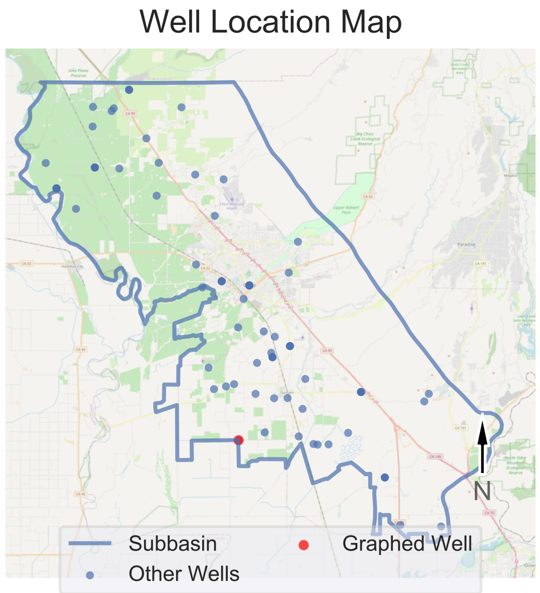
Water Year 2023 Annual Report

Appendix A

Characteristics and Hydrographs of Representative Monitoring Site (RMS) Wells and Regional Groundwater Contour Maps

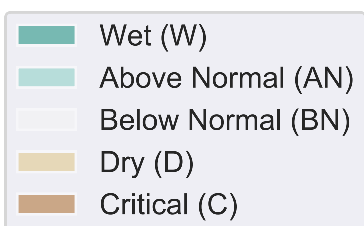
VINA Subbasin - State Well Number (SWN): 20N01E10C002M

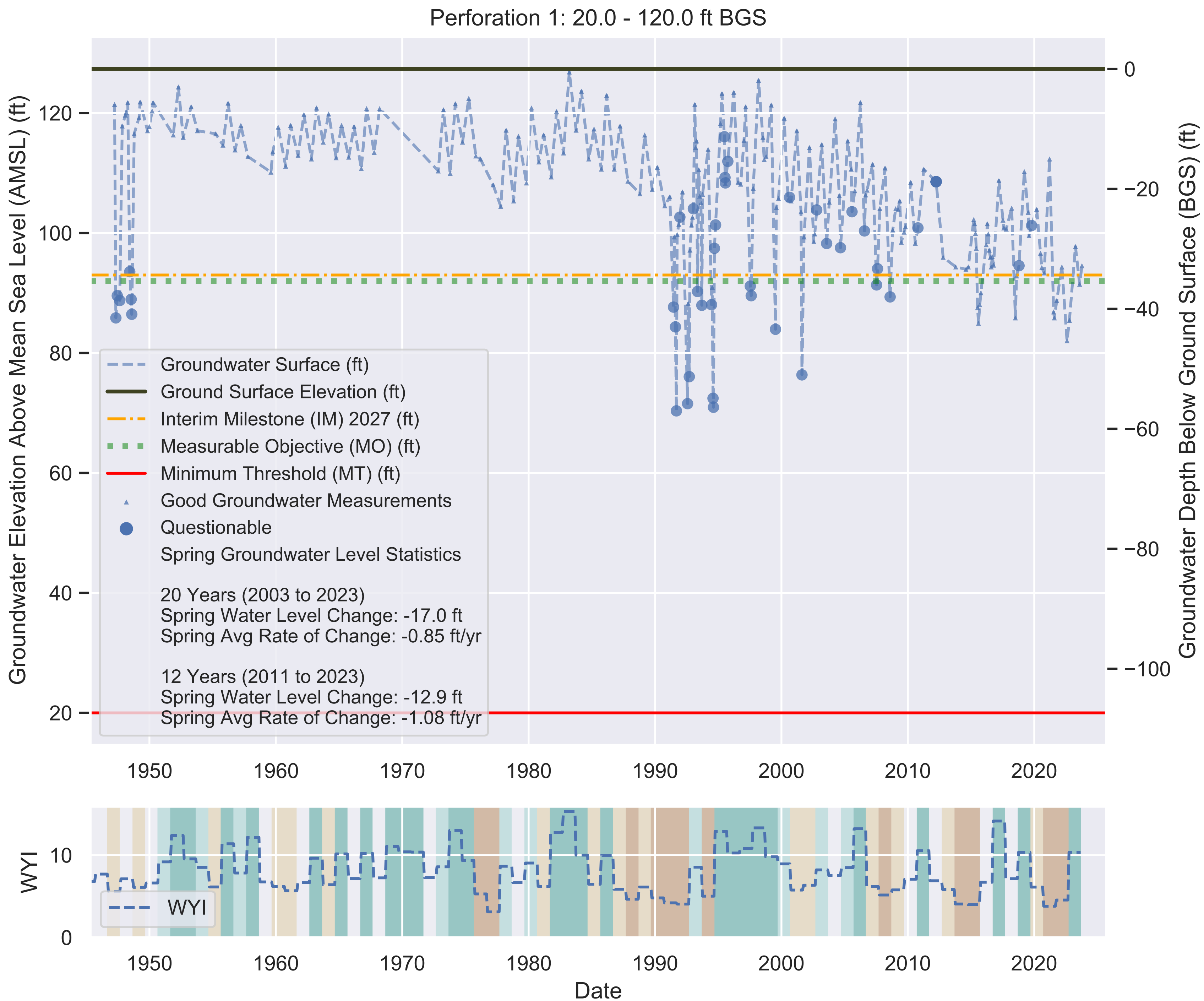


Sustainable Management Criteria:

IM (2027) = 93.0 ft AMSL
MO = 92.0 ft AMSL
MT = 20.0 ft AMSL

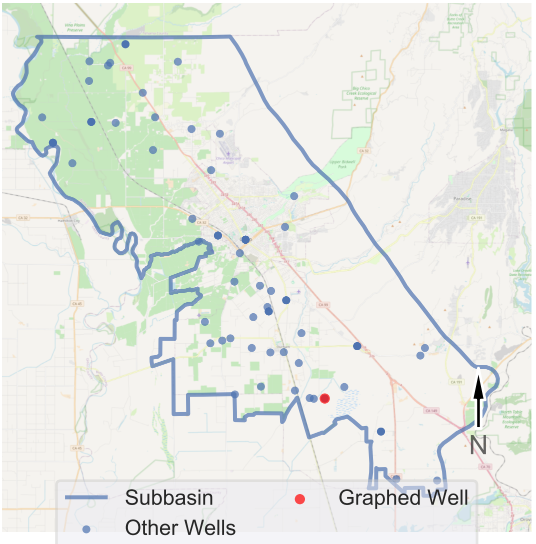
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





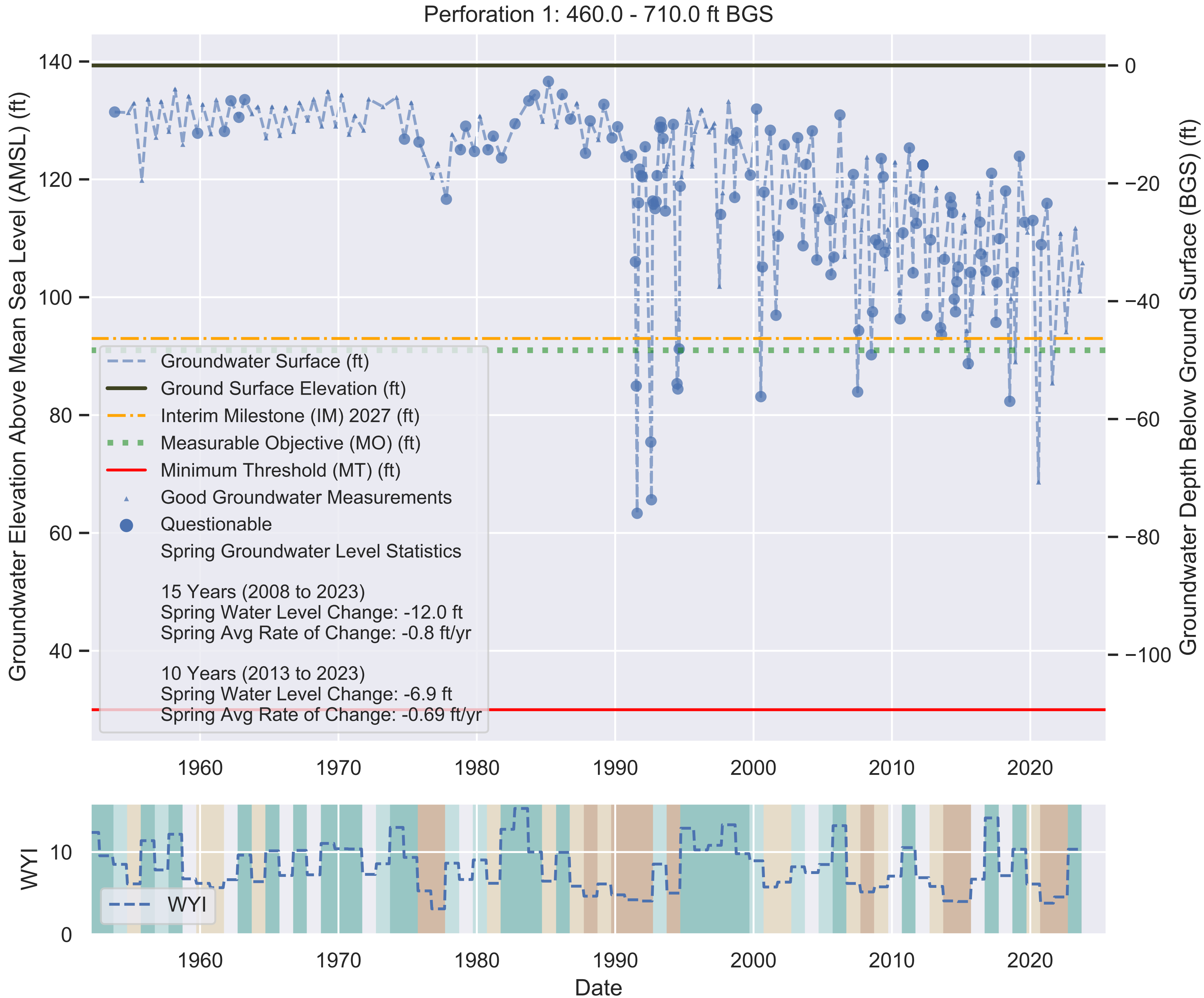
VINA Subbasin - State Well Number (SWN): 20N02E09L001M

Well Location Map



Sustainable Management Criteria:

IM (2027) = 93.0 ft AMSL
MO = 91.0 ft AMSL
MT = 30.0 ft AMSL

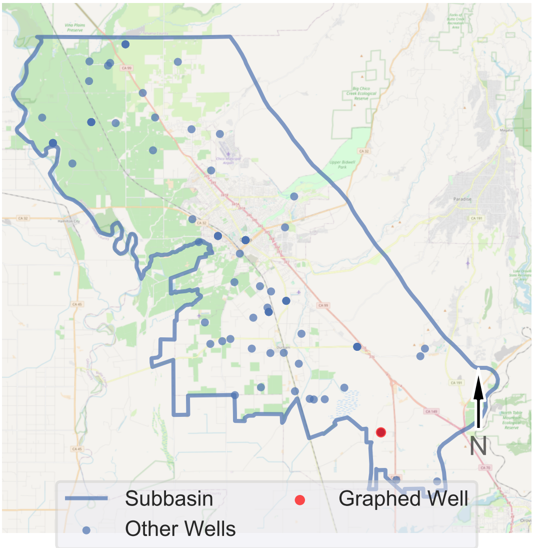


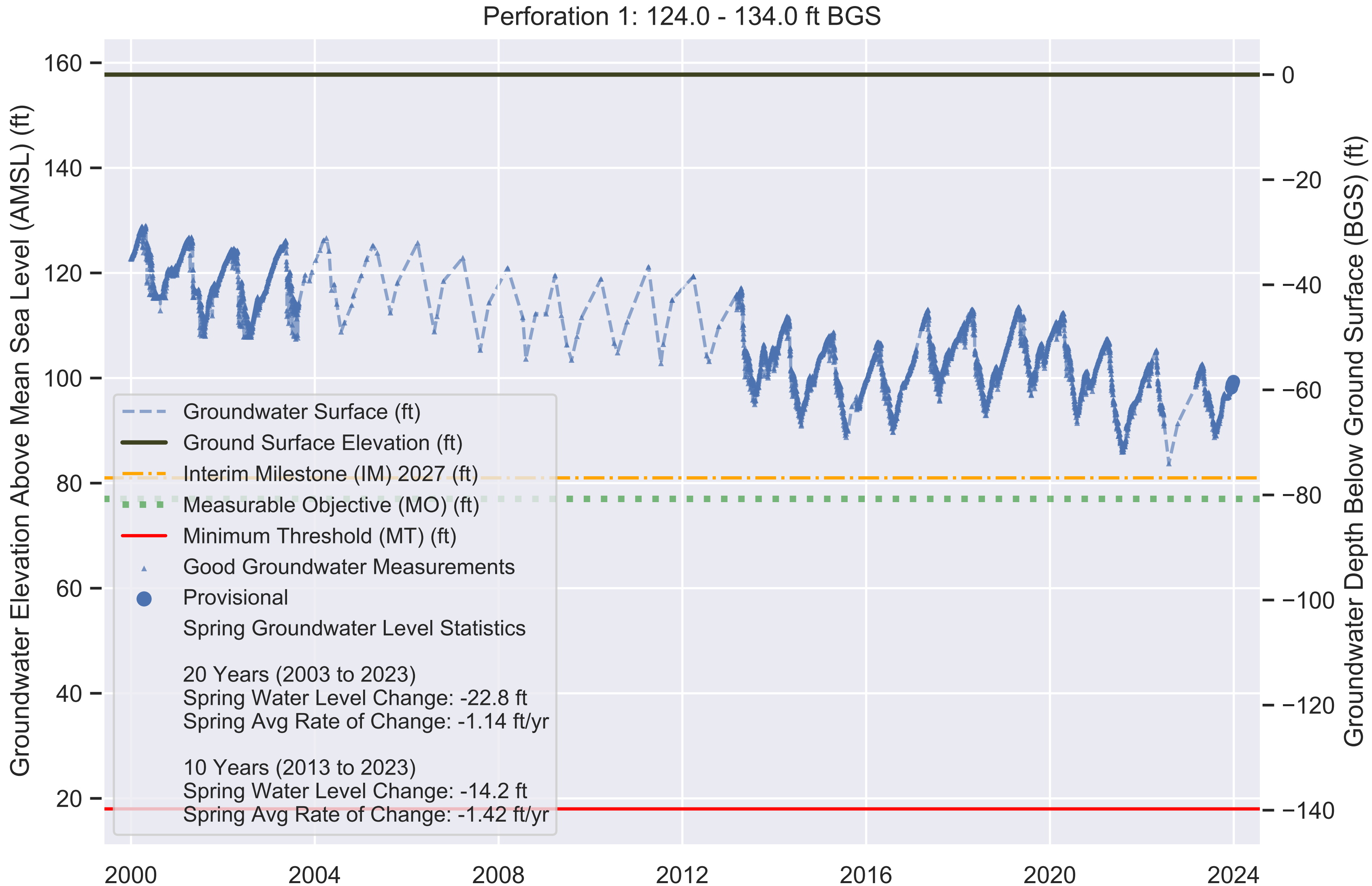
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

VINA Subbasin - State Well Number (SWN): 20N02E24C001M

Well Location Map

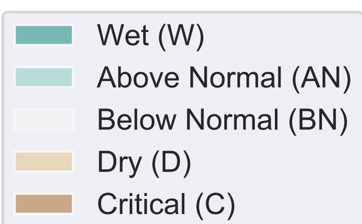


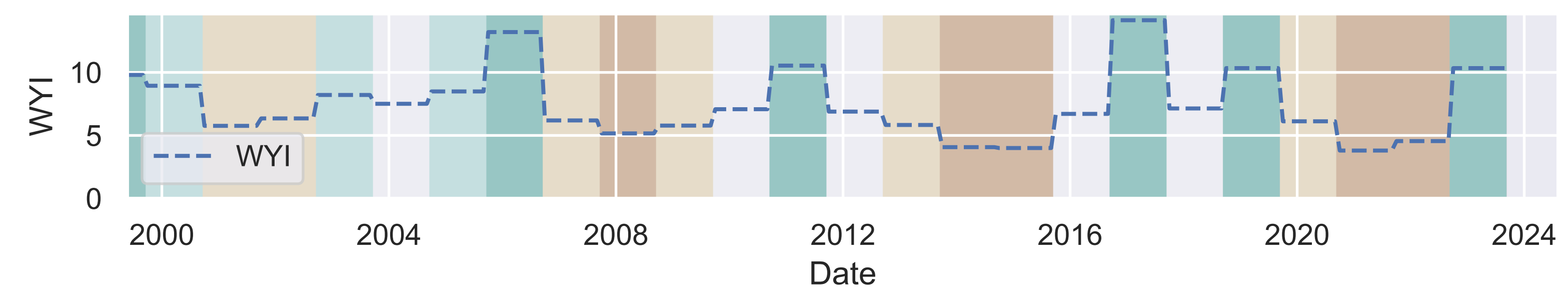


Sustainable Management Criteria:

IM (2027) = 81.0 ft AMSL
MO = 77.0 ft AMSL
MT = 18.0 ft AMSL

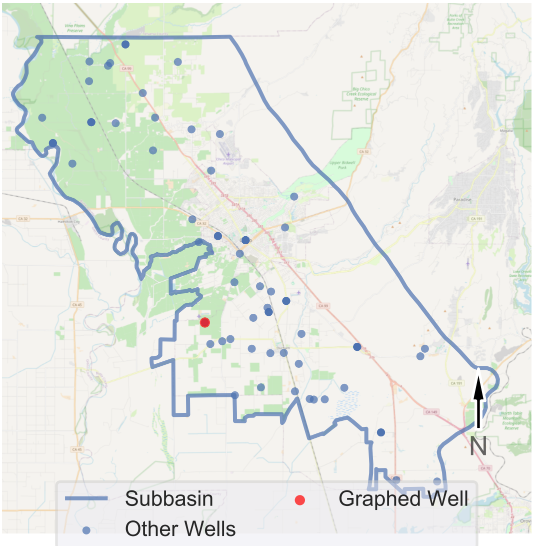
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





VINA Subbasin - State Well Number (SWN): 21N01E21C001M

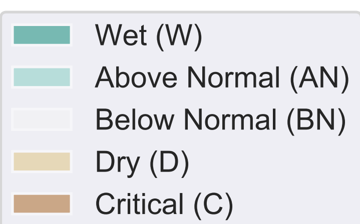
Well Location Map

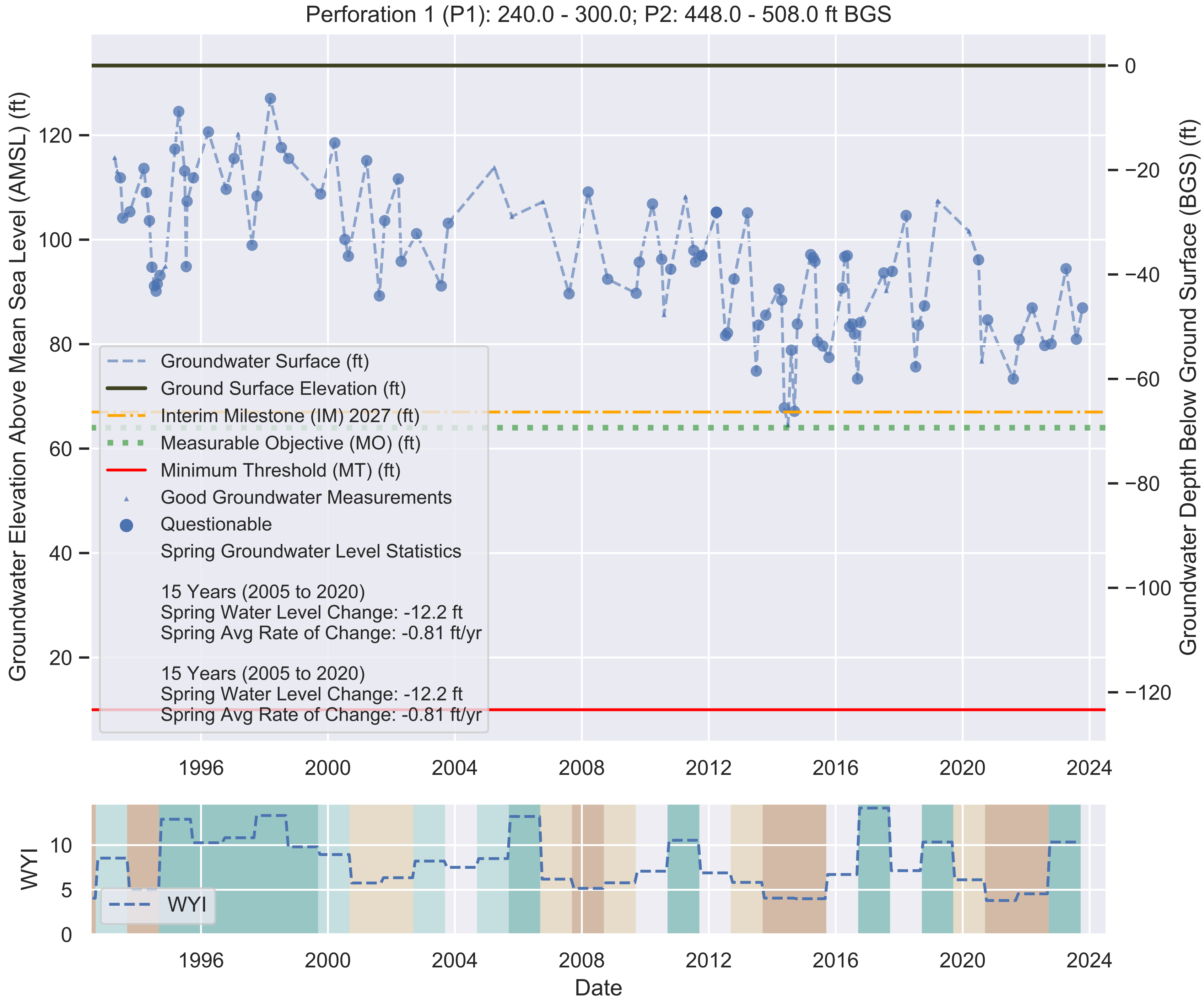


Sustainable Management Criteria:

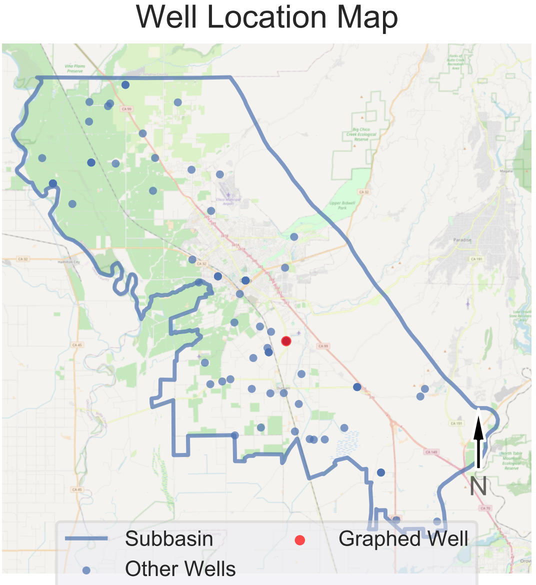
IM (2027) = 67.0 ft AMSL
MO = 64.0 ft AMSL
MT = 10.0 ft AMSL

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





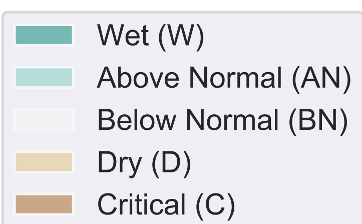
VINA Subbasin - State Well Number (SWN): 21N02E18C003M

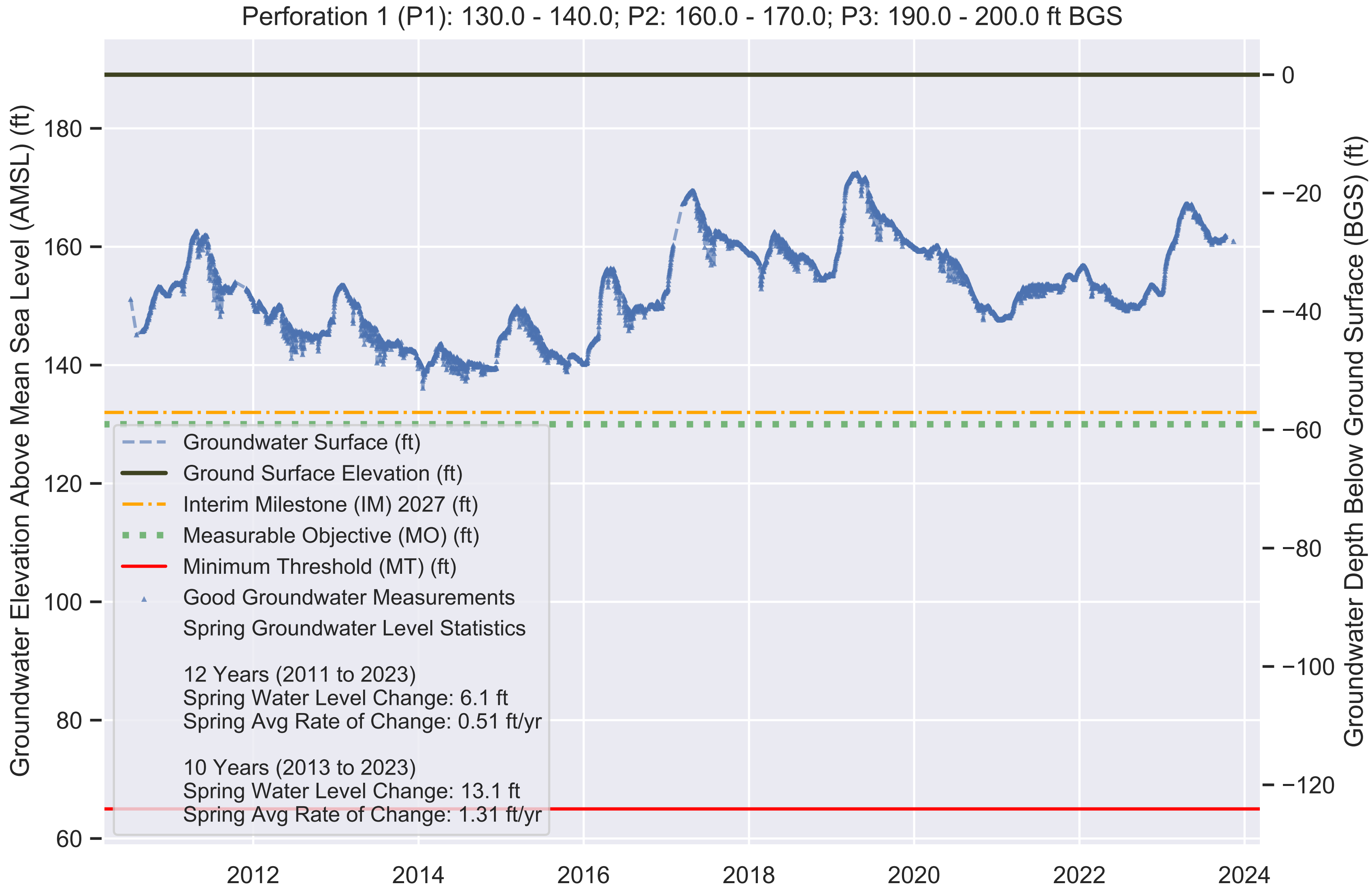


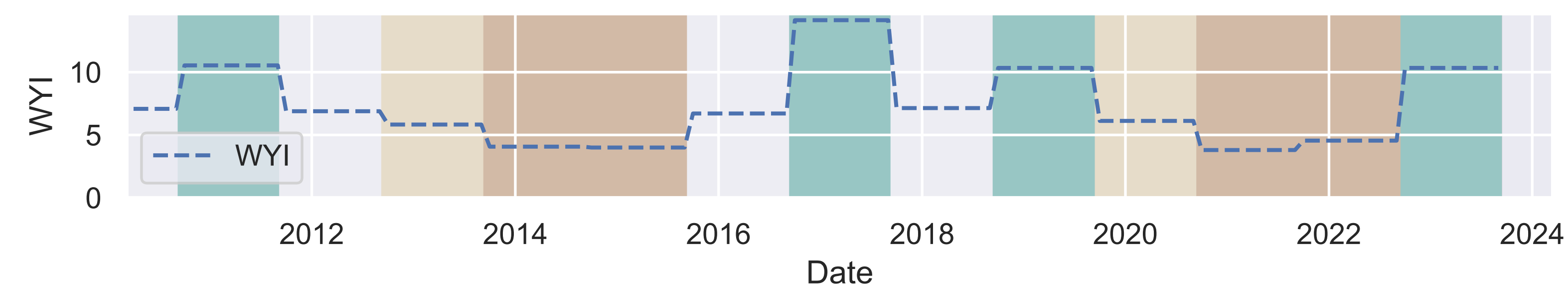
Sustainable Management Criteria:

IM (2027) = 132.0 ft AMSL
MO = 130.0 ft AMSL
MT = 65.0 ft AMSL

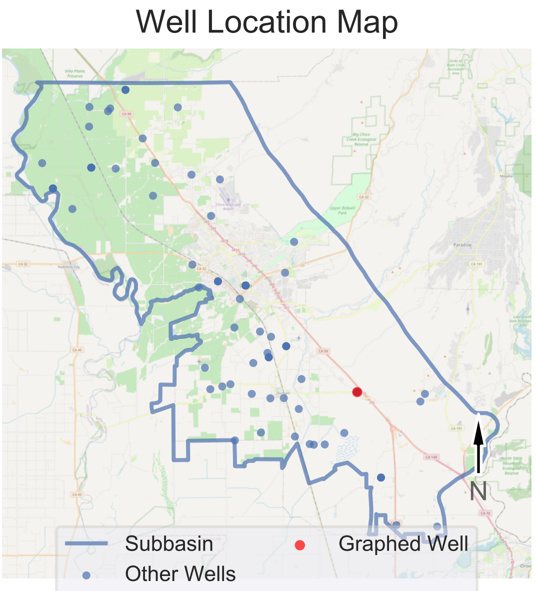
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.







VINA Subbasin - State Well Number (SWN): 21N02E26E005M

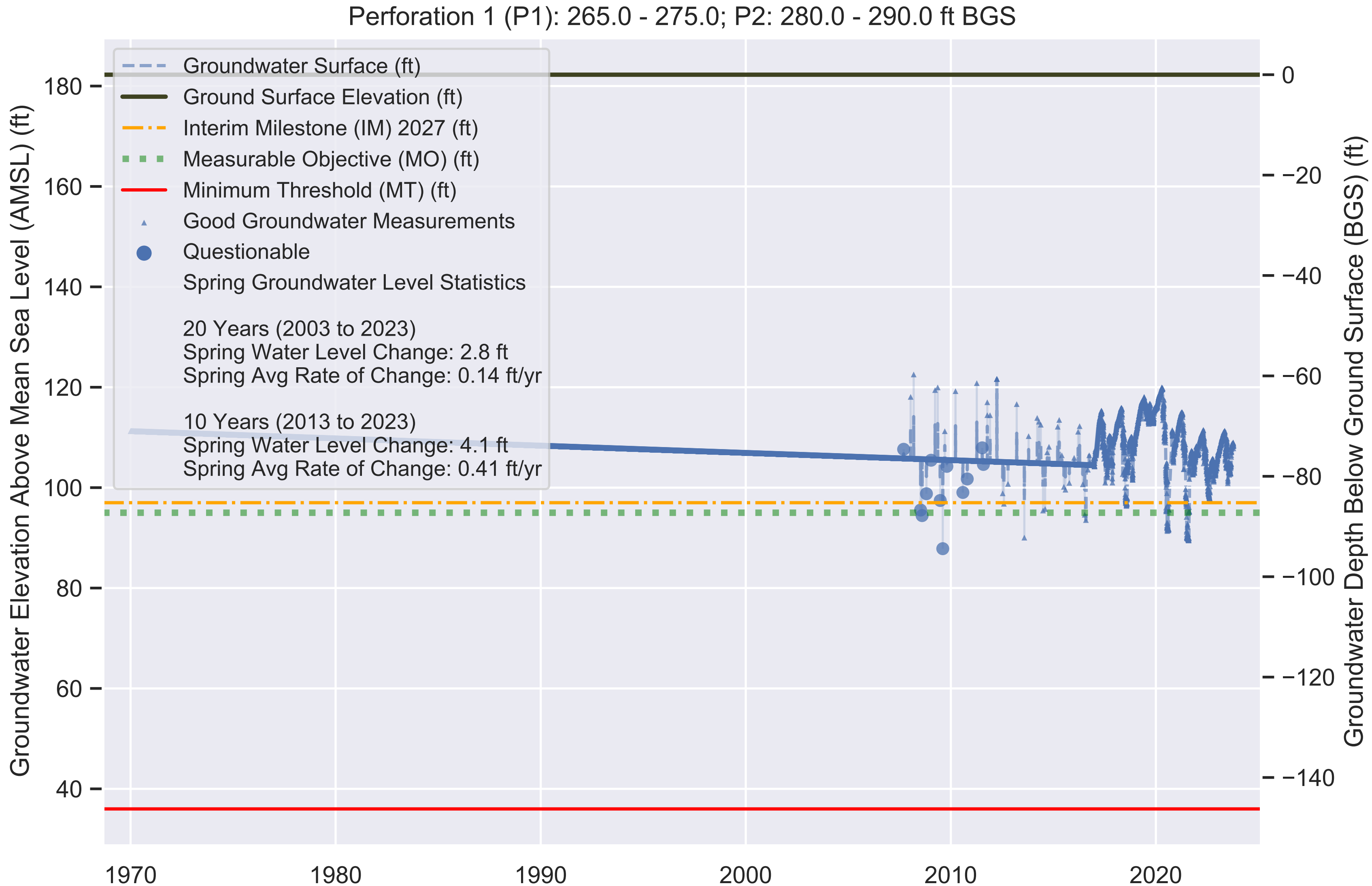


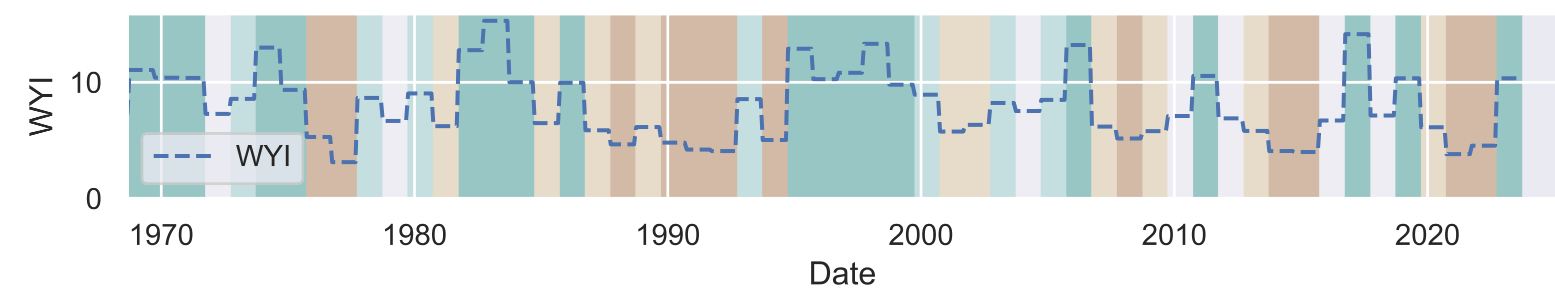
Sustainable Management Criteria:

IM (2027) = 97.0 ft AMSL
MO = 95.0 ft AMSL
MT = 36.0 ft AMSL

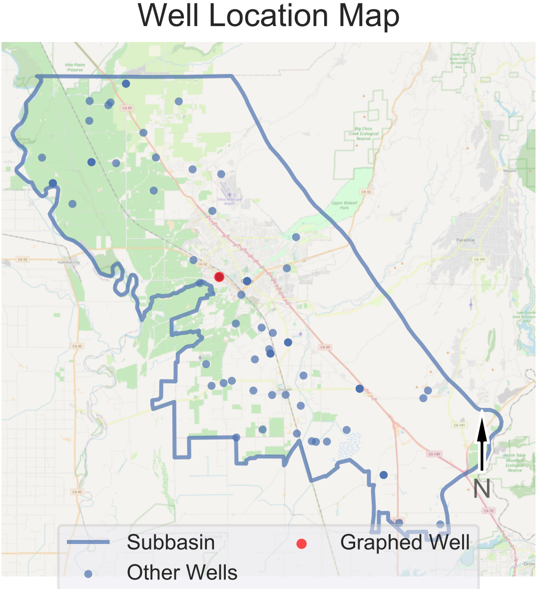
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)





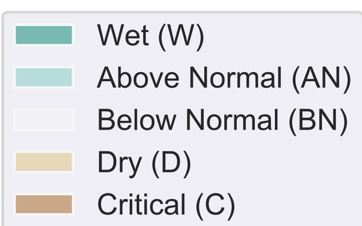
VINA Subbasin - State Well Number (SWN): 22N01E28J003M

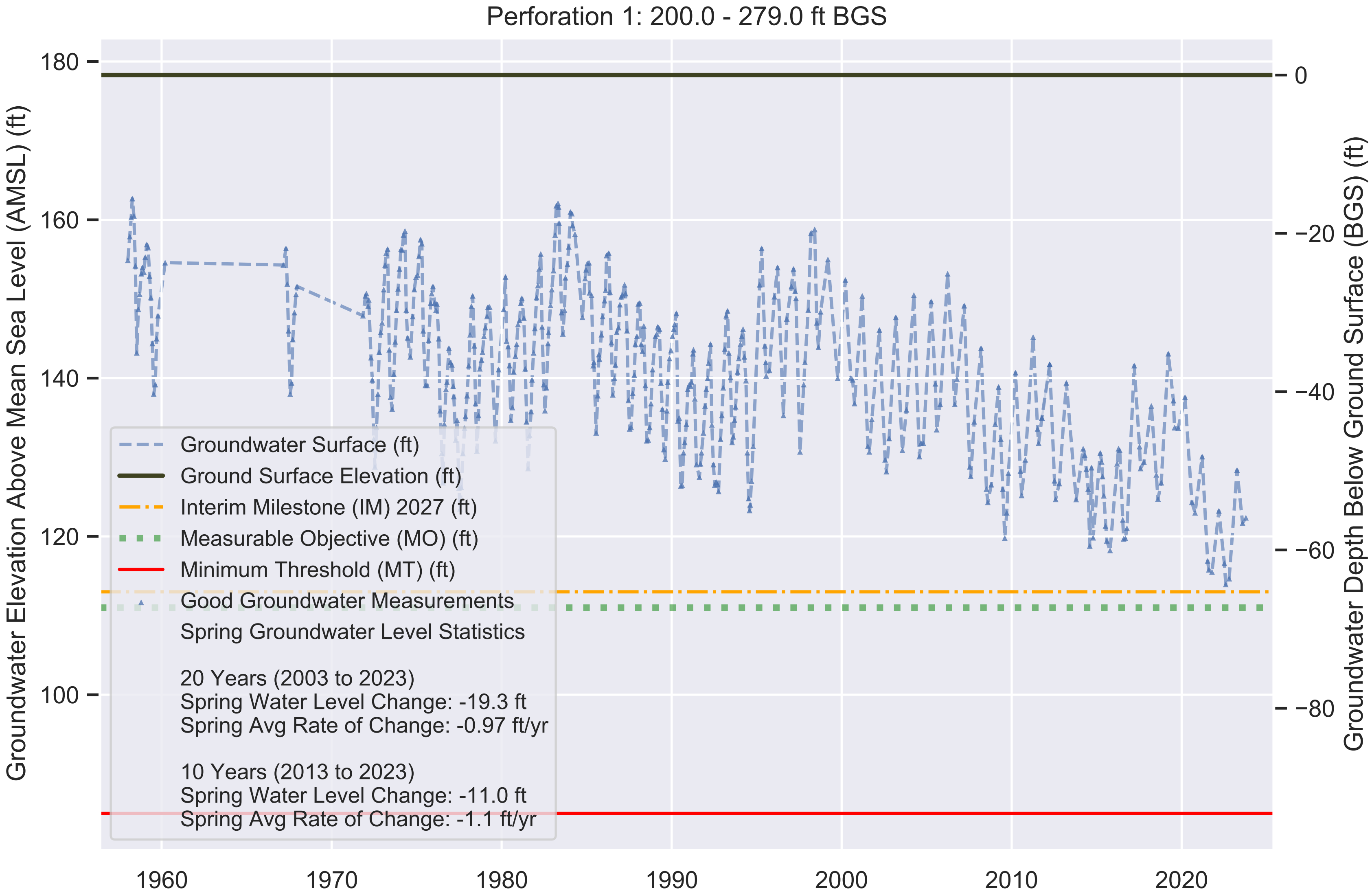


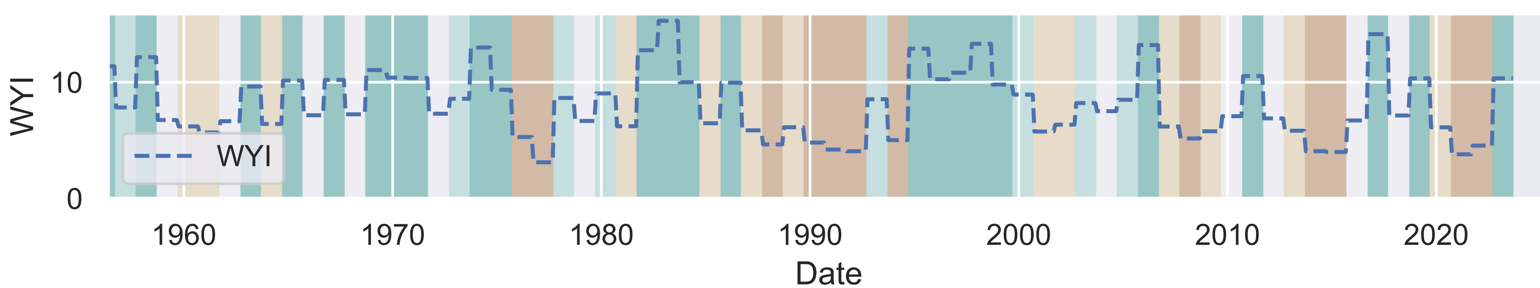
Sustainable Management Criteria:

IM (2027) = 113.0 ft AMSL
MO = 111.0 ft AMSL
MT = 85.0 ft AMSL

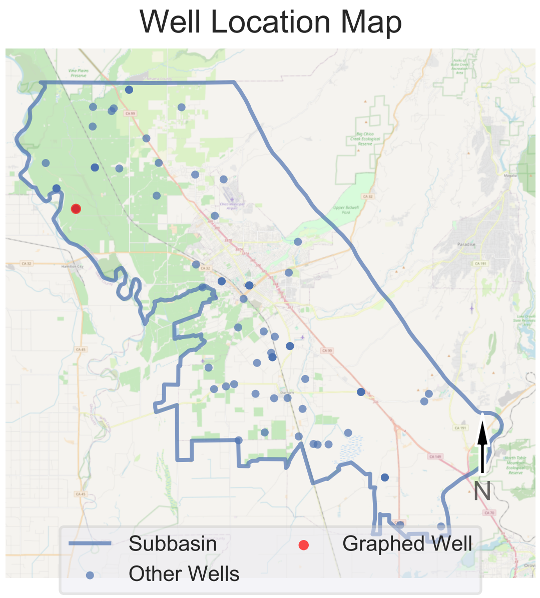
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.







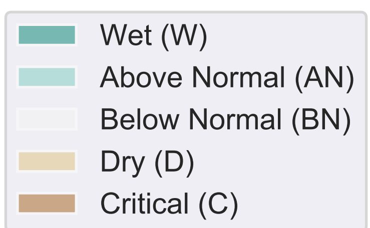
VINA Subbasin - State Well Number (SWN): 22N01W05M001M

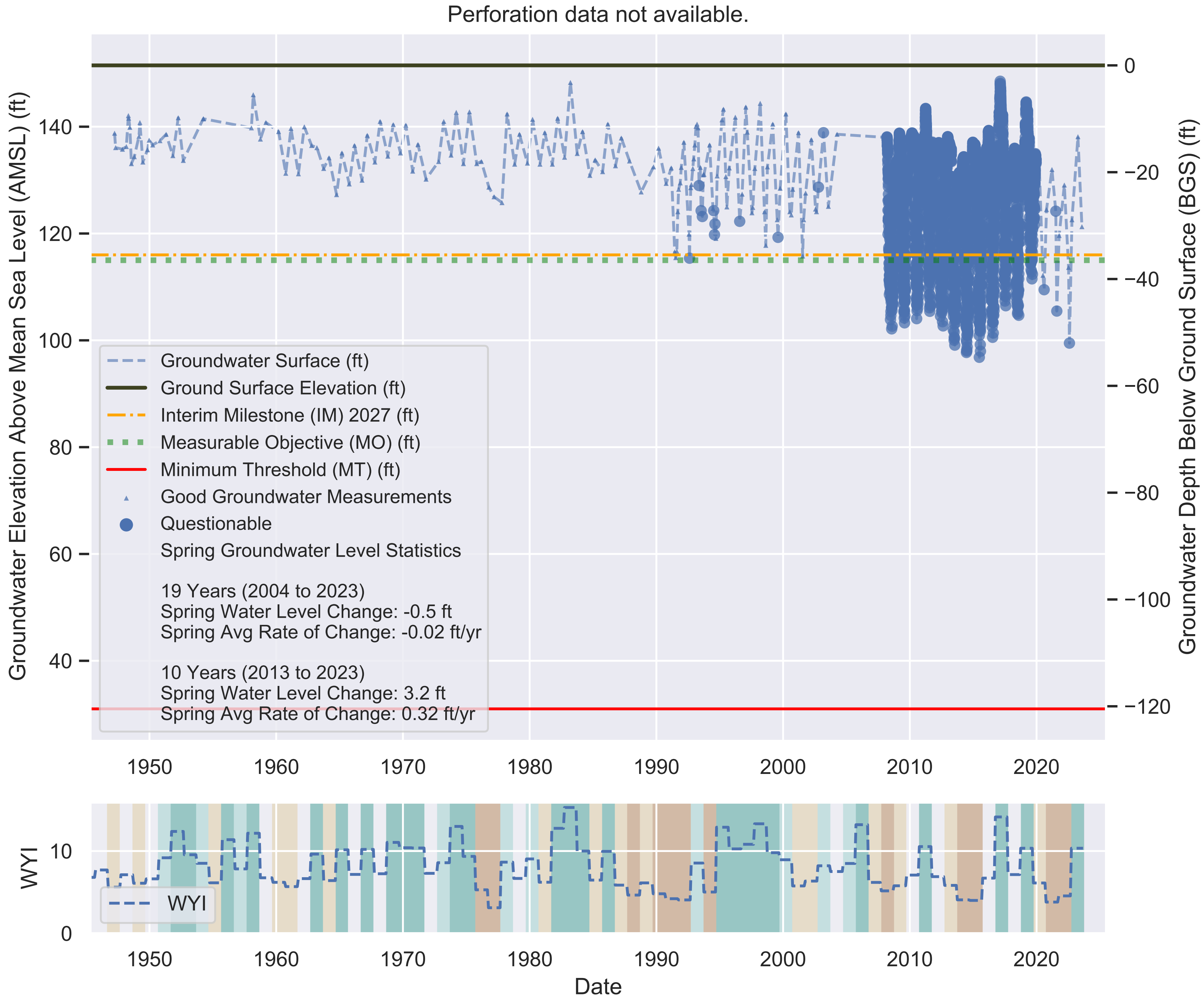


Sustainable Management Criteria:

IM (2027) = 116.0 ft AMSL
MO = 115.0 ft AMSL
MT = 31.0 ft AMSL

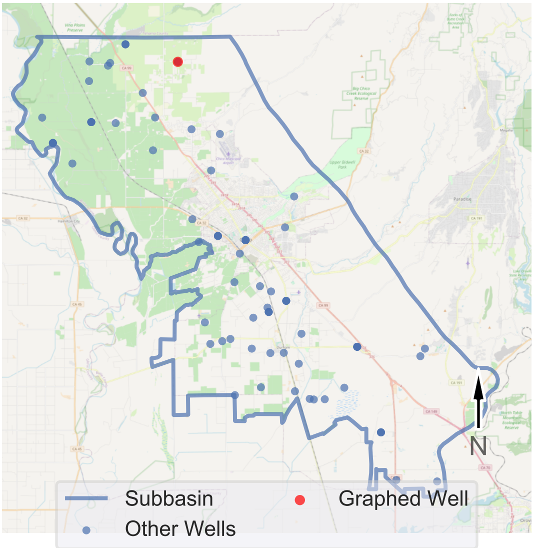
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





VINA Subbasin - State Well Number (SWN): 23N01E07H001M

Well Location Map



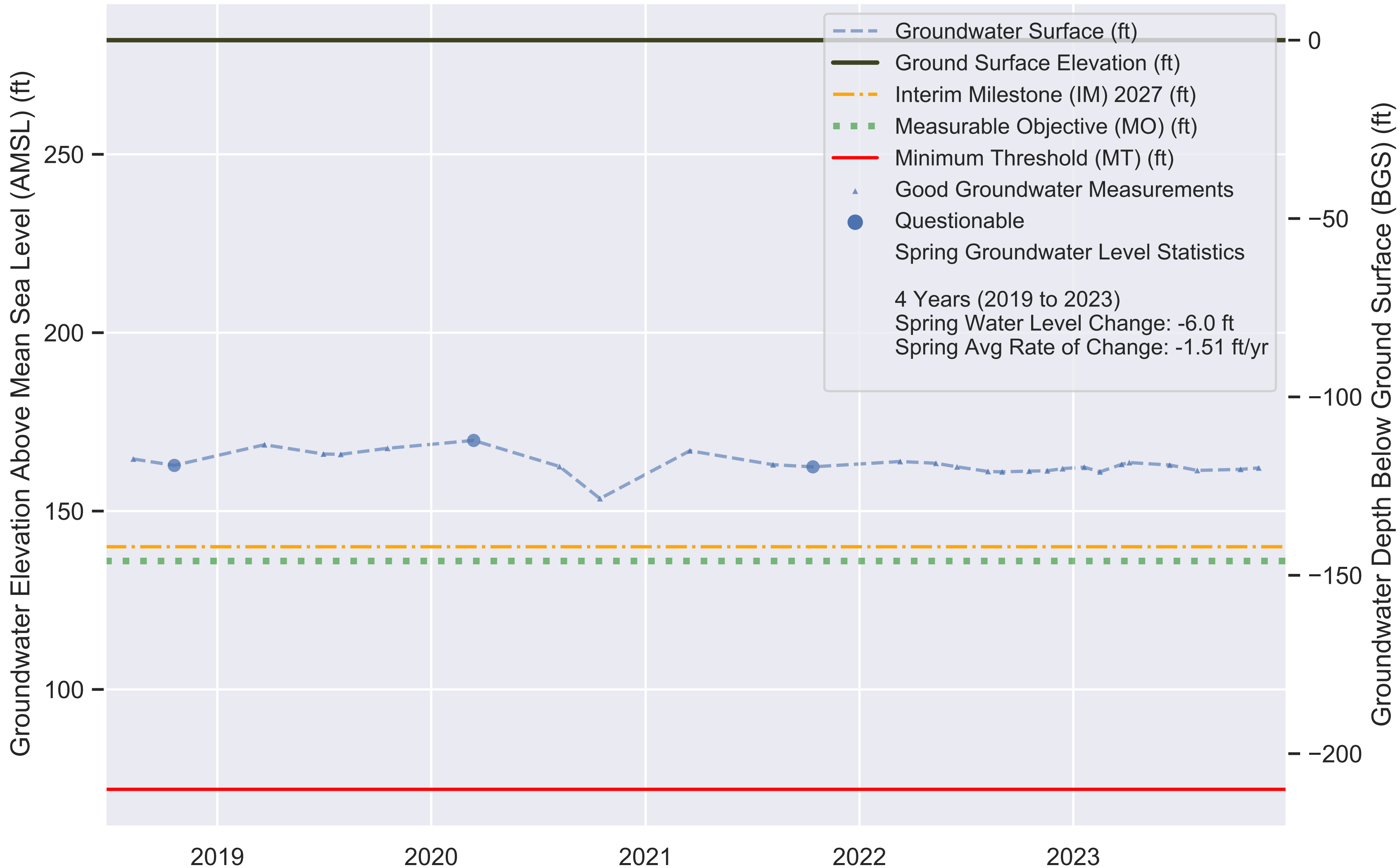
Sustainable Management Criteria:

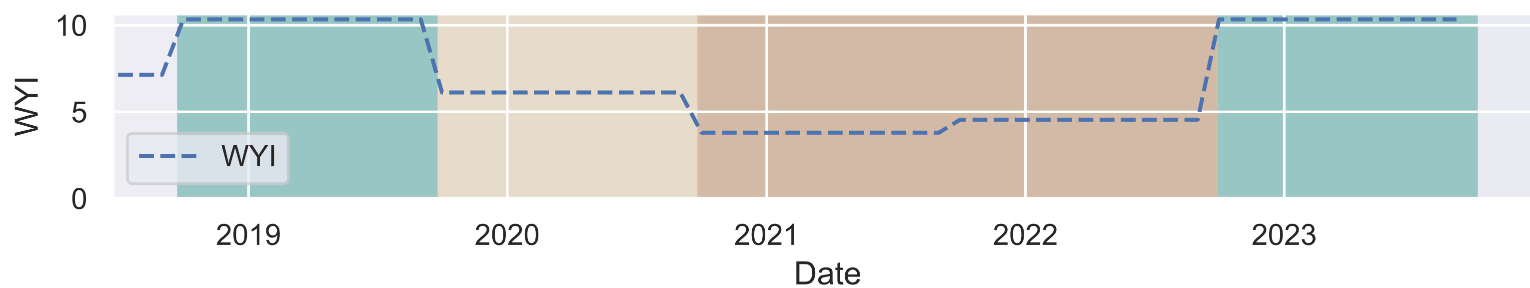
IM (2027) = 140.0 ft AMSL
MO = 136.0 ft AMSL
MT = 72.0 ft AMSL

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

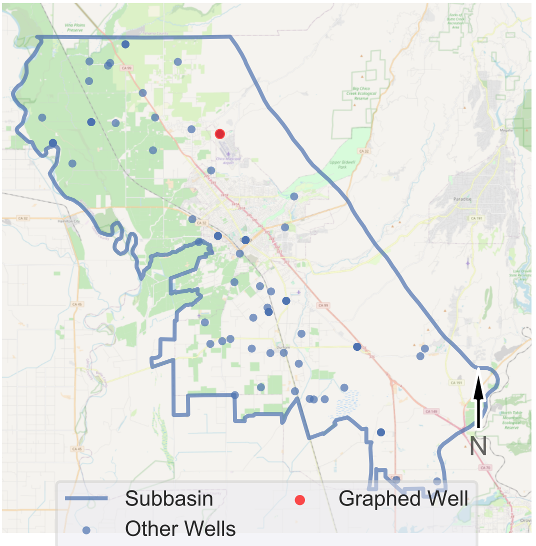
Perforation 1: 115.0 - 195.0 ft BGS





VINA Subbasin - State Well Number (SWN): 23N01E33A001M

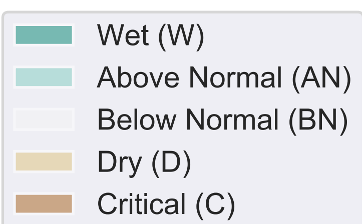
Well Location Map

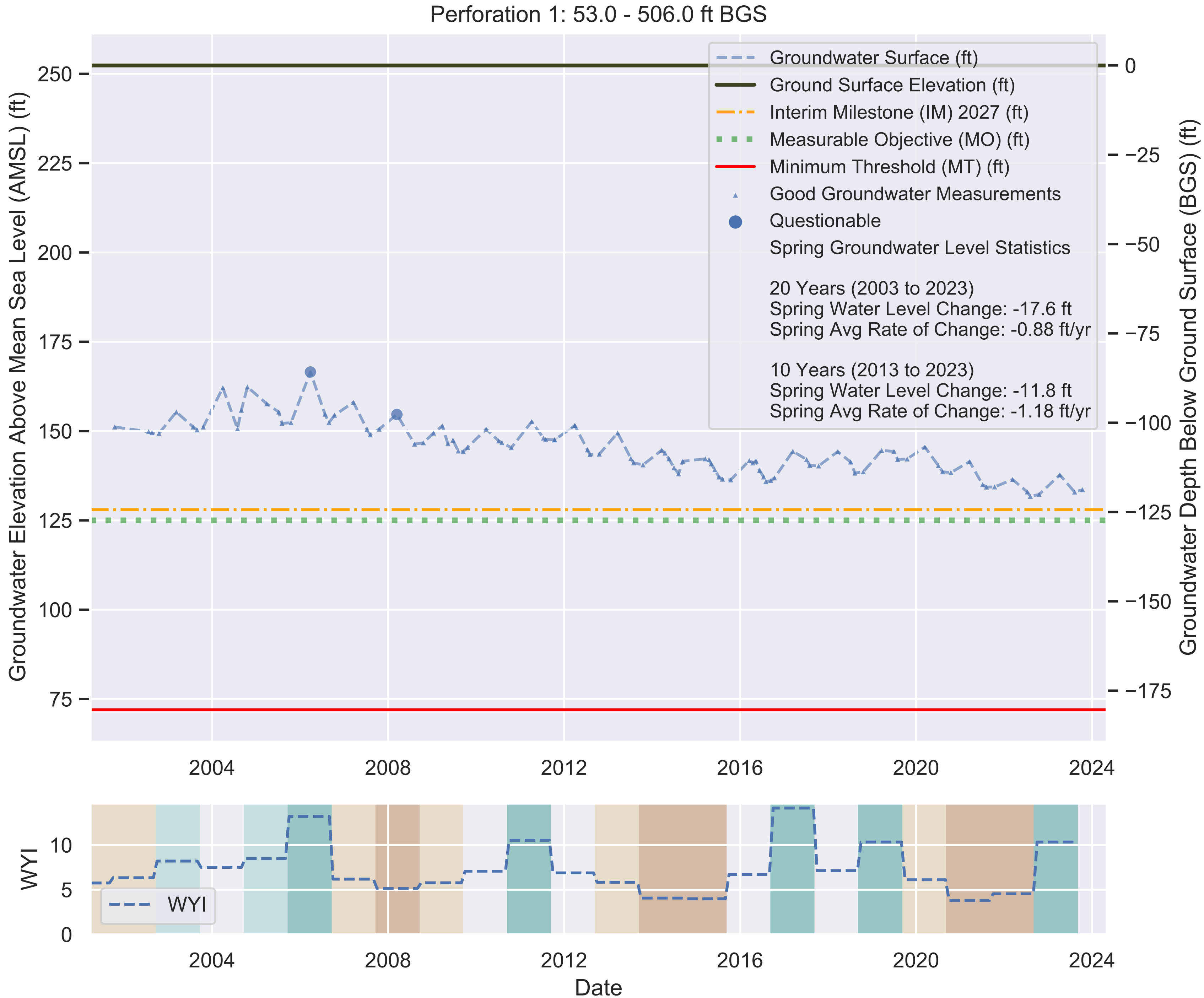


Sustainable Management Criteria:

IM (2027) = 128.0 ft AMSL
MO = 125.0 ft AMSL
MT = 72.0 ft AMSL

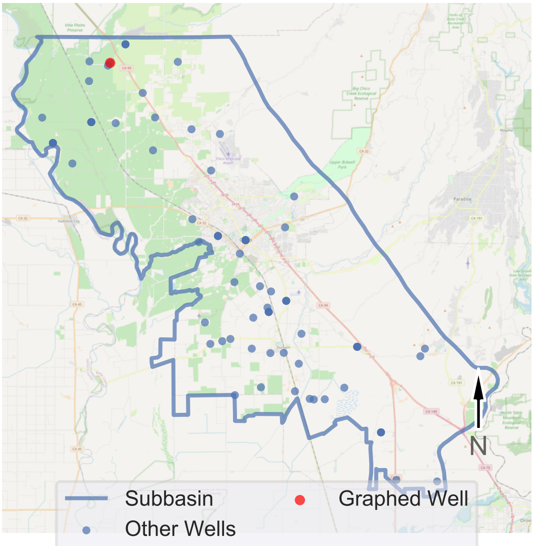
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





VINA Subbasin - State Well Number (SWN): 23N01W10E001M

Well Location Map

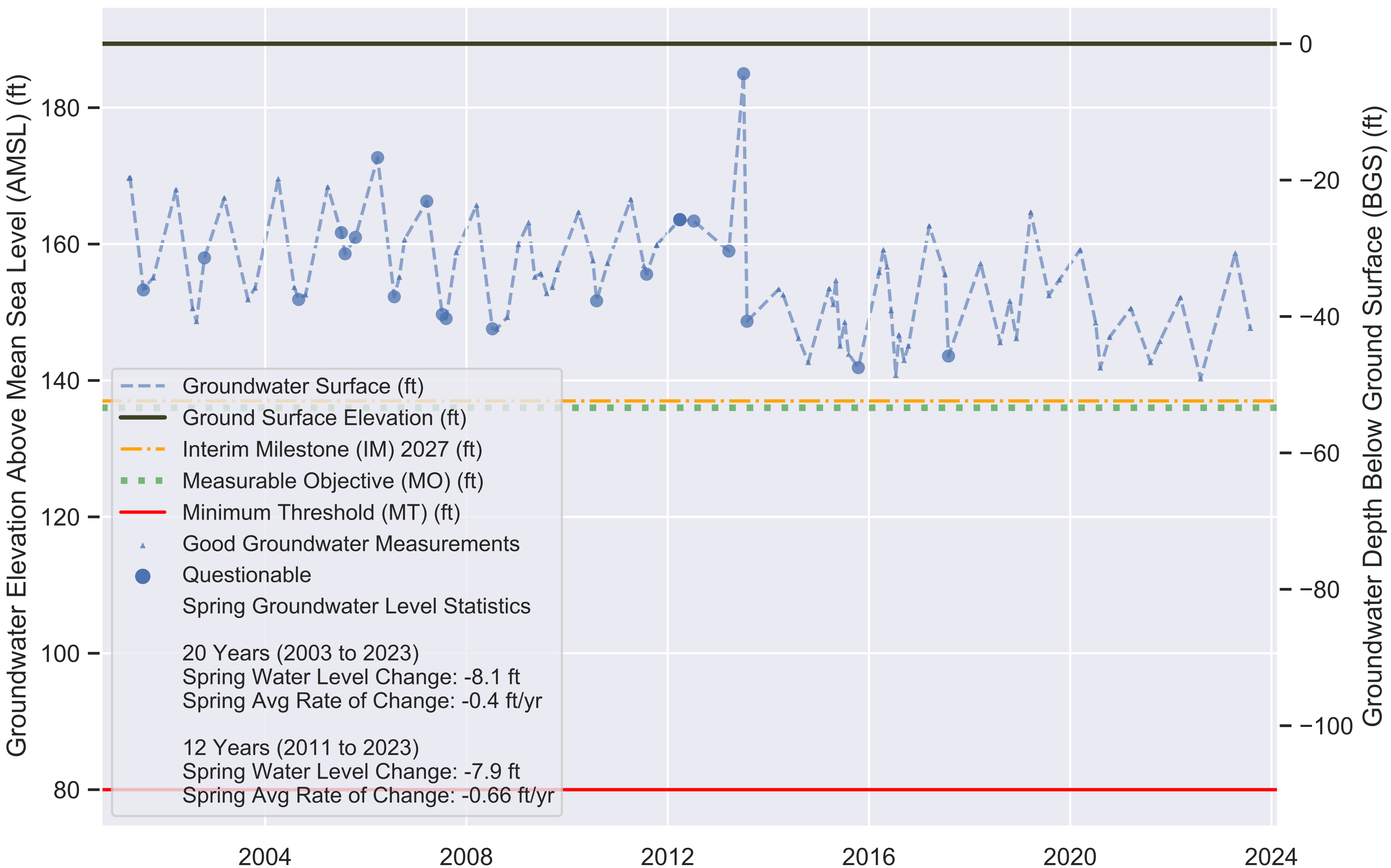


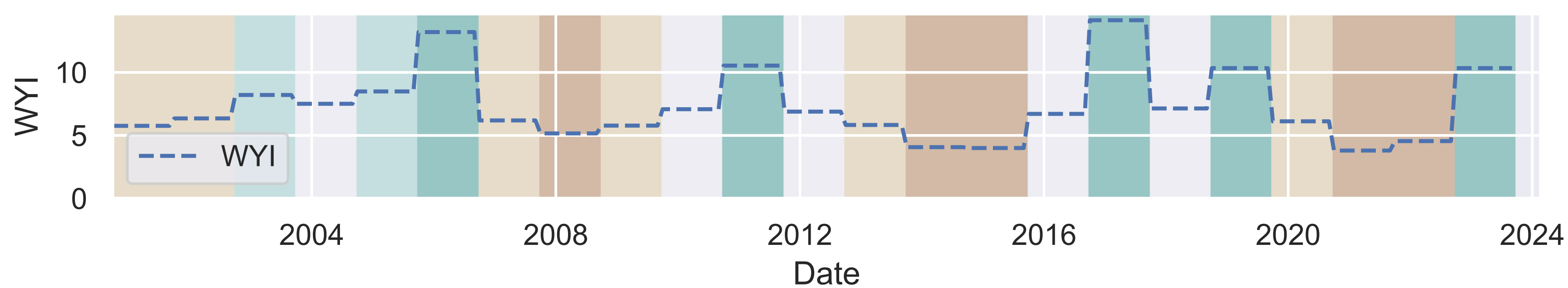
Sustainable Management Criteria:

IM (2027) = 137.0 ft AMSL
MO = 136.0 ft AMSL
MT = 80.0 ft AMSL

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

Perforation 1: 600.0 - 668.0 ft BGS

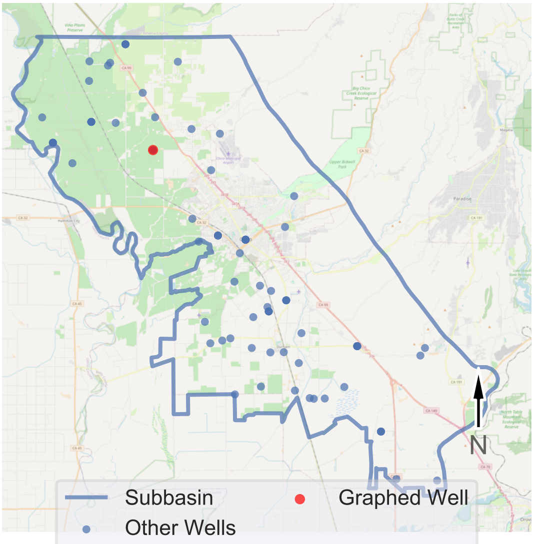




- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

VINA Subbasin - State Well Number (SWN): 23N01W36P001M

Well Location Map

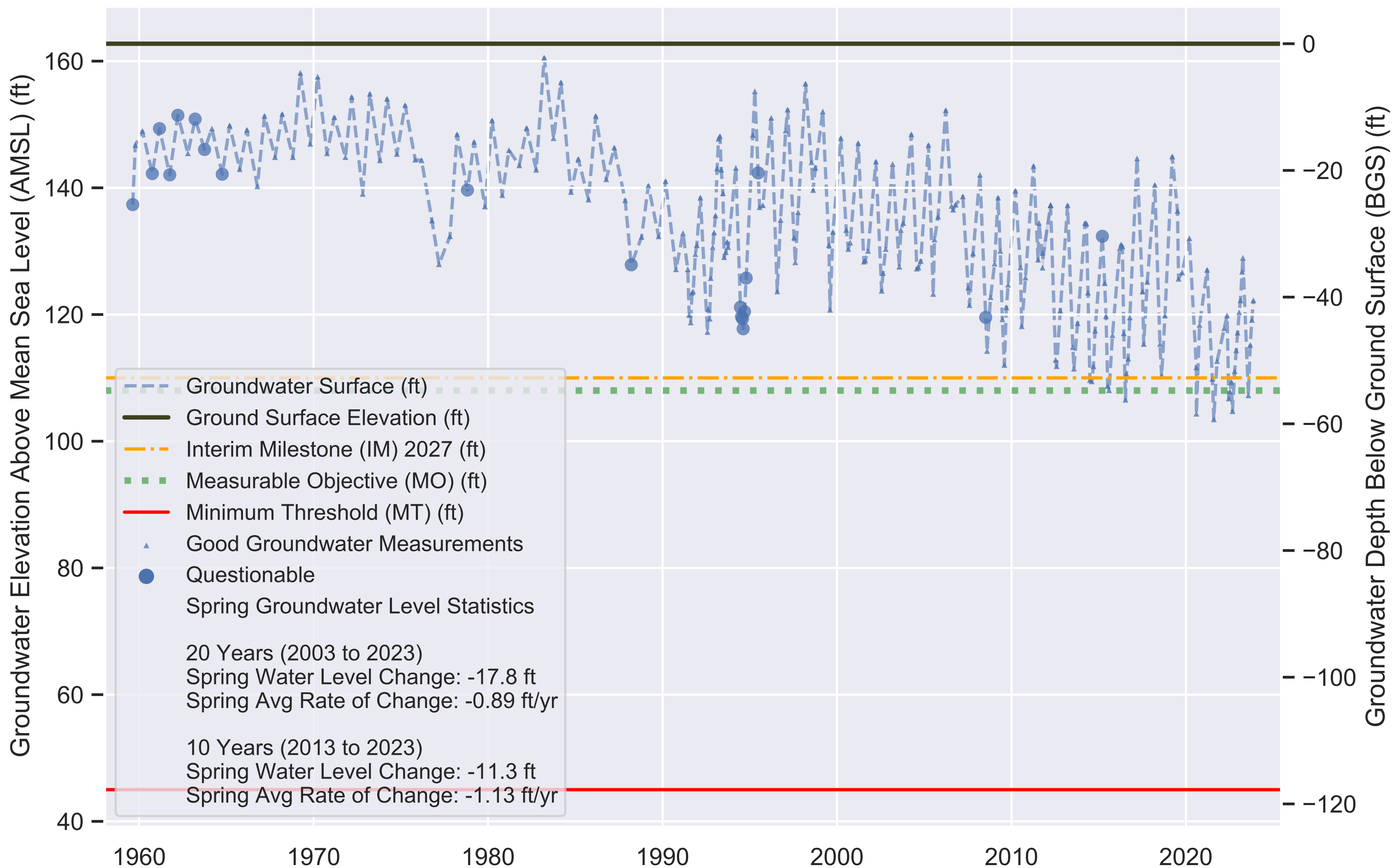


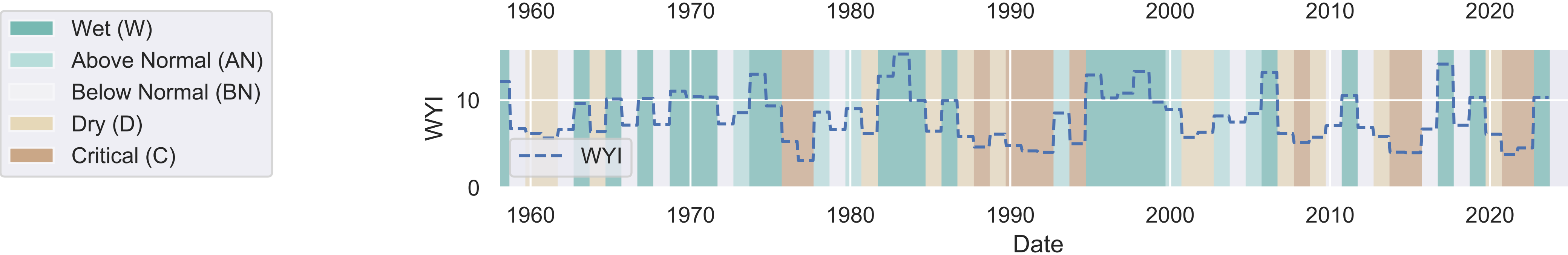
Sustainable Management Criteria:

IM (2027) = 110.0 ft AMSL
MO = 108.0 ft AMSL
MT = 45.0 ft AMSL

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

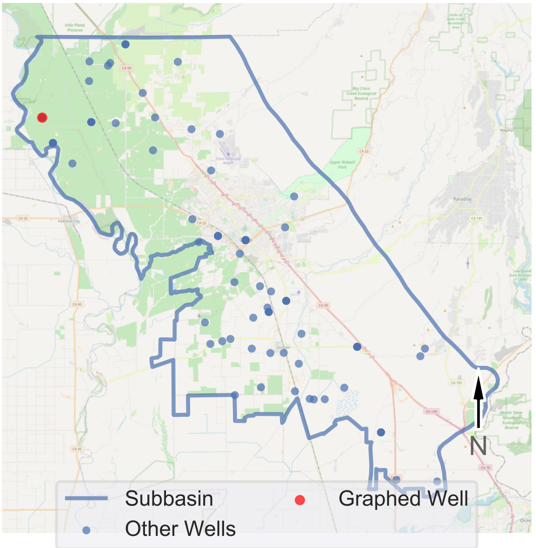
Perforation data not available.





VINA Subbasin - State Well Number (SWN): 23N02W25C001M

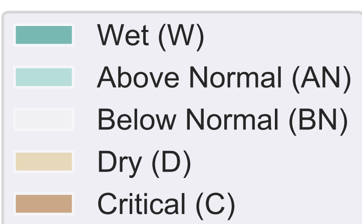
Well Location Map



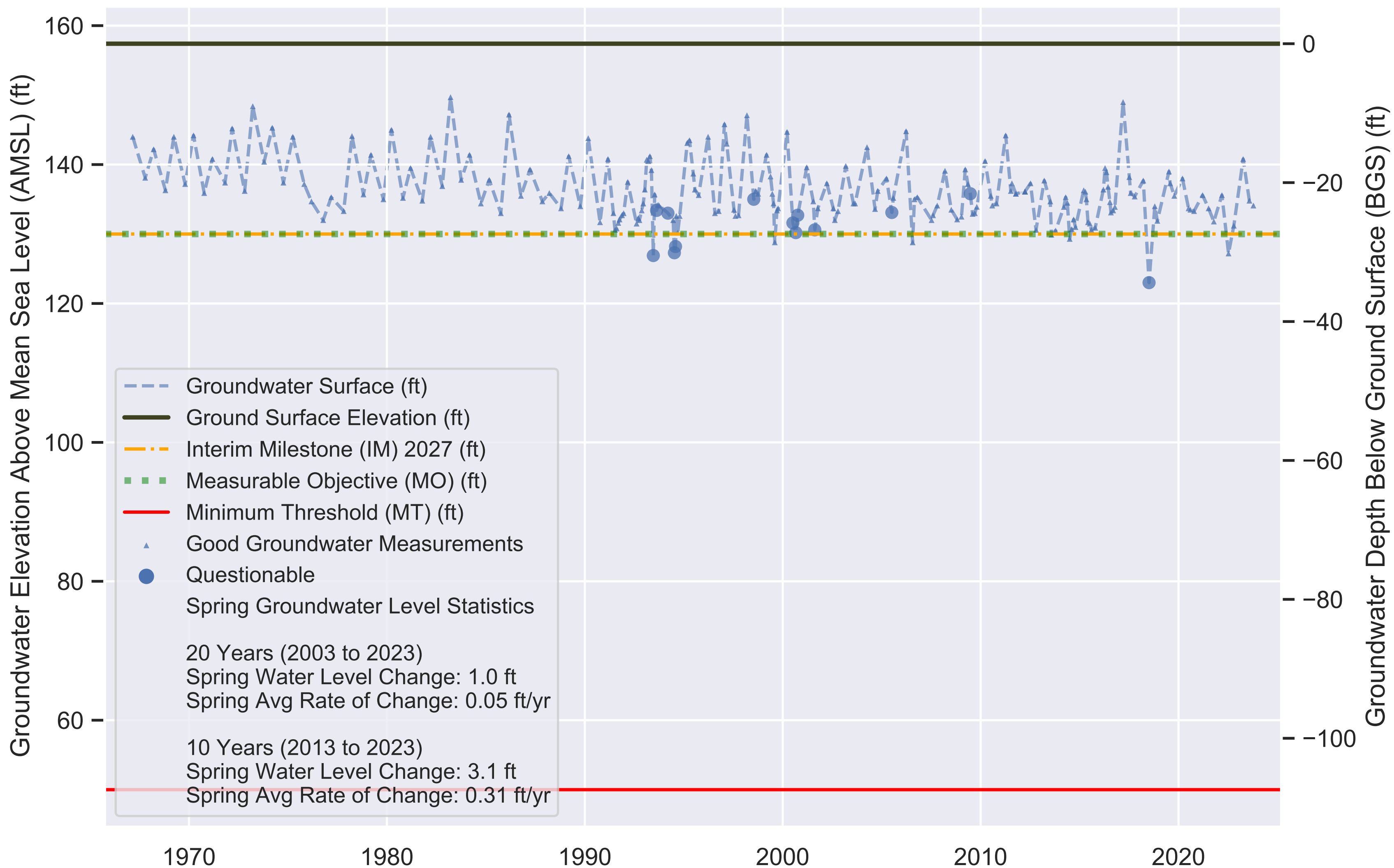
Sustainable Management Criteria:

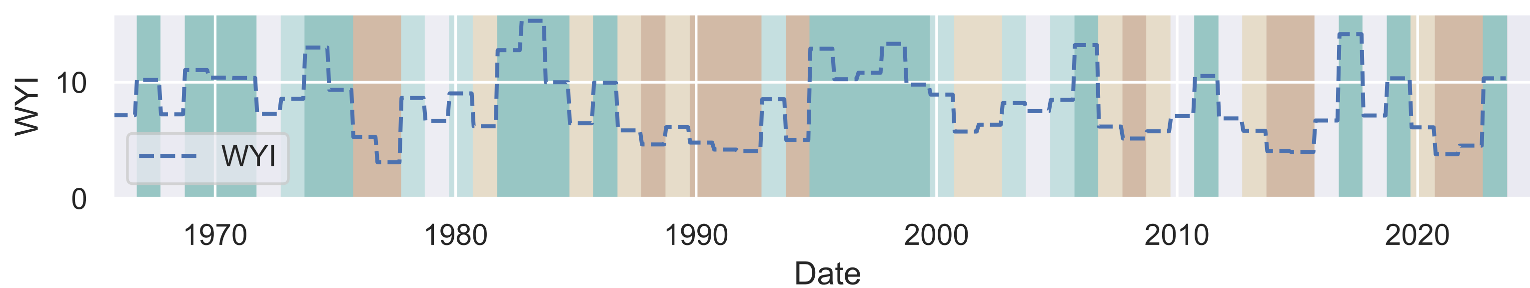
IM (2027) = 130.0 ft AMSL
MO = 130.0 ft AMSL
MT = 50.0 ft AMSL

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



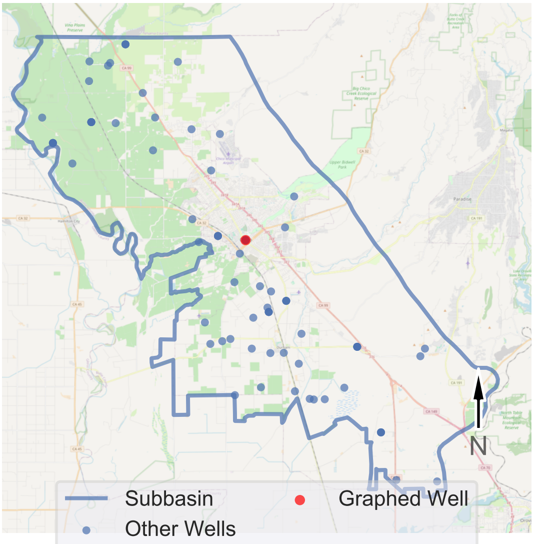
Perforation data not available.





VINA Subbasin - State Well Number (SWN): CWSCH01b

Well Location Map



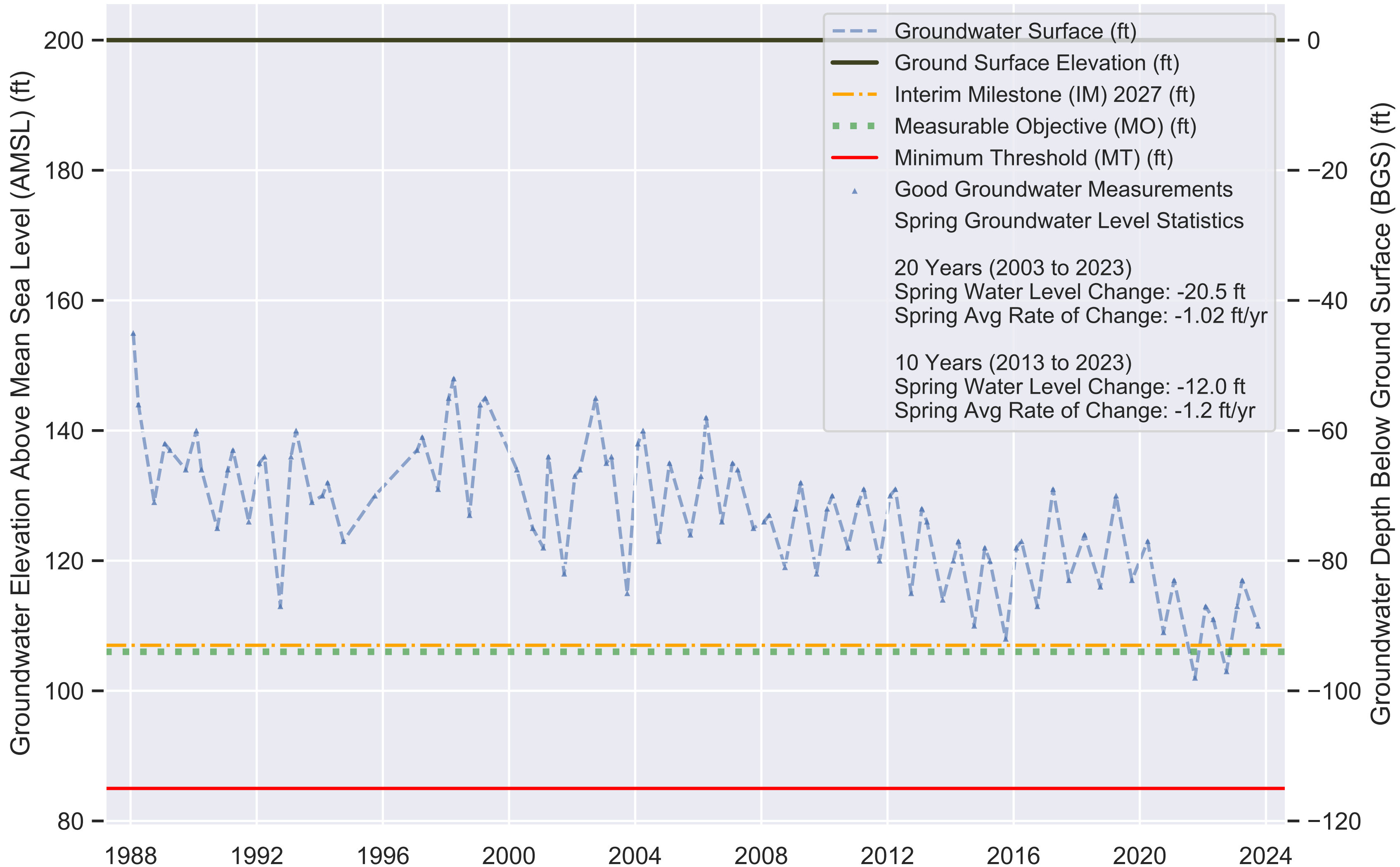
Sustainable Management Criteria:

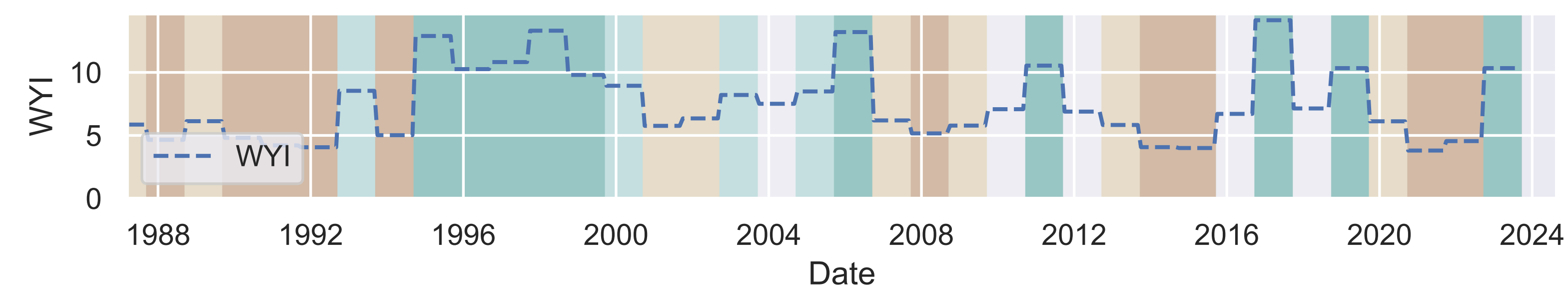
IM (2027) = 107.0 ft AMSL
MO = 106.0 ft AMSL
MT = 85.0 ft AMSL

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

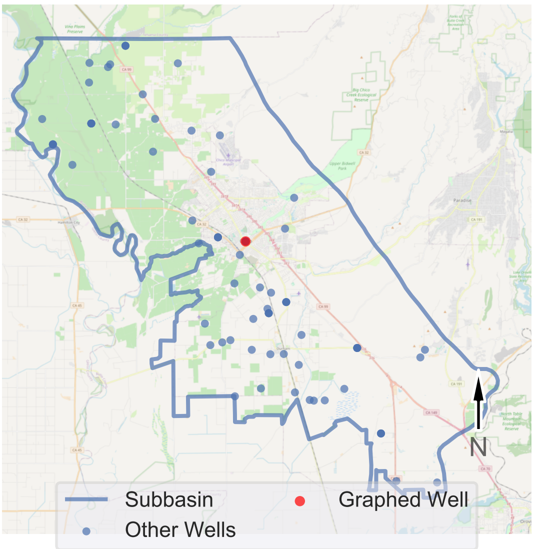
Perforation data not available.



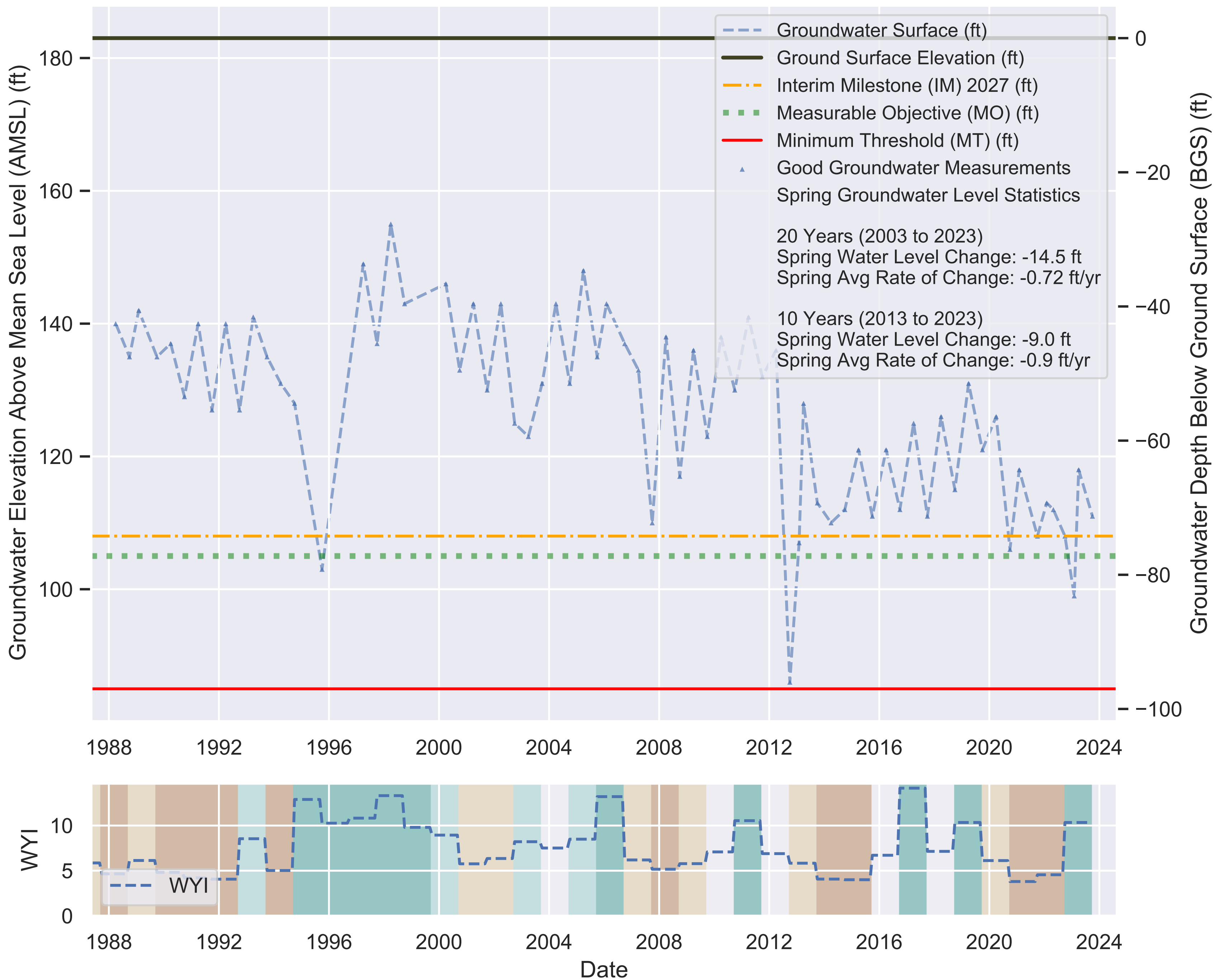


VINA Subbasin - State Well Number (SWN): CWSCH02

Well Location Map



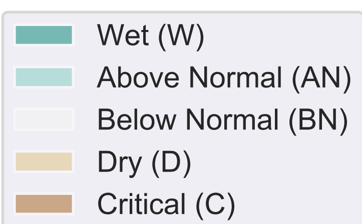
Perforation data not available.



Sustainable Management Criteria:

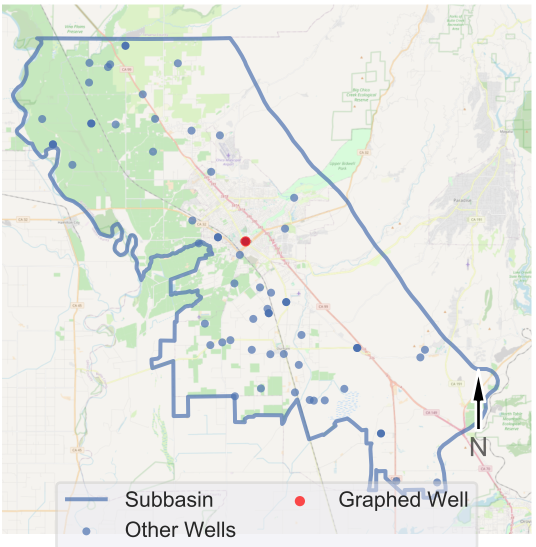
IM (2027) = 108.0 ft AMSL
MO = 105.0 ft AMSL
MT = 85.0 ft AMSL

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



VINA Subbasin - State Well Number (SWN): CWSCH03

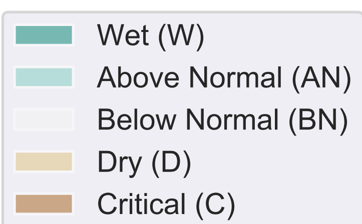
Well Location Map



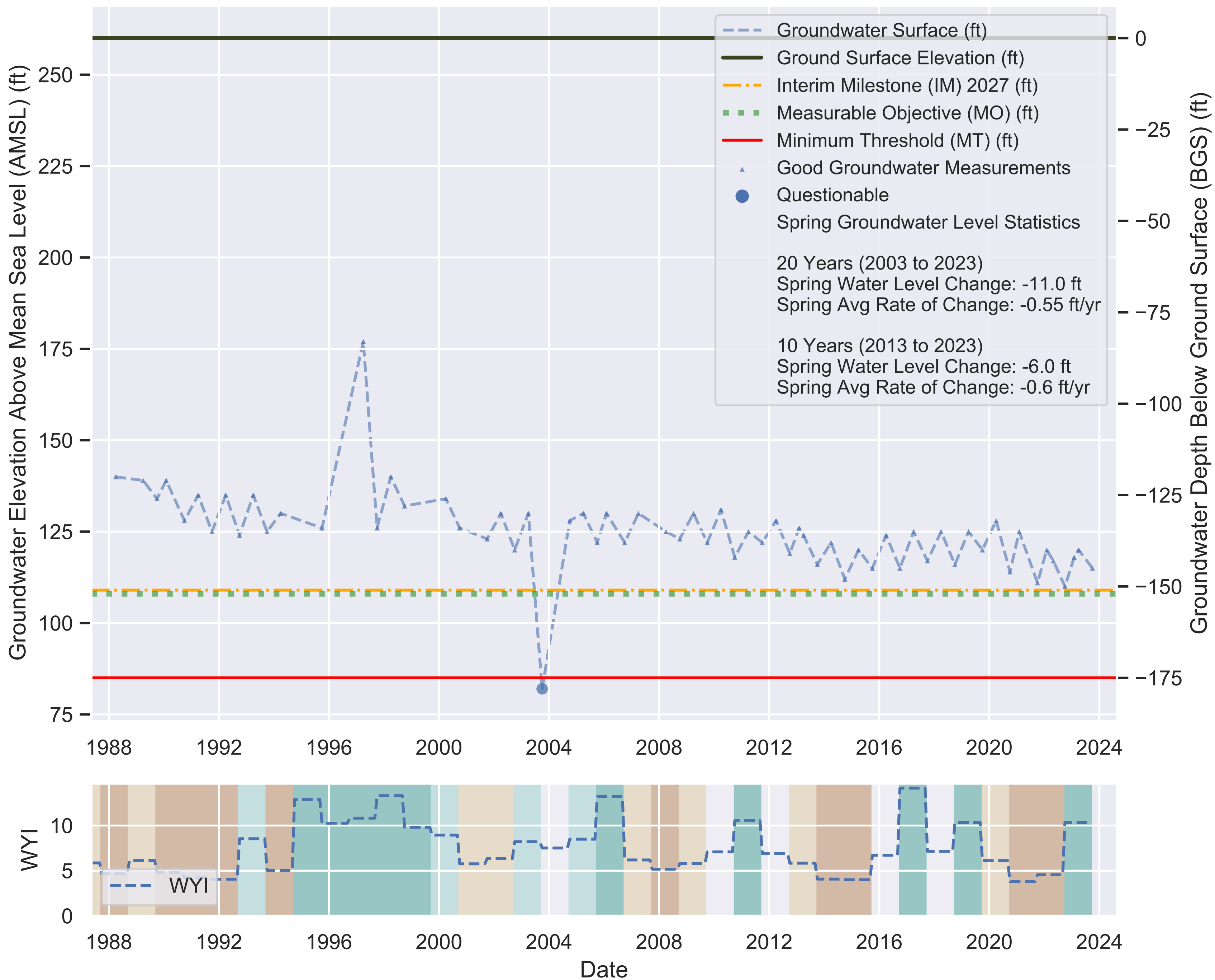
Sustainable Management Criteria:

IM (2027) = 109.0 ft AMSL
MO = 108.0 ft AMSL
MT = 85.0 ft AMSL

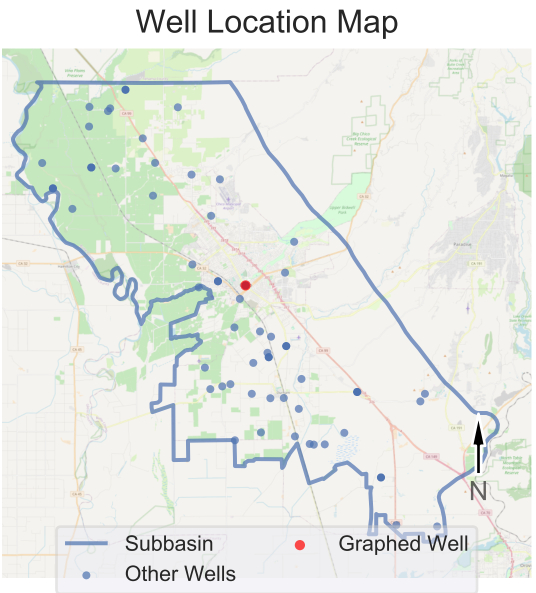
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



Perforation data not available.

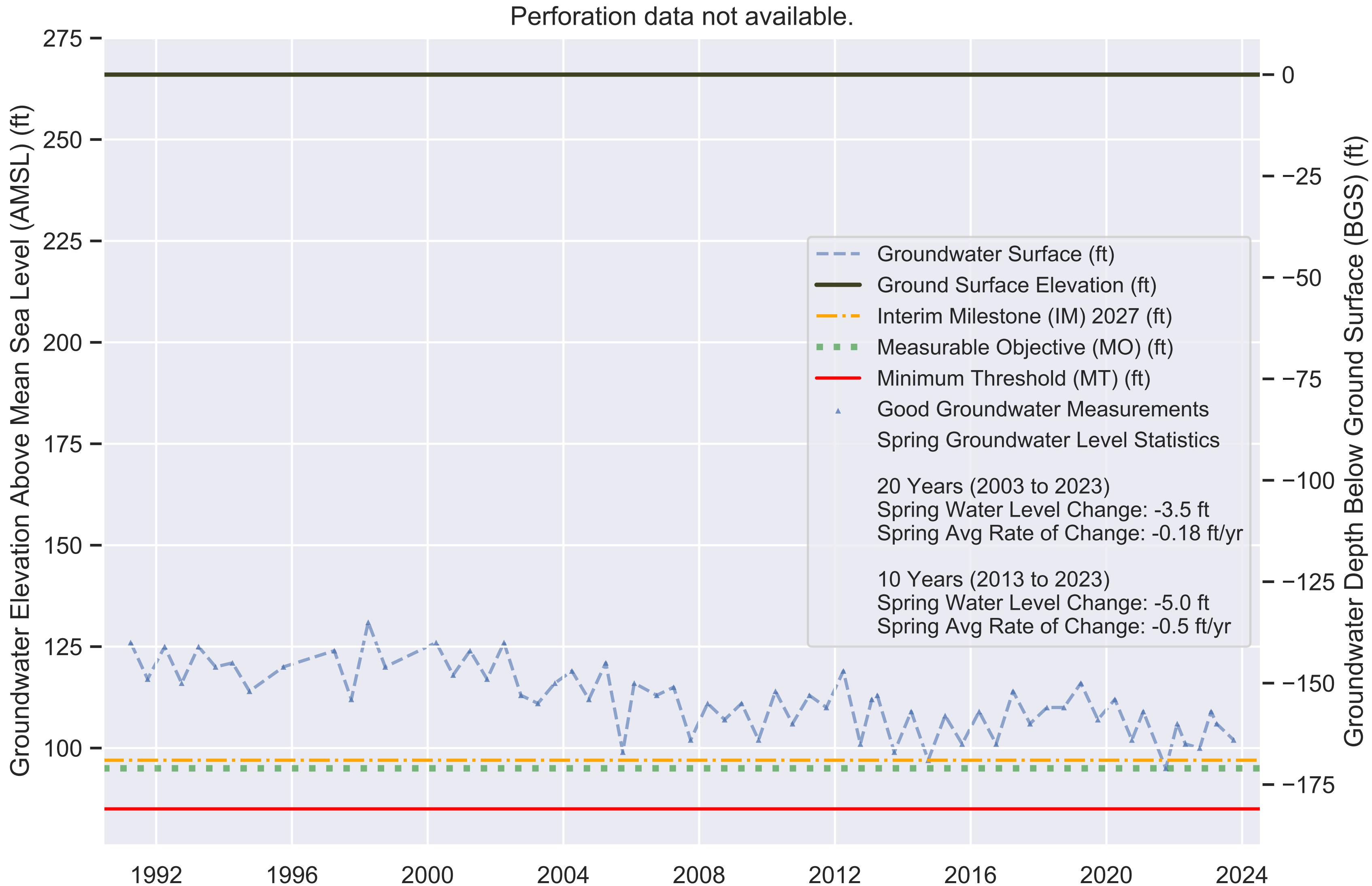


VINA Subbasin - State Well Number (SWN): CWSCH07

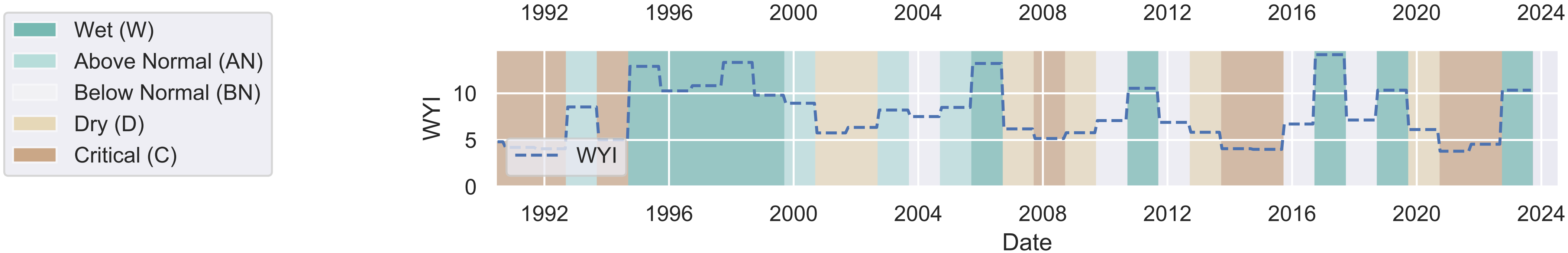


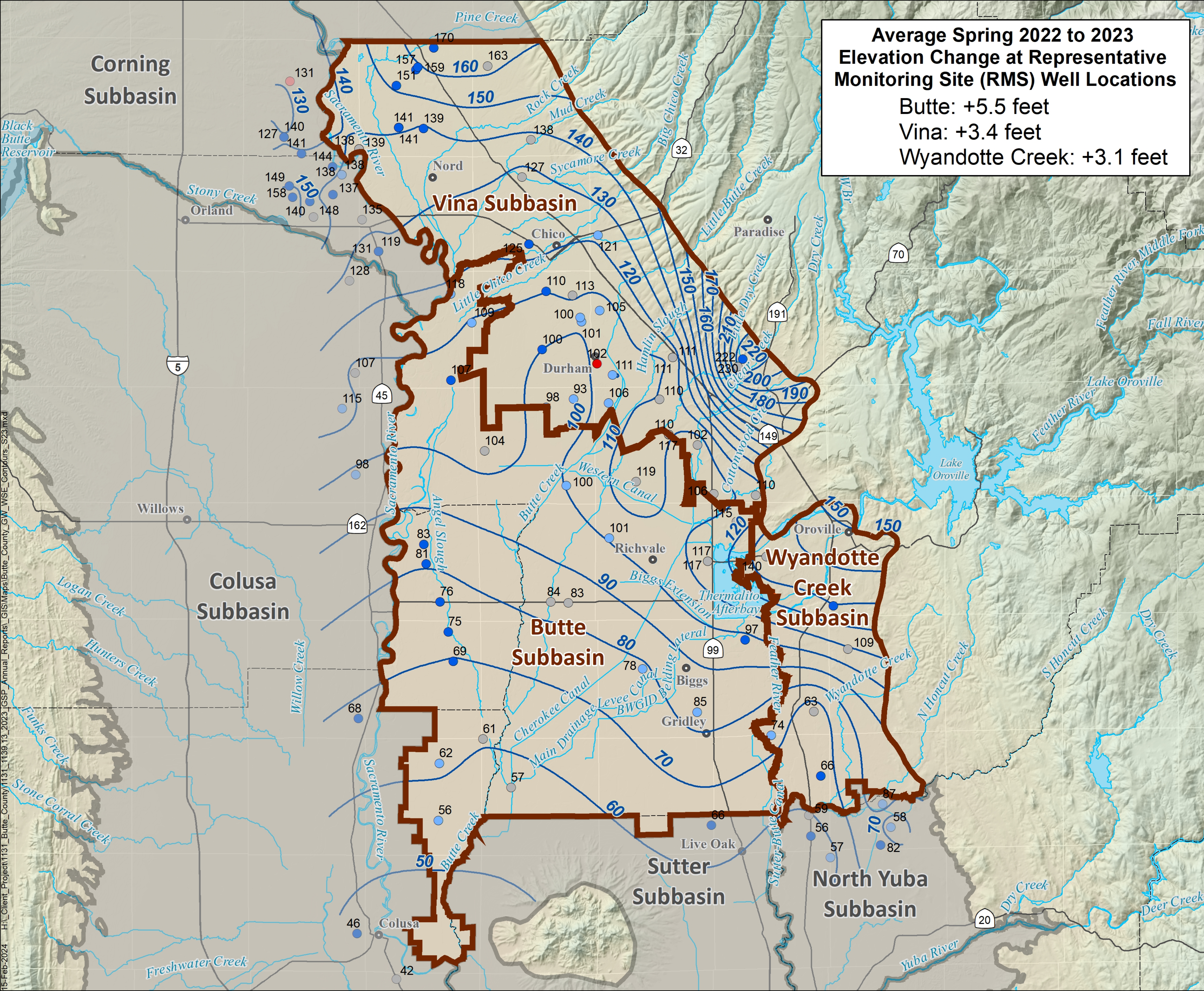
Sustainable Management Criteria:

IM (2027) = 97.0 ft AMSL
MO = 95.0 ft AMSL
MT = 85.0 ft AMSL



Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





SPRING 2023 GROUNDWATER ELEVATION CONTOURS FOR PRIMARY AQUIFER IN BUTTE COUNTY SUBBASINS

Contouring Wells*

- Greater than 5 ft decline
- Between 2 and 5 ft decline
- Less than 2 ft decline/increase
- Between 2 and 5 ft increase
- Greater than 5 ft increase

Contour Lines

- Spring 2023 Water Surface Elevation Contour (feet above mean sea level)

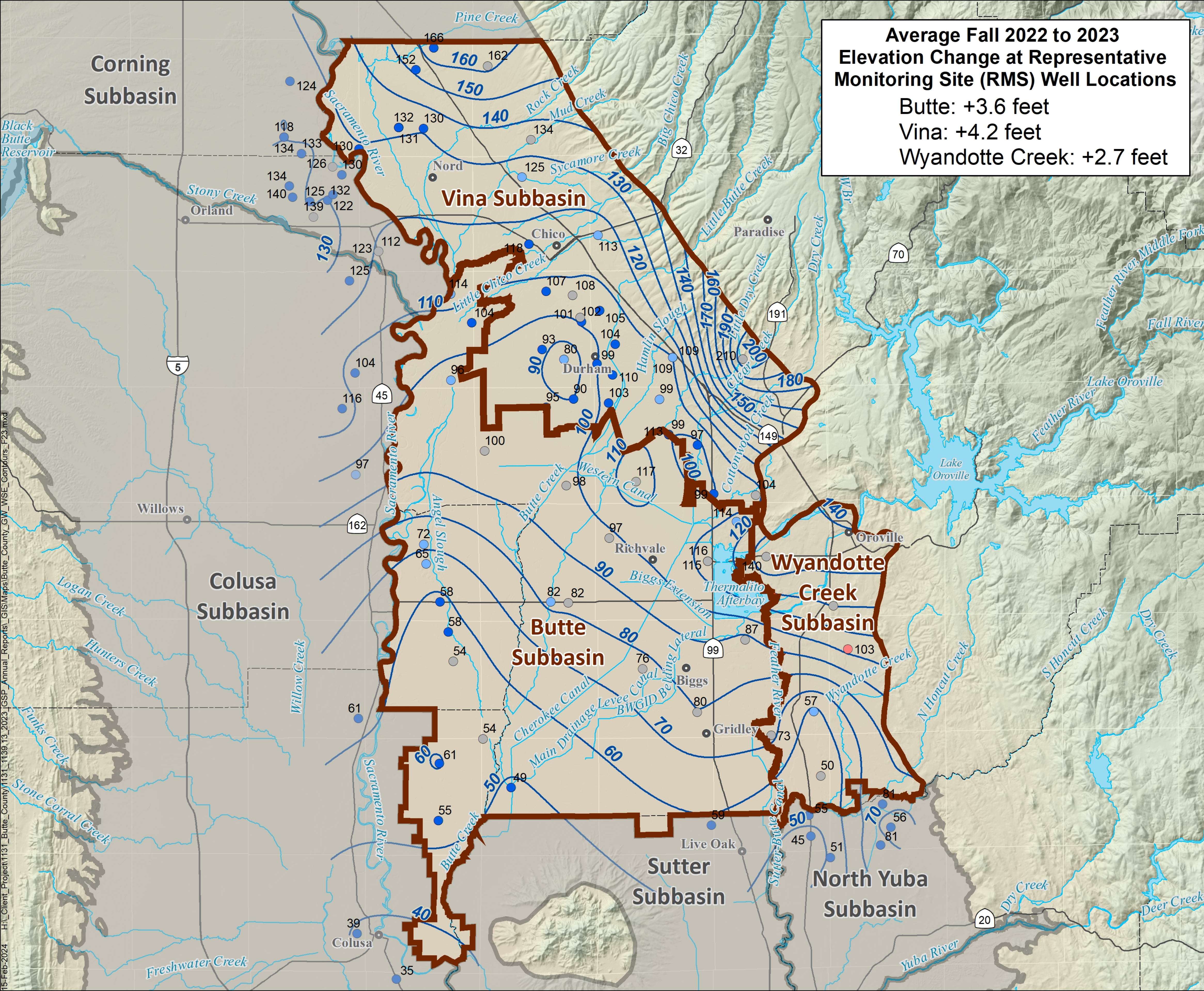
All Other Features

- Groundwater Well
- Cities and Towns
- Highway
- Butte, Vina, and Wyandotte Creek Subbasins
- Neighboring Subbasin

*Note: Elevation shown for contouring wells is in feet above mean sea level and changes are relative to the same period of the prior year.

0 4 8
Miles

N



FALL 2023 GROUNDWATER ELEVATION CONTOURS FOR PRIMARY AQUIFER IN BUTTE COUNTY SUBBASINS

Contouring Wells*

- Greater than 5 ft decline
- Between 2 and 5 ft decline
- Less than 2 ft decline/increase
- Between 2 and 5 ft increase
- Greater than 5 ft increase

Contour Lines

- Fall 2023 Water Surface Elevation Contour (feet above mean sea level)

All Other Features

- Groundwater Well
- Cities and Towns
- Highway
- Butte, Vina, and Wyandotte Creek Subbasins
- Neighboring Subbasin

*Note: Elevation shown for contouring wells is in feet above mean sea level and changes are relative to the same period of the prior year.

0 4 8
Miles

N

Water Year 2023 Annual Report

Appendix B

Explanation of Sustainable Management Criteria

Appendix B: Explanation of Sustainable Management Criteria

The Sustainable Groundwater Management Act (SGMA) requires a Groundwater Sustainability Plan (GSP) to define Sustainable Management Criteria (SMC) for the groundwater subbasin. The SMC offer guideposts and guardrails for groundwater managers seeking to achieve sustainable groundwater management. SGMA defines sustainable groundwater management as "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results," where the planning and implementation horizon is 50 years with the first 20 years spent working toward achieving sustainable groundwater management and the following 30 years (and beyond) spent maintaining it (California Water Code §10721).

"Undesirable Results" are associated with up to six Sustainability Indicators (SI), including groundwater levels, groundwater storage, water quality, seawater intrusion, land subsidence, and interconnected surface water. SGMA defines undesirable results as those having significant and unreasonable negative impacts. Failure to avoid undesirable results on the part of the GSAs may lead to intervention by the State. Once the sustainability goal and undesirable results have been locally identified, projects and management actions are formulated to achieve the sustainability goal and avoid undesirable results.

SI and associated undesirable results, if significant and unreasonable

The associated undesirable results for each SI have been defined similarly across the Butte Subbasin. In turn, the rationale and approach for determining Minimum Thresholds and Measurable Objectives for each SI are the same across the Butte Subbasin.

The terminology for describing SMC is defined as follows:

Undesirable Results – Significant and unreasonable negative impacts associated with each SI.

Minimum Threshold (MT) – Quantitative threshold for each SI used to define the point at which undesirable results may begin to occur.

Measurable Objective (MO) – Quantitative target that establishes a point above the MT that allows for a range of active management to prevent undesirable results.

Margin of Operational Flexibility – The range of active management between the MT and the MO.

Interim Milestones (IMs) – Targets set in increments of five years over the implementation period of the GSP offering a path to sustainability.

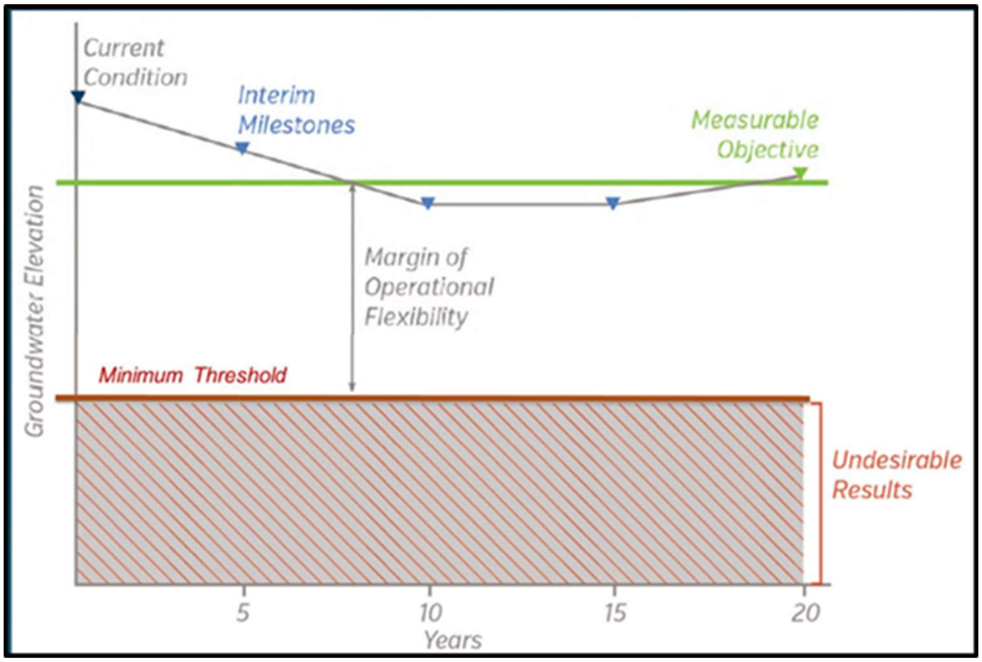


Illustration of Terms Used for Describing Sustainable Management Criteria Using the Groundwater Level SI

The Figure above illustrates these terms for the groundwater level SI.

SI are intended to be measured and compared against quantifiable SMC throughout a monitoring framework of Representative Monitoring Site (RMS) wells. Ongoing monitoring of SI can:

Determine compliance with the adopted GSP

Offer a means to evaluate the effectiveness of projects and management actions over time

Allow for course correction and adaptation in five-year updates

Facilitate understanding among diverse stakeholders

Support decision-making on the part of the GSAs into the future

The SMC for the Vina Subbasin is fully explained and defined in Section 3 of the GSP available

here:https://sgma.water.ca.gov/portal/gsp/preview/86

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Appendix C

GSP Annual Reporting Elements Guide

Groundwater Sustainability Plan Annual Report Elements Guide

Basin Name	Vina Subbasin		
GSP Local ID			
California Code of Regulations - GSP Regulation Sections	***Groundwater Sustainability Plan Elements***	**Document *page number(s) that address the applicable GSP element.***	***Notes: Briefly describe the GSP element does not apply.***
Article 5	**Plan Contents**		
Subarticle 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.	34-36; 84-99	
	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.	5-15	
	(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.	18-19	
	(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.	43-62	
	(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.	20-22;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.	23;24	
	(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.	24	
	(5) Change in groundwater in storage shall include the following:		
	(A) Change in groundwater in storage maps for each principal aquifer in the basin.	29	
	(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.	26	
	(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.	30-41	

Water Year 2023 Annual Report

Appendix D

DWR Upload Tables

A. Groundwater Extractions

Total Groundwater Extractions (AF)	Water Use Sector Urban (AF)	Water Use Sector Industrial (AF)	Water Use Sector Agricultural (AF)	Water Use Sector Managed Wetlands (AF)	Water Use Sector Managed Recharge (AF)	Water Use Sector Native Vegetation (AF)	Water Use Sector Other (AF)	Water Use Sector Other Description
242,000	21,900	0	218,600	0	0	0	1,500	Rural Residential

B. Groundwater Extraction Methods

Meters Volume (AF)	Meters Description	Meters Type	Meters Accuracy (%)	Meters Accuracy Description	Electrical Records Volume (AF)	Electrical Records Description	Electrical Records Type	Electrical Records Accuracy (%)	Electrical Records Accuracy Description	Land Use Volume (AF)	Land Use Description	Land Use Type	Land Use Accuracy (%)	Land Use Accuracy Description	Groundwater Model Volume (AF)	Groundwater Model Description	Groundwater Model Type	Groundwater Model Accuracy (%)	Groundwater Model Accuracy Description	Other Method(s) Volume (AF)	Other Method(s) Description	Other Method(s) Type	Other Method(s) Accuracy (%)	Other Method(s) Accuracy Description
21,900	Metered Municipal Wells	Direct	5-10 %	Metered connection maintained by California Water Service and Durham Irrigation District.	0					218,600	Land use estimates were derived from crop mapping and CropScape survey results	Estimate	20-30 %	Typical uncertainty for water balance calculation	0					1,500	Rural residential groundwater extraction is estimated based on California Water Service Company's 2020 Urban Water Management Plan 2020 usage of an average per capita water use of 181 gallons per capita per day. Population data from the 2020 census was coupled with parcel data to identify total population not serviced by municipal supplies	Estimate	10-20 %	Uncertainties are from population estimates and gallon per capita per day estimates

C. Surface Water Supply

Total Surface Water Supply (AF)	Methods Used To Determine	Water Source Type Central Valley Project (AF)	Water Source Type State Water Project (AF)	Water Source Type Colorado River Project (AF)	Water Source Type Local Supplies (AF)	Water Source Type Local Imported Supplies (AF)	Water Source Type Recycled Water (AF)	Water Source Type Desalination (AF)	Water Source Type Other (AF)	Water Source Type Other Description
27,200	Diversions for local supplies are estimated based on historic State Water Resource Control Board eWRIMS (Electronic Water Rights Information Management System) data for total diversions. Surface water delivery estimates are based on historic deliveries in the area that have occurred in dry and critical years	0	0	0	27,200	0	0	0	0	

D. Total Water Use

Total Water Use (AF)	Methods Used To Determine	Water Source Type Groundwater (AF)	Water Source Type Surface Water (AF)	Water Source Type Recycled Water (AF)	Water Source Type Reused Water (AF)	Water Source Type Other (AF)	Water Source Type Other Description	Water Use Sector Urban (AF)	Water Use Sector Industrial (AF)	Water Use Sector Agricultural (AF)	Water Use Sector Managed Wetlands (AF)	Water Use Sector Managed Recharge (AF)	Water Use Sector Native Vegetation (AF)	Water Use Sector Other (AF)	Water Use Sector Other Description
269,200	Methods used are a combination of estimates based on land use and population/ per capita water use, metered municipal water use, and estimates based on historic water rights data for dry and critical years	242,000	27,200	0	0	0		21,900	0	245,800	0	0	-	1,500	Rural Residential

Water Year 2023 Annual Report

Appendix E

Water Use Analysis Methodology

Water Year 2023 Annual Report

WY 2021

Water Use Analysis Methodology

TECHNICAL MEMORANDUM

DATE: February 16, 2024 Project No. 23-118

TO: Eddy Teasdale, PG/CHG

FROM: Cab Esposito, GIT

SUBJECT: Butte County Groundwater Estimate Methodology WY 2021

BACKGROUND

In Spring 2022, Luhdorff & Scalmanini Consulting Engineers (LSCE) was contracted by the Butte County Department of Water and Resource Conservation to assess drought impacts in Butte County. As part of this work, groundwater pumping was estimated for Butte County. These groundwater pumping estimates were utilized in the Sustainable Groundwater Management Act (SGMA) reporting for Water Year (WY) 2021. This memo is an abridged description of the methodology developed in the Drought Impact Analysis Study (LSCE, 2022).

AGRICULTURAL WATER DEMAND

Agricultural groundwater use was estimated using a simplified water balance approach which incorporates reference evapotranspiration (ET), land use, precipitation, and surface water supplies. The water balance is conducted on a monthly time-step. Surface water supplies and pumping are aggregated based on Water Balance Subregions (WBS) and are based on the Butte Basin Groundwater Model (BBGM; BCDWRC, 2021). Soil moisture is assumed to have no carry-over from month to month. Recharge based on applied water was not estimated.

Reference ET was taken from the California Irrigation Management Information System (CIMIS) Durham Station. Land use was from Land IQ 2018 (DWR, 2021) land use survey. Land use was updated by estimating fallowed rice fields based on remotely sensed data. It was assumed that the remaining irrigated land uses did not change from 2018 to 2021. Butte County-specific crop coefficients and irrigation efficiencies were taken from the BBGM. Precipitation data was utilized from the Parameter-Elevation Relationships on Independent Slopes Model (PRISM) 4-km monthly data.

To account for differences in acreages, precipitation, reference ET, and other factors accounted for in the calibration of the BBGM, a linear adjustment was made to the total monthly water demand per WBS in the simplified water balance to better reflect estimates in the BBGM.

Surface water deliveries for WY 2019 and WY 2020 were done through Water Year Type (WYT) estimation. The Sacramento Valley WYT for WY 2019 was “Wet”, and an average monthly delivery from WY 2006, 2011, and 2017 was used. The Sacramento Valley WYT for WY 2020 was “Dry,” and an average of monthly delivery from WY 2007, 2009, and 2013 was used.

Water deliveries in WY 2021 are taken from multiple sources. For the Western Canal Water District, Richvale Irrigation District, Biggs-West Gridley Water District, and Butte Water District, deliveries were estimated based on publicly available surface water (SW) diversions information. These diversions are available from requirements outlined in Senate Bill (SB) 88, which requires all water rights holders who have previously or intend to divert in excess of 10 ac-ft per year to measure and report the water they divert. Other areas in the BBGM area did not report SW diversions; these include areas outside of irrigation districts in the Butte Subbasin, Reclamation District 1004, the Vina Subbasin, and the Wyandotte Creek Subbasin. Diversions in these areas were estimated based on a review of riparian water diversion from 2018-2020, total appropriative water rights in the region, and a review of diversion inputs in the BBGM. Diversion estimates from the above steps were then scaled to match diminished diversion in the Sacramento Valley.

DOMESTIC AND MUNICIPAL DEMAND – VALLEY FLOOR

Dispersed domestic, i.e., household, groundwater pumping in the Butte County valley floor was estimated using the number and type of residential parcels and baseline/2020 gallon per capita per day (GPCD) water use from Chico-Hamilton City District’s 2020 Urban Water Management Plan (California Water Services Company, Chico-Hamilton City District, 2020).

Valley floor parcels were selected if their centers are located inside the Central Valley Basin and outside service area boundaries from the Division of Drinking Water of the California Water Resources Control Board and the California Environmental Health Tracking Program. Residential parcels were selected from the valley floor parcels using the General Plan Zoning Codes FR – Foothills Residential, MDR – Medium Density Residential, MHDR – Medium-High Density Residential, RR – Rural Residential, and VLDR – Very Low Density Residential.

Valley residential and rural residential parcels were considered to have households of 2.57 persons on average, as determined by the US Census Bureau for Butte County. Very low-density residential parcels may contain up to 1 household per acre and were estimated to have household densities of 0.5 households per acre (1.29 persons per acre, when adjusted for persons per household). Medium-density residential parcels may contain up to 6 households per acre and were estimated to have populations of 15.42 persons per acre. Medium-high-density residential parcels may contain up to 20 households per acre and were estimated to have populations of 25.7 persons per acre.

Municipal groundwater pumping was solicited from all applicable local agencies.

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California Department of Water Resources (DWR). 2021. 2018 California Statewide Agricultural Land Use. gis.water.ca.gov/app/CADWRLandUseViewer/.

California Water Service Company (Cal Water-Chico). 2020. 2020 Urban Water Management Plan's (UWMP) 2020 Chico-Hamilton City District. Available at: https://www.calwater.com/docs/uwmp2020/CH_2020_UWMP_FINAL.pdf.

Luhdorff and Scalmanini Consulting Engineers (LSCE). 2022. Drought Impact Analysis Study. Available at: https://www.buttecounty.net/1240/Drought-Impact-Analysis-Study.

Water Year 2023 Annual Report

WY 2022-2023

Water Use Analysis Methodology

TECHNICAL MEMORANDUM

To: Luhdorff and Scalmanini Consulting Engineers

From: Davids Engineering, Inc.

Date: Friday, February 09, 2024

Subject: **DRAFT - Water Use Analysis Methodology**

1 Introduction

Pursuant to the Groundwater Sustainability Plan (GSP) regulations (23 CCR[1] Section 356.2), the GSP Annual Report for the Vina Subbasin (Subbasin) includes quantification of water supplies and water uses in the reporting year, including groundwater extraction by water use sector[2]. Water supplies and water uses in the Subbasin have been quantified based on the best available data sources and information, either collected from measured records or estimated where necessary.

While some groundwater extraction in the Subbasin is measured, most groundwater extraction is unmeasured, including extraction from privately owned wells. For the Vina Subbasin Annual Report (Annual Report), the approach used to estimate unmeasured groundwater extraction for the agricultural and managed wetlands water use sectors is referred to as the Groundwater Extraction Estimates from Earth Observations (GEEEO) process. In this approach, a spatial water use analysis is computed on a monthly basis using current land use data, climate conditions (e.g., precipitation and evapotranspiration), crop water demands, and other local information, allowing for estimation of total water use and estimated groundwater extraction, after accounting for the use of other available water supplies.

This approach differs from the water budget methodology used in GSP development, where the Butte Basin Groundwater Model (BBGM) was used to generate historical, current, and projected water budgets for the Subbasin. The shift toward the GEEEO process is due to the time and cost constraints associated with updating the GSP groundwater model annually. Despite this change, key inputs and results from the GEEEO process have been compared with those of the GSP groundwater model to ensure consistency in the water use analyses.

This technical memorandum (TM) describes the methodology and data sources used in the GEEEO process. Results of the GEEEO process are documented in the Annual Report.

[1] California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2. Groundwater Sustainability Plans.

[2] Water use sectors are identified in the GSP Regulations as "categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation" (23 CCR Section 351(al)).

2 GEEEO Process and Computational Approach

2.1 Computational Approach

The GEEEO process utilizes available geospatial data and information to quantify water use, including groundwater extraction volumes, spatially across the Subbasin:

1. First, geospatial evapotranspiration (ET) information at a pixel-scale is used to quantify the total consumptive water use and total applied water requirements during a given time period in a given area of the Subbasin, and geospatial land use information is used to help identify where irrigation water may have been applied (i.e., whether the area in question features irrigated agricultural land, versus idled land or undeveloped vegetation).
2. After quantifying total applied water requirements, available surface water supply and groundwater extraction data is incorporated into the GEEEO process by distributing that water out to specific regions where that water is applied (e.g., irrigated lands in surface water supplier service areas).
3. The remaining groundwater extraction needed to meet applied water demands is then calculated based on the difference between total applied water requirements and available water supply information, with consideration for effective precipitation.
4. Finally, the pixel-scale results can then be aggregated to the desired spatial or temporal domains of interest.

The result is a spatially distributed water use analysis calculated with a finer spatial resolution than was possible in the GSP water budgets. The pixel-scale water budget results provide greater insight into where water use occurs in the Subbasin and are configurable to create water use summaries for any region of the Subbasin. Additional details about the GEEEO computational approach are provided in Attachment A, generally following the process described in Hessels et al. (2022).

2.2 Spatial Resolution

GEEEO quantifies water use and groundwater extraction volumes with pixel-scale resolution (30 meters (m) x 30 m), corresponding to the spatial resolution of satellite imagery used in developing many of the GEEEO inputs. For those inputs that are not available at the 30 m x 30 m resolution, available data and information is distributed as averages over the area where that information is applicable (e.g., district-reported surface water deliveries are distributed as an average acre-feet per acre (AF/ac) over irrigated lands in that district's service area[3]). Additional information about the spatial resolution of specific data sources is provided in Section 3.

The fine spatial resolution of the GEEEO inputs and computations allows for highly configurable GEEEO results summaries. For the Annual Report, results are summarized by subregions that are defined to roughly correspond with the boundaries of the water budget regions in the GSP groundwater model, with distinction between water districts, managed wetlands and refuge areas, and out-of-district lands.

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[3] Future refinements to the GEEEO process could potentially incorporate field-scale surface water delivery records to improve spatial detail of results rather than equally distributing surface water deliveries across the irrigated lands within the district's service area.

2.3 Period and Timestep

For each Annual Report, the GEEEO process operates from 2016 through the current reporting year[4] on a monthly timestep, although only the results from the current reporting year are included in the Annual Report. The period and timestep are set according to data availability and reporting needs. However, the GEEEO process is configurable to operate on different timescales (e.g., daily or weekly). The start year is currently limited by the availability of geospatial ET information from OpenET, although further historical ET information is expected to be available in the near future.

3 Data Sources

The GEEEO process uses data sources and information that capture the unique, local conditions within the Subbasin to the extent available. Details about the data and information used in the GEEEO process are described below.

3.1 Evapotranspiration

ET, or consumptive water use, is the major driver of water use in the Subbasin, particularly agricultural use. In this context, consumptive water use is defined as "*the part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment*" (ASCE, 2016). Unlike surface runoff or infiltration of water into the groundwater system (through seepage, deep percolation, managed recharge, or other means), ET is water that cannot be recovered or directly reused in the Subbasin.

In the GEEEO process, ET is quantified from satellite-based remote sensing analyses available from OpenET. OpenET is a multi-agency web-based geospatial information system (GIS) utility that quantifies ET over time with a spatial resolution of 30 m x 30 m (approximately 0.22 acres). OpenET information is available in raster coverages of the Subbasin on both a daily and monthly timestep from 2016 through present.[5] The GEEEO process utilizes monthly rasters of the ensemble ET from OpenET to calculate total water use for the Annual Report.

While OpenET is a new utility, the underlying methodologies to quantify ET apply a variety of well-established modeling approaches that are widely used in government and research applications. The OpenET modeling approaches are also similar to the approaches used to quantify ET in the GSP groundwater model. Additional information about the OpenET team, data sources, and methodologies are available at: https://openetdata.org/.

3.2 Land Use

Areas in each water use sector in the Subbasin were identified using the most recent and reliable spatial land use data in the region, including:

1. Statewide crop mapping, available from the California Department of Water Resources (DWR) (DWR, 2024)

[4] Annual Reports are required to be submitted by April 1 each year following the adoption of the GSP. The current reporting year for each Annual Report is the preceding water year (i.e., October 1 through September 30)

[5] OpenET raster information is typically available within about one month after the period has ended.

2. CropScape Cropland Data Layer coverage, available from the United States Department of Agriculture (USDA, 2024).

Land use data from these sources were compiled into 30 m x 30 m raster coverages of the Subbasin. To prepare the GEEEO process inputs, DWR data, which includes extensive ground-truthing review of results, is preferentially used to identify agricultural land (including irrigated and non-irrigated lands) and urban areas, and then USDA data is utilized to back-fill gaps of non-irrigated, idled, and non-developed land in the Subbasin. Local refinements are also applied, as needed, to account for local land use information.

These land use data sources and applications were similar to those used in development of the GSP water budgets. Comparisons were made to evaluate the consistency of the datasets and with earlier land use analyses; good correspondence was found for the major land use classes found in the Subbasin.

DWR data is typically available in provisional form approximately two years after a given year has passed. USDA data is typically available for the prior year in early- to mid-February. When data for the current reporting year is not yet available, raster coverages of the Subbasin are generally assembled utilizing land use data from the most recent, hydrologically similar year (i.e., similar water supply conditions and similar cropping patterns, to the extent possible). Idling of annual and ponded crops in a given year may also be locally refined through comparison with USDA data for the current reporting year or through an analysis of vegetation coverage in the current reporting year. However, it is noted that land use data is only used in the GEEEO process to identify areas in each water use sector where water is applied. The total water use for lands in the agricultural and managed wetlands water use sectors are determined through an analysis of OpenET data, regardless of the precise land use classification.

3.3 Precipitation

Spatial precipitation estimates were extracted from the Parameter-elevation Regressions on Independent Slopes Model (PRISM), developed by the PRISM Climate Group at Oregon State University. PRISM quantifies spatial precipitation estimates, among other climate parameters, based on available weather station data and modeled spatial relationships with topography and other factors influencing weather and climate.

PRISM data is available in raster coverages of the Subbasin on both a daily and monthly timestep, with a spatial resolution of 4 kilometer (km) x 4 km. The GEEEO process utilizes monthly rasters for the Annual Report analysis, and the precipitation results for each 4 km pixel are applied to each of the 30 m pixels within it (i.e., downscaled) for which ET and land use data are available. Additional information about the PRISM data and methodologies are available at: https://prism.oregonstate.edu. PRISM precipitation data is consistent with the historical precipitation inputs to the GSP groundwater model.

PRISM precipitation data along with rooting estimated mean rooting depths from the rooting depth ranges listed in Appendix B of ASCE 70 (2016) is used to create pixel-level estimates of effective precipitation (ETPR). For crops not listed in ASCE 70, rooting depths are based on rooting depths of similar crops and professional judgement. ETPR is computed using the National Engineering Handbook Part 623 method (USDA, 1993).

3.4 Local Water Supply Data

As described in Section 2, available surface water supply and groundwater extraction data is incorporated into the GEEEO process to quantify the amount of known water supply available, prior to estimating the remaining groundwater extraction needed to meet demand. Water supply data is distributed as averages over the area where that information is applicable (e.g., average AF/ac over lands where that water is available for use).

Surface water supply and groundwater extraction data are collected from both publicly available and local sources. Information gathered may include, where applicable:

1. Water supply contract delivery records, from the United States Bureau of Reclamation (USBR), State Water Project (SWP), or other publicly available sources as applicable.
2. Water rights diversions records, from the State Water Resources Control Board (SWRCB) through the Electronic Water Rights Information Management System (eWRIMS)
3. Data requests to local water agencies and water users, requesting surface water diversions, surface water deliveries, surface water outflows, groundwater pumping records, or other available water use data.

In cases where current surface water data is not available, general information on surface water inflows and outflows may be gathered from other local sources as available (e.g., Agricultural Water Management Plan water budgets). More information about surface water data sources is described in the Annual Report.

While groundwater extraction data is not available in many parts of the Subbasin, local data is requested each year so that new data can be incorporated into the GEEEO process as it becomes available. It is noted that while groundwater extraction for municipal water supply systems is generally reported for urban areas in the Annual Report based on SWRCB and locally provided data, groundwater extraction for municipal areas is not directly included in the GEEEO process due to underlying differences in how the majority of water is used in urban areas. This also applies to estimates of rural residential groundwater use (e.g., domestic water use pumped through private domestic wells) outside of urban areas. The data sources and approaches used to quantify municipal and rural residential groundwater extraction are described in the Annual Report.

3.5 Other Agronomic Data

Other agronomic and climate-related data that is incorporated into the GEEEO process includes:

1. Representative consumptive use fractions for crops (i.e., fraction of total applied water that is consumed through ET). Values are based on typical irrigation methods and efficiencies for crops.
2. Conveyance system fractions for subregions (i.e., fraction of diverted water that is delivered, accounting for losses).
3. Reuse fractions for subregions (i.e., fraction of delivered water that is reused).

Information gathered from local sources is used where available, otherwise representative values for agronomic practices in the region are used.

4 References

American Society of Civil Engineers (ASCE). 2016. ASCE Manuals and Reports on Engineering Practice No. 70, Evaporation, Evapotranspiration, and Irrigation Water Requirements (Second Edition).

California Department of Water Resources (DWR). 2024. Provisional 2022 Statewide Crop Mapping GIS Data, Updated January 2024. Available at: https://data.cnra.ca.gov/dataset/statewide-crop-mapping.

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United States Department of Agriculture (USDA). 1993. National Engineering Handbook. Chapter 2, part 623, Irrigation water requirements. Washington, D.C.: U.S. Dept. Of Agriculture, Soil Conservation Service.

Attachment A. GEEEO Computational Approach Details

Figures A-1 and A-2, below, present a schematic of the GEEEO computational approach as it has been developed and is being generally applied to support Annual Report Development.

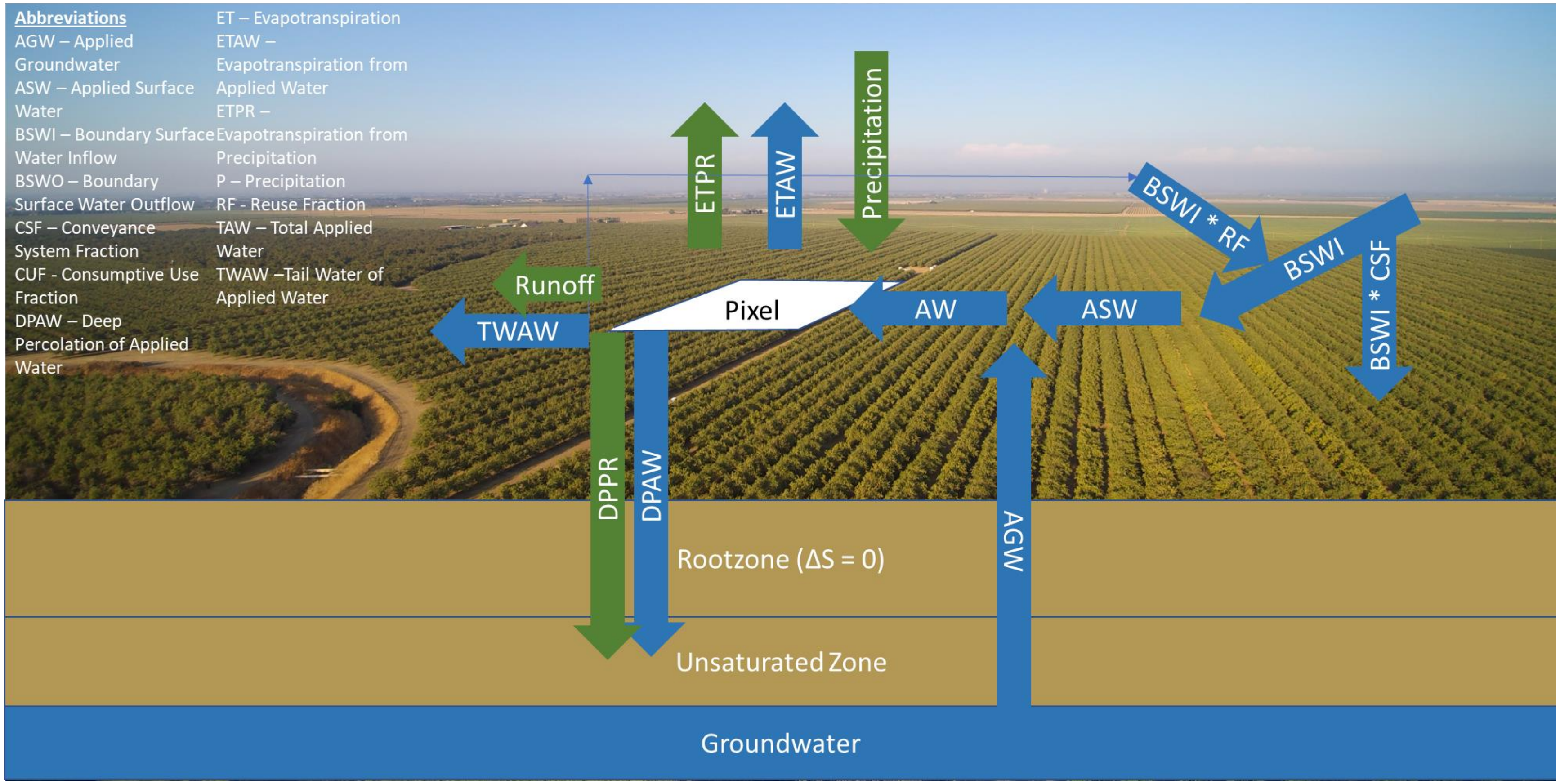

Figure A-1. Inflows and Outflows to Each 30 m x 30 m Pixel in the GEEEO Process.

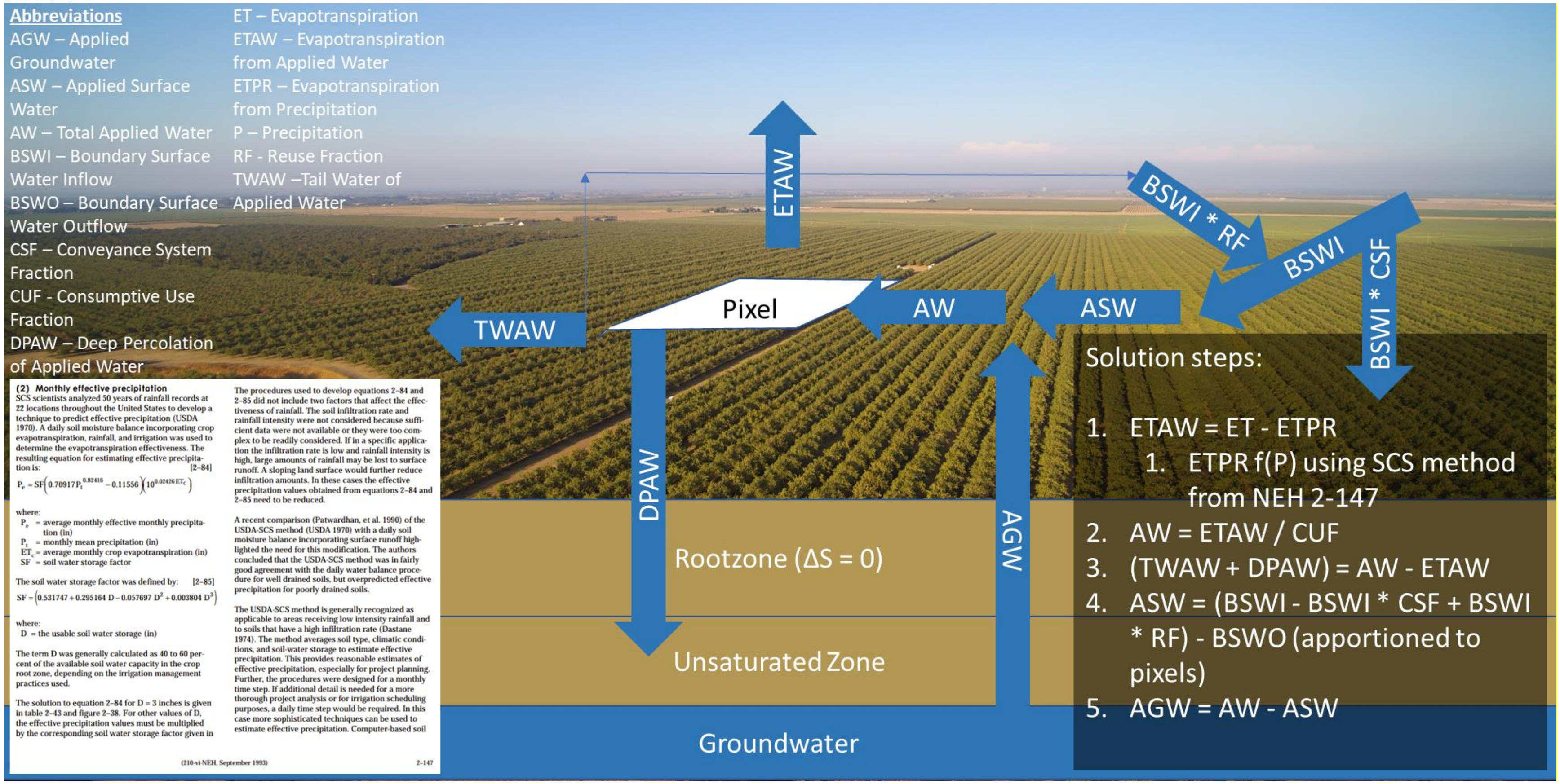

Figure A-2. Solution Steps for Calculating Applied Groundwater (AGW) in Each 30 m x 30 m Pixel in the GEEEO Process.

Water Year 2023 Annual Report

Appendix F

Water Quality

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TECHNICAL MEMORADUM

Groundwater Quality Monitoring Update for 2022 and 2023

Prepared by: Kelly Peterson, Water Resources Scientist, Department of Water and Resource Conservation

Purpose

The purpose of this memo is to summarize the groundwater quality conditions for salinity, measured as electrical conductivity (EC) in the Butte, Vina and Wyandotte Creek Subbasins during the first two years (2022 and 2023) of GSP related groundwater quality monitoring that occurred.

Background

The Sustainable Groundwater Management Act (SGMA) of 2014 required Groundwater Sustainability Agencies (GSAs) to develop, then submit, and implement long-term Groundwater Sustainability Plans (GSPs) to the California Department of Water Resources (DWR) in 2022. The Butte, Vina and Wyandotte Creek Subbasin GSPs include plans to monitor EC to avoid groundwater quality degradation (Davids, 2021; Geosyntec Consultants, Inc., 2021a; Geosyntec Consultants, Inc., 2021b).

Salinity is the main constituent of concern in all three Subbasins and is measured as EC as a basic groundwater quality characteristic to evaluate a basin for evidence of saline intrusion. Groundwater quality monitoring serves to establish baseline levels for these parameters throughout the Subbasins so that any future changes may be identified and further investigation and / or monitoring can subsequently be developed. Groundwater quality monitoring for implementation of the GSPs began in 2022, spearheaded by staff from the Butte County Water and Resource Conservation Department (Department) with assistance from various volunteers and GSA Managers for the fieldwork portion of the monitoring. The focus of the monitoring is targeting deep wells within each Subbasin to track the migration of connate water upwelling from deep portions of the aquifer.

Methodology

In 2021, the Department purchased a Solinst 107 EC meter which includes a probe that measures EC, temperature and water level (similar to an electric sounder) on a 1,000-foot-long laser-marked flat tape with markings every $1/100^{th}$ ft. This meter was purchased to conduct EC monitoring at various depths within wells in the monitoring network and was used in 2022 and 2023, the first two years of GSP related groundwater quality monitoring. The meter was calibrated at the beginning of each day with known standard solutions according to the manufacturer's specifications. At each site the probe was lowered to the water surface and a depth to water measurement was recorded. It was then lowered to the midpoint of each screened interval(s) within the well to record the EC of the water entering the well from that portion of the aquifer. The Solinst EC meter was only used in wells that did not have any pumping equipment within them i.e. multi-completion observation wells, in order to avoid damage to the equipment through entanglement in the wiring or pump.

For most of the remaining wells in the monitoring network with pumps, a Hach brand portable water quality meter with a conductivity probe was used to measure a water sample after the well was purged of standing water by pumping for at least 20 minutes. One exception, well 19N01W28A001M in the Glenn County portion of the Butte Subbasin, measured by Glenn County staff, was purged and pumped for less than 20 minutes.

Electrical conductivity measurements are taken at each RMS well once per year. The wells are typically measured within the month of August during the peak of the irrigation season.

The GSAs developed these new groundwater quality monitoring Representative Monitoring Site (RMS) networks to include wells distributed spatially throughout the Subbasins with a focus on including wells screened deep enough to capture changes in EC in the deeper portions of the aquifer where any changes in EC would be expected to be detected first. While there are shallow RMS wells within some of the networks, as part of future GSP implementation, GSAs may consider modifications to the groundwater quality RMS network as needed.

The Butte, Vina and Wyandotte Creek Subbasins groundwater quality monitoring networks are comprised of the individual groundwater quality monitoring RMS wells as described in each of the Subbasin's GSPs. Each Subbasin has a monitoring network of eight RMS wells; however, modifications to the Wyandotte Creek Subbasin's RMS network have been made since adoption of the GSP due to the inaccessibility of specific wells and the subsequent addition of sites described in more detail below. In 2023 the overall revised monitoring network included the eight original sites in both the Vina and Butte Subbasins as well as seven sites in the Wyandotte Creek subbasin for a total of 23 sites. Some of the water quality monitoring sites do have historic intermittent EC data, however most sites do not. A map of each Subbasin and the network of groundwater quality RMS sites is shown in **Figure 1.**

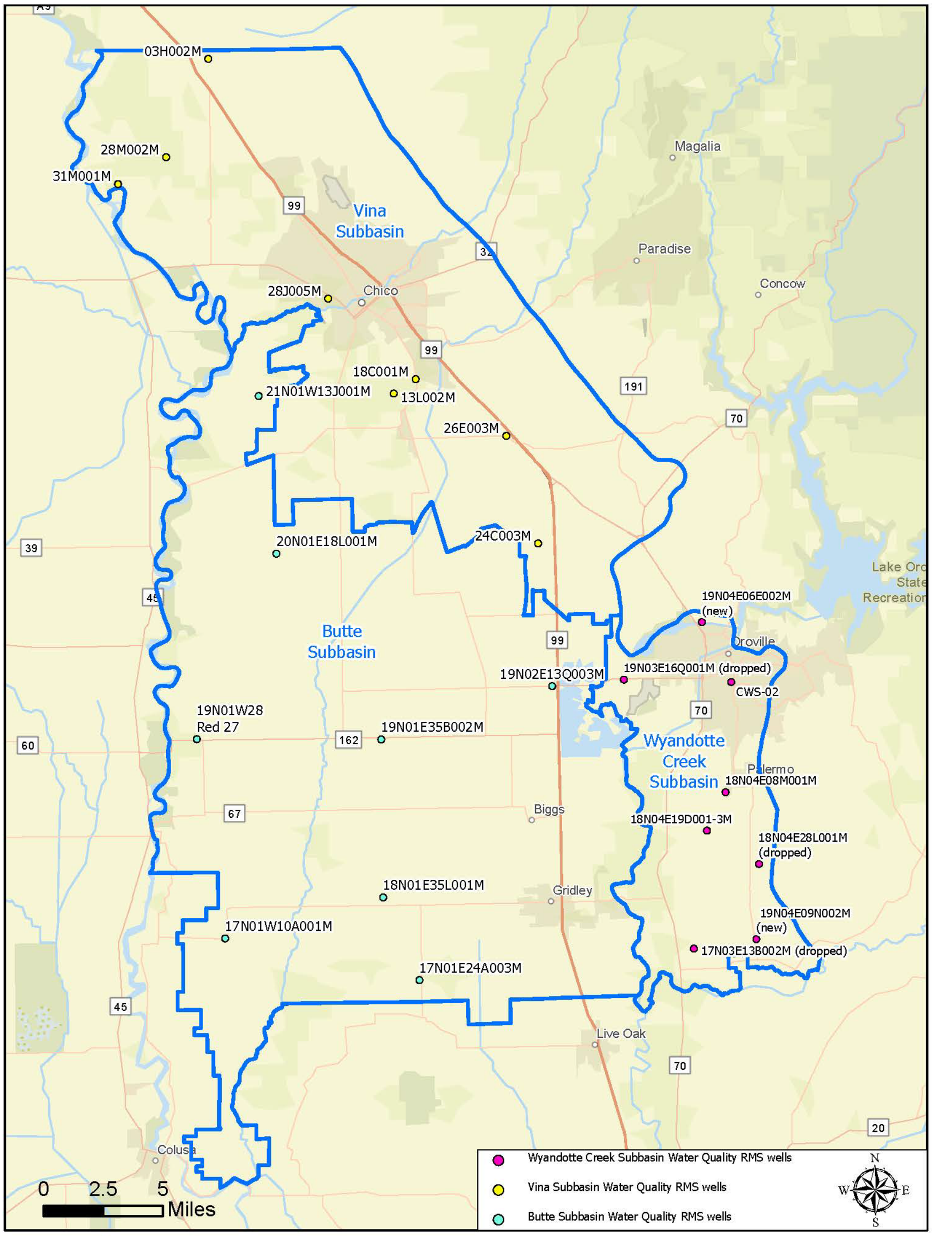

Figure 1. Groundwater Quality Representative Monitoring Site well locations in the Vina, Butte and Wyandotte Creek Subbasins

Modifications to the Wyandotte Creek Subbasins RMS network include removal of three original RMS wells and the addition of two wells. RMS well 13B002M was removed in 2022 due to an inoperative pump preventing access to a water sample. Two RMS wells were removed from the network per the request of the landowners, 28L001M in 2022 and 16Q001M in 2023. Efforts were made to identify other wells which could be used as alternatives in the Wyandotte Creek Subbasin. Two additional sites were identified and added to the monitoring network; 06E002M in 2022 and 09N002M in 2023. Well 06E002M has been monitored annually since 2002 as part of previous Butte County Basin Management

Objective (BMO) program groundwater quality monitoring effort sand 09N002M is a RMS well for groundwater level monitoring but a new groundwater quality monitoring well.

The RMS well details including well type, what equipment is used to monitor it, total well depth and depth of the screened zones(s) in each well are provided in **Table 1.** The RMS wells within the Butte Subbasin are predominantly multi-completion wells with the exception of 18N01E35L001M, a single observation well and 19N01W28A001M, a shallow irrigation well. Three of the RMS wells in the Butte Subbasin 18N01E35L001M, 19N01E35B002M and 20N01E18L001M are also extensometer sites which continuously monitor land subsidence. The RMS wells within the Vina Subbasin are all multi-completion wells (multiple wells at a single location screened at different depths below the ground surface) and the deepest of those wells at each location is selected for measurements. In the Wyandotte Creek subbasin, there are variety of well use types in the monitoring network including residential, irrigation, municipal and observation wells.

Sustainable Management Criteria

Groundwater quality monitoring measures EC levels in the Representative Monitoring Site (RMS) wells in comparison to the Measurable Objective (MO) and Minimum Threshold (MT) set for each RMS well in the GSPs as a way to gauge whether undesirable results are occurring in the subbasin. In each Subbasin's GSP, MTs were established to be protective of water uses and users. When considering MTs, it is important to note that in the case of groundwater levels, exceedance of a MT is caused by groundwater levels dropping below the threshold. However, for groundwater quality, exceedance of a MT is counterintuitively caused by measuring levels higher than the threshold. The MT for groundwater quality is a highest allowable value, rather than lowest. **Table 2**. identifies the MOs, MTs, and definition of Undesirable Results for each Subbasin.

As shown in **Table 2.** in the Butte Subbasin the preliminary MO for each RMS well for EC is set at 700 µs/cm for agricultural use, consistent with the Butte County Basin Management Objective (BMO) program, the previous 19-year long Butte County-wide groundwater quality monitoring effort. The MTs at the RMS wells are set as either the higher of 900 µs/cm or the measured historical high, whichever was greater. This MT was set based on best available data, the 19-year dataset of the Butte County BMO program, and maximum contamination levels established by the State. The occurrence of an Undesirable Result occurs in the Butte Subbasin if 25% of RMS wells exceed their MTs for 24 consecutive months.

In the Vina and Wyandotte Creek Subbasins the groundwater quality Sustainable Management Criteria (SMC) are established to address degraded groundwater quality caused by groundwater pumping where the potential exists for movement of underlying brackish water from greater depths into the freshwater pool where groundwater pumping for beneficial uses occurs. In these two subbasins, the MOs for salinity are set at 900 µs/cm and the MTs are 1,600 µs/cm, which is the upper limit of the Secondary Maximum Contaminant Level (SMCL) based on State Secondary Drinking Water Standards. Values exceeding this number are typically unacceptable for drinking water.

Table 1. Groundwater Quality Representative Monitoring Site Information

Subbasin	Representative Monitoring Site ID	Well Type	Monitoring Equipment	Total Well Depth (feet)	Depth of Screened Zone(s) (feet)
Butte	19N02E13Q003M	Observation*	Solinst 107	690	670 - 680
	17N01W10A001M	Observation*	Solinst 107	820	770 – 780, 790 - 800
	21N01W13J001M	Observation*	Solinst 107	830	780 - 820
	17N01E24A003M	Observation*	Solinst 107	833	770 - 790
	18N01E35L001M	Observation	Solinst 107	899	816 - 836
	19N01E35B002M	Observation*	Solinst 107	980	930 - 950
	20N01E18L001M	Observation	Solinst 107	1,000	767 – 810, 873 - 894
	19N01W28A001M	Irrigation	Hach Sension156	140	120 - 140
Vina	03H002M	Observation*	Solinst 107	553	510 - 540
	28M002M	Observation*	Solinst 107	1,031	791 – 801, 881 – 891, 951 – 961, 1011 - 1021
	31M001M	Observation*	Solinst 107	1,055	969 - 979
	28J005M	Observation*	Solinst 107	948	740 - 800
	18C001M	Observation*	Solinst 107	900	770 – 780, 800 – 810 830 – 840, 870 - 880
	13L002M	Observation*	Solinst 107	771	735 - 760
	26E003M	Observation*	Solinst 107	640	610 - 620
	24C003M	Observation*	Solinst 107	520	484 - 505
Wyandotte Creek	CWS-02	Municipal	Hach HQd	120	60 – 190, 300 - 322
	13B002M [1]	Irrigation	n/a	320	120 - 320
	08M001M	Irrigation	Solinst 107	656	168 – 204, 208 - 244
	19D001M	Observation*	Solinst 107	1,000	700 - 720
	19D002M	Observation*	Solinst 107	1,000	430 – 450, 550 - 570
	19D003M	Observation*	Solinst 107	1,000	120 - 130
	28L001M [1]	Irrigation	n/a	190	n/a
	16Q001M[2]	Residential	Hach HQd	120	100 - 120
	19N04E06E002M[3]	Municipal	Hach HQd	196	110 – 130, 164 – 174
	19N04E09N002M[4]	Irrigation	Hach HQd	325	45 – 55

[1] Removed from network in 2022 [2] Removed from network in 2023 [3] Added to network in 2022 [4] Added to network in 2023 * Multi-completion well

Table 2. Measurable Objectives and Minimum Thresholds for Electrical Conductivity [microsiemens (µs) / centimeter (cm)] in each Subbasin

Subbasin	Measurable Objective	Minimum Thresholds	Undesirable Result
Butte	700 µS/cm	The greater of 900 µS/cm or the measured historical high	25% of RMS wells exceed MTs for 24 consecutive months
Vina	900 µS/cm	1,600 µS/cm	2 RMS wells exceed their MT for two consecutive non-dry years
Wyandotte Creek	900 µS/cm	1,600 µS/cm	2 RMS wells exceed their MT for two consecutive non-dry years

Secondary Drinking Water Standards are set on the basis of aesthetic concerns. The occurrence of an Undesirable Result within both the Vina and Wyandotte Creek Subbasins occurs if two RMS wells within each Subbasin exceeds their MTs for two consecutive non-dry years.

Results

In 2022, a dry water year type, and 2023, a non-dry water year type, the majority of all wells monitored within each Subbasin had groundwater quality conditions (measured as EC) that fell within the acceptable range of groundwater quality values set forth by the GSPs and described in **Table 2.** Additionally, there were no indications of Undesirable Results in either year.

Butte Subbasin

In the Butte Subbasin the majority of RMS wells measured had EC values that were lower than the MO of 700 µS/cm and therefore lower than their specific MTs in both years. The MTs vary per well since they are based on historic data, if available, as shown in **Figures 2 - 4.** Results from one RMS well 17N01W10A001M, located in Colusa County, had EC values higher than the well's MT in 2023. Historic (DWR, 2020, DWR 2023a) and recent data for this well are shown in **Figure 4**. This well is near the Sutter Buttes mountain range in an area known for high concentrations of EC (Davids, 2021). Future plans may include the formation of the Sutter Buttes Water Quality Interbasin Working Group as described in more detail in section 6.1.2.2 of the Butte Subbasin GSP (Davids, 2021) to focus on collaborative discussions, consensus building and planning to address groundwater quality matters associated with the unique geology of the Sutter Buttes area.

Results from RMS well 20N01E18L001M are not depicted in the 2022 or 2023 figures as there was an obstruction within the well each year preventing the equipment from reaching the proper depths at the mid-point of the screening interval to measure EC. As part of future GSP implementation, the GSAs will consider modifications to the groundwater quality RMS network.

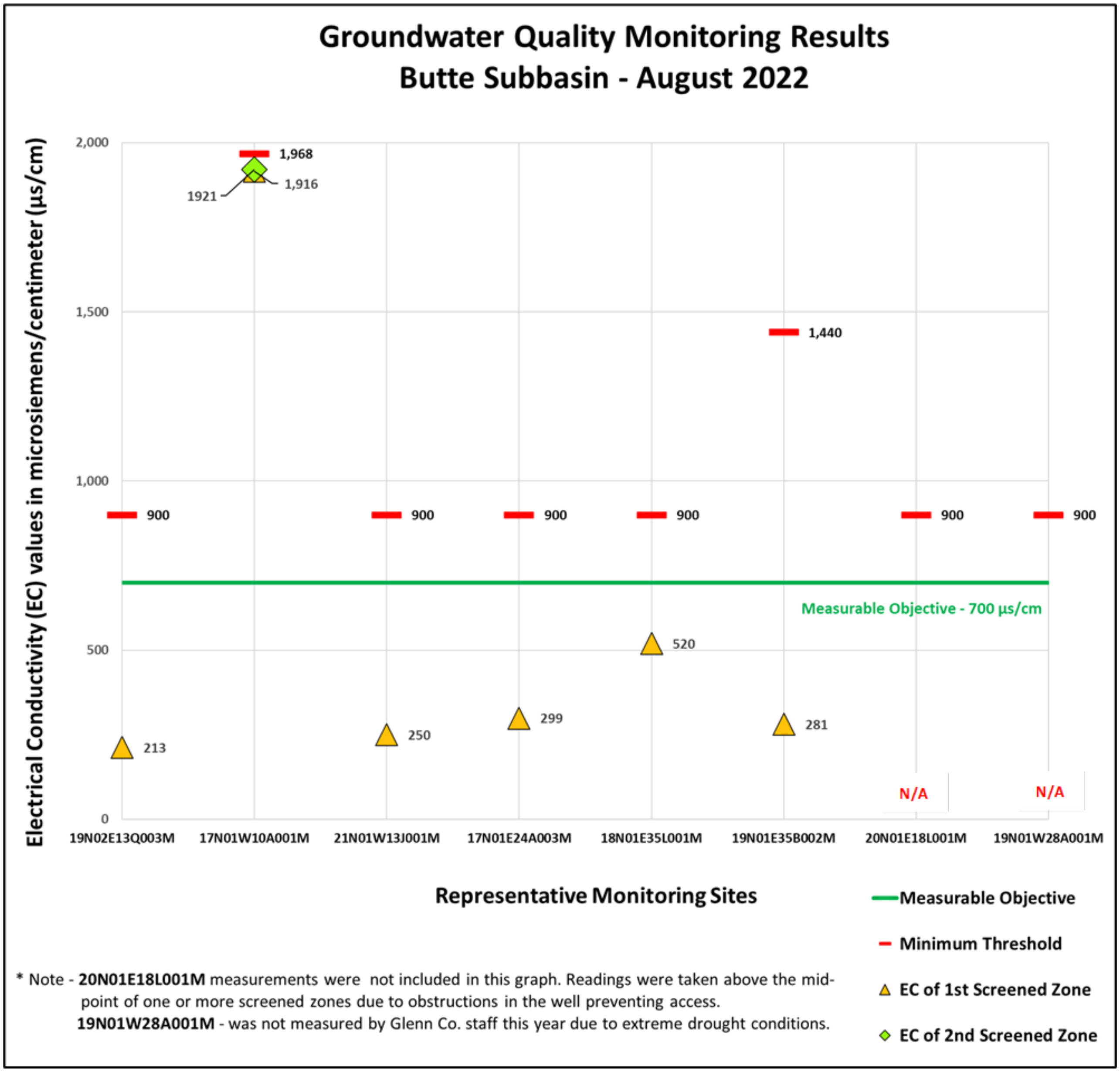

Figure 2. Groundwater quality monitoring results in the Butte Subbasin for the 2022 water year

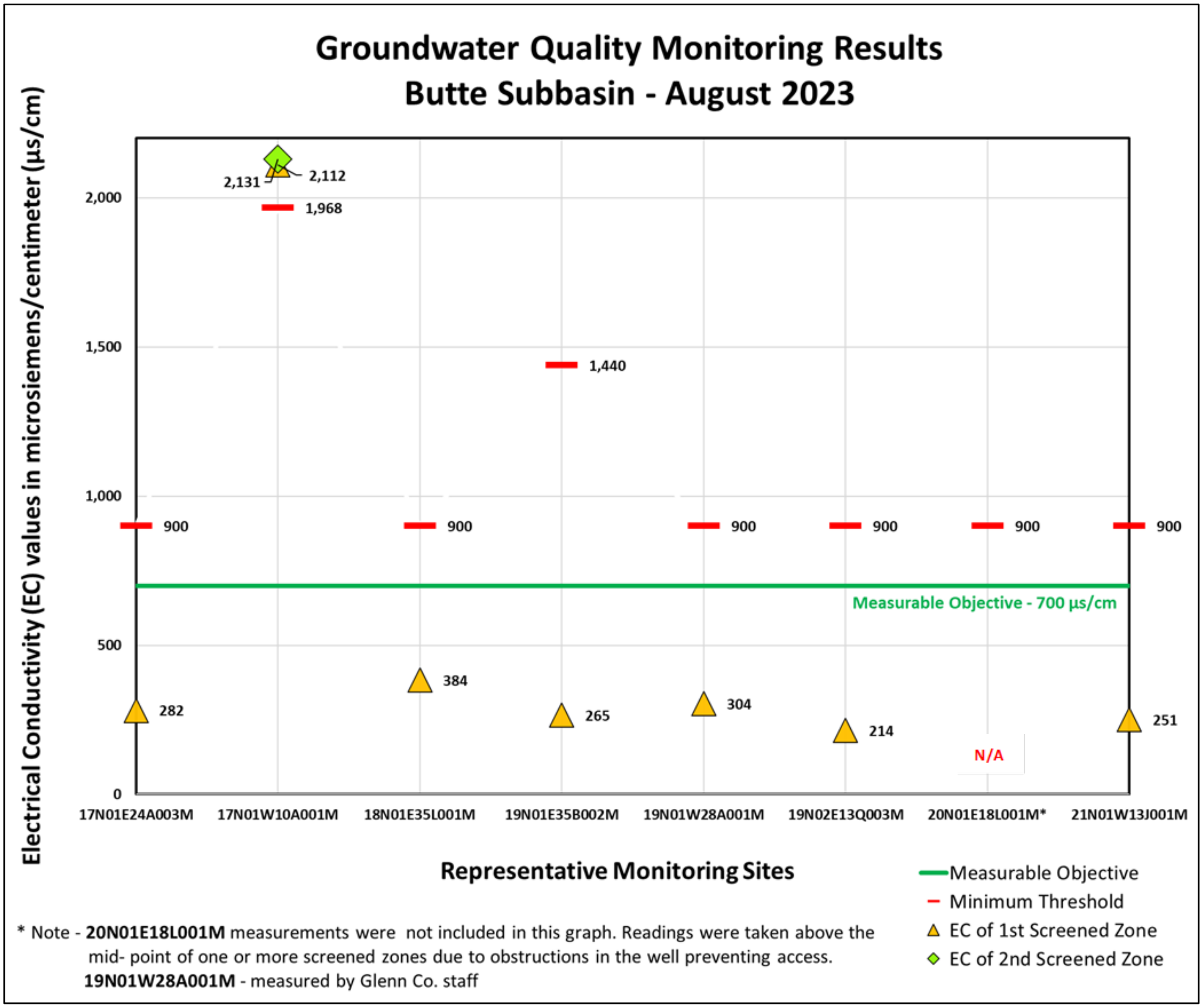

Figure 3. Groundwater quality monitoring results in the Butte Subbasin for the 2023 water year

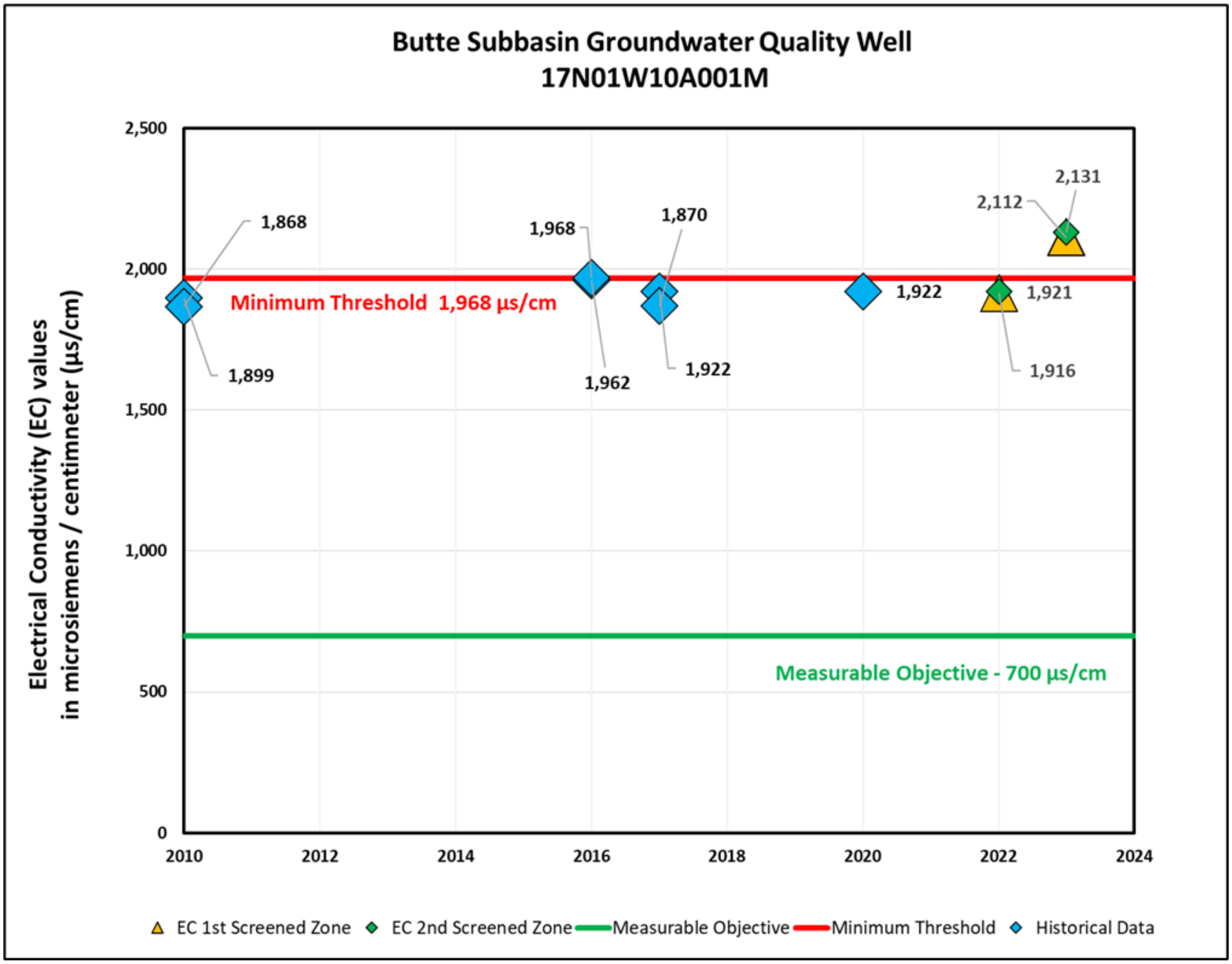

Figure 4. Groundwater quality data for well 17N01W10A001M in the Butte Subbasin

Vina Subbasin

In the Vina Subbasin all RMS wells measured had EC values that were lower than the MO of 900 µS/cm and therefore lower than the MT of 1,600 µS/cm in both years as shown in **Figures 5 and 6.** Results from RMS well 28J005 were not depicted in these figures as there was an obstruction within the well each year preventing the equipment from reaching the proper depths at the mid-point of the screening interval to measure EC. The probe could only be lowered to approximately 370' above the screened interval for this well.

Based on observations in the field it is possible that RMS well 28J005, developed in 1955 has filled in with materials due to a collapse of the walls above the screened interval of the well. As part of future

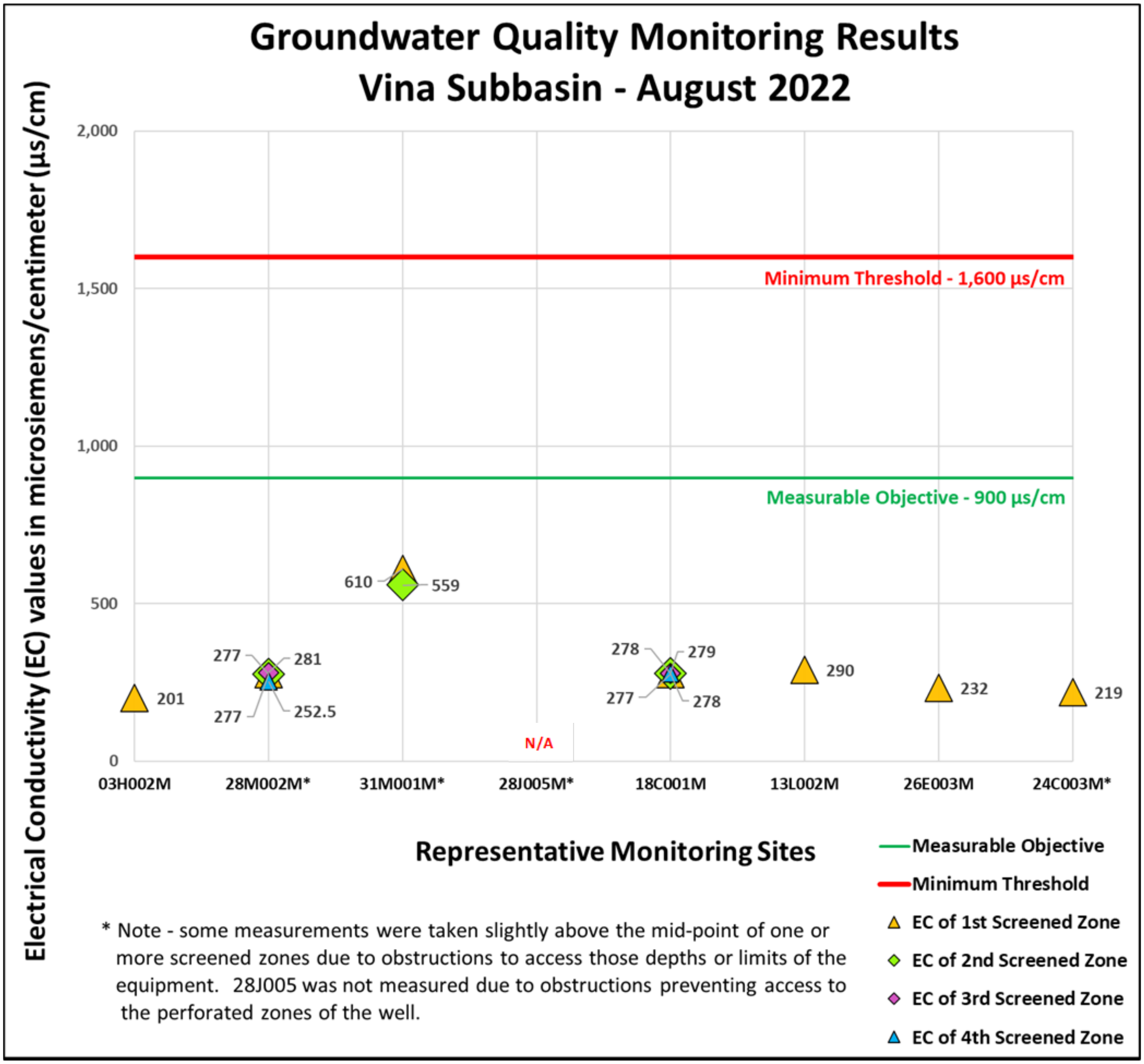

Figure 5. Groundwater quality monitoring results in the Vina Subbasin for the 2022 water year

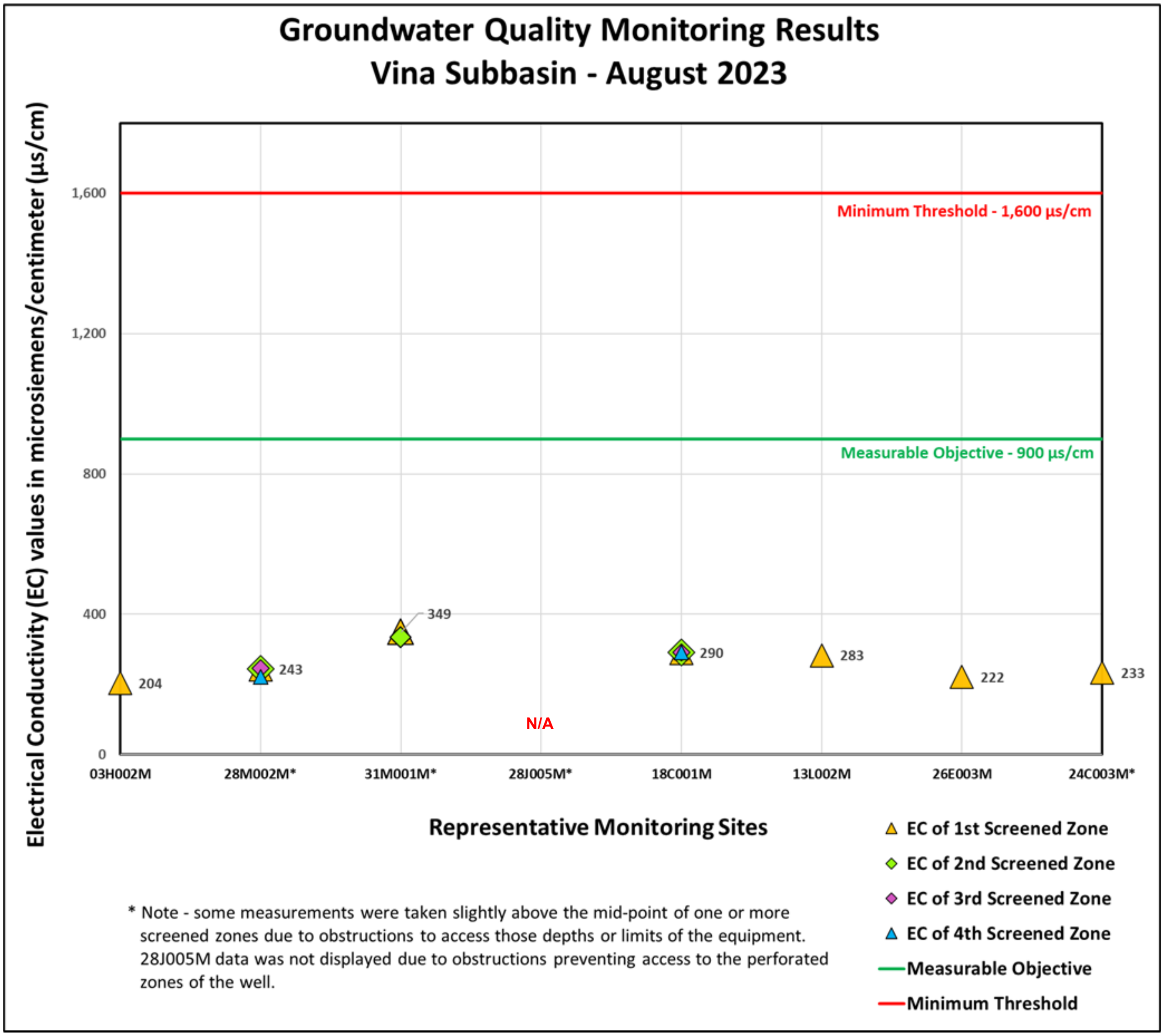

Figure 6. Groundwater quality monitoring results in the Vina Subbasin for the 2023 water year

GSP implementation, the GSAs may consider modifications to the groundwater quality RMS network as needed and / or technical support requests to DWR for video logging of the wells.

Wyandotte Creek Subbasin

In the Wyandotte Creek Subbasin the majority of RMS wells measured had EC values that were lower than the MO of 900 µS/cm and therefore lower than the MT of 1,600 µS/cm in both years as shown in **Figures 7 and 8.** Results from RMS well 08M001M were not depicted in these figures as the data deemed to be questionable based on site conditions. Anecdotally, this general area of the Subbasin is known to have areas of high concentrations of salinity and natural gas.

Additionally, two of the three new multi-completion wells drilled in 2021 by DWR through the Technical Support Services program exhibited high EC levels in 2023, exceeding the MT depicted in **Figures 8-9**. Wells 19D001M and 19D002M are each screened at varying intervals to monitor the deep and intermediate zones of the aquifer respectively. Both wells had high levels of EC greater than the MT when initially developed and again when the wells were re-tested months after initial development. Groundwater quality monitoring results for 2022 at these wells were not reported due to malfunctioning equipment. Better characterization of naturally occurring salinity is needed to help improve appropriate monitoring and management of groundwater with respect to water quality in this Subbasin.

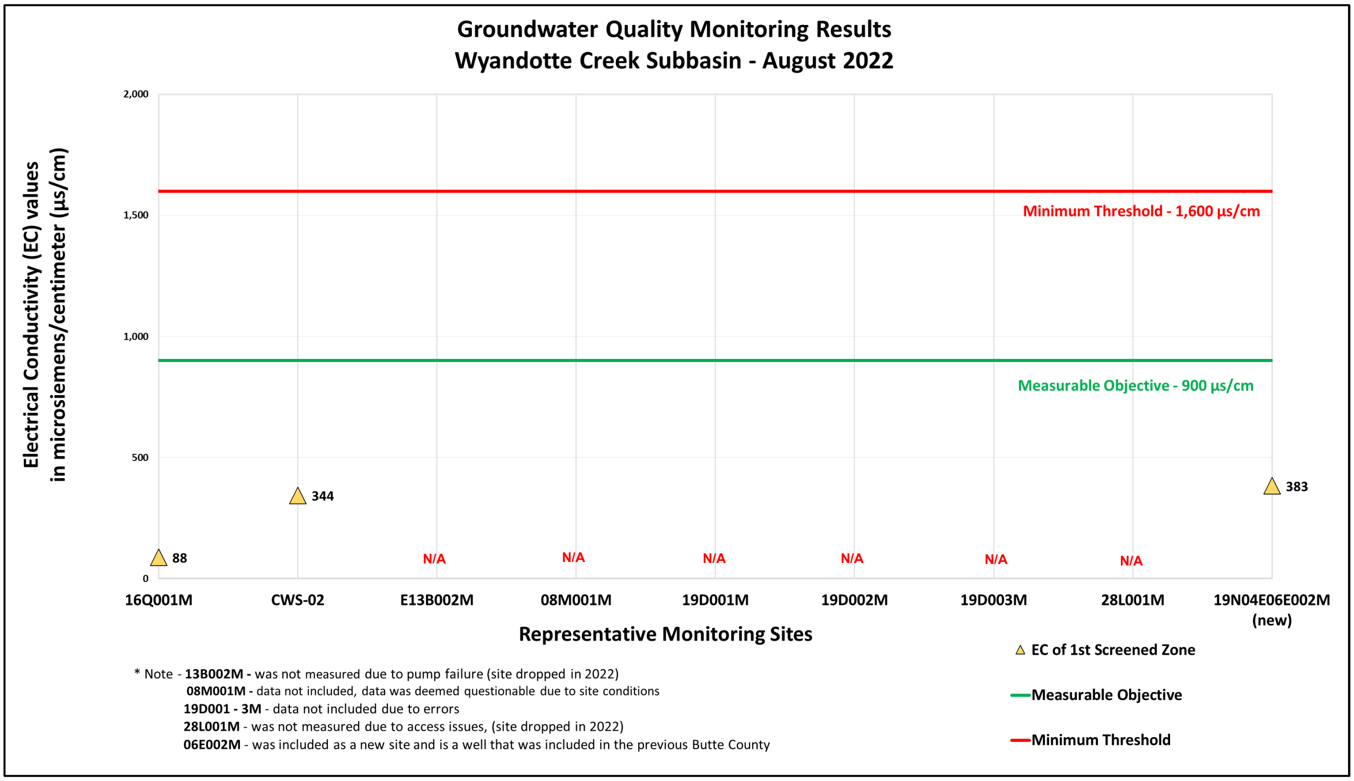

Figure 7. Groundwater quality monitoring results in the Wyandotte Creek Subbasin for the 2022 water year

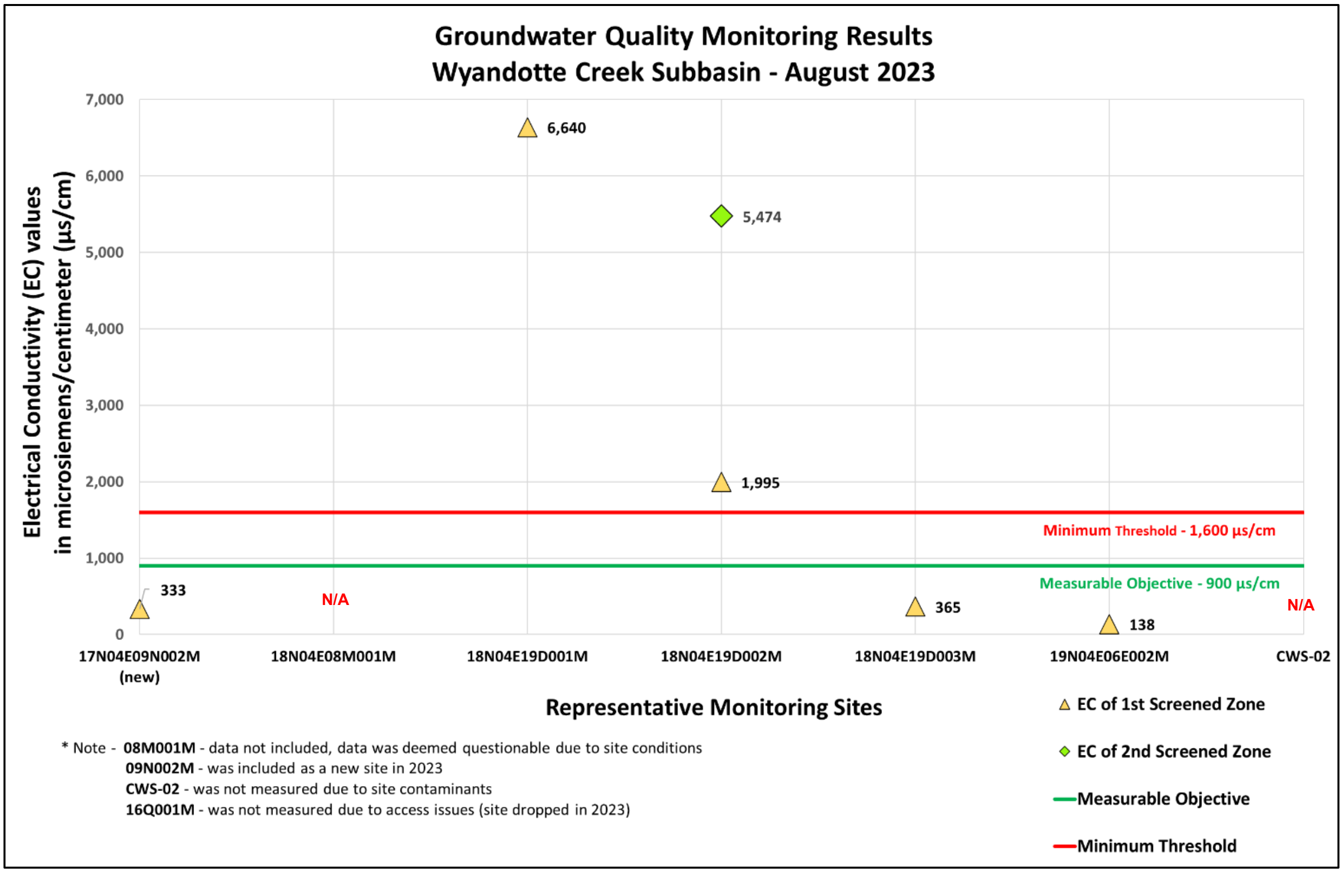

Figure 8. Groundwater quality monitoring results in the Wyandotte Creek Subbasin for the 2023 water year

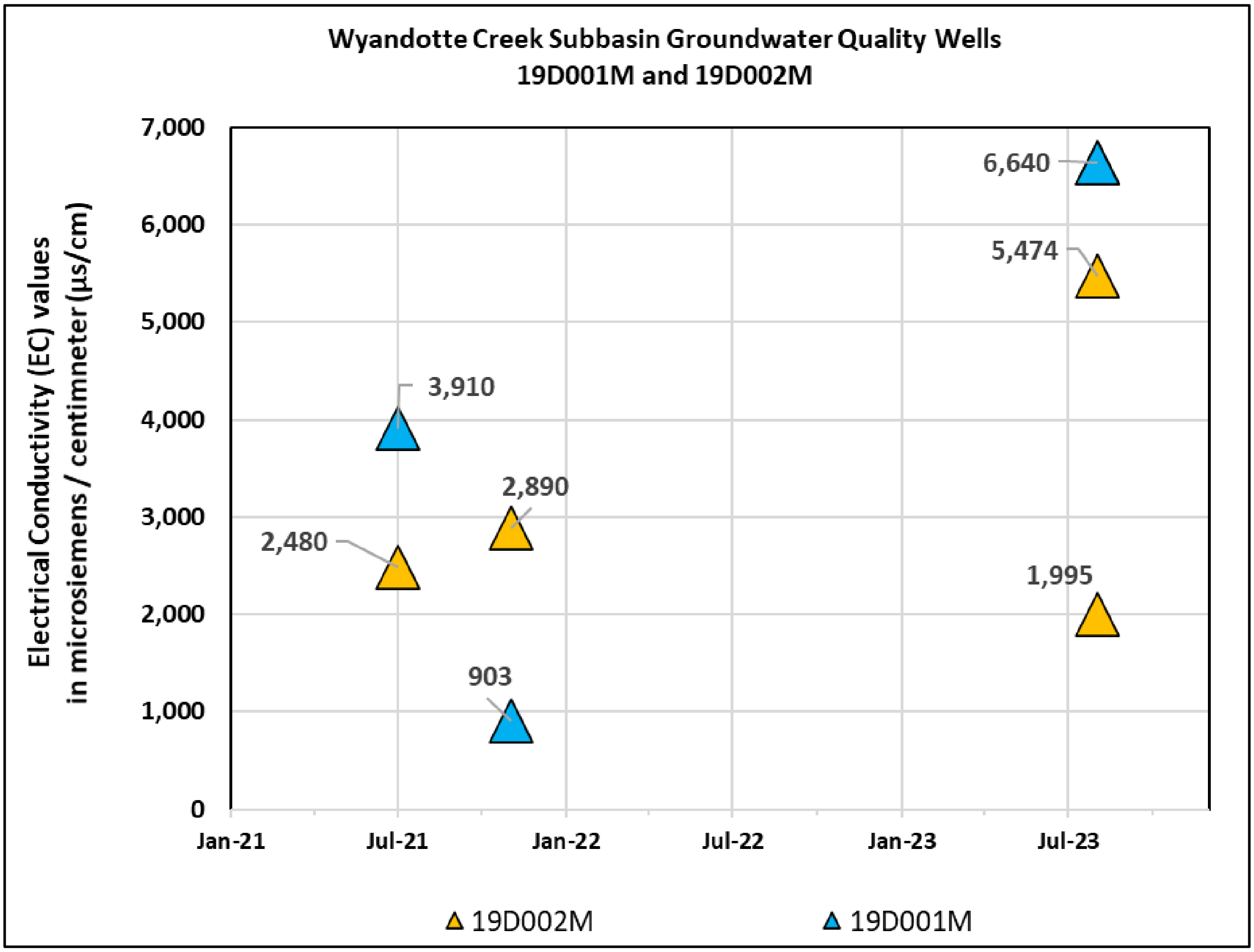

Figure 9. Groundwater quality monitoring results for wells 19D001M and 19D002M in the Wyandotte Creek Subbasin for the 2023 water year

Discussion

Groundwater quality monitoring serves to establish baseline levels for EC throughout the Subbasins so that any future changes may be identified and further investigation and or monitoring can subsequently be developed. There were no RMS wells in exceedance of any MTs in the Vina Subbasin. While there were some concentrated EC levels in one well within the Butte Subbasin and two wells within the Wyandotte Creek Subbasin over the first two years of monitoring for EC as part of GSP implementation, there were no indications of Undesirable Results as defined in the GSPs. In the Butte Subbasin, 2023 was the first year any RMS wells exceeded an MT. Undesirable Results in both the Vina and Wyandotte Creek Subbasins are tied to non-dry water year types and 2022 was a dry water year type. Next year is likely to be a non-dry year and as such there may be indications of Undesirable Results in the Wyandotte Creek Subbasin as defined the GSP, if wells there continue to show elevated levels of EC. Better characterization of naturally occurring salinity is needed to help improve appropriate monitoring and management of groundwater with respect to groundwater quality in this Subbasin.

Additional monitoring will continue to be conducted by DWR and other agencies to track constituents not managed under the current GSPs, including a variety of minerals, metals, pesticides and herbicides. Data from ongoing monitoring by various state and federal agencies will be available to the GSAs to augment local datasets and understanding of groundwater quality and can be found on the State Board's Groundwater Ambient Monitoring and Assessment (GAMA) program at https://www.waterboards.ca.gov/gama.

The County will work with the GSAs to address modifications to the monitoring networks, conduct monitoring to support data collection, and ensure that data is submitted to DWR as required by SGMA.

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