WATER YEAR 2023

Annual Report for the North American Subbasin

MARCH 2024

Prepared for the North American Subbasin GSAs:

- RD 1001
- Sacramento Groundwater Authority
- South Sutter Water District
- Sutter County
- West Placer

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Abbreviations and Acronyms

°F	Degrees Fahrenheit
AF	acre-feet
Ag	Agriculture
APN	Assessor Parcel Number
ASR	aquifer storage and recovery
CASGEM	California Statewide Groundwater Elevation Monitoring
CDEC	California Data Exchange Center
CII	commercial, industrial, and institutional
CIMIS	California Irrigation Management Information System
CoSANA	Cosumnes, South American, and North American Groundwater Subbasins Integrated Water Resources Model
DWR	California Department of Water Resources
ET	evapotranspiration
Etc	etcetera
EO	Executive Order
eWRIMS	Electronic Water Rights Information Management Sytem
ft	feet
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	Groundwater Dependent Ecosystem
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GW	groundwater
IDC	insulation-displacement contact
InSAR	interferometric synthetic-aperture radar
MAF	million acre-feet
MCL	maximum contaminant level
Mg/L	milligrams per liter
MO	measurable objective

MOA	Memorandum of Agreement
msl	mean sea level
MT	minimum threshold
N	nitrate
ND	non-detectable
NOAA	National Oceanic Atmospheric Administration
NASb	North American Subbasin
PMA	Project Management Action
RD 1001	Reclamation District 1001
RMS	representative monitoring site
RWA	Sacramento Regional Water Authority
SGA	Sacramento Groundwater Authority
SGM	Sustainable Groundwater Management
SGMA	Sustainable Groundwater Management Act
State	state of California
Subbasin	North American Subbasin
SSWD	South Sutter Water District
SVSim	Sacramento Valley Simulation Model
SWRCB	State Water Resources Control Board
TBD	to be determined
TDS	total dissolved solids
USGS	United States Geological Survey
WAF	Water Accommodated Fraction Analysis
WCR	well completion report
WPGSA	West Placer Groundwater Sustainability Agency
WP	West Placer
WY	Water Year

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Executive Summary

Introduction

This report summarizes Water Year (WY) 2023 (October 1, 2022 – September 30, 2023) conditions and groundwater management actions and projects in the North American Subbasin (NASb or Subbasin) consistent with the Sustainable Groundwater Management Act (SGMA) Annual Report requirements in the California Water Code (§10728) and further defined in California Code of Regulation, Title 23, Division 2, Chapter 15., Subchapter 2., (§356.2). (§10728) and (§356.2). The NASb Groundwater Sustainability Agencies (GSAs) submitted the adopted Groundwater Sustainability Plan (GSP) for review by the California Department of Water Resources (DWR) on January 24, 2022. The NASb GSAs refer to this GSP version as the NASb 2021 GSP. The Department of Water Resources found that the NASb 2021 GSP met the requirements of SGMA and the GSP regulations and provided an approved determination on July 27, 2023. This report represents the third Annual Report prepared since GSP adoption.

The Subbasin encompasses an area of about 535 square miles in portions of Placer, Sacramento, and Sutter counties. The Subbasin is managed by five GSAs comprised of the Reclamation District 1001 (RD 1001); Sacramento Groundwater Authority (SGA); South Sutter Water District (SSWD); Sutter County; and West Placer (WP).

Hydrologic Conditions

Water Year 2023 was preliminarily classified by DWR as a wet year with both precipitation and runoff being approximately twice the historical averages. Air temperatures were below their averages from 2000 through 2022.

Water Supply

Water supplies, also referred to as deliveries, within the Subbasin in WY 2023 consisted of about 40 percent groundwater (241,300 acre-feet [AF]), with the remainder coming from surface water (325,600 AF) and recycled water (6,000 AF). About one-third of water supply was used by the urban/industrial sector (183,900 AF) and about two-thirds of water supply was used by the rural/agricultural uses sector (387,200 AF).

Groundwater Levels

Water level hydrographs were updated for all 41 NASb representative monitoring sites (RMS) as defined in the NASb 2021 GSP (NASb, 2021). In general, groundwater level readings for both the Spring (annual high) and Fall (annual low) levels in WY 2023 followed seasonal trends observed historically within the Subbasin consisting of slightly higher spring groundwater levels compared with fall levels. Groundwater level data from the NASb RMS, with use of supplemental monitoring sites, was used to create Spring and Fall 2023 groundwater contour maps.

Change in Groundwater Storage

The change in groundwater storage in the Subbasin was estimated using the regional groundwater model. The model estimated a large positive change at the end of the WY (Fall-to-Fall) at about 161,000 AF.

GSP Implementation

The NASb 2021 GSP was adopted by each GSA and submitted to the DWR in January 2022. The NASb GSAs have had approximately two years to implement the GSP including the projects and management actions (PMAs) in accordance with the schedule identified in the GSP. There has been significant progress in several of the PMAs and the current status of implementation actions are shown in **Appendix B**. The NASb GSAs were awarded grant funding on October 2, 2023, from the DWR Sustainable Groundwater Management Grant Program SGMA Implementation – Round 2 (also referred to as DWR SGM Grant Round II) to support a more robust set of GSP implementation activities within the Subbasin.

Sustainability Indicators

After the three recent and consecutive dry years 2020 through 2022 (drought years) that contributed to groundwater level declines, WY 2023 resulted in a wet year that helped raise groundwater levels and storage in most areas of the NASb to near pre-drought conditions. Several NASb GSAs have observed some minimum threshold (MT) exceedances for the chronic lowering of groundwater, land subsidence, and depletions of interconnected stream sustainability indicators at a few Subbasin RMS locations. However, a few MT exceedances do not indicate that the Subbasin is experiencing undesirable results of the sustainability indicators and the Subbasin is still recovering from the three previous year drought conditions. Sustainability indicators, along with the Subbasins sustainable management criteria, are discussed in detail in **Chapter 8, *Sustainable Management Criteria***, of the 2021 NASb GSP (NASb, 2021).

1. Introduction

1.1 Purpose

The purpose of this report is to summarize Water Year (WY) 2023 (October 1, 2022 – September 30, 2023) conditions and groundwater management in the North American Subbasin (NASb or Subbasin). The NASb Groundwater Sustainability Agencies (GSAs) submitted the adopted Groundwater Sustainability Plan (GSP) for review by the California Department of Water Resources (DWR) on January 24, 2022. The Department of Water Resources found that the NASb 2021 GSP met the requirements of SGMA and the GSP regulations and provided an approved determination on July 27, 2023, with six recommended corrective actions which will be addressed and presented in the next GSP submission. This report represents the third Annual Report prepared since GSP adoption.

1.2 North American Subbasin

The NASb is identified by DWR in Bulletin 118 as Subbasin No. 5-021.64 (DWR, 2003). The Subbasin is part of the greater Sacramento Valley region of California. The location of the Subbasin and surrounding subbasins are shown in **Figure 1-1.** The Subbasin encompasses an area of about 342,516 acres (535 square miles) in Sacramento, Placer, and Sutter counties. The NASb is generally 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 (**Figure 1-1**).

1.3 North American Subbasin GSAs

The Subbasin is managed by five GSAs that cover the entire Subbasin (**Figure 1-1**) and is comprised of:

- Reclamation District 1001 (RD 1001)
- Sacramento Groundwater Authority (SGA)
- South Sutter Water District (SSWD)
- Sutter County
- West Placer (WP)

1.4 Organization of this Report

The requirements of an Annual Report are provided in the California Water Code (§10728) and further defined in California Code of Regulation, Title 23, Division 2, Chapter 15., Subchapter 2., (§356.2). **Table 1-1** provides the requirements for Annual Reports and provides a correlation of location of these requirements within this document. The page number provided in the table are pdf page numbers.

Organization of this report is meant to follow the regulations where possible to assist in the review of the document. Sections of the WY 2023 Annual Report include the following:

- **Section 1. Introduction:** a brief background of the Subbasin GSAs and a location map.
- **Section 2**. **Hydrologic Conditions:** a summary of WY 2023 precipitation, runoff, and temperature.
- **Section 3. Water Supply:** a summary of the sources and uses of supply/delivery.
- **Section 4. Groundwater Levels:** a summary of groundwater levels at individual monitoring wells in response to hydrologic supply and demand conditions, including contour maps of annual highs and lows.
- **Section 5. Change in Groundwater Storage:** a description of the methodologies and presentation of changes in groundwater storage.
- **Section 6. GSP Implementation:** a summary of progress toward implementing management activities and projects and management actions since adoption of the GSP.
- **Section 7. Sustainability Indicators:** a summary of the status of adopted sustainability indicators for the Subbasin.
- **Section 8. References.**

Figure 1-1. North American Subbasin

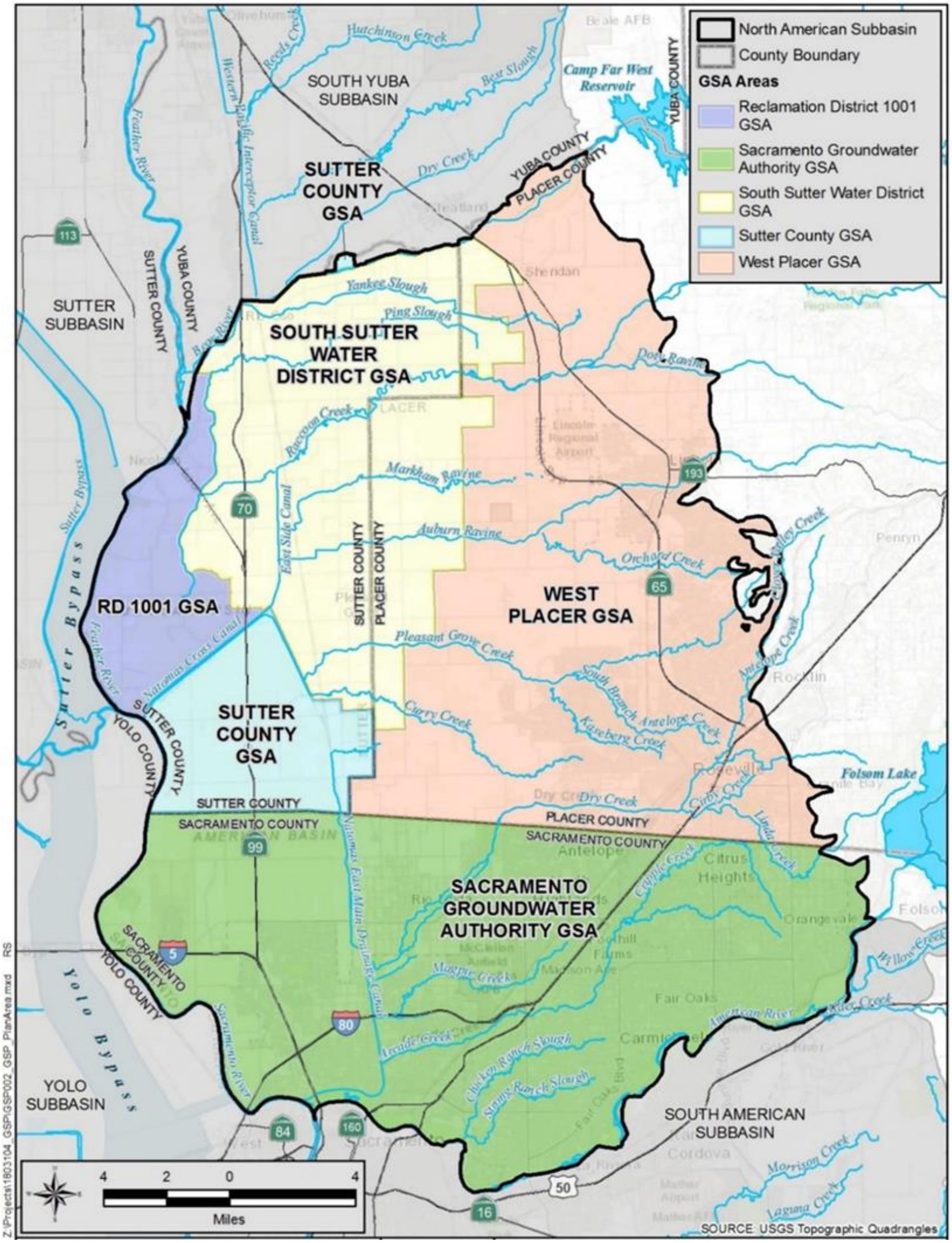

Table 1-1. Annual Report Element Guide

Basin Name:	North American Subbasin
Groundwater Basin Number:	5-021.64

California Code of Regulations - GSP Regulation Sections	Annual Report Elements	Report page number(s) that address requirements for Annual Report elements.
Article 5	Plan Contents	
Sub article 4	Monitoring Networks	
§ 354.40	Reporting Monitoring Data to the Department	
	Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.	28
	Note: Authority cited: Section 10733.2, Water Code. Reference: Sections 10728, 10728.2, 10733.2 and 10733.8, Water Code.	
Article 7	Annual Reports and Periodic Evaluations by the Agency	
§ 356.2	Annual Reports	
	Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:	
	(a) General information, including an executive summary and a location map depicting the basin covered by the report.	8:9, 12
	(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:	
	(1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:	
	(A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.	29:30
	(B) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year.	67:108
	(2) Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.	23:24
	(3) Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year.	22:23

California Code of Regulations - GSP Regulation Sections	Annual Report Elements	Report page number(s) that address requirements for Annual Report elements.
	(4) Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year.	20, 24:25
	(5) Change in groundwater in storage shall include the following:	
	(A) Change in groundwater in storage maps for each principal aquifer in the basin.	36
	(B) A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.	35
	(c) A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.	38:42

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2. Hydrologic Conditions

This section provides a brief description of the Subbasin hydrologic conditions in WY 2023. The state of California (State), along with other western states, has been experiencing abnormally dry hydrologic conditions with WYs 2020 through 2022 being three of the driest years on record. For example, in WY 2021, the Governor of California issued multiple proclamations of a state emergency related to drought which included the April 21, 2021, proclamation (Executive Department State of California, 2021a) that added the three counties located within the NASb to the drought emergency (e.g., Placer, Sacramento, and Sutter). On October 19, 2021, the Governor expanded prior drought emergency proclamations to include the remaining counties thus extending the drought emergency to cover all 58 counties within the State (Executive Department State of California, 2021b).

Following these abnormally dry hydrologic conditions, WY 2023 was a wet year with large amounts of snowfall, which in the latter part of the WY, resulted in both of the Governor's emergency proclamations for drought and flood being active concurrently (DWR, 2023). On March 1, 2023, the Governor issued a state of emergency to thirteen counties within the state (Executive Department State of California, 2023). While none of these counties were in the Subbasin, WY 2023 ended the year with 141 percent of statewide average precipitation. Additionally, WY 2023's snowpack was one of the largest on record and ended the water year with 237 percent of the April 1st Sierra-Cascades snowpack (DWR, 2023), an amount not seen since historical 1952, 1969, and 1983 snowpacks.

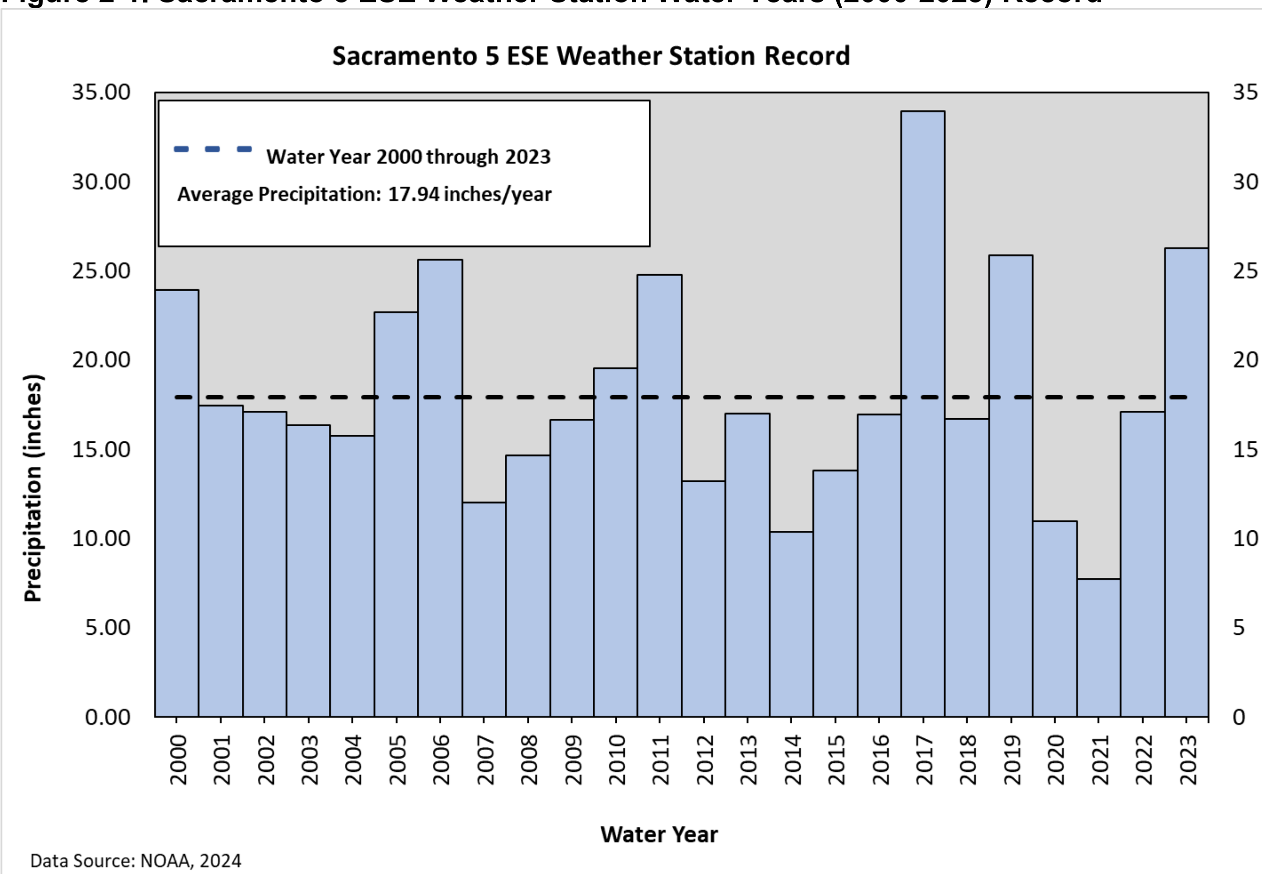
2.1 Precipitation

In the beginning of WY 2023, the water year saw similar dry conditions to the prior three drought years (e.g., WYs 2020 – 2022); however, starting in late December, the State began to experience an abnormally strong atmospheric river[1]. The State continued to see multiple atmospheric rivers throughout the remainder of the wet season and between December 26, 2022, and January 19, 2023, the State received approximately half of its average annual precipitation (DWR, 2023). As a result, and discussed above in **Section 2, *Hydrologic Conditions*,** the Governor issued multiple state emergency proclamations in March and most of the State was covered by these proclamations by the end of the month. The central and southern Sierra's were heavily impacted by these storms and saw 237 percent and 300 percent over average snowpacks, respectively. Flood damage occurred primarily in the central portion of the State. Overall, WY 2023 ended the year with 141 percent of statewide average precipitation, which is a vast increase from WY's 2022 average precipitation of 76 percent.

[1] The National Oceanic and Atmospheric Administration (NOAAs) definition of an atmospheric river is as follows: "Atmospheric Rivers are relatively long, narrow regions in the atmosphere – like rivers in the sky – that transport most of the water vapor outside of the tropics." (NOAA, 2023).

Precipitation within the Subbasin is measured at 29 weather stations (hereby referred to as stations), although many of the stations do not have a long period of record. The closest station to the Subbasin with a long record of historical data is the Sacramento 5 ESE station which has data that dates back to the 1880's. This station is located immediately south of the American River which falls outside of the NASb boundaries; however, it is representative due to its relatively close geographic location. The average precipitation at the Sacramento 5 ESE station, using recent years which may be more representative of current and potentially future conditions with climate change (e.g., WYs 2000 through 2022), is 17.94 inches. During WY 2023, annual precipitation was 26.27 inches, over eight inches above average precipitation (**Figure 2-1**).

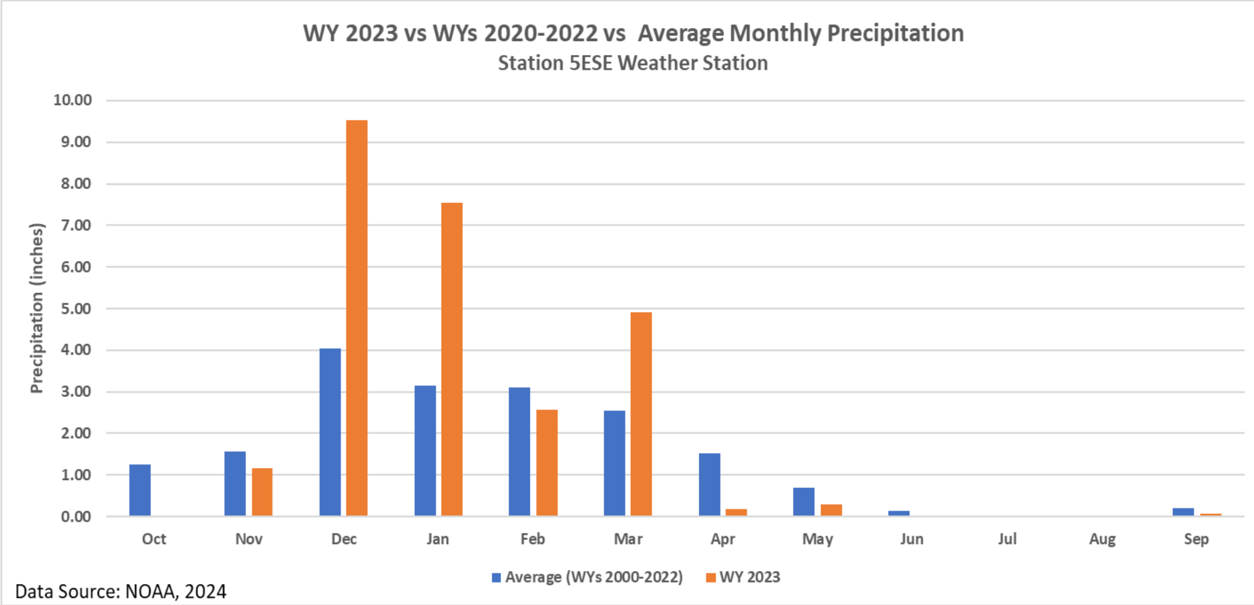
Figure 2-1. Sacramento 5 ESE Weather Station Water Years (2000-2023) Record



Source: NOAA, 2024.

Figure 2-2 below shows that seven of the 12 months in WY 2023 (e.g., October, November, February, April, May, June, and September) were below the monthly average precipitation and three months (e.g., December, January, and March) were above the monthly average precipitation for the period of WY 2000 through 2022. The remaining two months (e.g., July and August) in WY 2023 had no precipitation, similar to their monthly average for this period.

Figure 2-2. Sacramento 5 ESE Weather Station Monthly Record



Source: NOAA, 2024.

2.2 Runoff

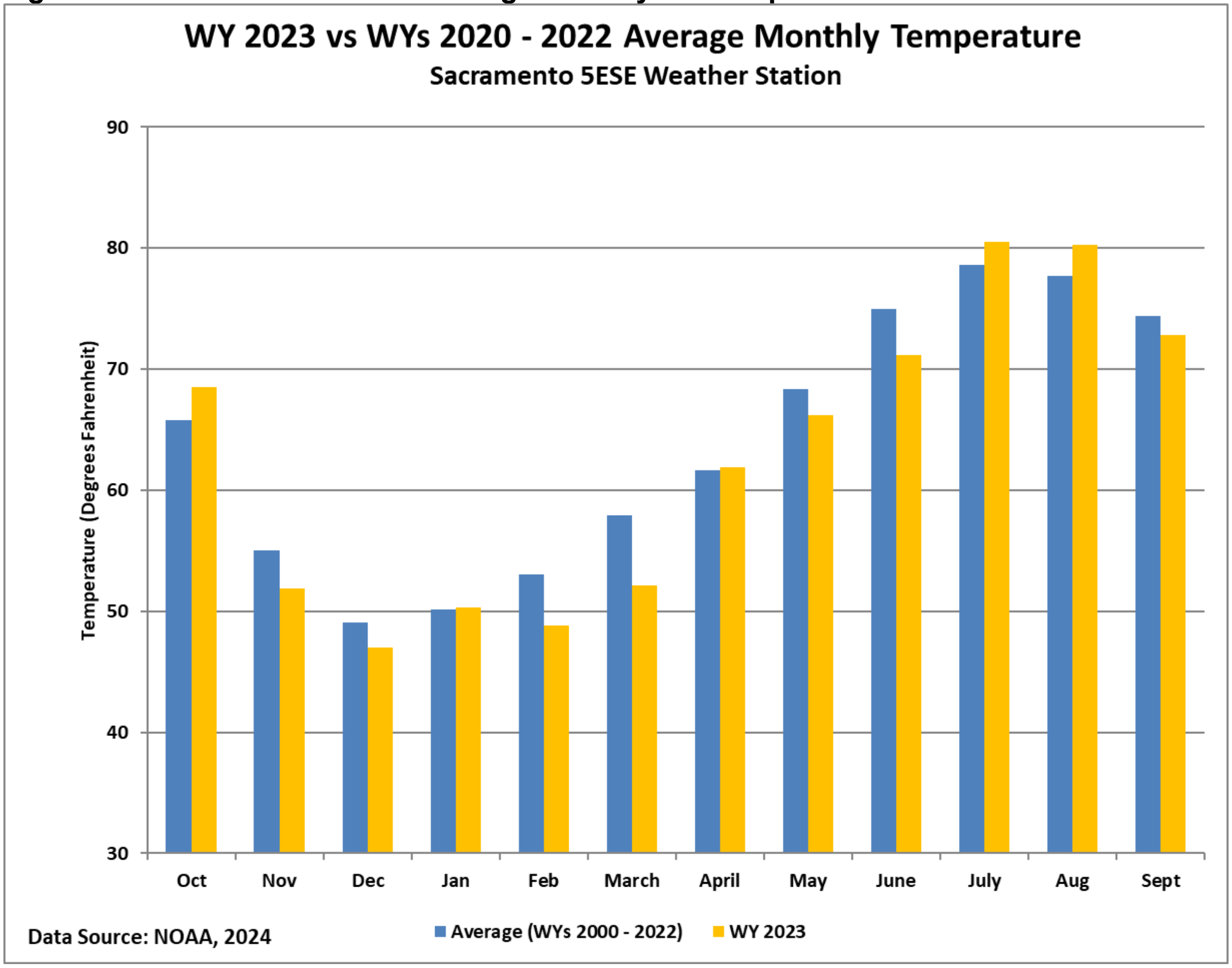
According to the DWRs Chronological Reconstructed Sacramento and San Joaquin Valley Water Year Hydrologic Classification Indices (DWR, 2024), WY 2023 was above average based on statewide runoff; this was preceded by WY 2022, which was California's third driest year on record. The Sacramento Valley Water Year Index[2] is based on runoff and is calculated by DWR on a WY basis and is used to classify the water year from the five following types: wet year, above normal year, below normal year, dry year, and critical year. Water Year 2023 has been preliminarily classified as a wet year, with 9.32 million acre-feet (MAF) of runoff compared to a 1991 to 2020 average of 7.91 MAF.

2.3 Temperature

The average annual air temperature at the Sacramento 5 ESE station in WY 2023 was approximately 1.25 degrees Fahrenheit (°F) colder than the 2000 through 2022 average (62.63 compared to 63.88 °F, respectively). Seven of the 12 months in WY were cooler than the 2002 through 2022 average temperature for the same month as shown in Figure 2-3, ***Sacramento 5 ESE Average Monthly Air Temperature***.

[2] Year Type Classification: Index based on flow in million acre-feet: Wet = equal to or greater than 9.2; Above Normal = greater than 7.8, and less than 9.2; Below Normal = greater than 6.5, and equal to or less than 7.8; Dry = greater than 5.4, and equal to or less than 6.5; Critical = equal to or less than 5.4.

Figure 2-3. Sacramento 5 ESE Average Monthly Air Temperature



3. Water Supply

This section describes the total water supply, also referred to as deliveries, by source and the total water use by sector. In addition, this section also provides a description of groundwater recharge and recycled water.

3.1 Water Supply by Source

Total water supply for WY 2023 was determined from a few sources including metered surface water deliveries and metered and estimated (modeled) groundwater production which are discussed in detail below. **Table 3-1** provides a list of the data requirements, data sources, and the accuracy of the data used.

Table 3-1. Data Sources and Certainty

Data Requirements	Data Source	Accuracy
Climate - Precipitation and ET	CIMIS, PRISM	Medium
Stream Flows	USGS, CDEC	High
Surface Water Deliveries	Direct Reporting, eWRIMS	High
Groundwater Levels	DWR, SGA, WPGSA member agencies, Aerojet, McClellan	High
Land Use	DWR, Sacramento County Survey	High
Groundwater Pumping Urban	Metered	High
Groundwater Pumping Ag	Estimated using IDC Method	Medium

Source: Woodard & Curran, 2024.

3.1.1 Surface Water Supply

On a monthly basis, metered surface water deliveries were reported by public water suppliers (Carmichael Water District, City of Sacramento, City of Roseville, Placer County Water Agency, and San Juan Water District) and for agriculture by SSWD, Pleasant Grove-Verona Mutual Water Company, Natomas Central Mutual Water Company, Nevada Irrigation District, and Placer County Water Agency. Surface water supplies by local and Central Valley Project supplies/water rights are combined and reported as local water supplies. The surface water deliveries by water use sector and by source are provided in **Tables 3-2 and 3-3**, respectively. Smaller riparian diversions for private use and tailwater reuse of surface water was estimated by the regional Cosumnes, South American, and North American Subbasins Integrated Groundwater Model (CoSANA).

Table 3-2. Surface Water Use by Sector

Surface Water Sector	WY2019 (AF)	WY2020 (AF)	WY2021 (AF)	WY2022 (AF)	WY2023 (AF)	Method Used to Determine
Urban	80,700	80,900	78,500	75,800	86,600	Metered
Industrial	34,600	34,700	33,600	32,500	37,100	---
Agricultural	201,600	197,700	130,300	179,200	200,100	Metered
Managed Wetlands	0	0	0	0	0	---
Managed Recharge	1,000	900	0	200	1,800	Metered
Native Vegetation	0	0	0	0	0	---
Other - Recycled	0	0	6,600	2,700	6,000	Metered
Total	**316,900**	**313,300**	**249,000**	**290,200**	**329,800**	

Source: Woodard & Curran, 2024. Managed recharge and recycled water from agencies.

Table 3-3. Surface Water Supplies by Source

Surface Water Supply	WY2019 (AF)	WY2020 (AF)	WY2021 (AF)	WY2022 (AF)	WY2023 (AF)	Method Used to Determine
Central Valley Project	0	0	96,900	0	0	Metered
State Water Project	0	0	0	0	0	Metered
Colorado River Project	0	0	0	0	0	---
Managed Local Supplies	316,900	313,200	145,500	287,500	323,800	Metered
Local Imported Supplies	0	0	0	0	0	Metered
Recycled Water	---	0	6,600	2,700	6,000	Metered
Reused Water	0	0	0	0	0	---
Desalination	0	0	0	0	0	---
Other	0	0	0	0	0	---
Total	**316,900**	**313,200**	**249,000**	**290,200**	**329,800**	

Source: Woodard & Curran, 2024. Managed recharge and recycled water from agencies.

Surface water use reached a 5-year high due to the abundance of supplies and urban water purveyors employing conjunctive use/in-lieu recharge. A fraction of the surface water deliveries is used for managed recharge and is described in detail in **Section 3.3**.

3.1.2 Recycled Water Supplies

Placer County, and the cities of Roseville and Lincoln as well, own and operate wastewater treatment facilities and report metered recycled water. The water is from both surface and groundwater sources. A portion of the water is used in urban areas (e.g., green belts and golf courses) with some usage for agriculture. Total recycled water for WY 2023 and a comparison to previous years is provided in **Tables 3-2** and **3-3.**

3.1.3 Groundwater Supply

Forty percent of the total water use in the Subbasin in WY 2023 was met by groundwater. Metered groundwater production was reported monthly by water agencies. Metered groundwater remediation was also reported for the former McClellan Air Force Base and a portion of Aerojet sites with respect to remediation pumping that occurs north of the American River within the Subbasin. Agricultural groundwater pumping is conducted by private landowners and is largely unmetered but has been estimated using industry standard methodology through groundwater modeling.

Groundwater pumping by agricultural/private landowners was estimated through the use of the CoSANA groundwater model. In general, to estimate the groundwater pumping in agricultural areas, water supplies (e.g., precipitation, metered groundwater pumping, and metered surface water diversions) were subtracted from the total crop evapotranspiration demands resulting in the remaining water deliveries that are estimated to be supplied by groundwater pumping for agriculture and agricultural-residential uses. A limited inspection of the land use coverages and surveys by LandIQ completed for the DWR indicated that there have not been any major changes to the agricultural cropping patterns in the NASb over the past several surveys. During the GSP development and CoSANA development and calibration, the 2014 cropping patterns from LandIQ 2014 survey were adjusted based on the local information from the irrigation and water districts throughout the model area. At this time, the NASb GSAs feel that the survey is reasonably representative of the current conditions but will be considering updates to all land use data in the model within the next couple of years.

Metered and estimated total groundwater extractions for WY 2023, along with previous water year totals, are shown in **Table 3-4** below. In WY 2023, groundwater extractions were at a 5-year historical low.

The sustainable yield of the Subbasin is estimated to be about 336,000 AF per year (NASb, 2021). In WY 2023, groundwater extractions were approximately 245,000 AF, indicating about 91,000 AF of water was stored in the Subbasin by reduced pumping and greater use of surface water.

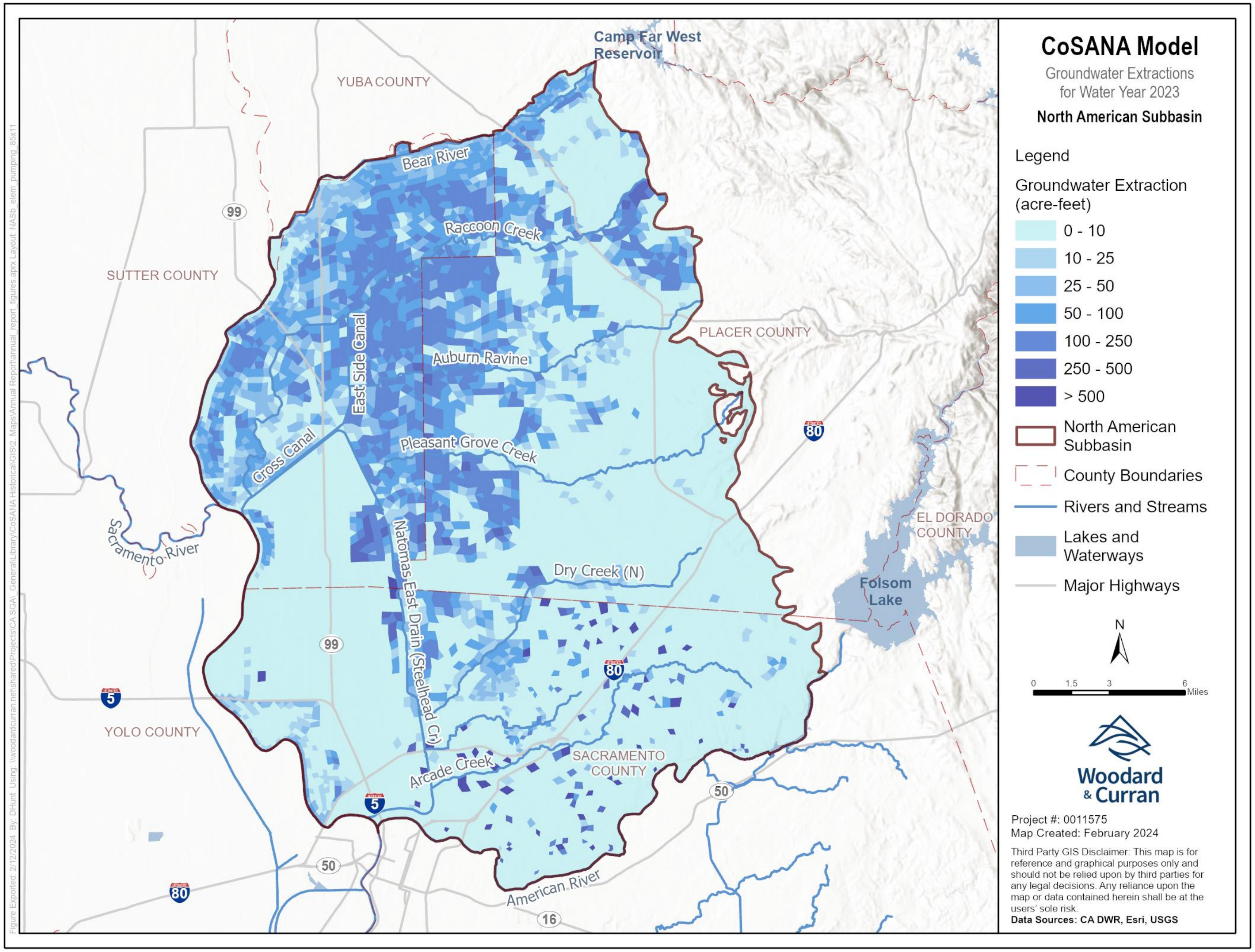
Table 3-4. Groundwater Extraction Water Use Sectors

Groundwater Extraction Sector	WY2019 (AF)	WY2020 (AF)	WY2021 (AF)	WY2022 (AF)	WY2023 (AF)
Urban	45,400	57,800	61,500	62,600	42,100
Industrial	19,500	24,800	26,400	26,800	18,100
Agricultural	188,100	263,700	290,800	207,700	181,100
Managed Wetlands	0	0	0	0	0
Managed Recharge	0	0	0	0	0
Native Vegetation	0	0	0	0	0
Other - Remediation	4,700	4,300	7,100	7,300	3,500
Total	**257,700**	**350,600**	**385,800**	**304,400**	**244,800**
Sustainable Yield	**336,000**	**336,000**	**336,000**	**336,000**	**336,000**
Approximate Increase or Decrease in Storage	**78,300**	**-14,600**	**-49,800**	**31,600**	**91,200**

Notes: Managed recharge is not reported in this table as it is not groundwater extraction, see Table 3-7.
Source: Woodard & Curran, 2024.

Based on metered extractions and results from the CoSANA model, the general location and volume of groundwater extractions in the Subbasin are shown in **Figure 3-3.**

Figure 3-1. Location and Volume of Groundwater Extractions



Source: Woodard & Curran, 2024.

3.2 Total Water Use by Sector and Source

This section summarizes the total annual groundwater and surface water used to meet urban/industrial and rural/agricultural demands, and remedial cleanup activities in the Subbasin. The total water uses in the Subbasin, by source and water use sector for WY 2023, is summarized in **Tables 3-5 and 3-6** and includes the method of measurement for each sector or source.

For WY 2023, urban/industrial uses accounted for about one-third of total water use in the Subbasin. These uses include residential, commercial, industrial, and institutional (CII) demands, and groundwater remediation extractions. Of the 183,900 AF urban/industrial water used, groundwater provided 25 percent (60,200 AF), and 75 percent (123,700 AF) from surface water. Of the total urban/industrial groundwater use, about 70 percent (42,100 AF) was estimated to be for residential uses, with the remaining 30 percent (18,100 AF) being for CII uses[3]. Approximately 3,500 AF of groundwater pumped was for remediation activities. In general, nearly all urban and industrial sectors utilize direct meter measurements. There are some urban uses (e.g., golf courses and parks) that are not directly metered. In comparison to the average year and the last three previous water years, groundwater use was at a historic low due to the abundance of surface water and the urban water purveyors employing conjunctive use/in-lieu recharge.

For WY 2023, rural/agricultural uses accounted for about two-thirds of total water demand in the Subbasin. These uses include agricultural, residential (e.g., domestic well owners), managed wetlands, and other rural uses. Of the 387,200 AF of total water used, groundwater was about 50 percent (181,100 AF) of the supply. For the rural/agricultural sector, 10 percent of groundwater extractions are metered, with the remaining 90 percent being estimated by the CoSANA model. Extractions to meet managed wetland demands are included in the CoSANA model as part of the overall agricultural demand. For surface water, about 80 percent of diversions are directly measured through meters and weirs. The remaining 20 percent of surface water diversions are estimated.

Recycled water used by cities and some agriculture was about 6,000 AF, consistent with historical uses.

[3] This 70/30 ratio of residential to CII uses was determined by downloading monthly water conservation and production reports from the State Water Resources Control Board at: https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/conservation_reporting.html. Monthly WY 2022 data for NASb public water suppliers was filtered from the data and a weighted average for the NASb was calculated for residential uses. Non-residential uses were classified as CII.

Table 3-5. Total Water Use by Sector

Water Use Sector	Total WY2019 (AF)	Total WY2020 (AF)	Total WY2021 (AF)	Total WY2022 (AF)	Total WY2023 (AF)	Method Used to Determine
Urban	126,100	138,700	140,000	138,400	128,700	Metered
Industrial	54,100	59,500	60,000	59,300	55,200	Metered
Agricultural	389,700	461,400	427,700	389,600	387,200	Metered and CoSANA Model
Managed Wetlands	0	0	0	0	0	---
Managed Recharge	1,000	900	0	200	1,800	Metered
Native Vegetation	0	0	0	0	0	---
Other - Remediation	4,700	4,300	7,100	7,300	3,500	Metered
Total	**575,600**	**664,800**	**634,800**	**594,800**	**576,400**	

Notes: -Managed recharge only includes the City of Roseville's Aquifer Storage and Recovery (ASR) program and does not include other forms of recharge (e.g., in-lieu) which has been a significant contribution of recharge - over the years within the NASb.
-Recycled water added to agricultural water use but includes water used within urban areas.
-Urban water use was reduced by water used for groundwater recharge.
Source: Woodard & Curran, 2024.

Table 3-6. Total Water Use by Water Source

Water Use Source	Total WY2019 (AF)	Total WY2020 (AF)	Total WY2021 (AF)	Total WY2022 (AF)	Total WY2023 (AF)	Method Used to Determine
Groundwater	253,000	346,300	378,700	297,100	241,300	Metered and CoSANA Model
Surface Water	317,900	314,200	242,400	287,700	325,600	Metered
Recycled Water	0	0	6,600	2,700	6,000	Metered
Reused Water	0	0	0	0	0	Metered
Other - Remediation	4,700	4,300	7,100	7,300	3,500	Metered
Total	**575,600**	**664,800**	**634,800**	**594,800**	**576,400**	

Source: Woodard & Curran, 2024.

3.3 Surface Water Used for Recharge

Several agencies in the NASb have access to both surface water and groundwater and are able to practice conjunctive use programs to adapt to changing hydrologic conditions. In 2010, the SGA developed a Water Accounting Framework (WAF) to promote conjunctive use operations in the central SGA area. The framework provides groundwater extraction targets and tracks surface water that is used to reduce groundwater demand targets. The WAF recognizes and accounts surface water use that has occurred in-lieu of groundwater pumping (e.g., conjunctive use) within the central SGA area. Using the WAF methodology, since conjunctive use activities started in the SGA area (predating 2010), approximately 400,000-acre feet of water has been banked through urban in-lieu recharge to date. The SGA staff provides conjunctive use banking estimates yearly during the April SGA Board of Directors meetings.

In addition to urban in-lieu recharge, the City of Roseville used their Aquifer Storage and Recovery (ASR) wells to directly recharge surface water in the NASb. During WY 2023, the City of Roseville recharged approximately 1,800 AF of surface water using ASR. The City of Roseville's ability to recharge surface water is dependent on the availability of excess surface water supplies.

Table 3-7 provides a summary of current and historic managed recharge in the Subbasin during WYs 2019 through 2023.

Table 3-7. Surface Water Used for Recharge

Managed Recharge	WY2019 (AF)	WY2020 (AF)	WY2021 (AF)	WY2022 (AF)	WY2023 (AF)
Groundwater Recharge	1,000	900	0	200	1,800

Notes: Managed recharge only includes the City of Roseville ASR programs and does not include other forms of recharge (e.g., in-lieu) which has been significant contribution of recharge over the years within the NASb.
Source: Woodard & Curran, 2024.

4. Groundwater Levels

This section provides groundwater level monitoring results through hydrographs and groundwater contours. Data included in this section is expressed by groundwater elevations.

Groundwater levels within the Subbasin were obtained from various entities including NASb GSAs and the DWR. Additionally, reports submitted by various agencies with groundwater quality monitoring programs overseen by the Regional Water Quality Control Board were also used. Groundwater level measurements taken during WY 2023 were uploaded to the SGMA portal and are contained in the NASb data management system.

4.1 Groundwater Contours

Spring (annual high) and Fall (annual low) water-level elevation contours were prepared for the principal aquifer for WY 2023 to illustrate groundwater conditions in the Subbasin. The annual low groundwater contours were developed using October 2023 groundwater level measurements, even though they are outside of the defined WY, because they represent groundwater conditions resulting from pumping during WY 2023 coinciding with CoSANA model results.

Groundwater level data from 69 wells in the NASb, including all 41 GSP representative monitoring sites (RMS), were used to create the Spring and Fall 2023 groundwater elevation contour maps and data from the South American (3 wells) and Yuba subbasins (3 wells) were used to better align groundwater contours with adjacent subbasins. The contour maps and the locations of monitoring wells used in their creation are shown in **Figures 4-1 and 4-2** below.

As expected, groundwater levels were generally lower in the Fall than in the Spring due to summer groundwater pumping, which is typical. Groundwater flow directions are generally toward the center of the Subbasin where a slight pumping depression has been present for decades. In the Spring, groundwater elevations ranged from approximately 200 feet above mean sea level (ft msl) in the eastern part of the Subbasin, down to -40 ft msl in Sacramento County near the former McClellan Air Force Base.

Figure 4-1. Spring 2023 Groundwater Elevation Contour Map

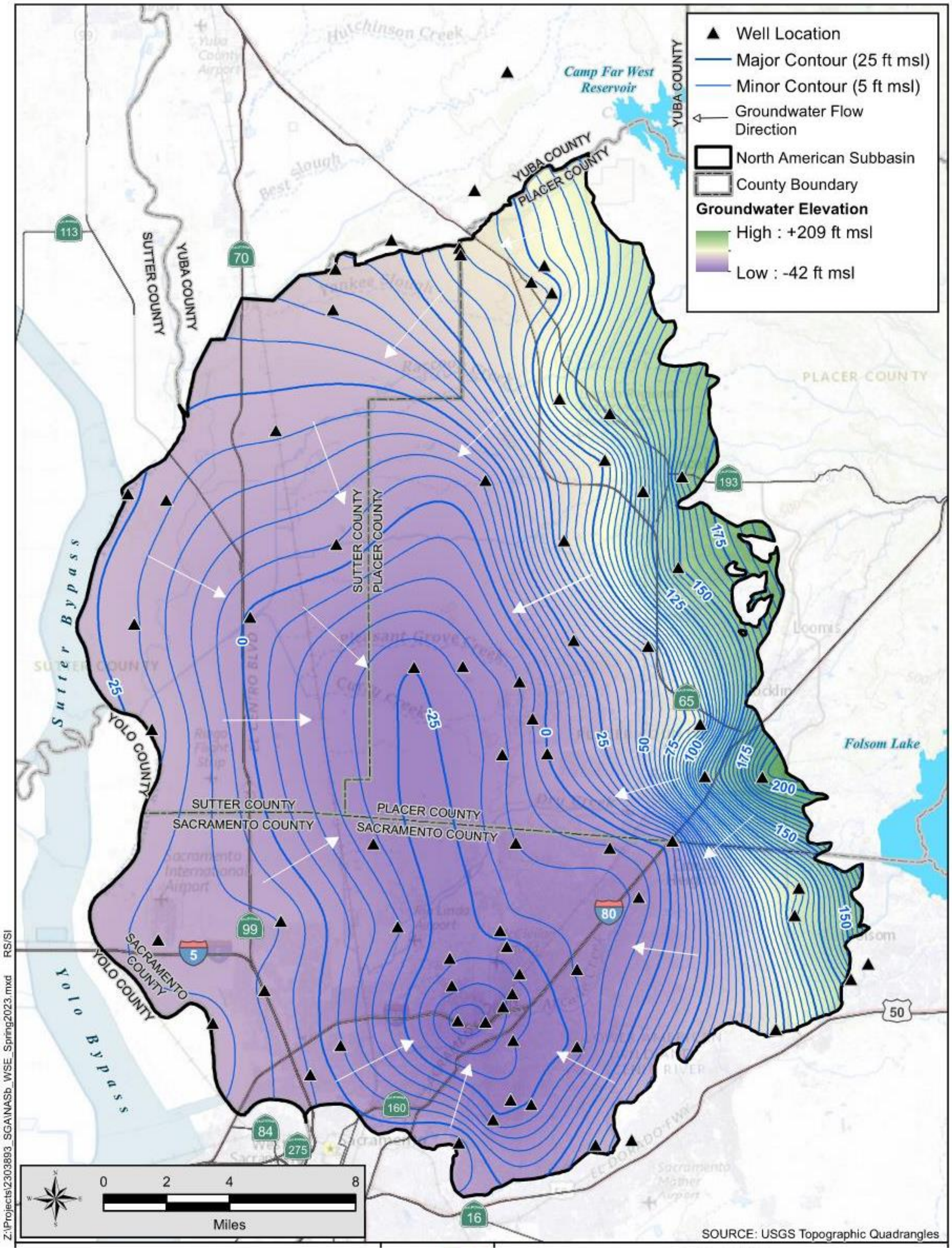
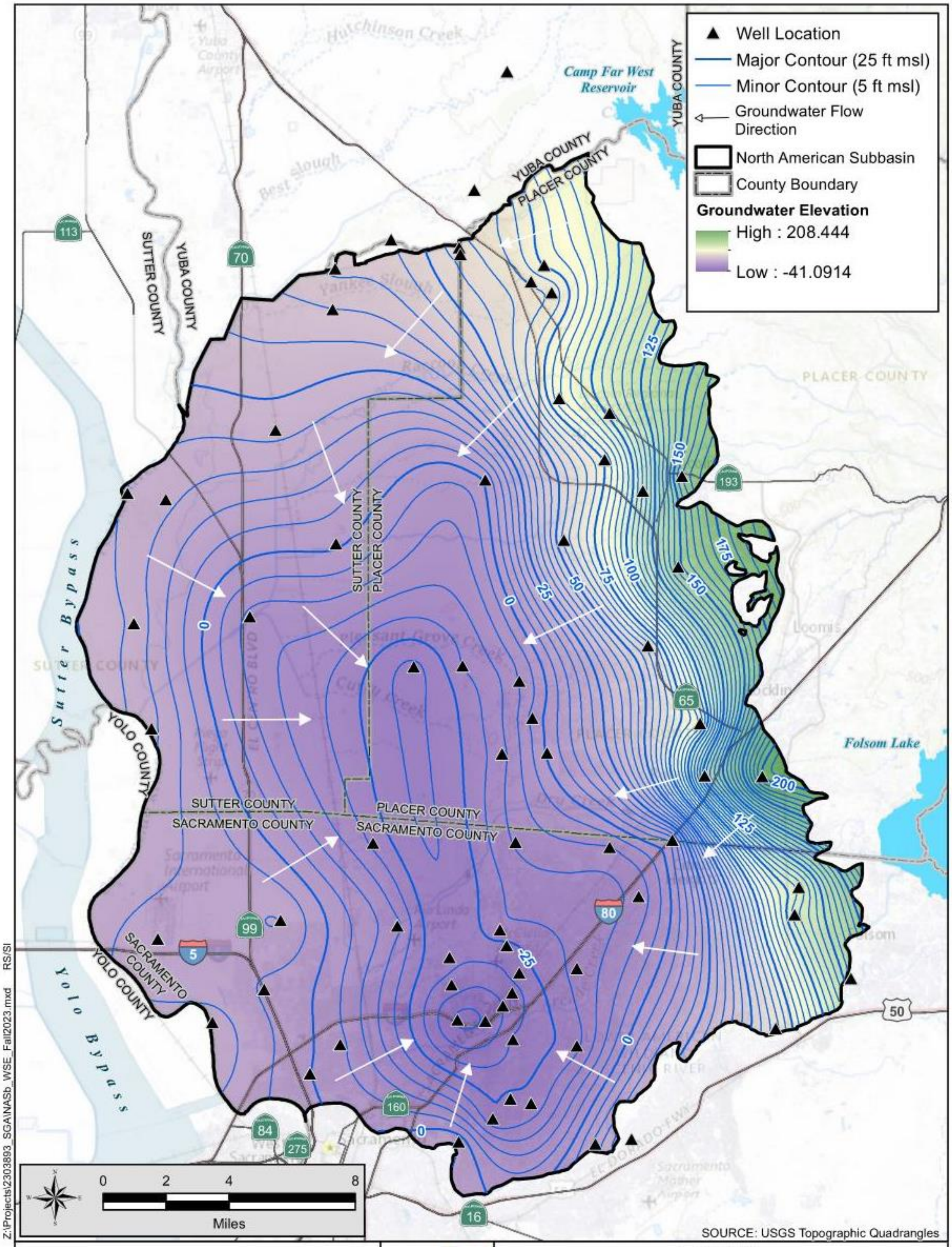


Figure 4-2. Fall 2023 Groundwater Elevation Contour Map



4.2 Hydrographs

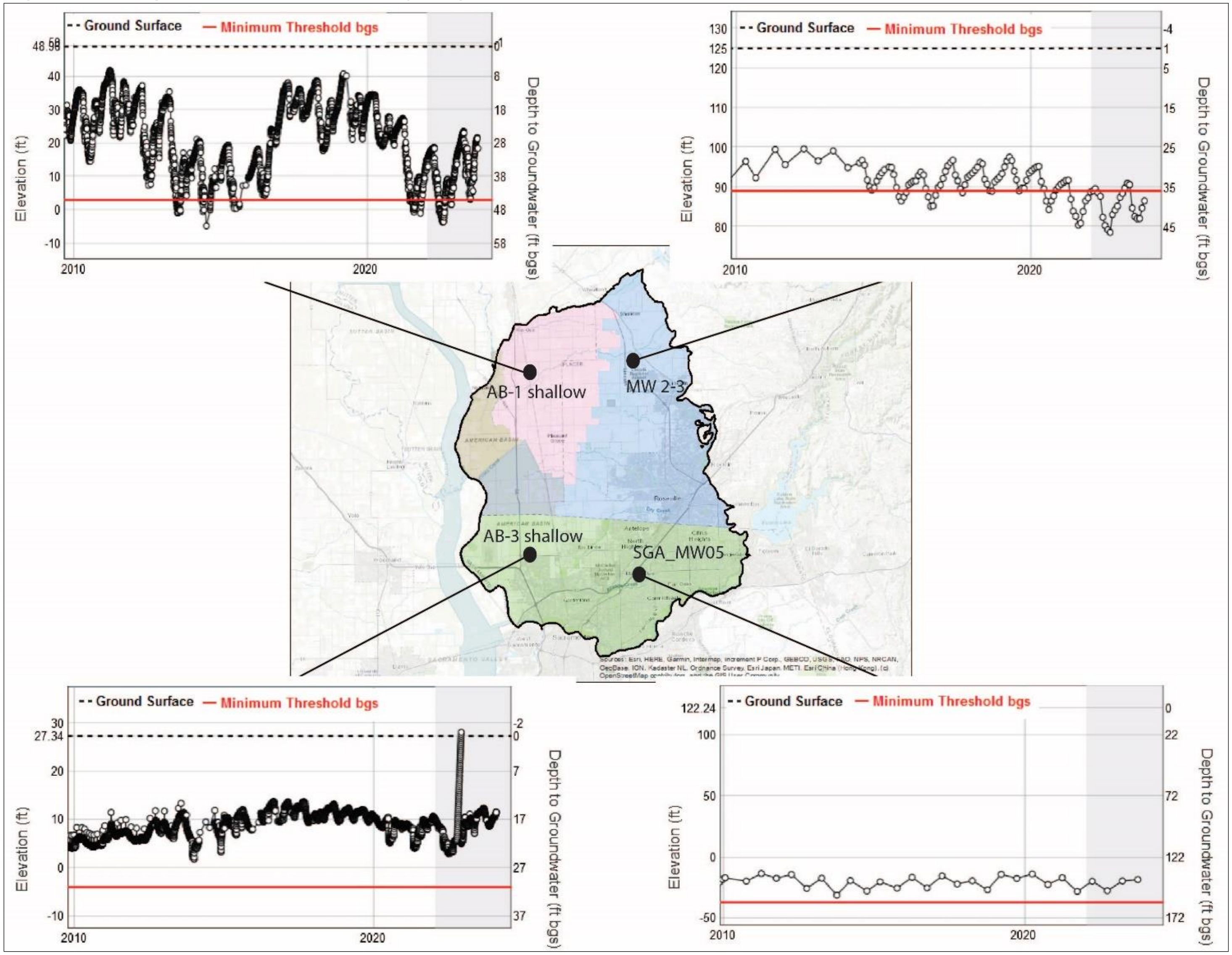
Fluctuations in groundwater elevations (e.g., highs and lows) occur yearly throughout the Subbasin. Seasonal trends of slightly higher Spring groundwater elevations compared with Fall levels are observed annually as reflected in hydrographs.

Hydrographs for all 41 GSP RMS wells and their established minimum thresholds (MTs) and measurable objectives (MOs) with interim milestones are shown in **Appendix A** and include groundwater levels through the end of WY 2023 (generally measured in October of each year[4]). A few of the hydrographs are shown on **Figure 4-3** below and provide a general representation of changes in groundwater levels during WY 2023 at RMS wells in different locations of the Subbasin. Overall, the hydrographs show a downward trend in groundwater levels from 2020 through 2022 which was predominately during a period of consecutive drought years. An upward trend in winter and Spring of WY 2023 was observed because of the precipitation events the State received. Additionally, and consistent with past water years, groundwater pumping resulted in lowering groundwater elevations during the summer. Fall 2023 groundwater elevations were found to be similar to Fall 2019, prior to the drought and the last wet year. A few wells did not fully recover from the recharge (e.g., precipitation) the Subbasin received from weather events that occurred during WY 2023. Most of the groundwater elevations for the wells in the Subbasin remained above their respective MTs in the Fall for WY 2023. This is discussed further in **Section 7, *Sustainability Indicators***.

As documented in **Chapter 8, *Sustainable Management Criteria***, of the NASb GSP, the GSAs collect additional data when a MT is exceeded to support any investigation of potential causes and effects of that exceedance. Specifically, during late calendar year 2022, the NASb GSAs collected additional water level data from select RMS wells where MT exceedances were observed in WYs 2021 and 2022. Because these MT occurrences occurred during critical dry years, the GSAs desired to collect data for an additional year to see if groundwater levels rose above the MTs. Groundwater levels were higher in most RMS wells in WY 2023 due to the benefits of the abundant precipitation the Subbasin received; however, four wells remained below their MTs. The GSAs have begun an investigation regarding these four wells. This proactive adaptive management effort by the GSAs will enable the NASb to further understand groundwater elevation trends in these wells.

[4] The CoSANA Model runs through the end of September. Typically, October measurement is used rather than September to represent the Model conditions more fully.

Figure 4-3. Regional Representative Hydrographs



Source: ESRI, 2024.

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5. Change in Groundwater Storage

The change in groundwater storage was estimated for the entire Subbasin using the calibrated CoSANA groundwater model. The model was used to estimate groundwater pumping for agricultural areas in the Subbasin as a residual of crop evapotranspiration minus precipitation, groundwater pumping, and surface water deliveries. Subbasin-wide groundwater pumping and the change in groundwater storage for WYs 2009 through 2023[5] are shown in **Table 5-2**. For WY 2023, the Subbasin had a model estimated positive change in groundwater storage of about 161,100 AF. Over the measured period (WY 2009–2023), the Subbasin still maintains a positive cumulative change in groundwater storage of about 360,000 AF at the end of WY 2023. Some of the decreases are due to only having four wet years out of the last 15 years, with the remaining years (e.g., 11 years) being below normal to critical years as shown in the WY classification in **Figure 5-1**.

Annual and cumulative changes in groundwater storage within the Subbasin from WYs 2009 through 2023 are shown in **Figure 5-1**. Groundwater in storage increased from WYs 2009 through 2019, by a little over 430,000 AF. Because of the drought conditions and the resulting higher reliance on groundwater in WYs 2020 through 2022, groundwater in storage was depleted by about 224,000 AF; however, in WY 2023 the changes in groundwater storage were increased by about 161,000 AF due to a reduction in groundwater pumping and recharge that occurred from precipitation events. **Figure 5-2** shows the distribution of the change in storage in the Subbasin.

Table 5-1. Model-Estimated Annual Change in Groundwater Storage from WYs 2019–2023

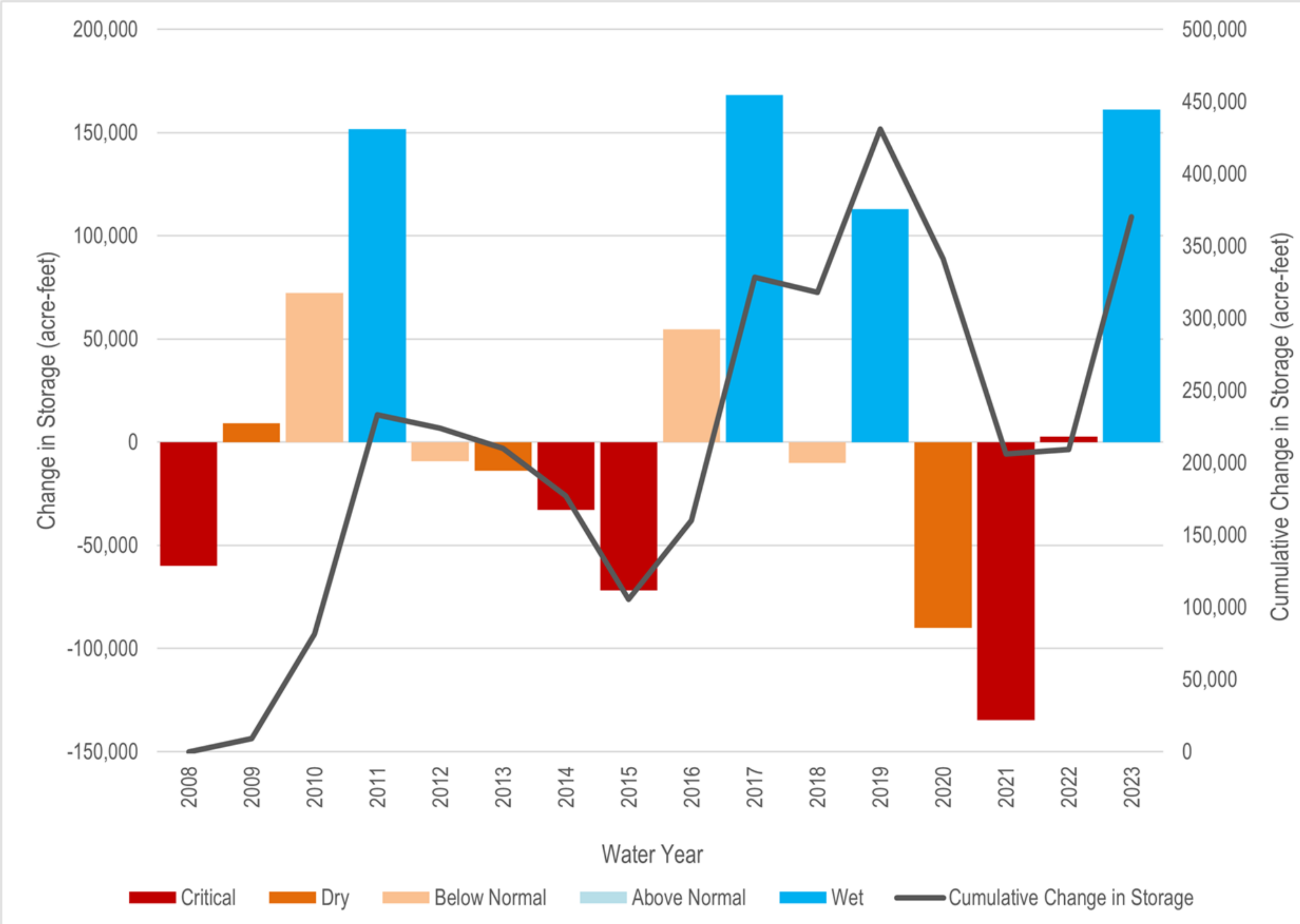
Water Year	2019	2020	2021	2022	2023	Method Used to Determine
Water Year Type	Wet	Dry	Critical	Critical	Wet	
Groundwater Extraction (AF)	257,700	350,600	382,200	300,400	244,800	Metered, CoSANA Model
Difference to Sustainable Yield (AF)	78,300	-14,600	-46,200	35,600	91,200	
Estimated Change in Storage (AF)	113,000	-90,000	-134,800	2,800	161,100	CoSANA Model

Notes: [1] Year Type Classification: Index based on flow in million acre-feet:
Wet = equal to or greater than 9.2; Above Normal = greater than 7.8, and less than 9.2; Below Normal = greater than 6.5, and equal to or less than 7.8; Dry = greater than 5.4, and equal to or less than 6.5; Critical = equal to or less than 5.4.
Source: Woodard & Curran, 2024.

The estimated change in storage, based on differences in groundwater levels presented in **Table 5-1**, are of similar magnitude as those in **Table 5-2**, developed by the CoSANA, and thus increasing confidence of the identified estimated change in groundwater storage.

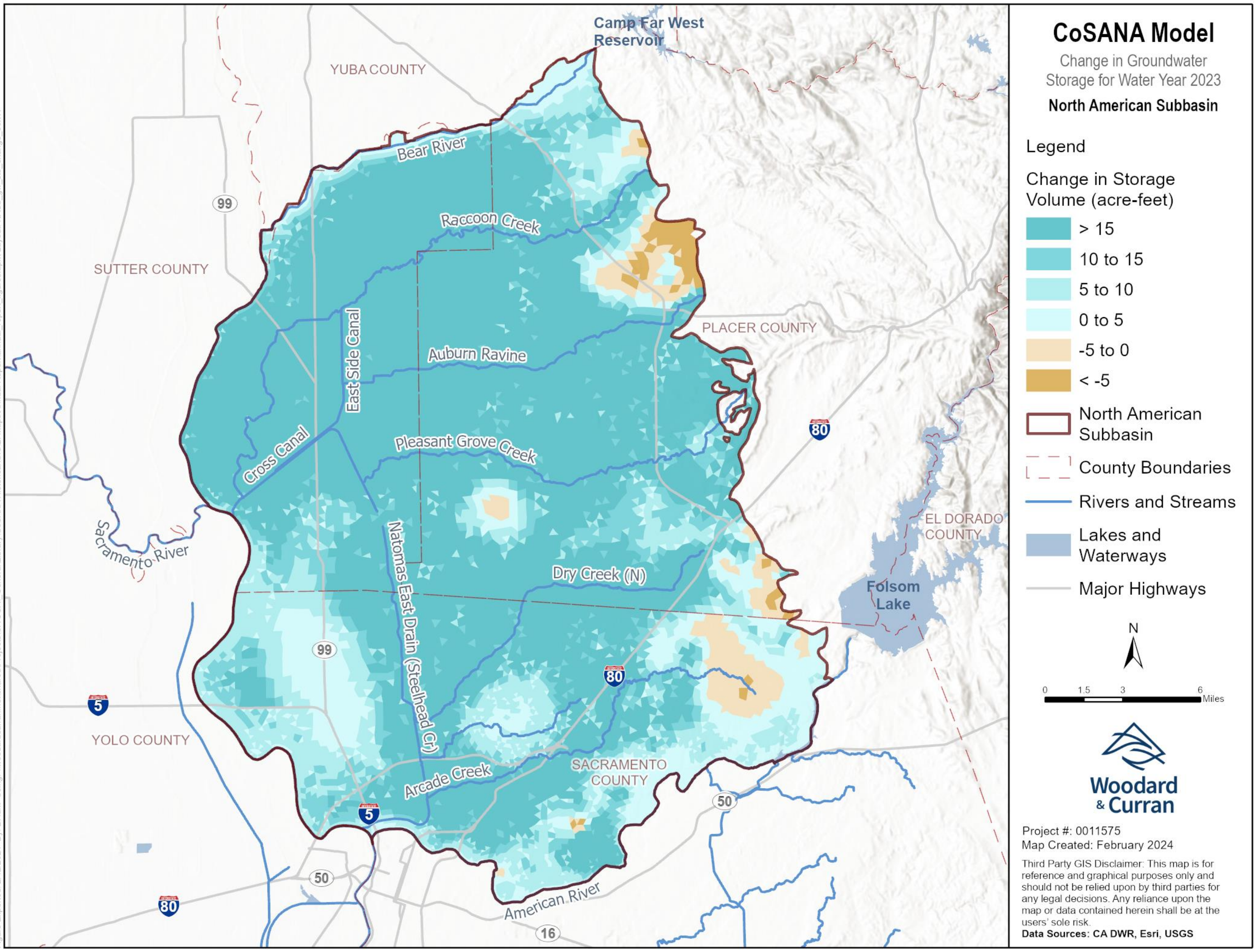
[5] WYs 2009–2018 were used as the most recent 10-year period during GSP development; WY 2009 has been used as a starting point for tracking cumulative change in groundwater storage for subsequent years.

Figure 5-1. Cumulative Change in Groundwater Storage Graph from WYs 2009–2023



Source: Woodard & Curran, 2024.

Figure 5-2. Fall 2022 to Fall 2023 Model Estimated Change in Groundwater Storage Map



Source: Woodard & Curran, 2024.

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6. GSP Implementation

The NASb GSAs have been working together under a Memorandum of Agreement (MOA) signed in 2022 to protect the groundwater resources of the Subbasin by meeting the defined sustainability goal and avoiding undesirable results. Project and management actions (PMAs) defined in the GSP (Chapter 9, Projects and Management Actions [NASb, 2021]) are designed to assist the Subbasin in meeting its 20-year sustainability goal. Water Year 2023, as expressed in this annual report, is the second year GSP implementation activities have occurred in the Subbasin since the submittal of the GSP and significant progress has been made in many areas. Groundwater Sustainability Agencies have continued to implement PMAs in accordance with the schedule identified in the GSP and the status of each PMA is provided in **Table 6-1*, Project and Management Actions Status,*** below.

The NASb GSAs held coordination meetings in January, March, May, July, September, and November of the calendar year 2023 (e.g., January through December) to assist with implementation of the GSP within the Subbasin. Additionally, following the submittal of the NASb WY 2022 Annual Report, the NASb GSAs held a public meeting on June 28, 2022, via Zoom™ during which the Subbasin conditions and upcoming implementation activities were presented to the public. The intention of this meeting is to engage and provide guidance to the public and interested parties, most of whom are beneficial users of groundwater within the Subbasin, along with providing an overview of the Subbasin's current conditions. As part of continued coordination and outreach efforts, the NASb GSAs plan to hold at least one public meeting each year following the completion of the annual report. Other public meetings that occurred in the Subbasin are provided in **Table 6-2*, Public Outreach and Engagement Activities,*** below.

Additional NASb GSP implementation actions performed within the Subbasin, along with their current status, are shown in **Appendix B.**

Table 6-1. Project and Management Actions

Project and Management Actions	Comments
Project #1: Regional Conjunctive Use Expansion – Phase 1	Continuation of implementing conjunctive use in accordance with WAF. Additional conjunctive use expansion will occur when Sacramento Regional Water Bank becomes operational - See Management Action #1 .
Project #2: Natomas Cross Canal Stability Berm and Channel Habitat Enhancements Project	Project is currently in progress. Permits are nearing completion and construction is anticipated to begin in late 2024 and be completed in 2025.
Management Action #1: Complete Planning for Sacramento Regional Water Bank	Planning and outreach activities commenced in Spring 2022. Multiple elements of project development were completed or are in development including: - Prepared Goals, Objectives, Principles and Constraints document that guides Water Bank development and implementation with Program Committee. - Prepared and developed Governance document that defines roles and responsibilities for Water Bank Implementation with Program Committee. - Worked with Program Committee to develop Project Description that was provided publicly to initiate the CEQA public engagement process. - Conducted Public Meetings associated with CEQA requirements on the Project Description and facilitated, presented, developed content for multiple Public Stakeholder Forum meetings. - Developed significant updates to the Water Bank website that included development of new content and a new modern website platform , a questions and answer forum, and education videos explaining the Water Bank, conjunctive use, and groundwater recharge. - Advanced preliminary CoSANA and CalSim development and begin modeling analysis consistent with the CEQA Project Description. - Engaged with multiple external partners evaluating the requirements to store and transfer future Water Bank supplies. The current target for completion of the environmental document necessary for federal acknowledgement of the Water Bank is in 2024.
Management Action #2: Explore Improvements with NASb Well Permitting Programs	Coordination meetings were held with Placer, Sacramento, and Sutter counties well permitting agencies. GSAs are developing approaches to Executive Order (EO) N-7-22, Action 9.a and 9.b, which implemented temporary improvements to well permitting programs. Technical analysis and coordination with respective well permitting programs are anticipated to take approximately two-years to complete. West Placer GSA and Placer County Environmental Health maintain an approach for well permitting pursuant to the EO N-7-22. Only one well permit application was reviewed by WPGSA in WY 2023.
Management Action #3: Proactive Coordination with Land Use Agencies	NASb GSAs regularly coordinate with land use planning agencies so they are aware of GSP analysis and implementation through methods such as stakeholder communications, annual public meetings, GSA meetings, and other methods. The WPGSA in coordination with the Placer County Planning Department developed a SGMA Guidance Document for Analysis of Groundwater Impacts for Development Requiring CEQA Analysis within Placer County. The document was shared with the other NASb GSAs.
Management Action #4: Domestic/Shallow Well – Data Collection and Communication Program	The NASb GSAs are currently using DWR's well completion reports (WCR) and assessor parcel number (APNs) data to identify potential domestic well owners within the Subbasin. This information would be used to develop a mailing list that would be sent to high concentration areas of domestic and other shallow wells to assist with the following actions: confirm the presence of a well; establish a voluntary group of domestic well owners interested in local groundwater conditions; and, provide regular information to interested domestic well owners and NASb well permitting agencies. SGA anticipates completing this effort for their portion of the Subbasin in spring and will develop an outreach method once completed. WPGSA completed the first task as described (using DWR's WCRs and APNs to identify domestic well owners and develop a mailing list). Next steps will be development of outreach this spring.
Management Action #5: Groundwater Dependent Ecosystem (GDE) Assessment Program	The NASb GSAs are researching options for assessing GDEs health. Additionally, the NASb was awarded funding through the DWRs SGM Grant Round II, and plans to construct four new monitoring wells within areas identified in Section 7.4.6 Data Gaps of the GSP that would help enhance the GSAs understanding of groundwater levels near priority GDE areas.

Source: NASb, 2021.

Table 6-2. Public Outreach and Engagement Activities

AGENCY ACTIVITIES	DATE	COMMUNICATION TACTICS / TOOLS	KEY MESSAGES
RWA	October 2022	Public Meeting	Conducted large hybrid public meeting (Stakeholder Forum #1) to obtain feedback and provide an update on the development of the Sacramento Regional Water Bank (Management Action #1).
SGA GSA	10/13/2022	Board Meeting	Update on the Groundwater Sustainability Program.
SGA GSA	12/8/2022	Board Meeting	Update on the Groundwater Sustainability Program.
RWA	February 2023	Public Meeting	Conducted large hybrid public meeting (Stakeholder Forum #2) to obtain feedback and provide an update on the development of the Sacramento Regional Water Bank (Management Action #1).
NCMWC / Sutter GSA	2/14/2023	Annual Meeting	SGMA update presentation.
NASb GSAs	3/9/2023	Email blast	Groundwater Awareness Week, groundwater facts, GSA information.
WPGSA	3/14/2023	Email blast, Facebook, Twitter, e-newsletter, postcard mailer	Groundwater Awareness Week, groundwater facts, GSA information.
SGA GSA	4/13/2023	Board Meeting	Update on the Sustainable Groundwater Management Act (SGMA) and Groundwater Management Program.
NASb GSAs	4/19/2023	Email blast	WY2022 Annual Report has been submitted; how to comment.
NASb GSAs	4/25/2023	Email blast	WY2022 Annual Report has been submitted; how to comment.
WPGSA	5/8/2023	Ag Commission public meeting presentation	WY2022 Annual Report overview, current conditions, GSP implementation activities.
NCMWC / Sutter GSA	5/9/2023	Board Meeting	Review of GSP WY2022 Annual Report.
SSWD GSA	5/30/2023	Board Meeting	Ongoing GSP activities, funding, and general updates.
NASb GSAs	6/15/2023	Email blast	NASb 2023 Public Meeting Announcement.
NASb GSAs	6/22/2023	NASb Public Meeting	WY2022 Annual Report, current conditions, ongoing GSP implementation activities.
SGA GSA	8/18/2023	Special Board Meeting	Update(s) on the NASb WY2022 Annual Report annual public meeting debrief; the NASb GSP Approval from the DWR; the DWR Sustainable Groundwater Management Round II Grant Recommendation; and, the Sacramento Regional Water Bank.
SSWD GSA	8/29/2023	Board Meeting	Update on GSP approval status.
RD1001 GSA	Monthly	Groundwater updates	Monthly agendas include standing item for sustainable groundwater updates.
RWA	Monthly	Water Agency Meetings	Conducted monthly meetings with project proponents (i.e., water agencies) on the development of the Sacramento Regional Water Bank (Management Action #1).
RWA	Continuous	Question and Answer Interactive Forum	Developed question and answer forum to support the development of the Sacramento Regional Water Bank (Management Action #1).
RWA	Continuous	Website and Videos	Developed website and series of educational videos on recharge, groundwater, water banking, and climate change to support the development of the Sacramento Regional Water Bank (Management Action #1).

Source: WPGSA.

6.1 GSP Corrective Actions

The DWR reviewed the NASb GSP and approved the plan on July 27, 2023. The DWR staff recommended six corrective actions. NASb GSAs plan to address these corrective actions and present solutions in the next update of the GSP.

6.2 Monitoring Network Changes

This section discusses current and potential upcoming changes to the RMS monitoring network since the adoption of the NASb GSP.

Well WPMW-2A (CASGEM ID 388145N1213491W001, identified as well number 60 in the NASb GSP), located in the West Placer GSA and slightly north of the Lincoln Regional Airport, was destroyed around September 2023 as part of a road widening project. This well was identified as an RMS well for chronic lowering of groundwater levels and land subsidence and thus, starting in WY 2024, reduces the monitoring network by one well:

- Chronic Lowering of Groundwater Levels - historically, 41 RMS wells, currently with the removal of well WPMW-2A, 40 RMS wells.
- Land Subsidence - historically, 41 RMS wells, currently with the removal of well WPMW-2A, 40 RMS wells.

Part of the NASb 5-year GSP evaluation and update will include revisions to the NASb RMS network. GSAs will consider whether RMS well WPMW-2A should be replaced with a new representative well that is consistent with the selection criteria identified for each sustainability indicator (e.g., chronic lowering of groundwater levels and land subsidence) identified in **Chapter 7.3, *Representative Monitoring Network*,** of the adopted NASb GSP. Additionally, although RMS Well WPMW-2A has been destroyed, for the purposes of this annual report, the Well is included as part of this year’s analysis because water level elevation data was collected through Fall 2023 prior to it being destroyed. Starting in WY 2024, RMS Well WPMW-2A will no longer be included as part of the Subbasins analysis.

Furthermore, as discussed below in **Section 6.3, *Progress Toward Filling Data Gaps***, the NASb GSAs are currently seeking to construct eight new monitoring wells (e.g., seven wells to assist with filling potential data gaps identified in the NASb GSP related to chronic lowering of groundwater and depletion of surface water, and one well to assist with filling potential data gaps related to tracking groundwater levels in an area with a high density of domestic wells) and anticipate that these eight new wells will be used as RMS wells. These potential additional RMS wells will be considered as part of the NASb 5-year GSP Plan Amendment.

6.3 Progress Toward Filling Data Gaps

The NASb GSP **Chapter 7, *Sustainable Management Criteria***, found that the RMS monitoring networks was adequate for all sustainability indicators and it described several potential data gaps that would improve the monitoring networks and better assess conditions in the Subbasin. This section describes progress toward filling these data gaps.

Groundwater quality samples were collected to monitor concentrations of select water quality elements to determine if management actions are needed to prevent degradation of water quality within the Subbasin. Groundwater sampling is scheduled to occur every two years, beginning in 2023. **Appendix C** provides the results of the first year of sampling efforts that began in October 2023. Water quality analytical results from this first year of sampling are in the process of being uploaded to the State Water Resources Control Board's GAMA Groundwater Information System website.

The NASb GSAs received funding from the DWR SGM Grant Round II for the construction of eight new monitoring wells that would assist with filling potential data gaps identified in the NASb 2021 GSP associated with areas containing high density of domestic well users, Groundwater Dependent Ecosystems (GDEs), and to augment monitoring near rivers for depletion of surface water. The SGA received a final award determination notice letter on September 12, 2023. The SGA and the DWR began discussions toward an agreement for the remaining portion of the water year (e.g., WY 2023) and a final grant agreement was completed in early January 2024. The SGA, acting as the GSA lead agency for the grant within the Subbasin, also began procuring professional services to implement construction of these new monitoring wells anticipated to begin in WY 2024.

6.4 Intrabasin Communication

Water Year 2023 was the second year GSP implementation activities occurred in the Subbasin since the submittal of the NASb 2021 GSP. These activities included coordination and outreach efforts such as meeting with each adjacent Subbasin, at least annually, to coordinate intrabasin activities. In WY 2023, the NASb GSAs met with the Consumnes Subbasin on May 17, 2023, the Yuba Subbasin on August 16, 2023, the Yolo Subbasin on August 28, 2023, and the South American Subbasin on September 28, 2023. These meetings included coordination efforts and discussion related to updated basin conditions, data provided in the previous submitted annual report (e.g., WY 2022 Annual Report), GDE analysis and coordination efforts, updates on PMAs, and other relevant information to support GSP implementation in all subbasins.

Additional NASb GSP implementation actions are shown in **Appendix B.**

7. Sustainability Indicators

The NASb GSAs are committed to implementing a GSP that achieves the sustainability goal for the Subbasin and avoids any undesirable results. For this reason, this section includes a detailed description of the groundwater conditions for WY 2023 (including comparisons to WYs 2019 through 2022 data) for each applicable GSP sustainability indicator as shown in **Table 7-1** below. It should be noted that although RMS Well MW WPMW-2A has been destroyed, for the purposes of this annual report (e.g., WY 2023), it is still included as an RMS well because groundwater data was collected through the Fall of 2023, prior to it being destroyed. In the future, starting with NASbs WY 2024 Annual Report, RMS Well WPMW-2A will no longer be included in consideration for sustainability indicators and undesirable results.

Table 7-1. Sustainability Indicators and Undesirable Results

Sustainability Indicator	Undesirable Result Definition
Chronic lowering of groundwater levels	*20% or more of all NASb RMS have MT exceedances for 2 consecutive Fall measurements (8 out of 41 wells)*
Reduction of storage	*20% or more of all NASb RMS have MT exceedances for 2 consecutive Fall measurements (8 out of 41 wells)*
Depletion of surface water	*20% or more of the NASb interconnected surface water RMSs have MT exceedances for 2 consecutive Fall measurements (5 out of 21 wells)*
Land Subsidence	*The rate of inelastic subsidence exceeds 0.5 feet over a 5-year period over an area covering approximately 5 or more square miles*
Degraded groundwater quality	For public water system wells • *The basin-wide average 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 RMSs, TDS and nitrate (as N) concentrations exceed state maximum contaminant levels*

Notes: mg/L= milligrams per liter; MT = minimum threshold; NASb = North American Subbasin; RMS = representative monitoring site; TDS = total dissolved solids
Source: NASb, 2021.

7.1 Chronic Lowering of Groundwater Levels

Four RMS wells out of a total of 41 wells monitored (or 10 percent of the total 41 RMS wells) exceeded their MT at the end of WY 2023 and is shown in **Table 7-2**. One of the four wells with MT exceedances (e.g., MW 2-3) has had four consecutive Fall MT exceedances and two of the four wells (e,g., RDMW-104 and Old Well #2) have had three consecutive Fall MT exceedances. Although these wells have had multiple Fall MT exceedances, this does not constitute a defined undesirable result[6] which would be eight or more wells out of the 41 RMS wells for two consecutive Fall measurements.

Additionally, the GSAs are in the process of trying to understand the potential causes of these exceedances. No dry wells were reported to the DWR in WY 2023. In response to these exceedances, the GSAs have begun an investigation which includes:

- Increased frequency of monitoring at four wells that have had two or more consecutive MT exceedances to assess if the lower groundwater levels are due to a nearby pumping or regional pumping is contributing to this observation.
- Continued to assess potential groundwater recharge options in portions of the Subbasin.
- Started evaluating potential causes of MT exceedances and evaluating whether these exceedances are resulting in negative effects to beneficial users.
- Evaluating whether MTs set for RMS wells identified in the NASb GSP are appropriate for evaluating Subbasin conditions.

Furthermore, it should be noted that two of the four RMS wells with MT exceedances in Fall 2023 had less than two years of monitoring data prior to the development of the GSP. Due to such a limited record of data, the NASb GSAs are trying to better understand whether the MTs set for RMS wells are truly effective for the purposes of establishing undesirable results for the Subbasin. As GSP implementation is in its second year, the GSAs will continue to evaluate the effectiveness and corresponding applicability of the set MTs at the 41 RMS wells as additional data and information is collected.

Thirty of the 41 wells have already at their MOs and the remaining 11 wells are within four feet of meeting their MOs.

Figure 7-1 shows the locations of the chronic lowering of groundwater level RMS wells and their Fall 2023 groundwater elevations in relation to their MTs (e.g., below, above, or no measurement). A list of the 41 RMS chronic lowering of groundwater level wells, their Spring and Fall groundwater measurements for WYs 2019 through WY 2023, their MTs and MOs with interim milestones (e.g., 20-year MO), whether their MT and/or MO were exceeded, and the 5-year Spring average are shown in **Table 7-2**.

[6] "Undesirable Result" as defined by **Water Code §10721** "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and 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." (California Legislative Information, 2024).

Table 7-2. Chronic Lowering of Groundwater Levels, Minimum Thresholds, and Measurable Objectives

DWR Assigned Well Number	NASb GSP RMS Number	Local Well Name	20-Year MO	MT	Spring 2019	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022	Fall 2022	Spring 2023	Fall 2023	5-Year Spring Average	Distance to 20-Year MO
DWR Assigned Well Number	NASb GSP RMS Number		Groundwater Elevation (ft msl)	Groundwater Elevation (ft msl)	Groundwater Elevation (ft msl) Shaded Values Below are Below the MT Value --- Represents No Measurement										Spring 2019 - Spring 2023	5-year Average minus 20-Year MO (ft above or below MO)
385828N1213385W001	2	SGA_MW06	5	1	13.79	12.34	12.59	9.24	9.69	7.79	9.44	7.78	13.09	11.97	12	7
385841N1214185W001	3	SGA_MW04	-1	-5	9.94	3.14	2.59	0.19	0.89	-1.36	0.34	-0.42	7.58	3.39	4	5
386160N1215054W001	11	Bannon Creek Park	-2	-5	5.31	0.46	1.66	-1.09	-0.40	-1.54	0.26	-1.74	4.65	0.16	2	4
386292N1214877W001	13	Chuckwagon Park	-13	-15	-5.99	-7.29	-7.19	-8.94	-8.69	-10.49	-9.39	-11.34	-4.54	-3.79	-7	6
389669N1214897W001	14	13N04E23A002M	45	26	51.38	45.58	45.28	40.98	39.88	28.88	32.18	27.88	36.64	34.72	41	-4
388593N1214885W003	17	AB-2 shallow	13	-17	24.23	19.37	19.8	10.01	11.61	-8.41	3.07	-7.69	7.24	0.91	13	0
386635N1213486W001	20	SGA_MW05	-25	-37	-13.93	-17.38	-13.68	-22.28	-16.78	-27.98	-19.63	-27.43	-19.44	-18.26	-17	8
386782N1215943W004	22	AB-4 shallow	4	-1	12.24	8.07	8.59	4.98	6.26	4.93	9.03	3.46	11.45	7.53	10	6
386836N1214536W001	24	SGA_MW02	-23	-27	-13.86	-14.16	-13.36	-15.11	-14.96	-16.86	-15.46	-16.91	-14.21	-13.91	-14	9
386864N1215222W003	27	AB-3 shallow	-1	-4	10.76	10.43	8.52	8.91	7.95	8.06	8.75	5.70	9.53	9.81	9	10
386964N1213120W001	28	Twin Creeks Park	-19	-28	-7.9	-9.45	-6.40	-12.75	-9.20	-16.10	-12.30	-16.00	-13.45	-12.85	-10	9
388260N1215394W004	37	SUT-P1	20	10	29.24	21.59	19.23	18.71	16.50	18.65	16.51	12.21	24.81	19.50	21	1
387216N1213842W001	38	Lone Oak Park	-21	-27	-12.23	-13.48	-10.53	-15.03	-12.88	-17.68	-15.23	-16.91	-15.18	-14.43	-13	8
389116N1215238W003	39	AB-1 shallow	31	3	40.18	33.63	34.16	27.46	27.08	9.70	17.66	5.39	22.92	21.38	28	-3
387515N1212725W001	44	WPMW-10A	140	133	139.31	136.21	137.21	135.21	136.11	134.01	135.51	134.37	139.56	134.81	138	-2
387517N1212727W001	45	WPMW-9A	143	135	141.56	138.46	140.66	137.86	139.26	136.76	138.53	137.46	142.08	136.86	140	-3
387623N1213915W001	46	SVMW West - 1A	-22	-32	-14.25	-18.35	-12.35	-17.45	-13.81	-20.70	-16.55	-21.25	-16.48	-16.27	-15	7
387755N1212753W001	48	WPMW-4A	78	75	76.97	77.77	78.47	79.07	79.47	79.07	79.19	79.07	79.37	81.68	79	1
388145N1213491W001	60	WPMW-2A [1]	26	22	26.98	26.80	29.25	27.48	28.30	23.80	26.10	24.70	27.20	---	28	2
388235N1216079W001	61	Sutter County MW-5A	18	10	21.42	17.98	17.15	16.80	14.34	10.88	14.95	14.40	20.70	18.40	18	0
388476N1212872W001	63	WPMW-3A	147	145	147.97	147.43	147.57	147.43	147.29	146.60	147.51	146.90	148.60	148.00	148	1
388604N1213544W003	65	MW 1-3	55	49	58.01	54.02	58.37	56.47	57.88	55.23	57.03	54.74	58.31	56.86	58	3
388826N1213078W002	66	MW 5-2	112	108	112.64	109.80	110.51	108.65	109.31	108.05	110.96	108.93	112.59	110.05	111	-1
386280N1213493W001	71	WCMSS	-32	-40	-19.76	-20.06	-15.26	-28.76	-20.26	-27.76	-22.41	-29.31	-22.76	-21.26	-20	12
389255N1213566W003	75	MW 2-3	94	89	97.53	89.70	95.19	87.79	91.72	83.83	88.58	83.04	90.95	84.72	93	-1
387749N1215975W001	77	SREL-1-27-F1	16	9	28.45	14.51	14.061	11.55	13.84	11.57	11.84	10.38	22.22	16.26	18	2
387191N1213287W001	89	Roseview Park - 315	-13	-22	-6.21	-7.51	-4.86	-9.41	-6.61	-11.91	-9.46	-11.76	-10.46	-10.06	-8	5
388026N1214432W002	90	WPMW-12A	-30	-45	---	-22.93	-13.98	-27.28	-18.93	-34.54	-23.08	-35.53	-24.63	-30.95	-20	10
388882N1214005W002	91	WPMW-11A	13	3	---	14.34	22.47	13.43	19.55	6.04	12.58	0.52	11.48	0.72	17	4
388829N1216110W001	92	RDMW-101	18	15	---	19.98	19.69	17.92	17.65	16.73	19.49	16.46	26.35	19.71	21	3
388798N1215885W001	93	RDMW-102	16	12	---	17.02	19.26	13.86	15.48	10.40	15.33	11.03	20.85	16.28	18	2
389950N1214148W002	94	RDMW-103	65	58	---	65.97	68.09	61.09	62.99	54.13	59.71	50.68	65.76	58.38	64	-1
389919N1214141W002	95	RDMW-104	65	57	---	65.18	67.20	59.91	61.80	52.01	58.52	51.08	64.58	56.68	63	-2
386348N1212319W001	96	Aerojet - 1516 [2]	70	67	72.72	69.8	70.87	70.2	69.89	69.43	69.76	69.72	73.89	---	71	1
386351N1212323W001	97	Aerojet - 1518 [2]	59	57	64.92	62.85	62.5	61.46	60.56	59.87	60.42	60.48	65.56	62.97	63	4
386397N1215624W001	98	URS71000-700+00C	10	7	9.76	9.98	11.80	9.85	9.04	7.74	10.38	7.60	16.03	11.84	11	1
389857N1214880W001	103	BR-1B	45	36	49.45	43.92	46.81	43.95	40.46	36.28	40.99	36.97	43.86	41.17	44	-1
387000N1212180W001	104	SGA_MW08	99	97	107.06	106.96	107.21	106.71	106.76	106.31	106.21	105.76	105.76	105.46	107	8
387218N1214677W001	109	SGA_MW01	-30	-33	-17.16	-18.01	-15.66	-18.61	-16.51	-20.41	-18.26	-20.61	-18.71	-21.08	-17	13
389791N1213727W001	116	Old Well #2	76	68	79.03	77.45	78.3	72.93	72.98	67.22	69.10	65.30	69.05	66.05	74	-2
387251N1214954W001	126	DeWit	-13	-25	---	---	---	---	4.95	-2.30	5.30	-3.80	6.85	5.30	6	19

Notes:
[1] Reason for missing Fall 2023 data is because the well has been destroyed.
[2] Spring 2019 through Fall 2021 water level have been extrapolated from historic Aeroject reports. Spring 2022 through current water level data is obtained directly through Aerojet.
All data retrieved from SGMA Data Viewer. Measurements where chosen on or as close to April 15th for Spring and October 15th for Fall values.
ft msl = feet above or below mean sea level
Mimium Thresholds (MTs) are compared to Fall measurements, whereas Measureable Objectives (MO) are compared to Spring measurements.

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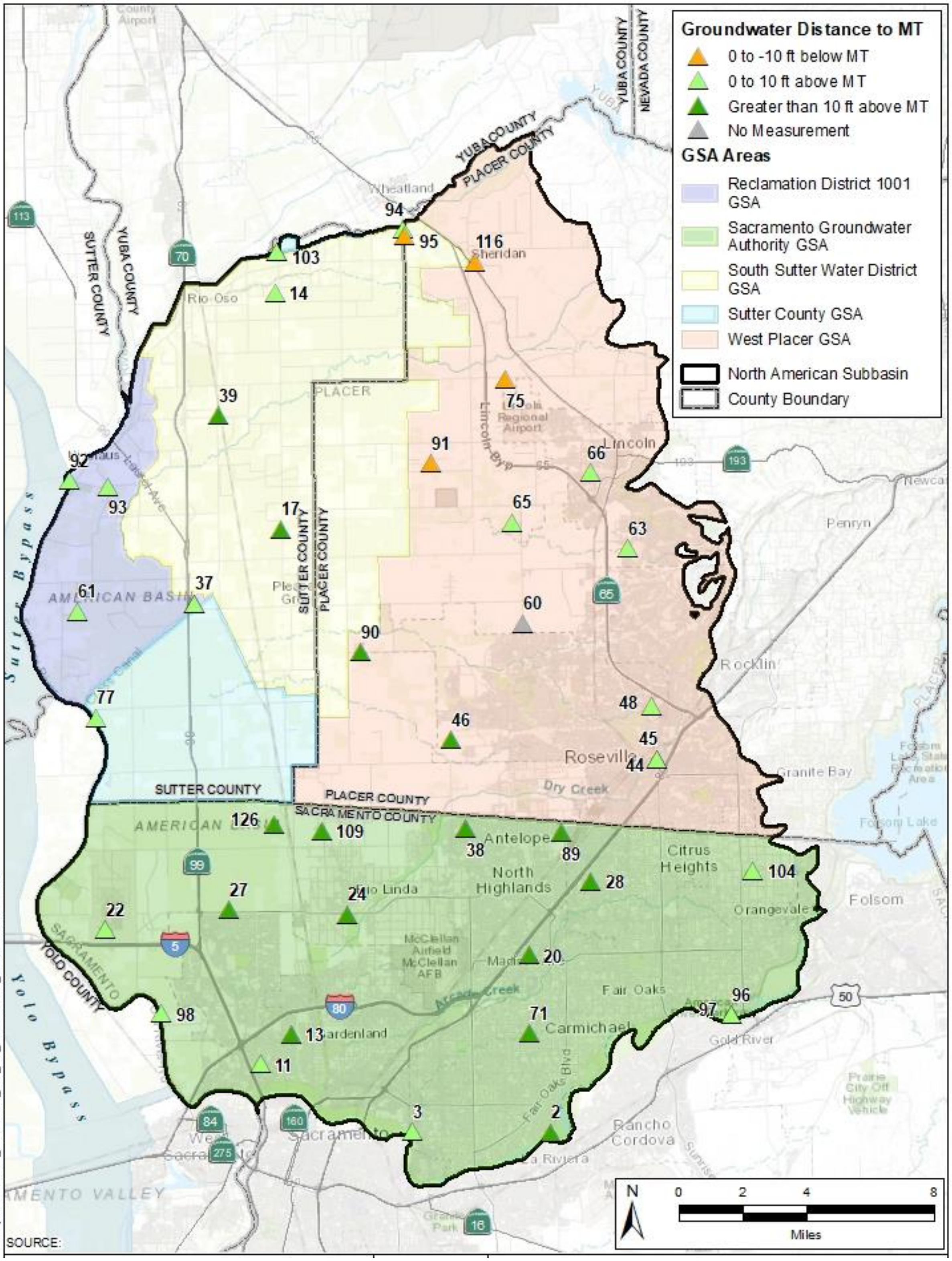
Figure 7-1. Fall 2023 Chronic Lowering of Groundwater Levels RMS



7.2 Reduction of Storage

The GSAs used groundwater levels as a proxy for defining the quantitative thresholds for this sustainability indicator as supported in the GSP regulations. As described above, the NASb is not currently experiencing an undesirable result with respect to reduction of storage.

7.3 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, groundwater levels are used as a proxy for this sustainability indicator. There are 24 wells at 21 locations used for evaluation purposes. At the end of WY 2023, there were three wells (e.g., SUT-P1, MW 2-3, and RDMW-104) that exceeded their MTs and are shown in **Table 7-3**. One of these wells (e.g., SUT-P1) has had five consecutive Fall MT exceedances, well MW 2-3 has had four consecutive MT exceedances, and well RDMW-104 has had three consecutive Fall MT exceedances. However, as discussed above in **Section 7.1, *Chronic Lowering of Groundwater Levels*,** the Subbasin is not experiencing an undesirable result with respect to this sustainability indicator. Additionally, the NASb GSAs are evaluating potential causes of the MT exceedances and whether these could be resulting in any negative effects. The GSAs are also evaluating whether the monitoring wells and their MTs established in the NASb GSP are appropriate for evaluating these effects.

Fourteen of the 21 wells have already met their MOs and the remaining eight wells are within 5-feet of meeting their MOs.

A list of the 21 RMS depletion of interconnected surface water wells, their Spring and Fall groundwater measurements for WYs 2019 through 2023, their MTs and MOs with interim milestones (e.g., 20-year MO), whether the MT and/or MO were exceeded, and the 5-year Spring average are shown in **Table 7-3**.

Table 7-3. Depletion of Surface Water, Minimum Thresholds, and Measurable Objectives

DWR Assigned Well Number	Representative Well Number	Local Well Name	20-yr Measurable Objective	Minimum Threshold	Spring 2019	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022	Fall 2022	Spring 2023	Fall 2023	5-yr Spring Average	Distance to 20-year Measurable Objective
DWR Assigned Well Number	NASb GSP Well Number	Local Well Name	Groundwater Elevation (ft msl)	Groundwater Elevation (ft msl)	Groundwater Elevation (feet msl) Shaded Values Below are Below the Minimum Threshold Value --- Represents No Measurement										Spring 2019 - Spring 2023	5-year Average minus 20-year Measurable Objective (feet above or below MO)
385828N1213385W001	2	SGA_MW06	5	1	13.79	12.34	12.59	9.24	9.69	7.79	9.44	7.78	13.09	11.97	12	7
385841N1214185W001	3	SGA_MW04	-1	-5	9.94	3.14	2.59	0.19	0.89	-1.36	0.34	-0.42	7.58	3.39	4	5
386160N1215054W001	11	Bannon Creek Park	-2	-5	5.31	0.46	1.66	-1.09	-0.40	-1.54	0.26	-1.74	4.65	0.16	2	4
386292N1214877W001	13	Chuckwagon Park	-13	-15	-5.99	-7.29	-7.19	-8.94	-8.69	-10.49	-9.39	-11.34	-4.54	-3.79	-7	6
389669N1214897W001	14	13N04E23A002M	45	26	51.38	45.58	45.28	40.98	39.88	28.88	32.18	27.88	36.64	34.72	41	-4
386782N1215943W004	22	AB-4 shallow	4	-1	12.24	8.07	8.59	4.98	6.26	4.93	9.03	3.46	11.45	7.53	10	6
386864N1215222W003	27	AB-3 shallow	-1	-4	10.76	10.43	8.52	8.91	7.95	8.06	8.75	5.70	9.53	9.81	9	10
386964N1213120W001	28	Twin Creeks Park	-19	-28	-7.9	-9.45	-6.4	-12.75	-9.20	-16.10	-12.30	-16.00	-13.45	-12.85	-10	9
388260N1215394W004	37	SUT-P1	20	10	29.24	21.59	19.23	18.71	16.50	18.65	16.51	12.21	24.81	19.5	21	1
387515N1212725W001	44	WPMW-10A	140	133	139.31	136.21	137.21	135.21	136.11	134.01	135.51	134.37	139.56	134.81	138	-2
387517N1212727W001	45	WPMW-9A	143	135	141.56	138.46	140.66	137.86	139.26	136.76	138.53	137.46	142.08	136.86	140	-3
388235N1216079W001	61	Sutter County MW-5A	18	10	21.42	17.98	17.15	16.8	14.34	10.88	14.95	14.40	20.7	18.4	18	0
388476N1212872W001	63	WPMW-3A	147	145	147.97	147.43	147.57	147.43	147.29	146.60	147.51	146.90	148.6	148	148	1
388826N1213078W001	66	MW 5-2	112	108	112.64	109.8	110.51	108.65	109.31	108.05	110.96	108.93	112.59	110.05	111	-1
389255N1213566W003	75	MW 2-3	94	89	97.53	89.7	95.19	87.79	91.72	83.83	88.58	83.04	90.95	84.72	93	-1
387749N1215975W001	77	SREL-1-27-F1	16	9	28.45	14.51	14.061	11.55	13.84	11.57	11.84	10.38	22.22	16.26	18	2
388829N1216110W001	92	RDMW-101	18	15	---	19.98	19.69	17.92	17.65	16.73	19.49	16.46	26.35	19.71	21	3
388798N1215885W001	93	RDMW-102	16	12	---	17.02	19.26	13.86	15.48	10.40	15.33	11.03	20.85	16.28	18	2
389950N1214148W002	94	RDMW-103	65	58	---	65.97	68.09	61.09	62.99	54.13	59.71	50.68	65.76	58.38	64	-1
389919N1214141W002	95	RDMW-104	65	57	---	65.18	67.2	59.91	61.80	52.01	58.52	51.08	64.58	56.68	63	-2
386348N1212319W001	96	Aerojet - 1516	70	67	72.72	69.8	70.87	70.2	69.89	69.43	69.76	69.72	73.89	---	71	1
386351N1212323W001	97	Aerojet - 1518	59	57	64.92	62.85	62.5	61.46	60.56	59.87	60.42	60.48	65.56	62.97	63	4
386397N1215624W001	98	URS71000-700+00C	10	7	9.76	9.98	11.8	9.85	9.04	7.74	10.38	7.60	16.03	11.84	11	1
389857N1214880W001	103	BR-1B	45	36	49.45	43.92	46.81	43.95	40.46	36.28	40.99	36.97	43.86	41.17	44	-1

Note: ft msl = feet above or below mean sea level; Minimum Thresholds are comparison of Fall measurements. Measurable Objectives are compared to Spring measurements.

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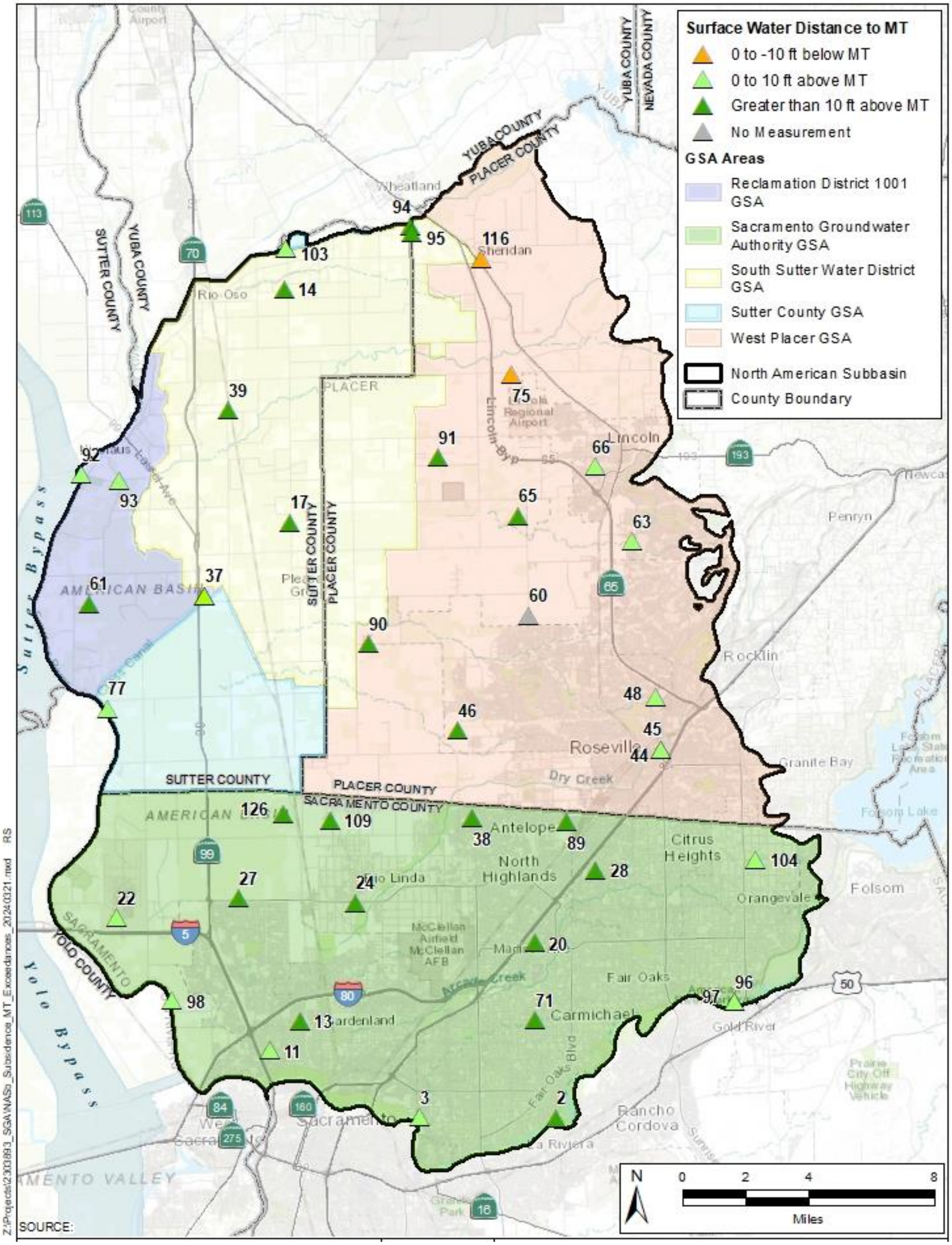
Figure 7-2. Fall 2023 Depletion of Surface Water RMS



7.4 Land Subsidence

Groundwater levels were used to establish MTs for land subsidence. The MTs established for subsidence, and summarized in **Table 7-4**, were in part based on CoSANA model results of future/projected conditions and the MTs for chronic lowering of groundwater levels. This resulted in MTs being set at the minimum measured groundwater elevation at each of the designated RMS. For WY 2023, two wells (e.g., Old Well #2 and MW 2-3) exceeded their MTs for the second year in a row. Their locations are displayed in **Figure 7-3**. Both wells exceeded their MT by less than 2-feet, as shown in **Table 7-4**; however, in this situation, these exceedances are unlikely to cause subsidence. For comparison to regional subsidence data, the location of the two wells are shown in **Figure 7-4**, which confirms the lack of subsidence near these wells.

Twenty-nine of the 41 wells already have groundwater levels above the MOs. Groundwater levels in the remaining eleven wells are within 4-feet of meeting the MOs.

A list of the 41 RMS land subsidence wells their Spring and Fall groundwater measurements for WYs 2019 through WY 2023, their MTs and MOs with interim milestones (e.g., 20-year MO), whether their MT and/or MO were exceeded, and the 5-year Spring average are shown in **Table 7-4**.

The lack of subsidence in the NASb in WY 2023 is confirmed by Interferometric Synthetic-Aperture Radar (InSAR). Interferometric Synthetic Aperture Radar measures ground elevation using microwave satellite imagery data. **Figure 7-5** shows InSAR measured ground surface elevations between October 1, 2022, to October 1, 2023, for the Subbasin (DWR, 2024). This data shows that the rate of subsidence basin-wide was -0.10 to +0.10 foot per year in WY 2023. Based on the water level measurements and InSAR data, the Subbasin is not experiencing undesirable results with respect to subsidence.

Table 7-4. Land Subsidence Groundwater Levels, Minimum Thresholds, and Measurable Objectives

DWR Assigned Well Number	Representative Well Number	Local Well Name	20-yr Measurable Objective	Minimum Threshold	Spring 2019	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022	Fall 2022	Spring 2023	Fall 2023	5-yr Fall Average	Distance to 20-year Measurable Objective
DWR Assigned Well Number	NASb GSP Well Number	Local Well Name	Groundwater Elevation (feet msl)	Groundwater Elevation (feet msl)	Groundwater Elevation (feet msl) Shaded Values Below are Below the Minimum Threshold Value --- Represents No Measurement										Spring 2019 - Spring 2023	5-year Average minus 20-year Measurable Objective (feet above or below MO)
385828N1213385W001	2	SGA_MW06	5	1	13.79	12.34	12.59	9.24	9.69	7.79	9.44	7.78	13.09	11.97	12	7
385841N1214185W001	3	SGA_MW04	-1	-5	9.94	3.14	2.59	0.19	0.89	-1.36	0.34	-0.42	7.58	3.39	4	5
386160N1215054W001	11	Bannon Creek Park	-2	-5	5.31	0.46	1.66	-1.09	-0.40	-1.54	0.26	-1.74	4.65	0.16	2	4
386292N1214877W001	13	Chuckwagon Park	-13	-15	-5.99	-7.29	-7.19	-8.94	-8.69	-10.49	-9.39	-11.34	-4.54	-3.79	-7	6
389669N1214897W001	14	13N04E23A002M	45	15	51.38	45.58	45.28	40.98	39.88	28.88	32.18	27.88	36.64	34.72	41	-4
388593N1214885W003	17	AB-2 shallow	13	-21	24.23	19.37	19.8	10.01	11.61	-8.41	3.07	-7.69	7.24	0.91	13	0
386635N1213486W001	20	SGA_MW05	-25	-37	-13.93	-17.38	-13.68	-22.28	-16.78	-27.98	-19.63	-27.43	-19.44	-18.26	-17	8
386782N1215943W004	22	AB-4 shallow	4	-1	12.24	8.07	8.59	4.98	6.26	4.93	9.03	3.46	11.45	7.53	10	6
386836N1214536W001	24	SGA_MW02	-23	-27	-13.86	-14.16	-13.36	-15.11	-14.96	-16.86	-15.46	-16.91	-14.21	-13.91	-14	9
386864N1215222W003	27	AB-3 shallow	-1	-4	10.76	10.43	8.52	8.91	7.95	8.06	8.75	5.70	9.53	9.81	9	10
386964N1213120W001	28	Twin Creeks Park	-19	-28	-7.9	-9.45	-6.4	-12.75	-9.20	-16.10	-12.30	-16.00	-13.45	-12.85	-10	9
388260N1215394W004	37	SUT-P1	20	8	29.24	21.59	19.23	18.71	16.50	18.65	16.51	12.21	24.81	19.5	21	1
387216N1213842W001	38	Lone Oak Park	-21	-27	-12.23	-13.48	-10.53	-15.03	-12.88	-17.68	-15.23	-16.91	-15.18	-14.43	-13	8
389116N1215238W003	39	AB-1 shallow	31	-5	40.18	33.63	34.16	27.46	27.08	9.70	17.66	5.39	22.92	21.38	28	-3
387515N1212725W001	44	WPMW-10A	140	133	139.31	136.21	137.21	135.21	136.11	134.01	135.51	134.37	139.56	134.81	138	-2
387517N1212727W001	45	WPMW-9A	143	131	141.56	138.46	140.66	137.86	139.26	136.76	138.53	137.46	142.08	136.86	140	-3
387623N1213915W001	46	SVMW West - 1A	-22	-32	-14.25	-18.35	-12.35	-17.45	-13.81	-20.70	-16.55	-21.25	-16.48	-16.27	-15	7
387755N1212753W001	48	WPMW-4A	78	72	76.97	77.77	78.47	79.07	79.47	79.07	79.19	79.07	79.37	81.68	79	1
388145N1213491W001	60	WPMW-2A	26	21	26.98	26.8	29.25	27.48	28.30	23.80	26.10	24.70	27.2	---	28	2
388235N1216079W001	61	Sutter County MW-5A	18	-1	21.42	17.98	17.15	16.8	14.34	10.88	14.95	14.40	20.7	18.4	18	0
388476N1212872W001	63	WPMW-3A	147	145	147.97	147.43	147.57	147.43	147.29	146.60	147.51	146.90	148.6	148	148	1
388604N1213544W003	65	MW 1-3	55	38	58.01	54.02	58.37	56.47	57.88	55.23	57.03	54.74	58.31	56.86	58	3
388826N1213078W001	66	MW 5-2	112	104	112.64	109.8	110.51	108.65	109.31	108.05	110.96	108.93	112.59	110.05	111	-1
386280N1213493W001	71	WCMSS	-32	-40	-19.76	-20.06	-15.26	-28.76	-20.26	-27.76	-22.41	-29.31	-22.76	-21.26	-20	12
389255N1213566W003	75	MW 2-3	94	86	97.53	89.7	95.19	87.79	91.72	83.83	88.58	83.04	90.95	84.72	93	-1
387749N1215975W001	77	SREL-1-27-F1	16	9	28.45	14.51	14.061	11.55	13.84	11.57	11.84	10.38	22.22	16.26	15	-1
387191N1213287W001	89	Roseview Park - 315	-13	-22	-6.21	-7.51	-4.86	-9.41	-6.61	-11.91	-9.46	-11.76	-10.46	-10.06	-8	5
388026N1214432W002	90	WPMW-12A	-30	-65	---	-22.93	-13.98	-27.28	-18.93	-34.54	-23.08	-35.53	-24.63	-30.95	-20	10
388882N1214005W002	91	WPMW-11A	13	-18	---	14.34	22.47	13.43	19.55	6.04	12.58	0.52	11.48	0.72	17	4
388829N1216110W001	92	RDMW-101	18	14	---	19.98	19.69	17.92	17.65	16.73	19.49	16.46	26.35	19.71	21	3
388798N1215885W001	93	RDMW-102	16	8	---	17.02	19.26	13.86	15.48	10.40	15.33	11.03	20.85	16.28	18	2
389950N1214148W002	94	RDMW-103	65	36	---	65.97	68.09	61.09	62.99	54.13	59.71	50.68	65.76	58.38	64	-1
389919N1214141W002	95	RDMW-104	65	36	---	65.18	67.2	59.91	61.80	52.01	58.52	51.08	64.58	56.68	63	-2
386348N1212319W001	96	Aerojet - 1516	70	67	72.72	69.8	70.87	70.2	69.89	69.43	69.76	69.72	73.89	---	71	1
386351N1212323W001	97	Aerojet - 1518	59	57	64.92	62.85	62.5	61.46	60.56	59.87	60.42	60.48	65.56	62.97	63	4
386397N1215624W001	98	URS71000-700+00C	10	6	9.76	9.98	11.8	9.85	9.04	7.74	10.38	7.60	16.03	11.84	11	1
389857N1214880W001	103	BR-1B	45	36	49.45	43.92	46.81	43.95	40.46	36.28	40.99	36.97	43.86	41.17	44	-1
387000N1212180W001	104	SGA_MW08	99	97	107.06	106.96	107.21	106.71	106.76	106.31	106.21	105.76	105.76	105.46	107	8
387218N1214677W001	109	SGA_MW01	-30	-33	-17.16	-18.01	-15.66	-18.61	-16.51	-20.41	-18.26	-20.61	-18.71	-21.08	-17	13
389791N1213727W001	116	Old Well #2	76	68	79.03	77.45	78.3	72.93	72.98	67.22	69.10	65.30	69.05	66.05	74	-2
387251N1214954W001	126	DeWit	-13	-25	---	---	---	---	4.95	-2.30	5.30	-3.80	6.85	5.3	6	19

Note: ft msl = feet above mean sea level; Minimum Thresholds are comparison of Fall measurements. Interim milestones and Measurable Objectives are compared to Fall measurements.

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Figure 7-3. Fall 2023 Land Subsidence RMS

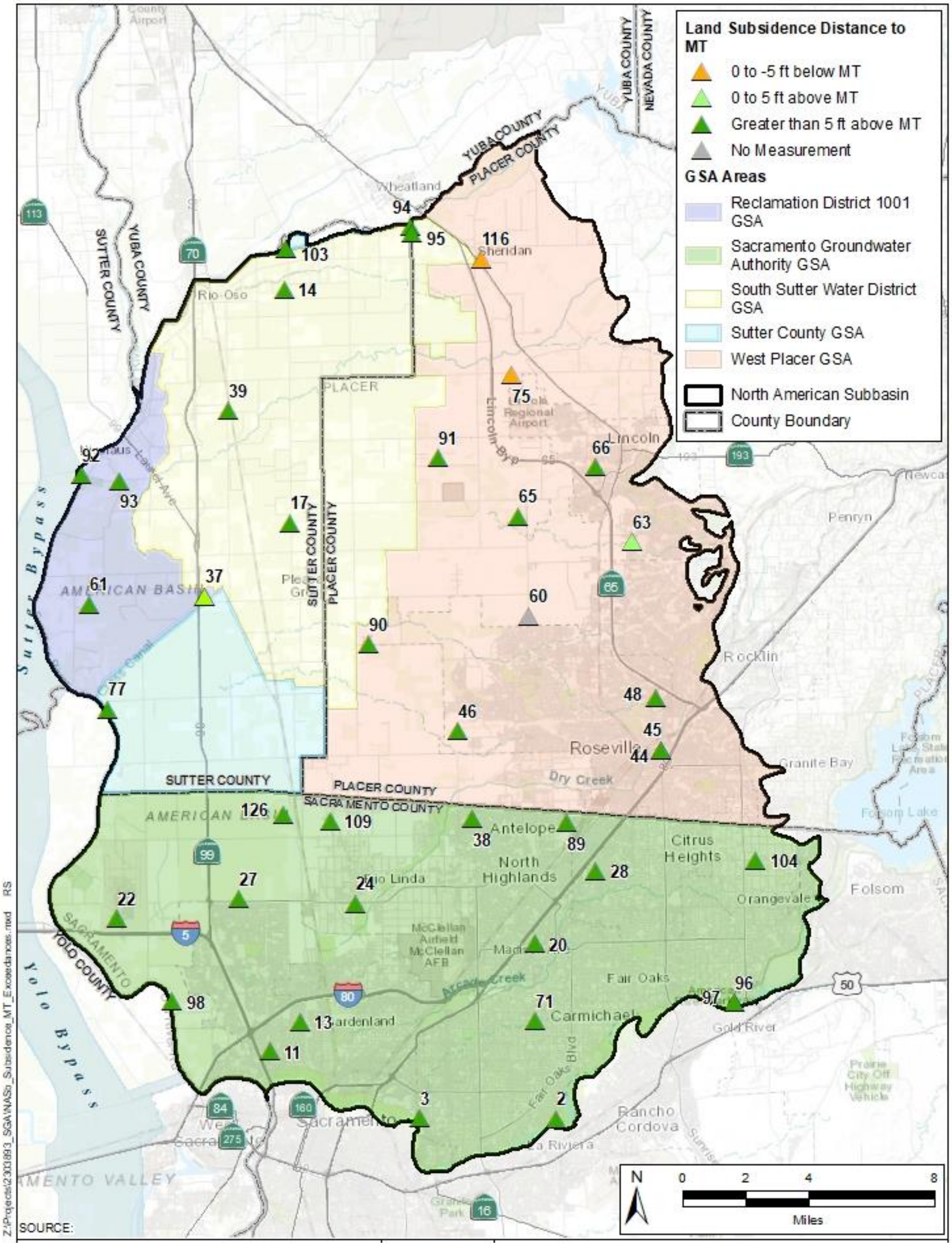
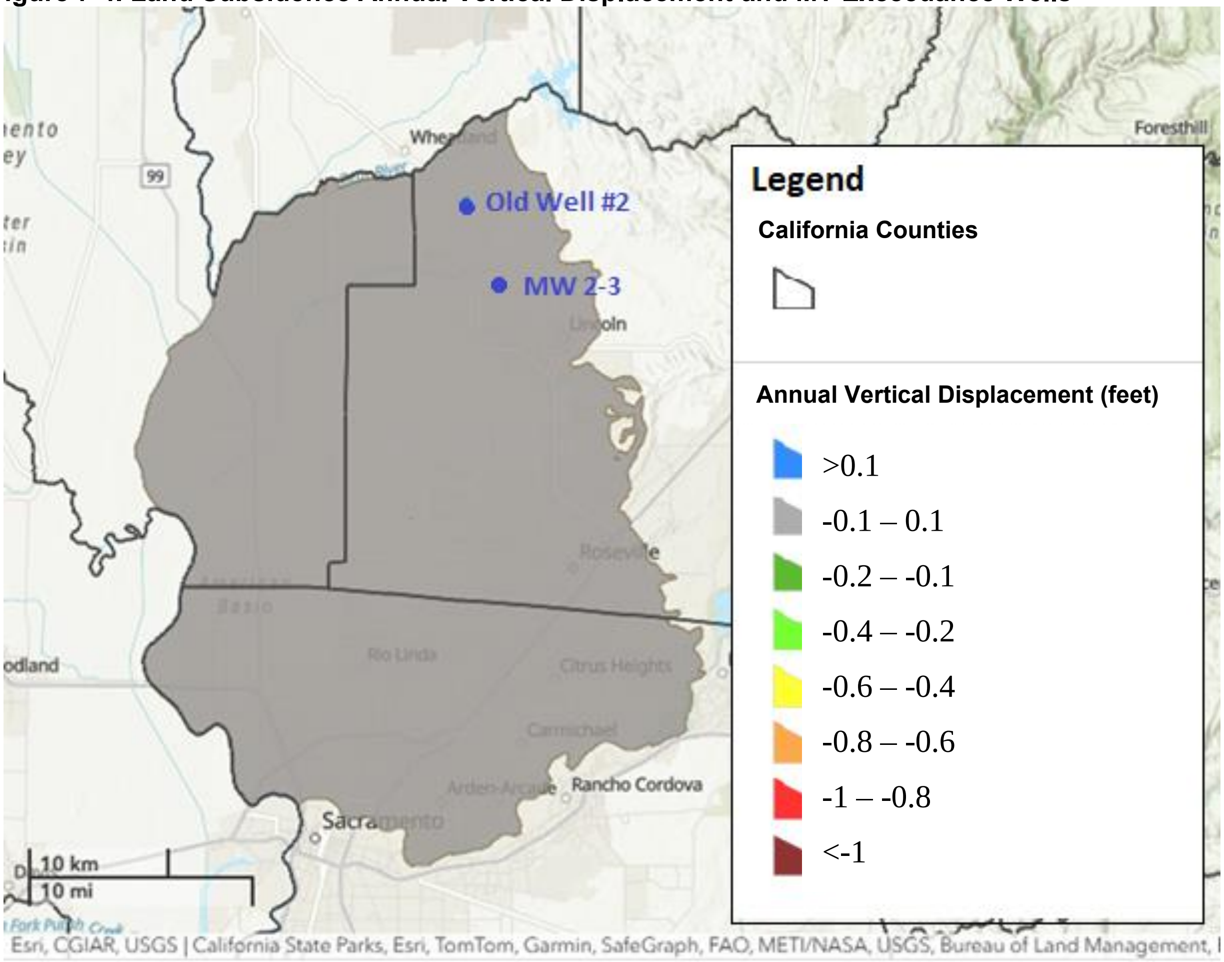


Figure 7-4. Land Subsidence Annual Vertical Displacement and MT Exceedance Wells



Source: DWR, 2024.

The long-term subsidence rate and area affected by previous water years are provided in **Table 7-5**. The results show that only one small area was affected by subsidence over 0.1 feet in WY 2022 and none in WY 2023.

Table 7-5. Subsidence Rates and Area Affected

InSAR	WY2019 (feet)	WY2020 (feet)	WY2021 (feet)	WY2022 (feet)	WY2023 (feet)
Subsidence Rate (feet/water year)	ND	ND	ND	>0.1	>0.1
Square Miles Affected	ND	ND	ND	1.8	0

Notes: ND = No Data

7.5 Degraded Water Quality

The GSP identified two methods to assess if degraded water quality is occurring in the NASb. The methods included evaluation of water quality data from municipal water supply wells (also referred to as public supply wells or public water system wells) and a network of shallow monitoring wells. The shallow monitoring wells assess potential changes in the upper portions of the aquifer, which is commonly used by domestic well owners, and the municipal wells assess changes within the deeper portions of the aquifer.

For all municipal water supply wells, or public water systems, the California State Water Resources Control Board's Division of Drinking Water requires all active municipal wells be periodically sampled and analyzed in accordance with California Water Code Title 22 constituent standards. For the WY 2023 Annual Report, data for Total Dissolved Solids (TDS) and Nitrate (N as Nitrogen) was downloaded from the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program (commonly referred to as GAMA) Groundwater Information System for annual analysis of the most recent data for each active public supply well. The data is summarized below by each constituent (e.g., TDS and N) in **Tables 7-8 and 7-9** below. Additionally, **Figures 7-6 and 7-7** below, show each constituent's average concentrations relating to water year type (e.g., wet, dry, and critical dry) for WYs 2019 through 2023. Based on the annual analysis of the public supply well data, the Subbasin is not exceeding the MTs and is not experiencing undesirable results with respect to water quality.

As identified in **Chapter 8.7, *Sustainability Indicator #4 – Degraded Water Quality***, of the NASb GSP, degraded water quality for public supply wells is considered significant and unreasonable when either of the following occur:

- *The basin wide average TDS concentrations for <u>all</u> public water systems well exceeds 400 mg/L; or,*
- *The basin wide average nitrate (as N) concentration for all public water system wells exceeds 8 mg/L.*

Additionally, as defined by the State Water Resources Control Board and identified in the NASb GSP, the Maximum Contamination Level (MCL) for N is a primary MCL and for TDS, is a secondary drinking standard relating to aesthetic "taste and odor". As a result, the MTs for degraded water quality within the NASb are the state drinking water standards for constituents of concern and includes the following:

- *Individual well TDS concentrations that exceed the state secondary recommended MCL; and,*
- *Individual well nitrate (as N) concentrations that exceed the state primary MCL.*

Degraded water quality MOs were set slightly higher than average concentrations observed in public supply wells from more than 300 samples of TDS and N (e.g., 258.4 mg/L and 1.8 mg/L, respectively) within the Subbasin to account for projected groundwater levels in 2042, which may increase concentrations of constituents. Therefore, the MOs for TDS and N are 300 mg/L and 3 mg/L, respectively.

Table 7-6. Summy of TDS in Municipal/Public Water Supply Wells from WY 2019 to WY 2023

TDS	WY 2019	WY 2020	WY 2021	WY 2022	WY 2023
Number of Wells with Analytical Results	50	75	70	46	74
Date Range of Samples	12/19/2018 - 9/17/2019	10/10/2019 - 9/3/202	11/19/2020 - 8/25/2021	12/7/2021 - 8/30/2022	10/6/2022 - 10/16/2023
Units	mg/L	mg/L	mg/L	mg/L	mg/L
Minimum Concentration	42	38	48	10	47
Maximum Concentration	460	500	650	471	510
Average Concentration[1]	256	247	270	256	247
MCL or Notification Level (MT)[2]	500	500	500	500	500
MO	300	300	300	300	300
Number of Wells Exceeding MCL	0	1	2	0	2

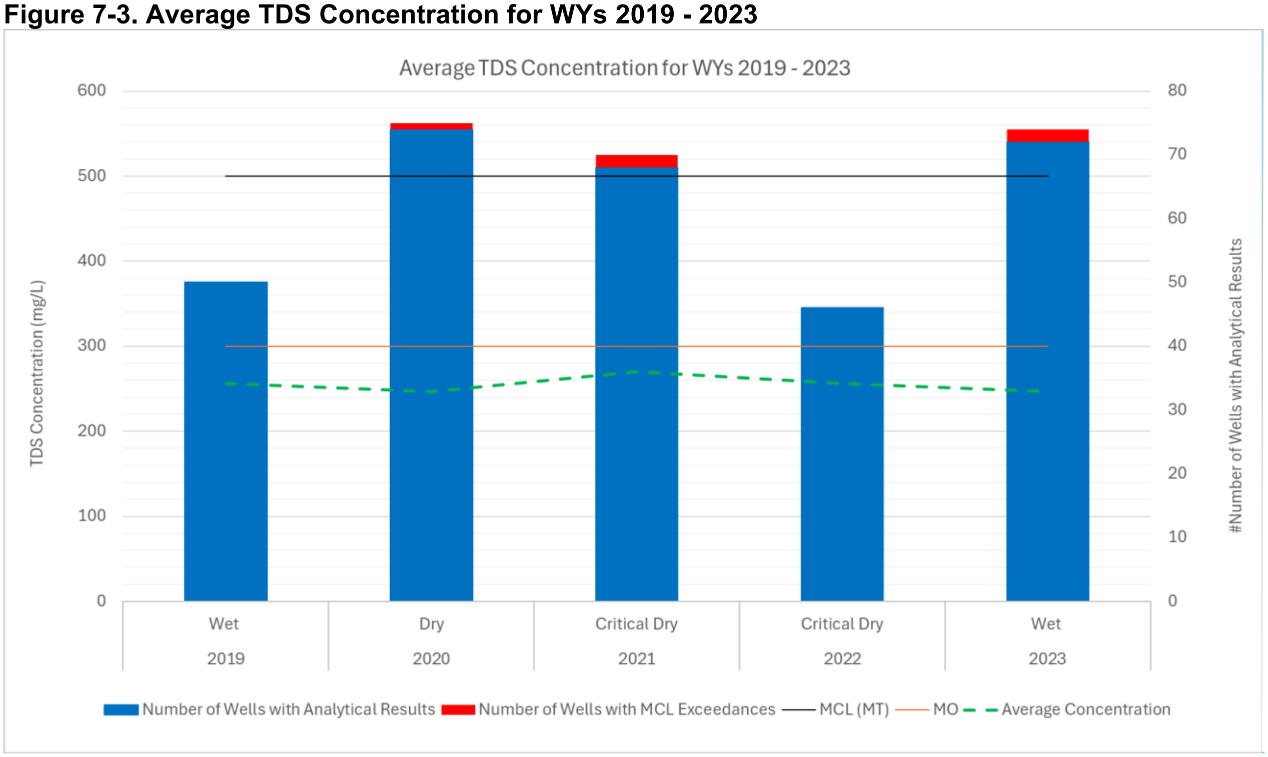
Notes: mg/L= milligrams per liter; TDS = total dissolved solids.

(1) For average concentrations, values below laboratory detection levels were calculated as half the reporting limit.

(2) The MT for TDS, as identified in the NASb GSP, is the secondary drinking water standard, which has a recommended MCL of 500 mg/L.

Source: SWRCB, 2024.

Figure 7-3. Average TDS Concentration for WYs 2019 - 2023



Notes: mg/L= milligrams per liter; TDS = total dissolved solids.
Source: SWRCB, 2024.

Table 7-7. Summy of N in Municipal/Public Water Supply Wells from WY 2019 to WY 2023

N	WY 2019	WY 2020	WY 2021	WY 2022	WY 2023
Number of Wells with Analytical Results	209	217	211	208	206
Date Range of Samples	11/6/2018 - 9/23/2019	10/10/2019 - 9/23/2020	10/9/2020 - 9/27/2021	11/17/2021 - 9/27/2022	10/13/2022 - 9/25/2023
Units	mg/L	mg/L	mg/L	mg/L	mg/L
Minimum Concentration	<0.5	<0.5	<0.5	<0.5	<0.5
Maximum Concentration	10.10	9.60	9.80	9.40	9.10
Average Concentration[1]	1.84	1.75	1.72	1.65	1.58
MCL or Notification Level (MT)[2]	10	10	10	10	10
MO	8	8	8	8	8
Number of Wells Exceeding MCL	1	0	0	0	0

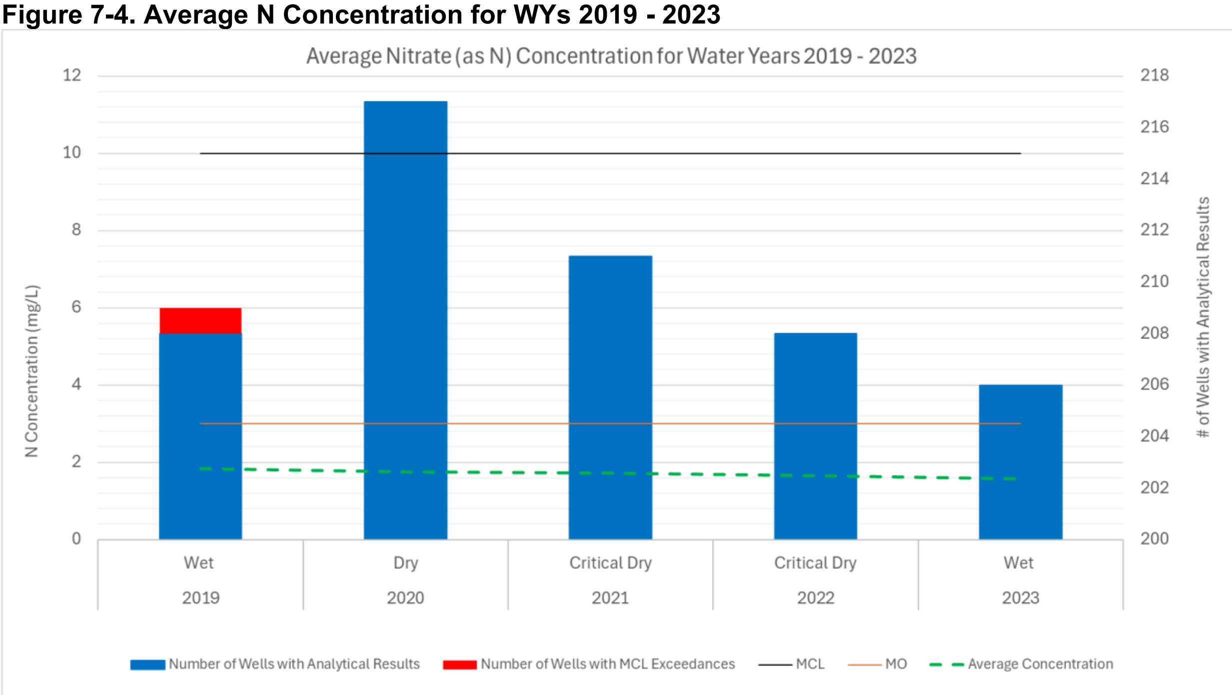
Notes: mg/L= milligrams per liter; N = Nitrate (as N).

(1) For average concentrations, values below laboratory detection levels were calculated as half the reporting limit.

(2) The MT for N, as identified in the NASb GSP, is the state drinking water standard, which has a primary MCL of 10 mg/L.

Source: SWRCB, 2024.

Figure 7-4. Average N Concentration for WYs 2019 - 2023



Notes: mg/L= milligrams per liter; N = Nitrate (as N)
Source: SWRCB, 2024.

As identified in **Table 10-2, *Summary of Implementation Actions***, of the NASb GSP (NASb, 2021), water quality samples were collected for wells in the shallow water quality monitoring network in October of 2023. This was the first year this data was collected and will continue to occur during odd numbered years (e.g., 2023, 2025, etc). The location of the shallow monitoring wells, along with the distribution of TDS in the Subbasin, are shown in **Figure 7-6.** The location of the shallow monitoring wells, along with the distribution of N in the Subbasin, are shown in **Figure 7-6**. The results of the shallow water quality monitoring water quality samples are displayed in **Tables 7-8 and 7-9** below. Additionally, **Appendix C** discusses the results of this year's water quality samples collected in the shallow quarter quality monitoring network.

Groundwater samples collected and analyzed in October 2023 from the shallow water quality monitoring network wells were all below their MTs for TDS (e.g., 500 mg/L) and N (e.g., 10 mg/L). Based on the shallow well water quality data, the Subbasin is not experiencing undesirable results with respect to water quality. The shallow monitoring wells are all below the established MOs (to be reached by 2024), except for TDS at three wells and nitrate at three wells.

Figure 7-5. Shallow Aquifer Water Quality Wells and TDS Distribution

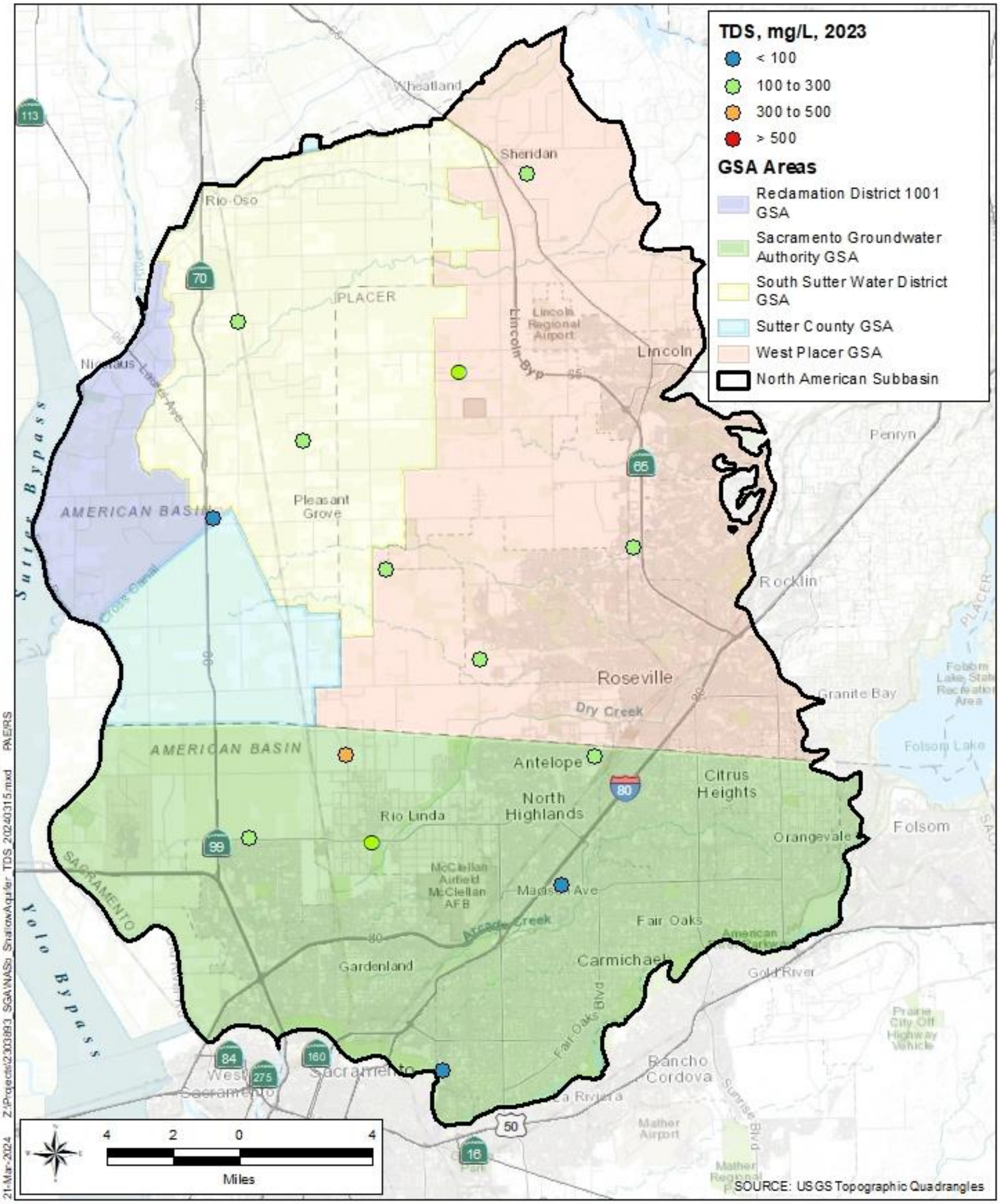


Figure 7-6. Shallow Aquifer Water Quality Wells and Nitrate Distribution

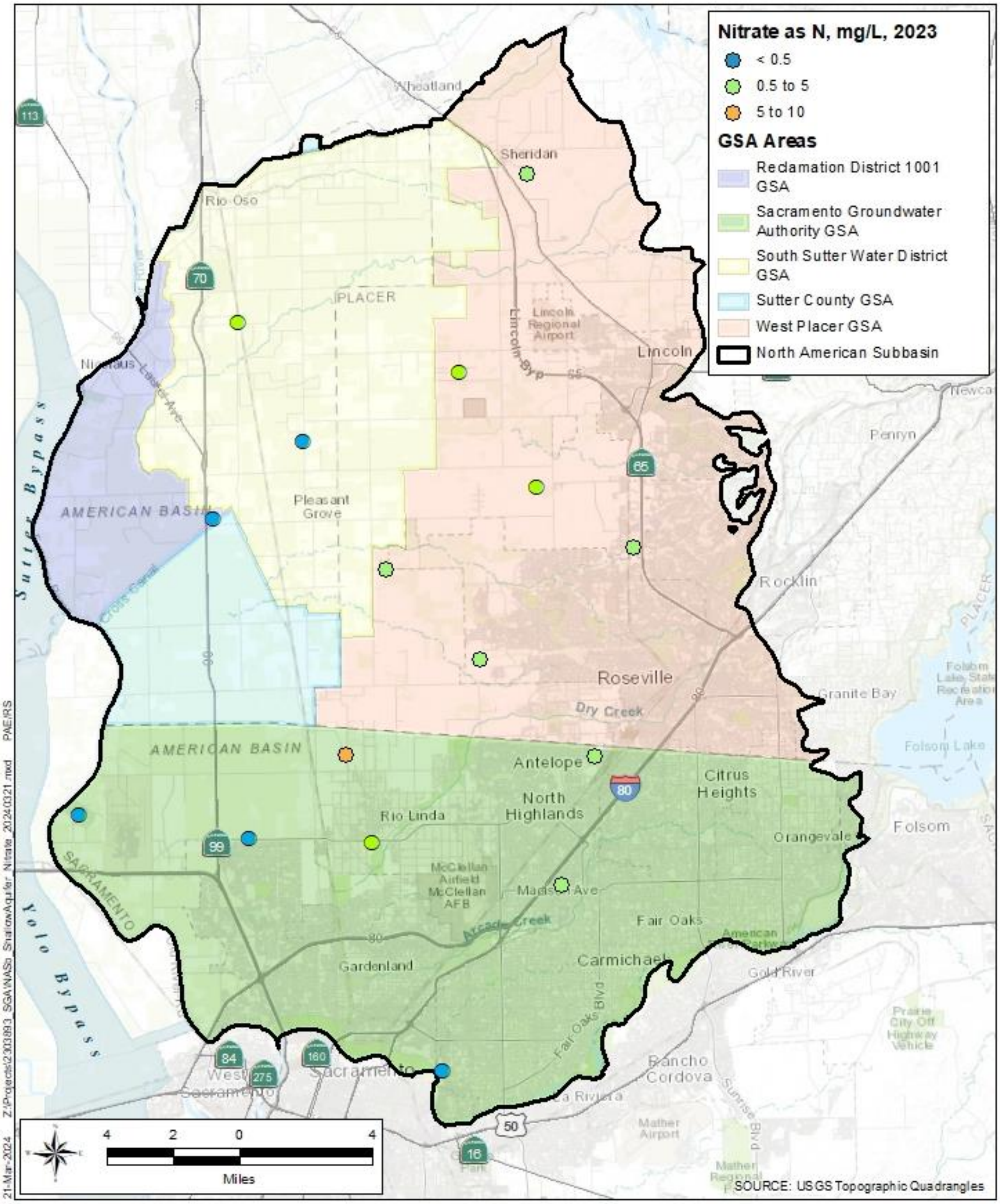


Table 7-8. Shallow Aquifer Total Dissolved Solids Summary

Well Number	Representative Well Number	Local Well Name	20-yr Measurable Objective	Minimum Threshold	2019	2020	2021	2022	2023	5-yr Average	Concentration to 20-year Measurable Objective	
DWR Assigned Well Number, DDW Assigned PWS-Source Number, GeoTracker Assigned Well Number	NASb GSP Water Quality Well Number	Local Well Name	Concentration (mg/L)	Concentration (mg/L)	Concentration (mg/L) Shaded Values Below are Above the Minimum Threshold Value --- Represents No Measurement					WY 2019 - WY2023	5-year Average minus 20-year Measurable Objective (concentration above or below MO)	
388593N1214885W003	17	AB-2 shallow	220	500	200	---	---	---	250	225		5
386635N1213486W001	20	SGA_MW05	300	500	---	---	---	---	98	98		-202
386836N1214536W001	24	SGA_MW02	300	500	---	---	---	---	250	250		-50
386864N1215222W003	27	AB-3 shallow	170	500	150	---	---	---	170	160		-10
388260N1215394W004	37	SUT-P1	120	500	110	---	---	---	97	104		-17
389116N1215238W003	39	AB-1 shallow	150	500	140	---	---	---	170	155		5
387623N1213915W001	46	SVMW West - 1A	TBD	500	---	---	180	---	200	190	---	---
389740N1213606W001	80	Cemetery (IRLP)	290	500	---	---	240	---	260	250		-40
387749N1215975W001	89	Roseview Park - 315	210	500	---	---	---	---	240	240		30
388026N1214432W002	90	WPMW-12A	230	500	210	200	210	---	220	210		-20
388882N1214005W002	91	WPMW-11A	240	500	220	---	210	---	220	217		-23
3400396-001	99	Main Well	TBD	500	---	---	---	---	---	---	---	---
387218N1214677W001	109	SGA_MW01	360	500	---	---	---	---	320	320		-40
L10007939295	133	LW-1	220	500	240	200	220	240	260	232		12
3410002-013	177	Well 22 - Northrop	120	500	---	110	---	---	94	102		-18
3110025-014	298	Tinker Road Well	240	500	160	220	280	200	241	220		-20
3110048-005	299	Well 03	290	500	260	---	---	260	---	260		-30

Notes: --- = sample not acquired; mg/L = milligrams per liter; TBD = to be determined.

Table 7-9. Shallow Aquifer Nitrate Summary

Well Number	Representative Well Number	Local Well Name	20-yr Measurable Objective	Minimum Threshold	2019	2020	2021	2022	2023	5-yr Average	Distance to 20-year Measurable Objective	
DWR Assigned Well Number, DDW Assigned PWS-Source Number, GeoTracker Assigned Well Number	NASb GSP Water Quality Well Number	Local Well Name	Concentration (mg/L)	Concentration (mg/L)	Concentration (mg/L) Shaded Values Below are Above the Minimum Threshold Value --- Represents No Measurement					WY 2019 - WY2023	5-year Average minus 20-year Measurable Objective (concentration above or below MO)	
388593N1214885W003	17	AB-2 shallow	ND	10	---	---	---	---	<0.23	<0.23	ND	ND
386635N1213486W001	20	SGA_MW05	1.7	10	---	---	---	---	0.63	0.63		-1.07
386836N1214536W001	24	SGA_MW02	4.5	10	---	---	---	---	6.2	6.2		1.7
386864N1215222W003	27	AB-3 shallow	ND	10	---	---	---	---	<0.23	<0.23	ND	ND
388260N1215394W004	37	SUT-P1	ND	10	---	---	---	---	<0.23	<0.23	ND	ND
389116N1215238W003	39	AB-1 shallow	ND	10	---	---	---	---	<0.23	<0.23	ND	ND
387623N1213915W001	46	SVMW West - 1A	TBD	10	---	---	1.6	---	1.8	1.7	---	---
389740N1213606W001	80	Cemetery (IRLP)	TBD	10	---	---	1.5	---	1.4	1.45	---	---
387749N1215975W001	89	Roseview Park - 315	TBD	10	---	---	---	---	1.1	1.1	---	---
388026N1214432W002	90	WPMW-12A	0.64	10	0.58	0.33	0.73	---	0.72	0.59		-0.05
388882N1214005W002	91	WPMW-11A	1.1	10	1	---	1.2	---	1.3	1.17		0.07
3400396-001	99	Main Well	ND	10	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	ND	ND
387218N1214677W001	109	SGA_MW01	1	10	---	---	---	---	6	6		5.00
L10007939295	133	LW-1	4	10	3.2	3.6	3.0	3.9	4	3.5		-0.46
3410002-013	177	Well 22 - Northrop	ND	10	<0.4	<0.4	<0.4	<0.4	<0.23	<0.37	ND	ND
3110025-014	298	Tinker Road Well	4.26	10	4.18	3.87	3.83	3.75	3.72	3.87		-0.39
3110048-005	299	Well 03	1.42	10	1.29	1.61	---	1.82	---	1.57		0.15

Notes: --- = sample not acquired; mg/L = milligrams per liter; ND = non-detectable; TBD = to be determined.

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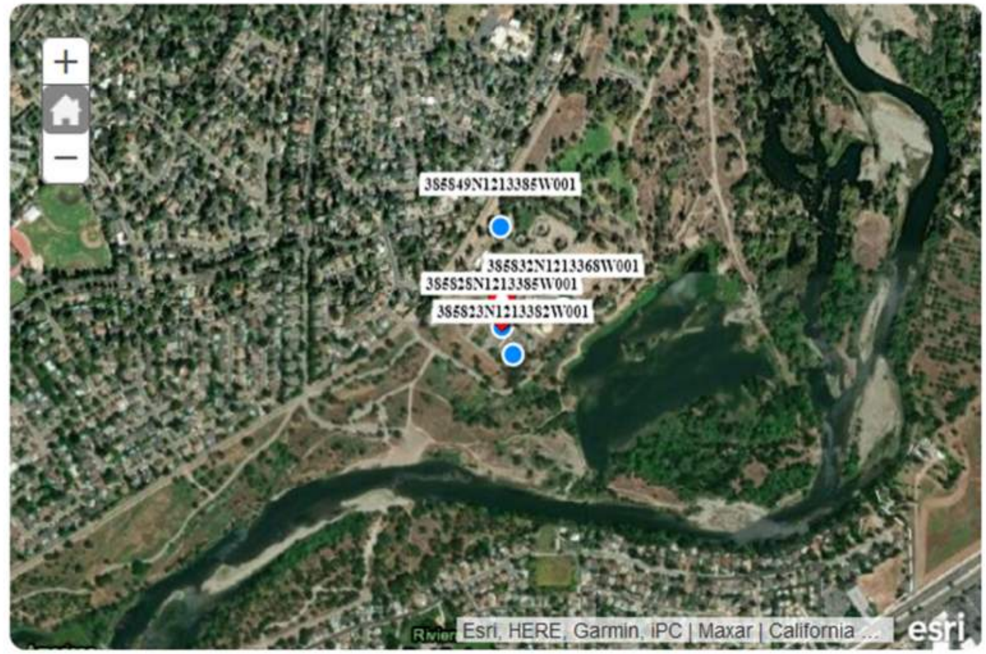
Appendix A RMS Hydrographs

Figure A-1. SGA_MW06, Map No. 2

Site Code: 385828N1213385W001 **State Well Number: Local Well Name:** SGA_MW06

Site Code:	385828N1213385W001
Local Well Name:	SGA_MW06
State Well Number:	
Station ID:	48014
WCR Number:	
Latitude:	38.58281
Longitude:	-121.33846
Station Organization ID:	
Station Organization Name:	
Well Location Description:	100 River Walk Way in Sheriff training facility
Well Use Type:	Observation
Well Completion Type:	Single Well
Well Depth (feet bgs):	72
Top Perforation (feet bgs):	62
Bottom Perforation (feet bgs):	72
Ground Surface Elevation:	49.68
Reference Point Elevation:	49.49
Reference Point Description:	top of casing
Station Comments:	



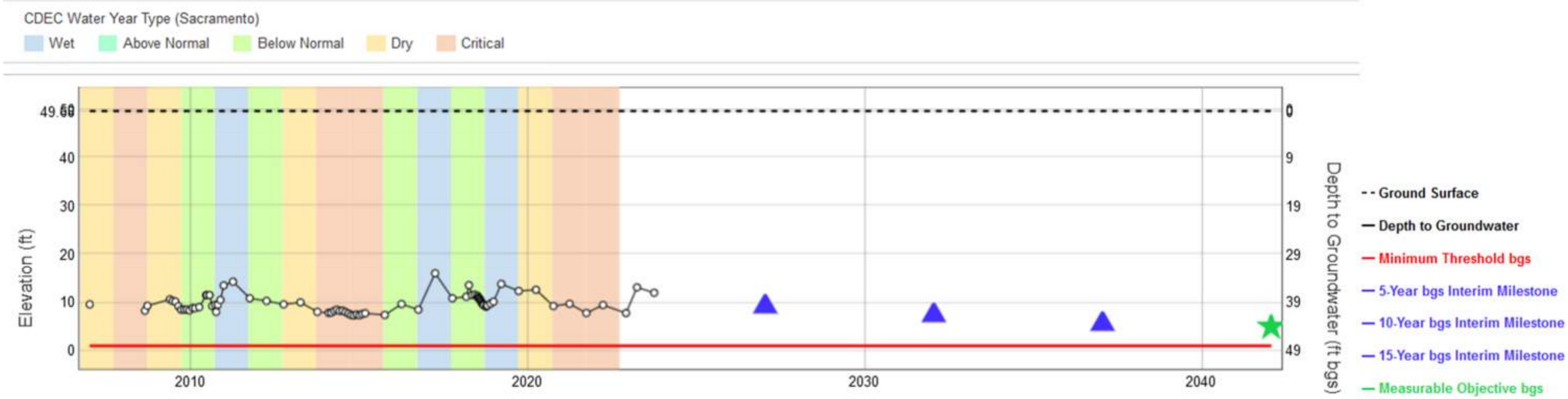


Figure A-2. SGA_MW04, Map No. 3

Site Code: 385841N1214185W001 **State Well Number: Local Well Name:** SGA_MW04

Site Code:	385841N1214185W001
Local Well Name:	SGA_MW04
State Well Number:	
Station ID:	48012
WCR Number:	
Latitude:	38.58414
Longitude:	-121.41852
Station Organization ID:	
Station Organization Name:	
Well Location Description:	Enterprise water storage tank at Enterprise Dr near Howe Ave
Well Use Type:	Observation
Well Completion Type:	Single Well
Well Depth (feet bgs):	65
Top Perforation (feet bgs):	55
Bottom Perforation (feet bgs):	65
Ground Surface Elevation:	36.85
Reference Point Elevation:	38.69
Reference Point Description:	top of casing
Station Comments:	

CDEC Water Year Type (Sacramento)

Wet | Above Normal | Below Normal | Dry | Critical

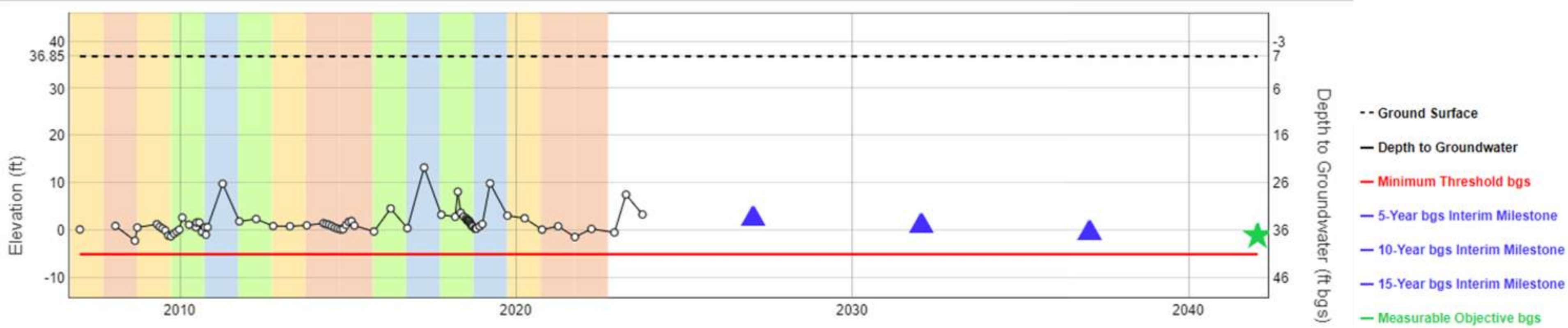


Figure A-3. Bannon Creek Park, Map No. 11

Site Code: 386160N1215054W001 **State Well Number:** 09N04E23R002M **Local Well Name:** Bannon Creek Park

Site Code:	386160N1215054W001
Local Well Name:	Bannon Creek Park
State Well Number:	09N04E23R002M
Station ID:	48041
WCR Number:	
Latitude:	38.61603
Longitude:	-121.50540
Station Organization ID:	
Station Organization Name:	
Well Location Description:	.20 mi north of West El Camino Dr and Azevedo Dr, 14 feet east of sidewalk.
Well Use Type:	Observation
Well Completion Type:	Single Well
Well Depth (feet bgs):	48
Top Perforation (feet bgs):	33
Bottom Perforation (feet bgs):	43
Ground Surface Elevation:	14
Reference Point Elevation:	13.76
Reference Point Description:	top of casing
Station Comments:	

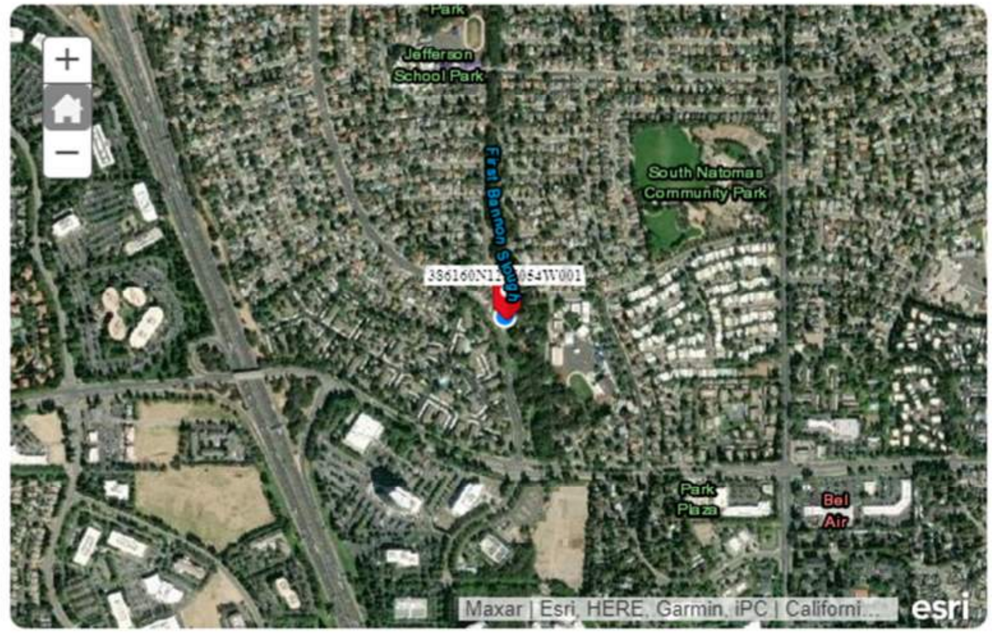


Figure A-4. Chuckwagon Park, Map No. 13

Site Code: 386292N1214877W001 **State Well Number:** 09N04E13R001M **Local Well Name:** Chuckwagon Park

Site Code: 386292N1214877W001
Local Well Name: Chuckwagon Park
State Well Number: 09N04E13R001M
Station ID: 48040
WCR Number:
Latitude: 38.62921
Longitude: -121.48770
Station Organization ID:
Station Organization Name:
Well Location Description: .02 mi west of Chuckwagon Dr and Bridgeford Dr, 15 feet north of sidewalk.
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 52
Top Perforation (feet bgs): 27
Bottom Perforation (feet bgs): 37
Ground Surface Elevation: 12
Reference Point Elevation: 11.71
Reference Point Description: top of casing
Station Comments:

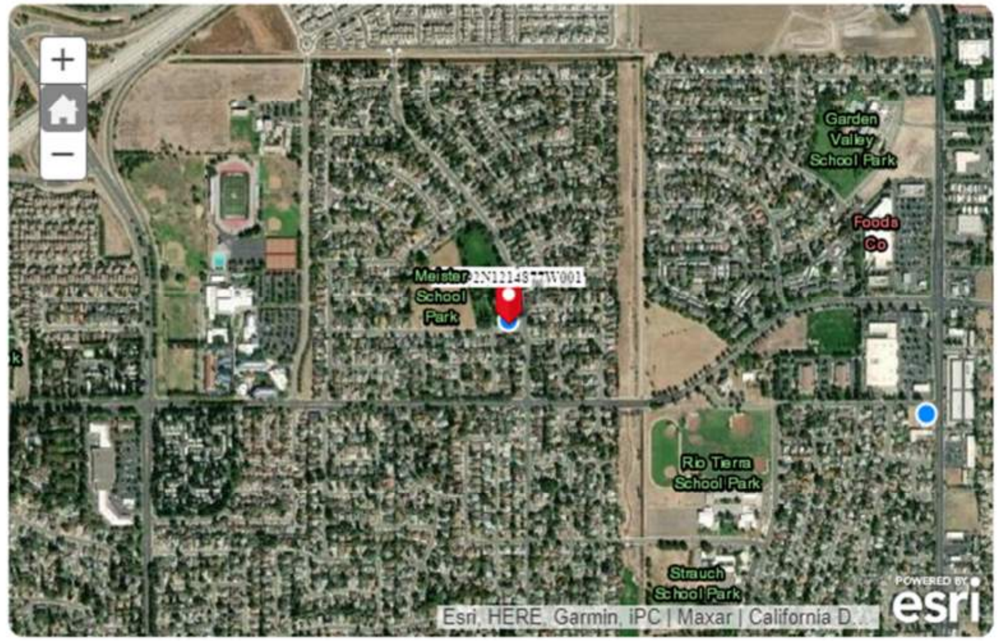
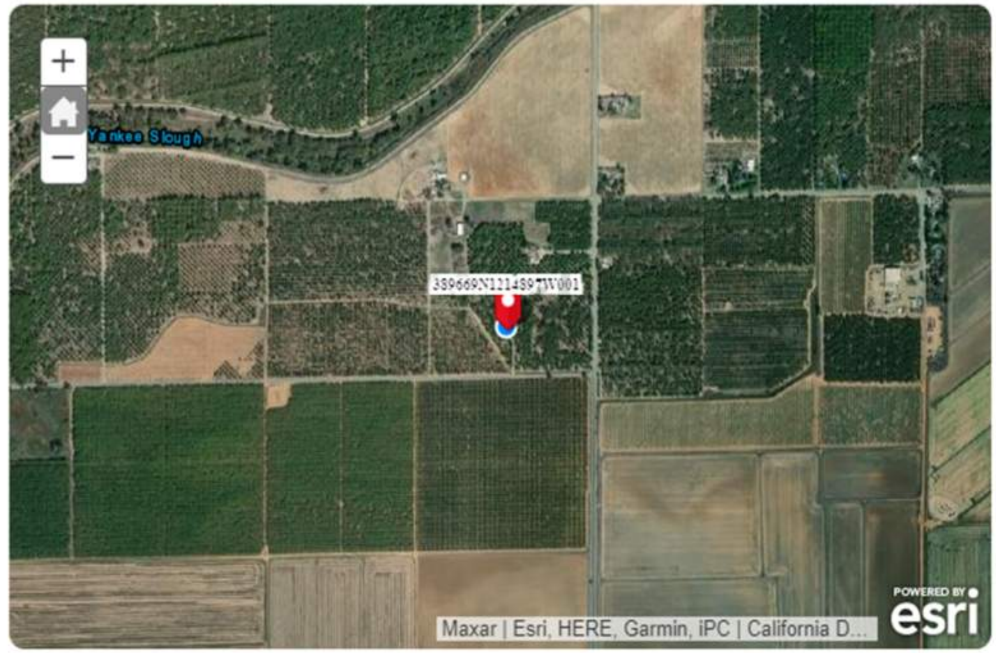


Figure A-5. 13N04E23A002M, Map No. 14

Site Code: 389669N1214897W001 **State Well Number:** 13N04E23A002M **Local Well Name:** 13N04E23A002M

Site Code:	389669N1214897W001
Local Well Name:	13N04E23A002M
State Well Number:	13N04E23A002M
Station ID:	17193
WCR Number:	WCR1954-000963
Latitude:	38.96650
Longitude:	-121.49008
Station Organization ID:	
Station Organization Name:	
Well Location Description:	
Well Use Type:	Residential
Well Completion Type:	Single Well
Well Depth (feet bgs):	83
Top Perforation (feet bgs):	
Bottom Perforation (feet bgs):	
Ground Surface Elevation:	59.28
Reference Point Elevation:	59.28
Reference Point Description:	None Provided
Station Comments:	DWR Surveyed well in 2022.



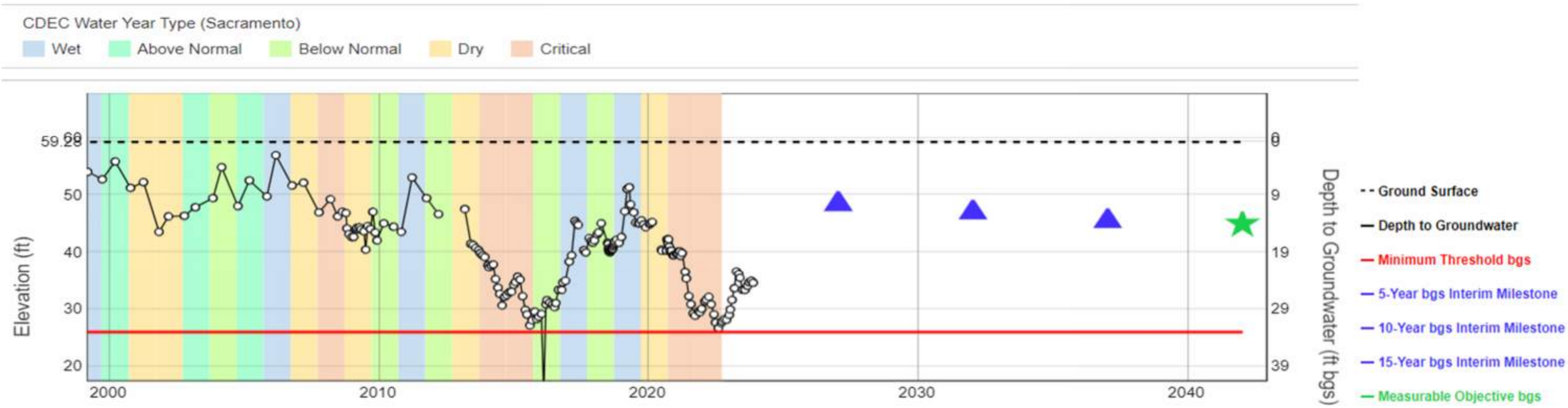


Figure A-6. AB-2 shallow, Map No. 17

Site Code: 388593N1214885W003 **State Well Number:** 12N04E26J004M **Local Well Name:** AB-2 shallow

Site Code: 388593N1214885W003
Local Well Name: AB-2 shallow
State Well Number: 12N04E26J004M
Station ID: 39691
WCR Number:
Latitude: 38.85930
Longitude: -121.48850
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 155
Top Perforation (feet bgs): 135
Bottom Perforation (feet bgs): 145
Ground Surface Elevation: 51.62
Reference Point Elevation: 52.76
Reference Point Description: TOC
Station Comments: This site was surveyed by DWR in late 2014. The new RP and GS elevations reflect the elevations reported in the SR-14-20 - Sacramento Valley NCRO Well Site Survey Report dated 1/14/2015.

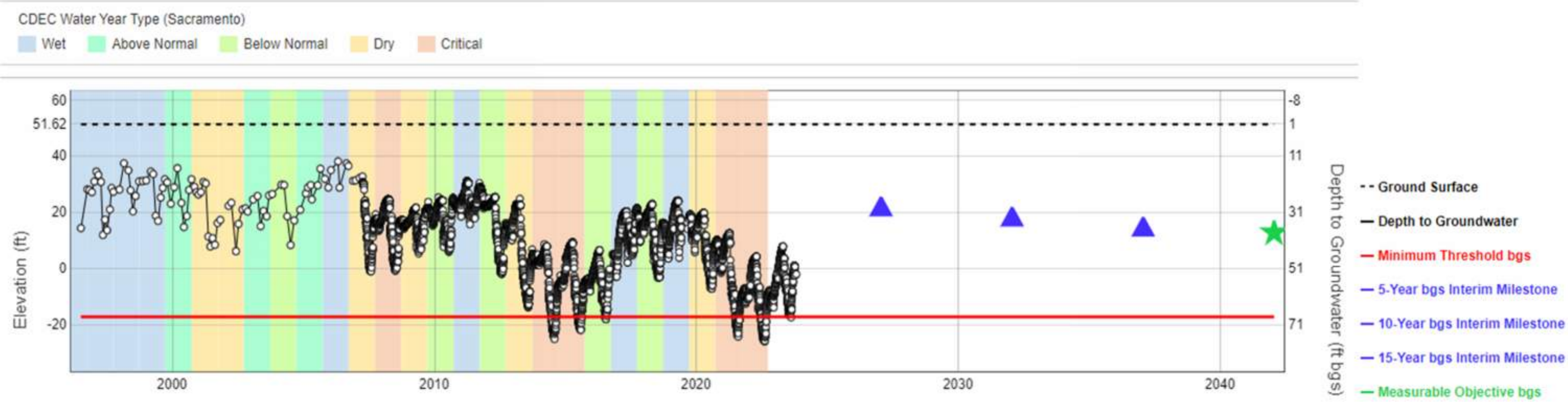
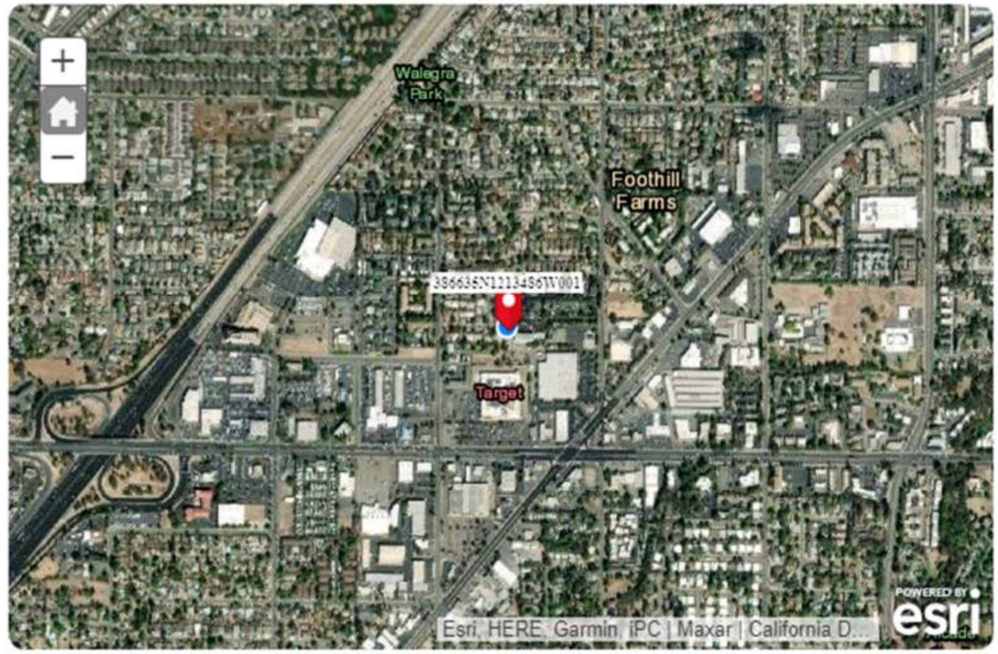


Figure A-7. SGA_MW05, Map No. 20

Site Code: 386635N1213486W001 **State Well Number: Local Well Name:** SGA_MW05

Site Code: 386635N1213486W001
Local Well Name: SGA_MW05
State Well Number:
Station ID: 48013
WCR Number:
Latitude: 38.66347
Longitude: -121.34859
Station Organization ID:
Station Organization Name:
Well Location Description: SSWD Corp Yard 5331 Walnut Ave
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 220
Top Perforation (feet bgs): 205
Bottom Perforation (feet bgs): 215
Ground Surface Elevation: 122.24
Reference Point Elevation: 121.87
Reference Point Description: top of casing
Station Comments:



CDEC Water Year Type (Sacramento)

Wet | Above Normal | Below Normal | Dry | Critical

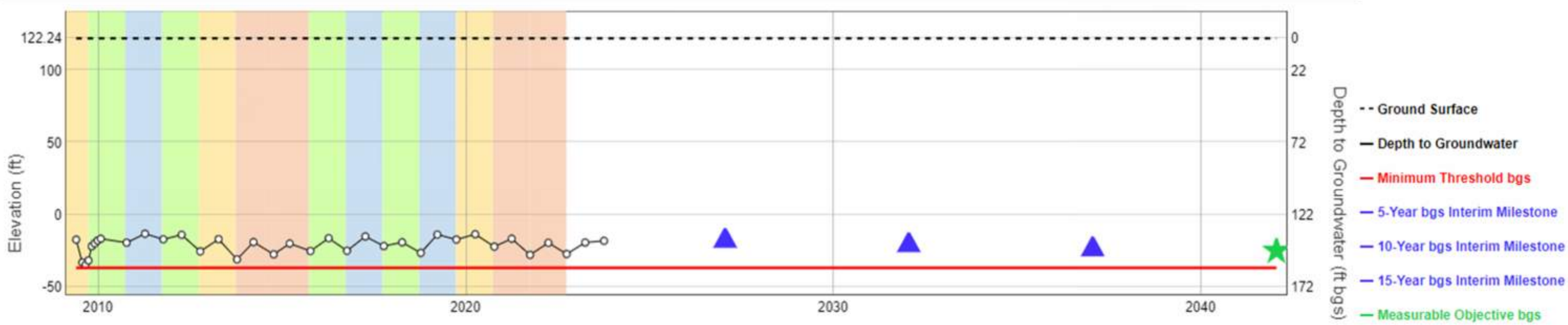


Figure A-8. AB-4 shallow, Map No. 22

Site Code: 386782N1215943W004 **State Well Number:** 10N04E31M004M **Local Well Name:** AB-4 shallow

Site Code: 386782N1215943W004
Local Well Name: AB-4 shallow
State Well Number: 10N04E31M004M
Station ID: 24318
WCR Number:
Latitude: 38.67820
Longitude: -121.59430
Station Organization ID:
Station Organization Name:
Well Location Description: This site was surveyed by DWR in late 2014. The new RP and GS elevations reflect the elevations reported in the SR-14-20 - Sacramento Valley NCRO Well Site Survey Report dated 1/14/2015.
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 200
Top Perforation (feet bgs): 170
Bottom Perforation (feet bgs): 190
Ground Surface Elevation: 16.78
Reference Point Elevation: 18.53
Reference Point Description: TOC
Station Comments: THIS WELL WAS PREVIOUSLY IDENTIFIED BY SWN: 10N03E31M004M. SWN WAS CHANGED TO 10N04E31M004M ON 06-04-2007 (TO CORRECTLY REFLECT WELLS TRS). DWR DATABASES WERE UPDATED WITH CORRECT SWN ON THIS DATE.

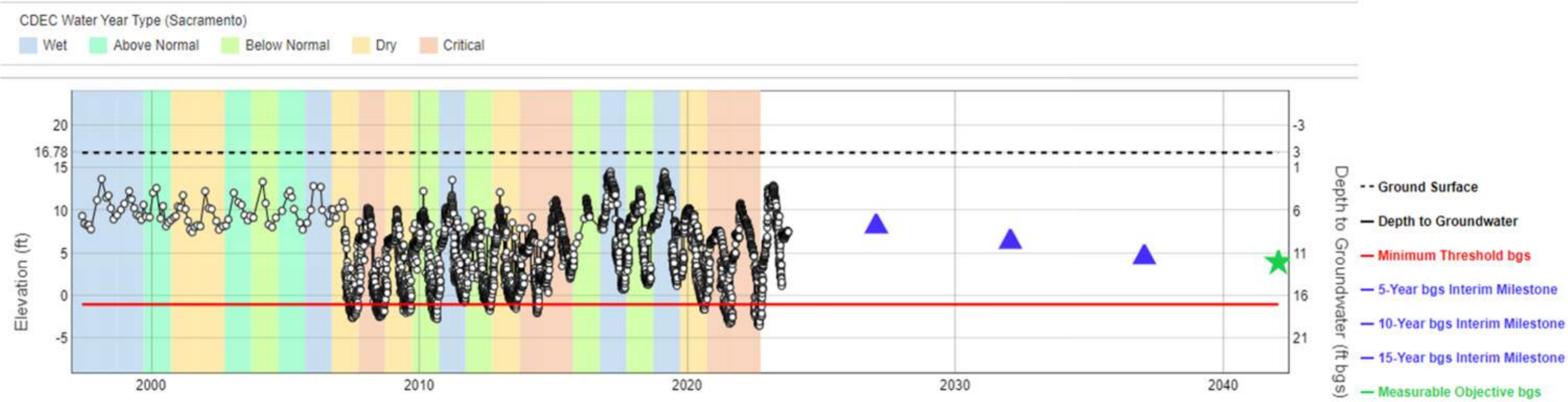
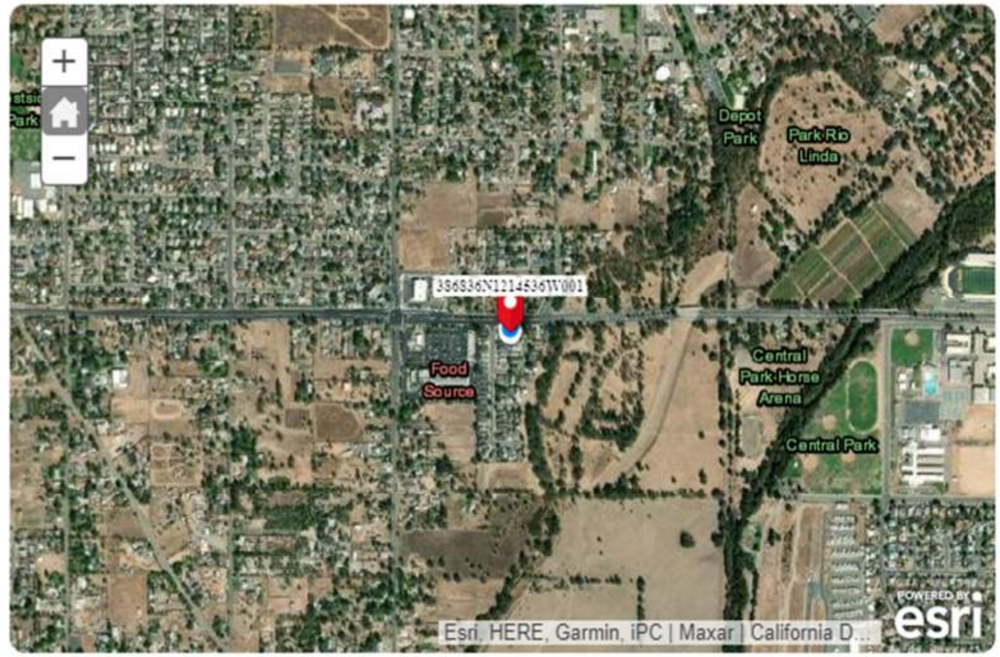


Figure A-9. SGA_MW02, Map No. 24

Site Code: 386836N1214536W001 **State Well Number:** **Local Well Name:** SGA_MW02

Site Code: 386836N1214536W001
Local Well Name: SGA_MW02
State Well Number:
Station ID: 48010
WCR Number:
Latitude: 38.68362
Longitude: -121.45363
Station Organization ID:
Station Organization Name:
Well Location Description: south side of Elkhorn Blvd, 100 feet west of Elkhorn Manor Dr
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 110
Top Perforation (feet bgs): 100
Bottom Perforation (feet bgs): 110
Ground Surface Elevation: 49.11
Reference Point Elevation: 52.39
Reference Point Description: top of casing
Station Comments: northern of the two wells on lot



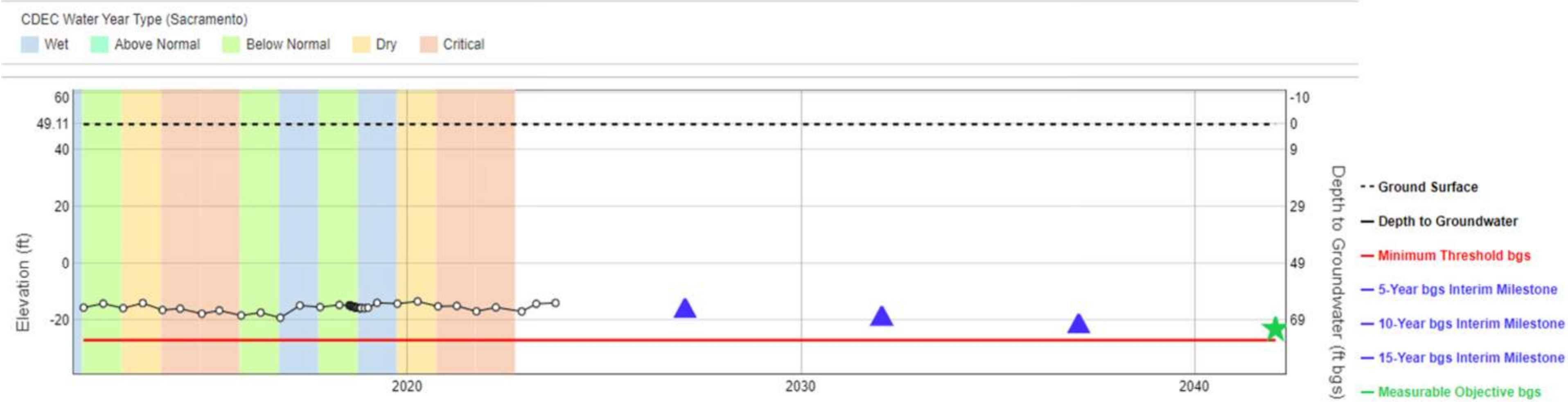
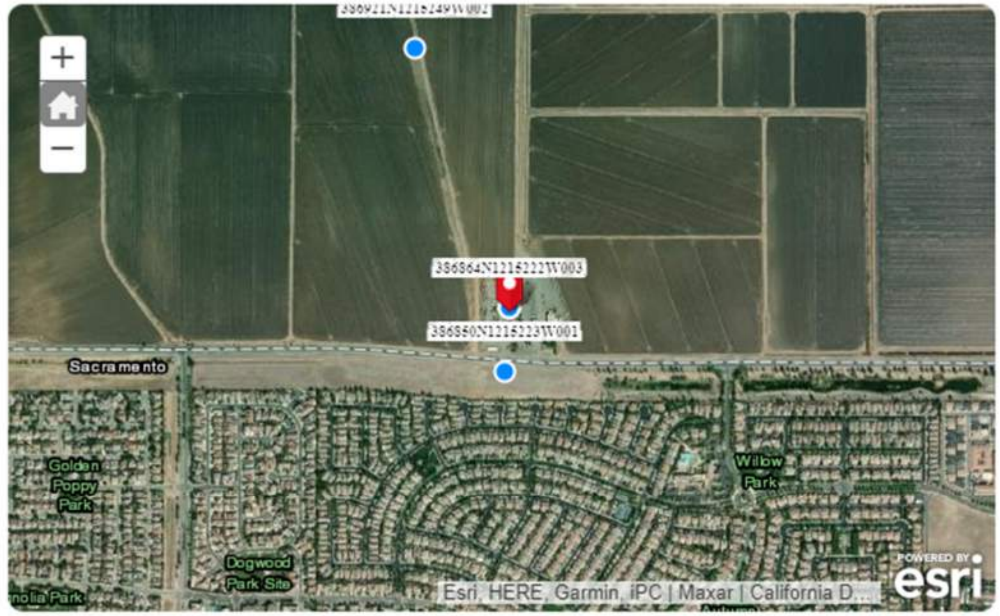


Figure A-10. AB-3 shallow, Map No. 27

Site Code: 386864N1215222W003 **State Well Number:** 10N04E27R004M **Local Well Name:** AB-3 shallow

Site Code: 386864N1215222W003
Local Well Name: AB-3 shallow
State Well Number: 10N04E27R004M
Station ID: 15690
WCR Number:
Latitude: 38.68640
Longitude: -121.52220
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 220
Top Perforation (feet bgs): 190
Bottom Perforation (feet bgs): 210
Ground Surface Elevation: 27.34
Reference Point Elevation: 28.31
Reference Point Description: TOC
Station Comments: This site was surveyed by DWR in late 2014. The new RP and GS elevations reflect the elevations reported in the SR-14-20 - Sacramento Valley NCRO Well Site Survey Report dated 1/14/2015.



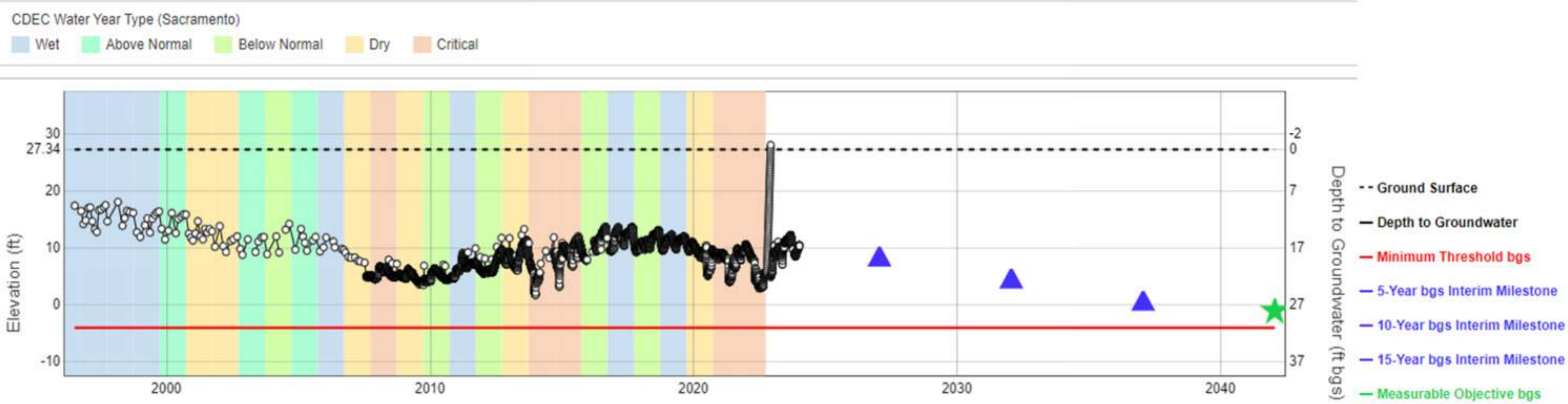
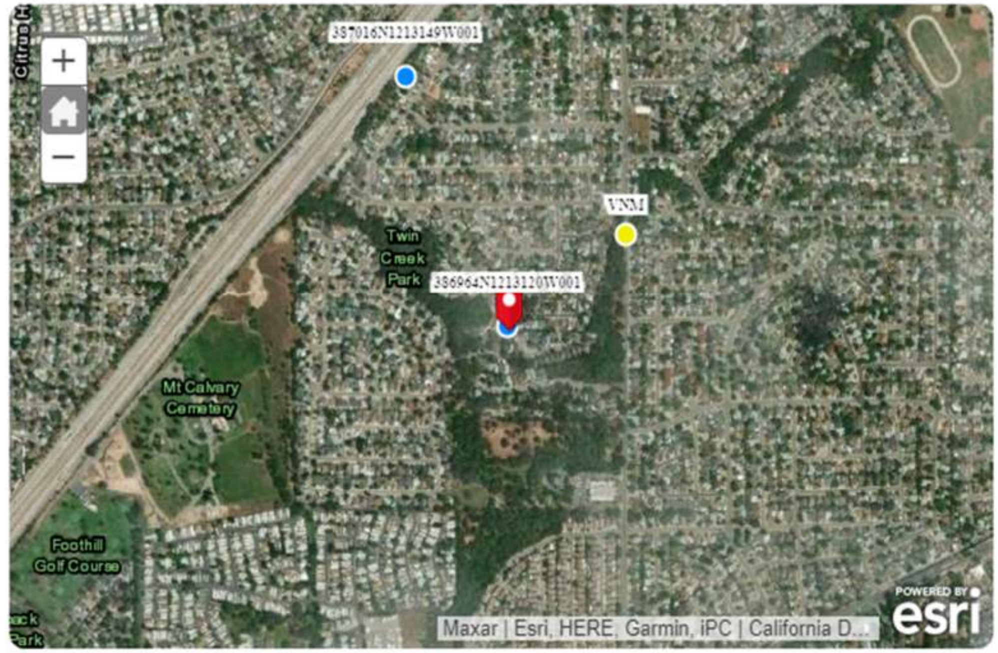


Figure A-11. Twin Creeks Park, Map No. 28

Site Code: 386964N1213120W001 **State Well Number:** 10N06E27F001M **Local Well Name:** Twin Creeks Park

Site Code: 386964N1213120W001
Local Well Name: Twin Creeks Park
State Well Number: 10N06E27F001M
Station ID: 48042
WCR Number:
Latitude: 38.69640
Longitude: -121.31203
Station Organization ID:
Station Organization Name:
Well Location Description: Intersection of Starflower Dr and Creekmont Way 30' south of sidewalk.
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 198
Top Perforation (feet bgs): 183
Bottom Perforation (feet bgs): 193
Ground Surface Elevation: 122
Reference Point Elevation: 121.8
Reference Point Description: top of casing
Station Comments:



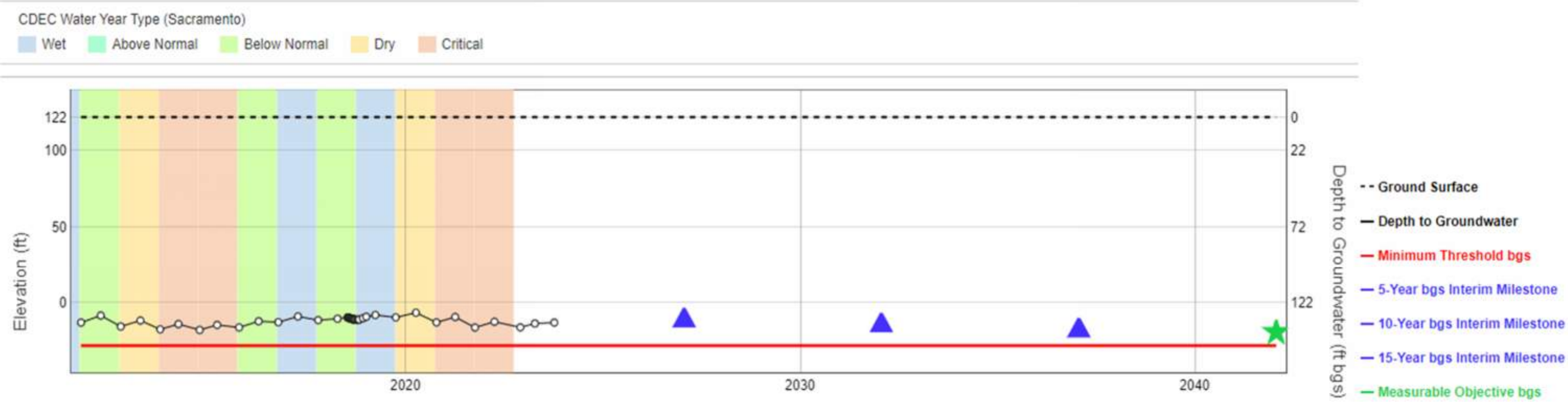
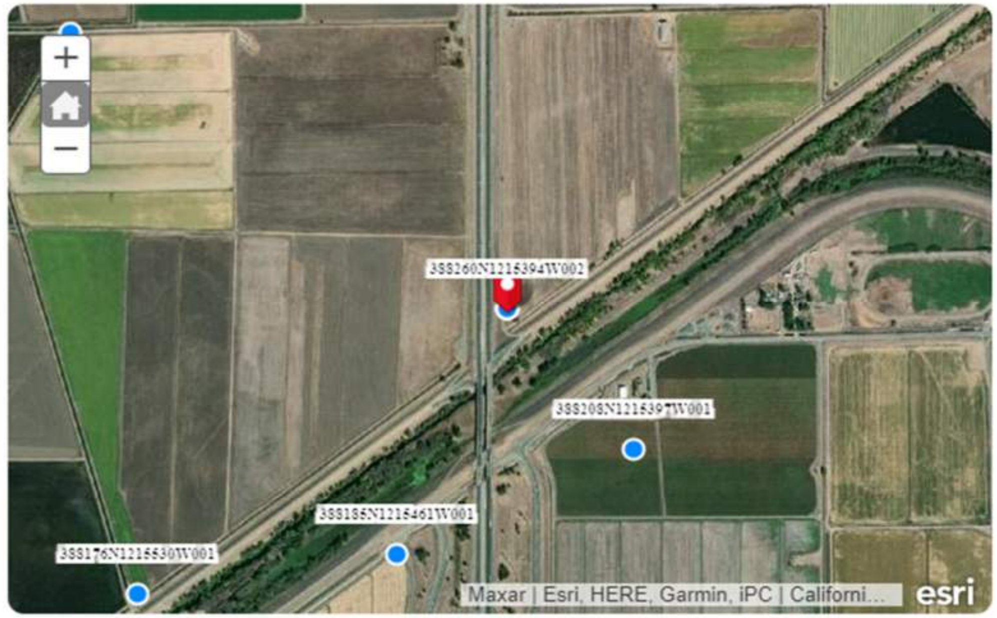
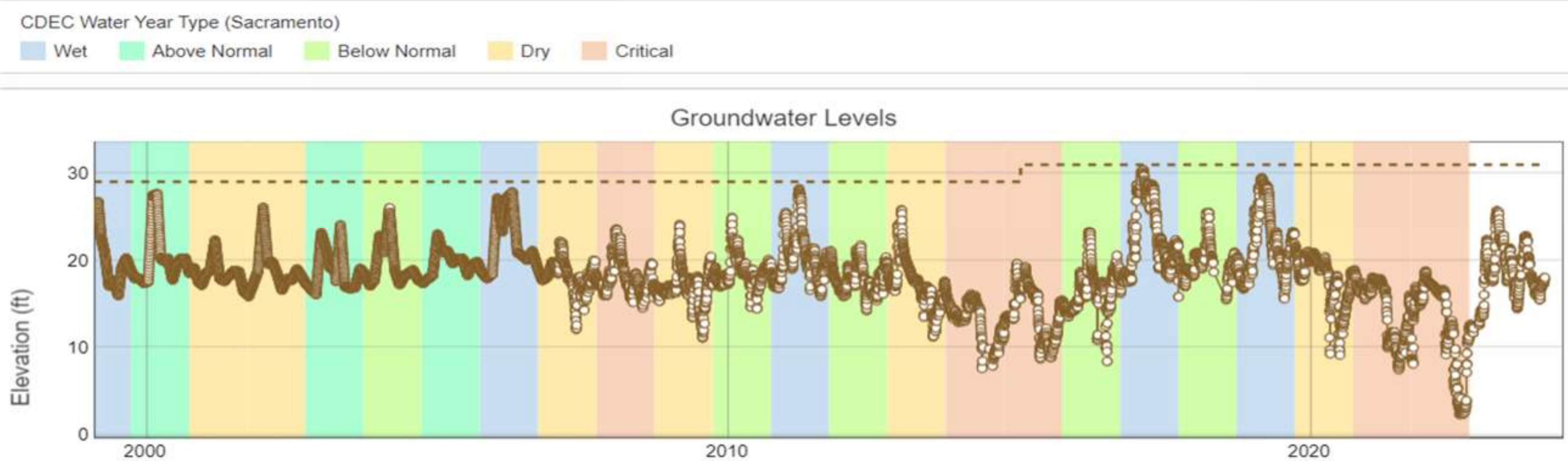


Figure A-12. SUT-P1, Map No. 37

Site Code: 388260N1215394W004 **State Well Number:** 11N04E04N004M **Local Well Name:** SUT-P1

Site Code: 388260N1215394W004
Local Well Name: SUT-P1
State Well Number: 11N04E04N004M
Station ID: 25773
WCR Number: WCR1993-003719
Latitude: 38.82388
Longitude: -121.54310
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 120
Top Perforation (feet bgs): 110
Bottom Perforation (feet bgs): 120
Ground Surface Elevation: 31
Reference Point Elevation: 32.31
Reference Point Description: TOC
Station Comments: This site was surveyed by DWR in late 2014. The new RP and GS elevations reflect the elevations reported in the SR-14-20 - Sacramento Valley NCRO Well Site Survey Report dated 1/14/2015.



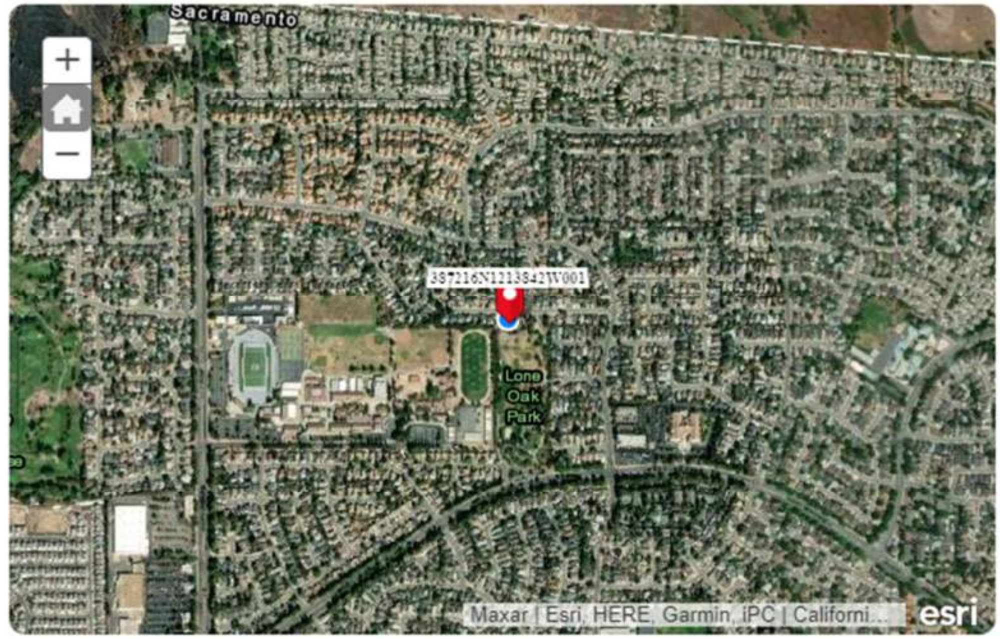


Note: MT, IMs and MO not being displayed on SGMA dataview.

Figure A-13. Lone Oak Park, Map No. 38

Site Code: 387216N1213842W001 **State Well Number:** 10N05E13F001M **Local Well Name:** Lone Oak Park

Site Code: 387216N1213842W001
Local Well Name: Lone Oak Park
State Well Number: 10N05E13F001M
Station ID: 48043
WCR Number:
Latitude: 38.72163
Longitude: -121.38417
Station Organization ID:
Station Organization Name:
Well Location Description: .15 mi W of intersection of Esterbrook Way and Black Eagle Drive, 60' S of sidewalk
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 166
Top Perforation (feet bgs): 151
Bottom Perforation (feet bgs): 161
Ground Surface Elevation: 106
Reference Point Elevation: 105.77
Reference Point Description: top of casing
Station Comments:



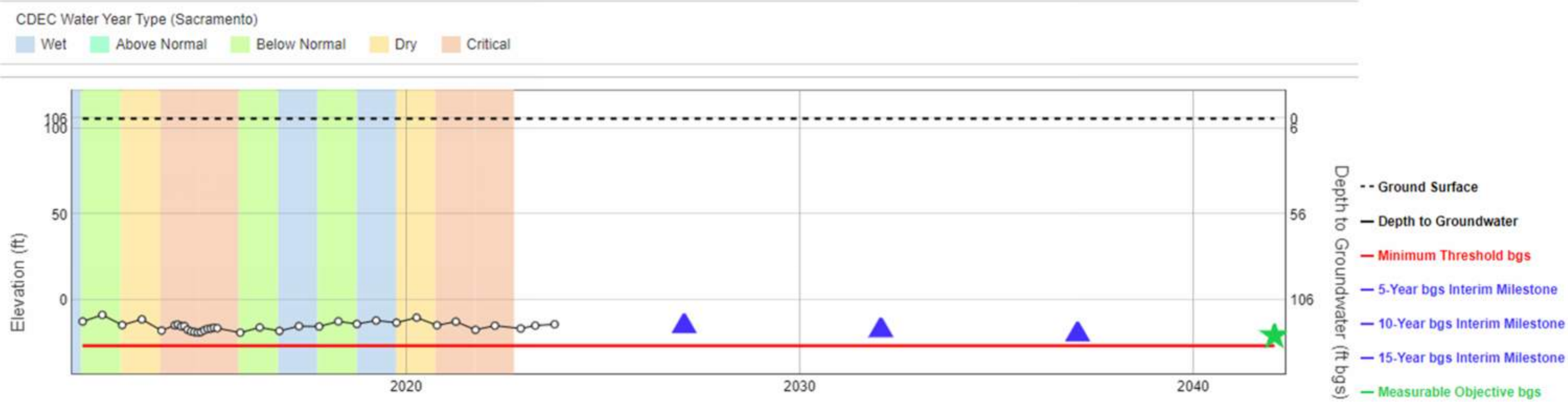
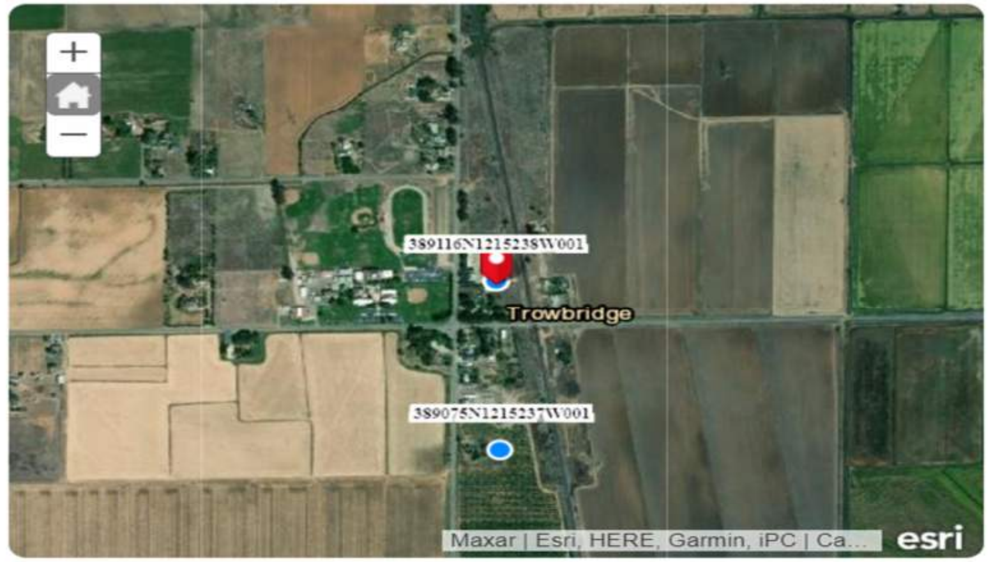


Figure A-14. AB-1 shallow, Map No. 39

Site Code: 389116N1215238W003 **State Well Number:** 12N04E03N004M **Local Well Name:** AB-1 shallow

Site Code: 389116N1215238W003
Local Well Name: AB-1 shallow
State Well Number: 12N04E03N004M
Station ID: 17023
WCR Number:
Latitude: 38.91160
Longitude: -121.52380
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 190
Top Perforation (feet bgs): 170
Bottom Perforation (feet bgs): 180
Ground Surface Elevation: 48.96
Reference Point Elevation: 50.58
Reference Point Description: TOC
Station Comments: This site was surveyed by DWR in late 2014. The new RP and GS elevations reflect the elevations reported in the SR-14-20 - Sacramento Valley NCRO Well Site Survey Report dated 1/14/2015.



CDEC Water Year Type (Sacramento)

Wet Above Normal Below Normal Dry Critical

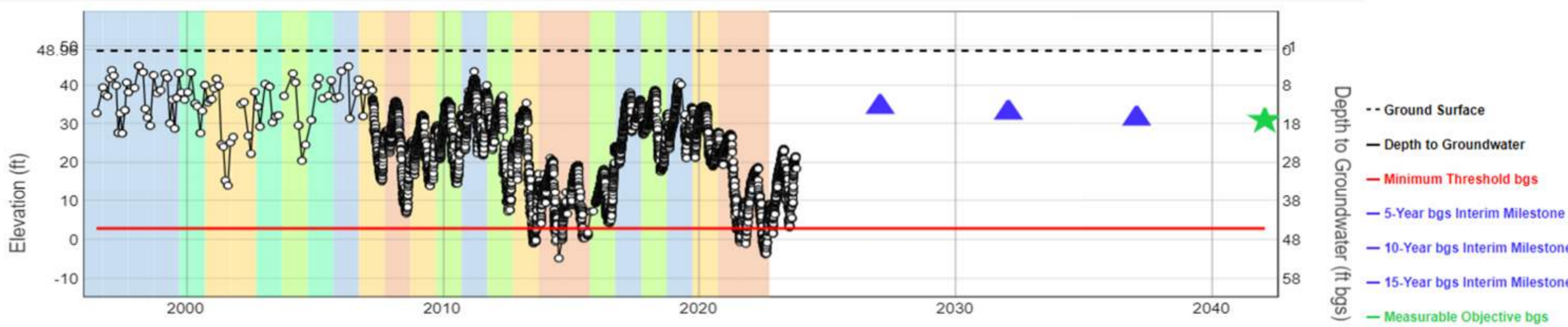


Figure A-15. WPMW-10A, Map No. 44

Site Code: 387515N1212725W001 **State Well Number: Local Well Name:** WPMW-10A

Site Code: 387515N1212725W001
Local Well Name: WPMW-10A
State Well Number:
Station ID: 51287
WCR Number:
Latitude: 38.75149
Longitude: -121.27251
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 36
Top Perforation (feet bgs): 26
Bottom Perforation (feet bgs): 36
Ground Surface Elevation: 150.98
Reference Point Elevation: 153.21
Reference Point Description: Notch on PVC Casing
Station Comments: City of Roseville Well

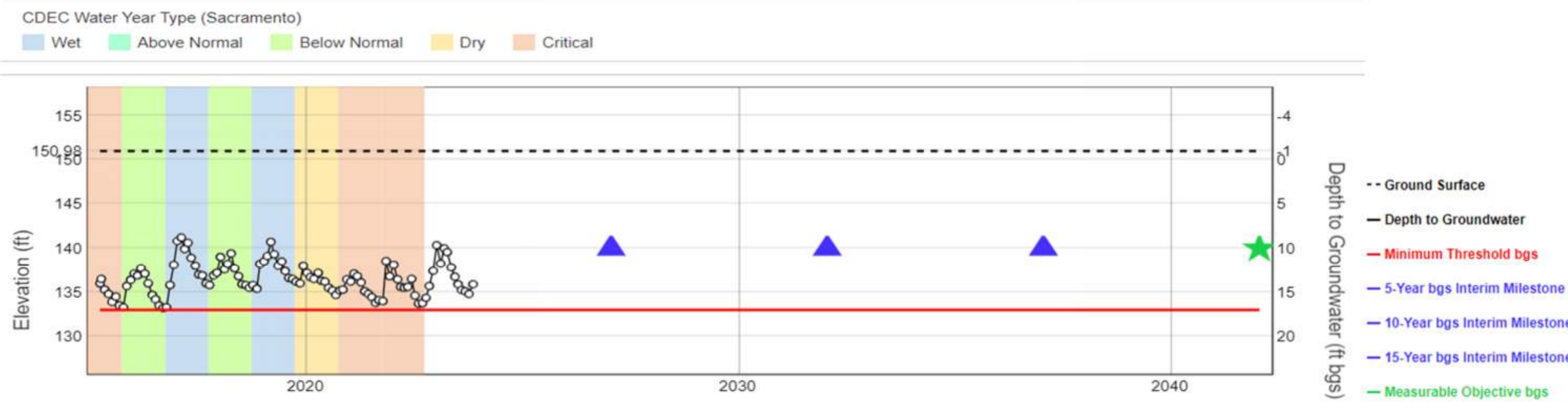


Figure A-16. WPMW-9A, Map No. 45

Site Code: 387517N1212727W001 **State Well Number: Local Well Name:** WPMW-9A

Site Code:	387517N1212727W001
Local Well Name:	WPMW-9A
State Well Number:	
Station ID:	51286
WCR Number:	
Latitude:	38.75167
Longitude:	-121.27266
Station Organization ID:	
Station Organization Name:	
Well Location Description:	
Well Use Type:	Observation
Well Completion Type:	Single Well
Well Depth (feet bgs):	36
Top Perforation (feet bgs):	26
Bottom Perforation (feet bgs):	36
Ground Surface Elevation:	152.4
Reference Point Elevation:	154.66
Reference Point Description:	Notch on PVC Casing
Station Comments:	City of Roseville Well

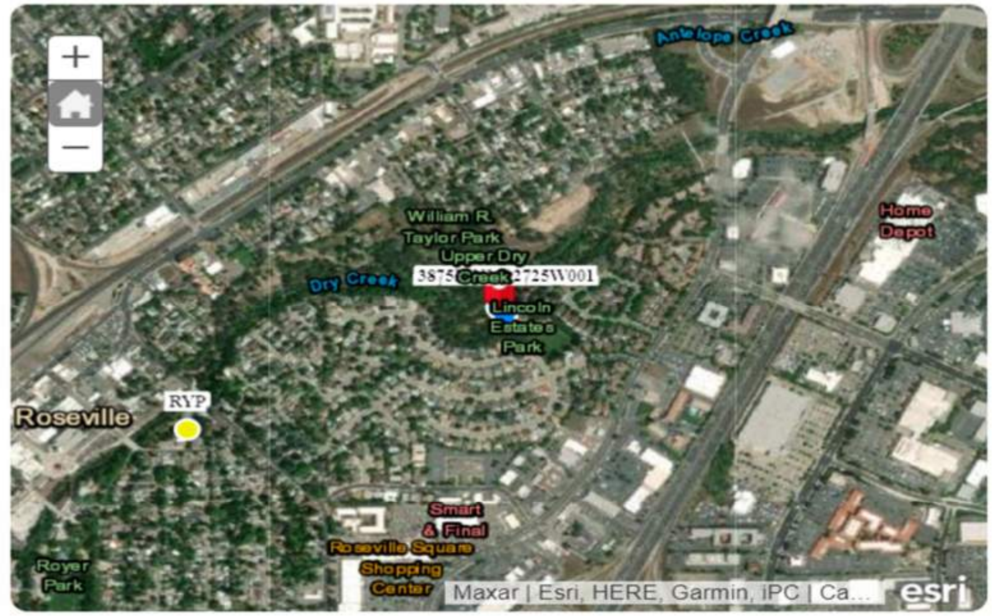


Figure A-17. SVMW West - 1A, Map No. 46

Site Code: 387623N1213915W001 **State Well Number:** **Local Well Name:** SVMW West - 1A

Site Code: 387623N1213915W001
Local Well Name: SVMW West - 1A
State Well Number:
Station ID: 48573
WCR Number:
Latitude: 38.76232
Longitude: -121.39153
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 145
Top Perforation (feet bgs): 120
Bottom Perforation (feet bgs): 140
Ground Surface Elevation: 91.56
Reference Point Elevation: 94.25
Reference Point Description: notch on casing
Station Comments:

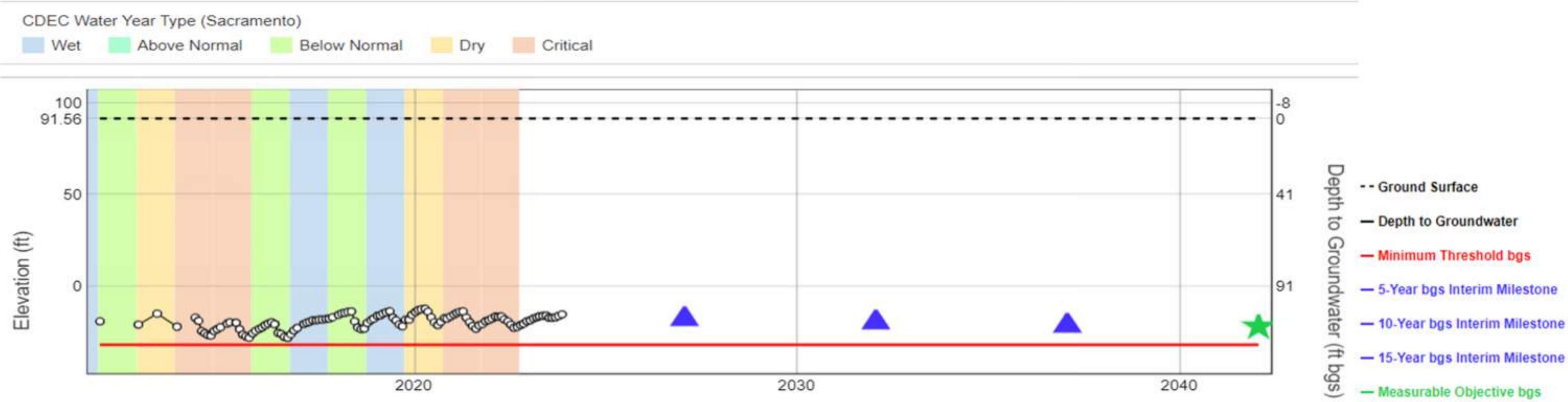


Figure A-18. WPMW-4A, Map No. 48

Site Code: 387755N1212753W001 **State Well Number:** **Local Well Name:** WPMW-4A

Site Code: 387755N1212753W001
Local Well Name: WPMW-4A
State Well Number:
Station ID: 48567
WCR Number:
Latitude: 38.77554
Longitude: -121.27525
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 145
Top Perforation (feet bgs): 120
Bottom Perforation (feet bgs): 140
Ground Surface Elevation: 180.02
Reference Point Elevation: 181.67
Reference Point Description: notch on casing
Station Comments:

CDEC Water Year Type (Sacramento)
Wet Above Normal Below Normal Dry Critical

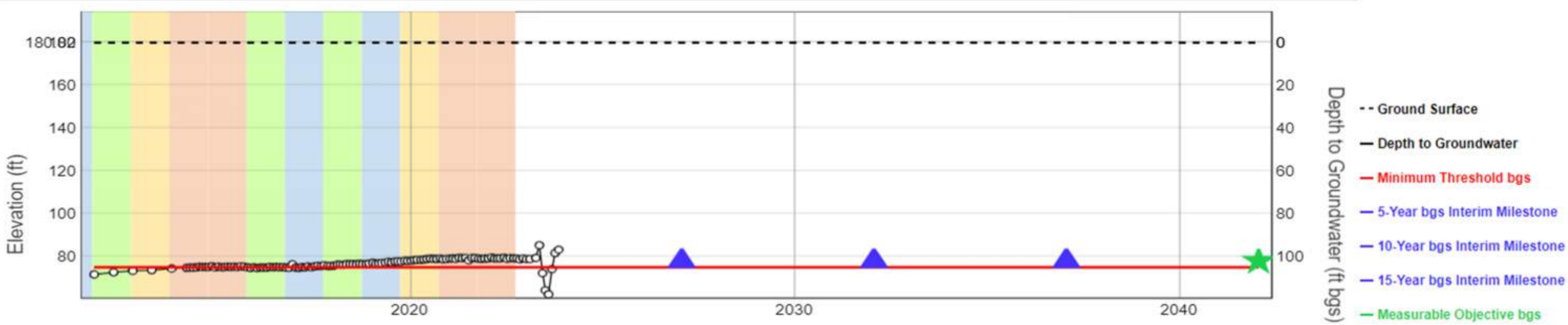


Figure A-19. WPMW-2A, Map No. 60

Site Code: 388145N1213491W001 **State Well Number:** **Local Well Name:** WPMW-2A

Site Code: 388145N1213491W001
Local Well Name: WPMW-2A
State Well Number:
Station ID: 48563
WCR Number:
Latitude: 38.81450
Longitude: -121.34914
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 230
Top Perforation (feet bgs): 215
Bottom Perforation (feet bgs): 225
Ground Surface Elevation: 105.69
Reference Point Elevation: 108.2
Reference Point Description: notch on casing
Station Comments: PCWA well

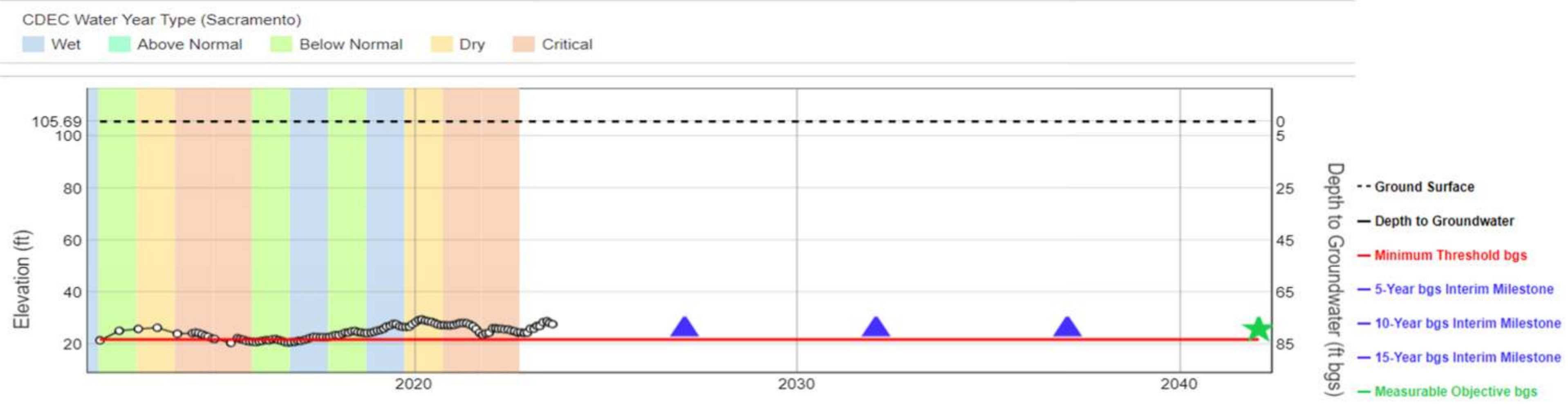
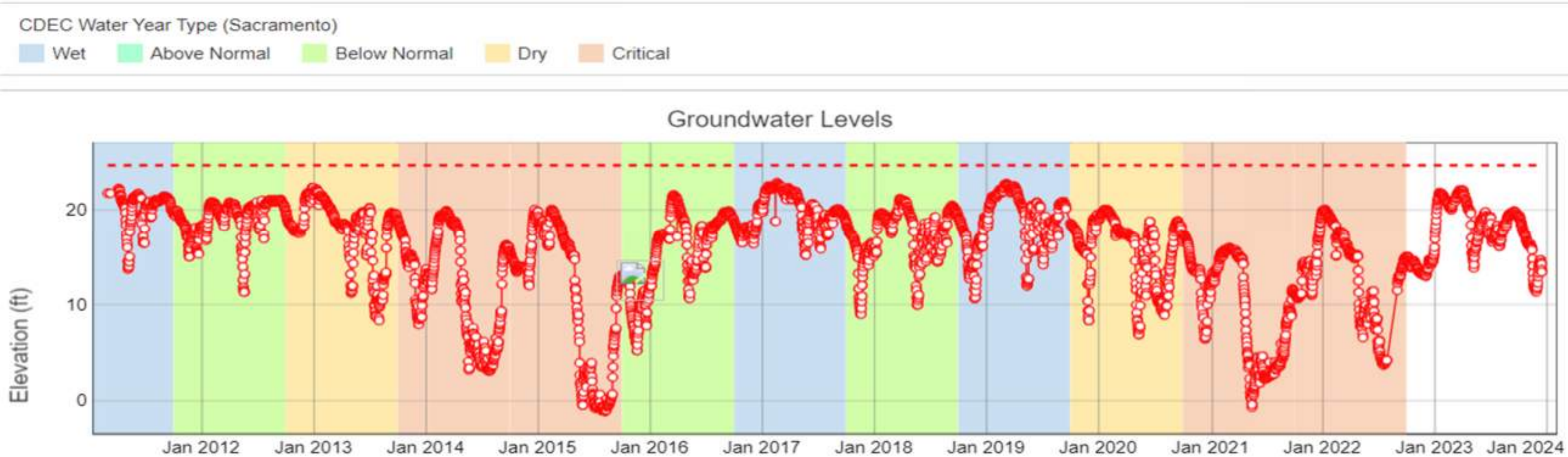


Figure A-20. Sutter County MW-5A, Map No. 61

Site Code: 388235N1216079W001 **State Well Number:** 11N03E02Q002M **Local Well Name:** Sutter County MW-5A

Site Code: 388235N1216079W001
Local Well Name: Sutter County MW-5A
State Well Number: 11N03E02Q002M
Station ID: 47776
WCR Number: WCR0016059
Latitude: 38.82324
Longitude: -121.60763
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 170
Top Perforation (feet bgs): 130
Bottom Perforation (feet bgs): 160
Ground Surface Elevation: 24.71
Reference Point Elevation: 26.45
Reference Point Description: North Edge of Casing
Station Comments: NAVD88. Managed by Department of Water Resources.



Note: MT, IMs and MO not being displayed on SGMA dataview.

Figure A-21. WPMW-3A, Map No. 63

Site Code: 388476N1212872W001 **State Well Number: Local Well Name:** WPMW-3A

Site Code: 388476N1212872W001
Local Well Name: WPMW-3A
State Well Number:
Station ID: 48565
WCR Number:
Latitude: 38.84761
Longitude: -121.28719
Station Organization ID:
Station Organization Name:
Well Location Description: At Lincoln lift station, intersection of E. Joiner Pkwy & Fieldstone Dr
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 53
Top Perforation (feet bgs): 48
Bottom Perforation (feet bgs): 53
Ground Surface Elevation: 148.45
Reference Point Elevation: 150.95
Reference Point Description: notch on casing
Station Comments: Lincoln well

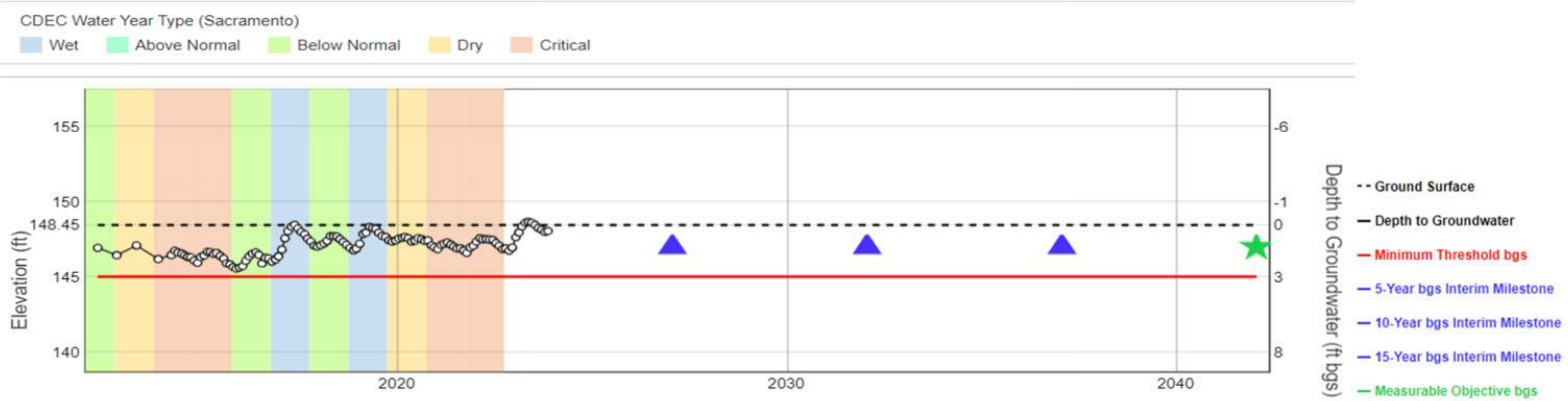
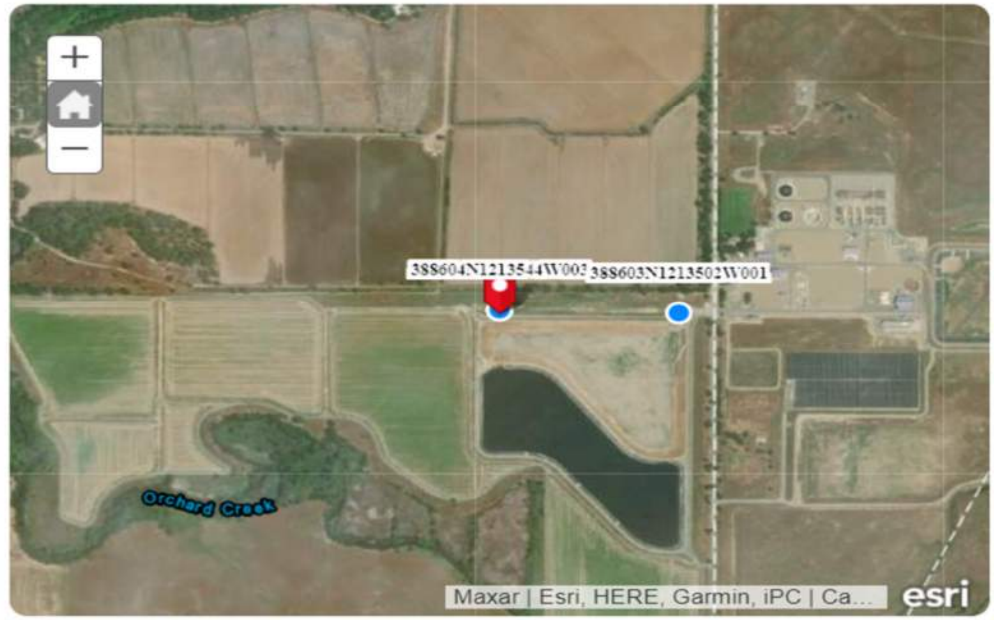


Figure A-22. MW 1-3, Map No. 65

Site Code: 388604N1213544W003 **State Well Number: Local Well Name:** MW 1-3

Site Code: 388604N1213544W003
Local Well Name: MW 1-3
State Well Number:
Station ID: 49929
WCR Number:
Latitude: 38.86038
Longitude: -121.35438
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 204
Top Perforation (feet bgs): 184
Bottom Perforation (feet bgs): 204
Ground Surface Elevation: 111
Reference Point Elevation: 113.81
Reference Point Description: Top of SW casing
Station Comments: Lincoln well



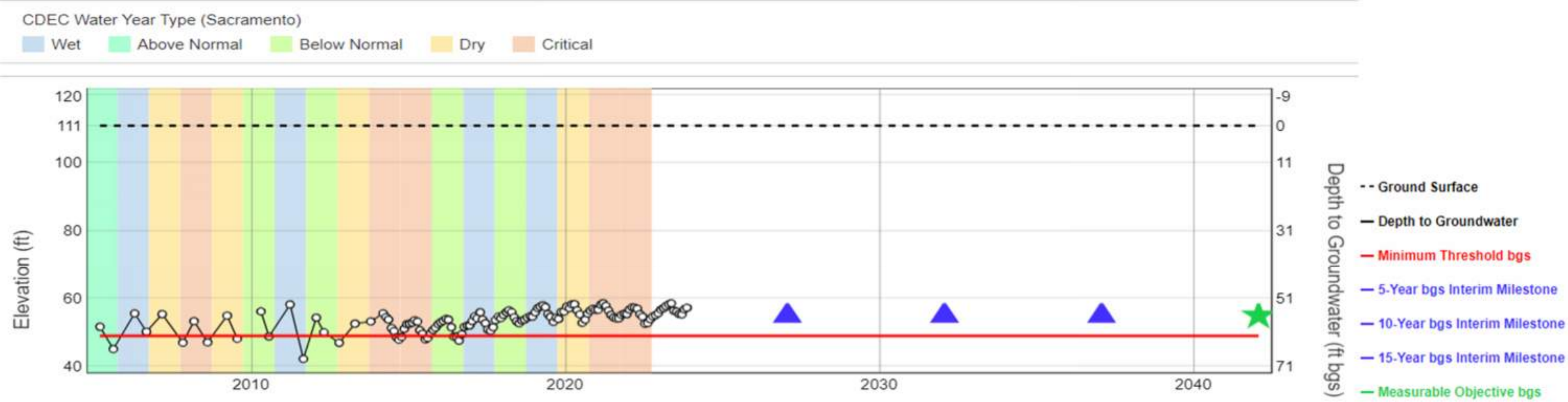


Figure A-23. MW 5-2, Map No.66

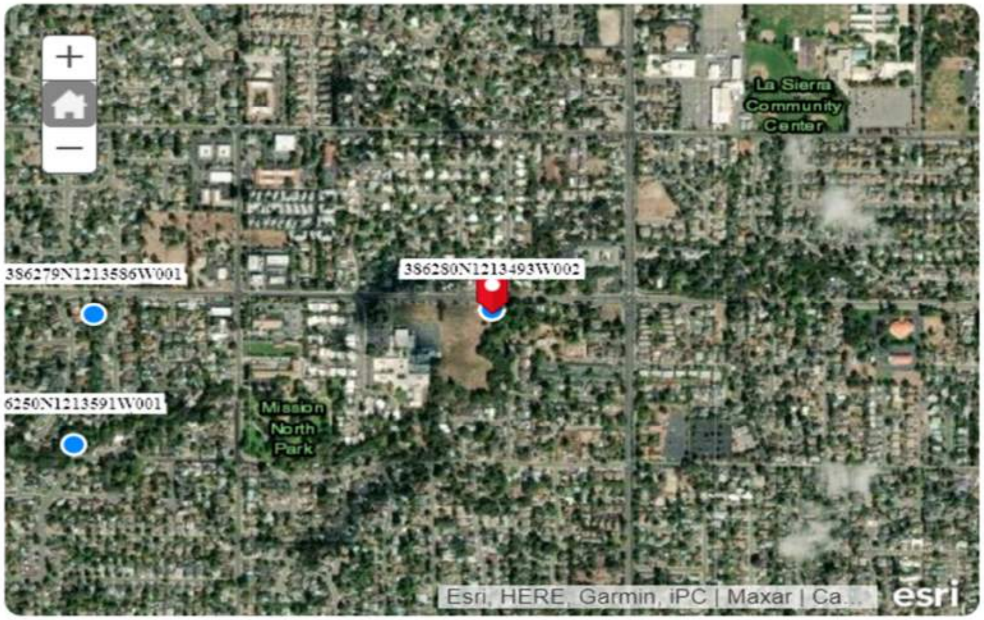
Site Code: 388826N1213078W002 **State Well Number: Local Well Name:** MW 5-2

Site Code: 388826N1213078W002
Local Well Name: MW 5-2
State Well Number:
Station ID: 49938
WCR Number:
Latitude: 38.88258
Longitude: -121.30775
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 62
Top Perforation (feet bgs): 52
Bottom Perforation (feet bgs): 62
Ground Surface Elevation: 146
Reference Point Elevation: 148.65
Reference Point Description: Top of S casing
Station Comments: Lincoln well

Figure A-24. WCMSS, Map No. 71

Site Code: 386280N1213493W001 **State Well Number: Local Well Name:** WCMSS

Site Code: 386280N1213493W001
Local Well Name: WCMSS
State Well Number:
Station ID: 52461
WCR Number:
Latitude: 38.62799
Longitude: -121.34925
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 170
Top Perforation (feet bgs): 130
Bottom Perforation (feet bgs): 150
Ground Surface Elevation: 91
Reference Point Elevation: 90.74
Reference Point Description: Pipe Sleeve
Station Comments:



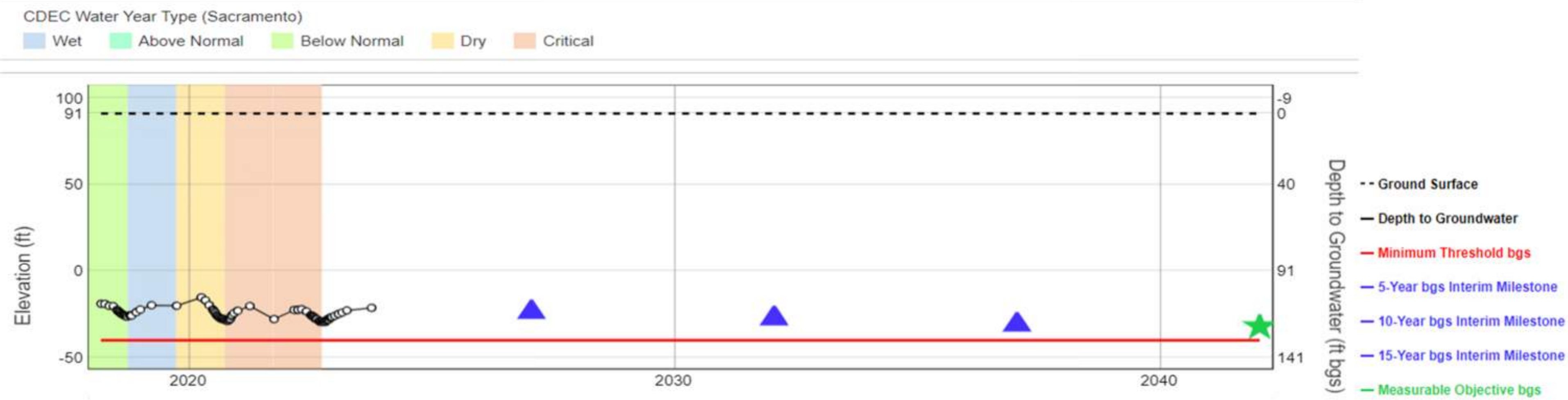


Figure A-25. MW 2-3, Map No. 75

Site Code: 389255N1213566W003 **State Well Number: Local Well Name:** MW 2-3

Site Code:	389255N1213566W003
Local Well Name:	MW 2-3
State Well Number:	
Station ID:	49933
WCR Number:	
Latitude:	38.92547
Longitude:	-121.35663
Station Organization ID:	
Station Organization Name:	
Well Location Description:	
Well Use Type:	Observation
Well Completion Type:	Part of a nested/multi-completion well
Well Depth (feet bgs):	85
Top Perforation (feet bgs):	75
Bottom Perforation (feet bgs):	85
Ground Surface Elevation:	125
Reference Point Elevation:	127.67
Reference Point Description:	Top of S casing
Station Comments:	Lincoln well

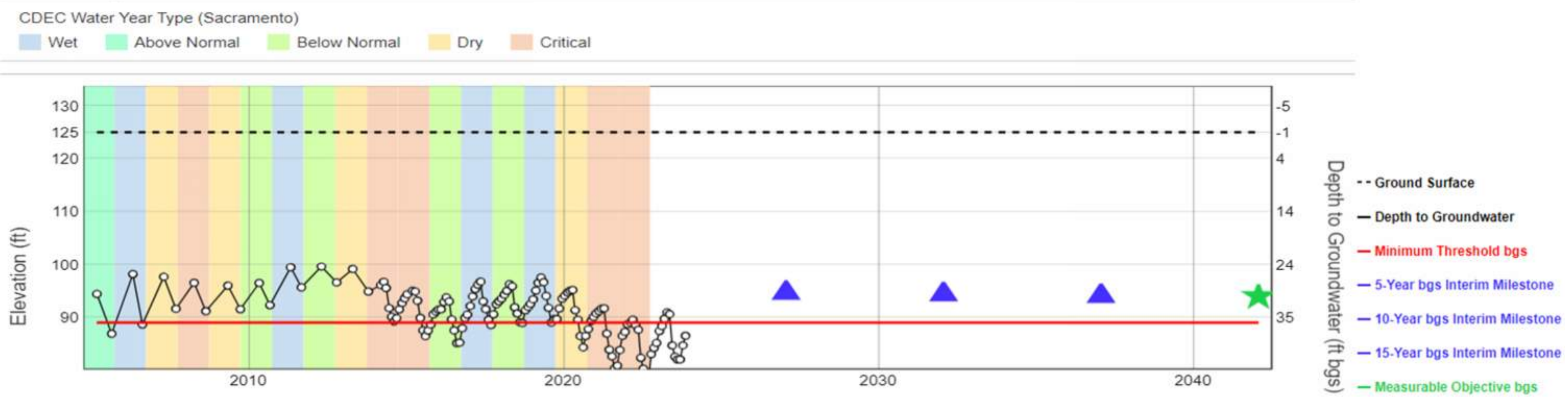


Figure A-26. SREL-1-27-F1, Map No. 77

Site Code: 387749N1215975W001 **State Well Number: Local Well Name:** SREL-1-27-F1

Site Code: 387749N1215975W001
Local Well Name: SREL-1-27-F1
State Well Number:
Station ID: 57541
WCR Number:
Latitude: 38.77491
Longitude: -121.59753
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 49
Top Perforation (feet bgs):
Bottom Perforation (feet bgs):
Ground Surface Elevation: 31
Reference Point Elevation: 30.76
Reference Point Description: Top of casing
Station Comments:

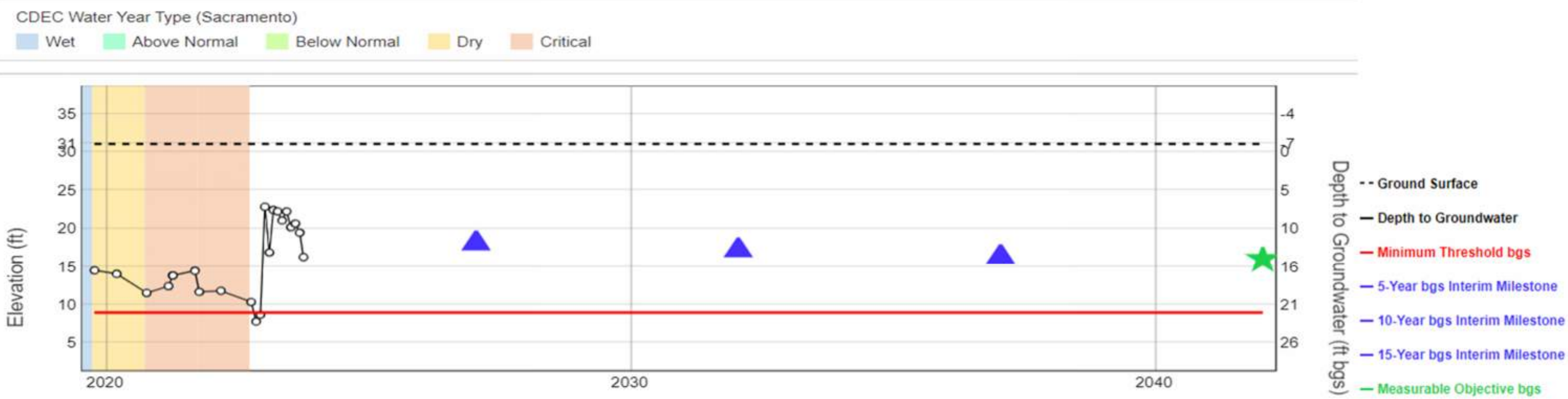


Figure A-27. Roseview Park - 315, Map No. 89

Site Code: 387191N1213287W001 **State Well Number: Local Well Name:** Roseview Park - 315

Site Code: 387191N1213287W001
Local Well Name: Roseview Park - 315
State Well Number:
Station ID: 57530
WCR Number:
Latitude: 38.71912
Longitude: -121.32879
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 315
Top Perforation (feet bgs): 295
Bottom Perforation (feet bgs): 305
Ground Surface Elevation: 157
Reference Point Elevation: 156.84
Reference Point Description: Top of casing
Station Comments:

CDEC Water Year Type (Sacramento)
Wet Above Normal Below Normal Dry Critical

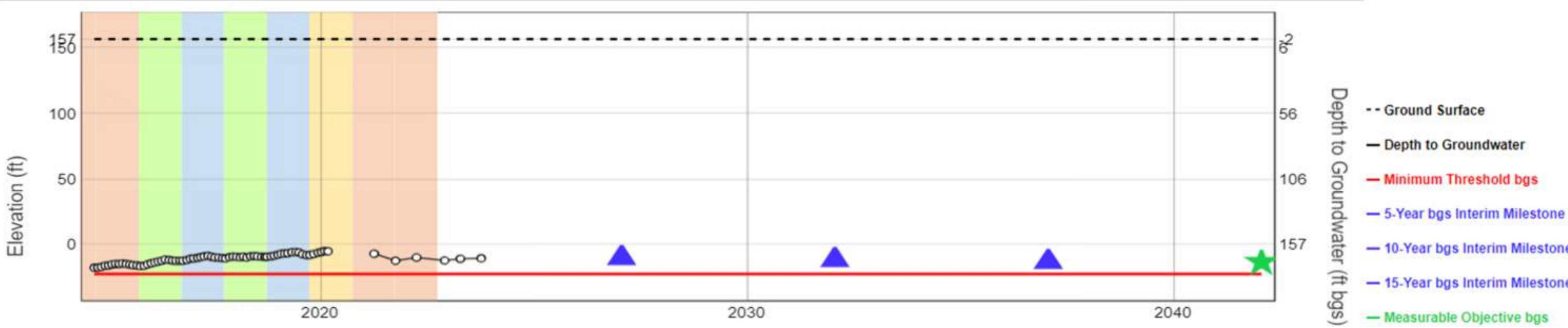


Figure A-28. WPMW-12A, Map No. 90

Site Code: 388026N1214432W002 **State Well Number: Local Well Name:** WPMW-12A

Site Code: 388026N1214432W002
Local Well Name: WPMW-12A
State Well Number:
Station ID: 54777
WCR Number:
Latitude: 38.80264
Longitude: -121.44322
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 300
Top Perforation (feet bgs): 260
Bottom Perforation (feet bgs): 280
Ground Surface Elevation: 67.64
Reference Point Elevation: 69.62
Reference Point Description: Top of PVC Casing
Station Comments:

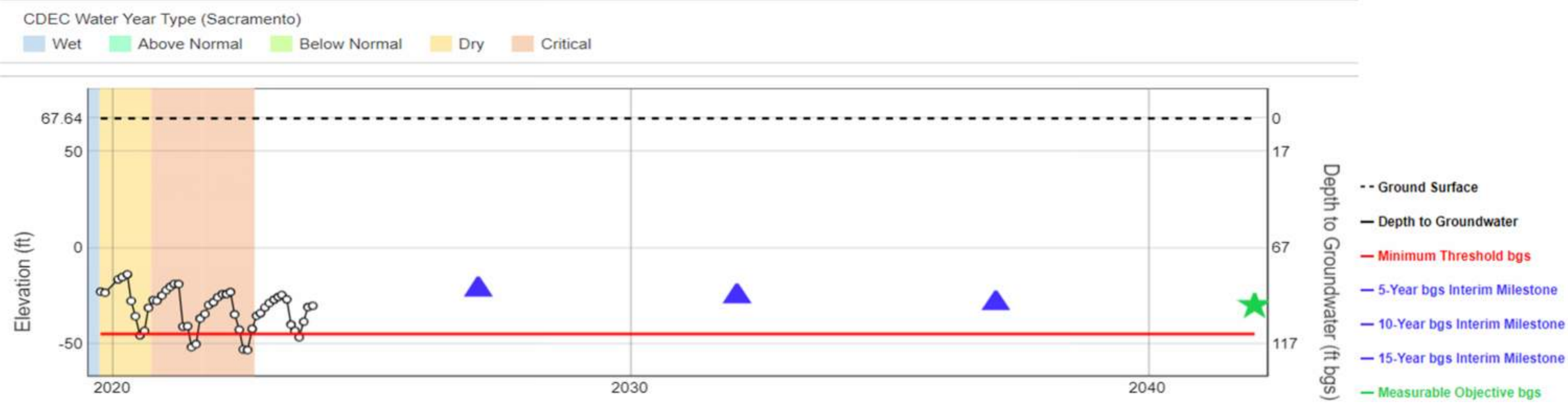


Figure A-29. WPMW-11A, Map No. 91

Site Code: 388882N1214005W002 **State Well Number: Local Well Name:** WPMW-11A

Site Code: 388882N1214005W002
Local Well Name: WPMW-11A
State Well Number:
Station ID: 54779
WCR Number:
Latitude: 38.88816
Longitude: -121.40046
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 162
Top Perforation (feet bgs): 132
Bottom Perforation (feet bgs): 152
Ground Surface Elevation: 89.35
Reference Point Elevation: 92.07
Reference Point Description: Top of PVC casing
Station Comments:

Figure A-30. RDMW-101, Map No. 92

Site Code: 388829N1216110W001 **State Well Number: Local Well Name:** RDMW-101

Site Code: 388829N1216110W001
Local Well Name: RDMW-101
State Well Number:
Station ID: 57539
WCR Number:
Latitude: 38.88294
Longitude: -121.61105
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 48
Top Perforation (feet bgs): 28
Bottom Perforation (feet bgs): 43
Ground Surface Elevation: 30.17
Reference Point Elevation: 30.18
Reference Point Description: Top of casing
Station Comments:

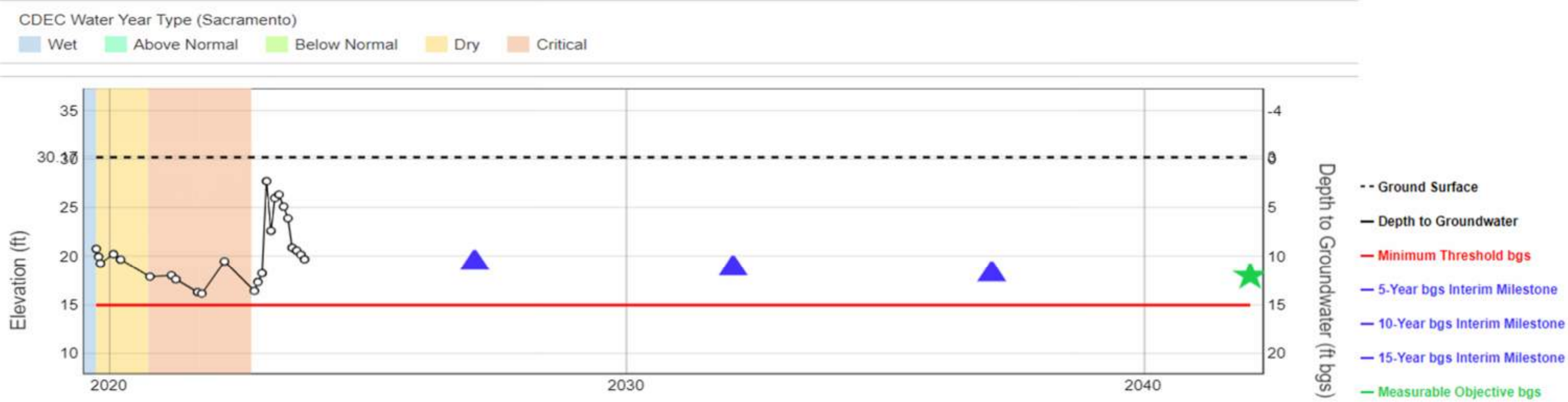


Figure A-31. RDMW-102, Map No. 93

Site Code: 388798N1215885W001 **State Well Number: Local Well Name:** RDMW-102

Site Code: 388798N1215885W001
Local Well Name: RDMW-102
State Well Number:
Station ID: 57540
WCR Number:
Latitude: 38.87987
Longitude: -121.58853
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 48
Top Perforation (feet bgs): 28
Bottom Perforation (feet bgs): 43
Ground Surface Elevation: 30.62
Reference Point Elevation: 30.47
Reference Point Description: Top of casing
Station Comments:

CDEC Water Year Type (Sacramento)

Wet | Above Normal | Below Normal | Dry | Critical

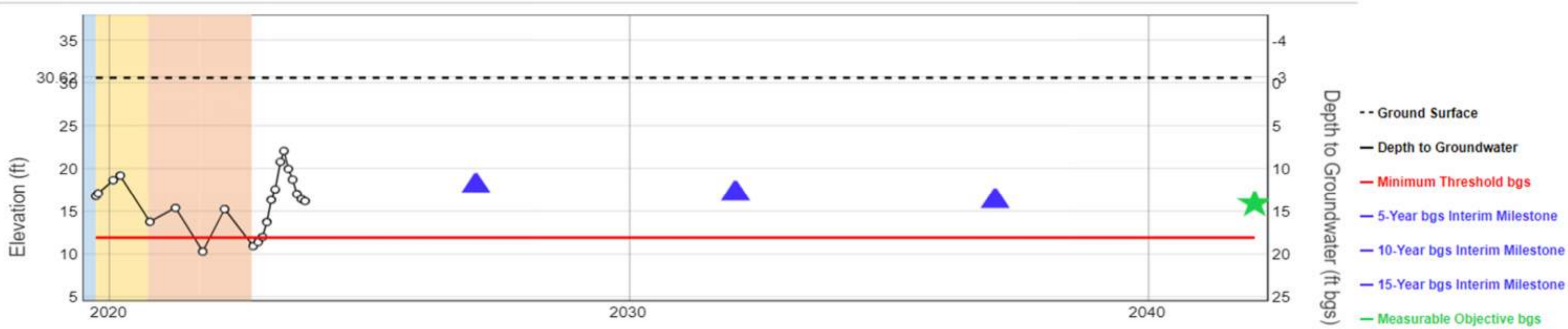
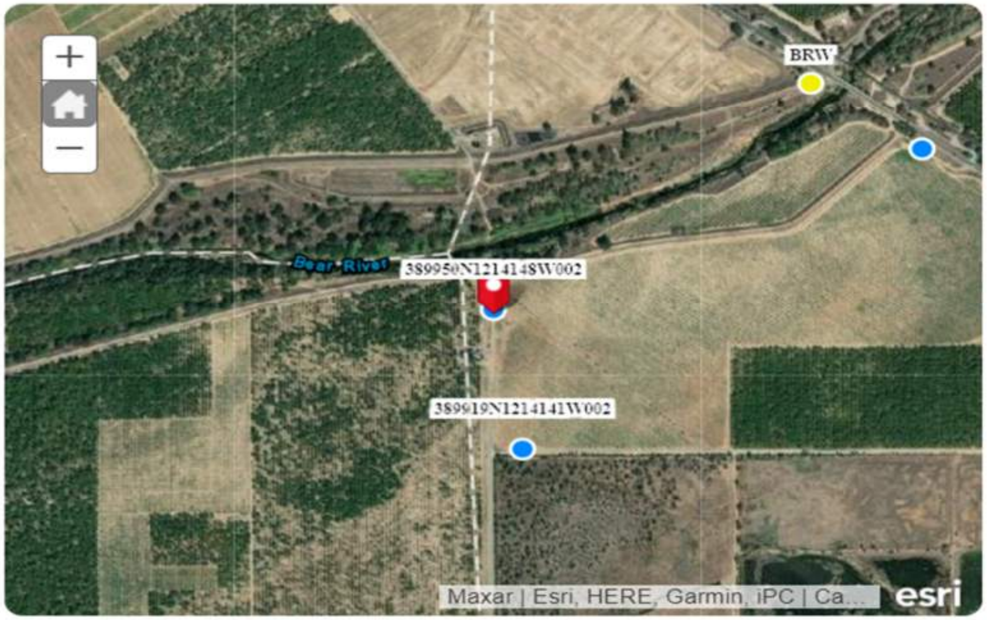


Figure A-32. RDMW-103, Map No. 94

Site Code: 389950N1214148W002 **State Well Number: Local Well Name:** RDMW-103

Site Code: 389950N1214148W002
Local Well Name: RDMW-103
State Well Number:
Station ID: 54781
WCR Number:
Latitude: 38.99499
Longitude: -121.41479
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 52
Top Perforation (feet bgs): 28
Bottom Perforation (feet bgs): 43
Ground Surface Elevation: 89.34
Reference Point Elevation: 89.38
Reference Point Description: Top of PVC Casing
Station Comments:



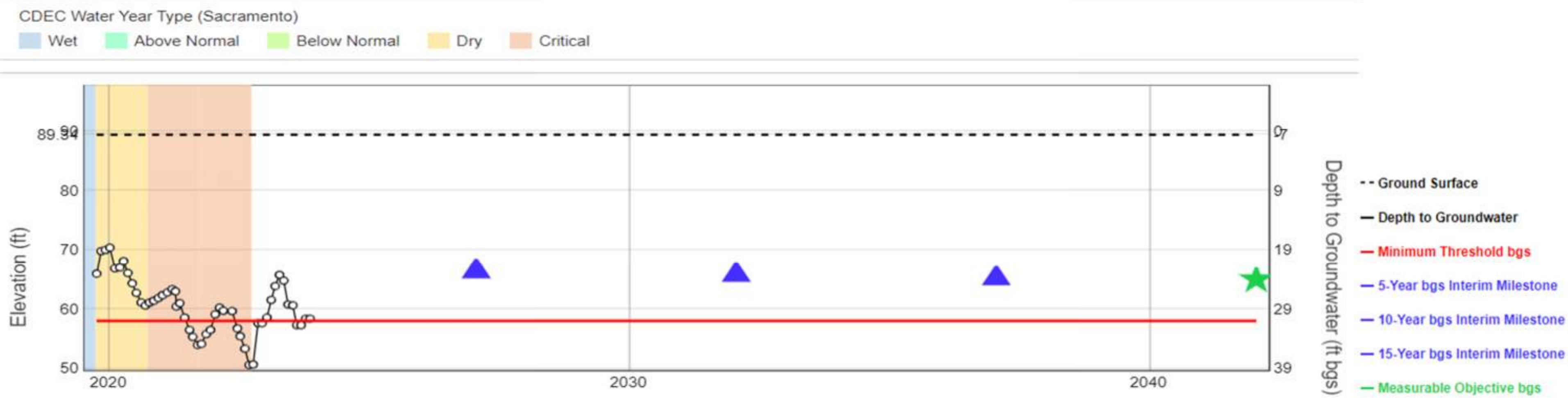


Figure A-33. RDMW-104, Map No. 95

Site Code: 389919N1214141W002 **State Well Number: Local Well Name:** RDMW-104

Site Code: 389919N1214141W002
Local Well Name: RDMW-104
State Well Number:
Station ID: 54782
WCR Number:
Latitude: 38.99194
Longitude: -121.41407
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 50
Top Perforation (feet bgs): 28
Bottom Perforation (feet bgs): 43
Ground Surface Elevation: 87.69
Reference Point Elevation: 87.68
Reference Point Description: Top of PVC casing
Station Comments:

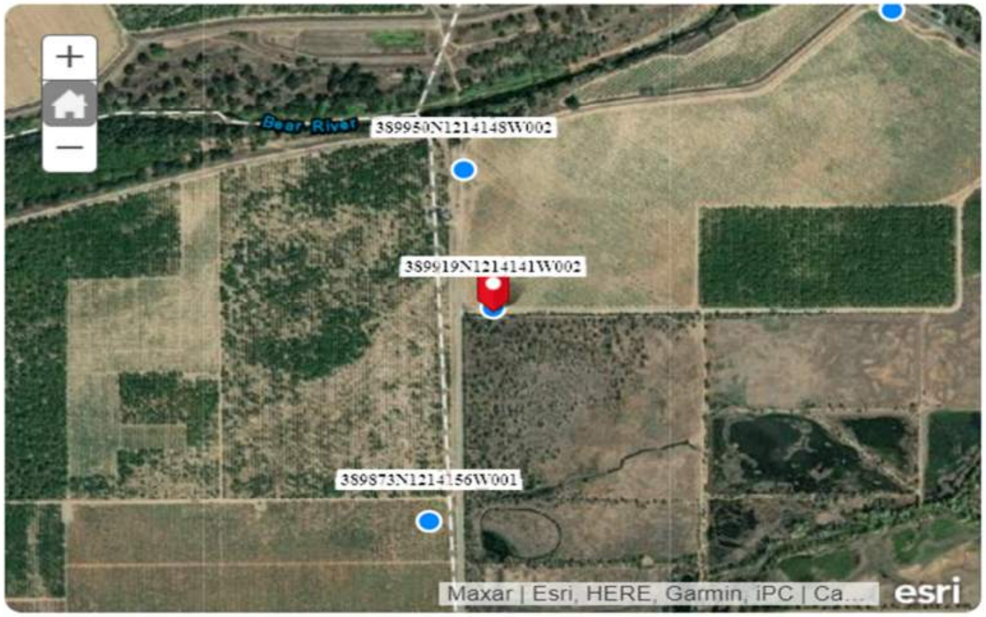


Figure A-34. Aerojet - 1516, Map No. 96

Site Code: 386348N1212319W001 **State Well Number: Local Well Name:** Aerojet-1516

Site Code: 386348N1212319W001
Local Well Name: Aerojet-1516
State Well Number:
Station ID: 57533
WCR Number:
Latitude: 38.63487
Longitude: -121.23192
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 40
Top Perforation (feet bgs): 13
Bottom Perforation (feet bgs): 33
Ground Surface Elevation: 89
Reference Point Elevation: 88.38
Reference Point Description: Top of casing
Station Comments:

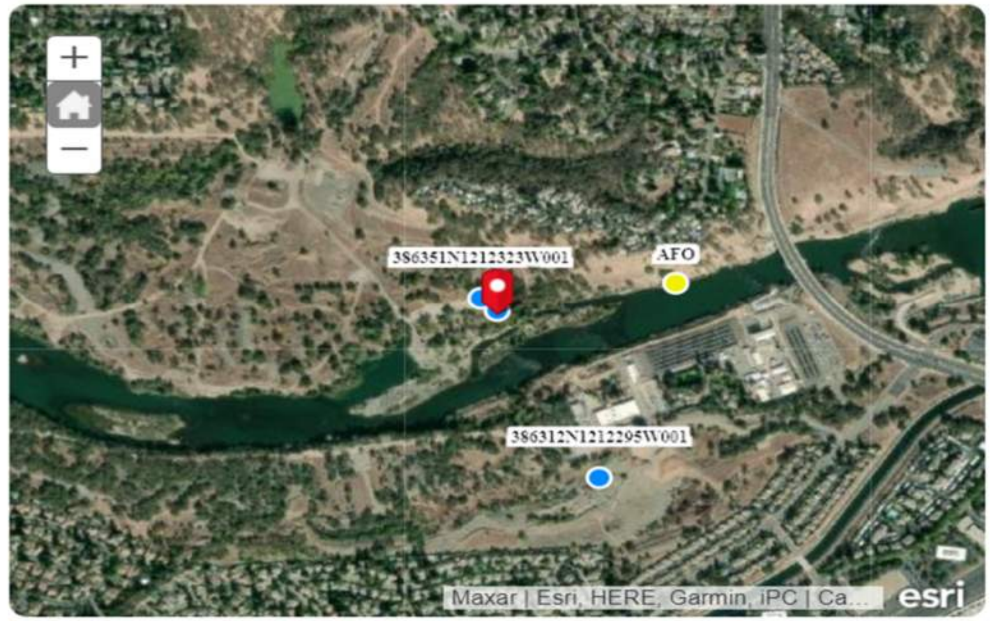


Figure A-35. Aerojet - 1518, Map No. 97

Site Code: 386351N1212323W001 **State Well Number: Local Well Name:** Aerojet-1518

Site Code: 386351N1212323W001
Local Well Name: Aerojet-1518
State Well Number:
Station ID: 57534
WCR Number:
Latitude: 38.63513
Longitude: -121.23231
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 80
Top Perforation (feet bgs): 55
Bottom Perforation (feet bgs): 75
Ground Surface Elevation: 131
Reference Point Elevation: 130.71
Reference Point Description: Top of casing
Station Comments:

CDEC Water Year Type (Sacramento)
Wet Above Normal Below Normal Dry Critical

Figure A-36. URS71000-700+00C, Map No. 98

Site Code: 386397N1215624W001 **State Well Number: Local Well Name:** URS71000-700+00C

Site Code: 386397N1215624W001
Local Well Name: URS71000-700+00C
State Well Number:
Station ID: 57536
WCR Number:
Latitude: 38.63970
Longitude: -121.56243
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 44
Top Perforation (feet bgs):
Bottom Perforation (feet bgs):
Ground Surface Elevation: 42
Reference Point Elevation: 41.7
Reference Point Description: Top of casing
Station Comments:

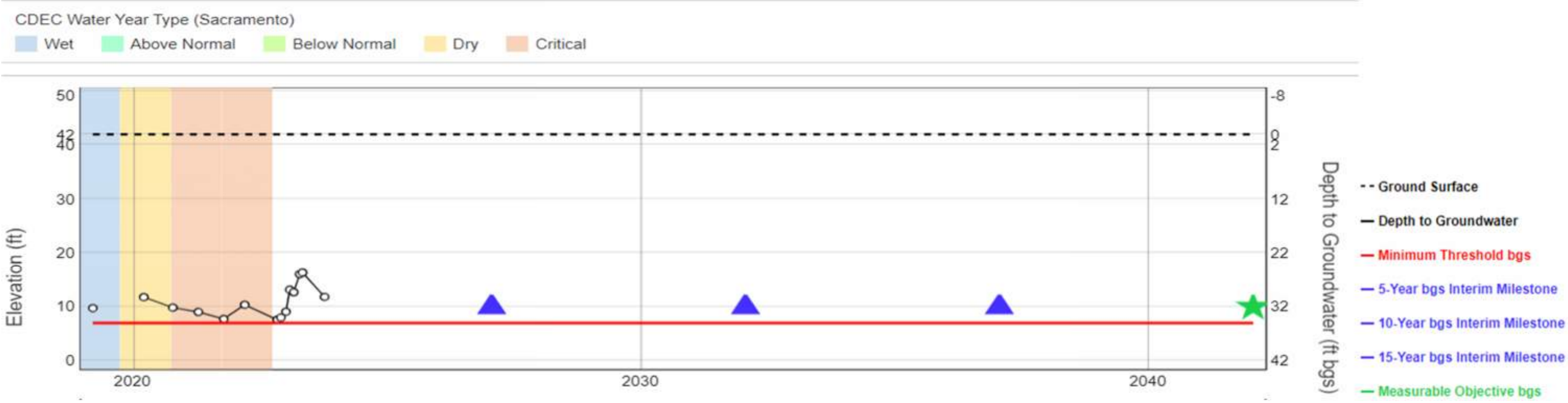
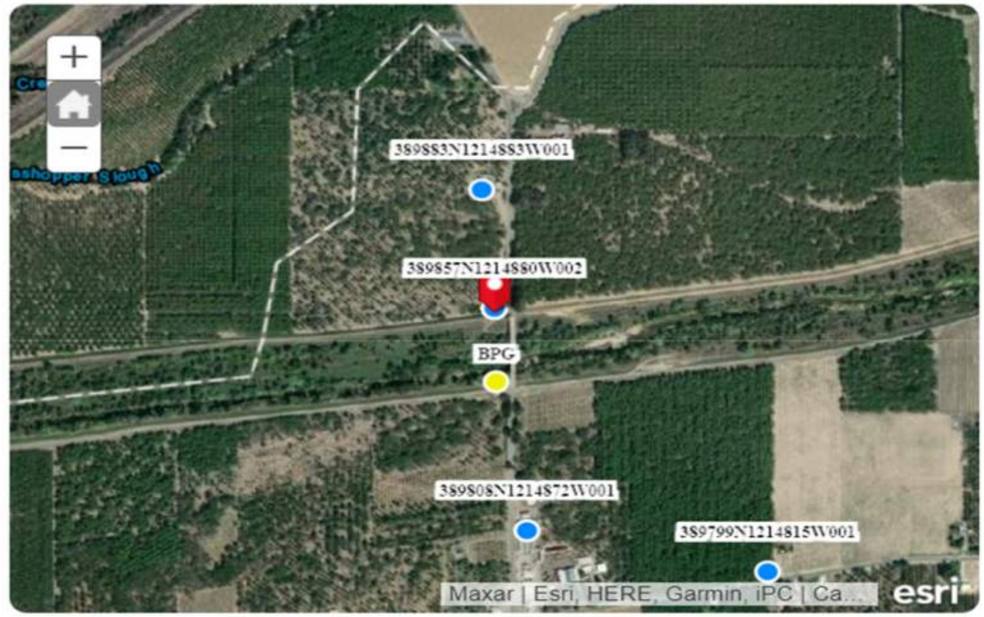


Figure A-37. BR-1B, Map No. 103

Site Code: 389857N1214880W001 **State Well Number:** 13N04E11R002M **Local Well Name:** BR-1B

Site Code: 389857N1214880W001
Local Well Name: BR-1B
State Well Number: 13N04E11R002M
Station ID: 39886
WCR Number: WCR2003-004795
Latitude: 38.98570
Longitude: -121.48800
Station Organization ID:
Station Organization Name:
Well Location Description:
Well Use Type: Observation
Well Completion Type: Part of a nested/multi-completion well
Well Depth (feet bgs): 98
Top Perforation (feet bgs): 78
Bottom Perforation (feet bgs): 98
Ground Surface Elevation: 62.77
Reference Point Elevation: 65.57
Reference Point Description: None Provided
Station Comments:



CDEC Water Year Type (Sacramento)

Wet | Above Normal | Below Normal | Dry | Critical

Groundwater Levels

Note: MT, IMs and MO not being displayed on SGMA dataview.

Figure A-38. SGA_MW08, Map No. 104

Site Code: 387000N1212180W001 **State Well Number: Local Well Name:** SGA_MW08

Site Code: 387000N1212180W001
Local Well Name: SGA_MW08
State Well Number:
Station ID: 48015
WCR Number:
Latitude: 38.69998
Longitude: -121.21795
Station Organization ID:
Station Organization Name:
Well Location Description: Northwest corner Orangevale Park off Oak Ave
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 145
Top Perforation (feet bgs): 130
Bottom Perforation (feet bgs): 140
Ground Surface Elevation: 215.19
Reference Point Elevation: 218.06
Reference Point Description: top of casing
Station Comments:

CDEC Water Year Type (Sacramento)
Wet Above Normal Below Normal Dry Critical

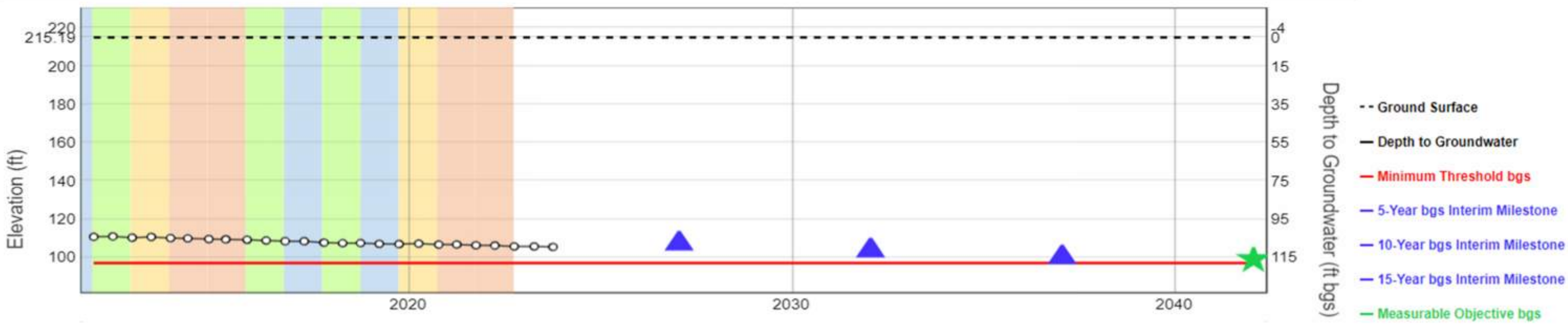


Figure A-39. SGA_MW01, Map No. 109

Site Code: 387218N1214677W001 **State Well Number: Local Well Name:** SGA_MW01

Site Code: 387218N1214677W001
Local Well Name: SGA_MW01
State Well Number:
Station ID: 48009
WCR Number:
Latitude: 38.72178
Longitude: -121.46771
Station Organization ID:
Station Organization Name:
Well Location Description: Rio Linda Blvd, 120 feet south of Rafael Dr
Well Use Type: Observation
Well Completion Type: Single Well
Well Depth (feet bgs): 110
Top Perforation (feet bgs): 100
Bottom Perforation (feet bgs): 110
Ground Surface Elevation: 45.04
Reference Point Elevation: 47.59
Reference Point Description: top of casing
Station Comments:

CDEC Water Year Type (Sacramento)
Wet Above Normal Below Normal Dry Critical

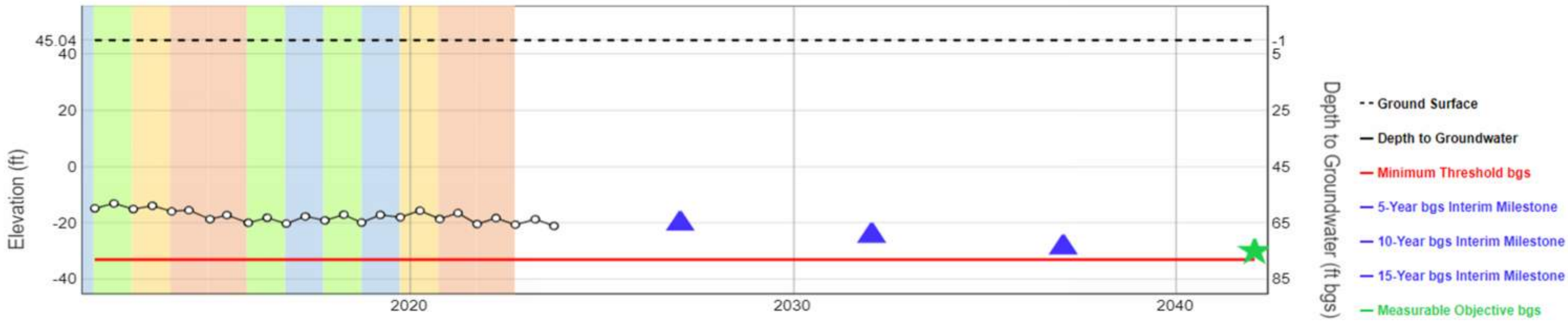


Figure A-40. Old Well #2, Map No. 116

Site Code: 389791N1213727W001 **State Well Number:** 13N05E13D003M **Local Well Name:** Old Well #2

Site Code:	389791N1213727W001
Local Well Name:	Old Well #2
State Well Number:	13N05E13D003M
Station ID:	51327
WCR Number:	
Latitude:	38.97913
Longitude:	-121.37269
Station Organization ID:	
Station Organization Name:	
Well Location Description:	In the Town of Sheridan. Two block east of old Highway 65 on south side of F Street.
Well Use Type:	Industrial
Well Completion Type:	Single Well
Well Depth (feet bgs):	209
Top Perforation (feet bgs):	144
Bottom Perforation (feet bgs):	209
Ground Surface Elevation:	107
Reference Point Elevation:	107
Reference Point Description:	Top of casing
Station Comments:	

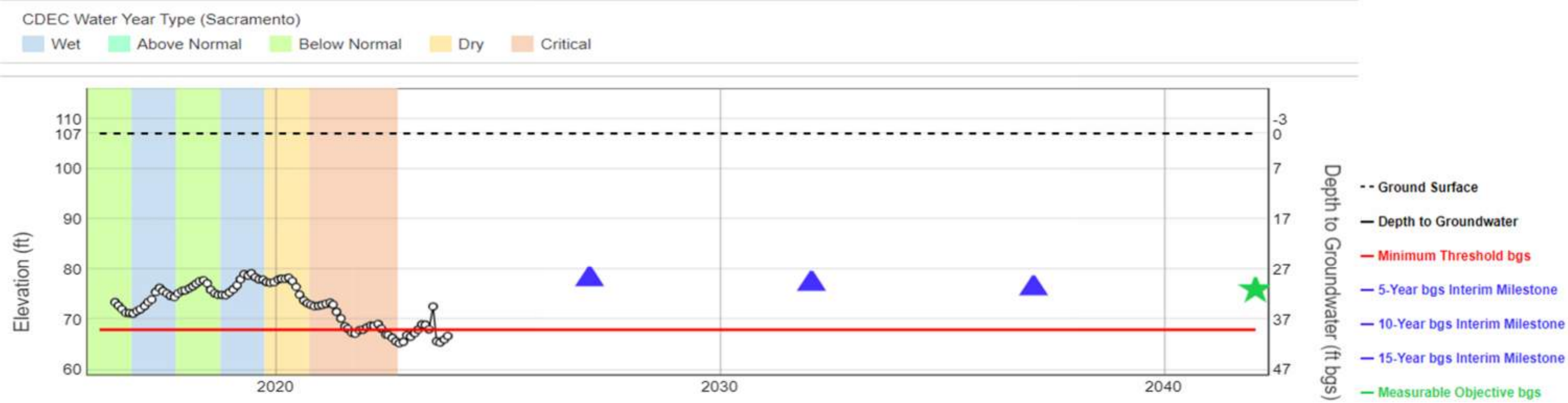


Figure A-41. DeWit, Map No. 126

Site Code: 387251N1214954W001 **State Well Number:** 10N04E13F001M **Local Well Name:** DeWit

Site Code:	387251N1214954W001
Local Well Name:	DeWit
State Well Number:	10N04E13F001M
Station ID:	57535
WCR Number:	
Latitude:	38.72512
Longitude:	-121.49544
Station Organization ID:	
Station Organization Name:	
Well Location Description:	
Well Use Type:	Observation
Well Completion Type:	Single Well
Well Depth (feet bgs):	50
Top Perforation (feet bgs):	
Bottom Perforation (feet bgs):	
Ground Surface Elevation:	21
Reference Point Elevation:	22
Reference Point Description:	Top of casing
Station Comments:	

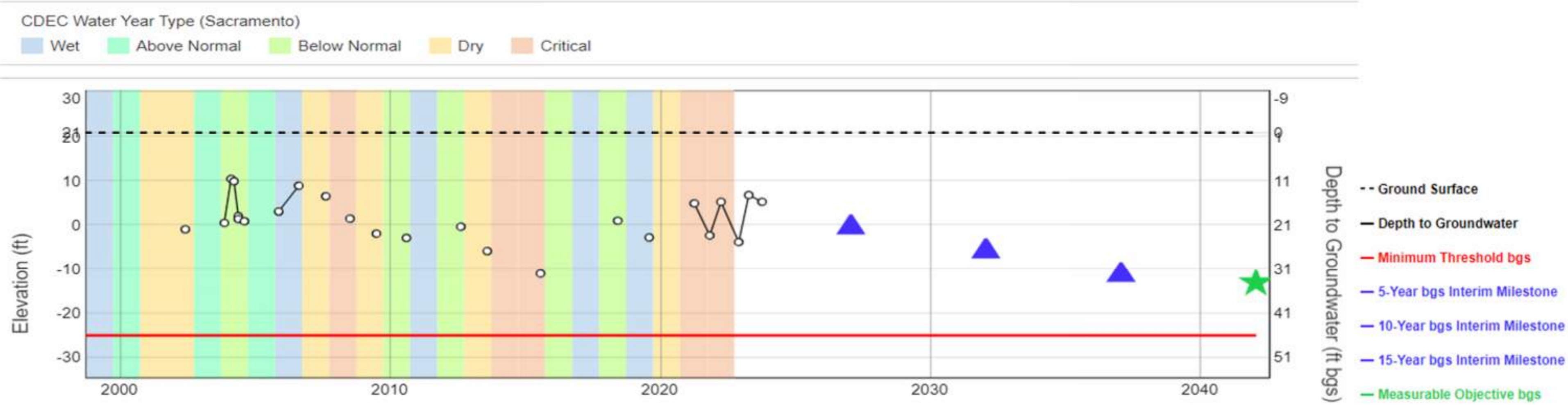


Figure A-1. Representative Groundwater Level Monitoring Wells Locations.

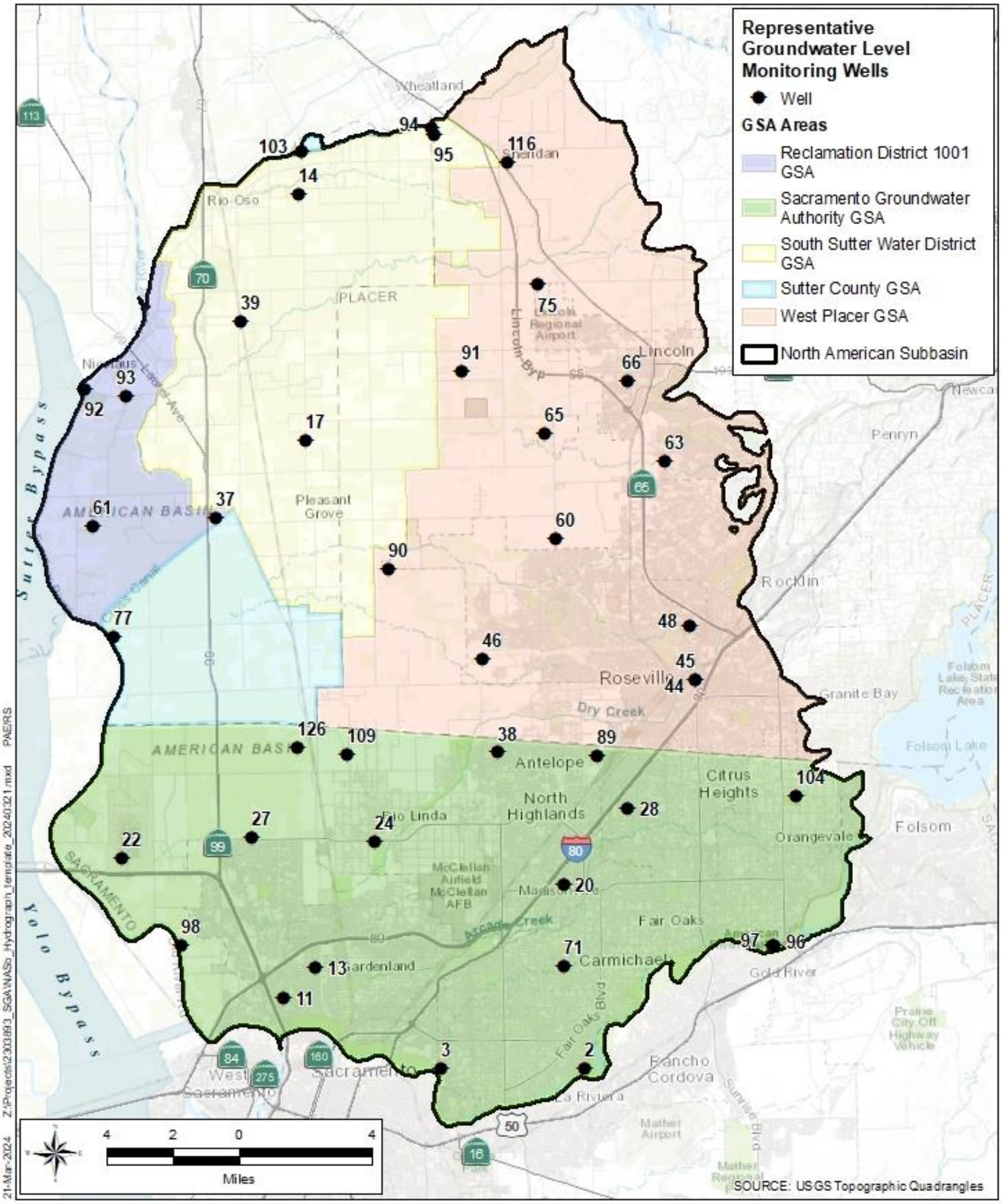


Table A-1. Representative Groundwater Level Monitoring Wells Information

Map No.	CASGEM ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)
2	385828N1213385W001	SGA_MW06	38.58281	-121.33846	62-72	72
3	385841N1214185W001	SGA_MW04	38.58414	-121.41852	55-65	65
4	385947N1213985W003	MW12C	38.59472	-121.39847	590-610	615
11	386160N1215054W001	Bannon Creek Park	38.61603	-121.5054	33-48	48
13	386292N1214877W001	Chuckwagon Park	38.62921	-121.4877	27-37	52
14	389669N1214897W001	13N04E23A002M	38.9669	-121.4897	56-83	83
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155
20	386635N1213486W001	SGA_MW05	38.66347	-121.34859	205-215	215
22	386782N1215943W004	AB-4 shallow	38.6782	-121.5943	170-190	200
24	386836N1214536W001	SGA_MW02	38.68362	-121.45363	100-110	110
27	386864N1215222W003	AB-3 shallow	38.6864	-121.5222	190-210	220
28	386964N1213120W001	Twin Creeks Park	38.6964	-121.31203	183-193	193
37	388260N1215394W004	SUT-P1	38.826	-121.5394	110-120	120
38	387216N1213842W001	Lone Oak Park	38.72163	-121.38417	151-161	166
39	389116N1215238W003	AB-1 shallow	38.9116	-121.5238	170-180	190
44	387515N1212725W001	WPMW-10A	38.75149	-121.27251	26-36	36
45	387517N1212727W001	WPMW-9A	38.75167	-121.27266	26-36	36
46	387623N1213915W001	SVMW West - 1A	38.76232	-121.39153	120-140	145
48	387755N1212753W001	WPMW-4A	38.77554	-121.27525	120-140	145
60	388145N1213491W001	WPMW-2A	38.8145	-121.34914	215-225	230
61	388235N1216079W001	Sutter County MW-5A	38.82324	-121.60763	130-160	170
63	388476N1212872W001	WPMW-3A	38.84761	-121.28719	48-53	53
65	388604N1213544W003	MW 1-3	38.86038	-121.35438	184-204	204
66	388826N1213078W002	MW 5-2	38.88258	-121.30775	52-62	62
71	386280N1213493W001	WCMSS	38.62799	-121.34925	130-150	170
75	389255N1213566W003	MW 2-3	38.92547	-121.35663	75-85	85
77	387749N1215975W001	SREL-1-27-F1	38.77491	-121.59754	Unknown	46
89	387191N1213287W001	Roseview Park - 315	38.71912	-121.32879	295-305	315
90	388026N1214432W002	WPMW-12A	38.80264	-121.44322	260-280	300
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162
92	388829N1216110W001	RDMW-101	38.88294	-121.61105	28-43	48
93	388798N1215885W001	RDMW-102	38.87987	-121.58853	28-43	48
94	389950N1214148W002	RDMW-103	38.99461	-121.41479	28-43	48
95	389919N1214141W002	RDMW-104	38.99195	-121.4135	28-43	48
96	386348N1212319W001	1516	38.63487	-121.23192	13-33	40
97	386351N1212323W001	1518	38.63513	-121.23231	55-75	80
98	386397N1215624W001	URS71000-700+00C	38.6397	-121.56244	Unknown	45
103	389857N1214880W001	BR-1B	38.9857	-121.488	78-98	98
104	387000N1212180W001	SGA_MW08	38.69998	-121.21795	130-140	140
109	387218N1214677W001	SGA_MW01	38.72178	-121.46771	100-110	110
116	389791N1213727W001	Old Well #2	38.97913	-121.37269	144-209	209
126	384330121293901	10N04E13F001M	38.72512	-121.49544	Unknown	50

Appendix B NASb GSP Implementation Tracker

WY22 NASb GSP Implementation Action Tracker				
WY 23 (October 1, 2022 through September 30, 2023)				
Implementation Action	**Action Due/Requirements**	**Status**	**Comments**	**Responsibility**
Monitoring				
Groundwater Elevation Monitoring				
1. Continue ongoing semi-annual monitoring of the groundwater elevation monitoring network.	*Semi-annual*	Complete for 2023	Complete for Spring 2023. Complete for Fall 20223.	All NASb GSAs
2. Conduct confirmation water level monitoring, as needed.	*As needed*	Complete for 2023	More frequent monitoring being conducted at sites that measured below MT in Fall 2023.	GSAs where MT occurs
3. Download transducer data semi-annually.	*Semi-annual*	Complete for 2023	Spring 2023 data downloaded. Fall 2023 data downloaded.	Applicable GSA
Groundwater Quality Monitoring				
1. Download public supply well water quality monitoring data for TDS and Nitrates from the State DDW by December 31st of each year for MT and MO evaluation.	*December 31st*	Complete for 2023	For Water Year 2023 (WY23), downloaded 74 distinct data points for TDS and 206 distinct values for N in February 2024.	SGA
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.*	*As available*	Complete for 2023	For WY 2023, downloaded 77 distinct data points for Arsenic, 94 distinct data points for Hexavalent Chromium, 70 distinct data points for Iron, and 67 distinct data points for Manganese in January 2024. Based on this analysis, no significant or sustained upward trends have been observed in the Subbasin.	SGA
3. Collect water quality samples in the shallow water quality monitoring network in the Fall of odd numbered years (e.g., 2023).	*Fall 2023*	Complete for 2023	This is the first year implementing this effort and SGA contracted GEI (and subconsultants) to complete in Fall 2023. Water quality samples were collected for the shallow water quality monitoring network and results can be found in Append C of this report.	Applicable GSA
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.	*None*	In Progress	More frequent monitoring being conducted at sites that measured below MT in Fall 2023. Additionally, West Placer GSA is conducting a well investigation to help assess areas that measured below the MT.	GSAs where MT occurs
Other Monitoring				
1. Collect additional monitoring data (e.g., surface water stages) from the CDEC on an as-needed basis (e.g., during preparation of Annual Report).	*As needed*	Complete for 2023	Included in WY23 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.	*One month after semi-annual monitoring*	Complete for 2023	Complete for Spring 2023. Complete for Fall 2023.	
2. Upload water quality data from shallow monitoring well network by December 31 of each year that it is collected.	*December 31st*	Complete for 2023	To be uploaded.	
3. Update NASb Data Management System with appropriate data by December 31 of each year.	*December 31st*	In Progress	Training received from GEI on June 15, 2023. GEI implements semi-annual updates to the NASb Data Management System.	
Data Analysis				
Sustainability Indicators				
1. Review all representative groundwater levels in comparison to MOs and MTs by December 31 of each year for potential emergence of undesirable results.	*December 31st*	Complete for 2023	Included in WY23 Annual Report.	
2. Calculate the public water supply wells TDS and N rolling averages to determine if the Subbasin is meeting MOs and MTs by January 31 each year.	*January 31st*	Complete for 2023	Included in WY23 Annual Report.	
3. Review shallow monitoring network TDS and N data to determine if the Subbasin is meeting MOs and MTs by January 31 of each year following its collection.	*January 31st*	Complete for 2023	This is the first year implementing this effort and SGA contracted GEI (and subconsultants) to complete in Fall 2023. Water quality samples were collected for the shallow water quality monitoring network and results can be found in Append C of this report.	
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.	*Review: February 28 Submit to DWR: April 1*	Complete for 2023	NASb GSAs met March 6, 2022 to discuss the WY22 Annual Report. Preparation of Draft WY23 Annual Report began November 2023. Final draft was completed in late March 2023.	

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.	*Continuous*	In Progress	Annual land use and hydrology are being routinely updated as part of the annual report preparation. Additionally, the North American Subbasin (NASb) was awarded funding through the Department of Water Resources (DWR) SGM Grant Round II funding which includes a comprehensive assessment and update of the CoSANA model. NASb is currently working with adjacent Subbasins to assess opportunities for interbasin coordination for this effort.	
Coordination and Outreach				
1. Continue quarterly meetings of the NASb GSAs.	*Quarterly*	Complete for 2023	For calendar year 2023 (January through December), met on January 9, 2023, March 6, 2023, May 1, 2023, July 10, September 6, and November 6, 2023.	
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.	*At least one meeting each year (scheduled after completion of the Annual Report)*	Complete for 2023	The NASb GSAs presented WY22 Annual Report, along with current and upcoming GSP Implementation activities, on June 28, 2022 via Zoom. Meeting materials can be found at: https://nasbgroundwater.org.	
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.	*Annually (scheduled during preparation of the Annual Report)*	Complete for 2023	Met with Consumnes Subbasin May 17, 2023 (GDE Discussion). Met with Yuba Subbasin August 16, 2023. Met with Yolo Subbasin August 28, 2023. Met with South American Subbasin September 28, 2023.	
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.	*Once per year (scheduled shortly after Annual Report is submitted)*	Complete for 2023	To be scheduled by September 30, 2023 at the latest - on hold until DWR GSP Determination (June 30th wait date).	
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.	*Quarterly*	Complete for 2023	Meetings were held on January 26, 2023, April 27, 2023, July 27, 2023, and October 26, 2023.	
Other Management Activities				
1. Fill data gaps noted in the monitoring well network by December 31, 2024.	*December 31, 2024*	In Progress	Have not begun Technical Support Services funding application - waiting for DWR's GSP determination. SGA staff is currently reviewing application and steps needed to complete application. Additionally, the NASb was awarded funding through the DWR SGM Grant Round II that addresses and helps fill data gaps noted in the monitoring well network.	
2. Track implementation of urban area conjunctive use program as part of Annual Report preparation. Identify if there are barriers to its planned expansion.	*Continuous*	Complete for 2023	Water use reported in WY23 Annual Report.	
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 in the NASb.	*Continuous*	Complete for 2023	RWA began public engagement for the Water Bank and held its first Stakeholder Forum on October 26, 2022. The second Stakeholder Forum was held February 13, 2023. The third Stakeholder Forum date has not yet been determined and is currently in the progress of getting scheduled.	
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.	*Begin early 2022 Completed by 2023*	Postponed	Original scope of this task has been postponed (for WY 22 and WY 23) due to the Governor's Executive Order related to drought requiring GSA's to determine consistency with new well permits. Need to work with County(s) to figure out the process.	-
5. Commence shallow/domestic well analysis in early 2022 and conclude by early 2024.	*Begin early 2022 Completed by early 2024*	In Progress	SGA and WPGSA staff have initiated study. Approach is to identify parcels in subbasin that have homes that are not served by public water suppliers. SGA is on target to have this effort completed by early 2024. WPGSA has completed their study and are currently drafting a brochure to send out to beneficial users.	

6. Commence GDE assessment management action in early 2022 and conclude major assessment by early 2024. Continue annual monitoring of GDE health.	*Begin early 2022 Conclude assessment by early 2024 Continuous yearly annual monitoring of GDE health*	Postponed	SGA staff is researching options for assessing GDE health. Several coordination meetings were held with adjacent subbasins and The Nature Conservancy to determine best approach.	
7. Track progress on supplemental projects on an annual basis. Update progress and any information on newly proposed supplemental projects in the Annual Report.	*Annually*	Complete for 2023	Included in WY23 Annual Report.	

Appendix C Water Quality Report

Technical Memorandum Groundwater Quality Sampling 2023 North American Subbasin

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March 21, 2024

GEI Project No. 2303254 Task 5

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GROUNDWATER QUALITY SAMPLING 2023
NORTH AMERICAN SUBBASIN

Certifications and Seals

This report and analysis were prepared by the following GEI Consultants Inc. staff.

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Abbreviations and Acronyms

As	arsenic
bgs	below ground surface
B	boron
BSK	BSK Laboratories
COCs	Chain of custody
Cr+6	Hexavalent Chromium
DO	Dissolved Oxygen
Fe	iron
ft	feet
GSAs	Groundwater Sustainability Agencies
GEI	GEI Consultants, Inc.
GSP	Groundwater Sustainability Plan
L	Liter
Lat	Latitude
Long	Longitude
MCL	Maximum Contaminant Level
mg	milligrams
mg/L	millligrams per liter
Mn	manganese
MO	Measurable Objective
MT	Measurable Threshold
N	nitrogen
NASb	North American Subbasin
NTU	Nephelmotric Turbidity Unit
pH	potential of hydrogen
RD 1001	Reclamation District 1001
RDL	Reporting Detection Limits
RMS	Representative Monitoring Sites
SGA	Sacramento Groundwater Authority
SGMA	Sustainable Groundwater Management Act

SMC	Sustainable Management Criteria
SMCL	Secondary Maximum Contaminant Level
SSWD	South Sutter Water District
Subbasin	North American Subbasin
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
WSE	Water Surface Elevation
WQ	Water Quality
µg/L	micrograms per liter

1. Executive Summary

The North American Subbasin (NASb or Subbasin) Groundwater Sustainability Plan (GSP) evaluated sustainable management criteria (SMC) for water quality. Within the GSP, two groundwater quality monitoring networks were identified to track groundwater quality and determine if management actions are needed to prevent degradation of water quality within the Subbasin. The first network is a shallow aquifer representative monitoring site network (shallow aquifer RMS network) used to assess water quality in the shallow portions of the aquifer that could be used by domestic well owners. The second is a sentry well monitoring network (sentry wells) that was developed 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. This network would also assess changes to water quality from sources outside of the Subbasin and from marine sediment beneath the NASb. Concentrations for total dissolved solids (TDS) and nitrate (as N) were used in the GSP to assess groundwater quality throughout the Subbasin for both water quality monitoring networks. For the shallow aquifer water quality monitoring network, undesirable results were considered in the GSP and minimum thresholds (MTs) and measurable objectives (MOs) with interim milestones were established for these wells defining sustainable groundwater quality for the Subbasin. For the sentry wells, MOs and MTs were not established as their purpose is to evaluate trends and water quality changes related to groundwater level changes that could result in MT exceedances.

Twenty-seven shallow aquifer RMS network and sentry wells across Sacramento, Sutter, and Placer Counties were sampled as part of this study, along with supplemental data pulled from three public water supply wells and one monitoring well from the State Water Resources Control Board (SWRCB) websites.

It is important to note that the monitoring wells sampled for this study are not used for drinking water purposes. Drinking water served by public agencies must be below all primary maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs) established by the SWRCB and the Environmental Protection Agency. Maximum contaminant levels are for those constituents that pose health risks, while SMCLs have been established for aesthetics such as taste, odor, and color and are not considered a risk to human health.

Results from the shallow aquifer RMS network were evaluated against MTs and MOs (to be obtained by 2042). Results from the sentry wells were evaluated against SMCLs and for upward trends.

Supplemental constituents were analyzed this year to further assess the water quality in the Subbasin to further the groundwater quality evaluation of these constituents in the GSP. Water samples were analyzed for the following constituents: , arsenic, boron, hexavalent chromium, iron, manganese, and nitrate (sentry wells only). Not all wells were sampled for all constituents.

Statistical analyses were planned to be performed on constituents analyzed for this study. Statistical analyses require a minimum of five analytical results to be able to develop trends. Because this report represents the first year of sampling, only five wells had five or more analyses that could be analyzed statistically. All analyses showed stable trends.

Analyses of groundwater for TDS and N at the wells identified in the shallow aquifer water quality monitoring network showed all results were below the MTs. Groundwater at three locations had TDS concentrations above the MO and at two locations for nitrate. **Table ES-1** summarizes the analyses.

Table ES-1: Shallow Aquifer RMS Network Water Quality Sampling Results

Element	Number of Analyses	Above MT	Above MO	Stastical Trend			
				Stable	Upward	Downward	Insufficent Data
Shallow Aquifer RMS Network Wells							
TDS	15	0	5	1	0	0	14
Nitrate	16	0	4	2	0	1	13

Analyses for TDS at the sentry wells, which do not have MTs, MOs, or interim milestones, were compared to SMCLs. Three wells were above the SMCL. Only one monitoring well could be statistically analyzed (a minimum of five analyses required) and showed stable trends. **Table ES-2** provides a summary of these results.

Table ES-2: Sentry Well Water Quality Sampling Results

Element	Number of Analyses	Above				Stastical Trend			
		Not Detectable	MCL	SMCL	Notification Level	Stable	Upward	Downward	Insufficent Data
Sentry Wells - No established Minimum Thresholds, Interim Milestones and Measureable Objectives									
TDS	19	0		3		1			18

Samples from both the shallow aquifer RMS network water quality and sentry wells were analyzed for supplementary constituents. The GSP assessed these constituents and found that concentrations vary 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. Concentrations for arsenic, boron, and hexavalent chromium were all less than the MCLs or Notification Limit; however, one well exceeded the MCL for arsenic. Nitrate, arsenic, and boron were less than detectable in over 50 percent of the analyses. **Table ES-3** provides a summary of these results.

Table ES-3: Supplemental Water Quality Sampling Results

Element	Number of Analyses	Not Detectable	Above			Stastical Trend			
			MCL	SMCL	Notification Level	Stable	Upward	Downward	Insufficent Data
Shallow Aquifer RMS Network and Sentry Wells Supplementary Analyses									
Nitrate	19	12	0						19
Arsenic (total)	31	16	1			1			30
Boron (total)	27	19			0				27
Hexavalent Chromium (total)	5	0	0				1		4
Iron (total)	30	5		19		1	1		25
Manganese (total)	30	2		16				1	26

Concentrations of total iron and manganese were elevated above the SMCL for a high percent (approximately 70%) of the wells sampled. All detections that exceeded the SMCL were from monitoring wells. Water from the public water supply wells were at less than detectable levels. Additional sampling is warranted for these two constituents (e.g., iron and manganese) along with filtering to remove sediments that may be affecting the results to properly evaluate dissolved concentrations.

Statistical analyses require a minimum of five analytical results to be able to develop trends. Because the analysis is in its first year of sampling, only five of the shallow aquifer RMS network water quality and sentry wells could be analyzed for trends. All five showed a stable trend. It is anticipated that only a few additional wells will have the minimum number of five analyses after sampling planned in year 2025. After calendar year 2027 is complete almost 50 percent of wells are anticipated to have sufficient analyses to perform statistical analyses.

Although statistical analyses were limited, visual trends were made using historic and current results. Only two out of twenty-seven wells had visual upward trends. One well (WPMW-12B) had an increasing trend for TDS which may be due to upwelling of brackish water from underlying marine sediment. Another well (WPMW-12A) had an increasing trend for hexavalent chromium, but its cause is yet to be established. Both wells are located in West Placer.

Continued monitoring and investigation to track and assess changes in water quality is recommended and the collection of water quality samples should continue to coincide with monitoring frequency proposed in the GSP.

Overall, as stated in the GSP, the concentration of water quality 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. The results identified in this memorandum further support this assessment.

2. Introduction

GEI Consultants, Inc. (GEI) prepared this technical memorandum (memo) to document and describe results of groundwater quality sampling that occurred in October 2023. This effort was conducted collectively by the North American Subbasin (NASb) Groundwater Sustainability Agencies (GSAs) to support implementation of the NASb GSP. Groundwater in the NASb is being sustainably managed by five GSAs in compliance with the Sustainable Groundwater Management Act (SGMA) of 2014 and includes the Reclamation District 1001 (RD 1001); Sacramento Groundwater Authority (SGA); South Sutter Water District (SSWD); Sutter County; and, West Placer as shown on **Figure 1**.

The NASb GSAs submitted the adopted GSP for review by the California Department of Water Resources (DWR) on January 24, 2022. The GSP was approved by DWR in July 2023. As identified in the GSP, the concentration of water quality 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. Total dissolved solids (TDS) and nitrate (as N) have been used as to establish the NASb Sustainable Management Criteria (e.g., minimum thresholds [MTs], measurable objectives [MOs], and interim milestones) within the GSP. These two constituents were identified as good metrics for evaluating the general water quality health of the groundwater basin under SGMA.

Three approaches to assessing groundwater quality were developed in the GSP: one using just public supply wells (not part of this study), the second using a shallow aquifer water quality representative monitoring sites (RMS well), and the third a network of sentry wells. The GSP planned for groundwater quality samples to be collected from the shallow aquifer RMS network and sentry wells once every two years, in the Fall, starting in 2023. This memo represents the first year of sampling since the development of the GSP.

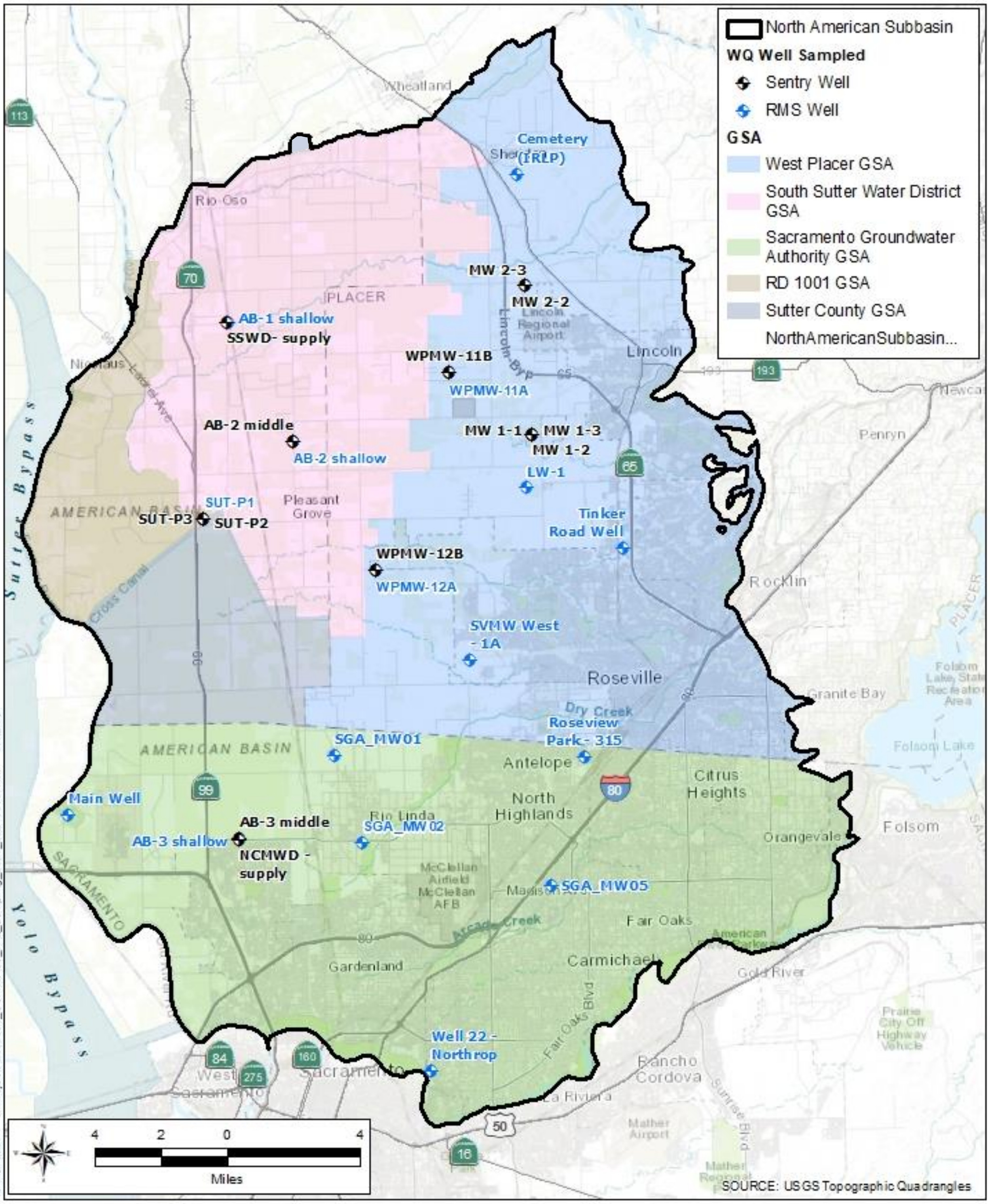
The shallow aquifer RMS network was developed to be representative of water quality in the NASb using concentrations of TDS and N as representative constituents. The location of these wells are shown in **Figure 1**. Sixteen shallow aquifer RMS network wells were designated as the RMS monitoring network (monitoring, municipal, and one upgradient monitoring well). The shallow aquifer is typically used by domestic well owners. Minimum thresholds, MOs with interim milestones were established at these RMS wells. The maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) for drinking water were used as basis to establish the MTs.

In addition to the shallow aquifer RMS network, a water quality sentry well monitoring network was also established to track groundwater quality (salinity). The location of these wells are shown in **Figure 1**. The sentry wells are not for compliance purposes but purely to assess groundwater quality from sources outside of the Subbasin or from marine sediments beneath the Subbasin that could affect water quality in the NASb. Nineteen sentry wells (monitoring and domestic wells) were selected to be sampled. MTs, MOs with interim milestones were not established for these sentry wells. The sentry wells were designated to be sampled and analyzed for TDS.

This year, five additional supplementary constituents (e.g., arsenic [As], boron [Br], hexavalent chromium [Cr^{6+}], iron [Fe], and manganese [Mn]) were analyzed to further assess groundwater quality conditions in the Subbasin and the shallow aquifer that is used by domestic well owners. As described in the NASb GSP, Section 5 – Groundwater Conditions, there are some scattered occurrences of elevated As, Cr^{6+}, Fe, Mn, and Br. The NASb GSP did not establish sustainable management criteria (e.g., MTs and MOs with interim milestones) for these constituents as a result do not indicate any basin wide concerns regarding elevated concentrations of these constituents associated with groundwater pumping that would potentially cause water quality concern for beneficial uses and users of groundwater in the Subbasin. Additionally, there are no significant changes in the planned use or management activities in the Subbasin for these constituents. Rather, the GSAs plan to continue to monitor these constituents to observe if changing concentrations emerge. To support this effort, water samples were collected from both the shallow aquifer RMS network and sentry wells and analyzed for these supplemental constituents.

This technical memorandum represents the first year of sampling and documents the process and analyses of TDS and N, along with the five supplemental constituents in the shallow aquifer RMS network and sentry wells. The location of these wells are shown in **Figure 1**.

Figure 1: Shallow Aquifer RMS network and Sentry Well Locations



3. Occurrence of Commonly Evaluated Constituents in Groundwater

Groundwater quality constituents can be assessed by analyzing for general indicators of the water quality such as TDS or other specific constituents (such as arsenic, boron, hexavalent chromium, iron, nitrate, and manganese). The following sections provide a brief description of the constituents analyzed in this memo and as part of the NASb groundwater quality sampling effort.

3.1 Total Dissolved Solids

Total dissolved solids are a measurement of the combined content of dissolved minerals in water (e.g., calcium, sodium, magnesium, potassium, bicarbonate, chloride, sulfate, and nitrate) and can be found in nature, naturally occurring, or a result of human activity. Total dissolved solids are regulated in California under a secondary drinking water standard with a recommended SMCL of 500 milligrams per liter (mg/L). SMCLs generally do not pose a risk to human health but are enforceable drinking water regulations due to aesthetics and nuances such as taste, color, and odor.

It is surmised that higher TDS concentrations in the western portion of the Subbasin could be present due to the area historically being a slough and a salt sink, or due to migration of groundwater from adjacent subbasins. Elevated concentrations could also be due to evaporation of agricultural applied water or water bodies, wastewater, and/or evaporation of water from shallow groundwater. The shallow aquifer RMS network assesses changes from these sources. Elevated TDS concentrations could also be from the influence of the marine sediments, which contains brackish water that underlies the freshwater formations. Sentry wells were selected for the specific purpose of providing early warning of groundwater quality changes (spatially or vertically) due to shifting changes in groundwater use in the Subbasin. This network also assess changes to water quality from sources outside of the Subbasin and from marine sediment beneath the NASb.

3.2 Nitrate

Nitrate is a naturally occurring nutrient found in living organisms and can also be a result of human activity. Natural concentrations of nitrate in groundwater are typically low (less than 3 mg/L). Higher concentrations generally originate from anthropogenic sources such as fertilizers, wastewater, or concentrated animal feed lots. Nitrate (as nitrogen) is regulated under a drinking water MCL of 10 mg/L.

3.3 Supplementary Constituents

The following are descriptions of supplementary constituents analyzed during this effort.

3.3.1 Arsenic

Arsenic is a naturally occurring element that is found in many rocks and minerals within certain igneous and volcanic formations, including the Mehrten and Turlock Lake/Laguna Formations. These formations contain aquifers used to supply water to agricultural, domestic, and municipal wells. Arsenic is regulated under a drinking water MCL of 10 micrograms per liter (µg/L).

3.3.2 Boron

The most prevalent sources of boron in drinking water are from the leaching of rocks and soils of volcanic origin (including the Mehrten Formation), wastewater, and fertilizers/pesticides. Boron is an unregulated chemical without an established MCL; however, it has a Notification Level of 1.0 mg/L.

3.3.3 Hexavalent Chromium

Hexavalent chromium ($Cr^{+6)}$ is a variety of chromium which has a +6-oxidation state and can be naturally occurring or a result of human activity. In 2014, an MCL of 10 µg/L (parts per billion) was established for Cr^{+6}. Compliance with the MCL was based on a rolling average of the last four sampling events. However, on August 8, 2017, the State Water Resources Control Board (SWRCB) redacted the MCL for Cr^{+6} in response to a judge's ruling that California had failed to consider economic feasibility in setting the rule. As a result, the SWRCB is re-evaluating the MCL. As of December 2023, the SWRCB have started the formal rulemaking process for establishing a MCL 10 µg/L for Cr^{+6} and are currently going through the steps toward adoption.

3.3.4 Iron

Iron is a naturally occurring element that is found in many rocks and minerals within certain igneous and volcanic formations, including the Mehrten and Turlock Lake/Laguna Formations. Iron is regulated under a drinking water SMCL of 0.30 mg/L.

3.3.5 Manganese

Manganese is a naturally occurring element that is found in many rocks and minerals within certain igneous and volcanic formations, including the Mehrten and Turlock Lake/Laguna Formations. Manganese is regulated under a drinking water SMCL of 0.050 mg/L.

Manganese is a naturally occurring element in groundwater sources. Manganese is currently a regulated contaminant with a SMCL of 50 µg/L. A secondary standard was established to address issues of aesthetics (discoloration), not health concerns. However, recent studies suggest there may be health concerns associated with lower concentrations of manganese. The Division of Drinking Water (DDW) has initiated the process to establish a MCL and is anticipated to be established at about 0.02 mg/L.

3.3.6 Nitrate

The occurrence of nitrate and its drinking water standard are discussed in Section 3.2. Nitrate is included as a supplementary constituent for only the sentry well monitoring network.

4. Groundwater Quality Sampling

Groundwater quality sampling took place between October 16 through October 30, 2023. The construction details, and the locations, of the shallow aquifer RMS network wells sampled are shown in **Table 1** and **Figure 1**, respectively. Note that the public water supply wells listed in **Table 1** were not sampled during this effort but were sampled by their owners as part of drinking water regulatory required programs. LW-1 is an upgradient well and was sampled for compliance with the Waste Discharge Requirements for Placer County Western Regional Sanitary Landfill. Sentry wells were also sampled, and their construction details are listed in **Table 2** and their locations are shown on **Figure 1**. Note that four shallow aquifer RMS network wells are part of the sentry well monitoring network and are present to vertically profile water quality in the aquifers.

Water samples were collected from each monitoring well by Confluence Environmental, Inc. (Confluence), located in Sacramento, California. Each well was purged a minimum of three well volumes using a temporary submersible purge pump. Field parameters (e.g., potential hydrogen [pH], dissolve oxygen, oxidization/reduction potential, electric conductivity, and turbidity, temperature) were measured as the water was purged. Field logs are provided in **Appendix A.** The samples were collected using a new bailer and were placed directly into laboratory prepared sample bottles, without filtration. Analyses for metals therefore represent total and not dissolved concentrations. When sampling each well the pump was decontaminated, and the tubing replaced to eliminate the potential for cross contamination.

Water quality analyses were performed by BSK Associates (BSK) of Fresno, California. Samples were picked up at Confluence's office by BSK staff and transported to their Rancho Cordova location where they were prepared for shipping to Fresno and analyses. Laboratory data sheets and Chain of Custody forms for each sample are provided in **Appendix B.** A summary table of historical and current analytical results for each well are provided in **Appendix C**.

GEI coordinated sampling and analyses activities with Confluence and BSK, while also arranging access to local wells with local well owners. GEI also performed a quality check of the analytical results.

Table 1: Shallow Aquifer RMS Network Construction Details

Map No.	CASGEM_ID	Well Name	Lat	Long	Total Well Depth (ft bgs)	Screen int. Top (ft bgs)	Screen Int Bot (ft bgs)
Shallow Aquifer RMS Network							
Monitoring Wells							
17	388593N1214885W003	AB-2 shallow	38.859300	-121.48850	155	135	145
20	386635N1213486W001	SGA_MW05	38.663470	-121.34859	220	205	215
24	386836N1214536W001	SGA_MW02	38.683620	121.45363	110	100	110
27	386864N1215222W003	AB-3 shallow	38.686400	-121.52220	220	190	210
37	388260N1215394W004	SUT-P1	38.826000	-121.53940	120	110	120
39	389116N1215238W003	AB-1 shallow	38.911600	-121.52380	190	170	180
46	387623N1213915W001	SVMW West - 1A	38.762320	-121.39153	145	120	140
80	389740N1213606W002	Cemetery (IRLP)	38.974030	-121.36062	111	70	111
89	387191N1213287W001	Roseview Park - 315	38.719120	-121.32879	315	295	305
90	388026N1214432W002	WPMW-12A	38.802639	-121.44322	300	260	280
91	388882N1214005W002	WPMW-11A	38.888164	-121.40046	162	132	152
109	387218N1214677W001	SGA_MW01	38.721780	-121.46771	110	100	110
Public Water Supply Wells							
133	388373N1213583W001	LW-1	38.837310	-121.358310	108	68	108
298	3110025-014	Tinker Road Well	--	--	177	117	177
99	3400396-001	Main Well	--	--	73	53	73
177	3410002-013	Well 22 - Northrop	--	--	265	113	225

Table 2: Sentry Well Monitoring Network Construction Details

Map No.	CASGEM_ID	Well Name	Lat	Long	Total Well Depth (ft bgs)	Screen int. Top (ft bgs)	Screen Int Bot (ft bgs)
Sentrt Well Monitoring Network							
Monitoring Wells							
17	388593N1214885W003	AB-2 shallow	38.85930	-121.48850	155	135	145
17	388593N1214885W002	AB-2 middle	38.85930	-121.48850	500	380	490
17	388593N1214885W001	AB-2 deep	38.85930	-121.48850	700	670	690
27	386864N1215222W002	AB-3 middle	38.68640	-121.52220	500	470	500
37	388260N1215394W004	SUT-P1	38.82600	-121.53940	120	110	120
37	388260N1215394W003	SUT-P2	38.82600	-121.53940	195	185	195
37	388260N1215394W002	SUT-P3	38.82600	-121.53940	305	295	305
5	388604N1213544W001	MW 1-1	38.86038	-121.35438	398	378	398
65	388604N1213544W002	MW 1-2	38.86038	-121.35438	318	298	318
65	388604N1213544W003	MW 1-3	38.86038	-121.35438	204	184	204
65	388604N1213544W004	MW 1-4	38.86038	-121.35438	92	82	92
75	389255N1213566W002	MW 2-2	38.92547	-121.35663	170	160	170
75	389255N1213566W003	MW 2-3	38.92547	-121.35663	85	75	85
90	388026N1214432W002	WPMW-12A	38.80264	-121.44322	300	260	280
90	388026N1214432W004	WPMW-12B	38.80264	-121.44322	550	508	528
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	162	132	152
91	388882N1214005W004	WPMW-11B	38.88816	-121.40046	309	264	304
131	--	SSWD- supply	38.91158	-121.52438	140	85	140
132	--	NCMWD - supply	38.68561	-121.52211	Uknown	Uknown	Uknown

Note: Some shallow aquifer RMS wells used as part of the sentry monitoring well network.

5. Shallow Aquifer Network Results

Analytical water quality results for all shallow aquifer monitoring network, sampled wells public supply wells, and LW-1 well are provided in **Table 3** along with MTs and MOs (established to be reached by 2024) in the GSP for these constituents. MTs and MOs have not been established at some wells, typically because historic data had concentrations less than laboratory reportable detection limits (RDLs). Field parameters recorded for each well at the time of sampling are provided in the field notes located in **Appendix A**. Water quality sample results are compared against MTs and MOs which were established for these representative monitoring wells. However, it is important to note that most wells sampled for this study are monitoring wells which are not used for drinking water purposes. Three samples in **Table 3** are from drinking water wells and the water is served to the public.

Table 3: Shallow Aquifer RMS Network Sampling Results

Well Name	Date Sampled	MO TDS (mg/L)	MT TDS (mg/L)	MO Nitrate (mg/L)	MT Nitrate (mg/L)	Element	
						TDS	Nitrate
						mg/L	mg/L
Drinking Water MCL, SMCL (Recommended, or Notification Level (Boron)						**500**	**10**
Shallow Aquifer RMS Network							
Monitoring Wells Sampled as Part of this Program							
AB-2 shallow	10/16/2023	220	500	ND	10	250	<0.23
SGA_MW05	10/19/2023	300	500	1.7	10	98	0.63
SGA_MW02	10/17/2023	300	500	4.5	10	250	6.2
AB-3 shallow	10/17/2023	170	500	ND	10	170	<0.23
SUT-P1	10/18/2023	120	500	ND	10	97	<0.23
AB-1 shallow	10/16/2023	150	500	ND	10	170	<0.23
SVMW West - 1A	10/16/2023	TBD	500	TBD	10	200	1.8
Cemetery (IRLP)	10/30/2023	290	500	TBD	10	260	1.4
Roseview Park - 315	10/19/2023	210	500	TBD	10	240	1.1
WPMW-12A	10/19/2023	230	500	0.64	10	220	0.72
WPMW-11A	10/19/2023	240	500	1.1	10	220	1.3
SGA_MW01	10/17/2023	360	500	1.0	10	320	6
Wells Sampled for Other Regulatory Programs							
LW-1 [1]	10/19/2023	220	500	4.0	10	260	4
Main Well [2]	3/9/2023	TBD	500	ND	10	--	<0.4
Well 22 - Northrop [2]	2/7/2023	120	500	ND	10	94	<0.23
Tinker Road Well [2]	8/24/2023	240	500	4.26	10	241	3.72

Notes: [1] Not sampled as part of this project, data supplied from Geotracker.

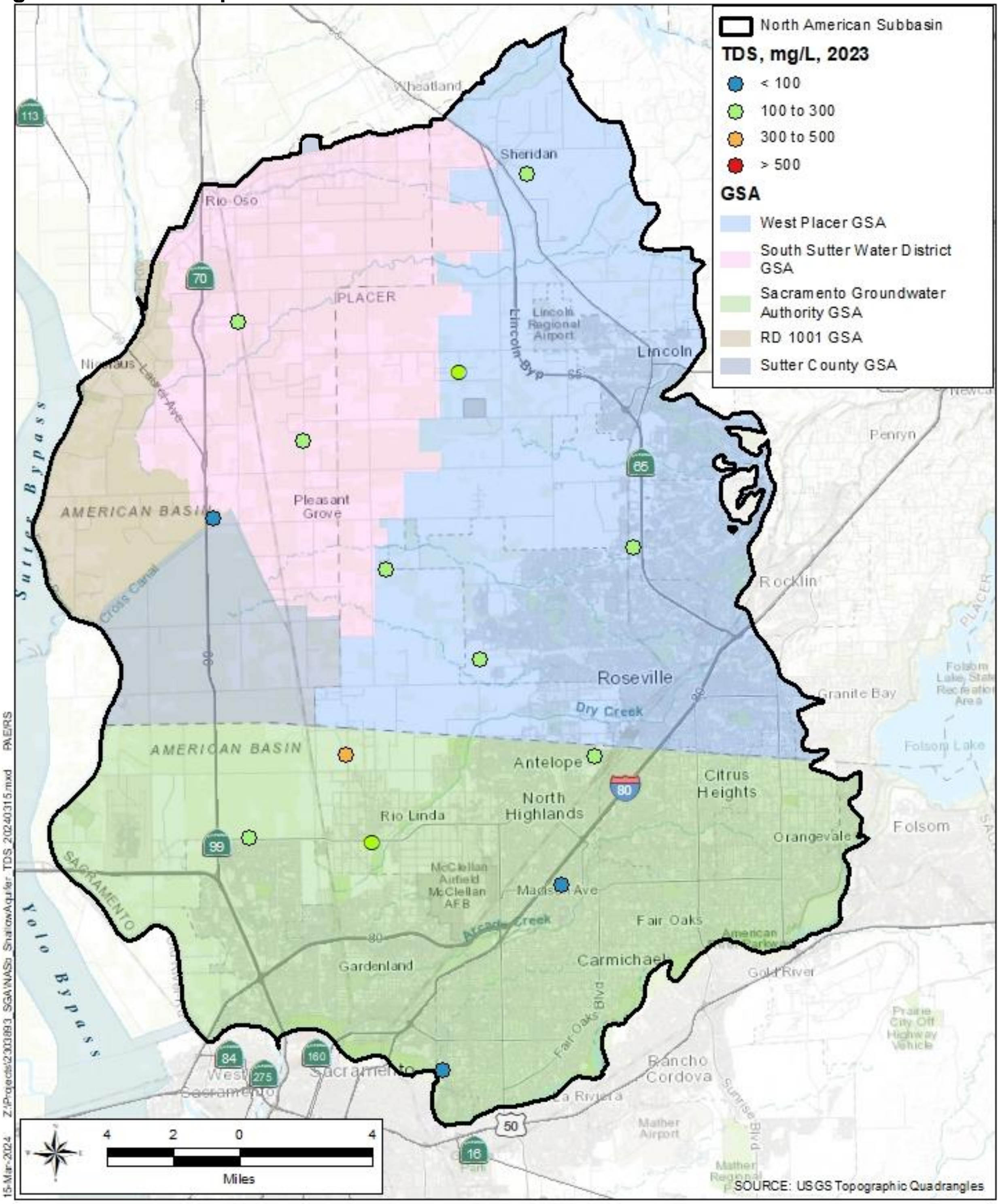
[2] Not sampled as part of this project, data supplied from Drinking Water Watch.

5.1 Total Dissolved Solids

Twelve shallow aquifer monitoring wells were sampled for TDS as part of this effort and includes results from two public water supply wells and one monitoring well (e.g., LW-1) which were obtained from the SWRCB website. Analytical results are shown in **Table 3**, along with established MTs and MOs.

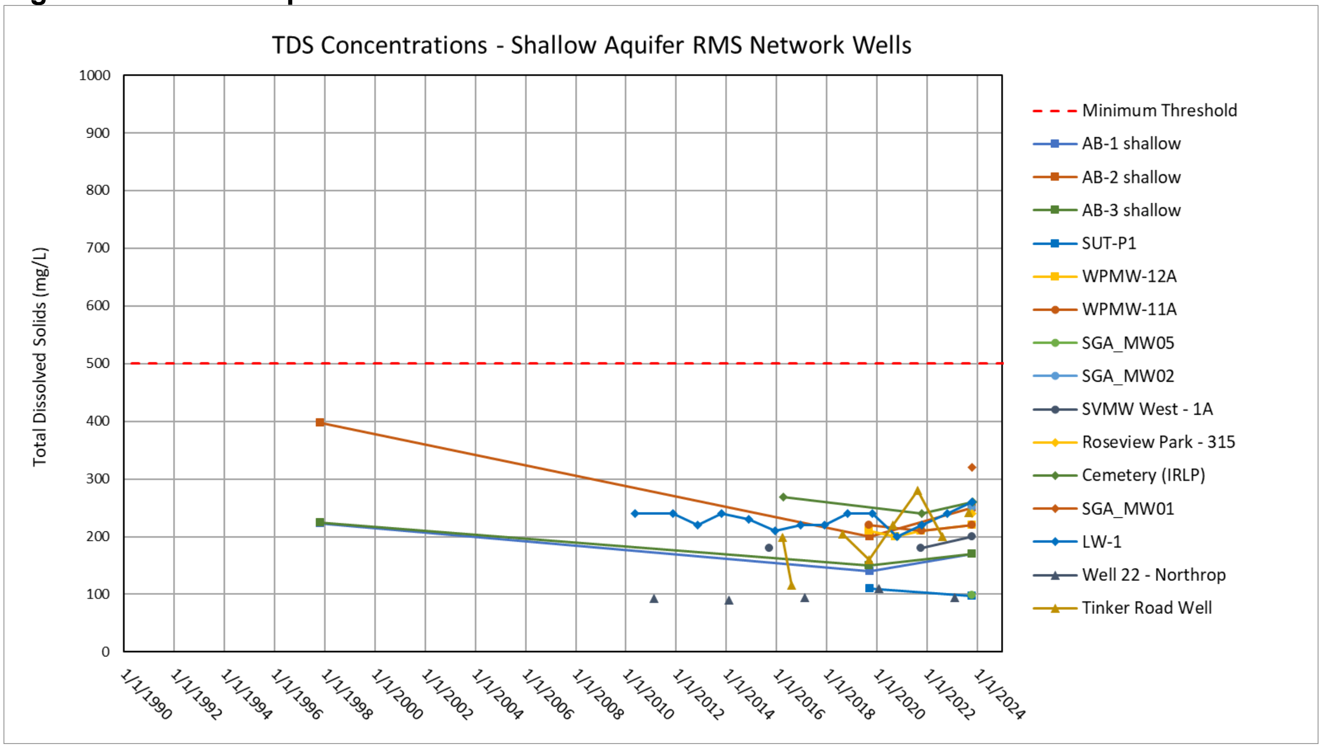
No wells exceeded the MTs for TDS. Ten wells have TDS concentrations below their MOs and five wells exceed the MOs by 1 to 40 mg/L. The distribution of TDS concentrations from the shallow aquifer monitoring wells in the Subbasin are shown in **Figure 2**.

Figure 2: Shallow Aquifer RMS Network TDS Concentration Distribution



A plot of the concentrations for TDS are shown in **Figure 3** to allow a comparison of the current and historic data at each well, the MT, and also in comparison to each other and apparent visual trends. Minimum objectives are not shown in **Figure 3** as they have various levels.

Figure 3: Shallow Aquifer RMS Network TDS Concentrations



Note: Wells with similar concentrations may not be visible on graph.

The trends in the concentrations at each well were analyzed statistically to determine if the concentrations are increasing, decreasing, or no trend (stable). The Mann-Kendall method was used to assess stastistical trends, which is a non-parametric (i.e. does not assume distribution in the data) test to detect trends in time series data. The method requires that a minimum of five analyses must be available to perform the analysis.

Three wells had sufficient historical data to analyze for statistical trends. The analysis showed:

- Stable trends for TDS at LW-1 and Well 22 – Northrop
- Decreasing trends for TDS at Tinker Road Well

All other representative monitoring wells have fewer than five analyses, so sufficient data is not available to assess trends at this time. Results by well and trends are provided in **Appendix D.**

Wells with at least three analyses but less than five were assessed visually with the following apparent trends:

- Stabletrends at AB-2 shallow, AB-3 shallow, Cemetery (IRLP), SVMW-West 1A, WPMW-11A, and WPMW-12A

5.2 Nitrate

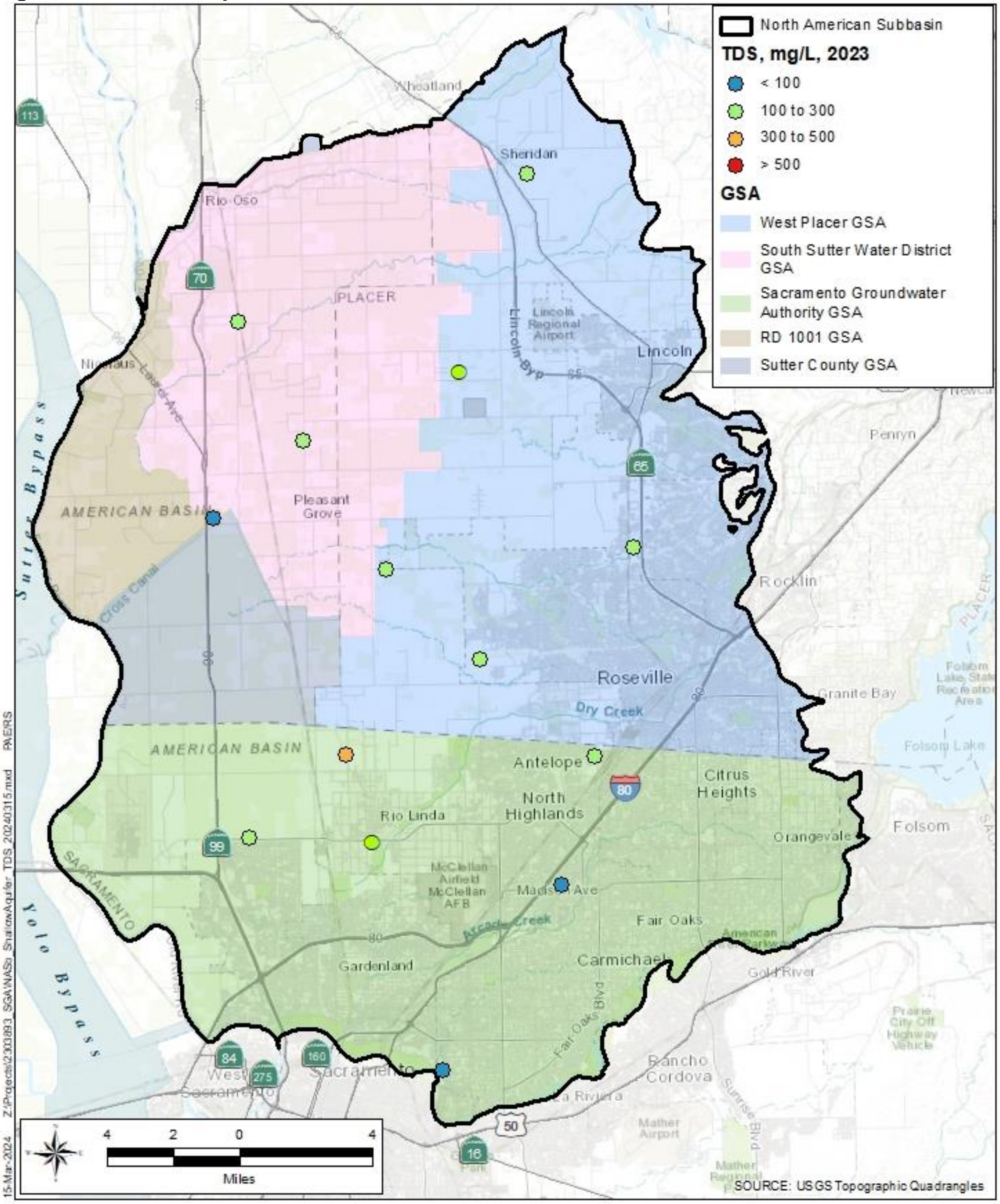
Twelve monitoring wells were sampled for nitrate as part of this effort and results from two public water supply wells and one monitoring well (e.g., LW-1) were obtained from the SWRCBs websites.

Analytical results are shown in **Table 3**. All wells had nitrate results below the MT of 10 mg/L. Of the sixteen RMS wells, only nine have established MOs. Four wells have concentrations exceeding the MOs by 0.08 to 5 mg/L.

Concentrations of nitrate in groundwater less than 3 mg/L may be naturally occurring whereas concentrations above 3 mg/L generally originate from anthropogenic sources such as fertilizers, wastewater, or concentrated animal feed lots (EPA). Four wells had concentrations above 3 mg/L, two in the western portion of the Subbasin near the area where sloughs and salt sinks have historically been present and two wells in the eastern portion of the Subbasin near the Placer County and City of Lincoln wastewater treatment plant.

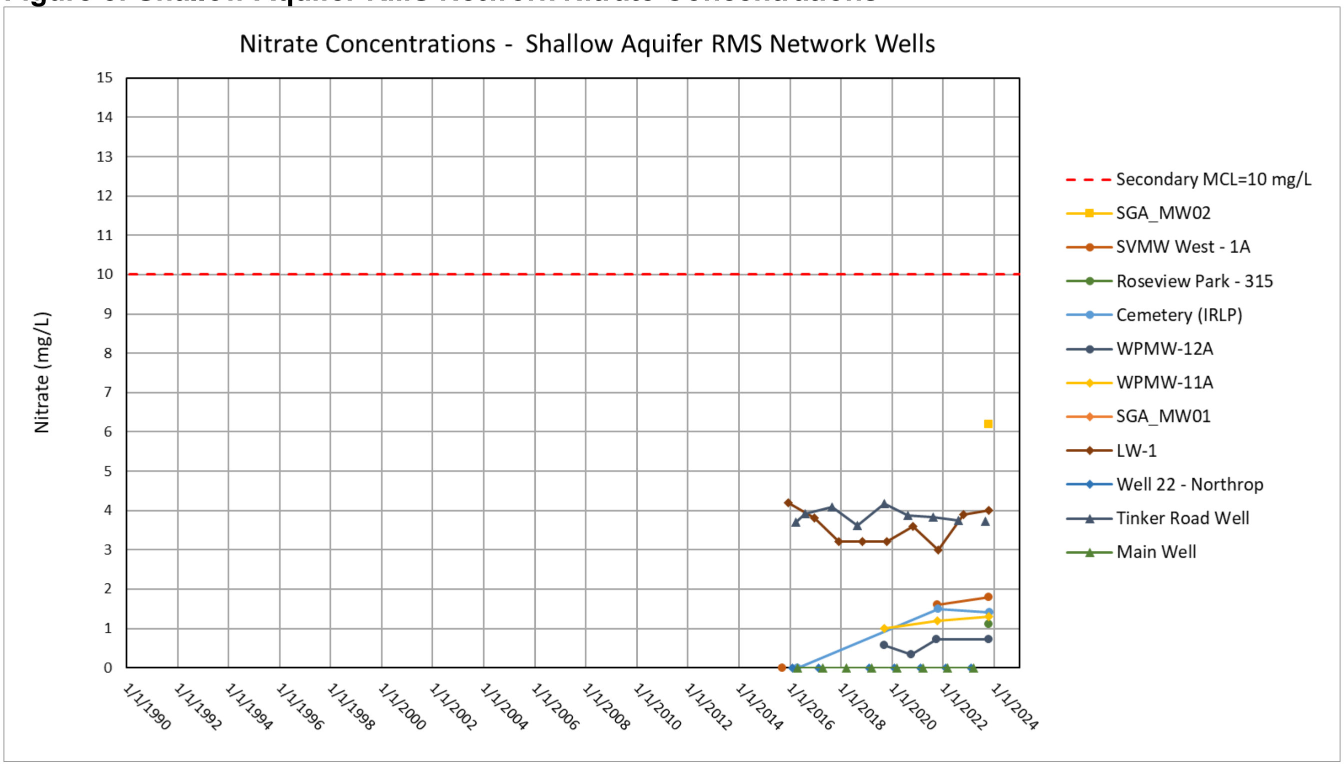
The distribution of nitrate concentrations from the shallow aquifer RMS network wells in the Subbasin are shown in **Figure 4.**

Figure 4: Shallow Aquifer RMS Network Nitrate Distribution



The concentrations detected at each shallow aquifer monitoring network are shown in **Figure 5** to illustrate the ranges in concentrations. Wells with concentrations less than the laboratory RDLs (concentrations shown in **Table 3** with less than symbols) are not shown on this figure.

Figure 5: Shallow Aquifer RMS Network Nitrate Concentrations



Note: Wells with results below detection limits are not shown on this figure.

The trends in the concentrations at each well were analyzed statistically to determine if the concentrations are trending stable, increasing, or decreasing. The Mann-Kendall method was used to assess stastistical trends, which is a non-parametric (i.e. does not assume distribution in the data) test to detect trends in time series data. The method requires that a minimum of five analyses must be available to perform the analysis.

Three wells had current and sufficient historic data to analyze for statistical trends. The analysis showed:

- Stable trends at the Main Well and Tinker Road Well
- Decreasing trends at well LW-1

All other representative monitoring wells have fewer than five data points, so sufficient data is not available to assess trends at this time.

Wells with at least three analyses but less than five were assessed visually with the following apparent trends:

- Visual upward trend at SVMW West-1A
- Visual stable trends at all other wells

6. Sentry Well Monitoring Network Results

Analytical water quality results for all sentry wells sampled are shown in **Table 4**. Additional field parameters for each well are provided in the field notes in **Appendix A**. Water quality sample results and trends are compared against drinking water MCLs and SMCLs. Most wells sampled are monitoring wells which are not used for drinking water purposes. The NMWC-supply well is only used for limited domestic non potable uses. Many of the wells are nested types of monitoring wells (e.g., wells constructed with isolated intake screens at various depths) allowing for vertical profiling of water quality. A few of the sentry wells are also shallow aquifer RMS network wells and are included as sentry wells to provide vertical profiling of the aquifers to assess whether the elevated constituents are from near surface or from below.

Table 4: Sentry Well Monitoring Network Water Quality Sampling Results

Well Name	Date	Element
		TDS
		mg/L
Drinking Water MCL, SMCL (Recommended)		**500**
Sentry Well Monitoring Network		
Monitoring Wells		
AB-2 shallow	10/16/2023	250
AB-2 middle	10/16/2023	93
AB-2 deep	10/16/2023	85
AB-3 middle	10/17/2023	160
SUT-P1	10/18/2023	97
SUT-P2	10/18/2023	67
SUT-P3	10/18/2023	72
MW 1-4	10/18/2023	190
MW 1-3	10/18/2023	200
MW 1-2	10/17/2023	220
MW 1-1	10/16/2023	350
MW 2-3	10/18/2023	270
MW 2-2	10/18/2023	200
WPMW-12A	10/19/2023	220
WPMW-12B	10/19/2023	640
WPMW-11A	10/19/2023	220
WPMW-11B	10/19/2023	210
SSWD- supply	10/16/2023	580
NMWC - supply	10/17/2023	500

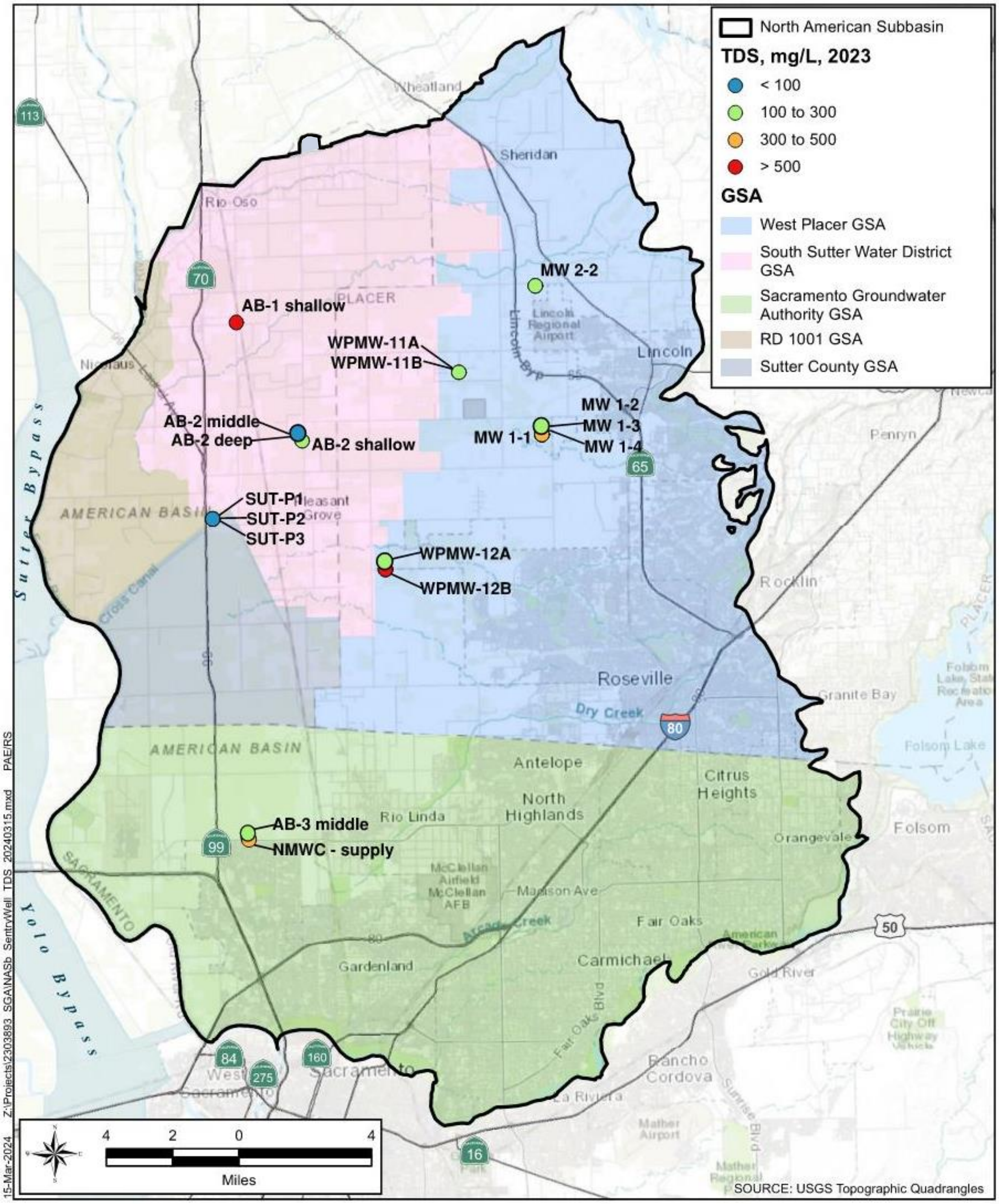
Note: AB-2 shallow, SUT-P1, WPMW-12A, and WPMW-11A are designated RMS but are also used as part of the sentry network.

6.1 Total Dissolved Solids

Nineteen sentry wells were sampled for TDS. Analytical results are shown in **Table 4**. Additionally, **Table 4** has been organized to illustrate vertical profiling and therefore, starts with the shallowest monitoring well series progressively getting deeper, regardless of the well number. Three wells were above the SMCL of 500 mg/L.

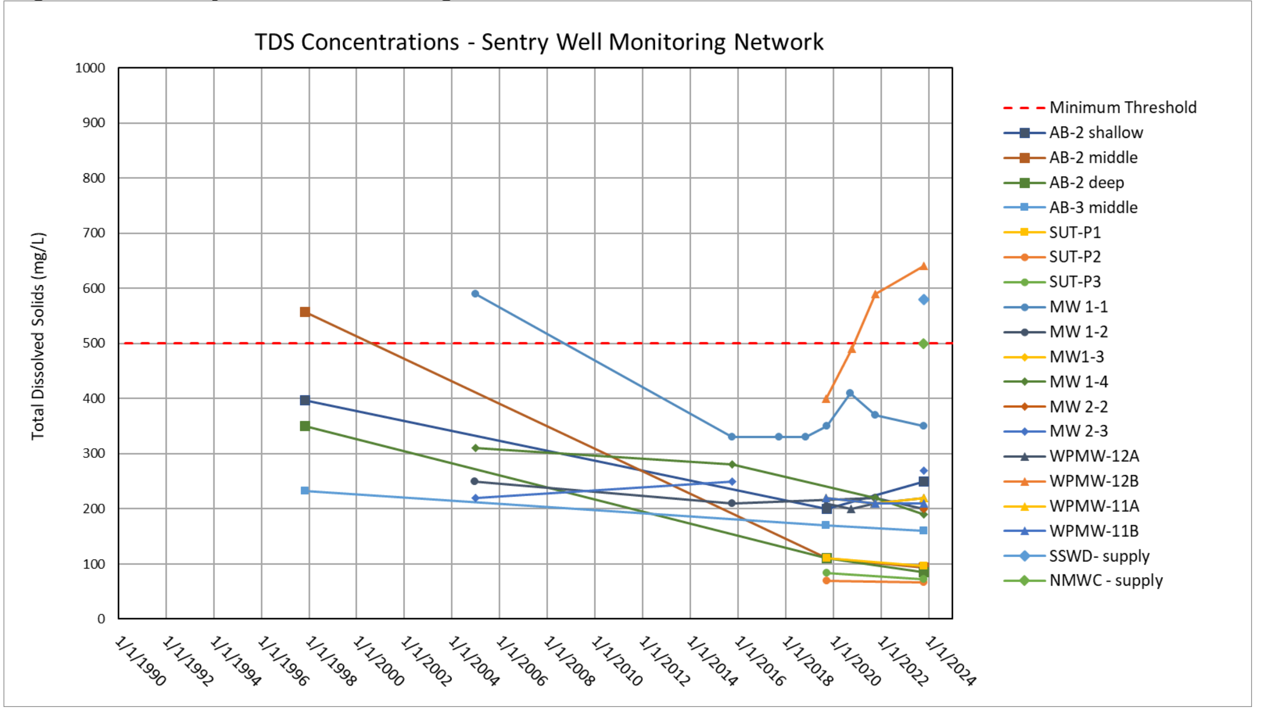
The distribution of TDS concentrations at the sentry wells in the Subbasin are shown in **Figure 6.** Well names are shown on this figure as many of these wells are nested (e.g., multiple wells installed in a single borehole.) to illustrate the variability with depth.

Figure 6: Sentry Well Monitoring Network TDS Distribution



A plot of the concentrations for TDS are shown in **Figure 7** to allow a comparison of the current and historic data at each well and also in comparison to each other.

Figure 7: Sentry Well Monitoring Network TDS Concentrations



The trends in the concentrations at each well were analyzed statistically to determine if the concentrations are trending stable, increasing, or decreasing. The Mann-Kendall method was used to assess stastistical trends, which is a non-parametric (i.e. does not assume distribution in the data) test to detect trends in time series data. The method requires that a minimum of five analyses must be available to perform the analysis.

Only one well had current and sufficient historic data to analyze for statistical trends. The analysis showed:

- Stable trends for TDS at well MW 1-1

All other representative monitoring wells have fewer than five data points, as a result, sufficient data is not available to assess trends at this time. Results by well and trends are provided in **Appendix D.**

Wells with at least three analyses but less than five were assessed visually with the following apparent trends:

- Upward trends at WPMW-12B and MW 2-3
- Downward trends at AB-2 middle, AB-2 deep, and MW 1-4
- Stable trends at WPMW-11A, WPMW-11B, WPMW-12A, and MW 1-2,

Vertical profiling of the concentrations of TDS in the sentry well monitoring network show that TDS concentrations are higher in the shallowest wells at AB-2, SUT, MW-2, and WPMW-11 nested wells. This suggests that the source is from surface activities. In contrast, MW-1, MW-12, and MW-11 nested wells have higher TDS concentrations in the deeper monitoring wells than in shallow monitoring wells. This suggests that the source of higher concentrations is potentially from the underlying marine sediments.

7. Supplementary Water Quality Analyses

The GSAs wanted to assess the Subbasin for other constituents contained in the GSP to further understand the distribution and trends for five supplemental constituents. Analytical results are shown in **Table 5**. Water quality for the three municipal supply wells were sampled by their owners as part of Title 22 water quality regulatory monitoring and were obtained from the SWRCB Drinking Water Watch. Results from one monitoring well (e.g., LW-1) were obtained from the SWRCBs GeoTracker website.

Table 5: Supplemental Constituents Water Quality Sampling Results

Well Name	Date	Field Parameters pH (pH units)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Element Nitrate mg/L	Arsenic ug/L	Boron mg/L	Cr^{6+} ug/L	Fe mg/L	Mn mg/L
Drinking Water MCL, SMCL (Recommended)					**10**	**10**	**1**	**10**	**0.3**	**0.05**
Shallow Aquifer RMS Network										
Monitoring Wells Sampled as Part of this Program										
AB-2 shallow	10/16/2023	7.76	3.40	9.55	--	<2.0	<0.1	--	23	0.27
SGA_MW05	10/19/2023	6.69	3.60	4.88	--	<2.0	<0.1	--	0.10	0.01
SGA_MW02	10/17/2023	7.03	5.11	6.31	--	8.6	<0.1	--	0.31	0.01
AB-3 shallow	10/17/2023	7.48	2.16	6.62	--	3.1	<0.1	--	140	0.49
SUT-P1	10/18/2023	8.78	1.53	139	--	<2.0	<0.1	--	19	0.092
AB-1 shallow	10/16/2023	7.76	3.40	9.55	--	<2.0	<0.1	--	32	0.19
SVMW West - 1A	10/16/2023	7.60	6.41	2.76	--	7.5	<0.1	14	2.5	0.09
Cemetery (IRLP)	10/30/2023	7.22	6.03	1.01	--	<2.0	0.21	2.9	0.03	0.01
Roseview Park - 315	10/19/2023	6.70	7.36	2.34	--	3.8	0.14	--	1.4	0.027
WPMW-12A	10/19/2023	7.22	3.18	4.01	--	2.7	<0.1	6.6	0.33	0.17
WPMW-11A	10/19/2023	6.73	3.53	6.70	--	7.2	0.17	5	0.12	0.01
SGA_MW01	10/17/2023	6.95	4.50	22.00	--	8.8	0.11	--	1.2	0.019
Wells Sampled for Other Regulatory Programs										
LW-1 [1]	10/19/2023	7.09	--	--	--	<10J	--	--	<0.03	<0.04
Main Well [2]	3/9/2023	--	--	--	--	--	--	--	--	--
Well 22 - Northrop [2]	2/7/2023	--	--	0.2 [3]	--	3.5	--	0.45	<0.03	<0.01
Tinker Road Well [2]	8/24/2023	--	--	0.3 [3]	--	<2	--	--	<0.10	<0.02
Sentry Well Monitoring Network										
Monitoring Wells										
AB-2 shallow	10/16/2023	7.76	3.40	9.55	<0.23	<2.0	<0.1	--	23	0.27
AB-2 middle	10/16/2023	10.57	1.75	6.15	<0.46	<2.0	<0.1	--	120	0.59
AB-2 deep	10/16/2023	7.71	1.09	21.4	<0.46	2.1	<0.1	--	60	0.3
AB-3 middle	10/17/2023	7.70	1.72	12.6	<0.23	<2.0	0.12	--	70	0.3
SUT-P1	10/18/2023	8.78	1.53	139	<0.23	<2.0	<0.1	--	19	0.092
SUT-P2	10/18/2023	8.34	1.14	38.5	<0.23	<2.0	<0.1	--	4.2	0.026
SUT-P3	10/18/2023	9.03	1.40	--	<0.23	<2.0	0.1	--	1.8	0.01
MW 1-1	10/16/2023	7.01	1.31	<999	<0.23	8.2	0.36	--	3.9	0.47
MW 1-2	10/17/2023	7.67	1.66	5.82	0.83	4.9	0.26	--	4.9	0.051
MW 1-3	10/18/2023	7.08	3.83	36.8	2.1	2.3	<0.1	6.7	5.6	0.046
MW 1-4	10/18/2023	6.52	1.84	8.25	5.2	<2.0	<0.1	--	1.3	0.09
MW 2-2	10/18/2023	7.14	2.20	5.5	0.92	<2.0	0.19	--	5.9	0.018
MW 2-3	10/18/2023	6.84	3.89	7.75	2	<2.0	<0.1	--	9.4	0.026
WPMW-12A	10/19/2023	7.22	3.18	4.01	0.72	2.7	<0.1	6.6	3.3	0.17
WPMW-12B	10/19/2023	7.04	0.14	4.44	<0.23	<2.0	0.42	--	1.2	0.35
WPMW-11A	10/19/2023	6.73	3.57	6.7	1.3	7.2	0.17	5	1.2	0.01
WPMW-11B	10/19/2023	7.14	1.91	8.03	<0.23	6.8	0.58	--	4.2	0.3
SSWD- supply [1]	10/16/2023	7.02	3.42	4.69	1.1	2.4	<0.1	--	<0.03	0.01
NMWC - supply [1]	10/17/2023	7.48	3.51	11.4	0.55	16	<0.1	--	<0.03	0.049

Notes: [1] Not sampled as part of this project, data supplied from Geotracker.

[2] Not sampled as part of this project, data supplied from Drinking Water Watch.

[3] Turbidity is lab sampled.

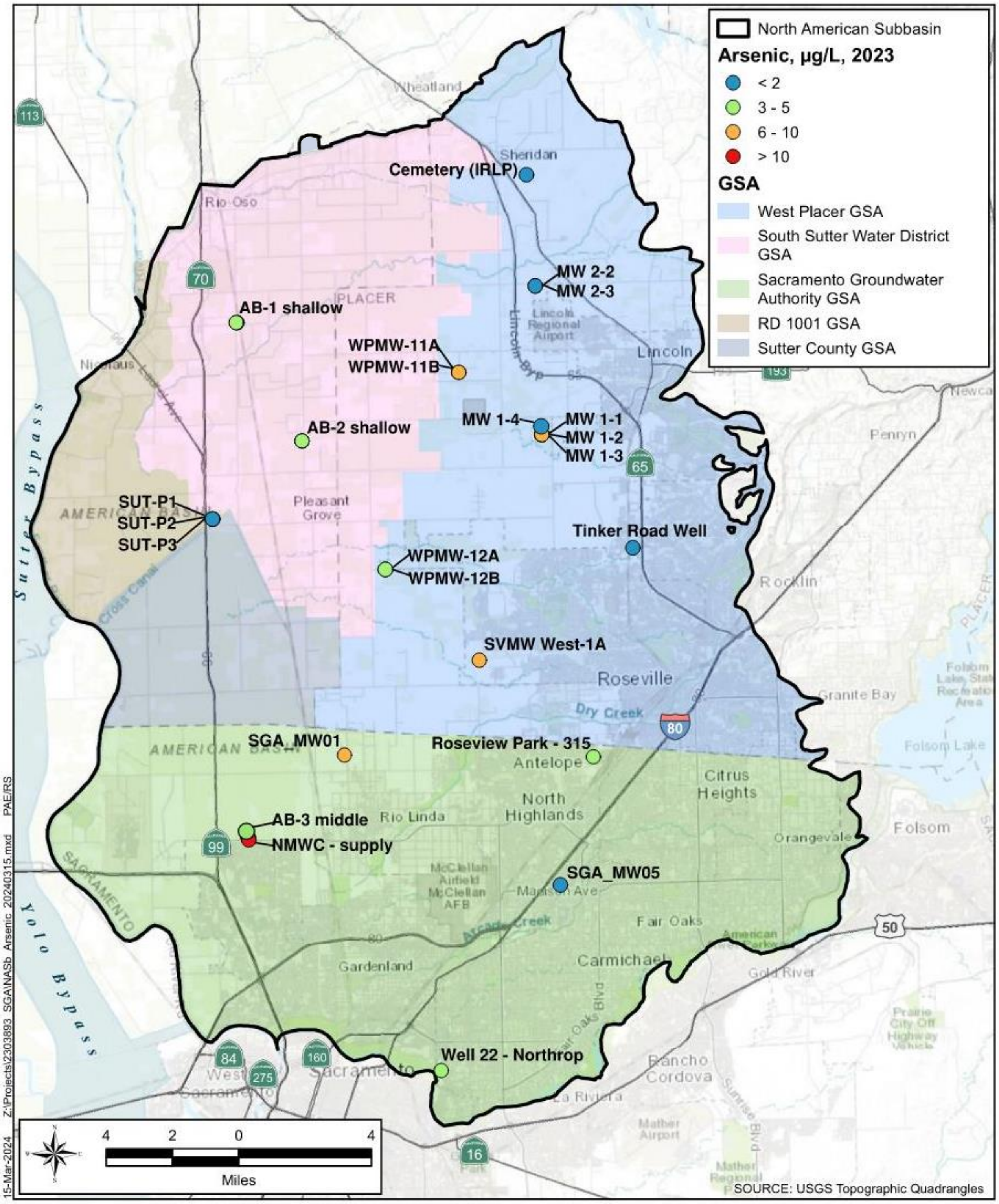
J = Estimated value. Result is less than reporting limit and greater than the method detection limit.

AB-2 shallow, SUT-P1, WPMW-12A and WPMW-11A are designated RMS sites but are also used as part of the sentry network.

7.1 Arsenic

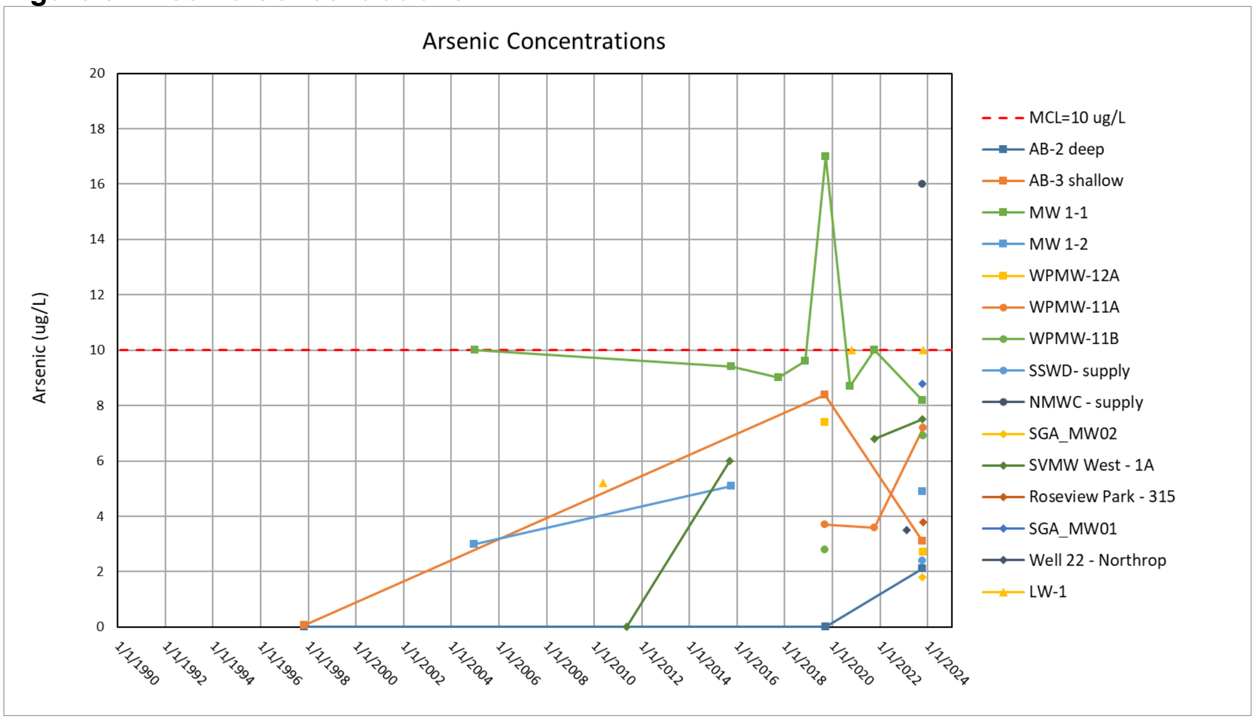
Twenty-seven shallow aquifer RMS network and sentry wells were sampled for arsenic as part of this effort and includes results from two municipal supply wells and one monitoring well (e.g., LW-1) which were obtained from the SWRCB websites. Analytical results are shown in **Table 5**. All wells had arsenic results below the MCL of 10 μg/L, except for one well (e.g., NMWC-supply) which is not used for drinking water. The concentration distribution in the Subbasin is shown in **Figure 10.** Sixteen wells had less than detectable concentrations. Six wells had concentrations greater than one-half the MCL.

Figure 8: Arsenic Distribution



A plot of the concentrations for arsenic are shown in **Figure 11** to allow a comparison of the current and historic data at each well and also in comparison to each other. Wells with concentrations less than the laboratory reportable detection limit (concentrations shown in **Table 5** with less than symbols) are not shown in this figure. The figure illustrates the wide range of concentrations, similar to that described in the GSP.

Figure 9: Arsenic Concentrations



The trends in the concentrations at each well were analyzed statistically to determine if the concentrations are trending stable, increasing, or decreasing. The Mann-Kendall method was used to assess stastistical trends, which is a non-parametric (i.e. does not assume distribution in the data) test to detect trends in time series data. The method requires that a minimum of five analyses must be available to perform the analysis.

Only one montioring well had sufficient analyses to be analyzed and showed:

- Stabletrend at well MW1-1

The remaining wells did not have enough water quality results to perform the statistical analysis.

Wells with at least three analyses but less than five were assessed visually with the following apparent trends:

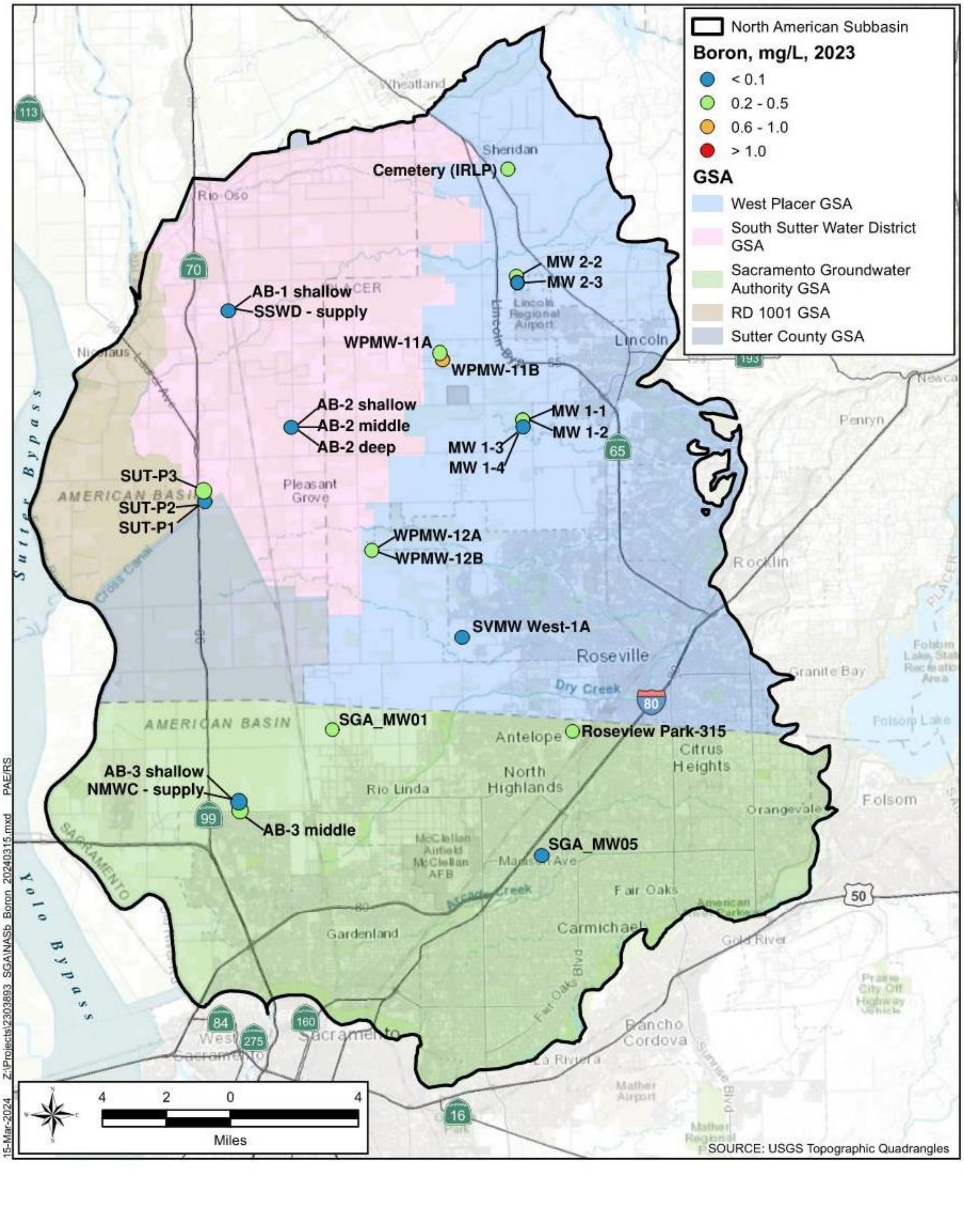
- Unable to interpret due to wide variance of concentrations

Vertically, the highest concentrations in the western portion of the Subbasin occur at deeper levels while in the eastern portion of the Subbasin the highest concentration were found at shallower levels.

7.2 Boron

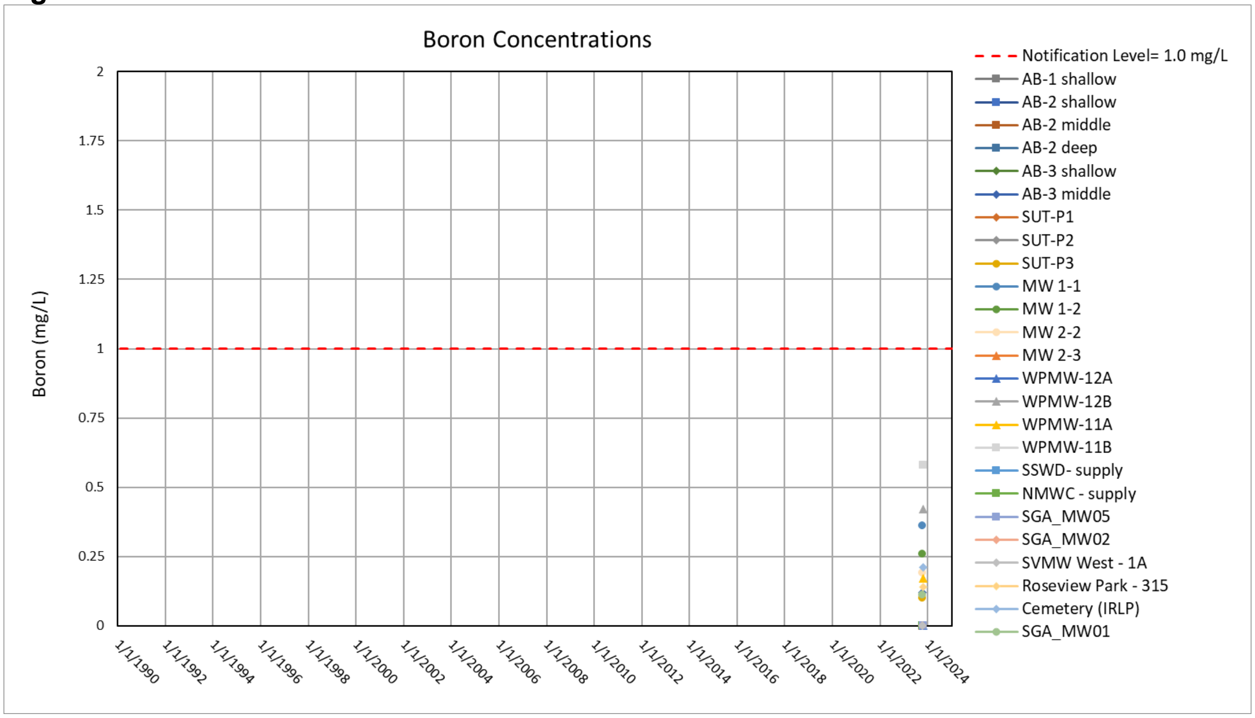
Twenty-seven shallow aquifer RMS network and sentry wells were sampled for boron as part of this effort. Boron was not analyzed at any of the public water supply wells or at well LW-1. Analytical results are shown in **Table 5**. Nineteen wells had concentrations below the RDLs (<0.01 mg/L), and as a result, only eight wells had detectable concentrations. All wells had boron results below the drinking water Notification Level of 1.0 mg/L. The concentration distribution in the Subbasin is shown in **Figure 12**.

Figure 10: Boron Distribution



The concentrations detected at each shallow aquifer RMS network and sentry wells are shown in **Figure 13** to illustrate the ranges in concentrations. Only three wells with concentrations greater than the RDL are shown in this figure.

Figure 11: Boron Concentrations

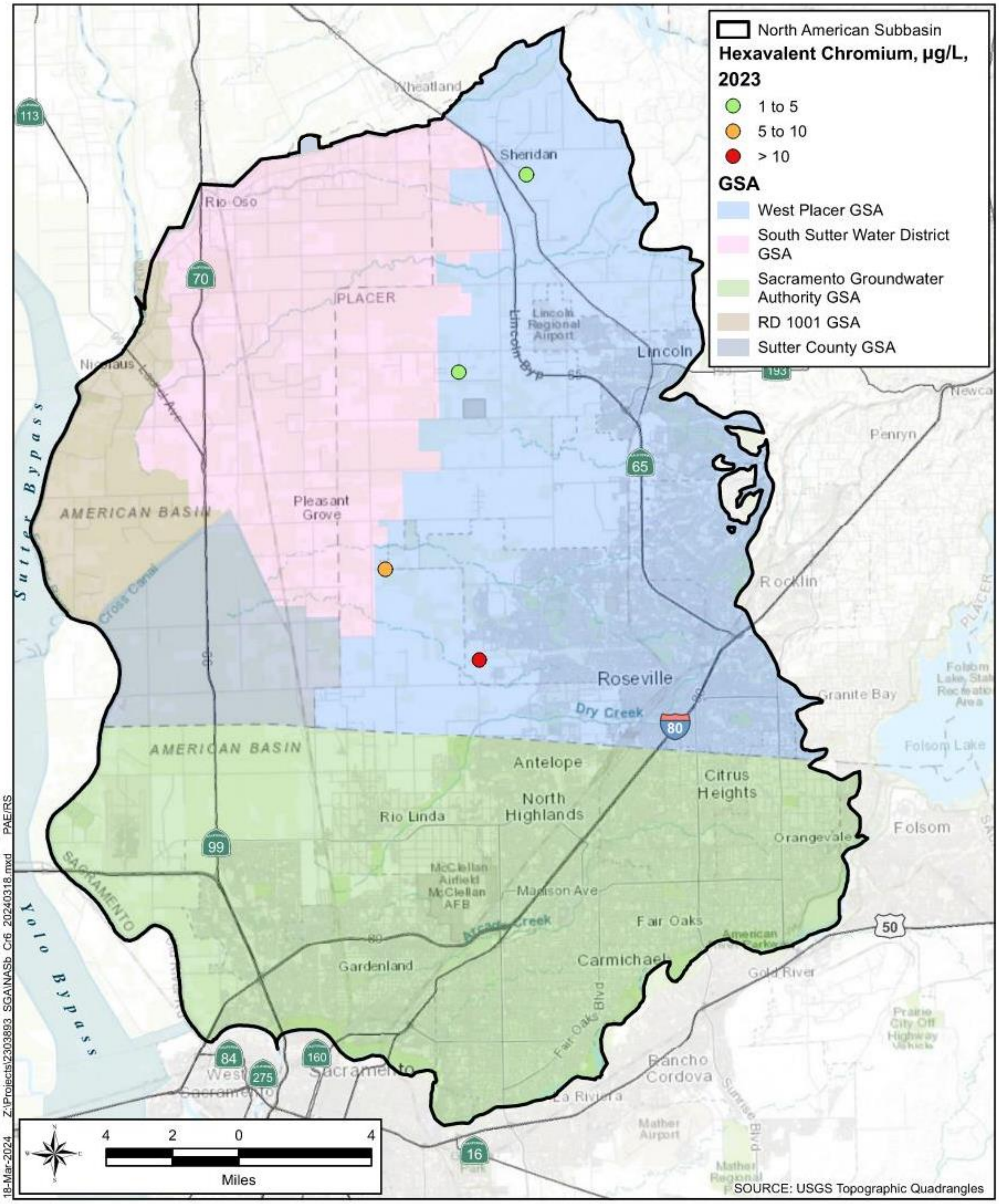


All monitoring wells have fewer than five data points, and as a result, sufficient data is not available to assess trends or statistical analysis at this time.

7.3 Hexavalent Chromium

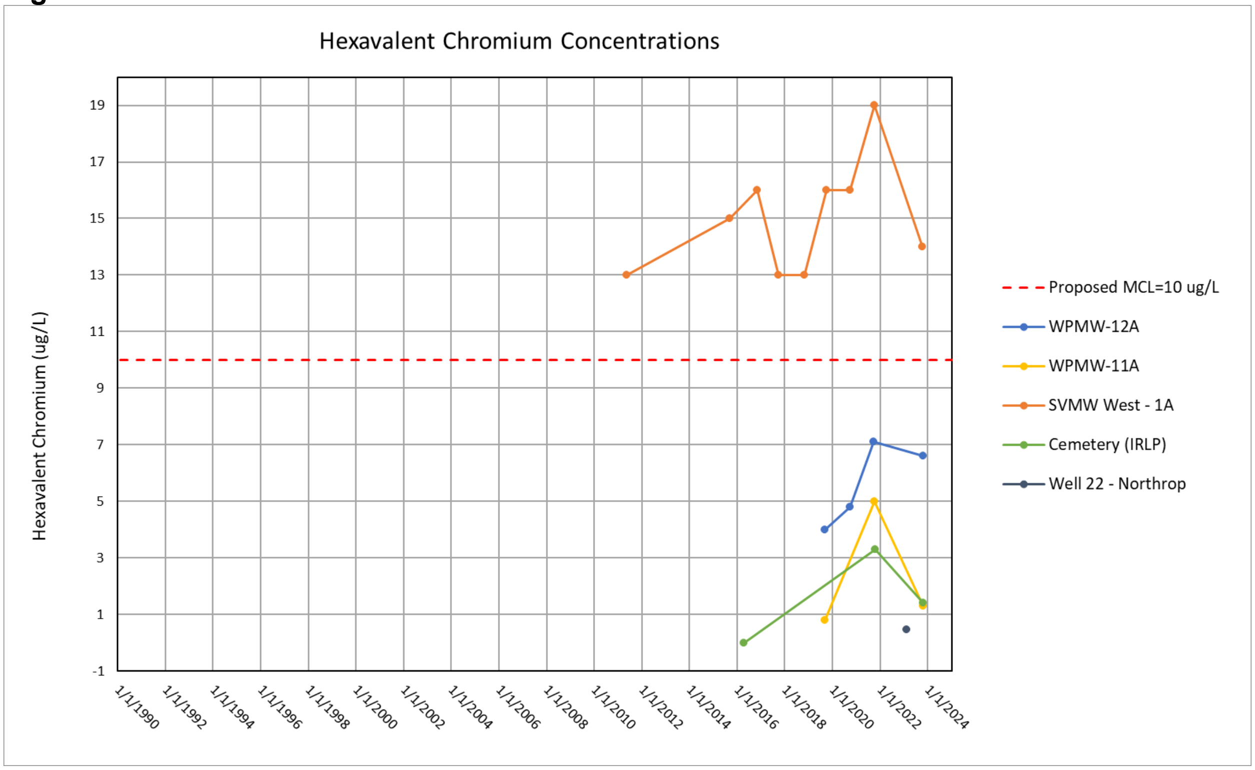
Five shallow aquifer RMS network and sentry wells were analyzed for hexavalent chromium (Cr^{+6}) as part of this effort and included analysis for one municipal supply well and well LW-1, which was obtained from the SWRCB websites. Only five wells were analyzed for this constituent during this project due to miscommunication with the laboratory. Analytical results are shown in **Table 5**. The proposed drinking water MCL for hexavalent chromium is 10 μg/L. All five wells had concentrations below the proposed MCL, except for one well (e.g., SVMW West-1A). All five wells had detectable concentrations of hexavalent chromium. The concentrations distribution in the Subbasin are shown in **Figure 14**.

Figure 12: Hexavalent Chromium Distribution



The concentrations detected at each shallow aquifer RMS network and sentry wells are shown in **Figure 15** to illustrate the ranges in concentrations.

Figure 13: Hexavalent Chromium Concentrations



Only one well, well SVMW West-1A, had more than five data points to perform statistical analysis. The statistical trend for this well is increasing.

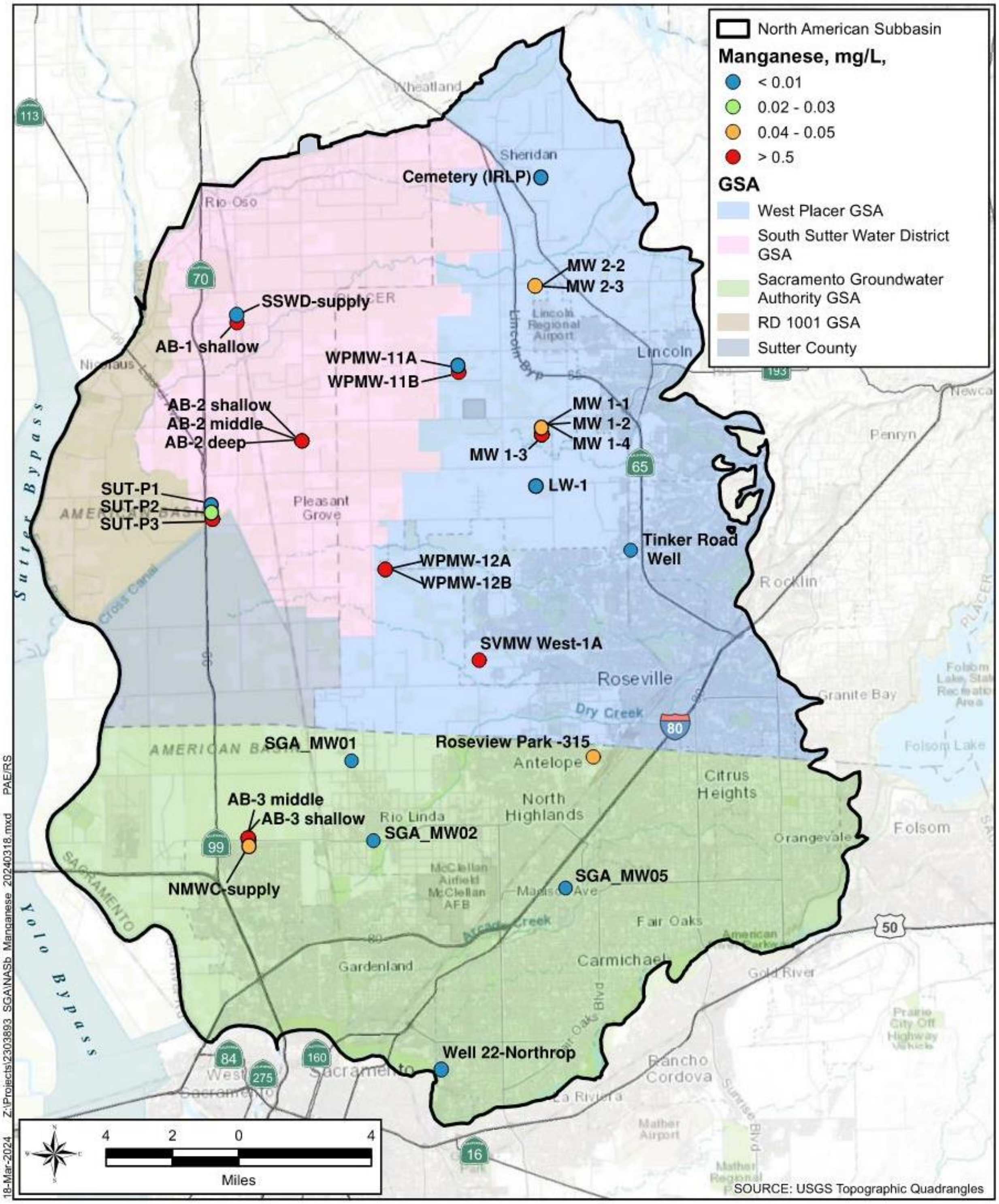
Wells with at least three analyses but less than five were assessed visually with the following apparent trends:

- Stabletrend at well Cemetery (IRLP)
- Increasing trend at well WPMW-12A

7.4 Iron

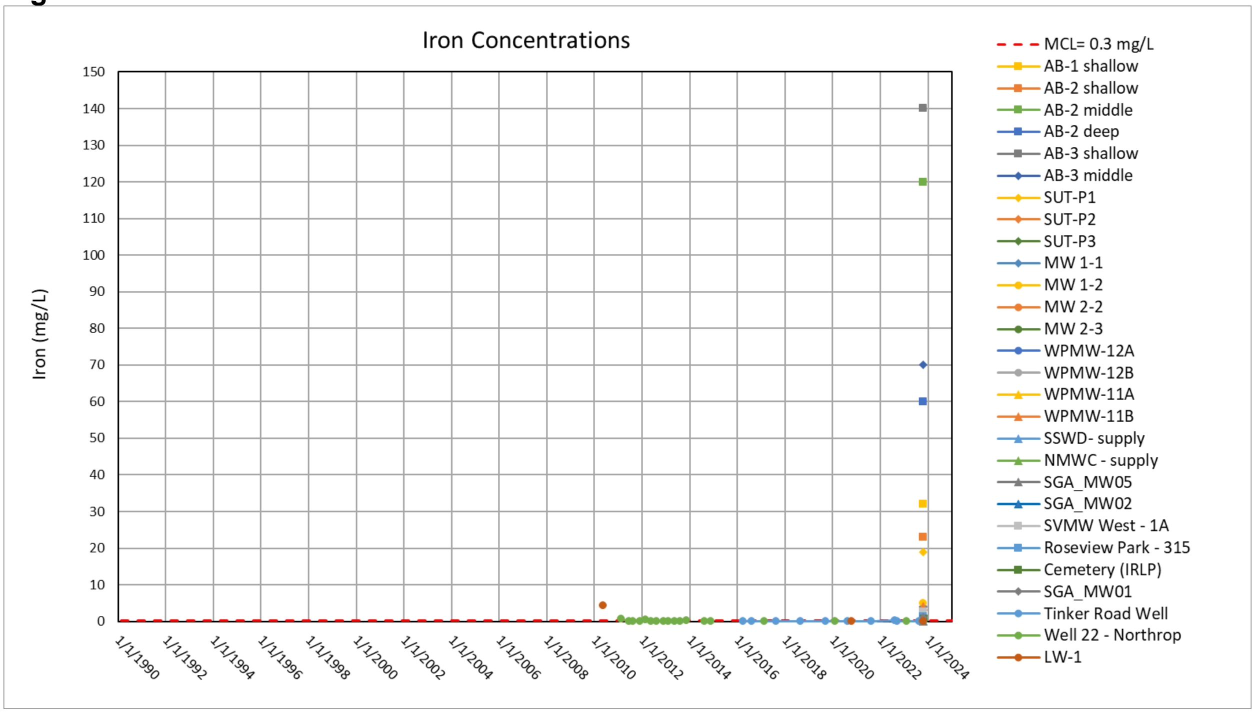
Twenty-seven shallow and sentry wells were analyzed for total iron as part of this effort and results from two municipal supply wells and one from LW-1 were obtained from the SWRCB websites. Analytical results are shown in **Table 5**. Twenty-two wells had iron results above the SMCL of 0.3 mg/L and eight wells had iron results below the MCL of 0.3 mg/L. The number of analyses that exceeded the SMCL, is unusual and is likely being caused by the elevated turbidity (see Table 5 field parameters) and should not be relied upon to be representative of conditions in the Subbasin. The concentration distribution in the Subbasin are shown in **Figure 16**.

Figure 14:Iron Distribution



The concentrations detected at each of the shallow and sentry wells are shown in **Figure 17** to illustrate the ranges in concentrations.

Figure 15: Iron Concentrations



The trends in the concentrations at each well were analyzed statistically to determine if the concentrations are trending stable, increasing, or decreasing. The Mann-Kendall method was used to assess stastistical trends, which is a non-parametric (i.e. does not assume distribution in the data) test to detect trends in time series data. The method requires that a minimum of five analyses must be available to perform the analysis.

Two wells had current and sufficient historic data to analyze for statistical trends. The analysis showed:

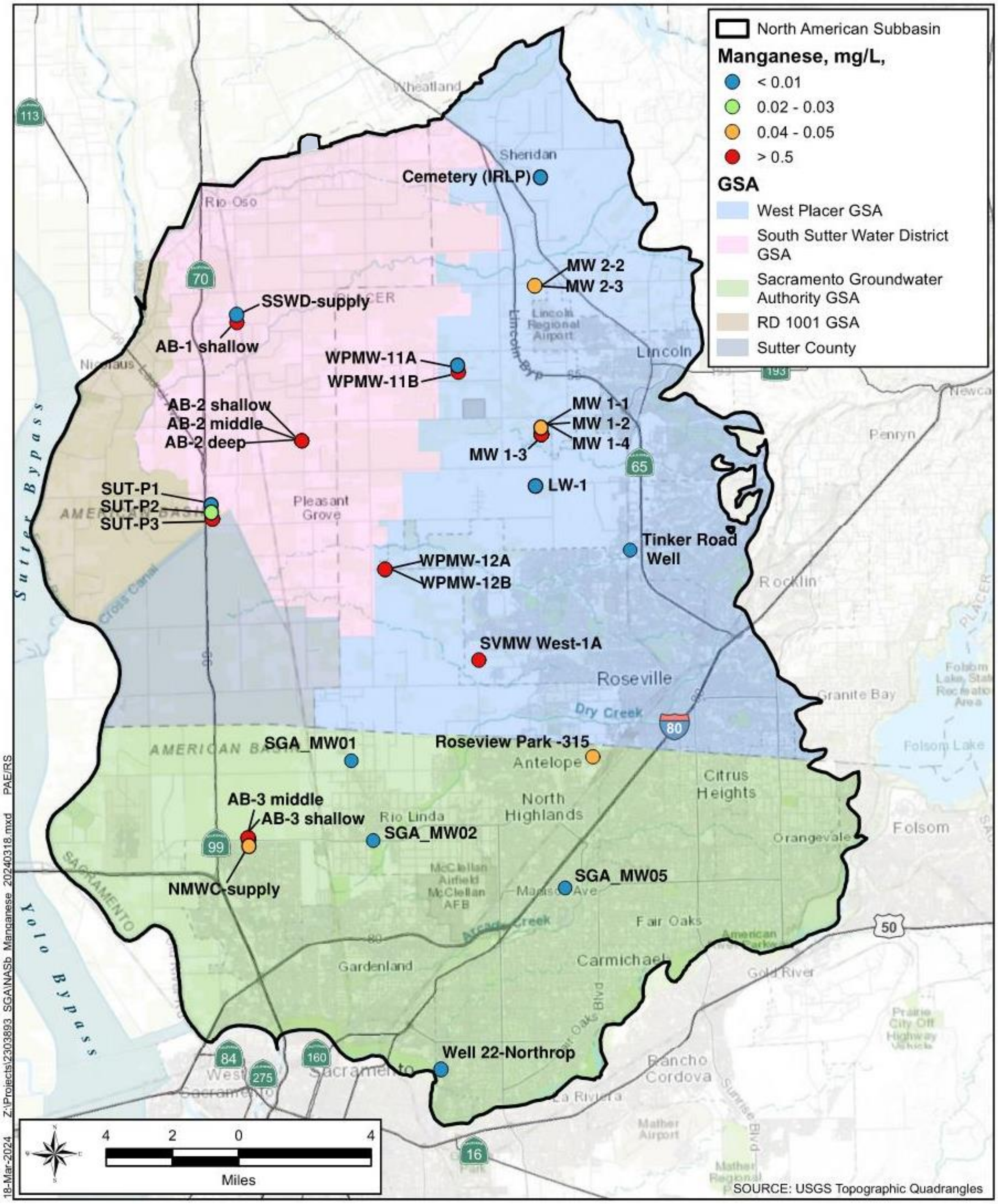
- Stable trend at Well Tinker Road Well
- Increasing trend at Well 22 - Northrop

The remaining wells sampled have fewer than five data points. Therefore, sufficient data is not available to assess trends or statistical analysis at this time.

7.5 Manganese

Twenty-seven shallow and sentry wells were sampled and the water analyzed for total manganese as part of this effort and results from two municipal supply wells and LW-1 were obtained from the SWRCB websites. Analytical results are shown in **Table 5**. Three wells had concentrations less than the RDL, all were municipal supply wells with low turbidities. Fifteen wells had manganese results below the SMCL of 0.05 mg/L and twelve wells had manganese results above the SMCL. The number of analyses that exceeded the SMCL is unusual and is likely being caused by the elevated turbidity and should not be relied upon to be representative of conditions in the Subbasin. The distribution of concentrations in the Subbasin are shown in **Figure 16**.

Figure 16: Manganese Distribution



The concentrations detected at each shallow aquifer RMS network well are shown in **Figure 17** to illustrate the ranges in concentrations.

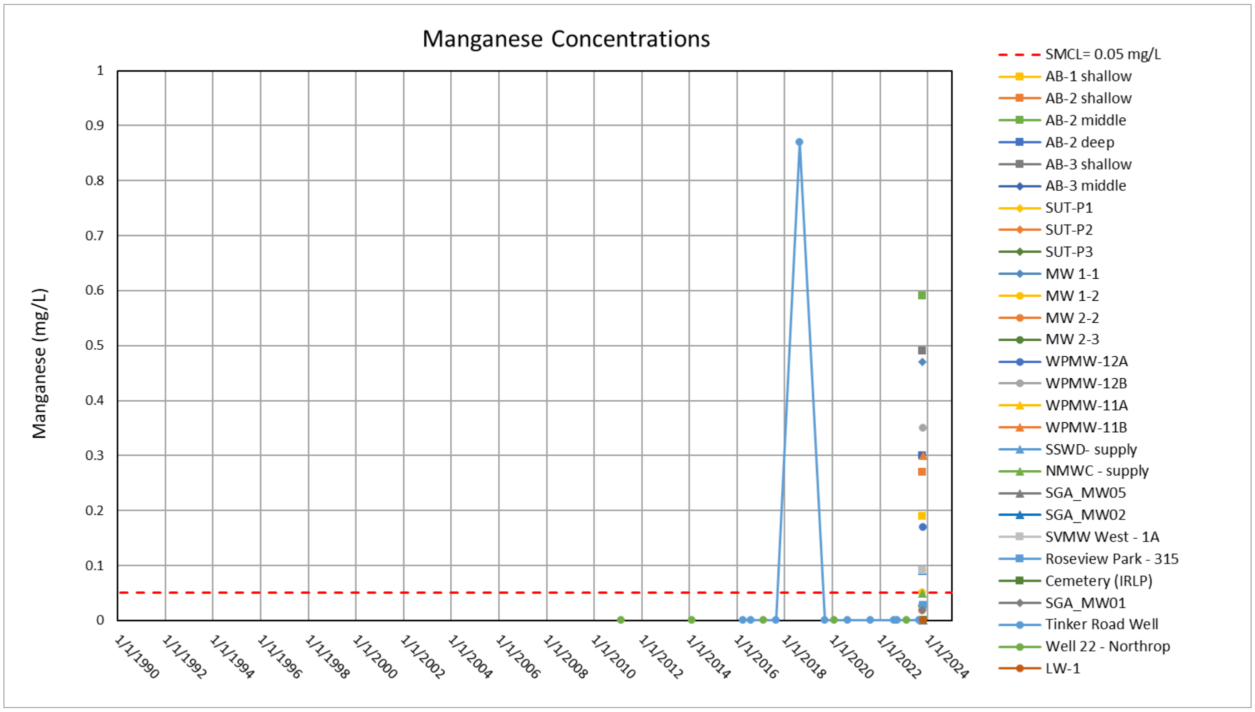


Figure 17: Manganese Concentrations

The trends in the concentrations at each well were analyzed statistically to determine if the concentrations are trending stable, increasing, or decreasing. The Mann-Kendall method was used to assess stastistical trends, which is a non-parametric (i.e. does not assume distribution in the data) test to detect trends in time series data. The method requires that a minimum of five analyses must be available to perform the analysis.

One wells had current and sufficient historic data to analyze for statistical trends. The analysis showed:

- Decreasing trend at Well 22 – Northrop

The remaining wells sampled have fewer than five data points. Therefore, sufficient data is not available to assess trends or statistical analysis at this time.

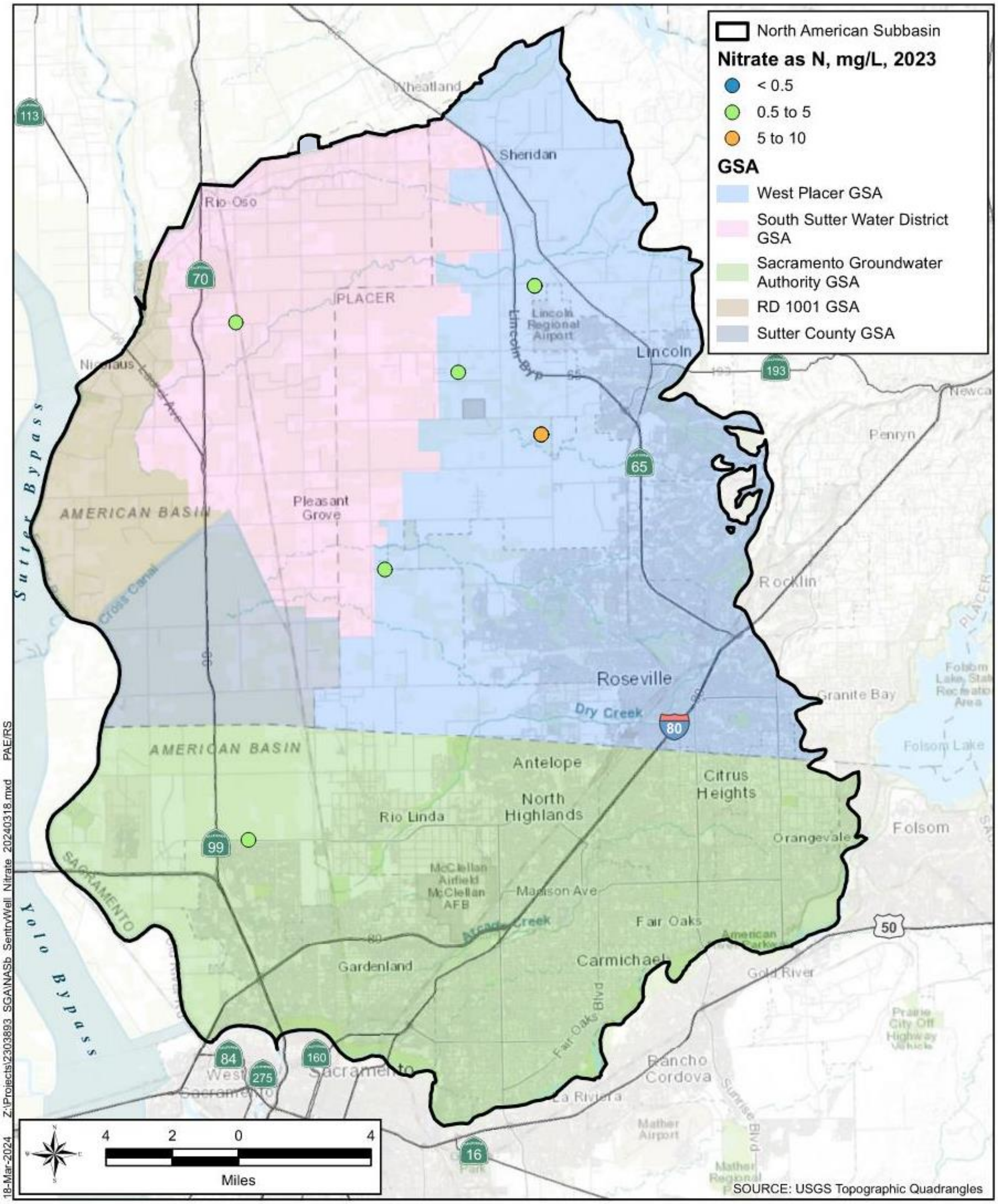
7.6 Nitrate

Samples for the nineteen sentry wells were analyzed for nitrate as part of this effort. Analytical results are shown in **Table 5**. Ten wells had nitrate concentration less than the RDL. All wells had nitrate results below the MCL of 10 mg/L.

Concentrations of nitrate in groundwater less than 3 mg/L are typically naturally occurring whereas concentrations above 3 mg/L generally originate from anthropogenic sources such as fertilizers, wastewater, or concentrated animal feed lots. Only one well had concentrations above 3 mg/L. Monitoring well MW 1-4 is a shallow completion well, so these levels could potentially be influenced by surficial factors. Only one well had concentrations above 3 mg/L, indicating a man-made source or activity. It is near the two shallow aquifer RMS network wells that had elevated nitrate concentrations.

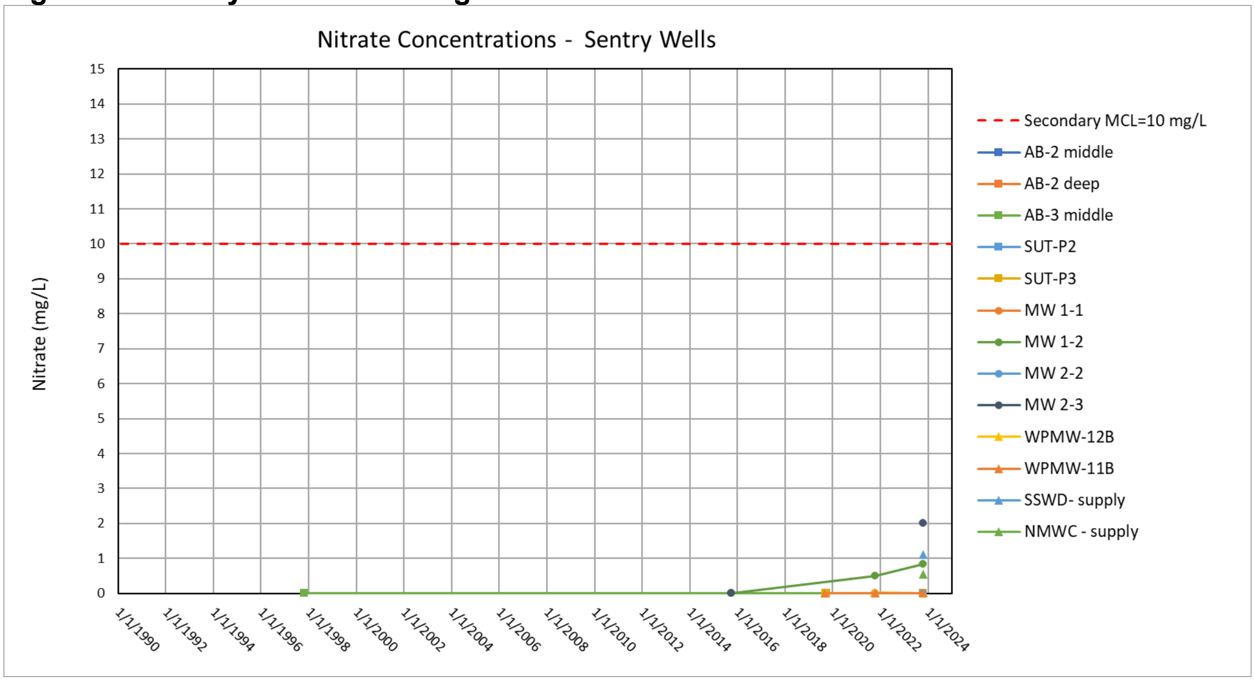
The distribution of nitrate concentrations from the shallow aquifer RMS network wells in the Subbasin are shown in **Figure 18.**

Figure 18: Sentry Well Monitoring Network Nitrate Distribution



The current and historical concentrations detected at each sentry well are shown in **Figure 19** to illustrate the ranges in concentrations. Wells with concentrations less than the laboratory reportable detection limit (concentrations shown in **Table 5** with less than symbols) are not shown in this figure.

Figure 19: Sentry Well Monitoring Network Nitrate Concentrations



Note: Wells with similar concentrations may not be visible on graph.

The trends in the concentrations at each well were analyzed statistically to determine if the concentrations are trending stable, increasing, or decreasing. The Mann-Kendall method was used to assess stastistical trends, which is a non-parametric (i.e. does not assume distribution in the data) test to detect trends in time series data. The method requires that a minimum of five analyses must be available to perform the analysis.

All sentry wells have fewer than five measurements, as a result, sufficient data is not available to assess statistical trends at this time.

Wells with at least three analyses but less than five were assessed visually with the following apparent trends:

- Upward trend at at NMWC – supply
- Decreasing trend at MW 1-2
- Stable trends at SSWD -supply, WPMW-11B, WPMW-12B, and MW 1-1

Vertical profiling of the concentrations show that the highest nitrate concentrations are present in the upper portions of the aquifer at wells MW-1, MW-2, WPMW-11, and WPMW-12, all located in the eastern portion of the Subbasin. The concentrations appear to be related to human activities. In wells located in the western portion of the Subbasin, nitrate concentraions were at less than dectable concentrations suggesting no influence from agriculatural acticities.

8. Conclusions

The concentrations of water quality constituents varies widely, both spatially and by depth in the NASb. The quality of groundwater in the NASb has been suitable for nearly all beneficial uses and users based on the sampling and analyses results and analysis from this first year effort. Iron and manganese were detected in multiple wells at concentrations exceeding the SMCL. The analysis may have been affected by sediments in water samples, which would not be present in water used for drinking water purposes.

No shallow aquifer RMS network wells exceeded the MT for either TDS or nitrate. Five wells have groundwater with TDS above the MOs (up to 40 mg/L) and four wells have nitrate above their MOs (up to 2 mg/L at most wells besides SGA_MW01, which is 4 mg/L above the MO). (to be reached by 2042). Since this is only the second year of implementation of the GSP and managing of the subbasin, no projects and management actions have been performed which could have affected these concentrations. The GSAs may want to consider further evaluation of the MOs for potential revisions at these wells.

Three sentry wells out of 19 wells sampled reported TDS concentrations above the SMCL. Two of the wells with concentrations above the SMCL are in the western portion of the Subbasin, which is historically known as being a slough and a salt sink. The third well (e.g., WPMW-12B) is in the center of the Subbasin screened in the freshwater aquifers just above the marine sediments and could be showing upwelling of brackish water.

Supplemental analyses for arsenic, boron, and hexavalent chromium showed a wide range of concentrations with a few concentrations being above the MCL, proposed MCL, or Notification Level.

Concentrations of total iron and total manganese exceeded the SMCL at over 70 percent of the wells sampled. All detections that exceeded the SMCL were from monitoring wells. Water from the public water supply wells were at less than detectable levels. Additional sampling is warranted for these two constituents along with filtering in the field and laboratory to remove sediments that may be affecting the results.

Statistical analyses require a minimum of five analytical results to be able to develop trends. Because this report represents the first year of sampling, only five wells could be analyzed for trends and showed a stable trend It is anticipated that few additional wells will have the minimum number of five analyses after sampling planned in year 2025. After calendar year 2027 is complete almost 50 percent of wells are anticipated to have sufficient analyses to perform statistical analyses.

For wells that had a minimum of three analyses but less than five, trends were evaluated visually. Upward trends were observed for TDS at well WPMW-12B which is screened just above the marine sediments and could be detecting upwelling brackish groundwater. At well SVMW West-1A for hexavalent chromium, the source of which is currently unknown, but could be from oxygenated surface water reaching the groundwater table.

9. Recommendations

This report represents the first sampling event in compliance with the NASb GSP implementation and occurred in Fall 2023. The frequency of sampling for the shallow aquifer RMS network and sentry wells, as identified in the GSP, is once every two years, in the Fall.

GEI's recommendations for future groundwater quality monitoring are:

- Shift the sampling event to occur in September to coincide with the water year.
- Develop vertical profiles through the basin to better illustrate water quality at nested wells.
- Field filter samples to obtain dissolved concentrations for iron and manganese metal analyses in the field prior to laboratory analysis.
- Perform the Mann-Kendall analysis for all wells with enough data (e.g., five analyses) where seasonal variability is not a factor, to establish water quality trends and guide future monitoring.

10. References

United State Environmental Protection Agency (EPA), 2024. EPA website, accessed March 2024. Available at: https://www.epa.gov/nutrientpollution/estimated-nitrate-concentrations-groundwater-used-drinking

North American Subbasin GSP, 2024. North American Subbasin website, accessed January 2024. Available at: https://nasbgroundwater.org/gsp/

State Water Resources Control Board (SWRCB), 2024. GEOTracker website, accessed January 2024. Available at: https://geotracker.waterboards.ca.gov/

State Water Resources Control Board (SWRCB), 2021. SWRCB website, accessed December 2023. Available at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chromium6.html.

Appendix A: Purge Logs and Field Notes

(Available Upon Request)

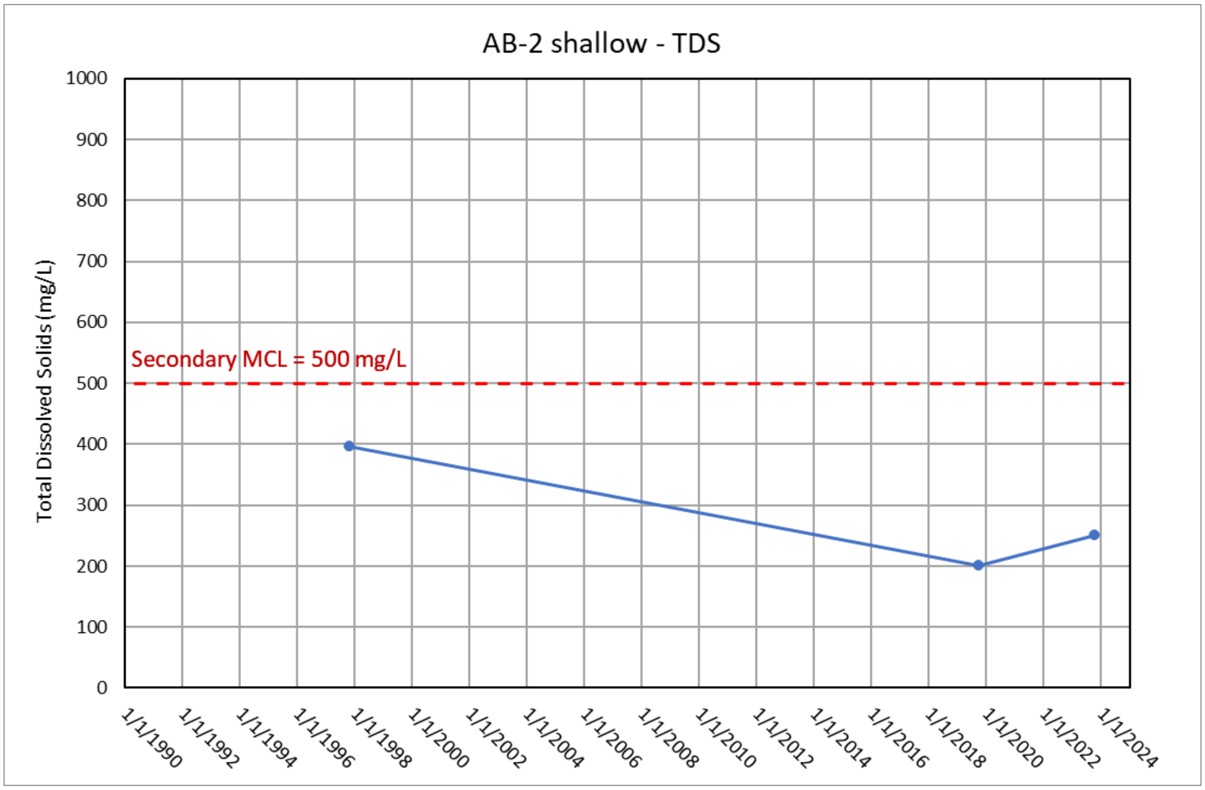
Appendix B: Laboratory Analytical Results and COCs

(Available Upon Request)

Appendix C: Previous Sampling Results

(Available Upon Request)

Appendix D: Well Chemographs


AB-2 shallow - TDS
Total Dissolved Solids (mg/L)
0
100
200
300
400
500
600
700
800
900
1000
Secondary MCL = 500 mg/L
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
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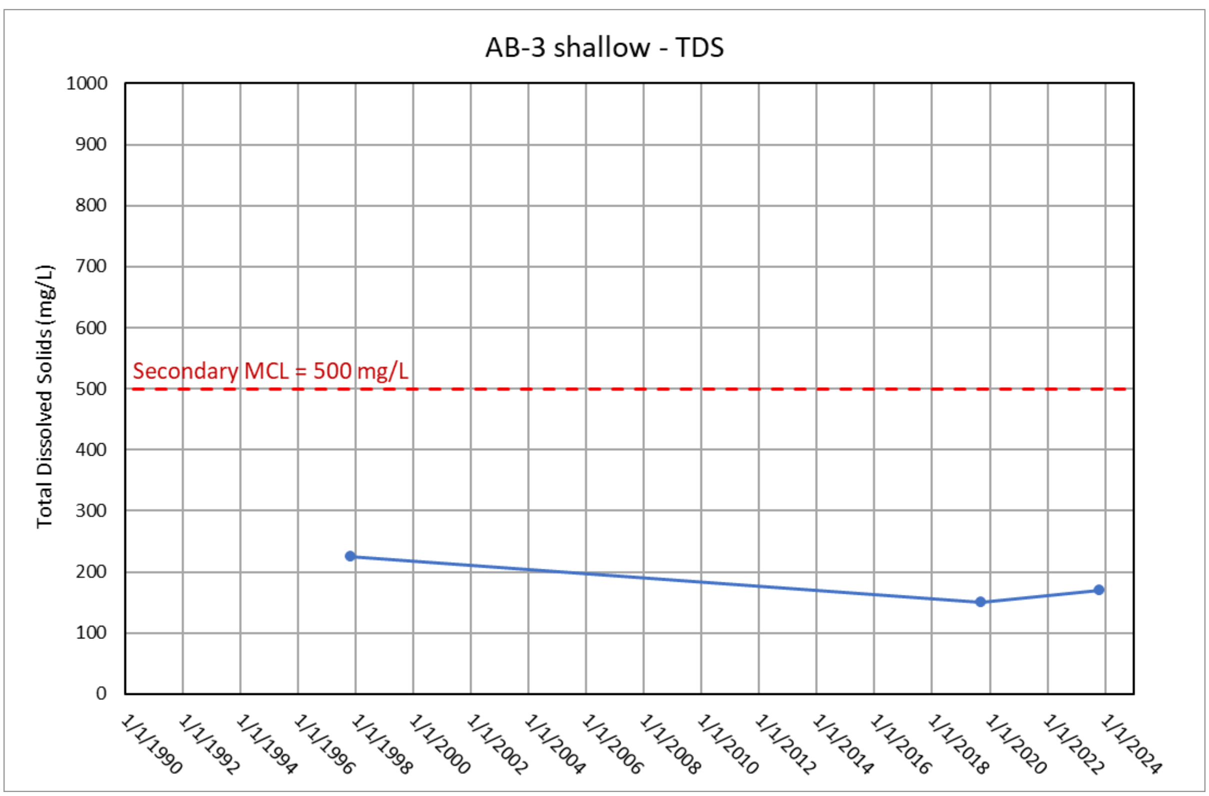
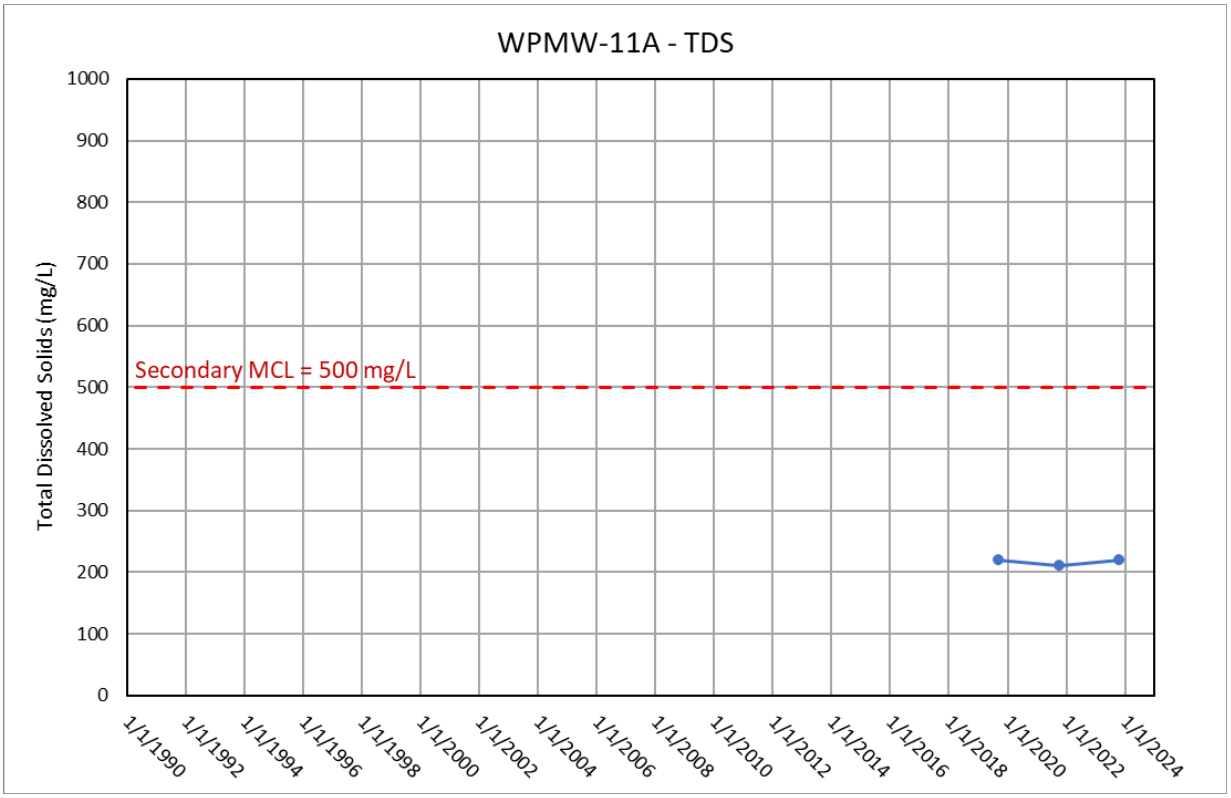
1/1/2014
1/1/2016
1/1/2018
1/1/2020
1/1/2022
1/1/2024


AB-3 shallow - TDS
Total Dissolved Solids (mg/L)
0
100
200
300
400
500
600
700
800
900
1000
Secondary MCL = 500 mg/L
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
1/1/2022
1/1/2024


WPMW-11A - TDS
Total Dissolved Solids (mg/L)
Secondary MCL = 500 mg/L
0
100
200
300
400
500
600
700
800
900
1000
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
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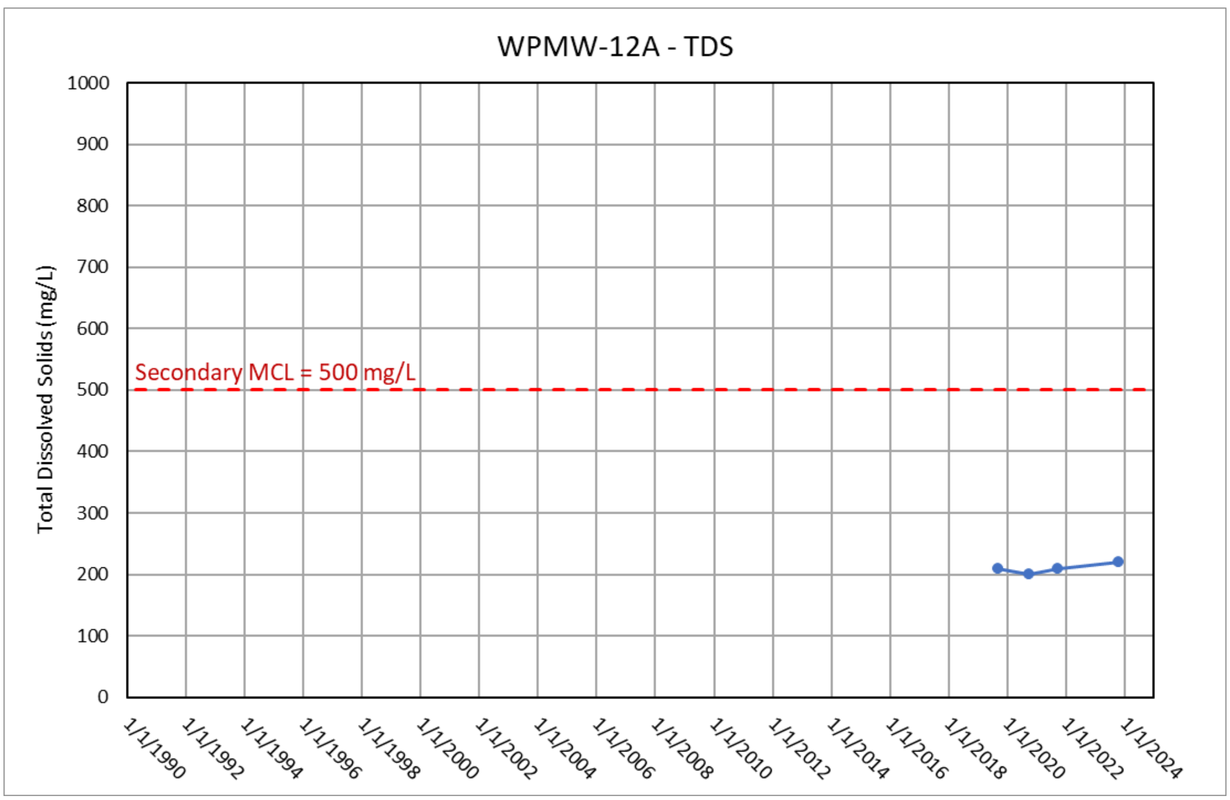
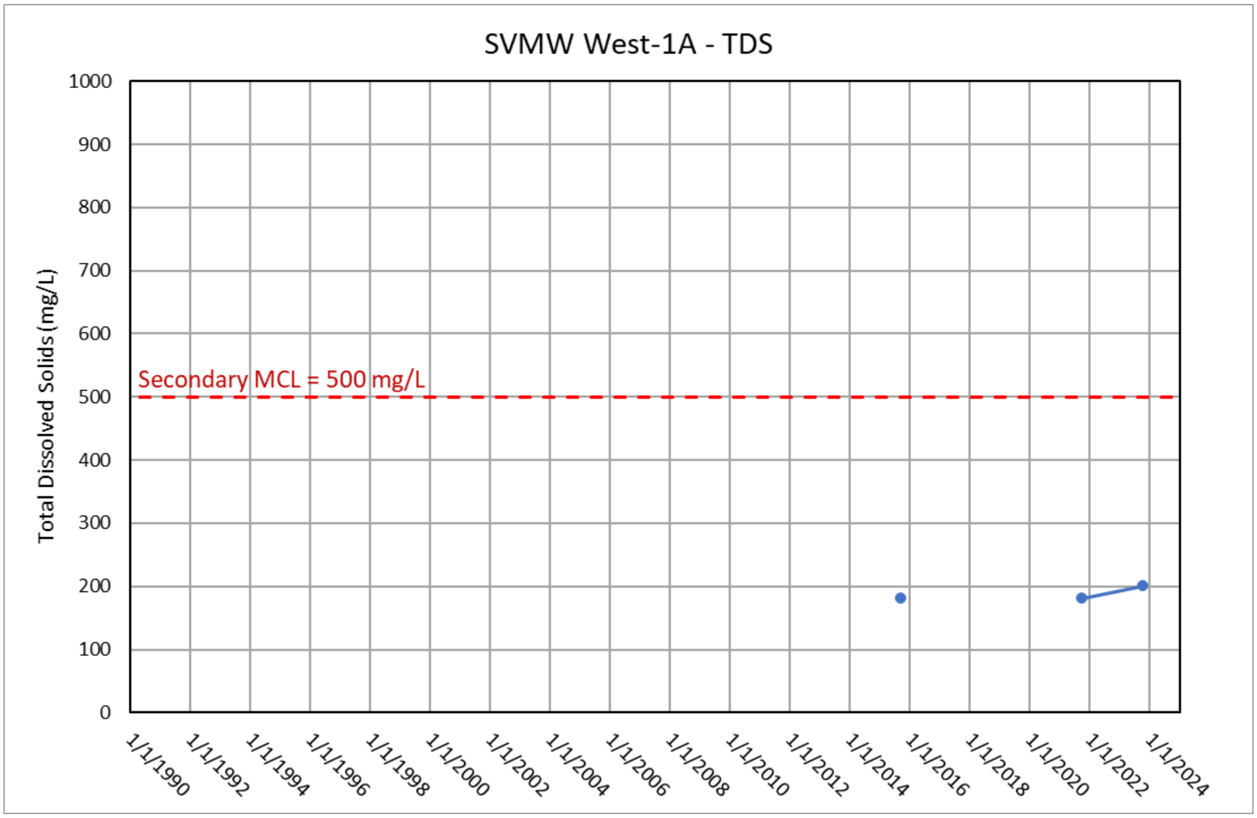
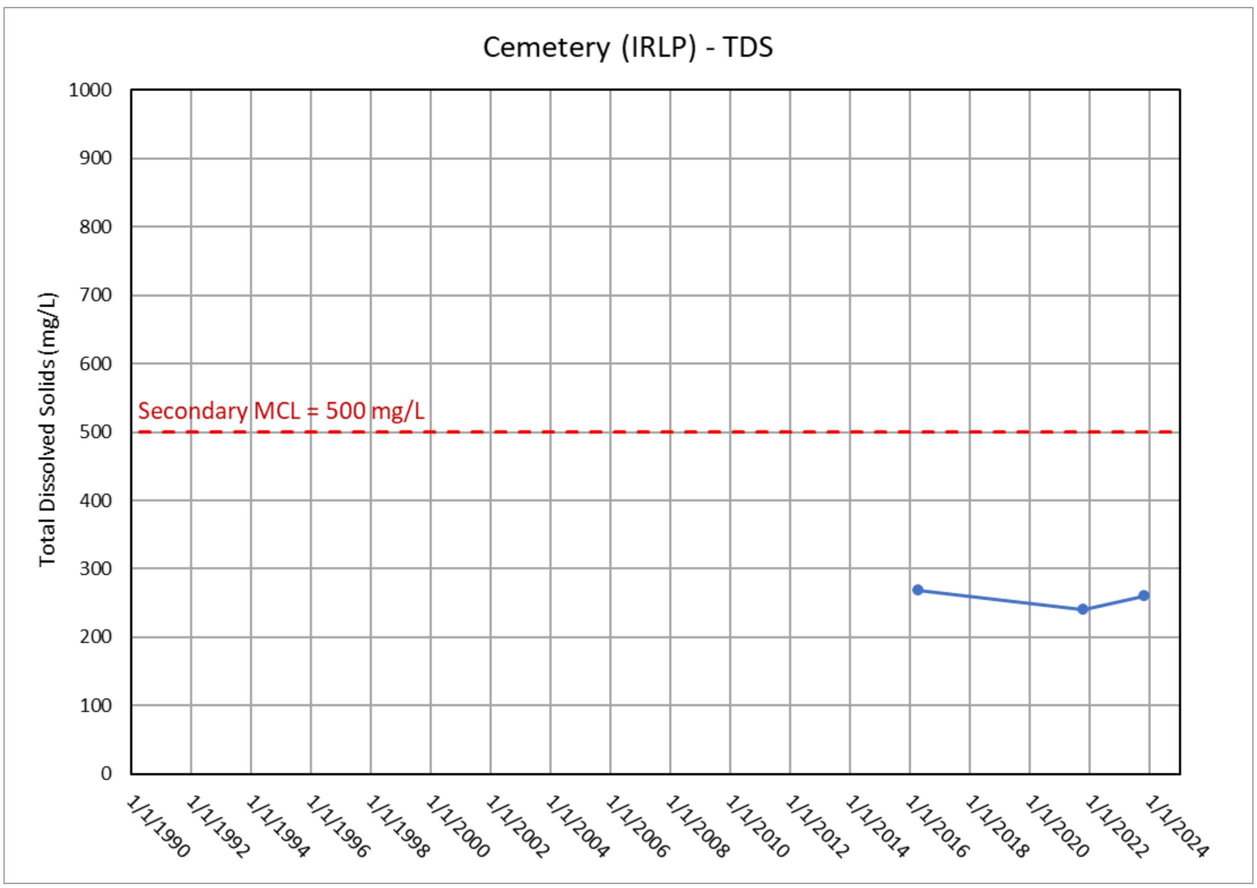
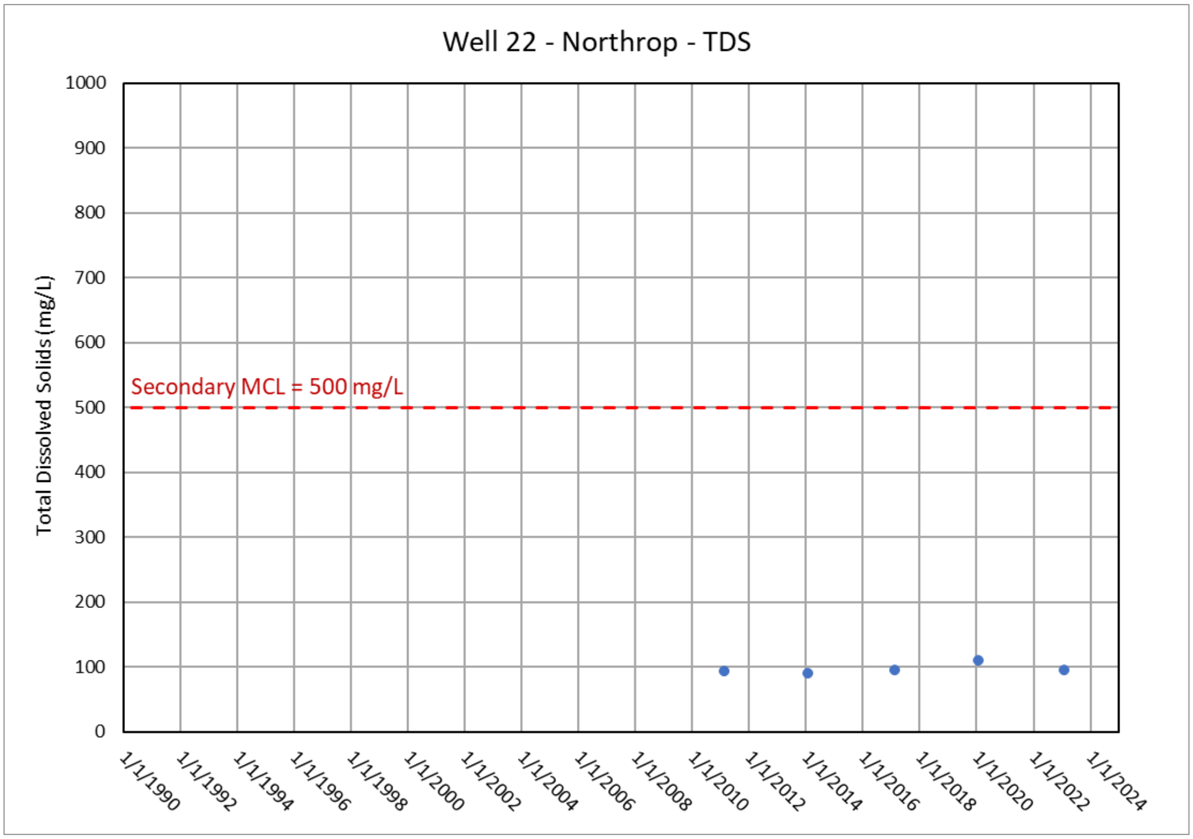
1/1/2020
1/1/2022
1/1/2024


WPMW-12A - TDS
Total Dissolved Solids (mg/L)
Secondary MCL = 500 mg/L
0
100
200
300
400
500
600
700
800
900
1000
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
1/1/2022
1/1/2024


SVMW West-1A - TDS
Total Dissolved Solids (mg/L)
1000
900
800
700
600
500
400
300
200
100
0
Secondary MCL = 500 mg/L
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
1/1/2022
1/1/2024


Cemetery (IRLP) - TDS
Total Dissolved Solids (mg/L)
1000
900
800
700
600
500
400
300
200
100
0
Secondary MCL = 500 mg/L
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
1/1/2022
1/1/2024


Well 22 - Northrop - TDS
Total Dissolved Solids (mg/L)
Secondary MCL = 500 mg/L
1000
900
800
700
600
500
400
300
200
100
0
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
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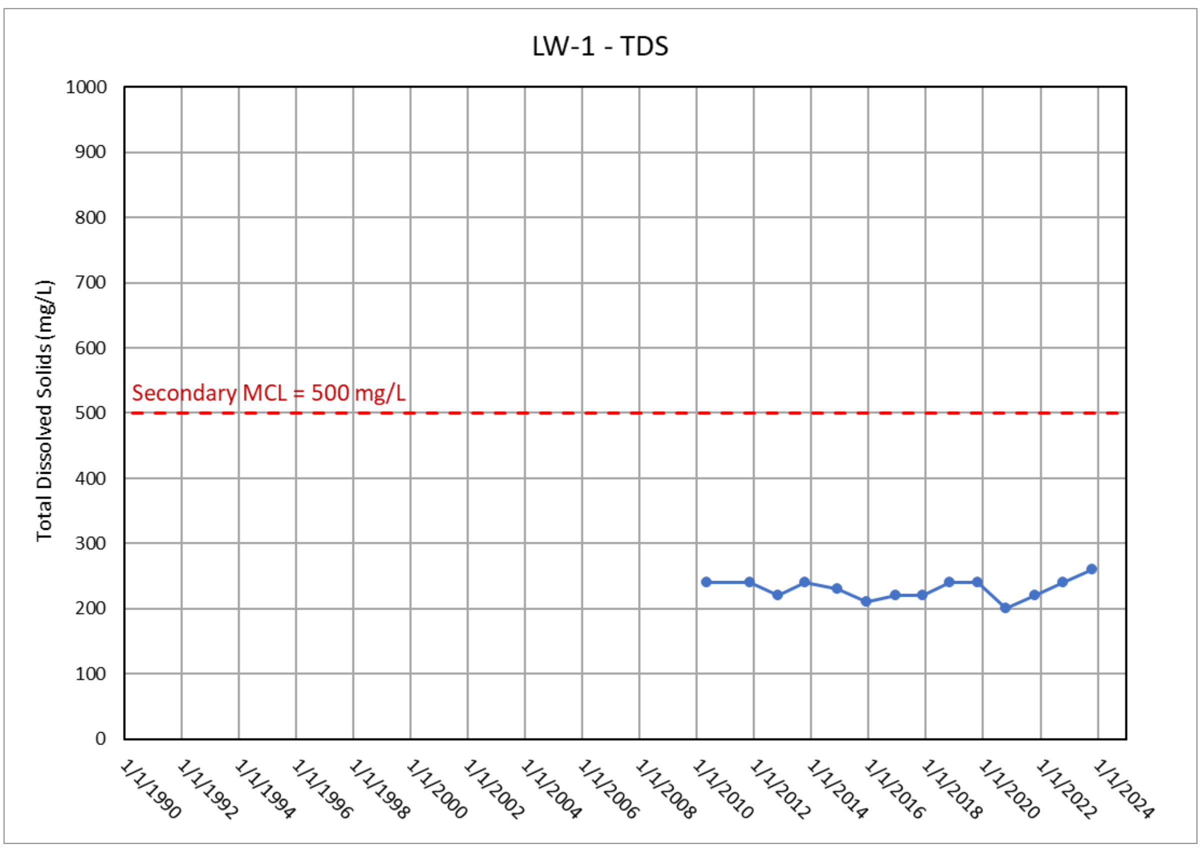
1/1/2022
1/1/2024


LW-1 - TDS
Total Dissolved Solids (mg/L)
Secondary MCL = 500 mg/L
1000
900
800
700
600
500
400
300
200
100
0
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
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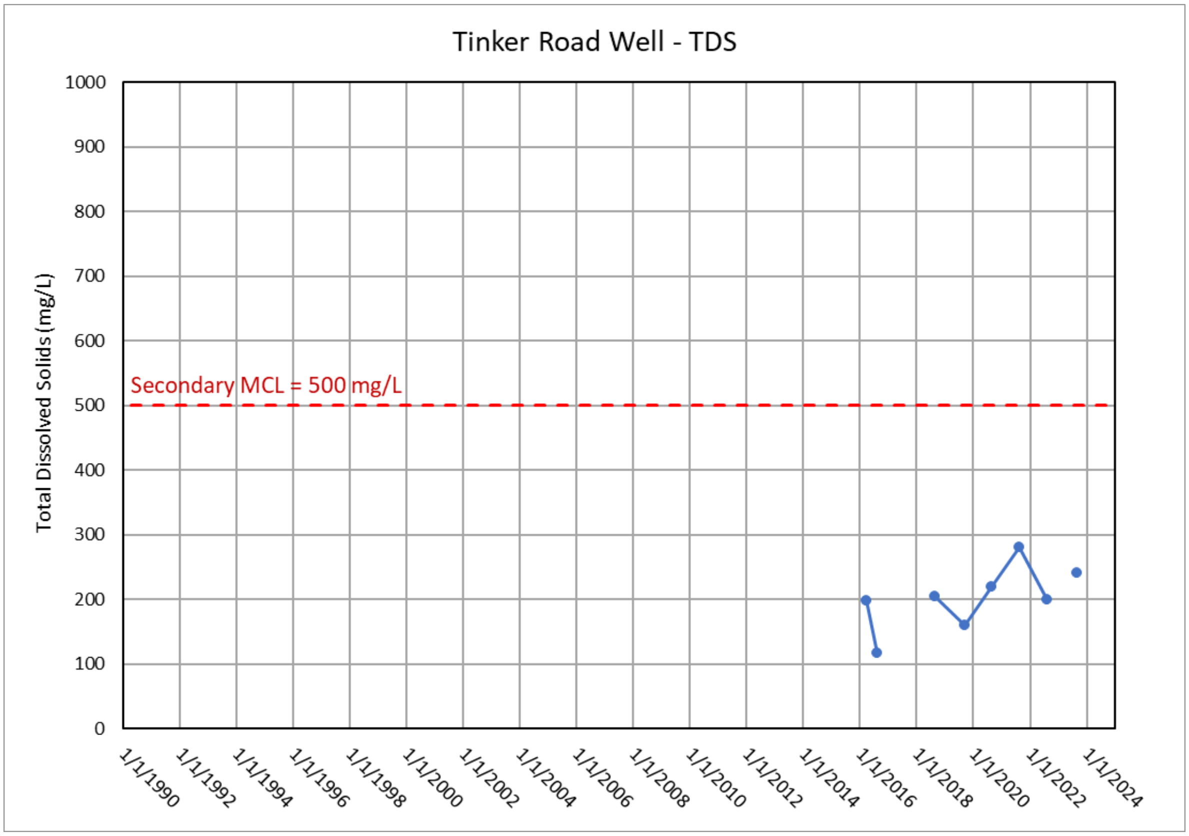
1/1/2022
1/1/2024



Tinker Road Well - TDS
Total Dissolved Solids (mg/L)
Secondary MCL = 500 mg/L
1000
900
800
700
600
500
400
300
200
100
0
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
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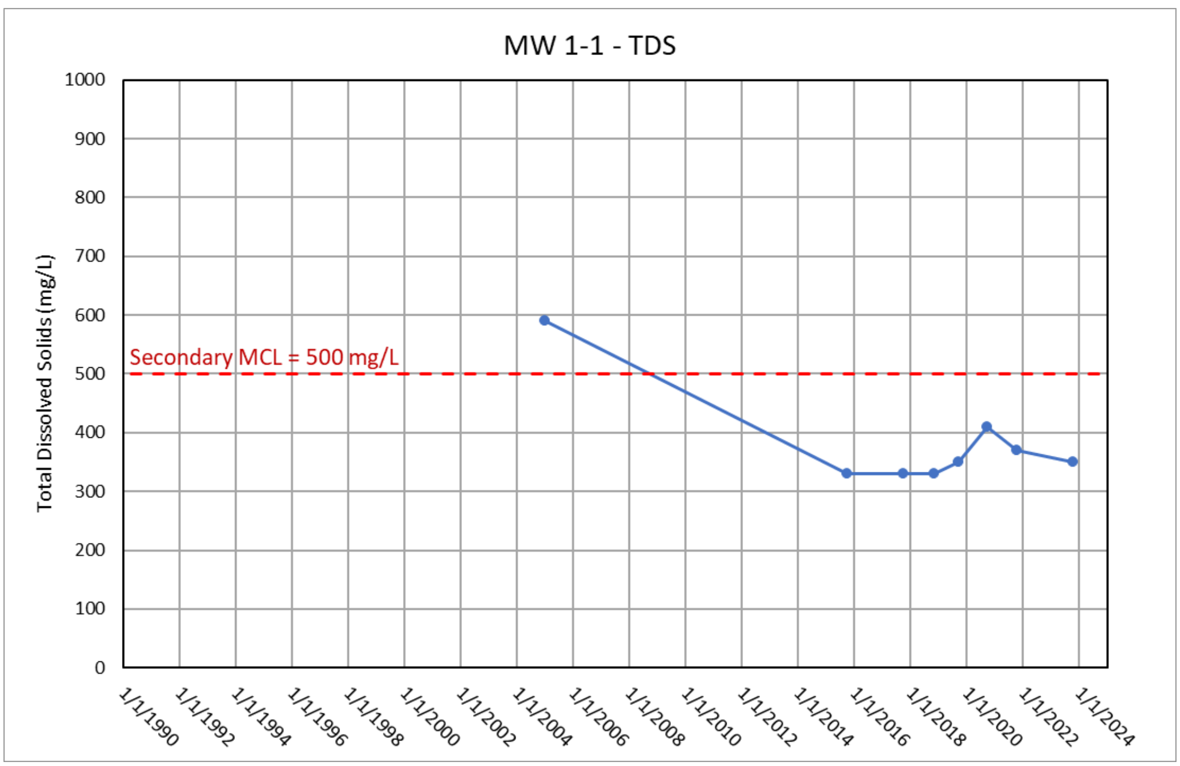
1/1/2022
1/1/2024



MW 1-1 - TDS
Total Dissolved Solids (mg/L)
Secondary MCL = 500 mg/L
1000
900
800
700
600
500
400
300
200
100
0
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
1/1/2022
1/1/2024

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