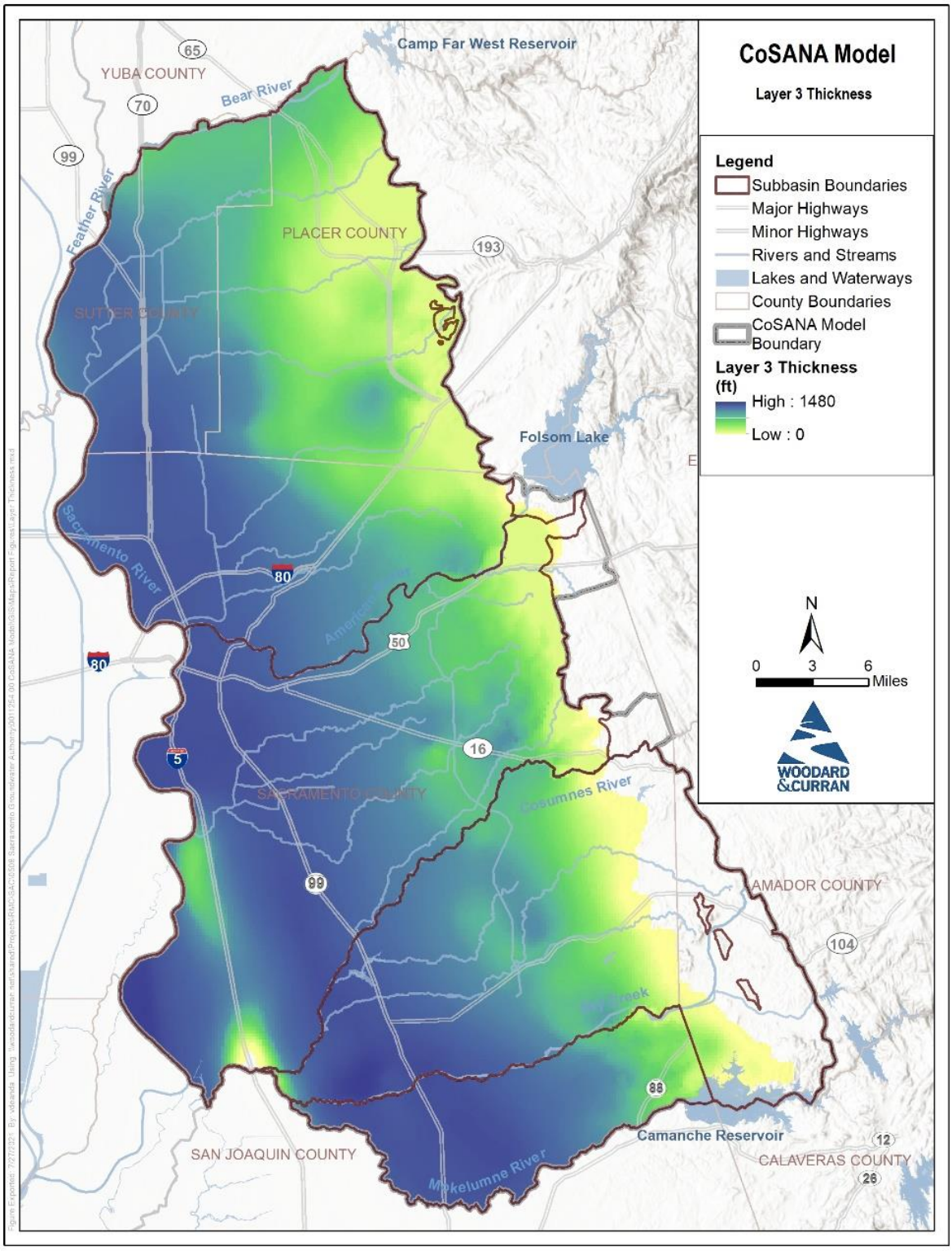


Figure 2-23: Thickness of Layer 3

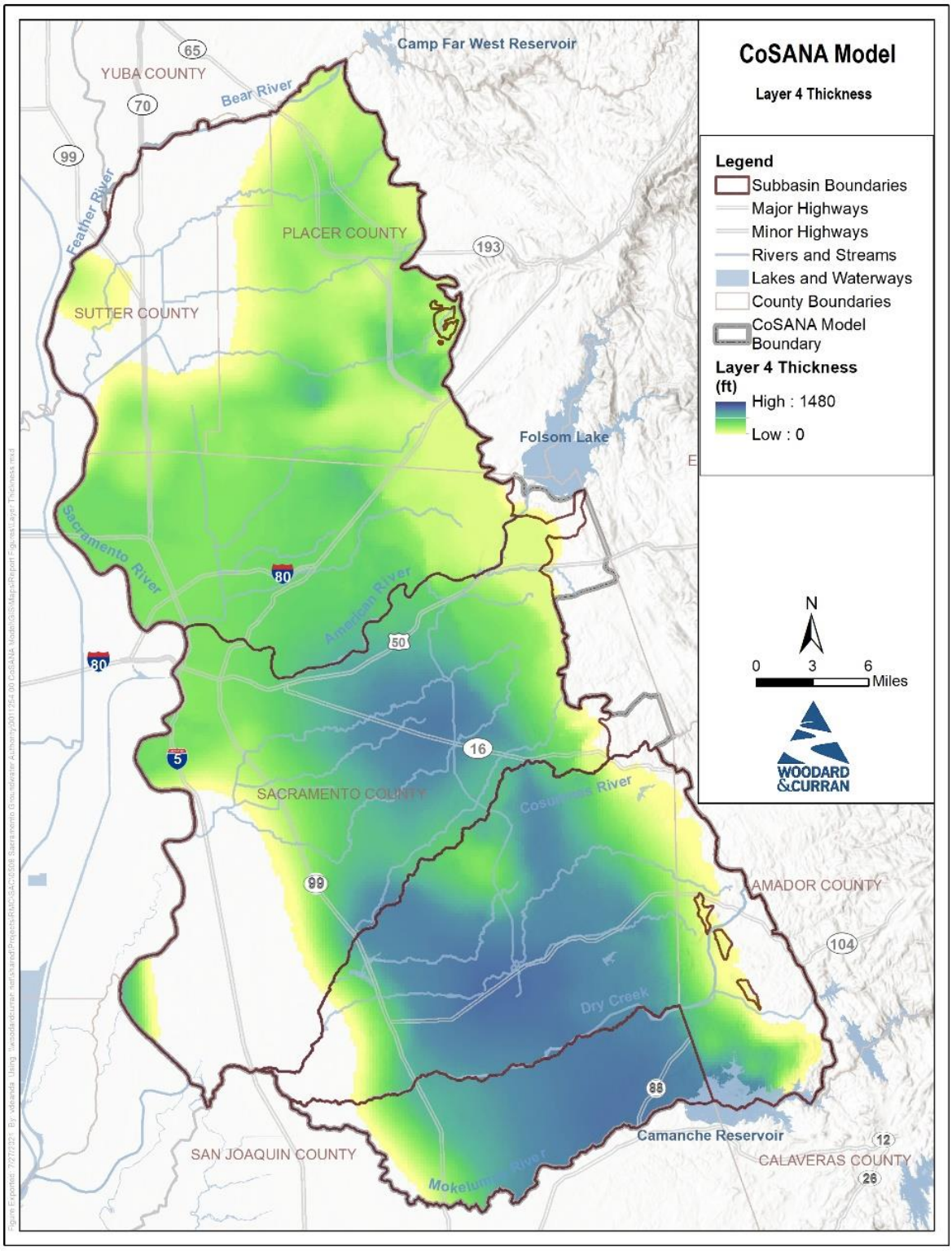


Figure 2-24: Thickness of Layer 4

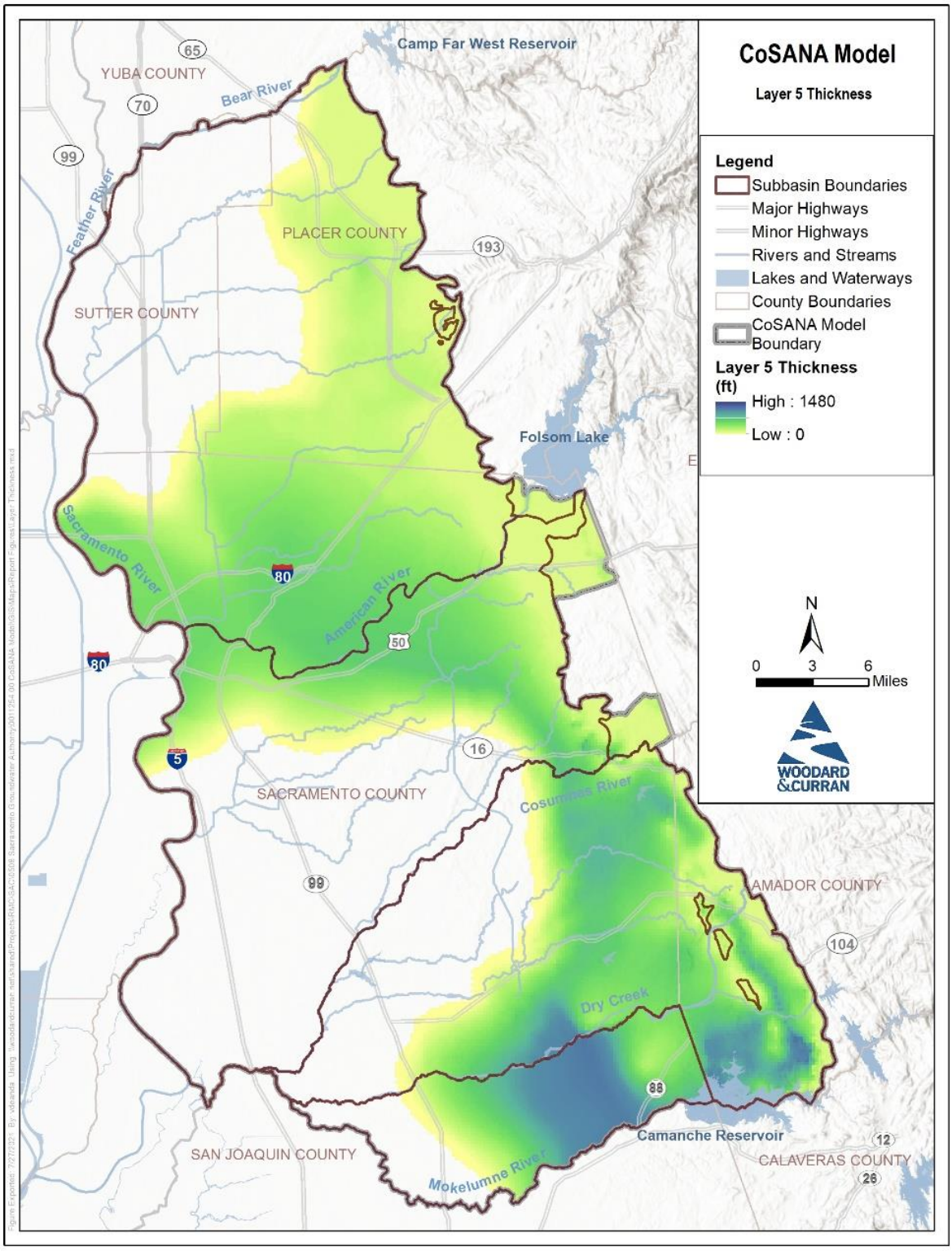


Figure 2-25: Thickness of Layer 5

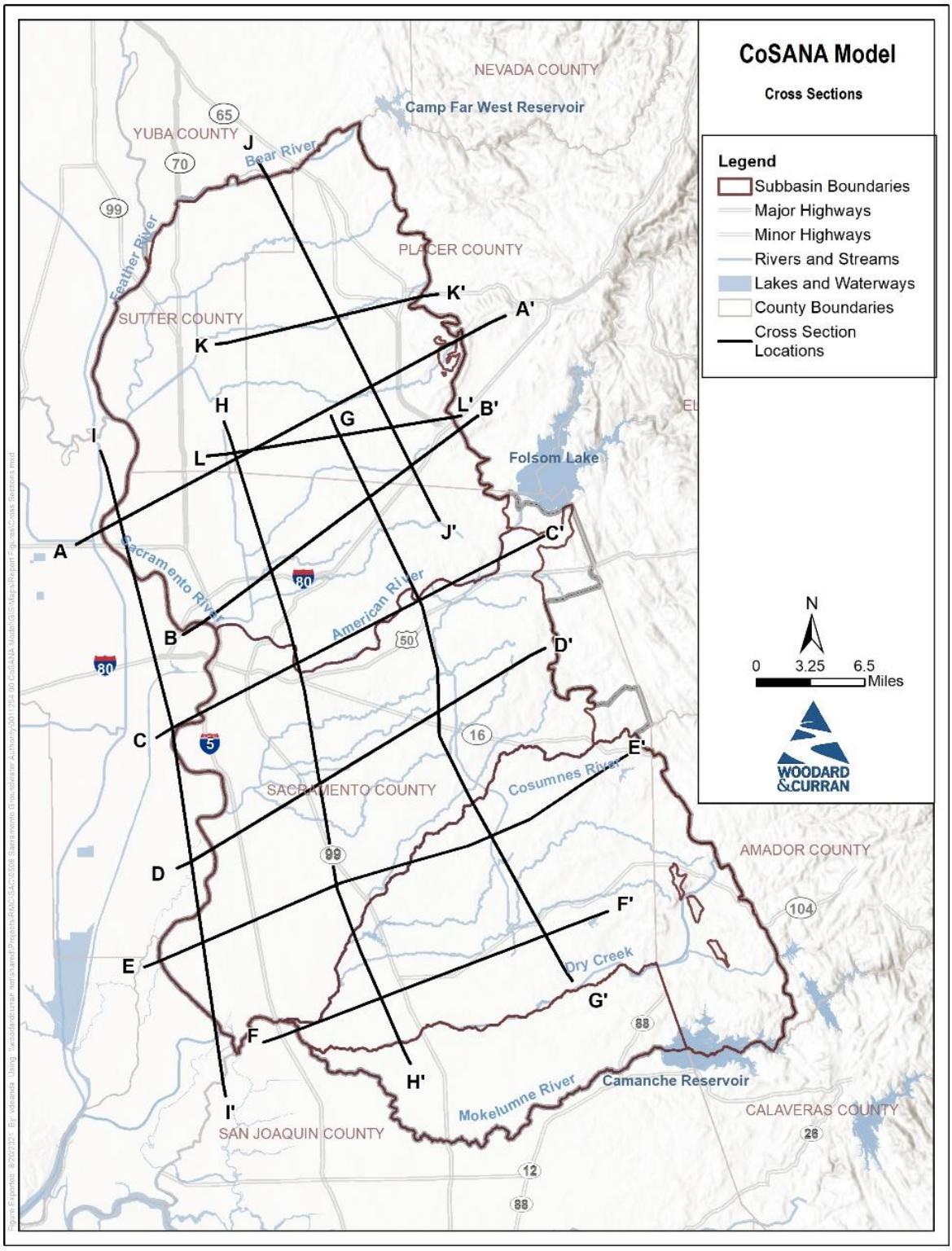


Figure 2-26: CoSANA Cross Sections

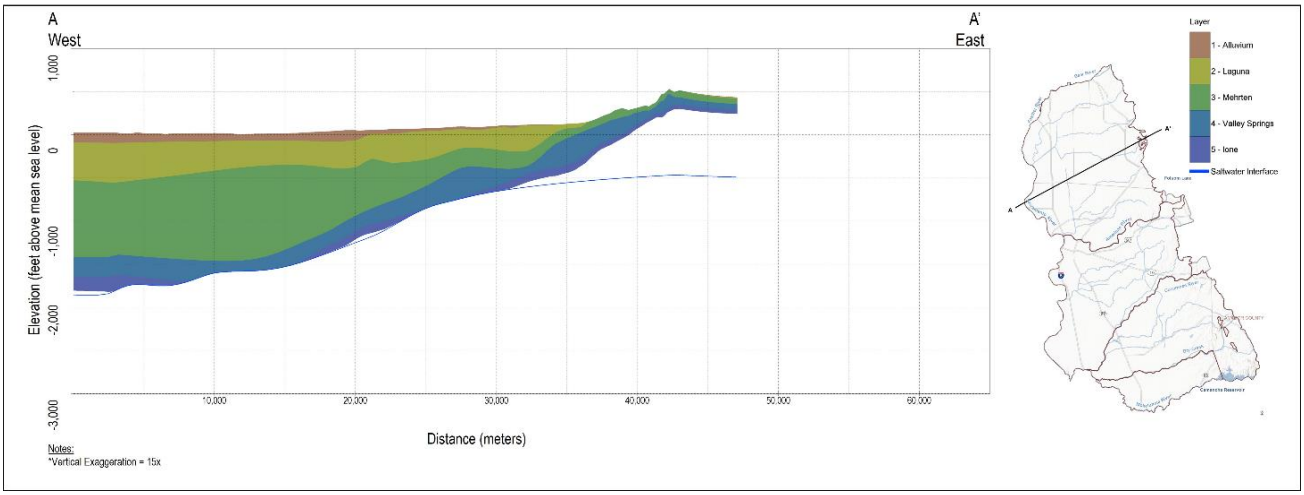


Figure 2-27: CoSANA Cross Section A-A'

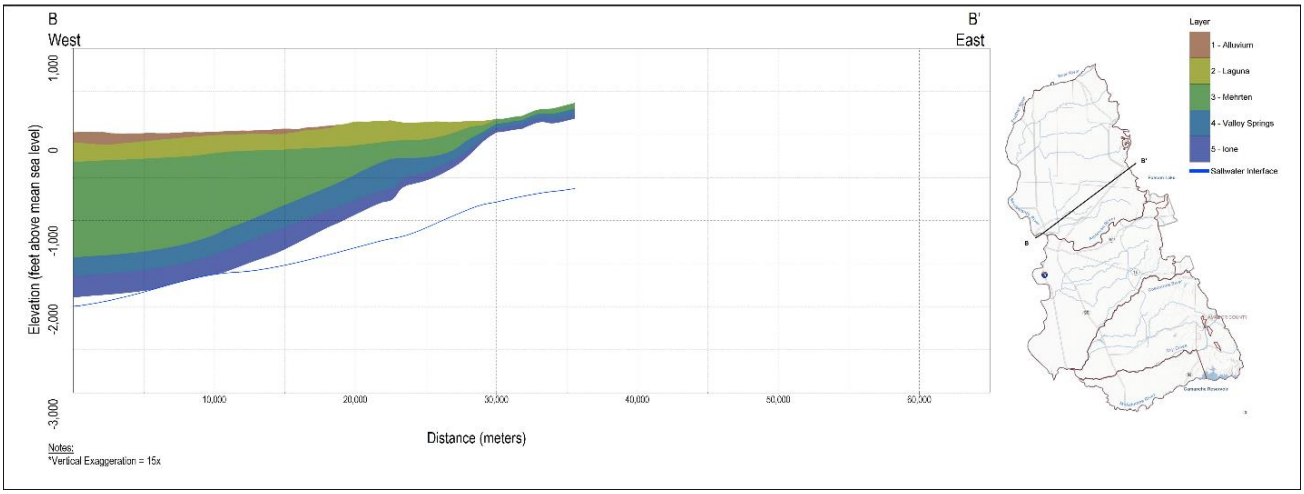


Figure 2-28: CoSANA Cross Section B-B'

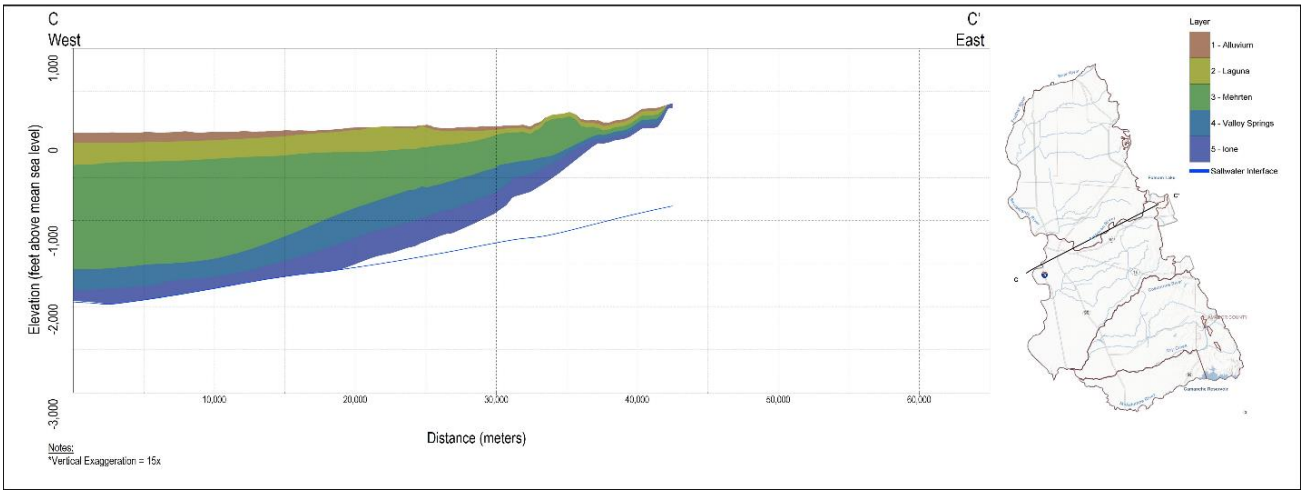


Figure 2-29: CoSANA Cross Section C-C'

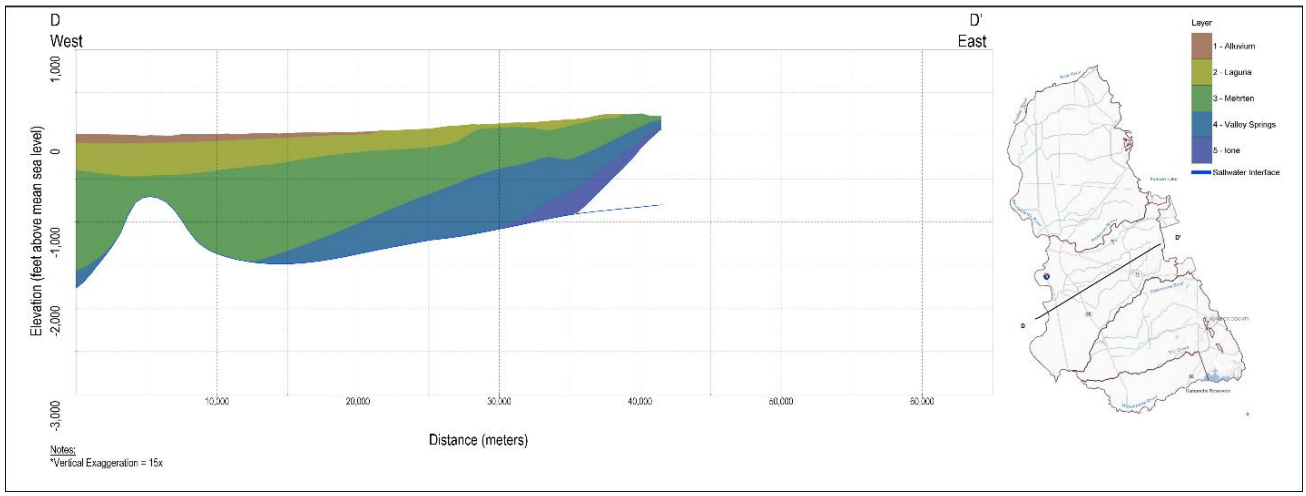


Figure 2-30: CoSANA Cross Section D-D'

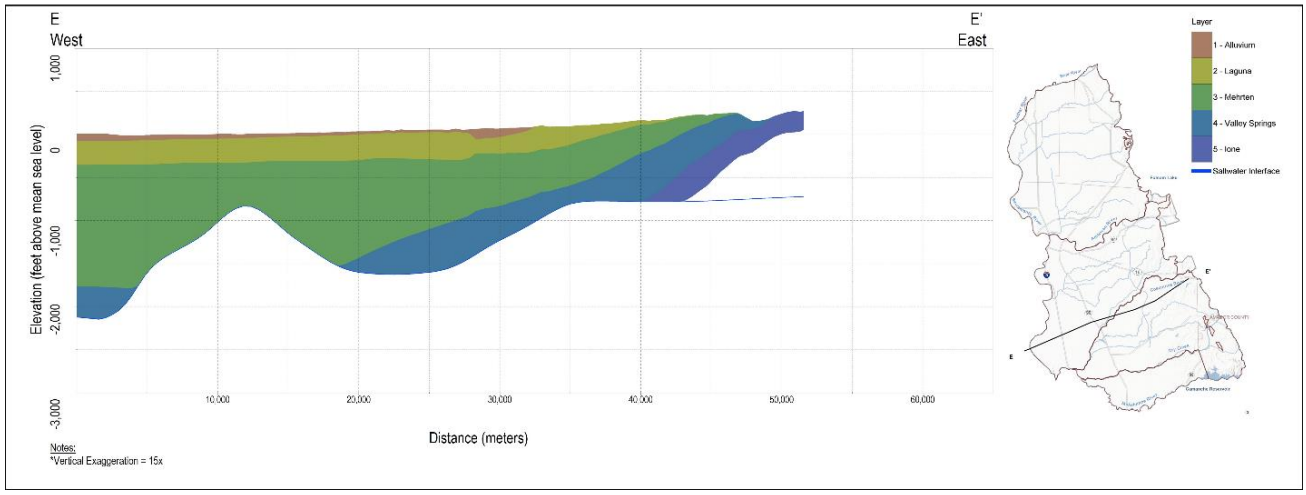


Figure 2-31: CoSANA Cross Section E-E'

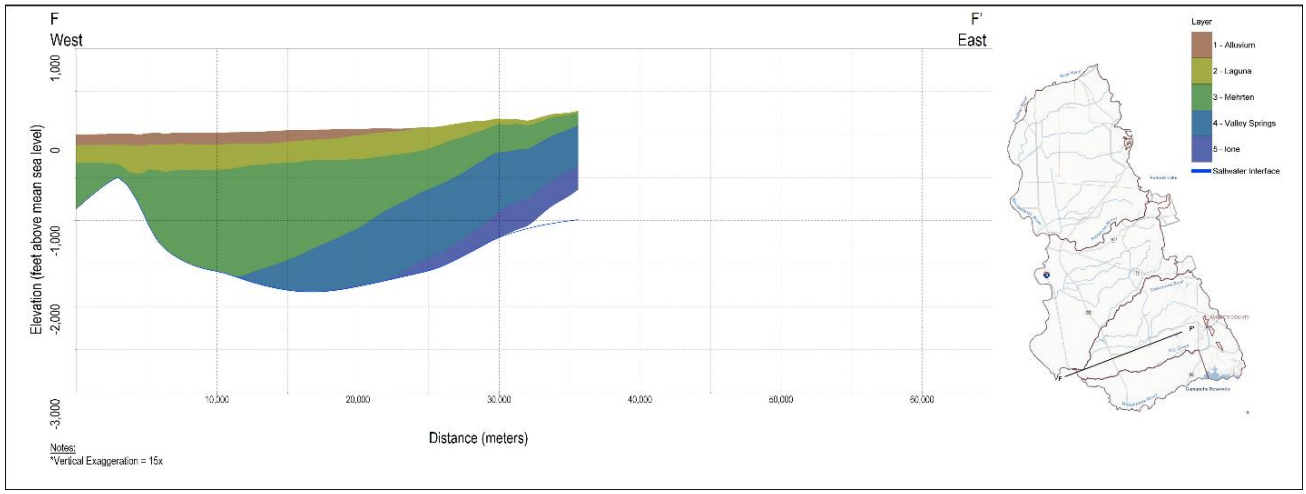


Figure 2-32: CoSANA Cross Section F-F'

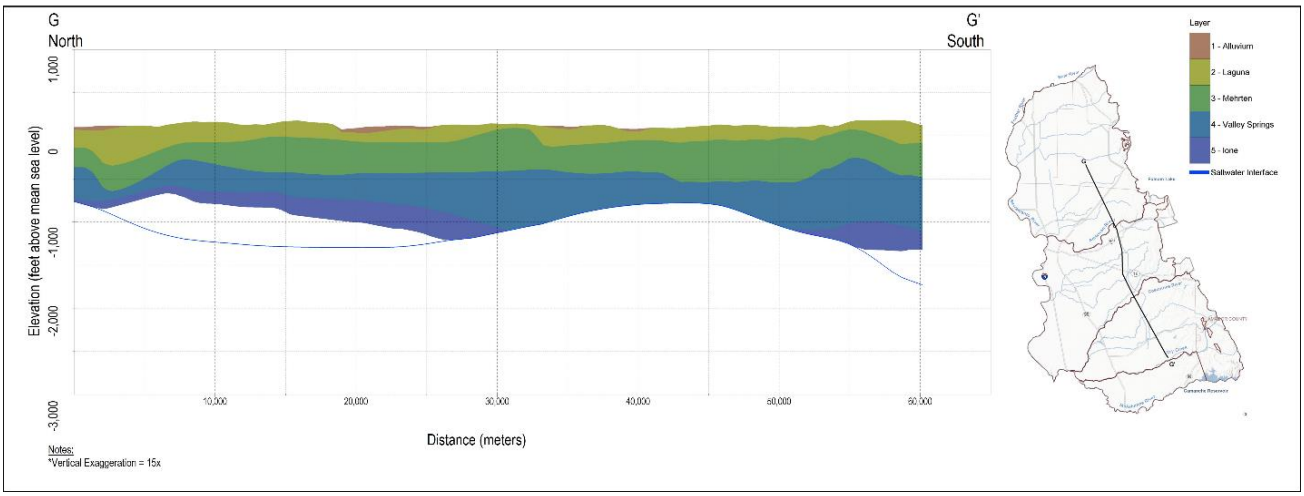


Figure 2-33: CoSANA Cross Section G-G'

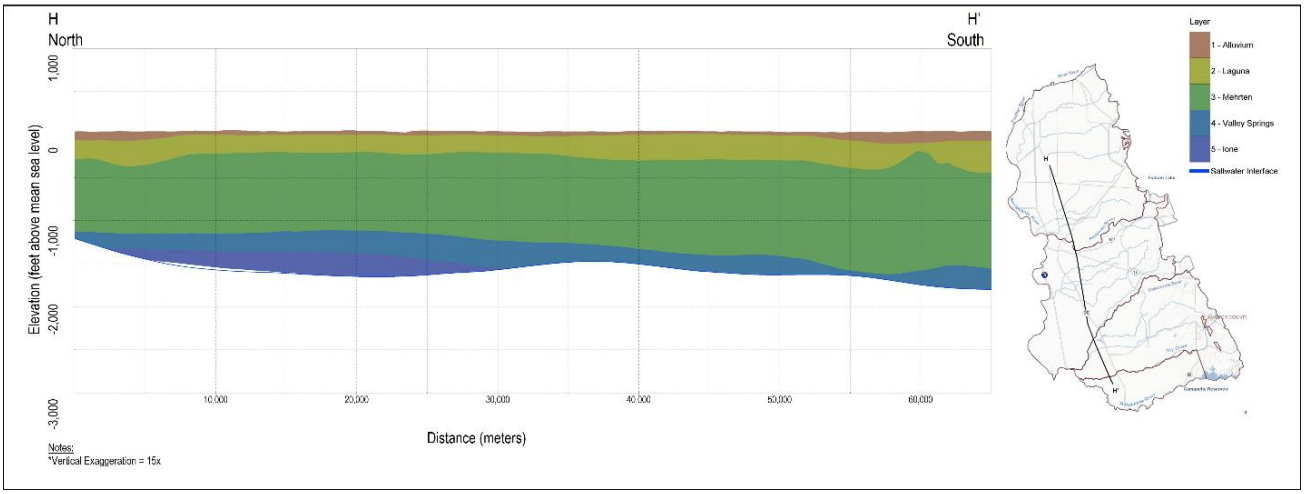


Figure 2-34: CoSANA Cross Section H-H'

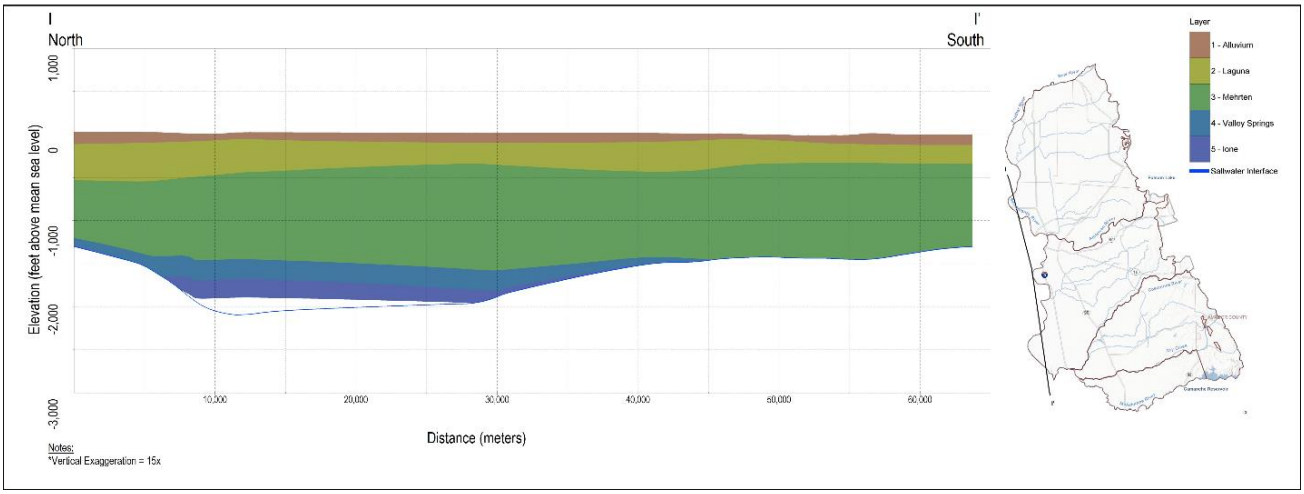


Figure 2-35: CoSANA Cross Section I-I'

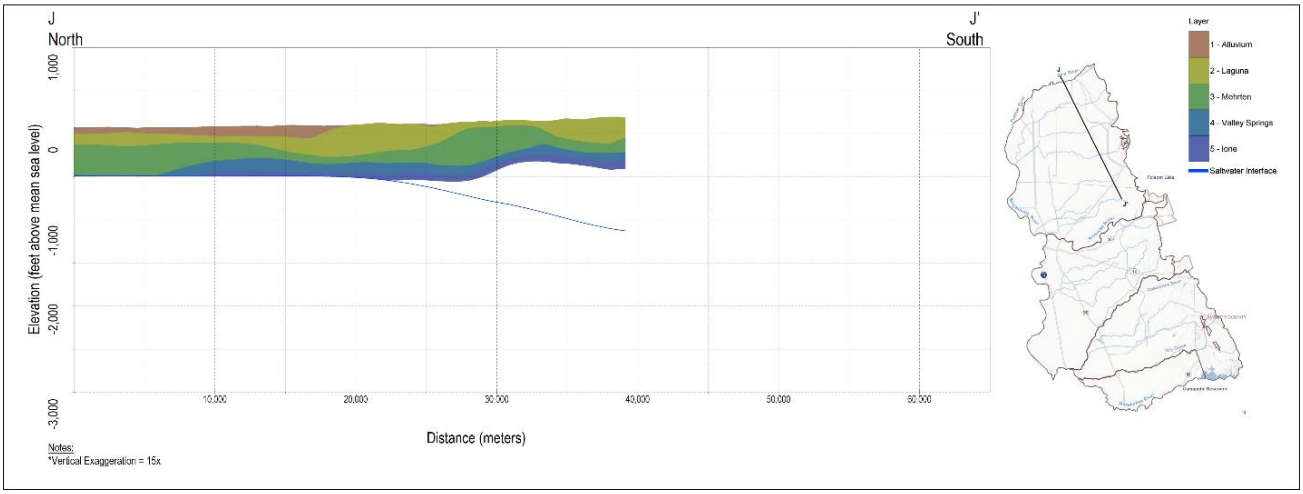


Figure 2-36: CoSANA Cross Section J-J'

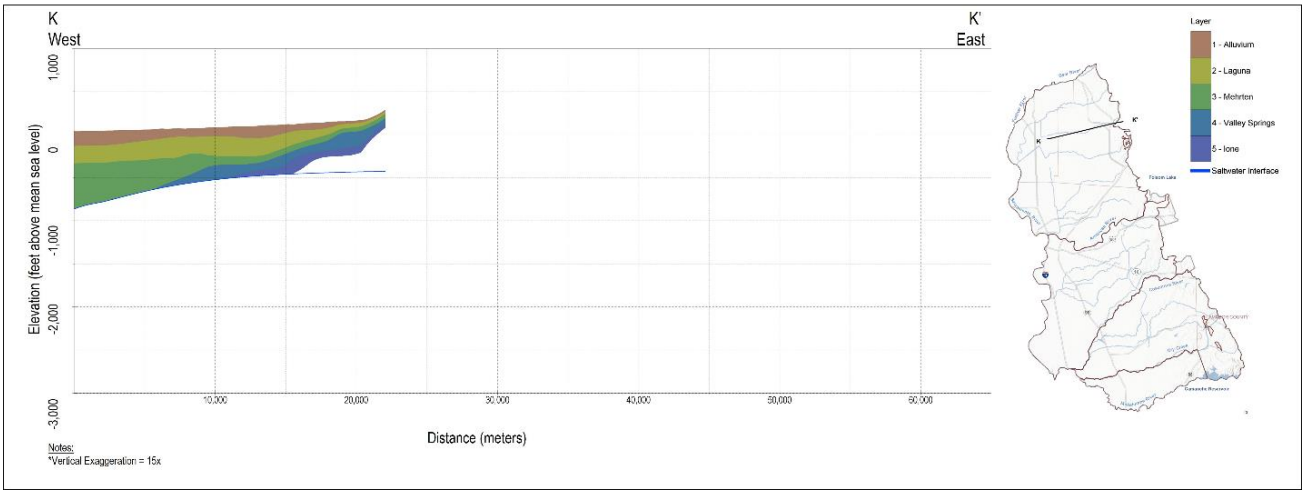


Figure 2-37: CoSANA Cross Section K-K'

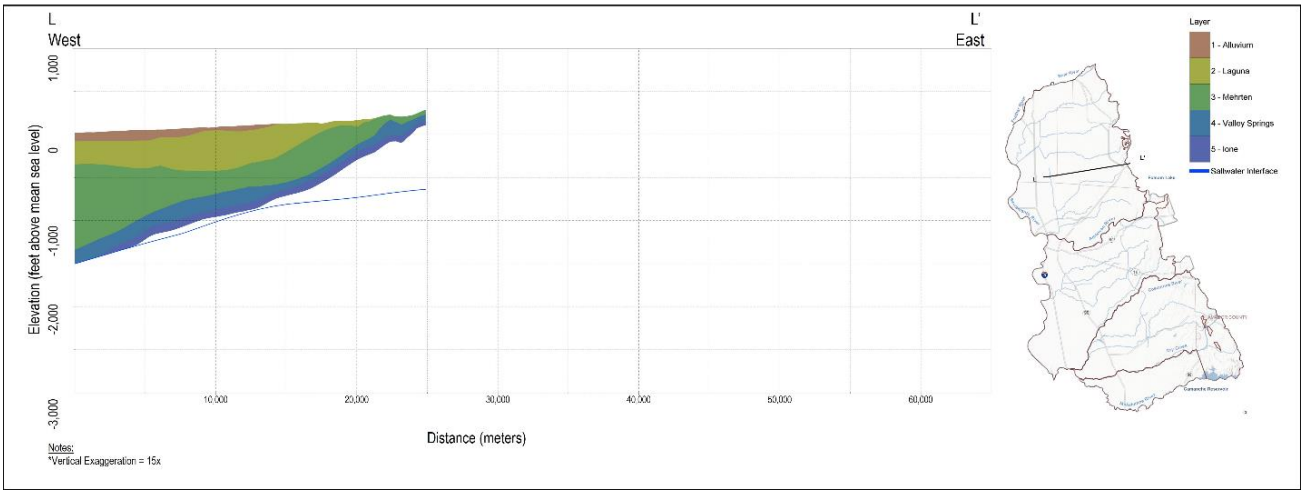


Figure 2-38: CoSANA Cross Section L-L'

2.11 Tributary Watersheds

The inflow from the eastern boundary of the model (i.e., Sierra Nevada foothills) originates from tributary watersheds, including both gaged and ungaged watersheds. The simulation of runoff and inflows from the gaged watersheds (i.e., stream inflows into the model) was discussed in Section 2.4. The simulation of surface and subsurface flows from the ungaged watersheds is explained in this section.

CoSANA simulates the ungaged eastern inflow using 32 small watersheds (Figure 2-39), based on the latest version of C2VSimFG. Flow from ungaged small watersheds is estimated based on precipitation rates and characteristics assigned to each identified ungaged watershed, again based on parameters from C2VSimFG. A portion of flow from the small watershed enters the model area as surface runoff and flows to simulated streams. The remaining small watershed flow contributes as subsurface boundary flow to the groundwater system.

All subsurface inflows from these small watersheds are routed to model Layer 5 along specified groundwater nodes, with a defined maximum percolation rate at each node. Excess flows that do not infiltrate to groundwater enter the simulated streams at specified locations, delineated using the USGS Watershed Boundary Dataset (HUC12 watersheds).

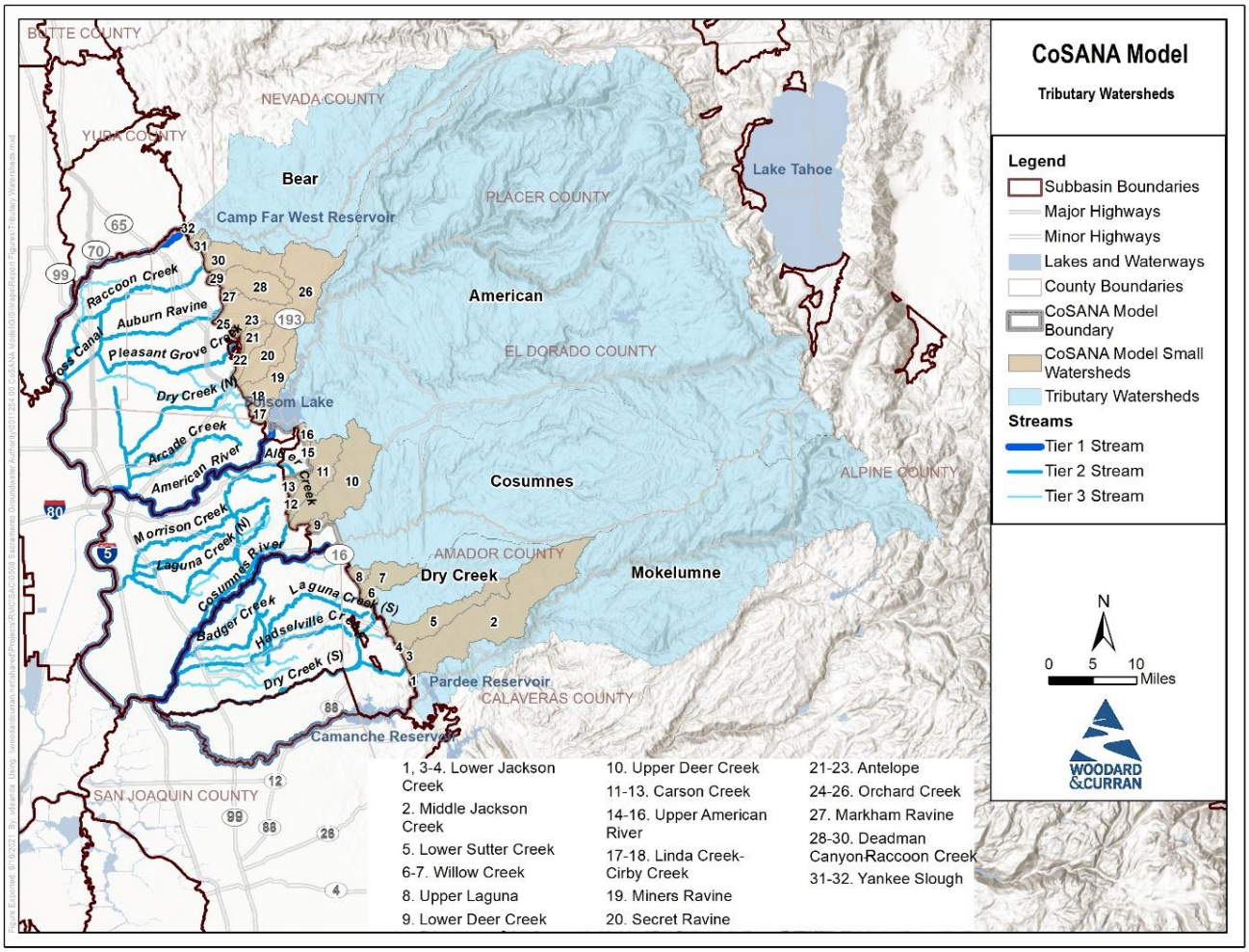


Figure 2-39: Tributary Watersheds

2.12 Boundary Conditions

Boundary conditions define the subsurface inflows for the northern, western, and southern borders of the model. The following boundary conditions are set in CoSANA:

2.12.1 General Head

Time-series general-head boundary conditions representing groundwater levels outside of the model area were defined for all active layers for 713 boundary nodes on the northern, western, and southern limits (i.e., along Bear River, Sacramento River, and Mokelumne River). General head boundary conditions, for each model node that it is defined, use a defined conductance and a reference groundwater level time series at a location outside the model domain with a known distance. The conductance values at the boundary condition nodes were calculated from the horizontal hydraulic conductivity, distance to the reference point, layer thickness, and the length of the boundary section represented by each node.

Groundwater level time-series data at a distance of approximately 3,000 feet from the boundary were extracted from the C2VSimFG model. The extracted values were compared with observed groundwater elevations from DWR's Water Data Library (WDL) and modified to better fit the observed elevations by trend and bias correction while protecting the spatial variation provided by C2VSimFG.

2.12.2 Small Watersheds

As discussed in the previous section, subsurface inflows and surface runoff contributions along the eastern boundary of model are represented using small watersheds.

2.12.3 Constrained Head

Additional boundary conditions were defined to simulate known water elevations for Camanche Reservoir. Seepage from Camanche Reservoir was represented by constrained head boundary conditions for the uppermost layer of the 228 groundwater nodes representing the reservoir elevations.

2.13 Initial Conditions

Groundwater heads for each model node and each layer at the beginning of the calibration simulation (October 1, 1989) were developed using DWR's WDL database. Over 815 wells with data were analyzed for use in building the initial groundwater heads. Due to the availability of data in different wells, a hierarchy of data was used to compile sufficient coverage over the model domain for development of initial conditions:

- Fall 1989 (August through October) where available
- Extended Fall 1989 (July through November)
- Surrounding years data, averaged (Fall 1988 or Fall 1990)
- Surrounding two years data, averaged (Fall 1987 or Fall 1991)
- Other timeframes were selected by examining hydrographs and groundwater level trends
- Where all above unavailable outside of the model boundary, depth to water was extrapolated

Observation data were interpolated to develop a raster representing initial groundwater levels over the model domain. Due to the lack of construction information for many of the WDL monitoring locations, the groundwater heads described above are used for all layers. The model "warm up" period from WY1989 to WY1994 allows the model time to equilibrate the groundwater conditions to smooth any issues that might arise from lack of data or erroneous data. The initial conditions for CoSANA representing October 1, 1989 are shown in Figure 2-40.

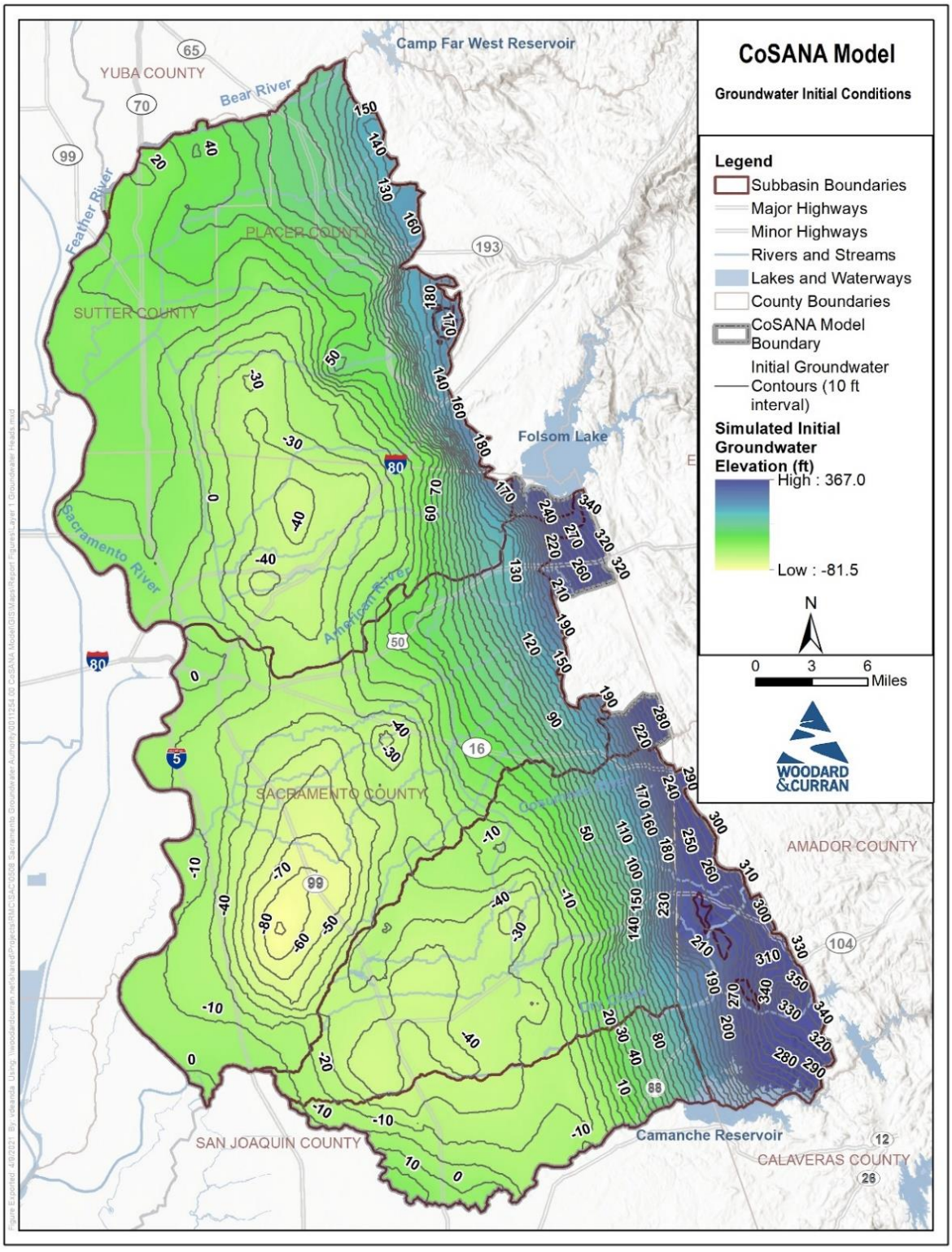


Figure 2-40: Initial Conditions, Groundwater Heads, Fall 1989

3. WATER SUPPLY AND DEMAND DATA

The following sections describe the data and methodology for developing CoSANA water demand and supply input data. Typically, agricultural and urban supplies are specified in IWFM's groundwater pumping and surface water diversion data, and agricultural and urban demands are calculated using the IWFM IDC. In the case of CoSANA, the urban demands for historical period were provided for each one of the urban water purveyors and were input in the model directly.

3.1 Water Supply

Both the agricultural demands estimated by IDC and the urban demands are primarily met through the IWFM representation of surface water diversions and groundwater pumping. Other sources of water simulated in IWFM to meet demand include recycled water, remediated (reuse) water, precipitation, and existing moisture in the soil.

3.1.1 Surface Water Supply

Historical surface water diversions for the simulation period were compiled from a combination of sources discussed in more detail in Sections 3.2 and 3.3, including gage data, water rights reports, Urban Water Management Plans (UWMPs), Agricultural Water Management Plans (AWMPs), and other sources. Some diversions were estimated based on historical demands. A summary of diversions simulated in the model is provided in Appendix A, along with the actual percentage of diverted water that is delivered after the delivery losses are accounted for. Delivery losses comprise recoverable losses (i.e., seepage along delivery and unlined canals) and non-recoverable losses (i.e., evaporation from canals).

Many diversions provide water across two or more model subregions, so deliveries are assigned to a group of elements representing the delivery area, rather than a subregion. Diversions are either assigned to a stream node near the point of diversion or they are treated as imports if the point of diversion is outside model area. Figure 3-1 to Figure 3-3 show schematic diagrams of the surface water delivery system simulated in CoSANA.

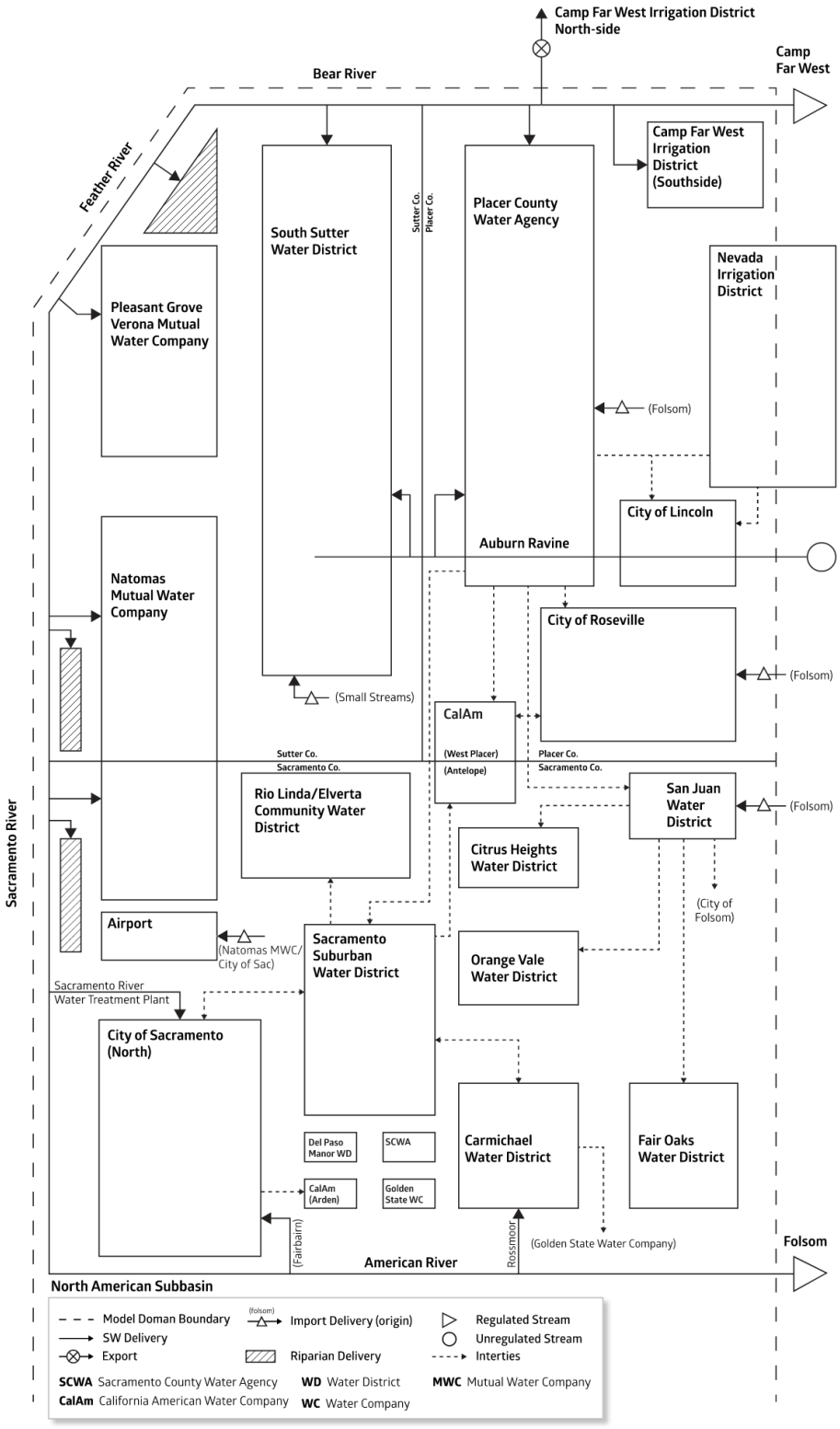


Figure 3-1: CoSANA NASb Surface Water Delivery Schematic

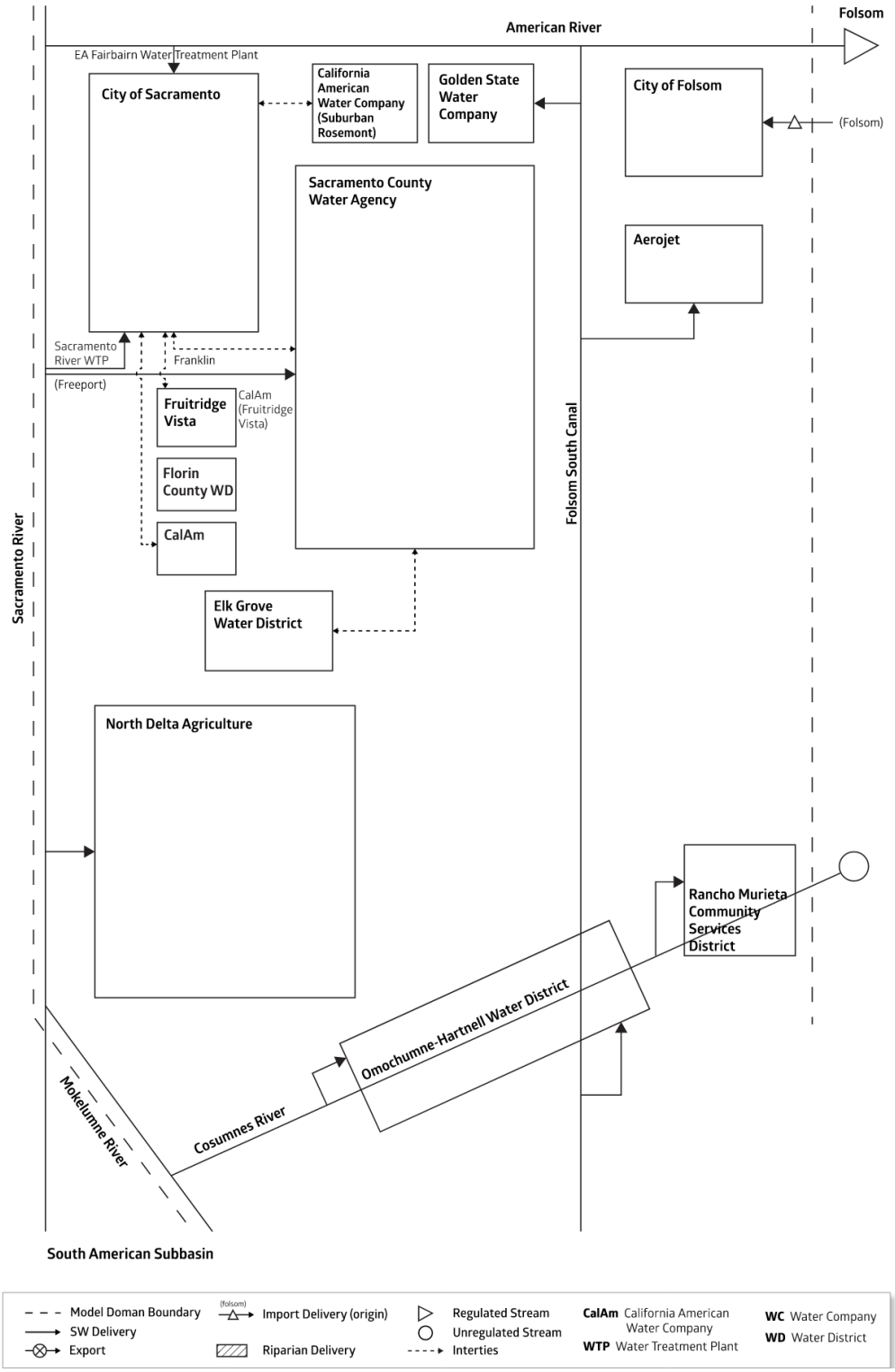


Figure 3-2: CoSANA SASb Surface Water Delivery Schematic

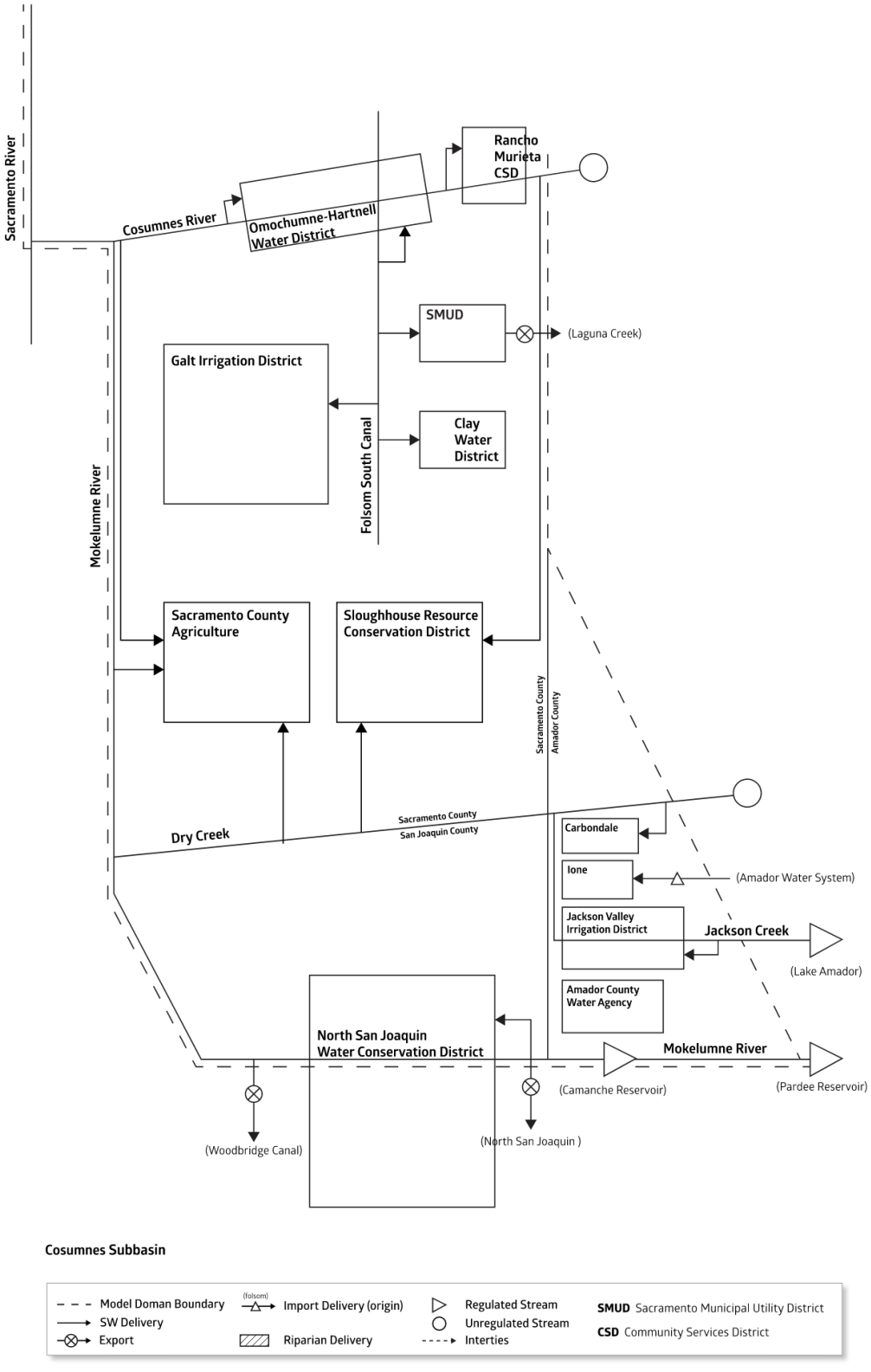


Figure 3-3: CoSANA CoSb Surface Water Delivery Schematic

3.1.2 Groundwater Pumping

Groundwater pumping within CoSANA is separated into pumping by wells and pumping by elements. The former largely includes agency-operated wells that deliver groundwater to a public water supply system, as well as groundwater contamination remediation operations where data are available by well. The latter includes estimated agricultural and domestic (including rural residential) groundwater pumping.

Where available, pumping data are specified on a monthly basis throughout the historical simulation period. Data provided typically included well locations, total depth, screen perforation depth, use (agricultural, urban, or remediation) and historical monthly pumping records. Agricultural and rural residential pumping volumes are not typically known and were estimated by the model to meet demands not satisfied through other sources (e.g., well pumping and surface water deliveries.)

3.2 Urban Water Demand and Supply

Urban demands are provided by the urban water purveyors for the historical model period. The monthly urban demands are directly inputted into the model for each urban purveyor.

It was assumed that an annual average of 60% of urban water is used indoors and 40% is used outdoors. CoSANA uses monthly fractions for indoor and outdoor use, with the majority of urban water demand due to indoor activities from November through March and up to 60% of urban water used outdoors for the remainder of the year. Assumed monthly fractions for City of Galt indoor and outdoor use were adjusted to better match those reported by the City of Galt.

Table 3-1 lists the number of wells by type and purveyor included in CoSANA. Figure 3-4 shows the locations of the urban pumping wells in CoSANA, including those shown in Table 3-1 and some additional smaller users including Sacramento International Airport, fish farms, and others.

Table 3-1: Summary of CoSANA Well Pumping by Urban Purveyor

Purveyor	Number of Municipal Pumping Wells	Average Annual Municipal Pumping (WY 1995-2018, acre-feet)
California American Water Company	135	39,666
Cal Am (formerly Fruitridge Vista WC)	20	4,220
Camanche Village (Amador County WA)	6	258
Carmichael WD	17	4,025
Citrus Heights WD	14	987
City of Galt	25	4,716
City of Lincoln	5	717
City of Roseville	6	18
City of Sacramento	68	20,427
Del Paso Manor WD	10	1,536
Elk Grove WD	17	5,144
Fair Oaks WD	12	1,262
Florin County WA	10	2,624
Golden State WC	33	9,897
Orange Vale WC	2	0
Rio Linda Elverta CWD	13	2,990
Sacramento County WA	118	27,510
Sacramento Suburban WD	119	29,905
Total Average Annual Pumping (acre-feet)		155,902

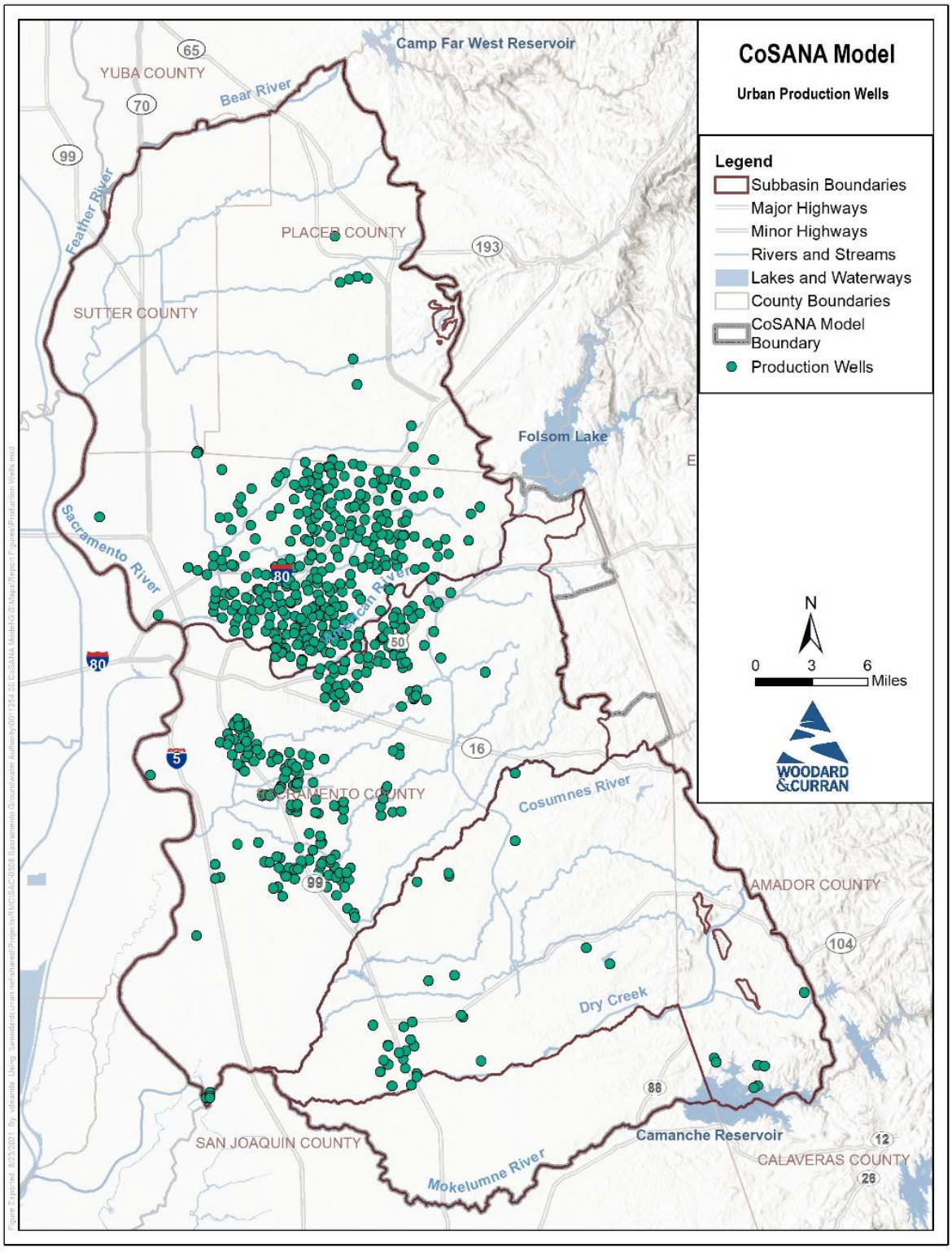


Figure 3-4: Locations of Urban Groundwater Production Wells

The following sections provide a brief description of water supplies for each of the urban water purveyors in each Subbasin.

3.2.1 North American Subbasin

This section briefly describes the urban demand and supply assumptions used in the historical CoSANA for the purveyors within the NASb. Averages presented are for the calibration period, WY 1995-2018. RWA (M. Garcia, personal communication, August 29, 2019) provided data for many of the individual entities listed below.

3.2.1.1 California American Water Company (Antelope)

California American Water Company (Cal Am) Antelope receives an average of 170 acre-feet per year (AFY) of surface water supplied via an intertie with Sacramento Suburban Water District (WD). Groundwater supply meets remaining demand with an average of 5,621 AFY. Data sources include SacIWRM (to 2004), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.1.2 California American Water Company (Arden)

Cal Am Arden is primarily supplied by groundwater, an average of 2,830 AFY, with approximately 2 AFY being met by surface water supplied by the City of Sacramento. Data sources include SacIWRM (to 2004), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.1.3 California American Water Company (Lincoln Oaks)

Cal Am Lincoln Oaks receives an average of 245 AFY of surface water supplied via an intertie with Sacramento Suburban WD. Groundwater supply meets remaining demand, with an average of 8,869 AFY. Data sources include SacIWRM (to 2004), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.1.4 California American Water Company (West Placer)

Cal Am West Placer service area supply includes 725 AFY of surface water sourced from Placer County Water Agency (PCWA). RWA provided data for 2011-2018. Data prior to 2011 is estimated based on annual data provided by GEI Consultants (R. Shatz, personal communication, March 5, 2020).

3.2.1.5 Carmichael Water District

Carmichael WD uses an average 7,155 AFY of surface water from the American River and 4,080 AFY of groundwater from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.6 Citrus Heights Water District

Citrus Heights WD supply includes 16,015 AFY of surface water sourced from San Juan WD and 952 AFY of groundwater from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.7 Del Paso Manor Water District

Supply for Del Paso Manor WD is met entirely by groundwater pumping from district wells and averages 1,549 AFY. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.8 Fair Oaks Water District

Fair Oaks WD supplies include an average of 11,145 AFY of surface water received from San Juan WD and 1,183 AFY of groundwater from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.9 Golden State Water Company (Arden)

Golden State Water Company (WC) Arden supply includes an average of 1,169 AFY of groundwater pumping from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.10 City of Lincoln

On average, 6,218 AFY of the City of Lincoln's water supply comes from surface water supplied by PCWA and Nevada Irrigation District. The remaining 739 AFY of supply is provided by groundwater production from city wells. Data for 2008-2018 was provided by the City of Lincoln. Data for 2005 to 2008 is estimated based on annual data from the City of Lincoln UWMPs (2010, 2015). Data prior to 2005 is from SacIWRM

3.2.1.11 Orange Vale Water Company

Orange Vale WC on average receives 4,191 AFY of surface water sourced from San Juan WD. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.12 Placer County Water Agency (City of Rocklin Retail Service Area)

PCWA serves the City of Rocklin for retail customers. Remaining portions of PCWA's service area within the model are served by other retail water purveyors or are self-supplied by groundwater. Supply to the City of Rocklin is on average 4,578 AFY, based on data from PCWA (R. Cox, personal communication, July 17, 2019) for WY 2016-2018. All demand is assumed to be met by surface water. Lacking other data sources, data from 2016 was used for previous years.

3.2.1.13 Rio Linda / Elverta Community Water District

Rio Linda/Elverta CWD is primarily supplied by groundwater pumping, averaging 3,010 AFY. The remaining 5 AFY is from surface water sourced from an intertie with the City of Sacramento. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.14 City of Roseville

The City of Roseville receives, on average, 27,943 AFY of surface water sourced from Folsom Reservoir, with the remaining 126 AFY of supply met by groundwater pumping from city wells. Data were provided by the City of Roseville for 1986-2018. Gaps in data existed for 1999-2000 and 2008-2009; these were filled by interpolating data from surrounding years. Data prior to 1986 is from SacIWRM. Data from the City of Roseville also included details on groundwater injection as part of the city's aquifer storage and recovery program.

3.2.1.15 Sacramento Suburban Water District

Sacramento Suburban WD supply mix includes 32,396 AFY of groundwater production from district wells and 10,024 AFY from surface water sourced via intertie with PCWA and the City of Sacramento. Data sources include SacIWRM (to 2004), and RWA (after 2004).

3.2.1.16 City of Sacramento

The City of Sacramento receives on average 97,488 AFY of surface water from their water treatment plants on the American and Sacramento Rivers. Remaining demand is met by groundwater production from city wells that averages 20,225 AFY. This demand is spread across both the NASb and the SASb. Data sources include SacIWRM (to 2004), and RWA (after 2004).

3.2.1.17 Sacramento International Airport

The Sacramento International Airport receives on average 175 AFY from the City of Sacramento (based on data from RWA). Remaining demand of 968 AFY is assumed to be met by groundwater (based on SacIWRM demand).

3.2.1.18 San Juan Water District

San Juan WD average supply is estimated to be 5,196 AFY within the model area and is met entirely by surface water from Folsom Lake. This is based on retail data for the district supplied by RWA (after 2004) and assumes that 37% of the districts retail service area is within the CoSANA boundary. Data prior to 2004 is based on SacIWRM.

3.2.1.19 Sacramento County Water Agency (Arden Park Vista)

Demand for the Sacramento County Water Agency (SCWA) Arden Park Vista service area averages 3,911 AFY and is met entirely by groundwater pumping from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.20 Sacramento County Water Agency (Northgate)

Supply for the SCWA Northgate service area averages 940 AFY and is met entirely by groundwater pumping from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.2 South American Subbasin

This section briefly describes the urban demand and supply assumptions used in the historical CoSANA for the purveyors located within the SASb.

3.2.2.1 California American Water Company (Fruitridge - formerly Fruitridge Vista Water Company)

Cal Am Fruitridge Vista is serviced almost entirely by groundwater production from Cal Am wells. Some small surface water transfers are reported, which average to 1 AFY. Data sources include SacIWRM (to 2011), HydroDMS (2012-2013), and SCGA (2014-2018).

3.2.2.2 California American Water Company (Parkway)

Cal Am Parkway receives on average 592 AFY of surface water delivered via an intertie with the City of Sacramento; the remaining 10,699 AFY is supplied from groundwater production from Cal Am wells. Data sources include SacIWRM (to 2011), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.2.3 California American Water Company (Security Park)

Cal Am Security Park averages 31 AFY demand, met by groundwater production from Cal Am wells. Data sources include SacIWRM (to 2011), RWA (service area level data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.2.4 California American Water Company (Suburban Rosemont)

Cal Am Suburban Rosemont receives on average 110 AFY of surface water delivered via an intertie with the City of Sacramento, with the remaining 12,296 AFY supplied from groundwater production from Cal Am wells. Data sources include SacIWRM (to 2011), RWA (service area level data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.2.5 Elk Grove Water District (Service Area 1)

Supply for Elk Grove WD Service Area 1 averages 5,189 AFY and is met by groundwater production from district wells. Data sources include SacIWRM (to 2009) and Elk Grove Water District (after 2009).

3.2.2.6 Florin County Water District

Florin County WD supply averages 2,623 AFY, entirely sourced by groundwater production from district wells. Data is from SacIWRM. Actual production values are not known for this area, and demand is estimated.

3.2.2.7 City of Folsom

The City of Folsom has an average demand of 20,451 AFY, with 100% of its supply coming from surface water diverted from Folsom Lake. Data sources include SacIWRM (to 2011) and RWA (after 2011).

3.2.2.8 Golden State Water Company (Cordova)

Golden State WC Cordova receives on average 6,287 AFY of surface water, primarily from water diverted from the American River via the Folsom South Canal. The remaining 8,977 AFY of demand is met by groundwater production from Golden State wells. Data sources include SacIWRM (to 2011) and RWA (after 2011).

3.2.2.9 Rancho Murieta Community Service District

Rancho Murieta CSD supply averages to 1,833 AFY, which is fully met by surface water diverted from the Cosumnes River. This is based on data on the number of service connections and water use from the 2006 Rancho Murieta Community Services District Integrated Water Master Plan and the 2010 Update.

3.2.2.10 City of Sacramento

(See North American Subbasin)

3.2.2.11 Sacramento County Water Agency (Hood)

SCWA Hood service area has an average demand of 47 AFY which is supplied by groundwater production from agency wells. Data sources include SacIWRM (to 2011) and RWA (after 2011).

3.2.2.12 Sacramento County Water Agency (Laguna Vineyard)

SCWA Laguna Vineyard service area (including Elk Grove WD Service Area 2) has an average supply mix of 17,340 AFY of groundwater production from agency wells, 3,314 AFY of surface water primarily sourced from the Sacramento River, and 232 AFY of recycled water. Data sources include SacIWRM (to 2011), HydroDMS (2012-2013), and SCGA (2014-2018).

3.2.2.13 Sacramento County Water Agency (Mather)

SCWA Mather service area average supply mix that includes 3,958 AFY of groundwater production from agency wells, and 233 AFY surface water primarily sourced from the Sacramento River via the Vineyard Surface Water Treatment Plant. Data sources include SacIWRM (to 2011), HydroDMS (2012-2013), and SCGA (2014-2018).

3.2.3 Cosumnes Subbasin

This section briefly describes the urban demand and supply assumptions used in the historical CoSANA for the purveyors located within the CoSb.

3.2.3.1 Amador County Water Agency (Camanche Village)

Amador County WA Camanche Village service area has an average supply of 257 AFY which is met 100% by groundwater production from agency wells. Data sources include monthly pumpage from four Camanche wells and two Camanche north shore wells, as reported by Amador County Water Agency (G. Mancebo, personal communication, April 29, 2019).

3.2.3.2 Amador County Water Agency (Ione)

Amador County WA supply to the City of Ione averages 2,130 AFY which is entirely surface water. Ione supply was estimated from reported wastewater treatment plant flows and population. Data sources include treated wastewater flows from Amador Water Agency (B. Cook, personal communication, December 9, 2019) and population data from the California Department of Finance.

3.2.3.3 City of Galt

The City of Galt has an average supply of 4,737 AFY, which comes entirely from groundwater production from municipal wells. Data sources include monthly pumpage from a total of 18 wells, as reported by the City of Galt (M. Clarkson, personal communication, March 22, 2019).

3.2.3.4 Rancho Murieta Community Service District

(see South American Subbasin section)

3.2.4 Fish Farms

The 2011 South Basin Groundwater Management Plan reported that there is approximately 11,000 AFY pumping to supply water to fish farms in the Cosumnes Subbasin. This annual pumping estimate was allocated to six fish farms based on the relative area of each fish farm and the annual pumping rate was converted to monthly rates in proportion to monthly ET_o rates. Inspection of aerial photos in Google Earth was used to determine when each fish farms was developed and when pumping from each fish farm was likely to have begun.

3.2.5 Galt Wastewater Treatment Plant Effluent

All effluent and stormwater from the City of Galt is routed to the wastewater treatment plant, where it is ultimately either released to Skunk Creek (tributary of Laguna Creek) or used for irrigation of surrounding fields. The 2011 South Basin Groundwater Management Plan (South Area Water Council, 2011) reported that the City of Galt applies an average of approximately 700 AFY to fields for irrigation. The wastewater treatment plant came online in 1983. As such, a variable monthly application rate based on an assumed monthly supply requirement was specified for 1983 through 2019.

3.3 Agricultural Water Demand and Supply

Agricultural water demand is the amount of irrigation water that is required to satisfy the crop evapotranspiration requirement and to meet other irrigation practices. IDC is designed to estimate the agricultural water demand for each model element through consumptive use methodology. IDC dynamically calculates crop demand at each model time step based on factors including crop type, crop evapotranspiration, rainfall, hydrologic soil type, and irrigation practices. The IDC calculations rely on model input data for historical crop acreage, irrigation practices (e.g., return and reuse fractions, irrigation period), soil moisture requirements, effective rainfall (the portion of rainfall available for crop consumptive use), crop evapotranspiration, and localized soil parameters. These data were compiled, analyzed, synthesized, and processed for input in CoSANA.

Precipitation, land use, evapotranspiration, and soil properties are discussed in the relevant sections in Chapter 2. The irrigation period, using data from C2VSimFG, defines irrigation as either on or off for each crop and for each month of

the model simulation period. Most trees are assumed irrigated from April through October, vineyards from April through November, most field crops from May through September, and most truck crops from April through September. Crops with irrigation assumed year-round include citrus and subtropical trees, irrigated pasture, and alfalfa. Fractions to represent return flow (i.e., irrigation flow following the model drainage pattern discussed in Section 2.5) and reuse (i.e., the fraction of applied irrigation water to be reused for irrigation) are based on data from C2VSimFG. All non-ponded CoSANA agricultural lands are assigned a 5% return flow and 1% reuse factor. Rice during the growing season is assigned an average 13% return flow and an average 9% reuse factor, with variability depending on the month of the year. Riceland when flooded for decomposition in the non-growing season is assigned an average 9% return flow and an average 6% reuse factor, also with variability depending on the month of the year. Urban landscape areas are assumed to have 0% return flow and 0% reuse.

3.3.1 Rural-Residential Pumping

Private groundwater pumping quantities on an individual well basis are largely unknown; therefore, private rural-residential pumping in CoSANA is estimated by IWFM on an element basis. Water demands at each relevant element are used to calculate pumping necessary to meet the urban demand estimated by IDC after water purveyor pumping and surface water has been distributed.

The perforation interval, which dictates the layers a simulated well extracts water from, were assigned separately to the domestic (i.e., rural residential) and agricultural wells. Rural residential wells used a statistical analysis of perforation interval developed for C2VSimFG. Perforation interval data were compiled by DWR using data from the CASGEM and Online System for Well Completion Reports databases. Simulated perforation intervals were assigned as the 5th and 95th percentiles of the well perforation interval data for each township/range block.

Demand for rural residential areas, or areas outside of those supplied by a public water system, was based on estimated population and water consumption outside of areas supplied by a public water system. To estimate demand in these areas, the areas themselves were isolated spatially by removing all areas served by a public water system. Population density for the rural residential areas is developed based on census tract data, and estimated per capita water use is developed for a typical household based on information from the California Water Plan (DWR, 2018b).

For the rural-residential area within the CoSb, outdoor water use was estimated from per-parcel water demand and approximate total number of rural-residential parcels. The estimated average per-parcel outdoor water demand is 2.5 AFY based on a detailed inspection of land use for 10 random parcels. Visual inspection of Google Earth aerial photographs identified approximately 3,200 rural-residential parcels, resulting in an average annual outdoor water use of 8,000 AFY. All indoor water use was assumed to return to the subsurface through septic systems and was therefore not explicitly modeled.

3.3.2 Agricultural Pumping

Private groundwater pumping volumes, location, and pumping depth for agricultural water supplies are largely unknown, though aggregate estimates for private pumping are often included in planning documents (e.g., AWMPs, groundwater management plans). Therefore, agricultural pumping in CoSANA is estimated by IWFM on an element basis. Water demand at each relevant element is used to calculate any additional pumping necessary to meet the agricultural demand estimated by IDC after public water system pumping and surface water has been distributed.

3.3.3 Agricultural Groundwater Substitution Transfers

CoSANA includes 55 agricultural groundwater substitution transfer pumping wells, shown in Figure 3-5. All agricultural groundwater substitution transfer pumping operations occur in the NASb and include Pleasant Grove Verona MWC (PGVMWC) and Natomas MWC (NMWC). South Sutter WD also operates a transfer program that is similar in many respects to a groundwater substitution transfer. Transfer pumping volumes are known for PGVMWC and NMWC on a well-by-well basis. The volume of groundwater pumped is assumed to be applied to meet agricultural demand in the

respective service areas. South Sutter WD transfer wells and pumping volumes are not known, but it is assumed that a reduction in surface water deliveries to the service area creates increased pumping demand, resulting in transfer pumping operations. A summary of agricultural transfer pumping wells in CoSANA is shown in Table 3-2.

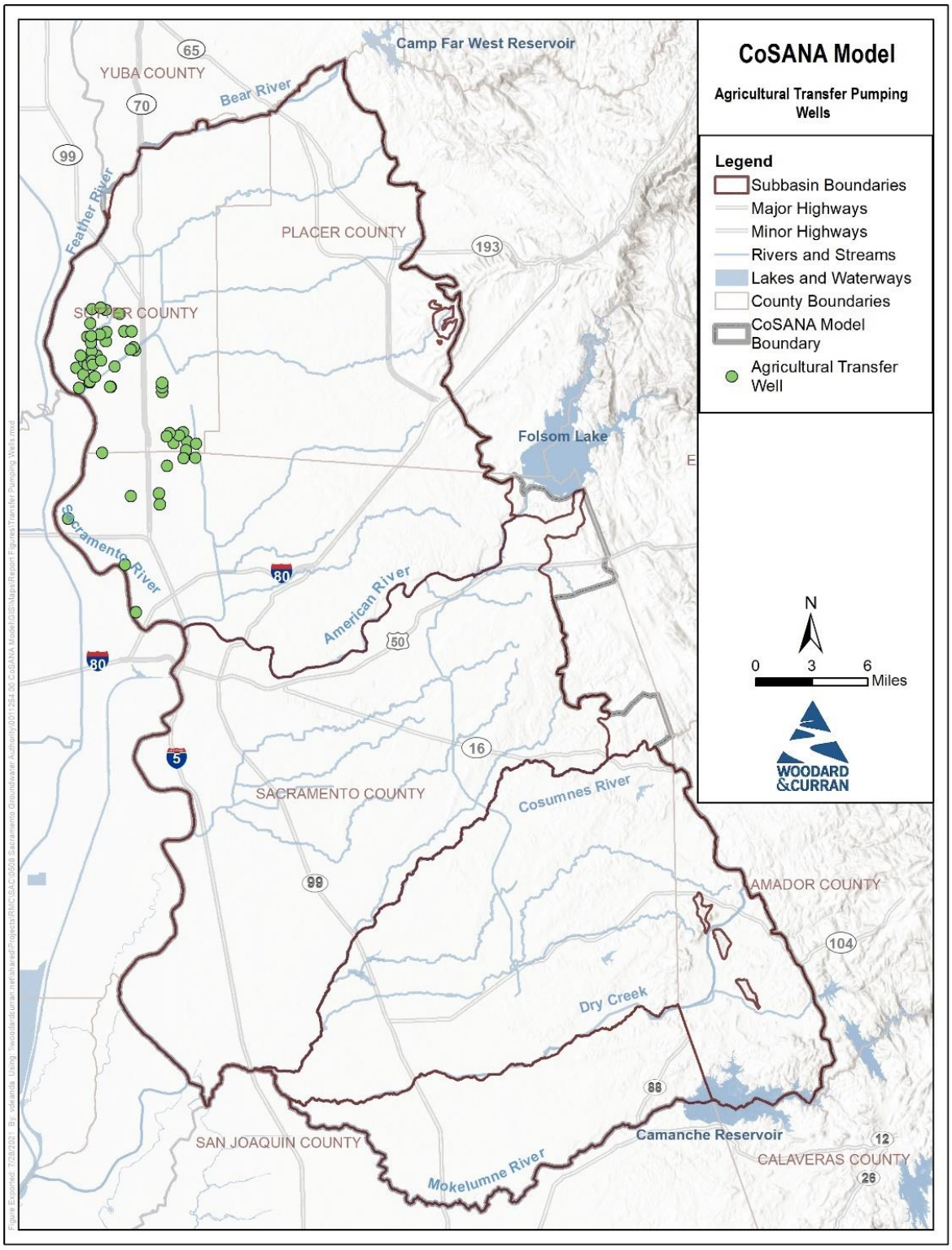


Figure 3-5: Locations of Agricultural Groundwater Substitution Transfer Pumping Wells

Table 3-2: Summary of Agricultural Groundwater Substitution Transfer Pumping

Agency	Number of Groundwater Transfer Pumping Wells	Number of Simulated Transfer Years	Average Annual Pumping in a Transfer Year WY 1995-2018, (acre-feet)
Pleasant Grove Verona MWC	30	6	7,668
Natomas MWC	25	4	8,412
Total Average Annual Pumping (acre-feet)			16,080

3.4 Remediation Pumping

CoSANA includes 344 remediation wells (Figure 3-6) simulating remediation operations for Aerojet/IRCTS, McClellan AFB, Mather AFB, and Kiefer landfill. Data for Aerojet and IRCTS operations were provided by Aerojet (personal communication, J. Fourie, January 16, 2020); McClellan AFB remediations data were provided by McClellan AFB (G. Yuki, personal communication, October 23, 2020) and AECOM (P. Graff, personal communication, October 10, 2020); Mather AFB data were developed based on annual reports; data for Kiefer Landfill operations were provided by Sacramento County (M. Koza, personal communication, June 11, 2020). Remediation pumping volumes by entity are shown in Table 3-3. An annual summary of remediation pumping volumes by extraction entity is provided in Appendix B. Further, annual simulated pumping volumes for the major remediation efforts in the CoSANA model area are summarized by subregion in the land and water use budgets in Appendix C.

Table 3-3: Summary of CoSANA Remediation Operations:

Remediation Area (Subbasin)	Number of Groundwater Remediation Pumping Wells	Average Annual Remediation Pumping (WY 1995-2018, acre-feet)
Aerojet/IRCTS (NASb)	15	1,970
Aerojet/IRCTS (SASb)	190	19,703
Kiefer Landfill (SASb)	15	969
Mather AFB (SASb)	4	207
McClellan AFB (NASb)	113	1,899
Total Average Annual Pumping (acre-feet)		24,748

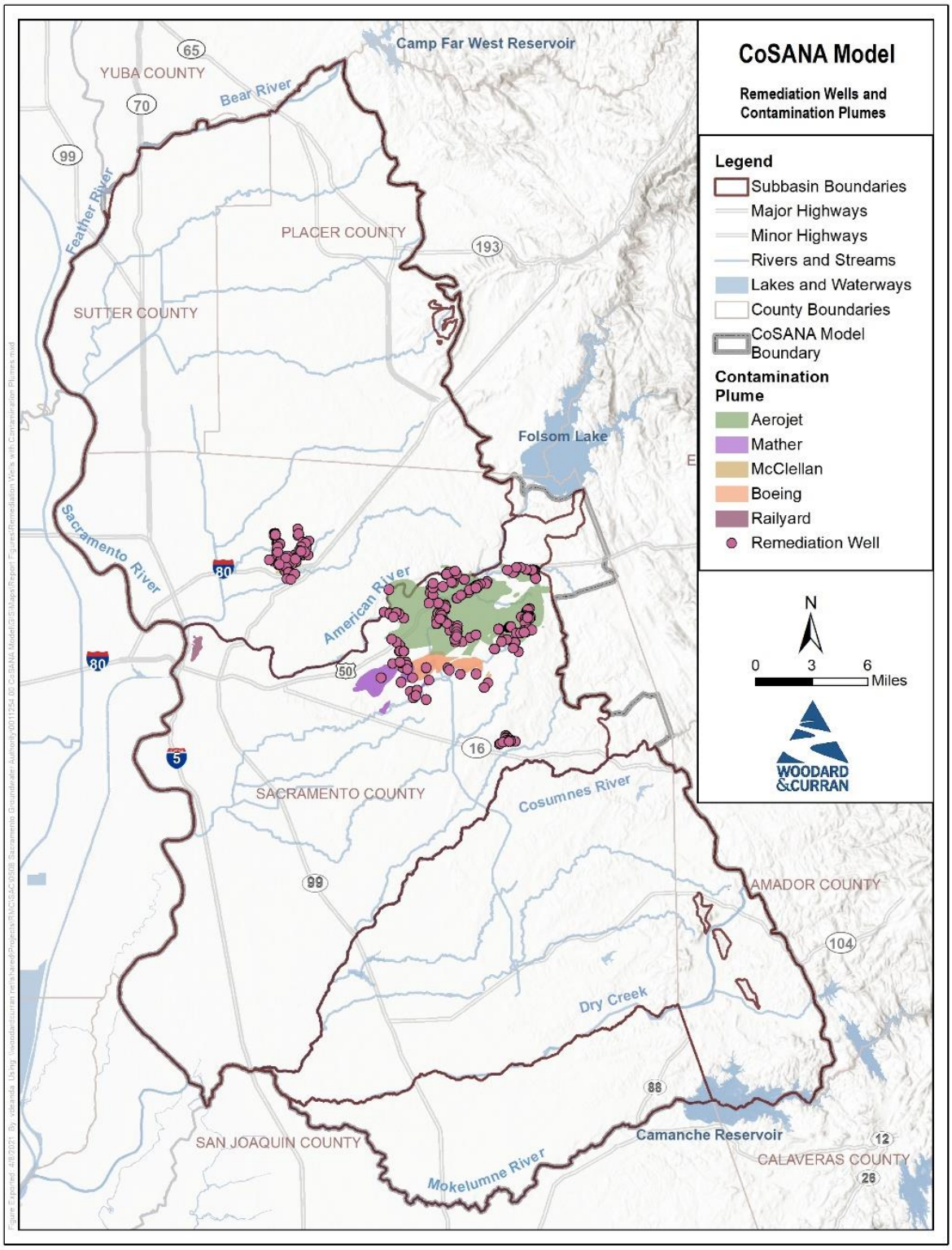


Figure 3-6: Locations of Remediation Pumping Wells

4. MODEL CALIBRATION AND SENSITIVITY ANALYSIS

CoSANA model is an integrated water resources model developed to simulate the integrated nature of the various components of the hydrologic system. Model calibration is an important part of model development, performed to meet the following objectives:

- Develop water budgets that properly represent various geographic scales, including the subbasin, GSA, and subregion scales, at both monthly and annual time scales,
- Represent the regional distribution of groundwater conditions, as well as the seasonal and long-term trends in groundwater levels at target calibration wells,
- Represent appropriate level of stream-aquifer interaction by simulating the modeled streams in such a way that the monthly and long-term streamflows at specific gaging stations properly represent the observed stream flow or stream stage data,
- Properly represent the interbasin flows across the boundaries internal to the CoSANA between the three subbasins modeled, as well as those between the neighboring subbasins outside the model area, in specific, Yuba, Yolo, Solano, and Eastern San Joaquin Subbasins.

Due to the complexities of calibrating an integrated water resources model, a hybrid approach for calibration was utilized to perform a manual calibration on initial water budgets and regional groundwater conditions and an automated calibration using PEST (Doherty, 2015) to achieve a refinement of the calibrated parameters that would result in a more accurate simulation. This calibration approach and process is similar to that used for calibration of the Central Valley's C2VSimFG, with special focus and attention to the regional and local data sets and information.

4.1 Calibration Goals

The goals of model calibration are to:

1. Represent the physical understanding of the model parameters within a range of reported values
2. Obtain a reasonable representation of water budgets for each of the hydrologic systems modeled (i.e., land and water use, stream flow, and groundwater budgets)
3. Achieve a reasonable general pattern of groundwater levels and flow directions
4. Optimize the agreement between simulated results and observed values for short-term seasonal and long-term trends in groundwater levels at selected calibration well
5. Optimize the agreement between simulated results and observed streamflow hydrographs or stream stage gages at selected gaging stations.

These goals are achieved through careful review of model input data and adjustments to model parameters. The model results also provide insight to key components of the groundwater basin including historical recharge, subsurface flows, gains/losses from/to streams and changes in groundwater storage.

CoSANA was calibrated to local data and knowledge, surface water flows, groundwater levels, and groundwater contours. The sources used include local knowledge (mainly gathered during the GSP Working Groups meetings), AWMPs, UWMPs, other local planning efforts, observed groundwater levels and associated contours, and observed streamflow data.

Due to uncertainty in the initial conditions, a "warm up" period is included to allow groundwater levels to stabilize. As previously noted, CoSANA includes data starting in October 1969 (WY 1970). To reduce run time, the model used for the historical calibration begins in October 1989 (WY 1990). The CoSANA calibration period begins after a five-year warm up period, in October 1994, and ends in September 2018; thus, the full period for model calibration is WY 1995 through 2018 (24 years).

4.2 Calibration Process

The calibration process is conducted as shown in Figure 4-1 and as described in the following subsections.

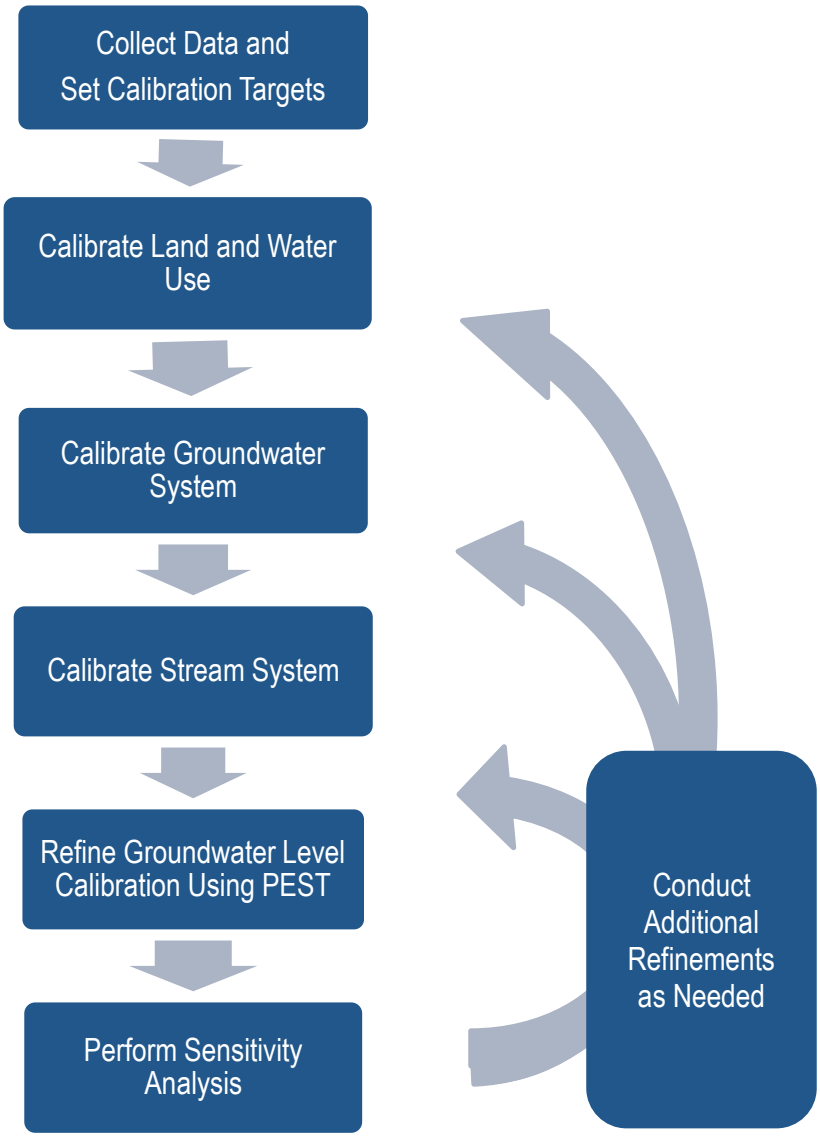


Figure 4-1: CoSANA Calibration Process

4.2.1 Water Budget Calibration

Water budgets are calibrated to improve the accuracy of the representation of the hydrologic characteristics of the groundwater basin. A water budget balances supplies, demands, and any subsequent change in storage occurring within that specific portion of the hydrologic cycle. IWFM automatically outputs budgets at the subregion scale for processes involving groundwater, the surface layer, streams, the root zone, small watersheds, and the unsaturated zone. IWFM can output budgets down to a single element or any specific grouping of elements.

During this step of the calibration process, model results are reviewed and summarized into monthly and annual (by water year) budgets. The primary budgets reviewed for calibration are the groundwater budget and the land and water use budget. Other budgets, notably the stream budget (see Appendix D), are also reviewed as part of the calibration process. After extensive budget analysis, key model datasets and parameters are adjusted, particularly groundwater aquifer parameters, to better match local budgets from local agricultural water purveyors and local planning efforts. The CoSANA water budget results are summarized in the following sections.

4.2.1.1 Land and Water Use Budget

The land and water use budget represents the balance of the IDC-calculated water demands with the water supplied and includes two different versions, agricultural and urban. Both the agricultural and urban versions include the same components that make up the water balance:

- Demands:
  - Demand (either agricultural or urban)
  - Surplus (if applicable)
- Supplies:
  - Groundwater pumping
  - Surface water deliveries (including recycled water deliveries)
  - Shortage (if applicable)

As part of the calibration of the land and water use budget, root zone parameters are adjusted as needed to achieve reasonable estimates of agricultural demand and to develop the components of a balanced root zone budget. IDC calibration serves as the foundation of the IWFM calibration for agricultural areas, as demand estimated often translates directly to groundwater pumping, which is the primary stress on the groundwater system. To adjust agricultural demand, element-level root zone parameters, particularly the soil hydraulic conductivity and the pore size distribution index, were adjusted in accordance with the hydrologic soil group and subregion. Spatial representation of these calibrated parameters is shown in Figure 4-2 through Figure 4-6. The IDC model was calibrated to achieve an irrigation efficiency of approximately 68% to 72%, consistent with agricultural water use values reported by irrigation districts in their AWMPs, as well as data from DWR's California Agricultural Water Use Model and California Water Plan.

The average annual water demand and supply mix used to meet the demand is summarized in Table 4-1. The average annual simulated land and water use budgets for the calibration period are presented in Figure 4-7 through Figure 4-14, showing the agricultural and urban demands and supplies in CoSANA both model wide and by subbasin. Additional detail on the Land and Water Use budget is included in Appendix C.

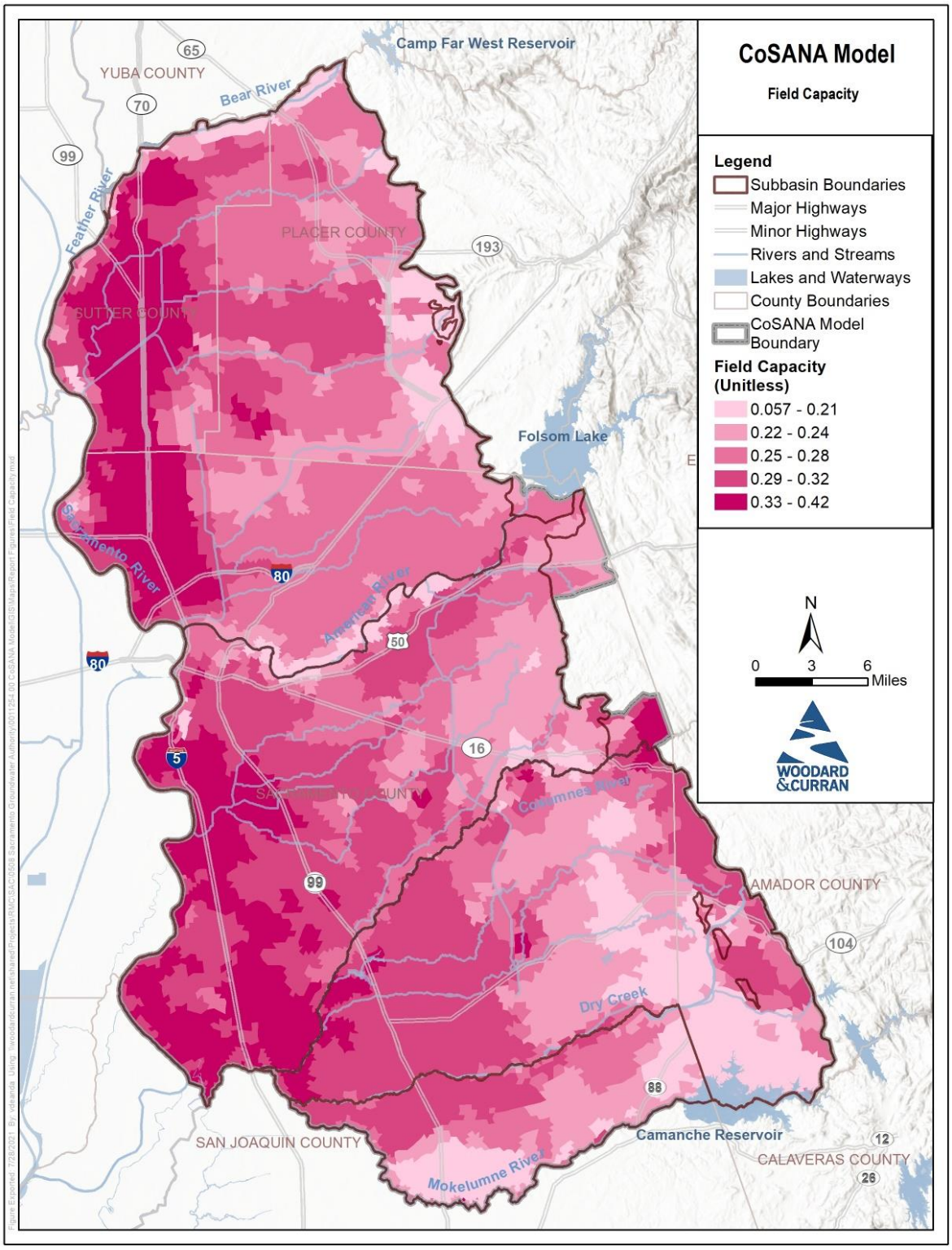


Figure 4-2: CoSANA Field Capacity

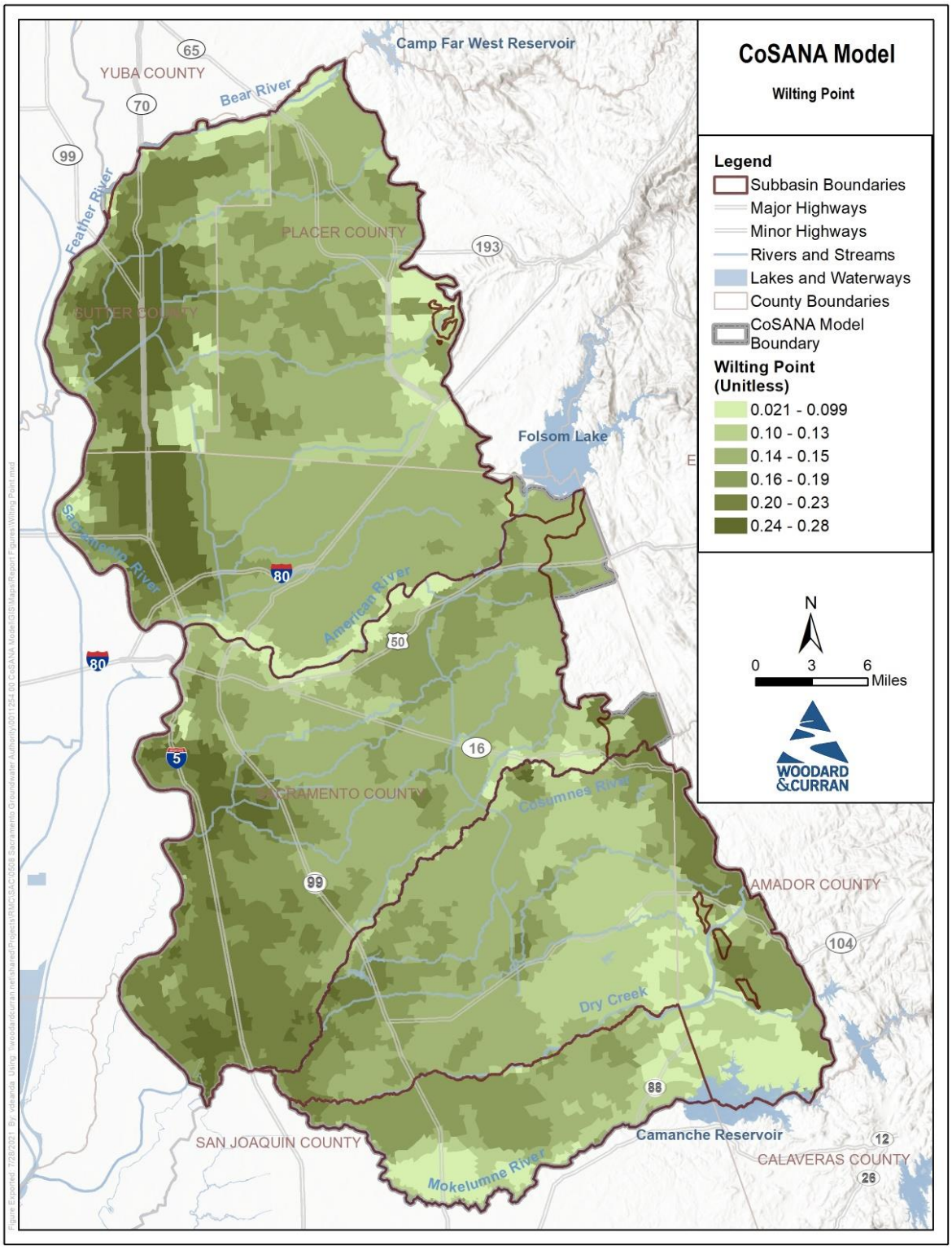


Figure 4-3: CoSANA Wilting Point

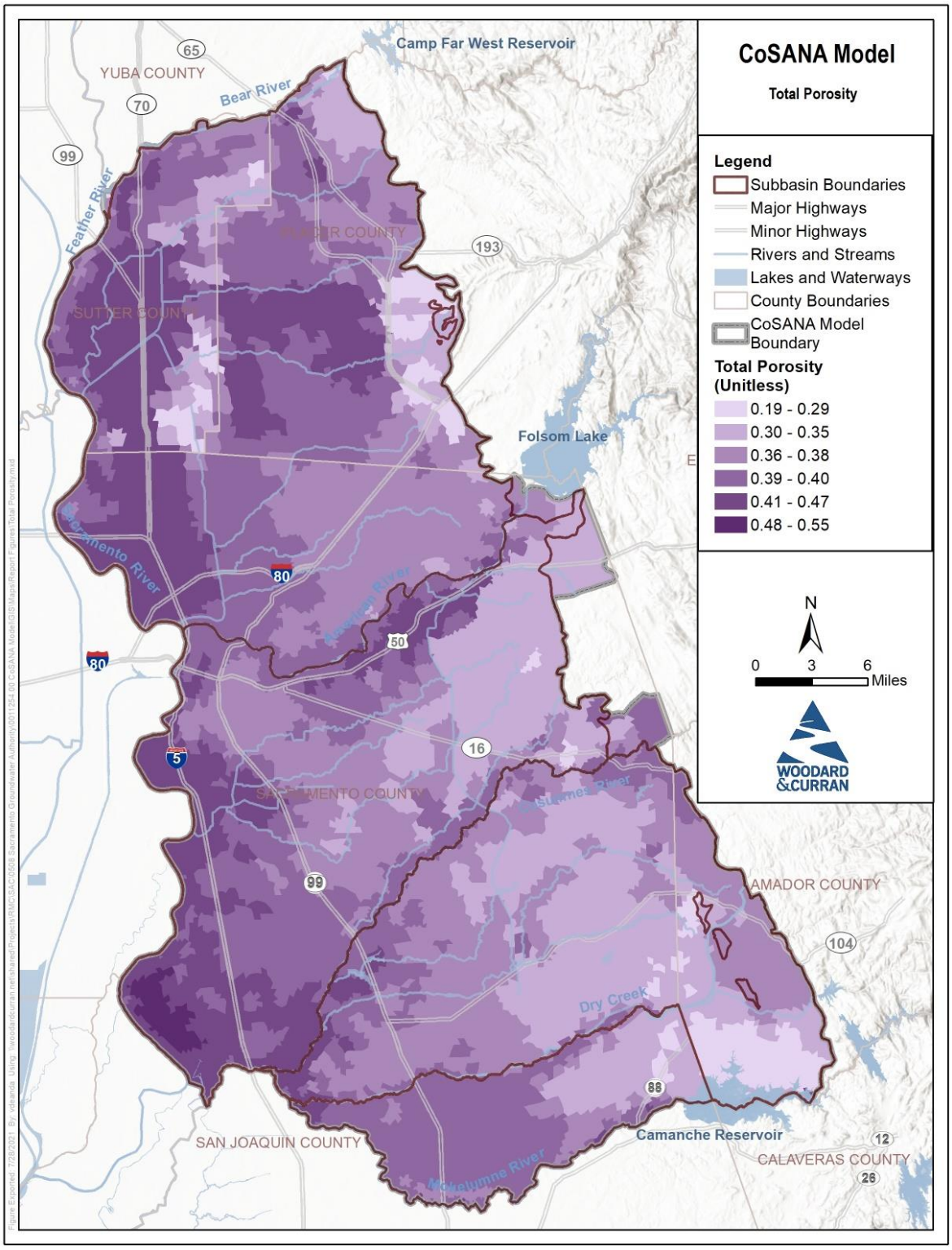


Figure 4-4: CoSANA Total Porosity

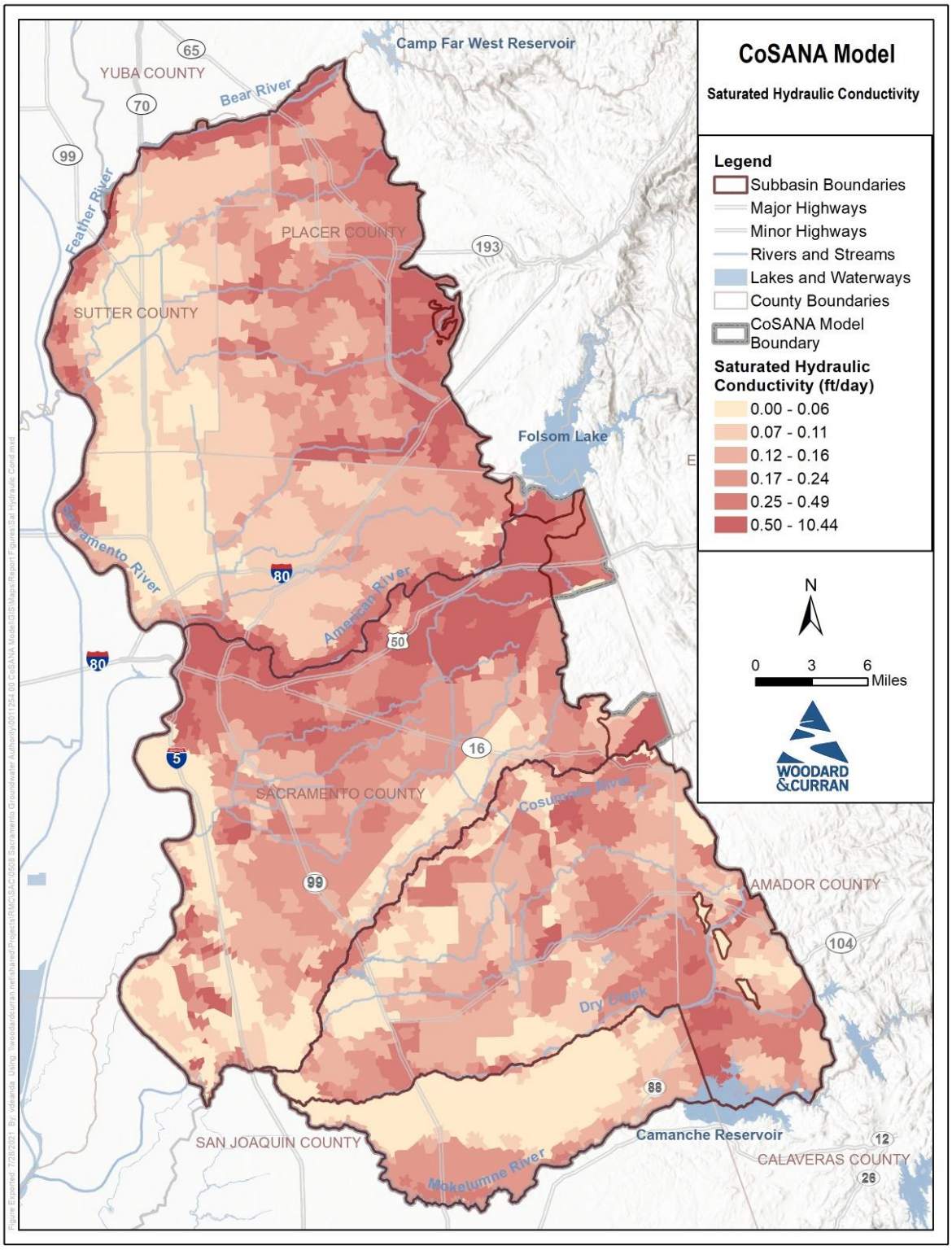


Figure 4-5: CoSANA Saturated Soil Hydraulic Conductivity

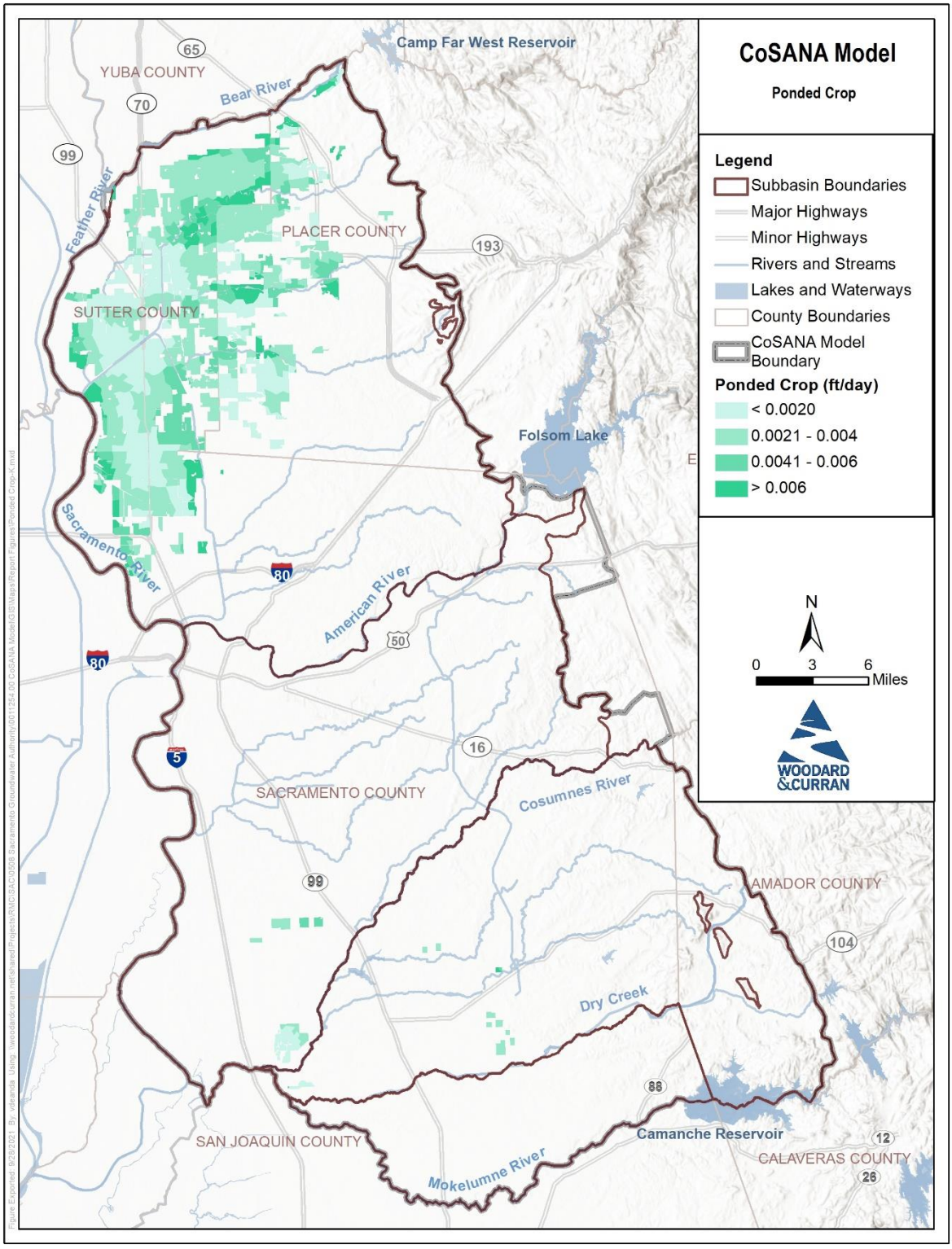
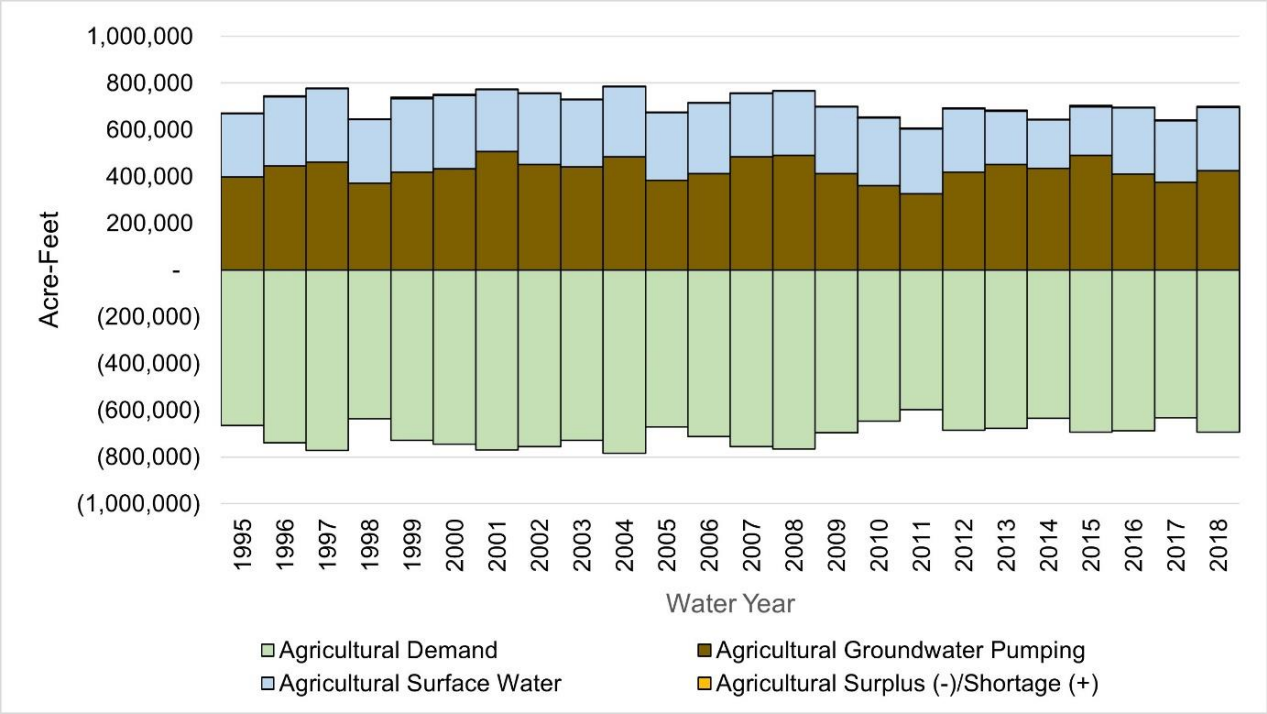


Figure 4-6: CoSANA Ponded Crop Saturated Soil Hydraulic Conductivity

Table 4-1: Land and Water Use Budget Demand and Supply Mix
(Average Annual for the Period WY 1995-2018)

Subbasin	Ag. Demand (AFY)	Ag. Ground-water Use (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-water Use (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	410,136	205,563	207,225	215,951	91,263	124,687	0	3,869
SASb	160,694	116,397	44,667	182,760	93,515	89,324	232	20,879
CoSb	132,690	107,167	25,576	26,861	22,881	2,417	0	0
Total	**703,520**	**429,127**	**277,468**	**425,572**	**207,659**	**216,428**	**232**	**24,748**

Note: Small differences exist between total supplies and total demands. These shortages and surpluses are delivered and applied regardless of the demand specified in the model. Surpluses tend to result in deep percolation. Remediation pumping is not considered part of demand in the L&WU budget but is shown for information purposes. CoSANA total is a summation of the three subbasins (NASb, SASb, and CoSb) and excludes areas in the Eastern San Joaquin subbasin and areas outside of B118 subbasins.



Note: This figure is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins

Figure 4-7: CoSANA Agricultural Land and Water Use Budget

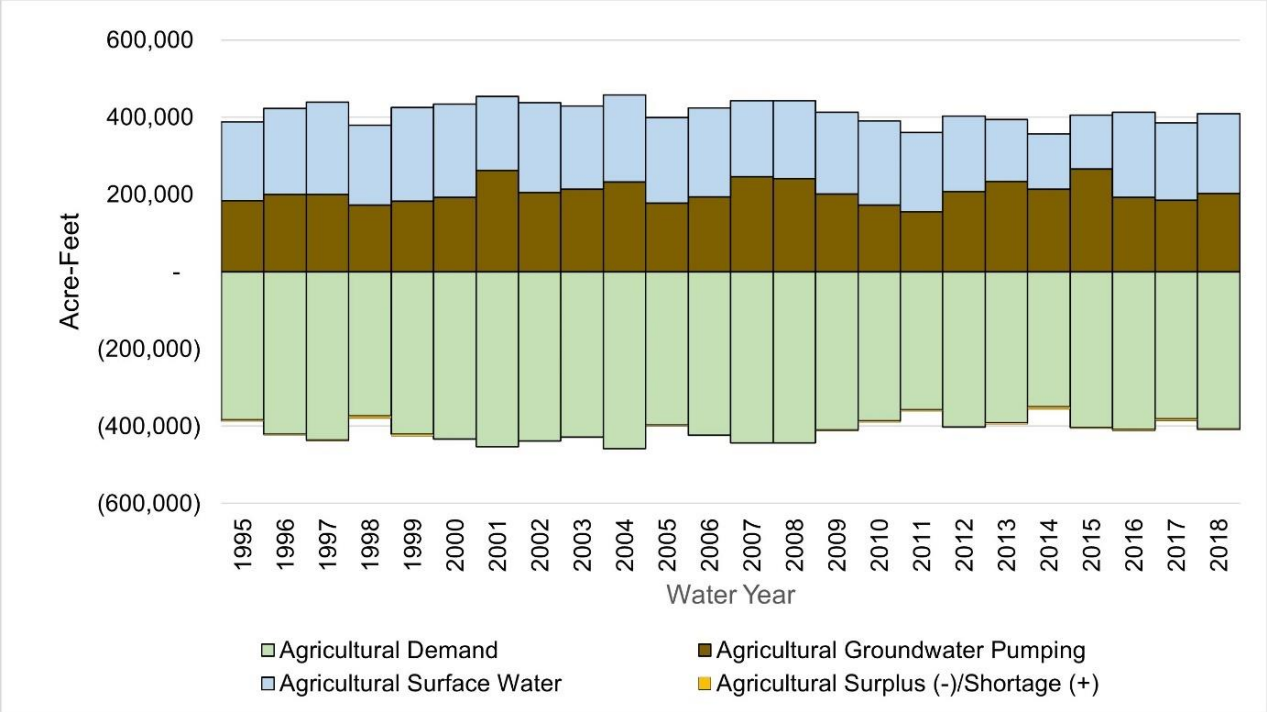


Figure 4-8: NASb Agricultural Land and Water Use Budget

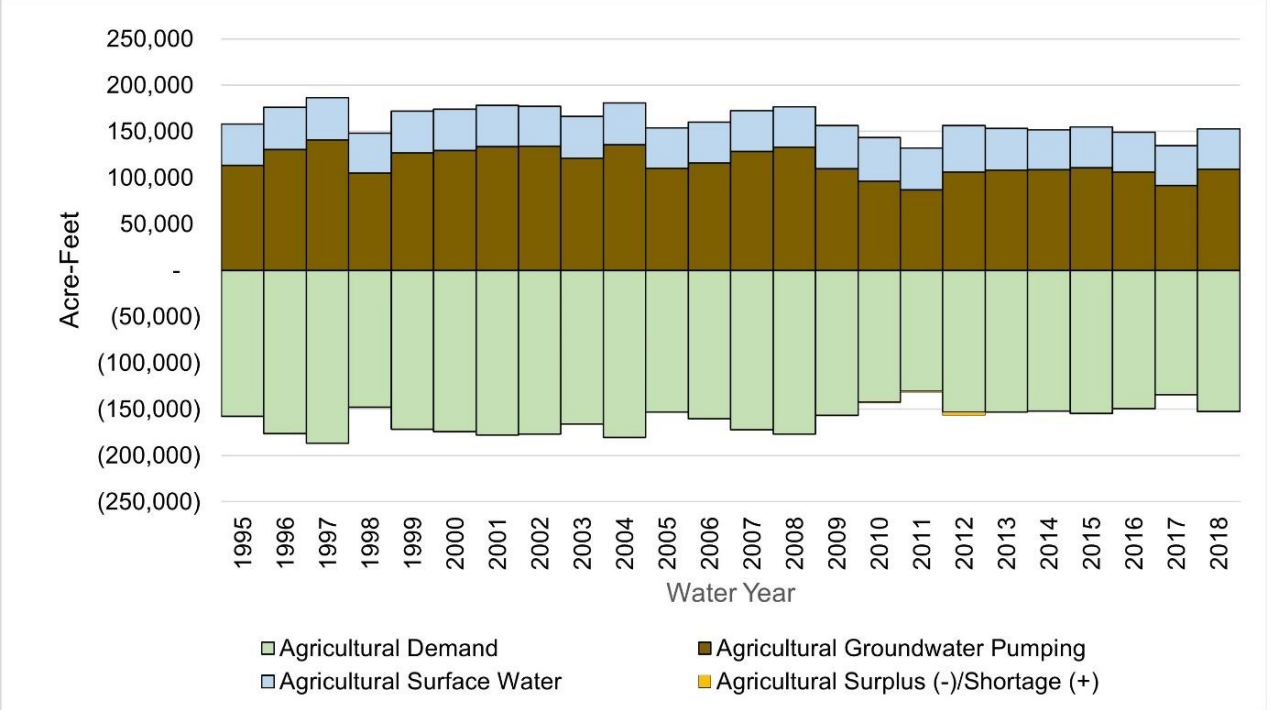


Figure 4-9: SASb Agricultural Land and Water Use Budget

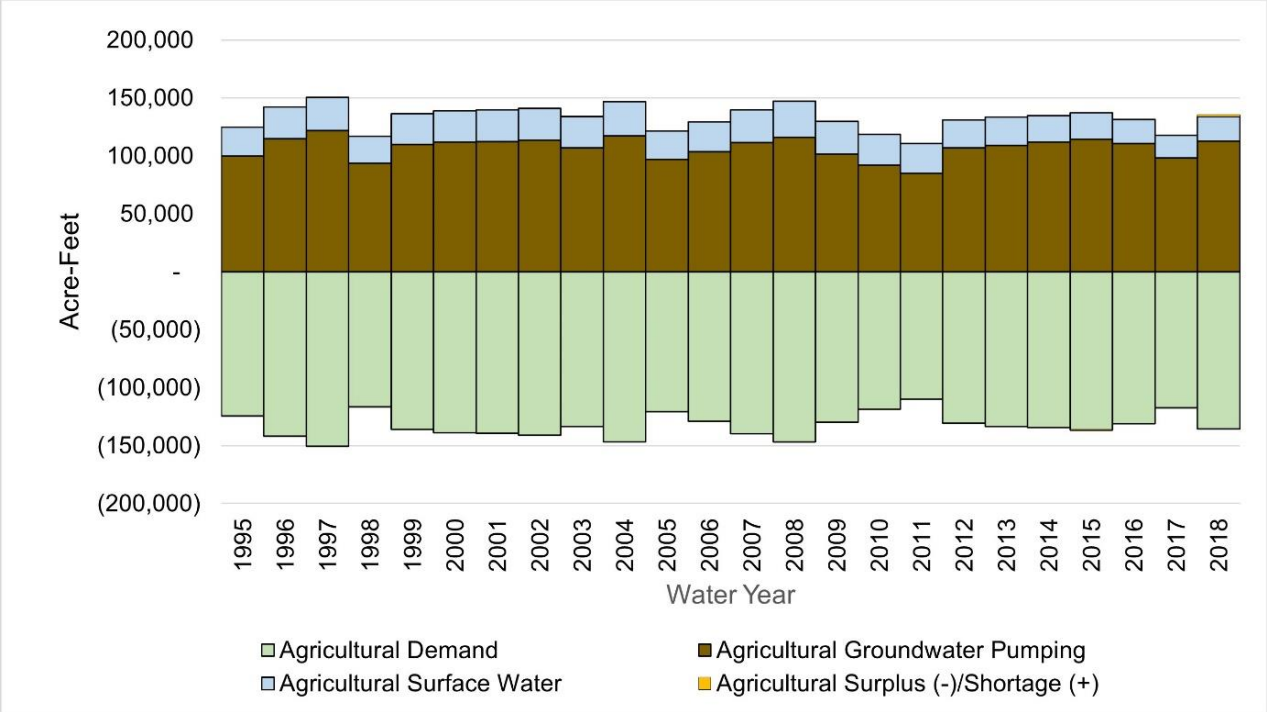
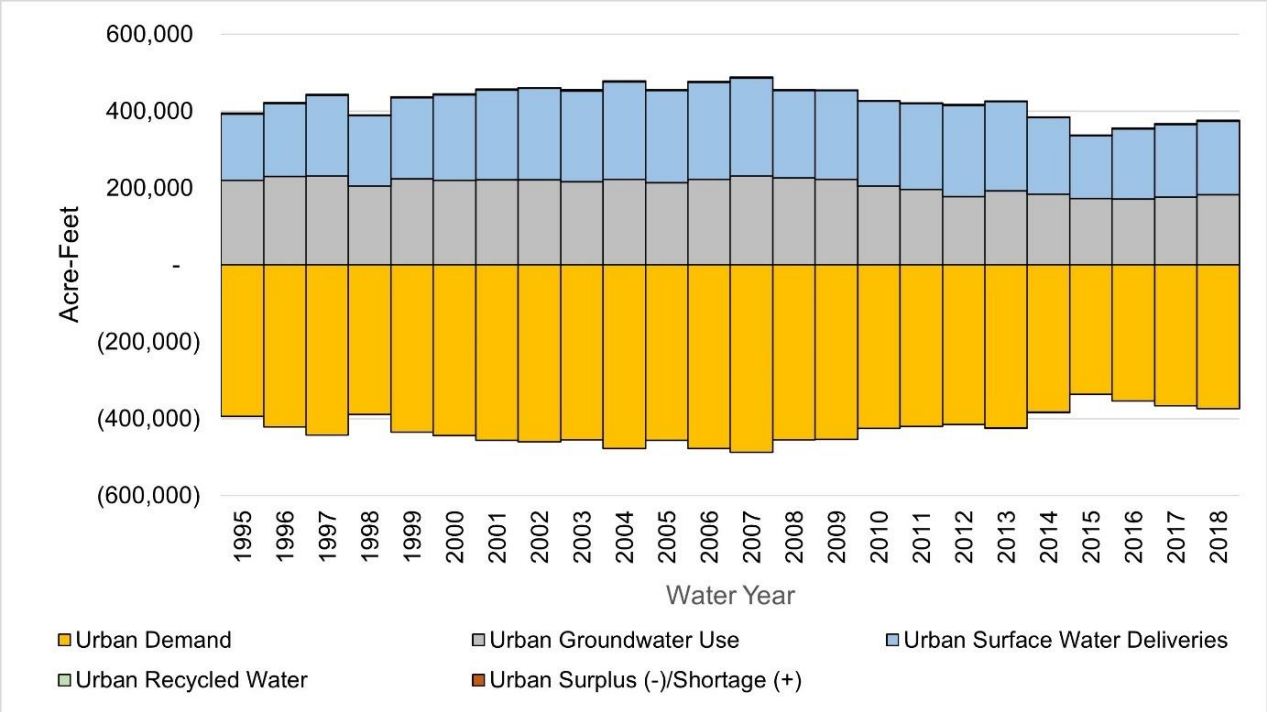


Figure 4-10: CoSb Agricultural Land and Water Use Budget



Note: This figure is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins

Figure 4-11: CoSANA Model Urban Land and Water Use Budget

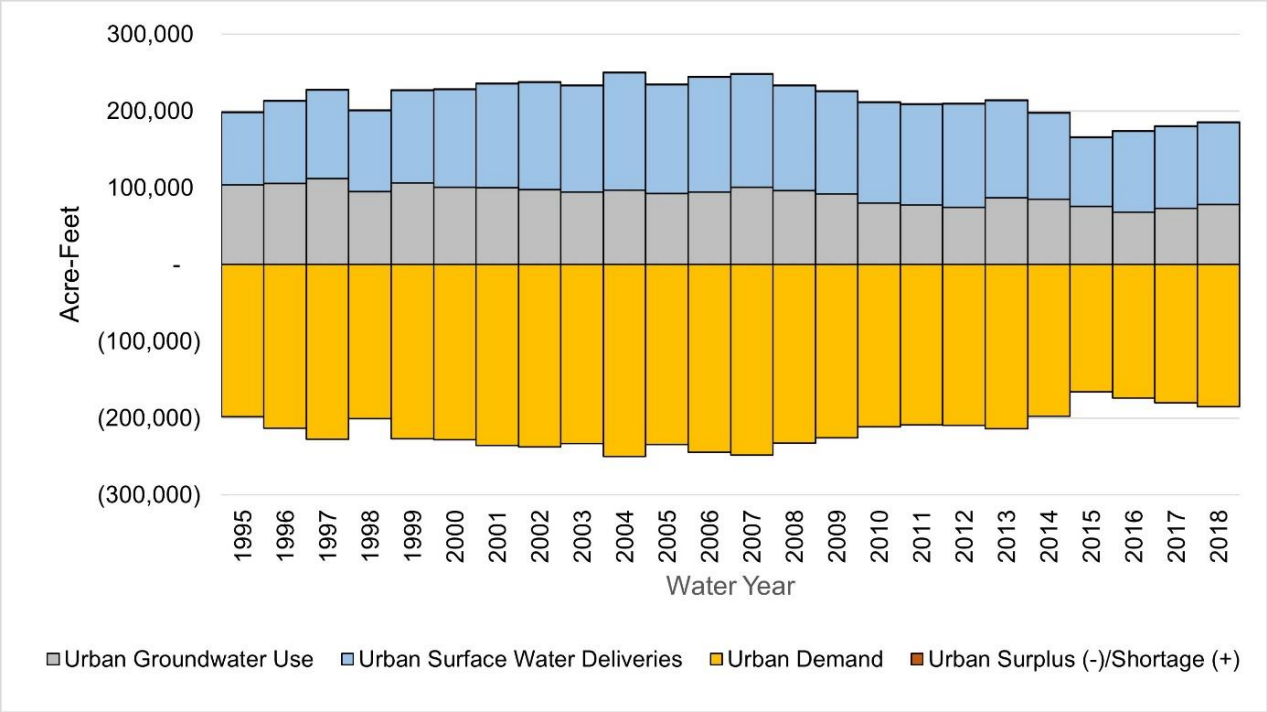


Figure 4-12: NASb Urban Land and Water Use Budget

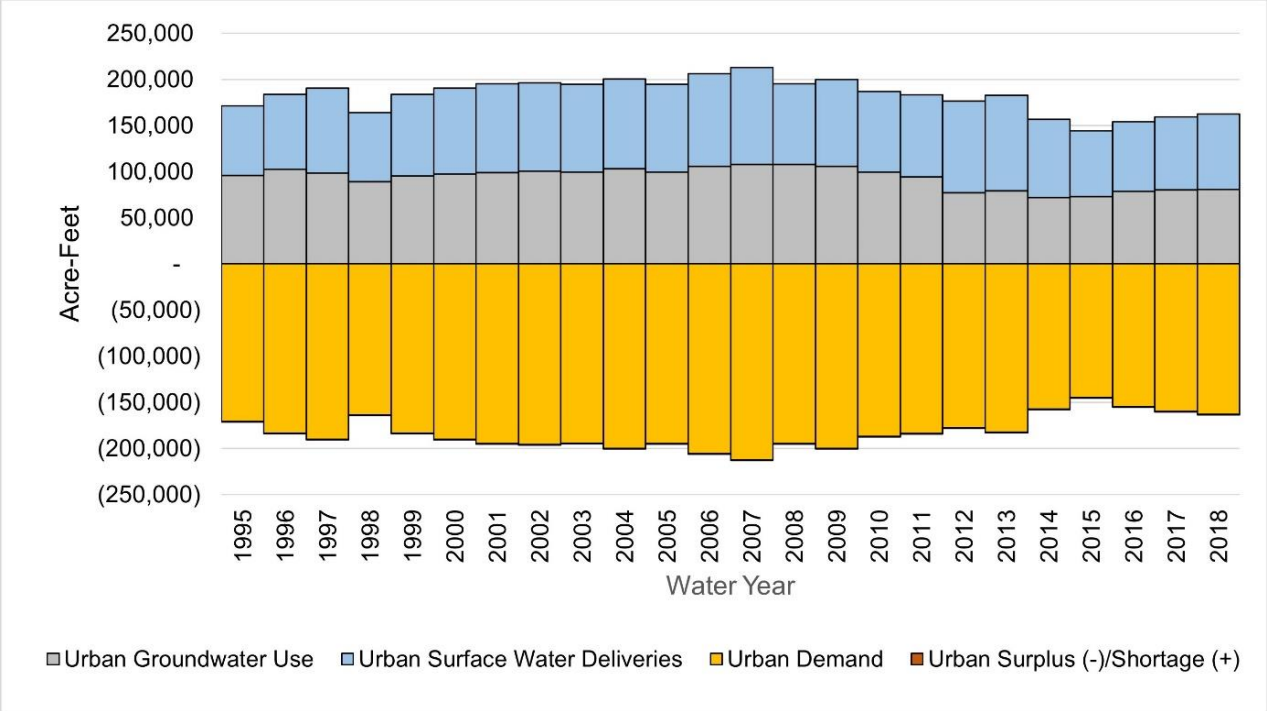
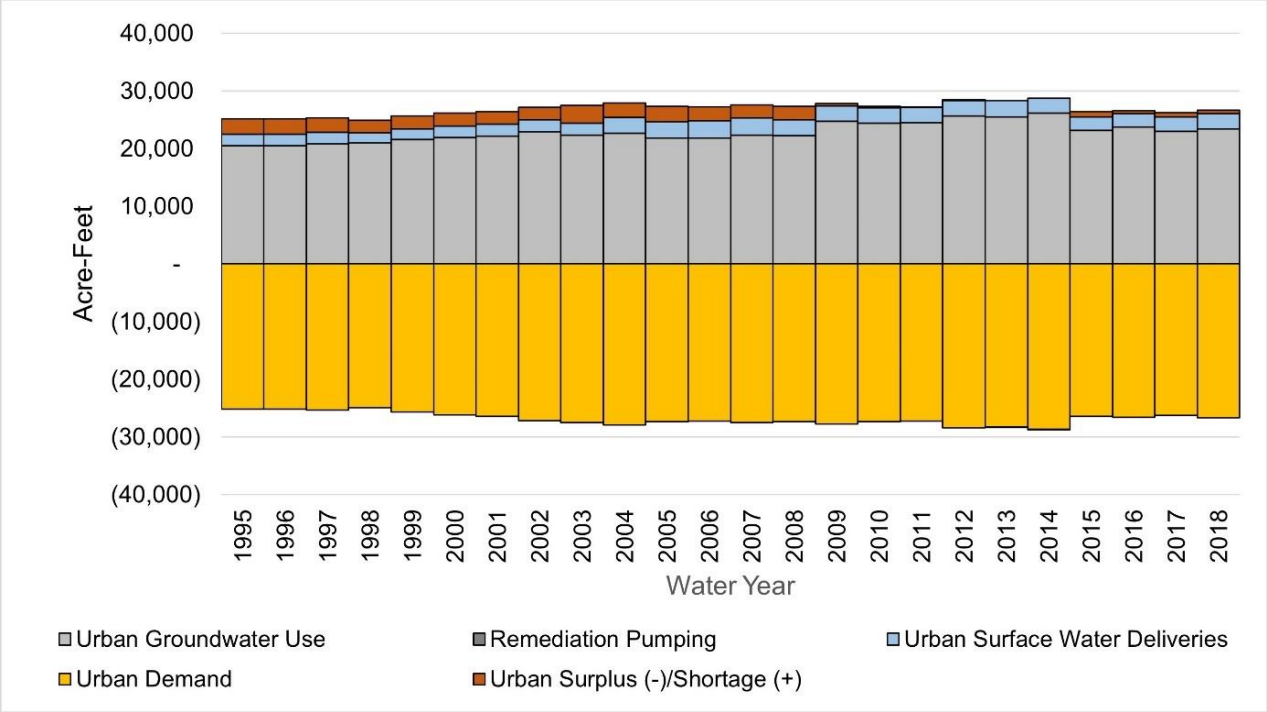


Figure 4-13: SASb Urban Land and Water Use Budget



Note: Urban groundwater use is specified in the CoSb model input data set. The model-calculated surplus/shortage in urban demand is therefore not utilized to calculate the CoSb groundwater budget.

Figure 4-14: CoSb Urban Land and Water Use Budget

4.2.1.2 Groundwater Budget

The groundwater budget quantifies inflows and outflows from the groundwater system. The primary components of the groundwater budget, corresponding to the major hydrologic processes affecting groundwater flow in the model area, are:

- Inflows:
  - Deep percolation (from rainfall and irrigation applied water)
  - Gain from stream (recharge due to stream seepage)
  - Recharge (from other sources such as irrigation canal seepage and recharge ponds)
  - Boundary inflow (from outside the model area)
  - Net subsurface inflow (from adjacent subregions)
- Outflows:
  - Groundwater pumping
  - Loss to stream (outflow to streams and rivers)
  - Boundary outflow (to outside the model area)
  - Subsurface outflow (to adjacent subregions)
- Change in groundwater storage (positive indicates withdrawal from groundwater storage, and negative indicates contribution to groundwater storage)

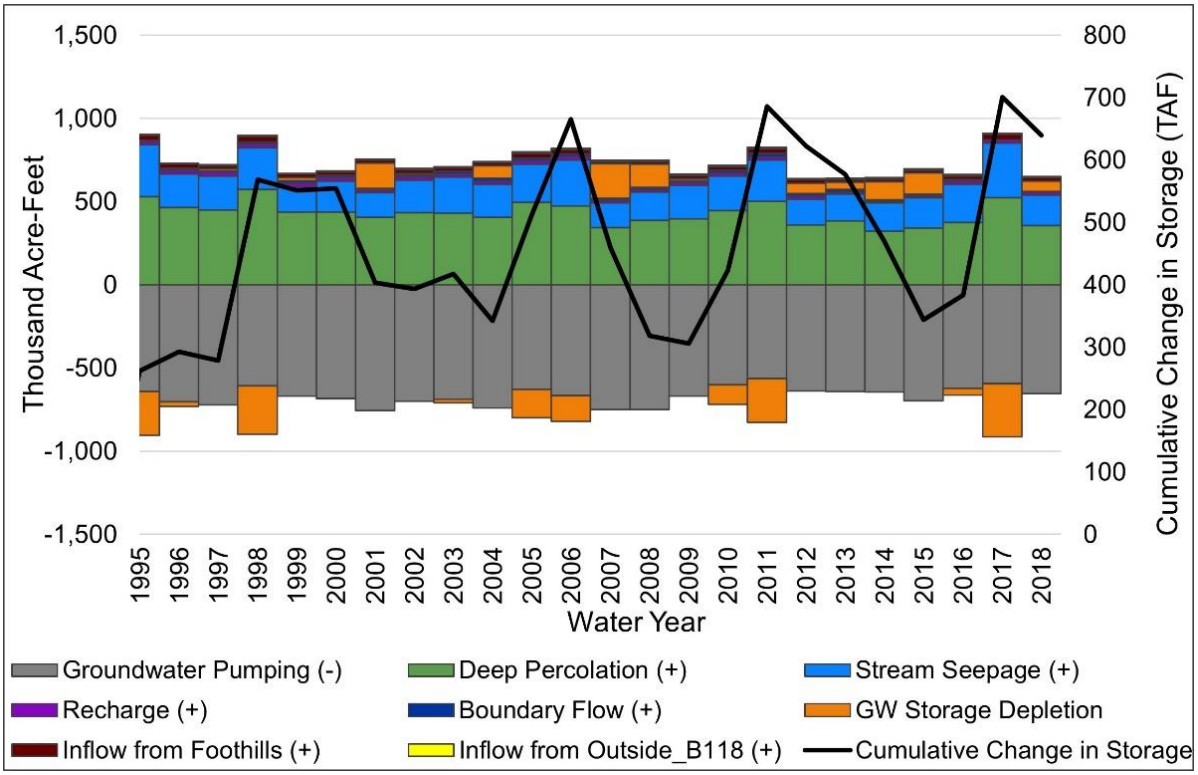
The groundwater budgets, including cumulative change in storage, are summarized in Table 4-2 and shown in Figure 4-15 through Figure 4-18 for three subbasins combined and for the NASb, SASb, and CoSb, respectively. Though results vary area to area, the primary sources of groundwater inflows are deep percolation and interaction with the model streams.

Subregion-level budgets are provided in Appendix E.

Table 4-2: Summary of CoSANA Groundwater Budget
(Average Annual for the Period WY 1995-2018)

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Subsurface Inflow (AFY)	Boundary Flows (AFY)	Change in Storage (AFY)
NASb	315,794	189,988	85,907	18,320	18,220	30,019	26,661
SASb	221,618	130,317	101,953	15	-8,884	3,769	5,551
CoSb	130,048	108,054	18,977	0	-2,333	-162	-5,510
Total	**667,460**	**428,359**	**206,837**	**18,335**	**7,003***	**11,302**	**26,702**

Note: CoSANA total is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins.
* The model-wide subsurface inflow value includes subsurface flows to and from areas outside of the combined NASb, SASb, and CoSb area.



Note: This figure is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins

Figure 4-15: CoSANA Groundwater Budget

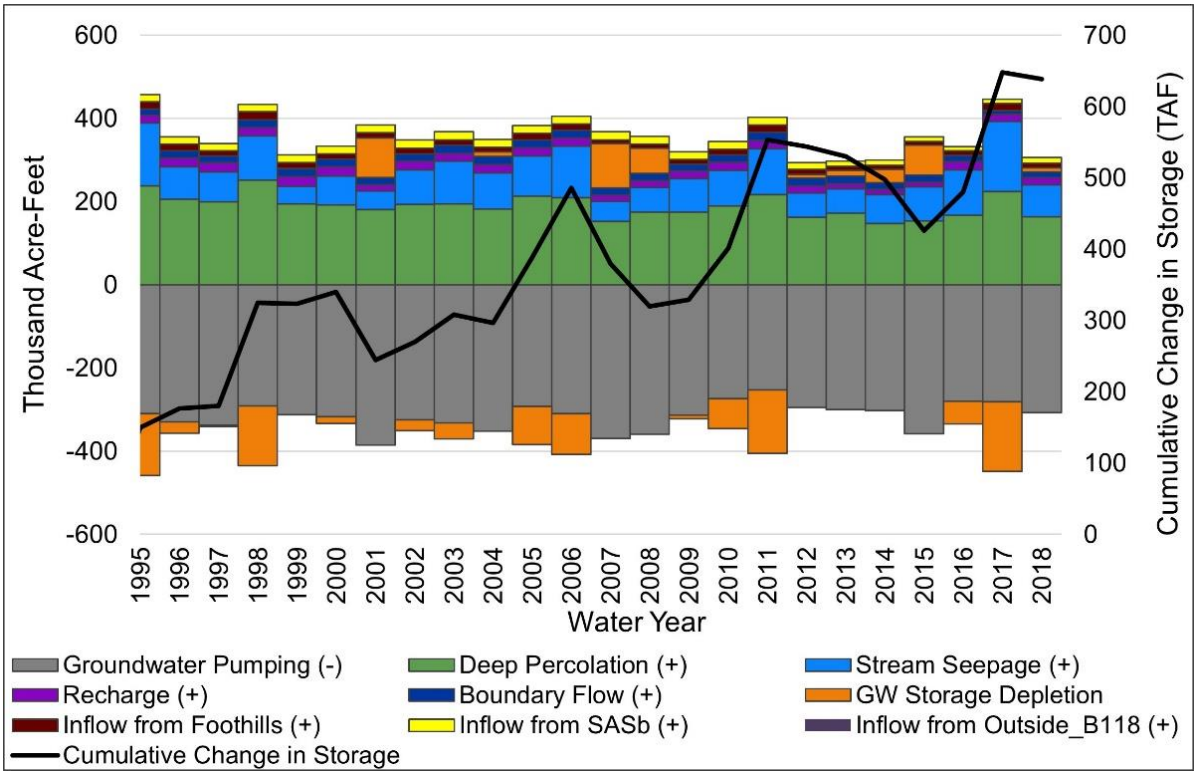


Figure 4-16: NASb Groundwater Budget

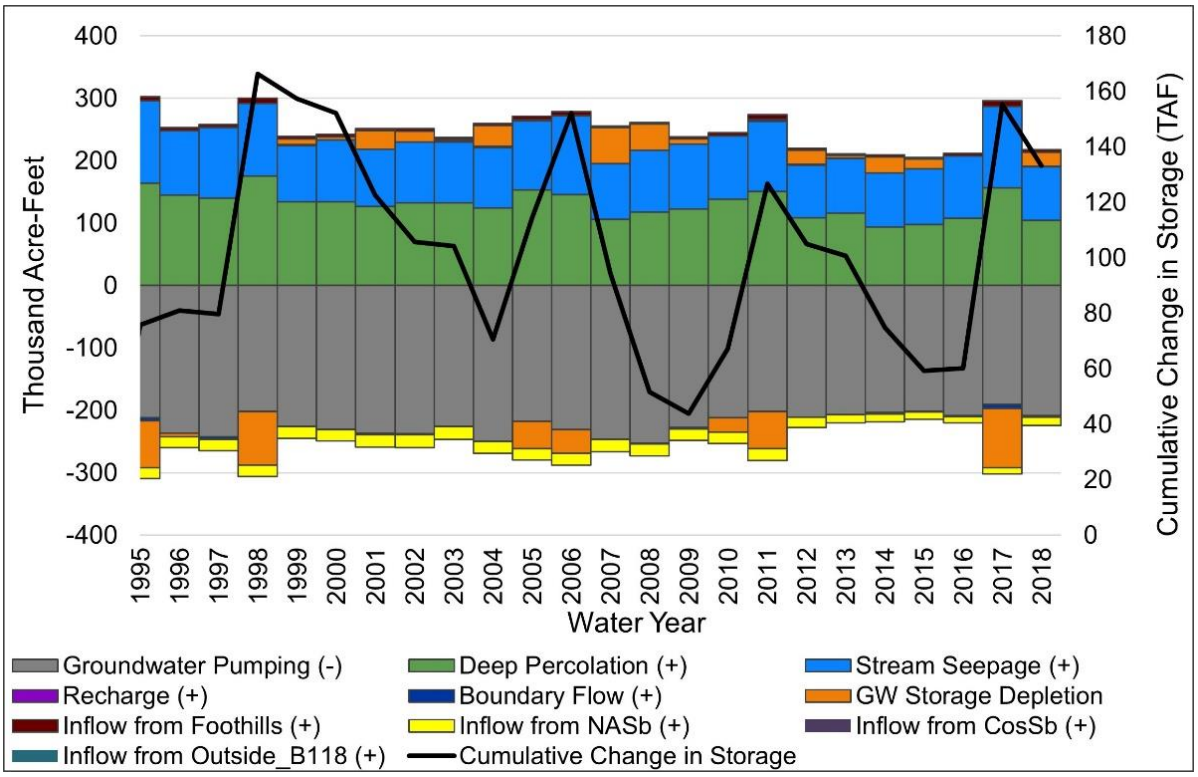


Figure 4-17: SASb Groundwater Budget

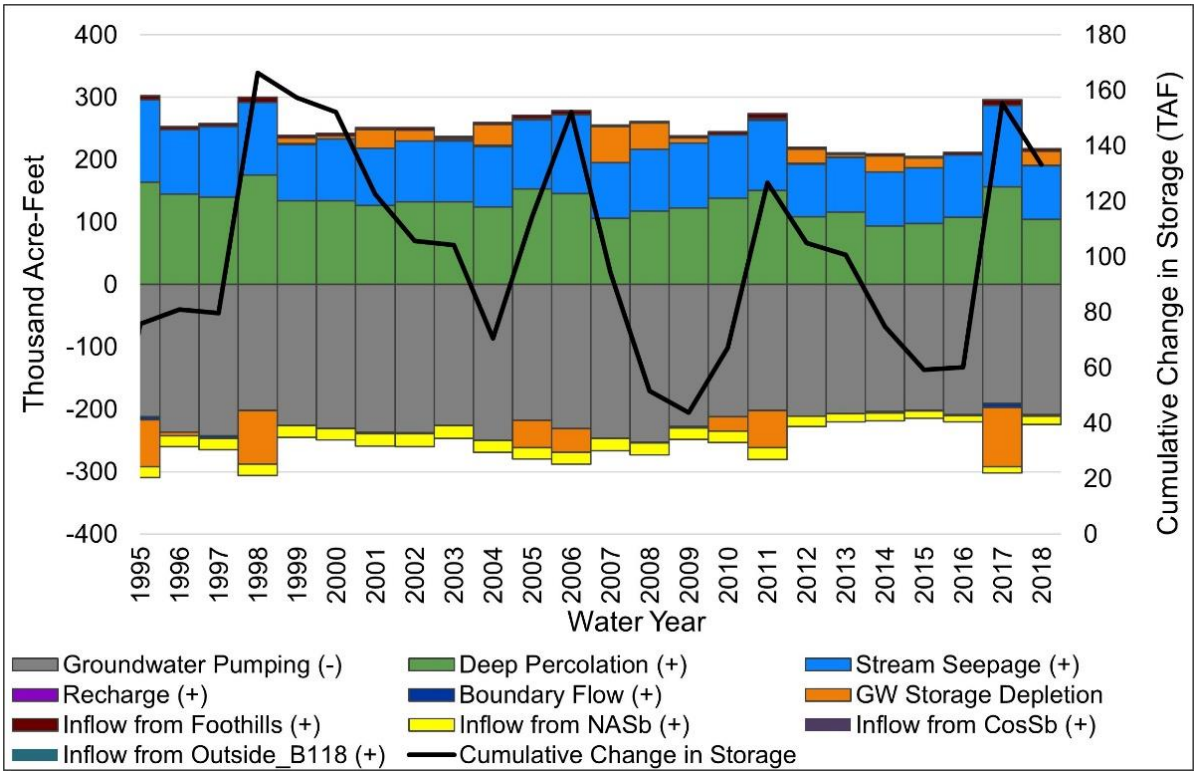


Figure 4-18: CoSb Groundwater Budget

4.2.2 Groundwater Level Calibration

Groundwater levels are calibrated to achieve acceptable agreement between the simulated and observed values (in this case, groundwater levels at the calibration wells). Within CoSANA, over 1,600 wells were evaluated for developing groundwater observation locations (calibration wells) to allow CoSANA's calibration at both a regional and local scale. Data for these wells were obtained from DWR's CASGEM program, DWR's Water Data Library, and local monitoring data from Aerojet, Elk Grove Water District, The Nature Conservancy, and the University of California - Davis. The calibration wells were selected based on their period of record, availability of observation data, spatial distribution across the model, representative nature of the data, and trends of nearby wells. After a review of the available observation data, a working set of 761 wells was selected to be used for the calibration process.

The groundwater level calibration process included both manual refinements to the model as well as automated calibration using the PEST software package. The set of 761 wells with associated observations was used to perform PEST calibration. Of the identified 761 wells, a refined subset of 403 wells that are considered representative of the long-term conditions of groundwater levels both at a local and regional scale were selected for analysis in each PEST run. The location and number of observations for the full set of 761 wells are shown in Figure 4-19, the period of record for each of these wells is shown in Figure 4-20. Maps showing the locations of each of the 403 wells in the subset and calibration hydrographs are shown in Appendix F.

With the observation data identified, a preliminary manual calibration was performed to adjust the water budgets, primarily the land and water use budgets and the small watershed budgets, to have a reasonable starting point for calibrating the aquifer parameters. Simulated groundwater levels are calibrated to observed levels through adjustments to hydrogeologic parameters or aquifer parameters including hydraulic conductivity, specific storage, and specific yield (discussed in Section 4.4). Input datasets were also refined where the calibration process identified issues. The goal of groundwater level calibration is to achieve the maximum agreement between simulated and observed groundwater elevations at calibration wells while maintaining reasonable values for aquifer parameters.

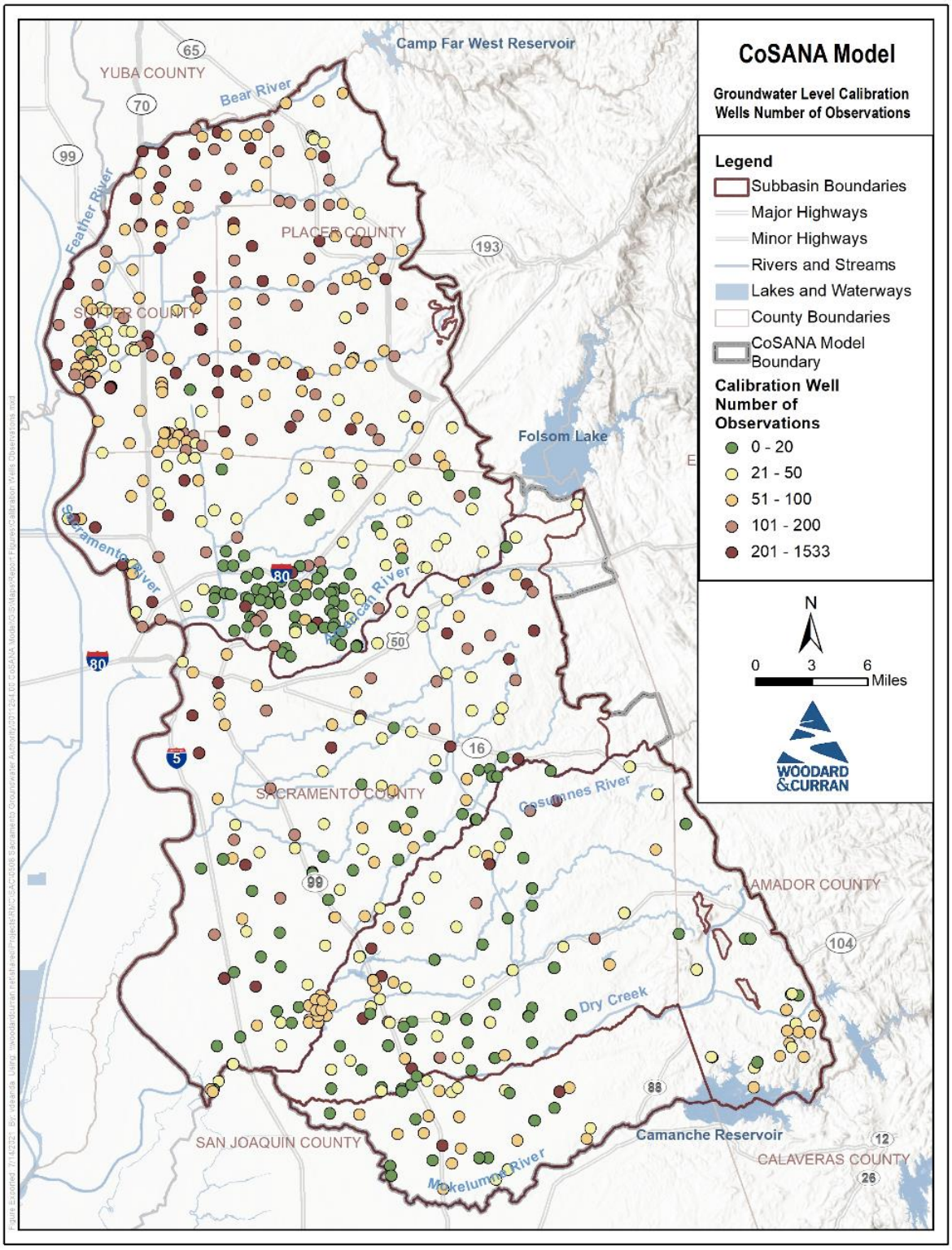


Figure 4-19: Number of Observations for Calibration Wells

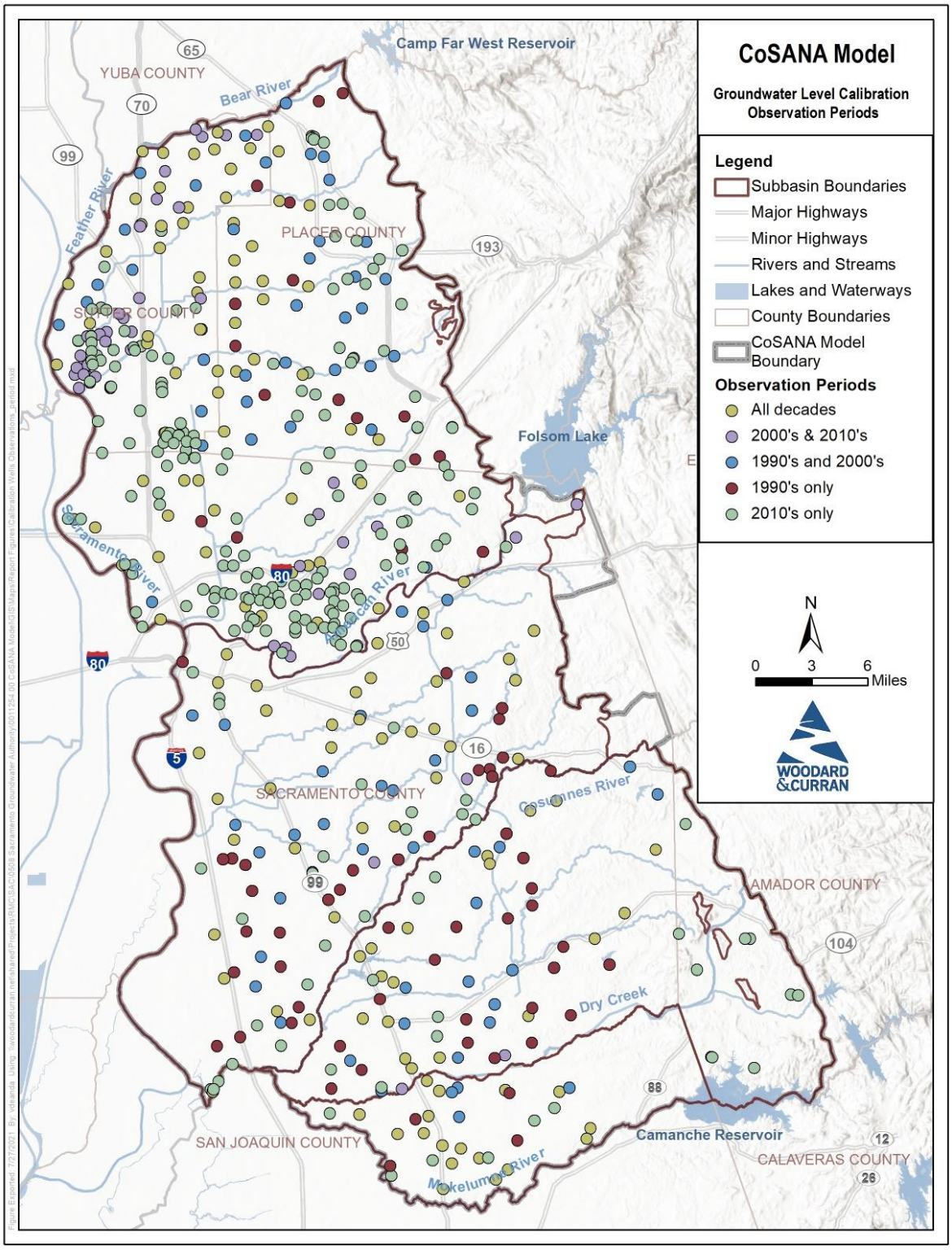


Figure 4-20: Period of Record for Calibration Wells

The automated parameter estimation tool, PEST, was used to assist in refinement of aquifer parameters to improve model calibration. PEST-assisted calibration is performed to interact with CoSANA via input and output files and iteratively modifies parameter values to reduce an objective function representative of the model residual error. These modifications are made within identified bounds of reasonable values for each parameter. PEST-assisted calibration focused on the aquifer parameters such as horizontal and vertical conductivities and storage parameters.

Between PEST-assisted calibration iterations, the modeling team revisited the land system and small watershed budgets and made manual adjustments where needed, until calibration goals were met.

Simulated groundwater level contours and observed values for calibration wells are shown in Figure 4-21, Figure 4-22, and Figure 4-23 for spring 1998, fall 2015, and fall 2018, respectively. Simulated groundwater level hydrographs and observations for selected wells (locations shown in Figure 4-24) are shown in Figure 4-25 through Figure 4-49. Simulated values represent the layers screened at that well, except for 7223 and 7224 which do not have screened interval information.

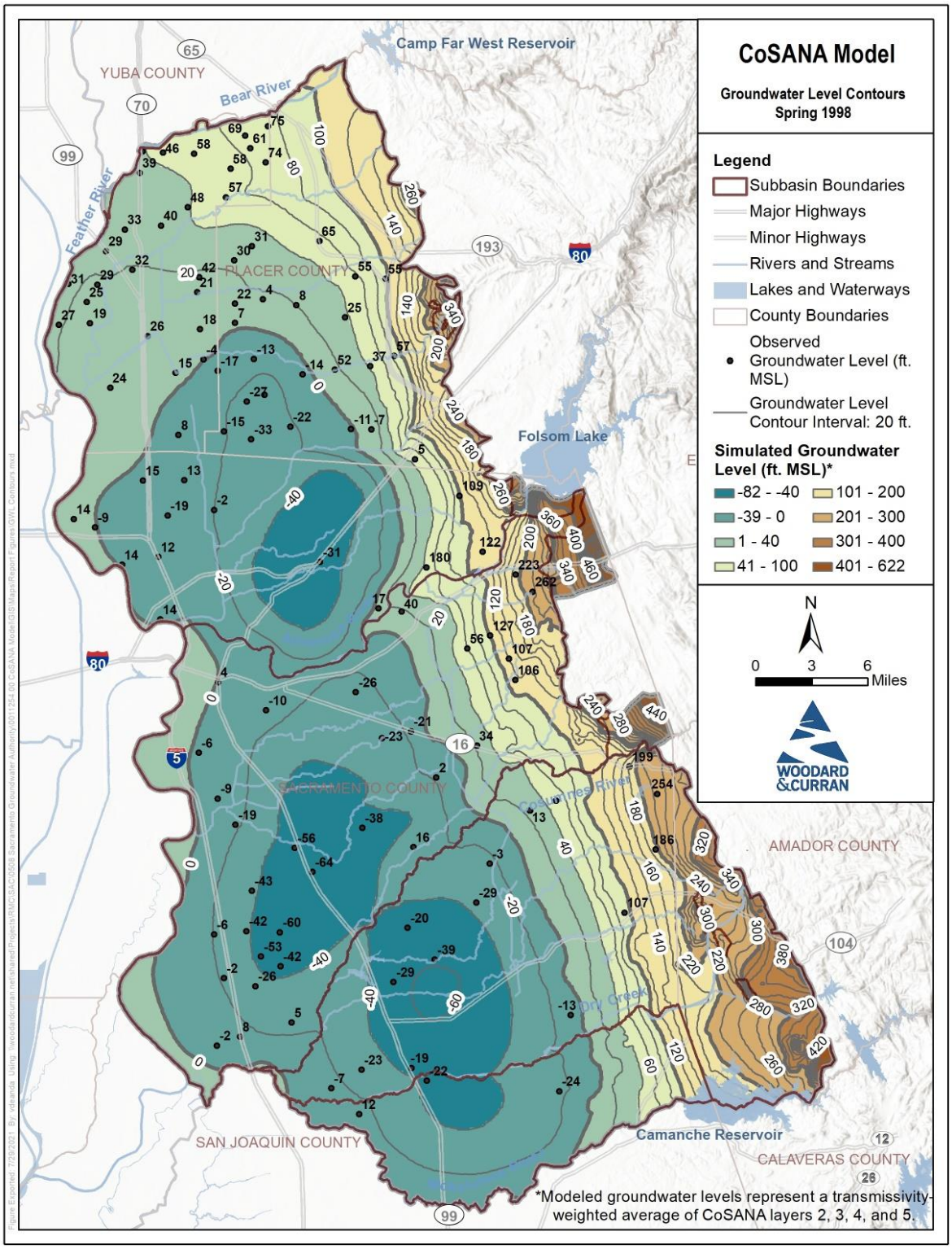


Figure 4-21: CoSANA Groundwater Level Contours – Spring 1998 (End of Wet Period)

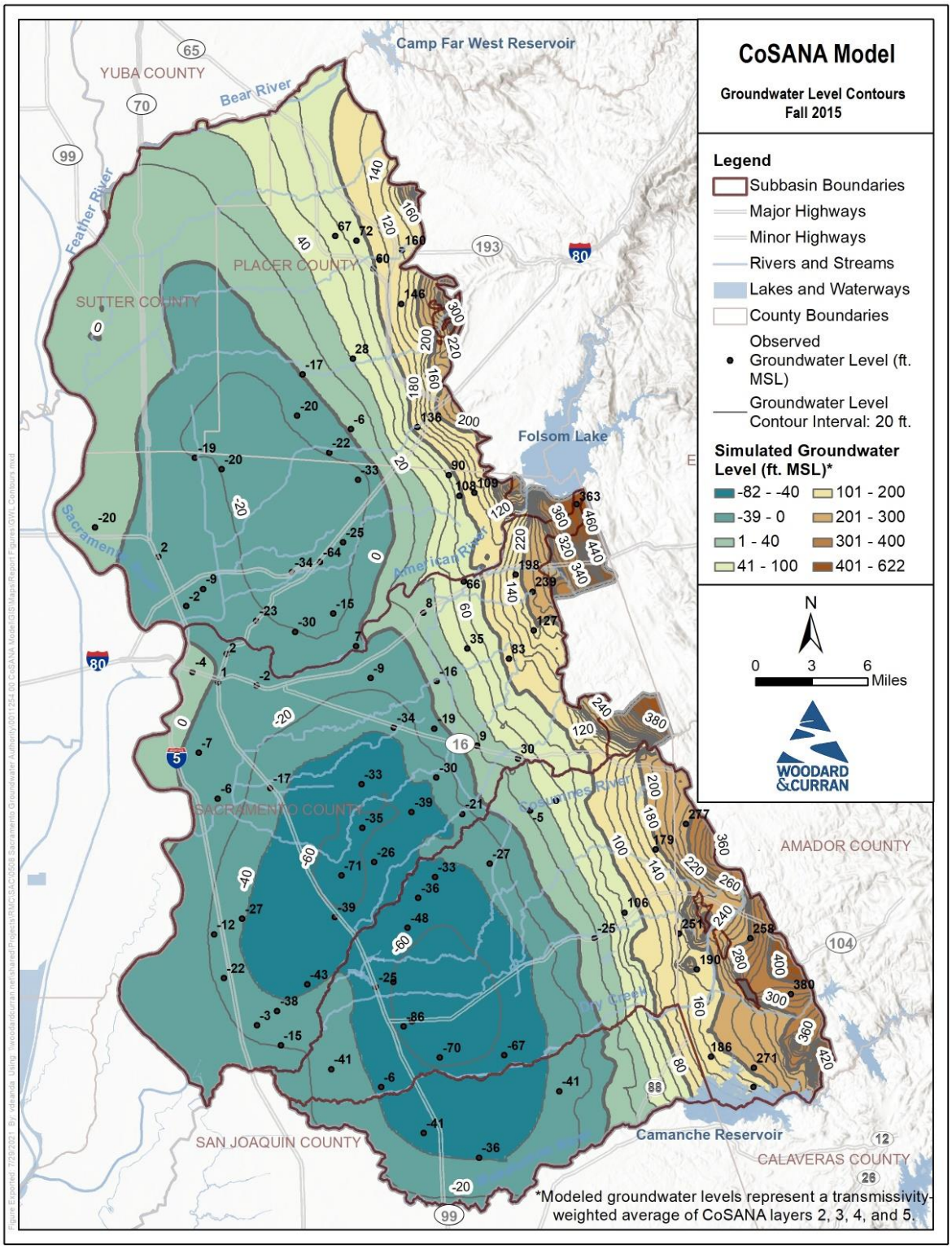


Figure 4-22: CoSANA Groundwater Level Contours – Fall 2015 (End of Drought Period)

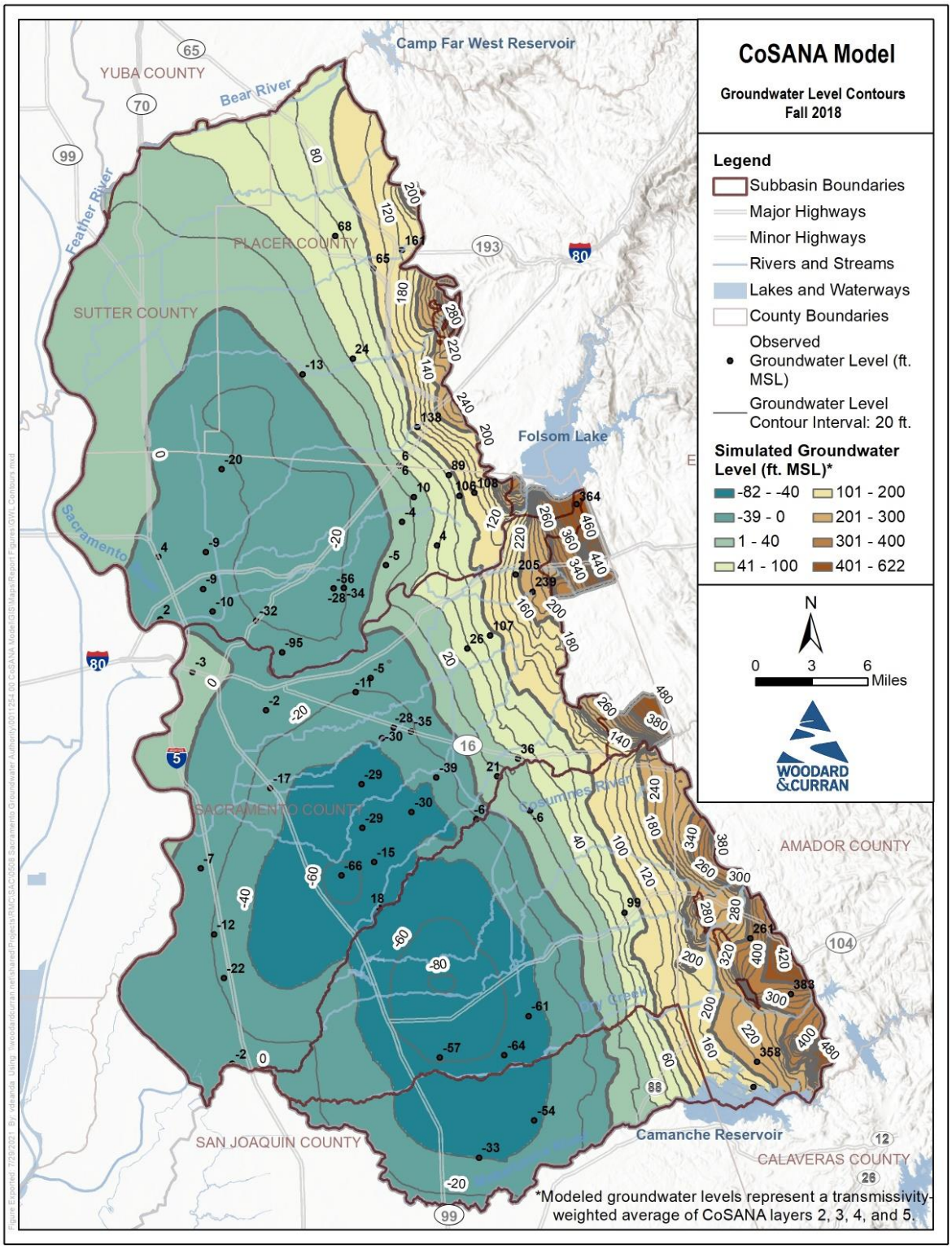


Figure 4-23: CoSANA Groundwater Level Contours – Fall 2018 (End of Simulation)

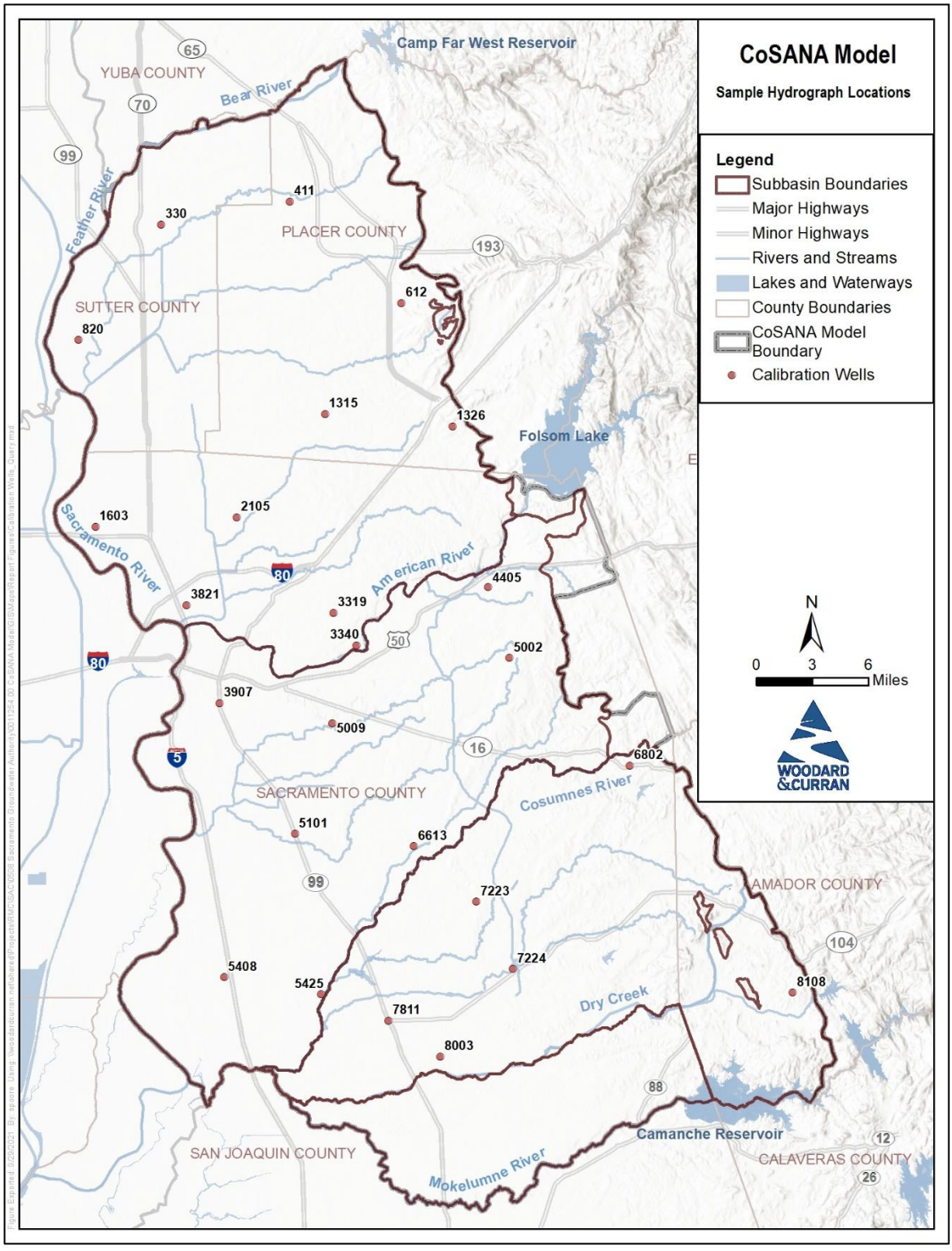


Figure 4-24: Location of Sample Hydrographs

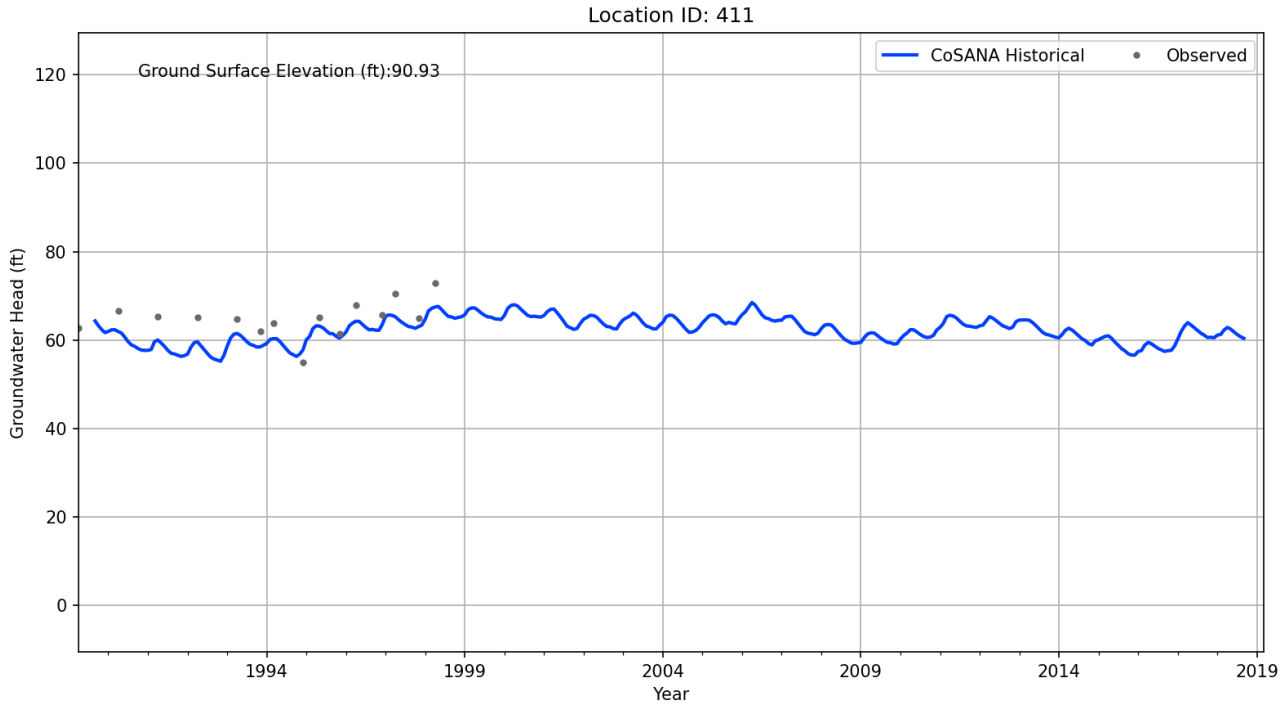


Figure 4-25: CoSANA Groundwater Level Hydrograph – Hydrograph #1

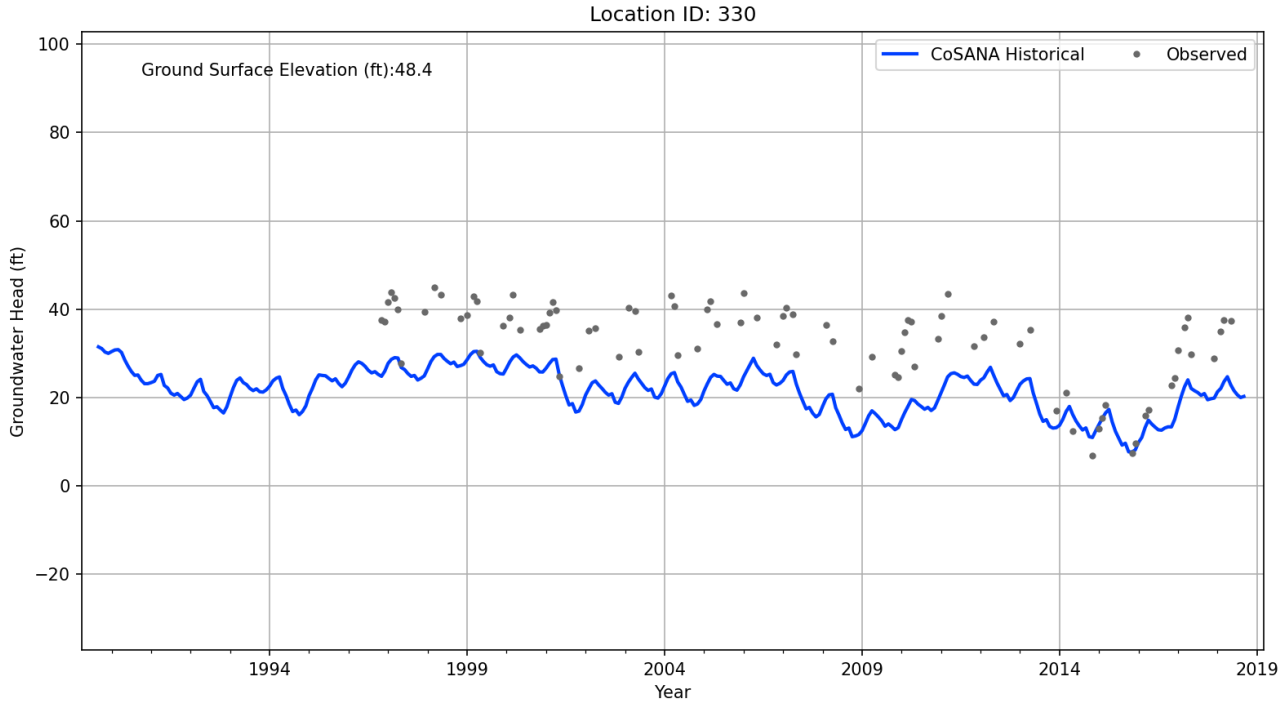


Figure 4-26: CoSANA Groundwater Level Hydrograph – Hydrograph #2

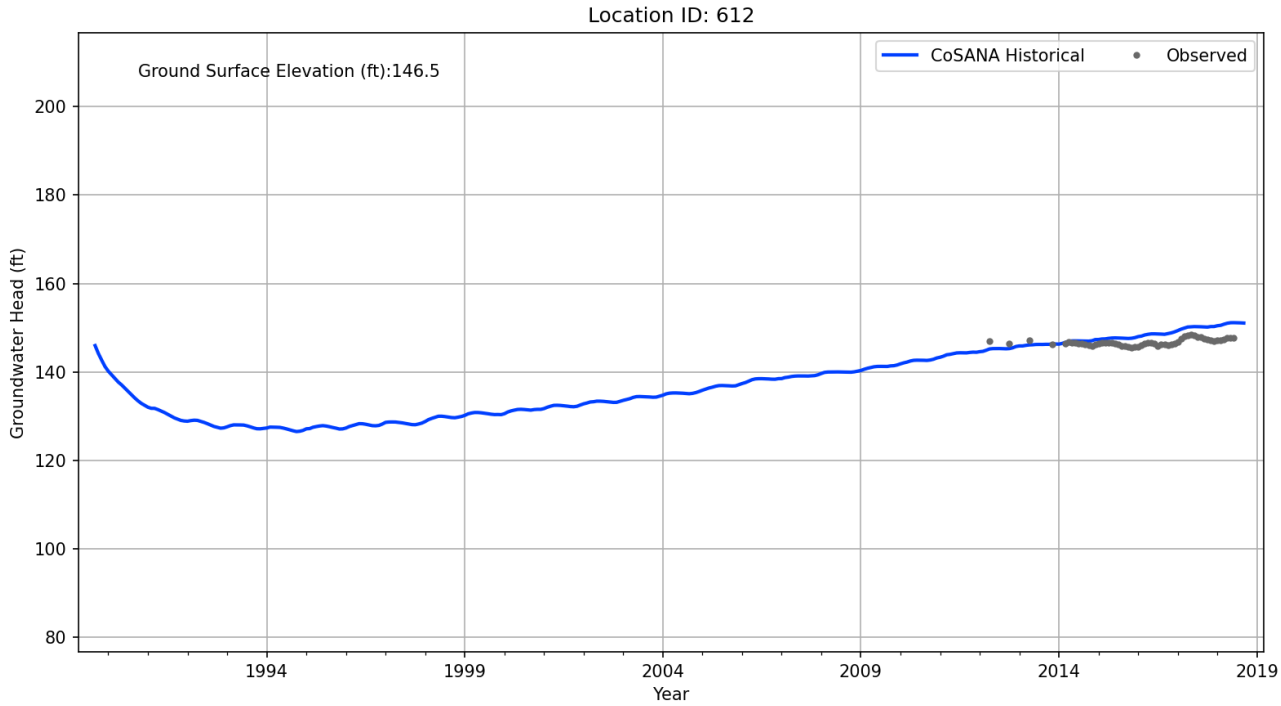


Figure 4-27: CoSANA Groundwater Level Hydrograph – Hydrograph #3

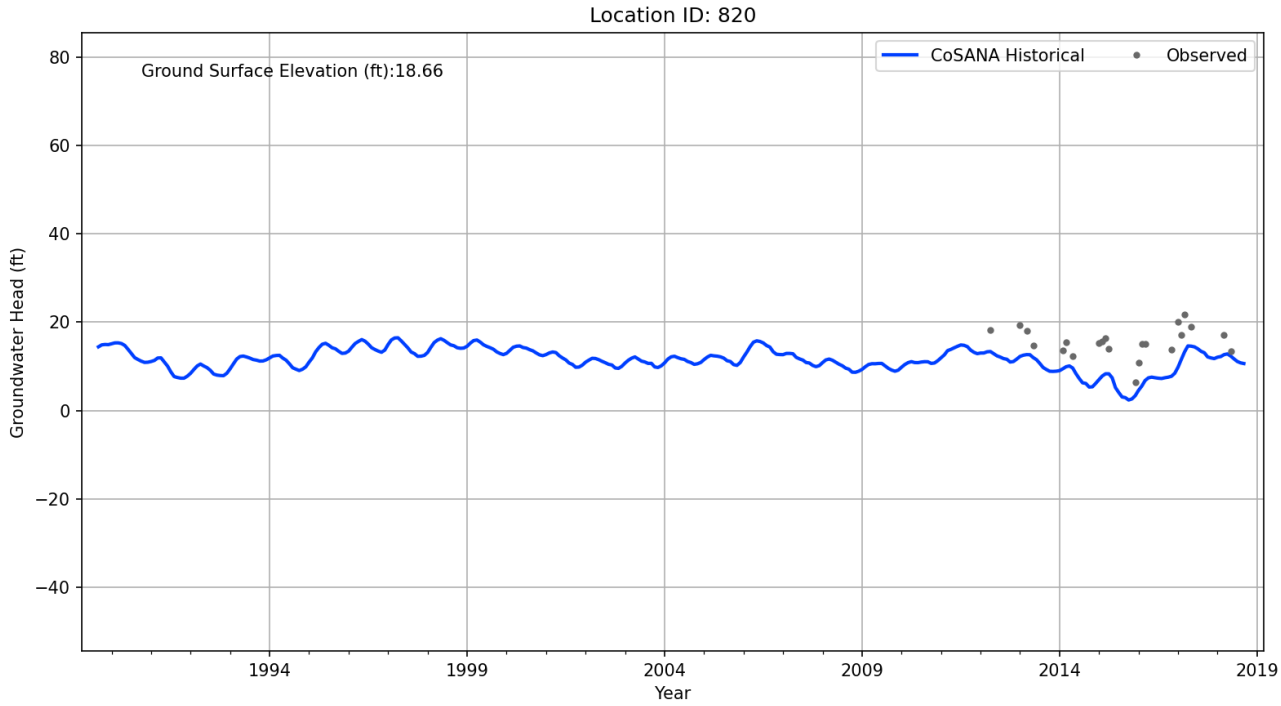


Figure 4-28: CoSANA Groundwater Level Hydrograph – Hydrograph #4

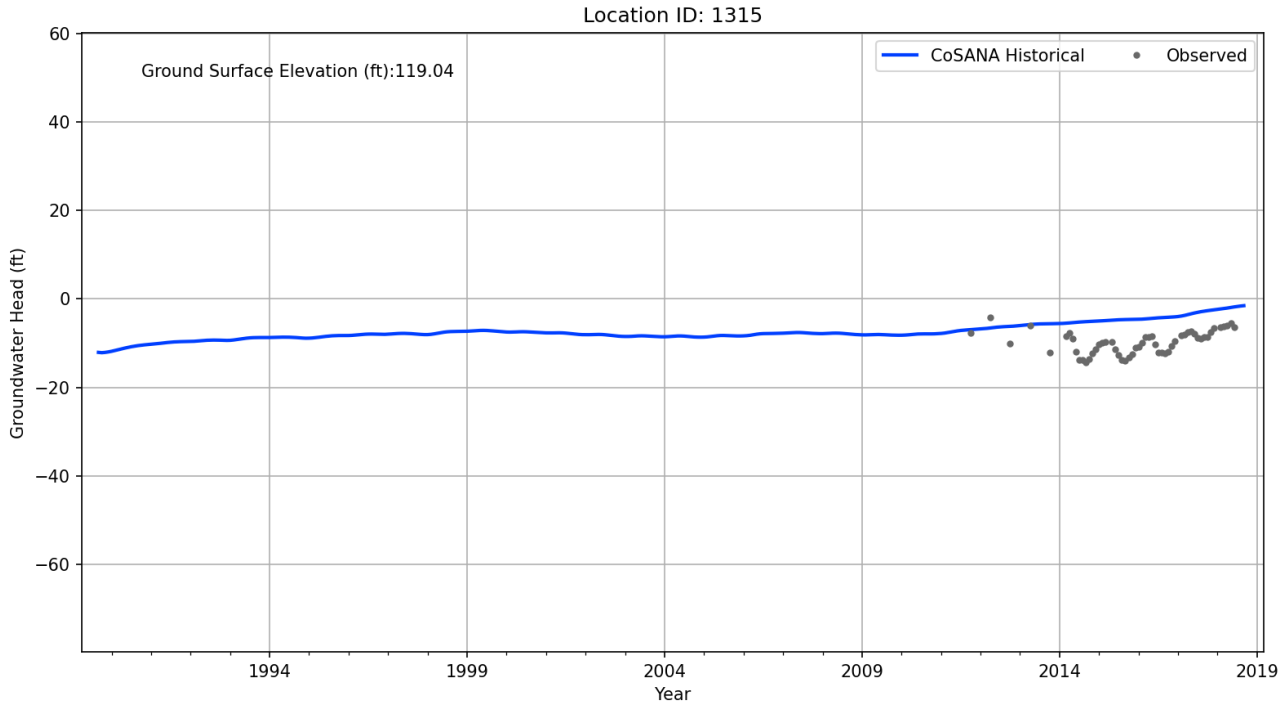


Figure 4-29: CoSANA Groundwater Level Hydrograph – Hydrograph #5

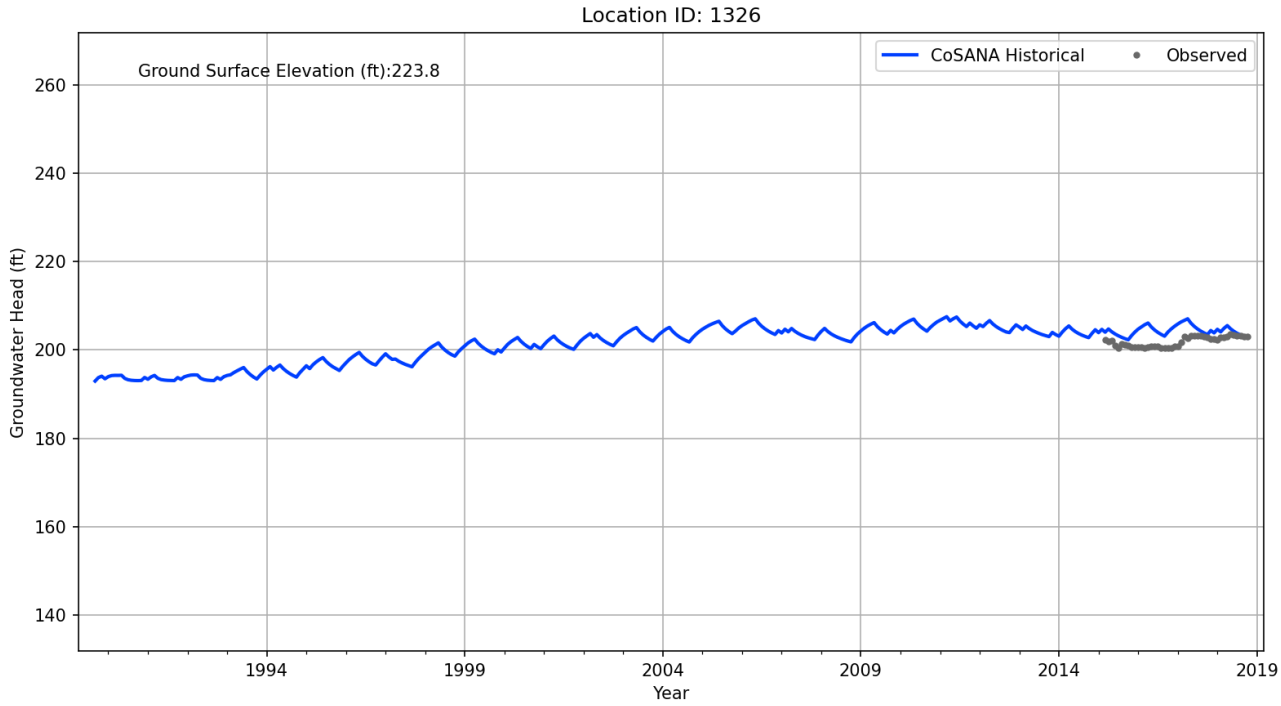


Figure 4-30: CoSANA Groundwater Level Hydrograph – Hydrograph #6

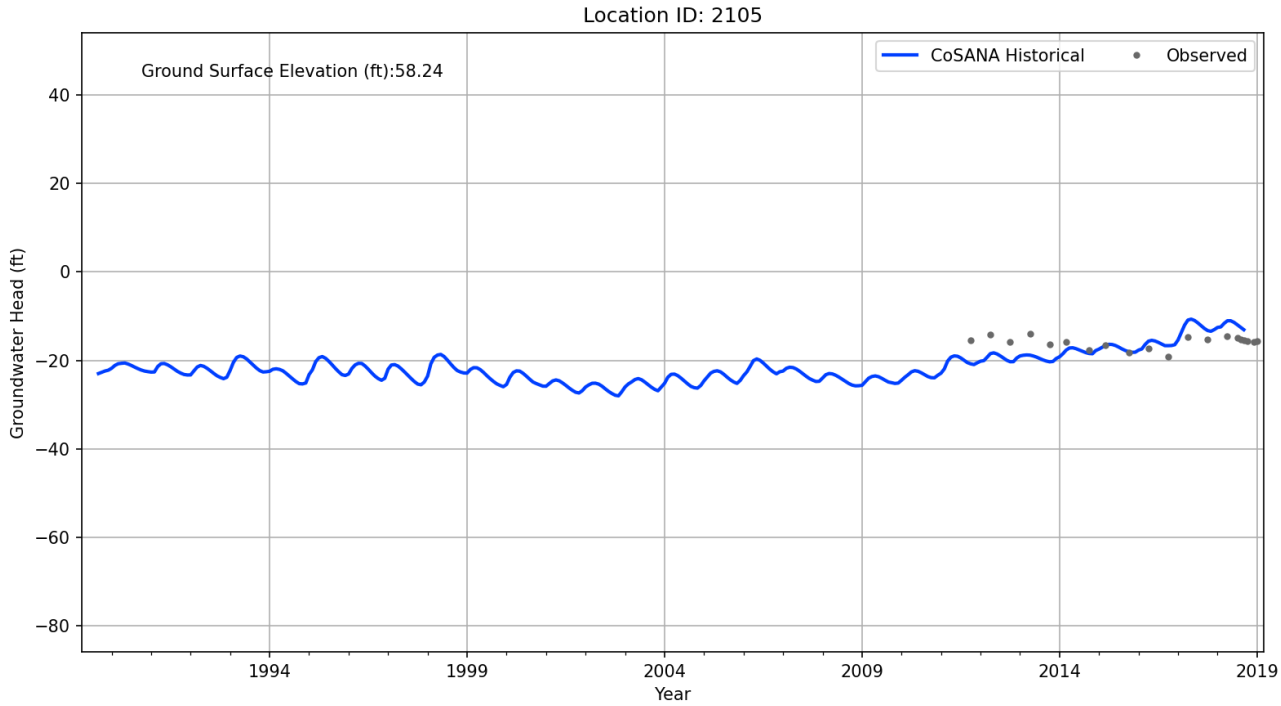


Figure 4-31: CoSANA Groundwater Level Hydrograph – Hydrograph #7

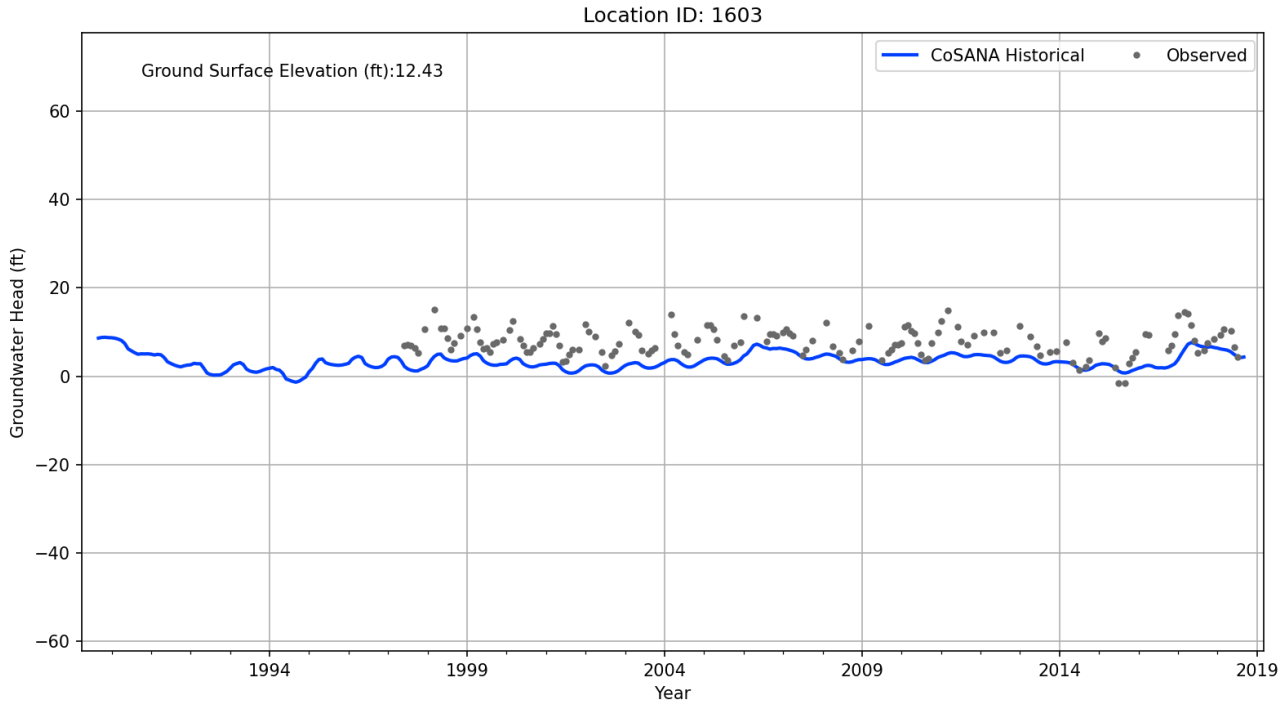


Figure 4-32: CoSANA Groundwater Level Hydrograph – Hydrograph #8

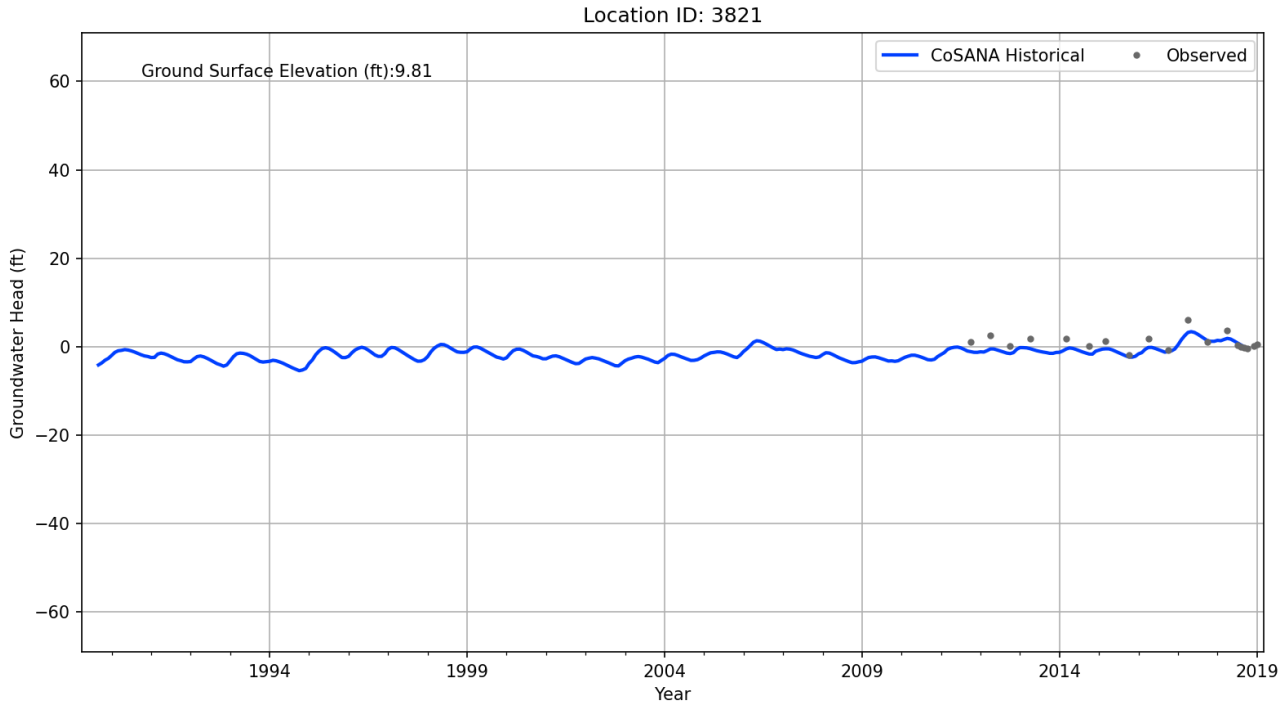


Figure 4-33: CoSANA Groundwater Level Hydrograph – Hydrograph #9

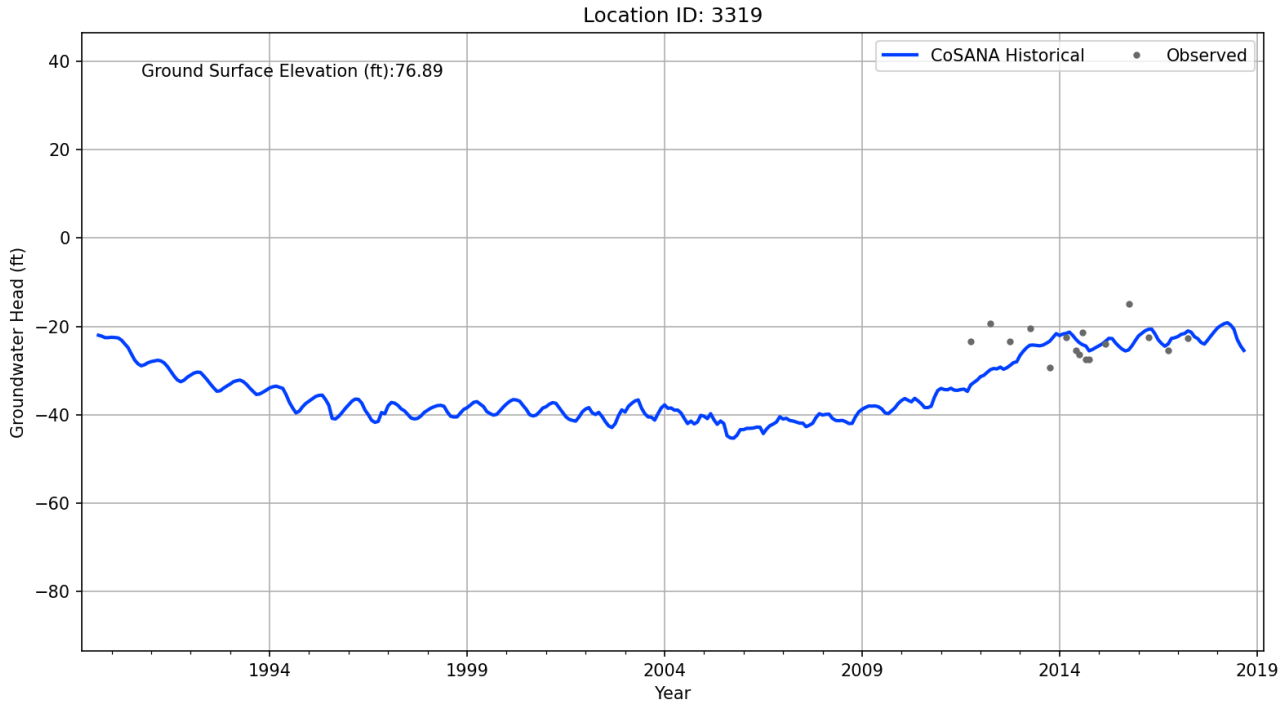


Figure 4-34: CoSANA Groundwater Level Hydrograph – Hydrograph #10

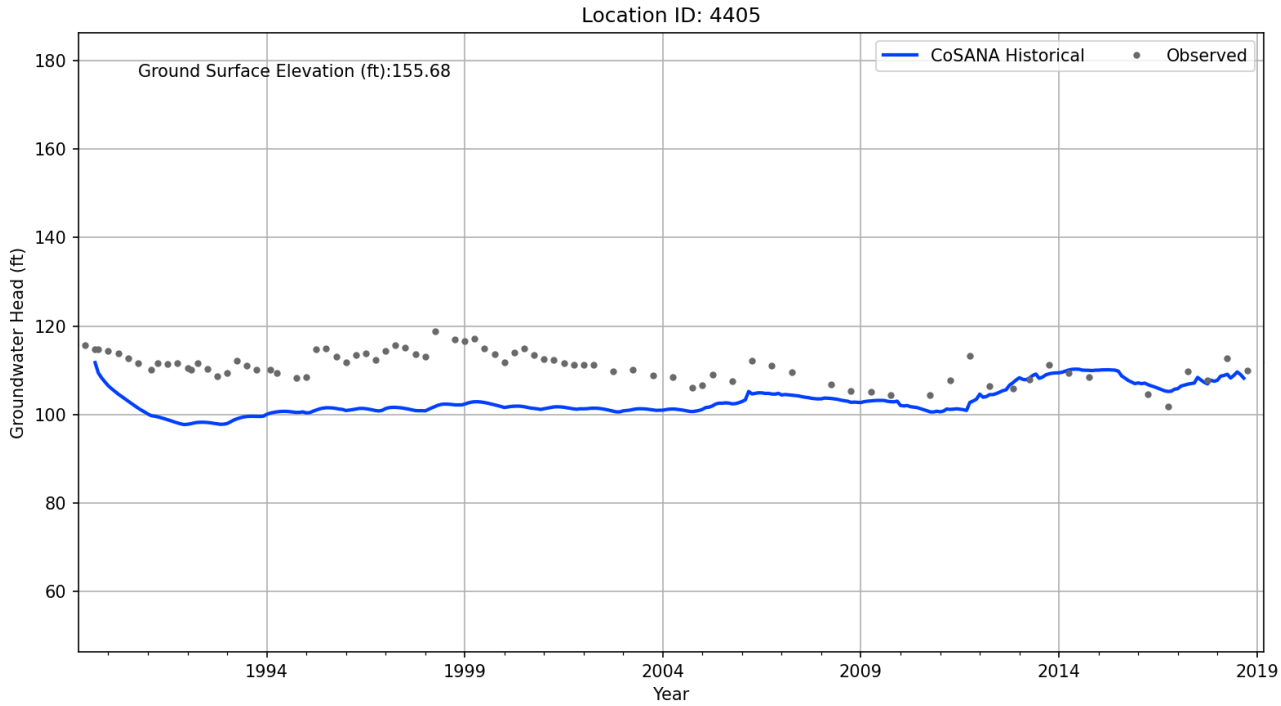


Figure 4-35: CoSANA Groundwater Level Hydrograph – Hydrograph #11

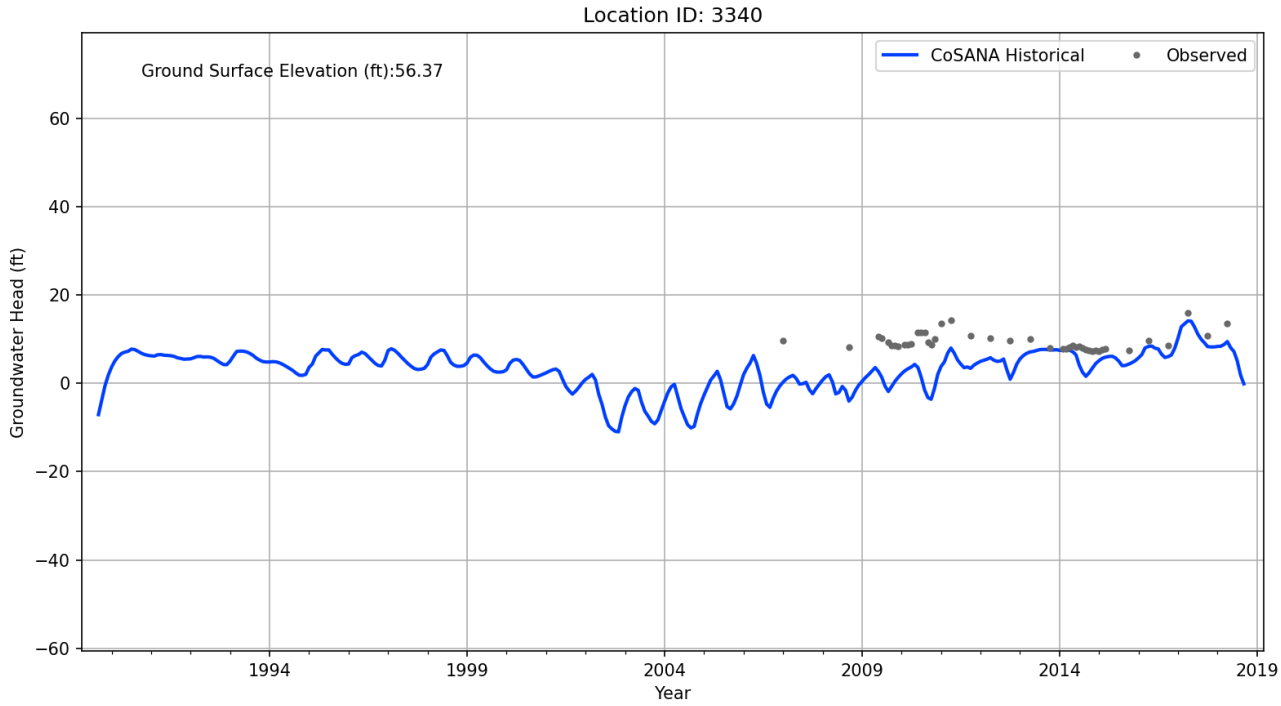


Figure 4-36: CoSANA Groundwater Level Hydrograph – Hydrograph #12

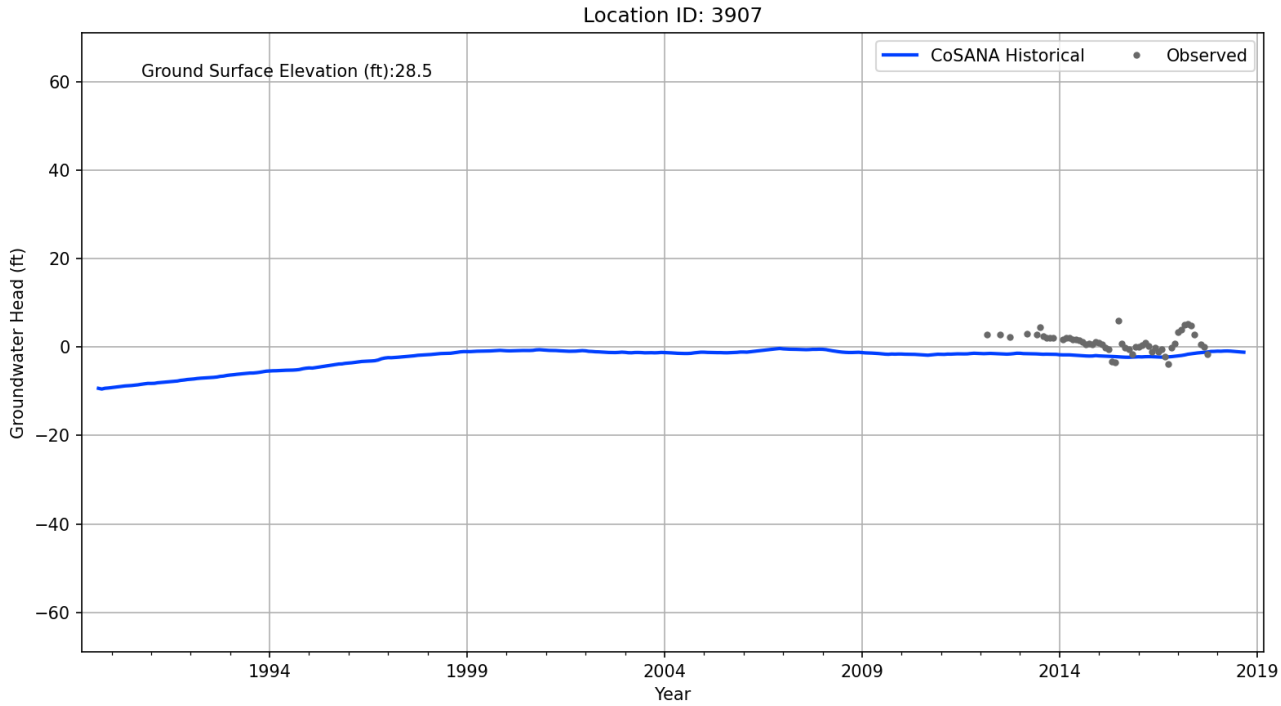


Figure 4-37: CoSANA Groundwater Level Hydrograph – Hydrograph #13

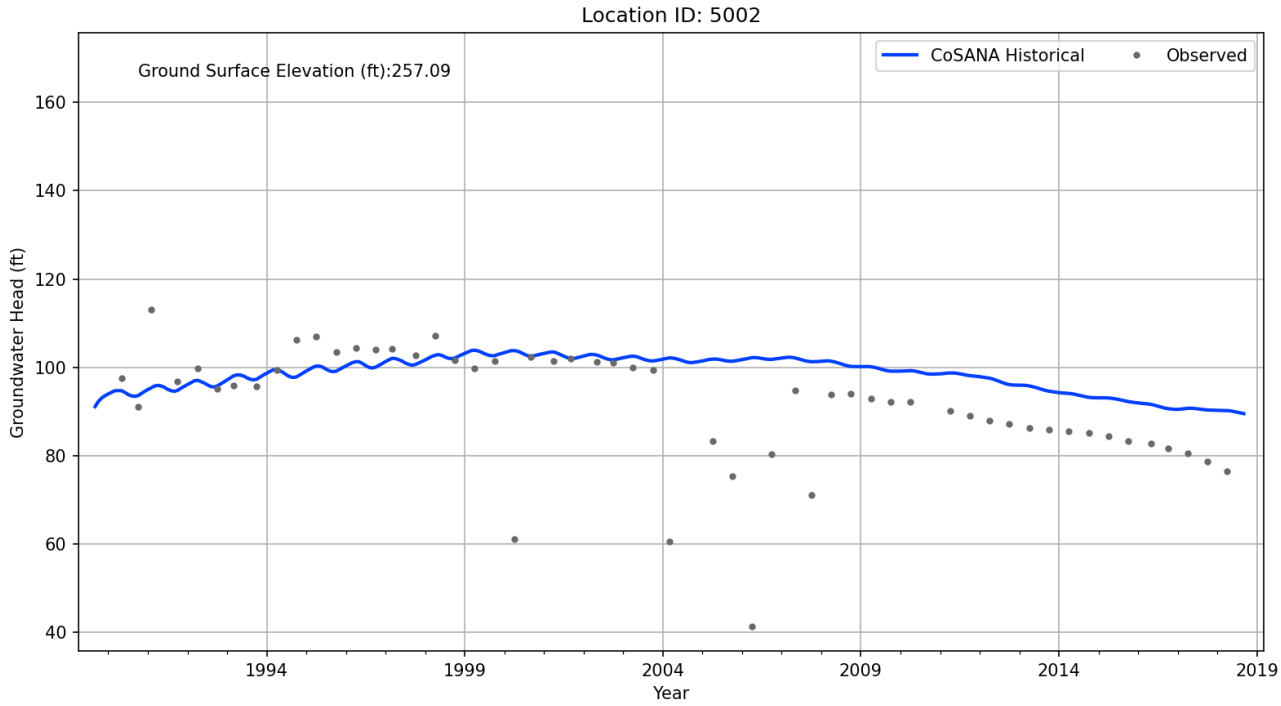


Figure 4-38: CoSANA Groundwater Level Hydrograph – Hydrograph #14

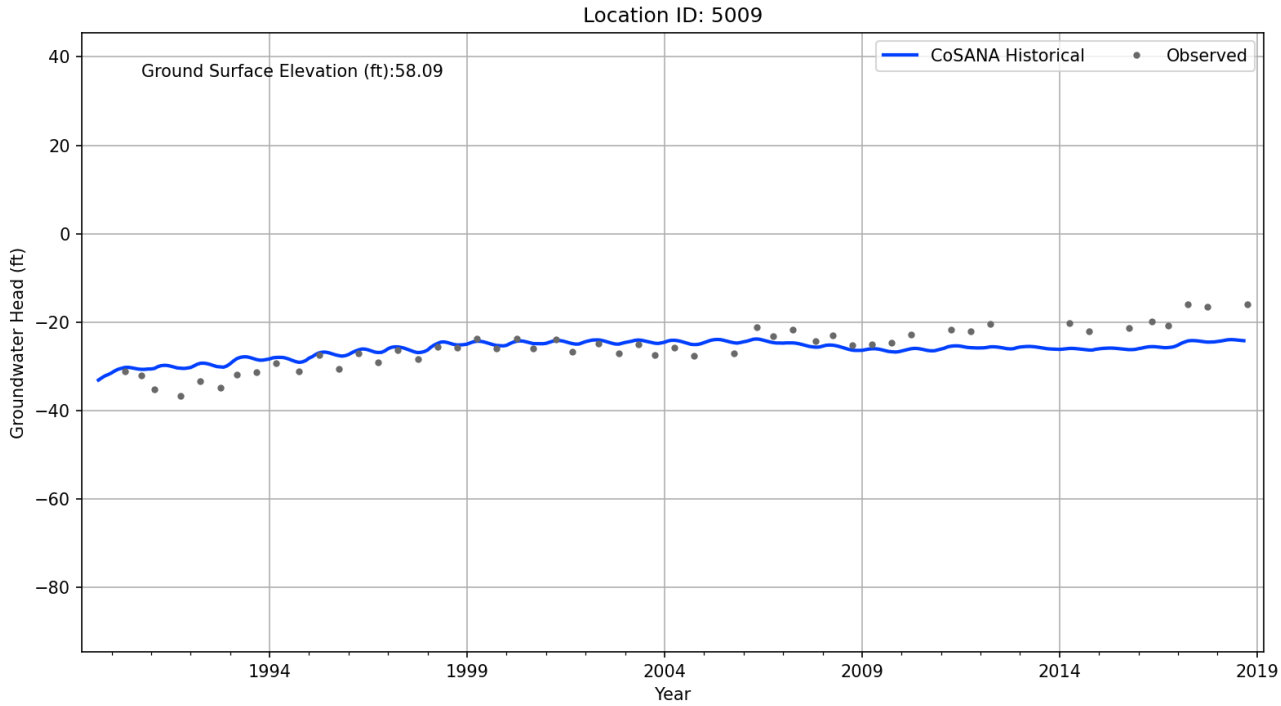


Figure 4-39: CoSANA Groundwater Level Hydrograph – Hydrograph #15

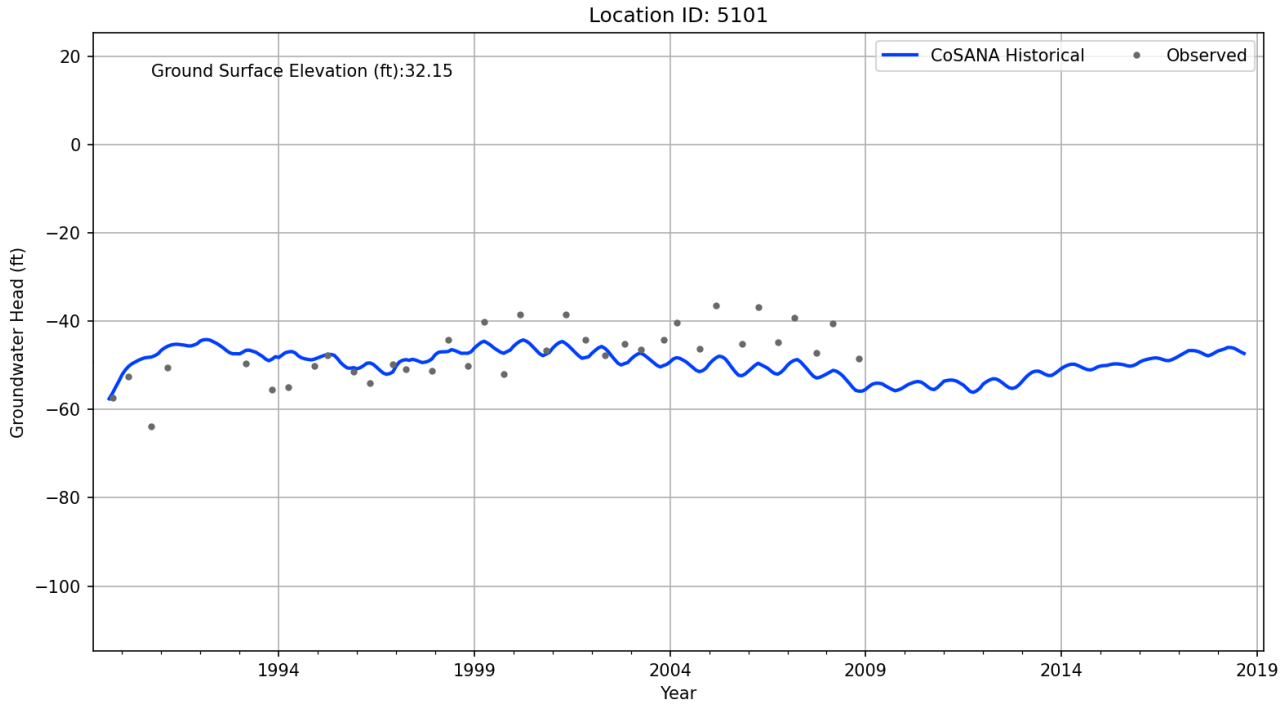


Figure 4-40: CoSANA Groundwater Level Hydrograph – Hydrograph #16

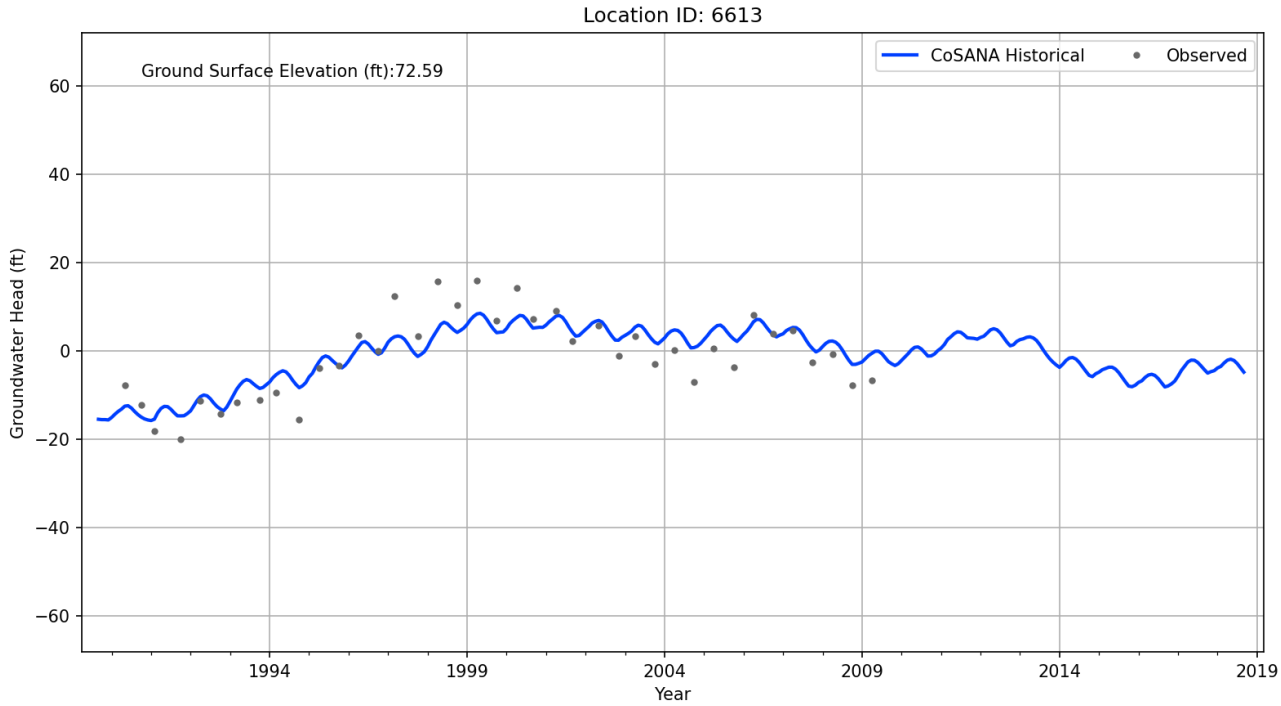


Figure 4-41: CoSANA Groundwater Level Hydrograph – Hydrograph #17

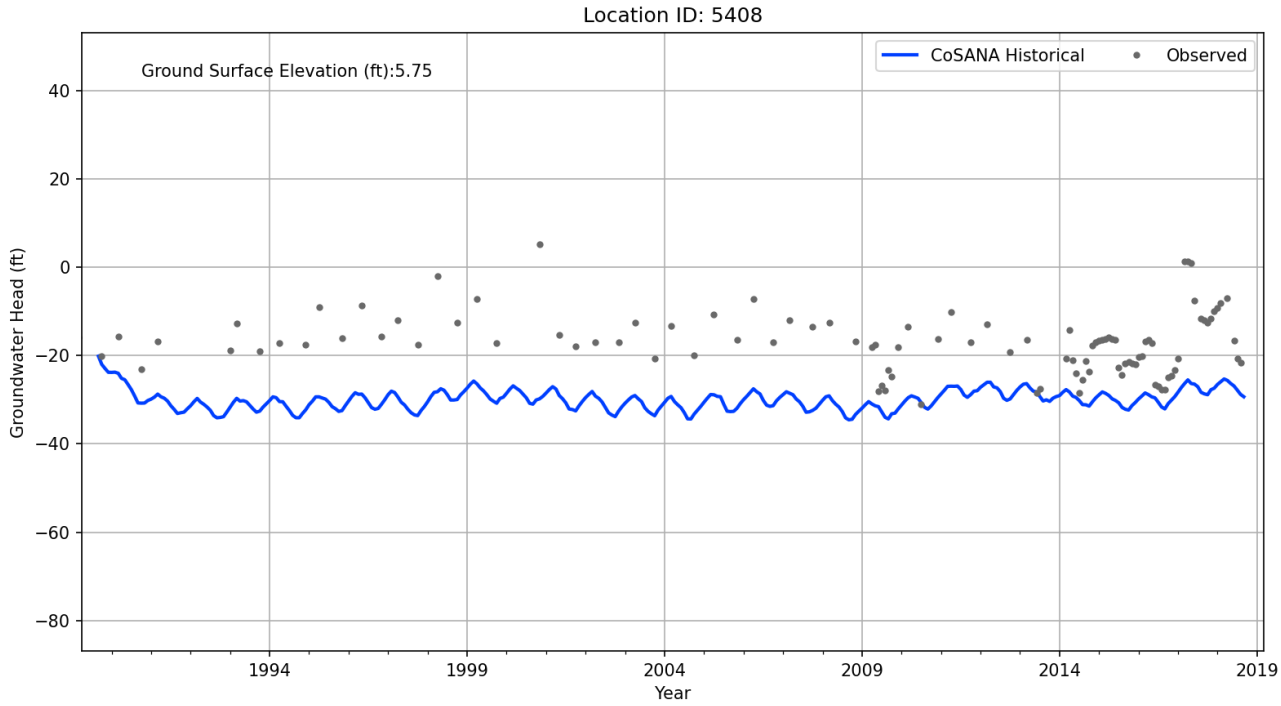


Figure 4-42: CoSANA Groundwater Level Hydrograph – Hydrograph #18

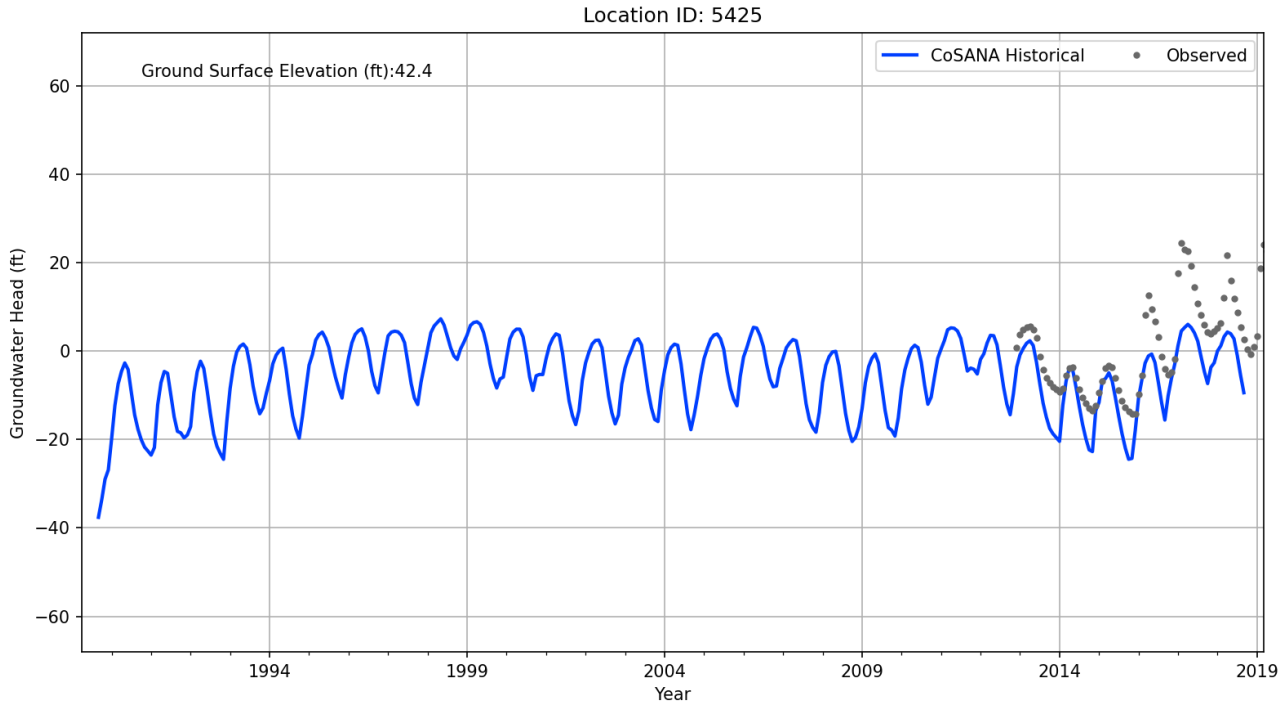


Figure 4-43: CoSANA Groundwater Level Hydrograph – Hydrograph #19

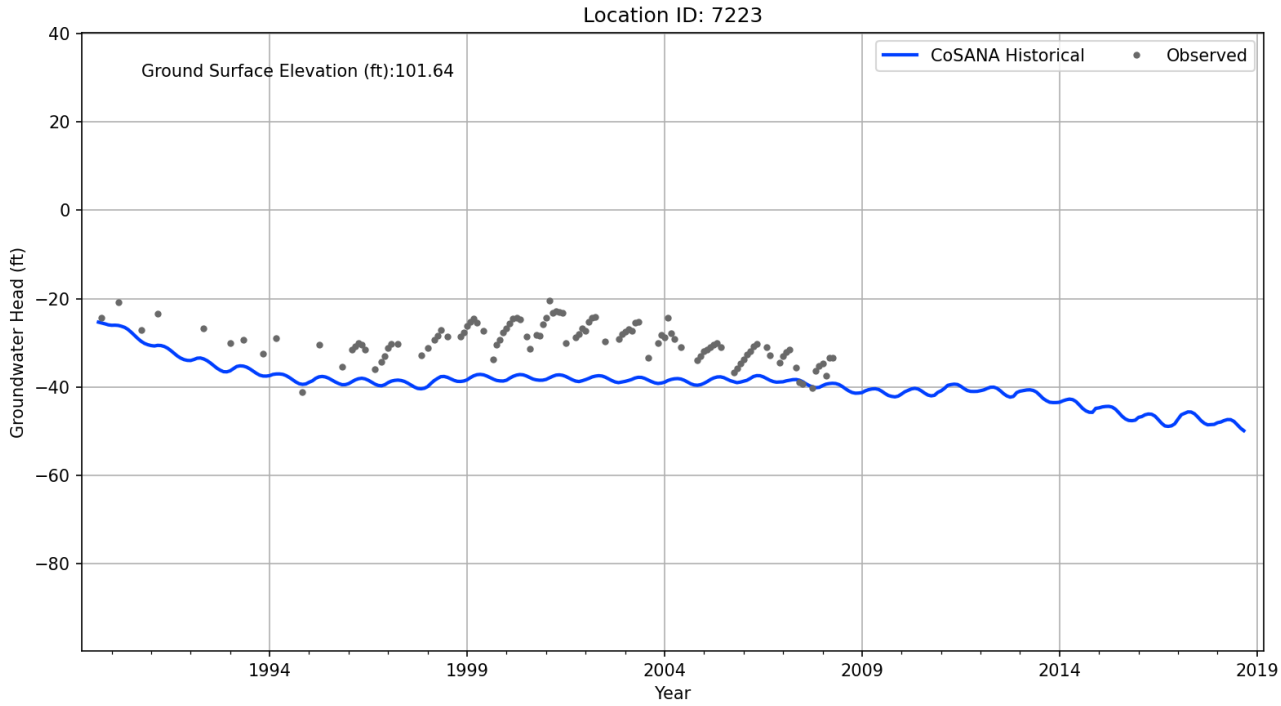


Figure 4-44: CoSANA Groundwater Level Hydrograph – Hydrograph #20

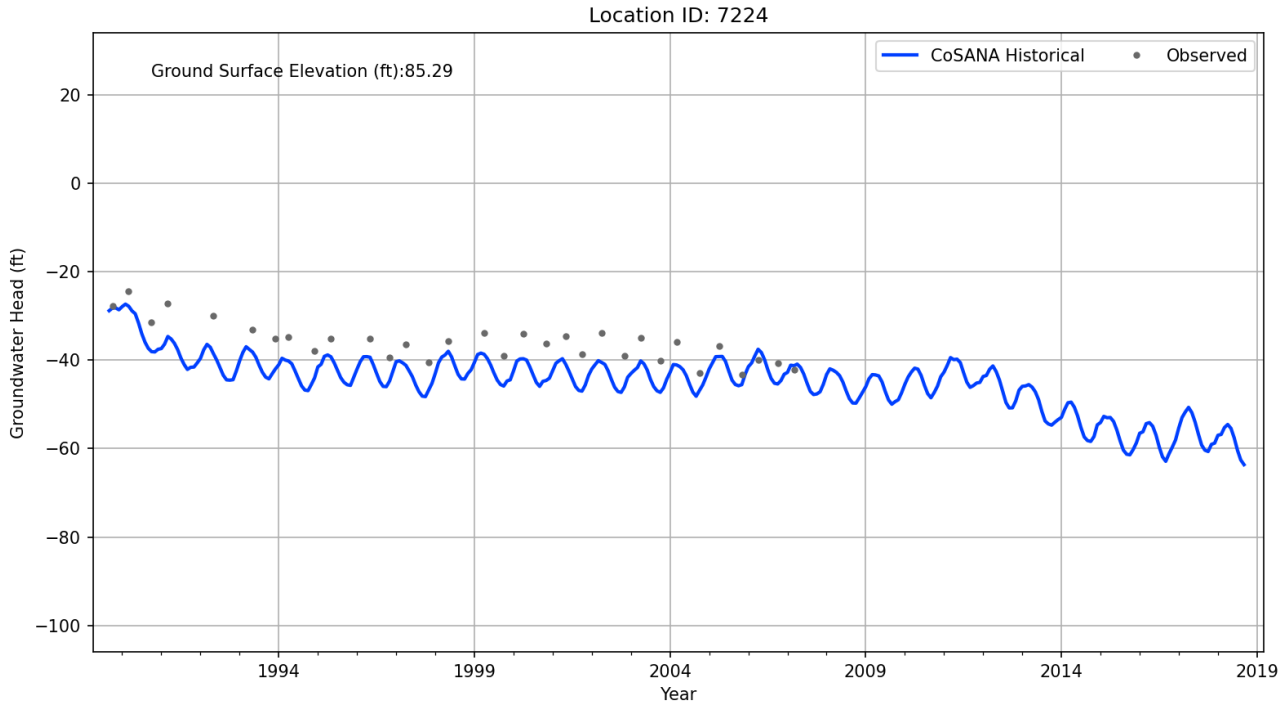


Figure 4-45: CoSANA Groundwater Level Hydrograph – Hydrograph #21

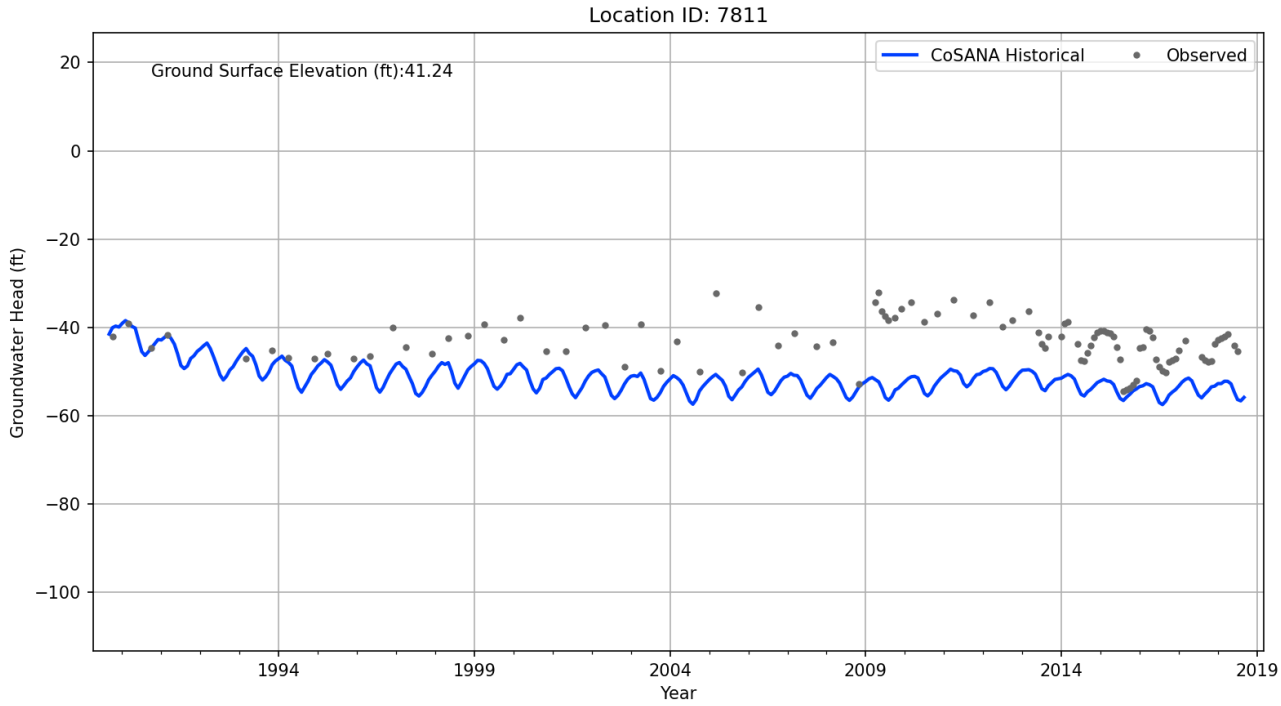


Figure 4-46: CoSANA Groundwater Level Hydrograph – Hydrograph #22

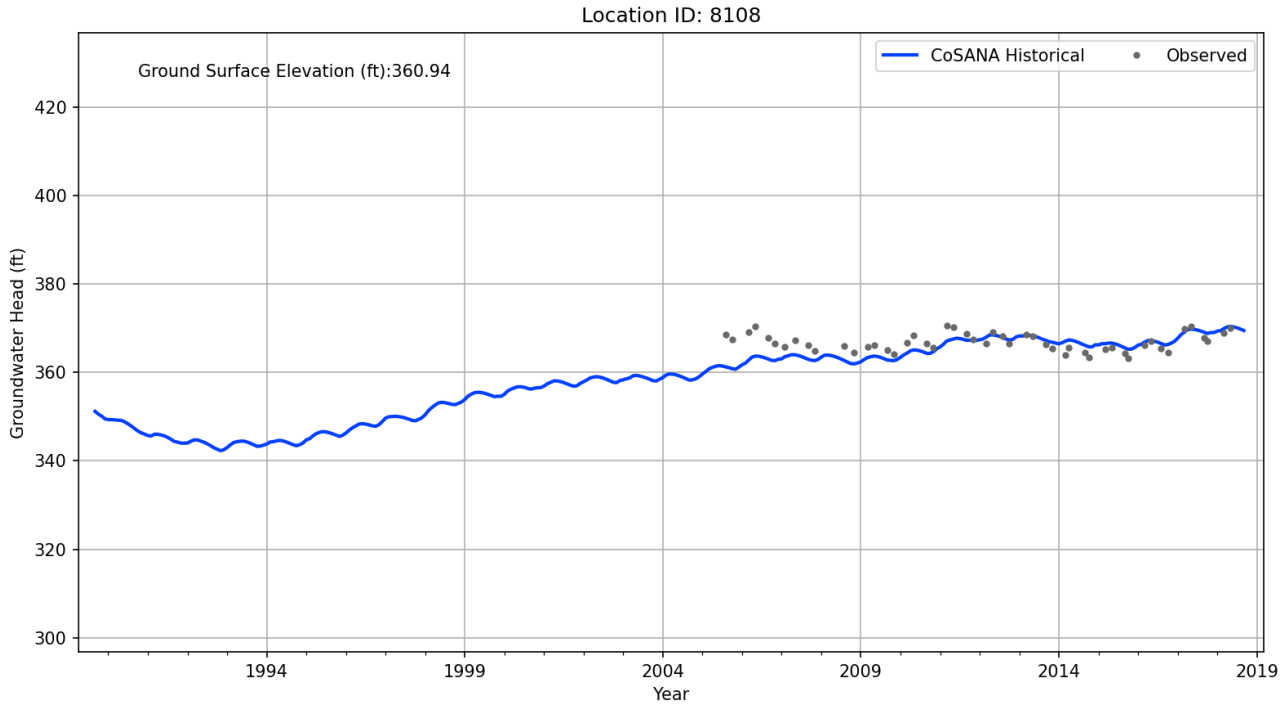


Figure 4-47: CoSANA Groundwater Level Hydrograph – Hydrograph #23

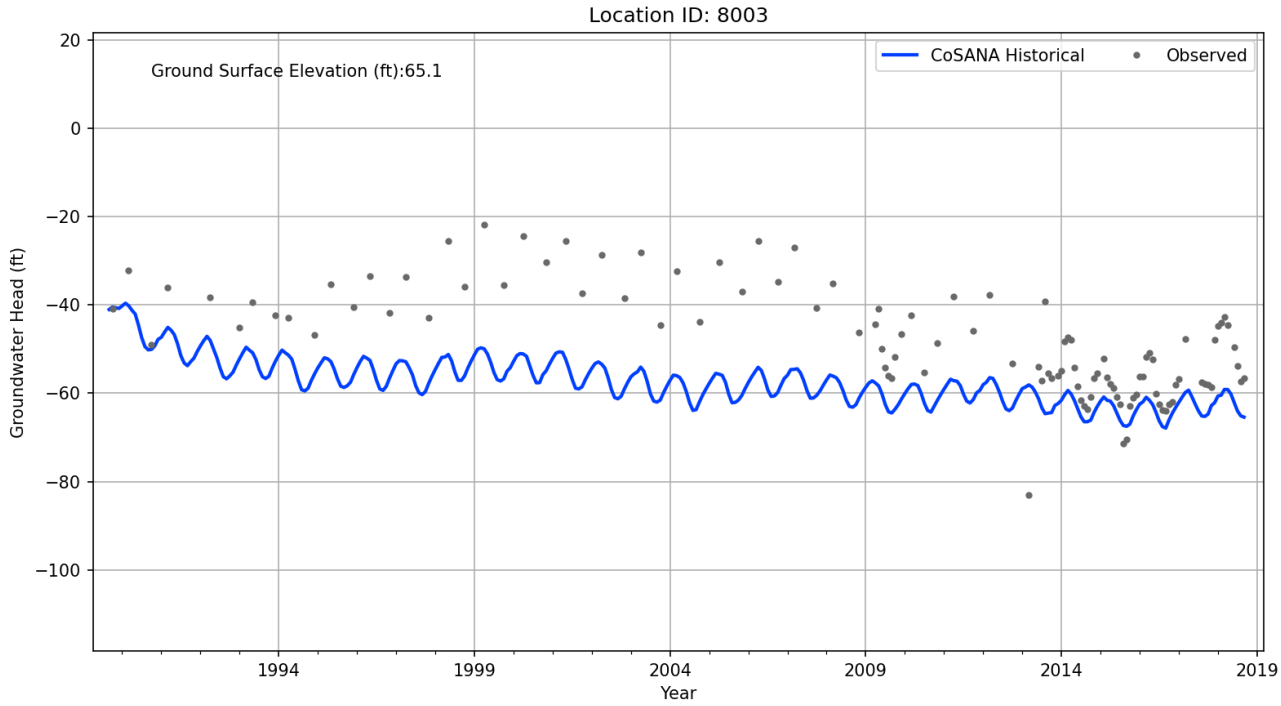


Figure 4-48: CoSANA Groundwater Level Hydrograph – Hydrograph #24

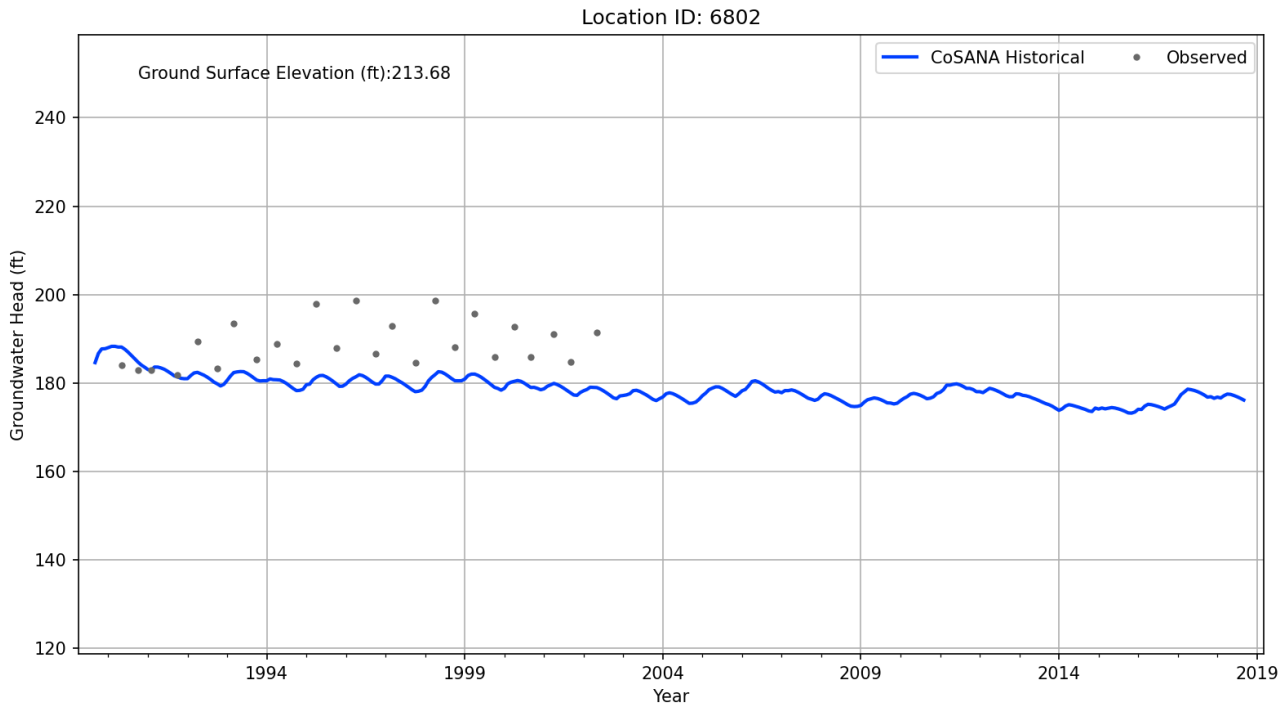


Figure 4-49: CoSANA Groundwater Level Hydrograph – Hydrograph #25

4.2.3 Streamflow Calibration

Similar to the process for groundwater levels, streamflows are calibrated to achieve reasonable agreement between the simulated and observed values (in this case, streamflows at the gaging stations). Streamflow gaging stations near the eastern boundary of the model are often used for inflow data (see Section 2.4). Other streamflow gaging stations are downstream of these inflow points and associated observed streamflow data can be compared to simulated streamflow in the calibration process. The comparison assists in modifications to parameters associated with stream aquifer interaction.

Streamflow calibration is primarily performed by comparing the simulated streamflow with local data from 15 stream gages (Table 4-3 and Figure 4-50). Data for these gages came from USGS or the California Data Exchange Center (CDEC).

Table 4-3: Summary of CoSANA Stream Calibration Gages

Stream	Stream Node	Description	Agency	Station ID	Period of Record
American River	895	American R at H St Bridge	CA DWR	CDEC ID: HST	1986 - Present
Arcade Creek	619	Arcade Cr at Winding Way	Sacramento County	CDEC ID: AMC	1995 - Present
Arcade Creek	625	Arcade Cr near Del Paso Heights	USGS	11447360	1995 - Present
Arcade Creek	600	Arcade Cr at Sunrise Blvd	Sacramento County Dep't Public Works	CDEC ID: ARD	1997 - Present
Bear River	49	Bear R at Pleasant Grove Rd	CA DWR	CDEC ID: BPG	2005 - Present
Cosumnes River	1667	Cosumnes R at McConnell, CA	USGS	11336000	1941 to 1982
Dry Creek (NASb)	510	Dry Cr at Vernon St. Bridge	City of Roseville	CDEC ID: VRS	1995 - Present
Dry Creek (CoSb)	1998	Dry Cr near Galt	USGS	11329500	1926 - 1997
Feather River	107	Feather R near Nicolaus	CA DWR	CDEC ID: NIC	1984 - Present
Laguna Creek (SASb)	1202	Laguna Cr near Eagles Nest Rd.	Sacramento County	CDEC ID: EGN	1996 - Present
Mokelumne River	2212	Mokelumne R at Woodbridge	EBMUD	CDEC ID: WBR	1997 - Present
Morrison Creek	1105	Morrison Cr at Mack Rd	Sacramento Dep't Public Works	CDEC ID: MCM	1998 - 2009
Sacramento River	947	Sacramento R at I St Bridge	CA DWR	CDEC ID: IST	1984 - Present
Sacramento River	1020	Sacramento R at Freeport	USGS	11447650	1948 - Present

Streamflow calibration included refinement of the streambed hydraulic conductivity originally from C2VSim. The calibrated streambed hydraulic conductivity is shown in Figure 4-51. Simulated streamflows were compared with observed records, and exceedance charts were also used to check the model performance when simulating high and low flows at each gage location. Calibration results for the Sacramento River at Freeport are shown in Figure 4-52 and Figure 4-53. Calibration results for the Cosumnes River at McConnell are shown in Figure 4-54 and Figure 4-55 (note that stage data but not flow data are available at McConnell).

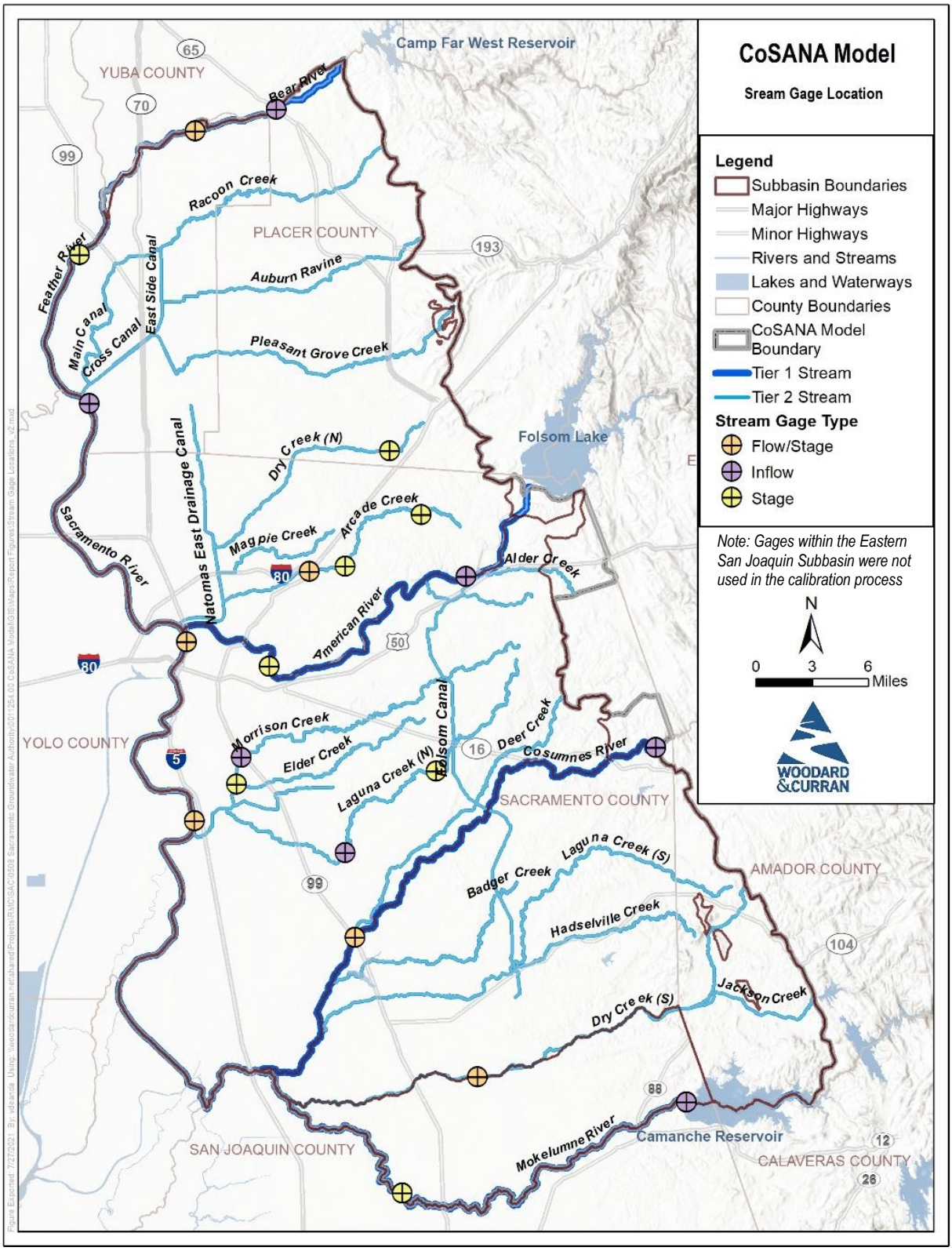


Figure 4-50: Stream Gage Locations

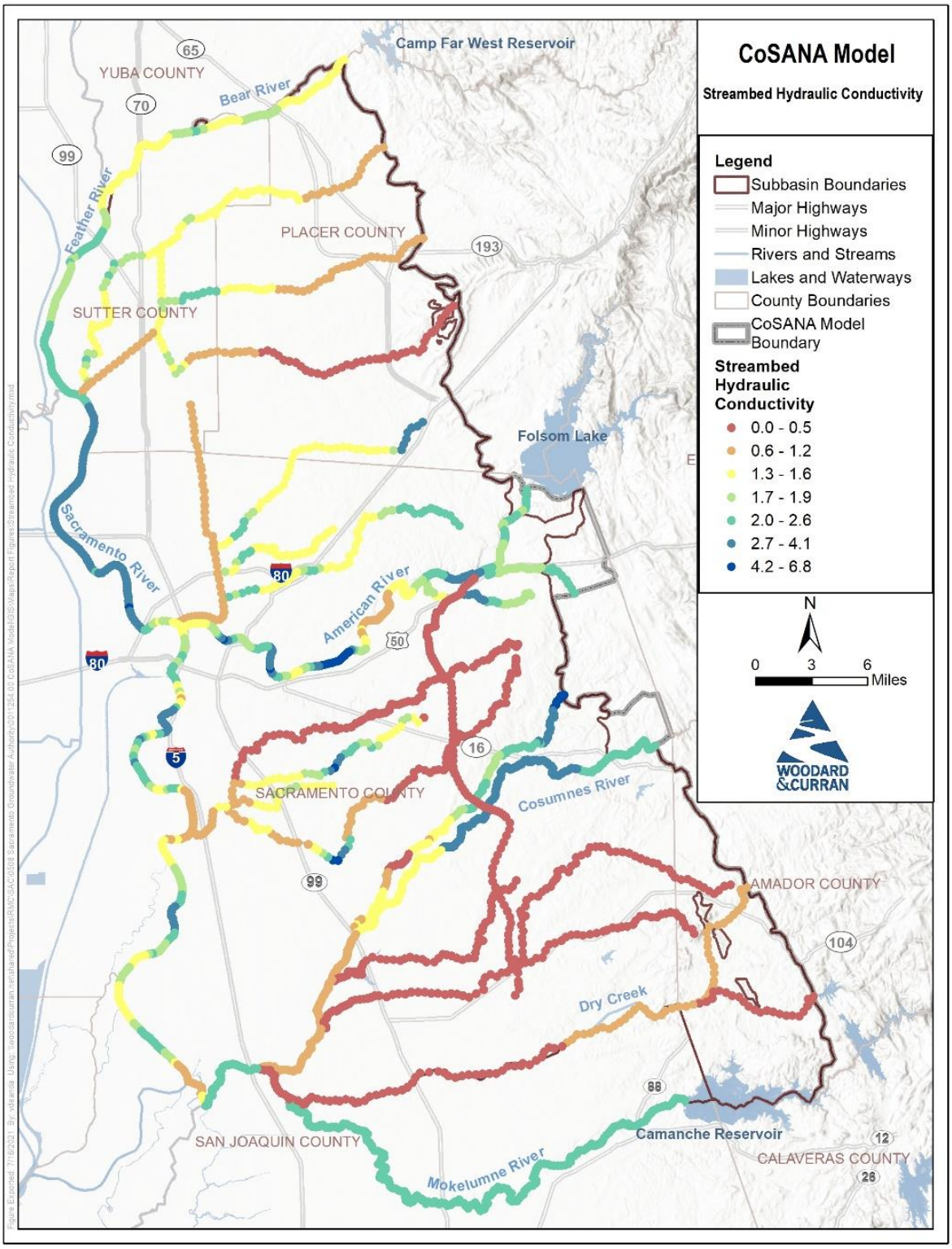


Figure 4-51: CoSANA Streambed Hydraulic Conductivity

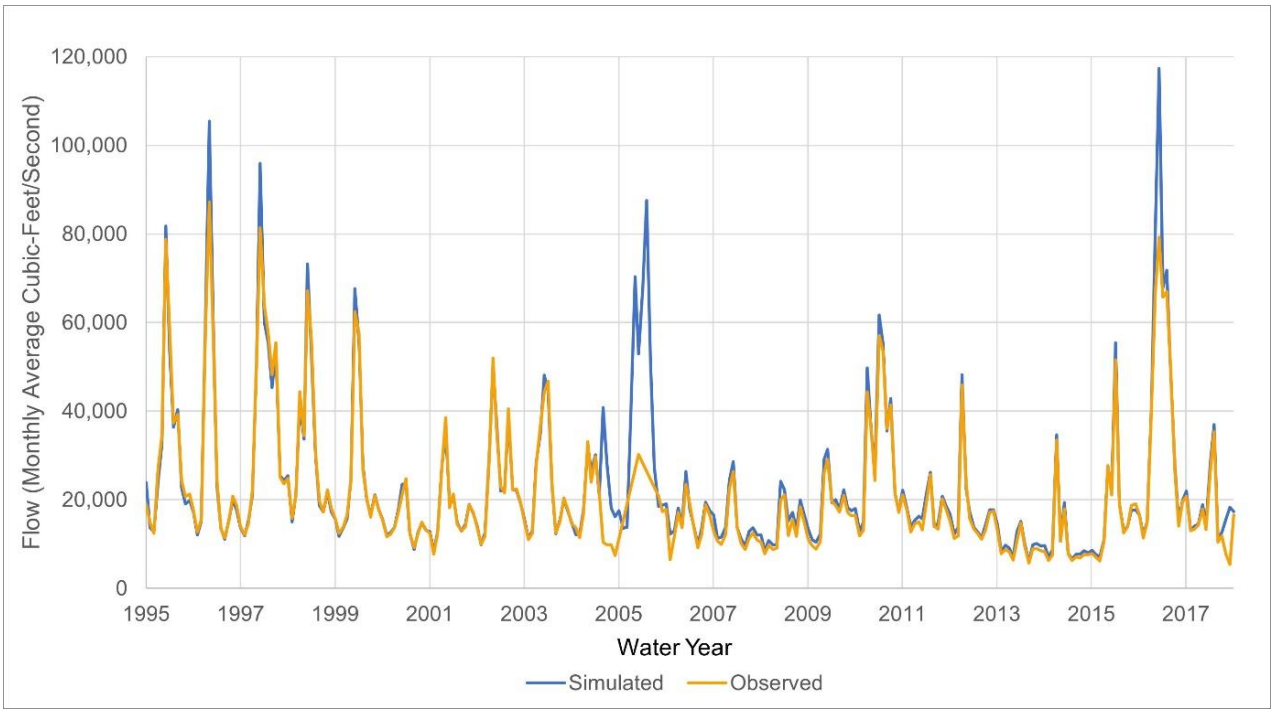


Figure 4-52: Streamflow Hydrograph for Sacramento River at Freeport, Simulated and Observed

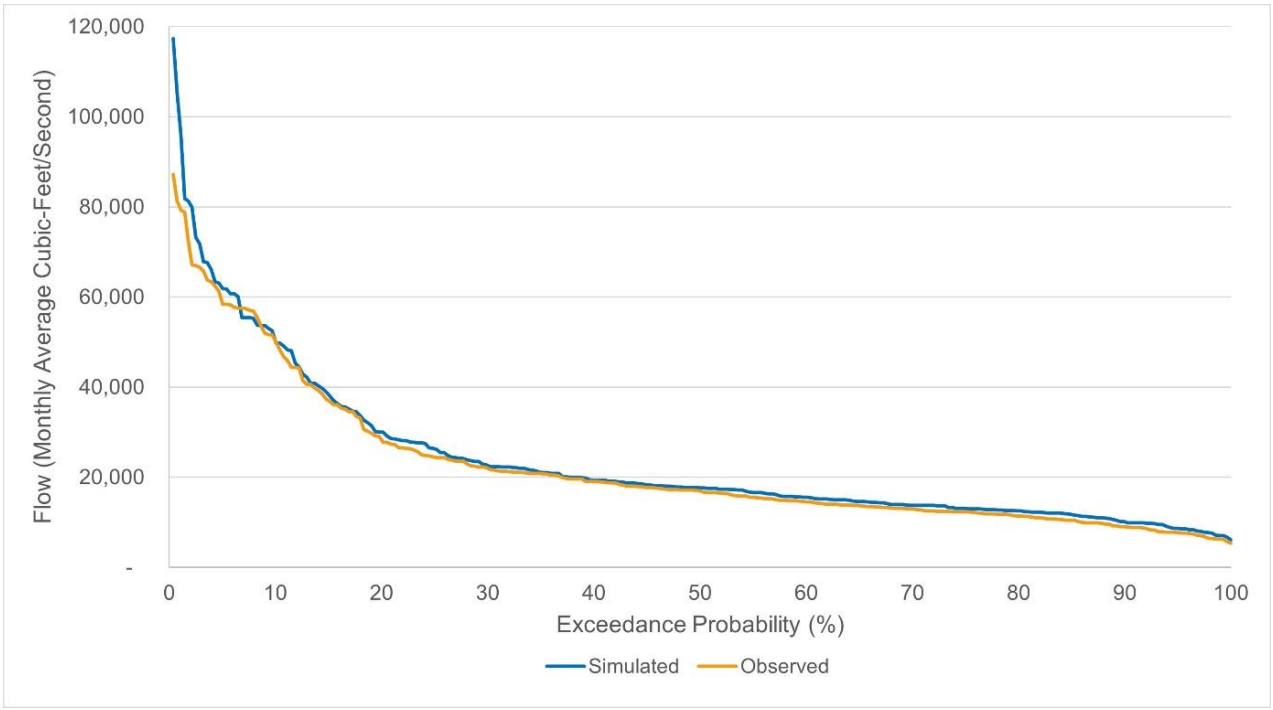


Figure 4-53: Sacramento River at Freeport Streamflow Exceedance, Simulated and Observed

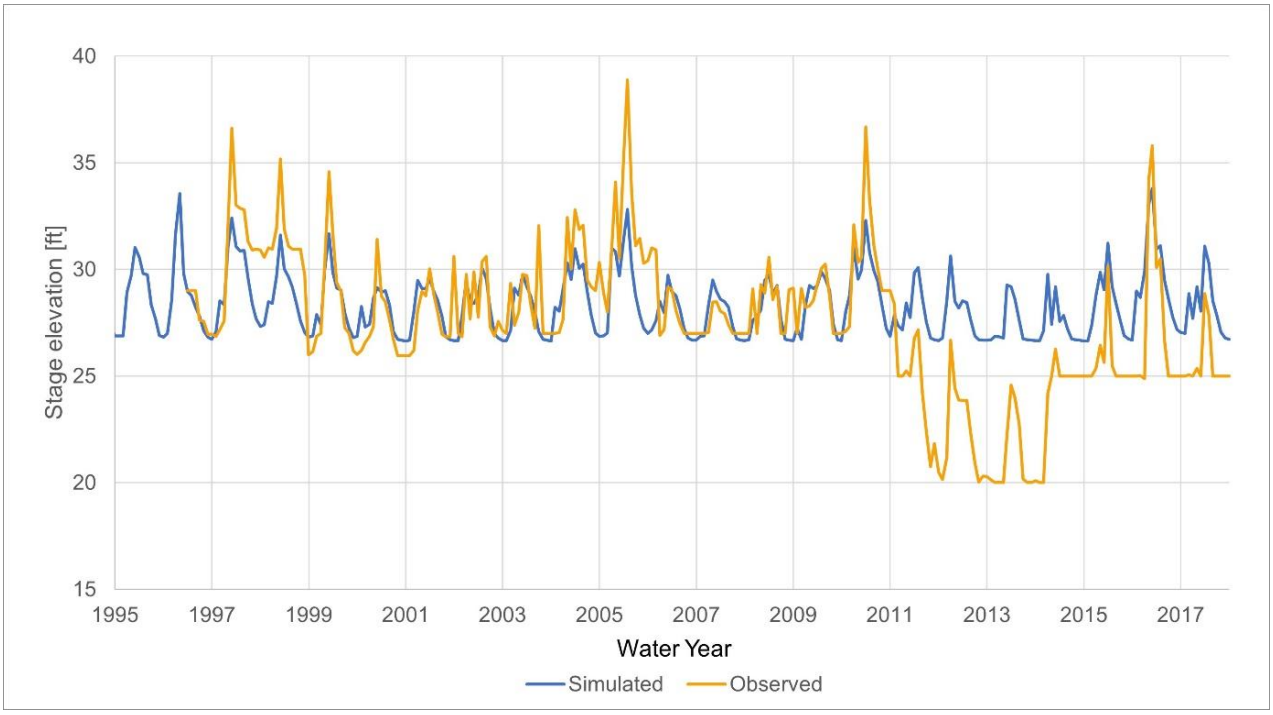
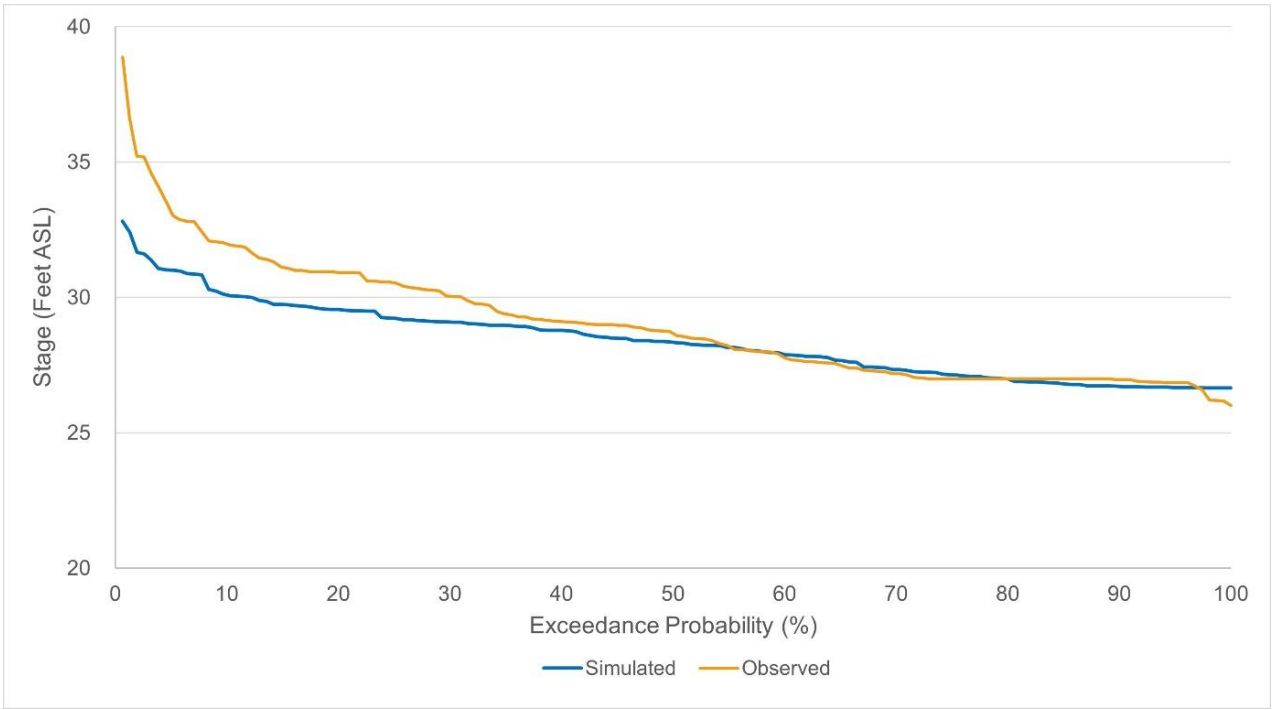


Figure 4-54: Stage for Cosumnes River at McConnell, Simulated and Observed



Note: due to apparent vertical datum issues (shown in Figure 4 53) the above exceedance chart shows data from only Mar-1997 to Sept-2010

Figure 4-55: Cosumnes River at McConnell Stage Exceedance, Simulated and Observed

4.2.4 Small Watershed Calibration

As discussed in Section 2.11, small watersheds are used to simulate inflows into the model from ungaged watersheds. The small watershed contributions are split between surface water runoff that enters the stream system, percolation that occurs during transport to the streams, and baseflow entering the groundwater system at the model boundary. Groundwater level hydrographs along the model boundary selected for groundwater level calibration (Section 4.2.2) were referenced to confirm and edit, as necessary, the various parameters of the small watersheds.

The distribution of small watershed inflows between surface runoff, percolation, and baseflow is primarily driven by the maximum recharge rate and recession coefficients. The recession coefficient governs how much of the total water enters the system as surface water and groundwater. The maximum recharge controls the percolation from runoff. Observed groundwater hydrographs along the model boundary were used to assess how much watersheds contributed to groundwater levels with a focus on seasonal fluctuations. Parameter adjustments were implemented across the small watersheds to maintain reasonable groundwater elevations and streamflows. Additionally, some small watersheds were turned off where additional data were available to characterize the inflows.

There is considerable uncertainty in subsurface conditions and nature of hydraulic interactions between the small watersheds adjacent and upslope to the Cosumnes Subbasin. Two small watersheds adjacent to Cosumnes Subbasin were set to zero area to minimize adjacent flooding of the Foothills Subarea (flooding refers the condition when model-calculated water levels exceed land surface). As Jackson Creek is controlled by Lake Amador dam, it was instead specified as a stream inflow. The Lower Sutter Creek watershed area is the next largest contributing small watershed whose surficial geology is composed of Jurassic-age bedrock, and therefore was assumed that no baseflow or subsurface percolation to groundwater occurs from this watershed. Even with these specifications, model-calculated water budgets and groundwater levels indicated additional data and model refinements are needed to improve reliability in this portion of the Cosumnes Subbasin.

4.3 Calibration Statistics and Goodness of Fit

The CoSANA calibration was primarily assessed using two metrics: groundwater level trends and the correlation between simulated and observed groundwater levels. In addition to quantifiable metrics, the CoSANA calibration included comparisons and modifications to result in regional groundwater flow directions and water budgets that are consistent with available information on observed conditions and consistent with the understanding of basin conditions by stakeholders.

Statistics related to the differences between simulated and observed groundwater levels were evaluated relative to the American Standard Testing Method (ASTM) standard. The “Standard Guide for Calibrating a Groundwater Flow Model Application” (ASTM D5981) states that “the acceptable residual should be a small fraction of the head difference between the highest and lowest heads across the site.” The residual is defined as the simulated head minus the observed head. An analysis of all calibration water levels within the model indicated the presence of a range in groundwater levels of approximately 500 feet. Using 10 percent as the small fraction, the acceptable residual level would be 50 feet. The calibration exceeds that standard, as shown by the following statistics.

- 56% of observed groundwater levels are within +/- 10 feet of its respective simulated values
- 83% of observed groundwater levels are within +/- 20 feet of its respective simulated values
- 94% of observed groundwater levels are within +/- 30 feet of its respective simulated values

The residual histogram for the CoSANA is shown in Figure 4-56. Additionally, a scatter plot of simulated versus observed values is shown in Figure 4-57.

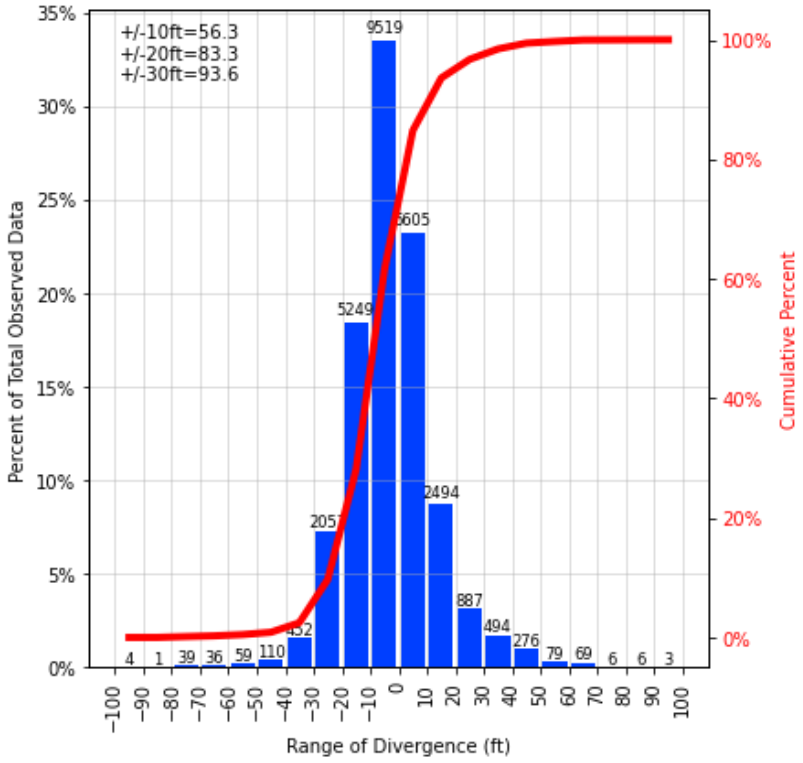
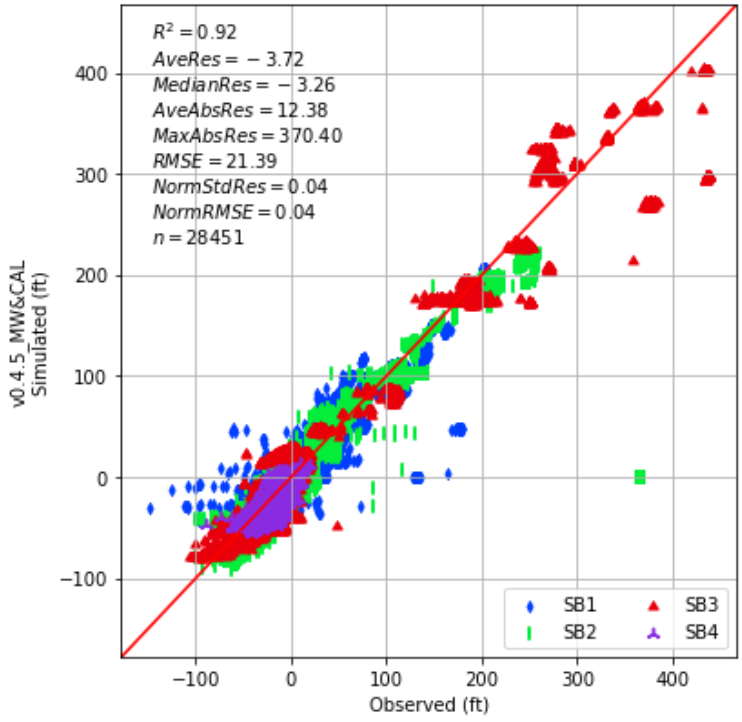


Figure 4-56: Residual histogram for the CoSANA Model



Note: SB1 = NASb, SB2 = SASb, SB3 = CoSb, SB4 = Eastern San Joaquin Subbasin

Figure 4-57: Scatter Plot of CoSANA Simulated versus Observed Values

4.4 Final Calibration Parameters

The parameters resulting from the calibration process are listed in Table 4-4. The spatial distribution of horizontal hydraulic conductivity is presented in Figure 4-58 through Figure 4-62.

Table 4-4: Range of Aquifer Parameter Values

Data		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Horizontal Hydraulic Conductivity (ft/day)	Minimum	2.1	1.9	0.65	0.58	0.33
	Average	33.9	24.1	16.3	14.1	10.2
	Maximum	108.3	86.8	51.9	42.0	37.6
Vertical Hydraulic Conductivity (ft/day)	Minimum	0.012	0.0066	0.00045	0.0020	0.0012
	Average	0.99	0.73	0.19	0.42	0.35
	Maximum	4.6	5.2	2.0	2.6	2.3
Specific Storage (1/ft)	Minimum	2.67×10^{-6}	1.88×10^{-6}	1.54×10^{-6}	1.15×10^{-6}	9.80×10^{-6}
	Average	6.30×10^{-5}	6.40×10^{-5}	5.95×10^{-5}	6.09×10^{-5}	7.52×10^{-5}
	Maximum	4.73×10^{-4}	4.59×10^{-4}	4.68×10^{-4}	4.91×10^{-4}	4.96×10^{-4}
Specific Yield (unitless)	Minimum	0.057	0.068	0.056	0.073	0.052
	Average	0.13	0.12	0.13	0.13	0.11
	Maximum	0.24	0.22	0.24	0.24	0.22
Transmissivity (ft^2/day)	Minimum	0.64	0.067	0.077	0.25	0.23
	Average	2,765	5,128	9,679	3,489	1,726
	Maximum	15,005	24,090	69,562	17,019	11,078

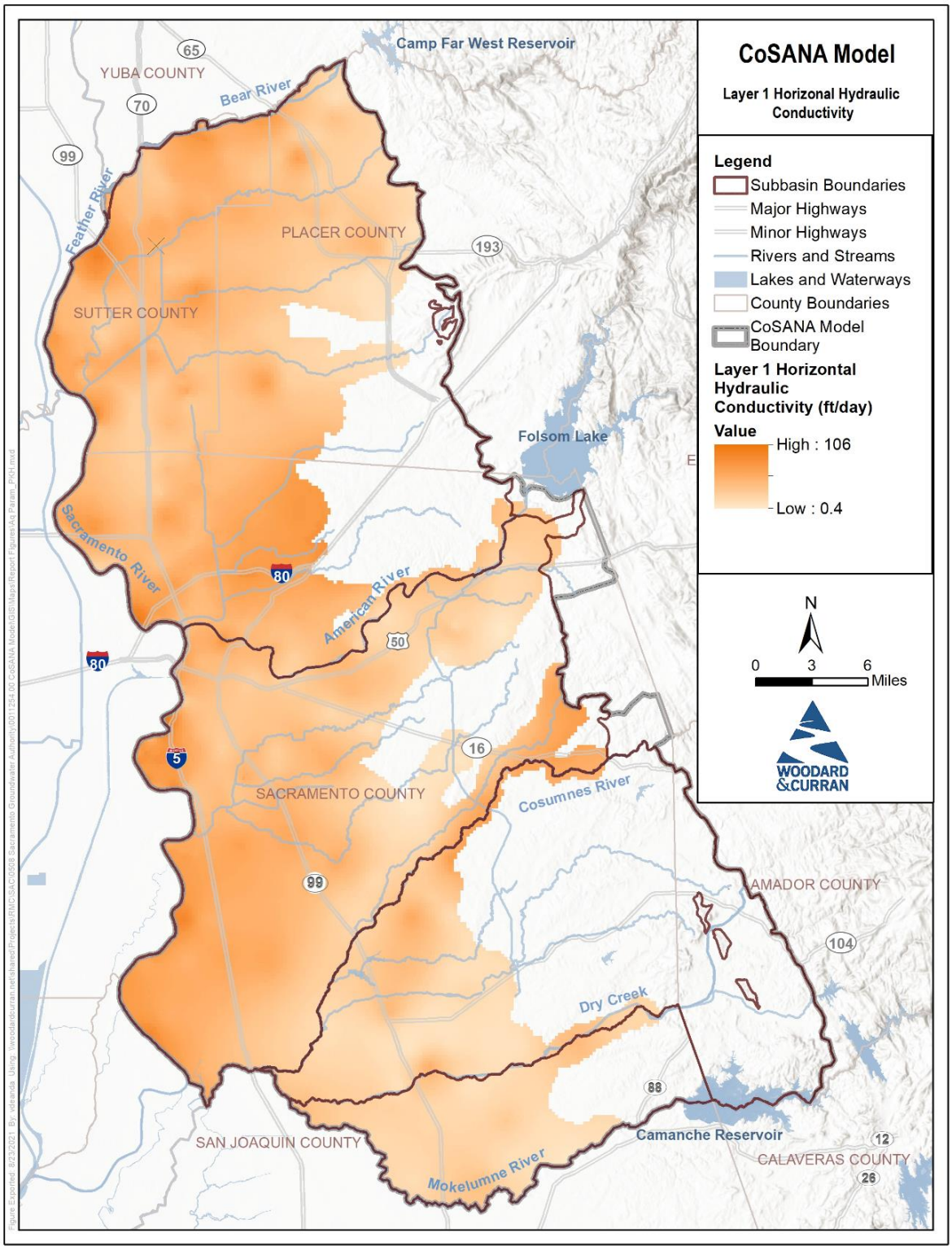


Figure 4-58: Distribution of CoSANA Layer 1 Horizontal Hydraulic Conductivity (K_H)

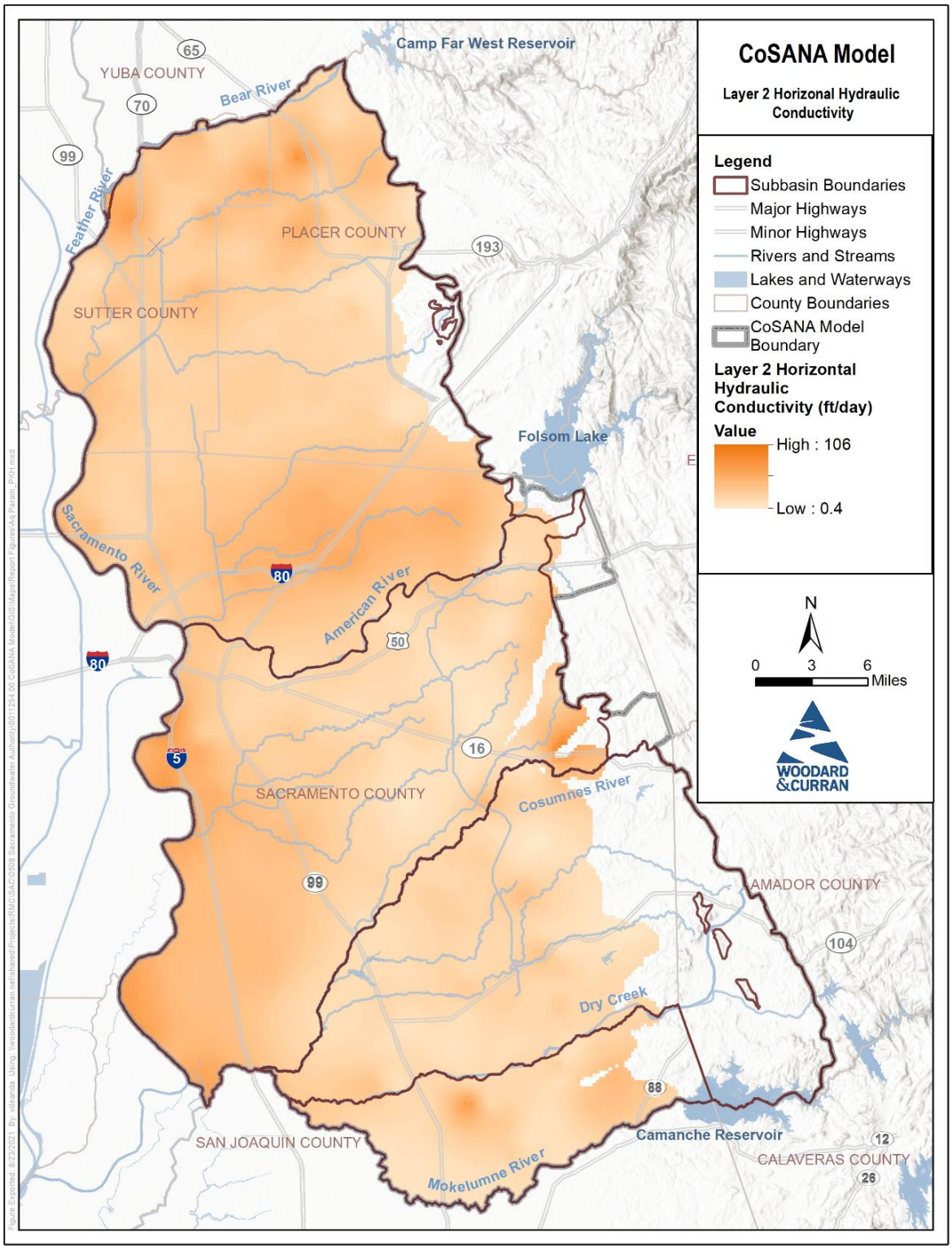


Figure 4-59: Distribution of CoSANA Layer 2 Horizontal Hydraulic Conductivity (K_H)

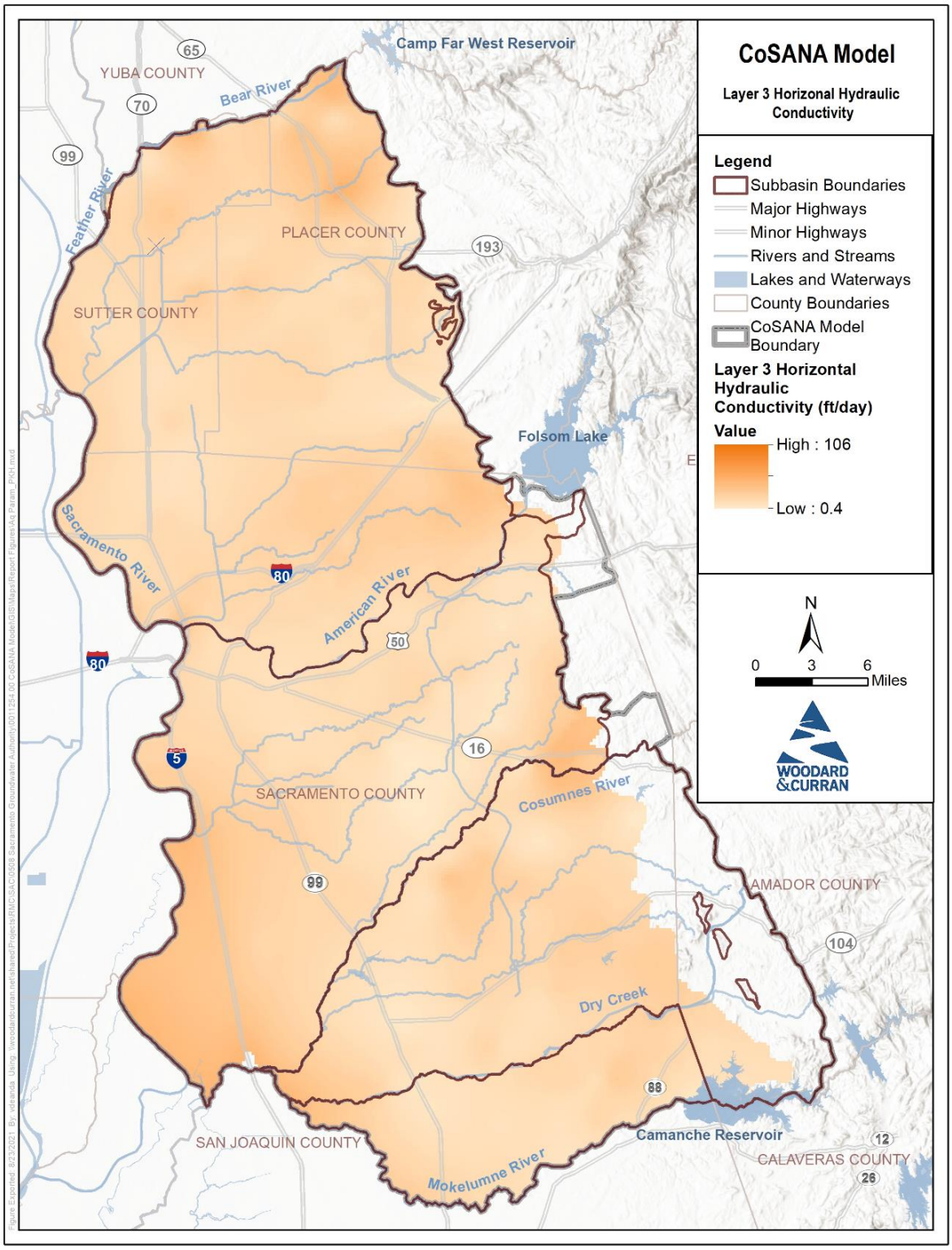


Figure 4-60: Distribution of CoSANA Layer 3 Horizontal Hydraulic Conductivity (K_H)

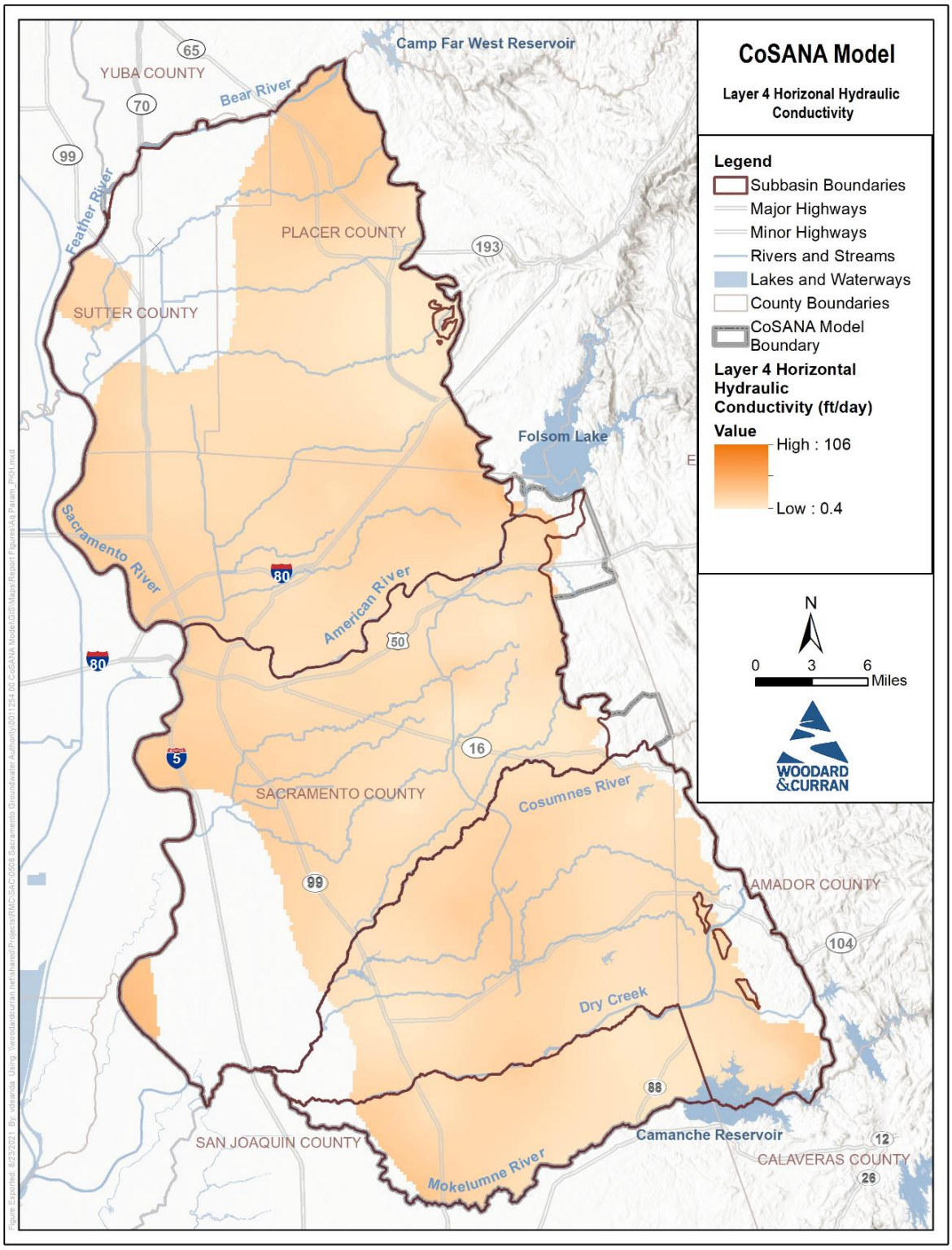


Figure 4-61: Distribution of CoSANA Layer 4 Horizontal Hydraulic Conductivity (K_H)

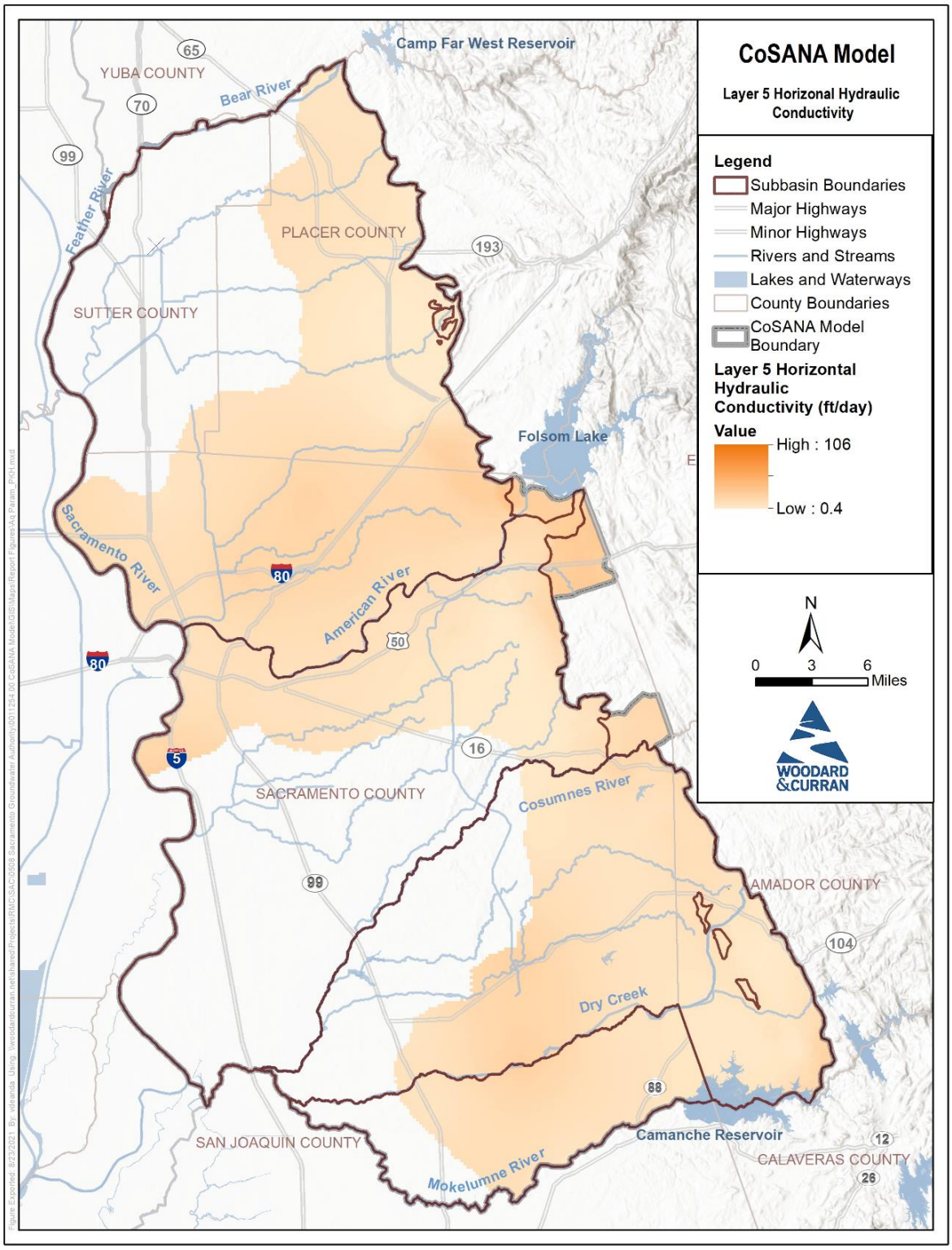


Figure 4-62: Distribution of CoSANA Layer 5 Horizontal Hydraulic Conductivity (K_H)

4.5 Model Features, Strengths, and Limitations

CoSANA has been developed based on years of integrated model development expertise and experience for the Sacramento area, including the SacIWRM and other groundwater planning and analysis efforts in the area. As such, the model data sets, conceptual representation of the groundwater system, the interaction with the surface water and land surface processes, and model calibration conditions are built on a strong foundation and reflect the experience and expertise of hydrologic and hydrogeologic conditions and modeling in the area. Having said that, the model has certain limitations that are outlined as follows:

4.5.1 Spatial Extent and Resolution

The accuracy of the model simulation is a function of spatial resolution of the data, as well as spatial discretization of the finite elements. As the spatial data such as land use or soil conditions are mapped to the elements, the size of elements reflect the accuracy of the underlying data sets as mapped. Much of the spatial data has been reviewed and verified against available statewide and local data available. The model is calibrated to target levels based on the spatial resolution in the model. However, when using the model for local scale analysis and modeling, the experienced user is encouraged to perform further validation of the underlying spatial data prior to use of the model for analysis of projects or management actions.

4.5.2 Temporal Scale

CoSANA includes monthly hydrologic data for the period WY 1970-2018. The model is calibrated for the period WY 1995-2018. Additionally, the model simulations are verified for the entirety of the period WY 1970-2018 for long-term trends and short -term seasonal conditions for groundwater levels and groundwater storage. The monthly time step is a reasonable one for a regional model and reflects the resolution of much of the recorded and reported data. However, the monthly time step at times may pose limitations for simulation of some of the model features, such as streamflows during high and peak flows. This is not of major concern as the regional model context and utilization of model for most long-term water supply planning needs is not affected by this limitation.

4.5.3 Geology and Hydrogeology

CoSANA includes an updated aquifer stratigraphy based on available maps and cross sections. CoSANA also uses the aquifer texture model used in C2VSimFG and SVSim (DWR, 2018a), which is based on the USGS aquifer texture data. The texture data is used in the model calibration and distribution of aquifer properties based on a field level set of lithologic log information. The details of the texture model affect the model performance and calibration in simulation of the various hydrogeologic conditions. The user is reminded to consider variabilities and uncertainties in the texture model as the model results are being interpreted and used for policy and planning purposes.

4.5.4 Land Use Data

Land use is one of the key data sets that affect water demand estimation as well as rainfall runoff, infiltration, and recharge conditions. This data set was developed based on numerous DWR county-level land use surveys, land use and cropping data available from the recent statewide DWR land use surveys, and local sources. This information was assembled, analyzed, and discrepancies were reconciled, which resulted in annual crop data by each model element. Mapping of land use data from various maps to element level within the model and temporal interpolation of land use changes between years of available data may introduce inaccuracies that need to be considered in evaluation of land use conditions at smaller spatial scales, such as parcel level, and for years in between dates of source data.

4.5.5 Water Demand Estimates

Water demands in the model are estimated for three user categories, urban purveyors, agricultural entities, and rural residential areas. The urban demands are based on the reported water supply and demand data from the urban purveyors. The agricultural demand estimates are based on respective model data sets and calibration of the model

for each agricultural area. While care has been given to estimation of agricultural water use estimates, and the results have been shared and reviewed by the agricultural entities within the model area, inaccuracies in the source data or those mapped to the model may introduce inaccurate estimates in certain conditions. The rural residential water use estimates have also been shared and presented to the representatives of the rural residential water users at a number of public workshops. In general, the model user is encouraged to validate the estimates with additional local data and is also requested to share their findings with the model developers for future refinements of the model.

4.5.6 Water Supply Data

The surface water delivery data set in the model is one of the most reliable data sets as it is provided by the purveyors. However, some surface water diversions by the agricultural entities are subject to more uncertainty, which affects the model simulation results. Local entities are encouraged to review the surface water delivery data and provide feedback to the model developers as issues arise or inaccuracies are identified.

4.5.7 Groundwater Pumping Estimates

CoSANA includes groundwater wells for all urban purveyors and groundwater pumping rates are, with a few exceptions, provided by the urban purveyors. The model includes estimated monthly groundwater pumping by each model element for the agricultural water use and rural residential users. Agricultural groundwater pumping is estimated as the balance of agricultural demand estimates and surface water that is available to meet the demand for each element and at each model time step. The contamination remediation groundwater extractions are based on data supplied by the entity performing the remediation and are assumed to be accurate. However, these remediation systems are complex, and some details of extraction and the fate of extracted water may be missing or inaccurate. Notably, details on individual well pumping volumes and injection volumes at Mather are not known, although overall pumping and injection volumes are incorporated into CoSANA. Where data were not available, values have been estimated for the model to the best of the model development team's knowledge.

4.5.8 Water Budgets

CoSANA provides detailed water budgets at each model element, which, when aggregated, can provide water budgets for a selected geographic area representing a subregion, subbasin, water/irrigation district, a GSA, or other geographies. The model water budgets have been verified for major model subregions against data and information available from local sources. Additionally, the subbasin-scale model water budgets have been reviewed and verified by the respective technical staff and/or representatives of the GSAs to check the accuracy and reliability of the water budgets for GSP use. When using the CoSANA for more detailed analysis, the user is encouraged to verify the water budgets for reasonableness and consistency with local data and information.

4.5.9 Groundwater Flow and Levels

CoSANA has been calibrated against long-term groundwater trends and seasonal groundwater level changes at approximately 761 wells throughout the model area. The calibration process included adjustments to model input data and/or parameters to ensure that reasonable water budgets are achieved for each model subregion, and long-term simulated groundwater levels match the observed levels within acceptable tolerances. Subsequently, an automated calibration process using PEST was performed to further refine the model calibration by adjusting the aquifer hydraulic properties throughout the model domain. The process of automated calibration also used aquifer texture data for spatial distribution of aquifer parameters. Inaccuracies in observation and reported groundwater levels may influence the quality of calibration. Further, lack of detailed well construction information in many of the calibration wells limited the ability to use data at those sites to properly calibrate the model with depth.

4.5.10 Streamflows

CoSANA simulates streamflows many rivers and streams, including the Sacramento, American, and Cosumnes Rivers. CoSANA stream budgets have been developed and reviewed for several key stream reaches, including reaches along the major river reaches. Additional care has been given to the nature of stream-aquifer interaction to allow proper representation of the stream reaches that potentially have hydraulic connection to the groundwater system, as well as reaches that are gaining or losing. In specific, published information by various non-governmental organizations, such as TNC have been used in model calibration. The quantity and quality of data on the physical nature, extent, and rate of stream-aquifer interaction is, in general, low throughout the state. The Sacramento region and the CoSANA model area is not an exception to this lack of quality data, despite improvements over the past decades. Government agencies and non-governmental organizations are encouraged to allocate additional research to this area for better representation of the nature, extent, and conditions of stream-aquifer relationship.

4.6 Modeling Uncertainties

A model is a numerical representation of physical process and inherently possesses uncertainties that affect the calibration, performance, and results of the model. Integrated hydrologic models are complex models that involve simulation of complex physical systems and interrelationships and require many different types of data, each of which may be available at different temporal and spatial scales. Uncertainties in the performance of an integrated hydrologic model can arise from uncertainties in how the physical processes are conceptualized and formulated, inaccuracies in the underlying data, calibration process and eventually the assumptions used in applications of the model to evaluate projects, including projections of future conditions. The following are additional details on each of these uncertainty categories.

4.6.1 Structural Uncertainties

First set of model uncertainties can arise due to the structural framework of the model, which can include:

- Representation of Physical Features- In order to properly represent natural conditions, the physical and natural features need to be well understood so that they can be conceptualized in a simplified manner for development of theoretical formulations.
- Theoretical Concepts and Representation of the Natural and Physical Systems- This type of uncertainty can be attributed to the conceptualization of the physical and natural systems in the form of mathematical functions and formulas that govern the movement of groundwater and surface water systems and the interrelation of these systems. These formulas are typically referred to as governing equations for each of the hydrologic or hydrogeologic features modeled.
- Formulation, Code Development, Solution Techniques, and Assumptions- The governing equations are typically so complex that analytical solutions to these equations are either not available or are so simplified that they would add to the inaccuracies in the representation of complex hydrologic systems. Therefore, numerical solutions are employed, including finite element or finite difference techniques, which require their own set of assumptions. Computer software is used to implement the theoretical formulations.
- Model Spatial and Temporal Resolution- The governing equations representing the natural and/or physical systems are either solved at two levels:
    - Lumped solution- At this level, the formulation represents a lumped parameter system, and the solution will be for an aggregated system at the large scale. This aggregated and lumped scale can be both for the spatial and temporal scale of the problem. Lumped level solutions are typically employed in conditions where there is a lack of accurate information or where the system is small enough that further spatial or temporal breakdown of the system is not possible due to lack of data and information.

- Distributed Solution- At this level, the system is subdivided in further spatial resolution to take advantage of spatial variability in the data and information that is available at smaller scales. Additionally, the solution to the formulation of the system is also subdivided in smaller temporal scales, such as a monthly or daily time step, so that short-term and long-term variability in the data over time is properly represented in the solution.

4.6.2 Data Uncertainties

This category of uncertainty is related to the data and information that is used and employed in development of a model.

- Data and Information Accuracy, Data Gaps, and Estimates- Collection and compilation of data for natural and physical systems, including precipitation, streamflow, land use, cropping patterns, population, water use, crop evapotranspiration, soil conditions, groundwater levels, streamflow, surface water use, groundwater pumping, infrastructure, facilities, and operations all include a certain level of inaccuracy and uncertainty. This uncertainty is exacerbated when data gaps and inconsistencies exist. The methodology used to identify and fill data gaps can introduce levels of uncertainty.
- Data Spatial and Temporal Resolution- In addition to the above, the spatial and temporal resolution of data may contain inaccuracies and uncertainties that would affect the data that are used in the model.

4.6.3 Calibration Uncertainties

- Estimates of Hydrologic and Hydrogeologic Parameters- Often, data and/or information for specific parameters that are used to represent the governing equations in the model may not be available. In these circumstances, the modeler uses professional judgement, or adopts conditions from similar areas, which may introduce uncertainties and inaccuracies in model simulations.
- Calibration Approach, Target Characteristics, and Accuracy- Model calibration requires certain quality, consistency, and care, so that the model properly represents the natural and physical conditions observed in the field. In addition to the quality and uncertainties in data and methodologies, the approach employed, tools and techniques used, and experience and expertise of the model developer affects the quality of model calibration and accuracy of the results. Often, the calibration targets are prone to uncertainty or lack of information. For example, information on the depth of the screened interval, as well as pumping rate and depth at the well, whether the recorded groundwater level reflects static or pumping conditions, and whether a well is under the influence from other nearby wells or a nearby stream can have significant bearing on the approach and quality of the calibration.

4.6.4 Application Uncertainties

- Assumptions and Project Applications, Including Data Projections and Forecasting Methods- It is imperative that model application be defined and considered in such a way that is supported by model calibration. Assumptions on a model application to analyze a particular project can often be generalized with little knowledge of the conditions. For example, significant uncertainties exist with respect to the following data, which can affect the quality and results of the model output for planning and policy making:
  - Hydrologic conditions and rainfall patterns
  - Land use and cropping patterns
  - Population and water use
  - Water supply conditions
  - Climate change conditions

While modeling uncertainties need to be considered in use and application of models for evaluation of project conditions for potential impacts, benefits, and design of plans and facilities, the model should be considered a reasonably robust tool to support the major decisions, including GSPs, projects and management actions, and sustainability analysis.

4.7 Sensitivity Analysis

Sensitivity analysis is a way of investigating how sensitive certain model results are to changes in certain model parameters. A sensitive parameter is when the simulation results are greatly affected by changes in that parameter within its valid range. Conversely, an insensitive parameter means the changes in that parameter within its valid range do not affect the simulation results greatly.

Model parameters that are sensitive can be the largest sources of error and uncertainty when not precisely measured and well understood. For this reason, sensitivity analysis is an important step of the model calibration process. The sensitivity analysis serves the following purposes:

- To improve the understanding of input-output relationships
- To quantify the impact of inaccuracies in model parameters
- To evaluate the stability and robustness of the model
- To understand the overall range of accuracy of the model results

For these purposes, the following set of calibration parameters were selected for investigation under CoSANA Model sensitivity analysis:

- Aquifer horizontal hydraulic conductivity (PKH) changed globally by factors of 0.5, 0.67, 1.5, 2.0
- Aquifer vertical hydraulic conductivity (PL) changed globally by factors of 0.5, 0.67, 1.5, 2.0
- Specific yield (PN) changed globally by factors of 0.8, 1.2
- Specific storage (PS) changed globally by factors of 0.1, 0.2, 5, 10
- Streambed conductivity (CSTRM) changed globally by factors of 0.2, 0.5, 2.0, 5.0
- Small watersheds curve number (CNS) changed globally by -10, -5, 5, 10
- General head boundary condition head time series (BHTS) changed globally by -10, 10 feet

4.7.1 Metrics of the Sensitivity Analysis

In the process of evaluating the sensitivity of model results to certain parameter changes, the results from the sensitivity runs were analyzed for the NASb, SASb, and CoSb and compared to the calibrated model in terms of the groundwater residual statistics.

The changes to the input parameters for sensitivity analysis were made globally. Therefore, the changes in the model performance should be considered on a global scale. An improvement in the model performance based on changes in one parameter at a global scale does not necessarily mean improvements in the overall model performance and/or calibration, as the model is calibrated to a number of target parameters, only some of which may be included in the performance assessment during the sensitivity analysis. The residual statistics for this sensitivity analysis was used as the performance indicator.

4.7.2 Results of the Sensitivity Analysis

Figure 4-63, Figure 4-64, and Figure 4-65 present the relative change in the three groundwater level residual statistics used in the evaluation of model calibration performance for 10 sensitive parameters in NASb, SASb, and CoSb respectively. These three statistics are:

- Root mean square error (RMSE): This statistic is a measure of how spread out the residuals are.
- Average residual: This statistic measures how inaccurate simulation results are with respect to the corresponding observations on average.

- Correlation coefficient (R2): This statistic is a measure of the strength of the linear relationship between the simulated and observed pairs.

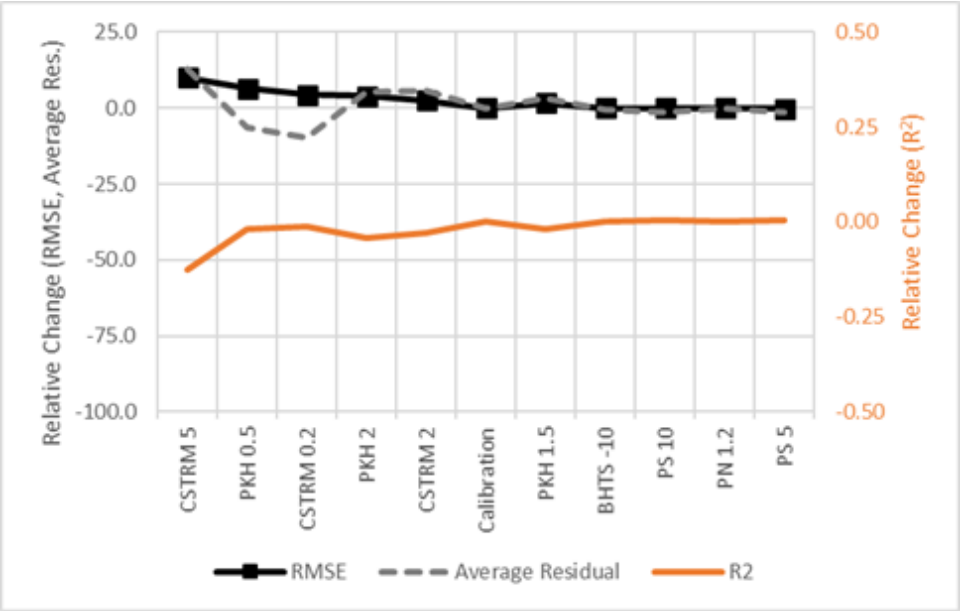


Figure 4-63: Sensitivity of Groundwater Level Residual Statistics in NASb

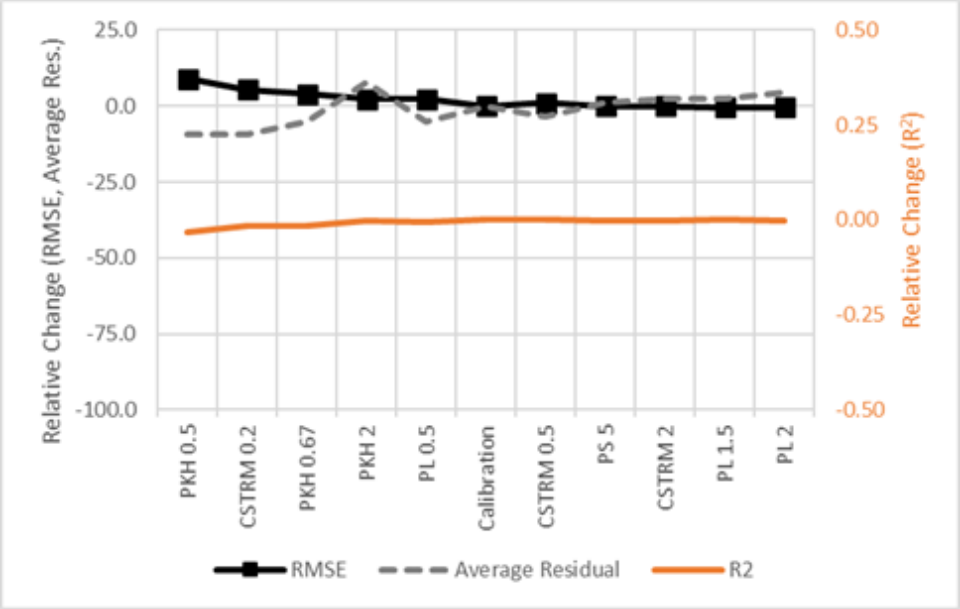


Figure 4-64: Sensitivity of Groundwater Level Residual Statistics in SASb

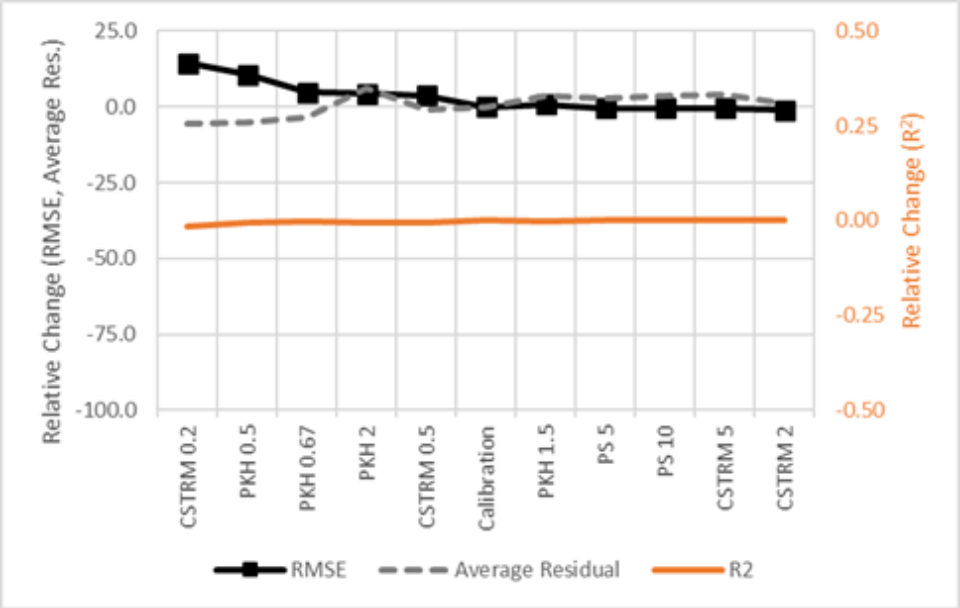


Figure 4-65: Sensitivity of Groundwater Level Residual Statistics in CoSb

None of the sensitivity runs resulted in a significant improvement in these statistics for any of the subbasins. This means that the model is stable and that the calibration is at or near an optimal point when global parameter changes are considered.

5. BASELINE CONDITIONS

Integrated hydrologic and water resources models are used to evaluate effects, benefits, and impacts of particular projects and management actions under a set of baseline conditions. These baseline conditions can represent a set of pre-established hydrologic, land and water use, water demand, water supply, and basin operational conditions. As part of the development of the GSPs for the NASb, SASb, and CoSb, three sets of baseline conditions have been defined for the CoSANA model. These represent the current, projected, and projected under climate change baseline conditions.

Following are descriptions of the assumptions and results for each of these baseline scenarios.

5.1 Current Conditions Baseline

The CoSANA Current Conditions Baseline (CCBL) is a representation of long-term average conditions assuming that a recent level of development and water demand persists over a long-term period of hydrologic conditions. Initial groundwater levels and soil conditions in the CCBL represent those at the end of the simulation period of the historical CoSANA (representing September 30, 2018).

5.1.1 Hydrology

The CCBL uses a 50-year historical hydrology from water years (WY) 1970 through 2019 (October 1, 1969 through September 30, 2019) for precipitation, evapotranspiration, and streamflow.

5.1.1.1 Precipitation

Precipitation in the historical simulation, discussed in Section 2.6, uses the PRISM database for the entire period of record. The precipitation used in the historical simulation was extended through WY 2019 for use in the CCBL. The average CCBL precipitation across the entire model area is 20.2 inches, with a minimum of 7.5 inches in WY 1977 and a maximum of 38.9 inches in WY 1983.

Figure 5-1 graphically illustrates the cumulative departure of the spatially averaged rainfall within the CoSANA model area. The figure includes bars displaying annual precipitation for each water year from WY 1970 through 2019 and a horizontal line representing the long-term mean precipitation of 20.2 inches. The cumulative departure from mean precipitation is displayed as a line that highlights wet periods with upward slopes (positive departure) and dry periods with downward slopes (negative departure). More severe events are shown by steeper slopes and greater changes.

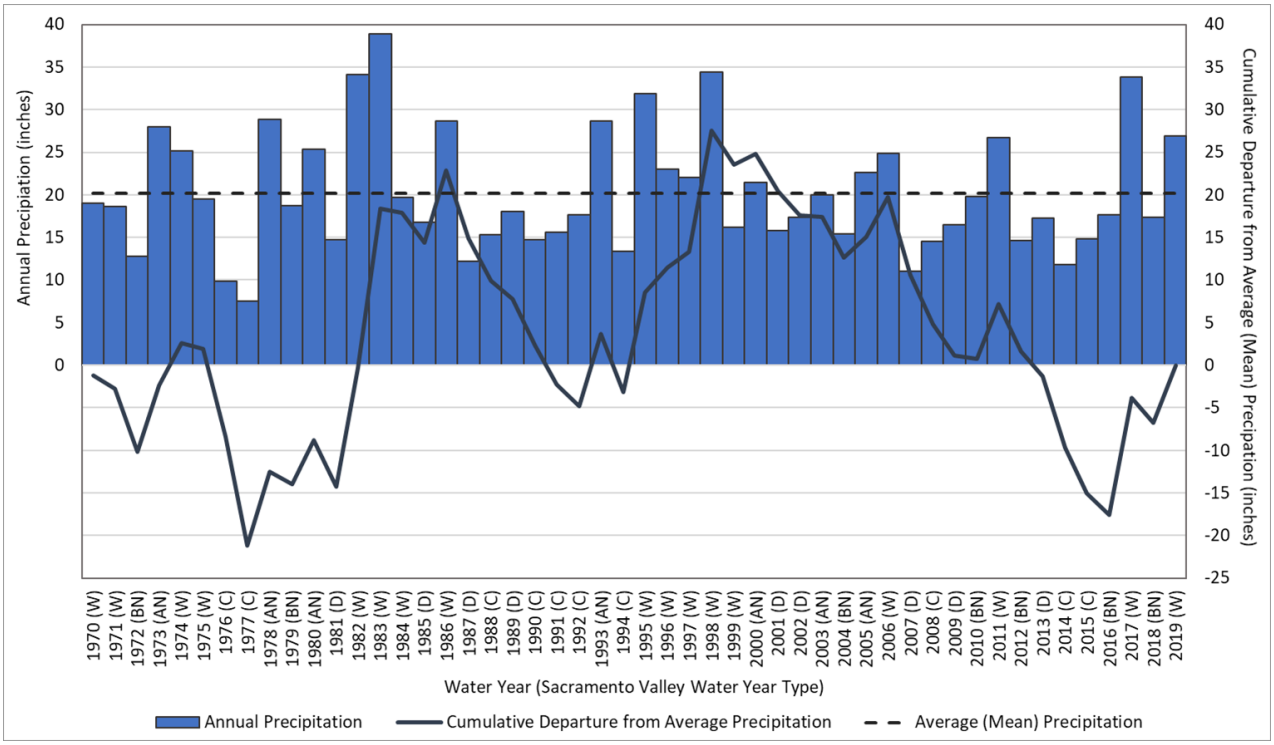


Figure 5-1: 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation

5.1.1.2 Evapotranspiration

As discussed in Section 2.8, the crop ET requirement was based on values from regional modeling (C2VSimFG) and associated CIMIS Zones 12 and 14. The ET used in the historical simulation was extended through WY 2019 for use in the CCBL.

5.1.1.3 Stream Inflow

As discussed in Section 2.4, stream inflows are from stream gaging stations at the upstream area of CoSANA river reaches. The stream inflow points and gaging stations are described in Section 2.4 and listed in Table 2-4. As the CCBL uses the historical hydrologic conditions as the basis for planning the baseline conditions, the stream inflows used in the historical simulation were extended through WY 2019 for use in the CCBL.

5.1.1.4 Hydrologic Year Types

The 50 years of the CCBL, from WY 1970 through 2019, represent a range of hydrologic conditions, as identified by the water year types in the Sacramento Valley Water Year Hydrologic Classification, which classifies water years 1901 through 2020 as Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critical (C) based on inflows to major reservoirs or lakes. A description of how this index is calculated and the specific data used to calculate this index is available online from CDEC at http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST. In the 50 years of hydrology used in the CCBL, there are 10 Critical years, 9 Dry years, 7 Below Normal years, 7 Above Normal years, and 17 Wet years.

To facilitate assumptions for baseline water supplies and demands, these five water year types were simplified into three water year types. Critical and Dry years are combined into one category in the baseline water year types (called Dry years), Above Normal and Below Normal years are also combined into one category (Normal years), and Wet years remain in one category (called Wet years). With this breakdown, the three baseline water year types have a

distribution of 19 Dry years, 14 Normal years, and 17 Wet years. These baseline water year types (Table 5-1) are used in the remainder of the CCBL data development and results discussion.

Table 5-1: Hydrologic Water Year Types

Baseline Year	Water Year	Sacramento Valley Water Year Hydrologic Classification	Baseline Year Type		Baseline Year	Water Year	Sacramento Valley Water Year Hydrologic Classification	Baseline Year Type
1	1970	Wet	Wet		26	1995	Wet	Wet
2	1971	Wet	Wet		27	1996	Wet	Wet
3	1972	Below Normal	Normal		28	1997	Wet	Wet
4	1973	Above Normal	Normal		29	1998	Wet	Wet
5	1974	Wet	Wet		30	1999	Wet	Wet
6	1975	Wet	Wet		31	2000	Above Normal	Normal
7	1976	Critical	Dry		32	2001	Dry	Dry
8	1977	Critical	Dry		33	2002	Dry	Dry
9	1978	Above Normal	Normal		34	2003	Above Normal	Normal
10	1979	Below Normal	Normal		35	2004	Below Normal	Normal
11	1980	Above Normal	Normal		36	2005	Above Normal	Normal
12	1981	Dry	Dry		37	2006	Wet	Wet
13	1982	Wet	Wet		38	2007	Dry	Dry
14	1983	Wet	Wet		39	2008	Critical	Dry
15	1984	Wet	Wet		40	2009	Dry	Dry
16	1985	Dry	Dry		41	2010	Below Normal	Normal
17	1986	Wet	Wet		42	2011	Wet	Wet
18	1987	Dry	Dry		43	2012	Below Normal	Normal
19	1988	Critical	Dry		44	2013	Dry	Dry
20	1989	Dry	Dry		45	2014	Critical	Dry
21	1990	Critical	Dry		46	2015	Critical	Dry
22	1991	Critical	Dry		47	2016	Below Normal	Normal
23	1992	Critical	Dry		48	2017	Wet	Wet
24	1993	Above Normal	Normal		49	2018	Below Normal	Normal
25	1994	Critical	Dry		50	2019	Wet	Wet

5.1.2 Initial Conditions

The initial conditions for the 50-year CCBL are defined as the groundwater, surface water, and hydrologic conditions for the end of WY 2018 from the end of simulation of the CoSANA historical model. Figure 5-2 shows a map of initial groundwater levels used in the CCBL. The initial conditions for the CCBL are also used for other baseline models.

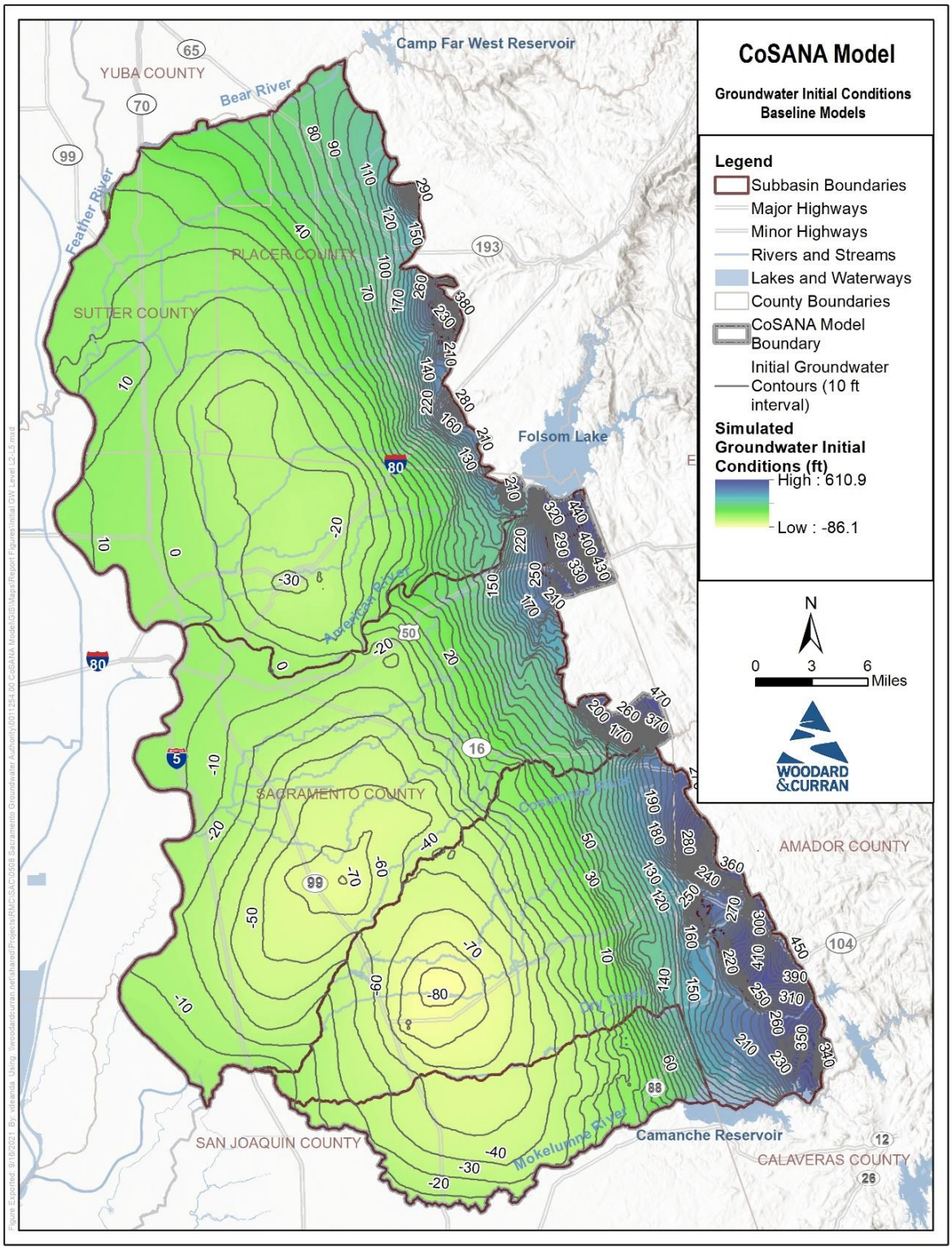


Figure 5-2: Initial Groundwater Levels for CoSANA Baseline Models

5.1.3 Boundary Conditions

CCBL boundary conditions are based on an average for each baseline water year type (normal, wet, and dry) during the last 10 years of the historical simulation (WY 2009-2018). This averaging is applied to the constrained head boundary conditions that represent Lake Camanche in the southeast corner of the model, and the general head boundary conditions that represent groundwater levels to the north, south, and west of the model boundary. Water year type averaging is not applied to the small watersheds form the eastern boundary of the model, as these are driven by hydrology (precipitation and evapotranspiration.) Further detail of how boundary conditions are applied in CoSANA are provided in Section 2.12.

5.1.4 Land Use

The CCBL used the land use from the last year of the historical simulation, discussed in Section 2.7. The last year of the historical simulation represents the digital land use coverage developed to represent 2015 (see Figures 15-21). As also described in Section 2.7, certain lands regarded as temporarily fallowed due to drought were represented as their typical land use for purposes of historical interpolation and for purposes of the CCBL. Minor changes to specified land use conditions were made to account for recent changes. Land use in Sutter County and Placer County was updated to incorporate recent conversions of rice fields to orchards. In the Cosumnes Subbasin, the land use was updated to incorporate recent conversion of vineyards or pasture to almonds and native land to agricultural and urban uses. A spatial representation of the CCBL land use is shown in Figure 5-3. The time-series of land use for the CoSANA CCBL is shown in Figure 5-4, highlighting the constant nature of land and water use in the baseline conditions. Figure 5-5 through Figure 5-7 show time-series of land use for the NASb, SASb, and CoSb, respectively.

.

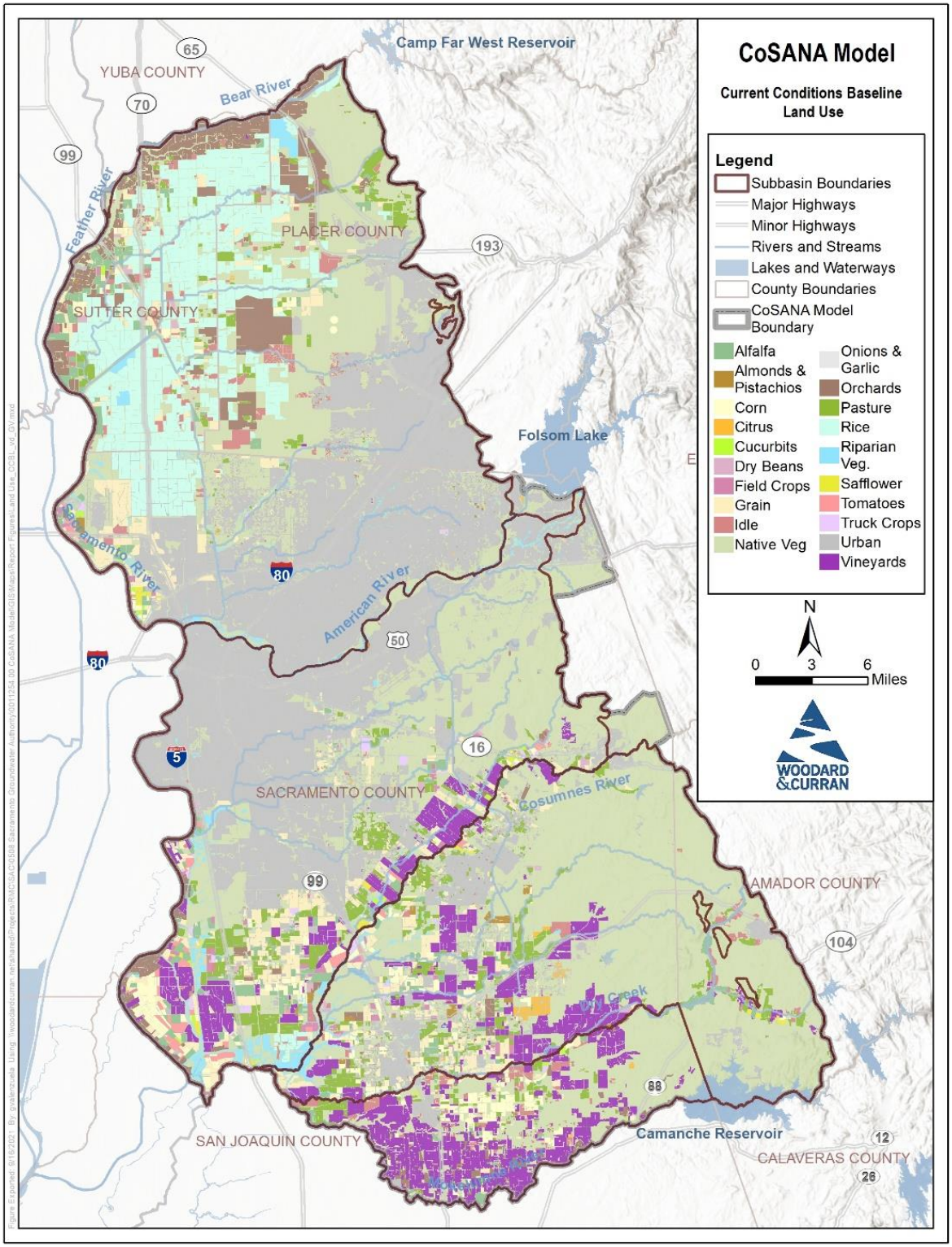


Figure 5-3: Current Conditions Baseline Land Use

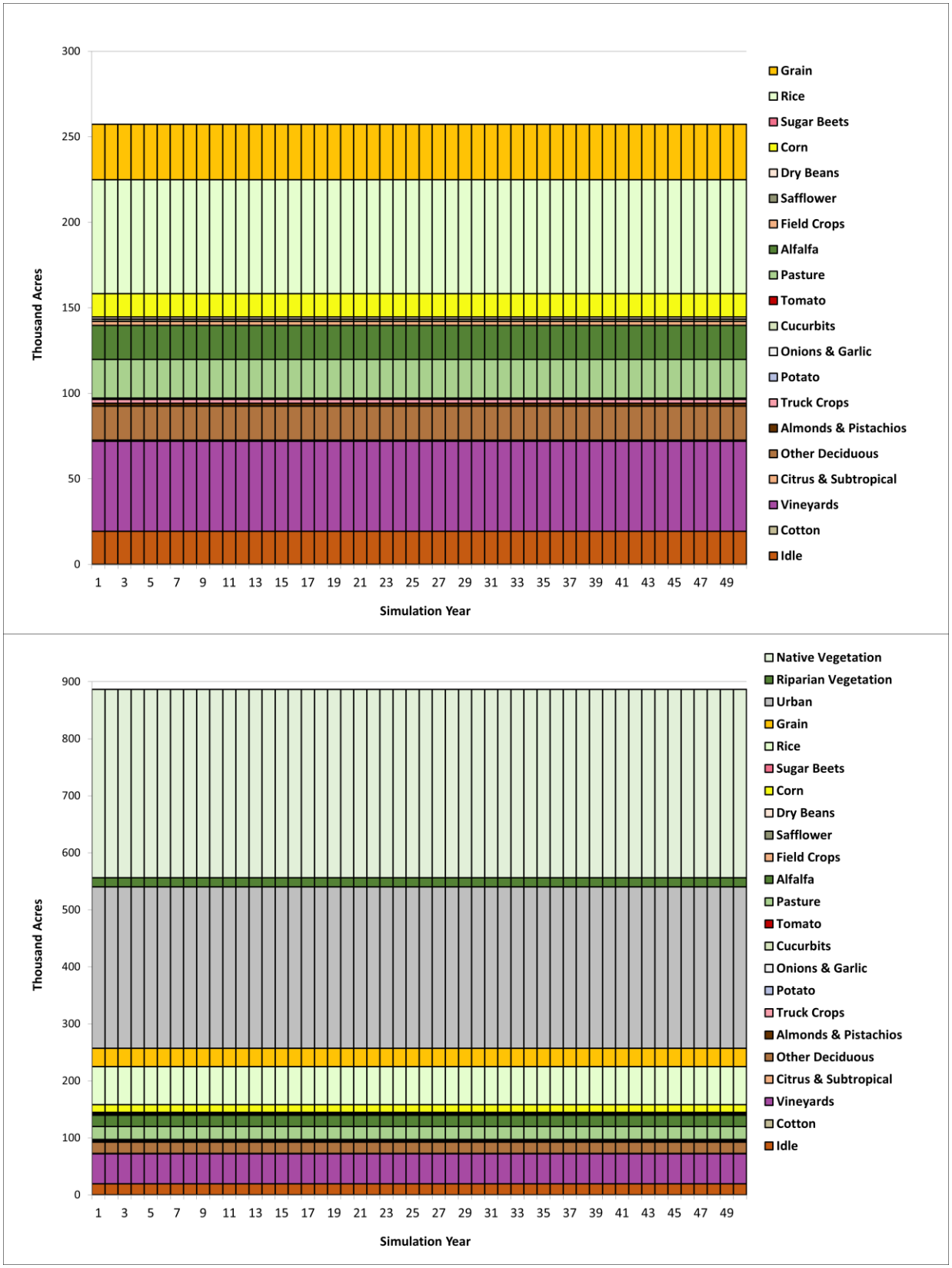


Figure 5-4: Current Conditions Baseline Land Use for CoSANA

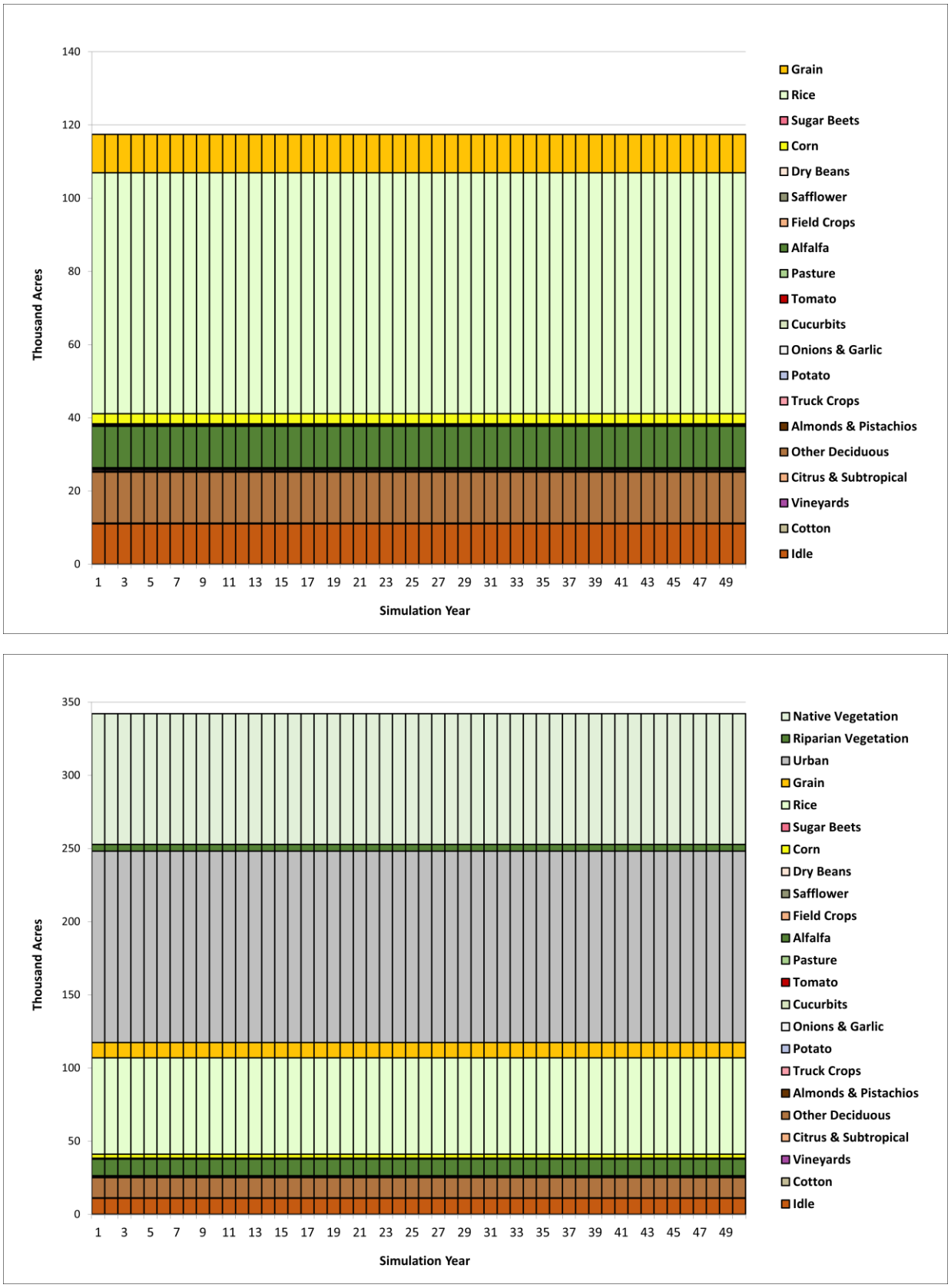


Figure 5-5: Current Conditions Baseline Land Use for North American Subbasin

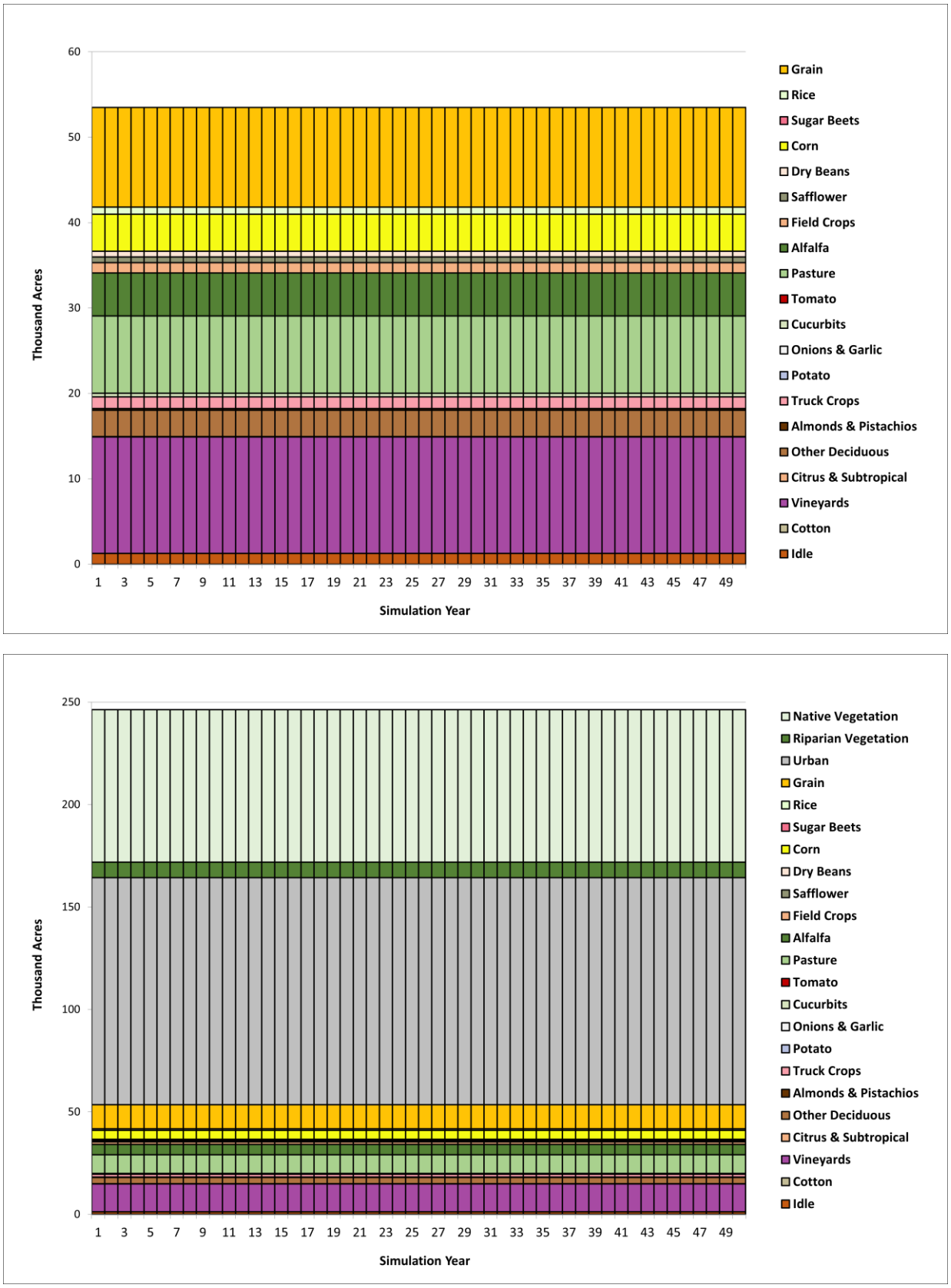


Figure 5-6: Current Conditions Baseline Land Use for South American Subbasin

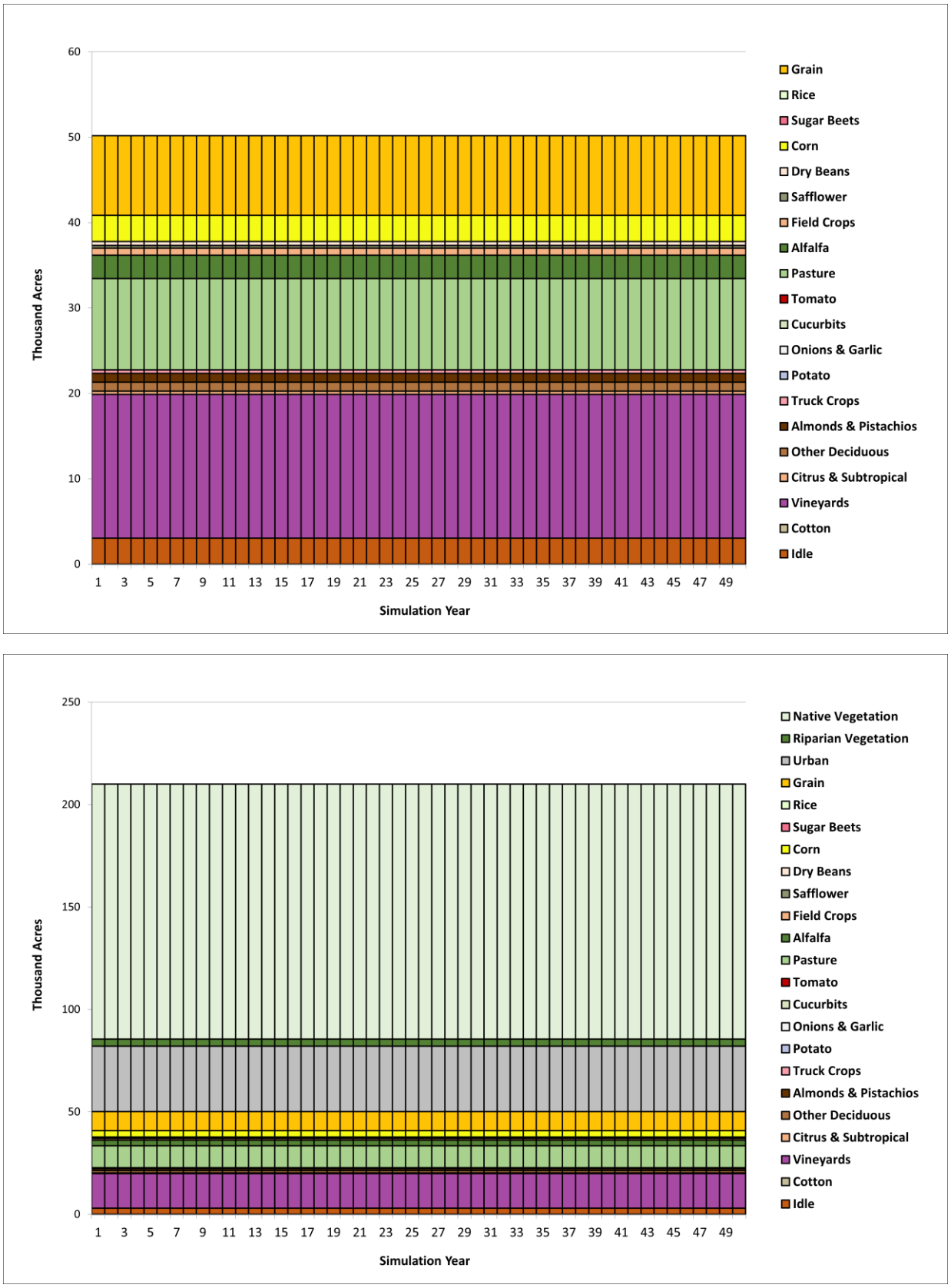


Figure 5-7: Current Conditions Baseline Land Use for Cosumnes Subbasin

5.1.5 Urban Demand and Supply

Urban demand is represented for each urban area based on supply data. Like the CoSANA historical model, each baseline assumes that urban supply (combined groundwater, surface water, and other sources such as recycled water) is equal to urban demand.

Urban water supply, including surface water deliveries, groundwater pumping, recycled water, and remediated water, are all calculated using the method described below, unless exceptions are listed in the individual purveyor sections that follow. To estimate CCBL water supply, the information for the last 10 years of the historical simulation (WY 2009 through 2018) was averaged by the three baseline water year types (normal, wet, and dry) described in Section 5.1.1.4. WY 2009 through 2018 contains four normal years (2010, 2012, 2016, and 2018), two wet years (2011 and 2017), and 4 dry years (2009, 2013, 2014, and 2015). Appendix G shows subregion/purveyor urban demand and supply for each entity for the three WY types (normal, wet, and dry). The water supply conditions for these three baseline year types were applied to the 50 years of hydrology within the CCBL.

For urban groundwater pumping, a well was assumed active in the CCBL if there was historical recorded pumping in WY 2016-2018. Average pumping by baseline year type was distributed in the CCBL to all active wells by purveyor based on their proportion of the historical simulation purveyor totals.

As previously noted, urban demand and supply were calculated using averages developed from the last 10 years of the historical simulation for all agencies except those specified otherwise in the following subsections.

5.1.5.1 North American Subbasin

The following subsections present demand and supply assumptions for purveyors within the North American Subbasin whose assumptions are different from the standard methodology outlined above.

5.1.5.1.1 City of Sacramento

City of Sacramento's demand was based on the last 10 years of the historical simulation. Demand varies slightly with water year types from 34,702 AFY for wet years to 35,274 AFY for dry years. Approximately 35% of the demand was assumed to be in the NASb portion of the model, based on urban area.

The City of Sacramento's current supplies include groundwater pumping and surface water supplies that vary by five water year types (as opposed to three water year types used for other purveyors) based on the City of Sacramento's 2017 Groundwater Master Plan (GWMP) (City of Sacramento, 2017). Groundwater pumping assumptions for the CCBL were consistent with the Future Conditions Baseline scenario developed in the 2017 GWMP, based on the discussions with the City of Sacramento (B. Ewart, personal communication, December 2020). Monthly pumping assumptions by each well were incorporated into the CCBL based on well locations and monthly well operations, as specified in the 2017 GWMP. Groundwater pumping in the NASb varies from 6,989 AFY during wet years to 41,841 AFY during driest years. Demand after groundwater pumping was assumed to be supplied by surface water.

The City of Sacramento also has specific wells that supply certain larger parks and green areas within the city. These irrigation wells are simulated using six representative irrigation wells that pump 2,400 AFY. Based on the locations of the irrigated parks and green areas, approximately half of the irrigation pumping was estimated in the NASb and the remaining half in the SASb.

5.1.5.1.2 Sacramento County Water Agency (Arden Park Vista and Northgate)

Due to changing supply conditions over the last 10 years of the historical simulation, the SCWA service areas of Northgate and Arden Park Vista in the CCBL use groundwater pumping from WY 2018 for normal and dry baseline years and WY 2019 for wet baseline years.

5.1.5.2 South American Subbasin

The following subsections present demand and supply assumptions for purveyors within the South American Subbasin whose assumptions are different from the standard methodology.

5.1.5.2.1 City of Sacramento

The discussion also applies to the portion of the City of Sacramento that lies within the South American Subbasin; the portion within the NASb was discussed above in Section 5.1.5.1. Groundwater pumping in the SASb by the city varies from 1,761 AFY during wet years to 11,885 AFY during driest years, based on the Future Conditions Baseline scenario developed in the 2017 GWMP and the discussions with the City of Sacramento (B. Ewart, personal communication, December 2020). Monthly pumping assumptions by each well and by each water year type were incorporated into the CCBL based on well locations and monthly well operations, as specified in the 2017 GWMP. Demand after groundwater pumping was assumed to be supplied by surface water.

5.1.5.2.2 Sacramento County Water Agency (Hood, Laguna Vineyard, and Mather)

Due to changing supply conditions over the last 10 years of the historical simulation, including construction of the Vineyard Surface Water Treatment Plant (online in WY 2011), the SCWA service areas of Hood, Laguna Vineyard, and Mather in the CCBL use surface water deliveries, groundwater pumping, recycled water, and remediated water from WY 2018 for normal and dry baseline years and WY 2019 for wet baseline years.

5.1.5.3 Cosumnes Subbasin

The following subsections present demand and supply assumptions for purveyors within the Cosumnes Subbasin whose assumptions are different from the standard methodology.

5.1.5.3.1 City of Galt

The average historical groundwater production for WY 2015-2018 for the City of Galt was used to estimate groundwater pumping for all CCBL years. This pumping occurs at six active wells.

5.1.5.3.2 City of Ione

To estimate CCBL surface water supply to the City of Ione, the average for WY 2015-2018 was used for all CCBL years.

5.1.5.3.3 Camanche Village

To estimate CCBL groundwater pumping water supply for Camanche Village from six active wells, the average for WY 2015-2018 was used for all CCBL years.

5.1.5.3.4 Sacramento Municipal Utility District

The imported Central Valley Project water from the American River via the Folsom South Canal to the Sacramento Municipal Utility District (SMUD) facility uses the average for WY 2015-2018 for all CCBL years.

5.1.5.4 Fish Farms

In the North American Subbasin, four wells were used to simulate 3,480 AFY of pumping for Sterling Caviar, which is located near the Sutter/Sacramento County line just east of Highway 99.

Groundwater pumping at fish farms in the South American Subbasin and Cosumnes Subbasin uses the average for WY 2015-2018 for all CCBL years.

5.1.6 Agricultural Demand and Supply

Agricultural demand in the CCBL is calculated within the model using land use, evapotranspiration, precipitation, and other information, as described for the historical simulation in Section 3.3.

Agricultural supply in the CCBL made of up primarily of surface water deliveries and groundwater pumping. Surface water deliveries are based on water year types (normal, wet, and dry) averages calculated using the last 10 years of the historical simulation (WY 2009-2018). Demand not met by surface water is assumed to be met by groundwater pumping, which is pumped within the associated model element, rather than coming from specific agricultural pumping wells.

5.1.6.1 Rural-Residential Pumping

Rural residential pumping for the current conditions baseline is assumed to be the same as the historical model for water year 2018. Refer to Section 3.3.1 in the historical model documentation.

5.1.6.2 Galt Wastewater Treatment Plant Effluent

The reclaimed water use from the Galt Wastewater Treatment Plant (WWTP) uses the average for WY 2015-2018 for all CCBL years, regardless of baseline water year type.

5.1.6.3 Agricultural Groundwater Substitution Transfers

Pumping associated with agricultural water transfers occurs in three entities in the North American Subbasin: Natomas Mutual Water Company (NMWC), Pleasant Grove-Verona Mutual Water Company (PGVMWC), and South Sutter Water District. NMWC and PGVMWC participate in groundwater substitution transfers under certain conditions. South Sutter Water District is different from the other two, as they transfer water based on a hybrid approach. The water made available is released from storage in Camp Far West Reservoir. Generally, a similar volume of groundwater is pumped by private well owners within the district. This volume is not directly measured and is assumed to be slightly less than the amount released from storage. This is represented in the CCBL by delivering less surface water during dry years than normal or wet years, with averages calculated using the data from the last 10 years of the historical simulation. The groundwater pumping is calculated internally in the model and therefore automatically adjusts for years with less or more surface water.

For NMWC and PGVMWC, historical groundwater substitution transfer pumping data was provided for water years 2020 and 2021 (2019 was not a transfer year). For the CCBL estimates of groundwater substitution transfer pumping, dry year averages were calculated using historical data for WY 2012-2021. During this 10-year period, all groundwater substitution transfer pumping occurs in the five dry years (2013, 2014, 2015, 2020, and 2021). The estimated dry year transfer pumping for NMWC and PGVMWC was distributed among all transfer wells in the same proportion as in the historical data. The surface water deliveries to NMWC and PGVMWC in the CCBL are adjusted based on the amount of dry year transfer pumping.

5.1.7 Remediation Operations

Remediation operations for Mather, McClellan, Kiefer, and Aerojet, discussed for the historical simulation in Section 3.4, in the CCBL are held constant at the WY 2018 level of pumping for the entire CCBL. The number and location of the remediation wells is assumed to remain the same as in the historical simulation. Mather remediation pumping is set at 209 AFY, McClellan remediation pumping is set at 2,409 AFY, Kiefer remediation pumping is set at 621 AFY, and Aerojet remediation pumping is set at 32,040 AFY.

5.1.8 Results

This section provides a summary of the CoSANA CCBL results.

5.1.8.1 Land and Water Use Budget

The land and water use budget provides details on the urban and agricultural demand and the water supply meeting the demand (groundwater pumping, surface water deliveries, recycled water, or remediation pumping). Average annual CCBL model results by groundwater subbasin are shown in Table 5-2. Annual agricultural water demand and supply by subbasin are shown in Figure 5-8 through Figure 5-10. Annual urban demand and supply by subbasin are shown in Figure 5-11 through Figure 5-13. Appendix H includes model subregion land and water use budgets for the baselines.

Table 5-2: CCBL Average Annual Land and Water Use Budget

Subbasin	Ag. Demand (AFY)	Ag. Ground-Water Use* (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-Water Use** (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	392,619	206,201	188,962	200,913	83,319	117,596	-	5,515
SASb	142,961	98,369	44,804	174,487	79,948	93,871	856	29,765
CoSb	126,838	105,049	21,458	27,520	22,825	2,483	-	-
Total	**662,418**	**409,619**	**255,224**	**402,920**	**186,092**	**213,950**	**856**	**35,280**

Note:
* Agricultural groundwater use presented in the above table may differ slightly from the values shown in the respective GSP due to minor difference in the methodology on calculation of rural residential water use.
** Urban groundwater use in the above table represents water used that originated from groundwater production but can include water that was pumped in areas outside of the respective subbasin.

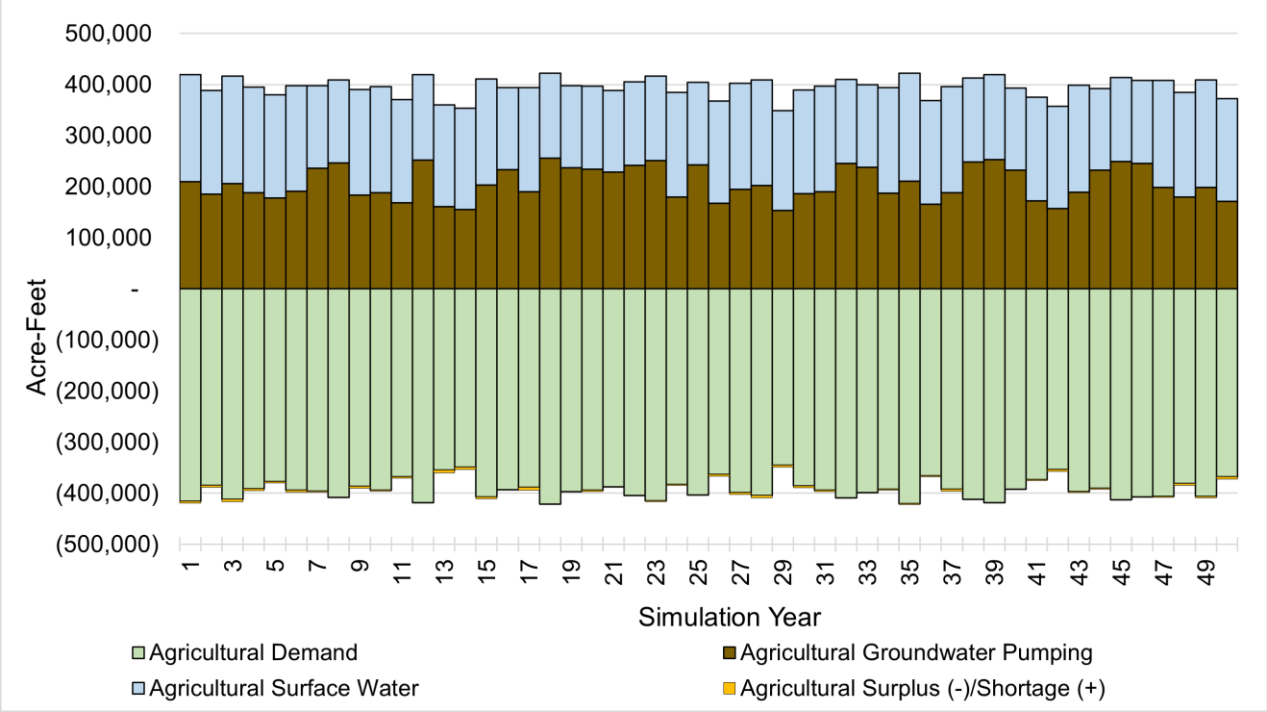


Figure 5-8: Annual Agricultural Water Demand and Supply – North American Subbasin, Current Conditions Baseline

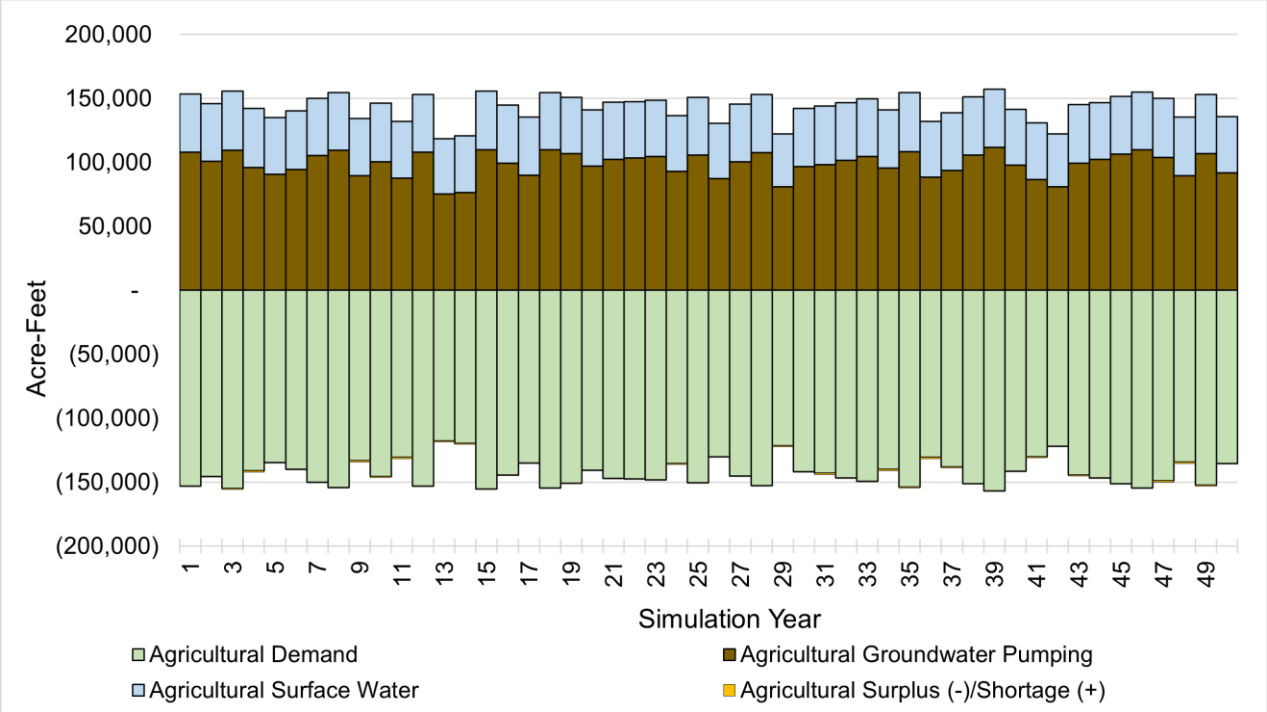


Figure 5-9: Annual Agricultural Water Demand and Supply – South American Subbasin, Current Conditions Baseline

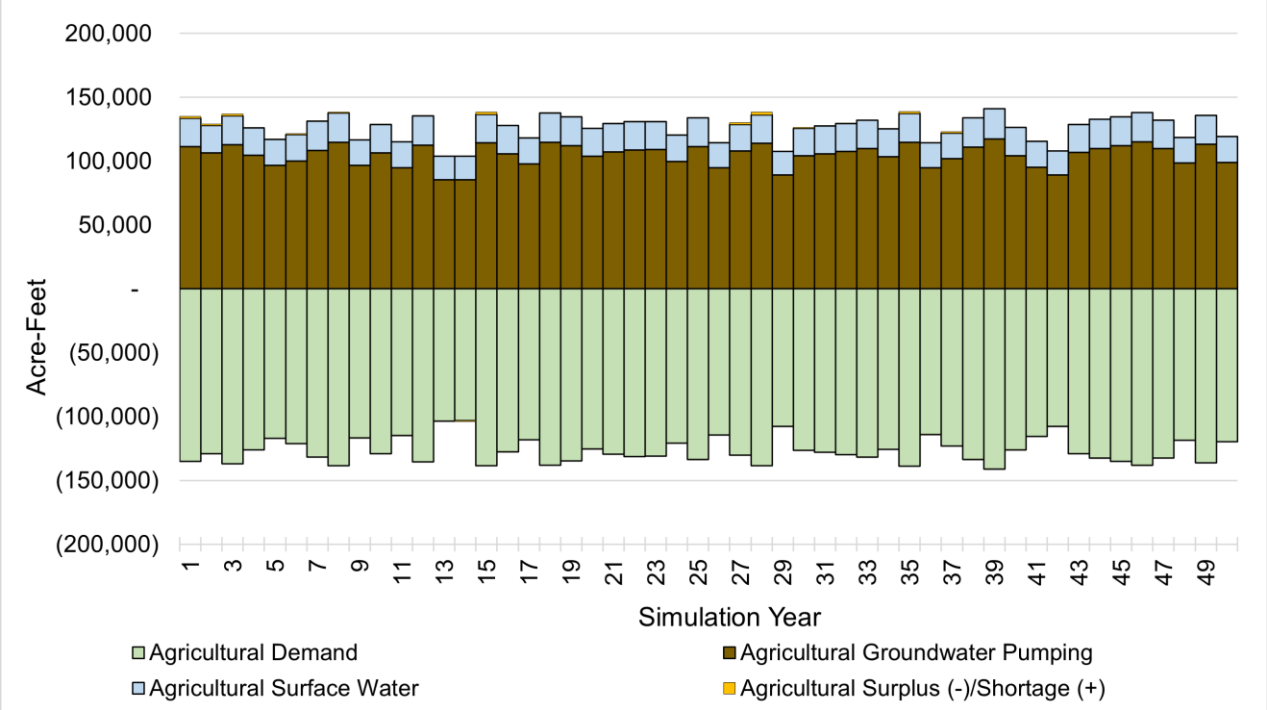


Figure 5-10: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Current Conditions Baseline

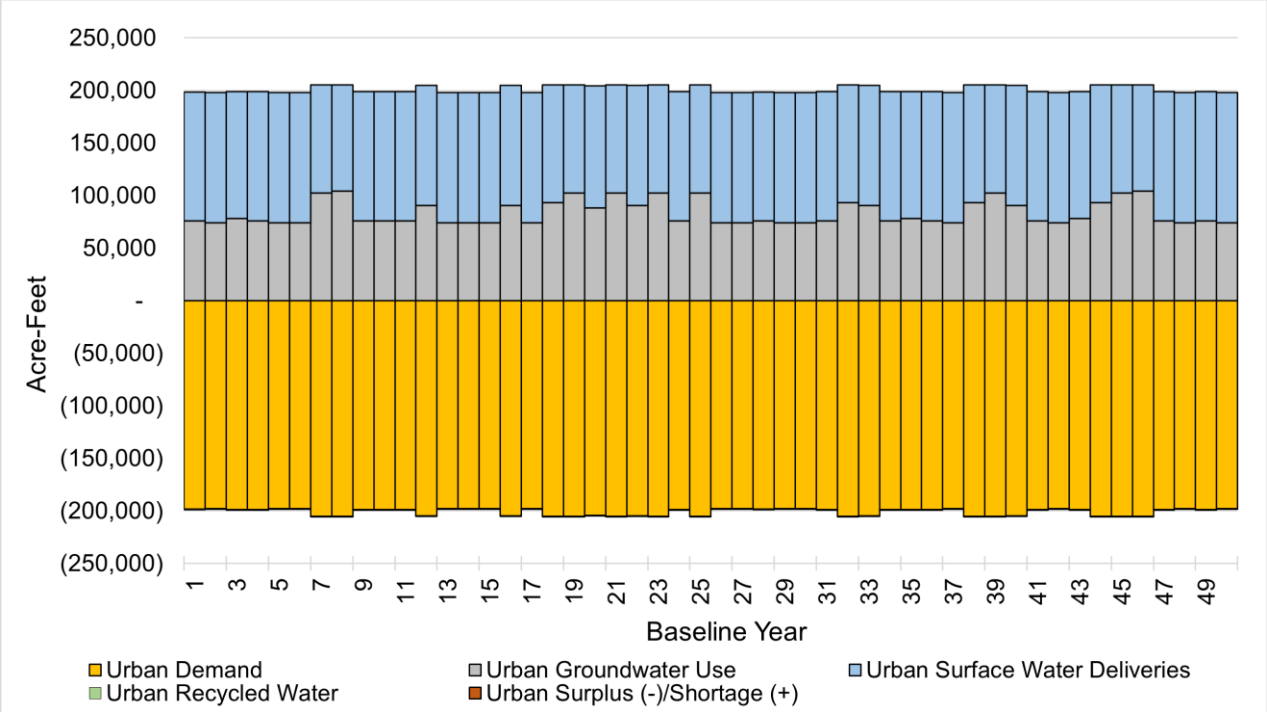


Figure 5-11: Annual Urban Water Demand and Supply – North American Subbasin, Current Conditions Baseline

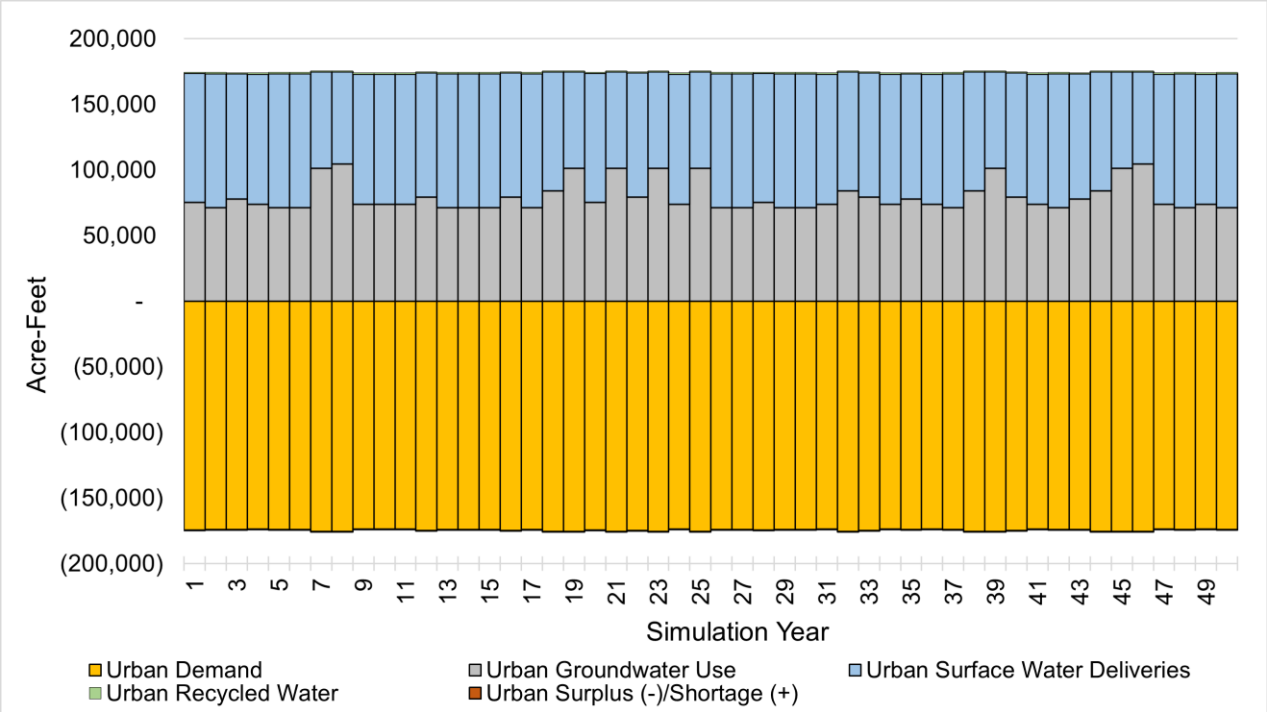
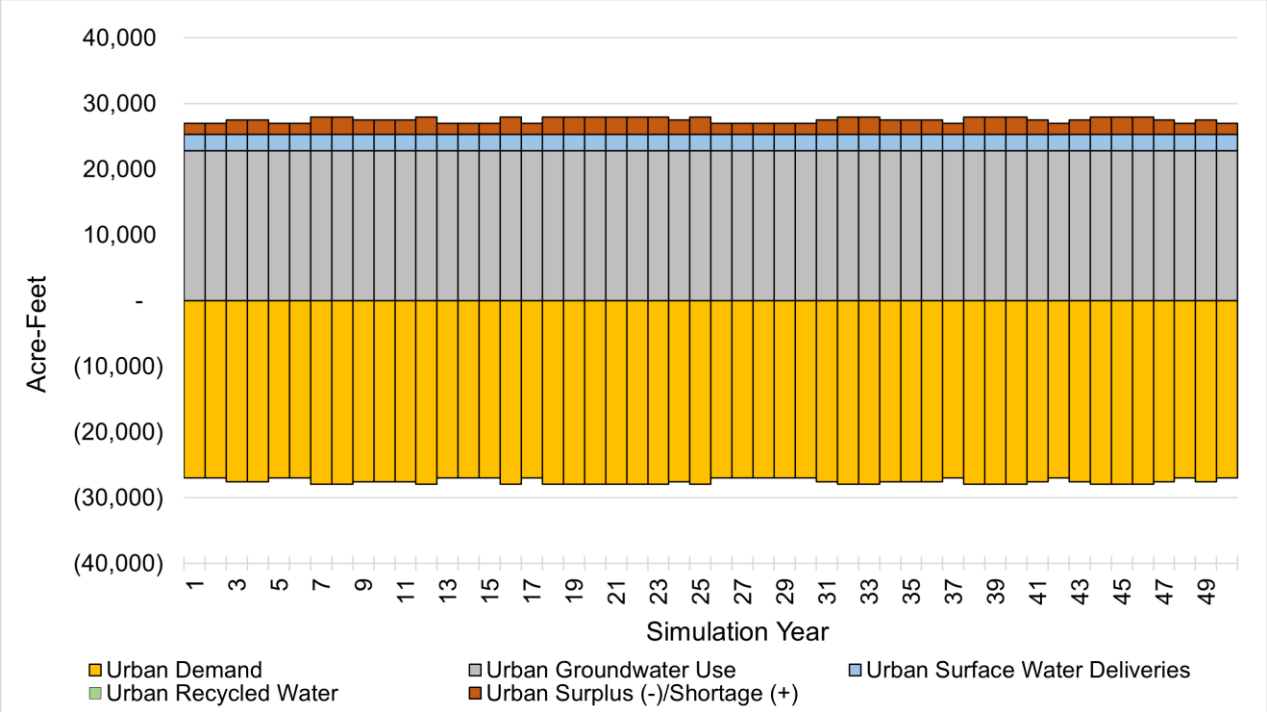


Figure 5-12: Annual Urban Water Demand and Supply – South American Subbasin, Current Conditions Baseline



Note: Urban groundwater use is specified in the CoSb model input data set. The model-calculated surplus/shortage in urban demand is therefore not utilized to calculate the CoSb groundwater budget.

Figure 5-13: Annual Urban Water Demand and Supply – Cosumnes Subbasin, Current Conditions Baseline

5.1.8.2 Groundwater Budget

The groundwater budget provides all inflows and outflows to the groundwater aquifer system. Average annual CCBL model results by groundwater subbasin are shown in Table 5-3. Annual groundwater budgets with cumulative change in storage by subbasin are shown in Figure 5-14 through Figure 5-16. Appendix I includes model subregion groundwater budgets for the baselines. Appendix J includes a set of sample hydrographs for the baseline models.

Table 5-3: CCBL Average Annual Groundwater Budget

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
NASb	303,094	183,468	81,494	16,732	28,125	8,161	14,843
SASb	212,626	120,915	91,328	26	4,089	-1,573	2,158
CoSb	127,875	109,064	15,575	0	1,442	1,559	-233
Total	**643,595**	**413,447**	**188,397**	**16,758**	**33,656**	**8,147**	**16,768**

Note: Boundary Flows term includes flow between areas outside of the CoSANA model domain and baseflow from small watersheds. Subsurface Inflows includes flow between the simulated subbasins in CoSANA and areas outside of Bulletin 118 subbasins.

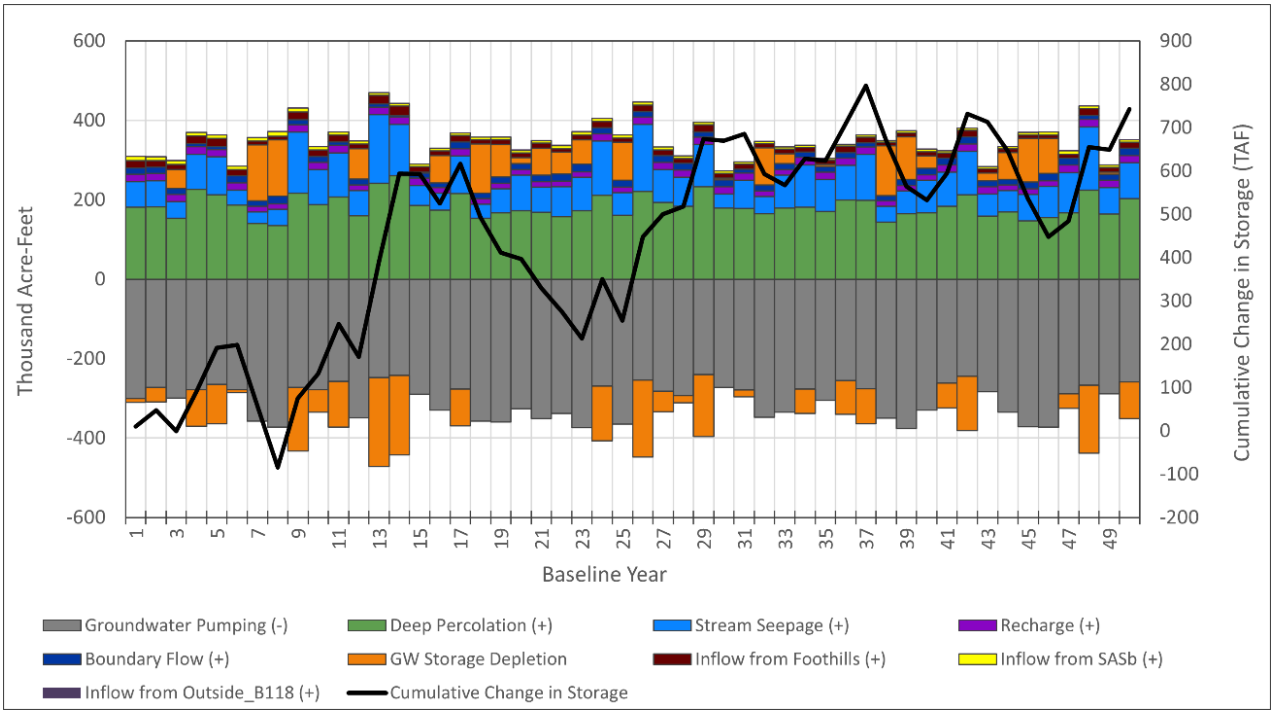


Figure 5-14: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Current Conditions Baseline

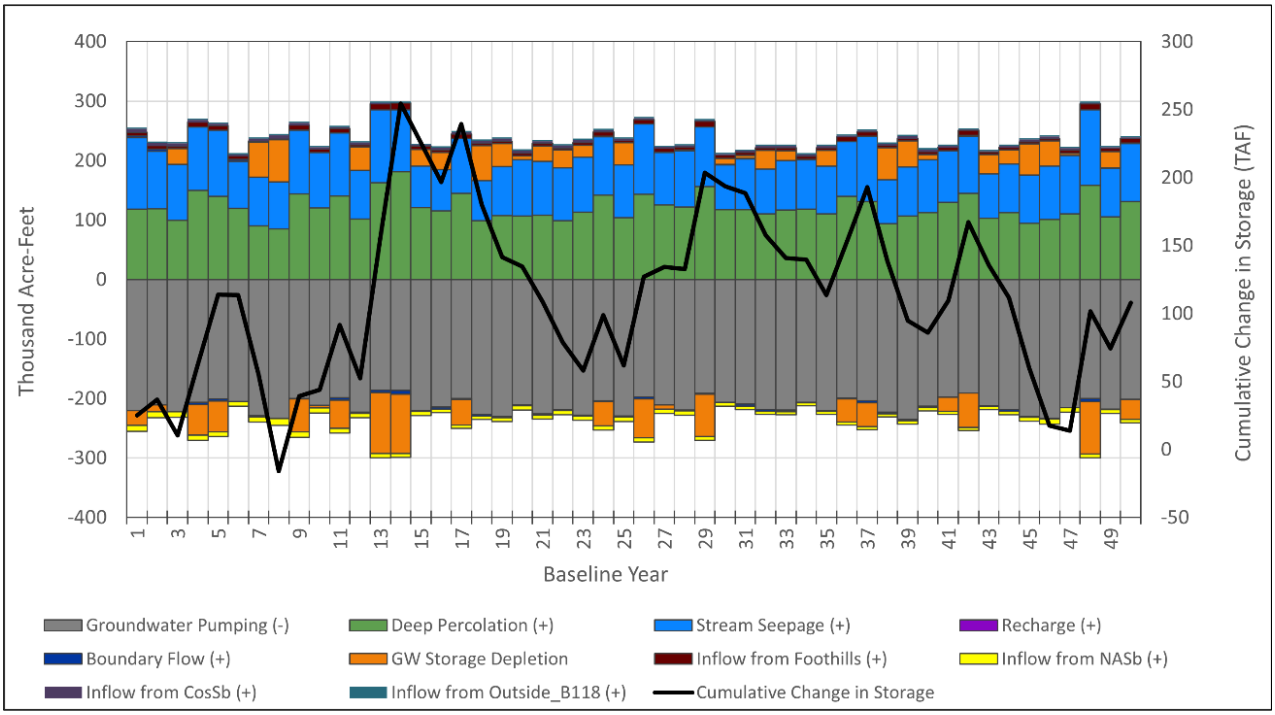


Figure 5-15: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Current Conditions Baseline

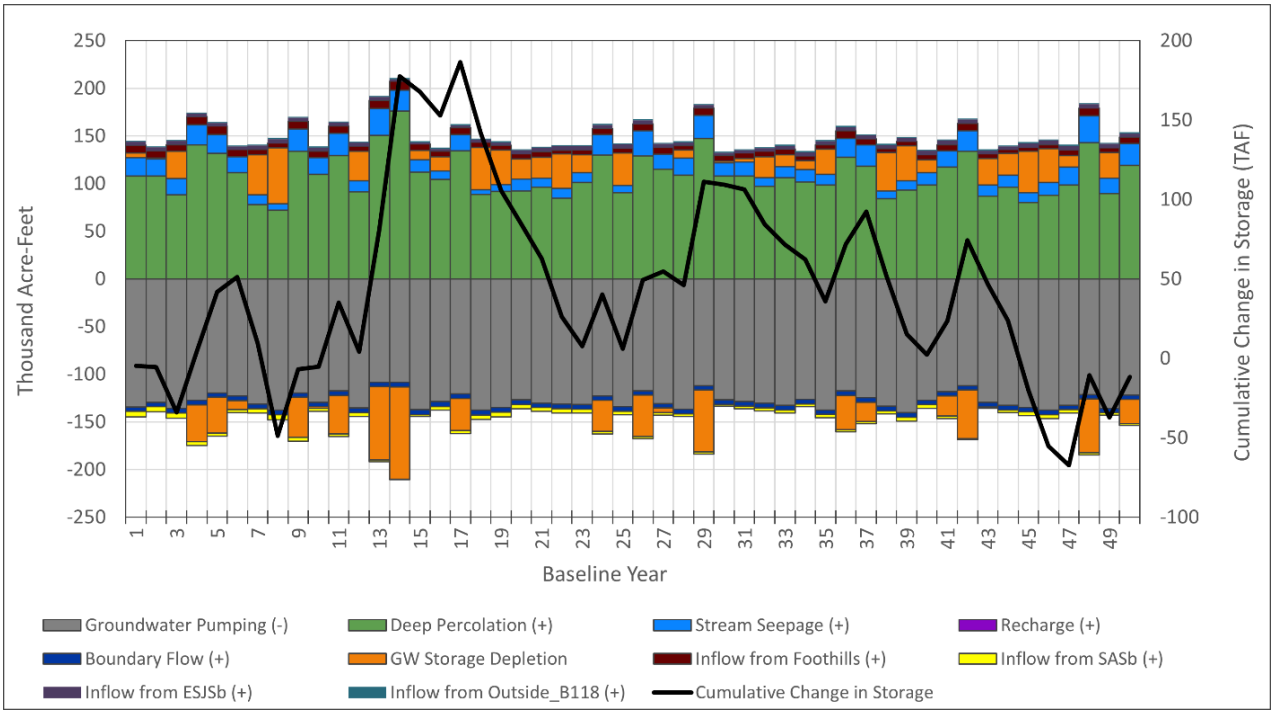


Figure 5-16: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Current Conditions Baseline

5.2 Projected Conditions Baseline

The CoSANA Projected Conditions Baseline (PCBL) is a representation of the projected land and water use conditions of 2040, or the closest information available from planning documents. This section presents the key data sources and assumptions used to develop the PCBL and provides the model results. Initial groundwater levels and soil conditions in the PCBL represent those at the end of the simulation period of the historical CoSANA (September 30, 2018).

5.2.1 Hydrologic Period

The PCBL uses the 50-year historical hydrology from WY 1970 through 2019 (October 1, 1969 through September 30, 2019) for precipitation, evapotranspiration, and streamflow. This is the same as for the CCBL, discussed in Section 5.1. The hydrologic year types discussed in Section 5.1.1.4 are used in the PCBL to develop projected water demands and supplies.

5.2.2 Land Use

The PCBL incorporates the proposed new developments to reflect the 2040 land use conditions or the closest data available from planning documents. The existing land use data for 2015 conditions used in the CCBL were modified to incorporate the future projected urban footprint. The urban footprint for the proposed new developments, urban demand, and urban supply projections including the new developments were incorporated into the model, as further explained below.

Table 5-4 lists the proposed new developments incorporated into the PCBL. A total of 62 proposed new developments were identified, including 34 in the NASb, 25 in the SASb, and 3 in CoSb. In the CoSb, urban land was expanded around existing developed areas, as projected in planning documents.

The main data source for identifying the new developments in Sacramento County was information and GIS files provided by the Sacramento County Office of Planning and Environmental Review (T. Smith, personal communication, October 2020). In addition, public information available from the Sacramento Area Council of Governments (SACOG) was also collected and reviewed for identifying and confirming the developments within Placer and Sutter Counties. Placer County also reviewed the list of the new developments and provided inputs (J. Byous, personal communication, December 2020). Information was also available for many of the developments in Sutter and Placer Counties (R. Shatz, personal communication, December 2020).

The majority of the new developments in the NASb are located in Placer County near the City of Rocklin (Sunset Ranchos and Clover Valley), City of Lincoln (SUD A, SUD B, SUD C, Village 1, Village 2, Village 3, Village 4, Village 5, Village 6, and Village 7), City of Roseville (Amoruso Ranch, Creekview, HP Campus Oaks, North Area, Northwest Roseville, Sierra Vista, Sun City Roseville [or Del Webb] and West Roseville Specific Plans), and Cal-Am West Placer (Placer Vineyards Specific Plans East and West and Riolo Vineyards). Other proposed developments include the Placer Ranch and Regional University in Placer County, Sutter Pointe in Sutter County; and Grandpark Specific Plan, Elverta, Greenbrier, Panhandle, Northborough, and Upper Westside in Sacramento County.

The majority of the proposed new developments in the SASb are located within the SCWA service areas (Arboretum, Jackson Township, Laguna Ridge, Ranch at Sunridge, Rio del Oro (partially in the Cal-Am service area), Southeast Planning Area (Meridian), Sterling Meadows, SunCreek, SunRidge, Vineyards, Cordova Hills, Florin Vineyard Gap, Mather South, NewBridge, North Vineyard Station, Vineyard Springs, Lent Ranch, and West Jackson Highway Master Plan). Other proposed developments are located around or within the City of Folsom (Easton, Folsom South Area, and Glenborough), Rancho Murieta Community Service District (Rancho Murieta), and Elk Grove Water District (Triangle).

In the CoSb, urban land in the City of Galt was expanded based on 2030 projections in the City's General Plan, and areas in the vicinity of Ione ("Urban Planning Area") and Camanche Village ("Rural Residential") were expanded based on Amador County's General Plan. The footprint of the Buena Vista Rancheria was converted from native to urban.

The proposed new developments and future land use conditions are shown in Figure 5-17. The time-series of land use for the CoSANA PCBL is shown in Figure 5-18, highlighting the constant nature of land and water use in the baseline conditions. Figure 5-19 through Figure 5-21 show time-series of land use for the NASb, SASb, and CoSb, respectively.

Table 5-4: Proposed New Developments

Proposed Development Name	ID		Proposed Development Name	ID
Village 4	1		Greenbriar	32
SUD A	2		Panhandle	33
Village 3	3		Upper Westside	34
Village 5	4		Westborough	35
SUD B	5		Easton	36
Village 2	6		Glenborough	37
Village 1	7		Folsom South Area	38
Village 6	8		Rio Del Oro	39
Village 7	9		Mather South	40
SUD C	10		Ranch At Sunridge	41
Sunset Ranchos	11		SunRidge	42
Amoruso Ranch Specific Plan	12		SunCreek	43
Clover Valley	13		Cordova Hills	44
Placer Ranch	14		West Jackson Highway Master Plan	45
Creekview	15		Jackson Township	46
West Roseville	16		NewBridge	47
North Area Specific Plan	17		Arboretum	48
Sun City Roseville	18		Rancho Murrieta	49
HP Campus Oaks	19		Florin-Vineyard	50
Sierra Vista Specific Plan	20		North Vineyard Station	51
North Area Specific Plan 2	21		Delta Shores	52
Northwest Roseville Specific Plan	22		Vineyards	53
Sutter Pointe	23		Vineyard Springs	54
Regional University	24		Triangle	55
Riolo Vineyards	25		Laguna Ridge	56
Placer Vineyards Specific Plan (east)	26		Southeast Planning Area (Meridian)	57
Placer Vineyards Specific Plan (west)	27		Sterling Meadows	58
Dry Creek-West Placer Community Plan	28		Lent Ranch	59
Grandpark Specific Plan	29		Galt Sphere of Influence	60
Elverta Specific Plan	30		Camanche Village Rural Residential	61
Northborough Boundary	31		Ione Urban Planning Area	62

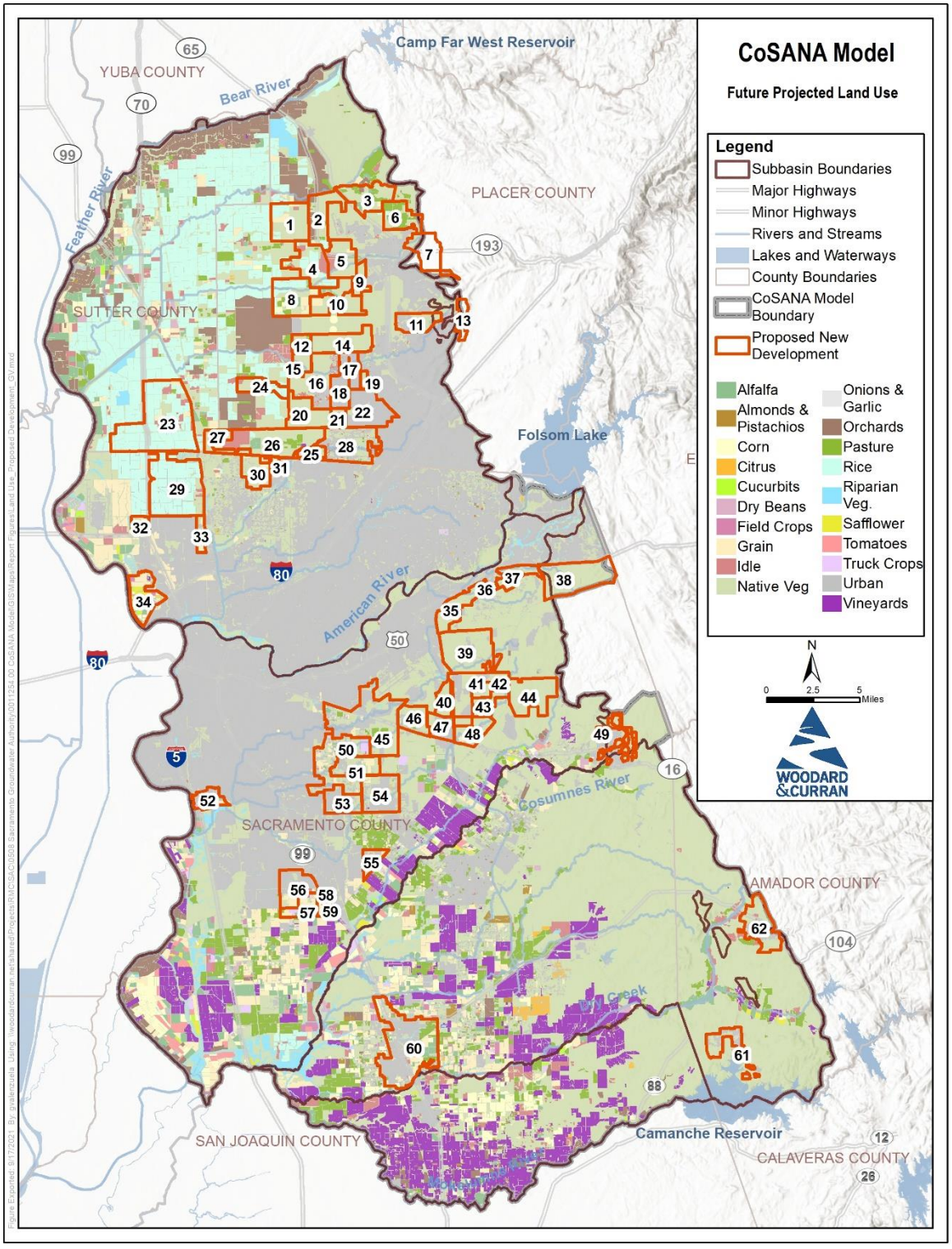


Figure 5-17: Projected Land Use and Proposed New Developments

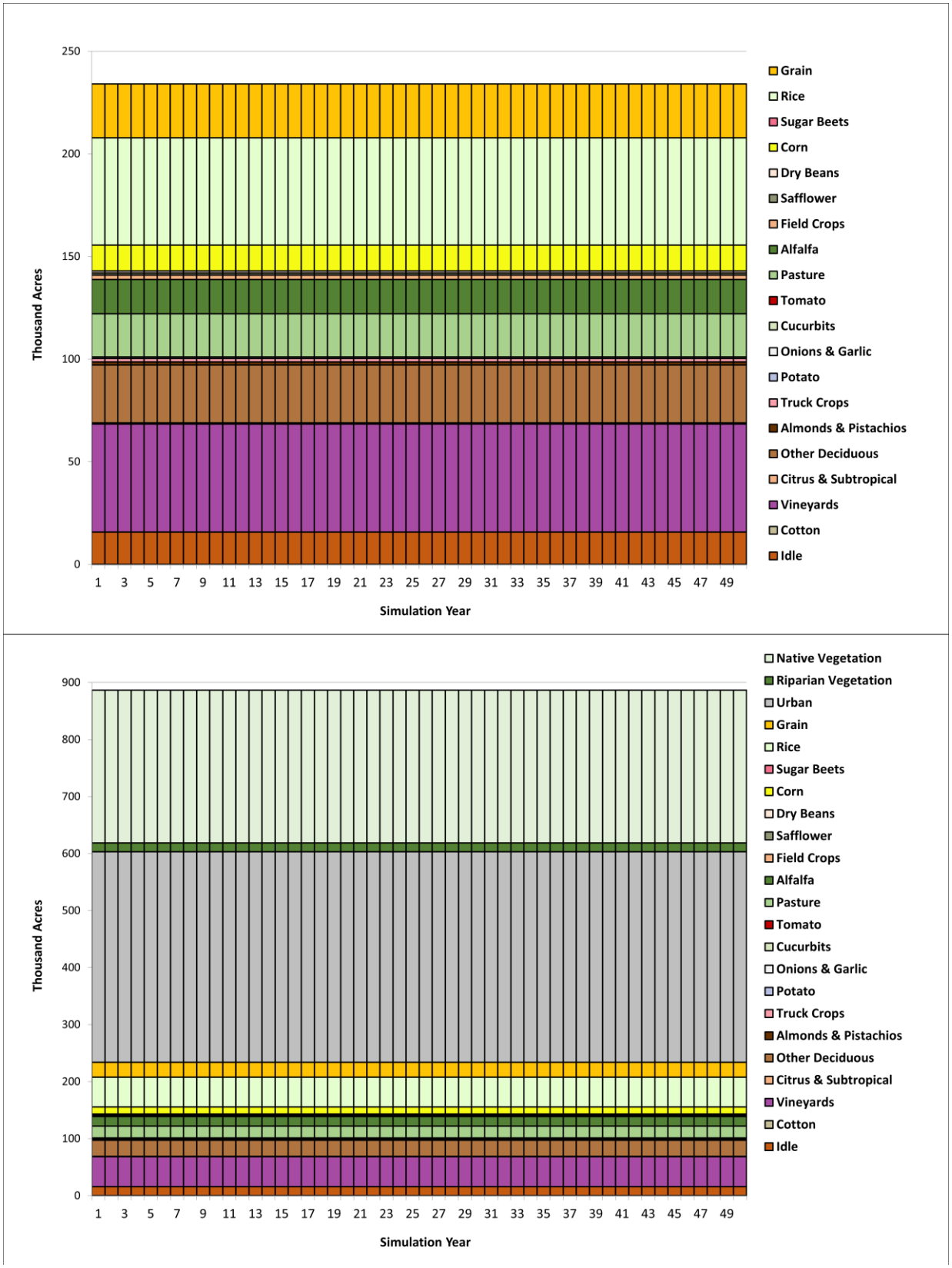


Figure 5-18: Projected Conditions Baseline Land Use for CoSANA

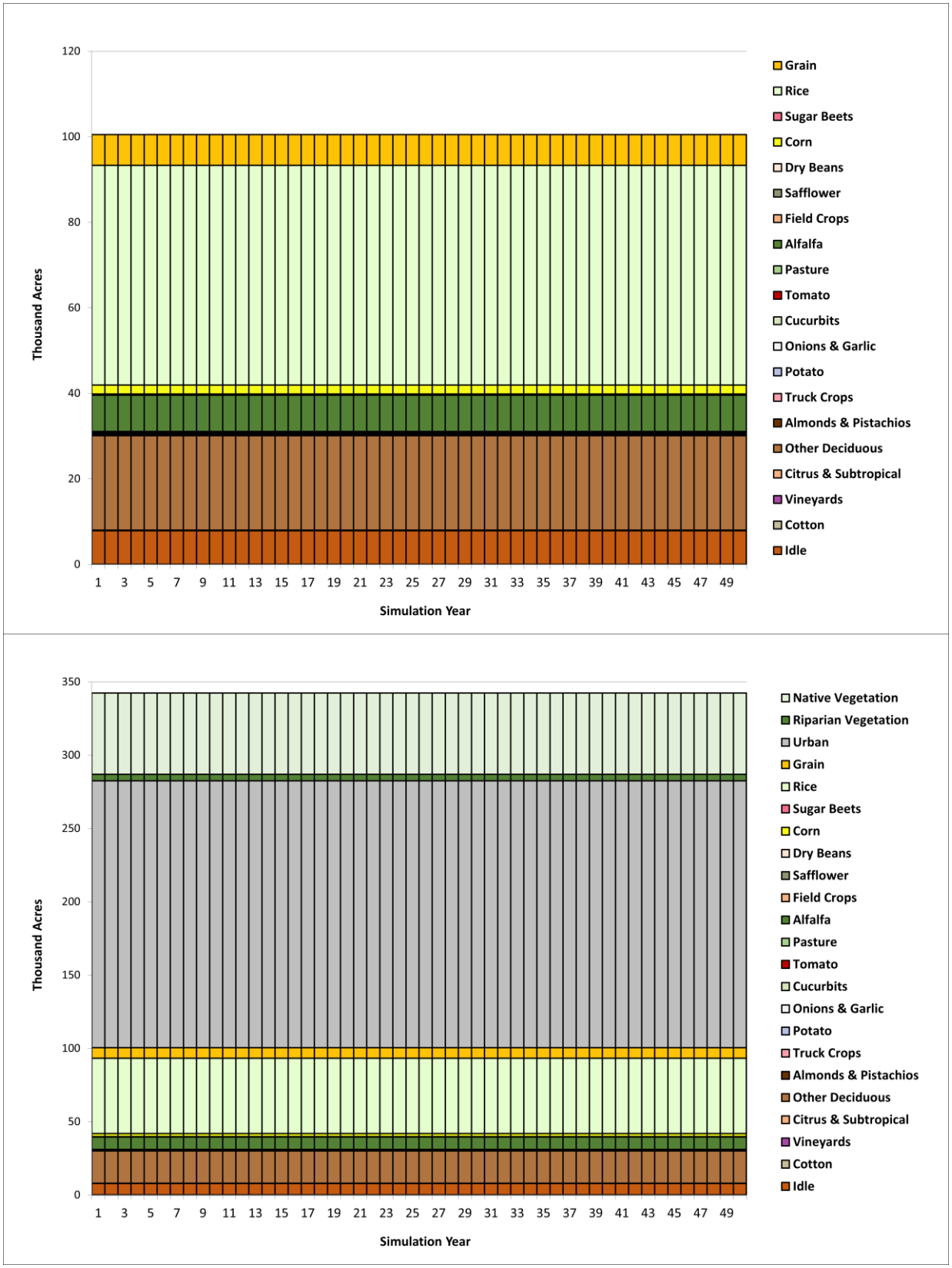


Figure 5-19: Projected Conditions Baseline Land Use for North American Subbasin

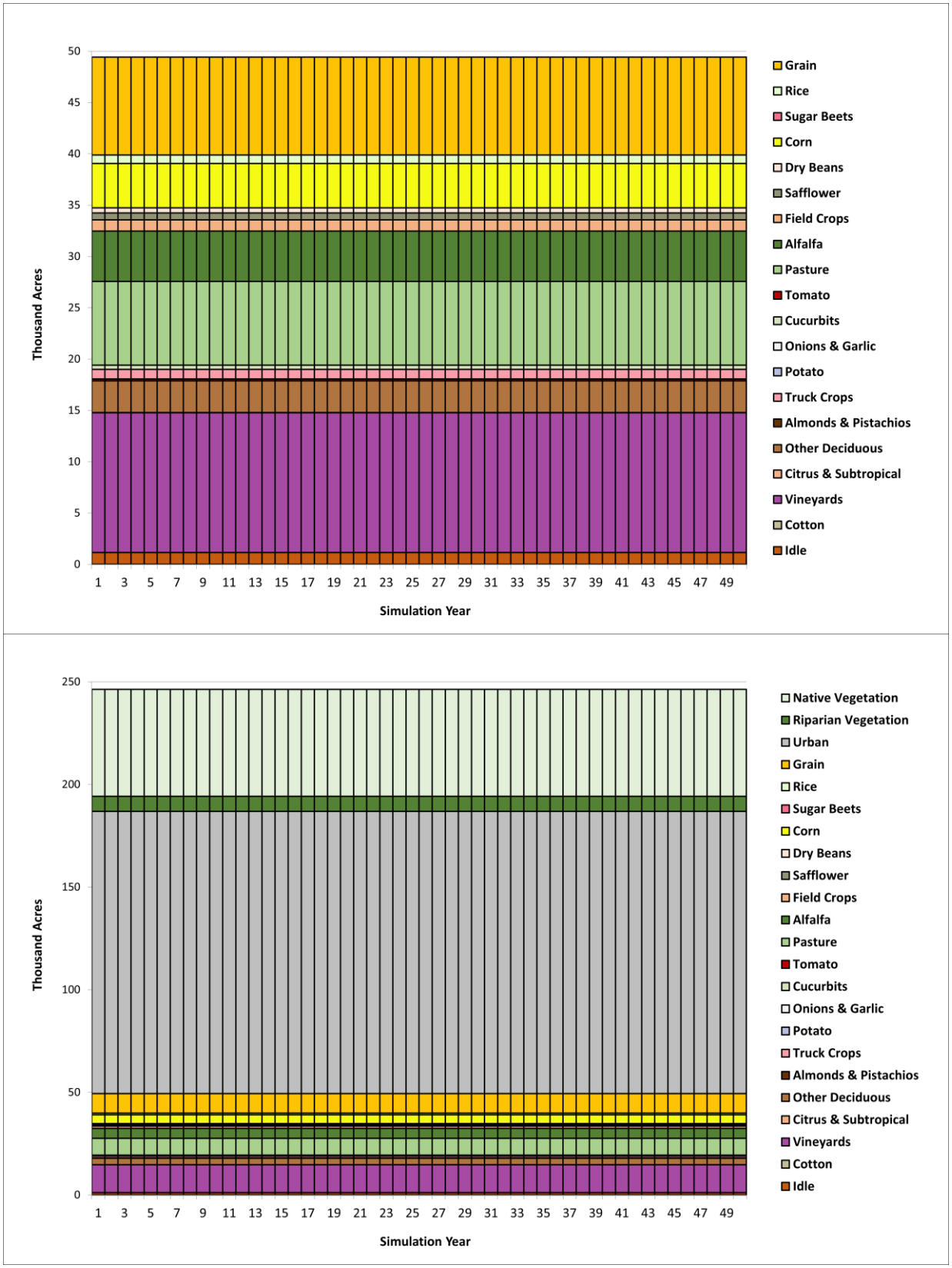


Figure 5-20: Projected Conditions Baseline Land Use for South American Subbasin

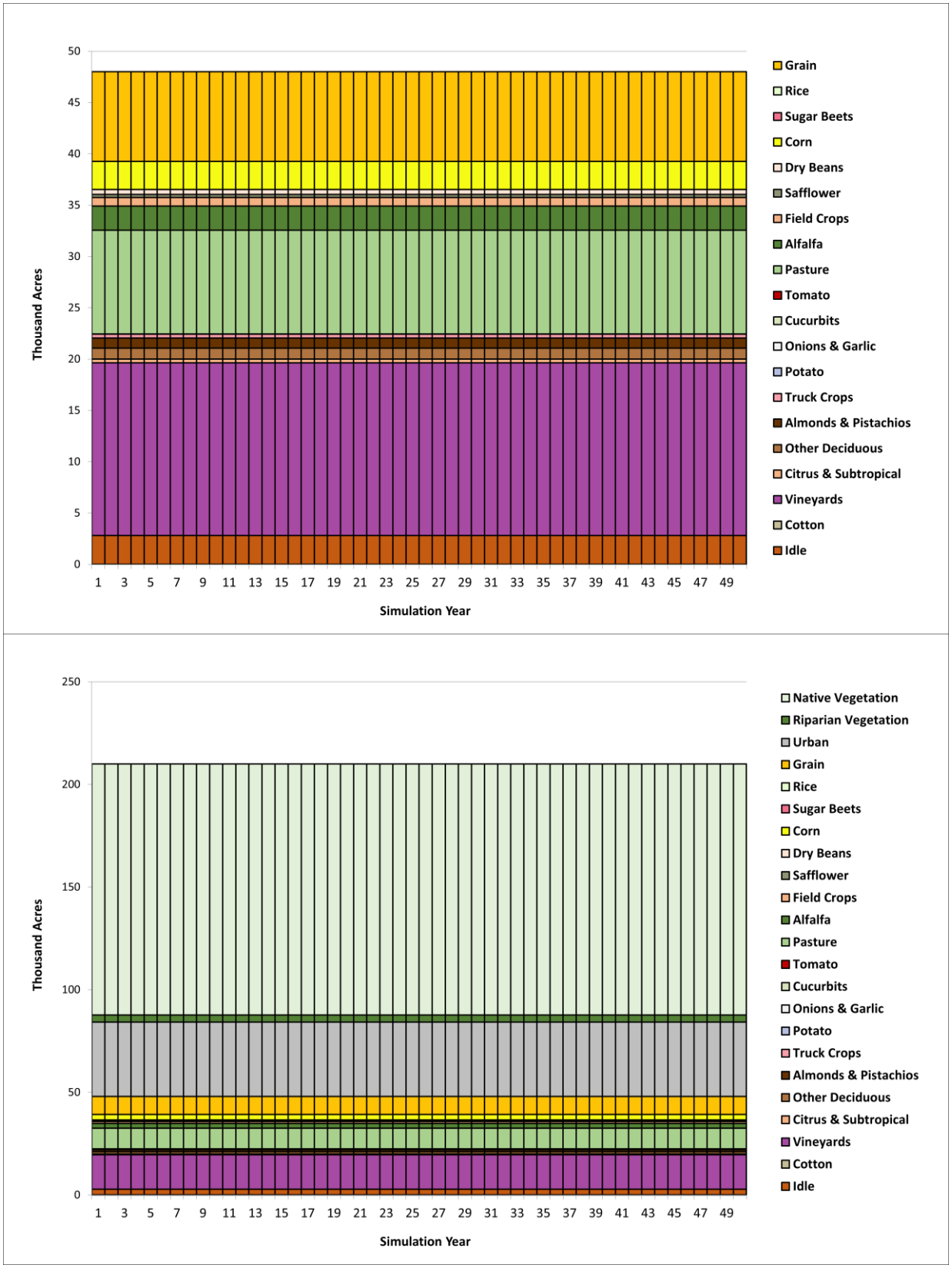


Figure 5-21: Projected Conditions Baseline Land Use for Cosumnes Subbasin

5.2.3 Urban Demand and Supply

Urban water demand in the PCBL is generally reflective of 2040 conditions. Demand and supply projections were generally available for 2040 conditions; when data for 2040 was not readily available, 2035 projections were used as the latest information. Water demand and supply assumptions are based on the 2015 UWMPs, general plans, other planning documents, or most current information provided by purveyors. Note that the 2020 UWMPs were not available at the time of model development. Appendix G presents the annual average demand and supply assumptions used in the PCBL by three water year types for each purveyor and five water year types for the City of Sacramento. Urban demand and supply projections were defined by three water year types for wet, normal, and dry conditions, using the same water year types as in the CCBL. All dry year projections were assumed to be single dry year projections based on the information available. Projections for wet years were assumed to be the same as normal conditions when wet year projections were unavailable. For the purpose of the modeling, supply was assumed to meet the demand with no surplus.

2015 UWMPs and other planning and environmental permitting documents were reviewed to estimate demand and supply sources for the proposed developments. Review of the publicly available information suggested that demand and supply projections were generally included in the purveyors' projected demand and supply estimates as reported in the 2015 UWMPs with the exception of two new developments - Sutter Pointe and Grandpark Specific Plans. Sutter Pointe and Grandpark Specific Plans were assumed to be on a mix of groundwater pumping and surface water supplies based on available documentation. It was assumed that all new developments in Placer County would be on surface water supplies.

This section briefly describes the demand and supply assumptions used in the PCBL for each purveyor. Similar to the approach in the CCBL, demand and supply information is described for purveyors grouped by the three subbasins NASb, SASb, and CoSb.

5.2.3.1 North American Subbasin

This section briefly describes the demand and supply assumptions used in the PCBL within the NASb.

5.2.3.1.1 Placer County Water Agency – Rocklin Retail Area

- **Demand**: The City of Rocklin's future demand of 18,942 AFY was based on the Placer County Water Agency's 2015 UWMP (Table 4-9; PCWA, 2016) with a partial demand estimated and incorporated into the PCBL to represent the portion of the City of Rocklin within the model domain. It is estimated that approximately 33% of the City of Rocklin's demand was within the model area. Demand was adjusted by water year type based on the trends seen in the CCBL, with slightly lower demand during dry years than normal and wet years.

- **Supply**: All future demand was assumed to be met by surface water.

5.2.3.1.2 City of Lincoln

- **Demand**: 2040 demand projections were 20,336 AFY for normal and wet years and 20,947 AFY for dry years, based on the 2015 UWMP (Table 4-6 and Table 7-2) (City of Lincoln, 2016a).

- **Supply**: Demand was assumed to be met by 3,300 AFY of groundwater pumping, 6,063 AFY of recycled water, and the remaining demand met by surface water. These values were based on the Water Master Plan (Tables 3-10 and 3-11; City of Lincoln, 2016b) and the latest information available (R. Shatz, personal communication, December 2020). The City of Lincoln's proposed future wells to support the proposed developments were incorporated into the PCBL.

5.2.3.1.3 City of Roseville

- **Demand**: The 2040 demand projection was based on the 2015 UWMP (City of Roseville, 2016) and information provided by the City of Roseville (T. Joseph, personal communication, December 2020). Demand was assumed at 56,865 AFY during normal and wet years and reduced to 46,708 AFY during dry years, which accounts for a reduction of 11,677 AFY through water conservation.

- **Supply**: Demand was assumed to be met by 5,958 AFY of recycled water in all years, based on the 2015 UWMP (Table 6-11); the remaining demand was assumed to be met by surface water and the city's aquifer storage and recovery (ASR) program. The PCBL incorporated the ASR program at buildout with 15 ASR wells operating and included well information (well IDs, well locations, and well screens) and annual extraction and injection schedules provided by the City of Roseville. With the ASR program, the city assumes no net take on groundwater supply over the long-term, based on the following ASR operations by water year types:

    - During dry years, the City of Roseville's ASR wells extract 6,907 AFY of groundwater.

    - During wet years, the City of Roseville recharges groundwater through injection of 6,200 AFY of surface water into aquifer.

    - During normal and wet years, ASR wells pump a small volume of 25 AFY for maintenance.

5.2.3.1.4 California American Water Company (West Placer, Antelope, Lincoln Oaks, and Arden)

- **Demand**: A 2035 demand projection was developed for each service area based on the 2015 UWMP (Table 4-2; Cal-Am, 2016). Demand remains the same in all water year types.

- **Supply:** Supply projections by service area were based on the 2015 UWMP as follows:

    - West Placer was assumed to be all surface water provided to Cal-Am by the wholesaler, PCWA.

    - Antelope and Lincoln Oaks were assumed to be on surface water from Sacramento Suburban WD (only during normal and wet years) and groundwater pumping. The 2,000 AFY of surface water supply was assumed to be distributed as 60% to Antelope and 40% to Lincoln Oaks (2015 UWMP Table 5-9); the remaining supply comes from groundwater.

    - The City of Sacramento supply of 4,831 AFY was distributed between Arden (NASb), Parkway (SASb), and Suburban Rosemont (SASb) based on the 2015 UWMP (Table 5-9).

5.2.3.1.5 Sacramento International Airport

- **Demand**: Demand was estimated based on the average of 2017 and 2018 in the CCBL.

- **Supply**: Demand was assumed to be met by surface water and groundwater, proportional to the volumes in 2017 and 2018.

5.2.3.1.6 Rio Linda / Elverta Community Water District

- **Demand**: A 2035 demand projection of 7,462 AFY for normal and wet years (Table 4-2) and 8,208 AFY for dry years (Table 7-3) was assumed based on the 2015 UWMP (RLECWD, 2016).

- **Supply**: Demand was assumed to be met by groundwater, similar to the CCBL conditions (UWMP Table 6-9).

- **Proposed Development**: The PCBL incorporates the Elverta and Northborough Specific Plans, which are located outside of the RLECWD's current service area.

5.2.3.1.7 Sacramento Suburban Water District

- **Demand**: A 2040 demand projection of 41,304 AFY was assumed based on the 2015 UWMP (Table 3-5) (Sacramento Suburban WD, 2016). Demand remains the same for all water year types.

- **Supply**: Demand was assumed be met by a maximum groundwater pumping of 35,000 AFY during dry years, based on the 2015 UWMP (Table 5-11); the remaining demand was assumed to come from surface water. For normal and wet years, the groundwater and surface water supply mix was assumed to be proportional to CCBL conditions.

5.2.3.1.8 Citrus Heights Water District

- **Demand**: 2035 demand was assumed as 18,210 AFY for normal and wet years and 15,478 AFY for dry years, based on the 2015 UWMP (Table 4-2 and Table 7-3; Citrus Heights Water District, 2016).

- **Supply**: Demand was assumed be met by 900 AFY of groundwater pumping, with the remaining demand from San Juan WD surface water, based on the 2015 UWMP (Table 6-9).

5.2.3.1.9 Orange Vale Water Company

- **Demand**: 2035 demand was assumed as 4,981 AFY for normal and wet years and 4,234 AFY for dry years, based on the 2015 UWMP (Table 4-2 and Table 7-3; Orange Vale Water Company, 2016).

- **Supply**: Demand was assumed be met by San Juan WD surface water, similar to the CCBL.

5.2.3.1.10 San Juan Water District

- **Demand**: A 2040 demand projection of 19,393 AFY was assumed for retail demand, based on the 2015 UWMP (Table 4-2b; SJWD, 2016).

- **Supply**: Demand was assumed to be met by surface water, based on the 2015 UWMP (Table 6-9).

5.2.3.1.11 City of Sacramento

- **Demand**: A 2040 demand projection of 161,029 AFY was assumed based on the 2015 UWMP (Table 4-2) (City of Sacramento, 2016). Demand remains the same for all water year types. Approximately 35% of the demand was assumed to be in the NASb portion of the model, based on urban area.

- **Supply**: Supply projections include groundwater pumping and surface water supplies that vary by five water year types (as opposed to three water year types used for other purveyors) based on the City of Sacramento's 2017 GWMP (City of Sacramento, 2017). Groundwater pumping assumptions were consistent with the Maximum Groundwater Use scenario developed in the 2017 GWMP, based on the discussions with the City of Sacramento. Monthly pumping assumptions by each well were incorporated into the PCBL based on well locations and monthly well operations, as specified in the 2017 GWMP. Groundwater pumping in the NASb varies from 11,553 AFY during wet years to 38,261 AFY during driest years. Demand after groundwater pumping was assumed to be supplied by surface water. The City of Sacramento also has specific wells that supply some of the larger parks and green areas within the city boundaries. These irrigation wells are simulated using six representative irrigation wells that pump 2,200 AFY. Based on the locations of the irrigated parks and green areas, approximately half of the irrigation pumping was estimated in the NASb and the remaining half in the SASb.

5.2.3.1.12 Sacramento County Water Agency (Arden Park Vista and Northgate)

- **Demand**: 2045 demand projections for Arden Park Vista and Northgate were based on the Draft 2020 UWMP (Tables 4-10(b) and 4-10(c)) provided by SCWA and input from SCWA (M. Grinstead, personal communication, April 2021).
- **Supply**: Arden Park Vista and Northgate were assumed to be on groundwater, similar to the CCBL conditions.

5.2.3.1.13 Del Paso Manor Water District

- **Demand**: Demand was estimated based on the average of 2017 and 2018 in the CCBL.
- **Supply**: Demand was assumed to be met by groundwater, similar to the CCBL.

5.2.3.1.14 Golden State Water Company (Arden)

- **Demand**: Demand for the Arden service area was assumed to remain the same as in the CCBL conditions.
- **Supply**: Arden service area was assumed to be on groundwater, consistent with the CCBL conditions.

5.2.3.1.15 Carmichael Water District

- **Demand**: A 2040 demand projection was assumed as 10,334 AFY for normal and wet years and 10,851 AFY for dry years, based on the 2015 UWMP (Table 4-6 and Table 7-2) (Carmichael Water District, 2016).
- **Supply**: Demand was assumed to be met by groundwater pumping and surface water, proportional to the CCBL conditions.

5.2.3.1.16 Fair Oaks Water District

- **Demand**: A 2035 demand projection of 12,726 AFY was assumed based on the 2015 UWMP (Table 4-2) (Fair Oaks Water District, 2016).
- **Supply**: Demand was assumed to be met by groundwater pumping and surface water, proportional to the CCBL conditions.

5.2.3.1.17 Sutter Pointe

- **Demand**: A demand projection of 15,786 AFY was assumed, based on the Phase 2+B proposed water supply program from the *Supplement to the Water Supply Assessment for Lakeside at Sutter Pointe* (Golden State Water Company, 2020).
- **Supply**: Demand was assumed to be met by a mixture of groundwater pumping and surface water. Groundwater pumping is assumed to meet 10,919 AFY of demand, and surface water is assumed to meet the remaining 4,867 AFY of demand.

5.2.3.1.18 Grandpark

- **Demand**: A demand projection of 12,030 AFY was assumed, based on build out projections for the project (K. Giberson, pers comm. Feb 14, 2019).
- **Supply**: Demand was assumed to be met by a mixture of groundwater pumping and surface water. Groundwater pumping is assumed to meet 2,407 AFY of demand during normal and wet years, and 3,007 AFY

of demand during dry years. Surface water is assumed to meet 9,623 AFY of demand during normal and wet years, and 9,395 AFY of demand during dry years.

5.2.3.2 South American Subbasin

This section briefly describes the demand and supply assumptions used in the PCBL for the purveyors located within the SASb. All new developments were assumed to be on supplies projected by the purveyors.

5.2.3.2.1 City of Sacramento

- **Demand**: As described above in Section 5.2.3.1.11, a city-wide 2040 demand projection of 161,029 AFY was assumed, based on the 2015 UWMP (Table 4-2) (City of Sacramento, 2016). Approximately 65% of the demand was assumed to be in the SASb portion of the model, based on urban area.

- **Supply**: As with the NASb, supply projections include groundwater pumping and surface water that vary by five water year types (as opposed to three water year types used for other purveyors) based on the City of Sacramento's 2017 GWMP (City of Sacramento, 2017). Groundwater pumping follows the Maximum Groundwater Use scenario specified in the 2017 GWMP. Based on the specific well pumping assumptions, groundwater pumping in the SASb varies from 12,749 AFY during wet years to 43,029 AFY during driest years. Remaining demand after groundwater pumping was assumed to be supplied by recycled water (1,000 AFY) and surface water. As described above in Section 5.2.3.1.11, the City of Sacramento also has specific wells that supply some parks and green areas within the city boundaries. These irrigation wells are simulated using six representative irrigation wells that pump 2,600 AFY. Based on the locations of the irrigated parks and green areas, approximately half of the irrigation pumping was estimated in the SASb.

5.2.3.2.2 California American Water Company (Suburban Rosemont, Security Park, and Parkway)

- **Demand**: As described above in Section 5.2.3.1.4 for Cal Am service areas within the NASb, demand projections reflect the 2035 conditions based on the 2015 UWMP (Tables 4-2) (Cal-Am, 2016). Demand remains the same in all water year types.

- **Supply:** Supply projections by service area were based on the 2015 UWMP as follows:

    - Security Park was assumed to be all on groundwater and served water from SCWA, similar to the CCBL conditions.

    - As described above in Section 5.2.3.1.4, surface water supply from the City of Sacramento was distributed between Arden (NASb), Parkway (SASb), and Suburban Rosemont (SASb), based on the 2015 UWMP (Table 5-9). Remaining demand is met by groundwater from Cal Am wells.

5.2.3.2.3 California American Water Company (former Fruitridge Vista Water Company)

- **Demand**: A 2035 demand projection of 4,957 AFY was assumed, based on the discussions with Cal-Am.

- **Supply**: Supply projections include local groundwater pumping and surface water wholesale supply from the City of Sacramento, with 50% of demand met by groundwater and the remaining 50% of demand met by surface water.

5.2.3.2.4 Golden State Water Company (Cordova)

- **Demand**: A 2040 demand projection of 19,572 AFY was assumed for the Cordova service area, based on the 2015 UWMP (Table 4-4) (GSWC, 2016).

- **Supply**: Cordova's supply projections include groundwater pumping of 9,752 AFY, 5,000 AFY of remediated water from the Aerojet Granted Water Supply, and 5,000 AFY of American River diversion from Folsom South Canal, as reported in the 2015 UWMP (Table 6-12).

5.2.3.2.5 City of Folsom

- **Demand**: A 2040 demand projection was assumed as 29,923 AFY for normal and wet years and 30,819 AFY for dry years, based on the 2015 UWMP (Table 4-2 and Table 7-2) (City of Folsom, 2016).

- **Supply**: City of Folsom supply was assumed all surface water, as with the CCBL conditions.

5.2.3.2.6 Florin County Water District

- **Demand**: Demand was estimated based on the average of 2017 and 2018 in the CCBL.

- **Supply**: Demand was assumed to be met by groundwater, consistent with CCBL conditions.

5.2.3.2.7 Sacramento County Water Agency (Hood, Laguna Vineyard, and Mather)

- **Demand**: The 2045 demand projection for Hood was based on the Draft 2020 UWMP (Table 4-10[e]), provided by SCWA and input from SCWA (M. Grinstead, personal communication, April 2021). Demand projections for Laguna Vineyard and Mather reflect 2052 conditions based on the 2021 Zone 40 Water Supply Master Plan Amendment (Tables B-6, B-7, and B-8) (SCWA, 2021), and discussions with SCWA (M. Grinstead, personal communication, April 2021). Laguna Vineyard in the PCBL represents the South Service Area and Central Service Area; and Mather represents the North Service Area.

- **Supply**: Hood was assumed to be on groundwater, consistent with the CCBL. Supply projections for Laguna Vineyard and Mather reflect 2052 conditions based on a mix of groundwater, surface water, recycled water, and remediated water, as reported in the 2021 Zone 40 Master Plan Amendment (Tables B-6, B-7, and B-8). Recycled water of 1,700 AFY would be available in the Laguna Vineyard demand area (South Service Area) and remediated water of 8,900 AFY would be available every year.

5.2.3.2.8 Elk Grove Water District

- **Demand**: A 2045 demand projection was assumed be 8,080 AFY for normal and wet years and includes demand both for Service Area 1 and Service Area 2 based on the 2015 UWMP (Table 4-6; EGWD, 2016). Dry year demand projection was assumed to 8,323 AFY based on the 2015 UWMP (Table 7-2) and was assumed to be distributed to Service Area 1 and Service Area 2 proportional to demand in normal and wet years in the two service areas.

- **Supply**: The 2015 UWMP does not break future supply projections into groundwater and surface water supplies by service areas. It was assumed Service Area 1 was served with groundwater and Service Area 2 served with a mix of groundwater and surface water by SCWA.

5.2.3.2.9 Rancho Murieta Community Service District

- **Demand**: Demand for the entire service area was assumed to be 3,477 AFY based on a medium growth projection of 3,659 AFY at buildout with 20% reduction (or 2,927 AFY potable demand) and additional recycled water demand of approximately 550 AFY, based on the information available from the Rancho Murieta Community Services District's (CSD) 2010 Integrated Water Master Plan Update (Figure ES-1, Table 2-3, and Table 3-2; Rancho Murieta CSD, 2010). Approximately 32% of demand falls within the SASb based on urban area.

- **Supply**: Demand was assumed to be met by surface water for potable demand and recycled water of 550 AFY for golf course irrigation.

5.2.3.3 Cosumnes Subbasin

This section briefly describes the demand and supply assumptions used in the PCBL for the purveyors located within the CoSb.

5.2.3.3.1 Rancho Murieta Community Service District

Several proposed developments were identified within the Rancho Murieta CSD and incorporated into the PCBL. Note that the majority of the developments would occur outside of the three subbasins but within the model boundary.

- **Demand**: As described above in Section 5.2.3.2.9, total demand was assumed to be 3,477 AFY. Approximately 22% of the demand falls within the CoSb based on urban area, compared to 32% within the NASb. The remaining demand of 46% falls outside of the NASb, SASb and CoSb, but within the model boundary.
- **Supply**: As described above in Section 5.2.3.2.9, demand was assumed to be met by surface water for potable demand and recycled water.

5.2.3.3.2 City of Galt

- **Demand**: A 2040 groundwater demand projection of 7,663 AFY was assumed based on the 2015 UWMP (Table 4-3; City of Galt, 2016).
- **Supply**: Demand was assumed to be met by groundwater with pumping distributed between six active CCBL wells proportional to their historical maximum annual yield. Dry year supply projections were assumed to be the same as normal year supplies.

5.2.3.3.3 Amador County Water Agency

- **Demand**: 2040 demand projections were updated based on supply assumptions, as discussed below, and distributed to the expanded urban land use areas.
- **Supply**: Supply projections include surface water and recycled water for the City of Ione and groundwater, surface water, and recycled water for Camanche Village. CCBL City of Ione surface water supply was doubled based on the projected demand increases from the Amador Water Agency 2015 UWMP; there was no change to the recycled water use relative to the CCBL. CCBL groundwater pumping for Camanche Village from the four active wells was doubled based on expansion and development of currently vacant parcels (Dunn Environmental, 2012). CCBL groundwater pumping for Camanche North Shore from the two active wells was increased by a total of 11 AFY based on a projected maximum daily treated water demand increase from the *Camanche Area Regional Water Supply Plan Feasibility Study and Conceptual Design* (RMC Water and Environment, 2012). Specified groundwater pumping to three wells operated by the Buena Vista Rancheria are based on reported May 2019-April 2020 pumping, in which the seasonal average pumping rates were distributed to associated months.

5.2.3.3.4 Sacramento Municipal Utility District

No change in demand or supply relative to the CCBL.

5.2.3.4 Fish Farms

No change in demand or supply relative to the CCBL.

5.2.4 Agricultural Demand and Supply

Agricultural demand and supply in the PCBL is similar to the discussion in the CCBL (Section 5.1.6), with demand being driven by the land use changes in the PCBL discussed in Section 5.2.2 and much of the supply being internally calculated within the model or based on the last 10 years of the historical simulation.

5.2.4.1 Galt Wastewater Treatment Plant Effluent

No change in treatment plant effluent use relative to the CCBL.

5.2.4.2 Rural Residential

Refer to section 3.3.1 in the historical model report for a description of the methodology used to estimates rural residential pumping.

Rural residential demand in the PCBL version of CoSANA accounts for the urbanization of areas that would lead to a decrease in the rural residential population. It is assumed that the projected urbanization of areas previously used for agricultural purposes would result in a decline in rural residential population, and therefore demand. These areas are subsequently served by an urban water purveyor.

In the CoSb, rural residential demand was assumed to increase as a result of projected population increases. Assuming a rural residential population, and associated demand increase of 1% per year, total projected annual groundwater consumption was estimated to be 9,448 AFY and was proportionally distributed monthly as specified in the CCBL.

5.2.4.3 Agricultural Groundwater Substitution Transfers

As discussed for the CCBL, two purveyors engage in agricultural groundwater substitution transfer pumping in the NASb: NMWC and PGVMWC, Additionally, South Sutter Water District operates a transfer program that behaves very similarly to a groundwater substitution transfer. South Sutter Water District uses a hybrid approach to groundwater substitution transfer pumping similar to the CCBL model. Dry year decreases of surface water deliveries from Camp Far West Reservoir are offset by an increase in groundwater pumping.

For NMWC and PGVMWC, agricultural transfer pumping was assumed to occur in 16 years of the baseline (15 of the 19 dry years and one normal year), with timing and pumping volumes based on information included in the Long-Term Water Transfer (LTWT) EIS/R (Reclamation, 2019). The estimated transfer pumping for NMWC and PGVMWC was distributed among all transfer wells in the same proportion as in the historical data. NMWC surface water deliveries are automatically adjusted to meet total agricultural demand, and PGVMWC surface water deliveries are estimated using the last 10 years of historical simulation data, reduced by the amount of agricultural transfer pumping estimated to occur in the PCBL.

5.2.5 Remediation Operations

Information about future remediation operations is not available, so remediation operations in the PCBL are the same as in the CCBL, discussed in Section 5.1.7.

5.2.6 Results

This section provides a summary of the CoSANA PCBL results.

5.2.6.1 Land and Water Use Budget

The land and water use budget provides details on the urban and agricultural demand and the water supply meeting the demand (groundwater pumping, surface water deliveries, recycled water, and remediation pumping). Average annual PCBL model results by groundwater subbasin are shown in Table 5-5. Annual agricultural water demand and

supply by subbasin are shown in Figure 5-22 through Figure 5-24. Annual urban demand and supply by subbasin are shown in Figure 5-25 through Figure 5-27. Appendix H includes model subregion land and water use budgets.

Table 5-5: PCBL Average Annual Land and Water Use Budget

Subbasin	Ag. Demand (AFY)	Ag. Ground-Water Use* (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-Water Use** (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	349,317	202,228	149,868	328,654	108,492	220,161	-	5,515
SASb	135,956	91,599	44,369	301,060	116,385	167,661	17,200	29,765
CoSb	121,676	99,886	21,460	30,168	28,445	3,943	-	-
Total	**606,949**	**393,713**	**215,697**	**659,882**	**253,322**	**391,765**	**17,200**	**35,280**

Note:
* Agricultural groundwater use presented in the above table may differ slightly from the values shown in the respective GSP due to minor difference in the methodology on calculation of rural residential water use.
** Urban groundwater use in the above table represents water used that originated from groundwater production but can include water that was pumped in areas outside of the respective subbasin.

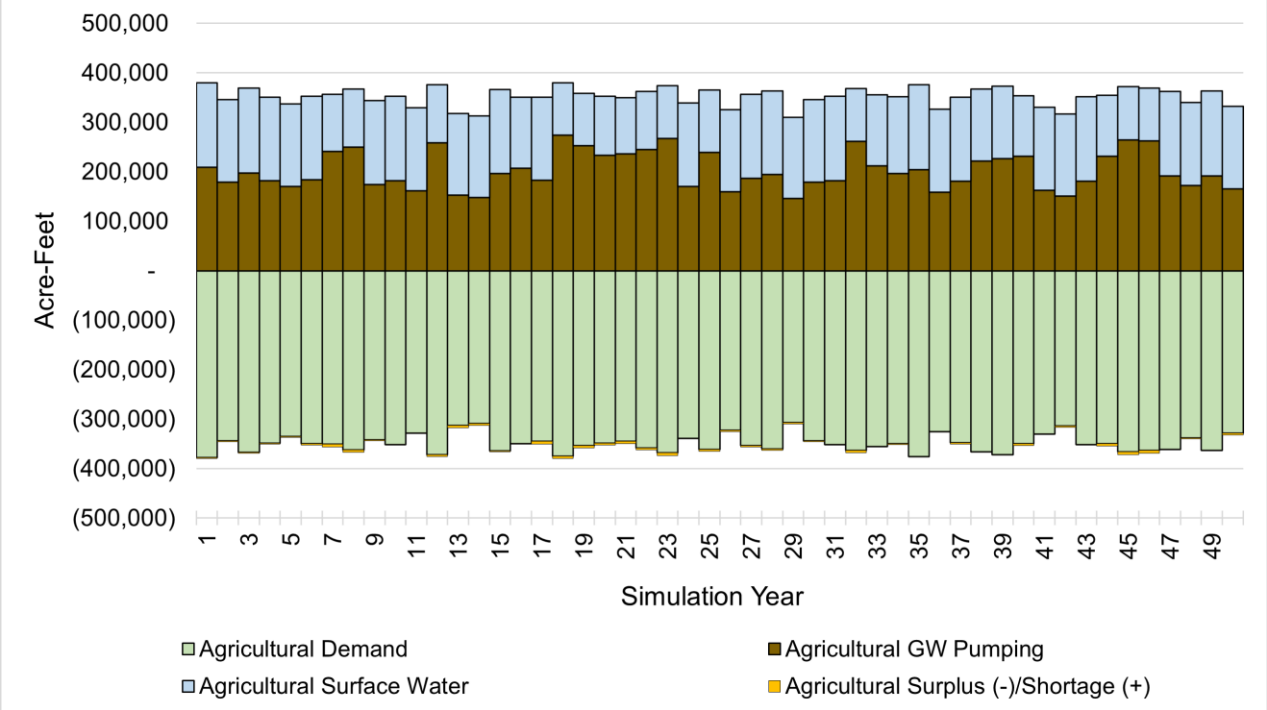


Figure 5-22: Annual Agricultural Water Demand and Supply – North American Subbasin, Projected Conditions Baseline

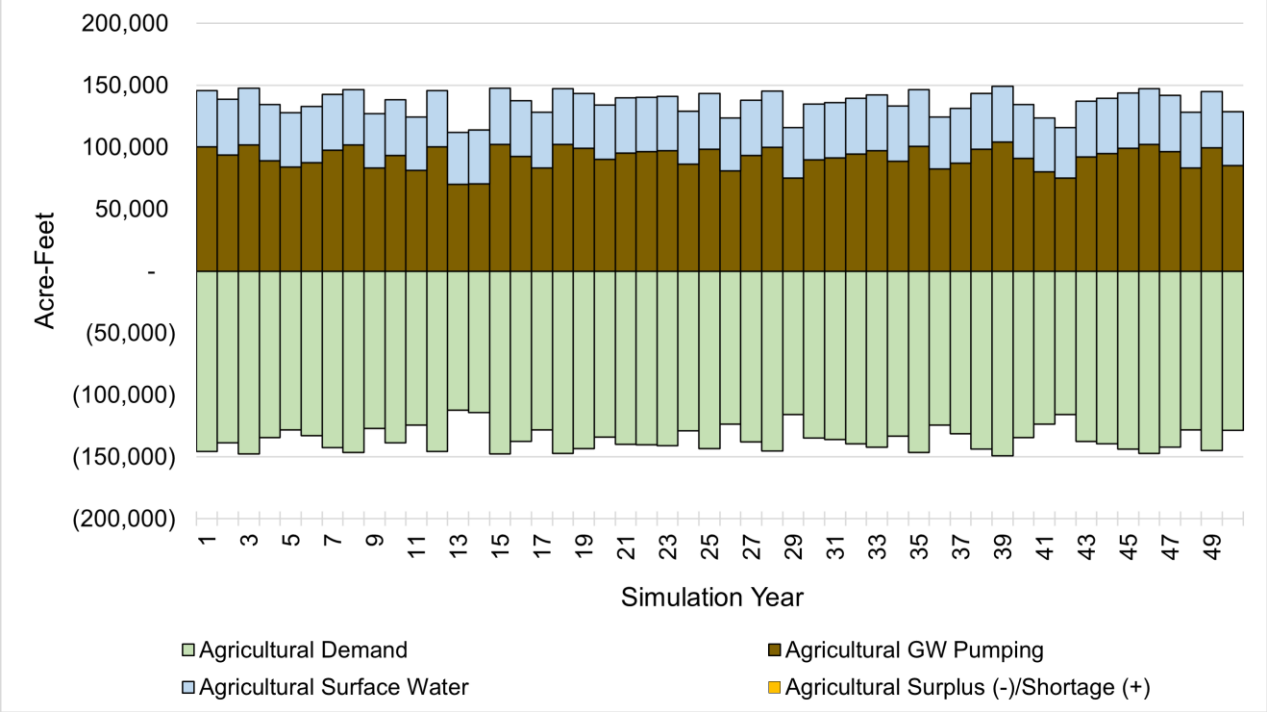


Figure 5-23: Annual Agricultural Water Demand and Supply – South American Subbasin, Projected Conditions Baseline

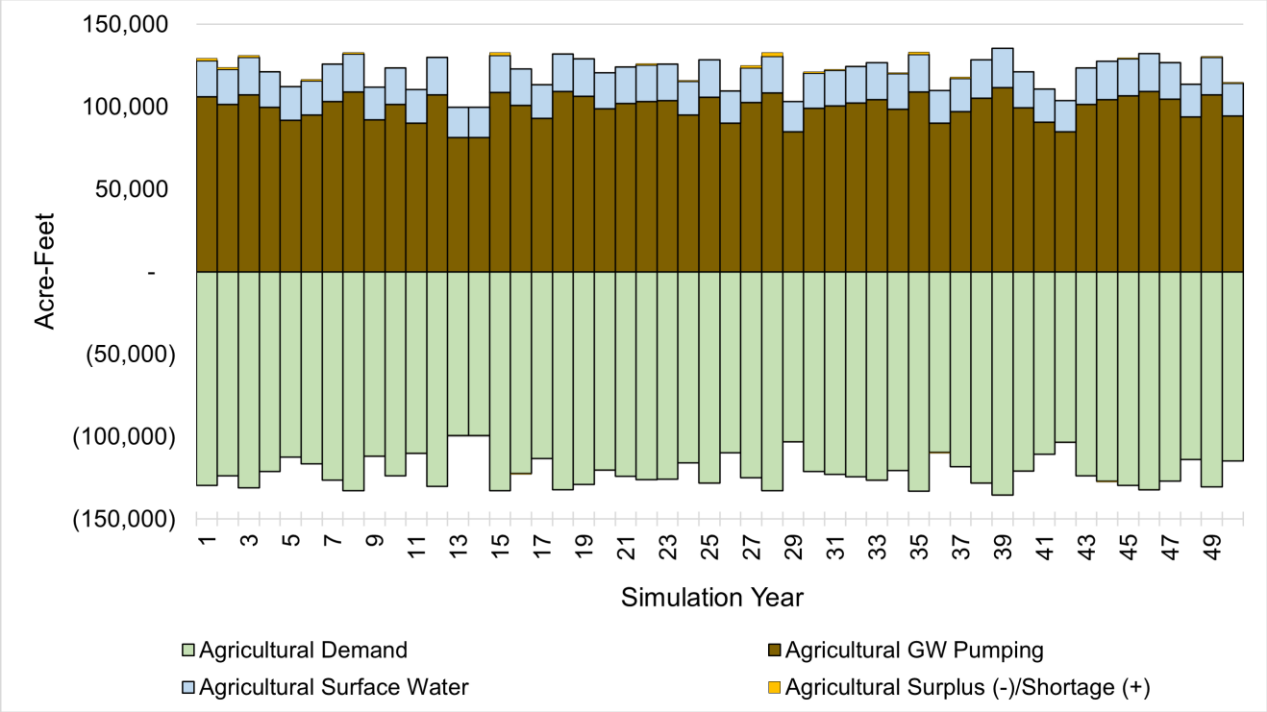


Figure 5-24: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline

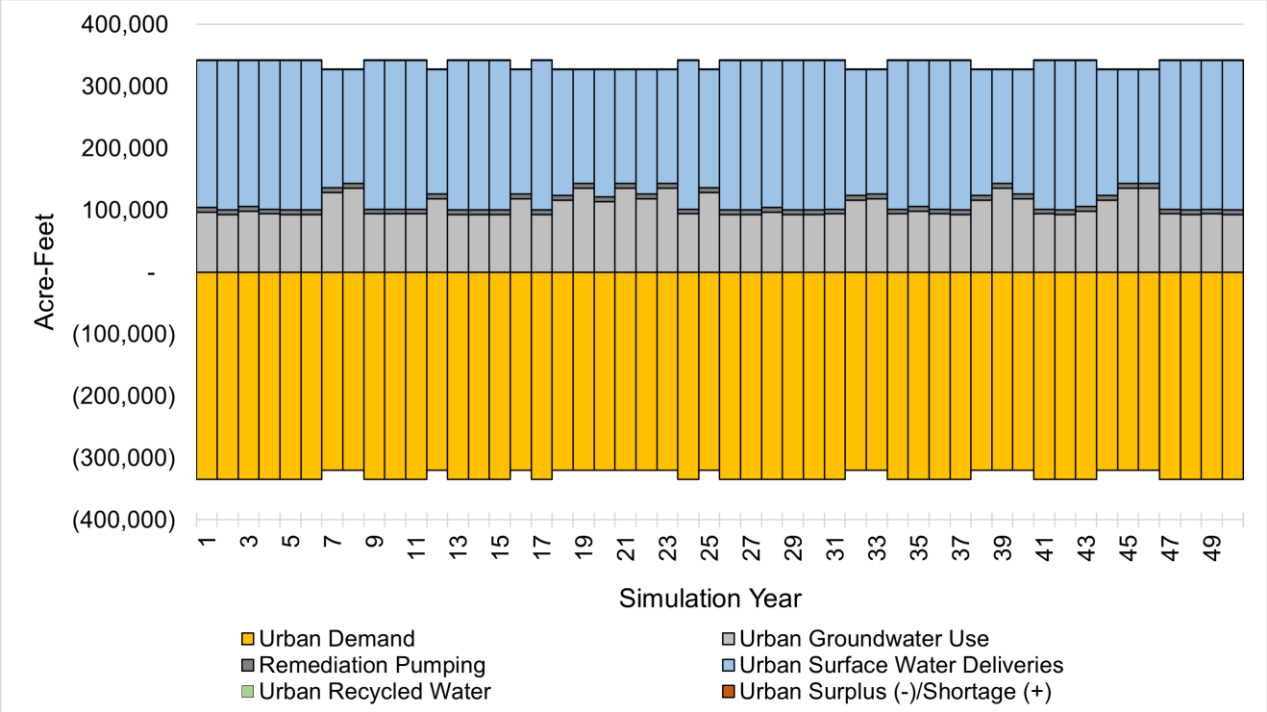


Figure 5-25: Annual Urban Water Demand and Supply – North American Subbasin, Projected Conditions Baseline

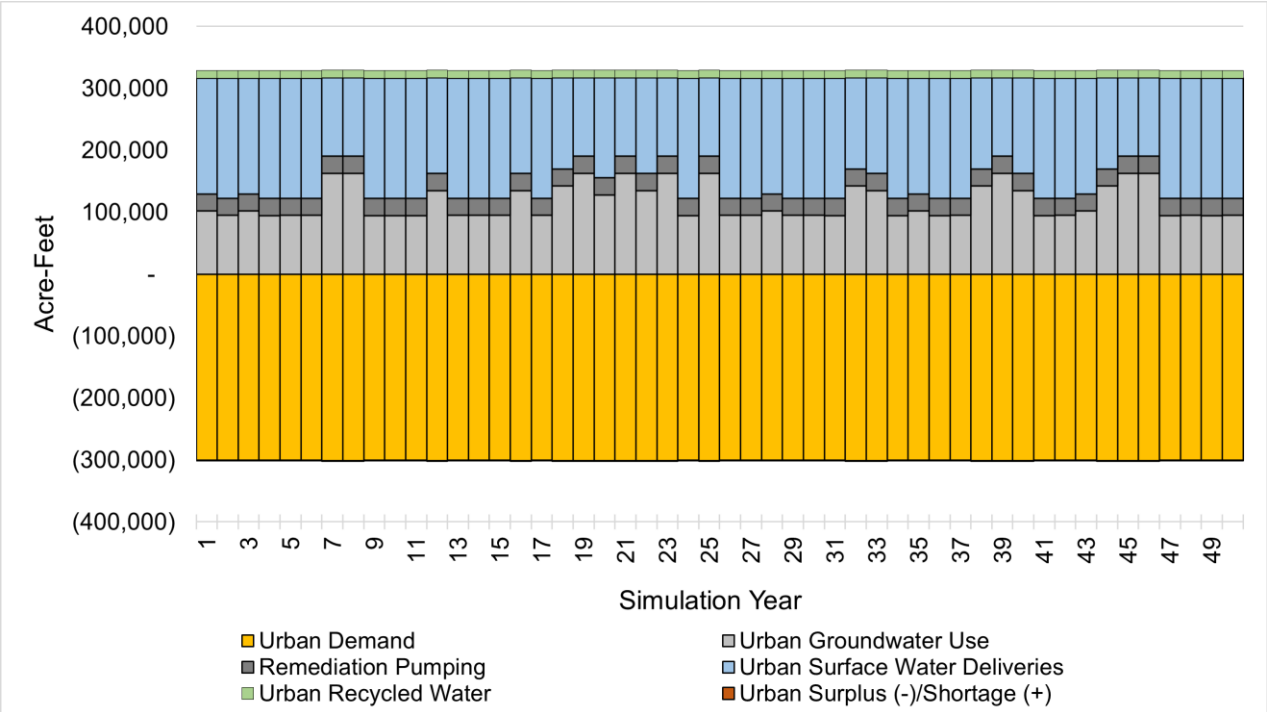
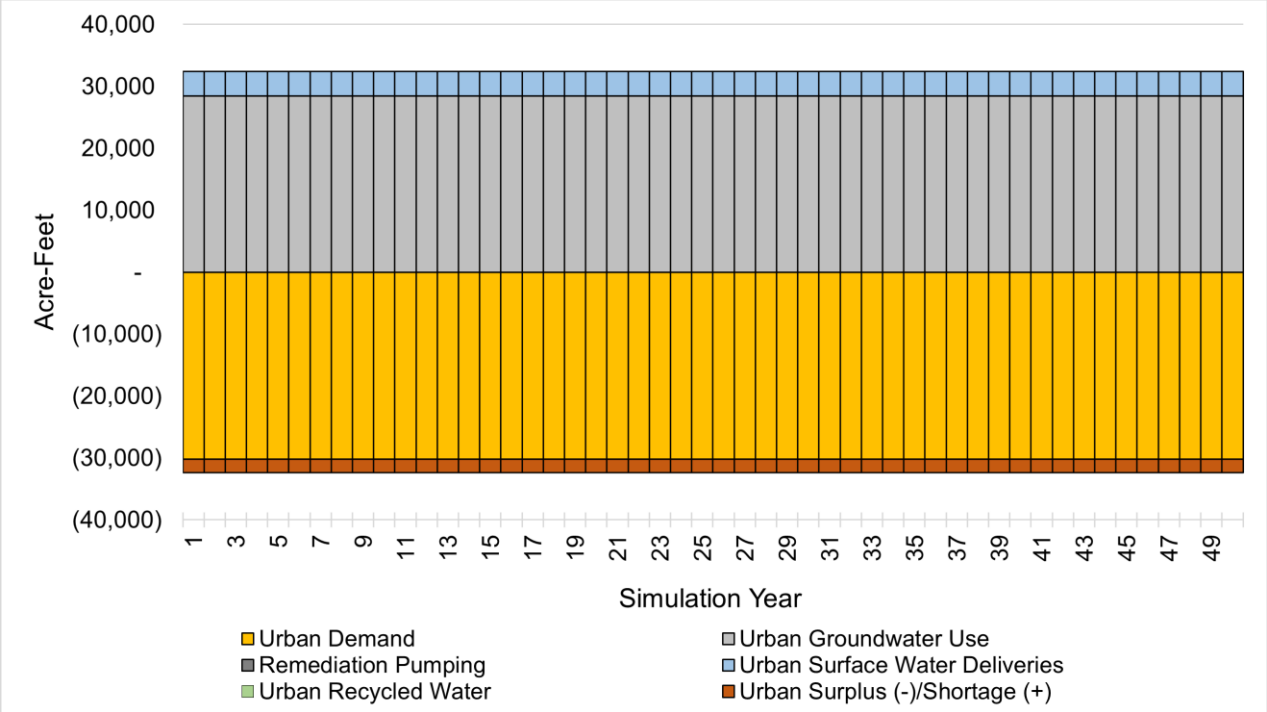


Figure 5-26: Annual Urban Water Demand and Supply – South American Subbasin, Projected Conditions Baseline



Note: Urban groundwater use is specified in the CoSb model input data set. The model-calculated surplus/shortage in urban demand is therefore not utilized to calculate the CoSb groundwater budget.

Figure 5-27: Annual Urban Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline

5.2.6.2 Groundwater Budget

The groundwater budget summarizes all inflows and outflows to the groundwater aquifer system. Average annual PCBL model results by groundwater subbasin are shown in Table 5-6. Annual groundwater budgets with cumulative change in storage by subbasin are shown in Figure 5-28 through Figure 5-30. Appendix I includes model subregion groundwater budgets. Appendix J includes a set of sample hydrographs for the baseline models.

Table 5-6: PCBL Average Annual Groundwater Budget

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
NASb	323,167	167,424	107,950	16,376	30,140	6,710	5,390
SASb	234,003	121,313	105,665	26	4,886	986	-1,128
CoSb	128,332	107,977	16,494	0	1,536	1,030	-1,293
Total	**685,501**	**396,714**	**230,109**	**16,402**	**36,561**	**8,726**	**2,969**

Note: Boundary Flows term includes flow between areas outside of the CoSANA model domain and baseflow from small watersheds. Subsurface Inflows includes flow between the simulated subbasins in CoSANA and areas outside of Bulletin 118 subbasins.

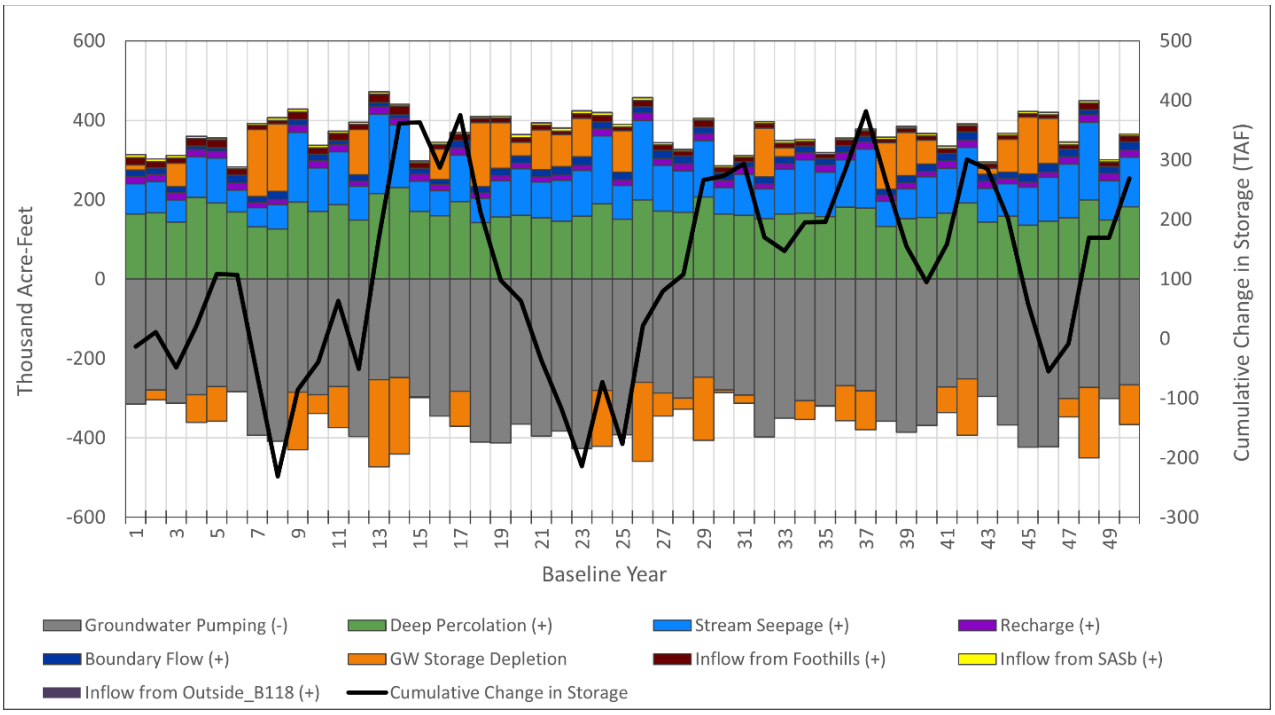


Figure 5-28: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Projected Conditions Baseline

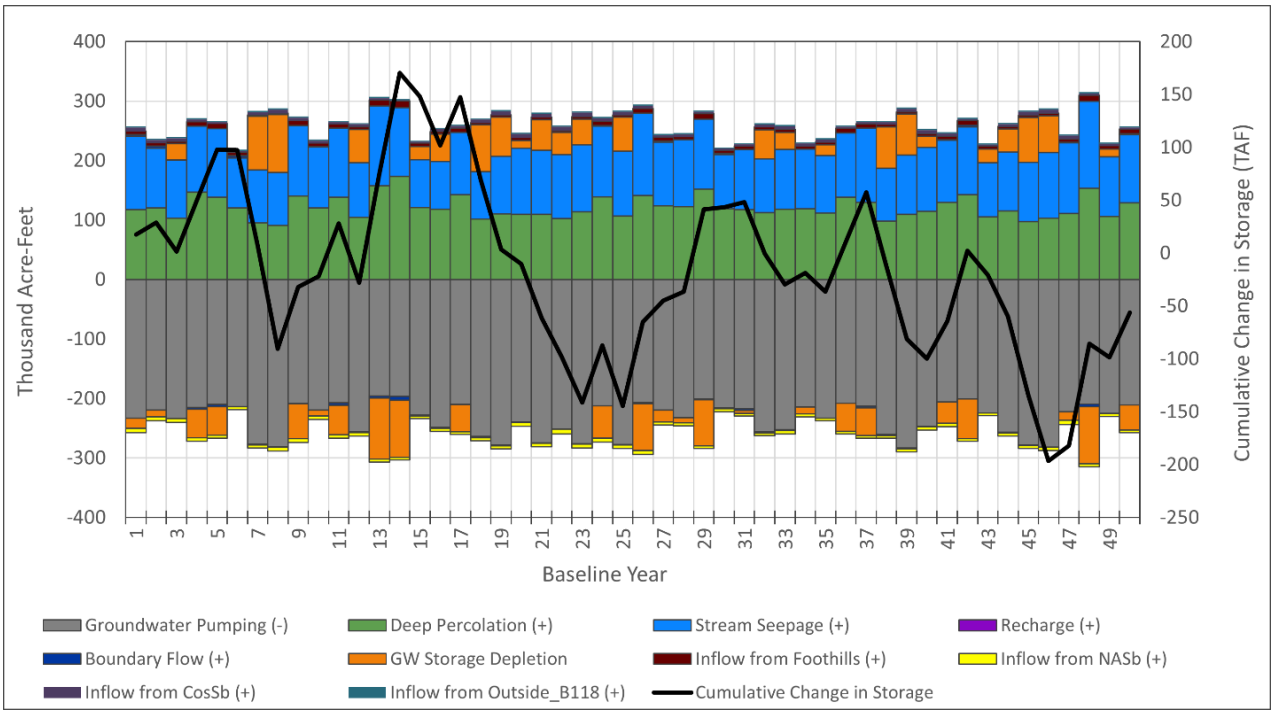


Figure 5-29: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Projected Conditions Baseline

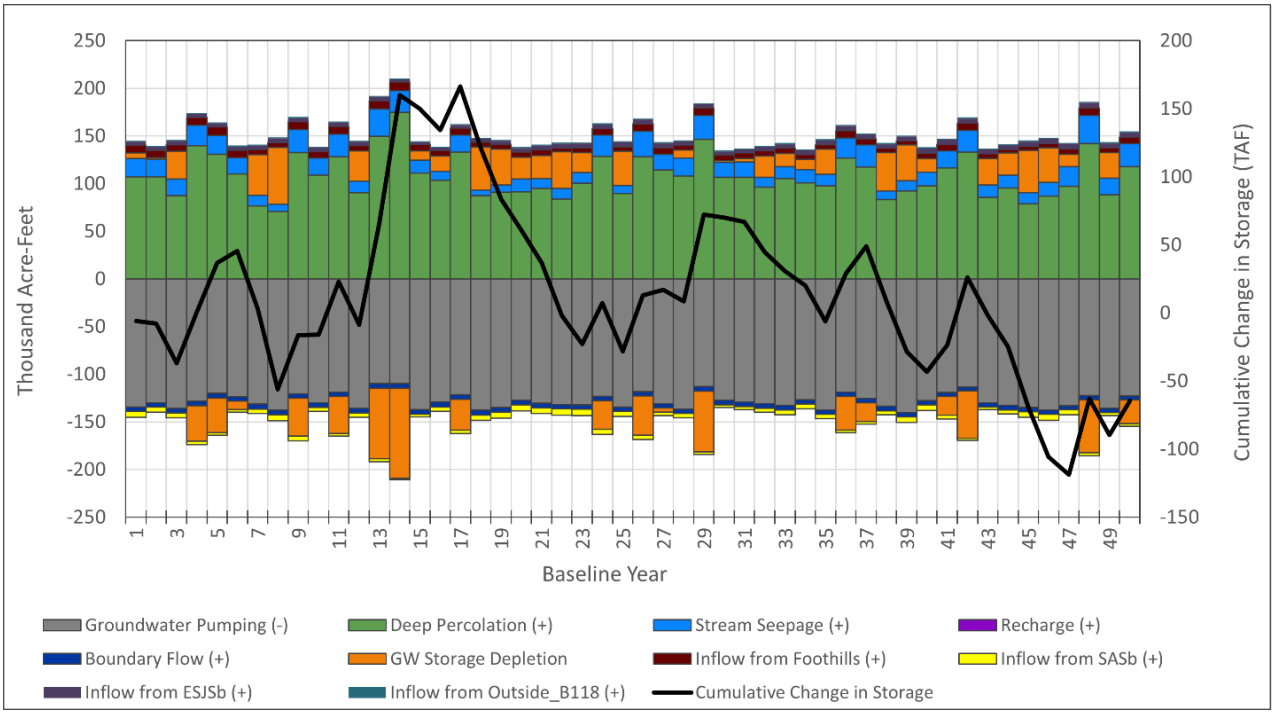


Figure 5-30: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Projected Conditions Baseline

5.3 Projected Conditions Baseline with Climate Change

The CoSANA Projected Conditions Baseline with Climate Change (PCBL with Climate Change) shares many of the same inputs as the PCBL, but with additional factors to incorporate potential climate change conditions. These conditions affect the hydrologic cycle as changes in precipitation and temperature. In the CoSANA model files, the change in precipitation is incorporated by the precipitation rate and stream inflow inputs while the change in temperature is reflected by the change in evapotranspiration rate and stream inflow inputs. Changes in water use are incorporated by estimation of agricultural water demands within CoSANA based on changes in precipitation and evapotranspiration. Urban water use is assumed to remain unchanged, based on assumed changes in conservation and landscape choices.

5.3.1 Hydrologic Period

The hydrologic period used for the projected conditions baseline with climate change is the same as the projected conditions baseline (WY 1970 to 2019), modified according to the methodology explained below to incorporate climate change conditions.

5.3.1.1 Methodology

In order to incorporate climate change conditions, precipitation, stream inflow, and evapotranspiration time series data from the projected conditions baseline are modified using the findings from the American River Basin Study (ARBS; Reclamation, in press). ARBS aims to examine the water management challenges around the American River Basin under recent changes in conditions, regulatory requirements, and the science of climate change. Towards this goal, ARBS provides regional climate change data with improved resolution that can be used with other modeling and planning studies.

ARBS used 64 downscaled climate projections with 1/16-degree grid resolution from 32 global climate models under RCP4.5 and RCP8.5 emissions scenarios. These 64 scenarios are then evaluated for three future periods (2040-2069, 2055-2084, and 2070-2099) and grouped into five climate scenarios based on percentiles of projected changes to simulate possible temperature and precipitation effects: Warm-Wet, Warm-Dry, Hot-Wet, Hot-Dry, and Central-Tendency.

The ensemble of climate models used in the study found clear trends with projected temperature changes. Precipitation trends were not found to be as consistent with around half of the projections indicating an increase in precipitation, and the other half indicating a decrease in precipitation.

Upon evaluation of these climate scenarios, the Central Tendency scenario for the 2055-2084 period, also commonly called as 2070CT conditions, was selected for groundwater sustainability planning because it was determined that it has the highest probability and likelihood to be experienced. Other climate scenarios are subject to significantly more uncertainty and less likely to occur. Additionally, to assess uncertainty and the effects of a possible extreme condition, the 2055-2084 Hot-Dry (2070HD) scenario was also simulated, with results presented in Section 5.3.7.

In ARBS, the downscaled climate variables of the scenarios were then used with the Variable Infiltration Capacity (VIC) hydrology model to simulate hydrologic conditions at the land surface. VIC uses a spatial grid that covers the entire CoSANA model domain. This grid was used to resample the precipitation time series from 2070CT and 2070HD conditions to the CoSANA model grid and for the small watersheds using area weighted averaging.

ARBS uses the outputs from the VIC model to develop corresponding inputs to the operations model CalSim 3.0 that covers the entire Sacramento and San Joaquin River Basins. One of those inputs is the evapotranspiration rates for each crop type. For the PCBL with Climate Change scenarios in CoSANA, evapotranspiration time series input from the PCBL were perturbed with the perturbation factors calculated between the 2070CT and 2070HD climate change scenarios and the 2015 baseline scenario for each crop type averaged across the CoSANA domain. Additionally, stream inflow time series input at six locations (Sacramento River at Verona, Folsom Reservoir releases, Cosumnes River, Camanche Reservoir release, Bear River, and Feather River) were replaced with the simulated flows by CalSim 3.0 in ARBS.

A summary comparison table of the ARBS historical baseline hydrology and percent changes to different system components in the 2070CT and 2070HD is shown in Table 5-7.

Table 5-7: Percent Change in Annual Climatic and Hydrologic Indicators in the American River Basin Study*

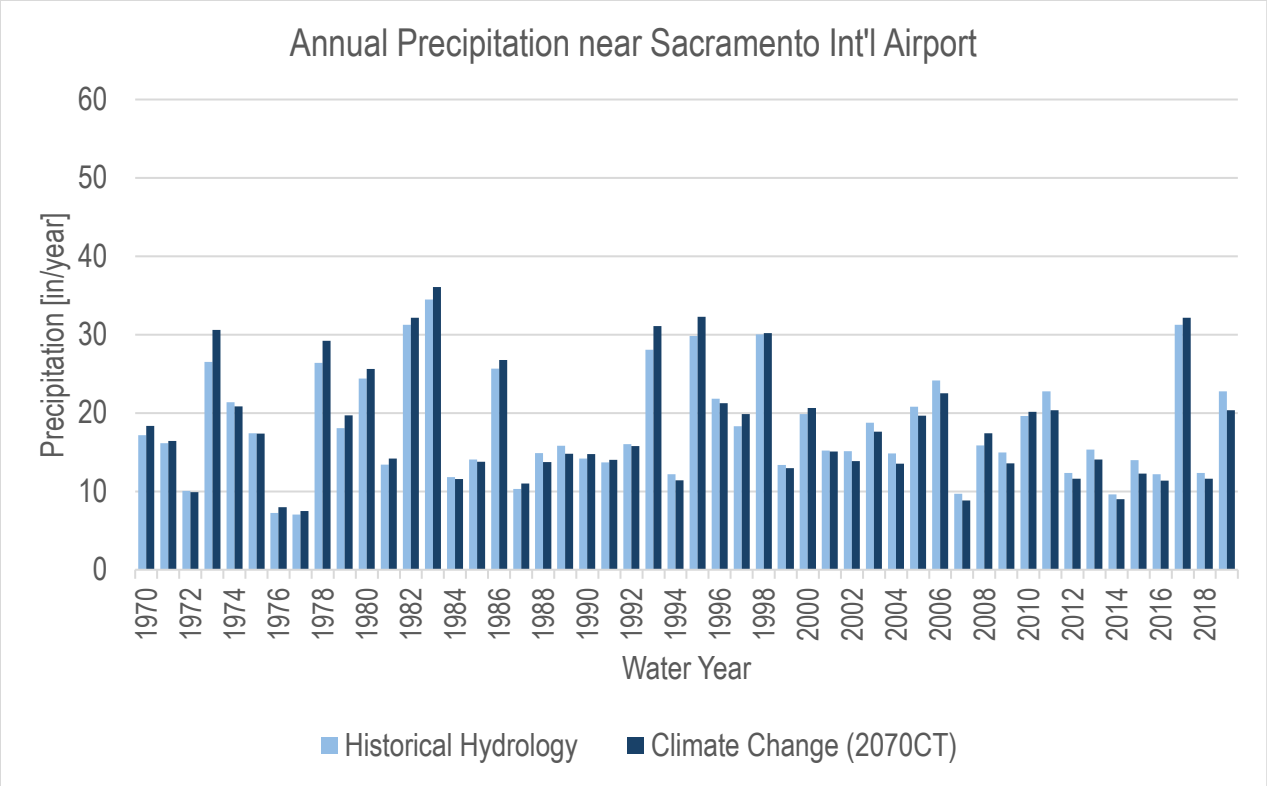
Climate Scenario	Precipitation	Temperature (average)	Potential Evapotranspiration	Runoff
Historical Observations (1915-2015 average)	38.2 inches	54.8^{0}F	42.8 inches	1,458,000 AFY
2070 Central-Tendency	-3%	+11%	+10%	-6%
2070 Hot and Dry	-9%	+14%	+12%	-13%

* The values are for the entire American River Basin Study area and are based on Table 2-4 in the study report.

5.3.1.2 Precipitation

Annual precipitation near Sacramento International Airport and on the small watershed areas are shown in Figure 5-31 for with- and without-climate change conditions for comparison purposes. As a result of the 2070CT climate change conditions, average annual precipitation increased from 17.5 inches to 17.8 inches on the valley floor and increased from 30.6 inches to 30.9 inches on the small watersheds.

Figure 5-32 illustrates the changes in average monthly precipitation before and after climate change conditions are applied. For both the valley floor and the small watersheds, a slight shift in the distribution of precipitation can be observed.



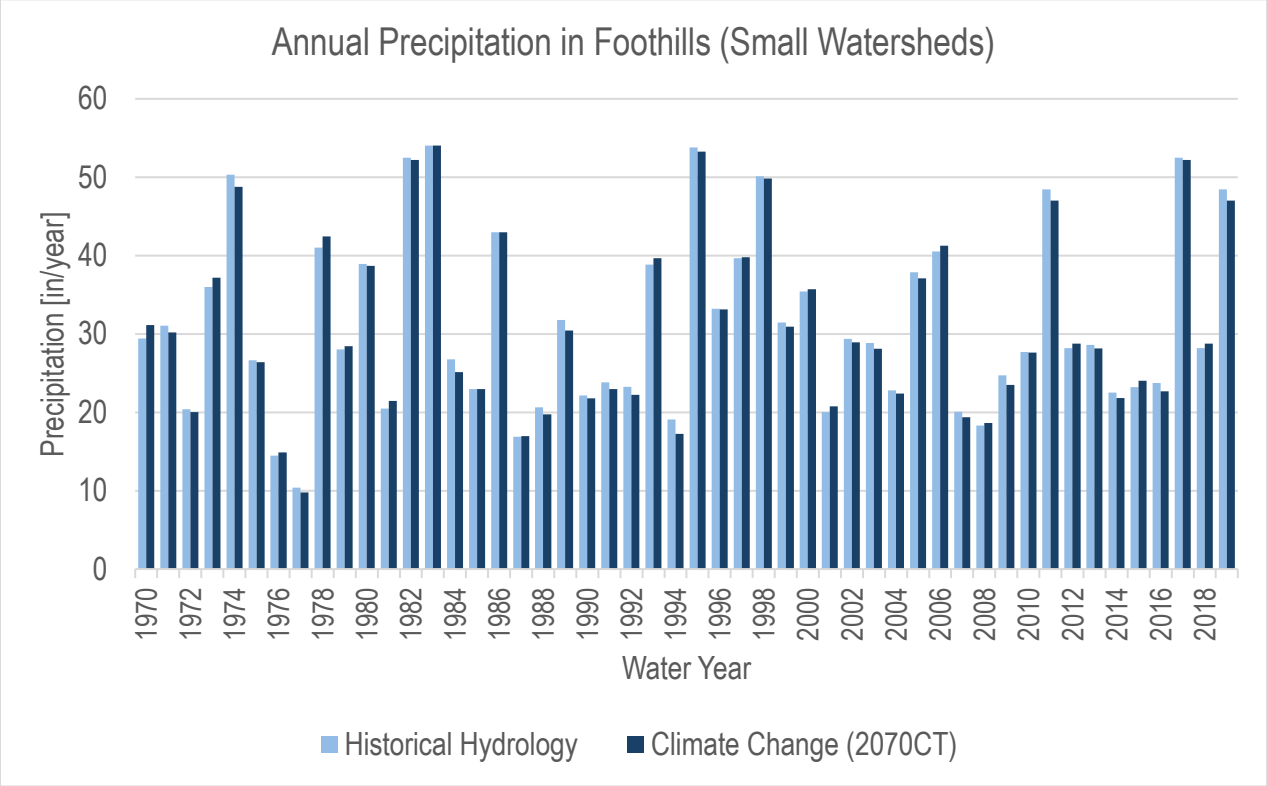


Figure 5-31: Annual Precipitation with and without Climate Change

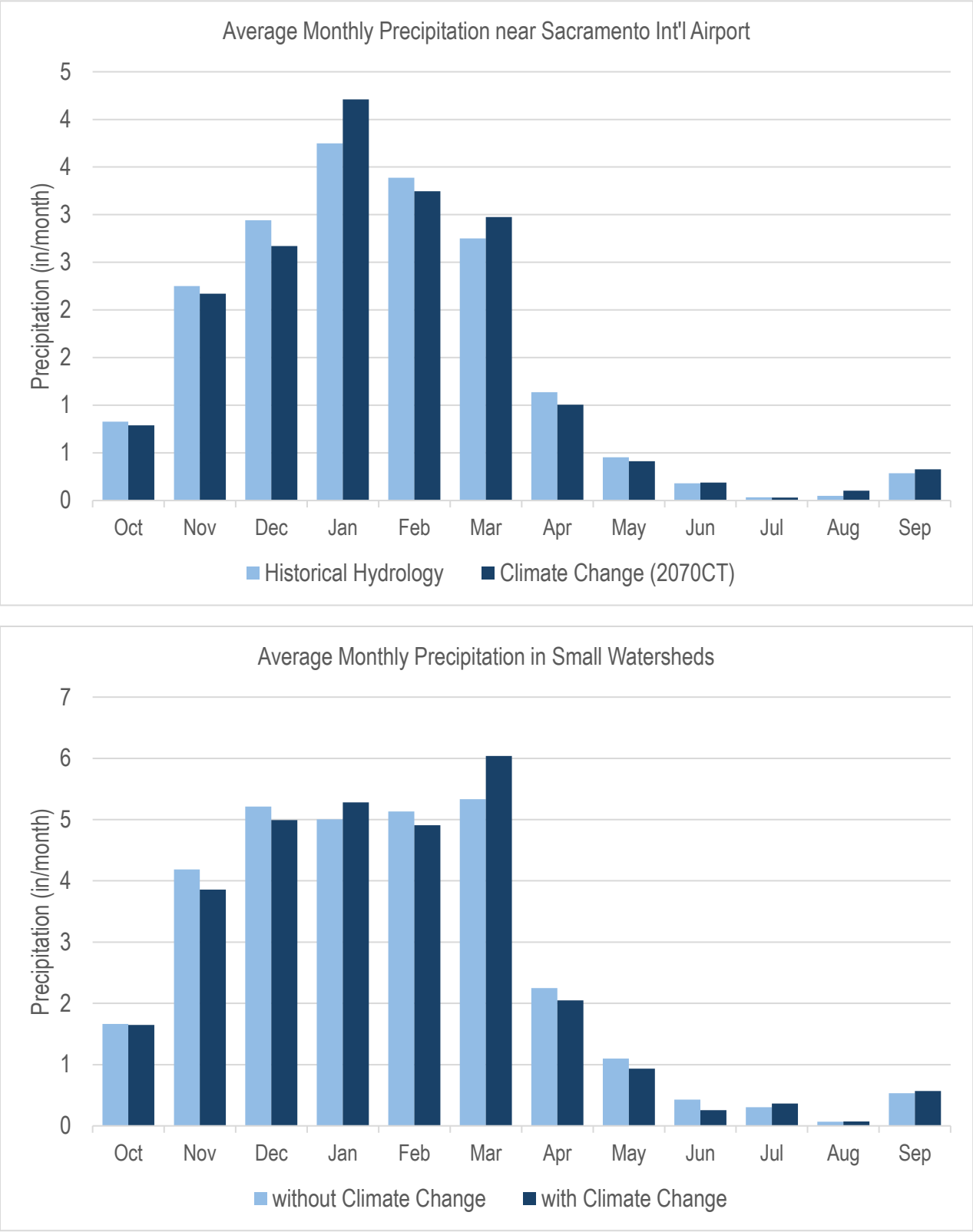


Figure 5-32: Average Monthly Precipitation with and without Climate Change

5.3.1.3 Stream Inflow

Major stream flows entering to the CoSANA domain were modified to accommodate the climate change according to 2070CT conditions. In Figure 5-33, American River releases from the Folsom Reservoir are shown with and without climate change for comparison purposes. As a result of the 2070CT climate change conditions, average annual stream flow on the American River below Folsom Reservoir is decreased from around 3,500 cubic feet per second (cfs) to around 3,000 cfs.

Figure 5-34 illustrates the changes in average monthly stream inflow before and after climate change conditions are applied. According to this chart average flows in early winter and late spring decrease, while March flows increase.

An exceedance chart comparing the monthly Folsom Reservoir Release to American River is given in Figure 5-35 According to this chart, peak monthly flows show an increase in probability, while the probability of lower flows show a slight decrease.

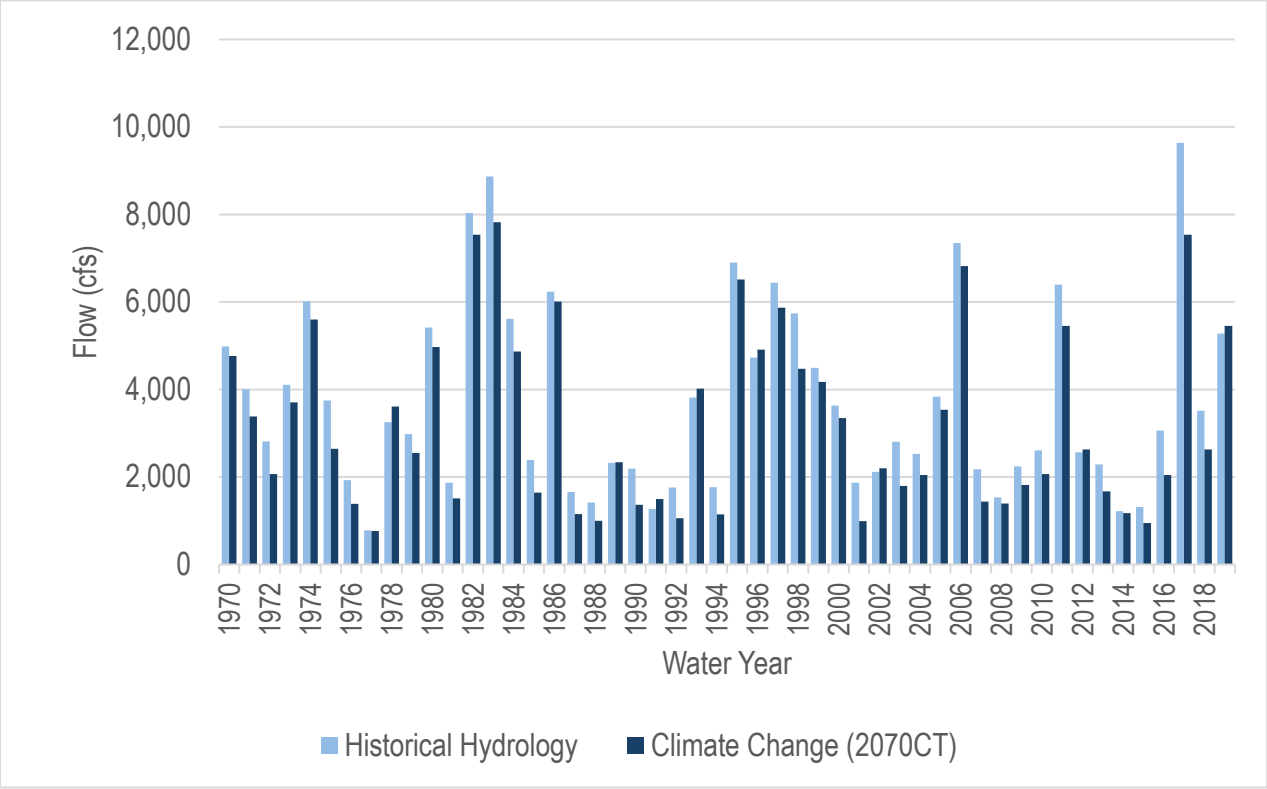


Figure 5-33: Annual Folsom Reservoir Releases to American River with and without Climate Change

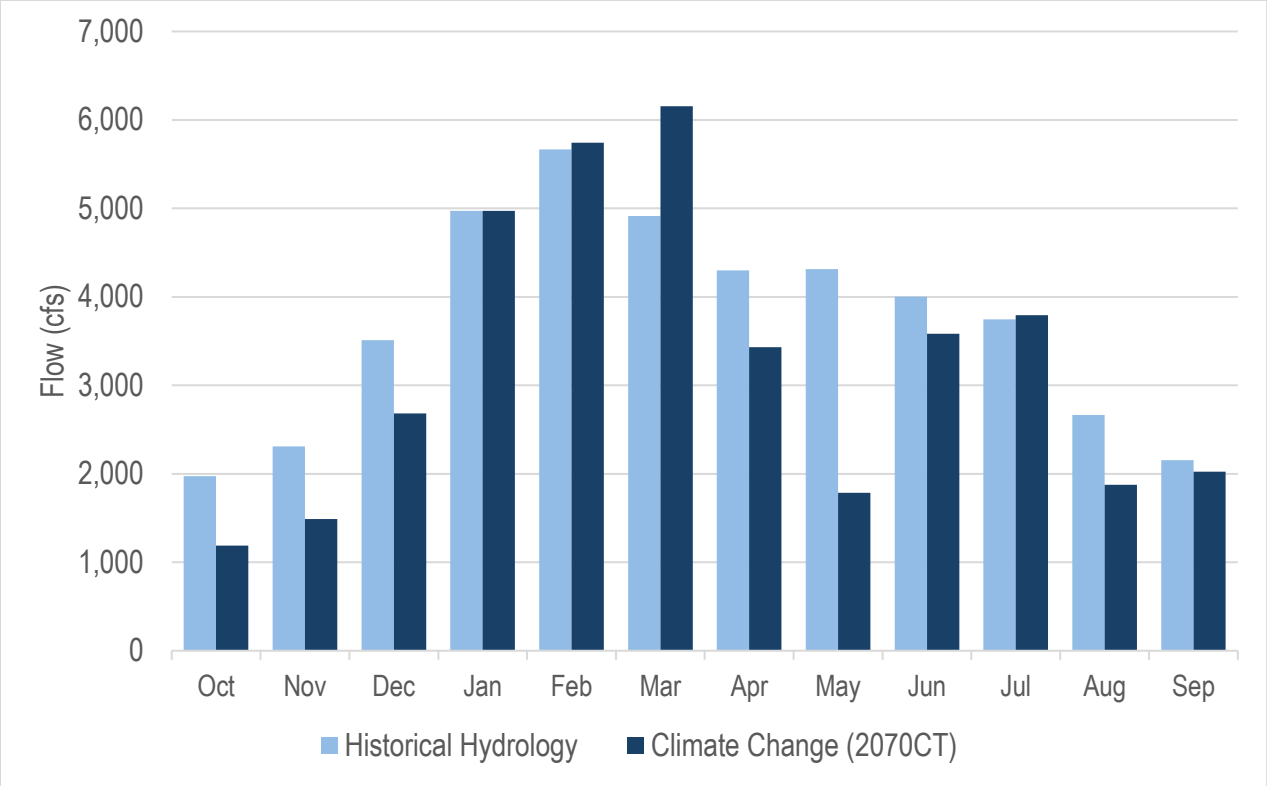


Figure 5-34: Monthly Average Folsom Reservoir Releases to American River

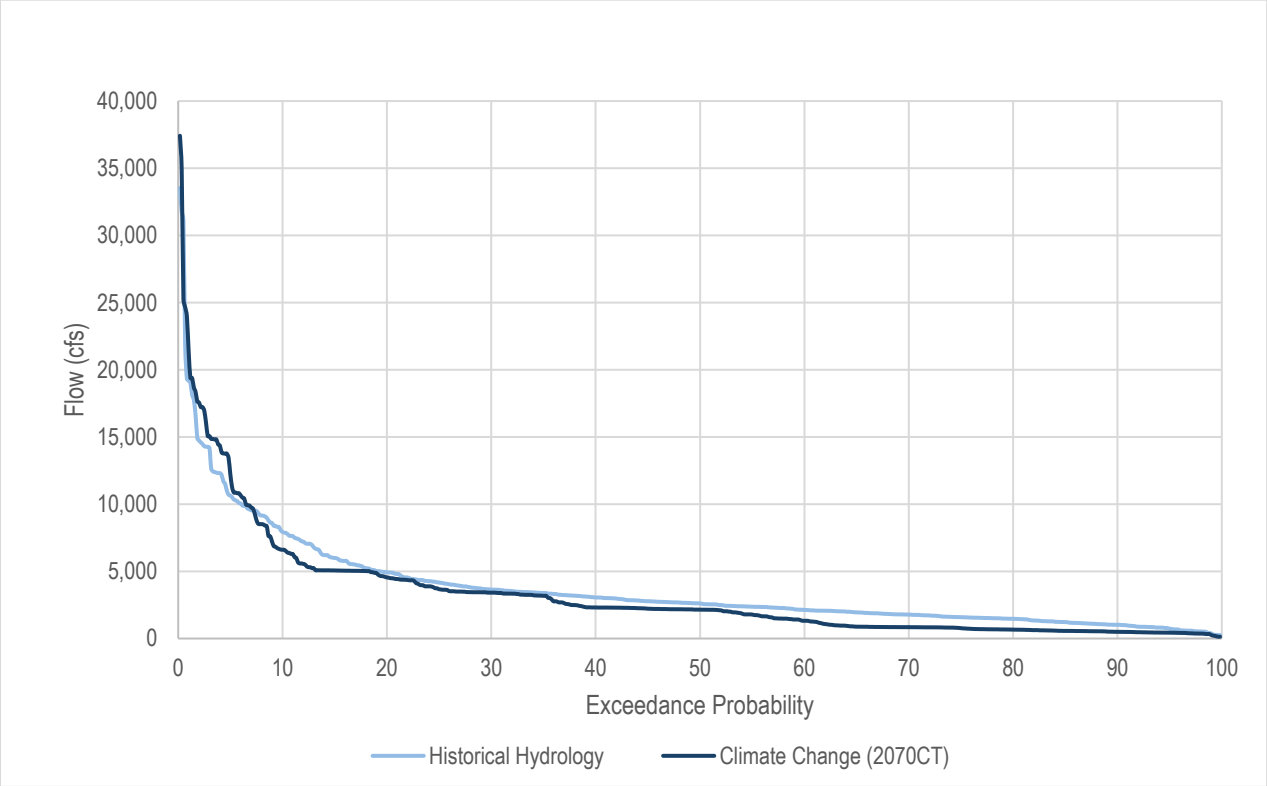


Figure 5-35: Exceedance Chart for the Monthly Folsom Reservoir Releases to American River

5.3.1.4 Evapotranspiration

Potential evapotranspiration time series data for each land cover type in CoSANA were modified to accommodate climate change according to 2070CT conditions. 2070CT conditions predict higher temperature than historical conditions which will result in higher potential evapotranspiration rates. Annual potential evapotranspiration for pasture over the valley floor is shown in Figure 5-36 for with- and without-climate change conditions for comparison purposes. Among all the land cover types defined in CoSANA, pasture was chosen here for its similarity to the reference evapotranspiration. As a result of the 2070CT climate change conditions, average annual potential evapotranspiration for pasture is expected to increase from 49.9 inches to 54.6 inches. Figure 5-37 illustrates the changes in average monthly potential evapotranspiration for pasture before and after climate change conditions are applied.

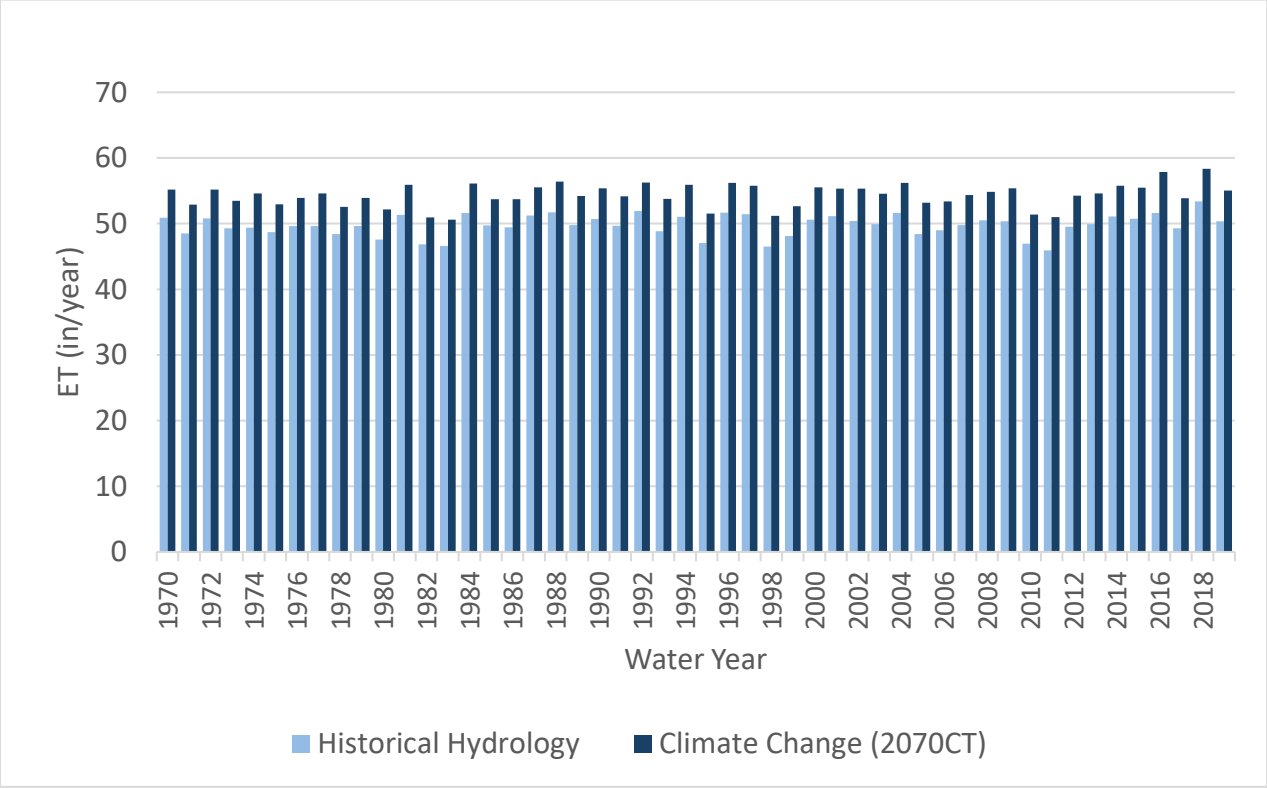


Figure 5-36: Annual Potential Evapotranspiration for Pasture

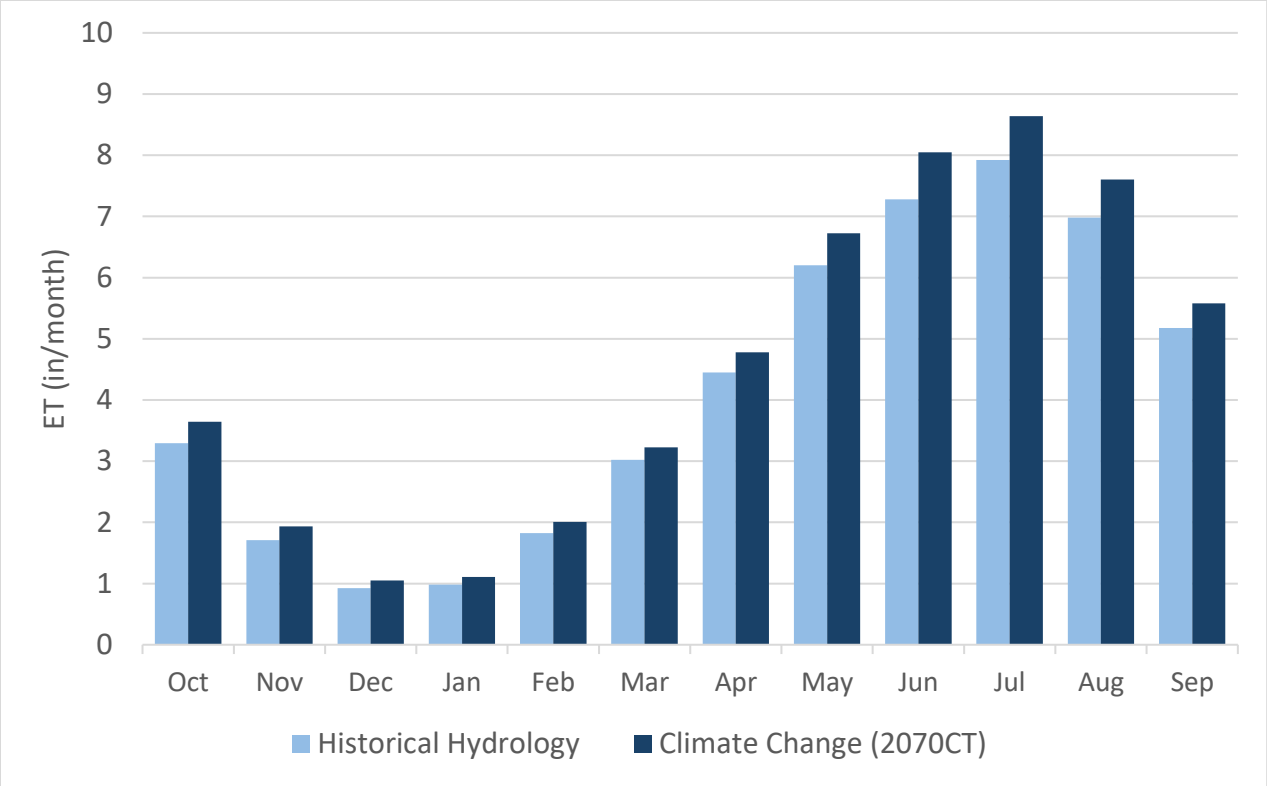


Figure 5-37: Monthly Average Potential Evapotranspiration for Pasture.

5.3.2 Land Use

The PCBL with Climate Change land use is the same as the PCBL, described in Section 5.2.2.

5.3.3 Urban Demand and Supply

The PCBL with Climate Change urban demand and supply is the same as the PCBL, described in Section 5.2.3. It is noted that water demands for urban landscape will increase with increasing ET under climate change, however demand and supply remain unchanged in the baseline due to likely changes in ordinances and likely changes in landscaping practices.

5.3.4 Agricultural Demand and Supply

The PCBL with Climate Change agricultural demand and supply is based on the PCBL, described in Section 5.2.4. The agricultural demand under the climate change conditions is impacted by the effect of climate change on the hydrology, notably evapotranspiration, which increases demands. The increased supply needed to meet this demand is typically met by additional groundwater pumping.

5.3.5 Remediation Operations

Information about future remediation operations is not available, so remediation operations in the PCBL with Climate Change are the same as in the CCBL, discussed in Section 5.1.7.

5.3.6 Results

This section provides a summary of the CoSANA PCBL with Climate Change results.

5.3.6.1 Land and Water Use Budget

The land and water use budget provides details on urban and agricultural demand and the water supply meeting the demand (groundwater pumping, surface water deliveries, recycled water, and remediation pumping). Average annual PCBL with Climate Change model results by groundwater subbasin are shown in Table 5-8. Annual agricultural water demand and supply by subbasin are shown in Figure 5-38 through Figure 5-40. As discussed in Section 5.3.3, urban demand and supply for the PCBL with Climate Change are the same as the PCBL; refer to Figure 5-25 through Figure 5-27 for urban land and water use budgets. Appendix H includes model subregion land and water use budgets.

Table 5-8: PCBL with Climate Change Average Annual Land and Water Use Budget

Subbasin	Ag. Demand (AFY)	Ag. Ground-Water Use* (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-Water Use** (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	372,286	222,061	152,544	328,654	108,492	220,161	-	5,515
SASb	148,520	103,348	45,178	301,060	116,385	167,661	17,200	29,765
CoSb	132,348	108,831	22,744	30,168	28,445	3,943	-	-
Total	**653,154**	**434,240**	**220,466**	**659,882**	**253,322**	**391,765**	**17,200**	**35,280**

Notes:
* Agricultural groundwater use presented in the above table may differ slightly from the values shown in the respective GSP due to minor difference in the methodology on calculation of rural residential water use.
** Urban groundwater use in the above table represents water used that originated from groundwater production but can include water that was pumped in areas outside of the respective subbasin.

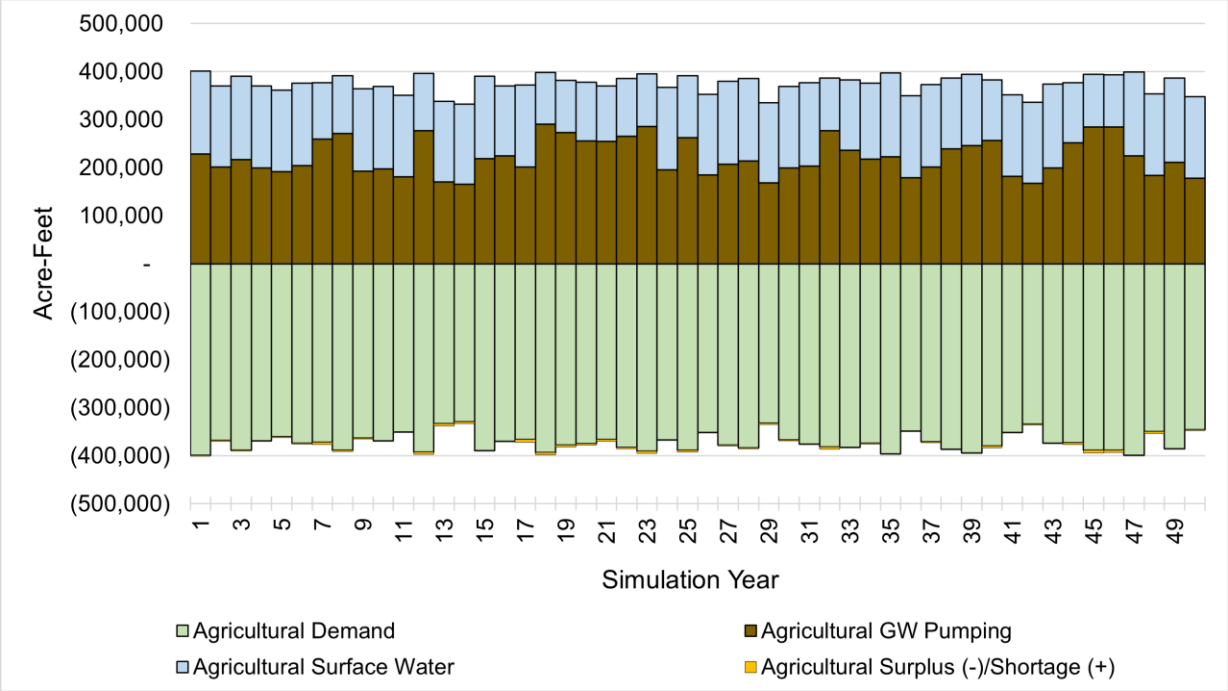


Figure 5-38: Annual Agricultural Water Demand and Supply – North American Subbasin, Projected Conditions Baseline with Climate Change

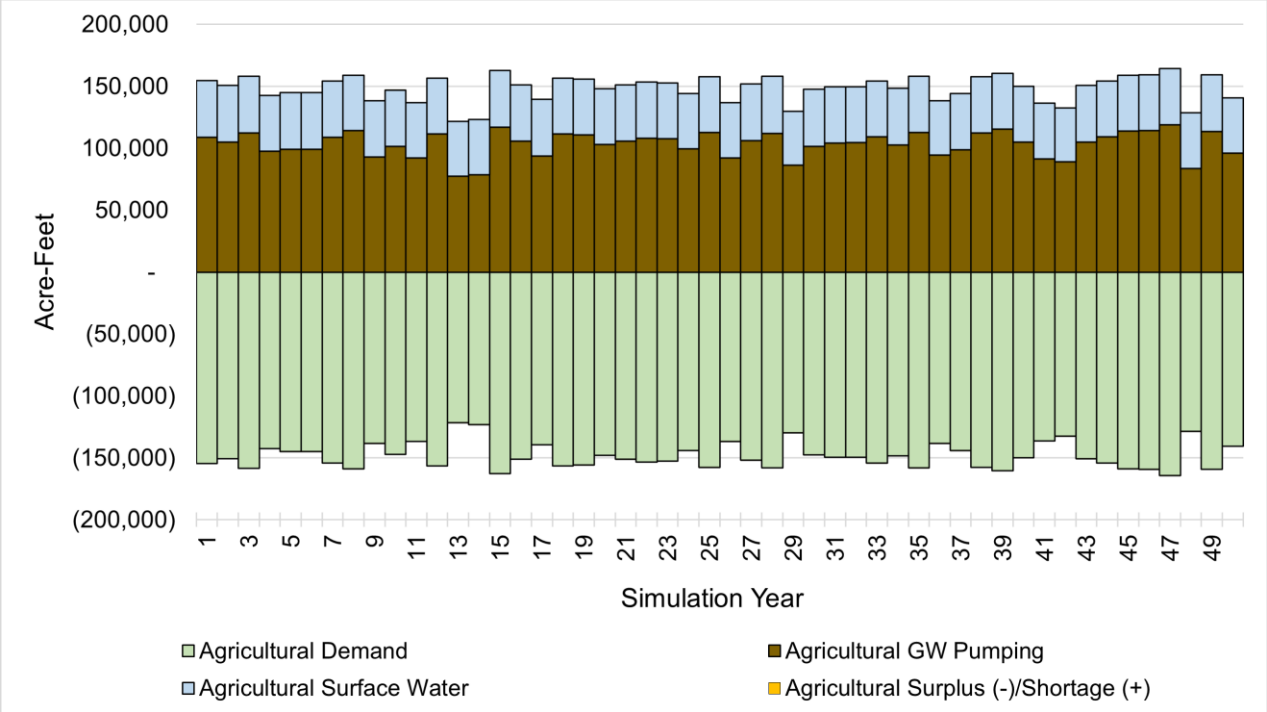


Figure 5-39: Annual Agricultural Water Demand and Supply – South American Subbasin, Projected Conditions Baseline with Climate Change

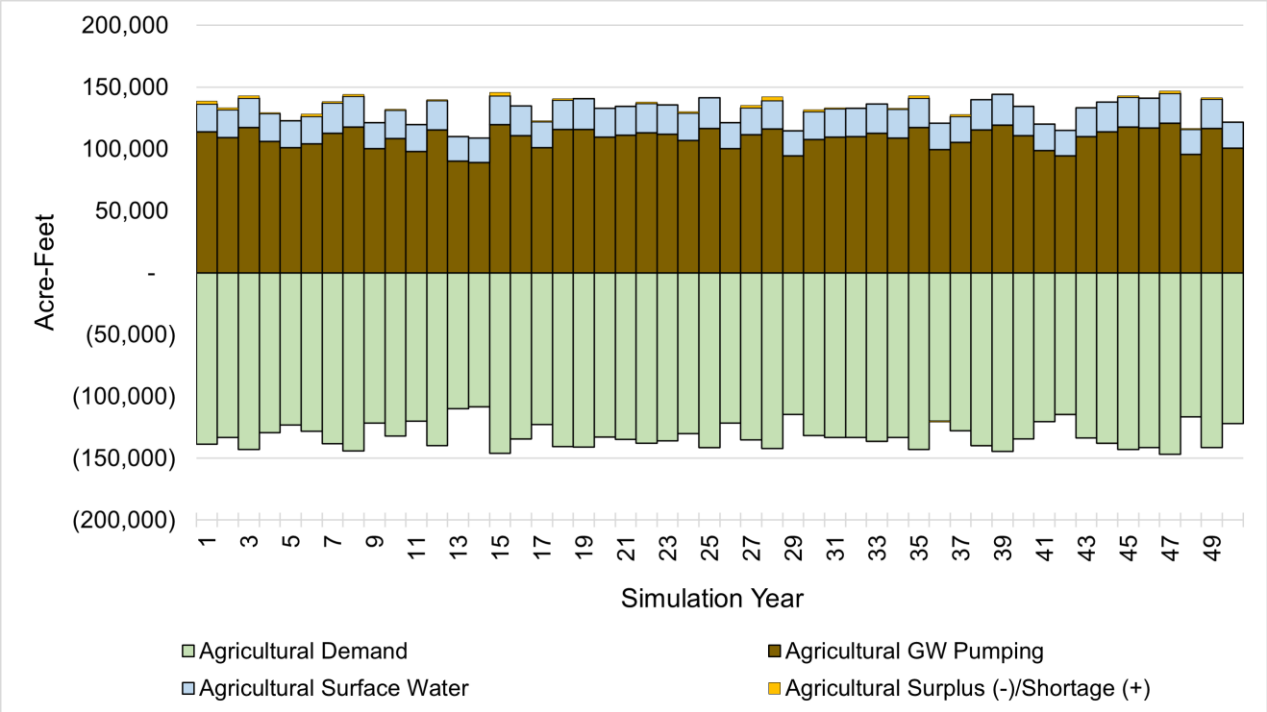


Figure 5-40: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline with Climate Change

5.3.6.2 Groundwater Budget

The groundwater budget provides all inflows and outflows to the groundwater aquifer system. Average annual PCBL with Climate Change model results by groundwater subbasin are shown in Table 5-9. Annual groundwater budgets with cumulative change in storage by subbasin are shown in Figure 5-41 through Figure 5-43. Appendix I includes model subregion groundwater budgets. Appendix J includes a set of sample hydrographs for the baseline models.

Table 5-9: PCBL with Climate Change Average Annual Groundwater Budget

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
NASb	343,000	160,987	122,181	16,401	32,744	7,228	-3,502
SASb	245,752	114,730	118,164	26	6,198	411	-6,222
CoSb	137,276	101,490	20,744	0	1,540	3,739	-9,762
Total	**726,028**	**377,207**	**261,089**	**16,427**	**40,481**	**11,378**	**-19,486**

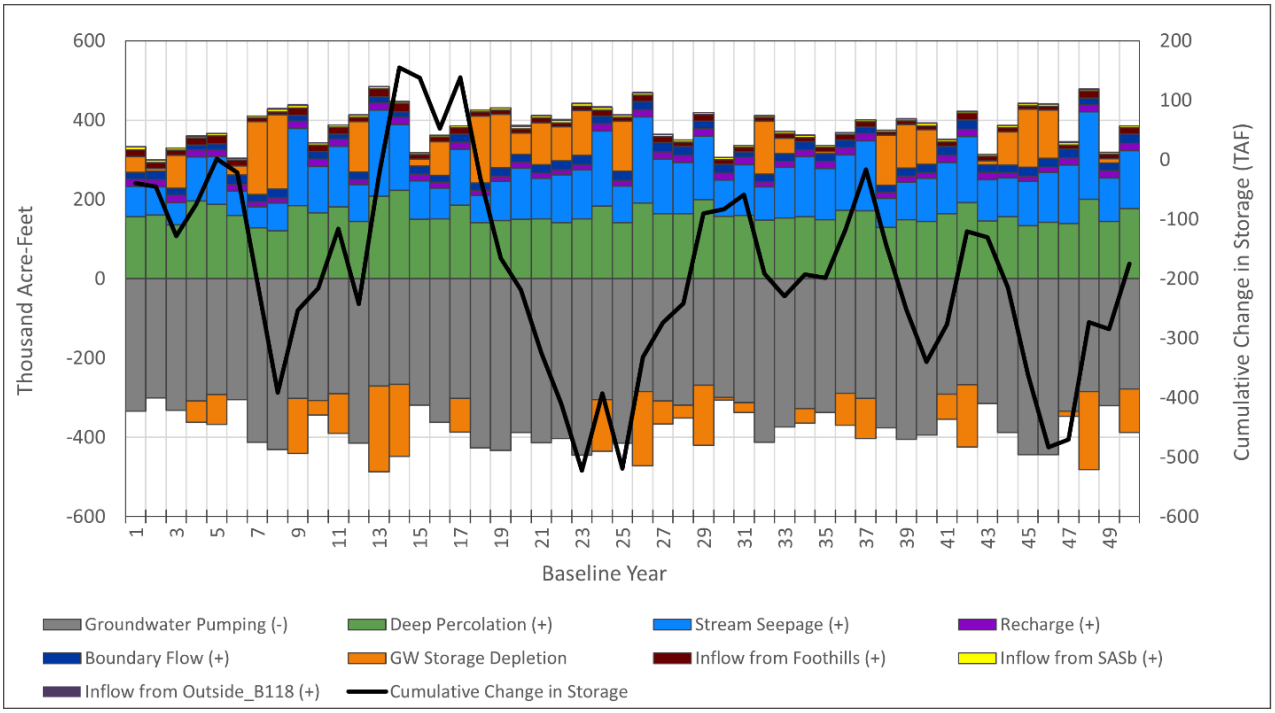


Figure 5-41: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Projected Conditions Baseline with Climate Change

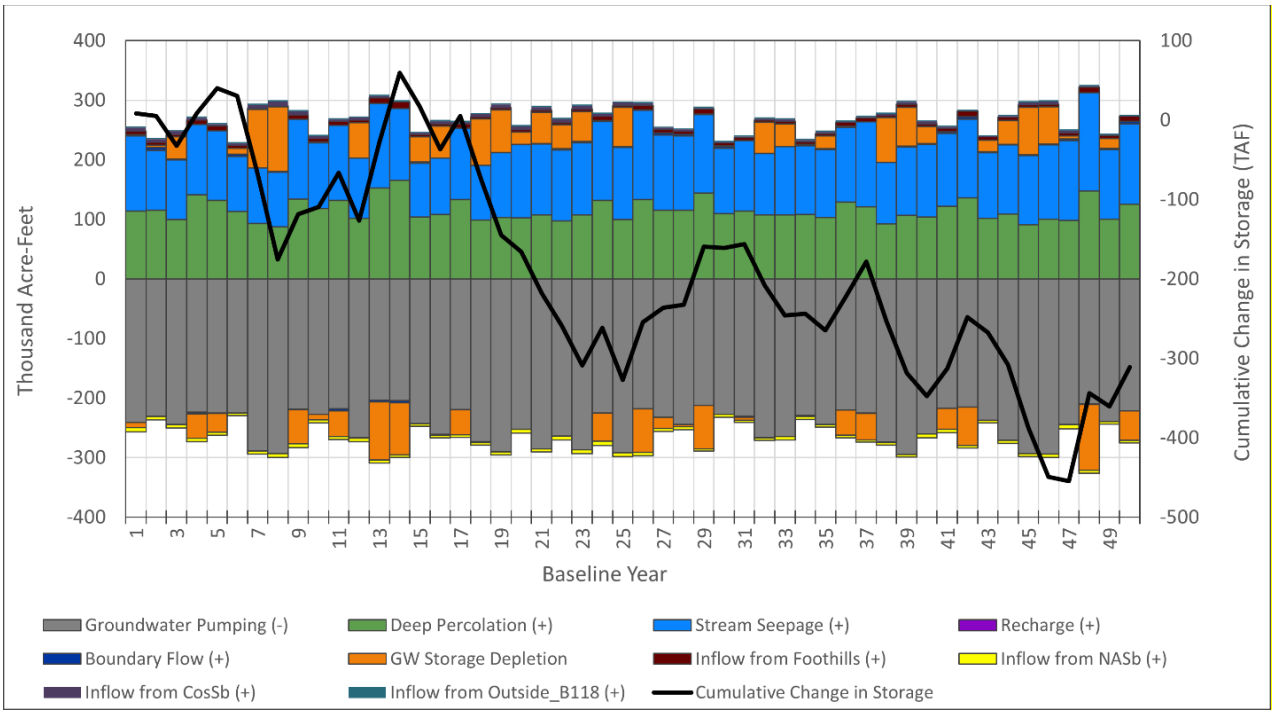


Figure 5-42: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Projected Conditions Baseline with Climate Change

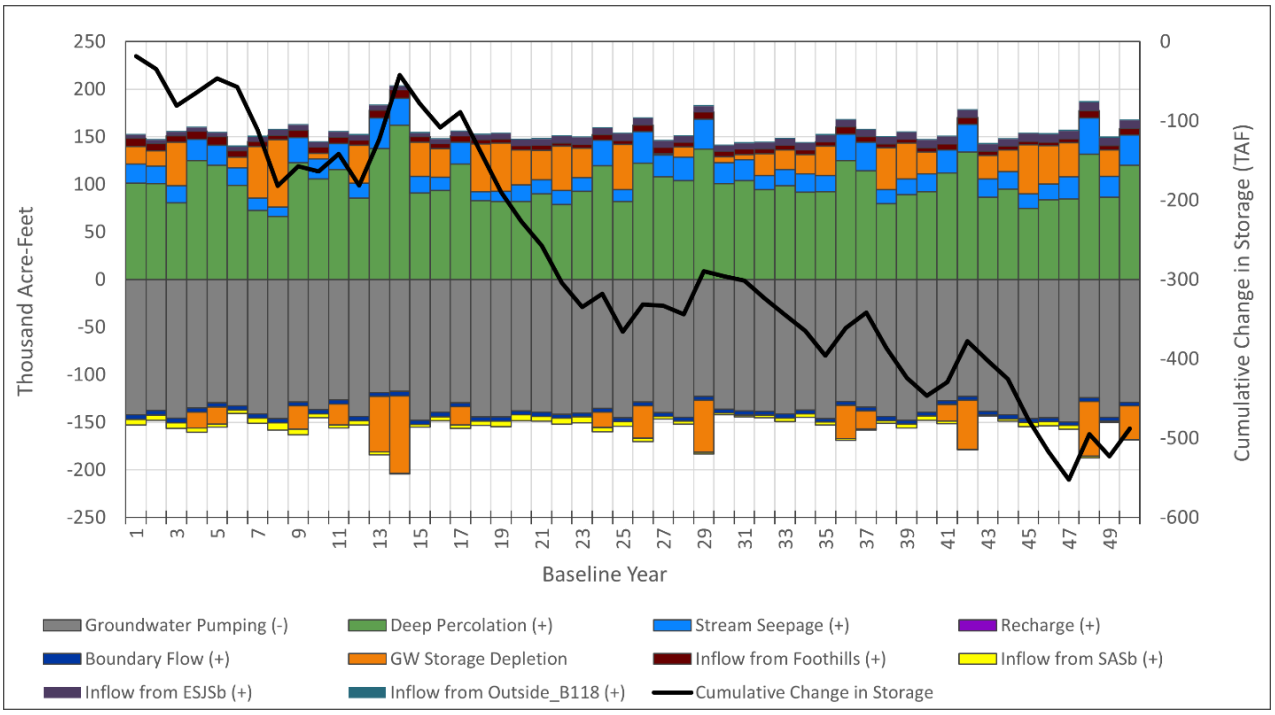


Figure 5-43: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Projected Conditions Baseline with Climate Change

5.3.7 Sensitivity Analysis: Hot-Dry Scenario

The 2070HD scenario was analyzed as an extreme case to determine the potential effects of the 2070HD scenario on the groundwater and surface water systems. 2070HD simulates lower overall precipitation, and higher temperature, than the 2070CT. A comparison of groundwater budgets (summation of the 3 subbasins, does not include areas outside of NASb, SASb, and CoSb) can be seen in Table 5-10 below.

Table 5-10: Comparison Groundwater Budgets of CoSANA Climate Change Models to the Projected Conditions Baseline

Model Version	Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
PCBL	NASb	323,167	167,424	107,950	16,376	30,140	6,710	5,390
PCBL	SASb	234,003	121,313	105,665	26	4,886	986	-1,128
PCBL	CoSb	128,332	107,977	16,494	0	1,536	1,030	-1,293
PCBL	**Total**	**685,501**	**396,714**	**230,109**	**16,402**	**36,561**	**8,726**	**2,969**
PCBL+CC (2070CT)	NASb	343,000	160,987	122,181	16,401	32,744	7,228	-3,502
PCBL+CC (2070CT)	SASb	245,752	114,730	118,164	26	6,198	411	-6,222
PCBL+CC (2070CT)	CoSb	137,276	101,490	20,744	0	1,540	3,739	-9,762
PCBL+CC (2070CT)	**Total**	**726,028**	**377,207**	**261,089**	**16,427**	**40,481**	**11,378**	**-19,486**
PCBL+CC (2070HD)	NASb	351,979	155,616	128,609	16,410	33,728	7,482	-10,179
PCBL+CC (2070HD)	SASb	250,445	110,570	122,767	26	7,058	614	-9,409
PCBL+CC (2070HD)	CoSb	140,677	97,337	22,515	0	1,439	4,838	-14,545
PCBL+CC (2070HD)	**Total**	**743,100**	**363,524**	**273,892**	**16,436**	**42,224**	**12,934**	**-34,133**

As shown in Table 5-10, the 2070HD scenario leads to an overall increase in pumping of approximately 2% above the 2070CT, this is largely due to increased evapotranspiration causing an increase in agricultural demand. Decreases in deep percolation are largely attributable to decreasing precipitation. Increases in stream seepage, boundary flows, and subsurface flows are all due to lower groundwater levels being observed in the 2070HD scenario.

6. SUMMARY AND RECOMMENDATIONS

6.1 Summary

The CoSANA model is built upon the previous SacIWRM by migrating to the IWFM platform, providing finer resolution spatially and with depth, and by refining and extending the data incorporated into the model. CoSANA provides a robust, comprehensive, defensible model for assessing water resources conditions in the Sacramento region through integrated modeling of land surface, groundwater, and surface water conditions using detailed local and regional data and the DWR-supported IWFM modeling platform. This includes simulation under historical, current, projected, and projected with climate change conditions. The tool is well calibrated and ready to be used in various water supply and management studies and includes flexibility for updates and refinements to meet future needs of the region.

CoSANA simulates historical hydrology for the water year 1970 – 2018 on a monthly time step, with a focused calibration period of water years 1995 – 2018. Model calibration is based on water budgets, regional groundwater level and flow trends, groundwater level elevations at designated calibration wells, streamflows at selected stream gaging stations, interaction between the stream and the aquifer system along major river courses, surface and subsurface flow contributions from the tributary watersheds to the east, and subsurface flow directions and rates among the three groundwater subbasins within the model.

Three baseline scenarios are developed to support SGMA activities, development of the GSPs within the three subbasins, and other potential water resources planning needs. The Current Conditions Baseline, Projected Conditions Baseline, and Projected Conditions with Climate Change Baseline allow for assessment of water budgets under respective hydrologic, land and water use, and operations conditions and also facilitate analysis of future projects and management activities. The baselines incorporate 50 years of hydrology (1970-2019) to meet SGMA requirements and to provide climatic uncertainty based on 2070 Central Tendency climate change to assess future projects and management actions. A sensitivity analysis was also performed to assess the groundwater conditions under the 2070 Hot and Dry climate conditions.

6.2 Recommendations

CoSANA is intended to be a living model, which would evolve over time for better and more accurate representation of the surface and groundwater systems in the greater Sacramento area. Model refinements and updates need to take place on a regular basis to ensure the most recent and best representation of the changing needs of the region and to incorporate the latest conditions, data, and modeling platforms. During the development of the model, several items were identified for future refinements to improve the capability of CoSANA:

- **Continue collaboration and engagement with local GSAs, water purveyors, groundwater users, and water managers**. Continue working with local agencies and groundwater users in the region to further understand the local operations of the groundwater system and improve representation of groundwater users in the CoSANA.
- **Collaborate with DWR.** The fine grid version of C2VSim as well as the SVSim were developed by DWR to evaluate the integrated surface water and groundwater conditions at a regional scale, and to assess surface water-groundwater interaction and stream depletions at regional scale. CoSANA, being a local scale model with significantly more detail data and information provides a much better platform for evaluation of stream-aquifer interaction for the Sacramento area. It would be important to support the DWR in increasing the accuracy of the regional groundwater conditions in the fine grid C2VSim and SVSim, so that the regional scale results and policy decisions are consistent with the analysis at the local scale. It is therefore recommended that coordination occur with DWR to provide data and information for further refinement and update of the C2VSimFG and SVSim in the CoSANA area.
- **Develop model update schedule.** In order to keep the CoSANA up-to-date and current for analysis of water resources and especially for supporting SGMA implementation, it is recommended that the model

hydrology and land and water use data be updated and used for preparation of the GSP Annual Reports on an annual basis. It is further recommended that the model be updated for other major data sets, as well as enhanced for additional features every 5 years. This 5-year update would include an update of the model calibration and would be developed for use in the 5-year GSP updates for the three subbasins in the model area.

- **Enhance representation of variability of potential evapotranspiration**. The current version of the IDC used for estimation of the consumptive use of crops in the CoSANA uses monthly potential ET values that are uniform across the model domain. Future refinements are recommended to incorporate spatial variability of ET.
- **Map Soil Survey Geographic Database (SSURGO) rootzone parameters directly to CoSANA:** CoSANA used C2VSim rootzone parameters mapped to the CoSANA grid. Due to the difference in grid resolution, this may lead to a loss of detail on the original rootzone parameters. Remapping of the rootzone parameters should be considered to improve this resolution.
- **Refine surface water deliveries in NASb/SASb:** Some surface water diversions have limited detail on the delivery area, with some of this water sent to the appropriate subregion, but not specifically to the delivery area. Additional information on delivery areas is recommended for incorporation into CoSANA, including those in OHWD, and PCWA zone 5.
- **Improve inflow estimates for tributary streams:** Tributary streams were found to have a substantial effect on simulation of groundwater levels during calibration. Improvements could include flow measurements on small streams and/or developing improved regression analyses. Some tributary streams are not connected to a small watershed or receive very little flow from the small watershed simulation (for example: Magpie Creek and Arcade Creek in NASb, Elder Creek in SASb). Finally, subsurface conditions and simulated inflows from small watersheds east of the Cosumnes Subbasin require refinement to address model-calculated water levels that are significantly above land surface (flooded conditions).
- **Improve return flow routing within IWFM and CoSANA:** IWFM allows only one location for return flows, thus surface runoff must be routed to the same stream node as urban wastewater. In much of the Sacramento region, urban wastewater is routed to the Sacramento Regional Wastewater Treatment Plant northwest of Elk Grove. However, surface runoff is typically routed to the nearest surface water course. Coordination with DWR's IWFM development team is recommended to allow flexibility to route these differently according to the physical system.
- **Improve data and simulation of Auburn Ravine flows:** Auburn Ravine has complex operations that include inflows and diversions from several different entities. Currently, CoSANA simulation of Auburn Ravine flows is based on a regression analysis that uses flows from nearby Dry Creek. Though these may represent a reasonable estimate of natural flows that could occur in Auburn Ravine, this analysis does not capture any of the operational flows that occur through the ravine. There is a streamflow gage that is installed in Auburn Ravine, but the gage does not read flows above 200 cfs and therefore cannot be used to develop model inflows. It is recommended that streamflow measurements be taken on Auburn Ravine to either provide a data series for model input or to allow for an improved regression.
- **Develop improved rating tables for major streams:** many of the major stream rating tables are based on C2VSim/SVSim (Sacramento Valley Groundwater-Surface Water Simulation Model) rating tables from a flood study. These rating tables are heavily biased towards high flows that rarely occur in the model. The lower first or second interval includes almost all of the flows observed in a 10-point rating table. This results in the model not having much stage sensitivity, which may affect groundwater / surface water interaction as well as calibration of flow and stage. It is recommended that future efforts to develop rating tables include more focus on low flow conditions that are important for water resource management.
- **Improve simulation of complex water systems:** CoSANA incorporates substantial detail on complex public water systems. In some cases, additional detail on where water is produced, how much water is

lost in transmission, and where water is used can improve the simulation and improve the ease of reporting data from the model. This is typically most relevant to larger public water systems with mixed surface water and groundwater supplies and those systems that utilize interties or perform transfers.

- **Improve data for Mather AFB remediation operations:** Pumping data was received, but well location information is not known. Incorporation of the locations of wells could improve simulation of remediation operations.
- **Improve model information and data sets on the eastern areas:** The model geologic, hydrogeologic, and land use information for the eastern areas of the model near the foothills will need to be further enhanced, once additional data are collected. Such data may include boring logs, groundwater data, or geophysical data such as from airborne electromagnetic surveys. Model calibration will need to be improved upon collection of additional groundwater level data from the representative monitoring wells on the east side.

7. REFERENCES

Amador Water Agency, 2016. 2015 Urban Water Management Plan. Prepared by RMC Water and Environment. June.

Berkstresser, C.F. Jr., 1973. *Base of Fresh Ground Water – Approximately 3,000 Micromhos – in the Sacramento Valley and Sacramento-San Joaquin Delta, California*. December. Accessed online at https://pubs.er.usgs.gov/publication/wri7340.

Brush, Charles F, Emin C Dogrul, and Tariq N Kadir, 2013. *Development and Calibration of the California Central Valley Groundwater-Surface Water Simulation Model (C2VSim), Version 3.02-CG*. accessed online at http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/download/C2VSim_Model_Report_2016-03_vR374.pdf.

California American Water (Cal-Am), 2016. Final 2015 Urban Water Management Plan for the Northern Division-Sacramento District. Prepared by Water System Consulting, Inc. June 30.

California Geological Survey, 2009. Preliminary Geologic Map of the Lodi 30' x 60' Quadrangle, California.

California Geological Survey, 2011. Preliminary Geologic Map of the Sacramento 30' x 60' Quadrangle, California.

Carmichael Water District, 2016. 2015 Urban Water Management Plan. Prepared by Tully & Young. Final June 27.

Citrus Heights Water District, 2016. 2015 Urban Water Management Plan. Prepared by J. Crowley Group Water Resources Planning and Policy. June.

City of Folsom, 2016. 2015 Urban Water Management Plan. Prepared by Tully & Young. June.

City of Galt, 2016. 2015 Urban Water Management Plan Update. Prepared by Carollo Engineers. July.

City of Lincoln, 2016a. Final 2015 Urban Water Management Plan. Prepared by Tully & Young.

City of Lincoln, 2016b. Water Master Plan, Public review Draft. Prepared by Tully & Young. November.

City of Roseville, 2016. Final 2015 Urban Water Management Plan. Prepared by West Yost Associates Consulting Engineers. May.

City of Sacramento, 2016. 2015 Urban Water Management Plan. Prepared by West Yost Associates Consulting Engineers. June.

City of Sacramento, 2017. Groundwater Master Plan Final Report. Prepared by RMC Water and Environment, a Woodard & Curran Company. December.

Dogrul, Emin C., Tariq N. Kadir, and Charles F. Brush, 2017a. *Integrated Water Flow Model Theoretical Documentation (IWFM-2015), Revision 630*. accessed online at http://baydeltaoffice.water.ca.gov/modeling/hydrology/IWFM/IWFM-2015/v2015_0_630/downloadables/IWFM-2015.0.630_Theoretical Documentation.pdf.

Dogrul, Emin C., Tariq N. Kadir, and Charles F. Brush, 2017b. *DWR Technical Memorandum: Theoretical Documentation and User's Manual for IWFM Demand Calculator (IDC-2015)*, Revision 63. Bay-Delta Office, California Department of Water Resources. accessed online at http://baydeltaoffice.water.ca.gov/modeling/hydrology/IDC/IDC-2015/v2015_0_63/index_ IDCv2015_0_63.cfm.

Doherty, J., 2015. *Calibration and Uncertainty Analysis for Complex Environmental Models*. Watermark Numerical Computing, Brisbane, Australia. ISBN: 978-0-9943786-0-6.

Dunn Environmental, 2012 *Groundwater Supply Study and Integrated Regional Groundwater Management Plan for the Lake Camanche Water Improvement District No. 7*. June.

DWR, 1974. *Evaluation of Ground Water Resources: Sacramento County.* Bulletin 118-3. July.

DWR, 2018a. *Sacramento Valley Groundwater-Surface Water Simulation Model Technical Memorandum 1B*. April.

DWR, 2018b. *California Water Plan*. June. accessed online at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/California-Water-Plan-Update-2018.pdf.

DWR, 2020. *California Central Valley Groundwater-Surface Water Simulation Model – Fine Grid (C2VSimFG): Development and Calibration Version 1.0*. December. accessed online at https://data.cnra.ca.gov/dataset/b313f4b2-1f5a-4028-9680-277cc04f6ded/resource/4f904e97-a47b-4138-81df-9b74bd952948/download/c2vsimfg-report-draft-clean_12072020_adaaccessible.pdf.

Fair Oaks Water District, 2016. 2015 Urban Water Management Plan. Prepared by Peterson Brustad Inc. Engineering Consulting. June.

Golden State Water Company, 2016. 2015 Urban Water Management Plan Cordova. Prepared by Kennedy/Jenks Consultants. June.

Golden State Water Company, 2020. *Supplement to the Water Supply Assessment for Lakeside at Sutter Pointe.* Prepared by Holland Knight and Wood Rodgers. October.

Orange Vale Water Company, 2016. 2015 Urban Water Management Plan. Prepared by J. Crowley Group Water Resources Planning and Policy. June.

Page, 1974. *Base and Thickness of the Post Eocene Continental Deposits in the Sacramento Valley, California.* USGS Water-Resources Investigations 45-73. September. accessed online at https://pubs.usgs.gov/wri/1973/0045/report.pdf.

Placer County Water Agency (PCWA), 2016. 2015 Urban Water Management Plan. Prepared by Tully & Young. June.

RMC Water and Environment, 2012. *Camanche Area Regional Water Supply Plan Feasibility Study and Conceptual Design.* January.

Rancho Murieta Community Services District, 2010. 2010 Integrated Water Supply Master Plan Update. Prepared by Brown and Caldwell. October.

Rio Linda / Elverta Community Water District, 2016. 2015 Urban Water Management Plan. Prepared by J. Crowley Group Water Resources Planning and Policy. June.

Roseville, City of, City of Lincoln, Placer County Water Agency, California American Water Company, 2007. *Western Placer County Groundwater Management Plan*. November.

Sacramento County Water Agency (SCWA), 2021. Draft Zone 40 Water Supply Master Plan Amendment. Prepared by Brown and Caldwell. January.

Sacramento Suburban Water District, 2016. 2015 Urban Water Management Plan. Prepared by Brown and Caldwell. June.

San Juan Water District, 2016. Final 2015 Urban Water Management Plan. Prepared by Kennedy/Jenks Consultants. June.

South Area Water Council, 2011.South Basin Groundwater Management Plan. Prepared by RBI and WRIME. October.

U.S. Bureau of Reclamation, 2019. *Long-Term Water Transfer EIS/R*. September.

U.S. Bureau of Reclamation, in press. *American River Basin Study*.

USDA NRCS, 2007. *National Engineering Handbook*, Part 630 Hydrology, Chapter 7, Hydrologic Soil Groups. May. accessed online at https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba.

APPENDIX A: MODEL SURFACE WATER DELIVERIES

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
1	North-Side Bear River Diversion - Import to Camp Far West ID for Agriculture	Import	Subregion 1	Agriculture	0.14	0.04	1	5,888	SacIWRM	
2	Bear River Diversions - Import to South Sutter WD for Agriculture	Import	Subregion 3	Agriculture	0.14	0.04	1	93,421	SacIWRM, MBK	
3	Auburn Ravine Diversions to South Sutter WD for Agriculture	Auburn Ravine	Subregion 3	Agriculture	0.14	0.04	1	1,529	MBK	
4	Small Stream Diversions - Import to South Sutter WD for Agriculture	Import	Subregion 3	Agriculture	0	0	1	331	MBK	
5	Auburn Ravine Diversions to Zone 5 - Import to Placer County Water Agency for Agriculture	Import	Subregion 4	Agriculture	0.14	0.04	1	9,998	SacIWRM, Placer County Water Agency	
6	Hemphill Canal - Import to Nevada Irrigation District for Agriculture	Import	Subregion 5	Agriculture	0.07	0.02	0.25	19,583	C2VSim, Nevada Irrigation District	Estimated portion of volume coming into model area
7	Auburn Ravine Diversions - Import to Nevada Irrigation District for Agriculture	Import	Subregion 5	Agriculture	0.07	0.02	0.25	3,497	C2VSim, Nevada Irrigation District	Estimated portion of volume coming into model area
8	From PCWA/NID Intertie - Import to City of Lincoln for Urban	Import	Subregion 6	Urban	0	0	1	6,218	SacIWRM, City of Lincoln	
9	Feather River Riparian Diversions for Agriculture	Feather River	Subregion 7	Agriculture	0.12	0.03	1	11,000	SacIWRM	
10	Sacramento River Diversions to Pleasant Grove Verona MWC for Agriculture	Sacramento River Upstream Cross Canal	Subregion 8	Agriculture	0.12	0.03	1	14,528	C2VSim, USBR	
11	Sacramento River Riparian Diversions below Feather River confluence for Agriculture	Sacramento River Upstream Natomas East Drain	Subregion 9	Agriculture	0.12	0.03	1	1,260	SacIWRM	
12	Natomas Mutual Water Company USBR Diversions for Agriculture	Sacramento River Upstream Natomas East Drain	Element group representing / NMWC	Agriculture	0.01	0.0033	1	61,850	SacIWRM, Natomas Mutual Water Company	
13	NOT USED	N/A	Out of model	Agriculture	0	0	0	0	N/A	Not used
14	Folsom Diversions - Import to City of Roseville for Urban	Import	Subregion 13	Urban	0	0	1	27,943	City of Roseville	
15	From PCWA Intertie - Import to City of Roseville for Urban	Import	Subregion 13	Urban	0	0	1	0	N/A	Placeholder, no data
16	From PCWA Intertie - Import to Cal-Am West Placer for Urban	Import	Subregion 14	Urban	0	0	1	725	RWA, GEI	
17	Import to Sacramento Int'l Airport for Urban	Import	Subregion 16	Urban	0	0	1	175	SacIWRM, RWA	
18	Sacramento River Riparian Imports near Sacramento Int'l Airport	Import	Subregion 18	Agriculture	0	0	1	3,124	SacIWRM	
19	Import to Rio Linda Elverta CWD from SSWD Intertie for Urban	Import	Element group representing / Rio Linda Elverta CWD Service Area	Urban	0	0	1	5	RWA	
20	From SSWD Intertie - Import to Cal-Am Antelope for Urban	Import	Subregion 23	Urban	0	0	1	170	RWA	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
21	From SSWD Intertie - Import to Cal-Am Lincoln Oaks for Urban	Import	Subregion 24	Urban	0	0	1	245	RWA	
22	Folsom Diversions Via SJWD Intertie - Import to Citrus Heights WD for Urban	Import	Subregion 25	Urban	0	0	1	16,015	RWA, SacIWRM	
23	From PCWA Intertie - Import to San Juan WD for Urban	Import	Subregion 26	Urban	0	0	1	0	N/A	Placeholder, no data
24	Total Folsom Diversions Inc. Wholesale - Import to San Juan WD for Urban	Import	Out of model	Urban	0	0	1	33,020	RWA	
25	Retail Only - Import to San Juan WD for Urban	Import	Element group representing / SAN JUAN WD RETAIL AREA	Urban	0	0	0.37	14,043	RWA, SacIWRM	
26	Sac Suburban North District Total GW Production	Import	Subregion 32	Urban	0	0	1	16,044	RWA	
27	From SSWD Intertie - Import to San Juan WD for Urban	Import	Subregion 26	Urban	0	0	1	0	N/A	Placeholder, no data
28	From PCWA Intertie - Import to San Juan WD for Urban	Import	Subregion 26	Urban	0	0	1	0	N/A	Placeholder, no data
29	Folsom Diversions via SJWD Intertie - Import to Orange Vale WC for Urban	Import	Subregion 28	Urban	0	0	1	4,191	RWA, SacIWRM	
30	Folsom Diversions Via SJWD Intertie - Import to Fair Oaks WD for Urban	Import	Subregion 30	Urban	0	0	1	11,145	RWA, SacIWRM	
31	American River Diversions to Carmichael WD for Urban	American River	Subregion 31	Urban	0	0	1	7,155	RWA, SacIWRM	
32	From Sac Suburban Intertie - Import to Carmichael WD for Urban	Import	Subregion 31	Urban	0	0	1	0	N/A	Placeholder, no data
33	From CHWD Intertie - Import to Carmichael WD for Urban	Import	Subregion 31	Urban	0	0	1	0	N/A	Placeholder, no data
34	Sac Suburban North District Imports - Import to Sac Suburban North for Urban	Import	Subregion 32	Urban	0	0	1	8,987	RWA, SacIWRM	
35	From City of Sac Intertie - Import to Sac Suburban South for Urban	Import	Subregion 33	Urban	0	0	1	1,037	RWA	
36	From SSWD SSA Intertie - Import to City of Sacramento for Urban	Import	Element group representing / CITY OF SACRAMENTO	Urban	0	0	1	161	RWA	
37	From PCWA - Import to City of Rocklin for Urban	Import	Element group representing Rocklin	Urban	0	0	1	4,578	Placer County Water Agency	
38	Metro Air Park - Import to Metro Air Park for Urban	Import	Subregion 17	Urban	0	0	1	0	N/A	Placeholder, no data
39	From City of Sac Intertie - Import to Cal-Am Arden for Urban	Import	Subregion 36	Urban	0	0	1	2	RWA, SacIWRM	
40	City of Sacramento - American River Diversions to City of Sacramento for Urban	American River	Out of model	Urban	0	0	1	48,211	RWA	
41	City of Sacramento - Sacramento River Diversions to City of Sacramento for Urban	Sacramento River Upstream Morrison Crk	Out of model	Urban	0	0	1	52,300	RWA	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
42	City of Sacramento - Retail SW Delivery Volumes - Import to City of Sacramento for Urban	Import	Element group representing / CITY OF SACRAMENTO	Urban	0	0	1	97,195	RWA, SacIWRM	
43	Sac Suburban South District Total GW Production - Import to Sac Suburban South for Urban	Import	Subregion 33	Urban	0	0	1	16,351	RWA, SacIWRM	Represents total GW production for service area
44	NOT USED - Import for Agriculture	Import	Out of model	Agriculture	0	0	0	470	N/A	
45	Arcade American River Diversions to Arcade for Urban	American River Upstream Sacramento R.	Subregion 39	Urban	0	0	1	132	SacIWRM	
46	From City of Sac Intertie - Import to Cal-Am Suburban Rosemont for Urban	Import	Subregion 40	Urban	0	0	1	85	RWA	
47	FSC/American River Diversions - Import to Golden State Water Company Cordova for Urban	Import	Subregion 42	Urban	0	0	1	5,922	SacIWRM, RWA	FSC operations not currently simulated
48	From Carmichael WD - Import to Golden State Water Company Cordova for Urban	Import	Subregion 42	Urban	0	0	1	366	RWA	
49	Aerojet FSC Diversions - Import to Aerojet FSC for Urban	Import	Out of model	Urban	0	0	1	1,083	SacIWRM	FSC operations not currently simulated
50	Folsom Diversions, Estimated Prior to 1983 - Import to City of Folsom for Urban	Import	Subregion 44	Urban	0	0	1	20,451	SacIWRM, RWA	
51	SJWD Intertie) - Placeholder No Dat - Import to City of Folsom for Urban	Import	Subregion 44	Urban	0	0	1	0	N/A	Placeholder, no data
52	From SCWA Intertie - Import to Cal-Am Security Park for Urban	Import	Subregion 45	Urban	0	0	1	0	N/A	Placeholder, no data
53	From City of Sac Intertie - Import to Fruitridge Vista WC for Urban	Import	Subregion 46	Urban	0	0	1	1	RWA	
54	From City of Sac Intertie - Import to Cal-Am Parkway for Urban	Import	Subregion 48	Urban	0	0	1	592	RWA	
55	GW Imports - Import to SCWA - Arden Park Vista for Urban	Import	Subregion 37	Urban	0	0	1	3,911	SacIWRM, RWA, SCWA	Represents total GW production for service area
56	SW Imports - Import to SCWA - Arden Park Vista for Urban	Import	Subregion 37	Urban	0	0	1	0	N/A	Represents total SW delivered to service area
57	RW Imports - Import to SCWA - Arden Park Vista for Urban	Import	Subregion 37	Urban	0	0	1	0	N/A	Represents total RW for service area
58	GW Imports - Import to SCWA - Hood for Urban	Import	Element group representing SCWA - Hood	Urban	0	0	1	47	SacIWRM, RWA, SCWA	Represents total GW production for service area
59	SW Imports - Import to SCWA - Hood for Urban	Import	Element group representing SCWA - Hood	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
60	RW Imports - Import to SCWA - Hood for Urban	Import	Element group representing SCWA - Hood	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total RW for service area

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
61	GW Imports - Import to SCWA - Northgate for Urban	Import	Subregion 20	Urban	0	0	1	940	SacIWRM, RWA, SCWA	Represents total GW production for service area
62	SW Imports - Import to SCWA - Northgate for Urban	Import	Subregion 20	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
63	RW Imports - Import to SCWA - Northgate for Urban	Import	Subregion 20	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total RW for service area
64	GW Imports - Import to SCWA - Laguna Vineyard for Urban	Import	Element group representing SCWA - South and Central Service Areas (including Elk Grove)	Urban	0	0	1	17,340	SacIWRM, RWA, SCWA	Represents total GW production for service area
65	SW Imports - Import to SCWA - Laguna Vineyard for Urban	Import	Element group representing SCWA - South and Central Service Areas (including Elk Grove)	Urban	0	0	1	3,314	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
66	RW Imports - Import to SCWA - Laguna Vineyard for Urban	Import	Element group representing SCWA - South and Central Service Areas (including Elk Grove)	Urban	0	0	1	232	SacIWRM, RWA, SCWA	Represents total RW for service area
67	GW Imports - Import to SCWA Mather for Urban	Import	Element group representing SCWA - NSA	Urban	0	0	1	3,958	SacIWRM, RWA, SCWA	Represents total GW production for service area
68	SW Imports - Import to SCWA Mather for Urban	Import	Element group representing SCWA - NSA	Urban	0	0	1	233	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
69	RW Imports - Import to SCWA Mather for Urban	Import	Element group representing SCWA - NSA	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total RW for service area
70	North Delta WA Ag Diversions - Import to North Delta WA for Agriculture	Import	Element group representing NDWA	Agriculture	0	0	1	43,072	SacIWRM	
71	Cosumnes River diversion 1 for ag use in element group 4 within Cosumnes River South and Sac Co. 8 subregions to for Agriculture	Cosumnes River Upstream Mokolumne R. / EKI	Element group representing CosSb_4	Agriculture	0	0	1	356	eWRIMS	
72	Cosumnes River diversion 2 for ag use in element group 4 within Cosumnes River South and Sac Co. 8 subregions to for Agriculture	Cosumnes River Upstream Laguna Crk /EKI	Element group representing CosSb_4	Agriculture	0	0	1	4	eWRIMS	
73	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	752	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
74	East Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_3	Agriculture	0	0	1	103	eWRIMS and Mark Stretars	
75	Cosumnes River diversion 3 for ag use in element group 4 within Cosumnes River South and Sac Co. 8 subregions for Agriculture	Cosumnes River Upstream Badger Crk / EKI	Element group representing CosSb_4	Agriculture	0	0	1	1,119	eWRIMS	
76	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	1,143	eWRIMS	
77	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	130	eWRIMS	
78	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	307	eWRIMS	
79	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	2,153	eWRIMS	
80	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_2	Agriculture	0	0	1	354	eWRIMS	
81	East Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_3	Agriculture	0	0	1	42	eWRIMS	
82	Cos and S Am Subbasins for Urban	Cosumnes River Upstream Deer Crk / EKI	Out of model	Urban	0	0	1	3,755	eWRIMS	
83	Dry Creek diversion for ag use in element group 7 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Out of model	Agriculture	0	0	1	432	eWRIMS	
84	Dry Creek diversion for ag use in element group 8 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Out of model	Agriculture	0	0	1	2,238	eWRIMS	
85	Dry Creek diversion 1 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk / EKI	Element group representing CosSb_9	Agriculture	0	0	1	31	eWRIMS	
86	Dry Creek diversion 2 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Element group representing CosSb_9	Agriculture	0	0	1	62	eWRIMS	
87	Dry Creek diversion 3 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Element group representing CosSb_9	Agriculture	0	0	1	3	eWRIMS	
88	Dry Creek diversion 4 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Element group representing CosSb_9	Agriculture	0	0	1	1	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
89	Dry Creek diversion 1 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	5,398	eWRIMS	
90	East Subregion to for Agriculture	Dry Creek Upstream Mokolumne R.	Element group representing CosSb_6	Agriculture	0	0	1	413	eWRIMS	
91	East Subregion for Agriculture	Dry Creek Upstream Mokolumne R.	Element group representing CosSb_6	Agriculture	0	0	1	59	eWRIMS	
92	Dry Creek diversion 2 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	547	eWRIMS	
93	East Subregion for Agriculture	Dry Creek Upstream Mokolumne R.	Element group representing CosSb_6	Agriculture	0	0	1	19	eWRIMS	
94	Dry Creek diversion 3 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	1,748	eWRIMS	
95	Dry Creek diversion 4 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	1,748	eWRIMS	
96	Dry Creek diversion 5 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	1,748	eWRIMS	
97	East Subregion for Agriculture	Badger Creek	Element group representing CosSb_15	Agriculture	0	0	1	10	eWRIMS	
98	West Subregion for Agriculture	Badger Creek	Element group representing CosSb_12	Agriculture	0	0	1	35	eWRIMS	
99	Laguna Creek diversion for ag use in element group 21 within Clay WD subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_21	Agriculture	0	0	1	301	eWRIMS	
100	East Subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_11	Agriculture	0	0	1	362	eWRIMS	
101	East Subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_11	Agriculture	0	0	1	3	eWRIMS	
102	East Subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_10	Agriculture	0	0	1	49	eWRIMS	
103	Jackson Creek diversion for ag use in element group 14 within Jackson ID subregion - Import for Agriculture	Import	Element group representing CosSb_14	Agriculture	0	0	1	10,558	eWRIMS	
104	Mokelumne River diversion 1 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_16	Agriculture	0	0	1	2,376	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
105	Mokelumne River diversion 2 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	436	eWRIMS	
106	Mokelumne River diversion 3 for ag use in element group 16 within Cosumnes River South subregion to for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	232	eWRIMS	
107	Mokelumne River diversion 4 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	933	eWRIMS	
108	Mokelumne River diversion 5 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	4	eWRIMS	
109	Mokelumne River diversion 6 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	141	eWRIMS	
110	East Subregion - Import for Agriculture	Import	Element group representing CosSb_19	Agriculture	0	0	1	1,263	eWRIMS	
111	East Subregion - Import for Agriculture	Import	Element group representing CosSb_17	Agriculture	0	0	1	651	eWRIMS	
112	East Subregion - Import for Agriculture	Import	Element group representing CosSb_18	Agriculture	0	0	1	142	eWRIMS	
113	Diversion from unmodeled stream or spring for ag use in OHWD Cosumnes Subbasin subregion - Import for Agriculture	Import	Subregion 67	Agriculture	0	0	1	232	eWRIMS	
114	East Subregion - Import for Agriculture	Import	Subregion 69	Agriculture	0	0	1	200	eWRIMS	
115	Diversion from unmodeled stream or spring for ag use in Wilton subregion - Import for Agriculture	Import	Subregion 70	Agriculture	0	0	1	11	eWRIMS	
116	Diversion from unmodeled stream or spring for ag use in Sloughhouse RCD West subregion - Import for Agriculture	Import	Subregion 71	Agriculture	0	0	1	133	eWRIMS	
117	Diversion from unmodeled stream or spring for ag use in Galt ID East subregion - Import for Agriculture	Import	Subregion 72	Agriculture	0	0	1	10	eWRIMS	
118	Diversion from unmodeled stream or spring for ag use in SMUD Rancho Seco subregion - Import for Agriculture	Import	Subregion 75	Agriculture	0	0	1	455	eWRIMS	
119	Diversion from unmodeled stream or spring for ag use in Cosumnes River South subregion - Import for Agriculture	Import	Subregion 76	Agriculture	0	0	1	5	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
120	Diversion from unmodeled stream or spring for ag use in Amador Co. 1 subregion - Import for Agriculture	Import	Subregion 81	Agriculture	0	0	1	217	eWRIMS	
121	Diversion from unmodeled stream or spring for ag use in Jackson ID subregion - Import for Agriculture	Import	Subregion 83	Agriculture	0	0	1	91	eWRIMS	
122	Diversion from unmodeled stream or spring for ag use in Comanche subregion - Import for Agriculture	Import	Subregion 84	Agriculture	0	0	1	80	eWRIMS	
123	Diversion from unmodeled stream or spring for ag use in Amador County WA subregion - Import or Agriculture	Import	Subregion 85	Agriculture	0	0	0	3	eWRIMS	
124	East Subregion - Import to for Agriculture	Import	Element group representing CosSb_20	Agriculture	0	0	1	150	eWRIMS	
125	Cosumnes Subbasin Subregion - Import for Agriculture	Import	Subregion 67	Agriculture	0	0	1	180	SacIWRM	
126	East Subregion - Import for Agriculture	Import	Subregion 72	Agriculture	0	0	1	1,128	SacIWRM	
127	Tailwater Reuse from fish farms for ag use in Clay WD subregion - Import to for Agriculture	Import	Subregion 73	Agriculture	0	0	1	150	SacIWRM	
128	East) Subregion - Import for Agriculture	Import	Subregion 69	Agriculture	0	0	1	300	SacIWRM	
129	Import to Ione for local surface water supply - Import for Urban	Import	Subregion 82	Urban	0	0	1	1,878	SacIWRM	
130	Recoverable Loss from Rancho Seco Export Water to Laguna Creek - Import for Agriculture	Import	Out of model	Agriculture	0	0	0	12,028	SacIWRM	
131	NOT USED - Import for Agriculture	Import	Out of model	Agriculture	0	0	0	786	N/A	
132	Cosumnes Subbasin) Subregion to O-H for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 67	Agriculture	0	0	0.34	0	SacIWRM	
133	South American) Subregion to O-H for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 66	Agriculture	0	0	0.66	0	SacIWRM	
134	East Subregion to Galt ID for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 72	Agriculture	0	0	1	2,279	SacIWRM	
135	Clay ID FSC diversions to Clay ID subregion to Clay ID for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 73	Agriculture	0	0	1	1,051	SacIWRM	
136	SMUD FSC diversions to SMUD Rancho Seco subregion to SMUD FSC for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 75	Agriculture	0	0	1	14,615	SacIWRM	
137	SCWA Freeport Diversions for Mather and Vineyard SW Supply	Sacramento River at Freeport	Out of model	Urban	0	0	1	3,154	RWA	Retail delivery handled with Divs 65, 68

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
138	Deer Creek diversion to SRCD to Deer Creek for Agriculture	Deer Creek	Subregion 65	Agriculture	0	0	1	29	eWRIMS	
139	Deer Creek diversions to OHWD to Deer Creek for Agriculture	Deer Creek	Subregion 66	Agriculture	0	0	1	175	eWRIMS	
140	Cosumnes River diversion to RMCSD area Ag to Cosumnes River for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Subregion 64	Agriculture	0	0	1	570	eWRIMS	
141	Cosumnes River diversions to OHWD to Cosumnes River for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Subregion 66	Agriculture	0	0	1	1,388	eWRIMS	
142	Not Used	Import	N/A	N/A	1	0	1	0	N/A	
143	Diversion from water stored in Loch Lane for at use, adjusted to meet demand	Import	Element group representing / CosSb_22	Agriculture	0	0	1	2,670	eWRIMS	
144	Galt WWTP flows through Laguna Creek to Galt WWTP for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing / Galt WWTP	Agriculture	0	0	1	700	South Basin Groundwater Management Plan, Robertson-Bryan Inc. and WRIME, 2011	
145	Rancho Murieta diversion from stored water to meet estimated demand. - Import to Rancho Murieta for Urban	Import	Element group representing CosSb_13	Urban	0	0	1	1,833	RMCSD	

RL: Recoverable Loss
NL: Non-recoverable Loss

APPENDIX B: REMEDIATION PUMPING BY ENTITY

Water Year	Aerojet Remediation (NASb) (acre-feet)	Aerojet Remediation (SASb) (acre-feet)	Kiefer Landfill Remediation (acre-feet)	Mather Air Force Base Remediation (acre-feet)	McClellan Air Force Base Remediation (acre-feet)
1995	0	14,568	102	157	745
1996	0	15,189	468	209	1,145
1997	0	14,672	517	209	1,157
1998	270	16,916	898	209	1,167
1999	2,018	14,586	870	209	1,032
2000	1,900	12,747	1,500	209	2,020
2001	1,672	13,297	1,339	209	1,440
2002	1,583	12,657	1,793	209	1,105
2003	1,551	15,267	1,531	209	1,098
2004	1,695	18,682	1,622	209	1,569
2005	1,953	17,591	1,333	209	1,446
2006	2,069	18,892	1,280	209	2,272
2007	2,382	19,568	1,555	209	2,838
2008	2,287	21,786	1,391	209	2,743
2009	2,093	21,383	1,321	209	2,386
2010	2,424	24,938	1,111	209	2,369
2011	2,674	26,618	1,141	209	2,406
2012	3,394	26,058	575	209	2,483
2013	2,125	18,808	488	209	2,394
2014	2,479	21,932	522	209	2,317
2015	2,689	20,137	494	209	2,213
2016	3,482	28,274	375	209	2,432
2017	3,430	29,362	422	209	2,395
2018	3,105	28,935	621	209	2,409
Average WY 1995-2018	**1,970**	**19,703**	**969**	**207**	**1,899**

APPENDIX C: SUBREGION LAND AND WATER USE BUDGETS

Historical Water Use Budget Summary, Annual Average for WY 1995 - 2018

Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,760	9,327	5.3	169	150	0.9	9,477	4,472	4,990	150	-	-	9,612	-	-
2	Sutter Co. 1	147	643	4.4	2	1	0.4	644	643	-	1	-	-	644	-	-
3	South Sutter WD GSA	52,398	183,202	3.5	1,962	1,490	0.8	184,693	103,768	80,796	1,490	-	-	186,055	-	-
4	Placer County WA[1]	12,243	31,383	2.6	7,202	8,308	1.2	39,692	22,996	8,473	3,730	4,578	-	39,778	-	-
5	Nevada ID	3,168	11,467	3.6	482	397	0.8	11,864	6,030	5,770	397	-	-	12,196	-	-
6	Lincoln[1]	527	1,275	2.4	4,573	6,958	1.5	8,233	1,275	-	739	6,218	-	8,233	-	-
7	RD1001 [1]	7,476	28,604	3.8	371	165	0.4	28,769	19,039	9,565	165	-	-	28,769	-	-
8	Pleasant Grove Verona MWC	6,813	23,943	3.5	99	45	0.5	23,988	12,036	12,633	45	-	-	24,714	-	-
9	Sutter Co. 2	985	3,447	3.5	87	39	0.5	3,486	2,278	1,169	39	-	-	3,486	-	-
10	Natomas MWC (Sutter Co.)	11,694	41,428	3.5	436	197	0.5	41,625	717	40,744	197	-	-	41,658	-	-
11	Sutter Co. 3	2,912	9,152	3.1	440	289	0.7	9,441	9,152	-	289	-	-	9,441	-	-
12	Roseville SOI	1,127	3,037	2.7	44	105	2.4	3,141	3,037	-	105	-	-	3,141	-	-
13	City of Roseville	488	623	1.3	16,617	28,069	1.7	28,692	623	-	126	27,943	-	28,692	-	-
14	Cal Am (West Placer)	3,223	6,459	2.0	2,146	725	0.3	7,184	6,459	-	-	725	-	7,184	-	-
15	Natomas MWC (Sacramento Co.)	13,037	41,942	3.2	1,357	2,973	2.2	44,915	687	41,291	2,973	-	-	44,951	-	-
16	Sacramento International Airport	946	893	0.9	1,621	1,143	0.7	2,037	893	-	968	175	-	2,037	-	-
17	Metro Air Park	1,643	1,458	0.9	37	-	0.0	1,458	1,458	-	-	-	-	1,458	-	-
18	Sac Co. 1	928	1,896	2.0	139	604	4.3	2,500	100	1,796	604	-	-	2,500	-	-
19	Sac Co. 2	793	2,636	3.3	141	17	0.1	2,653	2,636	-	17	-	-	2,653	-	-
20	Sac County WA (Northgate 880)	43	52	1.2	792	940	1.2	992	52	-	940	-	-	992	-	-
21	Rio Linda Elverta	630	905	1.4	5,873	8,941	1.5	9,846	905	-	8,936	5	-	9,846	-	-
22	Sac Co. 3	327	250	0.8	214	335	1.6	584	250	-	335	-	-	584	-	-
23	Cal Am (Antelope)	4	8	1.8	2,664	5,790	2.2	5,798	8	-	5,621	170	-	5,798	-	-
24	Cal Am (Lincoln Oaks)	3	8	2.3	4,254	9,114	2.1	9,122	8	-	8,869	245	-	9,122	-	-
25	Citrus Heights WD	66	262	3.9	7,706	16,967	2.2	17,229	262	-	952	16,015	-	17,229	-	-
26	San Juan WD (Placer Co.)	41	18	0.4	1,130	1,817	1.6	1,835	18	-	-	1,817	-	1,835	-	-
27	San Juan WD (Sacramento Co.)	79	246	3.1	2,043	3,378	1.7	3,624	246	-	-	3,378	-	3,624	-	-
28	Orange Vale WC	119	618	5.2	2,839	4,191	1.5	4,809	618	-	-	4,191	-	4,809	-	-
29	Lake Natoma/Mississippi Bar	1	35	36.0	128	-	0.0	35	35	-	-	-	-	35	-	-
30	Fair Oaks WD	97	284	2.9	6,159	12,328	2.0	12,611	284	-	1,183	11,145	-	12,611	1,401	-
31	Carmichael WD	0	0	3.5	5,255	11,234	2.1	11,234	0	-	4,080	7,155	-	11,234	568	-
32	Sacramento Suburban WD (North)	154	74	0.5	13,736	25,031	1.8	25,105	74	-	16,130	8,902	-	25,105	1,843	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,765	17,388	2.2	17,388	-	-	16,387	1,001	-	17,388	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,549	2.5	1,549	-	-	1,549	-	-	1,549	-	-
35	Golden State WC Arden	-	-	0.0	496	1,169	2.4	1,169	-	-	1,169	-	-	1,169	-	-
36	Cal Am (Arden)	-	-	0.0	640	2,832	4.4	2,832	-	-	2,830	2	-	2,832	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,348	3,911	2.9	3,911	-	-	3,911	-	-	3,911	-	-
38	City of Sacramento (North)	3,522	4,546	1.3	17,106	37,754	2.2	42,300	4,546	-	6,459	31,296	-	42,300	56	-
	Total NASb	127,396	410,120	120	118,685	216,346	58	626,466	205,605	207,227	91,384	124,961	-	629,177	3,869	-
39	City of Sacramento (South)	735	1,230	1.7	35,588	79,828	2.2	81,058	1,146	84	13,767	66,193	-	81,190	-	-
40	Cal Am (Suburban Rosemont)	291	938	3.2	7,186	12,381	1.7	13,318	938	-	12,296	110	-	13,343	131	-
41	Sac Co. 4	65	29	0.4	15	-	0.0	29	29	-	-	-	-	29	-	-
42	Golden State WC (Cordova)	72	76	1.1	6,310	15,264	2.4	15,341	76	-	8,977	6,287	-	15,341	4,422	-
43	Sac Co. 5	-	-	0.0	269	3	0.0	3	-	-	-	3	-	3	7,351	-
44	City of Folsom[1]	53	55	1.1	9,505	20,451	2.2	20,507	35	-	-	20,451	-	20,487	3,137	-
45	Cal Am (Security Park)	-	-	0.0	171	31	0.2	31	-	-	31	0	-	31	48	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,224	2.2	4,224	-	-	4,387	1	-	4,388	-	-
47	Florin County WD	1	4	3.9	1,369	2,623	1.9	2,628	4	-	2,623	-	-	2,628	-	-
48	Cal Am (Parkway)	5	11	1.9	5,007	11,291	2.3	11,302	11	-	10,699	592	-	11,302	-	-
49	Sac Co. 6	463	898	1.9	1,056	57	0.1	955	598	300	57	-	-	955	-	-
50	Sac County WA (North/Central)	4,080	11,378	2.8	12,881	16,425	1.3	27,803	11,378	-	14,874	1,435	92	27,779	4,819	207
51	Sac County WA (South)	3,303	8,188	2.5	7,996	11,375	1.4	19,564	8,188	-	9,397	1,851	128	19,564	-	-
52	Elk Grove WD (2 - Intertie Service Area)	639	1,717	2.7	2,374	3,430	1.4	5,147	1,717	-	2,833	558	38	5,147	-	-
53	Elk Grove WD (1 - GW Service Area)	33	115	3.5	2,934	5,189	1.8	5,305	115	-	5,189	-	-	5,305	-	-
54	Cosumnes River West	18,072	56,004	3.1	1,824	4,533	2.5	60,536	51,495	4,509	4,533	-	-	60,537	-	-
55	RD744	1,294	2,738	2.1	102	60	0.6	2,798	702	2,036	60	-	-	2,798	-	-
56	Franklin Drainage District	2,825	8,515	3.0	250	158	0.6	8,673	3,180	5,336	125	33	-	8,674	-	-
57	RD813	2,075	4,676	2.3	82	48	0.6	4,724	1,287	3,389	33	15	-	4,724	-	-
58	RD755	354	1,497	4.2	26	16	0.6	1,513	520	978	16	-	-	1,513	-	-
59	RD1002	4,303	10,037	2.3	254	166	0.7	10,203	2,889	7,148	166	-	-	10,203	-	-
60	RD551	7,927	22,522	2.8	423	245	0.6	22,767	6,062	16,462	245	-	-	22,768	-	-
61	RD369	108	382	3.5	37	23	0.6	406	130	252	23	-	-	406	-	-
62	RD2110	1,401	2,033	1.5	52	28	0.5	2,061	409	1,624	28	-	-	2,061	-	-
63	Sac Co. 7	306	680	2.2	88	94	1.1	773	176	504	94	-	-	773	-	-
64	Rancho Murieta (North) [1]	381	1,239	3.2	1,098	1,415	1.3	2,654	740	499	153	1,262	-	2,654	-	-
65	Sloughouse RCD (North)	575	1,318	2.3	631	616	1.0	1,934	1,290	28	584	31	-	1,934	-	-
66	OHWD (Sth American Subbasin)	9,592	24,431	2.5	2,469	1,970	0.8	26,401	23,282	1,517	1,554	431	-	26,784	969	-
	Total SASb	58,954	160,714	62	101,890	191,942	33	352,656	116,398	44,668	92,742	99,252	258	353,318	20,879	207
67	OHWD (Cosumnes Subbasin)	2,633	7,608	2.9	1,049	975	0.9	8,583	5,202	2,407	1,053	-	-	8,661	-	-
68	Rancho Murieta (South)	4	20	4.7	365	465	1.3	485	6	14	-	412	-	432	-	-
69	Sloughouse RCD (East)	8,331	21,515	2.6	1,303	1,322	1.0	22,838	19,813	1,702	109	128	-	21,752	-	-
70	Wilton	1,018	3,611	3.5	3,502	2,742	0.8	6,353	3,600	11	4,352	-	-	7,963	-	-
71	Sloughouse RCD (West)	4,111	10,694	2.6	324	242	0.7	10,936	10,562	132	8	-	-	10,701	-	-
72	Galt ID (East)	14,401	41,762	2.9	6,071	5,336	0.9	47,098	38,080	3,682	9,526	-	-	51,288	-	-
73	Clay WD	1,918	7,109	3.7	172	479	2.8	7,588	5,634	1,474	-	-	-	7,109	-	-
74	Clay	61	180	2.9	2,805	1,945	0.7	2,126	180	-	1,903	-	-	2,084	-	-
75	SMUD Rancho Seco	21	36	1.7	137	138	1.0	174	-	36	7	-	-	43	-	-
76	Cosumnes River South	4,405	12,174	2.8	191	315	1.6	12,488	9,159	3,046	-	-	-	12,205	-	-
77	Galt ID (West)	1,847	5,355	2.9	1,331	1,222	0.9	6,577	5,355	-	707	-	-	6,062	-	-
78	Sac Co. 8	2,882	6,480	2.2	623	924	1.5	7,404	5,124	1,356	165	-	-	6,645	-	-
79	City of Galt	182	361	2.0	3,035	4,650	1.5	5,011	361	-	4,737	-	-	5,099	-	-
80	Sloughouse RCD (South)	1,034	2,418	2.3	320	497	1.6	2,915	2,418	-	56	-	-	2,474	-	-
81	Amador Co. 1	1,812	3,278	1.8	1,832	2,530	1.4	5,809	1,259	2,018	0	-	-	3,277	-	-
82	Ione	153	425	2.8	1,109	2,130	1.9	2,555	425	0	-	1,878	-	2,303	-	-
83	Jackson ID	2,693	9,258	3.4	361	456	1.3	9,713	-	9,018	-	-	-	9,018	-	-
84	Camanche	63	-	0.0	133	164	1.2	164	-	-	76	-	-	76	-	-
85	Amador County WA	0	-	0.0	199	245	1.2	245	-	-	181	-	-	181	-	-
87	Galt WWTP	148	209	1.4	57	88	1.5	297	-	698	-	-	-	698	-	-
	Total CoSb	47,717	132,494	49	24,918	26,866	26	159,360	107,180	25,594	22,881	2,417	-	158,072	-	-
86	Mokelumne	34,664	79,056	2.3	3,200	4,222	1.3	83,278	79,056	-	4,222	-	-	83,278	-	-
	Total Other	34,664	79,056	2.3	3,200	4,222	1.3	83,278	79,056	-	4,222	-	-	83,278	-	-
	CoSANA Grand Total (NASb, SASb, CoSb)	234,067	703,329	231	245,493	435,154	116	1,138,482	429,183	277,488	207,008	226,630	258	1,140,568	24,748	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

APPENDIX D: STREAM REACH BUDGETS

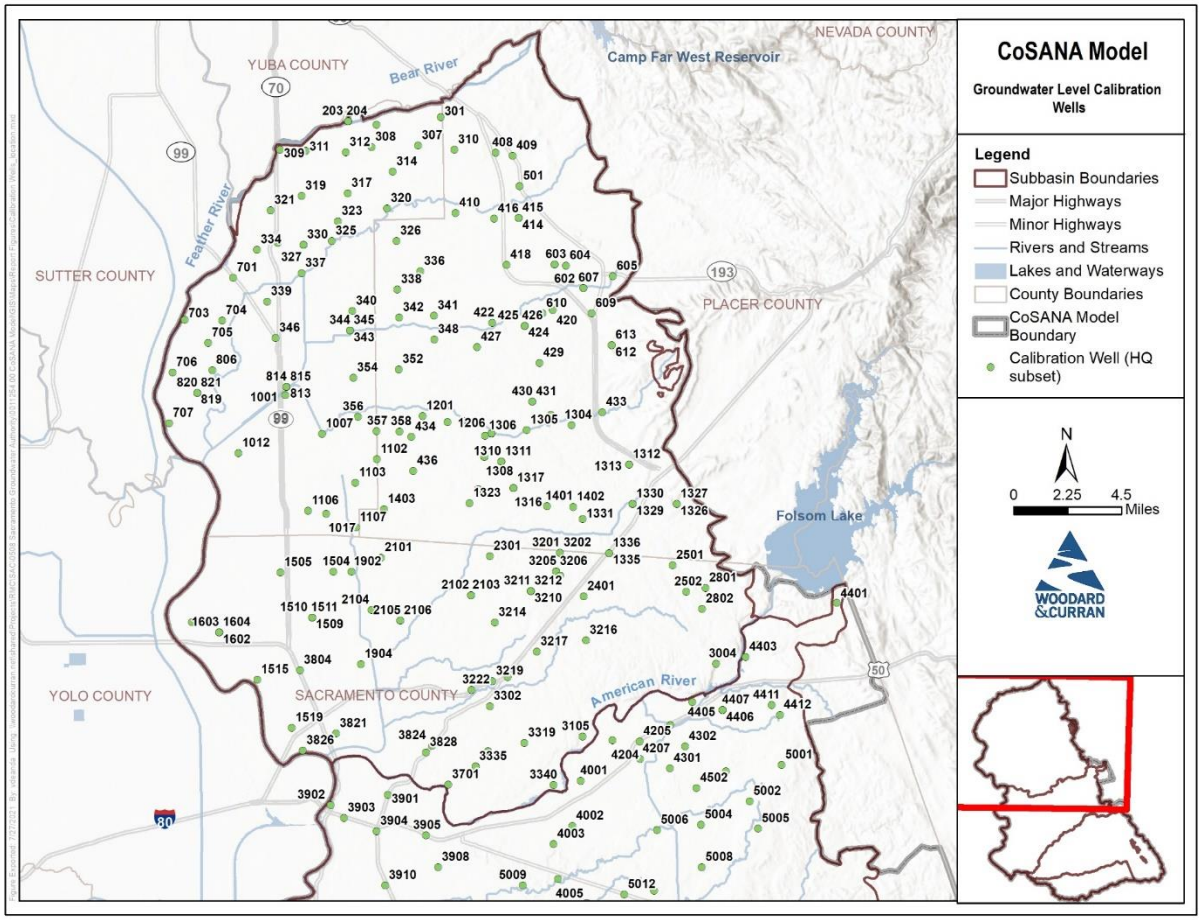
Reach Number	Reach Description	Upstream Inflow (acre-feet)	Downstream Outflow (acre-feet)	Tributary Inflow (acre-feet)	Runoff (acre-feet)	Return Flow (acre-feet)	Gain from Groundwater (acre-feet)	Riparian ET (acre-feet)	Runoff (acre-feet)	Diversion Shortage (acre-feet)
1	Bear River	325,762	362,711	1,587	15,179	3,535	16,654	0	0	0
2	Feather River	5,680,692	5,643,013	0	0	0	-26,679	0	11,000	0
3	Sacramento River Upstream Cross Canal	14,471,419	14,512,137	0	31,663	8,137	15,455	0	14,528	0
4	Racoon Creek (formerly Coon Creek)	28,867	73,106	21,978	35,599	7,876	-21,201	0	0	0
5	East Side Canal I	0	21,499	334	17,074	4,405	-307	0	0	0
6	Auburn Ravine	19,365	26,950	0	13,451	3,115	-7,449	0	1,528	1
7	East Side Canal II	48,450	47,304	0	0	0	-1,146	0	0	0
8	Pleasant Grove Creek	28,846	76,604	386	38,745	12,405	-3,773	0	0	0
9	Pleasant Grove Creek Canal	76,604	73,288	0	0	0	-3,321	0	0	0
10	Cross Canal 1	120,591	114,705	0	0	0	-5,881	0	0	0
11	Cross Canal 2	187,811	189,809	0	0	0	1,998	0	0	0
12	Sacramento River Upstream Natomas East Drain	14,701,946	14,624,027	0	0	0	6,551	0	84,471	0
13	Natomas East Drain Upstream Dry Crk	0	128,860	0	86,007	50,192	-7,347	0	0	0
14	Dry Creek (North American Subbasin)	35,968	47,216	2,438	16,213	7,721	-15,123	0	0	0
15	Natomas East Drain Upstream Magpie Crk	47,216	96,191	0	30,091	20,647	-1,752	0	0	0
16	Magpie Creek	2,470	1,915	0	0	0	-554	0	0	0
17	Natomas East Drain Upstream Arcade Crk	98,107	155,478	0	34,602	26,267	-3,498	0	0	0
18	Arcade Crk	0	0	0	0	0	0	0	0	0
19	Natomas East Drain Upstream Sacramento R.	155,478	147,333	0	0	0	-8,144	0	0	0
20	Sacramento River Upstream American R.	14,771,360	14,777,536	0	0	0	6,176	0	0	0
21	Alder Creek	0	3,728	999	0	0	2,729	0	0	0
22	Buffalo Creek	7,203	53,112	0	32,572	16,776	-3,438	0	0	0
23	American River Upstream Alder Crk	2,747,286	2,754,396	409	0	0	6,700	0	0	0
24	American River Upstream Buffalo Crk	2,758,124	2,750,442	0	0	0	-7,682	0	0	0
25	American River Buffalo Crk to H St Bridge	2,815,189	2,718,995	0	0	0	-40,829	0	55,365	0
26	American River Upstream Sacramento R.	2,718,995	2,736,106	0	0	0	17,242	0	132	0
27	Sacramento River Upstream Morrison Crk	17,513,642	17,502,205	0	42,933	35,792	-34,708	0	55,453	0
28	Morrison Creek Upstream Elder Crk	17,995	77,197	0	41,487	20,118	-2,388	0	0	0
29	Elder Creek	0	0	0	0	0	0	0	0	0
30	Morrison Creek Upstream Beacon Crk	77,197	74,208	0	0	0	-2,989	0	0	0
31	Beacon Creek	0	57	0	0	0	57	0	0	0
32	Morrison Creek Upstream Laguna Crk	74,265	111,174	0	28,492	9,394	-970	0	0	0
33	Laguna Creek (South American Subbasin)	8,342	2,940	0	0	0	-5,402	0	0	0
34	Morrison Creek Upstream Sacramento R.	114,114	134,109	0	11,790	7,076	1,133	0	0	0
35	Sacramento River Upstream Mokolumne Confluence	17,636,315	17,649,814	0	38,822	12,907	-38,209	0	0	0
36	Deer Creek	1,214	104,376	87,005	23,491	2,701	-9,833	0	197	6
37	Cosumnes River Upstream Deer Crk	397,070	409,057	0	25,669	3,406	-8,031	1,239	7,818	197
38	Cosumnes River Upstream Badger Crk	513,433	505,527	0	662	182	-7,340	640	769	0
39	Badger Creek	0	6,524	0	6,425	486	199	579	0	45
40	Cosumnes River Upstream Laguna Crk	512,051	522,840	0	17,105	1,617	-7,584	340	4	0
41	Laguna Creek (Cosumnes Subbasin)	21,012	96,118	17,138	52,214	7,685	1,003	1,544	1,388	0
42	Cosumnes River Upstream Mokolumne R.	618,958	617,231	0	8,449	2,085	-10,375	1,817	68	0
43	Dry Creek Upstream Jackson Crk	30,040	53,117	0	19,708	1,448	4,570	0	2,649	75
44	Jackson Creek	30,295	36,670	804	0	0	5,570	0	0	0
45	Dry Creek Upstream Mokolumne R.	89,787	119,068	0	46,628	6,563	-18,302	1,614	3,955	505
46	Mokolumne River Upstream Dry Crk	569,130	534,845	0	5,415	1,306	-41,001	0	0	0
47	Mokolumne River Upstream Cosumnes R.	653,913	649,754	0	0	0	-3,591	281	290	0
48	Mokolumne River Upstream Sacramento R. Confluence	1,266,985	1,278,877	0	0	0	11,894	0	0	0
49	Folsom South Canal (North of Cosumnes R.)	0	0	0	0	0	0	0	0	0
50	Folsom South Canal (South of Cosumnes R.)	0	0	0	0	0	0	0	0	0
51	Hadselville Creek	12,039	11,985	0	0	0	-27	27	0	0

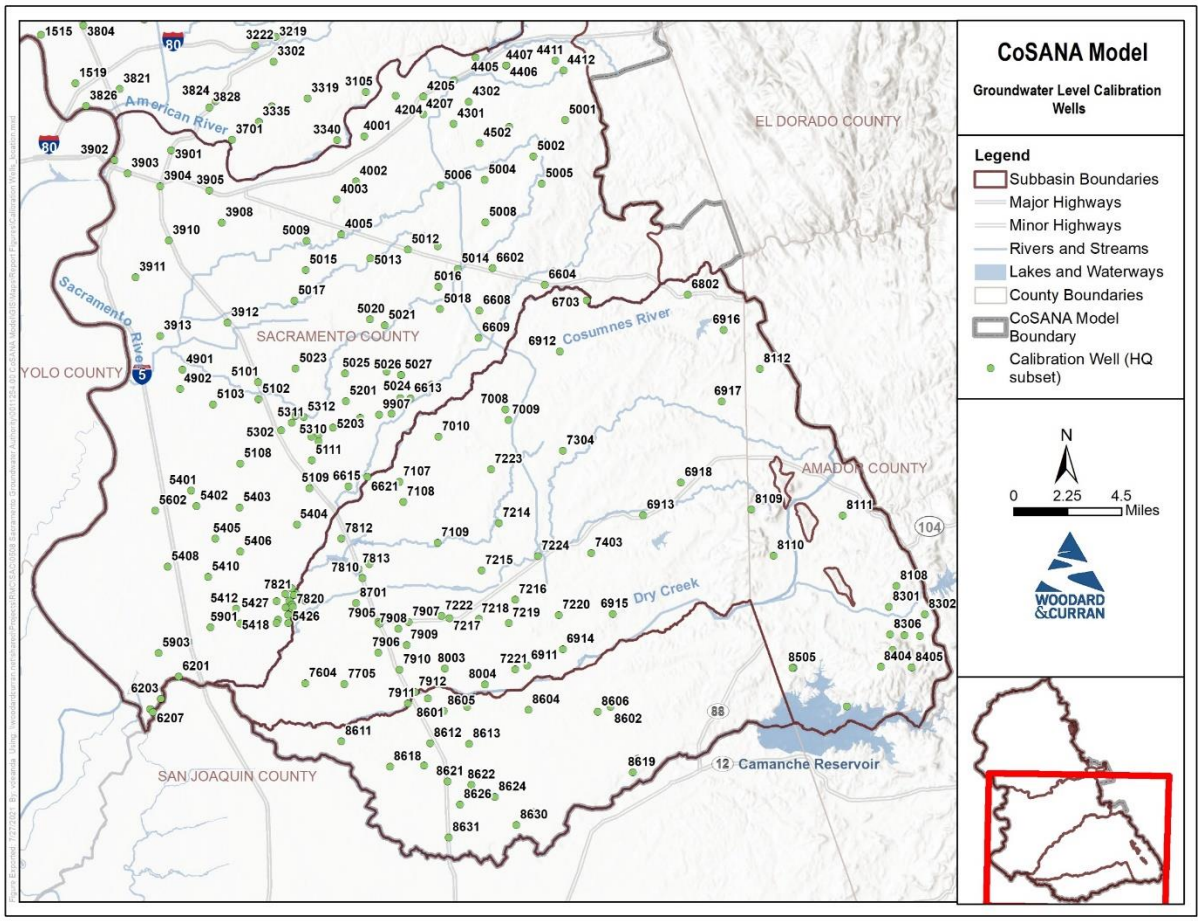
APPENDIX E: SUBREGION GROUNDWATER BUDGETS

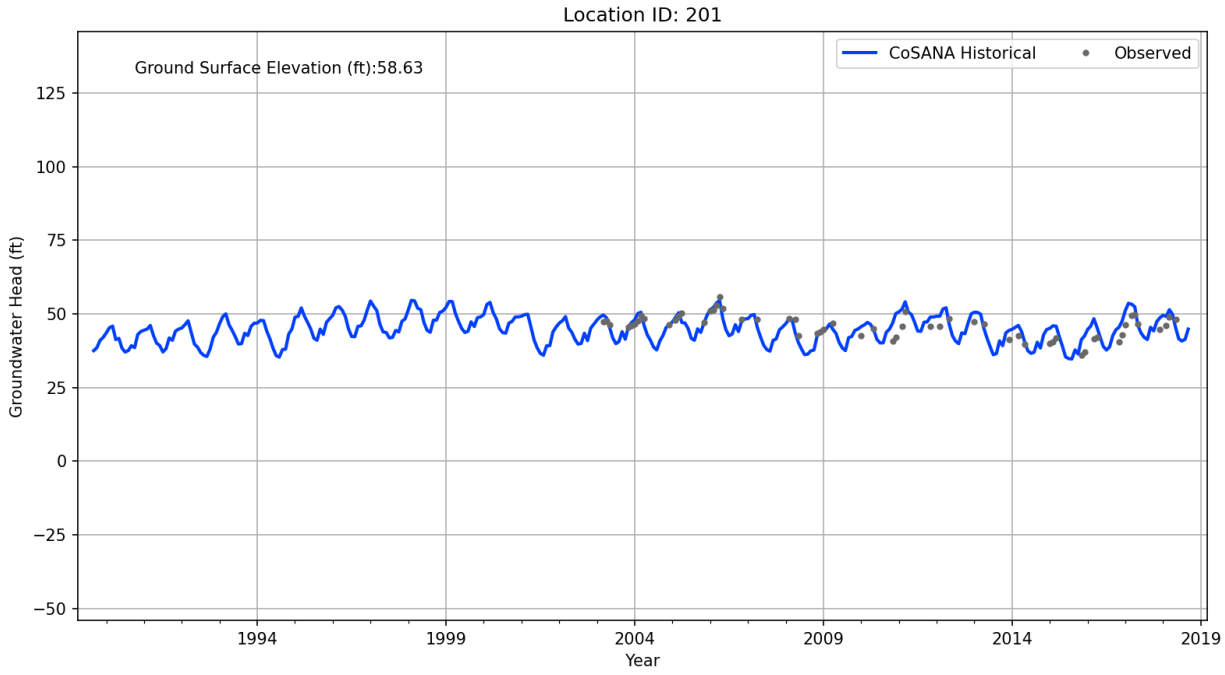
Historical Groundwater Budget Summary, Annual Average for WY 1995 - 2018							
Subregion	**Description**	**Deep Percolation**	**Gain from Stream**	**Recharge (Recoverable Loss)**	**Boundary Inflow**	**Net Subsurface Inflow**	**Pumping**
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
North American Subbasin							
1	Camp Far West ID	6,135	-5,792	699	2,385	1,193	4,622
2	Sutter Co. 1	309	19	0	1,042	-723	644
3	South Sutter WD GSA	53,729	24,620	11,265	3,832	12,707	105,258
4	Placer County WA	32,625	3,435	1,186	1,469	-4,129	26,874
5	Nevada ID	7,990	850	1,616	4,455	-8,249	6,426
6	Lincoln	6,143	933	0	505	-1,859	1,866
7	RD1001	15,990	3,411	1,148	741	-1,978	19,204
8	Pleasant Grove Verona MWC	5,444	2,754	1,516	0	2,447	12,081
9	Sutter Co. 2	1,438	-2,571	140	1,429	1,889	2,318
10	Natomas MWC (Sutter Co.)	7,966	5,839	306	72	-10,265	3,933
11	Sutter Co. 3	3,321	938	0	0	5,114	9,441
12	Roseville SOI	1,287	1,178	0	0	1,043	3,141
13	City of Roseville	5,768	6,041	145	2,486	-8,724	749
14	Cal Am (West Placer)	4,747	4,279	0	0	-1,597	6,465
15	Natomas MWC (Sacramento Co.)	11,773	-3,535	514	4,246	-8,920	3,477
16	Sacramento International Airport	1,060	0	0	0	982	1,862
17	Metro Air Park	878	0	0	0	745	1,468
18	Sac Co. 1	964	-2,655	0	4,068	-1,619	704
19	Sac Co. 2	1,336	2,281	0	0	-242	3,286
20	Sac County WA (Northgate 880)	77	603	0	0	238	846
21	Rio Linda Elverta	2,156	5,736	0	0	2,732	9,840
22	Sac Co. 3	231	793	0	0	-356	584
23	Cal Am (Antelope)	618	663	0	0	4,262	5,134
24	Cal Am (Lincoln Oaks)	618	0	0	0	8,459	8,402
25	Citrus Heights WD	1,760	0	0	476	-292	1,680
26	San Juan WD (Placer Co.)	434	0	0	1,159	-1,751	18
27	San Juan WD (Sacramento Co.)	649	-488	0	811	-931	246
28	Orange Vale WC	1,338	0	0	0	-1,018	618
29	Lake Natoma/Mississippi Bar	1,516	-4,959	0	30	3,461	35
30	Fair Oaks WD	2,910	5,159	0	0	-5,449	2,877
31	Carmichael WD	1,165	6,118	0	0	-1,996	4,906
32	Sacramento Suburban WD (North)	2,802	53	0	0	16,599	17,456
33	Sacramento Suburuban WD (South)	954	7,379	0	0	9,721	17,166
34	Del Paso Manor WD	84	0	0	0	1,550	1,549
35	Golden State WC Arden	45	0	0	0	956	931
36	Cal Am (Arden)	481	0	0	0	1,492	1,901
37	Sac County WA (Arden Park	237	991	0	0	1,819	2,896
38	City of Sacramento (North)	4,793	19,148	0	1,130	1,947	25,074
Total NASb		191,772	83,222	18,535	30,336	19,257	315,980
South American Subbasin							
39	City of Sacramento (South)	16,041	15,444	0	1,403	-28,141	3,252
40	Cal Am (Suburban Rosemont)	1,950	7,140	0	0	4,865	13,511
41	Sac Co. 4	301	2,827	0	0	-3,093	29
42	Golden State WC (Cordova)	6,644	14,347	0	0	-7,641	13,361
43	Sac Co. 5	1,939	0	0	0	5,527	7,351
44	City of Folsom	17,068	-2,544	0	2,135	-10,936	3,171
45	Cal Am (Security Park)	1,608	37	0	0	-1,613	79
46	Fruitridge Vista WC	306	235	0	0	3,194	3,621
47	Florin County WD	158	0	0	0	2,209	2,315
48	Cal Am (Parkway)	857	303	0	0	9,845	10,762
49	Sac Co. 6	1,228	3,807	0	228	-4,544	655
50	Sac County WA (North/Central)	18,508	3,649	207	0	8,510	32,290
51	Sac County WA (South)	5,692	203	0	0	14,360	19,306
52	Elk Grove WD (2 - Intertie Service Area)	1,525	1,066	0	0	1,132	3,758
53	Elk Grove WD (1 - GW Service Area)	493	632	0	0	6,665	7,568
54	Cosumnes River West	23,325	11,899	0	0	21,878	56,028
55	RD744	885	6,948	0	-718	-6,346	762
56	Franklin Drainage District	3,383	6,324	0	-205	-6,030	3,365
57	RD813	1,648	3,037	0	-91	-3,265	1,320
58	RD755	549	1,415	0	-249	-1,180	535
59	RD1002	3,199	0	0	0	-115	3,055
60	RD551	8,934	6,259	0	-1,397	-7,491	6,307
61	RD369	441	2,023	0	-201	-2,110	153
62	RD2110	865	-745	0	516	-197	437
63	Sac Co. 7	407	1,342	0	29	-1,507	270
64	Rancho Murieta (North)	5,053	-1,984	0	0	-1,382	893
65	Sloughouse RCD (North)	4,971	93	0	2,791	-5,805	1,874
66	OHWD (Sth American Subbasin)	11,701	15,439	15	64	-969	25,837
Total SASb		139,681	99,195	222	4,307	-14,179	221,865
Cosumnes Subbasin							
67	OHWD (Cosumnes Subbasin)	5,590	5,181	0	0	-4,272	6,255
68	Rancho Murieta (South)	1,070	-1,843	0	0	768	6
69	Sloughouse RCD (East)	22,178	3,548	0	1,116	-9,591	19,922
70	Wilton	4,641	45	0	0	3,051	7,953
71	Sloughouse RCD (West)	4,099	381	0	0	5,687	10,570
72	Galt ID (East)	20,192	1,970	0	0	23,121	47,606
73	Clay WD	3,514	1,115	0	0	629	5,634
74	Clay	1,051	3	0	0	733	2,084
75	SMUD Rancho Seco	473	0	0	0	-666	7
76	Cosumnes River South	4,860	9,984	0	-523	-5,018	9,159
77	Galt ID (West)	2,736	776	0	0	2,631	6,062
78	Sac Co. 8	4,301	8,367	0	0	-7,323	5,289
79	City of Galt	1,744	668	0	0	2,623	5,099
80	Sloughouse RCD (South)	1,225	993	0	0	224	2,474
81	Amador Co. 1	13,266	-5,448	0	3,367	-8,492	1,259
82	Ione	1,513	0	0	0	-602	425
83	Jackson ID	8,648	-6,775	0	507	-2,429	0
84	Camanche	5,130	0	0	-4,621	-1,420	81
85	Amador County WA	1,477	0	0	5	-1,559	176
87	Galt WWTP	344	0	0	0	-352	0
Total CoSb		108,054	18,964	0	-149	-2,255	130,062
Other							
86	Mokelumne	29,317	49,564	0	3,650	-2,823	83,278
Total Other		29,317	49,564	0	3,650	-2,823	83,278
CoSANA Total (NASb, SASb, CoSb)		439,507	201,381	18,757	34,495	2,823	667,907

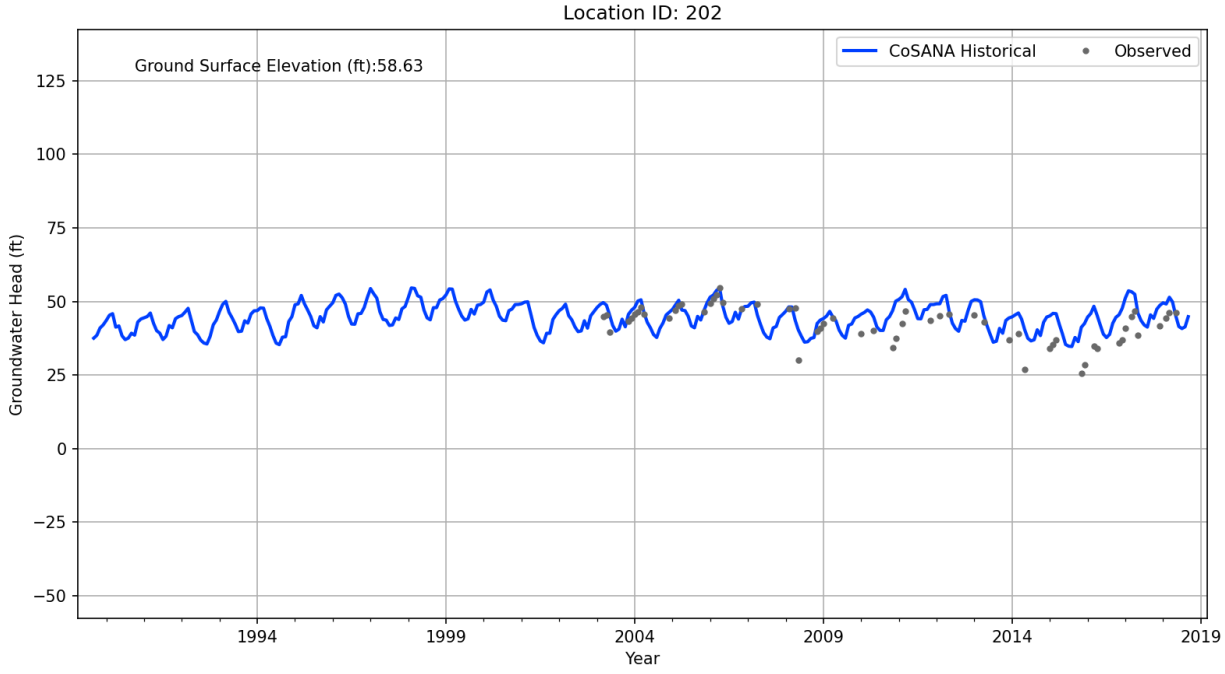
APPENDIX F: CALIBRATION HYDROGRAPHS

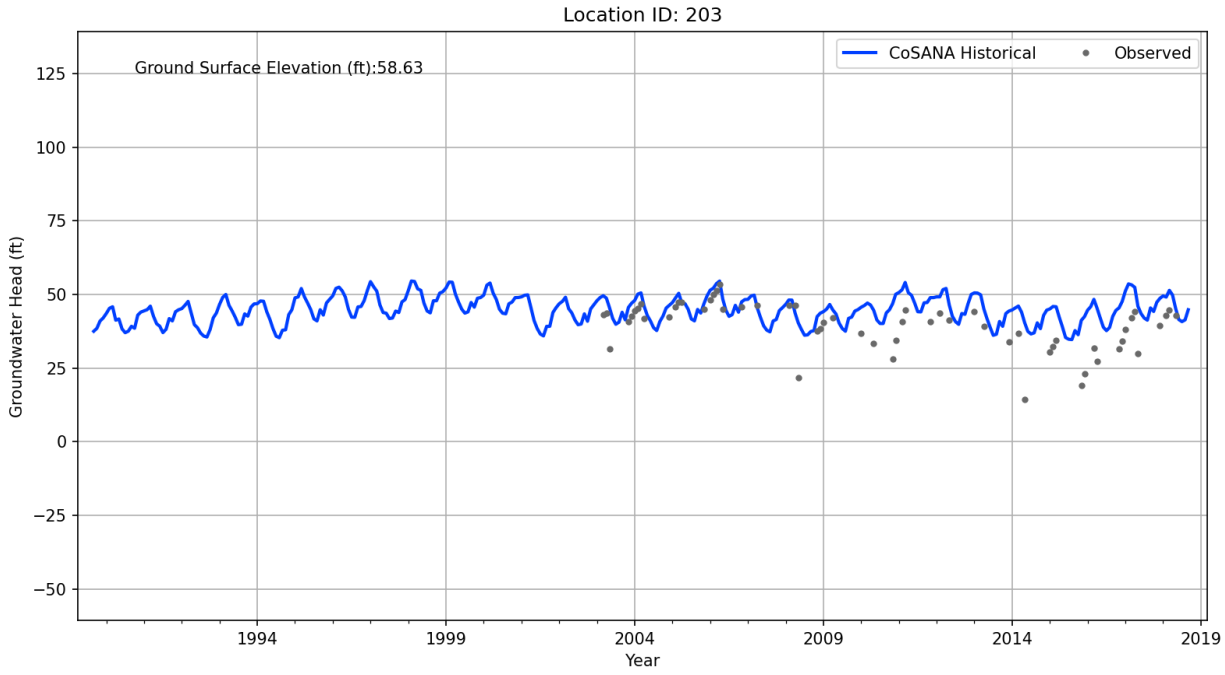
Note: *hydrographs developed for this appendix use a transmissivity-weighted average of layers 2 through 5 for simulated groundwater heads.*

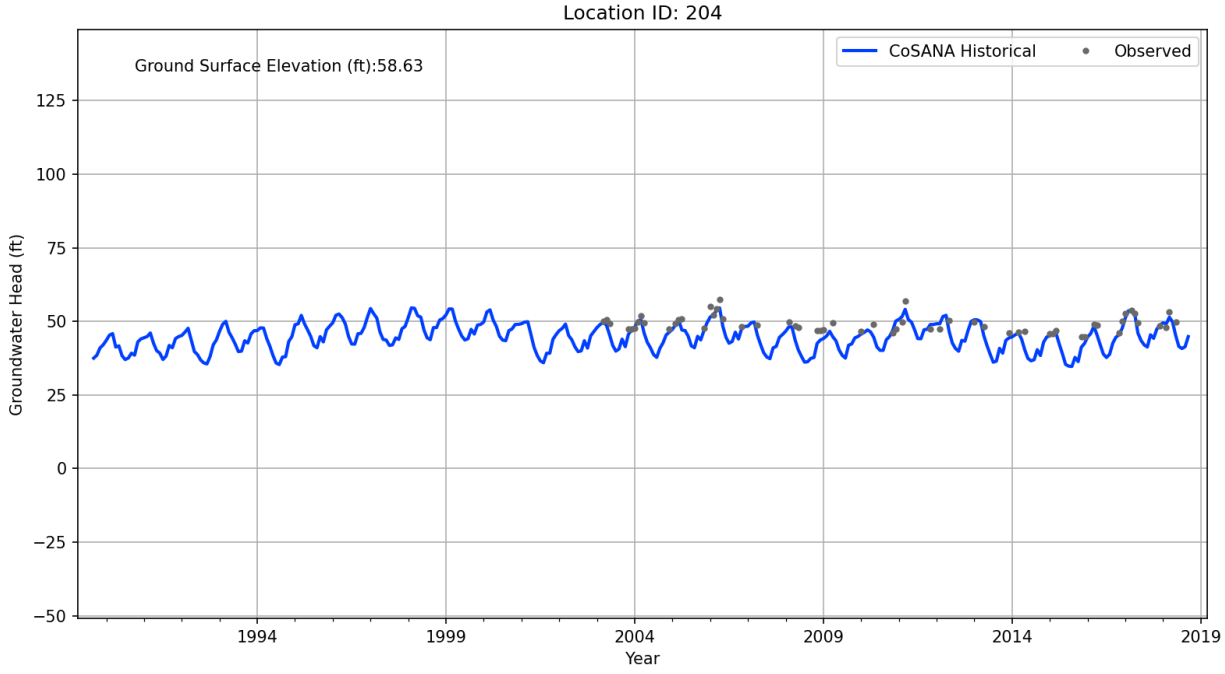


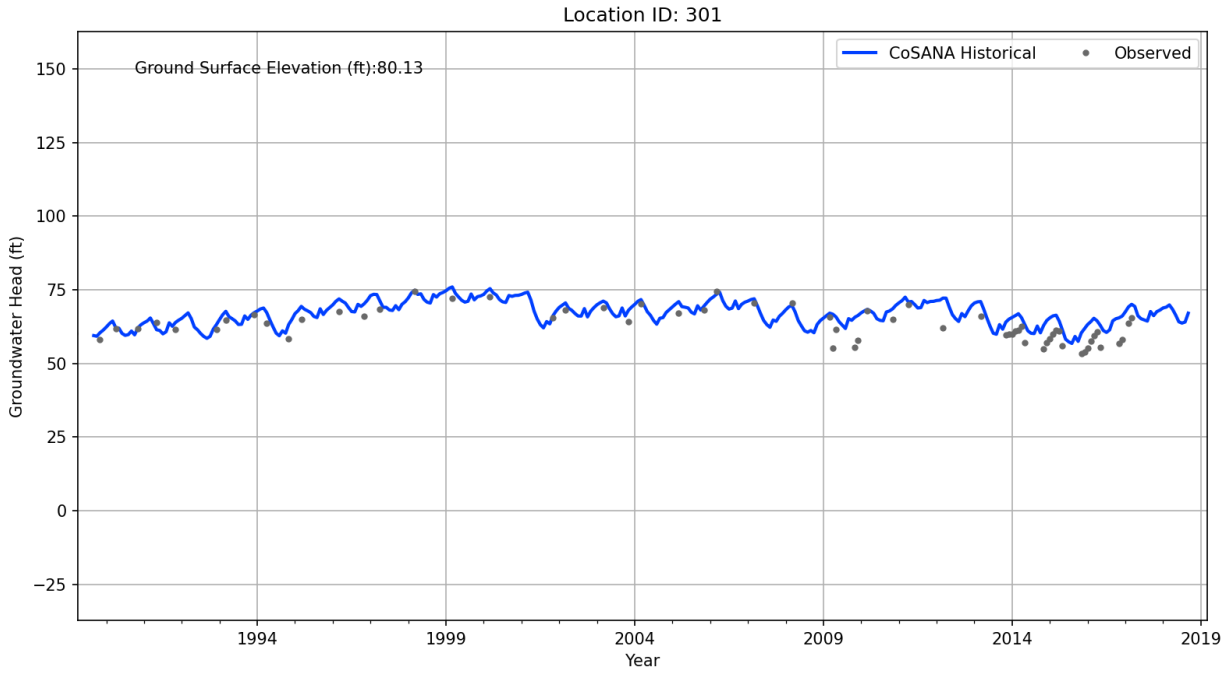

CoSANA Model
Groundwater Level Calibration Wells
Legend
Subbasin Boundaries
Major Highways
Minor Highways
Rivers and Streams
Lakes and Waterways
County Boundaries
CoSANA Model Boundary
Calibration Well (HQ subset)
N
0 2.25 4.5
Miles
WOODARD &CURRAN
EL DORADO COUNTY
SACRAMENTO COUNTY
YOLO COUNTY
AMADOR COUNTY
SAN JOAQUIN COUNTY
American River
Sacramento River
Cosumnes River
Dry Creek
Camanche Reservoir

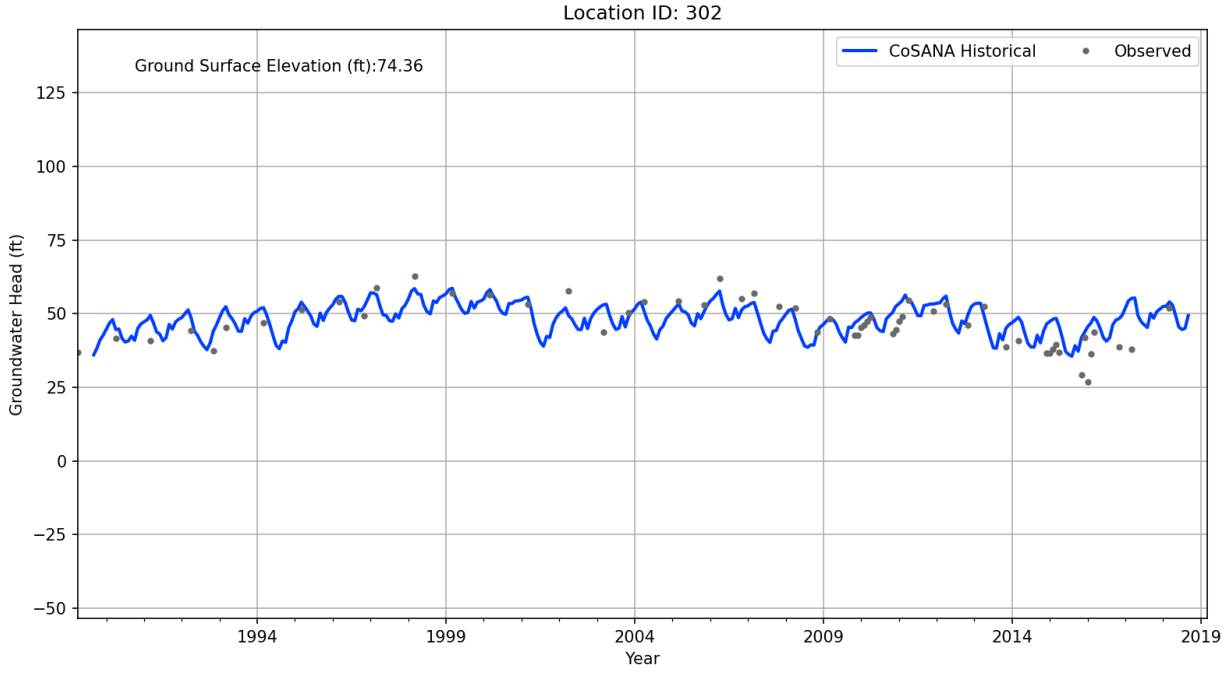

Location ID: 201
Ground Surface Elevation (ft):58.63
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

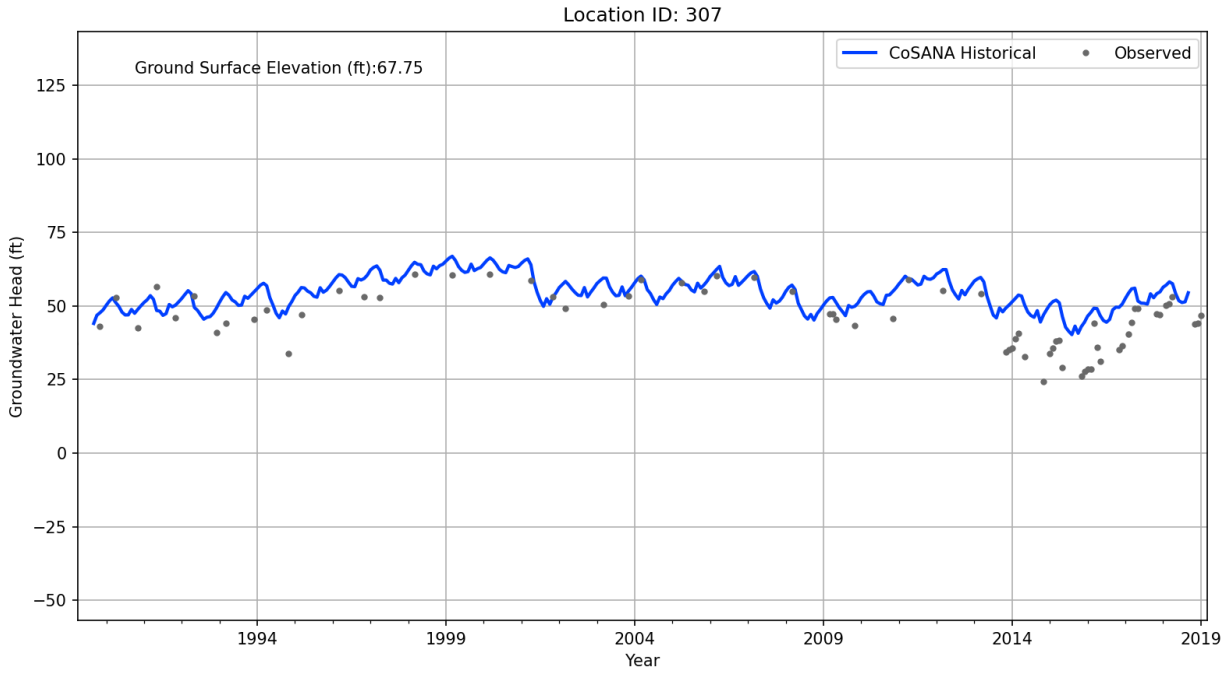

Location ID: 202
Ground Surface Elevation (ft):58.63
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

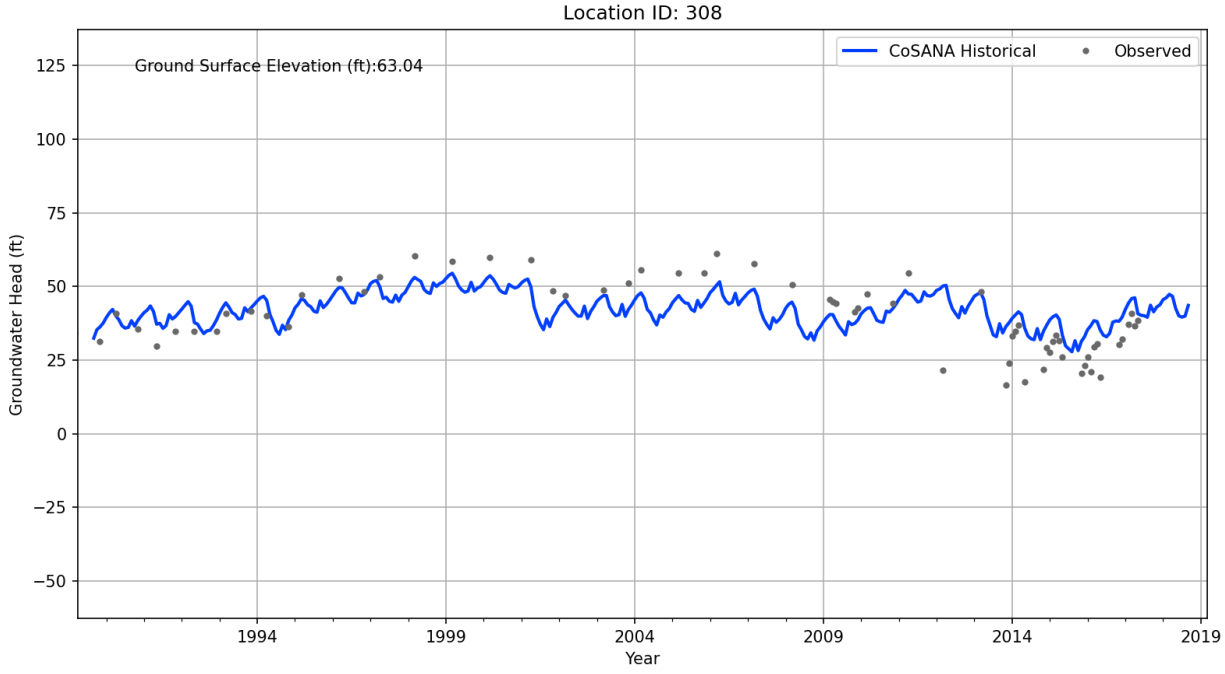

Location ID: 203
Ground Surface Elevation (ft):58.63
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

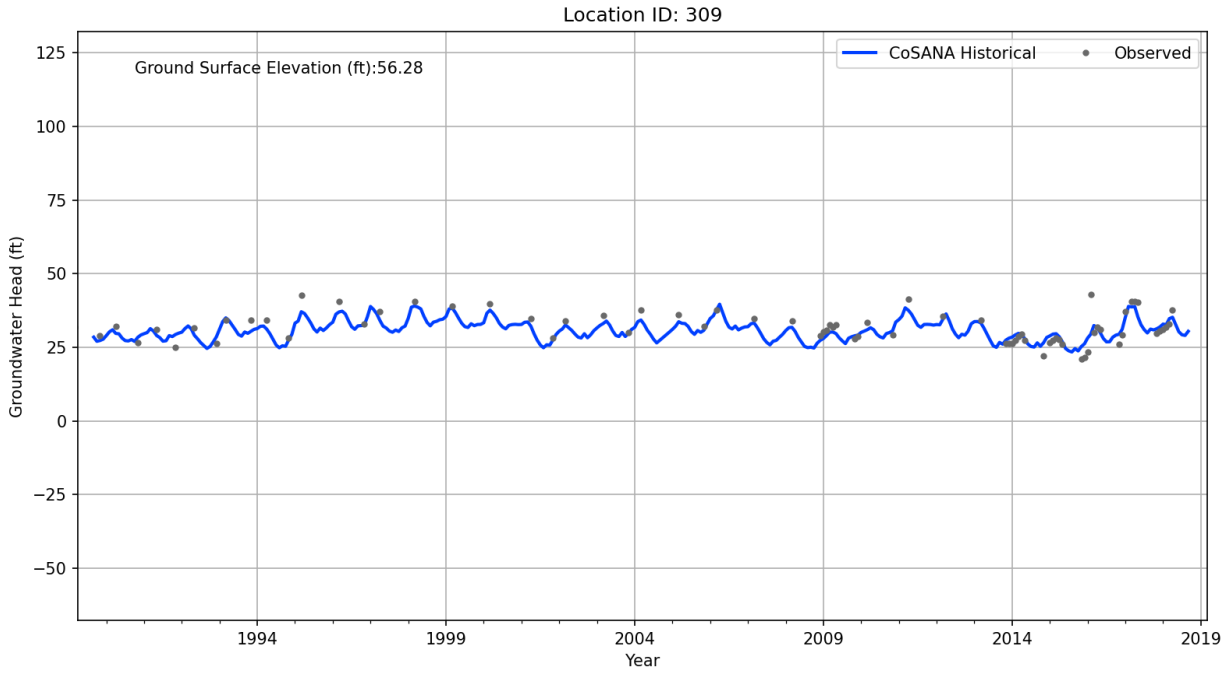

Location ID: 204
Ground Surface Elevation (ft):58.63
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

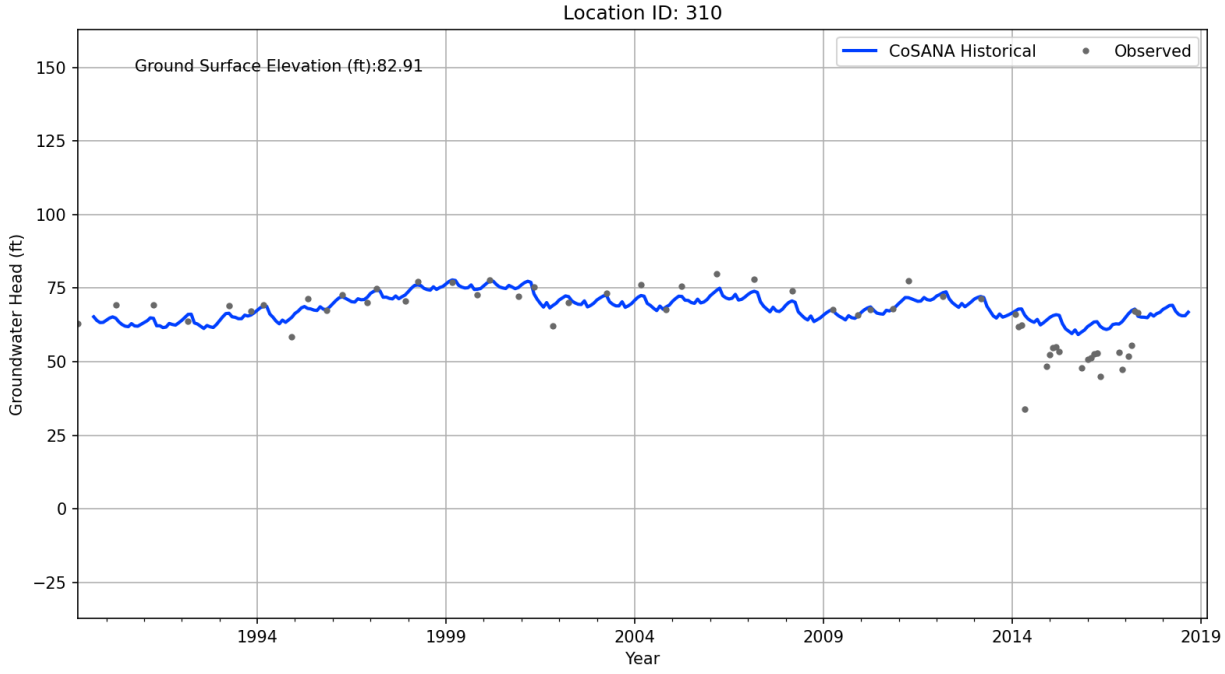

Location ID: 301
Ground Surface Elevation (ft):80.13
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

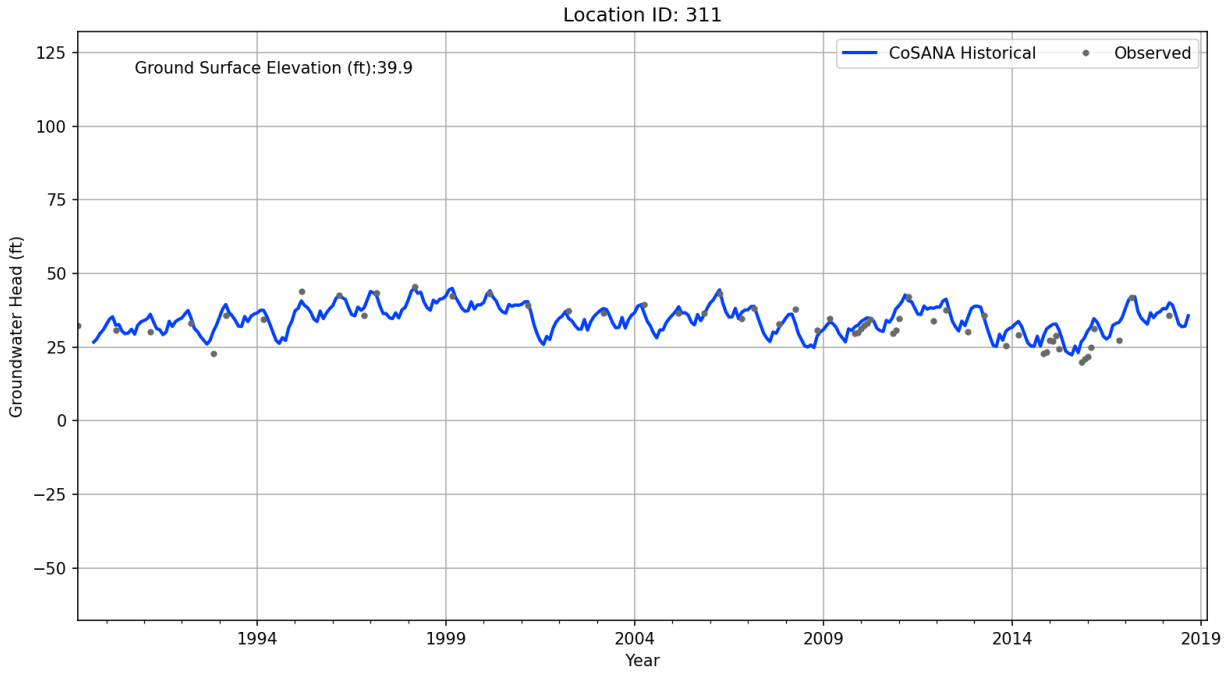

Location ID: 302
Ground Surface Elevation (ft):74.36
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

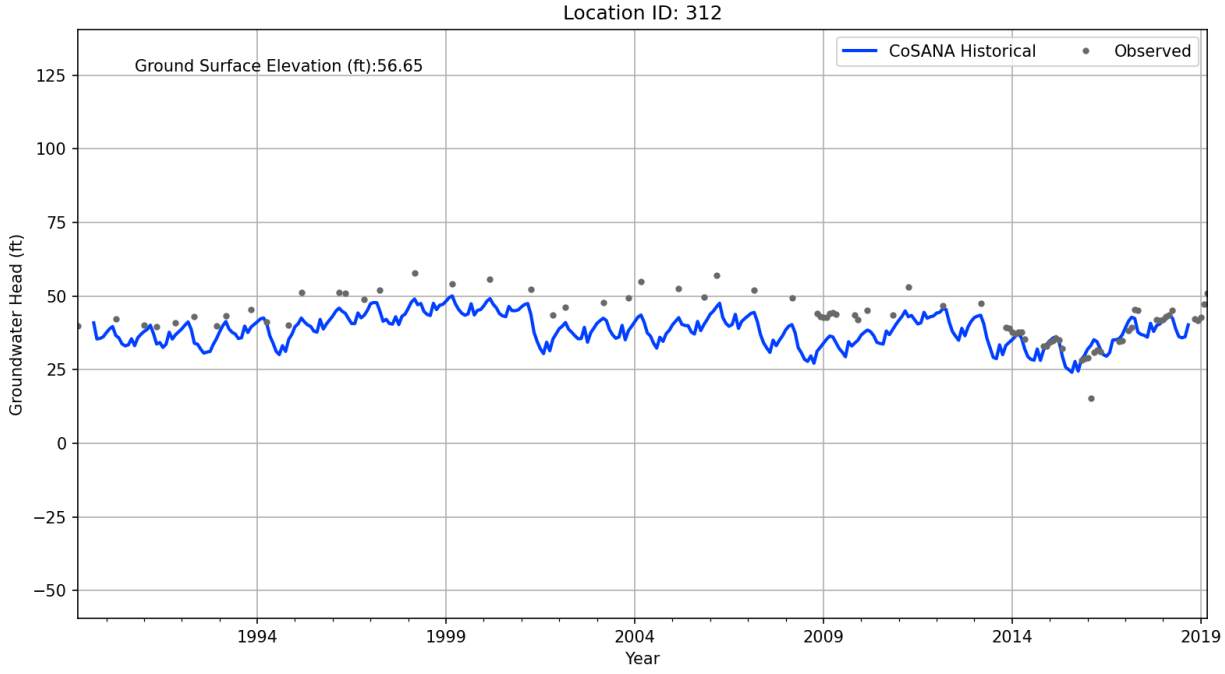

Location ID: 307
Ground Surface Elevation (ft):67.75
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

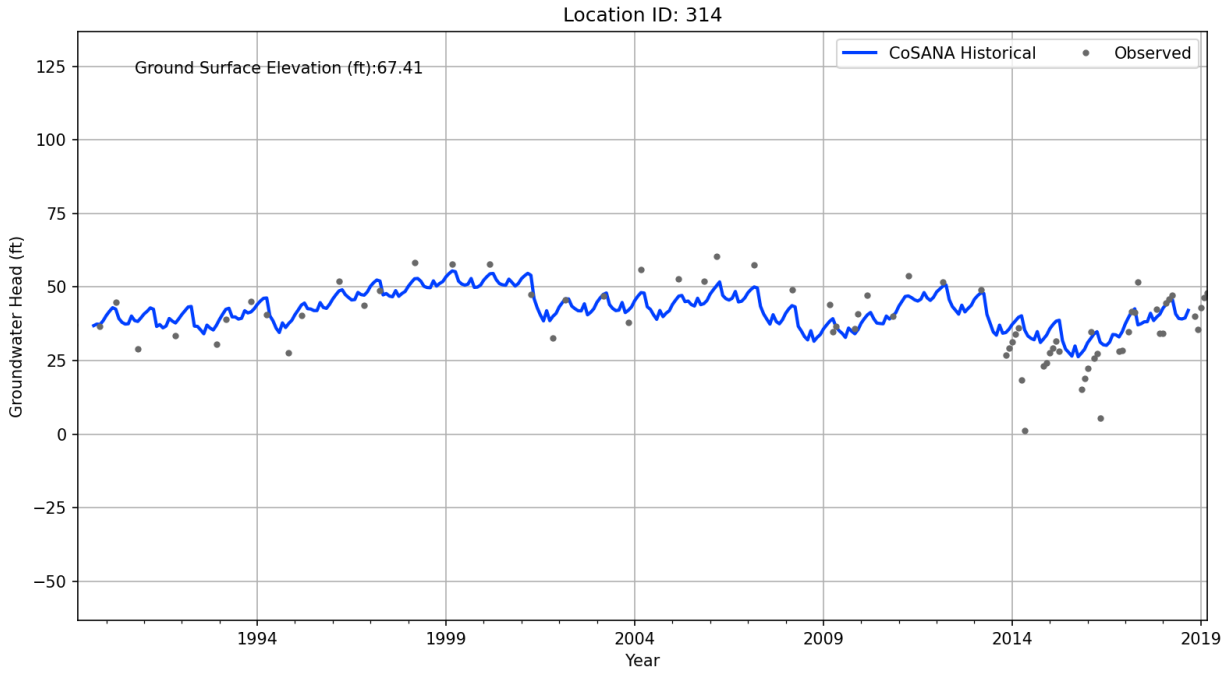

Location ID: 308
Ground Surface Elevation (ft):63.04
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

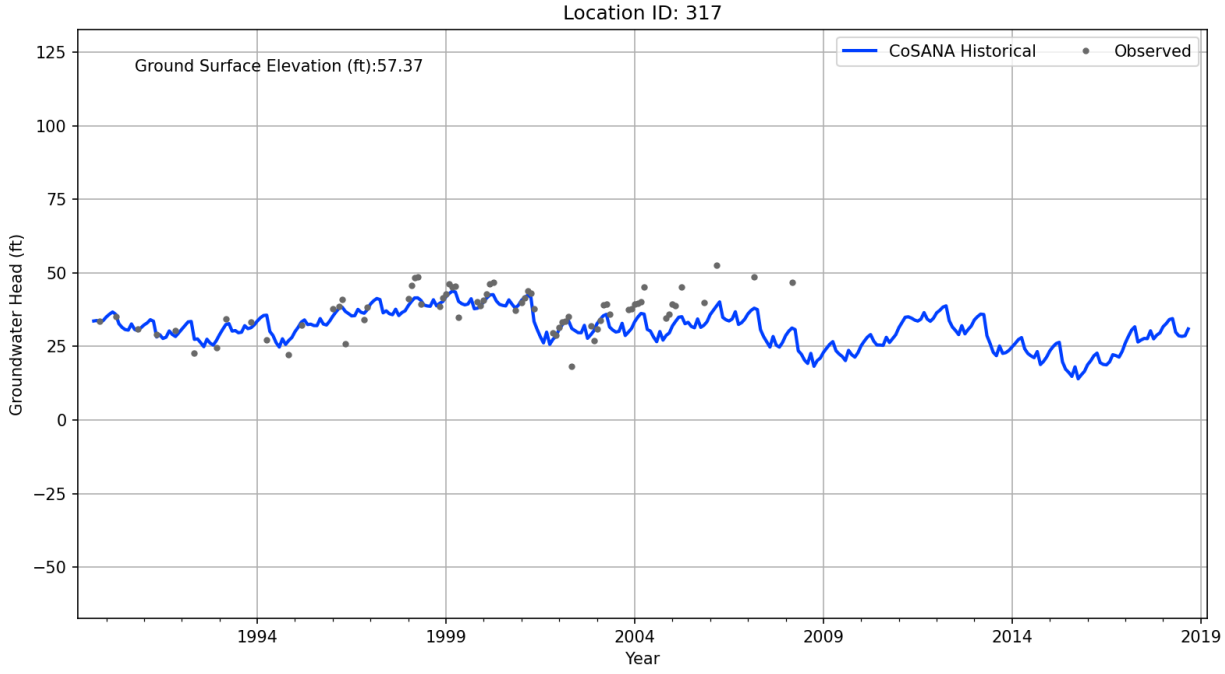

Location ID: 309
Ground Surface Elevation (ft):56.28
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

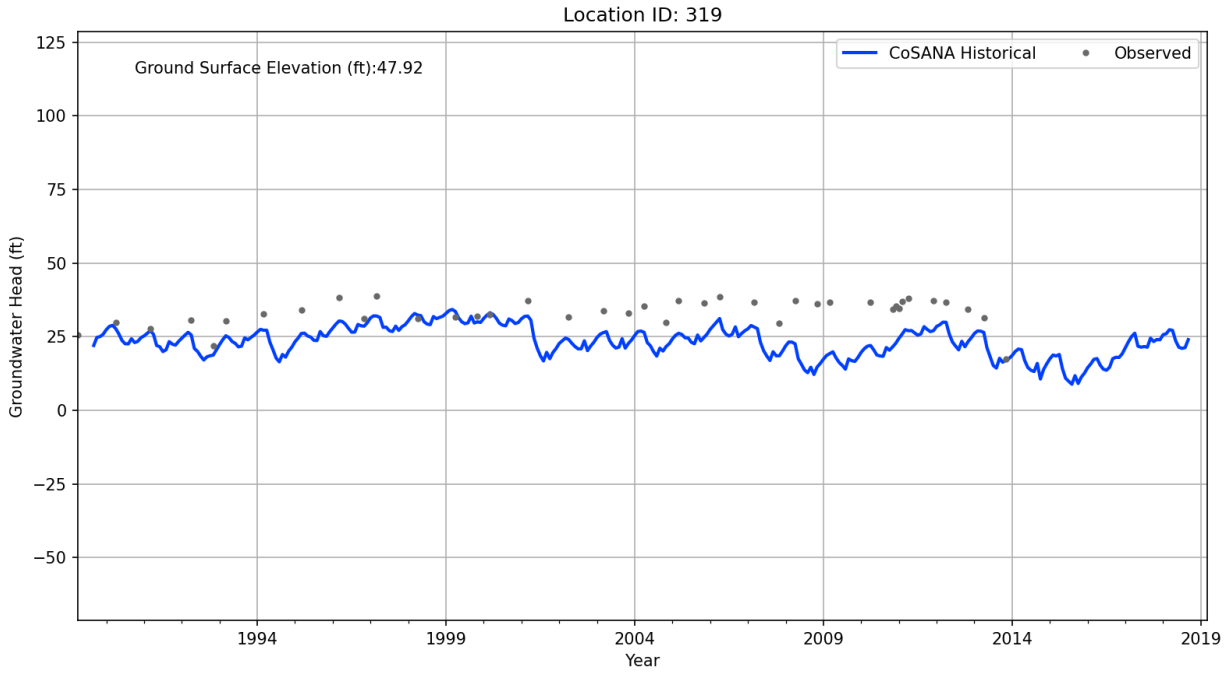

Location ID: 310
Ground Surface Elevation (ft):82.91
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

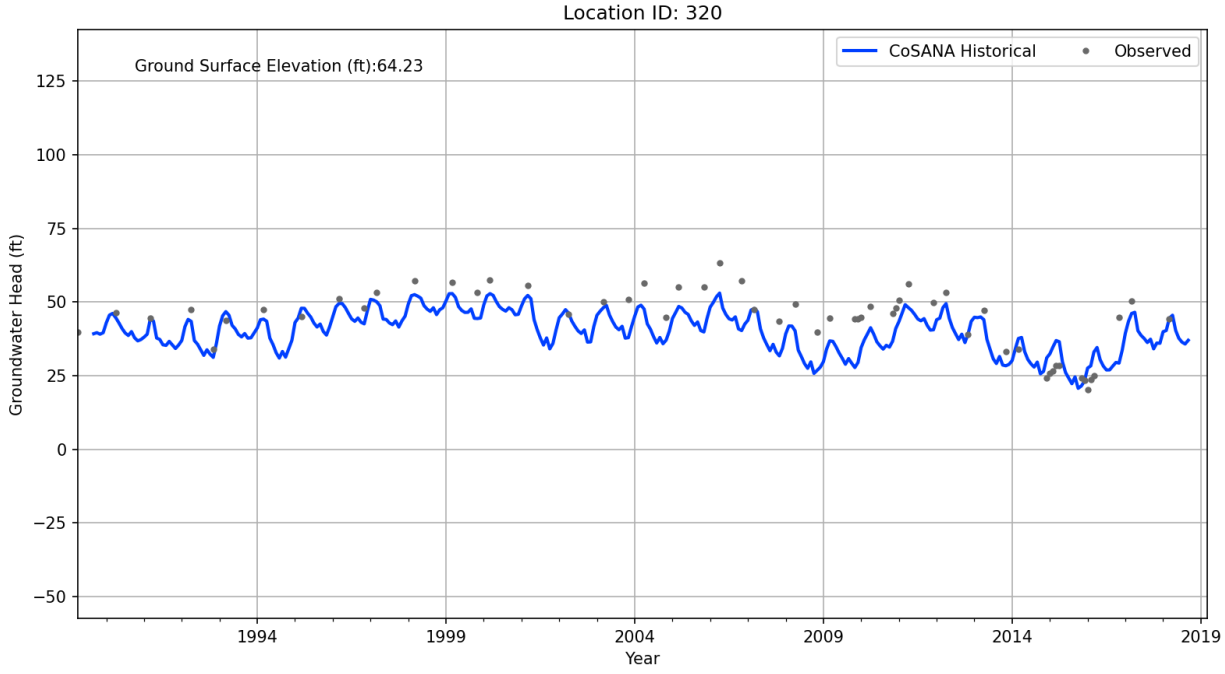

Location ID: 311
Ground Surface Elevation (ft):39.9
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

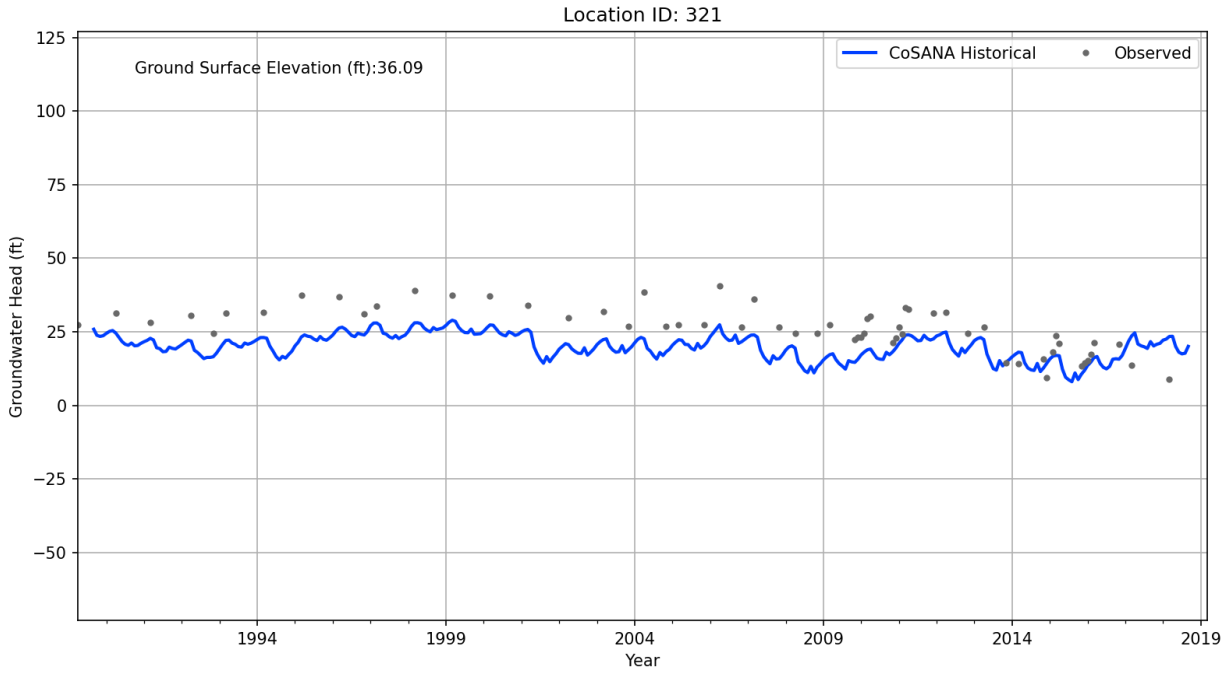

Location ID: 312
Ground Surface Elevation (ft):56.65
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

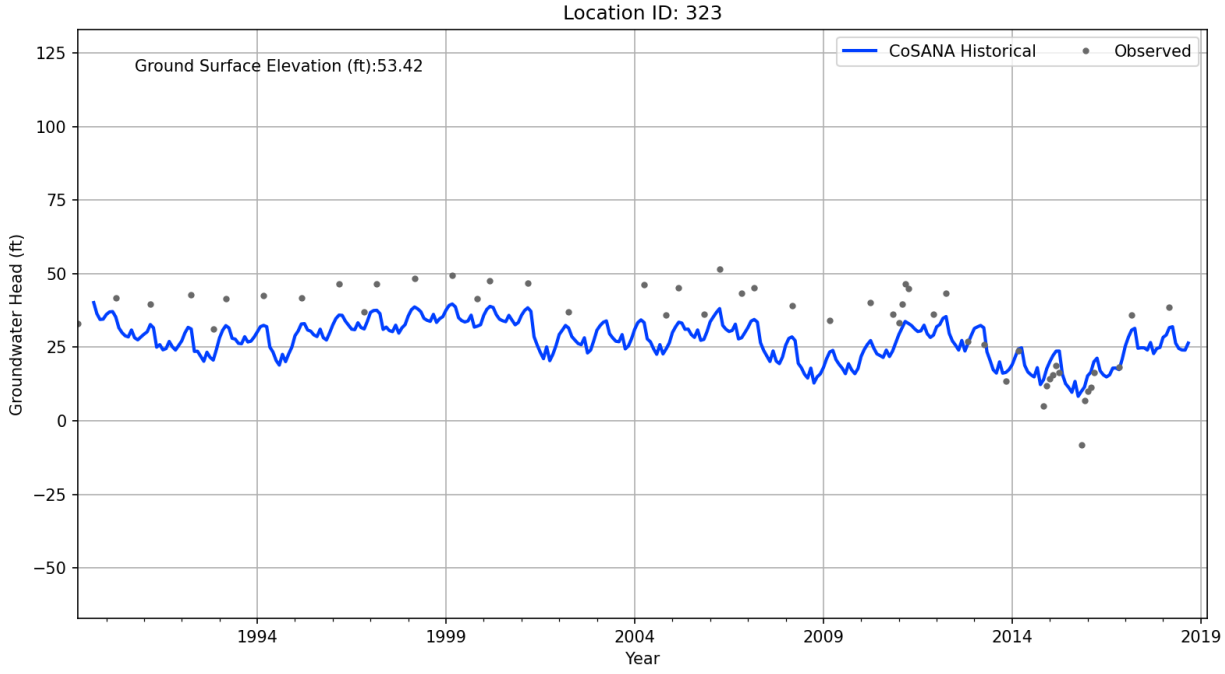

Location ID: 314
Ground Surface Elevation (ft):67.41
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

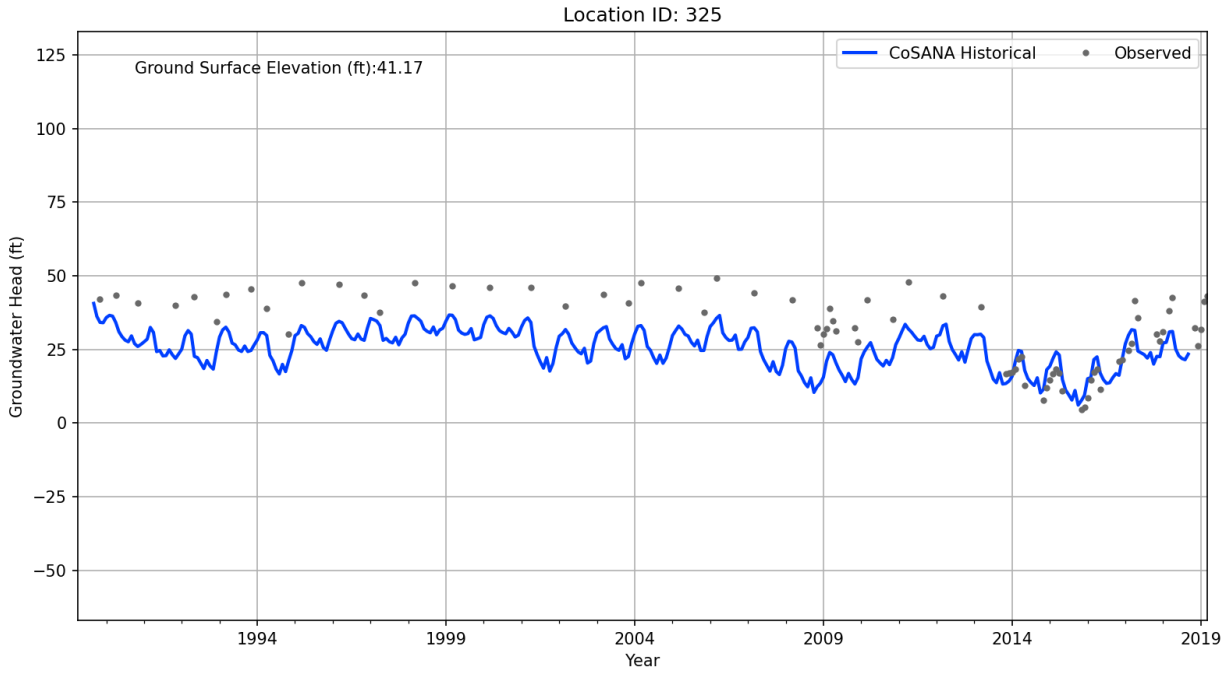

Location ID: 317
Ground Surface Elevation (ft):57.37
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

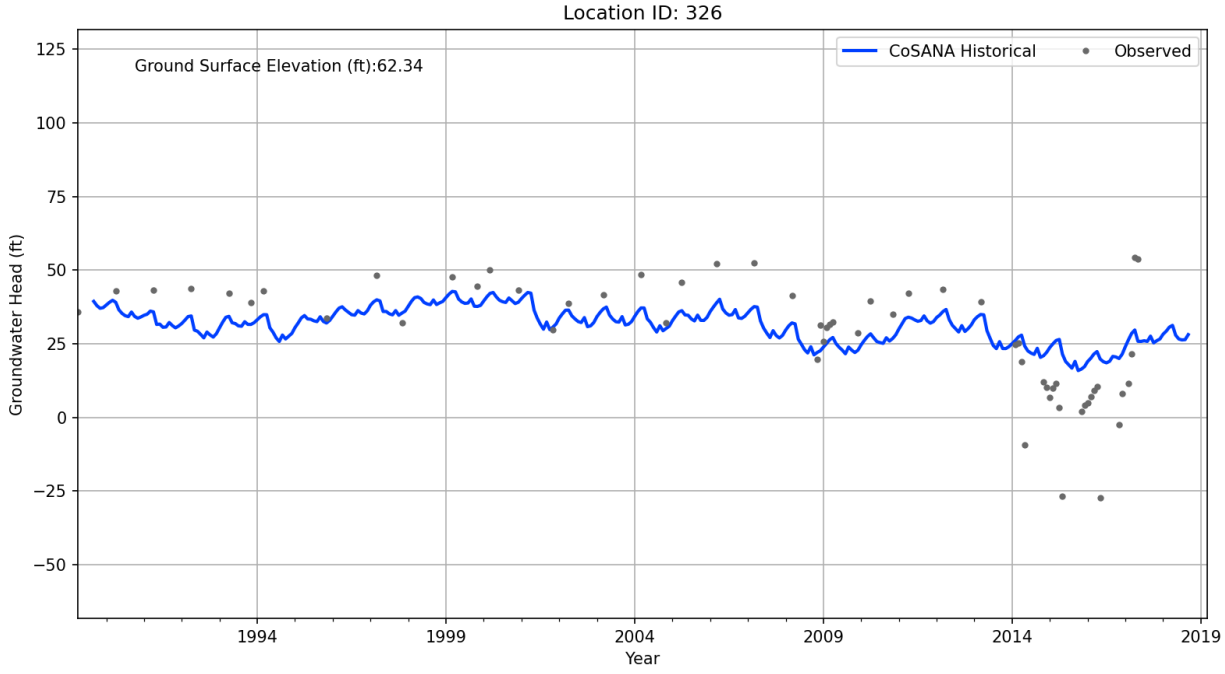

Location ID: 319
Ground Surface Elevation (ft):47.92
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

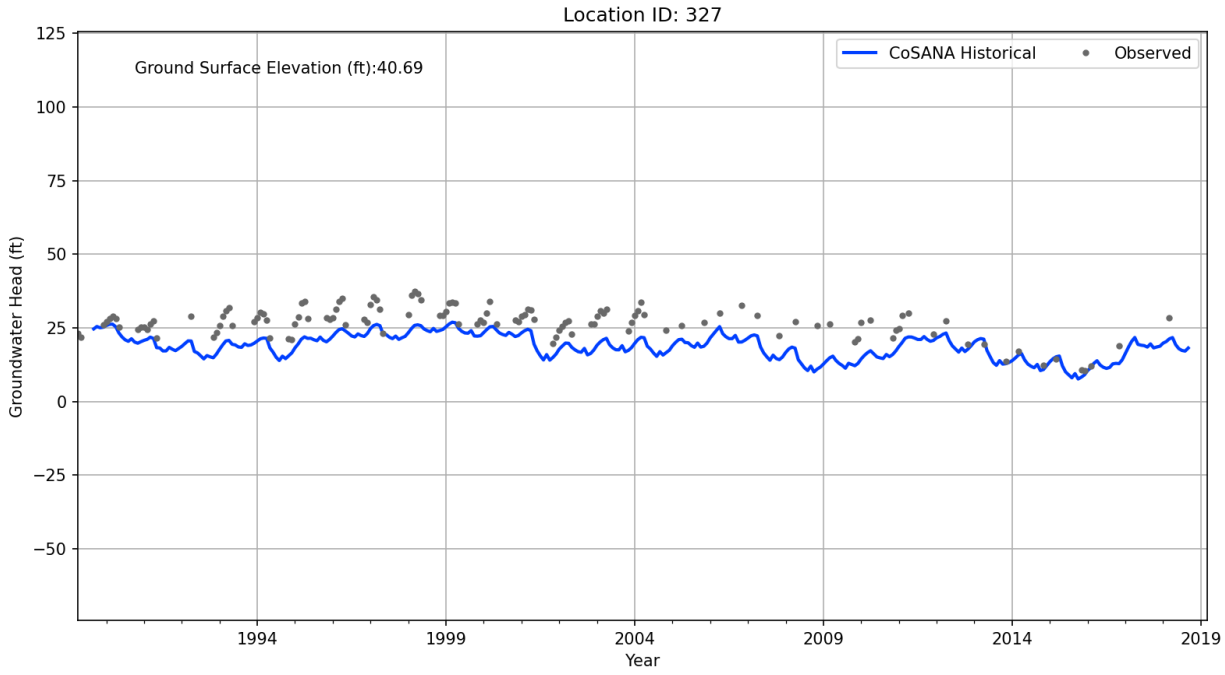

Location ID: 320
Ground Surface Elevation (ft):64.23
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

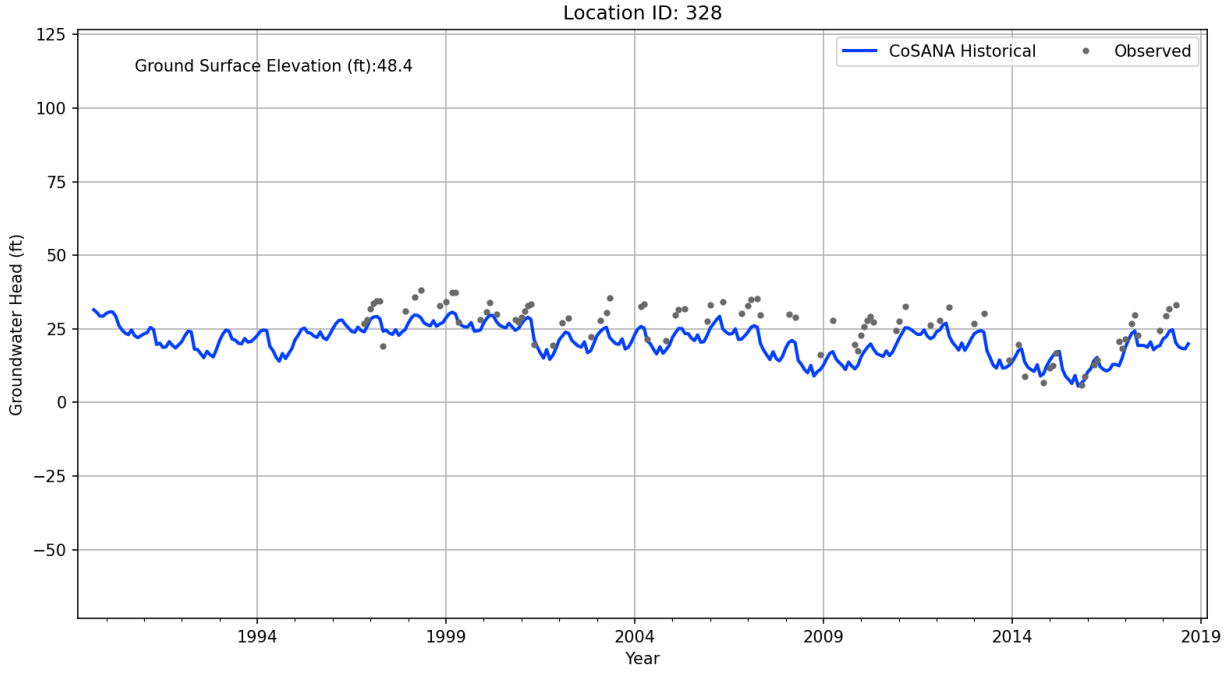

Location ID: 321
Ground Surface Elevation (ft):36.09
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

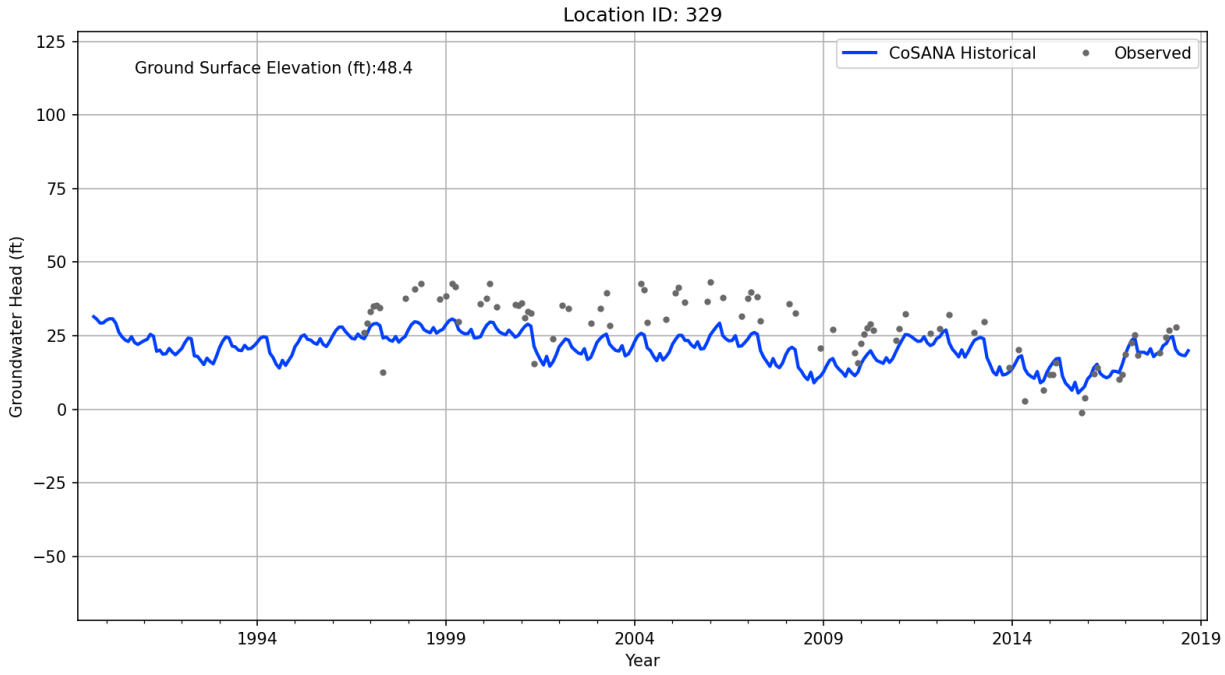

Location ID: 323
Ground Surface Elevation (ft):53.42
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

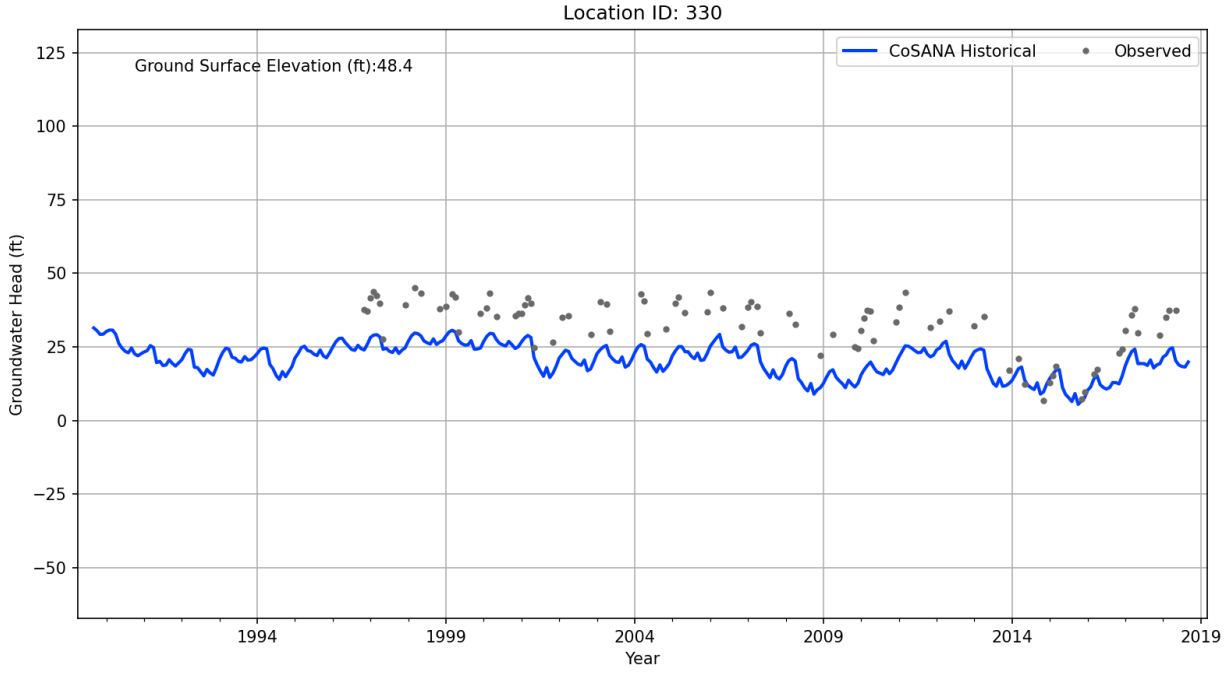

Location ID: 325
Ground Surface Elevation (ft):41.17
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

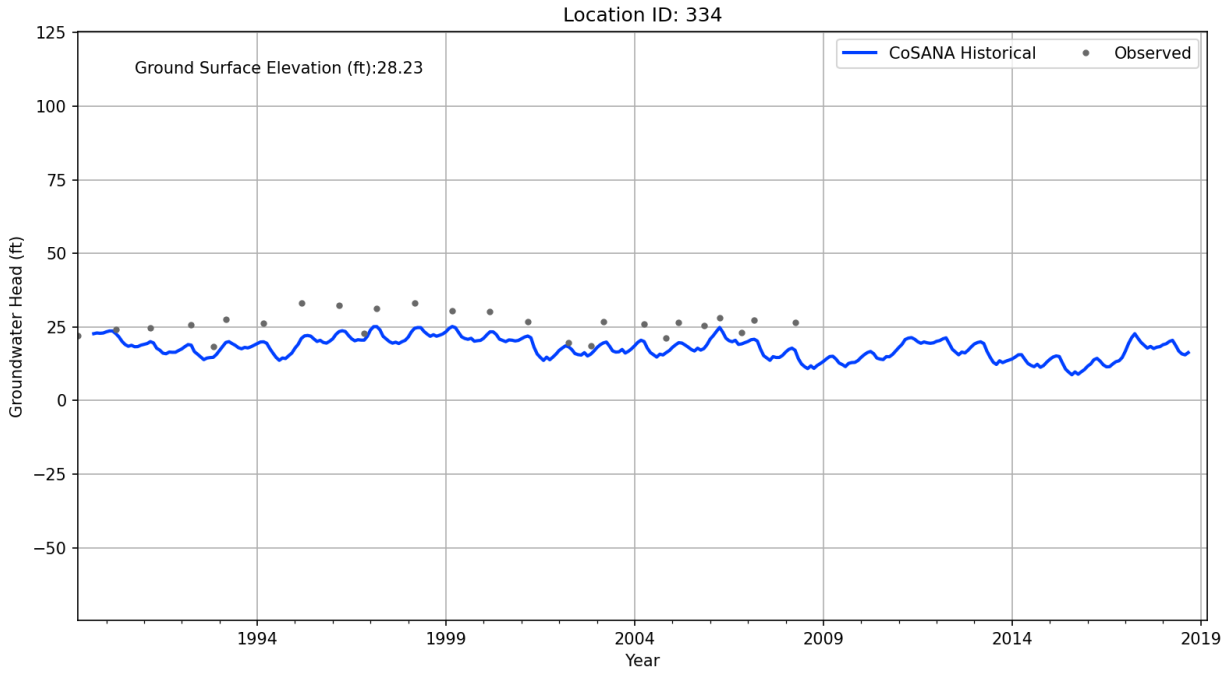

Location ID: 326
Ground Surface Elevation (ft):62.34
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

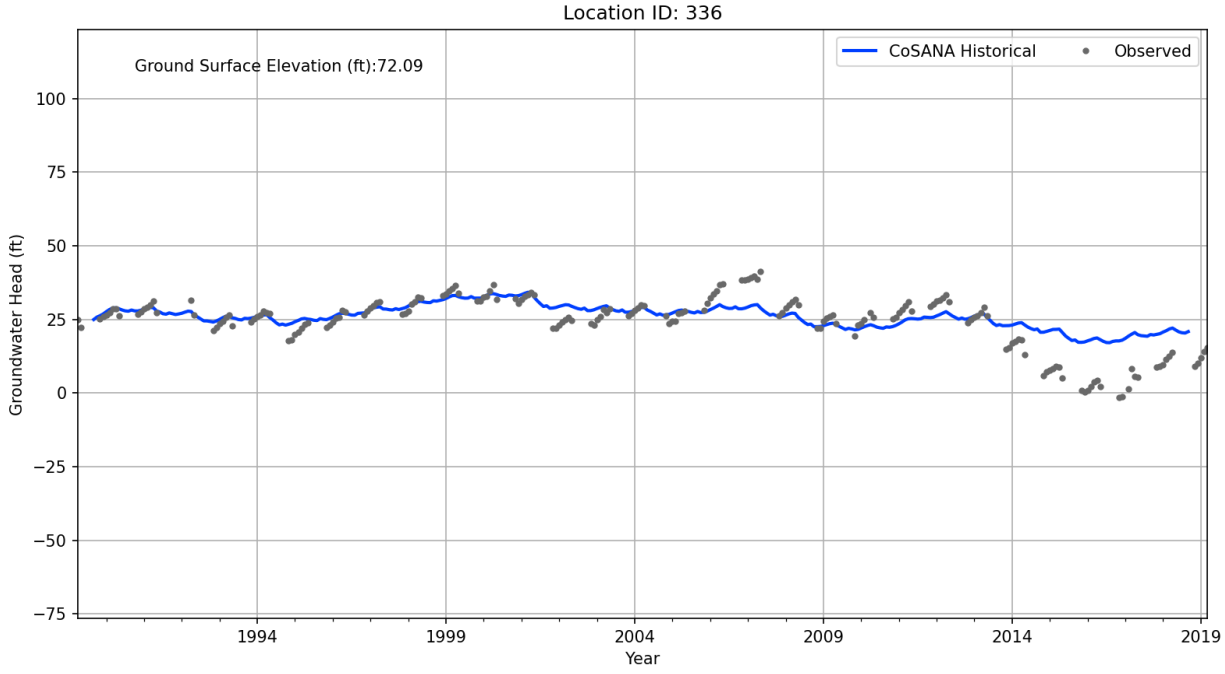

Location ID: 327
Ground Surface Elevation (ft):40.69
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

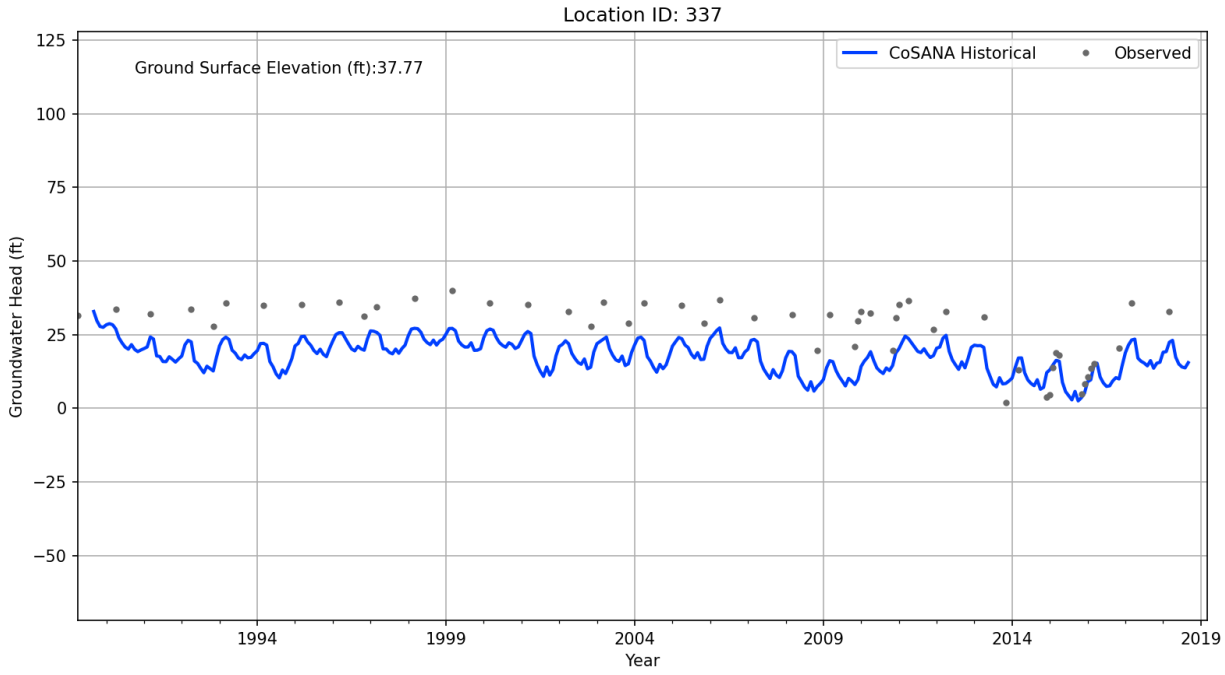

Location ID: 328
Ground Surface Elevation (ft):48.4
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

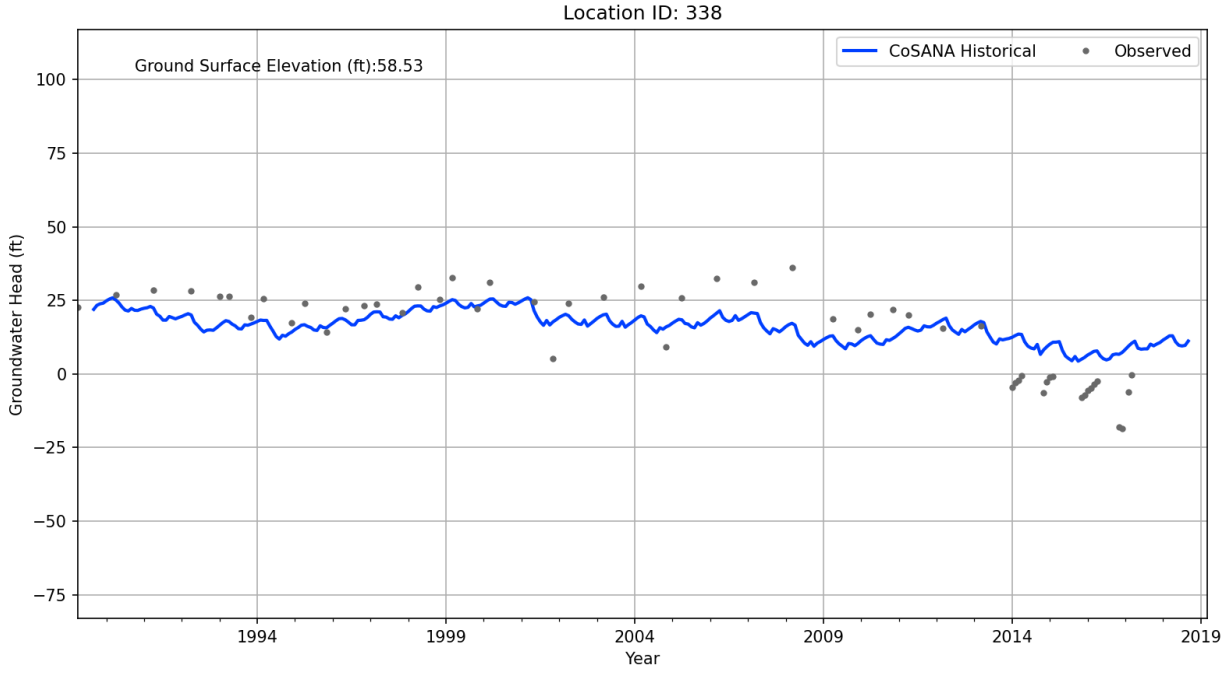

Location ID: 329
Ground Surface Elevation (ft):48.4
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

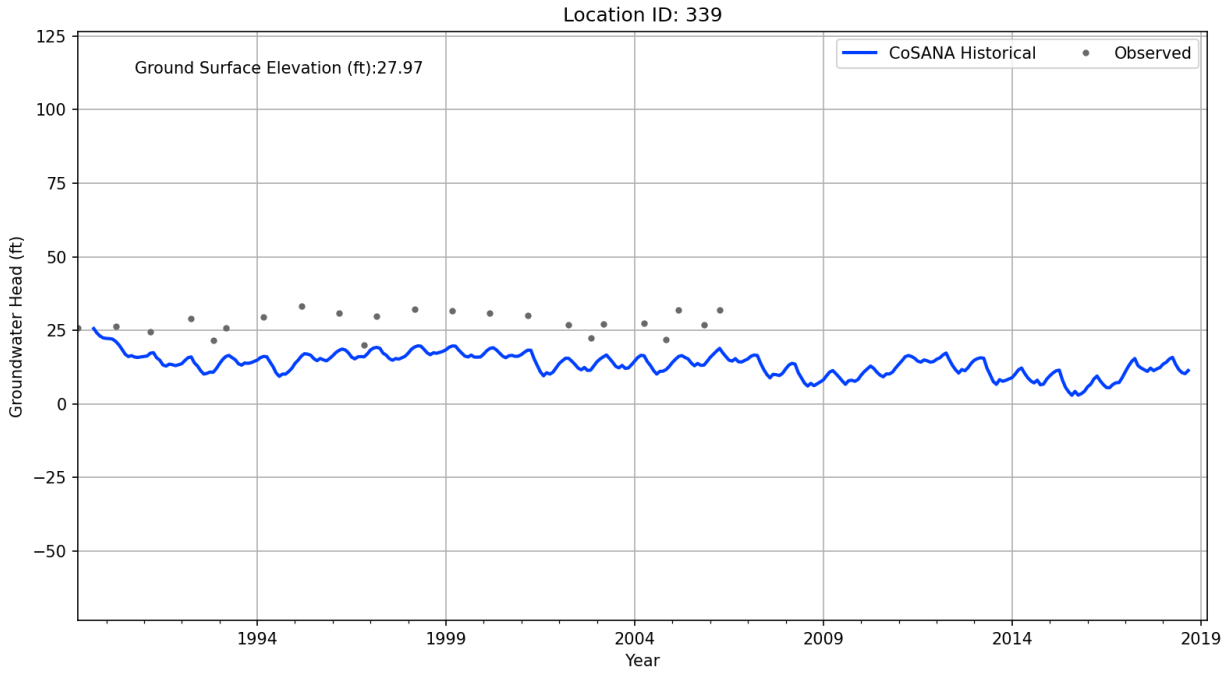

Location ID: 330
Ground Surface Elevation (ft):48.4
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

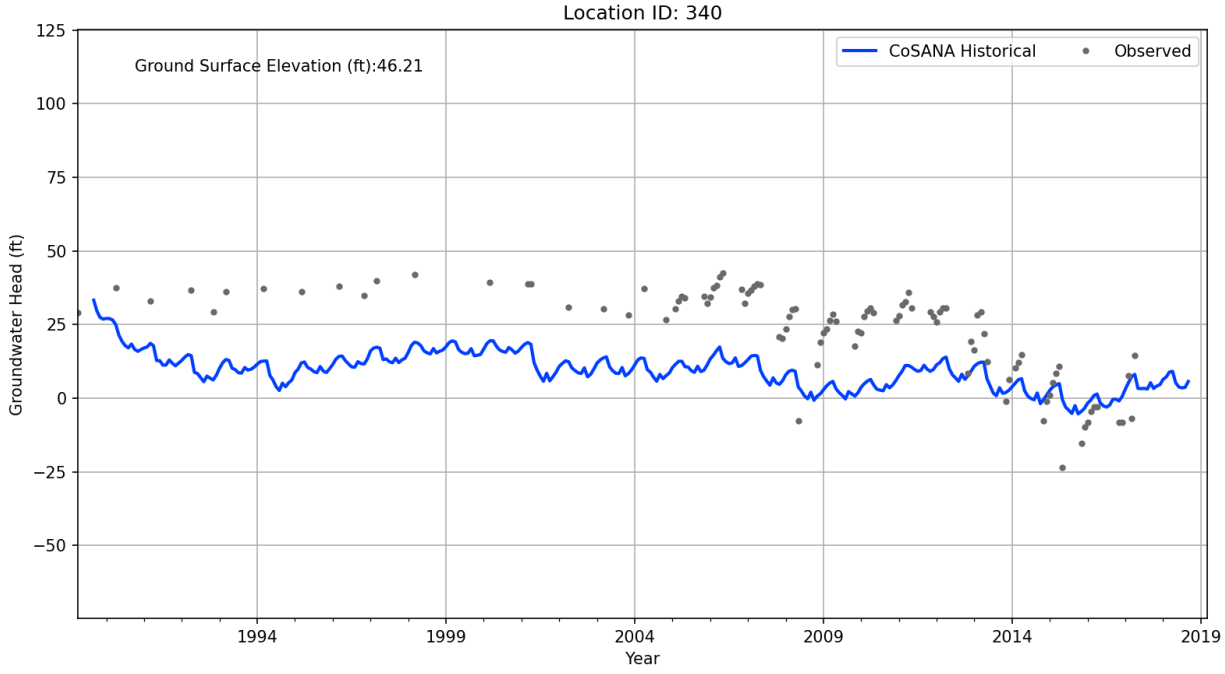

Location ID: 334
Ground Surface Elevation (ft):28.23
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

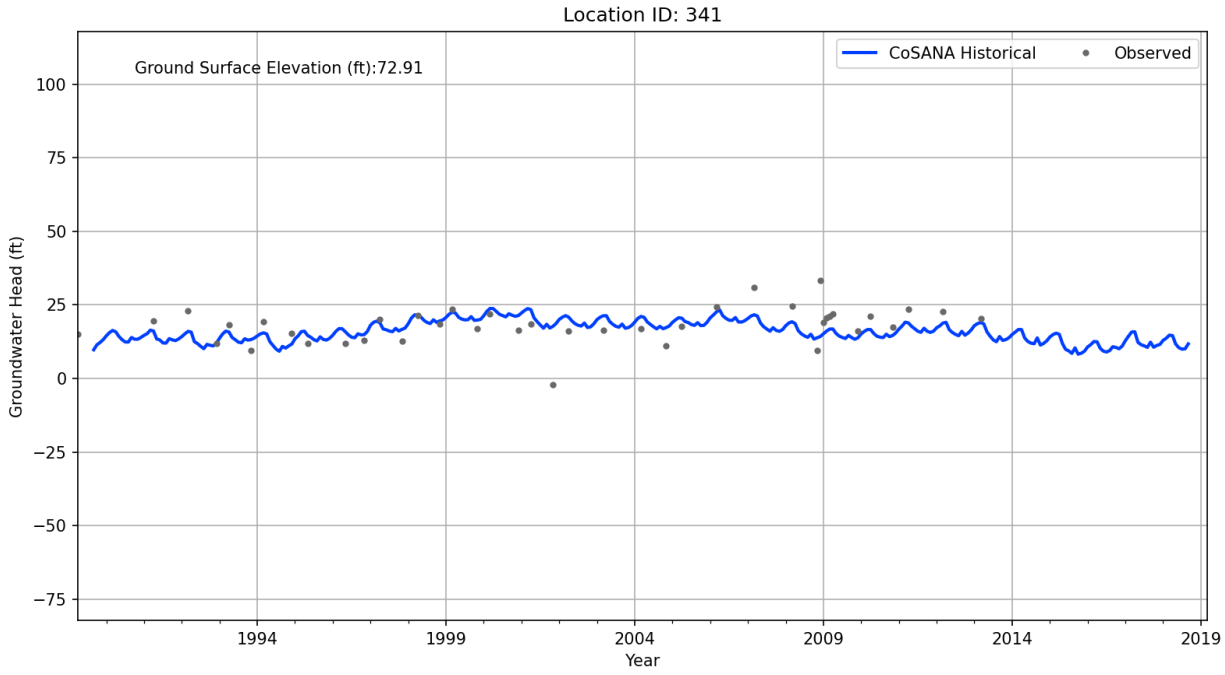

Location ID: 336
Ground Surface Elevation (ft):72.09
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

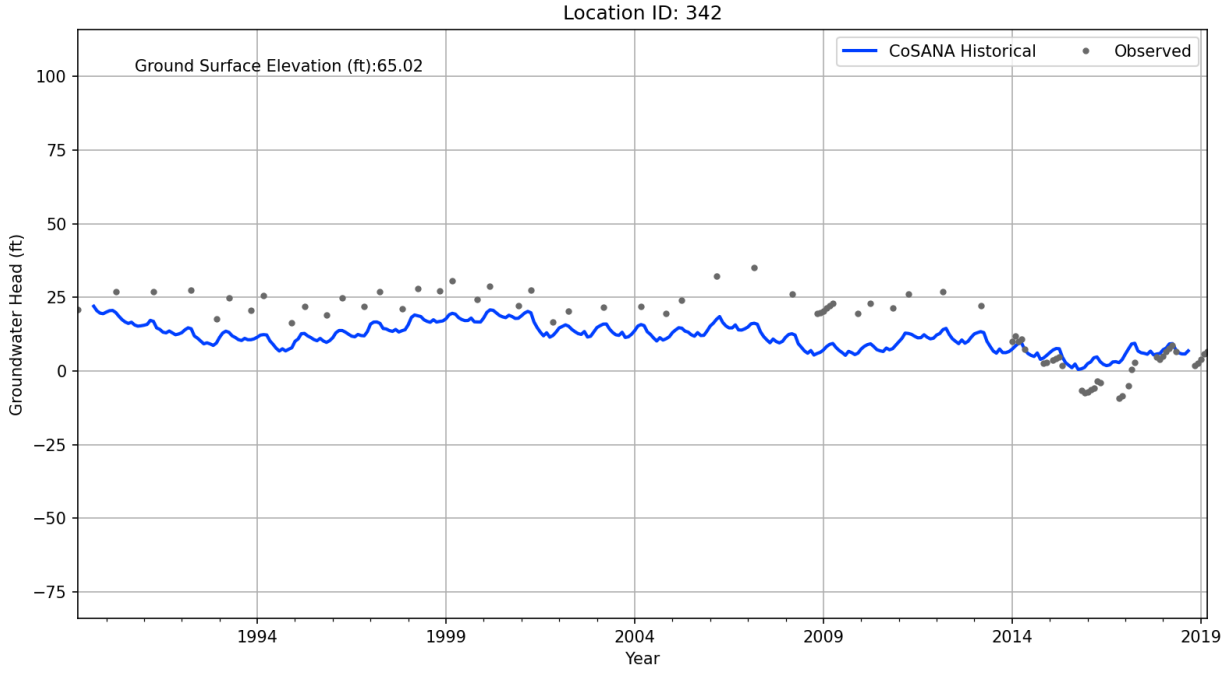

Location ID: 337
Ground Surface Elevation (ft):37.77
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

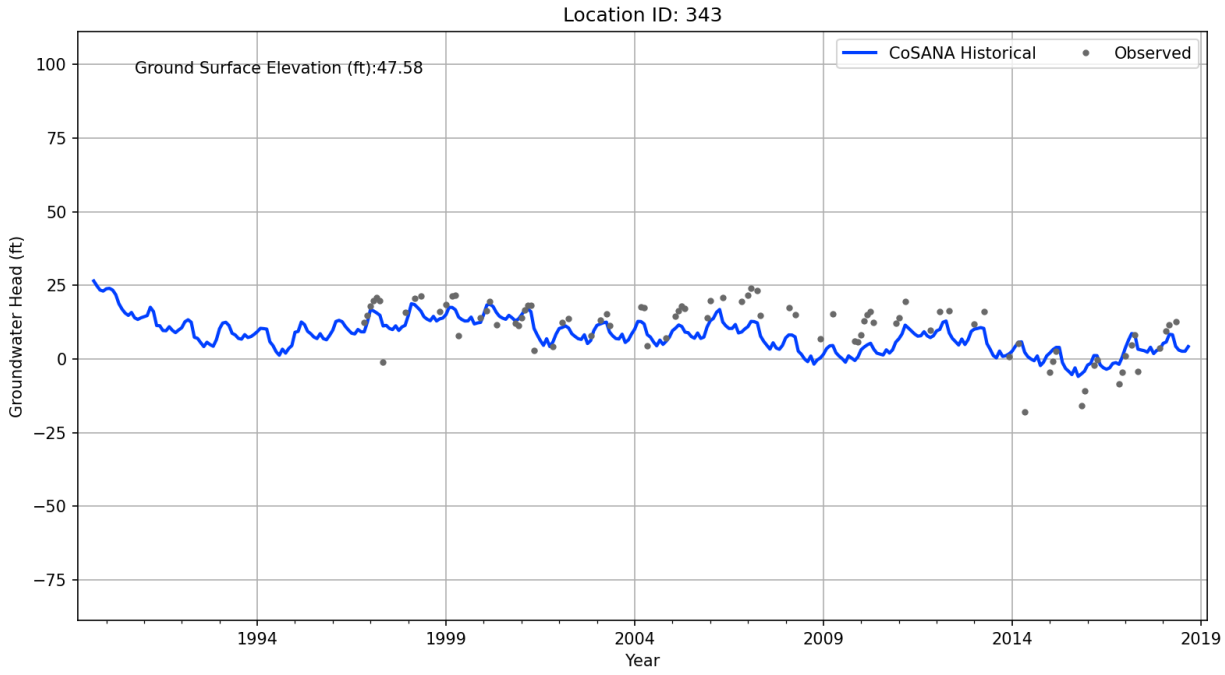

Location ID: 338
Ground Surface Elevation (ft):58.53
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

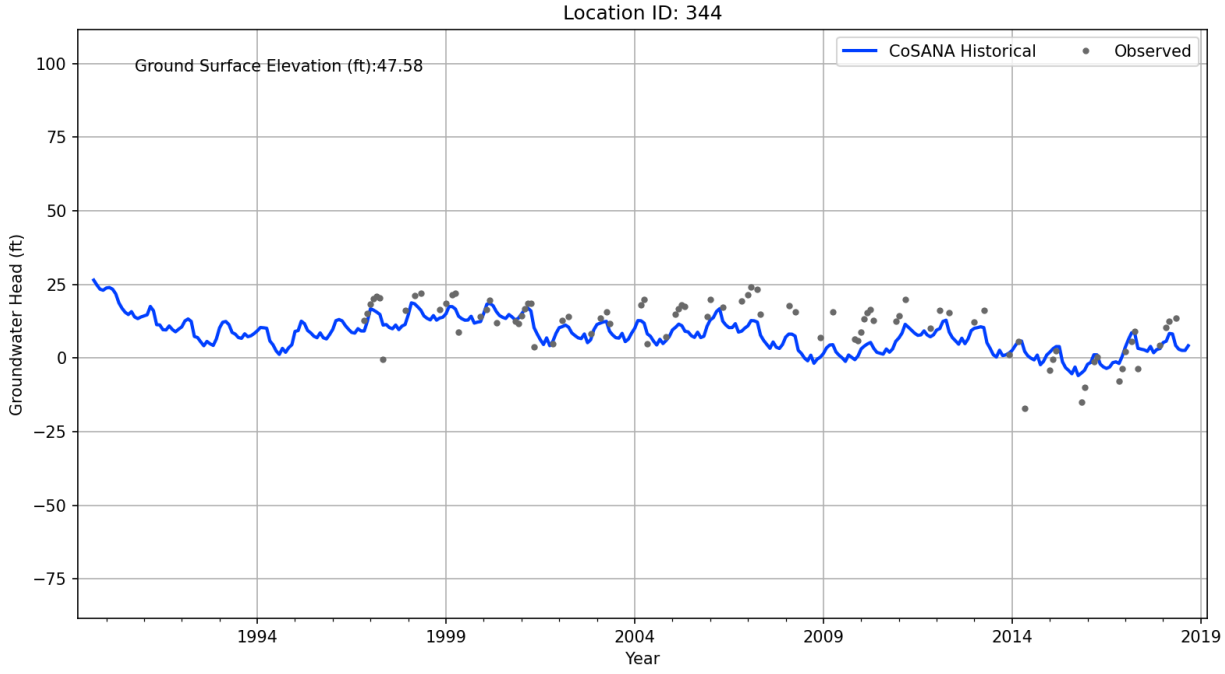

Location ID: 339
Ground Surface Elevation (ft):27.97
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

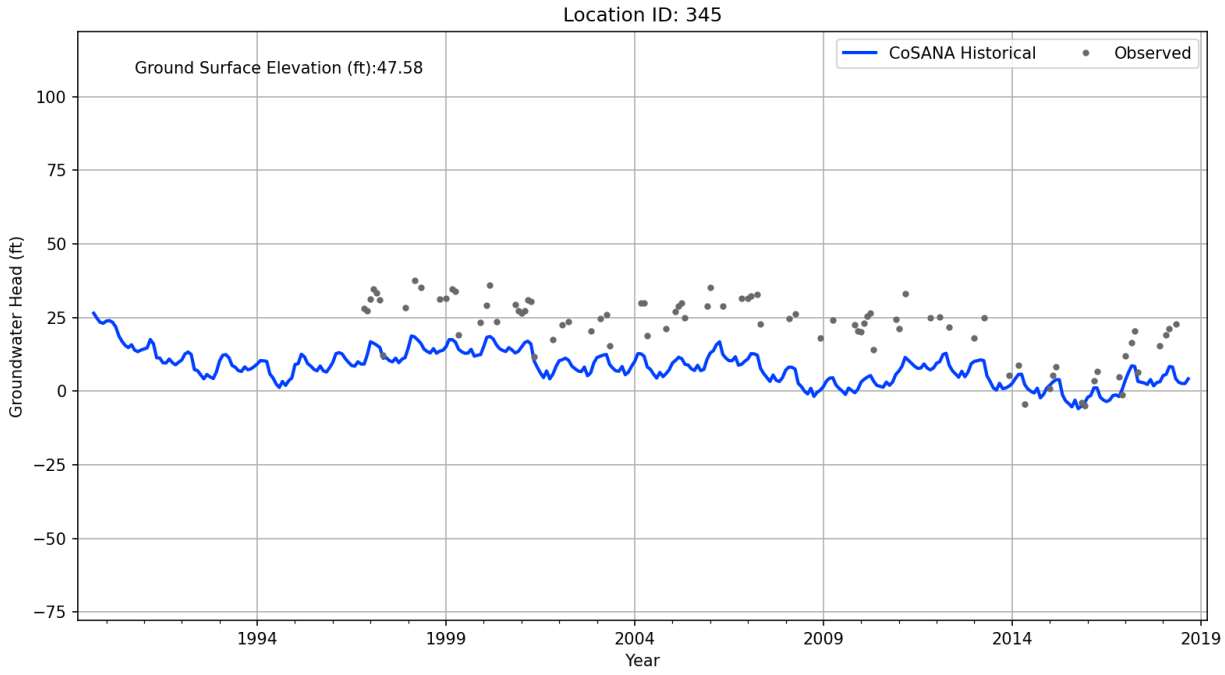

Location ID: 340
Ground Surface Elevation (ft):46.21
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

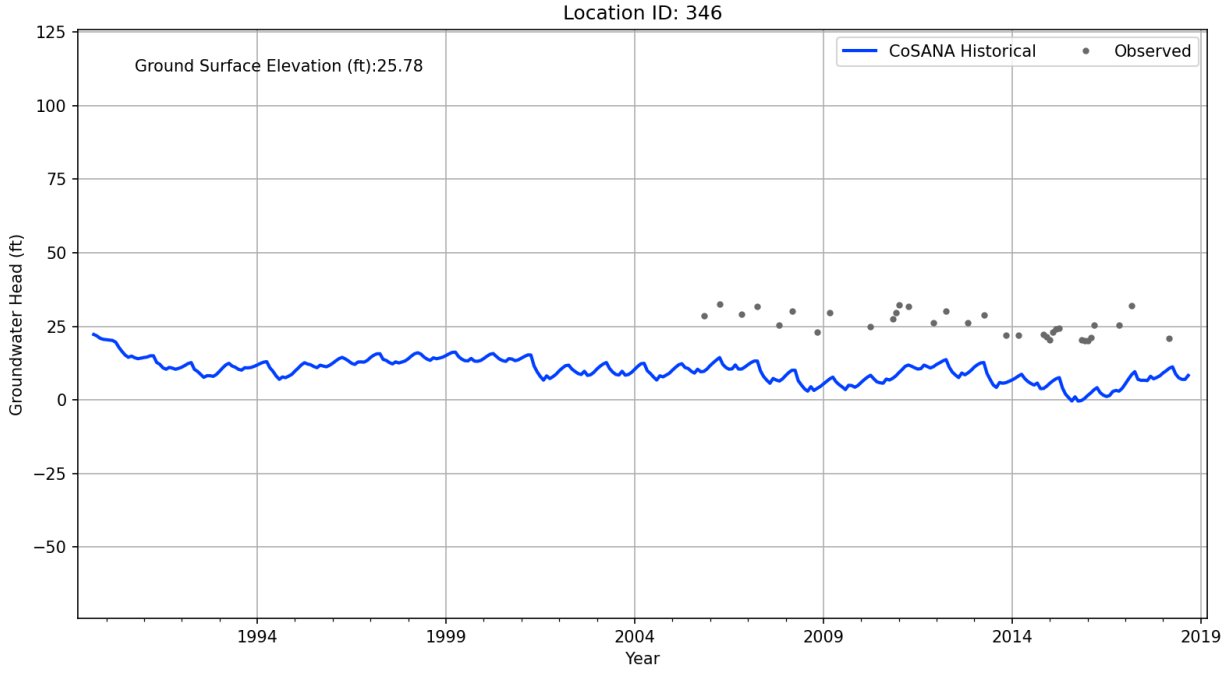

Location ID: 341
Ground Surface Elevation (ft):72.91
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

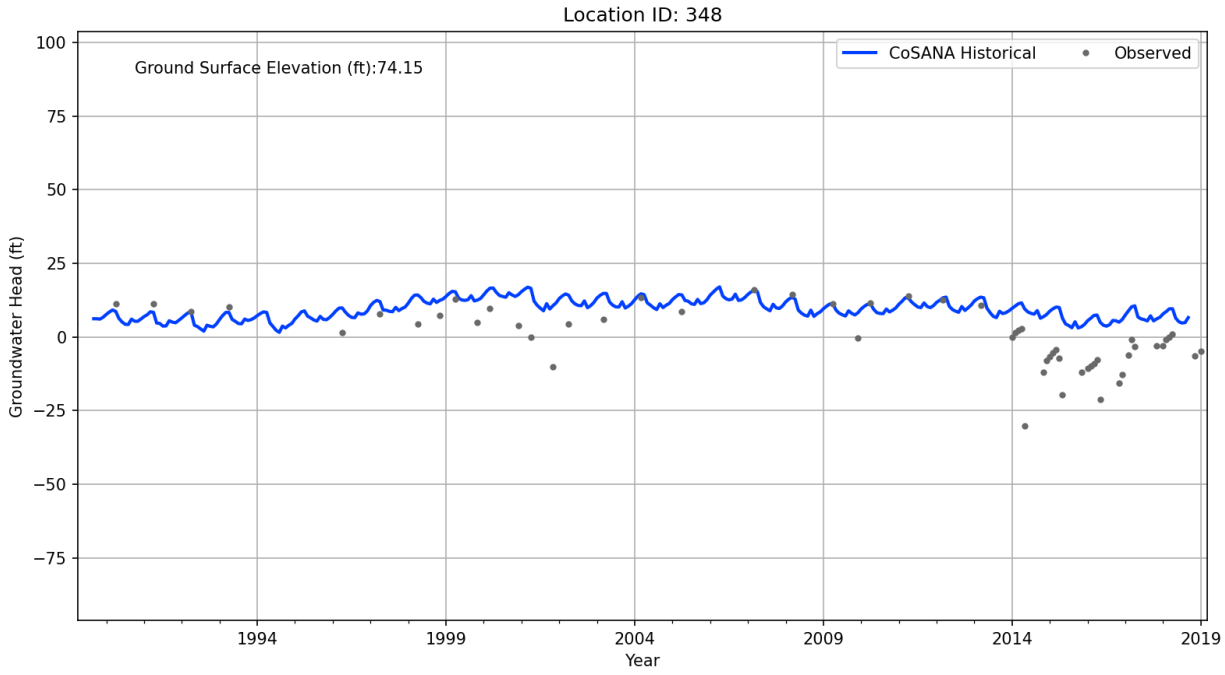

Location ID: 342
Ground Surface Elevation (ft):65.02
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

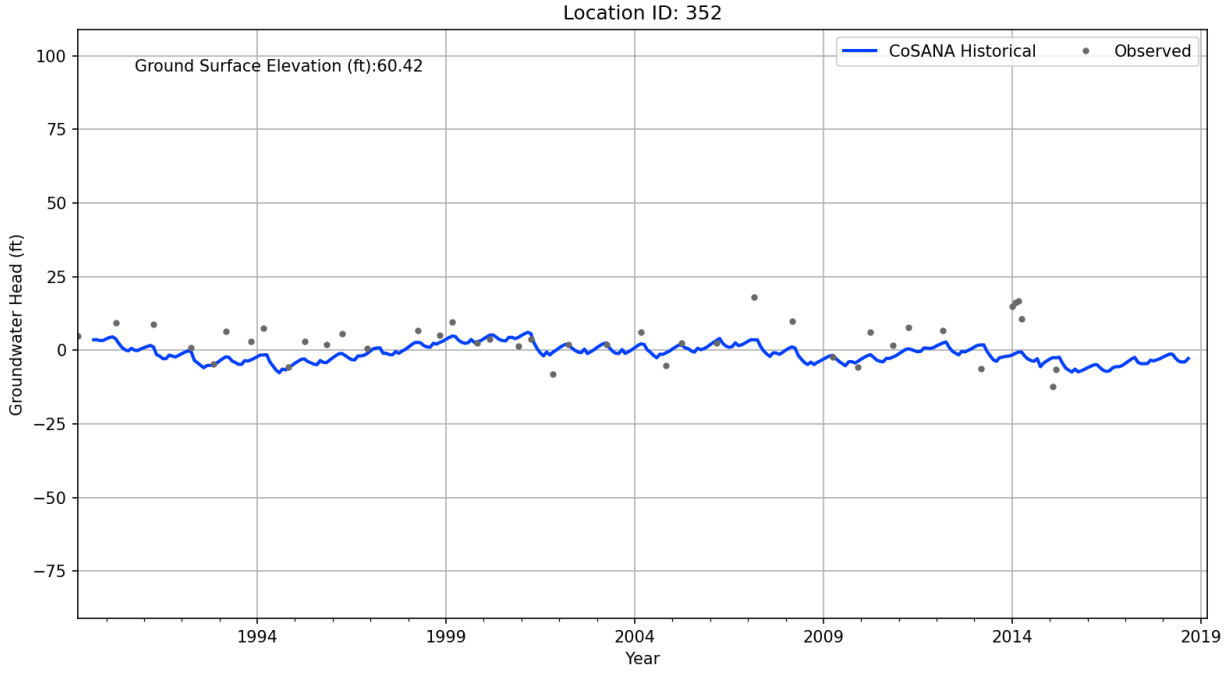

Location ID: 343
Ground Surface Elevation (ft):47.58
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

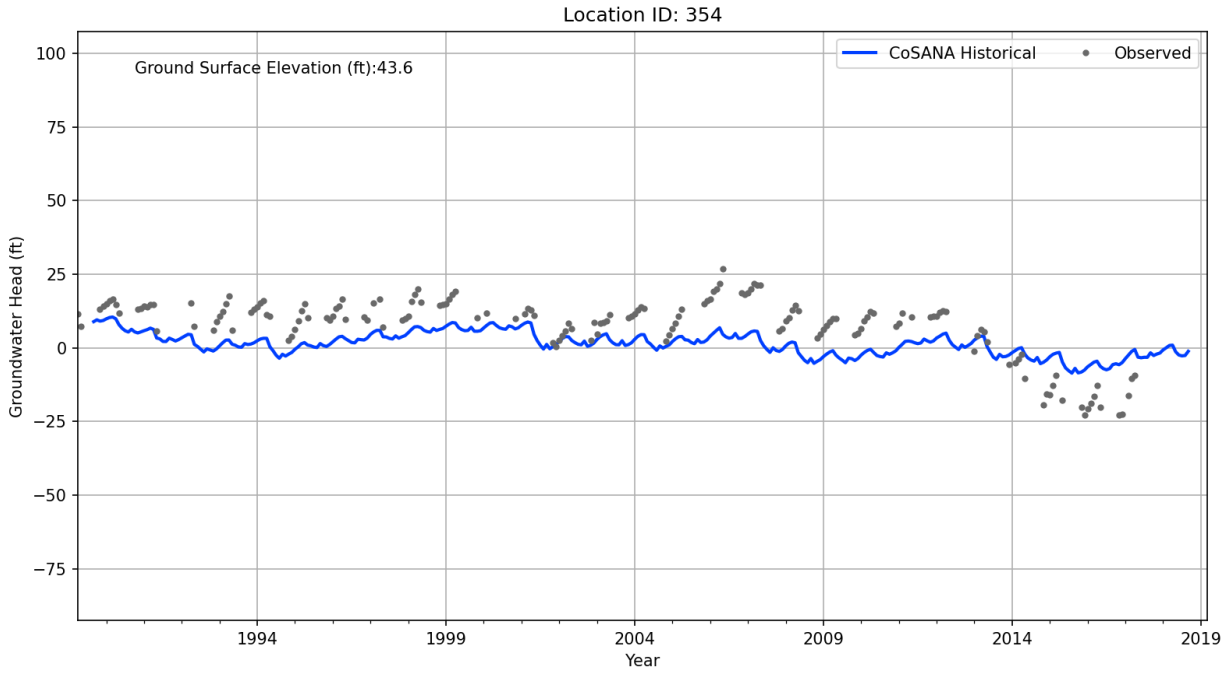

Location ID: 344
Ground Surface Elevation (ft):47.58
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

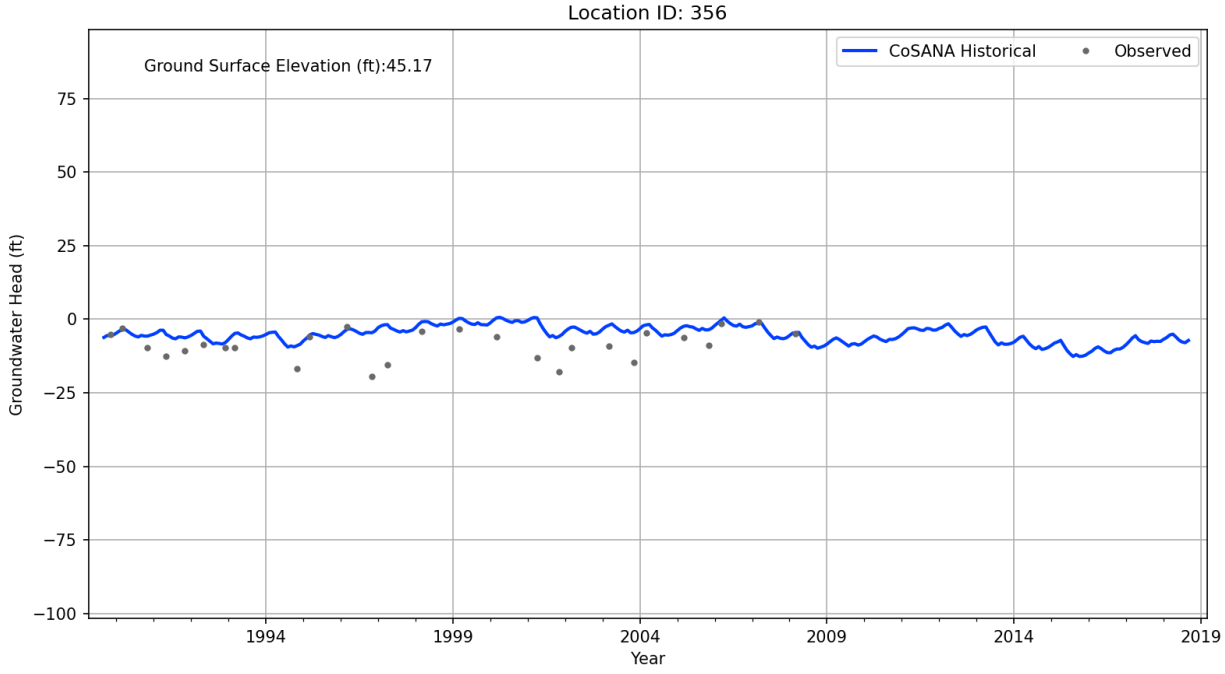

Location ID: 345
Ground Surface Elevation (ft):47.58
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

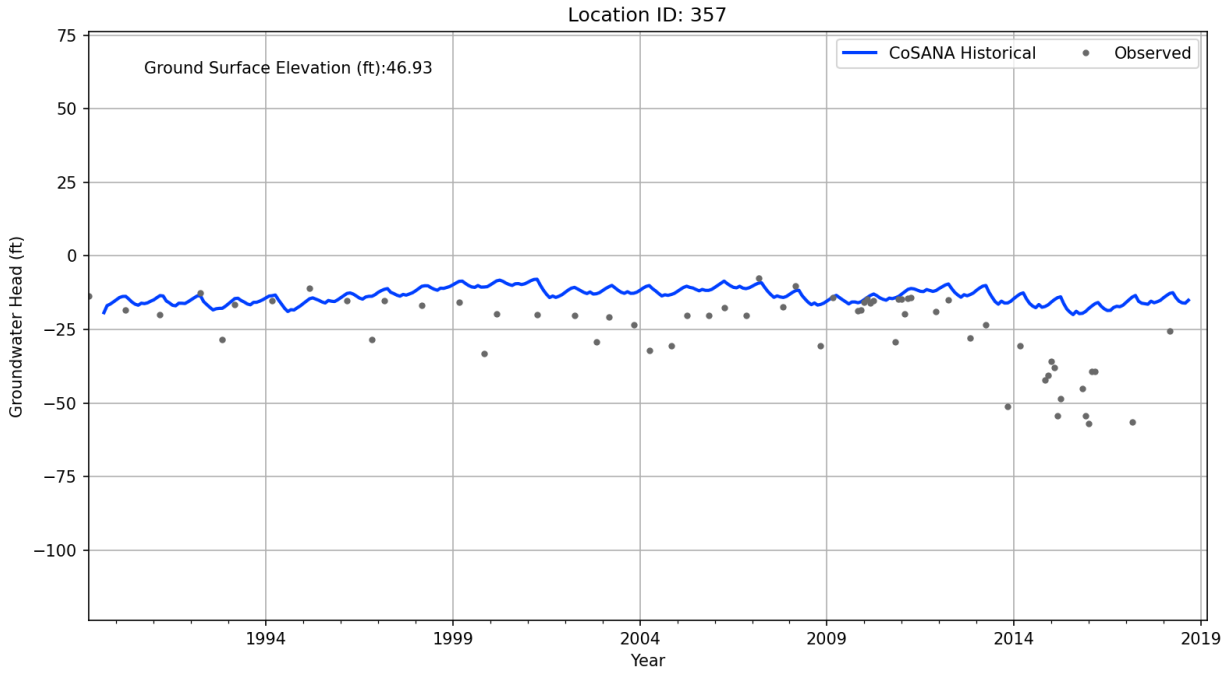

Location ID: 346
Ground Surface Elevation (ft):25.78
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

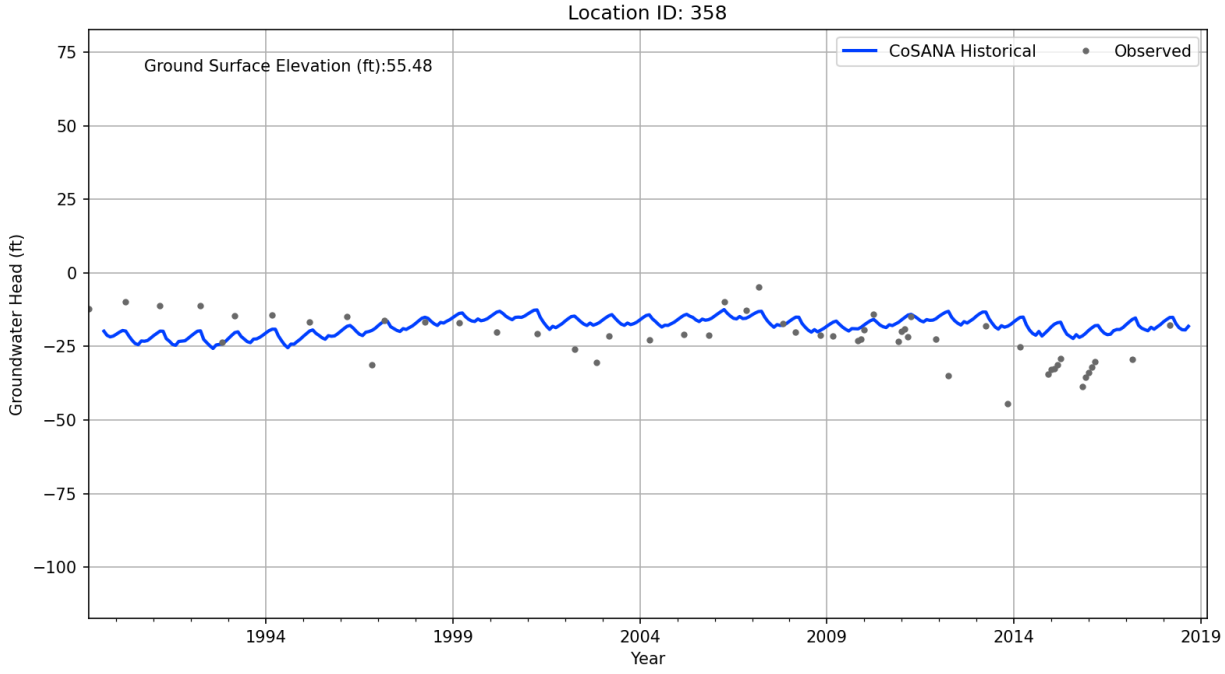

Location ID: 348
Ground Surface Elevation (ft):74.15
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

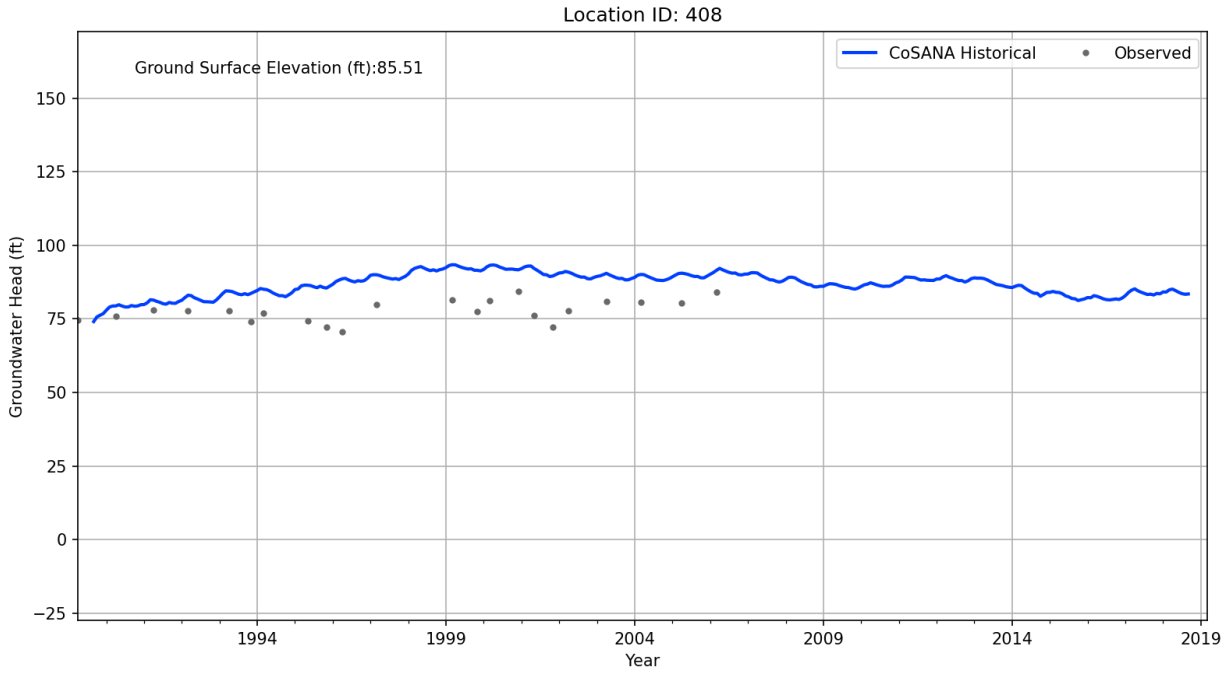

Location ID: 352
Ground Surface Elevation (ft):60.42
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

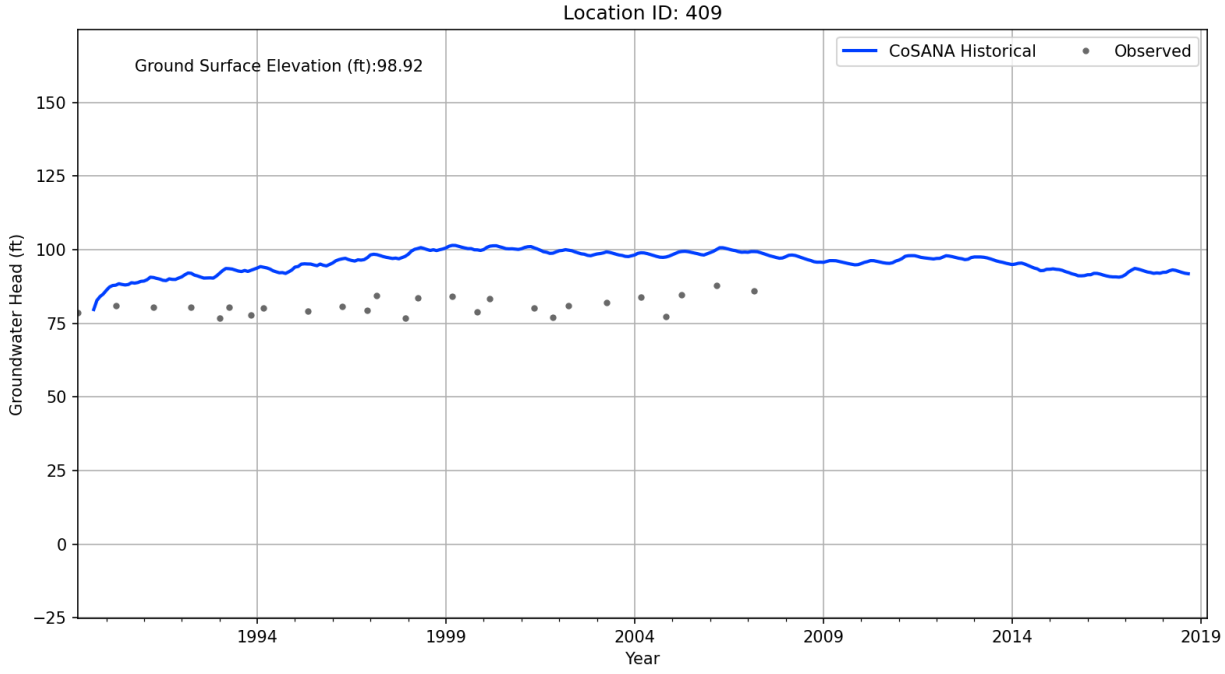

Location ID: 354
Ground Surface Elevation (ft):43.6
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

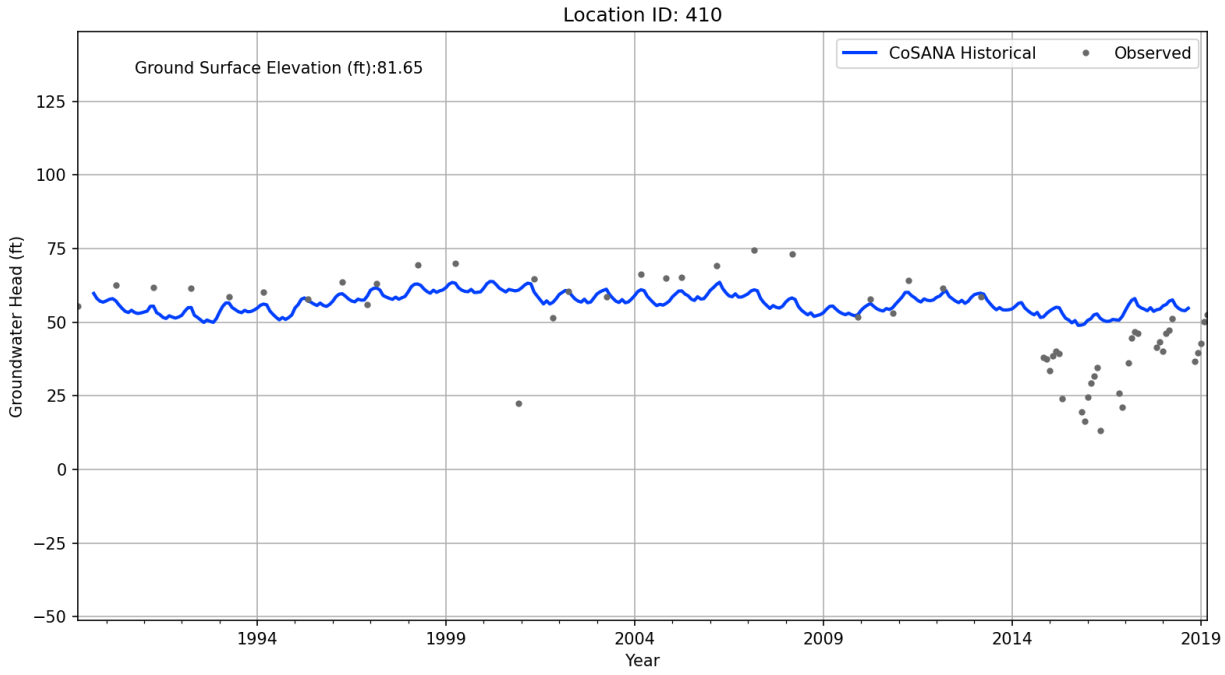

Location ID: 356
Ground Surface Elevation (ft):45.17
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

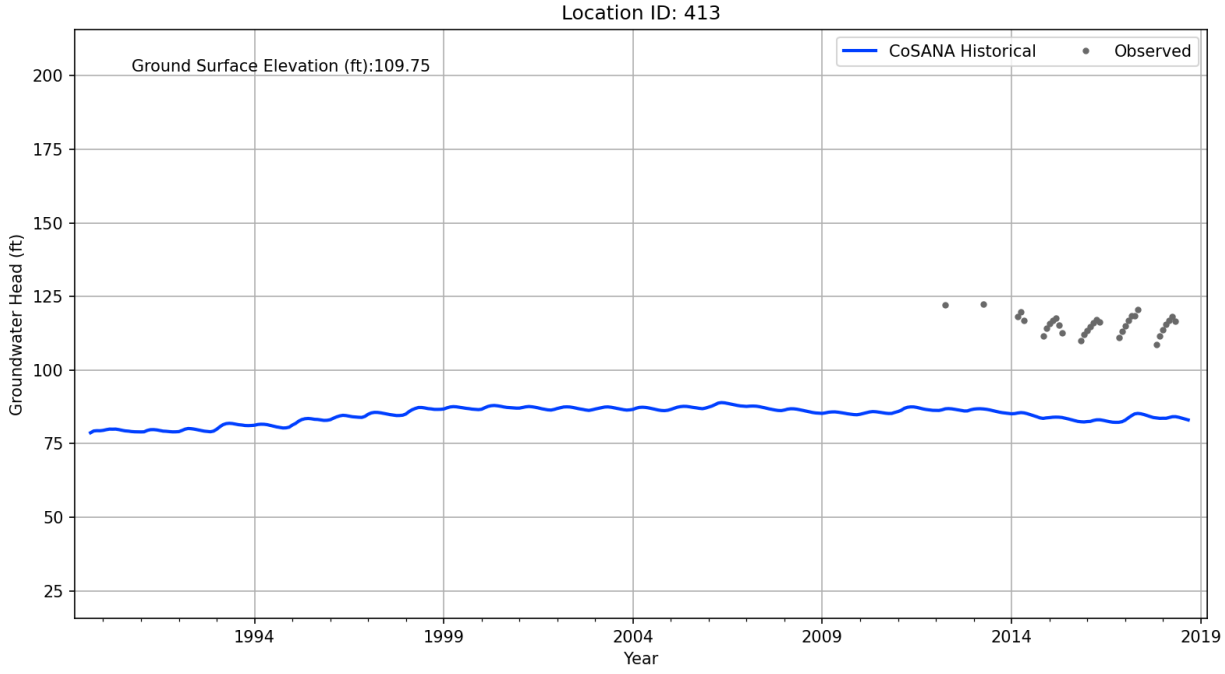

Location ID: 357
Ground Surface Elevation (ft):46.93
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

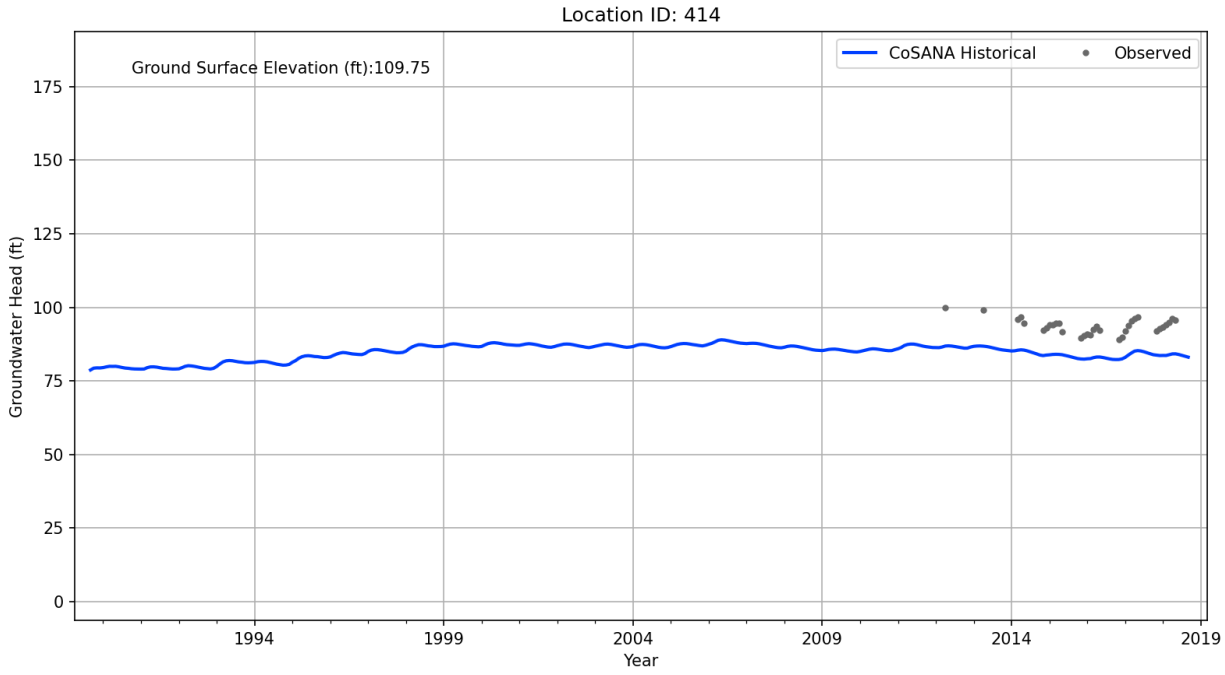

Location ID: 358
Ground Surface Elevation (ft):55.48
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

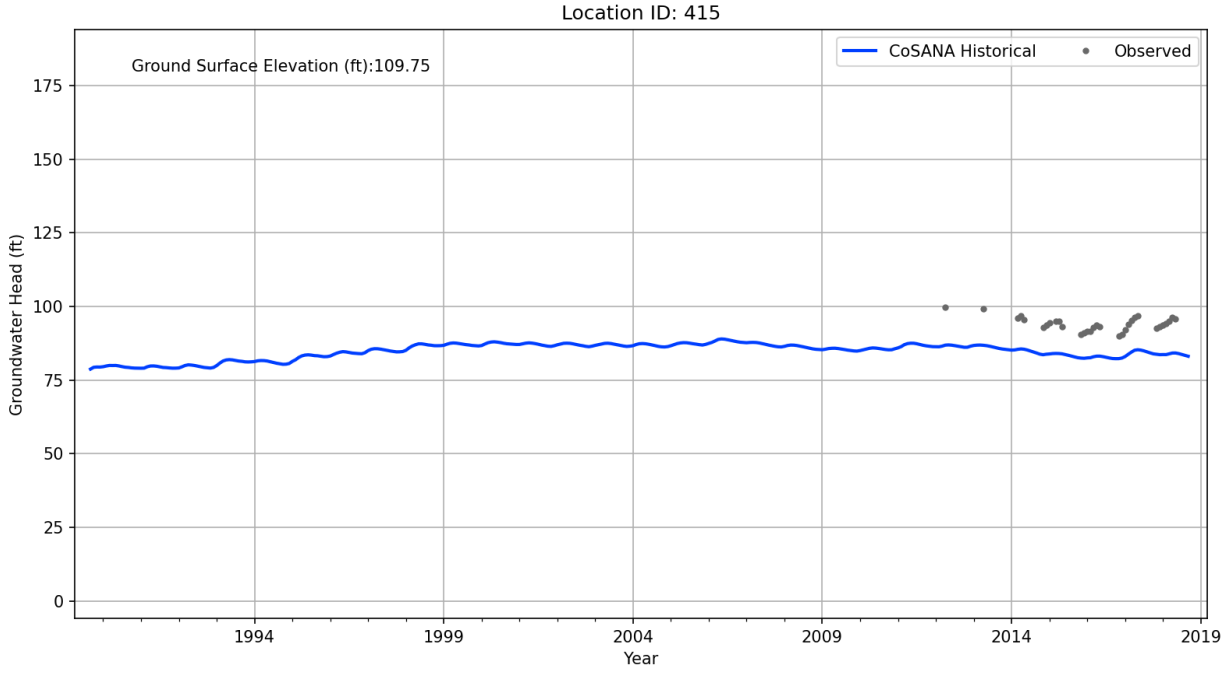

Location ID: 408
Ground Surface Elevation (ft):85.51
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

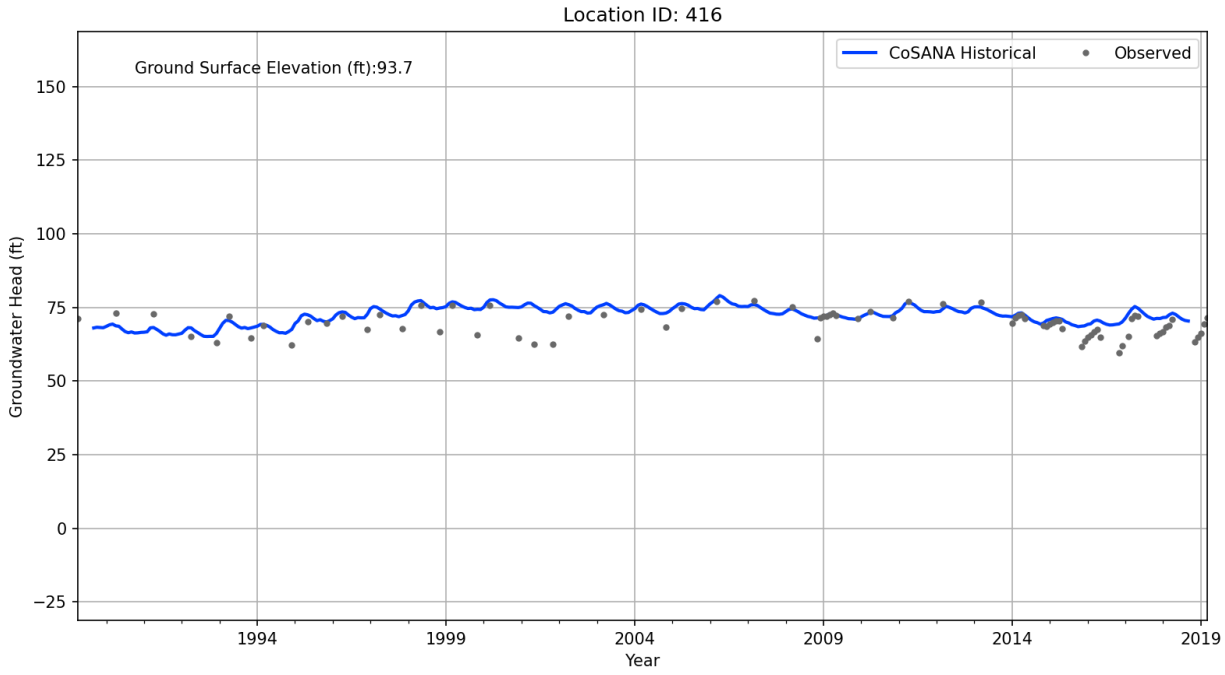

Location ID: 409
Ground Surface Elevation (ft):98.92
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

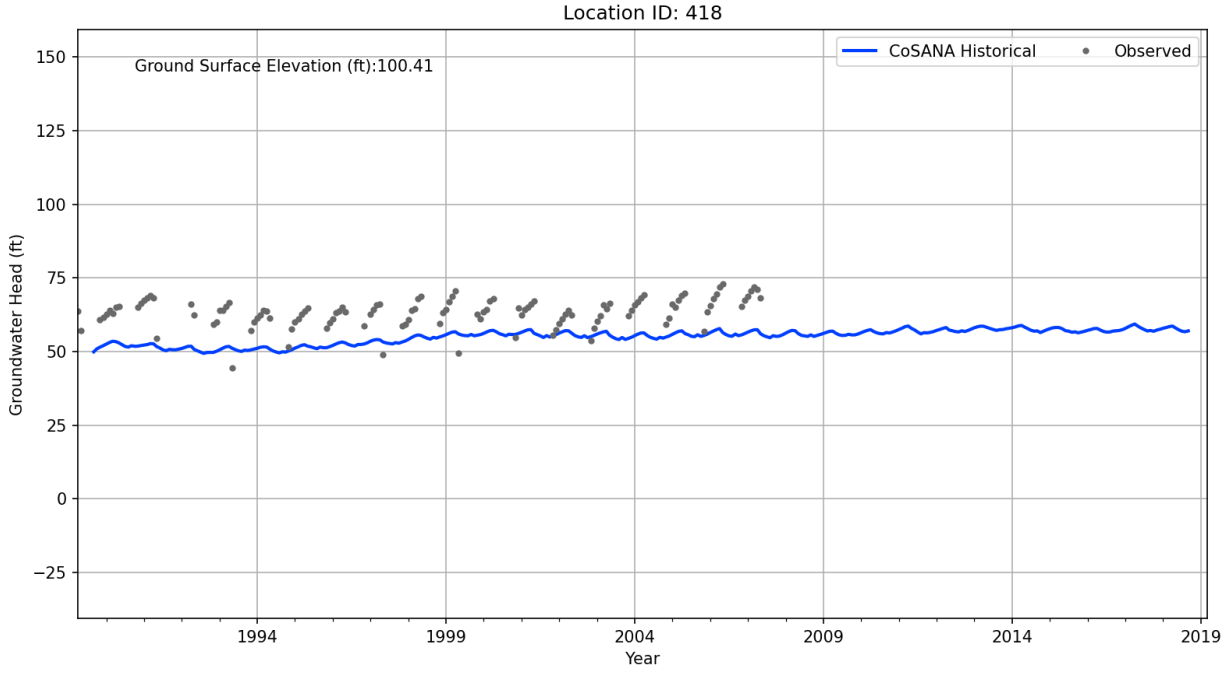

Location ID: 410
Ground Surface Elevation (ft):81.65
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

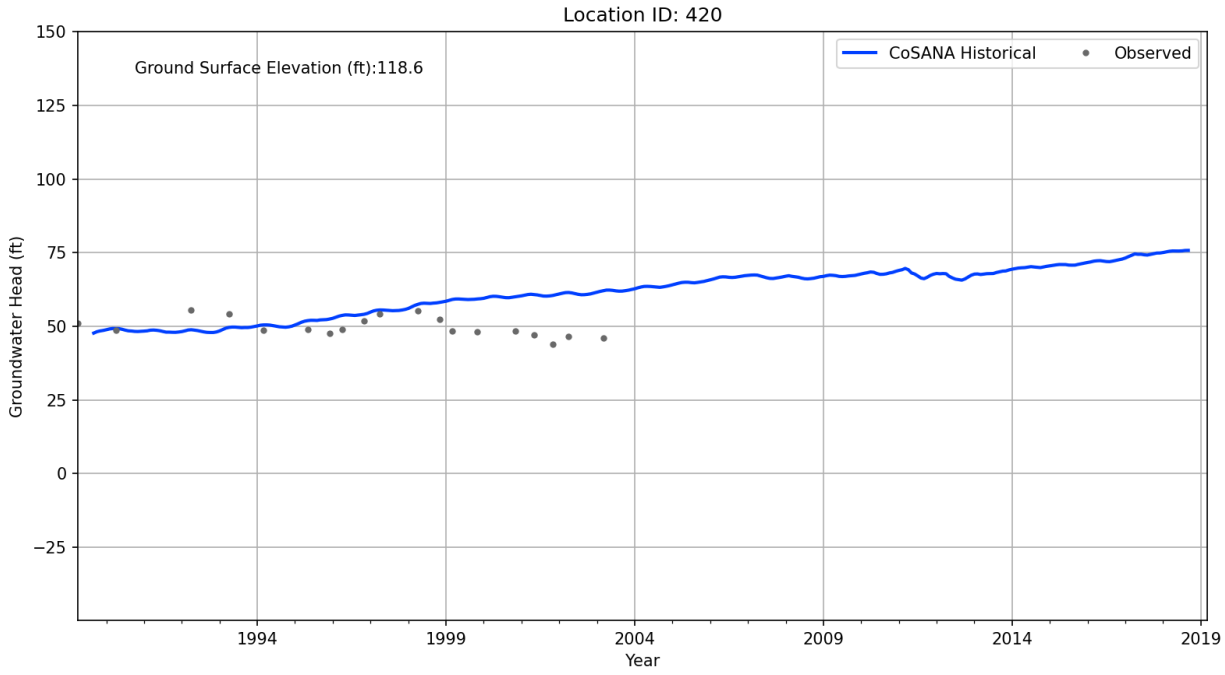

Location ID: 413
Ground Surface Elevation (ft):109.75
CoSANA Historical
Observed
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

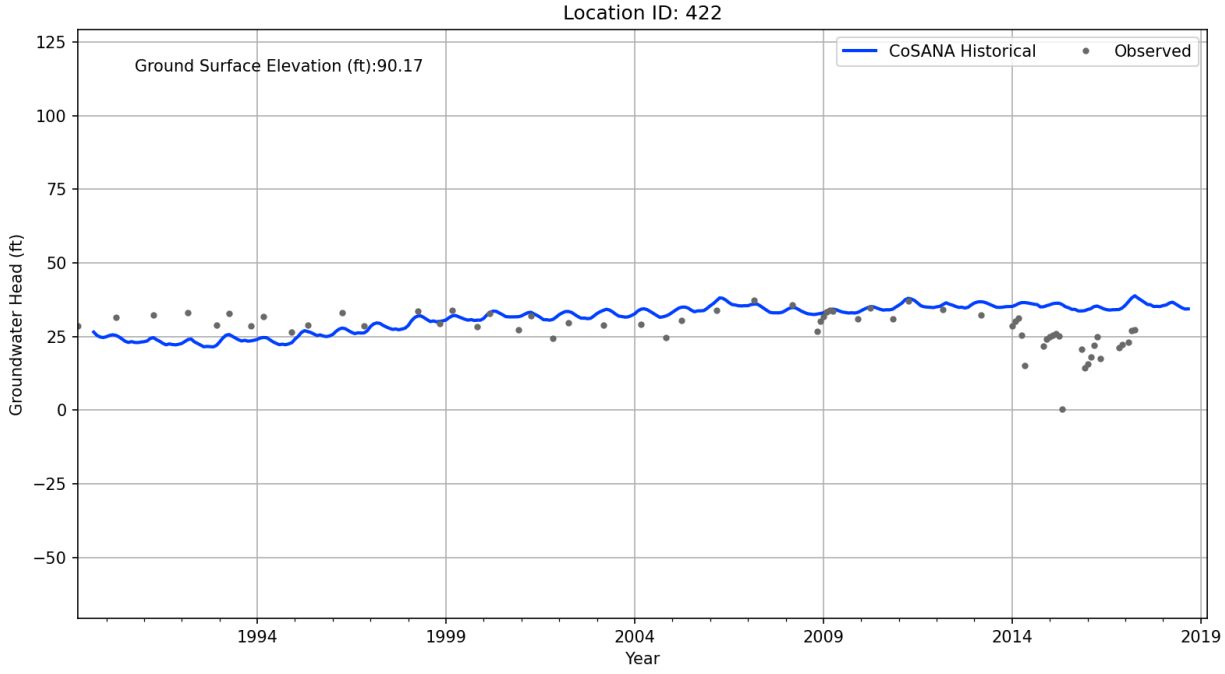

Location ID: 414
Ground Surface Elevation (ft):109.75
CoSANA Historical
Observed
Groundwater Head (ft)
Year
0
25
50
75
100
125
150
175
1994
1999
2004
2009
2014
2019

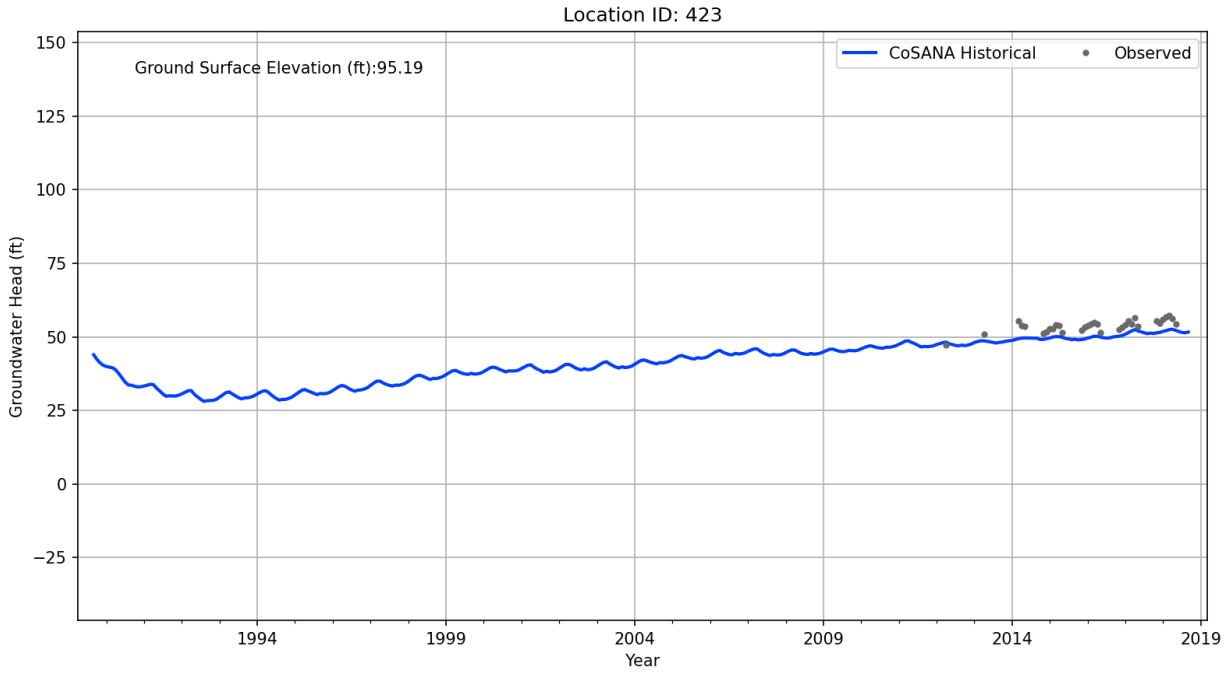

Location ID: 415
Ground Surface Elevation (ft):109.75
CoSANA Historical
Observed
Groundwater Head (ft)
Year
0
25
50
75
100
125
150
175
1994
1999
2004
2009
2014
2019

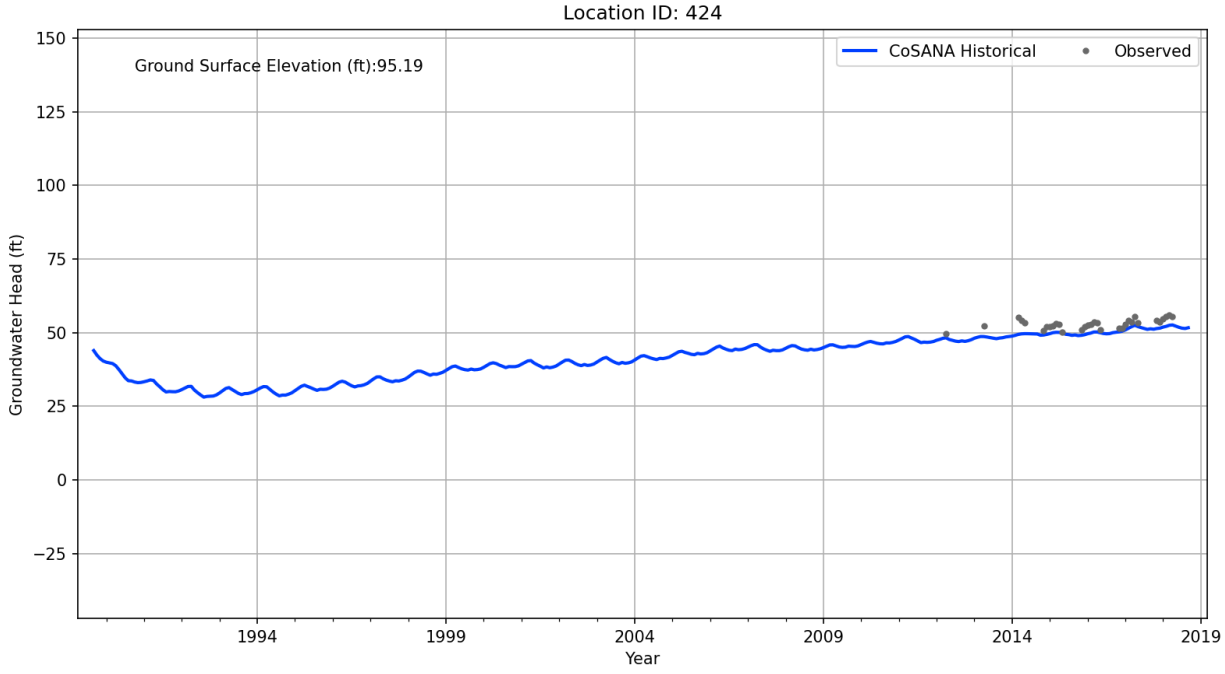

Location ID: 416
Ground Surface Elevation (ft):93.7
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

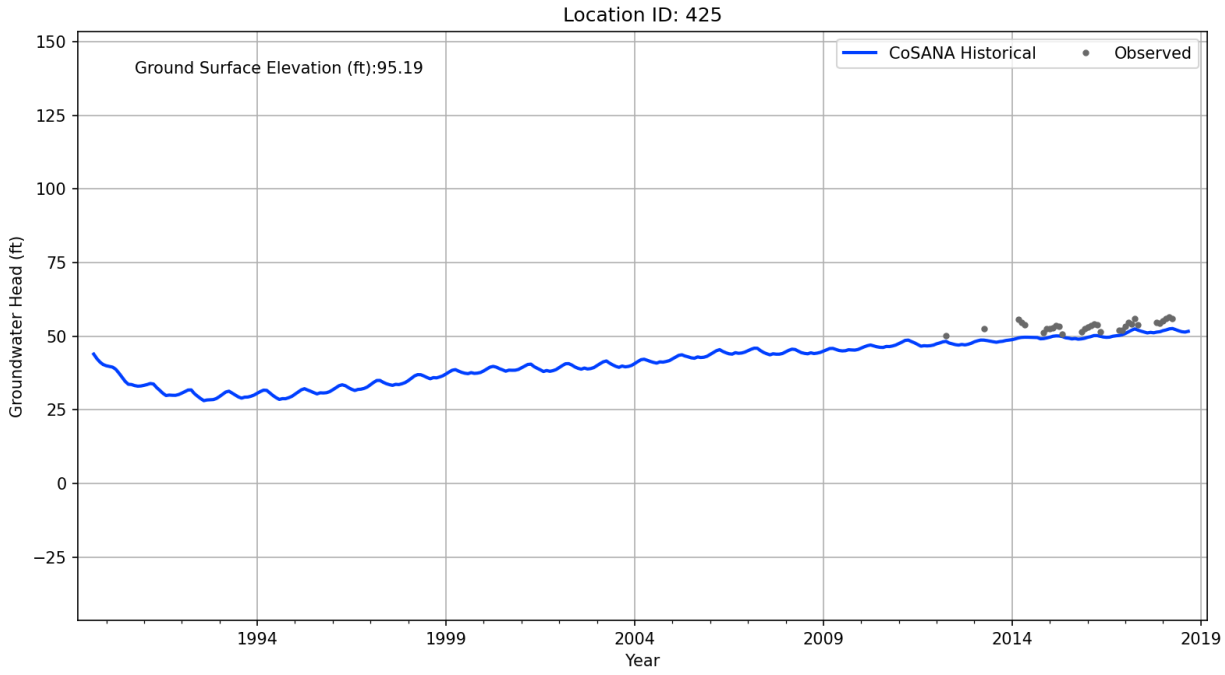

Location ID: 418
Ground Surface Elevation (ft):100.41
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

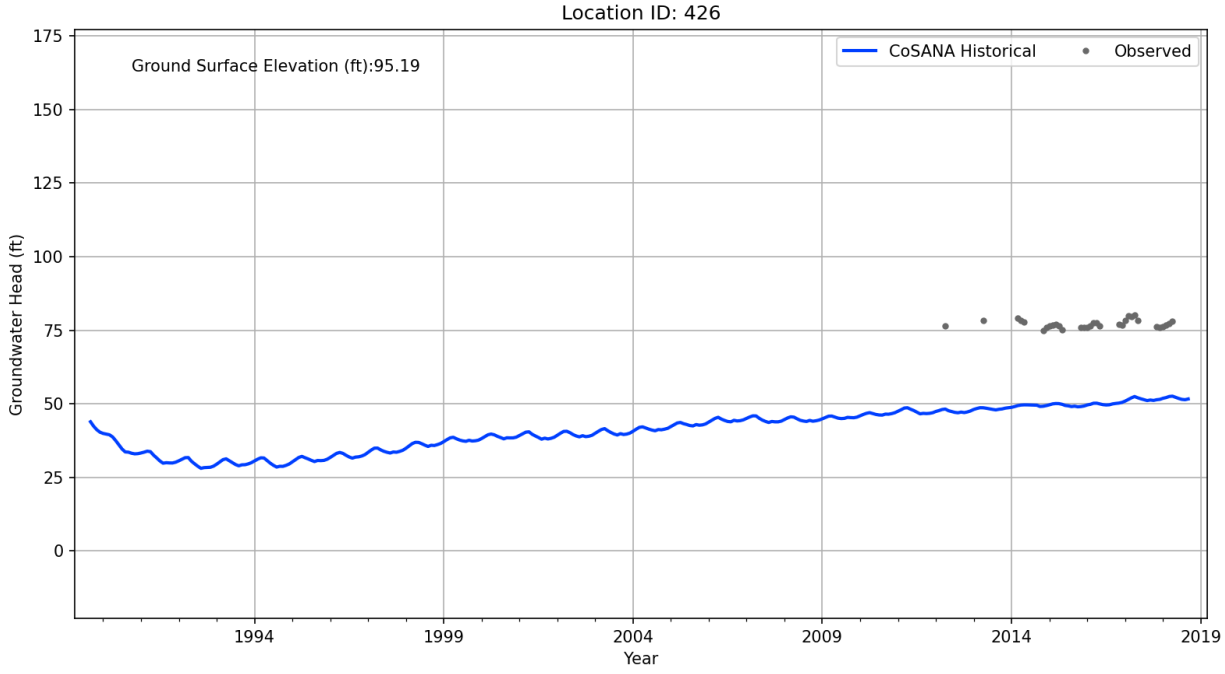

Location ID: 420
Ground Surface Elevation (ft):118.6
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

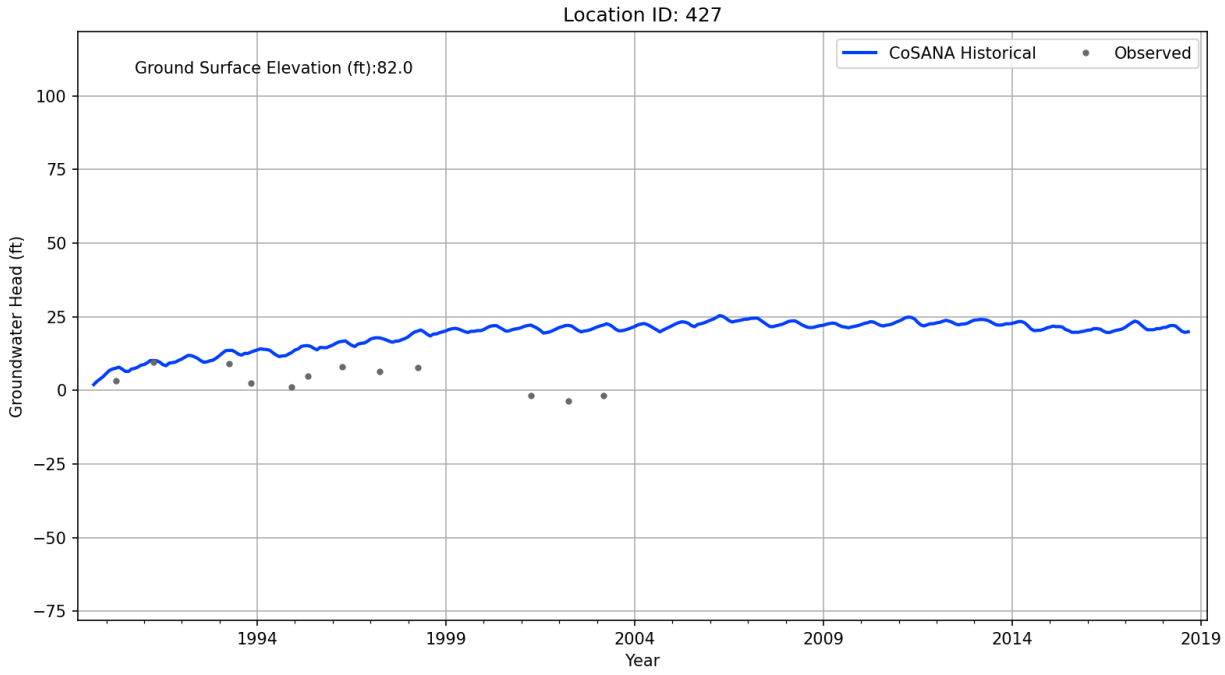

Location ID: 422
Ground Surface Elevation (ft):90.17
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

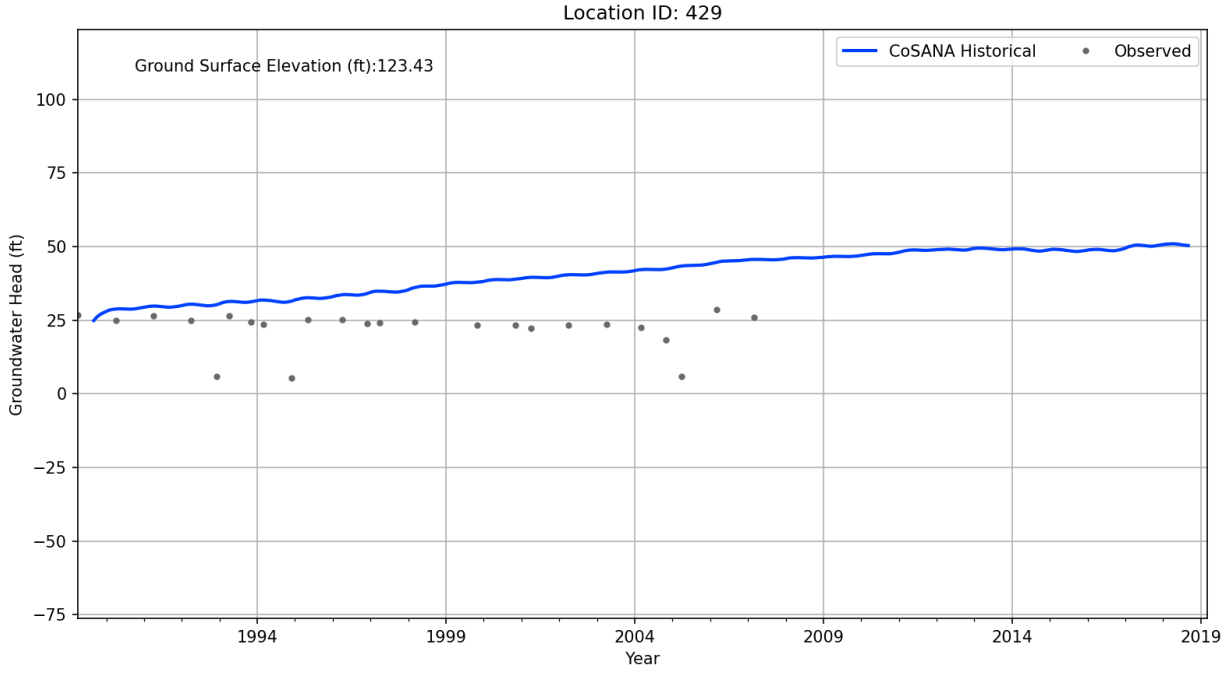

Location ID: 423
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

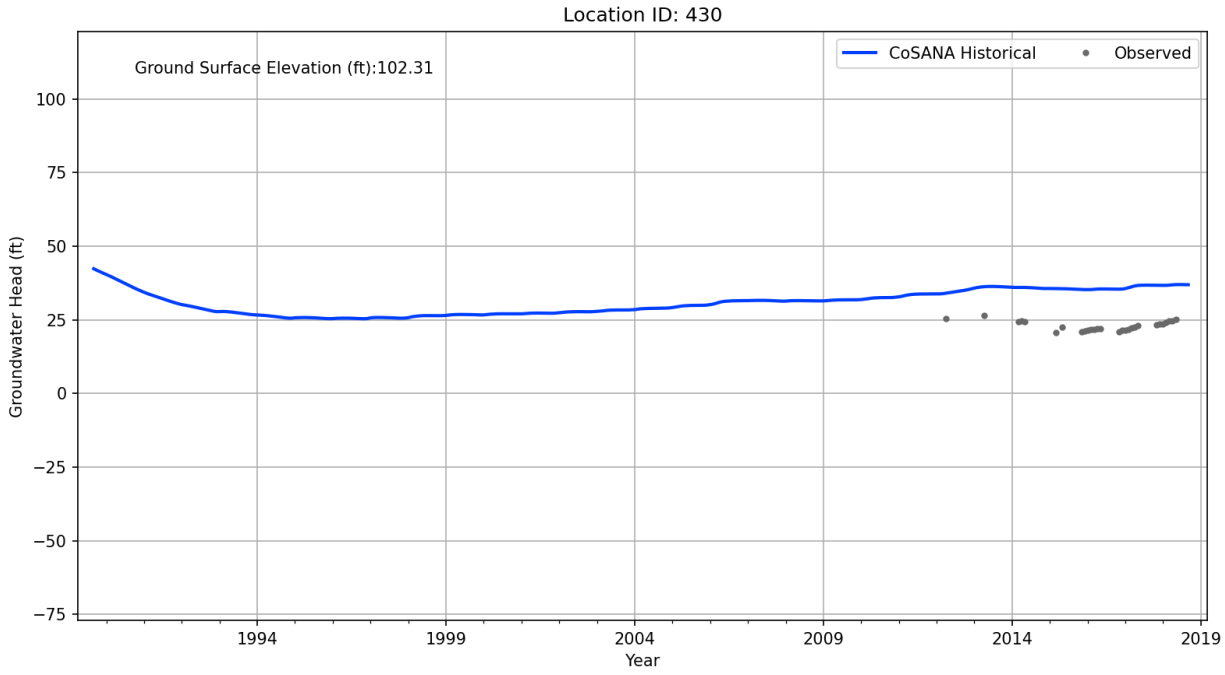

Location ID: 424
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

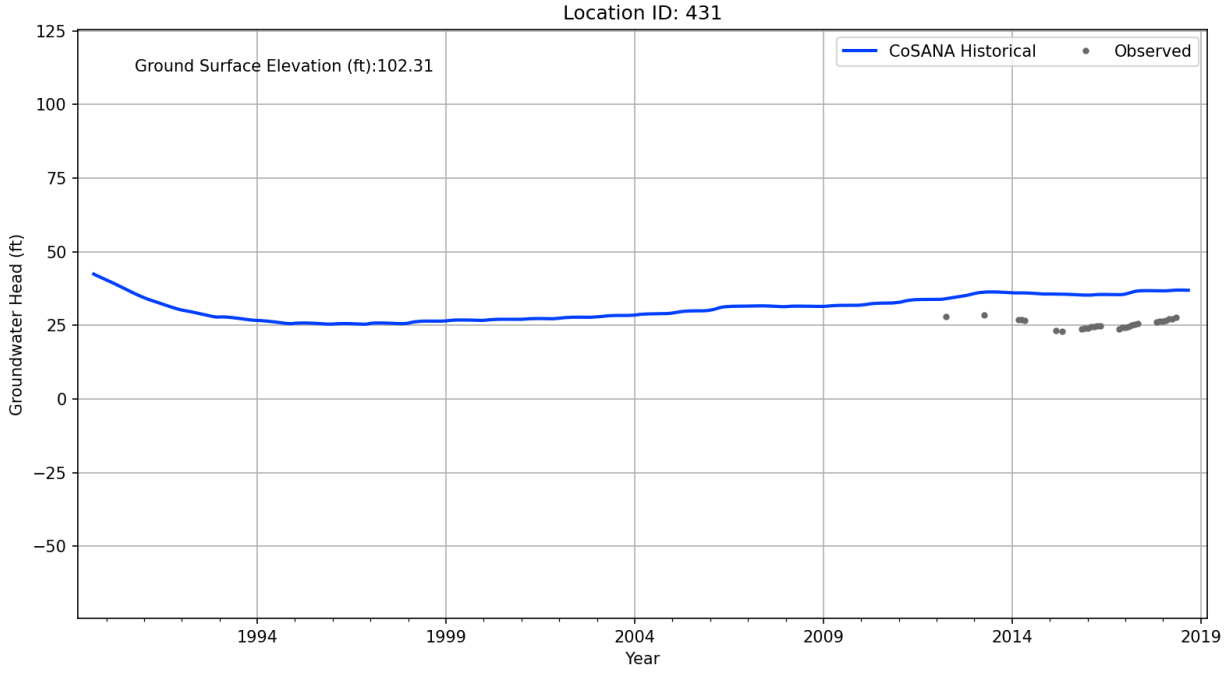

Location ID: 425
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

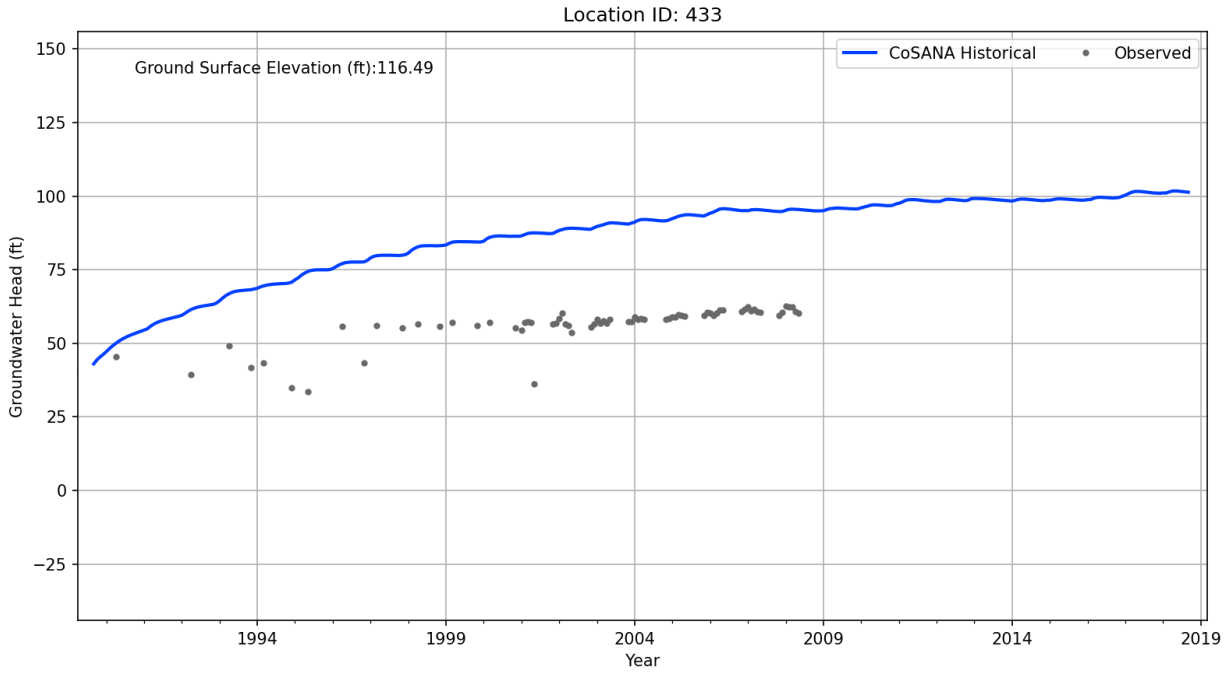

Location ID: 426
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

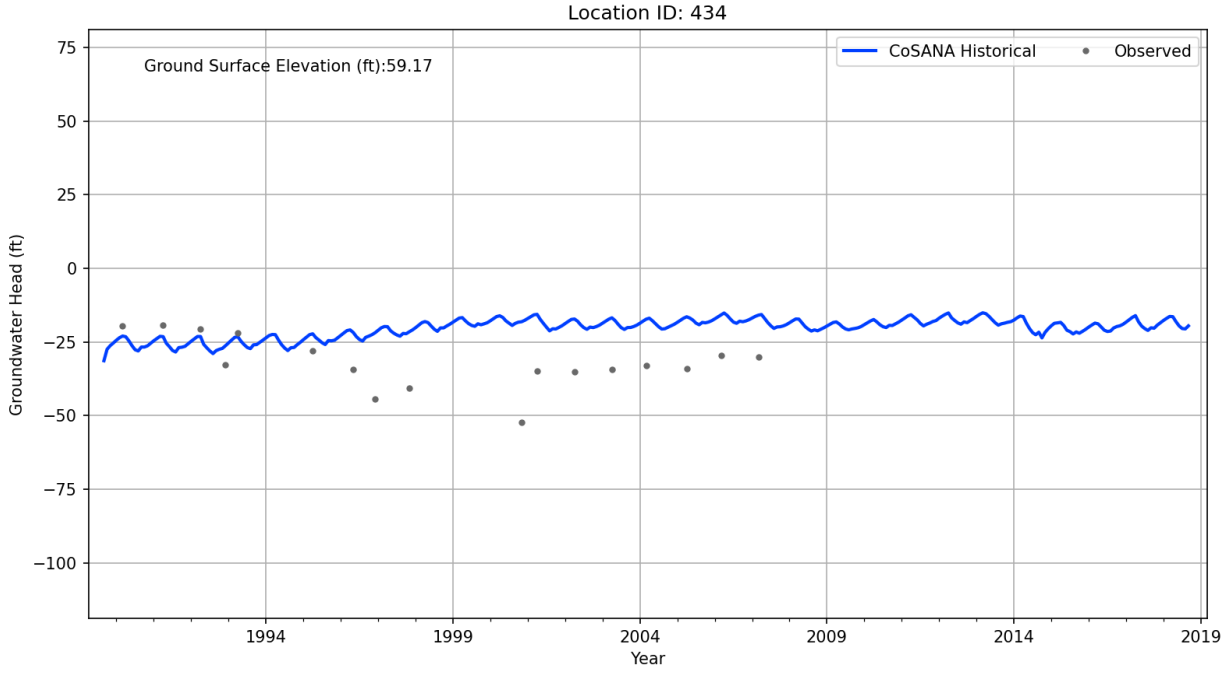

Location ID: 427
Ground Surface Elevation (ft):82.0
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

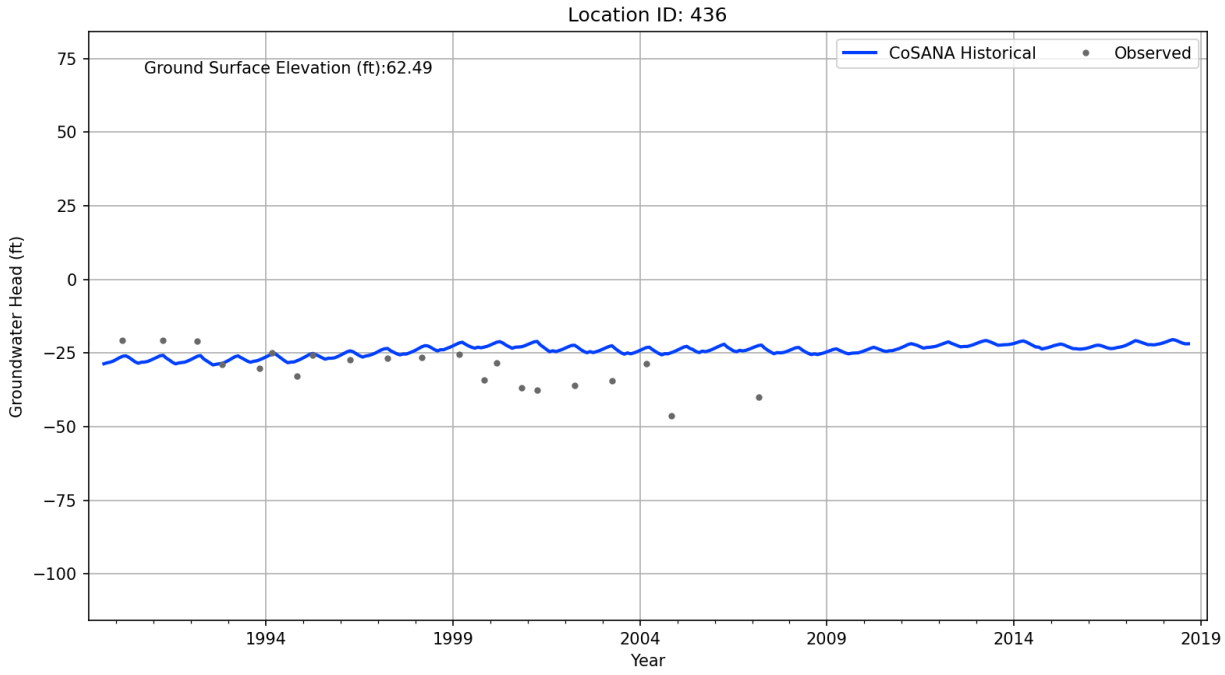

Location ID: 429
Ground Surface Elevation (ft):123.43
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

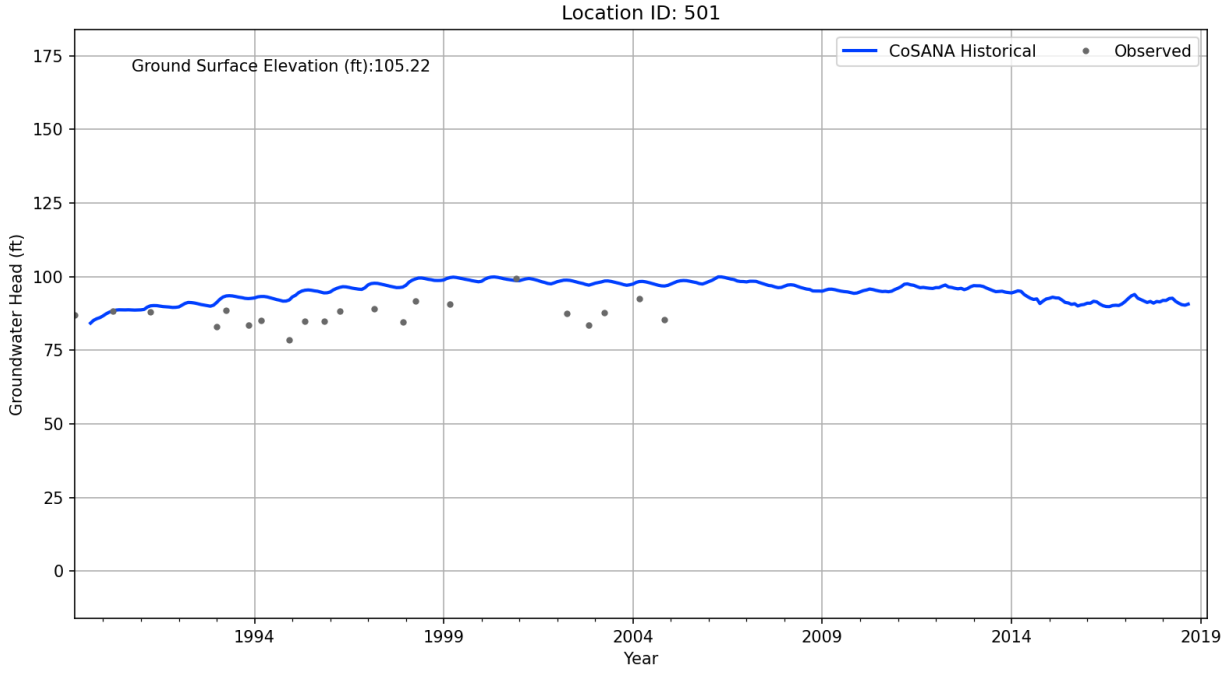

Location ID: 430
Ground Surface Elevation (ft):102.31
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

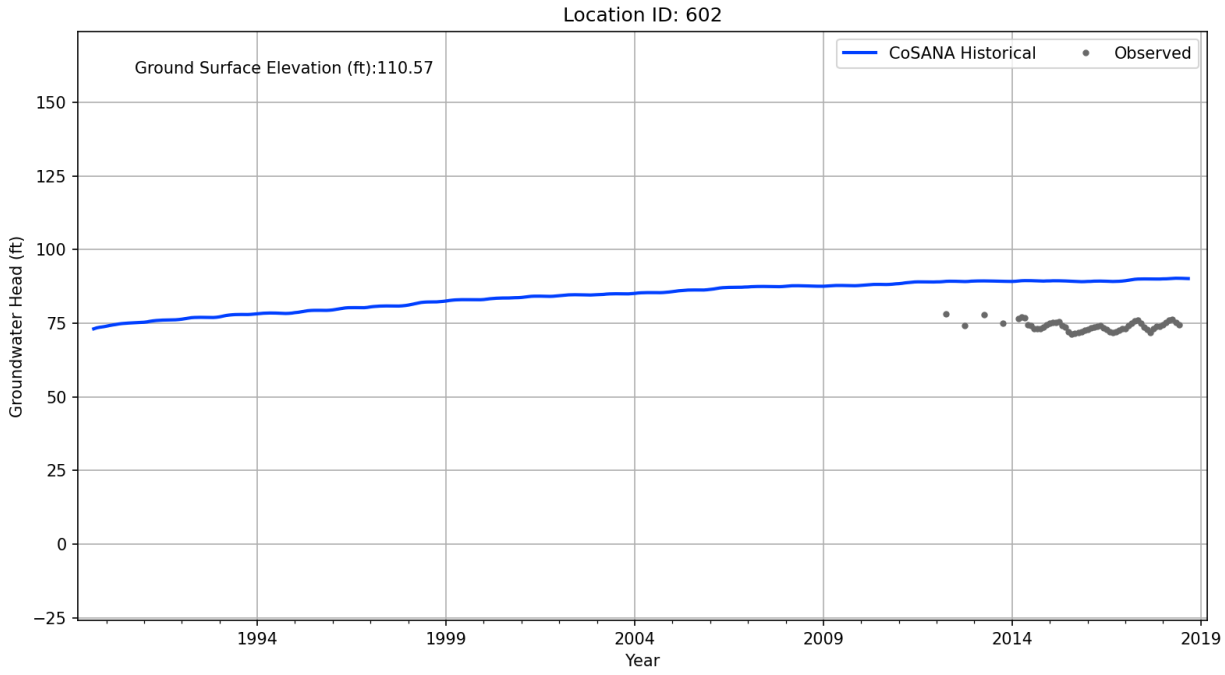

Location ID: 431
Ground Surface Elevation (ft):102.31
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

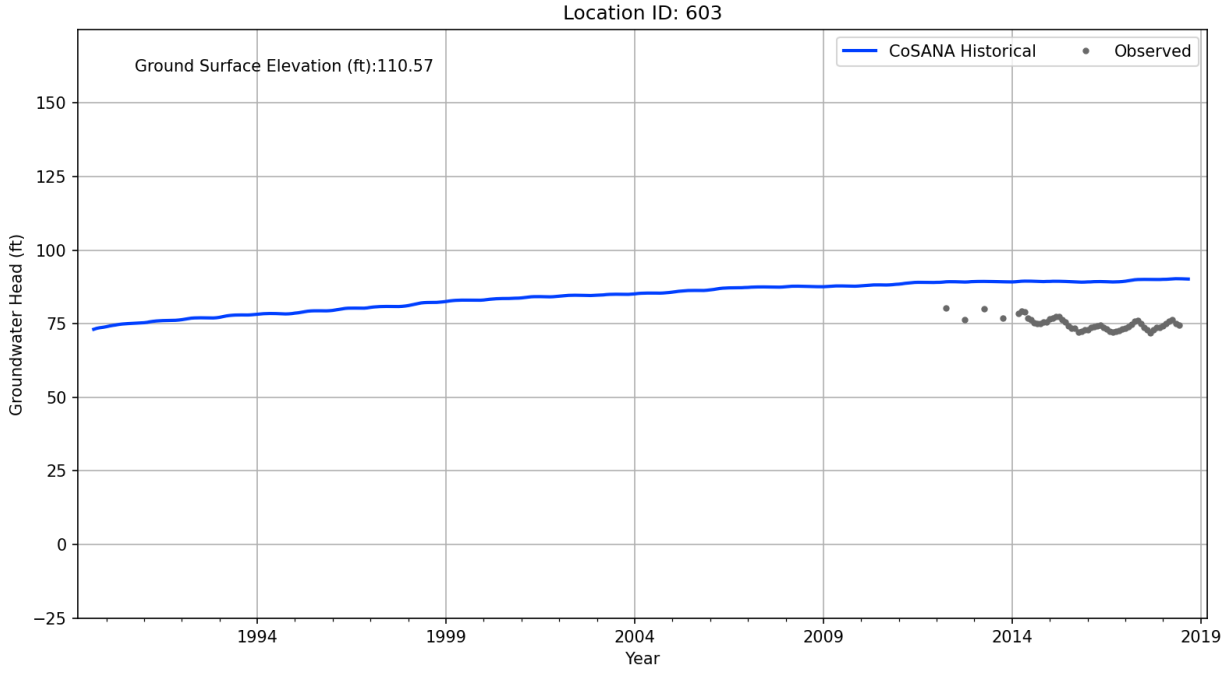

Location ID: 433
Ground Surface Elevation (ft):116.49
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

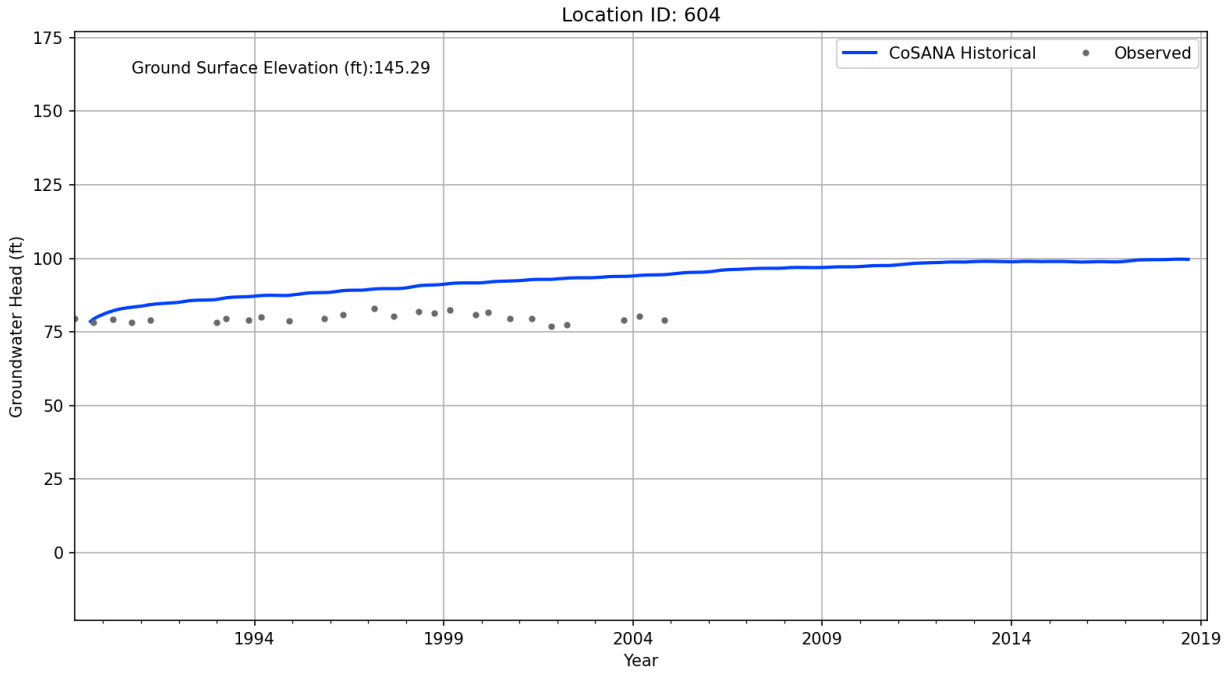

Location ID: 434
Ground Surface Elevation (ft):59.17
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

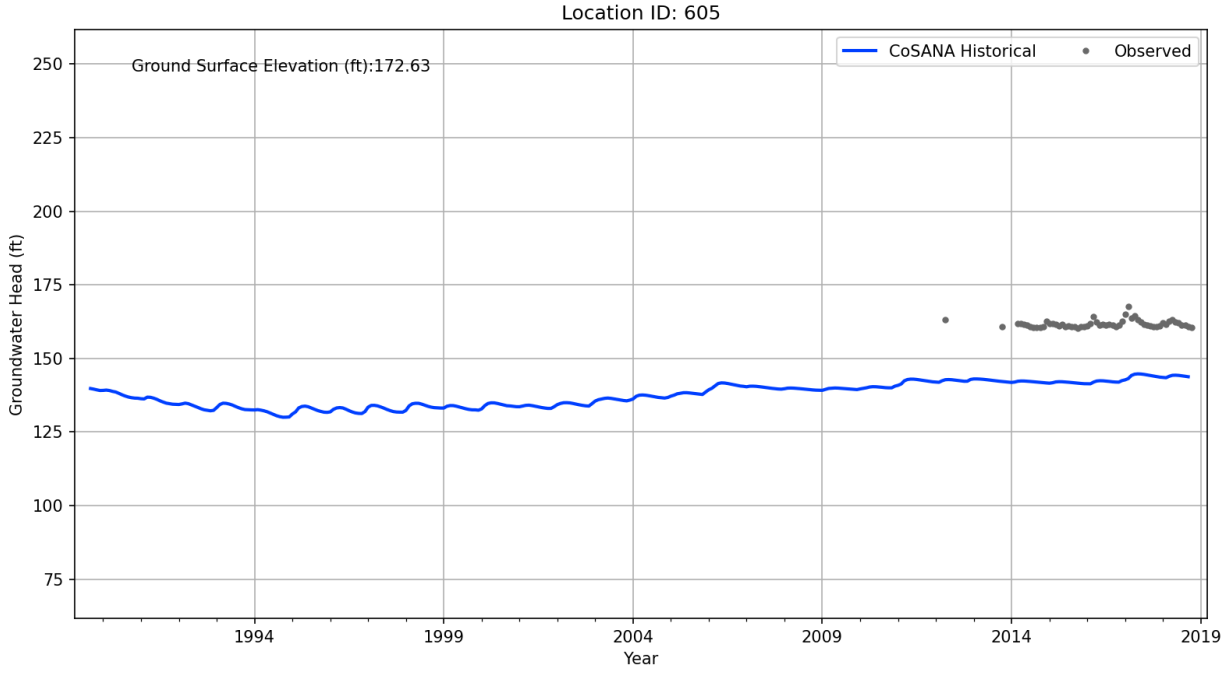

Location ID: 436
Ground Surface Elevation (ft):62.49
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

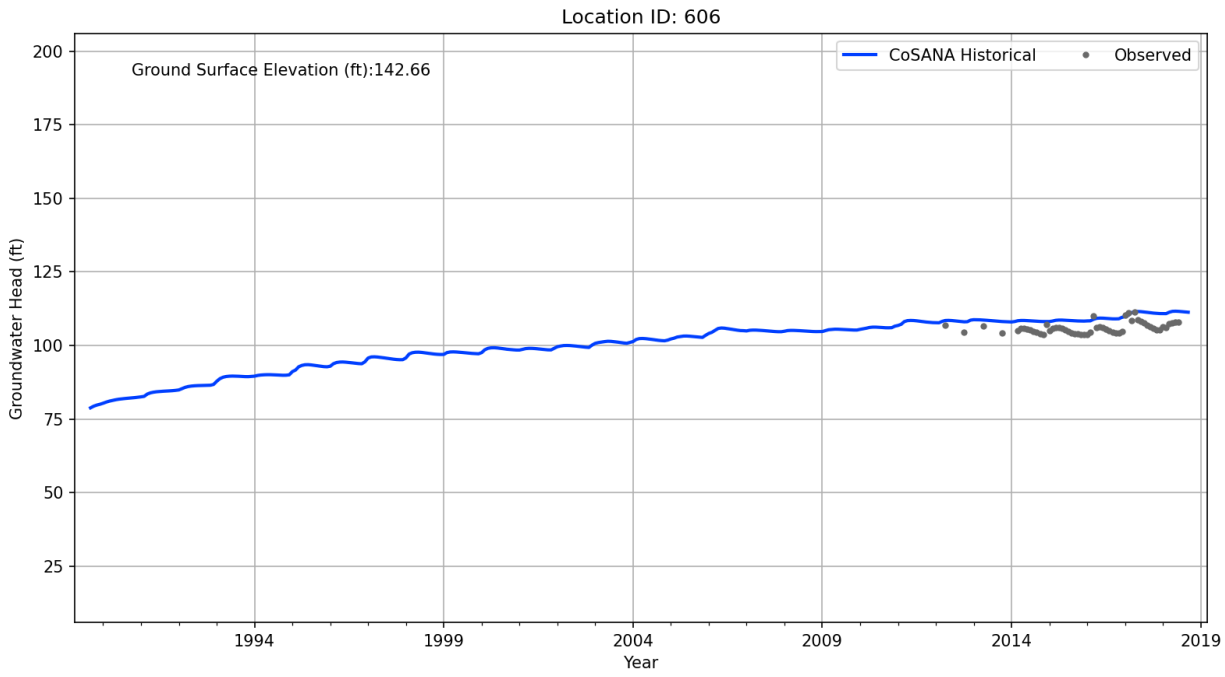

Location ID: 501
Ground Surface Elevation (ft):105.22
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

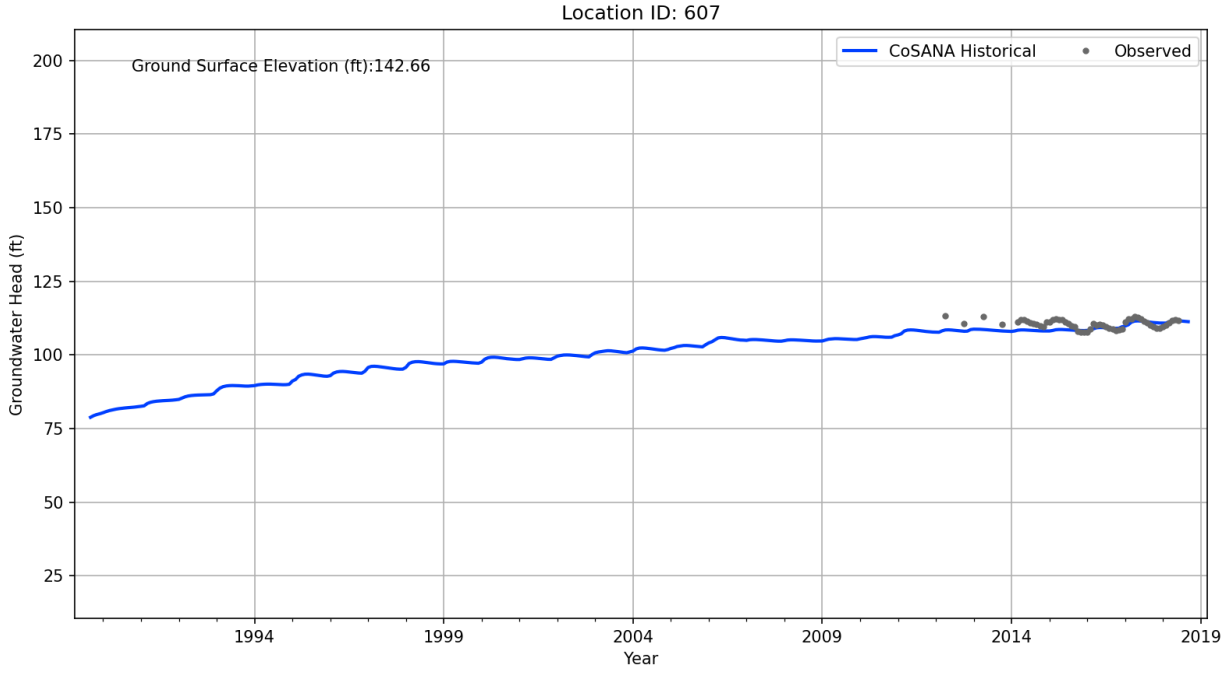

Location ID: 602
Ground Surface Elevation (ft):110.57
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

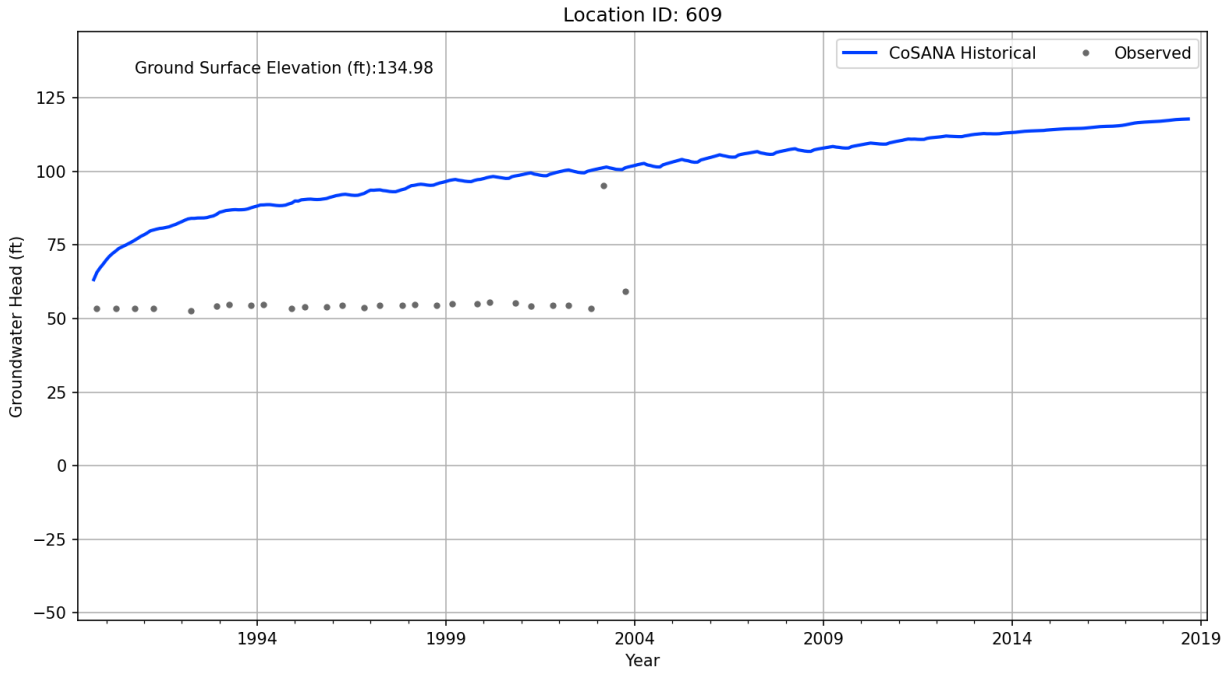

Location ID: 603
Ground Surface Elevation (ft):110.57
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

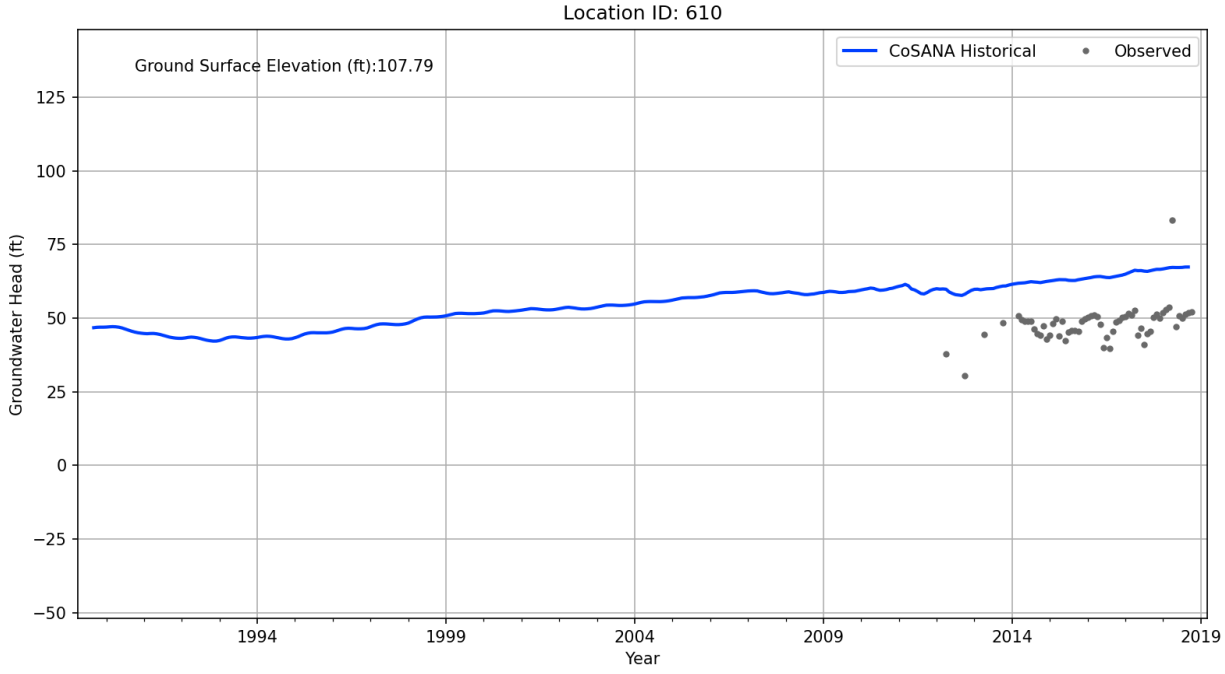

Location ID: 604
Ground Surface Elevation (ft):145.29
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

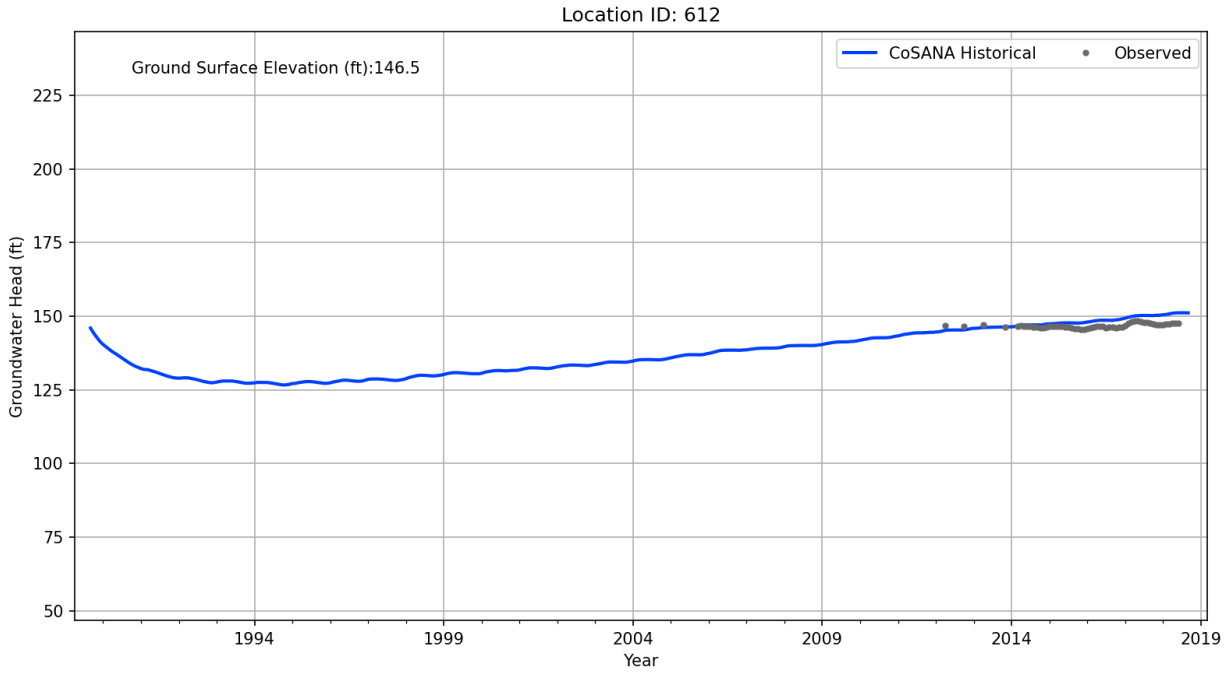

Location ID: 605
Ground Surface Elevation (ft):172.63
CoSANA Historical
Observed
Groundwater Head (ft)
250
225
200
175
150
125
100
75
1994
1999
2004
2009
2014
2019
Year

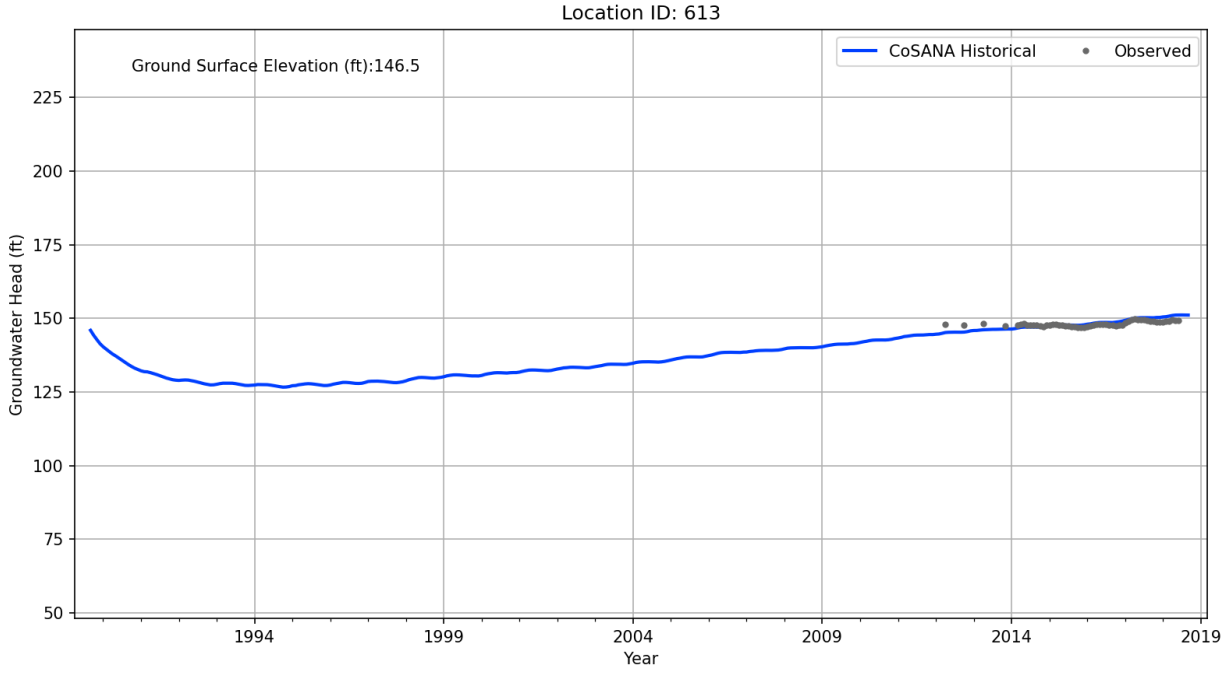

Location ID: 606
Ground Surface Elevation (ft):142.66
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

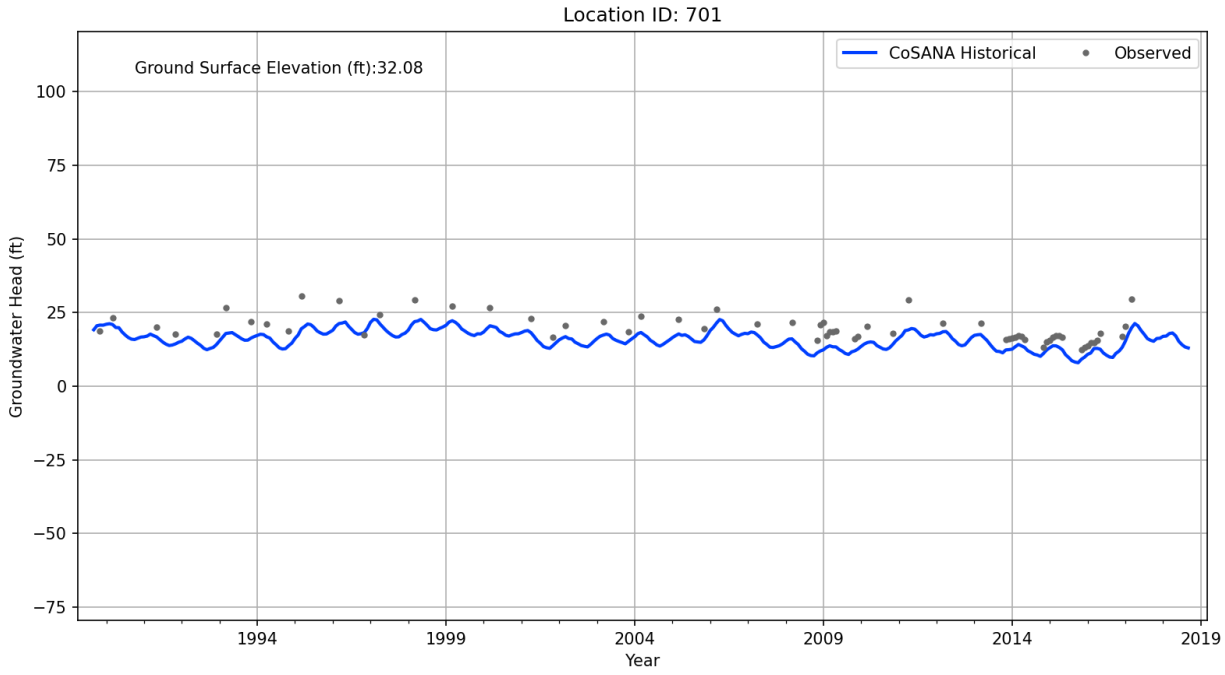

Location ID: 607
Ground Surface Elevation (ft):142.66
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

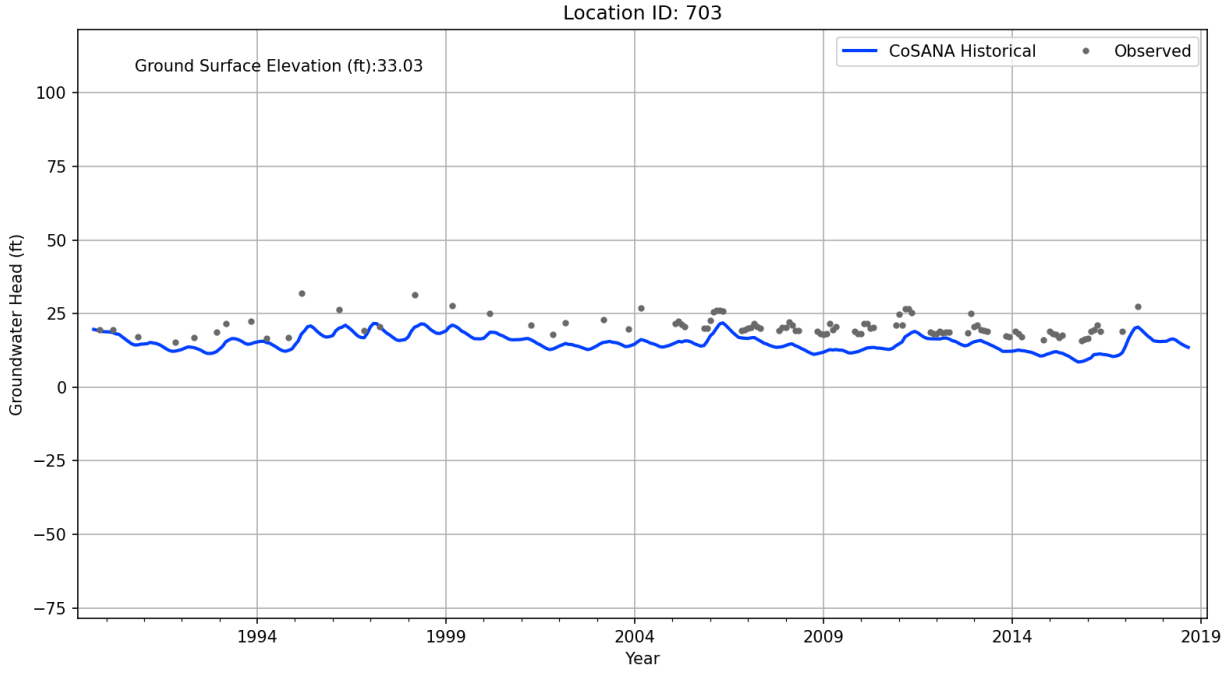

Location ID: 609
Ground Surface Elevation (ft):134.98
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

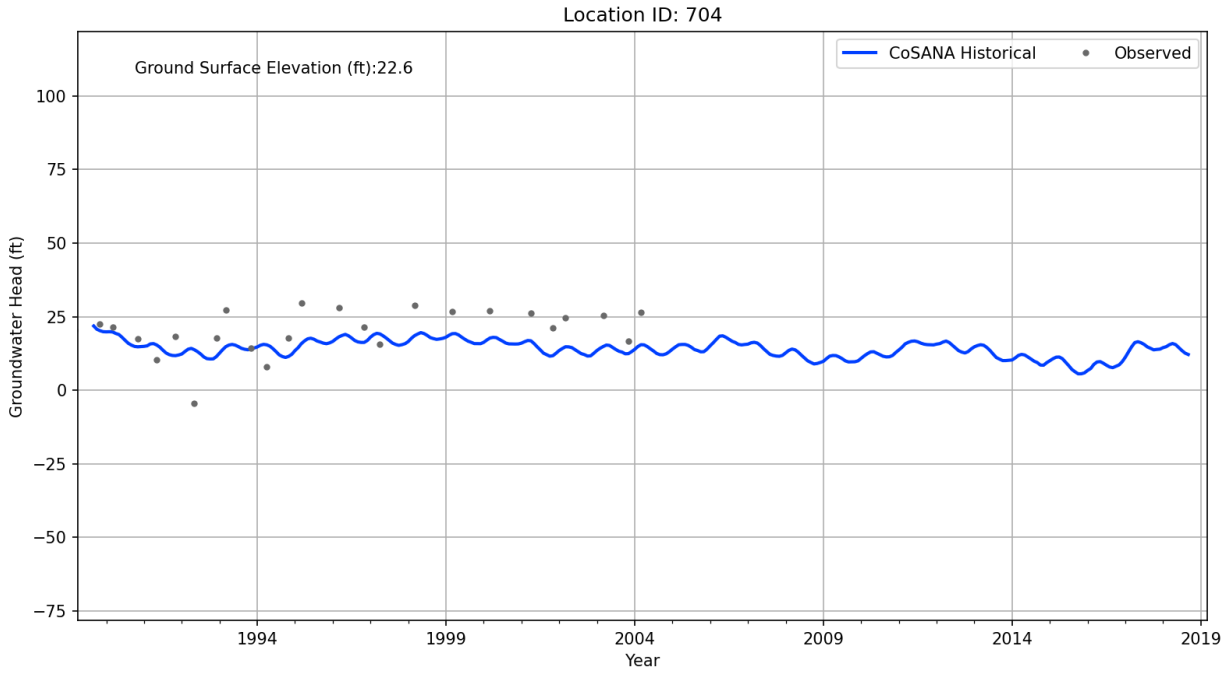

Location ID: 610
Ground Surface Elevation (ft):107.79
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

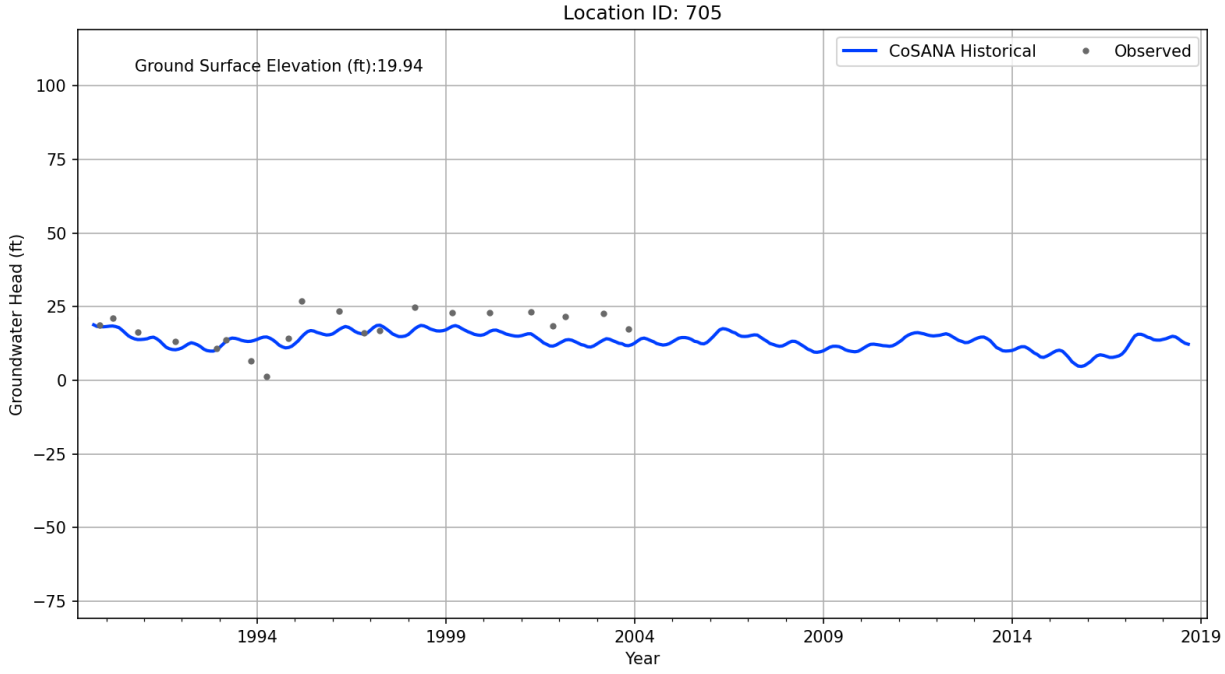

Location ID: 612
Ground Surface Elevation (ft):146.5
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

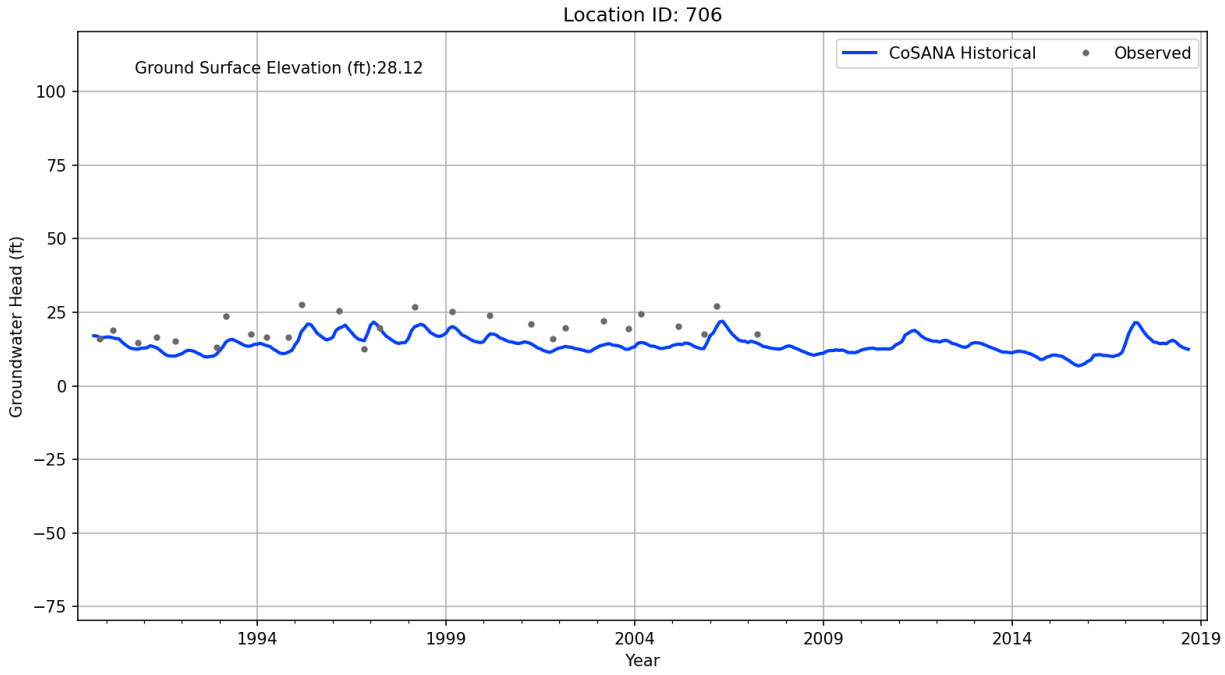

Location ID: 613
Ground Surface Elevation (ft):146.5
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

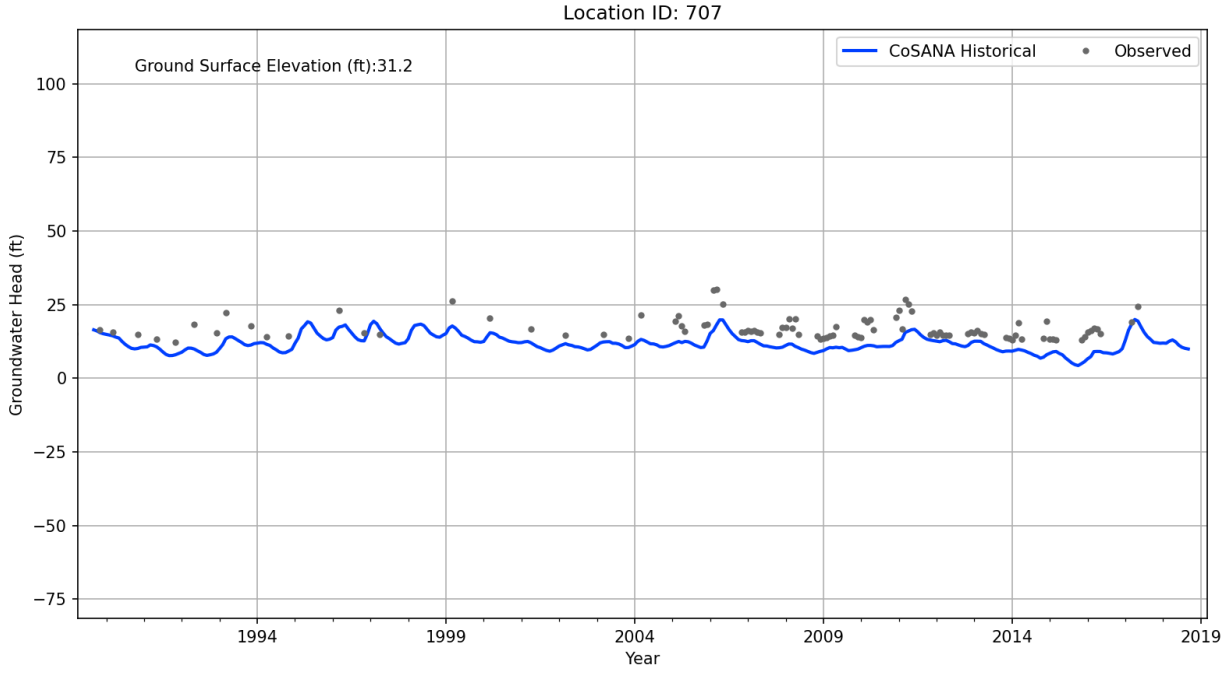

Location ID: 701
Ground Surface Elevation (ft):32.08
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

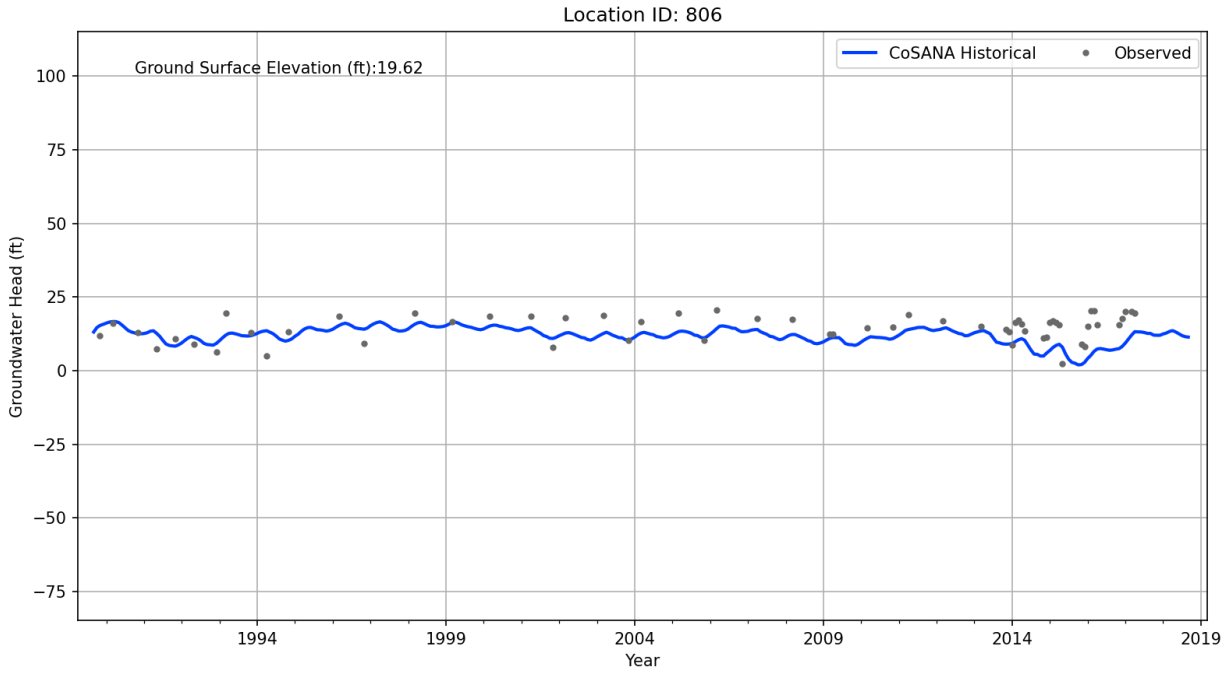

Location ID: 703
Ground Surface Elevation (ft):33.03
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

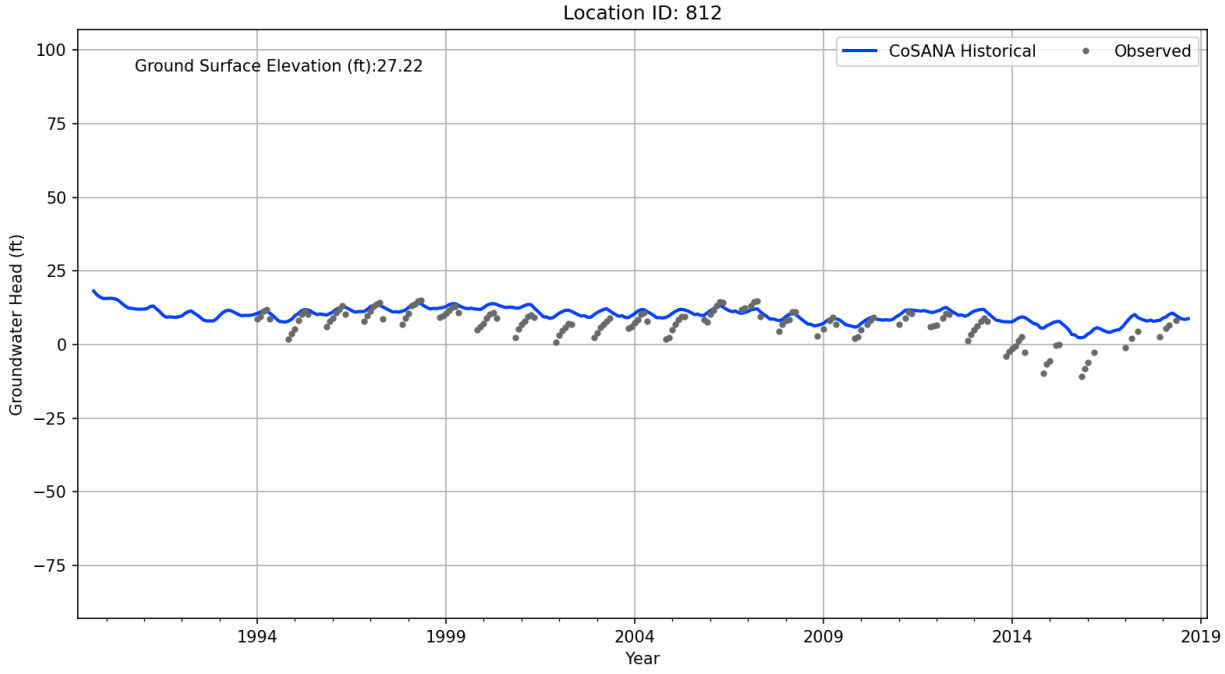

Location ID: 704
Ground Surface Elevation (ft):22.6
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

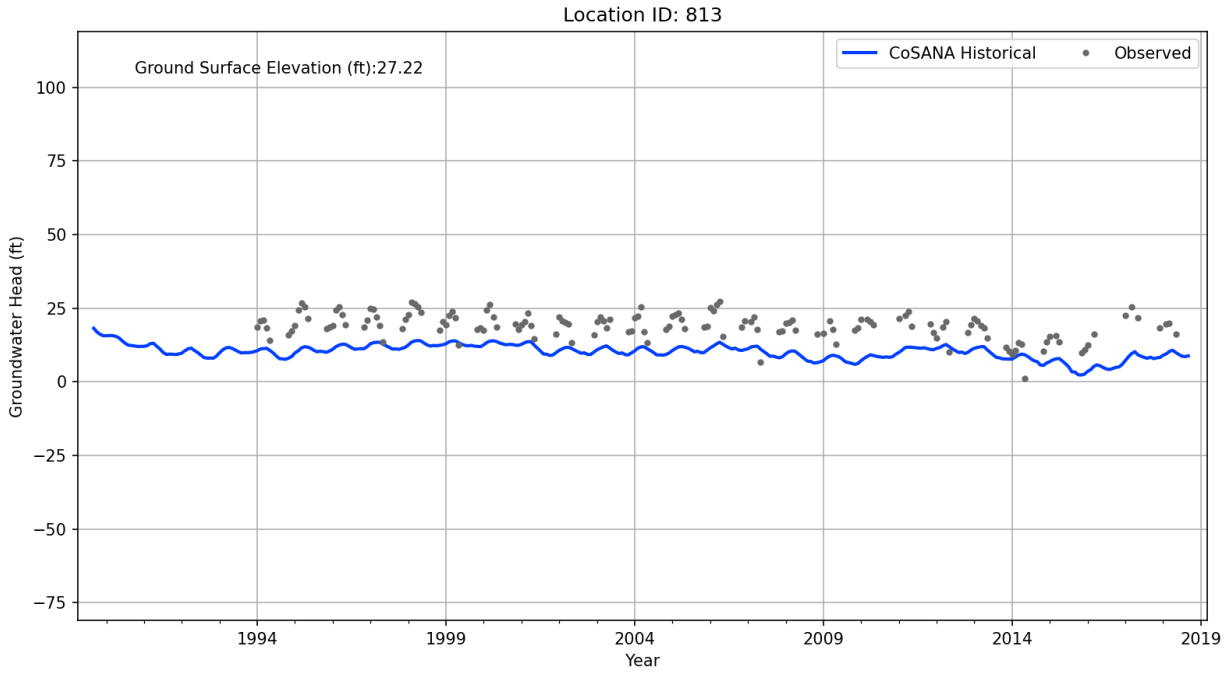

Location ID: 705
Ground Surface Elevation (ft):19.94
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

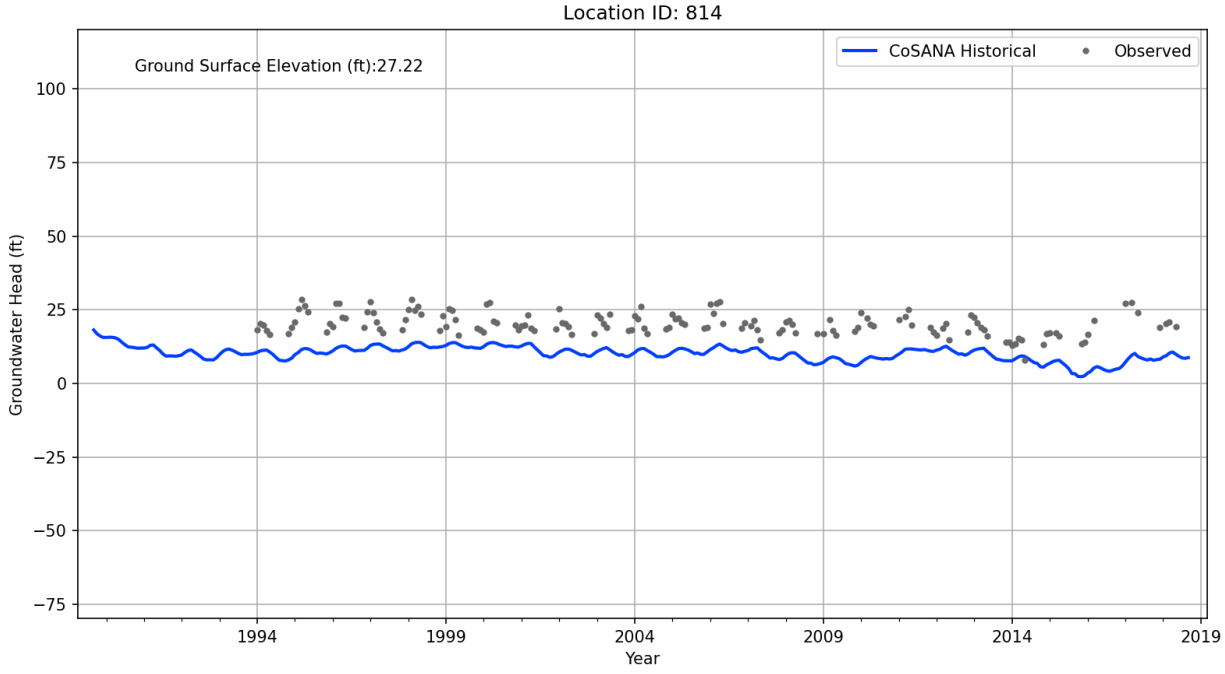

Location ID: 706
Ground Surface Elevation (ft):28.12
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

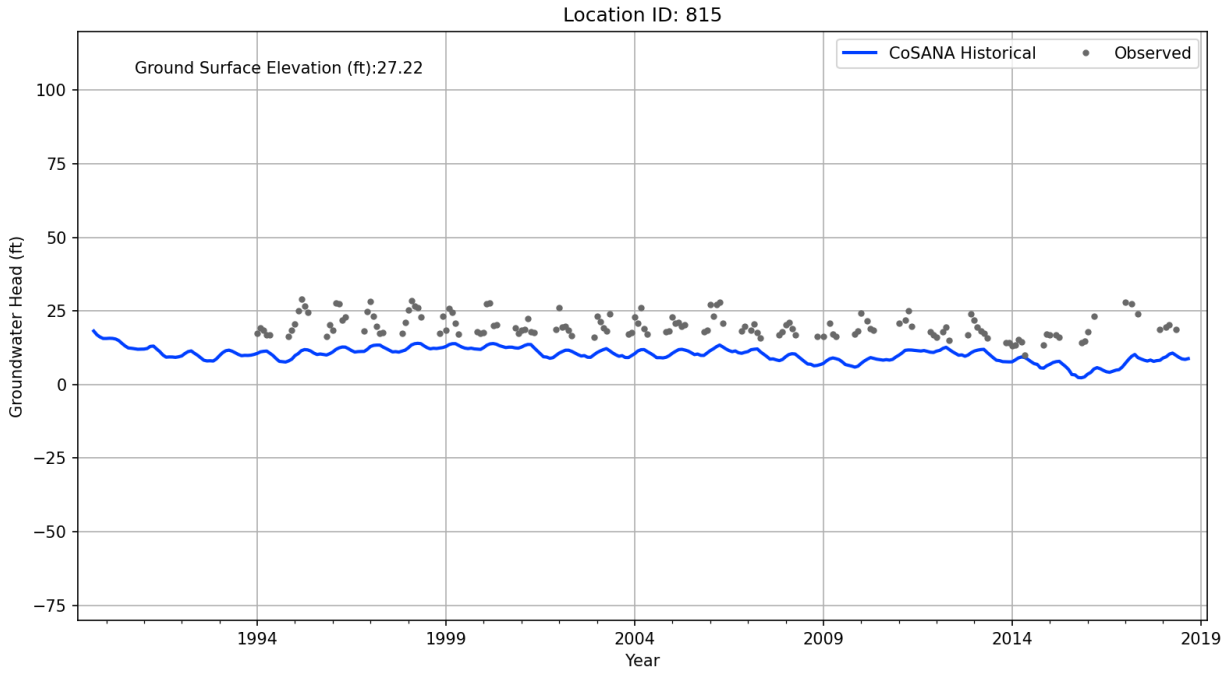

Location ID: 707
Ground Surface Elevation (ft):31.2
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

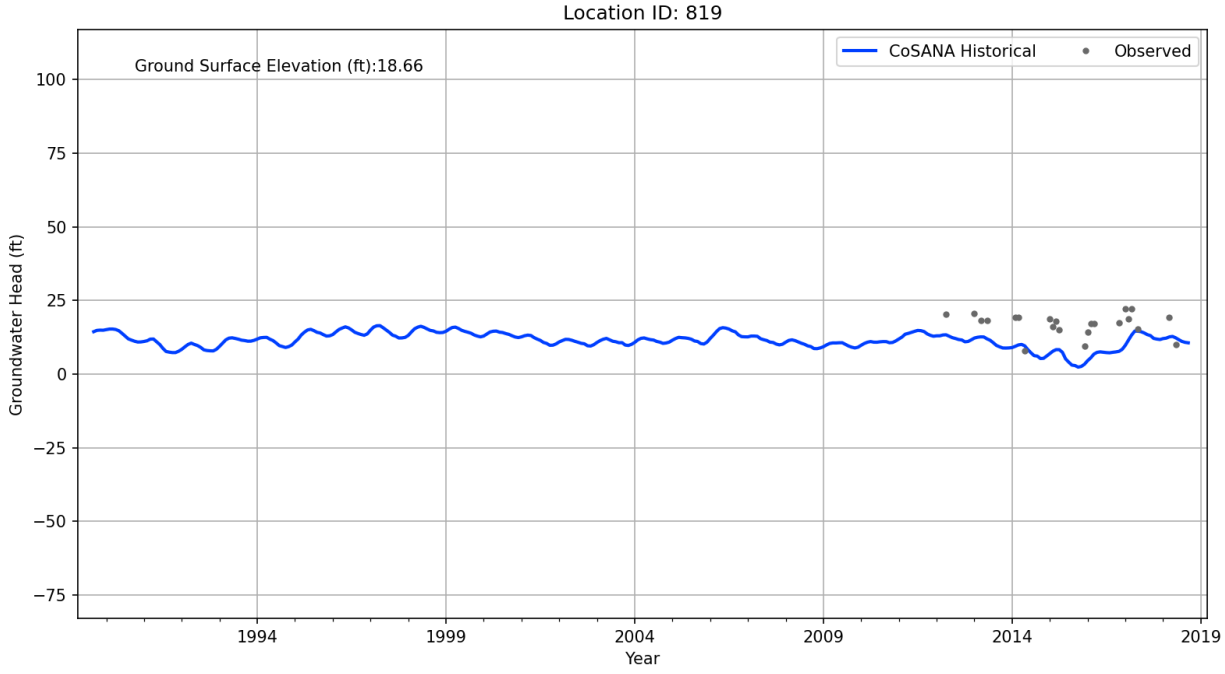

Location ID: 806
Ground Surface Elevation (ft):19.62
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

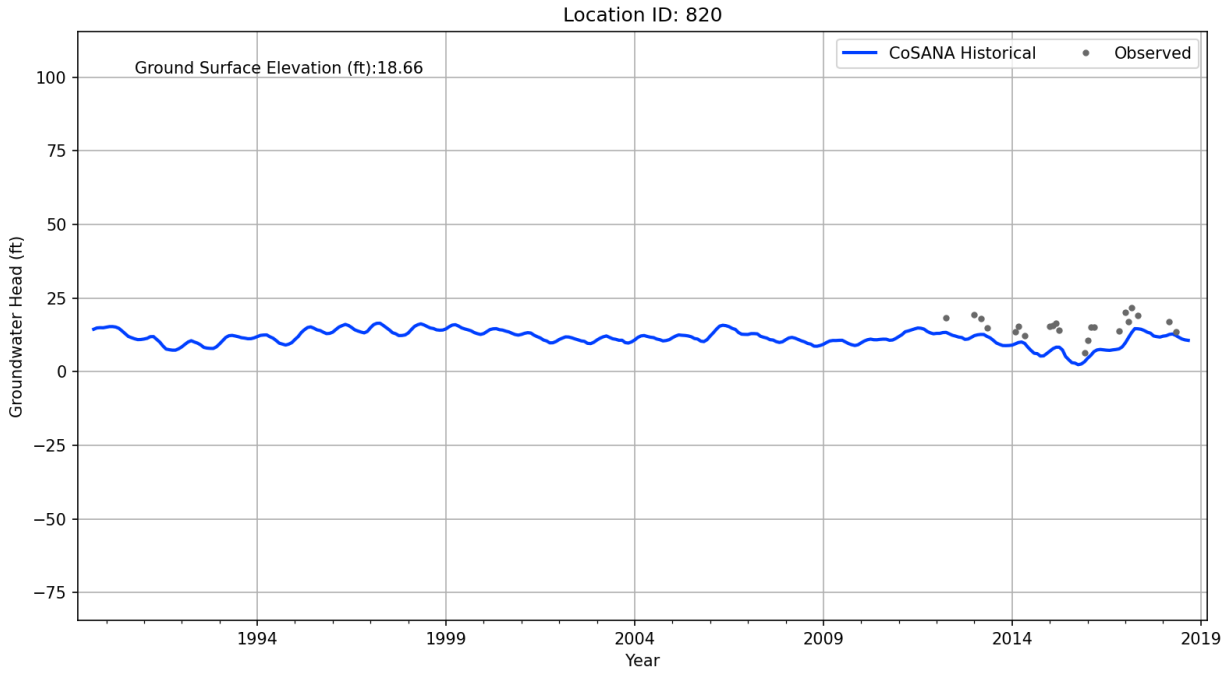

Location ID: 812
Ground Surface Elevation (ft):27.22
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

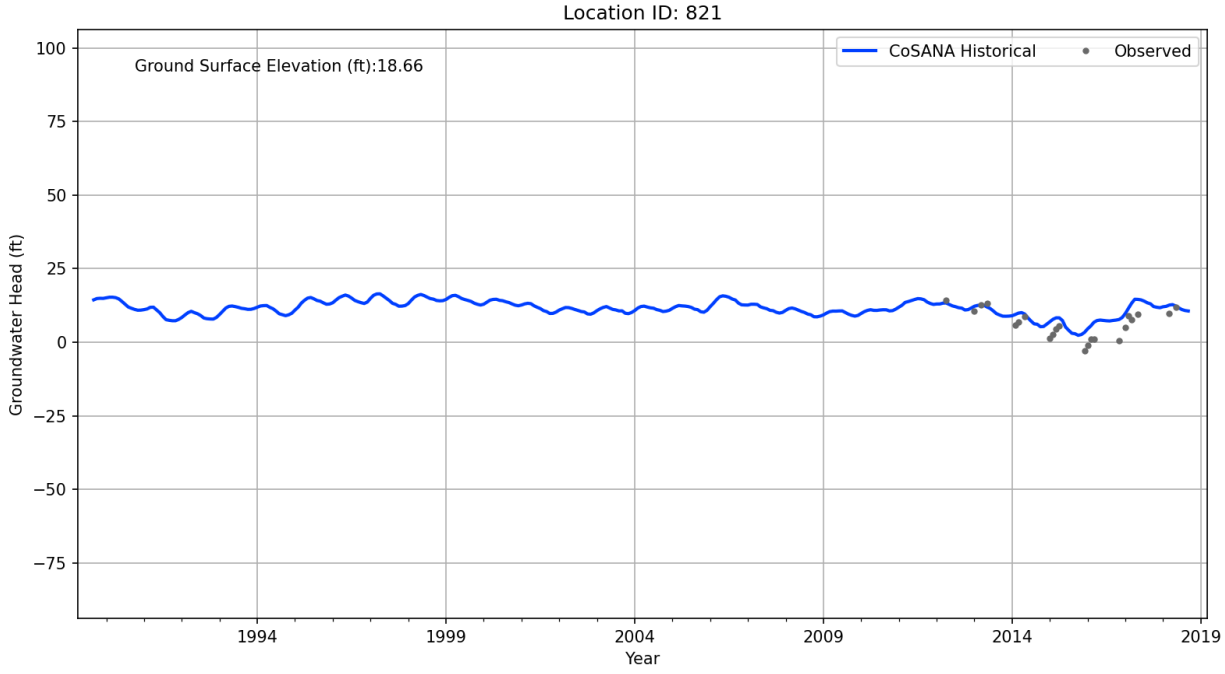

Location ID: 813
Ground Surface Elevation (ft):27.22
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

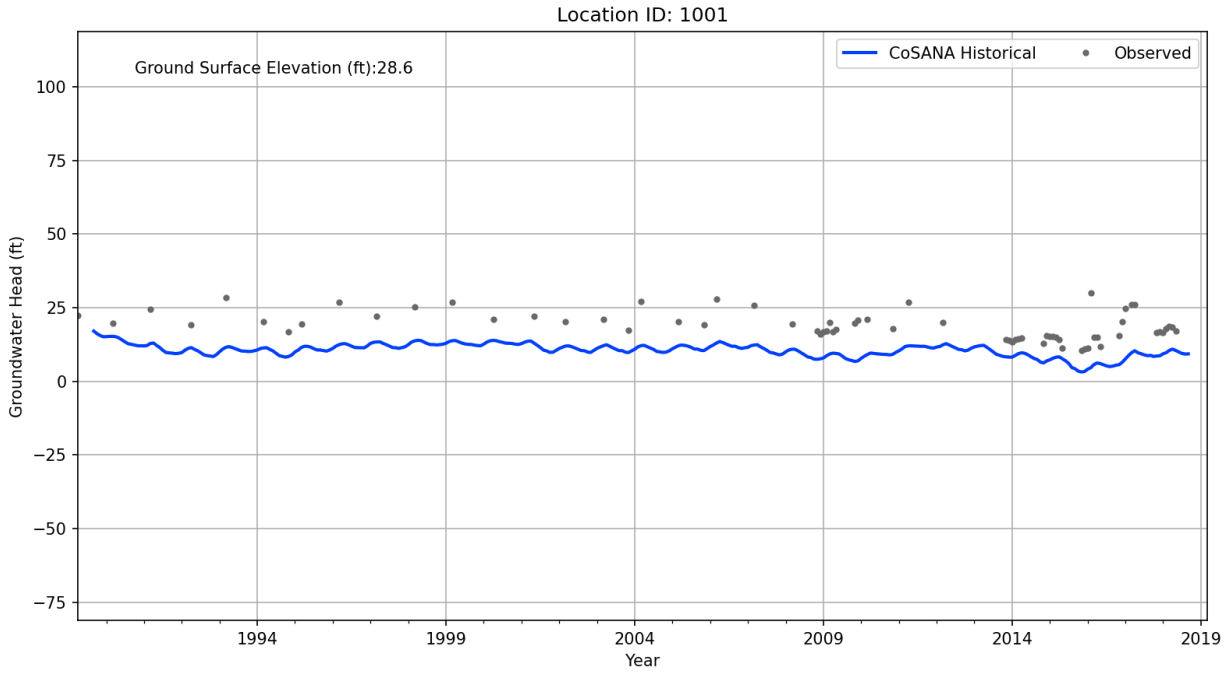

Location ID: 814
Ground Surface Elevation (ft):27.22
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

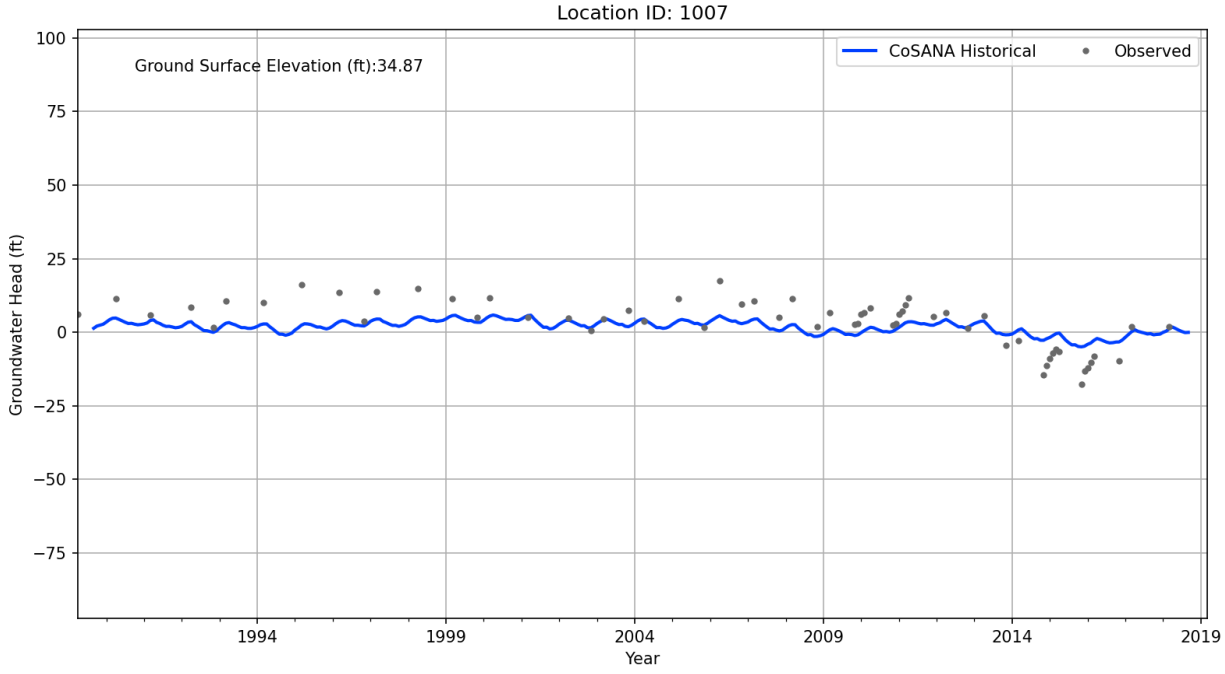

Location ID: 815
Ground Surface Elevation (ft):27.22
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

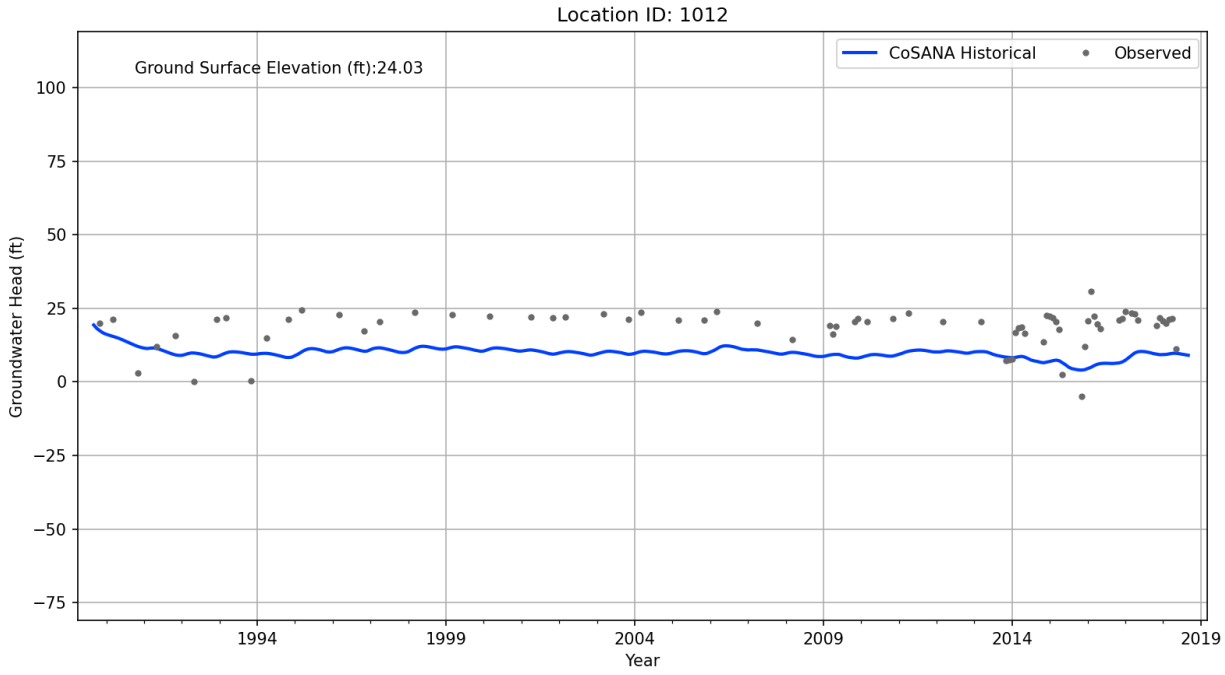

Location ID: 819
Ground Surface Elevation (ft):18.66
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

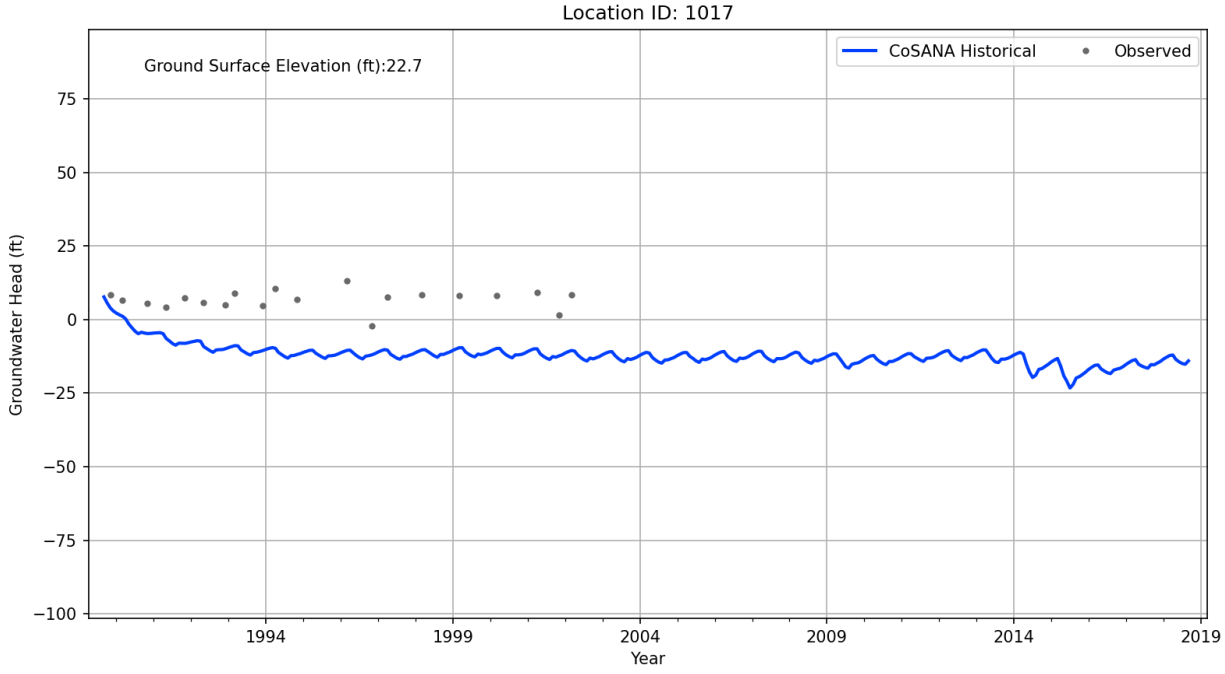

Location ID: 820
Ground Surface Elevation (ft):18.66
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

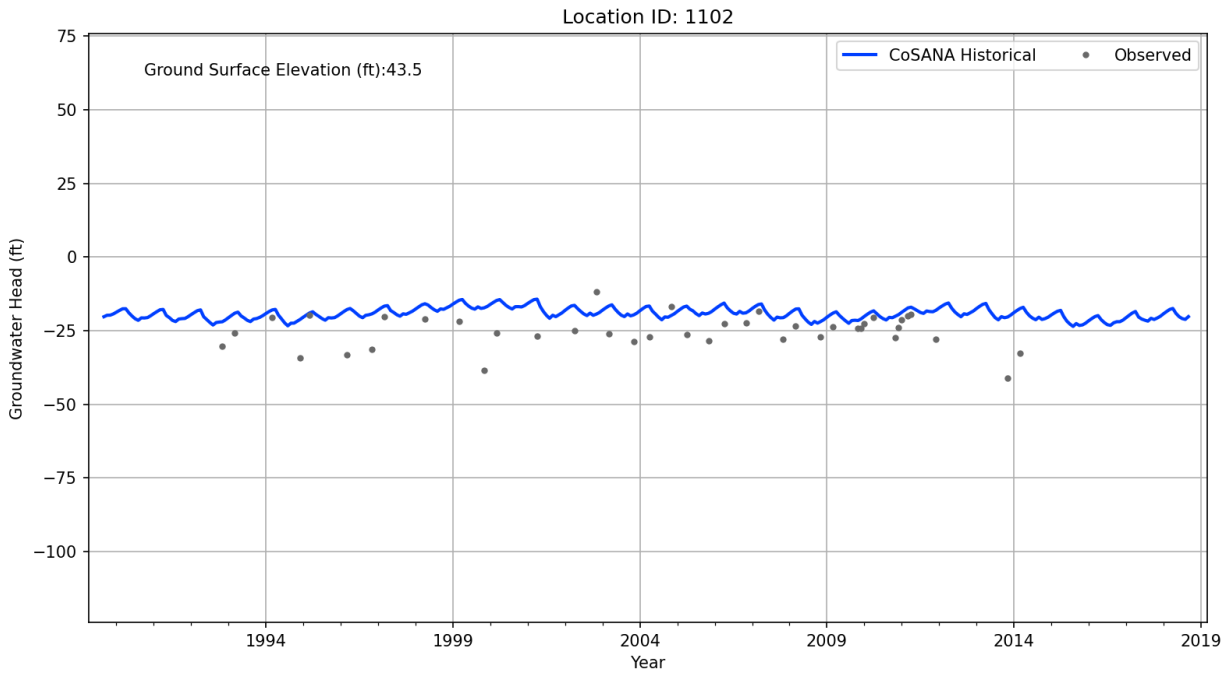

Location ID: 821
Ground Surface Elevation (ft):18.66
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

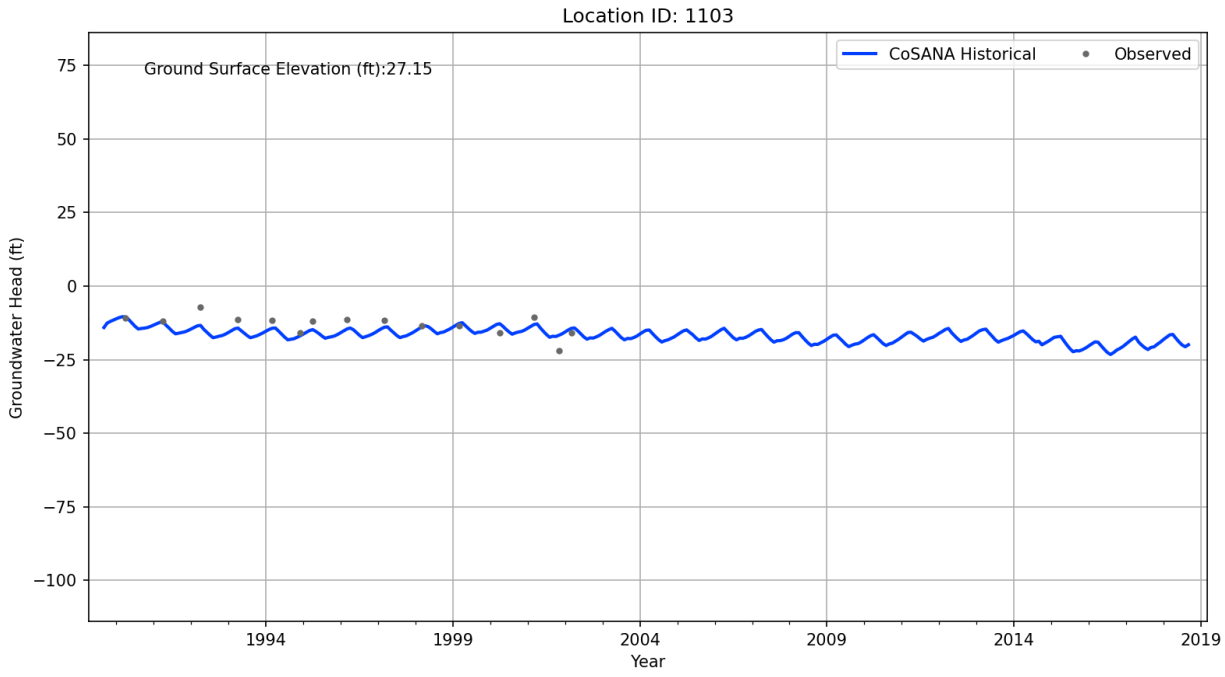

Location ID: 1001
Ground Surface Elevation (ft):28.6
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

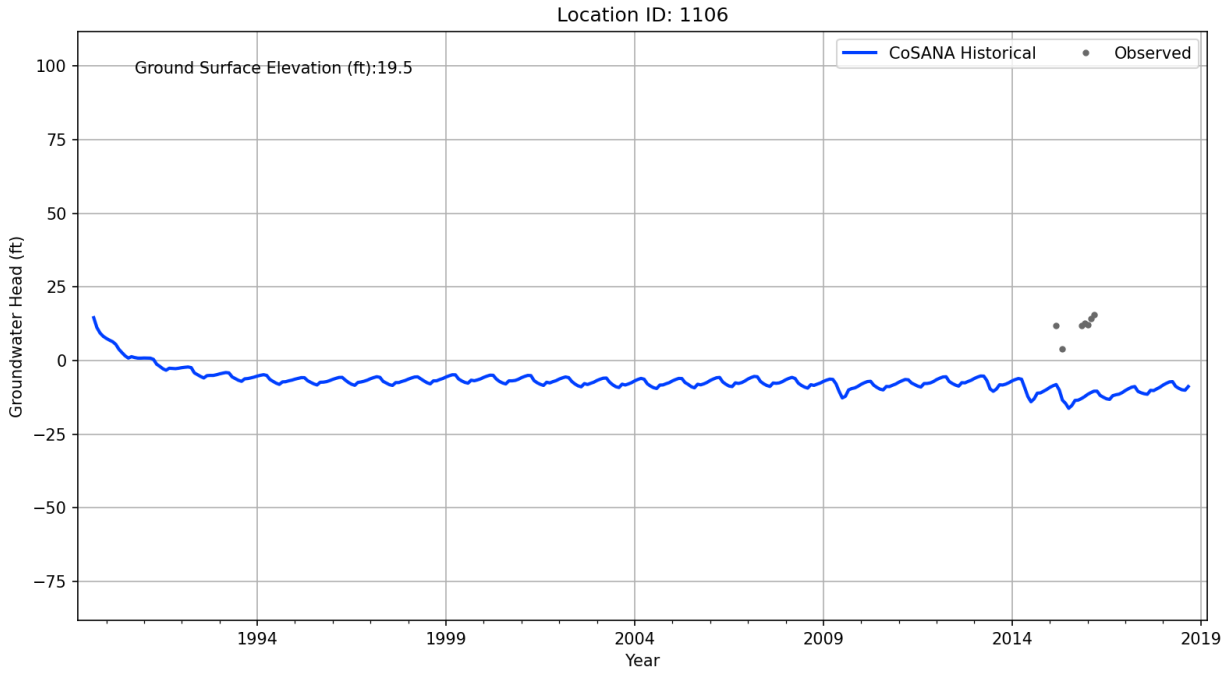

Location ID: 1007
Ground Surface Elevation (ft):34.87
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

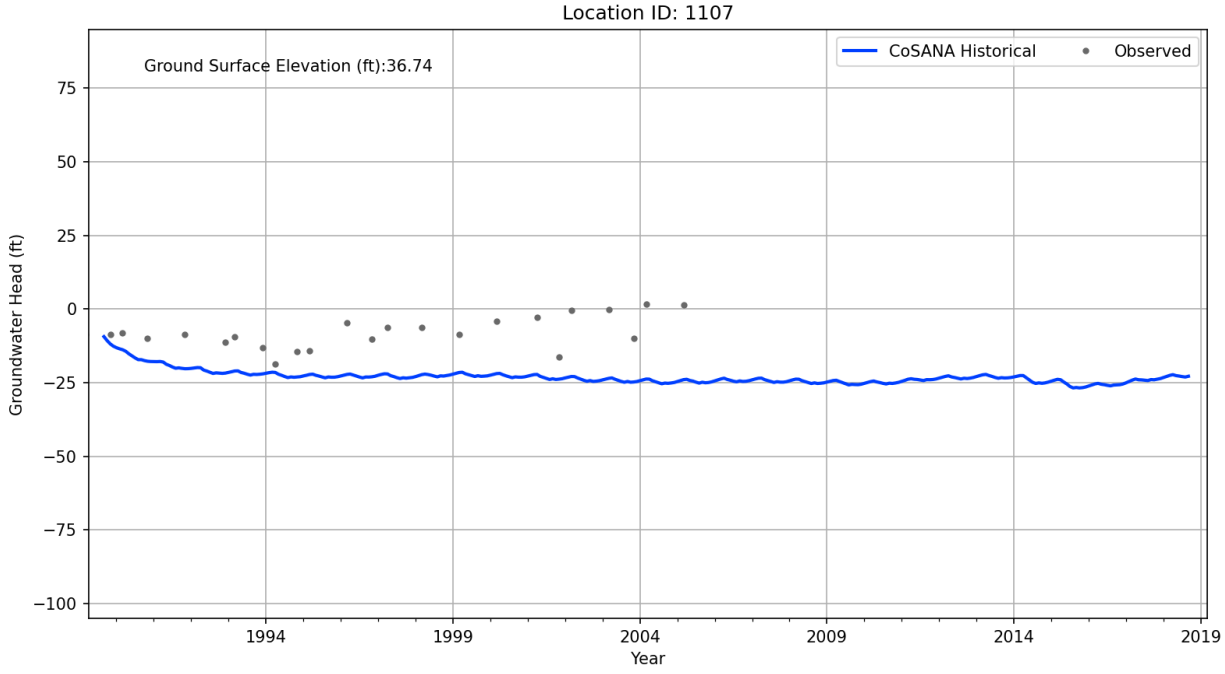

Location ID: 1012
Ground Surface Elevation (ft):24.03
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

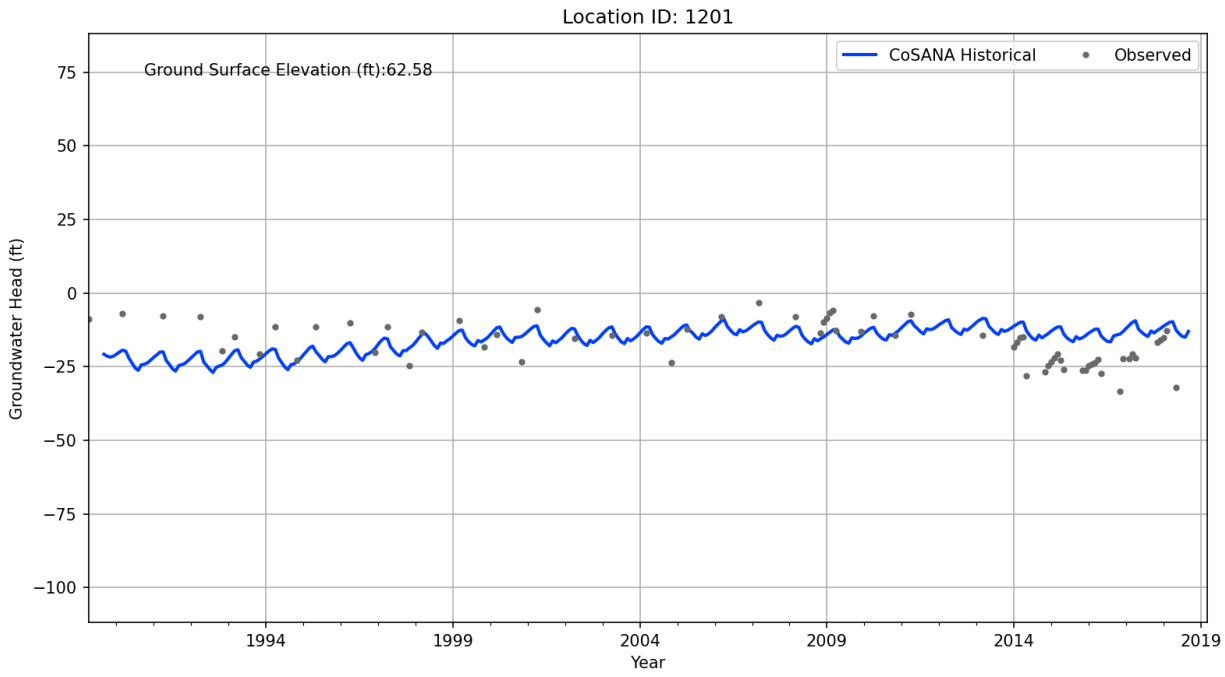

Location ID: 1017
Ground Surface Elevation (ft):22.7
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

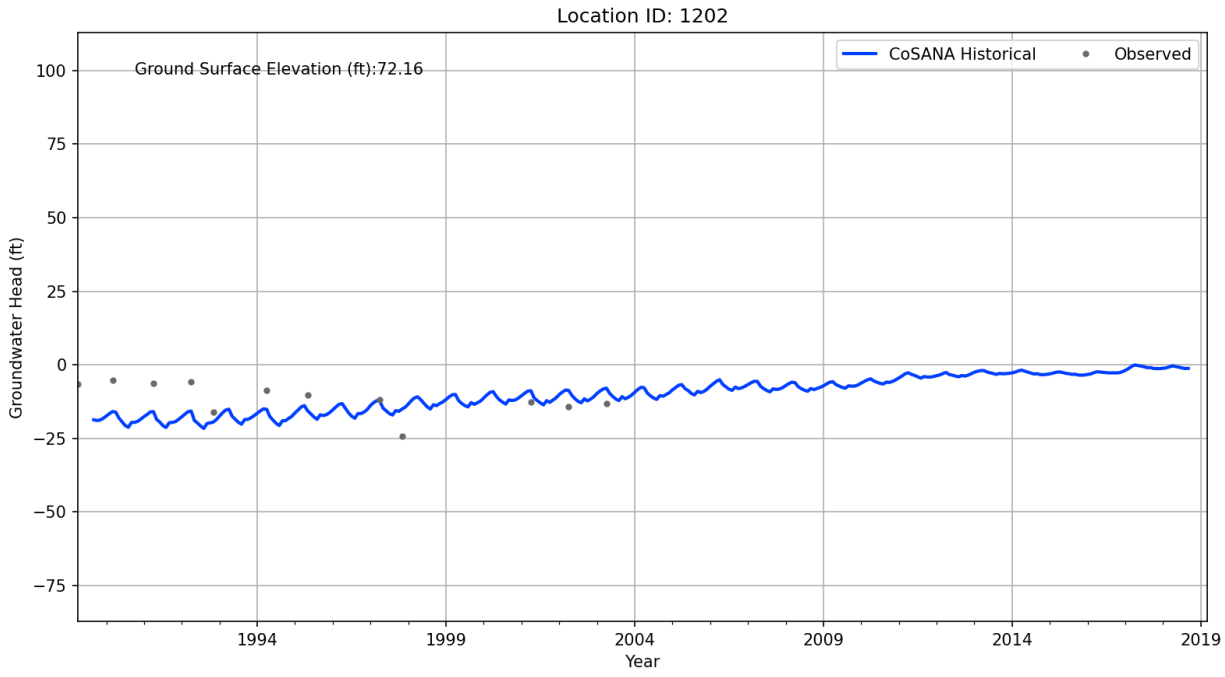

Location ID: 1102
Ground Surface Elevation (ft):43.5
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

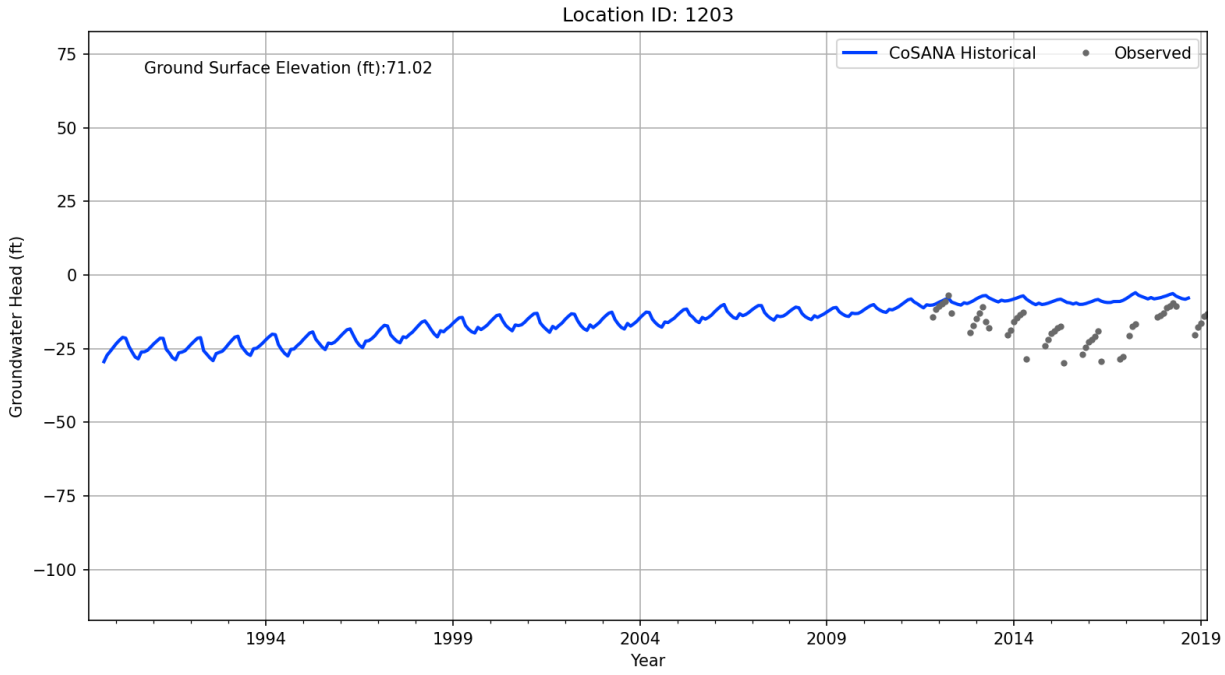

Location ID: 1103
Ground Surface Elevation (ft):27.15
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

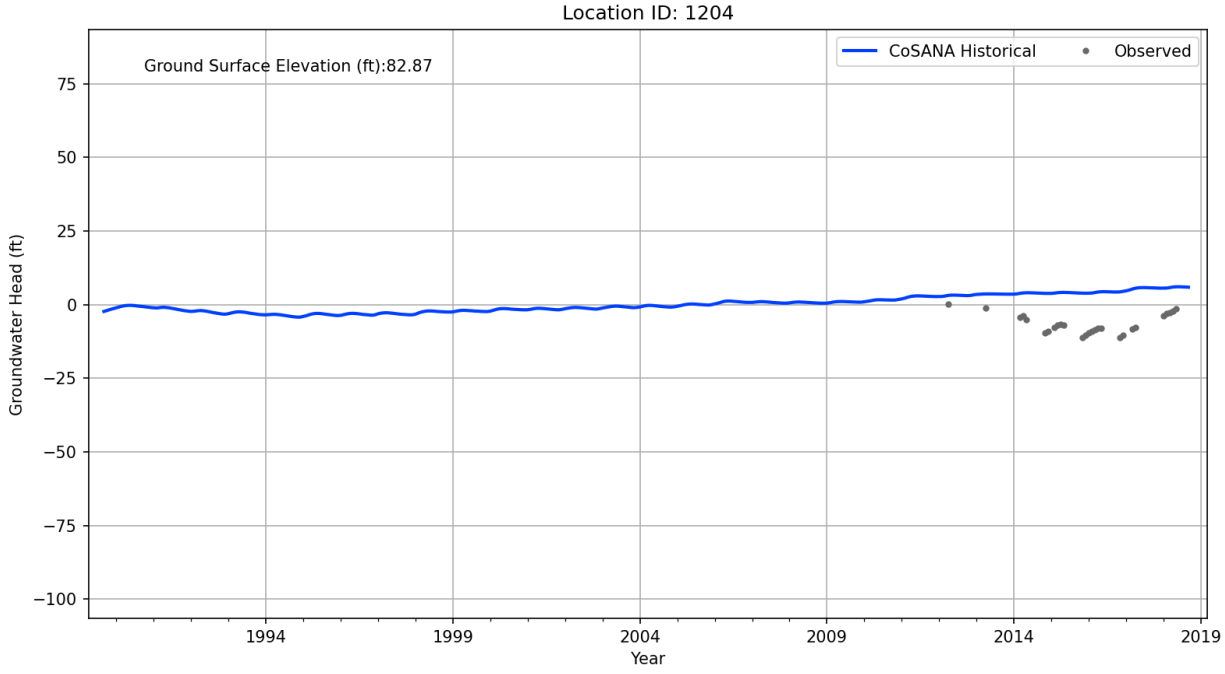

Location ID: 1106
Ground Surface Elevation (ft):19.5
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

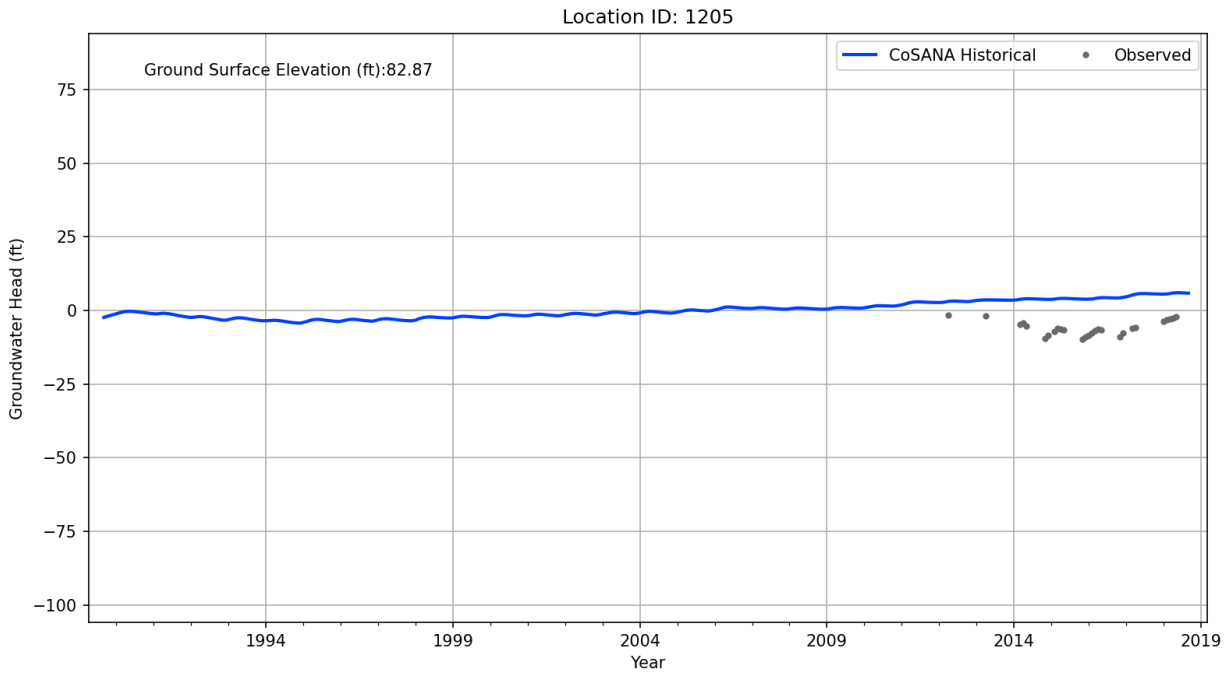

Location ID: 1107
Ground Surface Elevation (ft):36.74
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

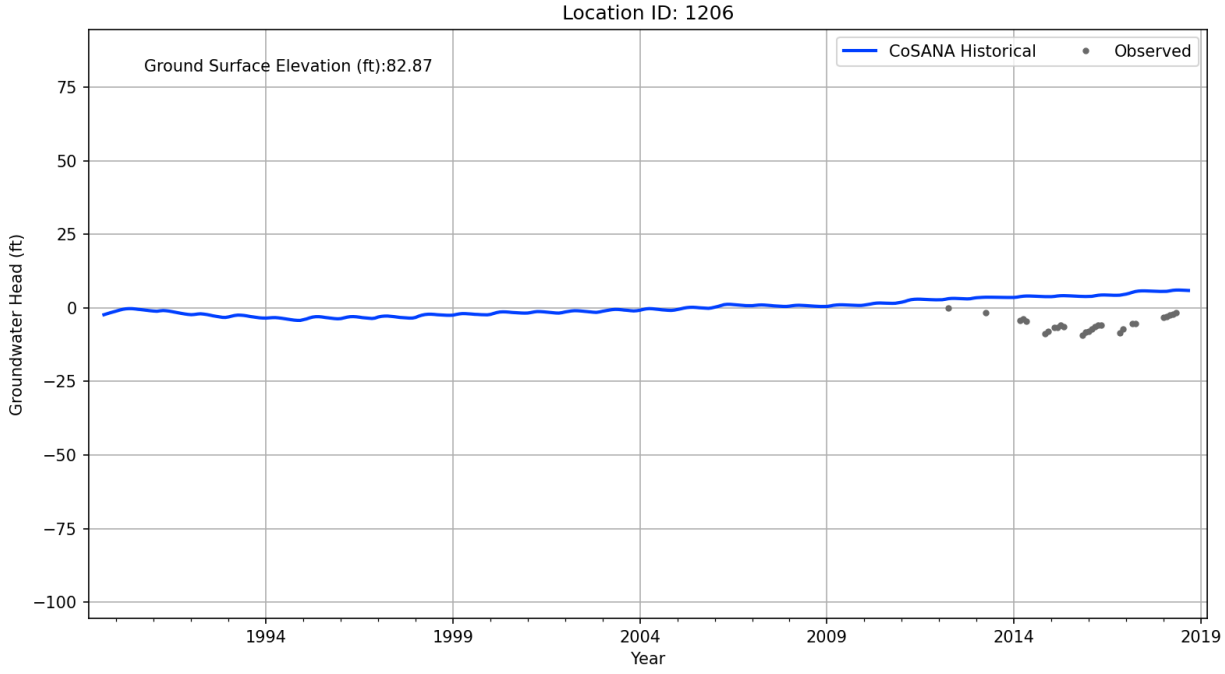

Location ID: 1201
Ground Surface Elevation (ft):62.58
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

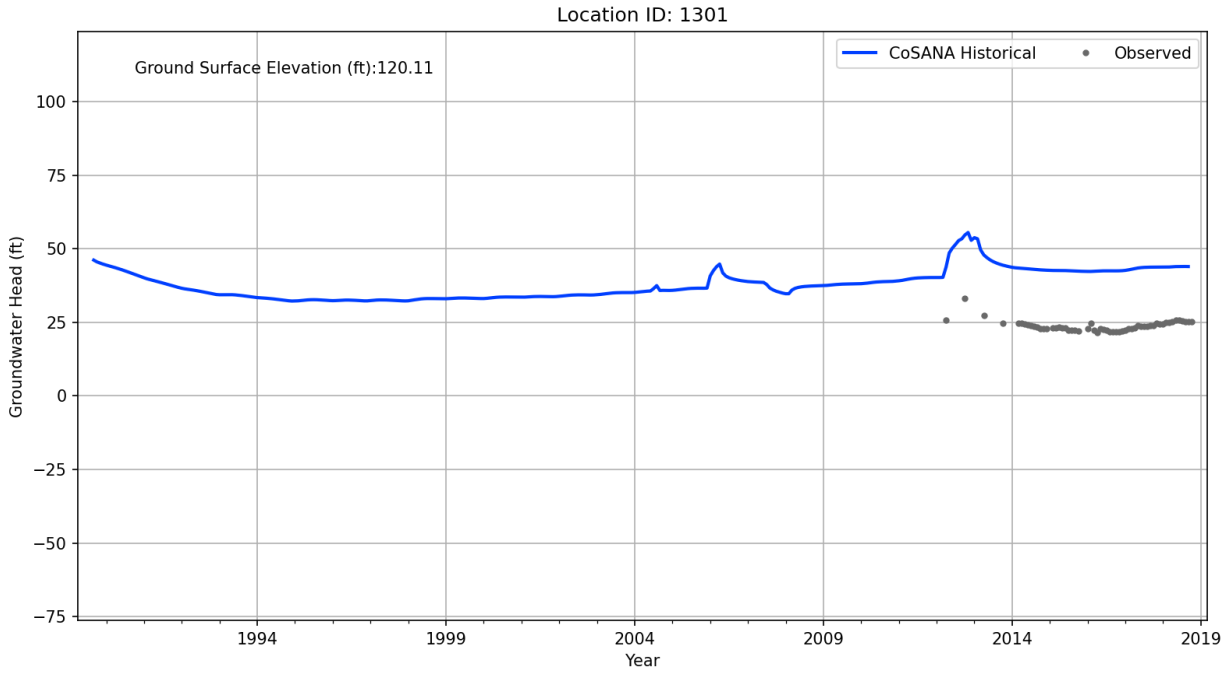

Location ID: 1202
Ground Surface Elevation (ft):72.16
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

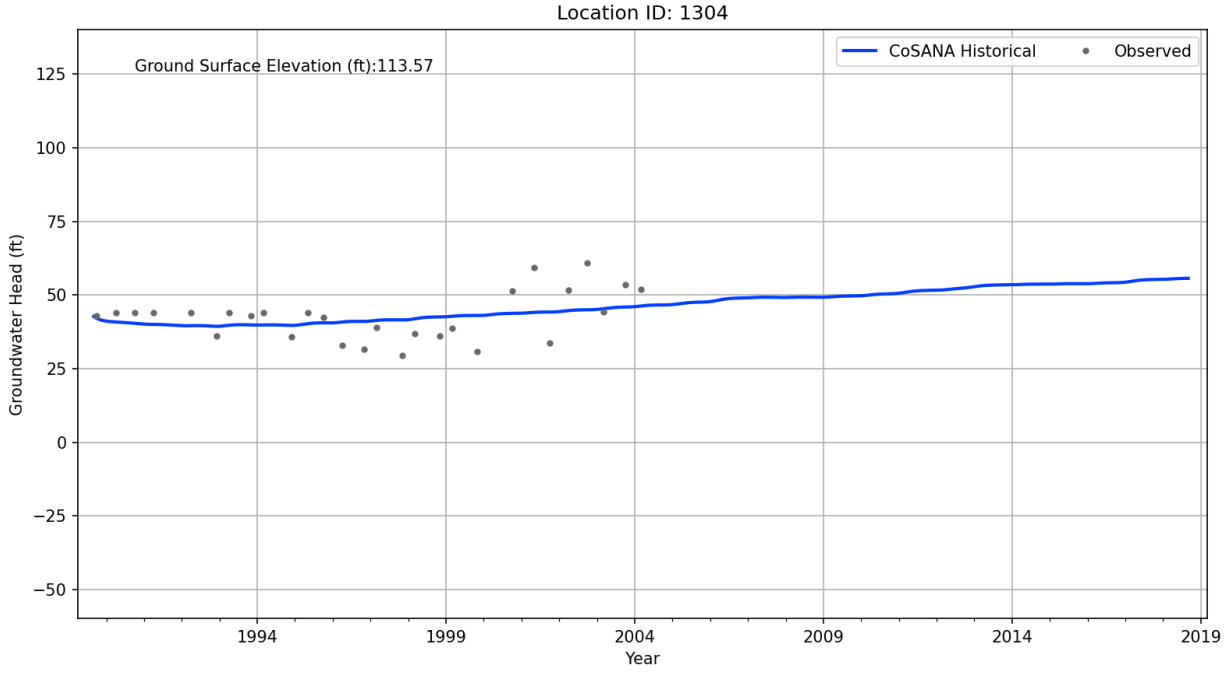

Location ID: 1203
Ground Surface Elevation (ft):71.02
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

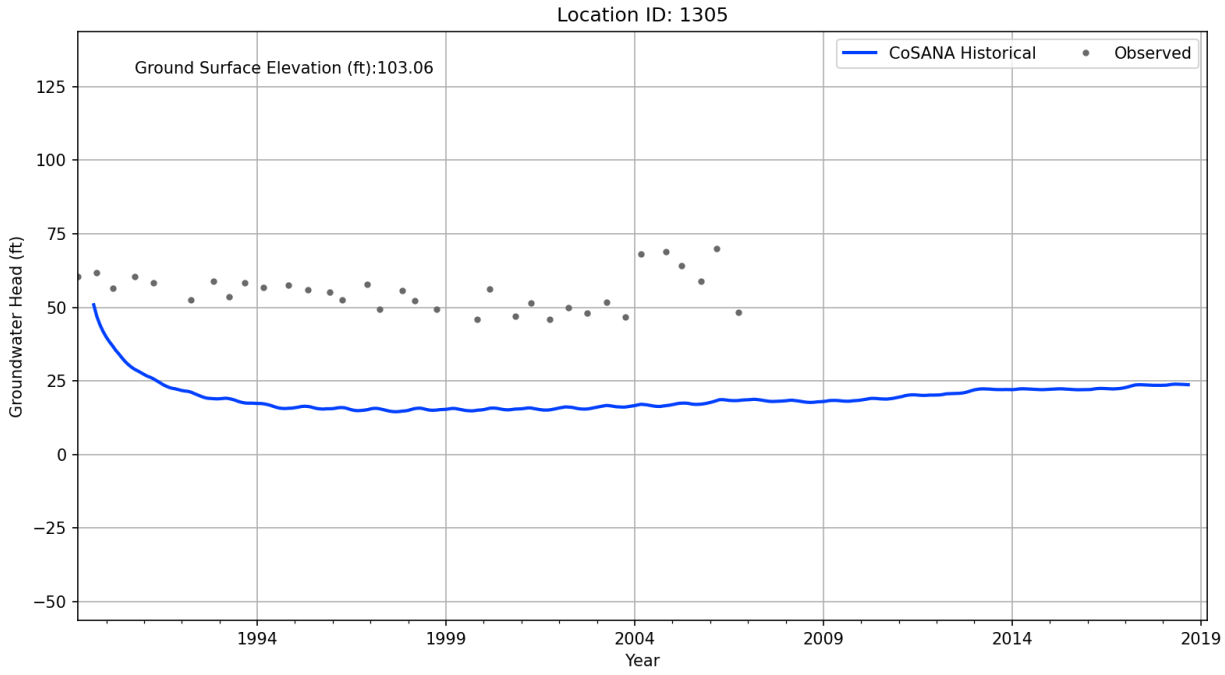

Location ID: 1204
Ground Surface Elevation (ft):82.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

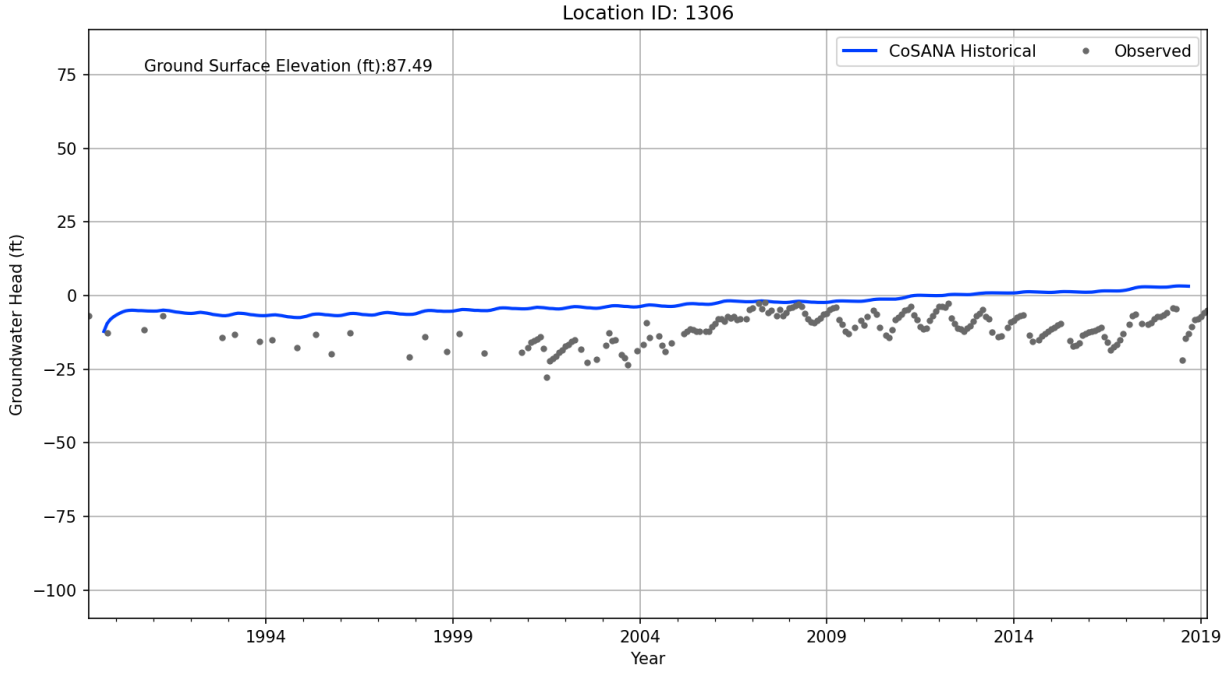

Location ID: 1205
Ground Surface Elevation (ft):82.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

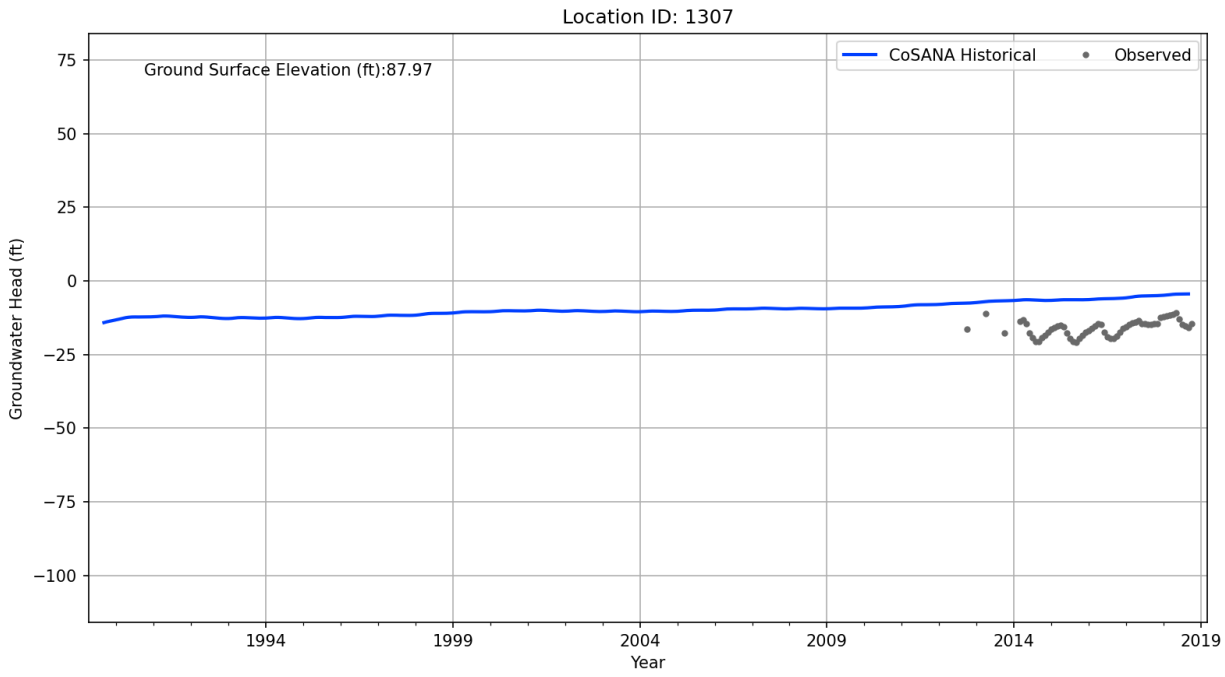

Location ID: 1206
Ground Surface Elevation (ft):82.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

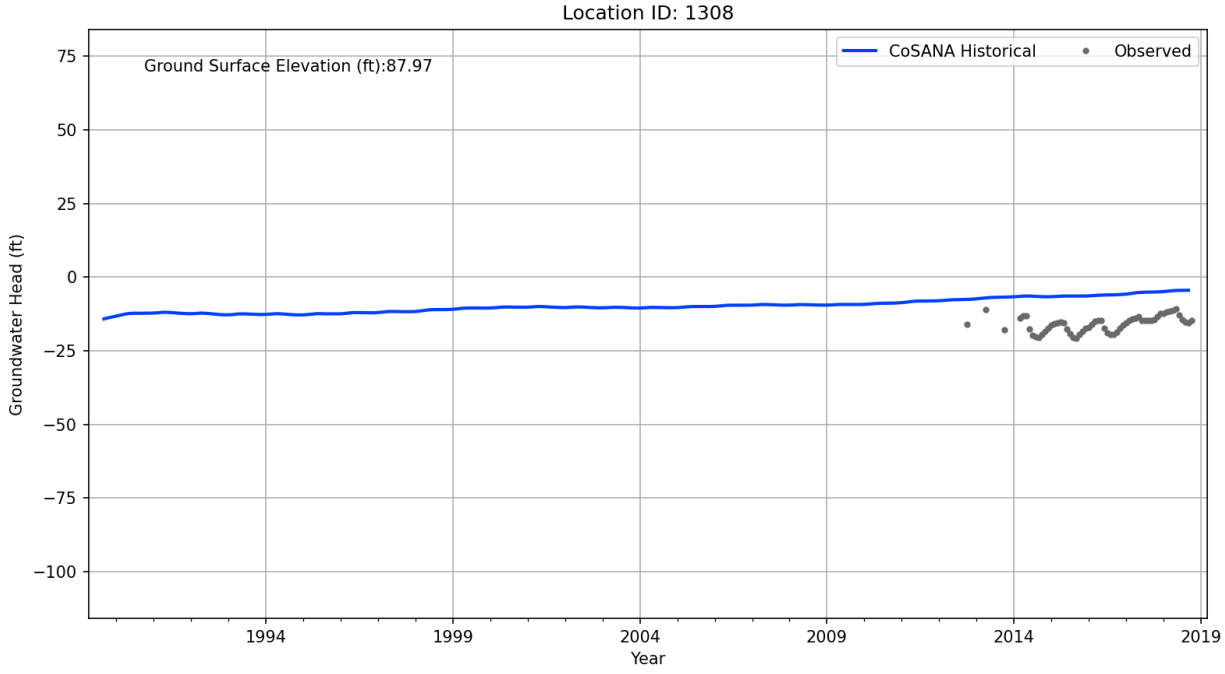

Location ID: 1301
Ground Surface Elevation (ft):120.11
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

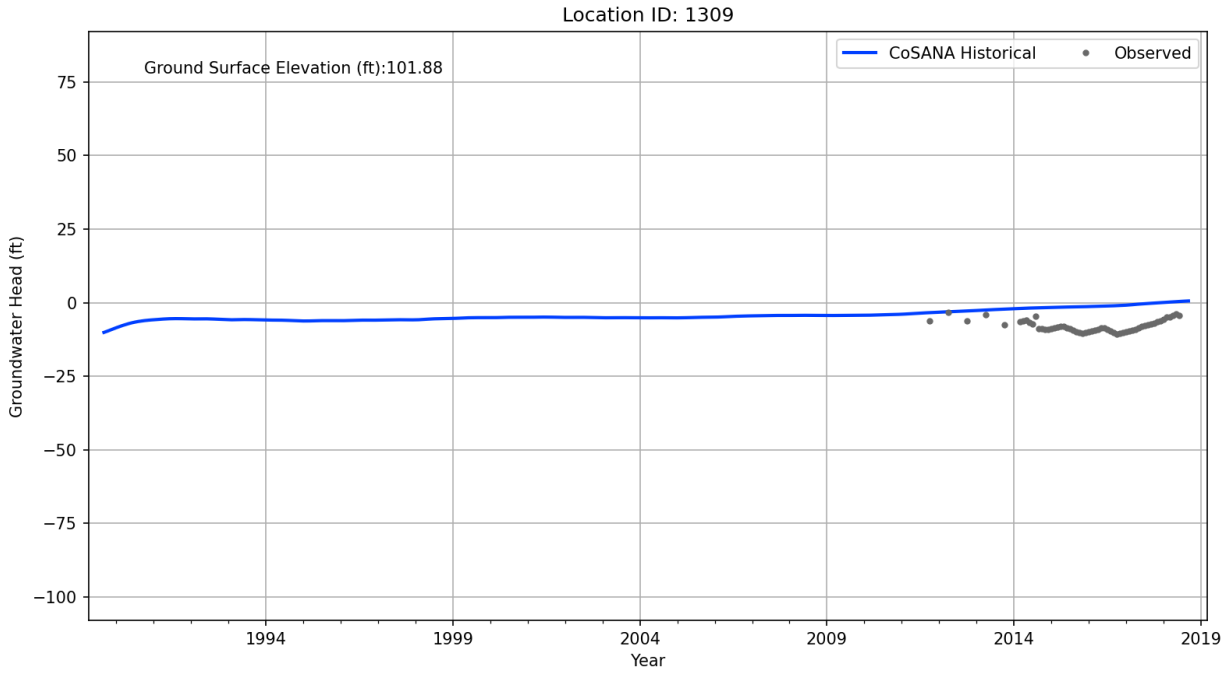

Location ID: 1304
Ground Surface Elevation (ft):113.57
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

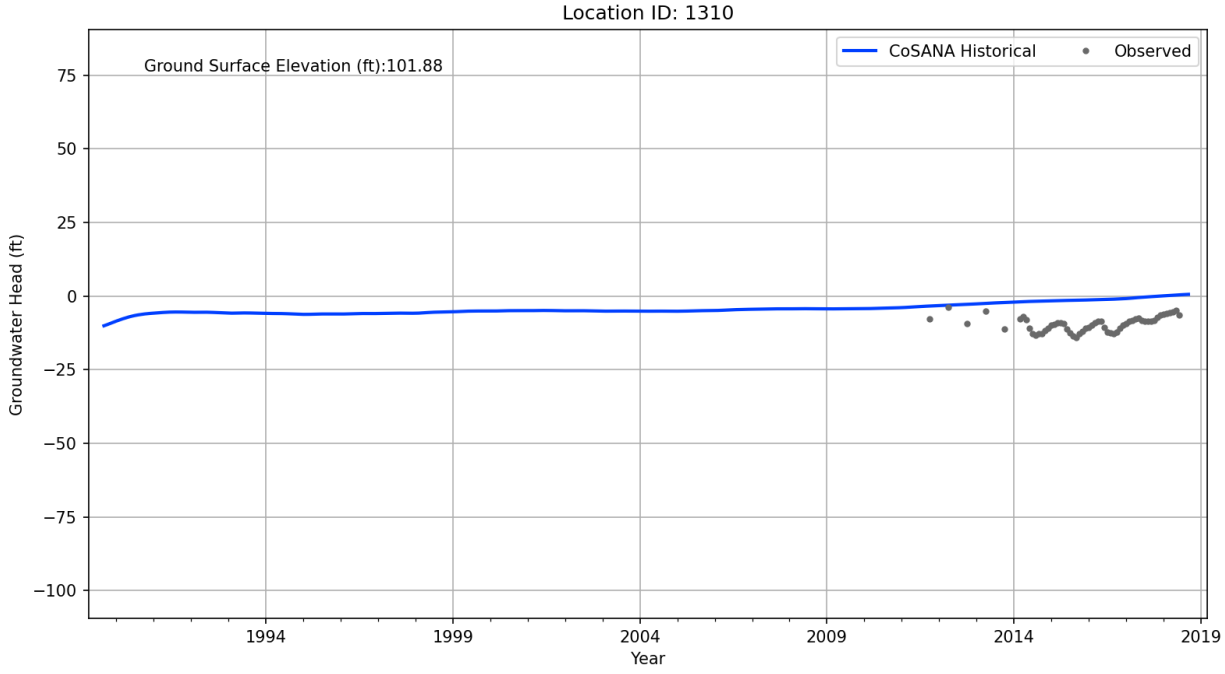

Location ID: 1305
Ground Surface Elevation (ft):103.06
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

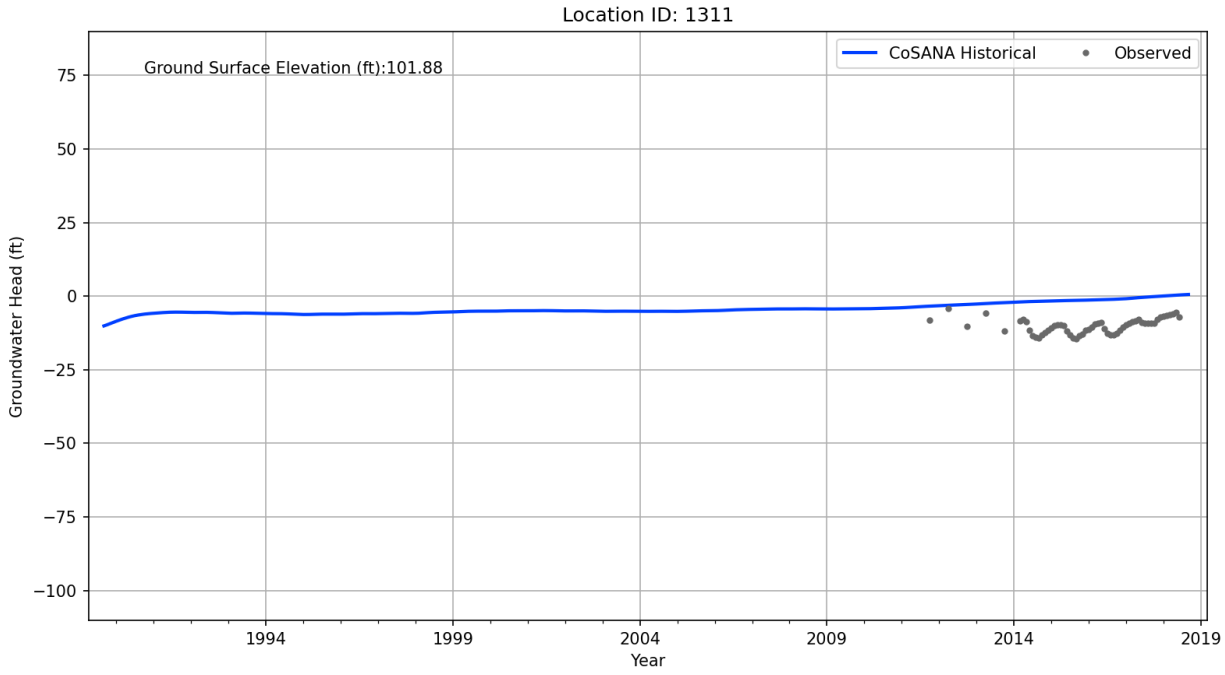

Location ID: 1306
Ground Surface Elevation (ft):87.49
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

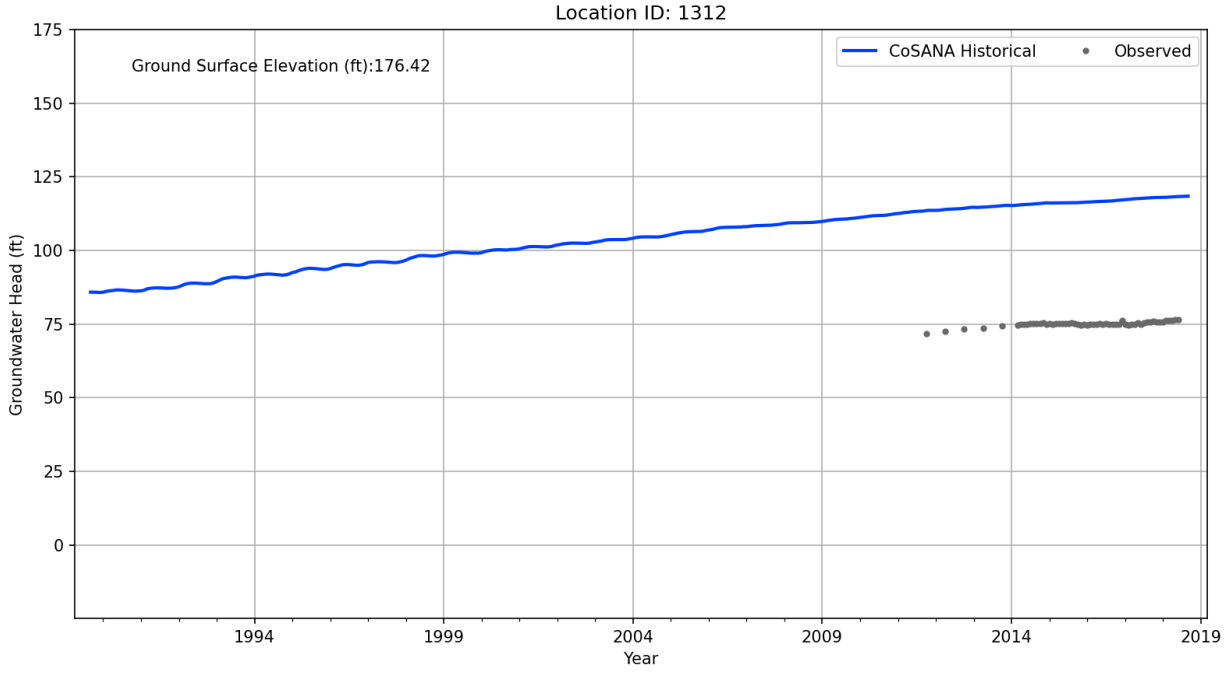

Location ID: 1307
Ground Surface Elevation (ft):87.97
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

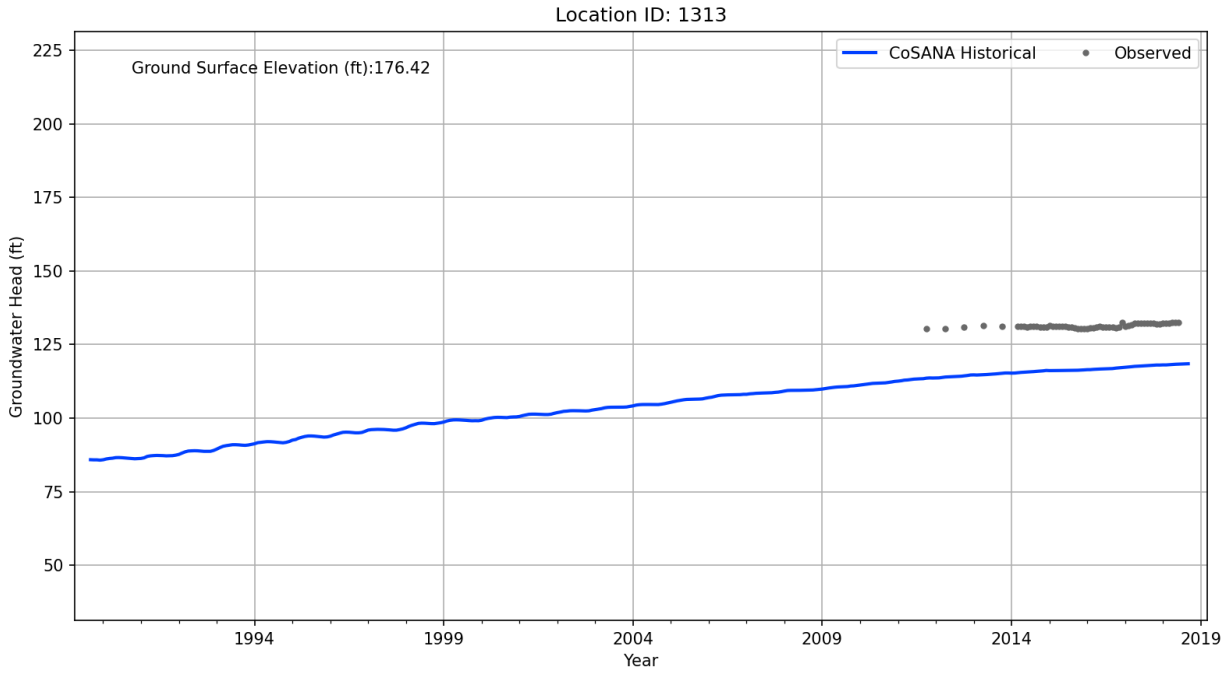

Location ID: 1308
Ground Surface Elevation (ft):87.97
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

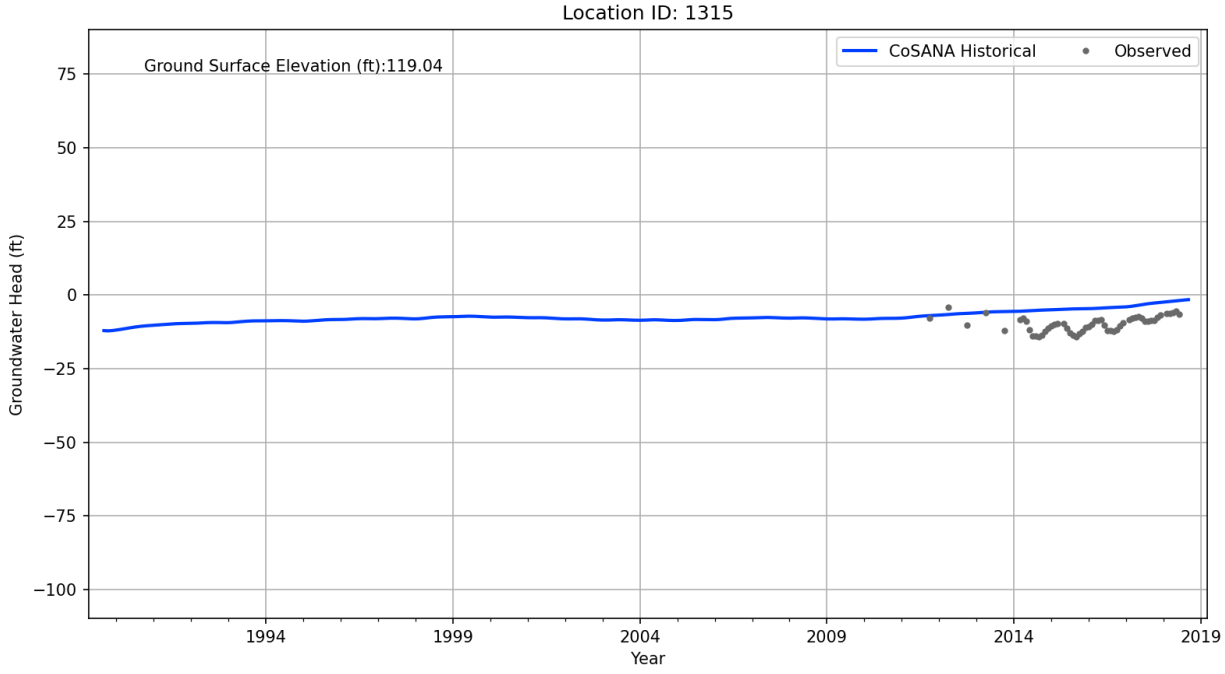

Location ID: 1309
Ground Surface Elevation (ft):101.88
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

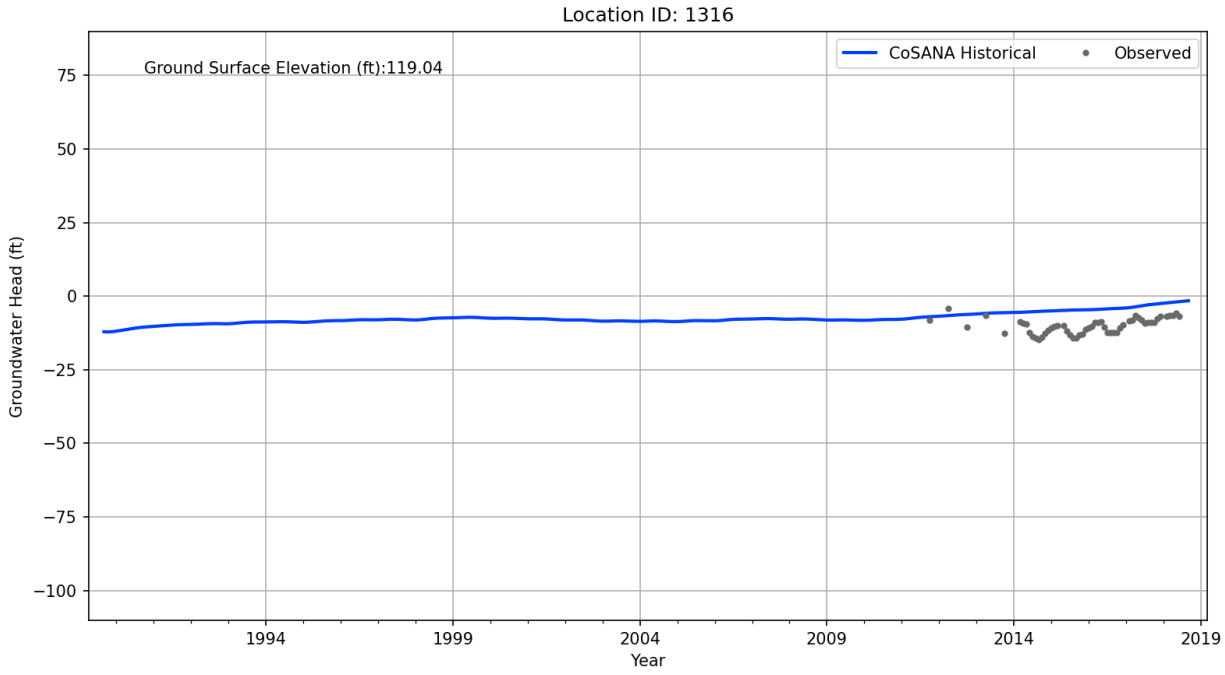

Location ID: 1310
Ground Surface Elevation (ft):101.88
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

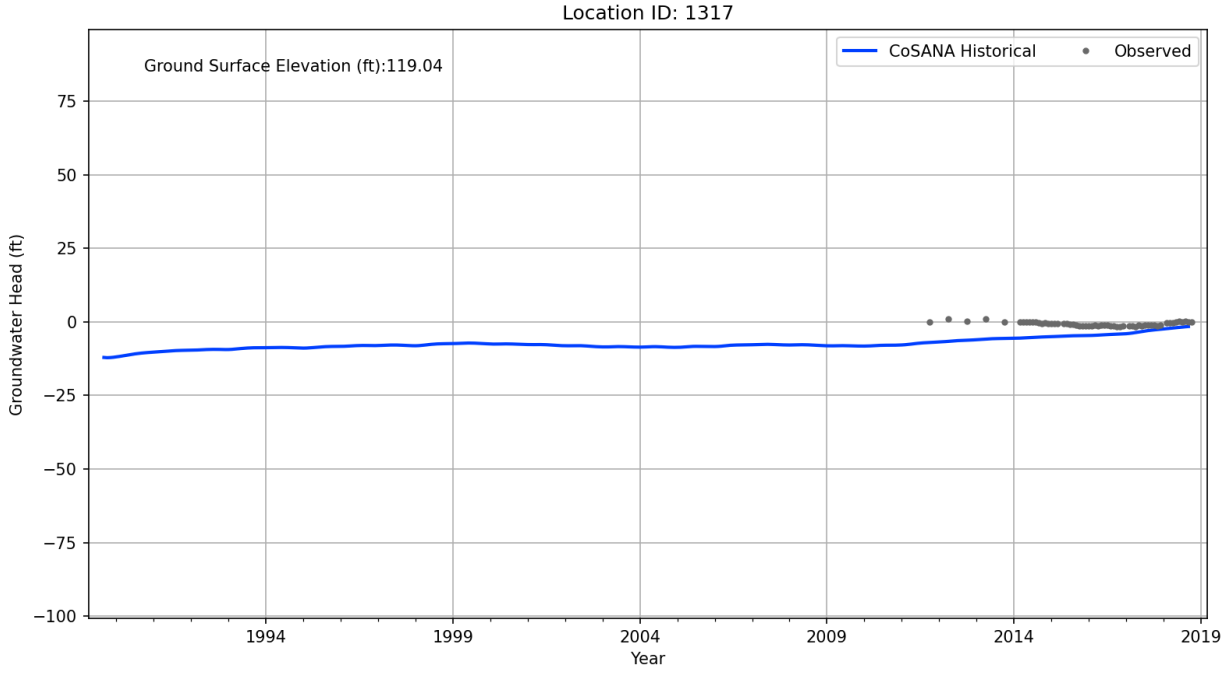

Location ID: 1311
Ground Surface Elevation (ft):101.88
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

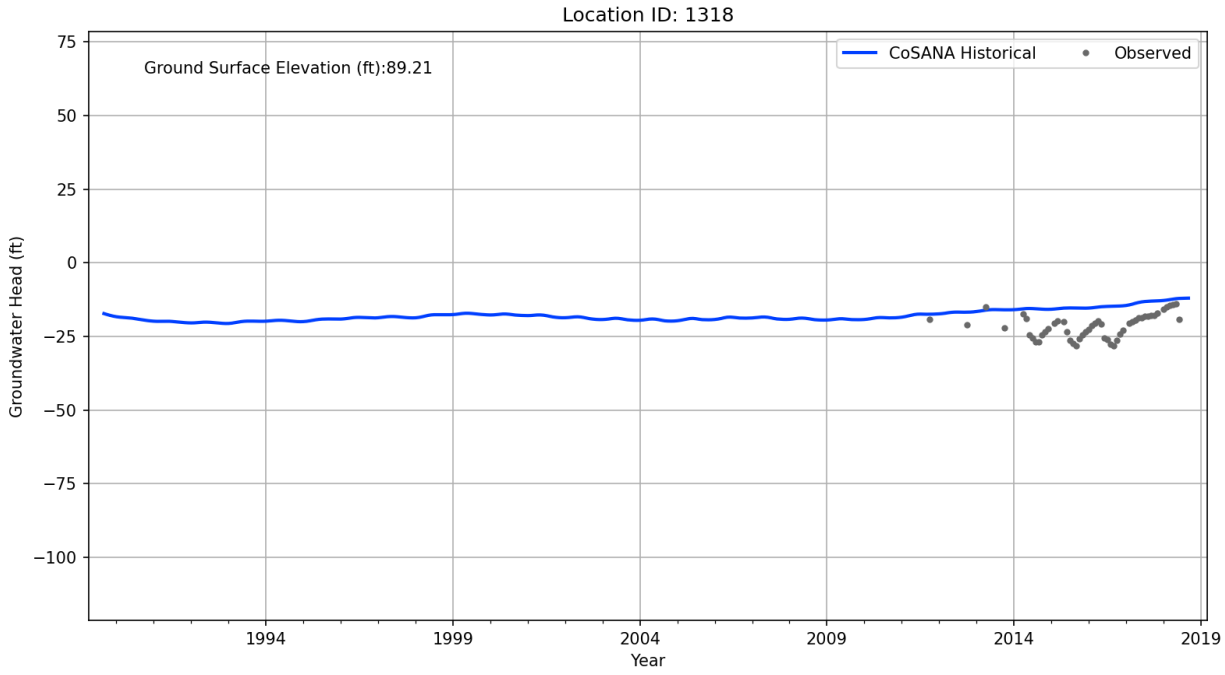

Location ID: 1312
Ground Surface Elevation (ft):176.42
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

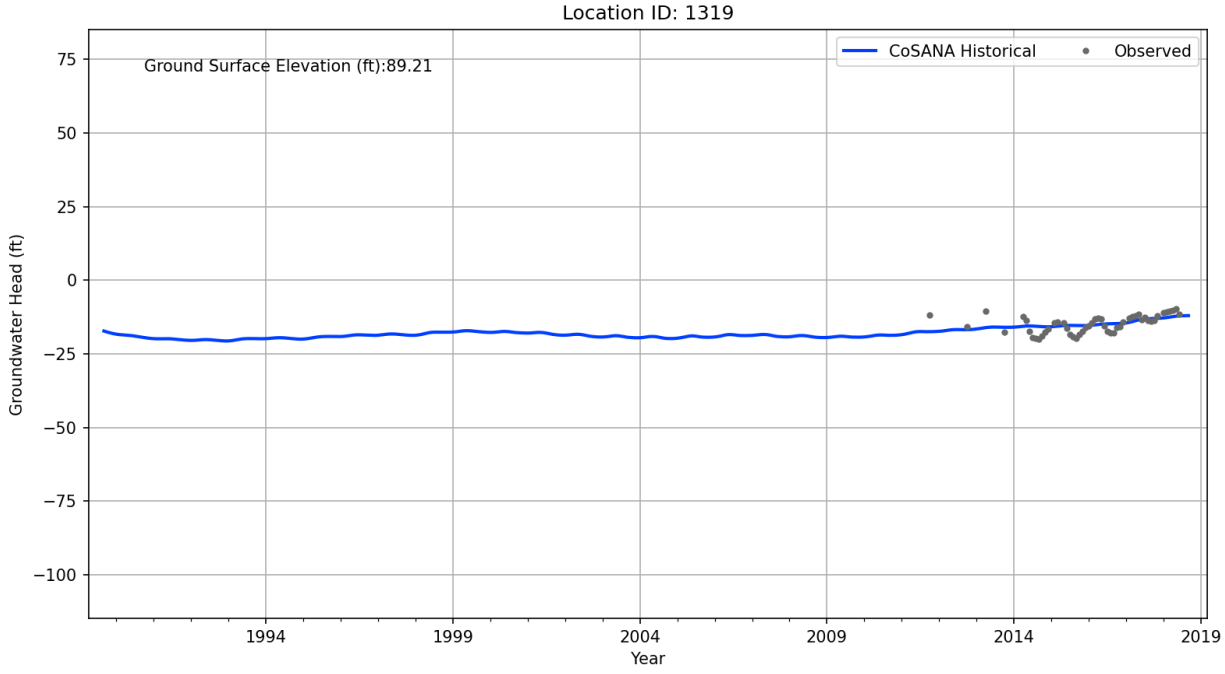

Location ID: 1313
Ground Surface Elevation (ft):176.42
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

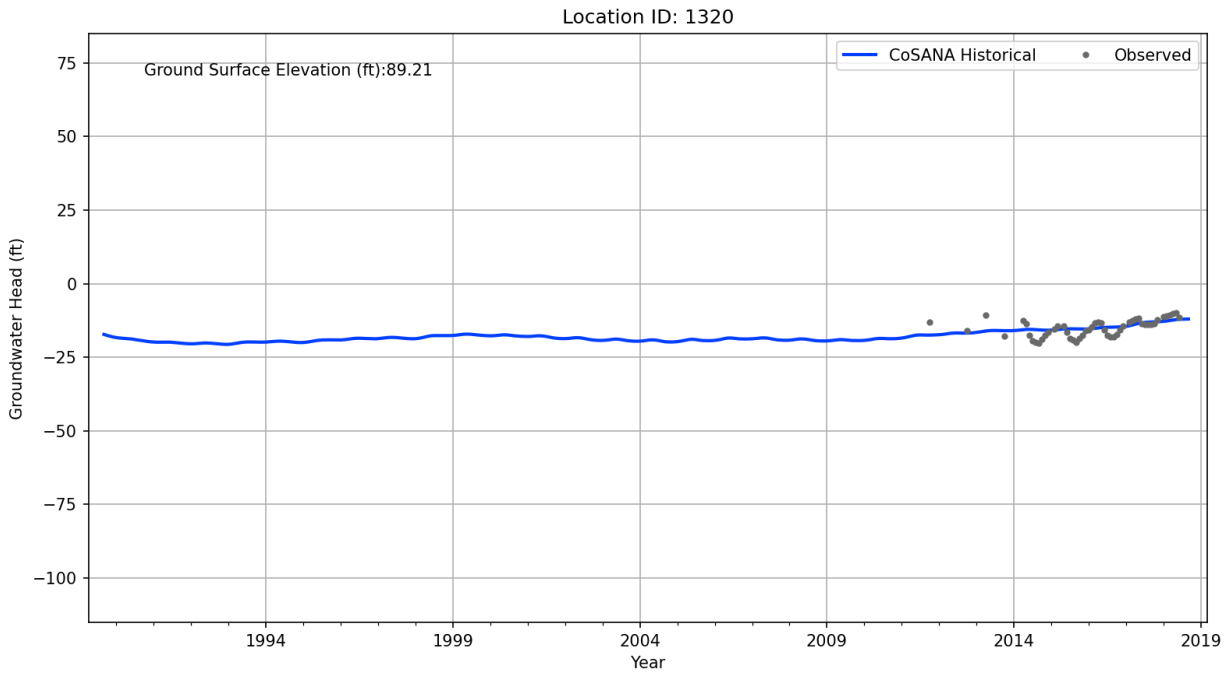

Location ID: 1315
Ground Surface Elevation (ft):119.04
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

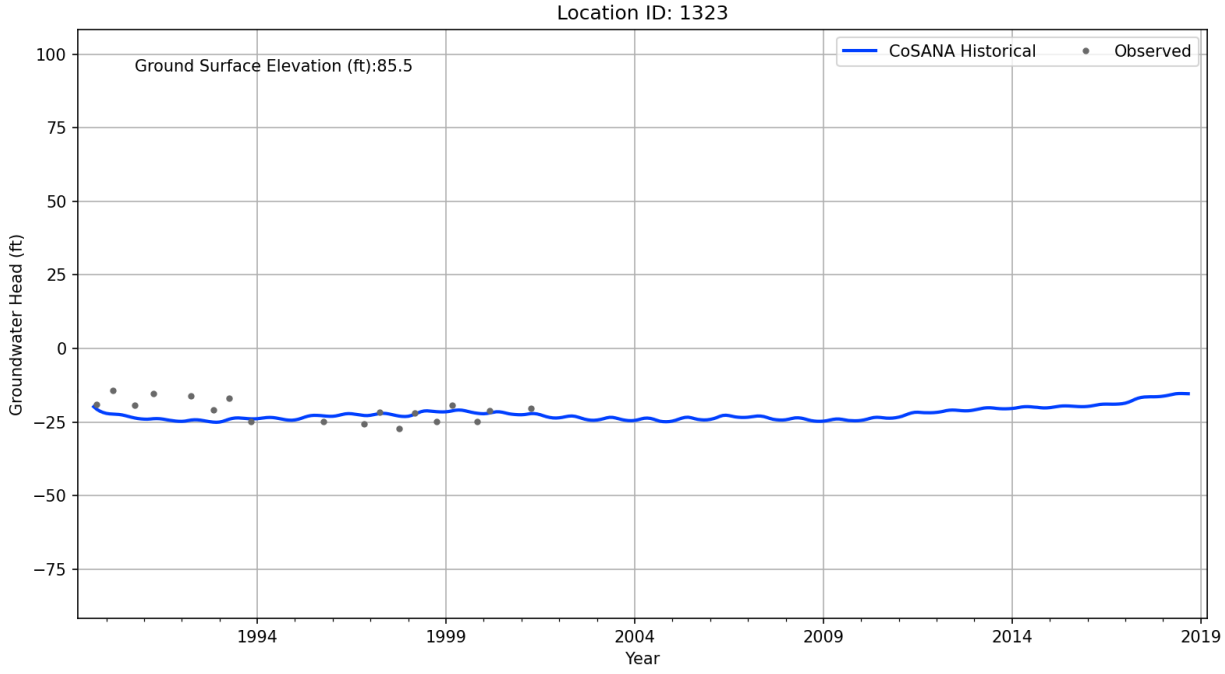

Location ID: 1316
Ground Surface Elevation (ft):119.04
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

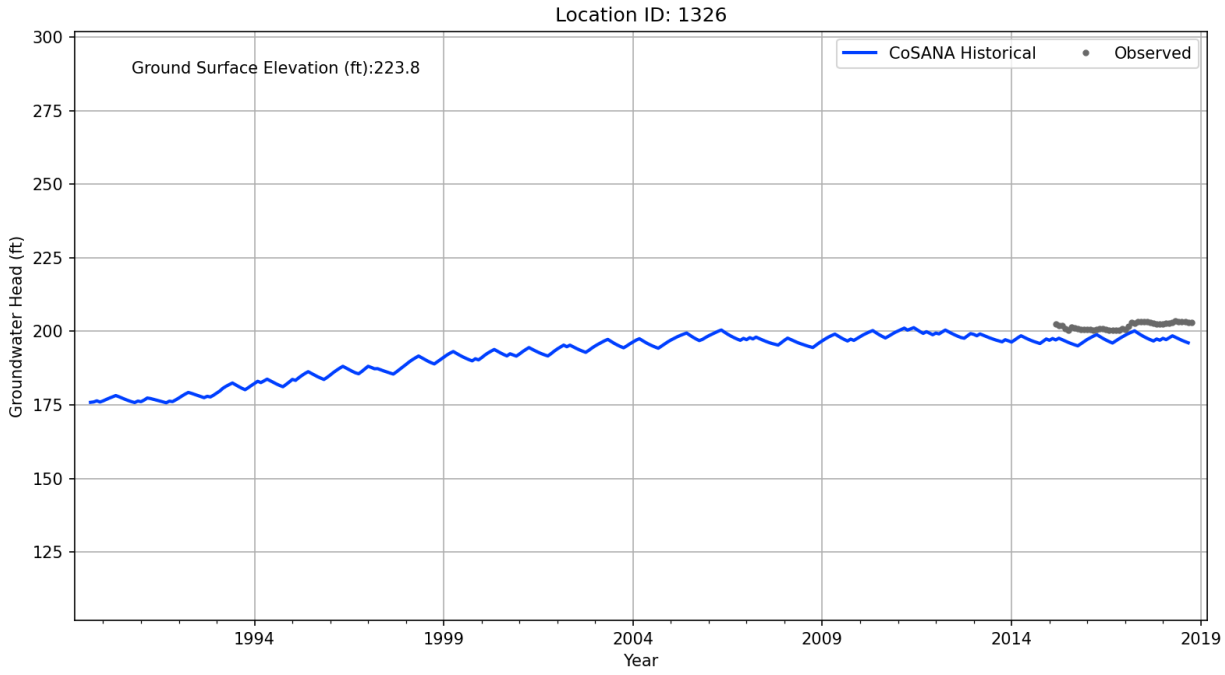

Location ID: 1317
Ground Surface Elevation (ft):119.04
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

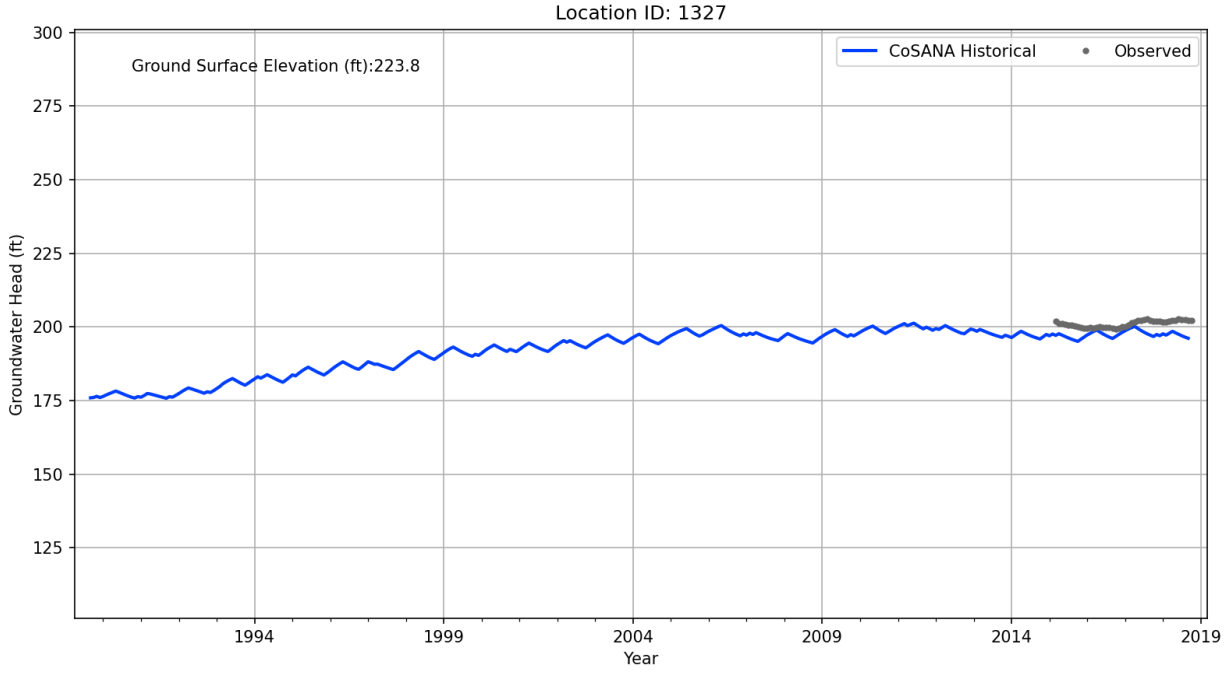

Location ID: 1318
Ground Surface Elevation (ft):89.21
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

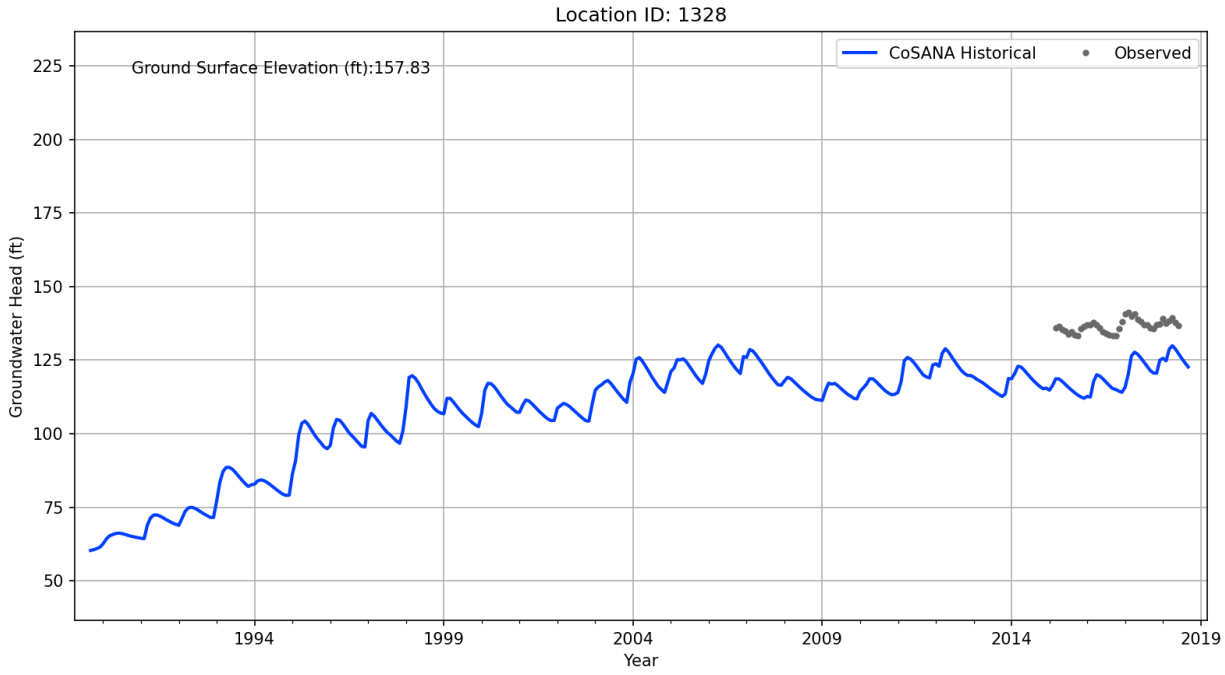

Location ID: 1319
Ground Surface Elevation (ft):89.21
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

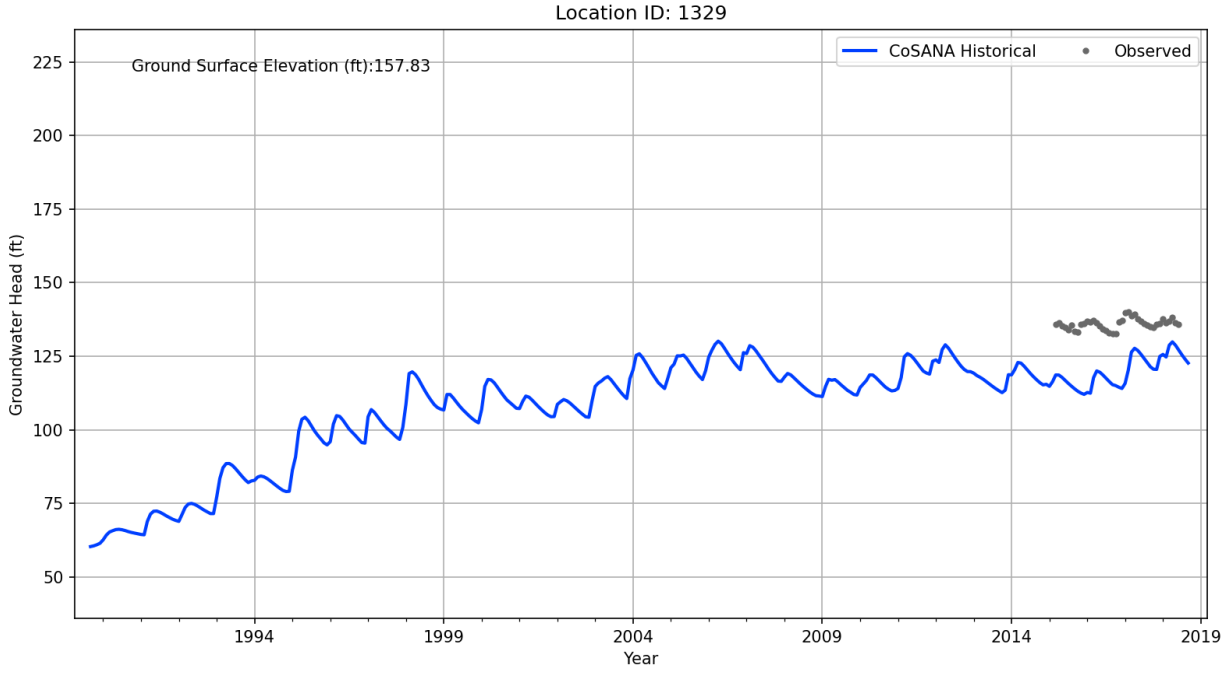

Location ID: 1320
Ground Surface Elevation (ft):89.21
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

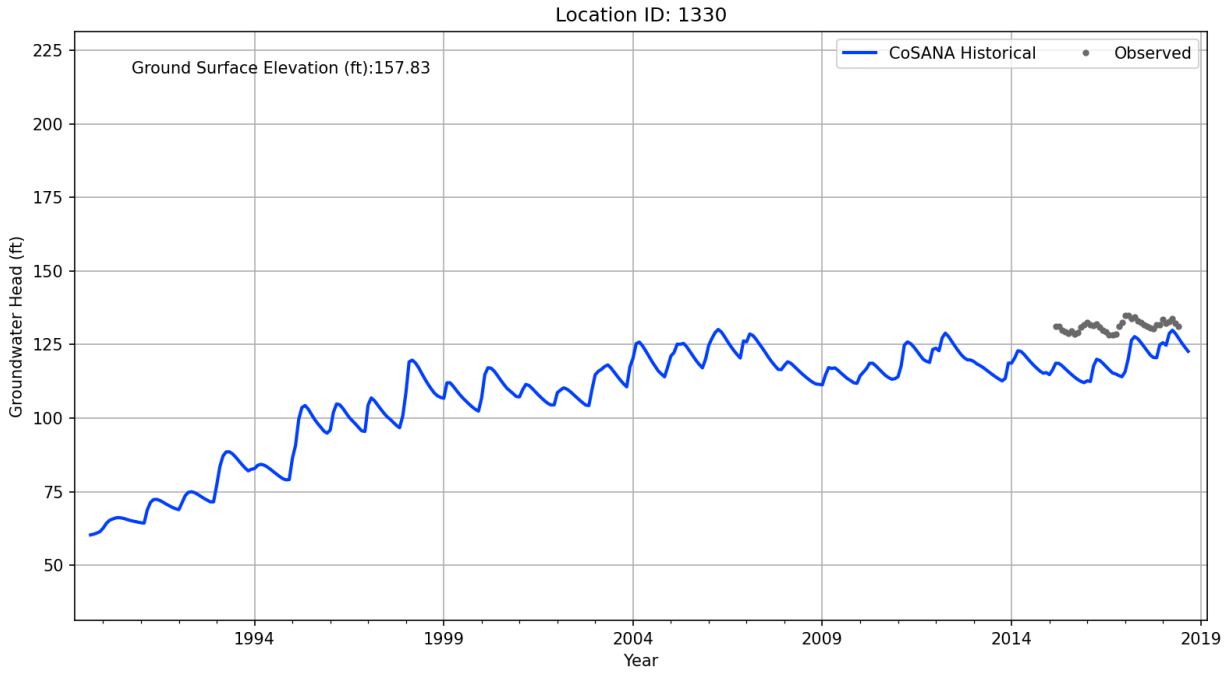

Location ID: 1323
Ground Surface Elevation (ft):85.5
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

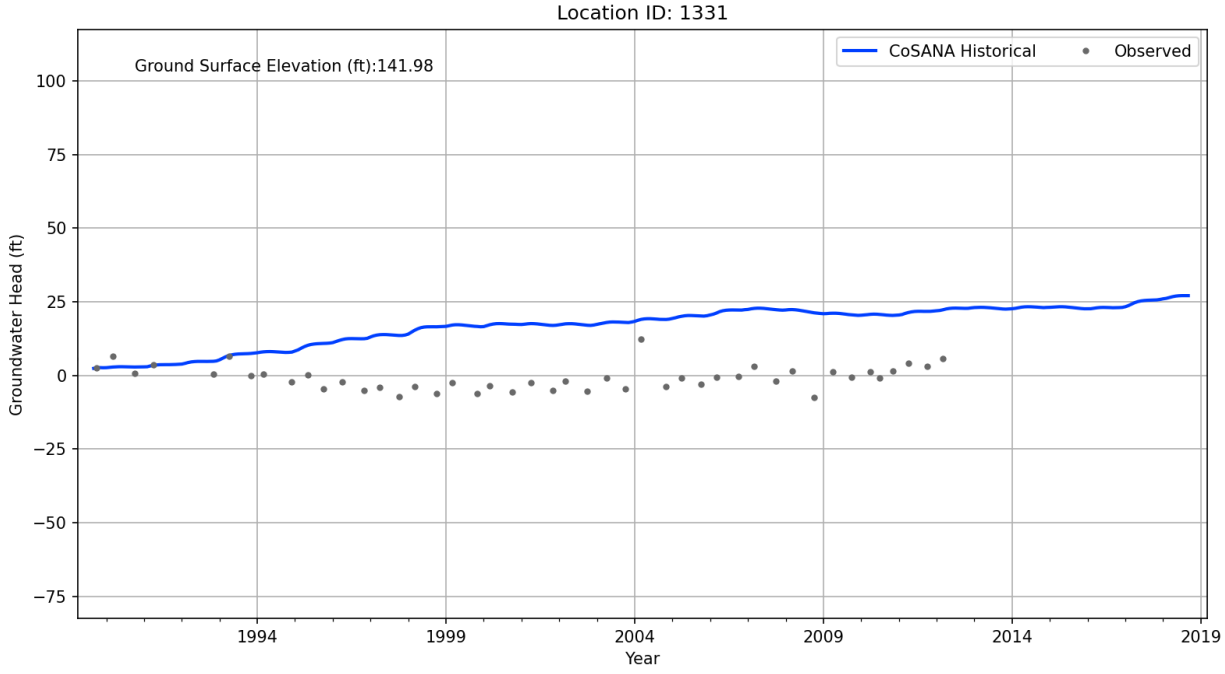

Location ID: 1326
Ground Surface Elevation (ft):223.8
CoSANA Historical
Observed
Groundwater Head (ft)
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019
Year

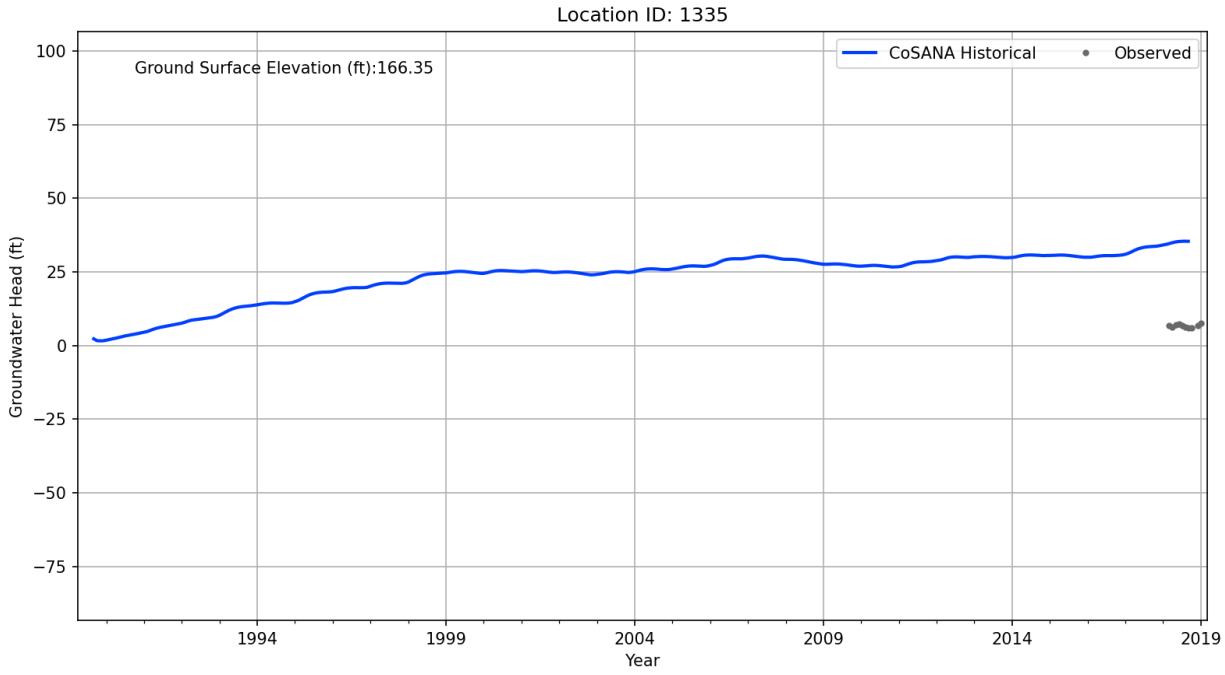

Location ID: 1327
Ground Surface Elevation (ft):223.8
CoSANA Historical
Observed
Groundwater Head (ft)
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019
Year

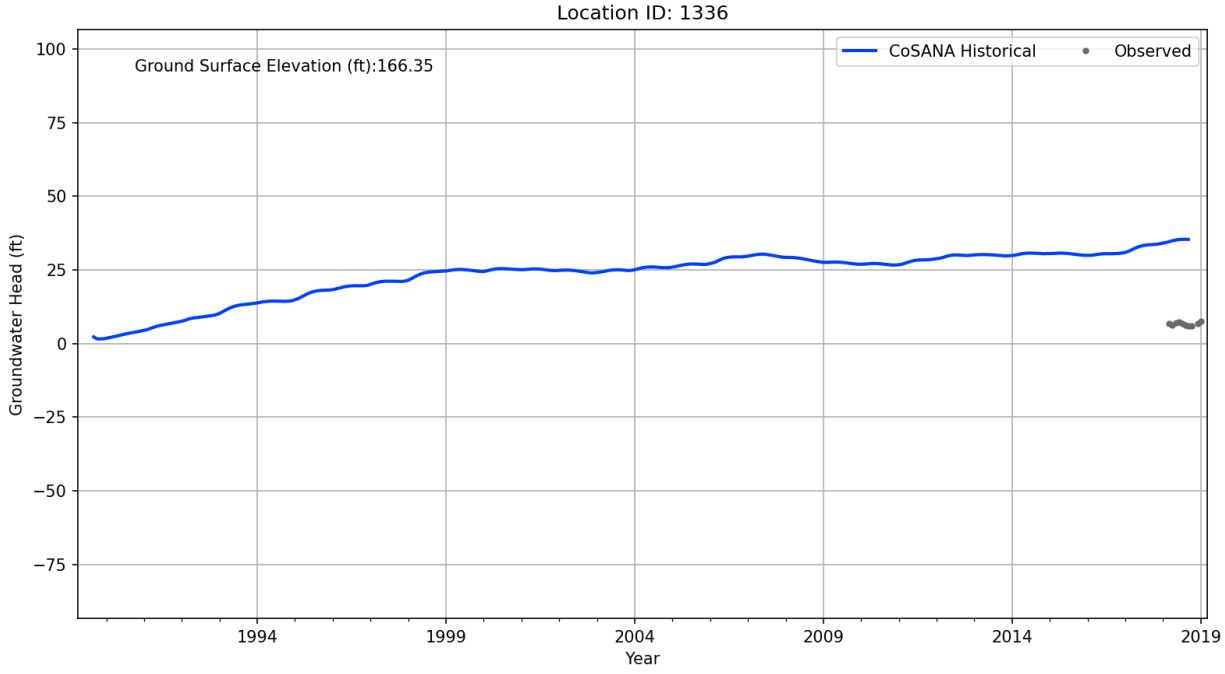

Location ID: 1328
Ground Surface Elevation (ft):157.83
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

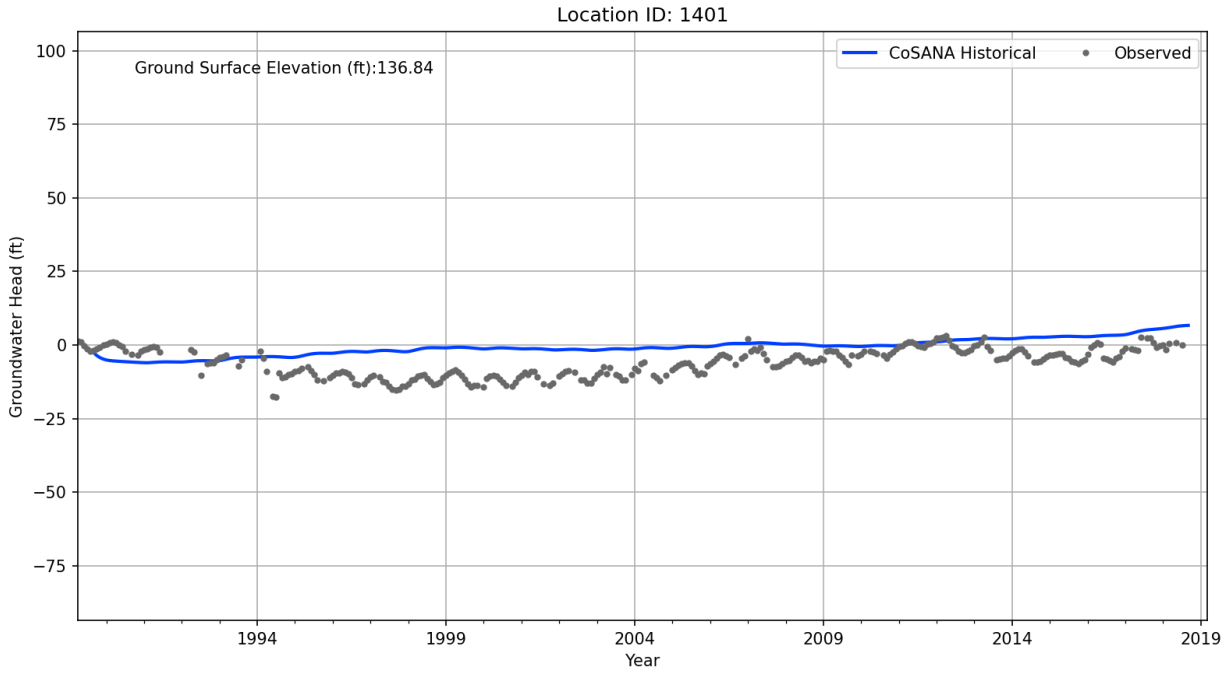

Location ID: 1329
Ground Surface Elevation (ft):157.83
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

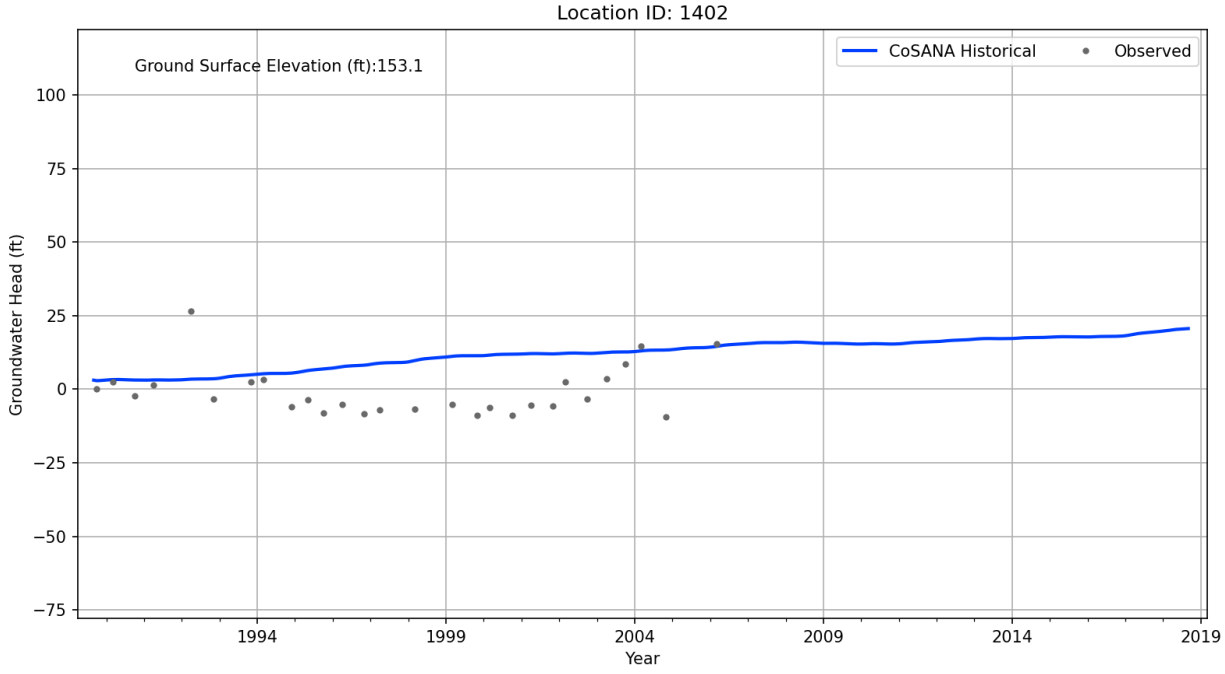

Location ID: 1330
Ground Surface Elevation (ft):157.83
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

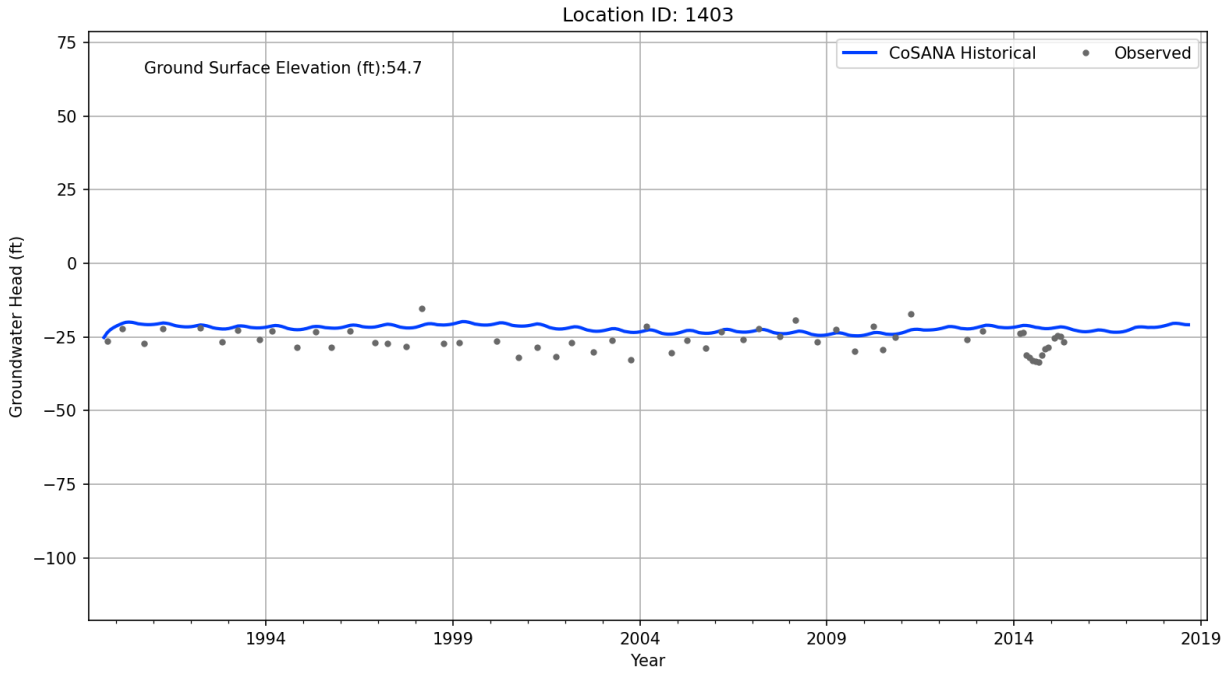

Location ID: 1331
Ground Surface Elevation (ft):141.98
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

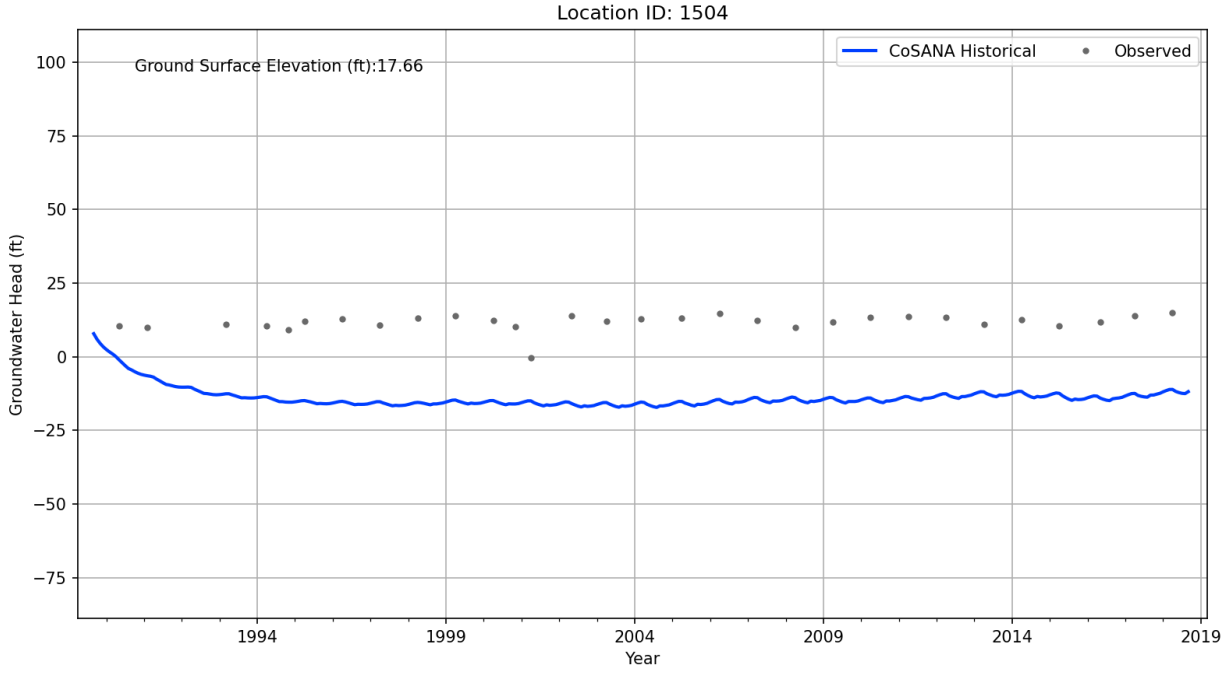

Location ID: 1335
Ground Surface Elevation (ft):166.35
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

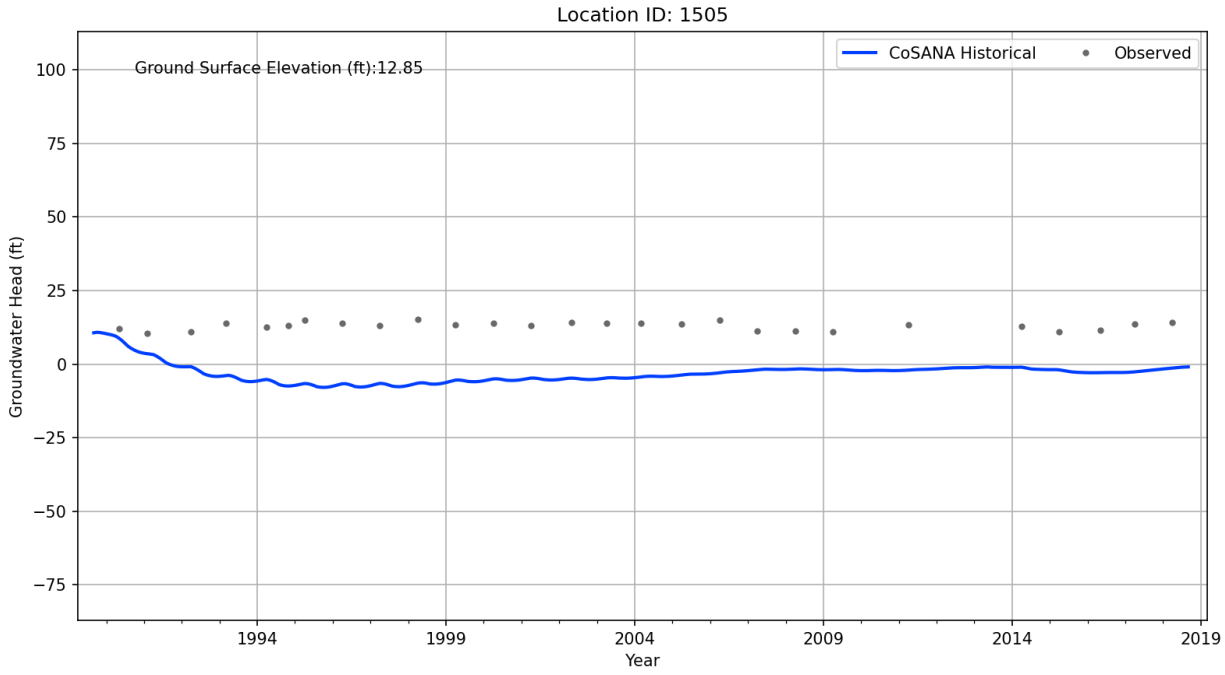

Location ID: 1336
Ground Surface Elevation (ft):166.35
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

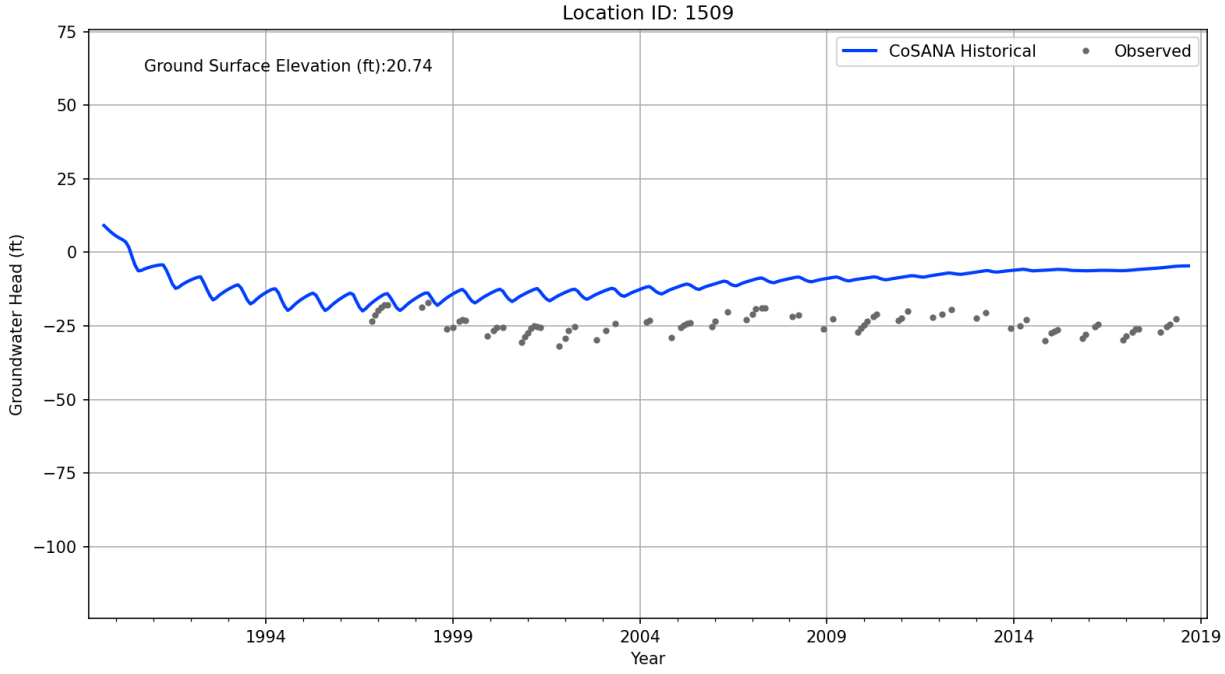

Location ID: 1401
Ground Surface Elevation (ft):136.84
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

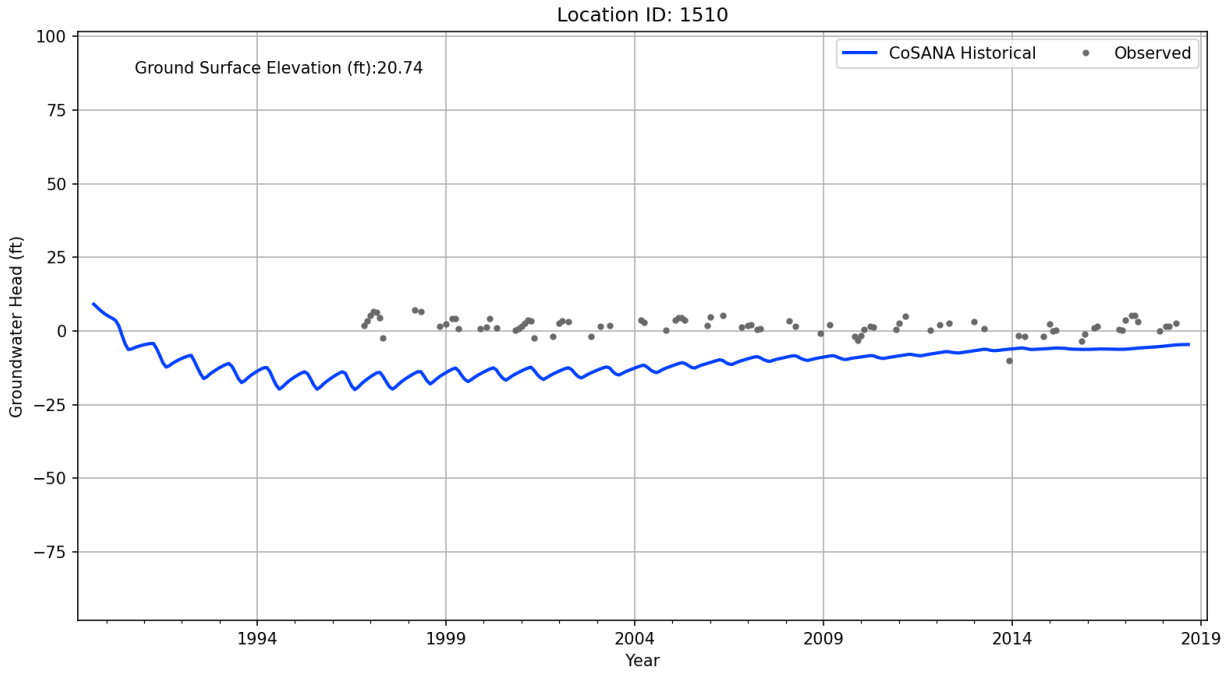

Location ID: 1402
Ground Surface Elevation (ft):153.1
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

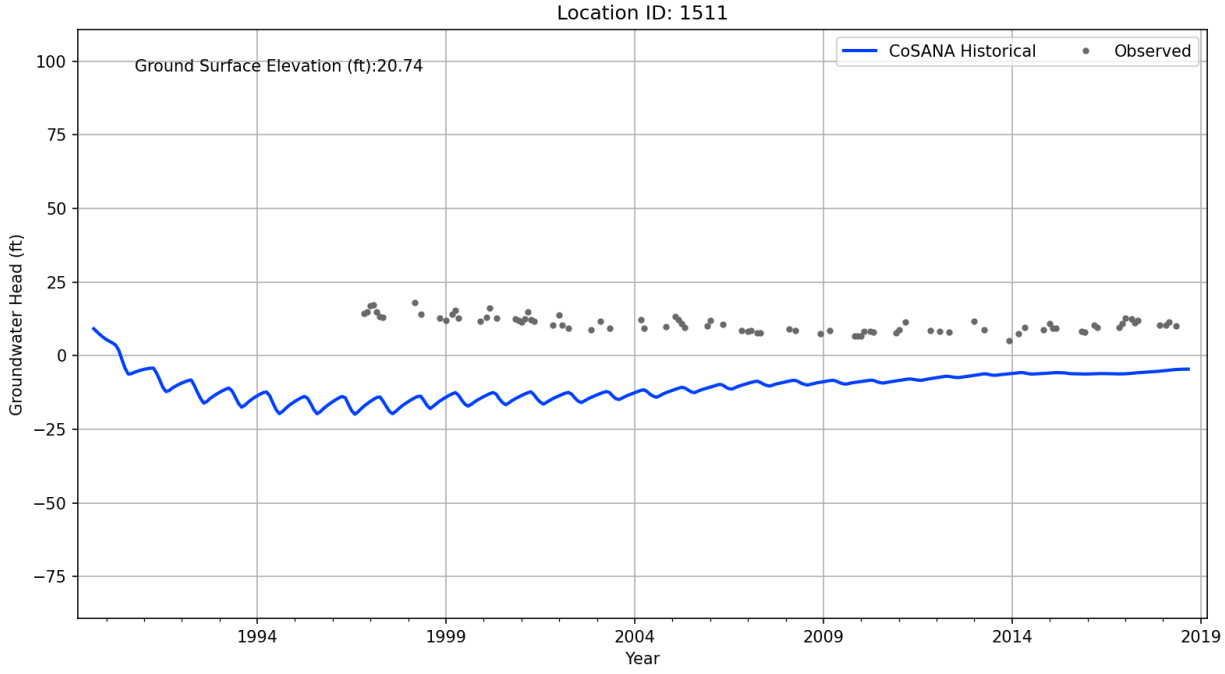

Location ID: 1403
Ground Surface Elevation (ft):54.7
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

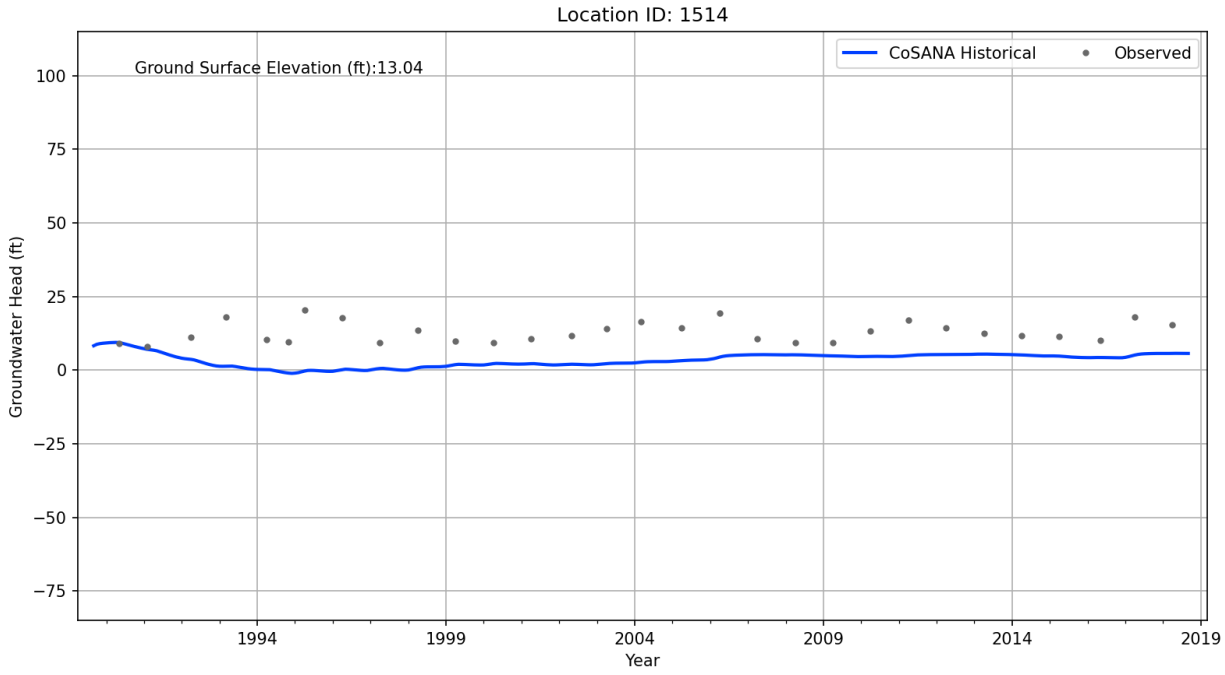

Location ID: 1504
Ground Surface Elevation (ft):17.66
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

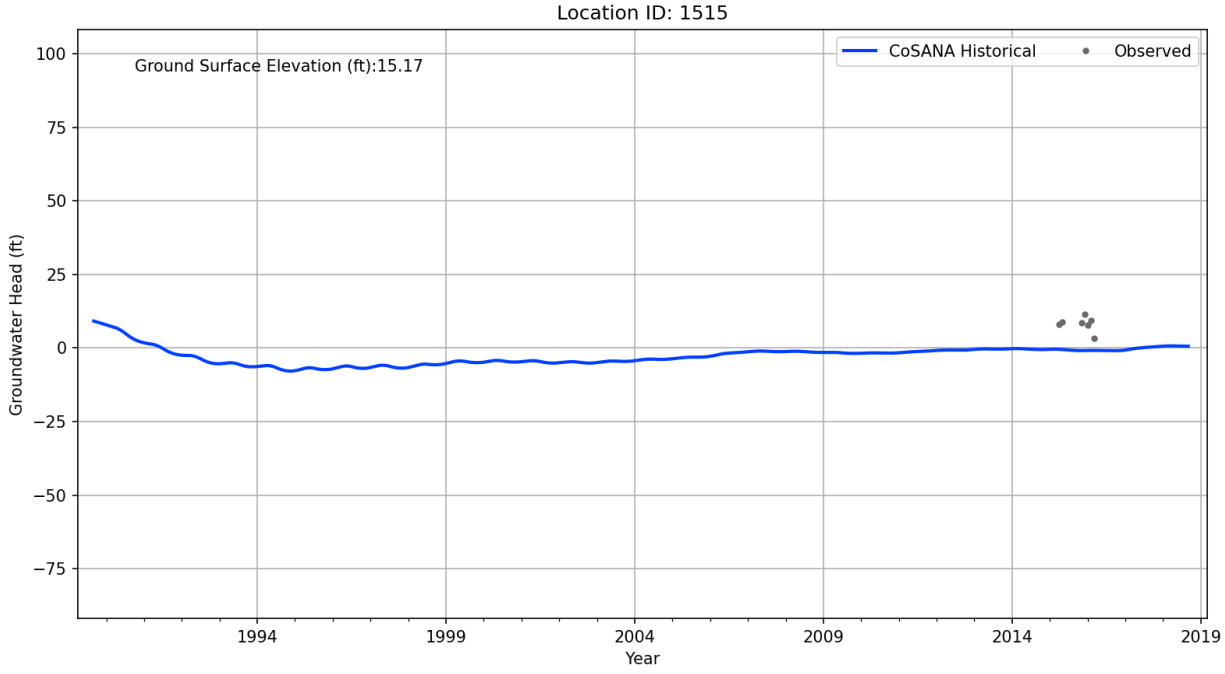

Location ID: 1505
Ground Surface Elevation (ft):12.85
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

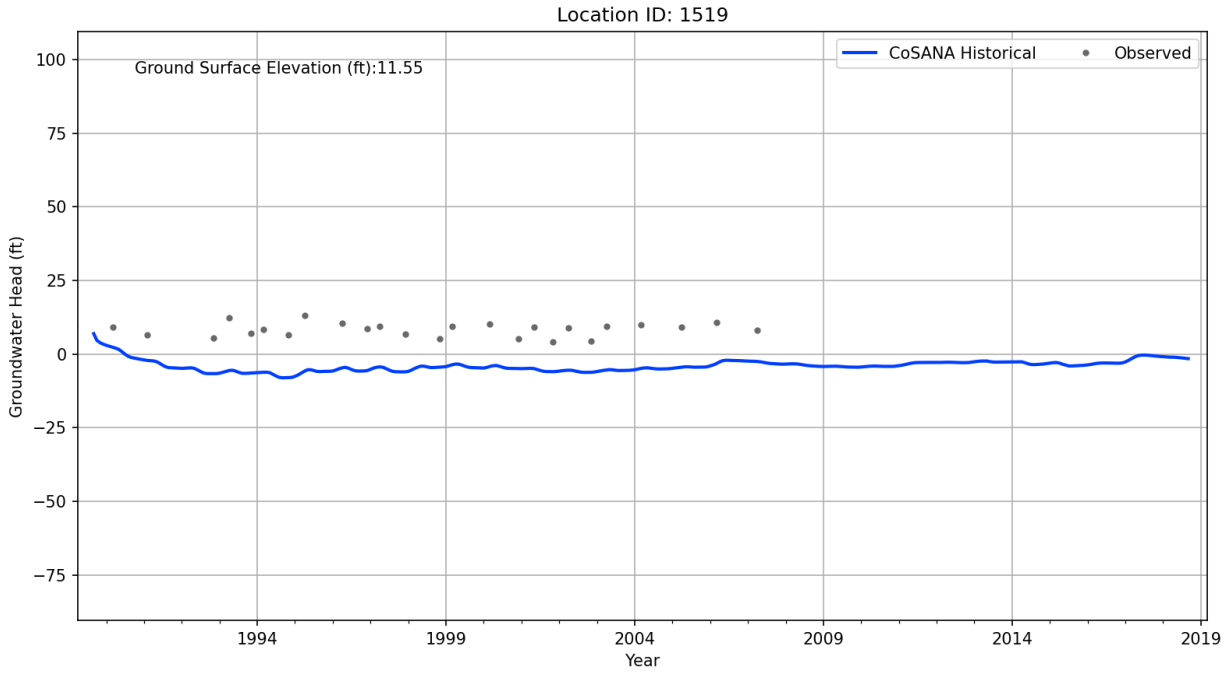

Location ID: 1509
Ground Surface Elevation (ft):20.74
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

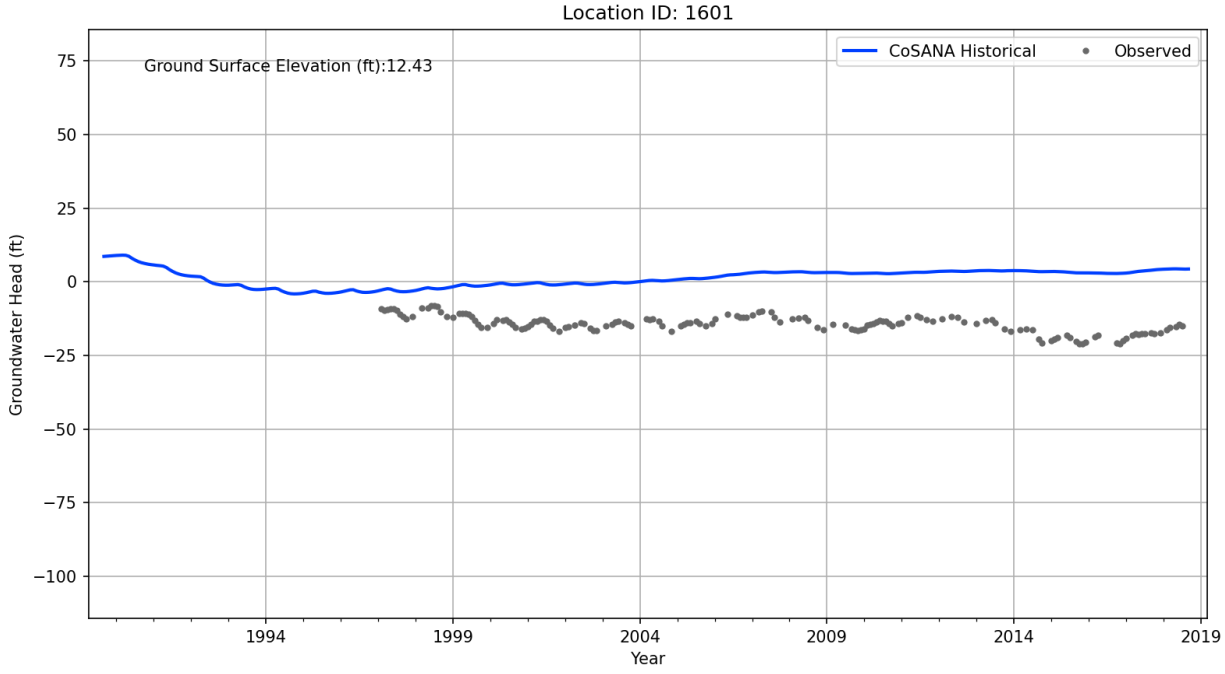

Location ID: 1510
Ground Surface Elevation (ft):20.74
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

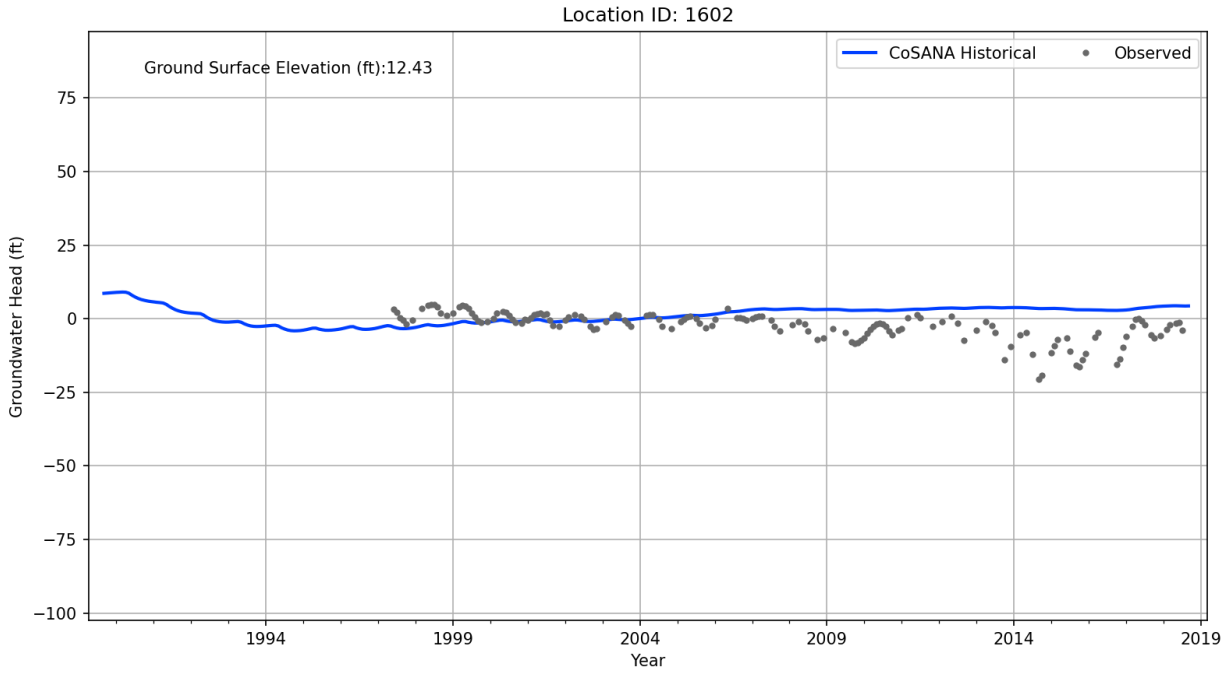

Location ID: 1511
Ground Surface Elevation (ft):20.74
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

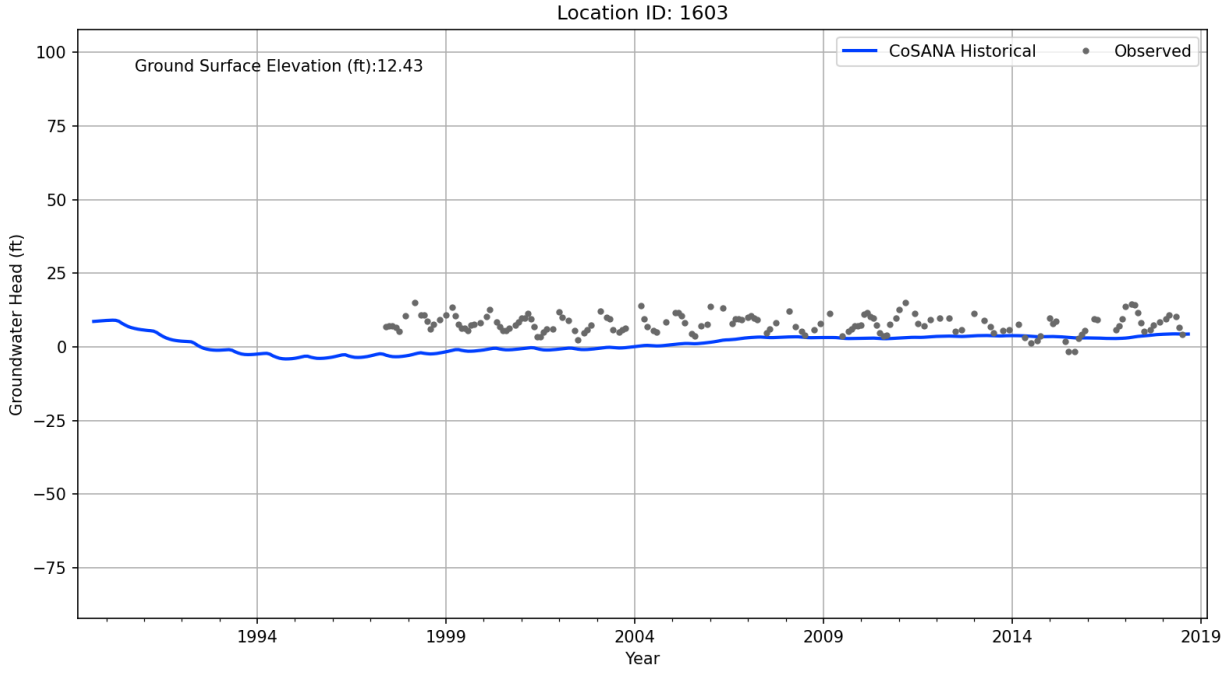

Location ID: 1514
Ground Surface Elevation (ft):13.04
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

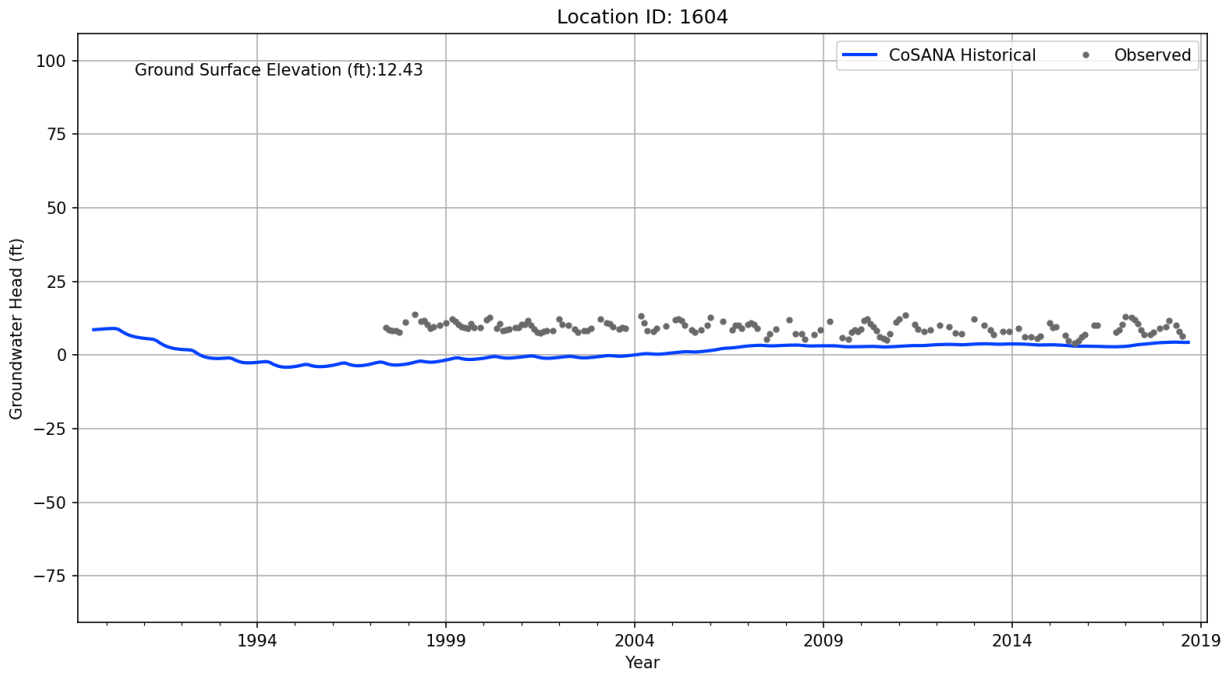

Location ID: 1515
Ground Surface Elevation (ft):15.17
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

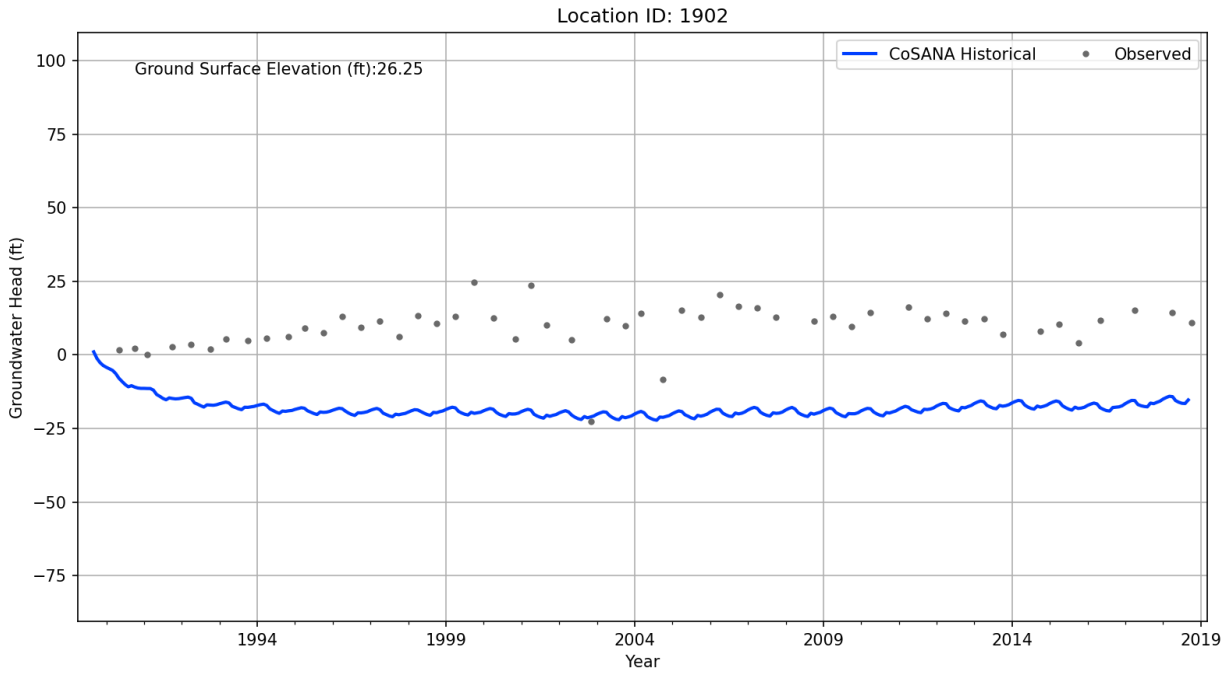

Location ID: 1519
Ground Surface Elevation (ft):11.55
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

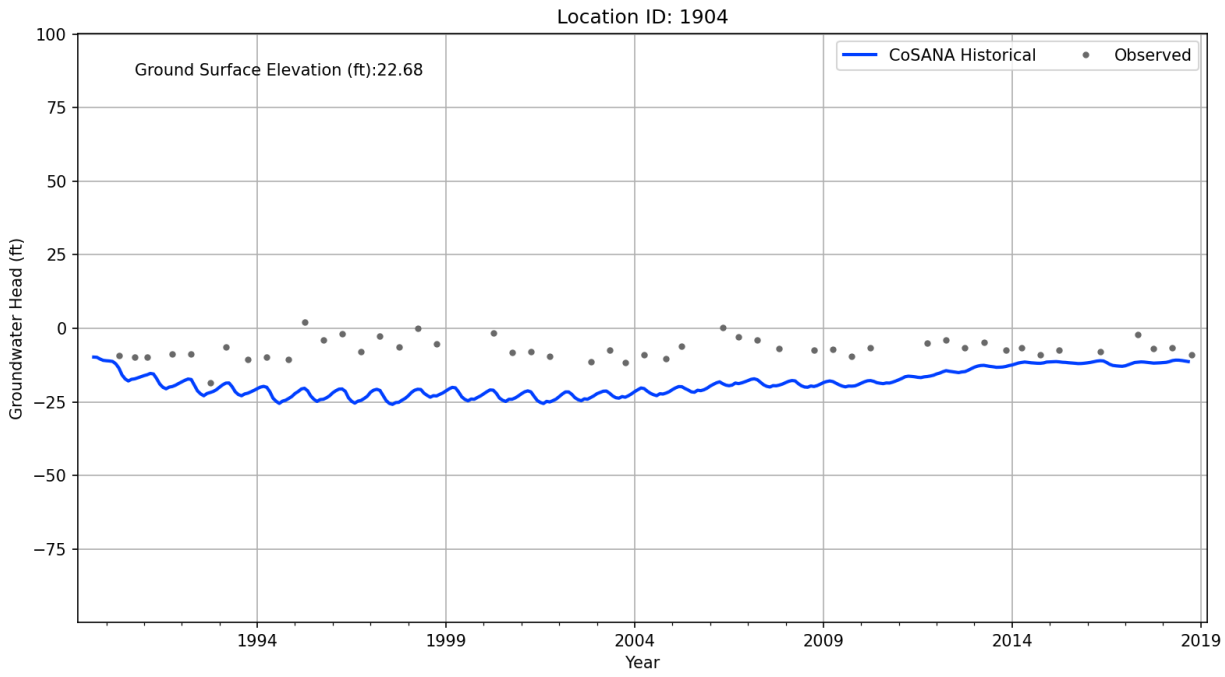

Location ID: 1601
Ground Surface Elevation (ft):12.43
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

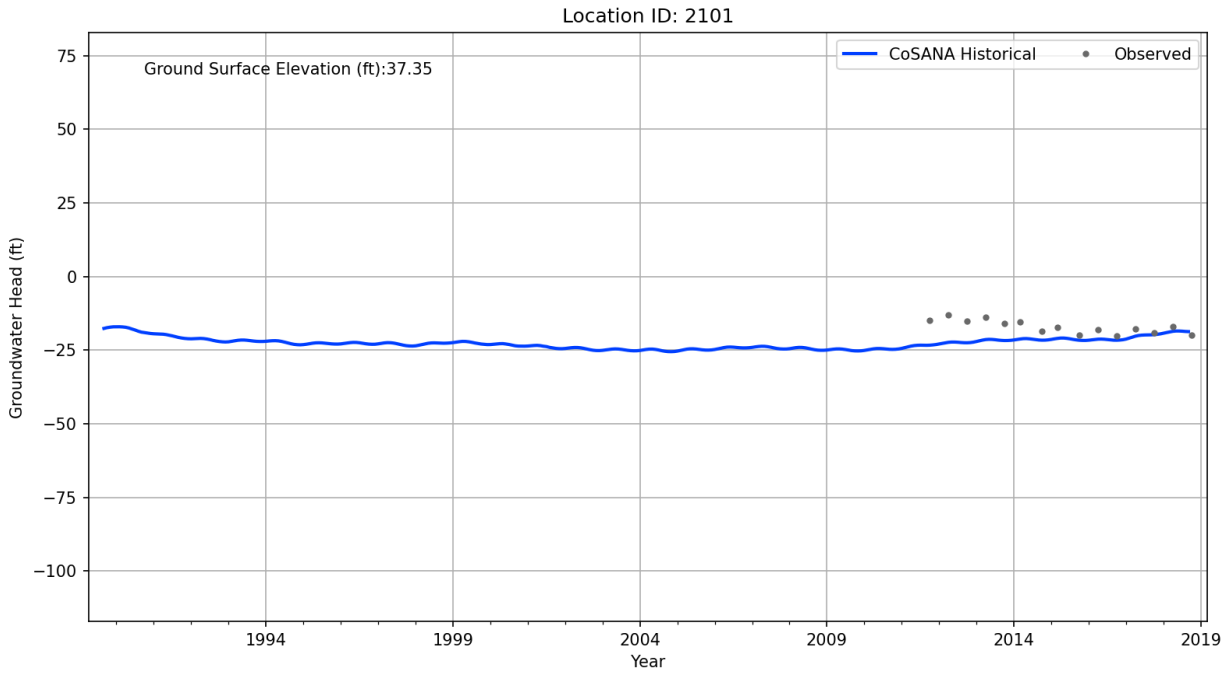

Location ID: 1602
Ground Surface Elevation (ft):12.43
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

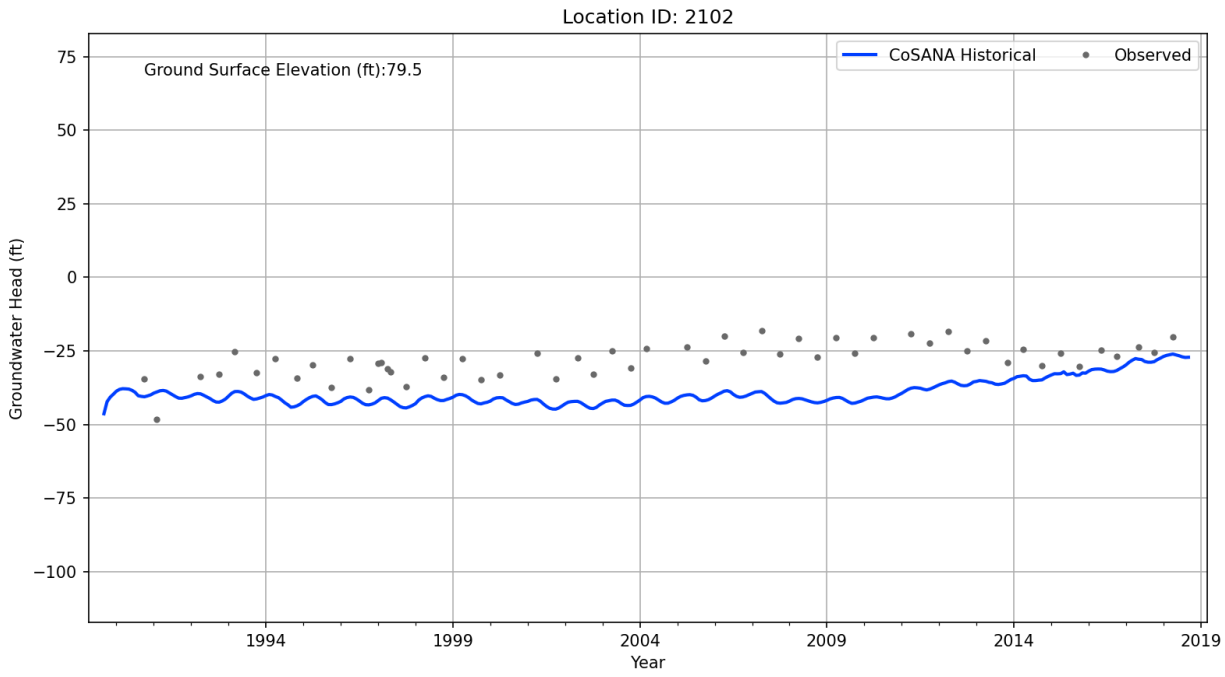

Location ID: 1603
Ground Surface Elevation (ft):12.43
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

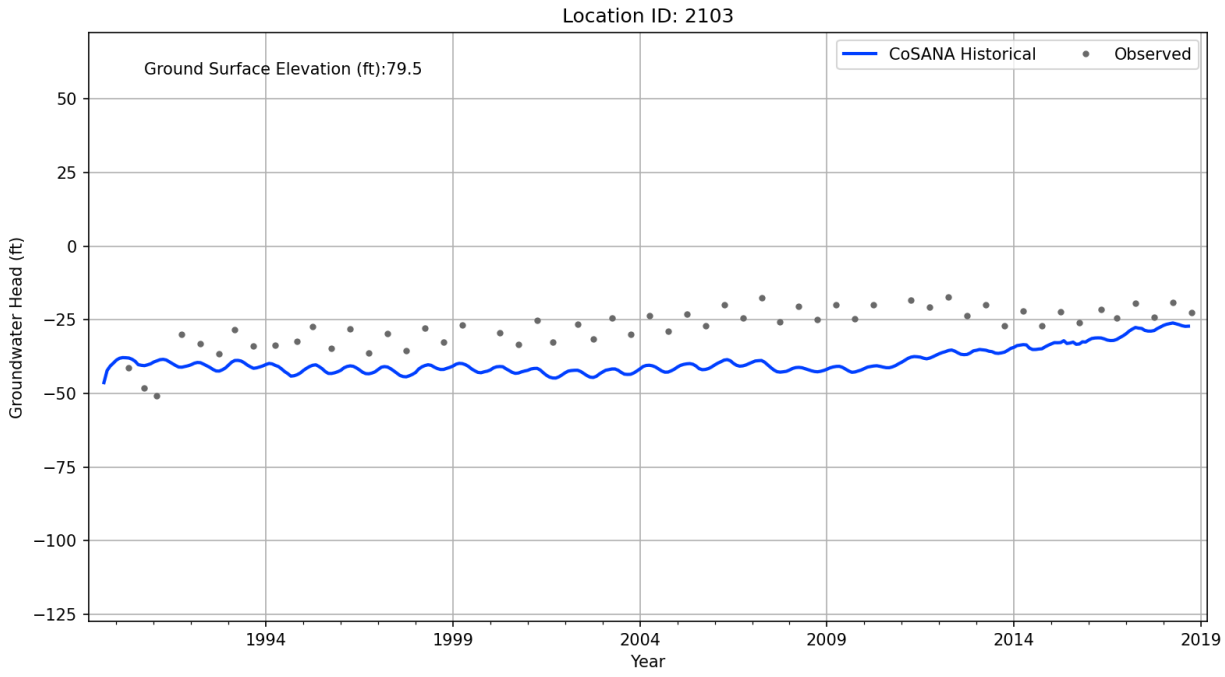

Location ID: 1604
Ground Surface Elevation (ft):12.43
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

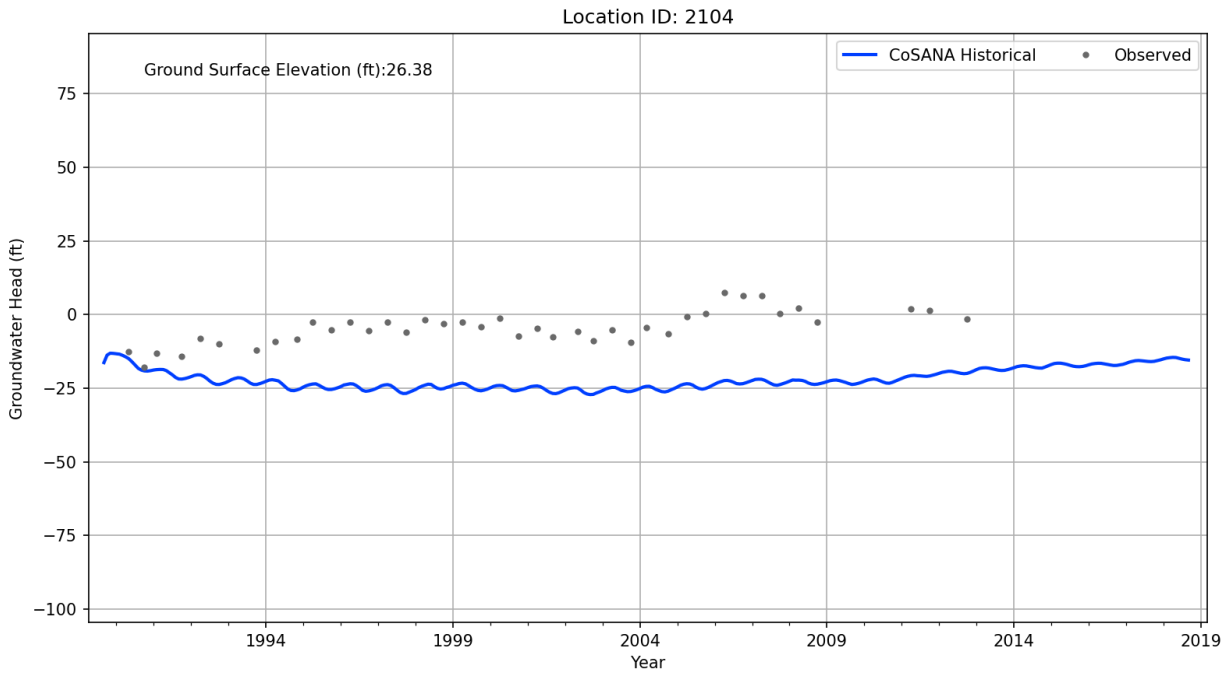

Location ID: 1902
Ground Surface Elevation (ft):26.25
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

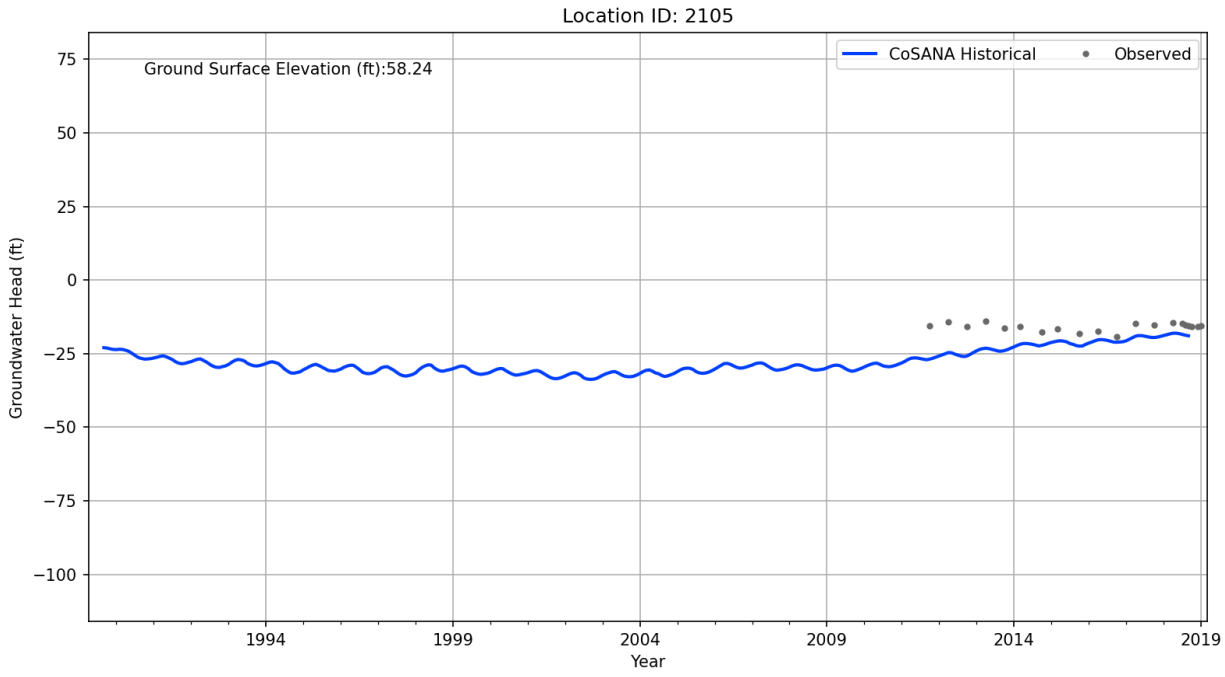

Location ID: 1904
Ground Surface Elevation (ft):22.68
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

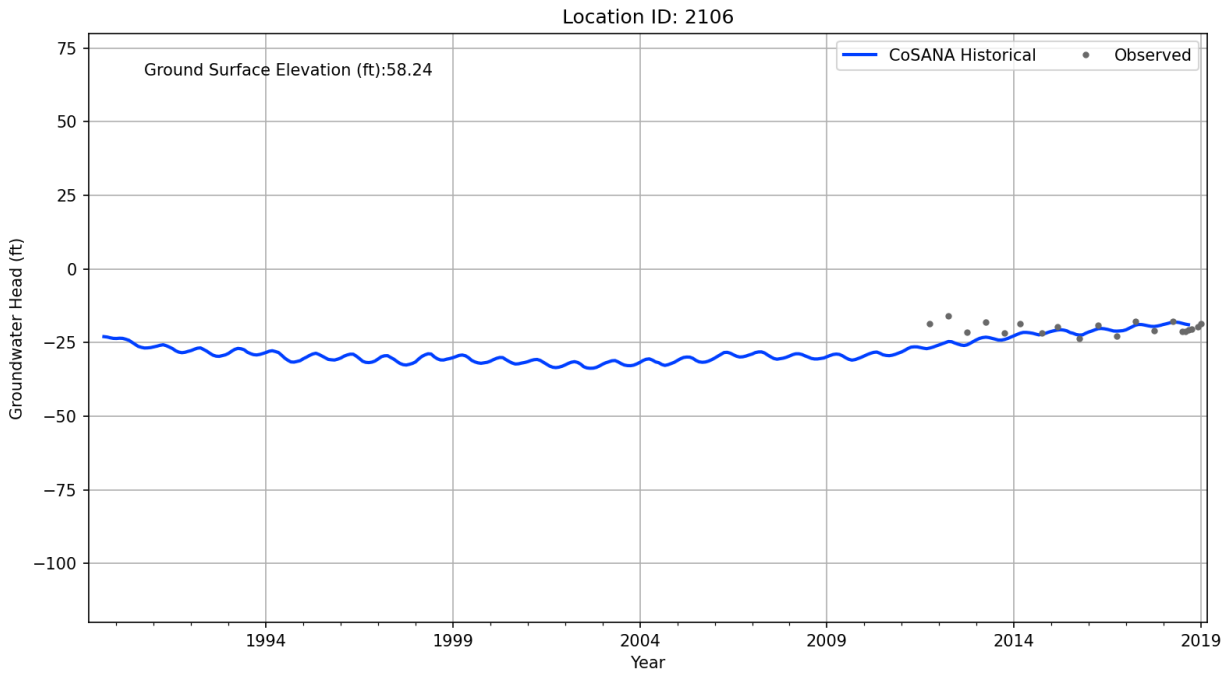

Location ID: 2101
Ground Surface Elevation (ft):37.35
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

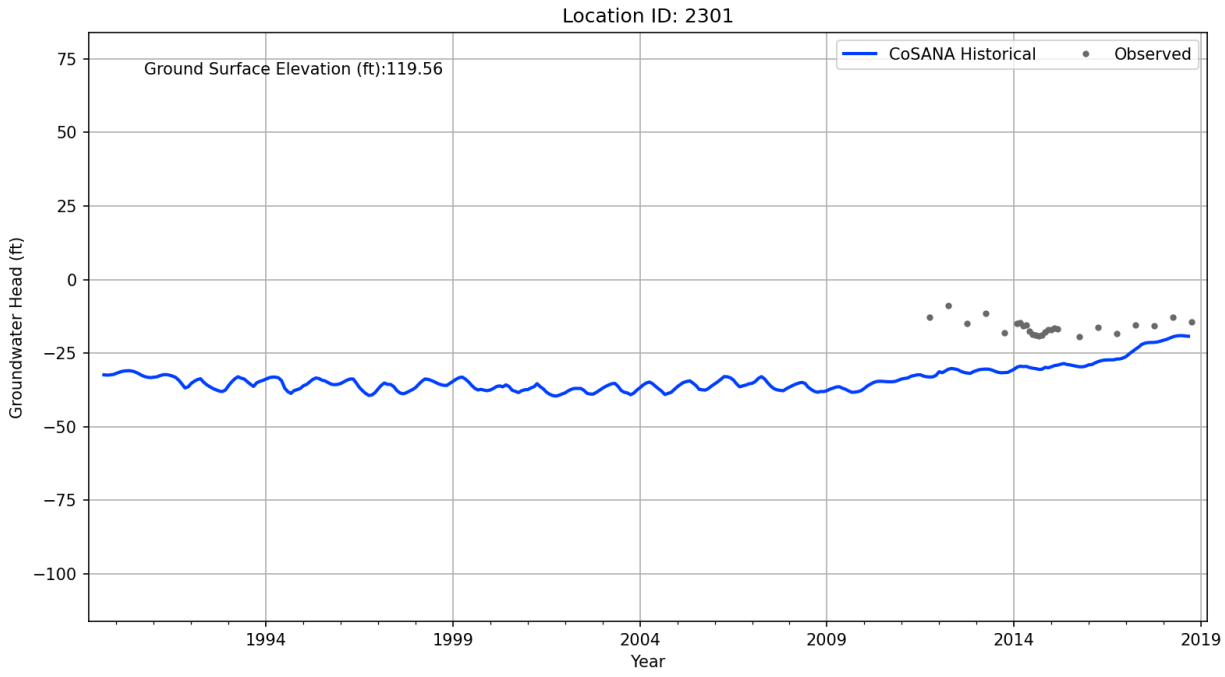

Location ID: 2102
Ground Surface Elevation (ft):79.5
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

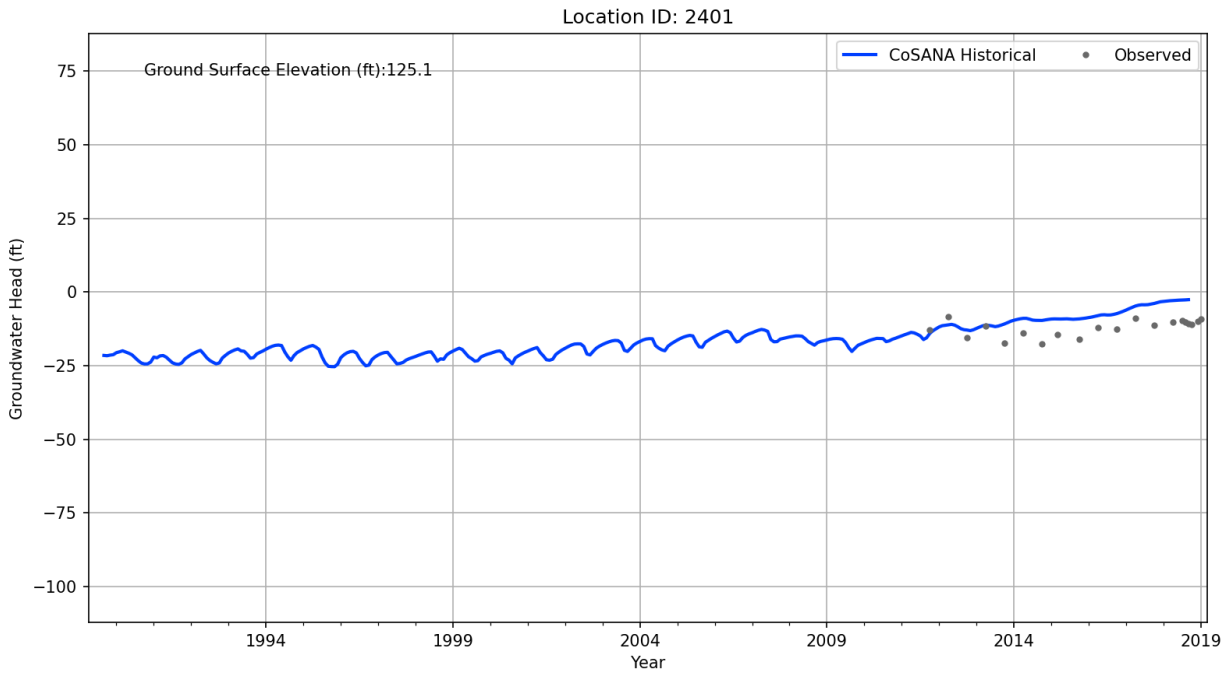

Location ID: 2103
Ground Surface Elevation (ft):79.5
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

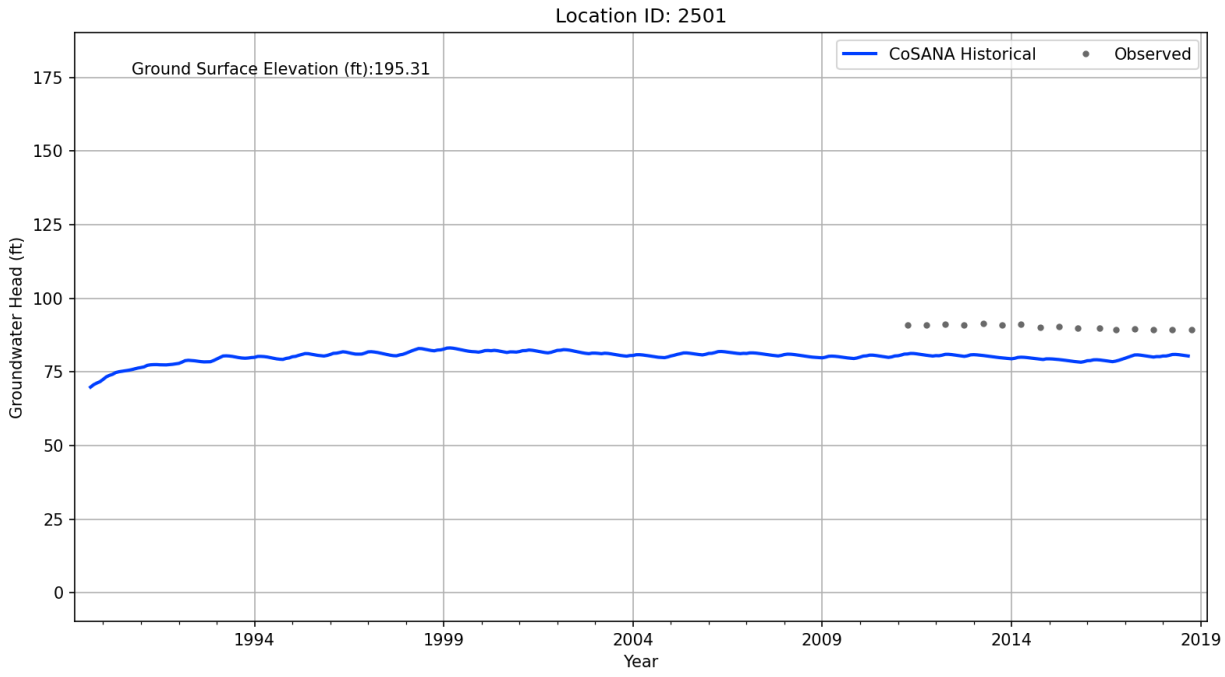

Location ID: 2104
Ground Surface Elevation (ft):26.38
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

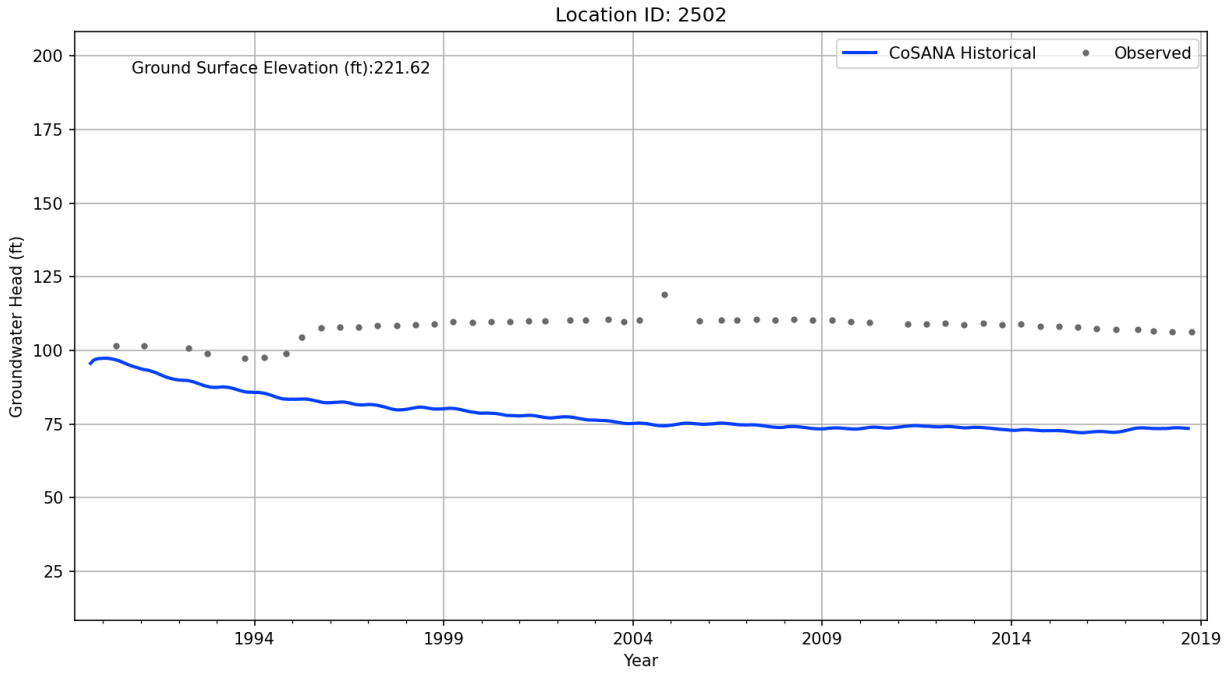

Location ID: 2105
Ground Surface Elevation (ft):58.24
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

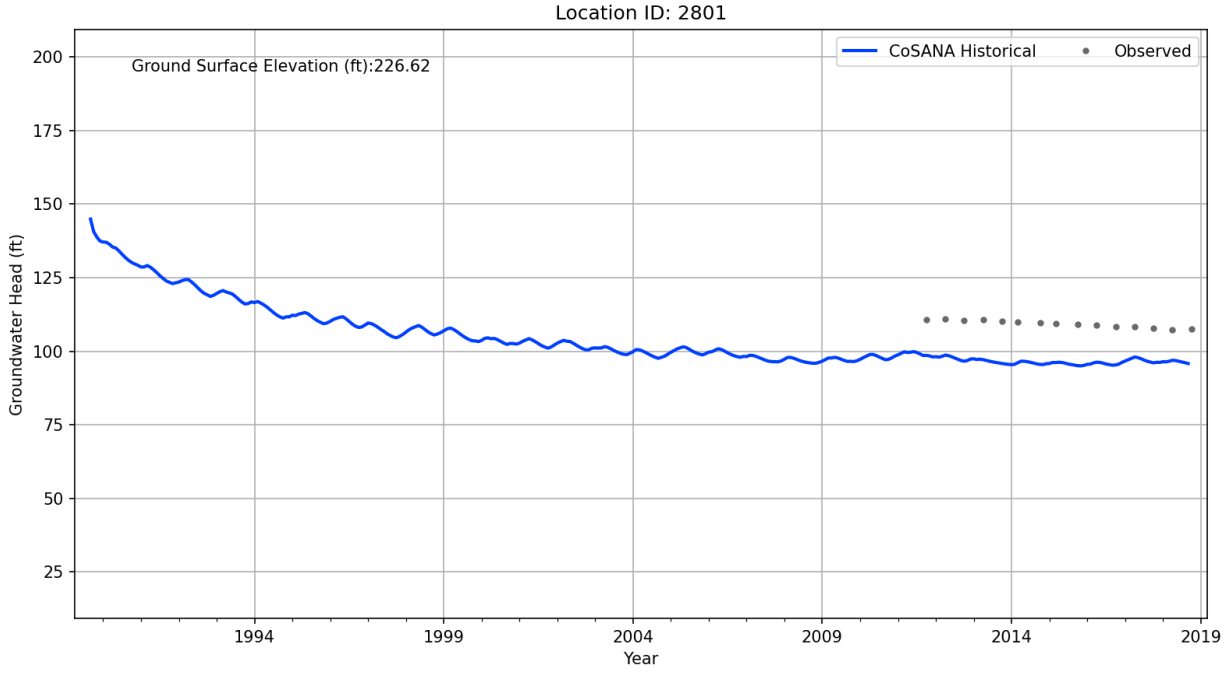

Location ID: 2106
Ground Surface Elevation (ft):58.24
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

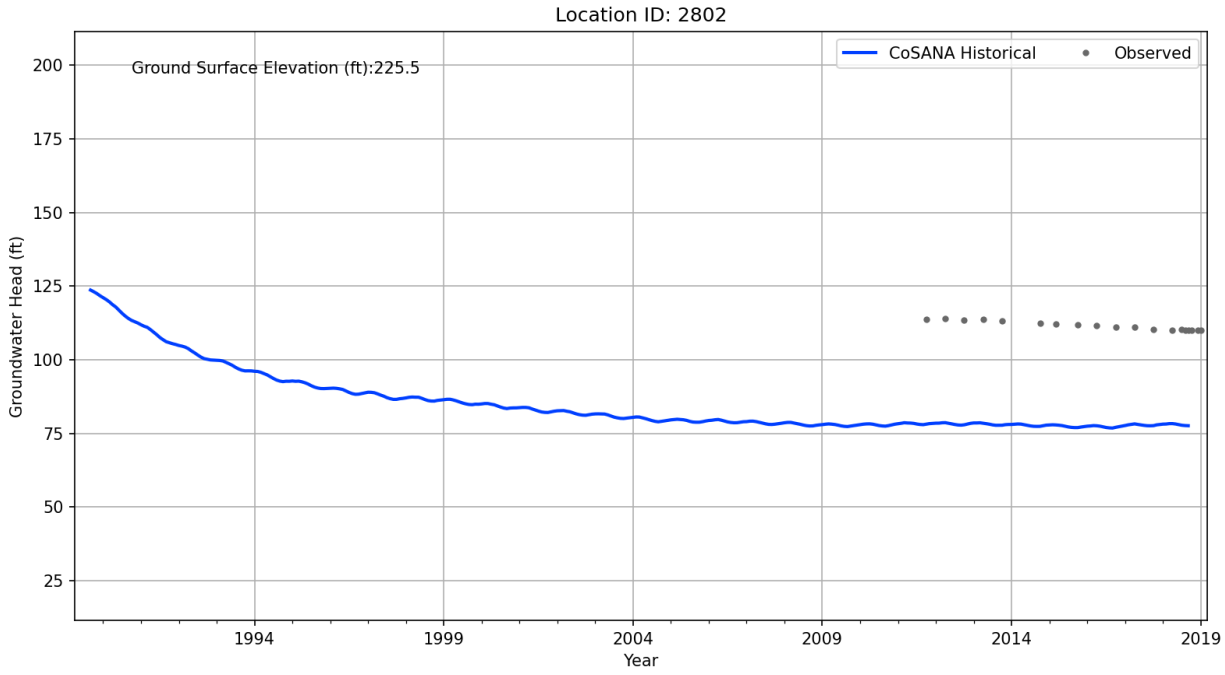

Location ID: 2301
Ground Surface Elevation (ft):119.56
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

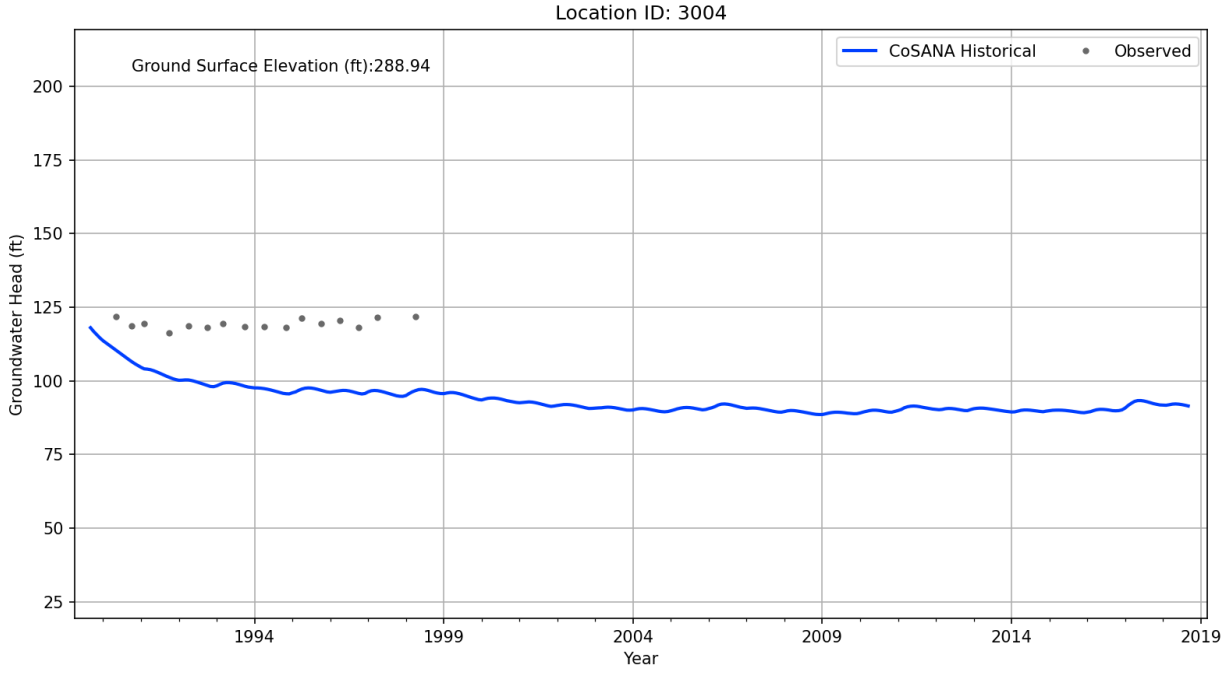

Location ID: 2401
Ground Surface Elevation (ft):125.1
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

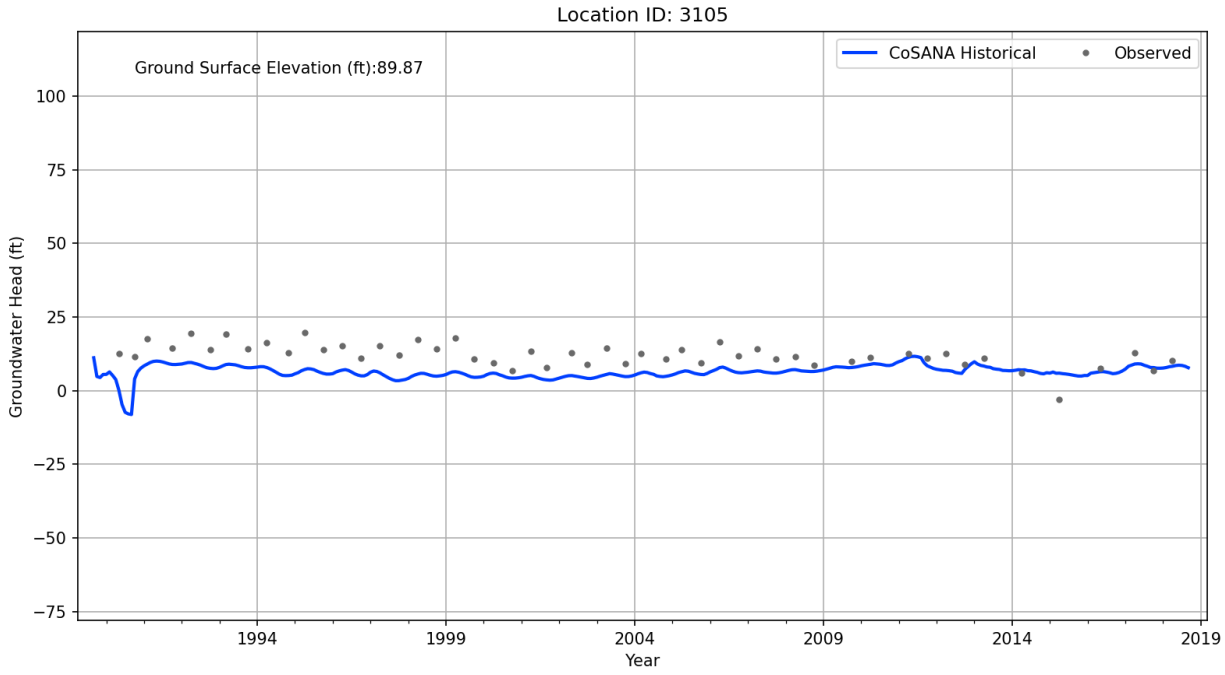

Location ID: 2501
Ground Surface Elevation (ft):195.31
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

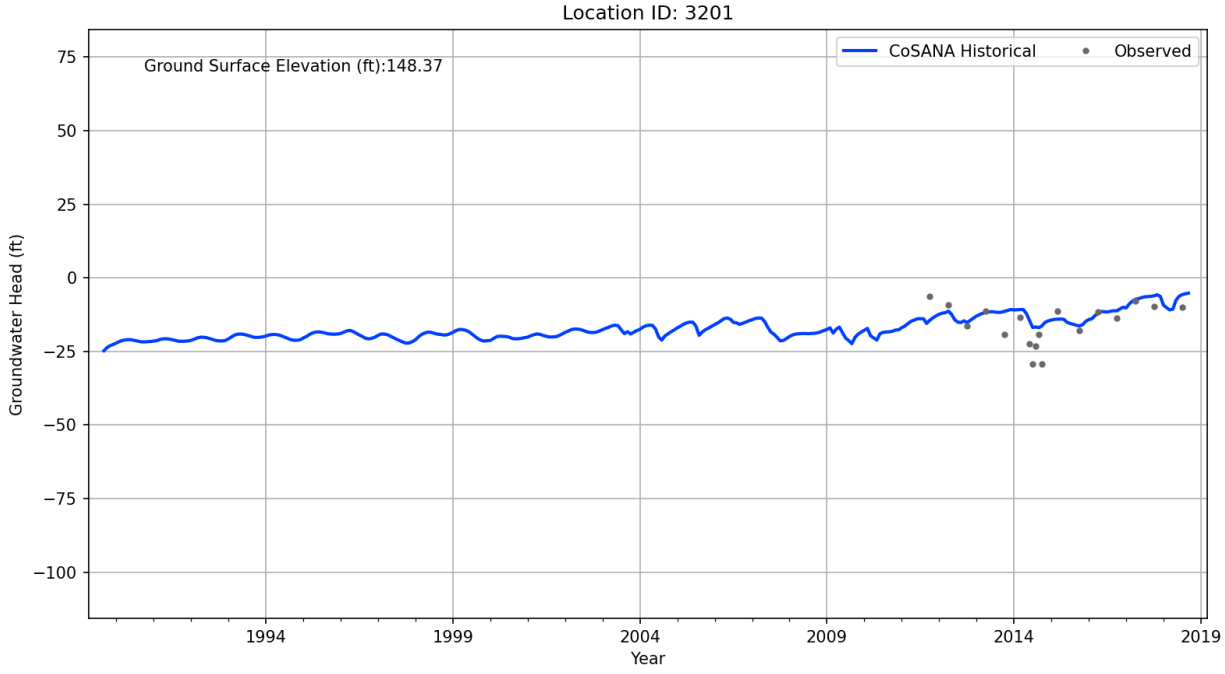

Location ID: 2502
Ground Surface Elevation (ft):221.62
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

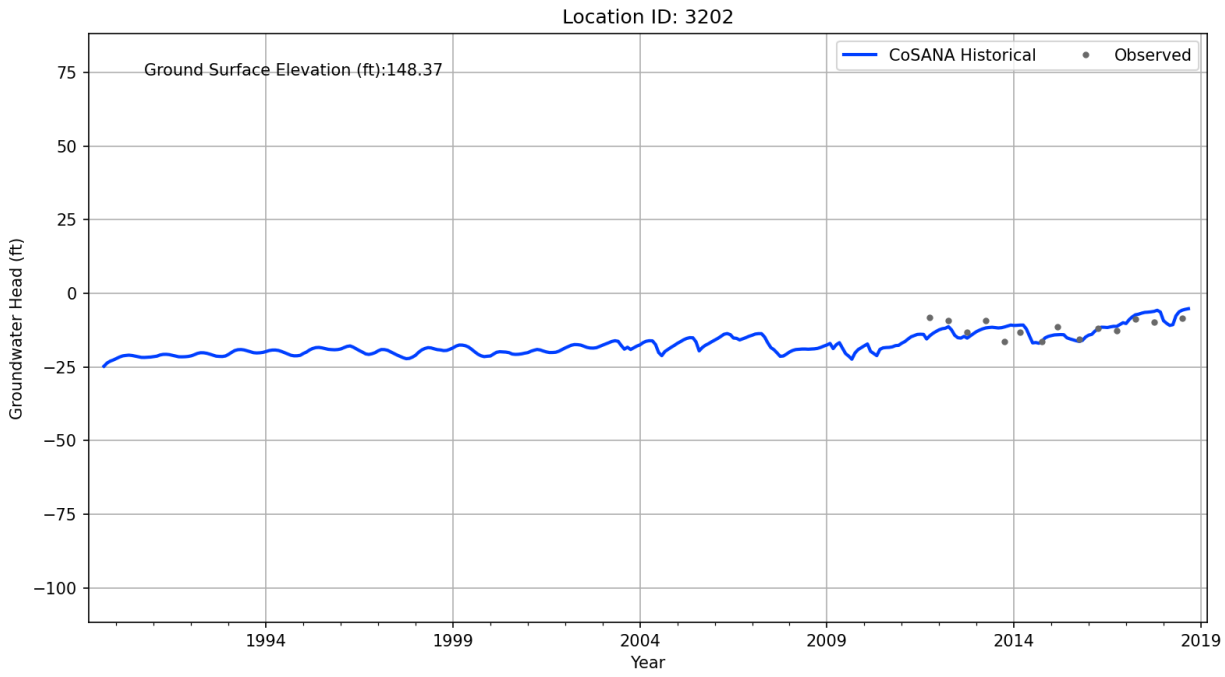

Location ID: 2801
Ground Surface Elevation (ft):226.62
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

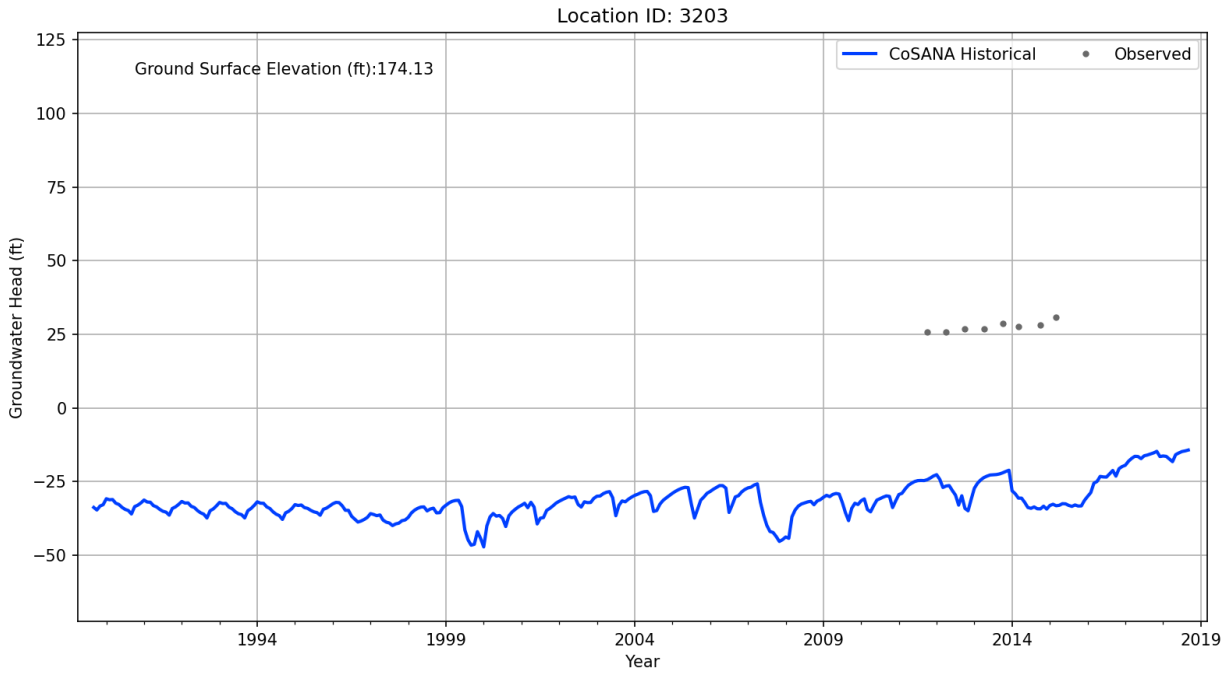

Location ID: 2802
Ground Surface Elevation (ft):225.5
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

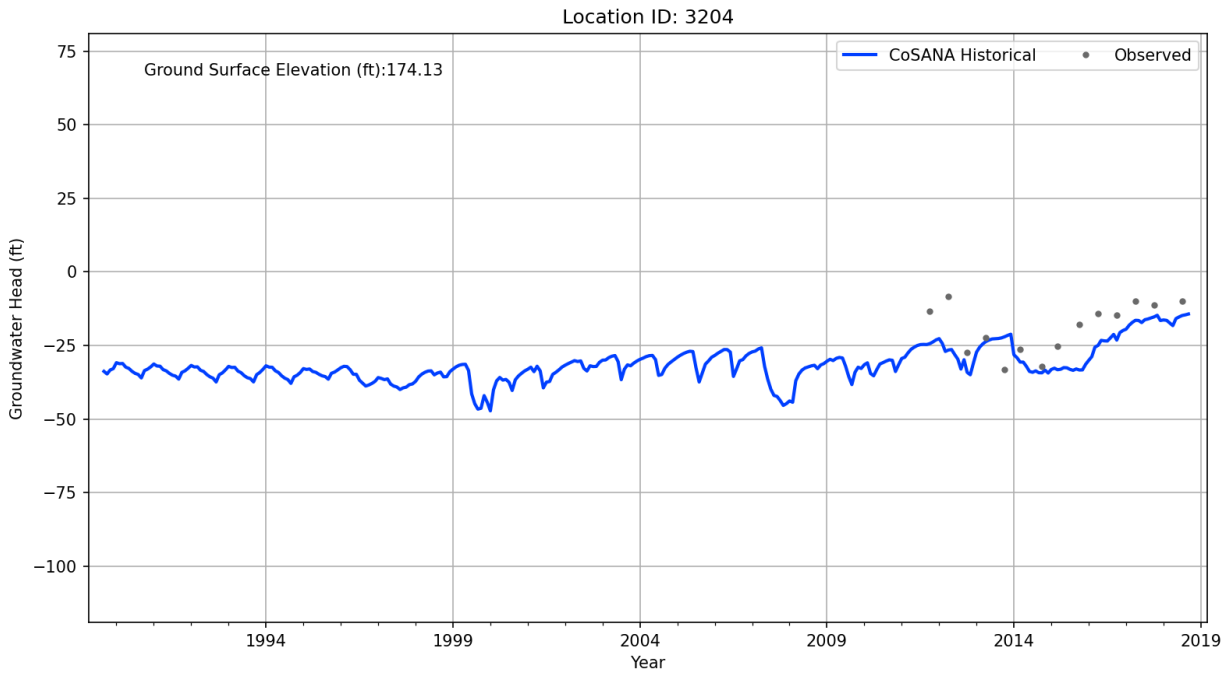

Location ID: 3004
Ground Surface Elevation (ft):288.94
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

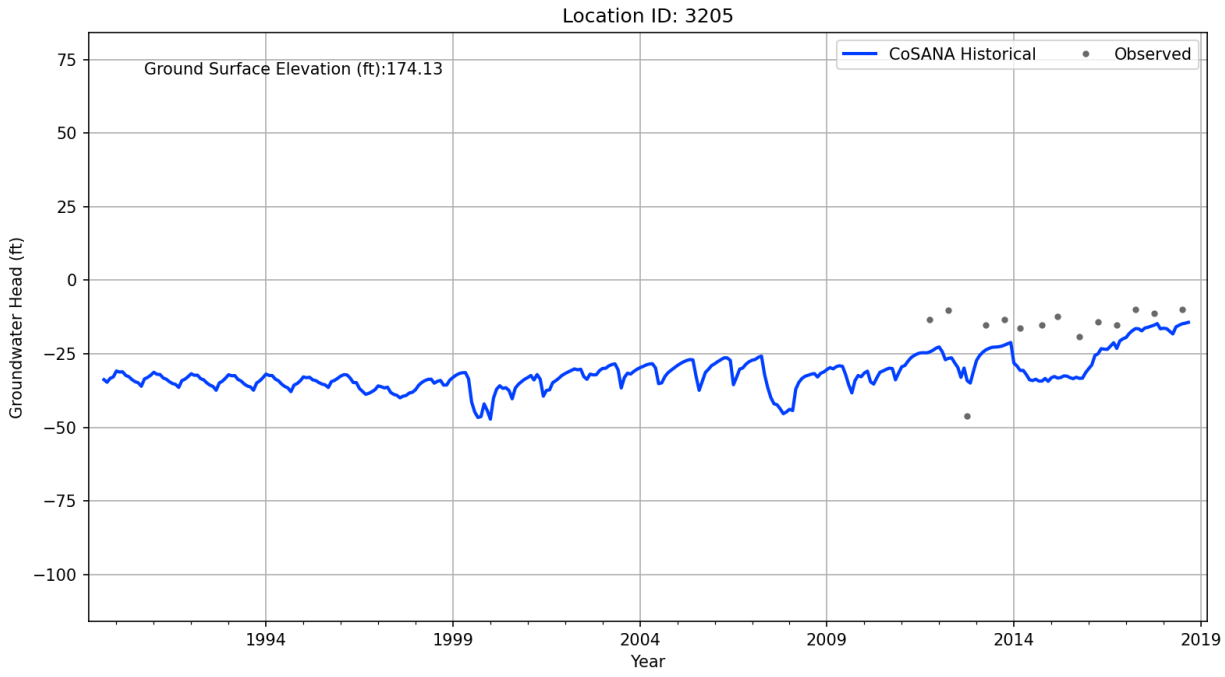

Location ID: 3105
Ground Surface Elevation (ft):89.87
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

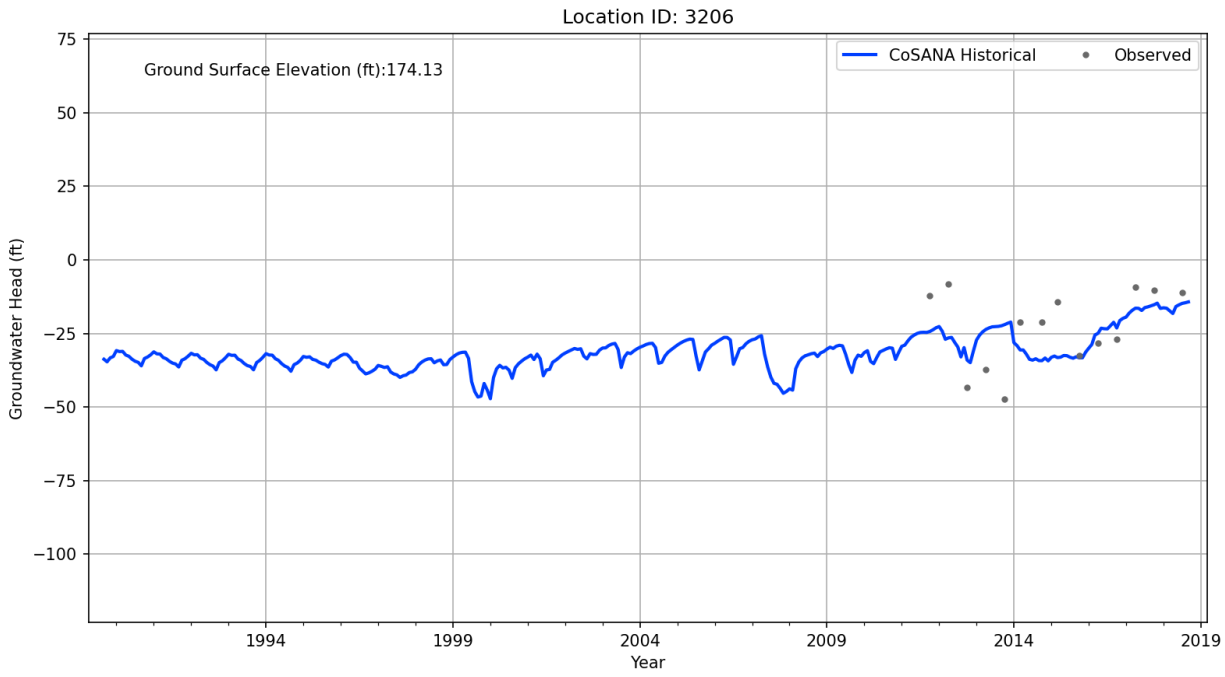

Location ID: 3201
Ground Surface Elevation (ft):148.37
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

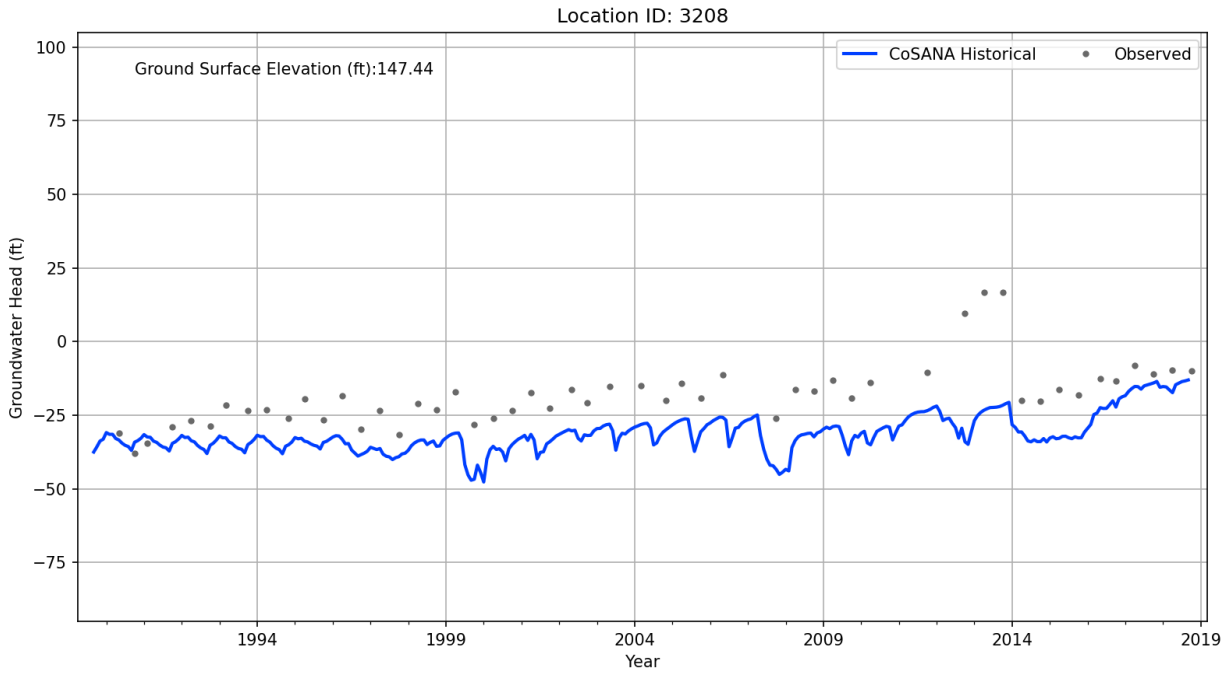

Location ID: 3202
Ground Surface Elevation (ft):148.37
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

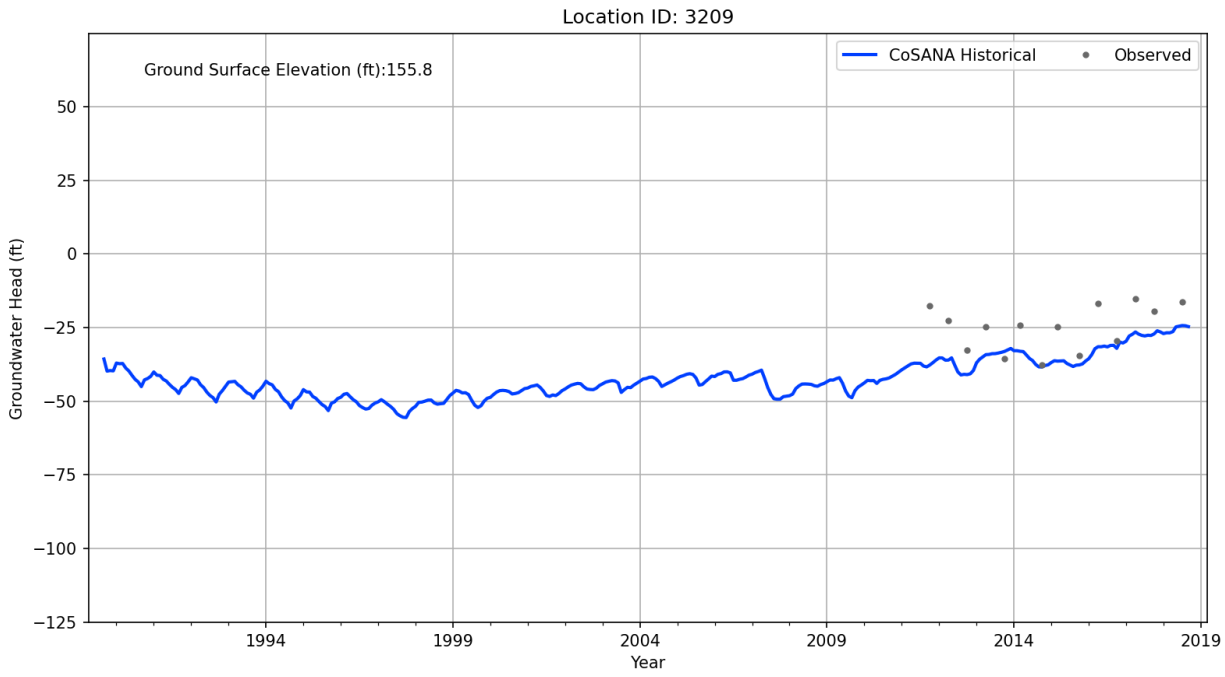

Location ID: 3203
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

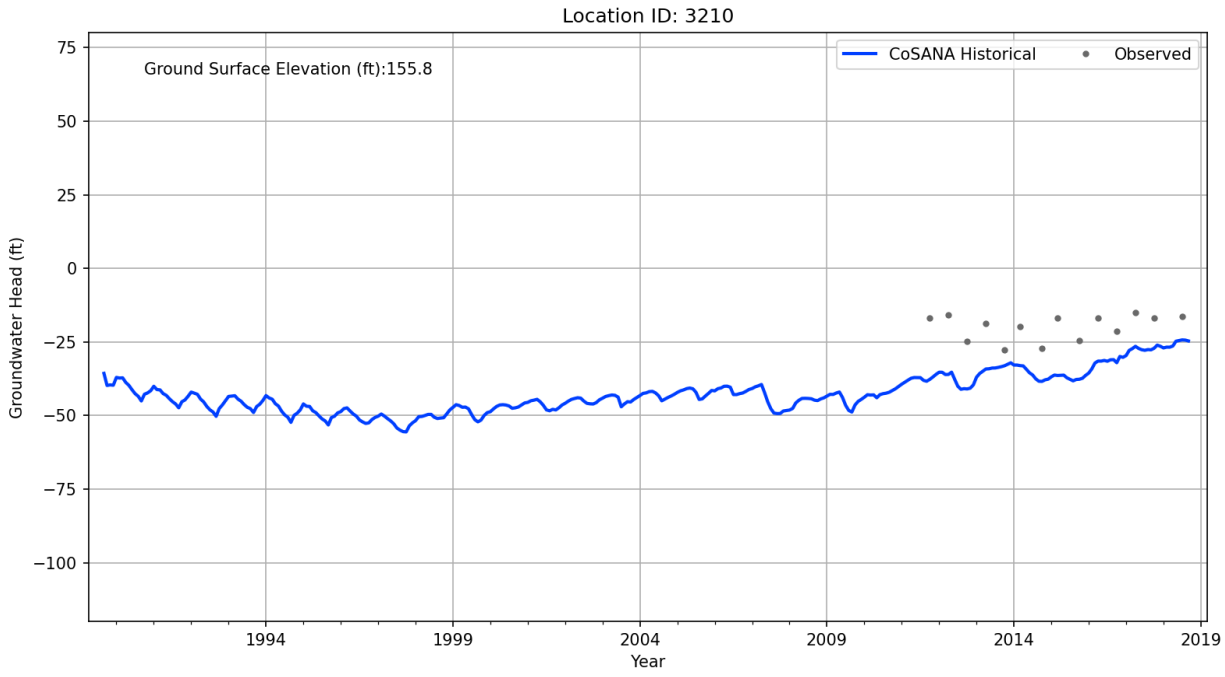

Location ID: 3204
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

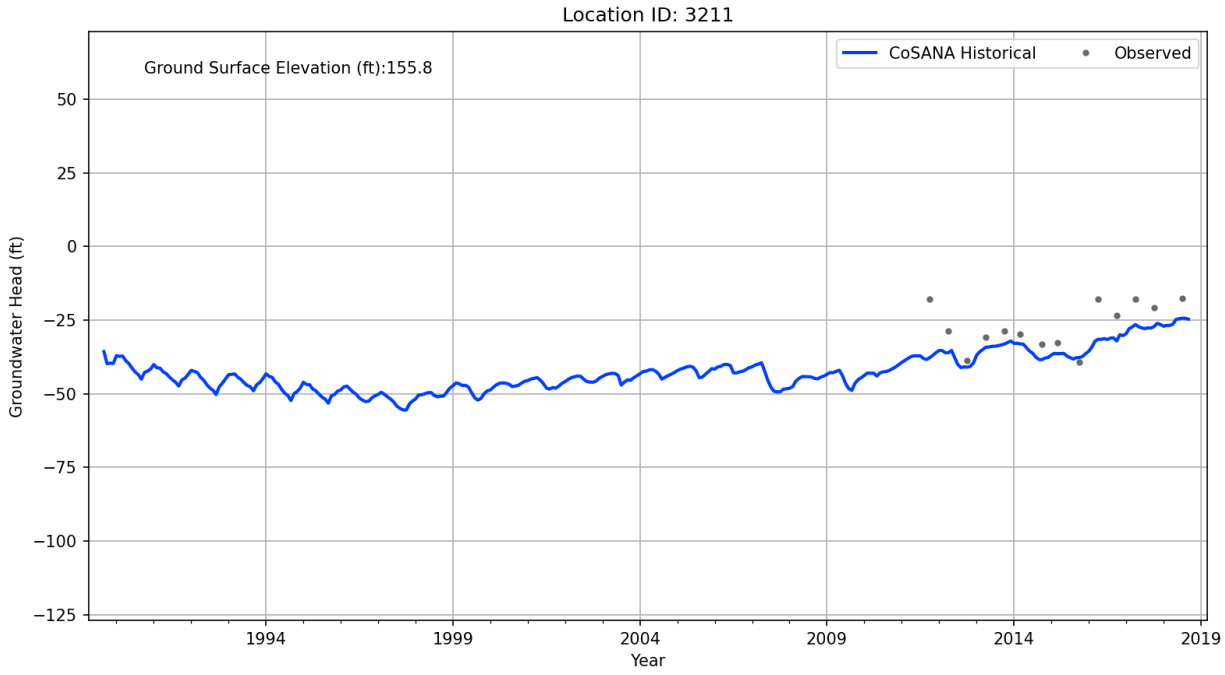

Location ID: 3205
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

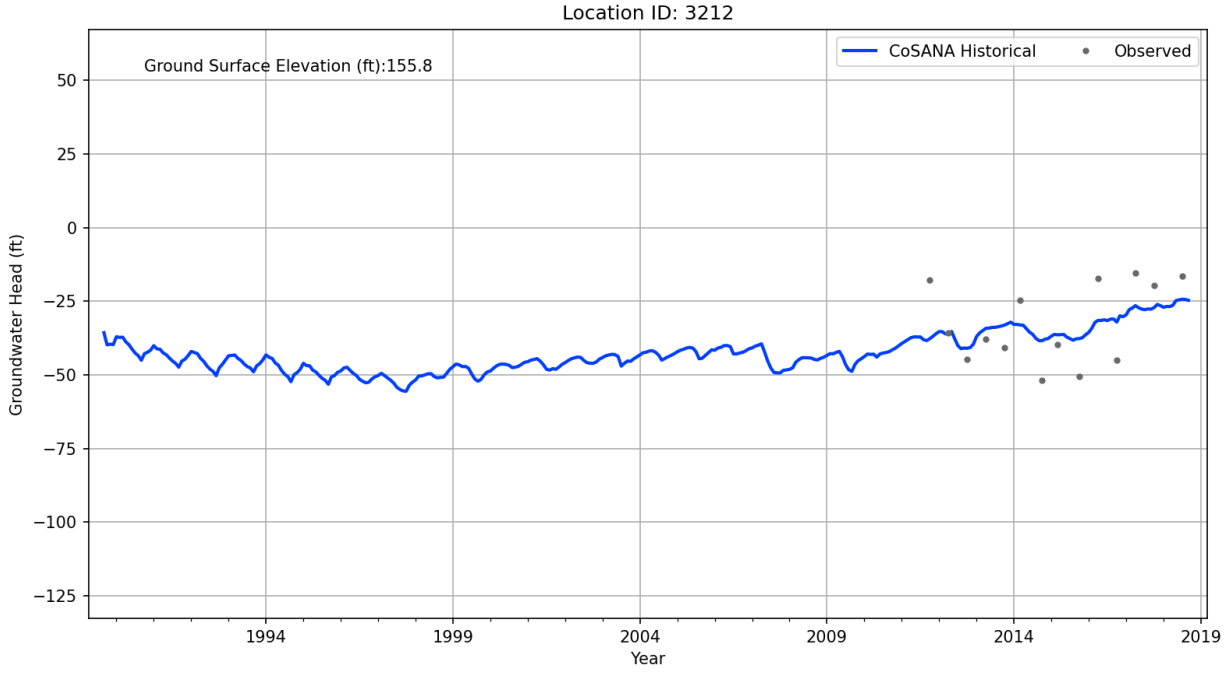

Location ID: 3206
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

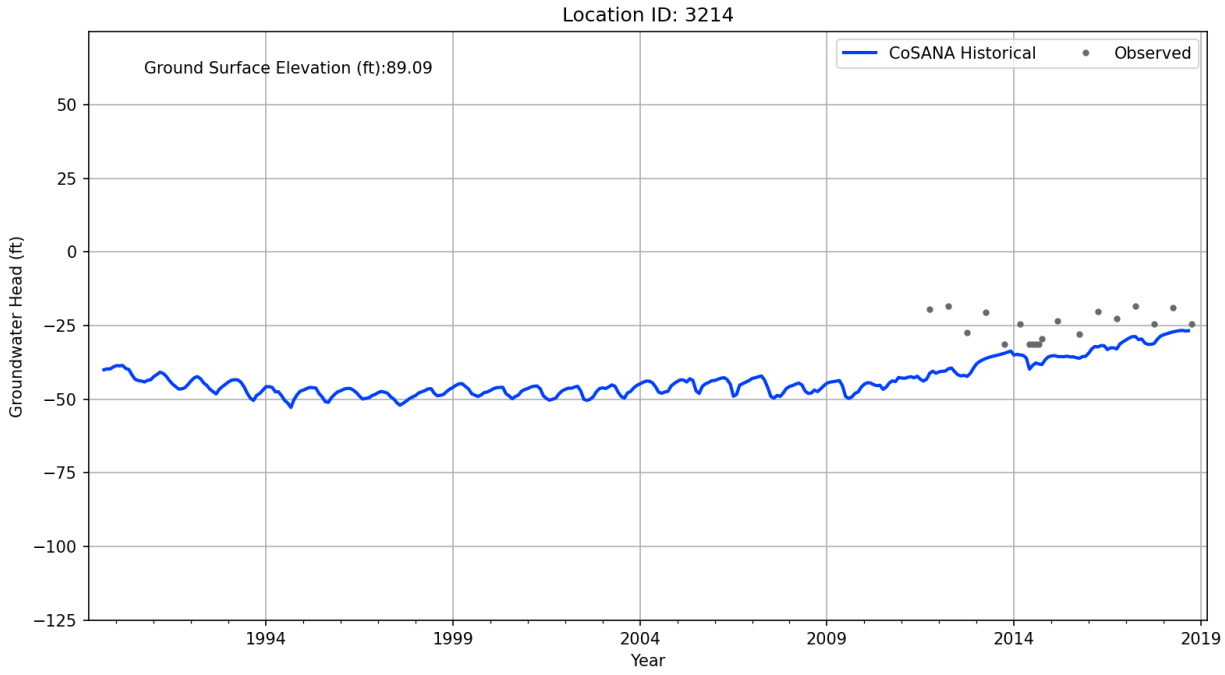

Location ID: 3208
Ground Surface Elevation (ft):147.44
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

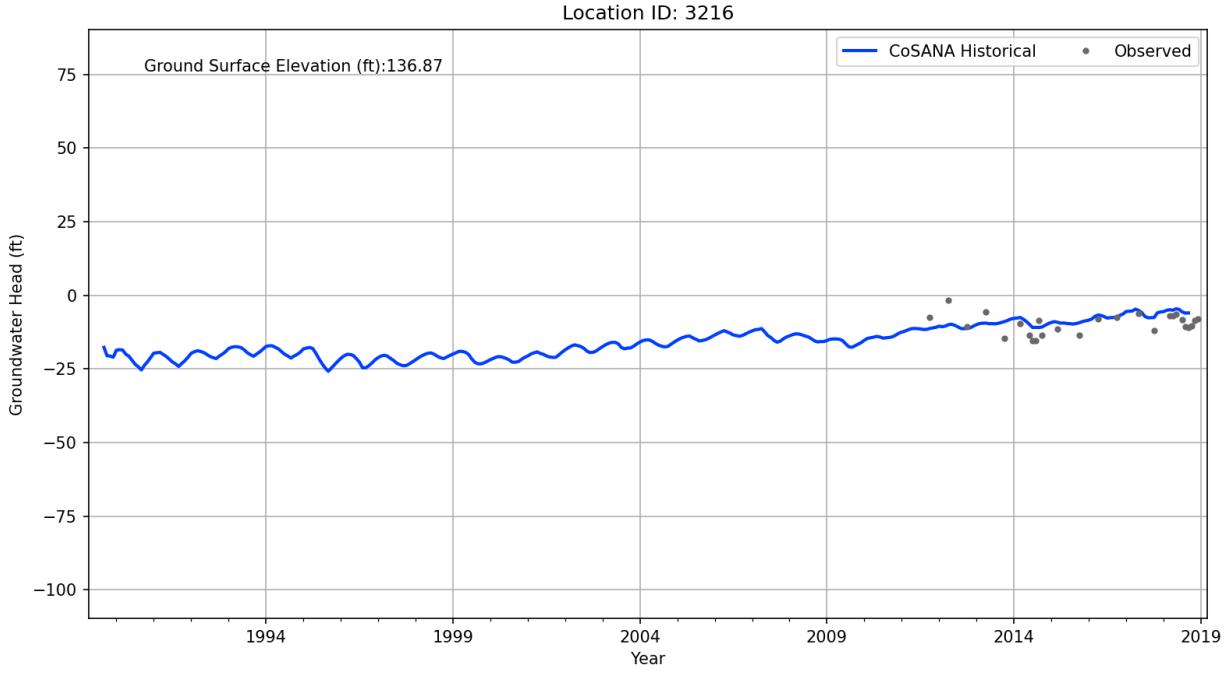

Location ID: 3209
Ground Surface Elevation (ft):155.8
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

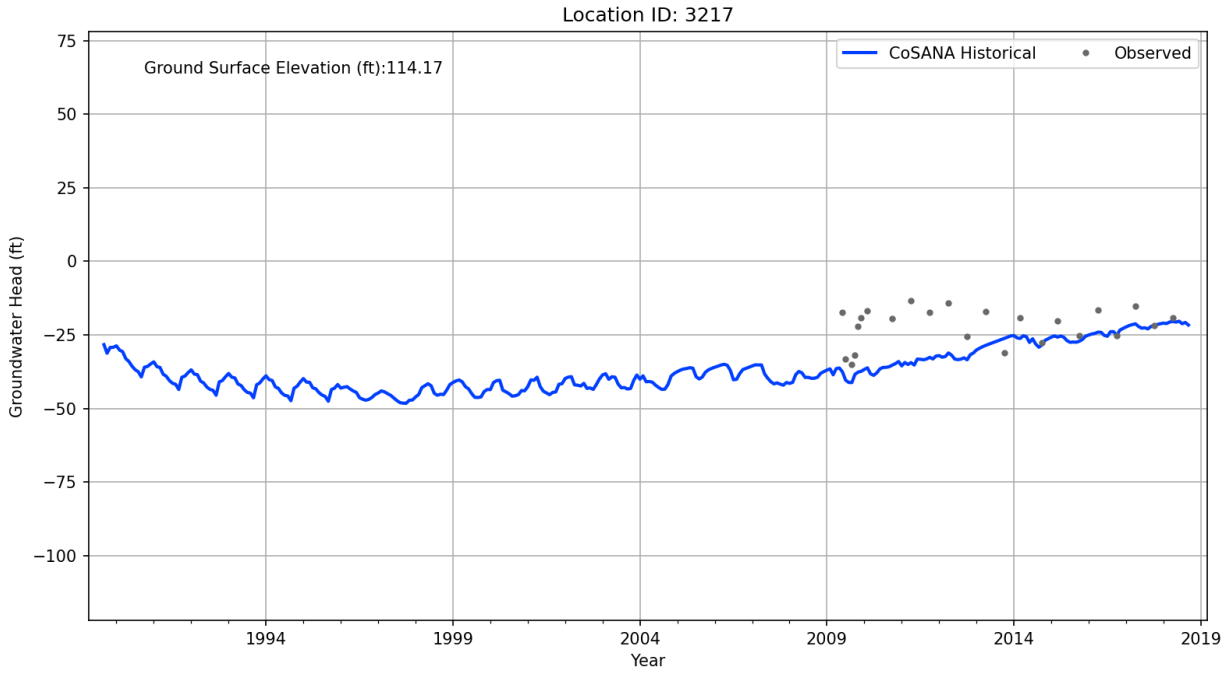

Location ID: 3210
Ground Surface Elevation (ft):155.8
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

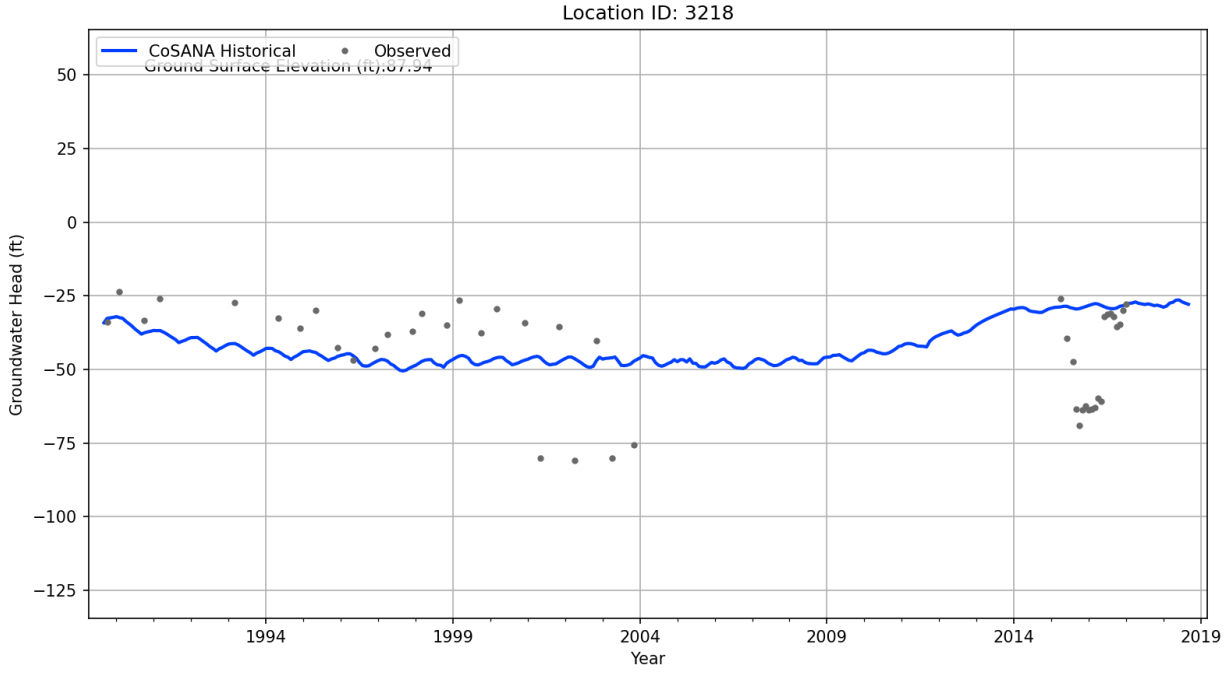

Location ID: 3211
Ground Surface Elevation (ft):155.8
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

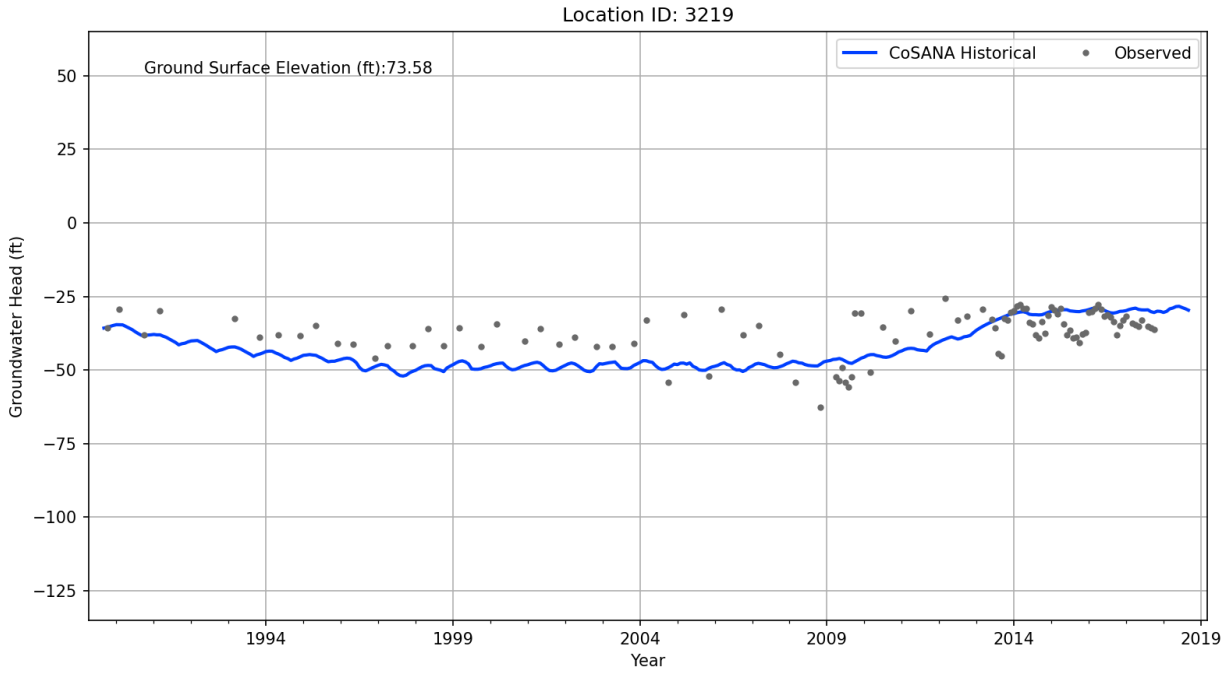

Location ID: 3212
Ground Surface Elevation (ft):155.8
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

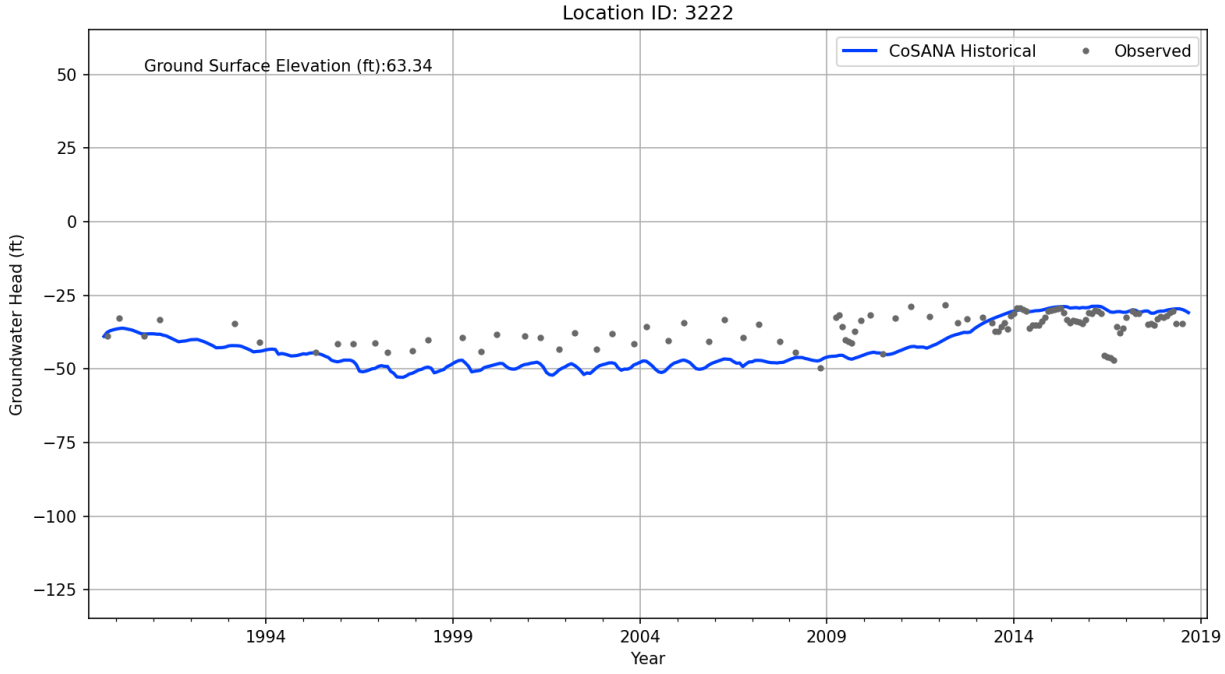

Location ID: 3214
Ground Surface Elevation (ft):89.09
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

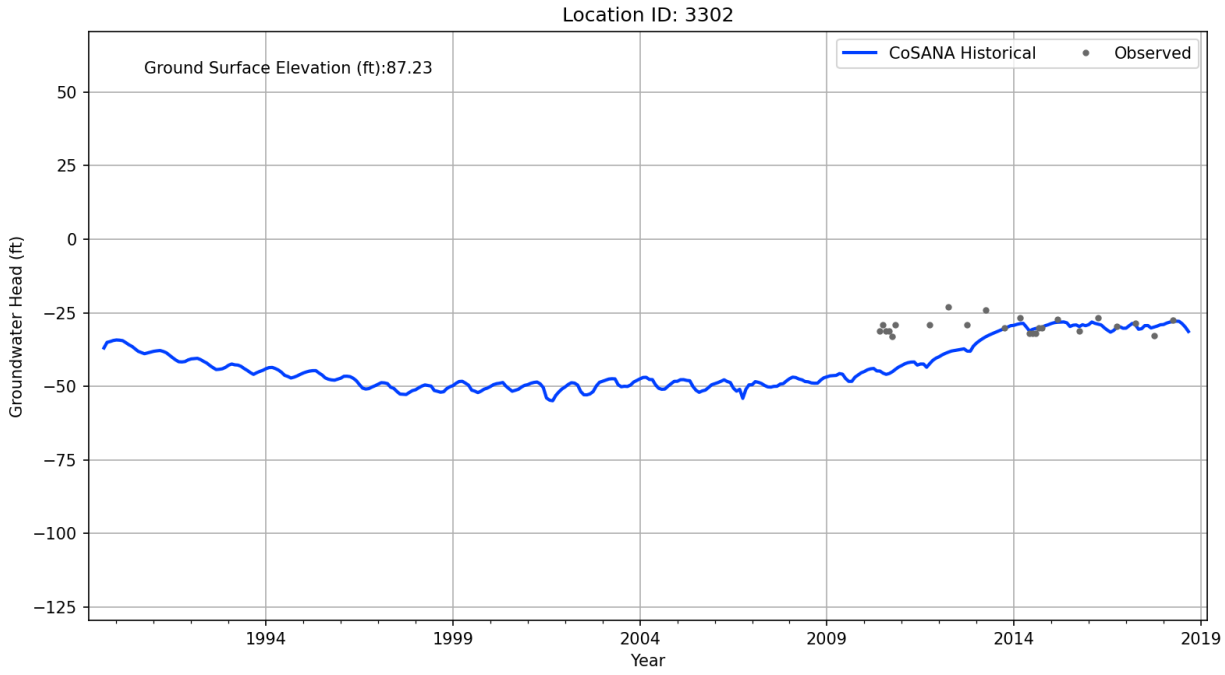

Location ID: 3216
Ground Surface Elevation (ft):136.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

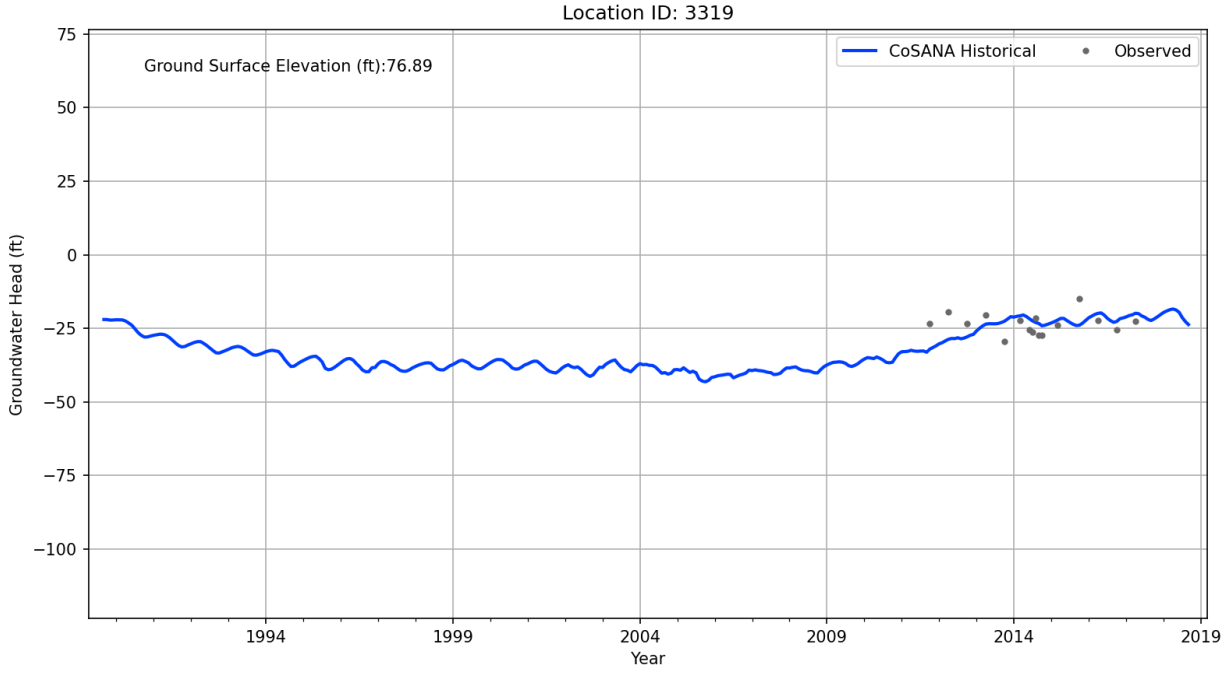

Location ID: 3217
Ground Surface Elevation (ft):114.17
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

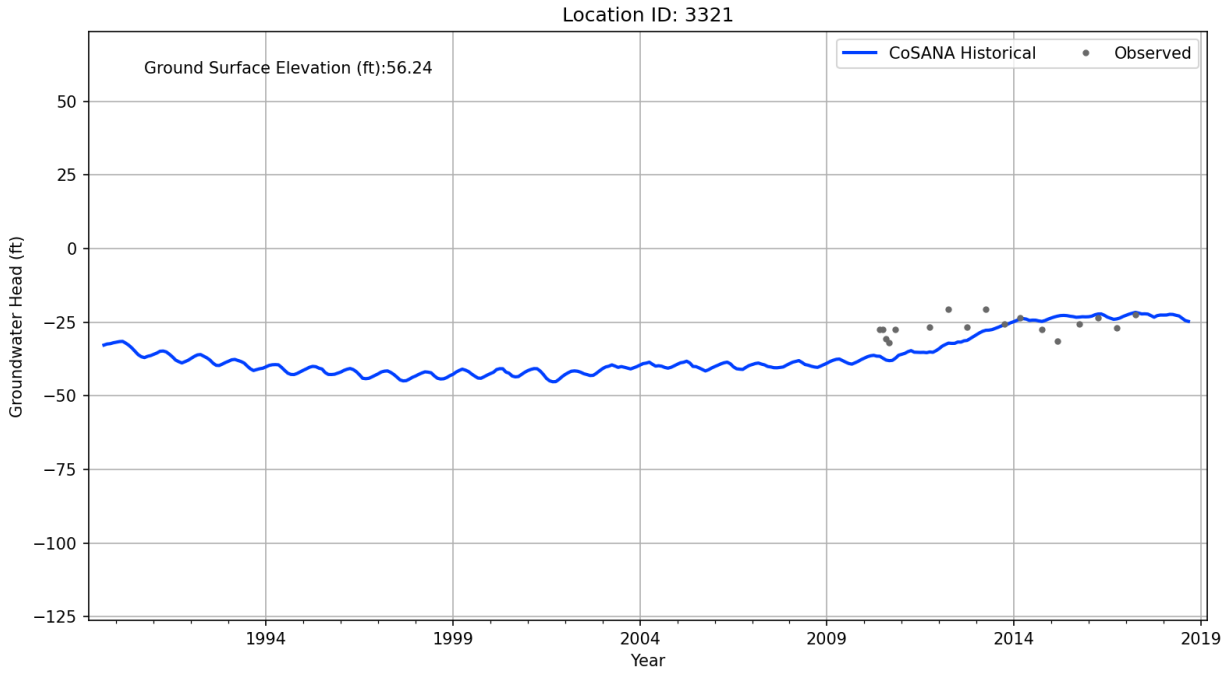

Location ID: 3218
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

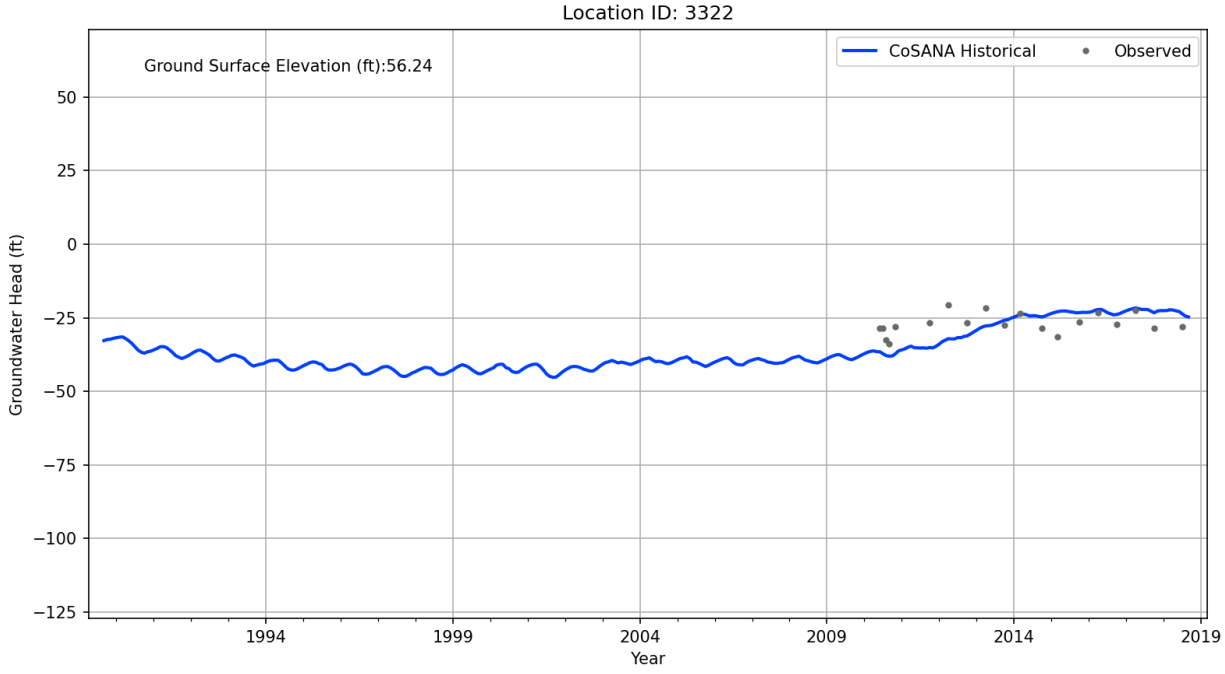

Location ID: 3219
Ground Surface Elevation (ft):73.58
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

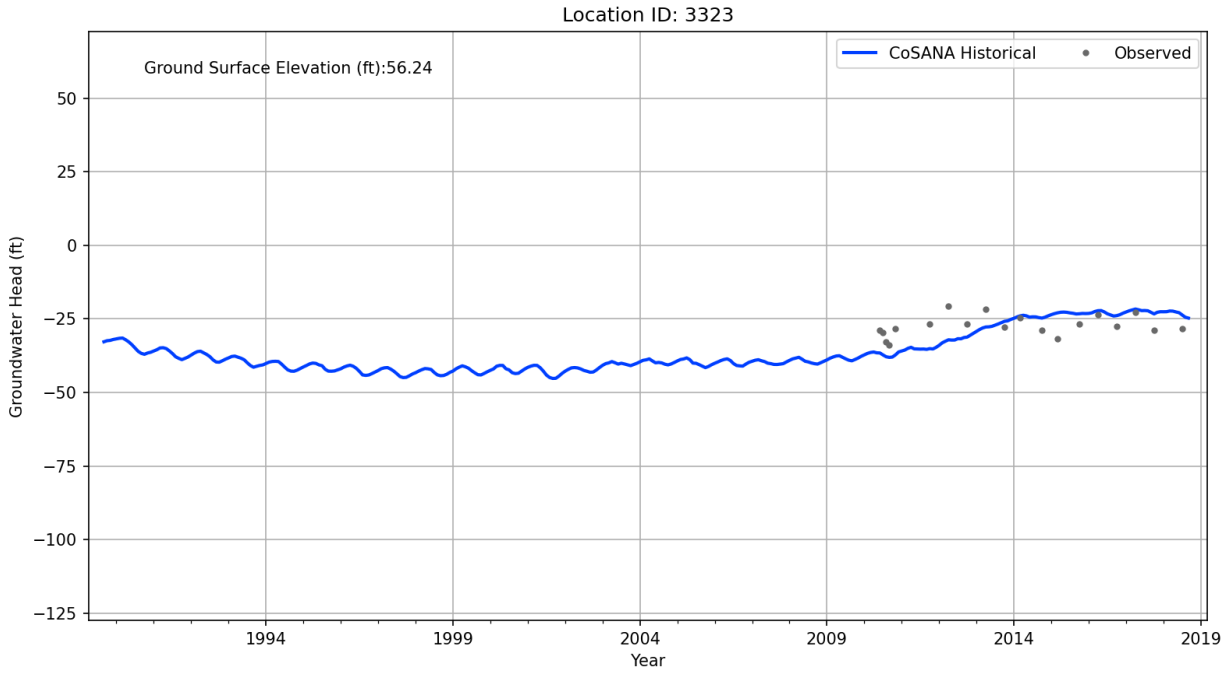

Location ID: 3222
Ground Surface Elevation (ft):63.34
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

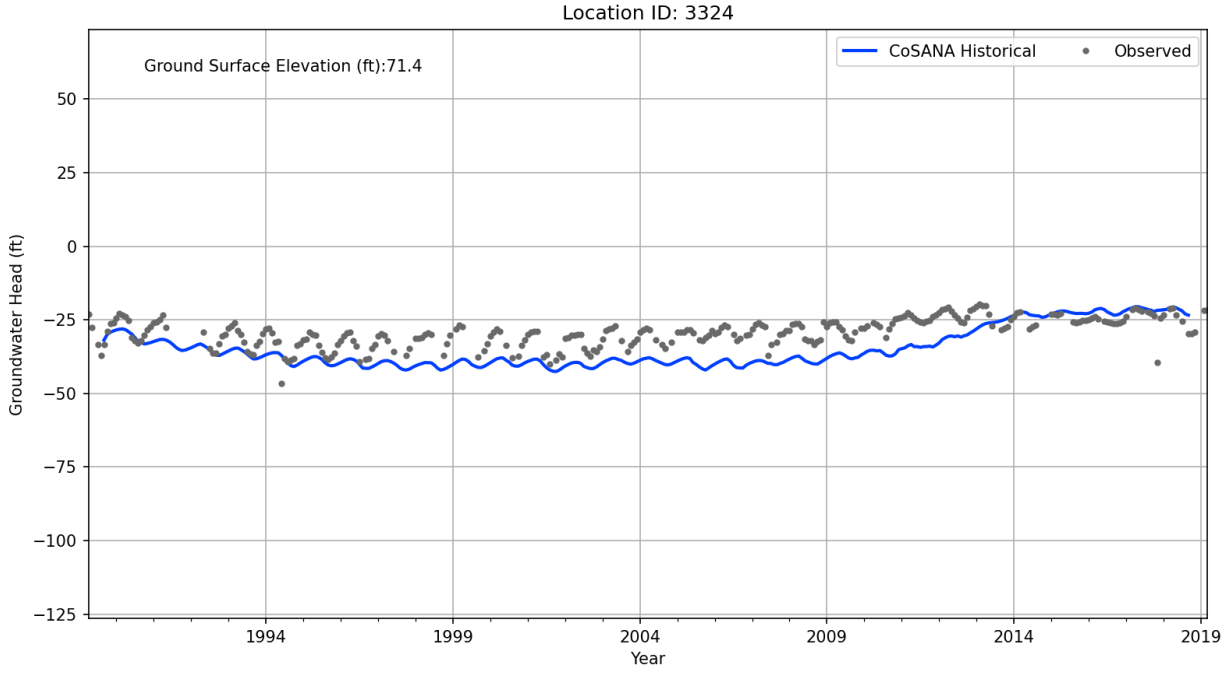

Location ID: 3302
Ground Surface Elevation (ft):87.23
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

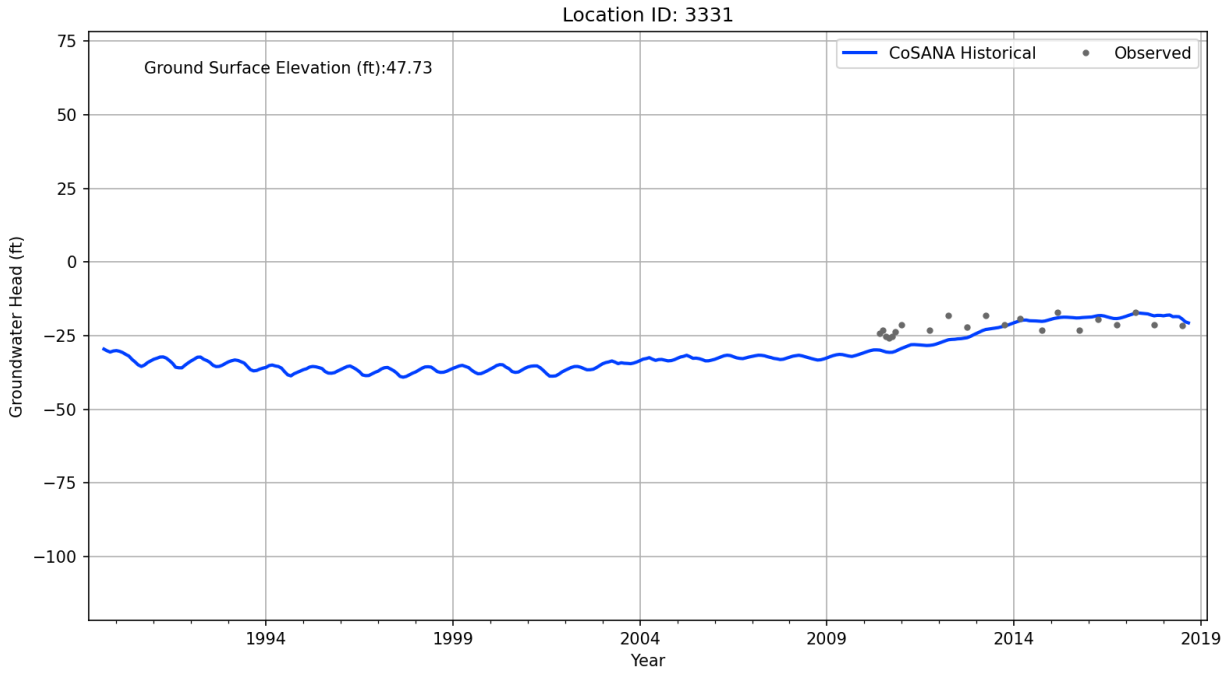

Location ID: 3319
Ground Surface Elevation (ft):76.89
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

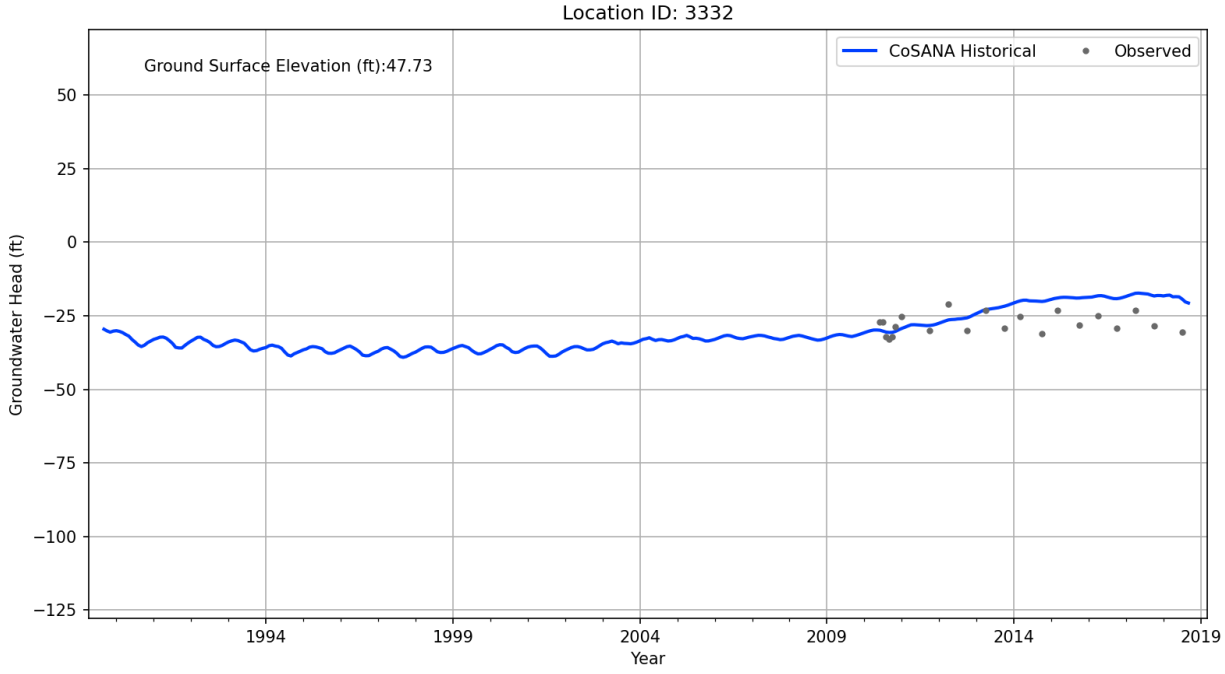

Location ID: 3321
Ground Surface Elevation (ft):56.24
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

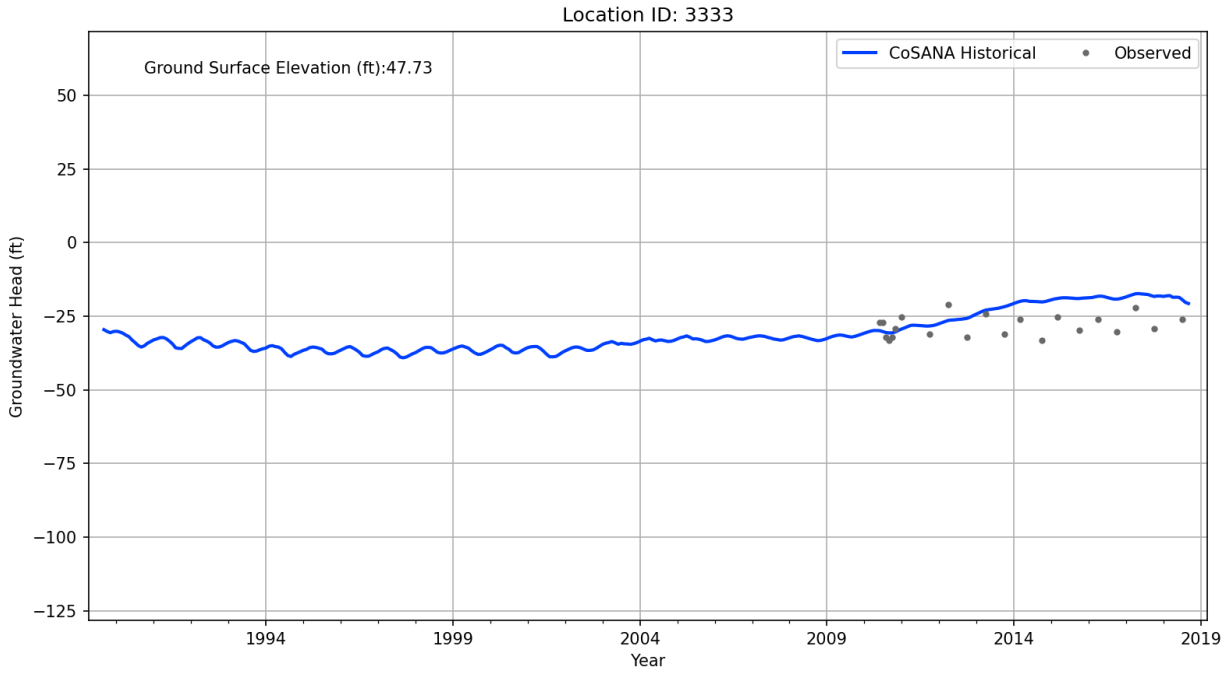

Location ID: 3322
Ground Surface Elevation (ft):56.24
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

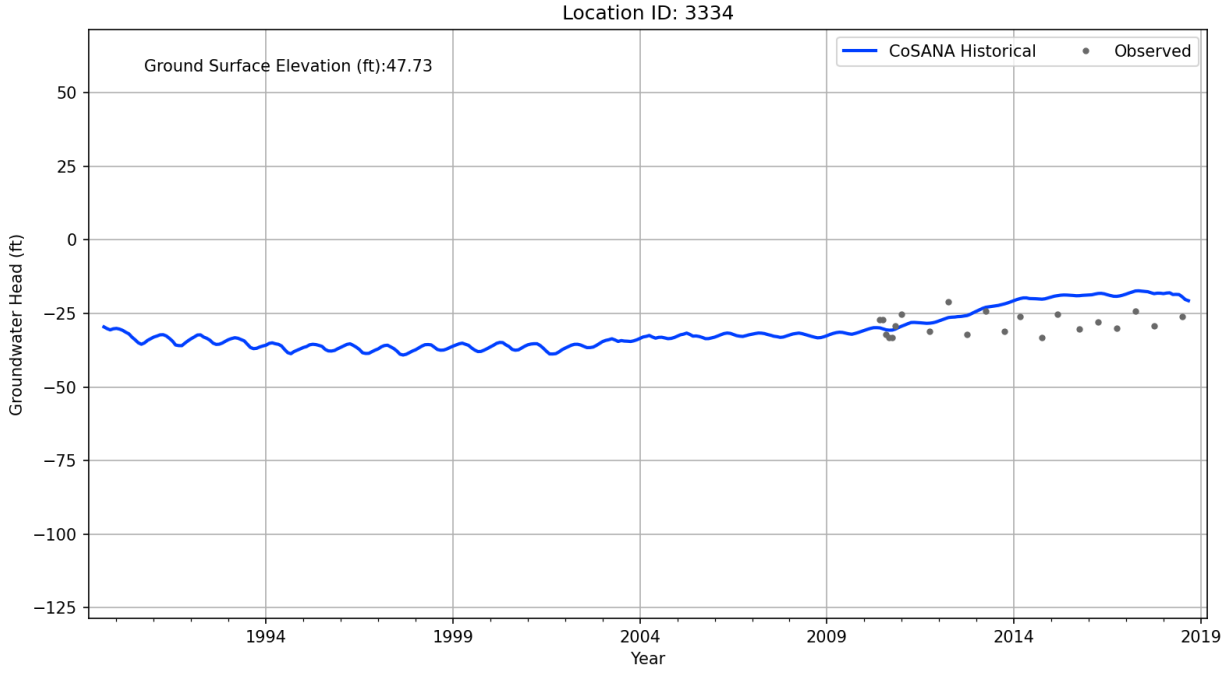

Location ID: 3323
Ground Surface Elevation (ft):56.24
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

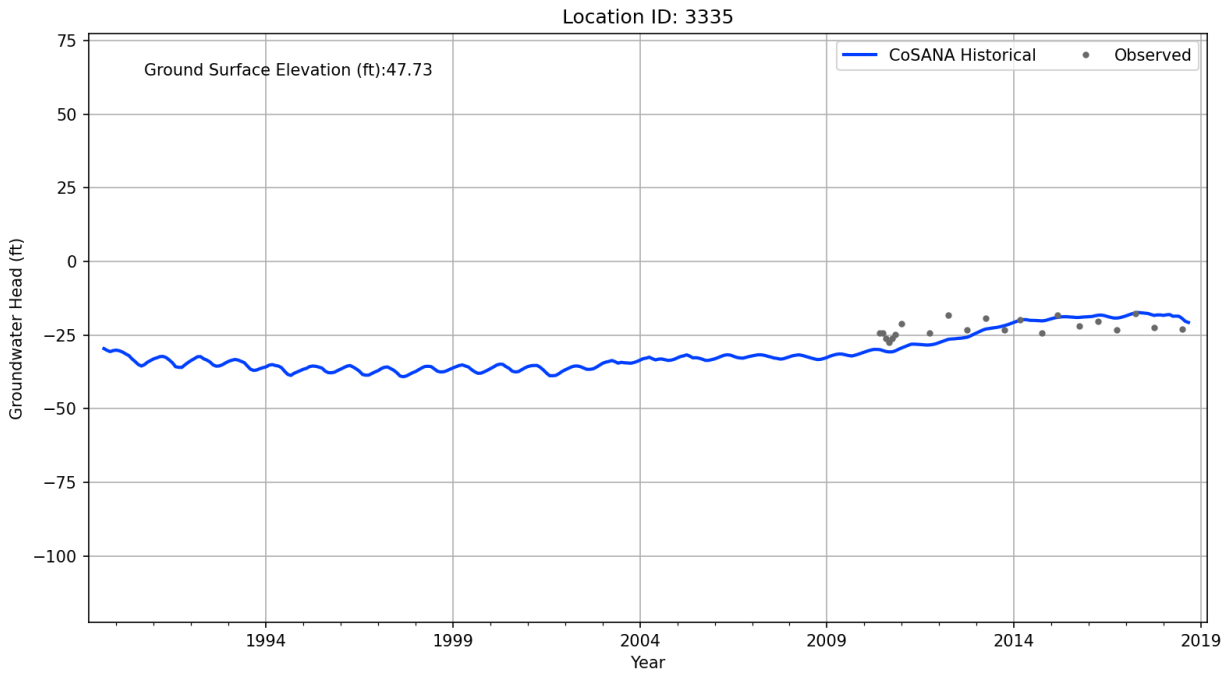

Location ID: 3324
Ground Surface Elevation (ft):71.4
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

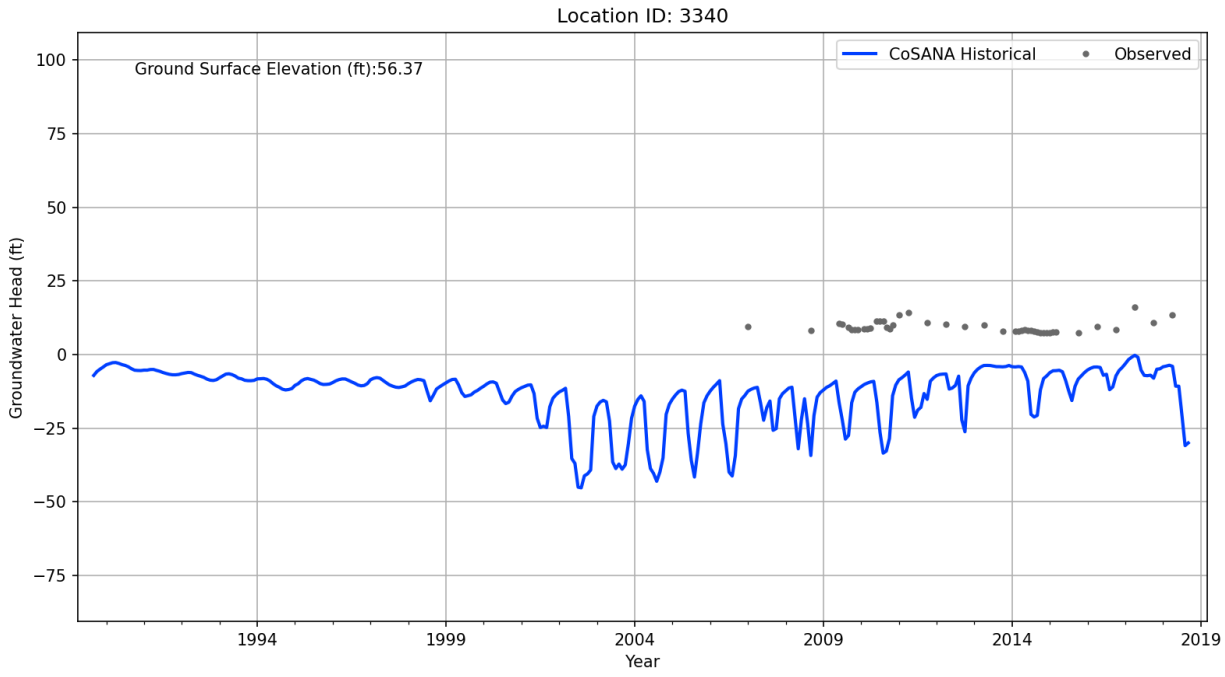

Location ID: 3331
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

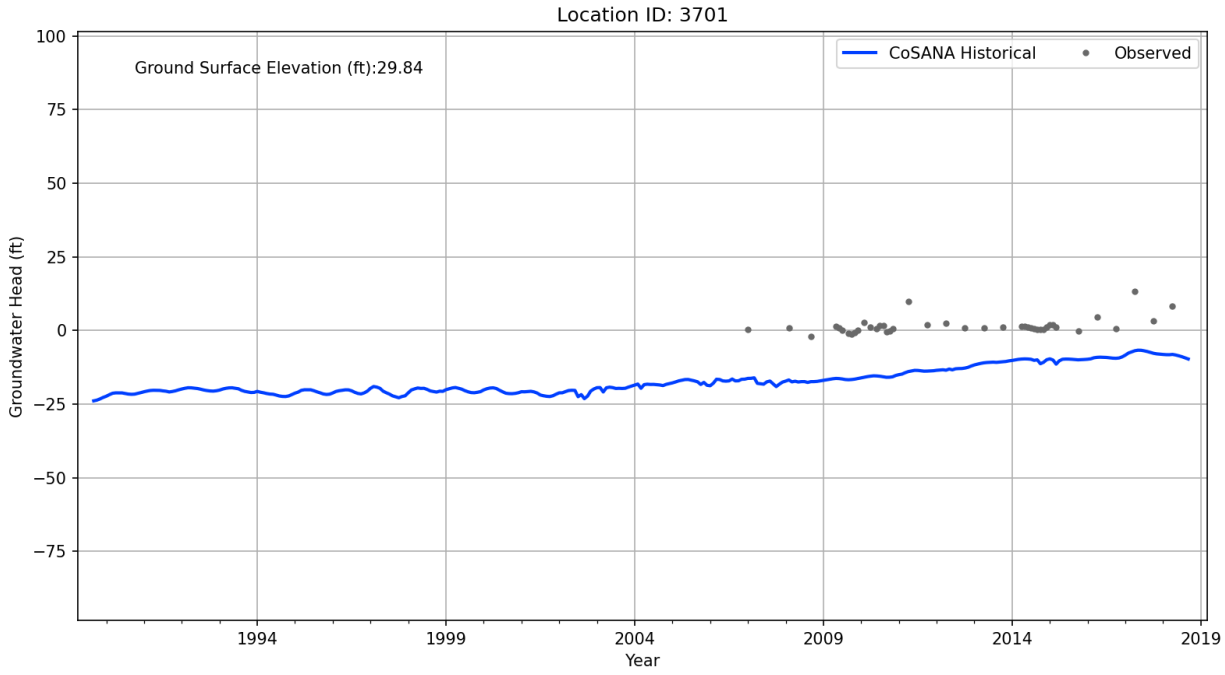

Location ID: 3332
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

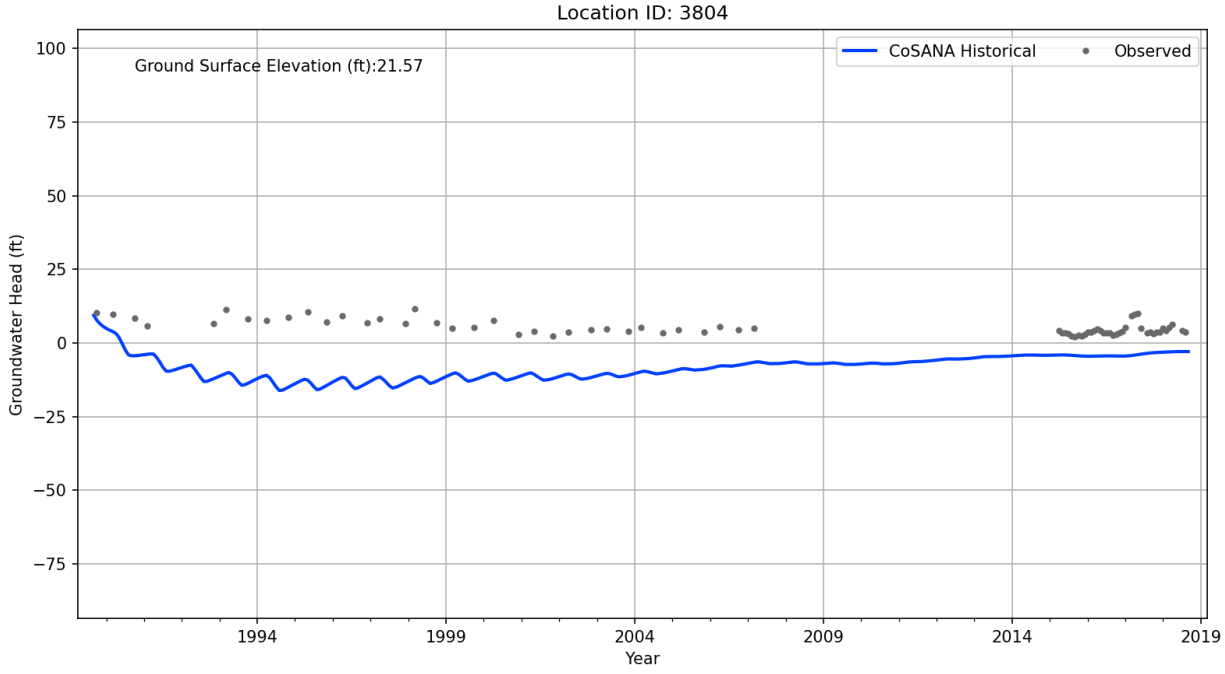

Location ID: 3333
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

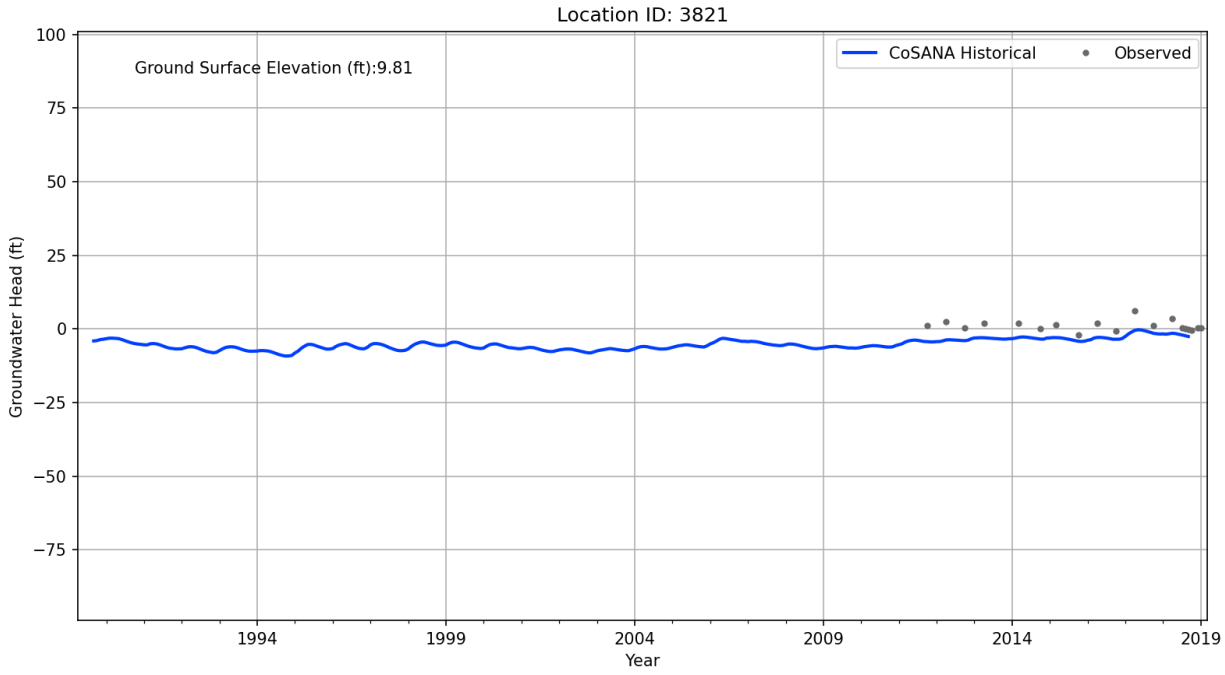

Location ID: 3334
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

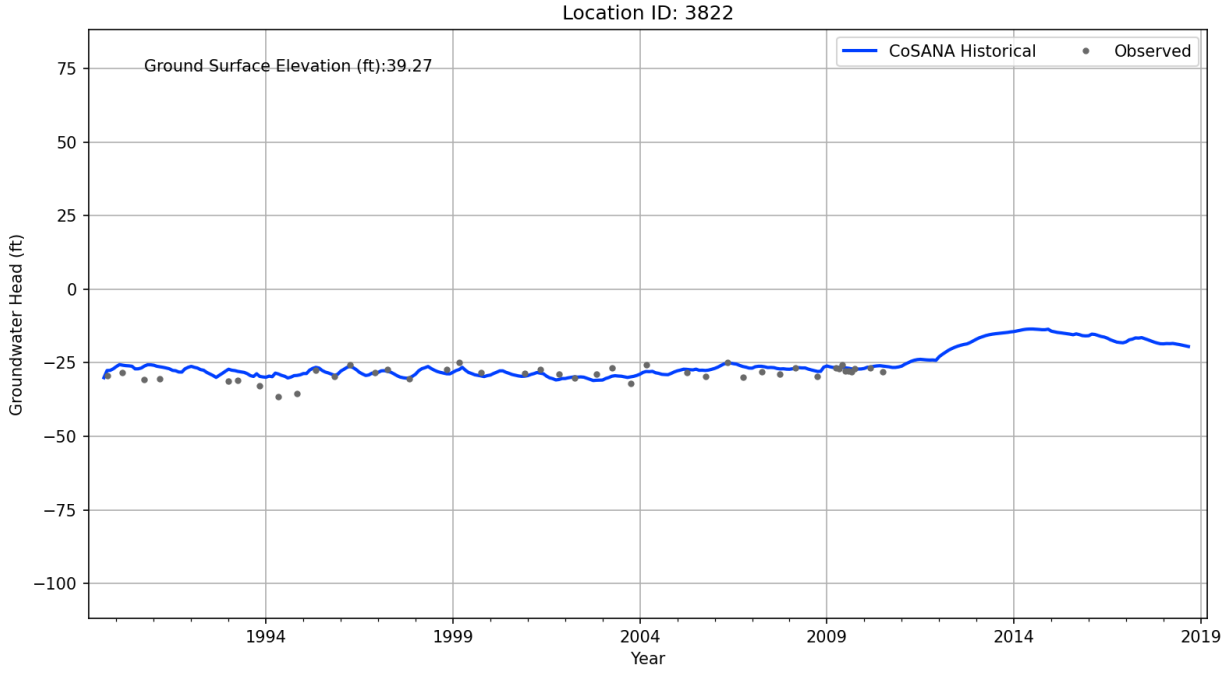

Location ID: 3335
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

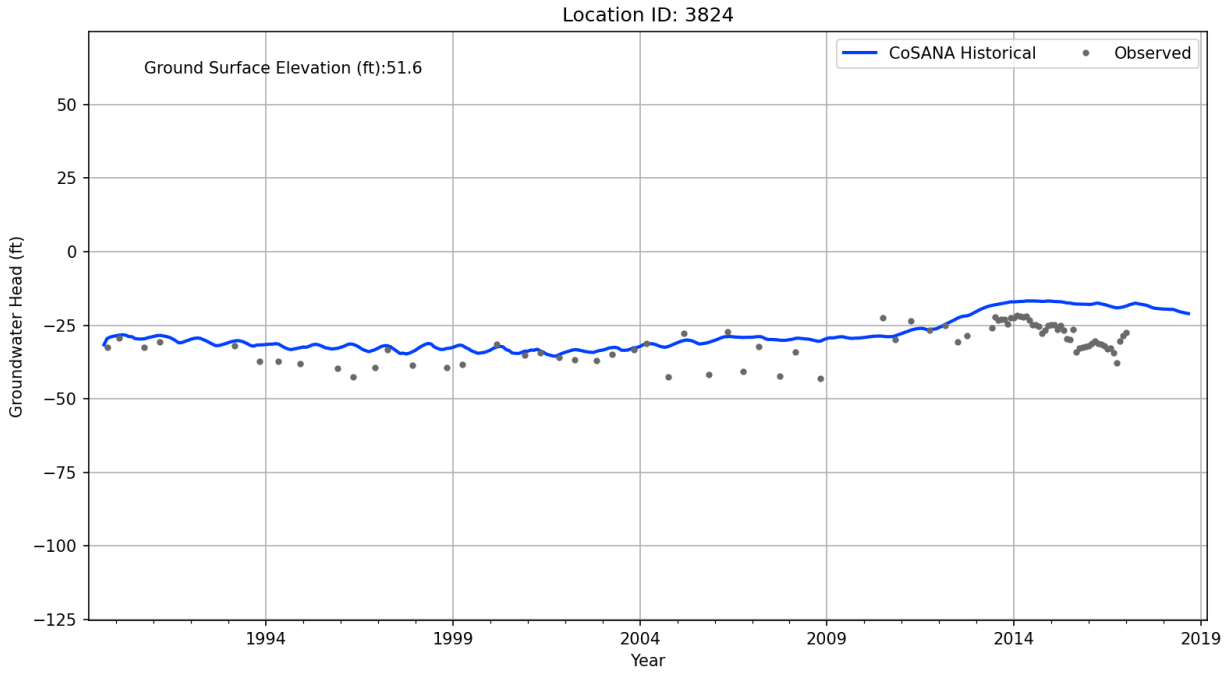

Location ID: 3340
Ground Surface Elevation (ft):56.37
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

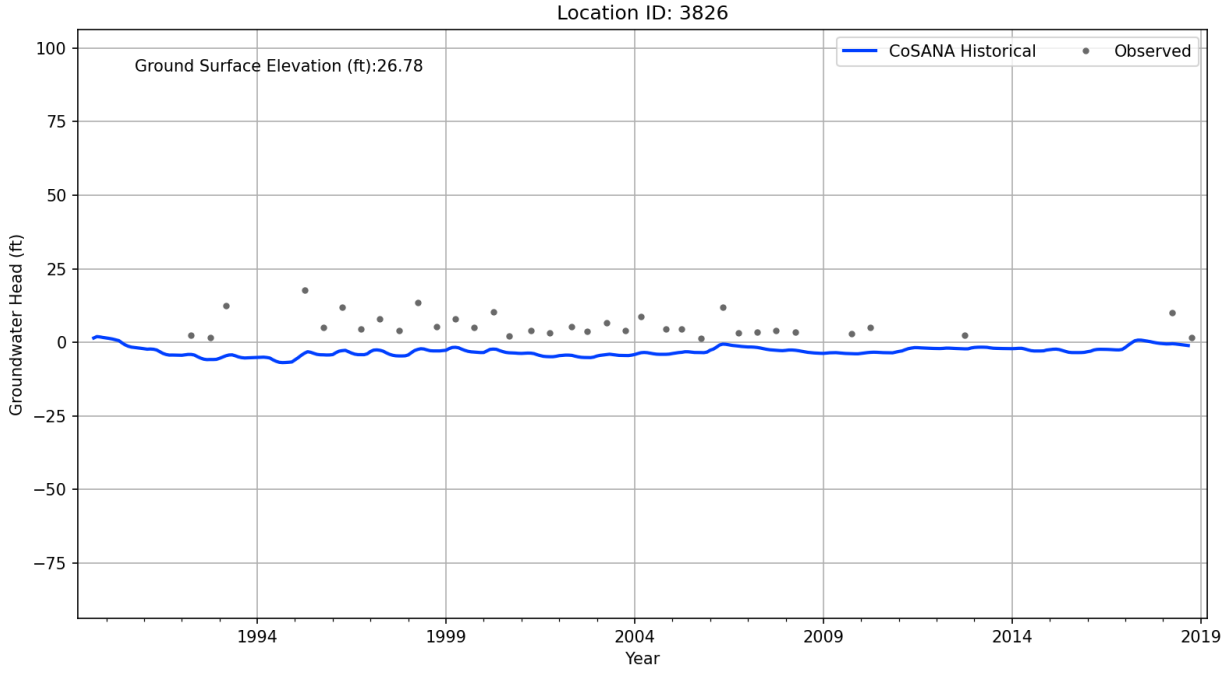

Location ID: 3701
Ground Surface Elevation (ft):29.84
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

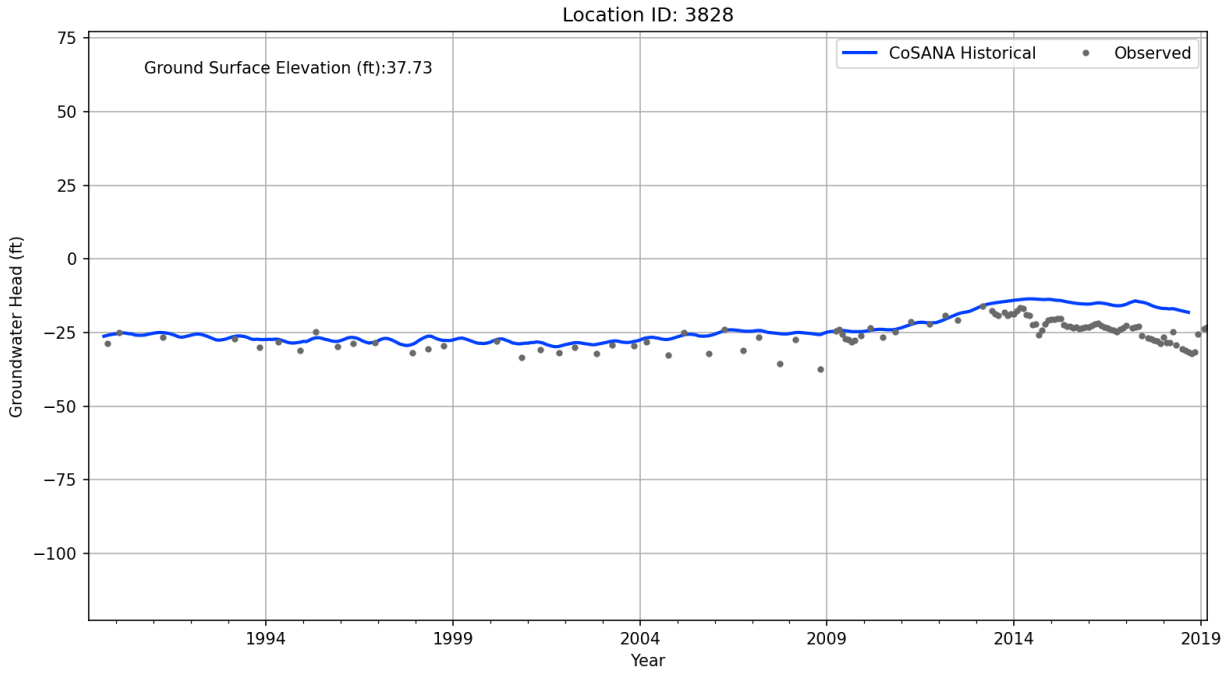

Location ID: 3804
Ground Surface Elevation (ft):21.57
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

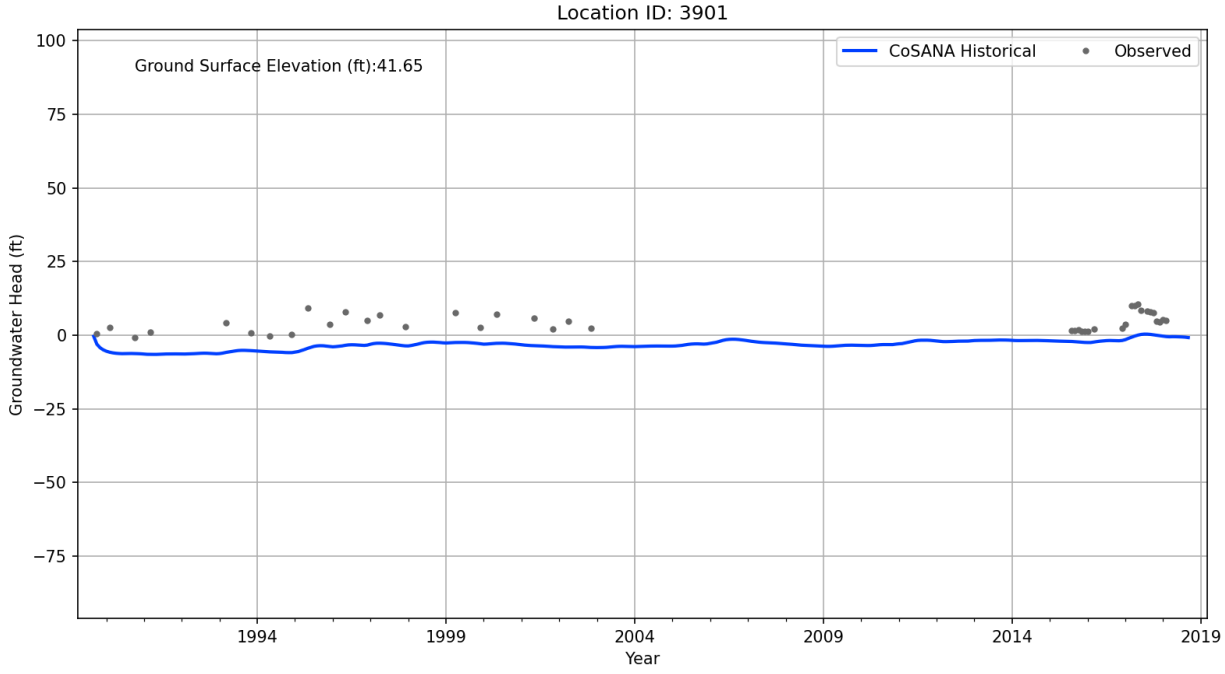

Location ID: 3821
Ground Surface Elevation (ft):9.81
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

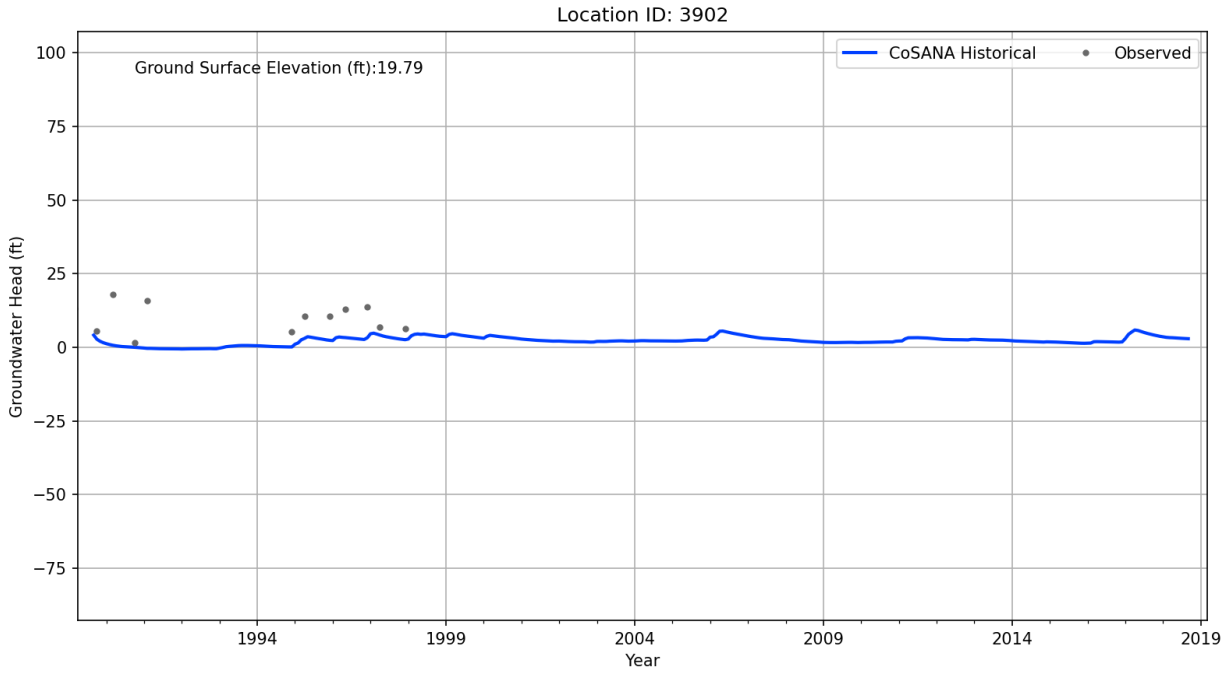

Location ID: 3822
Ground Surface Elevation (ft):39.27
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

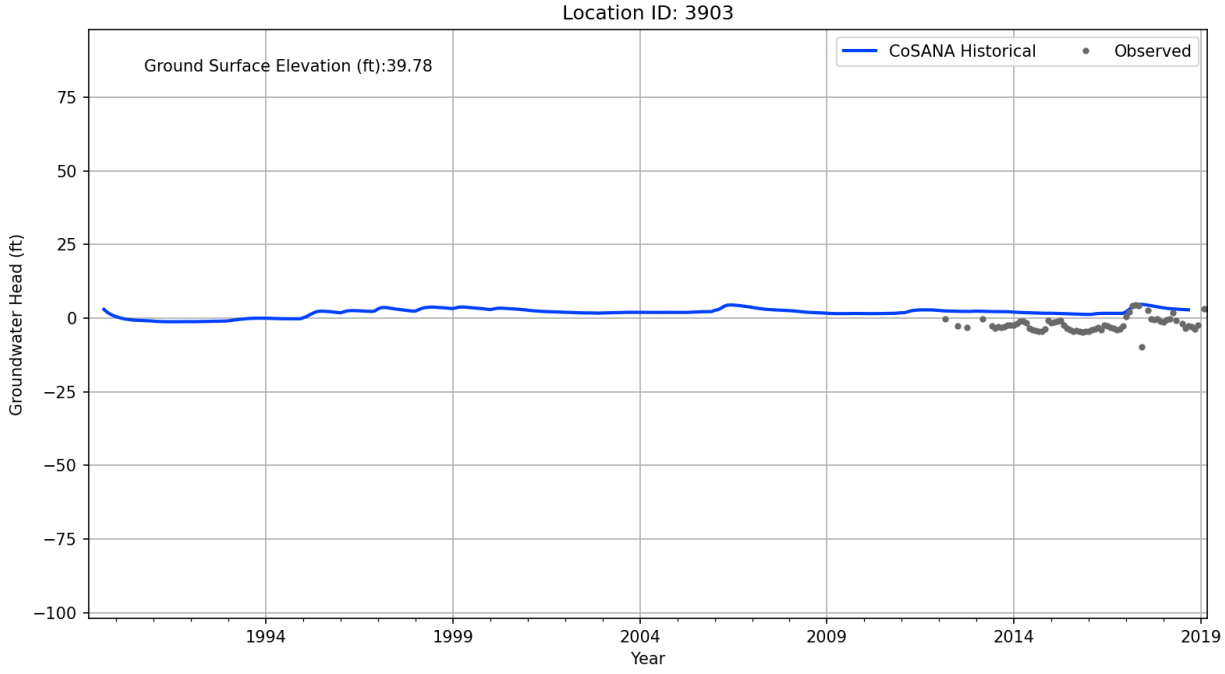

Location ID: 3824
Ground Surface Elevation (ft):51.6
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

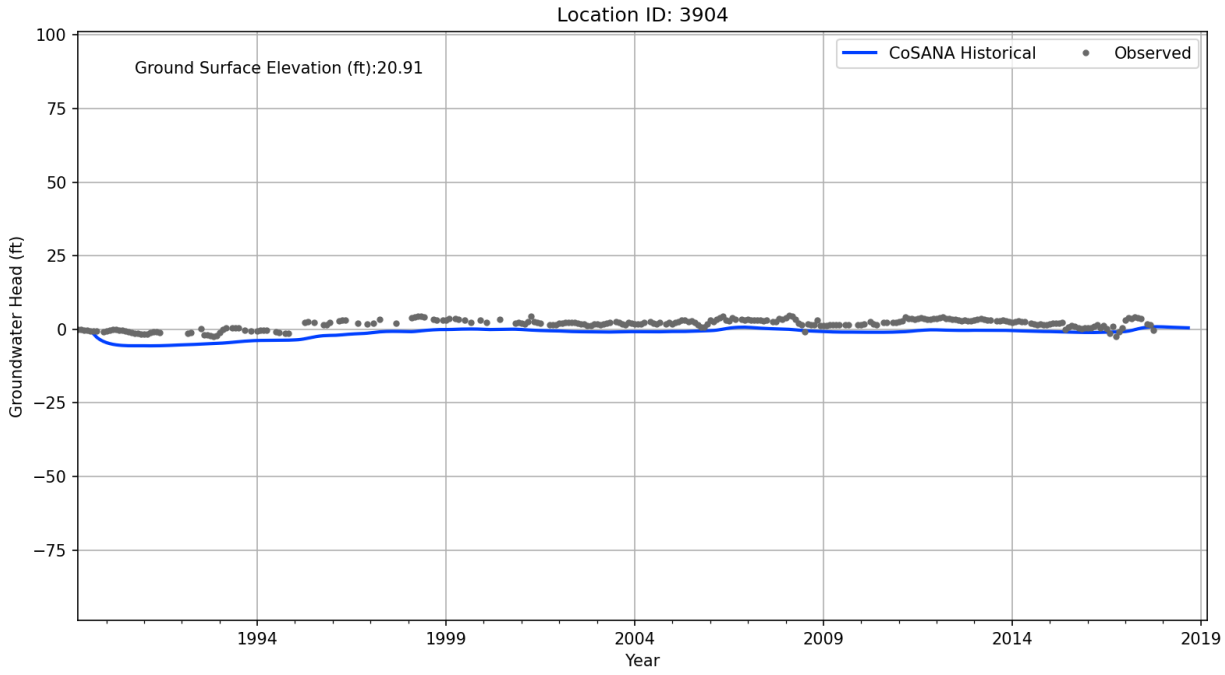

Location ID: 3826
Ground Surface Elevation (ft):26.78
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

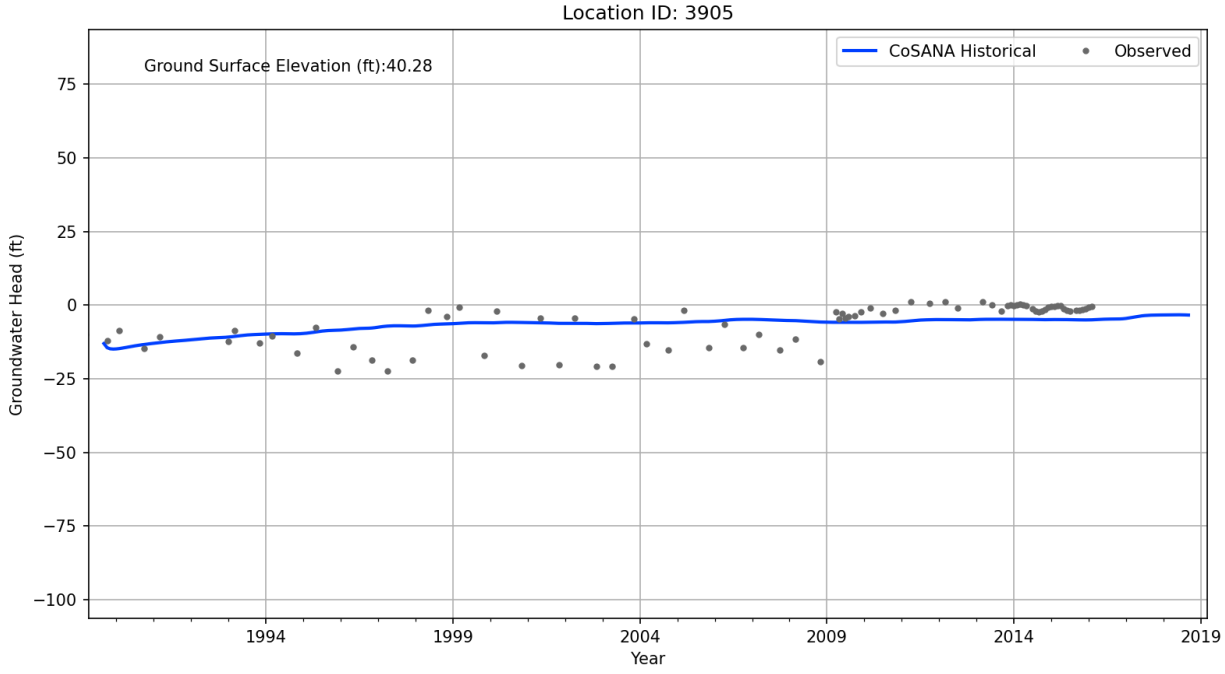

Location ID: 3828
Ground Surface Elevation (ft):37.73
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

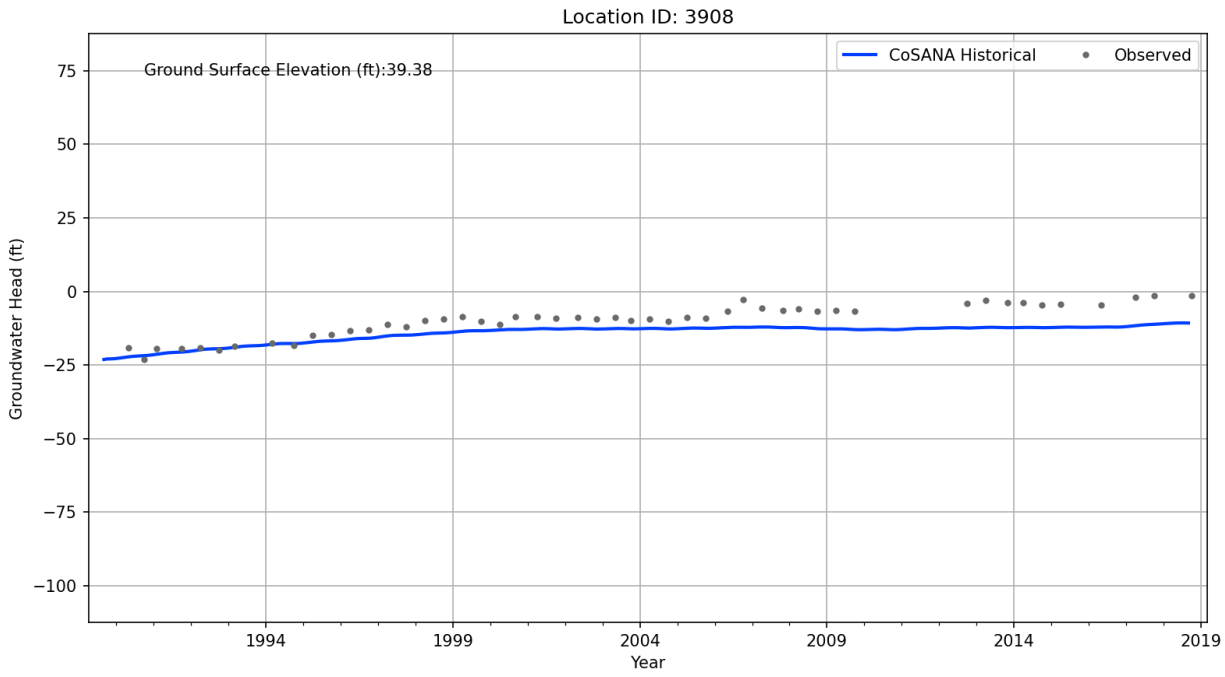

Location ID: 3901
Ground Surface Elevation (ft):41.65
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

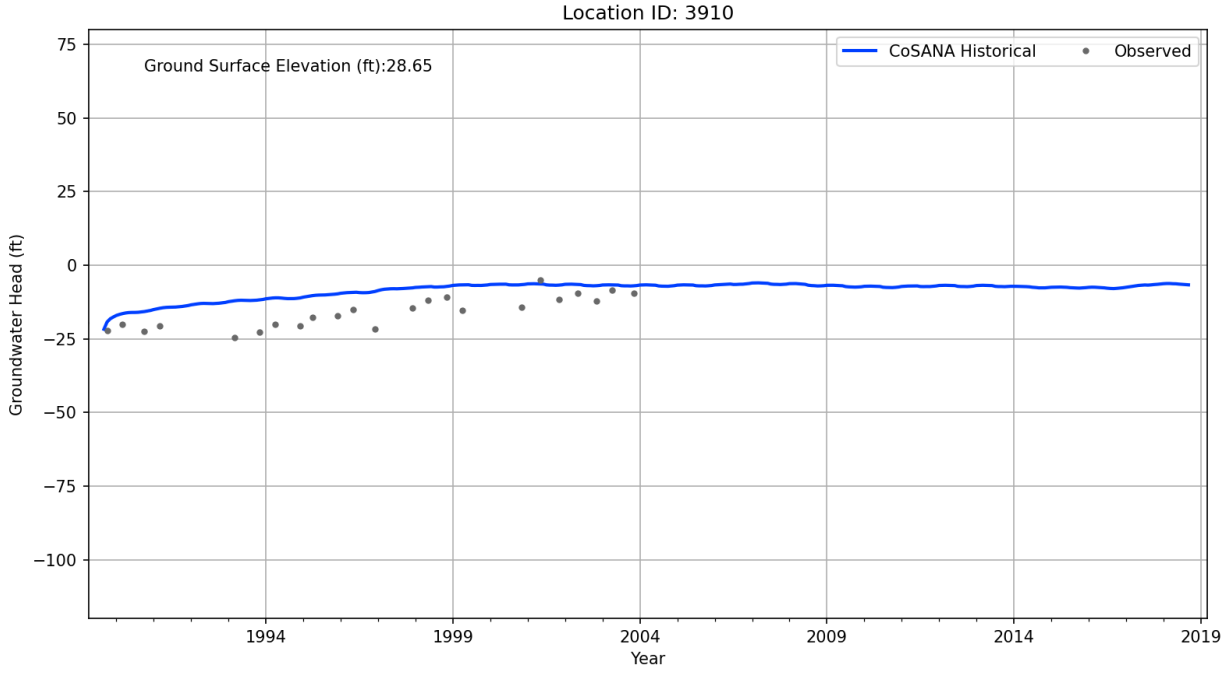

Location ID: 3902
Ground Surface Elevation (ft):19.79
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

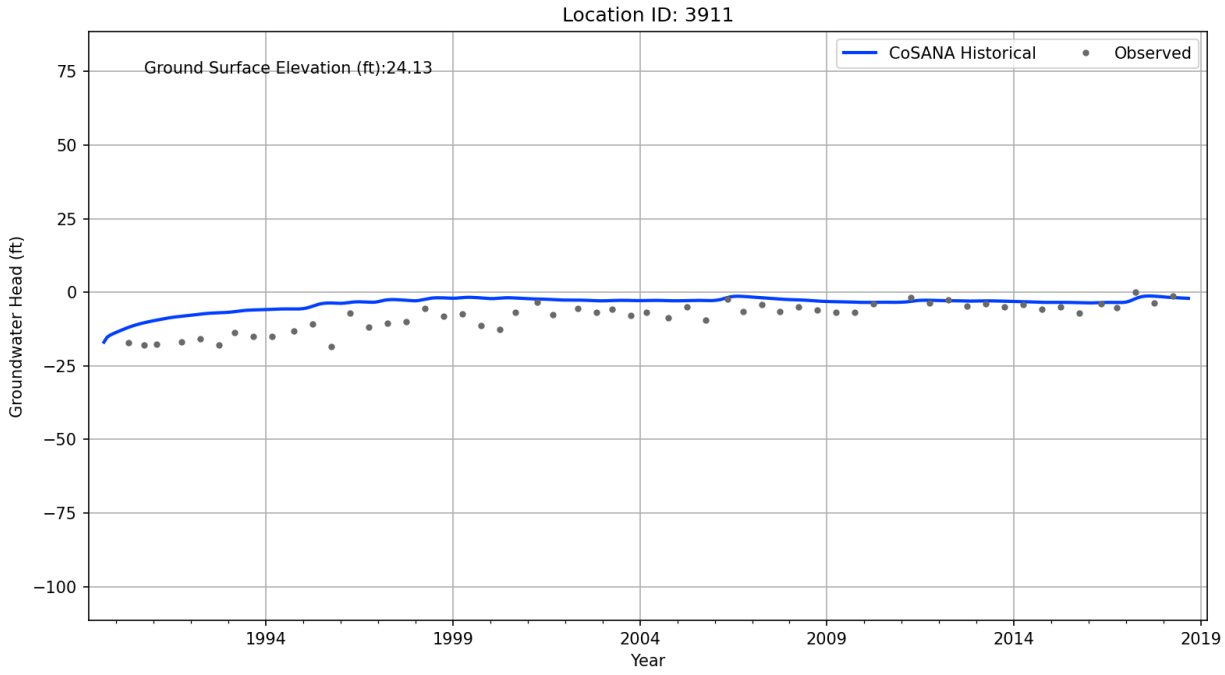

Location ID: 3903
Ground Surface Elevation (ft):39.78
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

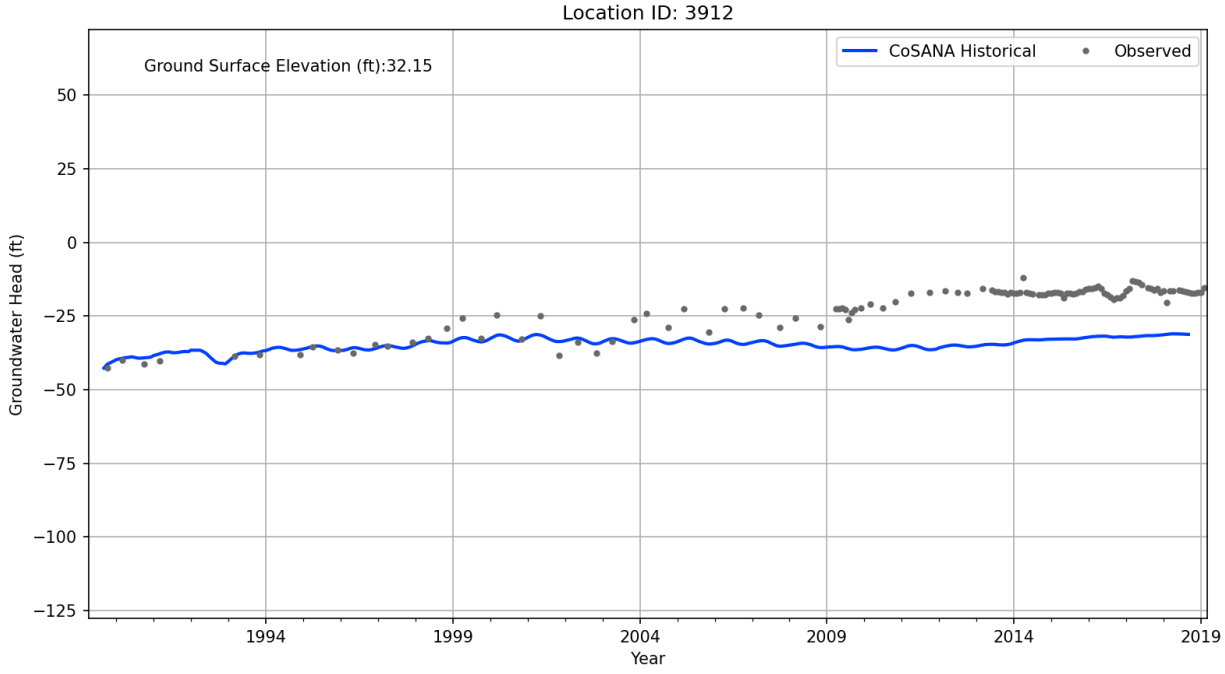

Location ID: 3904
Ground Surface Elevation (ft):20.91
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

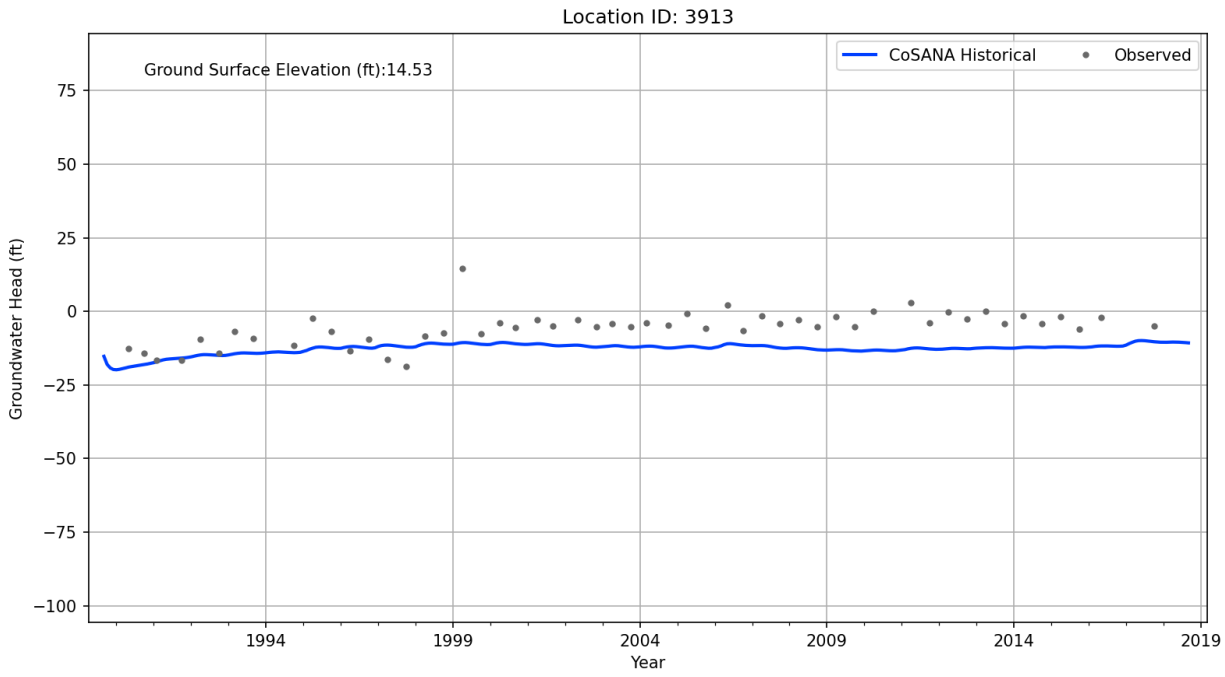

Location ID: 3905
Ground Surface Elevation (ft):40.28
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

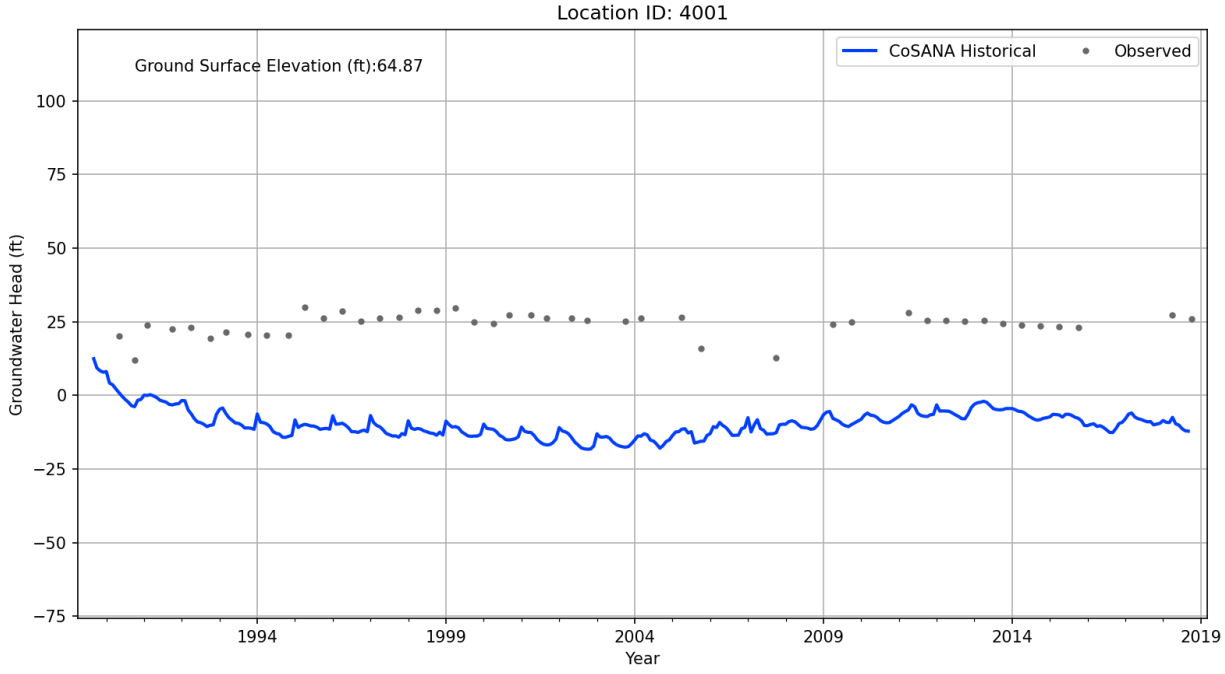

Location ID: 3908
Ground Surface Elevation (ft):39.38
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

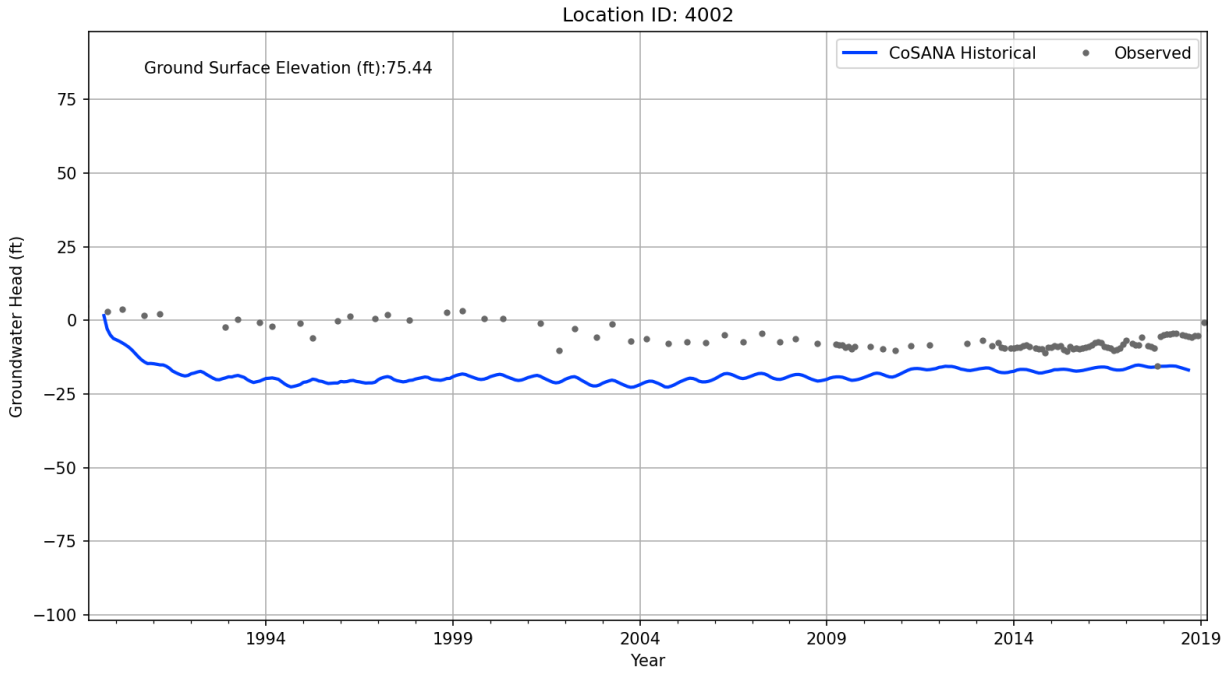

Location ID: 3910
Ground Surface Elevation (ft):28.65
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

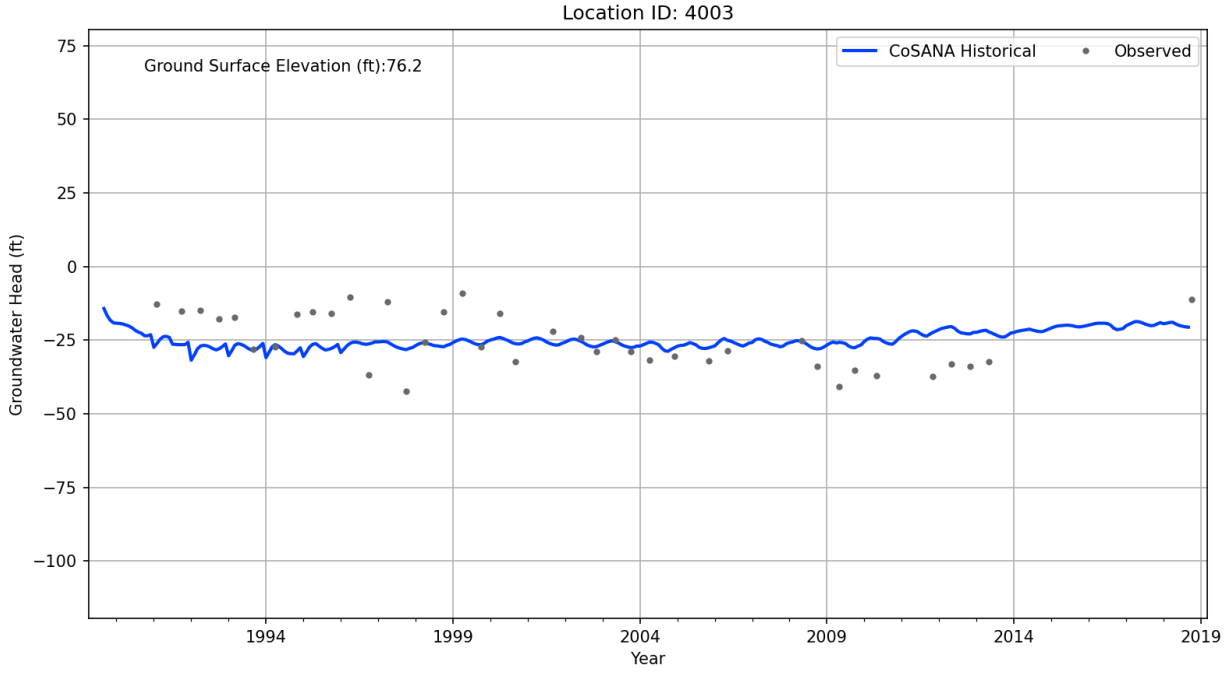

Location ID: 3911
Ground Surface Elevation (ft):24.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

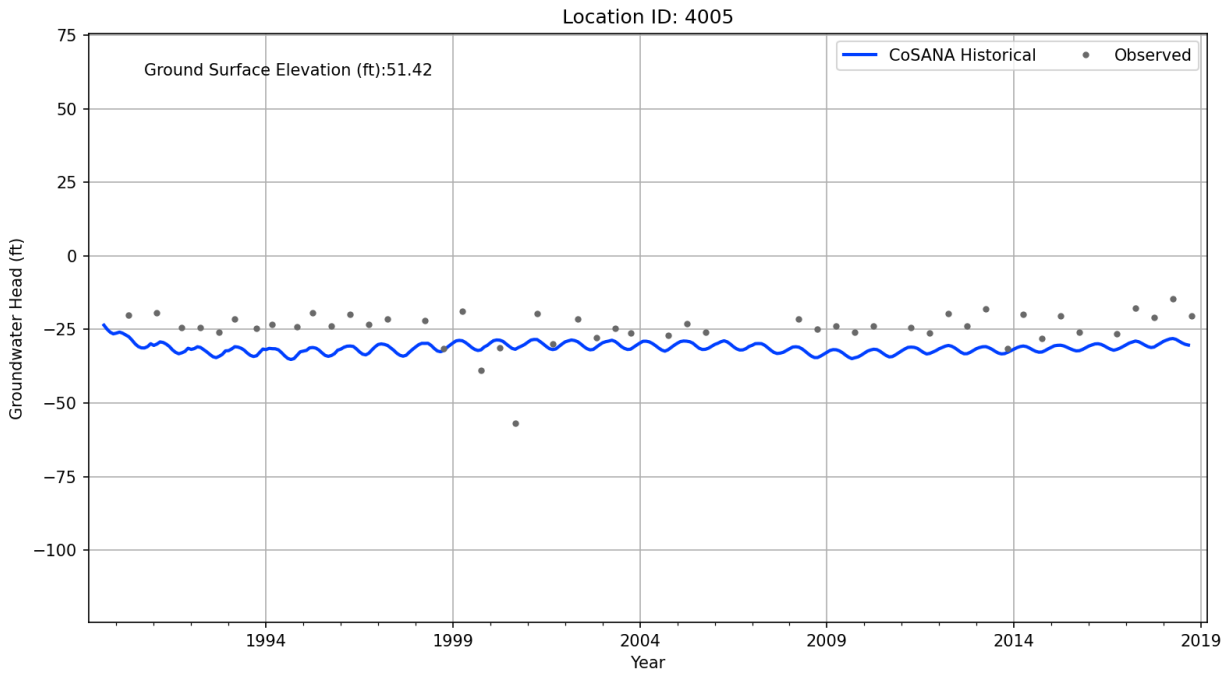

Location ID: 3912
Ground Surface Elevation (ft):32.15
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

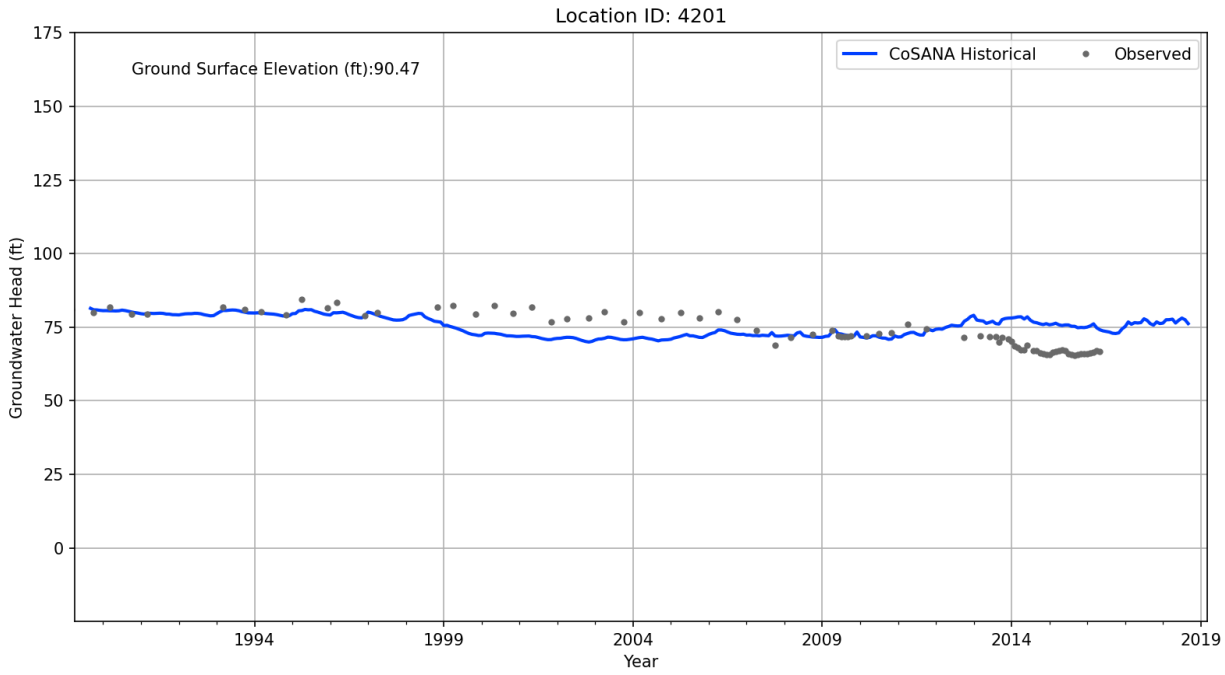

Location ID: 3913
Ground Surface Elevation (ft):14.53
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

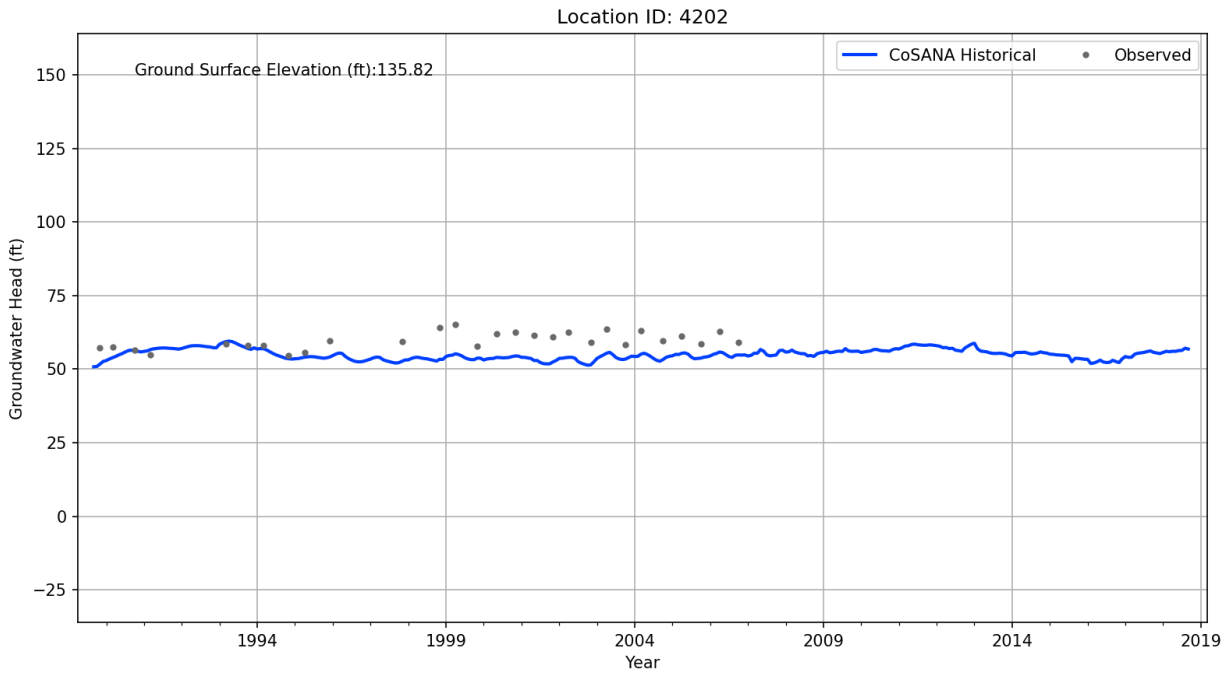

Location ID: 4001
Ground Surface Elevation (ft):64.87
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

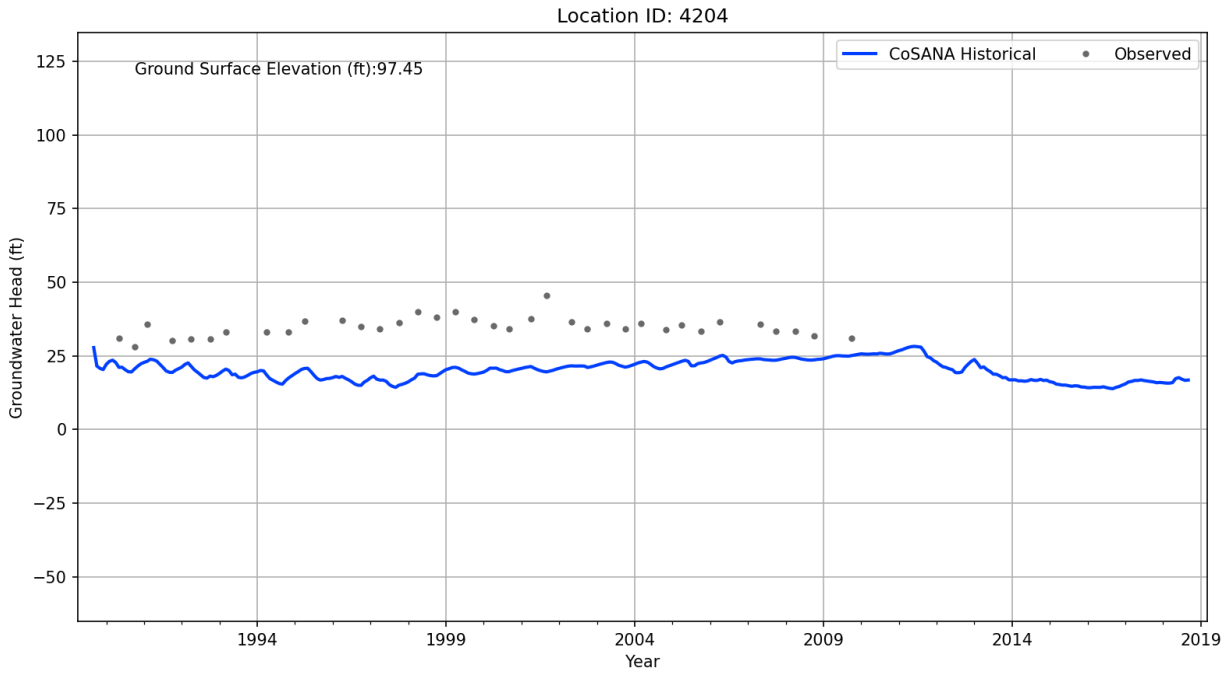

Location ID: 4002
Ground Surface Elevation (ft):75.44
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

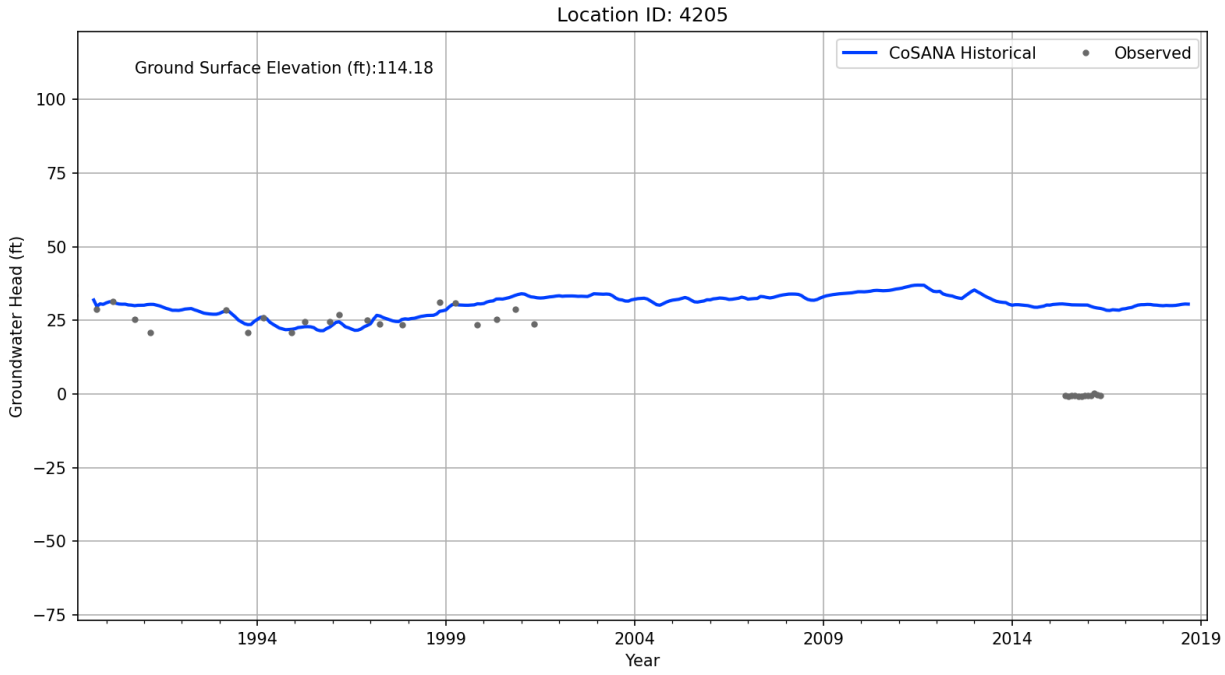

Location ID: 4003
Ground Surface Elevation (ft):76.2
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

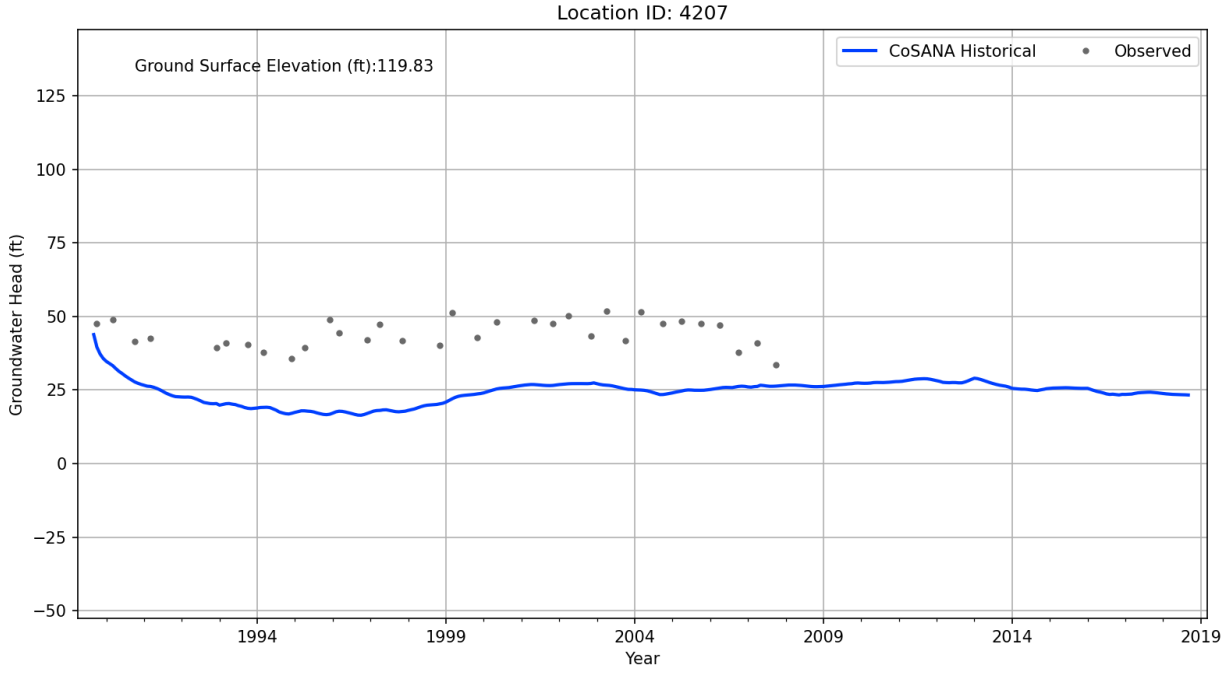

Location ID: 4005
Ground Surface Elevation (ft):51.42
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

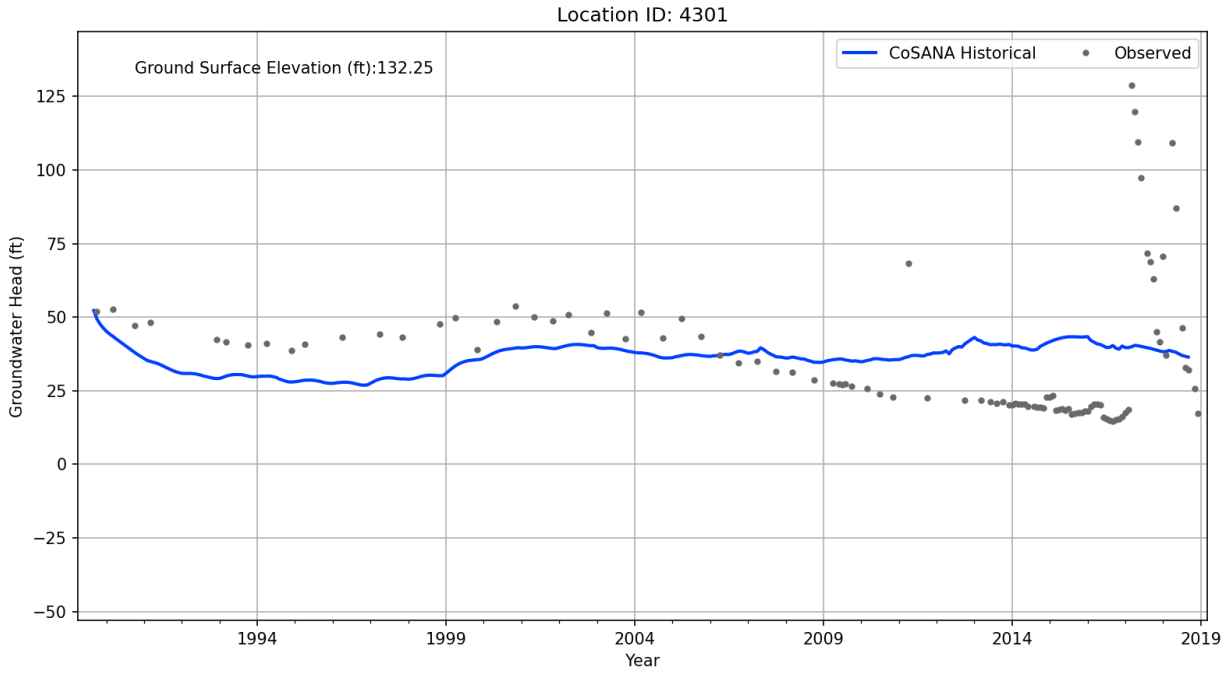

Location ID: 4201
Ground Surface Elevation (ft):90.47
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

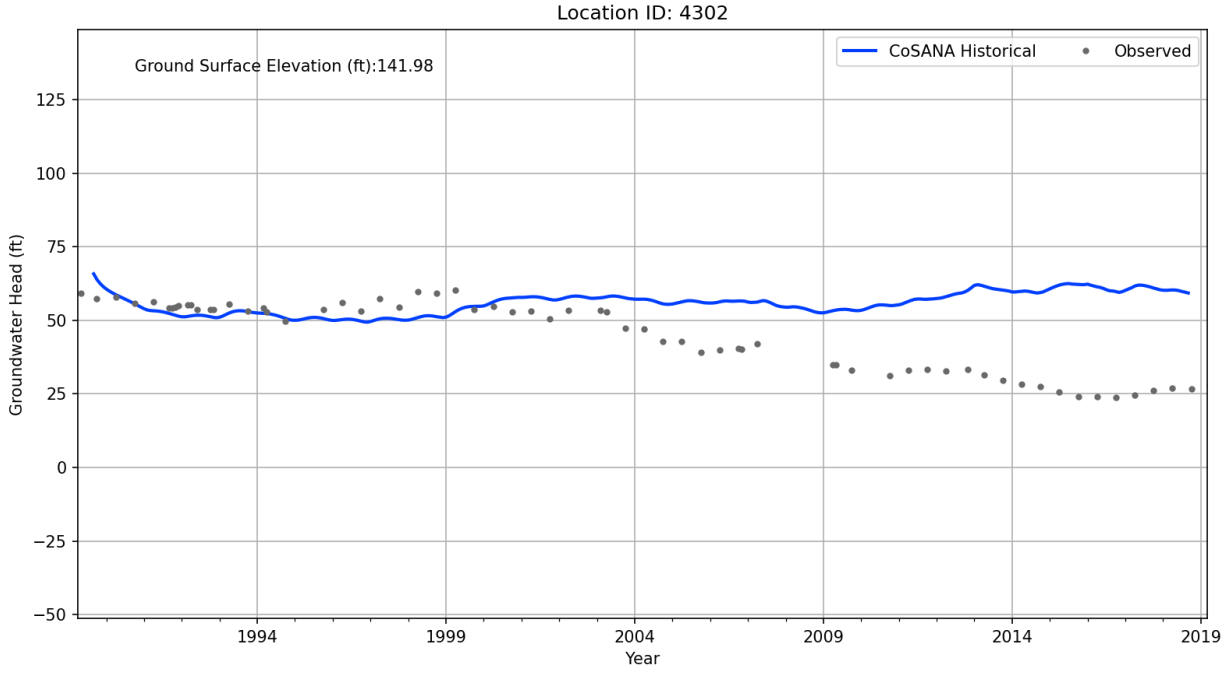

Location ID: 4202
Ground Surface Elevation (ft):135.82
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

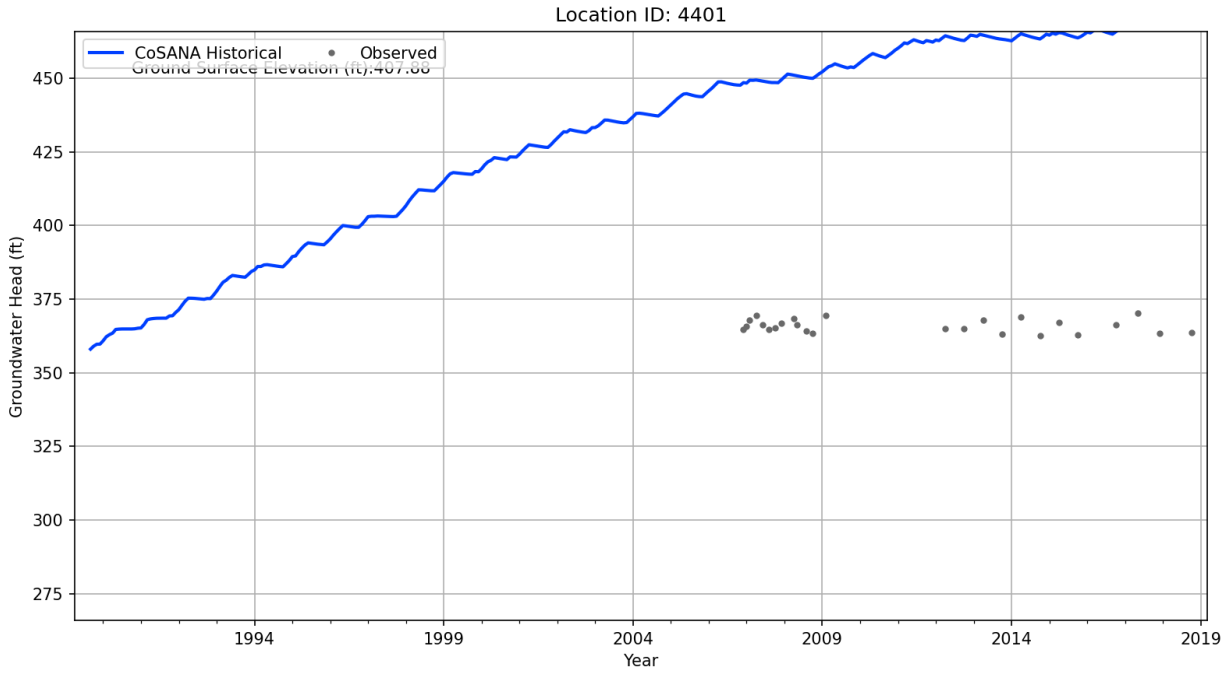

Location ID: 4204
Ground Surface Elevation (ft):97.45
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

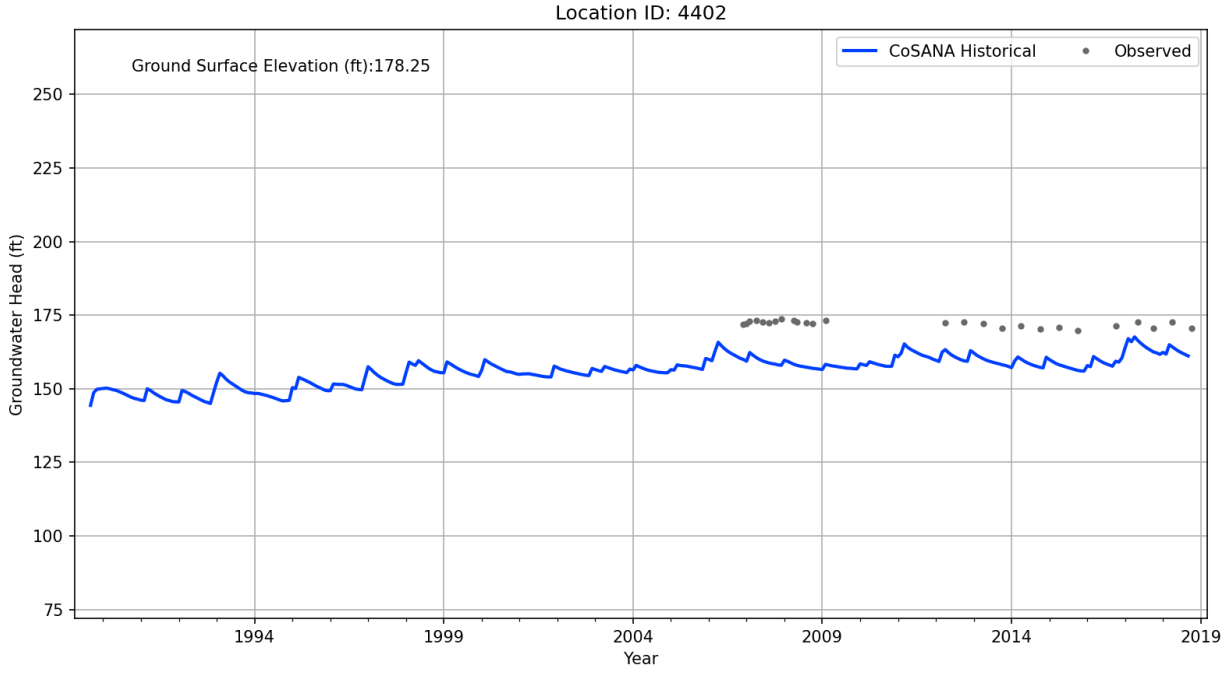

Location ID: 4205
Ground Surface Elevation (ft):114.18
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

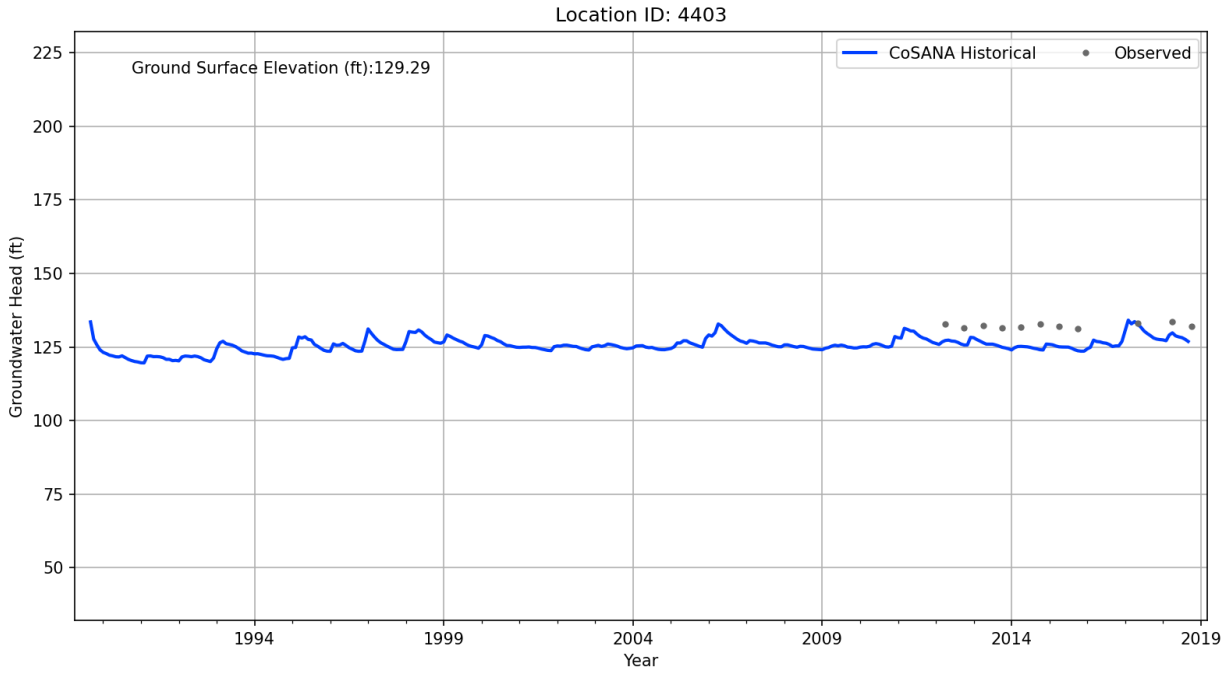

Location ID: 4207
Ground Surface Elevation (ft):119.83
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

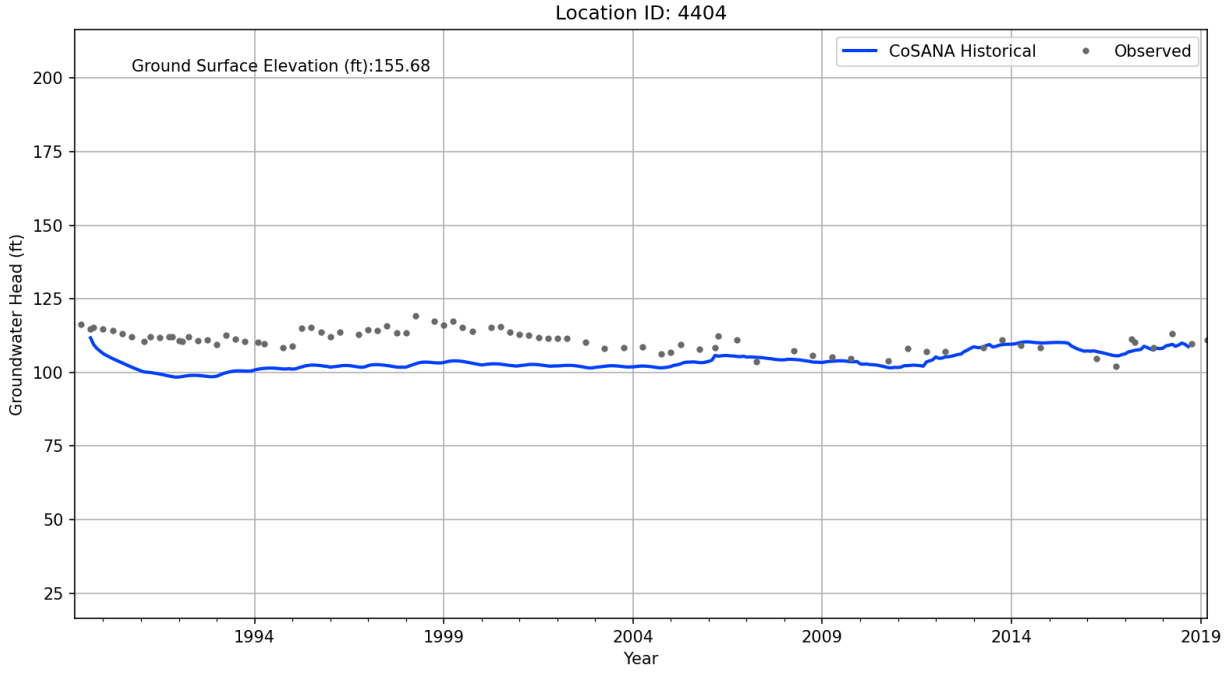

Location ID: 4301
Ground Surface Elevation (ft):132.25
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

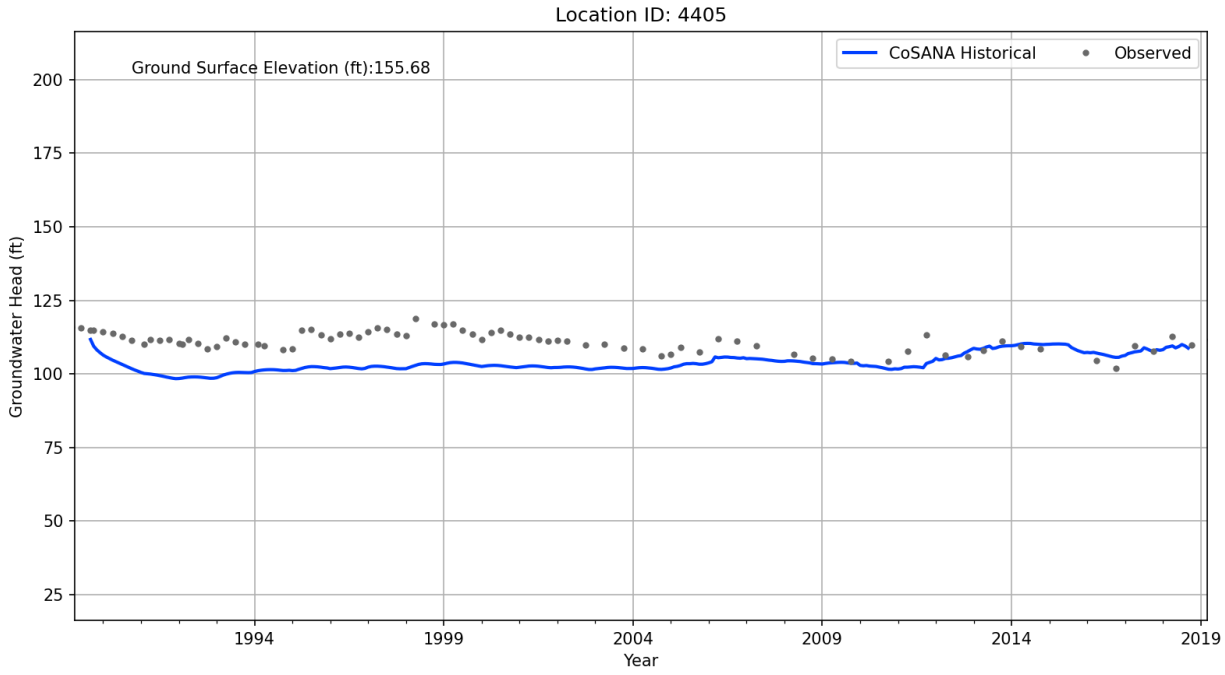

Location ID: 4302
Ground Surface Elevation (ft):141.98
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

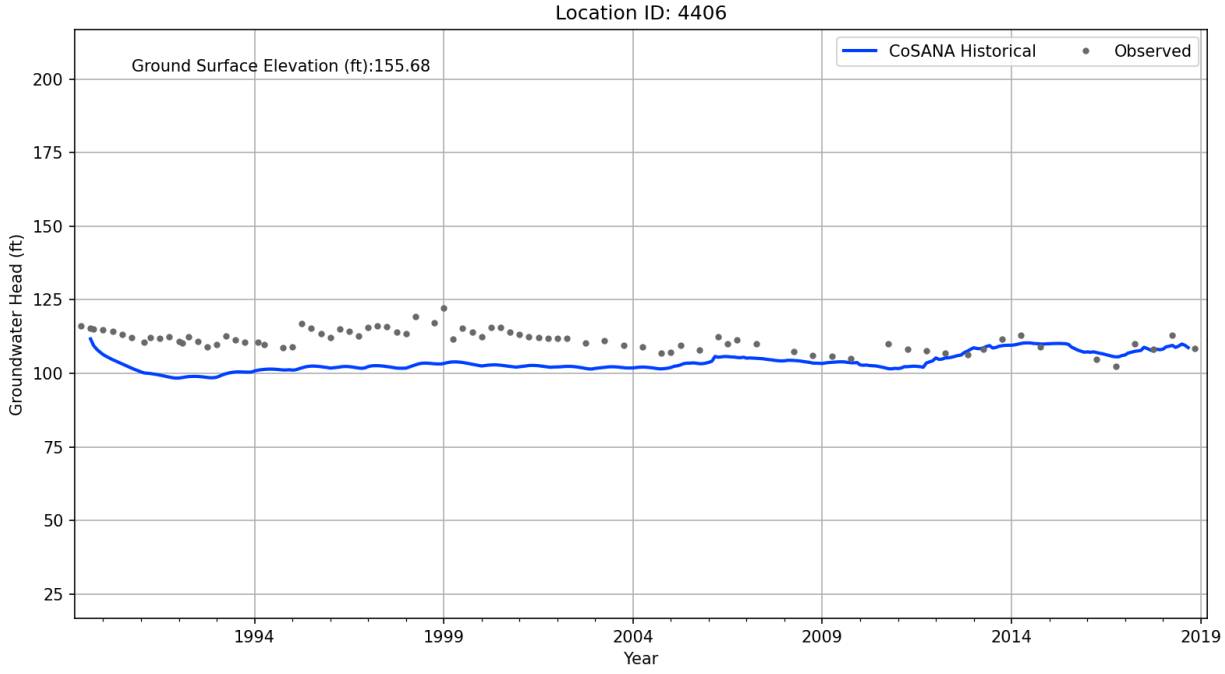

Location ID: 4401
CoSANA Historical
Observed
Ground Surface Elevation (ft):407.88
Groundwater Head (ft)
450
425
400
375
350
325
300
275
1994
1999
2004
2009
2014
2019
Year

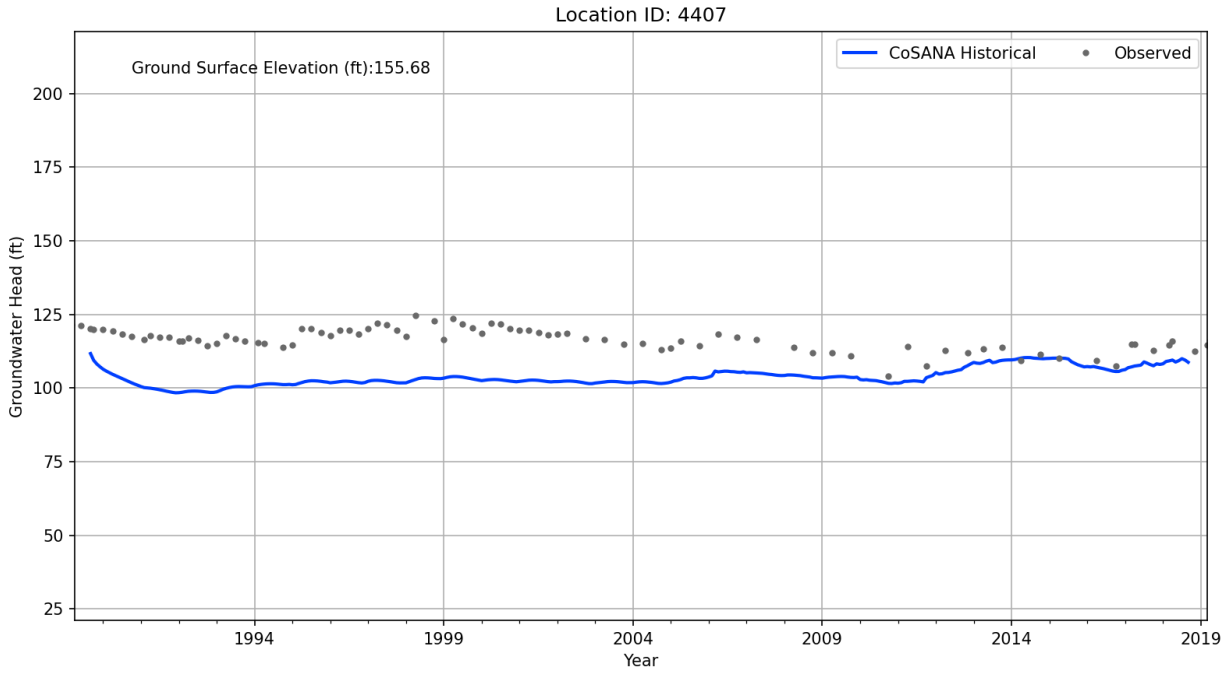

Location ID: 4402
Ground Surface Elevation (ft):178.25
CoSANA Historical
Observed
Groundwater Head (ft)
250
225
200
175
150
125
100
75
1994
1999
2004
2009
2014
2019
Year

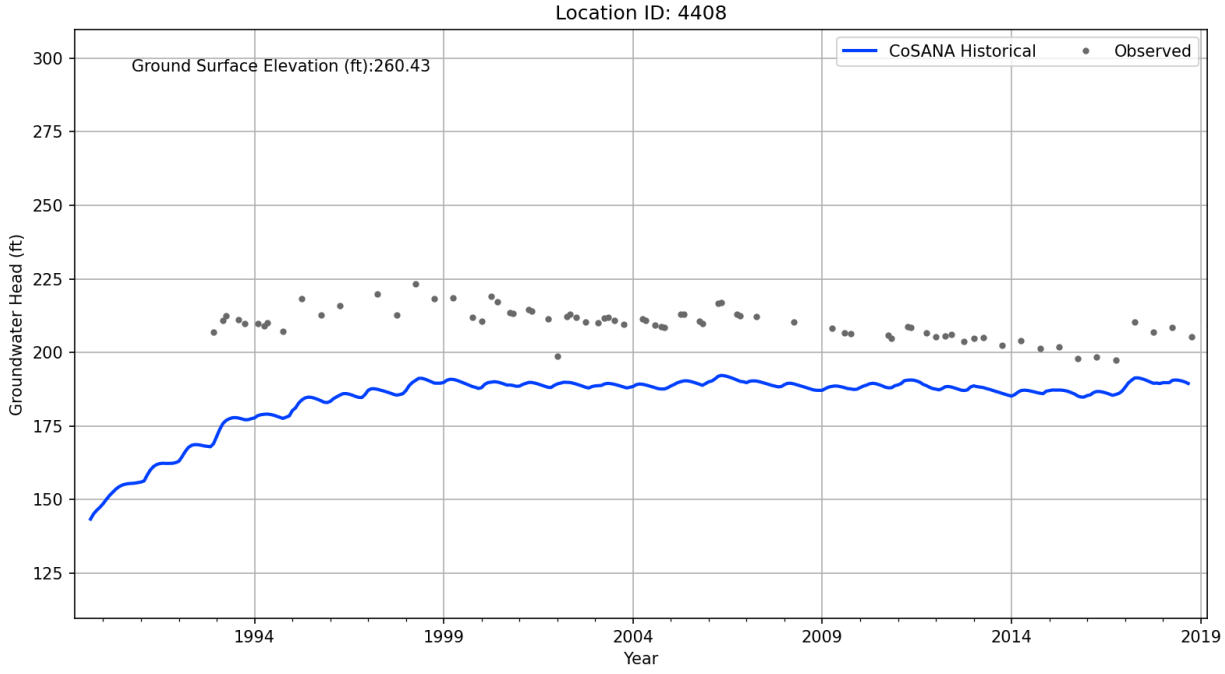

Location ID: 4403
Ground Surface Elevation (ft):129.29
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

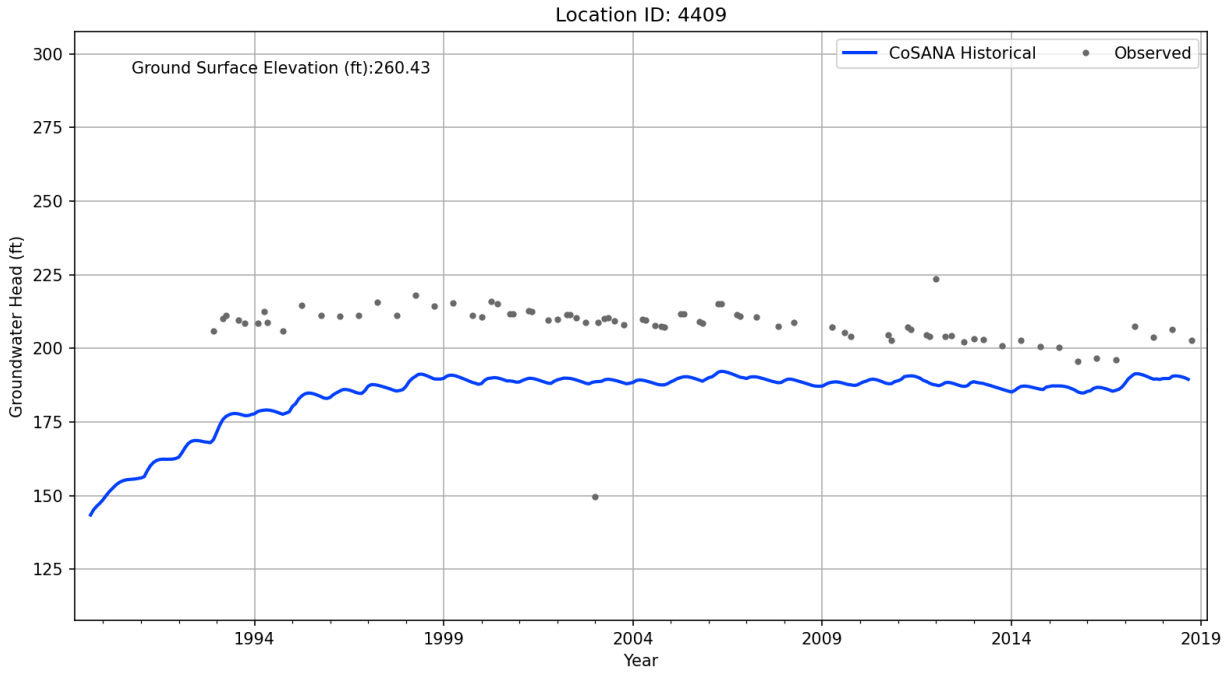

Location ID: 4404
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

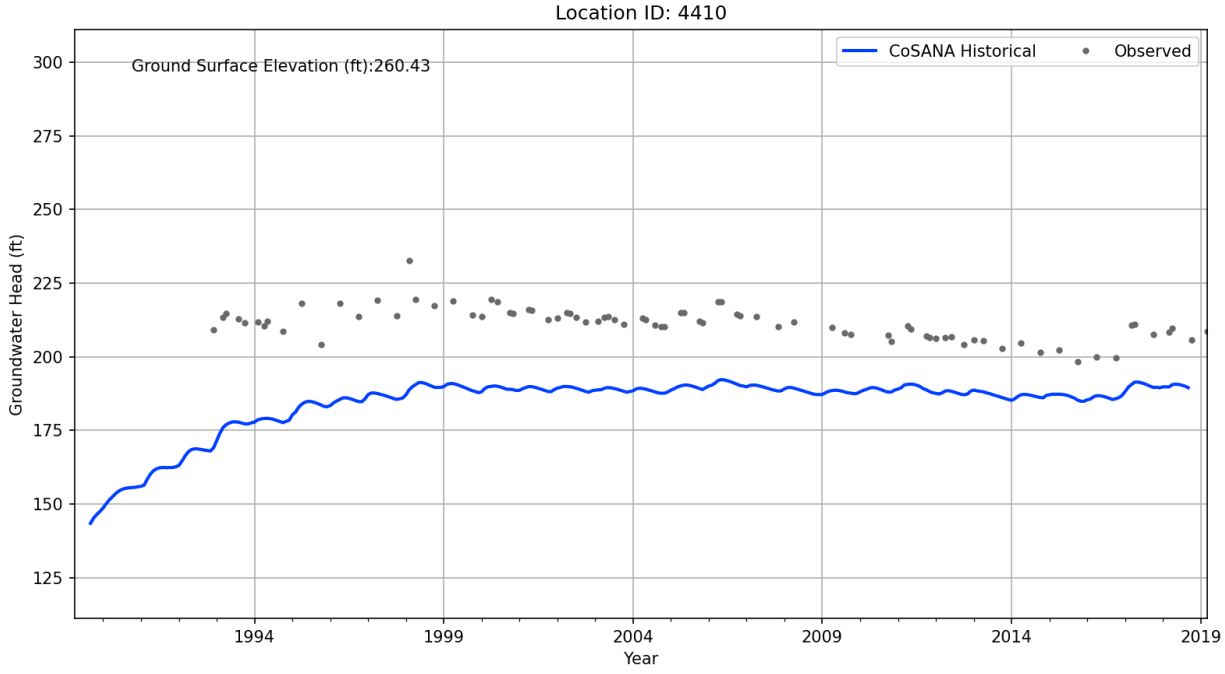

Location ID: 4405
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

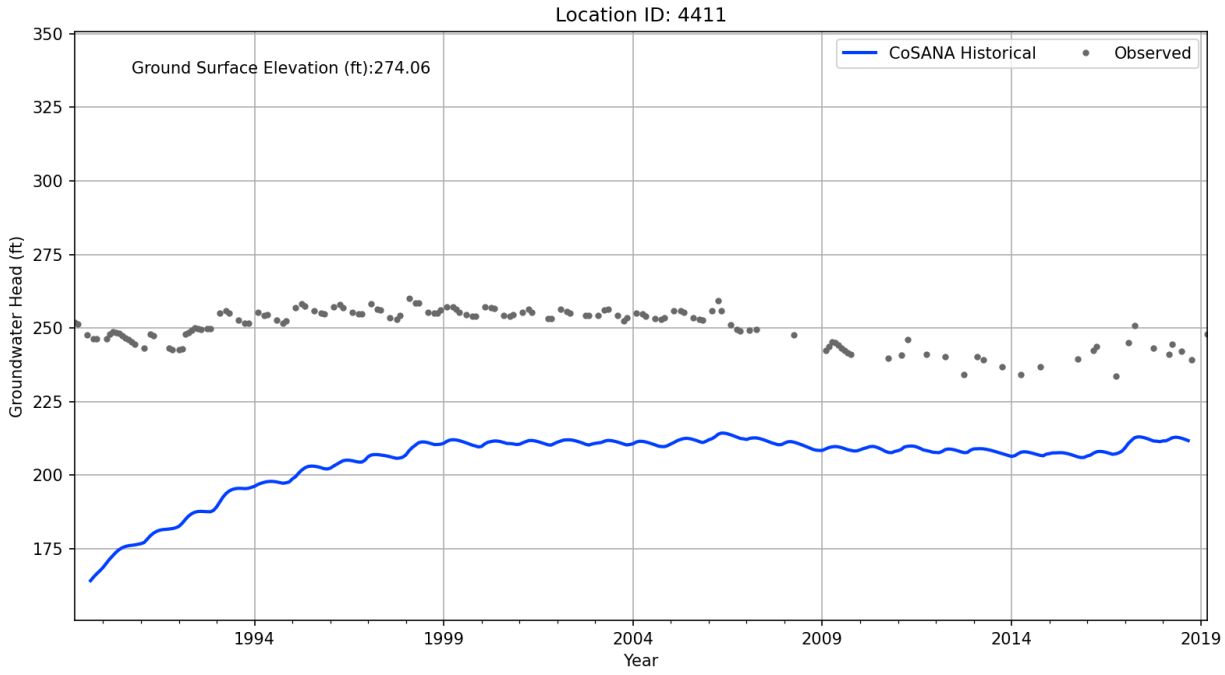

Location ID: 4406
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

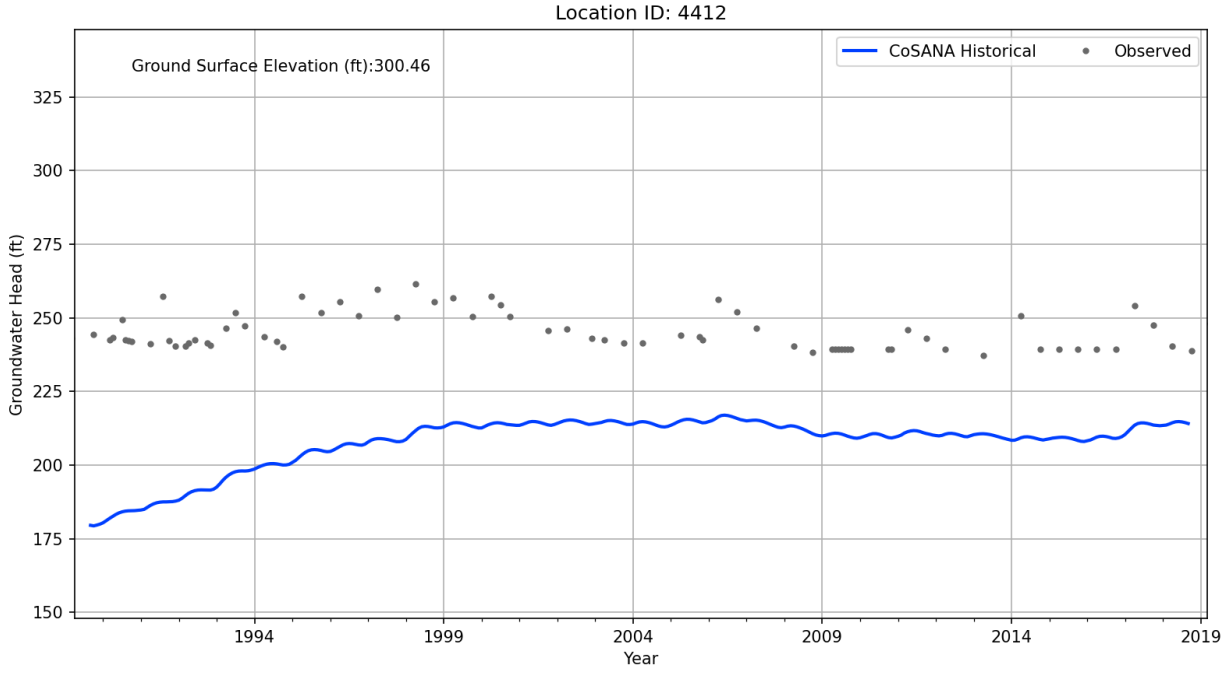

Location ID: 4407
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

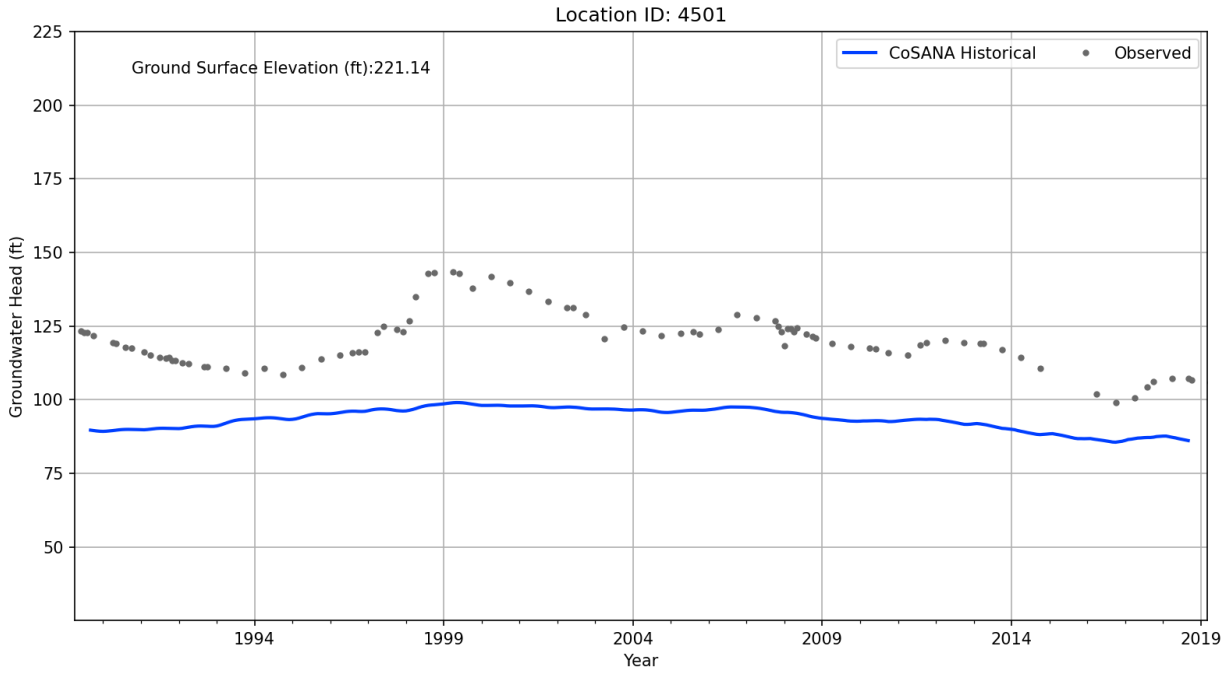

Location ID: 4408
Ground Surface Elevation (ft):260.43
CoSANA Historical
Observed
Groundwater Head (ft)
Year
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019

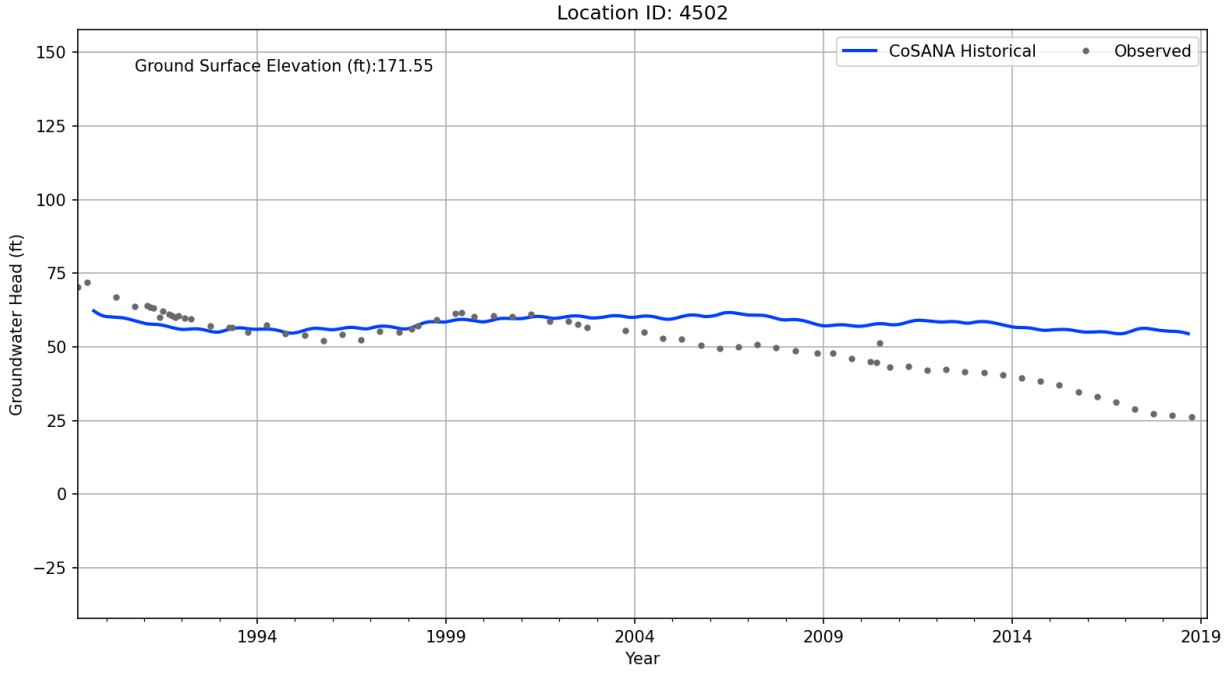

Location ID: 4409
Ground Surface Elevation (ft):260.43
CoSANA Historical
Observed
Groundwater Head (ft)
Year
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019

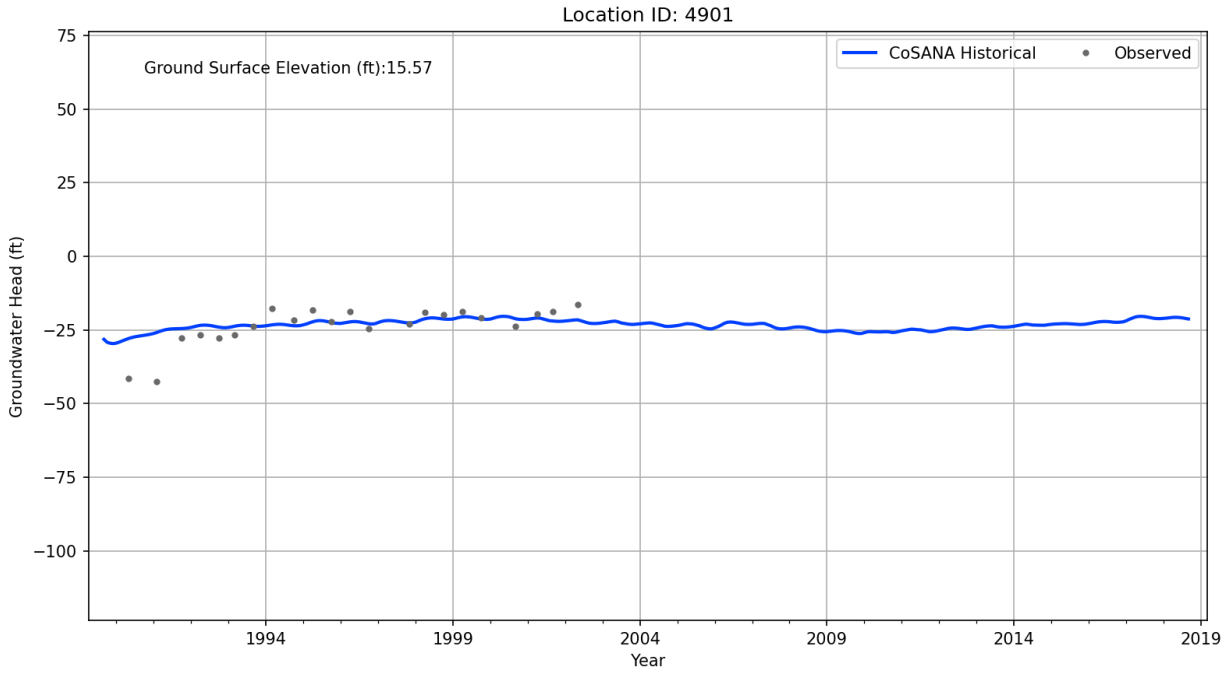

Location ID: 4410
Ground Surface Elevation (ft):260.43
CoSANA Historical
Observed
Groundwater Head (ft)
Year
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019

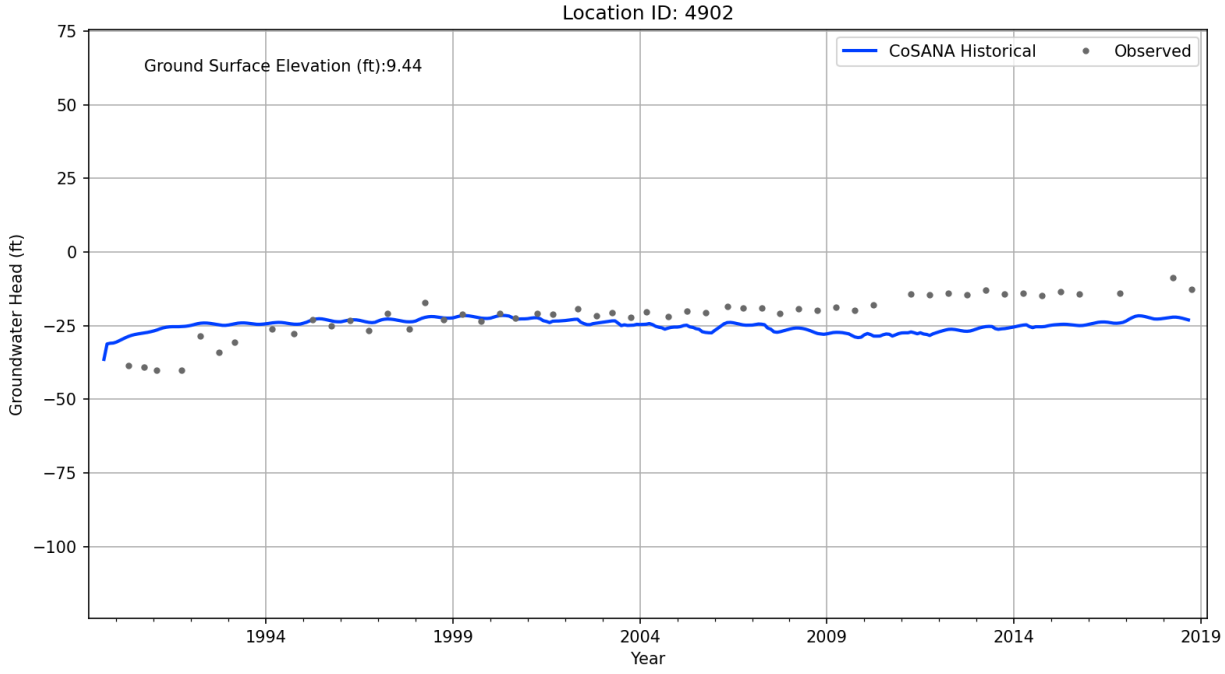

Location ID: 4411
Ground Surface Elevation (ft):274.06
CoSANA Historical
Observed
Groundwater Head (ft)
Year
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019

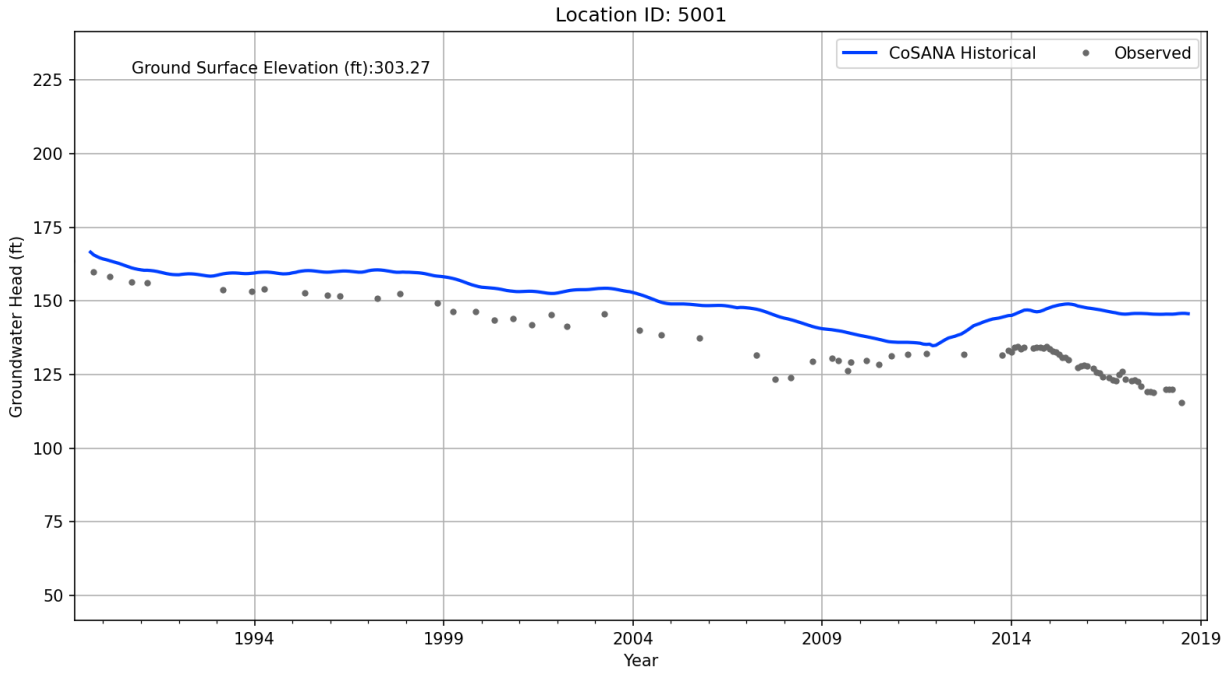

Location ID: 4412
Ground Surface Elevation (ft):300.46
CoSANA Historical
Observed
Groundwater Head (ft)
Year
325
300
275
250
225
200
175
150
1994
1999
2004
2009
2014
2019

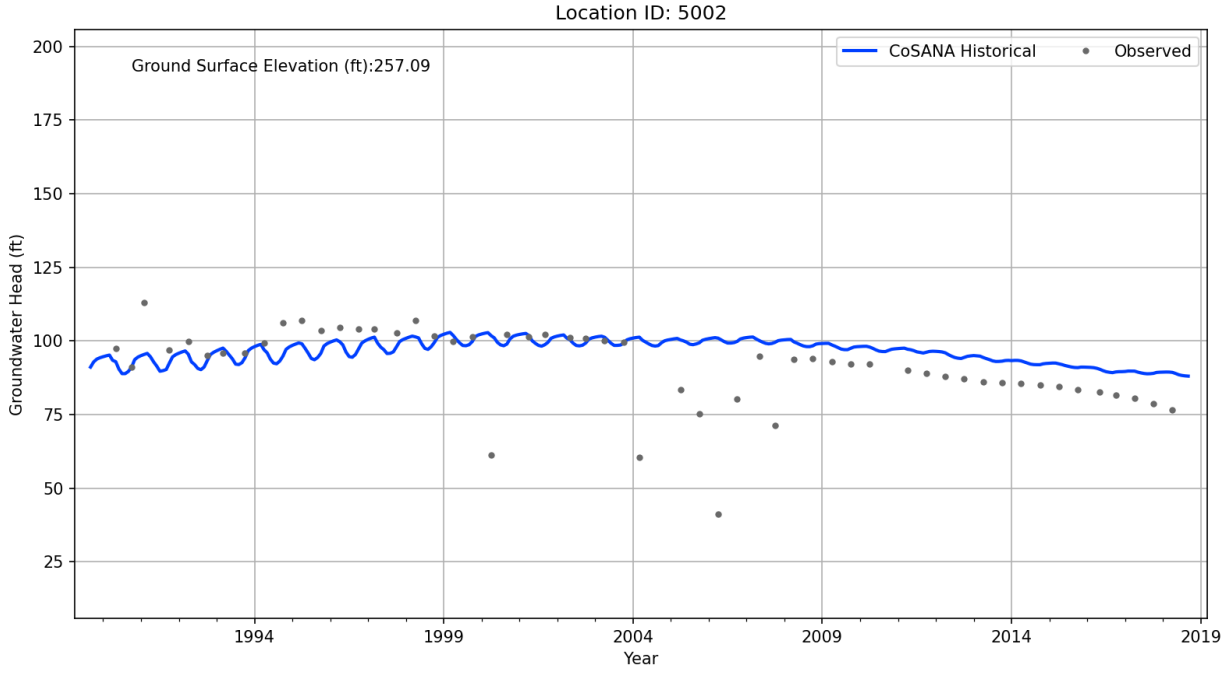

Location ID: 4501
Ground Surface Elevation (ft):221.14
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

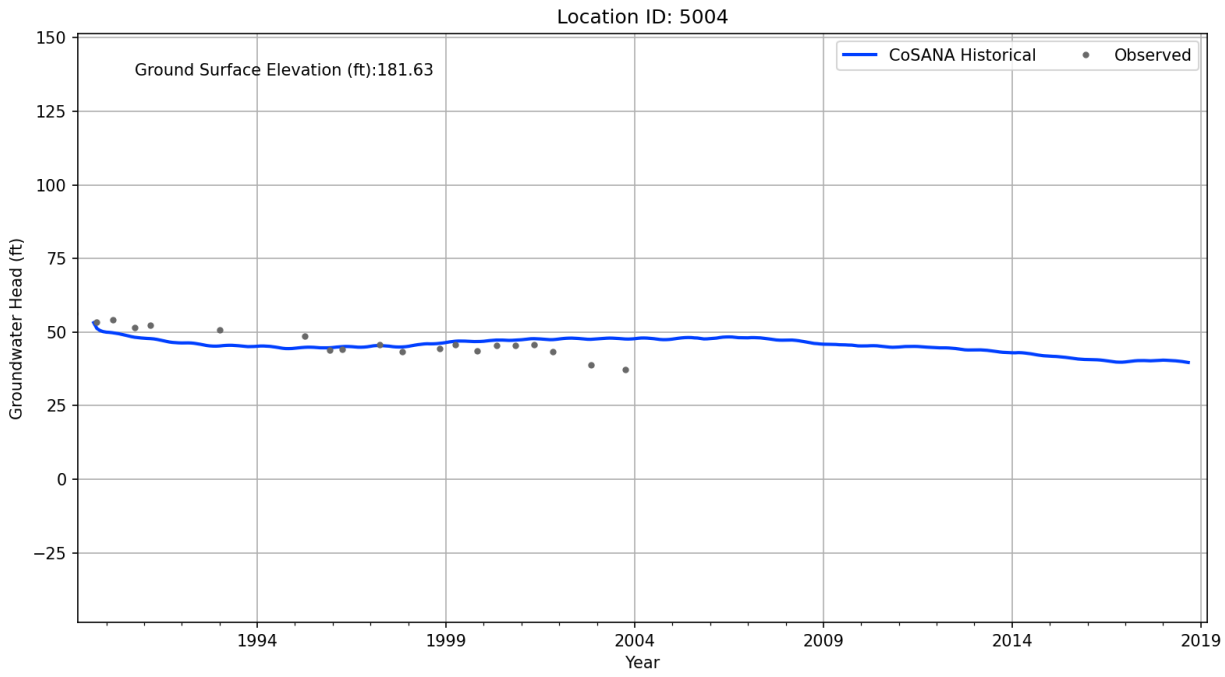

Location ID: 4502
Ground Surface Elevation (ft):171.55
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

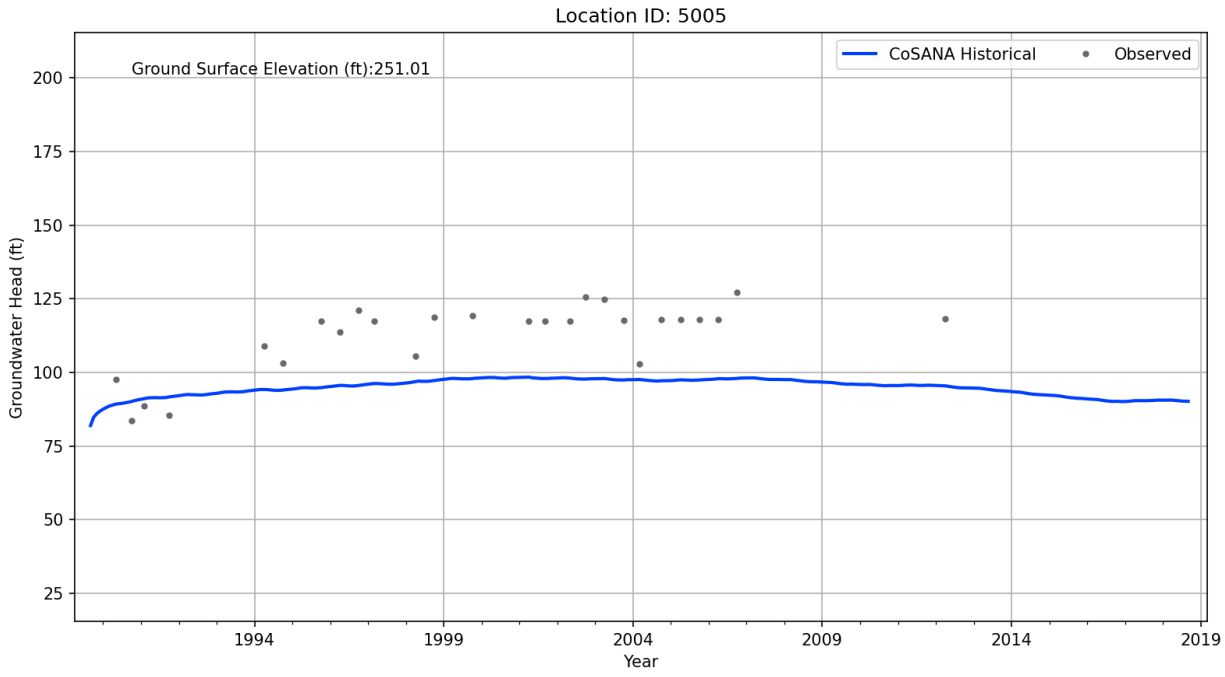

Location ID: 4901
Ground Surface Elevation (ft):15.57
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

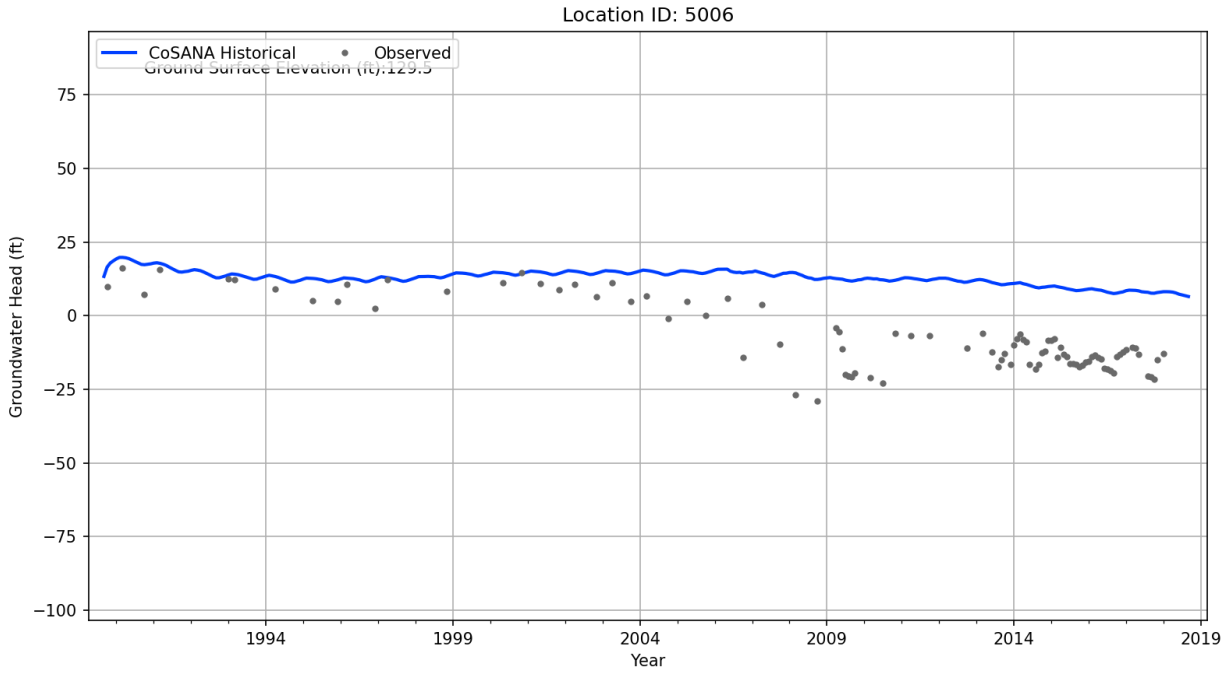

Location ID: 4902
Ground Surface Elevation (ft):9.44
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

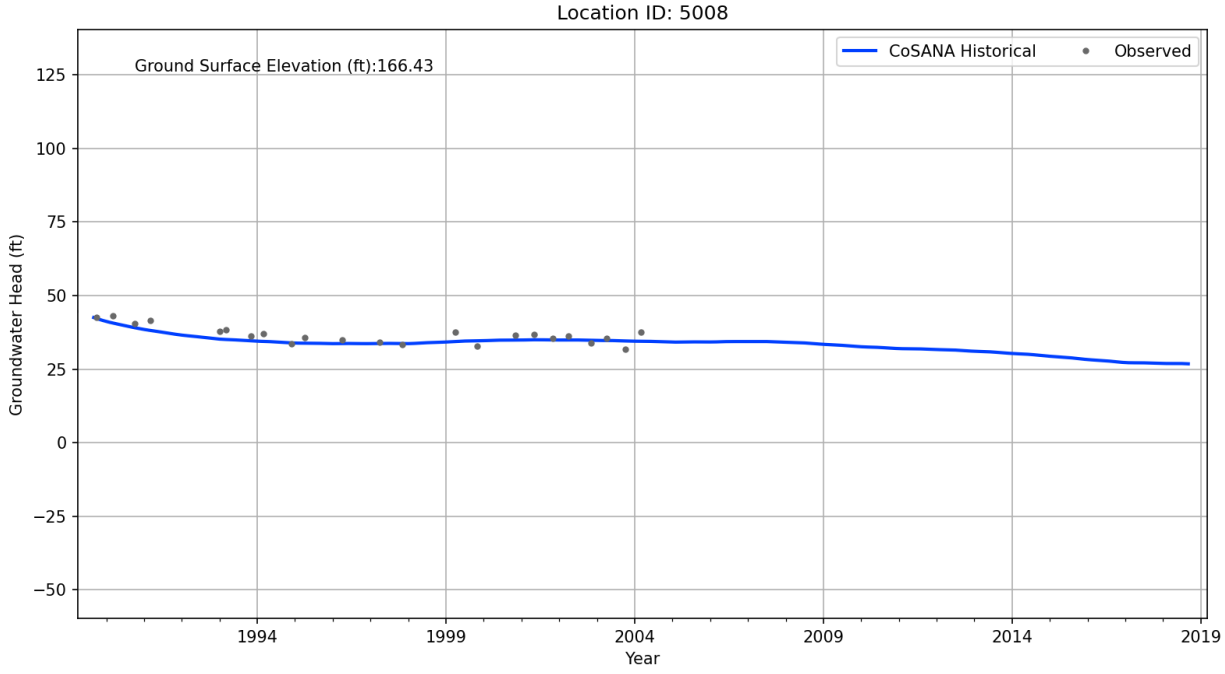

Location ID: 5001
Ground Surface Elevation (ft):303.27
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

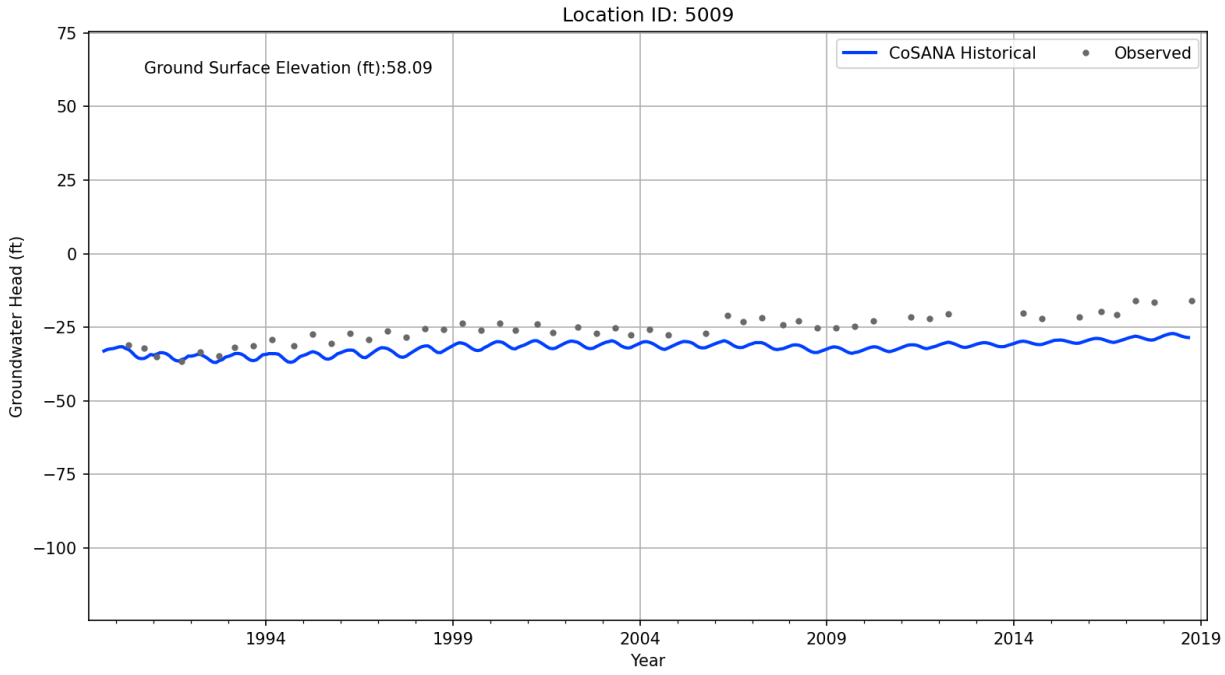

Location ID: 5002
Ground Surface Elevation (ft):257.09
CoSANA Historical
Observed
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

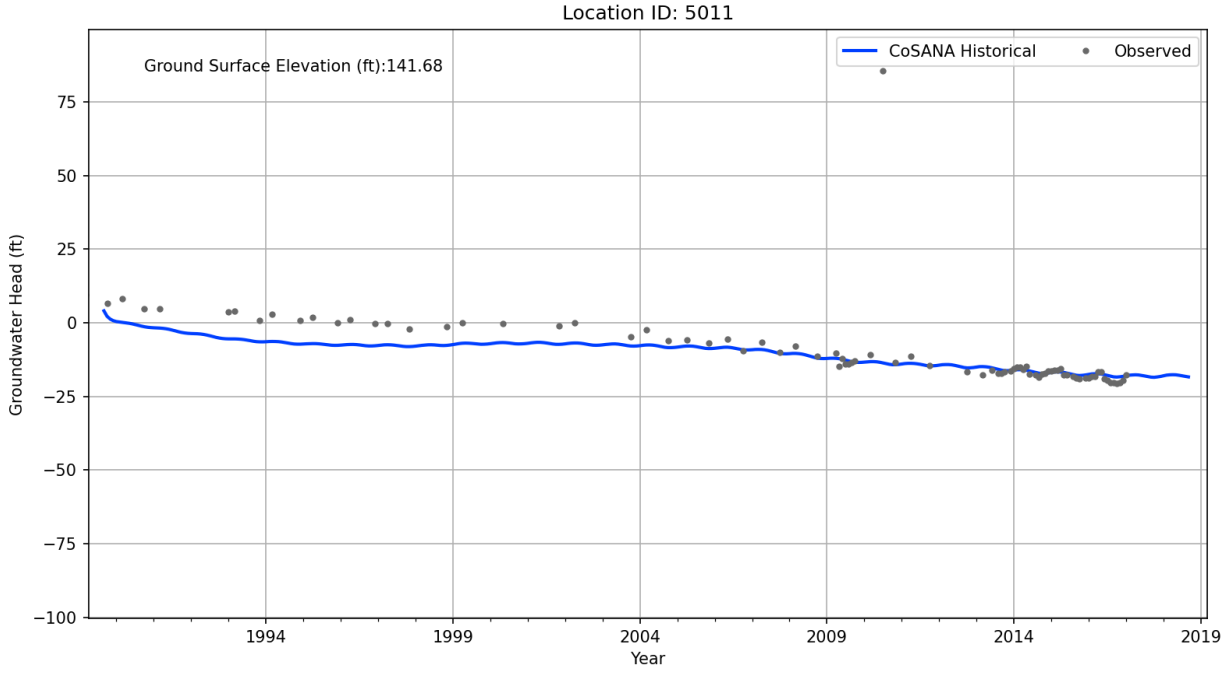

Location ID: 5004
Ground Surface Elevation (ft):181.63
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

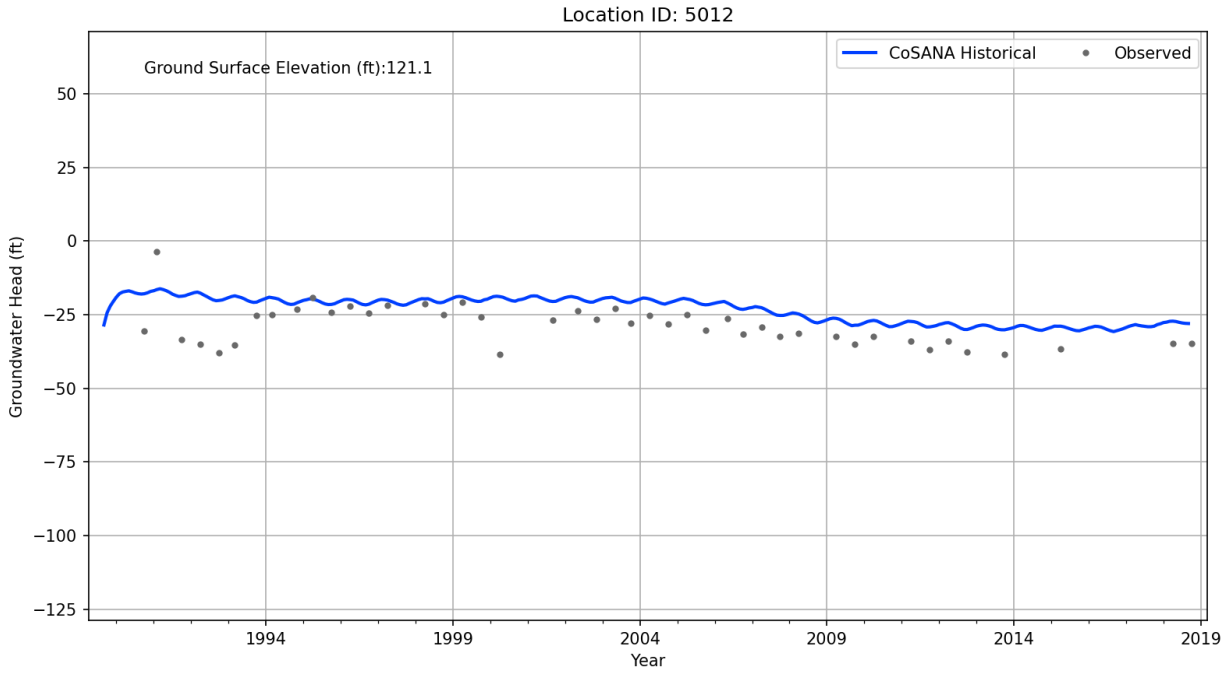

Location ID: 5005
Ground Surface Elevation (ft):251.01
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

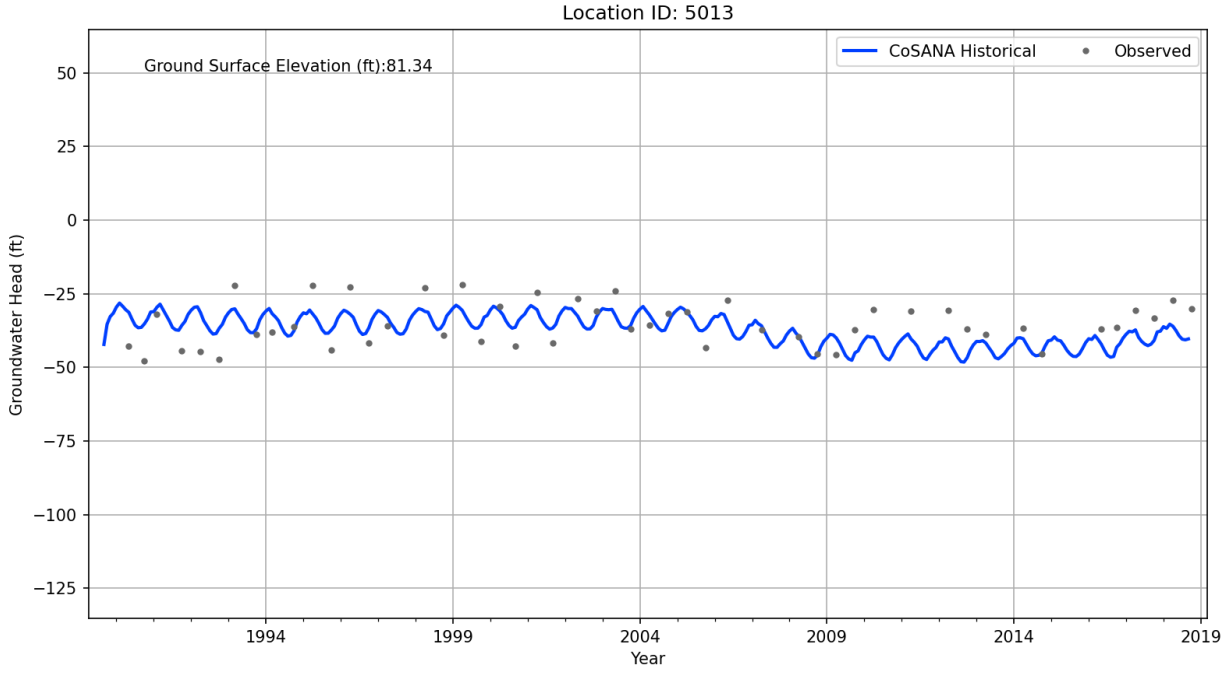

Location ID: 5006
CoSANA Historical
Observed
Ground Surface Elevation (ft):125.5
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

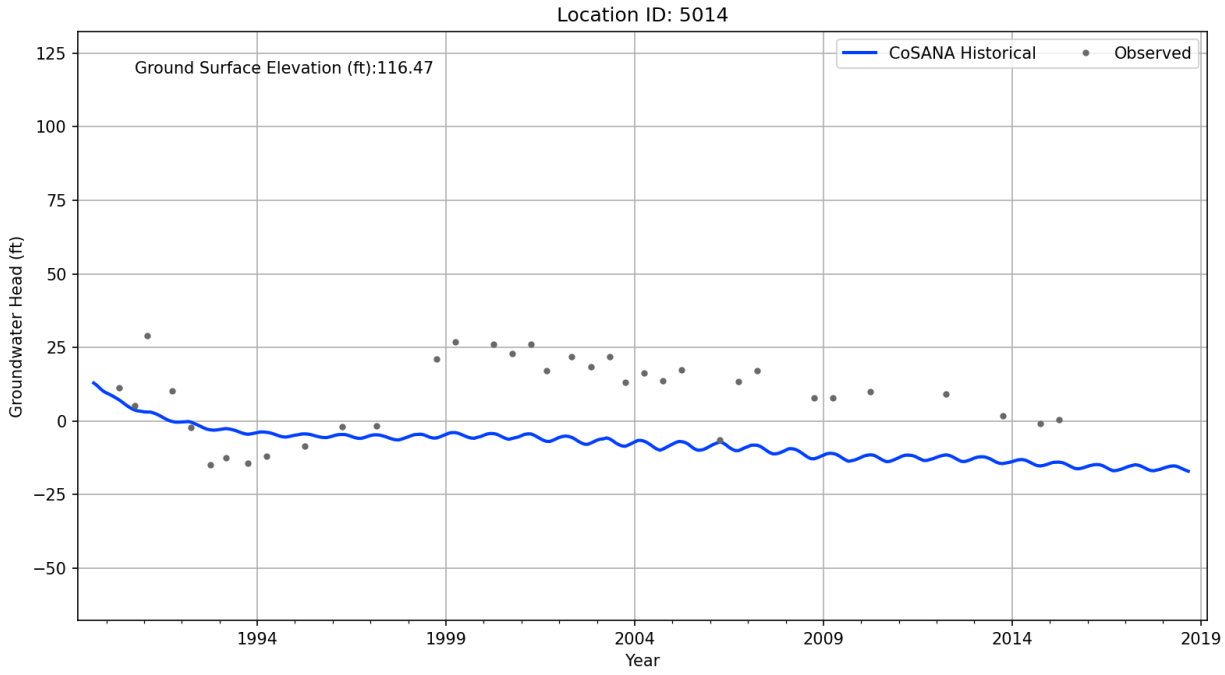

Location ID: 5008
CoSANA Historical
Observed
Ground Surface Elevation (ft):166.43
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

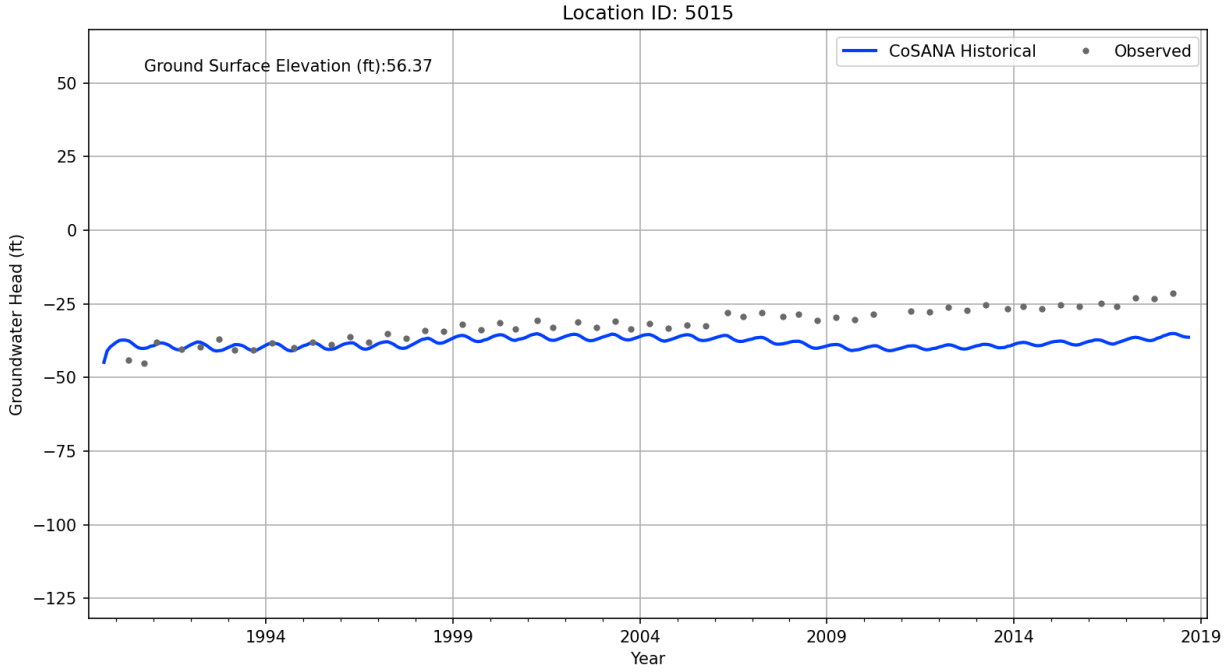

Location ID: 5009
Ground Surface Elevation (ft):58.09
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

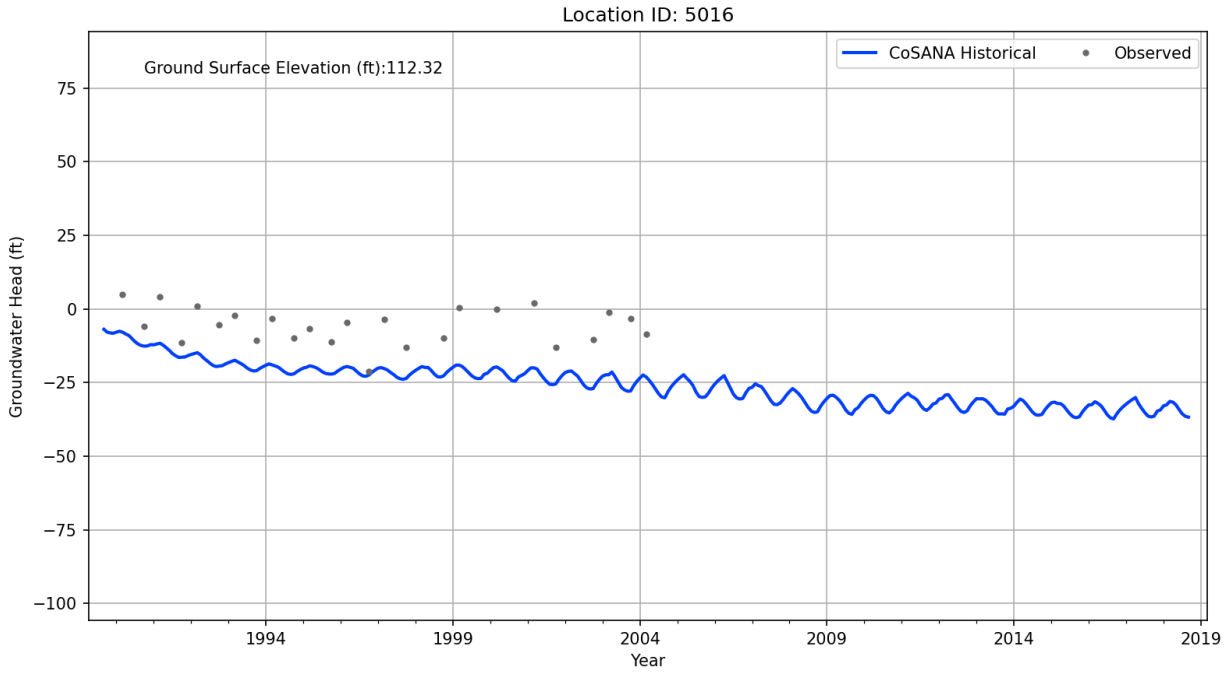

Location ID: 5011
Ground Surface Elevation (ft):141.68
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

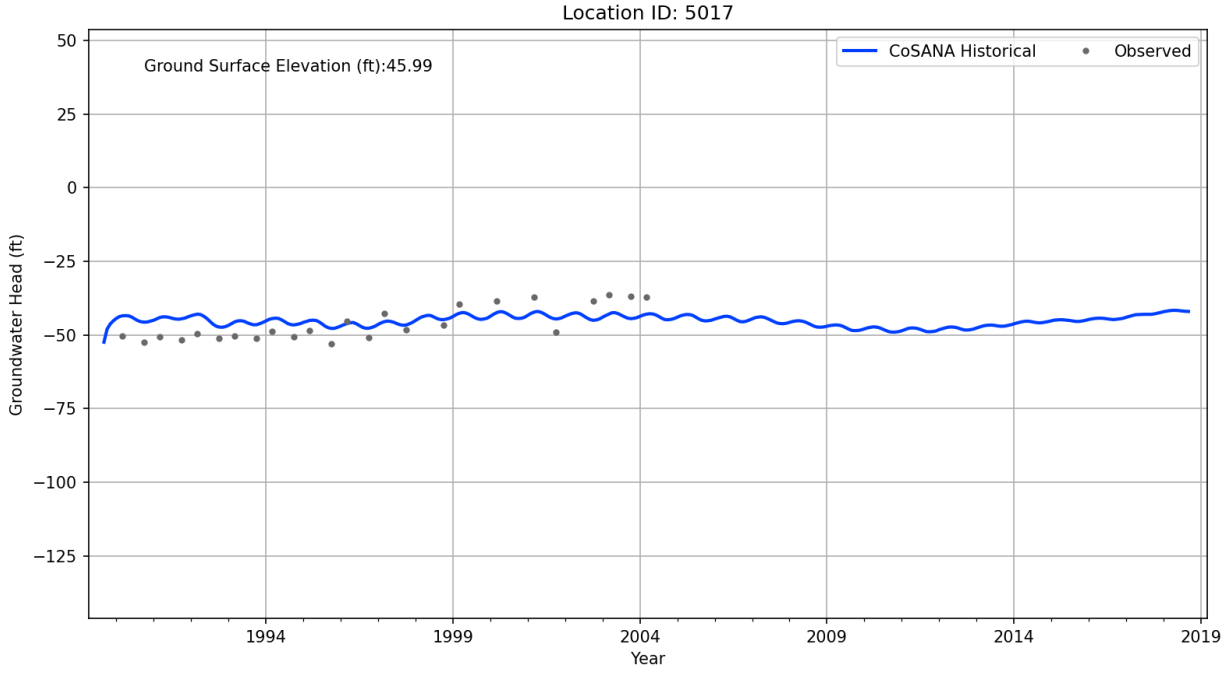

Location ID: 5012
Ground Surface Elevation (ft):121.1
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

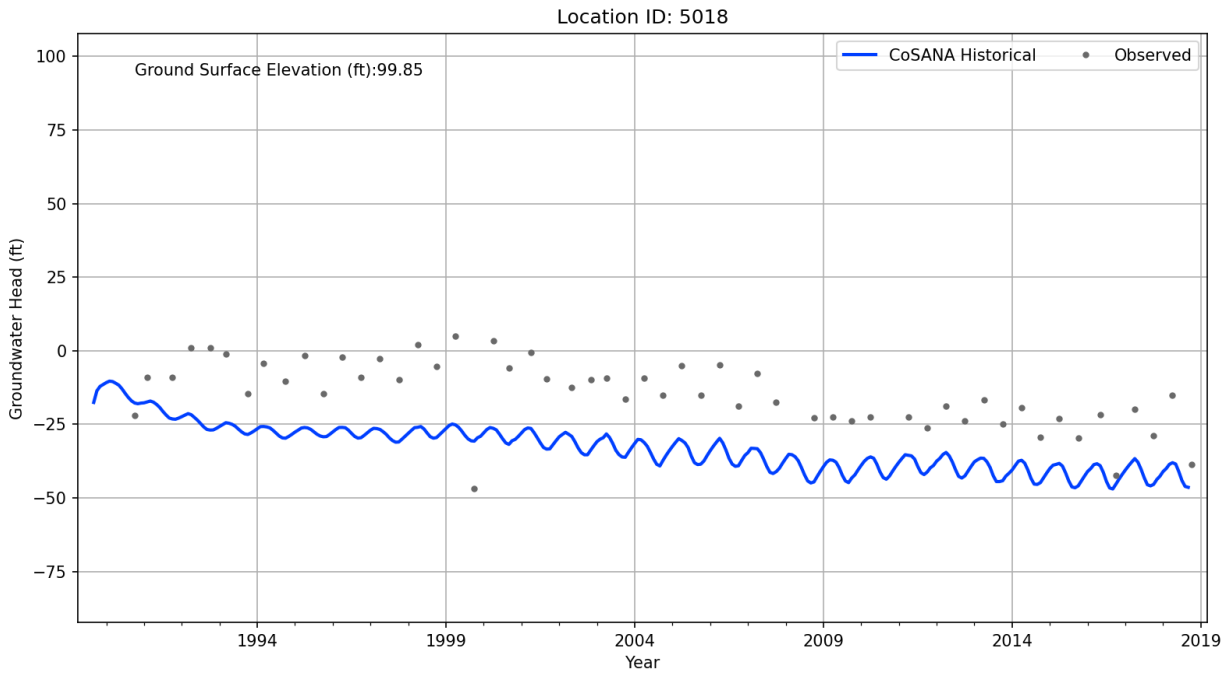

Location ID: 5013
Ground Surface Elevation (ft):81.34
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

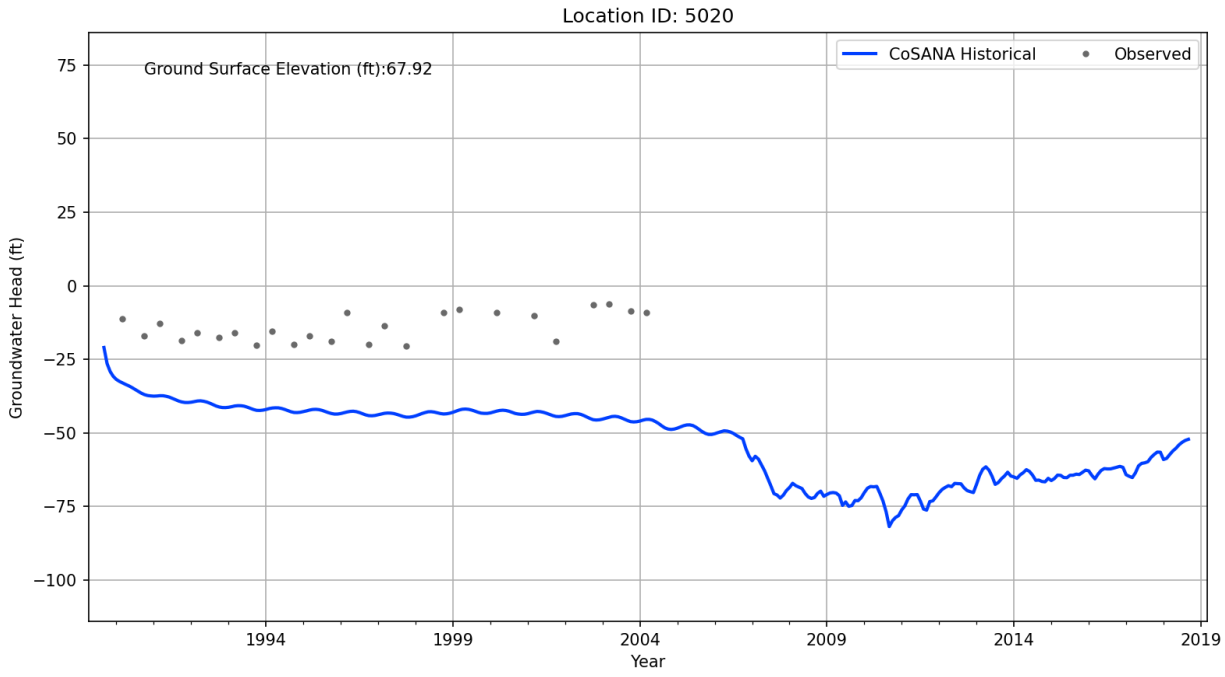

Location ID: 5014
Ground Surface Elevation (ft):116.47
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

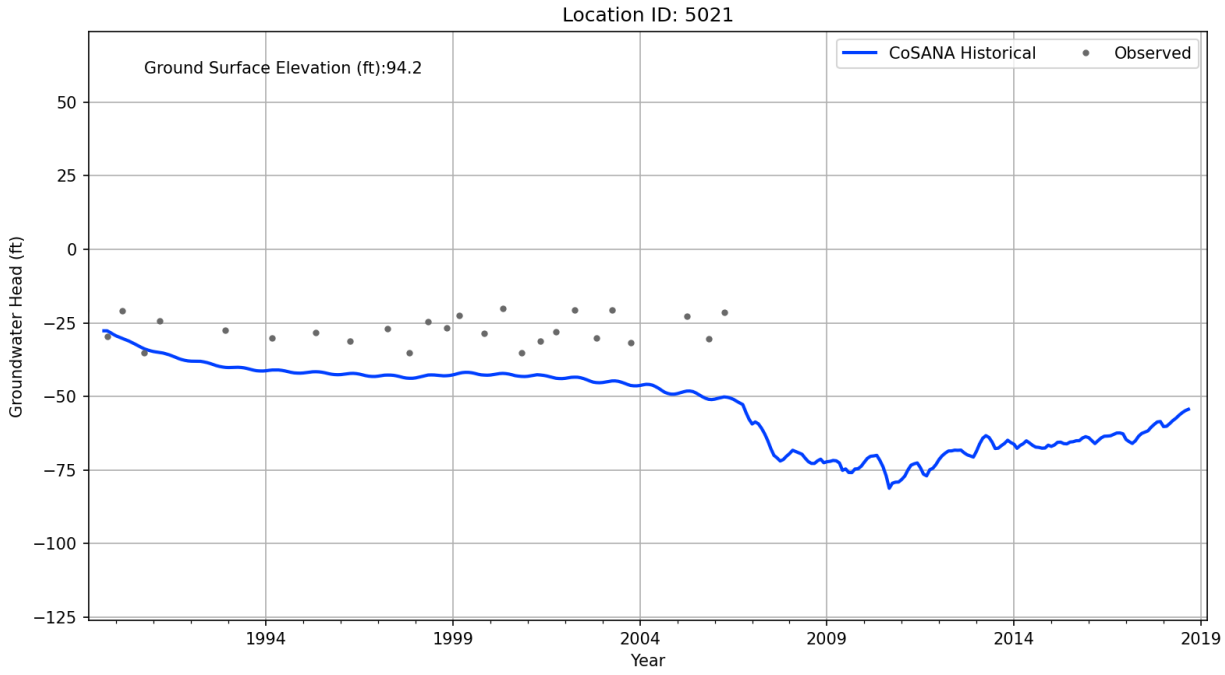

Location ID: 5015
Ground Surface Elevation (ft):56.37
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

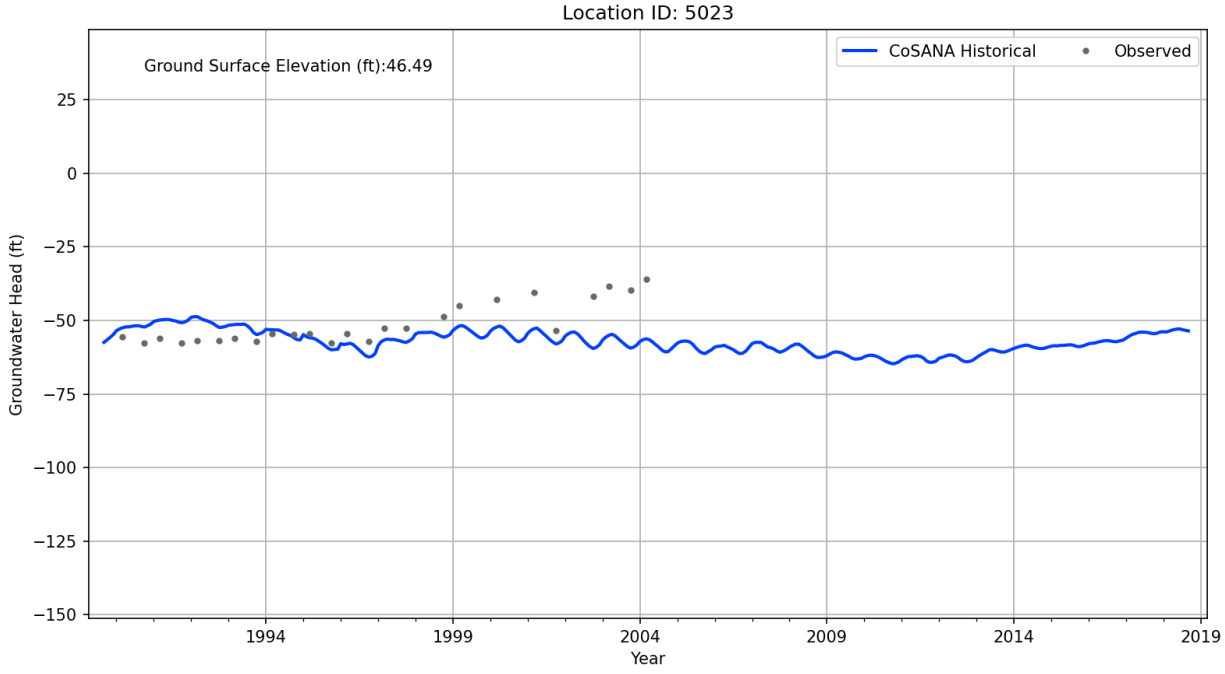

Location ID: 5016
Ground Surface Elevation (ft):112.32
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

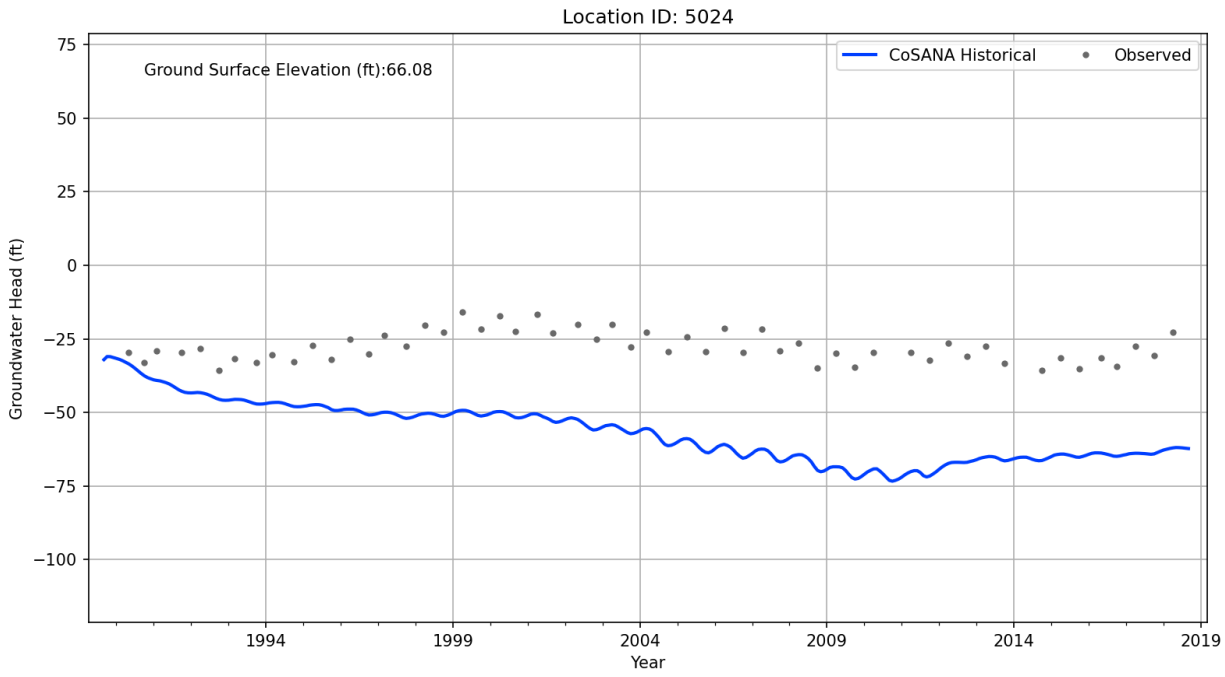

Location ID: 5017
Ground Surface Elevation (ft):45.99
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

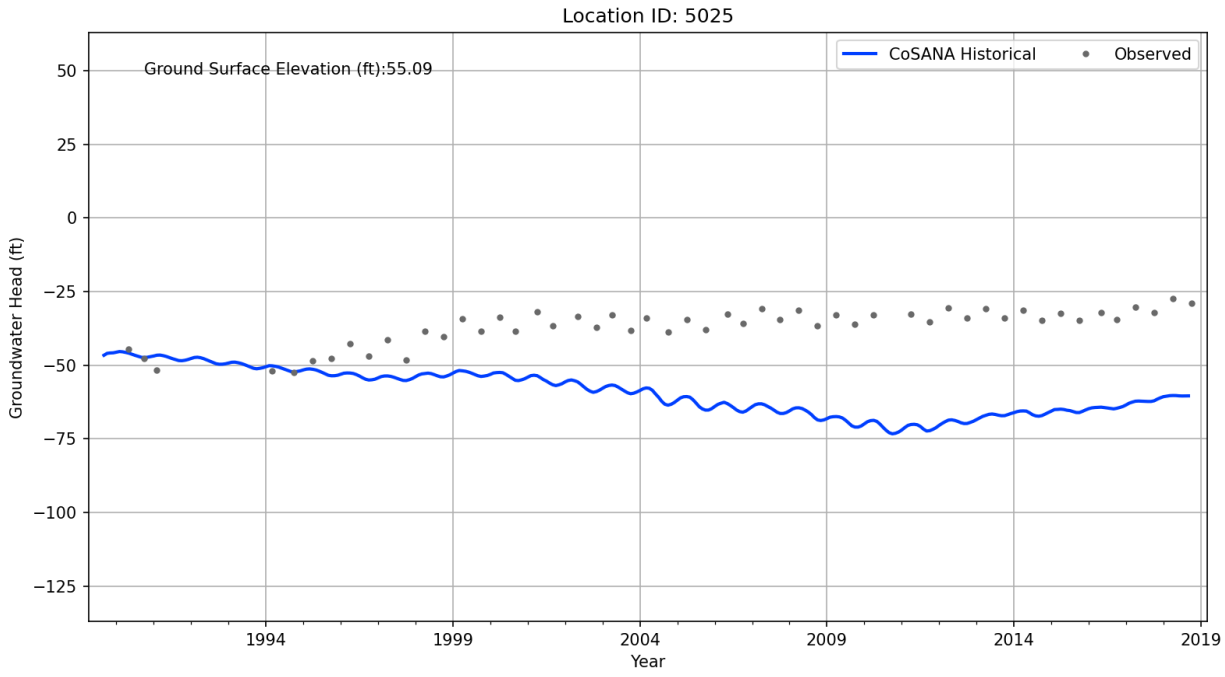

Location ID: 5018
Ground Surface Elevation (ft):99.85
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

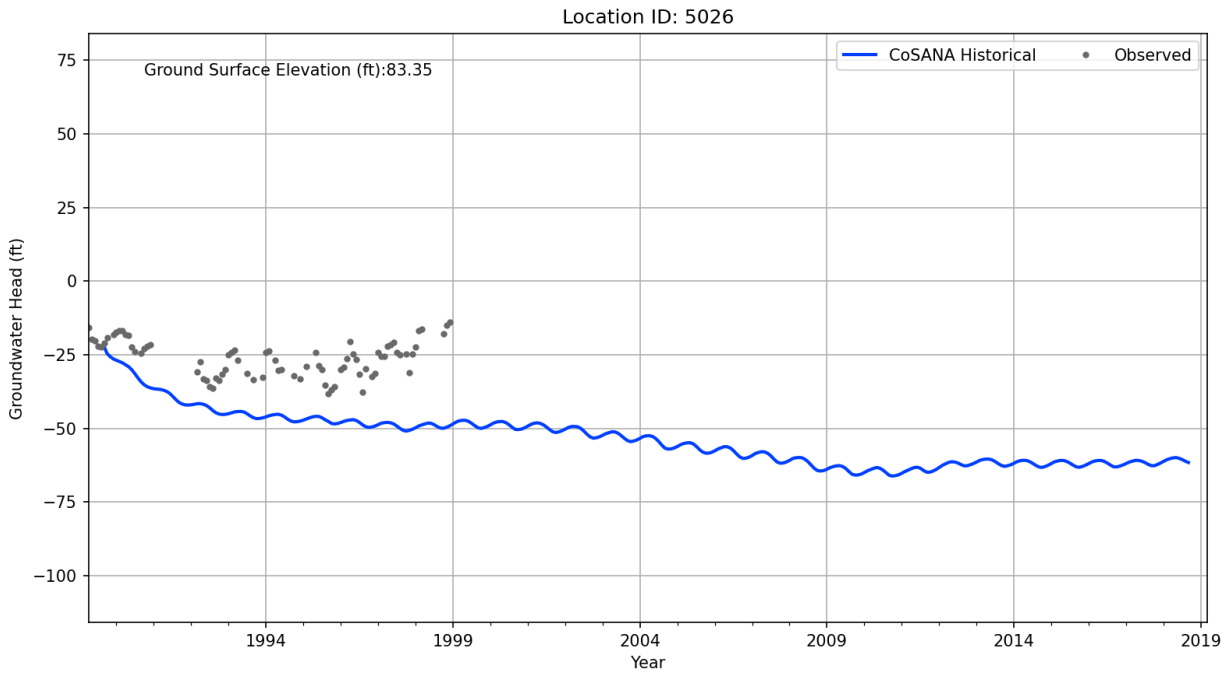

Location ID: 5020
Ground Surface Elevation (ft):67.92
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

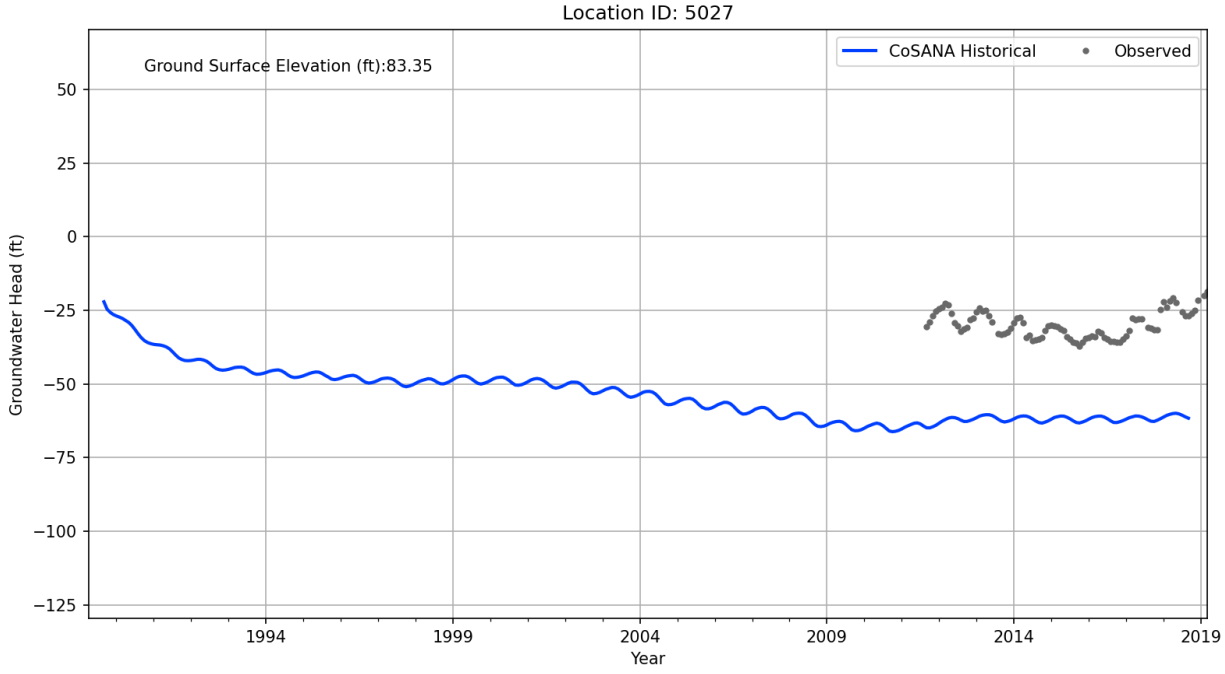

Location ID: 5021
Ground Surface Elevation (ft):94.2
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

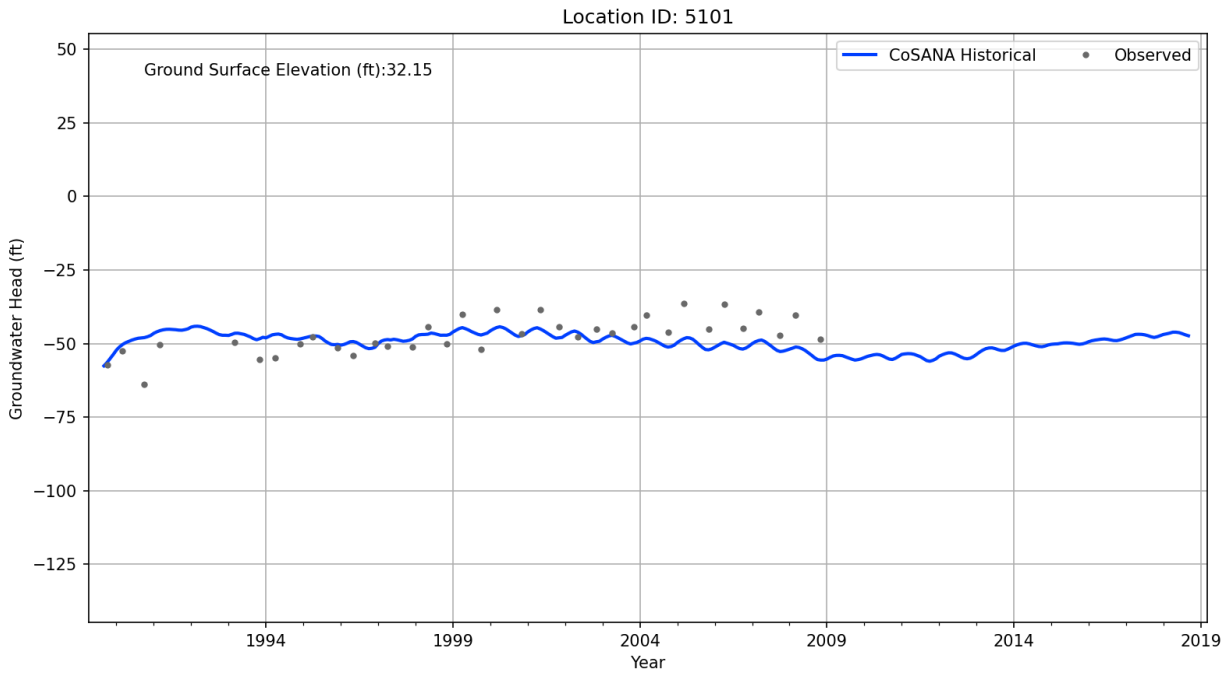

Location ID: 5023
Ground Surface Elevation (ft):46.49
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

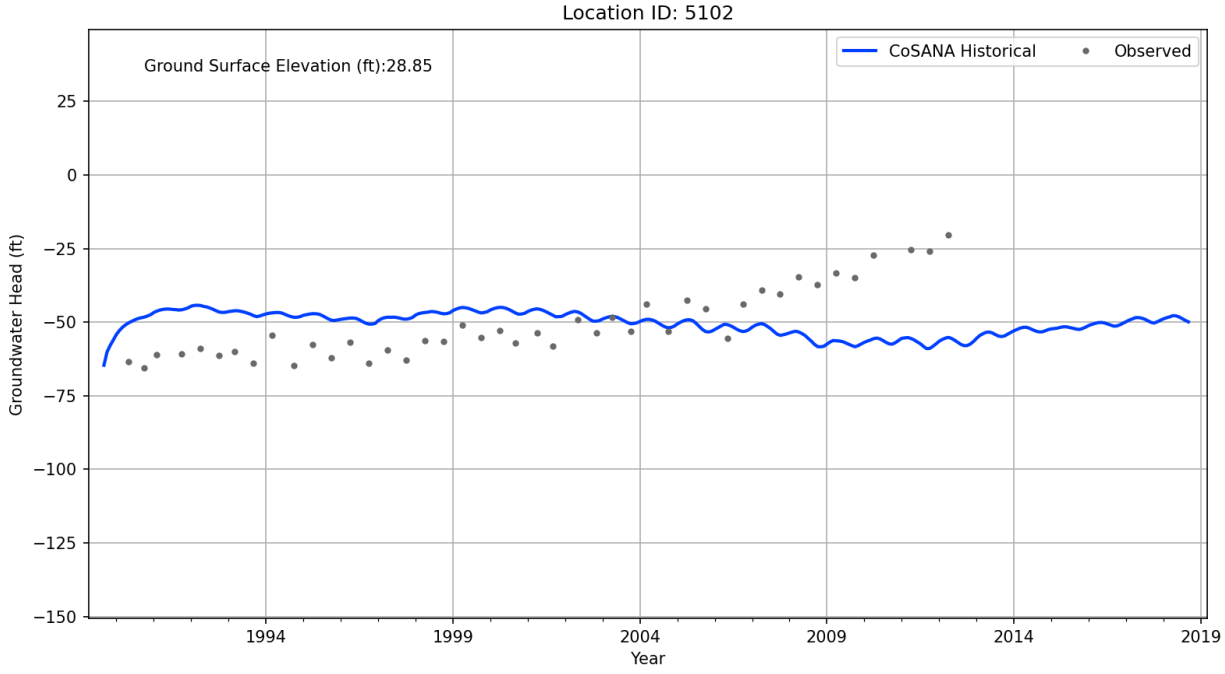

Location ID: 5024
Ground Surface Elevation (ft):66.08
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

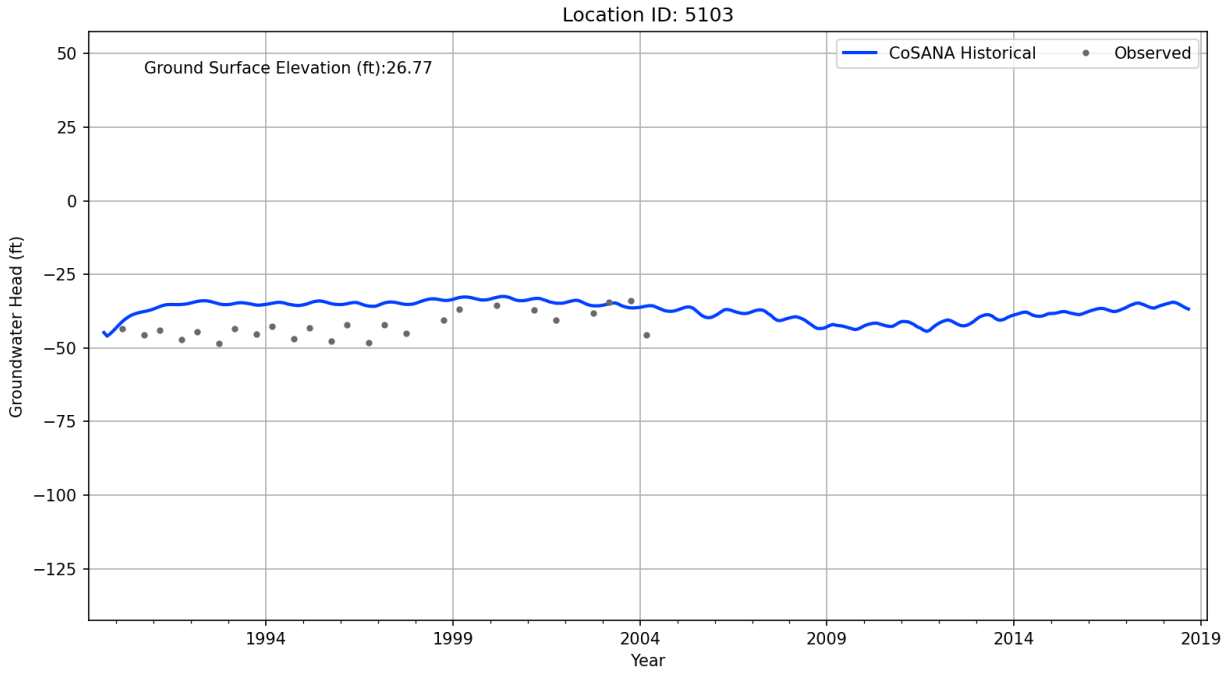

Location ID: 5025
Ground Surface Elevation (ft):55.09
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

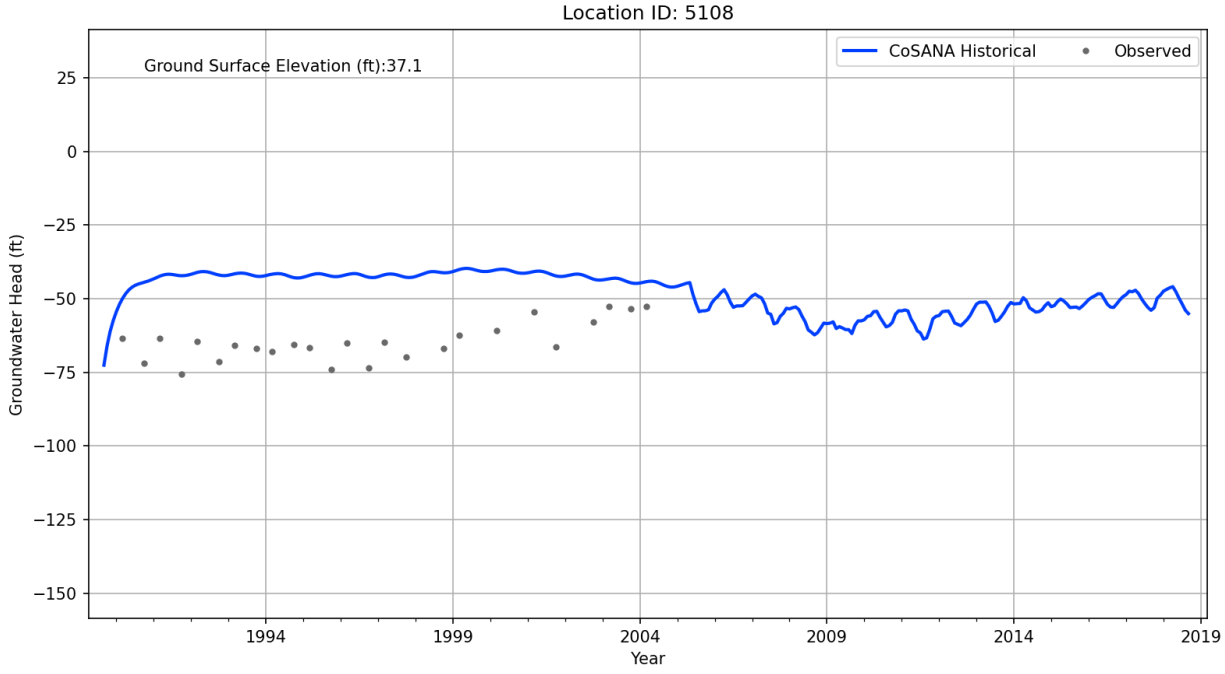

Location ID: 5026
Ground Surface Elevation (ft):83.35
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

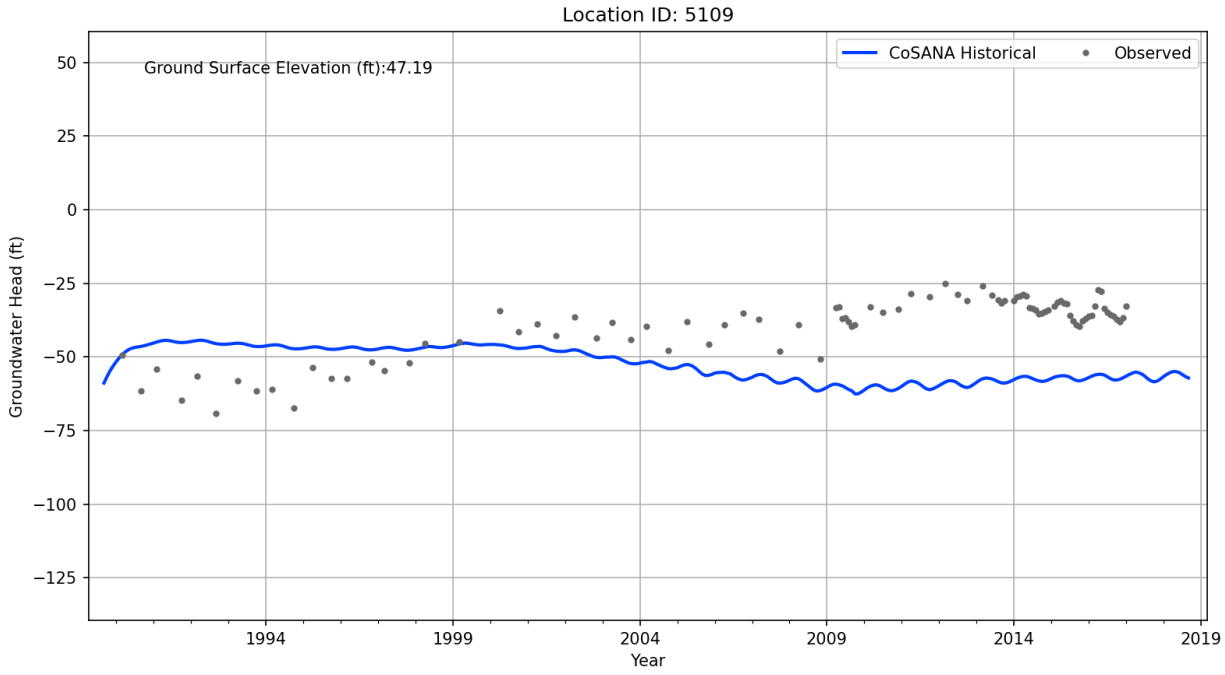

Location ID: 5027
Ground Surface Elevation (ft):83.35
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

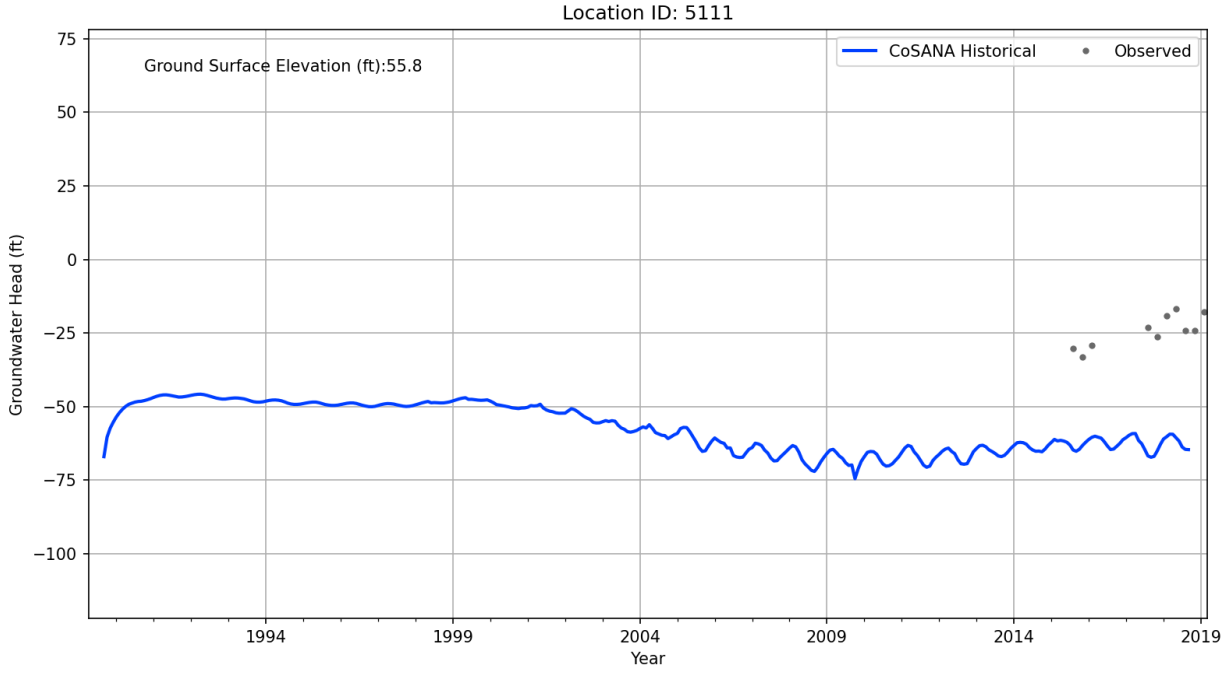

Location ID: 5101
Ground Surface Elevation (ft):32.15
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

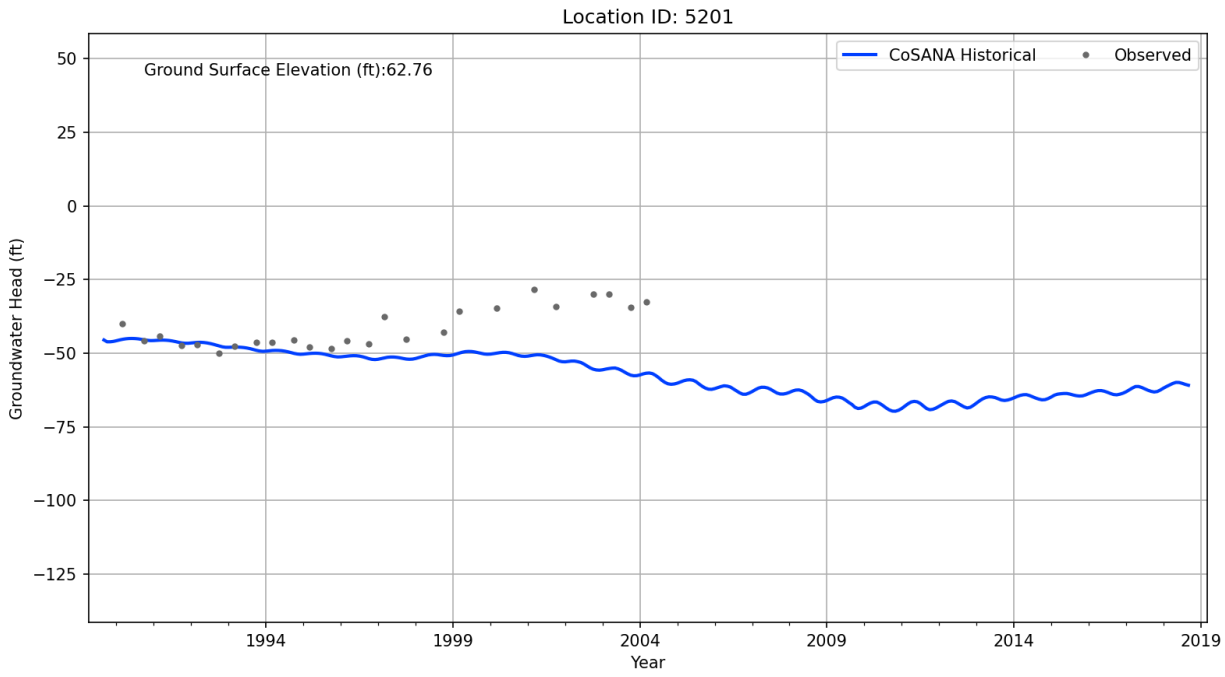

Location ID: 5102
Ground Surface Elevation (ft):28.85
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

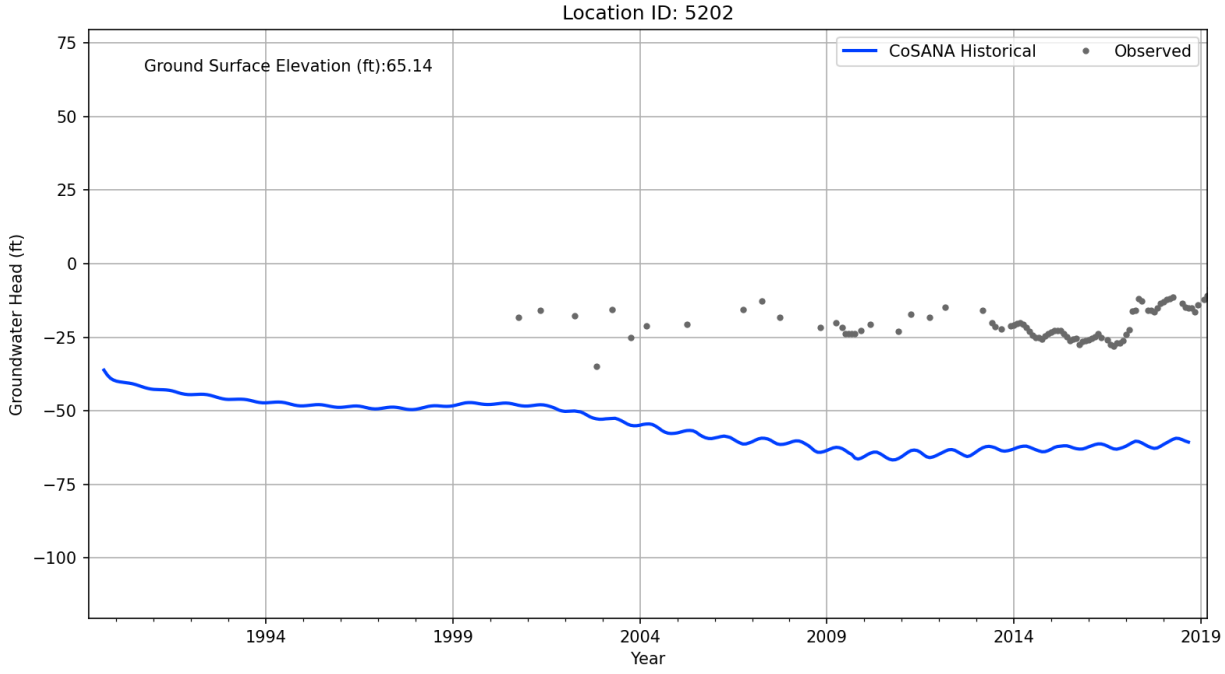

Location ID: 5103
Ground Surface Elevation (ft):26.77
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

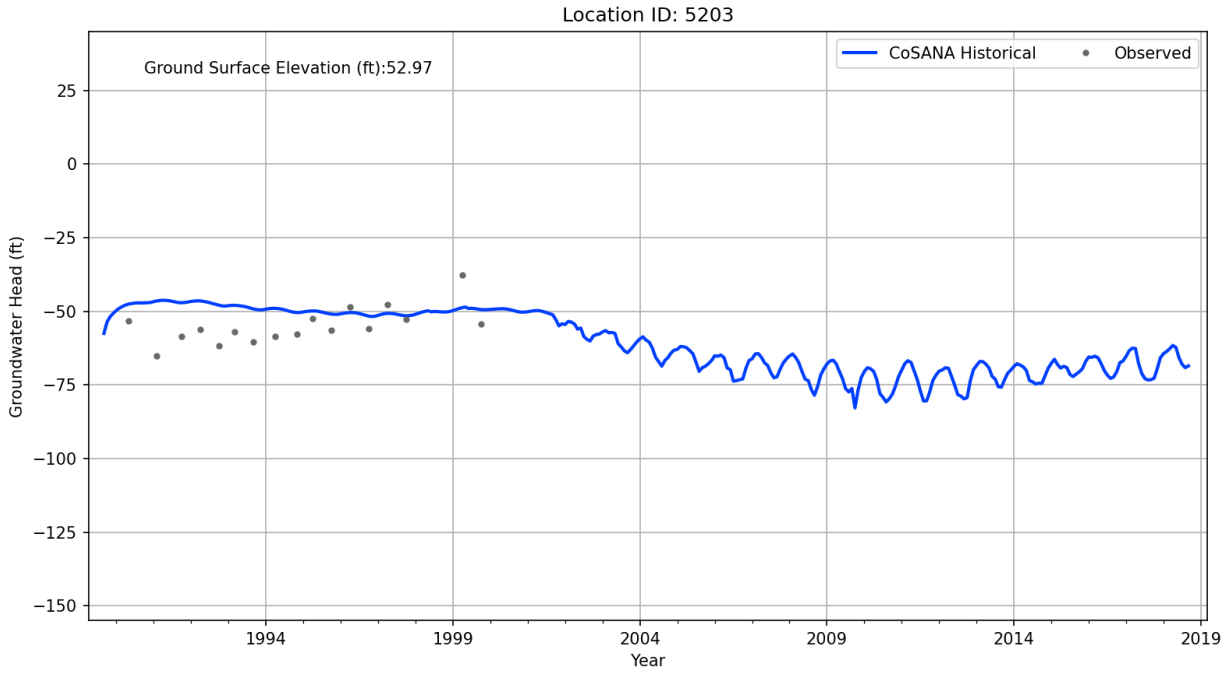

Location ID: 5108
Ground Surface Elevation (ft):37.1
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

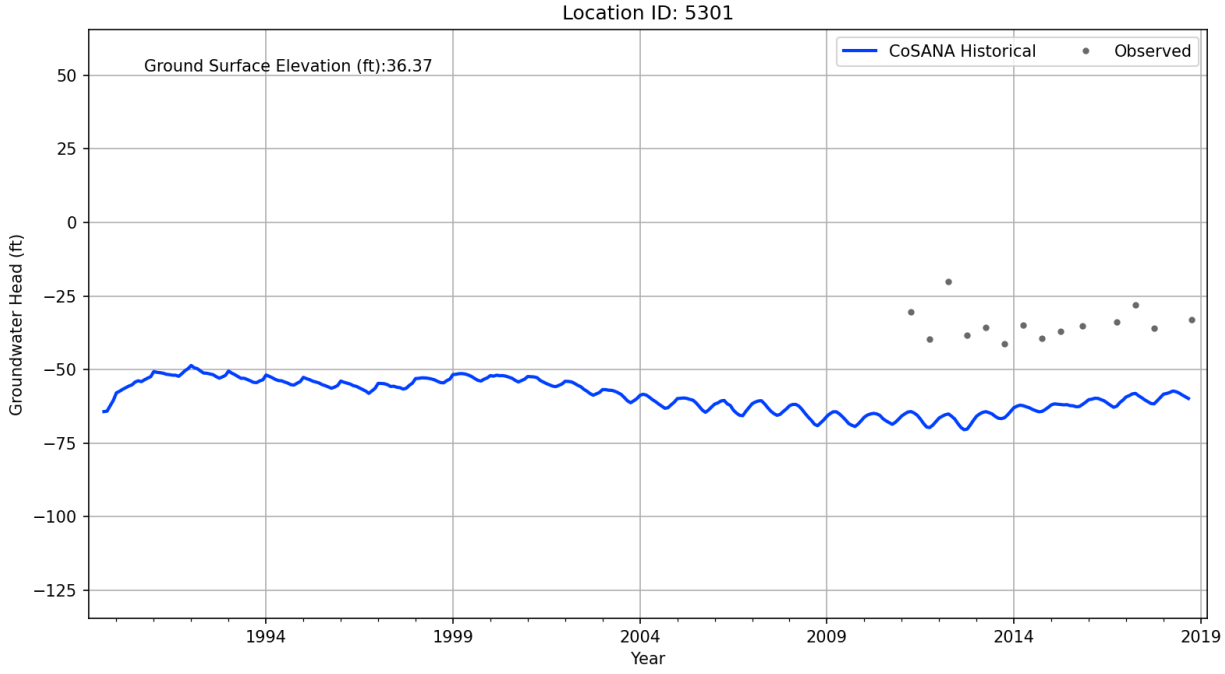

Location ID: 5109
Ground Surface Elevation (ft):47.19
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

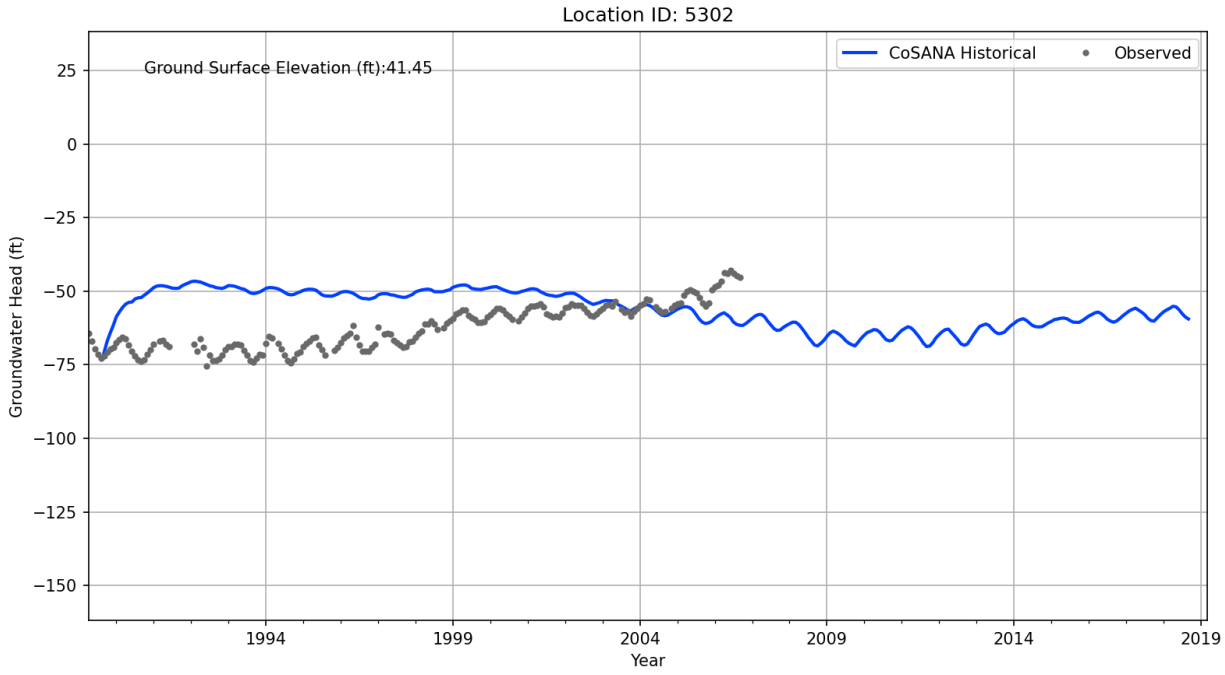

Location ID: 5111
Ground Surface Elevation (ft):55.8
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

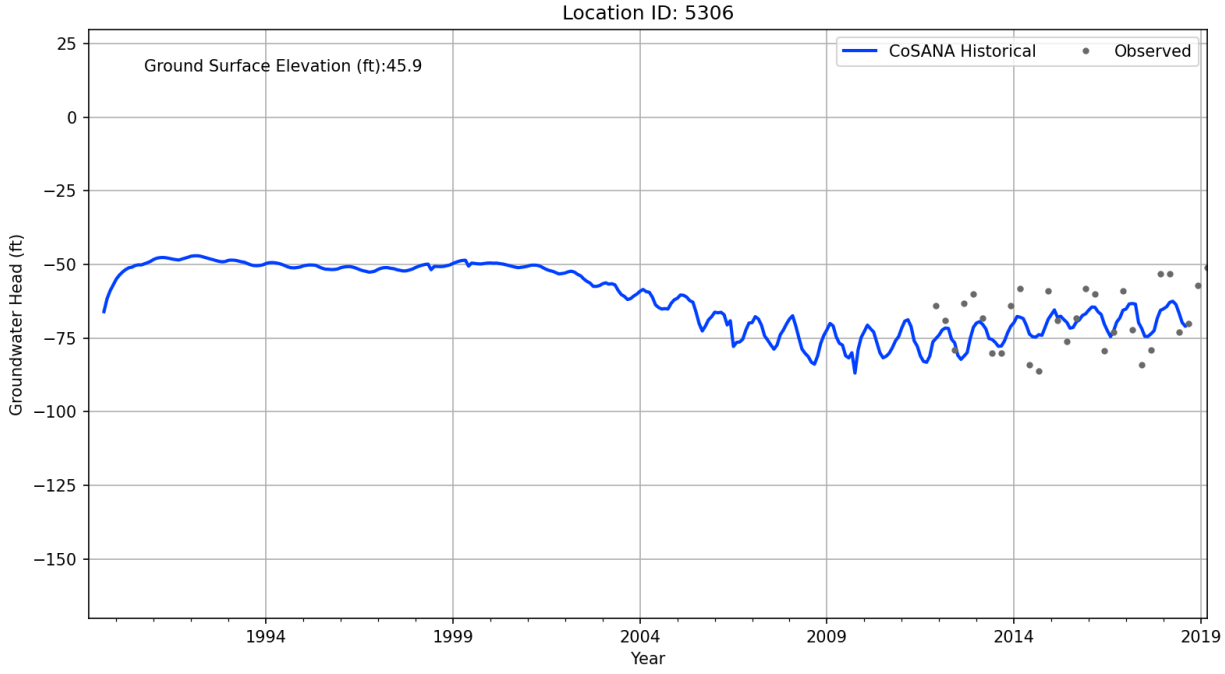

Location ID: 5201
Ground Surface Elevation (ft):62.76
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

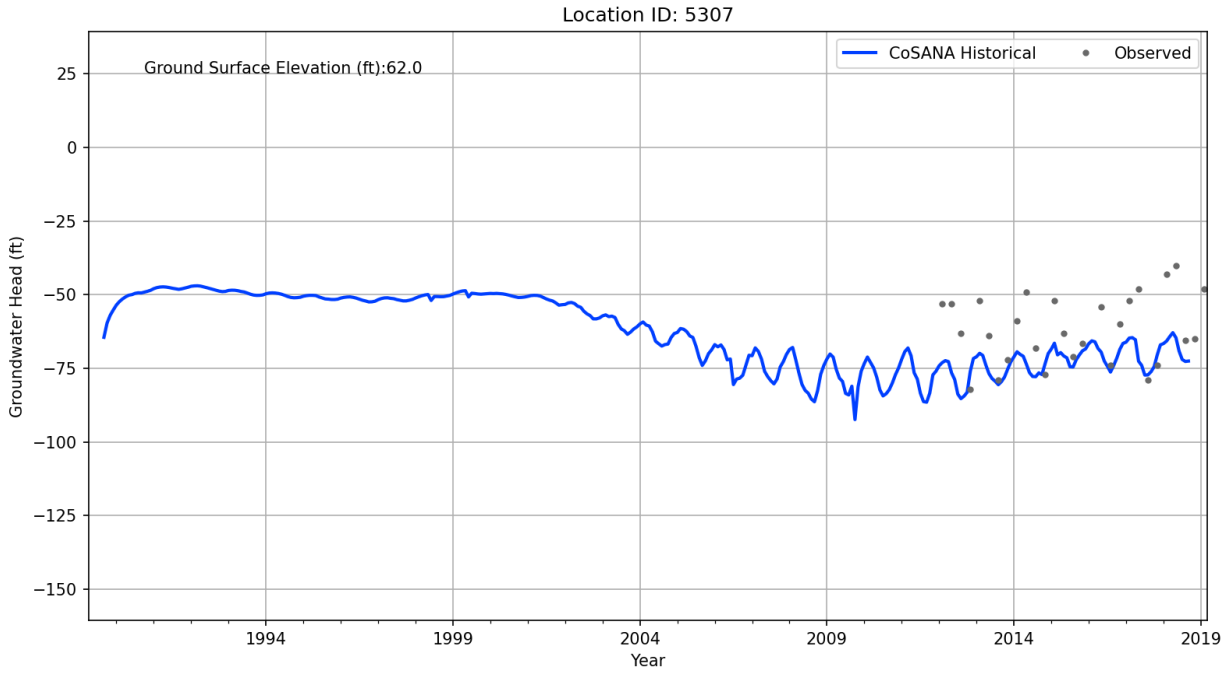

Location ID: 5202
Ground Surface Elevation (ft):65.14
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

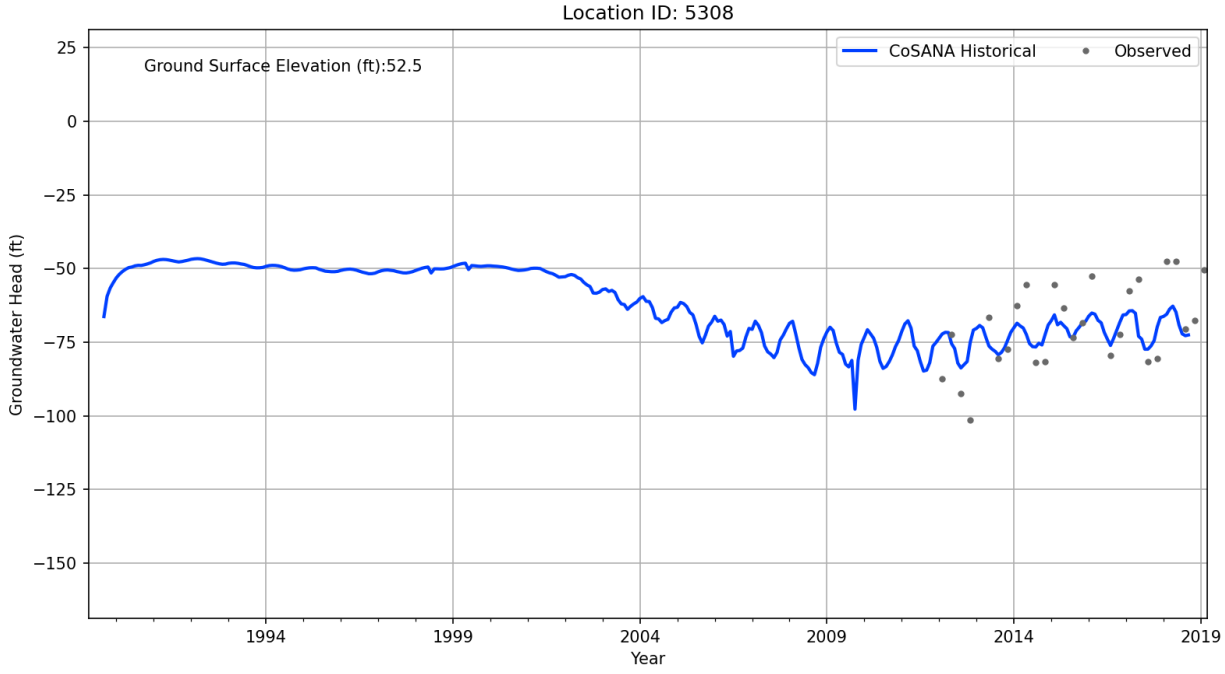

Location ID: 5203
Ground Surface Elevation (ft):52.97
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

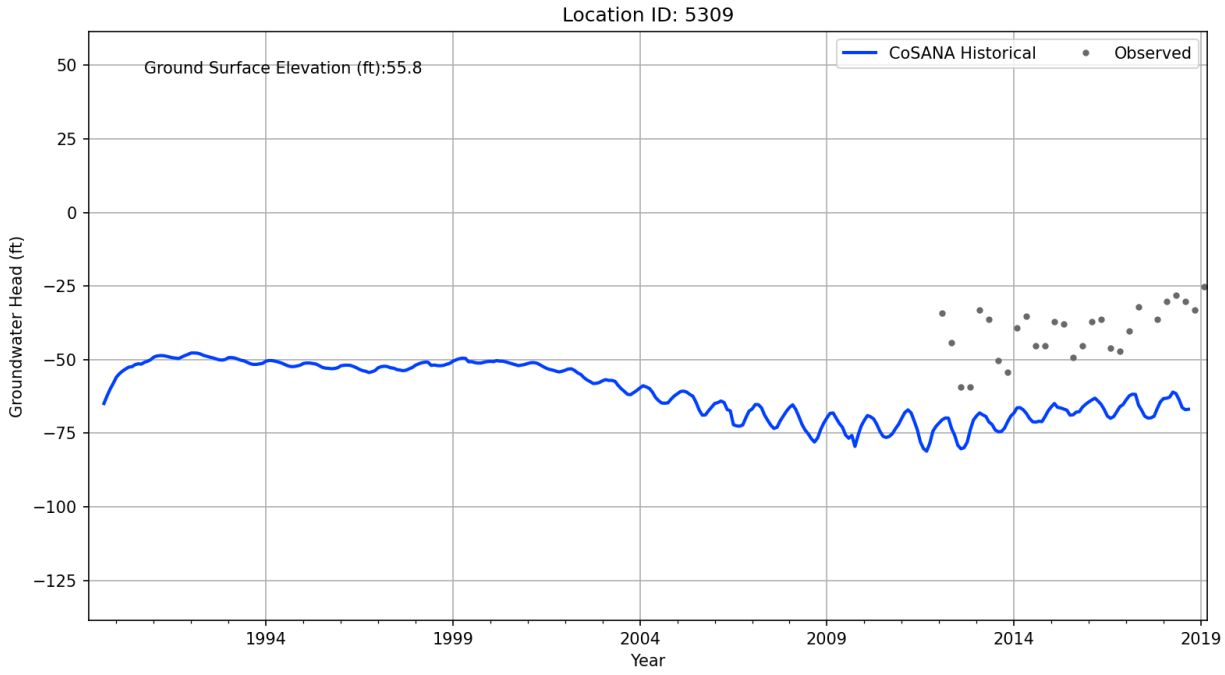

Location ID: 5301
Ground Surface Elevation (ft):36.37
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

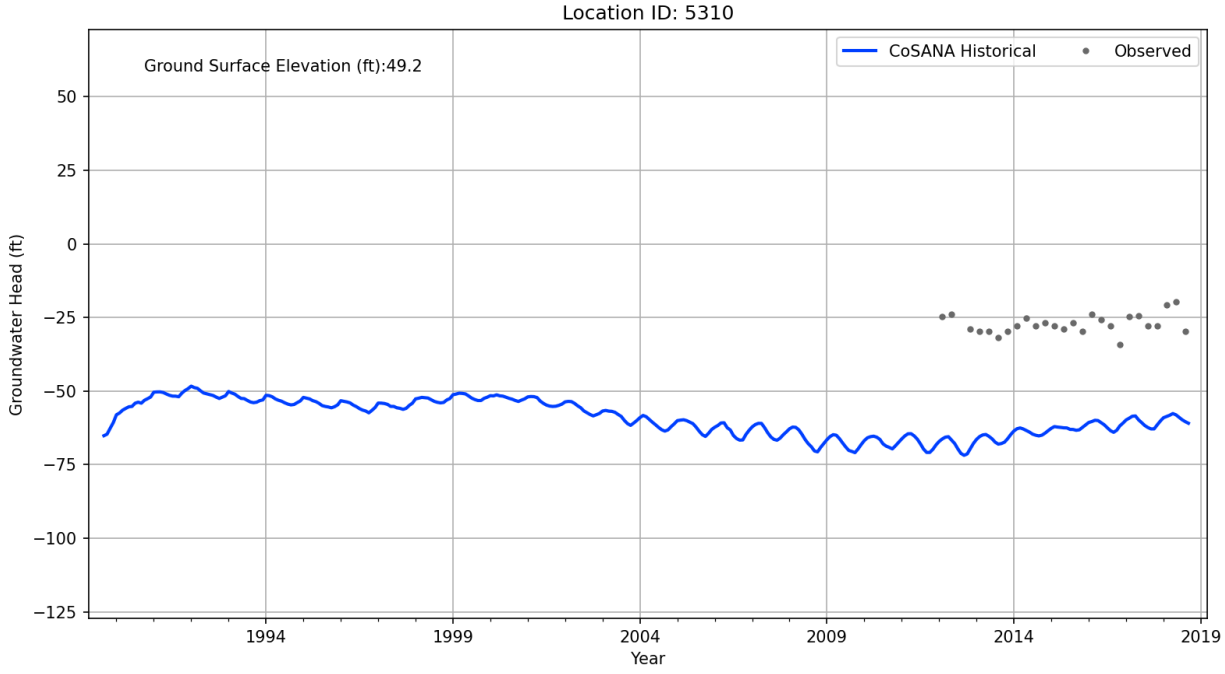

Location ID: 5302
Ground Surface Elevation (ft):41.45
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

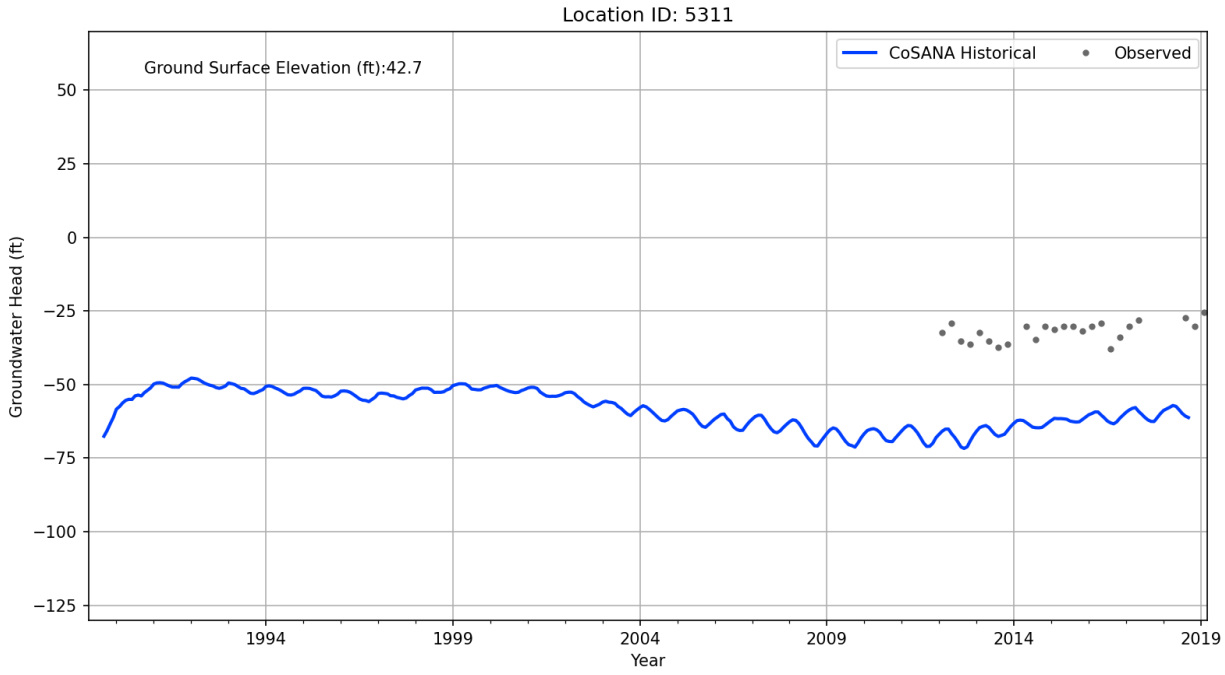

Location ID: 5306
Ground Surface Elevation (ft):45.9
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

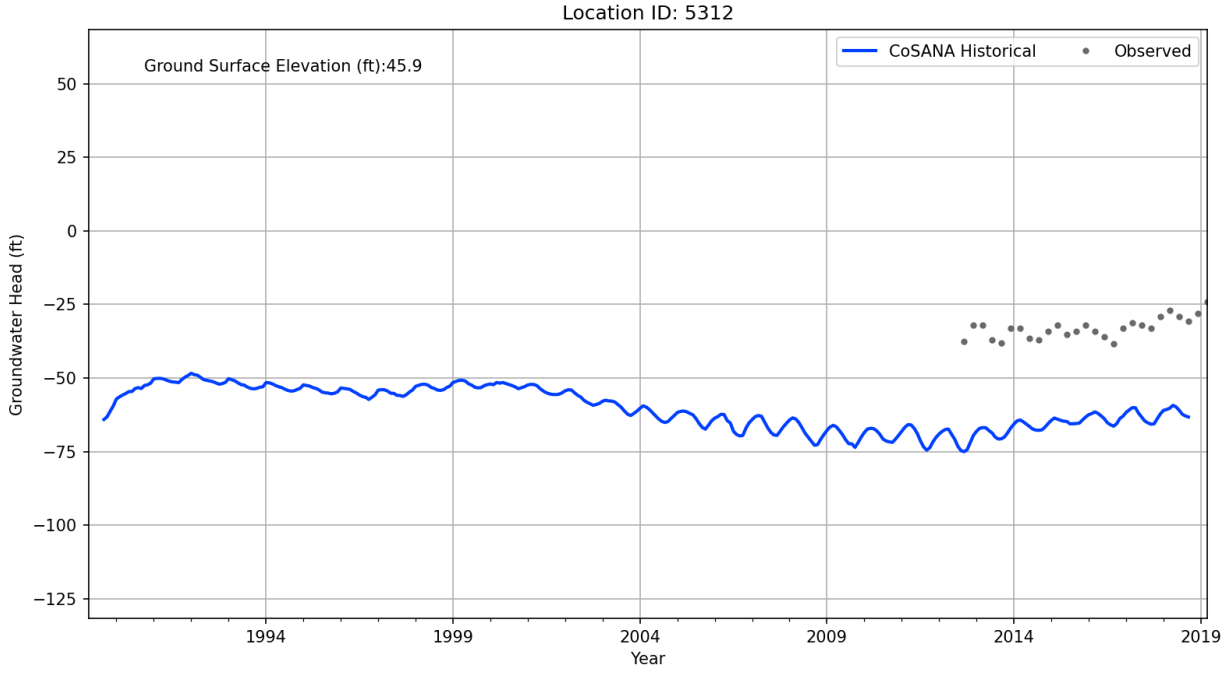

Location ID: 5307
Ground Surface Elevation (ft):62.0
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

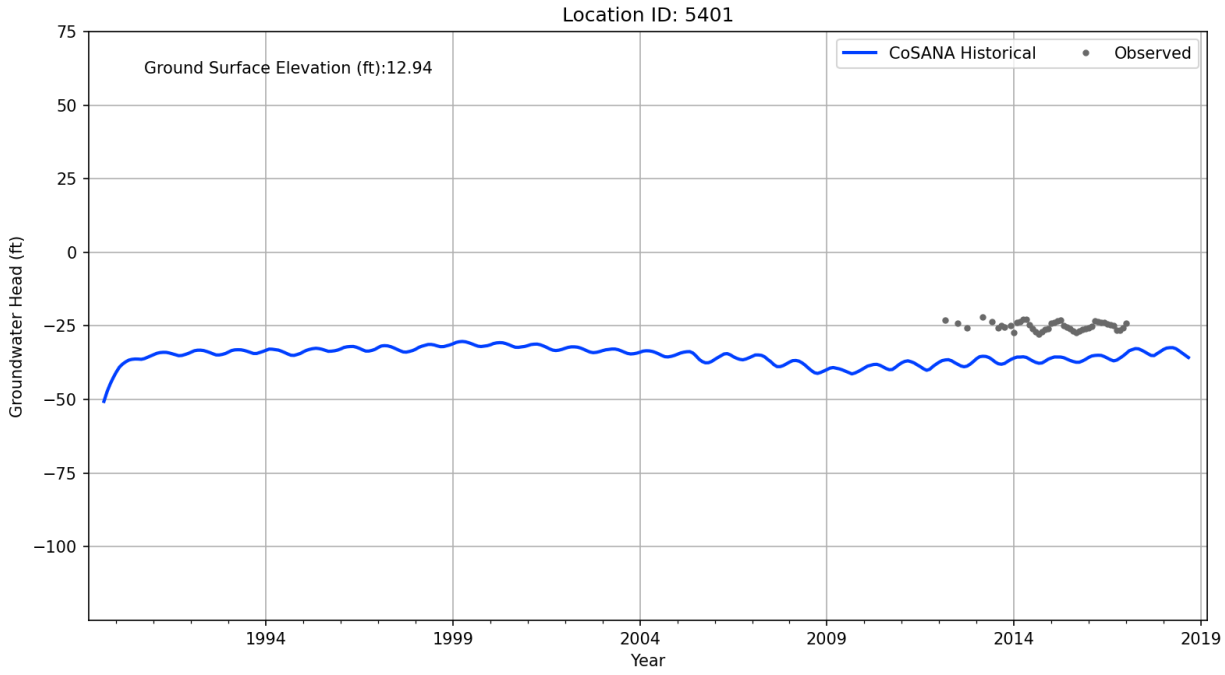

Location ID: 5308
Ground Surface Elevation (ft):52.5
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

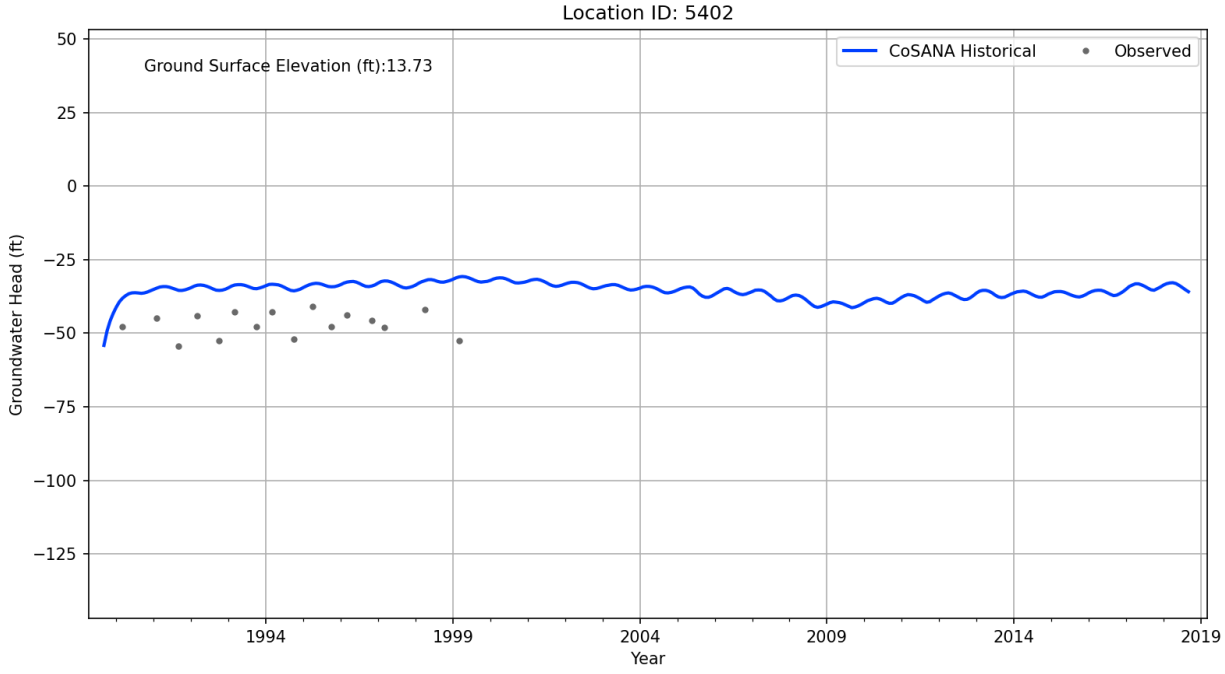

Location ID: 5309
Ground Surface Elevation (ft):55.8
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

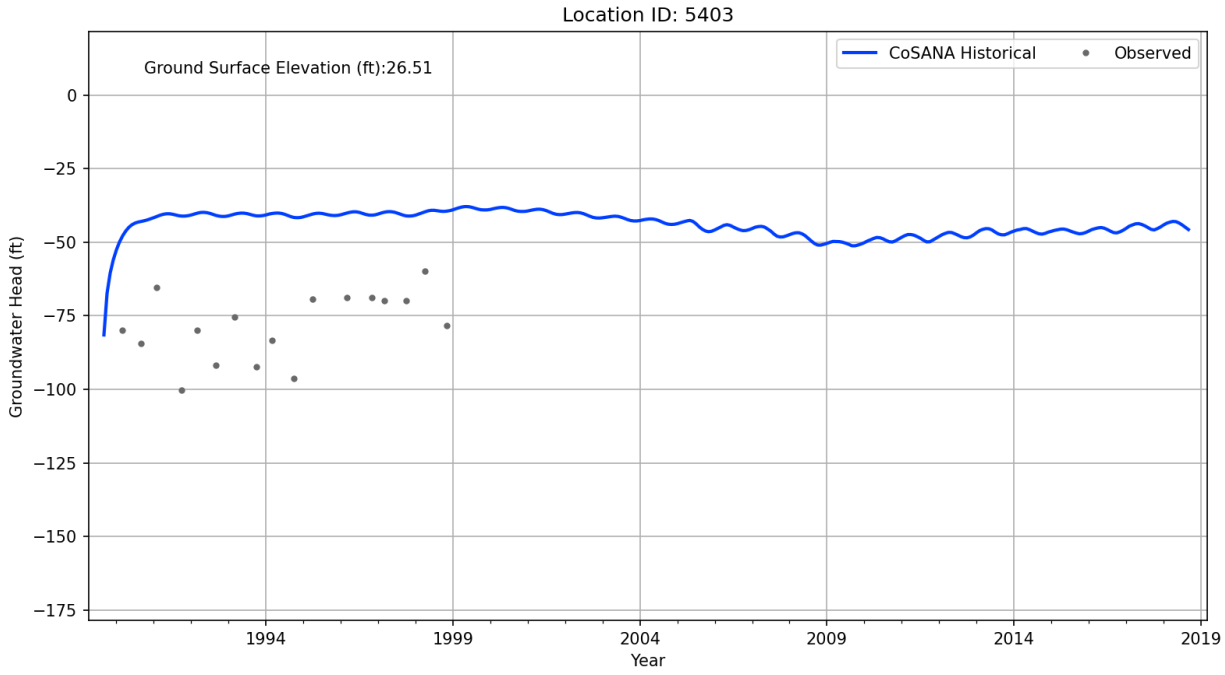

Location ID: 5310
Ground Surface Elevation (ft):49.2
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

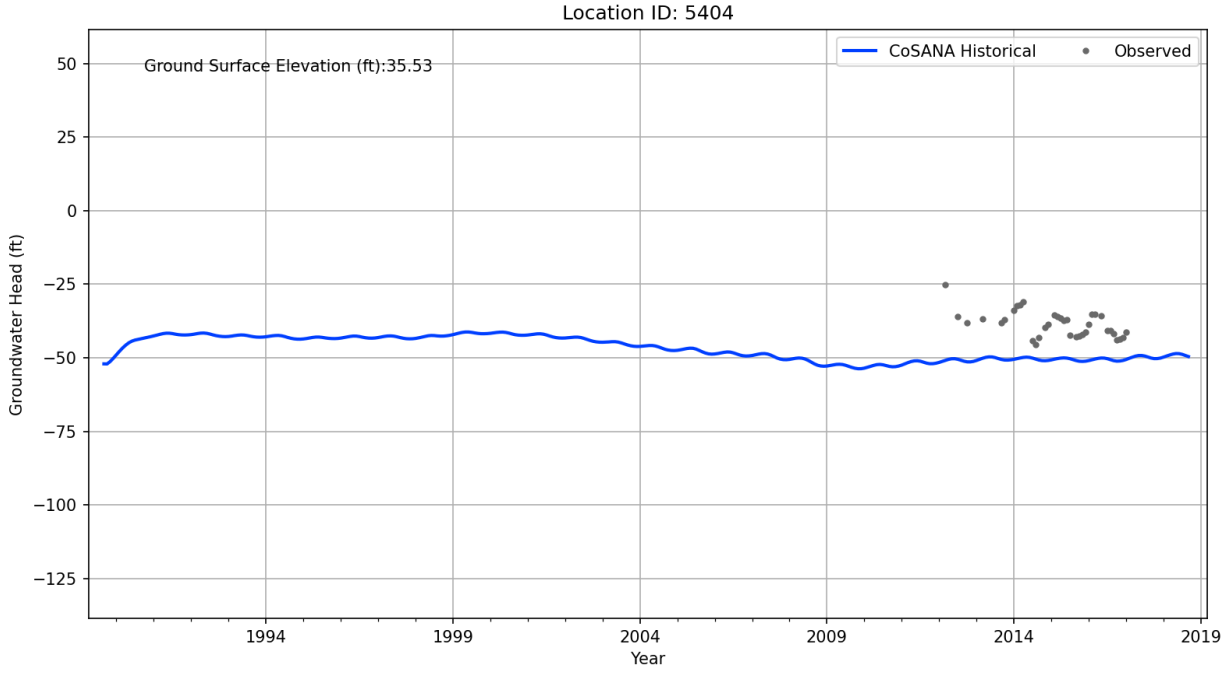

Location ID: 5311
Ground Surface Elevation (ft):42.7
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

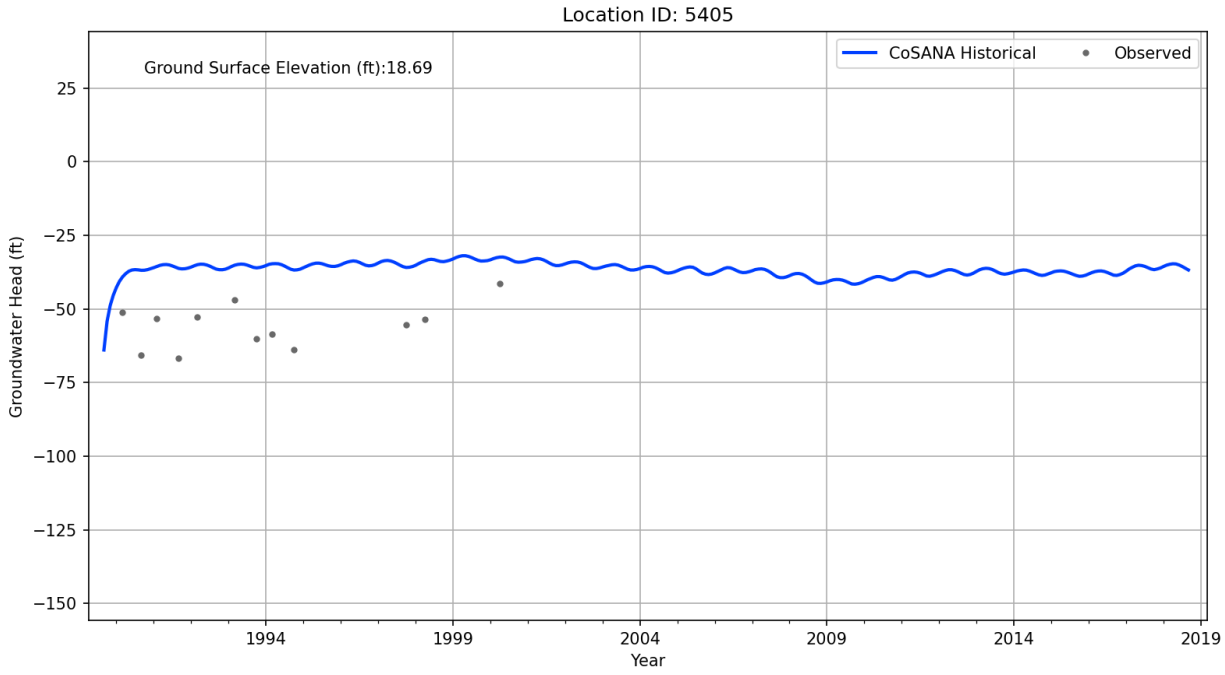

Location ID: 5312
Ground Surface Elevation (ft):45.9
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

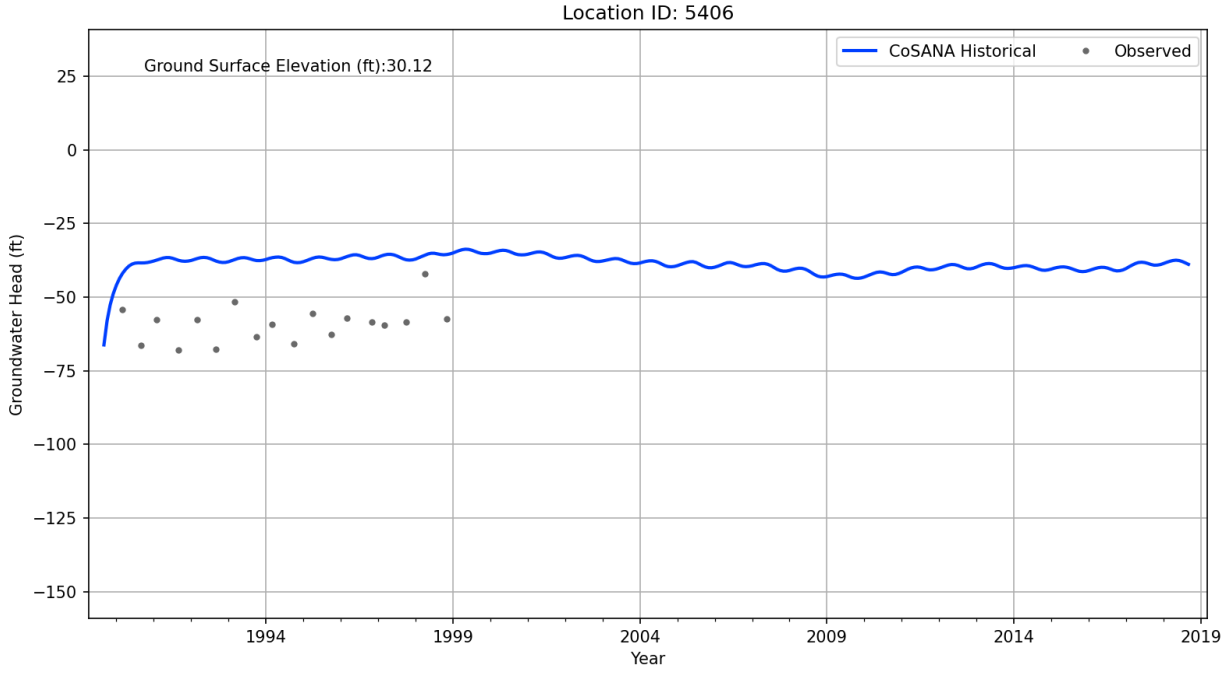

Location ID: 5401
Ground Surface Elevation (ft):12.94
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

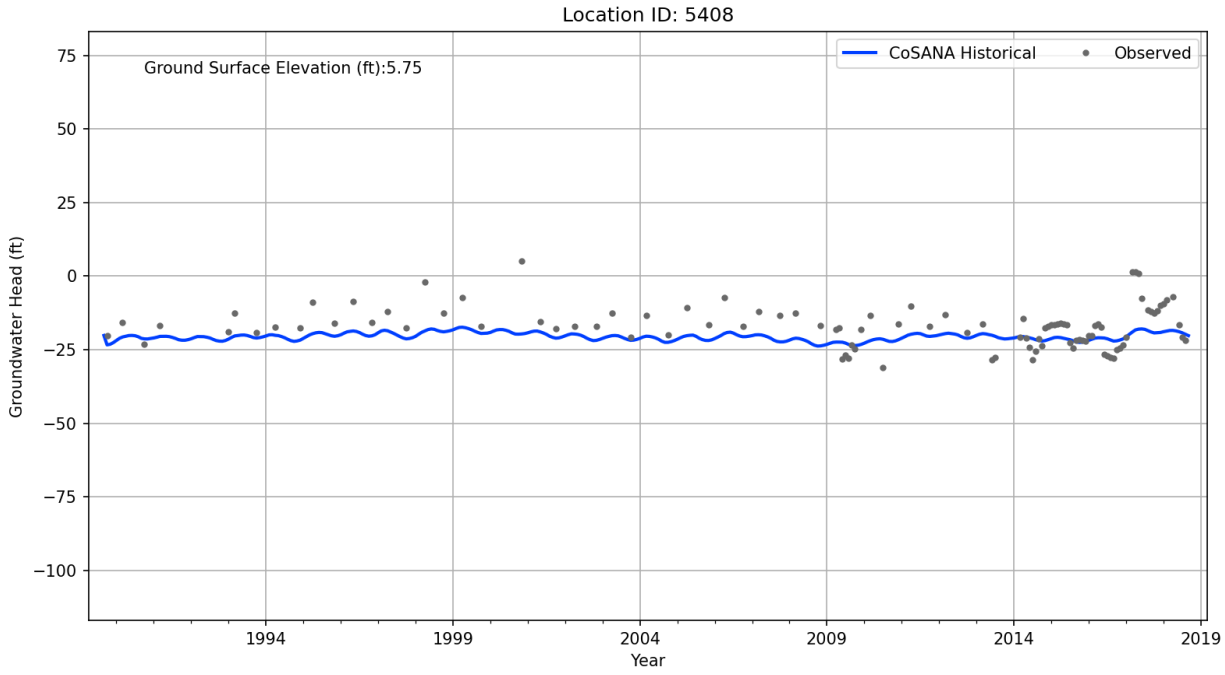

Location ID: 5402
Ground Surface Elevation (ft):13.73
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

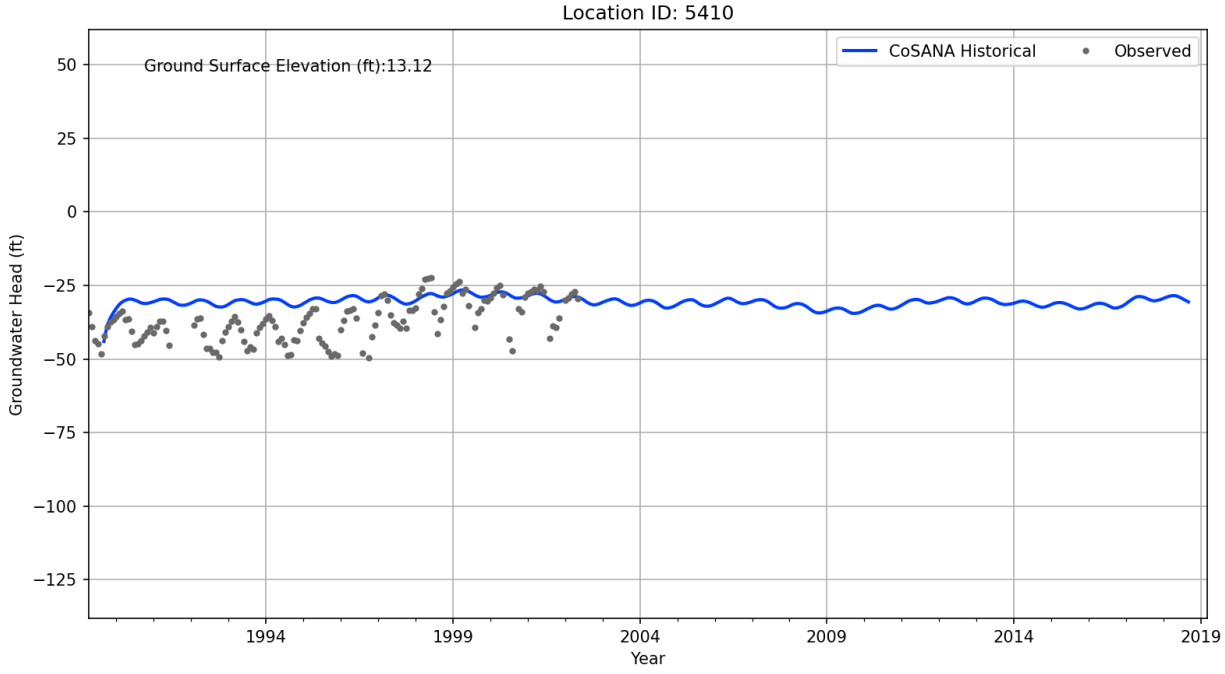

Location ID: 5403
Ground Surface Elevation (ft):26.51
CoSANA Historical
Observed
Groundwater Head (ft)
0
−25
−50
−75
−100
−125
−150
−175
1994
1999
2004
2009
2014
2019
Year

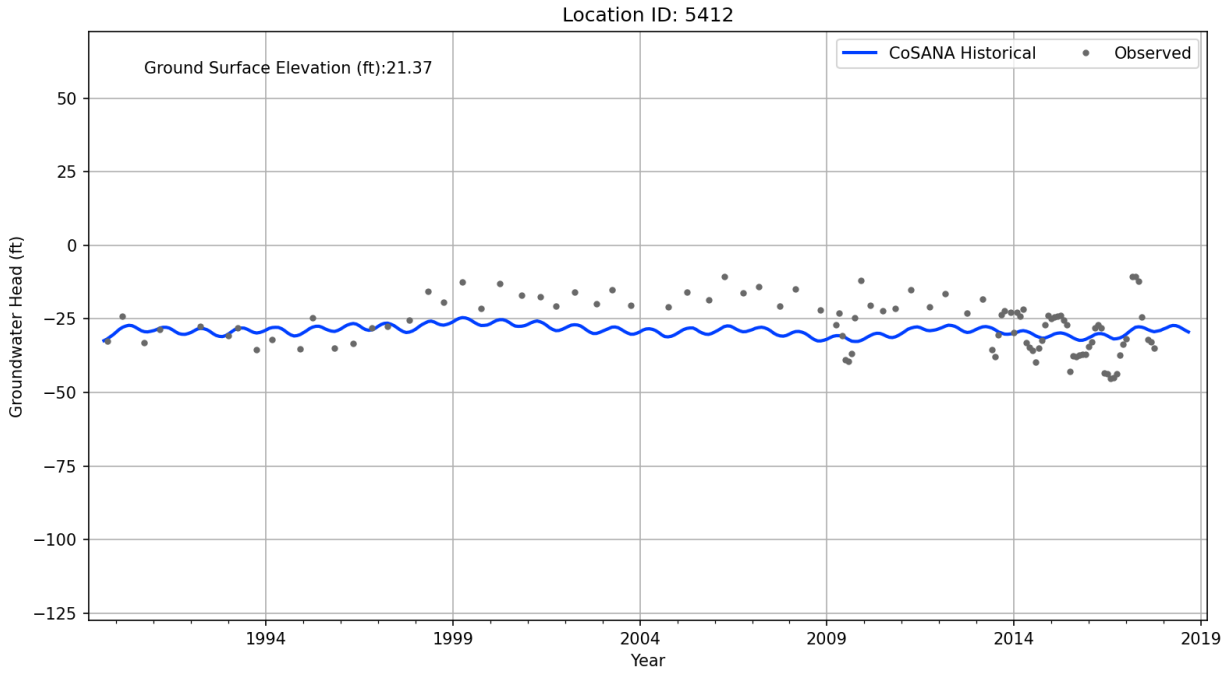

Location ID: 5404
Ground Surface Elevation (ft):35.53
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

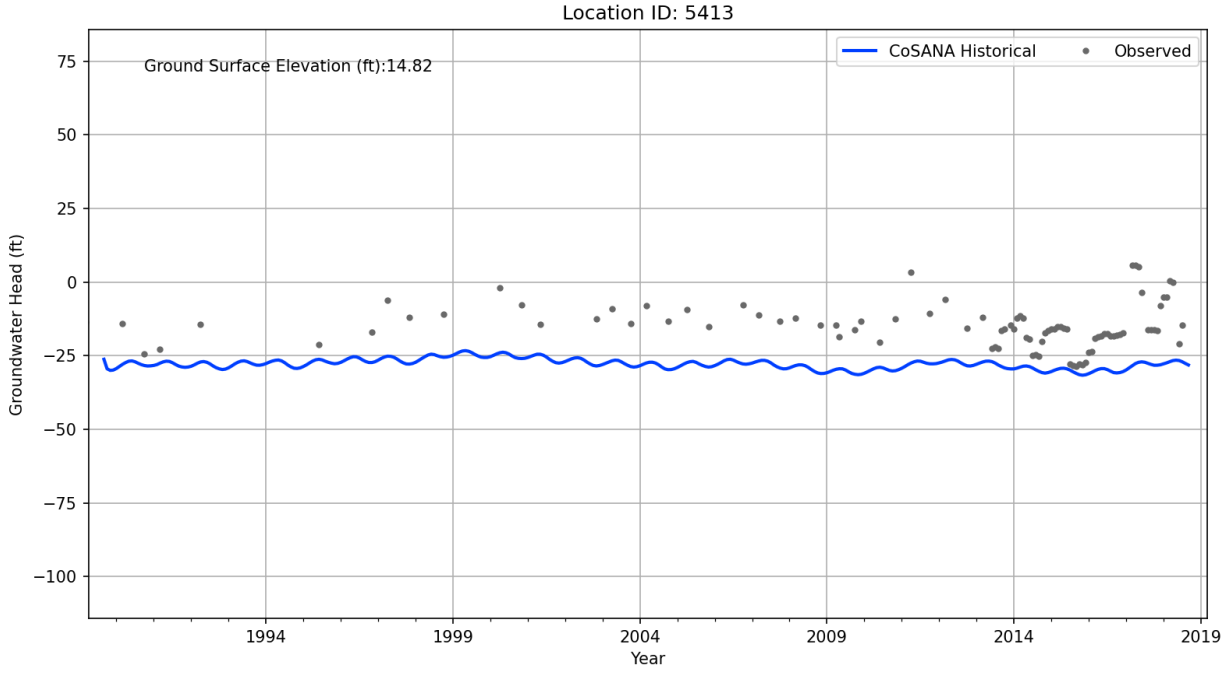

Location ID: 5405
Ground Surface Elevation (ft):18.69
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

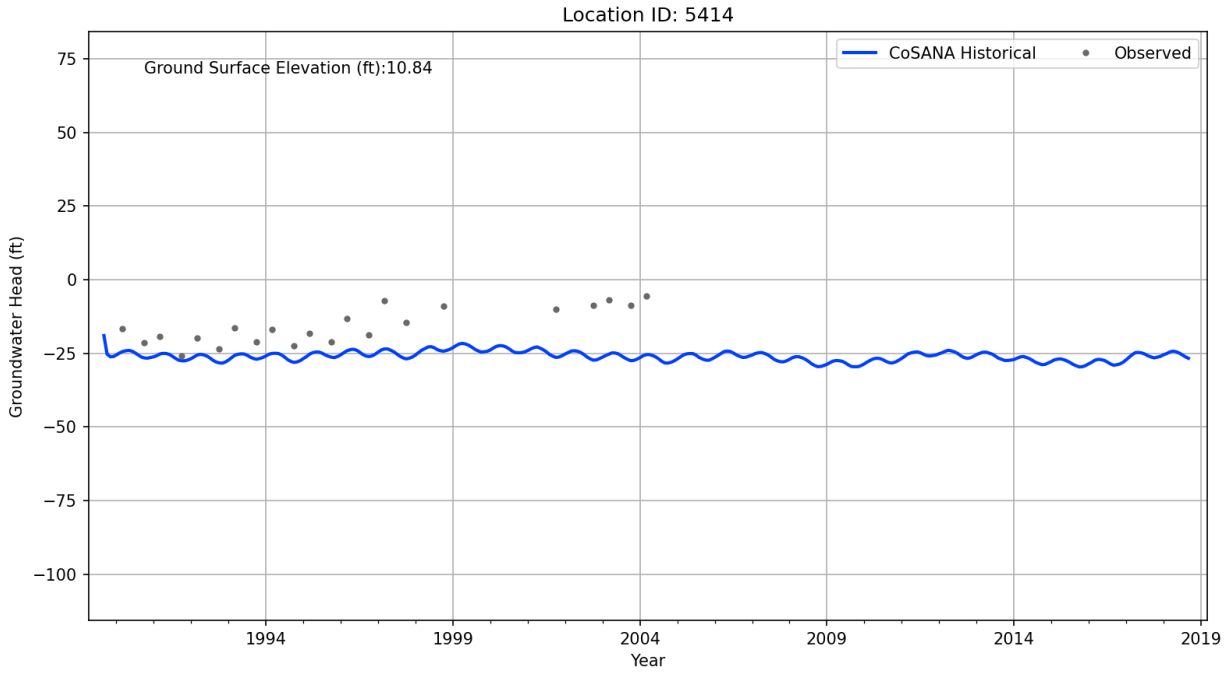

Location ID: 5406
Ground Surface Elevation (ft):30.12
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

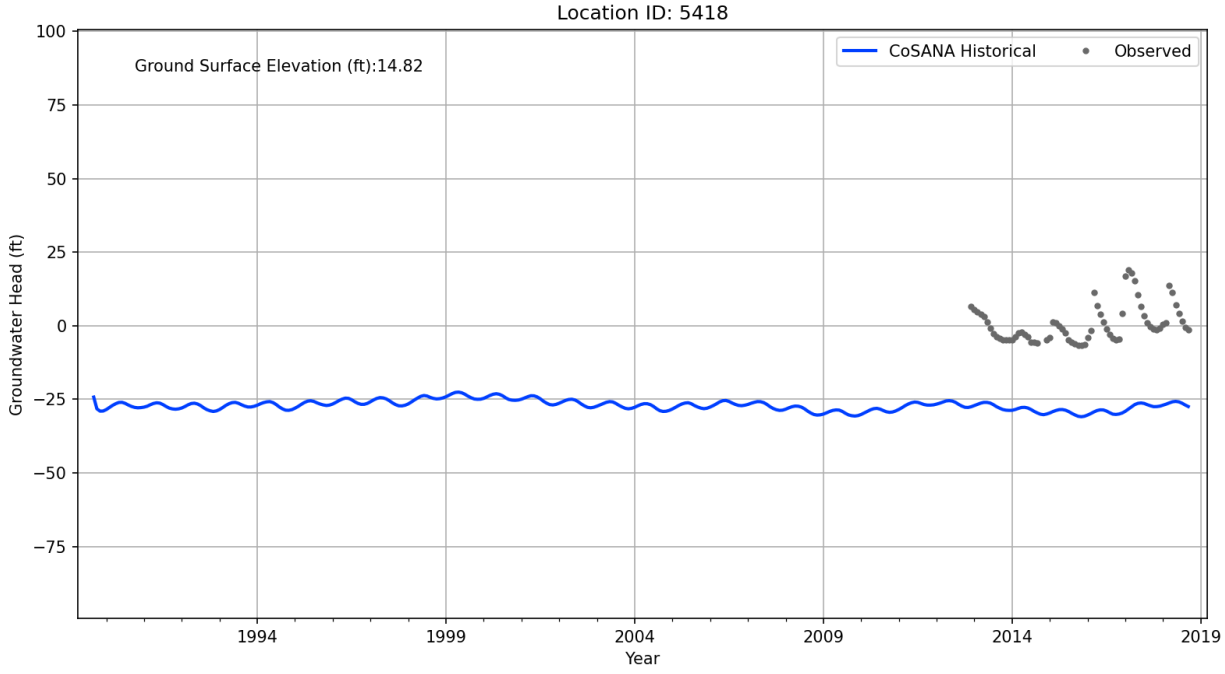

Location ID: 5408
Ground Surface Elevation (ft):5.75
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

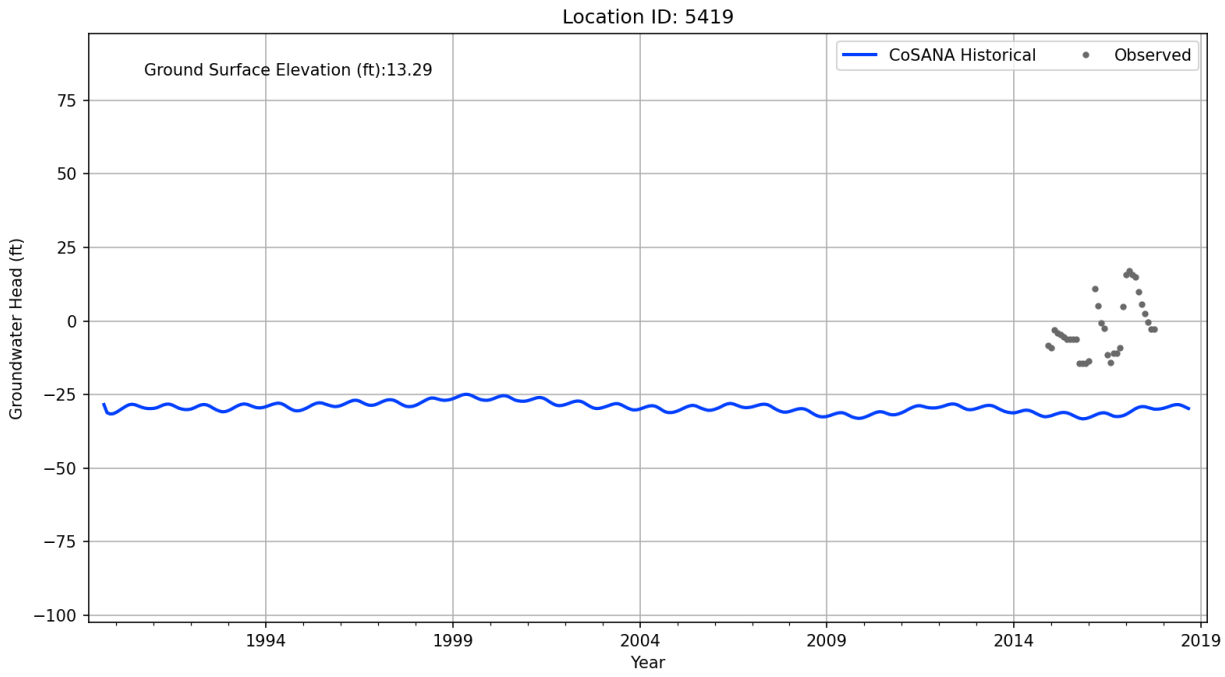

Location ID: 5410
Ground Surface Elevation (ft):13.12
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

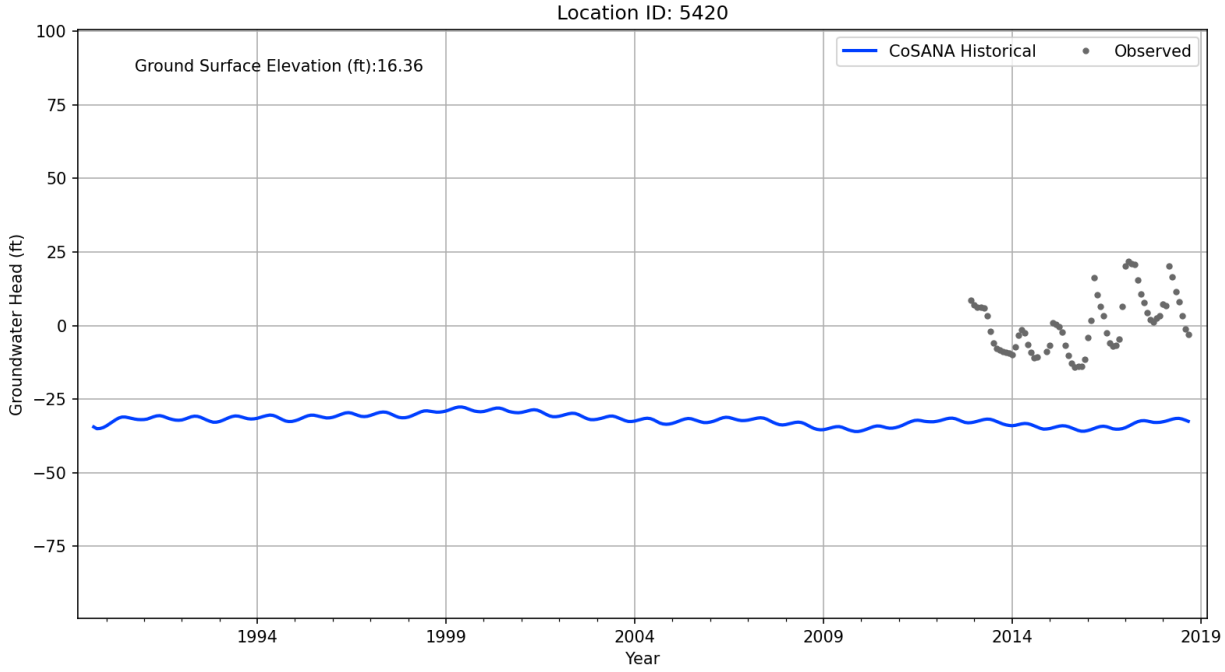

Location ID: 5412
Ground Surface Elevation (ft):21.37
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

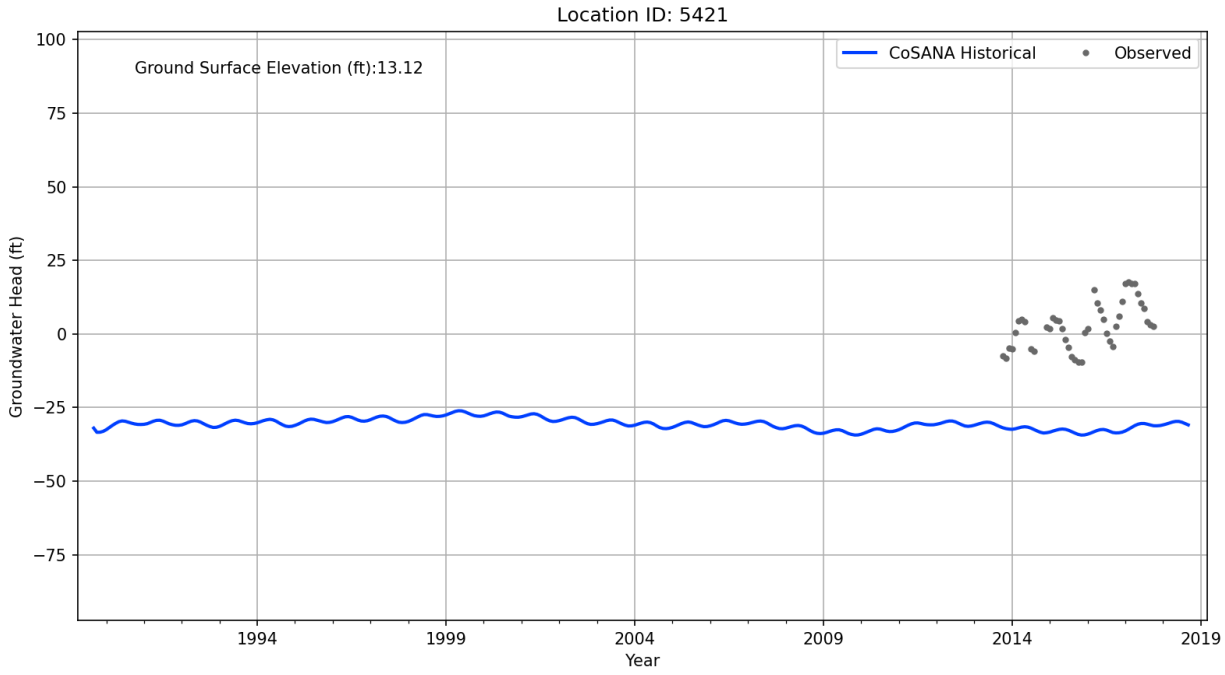

Location ID: 5413
Ground Surface Elevation (ft):14.82
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

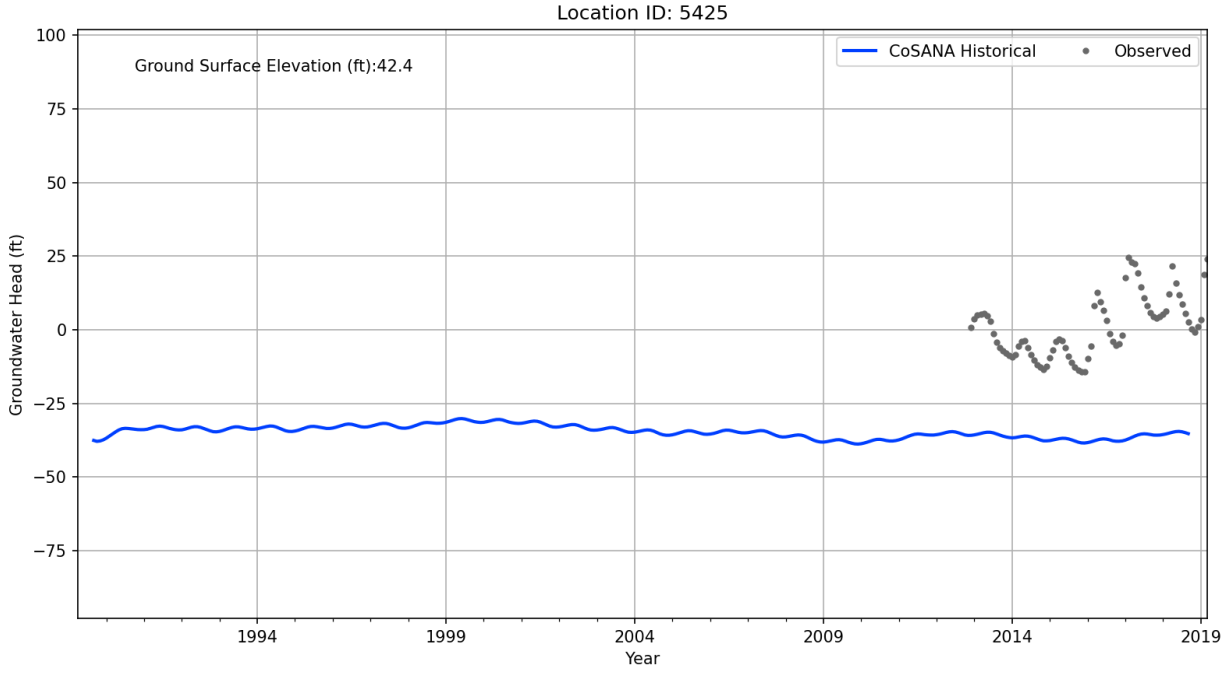

Location ID: 5414
Ground Surface Elevation (ft):10.84
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

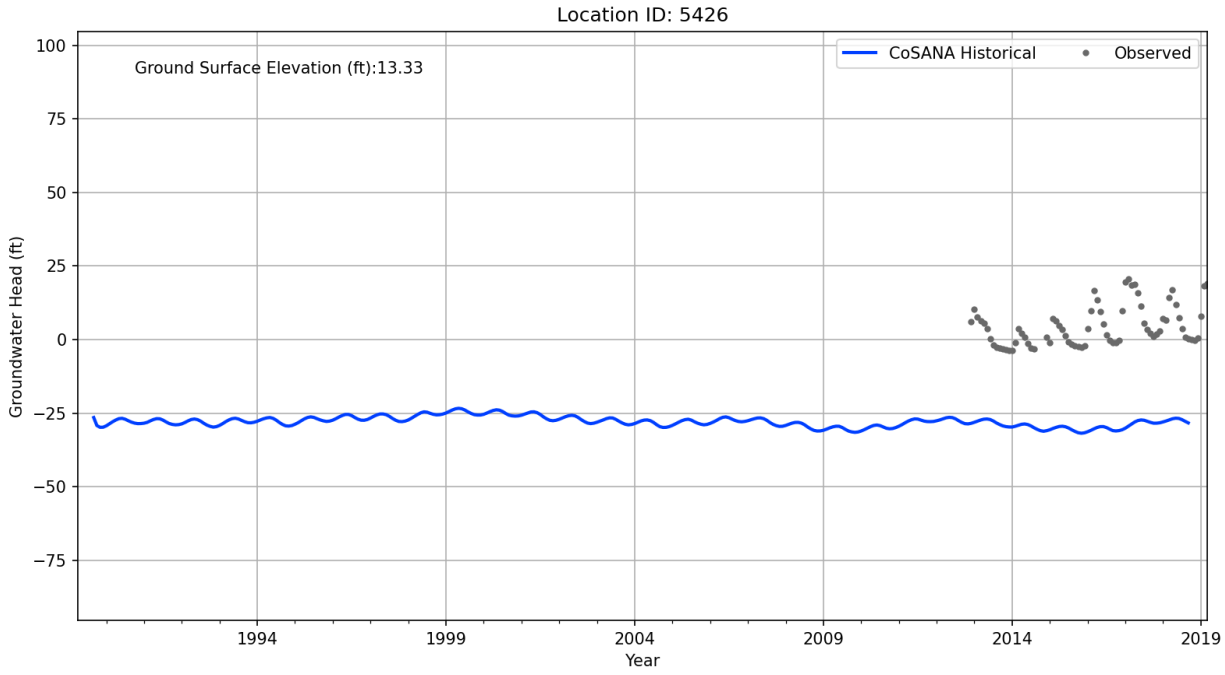

Location ID: 5418
Ground Surface Elevation (ft):14.82
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

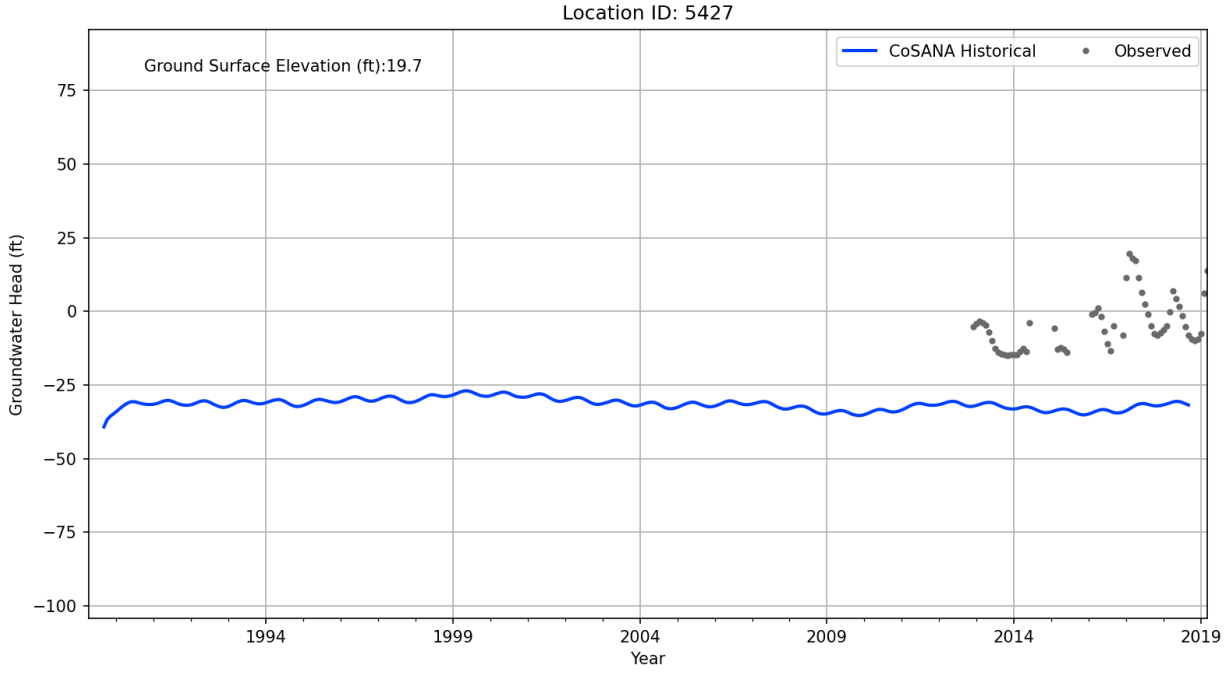

Location ID: 5419
Ground Surface Elevation (ft):13.29
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

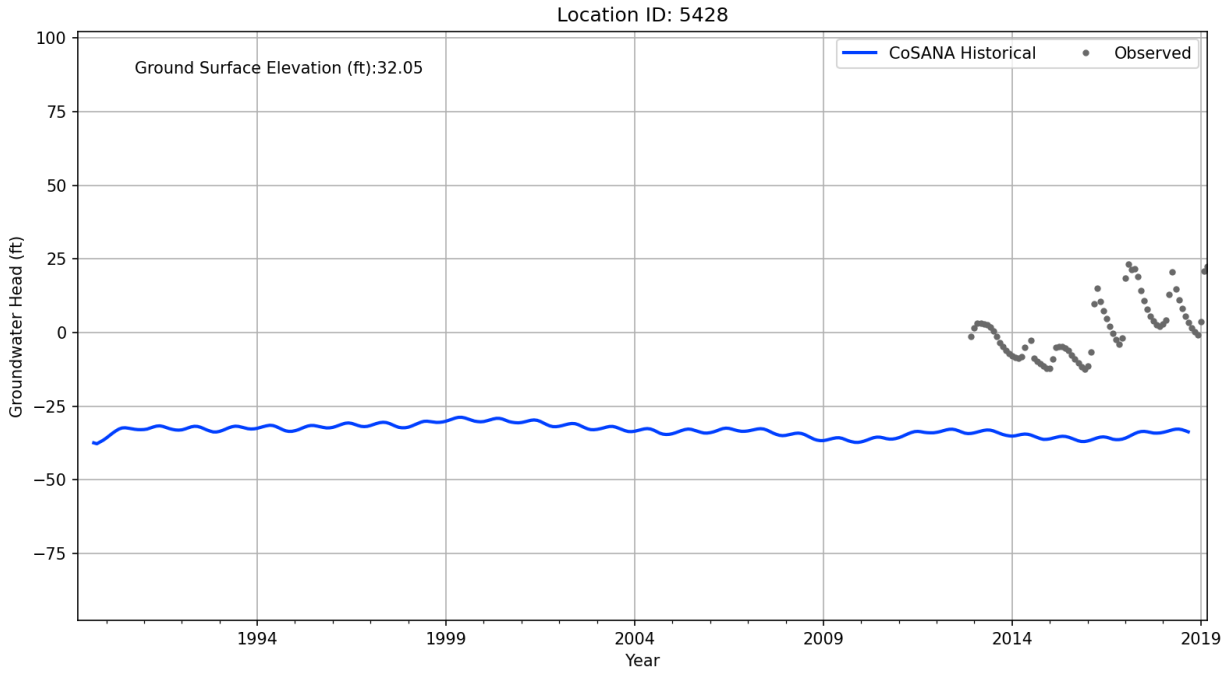

Location ID: 5420
Ground Surface Elevation (ft):16.36
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

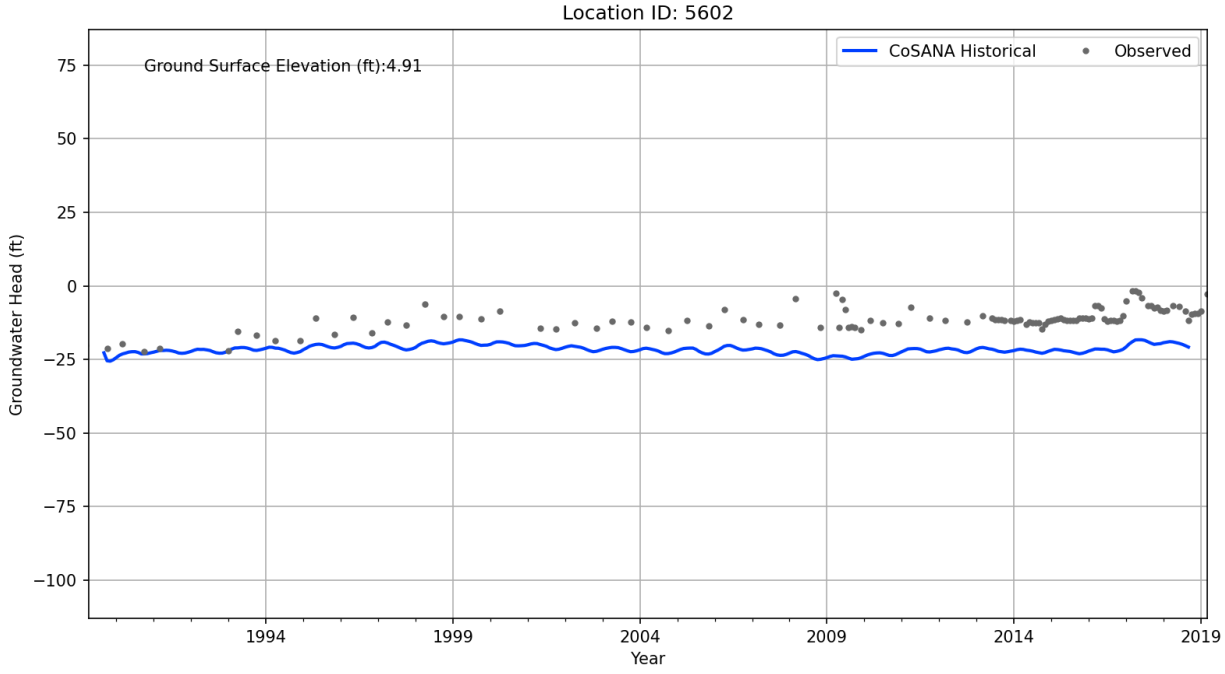

Location ID: 5421
Ground Surface Elevation (ft):13.12
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

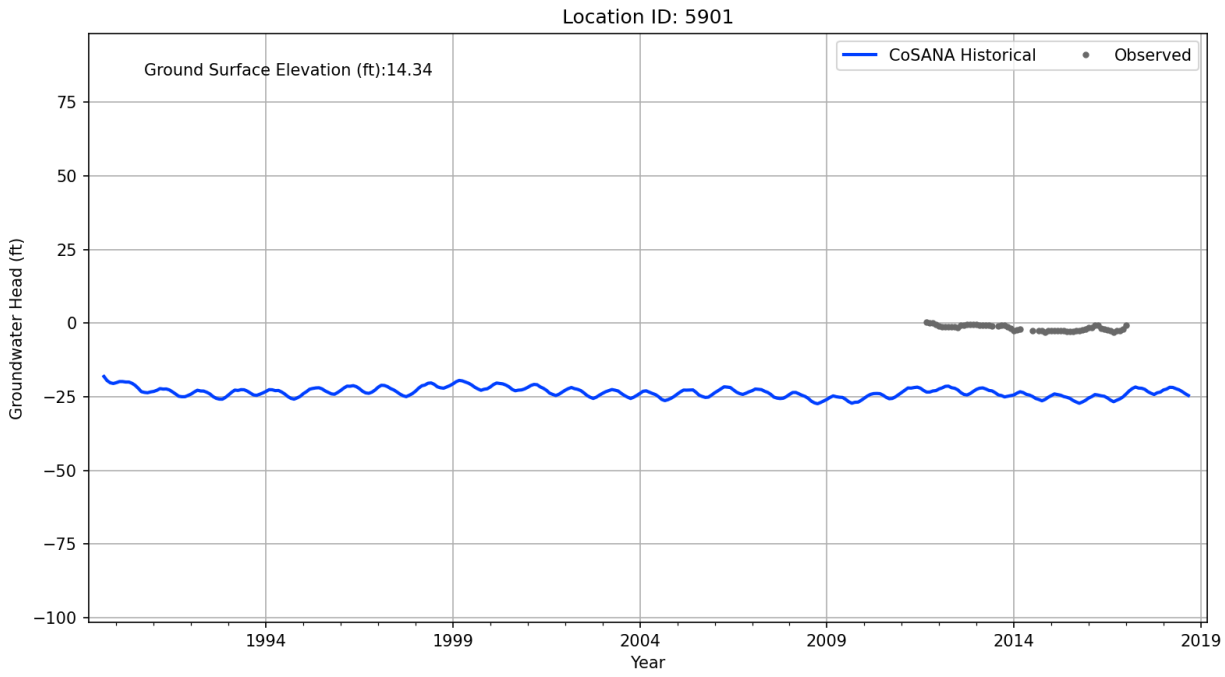

Location ID: 5425
Ground Surface Elevation (ft):42.4
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

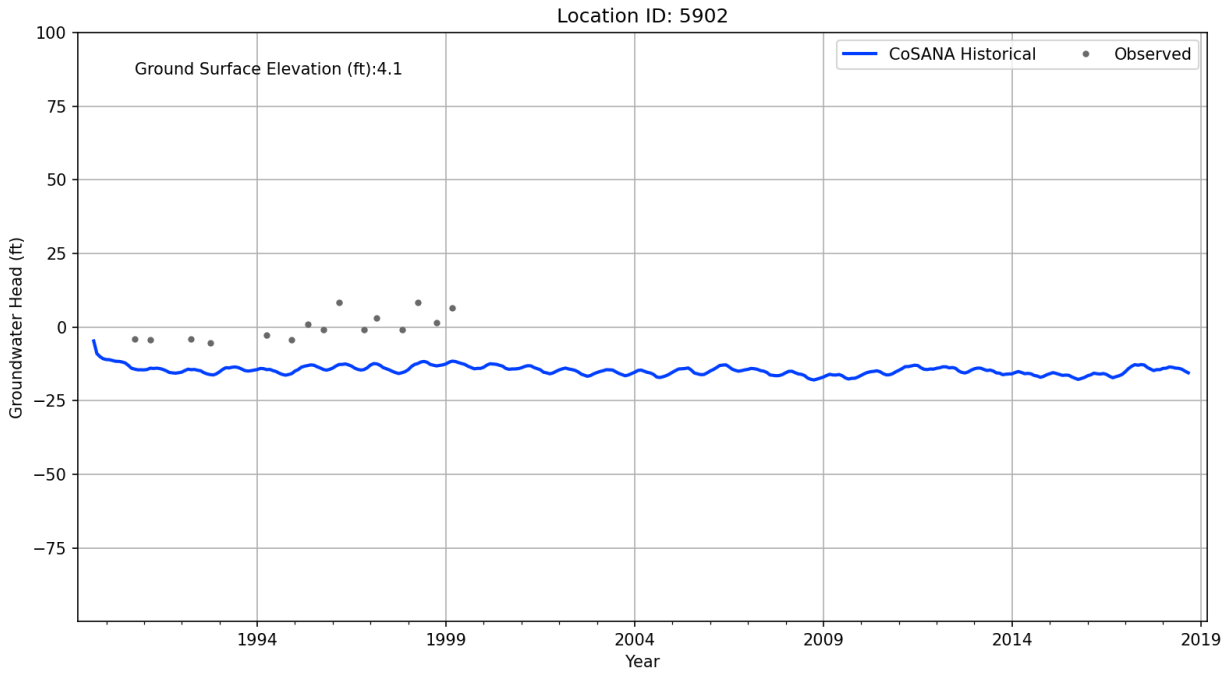

Location ID: 5426
Ground Surface Elevation (ft):13.33
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

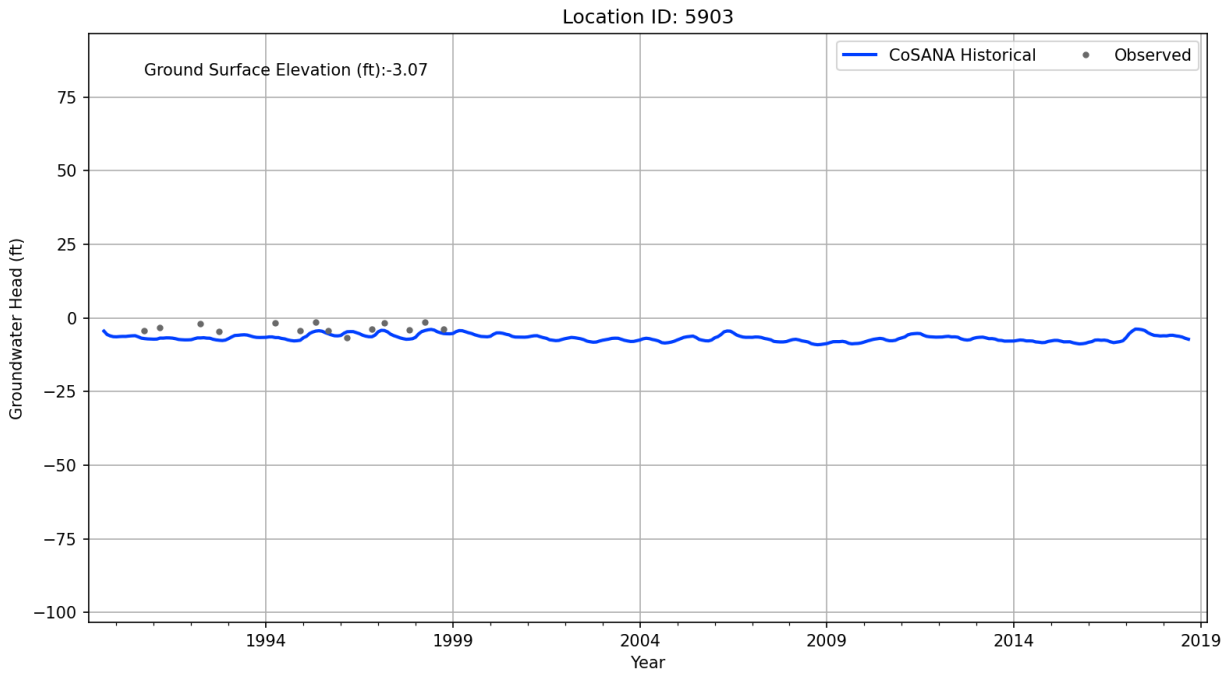

Location ID: 5427
Ground Surface Elevation (ft):19.7
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

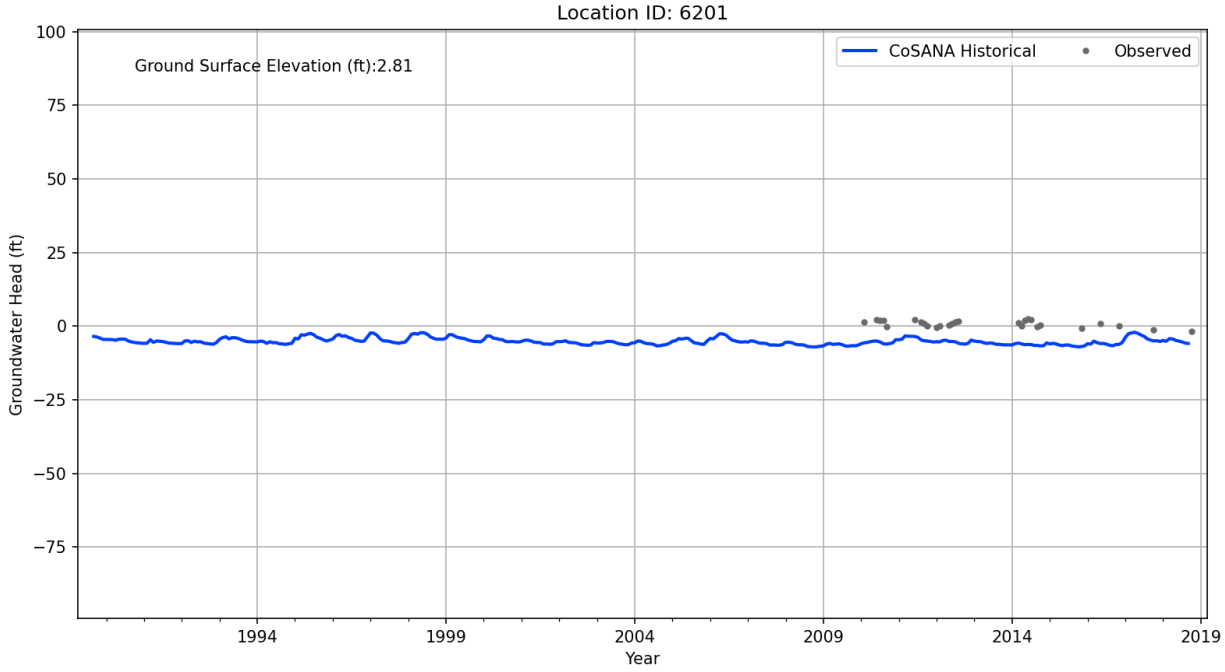

Location ID: 5428
Ground Surface Elevation (ft):32.05
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

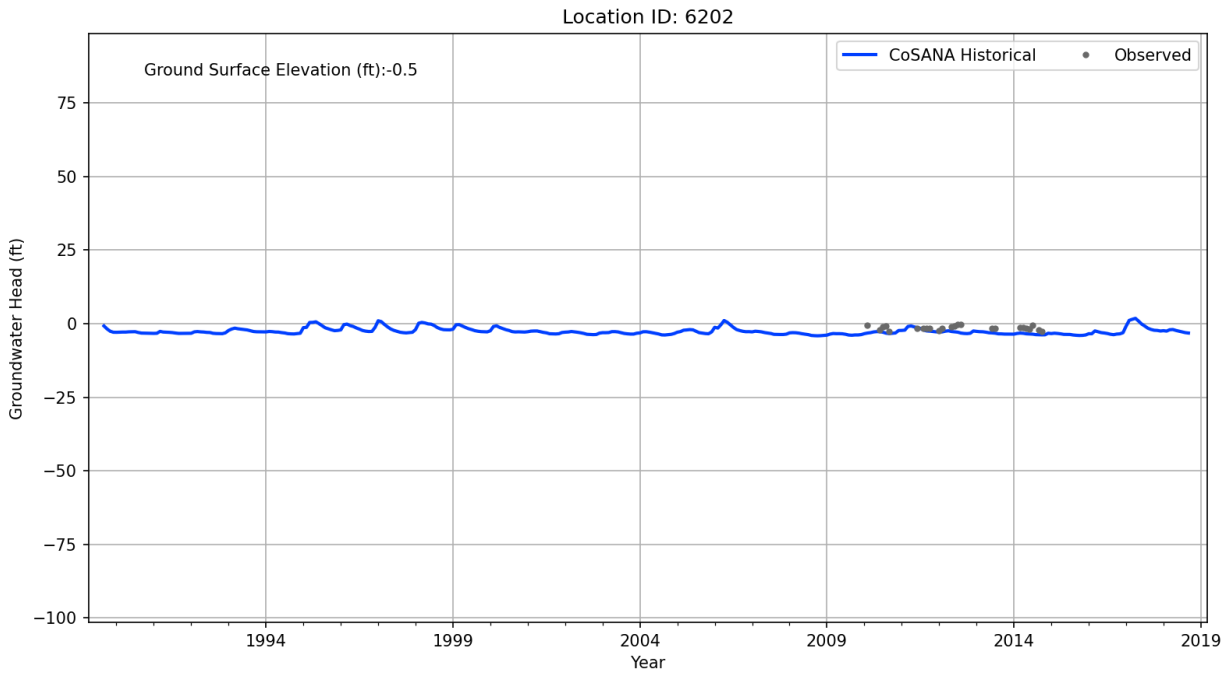

Location ID: 5602
Ground Surface Elevation (ft):4.91
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

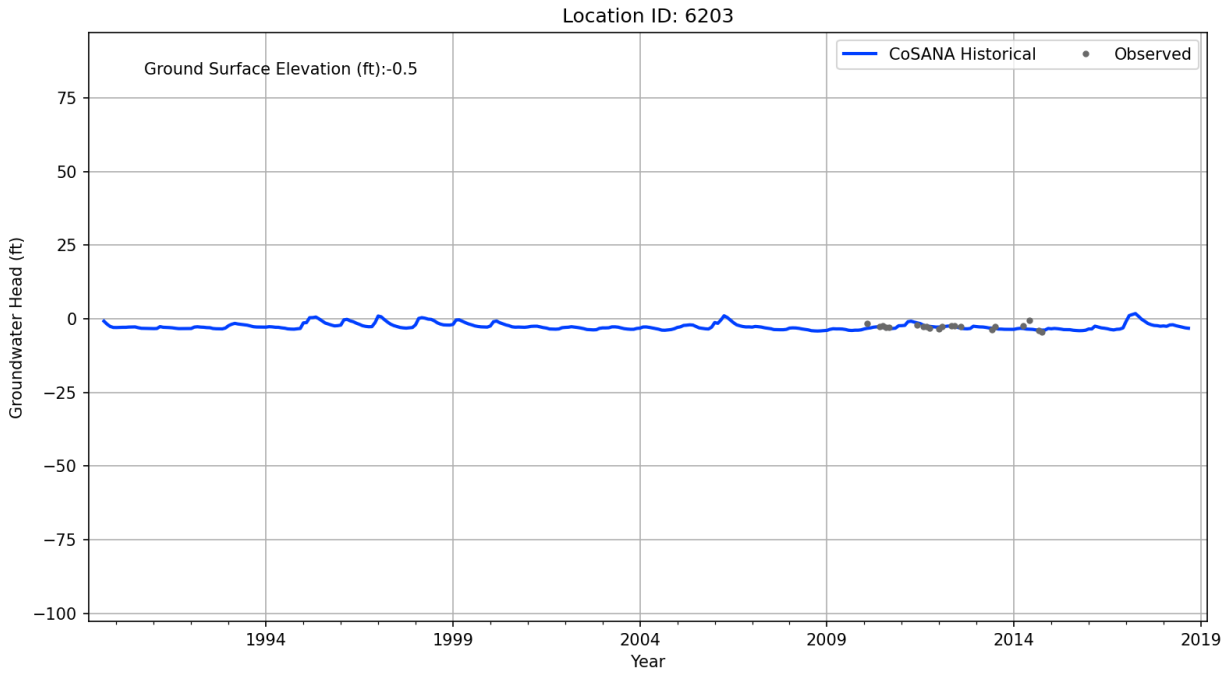

Location ID: 5901
Ground Surface Elevation (ft):14.34
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

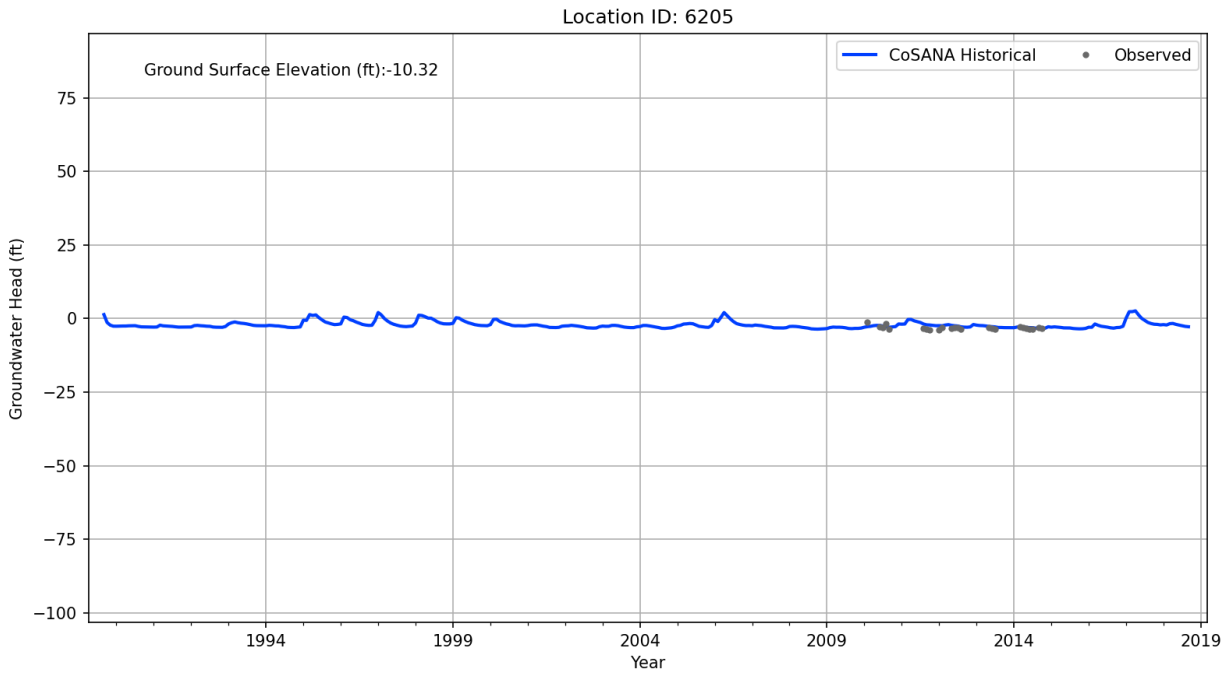

Location ID: 5902
Ground Surface Elevation (ft):4.1
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

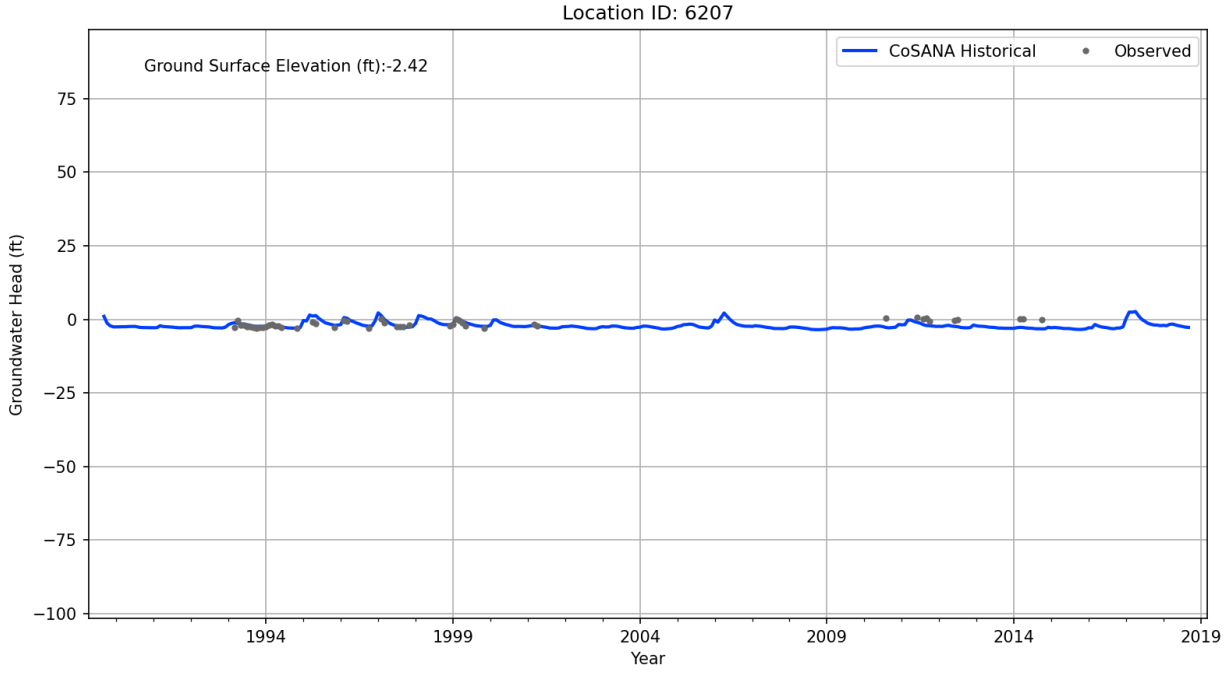

Location ID: 5903
Ground Surface Elevation (ft):-3.07
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

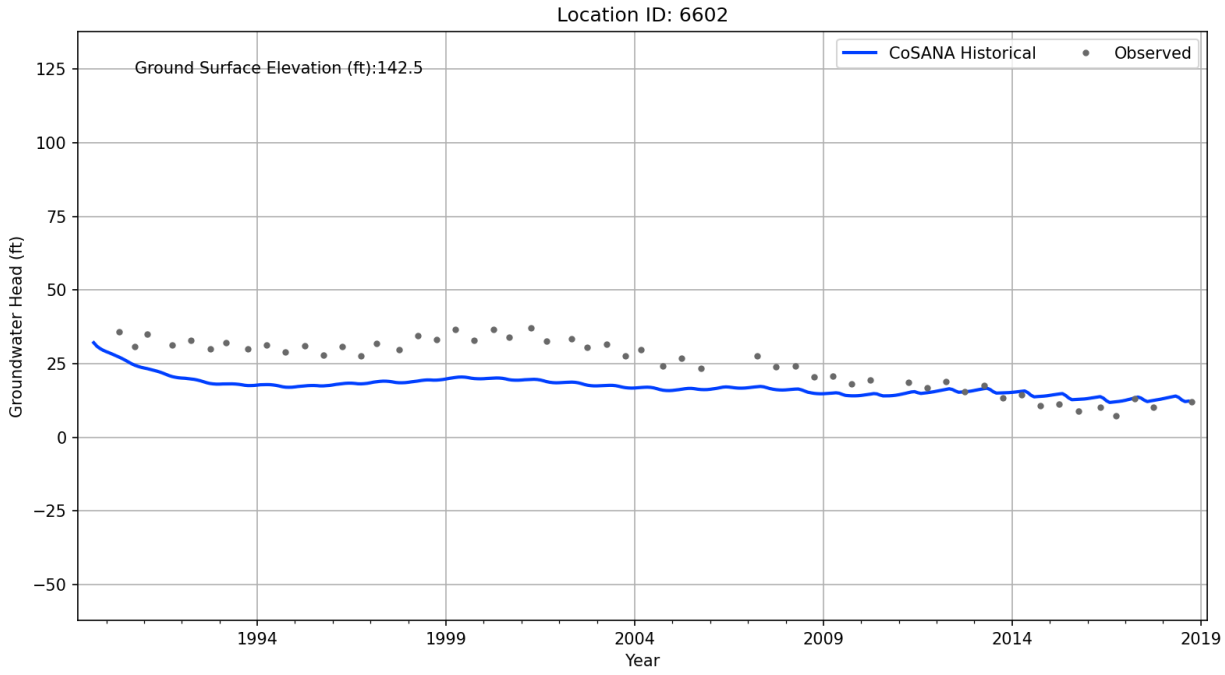

Location ID: 6201
Ground Surface Elevation (ft):2.81
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

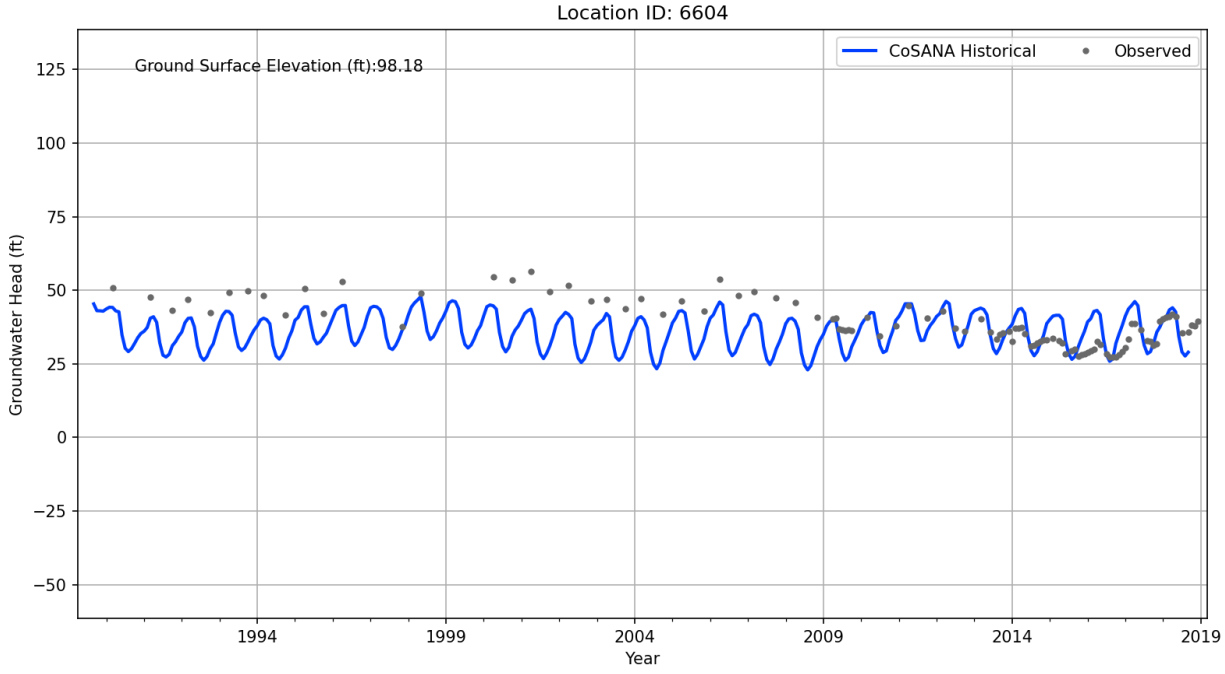

Location ID: 6202
Ground Surface Elevation (ft):-0.5
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

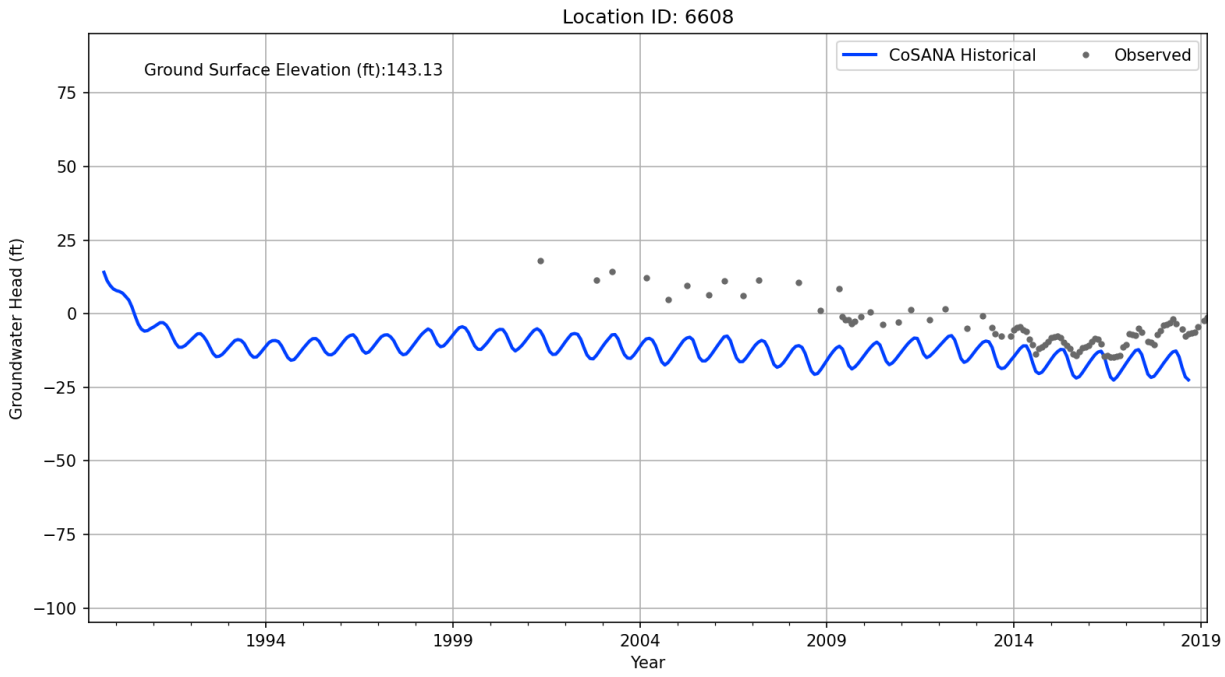

Location ID: 6203
Ground Surface Elevation (ft):-0.5
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

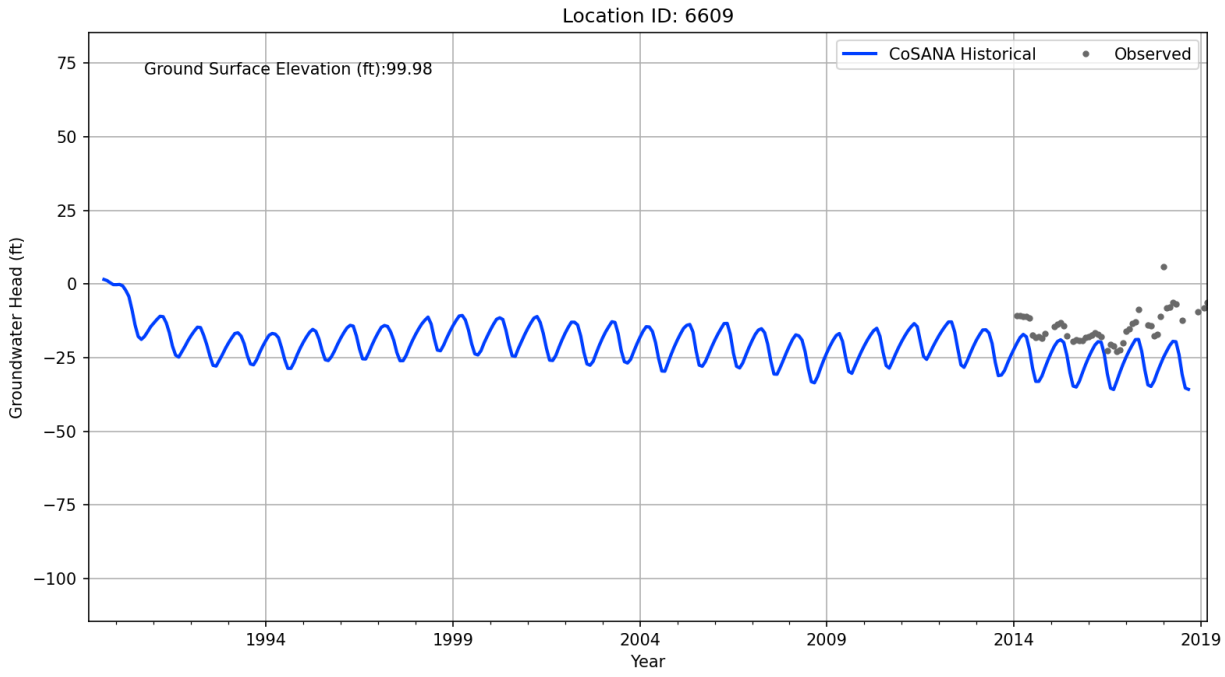

Location ID: 6205
Ground Surface Elevation (ft):-10.32
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

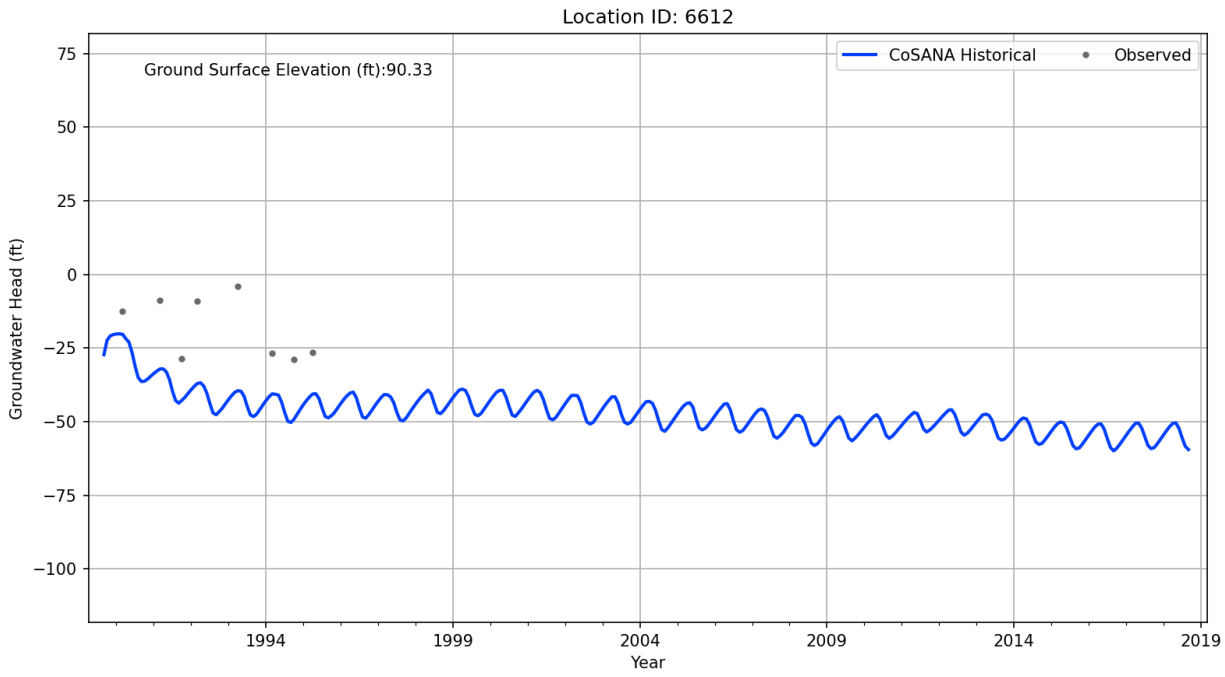

Location ID: 6207
Ground Surface Elevation (ft):-2.42
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

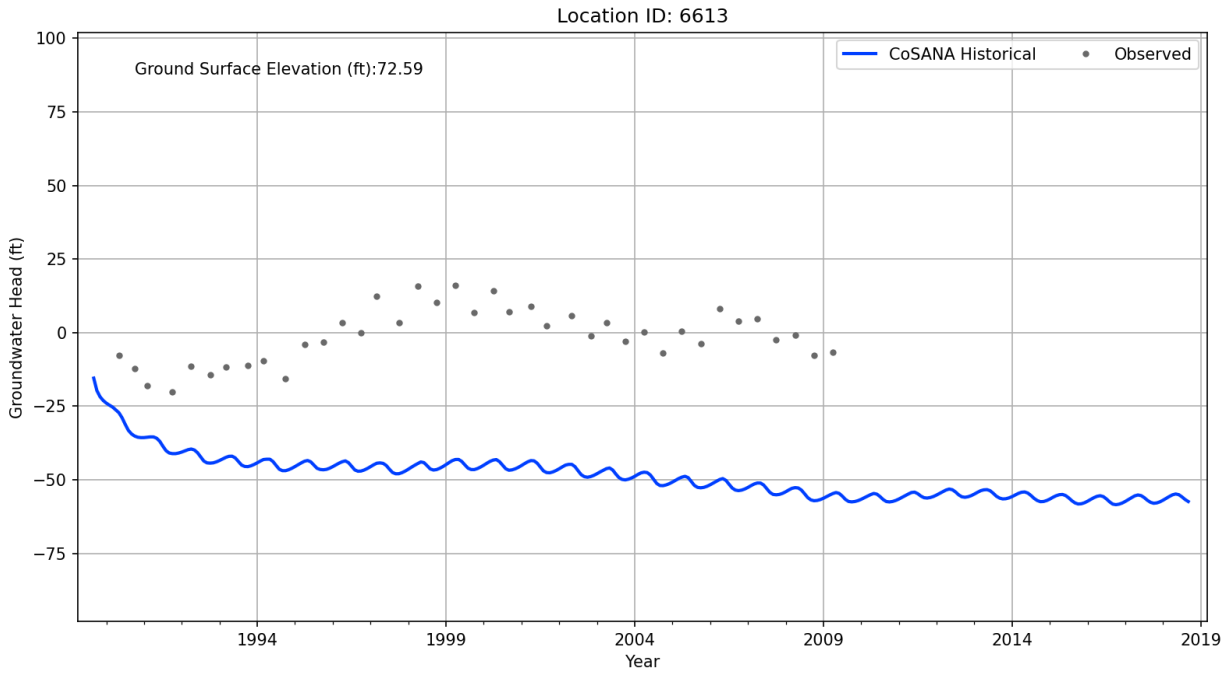

Location ID: 6602
Ground Surface Elevation (ft):142.5
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

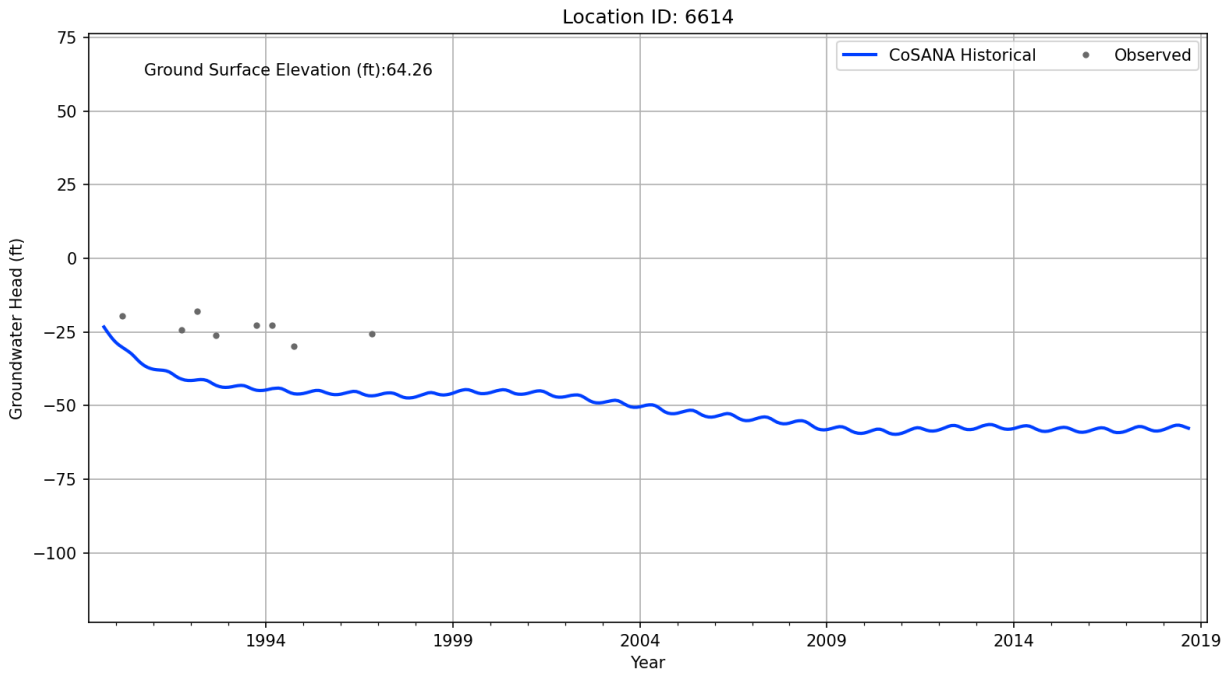

Location ID: 6604
Ground Surface Elevation (ft):98.18
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

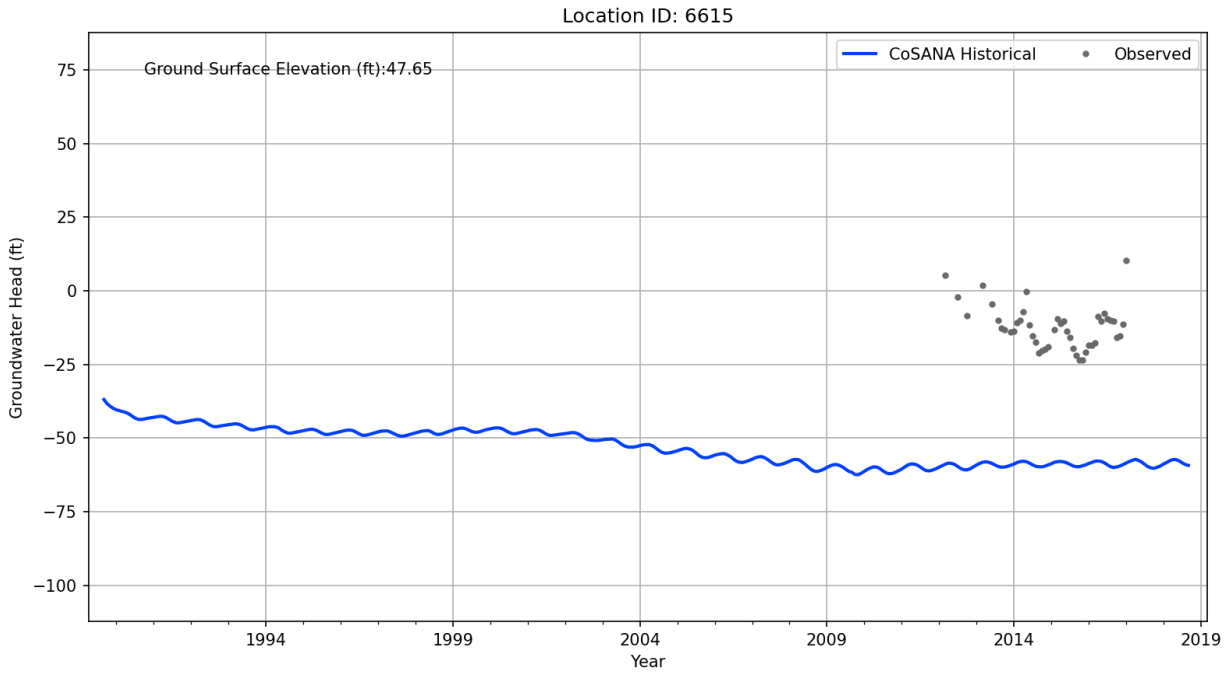

Location ID: 6608
Ground Surface Elevation (ft):143.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

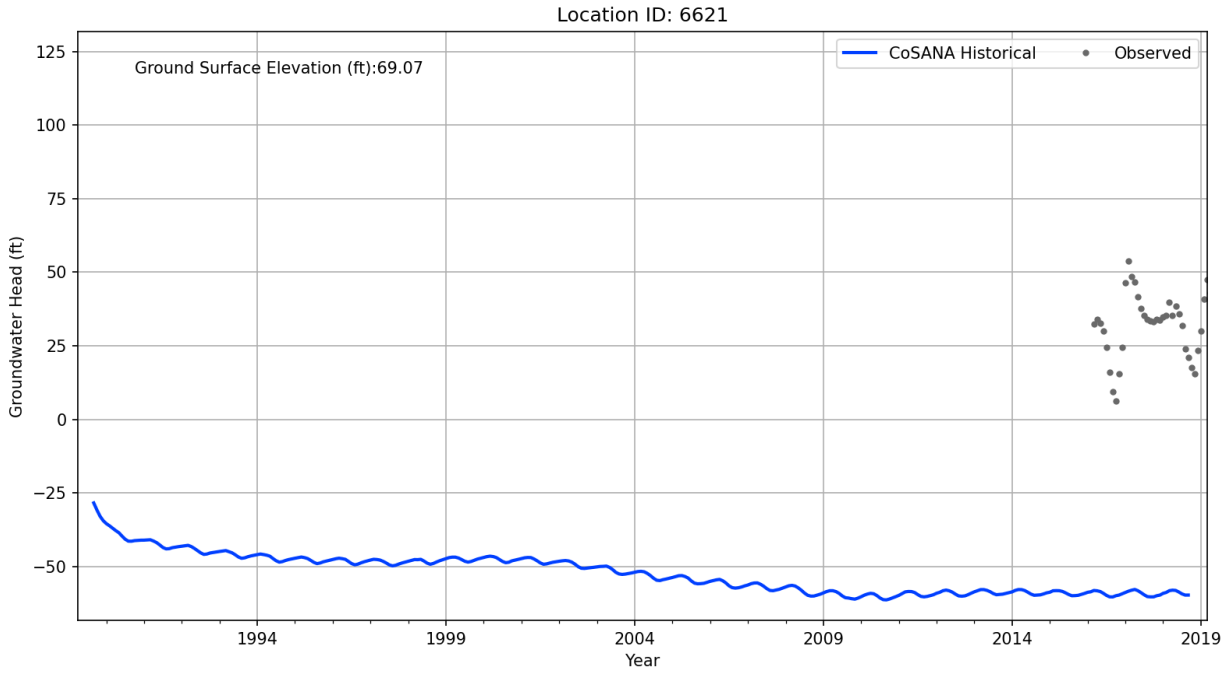

Location ID: 6609
Ground Surface Elevation (ft):99.98
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

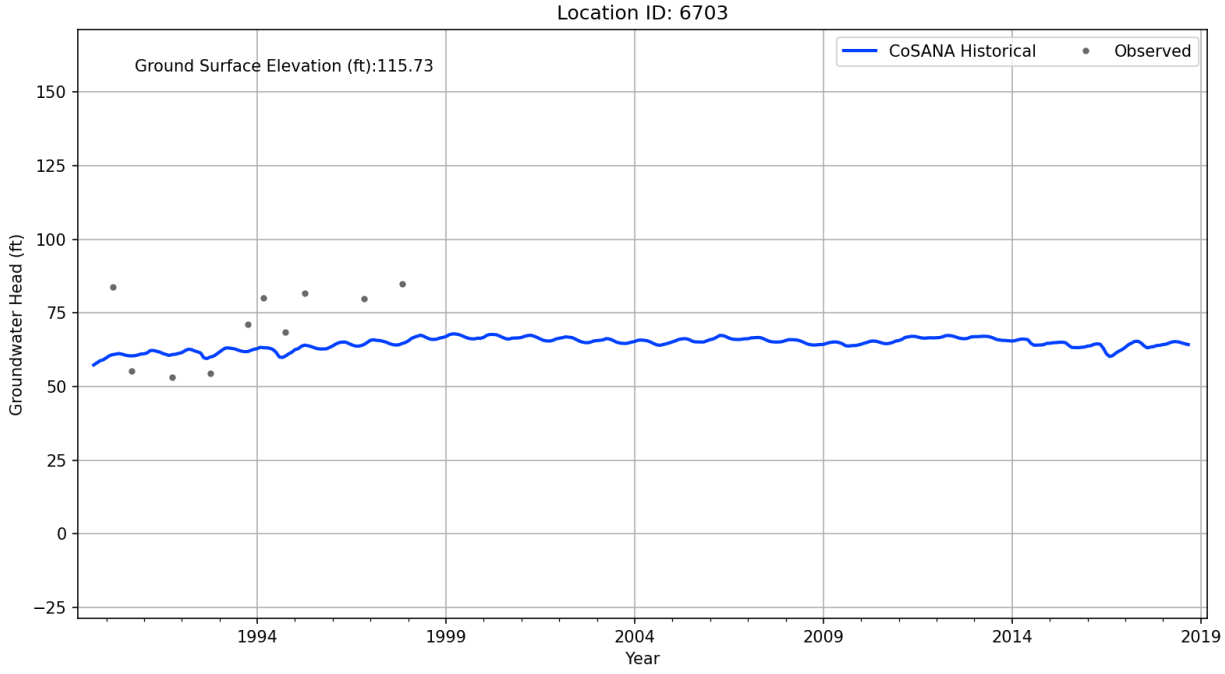

Location ID: 6612
Ground Surface Elevation (ft):90.33
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

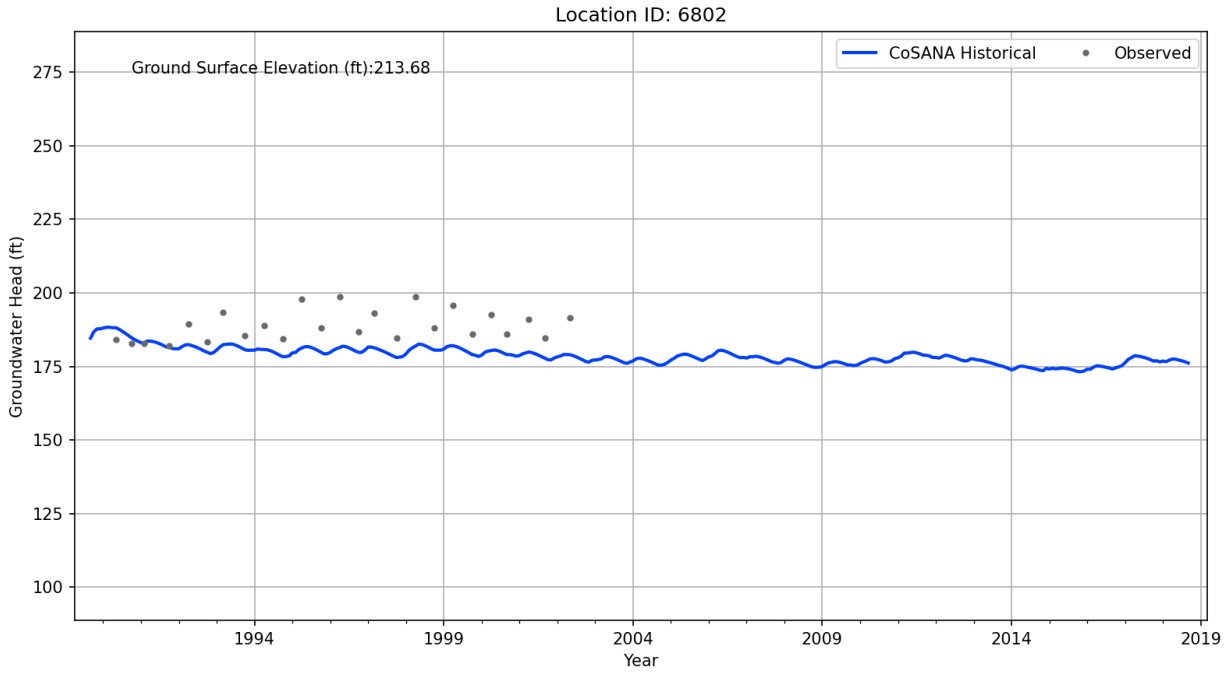

Location ID: 6613
Ground Surface Elevation (ft):72.59
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

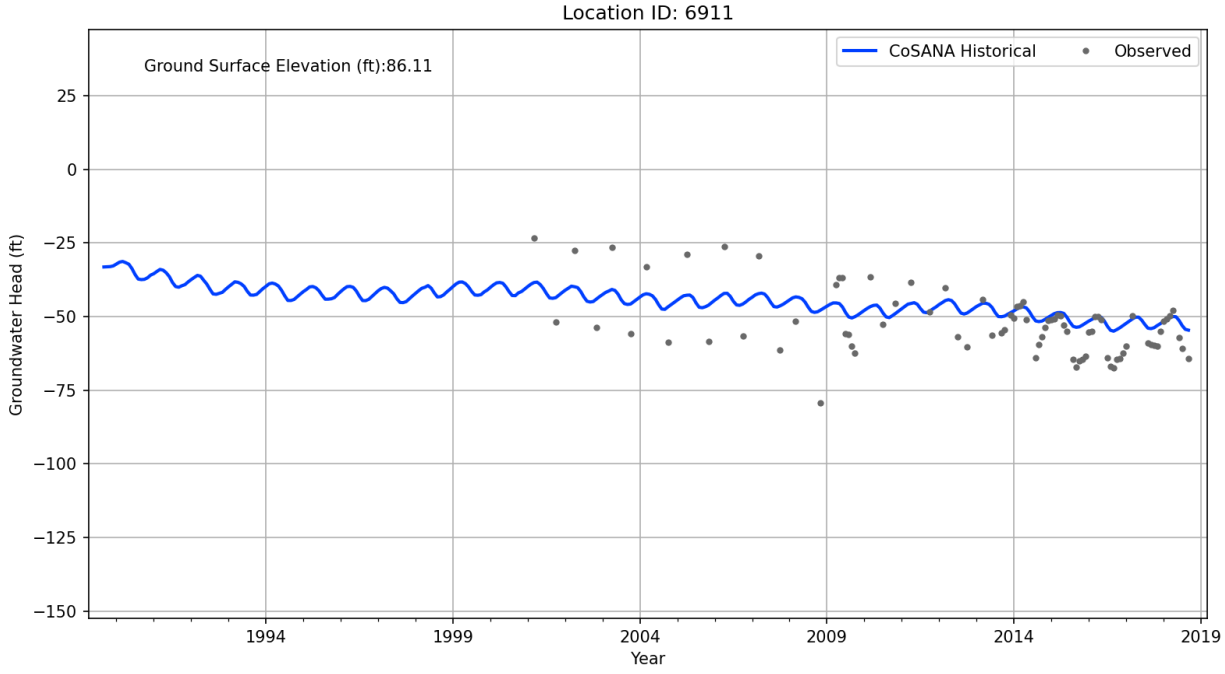

Location ID: 6614
Ground Surface Elevation (ft):64.26
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

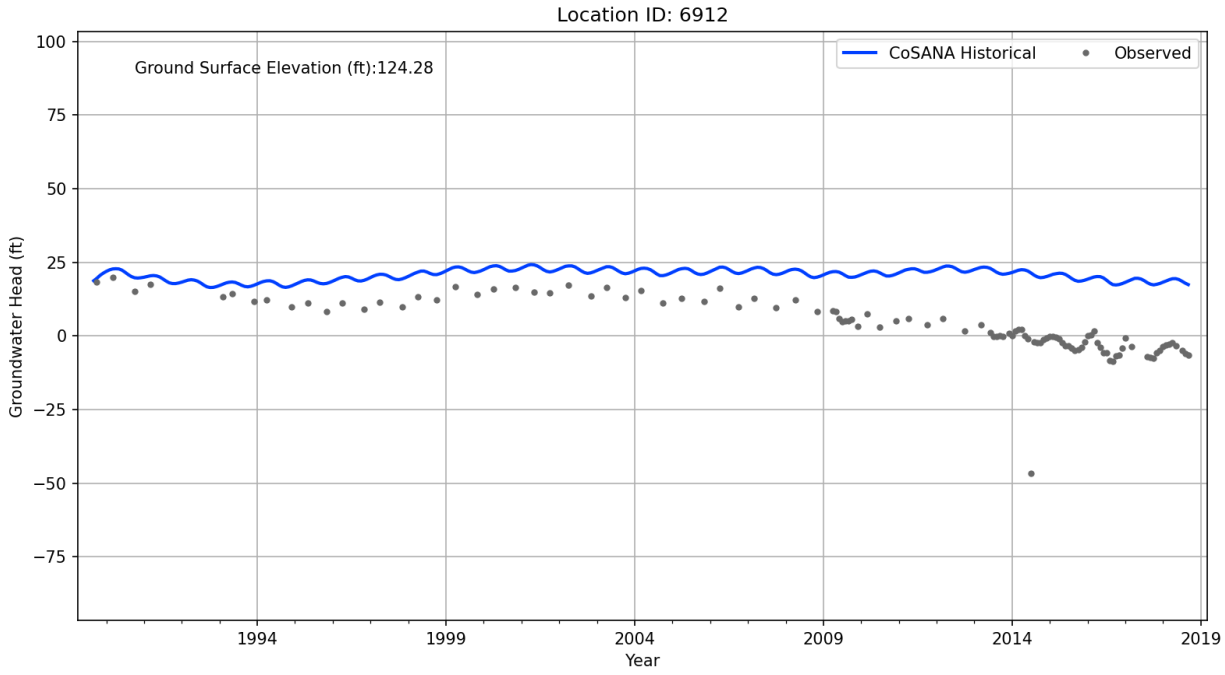

Location ID: 6615
Ground Surface Elevation (ft):47.65
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

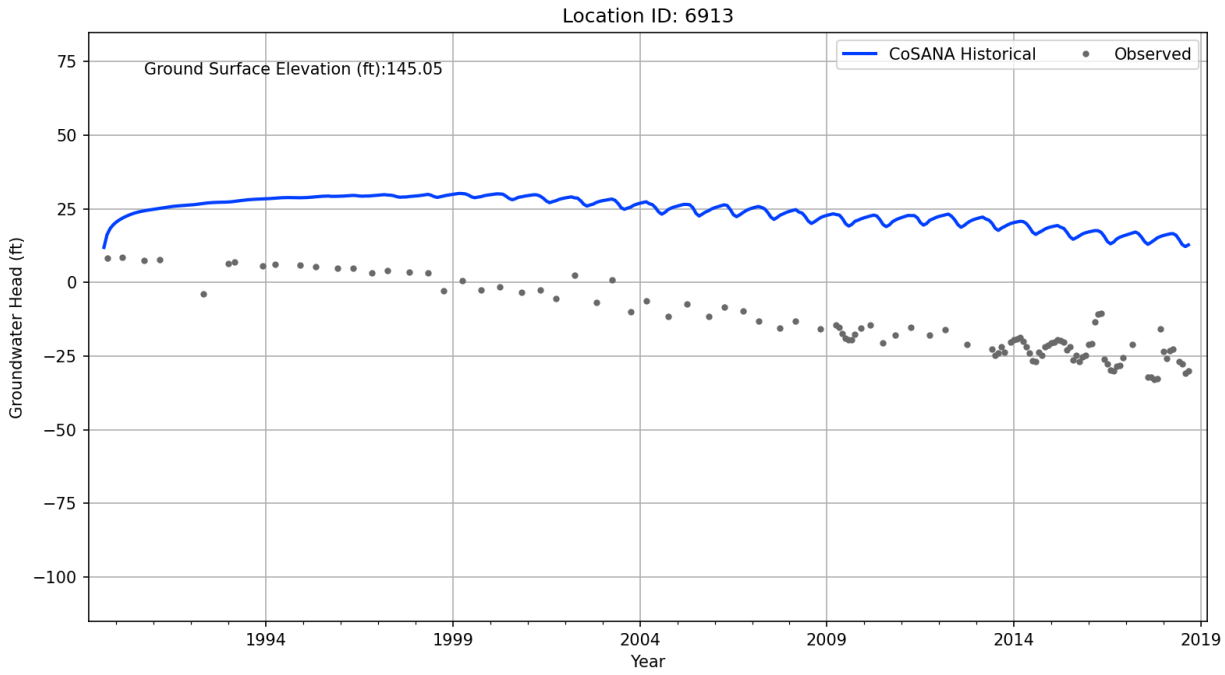

Location ID: 6621
Ground Surface Elevation (ft):69.07
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

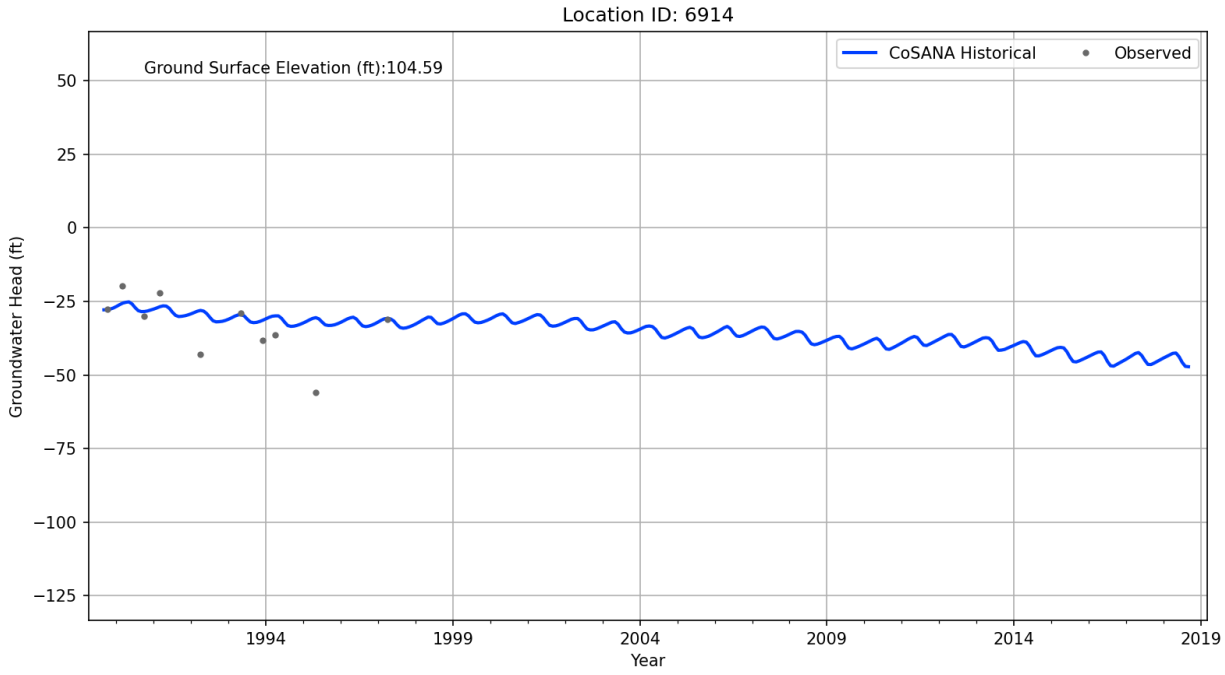

Location ID: 6703
Ground Surface Elevation (ft):115.73
CoSANA Historical
Observed
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year

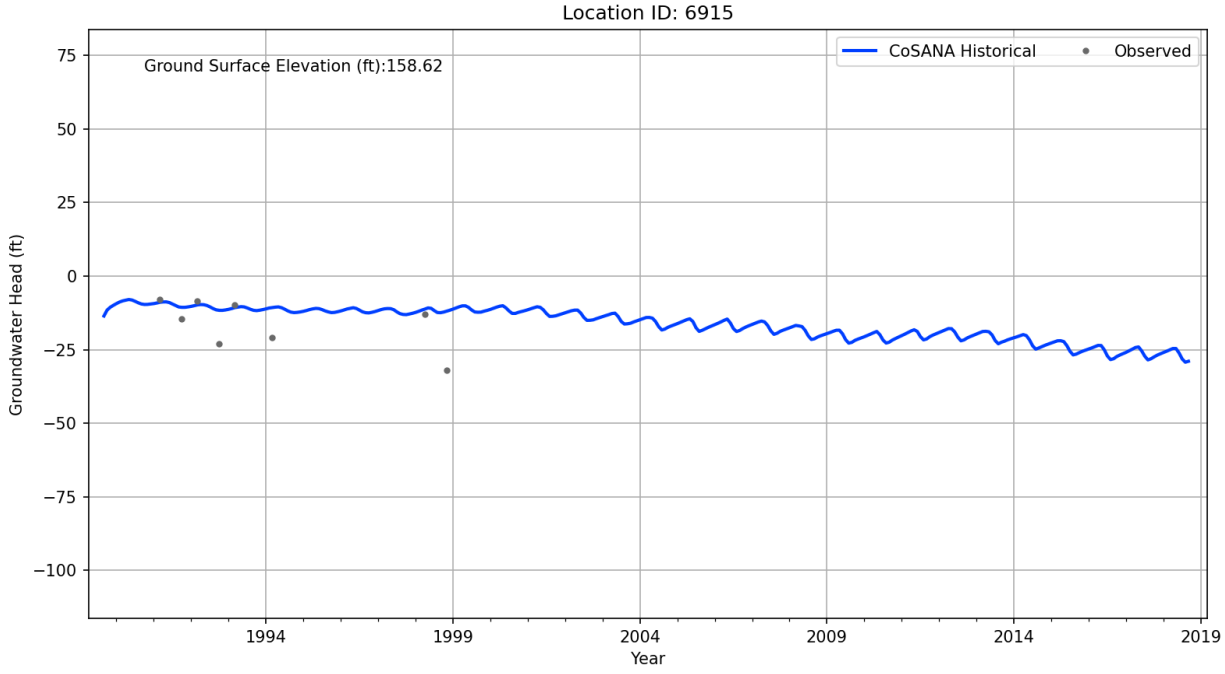

Location ID: 6802
Ground Surface Elevation (ft):213.68
CoSANA Historical
Observed
Groundwater Head (ft)
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019
Year

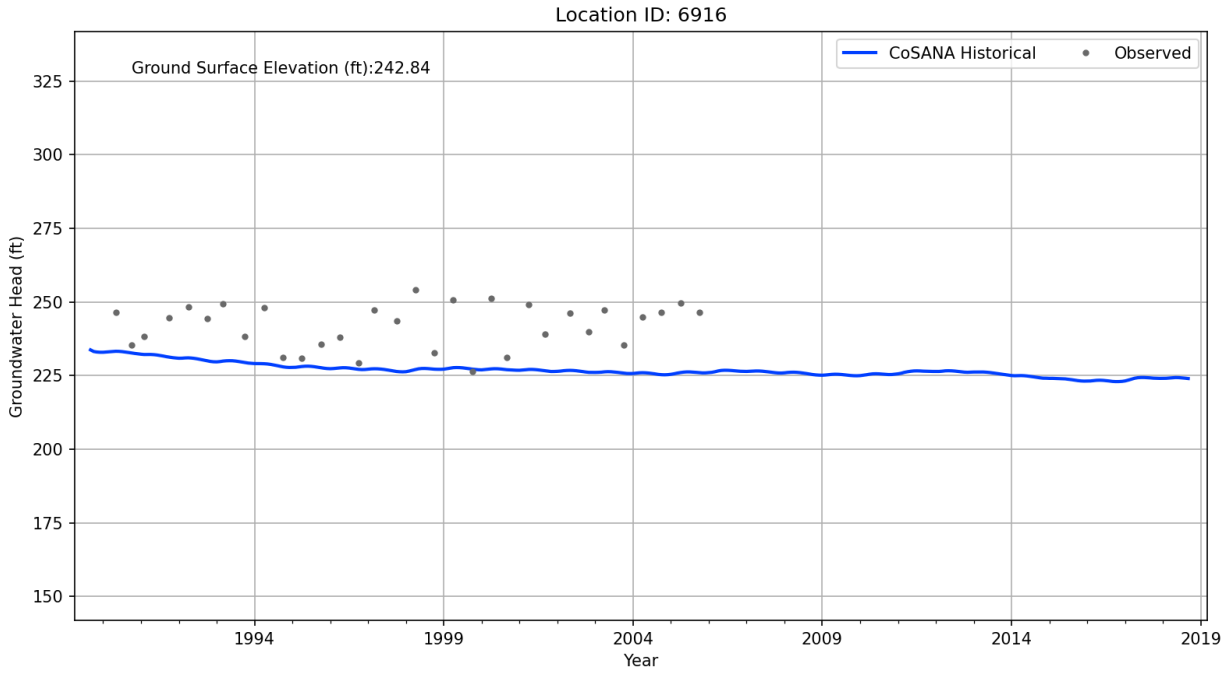

Location ID: 6911
Ground Surface Elevation (ft):86.11
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

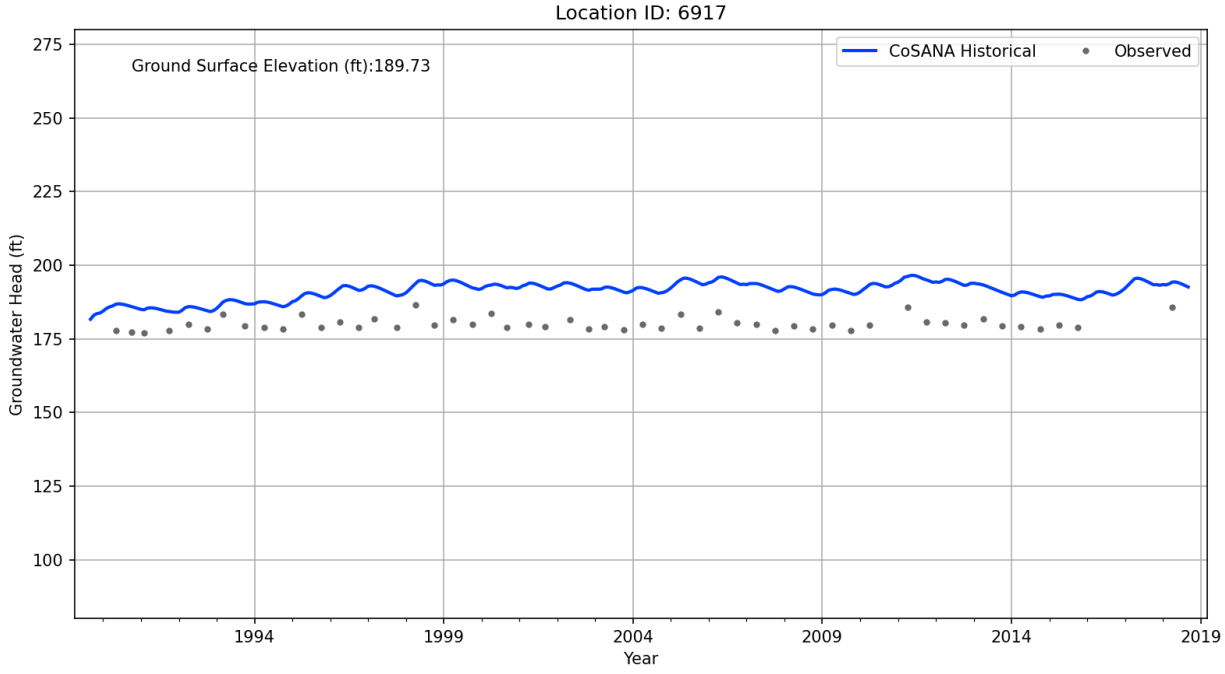

Location ID: 6912
Ground Surface Elevation (ft):124.28
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

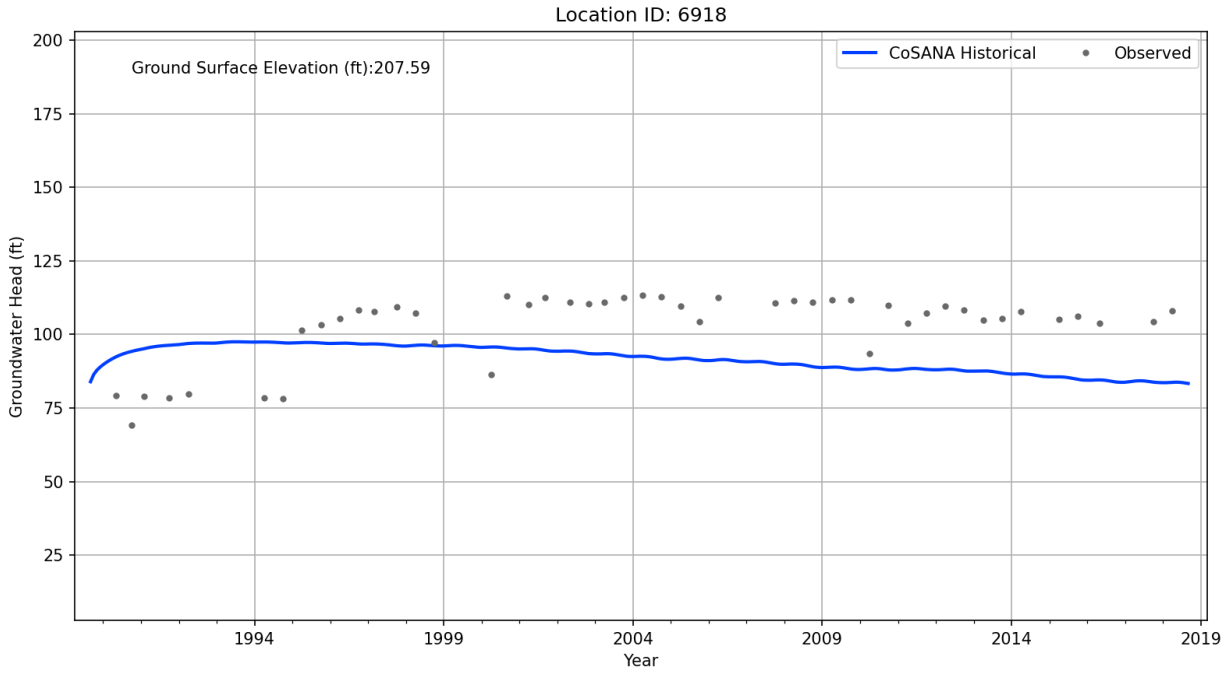

Location ID: 6913
Ground Surface Elevation (ft):145.05
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

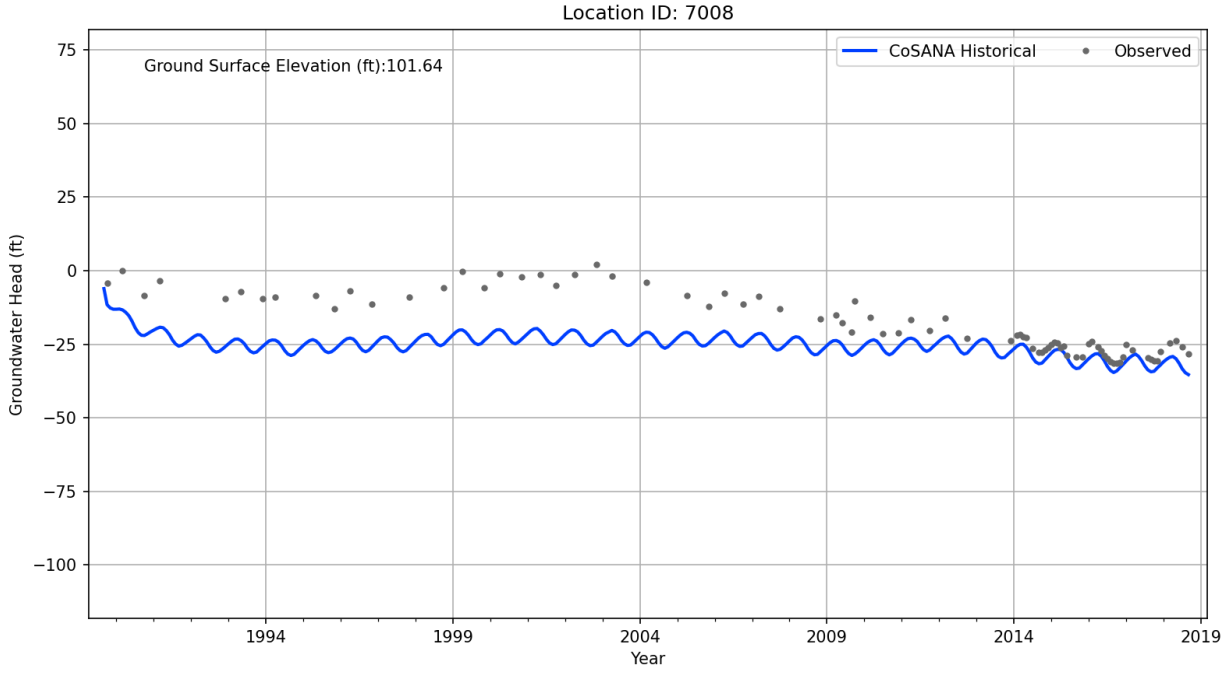

Location ID: 6914
Ground Surface Elevation (ft):104.59
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

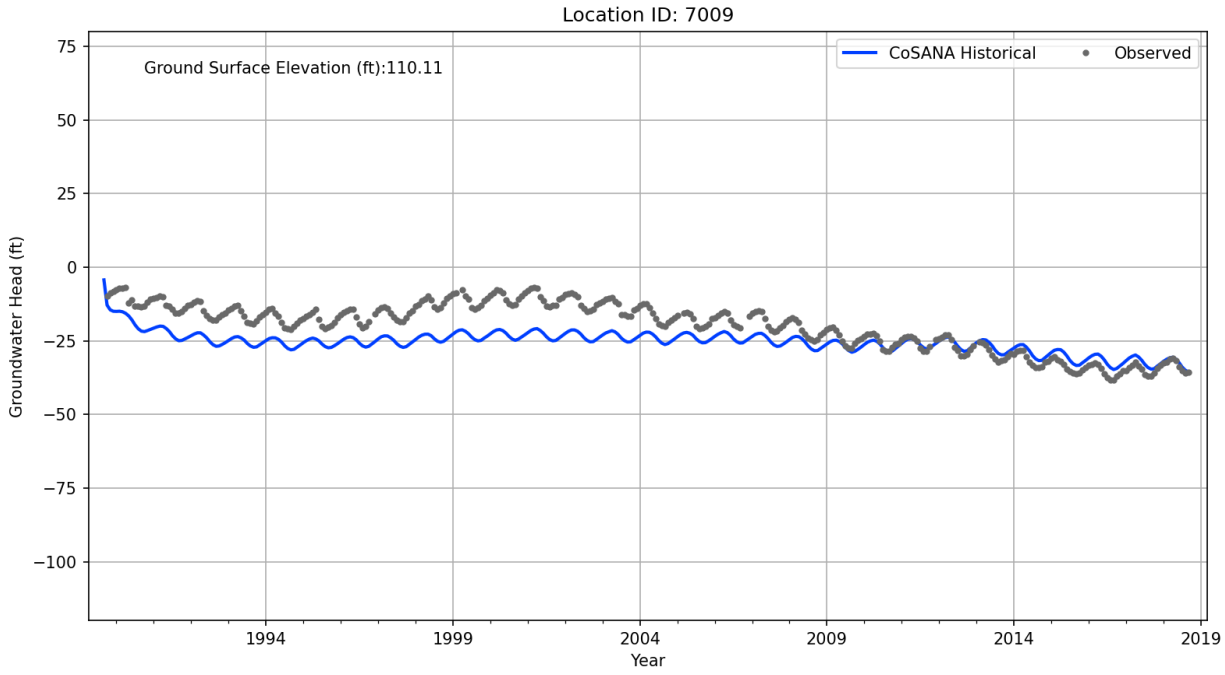

Location ID: 6915
Ground Surface Elevation (ft):158.62
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

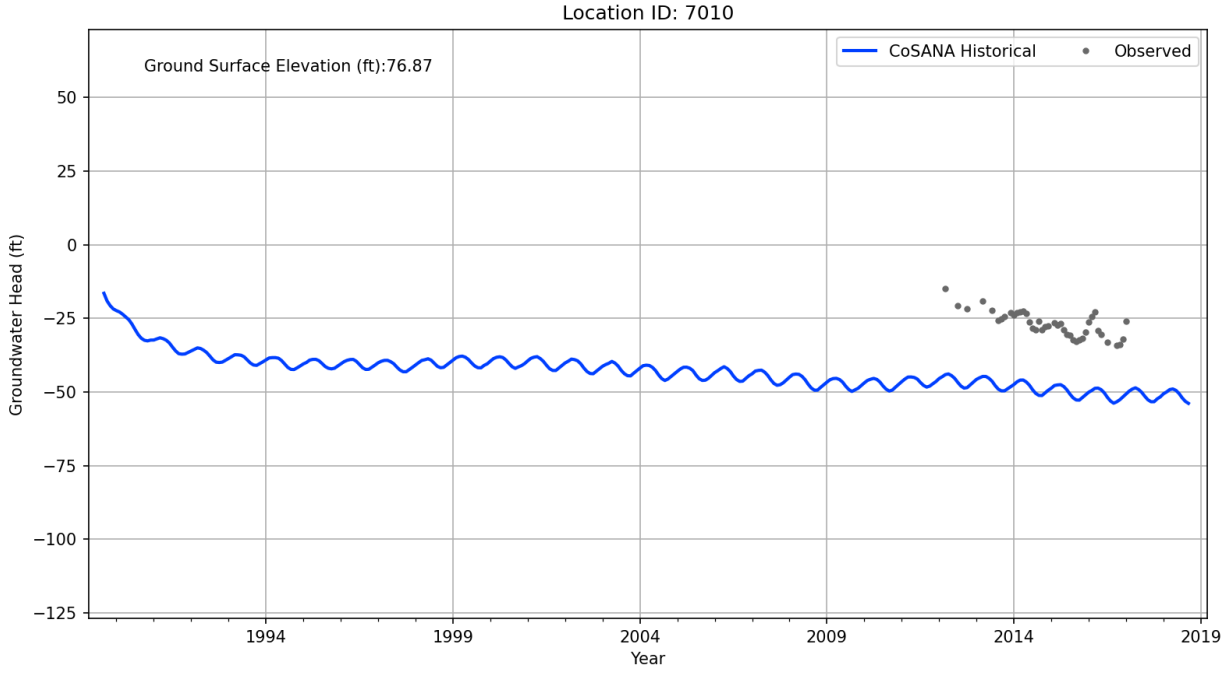

Location ID: 6916
Ground Surface Elevation (ft):242.84
CoSANA Historical
Observed
Groundwater Head (ft)
325
300
275
250
225
200
175
150
1994
1999
2004
2009
2014
2019
Year

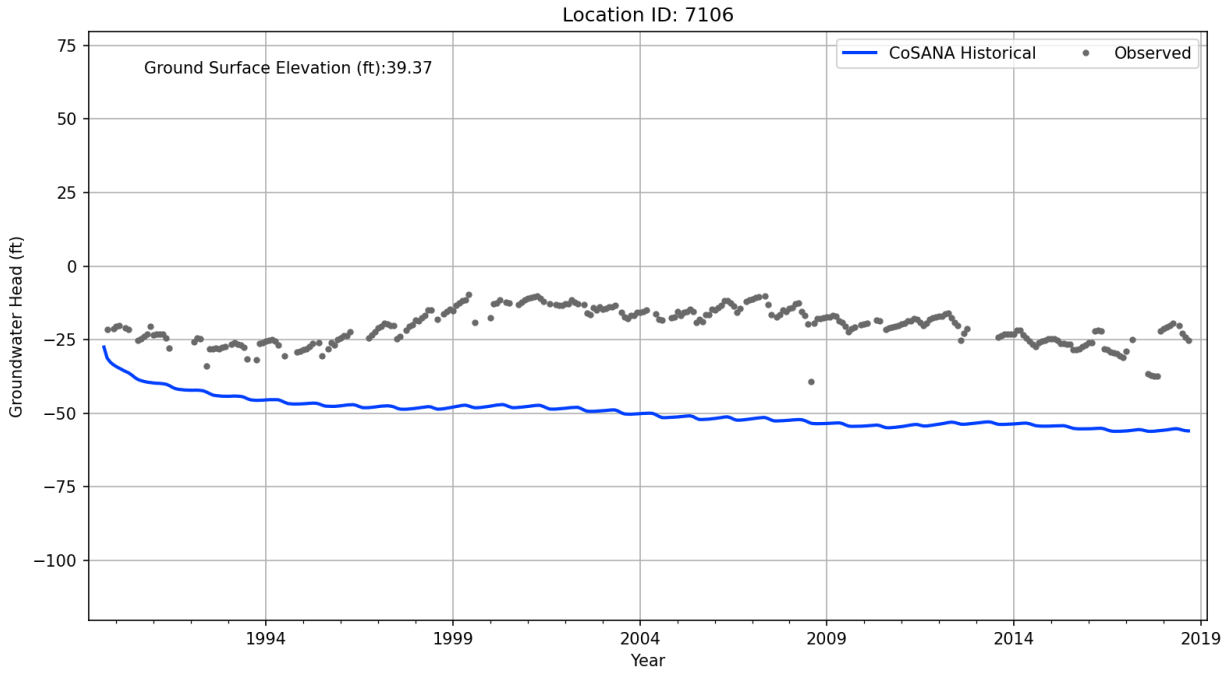

Location ID: 6917
Ground Surface Elevation (ft):189.73
CoSANA Historical
Observed
Groundwater Head (ft)
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019
Year

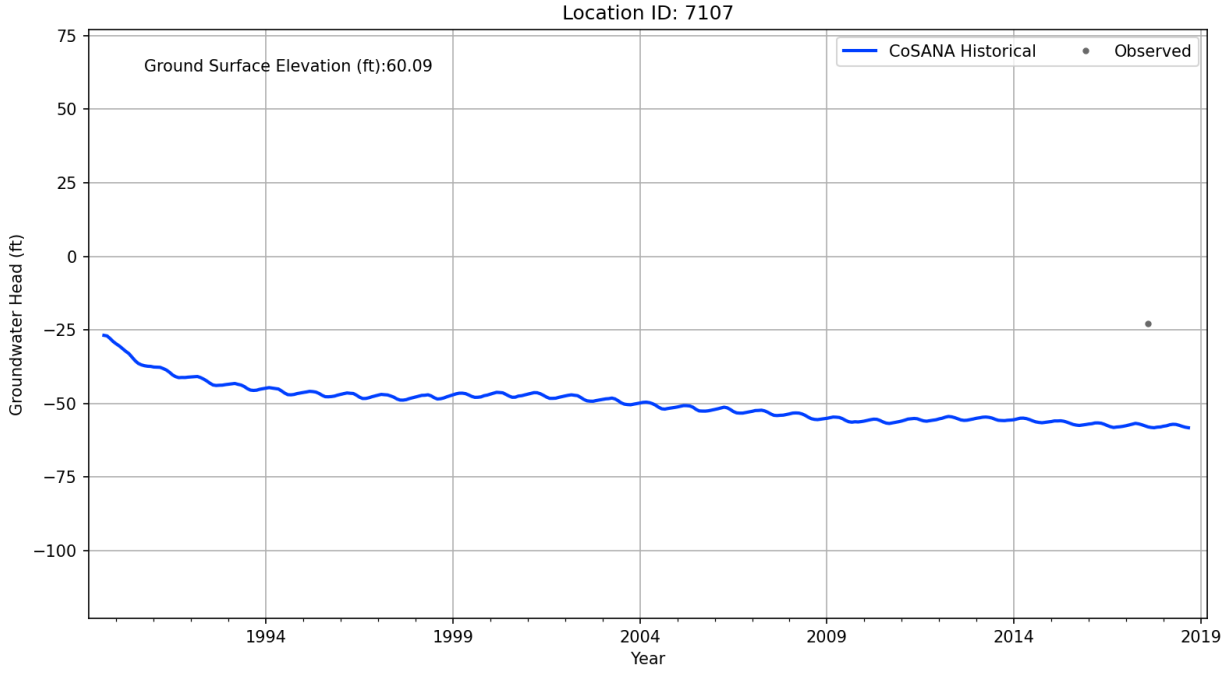

Location ID: 6918
Ground Surface Elevation (ft):207.59
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

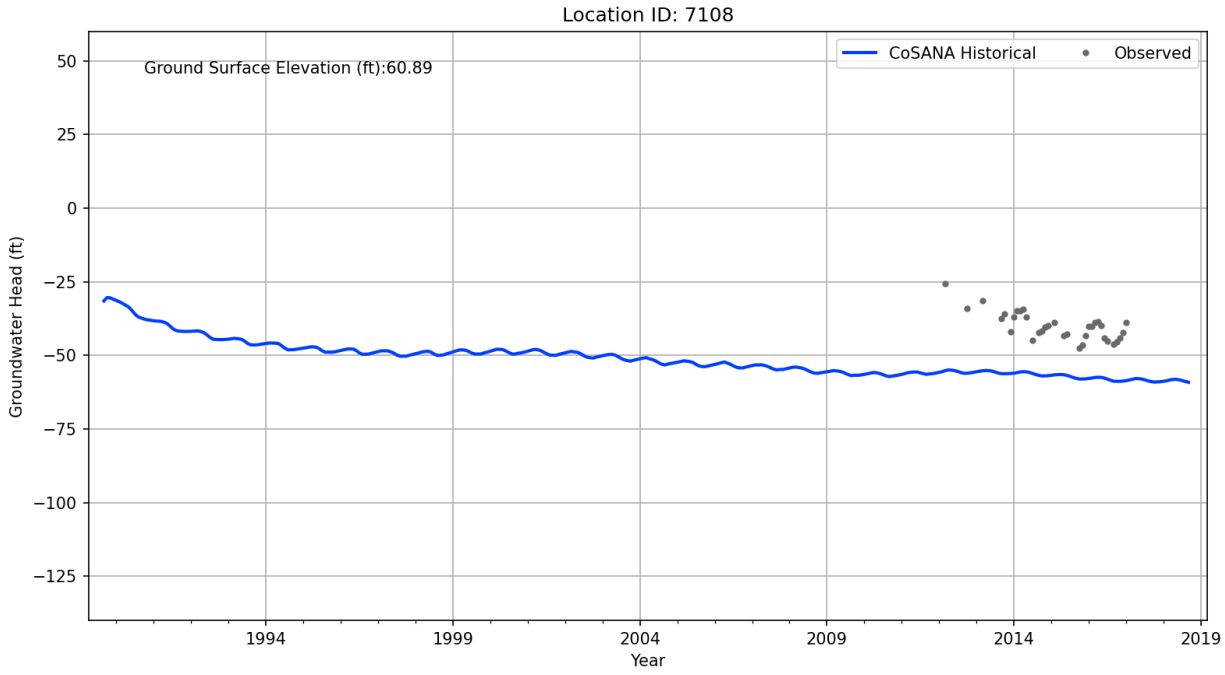

Location ID: 7008
Ground Surface Elevation (ft):101.64
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

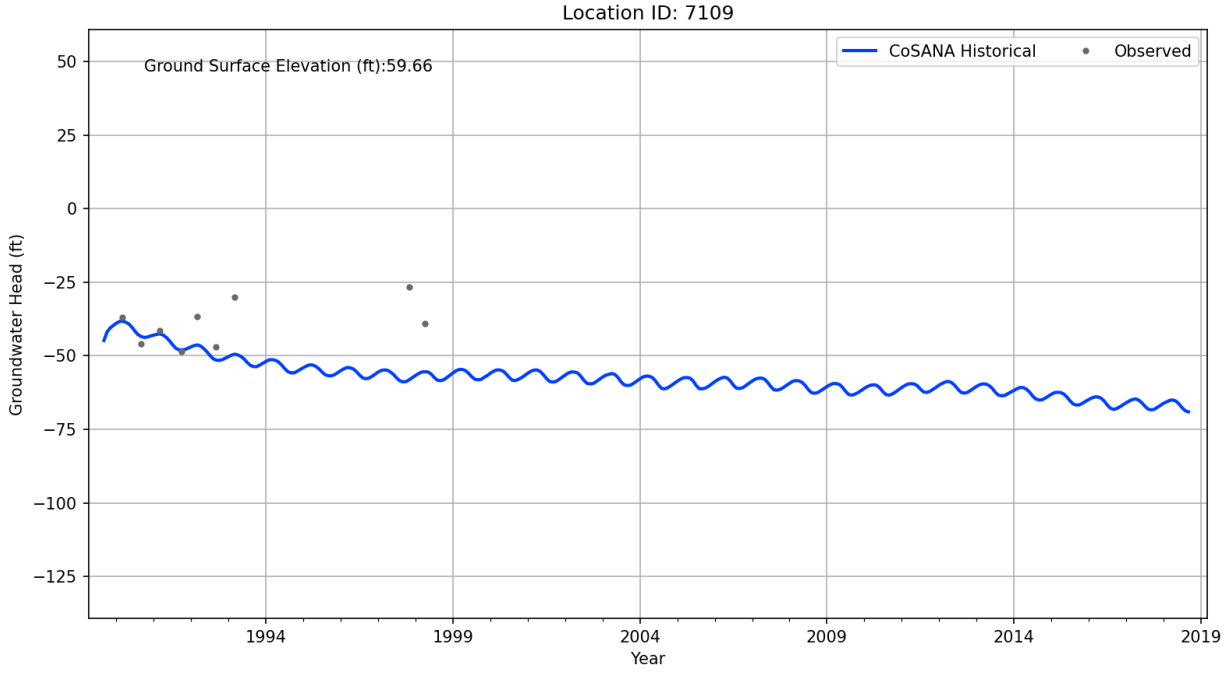

Location ID: 7009
Ground Surface Elevation (ft):110.11
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

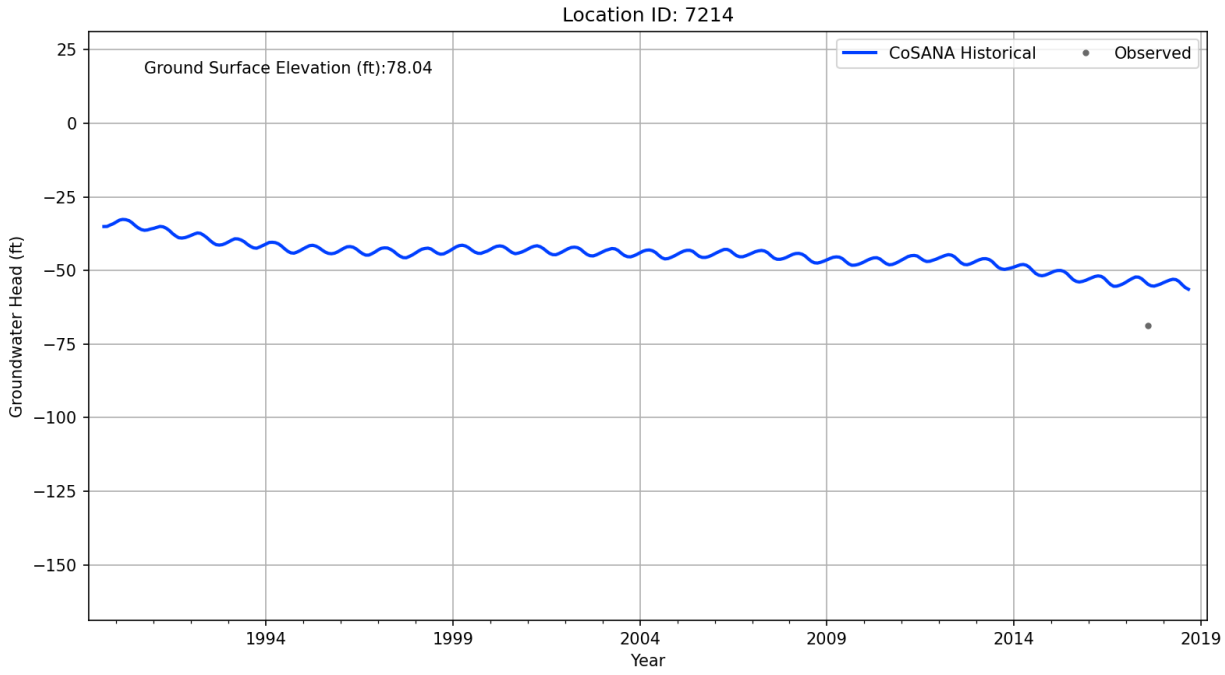

Location ID: 7010
Ground Surface Elevation (ft):76.87
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

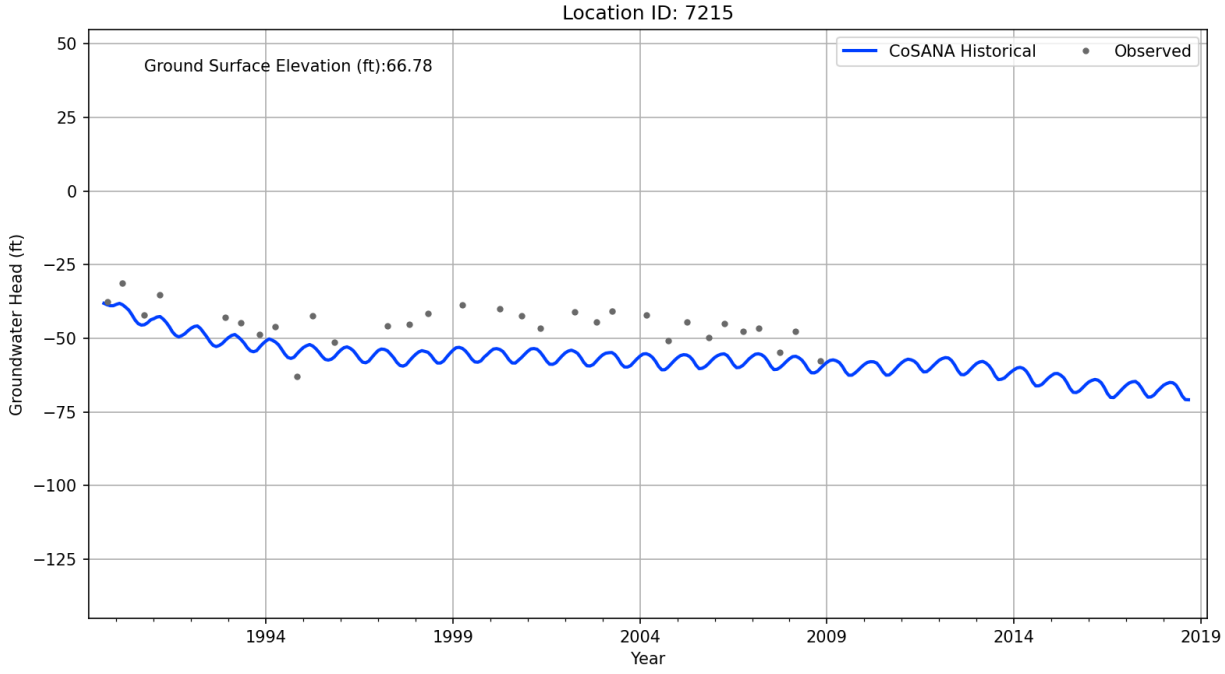

Location ID: 7106
Ground Surface Elevation (ft):39.37
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

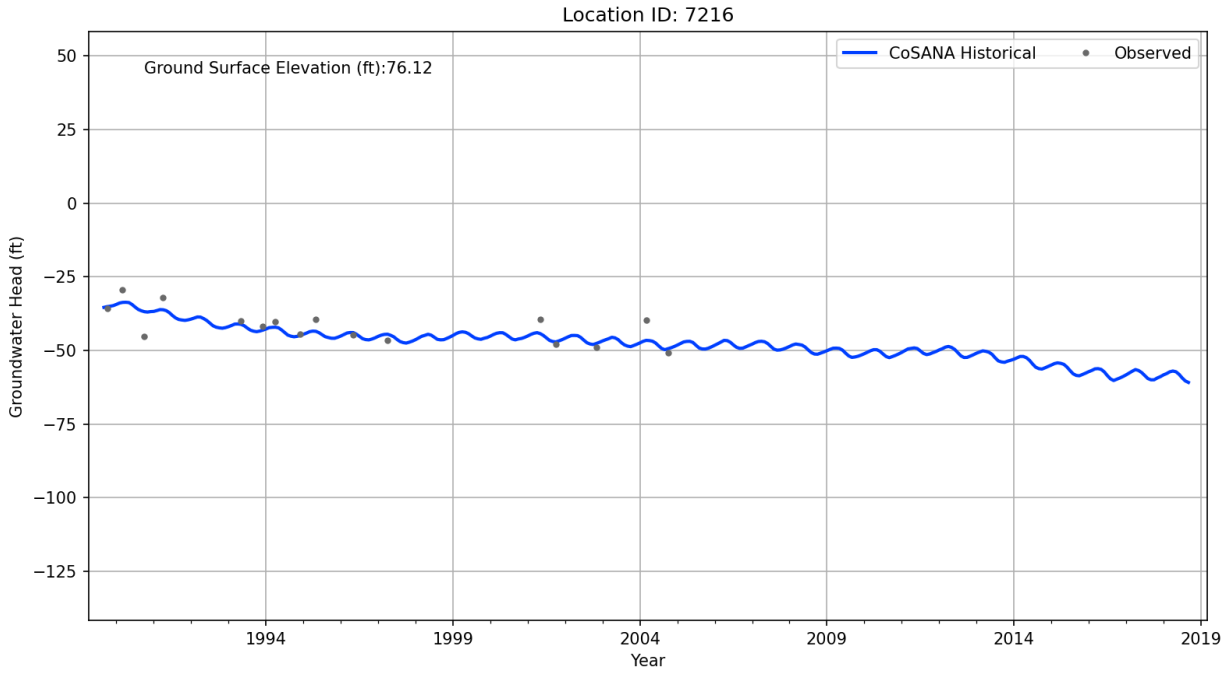

Location ID: 7107
Ground Surface Elevation (ft):60.09
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

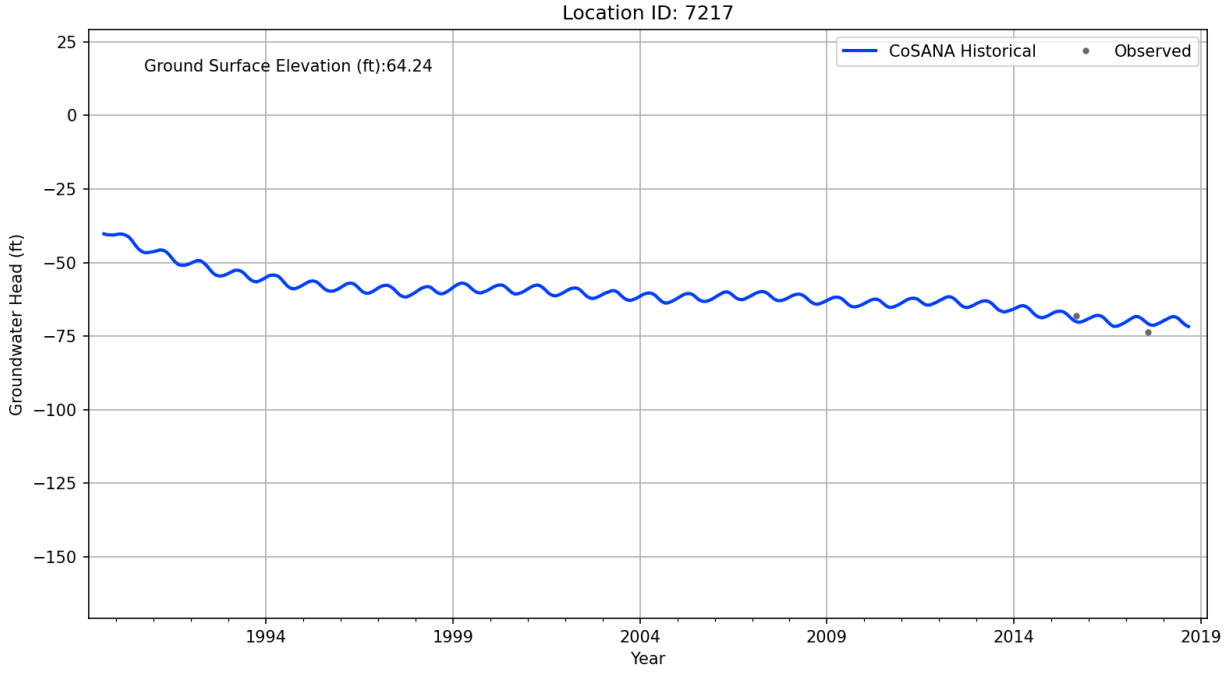

Location ID: 7108
Ground Surface Elevation (ft):60.89
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

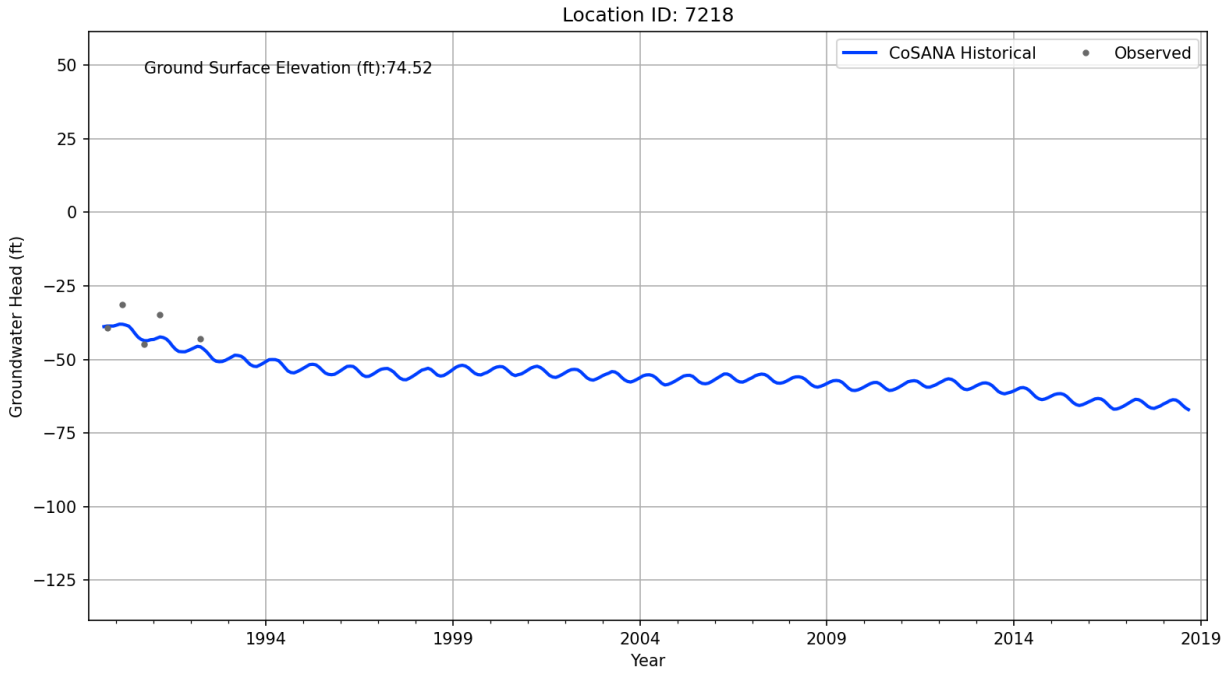

Location ID: 7109
Ground Surface Elevation (ft):59.66
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

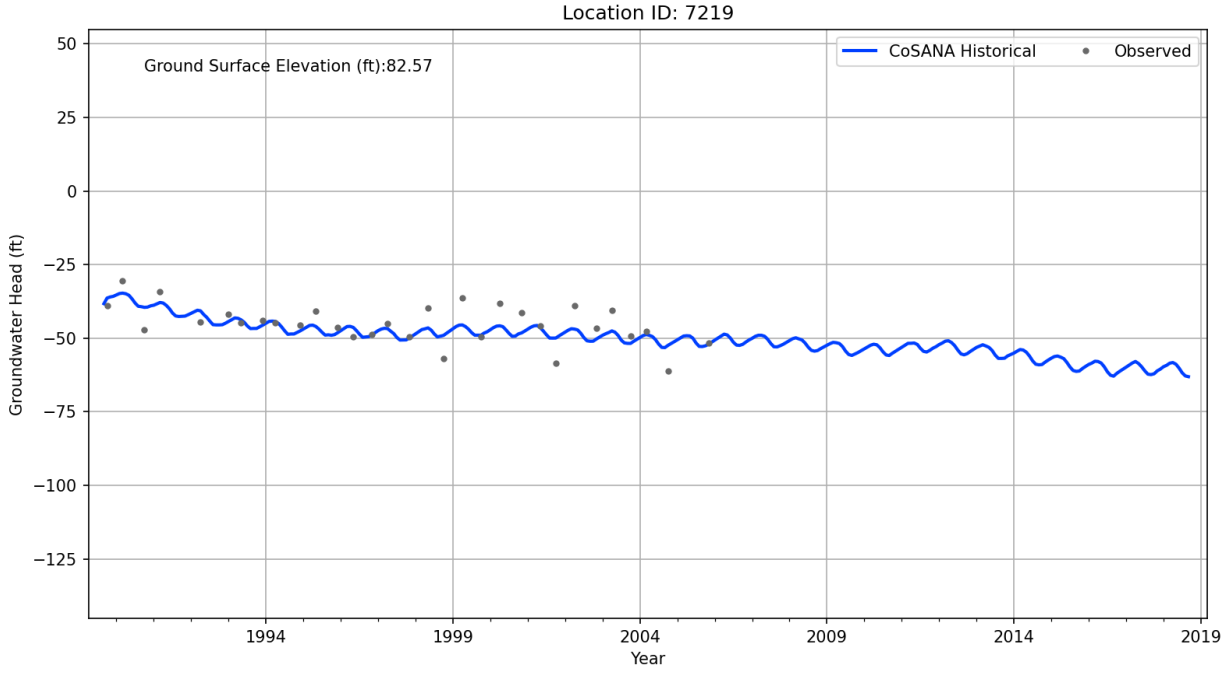

Location ID: 7214
Ground Surface Elevation (ft):78.04
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

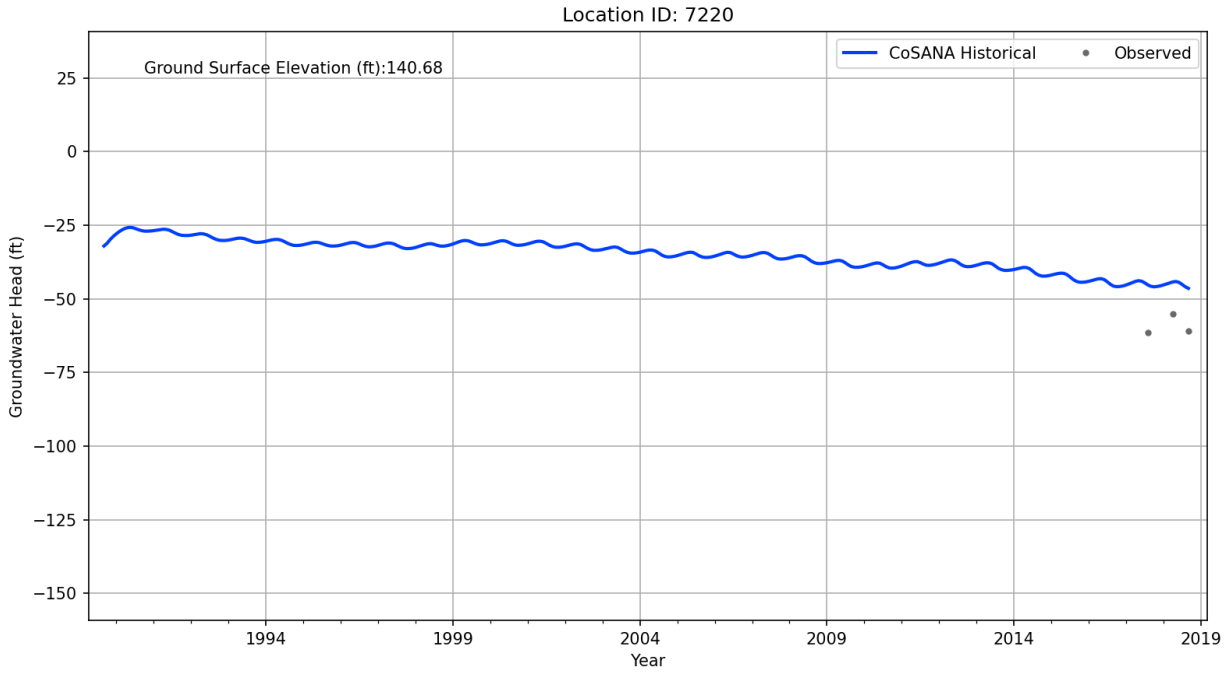

Location ID: 7215
Ground Surface Elevation (ft):66.78
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

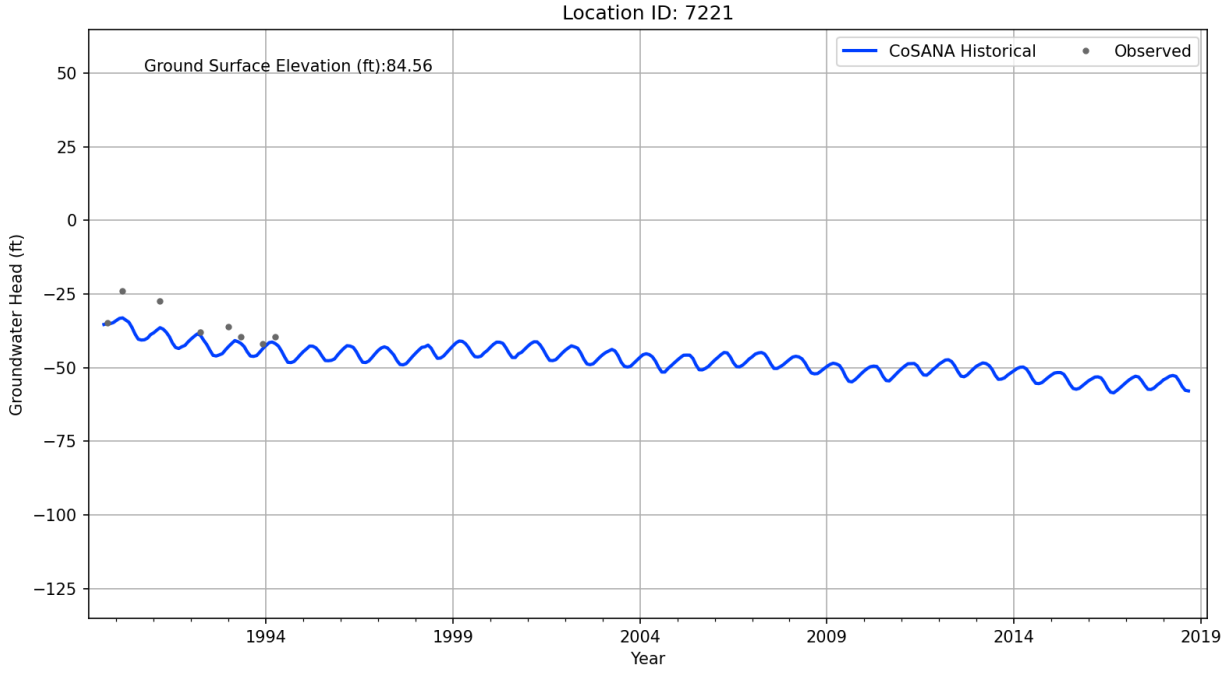

Location ID: 7216
Ground Surface Elevation (ft):76.12
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

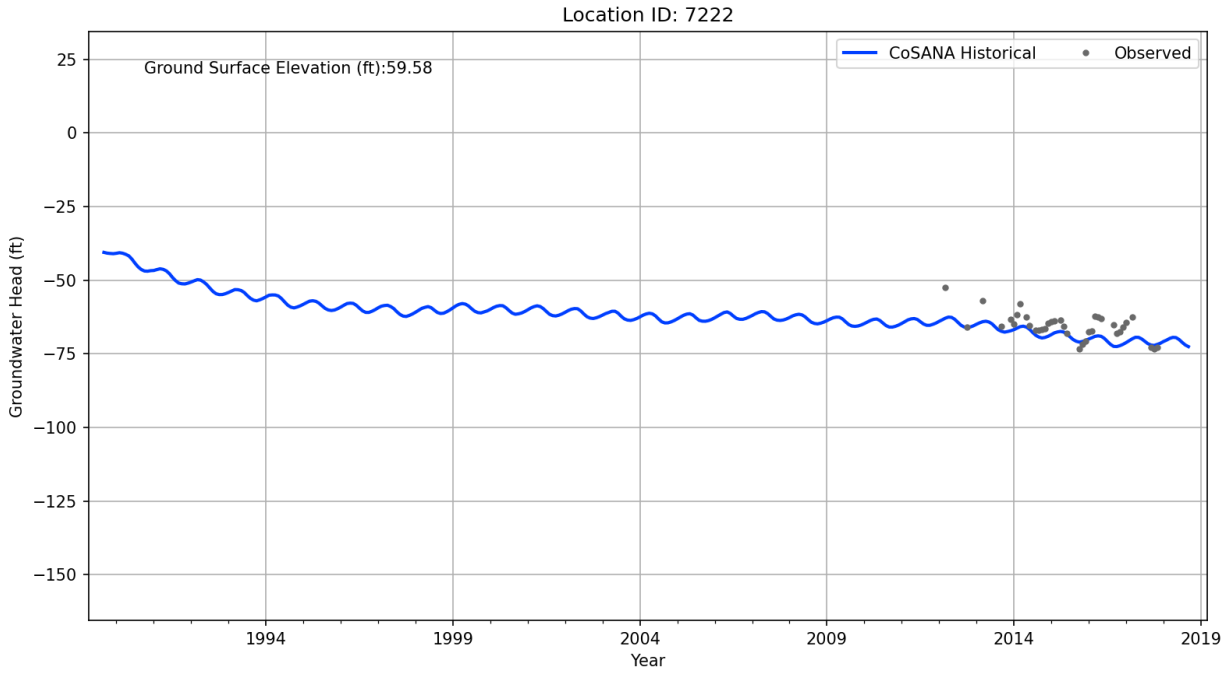

Location ID: 7217
Ground Surface Elevation (ft):64.24
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

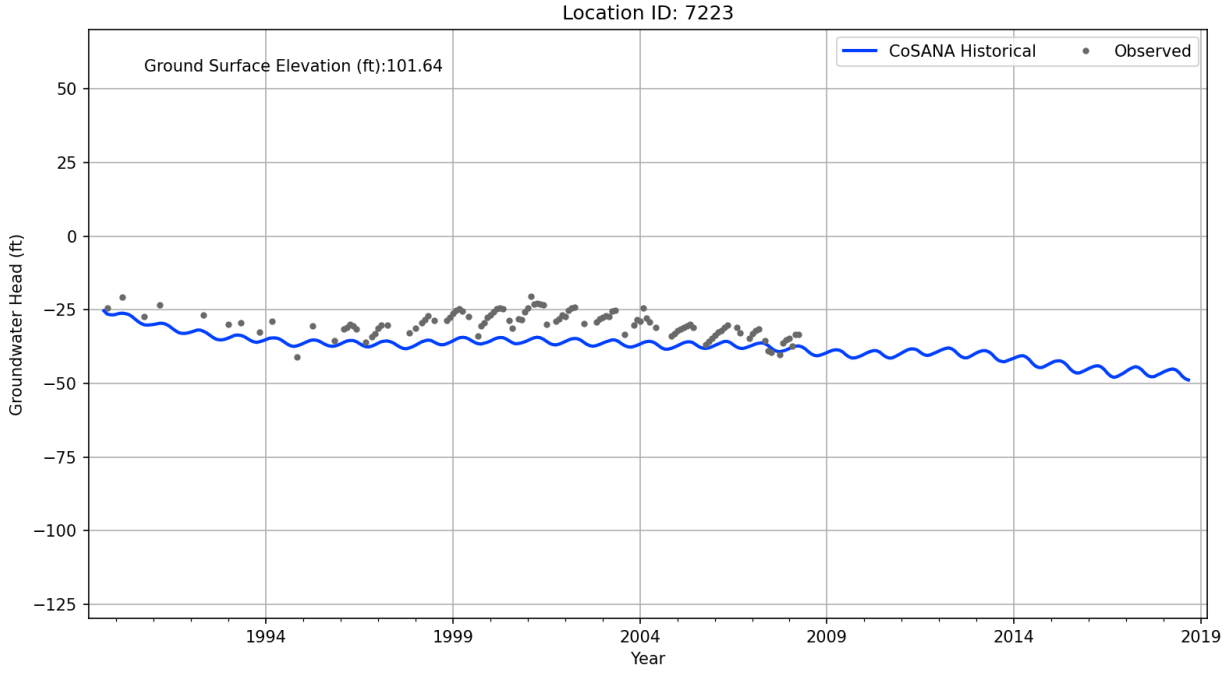

Location ID: 7218
Ground Surface Elevation (ft):74.52
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

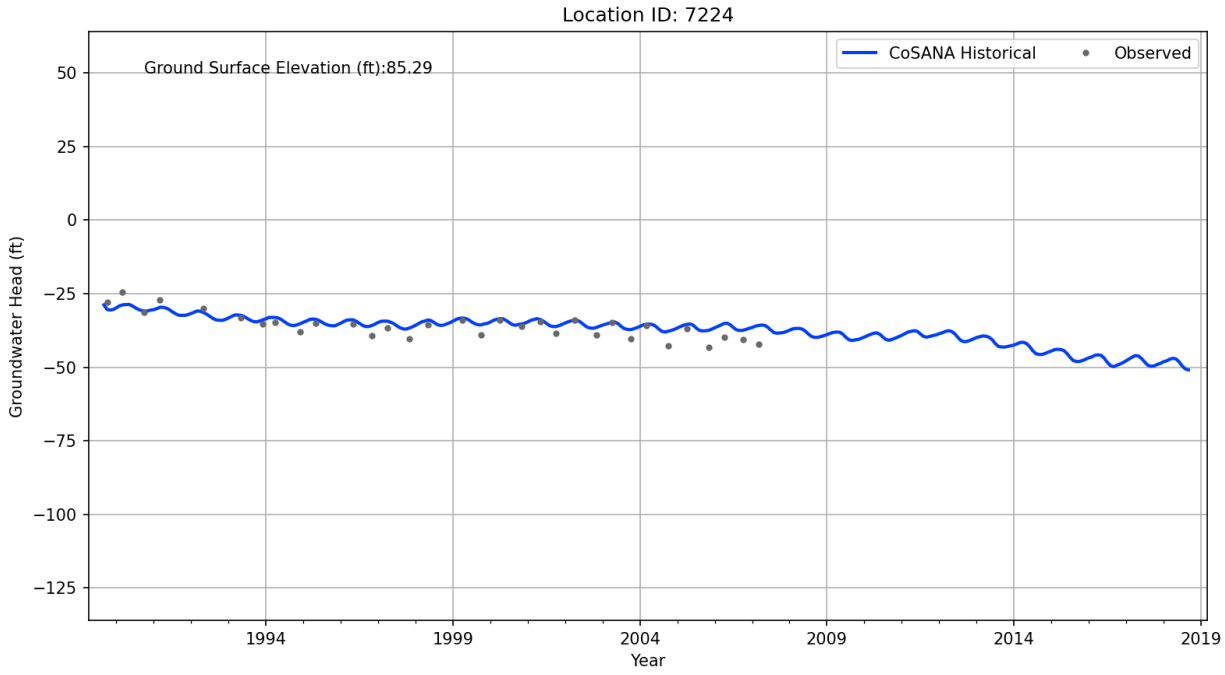

Location ID: 7219
Ground Surface Elevation (ft):82.57
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

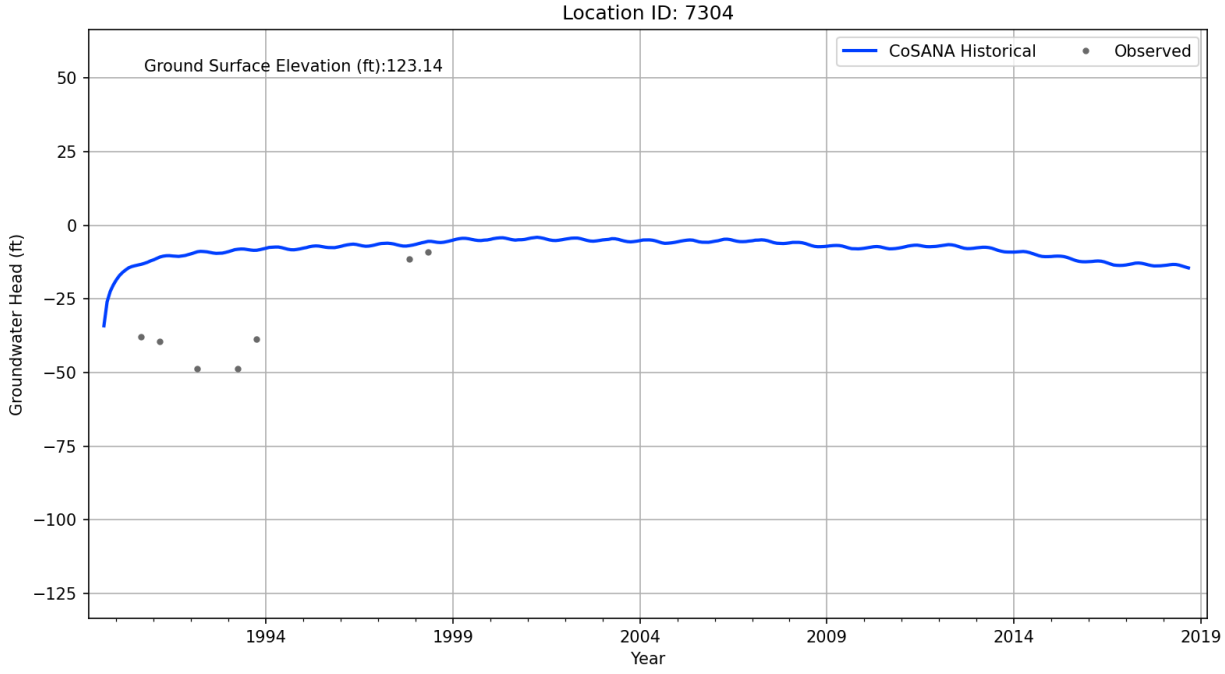

Location ID: 7220
Ground Surface Elevation (ft):140.68
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

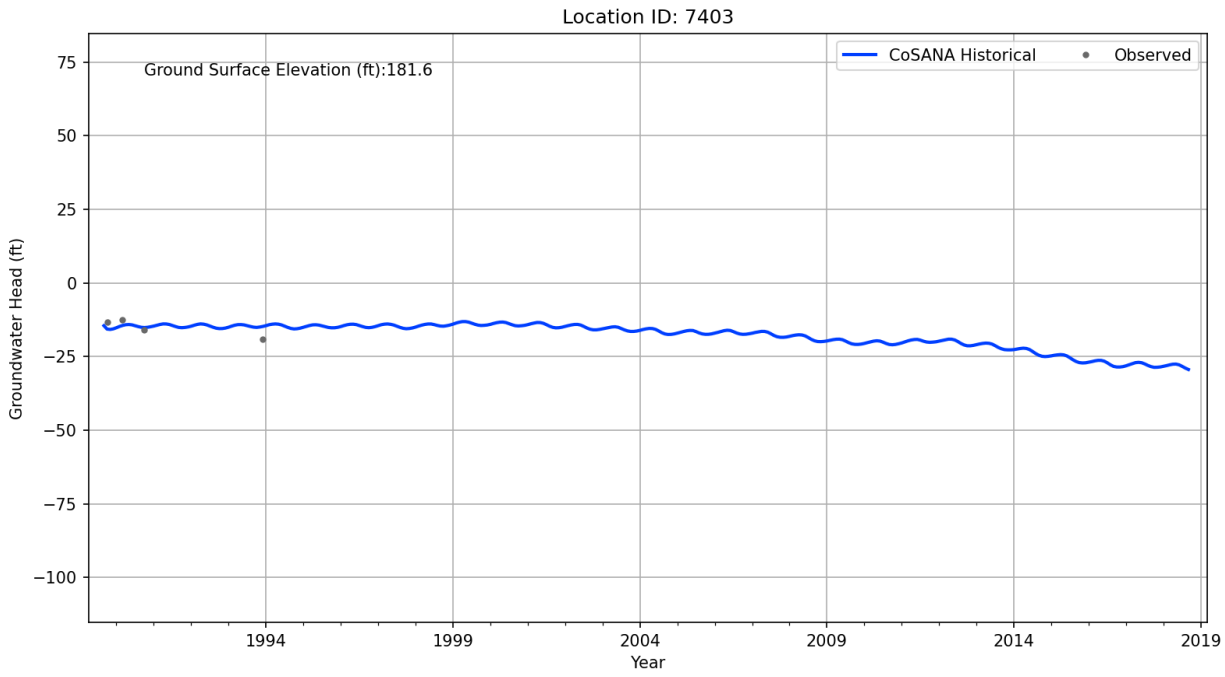

Location ID: 7221
Ground Surface Elevation (ft):84.56
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

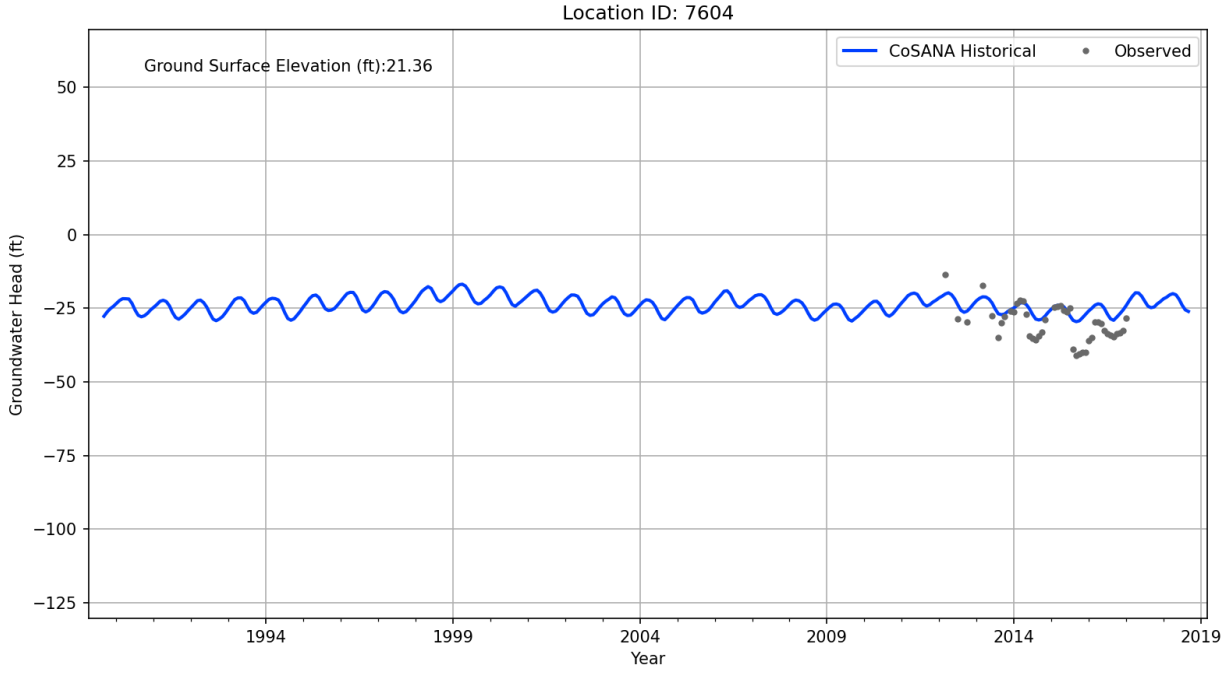

Location ID: 7222
Ground Surface Elevation (ft):59.58
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

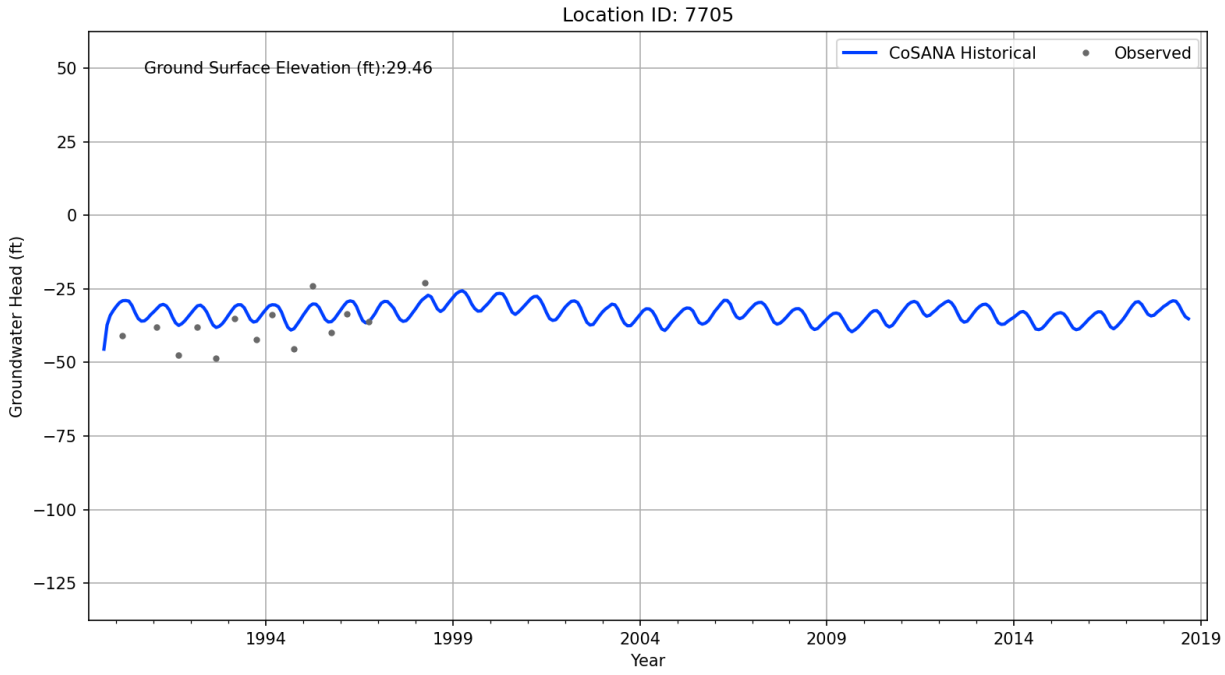

Location ID: 7223
Ground Surface Elevation (ft):101.64
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

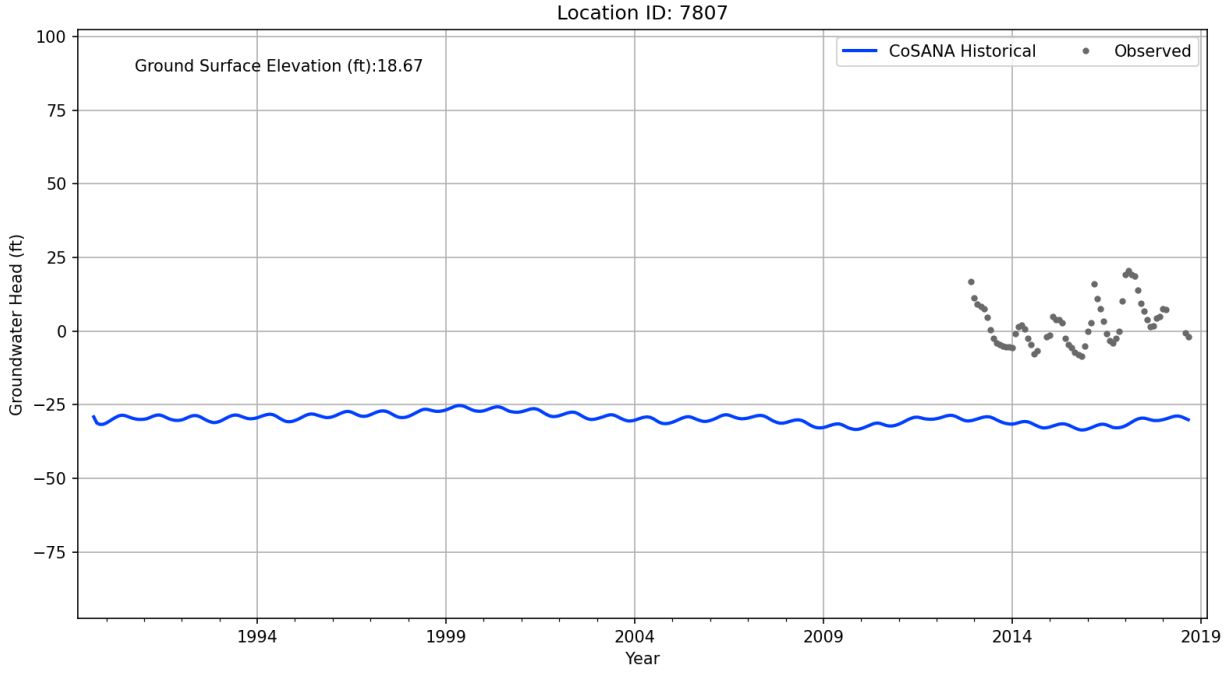

Location ID: 7224
Ground Surface Elevation (ft):85.29
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

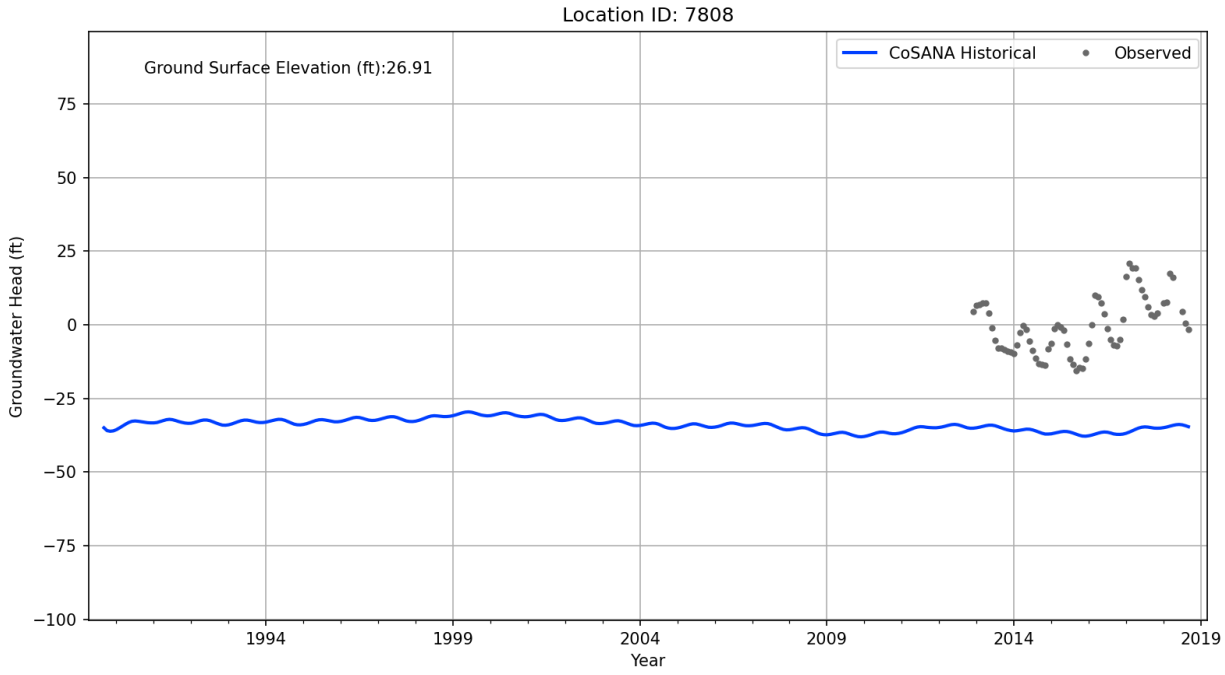

Location ID: 7304
Ground Surface Elevation (ft):123.14
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

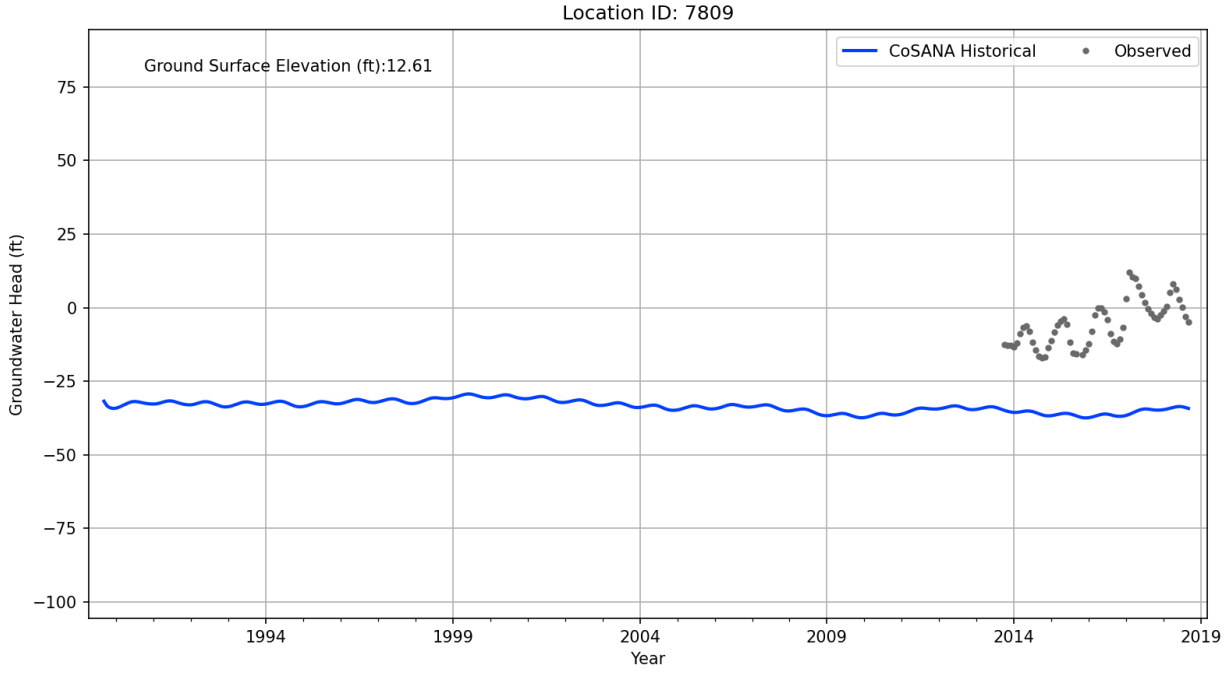

Location ID: 7403
Ground Surface Elevation (ft):181.6
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

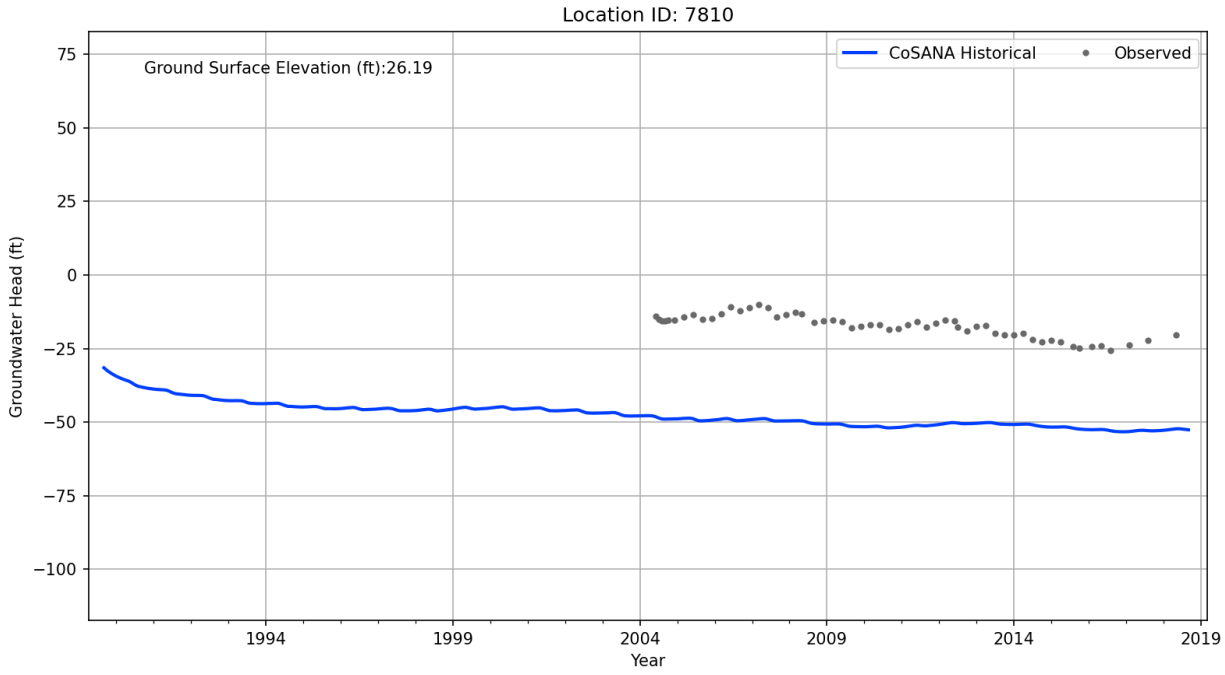

Location ID: 7604
Ground Surface Elevation (ft):21.36
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

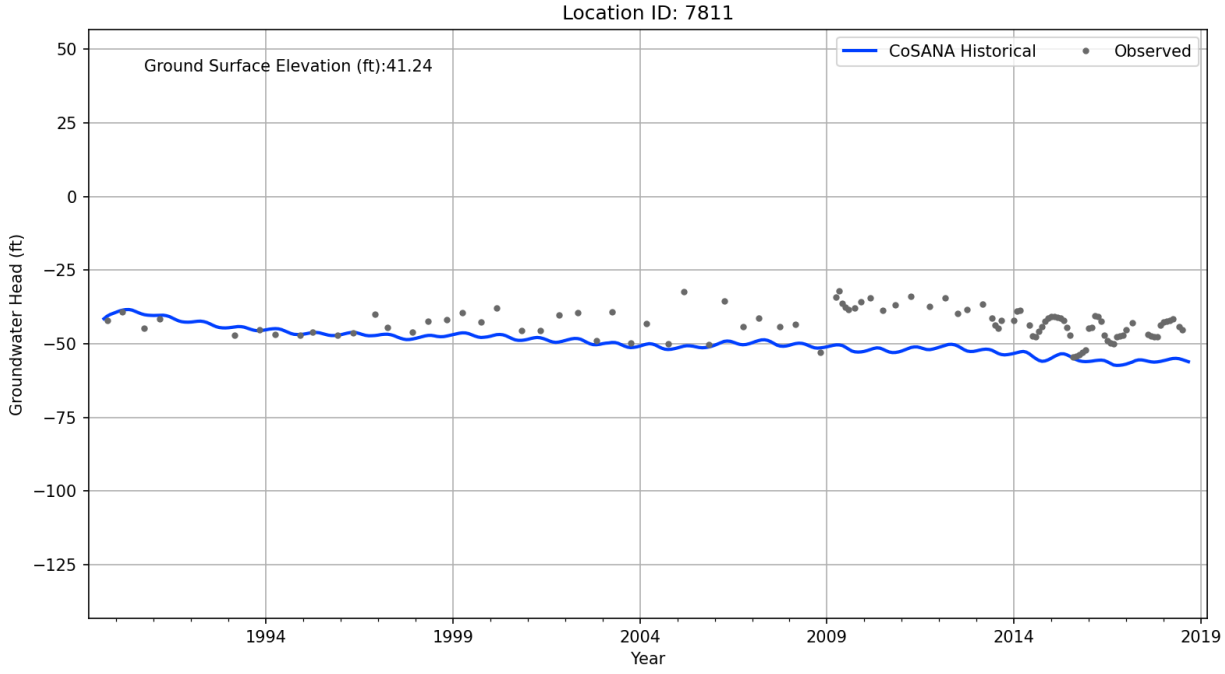

Location ID: 7705
Ground Surface Elevation (ft):29.46
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

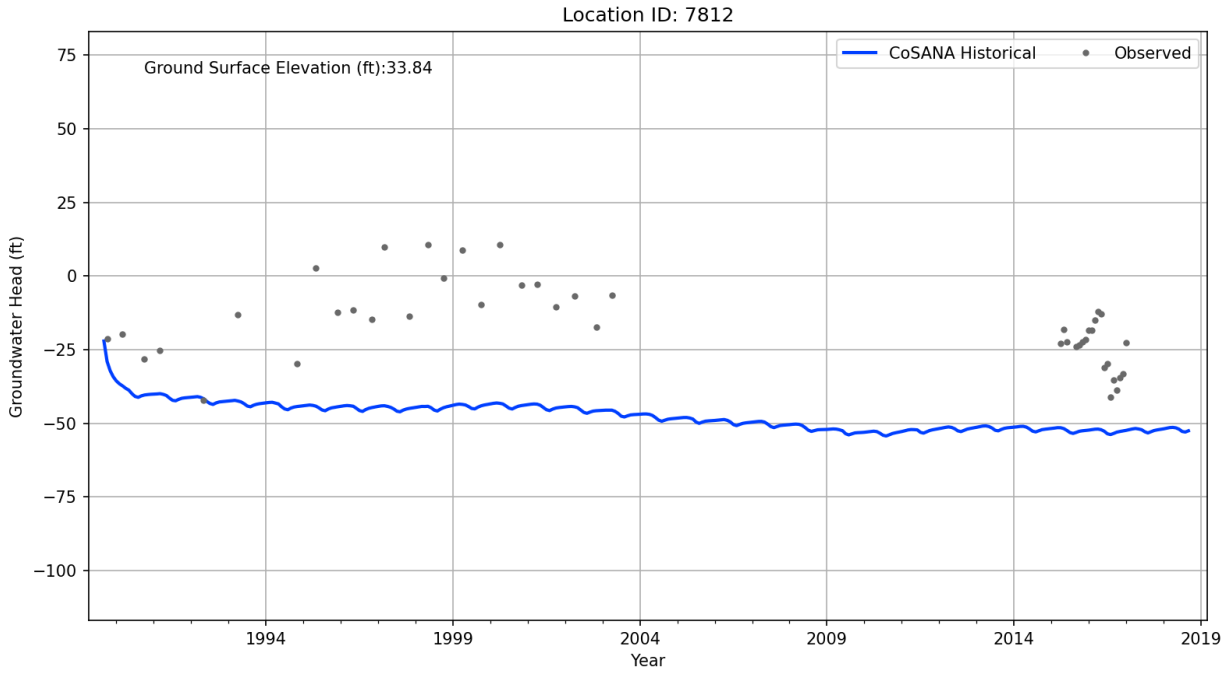

Location ID: 7807
Ground Surface Elevation (ft):18.67
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

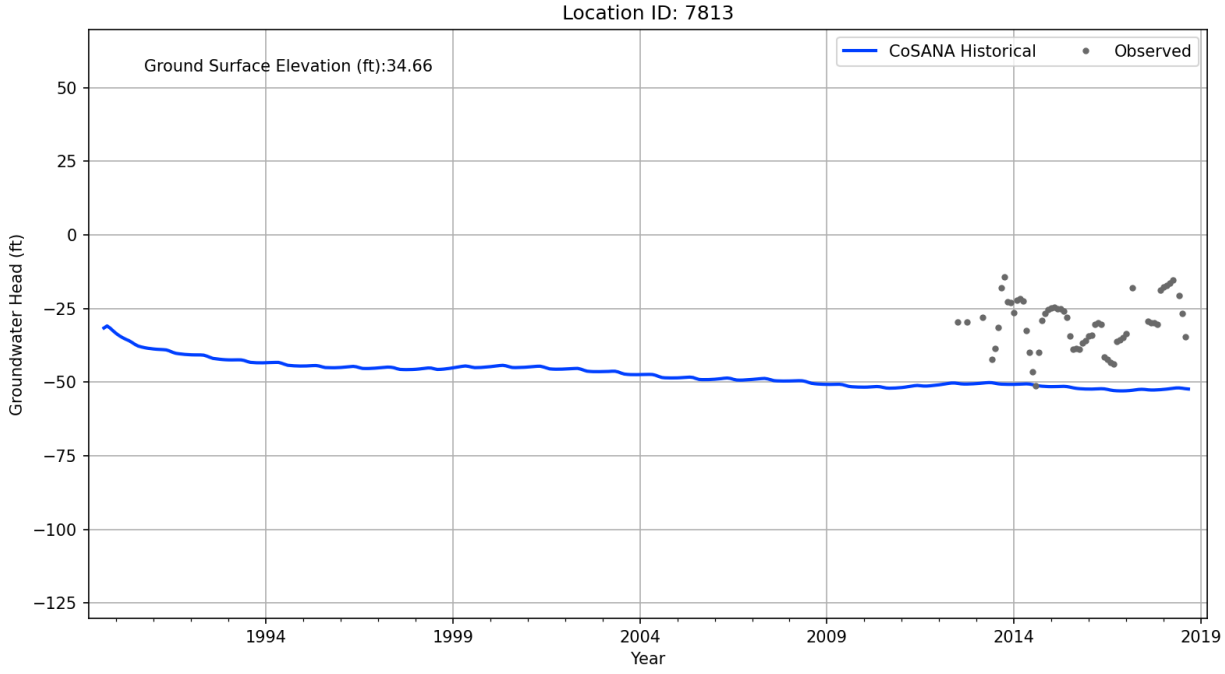

Location ID: 7808
Ground Surface Elevation (ft):26.91
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

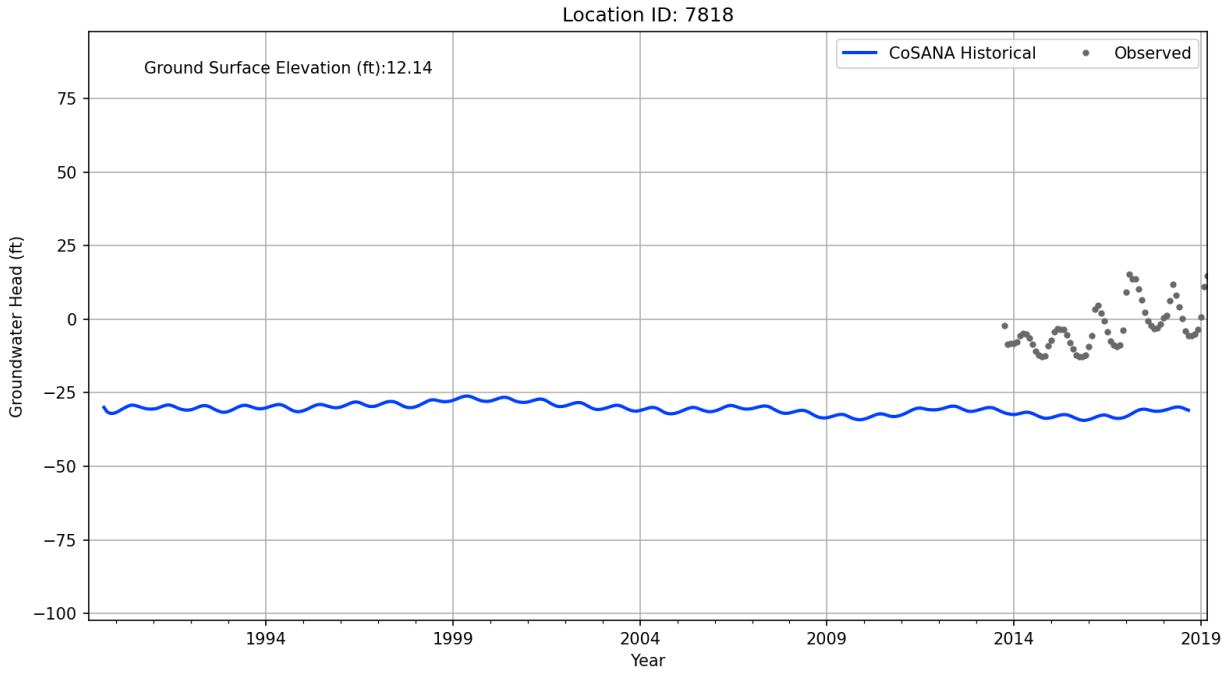

Location ID: 7809
Ground Surface Elevation (ft):12.61
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

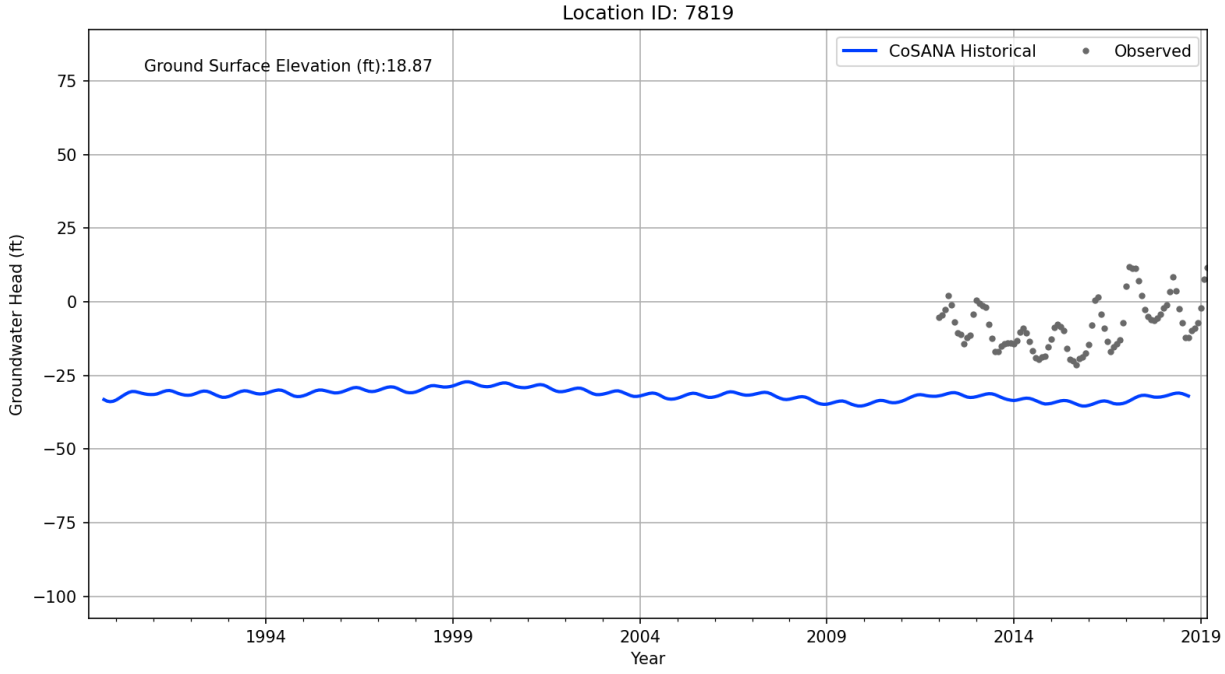

Location ID: 7810
Ground Surface Elevation (ft):26.19
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

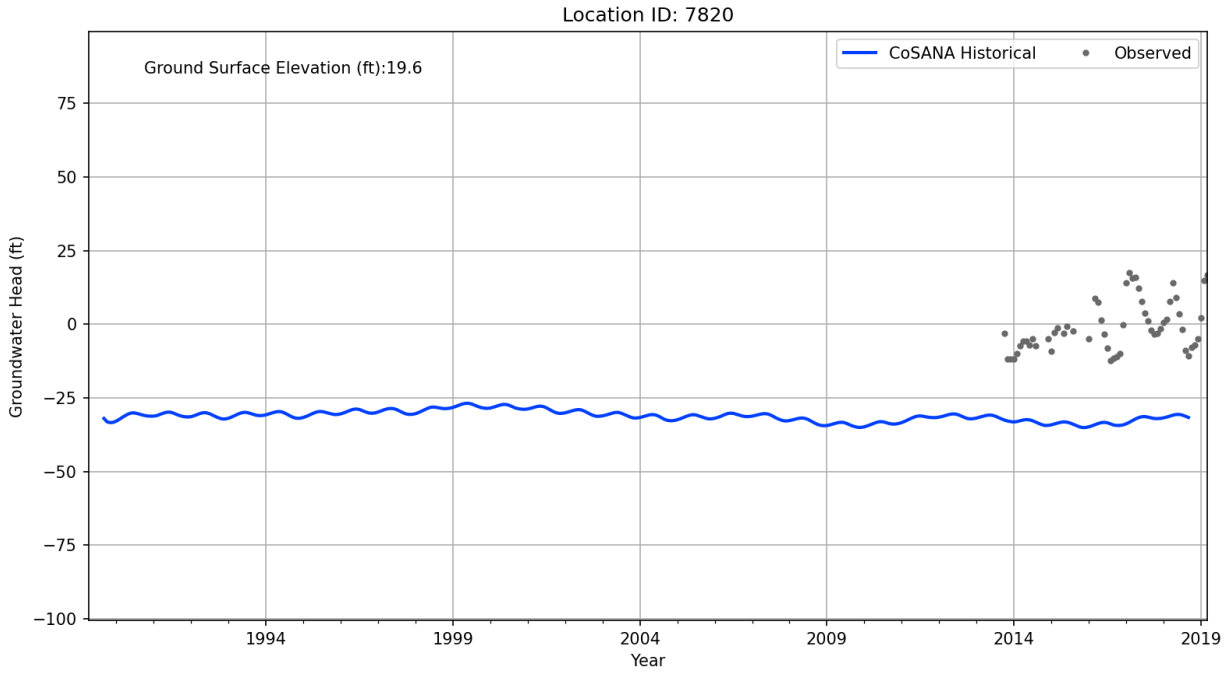

Location ID: 7811
Ground Surface Elevation (ft):41.24
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

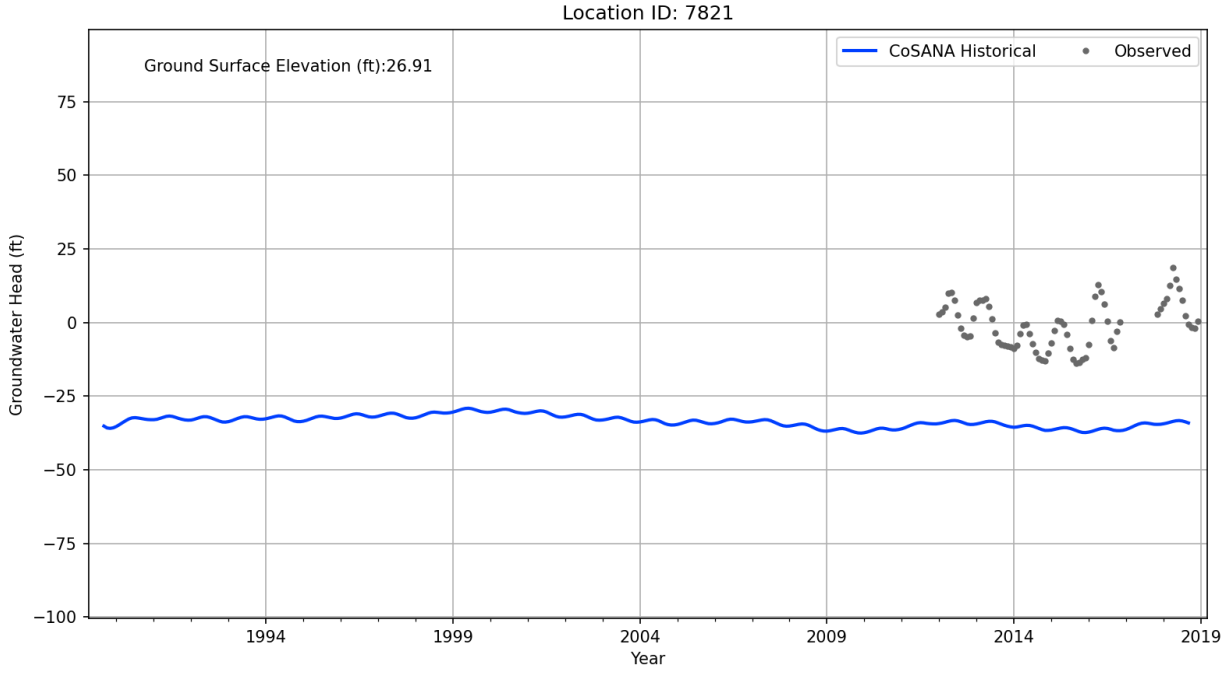

Location ID: 7812
Ground Surface Elevation (ft):33.84
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

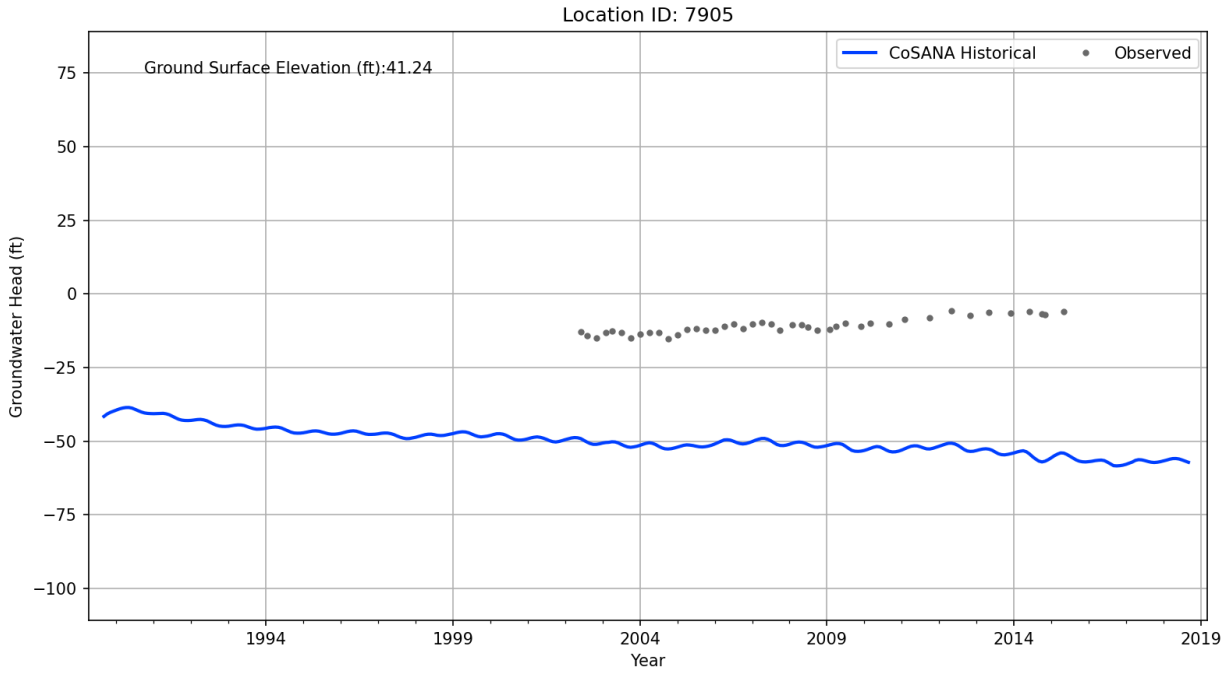

Location ID: 7813
Ground Surface Elevation (ft):34.66
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

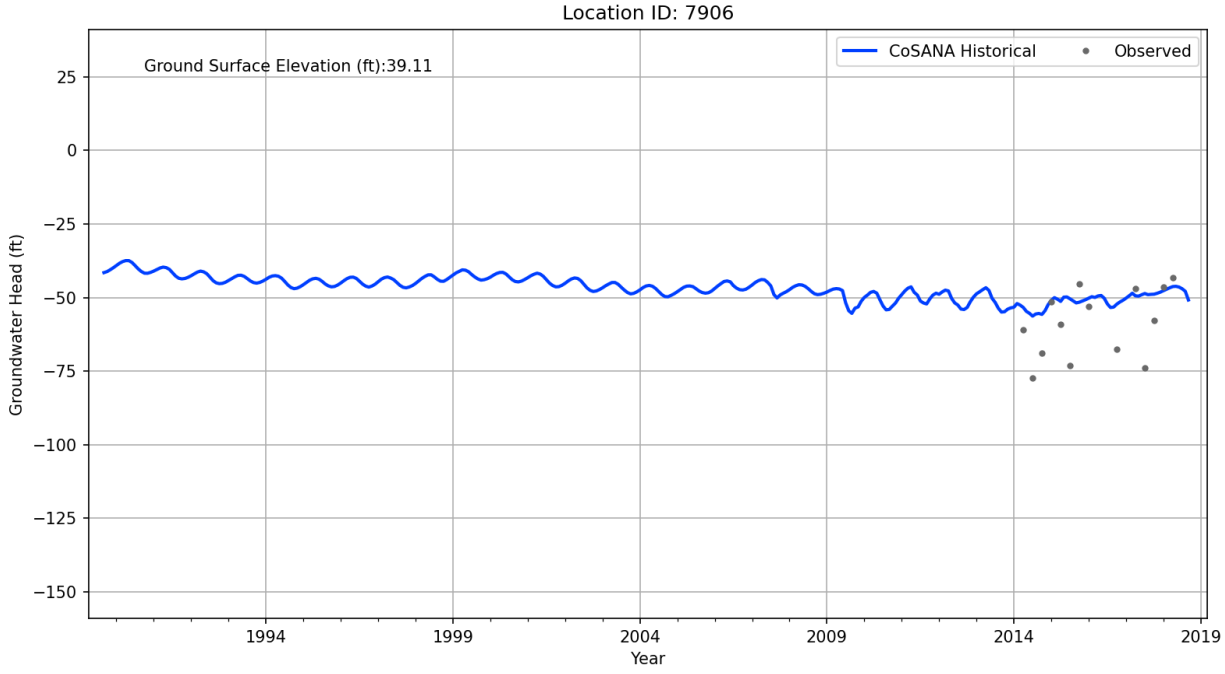

Location ID: 7818
Ground Surface Elevation (ft):12.14
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

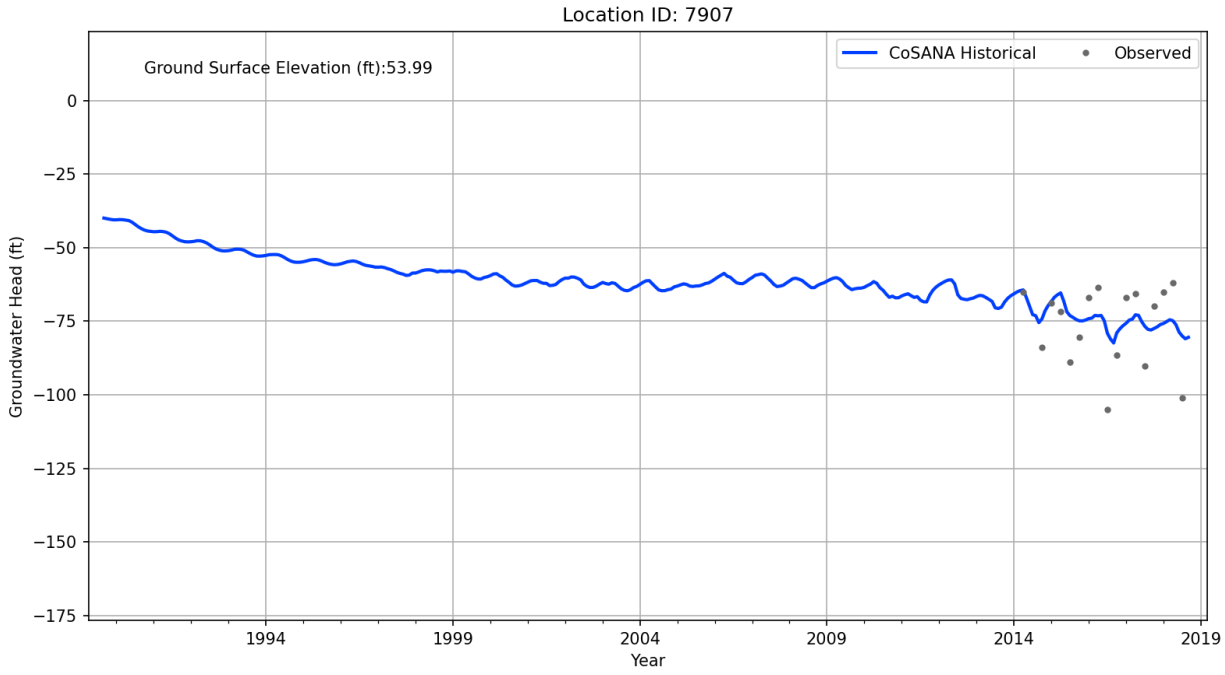

Location ID: 7819
Ground Surface Elevation (ft):18.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

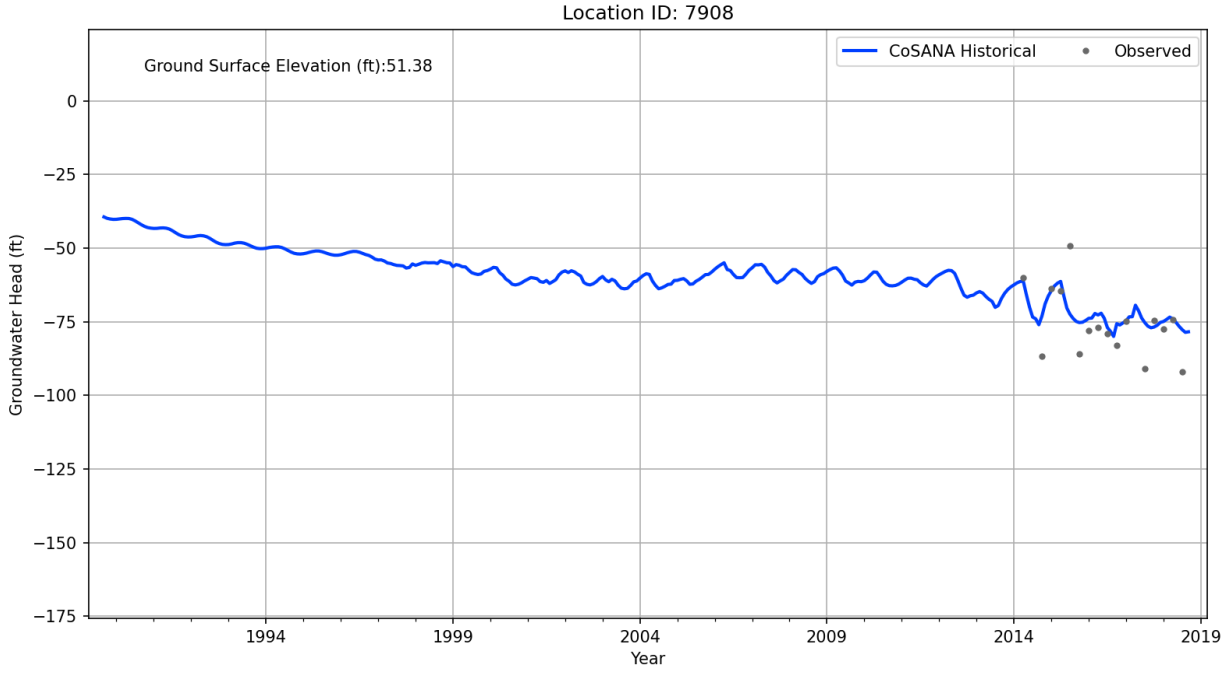

Location ID: 7820
Ground Surface Elevation (ft):19.6
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

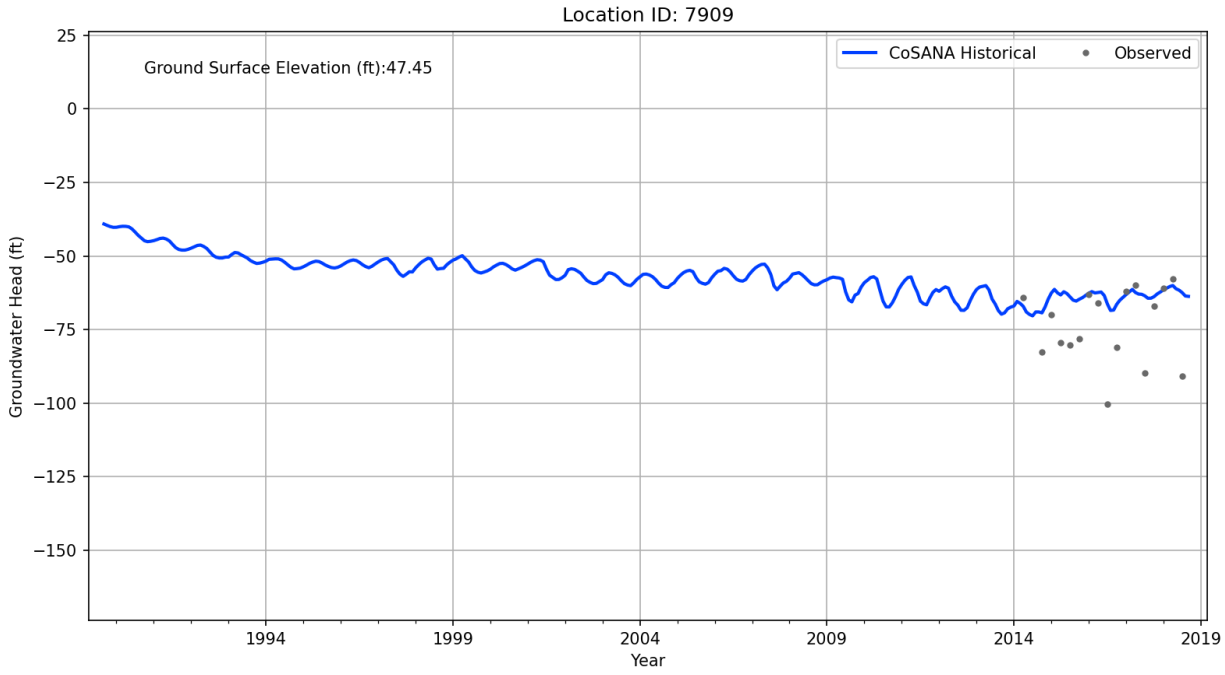

Location ID: 7821
Ground Surface Elevation (ft):26.91
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

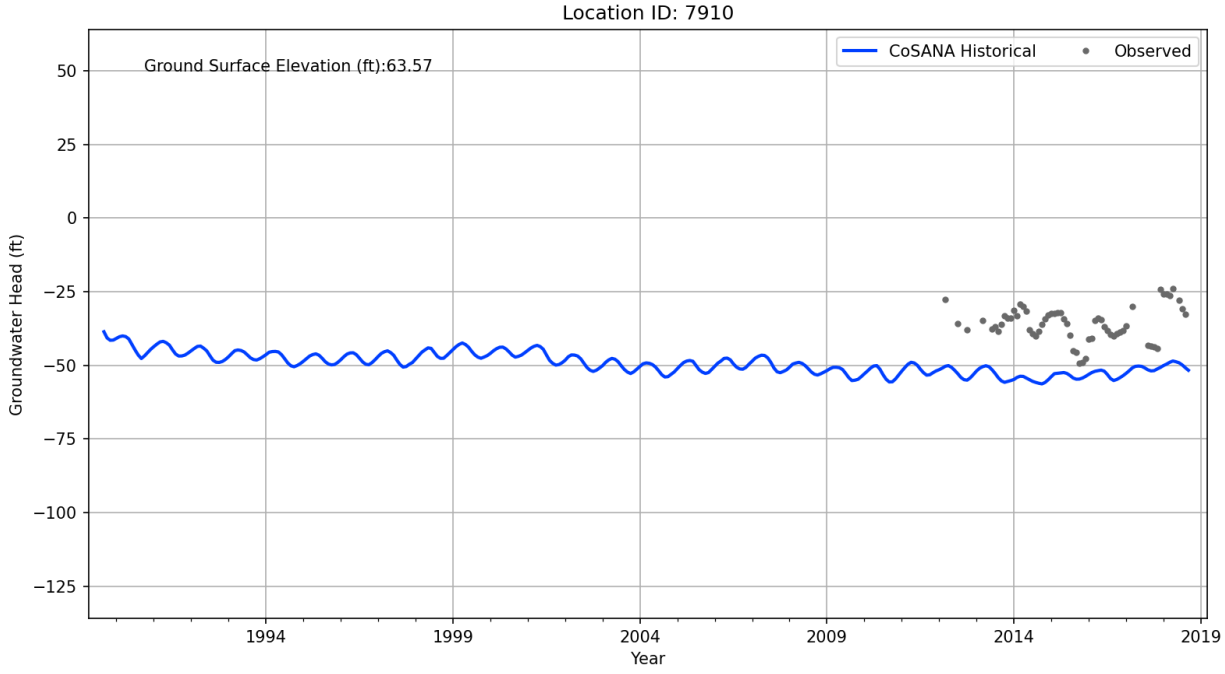

Location ID: 7905
Ground Surface Elevation (ft):41.24
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

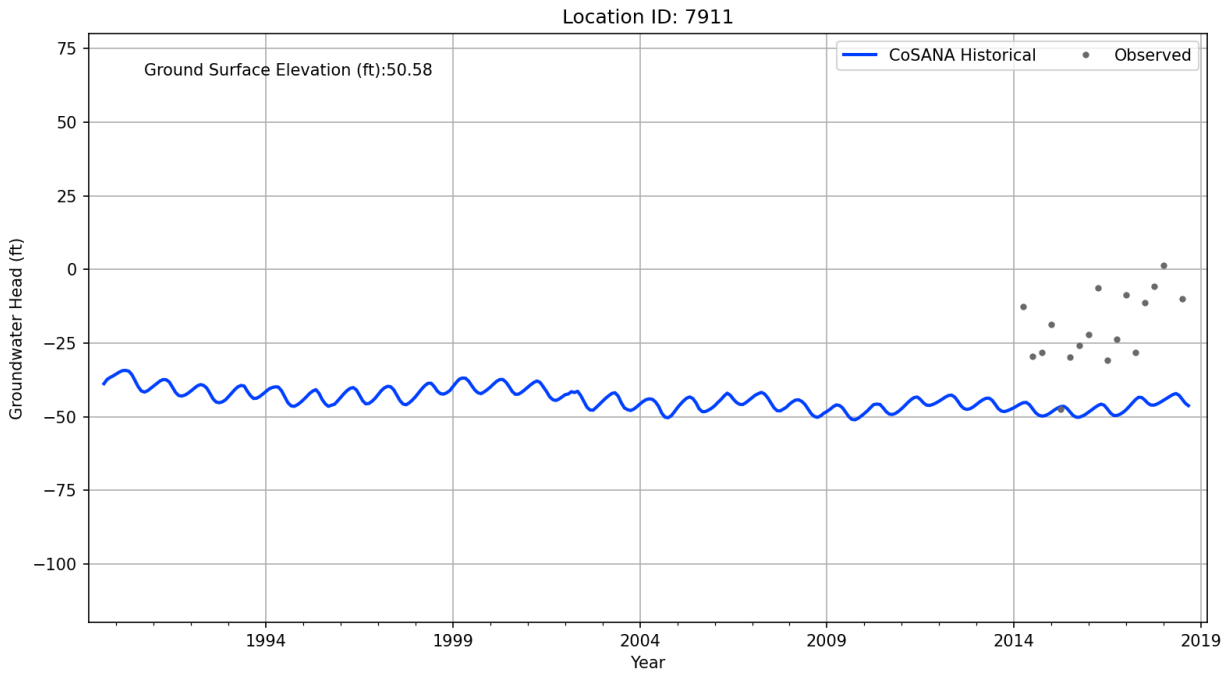

Location ID: 7906
Ground Surface Elevation (ft):39.11
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

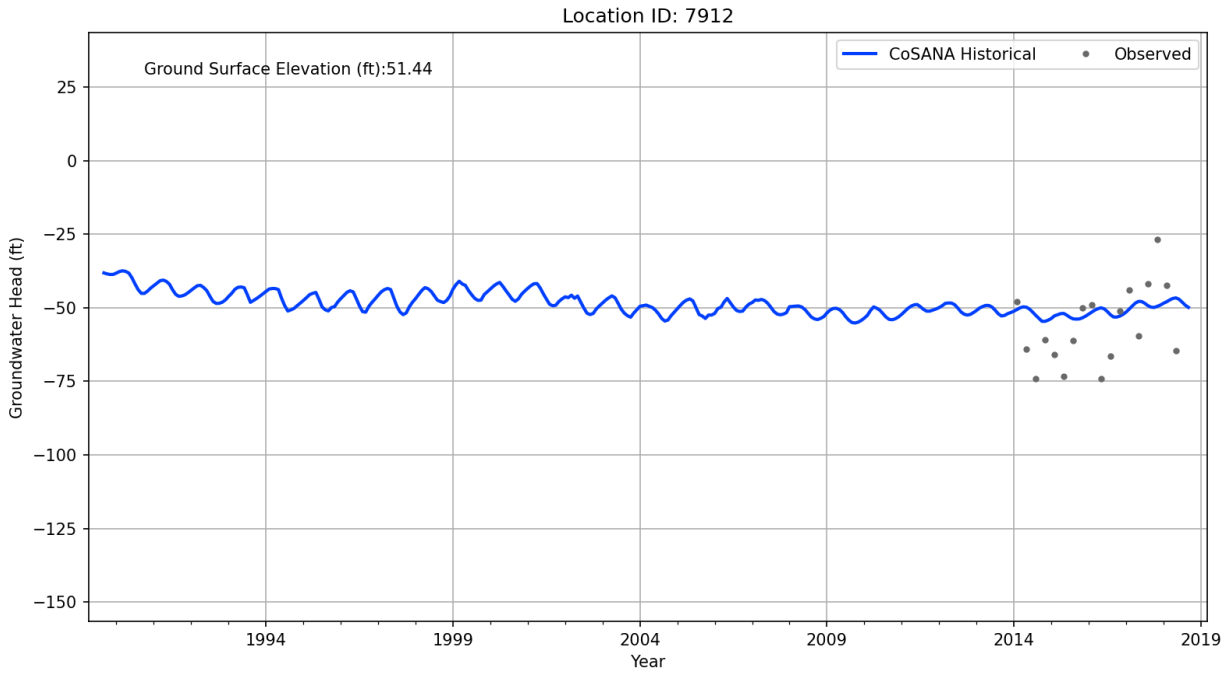

Location ID: 7907
Ground Surface Elevation (ft):53.99
CoSANA Historical
Observed
Groundwater Head (ft)
0
−25
−50
−75
−100
−125
−150
−175
1994
1999
2004
2009
2014
2019
Year

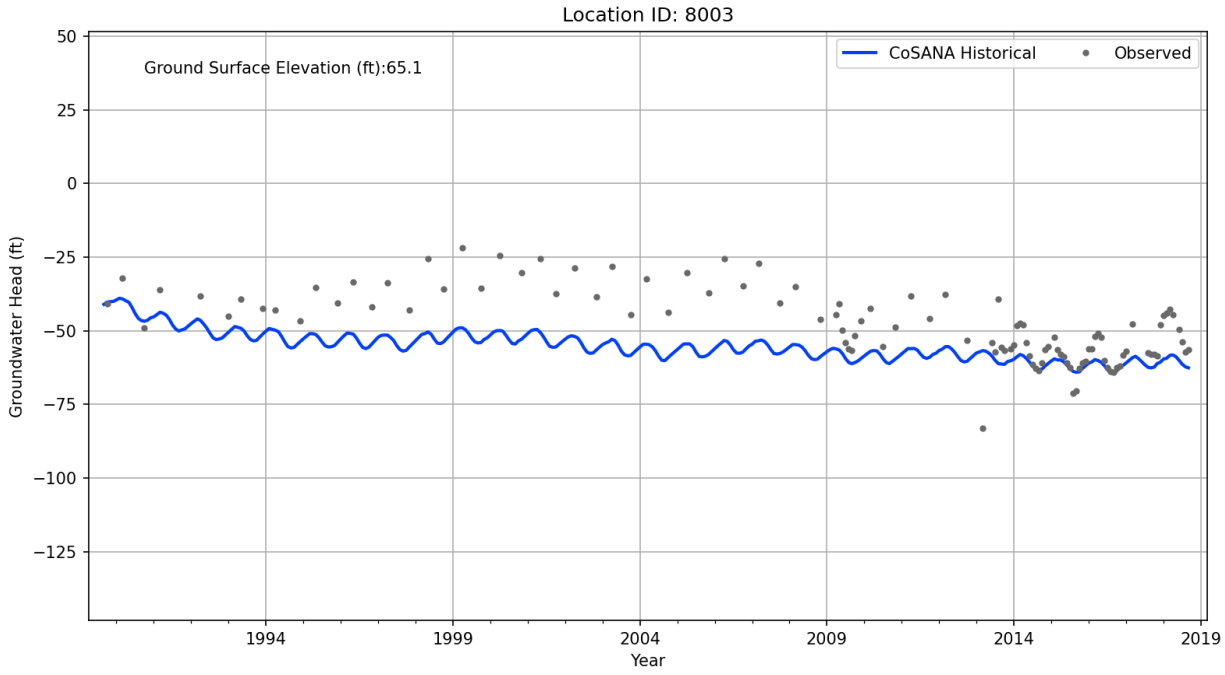

Location ID: 7908
Ground Surface Elevation (ft):51.38
CoSANA Historical
Observed
Groundwater Head (ft)
0
−25
−50
−75
−100
−125
−150
−175
1994
1999
2004
2009
2014
2019
Year

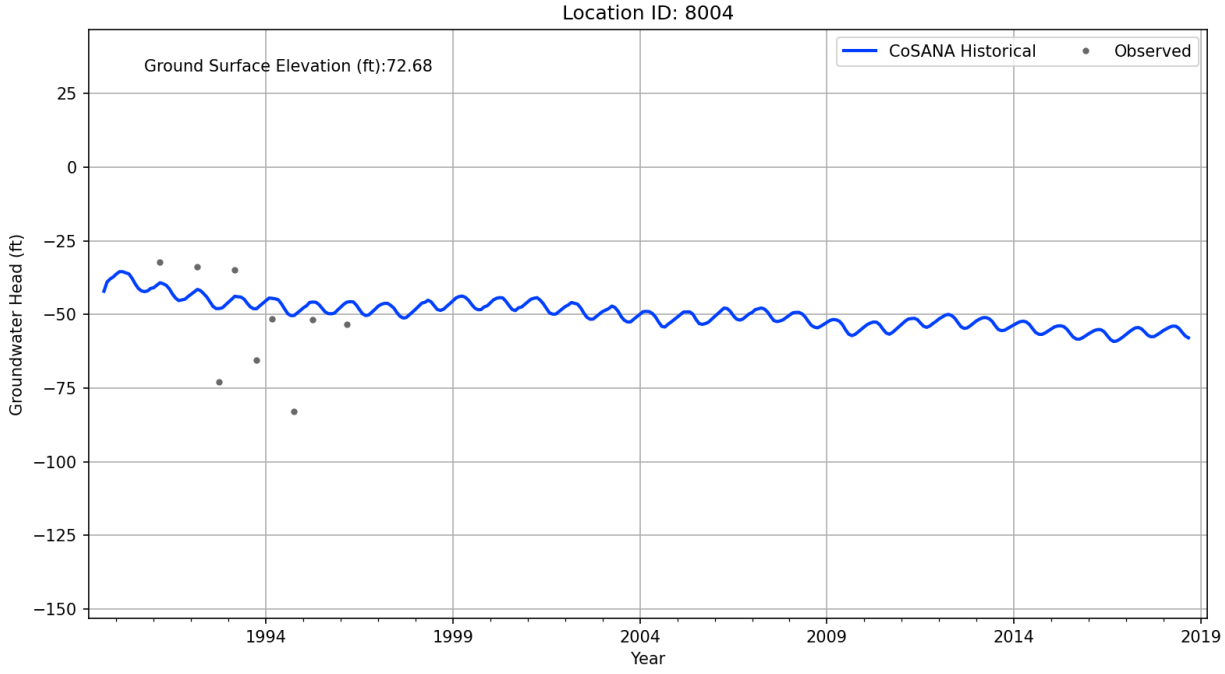

Location ID: 7909
Ground Surface Elevation (ft):47.45
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

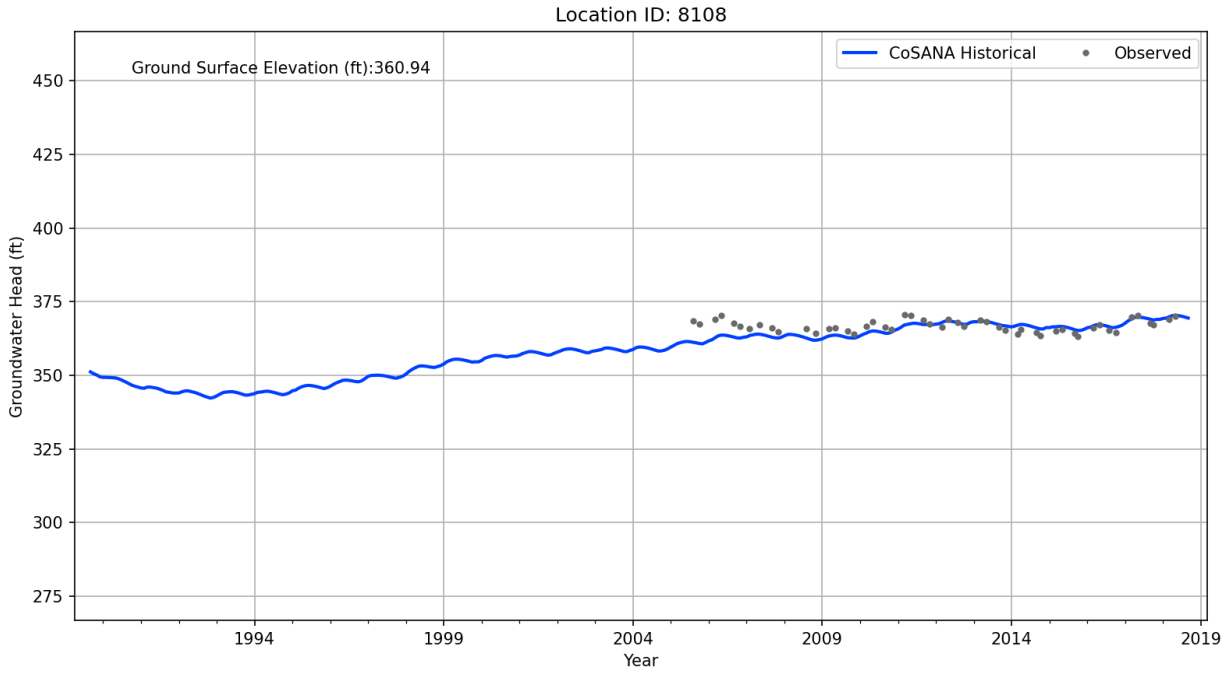

Location ID: 7910
Ground Surface Elevation (ft):63.57
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

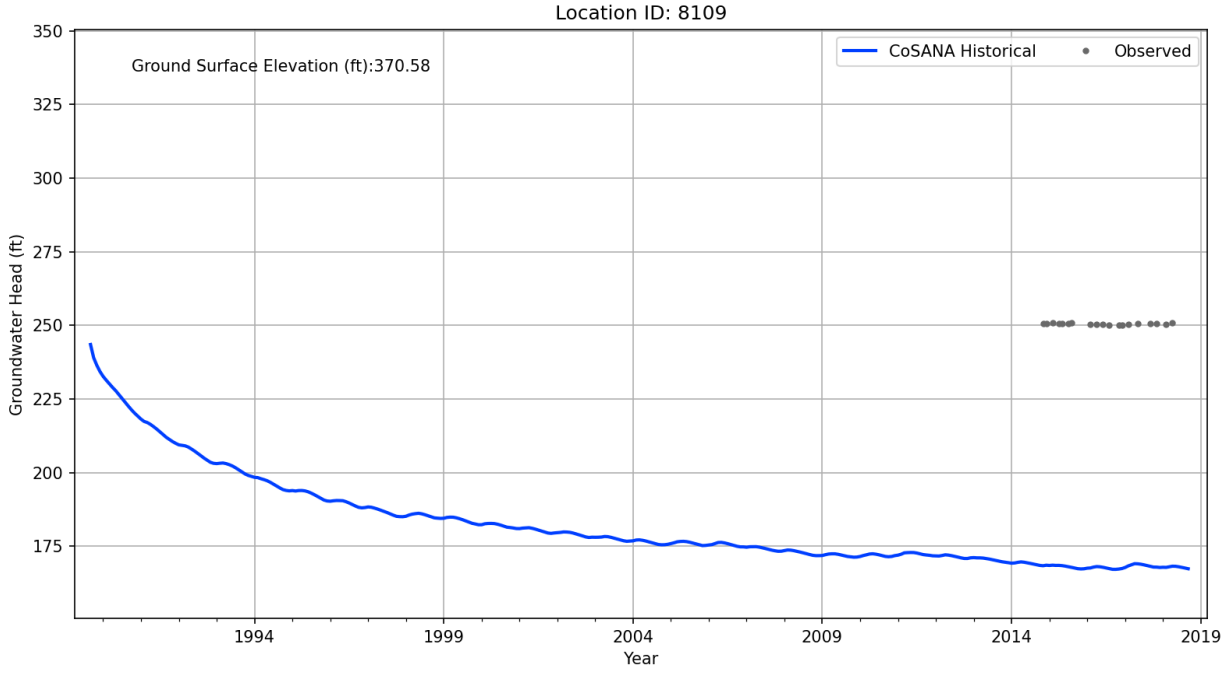

Location ID: 7911
Ground Surface Elevation (ft):50.58
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

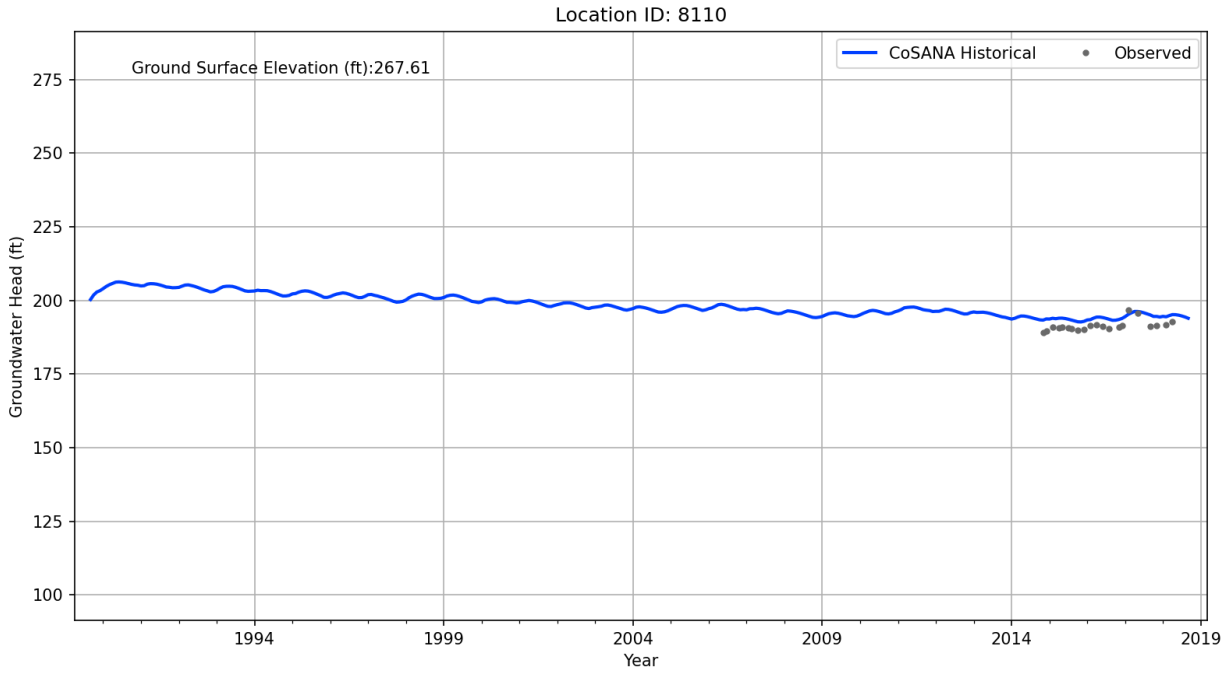

Location ID: 7912
Ground Surface Elevation (ft):51.44
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

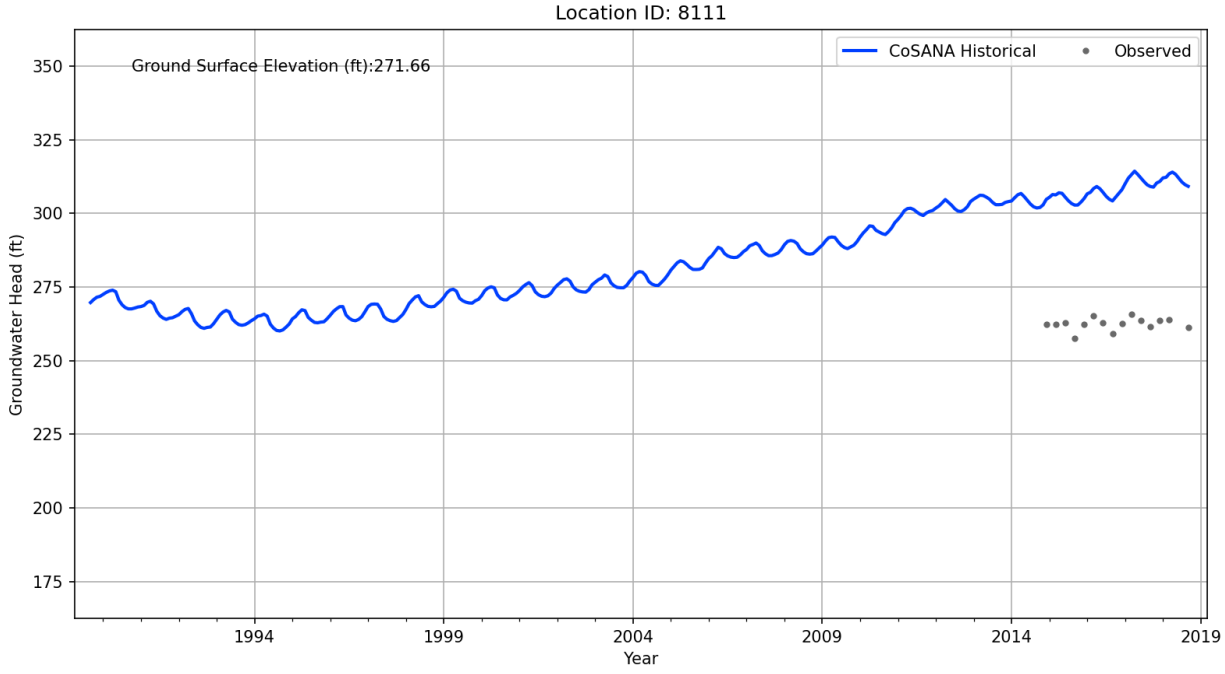

Location ID: 8003
Ground Surface Elevation (ft):65.1
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

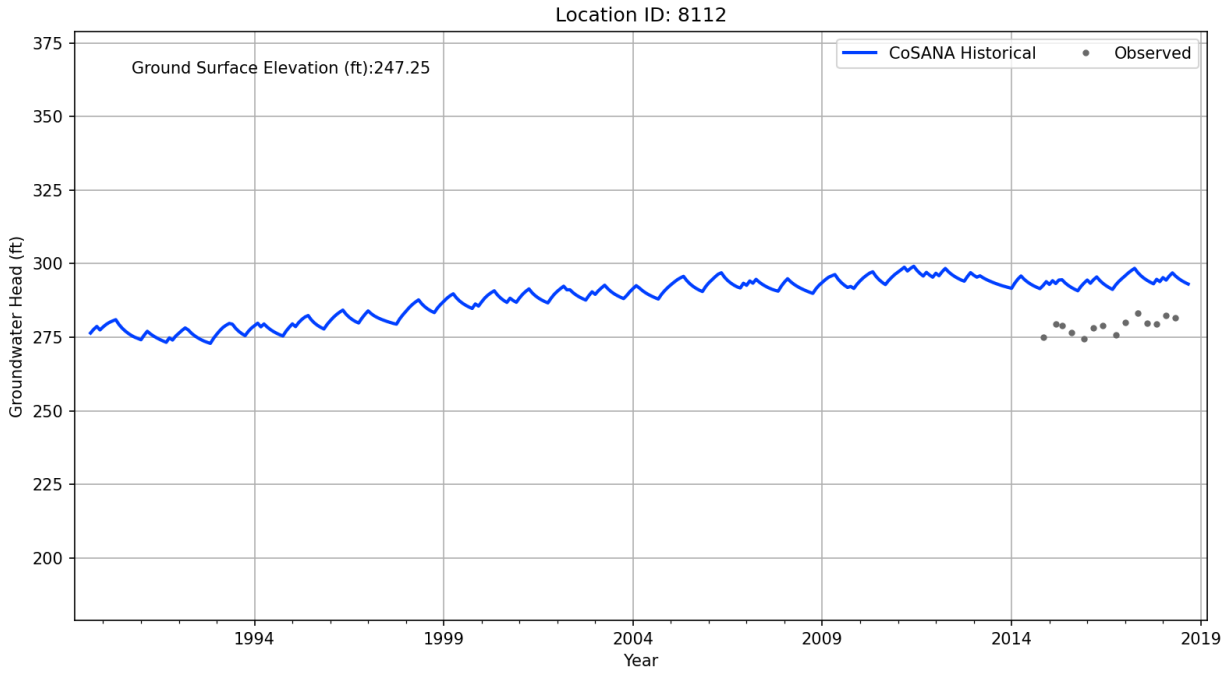

Location ID: 8004
Ground Surface Elevation (ft):72.68
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

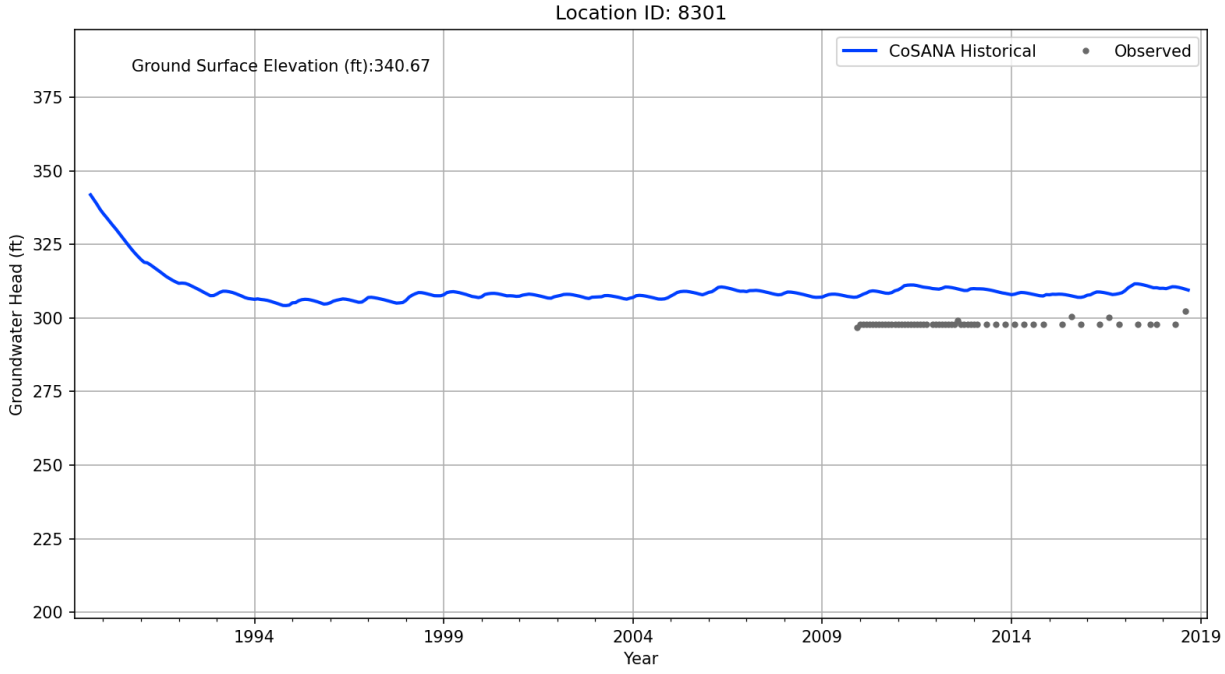

Location ID: 8108
Ground Surface Elevation (ft):360.94
CoSANA Historical
Observed
Groundwater Head (ft)
450
425
400
375
350
325
300
275
1994
1999
2004
2009
2014
2019
Year

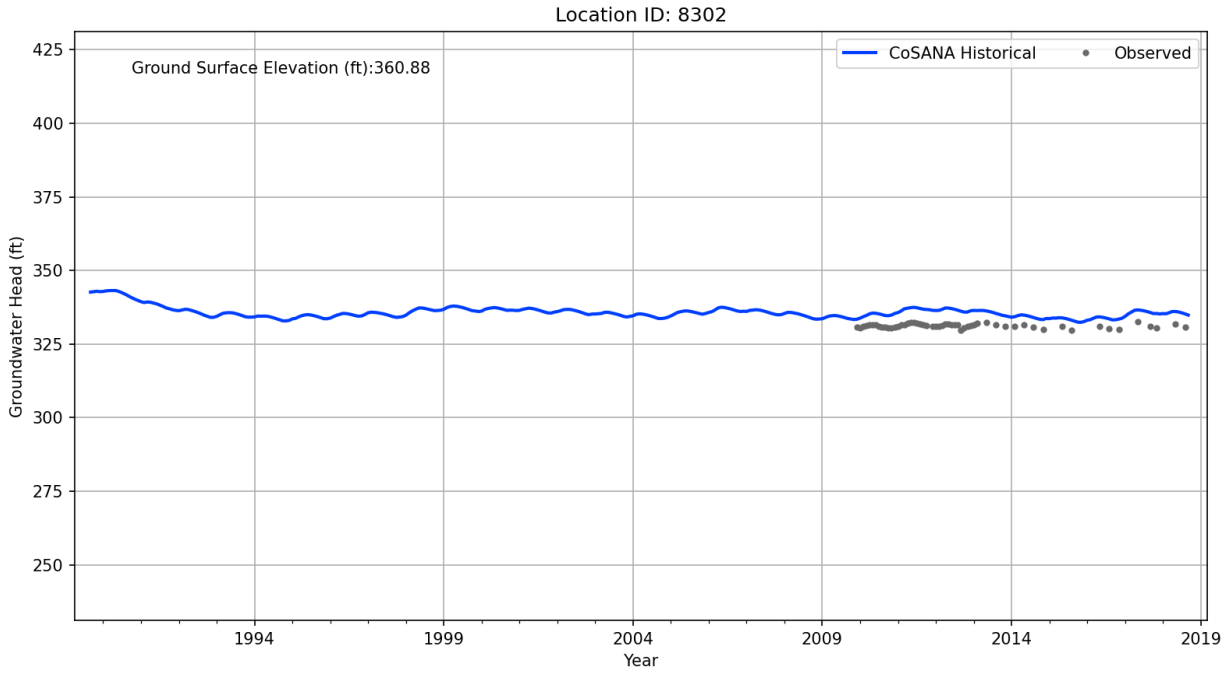

Location ID: 8109
Ground Surface Elevation (ft):370.58
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

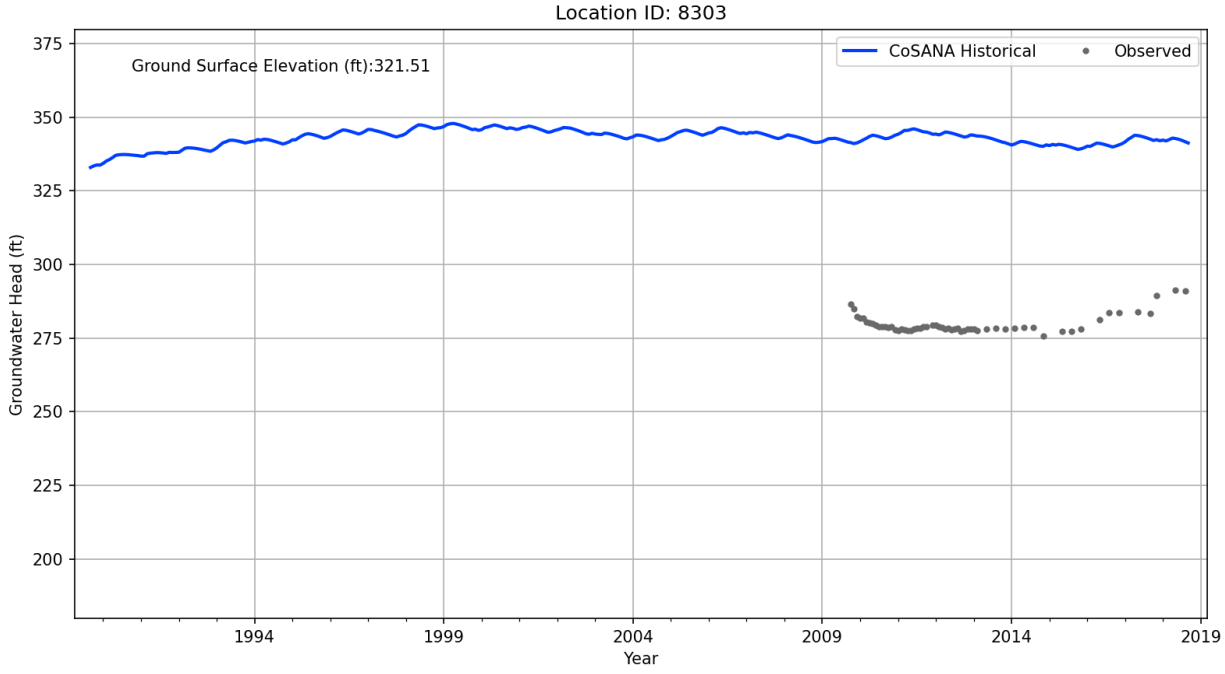

Location ID: 8110
Ground Surface Elevation (ft):267.61
CoSANA Historical
Observed
Groundwater Head (ft)
Year
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019

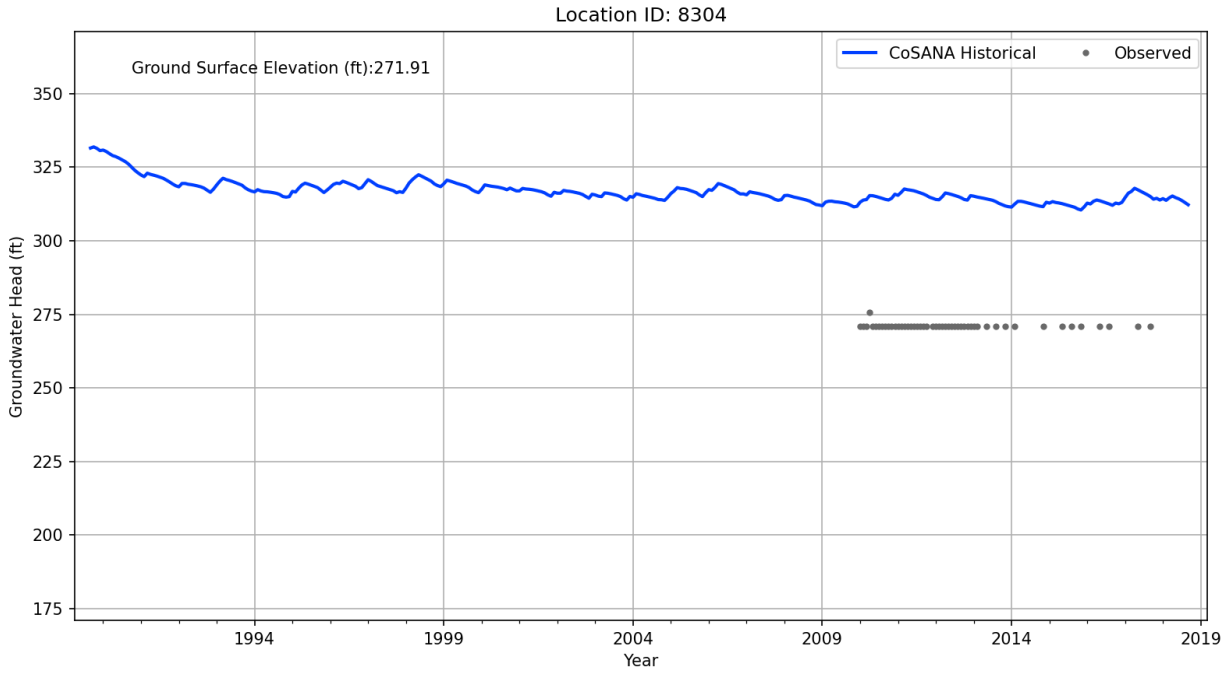

Location ID: 8111
Ground Surface Elevation (ft):271.66
CoSANA Historical
Observed
Groundwater Head (ft)
Year
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019

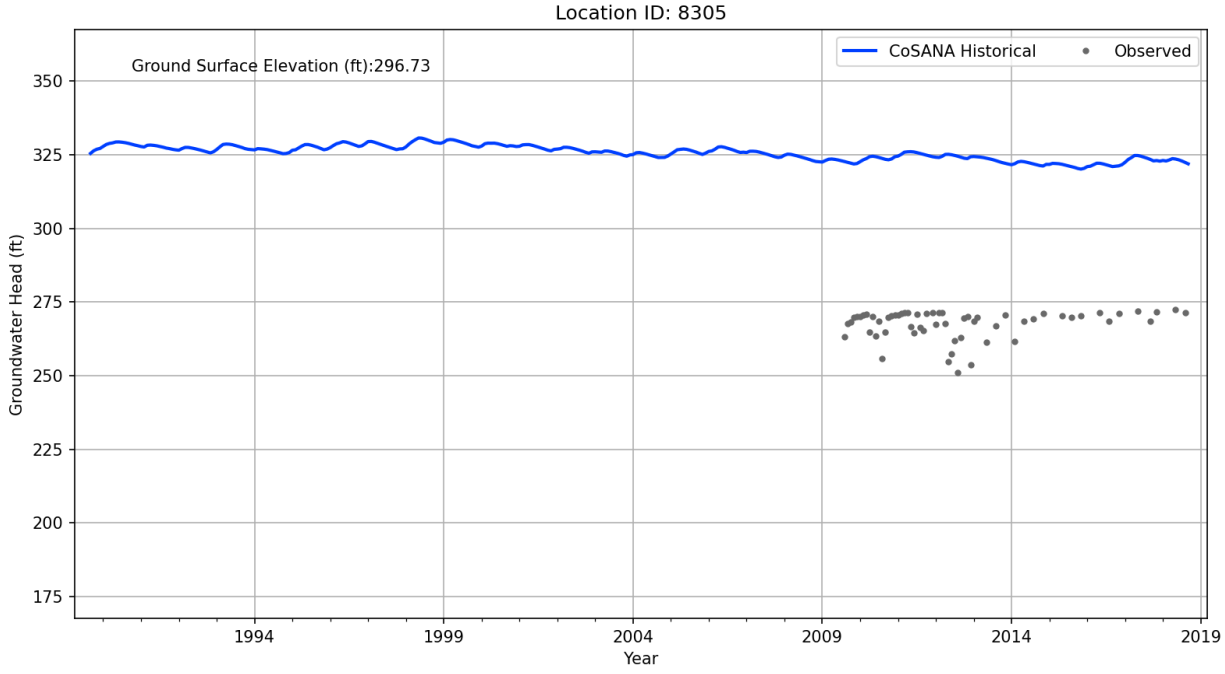

Location ID: 8112
Ground Surface Elevation (ft):247.25
CoSANA Historical
Observed
Groundwater Head (ft)
375
350
325
300
275
250
225
200
1994
1999
2004
2009
2014
2019
Year

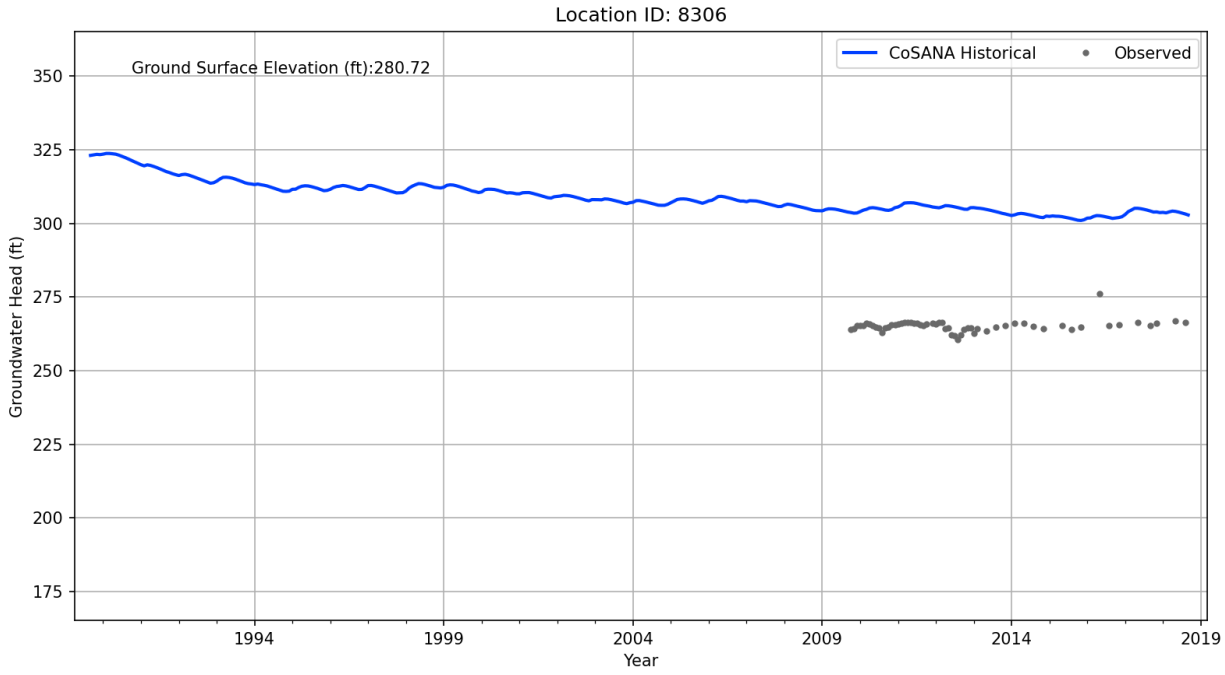

Location ID: 8301
Ground Surface Elevation (ft):340.67
CoSANA Historical
Observed
Groundwater Head (ft)
375
350
325
300
275
250
225
200
1994
1999
2004
2009
2014
2019
Year

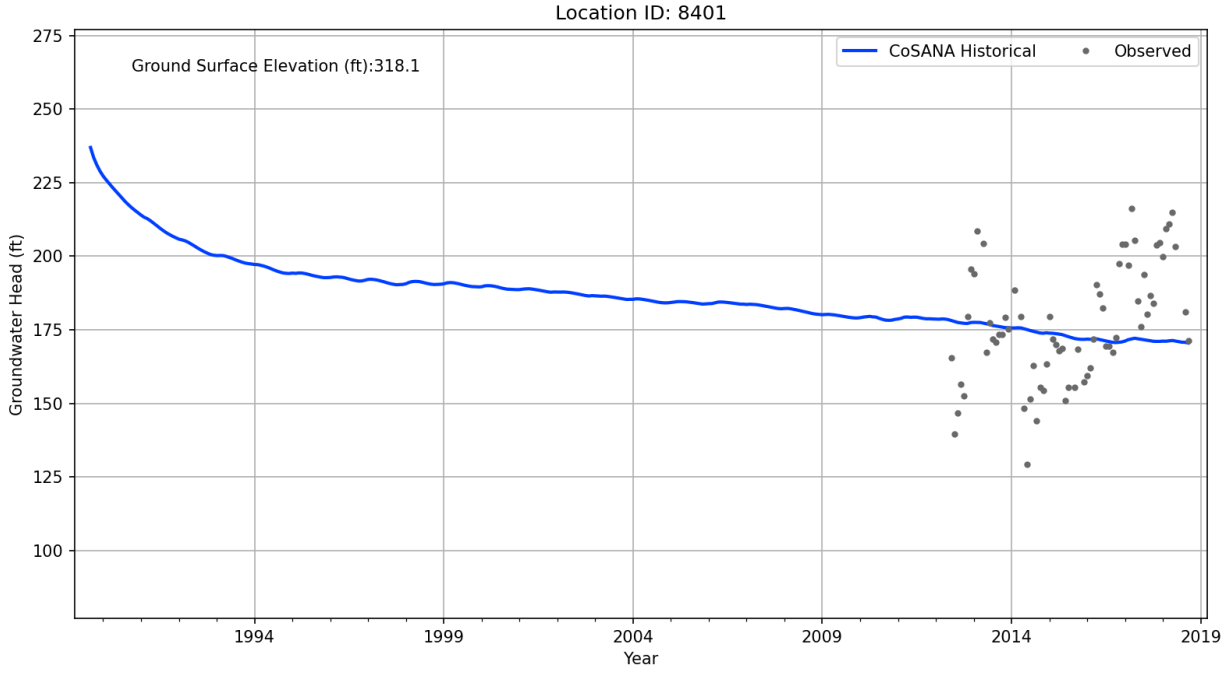

Location ID: 8302
Ground Surface Elevation (ft):360.88
CoSANA Historical
Observed
Groundwater Head (ft)
425
400
375
350
325
300
275
250
1994
1999
2004
2009
2014
2019
Year

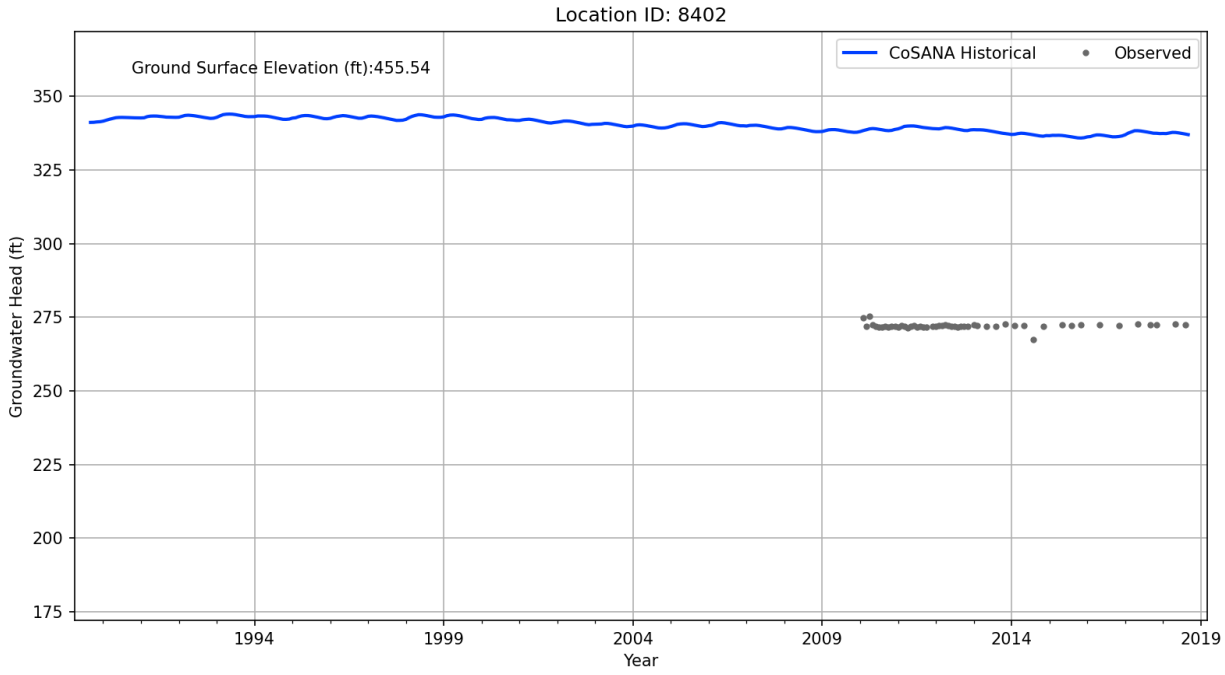

Location ID: 8303
Ground Surface Elevation (ft):321.51
CoSANA Historical
Observed
Groundwater Head (ft)
375
350
325
300
275
250
225
200
1994
1999
2004
2009
2014
2019
Year

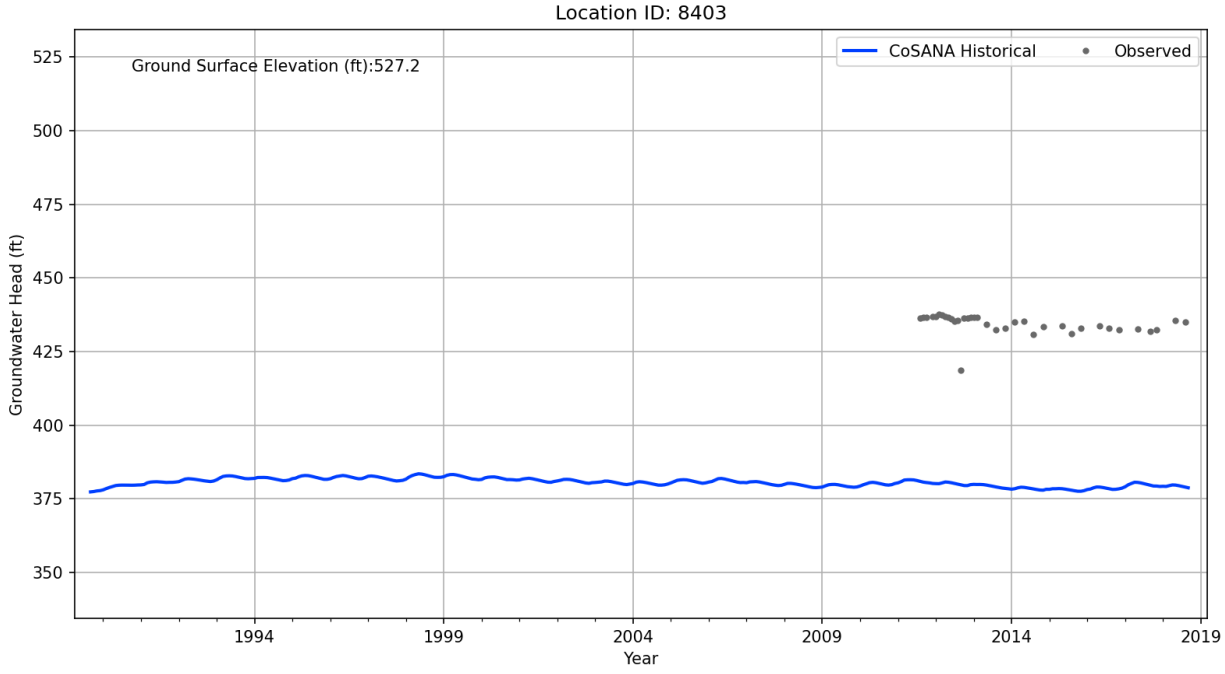

Location ID: 8304
Ground Surface Elevation (ft):271.91
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

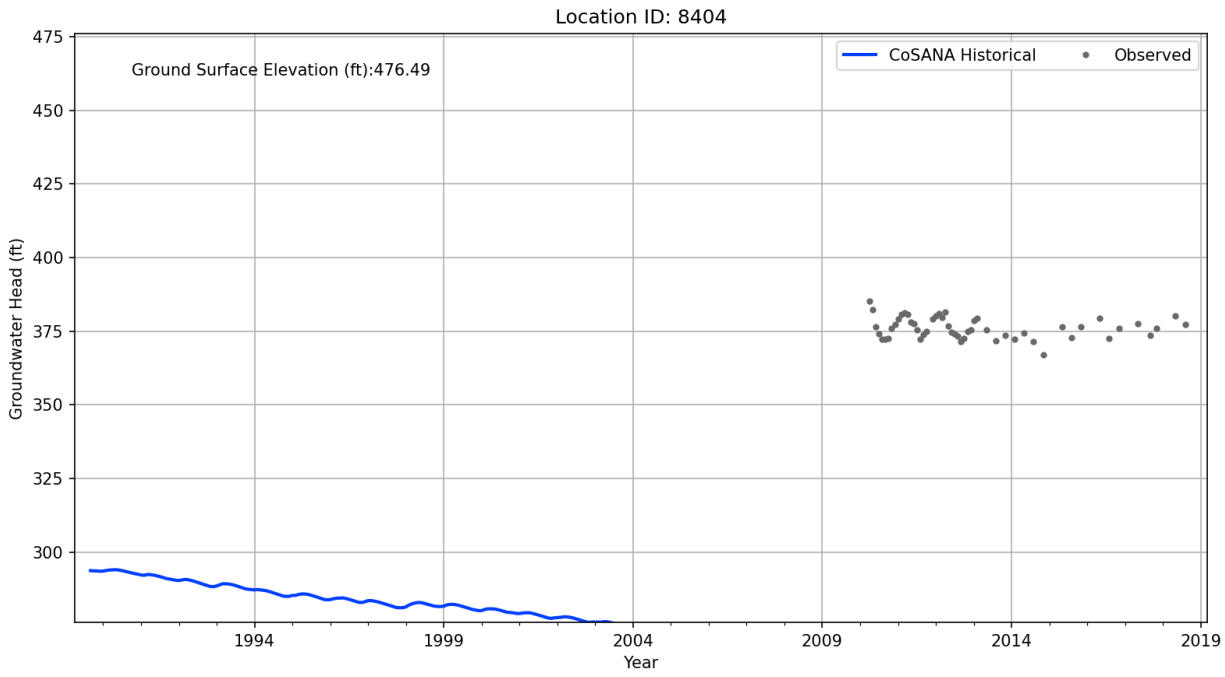

Location ID: 8305
Ground Surface Elevation (ft):296.73
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

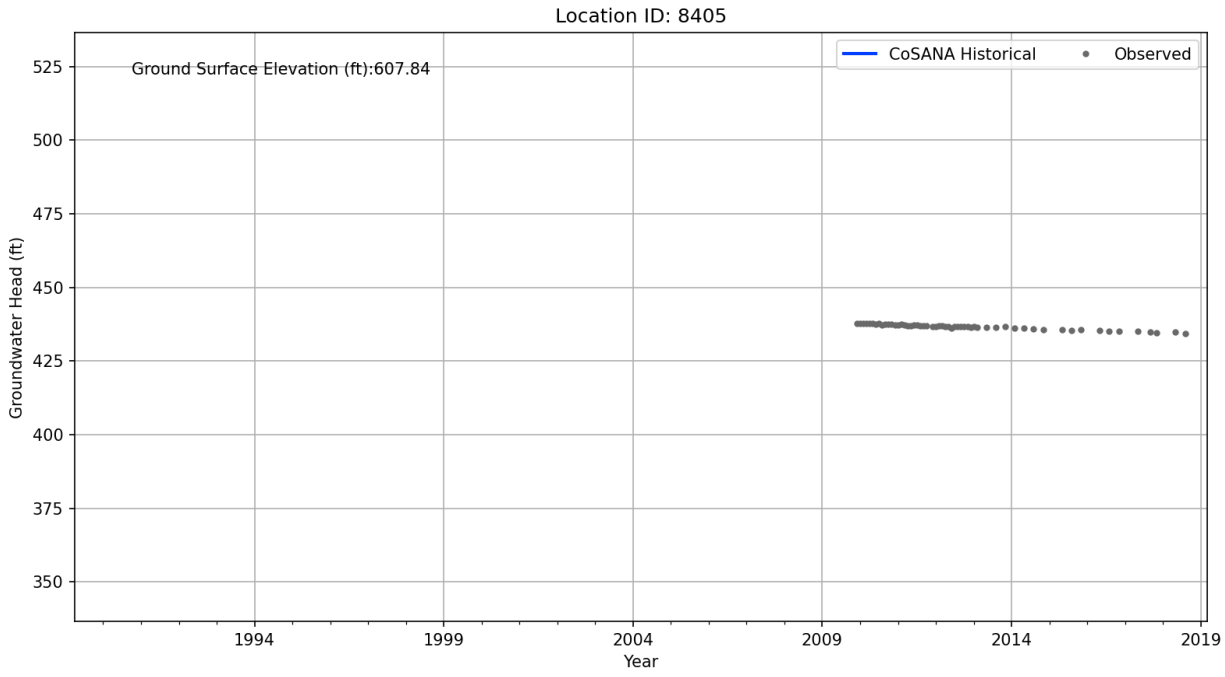

Location ID: 8306
Ground Surface Elevation (ft):280.72
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

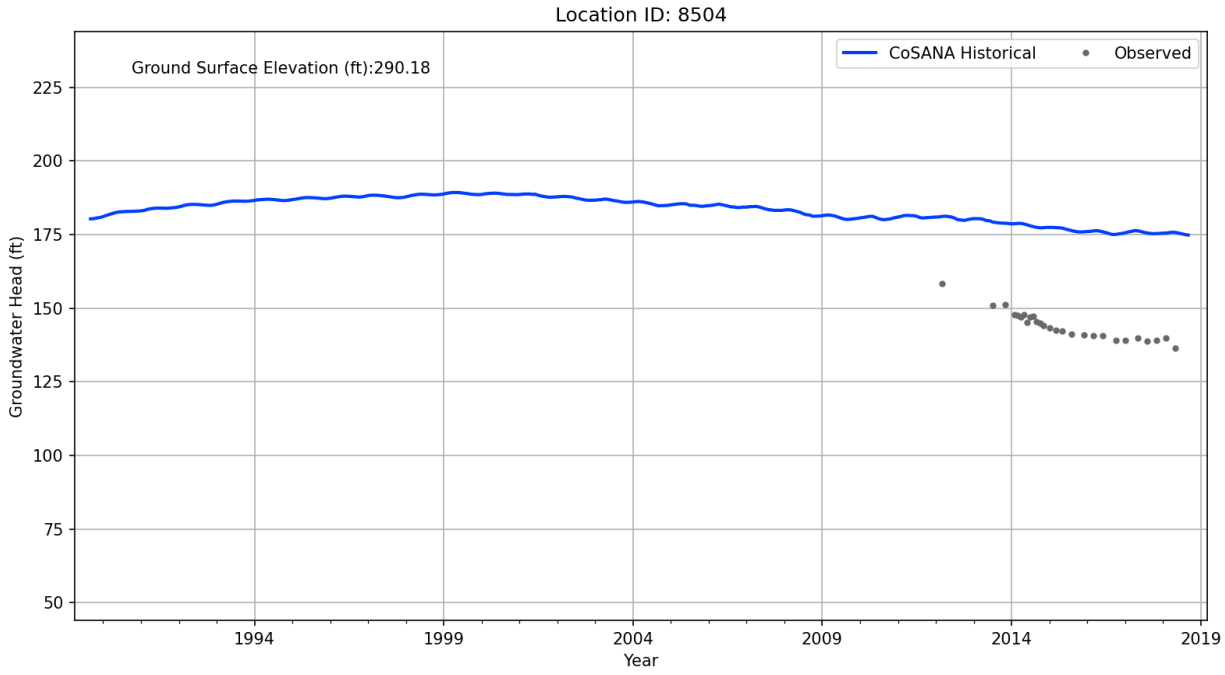

Location ID: 8401
Ground Surface Elevation (ft):318.1
CoSANA Historical
Observed
Groundwater Head (ft)
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019
Year

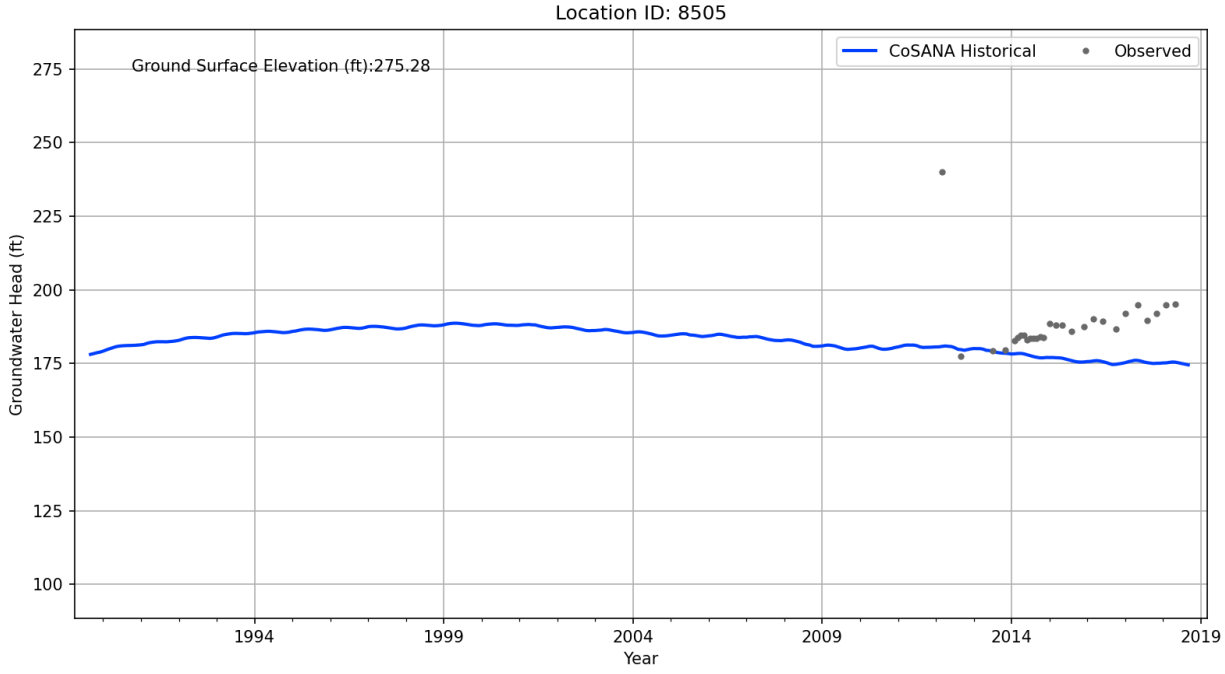

Location ID: 8402
Ground Surface Elevation (ft):455.54
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

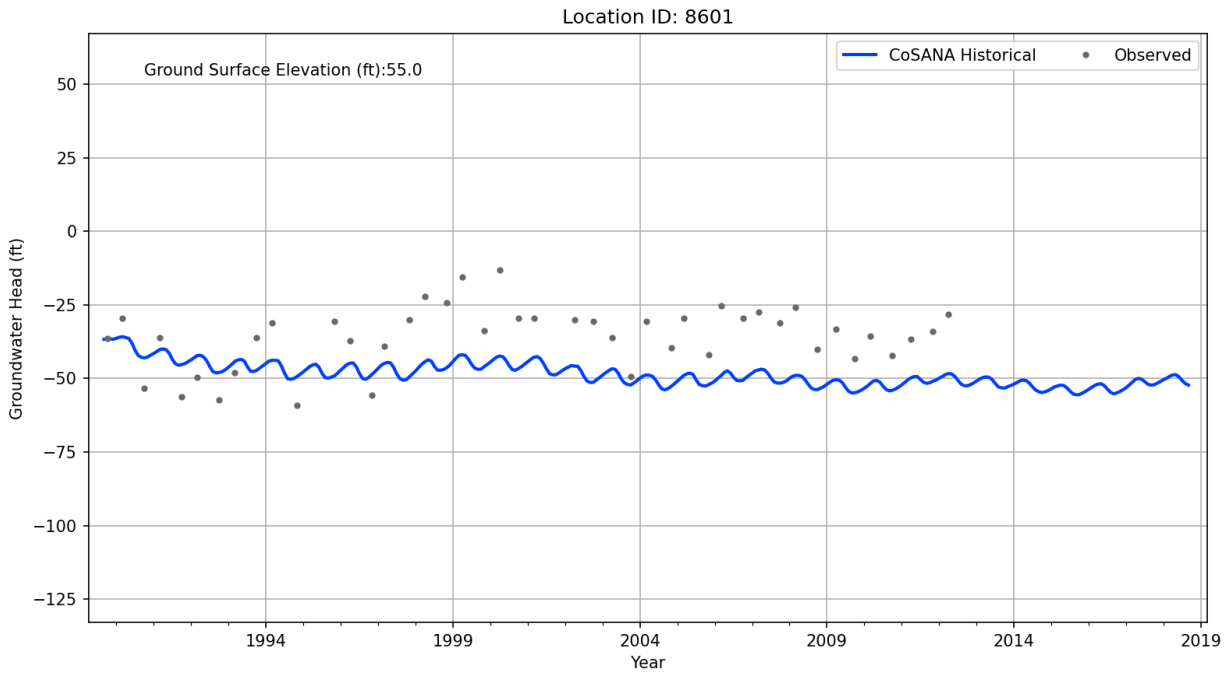

Location ID: 8403
Ground Surface Elevation (ft):527.2
CoSANA Historical
Observed
Groundwater Head (ft)
525
500
475
450
425
400
375
350
1994
1999
2004
2009
2014
2019
Year

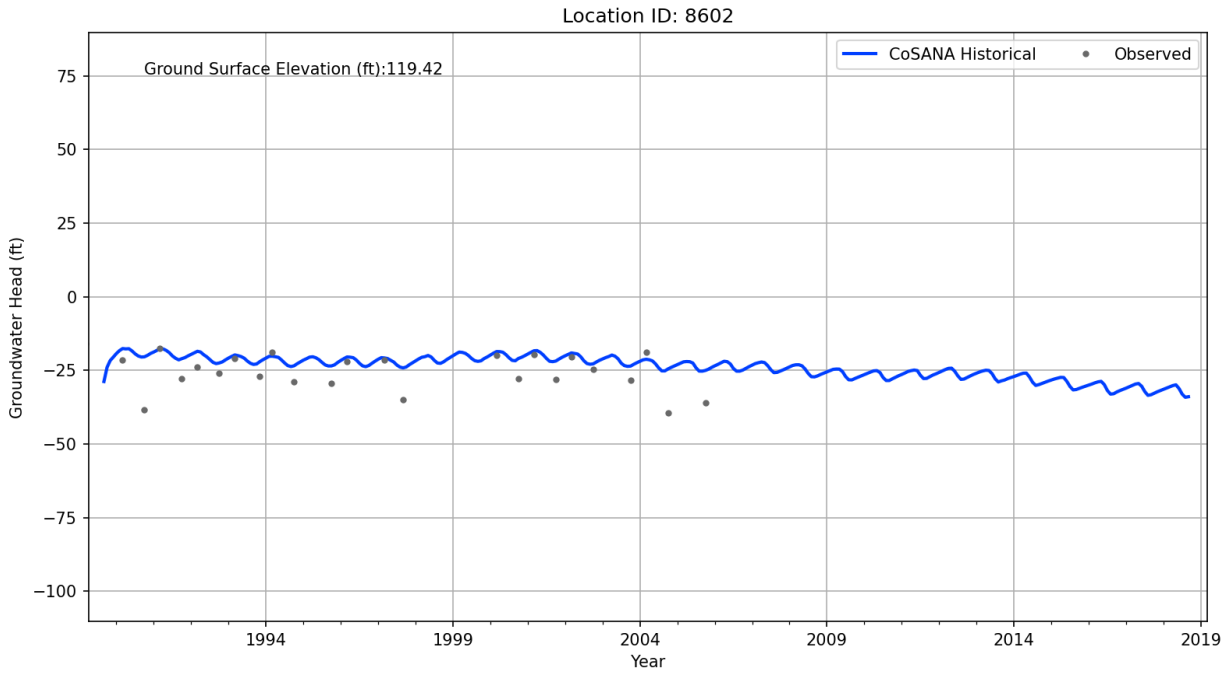

Location ID: 8404
Ground Surface Elevation (ft):476.49
CoSANA Historical
Observed
Groundwater Head (ft)
Year
475
450
425
400
375
350
325
300
1994
1999
2004
2009
2014
2019

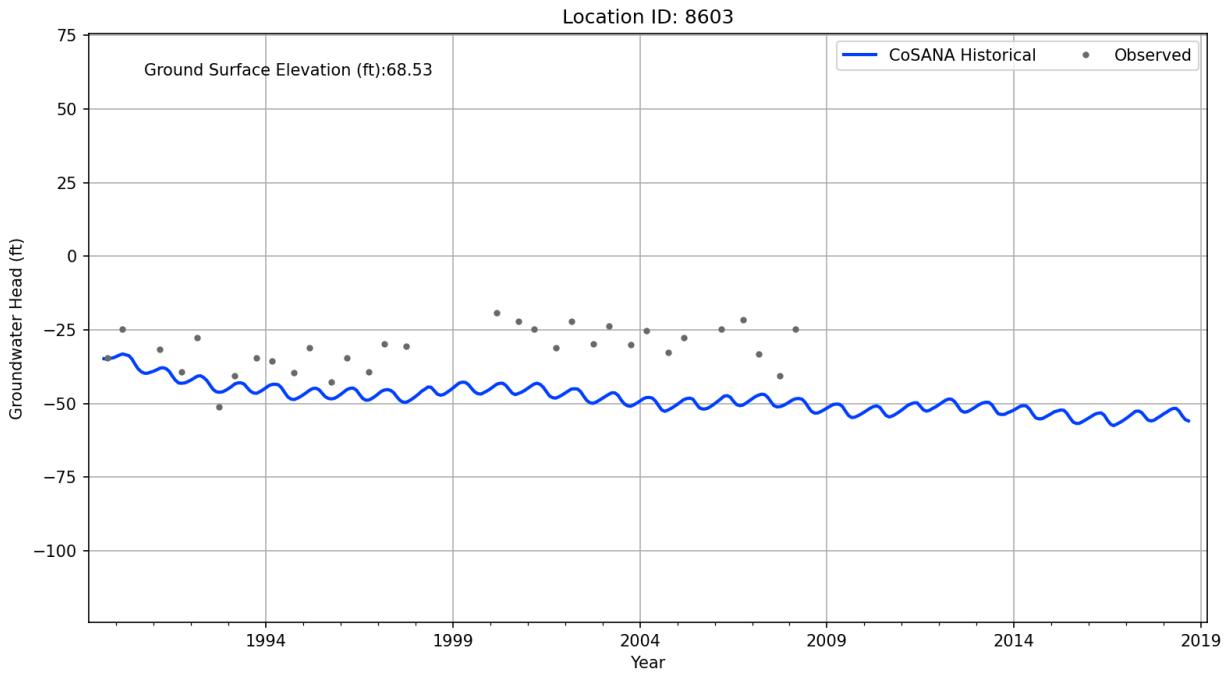

Location ID: 8405
Ground Surface Elevation (ft):607.84
CoSANA Historical
Observed
Groundwater Head (ft)
Year
525
500
475
450
425
400
375
350
1994
1999
2004
2009
2014
2019

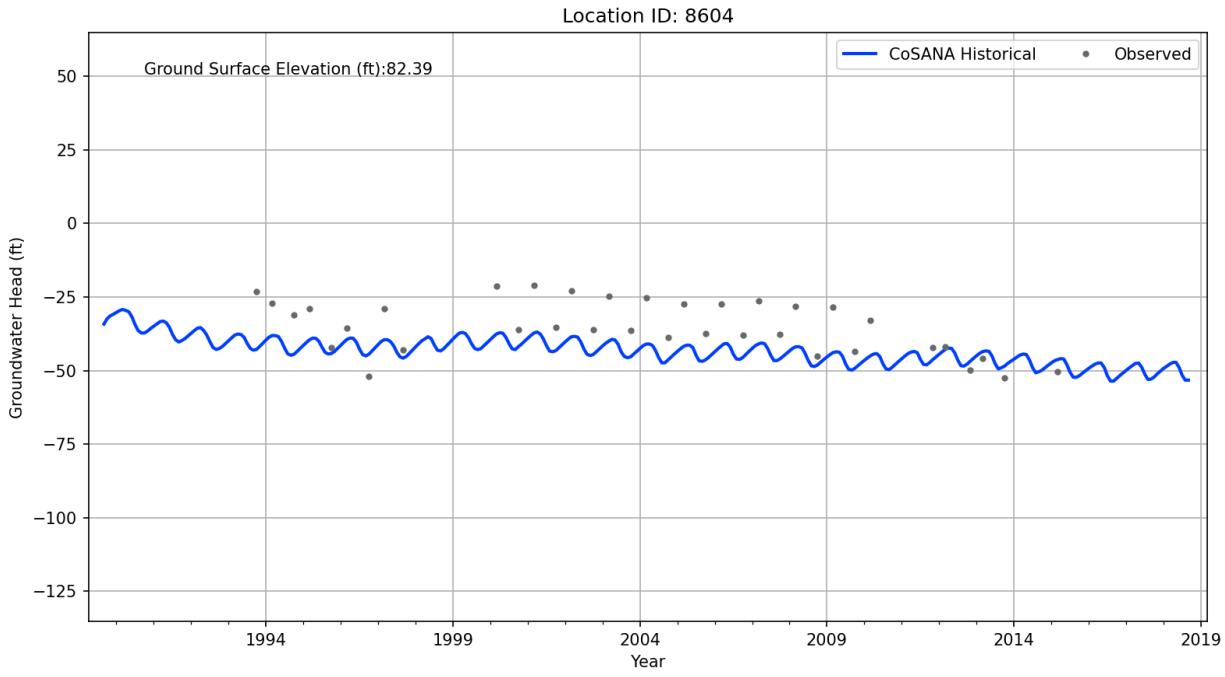

Location ID: 8504
Ground Surface Elevation (ft):290.18
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

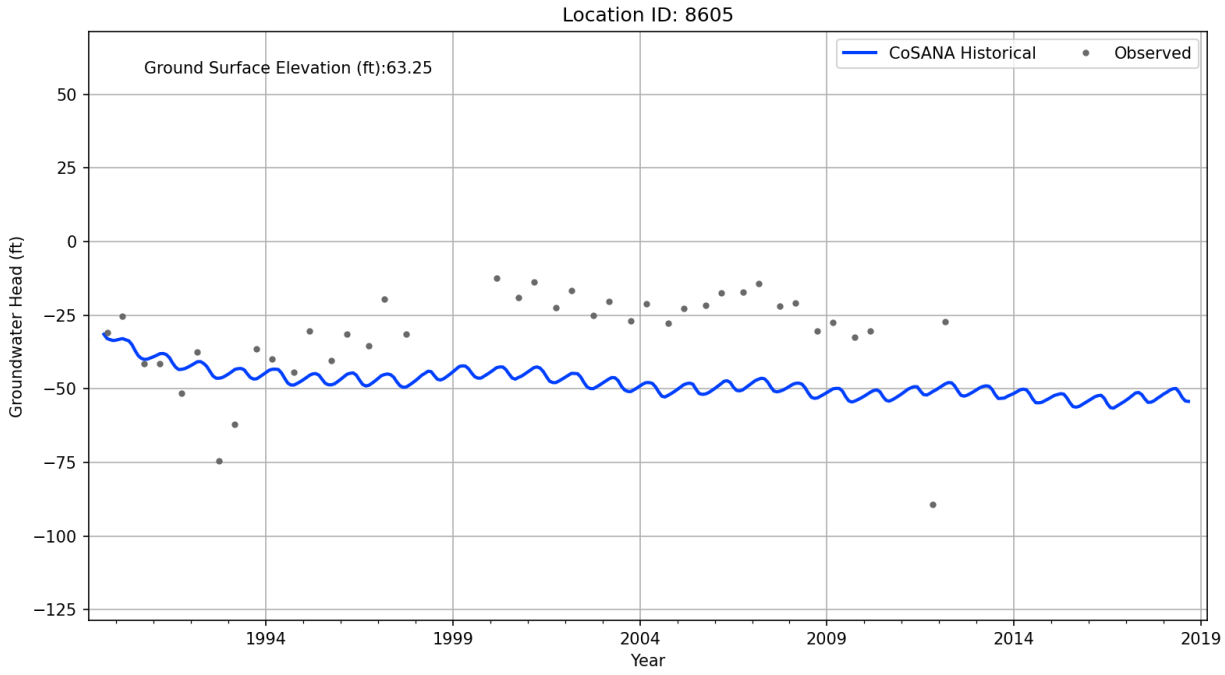

Location ID: 8505
Ground Surface Elevation (ft):275.28
CoSANA Historical
Observed
Groundwater Head (ft)
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019
Year

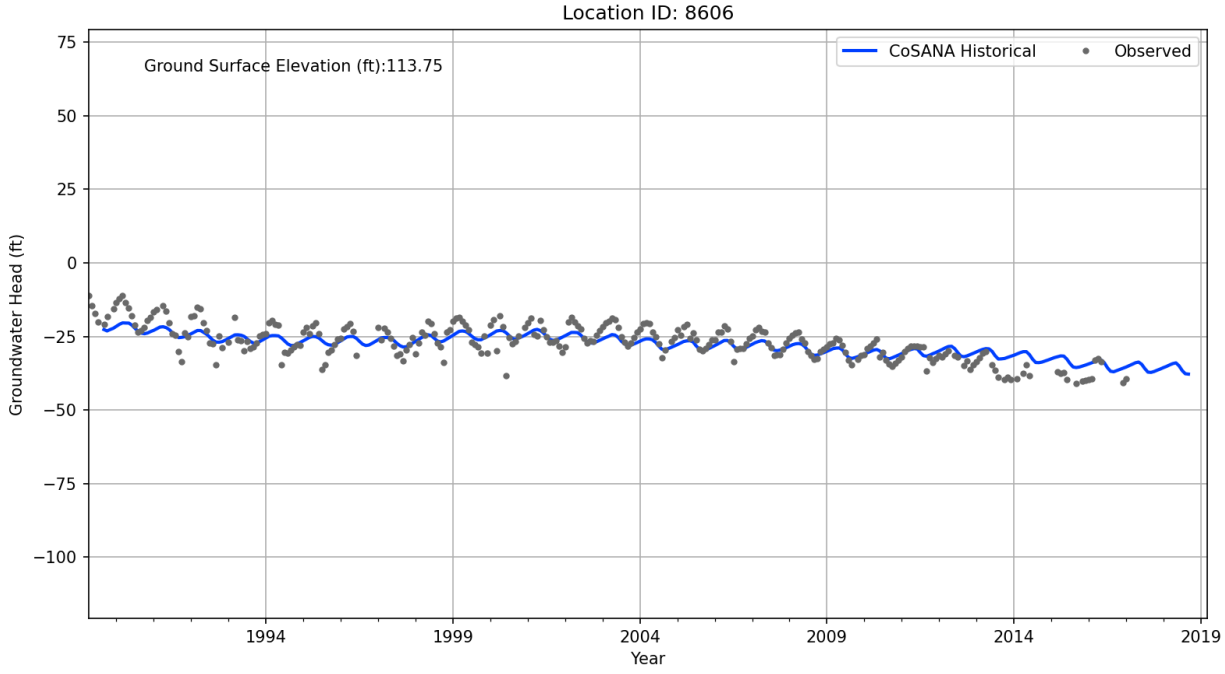

Location ID: 8601
Ground Surface Elevation (ft):55.0
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

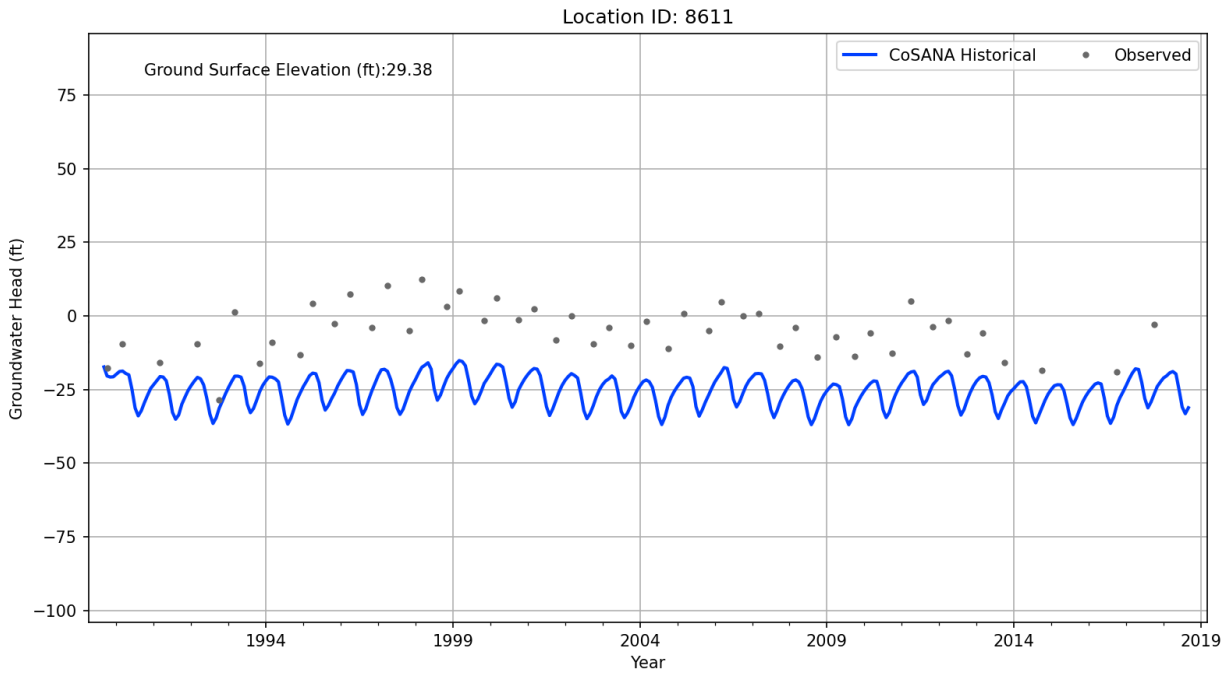

Location ID: 8602
Ground Surface Elevation (ft):119.42
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

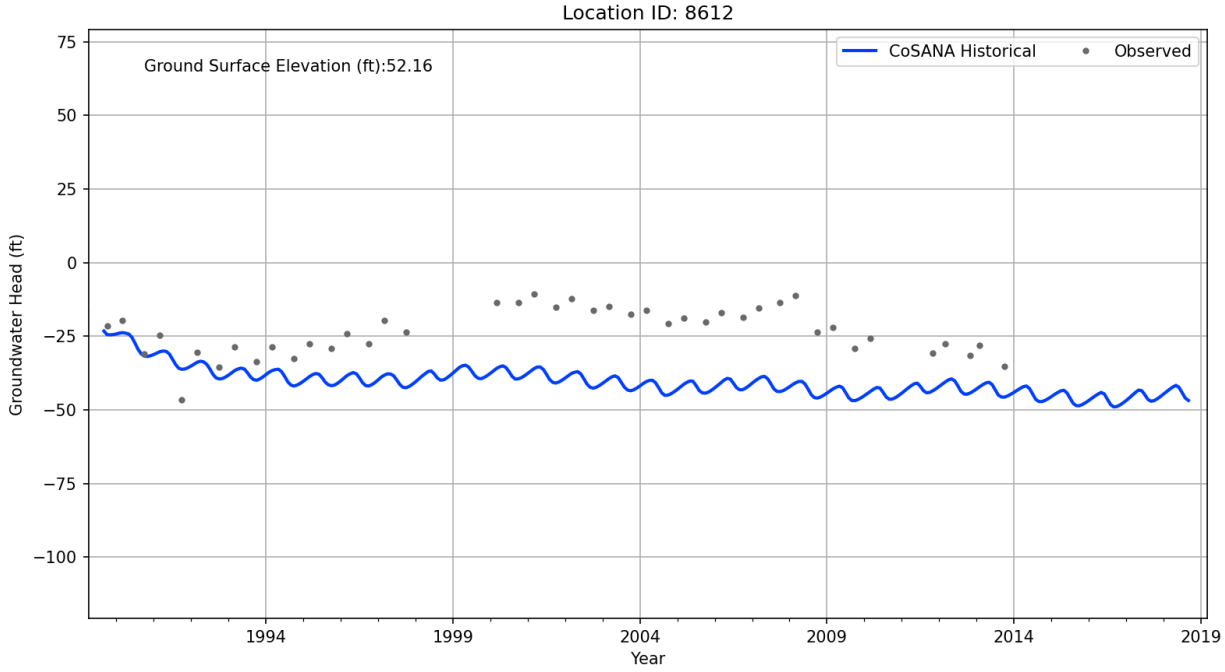

Location ID: 8603
Ground Surface Elevation (ft):68.53
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

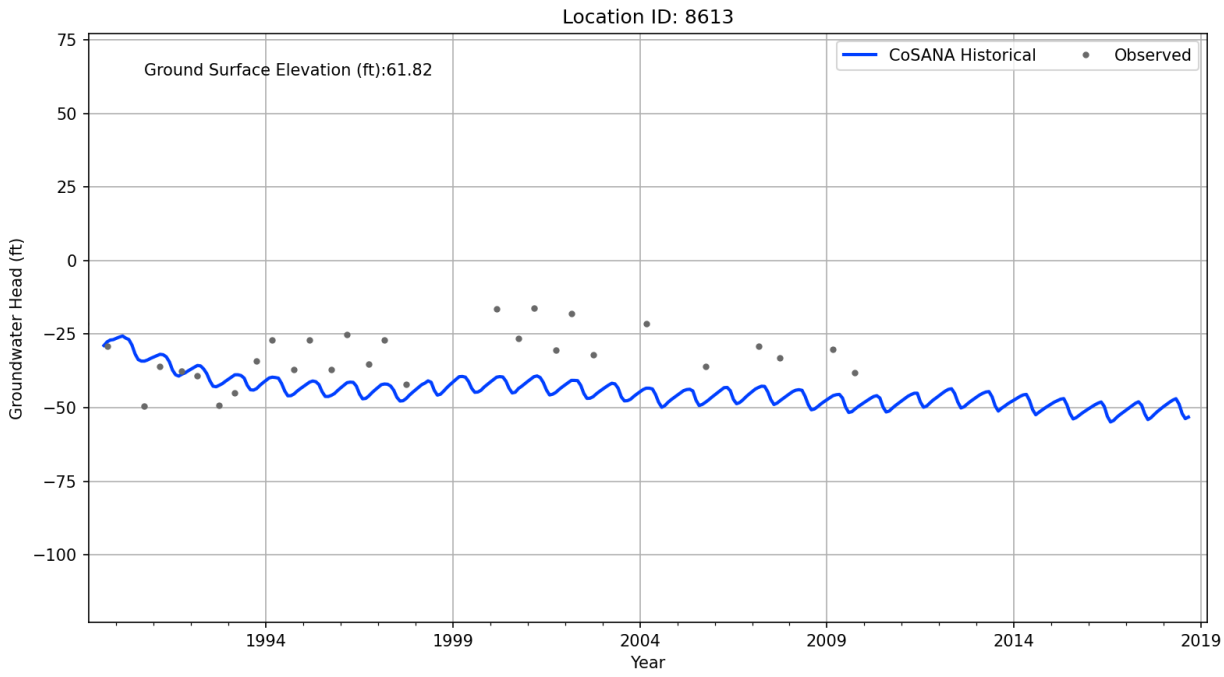

Location ID: 8604
Ground Surface Elevation (ft):82.39
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

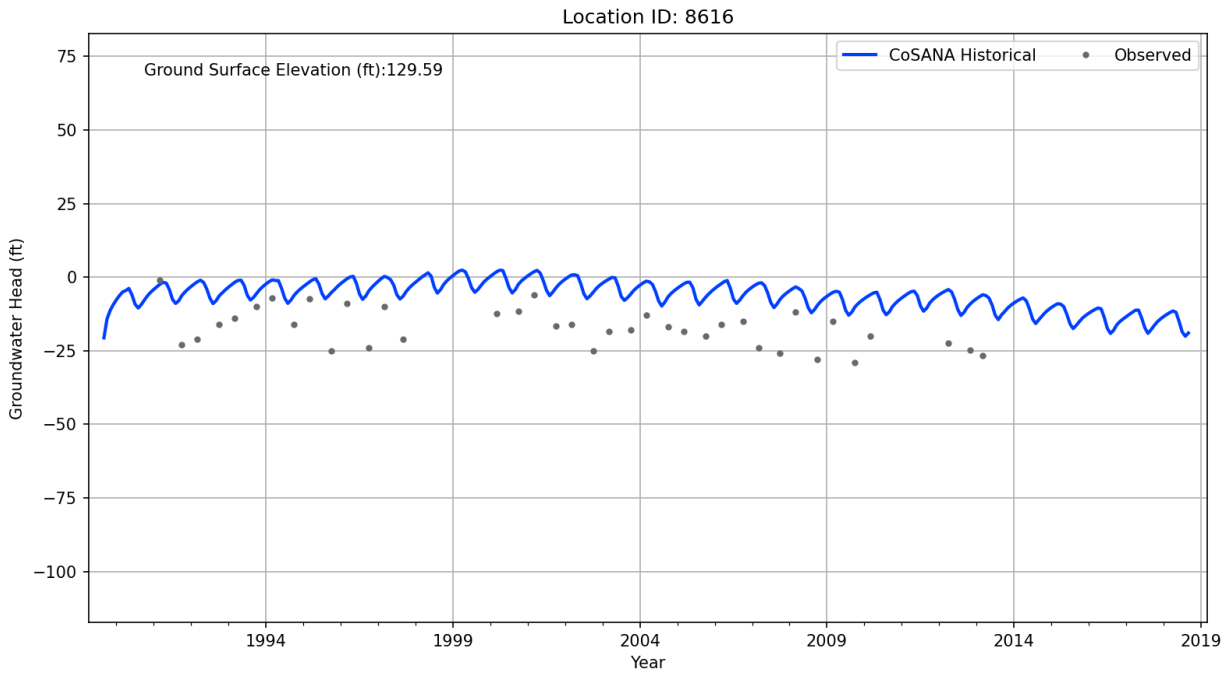

Location ID: 8605
Ground Surface Elevation (ft):63.25
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

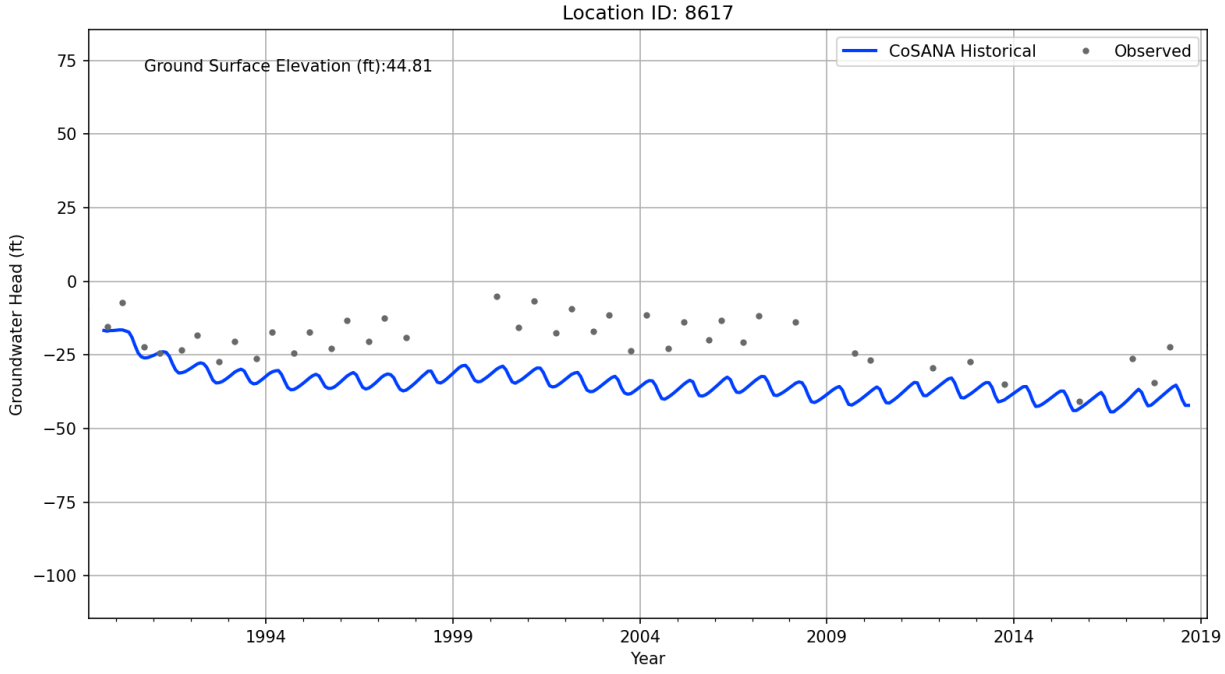

Location ID: 8606
Ground Surface Elevation (ft):113.75
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

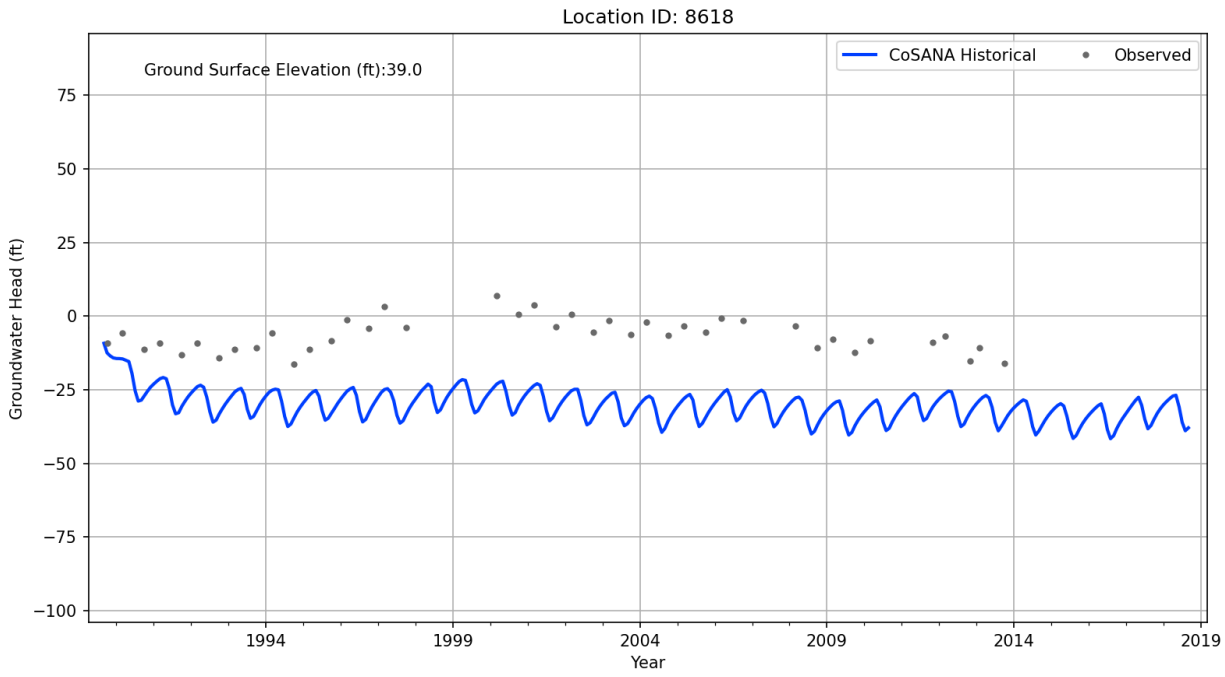

Location ID: 8611
Ground Surface Elevation (ft):29.38
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

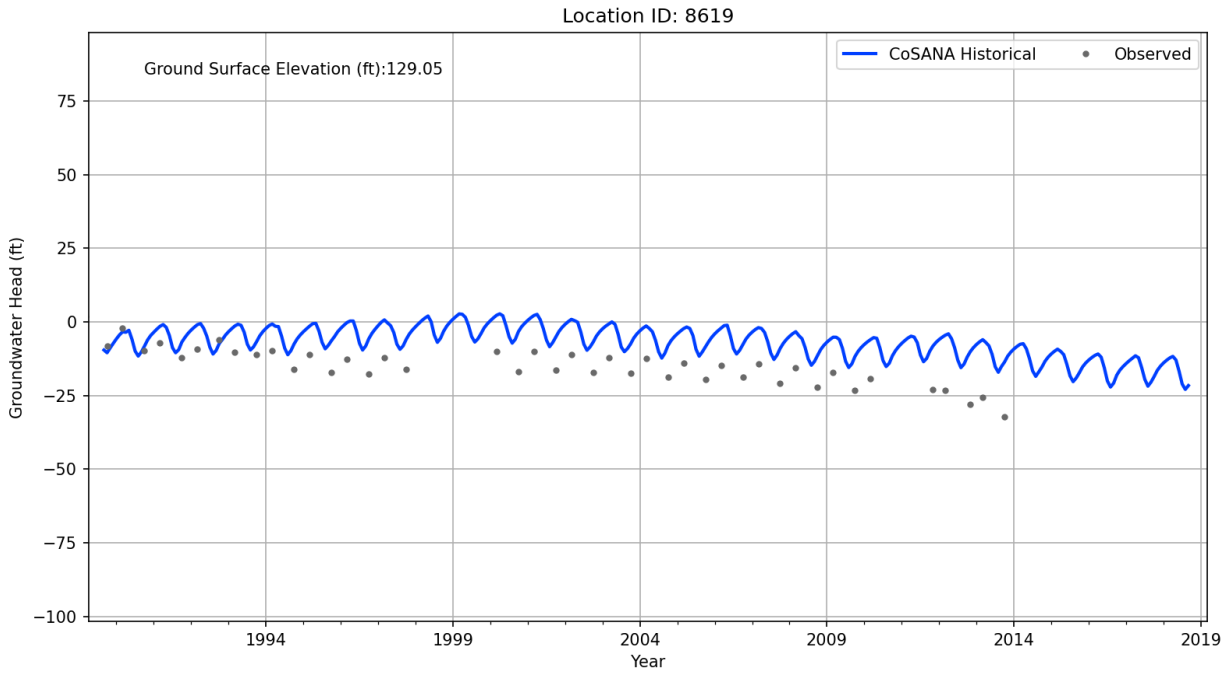

Location ID: 8612
Ground Surface Elevation (ft):52.16
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

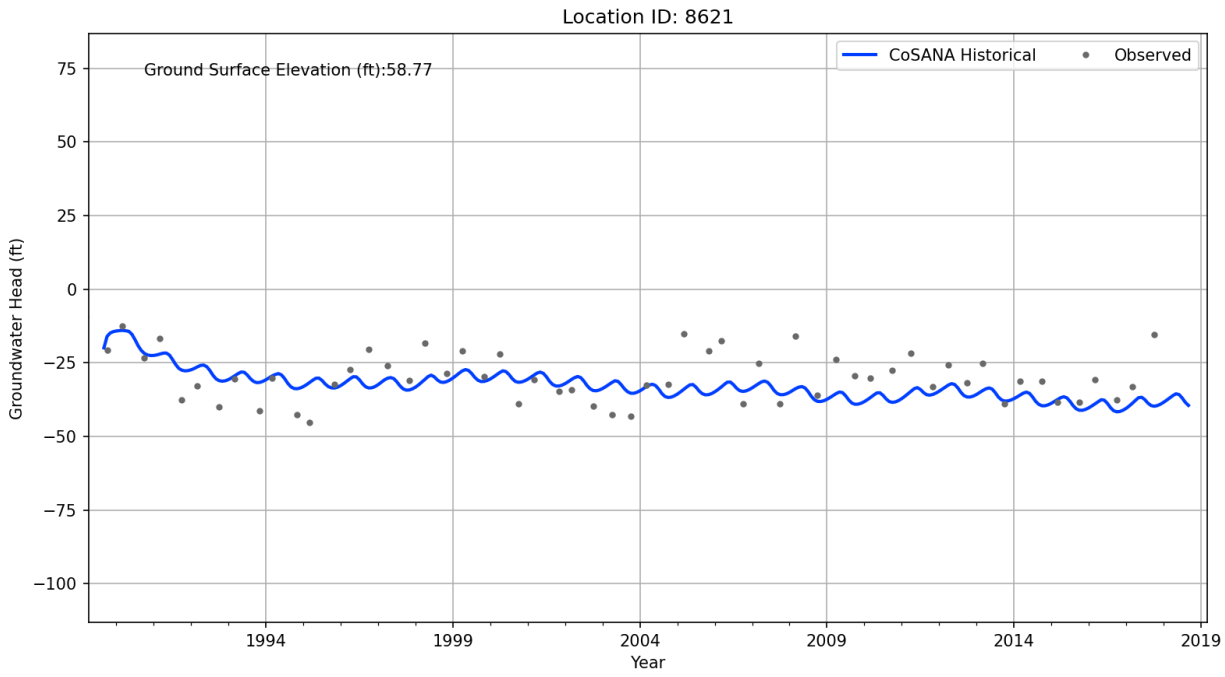

Location ID: 8613
Ground Surface Elevation (ft):61.82
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

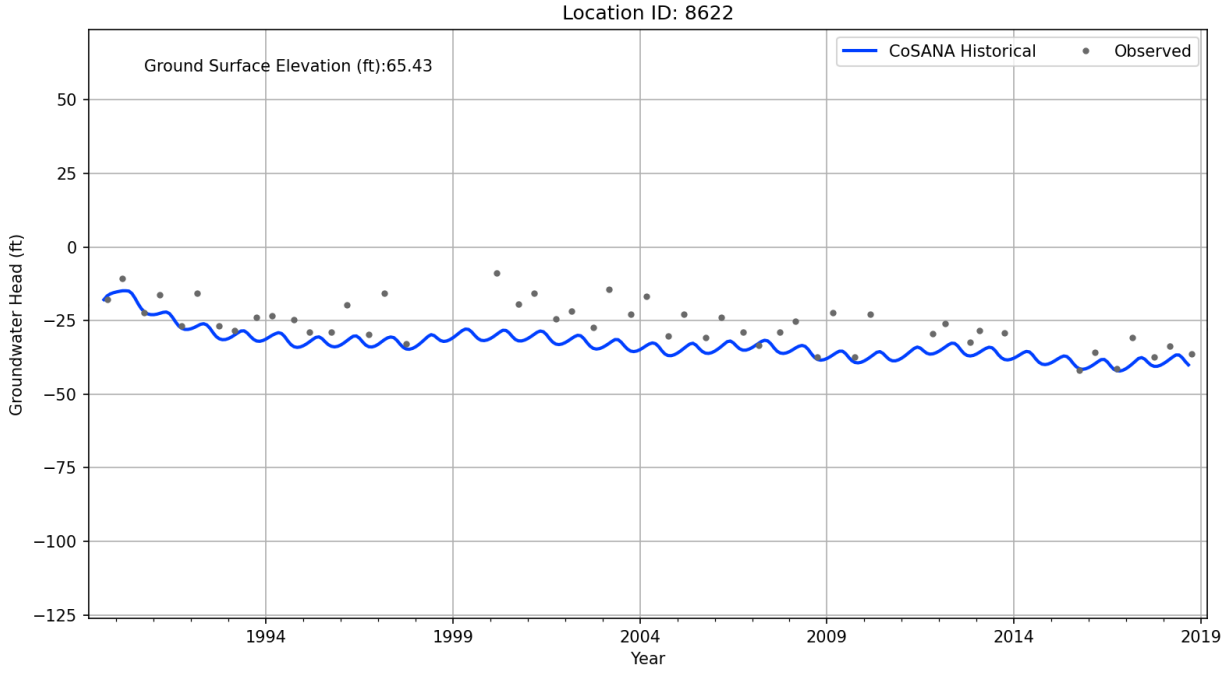

Location ID: 8616
Ground Surface Elevation (ft):129.59
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

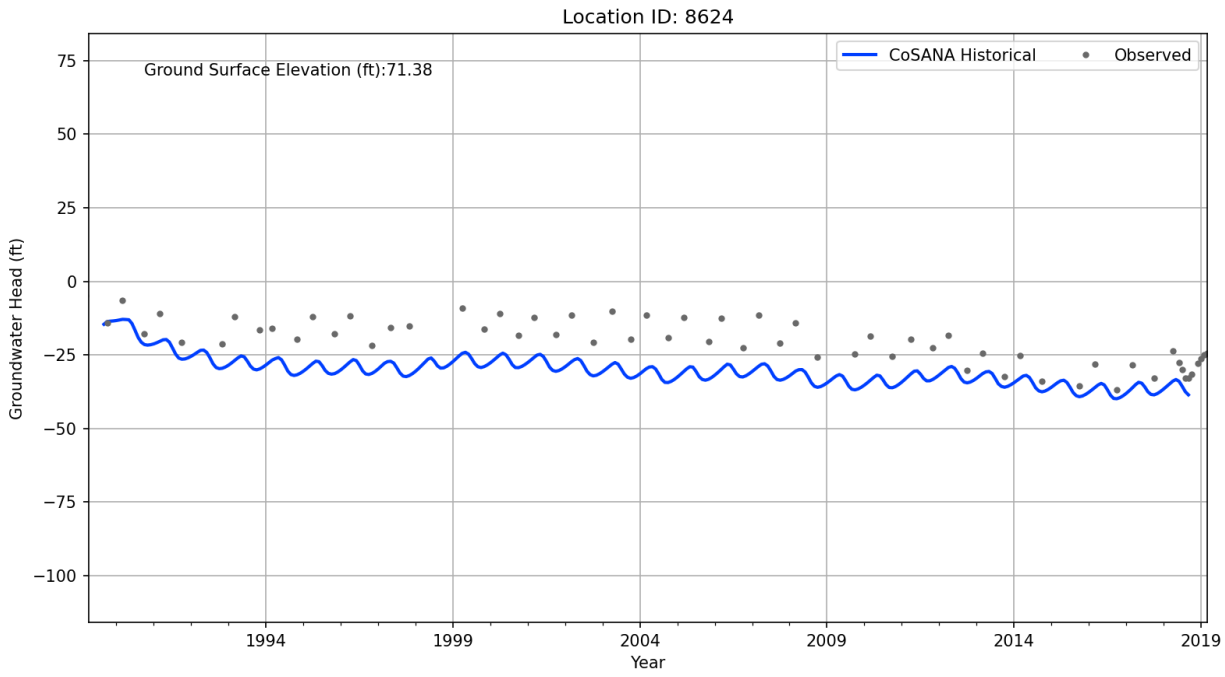

Location ID: 8617
Ground Surface Elevation (ft):44.81
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

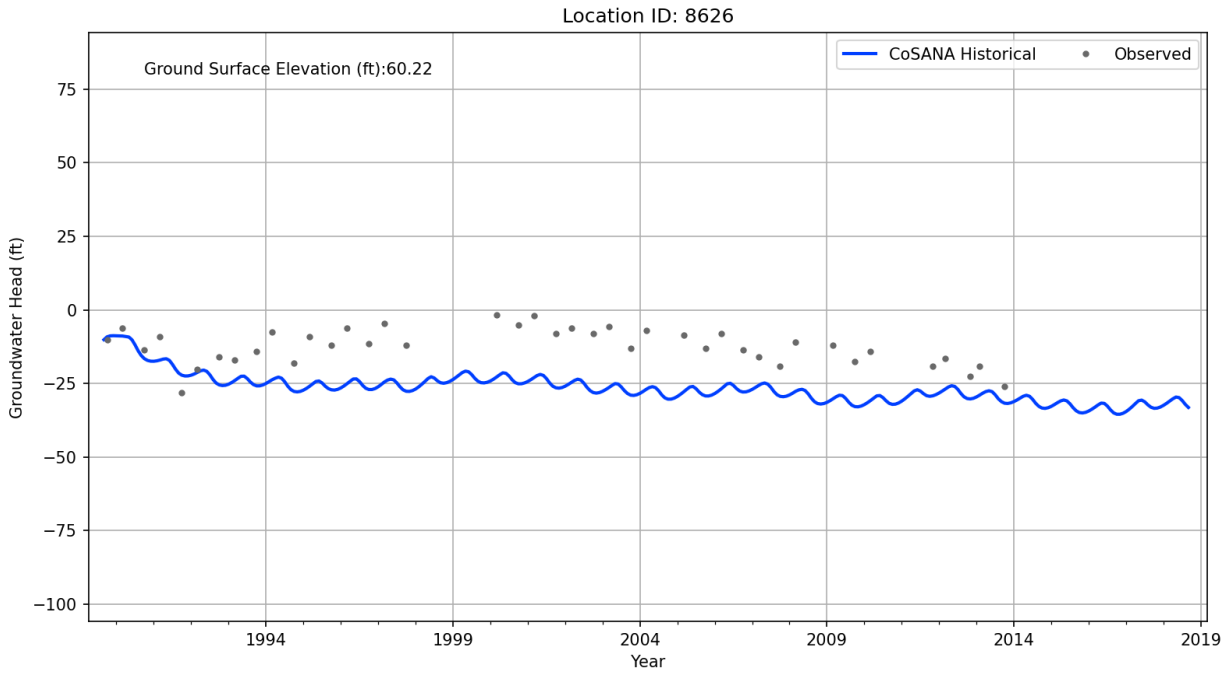

Location ID: 8618
Ground Surface Elevation (ft):39.0
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

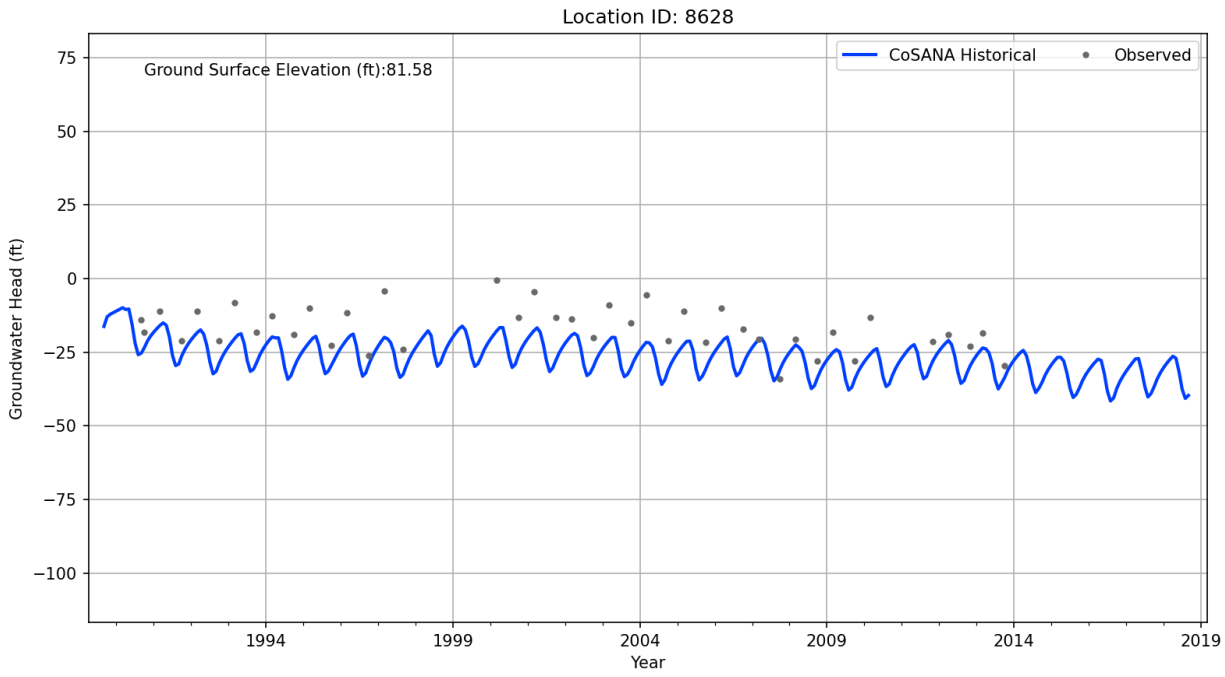

Location ID: 8619
Ground Surface Elevation (ft):129.05
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

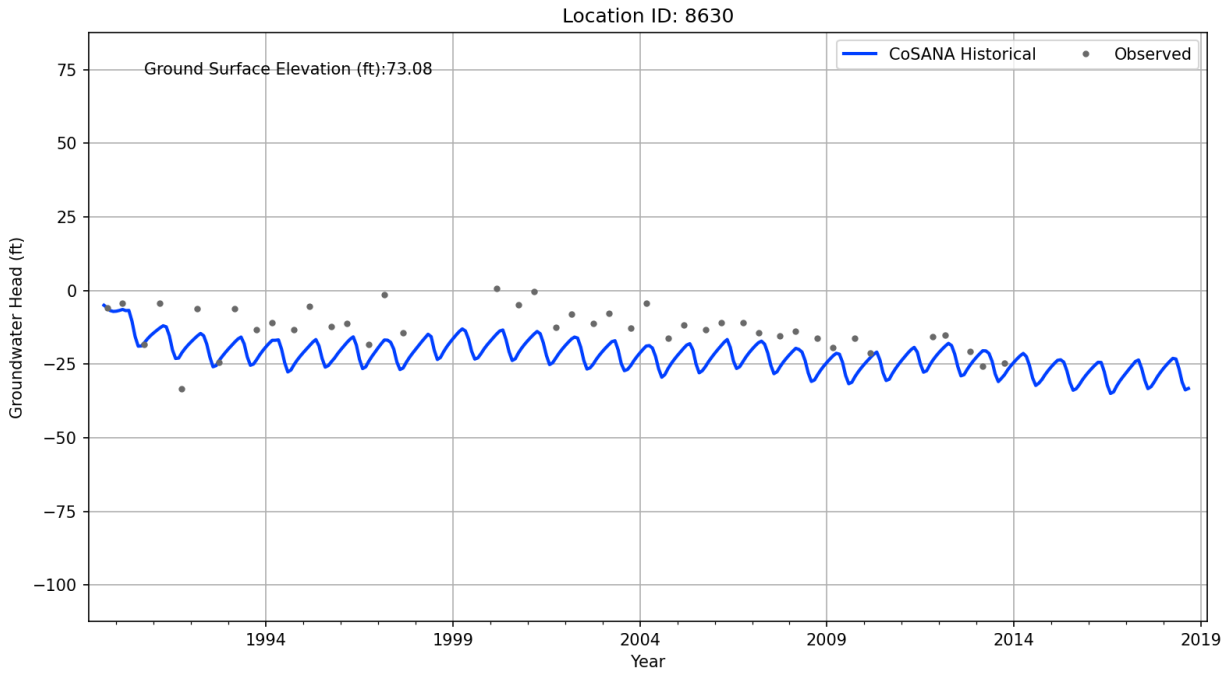

Location ID: 8621
Ground Surface Elevation (ft):58.77
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

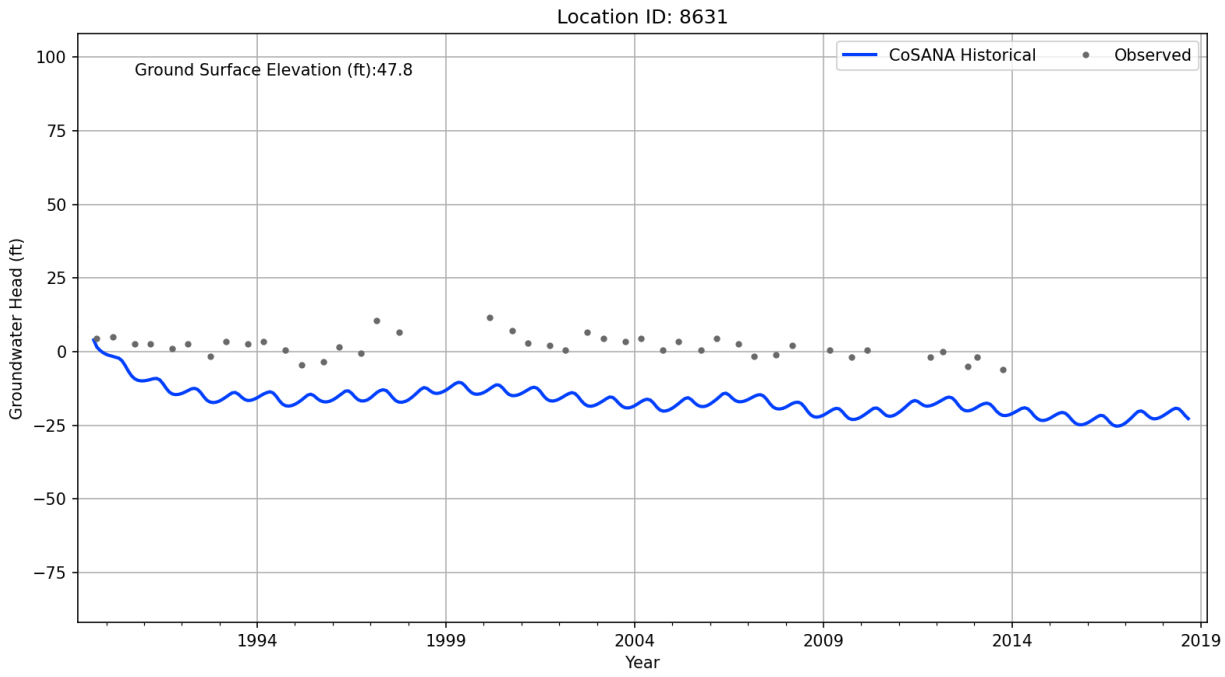

Location ID: 8622
Ground Surface Elevation (ft):65.43
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

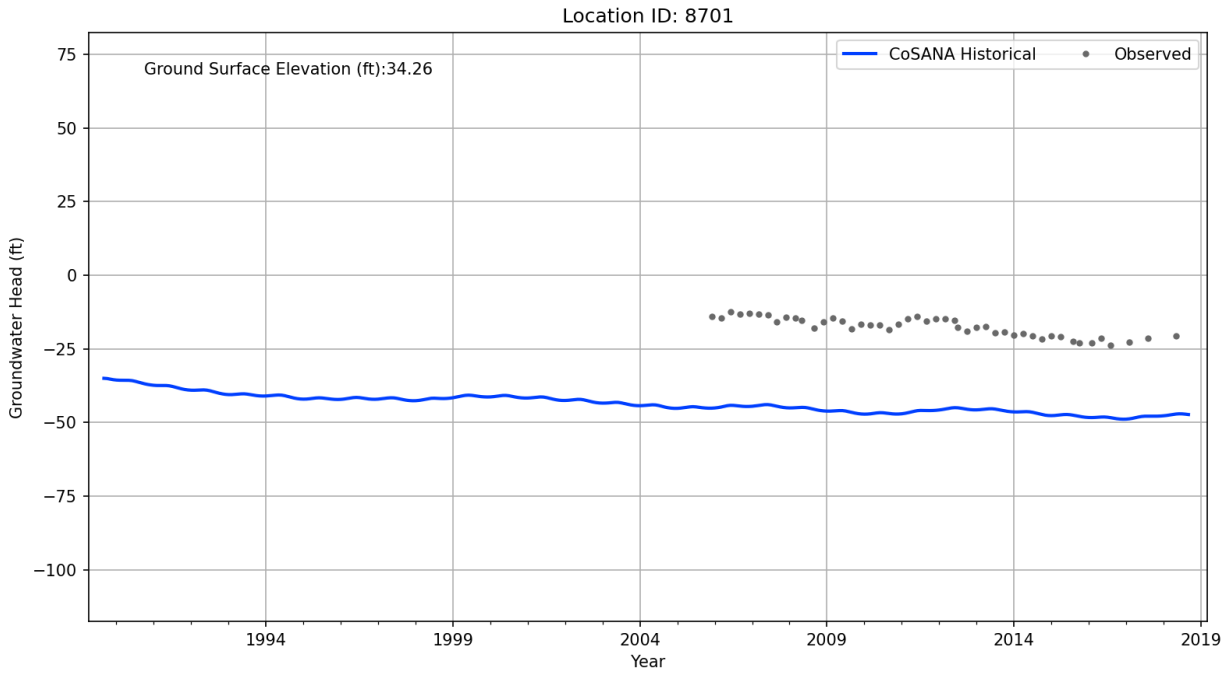

Location ID: 8624
Ground Surface Elevation (ft):71.38
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

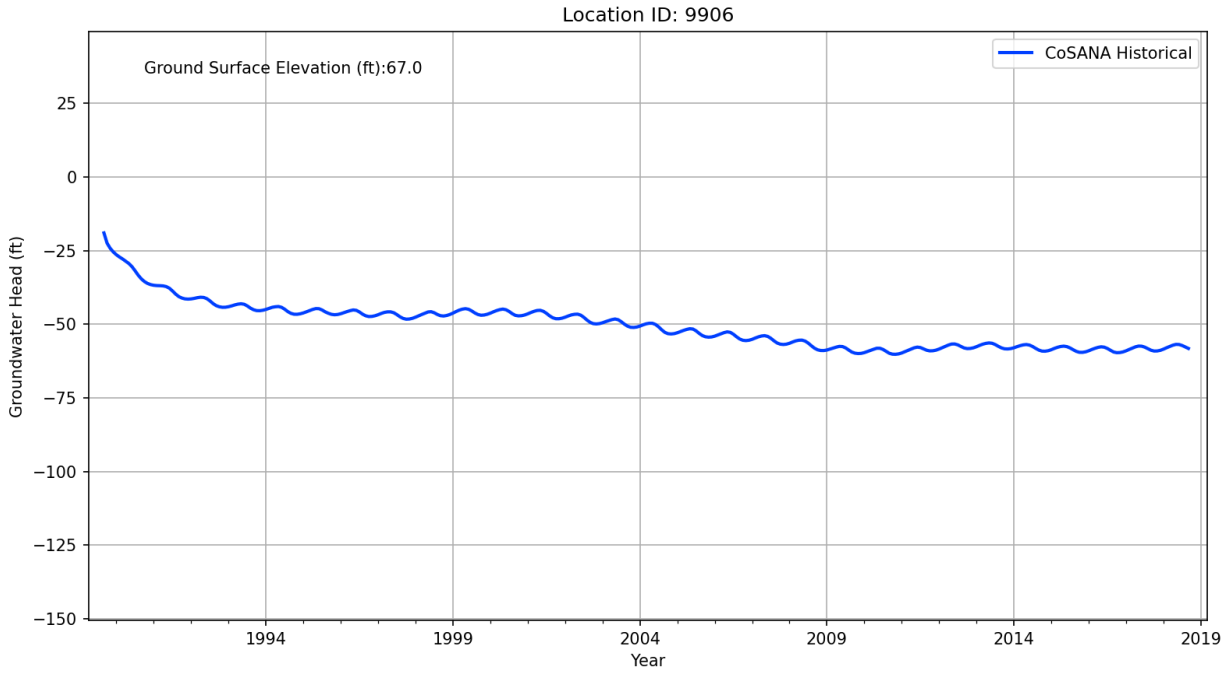

Location ID: 8626
Ground Surface Elevation (ft):60.22
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

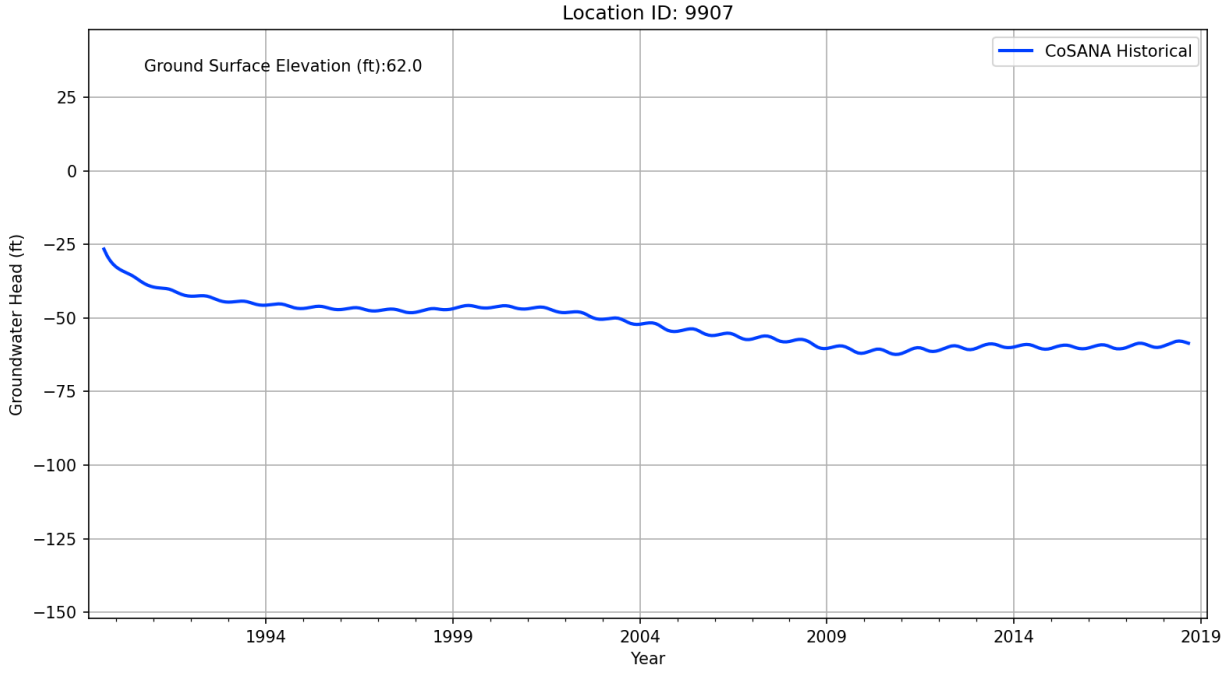

Location ID: 8628
Ground Surface Elevation (ft):81.58
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 8630
Ground Surface Elevation (ft):73.08
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 8631
Ground Surface Elevation (ft):47.8
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 8701
Ground Surface Elevation (ft):34.26
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 9906
Ground Surface Elevation (ft):67.0
CoSANA Historical
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year


Location ID: 9907
Ground Surface Elevation (ft):62.0
CoSANA Historical
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

APPENDIX G: BASELINE CONDITIONS DEMAND AND SUPPLY TABLES

CalAm Antelope

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,282	4,556	4,950	4,629	5,225	5,225	5,225	5,225
Groundwater	3,728	3,907	4,944	4,251	4,025	4,025	5,225	4,481
Surface Water	554	648	6	378	1,200	1,200	0	744
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,282	4,556	4,950	4,629	5,225	5,225	5,225	5,225

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Arden

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,421	1,459	1,509	1,467	1,606	1,606	1,606	1,606
Groundwater	1,408	1,459	1,509	1,464	1,123	1,123	1,123	1,123
Surface Water	13	0	0	4	483	483	483	483
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,421	1,459	1,509	1,467	1,606	1,606	1,606	1,606

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Fruitridge Vista

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,244	4,055	4,142	4,141	6,609	6,609	6,609	6,609
Groundwater	4,238	4,054	4,141	4,139	6,609	6,609	6,609	6,609
Surface Water	6	1	0	2	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,244	4,055	4,142	4,141	6,609	6,609	6,609	6,609

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Lincoln Oaks

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	6,826	6,395	7,770	7,038	6,213	6,213	6,213	6,213
Groundwater	6,131	5,504	7,766	6,539	5,413	5,413	6,213	5,717
Surface Water	695	891	4	499	800	800	0	496
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	6,826	6,395	7,770	7,038	6,213	6,213	6,213	6,213

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Parkway

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	9,266	8,629	9,538	9,153	16,604	16,604	16,604	16,604
Groundwater	8,821	8,148	8,979	8,652	14,430	14,430	14,430	14,430
Surface Water	445	482	560	501	2,174	2,174	2,174	2,174
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	9,266	8,629	9,538	9,153	16,604	16,604	16,604	16,604

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Security Park

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	10	7	15	11	97	97	97	97
Groundwater	9	7	15	11	0	0	15	6
Surface Water	1	0	0	0	97	97	82	91
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	10	7	15	11	97	97	97	97

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Suburban Rosemont

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	8,278	7,958	9,616	8,678	13,227	13,227	13,227	13,227
Groundwater	8,139	7,936	9,255	8,494	11,053	11,053	11,053	11,053
Surface Water	139	22	360	183	2,174	2,174	2,174	2,174
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	8,278	7,958	9,616	8,678	13,227	13,227	13,227	13,227

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm West Placer

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,059	1,011	1,042	1,036	6,819	6,819	6,819	6,819
Groundwater	0	0	0	0	0	0	0	0
Surface Water	1,059	1,011	1,042	1,036	6,819	6,819	6,819	6,819
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,059	1,011	1,042	1,036	6,819	6,819	6,819	6,819

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Camanche Village (ACWA)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	293	296	286	292	1,415	1,415	1,483	1,441
Groundwater	293	296	286	292	420	420	420	420
Surface Water	0	0	0	0	681	681	749	707
Recycled Water/ Remediated Water	0	0	0	0	314	314	314	314
Total Supply	293	296	286	292	1,415	1,415	1,483	1,441

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Carmichael WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	8,984	8,871	9,311	9,070	10,334	10,334	10,851	10,530
Groundwater	1,919	1,977	2,403	2,123	2,207	2,303	2,801	2,465
Surface Water	7,065	6,894	6,908	6,947	8,127	8,031	8,050	8,065
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	8,984	8,871	9,311	9,070	10,334	10,334	10,851	10,530

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Citrus Heights WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	12,370	12,130	13,083	12,559	18,210	18,210	15,478	17,172
Groundwater	1,179	748	1,126	1,012	900	900	900	900
Surface Water	11,191	11,382	11,957	11,547	17,310	17,310	14,578	16,272
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	12,370	12,130	13,083	12,559	18,210	18,210	15,478	17,172

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Del Paso Manor WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,300	1,334	1,361	1,335	1,214	1,214	1,214	1,214
Groundwater	1,300	1,334	1,361	1,335	1,214	1,214	1,214	1,214
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,300	1,334	1,361	1,335	1,214	1,214	1,214	1,214

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Elk Grove Water District

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	9,080	8,744	9,388	9,083	8,081	8,081	8,323	8,173
Groundwater	4,305	4,158	4,625	4,376	4,598	4,598	4,736	4,650
Surface Water	4,775	4,586	4,764	4,707	3,483	3,483	3,587	3,523
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	9,080	8,744	9,388	9,083	8,081	8,081	8,323	8,173

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Elk Grove Water District surface water supply shown is from SCWA supplied intertie. These volumes may include a mix of sources (groundwater, surface water, and recycled water) that are unknown. For the purposes of this table, these volumes are all shown as surface water.

Fair Oaks WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	10,518	10,322	10,676	10,511	12,726	12,726	12,726	12,726
Groundwater	1,983	2,222	1,416	1,849	2,399	2,399	1,688	2,129
Surface Water	8,535	8,100	9,260	8,663	10,327	10,327	11,038	10,597
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	10,518	10,322	10,676	10,511	12,726	12,726	12,726	12,726

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Florin County WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645
Groundwater	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Folsom, City of

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	21,235	21,329	20,445	20,967	29,923	29,923	30,819	30,263
Groundwater	0	0	0	0	0	0	0	0
Surface Water	21,235	21,329	20,445	20,967	29,923	29,923	30,819	30,263
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	21,235	21,329	20,445	20,967	29,923	29,923	30,819	30,263

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Galt, City of

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,841	4,286	5,452	4,884	8,266	8,266	8,266	8,266
Groundwater	4,841	4,286	5,452	4,884	7,663	7,663	7,663	7,663
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	603	603	603	603
Total Supply	4,841	4,286	5,452	4,884	8,266	8,266	8,266	8,266

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Grandpark

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	0	0	0	0	12,030	12,030	12,030	12,030
Groundwater	0	0	0	0	2,407	2,407	3,007	2,635
Surface Water	0	0	0	0	9,623	9,623	9,023	9,395
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	0	0	0	0	8,021	8,021	8,021	8,021

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Golden State WC Arden

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	942	937	1,016	968	942	937	1,016	968
Groundwater	942	937	1,016	968	942	937	1,016	968
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	942	937	1,016	968	942	937	1,016	968

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Golden State WC Cordova

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	14,780	16,099	14,162	14,994	19,752	19,752	19,752	19,752
Groundwater	5,499	4,762	5,210	5,139	9,752	9,752	9,752	9,752
Surface Water	9,281	11,337	8,952	9,855	5,000	5,000	5,000	5,000
Recycled Water/ Remediated Water	0	0	0	0	5,000	5,000	5,000	5,000
Total Supply	14,780	16,099	14,162	14,994	19,752	19,752	19,752	19,752

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Projected remediated water includes groundwater previously pumped for remediation activities.

Ione, City of (ACWA)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	2,434	2,448	2,256	2,371	11,744	11,744	11,676	11,718
Groundwater	0	0	0	0	0	0	0	0
Surface Water	2,434	2,448	2,256	2,371	10,794	10,794	10,726	10,768
Recycled Water/ Remediated Water	0	0	0	0	950	950	950	950
Total Supply	2,434	2,448	2,256	2,371	11,744	11,744	11,676	11,718

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Lincoln, City of

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	9,314	9,094	9,470	9,298	20,336	20,336	20,947	20,568
Groundwater	1,136	1,607	864	1,193	3,297	3,297	3,297	3,297
Surface Water	8,177	7,487	8,606	8,105	10,972	10,972	11,584	11,205
Recycled Water/ Remediated Water	0	0	0	0	6,063	6,063	6,063	6,063
Total Supply	9,314	9,094	9,470	9,298	20,332	20,332	20,944	20,565

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Orange Vale WC

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,075	3,905	4,217	4,071	4,981	4,981	4,234	4,697
Groundwater	0	0	0	0	0	0	0	0
Surface Water	4,075	3,905	4,217	4,071	4,981	4,981	4,234	4,697
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,075	3,905	4,217	4,071	4,981	4,981	4,234	4,697

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

PCWA (Regional Univ. and Placer Ranch)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	0	0	0	0	6,805	6,805	6,805	6,805
Groundwater	0	0	0	0	0	0	0	0
Surface Water	0	0	0	0	6,805	6,805	6,805	6,805
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	0	0	0	0	6,805	6,805	6,805	6,805

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Placer County WA (Rocklin)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,774	4,706	4,521	4,655	8,841	8,749	8,496	8,679
Groundwater	0	0	0	0	0	0	0	0
Surface Water	4,774	4,706	4,521	4,655	8,841	8,749	8,496	8,679
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,774	4,706	4,521	4,655	8,841	8,749	8,496	8,679

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Rancho Murietta CSD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,833	1,833	1,833	1,833	3,477	3,477	3,477	3,477
Groundwater	0	0	0	0	0	0	0	0
Surface Water	1,833	1,833	1,833	1,833	2,927	2,927	2,927	2,927
Recycled Water/ Remediated Water	0	0	0	0	550	550	550	550
Total Supply	1,833	1,833	1,833	1,833	3,477	3,477	3,477	3,477

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Rio Linda Elverta CWD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	2,563	2,489	2,672	2,579	7,462	7,462	8,208	7,745
Groundwater	2,562	2,489	2,670	2,578	7,462	7,462	8,208	7,745
Surface Water	1	0	2	1	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	2,563	2,489	2,672	2,579	7,462	7,462	8,208	7,745

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Roseville, City of

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	28,834	28,177	30,779	29,349	65,615	65,615	52,666	60,694
Groundwater	9	2	7	6	25	25	4,734	1,814
Surface Water	28,826	28,174	30,771	29,344	59,632	59,632	41,974	52,922
Recycled Water/ Remediated Water	0	0	0	0	5,958	5,958	5,958	5,958
Total Supply	28,834	28,177	30,779	29,349	65,615	65,615	52,666	60,694

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Sacramento International Airport

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,138	1,133	1,133	1,134	1,144	1,144	1,144	1,144
Groundwater	763	785	877	814	673	673	673	673
Surface Water	376	348	255	320	471	471	471	471
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,138	1,133	1,133	1,134	1,144	1,144	1,144	1,144

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Sacramento, City of

Values shown in acre-feet/year

	Current *						Projected **					
Year Type	**Normal**	**Wet**	**Dry**	**Drier-Critical**	**Driest**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**Drier-Critical**	**Driest**	**50-yr Average**
Total Demand	104,096	98,465	89,879	100,782	100,782	96,779	162,029	162,029	162,029	162,029	162,029	162,029
Groundwater	14,942	8,750	22,287	48,952	53,726	15,628	35,864	24,302	47,690	81,290	81,290	36,427
Surface Water	89,154	89,715	67,592	51,830	47,056	81,151	125,165	136,727	113,339	79,739	79,739	124,602
Recycled Water/ Remediated Water	0	0	0	0	0	0	1,000	1,000	1,000	1,000	1,000	1,000
Total Supply	104,096	98,465	89,879	100,782	100,782	96,779	162,029	162,029	162,029	139,000	139,000	162,029

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

City of Sacramento has an estimated 2,200 AFY of additional pumping from irrigation wells that provide water to parks, schools, etc.

Sac Suburban

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	35,262	37,206	35,990	36,200	41,304	41,304	41,304	41,304
Groundwater	23,586	22,005	33,212	26,706	27,627	24,428	35,000	29,341
Surface Water	11,676	15,202	2,779	9,494	13,677	16,876	6,304	11,963
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	35,262	37,206	35,990	36,200	41,304	41,304	41,304	41,304

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

San Juan WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	12,437	11,631	12,509	12,190	19,393	19,393	19,393	19,393
Groundwater	0	0	0	0	0	0	0	0
Surface Water	12,437	11,631	12,509	12,190	19,393	19,393	19,393	19,393
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	12,437	11,631	12,509	12,190	19,393	19,393	19,393	19,393

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA Arden

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	3,402	3,349	3,402	3,384	3,217	3,217	3,217	3,217
Groundwater	3,402	3,349	3,402	3,384	3,217	3,217	3,217	3,217
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	3,402	3,349	3,402	3,384	3,217	3,217	3,217	3,217

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA Hood

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	82	75	82	79	31	31	31	31
Groundwater	82	75	82	79	31	31	31	31
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	82	75	82	79	31	31	31	31

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA Laguna Vineyard

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	24,331	24,734	24,343	24,473	68,900	68,900	68,900	68,900
Groundwater	13,910	13,315	13,910	13,707	20,200	20,200	51,900	32,246
Surface Water	9,569	10,556	9,580	9,909	36,500	36,500	4,800	24,454
Recycled Water/ Remediated Water	853	863	853	856	12,200	12,200	12,200	12,200
Total Supply	24,331	24,734	24,343	24,473	68,900	68,900	68,900	68,900

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA remediated water is assumed to be split 25% to Mather service area and 75% to Laguna Vineyard service area

SCWA Mather

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	5,363	5,624	5,363	5,452	34,900	34,900	34,900	34,900
Groundwater	1,742	1,673	1,742	1,719	0	0	1,100	418
Surface Water	3,621	3,951	3,621	3,733	34,900	34,900	33,800	34,482
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	5,363	5,624	5,363	5,452	34,900	34,900	34,900	34,900

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA remediated water is assumed to be split 25% to Mather service area and 75% to Laguna Vineyard service area

SCWA Northgate

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,423	1,205	1,423	1,349	1,365	1,365	1,365	1,365
Groundwater	1,423	1,205	1,423	1,349	1,365	1,365	1,365	1,365
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,423	1,205	1,423	1,349	1,365	1,365	1,365	1,365

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Sutter Pointe

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	0	0	0	0	15,786	15,786	15,786	15,786
Groundwater	0	0	0	0	10,919	10,919	10,919	10,919
Surface Water	0	0	0	0	4,867	4,867	4,867	4,867
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	0	0	0	0	15,786	15,786	15,786	15,786

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

APPENDIX H: BASELINE CONDITIONS LAND AND WATER USE BUDGETS

Current Conditions Baseline Water Use Budget Summary, Annual Average over 50-year Simulation

Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,806	10,115	5.6	176	120	0.7	10,235	5,462	4,653	120	-	-	10,235	-	-
2	Sutter Co. 1	147	629	4.3	2	1	0.4	630	629	-	1	-	-	630	-	-
3	South Sutter WD GSA	51,339	183,798	3.6	2,094	2,044	1.0	185,842	109,495	76,260	2,044	-	-	187,799	-	-
4	Placer County WA[1]	10,653	29,617	2.8	9,186	11,101	1.2	40,718	23,214	6,415	6,446	4,655	-	40,730	-	-
5	Nevada ID	3,180	12,719	4.0	581	394	0.7	13,113	8,387	4,489	394	-	-	13,271	-	-
6	Lincoln[1]	372	91	0.2	6,577	9,298	1.4	9,390	91	-	1,193	8,106	-	9,390	-	-
7	RD1001 [1]	7,436	30,324	4.1	416	164	0.4	30,488	20,759	9,565	164	-	-	30,488	-	-
8	Pleasant Grove Verona MWC	6,667	23,324	3.5	101	40	0.4	23,364	12,521	11,216	40	-	-	23,777	-	-
9	Sutter Co. 2	904	3,238	3.6	88	35	0.4	3,272	2,063	1,175	35	-	-	3,272	-	-
10	Natomas MWC (Sutter Co.)	11,136	41,377	3.7	442	175	0.4	41,552	2,113	39,267	175	-	-	41,555	-	-
11	Sutter Co. 3	2,991	9,780	3.3	456	343	0.8	10,123	9,780	-	343	-	-	10,123	-	-
12	Roseville SOI	904	1,040	1.2	46	180	3.9	1,220	1,040	-	180	-	-	1,220	-	-
13	City of Roseville	512	202	0.4	20,005	29,349	1.5	29,551	202	-	6	29,344	-	29,552	-	-
14	Cal Am (West Placer)	2,211	4,122	1.9	2,514	1,037	0.4	5,158	4,122	-	-	1,037	-	5,158	-	-
15	Natomas MWC (Sacramento Co.)	11,732	37,038	3.2	1,882	3,562	1.9	40,600	2,168	34,874	3,562	-	-	40,604	-	-
16	Sacramento International Airport	526	130	0.2	1,669	1,134	0.7	1,264	130	-	814	321	-	1,264	-	-
17	Metro Air Park	1,578	-	0.0	71	-	0.0	-	-	-	-	-	-	-	-	-
18	Sac Co. 1	832	1,096	1.3	165	606	3.7	1,702	43	1,052	606	-	-	1,702	-	-
19	Sac Co. 2	803	2,086	2.6	194	21	0.1	2,107	2,086	-	21	-	-	2,107	-	-
20	Sac County WA (Northgate 880)	-	-	0.0	837	1,349	1.6	1,349	-	-	1,349	-	-	1,349	-	-
21	Rio Linda Elverta	515	801	1.6	6,094	8,590	1.4	9,391	801	-	8,589	1	-	9,391	-	-
22	Sac Co. 3	335	167	0.5	227	345	1.5	512	167	-	345	-	-	512	-	-
23	Cal Am (Antelope)	3	7	2.3	2,679	4,629	1.7	4,636	7	-	4,251	378	-	4,636	-	-
24	Cal Am (Lincoln Oaks)	9	20	2.3	4,285	7,038	1.6	7,058	20	-	6,539	499	-	7,058	-	-
25	Citrus Heights WD	12	50	4.3	7,744	12,559	1.6	12,609	50	-	1,012	11,547	-	12,610	-	-
26	San Juan WD (Placer Co.)	82	-	0.0	1,409	1,808	1.3	1,808	-	-	-	1,808	-	1,808	-	-
27	San Juan WD (Sacramento Co.)	47	89	1.9	2,106	2,702	1.3	2,792	89	-	-	2,702	-	2,792	-	-
28	Orange Vale WC	50	278	5.5	2,900	4,071	1.4	4,349	278	-	-	4,071	-	4,349	-	-
29	Lake Natoma/Mississippi Bar	3	97	35.9	140	-	0.0	97	97	-	-	-	-	97	-	-
30	Fair Oaks WD	75	240	3.2	6,204	10,511	1.7	10,751	240	-	1,849	8,663	-	10,751	1,229	-
31	Carmichael WD	-	-	0.0	5,264	9,070	1.7	9,070	-	-	2,123	6,947	-	9,070	1,876	-
32	Sacramento Suburban WD (North)	25	56	2.2	13,845	21,660	1.6	21,716	56	-	14,242	7,418	-	21,717	2,300	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,773	14,540	1.9	14,540	-	-	12,464	2,076	-	14,540	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,335	2.2	1,335	-	-	1,335	-	-	1,335	-	-
35	Golden State WC Arden	-	-	0.0	496	968	2.0	968	-	-	968	-	-	968	-	-
36	Cal Am (Arden)	-	-	0.0	641	1,467	2.3	1,467	-	-	1,464	4	-	1,467	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,350	3,384	2.5	3,384	-	-	3,384	-	-	3,384	-	-
38	City of Sacramento (North)	1,258	200	0.2	19,767	35,728	1.8	35,928	200	-	7,261	28,467	-	35,928	110	-
	Total NASb	118,141	392,731	109	131,039	201,360	51	594,091	206,311	188,966	83,319	118,044	-	596,640	5,515	-
39	City of Sacramento (South)	262	130	0.5	36,584	66,122	1.8	66,253	45	86	13,438	52,684	-	66,252	-	-
40	Cal Am (Suburban Rosemont)	211	575	2.7	7,563	8,677	1.1	9,252	575	-	8,494	205	-	9,274	508	-
41	Sac Co. 4	5	25	4.7	23	-	0.0	25	25	-	-	-	-	25	-	-
42	Golden State WC (Cordova)	8	27	3.3	6,459	14,994	2.3	15,021	27	-	5,139	9,855	-	15,021	10,981	-
43	Sac Co. 5	-	-	0.0	286	3	0.0	3	-	-	-	3	-	3	6,245	-
44	City of Folsom[1]	103	50	0.5	11,146	20,967	1.9	21,017	34	-	-	20,967	-	21,001	2,443	-
45	Cal Am (Security Park)	-	-	0.0	218	11	0.1	11	-	-	11	0	-	11	233	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,141	2.2	4,141	-	-	4,302	2	-	4,304	-	-
47	Florin County WD	2	10	4.0	1,380	2,645	1.9	2,655	10	-	2,645	-	-	2,655	-	-
48	Cal Am (Parkway)	7	3	0.4	5,162	9,153	1.8	9,156	3	-	8,652	501	-	9,157	-	-
49	Sac Co. 6	183	493	2.7	1,127	49	0.0	542	137	357	49	-	-	542	-	-
50	Sac County WA (North/Central)	3,581	8,940	2.5	17,404	21,456	1.2	30,395	8,940	-	14,039	7,065	330	30,374	8,733	207
51	Sac County WA (South)	2,225	3,237	1.5	10,542	15,858	1.5	19,095	3,237	-	7,450	7,943	465	19,095	-	-
52	Elk Grove WD (2 - Intertie Service Area)	676	1,470	2.2	3,225	4,852	1.5	6,322	1,470	-	2,279	2,430	142	6,322	-	-
53	Elk Grove WD (1 - GW Service Area)	18	1	0.0	3,074	4,376	1.4	4,377	1	-	4,376	-	-	4,377	-	-
54	Cosumnes River West	17,598	49,046	2.8	2,597	6,220	2.4	55,266	44,813	4,233	6,220	-	-	55,266	-	-
55	RD744	1,240	2,400	1.9	146	64	0.4	2,464	605	1,795	64	-	-	2,464	-	-
56	Franklin Drainage District	2,654	9,111	3.4	344	189	0.5	9,299	3,442	5,670	134	55	-	9,300	-	-
57	RD813	2,053	4,826	2.4	166	90	0.5	4,916	1,361	3,466	65	24	-	4,916	-	-
58	RD755	354	1,515	4.3	39	17	0.4	1,532	502	1,012	17	-	-	1,532	-	-
59	RD1002	4,060	9,611	2.4	423	222	0.5	9,833	2,483	7,129	222	-	-	9,834	-	-
60	RD551	7,767	21,698	2.8	683	301	0.4	21,999	5,464	16,236	301	-	-	22,001	-	-
61	RD369	92	376	4.1	39	17	0.4	393	121	255	17	-	-	393	-	-
62	RD2110	1,358	1,649	1.2	97	43	0.4	1,692	281	1,368	43	-	-	1,693	-	-
63	Sac Co. 7	254	635	2.5	98	105	1.1	740	151	483	105	-	-	740	-	-
64	Rancho Murieta (North) [1]	368	676	1.8	1,189	1,342	1.1	2,018	435	248	111	1,231	-	2,026	-	-
65	Sloughouse RCD (North)	722	1,633	2.3	903	574	0.6	2,207	1,594	39	545	29	-	2,208	-	-
66	OHWD (Sth American Subbasin)	10,099	24,772	2.5	3,345	1,985	0.6	26,757	22,821	2,431	1,420	588	-	27,261	621	-
	Total SASb	55,900	142,907	59	116,154	184,473	28	327,380	98,577	44,808	80,139	103,584	938	328,046	29,765	207
67	OHWD (Cosumnes Subbasin)	2,885	7,427	2.6	1,718	1,236	0.7	8,664	4,863	2,566	1,230	-	-	8,659	-	-
68	Rancho Murieta (South)	5	30	5.5	441	494	1.1	524	15	15	-	448	-	479	-	-
69	Sloughouse RCD (East)	9,647	22,821	2.4	1,872	1,383	0.7	24,204	21,177	1,644	122	124	-	23,068	-	-
70	Wilton	1,200	3,929	3.3	5,748	3,278	0.6	7,207	3,918	11	5,077	-	-	9,006	-	-
71	Sloughouse RCD (West)	4,261	9,306	2.2	490	256	0.5	9,562	9,182	125	6	-	-	9,312	-	-
72	Galt ID (East)	15,282	38,926	2.5	7,847	5,284	0.7	44,210	37,395	1,531	10,545	-	-	49,471	-	-
73	Clay WD	1,989	7,680	3.9	230	424	1.8	8,104	7,237	443	-	-	-	7,680	-	-
74	Clay	130	358	2.8	2,805	1,427	0.5	1,785	358	-	1,403	-	-	1,761	-	-
75	SMUD Rancho Seco	19	60	3.1	196	126	0.6	186	43	17	7	-	-	67	-	-
76	Cosumnes River South	4,231	10,943	2.6	329	465	1.4	11,408	8,293	2,651	-	-	-	10,944	-	-
77	Galt ID (West)	1,728	4,654	2.7	1,542	1,117	0.7	5,771	4,654	-	600	-	-	5,254	-	-
78	Sac Co. 8	2,693	5,929	2.2	697	799	1.1	6,728	5,410	518	131	-	-	6,059	-	-
79	City of Galt	197	216	1.1	3,206	4,777	1.5	4,993	216	-	3,413	-	-	3,629	-	-
80	Sloughouse RCD (South)	1,051	1,417	1.3	376	514	1.4	1,931	1,417	-	42	-	-	1,459	-	-
81	Amador Co. 1	1,900	2,863	1.5	1,832	2,418	1.3	5,282	858	2,003	0	-	-	2,861	-	-
82	Ione	147	14	0.1	1,128	2,371	2.1	2,385	14	0	-	1,911	-	1,925	-	-
83	Jackson ID	2,842	9,699	3.4	387	493	1.3	10,192	-	9,329	19	-	-	9,348	-	-
84	Camanche	81	-	0.0	325	240	0.7	240	-	-	87	-	-	87	-	-
85	Amador County WA	1	-	0.0	603	315	0.5	315	-	-	144	-	-	144	-	-
87	Galt WWTP	156	27	0.2	72	107	1.5	135	-	630	-	-	-	630	-	-
	Total CoSb	50,447	126,301	43	31,841	27,524	21	153,825	105,049	21,484	22,825	2,483	-	151,842	-	-
86	Mokelumne	35,660	75,590	2.1	3,287	4,606	1.4	80,196	75,590	-	4,606	-	-	80,196	-	-
	Total Other	35,660	75,590	2.1	3,287	4,606	1.4	80,196	75,590	-	4,606	-	-	80,196	-	-
	CoSANA Grand Total (NASb, SASb, CoSb)	224,487	661,939	212	279,035	413,358	100	1,075,297	409,937	255,259	186,284	224,111	938	1,076,528	35,279	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

Projected Conditions Baseline Water Use Budget Summary, Annual Average over 50-year Simulation

Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,807	10,113	5.6	177	101	0.6	10,214	5,459	4,653	101	-	-	10,214	-	-
2	Sutter Co. 1	147	629	4.3	2	1	0.4	629	629	-	1	-	-	629	-	-
3	South Sutter WD GSA	52,244	188,092	3.6	2,715	2,044	0.8	190,136	112,897	76,258	1,626	418	-	191,198	-	-
4	Placer County WA[1]	9,028	30,832	3.4	27,745	32,735	1.2	63,567	24,418	6,415	6,187	26,545	-	63,565	-	-
5	Nevada ID	1,481	6,536	4.4	4,231	3,433	0.8	9,969	2,243	4,489	765	2,667	-	10,164	-	-
6	Lincoln[1]	348	91	0.3	6,738	5,657	0.8	5,749	91	-	907	4,750	-	5,748	-	-
7	RD1001 [1]	7,436	30,319	4.1	416	167	0.4	30,486	20,754	9,565	167	-	-	30,486	-	-
8	Pleasant Grove Verona MWC	6,668	23,216	3.5	101	41	0.4	23,257	12,374	11,533	41	-	-	23,947	-	-
9	Sutter Co. 2	904	3,237	3.6	88	35	0.4	3,272	2,062	1,175	35	-	-	3,272	-	-
10	Natomas MWC (Sutter Co.)	6,336	23,929	3.8	5,699	11,492	2.0	35,421	3,662	20,320	7,979	3,512	-	35,473	-	-
11	Sutter Co. 3	1,424	4,445	3.1	2,344	4,577	2.0	9,021	4,445	-	3,222	1,355	-	9,021	-	-
12	Roseville SOI	1,104	2,081	1.9	1,056	2,530	2.4	4,612	2,081	-	188	2,342	-	4,612	-	-
13	City of Roseville	99	60	0.6	23,599	56,637	2.4	56,697	60	-	1,692	54,945	-	56,698	-	-
14	Cal Am (West Placer)	1,528	5,318	3.5	9,158	6,782	0.7	12,101	5,318	-	-	6,782	-	12,101	-	-
15	Natomas MWC (Sacramento Co.)	5,920	17,315	2.9	8,209	17,108	2.1	34,423	3,683	14,413	5,345	11,763	-	35,204	-	-
16	Sacramento International Airport	526	130	0.2	1,669	1,144	0.7	1,274	130	-	673	471	-	1,274	-	-
17	Metro Air Park	1,578	-	0.0	71	-	0.0	-	-	-	-	-	-	-	-	-
18	Sac Co. 1	832	1,096	1.3	165	568	3.5	1,664	43	1,052	568	-	-	1,664	-	-
19	Sac Co. 2	31	61	1.9	1,652	3,710	2.2	3,770	61	-	865	2,845	-	3,770	-	-
20	Sac County WA (Northgate 880)	-	-	0.0	837	1,365	1.6	1,365	-	-	1,365	-	-	1,365	-	-
21	Rio Linda Elverta	447	772	1.7	7,215	10,323	1.4	11,095	772	-	10,323	-	-	11,095	-	-
22	Sac Co. 3	36	129	3.5	652	1,064	1.6	1,193	129	-	1,064	-	-	1,193	-	-
23	Cal Am (Antelope)	3	5	2.0	2,706	5,225	1.9	5,230	5	-	4,481	744	-	5,230	-	-
24	Cal Am (Lincoln Oaks)	9	20	2.3	4,285	6,213	1.4	6,233	20	-	5,717	496	-	6,233	-	-
25	Citrus Heights WD	12	50	4.3	7,744	17,172	2.2	17,222	50	-	900	16,272	-	17,222	-	-
26	San Juan WD (Placer Co.)	82	-	0.0	1,409	2,876	2.0	2,876	-	-	-	2,876	-	2,876	-	-
27	San Juan WD (Sacramento Co.)	47	89	1.9	2,106	4,299	2.0	4,389	89	-	-	4,299	-	4,389	-	-
28	Orange Vale WC	50	277	5.5	2,899	4,697	1.6	4,975	277	-	-	4,697	-	4,975	-	-
29	Lake Natoma/Mississippi Bar	3	97	35.9	140	-	0.0	97	97	-	-	-	-	97	-	-
30	Fair Oaks WD	75	240	3.2	6,204	12,726	2.1	12,966	240	-	2,129	10,597	-	12,966	1,229	-
31	Carmichael WD	-	-	0.0	5,264	10,530	2.0	10,530	-	-	2,465	8,065	-	10,530	1,876	-
32	Sacramento Suburban WD (North)	25	56	2.2	13,846	24,848	1.8	24,904	56	-	15,597	9,251	-	24,904	2,300	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,773	16,456	2.1	16,456	-	-	13,744	2,712	-	16,456	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,214	2.0	1,214	-	-	1,214	-	-	1,214	-	-
35	Golden State WC Arden	-	-	0.0	496	969	2.0	969	-	-	968	-	-	968	-	-
36	Cal Am (Arden)	-	-	0.0	641	1,606	2.5	1,606	-	-	1,123	483	-	1,606	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,350	3,217	2.4	3,217	-	-	3,217	-	-	3,217	-	-
38	City of Sacramento (North)	806	191	0.2	20,363	55,977	2.7	56,168	191	-	13,955	42,022	-	56,168	110	-
	Total NASb	101,036	349,428	115	182,377	329,539	59	678,967	202,338	149,872	108,625	220,911	-	681,745	5,515	-
39	City of Sacramento (South)	122	24	0.2	36,875	101,356	2.7	101,381	24	1	25,256	76,100	-	101,381	-	-
40	Cal Am (Suburban Rosemont)	56	185	3.3	8,045	17,439	2.2	17,624	185	-	11,053	6,386	-	17,624	508	-
41	Sac Co. 4	5	25	4.7	23	-	0.0	25	25	-	-	-	-	25	-	-
42	Golden State WC (Cordova)	8	27	3.3	6,459	19,752	3.1	19,779	27	-	9,752	10,000	-	19,779	10,981	-
43	Sac Co. 5	-	-	0.0	1,815	2,863	1.6	2,863	-	-	-	2,863	-	2,863	6,245	-
44	City of Folsom[1]	75	50	0.7	15,728	27,405	1.7	27,455	34	-	-	27,405	-	27,439	2,443	-
45	Cal Am (Security Park)	-	-	0.0	1,770	3,408	1.9	3,408	-	-	6	3,402	-	3,408	233	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,957	2.6	4,957	-	-	2,642	2,478	-	5,120	-	-
47	Florin County WD	-	-	0.0	1,399	2,692	1.9	2,692	-	-	2,645	47	-	2,692	-	-
48	Cal Am (Parkway)	-	-	0.0	5,252	17,084	3.3	17,084	-	-	14,430	2,654	-	17,084	-	-
49	Sac Co. 6	183	493	2.7	1,141	60	0.1	553	136	357	60	-	-	553	-	-
50	Sac County WA (North/Central)	1,607	4,573	2.8	34,073	64,917	1.9	69,489	4,573	-	22,962	35,099	6,856	69,489	8,733	207
51	Sac County WA (South)	531	1,261	2.4	12,689	27,243	2.1	28,504	1,261	-	12,130	10,524	4,589	28,504	-	-
52	Elk Grove WD (2 - Intertie Service Area)	582	1,226	2.1	3,470	7,451	2.1	8,676	1,226	-	3,317	2,878	1,255	8,676	-	-
53	Elk Grove WD (1 - GW Service Area)	18	1	0.0	3,074	4,650	1.5	4,651	1	-	4,650	-	-	4,651	-	-
54	Cosumnes River West	17,599	49,045	2.8	2,597	4,968	1.9	54,013	44,805	4,240	4,968	-	-	54,014	-	-
55	RD744	1,240	2,400	1.9	146	78	0.5	2,478	601	1,799	78	-	-	2,479	-	-
56	Franklin Drainage District	2,654	9,111	3.4	344	185	0.5	9,295	3,431	5,680	163	21	-	9,296	-	-
57	RD813	2,053	4,826	2.4	166	89	0.5	4,915	1,354	3,473	80	10	-	4,916	-	-
58	RD755	354	1,514	4.3	39	21	0.5	1,535	500	1,014	21	-	-	1,535	-	-
59	RD1002	4,060	9,611	2.4	423	271	0.6	9,882	2,468	7,144	271	-	-	9,883	-	-
60	RD551	7,767	21,697	2.8	683	368	0.5	22,065	5,432	16,268	368	-	-	22,068	-	-
61	RD369	92	376	4.1	39	21	0.5	397	121	255	21	-	-	397	-	-
62	RD2110	1,358	1,649	1.2	97	52	0.5	1,702	278	1,371	52	-	-	1,702	-	-
63	Sac Co. 7	254	635	2.5	98	128	1.3	763	151	484	128	-	-	763	-	-
64	Rancho Murieta (North) [1]	367	675	1.8	1,945	2,837	1.5	3,512	433	249	182	2,655	-	3,519	-	-
65	Sloughouse RCD (North)	722	1,632	2.3	2,903	4,233	1.5	5,866	1,594	39	752	3,481	-	5,866	-	-
66	OHWD (Sth American Subbasin)	10,098	24,867	2.5	3,354	2,403	0.7	27,271	22,876	1,997	1,598	829	-	27,299	621	-
	Total SASb	51,804	135,904	57	146,542	316,931	40	452,836	91,537	44,372	117,584	186,834	12,700	453,027	29,765	207
67	OHWD (Cosumnes Subbasin)	2,885	7,427	2.6	1,718	1,234	0.7	8,661	4,861	2,568	1,321	-	-	8,750	-	-
68	Rancho Murieta (South)	5	30	5.5	441	633	1.4	663	15	15	-	583	-	614	-	-
69	Sloughouse RCD (East)	9,647	22,821	2.4	1,872	1,325	0.7	24,145	21,177	1,644	144	167	-	23,132	-	-
70	Wilton	1,200	3,929	3.3	5,748	3,631	0.6	7,560	3,918	11	5,574	-	-	9,503	-	-
71	Sloughouse RCD (West)	4,199	9,219	2.2	641	434	0.7	9,653	9,095	125	235	-	-	9,455	-	-
72	Galt ID (East)	14,125	35,219	2.5	9,175	6,681	0.7	41,900	33,688	1,531	12,889	-	-	48,108	-	-
73	Clay WD	1,990	7,680	3.9	230	301	1.3	7,981	7,237	443	-	-	-	7,680	-	-
74	Clay	130	358	2.8	2,805	1,673	0.6	2,031	358	-	1,653	-	-	2,011	-	-
75	SMUD Rancho Seco	19	60	3.1	196	105	0.5	165	43	17	7	-	-	67	-	-
76	Cosumnes River South	4,232	10,943	2.6	329	480	1.5	11,422	8,292	2,651	-	-	-	10,944	-	-
77	Galt ID (West)	1,562	4,294	2.7	1,753	1,480	0.8	5,774	4,294	-	1,139	-	-	5,433	-	-
78	Sac Co. 8	2,473	5,526	2.2	967	1,120	1.2	6,646	5,008	518	536	-	-	6,062	-	-
79	City of Galt	27	78	2.9	3,428	4,000	1.2	4,078	78	-	3,912	-	-	3,990	-	-
80	Sloughouse RCD (South)	822	964	1.2	677	784	1.2	1,748	964	-	546	-	-	1,510	-	-
81	Amador Co. 1	1,870	2,864	1.5	1,918	2,677	1.4	5,541	858	2,003	0	277	-	3,138	-	-
82	Ione	10	-	0.0	2,216	2,340	1.1	2,340	-	-	-	2,915	-	2,915	-	-
83	Jackson ID	2,842	9,699	3.4	400	549	1.4	10,247	-	9,329	17	-	-	9,346	-	-
84	Camanche	81	-	0.0	452	215	0.5	215	-	-	120	-	-	120	-	-
85	Amador County WA	0	-	0.0	1,184	429	0.4	429	-	-	353	-	-	353	-	-
87	Galt WWTP	156	27	0.2	72	84	1.2	111	-	630	-	-	-	630	-	-
	Total CoSb	48,275	121,140	45	36,220	30,173	19	151,314	99,886	21,487	28,445	3,943	-	153,761	-	-
86	Mokelumne	35,662	75,582	2.1	3,286	4,632	1.4	80,214	75,582	-	4,632	-	-	80,214	-	-
	Total Other	35,662	75,582	2.1	3,286	4,632	1.4	80,214	75,582	-	4,632	-	-	80,214	-	-
	CoSANA Grand Total (NASb, SASb, CoSb)	201,115	606,472	216	365,138	676,644	118	1,283,116	393,760	215,731	254,654	411,687	12,700	1,288,532	35,279	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

Projected Conditions Baseline with Climate Change Water Use Budget Summary, Annual Average over 50-year Simulation

Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,807	10,632	5.9	177	101	0.6	10,733	5,979	4,653	101	-	-	10,733	-	-
2	Sutter Co. 1	147	672	4.6	2	1	0.4	673	672	-	1	-	-	673	-	-
3	South Sutter WD GSA	52,244	200,075	3.8	2,715	2,044	0.8	202,119	124,690	76,246	1,626	418	-	202,980	-	-
4	Placer County WA[1]	9,028	33,233	3.7	27,745	32,735	1.2	65,967	26,818	6,415	6,187	26,545	-	65,965	-	-
5	Nevada ID	1,481	6,965	4.7	4,231	3,433	0.8	10,397	2,637	4,489	765	2,667	-	10,558	-	-
6	Lincoln[1]	348	98	0.3	6,738	5,657	0.8	5,755	98	-	907	4,750	-	5,754	-	-
7	RD1001 [1]	7,436	32,241	4.3	416	167	0.4	32,408	22,676	9,565	167	-	-	32,408	-	-
8	Pleasant Grove Verona MWC	6,668	24,847	3.7	101	41	0.4	24,887	13,800	11,533	41	-	-	25,373	-	-
9	Sutter Co. 2	904	3,469	3.8	88	35	0.4	3,504	2,286	1,183	35	-	-	3,504	-	-
10	Natomas MWC (Sutter Co.)	6,336	25,410	4.0	5,699	11,492	2.0	36,901	3,663	21,795	7,979	3,512	-	36,949	-	-
11	Sutter Co. 3	1,424	4,750	3.3	2,344	4,577	2.0	9,326	4,750	-	3,222	1,355	-	9,326	-	-
12	Roseville SOI	1,104	2,229	2.0	1,056	2,530	2.4	4,759	2,229	-	188	2,342	-	4,759	-	-
13	City of Roseville	99	63	0.6	23,599	56,637	2.4	56,700	63	-	1,692	54,945	-	56,700	-	-
14	Cal Am (West Placer)	1,528	5,790	3.8	9,158	6,782	0.7	12,572	5,790	-	-	6,782	-	12,572	-	-
15	Natomas MWC (Sacramento Co.)	5,920	18,453	3.1	8,209	17,108	2.1	35,561	3,691	15,528	5,345	11,763	-	36,327	-	-
16	Sacramento International Airport	526	139	0.3	1,669	1,144	0.7	1,283	139	-	673	471	-	1,283	-	-
17	Metro Air Park	1,578	-	0.0	71	-	0.0	-	-	-	-	-	-	-	-	-
18	Sac Co. 1	832	1,190	1.4	165	568	3.5	1,757	48	1,142	568	-	-	1,757	-	-
19	Sac Co. 2	31	64	2.0	1,652	3,710	2.2	3,774	64	-	865	2,845	-	3,774	-	-
20	Sac County WA (Northgate 880)	-	-	0.0	837	1,365	1.6	1,365	-	-	1,365	-	-	1,365	-	-
21	Rio Linda Elverta	447	842	1.9	7,215	10,323	1.4	11,166	842	-	10,323	-	-	11,166	-	-
22	Sac Co. 3	36	140	3.9	652	1,064	1.6	1,204	140	-	1,064	-	-	1,204	-	-
23	Cal Am (Antelope)	3	6	2.2	2,706	5,225	1.9	5,231	6	-	4,481	744	-	5,231	-	-
24	Cal Am (Lincoln Oaks)	9	22	2.5	4,285	6,213	1.4	6,235	22	-	5,717	496	-	6,235	-	-
25	Citrus Heights WD	12	54	4.7	7,744	17,172	2.2	17,226	54	-	900	16,272	-	17,226	-	-
26	San Juan WD (Placer Co.)	82	-	0.0	1,409	2,876	2.0	2,876	-	-	-	2,876	-	2,876	-	-
27	San Juan WD (Sacramento Co.)	47	97	2.1	2,106	4,299	2.0	4,396	97	-	-	4,299	-	4,396	-	-
28	Orange Vale WC	50	294	5.9	2,899	4,697	1.6	4,991	294	-	-	4,697	-	4,991	-	-
29	Lake Natoma/Mississippi Bar	3	98	36.2	140	-	0.0	98	98	-	-	-	-	98	-	-
30	Fair Oaks WD	75	257	3.4	6,204	12,726	2.1	12,984	257	-	2,129	10,597	-	12,983	1,229	-
31	Carmichael WD	-	-	0.0	5,264	10,530	2.0	10,530	-	-	2,465	8,065	-	10,530	1,876	-
32	Sacramento Suburban WD (North)	25	62	2.4	13,846	24,848	1.8	24,910	62	-	15,597	9,251	-	24,910	2,300	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,773	16,456	2.1	16,456	-	-	13,744	2,712	-	16,456	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,214	2.0	1,214	-	-	1,214	-	-	1,214	-	-
35	Golden State WC Arden	-	-	0.0	496	969	2.0	969	-	-	968	-	-	968	-	-
36	Cal Am (Arden)	-	-	0.0	641	1,606	2.5	1,606	-	-	1,123	483	-	1,606	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,350	3,217	2.4	3,217	-	-	3,217	-	-	3,217	-	-
38	City of Sacramento (North)	806	209	0.3	20,363	55,977	2.7	56,186	209	-	13,955	42,022	-	56,186	110	-
	Total NASb	101,036	372,398	121	182,377	329,539	59	701,937	222,172	152,548	108,625	220,911	-	704,255	5,515	-
39	City of Sacramento (South)	122	26	0.2	36,875	101,356	2.7	101,383	26	1	25,256	76,100	-	101,383	-	-
40	Cal Am (Suburban Rosemont)	56	196	3.5	8,045	17,439	2.2	17,635	196	-	11,053	6,386	-	17,635	508	-
41	Sac Co. 4	5	27	5.1	23	-	0.0	27	27	-	-	-	-	27	-	-
42	Golden State WC (Cordova)	8	29	3.5	6,459	19,752	3.1	19,781	29	-	9,752	10,000	-	19,781	10,981	-
43	Sac Co. 5	-	-	0.0	1,815	2,863	1.6	2,863	-	-	-	2,863	-	2,863	6,245	-
44	City of Folsom[1]	75	54	0.7	15,728	27,405	1.7	27,459	32	-	-	27,405	-	27,438	2,443	-
45	Cal Am (Security Park)	-	-	0.0	1,770	3,408	1.9	3,408	-	-	6	3,402	-	3,408	233	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,957	2.6	4,957	-	-	2,642	2,478	-	5,120	-	-
47	Florin County WD	-	-	0.0	1,399	2,692	1.9	2,692	-	-	2,645	47	-	2,692	-	-
48	Cal Am (Parkway)	-	-	0.0	5,252	17,084	3.3	17,084	-	-	14,430	2,654	-	17,084	-	-
49	Sac Co. 6	183	559	3.1	1,141	60	0.1	618	190	368	60	-	-	618	-	-
50	Sac County WA (North/Central)	1,607	4,981	3.1	34,073	64,917	1.9	69,897	4,981	-	22,962	35,099	6,856	69,897	8,733	207
51	Sac County WA (South)	531	1,377	2.6	12,689	27,243	2.1	28,620	1,377	-	12,130	10,524	4,589	28,620	-	-
52	Elk Grove WD (2 - Intertie Service Area)	582	1,333	2.3	3,470	7,451	2.1	8,784	1,333	-	3,317	2,878	1,255	8,784	-	-
53	Elk Grove WD (1 - GW Service Area)	18	1	0.1	3,074	4,650	1.5	4,651	1	-	4,650	-	-	4,651	-	-
54	Cosumnes River West	17,599	53,472	3.0	2,597	4,968	1.9	58,440	49,159	4,313	4,968	-	-	58,440	-	-
55	RD744	1,240	2,637	2.1	146	78	0.5	2,716	804	1,834	78	-	-	2,716	-	-
56	Franklin Drainage District	2,654	9,945	3.7	344	185	0.5	10,129	4,202	5,743	163	21	-	10,130	-	-
57	RD813	2,053	5,335	2.6	166	89	0.5	5,424	1,787	3,548	80	10	-	5,425	-	-
58	RD755	354	1,642	4.6	39	21	0.5	1,662	624	1,018	21	-	-	1,662	-	-
59	RD1002	4,060	10,637	2.6	423	271	0.6	10,908	3,281	7,356	271	-	-	10,908	-	-
60	RD551	7,767	23,766	3.1	683	368	0.5	24,134	7,291	16,477	368	-	-	24,135	-	-
61	RD369	92	409	4.4	39	21	0.5	430	152	257	21	-	-	430	-	-
62	RD2110	1,358	1,825	1.3	97	52	0.5	1,877	407	1,417	52	-	-	1,877	-	-
63	Sac Co. 7	254	704	2.8	98	128	1.3	832	207	497	128	-	-	832	-	-
64	Rancho Murieta (North)[1]	367	731	2.0	1,945	2,837	1.5	3,568	476	260	182	2,655	-	3,574	-	-
65	Sloughouse RCD (North)	722	1,760	2.4	2,903	4,233	1.5	5,993	1,721	39	752	3,481	-	5,993	-	-
66	OHWD (Sth American Subbasin)	10,098	27,030	2.7	3,354	2,403	0.7	29,434	24,981	2,053	1,598	829	-	29,461	621	-
	Total SASb	51,804	148,475	62	146,542	316,931	40	465,406	103,283	45,182	117,584	186,834	12,700	465,583	29,765	207
67	OHWD (Cosumnes Subbasin)	2,885	8,048	2.8	1,718	1,234	0.7	9,282	5,302	2,747	1,321	-	-	9,370	-	-
68	Rancho Murieta (South)	5	32	5.9	441	633	1.4	665	16	17	-	583	-	616	-	-
69	Sloughouse RCD (East)	9,647	24,790	2.6	1,872	1,325	0.7	26,115	23,102	1,689	144	167	-	25,102	-	-
70	Wilton	1,200	4,246	3.5	5,748	3,631	0.6	7,877	4,235	11	5,574	-	-	9,820	-	-
71	Sloughouse RCD (West)	4,199	10,057	2.4	641	434	0.7	10,491	9,932	125	235	-	-	10,293	-	-
72	Galt ID (East)	14,125	38,178	2.7	9,175	6,681	0.7	44,859	36,639	1,538	12,889	-	-	51,067	-	-
73	Clay WD	1,990	8,332	4.2	230	301	1.3	8,633	7,886	446	-	-	-	8,332	-	-
74	Clay	130	387	3.0	2,805	1,673	0.6	2,061	387	-	1,653	-	-	2,040	-	-
75	SMUD Rancho Seco	19	66	3.4	196	105	0.5	171	47	19	7	-	-	73	-	-
76	Cosumnes River South	4,232	11,994	2.8	329	480	1.5	12,473	9,084	2,924	-	-	-	12,008	-	-
77	Galt ID (West)	1,562	4,670	3.0	1,753	1,480	0.8	6,150	4,670	-	1,139	-	-	5,809	-	-
78	Sac Co. 8	2,473	5,969	2.4	967	1,120	1.2	7,089	5,433	536	536	-	-	6,505	-	-
79	City of Galt	27	83	3.1	3,428	4,000	1.2	4,082	83	-	3,912	-	-	3,995	-	-
80	Sloughouse RCD (South)	822	1,047	1.3	677	784	1.2	1,831	1,047	-	546	-	-	1,592	-	-
81	Amador Co. 1	1,870	3,126	1.7	1,918	2,677	1.4	5,804	968	2,155	0	277	-	3,400	-	-
82	Ione	10	-	0.0	2,216	2,340	1.1	2,340	-	-	-	2,915	-	2,915	-	-
83	Jackson ID	2,842	10,410	3.7	400	549	1.4	10,959	-	9,934	17	-	-	9,951	-	-
84	Camanche	81	-	0.0	452	215	0.5	215	-	-	120	-	-	120	-	-
85	Amador County WA	0	-	0.0	1,184	429	0.4	429	-	-	353	-	-	353	-	-
87	Galt WWTP	156	32	0.2	72	84	1.2	116	-	632	-	-	-	632	-	-
	Total CoSb	48,275	131,469	49	36,220	30,173	19	161,642	108,831	22,773	28,445	3,943	-	163,992	-	-
86	Mokelumne	35,662	83,220	2.3	3,286	4,632	1.4	87,852	83,220	-	4,632	-	-	87,852	-	-
	Total Other	35,662	83,220	2.3	3,286	4,632	1.4	87,852	83,220	-	4,632	-	-	87,852	-	-
	CoSANA Grand Total (NASb, SASb, CoSb)	201,115	652,342	231	365,138	676,644	118	1,328,986	434,286	220,503	254,654	411,687	12,700	1,333,830	35,279	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

APPENDIX I: BASELINE CONDITIONS GROUNDWATER BUDGETS

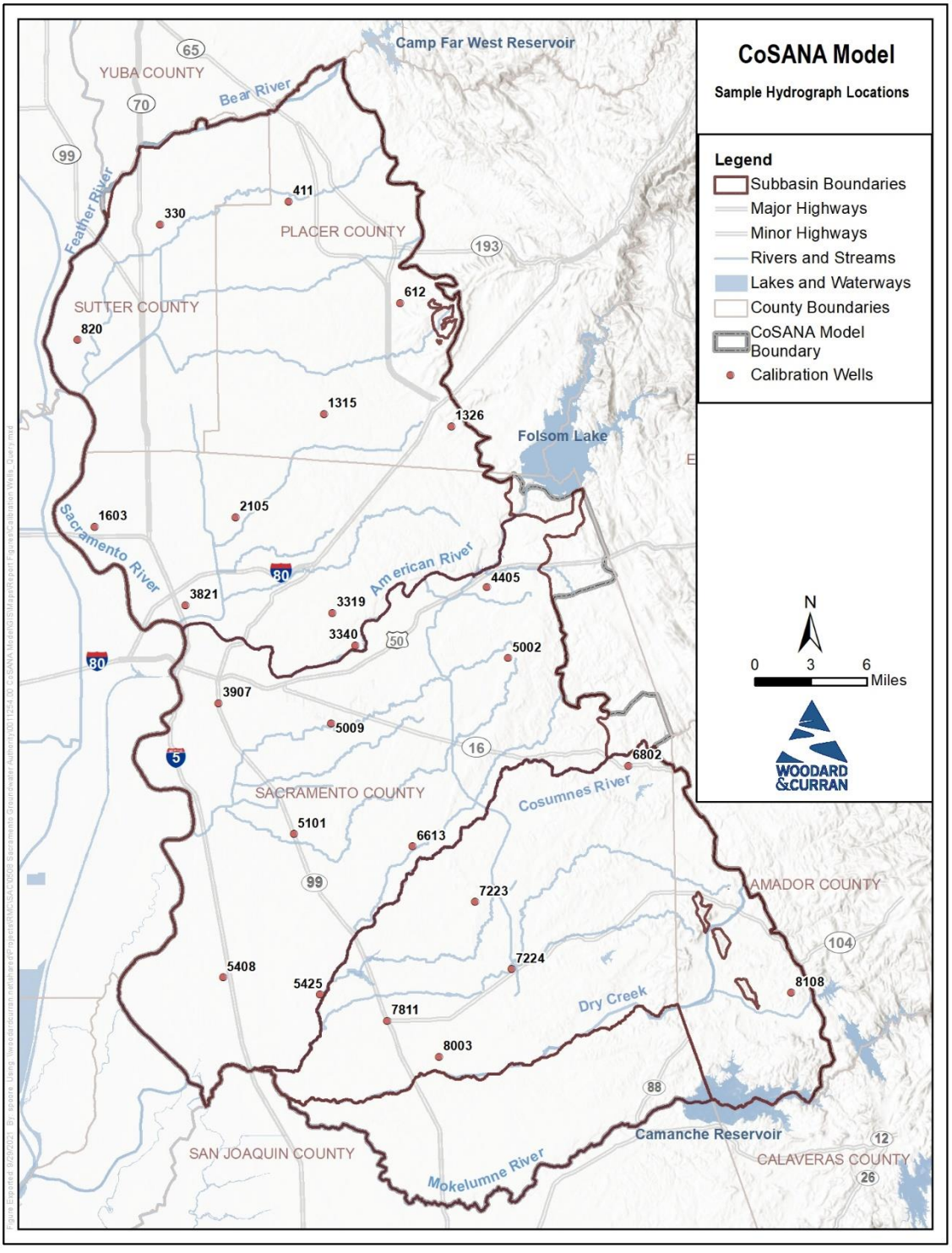
Current Conditions Baseline Groundwater Budget Summary, Annual Average over 50-year Simulation							
Subregion	**Description**	**Deep Percolation**	**Gain from Stream**	**Recharge (Recoverable Loss)**	**Boundary Inflow**	**Net Subsurface Inflow**	**Pumping**
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
North American Subbasin							
1	Camp Far West ID	6,458	-4,879	651	2,526	834	5,582
2	Sutter Co. 1	312	23	0	1,232	-937	630
3	South Sutter WD GSA	54,557	26,635	10,625	4,478	16,746	111,539
4	Placer County WA	32,195	2,096	898	1,539	-3,198	29,899
5	Nevada ID	8,411	776	1,257	4,345	-6,277	8,782
6	Lincoln	5,464	640	0	504	-4,060	1,046
7	RD1001	16,678	6,067	1,148	-86	-2,764	20,923
8	Pleasant Grove Verona MWC	5,013	3,705	1,346	0	2,564	12,561
9	Sutter Co. 2	1,351	-2,512	141	945	2,150	2,098
10	Natomas MWC (Sutter Co.)	7,920	6,075	277	46	-8,615	5,586
11	Sutter Co. 3	3,461	917	0	0	5,931	10,123
12	Roseville SOI	1,059	1,146	0	0	-715	1,220
13	City of Roseville	5,082	5,202	210	2,758	-9,643	208
14	Cal Am (West Placer)	4,628	4,071	0	0	-3,453	4,130
15	Natomas MWC (Sacramento Co.)	9,916	-3,968	465	2,663	-3,906	5,140
16	Sacramento International Airport	736	0	0	0	161	944
17	Metro Air Park	477	0	0	0	-457	31
18	Sac Co. 1	733	-3,297	0	3,897	-709	649
19	Sac Co. 2	1,188	2,090	0	0	-344	2,849
20	Sac County WA (Northgate 880)	61	585	0	0	70	696
21	Rio Linda Elverta	2,194	5,392	0	0	2,387	9,390
22	Sac Co. 3	164	754	0	0	-344	512
23	Cal Am (Antelope)	567	629	0	0	2,949	3,903
24	Cal Am (Lincoln Oaks)	523	0	0	0	6,174	6,359
25	Citrus Heights WD	1,417	0	0	460	-176	1,263
26	San Juan WD (Placer Co.)	380	0	0	1,566	-2,057	0
27	San Juan WD (Sacramento Co.)	567	-589	0	825	-773	89
28	Orange Vale WC	1,187	0	0	0	-868	278
29	Lake Natoma/Mississippi Bar	1,590	-5,831	0	34	4,313	97
30	Fair Oaks WD	2,746	4,824	0	0	-4,113	3,317
31	Carmichael WD	1,032	5,622	0	0	-2,545	3,999
32	Sacramento Suburban WD (North)	2,691	50	0	0	11,769	13,785
33	Sacramento Suburuban WD (South)	866	6,342	0	0	5,791	12,843
34	Del Paso Manor WD	75	0	0	0	1,270	1,335
35	Golden State WC Arden	33	0	0	0	772	800
36	Cal Am (Arden)	92	0	0	0	1,382	1,464
37	Sac County WA (Arden Park	203	766	0	0	1,650	2,611
38	City of Sacramento (North)	3,252	14,463	0	727	-1,197	16,734
Total NASb		185,281	77,793	17,017	28,461	9,761	303,413
South American Subbasin							
39	City of Sacramento (South)	13,704	12,643	0	842	-21,062	5,940
40	Cal Am (Suburban Rosemont)	1,529	6,147	0	0	2,224	9,911
41	Sac Co. 4	286	2,527	0	0	-2,785	25
42	Golden State WC (Cordova)	6,482	12,851	0	0	-3,452	15,892
43	Sac Co. 5	1,947	0	0	0	4,280	6,245
44	City of Folsom	16,480	-3,463	0	2,155	-12,339	2,475
45	Cal Am (Security Park)	1,583	38	0	0	-1,424	244
46	Fruitridge Vista WC	299	278	0	0	2,982	3,550
47	Florin County WD	161	0	0	0	2,134	2,288
48	Cal Am (Parkway)	660	359	0	0	7,943	8,919
49	Sac Co. 6	969	3,022	0	254	-4,025	185
50	Sac County WA (North/Central)	16,795	4,020	209	0	15,652	37,013
51	Sac County WA (South)	3,686	213	0	0	11,379	15,038
52	Elk Grove WD (2 - Intertie Service Area)	1,302	1,192	0	0	1,805	4,229
53	Elk Grove WD (1 - GW Service Area)	390	668	0	0	5,823	6,835
54	Cosumnes River West	21,988	10,970	0	0	18,478	51,033
55	RD744	837	6,390	0	-773	-5,730	669
56	Franklin Drainage District	3,404	5,872	0	-252	-5,133	3,626
57	RD813	1,594	2,833	0	-134	-2,774	1,426
58	RD755	552	1,312	0	-283	-1,036	519
59	RD1002	3,060	0	0	0	-280	2,705
60	RD551	8,754	5,686	0	-1,517	-6,924	5,765
61	RD369	433	1,947	0	-216	-2,013	138
62	RD2110	746	-919	0	495	19	324
63	Sac Co. 7	358	1,221	0	26	-1,342	256
64	Rancho Murieta (North)	4,945	-2,429	0	0	-1,821	546
65	Sloughouse RCD (North)	5,139	-606	0	3,948	-6,007	2,140
66	OHWD (Sth American Subbasin)	11,901	15,290	26	64	-2,207	24,862
Total SASb		129,985	88,059	235	4,610	-7,634	212,799
Cosumnes Subbasin							
67	OHWD (Cosumnes Subbasin)	5,611	5,146	0	0	-4,615	6,093
68	Rancho Murieta (South)	1,081	-2,163	0	0	1,095	15
69	Sloughouse RCD (East)	23,460	3,256	0	1,183	-7,110	21,299
70	Wilton	4,917	48	0	0	3,963	8,995
71	Sloughouse RCD (West)	4,059	361	0	0	4,768	9,187
72	Galt ID (East)	20,225	1,975	0	0	25,568	47,940
73	Clay WD	3,489	1,189	0	0	2,464	7,237
74	Clay	1,074	3	0	0	618	1,761
75	SMUD Rancho Seco	490	0	0	0	-496	50
76	Cosumnes River South	4,753	9,282	0	-561	-5,145	8,293
77	Galt ID (West)	2,506	785	0	0	1,989	5,254
78	Sac Co. 8	4,149	7,799	0	0	-6,412	5,541
79	City of Galt	1,489	675	0	0	1,487	3,629
80	Sloughouse RCD (South)	964	997	0	0	-496	1,459
81	Amador Co. 1	13,631	-6,996	0	4,477	-9,734	858
82	Ione	1,367	0	0	0	-1,088	14
83	Jackson ID	8,808	-6,794	0	538	-2,476	0
84	Camanche	5,218	0	0	-4,190	-1,146	60
85	Amador County WA	1,457	0	0	6	-1,324	190
87	Galt WWTP	316	0	0	0	-317	0
Total CoSb		109,064	15,562	0	1,453	1,591	127,874
Other							
86	Mokelumne	30,689	51,058	0	1,834	-3,718	80,196
Total Other		30,689	51,058	0	1,834	-3,718	80,196
CoSANA Total (NASb, SASb, CoSb)		424,331	181,414	17,252	34,525	3,718	644,087

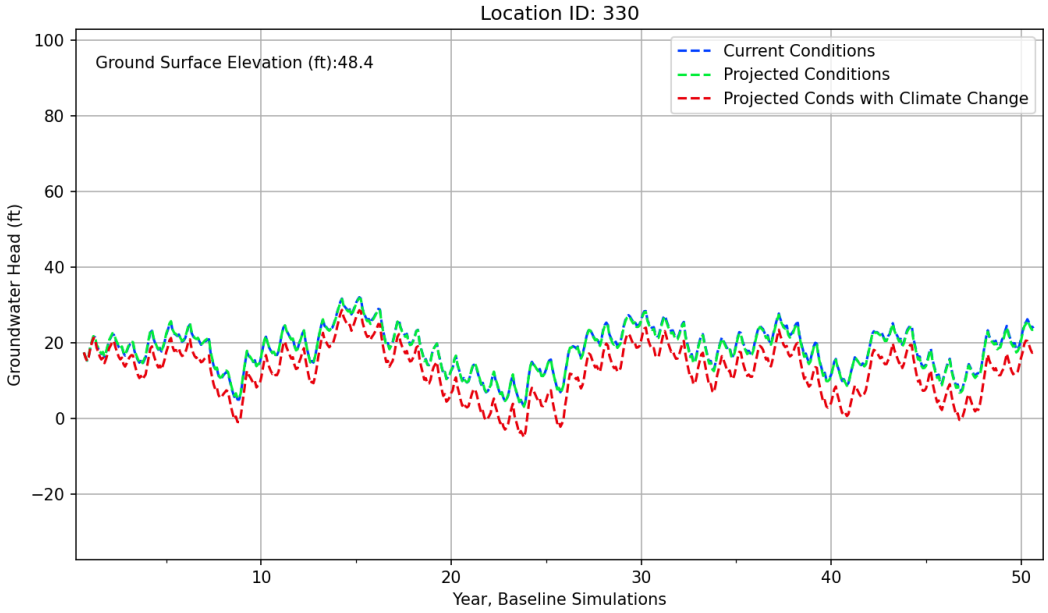
Projected Conditions Baseline Groundwater Budget Summary, Annual Average over 50-year Simulation							
Subregion	**Description**	**Deep Percolation**	**Gain from Stream**	**Recharge (Recoverable Loss)**	**Boundary Inflow**	**Net Subsurface Inflow**	**Pumping**
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
North American Subbasin							
1	Camp Far West ID	6,456	-4,691	651	2,549	603	5,560
2	Sutter Co. 1	312	63	0	1,246	-991	629
3	South Sutter WD GSA	54,699	31,313	10,625	4,579	13,738	114,443
4	Placer County WA	27,668	2,366	898	1,539	912	30,955
5	Nevada ID	6,315	702	1,257	4,345	-9,688	2,499
6	Lincoln	5,087	561	0	504	-3,418	1,187
7	RD1001	16,677	6,369	1,148	-40	-3,119	20,921
8	Pleasant Grove Verona MWC	5,152	5,551	1,384	0	376	12,414
9	Sutter Co. 2	1,351	116	141	1,340	-899	2,098
10	Natomas MWC (Sutter Co.)	4,579	8,640	130	70	1,220	15,205
11	Sutter Co. 3	1,690	1,136	0	0	4,552	7,667
12	Roseville SOI	1,244	1,143	0	0	-177	2,198
13	City of Roseville	5,939	5,388	2,108	2,758	-11,668	1,874
14	Cal Am (West Placer)	2,555	4,419	0	0	-1,515	5,327
15	Natomas MWC (Sacramento Co.)	6,500	-1,579	218	3,491	-2,793	6,635
16	Sacramento International Airport	737	0	0	0	-67	803
17	Metro Air Park	477	0	0	0	-525	52
18	Sac Co. 1	728	-2,650	0	4,361	-1,872	611
19	Sac Co. 2	113	2,768	0	0	-1,490	1,451
20	Sac County WA (Northgate 880)	61	656	0	0	877	1,614
21	Rio Linda Elverta	1,974	6,391	0	0	3,372	11,959
22	Sac Co. 3	95	818	0	0	-582	330
23	Cal Am (Antelope)	590	684	0	0	2,881	4,111
24	Cal Am (Lincoln Oaks)	490	0	0	0	5,224	5,562
25	Citrus Heights WD	1,712	0	0	460	-775	1,125
26	San Juan WD (Placer Co.)	461	0	0	1,566	-2,125	0
27	San Juan WD (Sacramento Co.)	662	-577	0	825	-879	89
28	Orange Vale WC	1,240	0	0	0	-946	277
29	Lake Natoma/Mississippi Bar	1,590	-5,522	0	34	4,002	97
30	Fair Oaks WD	2,921	6,048	0	0	-5,354	3,598
31	Carmichael WD	1,117	6,445	0	0	-3,261	4,342
32	Sacramento Suburban WD (North)	2,849	50	0	0	14,001	16,878
33	Sacramento Suburuban WD (South)	919	7,507	0	0	7,330	15,864
34	Del Paso Manor WD	67	0	0	0	1,134	1,214
35	Golden State WC Arden	33	0	0	0	757	800
36	Cal Am (Arden)	75	0	0	0	1,042	1,123
37	Sac County WA (Arden Park	194	1,061	0	0	1,949	3,227
38	City of Sacramento (North)	3,884	19,364	0	861	-3,804	20,646
Total NASb		169,212	104,540	18,560	30,488	8,023	325,385
South American Subbasin							
39	City of Sacramento (South)	17,819	18,440	0	1,275	-17,061	21,111
40	Cal Am (Suburban Rosemont)	1,969	7,265	0	0	2,923	12,392
41	Sac Co. 4	286	2,902	0	0	-3,168	25
42	Golden State WC (Cordova)	7,385	14,630	0	0	-1,909	20,280
43	Sac Co. 5	1,519	0	0	0	4,664	6,245
44	City of Folsom	14,874	-2,446	0	2,155	-11,968	2,475
45	Cal Am (Security Park)	1,422	38	0	0	-1,297	239
46	Fruitridge Vista WC	358	278	0	0	1,519	2,191
47	Florin County WD	160	0	0	0	2,049	2,278
48	Cal Am (Parkway)	1,228	359	0	0	12,848	14,625
49	Sac Co. 6	969	4,316	0	279	-5,357	196
50	Sac County WA (North/Central)	13,944	4,021	209	0	9,034	28,197
51	Sac County WA (South)	3,114	213	0	0	14,449	17,670
52	Elk Grove WD (2 - Intertie Service Area)	1,318	1,192	0	0	2,960	5,497
53	Elk Grove WD (1 - GW Service Area)	404	668	0	0	5,579	6,664
54	Cosumnes River West	21,470	11,391	0	0	17,120	49,774
55	RD744	837	7,064	0	-709	-6,460	679
56	Franklin Drainage District	3,404	6,558	0	-180	-5,152	4,401
57	RD813	1,594	3,174	0	-82	-3,167	1,433
58	RD755	552	1,417	0	-252	-1,170	521
59	RD1002	3,061	0	0	0	-263	2,739
60	RD551	8,756	6,090	0	-1,426	-7,399	5,800
61	RD369	433	2,014	0	-205	-2,088	141
62	RD2110	746	-769	0	512	-143	331
63	Sac Co. 7	359	1,322	0	29	-1,427	279
64	Rancho Murieta (North)	4,871	-2,372	0	0	-1,756	615
65	Sloughouse RCD (North)	4,881	-339	0	3,948	-5,913	2,346
66	OHWD (Sth American Subbasin)	11,612	15,651	26	64	-2,214	25,095
Total SASb		129,345	103,077	235	5,407	-4,767	234,238
Cosumnes Subbasin							
67	OHWD (Cosumnes Subbasin)	5,622	5,276	0	0	-4,737	6,182
68	Rancho Murieta (South)	1,109	-2,126	0	0	1,030	15
69	Sloughouse RCD (East)	23,465	3,320	0	1,183	-7,361	21,321
70	Wilton	4,980	48	0	0	4,283	9,492
71	Sloughouse RCD (West)	4,052	371	0	0	4,557	9,096
72	Galt ID (East)	19,433	1,984	0	0	22,831	44,622
73	Clay WD	3,489	1,187	0	0	2,414	7,237
74	Clay	1,108	3	0	0	812	2,011
75	SMUD Rancho Seco	490	0	0	0	-509	50
76	Cosumnes River South	4,753	9,573	0	-546	-5,472	8,292
77	Galt ID (West)	2,440	791	0	0	1,627	4,854
78	Sac Co. 8	4,095	8,071	0	0	-7,133	5,092
79	City of Galt	1,448	680	0	0	5,597	7,737
80	Sloughouse RCD (South)	856	1,005	0	0	-871	983
81	Amador Co. 1	13,634	-6,968	0	4,477	-9,790	858
82	Ione	1,279	0	0	0	-1,040	0
83	Jackson ID	8,806	-6,733	0	538	-2,539	17
84	Camanche	5,208	0	0	-4,112	-1,224	94
85	Amador County WA	1,396	0	0	6	-1,094	379
87	Galt WWTP	316	0	0	0	-318	0
Total CoSb		107,977	16,481	0	1,547	1,063	128,332
Other							
86	Mokelumne	30,691	51,342	0	2,032	-4,319	80,214
Total Other		30,691	51,342	0	2,032	-4,319	80,214
CoSANA Total (NASb, SASb, CoSb)		406,534	224,098	18,795	37,442	4,319	687,954

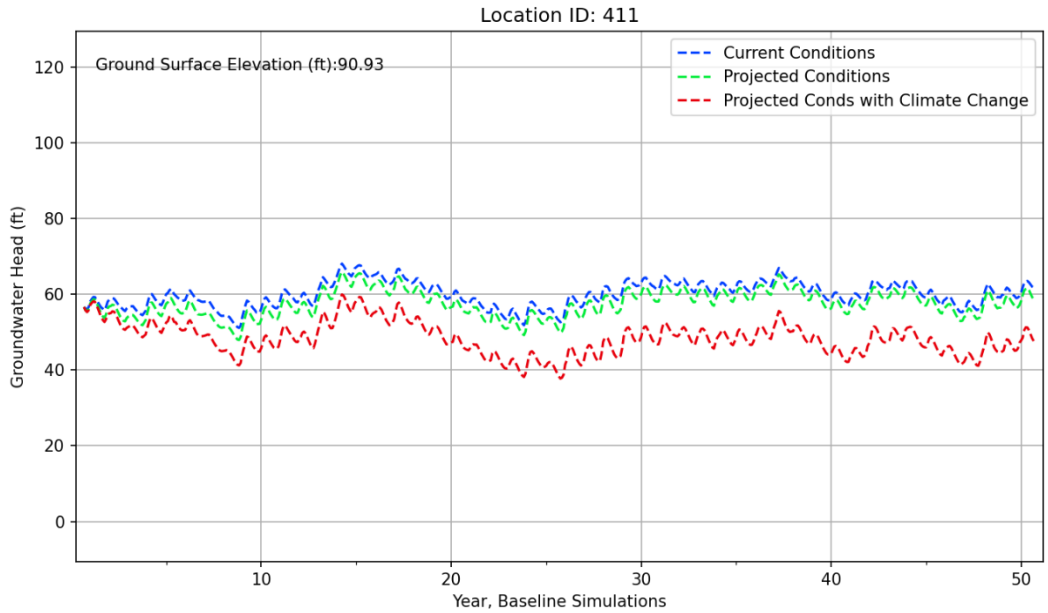
Projected Conditions Baseline with Climate Change Groundwater Budget Summary, Annual Average over 50-year Simulation							
Subregion	**Description**	**Deep Percolation**	**Gain from Stream**	**Recharge (Recoverable Loss)**	**Boundary Inflow**	**Net Subsurface Inflow**	**Pumping**
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
North American Subbasin							
1	Camp Far West ID	6,384	-3,554	651	2,802	-206	6,080
2	Sutter Co. 1	309	228	0	1,320	-1,184	673
3	South Sutter WD GSA	53,890	37,614	10,623	4,994	17,602	126,237
4	Placer County WA	26,028	2,902	898	1,483	2,003	33,355
5	Nevada ID	6,157	732	1,257	4,278	-9,411	2,892
6	Lincoln	4,928	664	0	483	-3,730	1,193
7	RD1001	16,409	7,802	1,148	1,380	-3,857	22,843
8	Pleasant Grove Verona MWC	5,050	8,165	1,384	0	-773	13,840
9	Sutter Co. 2	1,311	372	142	1,545	-1,108	2,321
10	Natomas MWC (Sutter Co.)	4,513	9,390	139	79	313	15,205
11	Sutter Co. 3	1,613	1,126	0	0	4,776	7,972
12	Roseville SOI	1,193	1,131	0	0	-155	2,345
13	City of Roseville	5,481	5,491	2,108	2,677	-12,114	1,877
14	Cal Am (West Placer)	2,330	4,464	0	0	-1,276	5,799
15	Natomas MWC (Sacramento Co.)	6,269	-1,584	234	3,962	-3,219	6,644
16	Sacramento International Airport	685	0	0	0	-33	812
17	Metro Air Park	426	0	0	0	-492	52
18	Sac Co. 1	671	-2,612	0	4,558	-2,055	616
19	Sac Co. 2	96	2,742	0	0	-1,480	1,455
20	Sac County WA (Northgate 880)	56	663	0	0	866	1,614
21	Rio Linda Elverta	1,708	6,397	0	0	3,469	12,029
22	Sac Co. 3	88	827	0	0	-595	341
23	Cal Am (Antelope)	520	691	0	0	2,870	4,111
24	Cal Am (Lincoln Oaks)	442	0	0	0	5,186	5,564
25	Citrus Heights WD	1,558	0	0	438	-737	1,130
26	San Juan WD (Placer Co.)	431	0	0	1,460	-2,016	0
27	San Juan WD (Sacramento Co.)	618	-548	0	772	-823	97
28	Orange Vale WC	1,193	0	0	0	-926	294
29	Lake Natoma/Mississippi Bar	1,600	-5,291	0	34	3,762	98
30	Fair Oaks WD	2,761	6,285	0	0	-5,475	3,615
31	Carmichael WD	1,024	6,582	0	0	-3,363	4,342
32	Sacramento Suburban WD (North)	2,480	50	0	0	14,128	16,883
33	Sacramento Suburuban WD (South)	797	7,717	0	0	7,148	15,864
34	Del Paso Manor WD	58	0	0	0	1,134	1,214
35	Golden State WC Arden	29	0	0	0	756	800
36	Cal Am (Arden)	66	0	0	0	1,045	1,123
37	Sac County WA (Arden Park	163	1,101	0	0	1,925	3,227
38	City of Sacramento (North)	3,413	19,844	0	990	-4,170	20,664
Total NASb		162,749	119,391	18,585	33,255	7,782	345,219
South American Subbasin							
39	City of Sacramento (South)	16,708	19,971	0	1,635	-18,250	21,113
40	Cal Am (Suburban Rosemont)	1,758	7,462	0	0	2,813	12,402
41	Sac Co. 4	266	2,940	0	0	-3,188	27
42	Golden State WC (Cordova)	7,090	14,997	0	0	-2,062	20,282
43	Sac Co. 5	1,478	0	0	0	4,683	6,245
44	City of Folsom	14,446	-2,148	0	2,013	-11,789	2,475
45	Cal Am (Security Park)	1,391	38	0	0	-1,303	239
46	Fruitridge Vista WC	311	278	0	0	1,542	2,191
47	Florin County WD	136	0	0	0	2,038	2,278
48	Cal Am (Parkway)	1,051	359	0	0	12,906	14,625
49	Sac Co. 6	913	5,011	0	302	-5,991	250
50	Sac County WA (North/Central)	13,021	4,022	209	0	9,027	28,605
51	Sac County WA (South)	2,803	213	0	0	14,509	17,786
52	Elk Grove WD (2 - Intertie Service Area)	1,193	1,192	0	0	2,963	5,605
53	Elk Grove WD (1 - GW Service Area)	352	668	0	0	5,513	6,664
54	Cosumnes River West	20,558	12,903	0	0	20,076	54,127
55	RD744	770	7,865	0	-605	-7,101	882
56	Franklin Drainage District	3,213	7,420	0	-49	-5,292	5,172
57	RD813	1,478	3,923	0	44	-3,524	1,867
58	RD755	522	1,961	0	-127	-1,689	644
59	RD1002	2,885	0	0	0	647	3,552
60	RD551	8,342	8,551	0	-968	-8,129	7,658
61	RD369	395	2,387	0	-141	-2,459	173
62	RD2110	667	-80	0	647	-765	460
63	Sac Co. 7	316	1,758	0	59	-1,807	334
64	Rancho Murieta (North)	4,788	-2,129	0	0	-1,887	658
65	Sloughouse RCD (North)	4,624	217	0	3,782	-6,084	2,473
66	OHWD (Sth American Subbasin)	11,032	15,967	26	60	-633	27,200
Total SASb		122,508	115,747	235	6,653	-5,232	245,986
Cosumnes Subbasin							
67	OHWD (Cosumnes Subbasin)	5,341	5,815	0	0	-4,966	6,623
68	Rancho Murieta (South)	1,095	-2,043	0	0	958	16
69	Sloughouse RCD (East)	21,910	3,688	0	1,094	-6,550	23,246
70	Wilton	4,623	45	0	0	4,353	9,809
71	Sloughouse RCD (West)	3,778	409	0	0	4,969	9,934
72	Galt ID (East)	18,352	1,928	0	0	24,803	47,573
73	Clay WD	3,368	1,112	0	0	2,873	7,886
74	Clay	977	3	0	0	744	2,040
75	SMUD Rancho Seco	448	0	0	0	-594	54
76	Cosumnes River South	4,481	11,014	0	-404	-6,143	9,084
77	Galt ID (West)	2,241	767	0	0	2,072	5,230
78	Sac Co. 8	3,795	8,781	0	0	-7,484	5,517
79	City of Galt	1,277	659	0	0	5,614	7,742
80	Sloughouse RCD (South)	777	974	0	0	-790	1,065
81	Amador Co. 1	13,068	-6,388	0	4,209	-9,703	968
82	Ione	1,194	0	0	0	-1,002	0
83	Jackson ID	8,289	-6,033	0	485	-2,765	17
84	Camanche	4,849	0	0	-3,840	-1,251	94
85	Amador County WA	1,316	0	0	7	-1,046	379
87	Galt WWTP	311	0	0	0	-330	0
Total CoSb		101,490	20,732	0	1,552	3,763	137,276
Other							
86	Mokelumne	27,801	53,146	0	9,567	-6,313	87,852
Total Other		27,801	53,146	0	9,567	-6,313	87,852
CoSANA Total (NASb, SASb, CoSb)		386,746	255,871	18,820	41,460	6,313	728,482

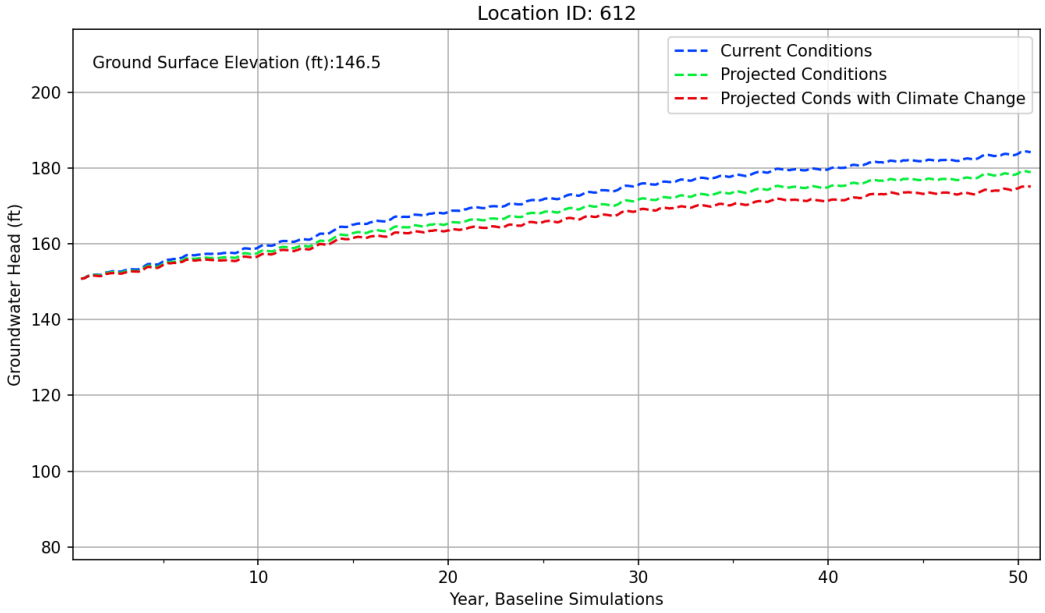
APPENDIX J: BASELINE CONDITIONS SAMPLE HYDROGRAPHS

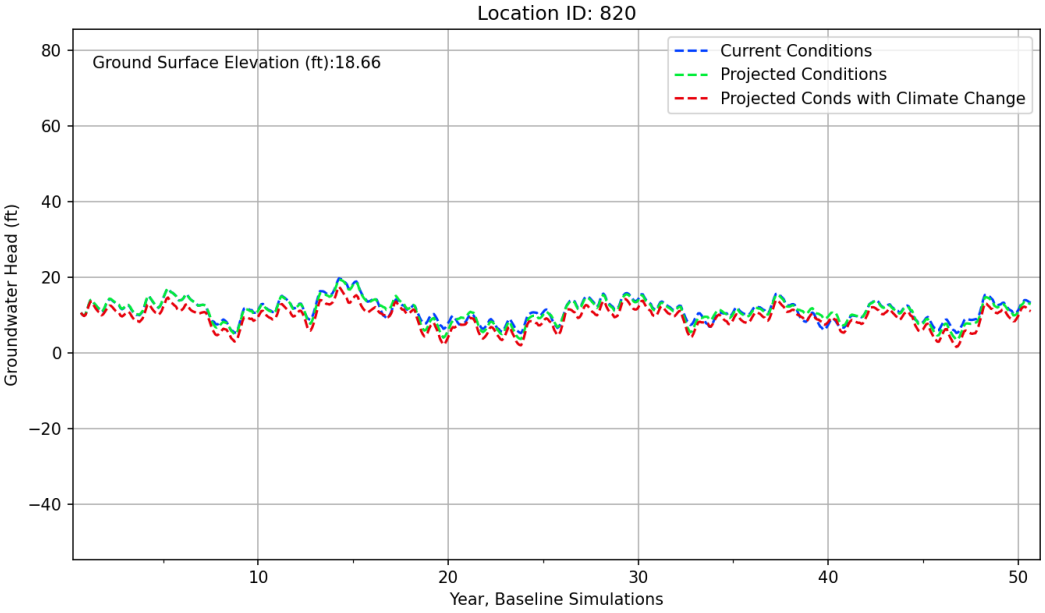
Note: *Simulated values represent the layers screened at that well, except for 7223 and 7224 which do not have screen interval information.*

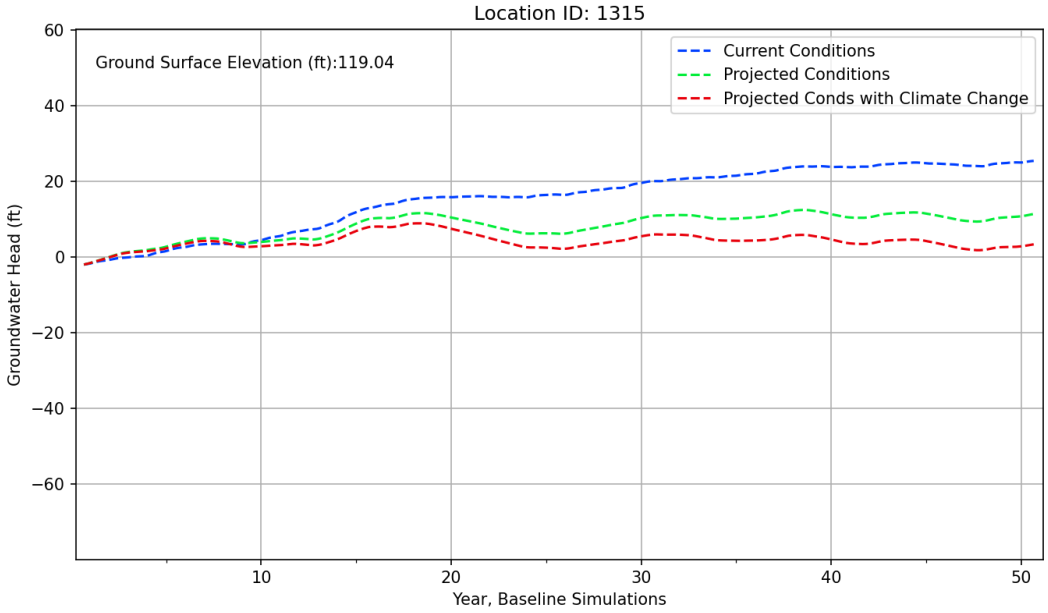


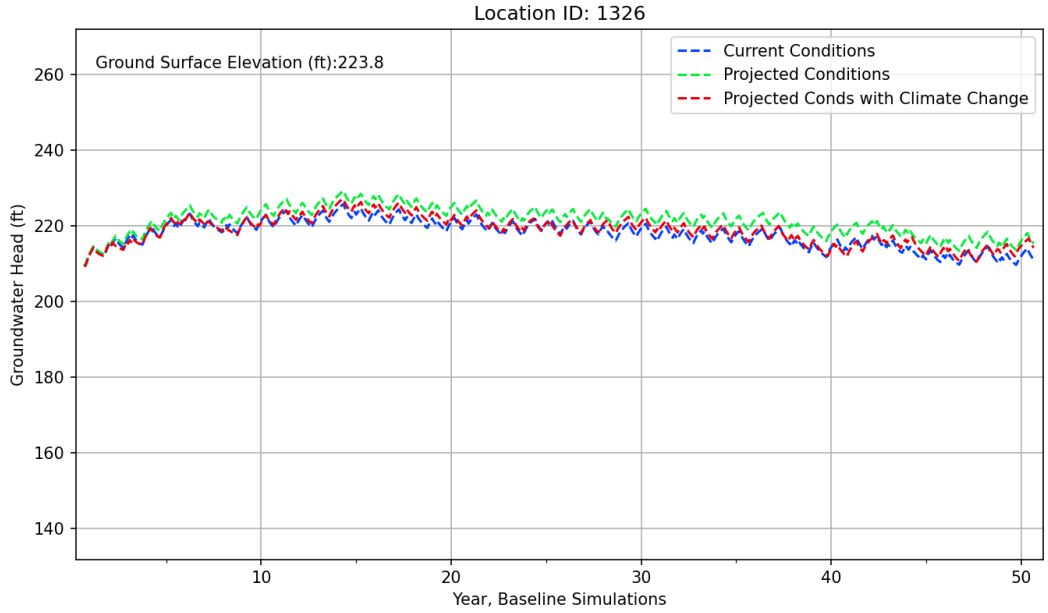

Location ID: 330
Ground Surface Elevation (ft):48.4
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
100
80
60
40
20
0
−20
10
20
30
40
50
Year, Baseline Simulations

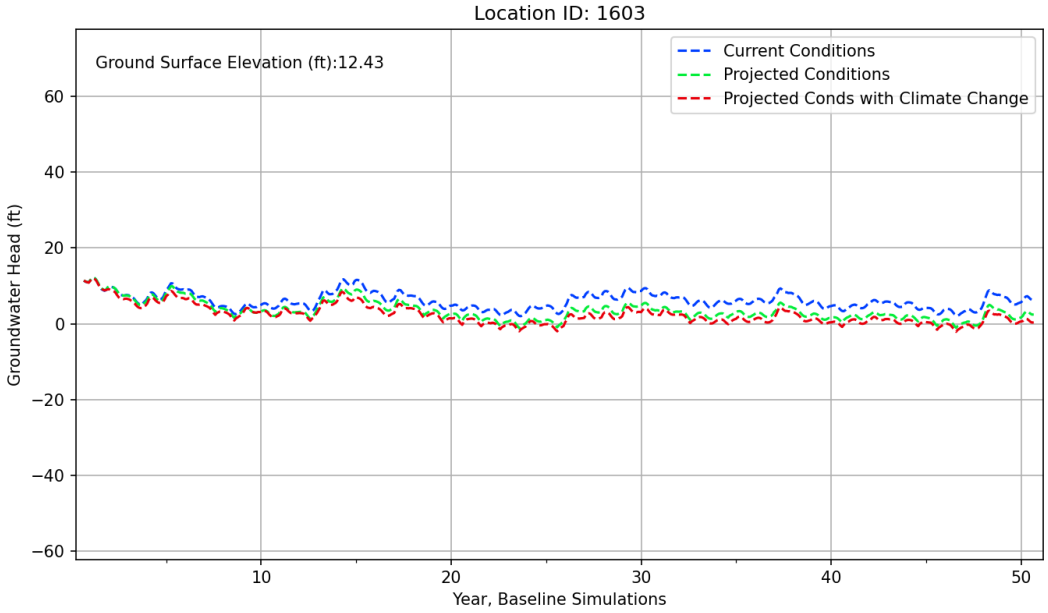

Location ID: 411
Ground Surface Elevation (ft):90.93
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
120
100
80
60
40
20
0
10
20
30
40
50
Year, Baseline Simulations

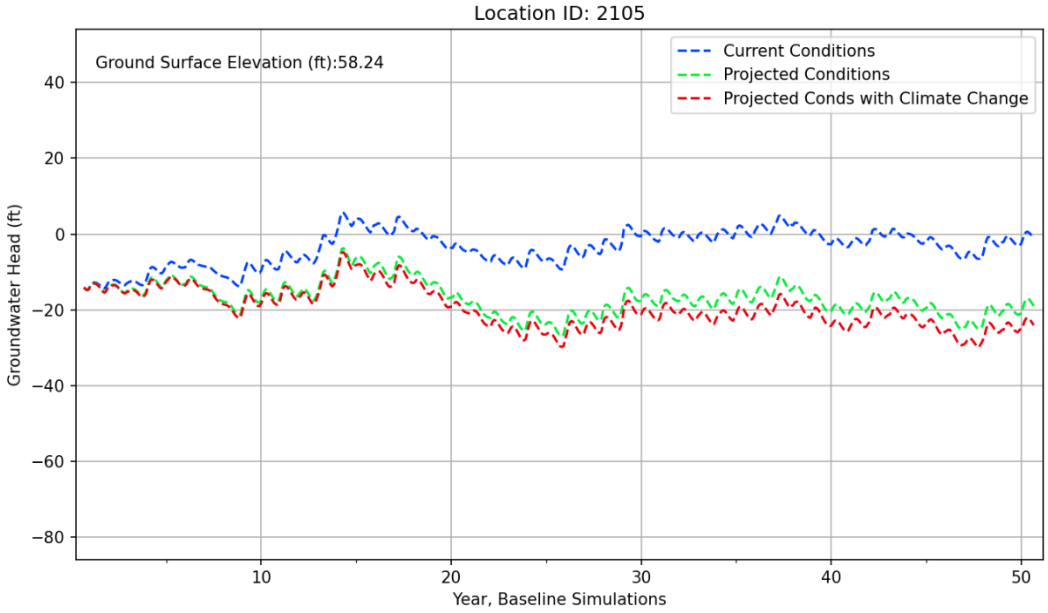

Location ID: 612
Ground Surface Elevation (ft):146.5
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
200
180
160
140
120
100
80
10
20
30
40
50
Year, Baseline Simulations

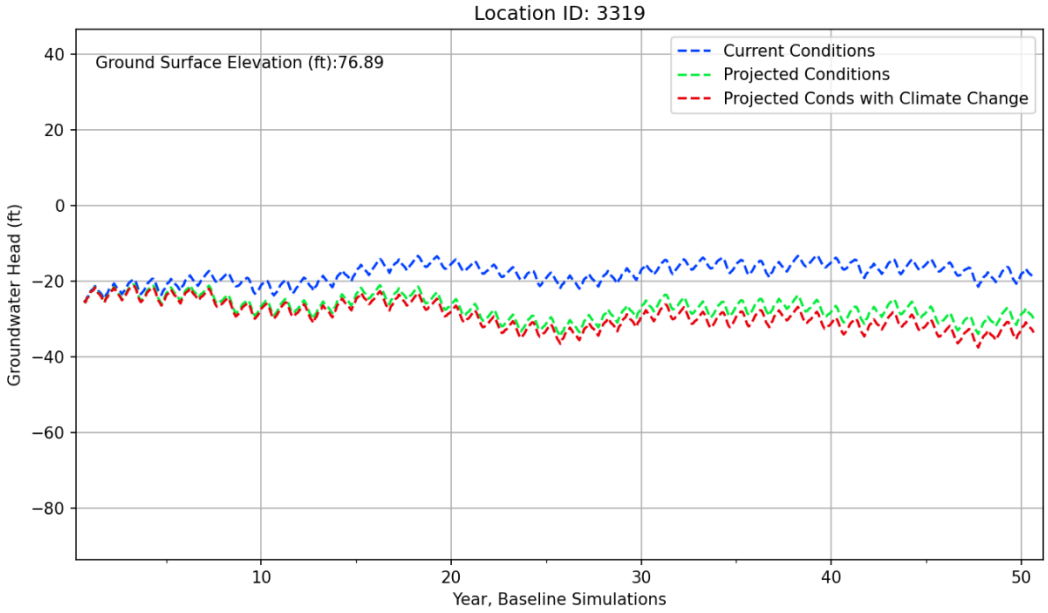

Location ID: 820
Ground Surface Elevation (ft):18.66
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
80
60
40
20
0
−20
−40
10
20
30
40
50
Year, Baseline Simulations

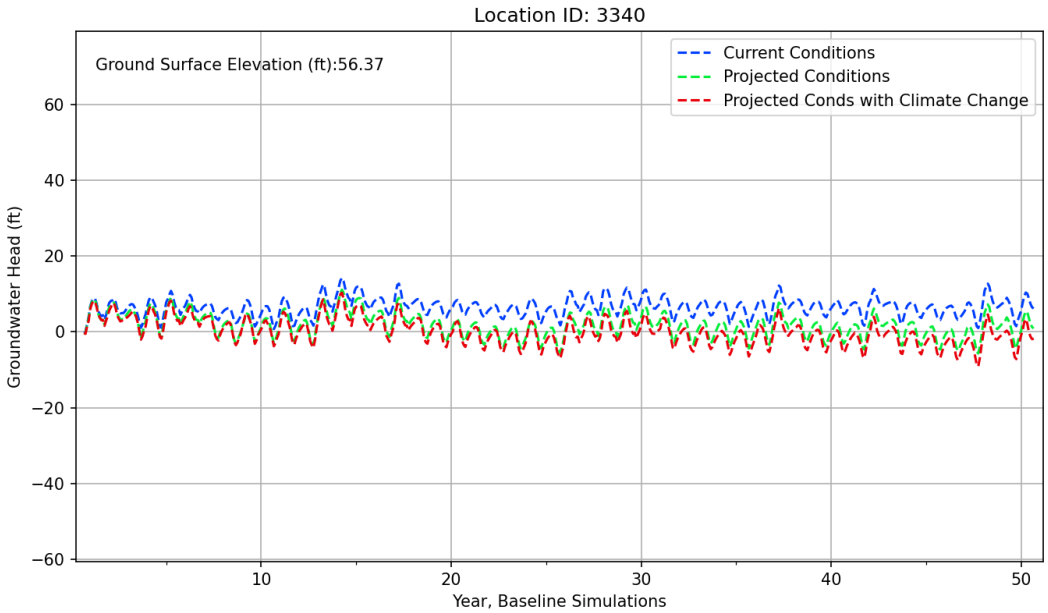

Location ID: 1315
Ground Surface Elevation (ft):119.04
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

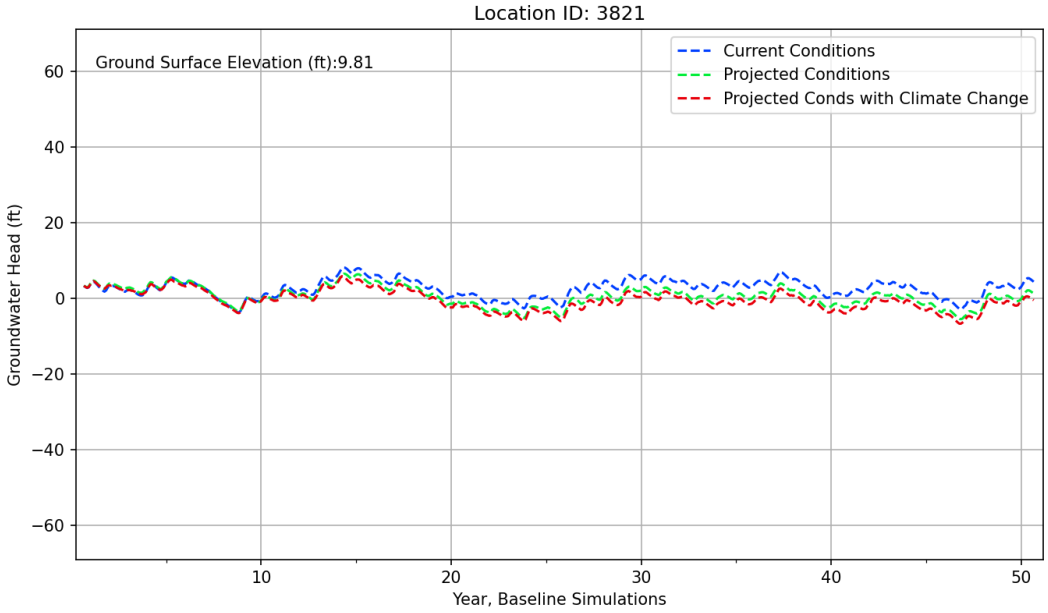

Location ID: 1326
Ground Surface Elevation (ft):223.8
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
260
240
220
200
180
160
140
10
20
30
40
50
Year, Baseline Simulations

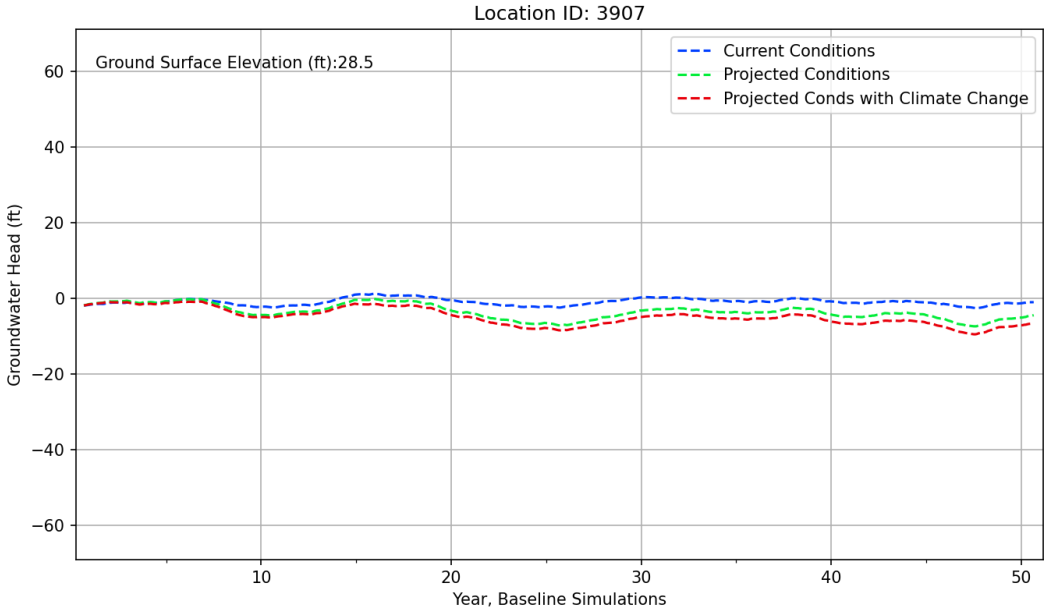

Location ID: 1603
Ground Surface Elevation (ft):12.43
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

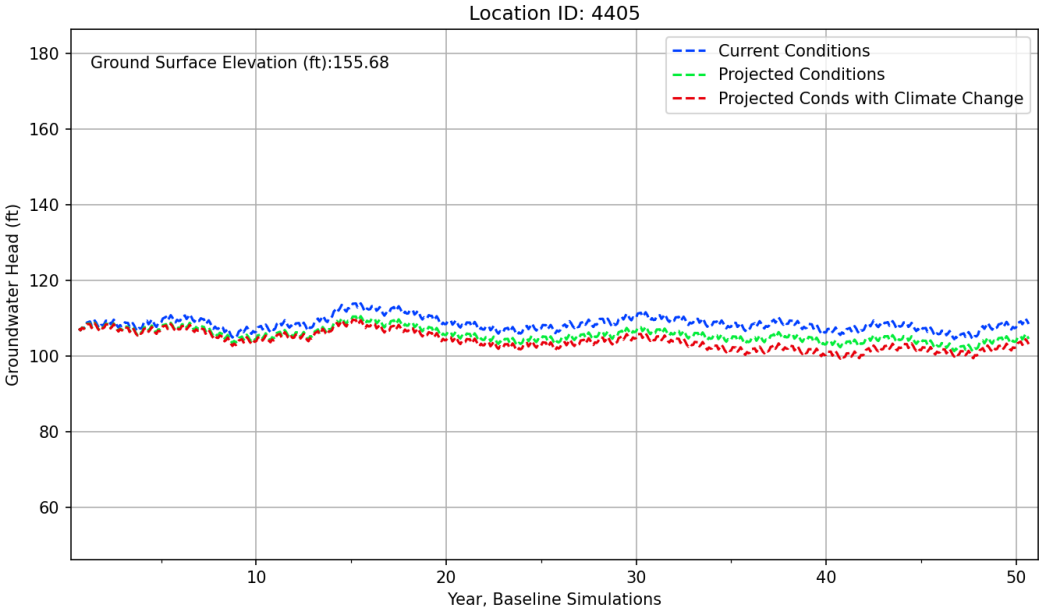

Location ID: 2105
Ground Surface Elevation (ft):58.24
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations

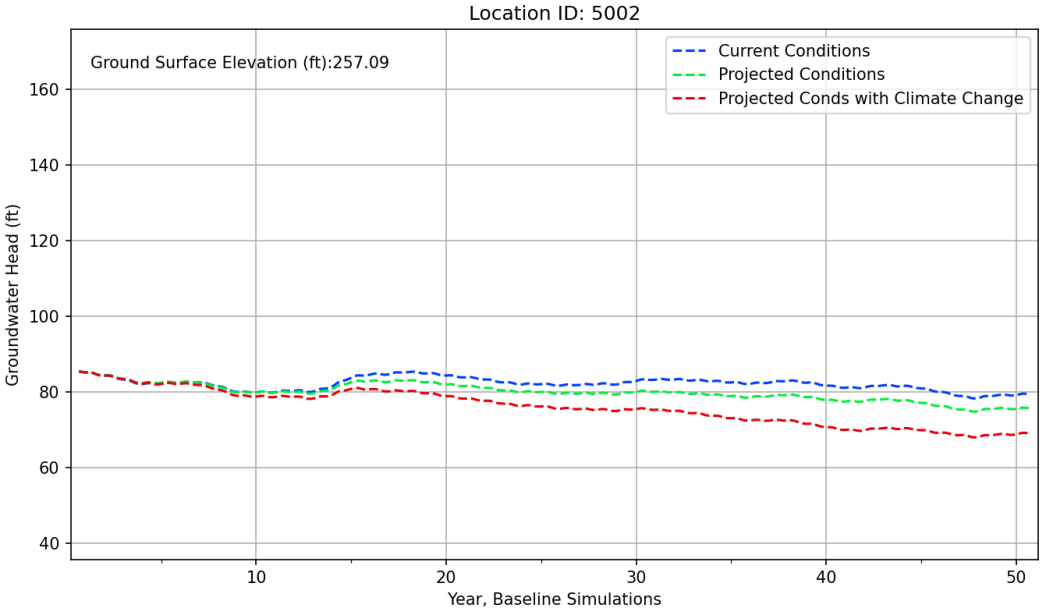

Location ID: 3319
Ground Surface Elevation (ft):76.89
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations

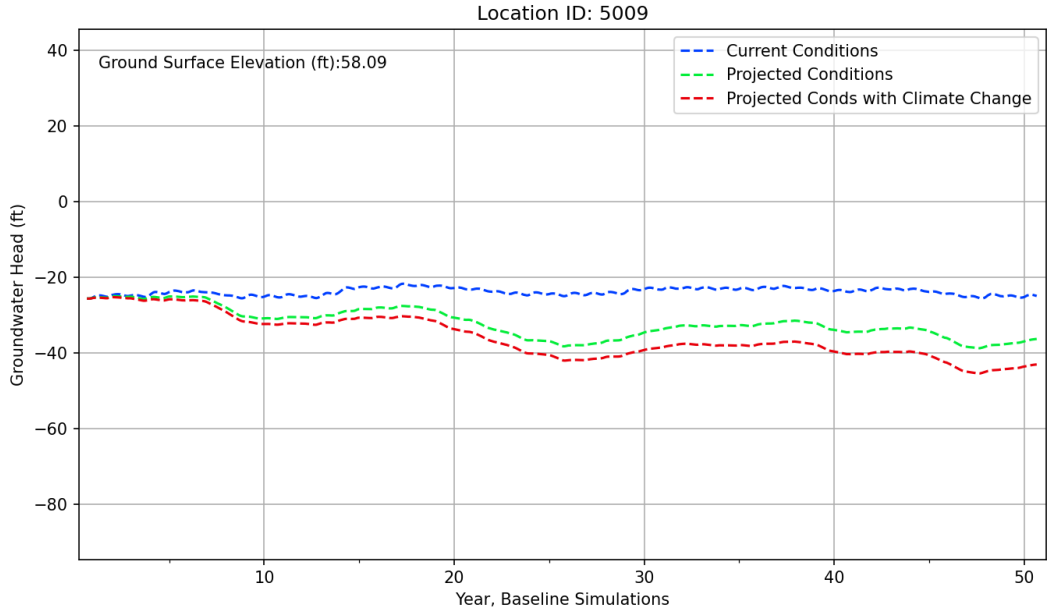

Location ID: 3340
Ground Surface Elevation (ft):56.37
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

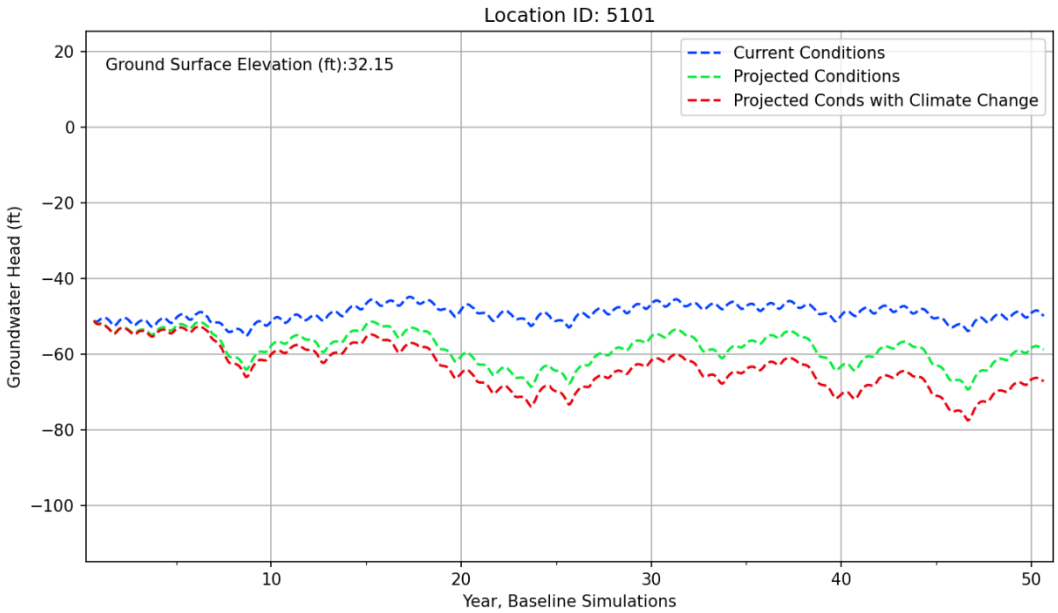

Location ID: 3821
Ground Surface Elevation (ft):9.81
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

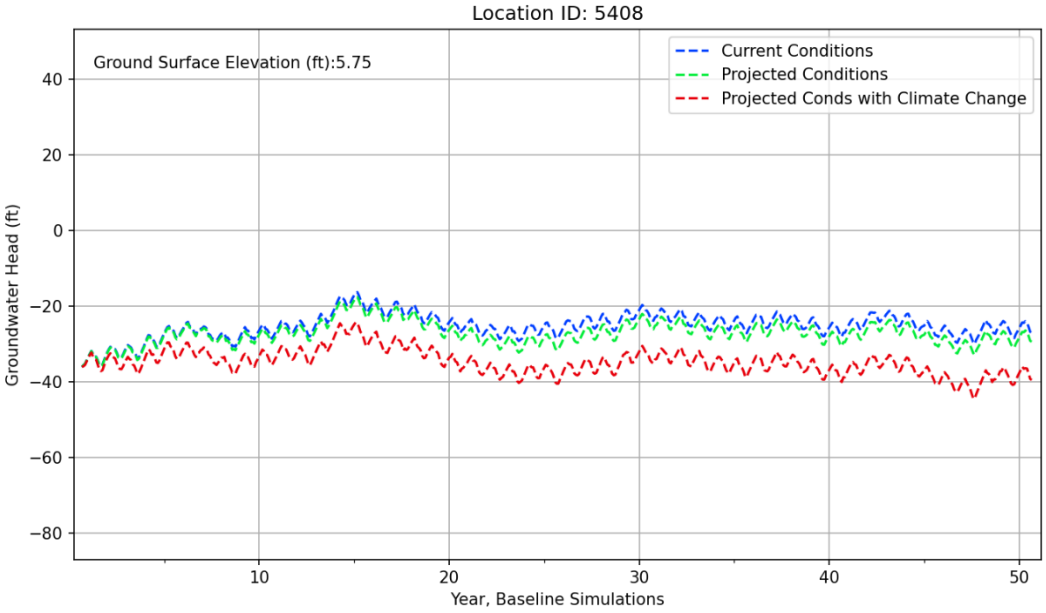

Location ID: 3907
Ground Surface Elevation (ft):28.5
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

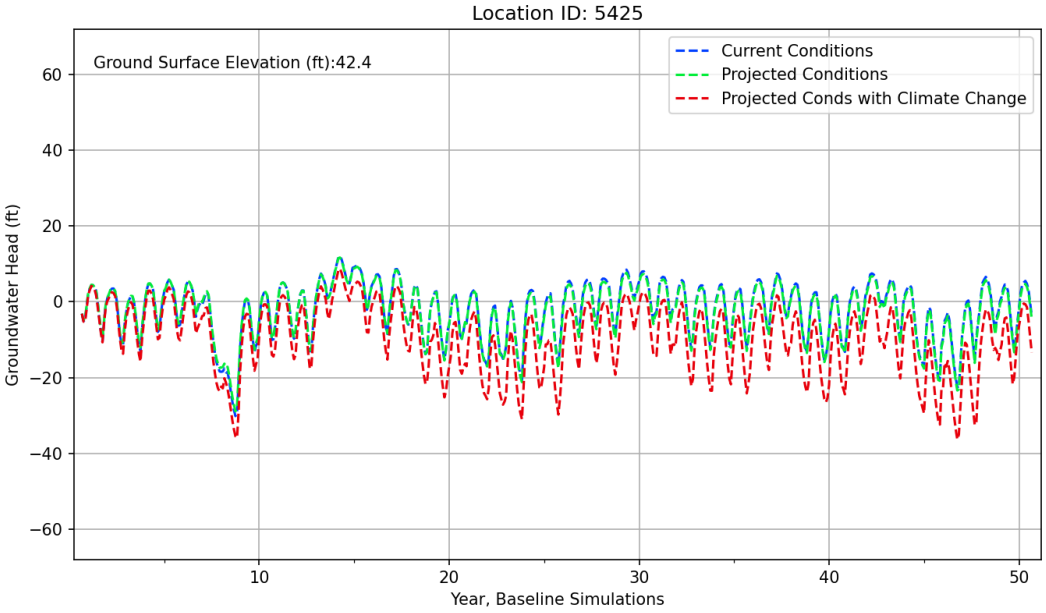

Location ID: 4405
Ground Surface Elevation (ft):155.68
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
180
160
140
120
100
80
60
10
20
30
40
50
Year, Baseline Simulations

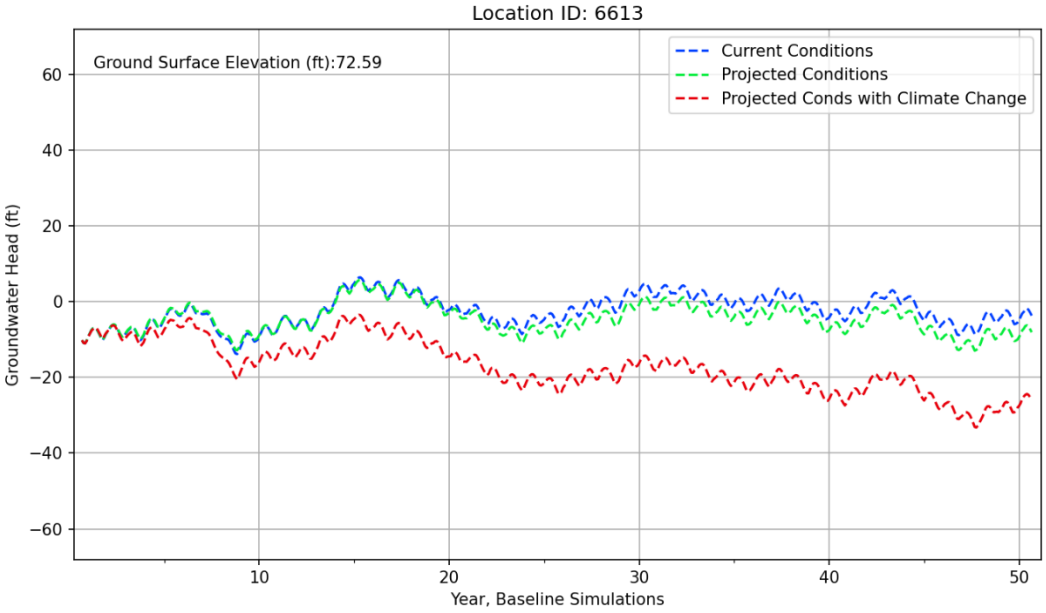

Location ID: 5002
Ground Surface Elevation (ft):257.09
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
160
140
120
100
80
60
40
10
20
30
40
50
Year, Baseline Simulations

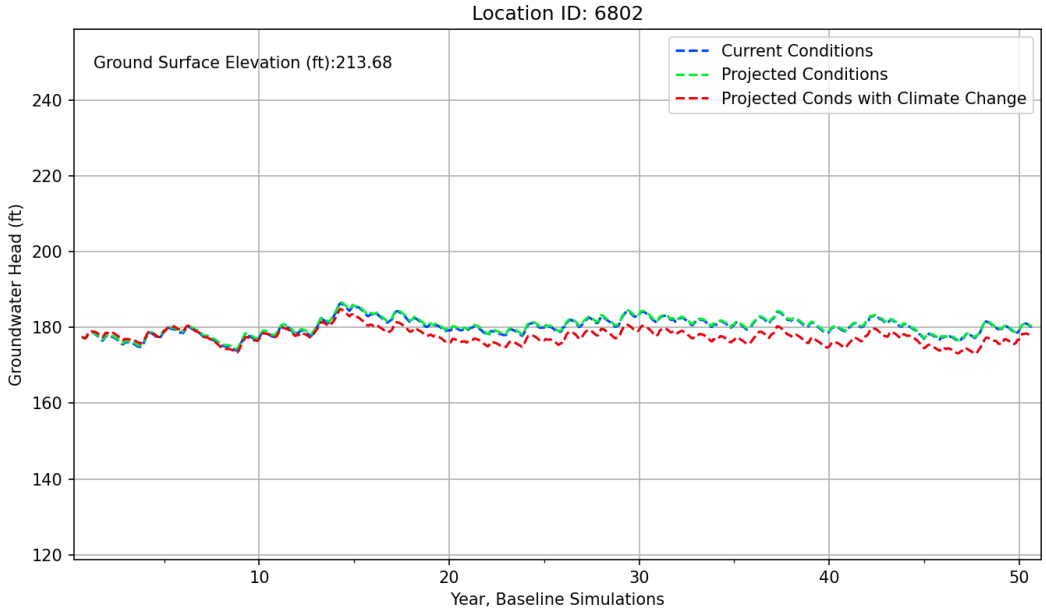

Location ID: 5009
Ground Surface Elevation (ft):58.09
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations

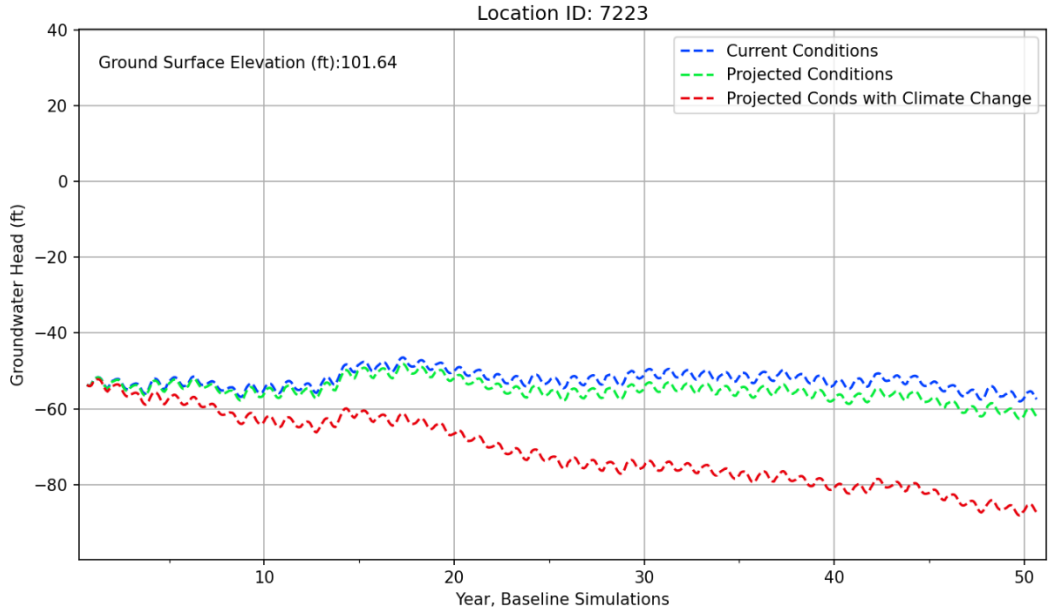

Location ID: 5101
Ground Surface Elevation (ft):32.15
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
20
0
−20
−40
−60
−80
−100
10
20
30
40
50
Year, Baseline Simulations

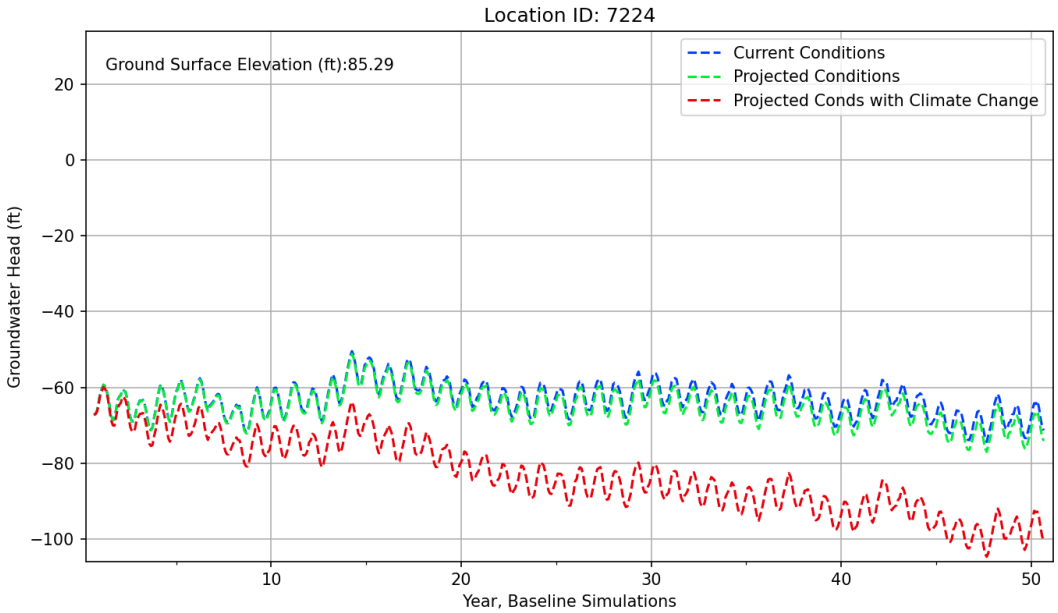

Location ID: 5408
Ground Surface Elevation (ft):5.75
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations

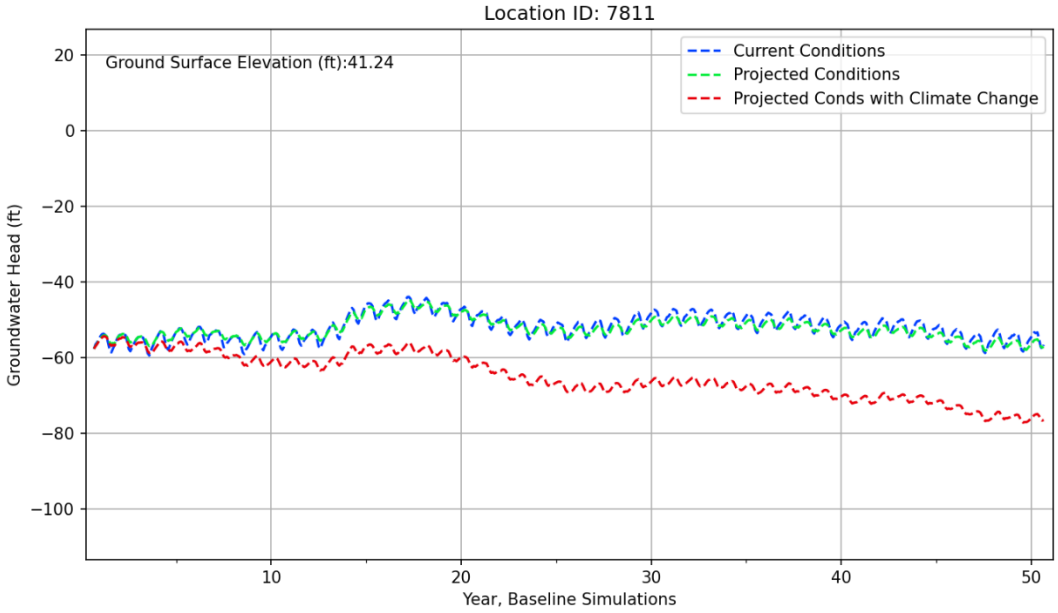

Location ID: 5425
Ground Surface Elevation (ft):42.4
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

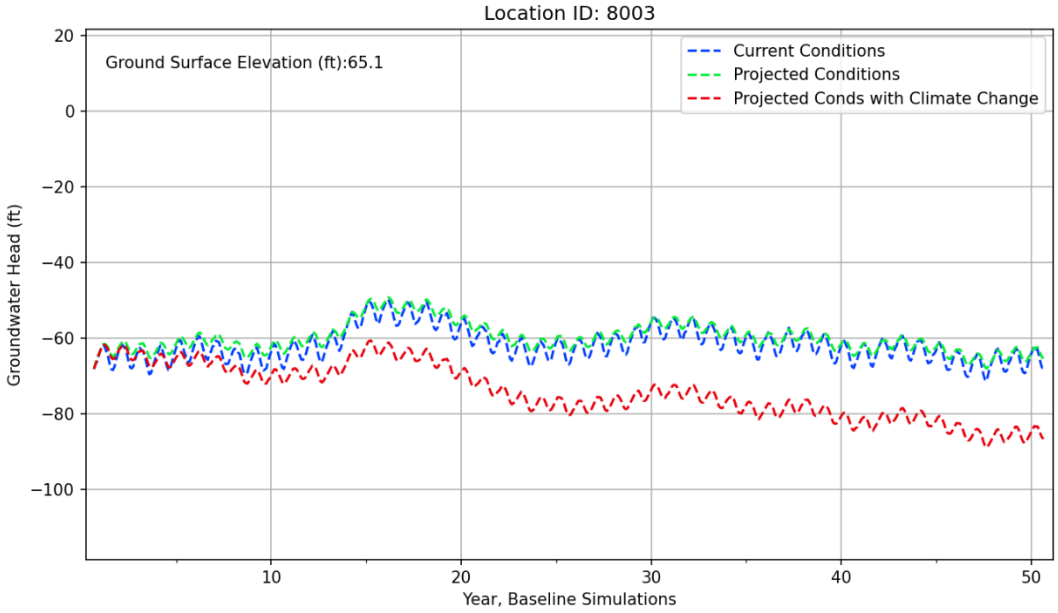

Location ID: 6613
Ground Surface Elevation (ft):72.59
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

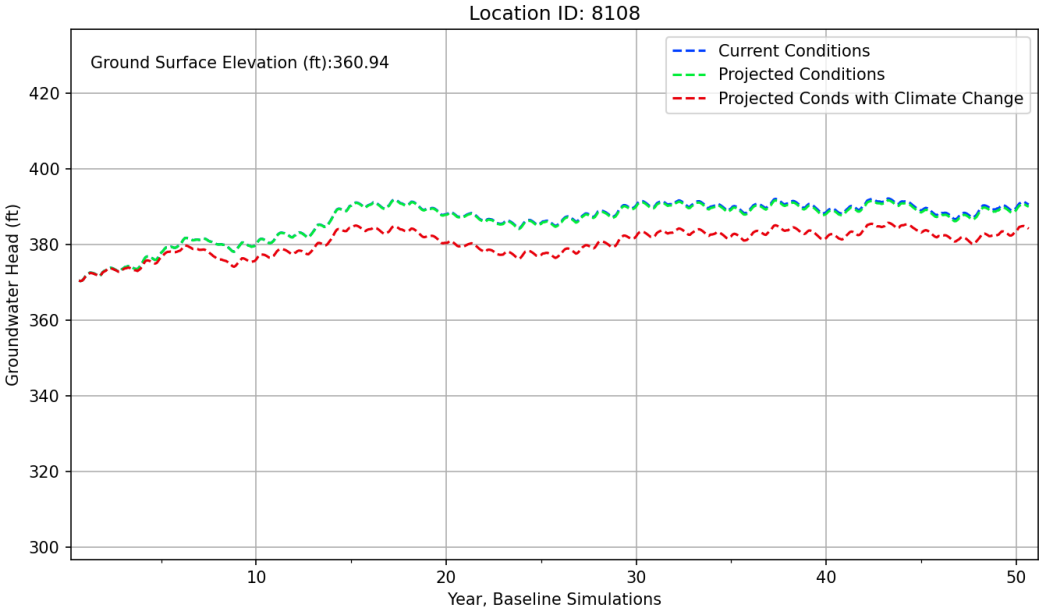

Location ID: 6802
Ground Surface Elevation (ft):213.68
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
240
220
200
180
160
140
120
10
20
30
40
50
Year, Baseline Simulations

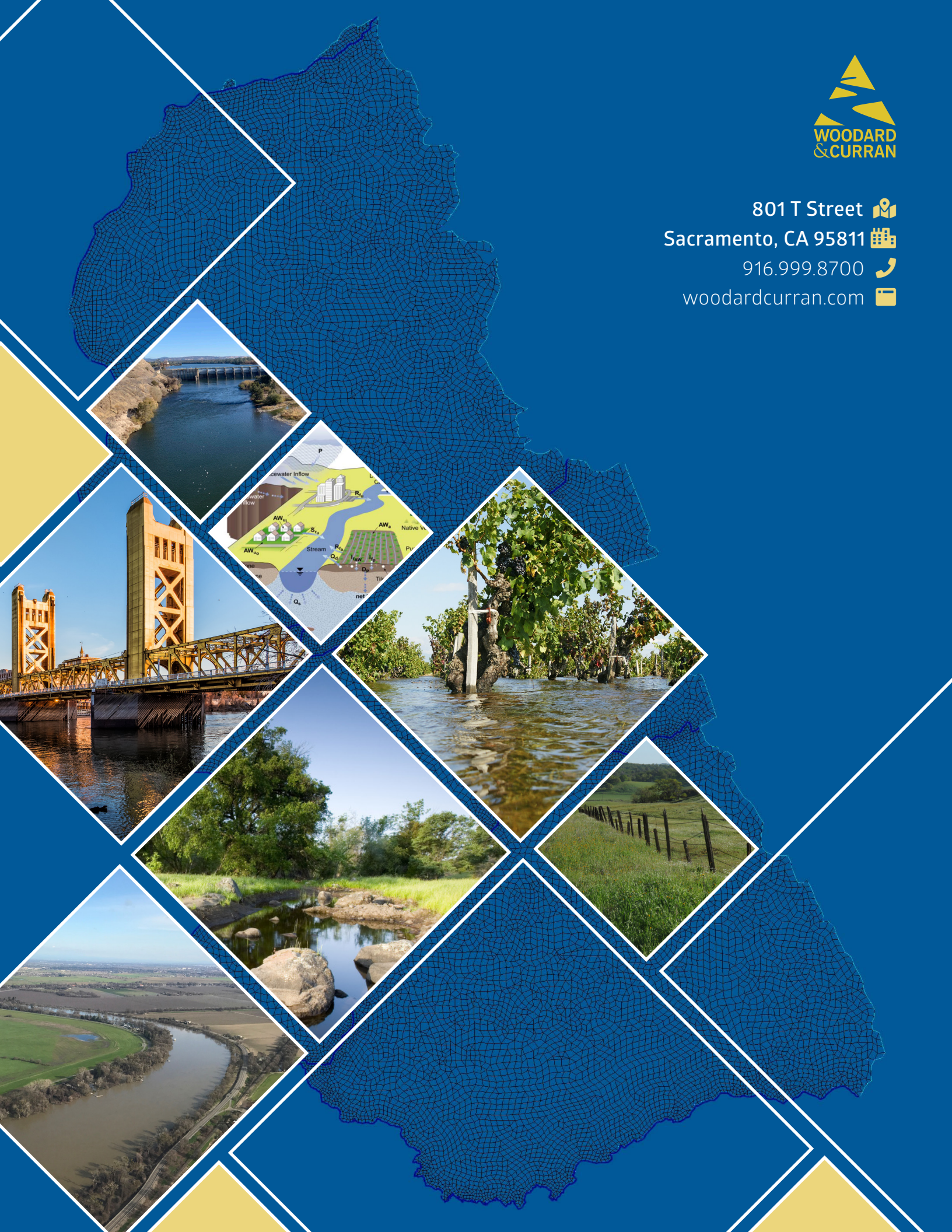

Location ID: 7223
Ground Surface Elevation (ft):101.64
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations


Location ID: 7224
Ground Surface Elevation (ft):85.29
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
20
0
−20
−40
−60
−80
−100
10
20
30
40
50
Year, Baseline Simulations


Location ID: 7811
Ground Surface Elevation (ft):41.24
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
20
0
−20
−40
−60
−80
−100
10
20
30
40
50
Year, Baseline Simulations


Location ID: 8003
Ground Surface Elevation (ft):65.1
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
20
0
−20
−40
−60
−80
−100
10
20
30
40
50
Year, Baseline Simulations


Location ID: 8108
Ground Surface Elevation (ft):360.94
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
420
400
380
360
340
320
300
10
20
30
40
50
Year, Baseline Simulations



801 T Street
Sacramento, CA 95811
916.999.8700
woodardcurran.com

Appendix Q: SMC Hydrographs

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

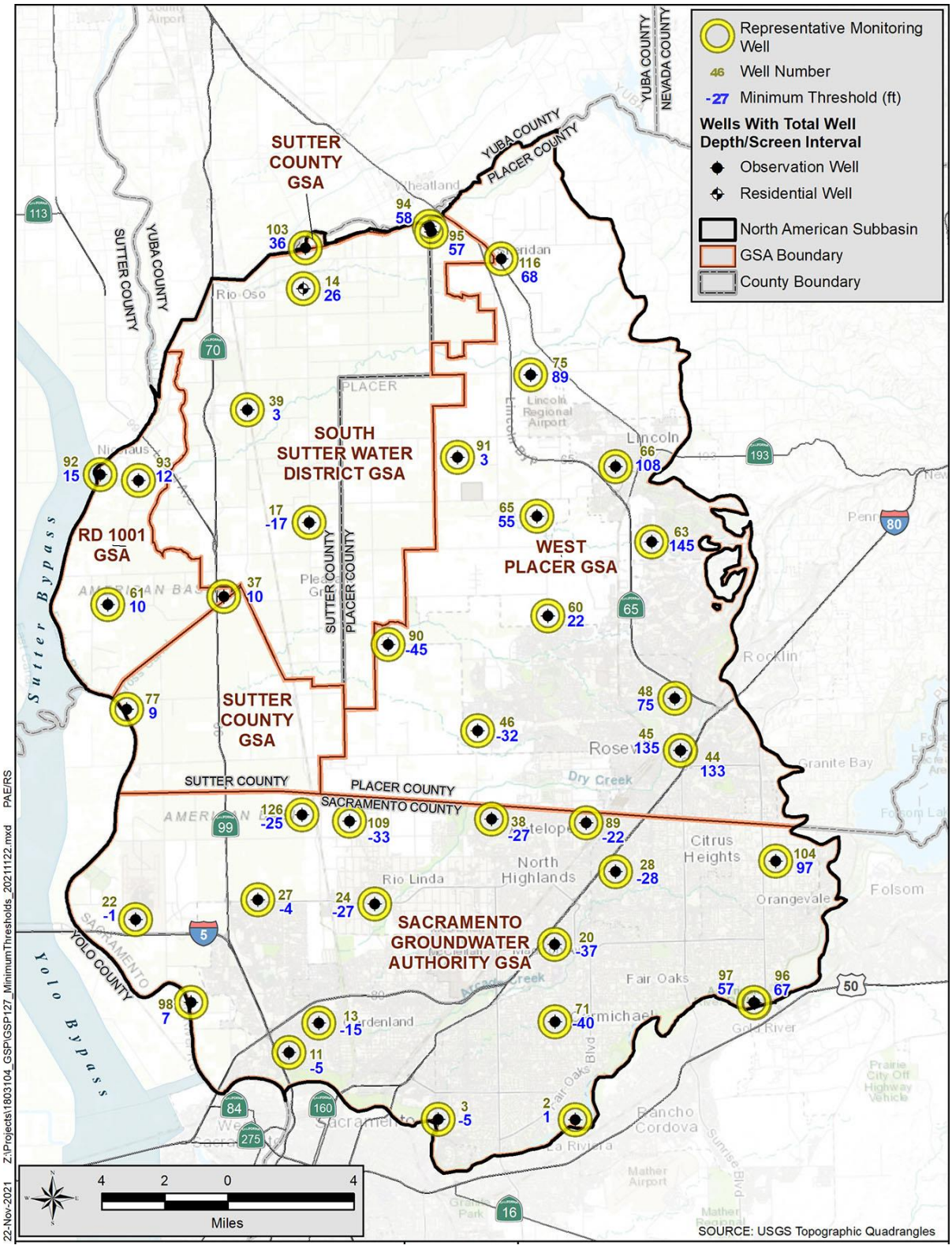
APPENDIX Q
Sustainable Management Criteria Hydrographs

December 2021

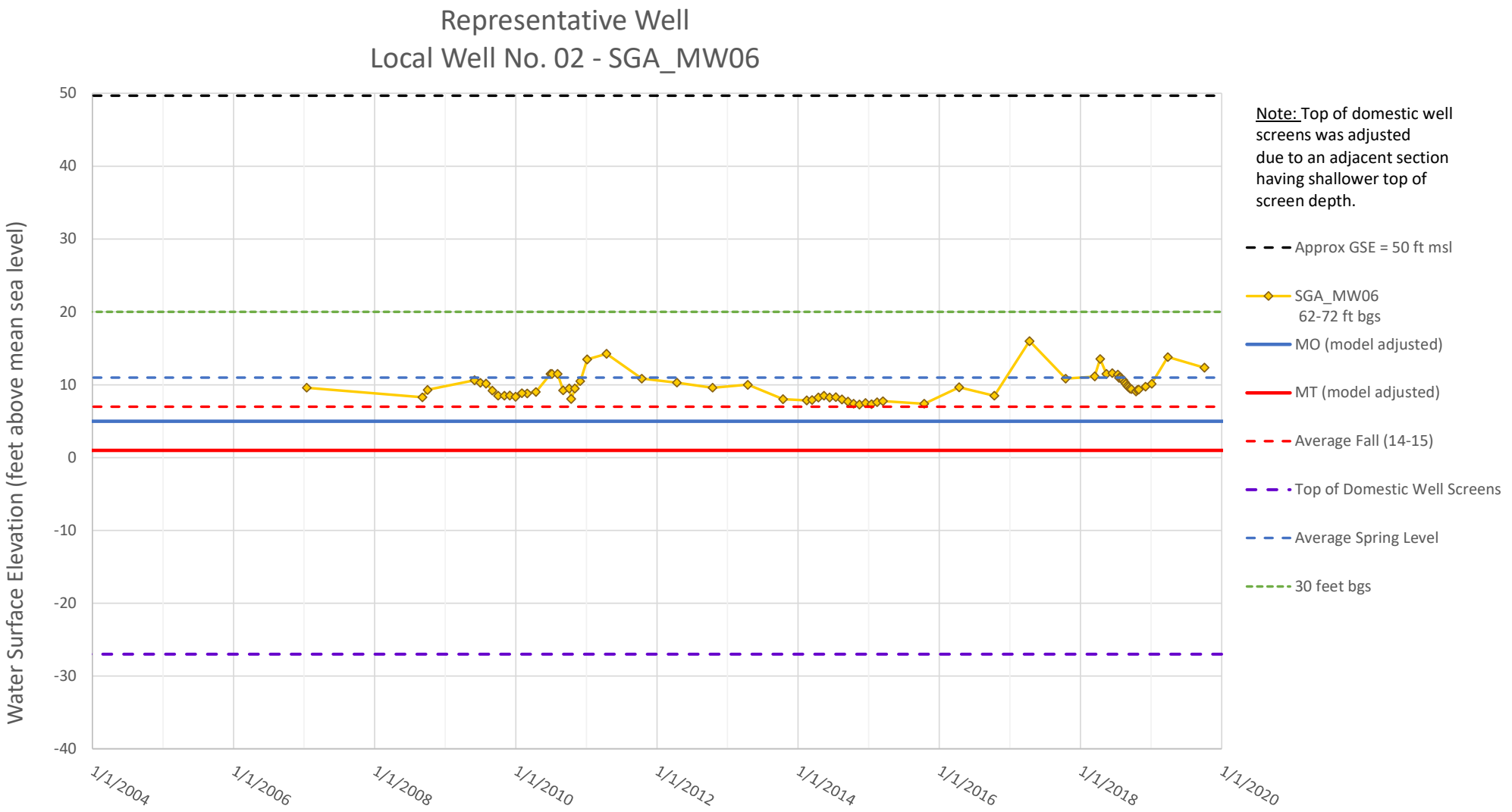
APPENDIX Q – SUSTAINABLE MANAGEMENT CRITERIA HYDROGRAPHS

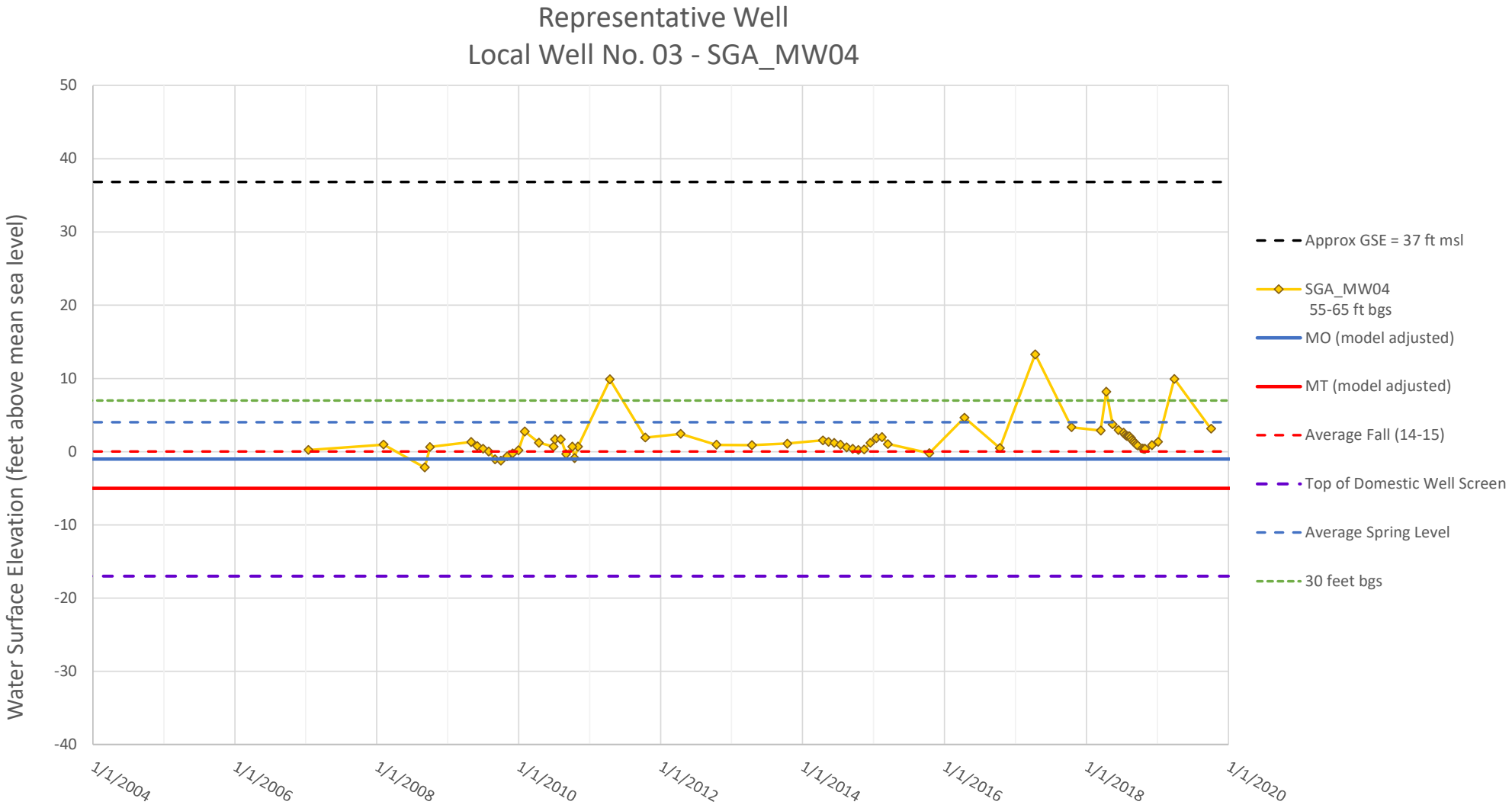
This section provides a reference location map and hydrographs for each of the North American Subbasin's 41 representative monitoring sites (RMS) for groundwater elevation sustainable management criteria. The location map includes the RMS local well number and the elevation of the minimum threshold.

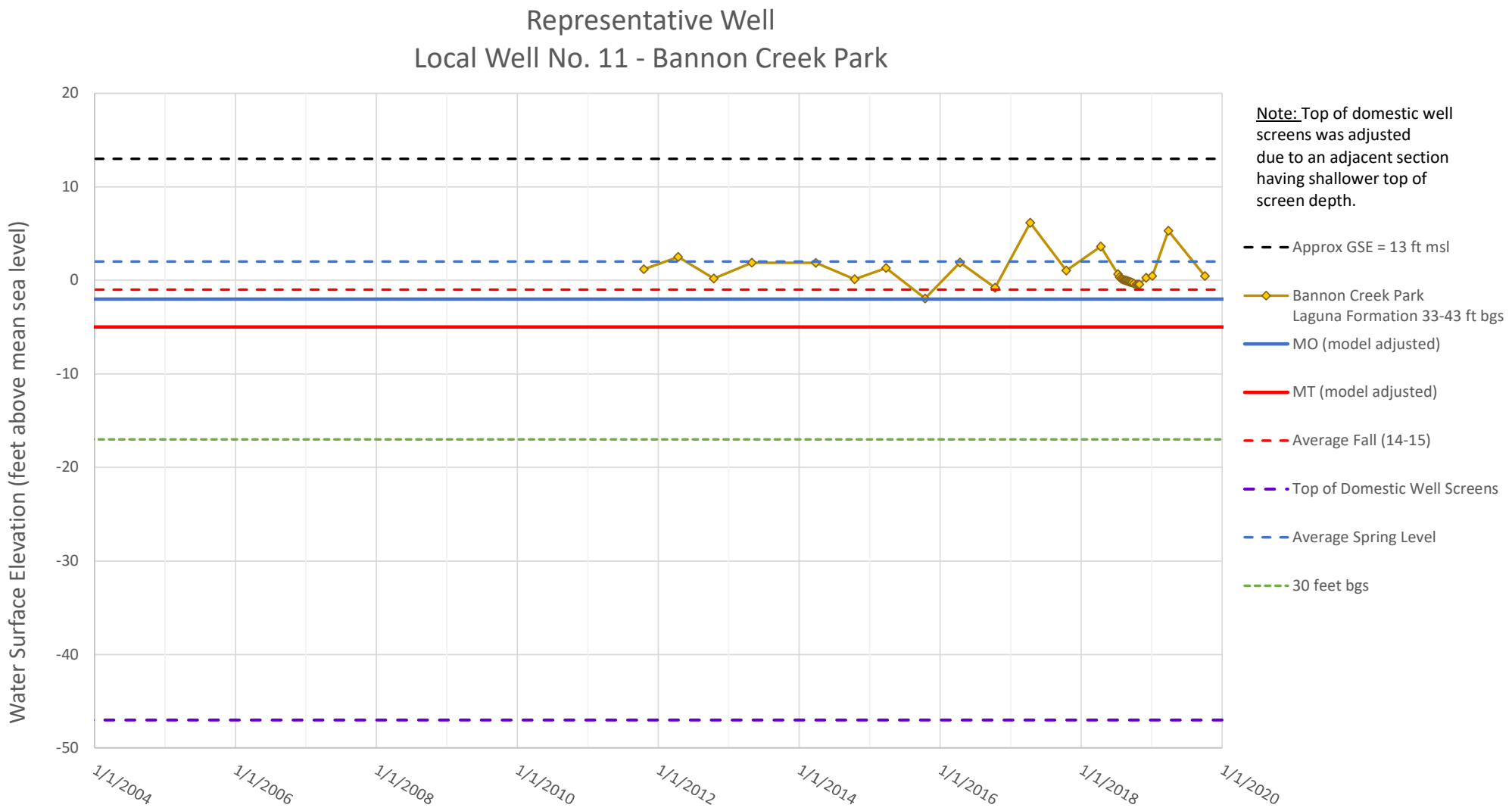
Each graph includes the approximate land surface elevation at the well (dashed black line), available historical groundwater elevation data from the well, observed average Spring (dashed blue line) and Fall (dashed red line) elevations that serve as the baseline for developing measurable objectives (MOs) and minimum thresholds (MTs), and the final MOs (solid blue line) and MTs (solid red line) based on projected modeling results.

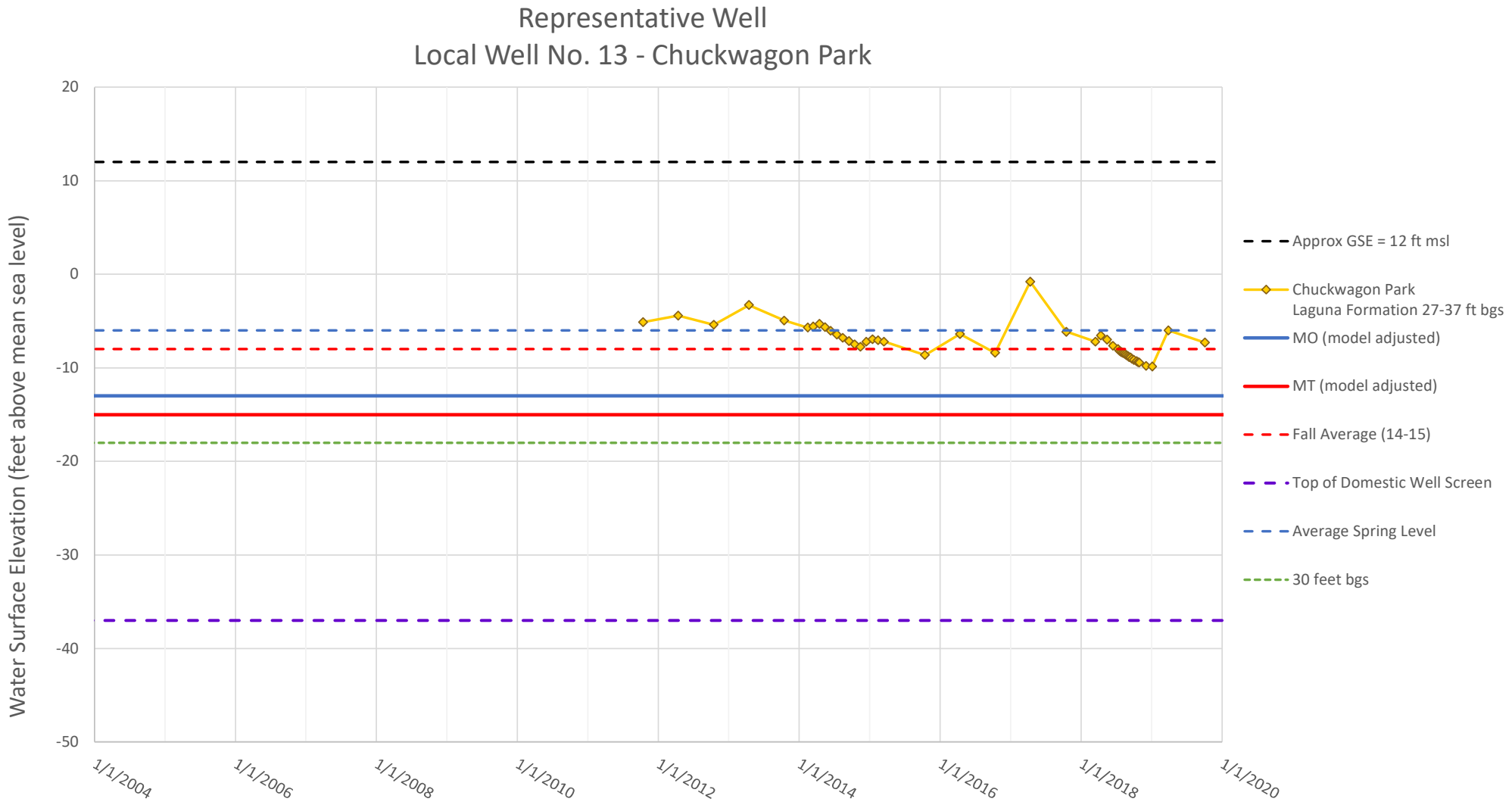


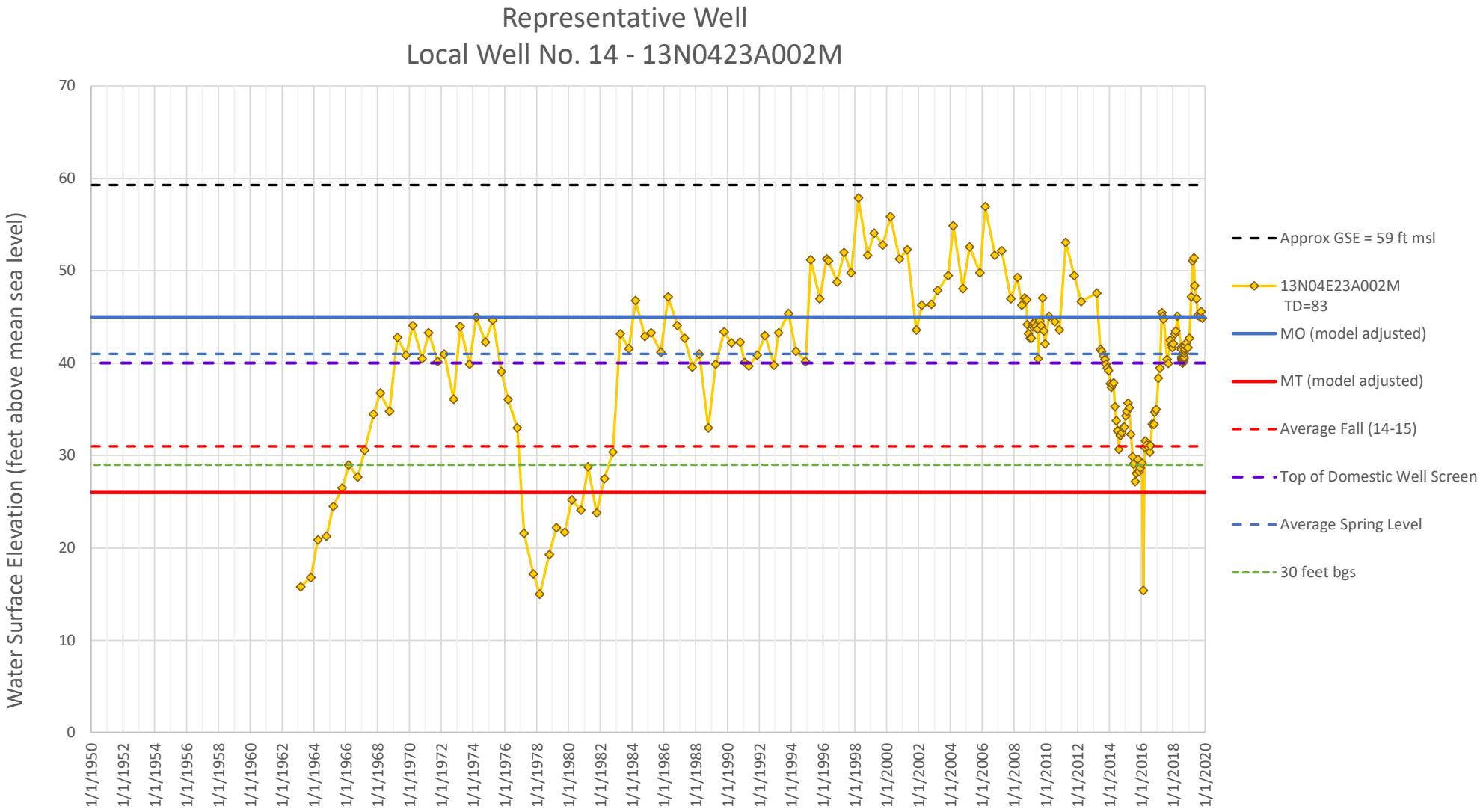
Locations of Representative Monitoring Sites with Minimum Threshold Elevations

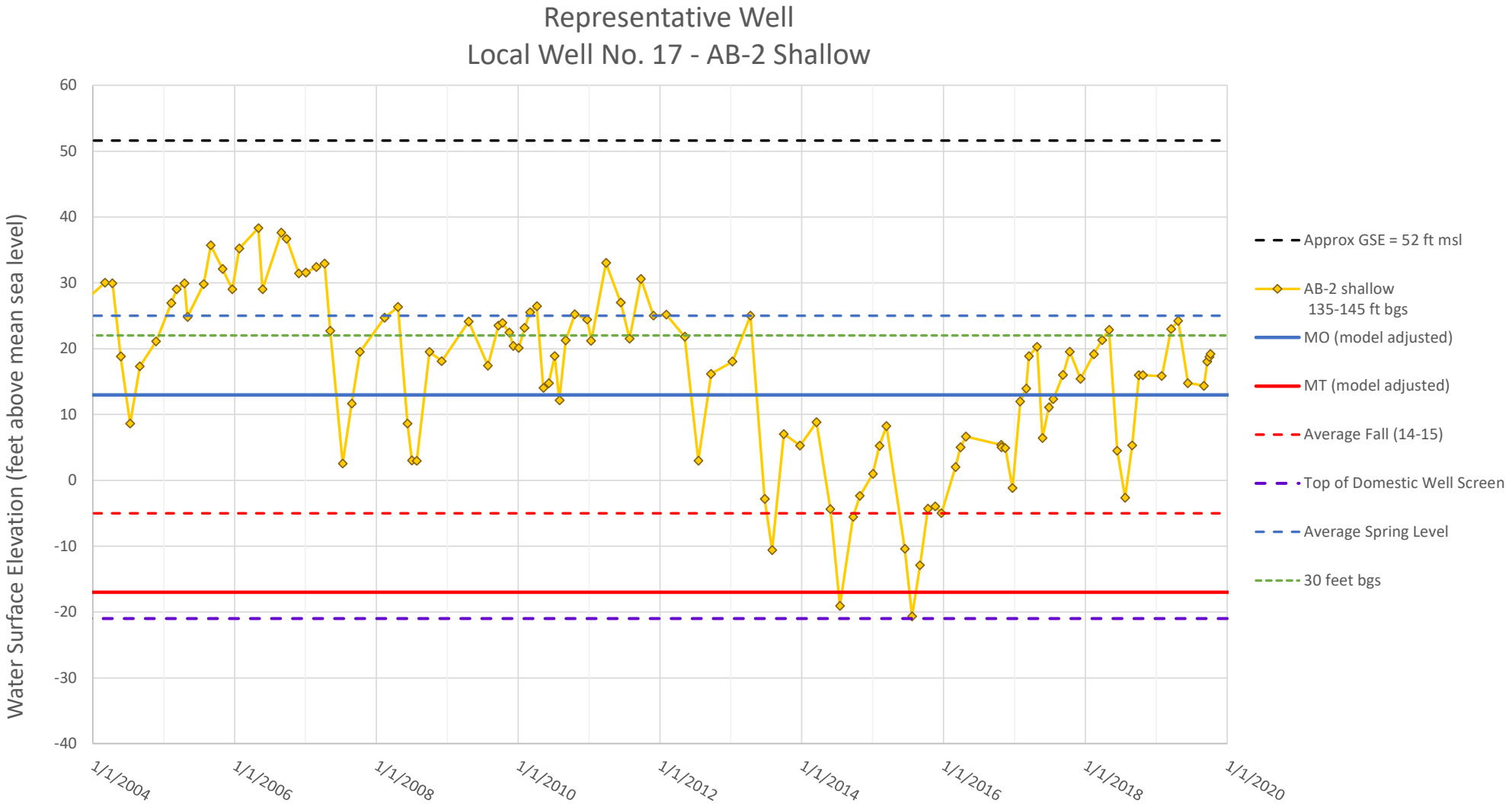

Representative Well
Local Well No. 02 - SGA_MW06
Water Surface Elevation (feet above mean sea level)
50
40
30
20
10
0
-10
-20
-30
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Top of domestic well screens was adjusted due to an adjacent section having shallower top of screen depth.
Approx GSE = 50 ft msl
SGA_MW06 62-72 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screens
Average Spring Level
30 feet bgs

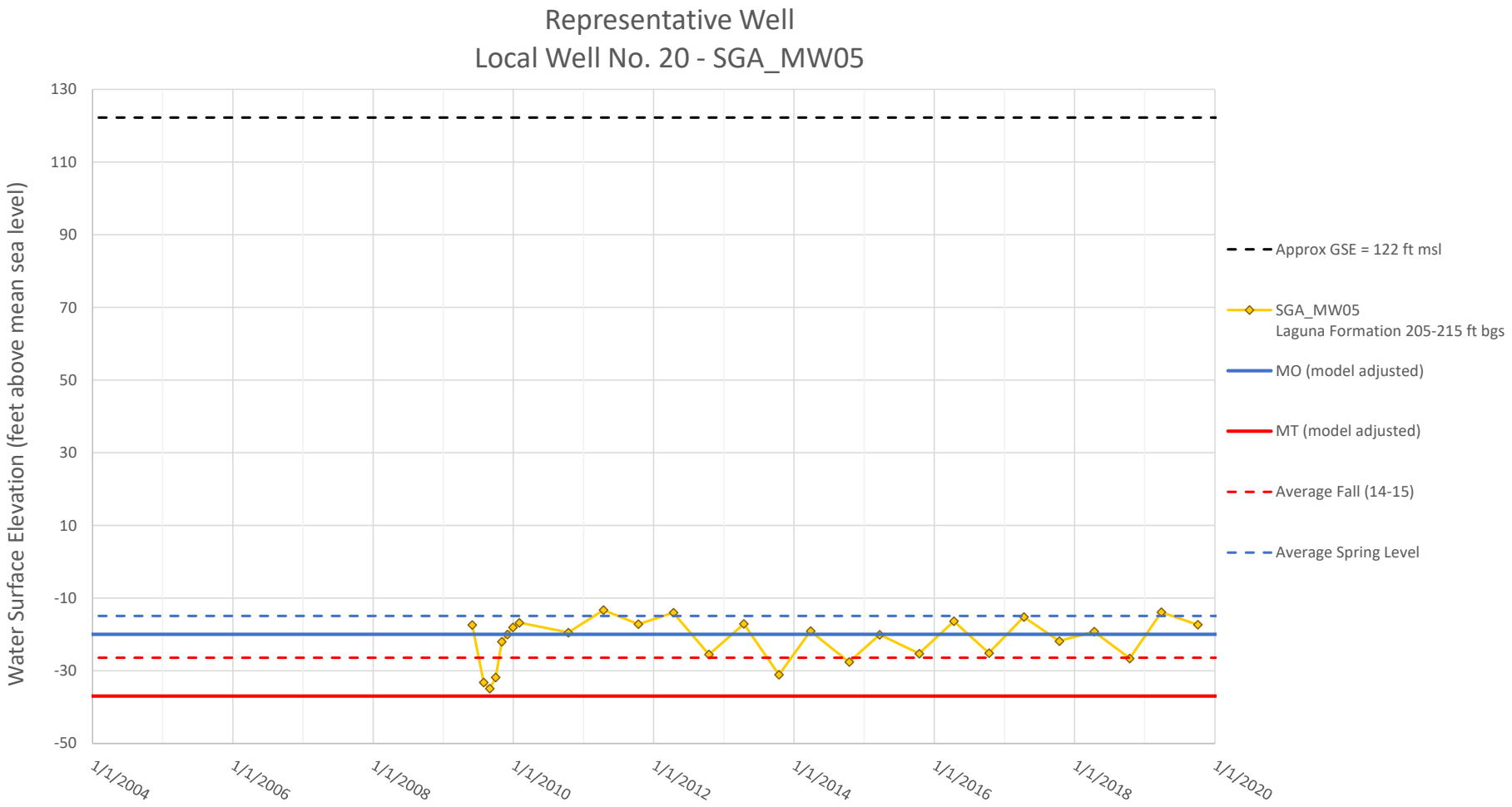

Representative Well
Local Well No. 03 - SGA_MW04
Water Surface Elevation (feet above mean sea level)
50
40
30
20
10
0
-10
-20
-30
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 37 ft msl
SGA_MW04
55-65 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screen
Average Spring Level
30 feet bgs

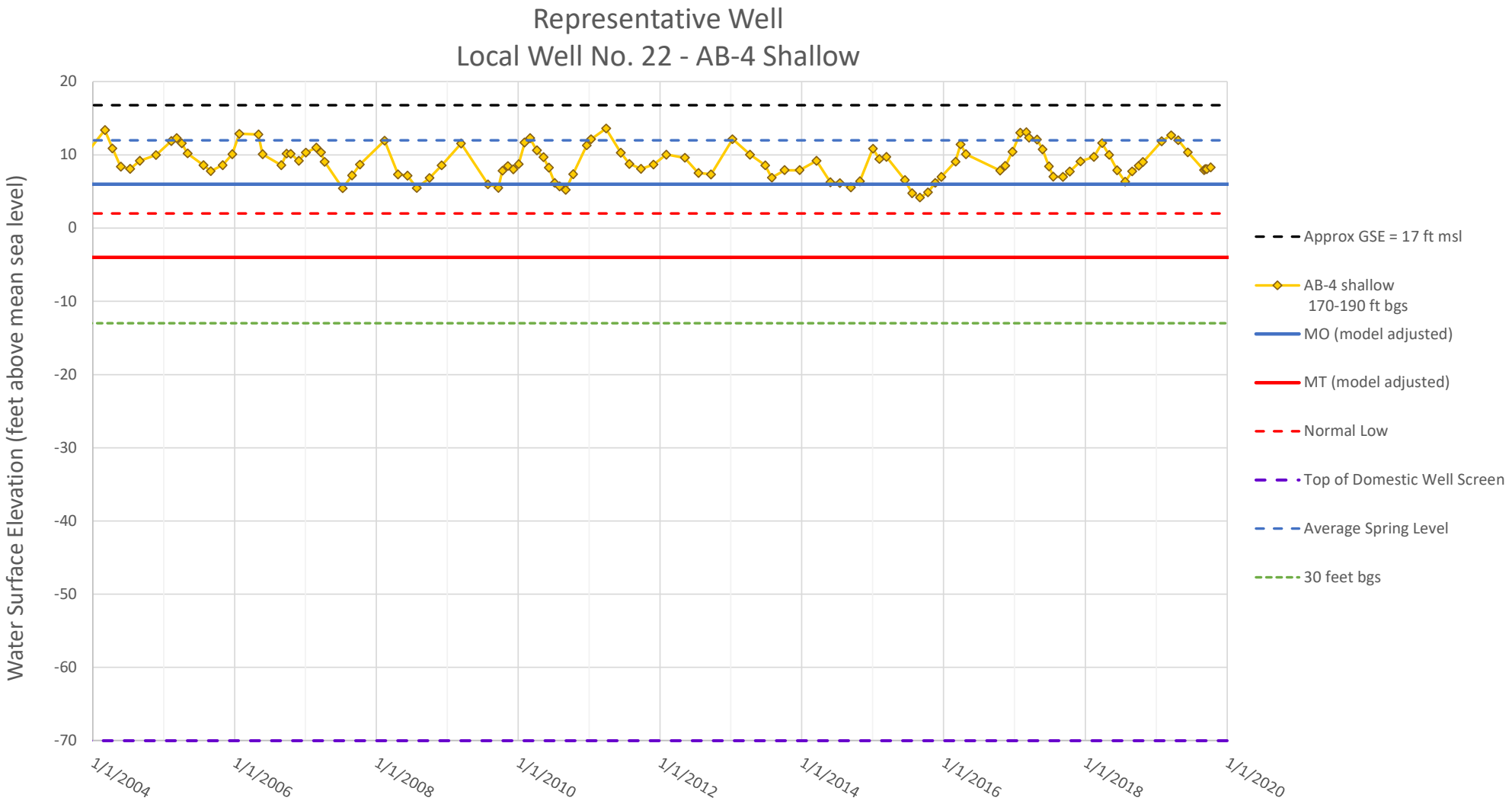

Representative Well
Local Well No. 11 - Bannon Creek Park
Water Surface Elevation (feet above mean sea level)
20
10
0
-10
-20
-30
-40
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: Top of domestic well screens was adjusted due to an adjacent section having shallower top of screen depth.
Approx GSE = 13 ft msl
Bannon Creek Park Laguna Formation 33-43 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screens
Average Spring Level
30 feet bgs

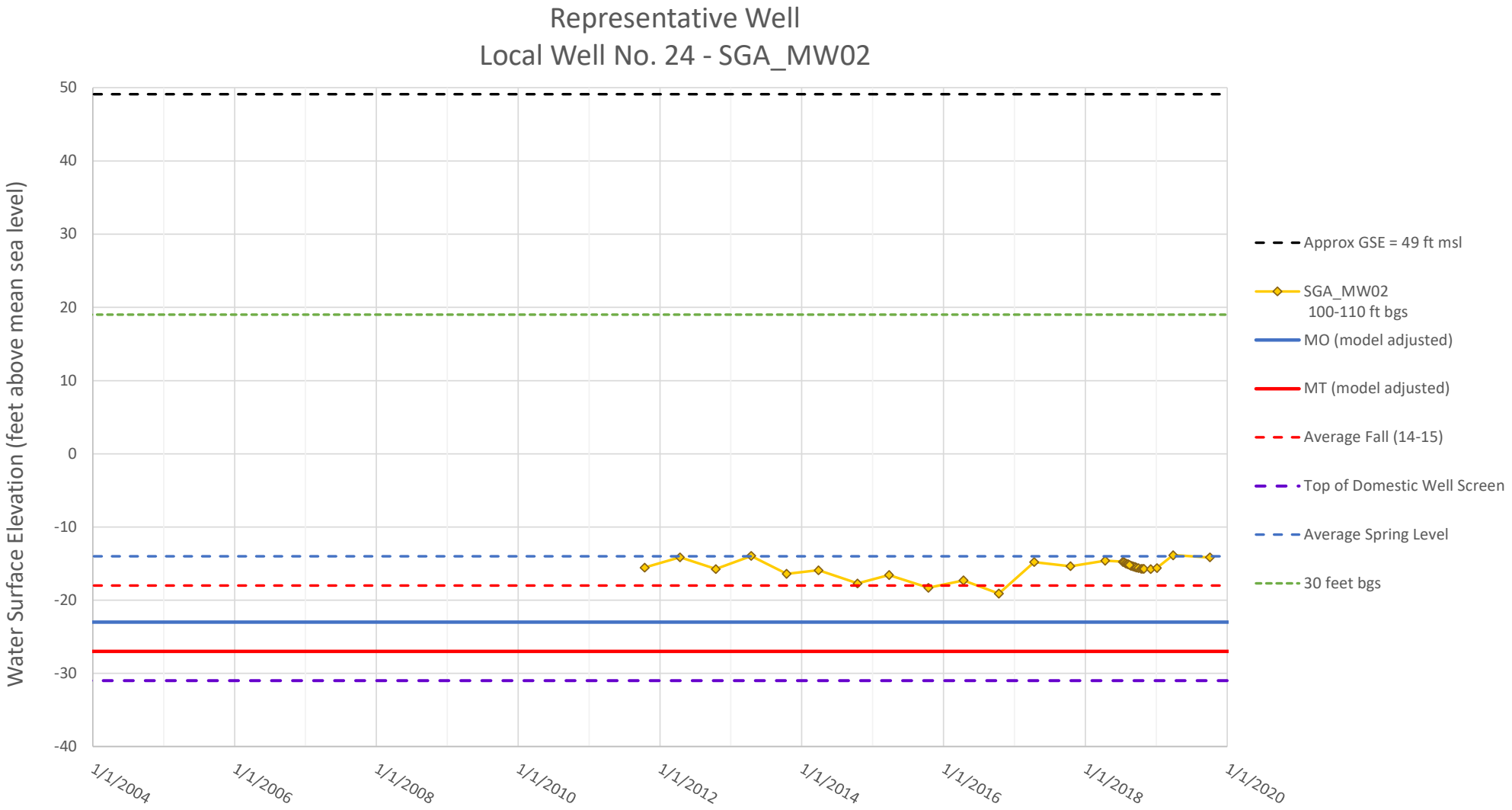

Representative Well
Local Well No. 13 - Chuckwagon Park
Water Surface Elevation (feet above mean sea level)
20
10
0
-10
-20
-30
-40
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 12 ft msl
Chuckwagon Park
Laguna Formation 27-37 ft bgs
MO (model adjusted)
MT (model adjusted)
Fall Average (14-15)
Top of Domestic Well Screen
Average Spring Level
30 feet bgs

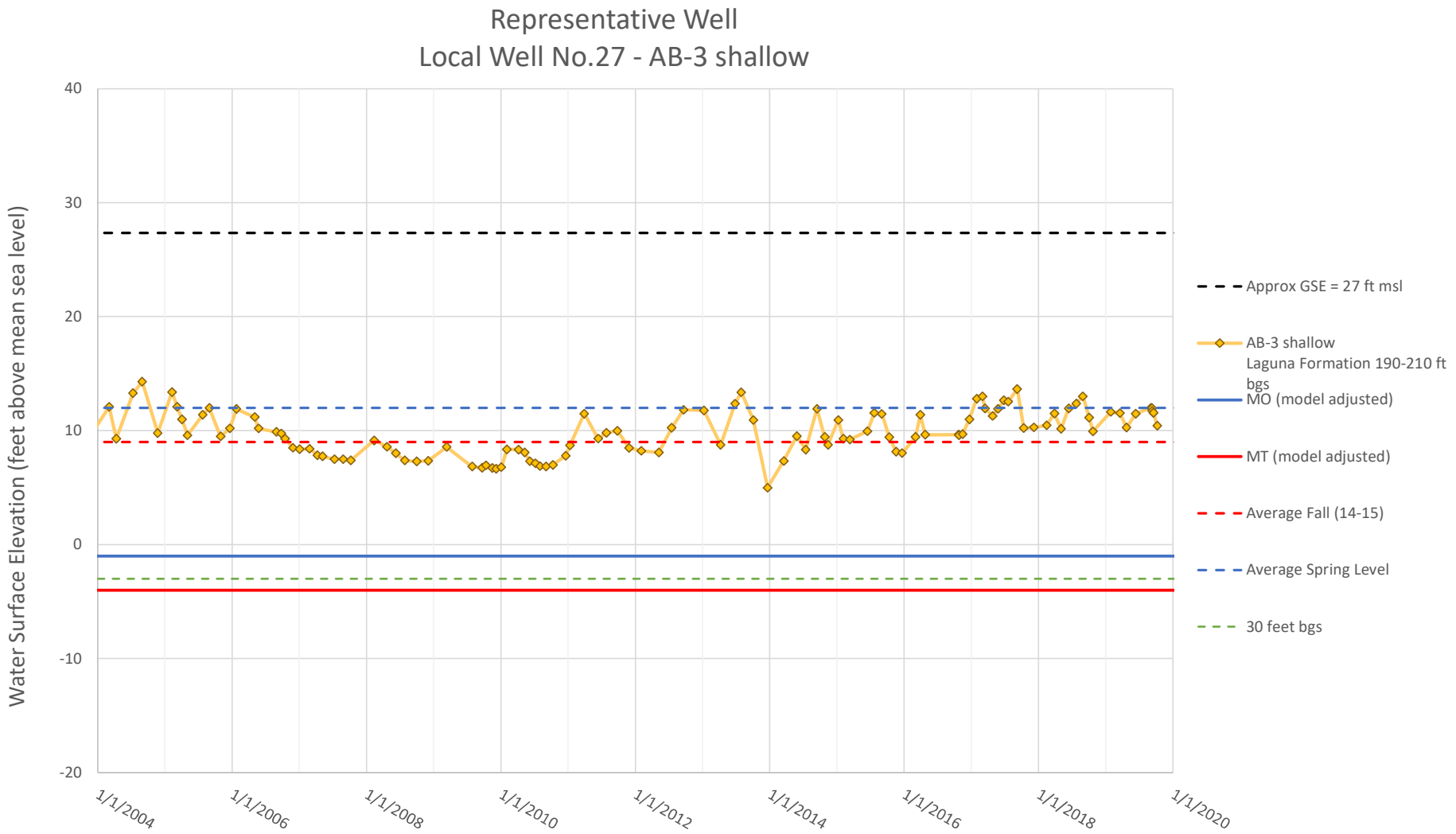

Representative Well
Local Well No. 14 - 13N0423A002M
Water Surface Elevation (feet above mean sea level)
70
60
50
40
30
20
10
0
1/1/1950
1/1/1952
1/1/1954
1/1/1956
1/1/1958
1/1/1960
1/1/1962
1/1/1964
1/1/1966
1/1/1968
1/1/1970
1/1/1972
1/1/1974
1/1/1976
1/1/1978
1/1/1980
1/1/1982
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 59 ft msl
13N04E23A002M
TD=83
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screen
Average Spring Level
30 feet bgs

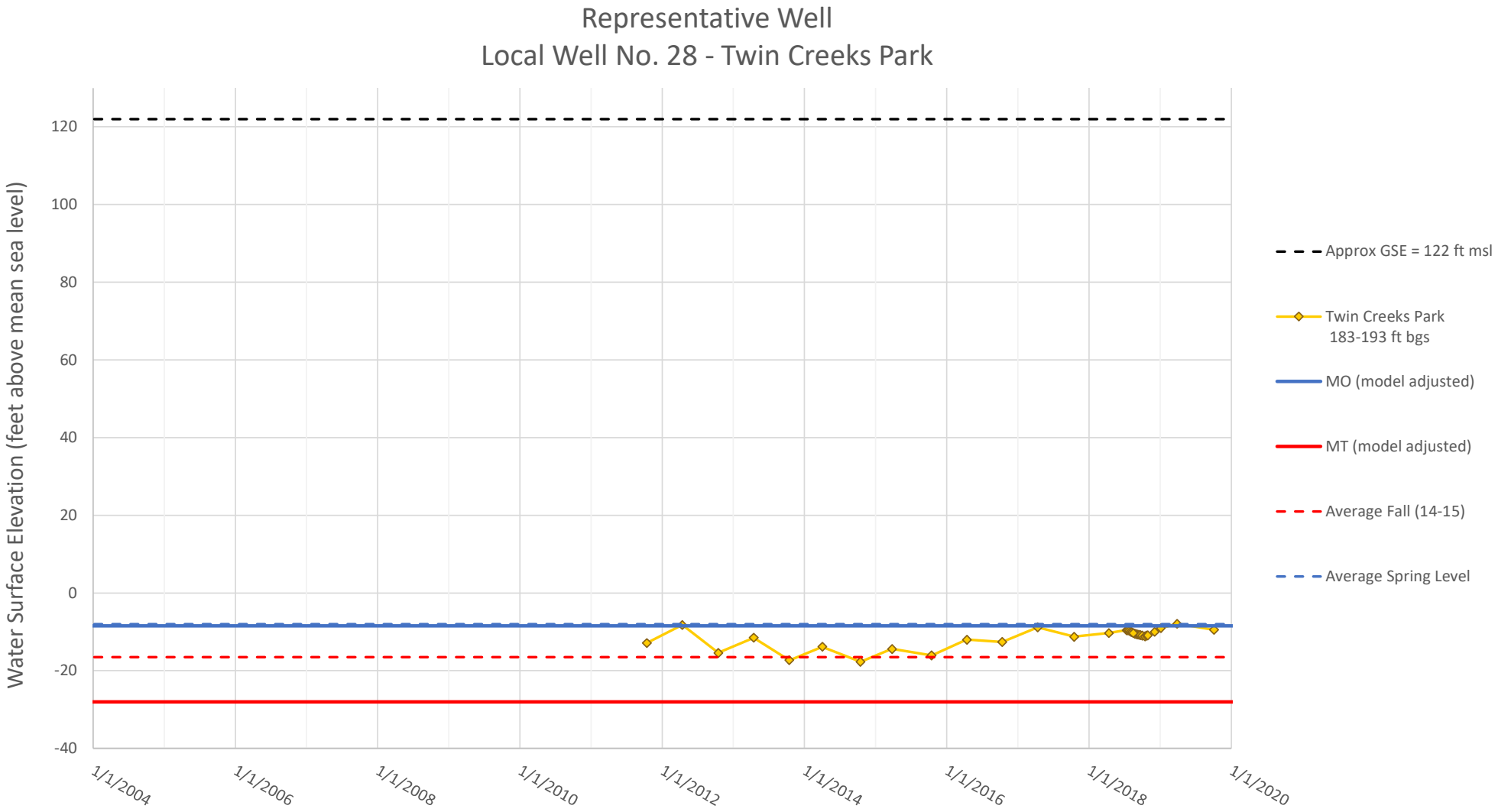

Representative Well
Local Well No. 17 - AB-2 Shallow
Water Surface Elevation (feet above mean sea level)
60
50
40
30
20
10
0
-10
-20
-30
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 52 ft msl
AB-2 shallow
135-145 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screen
Average Spring Level
30 feet bgs

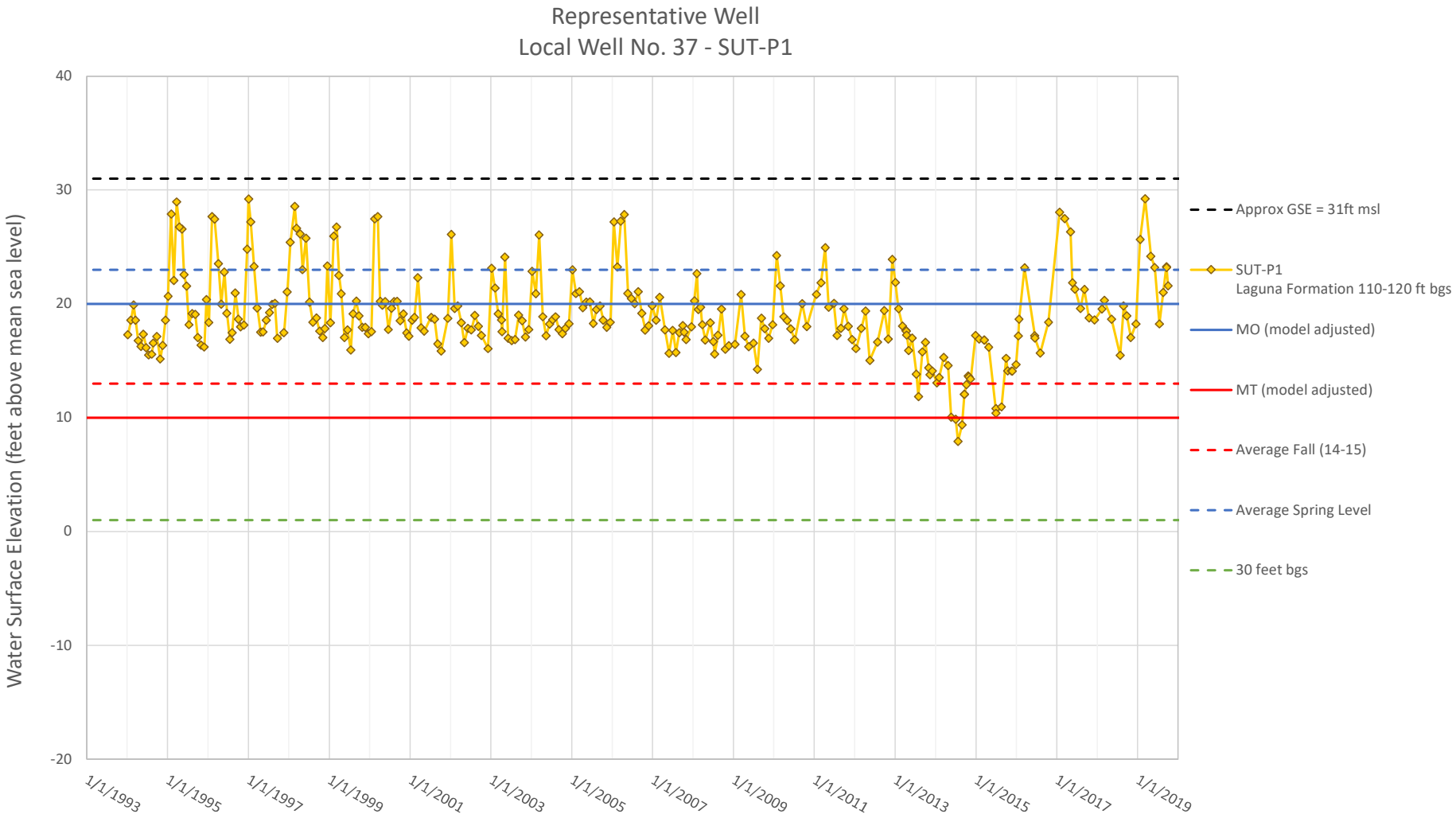

Representative Well
Local Well No. 20 - SGA_MW05
Water Surface Elevation (feet above mean sea level)
130
110
90
70
50
30
10
-10
-30
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 122 ft msl
SGA_MW05
Laguna Formation 205-215 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level

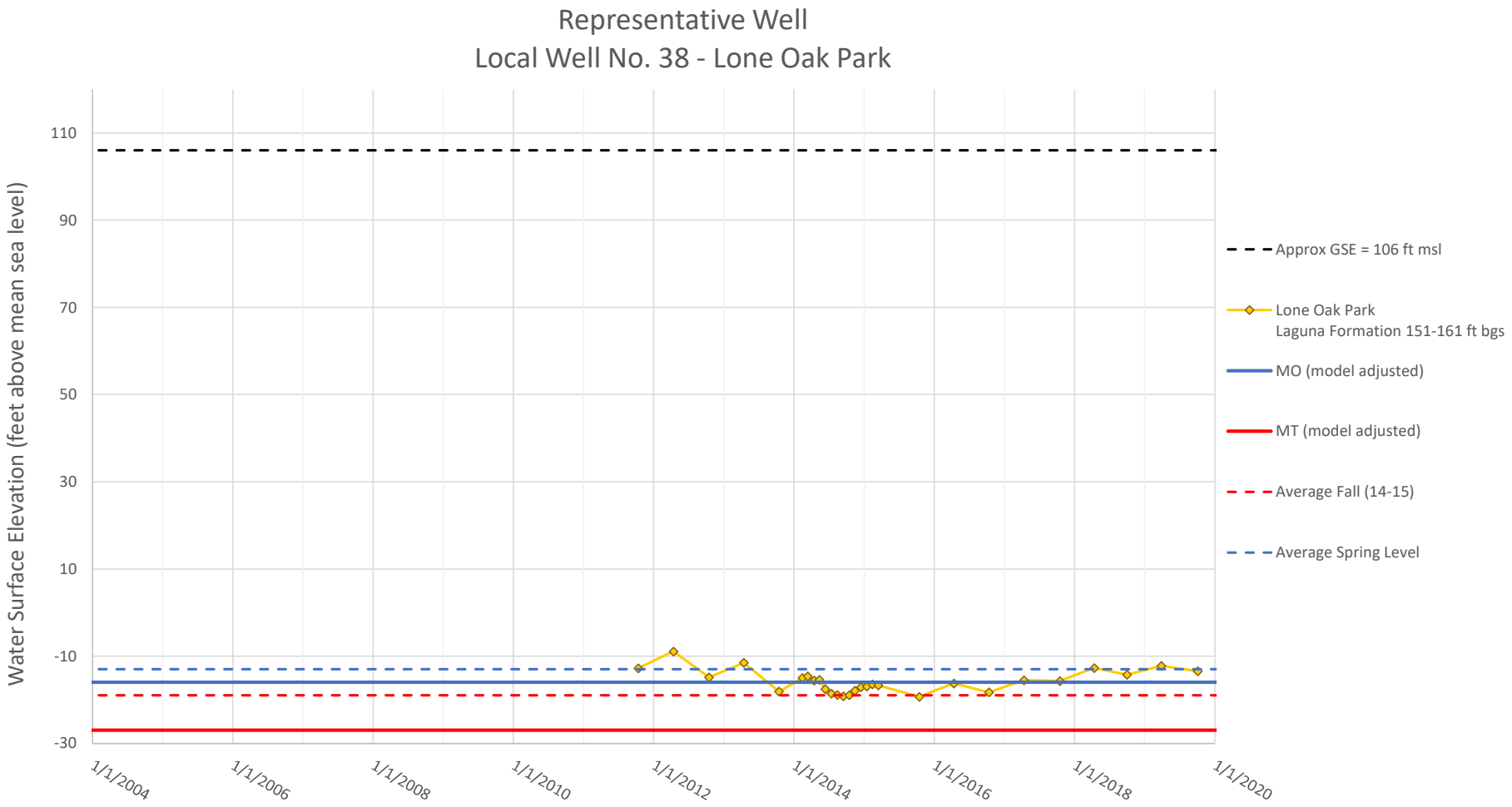

Representative Well
Local Well No. 22 - AB-4 Shallow
Water Surface Elevation (feet above mean sea level)
20
10
0
-10
-20
-30
-40
-50
-60
-70
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 17 ft msl
AB-4 shallow
170-190 ft bgs
MO (model adjusted)
MT (model adjusted)
Normal Low
Top of Domestic Well Screen
Average Spring Level
30 feet bgs

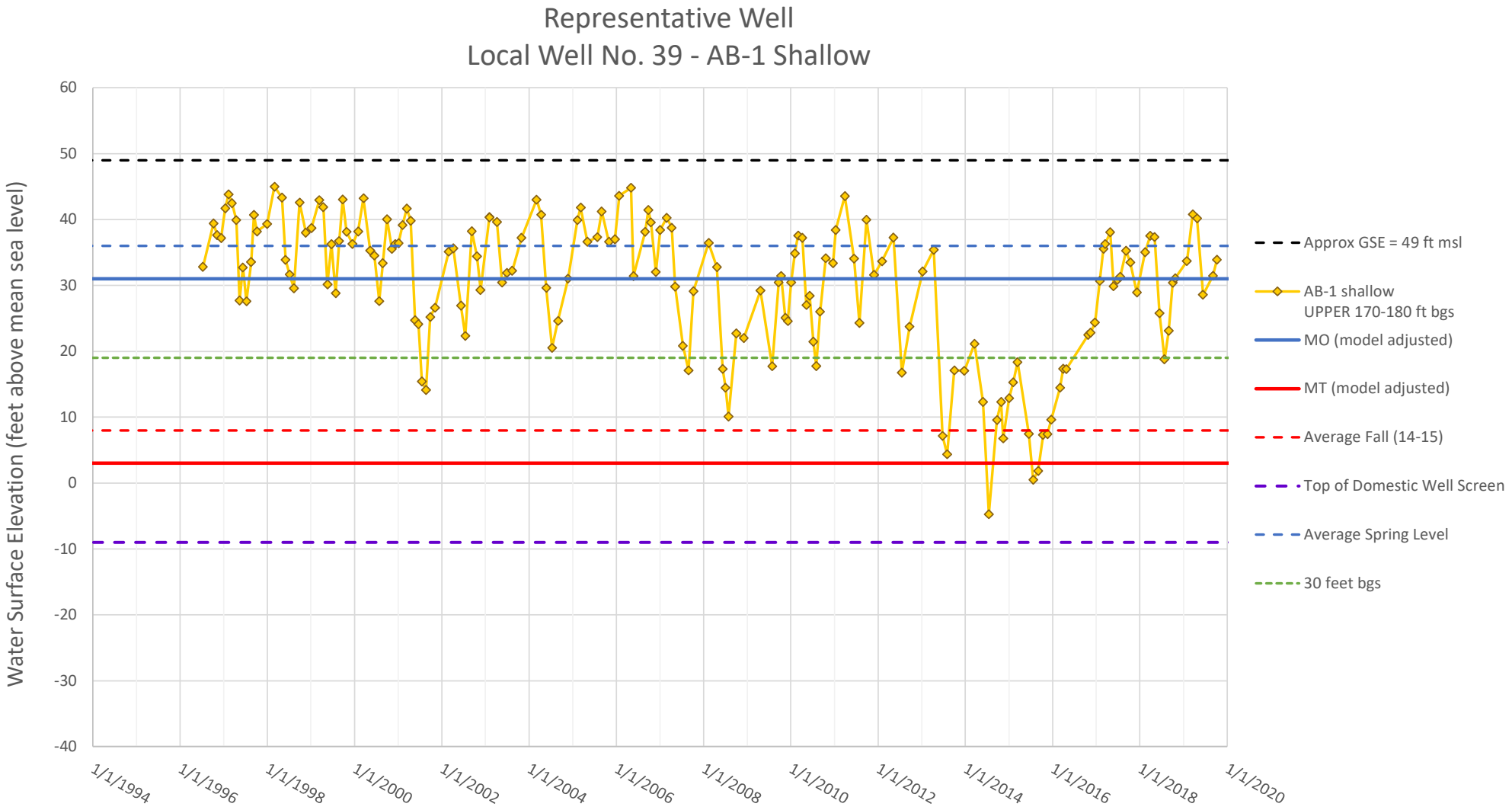

Representative Well
Local Well No. 24 - SGA_MW02
Water Surface Elevation (feet above mean sea level)
50
40
30
20
10
0
-10
-20
-30
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 49 ft msl
SGA_MW02
100-110 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screen
Average Spring Level
30 feet bgs

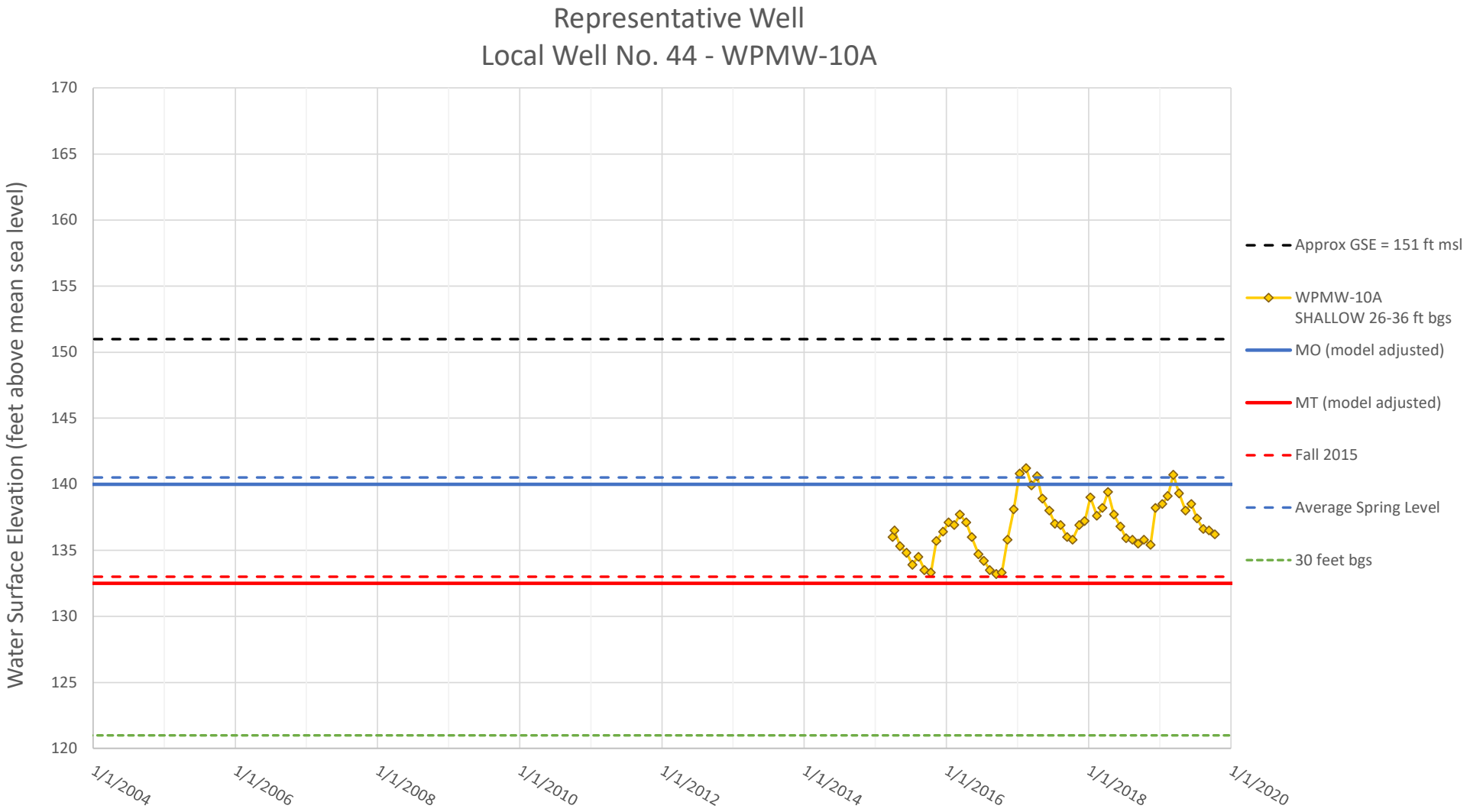

Representative Well
Local Well No.27 - AB-3 shallow
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 27 ft msl
AB-3 shallow
Laguna Formation 190-210 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level
30 feet bgs

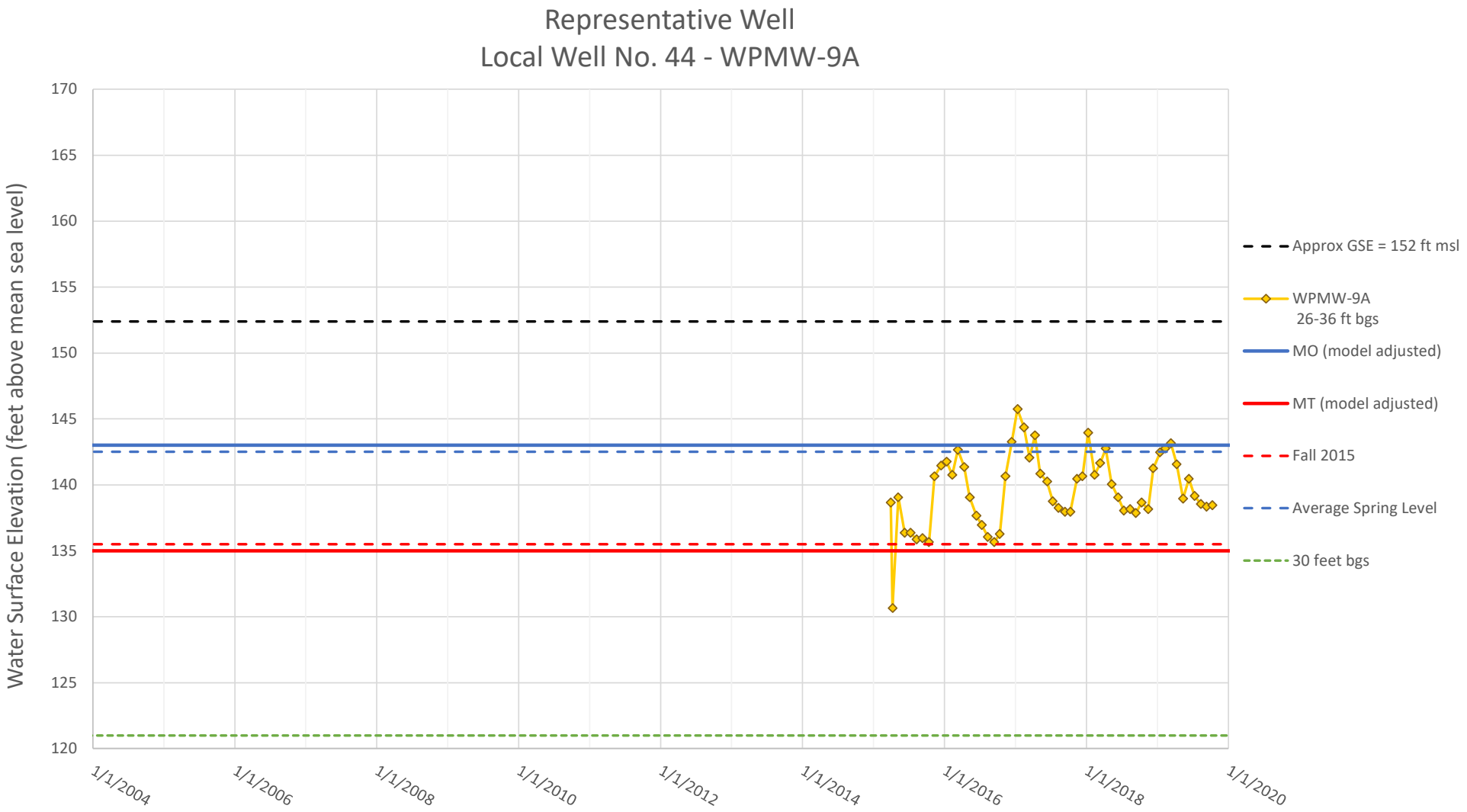

Representative Well
Local Well No. 28 - Twin Creeks Park
Water Surface Elevation (feet above mean sea level)
120
100
80
60
40
20
0
-20
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 122 ft msl
Twin Creeks Park
183-193 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level

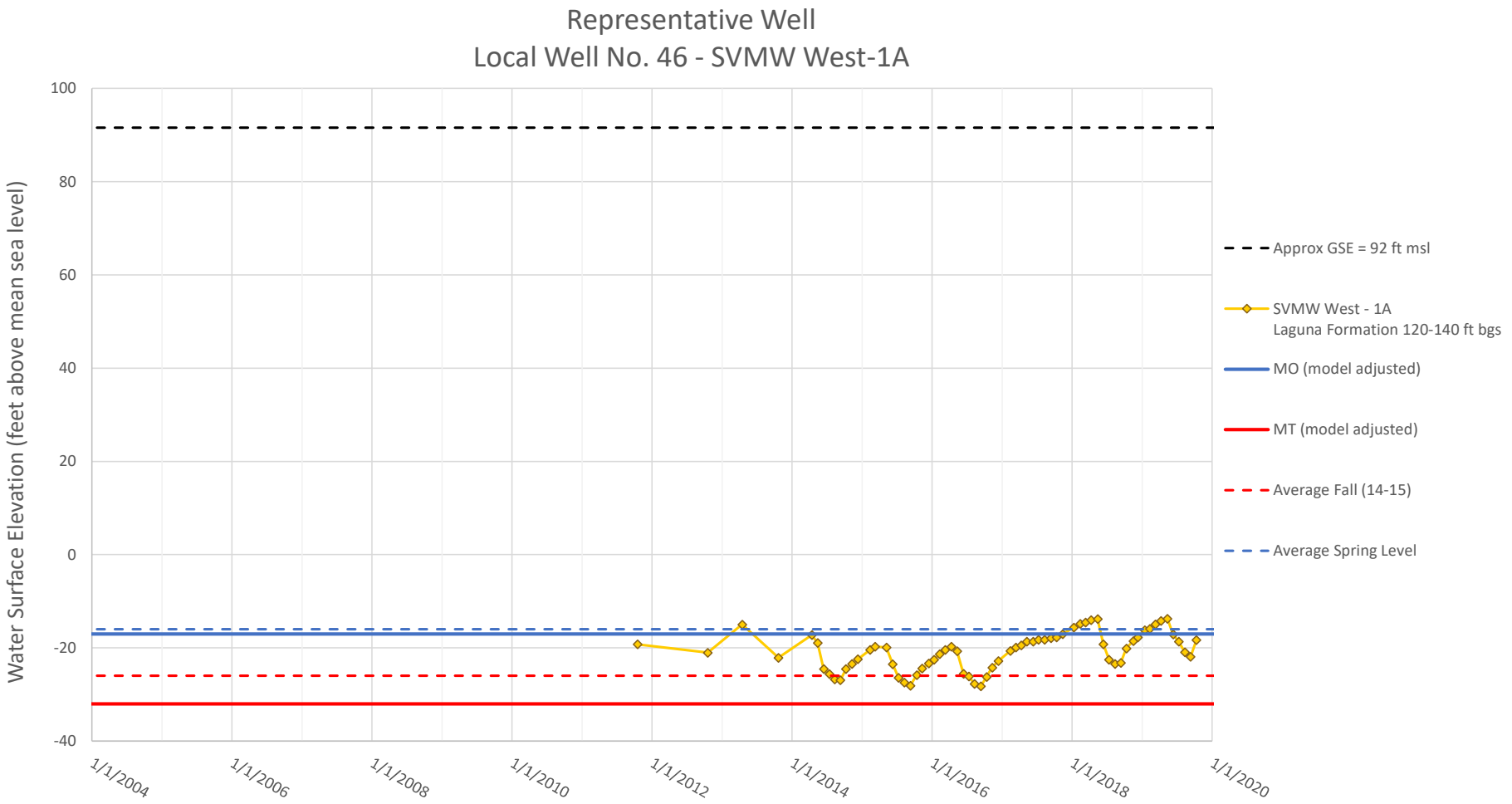

Representative Well
Local Well No. 37 - SUT-P1
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
1/1/2009
1/1/2011
1/1/2013
1/1/2015
1/1/2017
1/1/2019
Approx GSE = 31ft msl
SUT-P1
Laguna Formation 110-120 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level
30 feet bgs

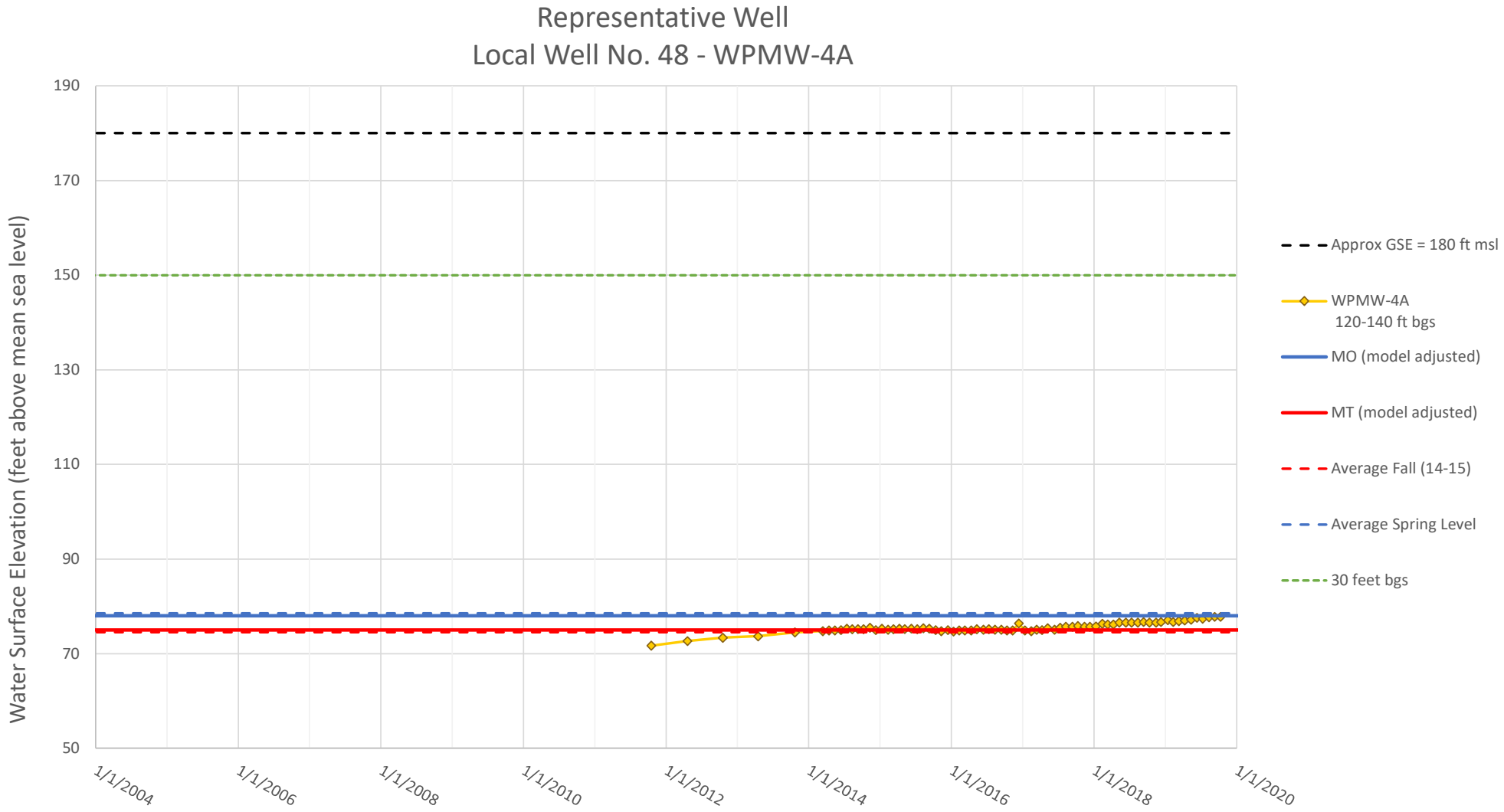

Representative Well
Local Well No. 38 - Lone Oak Park
Water Surface Elevation (feet above mean sea level)
110
90
70
50
30
10
-10
-30
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 106 ft msl
Lone Oak Park
Laguna Formation 151-161 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level

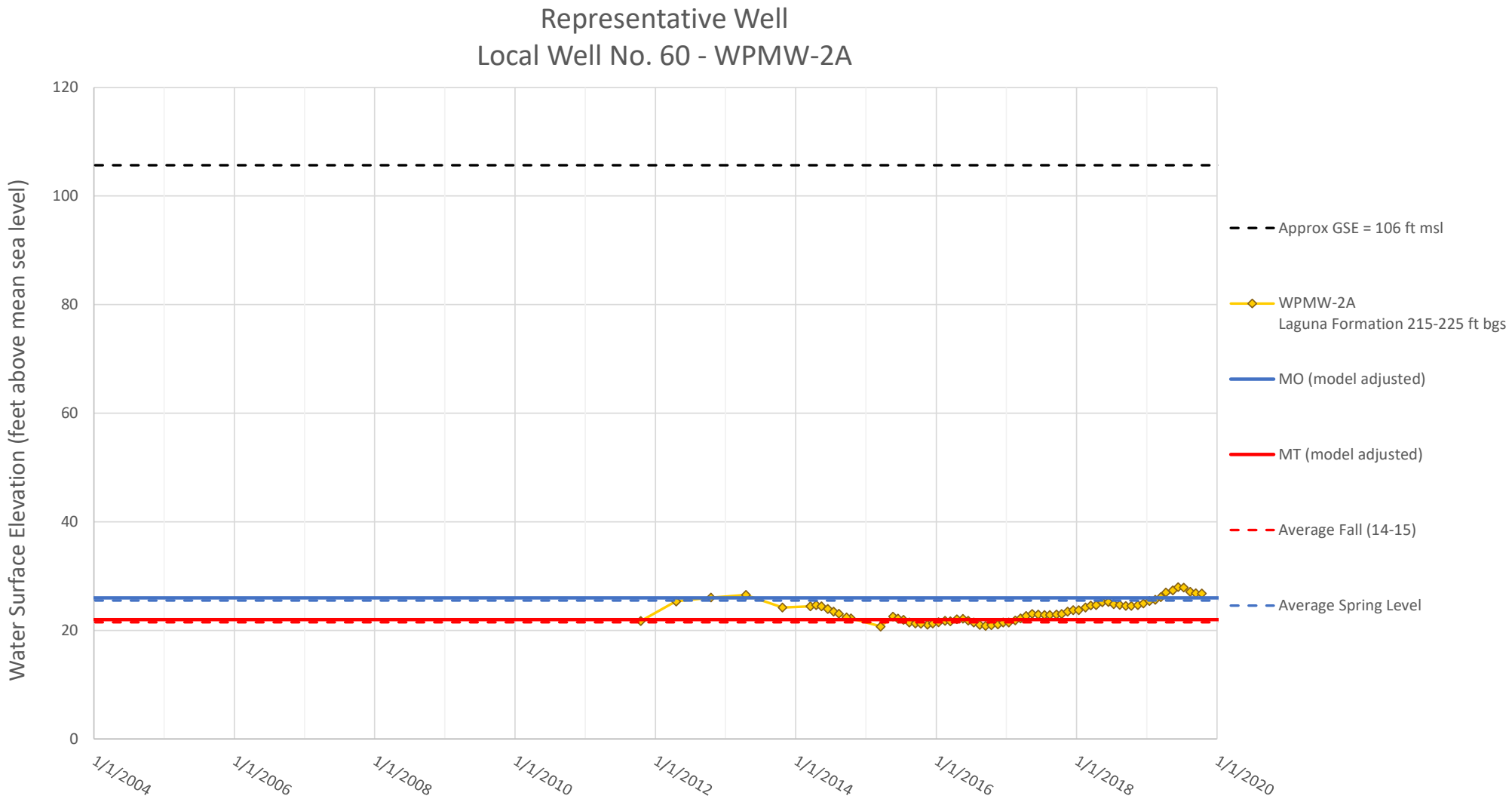

Representative Well
Local Well No. 39 - AB-1 Shallow
Water Surface Elevation (feet above mean sea level)
60
50
40
30
20
10
0
-10
-20
-30
-40
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 49 ft msl
AB-1 shallow
UPPER 170-180 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screen
Average Spring Level
30 feet bgs

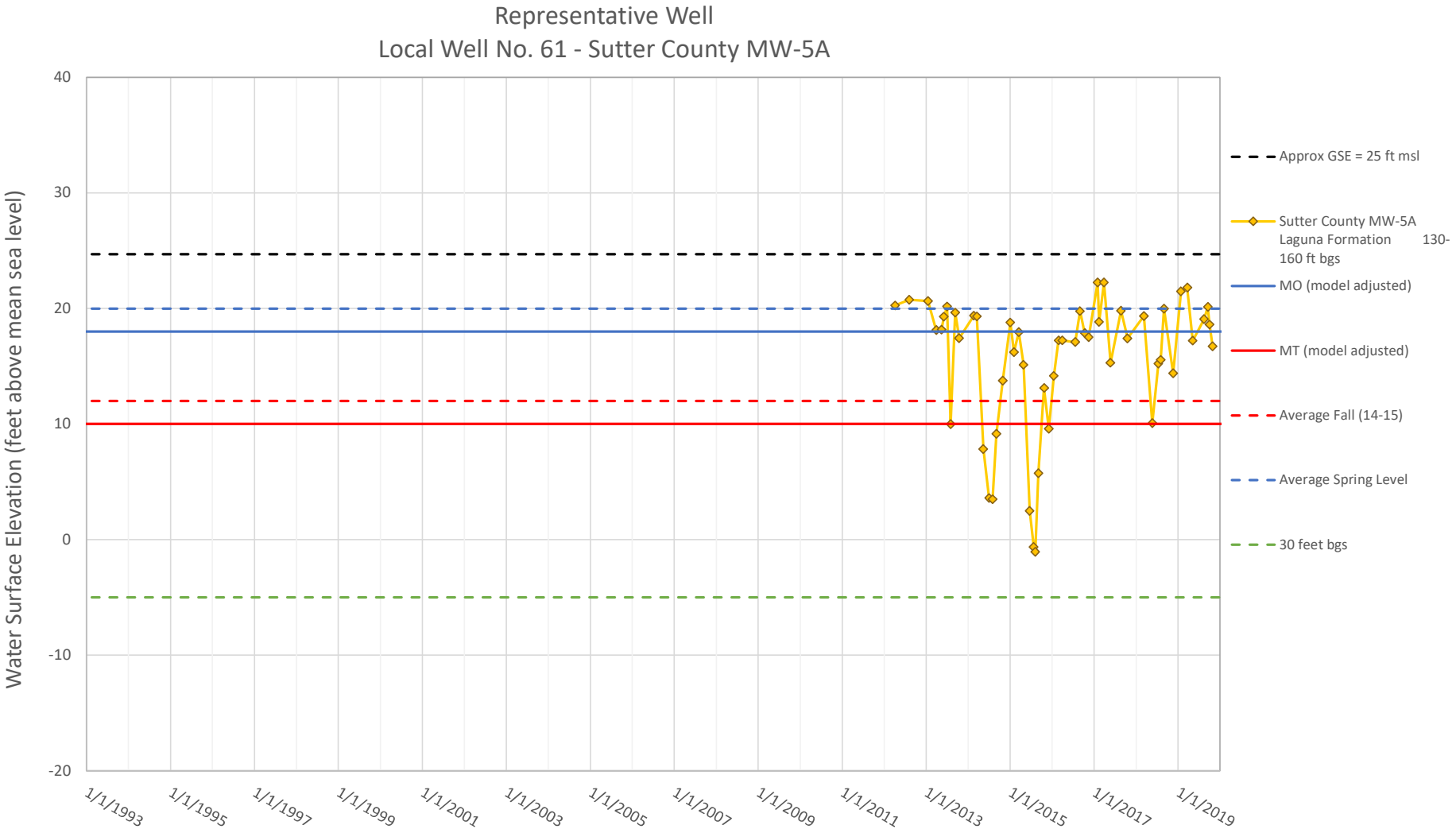

Representative Well
Local Well No. 44 - WPMW-10A
Water Surface Elevation (feet above mean sea level)
170
165
160
155
150
145
140
135
130
125
120
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 151 ft msl
WPMW-10A
SHALLOW 26-36 ft bgs
MO (model adjusted)
MT (model adjusted)
Fall 2015
Average Spring Level
30 feet bgs

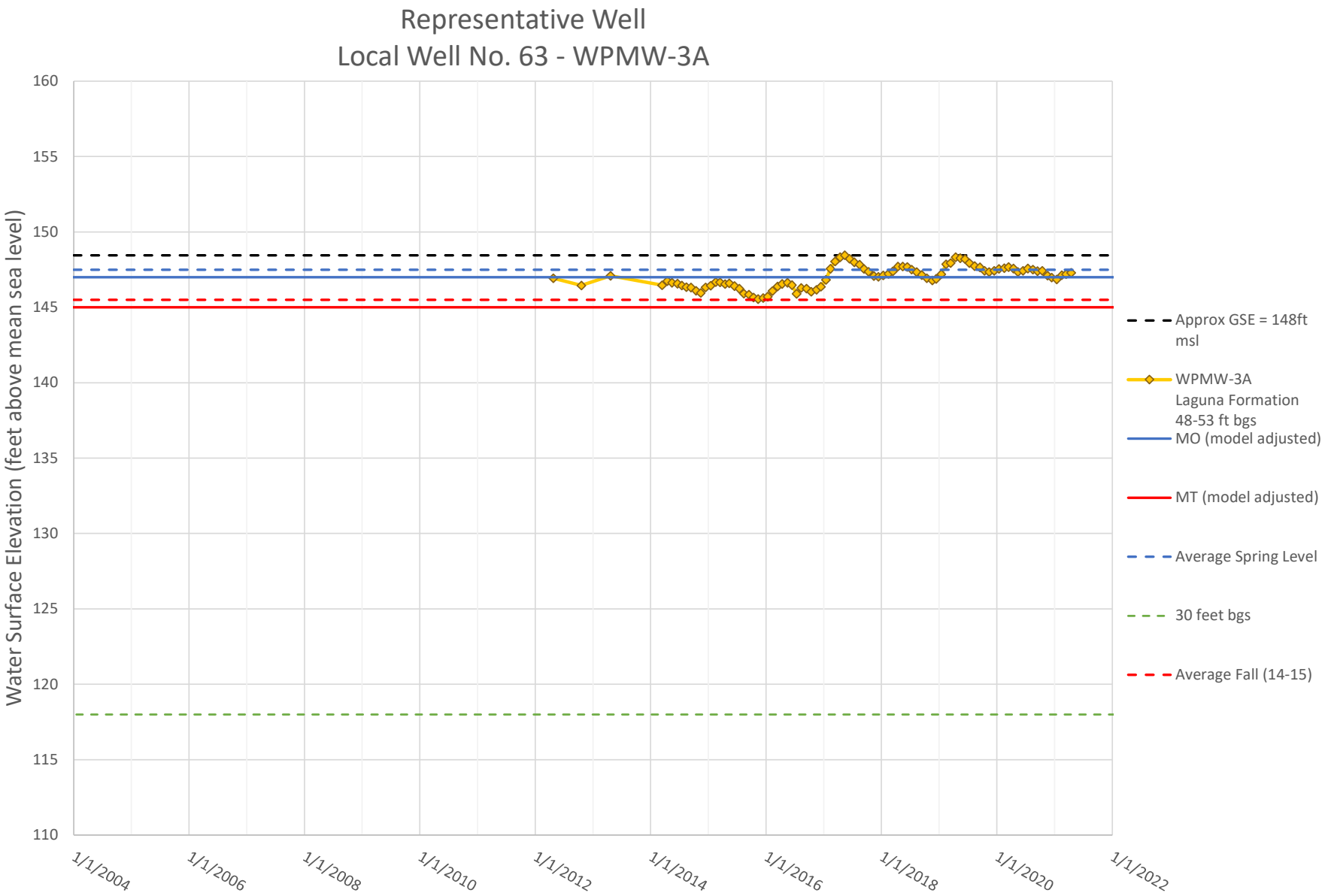

Representative Well
Local Well No. 44 - WPMW-9A
Water Surface Elevation (feet above mean sea level)
170
165
160
155
150
145
140
135
130
125
120
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 152 ft msl
WPMW-9A
26-36 ft bgs
MO (model adjusted)
MT (model adjusted)
Fall 2015
Average Spring Level
30 feet bgs

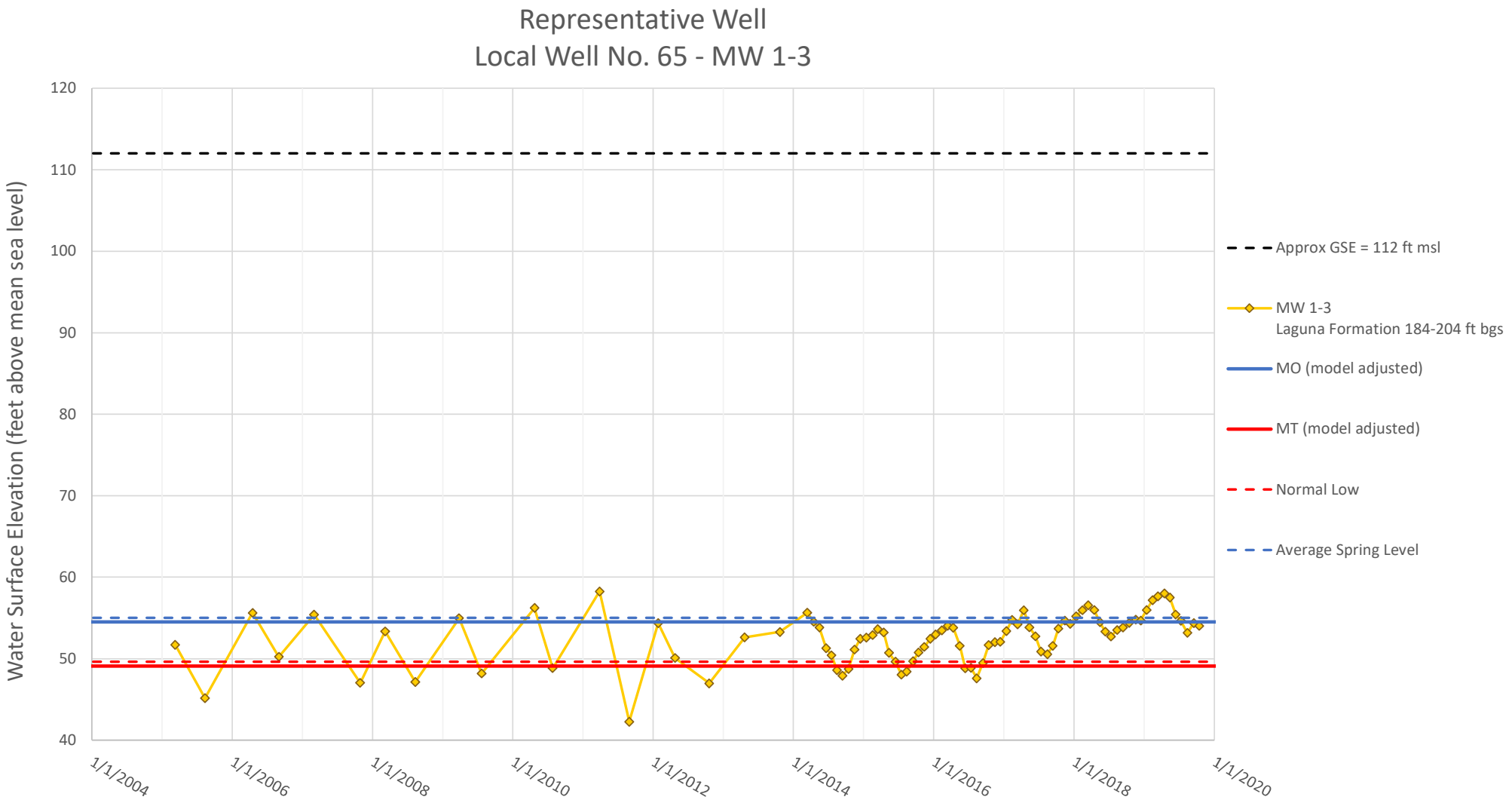

Representative Well
Local Well No. 46 - SVMW West-1A
Water Surface Elevation (feet above mean sea level)
100
80
60
40
20
0
-20
-40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 92 ft msl
SVMW West - 1A
Laguna Formation 120-140 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level

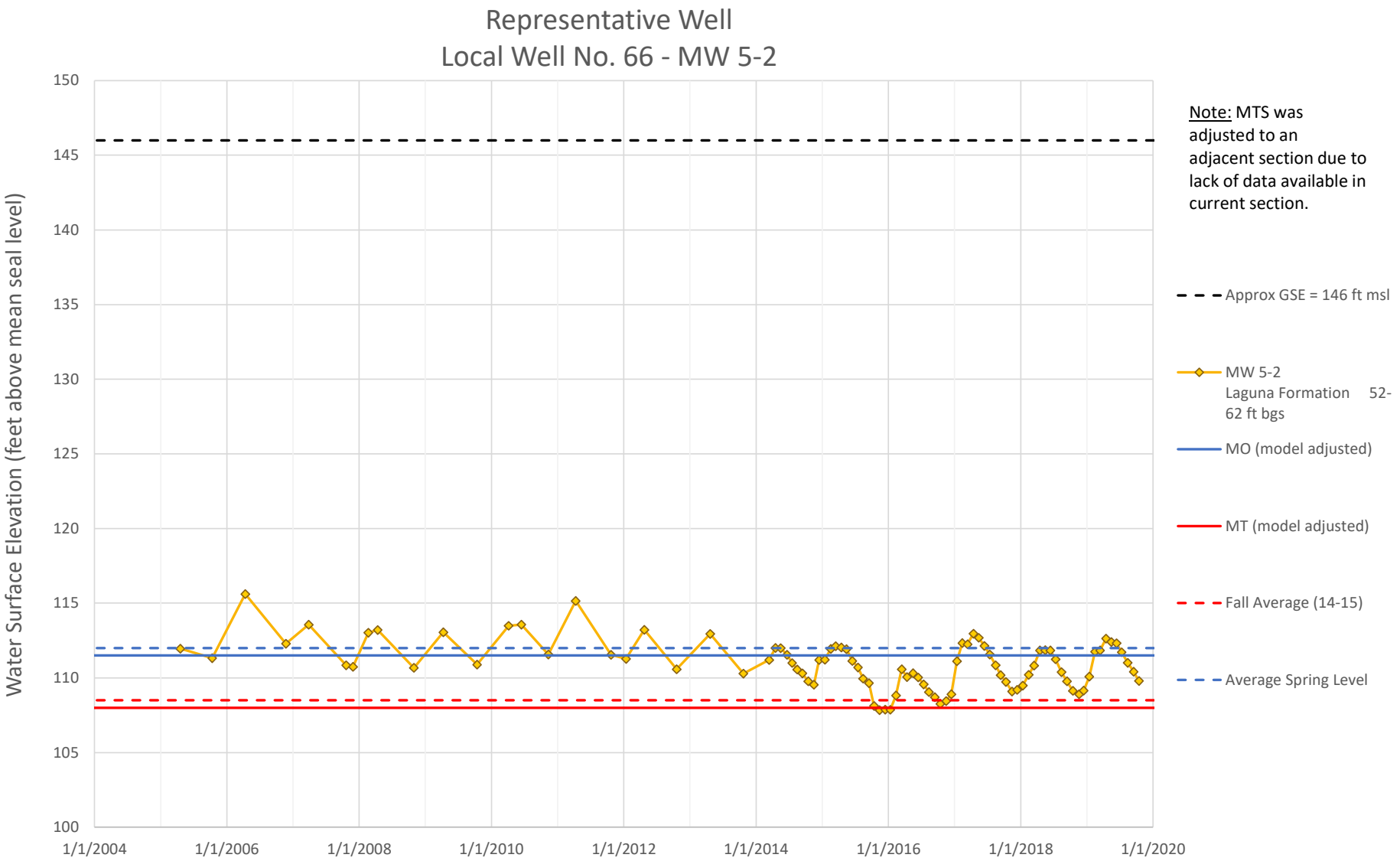

Representative Well
Local Well No. 48 - WPMW-4A
Water Surface Elevation (feet above mean sea level)
190
170
150
130
110
90
70
50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 180 ft msl
WPMW-4A
120-140 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level
30 feet bgs

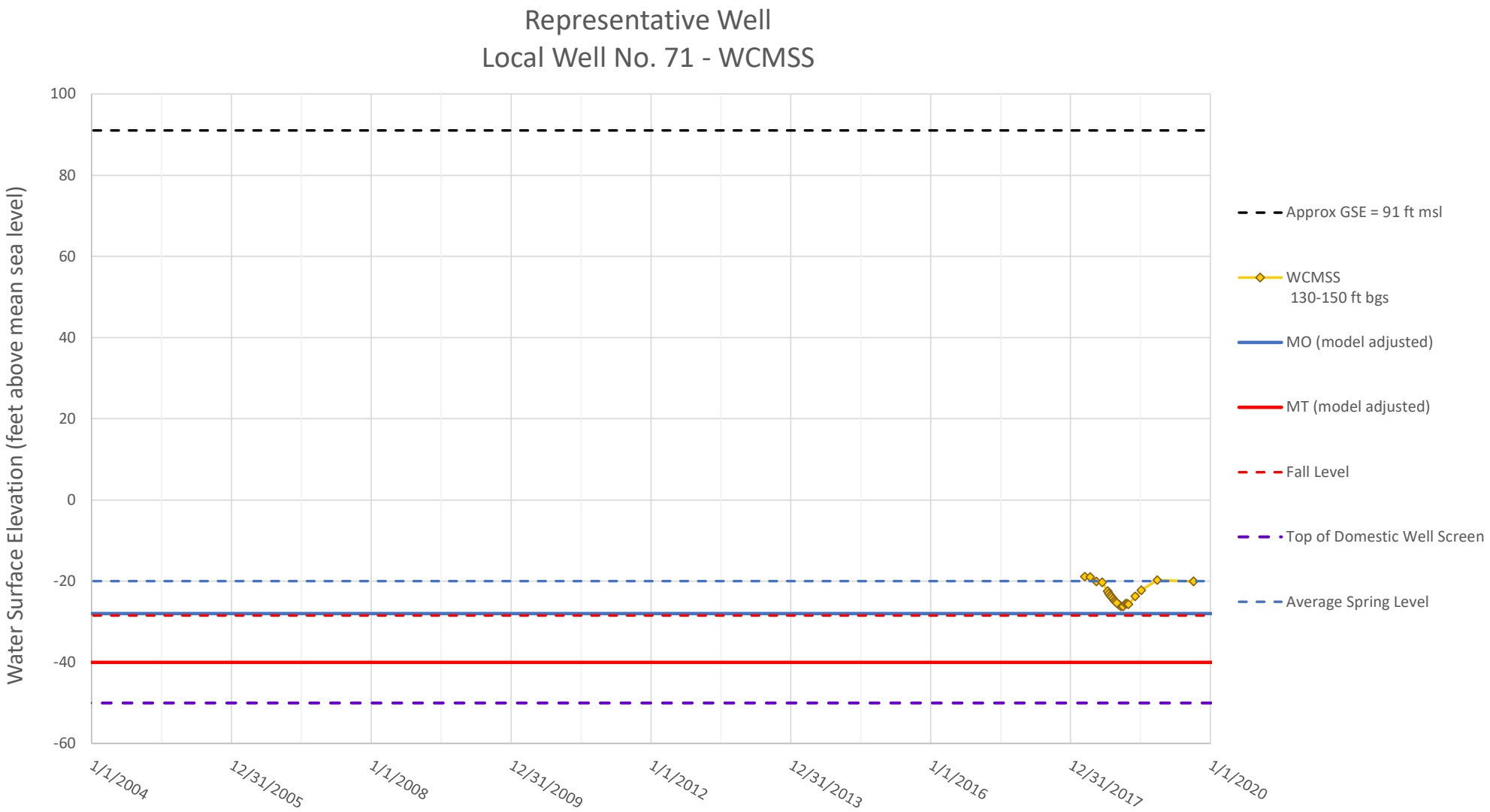

Representative Well
Local Well No. 60 - WPMW-2A
Water Surface Elevation (feet above mean sea level)
120
100
80
60
40
20
0
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 106 ft msl
WPMW-2A
Laguna Formation 215-225 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level

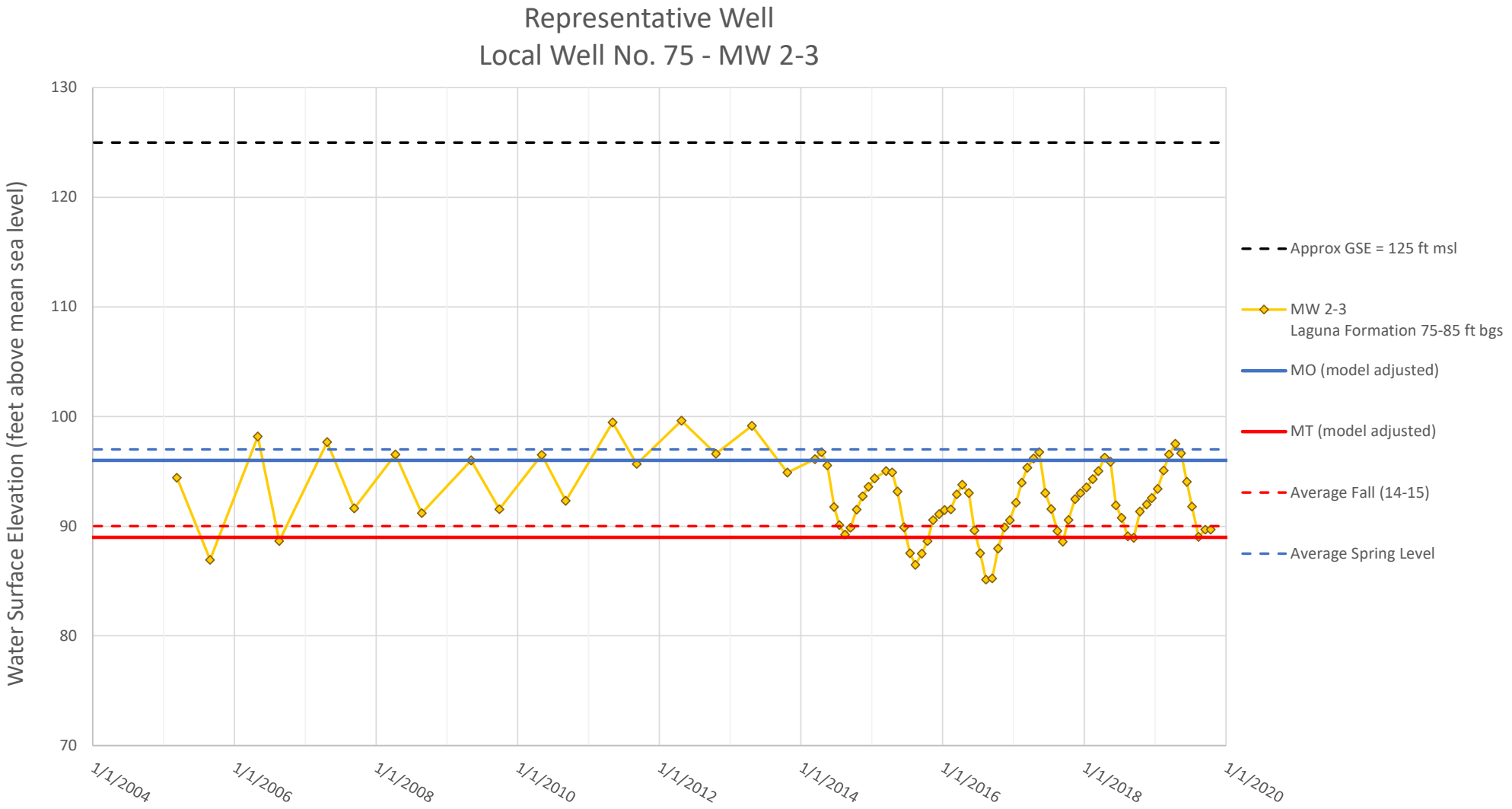

Representative Well
Local Well No. 61 - Sutter County MW-5A
Water Surface Elevation (feet above mean sea level)
40
30
20
10
0
-10
-20
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
1/1/2009
1/1/2011
1/1/2013
1/1/2015
1/1/2017
1/1/2019
Approx GSE = 25 ft msl
Sutter County MW-5A Laguna Formation 130-160 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level
30 feet bgs

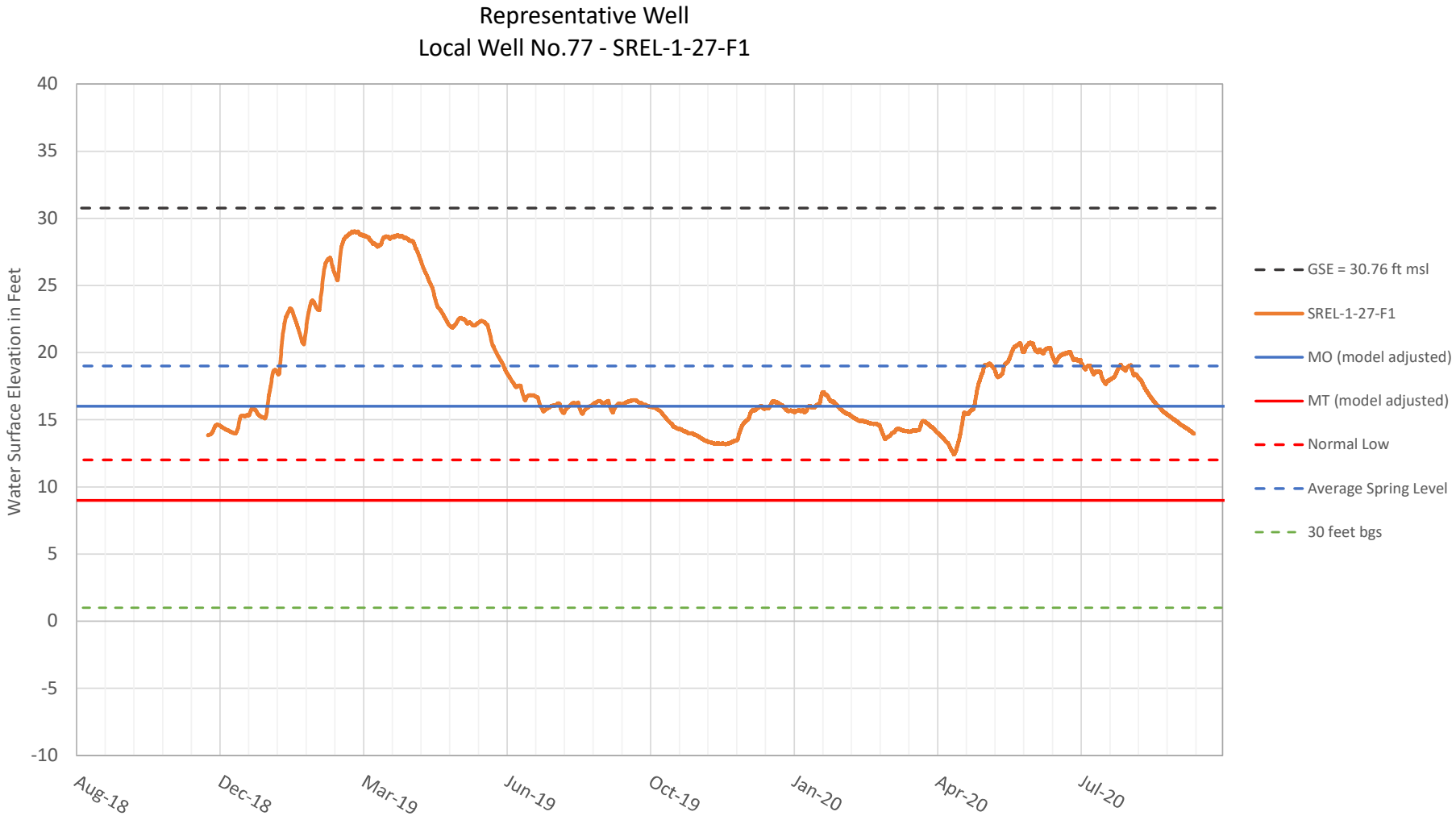

Representative Well
Local Well No. 63 - WPMW-3A
Water Surface Elevation (feet above mean sea level)
160
155
150
145
140
135
130
125
120
115
110
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
1/1/2022
Approx GSE = 148ft msl
WPMW-3A
Laguna Formation
48-53 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Spring Level
30 feet bgs
Average Fall (14-15)

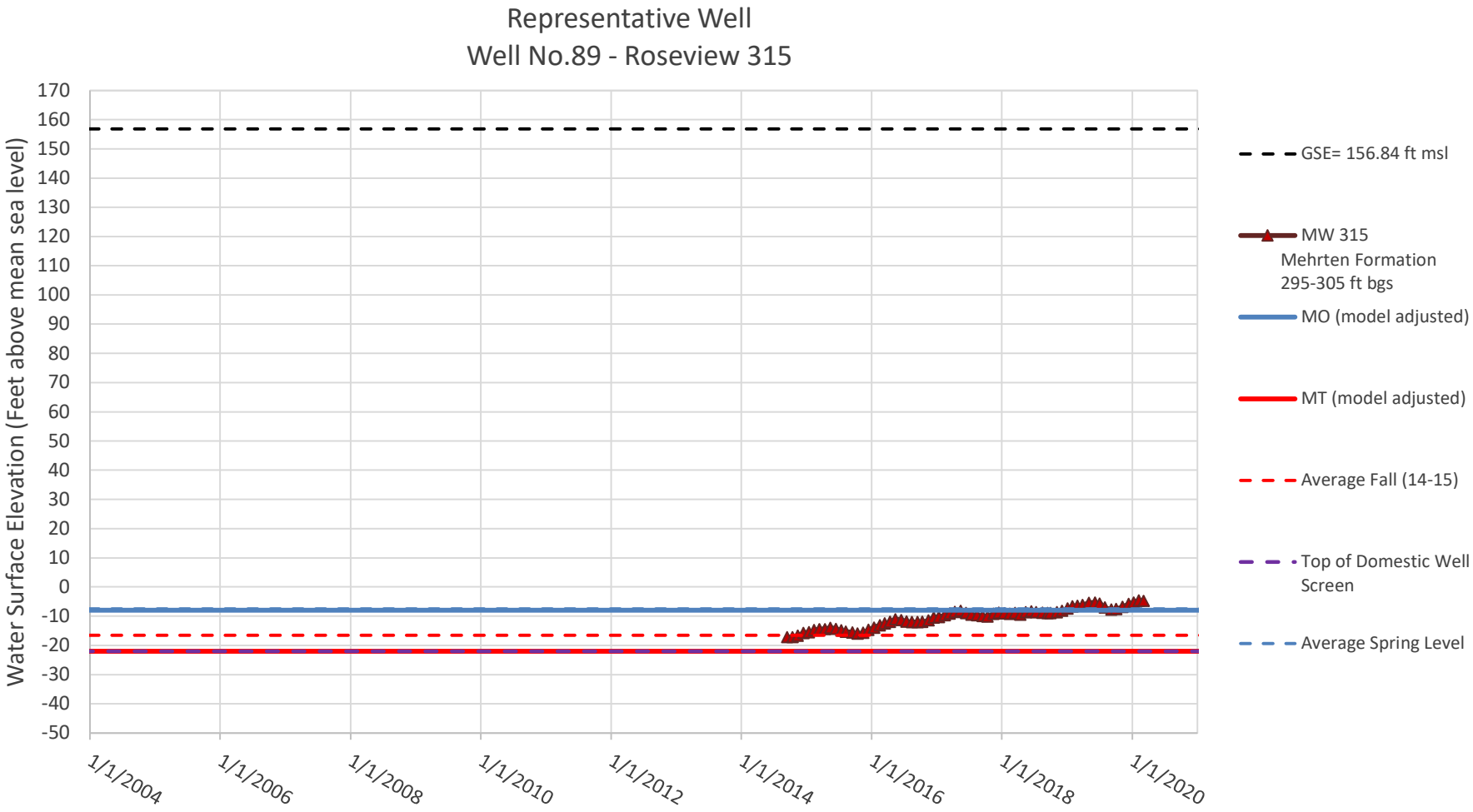

Representative Well
Local Well No. 65 - MW 1-3
Water Surface Elevation (feet above mean sea level)
120
110
100
90
80
70
60
50
40
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 112 ft msl
MW 1-3
Laguna Formation 184-204 ft bgs
MO (model adjusted)
MT (model adjusted)
Normal Low
Average Spring Level

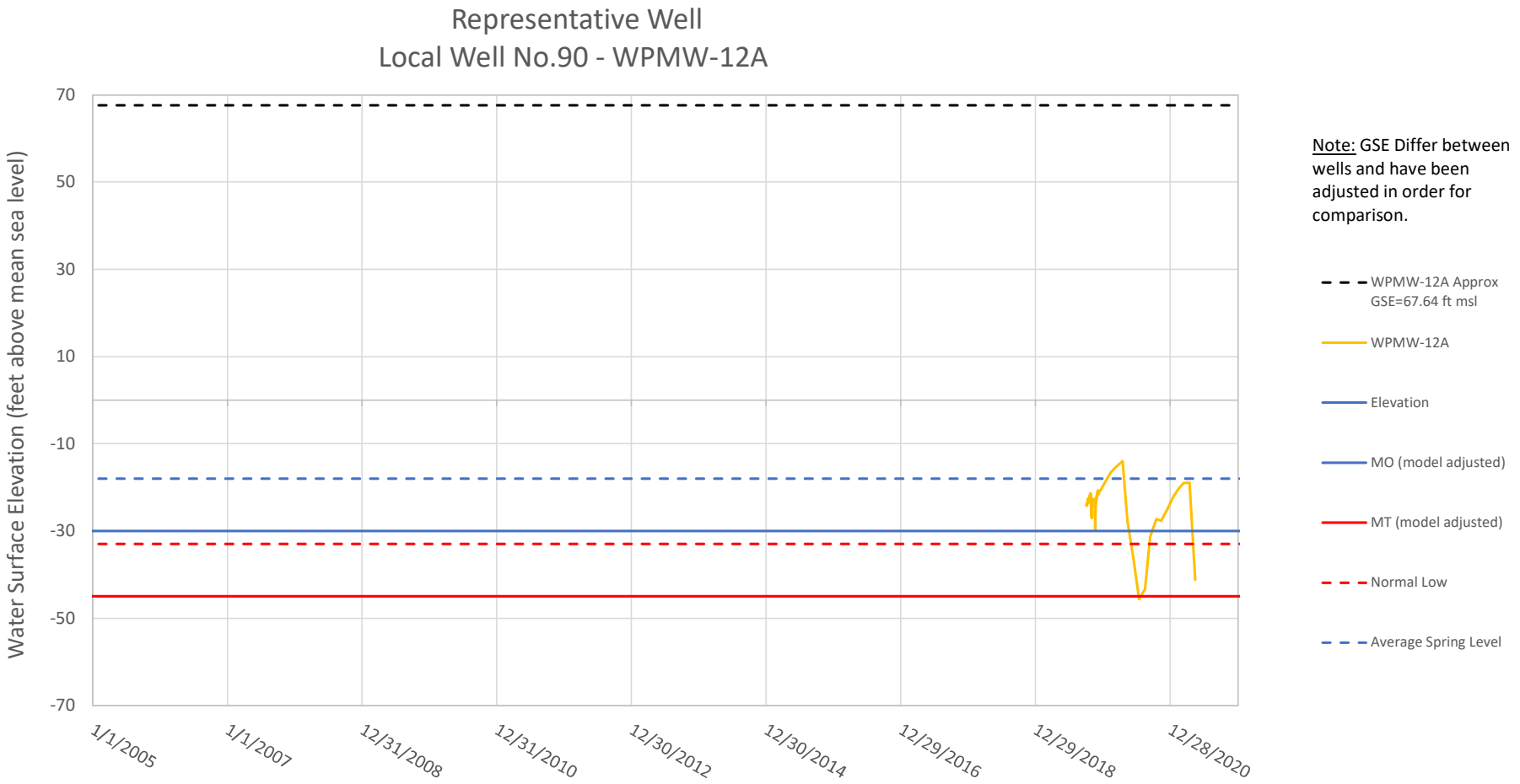

Representative Well
Local Well No. 66 - MW 5-2
Water Surface Elevation (feet above mean seal level)
150
145
140
135
130
125
120
115
110
105
100
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Note: MTS was adjusted to an adjacent section due to lack of data available in current section.
Approx GSE = 146 ft msl
MW 5-2 Laguna Formation 52-62 ft bgs
MO (model adjusted)
MT (model adjusted)
Fall Average (14-15)
Average Spring Level

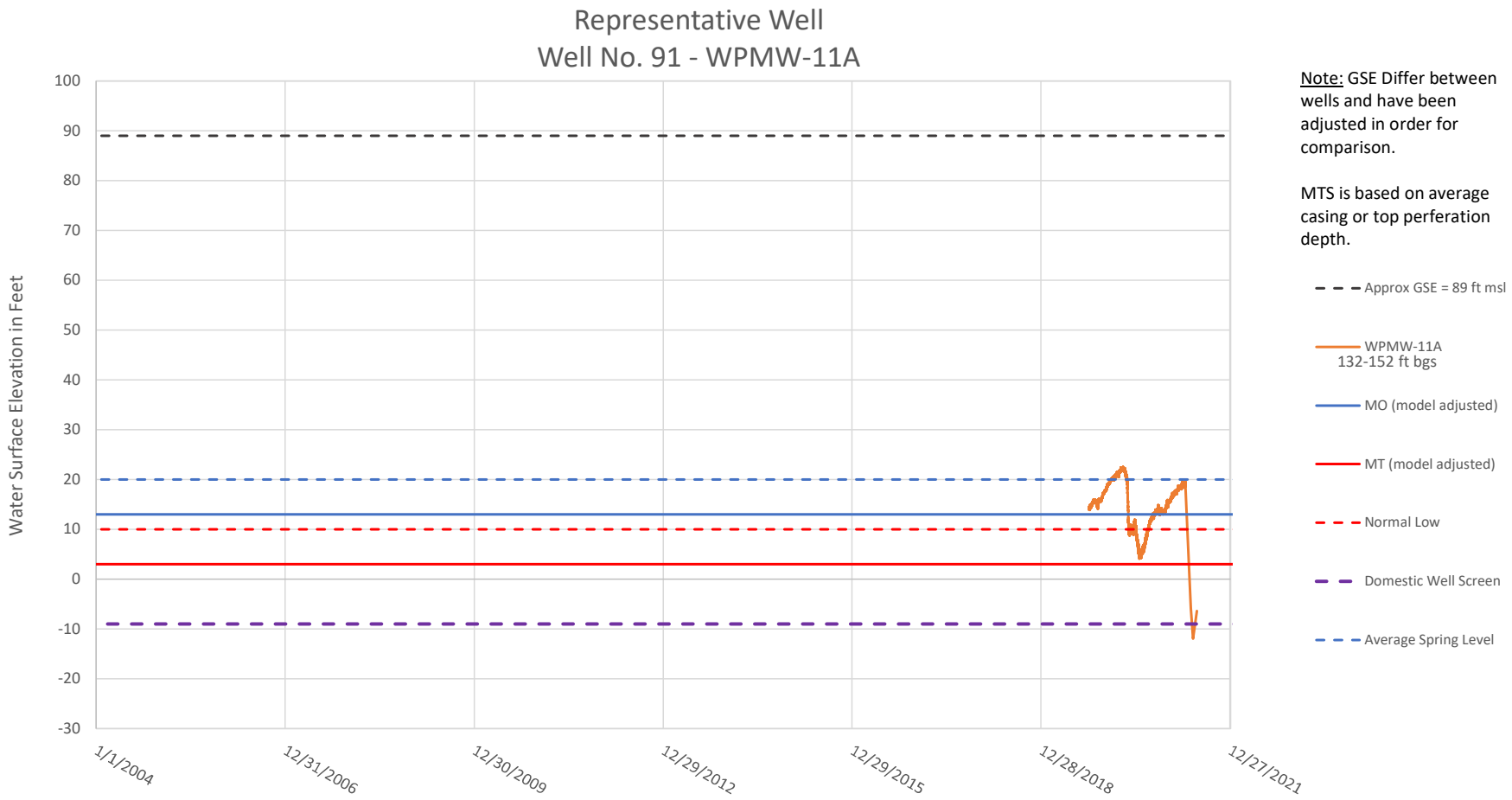

Representative Well
Local Well No. 71 - WCMSS
Water Surface Elevation (feet above mean sea level)
100
80
60
40
20
0
-20
-40
-60
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 91 ft msl
WCMSS
130-150 ft bgs
MO (model adjusted)
MT (model adjusted)
Fall Level
Top of Domestic Well Screen
Average Spring Level


Representative Well
Local Well No. 75 - MW 2-3
Water Surface Elevation (feet above mean sea level)
130
120
110
100
90
80
70
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 125 ft msl
MW 2-3
Laguna Formation 75-85 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Average Spring Level

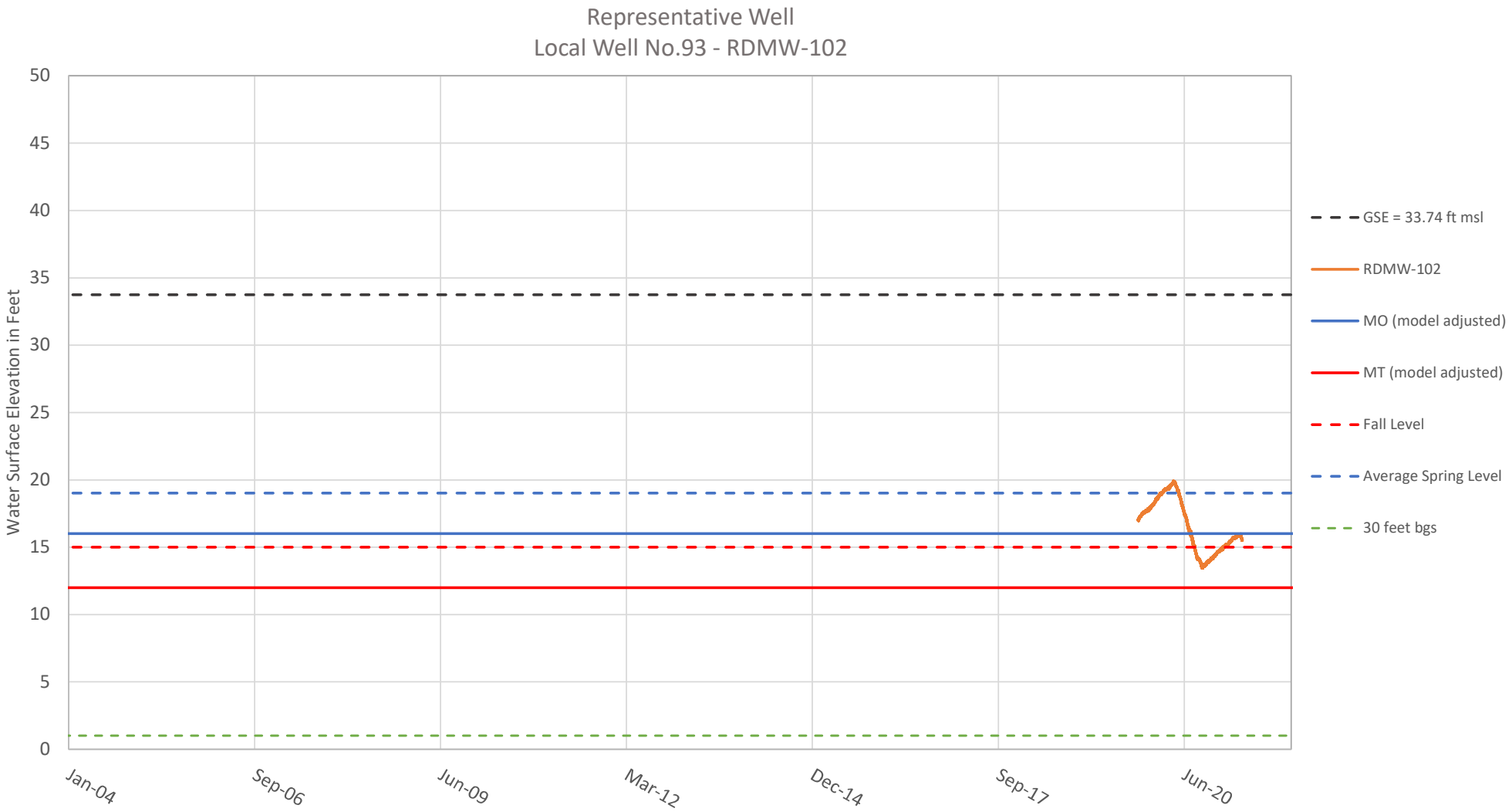

Representative Well
Local Well No.77 - SREL-1-27-F1
Water Surface Elevation in Feet
40
35
30
25
20
15
10
5
0
-5
-10
Aug-18
Dec-18
Mar-19
Jun-19
Oct-19
Jan-20
Apr-20
Jul-20
GSE = 30.76 ft msl
SREL-1-27-F1
MO (model adjusted)
MT (model adjusted)
Normal Low
Average Spring Level
30 feet bgs

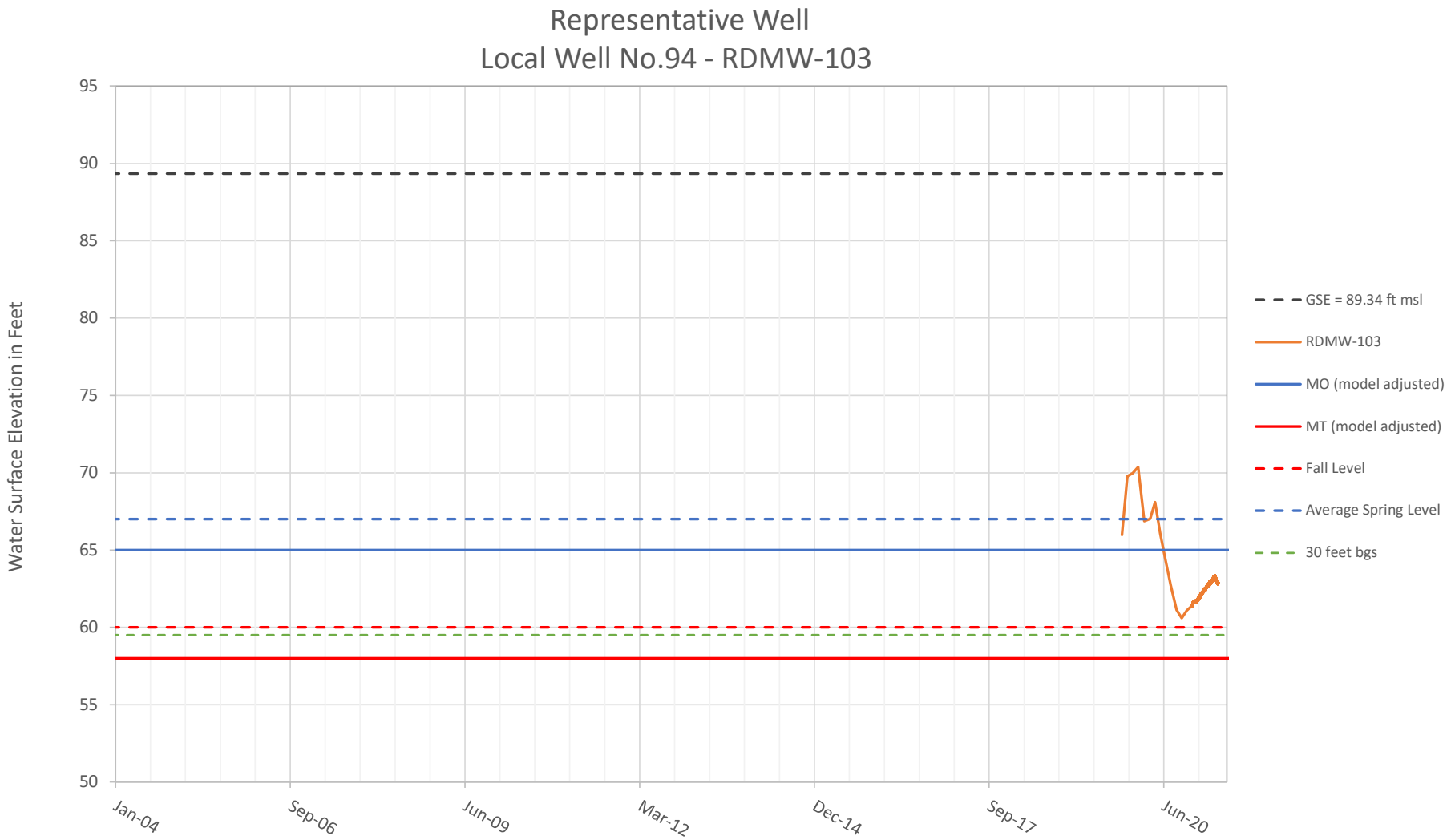

Representative Well
Well No.89 - Roseview 315
Water Surface Elevation (Feet above mean sea level)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
GSE= 156.84 ft msl
MW 315
Mehrten Formation
295-305 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Top of Domestic Well Screen
Average Spring Level

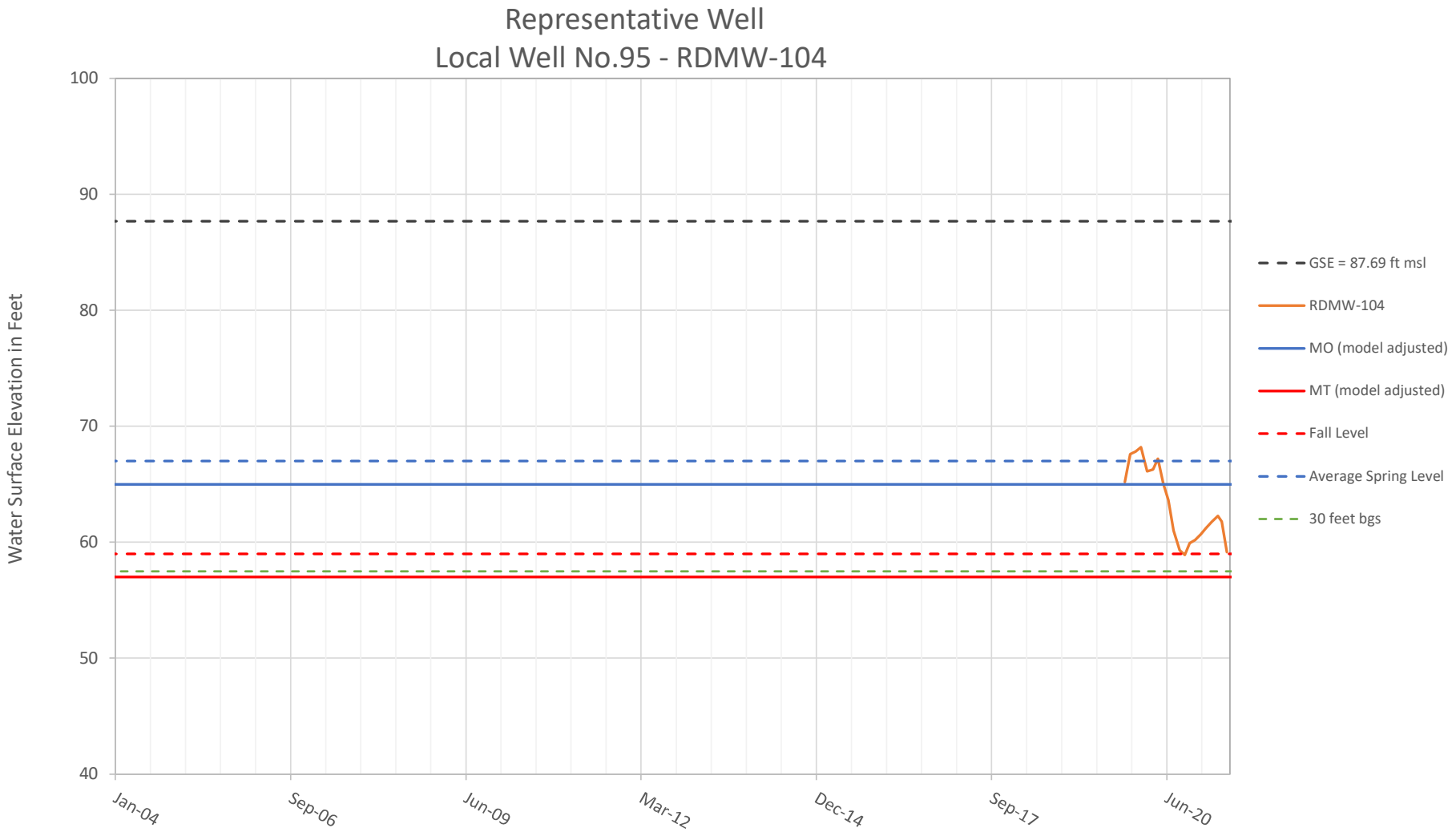

Representative Well
Local Well No.90 - WPMW-12A
Water Surface Elevation (feet above mean sea level)
70
50
30
10
-10
-30
-50
-70
1/1/2005
1/1/2007
12/31/2008
12/31/2010
12/30/2012
12/30/2014
12/29/2016
12/29/2018
12/28/2020
Note: GSE Differ between wells and have been adjusted in order for comparison.
WPMW-12A Approx GSE=67.64 ft msl
WPMW-12A
Elevation
MO (model adjusted)
MT (model adjusted)
Normal Low
Average Spring Level

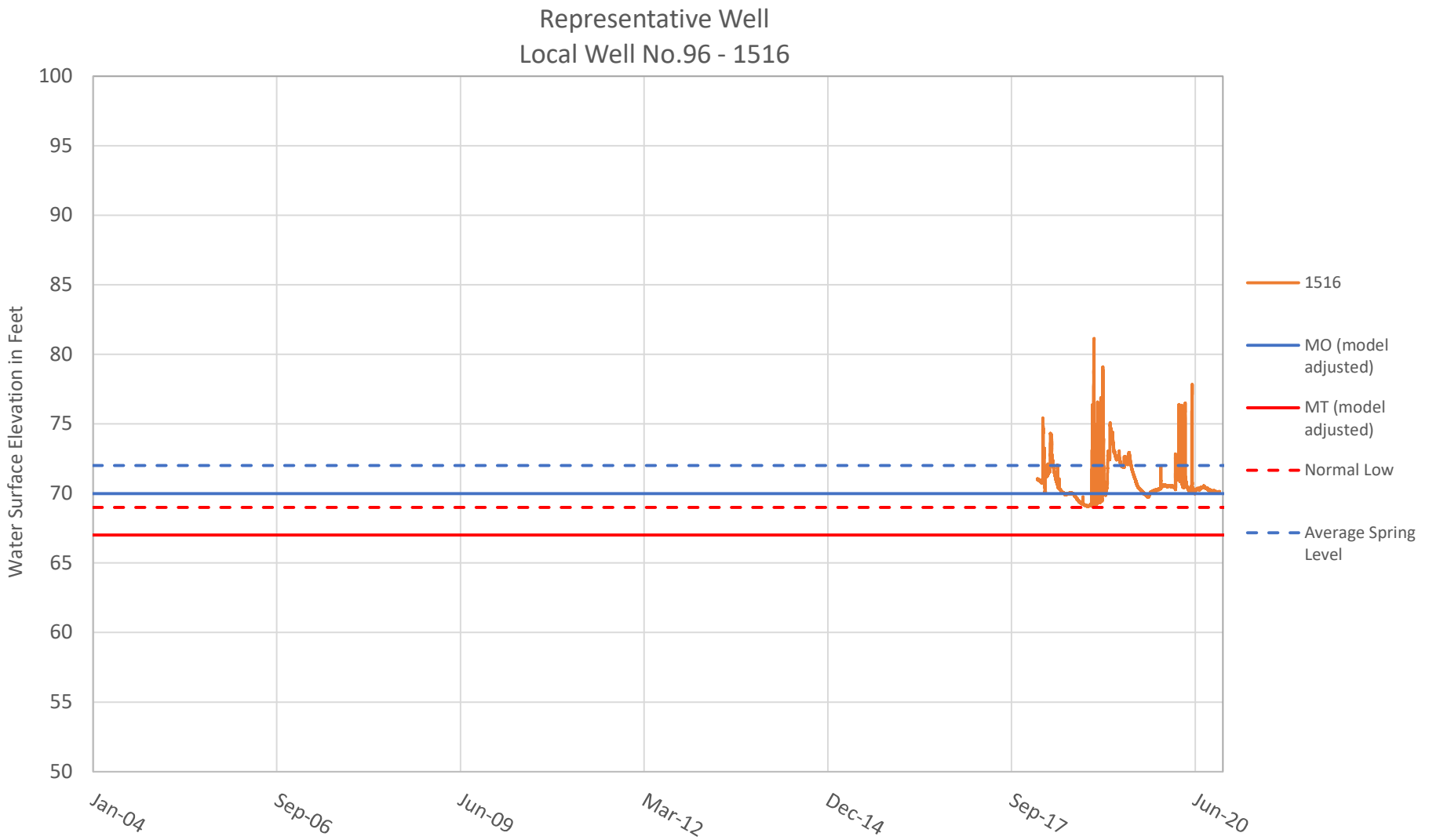

Representative Well
Well No. 91 - WPMW-11A
Water Surface Elevation in Feet
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
1/1/2004
12/31/2006
12/30/2009
12/29/2012
12/29/2015
12/28/2018
12/27/2021
Note: GSE Differ between wells and have been adjusted in order for comparison.
MTS is based on average casing or top perferation depth.
Approx GSE = 89 ft msl
WPMW-11A 132-152 ft bgs
MO (model adjusted)
MT (model adjusted)
Normal Low
Domestic Well Screen
Average Spring Level

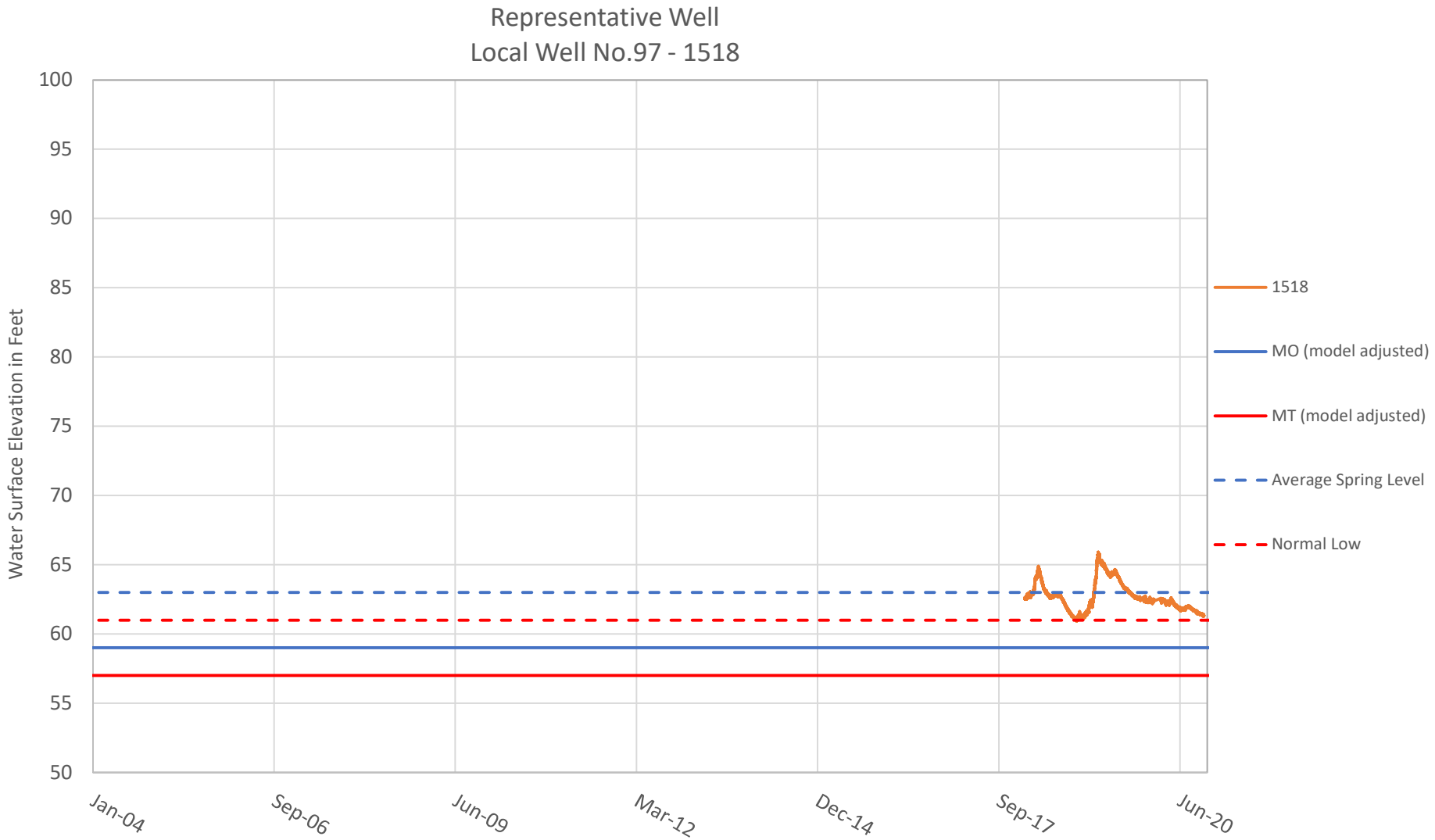

Representative Well
Local Well No.92 - RDMW-101
Water Surface Elevation in Feet
40
35
30
25
20
15
10
5
0
Jan-04
Sep-06
Jun-09
Mar-12
Dec-14
Sep-17
Jun-20
GSE = 33.74 ft msl
RDMW-101
MO (model adjusted)
MT (model adjusted)
Fall Level
Average Spring Level
30 feet bgs

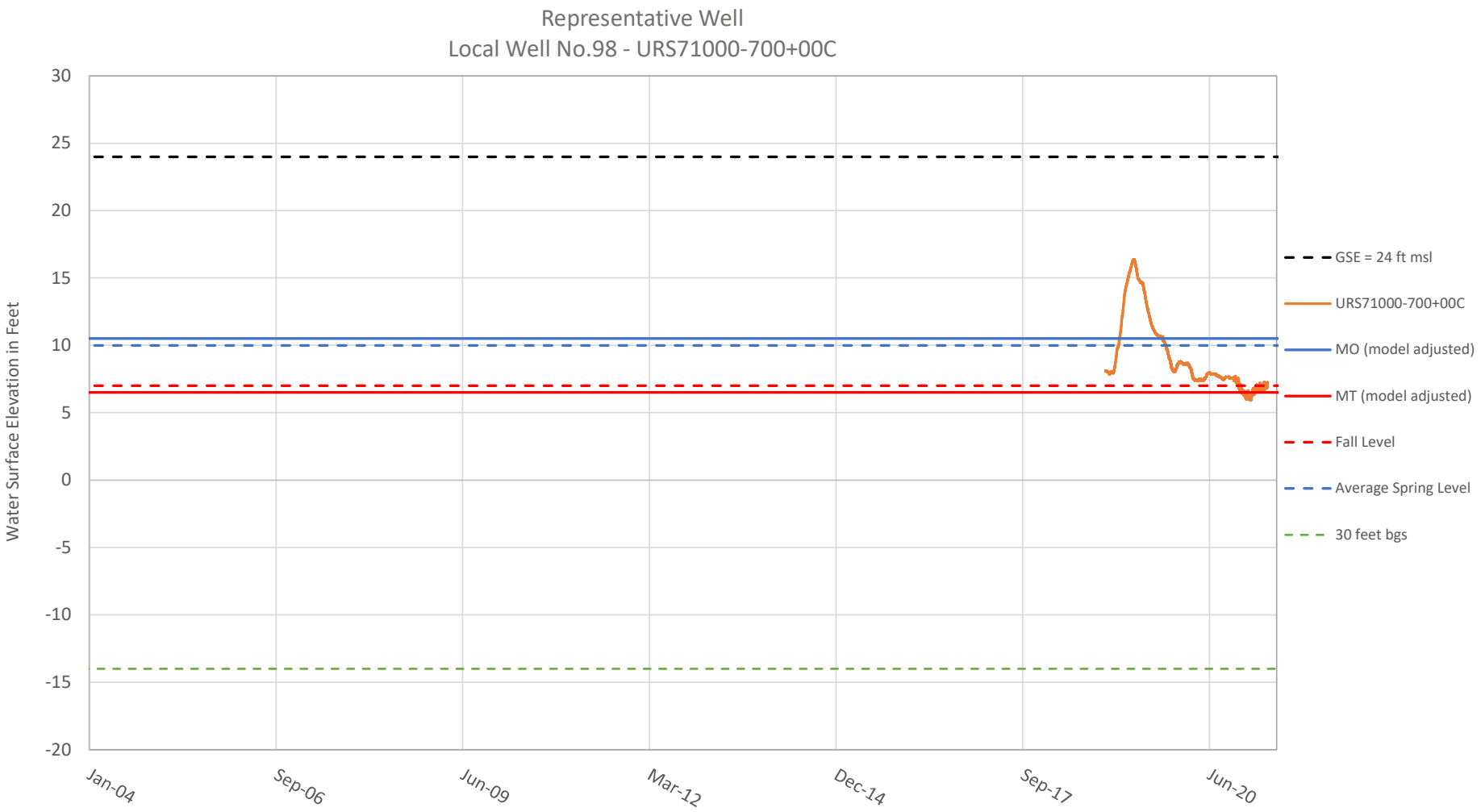

Representative Well
Local Well No.93 - RDMW-102
Water Surface Elevation in Feet
50
45
40
35
30
25
20
15
10
5
0
Jan-04
Sep-06
Jun-09
Mar-12
Dec-14
Sep-17
Jun-20
GSE = 33.74 ft msl
RDMW-102
MO (model adjusted)
MT (model adjusted)
Fall Level
Average Spring Level
30 feet bgs

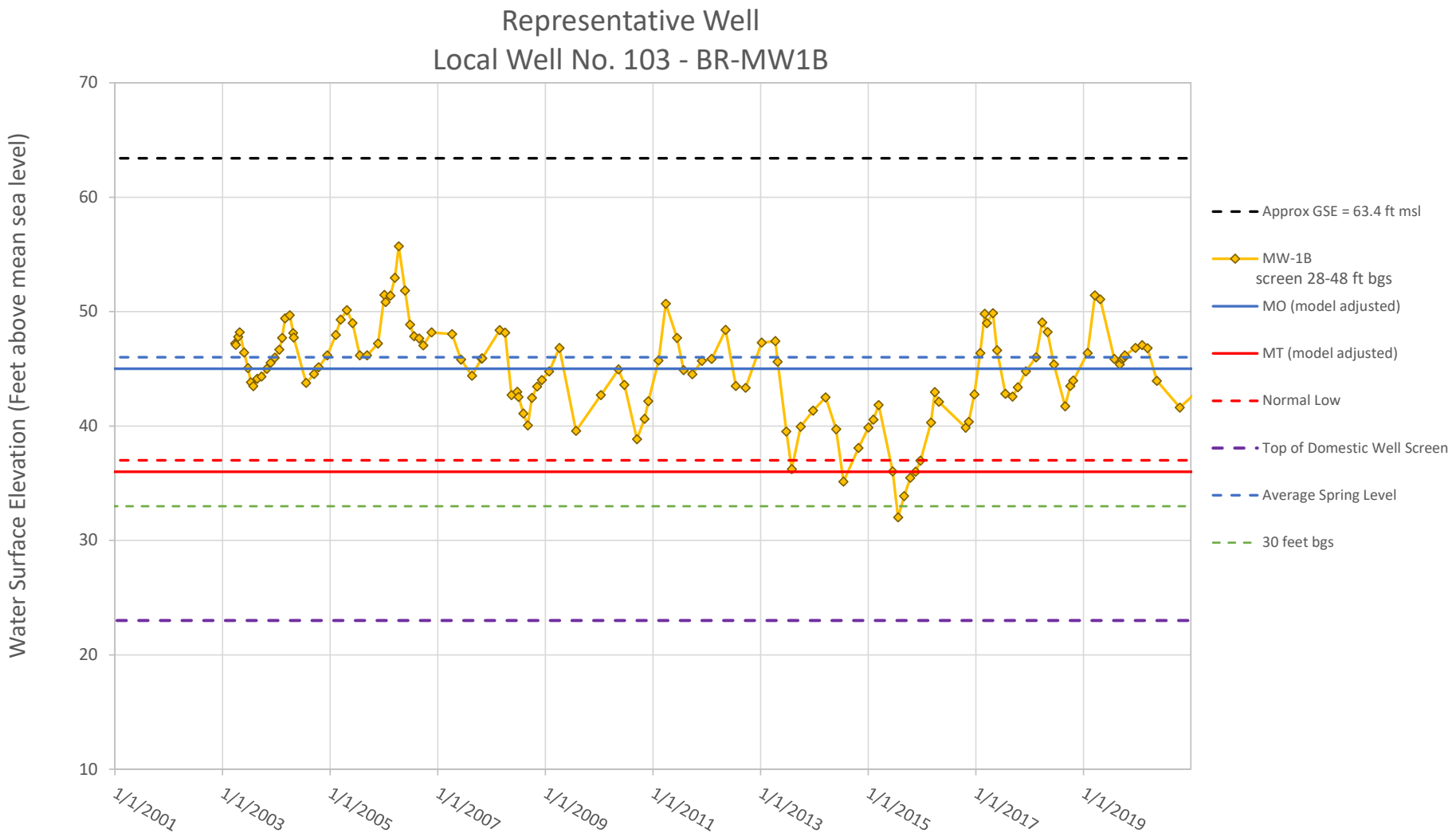

Representative Well
Local Well No.94 - RDMW-103
Water Surface Elevation in Feet
95
90
85
80
75
70
65
60
55
50
Jan-04
Sep-06
Jun-09
Mar-12
Dec-14
Sep-17
Jun-20
GSE = 89.34 ft msl
RDMW-103
MO (model adjusted)
MT (model adjusted)
Fall Level
Average Spring Level
30 feet bgs

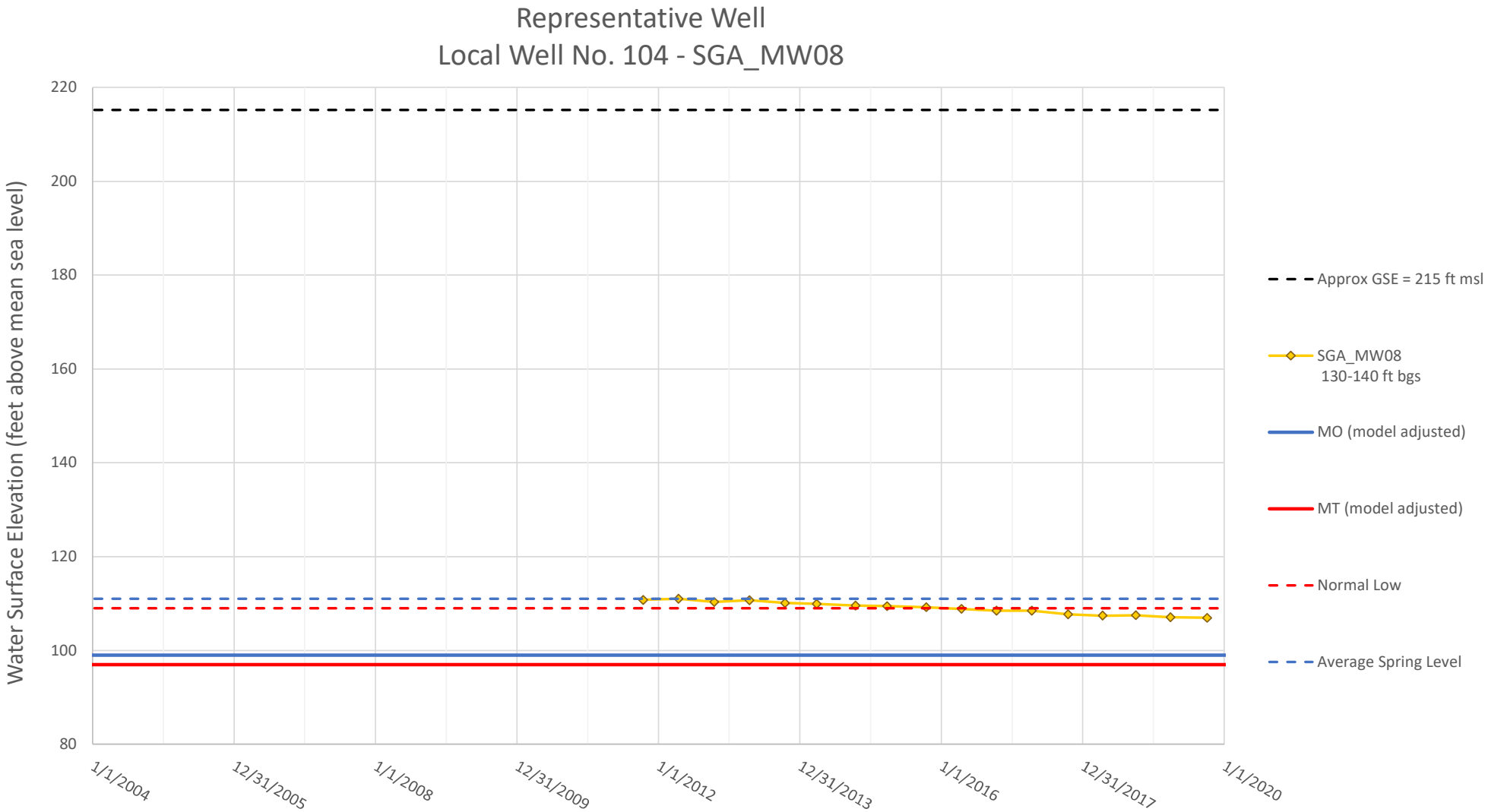

Representative Well
Local Well No.95 - RDMW-104
Water Surface Elevation in Feet
100
90
80
70
60
50
40
Jan-04
Sep-06
Jun-09
Mar-12
Dec-14
Sep-17
Jun-20
GSE = 87.69 ft msl
RDMW-104
MO (model adjusted)
MT (model adjusted)
Fall Level
Average Spring Level
30 feet bgs

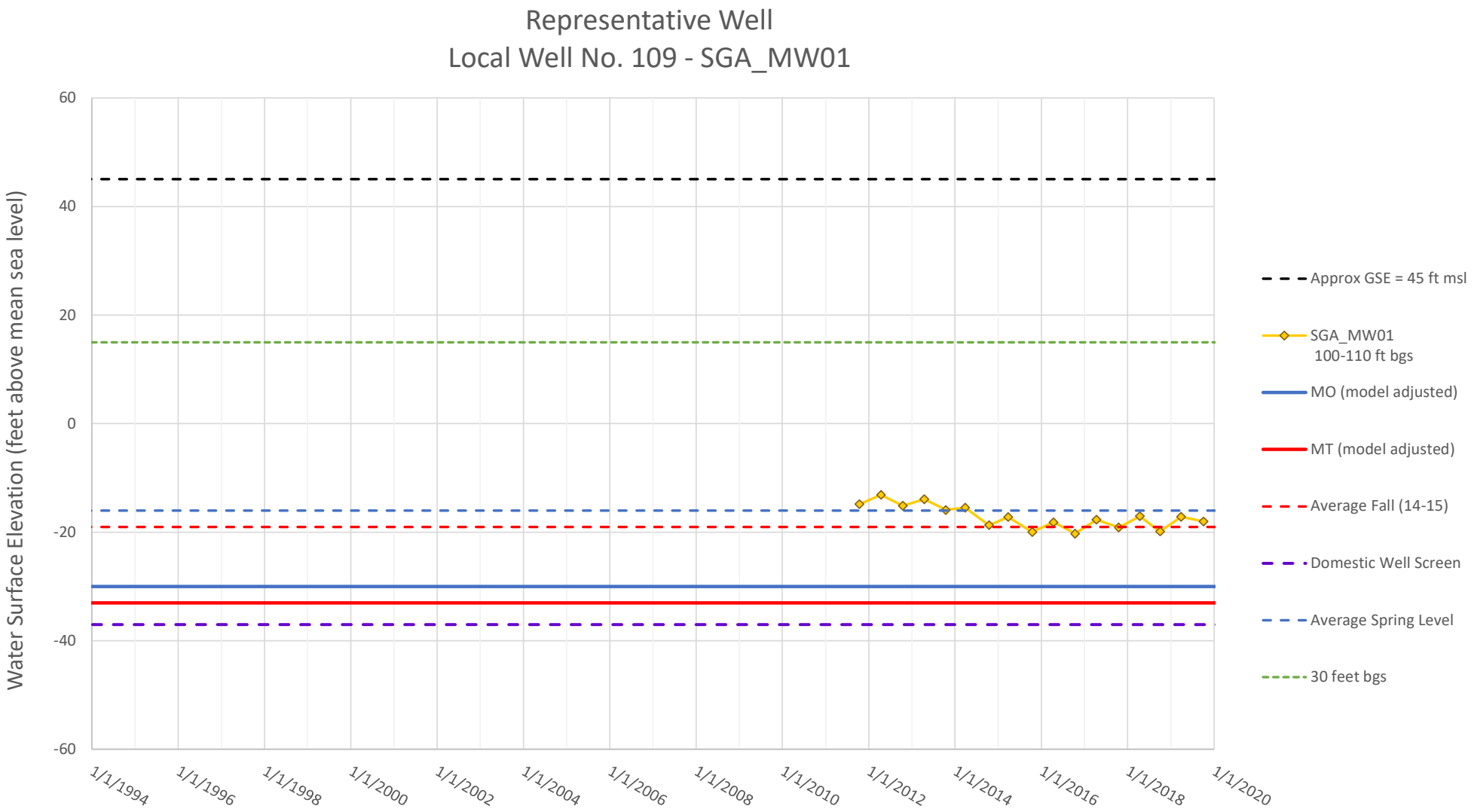

Representative Well
Local Well No.96 - 1516
Water Surface Elevation in Feet
100
95
90
85
80
75
70
65
60
55
50
Jan-04
Sep-06
Jun-09
Mar-12
Dec-14
Sep-17
Jun-20
1516
MO (model adjusted)
MT (model adjusted)
Normal Low
Average Spring Level

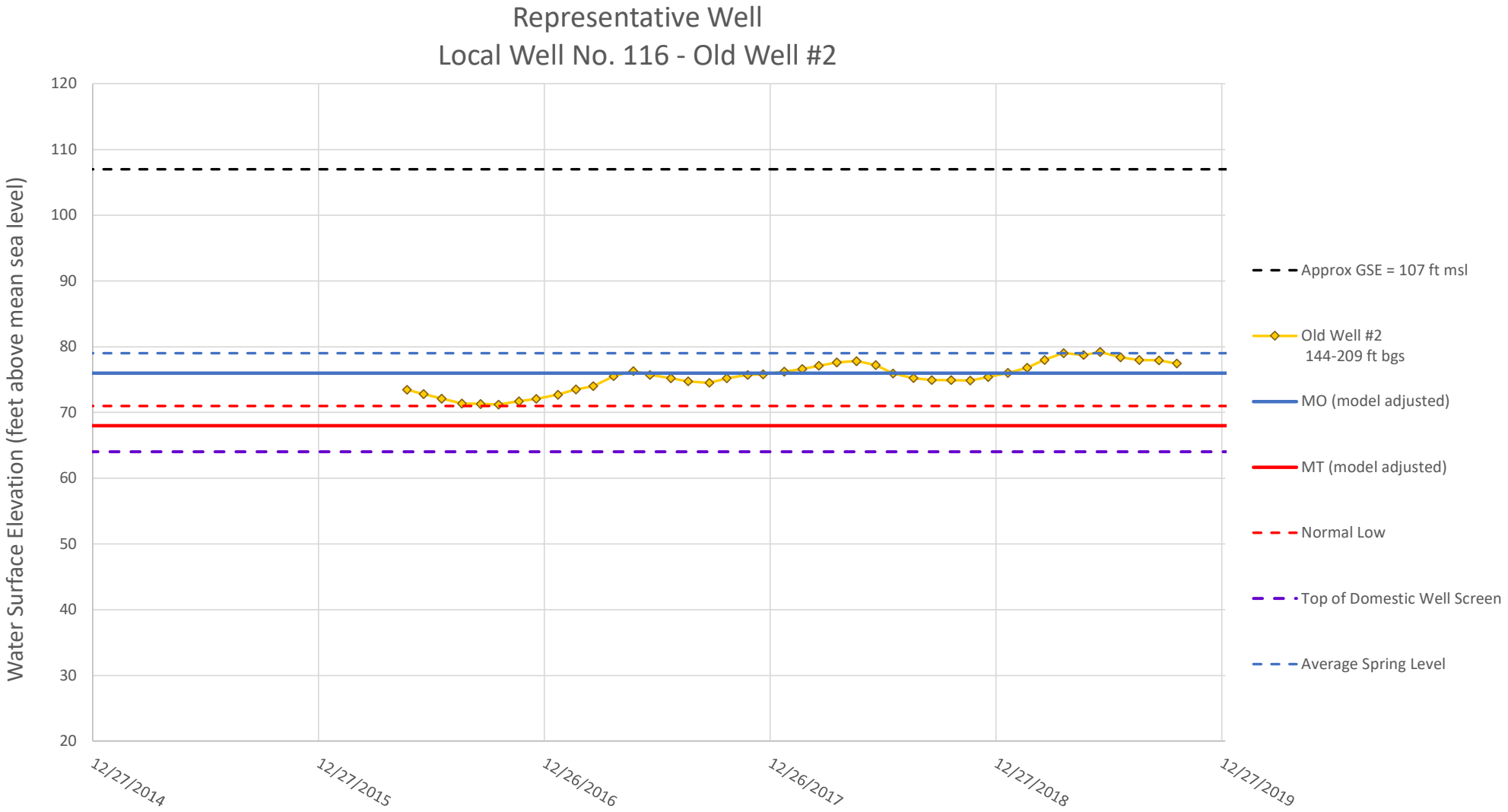

Representative Well
Local Well No.97 - 1518
Water Surface Elevation in Feet
100
95
90
85
80
75
70
65
60
55
50
Jan-04
Sep-06
Jun-09
Mar-12
Dec-14
Sep-17
Jun-20
1518
MO (model adjusted)
MT (model adjusted)
Average Spring Level
Normal Low

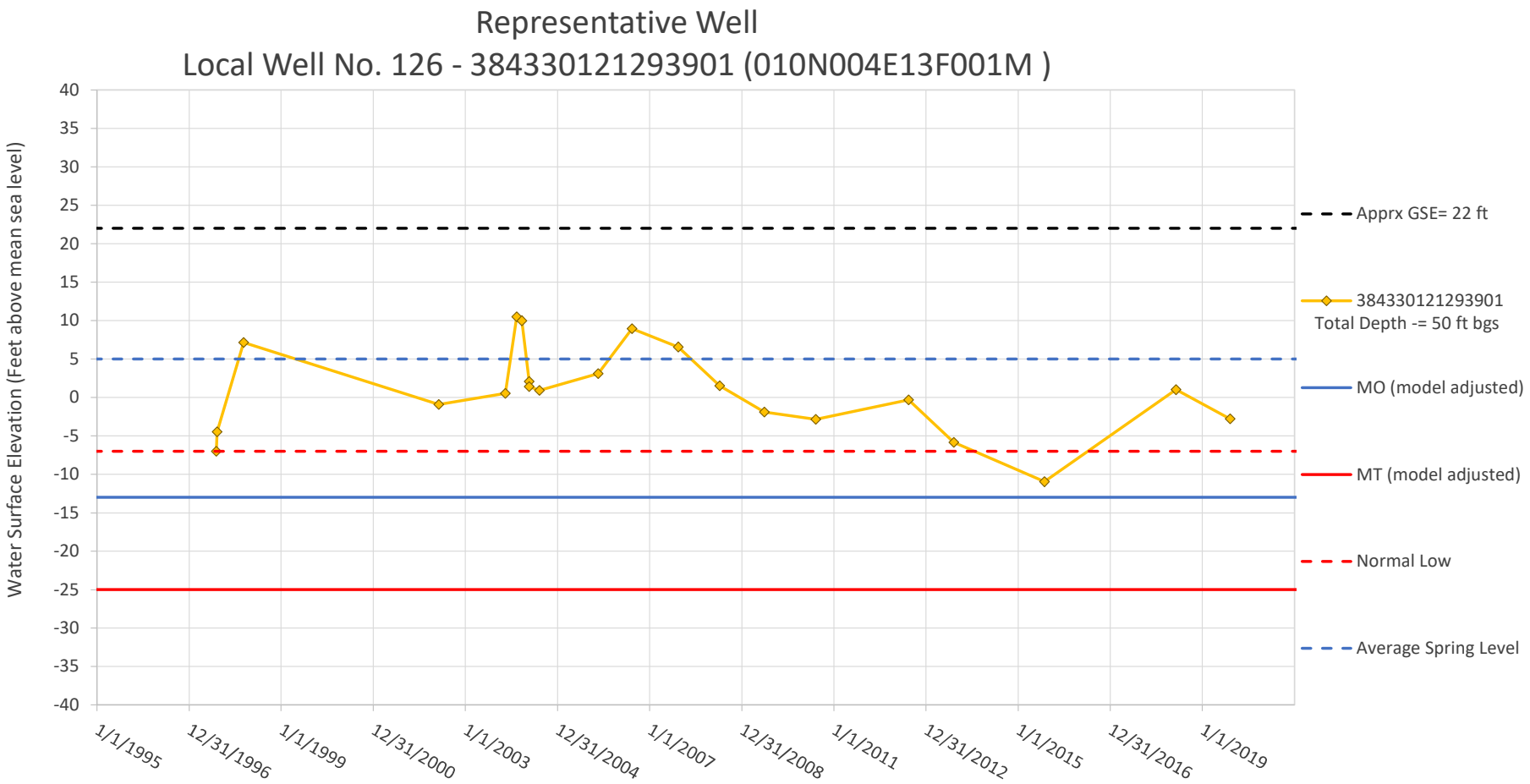

Representative Well
Local Well No.98 - URS71000-700+00C
Water Surface Elevation in Feet
30
25
20
15
10
5
0
-5
-10
-15
-20
Jan-04
Sep-06
Jun-09
Mar-12
Dec-14
Sep-17
Jun-20
GSE = 24 ft msl
URS71000-700+00C
MO (model adjusted)
MT (model adjusted)
Fall Level
Average Spring Level
30 feet bgs


Representative Well
Local Well No. 103 - BR-MW1B
Water Surface Elevation (Feet above mean sea level)
70
60
50
40
30
20
10
1/1/2001
1/1/2003
1/1/2005
1/1/2007
1/1/2009
1/1/2011
1/1/2013
1/1/2015
1/1/2017
1/1/2019
Approx GSE = 63.4 ft msl
MW-1B
screen 28-48 ft bgs
MO (model adjusted)
MT (model adjusted)
Normal Low
Top of Domestic Well Screen
Average Spring Level
30 feet bgs


Representative Well
Local Well No. 104 - SGA_MW08
Water Surface Elevation (feet above mean sea level)
220
200
180
160
140
120
100
80
1/1/2004
12/31/2005
1/1/2008
12/31/2009
1/1/2012
12/31/2013
1/1/2016
12/31/2017
1/1/2020
Approx GSE = 215 ft msl
SGA_MW08
130-140 ft bgs
MO (model adjusted)
MT (model adjusted)
Normal Low
Average Spring Level


Representative Well
Local Well No. 109 - SGA_MW01
Water Surface Elevation (feet above mean sea level)
60
40
20
0
-20
-40
-60
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
Approx GSE = 45 ft msl
SGA_MW01
100-110 ft bgs
MO (model adjusted)
MT (model adjusted)
Average Fall (14-15)
Domestic Well Screen
Average Spring Level
30 feet bgs


Representative Well
Local Well No. 116 - Old Well #2
Water Surface Elevation (feet above mean sea level)
120
110
100
90
80
70
60
50
40
30
20
12/27/2014
12/27/2015
12/26/2016
12/26/2017
12/27/2018
12/27/2019
Approx GSE = 107 ft msl
Old Well #2
144-209 ft bgs
MO (model adjusted)
MT (model adjusted)
Normal Low
Top of Domestic Well Screen
Average Spring Level


Representative Well
Local Well No. 126 - 384330121293901 (010N004E13F001M)
Water Surface Elevation (Feet above mean sea level)
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
1/1/1995
12/31/1996
1/1/1999
12/31/2000
1/1/2003
12/31/2004
1/1/2007
12/31/2008
1/1/2011
12/31/2012
1/1/2015
12/31/2016
1/1/2019
Apprx GSE= 22 ft
384330121293901
Total Depth -= 50 ft bgs
MO (model adjusted)
MT (model adjusted)
Normal Low
Average Spring Level

Appendix R: List of Public Meetings

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX R
List of Public Meetings

December 2021

Table R-1 - List of Public Meetings

	AGENCY ACTIVITIES	DATE	COMMUNICATION TACTICS / TOOLS	KEY MESSAGES
PRIOR TO GSP PREPARATION	PRE-GSP NOTIFICATION			
	Natomas Central Mutual Water Company	February 10, 2015	Public meeting, standard public notice, mailers to all Shareholders and Farmers in the Natomas Basin.	Update on SGMA, GSA formation, how to participate in GSP. Review of groundwater levels in Natomas Basin.
	Sacramento Groundwater Authority	September 23, 2015	Direct letter to small water systems in GSA service area	Informed systems of SGMA requirement and invited them to participate in GSP development. Two systems requested to be added to distribution list.
	Natomas Central Mutual Water Company	February 9, 2016	Public meeting, standard public notice, mailers to all Shareholders and Farmers in the Natomas Basin.	Update on SGMA, GSA formation, how to participate in GSP. Review of groundwater levels in Natomas Basin.
	Placer County Agricultural Commission	January 9, 2017	Public meeting, standard public notice	Update on SGMA, WPGSA formation, GSP requirements, how the public may engage
	Nevada Irrigation District Board Meeting	January 10, 2017	Public meeting, standard public notice	Update on SGMA, WPGSA formation, GSP requirements, how the public may engage
	Rural Lincoln Municipal Advisory Committee	February 7, 2017	Public meeting, standard public notice	Update on SGMA, WPGSA formation, GSP requirements, how the public may engage
	Natomas Central Mutual Water Company	February 14, 2017	Public meeting, standard public notice, mailers to all Shareholders and Farmers in the Natomas Basin.	Update on SGMA, GSA formation, participation in GSP. Review of groundwater levels in Natomas Basin.
	Sheridan Municipal Advisory Committee	February 27, 2017	Public meeting, standard public notice	Update on SGMA, WPGSA formation, GSP requirements, how the public may engage
	Placer Resource Conservation District	February 28, 2017	Public meeting, standard public notice	Update on SGMA, WPGSA formation, GSP requirements, how the public may engage
	Nevada Irrigation District Board Meeting	March 8, 2017	Public meeting, standard public notice	Update on SGMA, WPGSA formation, GSP requirements, how the public may engage
	Public Workshop - WPGSA	October 12, 2017	Public meeting. Standard Stakeholder blast: Email Notification to all stakeholders, interested parties, social and traditional media outlets, agency specific posts.	Update on SGMA, WPGSA formation, GSP requirements, how the public may engage
	Notice of Grant Opportunities	December 18, 2017	Standard stakeholder / interested parties blast.	Seeking input on grant opportunities for groundwater and agriculture-related projects
	Notice of Public GSA Meeting	January 1, 2018	Standard stakeholder / interested parties blast.	Public meeting announcement
	Public Workshop - Lincoln City Hall	February 8, 2018	Public meeting	Update on GSA activities
	Natomas Central Mutual Water Company	February 13, 2018	Public meeting, standard public notice, mailers to all Shareholders and Farmers in the Natomas Basin.	Update on SGMA, GSA formation, participation in GSP. Review of groundwater levels in Natomas Basin.
	Notice of Public GSA Meeting	May 2, 2018	Standard stakeholder / interested parties blast.	Public meeting announcement
	Public Workshop - Lincoln City Hall	May 31, 2018	Public meeting, standard public notice	Update on GSA activities, grant, GSP, seasonal water update
	Public Survey	August 2, 2018	Standard stakeholder / interested parties blast.	How are we doing to keep stakeholders / interested parties up to date and part of the process?
	Placer County Agricultural Commission	August 13, 2018	Public meeting	Update on SGMA, WPGSA activities
	City of Rocklin Council Meeting	October 9, 2018	Public meeting	Update on SGMA, WPGSA activities
	ASR Well Open House	October 20, 2018	Standard stakeholder / interested parties blast.	Local efforts to conserve groundwater
	WPGSA Media Campaign	October 11, 2018	Placer County online news post, promoted through County newsletter, online blog post, FaceBook, Next Door, Twitter, and press release (Roseville Today, Sacramento Bee, KCRA, ABC 10, CBS).	Participate in your local groundwater plan
	GSP INITIAL NOTIFICATION			
	Initial Notification Filed	September 24, 2018	Email Notification to all stakeholders. Public notification pursuant to Gov. Code.	Notice of Intent to Develop GSP
	Stakeholder announcement		Standard stakeholder / interested parties blast.	Initial notification filed, how to comment, grant funding received, GSP preparation to begin, methods for interested parties to participate.
	GSA Member Board/Council Meetings:			
	Placer County Board Meeting	September 25, 2018	Public meeting, standard public noticing.	Initial notification filed, grant funding received, GSP preparation to begin, methods for interested parties to participate.

PRIOR TO GSP PREPARATION	PCWA Board Meeting	October 4, 2018	Public meeting, standard public noticing.	Initial notification filed, grant funding received, GSP preparation to begin, methods for interested parties to participate.
	Nevada Irrigation District Board Meeting	October 24, 2018	Public meeting, standard public noticing.	Initial notification filed, grant funding received, GSP preparation to begin, methods for interested parties to participate.
	City of Lincoln Council Meeting	October 9, 2018	Public meeting, standard public noticing.	Initial notification filed, grant funding received, GSP preparation to begin, methods for interested parties to participate.
	City of Rocklin Council Meeting	October 9, 2018	Public meeting, standard public noticing.	Initial notification filed, grant funding received, GSP preparation to begin, methods for interested parties to participate.
	City of Roseville Council Meeting	October 17, 2018	Public meeting, standard public noticing.	Initial notification filed, grant funding received, GSP preparation to begin, methods for interested parties to participate.
	PROGRESS UPDATES			
	Natomas Central Mutual Water Company	February 12, 2019	Public meeting, standard public notice, mailers to all Shareholders and Farmers in the Natomas Basin.	Update on SGMA, GSP, methods for interested parties to participate. Review of groundwater levels in the North American Sub Basin
	Reclamation District 1001	July 1, 2019	Annual letter to landowners	Update on SGMA, GSP, methods for interested parties to participate.
	Natomas Central Mutual Water Company	February 11, 2020	Public meeting, standard public notice, mailers to all Shareholders and Farmers in the Natomas Basin.	Update on SGMA, GSP status, methods for interested parties to participate. Review of groundwater levels in the North American Sub Basin
	Sacramento Groundwater Authority	February 13, 2020	Posted notice to SGA distribution list and website.	Gave SGMA information and GSP development status.
	Public GSA Meeting (rescheduled to June)	March 26, 2020	Cancelled due to COVID-19	What to Expect from the 1st 6 chapters GSP
	Sacramento Groundwater Authority	April 9, 2020	Posted notice to SGA distribution list and website.	Gave SGMA information and GSP development status.
	Placer County Agricultural Commission	April 21, 2020	Public Meeting	Sustainable Agriculture Groundwater Recharge Program (GSP Project)
	Sacramento Groundwater Authority	June 11, 2020	Posted notice to SGA distribution list and website.	Gave SGMA information and GSP development status.
	Virtual Public GSA Update	June 23, 2020	Recorded PowerPoint presentation emailed to WPGSA interested parties list and stakeholder list, and NASb GSAs. Posted on YouTube, WPGSA website. Placer County social media outlets.	Summary of activities since last public update, "what to expect" from first 6 GSA chapters, water year update, recharge project update, next steps.
	Reclamation District 1001	July 1, 2020	Annual letter to landowners	Update on SGMA, GSP, methods for interested parties to participate.
	Sacramento Groundwater Authority	August 13, 2020	Posted notice to SGA distribution list and website.	Gave SGMA information and GSP development status.
	Sacramento Groundwater Authority	October 8, 2020	Posted notice to SGA distribution list and website.	Gave SGMA information and GSP development status.
	Notice of Public GSA Meeting	March 4 and 6, 2020	Email notice to interested parties list, SGMA stakeholders list. Posted on WPGSA website. Placer County social media outlets.	This year, agencies that make up the WPGSA will begin developing the plan and will release draft chapters as they become available throughout plan development to get feedback from our stakeholders.
GSP PREPARATION	GSP PREPARATION / DRAFT CHAPTER UPDATES / PUBLIC RELEASES			
	SECTIONS 1-5	*Posted online DATE*	https://nasbgroundwater.org	
	Public Notice of Comment Period	November 11, 2020	Email notice to NASb interested parties list, stakeholders list. Posted on agency websites and social media outlets.	Draft chapters available for public comment.
	Virtual Public Meeting	November 12, 2020	Live Zoom meeting noticed through standard methods.	Update on GSP preparation, overview of draft chapters recently released, how to comment and engage, Q&A.
	Agriculture Community Tailgate Meeting	November 17, 2020	Socially distanced in-person meeting with agriculture community. Direct mailer to agriculture community.	Update on GSP preparation, overview of draft chapters recently released, how to engage, discuss ag related questions/concerns.
	California American Water Company	November 15, 2020	Email blast to all customers; social media blast.	Announcing upcoming GSP and public meetings, how to engage.

GSP PREPARATION	Sacramento Groundwater Authority	December 10, 2020	Posted notice to SGA distribution list and website.	Invited comments on draft GSP chapters.
	Sacramento Groundwater Authority	February 11, 2021	Posted notice to SGA distribution list and website.	Invited comments on draft GSP chapters.
	Reclamation District 1001 Board Meeting	March 24, 2021	Public Meetings. Individual agency standard noticing procedures.	Gave SGMA overview and GSP development status.
	NASB PUBLIC MEETING #1 SUSTAINABLE MANAGEMENT CRITERIA	February 10, 2021	Email notice to 300+ interested parties list, SGMA stakeholders list. Posted on NASb website and social media outlets throughout basin.	Overview of SGMA, the draft sections (1-5) recently completed, and our current efforts to define groundwater levels and other criteria to measure sustainability in the basin
	NASB PUBLIC MEETING #2 WATER BUDGET	March 10, 2021	Email notice to 300+ interested parties list, SGMA stakeholders list. Posted on NASb website and social media outlets throughout basin.	Results of the basin wide groundwater model and groundwater budget.
	NASB PUBLIC MEETING #3 PROJECTS AND MANAGEMENT ACTIONS	May 12, 2021	Email notice to 300+ interested parties list, SGMA stakeholders list. Posted on NASb website and social media outlets throughout basin.	Proposed process for SMC and UR development, proposed projects and management actions.
	GSP STATUS UPDATES			
	Sacramento Groundwater Authority	April 8, 2021	Public Meetings. Individual agency standard noticing procedures. Posted notice to SGA distribution list and website.	SGMA and GSP status update, how the public may engage in GSP development.
	Reclamation District 1001 Board Meeting	May 26, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, how the public may engage in GSP development.
	Placer County Water Agency Board Meeting	June 3, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, how the public may engage in GSP development.
	Sacramento Groundwater Authority	June 10, 2021	Public Meetings. Individual agency standard noticing procedures. Posted notice to SGA distribution list and website.	SGMA and GSP status update, how the public may engage in GSP development.
	Placer County Agricultural Commission	June 14, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, how the public may engage in GSP development.
	Reclamation District 1001	July 1, 2021	Letter to landowners.	SGMA and GSP information and update, assessment funding.
	Placer County Board of Supervisors	July 6, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, how the public may engage in GSP development.
	City of Lincoln Council Meeting	July 13, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, how the public may engage in GSP development.
	Sheridan Municipal Advisory Committee	July 14, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, how the public may engage in GSP development.
	Rural Lincoln Municipal Advisory Committee	July 19, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, how the public may engage in GSP development.
	Reclamation District 1001	July 28, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, planned notification to landowners.
	Reclamation District 1001	August 25, 2021	Public Meetings. Individual agency standard noticing procedures.	SGMA and GSP status update, NASb Memorandum of Agreement development.
	PUBLIC DRAFT GSP RELEASE & PUBLIC COMMENT PERIOD	August 31, 2021		Opportunity to comment on draft chapters of GSP.
	Notice of Public Comment Period	September 1, 2021	Email notice to 300+ interested parties list, SGMA stakeholders list. Posted on NASb website and social media outlets throughout basin. Direct mail postcards to agriculture / DAC in rural areas.	Draft GSP available for public comment.
	NASB PUBLIC MEETING #4 PUBLIC DRAFT GSP RELEASE	September 8, 2021	Email notice to 300+ interested parties list, SGMA stakeholders list. Posted on NASb website and social media outlets throughout basin.	Public Draft GSP contents, update/changes to approach since Workshop #3, request for public to comment on Public Draft GSP.
	Reclamation District 1001	September 9, 2021	Letter to landowners.	SGMA and GSP status update, how the public may comment on the GSP.

GSP ADOPTION	NOTICE OF PROPOSED ADOPTION			
	Notice of Public Hearing (90-day notice)	August 30, 2021	GSA 90-day notices sent to cities and counties.	GSAs intend to adopt GSP.
	GSP PUBLIC HEARING / ADOPTIONS			
	Reclamation District 1001 - Board Meeting	December 22, 2021	Public Meetings. Individual agency standard noticing procedures.	Final GSP content. Request for approval for resolution to adopt.
	Sacramento Groundwater Authority - Board of Directors Meeting	December 9, 2021	Public Meetings. Individual agency standard noticing procedures. Posted notice to SGA distribution list and website.	Final GSP content. Request for approval for resolution to adopt.
	South Sutter Water District - Board of Directors Meeting	December 16, 2021	Public Meetings. Standard noticing procedures.	Final GSP content. Request for approval for resolution to adopt.
	Sutter County - Board of Supervisors Meeting	December 14, 2021	Public Meetings. Individual agency standard noticing procedures.	Final GSP content. Request for approval for resolution to adopt.
	West Placer GSA			
	Placer County - Board of Supervisors Meeting	January 11, 2022	Public Meetings. Individual agency standard noticing procedures.	Final GSP content. Request for approval for resolution to adopt.
	City of Lincoln - Council Meeting	January 11, 2022	Public Meetings. Individual agency standard noticing procedures.	Final GSP content. Request for approval for resolution to adopt.
	City of Roseville - Council Meeting	December 15, 2021	Public Meetings. Individual agency standard noticing procedures.	Final GSP content. Request for approval for resolution to adopt.
	Placer County Water Agency - Board of Directors Meeting	January 6, 2022	Public Meetings. Individual agency standard noticing procedures.	Final GSP content. Request for approval for resolution to adopt.

Appendix S: Public Comments

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX S
Public Comments

December 2021

Table S-1

Responses to Public Comments to Draft Sections 1-5

Comment No.	Name	Comment	Response to Comment/Changes to the Draft GSP Section 1-5
1	Rebecca Lillis	We request the following edits be made to section 3.5, Habitat Preserves and Easements: Please update the year of the Placer County Conservation Plan to 2020. Please add the following sentence, beginning on line 3 of Section 3.5, after "...Natomas Basin...Plan 2003).": "The Placer County Conservation Plan was jointly developed by the County of Placer, the City of Lincoln, the Placer County Water Agency and the South Placer Transportation Authority." Please add the following sentences, beginning on line 14 of Section 3.5, after "Other natural marsh areas...Sacramento County.": "In unincorporated western Placer County, some fresh emergent marsh habitats are created by irrigation runoff and many of the wetland habitats are fed by leakage or runoff from irrigation canals or irrigated pastures. Riparian habitat occurs on the American and Bear River corridors and along Raccoon Creek, lower Auburn Ravine, and lower Dry Creek."	Comment noted. Additional clarification added to NASb GSP.
2	Albert Scheiber	Given the proximity of the wells represented by hydrographs in Appendix G, and specifically to the wells in relation to Streams in the Eastern Area – what is the certainty that these hydrographs are reflecting groundwater conditions as opposed to the levels of underflow associated with these streams?	Comment noted. Section 5.2.3, sentences added in relation of monitoring wells proximity of wells near streams and whether these are representative of perched groundwater or the groundwater table.
3	Albert Scheiber	Is the Basin simply made up of underflow and underground streams – and not resident groundwater? And if so, what would this circumstance mean with respect to the jurisdiction of the West Placer County Groundwater Sustainability Agency? Wouldn't this mean that jurisdiction rests with the SWRCB for much of the Basin and not the Sustainability Agency?	Comment noted. No change to text. Section 2.1 indicates that each of the five GSAs have been granted exclusive rights to manage groundwater in the Subbasin. Jurisdiction in the Subbasin therefore rests with the GSAs unless the GSP is found to be inadequate, at which time the Subbasin may be placed into probationary status and the SWRCB may begin to temporarily manage the Subbasin.
4	Albert Scheiber	It appears that many of the larger private agricultural groundwater users have not been included in the analysis, or in the baseline/historic conditions, for the Plan. How can the Plan analyze the groundwater conditions and sustainability without having information relating to the use of groundwater by private agricultural landowners?	Comment noted. All groundwater users, have been included in the GSP analysis based on best available data. Figure 3-13, shows the number of agricultural wells in the Subbasin (DWR, 2019). Section 6.1 - Water Budget Information (which has yet to be released at the time of these comments) documents how groundwater use was estimated (calculated) based on evapotranspiration.
5	Albert Scheiber	Thus far, the SGMA Plan (GSP) does not contain any information or analysis on groundwater levels in the eastern basin in relation to the planned well expansion and pumping programs by the City of Lincoln. Lincoln plans to increase pumping by adding over 10 new wells west of the City and increasing groundwater pumping during drought periods up to 75% of the City's total water use.	Comment noted. Section 6, Water Budgets and Section 8, Sustainable Management Criteria, had not yet been released at the time of this comment. Section 6.4.3 describes the projected water budget and a description of the projected conditions input. Direct input was received on future projects from local agencies. The City of Lincoln's proposed new wells were included in the model with projected annual pumping. Figure 8-5 shows the projected groundwater elevation declines at representative wells in the Subbasin with information near the City of Lincoln. The difference between 2019 and projected groundwater levels for a 50-year simulation are shown on Figure 8-5 and indicate groundwater levels west of Lincoln area are projected to decline in this area by up to 7 feet.

Table S-1

Responses to Public Comments to Draft Sections 1-5

Comment No.	Name	Comment	Response to Comment/Changes to the Draft GSP Section 1-5
6	Albert Scheiber	In 2011, the City pumped groundwater nearly exclusively for its water use due to a PCWA facility issue and this caused this part of the basin to go into severe decline and overdraft. The City's expanded demand along with a 75% drought pumping program will vastly outpace the water pumped in 2011 that caused the basin to go into decline. It is therefore not entirely true for the GSP to conclude that groundwater levels are stable in the area of the basin near Lincoln.	Comment noted. Section 5.2.3 was modified and further discussion regarding this area was included. For the most part groundwater levels are rising in this area, but a few did not recover completely since the 2012 to 2016 drought as of 2019. The few that did not recover completely have declined by about 2 feet.
7	Albert Scheiber	The city of Lincoln currently has a lawsuit against the United States Air Force regarding the closed landfill on the East side of Lincoln. What steps is the SGMA Plan taking to insure that if there is contamination coming from that landfill, it will not follow the flow on the graphs to the west and contaminate the entire basin in times of drought and highly increased groundwater pumping?	Comment noted. Clarification sentence added to Section 5.8.3.
8	Albert Scheiber	The SGMA plan should also specifically address the two new proposed PCWA wells planned for Sunset Area Plan/Placer Ranch Project, which are to be located fairly near the current cone of depression in the southwest part of the Basin.	Comment noted. Section 6.4.3 describes the that local agencies were consulted for future projections of new wells and potential pumping. Figure 3-6 provides the location of planned development areas in the Subbasin that were included in the analyses.
9	Albert Scheiber	To many non-municipal groundwater users, it appears that this SGMA plan is primarily intended to protect and expand municipal groundwater use at the expense of agriculture and other overlying uses. The basin is not stable and is in decline (or subject to decline) in the eastern area – with little to no surplus water existing during drought periods. Again, this situation is made obvious from the hydrographs.	Comment noted. All beneficial uses and users of groundwater were considered during the development of the GSP as required by SGMA.
10	Albert Scheiber	I also find it interesting that most of the data on the graphs go back less than ten years. It seems like a plan of this nature and size should contain more data than that.	Comment noted. As stated in Section 5.2.3 there are only a few wells in the Eastern area with long-term historic measurements because this area primarily utilizes surface water. With urbanization of the area and development of groundwater management organizations, over 40 monitoring wells have been constructed since 2003.

Re: Comments on the North American Subbasin GSP

To whom it may concern,

I would like to start by saying my comments will be under the "general comment" section because most of what has been presented in the GSP is general information. It is my goal to inform you of items and concerns that I feel are being overlooked and downplayed, but will hopefully be addressed in the future chapters of the draft GSP. My comments are also going under "general comments" because I find the comment form to be ridiculous and more of a headache than any comment process I have ever participated in and I've participated in a fair number.

To date, there has been no meaningful participation sought from "stakeholders". At the PCWA growers meeting on 9/9/2020, we were informed we would have a seat at the table for the GSP. While there has been some halfhearted outreach by West Placer County Groundwater Sustainability Agency, this outreach has thus far appeared to be more about deflecting questions from stakeholders rather than addressing any questions or concerns. For example, the November 12th 2020 zoom meeting allowed for public comments, but wasn't really an "official" comment format. And at the November 17th 2020 SGMA and Agriculture meeting, our comments and questions were either challenged, blown off or labeled as incorrect. Outreach has also only really begun recently now that a Plan has already been developed. It is very unlikely that any input from stakeholders at this stage is meaningful, based on past experience with Placer County and the City of Lincoln. However, the WPGSA will be able to check the box that they held public outreach for "stakeholders".

Given the proximity of the wells represented by hydrographs in Appendix G, and specifically to the wells in relation to Streams in the Eastern Area – what is the certainty that these hydrographs are reflecting groundwater conditions as opposed to the levels of underflow associated with these streams? Is the Basin simply made up of underflow and underground streams – and not resident groundwater? And if so, what would this circumstance mean with respect to the jurisdiction of the West Placer County Groundwater Sustainability Agency? Wouldn't this mean that jurisdiction rests with the SWRCB for much of the Basin and not the Sustainability Agency?

It appears that many of the larger private agricultural groundwater users have not been included in the analysis, or in the baseline/historic conditions, for the Plan. How can the Plan analyze the groundwater conditions and sustainability without having information relating to the use of groundwater by private agricultural landowners?

Thus far, the SGMA Plan (GSP) does not contain any information or analysis on groundwater levels in the eastern basin in relation to the planned well expansion and pumping programs by the City of Lincoln. Lincoln plans to increase pumping by adding over 10 new wells west of the City and increasing groundwater pumping during drought periods up to 75% of the City's total water use. In 2011, the City pumped groundwater nearly exclusively for its water use due to a

PCWA facility issue and this caused this part of the basin to go into severe decline and overdraft. The City's expanded demand along with a 75% drought pumping program will vastly outpace the water pumped in 2011 that caused the basin to go into decline. It is therefore not entirely true for the GSP to conclude that groundwater levels are stable in the area of the basin near Lincoln. Even if "stable," it is highly unlikely that any surplus water exists in this area for the amount of future municipal expansion of use planned by Lincoln – especially given the information in the hydrographs showing decline in groundwater levels during droughts. All of this information is publicly available in the City's Village 5 EIR and Water Supply Assessment.

The city of Lincoln currently has a lawsuit against the United States Air Force regarding the closed landfill on the East side of Lincoln. What steps is the SGMA Plan taking to insure that if there is contamination coming from that landfill, it will not follow the flow on the graphs to the west and contaminate the entire basin in times of drought and highly increased groundwater pumping?

The SGMA plan should also specifically address the two new proposed PCWA wells planned for Sunset Area Plan/Placer Ranch Project, which are to be located fairly near the current cone of depression in the southwest part of the Basin. It is also my understanding that these wells will be turned on and up during times of drought. So at the worst possible time, Lincoln and PCWA will be relying on groundwater, when surface water and surface water recharge will be at a minimum.

To many non-municipal groundwater users, it appears that this SGMA plan is primarily intended to protect and expand municipal groundwater use at the expense of agriculture and other overlying uses. The basin is not stable and is in decline (or subject to decline) in the eastern area – with little to no surplus water existing during drought periods. Again, this situation is made obvious from the hydrographs. It appears to be a program to allow the prescription of existing water rights by municipalities such as is occurring along the Central California Coast. I also find it interesting that most of the data on the graphs go back less than ten years. It seems like a plan of this nature and size should contain more data than that.

In the Eastern Area of the Basin, there appears to be an attempt to "cold store" PCWA's surface water rights to the American River. Some of those rights are by way of permits from the SWRCB. With Lincoln's expansion of its groundwater pumping while at the same time having more water available to it from PCWA that it can presently put to beneficial use, it raises the application of the Cold Storage doctrine. This situation essentially puts PCWA's water rights into cold storage by delaying the application of high value surface water rights to a beneficial use while waiting for Lincoln to develop – while at the same time, Lincoln is developing a program of more groundwater pumping than it can presently use. A program that delays the use of water for future municipal use is prohibited by law. This situation also raises the issue of reasonable use by having a City such as Lincoln expanding groundwater pumping and building additional wells, while having more surface water availability from PCWA than it can presently use beneficially.

I don’t believe that all of the SGMA partners are communicating together as they should. We should all be on the same team, working towards the same goal. But when you have the City of Lincoln and Placer County planning for over 16 wells vs. the City of Roseville currently doing and expanding groundwater recharge, and PCWA not in the least worried about pricing agriculture surface water out of affordability, I’m not sure how you are going to ensure water for everyone.

Many of my comments do not directly relate to the current SGMA plan sections available for public review. It is my hope that by pointing out these issues now, they will be addressed in the future draft sections of the GSP.

This is, in my opinion, a simple problem. Don’t get rid of surface water because if you do, groundwater pumping and lack of groundwater recharge will put the basin in overdraft, period. Learn from the mistakes of Central California.

Thank you

Albert Scheiber

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
1	Janice Mcalpine	Large ponds using ground water to water ski. My pump had to be lowered due to neighboring business of water ski and jet ski events. Year round pumping ground water to fill massive ponds	Comment noted. Please see Management Action #1 that could potentially address future well spacing and well zoning requirements.
2	Mark Sigl	I hope the water & power agencies are looking at using the America River as a possible battery (able to store water, power, improve fish & wildlife habit, improve ground water, etc,..). I was looking at the surplus or developing excess solar power availability and using that clean cheap energy to help meet the water & peak power energy needs by creating a massive reverse flow water pumping / storage / energy system. I have some water & power engineering background and have done a couple ground water banking sites. I was looking at a 23 to 25 mile pipeline/canal that could transfer water back up the hill to the Placerville Area (1,000 ft elev) from the Sac Regional WWTP which recycles 25k GPD & Sacramento River. Recycling the water back up the hill to Placerville will allow for additional peak power needs that would pass through the 7 power sites. The additional water flow back into the basin area would also help replenish the ground water tables. Using Hwy 50 as a corridor and doing 150-200 ft lift elevations (5 to 8 stations needed) instead of one massive lift station would be more cost effecting using lower cost equipment, lower water pressures to deal with and could be done with intern storage tanks. A couple pipelines next to each other (lower construction costs since the pipelines would be smaller than using one massive one set up to be able to deliver 1-10k cfs flow. This also allows for easier maintenance & lower O&M costs since down time would be less and various pump combos could be operated for best use of power. This would be more beneficial to everyone (more power & water) while improving several other concerns (using cheap solar power, offsetting peak power, maintaining more water in the American River System while also helps recharge the ground water table, more water for fish & wildlife & recreationally while not wasting or removing water since it is basically being reused and recycled pumping it back up the hill and using the Sac Regional Recycled water which normally would go out to sea. This would like keeping that recycle surplus to keep recycling the water & power system using low cheap abundant solar power to help improve the system and maintain a more consistent level system. Using one technology Solar to help improve the water & peak power needs for the area.	Comment noted.
3	Amanda Cranford-NOAA - NMFS	The GSA should qualitatively describe what conditions within the subbasin would constitute an undesirable result with regard to streamflow depletion, ensuring that the description accounts for impacts to instream habitat that supports ESA-listed salmonids and green sturgeon. If data that would inform potential streamflow depletion impacts is lacking, NMFS recommends the final GSP follow guidance from California Department of Fish and Wildlife (2019) and develop conservative streamflow depletion thresholds as a cautionary principle until the surface flow/groundwater dynamic in the North American subbasin is better studied and understood.	Comment noted. The NASb GSAs have worked to develop reasonable conservative thresholds to safeguard beneficial uses and users for each sustainability indicator including depletions of interconnected streams. The GSAs will evaluate conditions and thresholds as additional data or information becomes available. Additional information has been provided within the NASb GSP, Appendix Q which estimated location of salmonids.
4	Amanda Cranford-NOAA - NMFS	SGMA regulations require that a GSP demonstrate "that there is a significant correlation between groundwater levels and the other metric" (DWR 2017), with the "other metric" in question appearing to be "the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results" (CCR 23§354.28(c)(6)). The draft GSP should explain, with supporting evidence, what significant correlation exists between groundwater elevations and streamflow depletion rates or volumes, and how that correlation would allow the GSA to adequately predict and monitor impacts to beneficial uses of surface water.	Comment Noted. Included in the NASb GSP, within Appendix N are hydrographs of surface water levels correlating to groundwater elevations in multiple areas of the NASb demonstrating that groundwater levels can be used as a proxy for stream water depletion. The NASb GSAs have added Table 8-8 to show the seasonal streamflow depletion estimates in terms of the rate and volume.
5	Amanda Cranford-NOAA - NMFS	The above definition is not appropriate for avoiding significant and unreasonable impacts to surface water beneficial uses because it is completely disconnected from ecological principlesthat govern how those beneficial uses are impacted. Requiring two consecutive years of exceeding the minimum threshold does not account for the fact that organisms live or die depending on the habitat conditions at a moment in time. If streamflow depletion contributes to a creek drying up during a given year, the fish that reside in that creek will perish and an impact to surface water beneficial use will likely have resulted. Requiring two consecutive years of such conditions impacting surface water beneficial uses makes little sense when attempting to avoid impacts to surface water beneficial uses.	Comment noted. The minimum thresholds established in the NASb GSP for the depletion of interconnected surface water sustainable indicator are intended to maintain the maximum acceptable rate of seepage. Furthermore, there was during the development of these minimum thresholds there was no evidence that creeks or streams would dry up under planned groundwater management projections.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
6	Amanda Cranford-NOAA - NMFS	The minimum threshold for streamflow depletion was established by averaging the lowest groundwater elevations from fall 2014 and fall 2015. However, using recent groundwater elevations to inform or set streamflow depletion minimum thresholds and measurable objectives is likely inappropriate for avoiding significant impacts to ESA-listed salmonids and sturgeon, and their habitat, including EFH. Basic hydraulic principles dictate that groundwater flow is proportional to the difference between groundwater elevations at different locations along a flow path. Using this basic principle, groundwater flow to a stream or, conversely, seepage from a stream to the underlying aquifer is proportional to the difference between water elevation in the stream and groundwater elevations at locations away from the stream. Basing sustainable management criteria upon groundwater elevations that occurred during California's recent historical drought (2011-2016) will likely result in historically high streamflow depletion rates, producing instream conditions that negatively affect ESA-listed Chinook salmon, steelhead, green sturgeon, and their critical habitat	Comment noted. The GSP includes multiple groundwater hydrographs from representative monitoring wells throughout the NASb (see appendix Q). Relatively nominal changes in groundwater levels were observed on these hydrographs during the dry hydrology of 2014 and 2015. The GSAs can rely on both historic and recent data when setting the minimum thresholds in the GSP that are protective for beneficial uses and users of groundwater.
7	Amanda Cranford-NOAA - NMFS	The GSP asserts that the North American subbasin is "currently under its estimated sustainable yield and in position to support additional groundwater development" (Page 8-12). However, a sustainable yield estimation requires the avoidance of all undesirable results and, as noted throughout this letter, we do not believe significant and unreasonable streamflow depletion will be avoided when using the sustainable management criteria proposed within the draft GSP. Similarly, the assertion that "the sustainability goal is currently being met" within the basin also appears to be unfounded, and directly contradicts DWR's evaluation process that assigned a "high" priority to the subbasin. Per the SGMA regulations, if the GSA wishes to assert that the basin is sustainably managed currently, then they must demonstrate and provide evidence that each sustainability indicator "does not exist and cannot occur" (DWR 2017). Suffice to say, the draft GSP fails to accomplish this. If the GSA wishes to keep this assertion within the draft GSP, they should fully explain, in detail, why the historically high streamflow depletion rates that correspond to their proposed sustainable management criteria will avoid significant and unreasonable impacts to surface water beneficial uses.	Comment noted. The GSA believes that groundwater in the NASb are likely already sustainably being managed based on the understanding of conditions and beneficial uses and users in the basin.
8	Amanda Cranford-NOAA - NMFS	We suspect that groundwater recharge projects are likely to be an important action implemented as part of the effort to achieve groundwater sustainability in the North American subbasin. NMFS encourages the GSA to consider implementing recharge projects that facilitate floodplain inundation and offer multiple benefits, including downstream flood attenuation, groundwater recharge, and ecosystem restoration. Managed floodplain inundation can recharge floodplain aquifers, which in turn slowly release stored water back to the stream during summer months. These projects also reconnect the stream channel with floodplain habitat, which can benefit juvenile salmon, steelhead, and sturgeon by creating off-channel habitat characterized by slow water velocities, ample cover in the form of submerged vegetation, and high food availability. As an added bonus, these types of multi-benefit projects likely have more diverse grant funding streams that can lower their cost as compared to traditional off-channel recharge projects.	Comment noted. The GSA appreciates stakeholder input identifying potential opportunities. It should be noted that many GSA members are working in other capacities on habitat and conservation and management plans that may address stakeholder interests.
9	Barbara Evoy - ECOS	Section 6 Water BudgetsLine 211 Table 6-4 Lines 130-210 Provide specifics of the data sets for calculating the current water budgets. However, starting with Table 6-4, Tables list Projected Condition Water Budget with Climate Change.There is no discussion of how Climate Change was analyzed. The document cited in the earlier tables (as the 2015 UWMPs) does not include climate change analysis discussion either. This is a major flaw in the document and needs to corrected in order to provide the reviewer an understanding of the assumptions and the modeling effort. See summary comments above.	Comment noted. The GSAs have added additional information in Appendix P as to how climate change was analyzed.
10	Barbara Evoy - ECOS	Section 5 Groundwater Conditions Line 94. It would be useful to be clear throughout the document as to timeframe. The statement "some wells have still not fully recovered" (from 2012-2016 pumping) is not clear without knowing whether this is 2018, 2019 or 2020 /2021 data (referencing separate file Appendices makes this clunky). In the context of the current drought crisis, it is important to know whether this conclusion includes the most recent dry years. It is not possible to read the axis of the hydrographs in Figure 5-3. See also line 123, line 131, line 149. Line 489 There is no mention of an effort to address the hexavalent chromium nor a source. Is there a known source for this contaminant or is follow-up investigation warranted? Line 506 The paragraph discusses the process for coordination with others on NDMA but not what levels of NDMA have been detected in Feb. 2004 and beyond. It would be useful to know how significant the problem is and whether or not the coordinated process is having any effect on the levels detected in the last 17 years. Line 652 New information presented recently (Lewis and Burgy 1964 study) to the South American GSP working group suggests root depth analysis for GDEs should use a depth of 80 feet, not the 30 feet used in the GSPD. In addition, The Nature Conservancy (TNC) is about to publish a study indicating root depths for certain oak species are 25 meters. In addition, a recent TNC study identifies the inability of oak woodlands to reproduce when ground water levels are too low. Therefore, a determination of appropriate root depths to maintain GDEs should be included as a potential data gap and for priority Management Action in the final GSP. Line 659 Given the number of monitoring wells with incomplete construction details in Appendix C, is there no need for further investigation as to the screened intervals?	Comment noted. Based on the data and information provided in the NASb GSP (see Appendix B), there does not appear to be the potential for significant levels of negative effects to domestic wells. A domestic/shallow well data collection and communication program has been added as a GSP management actions strengthen communication and the transfer of data and information between the GSA and domestic well owners during GSP implementation.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
11	Barbara Evoy - ECOS	Section 3.8.2 Line 422-475 Given the number of historic curtailments in 2021, the document should be updated to provide some idea of the security of the water allocations discussed. Simply saying there is a post 1914 water right does not provide an idea of reliability. Many of the current 2021 curtailments are 1880s -1920s water rights or earlier. It is unclear how much of the regional supply is in jeopardy in the now drier water supply climate. As climate change continues to drive watershed systems to less snow and drier early spring/summers, water rights should not be discussed as a given allocation. They are subject to curtailment and are likely to be curtailed earlier and more frequently. To develop a regional budget, clear analysis of the surface water supplies is needed. Lack of surface water (cited as a little more than half of the regional supply (line 812)) will directly impact the groundwater demand. Figure 3-13 The Figure: Density of Domestic Wells Per Square Mile provides a very good attempt at a graphic depiction of the number of domestic wells in Disadvantaged and Severely disadvantaged community areas (although it is difficult to identify the enclosing boundaries along the water courses). This highlights the need to very carefully monitor the effects of GSA activities on these vulnerable areas. The South American Subbasin plans to institute a vulnerable well program to protect primarily shallow domestic users. This need is amplified where there are significant areas of disadvantaged community wells. We recommend that the NASb GSA consider instituting a similar program. Figure 3-16 Groundwater Level Monitoring Network. It appears to be some of the largest gaps in the Northeast corner of the GSA where there are some of the greatest densities of domestic wells and disadvantaged communities (Figure 3-13). Similarly, there does not appear to be good coverage in the southern part of the subbasin in high density domestic well areas. Figure 3-19 See typo in title Section 3 Line 827-834 As noted in the general comments, it is important to include the Water Accounting Framework in the accounting of the GSP gross input/output modeling. If specific allocations are to be considered in future water banking, it will affect the ability of others to withdraw water. Without this allocation within the overall budget, it is not possible to determine whether the management actions will be sufficient to address future groundwater level changes. This is especially important when there is the possibility of out of the basin transfers. Line 897 States that "Most of the land within the Subbasin is currently developed to some use and conversion from agricultural uses to urban uses is not anticipated to increase demand." This does not seem consistent with the fact that the draft stated on ES -1 that that 30 percent of the GSP area is either native vegetation or fallowed farmland. How does non irrigated land conversion to urban uses not increase water use?Line 920 Given modeling that indicates well levels overall are expected to remain near their current levels, it is understandable the conclusion is that there could be little to no impacts to domestic wells. Given that there are a) 2, 563 known domestic wells, b) 6, 471 Other/Abandoned/Unknown wells, and water purveyors in the area that expect to withdraw banked water in certain areas, it would prudent to have a backup approach to ensure domestic and disadvantaged community wells do not run dry. We suggest the North American Subbasin consider this possibility and consider a vulnerable well program such as the South American Subbasin is developing. At a minimum, there should be a commitment to include robust monitoring as part of the Water Bank proposal. The discussion of the Water Accounting Framework includes no discussion of how the program may be operated to ensure no wells will run dry. There are similar concerns with the conclusions on GDEs in the area of potential water banking activities. (Line 926). Line 980-982 The draft GSP points out a very significant gap in the regional well permitting system - None of the well permitting agencies coordinates with county or city land developers. There are no setbacks or special investigation requirements for construction of supply wells near rivers or tributaries. It would be useful for this statement to point to the suggested action section.	Comment noted. As GSP implementation commences, the NASb GSAs plan to continue to work with domestic well owners through the communication and engagement management action activities as identified in Section 8.
12	Barbara Evoy - ECOS	Executive Summary ES 80-87. This paragraph is awkward and should be edited for clarity. The layperson will have difficulty understanding the intent with the current sentence structure. ES 93 The sentence should specific generally stable over X timeframe reviewed. Same with statement on line 97. Perhaps starting the section with "Groundwater levels were analyzed over the time period of X to", as a way to clearly frame the conclusions of overall declines/recovery. ES 106 GDE depth to groundwater (see summary comments). ES 146 Without an explanation of how the climate change model was run, Table ES-1 has no context when "with Climate Change" is used. See summary comments on Climate Change. Table ES-2 The NASb is proposing a better definition of chronic lowering of groundwater levels, reduction in storage, and depletion of surface water undesirable results, with more clarity, than the South American Subbasin. Kudos.	Comment noted. The NASb GSP executive summary has been updated.
13	April Doran - Cal F&W	The GSP identifies the locations of interconnected surface waters within the subbasin (Figure 5-31) and presents hydrographs that demonstrate the relationship between groundwater levels and surface water elevations. However, the GSP does not include information related to the quantity and timing of depletions from these interconnected surface waters as required by 23 CCR § 354.16(f). The Department recommends that the GSP include a table quantifying the volume of surface water depletions, by month, for all interconnected surface waters identified within the subbasin.	Comment noted. The rate and volume of seasonal streamflow depletion has been added to the GSP (Table 8-8).
14	April Doran - Cal F&W	Depth to Water: Further refinement and clarification of GDE identification methods used in the GSP will help to create a more robust analysis. Appendix O states that groundwater contours were developed using groundwater level measurements from Spring 2020 (Section 1.3, page 3), but then also states that GDEs were prioritized using 2019 depth to groundwater contours (Section 1.4, page 3). It is unclear which year of groundwater data was used in the analysis. Additionally, while the Department supports the use of seasonal high spring measurements, 2020 was a dry water year type for the Sacramento Valley. Analysis that relies on depth to water thresholds should incorporate data from a representative hydrologic period that includes a variety of water year types, rather than from a single point in time. The analysis also assumes that groundwater must be less than 30 feet below the ground surface (bgs) to support GDEs based on the maximum rooting depth of Valley Oak (*Q. lobata)* ; however, mature Valley Oak can access groundwater up to 80 feet below the ground surface (Howard 1992, Lewis & Burgy 1964). The use of a 30-foot threshold may incorrectly exclude Valley Oak communities within the subbasin from further consideration as a GDE. The Department recommends that Appendix O be revised to clarify which year of data was used to create the groundwater elevation contours for the GDE analysis and consider how the methodology could be updated to integrate a range of water years for determining potential GDEs. The Department also recommends the GSP narrowly update the methodology for GDE identification for areas within the subbasin that underlie Valley Oak communities to reflect a potential maximum rooting depth of 80 feet bgs.	Comment noted. Groundwater elevations observed during spring 2020 were not significantly different than those observed in spring 2019. Almost no changes in groundwater elevations were observed where groundwater is shallow relative to the ground surface (i.e. areas of the subbasin where groundwater is encountered at a depth of 30 feet or less) and therefore use of spring 2020 measurements was deemed appropriate for establishing sustainable management criteria. The GSP has been updated with use of a minimum threshold of 80 feet below ground surface in where areas of Valley Oak have been identified. This is a change from 30 feet below ground surface as documented in the draft GSP. Information related to these GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs as described in the added management action provided in Section 9.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
15	April Doran - Cal F&W	Perched Groundwater Areas: The GSP discusses locations within the subbasin that have a depth to groundwater of less than 30 feet and may also have areas of perched water, and potential GDEs from these areas were removed. The GSP does not sufficiently characterize the relationship between these perched groundwater areas and the Principal Aquifer, including the impacts of pumping or of seasonally elevated groundwater levels on the groundwater in these perched areas. The Department recommends the GSP include additional information characterizing the relationship between areas of perched groundwater and the Principal Aquifer. The GSP should discuss whether seasonal highs within the Principal Aquifer contribute to the perched areas, and whether pumping within the Principal Aquifer has the potential to deplete these perched areas that may support GDE communities. If the relationship cannot be adequately characterized, the GSP should conservatively include GDEs from these areas, particularly as depth to groundwater for the principal aquifer is within the identified potential root zone for GDEs.	Comment noted. The GSAs have provided additional information within the GSP in Appendix O regarding areas of perched water. However, perched water areas are not in direct hydraulic connect to the NASb principal aquifer and the ability for GSAs to managed perched water is extremely limited and not required by SGMA.
16	April Doran - Cal F&W	Special Status Species: The GSP methodology includes an evaluation of "non- aquatic critical fauna" that may be present in the subbasin. Interconnected surface waters and their associated aquatic species are also a type of groundwater dependent ecosystem that must be evaluated within the GSP and considered in the development of sustainability criteria and analysis of undesirable results. The critical species analysis included within the GSP should be broadened to include discussion of aquatic species that are supported by interconnected surface waters.	Comment noted. The GSAs have added the list of aquatic species referenced in CDFW's (see Appendix O). Additional analysis has been provided in Table 8-8 that provides seasonal rate and volume of streamflow depletion.
17	April Doran - Cal F&W	Groundwater Minimum Thresholds: The GSP uses the model-projected groundwater level declines at each representative monitoring site (RMS) to establish minimum thresholds (MTs) by subtracting this projected decline from a baseline set at the average of Fall 2014 and 2015 groundwater elevations (page 8-14, line 318). The GSP fails to contextualize that 2014 and 2015 were two consecutive critically dry water years that occurred during an extended dry period in the Sacramento Valley, wherein groundwater extraction increased to replace more than 70% of lost agricultural water supplies (Lund 2018). Though the GSP asserts that "no negative impacts were reported by beneficial users in the subbasin" (line 320), it is probable that environmental users of groundwater were experiencing adverse impacts due to combined groundwater depletion and reduced surface water availability. These adverse impacts include stressed or dying riparian vegetation, poor instream habitat availability, and increased water temperatures (DFW 2019). It is inappropriate to rely on groundwater levels from 2014 and 2015 as a baseline from which groundwater could continue to decline before reaching the established MTs, as undesirable results will likely be experienced before MTs are reached. The Department recommends the GSP reselect its chosen groundwater level baseline to a more representative hydrologic period for the subbasin, rather than relying on groundwater levels experienced during critically dry years. MTs should be updated accordingly.	Comment noted. Additional information that supports the rationale for use of groundwater elevations from 2014 and 2015 has been added to Section 8.
18	April Doran - Cal F&W	Depletion of Interconnected Surface Waters: As a result of the projected increases in groundwater use within the subbasin, the GSP projects that groundwater level declines along the interconnected Sacramento River will result in approximately 5,800 acre-feet per year (AFY) of surface water depletions. Though the GSP presents information related to the projected change in groundwater pumping, seepage, diversions, and streamflow in Figure 8-7 (page 8-42), a table summarizing this information by month would clarify potential ISW impacts and facilitate comparisons to baseline conditions (See Comment #1). The GSP asserts that though the Sacramento River will experience depletions, municipal development along the Sacramento River that takes agricultural land out of production will result in a net increase in flows of approximately 17,200 AFY (page 8-41, line 907). Additional information is needed in the GSP to support this claim and ensure that environmental users are protected from undesirable results. The GSP does not provide information related to interconnected surface waters within the subbasin other than the Sacramento River, and it is unclear what effect the SMCs will have on depletions. Furthermore, these anticipated land use changes and concurrent reduced surface water demands are not within the control of GSAs. GSAs should anticipate future scenarios wherein they are accountable for mitigating interconnected surface water depletions attributable to groundwater pumping, instead of leaning on proposed land use change to reduce surface water demand, particularly when surface water rights are not under GSA management. The GSP should include a discussion of projected depletions of all interconnected surface waters in the basin, not only the Sacramento River, based on the established SMCs. The GSP should include additional detail in a table that summarizes the projected depletions, reduced diversions, and streamflow by month to facilitate comparison to depletions under existing conditions. In order to better support its claim that Sacramento River flow would increase over the SGMA implementation period, the GSP must provide additional details related to the underlying assumptions used in this calculation, including the following: 1.A characterization of the water rights that the GSP assumes will stop diverting water from the Sacramento River, including a discussion of how the water will be maintained instream to support surface flows. 2.The anticipated timeline for the conversion of land from agricultural to municipal use. 3.The anticipated timeline for groundwater pumping increases within the subbasin. 4.Contingency plans, triggered by specific monitoring metrics, that will initiate projects to avoid surface water depletions should the land use changes fail to offset the increase in groundwater pumping as anticipated.	Comment noted. Additional information supporting the analysis for interconnected surface water has been added to Section 8.9. The anticipated timeline for land use changes and potential increases in pumping does not effect the ability for the NASb to reach sustainability. The established minimum thresholds and description of undesirable results as provided in the NASb GSP is protective of beneficial uses and users of groundwater within the implementation horizon identified in SGMA of 20 years.
19	April Doran - Cal F&W	Environmental Beneficial Users: The GSP does not sufficiently analyze potential impacts of the selected SMCs on environmental beneficial users of groundwater or interconnected surface waters. While the GSP does include sections that discuss the effects of the minimum thresholds for each sustainability indicator on each beneficial user within the subbasin, for the groundwater level MTs, the GSP states only that the groundwater level MTs "protect most known GDEs" within the subbasin (page 8-20, line 426). It is unclear what the GSP means by "most GDEs," and no further detail is provided about whether any analyses were completed that involve comparing the MTs at each RMS to nearby GDE communities and their rooting depths. Additionally, in its discussion of interconnected surface waters within the subbasin, the GSP does not analyze potential impacts to environmental users of surface waters, including aquatic habitat or species. The Department recommends the GSP include additional analysis related to the impacts of the established SMCs on environmental users, including GDEs and interconnected surface water. The groundwater level MTs at each representative monitoring well identified for GDEs in Figure 7-3 (page 7-14) should be compared to the rooting depths of the identified vegetation in each GDE community (See Comment #2(i)). Monitoring of physical indicators of GDE health (i.e., Normalized Difference Vegetation Index (NDVI)) should be completed in addition to the continued monitoring of groundwater levels. The GSP should also include additional analysis to demonstrate that environmental users of interconnected surface waters would not experience undesirable results under the established MTs. The GSP should explicitly discuss the impacts of projected depletions on surface flows, water temperatures, and aquatic species and habitat.	Comment noted. Information related to GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs Normalized Derived Moisture Index (NDMI) as described in the added management action provided in Section 9.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
20	April Doran - Cal F&W	The planned and supplemental project and management activities included in the GSP focus on increased surface water supplies and delivery, conjunctive use, or water banking and recharge. Though the GSP indicates that the planned projects are expected to be sufficient to achieve basin sustainability, should the projects fail to produce the anticipated groundwater benefit or encounter unexpected delays, it may be necessary to implement additional demand management projects that could likely produce groundwater benefits within a shorter timeframe. The Department recognizes that the GSP discusses existing demand management activities within the subbasin, including temporary conservation measures and urban and agricultural water use efficiency programs (page 9-3, line 38). Additional discussion of potential program expansion or other demand reduction projects that could be implemented within the subbasin would strengthen the GSP's list of supplemental projects.	Comment noted. The NASb GSP includes the appropriate existing and planned projects and management actions to reach or maintain sustainability.
21	Barbara Evoy - ECOS	Please see ECOS letter for general comments on the GSPD and incorporated them in my public comments by reference.Â Please also note the relevant concerns of the attached NGO and CDFW letters.	Comment noted.
22	Barbara Evoy - ECOS	Please attached the ECOS letter to my responses as the general comments apply to my earlier line by line submittal.	Comment noted
23	ECOS	CLIMATE CHANGE: As one of the most critical elements of long-term water supply planning, the GSPD should clearly describe the climate change study(ies) it based the analysis on, its assumptions, and the arguments for and against the selected approach. The NASb GSPD and the South American Subbasin (SASb) GSPD have little to no discussion in the body of the GSPDs as to how climate change was evaluated. The documents do not have any type of detailed summary of the process, the climatic range considered, how "change" was integrated with historical years reviewed in the past water budget nor how the earlier analysis fits into the current science of climate change. Both state that the work was done as part of the American River Basin Study (ARBS) but 1) provide both inaccurate citations to the study and 2) where it is linked in the NASb GSPD, it is only to a PCWA website that talks generally about it being developed. The climate change model is very generally discussed in 8 lines in Section 6., without offering any true overview of the effort. As it stands now, the GSPD does not set the stage for any of the Water Budget tables that show "climate change". The NASb GSPD includes "with and without climate change" in tables as if reviewers were fully familiar with the model parameters and they were generally agreed upon. While the document displays output, it lacks a clear discussion on the model. The conclusions of the water budget, without an understanding of the climate change analysis, are only speculative to the reviewers. Lack of climate documentation implies either the GSAs do not know how it was done, or the GSAs don't feel the work is of the quality to sustain public scrutiny. We hope neither is the case and encourage the GSAs to include a much clearer discussion of how climate change was handled.	Comment noted. Additional information as provided in Appendix P has being added to the NASb GSP.
24	Barbara Evoy - ECOS	On September 30, 2021, a 490 page Appendix was released which describes much of the data used in the model and some specifics of the climate change input data. The 490 pages provide a good description of these model inputs for future reference but do not digest the information in a way to provide the reader with an understanding of the overall process and how up to date the model is.	Comment noted.
25	Barbara Evoy - ECOS	The Delta Stewardship Council's Sacramento-San Joaquin Delta Climate Change Vulnerability Assessment work (Delta Adapts: Water Supply Technical Memorandum May, 2021) summarizes many recent regional climate studies and shows that climate change will substantially raise sea level in the delta. In addition to more frequent and longer curtailment of surface water, additional flows will be necessary from upstream diversions to stave off salinity intrusion. There is no discussion in the GSPD of these new studies, nor what the water supply impacts may be. Presumably, the impacts will not just affect surface water supplies but regional groundwater supplies as well. This report should be part of the GSPD analysis. Rob Swartz indicated both the Delta Stewardship climate change modeling and the anticipated additional surface water releases would be analyzed in relation to the GSPD water budget.	Comment noted. The climate change analysis included in the NASb GSP was inclusive of a scenario of approximately 45 centimeters of sea level rise. In addition, when preparing the water budget and modeling analysis, the GSAs considered the best available and most current information and science.
26	Barbara Evoy - ECOS	The newly released GSPD Appendix recommends future work to increase the accuracy of the model. These recommendations should be woven into both the management actions, timeline for completion and budget.	Comment noted.
27	Barbara Evoy - ECOS	GROUNDWATER DEPENDENT ECOSYSTEMS (GDEs): New information presented recently (Lewis and Burgy 1964 study) to the South American GSP working group suggests root depth analysis for GDEs should use a depth of 80 feet, not the 30 feet used in the GSPD. In addition, The Nature Conservancy (TNC) is about to publish a study indicating root depths for certain oak species are 25 meters. A recent TNC study also identifies the inability of oak woodlands to reproduce when ground water levels are too low. Therefore, a determination of appropriate root depths to maintain GDEs should be included as a potential data gap and for priority Management Action in the final GSP. Rob Swartz indicated he had already begun this analysis and that this would be included in the GSPD, if time allowed.	Comment noted. The GSP has been updated with use of a minimum threshold of 80 feet below ground surface in where areas of Valley Oak have been identified. This is a change from 30 feet below ground surface as documented in the draft GSP. Information related to these GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs as described in the added management action provided in Section 9.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
28	Barbara Evoy - ECOS	WATER BUDGET: The GSPD provides information from published 2015 Urban Water Management Plans (UWMPs). Earlier this year, water purveyors updated these plans for 2020 submittal. These plans include new forecasted demand data as well as updated actual supply and demand from 2015-2020. These 2020 numbers should be included in the final GSP analysis and discussion. The next GSP update should include information developed for the 2025 UWMP (Rob Swartz indicated this would be done). The Water Budgets should also provide a realistic view of how curtailed surface water rights will affect groundwater withdraws in dry years. Past groundwater demands appear to be extrapolated forward without the regards for climate change effects on surface water supplies	Comment noted. At the time the water budget was being prepared the GSAs used the best available and current information which included 2015 Urban Water Management Plan (UWMP) data. There was not sufficient time to incorporate 2020 UWMP data as most of these UMWP were not adopted by local agencies until the middle of 2021.
29	Barbara Evoy - ECOS	DEMAND REDUCTION: The GSPD does not include demand reduction as a Project and, therefore, does not reduce groundwater demand resulting from the associated water conservation and efficiency actions and programs that are expected to take place. As conservation programs can be more cost effective than new construction or permitting programs, these demand reducing programs should be described along with the logic for not including them in this GSP. Rob Swartz indicated these were already being done so he did not feel they should be included. We feel the document would be stronger with a clear definition of expected future demand management.	Comment noted. The NASb GSP includes the appropriate existing and planned projects and management actions to reach or maintain sustainability.
30	Barbara Evoy - ECOS	WATER BANKING: Water Banking is an important aspect of NASb groundwater management, both historically and in the future proposals. Therefore, it is critical to understand how previously banked water fits into the Water Budget described in the GSPD. The basin groundwater is not “all one color” if agencies believe they have not abandoned their banked water but intend to withdraw it under their groundwater rights as developed water. The Water Budget cannot be treated as a common resource and amount if this is the case. The GSPD uses gross input and output numbers to calculate the basin’s sustainability without this critical accounting. If all banked water is abandoned, then the basin’s pumpers can address sustainability with proposed projects. If one or more entity intends to make a significant withdraw of what they consider previously banked water (as discussed in Section 3 lines 827-834), however, the situation changes. The dynamics of the cost/benefit and necessary projects to mitigate groundwater draw down may significantly shift. Section 3 Line 833 cites that SGA has maintained an accounting of groundwater since 2007, but it is not reflected in the document. The document is not clear on what the status of the groundwater rights are nor how they are envisioned to be exercised.	Comment noted. These comments will be considered as the water bank project is further developed.
31	Barbara Evoy - ECOS	The need for proper accounting is particularly highlighted in a recent PPIC report, Improving California’s Water Market (https://www.ppic.org/publication/improving-californias-water-market/) and the legal discussion in an appendix by Brian Gray (https://www.ppic.org/wp-content/uploads/0921aar-appendix.pdf) If previously “banked” water is not adequately described in the 2020 GSP, it appears the GSP may have to be significantly revised to incorporate this activity, as the conclusions could be substantially different. Significant future revision to account for water banking allocations and management could reduce the amount of time the basin will have to implement projects and reach sustainability by 2040. It would appear that consensus on how the water bank will be operated and what withdraws will be permitted and when, should be a very high priority for the near term.	Comment noted. These comments will be considered as the water bank project is further developed.
32	Barbara Evoy - ECOS	Rob Swartz indicated that he considers the setting of minimum thresholds in the GSP to provide an operational base for water banking activities. If this is the expectation, then it should be detailed in the GSPD so the purveyors, public, and owners of shallow wells can understand both 1) the impacts to amounts of previously “banked” water, and 2) a minimum threshold that may become an operational constraint and regular groundwater level seen in dry years with water bank withdraws. As this is a different use of the GSPD minimum threshold idea discussed to date, ECOS would like to be engaged in the analysis and public review process of Water Bank impacts using this framework. The discussion of past water banking, accounting, loss, and criteria for withdraw, as well as potential impacts to adjacent subbasins, Interconnected Surface Water and GDEs should include a significant public review component. The outcomes should be clearly discussed in the context of the GSP and reflected in an update to the document.	Comment noted. These comments will be considered as the water bank project is further developed.
33	Barbara Evoy - ECOS	VULNERABLE SHALLOW WELLS: Given modeling that indicates well levels overall are expected to remain near their current levels, the GSPD conclusion is that there could be little to no impacts to domestic wells. There are, however, a) 2,563 known domestic wells, b) 6,471 “Other/Abandoned/Unknown” wells. Water purveyors in the area are also expected to withdraw banked water for various transfers at specific times. It would be prudent to have a backup approach to ensure domestic and disadvantaged community wells do not run dry. We suggest the NASb consider a vulnerable well program such as the one the SASb is developing. At a minimum, there should be a commitment to seek out additional information on the more than 6,000 unknown or abandoned wells and include robust monitoring as part of the Water Bank proposal. As of October 11, an Appendix B, “Refinement of Domestic Well Densities”, is not posted.	A domestic/shallow well data collection and communication program has been added as a GSP management actions strengthen communication and the transfer of data and information between the GSA and domestic well owners during GSP implementation. In addition, the State and Federal Agency's groundwater substitution transfer program guidance document include a process to evaluate the potential effects of transfer on other beneficial users of uses of groundwater.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
34	Barbara Evoy - ECOS	COMMUNICATION AND INVOLVEMENT OF THE PUBLIC: We recommend that the GSAs look carefully at their websites and outreach to fully involve the regional stakeholders in both the monitoring work, the development of Water Bank operating criteria, and the continued GSP evaluation and update process. Websites should have clearly defined standards for announcing public meetings, comment periods, comment procedures and public involvement. We also suggest that the GSAs present monitoring data to the public in a form that allows property owners to track information from sampling events that are of immediate interest to them. We suggest that the GSAs incorporate monitoring well telemetry so timely information is communicated. Residents in the SASb have been interested in making sure their well information is included, and additional domestic wells have been offered for water level and water quality monitoring. NASb residents may wish to provide additional well construction information with further outreach.	Comment noted. The NASb GSAs will continue to make information public as it becomes available during GSP implementation. One example of the GSAs commitment to do so is the addition of a domestic/shallow well data collection and communication program which has been added as a GSP Management Action #4 to strengthen communication and the transfer of data and information between the GSA and domestic well owners during GSP implementation.
35	Barbara Evoy - ECOS	Rob Swartz and Trevor Joseph indicated they would look at additional commitments to include the public in implementation. We suggest the GSPD consider a public advisory group similar to the one being set up in the Consumnes Basin. This would provide the GSAs feedback as to whether or not they are reaching critical segments of the public and how they might improve outreach.	Comment noted. The GSAs are commented to the outreach and engagement activities and process identified in Section 11.
36	Barbara Evoy - ECOS	The yet unfinished Water Bank discussion steps should be highlighted in the list of near term actions and any resulting management actions added. Project cost equity may need to be reconsidered if future water banking withdraws significantly change local conditions. Until Water Banking is addressed, the project list should be considered preliminary.	Comment noted.
37	Barbara Evoy - ECOS	CONCLUSION: The NASb GSPD has a lot of very useful information and will provide an excellent start to regional subbasin management of groundwater with the suggestions provided above. As one of the few community groups that participated in the development of all three subbasin GSPDs, however, we feel improvements not only need to be made in the individual plans, but that consistency is also needed between the plans. There does not appear to a reason for differences in key overarching management approaches, and analytical tools. This subbasin variability will not only hinder economies of scale for analysis, but efficient and effective management of the larger basin.	Comment noted. The NASb GSAs have coordinated with other adjacent subbasins during each respective GSAs development of their GSPs. Similar tools and methodology has been used between subbasins, however each GSP has been developed within the local control and unique characteristics and potential different objectives of each basin in accordance with SGMA.
38	Barbara Evoy - ECOS	Please add the ECOS Consumnes letter to my public comments, as there are common areas, esp in climate change modeling, that apply to the NASb	Comment noted
39	Barbara Evoy - ECOS	ECOS is seeing the ongoing, complex effects of climate change on the environment and people in the Cosumnes and Greater Sacramento regions, throughout California as a whole, and globally. Extreme heat waves are now more common in coastal areas, and torrential rains and flooding are becoming far more frequent in the eastern United States and in parts of Europe. While climate change is mentioned in a number of sections in the GSPPD, we are looking for much more robust, comprehensive discussion as it affects each topic.	Comment noted.
40	Barbara Evoy - ECOS	The document's Executive Summary (ES) does not adequately include the impacts and importance of climate change as a factor affecting CS groundwater sustainability. It is noted as an example of uncertainty in the Sustainable Yield modeling process, and it refers to "wetter" and "drier" years. However, the Executive Summary needs to discuss the pivotal importance of climate change as it could compromise the GSAs' long term best efforts. During the 1999-2018 interval, thirteen out of twenty years were recorded by the California Department of Water Resources in its Water Year Type classification system as Below Normal, Dry, or Critical (Dry) for precipitation. There is no indication that the next twenty to thirty years will have a greater number of wetter years, or years that would be considered "normal".	Comment noted.
41	Barbara Evoy - ECOS	Climate change needs to be explicitly presented as a key policy concern in every section of the GSP, including the Executive Summary. As is often the case, many readers will stop after reading the Executive Summary. Therefore, the key issues such as climate change, and related priorities for action need to be prominent in the first section of the document.	Comment noted.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
42	Amanda Cranford	Avoiding Undesirable Results: The requirement for minimum thresholds as spelled out in the SGMA regulations is as follows: "The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (CCR 23 §354.28(b)(2)) According to DWR (2021), "it is up to GSAs to define in their GSPs the specific significant and unreasonable effects that would constitute undesirable results and to define the groundwater conditions that would produce those results in their basins." The GSA should qualitatively describe what conditions within the subbasin would constitute an undesirable result with regard to streamflow depletion, ensuring that the description accounts for impacts to instream habitat that supports ESA-listed salmonids and green sturgeon. If data that would inform potential streamflow depletion impacts is lacking, NMFS recommends the final GSP follow guidance from California Department of Fish and Wildlife (2019) and develop conservative streamflow depletion thresholds as a cautionary principle until the surface flow/groundwater dynamic in the North American subbasin is better studied and understood.	Comment noted. At this time, the NASb GSP includes the appropriate minimum thresholds to avoid undesirable results and maintain sustainability. However, information related to GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs Normalized Derived Moisture Index (NDMI) as described in the added management action provided in Section 9 as an added measure to manage and understand beneficial uses and users of groundwater.
43	Jeff Litton	How much will the groundwater drop if Nevada Irrigation District(NID) achieves their plan to construct Centennial Dam, divert 221,400 acre feet of water from Bear River above Camp Far West Reservoir, and sell huge amounts of that water to Southern California entities through the California Aqueduct as they have clearly demonstrated to be their plan? They paid to be part of a study showing how they can legally take water from South Sutter Water District and sell it to the highest bidders south of the delta. They paid to be part of a study for the Association of California Water Agencies showing their marketability to Southern California buyers. Releases are made down the Bear River to augment system-wide supply when CVP South-of-Delta agricultural water service contract allocations are below 20 percent. https://www.acwa.com/wp-content/uploads/2017/06/2017-06-05-ACWA-Integrated-Storage-Final-Report.pdf NID literally has no way to pay for the dam without selling that water on the water market. Can SSWD compete against L.A.? NID is not measuring how much extra water there is in the Bear River watershed below the Camp Far West diversions, they are only measuring how much water can be legally stolen from SSWD. NID considers all water going to SSWD as excess water. They are planning to use 1927 water rights under application 5634 to over-allocate the Bear River supply, and create shortage for SSWD users that is their plan.NID would have shortchanged South Sutter Water District 13 out of the previous 18 years studied, or 8 of the previous 10 years studied. Simply look at the amount spilled below Camp Far West Reservoir diversions, and subtract 221,400 AF. 1999, not enough water. 2000, not enough water. 2001, not enough water. 2002, not enough water. 2004, not enough water. 2007, not enough water. 2008, not enough water. 2009, not enough water. 2010, not enough water. 2012, not enough water. 2013, not enough water. 2014, not enough water. 2015, not enough water, and so on. SSWD farmers would be forced to resort to pumping more groundwater, and thereby jeopardize and likely lower the North American Subbasin groundwater level. During the NID Director candidate debates of 2020, former director Scott Miller said NID would continue fighting downstream users in court and win those cases to take their(his) water. A thorough analysis should be conducted to find out the downstream impacts if NID diverts 221,400 acre feet. How many farmers will lose water? How many wells will go dry? I have been to the Colorado River delta, where a great American river dies before reaching the ocean. I've seen what over-allocation looks like. For the sake of our farmers, and our family's well in Wheatland, I hope action is taken to stop Centennial Dam before it's too late.https://yubariver.org/wp-content/uploads/2016/01/a5634X01_noticeSWRCB.pdf	Comment noted. The GSAs are unaware of any discussions related to the Centennial Dam as it relates to groundwater management planning under the SGMA.
44	Ralph Propper - ECOS	Plan should include a Management Action to form a technical working group (or similar mechanism) comprised of representatives of each of the region's three subbasins. The group should be charged with carrying out the work required to improve the model and to keep the model updated so that it can be used as needed for annual Plan reporting and five-year Plan updates. The work of the group should be open to public review so that diverse scientific viewpoints can be heard.	Comment noted. The NASb GSAs have not identified interbasin coordination as a specific management action as defined under the SGMA. However, GSAs will maintain an open communication and engagement process during GSP implementation including closely coordinating with other subbasins on many aspects of the GSP such as future updates to the groundwater model.
45	Ralph Propper - ECOS	Plan's Management Action section should identify the specific steps to carry out the model improvements called for in the CoSANA model report. The Plans should provide the funding and other resources needed to accomplish the model updates and improvements in time for the next Plan update in 2025	Comment noted. The NASb GSAs have included the costs for potential model updated within the GSP implementation budget as described in Section 10.
46	Ralph Propper - ECOS	Priority should be given to address the specific areas of model deficiency or short comings that are important to subbasin management including the protection of Groundwater Dependent Ecosystems and groundwater surface water interactions.	Comment noted.
47	Ralph Propper - ECOS	Additional emphasis should be placed on more recent climate conditions and their extrapolation into the future rather than depending on older sets of climate and hydrologic data. Older data sets are not as reflective of the changes in climate currently experienced and projected to occur. This includes increased likelihood of shorter rainy seasons, stronger atmospheric rivers, and warmer temperatures leading to lower peak snowpack. As part of this analysis, consideration should also be given to the changes in absorption that warmer soil will have upon snowpack and rainfall runoff	Comment noted. The NASb GSAs have and will continue to use best available science and data as information becomes available and can be incorporated into the GSP.
48	Ngodoo Atume - GLF	Provide the population of each identified DAC	Comment noted. The NASb GSP provides the required information under the SGMA.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
49	Ngodoo Atume - GLF	Include a map showing domestic well locations and average well depth across the subbasin.	Comment noted. The NASb GSP includes density and other relevant domestic well information is provided in Section 3 and Appendix B.
50	Ngodoo Atume - GLF	On applicable figures in Section 3, make block group map layers more transparent so that the cities and features are visible underneath, to help with understanding the communities and beneficial users that lie within each block group	Comment noted.
51	Ngodoo Atume - GLF	On the map of stream reaches in the subbasin (Figure 5-31), identify gaining and losing reaches in addition to interconnected and disconnected reaches. Consider any segments with data gaps as potential ISWs and clearly mark them as such on maps provided in the GSP	Comment noted.
52	Ngodoo Atume - GLF	Provide depth-to-groundwater contour maps using data from additional time periods other than just spring of 2020. Use seasonal data over multiple water year types to capture the variability in environmental conditions inherent in California's climate when mapping ISWs. We recommend the 10-year pre-SGMA baseline period of 2005 to 2015	Comment noted. The SGMA requires current groundwater levels for contour maps which is depicted the NASb GSP on Figure 5-2.
53	Ngodoo Atume - GLF	Reconcile ISW data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.	Comment noted. The NASb GSAs have not identified any significant interconnected surface water data gaps, however future monitoring network improvements are planned to aid in continued advancement of the basin understanding.
54	Ngodoo Atume - GLF	Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.	Comment noted. The NASb GSAs analysis supported use of 2020 year water levels as these provided conservative and appropriate estimates for establishment sustainable management criteria in this basin.
55	Ngodoo Atume - GLF	Refer to Attachment B for more information on TNC's plant rooting depth database. Deeper thresholds are necessary for plants that have reported maximum root depths that exceed the averaged 30-ft threshold, such as valley oak (*Quercus lobata*). We recommend that the reported max rooting depth for these deeper-rooted plants be used, if these species are present in the subbasin. For example, a depth-to-groundwater threshold of 80 feet should be used instead of the 30-ft threshold, when verifying whether Valley Oak polygons from the NC Dataset are connected to groundwater.	Comment noted. The GSP has been updated with use of a minimum threshold of 80 feet below ground surface in where areas of Valley Oak have been identified. This is a change from 30 feet below ground surface as documented in the draft GSP. Information related to these GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs as described in the added management action provided in Section 9.
56	Ngodoo Atume - GLF	Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including managed wetlands.	Comment noted.
57	Ngodoo Atume - GLF	In the Notice and Communications section, describe active and targeted outreach to engage DACs, domestic well owners, tribes, and environmental stakeholders throughout the GSP development and implementation phases. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process	Comment noted. The NASb GSAs reached out to community water systems in disadvantaged communities (DACs) areas. However many DACs are located within water districts or agencies which are represented by their respective district or agencies boards. Please refer to the Notice and Communication of the GSP (Section 11) for details. For NASb GSA coordination with environmental groups see Section 11.2.4. For NASb GSA coordination with DAC and domestic well owner outreach during development of the GSP see Section 11.2.5. For NASb GSA DAC outreach with domestic well owner during implementation see Section 11.6.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
58	Ngodoo Atume - GLF	Describe efforts to consult and engage with DACs and domestic well owners within the subbasin	See comment response above.
59	Ngodoo Atume - GLF	Utilize DWR's tribal engagement guidance to comprehensively address all tribes and tribal interests in the subbasin within the GSP	See comment response above.
60	Ngodoo Atume - GLF	Describe efforts to consult and engage with environmental stakeholders within the subbasin	See comment response above.
61	Ngodoo Atume - GLF	Chronic Lowering of Groundwater Levels - Describe direct and indirect impacts on DACs, drinking water users, and tribes when describing undesirable results and defining minimum thresholds for chronic lowering of groundwater levels	Comment noted. To evaluate the interests of each beneficial use and users of groundwater including but not limited to domestic, agriculture, municipal and industrial, the unique water level data and information was applied to collectively evaluate the potential negative effects of chronic lowering of groundwater levels as described in 8.4.1.3.
62	Ngodoo Atume - GLF	Degraded Water Quality - Describe direct and indirect impacts on drinking water users, DACs, and tribes when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act	Comment noted. To evaluate the interests of each beneficial use and users of groundwater including but not limited to domestic, agriculture, municipal and industrial, the unique water quality data and information was applied to collectively evaluate the potential negative effects of chronic lowering of groundwater levels as described in Section 8.7.1.3.
63	Ngodoo Atume - GLF	Degraded Water Quality - Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on DACs, drinking water users, and tribes	See comment response above.
64	Ngodoo Atume - GLF	Degraded Water Quality - Set minimum thresholds and measurable objectives for all water quality constituents within the subbasin that may be impacted or exacerbated by groundwater use and/or management. Ensure they align with drinking water standards	Comment noted. The NASb GSP includes additional water quality detail as documented in Sections 5.8 and 8.7.
65	Ngodoo Atume - GLF	When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the subbasin.[15] Defining undesirable results is the crucial first step before the minimum thresholds can be determined	Comment noted. Information related to GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs as described in the added management action provided in Section 9.
66	Ngodoo Atume - GLF	When establishing SMC for the subbasin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs should include "impacts on groundwater dependent ecosystems".	Comment noted. Information related to these GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs as described in the added management action provided in Section 9.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
67	Ngodoo Atume - GLF	When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the subbasin are reached.[17] The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts to environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law. [6, 18]	Comment noted. Based on the GSAs understanding of the water budget and modeling elements of the GSP, instream flows will see only very very minor changes in flow under projected condition (See monthly changes in flow data as described in Section 8.9). For this reason, a reasonable assumption is that groundwater management as described within the GSP will not have a significant and unreasonable impact to beneficial uses and users including environmental that are dependent on interconnected surface water and groundwater.
68	Ngodoo Atume - GLF	Incorporate climate change into imported water flow inputs for the projected water budget	Comment noted. Local water agencies do no import surface water in the NASb. Changes of surface water inflow into the NASb are contemplated in climate change analysis as described in Section 6 and Appendix P.
69	Ngodoo Atume - GLF	Incorporate climate change scenarios into projects and management actions	Comment noted. The water budget elements of the NASb GSP as described in Section 6 does incorporate climate change. Projects and management actions as described in the NASb GSP were selected to sustainably manage groundwater through a balanced water budget due to any effects seen from climate change and future land use changes.
70	Ngodoo Atume - GLF	Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, tribes, GDEs, and ISWs to clearly identify potentially impacted areas. Increase the number of RMWs in the shallow aquifer across the subbasin as needed to adequately monitor all groundwater condition indicators. Prioritize proximity to DACs, domestic wells, tribes, and GDEs when identifying new RMWs	Comment noted. The NASb GSAs specifically considered the interests of all beneficial uses and users of groundwater when specifically identifying each representative monitoring well. in addition, the NASb GSAs followed representative monitoring well density guidelines as provided by DWR. For example, the evaluation of the methodology for identifying representative monitoring wells that aid in safeguarding domestic well groundwater users interests are provided in Section 7.1.4.2.
71	Ngodoo Atume - GLF	Further describe the biological monitoring that can be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the subbasin.	Comment noted. Information related to GDEs is provided in Appendix O and the NASb GSAs are committed to monitoring GDEs Normalized Derived Moisture Index (NDMI) as described in the added management action provided in Section 9 as an added measure to manage and understand beneficial uses and users of groundwater.

Table S-2
Responses to Public Comments to Public Draft GSP

Comment No.	Name	Comment	Response to Comment / Changes to the GSP
72	Ngodoo Atume - GLF	For DACs and domestic well owners, include a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program	Comment noted. As GSP implementation commences, the NASb GSAs plan to continue to work with domestic well owners through the additional communication and engagement management action activities as identified in Section 8.
73	Ngodoo Atume - GLF	For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSAs plan to mitigate such impacts	Comment noted. Based on the NASb GSAs evaluation of water quality data and information and understanding of the projects and management actions included in the GSP, The GSAs are not anticipating any significant water quality changes during the implementation of the GSP.
74	Ngodoo Atume - GLF	Recharge ponds, reservoirs, and facilities for managed aquifer recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For further guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the “Multi-Benefit Recharge Project Methodology Guidance Document".	Comment noted.
75	Ngodoo Atume - GLF	Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.	Comment noted. Demand management is ongoing effort and consideration for virtually every water agency, city, or municipality serving water in California. Although the GSAs feel the NASb is sustainably being management, the goals and commitment of GSAs to expand conjunctive use is a direct response to address the potential for future undesirable results in the basin.

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
North Central Region/Region 2
1701 Nimbus Road
Rancho Cordova, CA 95670
www.wildlife.ca.gov
(916) 358-2900

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

October 7, 2021

Rob Swartz
North American Subbasin
5260 Birdcage St, Suite 180
Citrus Heights, CA 95610
Email: rswartz@rwah2o.org

Subject: COMMENTS ON THE NORTH AMERICAN SUBBASIN DRAFT GROUNDWATER SUSTAINABILITY PLAN

Dear Mr. Swartz,

The California Department of Fish and Wildlife's (Department) North Central Region is providing comments on the North American Subbasin Draft Groundwater Sustainability Plan (GSP) prepared by Reclamation District 1001 Groundwater Sustainability Agency (GSA), Sacramento Groundwater Authority GSA, South Sutter Water District GSA, Sutter County GSA, and Placer County GSA pursuant to the Sustainable Groundwater Management Act (SGMA).

As trustee agency for the State's fish and wildlife resources, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish & Game Code §§ 711.7 and 1802). Development and implementation of GSPs under SGMA represents a new era of California groundwater management. The Department has an interest in the sustainable management of groundwater, as many sensitive ecosystems and species depend on groundwater and interconnected surface waters, including ecosystems on Department-owned and -managed lands within SGMA-regulated basins.

SGMA and its implementing regulations afford ecosystems and species specific statutory and regulatory consideration, including the following as pertinent to Groundwater Sustainability Plans:

- GSPs must **consider impacts to groundwater dependent ecosystems** (GDEs) (Water Code § 10727.4(l); see also 23 CCR § 354.16(g));
- GSPs must consider the interests of all beneficial uses and users of groundwater, including environmental users of groundwater (Water Code § 10723.2) and GSPs must **identify and consider potential effects on all beneficial uses and users of groundwater** (23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3));
- GSPs must **establish sustainable management criteria that avoid undesirable results** within 20 years of the applicable statutory deadline, including **depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water** (23 CCR § 354.22 *et seq*. and Water Code §§ 10721(x)(6) and 10727.2(b)) and describe monitoring networks that can identify adverse impacts to beneficial uses of interconnected surface waters (23 CCR § 354.34(c)(6)(D)); and

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

- GSPs must **account for groundwater extraction for all water use sectors,** including managed wetlands, managed recharge, and native vegetation (23 CCR §§ 351(al) and 354.18(b)(3)).

Furthermore, the Public Trust Doctrine imposes a related but distinct obligation to consider how groundwater management affects public trust resources, including navigable surface waters and fisheries. Groundwater hydrologically connected to navigable surface waters and surface waters tributary to navigable surface waters are also subject to the Public Trust Doctrine to the extent that groundwater extractions or diversions affect or may affect public trust uses (Environmental Law Foundation v. State Water Resources Control Board (2018), 26 Cal. App. 5th 844). Accordingly, groundwater plans should consider potential impacts to and appropriate protections for navigable interconnected surface waters and their tributaries, and interconnected surface waters that support fisheries, including the level of groundwater contribution to those waters.

In the context of SGMA statutes and regulations, and Public Trust Doctrine considerations, the Department values SGMA groundwater planning that carefully considers and protects groundwater dependent ecosystems (GDEs) and fish and wildlife beneficial uses and users of groundwater and interconnected surface waters.

COMMENT OVERVIEW

The Department is writing to support ecosystem preservation in compliance with SGMA and its implementing regulations based on Department expertise and best available information and science.

The Department recognizes and appreciates the effort of the GSAs to characterize all beneficial users of groundwater in the subbasin and include detailed modeling based on robust monitoring data. However, the Department believes the GSP could improve its consideration of environmental users of groundwater and establish more protective management criteria. Accordingly, the Department recommends that the North American Subbasin GSAs address the following comments before submitting the GSP to the Department of Water Resources (DWR).

COMMENTS AND RECOMMENDATIONS

The Department's comments are as follows:

1. **Comment #1 Interconnected Surface Waters** (Groundwater Conditions, 5.11 Interconnected Surface Water; starting page 5-52): The GSP fails to include an estimate of the quantity and timing of depletions of interconnected surface water systems as required by 23 CCR § 354.16(f).
    a. *Issue*: The GSP identifies the locations of interconnected surface waters within the subbasin (Figure 5-31) and presents hydrographs that demonstrate the relationship between groundwater levels and surface water elevations. However, the GSP does not include information related to the quantity and timing of depletions from these interconnected surface waters as required by 23 CCR § 354.16(f).

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

b. *Recommendation*: The Department recommends that the GSP include a table quantifying the volume of surface water depletions, by month, for all interconnected surface waters identified within the subbasin.

2. **Comment #2 Groundwater Dependent Ecosystems** (Appendix O): GDE identification, required by 23 CCR § 354.16(g), is based on methods that risk exclusion of ecosystems that may depend on groundwater.
   a. *Issues*:
      i. Depth to Groundwater: The Department recognizes and appreciates the effort put into identifying GDEs within the subbasin, including the assessment of both vegetation diversity and critical species dependence to inform relative priority. Further refinement and clarification of GDE identification methods used in the GSP will help to create a more robust analysis. Appendix O states that groundwater contours were developed using groundwater level measurements from Spring 2020 (Section 1.3, page 3), but then also states that GDEs were prioritized using 2019 depth to groundwater contours (Section 1.4, page 3). It is unclear which year of groundwater data was used in the analysis. Additionally, while the Department supports the use of seasonal high spring measurements, 2020 was a dry water year type for the Sacramento Valley. Analysis that relies on depth to water thresholds should incorporate data from a representative hydrologic period that includes a variety of water year types, rather than from a single point in time. The analysis also assumes that groundwater must be less than 30 feet below the ground surface (bgs) to support GDEs based on the maximum rooting depth of Valley Oak (*Q. lobata)*; however, mature Valley Oak can access groundwater up to 80 feet below the ground surface (Howard 1992, Lewis & Burgy 1964). The use of a 30-foot threshold may incorrectly exclude Valley Oak communities within the subbasin from further consideration as a GDE.
      ii. Perched Groundwater Areas: The GSP discusses locations within the subbasin that have a depth to groundwater of less than 30 feet and may also have areas of perched water, and potential GDEs from these areas were removed. The GSP does not sufficiently characterize the relationship between these perched groundwater areas and the Principal Aquifer, including the impacts of pumping or of seasonally elevated groundwater levels on the groundwater in these perched areas.
      iii. Special Status Species: The GSP methodology includes an evaluation of "non-aquatic critical fauna" that may be present in the subbasin. Interconnected surface waters and their associated aquatic species are also a type of groundwater dependent ecosystem that must be evaluated within the GSP

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

and considered in the development of sustainability criteria and analysis of undesirable results.

b. *Recommendations*:

i. Depth to Groundwater: The Department recommends that Appendix O be revised to clarify which year of data was used to create the groundwater elevation contours for the GDE analysis and consider how the methodology could be updated to integrate a range of water years for determining potential GDEs. The Department also recommends the GSP narrowly update the methodology for GDE identification for areas within the subbasin that underlie Valley Oak communities to reflect a potential maximum rooting depth of 80 feet bgs.

ii. Perched Groundwater Areas: The Department recommends the GSP include additional information characterizing the relationship between areas of perched groundwater and the Principal Aquifer. The GSP should discuss whether seasonal highs within the Principal Aquifer contribute to the perched areas, and whether pumping within the Principal Aquifer has the potential to deplete these perched areas that may support GDE communities. If the relationship cannot be adequately characterized, the GSP should conservatively include GDEs from these areas, particularly as depth to groundwater for the principal aquifer is within the identified potential root zone for GDEs.

iii. Special Status Species: The critical species analysis included within the GSP should be broadened to include discussion of aquatic species that are supported by interconnected surface waters.

3. **Comment #3 Sustainable Management Criteria** (Sustainable Management Criteria; 8.4 Chronic Lowering of Groundwater Levels, 8.9 Depletion of Surface Water; starting page 8-9): Sustainable management criteria (SMC) are unlikely to protect against undesirable results for groundwater dependent ecosystems and fish and wildlife beneficial uses and users of groundwater and interconnected surface waters.

a. *Issues*:

i. Groundwater Levels Minimum Thresholds: The GSP projects that development and land use changes within the subbasin will result in increased groundwater use. Additionally, with climate change, some portions of the subbasin are projected to experience a climate-driven decline in groundwater elevations. The GSP uses the model-projected groundwater level declines at each representative monitoring site (RMS) to establish minimum thresholds (MTs) by subtracting this projected decline from a baseline set at the average of Fall 2014 and 2015 groundwater elevations (page 8-14, line 318). The GSP fails to contextualize that 2014 and

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

2015 were two consecutive critically dry water years that occurred during an extended dry period in the Sacramento Valley, wherein groundwater extraction increased to replace more than 70% of lost agricultural water supplies (Lund 2018). Though the GSP asserts that "no negative impacts were reported by beneficial users in the subbasin" (line 320), it is probable that environmental users of groundwater were experiencing adverse impacts due to combined groundwater depletion and reduced surface water availability. These adverse impacts include stressed or dying riparian vegetation, poor instream habitat availability, and increased water temperatures (DFW 2019). It is inappropriate to rely on groundwater levels from 2014 and 2015 as a baseline from which groundwater could continue to decline before reaching the established MTs, as undesirable results will likely be experienced before MTs are reached.

ii. Depletion of Interconnected Surface Waters: As a result of the projected increases in groundwater use within the subbasin, the GSP projects that groundwater level declines along the interconnected Sacramento River will result in approximately 5,800 acre-feet per year (AFY) of surface water depletions. Though the GSP presents information related to the projected change in groundwater pumping, seepage, diversions, and streamflow in Figure 8-7 (page 8-42), a table summarizing this information by month would clarify potential ISW impacts and facilitate comparisons to baseline conditions (See Comment #1). The GSP asserts that though the Sacramento River will experience depletions, municipal development along the Sacramento River that takes agricultural land out of production will result in a net increase in flows of approximately 17,200 AFY (page 8-41, line 907). Additional information is needed in the GSP to support this claim and ensure that environmental users are protected from undesirable results. The GSP does not provide information related to interconnected surface waters within the subbasin other than the Sacramento River, and it is unclear what effect the SMCs will have on depletions. Furthermore, these anticipated land use changes and concurrent reduced surface water demands are not within the control of GSAs. GSAs should anticipate future scenarios wherein they are accountable for mitigating interconnected surface water depletions attributable to groundwater pumping, instead of leaning on proposed land use change to reduce surface water demand, particularly when surface water rights are not under GSA management.

iii. Environmental Beneficial Users: The GSP does not sufficiently analyze potential impacts of the selected SMCs on environmental beneficial users of groundwater or interconnected surface waters. While the GSP does include sections that discuss the effects of the minimum thresholds for each

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

sustainability indicator on each beneficial user within the subbasin, for the groundwater level MTs, the GSP states only that the groundwater level MTs "protect most known GDEs" within the subbasin (page 8-20, line 426). It is unclear what the GSP means by "most GDEs," and no further detail is provided about whether any analyses were completed that involve comparing the MTs at each RMS to nearby GDE communities and their rooting depths. Additionally, in its discussion of interconnected surface waters within the subbasin, the GSP does not analyze potential impacts to environmental users of surface waters, including aquatic habitat or species (See Comment 2(iii)).

b. *Recommendations*:

i. Groundwater Levels Minimum Thresholds: The Department recommends the GSP reselect its chosen groundwater level baseline to a more representative hydrologic period for the subbasin, rather than relying on groundwater levels experienced during critically dry years. MTs should be updated accordingly.

ii. Depletion of Interconnected Surface Waters: The GSP should include a discussion of projected depletions of all interconnected surface waters in the basin, not only the Sacramento River, based on the established SMCs. The GSP should include additional detail in a table that summarizes the projected depletions, reduced diversions, and streamflow by month to facilitate comparison to depletions under existing conditions. In order to better support its claim that Sacramento River flow would increase over the SGMA implementation period, the GSP must provide additional details related to the underlying assumptions used in this calculation, including the following:

1. A characterization of the water rights that the GSP assumes will stop diverting water from the Sacramento River, including a discussion of how the water will be maintained instream to support surface flows.
2. The anticipated timeline for the conversion of land from agricultural to municipal use.
3. The anticipated timeline for groundwater pumping increases within the subbasin.
4. Contingency plans, triggered by specific monitoring metrics, that will initiate projects to avoid surface water depletions should the land use changes fail to offset the increase in groundwater pumping as anticipated.

iii. Environmental Beneficial Users: The Department recommends the GSP include additional analysis related to the impacts of the established SMCs on environmental users, including GDEs and interconnected surface water. The groundwater level MTs at each representative monitoring well identified for

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

GDEs in Figure 7-3 (page 7-14) should be compared to the rooting depths of the identified vegetation in each GDE community (See Comment #2(i)). Monitoring of physical indicators of GDE health (i.e., Normalized Difference Vegetation Index (NDVI)) should be completed in addition to the continued monitoring of groundwater levels. The GSP should also include additional analysis to demonstrate that environmental users of interconnected surface waters would not experience undesirable results under the established MTs. The GSP should explicitly discuss the impacts of projected depletions on surface flows, water temperatures, and aquatic species and habitat.

4. **Comment #4 Projects and Management Actions** (Projects and Management Actions; 9.2 Projects and Management Actions, 9.3 Supplemental Projects; starting page 9-3): Inclusion of additional demand management strategies would strengthen the GSP's list of supplemental projects.
    a. *Issue*: The planned and supplemental project and management activities included in the GSP focus on increased surface water supplies and delivery, conjunctive use, or water banking and recharge. Though the GSP indicates that the planned projects are expected to be sufficient to achieve basin sustainability, should the projects fail to produce the anticipated groundwater benefit or encounter unexpected delays, it may be necessary to implement additional demand management projects that could likely produce groundwater benefits within a shorter timeframe.
    b. *Recommendation*: The Department recognizes that the GSP discusses existing demand management activities within the subbasin, including temporary conservation measures and urban and agricultural water use efficiency programs (page 9-3, line 38). Additional discussion of potential program expansion or other demand reduction projects that could be implemented within the subbasin would strengthen the GSP's list of supplemental projects.

CONCLUSION

In conclusion, the draft GSP thoughtfully discusses all beneficial uses of groundwater, provides detailed characterization of groundwater conditions in the subbasin, and incorporates robust modeling of future scenarios; however, the GSP can further refine its management criteria to better avoid potential impacts to GDEs and interconnected surface water. The Department recommends that the North American Subbasin GSAs address the above comments before GSP submission to DWR to best prepare for the following regulatory criteria for plan evaluation:

1. The assumptions, criteria, findings, and objectives, including the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are not reasonable and/or not supported by the best available information and best available science. [23 CCR § 355.4(b)(1)] (See Comments #1, 2, 3)

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

2. The interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected by the use of groundwater in the basin, have not been considered. [23 CCR § 355.4(b)(4)] (See Comments #1, 2, 3)
3. The projects and management actions are not feasible and/or not likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield. [23 CCR § 355.4(b)(5)] (See Comment #4)

The Department appreciates the opportunity to provide comments on the North American Subbasin Draft GSP. Please contact Bridget Gibbons, Environmental Scientist, by email at Bridget.Gibbons@wildlife.ca.gov with any questions.

Sincerely,

DocuSigned by:
Jennifer Garcia
B35A7660DD7848B...

Kevin Thomas
Regional Manager, North Central Region

Enclosures (Literature Cited)

ec:

California Department of Fish and Wildlife

Joshua Grover, Branch Chief
Water Branch
Joshua.Grover@wildlife.ca.gov

Robert Holmes, Environmental Program Manager
Statewide Water Planning Program
Robert.Holmes@wildlife.ca.gov

Angela Murvine, Statewide SGMA Coordinator
Groundwater Program
Angela.Murvine@wildlife.ca.gov

Jennifer Garcia, Environmental Program Manager
North Central Region
Jennifer.Garcia@wildlife.ca.gov

Briana Seapy, Water Program Supervisor
North Central Region
Briana.Seapy@wildlife.ca.gov

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

Bridget Gibbons, Environmental Scientist
North Central Region
Bridget.Gibbons@wildlife.ca.gov

California Department of Water Resources

Craig Altare, Supervising Engineering Geologist
Groundwater Sustainability Plan Review Section Chief
Craig.Altare@water.ca.gov

Matti Siltanen, North American Subbasin SGMA Point of Contact
North Central Region Office
Mattipohto.Siltanen@water.ca.gov

Groundwater Sustainability Agencies

Reclamation District 1001
kreese@rd1001.org

Sacramento Groundwater Authority
rswartz@rwah2o.org

South Sutter Water District
sswd@hughes.net

Sutter County
grivera@co.sutter.ca.us

Placer County
chanson@placer.ca.gov

State Water Resources Control Board

Natalie Stork, Chief
Groundwater Management Program
Natalie.Stork@waterboards.ca.gov

NOAA National Marine Fisheries Service

Rick Rogers, Fish Biologist
West Coast Region
Rick.Rogers@noaa.gov

DocuSign Envelope ID: 913875DE-0495-4606-A7D1-A99E7236C2A5

Literature Cited

Department of Fish and Wildlife. 2019. Statewide Drought Response: Stressor Monitoring.

Howard, Janet L. Quercus lobata. In: Fire Effects Information System. 1992. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.

Lewis, D.C., Burgy, R.H. 1964. The Relationship between Oak Tree Roots and Groundwater in Fractured Rock as Determined by Tritium Tracing. *Journal of Geophysical Research*. *69*(12):2579-2588.

Lund, Jay, et al. Lessons from California's 2012-2016 Drought. 2018. *Journal of Water Resources Planning and Management*. *144*(10). https://doi.org/10.1061/(ASCE)WR.1943-5452.0000984

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

September 29, 2021

John Woodling, Executive Director
Sacramento Groundwater Authority GSA
5620 Birdcage Street, Suite 180
Sacramento, California 95610

Electronic transmittal only

Re: NOAA's National Marine Fisheries Service comments on the developing Groundwater Sustainability Plan for the North American subbasin

Dear Mr. Woodling:

NOAA's National Marine Fisheries Service (NMFS) is the federal agency responsible for managing, conserving, and protecting living marine resources in inland, coastal, and offshore waters of the United States. We derive our mandates from numerous statutes, including the Federal Endangered Species Act (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The purpose of the ESA is to conserve threatened and endangered species and their ecosystems.

The North American subbasin Groundwater Sustainability Agency (hereafter, "GSA") recently released their draft North American subbasin Groundwater Sustainability Plan (draft GSP) for public comment. The California Department of Water Resources (DWR) has designated the North American subbasin a "high" priority for groundwater management, necessitating the development of a GSP by January 2022, as required under California's Sustainable Groundwater Management Act of 2014 (SGMA). Several waterways that overlie portions of the North American subbasin support federally threatened California Central Valley (CCV) steelhead (*Oncorhynchus mykiss*), threatened Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*), the threatened Southern Distinct Population Segment (sDPS) of North American green sturgeon (*Acipenser medirostris*), and federally endangered Sacramento River winter-run Chinook salmon (*O. tshawytscha*). In addition, the North American subbasin is designated as Essential Fish Habitat (EFH) for Pacific Coast Chinook salmon, including CV fall-run Chinook salmon (*O. tshawytscha*) and CV late fall-run Chinook salmon (*O. tshawytscha*), which are managed under the MSA. This letter transmits NMFS' comments on the draft GSP.

Surface water and groundwater are hydrologically linked in the North American subbasin, and this linkage is critically important in creating seasonal habitat for Chinook salmon, steelhead, and green sturgeon. Where the groundwater aquifer supplements streamflow, the influx of cold, clean water is critically important for maintaining temperature and flow volume. Pumping water from these aquifer-stream complexes has the potential to affect Chinook salmon, steelhead, and sturgeon habitat by lowering groundwater levels and interrupting the hyporheic flow between

the aquifer and stream. NMFS is concerned that groundwater extraction in the North American subbasin is currently impacting Chinook salmon, steelhead, and green sturgeon instream habitat, and recommends the draft GSP adequately address and minimize these impacts.

Comments

Avoiding Undesirable Results: The requirement for minimum thresholds as spelled out in the SGMA regulations is as follows:

> "The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (CCR 23 §354.28(b)(2))

According to DWR (2021), "it is up to GSAs to define in their GSPs the specific significant and unreasonable effects that would constitute undesirable results and to define the groundwater conditions that would produce those results in their basins." The GSA should qualitatively describe what conditions within the subbasin would constitute an undesirable result with regard to streamflow depletion, ensuring that the description accounts for impacts to instream habitat that supports ESA-listed salmonids and green sturgeon. If data that would inform potential streamflow depletion impacts is lacking, NMFS recommends the final GSP follow guidance from California Department of Fish and Wildlife (2019) and develop conservative streamflow depletion thresholds as a cautionary principle until the surface flow/groundwater dynamic in the North American subbasin is better studied and understood.

Using Groundwater Elevations as a Proxy for Streamflow Depletion: Groundwater levels are used as a proxy for depletion of surface water because, as the draft GSP states, the "depletion of interconnected surface water is directly related to the gradient between the surface water system at the groundwater interface and the groundwater Subbasin." However, SGMA regulations require that a GSP demonstrate "that there is a significant correlation between groundwater levels and the other metric" (DWR 2017), with the "other metric" in question appearing to be "the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results" (CCR 23 §354.28(c)(6)). The draft GSP should explain, with supporting evidence, what significant correlation exists between groundwater elevations and streamflow depletion rates or volumes, and how that correlation would allow the GSA to adequately predict and monitor impacts to beneficial uses of surface water.

Undesirable result for depletion of surface water: The draft GSP includes the following definition for the streamflow depletion undesirable result:

> *20% or more of the NASb interconnected surface water (ISW) representative monitoring sites (RMSs) have minimum threshold exceedances for 2 consecutive fall measurements (5 out of 23).* (Page 8-42)

The above definition is not appropriate for avoiding significant and unreasonable impacts to surface water beneficial uses because it is completely disconnected from ecological principles

that govern how those beneficial uses are impacted. Requiring two consecutive years of exceeding the minimum threshold does not account for the fact that organisms live or die depending on the habitat conditions at a moment in time. If streamflow depletion contributes to a creek drying up during a given year, the fish that reside in that creek will perish and an impact to surface water beneficial use will likely have resulted. Requiring two consecutive years of such conditions impacting surface water beneficial uses makes little sense when attempting to avoid impacts to surface water beneficial uses.

Basing Sustainable Management Criteria on Historical Drought Conditions: The minimum threshold for streamflow depletion was established by averaging the lowest groundwater elevations from fall 2014 and fall 2015. However, using recent groundwater elevations to inform or set streamflow depletion minimum thresholds and measurable objectives is likely inappropriate for avoiding significant impacts to ESA-listed salmonids and sturgeon, and their habitat, including EFH. Basic hydraulic principles dictate that groundwater flow is proportional to the difference between groundwater elevations at different locations along a flow path. Using this basic principle, groundwater flow to a stream or, conversely, seepage from a stream to the underlying aquifer is proportional to the difference between water elevation in the stream and groundwater elevations at locations away from the stream. Basing sustainable management criteria upon groundwater elevations that occurred during California's recent historical drought (2011-2016) will likely result in historically high streamflow depletion rates, producing instream conditions that negatively affect ESA-listed Chinook salmon, steelhead, green sturgeon, and their critical habitat.

Any sustainable management criteria that result must avoid significant and unreasonable impacts to identified beneficial uses of surface water, which for surface waters within the North American subbasin include cold freshwater habitat; migration of aquatic organisms; and spawning, reproduction, and/or early development[1].

Sustainable Yield estimation: The GSP asserts that the North American subbasin is "currently under its estimated sustainable yield and in position to support additional groundwater development" (Page 8-12). However, a sustainable yield estimation requires the avoidance of all undesirable results and, as noted throughout this letter, we do not believe significant and unreasonable streamflow depletion will be avoided when using the sustainable management criteria proposed within the draft GSP. Similarly, the assertion that "the sustainability goal is currently being met" within the basin also appears to be unfounded, and directly contradicts DWR's evaluation process that assigned a "high" priority to the subbasin. Per the SGMA regulations, if the GSA wishes to assert that the basin is sustainably managed currently, then they must demonstrate and provide evidence that each sustainability indicator "does not exist and cannot occur" (DWR 2017). Suffice to say, the draft GSP fails to accomplish this. If the GSA wishes to keep this assertion within the draft GSP, they should fully explain, in detail, why the historically high streamflow depletion rates that correspond to their proposed sustainable management criteria will avoid significant and unreasonable impacts to surface water beneficial uses.

[1] Water Quality Control Plan for the Sacramento River and San Joaquin River Basins. Copy at https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

NMFS recommendation for future Projects and Management Actions: We suspect that groundwater recharge projects are likely to be an important action implemented as part of the effort to achieve groundwater sustainability in the North American subbasin. NMFS encourages the GSA to consider implementing recharge projects that facilitate floodplain inundation and offer multiple benefits, including downstream flood attenuation, groundwater recharge, and ecosystem restoration. Managed floodplain inundation can recharge floodplain aquifers, which in turn slowly release stored water back to the stream during summer months. These projects also reconnect the stream channel with floodplain habitat, which can benefit juvenile salmon, steelhead, and sturgeon by creating off-channel habitat characterized by slow water velocities, ample cover in the form of submerged vegetation, and high food availability. As an added bonus, these types of multi-benefit projects likely have more diverse grant funding streams that can lower their cost as compared to traditional off-channel recharge projects. NMFS stands ready to work with any GSA interested in designing and implementing floodplain recharge projects.

Please direct questions regarding this letter to Amanda Cranford, of my staff, at Amanda.Cranford@noaa.gov or (916) 930-3706.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator
California Central Valley Office

References:

California Department of Fish and Wildlife. 2019. Fish & Wildlife Groundwater Planning Considerations. California Department of Fish and Wildlife, Groundwater Program. June 2019. 28 pp. Available at: https://cawaterlibrary.net/document/fish-wildlife-groundwater-planning-considerations/

California Department of Water Resources. 2017. Best Management Practices for the Sustainable Management of Groundwater: Sustainable Management Criteria (Draft). Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf

California Department of Water Resources. 2021. Letter from Craig Altare (DWR) to Taylor Blakslee (Cuyama Basin GSA), re. Cuyama Valley - 2020 Groundwater Sustainability Plan. Available at https://sgma.water.ca.gov/portal/gsp/assessments/32

Cc: To the File ARN 151422-WCR2021-SA00121

Electronic copy only:

Angela Murvine, California Department of Fish and Wildlife Statewide SGMA Coordinator, Angela.Murvine@wildlife.ca.gov

Bridget Gibbons, California Department of Fish and Wildlife Central Valley SGMA Biologist, Bridget.Gibbons@wildlife.ca.gov

Craig Altare, California Department of Water Resources, Supervising Engineering Geologist, Craig.Altare@water.ca.gov

Matti Siltanen, North American subbasin SGMA Point of Contact, California Department of Water Resources, Mattipohto.Siltanen@water.ca.gov

Brett Storey, Principal Management Analyst, West Placer GSA, bstorey@placer.ca.gov

Joe Henderson, Manager, Reclamation District No. 1001 GSA, rd1001@syix.com

Guadalupe Rivera, Senior Civil Engineer, County of Sutter GSA - North American, grivera@co.sutter.ca.us

Brad Arnold, General Manager, South Sutter Water District GSA, sswd@hughes.net

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

October 14, 2021

To: Groundwater Sustainability Agencies in the North American Subbasin
Reclamation District 1001 GSA; Michael Phillips, mphillips@rd1001.org
Sacramento Groundwater Authority GSA; Rob Swartz, rswartz@rwah2o.org
South Sutter Water District GSA; Brad Arnold, sswd@hughes.net
Sutter County GSA; Guadalupe Rivera, grivera@co.sutter.ca.us
West Placer County GSA; Christina Hanson, chanson@placer.ca.gov
Jim Peifer, Executive Director, Regional Water Authority, jpeifer@rwah20.org

Subject: Comments on the North American Subbasin (NASb) draft Groundwater Sustainability Plan (GSPD)

ECOS commends the effort of the North American Subbasin Groundwater Sustainability Agencies (GSAs), and their consultants, for involving the public and in preparing the GSPD. The GSPD provides both a technical and lay understanding of the North American Subbasin (NASb) and how groundwater moves within it. The GSPD is an important reference document that brings together a wealth of information in one place. With additional information, projects and management Actions recommended below, the GSPD will present a clear direction for the subbasin's sustainable groundwater management.

Our comments were initially developed in September 2021 and forwarded to The Regional Water Authority (RWA). Two ECOS members, Ted Rauh and Barbara Evoy, participated in a meeting with Rob Swartz and Trevor Joseph, staff of RWA, on October 6, 2021, to discuss them before finalizing the comments. We have noted our understanding of the relevant commitments/direction that the staff provided during our discussion of the issues below.

CLIMATE CHANGE: As one of the most critical elements of long-term water supply planning, the GSPD should clearly describe the climate change study(ies) it based the analysis on, its assumptions, and the arguments for and against the selected approach. The NASb GSPD and the South American Subbasin (SASb) GSPD have little to no discussion in the body of the GSPDs as to how climate change was evaluated. The documents do not have any type of detailed summary of the process, the climatic range considered, how "change" was integrated with historical years reviewed in the past water budget nor how the earlier analysis fits into the current science of climate change. Both state that the work was done as part of the American River Basin Study (ARBS) but 1) provide both inaccurate citations to the study and 2) where it is linked in the NASb GSPD, it is only to a PCWA website that talks generally about it being developed. The climate change model is very generally discussed in 8 lines in Section 6., without offering any true overview of the effort. As it stands now, the GSPD does not set the stage for any of the Water Budget tables that show "climate change".

The NASb GSPD includes "with and without climate change" in tables as if reviewers were fully familiar with the model parameters and they were generally agreed upon. While the document

ECOS
ENVIRONMENTAL
COUNCIL
OF SACRAMENTO

HABITAT 2020
SACRAMENTO COUNTY
A COALITION OF ENVIRONMENTAL ORGANIZATIONS
A CLEAR VISION INTO THE FUTURE

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

displays output, it lacks a clear discussion on the model. The conclusions of the water budget, without an understanding of the climate change analysis, are only speculative to the reviewers. Lack of climate documentation implies either the GSAs do not know how it was done, or the GSAs don't feel the work is of the quality to sustain public scrutiny. We hope neither is the case and encourage the GSAs to include a much clearer discussion of how climate change was handled.

On September 30, 2021, a 490 page Appendix was released which describes much of the data used in the model and some specifics of the climate change input data. The 490 pages provide a good description of these model inputs for future reference but do not digest the information in a way to provide the reader with an understanding of the overall process and how up to date the model is. As the US Bureau of Reclamation has yet to publish the ARBS, Rob Swartz indicated they would work to provide GSPD information that clarifies how the central tendency model was chosen as being conservative, how it aligns (or doesn't) with other more recent regional climate change modeling, and how the ARBS compares to a new model run of much more hot and dry conditions that are thought to reflect serious climate change. He indicated the ARBS work would be updated with new 50-year weather sets in the future, as this will give a more accurate assessment.

The Delta Stewardship Council's Sacramento-San Joaquin Delta Climate Change Vulnerability Assessment work (Delta Adapts: Water Supply Technical Memorandum May, 2021) summarizes many recent regional climate studies and shows that climate change will substantially raise sea level in the delta. In addition to more frequent and longer curtailment of surface water, additional flows will be necessary from upstream diversions to stave off salinity intrusion. There is no discussion in the GSPD of these new studies, nor what the water supply impacts may be. Presumably, the impacts will not just affect surface water supplies but regional groundwater supplies as well. This report should be part of the GSPD analysis. Rob Swartz indicated both the Delta Stewardship climate change modeling and the anticipated additional surface water releases would be analyzed in relation to the GSPD water budget.

The newly released GSPD Appendix recommends future work to increase the accuracy of the model. These recommendations should be woven into both the management actions, timeline for completion and budget.

GROUNDWATER DEPENDENT ECOSYSTEMS (GDEs): New information presented recently (Lewis and Burgy 1964 study) to the South American GSP working group suggests root depth analysis for GDEs should use a depth of 80 feet, not the 30 feet used in the GSPD. In addition, The Nature Conservancy (TNC) is about to publish a study indicating root depths for certain oak species are 25 meters. A recent TNC study also identifies the inability of oak woodlands to reproduce when ground water levels are too low. Therefore, a determination of appropriate root depths to maintain GDEs should be included as a potential data gap and for priority Management Action in the final GSP. Rob Swartz indicated he had already begun this analysis and that this would be included in the GSPD, if time allowed.

ECOS ENVIRONMENTAL COUNCIL OF SACRAMENTO

HABITAT 2020 SACRAMENTO COUNTY A COALITION OF ENVIRONMENTAL ORGANIZATIONS A CLEAR VISION INTO THE FUTURE

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

WATER BUDGET: The GSPD provides information from published 2015 Urban Water Management Plans (UWMPs). Earlier this year, water purveyors updated these plans for 2020 submittal. These plans include new forecasted demand data as well as updated actual supply and demand from 2015-2020. These 2020 numbers should be included in the final GSP analysis and discussion. The next GSP update should include information developed for the 2025 UWMP (Rob Swartz indicated this would be done). The Water Budgets should also provide a realistic view of how curtailed surface water rights will affect groundwater withdraws in dry years. Past groundwater demands appear to be extrapolated forward without the regards for climate change effects on surface water supplies (see below).

DEMAND REDUCTION: The GSPD does not include demand reduction as a Project and, therefore, does not reduce groundwater demand resulting from the associated water conservation and efficiency actions and programs that are expected to take place. As conservation programs can be more cost effective than new construction or permitting programs, these demand reducing programs should be described along with the logic for not including them in this GSP. Rob Swartz indicated these were already being done so he did not feel they should be included. We feel the document would be stronger with a clear definition of expected future demand management.

WATER BANKING: Water Banking is an important aspect of NASb groundwater management, both historically and in the future proposals. Therefore, it is critical to understand how previously banked water fits into the Water Budget described in the GSPD. The basin groundwater is not "all one color" if agencies believe they have not abandoned their banked water but intend to withdraw it under their groundwater rights as developed water. The Water Budget cannot be treated as a common resource and amount if this is the case. The GSPD uses gross input and output numbers to calculate the basin's sustainability without this critical accounting.

If all banked water is abandoned, then the basin's pumpers can address sustainability with proposed projects. If one or more entity intends to make a significant withdraw of what they consider previously banked water (as discussed in Section 3 lines 827-834), however, the situation changes. The dynamics of the cost/benefit and necessary projects to mitigate groundwater draw down may significantly shift. Section 3 Line 833 cites that SGA has maintained an accounting of groundwater since 2007, but it is not reflected in the document. The document is not clear on what the status of the groundwater rights are nor how they are envisioned to be exercised.

The need for proper accounting is particularly highlighted in a recent PPIC report, Improving California's Water Market (https://www.ppic.org/publication/improving-californias-water-market/) and the legal discussion in an appendix by Brian Gray (https://www.ppic.org/wp-content/uploads/0921aar-appendix.pdf)

If previously "banked" water is not adequately described in the 2020 GSP, it appears the GSP may have to be significantly revised to incorporate this activity, as the conclusions could be substantially different. Significant future revision to account for water banking allocations and management could reduce the amount of time the basin will have to implement projects and reach

ECOS
ENVIRONMENTAL
COUNCIL
OF SACRAMENTO

HABITAT 2020
SACRAMENTO COUNTY
A COALITION OF ENVIRONMENTAL ORGANIZATIONS
A CLEAR VISION INTO THE FUTURE

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

sustainability by 2040. It would appear that consensus on how the water bank will be operated and what withdraws will be permitted and when, should be a very high priority for the near term.

Rob Swartz indicated that he considers the setting of minimum thresholds in the GSP to provide an operational base for water banking activities. If this is the expectation, then it should be detailed in the GSPD so the purveyors, public, and owners of shallow wells can understand both 1) the impacts to amounts of previously "banked" water, and 2) a minimum threshold that may become an operational constraint and regular groundwater level seen in dry years with water bank withdraws. As this is a different use of the GSPD minimum threshold idea discussed to date, ECOS would like to be engaged in the analysis and public review process of Water Bank impacts using this framework. The discussion of past water banking, accounting, loss, and criteria for withdraw, as well as potential impacts to adjacent subbasins, Interconnected Surface Water and GDEs should include a significant public review component. The outcomes should be clearly discussed in the context of the GSP and reflected in an update to the document.

VULNERABLE SHALLOW WELLS: Given modeling that indicates well levels overall are expected to remain near their current levels, the GSPD conclusion is that there could be little to no impacts to domestic wells. There are, however, a) 2,563 known domestic wells, b) 6,471 "Other/Abandoned/Unknown" wells. Water purveyors in the area are also expected to withdraw banked water for various transfers at specific times. It would be prudent to have a backup approach to ensure domestic and disadvantaged community wells do not run dry. We suggest the NASb consider a vulnerable well program such as the one the SASb is developing. At a minimum, there should be a commitment to seek out additional information on the more than 6,000 unknown or abandoned wells and include robust monitoring as part of the Water Bank proposal. As of October 11, an Appendix B, "Refinement of Domestic Well Densities", is not posted.

COMMUNICATION AND INVOLVEMENT OF THE PUBLIC: We recommend that the GSAs look carefully at their websites and outreach to fully involve the regional stakeholders in both the monitoring work, the development of Water Bank operating criteria, and the continued GSP evaluation and update process. Websites should have clearly defined standards for announcing public meetings, comment periods, comment procedures and public involvement. We also suggest that the GSAs present monitoring data to the public in a form that allows property owners to track information from sampling events that are of immediate interest to them. We suggest that the GSAs incorporate monitoring well telemetry so timely information is communicated.

Residents in the SASb have been interested in making sure their well information is included, and additional domestic wells have been offered for water level and water quality monitoring. NASb residents may wish to provide additional well construction information with further outreach.

Rob Swartz and Trevor Joseph indicated they would look at additional commitments to include the public in implementation. We suggest the GSPD consider a public advisory group similar to the one being set up in the Consumnes Basin. This would provide the GSAs feedback as to whether or not they are reaching critical segments of the public and how they might improve outreach.

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

KUDOS: There are two significant areas where the NASb GSPD provides superior information or clarity than the SASb GSPD. First, the NASb definitions of Undesirable Results for Chronic lowering of groundwater, reduction of storage and depletion of surface water, are a clearer and more conservative approach than that used in the SASb. We recommend that rather than two separate standards, the SASb consider adopting the NASb's.

Second, The NASb's Projects and Management Actions appear to be well thought out and the specificity of the budget, as it stands now, with in-kind resources needed, provides a good initial map of the first part of implementation. Recommendations made in several GSPD sections and appendices (such as the COSANA model needs) should be added to the management action lists, however.

The yet unfinished Water Bank discussion steps should be highlighted in the list of near term actions and any resulting management actions added. Project cost equity may need to be reconsidered if future water banking withdraws significantly change local conditions. Until Water Banking is addressed, the project list should be considered preliminary.

CONCLUSION: The NASb GSPD has a lot of very useful information and will provide an excellent start to regional subbasin management of groundwater with the suggestions provided above. As one of the few community groups that participated in the development of all three subbasin GSPDs, however, we feel improvements not only need to be made in the individual plans, but that consistency is also needed between the plans. There does not appear to a reason for differences in key overarching management approaches, and analytical tools. This subbasin variability will not only hinder economies of scale for analysis, but efficient and effective management of the larger basin.

ECOS strongly supported the use of common analytical tools to develop a basinwide understanding of the surface and groundwater flow elements. ECOS also strongly supported joint evaluation of GDEs and felt this was important to the regional outcome. Collaboration and consistency are also needed, however, in the setting of management objectives, shallow and disadvantaged well programs, water bank evaluation and potential adjacent subbasin impacts, additional GDE evaluation using new studies, baseline demand reduction measures, water demand data timeframes, public involvement and very importantly, climate change modeling. The NASB website promises a new Appendix R, Interbasin Coordination in the final GSP. ECOS requests that all three subbasins consider not just touch points between the subbasins, but a commitment to bring consistency in substantive approaches to the next round of GSPs.

The Environmental Council of Sacramento (ECOS) is a 501c3 nonprofit, with the mission to achieve regional and community sustainability and a healthy environment for existing and future residents. Member organizations of ECOS include: 350 Sacramento, Breathe California Sacramento Region, Environmental Democrats of Sacramento, Friends of Stone Lakes NWR, International Dark-Sky Association, Physicians for Social Responsibility Sacramento Chapter,

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

Sacramento Audubon Society, Sacramento Citizens' Climate Lobby, Sacramento Electric Vehicle Association, Sacramento Housing Alliance, Sacramento Natural Foods Coop, Sacramento Valley Chapter of the California Native Plant Society, Sacramento Vegetarian Society, Save Our Sandhill Cranes, Save the American River Association and Sierra Club Sacramento Group. Habitat 2020 is a coalition that works to protect the lands, waters, wildlife and native plants in the Sacramento region. Member organizations of Habitat 2020 include: the ECOS member groups italicized above, as well as the Friends of Swainson's Hawk, Sacramento Area Creeks Council and Sacramento Heron and Egret Rescue. Habitat 2020 also serves as ECOS' Habitat and Conservation committee.

We thank you for the opportunity to provide comments. If you have any questions regarding this letter, please feel free to contact us.

Sincerely,

Ralph Propper
President, ECOS

Sean Wirth
Co-Chair, Habitat 2020

Robert Burness
Co-Chair, Habitat 2020

cc: Jessica Law, Executive Director, Water Forum, jlaw@waterforum.org
John Woodling, Sacramento Central Groundwater Authority, jwoodling@rwah2o.org

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

October 26, 2021

To: GSAs associated with the development of GSPs for the North and South American subbasins and the Cosumnes Subbasin

North American Subbasin
Reclamation District 1001 GSA; Michael Phillips, mphillips@rd1001.org
Sacramento Groundwater Authority GSA; Rob Swartz, rswartz@rwah2o.org
South Sutter Water District GSA; Brad Arnold, sswd@hughes.net
Sutter County GSA; Guadalupe Rivera, grivera@co.sutter.ca.us
West Placer County GSA; Christina Hanson, chanson@placer.ca.gov

South American Subbasin
Sacramento County; Linda Dorn, dornl@saccounty.net
Northern Delta; Erik Ringelberg, erik@thefreshwatertrust.org
Omochumne-Hartnell Water District, Mike Wackman, info@ohwd.org
Sacramento Central Groundwtr Auth; John Woodling, jwoodling@geiconsultants.com
Sloughhouse Resource Conservation Dist; Austin Miller, austin@sloughhouseRCD.org

Cosumnes Subbasin
Omochumne-Hartnell Water District; Mike Wackman, info@ohwd.org
Sloughhouse Resource Conservation Dist; austin@sloughhouseRCD.org
Galt Irrigation District; Leo Van Warmerdam, galtirrigationdistrict@gmail.com
Clay Water District; Gary Silva Jr., soilstoppers@yahoo.com
City of Galt; Mark Clarkson, mclarkson@cityofgalt.org
Amador County Groundwater Mgmt Auth; Rick Ferriera, rferriera@amadorwater.org
Sacramento County; Linda Dorn, dornl@saccounty.net

Subject: Comments on CoSANA model report to be included as part of the Groundwater Sustainability Plan

Board Chairs,

ECOS/Habitat 2020 submit the following CoSANA comments for your consideration. These comments deal with the Recommendation Section, page 6-1 through 6-3 of the CoSANA model report proposed for inclusion in your Groundwater Sustainability Plans (Plans). Given the length of the report and the short time for review, we have not conducted a technical assessment of the model, but have instead limited our review to the Recommendations Section of the document. We focus our comments on what further work is needed to keep the CoSANA model updated for use in annual Plan reporting, five-year Plan updates, and to improve the model's shortcomings.

ECOS
ENVIRONMENTAL
COUNCIL
OF SACRAMENTO

HABITAT 2020
SACRAMENTO COUNTY
A COALITION OF ENVIRONMENTAL ORGANIZATIONS
A CLEAR VISION INTO THE FUTURE

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

First, we believe that each Plan should include a Management Action to form a technical working group (or similar mechanism) comprised of representatives of each of the region's three subbasins. The group should be charged with carrying out the work required to improve the model and to keep the model updated so that it can be used as needed for annual Plan reporting and five-year Plan updates. The work of the group should be open to public review so that diverse scientific viewpoints can be heard.

Second, we believe that each Plan's Management Action section should identify the specific steps to carry out the model improvements called for in the CoSANA model report. The Plans should provide the funding and other resources needed to accomplish the model updates and improvements in time for the next Plan update in 2025.

Third, we believe priority should be given to address the specific areas of model deficiency or short comings that are important to subbasin management including the protection of Groundwater Dependent Ecosystems and groundwater surface water interactions.

Fourth, we believe that more focus should be placed on integration of climate change predictive modeling and the CoSANA model so that improved climate change modeling scenarios can be run in subsequent years.

Finally, we believe that additional emphasis should be placed on more recent climate conditions and their extrapolation into the future rather than depending on older sets of climate and hydrologic data. Older data sets are not as reflective of the changes in climate currently experienced and projected to occur. This includes increased likelihood of shorter rainy seasons, stronger atmospheric rivers, and warmer temperatures leading to lower peak snowpack. As part of this analysis, consideration should also be given to the changes in absorption that warmer soil will have upon snowpack and rainfall runoff.

We appreciate and commend you for all of the work and resources that have gone into the development of the CoSANA model and the fact that all three subbasin GSAs have participated in its development and use. We strongly urge this type of regional coordination and hope that it will extend to other GSP areas.

* * * * *

The Environmental Council of Sacramento (ECOS) is a 501c3 nonprofit, with the mission to achieve regional and community sustainability and a healthy environment for existing and future residents. Member organizations of ECOS include: 350 Sacramento, Breathe California Sacramento Region, Environmental Democrats of Sacramento, *Friends of Stone Lakes NWR*, *International Dark-Sky Association*, Physicians for Social Responsibility Sacramento Chapter, *Sacramento Audubon Society*, Sacramento Citizens' Climate Lobby, Sacramento Electric Vehicle Association, Sacramento Housing Alliance, Sacramento Natural Foods Coop, *Sacramento Valley*

Environmental Council of Sacramento
P.O. Box 1526, Sacramento, California 95812
Phone: 916-444-0022

Chapter of the California Native Plant Society, Sacramento Vegetarian Society, *Save Our Sandhill Cranes, Save the American River Association* and *Sierra Club Sacramento Group.*

Habitat 2020 is a coalition that works to protect the lands, waters, wildlife and native plants in the Sacramento region. Member organizations of Habitat 2020 include: the ECOS member groups italicized above, as well as the Friends of Swainson's Hawk, Sacramento Area Creeks Council and Sacramento Heron and Egret Rescue. Habitat 2020 also serves as ECOS' Habitat and Conservation committee.

Signatures

Ralph Propper



Ralph Propper
President, ECOS



Sean Wirth
Co-Chair, Habitat 2020



Robert Burness
Co-Chair, Habitat 2020

cc: Jessica Law, Executive Director, Water Forum, jlaw@waterforum.org
Jim Peifer, Executive Director, Regional Water Authority, jpeifer@rwah2o.org

October 29, 2021

North American Subbasin GSAs
c/o Sacramento Groundwater Authority
5620 Birdcage Street, Suite 180
Citrus Heights, CA 95610

Submitted via web: https://portal.nasbgroundwater.org/comment/new

Re: Public Comment Letter for North American Subbasin Draft GSP

Dear Rob Swartz,

On behalf of the above-listed organizations, we appreciate the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the North American Subbasin being prepared under the Sustainable Groundwater Management Act (SGMA). Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is critical for the resilience of California's water portfolio, particularly in light of changing climate. Under the requirements of SGMA, Groundwater Sustainability Agencies (GSAs) must consider the interests of all beneficial uses and users of groundwater, such as domestic well owners, environmental users, surface water users, federal government, California Native American tribes and disadvantaged communities (Water Code 10723.2).

As stakeholder representatives for beneficial users of groundwater, our GSP review focuses on how well disadvantaged communities, drinking water users, tribes, climate change, and the environment were addressed in the GSP. While we appreciate that some basins have consulted us directly via focus groups, workshops, and working groups, we are providing public comment letters to all GSAs as a means to engage in the development of 2022 GSPs across the state. Recognizing that GSPs are complicated and resource intensive to develop, the intention of this letter is to provide constructive stakeholder feedback that can improve the GSP prior to submission to the State.

Based on our review, we have significant concerns regarding the treatment of key beneficial users in the Draft GSP and consider the GSP to be **insufficient** under SGMA. We highlight the following findings:

1. Beneficial uses and users **are not sufficiently** considered in GSP development.
    a. Human Right to Water considerations **are not sufficiently** incorporated.
    b. Public trust resources **are not sufficiently** considered.
    c. Impacts of Minimum Thresholds, Measurable Objectives and Undesirable Results on beneficial uses and users **are not sufficiently** analyzed.
2. Climate change **is not sufficiently** considered.
3. Data gaps **are not sufficiently** identified and the GSP **does not have a plan** to eliminate them.

4. Projects and Management Actions **do not sufficiently consider** potential impacts or benefits to beneficial uses and users.

Our specific comments related to the deficiencies of the North American Subbasin Draft GSP along with recommendations on how to reconcile them, are provided in detail in **Attachment A.**

Please refer to the enclosed list of attachments for additional technical recommendations:

Attachment A	GSP Specific Comments
Attachment B	SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users
Attachment C	Freshwater species located in the basin
Attachment D	The Nature Conservancy's "Identifying GDEs under SGMA: Best Practices for using the NC Dataset"
Attachment E	Maps of representative monitoring sites in relation to key beneficial users

Thank you for fully considering our comments as you finalize your GSP.

Best Regards,



Ngodoo Atume
Water Policy Analyst
Clean Water Action/Clean Water Fund



J. Pablo Ortiz-Partida, Ph.D.
Western States Climate and Water Scientist
Union of Concerned Scientists



Samantha Arthur
Working Lands Program Director
Audubon California



Danielle V. Dolan
Water Program Director
Local Government Commission



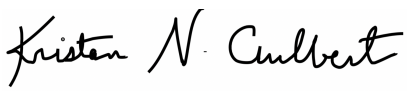
E.J. Remson
Senior Project Director, California Water Program
The Nature Conservancy



Melissa M. Rohde
Groundwater Scientist
The Nature Conservancy



Amy Merrill, Ph.D.
Acting Director, California Program
American Rivers



Kristan Culbert
Associate Director, California Central Valley River Conservation
American Rivers

Attachment A

Specific Comments on the North American Subbasin Draft Groundwater Sustainability Plan

1. Consideration of Beneficial Uses and Users in GSP development

Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes,[1] groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine.

A. Identification of Key Beneficial Uses and Users

Disadvantaged Communities, Drinking Water Users, and Tribes

The identification of Disadvantaged Communities (DACs), drinking water users, and tribes is **incomplete**. The GSP provides information on DACs, including identification by name and location on a map (Figure 3-8). Figure 3-3 highlights specific water systems as they relate to DACs, and water sources for DACs are identified as local water agencies and domestic wells. Tribal lands have been identified and mapped (Figure 3-2) within the subbasin.

However, we note the following deficiencies with the identification of these key beneficial users:

- The GSP fails to describe the population of each DAC.
- While the GSP provides a map of domestic well density on Figure 3-13, it fails to provide depth of these wells (such as minimum well depth, average well depth, or depth range) within the subbasin.

These missing elements are required for the GSAs to fully understand the specific interests and water demands of these beneficial users, and to support the consideration of beneficial users in the development of sustainable management criteria and selection of projects and management actions.

RECOMMENDATIONS
• Provide the population of each identified DAC. • Include a map showing domestic well locations and average well depth across the subbasin.

[1] Our letter provides a review of the identification and consideration of federally recognized tribes (Data source: SGMA Data viewer) within the GSP from non-tribal members and NGOs. Based on the likely incomplete information available to our organizations for this review, we recommend that the GSA utilize the California Department of Water Resources' "Engagement with Tribal Governments" Guidance Document (https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents) to comprehensively address these important beneficial users in their GSP.

- On applicable figures in Section 3, make block group map layers more transparent so that the cities and features are visible underneath, to help with understanding the communities and beneficial users that lie within each block group.

Interconnected Surface Waters

The identification of Interconnected Surface Waters (ISWs) is **insufficient**, due to lack of supporting information provided for the ISW analysis. To assess ISWs, the GSP presents depth-to-water contours from Spring 2020. The GSP states (p. 5-52): *"For purposes of this GSP the rivers and creeks were assumed to be interconnected when the depth to water is less than 30 feet bgs and are subject to future refinements."* However, using seasonal groundwater elevation data over multiple water year types is an essential component of identifying ISWs. Using depth-to-groundwater contours from one point in time, especially after the 2015 SGMA benchmark date, is not sufficient evidence to state that reaches are not connected to groundwater. In California's Mediterranean climate, groundwater interconnections with surface water can vary seasonally and interannually, and that natural variability needs to be taken into account when identifying ISWs.

The GSP discounts surface water supported by perched groundwater as potential ISW. The GSP states (5-53): *"Studies along the upper reaches of Racoon Creek, generally east of Highway 65, show the area is underlain by the Ione Formation and, due to its low permeability, would tend to perch water. Therefore, the surface water is not connected to the principal aquifer."* However, shallow aquifers that have the potential to support well development, support ecosystems, or provide baseflow to streams are principal aquifers, even if the majority of the subbasin's pumping is occurring in deeper principal aquifers.[2] If areas of perched groundwater are discounted as ISWs, the GSP should provide more supporting evidence of 1) vertical groundwater gradients between the perched system and deeper principal aquifers, and 2) whether perched groundwater is providing significant or economic quantities of water to streams, wells (e.g., domestic wells), and ecosystems (e.g., GDEs).

RECOMMENDATIONS

- On the map of stream reaches in the subbasin (Figure 5-31), identify gaining and losing reaches in addition to interconnected and disconnected reaches. Consider any segments with data gaps as potential ISWs and clearly mark them as such on maps provided in the GSP.
- Provide depth-to-groundwater contour maps using data from additional time periods other than just spring of 2020. Use seasonal data over multiple water year types to capture the variability in environmental conditions inherent in California's climate when mapping ISWs. We recommend the 10-year pre-SGMA baseline period of 2005 to 2015.
- Reconcile ISW data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.

[2] "'Principal aquifers' refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems." [23 CCR §351(aa)]

Groundwater Dependent Ecosystems

The identification of Groundwater Dependent Ecosystems (GDEs) is **incomplete**, due to use of inadequate temporal data to characterize groundwater conditions under GDEs. Appendix O (Identification of Likely Groundwater Dependent Ecosystems) presents groundwater contours from Spring 2020. The appendix states that this date was used because it has the most complete set of measurements. However, as stated above under the ISW section of this letter, use of depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) is essential to characterize groundwater conditions and the natural variability in conditions across the subbasin, and therefore should be used to determine the range of depth to groundwater around GDEs.

The GSP identified and mapped GDEs using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset). Appendix O presents a complete inventory of flora and fauna, and identifies critical species in the subbasin. Appendix O states (p. 2): *"Quercus lobata (Valley Oak) was considered to have the deepest rooting depth of all species evaluated (24 feet). Therefore, with allowing for some capillary action of the soils, if depth to groundwater of less than 30 feet below ground surface groundwater was assumed to potentially being capable of supporting dependent ecosystems."* We recommend instead that a 80-foot depth-to-groundwater threshold be used when inferring whether Valley Oak polygons in the NC dataset are likely reliant on groundwater. This recommendation is based on a recent correction in TNC's rooting depth database, after finding a typo in the max rooting depth units for Valley Oak.[3] This resulted in a specific change in the max rooting depth of Valley Oak from 24 feet to 24 meters (80 feet). For all other phreatophytes, we continue to recommend that a 30-foot depth-to-groundwater threshold be used when inferring whether all other NC dataset polygons are likely reliant on groundwater.

The NC dataset is a starting point for mapping GDEs in the subbasin, and contains information on vegetation, wetlands, and hydrologic features that are commonly known to be reliant on groundwater. For practicality purposes, the conservative use of depth-to-groundwater thresholds can cost-effectively screen which NC dataset polygons are most likely reliant on groundwater (see Attachment D for more details). Because phreatophytes are foundation species within many GDEs, the depth-to-groundwater threshold is based on a phreatophyte's ability to access the water table and capillary fringe. For the majority of phreatophytes, 10 meters is considered indicative of a phreatophyte's ability to access the water table and capillary fringe due to the maximum rooting depth of most phreatophytes globally.[4,5] However, for potentially deeper rooted plants, such as Valley Oak, a deeper depth-to-groundwater threshold is required to ensure that this endemic and iconic California species is not inaccurately removed from the GSP's GDE map; until other local studies (e.g., isotopic source water analyses, rooting depth studies) prove otherwise.

RECOMMENDATIONS

- Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types. Refer to Attachment D of this letter for best practices for using local groundwater data

[3] TNC. 2021. Plant Rooting Depth Database. Available at: https://groundwaterresourcehub.org/sgma-tools/gde-rooting-depths-database-for-gdes/
[4] Canadell, J. et al. 1996. Maximum rooting depth of vegetation types at the global scale. *Oecologia*, 108:583-595.
[5] Doody, T. et al. 2017. Continental mapping of groundwater dependent ecosystems: A methodological framework to integrate diverse data and expert opinion. *Journal of Hydrology: Regional Studies.* 10:61-81.

to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.

- Refer to Attachment B for more information on TNC's plant rooting depth database. Deeper thresholds are necessary for plants that have reported maximum root depths that exceed the averaged 30-ft threshold, such as valley oak (*Quercus lobata*). We recommend that the reported max rooting depth for these deeper-rooted plants be used, if these species are present in the subbasin. For example, a depth-to-groundwater threshold of 80 feet should be used instead of the 30-ft threshold, when verifying whether Valley Oak polygons from the NC Dataset are connected to groundwater.

Native Vegetation and Managed Wetlands

Native vegetation and managed wetlands are water use sectors that are required to be included in the water budget.[6,7] The integration of these ecosystems into the water budget is **insufficient**. The water budget did explicitly include the current, historical, and projected demands of native vegetation, but did not explicitly include the current, historical, and projected demands of managed wetlands. Table 3-1 states there are over 1,700 acres of managed wetlands in the subbasin, which are mapped on Figure 3-9. The omission of explicit water demands for managed wetlands is problematic because key environmental uses of groundwater are not being accounted for as water supply decisions are made using this budget, nor will they likely be considered in project and management actions.

RECOMMENDATION

- Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including managed wetlands.

B. Engaging Stakeholders

Stakeholder Engagement during GSP Development

Stakeholder engagement during GSP development is **insufficient**. SGMA's requirement for public notice and engagement of stakeholders is not fully met by the description in the Notice and Communications Section of the GSP (Section 11).[8]

We note the following deficiencies with the overall stakeholder engagement process:

[6] "'Water use sector' refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation." [23 CCR §351(al)]

[7] "The water budget shall quantify the following, either through direct measurements or estimates based on data: (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow." [23 CCR §354.18]

[8] "A communication section of the Plan shall include a requirement that the GSP identify how it encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin." [23 CCR §354.10(d)(3)]

- The opportunities for public involvement and engagement for DACs, domestic well owners, tribes, and environmental stakeholders during the GSP development and implementation processes are described in very general terms. They include attendance at meetings, notices, direct mailers, social media, and discussions with environmental organizations for developing sustainable management criteria. Details about the nature of the engagement process for beneficial users are not provided in the Notice and Communications section (i.e. planning for public listening sessions, actions to improve accessibility and increase participation among a diversity of beneficial users).

- The GSP does not include a plan for continual opportunities for engagement through the *implementation* phase of the GSP for DACs, domestic well owners, tribes, and environmental stakeholders.

RECOMMENDATIONS

- In the Notice and Communications section, describe active and targeted outreach to engage DACs, domestic well owners, tribes, and environmental stakeholders throughout the GSP development and implementation phases. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process.

- Describe efforts to consult and engage with DACs and domestic well owners within the subbasin.

- Utilize DWR's tribal engagement guidance to comprehensively address all tribes and tribal interests in the subbasin within the GSP.[9]

- Describe efforts to consult and engage with environmental stakeholders within the subbasin.

C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users

The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is **insufficient**. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results and establishing minimum thresholds.[10,11,12]

[9] Engagement with Tribal Governments Guidance Document. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Guidance-Doc-for-SGM-Engagement-with-Tribal-Govt_ay_19.pdf

[10] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." [23 CCR §354.26(b)(3)]

[11] "The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[12] "The description of minimum thresholds shall include [...] how state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the agency shall explain the nature of and the basis for the difference." [23 CCR §354.28(b)(5)]

Disadvantaged Communities and Drinking Water Users

For chronic lowering of groundwater levels, the GSP presents an analysis of the impact of minimum thresholds on domestic wells. Minimum thresholds were established to maintain groundwater elevations above the shallowest perforated intervals of nearby wells. The GSP states (p. 8-19): *"As documented in Appendix B, domestic well construction was analyzed to identify the top of screen intervals for existing domestic wells. By maintaining water levels above the top screen, domestic users are protected. At each RMS location, the top screen interval for domestic wells is shown in reference to the applicable MT (see Appendix Q – SMC Hydrographs). MTs could result in slightly higher energy costs associated with greater pumping lifts in limited areas. No wells are expected to go dry."*

The GSP does not however, sufficiently describe or analyze direct or indirect impacts on DACs, drinking water users or tribes when defining undesirable results, nor does it describe how the existing minimum threshold groundwater levels are consistent with avoiding undesirable results to DACs and tribes in the subbasin.

For degraded water quality, the GSP establishes SMC for total dissolved solids (TDS) and nitrate. Minimum thresholds are set to state secondary maximum contaminant level (MCL) and the state primary MCL, respectively. SMC have not been established for other constituents of concern (COCs), however. The GSP states (8-26): *"As described in Section 5 – Groundwater Conditions, there are some areas of elevated total dissolved solids (TDS), arsenic (As), hexavalent chromium (CrVI), iron (Fe), and manganese (Mn). With no trends in As, CrVI, Fe, and Mn observed to date, the NASb is not setting SMCs for these constituents at this time."* The GSP continues (p. 8-27): *"It is also worth noting that in the Sacramento County portion of the NASb, there are well-documented larger areas of contamination and localized quality issues as described in Section 5 – Groundwater Conditions. As also described in that section, the NASb has maintained active coordination with regulators and responsible parties to address effective remediation of these contaminants. For that reason, there are no SMC for the contaminants in groundwater."* SMC should be established for all COCs in the subbasin that may be impacted and/or exacerbated by groundwater use or management, in addition to coordinating with water quality regulatory programs. Naturally occurring COCs can be exacerbated as a result of groundwater use or groundwater management within the subbasin.

RECOMMENDATIONS

Chronic Lowering of Groundwater Levels

- Describe direct and indirect impacts on DACs, drinking water users, and tribes when describing undesirable results and defining minimum thresholds for chronic lowering of groundwater levels.

Degraded Water Quality

- Describe direct and indirect impacts on drinking water users, DACs, and tribes when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."[13]

- Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on DACs, drinking water users, and tribes.

[13] Guide to Protecting Water Quality under the Sustainable Groundwater Management Act https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

- Set minimum thresholds and measurable objectives for all water quality constituents within the subbasin that may be impacted or exacerbated by groundwater use and/or management. Ensure they align with drinking water standards.[14]

Groundwater Dependent Ecosystems and Interconnected Surface Waters

For chronic lowering of groundwater levels, the GSP states (p. 8-14): *"Following the calculations of the MTs, the resulting values were then compared to beneficial users to evaluate whether they would experience significant impacts at those future groundwater elevations. Hydrographs for each RMS showing actual groundwater elevations in comparison to baseline and model projected MTs are in Appendix Q – SMC Hydrographs."* Some of the hydrographs in Appendix Q show the 30 foot depth-to-water threshold used in the GDE identification. However, within the SMC section of the GSP, there is no further discussion or explanation of the impacts to GDEs, including discussion of the location of RMS wells in relation to GDEs or the impacts to GDEs when groundwater levels fall below the 30 foot threshold (or 80 feet within the context of Valley Oak).

For the depletion of interconnected surface water sustainability indicator, groundwater levels are used as a proxy. The GSP states (p. 8-42): *"Depletion of surface water is considered significant and unreasonable when the following occurs: 20% or more of the NASb interconnected surface water (ISW) representative monitoring sites (RMSs) have minimum threshold exceedances for 2 consecutive fall measurements (5 out of 23)."* The GSP continues (p. 8-43): *"The MTs for depletion of surface water are the same as for chronic lowering of groundwater, with the exception that only a subset of the RMS locations is considered interconnected with the surface water system."* However, no analysis or discussion is presented to describe how the SMC will affect GDEs, or the impact of these minimum thresholds on GDEs in the subbasin. Furthermore, the GSP makes no attempt to evaluate the impacts of the proposed minimum threshold on environmental beneficial users of surface water. The GSP does not explain how the chosen minimum thresholds and measurable objectives avoid significant and unreasonable effects on surface water beneficial users in the subbasin (see Attachment C for a list of environmental users in the subbasin), such as increased mortality and inability to perform key life processes (e.g., reproduction, migration).

RECOMMENDATIONS

- When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the

[14] "Degraded Water Quality [...] collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues." [23 CCR §354.34(c)(4)]

subbasin.[15] Defining undesirable results is the crucial first step before the minimum thresholds can be determined.[16]

- When establishing SMC for the subbasin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs should include "impacts on groundwater dependent ecosystems".

- When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the subbasin are reached.[17] The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts to environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.[6,18]

2. Climate Change

The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations require integration of climate change into the projected water budget to ensure that projects and management actions sufficiently account for the range of potential climate futures.[19] The effects of climate change will intensify the impacts of water stress on GDEs, making available shallow groundwater resources especially critical to their survival. Condon *et al.* (2020) shows that GDEs are more likely to succumb to water stress and rely more on groundwater during times of drought.[20] When shallow groundwater is unavailable, riparian forests can die off and key life processes (e.g., migration and spawning) for aquatic organisms, such as steelhead, can be impeded.

The integration of climate change into the projected water budget is **insufficient**. The GSP does incorporate climate change into the projected water budget using data from the American River Basin Study. However, the plan does not consider multiple climate scenarios (e.g., the 2070 extremely wet and extremely dry climate scenarios) in the projected water budget. The GSP should clearly and transparently incorporate extremely wet and dry scenarios into projected water budgets or select more appropriate extreme scenarios for the subbasin. The GSP assesses the effects of possible extreme conditions for a Hot-Dry (HD) scenario. Given the location of the subbasin between the American and Sacramento rivers,

---

[15] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results". [23 CCR §354.26(b)(3)]

[16] The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[17] "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." [23 CCR §354.28(c)(6)]

[18] Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/Critical_Species_LookBook_91819.pdf

[19] "Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow." [23 CCR §354.18(e)]

[20] Condon et al. 2020. Evapotranspiration depletes groundwater under warming over the contiguous United States. Nature Communications. Available at: https://www.nature.com/articles/s41467-020-14688-0

a cool and wet scenario may also help identify potential vulnerabilities and/or opportunity areas for recharge projects. While these extreme scenarios may have a lower likelihood of occurring, their consequences could be significant and their inclusion can help identify important vulnerabilities in the subbasin's approach to groundwater management.

The GSP incorporates climate change into key inputs (e.g., precipitation and evapotranspiration) of the projected water budget. However, imported water was not quantified as part of surface water flow inputs for future water budgets. If the water budgets are incomplete, including the omission of projected climate change effects on imported water flow inputs, then there is increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not adequately include climate change projections may underestimate future impacts on vulnerable beneficial users of groundwater such as ecosystems, DACs, tribes, and domestic well owners.

RECOMMENDATIONS

- Incorporate climate change into imported water flow inputs for the projected water budget.
- Incorporate climate change scenarios into projects and management actions.

3. Data Gaps

The consideration of beneficial users when establishing monitoring networks is **insufficient**, due to a lack of specific plans to increase the Representative Monitoring Wells (RMWs) in the monitoring network that represent water quality conditions and shallow groundwater elevations around DACs, domestic wells, tribes, GDEs, and ISWs in the subbasin.

Figure 7-8 (Representative Monitoring Wells for Chronic Lowering of Groundwater) and Figure 7-10 (Shallow Aquifer Water Quality Representative Monitoring Wells) show that no monitoring wells are located across portions of the subbasin near DACs, domestic wells, and tribes (see maps provided in Attachment E). Beneficial users of groundwater may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network.[21]

The GSP provides some discussion of data gaps for GDEs and ISWs in Sections 7.4.6 (Chronic Lowering of Groundwater Levels Data Gaps), however, it does not provide specific plans, such as locations or a timeline, to fill the data gaps.

RECOMMENDATIONS

- Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, tribes, GDEs, and ISWs to clearly identify potentially impacted areas. Increase the number of RMWs in the shallow aquifer across the subbasin as needed to adequately monitor all groundwater condition indicators. Prioritize proximity to DACs, domestic wells, tribes, and GDEs when identifying new RMWs.

[21] "The monitoring network objectives shall be implemented to accomplish the following: [...] (2) Monitor impacts to the beneficial uses or users of groundwater." [23 CCR §354.34(b)(2)]

- Further describe the biological monitoring that can be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the subbasin.

4. Addressing Beneficial Users in Projects and Management Actions

The consideration of beneficial users when developing projects and management actions is **insufficient**, due to the failure to completely identify benefits or impacts of identified projects and management actions, including water quality impacts, to key beneficial users of groundwater such as GDEs, aquatic habitats, surface water users, DACs, drinking water users, and tribes. While the expansion of the Sacramento Regional Water Bank is described as a recharge project within the subbasin, the plan fails to specify any benefits the project will have to the environment or DACs. Therefore, potential project and management actions as currently proposed may overlook the protection of these beneficial users. Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for *all* beneficial users.

RECOMMENDATIONS

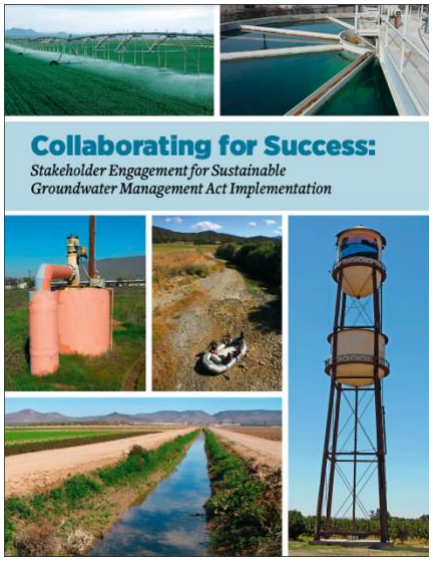
- For DACs and domestic well owners, include a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.
- For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSAs plan to mitigate such impacts.
- Recharge ponds, reservoirs, and facilities for managed aquifer recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For further guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document."[22]
- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

[22] The Nature Conservancy. 2021. Multi-Benefit Recharge Project Methodology for Inclusion in Groundwater Sustainability Plans. Sacramento. Available at: https://groundwaterresourcehub.org/sgma-tools/multi-benefit-recharge-project-methodology-guidance/

Attachment B

SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

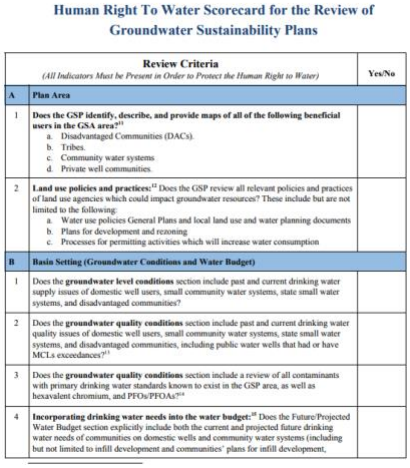
Stakeholder Engagement and Outreach



Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.
- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.
- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

The Human Right to Water

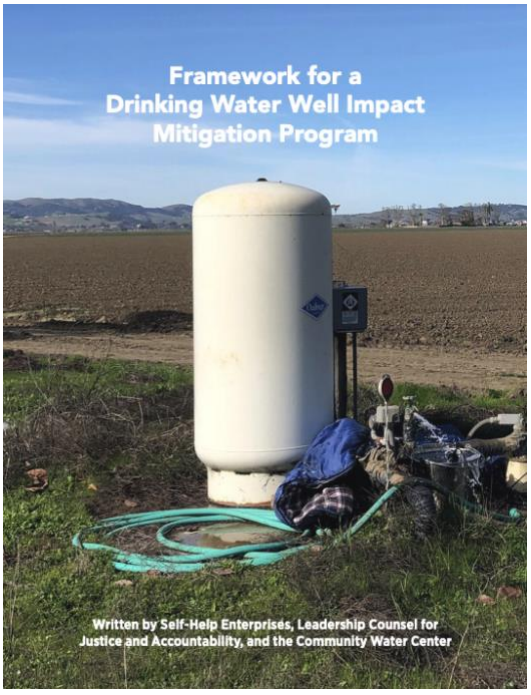


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	Yes/No
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[43] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems. d. Private well communities.	
2	**Land use policies and practices:**[44] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning c. Processes for permitting activities which will increase water consumption	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[45]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[46]	
4	**Incorporating drinking water needs into the water budget:**[47] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development,	

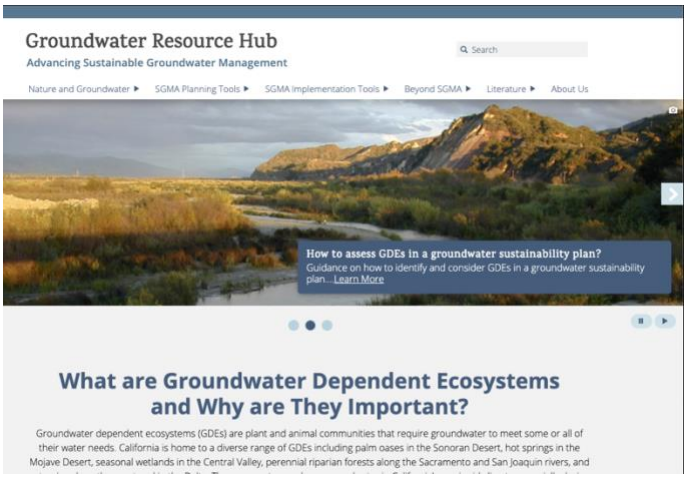
The [Human Right to Water Scorecard] was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



The [Drinking Water Well Impact Mitigation Framework] was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

Groundwater Resource Hub



The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database



The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and

availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

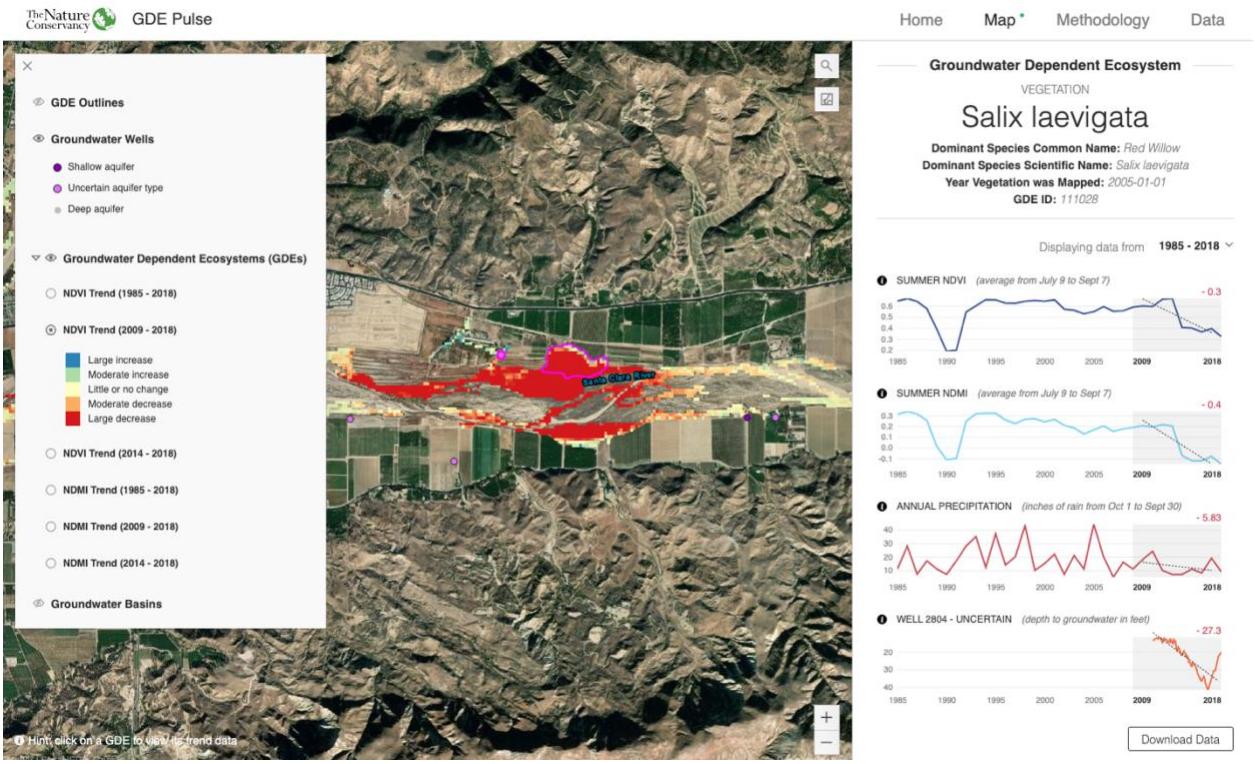
How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

---

[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



GDE Pulse is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

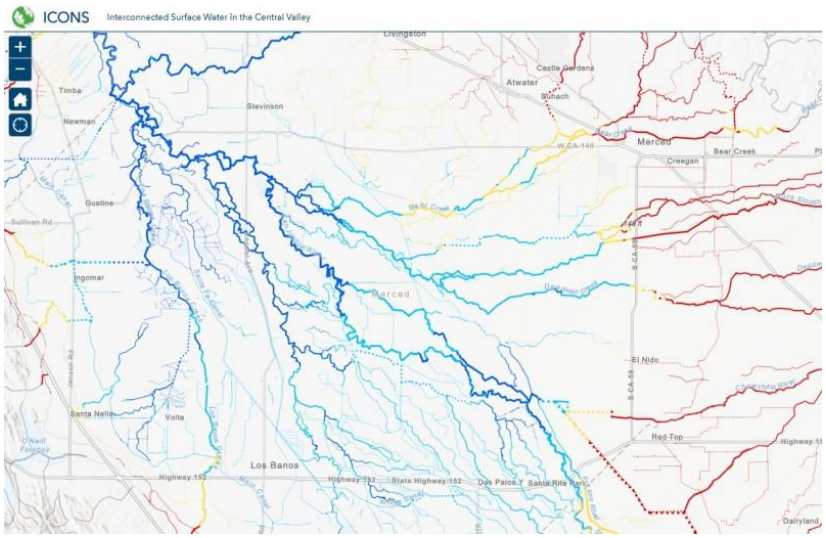
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



ICONS maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

Freshwater Species Located in the North American Subbasin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the North American Subbasin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[1]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[2] as well as on The Nature Conservancy's science website[3].

Scientific Name	Common Name	Legal Protected Status		
		Federal	State	Other
BIRDS				
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Egretta thula	Snowy Egret			
Nycticorax nycticorax	Black-crowned Night-Heron			
Phalacrocorax auritus	Double-crested Cormorant			
Riparia riparia	Bank Swallow		Threatened	
Actitis macularius	Spotted Sandpiper			
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Aix sponsa	Wood Duck			
Anas acuta	Northern Pintail			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas cyanoptera	Cinnamon Teal			
Anas discors	Blue-winged Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Anser albifrons	Greater White-fronted Goose			
Aythya affinis	Lesser Scaup			

[1] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710

[2] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[3] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Aythya americana	Redhead		Special Concern	BSSC - Third priority
Aythya collaris	Ring-necked Duck			
Aythya marila	Greater Scaup			
Aythya valisineria	Canvasback		Special	
Botaurus lentiginosus	American Bittern			
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			
Calidris alpina	Dunlin			
Calidris mauri	Western Sandpiper			
Calidris minutilla	Least Sandpiper			
Chen caerulescens	Snow Goose			
Chen rossii	Ross's Goose			
Chlidonias niger	Black Tern		Special Concern	BSSC - Second priority
Chroicocephalus philadelphia	Bonaparte's Gull			
Cistothorus palustris palustris	Marsh Wren			
Cygnus buccinator	Trumpeter Swan			
Cygnus columbianus	Tundra Swan			
Empidonax traillii	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Gallinula chloropus	Common Moorhen			
Grus canadensis	Sandhill Crane			
Haliaeetus leucocephalus	Bald Eagle	Bird of Conservation Concern	Endangered	
Himantopus mexicanus	Black-necked Stilt			
Icteria virens	Yellow-breasted Chat		Special Concern	BSSC - Third priority
Limnodromus scolopaceus	Long-billed Dowitcher			
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus merganser	Common Merganser			
Mergus serrator	Red-breasted Merganser			
Numenius americanus	Long-billed Curlew			
Numenius phaeopus	Whimbrel			
Oxyura jamaicensis	Ruddy Duck			
Pelecanus erythrorhynchos	American White Pelican		Special Concern	BSSC - First priority
Phalaropus tricolor	Wilson's Phalarope			
Piranga rubra	Summer Tanager		Special Concern	BSSC - First priority
Plegadis chihi	White-faced Ibis		Watch list	

Pluvialis squatarola	Black-bellied Plover			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Recurvirostra americana	American Avocet			
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa semipalmata	Willet			
Tringa solitaria	Solitary Sandpiper			
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
CRUSTACEANS				
Branchinecta lynchi	Vernal Pool Fairy Shrimp	Threatened	Special	IUCN - Vulnerable
Lepidurus packardi	Vernal Pool Tadpole Shrimp	Endangered	Special	IUCN - Endangered
Linderiella occidentalis	California Fairy Shrimp		Special	IUCN - Near Threatened
Branchinecta conservatio	Conservancy Fairy Shrimp	Endangered	Special	IUCN - Endangered
Cambaridae fam.	Cambaridae fam.			
Crangonyx spp.	Crangonyx spp.			
Cyprididae fam.	Cyprididae fam.			
Gammaridae fam.	Gammaridae fam.			
Gammarus spp.	Gammarus spp.			
Hyalella spp.	Hyalella spp.			
FISH				
Acipenser medirostris ssp. 1	Southern green sturgeon	Threatened	Special Concern	Endangered - Moyle 2013
Oncorhynchus mykiss irideus	Coastal rainbow trout			Least Concern - Moyle 2013
Pogonichthys macrolepidotus	Sacramento splittail		Special Concern	Vulnerable - Moyle 2013
Spirinchus thaleichthys	Longfin smelt	Candidate	Threatened	Vulnerable - Moyle 2013
Oncorhynchus mykiss - CV	Central Valley steelhead	Threatened	Special	Vulnerable - Moyle 2013
Oncorhynchus tshawytscha - CV spring	Central Valley spring Chinook salmon	Threatened	Threatened	Vulnerable - Moyle 2013
Oncorhynchus tshawytscha - CV winter	Central Valley winter Chinook salmon	Endangered	Endangered	Vulnerable - Moyle 2013
HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC

Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Thamnophis gigas	Giant Gartersnake	Threatened	Threatened	
Thamnophis sirtalis sirtalis	Common Gartersnake			
Pseudacris regilla	Northern Pacific Chorus Frog			
Thamnophis elegans elegans	Mountain Gartersnake			Not on any status lists
Thamnophis sirtalis fitchi	Valley Gartersnake			Not on any status lists
INSECTS & OTHER INVERTS				
Ablabesmyia annulata				Not on any status lists
Ablabesmyia spp.	Ablabesmyia spp.			
Acentrella spp.	Acentrella spp.			
Aeshna spp.	Aeshna spp.			
Aeshnidae fam.	Aeshnidae fam.			
Agabus lutosus				Not on any status lists
Agabus spp.	Agabus spp.			
Alotanypus spp.	Alotanypus spp.			
Ambrysus spp.	Ambrysus spp.			
Anax junius	Common Green Darner			
Anax spp.	Anax spp.			
Anopheles spp.	Anopheles spp.			
Apedilum spp.	Apedilum spp.			
Argia agrioides	California Dancer			
Argia emma	Emma's Dancer			
Argia spp.	Argia spp.			
Argia vivida	Vivid Dancer			
Baetidae fam.	Baetidae fam.			
Baetis spp.	Baetis spp.			
Baetis tricaudatus	A Mayfly			
Belostoma spp.	Belostoma spp.			
Brechmorhoga mendax	Pale-faced Clubskimmer			
Brillia spp.	Brillia spp.			
Caenis amica	A Mayfly			
Caenis latipennis	A Mayfly			
Caenis spp.	Caenis spp.			
Callibaetis spp.	Callibaetis spp.			
Camelobaetidius kickapoo				Not on any status lists
Camelobaetidius spp.	Camelobaetidius spp.			
Centroptilum album	A Mayfly			
Centroptilum spp.	Centroptilum spp.			

Ceraclea spp.	Ceraclea spp.			
Cheumatopsyche spp.	Cheumatopsyche spp.			
Chimarra spp.	Chimarra spp.			
Chironomidae fam.	Chironomidae fam.			
Chironomus spp.	Chironomus spp.			
Cladopelma spp.	Cladopelma spp.			
Cladotanytarsus marki				Not on any status lists
Cladotanytarsus spp.	Cladotanytarsus spp.			
Clinotanypus spp.	Clinotanypus spp.			
Coenagrionidae fam.	Coenagrionidae fam.			
Corisella decolor				Not on any status lists
Corixidae fam.	Corixidae fam.			
Cricotopus annulator				Not on any status lists
Cricotopus spp.	Cricotopus spp.			
Cryptochironomus spp.	Cryptochironomus spp.			
Cryptotendipes spp.	Cryptotendipes spp.			
Culex spp.	Culex spp.			
Culicidae fam.	Culicidae fam.			
Culiseta spp.	Culiseta spp.			
Dicrotendipes adnilus				Not on any status lists
Dicrotendipes spp.	Dicrotendipes spp.			
Dubiraphia brunnescens	Brownish Dubiraphian Riffle Beetle		Special	
Dubiraphia spp.	Dubiraphia spp.			
Dytiscidae fam.	Dytiscidae fam.			
Dytiscus marginicollis				Not on any status lists
Enallagma boreale	Boreal Bluet			
Enallagma carunculatum	Tule Bluet			
Enallagma civile	Familiar Bluet			
Enallagma cyathigerum				Not on any status lists
Enallagma praevarum	Arroyo Bluet			
Enallagma spp.	Enallagma spp.			
Endochironomus spp.	Endochironomus spp.			
Ephydridae fam.	Ephydridae fam.			
Epitheca canis	Beaverpond Baskettail			
Erythemis collocata	Western Pondhawk			
Eukiefferiella spp.	Eukiefferiella spp.			
Euryhapsis spp.	Euryhapsis spp.			
Fallceon quilleri	A Mayfly			
Fallceon spp.	Fallceon spp.			
Gerridae fam.	Gerridae fam.			
Glyptotendipes spp.	Glyptotendipes spp.			
Gomphidae fam.	Gomphidae fam.			

Gomphus kurilis	Pacific Clubtail			
Gomphus spp.	Gomphus spp.			
Helochares normatus				Not on any status lists
Helophorus spp.	Helophorus spp.			
Hetaerina americana	American Rubyspot			
Hydraena spp.	Hydraena spp.			
Hydrophilidae fam.	Hydrophilidae fam.			
Hydrophilus triangularis				Not on any status lists
Hydropsyche alternans				Not on any status lists
Hydropsyche californica	A Caddisfly			
Hydropsyche spp.	Hydropsyche spp.			
Hydropsychidae fam.	Hydropsychidae fam.			
Hydroptila ajax	A Caddisfly			
Hydroptila spp.	Hydroptila spp.			
Hydroptilidae fam.	Hydroptilidae fam.			
Ironodes spp.	Ironodes spp.			
Ischnura cervula	Pacific Forktail			
Ischnura perparva	Western Forktail			
Ischnura spp.	Ischnura spp.			
Labrundinia spp.	Labrundinia spp.			
Laccobius spp.	Laccobius spp.			
Laccophilus spp.	Laccophilus spp.			
Larsia spp.	Larsia spp.			
Lepidostoma spp.	Lepidostoma spp.			
Leptoceridae fam.	Leptoceridae fam.			
Lestes congener	Spotted Spreadwing			
Libellula forensis	Eight-spotted Skimmer			
Libellula luctuosa	Widow Skimmer			
Libellula pulchella	Twelve-spotted Skimmer			
Libellula saturata	Flame Skimmer			
Libellula spp.	Libellula spp.			
Libellulidae fam.	Libellulidae fam.			
Limnophyes spp.	Limnophyes spp.			
Liodessus obscurellus				Not on any status lists
Liodessus spp.	Liodessus spp.			
Mesovelia spp.	Mesovelia spp.			
Micrasema spp.	Micrasema spp.			
Microchironomus nigrovittatus				Not on any status lists
Microchironomus spp.	Microchironomus spp.			
Micropsectra spp.	Micropsectra spp.			
Microtendipes spp.	Microtendipes spp.			
Microvelia spp.	Microvelia spp.			

Mideopsis pumila				Not on any status lists
Mideopsis spp.	Mideopsis spp.			
Mystacides alafimbriatus	A Caddisfly			
Mystacides spp.	Mystacides spp.			
Nanocladius spp.	Nanocladius spp.			
Nectopsyche dorsalis	A Caddisfly			
Nectopsyche gracilis	A Caddisfly			
Nectopsyche spp.	Nectopsyche spp.			
Ochthebius spp.	Ochthebius spp.			
Ophiogomphus arizonicus				Not on any status lists
Ophiogomphus occidentis	Sinuous Snaketail			
Ophiogomphus spp.	Ophiogomphus spp.			
Ordobrevia nubifera				Not on any status lists
Orthocladius spp.	Orthocladius spp.			
Oxyethira spp.	Oxyethira spp.			
Pachydiplax longipennis	Blue Dasher			
Pantala hymenaea	Spot-winged Glider			
Parachaetocladius spp.	Parachaetocladius spp.			
Parachironomus spp.	Parachironomus spp.			
Paracloeodes minutus	A Small Minnow Mayfly			
Parakiefferiella spp.	Parakiefferiella spp.			
Parametriocnemus spp.	Parametriocnemus spp.			
Paraphaenocladius spp.	Paraphaenocladius spp.			
Paratanytarsus spp.	Paratanytarsus spp.			
Paratendipes spp.	Paratendipes spp.			
Peltodytes spp.	Peltodytes spp.			
Pentaneura inconspicua				Not on any status lists
Pentaneura spp.	Pentaneura spp.			
Perlodidae fam.	Perlodidae fam.			
Petrophila confusalis				Not on any status lists
Petrophila spp.	Petrophila spp.			
Phaenopsectra spp.	Phaenopsectra spp.			
Plathemis lydia	Common Whitetail			
Polypedilum albicorne				Not on any status lists
Polypedilum spp.	Polypedilum spp.			
Procladius spp.	Procladius spp.			
Progomphus borealis	Gray Sanddragon			
Protoptila spp.	Protoptila spp.			
Psectrocladius spp.	Psectrocladius spp.			
Psectrotanypus spp.	Psectrotanypus spp.			
Pseudochironomus spp.	Pseudochironomus spp.			
Pseudosmittia spp.	Pseudosmittia spp.			

Psychodidae fam.	Psychodidae fam.			
Rhagovelia spp.	Rhagovelia spp.			
Rheotanytarsus hamatus				Not on any status lists
Rheotanytarsus spp.	Rheotanytarsus spp.			
Rhionaeschna californica	California Darner			
Rhionaeschna multicolor	Blue-eyed Darner			
Robackia demeijeri				Not on any status lists
Simuliidae fam.	Simuliidae fam.			
Simulium spp.	Simulium spp.			
Sperchon spp.	Sperchon spp.			
Sperchon stellata				Not on any status lists
Stenochironomus spp.	Stenochironomus spp.			
Stylurus olivaceus	Olive Clubtail			
Sympetrum corruptum	Variegated Meadowhawk			
Tanypus spp.	Tanypus spp.			
Tanytarsus angulatus				Not on any status lists
Tanytarsus spp.	Tanytarsus spp.			
Tipulidae fam.	Tipulidae fam.			
Tramea lacerata	Black Saddlebags			
Tramea spp.	Tramea spp.			
Trichocorixa calva				Not on any status lists
Trichocorixa spp.	Trichocorixa spp.			
Tricorythodes explicatus	A Mayfly			
Tricorythodes spp.	Tricorythodes spp.			
Tropisternus spp.	Tropisternus spp.			
Unionicolidae fam.	Unionicolidae fam.			
Uvarus subtilis				Not on any status lists
Wormaldia spp.	Wormaldia spp.			
Xenochironomus spp.	Xenochironomus spp.			
Zavrelimyia spp.	Zavrelimyia spp.			
Zoniagrion exclamationis	Exclamation Damsel			
MAMMALS				
Castor canadensis	American Beaver			Not on any status lists
Lontra canadensis canadensis	North American River Otter			Not on any status lists
Neovison vison	American Mink			Not on any status lists
Ondatra zibethicus	Common Muskrat			Not on any status lists
MOLLUSKS				
Ferrissia spp.	Ferrissia spp.			
Galba spp.	Galba spp.			

Gonidea angulata	Western Ridged Mussel		Special	
Gyraulus circumstriatus	Disc Gyro			CS
Gyraulus crista	Star Gyro			CS
Gyraulus spp.	Gyraulus spp.			
Helisoma spp.	Helisoma spp.			
Hydrobiidae fam.	Hydrobiidae fam.			
Lymnaea spp.	Lymnaea spp.			
Lymnaeidae fam.	Lymnaeidae fam.			
Margaritifera falcata	Western Pearlshell		Special	
Menetus opercularis	Button Sprite			CS
Menetus spp.	Menetus spp.			
Physa acuta	Pewter Physa			Not on any status lists
Physa spp.	Physa spp.			
Pisidium spp.	Pisidium spp.			
Planorbidae fam.	Planorbidae fam.			
Sphaeriidae fam.	Sphaeriidae fam.			
Sphaerium spp.	Sphaerium spp.			
Anodonta californiensis	California Floater		Special	
PLANTS				
Chloropyron molle hispidum			Special	CRPR - 1B.1
Downingia pusilla	Dwarf Downingia		Special	CRPR - 2B.2
Gratiola heterosepala	Boggs Lake Hedge-hyssop		Endangered	CRPR - 1B.2
Legenere limosa	False Venus'-looking-glass		Special	CRPR - 1B.1
Orcuttia viscida	Sacramento Orcutt Grass	Endangered	Endangered	CRPR - 1B.1
Sagittaria sanfordii	Sanford's Arrowhead		Special	CRPR - 1B.2
Alnus rhombifolia	White Alder			
Alopecurus pratensis	NA			
Alopecurus saccatus	Pacific Foxtail			
Ammannia coccinea	Scarlet Ammannia			
Ammannia robusta	Grand Redstem			
Arundo donax	NA			
Baccharis salicina				Not on any status lists
Brodiaea nana				Not on any status lists
Callitriche heterophylla bolanderi	Large Water-starwort			
Callitriche marginata	Winged Water-starwort			
Cephalanthus occidentalis	Common Buttonbush			
Cotula coronopifolia	NA			
Crassula aquatica	Water Pygmyweed			
Crassula solieri	NA			Not on any status lists
Downingia bicornuta	NA			

Downingia cuspidata	Toothed Calicoflower			
Downingia ornatissima	NA			
Elatine brachysperma	Shortseed Waterwort			
Eleocharis acicularis acicularis	Least Spikerush			
Eleocharis macrostachya	Creeping Spikerush			
Eleocharis montevidensis	Sand Spikerush			
Elodea canadensis	Broad Waterweed			
Epilobium campestre	NA			Not on any status lists
Epilobium cleistogamum	Cleistogamous Spike-primrose			
Eryngium castrense	Great Valley Eryngo			
Eryngium vaseyi vallicola				Not on any status lists
Eryngium vaseyi vaseyi	Vasey's Coyote-thistle			Not on any status lists
Euthamia occidentalis	Western Fragrant Goldenrod			
Gratiola ebracteata	Bractless Hedge-hyssop			
Helenium puberulum	Rosilla			
Isoetes howellii	NA			
Isoetes orcuttii	NA			
Juncus acuminatus	Sharp-fruit Rush			
Juncus diffusissimus	NA			
Juncus effusus pacificus				
Juncus uncialis	Inch-high Rush			
Lasthenia fremontii	Fremont's Goldfields			
Leersia oryzoides	Rice Cutgrass			
Lemna minor	Lesser Duckweed			
Lemna valdiviana	Pale Duckweed			
Limnanthes alba alba	White Meadowfoam			
Limnanthes floccosa californica	Shippee Meadowfoam	Endangered	Endangered	CRPR - 1B.1
Ludwigia hexapetala	NA			Not on any status lists
Ludwigia palustris	Marsh Seedbox			
Ludwigia peploides montevidensis	NA			Not on any status lists
Ludwigia peploides peploides	NA			Not on any status lists
Lycopus americanus	American Bugleweed			
Mimulus cardinalis	Scarlet Monkeyflower			
Mimulus guttatus	Common Large Monkeyflower			
Mimulus tricolor	Tricolor Monkeyflower			
Myosotis laxa	Small Forget-me-not			
Myosotis scorpioides	NA			
Myosurus apetalus	Bristly Mousetail			
Myriophyllum aquaticum	NA			

Navarretia intertexta	Needleleaf Navarretia			
Navarretia leucocephala leucocephala	White-flower Navarretia			
Navarretia myersii myersii	Pincushion Navarretia		Special	CRPR - 1B.1
Panicum dichotomiflorum	NA			
Persicaria hydropiper	NA			Not on any status lists
Persicaria lapathifolia				Not on any status lists
Persicaria maculosa	NA			Not on any status lists
Persicaria punctata	NA			Not on any status lists
Phyla nodiflora	Common Frog-fruit			
Pilularia americana	NA			
Plagiobothrys distantiflorus	California Popcorn-flower			
Plagiobothrys greenei	Greene's Popcorn-flower			
Plagiobothrys undulatus	NA			Not on any status lists
Plantago elongata elongata	Slender Plantain			
Platanus racemosa	California Sycamore			
Pogogyne zizyphoroides				Not on any status lists
Psilocarphus brevissimus brevissimus	Dwarf Woolly-heads			
Psilocarphus oregonus	Oregon Woolly-heads			
Psilocarphus tenellus	NA			
Ranunculus bonariensis	NA			
Rorippa curvisiliqua curvisiliqua	Curve-pod Yellowcress			
Rumex conglomeratus	NA			
Sagittaria latifolia latifolia	Broadleaf Arrowhead			
Salix breweri	Brewer's Willow			
Salix exigua exigua	Narrowleaf Willow			
Salix gooddingii	Goodding's Willow			
Salix laevigata	Polished Willow			
Salix lasiandra lasiandra				Not on any status lists
Salix lasiolepis lasiolepis	Arroyo Willow			
Salix melanopsis	Dusky Willow			
Schoenoplectus acutus occidentalis	Hardstem Bulrush			
Schoenoplectus californicus	California Bulrush			
Sidalcea calycosa calycosa	Annual Checker-mallow			
Stachys stricta	Sonoma Hedge-nettle			

Triglochin scilloides	NA			Not on any status lists
Typha domingensis	Southern Cattail			
Typha latifolia	Broadleaf Cattail			
Veronica anagallis-aquatica	NA			

Attachment D

The Nature Conservancy

July 2019



IDENTIFYING GDEs UNDER SGMA

Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

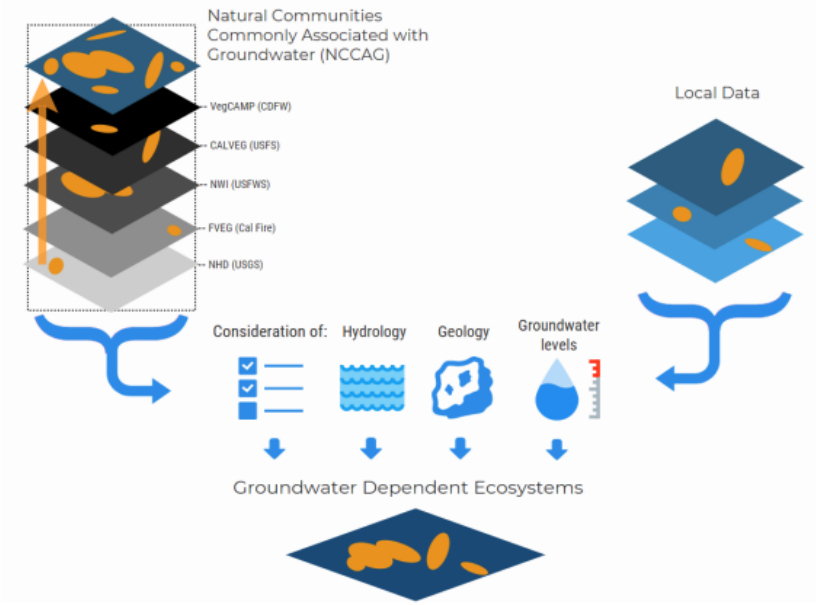


Figure 1. Considerations for GDE identification.
Source: DWR[2]

[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/
[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[3]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[4] on the Groundwater Resource Hub[5], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

[3] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf
[4] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/
[5] The Groundwater Resource Hub: www.GroundwaterResourceHub.org

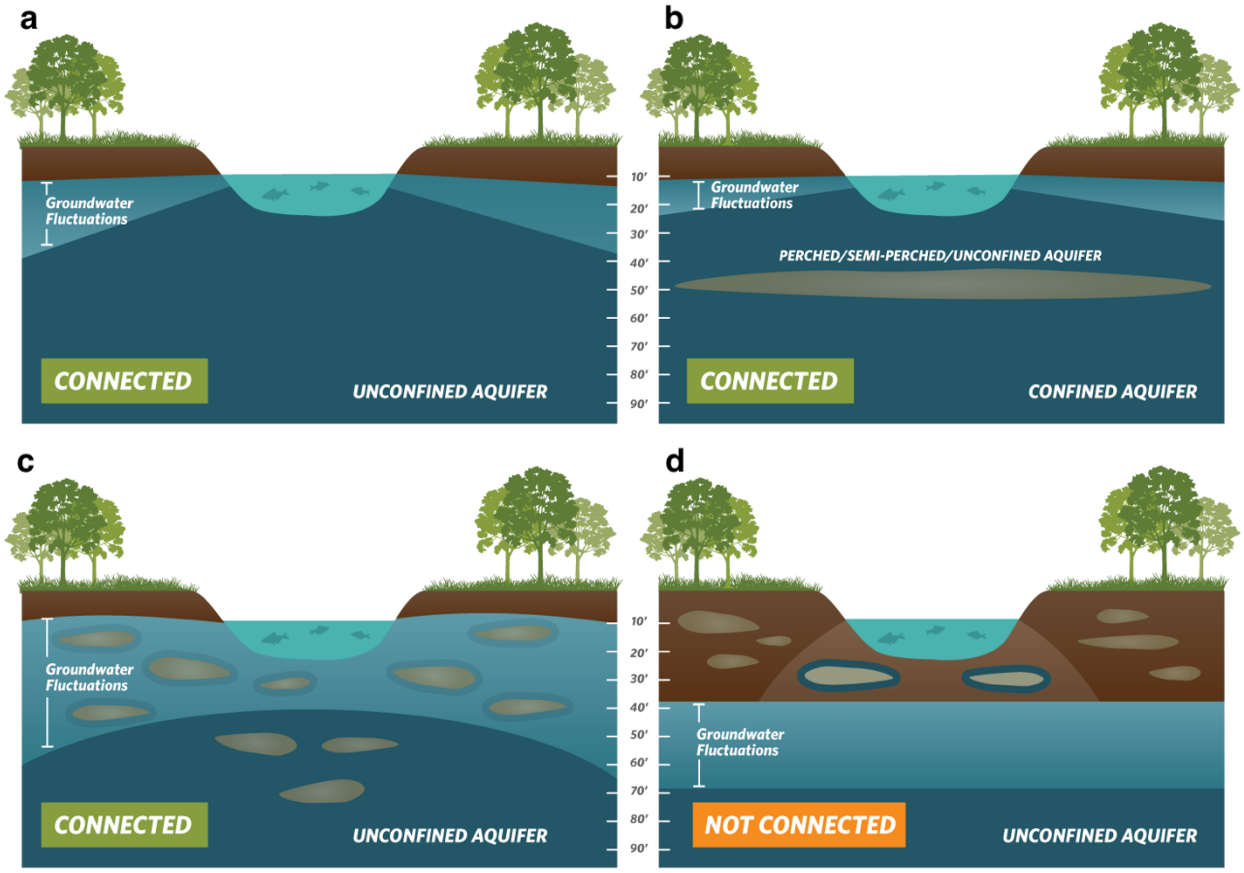


Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. **(b)** Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. **Bottom: (c)** Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. **(d)** Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[6] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[7] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[8] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[9]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).

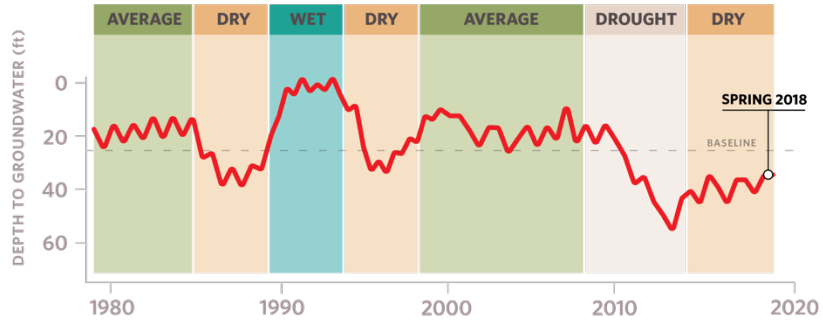


Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

[6] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[7] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]

[8] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[9] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[10], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

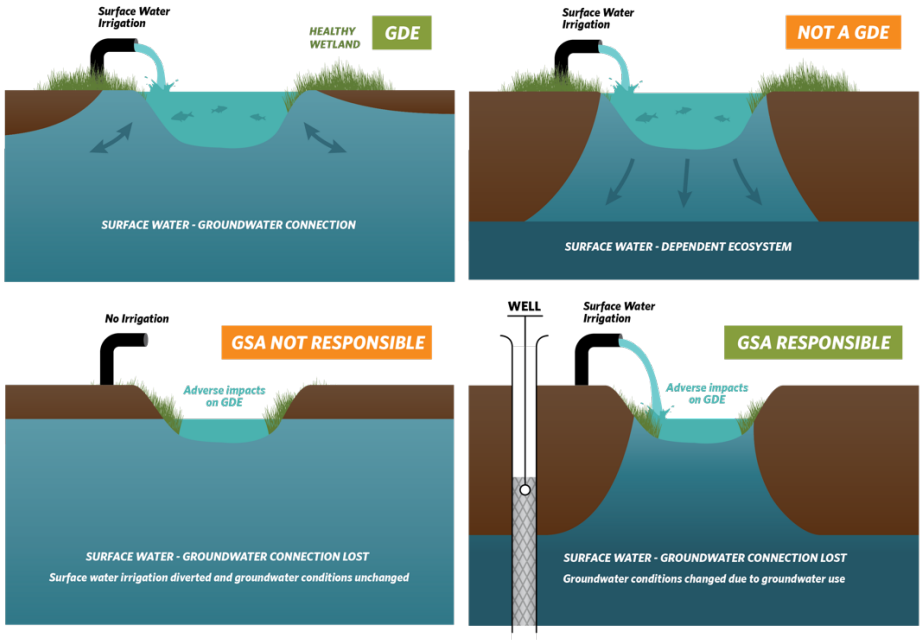


Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. **(Right)** Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. **Bottom: (Left)** An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. **(Right)** Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

[10] For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

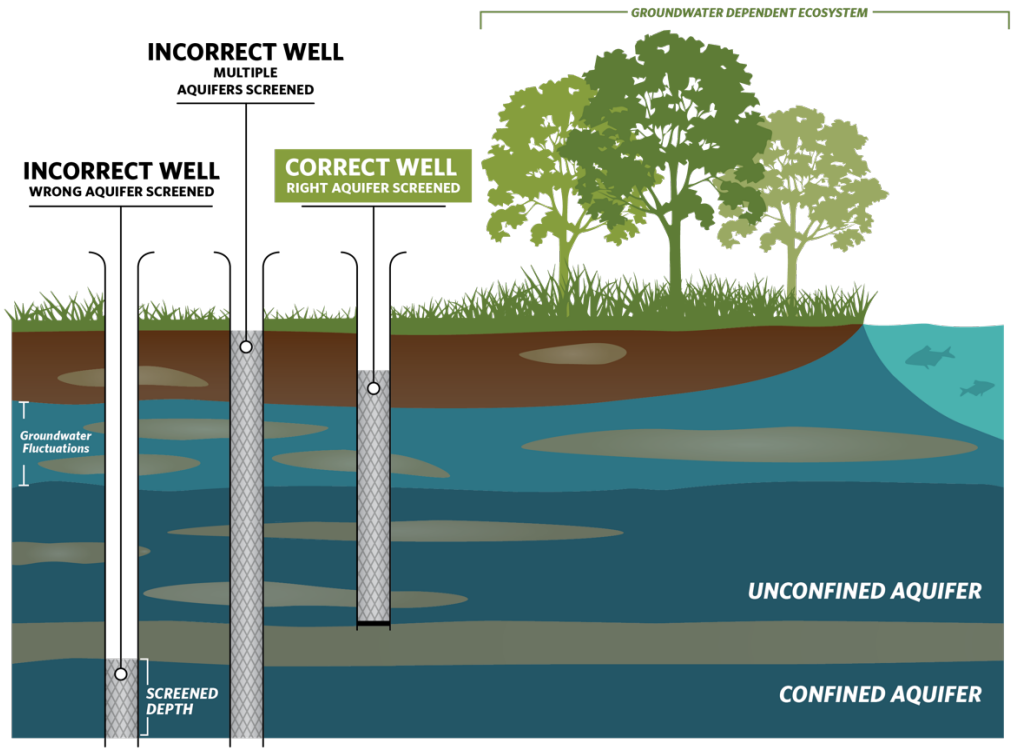


Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate **groundwater elevations** at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[11] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

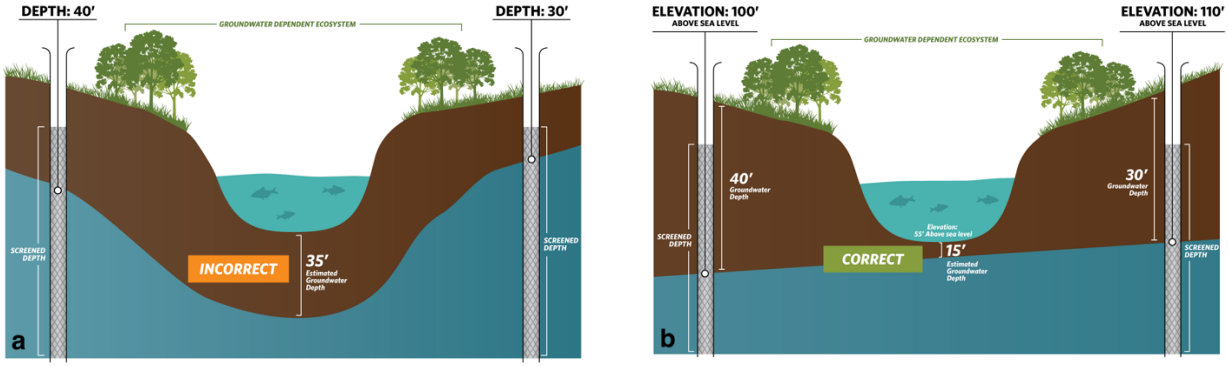


Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. **(b)** Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

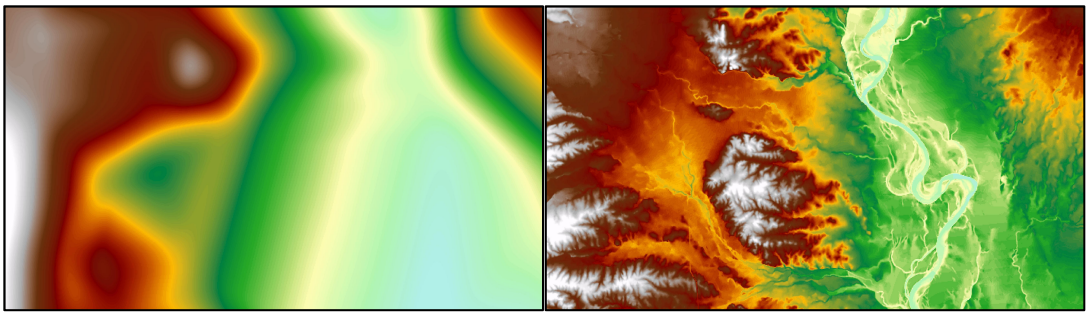


Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. **(Right)** Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

[11] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, **The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network.** Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Attachment E

Maps of representative monitoring sites in relation to key beneficial users

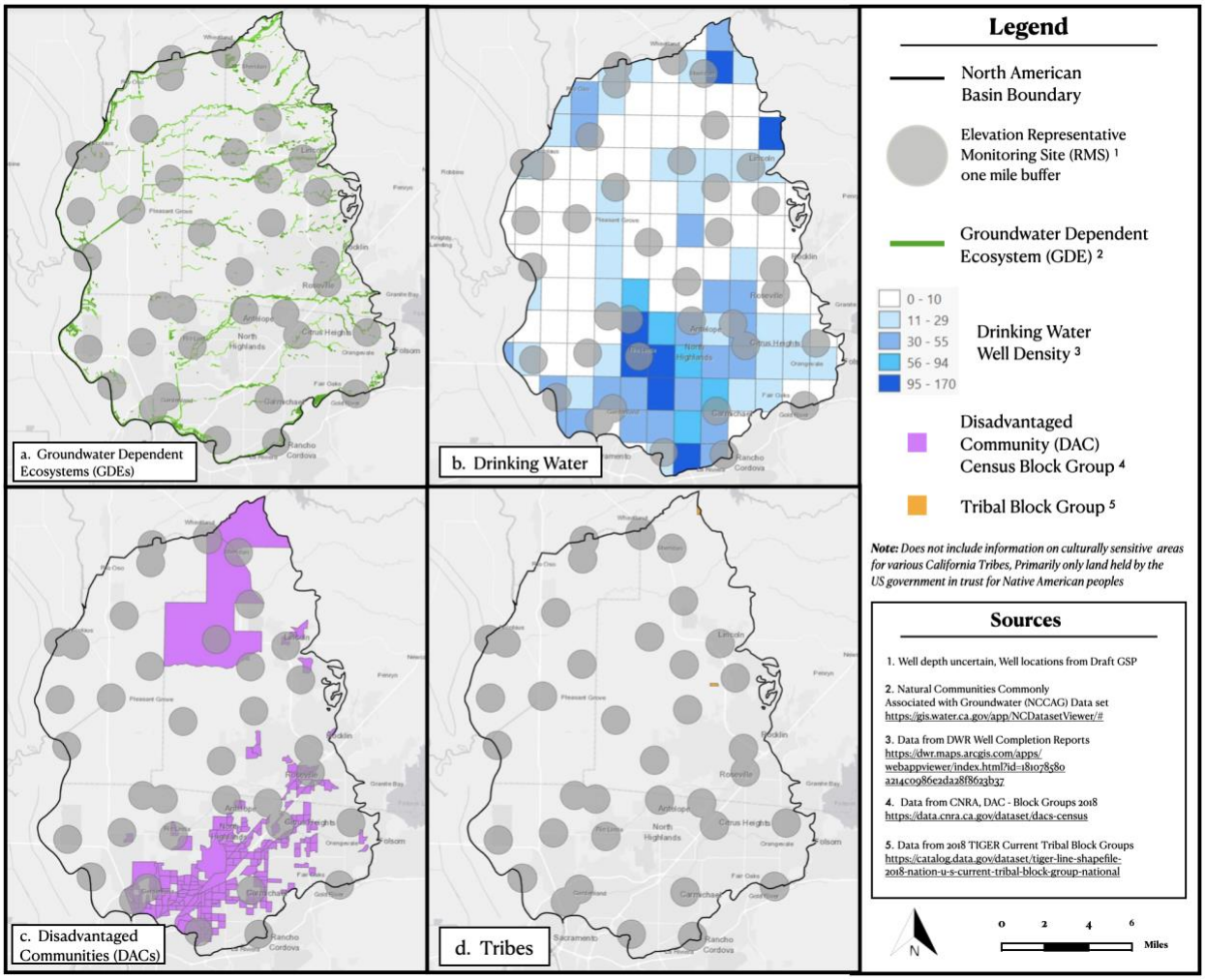


Figure 1. Groundwater elevation representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.

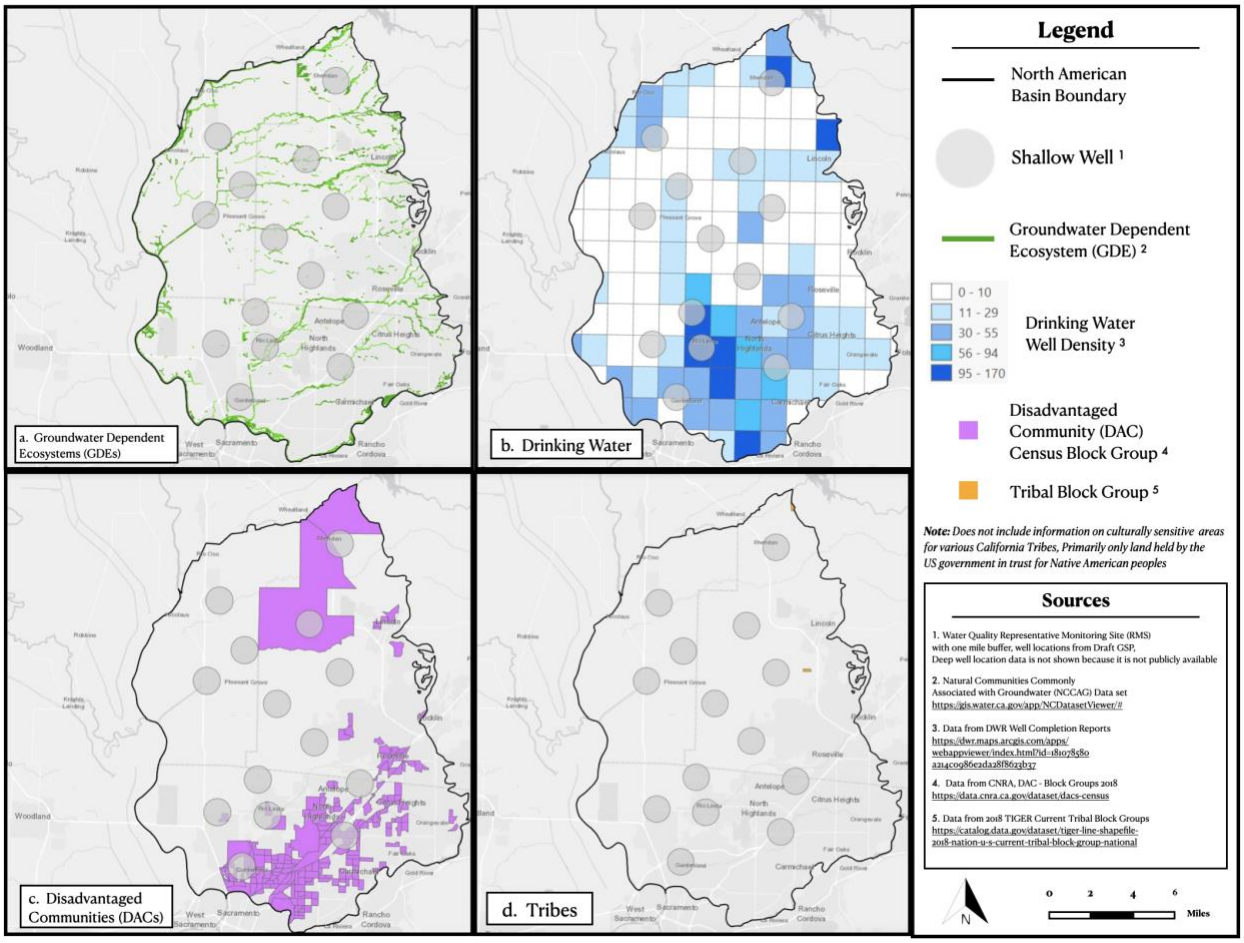


Figure 2. Groundwater quality representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.

Appendix T: Interbasin Coordination Communications

NORTH AMERICAN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

APPENDIX T
Interbasin Coordination Communications

December 2021

827 7th St, Rm 301
Sacramento, CA 95814

Sacramento Central Groundwater Authority
Managing Groundwater Resources in Central Sacramento County

Tel: (916) 874-6851
Fax: (916) 874-5698
scgah2o.saccounty.net

John Woodling
Interim Executive Director

California-American Water Company
City of Elk Grove
City of Folsom
City of Rancho Cordova
City of Sacramento
County of Sacramento
Florin Resource Conservation District/Elk Grove Water Service
Golden State Water Company
Omochumne-Hartnell Water District
Rancho Murieta Community Services District
Sacramento Regional County Sanitation District
Agricultural Representative
Agricultural-Residential Representative
Commercial/Industrial Representative
Conservation Landowners
Public Agencies/Self-Supplied Representative

November 24, 2021

Rob Swartz
North American Subbasin Plan Manager
Sacramento Groundwater Authority
5620 Birdcage Street, Suite 180
Citrus Heights, CA 95610

Subject: Interbasin Coordination Between North American and South American Subbasins

Dear Mr. Swartz:

The purpose of this letter is to document the coordination activities and to summarize our understanding related to the adjacent Groundwater Sustainability Plans (GSPs) covering the South American Subbasin (SASb) and the North American Subbasin (NASb).

Coordination meetings between representatives of the SASb and the NASb occurred on the following days:

- February 17, 2021
- March 16, 2021
- April 6, 2021
- April 21, 2021
- May 28, 2021
- July 27, 2021
- Plus additional calls in summer 2021 to coordinate on CoSANA modeling, development of a regional conjunctive use project, development of modeling scenarios, and development of sustainable yield estimates.

At the July 27, 2021 meeting, we discussed the following topics:

- Groundwater flow across our common boundary
- Projected land use changes along our common boundary
- Monitoring network along our common boundary
- Minimum Thresholds (MTs) along the boundary
- How to document our coordination (e.g., letter to include in GSP? something more formal?)

Based on our coordination, the SASb concludes the following with respect to the NASb:

1. Current and projected groundwater flow, projected land use changes, and MTs near our common boundary do not appear to impede our respective abilities to achieve our sustainability goals. We are particularly comfortable with the model-related results as we worked together to develop a single model (CoSANA) that encompasses the entirety of our basins.
2. The monitoring network along our common boundary is sufficient to detect significant changes that could impact our respective GSPs and we will actively share monitoring information along our common boundary.
3. It is currently preferable to document our coordination through this correspondence rather than through a more formal inter-basin agreement.

As noted regarding the above coordination, we have been able to share information to the mutual benefit of each subbasin's GSP development effort and have been able to confirm that the implementation of our respective GSPs will not adversely impact the attainment of our sustainability goals. We have examined findings in each GSP along our boundaries and either confirmed consistency or have agreed to work together during GSP implementation to resolve differences, to the extent they merit such effort.

We recommend a minimum of an annual meeting between our respective GSAs after the completion of each GSP annual report to facilitate the exchange of technical information, coordinate on implementation activities, and to identify and address any emerging trends that may be of concern along our common boundary.

Sincerely,



John Woodling
GSP Manager, South American Subbasin

Yolo Subbasin Groundwater Agency
Groundwater Sustainability Agency

34274 State Highway 16 ▪ Woodland, CA 95695 ▪ 530.662.3211 ▪ www.yologroundwater.org

November 22, 2021

Mr. Rob Swartz
North American Subbasin Groundwater Sustainability Plan Manager
Sacramento Groundwater Authority
5620 Birdcage Street, Suite 180
Citrus Heights, CA 95610
Emailed: rswartz@rwah2o.org

Mr. Swartz,

Like your letter, this letter documents the coordination activities and summarizes our understanding of the adjacent Groundwater Sustainability Plans (GSPs) covering the and Yolo Subbasin and North American Subbasin (NASb).

Coordination meetings between representatives of the Yolo Subbasin and NASb occurred on the following:

- August 31, 2020
- July 13, 2021
- August 10, 2021

On August 31, 2020, you and I briefly touched based on our individual efforts for developing the Yolo Subbasin and NASb GSPs, respectively. And we outlined a process for coordinating once plan development was further along.

At the July 13, 2021 meeting, we discussed the following topics:

- Groundwater flow across our common boundary
- Projected land use changes along our common boundary
- Monitoring network along our common boundary
- Minimum Thresholds (MTs) along the boundary
- Documentation of coordination efforts

At the August 10, 2021 meeting, our modeling consultants met to discuss technical aspects of our modeling effort, which was necessary because we are using different modeling platforms. Our modeling teams agreed that small differences in boundary flows calculated by the models are immaterial.

Based on our coordination, the Yolo Subbasin concludes the following related to NASb:

1. Current and projected groundwater flow, projected land use changes, and MTs near our common boundary do not appear to impede our respective abilities to achieve our sustainability goals.
2. The monitoring network along our common boundary is sufficient to detect significant changes that could impact our respective GSPs and we will actively share monitoring information along our common boundary.
3. It is currently preferrable to document our coordination through this correspondence rather than through a more formal interbasin agreement.

As a result of the above coordination, we have shared information to the mutual benefit of each subbasin's GSP development effort and have confirmed that the implementation of our respective GSPs will not adversely impact the attainment of our sustainability goals. We have examined findings in each GSP along our boundaries and either confirmed consistency or have agreed to work together during GSP implementation to resolve differences, to the extent they merit such effort.

We recommend a minimum of an annual coordination meeting after the completion of each GSP annual report to share information on monitoring results and other implementation activities and to identify and address any emerging trends that may be of concern along our common boundary. Additionally, we will coordinate through quarterly meetings of the Northern California Water Association Groundwater Management Task Force, and Association of California Water Agencies Groundwater Management Committee.

Thank you for being our neighbor,



Kristin Sicke
Executive Officer

530.741.5000
info@yubawater.org
yubawater.org

November 24, 2021

Rob Swartz
North American Subbasin Plan Manager
Sacramento Groundwater Authority
5620 Birdcage Street, Suite 180
Citrus Heights, CA 95610

Dear Mr. Swartz:

The purpose of this letter is to document the coordination activities and to summarize our understanding related to the adjacent Groundwater Sustainability Plans (GSPs) covering the North American Subbasin (NASb) and the South Yuba Subbasin.

At our July 22, 2021 meeting, we discussed the following topics:

- Groundwater flow across our common boundary
- Projected land use changes along our common boundary
- Monitoring network along our common boundary
- Minimum Thresholds (MTs) along the boundary
- How to document our coordination (e.g., letter to include in GSP? something more formal?)

Based on our discussion, Yuba Water Agency concludes the following with respect to the North American Subbasin:

1. Current and projected groundwater flow, projected land use changes, and MTs near our common boundary do not appear to impede our respective abilities to achieve our sustainability goals.
2. The monitoring network along our common boundary is sufficient to detect significant changes that could impact our respective GSPs and we will actively share monitoring information along our common boundary.
3. It is currently preferrable to document our coordination through this correspondence rather than through a more formal interbasin agreement.

As a result of the above coordination, we have been able to share information to the mutual benefit of each subbasin's GSP and have been able to confirm that the implementation of our respective GSPs will not adversely impact the attainment of our sustainability goals. We have examined findings in each GSP along our boundaries and either confirmed consistency or have agreed to work together during GSP implementation to resolve differences, to the extent they merit such effort.

We recommend a minimum of an annual coordination meeting after the completion of each GSP annual report to share information on monitoring results and other implementation activities and to identify and address any emerging trends that may be of concern along our common boundary. We will also coordinate through quarterly meetings of the Northern California Water Association Groundwater Management Task Force.

Sincerely,

Scott Matyac
Groundwater Sustainability Plan Manager
Yuba Water Agency

Main Office: 1220 F Street, Marysville, CA 95901
Colgate Power House: 12700 Lake Francis Road, P.O. Box 176, Dobbins, CA 95935

SUTTER COUNTY
DEVELOPMENT SERVICES DEPARTMENT

Building Inspection
Code Enforcement
Engineering/Water Resources
Environmental Health
Planning
Road Maintenance

November 22, 2021

Rob Swartz
North American Subbasin Plan Manager
Sacramento Groundwater Authority
5620 Birdcage Street, Suite 180
Citrus Heights, CA 95610

Dear Mr. Swartz:

The purpose of this letter is to document the coordination activities and to summarize our understanding related to the adjacent Groundwater Sustainability Plans (GSPs) covering the North American Subbasin (NASb) and the Sutter Subbasin.

At our August 20, 2021 coordination meeting, we discussed the following topics:

- Groundwater flow across our common boundary
- Projected land use changes along our common boundary
- Monitoring network along our common boundary
- Minimum Thresholds (MTs) along the boundary
- How to document our coordination (e.g., letter to include in GSP? something more formal?)

Based on our discussion, the Sutter Subbasin concludes the following with respect to the NASb Subbasin:

1. Current and projected groundwater flow, projected land use changes, and MTs near our common boundary do not appear to impede our respective abilities to achieve our sustainability goals.
2. The monitoring network along our common boundary is sufficient to detect significant changes that could impact our respective GSPs and we will actively share monitoring information along our common boundary.
3. It is currently preferable to document our coordination through this correspondence rather than through a more formal interbasin agreement.

As a result of the above coordination, we have been able to share information to the mutual benefit of each subbasin's GSP and have been able to confirm that the implementation of our respective GSPs will not adversely impact the attainment of our sustainability goals. We have examined findings in each GSP along our boundaries and either confirmed consistency or have agreed to work together during GSP implementation to resolve differences, to the extent they merit such effort.

We recommend a minimum of an annual coordination meeting after the completion of each GSP annual report to share information on monitoring results and other implementation activities and to identify and address any emerging trends that may be of concern along our common boundary.

Sincerely,



Guadalupe Rivera
Sutter County
Groundwater Sustainability Plan Manager
Sutter Subbasin

Appendix H Water Shortage Contingency Plan

H

2025

Water Shortage Contingency Plan

Adopted June 18, 2026



PCWA

www.pcwa.net



Water Shortage Contingency Plan

ADOPTED JUNE 18, 2026

ACKNOWLEDGEMENTS

The Water Shortage Contingency Plan was prepared by Water Systems Consulting, Inc. The primary authors are listed below.

Jeroen Olthof

Stephanie Ard

Adrianna Lemanek

Water Systems Consulting, Inc. would like to acknowledge the significant contributions of Placer County Water Agency. The primary contributors are listed below.

Steve Bowman

Brian Rickards

Tony Brillante

Jeremy Shepard

TABLE OF CONTENTS

1.0 Water Service Reliability Analysis 1
1.1 Zone 6 service area 1
1.2 Dry Year Supply Reliability 2
2.0 Annual Water Supply and Demand Assessment Procedures 2
2.1 Data Sources 4
2.2 PCWA Water System Capabilities and Constraints 4
2.3 Base PCWA Water Supply 6
2.4 Projecting Water Supply Availability 6
3.0 Water Shortage Stages 9
3.1 Water Shortage Actions – Treated Water Systems 10
4.0 Shortage Response Actions 11
4.1 Supply Augmentation 11
4.2 Demand Reduction 12
4.3 Operational Changes 16
4.4 Additional Mandatory Restrictions 16
4.5 Emergency Response Plan 17
4.6 Seismic Risk Assessment and Mitigation Plan 17
4.7 Shortage Response Action Effectiveness 17
5.0 Communication Protocols 18
5.1 Communication Methods 18
6.0 Compliance and Enforcement 19
7.0 Legal Authority 19
8.0 Financial Consequences of WSCP Implementation 20
9.0 Monitoring and Reporting 23
9.1 Stage Implementation and Monitoring Procedures 23
10.0 WSCP Refinement Procedures 23
11.0 Plan Adoption, Submittal, and Availability 23
Attachment A ..... A
Attachment B ..... B

ACRONYMS & ABBREVIATIONS

AF	Acre-Feet
CDEC	California Data Exchange Center
CII	Commercial, Industrial, and Institutional
CNRFC	California Nevada River Forecast Center
CVP	Central Valley Project
CFS	Cubic feet per second
DWR	California Department of Water Resources
ERP	Emergency Response Plan
FERC	Federal Energy Regulatory Commission
LHMP	Local Hazard Mitigation Plan
MFP	Middle Fork Hydroelectric Project
NID	Nevada Irrigation District
PCWA	Placer County Water Agency
PG&E	Pacific Gas and Electric
SNODAS	Snow Data Assimilation System
TAF	Thousand Acre-Feet
UIFR	Unimpaired Inflow to Folsom Reservoir
USBR	U.S. Bureau of Reclamation
UWMP	Urban Water Management Plan
WAC	Warren Act Contracts
WSCP	Water Shortage Contingency Plan

1.0 Water Service Reliability Analysis

1.1 Zone 6 service area

Through its Zone 6 service area, Placer County Water Agency (PCWA) currently provides approximately 130,700 acre-feet of water annually, either directly or indirectly, to over 60,000 individual homes, businesses, and irrigation customers, serving a total population of over 200,000. Historically PCWA has served 86 thousand acre-feet (TAF) (70%) for irrigation purposes serving approximately 4,200 customers, and 38 TAF (30%) was delivered as treated water for municipal and industrial purposes.

The area served by the Zone 6 service area extends from the community of Alta on the east, down the interstate 80 corridor, to the Sutter and Sacramento County lines on the west and south. The service area includes treated water deliveries from PCWA water treatment plants to the communities of Alta, Monte Vista, Applegate, Colfax, Weimar, Auburn, Loomis, Rocklin, and Lincoln and much of the surrounding unincorporated communities and areas. In addition to treated water service, PCWA provides untreated water through its extensive canal system to individual customers. PCWA also delivers untreated wholesale water to the City of Roseville (Roseville), Sacramento Suburban Water District (SSWD), San Juan Water District (SJWD), and several other small water districts, the amounts and populations of which are not included in the totals summarized above.

The Zone 6 service area has two primary sources of surface water that are currently in use: Pacific Gas and Electric (PG&E) contract supplies from the Yuba and Bear Rivers delivered through PG&E's Drum-Spaulding Hydroelectric Project (Drum-Spaulding) into a network of distribution canals at various locations that are owned and operated by PCWA and (2) PCWA's Middle Fork Hydroelectric Project (MFP) water rights that can be delivered through a pump station on the American River near Auburn into the Auburn Ravine Tunnel or from Folsom Lake for wholesale deliveries to the City of Roseville, the San Juan Water District, and the Sacramento Suburban Water District. In addition to these primary supplies, PCWA has a small amount of Pre-1914 water rights, a contract with the US Bureau of Reclamation for Central Valley Project water, two groundwater wells, and several intertie connections with other purveyors.

PCWA's canal system is the backbone of its Zone 6 service area, taking gravity water delivery from PG&E at various locations, and delivering water to PCWA water treatment plants, the treatment plants of several other public and private water purveyors, and delivering irrigation water to over 4,200 customers along the canal system and through Auburn Ravine to western Placer County.

The American River Pump Station was constructed in 2007 to facilitate continued planned urban developments and a highly reliable water supply to serve existing customers. The design

delivery rate from the American River is about 190 cubic feet per second (cfs), which is intended to ultimately provide about 70,500 acre-feet annually into the Zone 6 service area.

1.2 Dry Year Supply Reliability

PCWA has assessed various dry conditions based on historic years of records. Chapter 7 of the Agency's Urban Water Management Plan (UWMP) summarizes supplies available during these dry year constraints. Actual water supply availability over multiple years is dependent on many factors that will require flexibility for PCWA to manage the multiple sources of supplies and implementation of its Water Shortage Contingency Plan (WSCP) stages accordingly. In the event there is a shortage of one of these supplies that cannot be supplemented by an alternative supply, it would be expected that all customers would conserve. In most cases a greater reduction in deliveries would be expected from the raw water system.

2.0 Annual Water Supply and Demand Assessment Procedures

By July 1 of each year, each water purveyor with 3,000 or more service connections, or delivering 3,000 acre-feet or more of treated water, is required to complete and submit an Annual Water Supply and Demand Assessment to the California Department of Water Resources as required in AB 1414, Section 10632.1, that assesses the current year's water supply and demands, and the expected water supply and demand as if the following year will be categorized as dry. This assessment will be used to determine if a supply shortage exists and if actions need to be implemented to reduce demands. Prior to the annual submittal to the State a high-level summary of the assessment will be presented to the PCWA Board of Directors for information only or action if necessary.

Backup documentation for the annual submission will include details of each PCWA water supply source and projected total water demands. Early April has historically been the period of peak snowpack accumulation with a majority of the year's precipitation having already occurred. Water supply conditions for the remainder of the year are generally known around this time.

PG&E contracted water supply allocations are determined and are typically reported to PCWA in early May. PCWA's retail and wholesale water demand projections are then updated, and the information is used to determine if there is an excess or shortage of water supply available for the summer and fall demands. PCWA will prepare the Annual Water Supply and Demand Assessment based on the water supply information described above and the demands described in the UWMP. If deemed necessary by the responsible party, or if an action is required, the assessment will be provided to the Board no later than the last Board meeting in June.

Also, by July 1 of each year, PCWA will prepare an annual Water Shortage Assessment Report summarizing the water supply and demands estimates from the assessment, including

information on any anticipated shortages, and if necessary, the shortage response actions, compliance and enforcement actions, and communication actions to be implemented consistent with this Water Shortage Contingency Plan.

Table 2-1: Supply and Demand Assessment Timeline

Latest Start Period	Activity	Responsible Party
Jan - April	Assess current year unconstrained wholesale and retail demand from PCWA system	Agency Staff - Engineering
Jan - April	Determine annual allocations of PG&E, Central Valley Project (CVP), and MFP supplies	Agency Staff - Resource Management
April	Conduct initial supply and demand assessment; identify shortages	Agency Staff – Engineering/Resource Management
April	Evaluate infrastructure limitations and/or outages that impact water delivery	
Mid May	If shortage exists determine recommend response level from WSCP	Agency Staff - Engineering/Customer Services
Mid May	Prepare final assessment and presentation	Agency Staff - Resource Management
First Board Meeting in June	If shortage exists, receive presentation on and Supply and Demand Assessment and take action (if necessary)	Board
Mid-June	Implement WSCP actions, communications, and protocols	Agency Staff – Engineering/Customer Services
Mid-June	Finalize Supply and Demand Assessment and submit	Agency Staff – Engineering/Resource Management

2.1 Data Sources

There are many sources of data used to monitor hydrologic and water supply conditions and to estimate potential water supply availability to meet PCWA annual demands.

Customer Demands

- Historical treatment plant production
- Customer billing data
- Historical wholesale deliveries

Water Supply Conditions

- Precipitation
  - California Data Exchange Center (CDEC)
  - California Nevada River Forecast Center (CNRFC)
- Snowpack
  - California Department of Water Resources (DWR) California Cooperative Snow Surveys
  - Snow Sensors (CDEC, American River Hydrologic Observatory)
  - Remote sensing and models such as CNRFC and Snow Data Assimilation System (SNODAS)
- Reservoir Storage
  - PCWA, PG&E, and Nevada Irrigation District (NID) monitored reservoirs
  - CDEC
- Runoff Projections
  - PCWA Proprietary Runoff Forecasting Model
  - CNRFC
  - DWR B120

Weather Forecasts

- Energy Marketing Staff
- National Weather Service

2.2 PCWA Water System Capabilities and Constraints

2.2.1 Canal System

The PCWA untreated water conveyance system consists of 170 miles of earthen and lined canals, with flumes and pipelines where needed, beginning in the community of Alta, flowing southwest, generally following Interstate 80, and ending near the western edge of Placer County in Roseville.

The canal system is contractually separated by water supply agreements with PG&E into two service zones. Zone 3 begins at the PG&E Alta Forebay, continuing southwest until just below

PCWA's Lake Theodore north of Auburn. Zone 1 begins at Lake Theodore, continuing southwest to Roseville.

PCWA purchases water at several connections to the PG&E canal system called "Buy Points" individually identified as a "YB Point," positioned at key locations between Alta and the end of PG&E's South Canal. The maximum flow rate that PCWA can receive from all PG&E combined Zone 1 YB points is 244.8 cfs. The current maximum PG&E flow rate into Zone 3 due to canal system constraints below Lake Alta is 35 cfs

Water can also enter the canal system from accretion flows into the canals, Pre-1914 water rights, and return flows from PCWA untreated water customers (water that is delivered to customers and flows back into the canal). Middle Fork Project water can also be pumped out of the North Fork of the American River at the PCWA American River Pump Station, into a 3-mile tunnel (Auburn Tunnel) under the City of Auburn to a valved outlet into Auburn Ravine, where the water is purchased by customers west of the City of Lincoln.

The tunnel outlet can be closed, and the Middle Fork Water pumped out of the tunnel at the Ophir Pump Station into the PG&E South Canal, or to the Foothill and Ophir (future) Water Treatment Plants.

2.2.2 Pre-1914 Water Rights

Four Pre-1914 water rights were included with the purchase of portions of the PG&E canal system. These Pre-1914 water rights are on natural water courses which are also used to convey water purchased from PG&E to a downstream PCWA canal or diversion. Two of the Pre-1914 water rights diversions are near the headwaters of North and South Fork Dry Creeks. A third Pre-1914 water right is on an un-named tributary to the Auburn Ravine.

The last Pre-1914 water right is in Zone 3 near Alta. Natural flows, up to 40 cfs, can be diverted into the PCWA Pulp Mill Canal for use in either Zone 3 or Zone 1. One (1) cfs is diverted back into Canyon Creek by PG&E as a required stream maintenance flow upstream of the PCWA diversion point. PG&E can also deliver water to PCWA at this diversion point when performing maintenance on their Towle Canal, several miles upstream of this location.

2.2.3 Nevada Irrigation District Water to Foothill WTP

NID shares capacity in South Canal with PG&E to transport and release water into Auburn Ravine at YB 132 and YB 259, both below PG&E's Wise Powerhouse.

Until NID constructs and puts into operation a water treatment plant for their service area in the City of Lincoln, NID wheels water through PCWA and the City of Lincoln to its service area. NID uses a portion of their capacity in the South Canal to deliver NID untreated water to PCWA's Foothill Water Treatment Plant without affecting the maximum PCWA Zone 1 flow diversion of 244.8 cfs. This water is treated at the Foothill WTP and delivered to the City of Lincoln through the Lincoln Metering Station near the PCWA Sunset Water Treatment Plant. The City of Lincoln then delivers this treated water to the NID service area.

2.2.4 Middle Fork Project

PCWA owns and operates the MFP, a Federal Energy Regulatory Commission (FERC) licensed hydroelectric and water storage project on the Middle Fork American and Rubicon Rivers. PCWA's relicensing effort resulted in a new license being issued on June 8, 2020 for a 40-year term. Electricity is generated year-round, with water being diverted to storage between November 1 and July 1 each year.

There are five water right permits associated with the Middle Fork Project. Three of the Permits are for hydroelectric generation and two permits are for M&I consumptive use.

For this document, only the M&I consumptive permits are relevant. PCWA has a contractual limit from U.S. Bureau of Reclamation (USBR) that limits PCWA to divert up to 120,000 acre feet of water per year from the American River. PCWA has analyzed diversions of up to 35,500-acre feet of water at the American River Pump Station and anticipates needing to pump up to 70,500 acre-feet in the future after the environmental analysis is completed. MFP water is not currently fully utilized and is needed to meet the needs of future PCWA growth/development.

2.2.5 Folsom Reservoir

In addition to pumping MFP water from the American River Pump Station, MFP water is also diverted out of Folsom Reservoir by the Los Logos Homeowners Association, the City of Roseville, the San Juan Water District, and the Sacramento Suburban Water District. out-of-county water sales. PCWA does not currently own or control facilities that can convey Middle Fork Project or Central Valley Project water from Folsom Reservoir to the PCWA service area but anticipates future diversions of MFP and CVP supplies from the reservoir and/or Sacramento River (RiverArc Project).

2.2.6 Treated Water

PCWA owns and operates eight water treatment plants between Alta and Rocklin, produces approximately 42,000-acre feet of potable water each year. Treated water is distributed in over 615 miles of pressurized pipe and delivered to various retail and wholesale customers.

PCWA also has several treated water interties with neighboring water agencies: NID, San Juan Water District, the City of Lincoln, and the City of Roseville. Some these connections are one way due to pressure differences, while other connections can flow water in either direction with the use of pumps or pressure reducing valves.

2.2.7 Base PCWA Water Supply

Refer to PCWA's most recent UWMP for its water supply summary.

2.3 Projecting Water Supply Availability

PCWA has ample storage supplies through its PG&E contracts from the Drum-Spaulding Hydroelectric Project and water rights from its own MFP. These combined supplies provide

more than enough supply to meet all of PCWA's demands, including multiple dry years. Actual water supply availability from each source is dependent on annual hydrologic conditions and regulatory storage and release requirements. As a result of California's Mediterranean climate, the amount of annual precipitation and snowpack ranges widely from year to year. Historically, the region will begin to experience precipitation events in October following the dry summer months. October is the beginning of the Water Year which runs from October through September of the following year. Hydrologic forecasts, and thereby runoff projections have the greatest range of outcomes and the lowest confidence at the beginning of the water year. By late April, the majority of the years precipitation and snowfall will have already been observed as the climate transitions into the drier and warmer spring and summer months. The range of hydrologic projections begin to converge and confidence in water supply forecasts for determining how much water is available for consumptive demands for the remainder of the calendar year is greatly improved.

2.3.1 Middle Fork Project

On a monthly basis, PCWA's Energy Marketing Department produces an ensemble of operating plans for the Middle Fork Project that accounts for varying hydrologic and runoff projections, regulatory commitments required by the license to operate the MFP from the FERC, consumptive demands, and use of surplus discretionary water for optimized hydropower production.

Unimpaired runoff projections for French Meadows Reservoir, Hell Hole Reservoir, and other tributaries in the watershed are produced and provided to PCWA by the California-Nevada River Forecast Center (CNRFC). The CNRFC is a branch of the National Weather Service and provides detailed hydrologic forecasts throughout the nation. The Energy Marketing staff collaborate with CNRFC staff who are dedicated to the American River Basin to validate and calibrate the hydrologic runoff model. Additionally, the Energy Marketing staff monitor conditions in the basin from various Meteorological (MET) stations and participate in the monthly California Cooperative Snow Surveys by measuring snowpack conditions at four snow courses in the MFP watershed.

PCWA's FERC License dictates the minimum amount of water that needs to be maintained in the river reaches below the MFP storage reservoirs for environmental and recreational purposes. These minimum release requirements vary by water year type. The water year type is determined in April and May following the release of the Department of Water Resources Bulletin 120 (B120) water supply report. There are six water year type classifications varying from Critically Dry to Wet and are based on the median projection of unimpaired inflow into Folsom Reservoir (UIFR)

2.3.2 Drum-Spaulding Project

Like PCWA, PG&E staff regularly produce an ensemble of operating plans for the Drum-Spaulding Project to determine water supply availability. Both PCWA and the Nevada Irrigation

District have water supply contracts from PG&E for water from the Drum-Spaulding project and participate in weekly discussions of coordinated operations.

Following the May 1 snow surveys, PG&E makes a determination of water supply availability for the remainder of the year and provides PCWA with a water supply allocation Only in extremely dry water years has the Drum-Spaulding allocation been reduced. Should there be a reduction in allocation, there is currently excess capacity from the other water supply sources to meet total demands.

2.3.3 Central Valley Project

The CVP supply allocation amounts are based on an estimate of water available for delivery to CVP water users and reflects current reservoir storages, precipitation, and snowpack in the Central Valley and Sierra Nevada. Initial water supply allocations are typically reported in February and updated periodically until a final allocation is reported in May or June.

2.3.4 Projecting Unconstrained Demand

PCWA will utilize the 5-year demand forecast included in the UWMP to estimate retail and wholesale demands. If significant changes in development, operations, or other factors that influence demand are identified, these forecasts will be updated.

PCWA provides MFP Water Rights water via wholesale water supply contracts annually to the City of Roseville, San Juan Water District and Sacramento Suburban Water District (collectively referred to herein as “wholesale agencies”) at Folsom Reservoir, a Point of Diversion and Re-Diversion under PCWA’s MFP Water Rights (13856 & 13858).

All three contracts are similar in terms with each containing maximum entitlement volumes as follows.

- City of Roseville up to 44,000 AF
- San Juan Water District up to 25,000 AF
- Sacramento Suburban Water District up to 29,000 AF.

While the City of Roseville and San Juan Water District supplies are available every year, Sacramento Suburban Water District supplies are only available in wetter years to facilitate groundwater recharge when the March through November UIFR is more than 1.6 MAF.

Consistent with contract terms, each wholesale agency provides PCWA with an annual diversion schedule containing the projected monthly diversion volumes for each calendar year. Because wholesale agency demands for MFP wholesale water are typically realized after March, the wholesale agencies provide their annual delivery schedules to PCWA consistent with the requirements of their respective Warren Act Contracts (WAC). The WAC are agreements executed by each respective wholesale agency and the USBR governing the storage and conveyance of Non-Project water (e.g., PCWA’s MFP water) through Folsom Reservoir, a CVP facility. For the purposes of scheduling Non-Project water, the “year” is defined in each respective WAC as March 1 through the February of the following calendar year.

As such, PCWA receives wholesale agency delivery schedules around March 1 for the year as defined in these WAC. These schedules are used to plan deliveries from the MFP to Folsom Reservoir. In addition, each wholesale agency provides PCWA and the USBR with a monthly diversion report consistent with the terms of their WAC, which reports for actual monthly diversion volumes as well as adjustments to the requested volumes in the coming months to account for any projected changes in demand. The process is iterative and can change from month to month. At the end of the calendar year, diversion volumes are finalized, and reconciliations are made if warranted.

2.4 Planned Water Use for Current Year Considering Dry Subsequent Year

With the exception of groundwater and water supply from the Middle Fork Project, PCWA does not have large storage reservoirs to store water for future years. Water supply availability is determined on an annual basis. The Middle Fork Project is operated to an annual carryover storage that provides enough stored water for multiple dry years including any potential shortages from other water supply sources.

3.0 Water Shortage Stages

One of the keys to understanding how to respond to the loss of a significant amount of water is to first understand what is possible in terms of the use of the Middle Fork Project supply. Middle Fork Project water can be pumped from the American River into the Auburn Ravine Tunnel and from the tunnel up to the ground surface near Ophir, where it can be delivered to PCWA's Dutch Ravine Canal or the Foothill and Sunset water treatment plants. Middle Fork Project water would be able to supply the treatment plants with enough water to meet all near-term lower Zone 1 treated water demands, which represents approximately 85% of treated water use in the Zone 6 service area. Middle Fork Project water has a more limited ability to supply the canal customers of the Zone 6 service area. The Ophir Road pipeline, which connects this supply to the Dutch Ravine Canal, can deliver 20 TAF of water to this portion of the canal system. This represents approximately 23% of canal water use in the Zone 6 service area.

Based upon these physical delivery characteristics and the large difference between treated and untreated demands dependent upon the reduced PG&E supply, more severe cuts in delivery may be necessary for customers in the untreated systems than in the treated water systems during periods of extreme drought, such as a 50% cutback in PG&E supplies. Additionally, state law and practical necessity dictate that public health and safety be prioritized over irrigation and agriculture in very serious water shortage conditions. Public health and safety needs rely on the treated water systems and include fire protection, sanitation, hospitals, schools, and other critical needs.

Actions taken to conserve water in the untreated systems are different than those taken in the treated water systems. Specifics of these actions are described for the canal systems and treated water systems as follows.

3.1 Water Shortage Actions – Treated Water Systems

Regardless of water supply availability or service conditions, the Board of Directors reserves the right to set water conservation goals and modify stage declarations as necessary, based on the impact to the local conditions, or statewide water shortage conditions to align with regional or state water conservation policies, agreements, declarations, or legal requirements. The Board of Director's shall determine, based on present water conditions and any lawful directive of the State, the treated water shortage stage applicable to PCWA for the coming year. To promote the efficient use of water, PCWA has adopted inclining block consumptive water rates for residential and commercial treated water retail customers. When a water shortage stage is declared by PCWA's Board of Directors, resale water suppliers, to which PCWA provides water, are advised to implement conservation measures comparable to those adopted by PCWA, to achieve the same level conservation. All wasteful practices or unreasonable uses of water, whether willful or negligent, are always prohibited regardless of water supply.

PCWA's Water Shortage Contingency Plan consists of six stages of varying conservation actions and use restrictions intended to meet target demands. Implementation of the stages is cumulative; meaning that implementation of a higher stage shall also include implementation of previous stages. These actions shall be used as a starting point to meet targets and shall be monitored, as described later in this plan. For each stage, the water reduction for customers shall be as follows:

- **Stage 1 - ("Heighten Water Use Efficiency") –** Shall achieve a reduction up to 10% relative to the full allocation of water. Full allocation of water, which is total supply available to PCWA, may be used to determine allowable water use for each customer in this stage and compliance with the following stages.
- **Stage 2 - ("Water Conservation") –** Shall achieve a reduction of up to 20% relative to the full allocation of water.
- **Stage 3- ("Water Warning") –** Shall achieve a reduction of up to 30% relative to the full allocation of water.
- **Stage 4- ("Water Alert") –** Shall achieve a reduction of up to 40% relative to the full allocation of water.
- **Stage 5- ("Water Crisis") –** Shall achieve a reduction of up to 50% relative to the full allocation of water.
- **Stage 6- ("Water Emergency") –** Shall achieve a reduction of greater than 50% relative to the full allocation of water.

Table 3-1: Water Shortage Contingency Plan Levels

Shortage Level	Percent Shortage Range	Shortage Response Actions (*Narrative description*)
1	**Up to 10%**	Actions are voluntary and will be reinforced through local and regional public education and awareness measures. Actions include customers fixing leaking fixtures and covering pools with covers.
2	**Up to 20%**	Actions, which are mandatory, include limiting landscape watering to certain time of day and number of days; prohibiting washing down of impervious surfaces; and prohibiting non-essential flushing of mains and fire hydrants.
3	**Up to 30%**	Actions, which are mandatory, include limiting landscape watering to certain number of days; limiting construction water use; and requiring Commercial, Industrial, and Institutional properties to implement appropriate water efficiency measures for business types.
4	**Up to 40%**	Actions, which are mandatory, include limiting landscape watering to certain number of days; prohibiting irrigation of ornamental turf on public street medians with potable water and other irrigation activities; requiring car washing to occur at commercial carwash.
5	**Up to 50%**	Actions, which are mandatory, include water use for public health and safety purposes only and prohibiting irrigation of turf.
6	**>50%**	Actions, which are mandatory, include water use for public health and safety purposes only. Customer rationing may be implemented.

NOTE: Additional details on water shortages actions are provided in the following section.

4.0 Shortage Response Actions

4.1 Supply Augmentation

PCWA has several interties/connections with neighboring treated water systems including Nevada Irrigation District (4), San Juan Water District (4), City of Lincoln (2), and the City of Roseville (5). These interties can be called upon in times of emergency and/or extended outages due to maintenance or construction projects but typically would not be called upon for extended periods of time. The interties could be utilized in two different ways. First, water can be transferred from the neighboring agencies. Some of these transfers may require the manual assembly and operations of a pump, others are already equipped with pumps. Second, per our

various supply contracts, we can request of wholesale customers, California-American Water Company, and the City of Lincoln, to transfer demands to their groundwater systems. In addition, PCWA can utilize their two existing wells in Zone 1 for backup supply.

Because of the numerous scenarios that could trigger water shortage actions, the fact that our neighboring agencies could be affected by the same scenarios, and the limitations involved with the various interties, an augmented supply cannot be reliably quantified.

PCWA currently has no long-term new water supply development projects planned in the near future.

4.2 Demand Reduction

Stage 1 "Heighten Water Use Efficiency" – 10% Conservation

The following best practices are voluntary and will be reinforced through local and regional public education and awareness measures that may be funded in part by PCWA.

1. Wash only full loads when washing dishes or clothes.
2. Use pool covers to minimize evaporation.
3. Upgrade to water efficient indoor and outdoor fixtures when possible.
4. Fix leaks or faulty sprinklers within 72 hours of occurrence or time of discovery.
5. Decorative water features must recirculate and shall be leak proof.
6. Water shall be confined to the customer's property and shall not be allowed to run off to adjoining property, roadside, non-irrigated areas, private and public walkways, roadways, parking lots, ditch or gutter or any other impervious service. Care shall be taken not to water past the point of soil saturation.
7. No landscape watering shall occur during rain/snow events or within 48 hours after a ¼" or more of rainfall/snowfall.
8. Automatic shut-off devices shall be installed on any hose or filling apparatus in use.
9. Unauthorized use of hydrants shall be prohibited. Authorization for use must be obtained from PCWA.
10. Commercial, industrial, institutional equipment must be properly maintained and in proper working order.
11. Hotels and motels shall provide guests with the option of choosing not to have towels and linens laundered. The hotel or motel shall prominently display notice of this option in each bathroom using clear and easily understood language.
12. Restaurants shall serve water to customers only upon request.
13. All new landscaping shall, at a minimum, adhere to the specifications outlined in the State's Model Water Efficient Landscape Ordinance adopted by the California Department of Water Resources or specifications of any land use jurisdiction in effect. Link to ordinance here: Model Water Efficient Landscape Ordinance.
14. The use of potable water for the irrigation of nonfunctional turf located on commercial, industrial, and institutional properties, other than a cemetery, and on properties of homeowners' associations, common interest developments, and community service

organizations or similar entities is prohibited as outlined in PCWA's Rules, Regulations, Rates and Charges Governing the Distribution and Use of Water currently in effect.

Stage 2 "Water Conservation" – up to 20% Conservation

In addition to the above, the following actions are mandatory during Stage 2.

1. Resale water suppliers to which PCWA provides water are advised to implement conservation measures comparable to those adopted by PCWA, to achieve the same level conservation. Coordinated messaging will be important to achieve regional requirements imposed by the state.
2. Landscapes shall only be watered between the hours of 7:00 p.m. and 7:00 a.m. to reduce evaporation. Plant containers, trees, shrubs, and vegetable gardens may be watered outside of this watering timeframe if using only drip irrigation, hand watering, or smart controller systems.
3. Turf watering shall be limited to a maximum of three days per week during the months of July, August, and September, a maximum of two days per week in April, May, June, October, and November, and shall not be watered during the remaining winter months unless PCWA notifies customers that watering is allowed due to unseasonably and extended dry conditions. Plant containers, trees, shrubs, and vegetable gardens may be watered any day when using drip irrigation, hand watering, or smart controller systems.
4. Washing down impervious surfaces such as driveways and sidewalks shall be prohibited unless necessary for public health and safety purposes.
5. Non-essential flushing of mains and fire hydrants shall be prohibited.

Stage 3 "Water Alert" – up to 30% Conservation

In addition to all the above, the following actions are mandatory:

1. Decorative water features, such as fountains, shall be drained and kept dry.
2. A construction water use plan shall be submitted that mitigates the use of water for purposes such as dust control.
3. The installation of new landscaping for existing homes shall be limited to low water use trees, shrubs, and groundcover. Landscapes shall be watered with high efficiency nozzles using a smart controller or rain sensor on a typical controller. The installation of new turf or hydro seed for existing homes shall be prohibited unless watered using drip or micro spray systems. Customers who had installed new turf or hydro seed prior to the prohibition may apply for a waiver to irrigate during an establishment period.
4. Turf watering shall be limited to a maximum of two days per week April through November and the remaining winter months unless PCWA notifies customers that watering is allowed due to unseasonably and extended dry conditions. Plant containers, trees, shrubs, and vegetable gardens may be watered any day when using drip irrigation or hand watering.
5. Commercial, Industrial, and Institutional properties, such as campuses, golf courses, and cemeteries shall implement sector appropriate water efficiency measures to achieve a water usage reduction consistent with the objective of this stage.

Stage 4 "Water Warning" – up to 40% Conservation

In addition to all the above, the following actions are mandatory:

1. Existing pools shall not be emptied and refilled unless required for public health and safety purposes.
2. No new landscape installations or renovations shall be permitted.
3. Waivers granted previously for turf or hydro seed watering during an establishment period shall be revoked.
4. Wholesale customers to utilize reclaimed water for dust control, earthwork, or road construction as permits allow and as available.
5. Turf watering shall be limited to a maximum of one day per week April through November and shall not be watered during the remaining winter months unless PCWA notifies customers that watering is allowed due to unseasonably and extended dry conditions. Plant containers, trees, shrubs, and vegetable gardens may be watered any day when using drip irrigation, hand watering, or smart controller systems.
6. Car washing shall only be permitted using a commercial carwash that recirculates water and use high pressure/low volume wash systems.
7. Irrigation of ornamental turf on public street medians with potable water shall be prohibited.

Stage 5 "Water Crisis" – up to 50% Conservation

In addition to all the above, the following actions are mandatory:

1. Water use for public health and safety purposes only.
2. Turf shall not be watered.

Stage 6 "Water Emergency" – 50% and Greater Conservation

In addition to all the above, the following actions are mandatory:

1. Water use for public health and safety purposes only. Customer rationing may be implemented.

PCWA's demand reduction actions were combined into DWR's defined demand reduction actions for each shortage level. These combined demand reduction actions and estimated reduction are presented in Table 4-1.

Table 4-1: Demand Reduction Actions

SHORTAGE LEVEL	DEMAND REDUCTION ACTIONS	HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?[1]	PENALTY, CHARGE, OR OTHER ENFORCEMENT
1	CII - Lodging establishment must offer opt out of linen service	0-1%	No
1	CII - Other CII restriction or prohibition	0-1%	No

SHORTAGE LEVEL	DEMAND REDUCTION ACTIONS	HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?[1]	PENALTY, CHARGE, OR OTHER ENFORCEMENT
1	Decrease Line Flushing	0-1%	No
1	Expand Public Information Campaign	0-1%	No
1	Landscape - Other landscape restriction or prohibition	0-6%	No
1	Landscape - Restrict or prohibit runoff from landscape irrigation	0-15%	No
1	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	0-12%	No
1	Other - Require automatic shut of hoses	0-1%	No
1	Water Features - Restrict water use for decorative water features, such as fountains	0-1%	No
1	Pools and Spas - Require covers for pools and spas	0-1%	No
1	CII - Restaurants may only serve water upon request	0-1%	No
2	Decrease Line Flushing	5-15%	No
2	Landscape - Limit landscape irrigation to specific times	5-10%	No
2	Landscape - Limit landscape irrigation to specific days	5-10%	No
2	Other - Prohibit use of potable water for washing hard surfaces	0-1%	No
2	Other	0-10%	No
3	CII - Other CII restriction or prohibition	0-5%	No
3	Landscape - Limit landscape irrigation to specific days	10-25%	No
3	Landscape - Other landscape restriction or prohibition	0-1%	No

SHORTAGE LEVEL	DEMAND REDUCTION ACTIONS	HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?[1]	PENALTY, CHARGE, OR OTHER ENFORCEMENT
3	Other - Prohibit use of potable water for construction and dust control	0-1%	No
3	Other water feature or swimming pool restriction	0-1%	No
4	Landscape - Limit landscape irrigation to specific days	5-20%	No
4	Landscape - Other landscape restriction or prohibition	0-3%	No
4	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	0-1%	No
4	Other water feature or swimming pool restriction	0-1%	No
4	Other	0-1%	No
5	Landscape - Other landscape restriction or prohibition	0-50%	Yes
6	Landscape - Other landscape restriction or prohibition	0-70%	Yes

[1]Reduction in the shortage gap is estimated and can vary significantly.

4.3 Operational Changes

Operational changes to address a short-term water shortage may be implemented based on the severity of the reduction goal. Changes may include: non-essential flushing of mains and fire hydrants shall be prohibited, expand public information campaign, include target information on customer bills, modify staff schedules for expanded water waste patrol.

4.4 Additional Mandatory Restrictions

4.4.1 Water Shortage Actions – Irrigation Canal Systems

The actions taken to conserve water in the canal systems are more operational in nature on the part of PCWA and may include changing the sizes of the orifices through which water is delivered to customers and/or instituting “rolling” or alternating canal outages. Changes in customer water use practices will be necessary to work within the water delivered under shortage conditions. Canal operations staff can work with customers in groups along a specific canal or, in select cases, as individuals to meet the necessary level of conservation.

In a water shortage emergency, the PCWA Board of Directors will have declared a necessary level of conservation for the canal system. In the same action as declaring a level of

conservation, more specific details on how to implement these generalized operational procedures will also be adopted, giving canal operations staff and customers guidelines on how to work cooperatively to meet conservation needs. In the 2014 water year, a 20% level of conservation was sought, operations staff worked to minimize losses in the delivery system, orifices were resized to reduce their peak delivery rate by 10%, rolling outages were used in some cases, but minimized, and the achieved level of conservation was 35%.

PCWA Resolution 14-12 is an example of a resolution that could be used to include more specifics on operational procedures for the canal systems Water Shortage Contingency Plan. This resolution is written for a 20% level of conservation but could be modified for a higher level of conservation if needed.

4.5 Emergency Response Plan

PCWA has prepared an Emergency Response Plan that provides general procedures for responding to catastrophic supply interruption (i.e., infrastructure failure).

PCWA's water systems are susceptible to interruption in water supply due to catastrophic events. In particular, fire, landslides, major pipeline failures, power outages, and earthquakes are risks to PCWA water supply infrastructure.

Water supplied by PG&E is delivered through a canal system that traverses hillsides and crosses valleys using raised flumes and pipelines. PCWA has established a Renewal and Replacement Program to replace aging infrastructure along the canal system; however, this program is phased over a long period of time. The remaining supplies are delivered through pumping stations that have back-up power.

4.6 Seismic Risk Assessment and Mitigation Plan

Water Code Section 10632.5 requires the participating agencies to assess seismic risk to water supplies as part of their WSCP. The code also requires a mitigation plan for managing seismic risks.

In lieu of conducting their own seismic risk assessment, which can be a lengthy process, suppliers can comply with the Water Code requirement by submitting the relevant local hazard mitigation plan or multi-hazard mitigation plan.

Placer County, the county which PCWA serves water, prepared a Local Hazard Mitigation Plan (LHMP) in 2026. It is available on the Placer County's website at https://www.placer.ca.gov/1381/Local-Hazard-Mitigation-Plan. The LHMP contains an annex (Annex R) that details hazard mitigation planning elements specific to PCWA, including seismic risk assessment and mitigation strategies.

4.7 Shortage Response Action Effectiveness

PCWA has estimated the effectiveness of shortage response actions in terms of reducing the gap between expected supplies and demands. These estimates were developed using industry

resources and observations from recent operating history at PCWA. These estimates are included in

Table 4-1 above.

5.0 Communication Protocols

In the event of a water shortage, PCWA must inform its customers, the general public and interested parties, and local, regional, and state entities. When a water shortage is determined, PCWA will coordinate interdepartmentally, with the region's water service providers, and with the County for the possible proclamation of a local emergency in accordance with under California Government Code, California Emergency Services Act (Article 2, Section 8558).

5.1 Communication Methods

PCWA will inform customers (retail, wholesale, treated and raw), the general public, and interested parties through:

2. Bill inserts and newsletters
3. PCWA website updates
4. Press releases and media engagement
5. Social media posts
6. Email notifications when appropriate

PCWA will communicate with local, regional, and state entities primarily through email and direct coordination to ensure consistent and accurate messaging.

5.1.1 Scalability of Communications

The communication approach will vary depending on the severity and extent of any water shortage. Techniques will be adapted as necessary to ensure the public receives timely and accurate information until shortage conditions are resolved.

5.1.2 Communication During Unforeseeable Events

Unforeseen events—such as earthquakes, fires, infrastructure failures, or other emergencies—may necessitate immediate communication. In such cases, PCWA will follow established emergency response procedures, including those in the Agency's ERP, which provides communication roles, protocols, and contact lists for local, regional, and state notifications.

Communication will generally follow the chain of command. Assigned PCWA staff will carry out internal and external notifications, with the designated Public Information Officer serving as the primary spokesperson for media and public messaging. Additional communication channels (website, email, and social media) may be used as needed.

6.0 Compliance and Enforcement

6.1.1 Prohibitions and Penalties for Excessive Use

The goal of PCWA is to achieve voluntary compliance from our customers. PCWA will take reasonable measures to ensure that customers have information available to address water use issues promptly and efficiently. Where voluntary compliance cannot be achieved through initial contacts and warnings, then appropriate administrative penalties and further action are required and therefore, enforcement of the Water Shortage Contingency Plan. These penalties and actions will also be enforced for excessive residential water use during a drought as indicated in the Water Code Division 1, Chapter 3.3 Section 365. Violations of mandatory actions shall be addressed in PCWA's Rules, Regulations, Rates and Charges Governing the Distribution and Use of Water, currently in effect.

7.0 Legal Authority

The following provisions of the Placer County Water Agency Act provide PCWA with the legal authority to implement and enforce the response actions set forth in this WSCP. The Rules and Regulations contained in this Plan were adopted pursuant to the foregoing legal authorities.

> Section 4 provides PCWA with the authority "to do any and every lawful act necessary in order that sufficient water may be available for any present or future beneficial use or uses of the lands or inhabitants within the agency . . ." (Stats.1957, c. 1234, p. 2522, §4.).
>
> Section 4.3 provides PCWA with the authority "to conserve and reclaim water for present and future use within the agency . . ." (Stats. 1957, c. 1234, p. 2522, §4.3.)
>
> Section 5(c) provides PCWA with the authority to "[t]o establish rules and regulations to protect the public health in the operation of the works, to provide for the sale, distribution and use of water and the services and facilities of the works . . ." (Stats. 1957, c. 1234, p. 2525, §5, as amended Stats. 1959, c. 8l5, p. 2824, §9; Stats. 1965, c. 972, p. 2589, §l.)

PCWA shall declare a water shortage emergency in accordance with Chapter 3 (commencing with Section 350) of Division 1.

> Water Code Section Division 1, Section 350
>
> Declaration of water shortage emergency condition. The governing body of a distributor of a public water supply, whether publicly or privately owned and including a mutual water company, shall declare a water shortage emergency condition to prevail within the area served by such distributor whenever it finds and determines that the ordinary demands and requirements of water consumers cannot be satisfied without depleting the

water supply of the distributor to the extent that there would be insufficient water for human consumption, sanitation, and fire protection.

PCWA shall coordinate with any city or the County of Placer for the possible proclamation of a local emergency, as defined in Section 8558 of the Government Code (California Emergency Services Act). In all cases, the city manager, town manager, or CEO will be the primary point of contact. The following is a list of land jurisdictions who would be contacted:

- **City of Rocklin**
- **Town of Loomis**
- **City of Auburn**
- **City of Colfax**
- **Placer County CEO**
- **Sacramento County CEO**
- **City of Lincoln**
- **City of Roseville**

8.0 Financial Consequences of WSCP Implementation

8.1.1 Analysis of Revenue and Expenditures during Shortages

There are three primary objectives during a water shortage, 1) reduce water use 2) maintain adequate resources to meet revenue requirements 3) ensure customers are properly notified and educated. Portions of PCWA's operating revenue is derived from volumetric-based water rates, hence, during a water shortage with reduced water use, PCWA's revenue would decrease. PCWA's water rates have been designed within the legal framework and industry standards to support and optimize a blend of various objectives, including conservation and revenue stability. Based on the most recent Water Cost of Service and Rate Study, Water System revenue components are roughly 60% fixed and 40% commodity for retail customers - providing fixed revenue in years of water shortages than traditional commodity-heavy models.

Also, depending on the root cause of a water shortage, unbudgeted and unforeseen expenses would likely be incurred. A drought induced water shortage would result in additional expenses for public outreach, conservation enforcement, and various other associated costs. An infrastructure failure induced water shortage would incur similar costs as a drought situation, plus other costs such as construction of alternate source facilities or alternative supply transmission costs, such as pumping which can be very expensive.

8.1.2 Mitigation Actions

PCWA has established reserves to supplement resource needs during a water shortage. These reserves would be available to fund anticipated operating costs, as well as unanticipated operating and other costs. This is an alternative to implementing water shortage or drought pricing. Based on designation/reserve policies, over the years, PCWA has accumulated monies for a variety of unanticipated, unforeseen, or planned needs, whether those needs are operating or capital related. Based on PCWA policy, PCWA has funded reserve accounts that could be used as needed. The policy identifies events or conditions, which would prompt the use of these funds. PCWA has established an Operating Reserve for unanticipated, unforeseen, or planned variations in operating expenses or revenues.

In the event of a water shortage that results in a decline in revenue, PCWA's Board of Directors could consider the use of these Operating Reserves to meet necessary resource requirements as the use of reserves requires Board approval. Although PCWA has funded reserves as an alternative to drought pricing, that practice could change and if so, PCWA would follow the Proposition 218 notification process and other rate adjustment regulations to implement water shortage or drought rates.

Capital expenditures, including projects and capitalized expenses associated with the capital program are expected to be fully funded by fixed R&R rate revenue. However, during a water shortage, Renewal and Replacement (R&R) revenue may be used to supplement operating revenue and capital projects deferred as an alternative to, or in addition to the use of Reserves.

Table 8-1 below summarizes the WSCP potential financial implications and shortage response actions that align with the defined shortage levels as defined in Water Code Section 10632 (a)(3) & (4).

Table 8-1: Potential Financial Implications of Water Shortage Response Actions

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Shortage Level	< 10%	10% - 20%	20% - 30%	30% - 40%	40% - 50%	> 50%
Potential Water Revenue Reduction:	$0 - $1,700,000	$1,700,000 - $3,300,000	$3,300,000 - $5,000,000	$5,000,000 - $6,600,000	$6,600,000 - $8,200,000	> $8,200,000
Percent of Total Annual Water System Revenue	0% -4%	4% - 8%	8% - 12%	12% - 16%	16% - 20%	>20%
Increase in Expenses:						
Customer Service Expenses*	20,000	35,000	45,000	60,000	75,000	100,000
Pumping Expenses	350,000	650,000	1,000,000	1,200,000	1,400,000	1,600,000
Other Operating Expenses	50,000	120,000	250,000	350,000	450,000	600,000
Decrease in Expenses:						
O&M Expenses: Water Operations Savings (existing water purchase contract)	50,000	250,000	500,000	750,000	1,000,000	1,250,000
Net Potential Expense Increase:	$370,000	$555,000	$795,000	$860,000	$925,000	$1,050,000
Mitigation (Response) Actions:	1) Reduce O&M Expenses	1) Reduce O&M Expenses 2) Potentially Defer Capital Projects	1) Reduce O&M Expenses 2) Defer Capital Projects and/or 3) Utilize Reserves	1) Reduce O&M Expenses 2) Defer Capital Projects and/or 3) Utilize Reserves	1) Reduce O&M Expenses 2) Defer Capital Projects and/or 3) Utilize Reserves	1) Reduce O&M Expenses 2) Defer Capital Projects and/or 3) Utilize Reserves
Communications Protocols:	Customer Outreach: *PCWA website / social media *Flyers mailed to customers	Customer Outreach: *PCWA website / social media *Flyers mailed to customers	Customer Outreach: *PCWA website / social media *Flyers mailed to customers	Customer Outreach: *PCWA website / social media *Flyers mailed to customers	Customer Outreach: *PCWA website / social media *Flyers mailed to customers	Customer Outreach: *PCWA website / social media *Flyers mailed to customers

** Customer Service Expenses include costs associated with increased staff costs for customer outreach, tracking and reporting, and enforcing compliance with the WSCP and Chapter 3.3 (commencing with Section 365) of Division 1*

9.0 Monitoring and Reporting

9.1 Stage Implementation and Monitoring Procedures

PCWA maintains a draft water shortage contingency resolution that is adopted during water shortages. Legal requirements, including public notices and hearings, shall be followed in adopting any resolution. However, PCWA staff may implement operational changes in the canal systems and request voluntary actions by treated water customers on an interim basis to meet public health and safety needs as detailed above until such a resolution can be adopted.

In a water shortage, and particularly that resulting from failure of infrastructure, critical roles shall be established and appointed by the General Manager. These roles may include, but are not limited to Incident Commander, Operations Manager, and Public Information Officer.

Other supporting roles that should be considered are engineering, mapping, customer service, information service, and public outreach. Other more detailed instructions may be found in the PCWA's Emergency Response Plan.

Under normal water supply conditions, Field Services and Technical Services operations staff record water production figures daily. Totals are reported monthly and incorporated into a water supply report.

Based upon shortage level staff would prepare a monthly production target to coincide with the level of % reduction sought. During a water shortage, monthly production is compared to the target production to verify that the reduction goal is being met. Appropriate monthly reports are forwarded to the department heads and General Manager's office. Appropriate monthly reports are also included in the Board of Directors meeting materials.

10.0 WSCP Refinement Procedures

In all stages, if targets are not met, PCWA staff may implement further actions as long as they fall within the limits set by the resolution adopted by the Board of Directors in response to the shortage. Actions needed in excess of these limits, or reductions in actions, must be approved by the Board of Directors.

11.0 Plan Adoption, Submittal, and Availability

Prior to adoption of this WSCP, PCWA held a public adoption hearing on June 18, 2026. Before the hearing, PCWA made a draft of the WSCP available for public inspection at PCWA's office

and on the PCWA website. General notice of the public adoption hearing was provided through publication of the hearing date and time and posting of the hearing at PCWA's office.

A copy of the adopted WSCP will be provided to Placer County and cities within PCWA service area no later than 30 days after its adoption. The adopted WSCP will also be on PCWA's website.

After the adoption of the WSCP by PCWA Board of Directors, PCWA will submit all required documentation to DWR.

If an update to the WSCP is required, the adoption, submittal and availability procedures outline above should be followed.

Attachment A

WSCP Adoption Resolution

A

RESOLUTION 26-16 OF THE BOARD OF DIRECTORS OF THE
PLACER COUNTY WATER AGENCY
ADOPTING AN UPDATED WATER SHORTAGE CONTINGENCY PLAN

Whereas, in 1984 the California Legislature enacted the Urban Water Management Act, requiring every urban water supplier providing water for municipal purposes to more than 3,000 connections to update, adopt and submit an Urban Water Management Plan to the Department of Water Resources every five years; and

Whereas, Placer County Water Agency has updated its latest 2020 Urban Water Management Plan, which was previously adopted on June 3, 2021, and submitted to the Department of Water Resources; and

Whereas, a required component of Urban Water Management Plans is a Water Shortage Contingency Plan, which establishes criteria and guidelines for operations and water conservation during a period of water shortage conditions; and

Whereas, a revision to the Water Shortage Contingency Plan has been prepared in accordance with the requirements of the State Water Resources Control Board to coincide with the 2025 Urban Water Management Plan Update and is attached to this Resolution.

BE IT RESOLVED that the 2026 update to the Agency's Water Shortage Contingency Plan, with any changes incorporated by this board as a result of the hearing, is hereby adopted and staff is directed to transmit a copy of the adopted document to the California Department of Water Resources by the prescribed due date of July 1, 2026.

This resolution was duly adopted at a meeting of the Board of Directors of the Placer County Water Agency held on June 18, 2026, by the following vote on roll call:

AYES: Jefferson Willoughby, Primo Santini, III, Chris Wilson, Robert Dugan, and Chair Joshua Alpine

NOES: none

ABSTAINED: none

ABSENT: none

Signed and approved by me after its adoption this 18 day of June, 2026.

Chair of the Board
Placer County Water Agency

ATTEST:

Lori Young
Clerk to the Board

Attachment B

Notice of Public Hearing

B

132942

PUBLIC NOTICE

132942

NOTICE OF AVAILABILITY OF PLACER COUNTY WATER AGENCY DRAFT 2025 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN UPDATE AND PUBLIC HEARING TO RECEIVE COMMENTS

NOTICE IS HEREBY GIVEN that the Placer County Water Agency's Draft 2025 Urban Water Management Plan (UWMP) Update is available for public review and comment, and that the Board of Directors of the Placer County Water Agency (PCWA) has set a public hearing to receive comments on the Draft Update. The public hearing is to be conducted on June 18, 2026, at 2:00 pm at the regularly scheduled meeting of the PCWA Board of Directors, which will be held at its Business Center. The Business Center is located at 144 Ferguson Road, Auburn, CA, 95603.

NOTICE IS FURTHER GIVEN that, as part of the public hearing on the UWMP Update, PCWA will simultaneously conduct a public hearing of PCWA's Water Shortage Contingency Plan (WSCP) update.

Copies of the UWMP, which is inclusive of the Water Shortage Contingency Plan (WSCP), are available for public review at www.pcwa.net on and after Wednesday, June 3, 2026. Comments may be presented during the public hearing or may be submitted in writing prior to the hearing, addressed to Brian Rickards, Planning and Development Services Manager, mailed to Placer County Water Agency, PO Box 6570, Auburn, CA, 95604 or emailed to engineering@pcwa.net.

PUBLISHED IN AUBURN JOURNAL: JUNE 3 & 10, 2026

The above space is reserved for Court/County Filed Date Stamp

PROOF OF PUBLICATION
(2015.5 C.C.P.)

STATE OF CALIFORNIA
County of Placer

I am a citizen of the United States and employed by a publication in the County aforesaid. I am over the age of eighteen years, and not a party to the mentioned matter. I am the principal clerk of **The Auburn Journal**, a newspaper of general circulation, in the **City of Auburn**, which is printed and published in the **County of Placer**. This newspaper has been judged a newspaper of general circulation by the Superior Court of the State of California, in and for the **County of Placer**, on the date of May 26, 1952, (Case Number 17407). The notice, of which the attached is a printed copy (set in type not smaller than nonpareil) has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to-wit:

6/3/2026, 6/10/2026

I certify, under penalty of perjury, that the foregoing is true and correct.

Lily Philavanh

LILY PHILAVANH

Dated in Auburn, California

6/10/2026

PROOF OF PUBLICATION
AUBURN JOURNAL
1030 High Street
Auburn, CA 95603
P.O. Box 5910
Auburn, CA 95604

Appendix I Adoption Documentation

RESOLUTION 26-17 OF THE BOARD OF DIRECTORS OF THE
PLACER COUNTY WATER AGENCY
ADOPTING THE AGENCY'S 2025 URBAN WATER MANAGEMENT PLAN

Whereas, in 1984 the California Legislature enacted the Urban Water Management Act, requiring every urban water supplier providing water for municipal purposes to more than 3,000 connections to update, adopt and submit an Urban Water Management Plan to the Department of Water Resources every five years; and

Whereas, Placer County Water Agency has updated its latest 2020 Urban Water Management Plan, which was previously adopted on June 3, 2021, and submitted to the Department of Water Resources; and

Whereas, this Agency has prepared a draft update of its Urban Water Management Plan for 2025 for public review and for consideration to be adopted by this board; and

Whereas, a public hearing regarding the proposed update was held on the date of this resolution and notice of this hearing was given in accordance with the law beginning on June 3, 2026; and

Whereas, this board has received a report on the updated plan, considered plan contents, considered any public comments received, and requested such changes to the updated plan as it has deemed warranted.

BE IT RESOLVED that the 2025 update to the Agency's Urban Water Management Plan, with any changes incorporated by this board as a result of the hearing, is hereby adopted and staff is directed to transmit a copy of the adopted document to the California Department of Water Resources by the prescribed due date of July 1, 2026.

This resolution was duly adopted at a meeting of the Board of Directors of the Placer County Water Agency held on June 18, 2026, by the following vote on roll call:

AYES: Jefferson Willoughby, Primo Santini, III, Chris Wilson, Robert Dugan, and Chair Joshua Alpine

NOES: none

ABSTAINED: none

ABSENT: none

Signed and approved by me after its adoption this 18 day of June, 2026.

Chair of the Board
Placer County Water Agency

ATTEST:

Lori Young
CLERK TO THE BOARD