




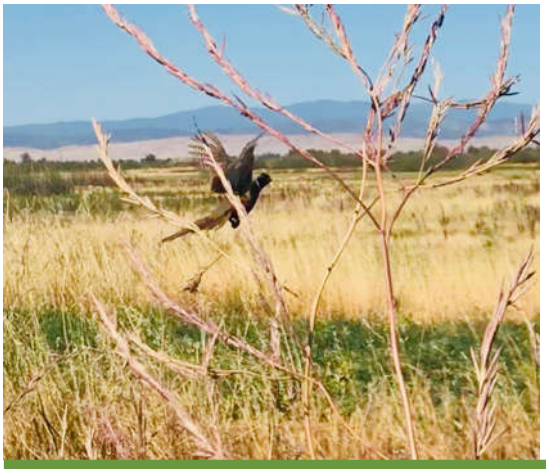


Colusa Groundwater Authority &
Glenn Groundwater Authority

Colusa Subbasin Groundwater Sustainability Plan

ANNUAL REPORT

APRIL 2025

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan

Annual Report

For Water Year 2024 (October 2023 – September 2024)

April 2025

Prepared For

Colusa Groundwater Authority
Glenn Groundwater Authority

Prepared By

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List of Abbreviations

af	acre-feet
af/yr	acre-feet per year
AMSL	above mean sea level
ASCE	American Society of Civil Engineers
bgs	below ground surface
C2VSimFG	fine-grid version of the California Central Valley Groundwater-Surface Water Simulation Model
CASGEM	California Statewide Groundwater Elevation Monitoring
CCR	California Code of Regulations
CCWD	Colusa County Water District
CDMWC	Colusa Drain Mutual Water Company
cfs	cubic feet per second
CGA	Colusa Groundwater Authority
CVO	Central Valley Operations
CVP	Central Valley Project
DWR	California Department of Water Resources
EC	electrical conductivity
ET	evapotranspiration
ET_{aw}	ET of applied water
ft	feet
GCID	Glenn-Colusa Irrigation District
GGA	Glenn Groundwater Authority
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
InSAR	Interferometric Synthetic Aperture Radar
IRWM	Integrated Regional Water Management
ISW	Interconnected Surface Water
LAFCO	Local Agency Formation Commission
MO	measurable objective
MT	minimum threshold
OAWD	Orland-Artois Water District
OUWUA	Orland Unit Water Users' Association
PLSS	Public Land Survey System
PMAs	projects and management actions
RD108	Reclamation District 108
RMS	representative monitoring site
SGMA	Sustainable Groundwater Management Act
SMC	Sustainable Management Criteria
SWN	state well number
SWRCB	State Water Resources Control Board
taf	thousands of acre-feet
TCC	Tehama-Colusa Canal
TCCA	Tehama-Colusa Canal Authority
TNC	The Nature Conservancy
uS/cm	microSiemens per centimeter
USDA	U.S. Department of Agriculture
UR	undesirable result
WMPP	Well Monitoring Pilot Program
WY	water year
yr	year

Executive Summary (§356.2.a)

INTRODUCTION

The California Code of Regulations Title 23 (23 CCR) Section (§) 356.2 requires that Annual Reports be submitted to the California Department of Water Resources (DWR) by April 1 of each year following the adoption of the Groundwater Sustainability Plan (GSP). This Annual Report for water year (WY) 2024[1] is the fourth Annual Report for the Colusa Subbasin GSP, which is required to be submitted to DWR by April 1, 2025.

The initial Colusa Subbasin GSP was adopted in December 2021 and was submitted to DWR in January 2022 in fulfillment of the requirements established under the Sustainable Groundwater Management Act (SGMA). The Colusa Subbasin GSP was later revised, adopted, and submitted to DWR in April 2024 following the GSP revisions process described below. The April 2024 Revised Colusa Subbasin GSP was formally approved by DWR in February 2025 (**Appendix E**).

The full extent of the Colusa Subbasin (Subbasin) is managed by two Groundwater Sustainability Agencies (GSAs): the Colusa Groundwater Authority (CGA) GSA, which manages the Colusa and Yolo County portions of the Subbasin, and the Glenn Groundwater Authority (GGA) GSA, which manages the Glenn County portions of the Subbasin (**Figure ES-1**). The CGA and GGA GSAs are coordinating implementation of the GSP[2] in alignment with the GSP sustainability goal:

> *"…to maintain, through a cooperative and partnered approach, locally managed sustainable groundwater resources to preserve and enhance the economic viability, social well-being and culture of all Beneficial Uses and Users, without experiencing undesirable results."* (GSP Section 5.2)

This Annual Report describes conditions across the Subbasin in WY 2024 and GSP implementation efforts by the GSAs and others in the Subbasin since the previous Annual Report. The Annual Report sections follow the requirements outlined in 23 CCR §356.2 and DWR's Annual Report guidance. The following appendices are also included at the end of this Annual Report:

- **Appendix A**. Groundwater Elevation Contour Maps – Spring/Fall 2020 through 2024.
- **Appendix B**. Groundwater Elevation Hydrographs for Groundwater Level RMS Wells.
- **Appendix C**. Maps of Annual Change in Groundwater Storage – Spring 2015-2016 through Spring 2023-2024.
- **Appendix D**. Approach for Estimating Groundwater Extraction in the Colusa Subbasin GSP Annual Report.

Key data sources and findings from each section of the Annual Report are summarized below, and are described in further detail in the associated Annual Report section.

[1] Water Year 2024 spans the period from October 1, 2023, through September 30, 2024. Some information provided in this Annual Report is also reported after the end of water year 2024, including groundwater level measurements collected in Fall 2024 (some after September 30, 2024) and available updates for projects, management actions, and other activities that occurred before April 1, 2025.

[2] References to the GSP herein refer to the April 2024 Revised Colusa Subbasin GSP, unless otherwise specified.

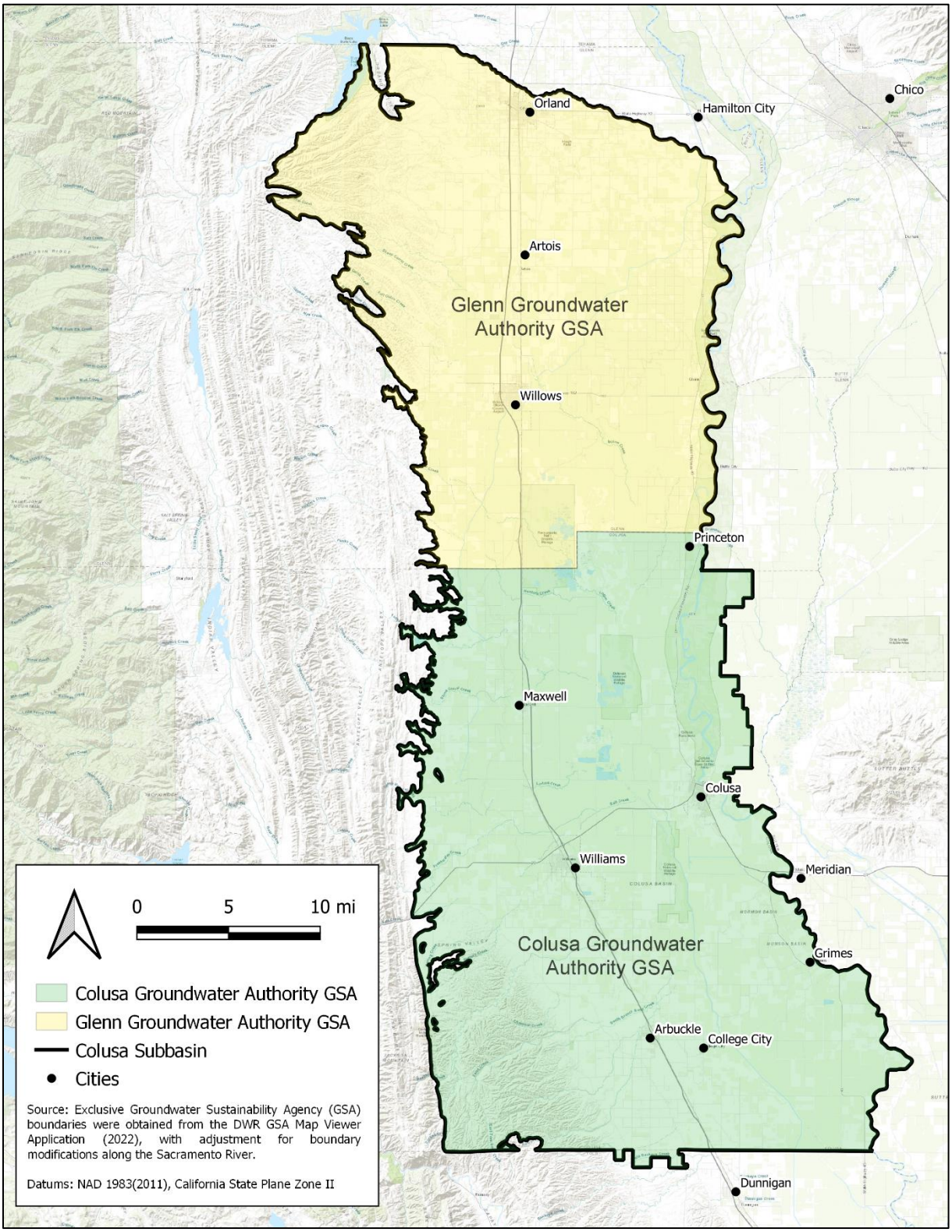

Figure ES-1. Map of Colusa Subbasin GSP Area and GSAs.

GSP REVISIONS, IMPLEMENTATION EFFORTS, AND ANNUAL REPORT UPDATES

In October 2023, DWR completed their evaluation of the initial 2022 Colusa Subbasin GSP (Initial GSP) and determined it to be "incomplete" pursuant to 23 CCR §355.2(e)(2), initiating a 180-day period for the GSAs to revise the Initial GSP to address the identified deficiencies by April 23, 2024. In this determination, DWR identified three deficiencies:

- DWR found that the GSP did not include a reasonable assessment of overdraft conditions and a reasonable means to mitigate overdraft,
- DWR found that the chronic lowering of groundwater levels sustainable management criteria (SMC) were not substantially compliant with the GSP regulations, and
- DWR found that the subsidence SMC were not substantially compliant with the GSP regulations.

In 2023-2024, the GSAs coordinated to address the three deficiencies through technical analyses and revisions to the initial GSP. The GSAs met with DWR on multiple occasions to discuss the revisions and signed two formal agreements to develop and implement a domestic well mitigation program and a demand management program for the Subbasin. Details about these efforts and agreements are included in the April 2024 Revised Colusa Subbasin GSP. The GSP was adopted and submitted to DWR ahead of the April 23, 2024 deadline. On February 27, 2025, DWR notified the GSAs that DWR had completed their review of the April 2024 Revised Colusa Subbasin GSP and determined the GSP is approved (**Appendix E**).

Since adoption of the April 2024 Revised Colusa Subbasin GSP, the GSAs have made significant strides toward GSP implementation, particularly toward develop of the domestic well mitigation program and demand management program for the Subbasin. Several updates have been made to this Annual Report to document these efforts and to reflect the changes made in the April 2024 Revised Colusa Subbasin GSP. Key updates include:

- A recurring evaluation of overdraft conditions in the Subbasin and the 5 and 10 year rolling average overdraft, quantified as the estimated change in groundwater storage based on changes in groundwater levels (see **Section 5**).
- Updates to the SMC for groundwater levels and subsidence, and evaluation of available monitoring data in WY 2024 in relation to those SMC (see **Sections 1 and 6.1**).
- Updates regarding the GSAs' focused efforts since April 2024 to develop the domestic well mitigation program and demand management program according to the timeline and provisions agreed upon during the GSP revisions process (see **Section 6.2**).
- Updates regarding implementation of other PMAs since the previous Annual Report, as available (see **Section 6.2**).
- Updates related to monitoring and evaluation of subsidence conditions in the Subbasin (see **Section 6.1**), including:
    - Updated subsidence maps and summaries to quantify the spatial extent, rate, and cumulative amounts of subsidence in the Subbasin, and
    - Feedback received from infrastructure operators and managers in the Subbasin in early 2025 related to any new potential undesirable results (URs) and impacts to land uses or property interests since earlier interviews.

GROUNDWATER ELEVATION (§356.2.B.1)

Groundwater level monitoring and groundwater elevation are described in **Section 1** of this Annual Report. Groundwater elevation data were assembled from publicly available databases for the entire available period of record. During spring of calendar year 2024 (Spring 2024), groundwater elevations at available representative monitoring site (RMS) wells in the Subbasin ranged from -1.1 feet (ft) above mean sea level (AMSL) to 193.8 ft AMSL. During fall of calendar year 2024 (Fall 2024), groundwater elevations at available RMS wells in the Subbasin ranged from -13.0 ft AMSL to 180.7 ft AMSL.

Spring 2024 and Fall 2024 groundwater elevation contour maps are shown in **Figures 1-2 and 1-3**. Spring contours typically represent seasonal high groundwater levels, while fall contours typically represent seasonal low groundwater levels. Groundwater hydrographs for all RMS wells are shown in **Appendix B** of this Annual Report. Seasonal groundwater trends in the Subbasin in 2024 were generally consistent with those seen in 2021-2023 and earlier. Higher groundwater elevations are generally seen along Stony Creek and the Sacramento River and along the southwestern boundary of the Subbasin, with lower groundwater elevations generally along the southeastern and northwestern boundary. Due to wet or above normal hydrologic conditions in 2023-2024, groundwater elevations in 2024 are higher than in 2021-2022 in nearly all areas of the Subbasin.

GROUNDWATER EXTRACTION (§356.2.B.2)

Groundwater extraction is summarized in **Section 2** of this Annual Report. Groundwater extraction in the Subbasin was measured directly from flowmeters when available, or was estimated through a water demand analysis approach using the best available information (**Appendix D**). The relative amounts of groundwater extraction that were quantified from flowmeter records or were estimated are summarized in **Tables 2-1 through 2-2**.

In total, an estimated 562,100 acre-feet (af) of groundwater was extracted for use within the Subbasin area during WY 2024 (**Table 2-3**). Of this total, the majority was extracted for agricultural use (approximately 535,000 af), while the remainder was extracted for urban, domestic, and environmental uses. The wetter hydrologic conditions in 2023-2024 compared to the 2020-2022 drought period and the substantial increase in surface water supplies in 2023-2024 compared to 2022 facilitated a substantial reduction in groundwater extraction compared to recent years.

SURFACE WATER SUPPLY (§356.2.B.3)

Surface water supplies used or available for use are summarized in **Section 3** of this Annual Report. Surface water supplies available to certain entities within the Subbasin include surface water deliveries, water rights diversions, and riparian or other diversions of natural flows crossing the Subbasin. In this Annual Report, surface water supplies used or available for use are assumed to be the volume of surface water diverted by agencies and water rights users in the Subbasin (**Table 3-1**). Estimated surface water deliveries to water users are also reported (**Table 3-2**). During WY 2024, approximately 1,543,500 af of surface water supplies were diverted by water users in the Subbasin, including approximately 1,502,100 af of Central Valley Project (CVP) supplies and approximately 41,400 af of local supplies. Similar to 2023, WY 2024 was marked by full allocations and thus substantially greater surface water supplies compared to the severe curtailments seen in the first year of GSP implementation. Sustained access to contract surface water supplies is inextricably tied to groundwater sustainability, and is necessary for the ongoing vitality of the Subbasin and its communities.

TOTAL WATER USE (§356.2.B.4)

Total water use is summarized in **Section 4** of this Annual Report. In this Annual Report, total water use is assumed to equal the total combined groundwater extractions (described in **Section 2**) and surface water diversions (described in **Section 3**) in the Subbasin. During WY 2024, total water use in the Subbasin area was estimated to be approximately 2,105,600 af. Of this total, approximately 73% came from surface water while the remaining use came from groundwater. Above normal hydrologic conditions and full surface water allocations in 2024 led to greater use of surface water compared to groundwater, similar to 2023 and historical conditions in the Subbasin prior to the 2020-2022 drought period.

CHANGE IN GROUNDWATER STORAGE (§356.2.B.5)

Change in groundwater storage is described in **Section 5** and maps are provided in **Appendix C** of this Annual Report. Consistent with 23 CCR §354.18.b, annual changes in groundwater elevation were calculated for the principal aquifer between Spring 2015 and Spring 2024 based on the difference in annual spring groundwater elevations (representing seasonal high groundwater conditions). **Section 5** also includes an evaluation of overdraft conditions in the Subbasin in 2024 and the 5-10 year rolling average overdraft, quantified as the estimated change in groundwater storage.

Table ES-1 lists the spring-to-spring changes in groundwater storage from 2015 through 2024, as well as the cumulative change in groundwater storage over the 2015-2024 period. A positive change in groundwater storage means that the volume of groundwater in storage increased, whereas a negative change in groundwater storage means that the volume of groundwater in storage decreased. Overdraft is also estimated as the annual change in groundwater storage (where negative change in storage represents overdraft). Average overdraft is also calculated based on the last five and ten years of annual change in groundwater storage. The change in groundwater storage from Spring 2023 to Spring 2024 was approximately +188 thousand acre-feet (taf), and the cumulative change in groundwater storage from Spring 2015 to Spring 2024 was approximately -337 taf. The average overdraft was approximately 92 taf per year over the last five-year period (beginning spring 2019), and approximately 55 taf per year over the last ten-year period (beginning spring 2014). The GSAs will continue to monitor and report overdraft each Annual Report. In the meantime, the GSAs are working diligently to develop PMAs, including recharge efforts as well as the demand management program, consistent with the terms and timeline expressed in the April 2024 Revised Colusa Subbasin GSP (described in **Section 6.2).**

Table ES-1. Estimated Change in Groundwater Storage in the Primary Aquifer and Overdraft – Spring 2015 through Spring 2024.

Analysis Time Period	Annual Change in Groundwater Storage[1,2] (taf)	Cumulative Change in Groundwater Storage since Spring 2015-2016 (taf)
Spring 2015-2016	-106	-106
Spring 2016-2017	+259	153
Spring 2017-2018	-149	4
Spring 2018-2019	+119	123
Spring 2019-2020	-196	-73
Spring 2020-2021	-268	-341
Spring 2021-2022	-204	-545
Spring 2022-2023	+20	-525
Spring 2023-2024	+188	-337
Overdraft[2] (5-year Average)	92	
Overdraft[2] (10-year Average)	55	

[1] Annual change in groundwater storage was recalculated in February 2025 using updated groundwater elevation data available from DWR. Values may have changed slightly from earlier Annual Reports following analysis of updated information.

[2] Consistent with the April 2024 Revised Colusa Subbasin GSP, overdraft is estimated as the annual change in groundwater storage (where negative change in storage represents overdraft) through analysis of empirical groundwater elevation data from RMS wells in the Subbasin. Averages are calculated based on the last five and ten years of annual change in groundwater storage.

CURRENT CONDITIONS FOR SUSTAINABILITY INDICATORS (§356.2.C)

A review of current conditions in the Subbasin for all applicable sustainability indicators is provided in **Section 6.1**. To track groundwater conditions in relation to the SMC in the GSP, conditions at monitoring network sites are presented in relation to the interim milestones (IMs), measurable objectives (MOs), and minimum thresholds (MTs) defined in the GSP. **Section 6.1** includes updates to the SMC for chronic lowering of groundwater levels and subsidence that were made in the April 2024 Revised Colusa Subbasin GSP.

Overall, groundwater levels in the Subbasin remain above their MTs, indicating that no undesirable results for chronic lowering of groundwater levels are currently occurring in the Subbasin. The majority of RMS wells remain at or above their MOs in Spring 2024, and all Focus RMS wells were above the 2027 IM in Spring and Fall 2024. Subsidence persists in two focus areas of the Subbasin (south of Orland and near Arbuckle), although subsidence rates have continued to slow compared to recent years. Conditions for interconnected surface water (ISW) also remain above the MTs. With respect to groundwater quality, all but two wells (two water quality RMS wells, one measured in 2018 and one in 2024) remain above the MTs.

IMPLEMENTATION OF PROJECTS AND MANAGEMENT ACTIONS (§356.2.C)

Projects and management actions (PMAs) are described in **Section 6.2**. As of early 2025, progress has been made in developing or implementing approximately 16 PMAs since adoption of the initial GSP, including 15 direct or in-lieu recharge projects and one ongoing management action for urban water conservation. In total, approximately 33,000 af of PMA-specific benefits to the Subbasin were achieved in 2024, not including the substantial recharge benefits of surface water supplies accounted for in the Subbasin water use estimates (see **Sections 2 through 4**). This represents approximately 40% of the estimated 83,000 af in total anticipated benefits of all planned PMAs at full implementation (GSP Table 6-3), although it is noted that many of the planned PMAs are currently being actively developed and have not achieved their full anticipated benefits as of early 2025. The GSAs have also moved forward with several efforts in support of GSP implementation, including groundwater recharge and water rights-related efforts and efforts to secure long-term funding for GSP implementation.

Since adoption of the April 2024 Revised Colusa Subbasin GSP, the GSAs have also made significant strides to ensure that the domestic well mitigation program and demand management program for the Subbasin are implemented according to the timeline and provisions agreed upon during the GSP revisions process. A description of these efforts is also provided in **Section 6.2**. Implementation of these programs is expected to provide the GSAs with additional means of mitigating overdraft, subsidence, and groundwater level decline in the Subbasin and of mitigating URs that may occur to domestic well users during GSP implementation while other projects and management actions are being developed, prior to achieving sustainable groundwater conditions (no later than 2042).

1 Groundwater Elevation (§356.2.b.1)

This Annual Report provides an update on groundwater elevation conditions in the Colusa Subbasin in WY 2024 and since the end of the initial GSP analysis period[3]. The representative monitoring sites (RMS) currently include 48 well completions within the Subbasin. RMS wells are shown in **Figure 1-1**. The RMS wells are a mix of active supply and dedicated observation wells. For nested multiple completion observation wells, the completion that best represents the pumping depth of nearby water supply wells was selected as the RMS well.

Groundwater elevation data were assembled from DWR's periodic groundwater levels dataset, a compilation of publicly available databases containing historical data collected by various entities, including DWR, California Statewide Groundwater Elevation Monitoring (CASGEM) Program monitoring entities, and other cooperating agencies. Groundwater elevation data were evaluated and summarized for the entire available period of record (including the period from January 1, 2015, through the current WY).

RMS wells are monitored two to three times per year (or more frequently), typically in spring, fall, and/or summer. Spring groundwater measurements (typically measured between February-April) provide an indication of groundwater conditions after winter precipitation and groundwater recharge. Fall groundwater measurements (typically measured between September-November) provide an indication of groundwater conditions after the primary irrigation season and (depending on timing) before winter flood-up for rice decomposition and wetlands habitat. In rice growing areas, summer groundwater levels may be relatively high compared to spring and fall levels due to field flooding using surface water supplies.

The above normal hydrologic conditions and full allocations of surface water supplies in 2024 generally resulted in higher groundwater elevations across much of the Subbasin as compared to recent drought years, particularly 2022. These conditions are seen throughout the groundwater level measurements, groundwater elevation contour maps, and hydrographs shown later in this section.

The GSAs made one change to the groundwater level representative monitoring network in 2024, during the GSP revisions process (**Table 1-1**). The change was made for one RMS site at a multi-completion well that was previously referencing the deepest completion (14N02W22A002M) and was instead updated to reference the shallowest completion (14N02W22A005M), which was determined to be more representative of nearby water supply wells. The SMC for this RMS site were also revised using data from the shallowest completion, consistent with the revised SMC methodology described in the April 2024 Revised Colusa Subbasin GSP.

The GSAs have noted that several RMS wells selected in the GSP have limited data availability in recent years, including three RMS wells that have not been measured since between 2015-2017. During the five-year GSP periodic evaluation and potential plan amendment (anticipated in 2027), the GSAs are planning to re-evaluate the RMS network and potentially select new RMS wells to replace sites with limited data to ensure there is sufficient information to monitor and manage groundwater conditions in the Subbasin and achieve sustainability.

[3] The initial Colusa Subbasin GSP documented existing and historical groundwater elevation conditions through the end of calendar year 2020.

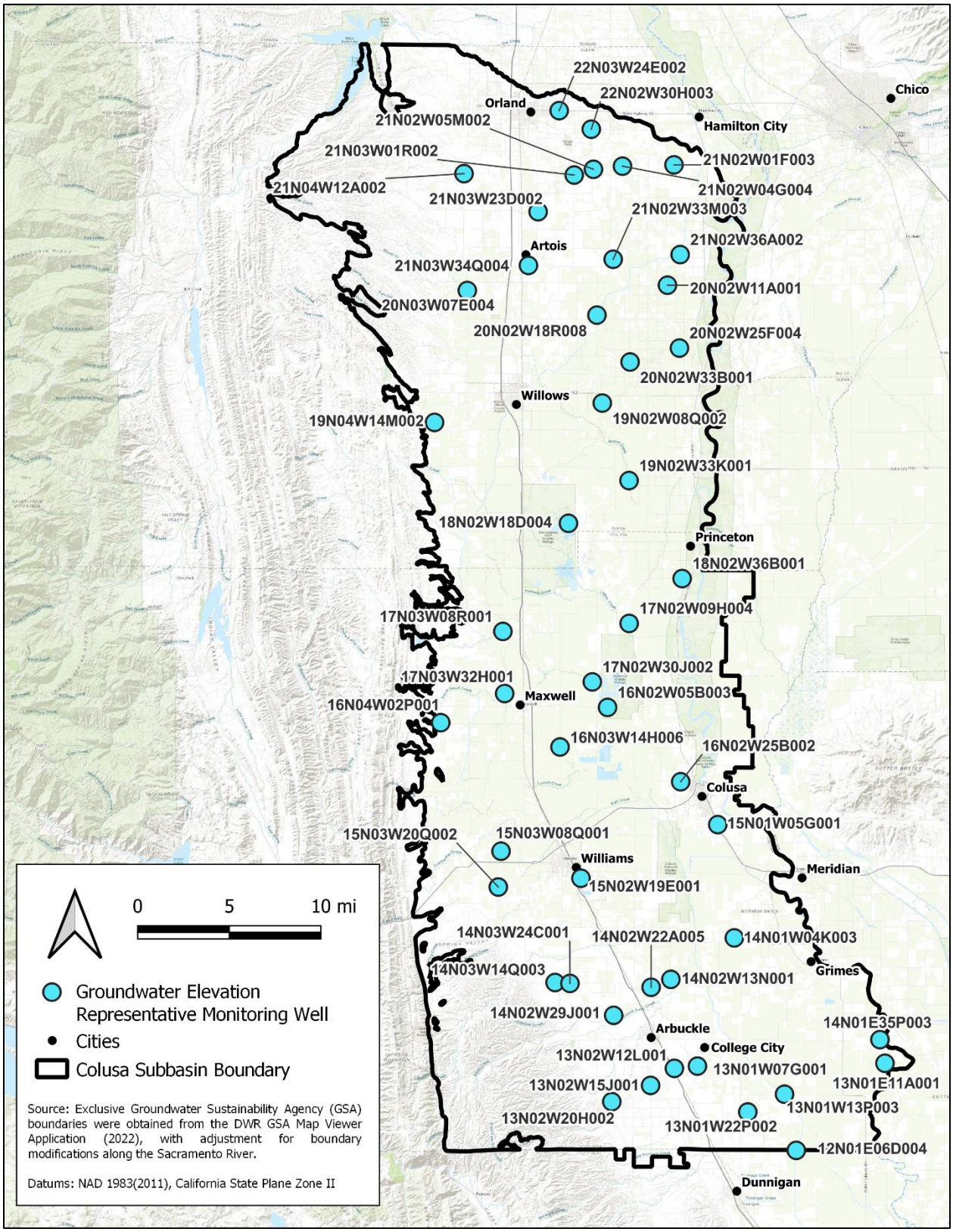

Figure 1-1. Groundwater Level RMS Wells.

Table 1-1. Changes to the Groundwater Level Representative Monitoring Network.

State Well Number	GSA	New Information	Changes
14N02W22A002M	CGA	This RMS site is part of a multi-completion observation well monitored since 2019. Prior to the changes, the RMS site referenced the deepest completion (14N02W22A002M). However, the shallowest completion (14N02W22A005M) was recommended as it is more representative of nearby water supply wells.	This RMS site was changed to 14N02W22A005M in 2024 (with revised SMC using data from 14N02W22A005M following the SMC methodology described in the April 2024 Revised Colusa Subbasin GSP).

1.1 GROUNDWATER LEVEL CONDITIONS

Groundwater elevations measured in Spring and Fall 2024 are listed in **Table 1-2**. During spring of calendar year 2024 (Spring 2024), groundwater elevations at available RMS wells in the Subbasin ranged from -1.1 feet (ft) above mean sea level (AMSL) to 193.8 ft AMSL. During fall of calendar year 2024 (Fall 2024), groundwater elevations at available RMS wells in the Subbasin ranged from -13.0 ft AMSL to 180.7 ft AMSL. Of the 48 RMS wells, groundwater elevation data were not available for six wells in Spring 2024 and for eight wells in Fall 2024. The primary reasons for unavailable groundwater level measurements were site accessibility issues and well pumping. Notes and issues regarding the RMS wells are documented in **Section 6.1.1.**

1.2 GROUNDWATER ELEVATION CONTOUR MAPS (§356.2.B.1.A)

Spring and Fall 2024 groundwater elevation contour maps are provided for the Primary Aquifer in **Figures 1-2 and 1-3**, respectively. Groundwater elevation contour maps for Spring and Fall 2020 through 2024 are included in **Appendix A** for reference. Those earlier contour maps come from the GSP and the previous Annual Reports. Spring contours typically represent seasonal high groundwater levels, while fall contours typically represent seasonal low groundwater levels. Groundwater elevation contours were developed by creating a continuous groundwater elevation surface based on available well data using the kriging interpolation method. Additional non-RMS wells were also used in 2024 to improve contours in areas when RMS measurements were missing. Measurements indicated as questionable in the DWR database were excluded, and minor refinements were made to the contours based on professional judgement.

Seasonal groundwater trends in the Subbasin in 2024 were generally consistent with those seen in 2021-2023 and earlier. Higher groundwater elevations are generally seen along Stony Creek and the Sacramento River and along the southwestern boundary of the Subbasin, with lower groundwater elevations generally along the southeastern and northwestern boundary. Regionally, groundwater generally flows from the north and west towards the south and east, although localized areas of lower groundwater elevation and depressions caused by groundwater pumping and/or a reduction in recharge has resulted in locally varying flow regimes. These can be seen in the area southeast of Orland and in areas around and east of College City in both the Spring and Fall 2024 groundwater elevation contour maps (**Figures 1-2 and 1-3**, respectively). These depressions in groundwater elevations are also evident in the 2020-2023 contours to varying extents (**Appendix A**).

Table 1-2. Summary of Groundwater Level RMS Well Information and Measurements During Annual Report Year (2024).

State Well Number (SWN)	Ground Surface Elevation (feet AMSL)[1]	Completed Well Depth (feet bgs)[2]	Screen Interval(s) (Top-Bottom) (feet bgs)	Spring 2024 GWE (feet AMSL)	Date of Spring 2024 GWE (feet AMSL)	Fall 2024 GWE (feet AMSL)	Date of Fall 2024 GWE (feet AMSL)	GSA
12N01E06D004M	27.94	298	275-285	16.5	4/16/2024	-4.0	10/7/2024	CGA
13N01E11A001M	31.8	145	136-158	27.1	4/23/2024	25.0	10/7/2024	CGA
13N01W07G001M	90.47	180	108-180	10.7	4/16/2024	-3.8	10/16/2024	CGA
13N01W13P003M	32.23	355	271-278	19.4	4/16/2024	4.8	10/8/2024	CGA
13N01W22P002M[4]	60.46	236	196-236	Not Available[3,4]	Not Available[3,4]	Not Available[3,4]	Not Available[3,4]	CGA
13N02W12L001M	135.49	Not Available	Not Available	16.7	3/26/2024	-13.0	10/22/2024	CGA
13N02W15J001M[4]	212.52	362	270-362	Not Available[3,4]	Not Available[3,4]	Not Available[3,4]	Not Available[3,4]	CGA
13N02W20H002M	342.58	320	200-260, 300-320	180.0	4/15/2024	180.7	10/7/2024	CGA
14N01E35P003M	46.88	275	135-145, 215-225	33.2	4/16/2024	28.5	10/16/2024	CGA
14N01W04K003M	37.43	73	46-70	33.5	3/13/2024	Not Available[3]	Not Available[3]	CGA
14N02W13N001M	62.45	392	104-392	26.4	3/26/2024	16.1	10/24/2024	CGA
14N02W22A005M	84	320	290-300	13.6	4/16/2024	-3.5	10/16/2024	CGA
14N02W29J001M[4]	162.5	412	119-143, 152-158, 176-182, 198-208, 215-239, 264-276, 307.5-319.5, 334.5-349.5	Not Available[3,4]	Not Available[3,4]	Not Available[3,4]	Not Available[3,4]	CGA
14N03W14Q003M	172.52	685	390-480, 500-590, 614-685	-1.1	3/13/2024	Not Available[3]	Not Available[3]	CGA
14N03W24C001M	172.51	312	292-312	Not Available[3]	Not Available[3]	Not Available[3]	Not Available[3]	CGA
15N01W05G001M	47.42	140	75-140	43.0	3/13/2024	35.4	10/15/2024	CGA

State Well Number (SWN)	Ground Surface Elevation (feet AMSL)[1]	Completed Well Depth (feet bgs)[2]	Screen Interval(s) (Top-Bottom) (feet bgs)	Spring 2024 GWE (feet AMSL)	Date of Spring 2024 GWE (feet AMSL)	Fall 2024 GWE (feet AMSL)	Date of Fall 2024 GWE (feet AMSL)	GSA
15N02W19E001M	87.46	334	162-182, 198-206, 262-274, 290-294, 310-334	72.5	4/15/2024	62.0	10/7/2024	CGA
15N03W08Q001M	115	350	30-130, 250-350	Not Available[3]	Not Available[3]	Not Available[3]	Not Available[3]	CGA
15N03W20Q002M	128.56	170	130-160	111.3	3/12/2024	111.5	10/14/2024	CGA
16N02W05B003M	65	301	174-184, 246-256	56.5	3/12/2024	43.9	10/16/2024	CGA
16N02W25B002M	55.42	274	254-274	48.0	3/12/2024	37.6	10/15/2024	CGA
16N03W14H006M	65.7	378	295-305	56.9	4/16/2024	46.0	10/14/2024	CGA
16N04W02P001M	162.53	203	112-203	142.3	4/23/2024	140.0	10/7/2024	CGA
17N02W09H004M	67	302	250-260	63.7	3/12/2024	51.6	10/16/2024	CGA
17N02W30J002M	63.43	159	157-159	59.5	3/12/2024	47.7	10/14/2024	CGA
17N03W08R001M	107.46	130	125-130	91.6	3/12/2024	91.1	10/7/2024	CGA
17N03W32H001M	100.47	112	68-72, 104-112	95.1	4/15/2024	94.5	10/15/2024	CGA
18N02W18D004M	85.43	266	246-256	76.8	3/18/2024	34.7	10/18/2024	GGA
18N02W36B001M	75.4	410	88-128, 195-225, 240-340	68.0	4/15/2024	62.0	10/7/2024	CGA
19N02W08Q002M	108.36	228	208-218	102.1	3/11/2024	97.9	10/14/2024	GGA
19N02W33K001M	87.41	260	160-260	82.6	3/1/2024	74.1	10/18/2024	GGA
19N04W14M002M	185.83	65	45-55	Not Available[3]	Not Available[3]	Not Available[3]	Not Available[3]	GGA
20N02W11A001M	125.4	90	70-90	119.4	3/15/2024	119.4	10/17/2024	GGA
20N02W18R008M	131.38	201	140-150, 70-180	118.5	3/15/2024	118.6	10/18/2024	GGA
20N02W25F004M	102.2	85	55-65	98.3	3/8/2024	97.6	10/17/2024	GGA

State Well Number (SWN)	Ground Surface Elevation (feet AMSL)[1]	Completed Well Depth (feet bgs)[2]	Screen Interval(s) (Top-Bottom) (feet bgs)	Spring 2024 GWE (feet AMSL)	Date of Spring 2024 GWE (feet AMSL)	Fall 2024 GWE (feet AMSL)	Date of Fall 2024 GWE (feet AMSL)	GSA
20N02W33B001M	105.41	320	100-120, 200-320	101.4	3/15/2024	100.0	10/17/2024	GGA
20N03W07E004M	179.17	138	118-128	68.4	3/15/2024	63.4	10/15/2024	GGA
21N02W01F003M	161.84	124	109-119	134.8	3/7/2024	127.5	10/16/2024	GGA
21N02W04G004M	178.41	289	165-175, 269-279	142.1	3/14/2024	122.1	10/17/2024	GGA
21N02W05M002M	188.93	153	122-132	157.7	4/22/2024	143.6	10/17/2024	GGA
21N02W33M003M	149	171.1	140-150	120.1	3/11/2024	118.6	10/14/2024	GGA
21N02W36A002M	135.39	145	120-140	112.6	3/15/2024	107.6	10/17/2024	GGA
21N03W01R002M	203.32	255	235-245	160.6	3/14/2024	150.4	10/17/2024	GGA
21N03W23D002M	204.76	191.5	142-152, 160-170	144.0	4/22/2024	137.7	10/15/2024	GGA
21N03W34Q004M	166.65	80	60-70	102.7	4/23/2024	99.1	10/15/2024	GGA
21N04W12A002M	247.88	278	247-257	40.6	3/14/2024	29.4	10/15/2024	GGA
22N02W30H003M	204.43	275	130-140, 150-160, 250-260	166.3	4/22/2024	158.1	10/17/2024	GGA
22N03W24E002M	230.51	195	130-150, 170-180	193.8	4/22/2024	176.4	10/16/2024	GGA

[1] Elevations are in reference to feet above mean sea level (AMSL).

[2] Depths are below ground surface (bgs).

[3] Notes and issues regarding the RMS wells are documented in Section 6.1.1. The primary reasons for unavailable groundwater level measurements were site accessibility issues and well pumping.

[4] RMS well has not been measured in five or more years. The adequacy of all RMS wells will be evaluated during the five-year GSP periodic evaluation (anticipated in 2027) . It is anticipated that RMS wells with severe data gaps will be prioritized for replacement at that time with alternate sites that have more recent data.

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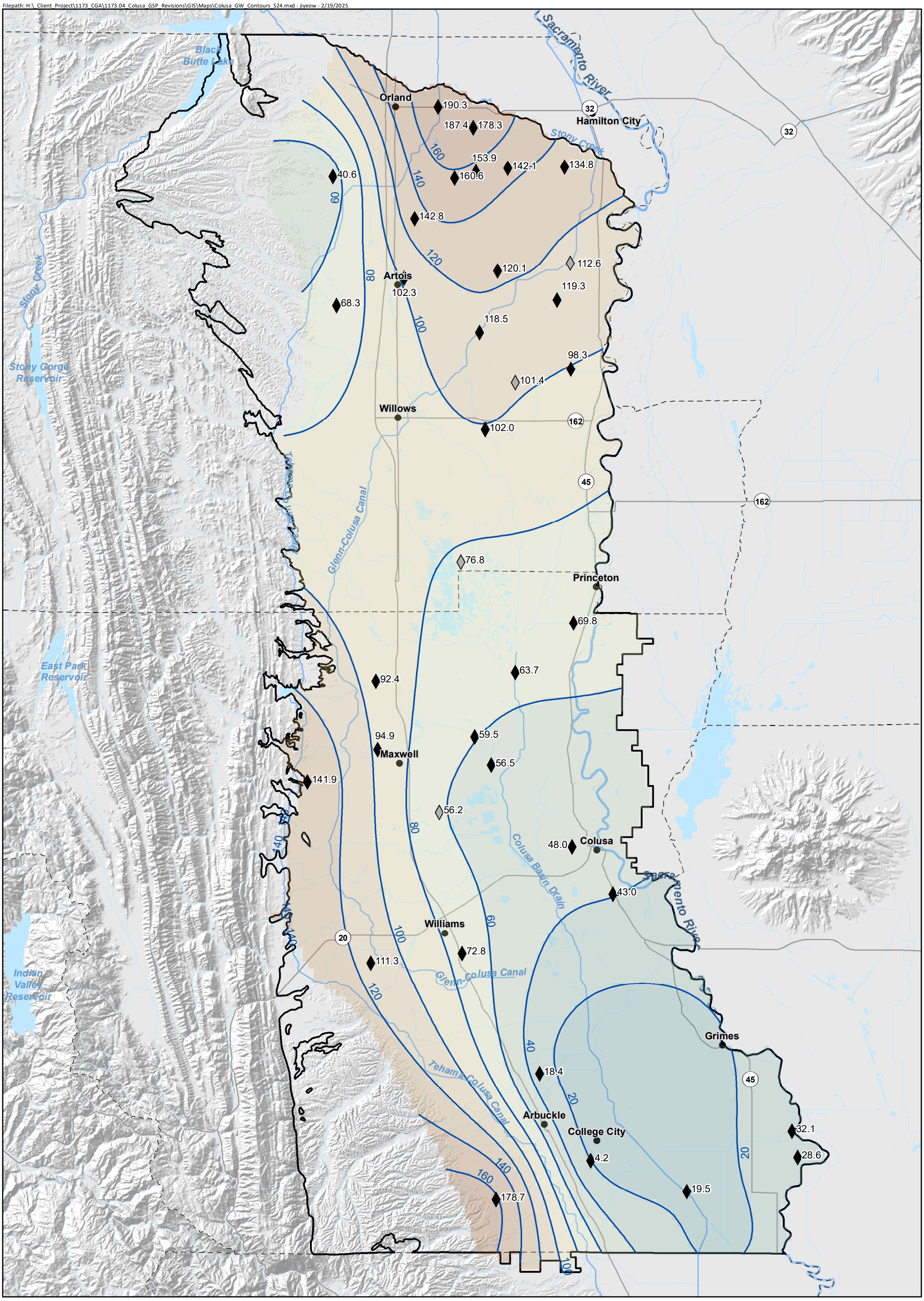

Groundwater Elevation Measurement (RMS Well Used for Contouring) (ft)

Groundwater Elevation Measurement (non RMS Well Used for Contouring) (ft)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

Scale in Miles

Figure 1-2

Groundwater Elevation Contours
Spring 2024

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2024

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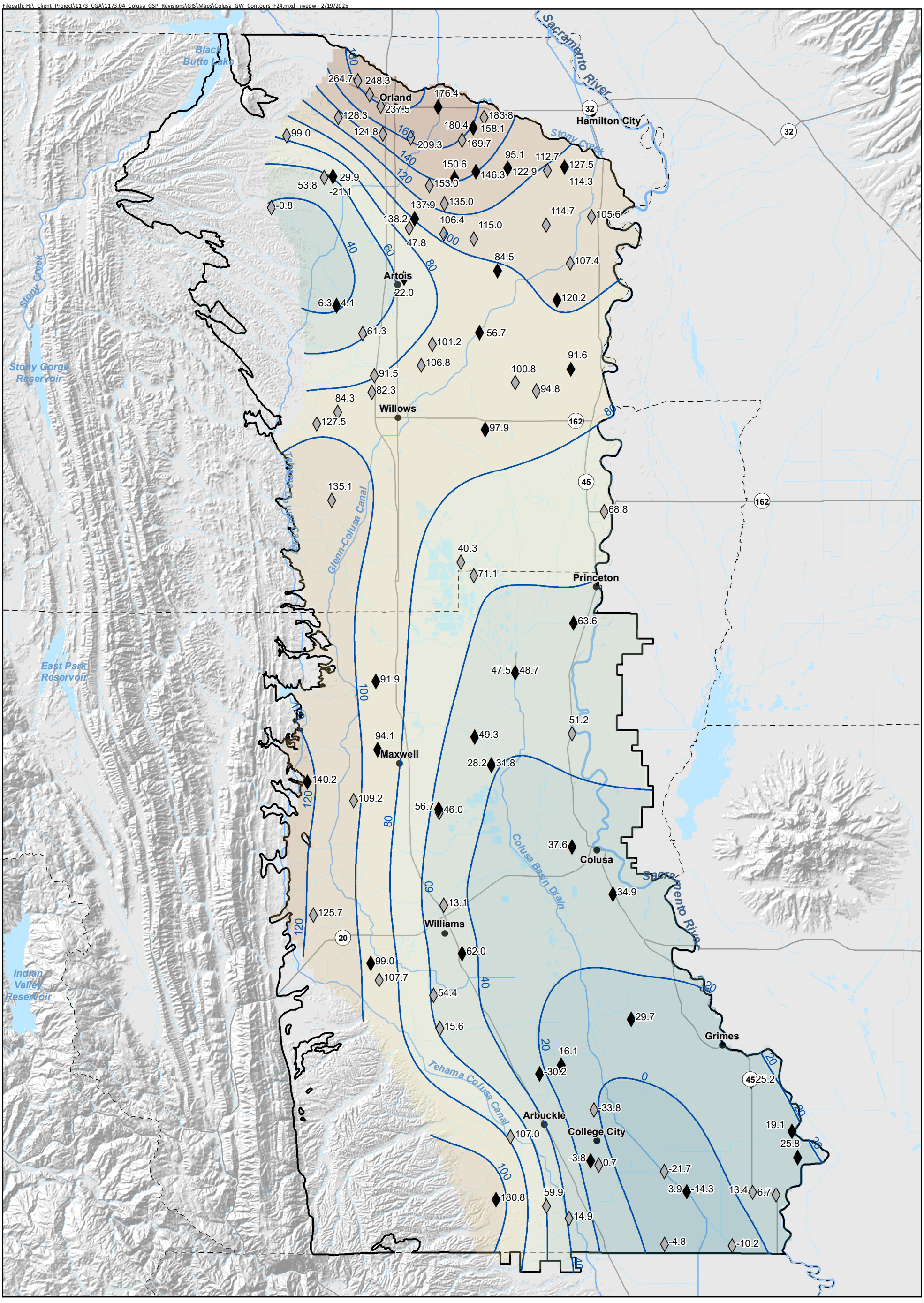

Groundwater Elevation Measurement (RMS Well Used for Contouring) (ft)

Groundwater Elevation Measurement (Non RMS Well Used for Contouring) (ft)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

Scale in Miles

Figure 1-3

Groundwater Elevation Contours Fall 2024

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2024

1.3 GROUNDWATER HYDROGRAPHS (§356.2.B.1.B)

Groundwater elevation hydrographs for each RMS well identified in the GSP are presented in **Appendix B**. The hydrographs include the RMS well Sustainable Management Criteria (SMC), groundwater elevation summary statistics, and WY index and type. The average Spring and Fall 2024 groundwater levels measured at each RMS well are presented in **Table 1-2**.

Groundwater levels typically fluctuate seasonally within and between WYs. Seasonal groundwater fluctuations occur primarily in response to groundwater pumping and recovery but can also be affected by land and water use activities (such as rice flood-up), recharge, and natural discharge. Precipitation, applied irrigation water, managed aquifer recharge projects, and seepage from local streams, rivers, and canals are all likely sources of groundwater recharge in the Subbasin. Groundwater pumping, which typically occurs from April to September, is the predominant contributor to groundwater discharge in the Subbasin. Consequently, groundwater levels are usually highest in the spring and lowest during the irrigation season in the summer months. However, the timing and spatial distribution of the above-mentioned events and activities may result in localized impacts to the typical seasonal trend. Groundwater fluctuations are particularly noticeable in groundwater dependent areas or where/when groundwater is relied upon during drought years to compensate for reductions in surface water supplies.

In WY 2024, above normal hydrologic conditions and full allocations of surface water supplies contributed to a stable or higher groundwater elevations across much of the Subbasin as compared to recent drought years, particularly 2022. Although most of the groundwater elevations recoveries occurred in WY 2023 due to its wet hydrologic conditions, the RMS wells near Stony Creek and the Sacramento River generally continued to exhibit additional groundwater elevation recoveries in 2024, or saw continued stability in groundwater levels. However, a smaller portion of wells, particularly those along the southwestern edge of the Subbasin, have not fully recovered from the decline in groundwater elevations since Spring 2022. This may be due to reduced recharge in those areas, greater extraction, or a combination of factors.

2 Groundwater Extraction (§356.2.b.2)

This section summarizes the measurement methods, accuracy, and volumes of groundwater extraction in the Colusa Subbasin for the current reporting year (WY 2024).

2.1 QUANTIFICATION AND ACCURACY

Groundwater extraction in the Subbasin was either measured directly from flowmeters or was estimated as the volume of water needed to satisfy water demand (i.e., evapotranspiration of applied water (ET_{aw}) or per capita water use requirements) after accounting for available surface water supplies and typical water use efficiencies. Flowmeter records were used when available. Otherwise, groundwater extraction was estimated using the best available information to characterize water use requirements in the Subbasin. Specific data sources and methods are described in **Section 2.2**, below, and in **Appendix D**.

Table 2-1 summarizes groundwater extraction in WY 2024 and the associated measurement methods, by water use sector. Additional details about the groundwater extraction measurement methods and accuracy are provided in **Table 2-2**.

Table 2-3 summarizes the total groundwater extraction by water use sector in the Subbasin between WY 2016 (following the historical water budget period in the GSP) and WY 2024 (the current reporting year). In total, an estimated 562,100 acre-feet (af) of groundwater was extracted for use within the Subbasin area during WY 2024. Of this total, the majority was extracted for agricultural use (approximately 535,000 af), while the remainder was extracted for urban and environmental uses. The wetter hydrologic conditions in 2023-2024 compared to the 2020-2022 drought period and the substantial increase in surface water supplies in 2023-2024 compared to 2022 facilitated a substantial reduction in groundwater extraction compared to recent years.

Figure 2-1 provides a map of the estimated groundwater extraction and applied surface water in each water budget subregion of the Subbasin in WY 2024. These results come from the water use analysis described in **Appendix D**, and are based on the methods and data sources described in **Sections 2 and 3**. The subregions are generally consistent with the C2VSimFG-Colusa subregions described in the GSP, representing the major water supplier service areas in the Subbasin. Subregions are also presented delineating urban areas and the three national wildlife refuges in the Subbasin. The remainder of the Subbasin is represented by two subregions that encompass all areas within each GSA that are outside the service areas of the water suppliers and are primarily dependent on groundwater supplies for irrigation and other water uses. Those “groundwater dependent areas” (GDAs) represent all noncontiguous "white areas” in each GSA outside the boundaries of all other subregions.

Notably, **Figure 2-1** illustrates the average depths of groundwater extraction and applied surface water over the entire gross area of each subregion based on available information. Groundwater extraction and applied surface water are reported in aggregate by subregion, so the precise location of use is neither verified nor indicated. However, it is expected that groundwater pumping would generally be higher in irrigated areas of the Subbasin without access to surface water, and generally lower in irrigated areas of the Subbasin with access to surface water in WY 2024.

Table 2-1. Groundwater Extraction Volumes and Measurement Methods by Water Use Sector, and Uncertainty (2024).

Water Use Sector	Groundwater Extraction, 2024 (acre-feet, rounded[1])	Measurement Method	Measurement Method Description
Agricultural	531,100	Estimate	Estimated from water budget (based on land use, ET, consumptive use fraction, and surface water supplies)
	3,890	Direct	Flowmeter records from the Colusa Subbasin WMPP
Urban[2]	6,700	Estimate	Estimated from water budget (based on population, per capita water use requirements, and outdoor use)
	4,290	Direct	Flowmeter records from cities
Managed Wetlands	16,100	Estimate	Estimated from water budget (based on land use, ET, consumptive use fraction, surface water supplies, and ponding water use requirements from GSP analyses)
Managed Recharge	0	Estimate	No groundwater extraction for groundwater recharge.
Native Vegetation	-	Estimate	No noted groundwater extraction for native vegetation, per GSP analyses
Colusa Subbasin	**Groundwater Extraction, 2024 (acre-feet, rounded)**	**Estimated Uncertainty**	**Uncertainty Source**
Total	**562,100**	20%	Volume-weighted combined uncertainty of water budget estimates (approximately 20%) and flowmeter records (approximately 5%)

[1] Estimates rounded to 100 af, direct measurements rounded to 10 af.
[2] The Urban water use sector includes urban, industrial, rural residential, and semi-agricultural areas in the Colusa Subbasin.

Table 2-2. Groundwater Extraction Volumes, Measurement Methods, and Accuracy Summary (2024).

Groundwater Extraction, 2024 (acre-feet, rounded)	Measure-ment Type	Measurement Method Description	Accuracy	Accuracy Description
8,180	Meters	Flowmeter records of groundwater extraction for urban use from cities and for agricultural use from the Colusa WMPP.	5-10%	Estimated based on the typical field accuracy of meters, and the typical combined accuracy of volumes in urban distribution systems (accounting for metered groundwater, metered deliveries, unmetered deliveries, and apparent losses)
547,200	Estimate based on Land Use, ET	Estimated from a water use analysis based on land use, ET, available surface water supplies, and ponding water use requirements (where applicable).	20-30%	Typical uncertainty of a water use analysis approach, considering the combined uncertainty of other flow paths and the data sources used to quantify those (Clemmens and Burt, 1997)
6,700	Estimate based on Population, Urban/Rural Water Use	Estimated in urban and rural areas where flowmeter records were unavailable based on annual population data, monthly per capita water use requirements, and outdoor use assumptions.	20-30%	Typical uncertainty when calculated from population, per capita water use, and outdoor use assumptions, considering the combined uncertainty of those data sources.

Table 2-3. Groundwater Extraction Volumes, by Water Use Sector (acre-feet, rounded).

WY (Type)	Agricultural	Urban[1]	Managed Wetlands	Native Vegetation	Total
2016 (BN)	598,000	9,500	24,000	-	631,500
2017 (W)	542,000	9,700	21,000	-	572,700
2018 (BN)	566,000	9,800	26,000	-	601,800
2019 (W)	611,000	9,600	22,000	-	642,600
2020 (D)	723,000	10,200	27,000	-	760,200
2021 (C)	933,000	10,200	34,000	-	977,200
2022 (C)	860,000	10,900	28,000	-	898,900
2023 (W)	552,900	8,700	15,800	-	577,400
2024 (AN)	535,000	11,000	16,100	-	562,100
Average (2016-2024)	**658,000**	**10,000**	**24,000**	**-**	**692,000**

[1] The Urban water use sector includes urban, industrial, rural residential, and semi-agricultural areas in the Colusa Subbasin.

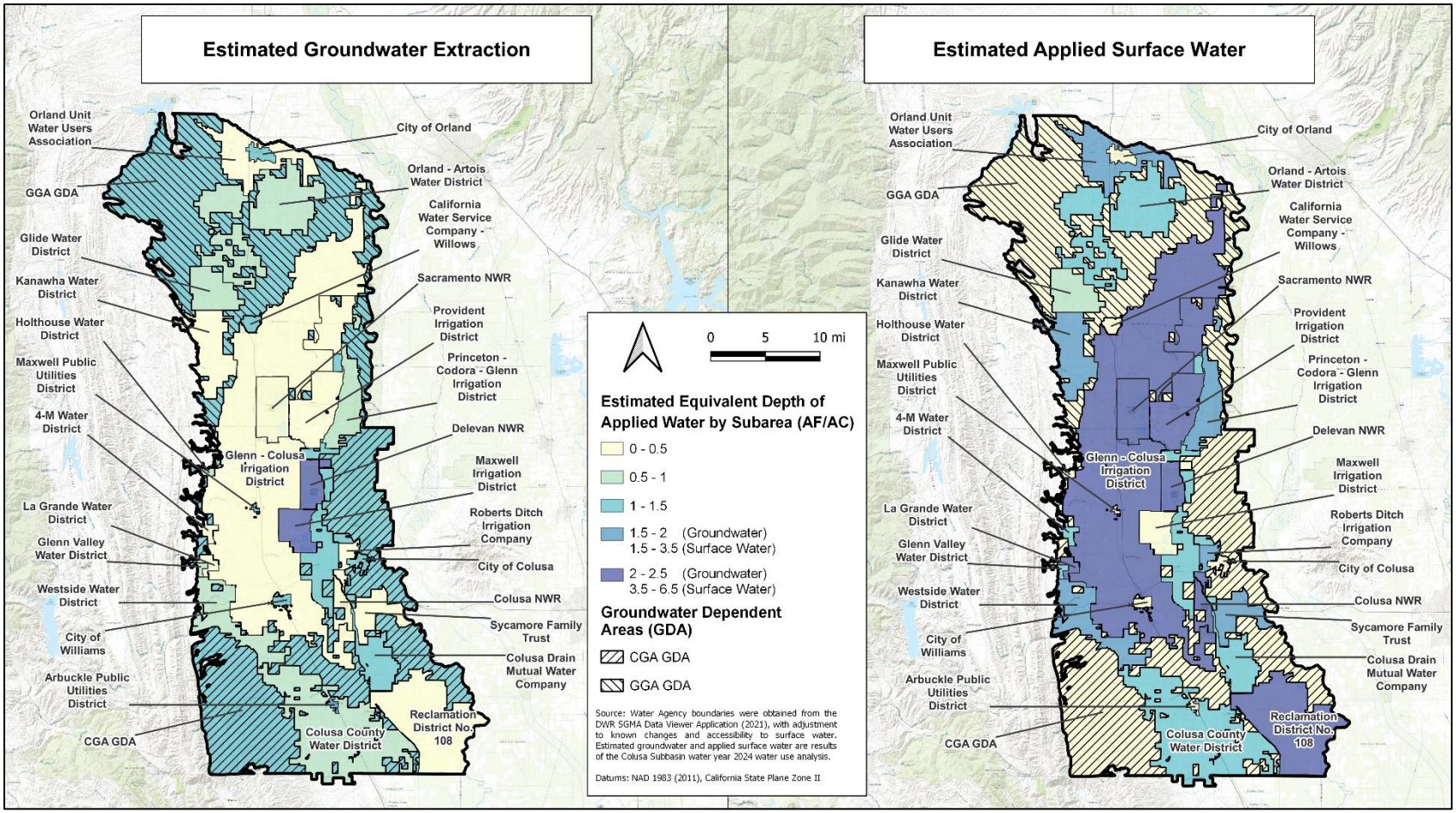

Figure 2-1. Estimated Groundwater Extraction and Applied Surface Water by Subregion.*

Subregions are generally consistent with the C2VSimFG-Colusa subregions described in the GSP, representing major water supplier service areas, urban areas, and national wildlife refuges. (Left) The groundwater extraction volumes per acre represent measured and/or estimated groundwater extraction in 2024. (Right) The surface water use volumes per acre represent measured and/or estimated applied surface water use in 2024.

2.2 DATA SOURCES

Direct measurements of groundwater extraction in urban areas were summarized from flowmeter records available from the Cities of Colusa, Orland, and Williams in 2024. These data are assumed to represent urban groundwater extraction for delivery and use within the boundaries of each respective service area. Direct measurements of groundwater extraction in agricultural areas were summarized from flowmeter records available from the Subbasin Well Monitoring Pilot Program (WMPP). While some water districts operate groundwater wells in certain years, no districts reported groundwater pumping for district supplies within the Subbasin in 2024.

Estimates of groundwater extraction in agricultural and managed wetland areas of the Subbasin were quantified through the Groundwater Extraction Estimates from Earth Observations (GEEEO) approach (described in **Appendix D**) as the amount of water needed to meet remaining ET_{aw} demand after applying available surface water supplies. Groundwater extraction estimates were calculated using GEEEO with consideration of land use, evapotranspiration (ET), consumptive use fractions, and other parameters impacting water demand and irrigation. Available surface water supplies were quantified as described in **Section 3**, below. Certain GEEEO refinements were made in 2024 to improve quantification of ET of precipitation and to incorporate parcel-level surface water delivery data, where available. These refinements are discussed in **Appendix D**, and have consequently refined the GEEEO-based groundwater extraction estimates in WY 2024.

Estimates of groundwater extraction in urban and rural areas where flowmeter records were unavailable were estimated based on annual population data, monthly per capita water use requirements, and consideration of outdoor water use in urban areas based on the GEEEO approach. Annual population data were obtained from the California Department of Finance or from the United States Census Bureau American Community Survey for cities and census designated places in Colusa and Glenn Counties. Average monthly per capita water use rates in 2024 were quantified from population data and available historical pumping data in Arbuckle, Maxwell, and Willows following similar methods identified during GSP development (see GSP Appendix 3D).

In the Subbasin, precipitation is understood to be the primary originating source of water available to native vegetation. Groundwater uptake through the root zone of native vegetation was evaluated during GSP analyses, but was ultimately not included in the final GSP water budgets due to confounding factors regarding the origins of water that is used. During GSP implementation, the GSAs will seek to work with resource agencies, stakeholders, beneficial users and the public to fill data gaps and refine the understanding of groundwater use by native vegetation, including groundwater dependent ecosystems that may be identified in the Subbasin. The best methodology for quantifying water use by native vegetation will be assessed in subsequent analyses moving forward and documented to the extent applicable in subsequent annual reports and/or periodic evaluations and potential plan amendments.

3 Surface Water Supply (§356.2.b.3)

This section summarizes the annual volumes and data sources for surface water supplies used, or available for use, within the Colusa Subbasin through the current reporting year (2024).

3.1 QUANTIFICATION BY WATER SOURCE TYPE

Surface water supplies available to certain entities within the Subbasin include surface water contract deliveries, water rights diversions, and riparian or other diversions of natural flows crossing the Subbasin.

In this Annual Report, surface water supplies used or available for use are assumed to be the volume of surface water diverted by agencies and water rights users in the Subbasin.[4] Estimated surface water deliveries to water users are also reported.

Per the GSP Regulations, surface water supplies must be reported by water source type. According to the Regulations:

> *"Water source type" represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.*

Table 3-1 summarizes the total surface water supplies diverted and **Table 3-2** summarizes the total estimated surface water supplies delivered (used or available for use) in the Subbasin, by water source type. Similar to 2023, WY 2024 was marked by full allocations and thus substantially greater surface water supplies compared to the severe curtailments seen in the first year of GSP implementation. Sustained access to contract surface water supplies is inextricably tied to groundwater sustainability, and is necessary for the ongoing vitality of the Subbasin and its communities.

3.1.1 CVP Supplies

Agencies that have contracts with the United States Bureau of Reclamation (USBR) for CVP supplies can receive CVP supplies in the Subbasin. CVP supplies used for agriculture are received via the Tehama-Colusa Canal and via the Sacramento River. CVP supplies are also delivered to the Sacramento, Delevan, and Colusa National Wildlife Refuges through the Refuge Water Supply Program according to their respective contract quantities established through the Central Valley Project Improvement Act.

Diversions and deliveries of CVP supplies reported in this Annual Report include only those supplies delivered to contractors whose service areas are located within the Subbasin. This water is used or available for various beneficial uses within and downstream of the service area of the entities that receive this water.

3.1.2 Local Supplies

Local supplies available to certain entities within the Subbasin primarily include Orland Project supplies delivered along the South Canal to areas within the Subbasin, and relatively smaller diversions of natural flows, when available, from along the Sacramento River and the Colusa

[4] In the first Annual Report (for water year 2021), surface water supplies used or available for use are assumed to be the volume of surface water diverted *and delivered* by agencies and water rights users in the Colusa Subbasin. The reporting approach in subsequent Annual Reports has changed following consideration that (1) all diversions are "available for use," and that (2) diversions data is directly measured, and thus provides a clearer understanding of "surface water supplies available for use" from year to year.

Basin Drain (Colusa Drain). Diversions of natural flows, especially along the Colusa Drain, are generally limited in dry years. Most of the water in the Colusa Drain is generally passed through by upstream diverters from the Sacramento River, and is therefore not accounted as local supplies to avoid double-counting surface water supplies.

3.1.3 Reuse

Some reuse does occur within the Subbasin, primarily along the Colusa Drain. The Colusa Drain captures rainfall runoff, agricultural runoff, return flows, and spillage and conveys flows from the agricultural lands in the Subbasin to the Sacramento River and the Tule Canal near Knights Landing in Yolo County. Some of the water within the Colusa Drain is captured and reused prior to being discharged into the Sacramento River. Some local reuse also occurs, particularly for irrigation of rice crops. However, these supplies originate as part of the CVP supplies and local supplies accounted in **Table 3-1** and are generally not distinguished from those supplies. Reuse is not quantified in this Annual Report to avoid double-counting water supplies, though reuse may be quantified in future Annual Reports.

3.2 DATA SOURCES

Table 3-3 summarizes the data sources and estimation procedures for quantifying diversions and deliveries in the Subbasin, by water source type. Diversions are generally directly measured and reported in the Subbasin. Deliveries were estimated based on diversions data with adjustments for seepage, evaporation, and downstream spillage outflows following methods similar to those used in GSP development.

Table 3-1. Surface Water Diversions (Supplies Used or Available for Use), by Water Source Type (acre-feet, rounded).

WY (Type)	CVP Supplies	Local Supplies	Total
2016 (BN)	1,258,000	42,000	1,300,000
2017 (W)	1,232,000	44,000	1,276,000
2018 (BN)	1,298,000	50,000	1,348,000
2019 (W)	1,191,000	45,000	1,236,000
2020 (D)	1,200,000	54,000	1,254,000
2021 (C)	986,000	28,000	1,014,000
2022 (C)	327,000	45,000	372,000
2023 (W)	1,298,600	44,500	1,343,100
2024 (AN)	1,502,100	41,400	1,543,500
Average (2016-2024)	**1,144,000**	**44,000**	**1,188,000**

Table 3-2. Surface Water Deliveries, by Water Source Type (acre-feet, rounded).

WY (Type)	CVP Supplies	Local Supplies	Total
2016 (BN)	1,146,000	35,000	1,181,000
2017 (W)	1,120,000	37,000	1,157,000
2018 (BN)	1,185,000	42,000	1,227,000
2019 (W)	1,082,000	37,000	1,119,000
2020 (D)	1,093,000	45,000	1,138,000
2021 (C)	895,000	23,000	918,000
2022 (C)	306,000	38,000	344,000
2023 (W)	1,181,300	37,300	1,218,600
2024 (AN)	1,357,700	34,700	1,392,400
Average (2016-2024)	**1,041,000**	**37,000**	**1,078,000**

Table 3-3. Data Sources for Surface Water Supplies.

Associated Agency	Water Source Type	Water Source Detail	Diversions Data Sources[1]
4-M Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR Central Valley Operations (CVO) delivery reports (2016-2024), Tehama-Colusa Canal Authority (TCCA) Report
Colusa County Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Colusa Drain Mutual Water Company	CVP Supplies	Colusa Basin Drain Diversions	District-reported diversions, GCID district records
Colusa National Wildlife Refuge	CVP Supplies	Refuge Water Supply Program Contract Deliveries	Contract Quantities and USBR Annual CVP Allocation Quantities
Cortina Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Davis Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Delevan National Wildlife Refuge	CVP Supplies	Refuge Water Supply Program Contract Deliveries	Contract Quantities and USBR Annual CVP Allocation Quantities
Glenn-Colusa Irrigation District	CVP Supplies	Tehama-Colusa Canal Deliveries, Main Canal Diversions from Sacramento River	USBR CVO delivery reports (2016-2024), district records, water rights deliveries during winter months
Glenn Valley Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Glide Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Holthouse Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Kanawha Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
La Grande Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Maxwell Irrigation District	CVP Supplies	Sacramento River Deliveries (Long-term contracts)	USBR CVO delivery reports (2016-2024)
Misc. Sac River Diversions	CVP Supplies	Sacramento River Deliveries (Long-term contracts)	USBR CVO delivery reports (2016-2024), aggregated for various water users in the Colusa Subbasin outside other district areas
Myers-Marsh Mutual Water Company	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Orland-Artois Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report
Orland Unit Water Users' Association	Local Supplies	Orland Project (South Canal only)	USBR CVO delivery reports (2016-2024)
Princeton-Codora-Glenn Irrigation District	CVP Supplies	Sacramento River Deliveries (Long-term contracts)	USBR CVO delivery reports (2016-2024)
Provident Irrigation District	CVP Supplies	Sacramento River Deliveries (Long-term contracts)	USBR CVO delivery reports (2016-2024), water rights diversions data
Reclamation District #108	CVP Supplies	Sacramento River Deliveries (Long-term contracts)	USBR CVO delivery reports (2016-2024), limited to estimated use in Colusa Subbasin
Robert's Ditch Irrigation Company	CVP Supplies	Sacramento River Deliveries (Long-term contracts)	USBR CVO delivery reports (2016-2024)
Sacramento National Wildlife Refuge	CVP Supplies	Refuge Water Supply Program Contract Deliveries	Contract Quantities and USBR Annual CVP Allocation Quantities
Sycamore Mutual Water Company	CVP Supplies	Sacramento River Deliveries (Long-term contracts)	USBR CVO delivery reports (2016-2024)
Westside Water District	CVP Supplies	Tehama-Colusa Canal Deliveries	USBR CVO delivery reports (2016-2024), TCCA Report

4 Total Water Use (§356.2.b.4)

Total water use in WY 2024 is reported in **Table 4-1** by water source type. Total water use in WY 2024 is also reported in **Table 4-2** by water use sector, distinguishing between agricultural, urban, managed wetlands, native vegetation, and managed recharge (the total volume of water used for groundwater recharge in the Subbasin in WY 2024). **Figure 4-1** graphically depicts the annual total water use in the Subbasin from 2016-2024, distinguishing between groundwater and surface water supplies. The volume of total water use is summarized from the results presented in **Section 2** and **Section 3** of this Annual Report. The methods used to determine the total water use volumes are the same as those indicated in **Section 2** and **Section 3.**

The above normal hydrologic conditions and full surface water allocations in 2024 led to greater use of surface water compared to groundwater, similar to 2023 and to historical conditions in the Subbasin seen prior to the 2020-2022 drought period. Conditions in 2024 have continued the positive change since the tumultuous conditions of 2020-2022, following three years of drought, difficult hydrologic and weather conditions, and severe constraints on water supplies.

Several pilot recharge projects and other efforts conducted in 2024 led to use of approximately 33,000 af of surface water for managed recharge and in-lieu recharge. All of this water, plus a large portion of other water supplies used for irrigation, has provided recharge benefits to the aquifer, as indicated by the increased groundwater levels (or continuance of stable groundwater levels) observed across much of the Subbasin in 2024.

Table 4-1. Total Water Use in Water Year 2024, by Water Source Type (acre-feet, rounded).

Water Source Type	Water Use (acre-feet)	Methods Used to Determine
Groundwater	562,100	Combined measured and estimated groundwater extraction (see Section 2).
Surface Water	1,543,500	Measured surface water diversions (see Section 3).
Recycled Water	0	No quantified recycled water use in the Colusa Subbasin.
Reused Water	0	No quantified reused water use in the Colusa Subbasin.
Other	0	No quantified other water use in the Colusa Subbasin.
Total	**2,105,600**	

Table 4-2. Total Water Use in Water Year 2024, by Water Use Sector (acre-feet, rounded).

Water Use Sector	Water Use (acre-feet)	Methods Used to Determine
Agricultural	1,953,100	Combined groundwater extraction and surface water diversions for agricultural use (see Sections 2-3).
Urban[1]	11,000	Groundwater for urban use (see Section 2).
Managed Wetlands	108,500	Surface water for managed wetlands use (see Section 3).
Managed Recharge	33,000	Benefits of projects and management actions (see Section 6.2).
Native Vegetation	-	No noted groundwater extraction or surface water diversions for native vegetation, per GSP analyses.
Other	-	No quantified other water use in the Colusa Subbasin.
Total	**2,105,600**	

[1] The Urban water use sector includes urban, industrial, rural residential, and semi-agricultural areas in the Colusa Subbasin.

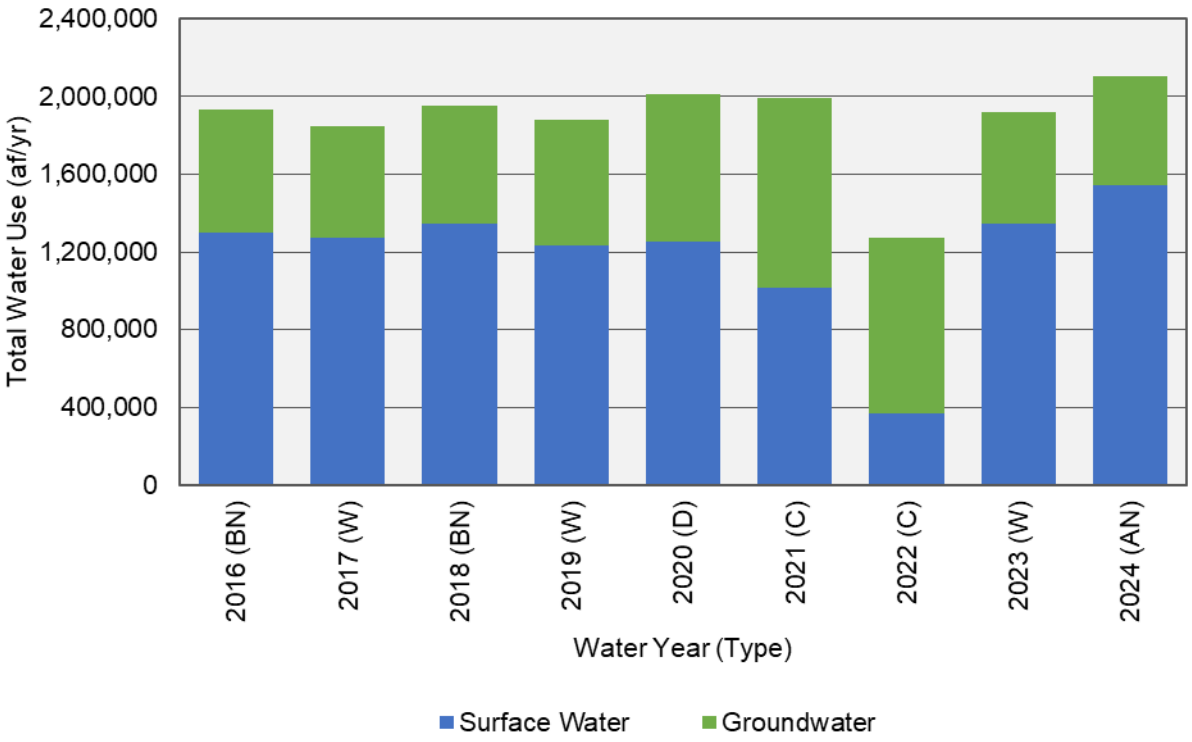

Figure 4-1. Annual Total Water Use – 2016 through 2024.

5 Change in Groundwater Storage (§356.2.b.5)

5.1 CHANGE IN GROUNDWATER STORAGE MAPS

Consistent with 23 CCR §354.18.b, changes in groundwater storage and groundwater elevation were calculated for individual years between Spring 2015 and Spring 2024, based on a comparison of the annual spring groundwater elevations representing seasonal high groundwater conditions.

Change in groundwater storage reported in the initial GSP was estimated using the C2VSimFG-Colusa groundwater model, an integrated hydrologic flow model application created and used during GSP development. Due to uncertainty in the model and limitations in the ability to update the complete groundwater model for each Annual Report, an alternate method for determining change in groundwater storage has been utilized for the Annual Reports. This method has been calibrated to provide comparable results in the pre-2015 period relative to the simulated change in storage outputs from the C2VSimFG-Colusa groundwater model.

Change in groundwater storage – as a measure of overdraft – was estimated from changes in groundwater levels at RMS wells using a Thiessen polygon method. Thiessen polygons, also known as Voronoi polygons, were constructed for each groundwater level RMS well with consecutive year-to-year spring groundwater elevation measurements. Annual change in groundwater storage was then calculated based on the change in measured spring-to-spring groundwater elevation at each RMS well multiplied by the area of the surrounding Thiessen polygon associated with that RMS well and a storage coefficient of 0.063.[5] Spring groundwater elevations were calculated each year as the average of all measurements flagged by DWR as "good" data between February-April. A storage coefficient of 0.063 is considered reasonable given the depositional history, sediment types, and aquifer characteristics of the Primary Aquifer within the Subbasin, and the range of coefficients proposed for the Subbasin in prior technical work. A constant storage coefficient was applied to the entire Subbasin.

Figure 5-1 shows the annual spring-to-spring change in groundwater storage for Spring 2023-2024. **Appendix C** contains the annual spring-to-spring change in groundwater storage maps for Spring 2015-2016 through Spring 2023-2024. A positive change in groundwater storage means that the volume of groundwater in storage increased, and is shown in blue, whereas a negative change in groundwater storage means that the volume of groundwater in storage decreased, and is shown in red.

Table 5-1 lists the annual change in groundwater storage and cumulative change in groundwater storage in the Primary Aquifer since Spring 2015. Consistent with the April 2024 Revised Colusa Subbasin GSP, overdraft is also estimated as the annual change in groundwater storage (where negative change in storage represents overdraft). Average overdraft is also calculated based on the last five and ten years of annual change in groundwater storage.

Fluctuations in groundwater storage in the Subbasin follow a pattern typically seen in the majority of the Sacramento Valley. Groundwater extraction typically peaks in the summer when demand is high. During this time the primary pathways for groundwater recharge are deep percolation from irrigation applications and canal seepage. During wetter years, net reductions in groundwater

[5] Annual change in groundwater storage was recalculated for all years in February 2024 using updated groundwater elevation data available from DWR and a refined aquifer storage coefficient of 0.063. The refined storage coefficient was updated from the storage coefficient used in previous years (0.10) during the GSP revisions process to more closely align the average groundwater storage estimates from this methodology with the average groundwater storage estimates from the GSP groundwater model over the 1990-2015 period. Earlier values have changed following the inclusion of this updated information.

storage during the summer are replenished over the winter from precipitation and surface water, allowing storage to potentially rebound by the following spring. This pattern is often disrupted during drier years and drought periods when demands for groundwater may equal or exceed those of normal and wet years, and reduced precipitation, lower stream levels, and the possibility of curtailed surface water deliveries reduces opportunities to replenish depleted storage. The seasonal and annual change in groundwater storage trends can be seen in groundwater level RMS hydrographs (**Appendix B**) and the Thiessen polygon change in storage estimates (**Appendix C**).

As described throughout this report, above normal hydrologic conditions and full allocations of surface water supplies in 2024 generally resulted in higher groundwater elevations across much of the Subbasin, as compared to the groundwater elevation declines and tumultuous conditions of 2020-2022, following three years of drought and severe constraints on water supplies. Conditions in WY 2024 have resulted in a net increase in groundwater storage. The change in groundwater storage from Spring 2023 to Spring 2024 was approximately +188 thousand acre-feet (taf), and the cumulative change in groundwater storage from Spring 2015 to Spring 2024 was approximately -337 taf. The average overdraft was approximately 92 taf per year over the last five-year period (beginning spring 2019), and approximately 55 taf per year over the last ten-year period (beginning spring 2014). The last five year period includes the 2020-2022 drought that preceded recent wet conditions, and thus the average change in groundwater storage is lower than the ten-year average. However, the overdraft over the longer-term ten-year average period is lower than the estimated overdraft for the Subbasin in the April 2024 Revised Colusa Subbasin GSP (62 taf per year, averaged over 2016-2021). The GSAs will continue to monitor and report overdraft each Annual Report. In the meantime, the GSAs are working diligently to develop PMAs, including recharge efforts as well as the demand management program. Development of the demand management program began in 2024 and will continue consistent with the terms and timeline expressed in the MOU signed and included in the April 2024 Revised Colusa Subbasin GSP. Additional details on this process are provided in **Section 6.2**.

5.2 GROUNDWATER USE AND CHANGE IN GROUNDWATER STORAGE

Annual groundwater extractions and change in groundwater storage in the Subbasin are shown in **Figure 5-2** for WY 2015 through WY 2024. Groundwater extractions in WY 2016 through WY 2024 were estimated or directly measured following the procedures described in **Section 2**. Change in groundwater storage was estimated based on an annual comparison of spring groundwater elevations, described in **Section 5.1**. Historical groundwater extraction in WY 1990 through WY 2015 – including the period from January 1, 2015, to September 30, 2015 (the end of WY 2015) – are provided in the GSP historical water budgets (see Section 3.3.4 and Appendix 3E of the GSP). Historical groundwater extractions shown in WY 2015 were calculated in the C2VSimFG-Colusa groundwater flow model (described in the GSP).

Total annual groundwater extraction increased during the 2020-2022 drought period, but wetter conditions and full surface water allocations in 2023-2024 led to greater use of surface water compared to groundwater, similar to historical conditions in the Subbasin prior to the 2020-2022 drought period. The annual change in groundwater storage has fluctuated between -284,000 af and +261,000 af since WY 2016 (**Figure 5-2**).

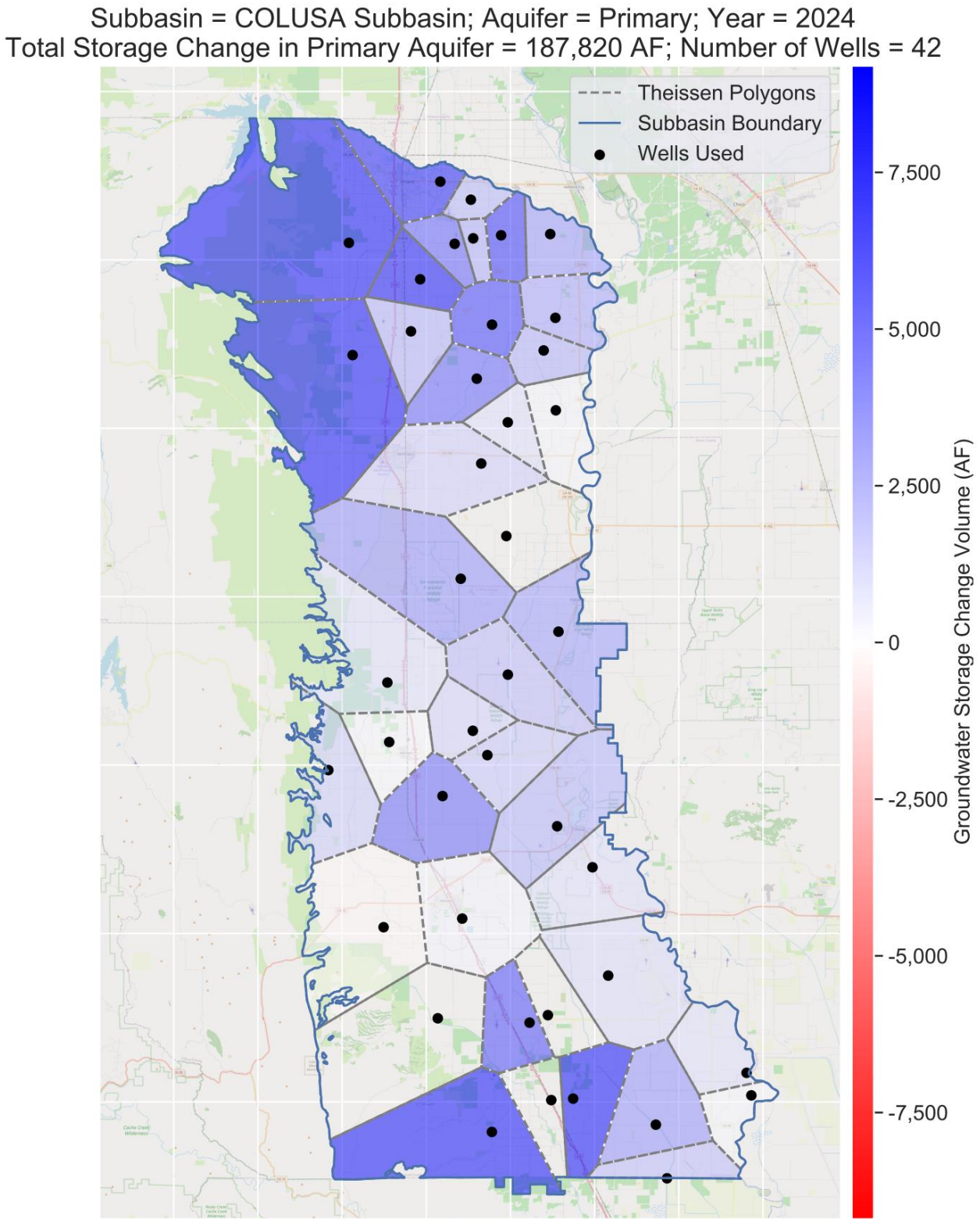

Figure 5-1. Change in Groundwater Storage in the Primary Aquifer – Spring 2023 through Spring 2024.

Table 5-1. Estimated Change in Groundwater Storage in the Primary Aquifer and Overdraft – Spring 2015 through Spring 2024.

Analysis Time Period	Annual Change in Groundwater Storage[1,2] (taf)	Cumulative Change in Groundwater Storage since Spring 2015-2016 (taf)	Calculation Method
Spring 2015-2016	-106	-106	Estimated based on spring-to-spring changes in groundwater levels at RMS wells and a representative aquifer storage coefficient.
Spring 2016-2017	+259	153	
Spring 2017-2018	-149	4	
Spring 2018-2019	+119	123	
Spring 2019-2020	-196	-73	
Spring 2020-2021	-268	-341	
Spring 2021-2022	-204	-545	
Spring 2022-2023	+20	-525	
Spring 2023-2024	+188	-337	
Overdraft[2] (5-year Average)	92		
Overdraft[2] (10-year Average)	55		

[1] Annual change in groundwater storage was recalculated in February 2025 using updated groundwater elevation data available from DWR. Values may have changed slightly from earlier Annual Reports following analysis of updated information.
[2] Consistent with the April 2024 Revised Colusa Subbasin GSP, overdraft is estimated as the annual change in groundwater storage (where negative change in storage represents overdraft) through analysis of empirical groundwater elevation data from RMS wells in the Subbasin. Averages are calculated based on the last five and ten years of annual change in groundwater storage.

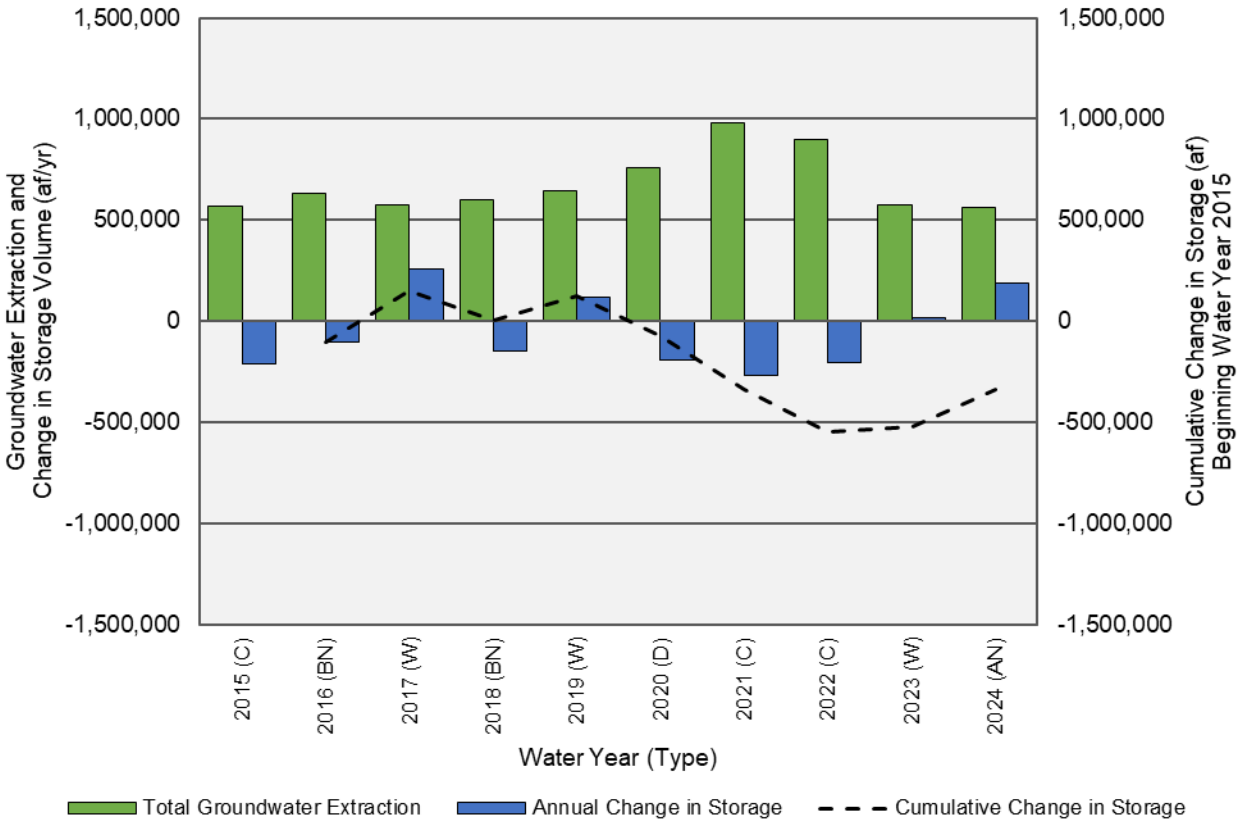

Figure 5-2. Annual Groundwater Extraction and Change in Groundwater Storage – 2015 through 2024.

6 Progress Toward Implementation (§356.2.c)

This section describes the progress that has been made toward GSP implementation in the Subbasin since the previous Annual Report, including current conditions in the Subbasin relative to each sustainability indicator, as well as efforts made toward implementation of the GSP and PMAs by the project proponents and GSAs.

6.1 CURRENT CONDITIONS FOR SUSTAINABILITY INDICATORS

The GSAs have been diligently tracking groundwater conditions in relation to the Sustainable Management Criteria (SMC) established in the GSP. This section presents the status of RMS measurements in relation to the Interim Milestones (IMs), Measurable Objectives (MOs), and Minimum Thresholds (MTs) defined in the GSP, including all applicable SMC revisions made in the April 2024 Revised Colusa Subbasin GSP (**Table 6-1**).

Details about the SMC revisions are included in the April 2024 Revised Colusa Subbasin GSP (Chapter 5), but broadly included:

- Revision of the groundwater level SMC to provide for:
    - Clear representation and evaluation of local conditions in different areas of the Subbasin, distinguishing between “Focus RMS wells” (RMS wells in areas where URs have occurred already, as observed by nearby subsidence and/or domestic wells impacts during the 2020-2022 drought period) and “Non-Focus RMS wells” (other RMS wells in areas where URs have not occurred, by the same metrics)
    - Updates to MTs that are clearly related to and will avoid URs, with distinction between MTs at Focus RMS wells (MTs set to the 2020-2022 lows, when URs occurred) and Non-Focus RMS wells (MTs set to the 2020-2022 lows minus a 15-25 ft margin, recognizing that URs have not occurred but protecting against potential well impacts and subsidence risk).
    - Updates to MOs to represent pre-SGMA conditions (2011-2015 average)
    - Updates to IMs to provide a realistic path from current condition to the MOs (for Focus RMS wells), or preserving groundwater levels at the MOs (for Non-Focus RMS wells).
- Revision of the subsidence SMC to provide for:
    - MTs that are clearly related to and will avoid URs based on analyses of critical infrastructure, recognizing the spatial extent, rate, and cumulative amounts of subsidence in the Subbasin.
    - MOs that represent sustainable conditions with no long-term subsidence.
    - IMs that provide a realistic path from current conditions to the MOs, given the groundwater level SMC and the GSAs’ planned PMAs, including demand management (see **Section 6.2**).

The April 2024 Revised Colusa Subbasin GSP also provided updates related to the GSAs’ approach to monitoring and evaluating subsidence conditions in the Subbasin, including:

- Revision of the subsidence monitoring program to provide for more frequent monitoring of the spatial extent, rate, and cumulative amounts of subsidence in the Subbasin using Interferometric Synthetic Aperture Radar (InSAR) data.
- Recurring evaluation of observed subsidence impacts on critical infrastructure, land uses, other beneficial uses and users or groundwater each year through a Colusa Subbasin Critical Infrastructure Working Group and annual solicitation of feedback and updates on any new potential undesirable results or subsidence-related impacts.

- Provision for specific actions that will guide the GSAs' subsidence response and mitigation efforts, including "yellow light" threshold (i.e., triggered prior to URs) and "red light" limit (i.e., triggered if URs occur) protocols.

These SMC revisions and changes in the approach to monitoring and evaluating groundwater conditions are included in the evaluation of WY 2024 in this Annual Report (see **Sections 6.1.1 and 6.1.4**).

The GSAs are continuing their efforts to avoid undesirable results and achieve the GSP sustainability goal by 2042 through proactive monitoring and management, including implementation of projects, management actions, and other efforts (see **Sections 6.2 and 6.3**).

Table 6-1. Summary of Minimum Thresholds, Measurable Objectives, and Undesirable Results (from Table 5-2 of the April 2024 Revised Colusa Subbasin GSP).

Sustainability Indicator	Monitoring Network	Undesirable Result	Minimum Threshold (MT)	Measurable Objective (MO)[1]
Chronic Lowering of Groundwater Levels	48 RMS wells monitored at least 2 to 3 times annually by DWR	12.5% (6 of 48) or more of RMS wells fall below their minimum threshold for two (2) consecutive fall measurements (seasonal lows)	Focus RMS wells: 2020-2022 minimum[1] Non-Focus RMS wells: 2020-2022 minimum[1] minus a margin of 15-25 feet selected for each RMS well to be protective of drinking water well impacts and subsidence (whichever is more limiting)	2011-2015 average[1]
Reduction in Groundwater Storage	Same as Groundwater Level monitoring network (Groundwater levels used as a proxy.)	Use groundwater levels as proxy	Use groundwater levels as proxy	Use groundwater levels as proxy
Seawater Intrusion	Not applicable	Not applicable	Not applicable	Not applicable
Degraded Groundwater Quality	25 RMS wells monitored by others at variable intervals under existing State of California regulatory programs	Electrical conductivity (EC) in 25% (6 of 23) of the RMS wells exceeds the MT for two (2) consecutive years	The higher of EC of 900 microSiemens per centimeter (µS/cm) (the recommended California Secondary Maximum Contaminant Level) OR the pre 2015 historical maximum measured EC	EC of 700 µS/cm (corresponding to an agricultural water quality objective providing for no yield reduction for crops commonly grown in the Subbasin)
Land Subsidence	InSAR data provided by DWR (annual rate of subsidence and cumulative subsidence, June 2015 to present, on a monthly time step)	• Cumulative subsidence averaged over 1 PLSS section exceeds 2 feet from January 2024, or • Average rate of subsidence in 10 or more contiguous PLSS sections, in any configuration, exceeds 0.1 feet per year (ft/yr) in two consecutive years	Cumulative Subsidence MT: • 2 ft from January 2024 Rate of Subsidence MT: • 0.1 ft/yr	Rate of subsidence is 0 ft/yr

Sustainability Indicator	Monitoring Network	Undesirable Result	Minimum Threshold (MT)	Measurable Objective (MO)[1]
Depletions of Interconnected Surface Water	12 RMS wells less than 200 feet deep and between 2,000 feet and five miles of interconnected streams (Sacramento River, Colusa Drain, Stony Creek)	25% (3 of 12) RMS wells fall below their MT for 24 consecutive months	Ten (10) feet below the observed fall 2015 groundwater level (Fall 2015 level is the measured elevation recorded on the date closest to Oct 15)	Mean of last 5 years available groundwater elevation measurements subject to interbasin coordination and consistency to ensure operational compatibility; A fixed value, not a rolling average

[1] Summary statistics from the indicated period were calculated using all available quality-controlled data flagged as "good" data in the DWR periodic groundwater levels dataset. For RMS wells where data was not available during the indicated period, the minimum threshold and measurable objective were calculated following the same method using available data from an alternate period representing recent historical conditions at that site.

6.1.1 Chronic Lowering of Groundwater Levels

During development of the April 2024 Revised Colusa Subbasin GSP, the GSAs determined that an undesirable result for chronic lowering of groundwater levels in the Subbasin is experienced if:

- Groundwater level decline results in drinking water well impacts that are unmitigated. Drinking water wells are identified as domestic wells and shallow wells that supply drinking water users (e.g., public water systems and state small water systems). Drinking water well impacts include (but are not limited to) wells that have gone dry and wells with significantly reduced supply.
- Groundwater level decline results in adverse impacts to land subsidence conditions in the Subbasin at rates observed since SGMA (i.e., since 2015), as evaluated by the land subsidence representative monitoring network in reference to the land subsidence SMC.
- Groundwater level decline results in adverse impacts to environmental uses and users of groundwater, as evaluated by the interconnected surface water representative monitoring network in reference to the interconnected surface water SMC.
- Adverse impacts occur for the agricultural economy of the Subbasin (provided that avoiding such impacts does not otherwise contribute to an undesirable result related to drinking water well impacts, subsidence impacts, or environmental impacts).

The specific, measurable groundwater conditions that could lead to these undesirable results are described in Section 5.3.1 of the April 2024 Revised Colusa Subbasin GSP.

The identification of an undesirable result for chronic lowering of groundwater levels was set to the conditions when 12.5% (6 of 48) or more of the RMS wells in the Subbasin fall below their MT groundwater elevation for two (2) consecutive fall measurements (seasonal lows). The methods used to define the MTs, MOs, and IMs for chronic lowering of groundwater levels are provided in **Table 6-1**. Notably, distinction is made between “Focus RMS wells” (RMS wells in areas where URs have occurred already, as observed by nearby subsidence and/or domestic wells impacts during the 2020-2022 drought period) and “Non-Focus RMS wells” (other RMS wells in areas where URs have not occurred, by the same metrics). The rationale and approach used to categorize RMS wells as Focus or Non-Focus RMS wells is described in Section 5.3.1 of the April 2024 Revised Colusa Subbasin GSP. In general, this approach was intended to spatially refine how SMC are defined in different portions of the Subbasin – which covers a large area of the Sacramento Valley, in excess of 720,000 acres – with consideration of the varied geologic, hydrogeologic, and water supply conditions experienced in different areas over time.

Table 6-2 provides a comparison of Spring and Fall 2024 groundwater levels to the established MT, MO, and IM (2027) groundwater elevations for each RMS well, with an indication of whether the RMS well is designated as a Focus or Non-Focus RMS well. The statuses of known monitoring site issues are also provided in **Table 6-2**. Note that groundwater elevation measurements are not available for some RMS wells during calendar year 2024, and so have no measurements to compare with MTs, MOs, and IMs. Hydrographs comparing the measured groundwater elevations with the MTs, MOs, and IMs are in **Appendix B**.

Of the 48 RMS wells for chronic lowering of groundwater levels, six were unable to be measured in the spring and eight were unable to be measured in the fall. All groundwater levels were above the MT at the Spring and Fall 2024 measurements, indicating that no undesirable results for chronic lowering of groundwater levels are currently occurring in the Subbasin.

The majority of RMS wells were at or above the MO and 2027 IM in Spring 2024, and all measured Focus RMS wells were above the 2027 IM in Spring and Fall 2024.

Table 6-2. Summary of Groundwater Levels Relative to Sustainable Management Criteria at Groundwater Level RMS Wells.

State Well Number	RMS Well Designation	Minimum Threshold (MT), feet AMSL[1]	Measurable Objective (MO), feet AMSL	Interim Milestone (IM) 2027, feet AMSL	Spring 2024 Conditions				Fall 2024 Conditions				Minimum Threshold Method	GSA	Status
					Groundwater Elevation (feet AMSL, rounded)	Difference relative to MT (feet AMSL, rounded)[2]	Difference relative to MO (feet AMSL, rounded)[2]	Difference relative to IM 2027 (feet AMSL, rounded)[2]	Groundwater Elevation (feet AMSL, rounded)	Difference relative to MT (feet AMSL, rounded)[2]	Difference relative to MO (feet AMSL, rounded)[2]	Difference relative to IM 2027 (feet AMSL, rounded)[2]			
12N01E06D004	Non-Focus	-67.8	1.1	1.1	16.5	84.3	15.4	15.4	-4.0	63.8	-5.1	-5.1	2020-2022 low minus margin (25.0 feet)	CGA	
13N01E11A001	Non-Focus	-8.1	26.0	26.0	27.1	35.2	1.1	1.1	25.0	33.1	-1.0	-1.0	2020-2022 low minus margin (25.0 feet)	CGA	
13N01W07G001	Focus	-36.2	12.7	-47.4	10.7	46.9	-2.0	58.1	-3.8	32.4	-16.5	43.6	2020-2022 low	CGA	
13N01W13P003	Non-Focus	-47.6	8.2	8.2	19.4	67.0	11.2	11.2	4.8	52.4	-3.4	-3.4	2020-2022 low minus margin (25.0 feet)	CGA	
13N01W22P002	Non-Focus	-11.7	28.6	28.6	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2010-2022 low minus margin (25.0 feet)	CGA	Measurement discontinued. Last meas. 2016.
13N02W12L001	Focus	-40.3	24.7	-56.0	16.7	57.0	-8.0	72.7	-13.0	27.3	-37.7	43.0	2020-2022 low	CGA	
13N02W15J001	Focus	-4.0	58.0	-11.7	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2010-2022 low	CGA	Measurement discontinued. Last meas. 2015.
13N02W20H002	Focus	167.7	189.6	155.0	180.0	12.3	-9.6	25.0	180.7	13.0	-8.9	25.7	2020-2022 low	CGA	
14N01E35P003	Non-Focus	-16.0	28.2	28.2	33.2	49.2	5.0	5.0	28.5	44.5	0.3	0.3	2020-2022 low minus margin (25.0 feet)	CGA	
14N01W04K003	Non-Focus	-2.2	32.2	32.2	33.5	35.7	1.3	1.3	Not Available	Not Available	Not Available	Not Available	2020-2022 low minus margin (25.0 feet)	CGA	Tape hung up.
14N02W13N001	Focus	6.8	25.1	0.5	26.4	19.6	1.3	25.9	16.1	9.3	-9.0	15.6	2020-2022 low	CGA	
14N02W22A005	Focus	-82.7	1.1	-94.8	13.6	96.3	12.5	108.4	-3.5	79.2	-4.6	91.3	2020-2022 low	CGA	
14N02W29J001	Focus	18.0	55.5	0.2	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2015-2022 low	CGA	Measurement discontinued. Last meas. 2017.
14N03W14Q003	Focus	-120.6	53.5	-132.7	-1.1	119.5	-54.6	131.6	Not Available	Not Available	Not Available	Not Available	2020-2022 low	CGA	Pumping in Fall
14N03W24C001	Focus	36.3	59.3	24.2	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2020-2022 low	CGA	Tape hung up. Last meas. 2021.
15N01W05G001	Non-Focus	0.6	34.7	34.7	43.0	42.4	8.3	8.3	35.4	34.8	0.7	0.7	2020-2022 low minus margin (25.0 feet)	CGA	
15N02W19E001	Non-Focus	36.5	73.6	73.6	72.5	36.0	-1.1	-1.1	62.0	25.5	-11.6	-11.6	2020-2022 low minus margin (22.8 feet)	CGA	
15N03W08Q001	Non-Focus	75.6	109.5	109.5	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2020-2022 low minus margin (25.0 feet)	CGA	Last meas. 2022.
15N03W20Q002	Non-Focus	83.2	113.1	113.1	111.3	28.1	-1.8	-1.8	111.5	28.3	-1.6	-1.6	2020-2022 low minus margin (25.0 feet)	CGA	
16N02W05B003	Non-Focus	1.1	49.0	49.0	56.5	55.4	7.5	7.5	43.9	42.8	-5.1	-5.1	2020-2022 low minus margin (25.0 feet)	CGA	
16N02W25B002	Non-Focus	7.4	35.6	35.6	48.0	40.6	12.4	12.4	37.6	30.2	2.0	2.0	2020-2022 low minus margin (15.8 feet)	CGA	
16N03W14H006	Non-Focus	8.5	51.4	51.4	56.9	48.4	5.5	5.5	46.0	37.5	-5.4	-5.4	2020-2022 low minus margin (25.0 feet)	CGA	
16N04W02P001	Non-Focus	101.2	144.3	144.3	142.3	41.1	-2.0	-2.0	140.0	38.8	-4.3	-4.3	2020-2022 low minus margin (25.0 feet)	CGA	
17N02W09H004	Non-Focus	0.9	56.2	56.2	63.7	62.8	7.5	7.5	51.6	50.7	-4.6	-4.6	2020-2022 low minus margin (25.0 feet)	CGA	
17N02W30J002	Non-Focus	6.1	51.1	51.1	59.5	53.4	8.4	8.4	47.7	41.6	-3.4	-3.4	2020-2022 low minus margin (25.0 feet)	CGA	
17N03W08R001	Non-Focus	63.6	92.4	92.4	91.6	28.0	-0.8	-0.8	91.1	27.5	-1.3	-1.3	2020-2022 low minus margin (25.0 feet)	CGA	
17N03W32H001	Non-Focus	67.4	95.1	95.1	95.1	27.7	0.0	0.0	94.5	27.1	-0.6	-0.6	2020-2022 low minus margin (25.0 feet)	CGA	
18N02W18D004	Non-Focus	-2.3	62.0	62.0	76.8	79.1	14.8	14.8	34.7	37.0	-27.3	-27.3	2020-2022 low minus margin (25.0 feet)	GGA	

State Well Number	RMS Well Designation	Minimum Threshold (MT), feet AMSL[1]	Measurable Objective (MO), feet AMSL	Interim Milestone (IM) 2027, feet AMSL	Spring 2024 Conditions				Fall 2024 Conditions				Minimum Threshold Method	GSA	Status
					Groundwater Elevation (feet AMSL, rounded)	Difference relative to MT (feet AMSL, rounded)[2]	Difference relative to MO (feet AMSL, rounded)[2]	Difference relative to IM 2027 (feet AMSL, rounded)[2]	Groundwater Elevation (feet AMSL, rounded)	Difference relative to MT (feet AMSL, rounded)[2]	Difference relative to MO (feet AMSL, rounded)[2]	Difference relative to IM 2027 (feet AMSL, rounded)[2]			
18N02W36B001	Non-Focus	24.1	62.4	62.4	68.0	43.9	5.6	5.6	62.0	37.9	-0.4	-0.4	2020-2022 low minus margin (25.0 feet)	CGA	
19N02W08Q002	Non-Focus	34.7	99.2	99.2	102.1	67.4	2.9	2.9	97.9	63.2	-1.3	-1.3	2020-2022 low minus margin (25.0 feet)	GGA	
19N02W33K001	Non-Focus	52.8	80.5	80.5	82.6	29.8	2.1	2.1	74.1	21.3	-6.4	-6.4	2020-2022 low minus margin (18.3 feet)	GGA	
19N04W14M002	Non-Focus	117.0	157.7	157.7	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2020-2022 low minus margin (25.0 feet)	GGA	Special/other
20N02W11A001	Non-Focus	79.6	119.4	119.4	119.4	39.8	0.0	0.0	119.4	39.8	0.0	0.0	2020-2022 low minus margin (25.0 feet)	GGA	
20N02W18R008	Non-Focus	73.3	121.1	121.1	118.5	45.2	-2.6	-2.6	118.6	45.3	-2.5	-2.5	2020-2022 low minus margin (25.0 feet)	GGA	
20N02W25F004	Non-Focus	66.0	97.5	97.5	98.3	32.3	0.8	0.8	97.6	31.6	0.1	0.1	2020-2022 low minus margin (21.0 feet)	GGA	
20N02W33B001	Non-Focus	55.1	99.1	99.1	101.4	46.3	2.3	2.3	100.0	44.9	0.9	0.9	2020-2022 low minus margin (25.0 feet)	GGA	
20N03W07E004	Focus	51.7	116.5	32.6	68.4	16.7	-48.1	35.8	63.4	11.7	-53.1	30.8	2020-2022 low	GGA	
21N02W01F003	Non-Focus	76.8	125.7	125.7	134.8	58.0	9.1	9.1	127.5	50.7	1.8	1.8	2020-2022 low minus margin (25.0 feet)	GGA	
21N02W04G004	Focus	62.8	125.7	56.5	142.1	79.3	16.4	85.6	122.1	59.3	-3.6	65.6	2020-2022 low	GGA	
21N02W05M002	Focus	91.8	153.4	82.5	157.7	65.9	4.3	75.2	143.6	51.8	-9.8	61.1	2020-2022 low	GGA	
21N02W33M003	Non-Focus	77.8	121.4	121.4	120.1	42.3	-1.3	-1.3	118.6	40.8	-2.8	-2.8	2020-2022 low minus margin (25.0 feet)	GGA	
21N02W36A002	Non-Focus	62.5	106.8	106.8	112.6	50.1	5.8	5.8	107.6	45.1	0.8	0.8	2020-2022 low minus margin (21.6 feet)	GGA	
21N03W01R002	Focus	101.6	155.8	91.0	160.6	59.0	4.8	69.6	150.4	48.8	-5.4	59.4	2020-2022 low	GGA	
21N03W23D002	Focus	108.2	146.2	96.5	144.0	35.8	-2.2	47.5	137.7	29.5	-8.5	41.2	2020-2022 low	GGA	
21N03W34Q004	Focus	97.9	119.2	90.2	102.7	4.8	-16.5	12.5	99.1	1.2	-20.1	8.9	2020-2022 low	GGA	
21N04W12A002	Focus	22.3	94.2	-4.2	40.6	18.3	-53.6	44.8	29.4	7.1	-64.8	33.6	2020-2022 low	GGA	
22N02W30H003	Focus	82.9	160.5	73.6	166.3	83.4	5.8	92.7	158.1	75.2	-2.4	84.5	2020-2022 low	GGA	
22N03W24E002	Focus	119.9	179.4	110.6	193.8	73.9	14.4	83.2	176.4	56.5	-3.0	65.8	2020-2022 low	GGA	

1 Groundwater elevations expressed in feet above mean sea level (feet AMSL).

2 Differences are rounded to nearest 0.1 feet AMSL, and may vary by +/- 0.1 feet due to rounding. Negative differences relative to the MT, MO, or IM indicate that the measured groundwater elevation is deeper than the MT, MO, or IM.

6.1.2 Reduction in Groundwater Storage

The GSP uses groundwater levels as a proxy for the groundwater storage sustainability indicator. Thus, current conditions related to the reduction in groundwater storage SMC are also captured in **Section 6.1.1.**

6.1.3 Degraded Groundwater Quality

Groundwater quality across the Subbasin is generally good. The sole groundwater quality concern not addressed by the existing groundwater quality regulatory programs is mobilization of saline water from deeper parts of the aquifer. Undesirable results caused by degraded water quality could affect the Human Right to Water by limiting the ability of drinking water beneficial users, including disadvantaged communities (DACs), severely disadvantaged communities (SDACs) and Tribes, to access safe, clean, and affordable water for human consumption, cooking, and sanitary purposes.

Monitoring locations for degraded groundwater quality include 25 RMS wells. The identification of an undesirable result for degraded water quality was defined as the conditions when electrical conductivity (EC) in 25% of the RMS wells exceeds the MT for two (2) consecutive years. Available EC measurements relative to the MT and MO for degraded water quality are provided in **Table 6-3**.

Of the 25 RMS wells for degraded water quality, data was not available for ten RMS wells. Of the remaining wells, only two wells exceeded the MT at the latest measurement date (one in Fall 2018 and one in Fall 2024), and four wells exceeded the MO at the latest measurement date. For the remaining RMS wells, all available EC measurements were below the MT and the MO.

Table 6-3. Summary of Groundwater Quality (Electrical Conductivity) Relative to Sustainable Management Criteria at Groundwater Quality RMS Wells.

Well ID	Well Name	Minimum Threshold (MT, EC uS/cm)[2]	Measurable Objective (MO, EC uS/cm)[2]	Latest EC Measurement (uS/cm)	Date of Latest Measurement	Previous EC Measurement (uS/cm)	Date of Previous Measurement
1100404-001	Del Oro Water Company - Black Butte District Representative Well	900	700	564	11/14/2017	387	7/20/2009
1110001-001	City of Orland Representative Well	900	700	479	12/13/2016	479	12/4/2007
1100203-002	Artois Community Service District Representative Well	900	700	374	3/8/2018	405	3/11/2015
1110003-007	Cal-Water Service Company - Willows Representative Well	900	700	480	6/8/2023	500	6/9/2020
0600013-002	Colusa County WWD #2 - Princeton Representative Well	900	700	420	12/12/2021	539	1/13/2013
0610003-003	Maxwell Public Utility District Representative Well	1200	700	1140	4/14/2021	1000	5/16/2012
0610002-002	City of Colusa Representative Well	900	700	518	4/7/2020	600	11/8/2011
0610004-004	City of Williams Representative Well	1180	700	1200	10/3/2018	740	10/28/2015
0600008-001	Colusa County WWD #1 - Grimes Representative Well	900	700	317	10/16/2019	315	9/18/2019
0610001-004	Arbuckle Public Utility District Representative Well	900	700	742	8/3/2017	698	7/31/2008
0606011-001	Del Oro Water Company - Arbuckle District Representative Well	900	700	8260	10/8/2024	714	12/22/2015
25A1M	Electrical Conductivity: CRC Well 25A1M (Screened Depth: 25-30 ft)	900	700	--[1]	--[1]	--[1]	--[1]
32J1M	Electrical Conductivity: CRC Well 32J1M (Screened Depth: 25-30 ft)	967	700	--[1]	--[1]	--[1]	--[1]
23E1M	Electrical Conductivity: CRC Well 23E1M	900	700	--[1]	--[1]	--[1]	--[1]
25E1M	Electrical Conductivity: CRC Well 25E1M (Screened Depth: 25-30 ft)	950	700	--[1]	--[1]	--[1]	--[1]
25R1M	Electrical Conductivity: CRC Well 25R1M (Screened Depth: 28.5-33.5 ft)	900	700	--[1]	--[1]	--[1]	--[1]
12G2M	Electrical Conductivity: CRC Well 12G2M (Screened Depth: 25-30 ft)	900	700	--[1]	--[1]	--[1]	--[1]
14G1M	Electrical Conductivity: CRC Well 14G1M (Screened Depth: 25-30 ft)	2120	700	--[1]	--[1]	--[1]	--[1]
35M1M	Electrical Conductivity: CRC Well 35M1M (Screened Depth: 25-30 ft)	1680	700	--[1]	--[1]	--[1]	--[1]
03E1M	Electrical Conductivity: CRC Well 03E1M (Screened Depth: 25-30 ft)	4060	700	--[1]	--[1]	--[1]	--[1]
16R1M	Electrical Conductivity: CRC Well 16R1M (Screened Depth: 25-30 ft)	5530	700	--[1]	--[1]	--[1]	--[1]

Well ID	Well Name	Minimum Threshold (MT, EC uS/cm)[2]	Measurable Objective (MO, EC uS/cm)[2]	Latest EC Measurement (uS/cm)	Date of Latest Measurement	Previous EC Measurement (uS/cm)	Date of Previous Measurement
SVWQC00005	Electrical Conductivity: SVWQC Well SVWQC00005 (Screened Depth: 145-225 ft)	900	700	626	9/19/2024	534	8/15/2023
SVWQC00021	Electrical Conductivity: SVWQC Well SVWQC00021 (Screened Depth: 90-120 ft)	900	700	507	9/18/2024	474	8/15/2023
SVWQC00019	Electrical Conductivity: SVWQC Well SVWQC00019 (Screened Depth: <126 ft)	900	700	675	9/17/2024	613	8/16/2022
SVWQC00006	Electrical Conductivity: SVWQC Well SVWQC00006 (Screened Depth: 180-260 ft)	900	700	549	9/17/2024	483	8/16/2023

[1] Indicates Missing or Questionable Measurement

[2] MTs, MOs, and measurements are in units microSiemens per centimeter (us/cm)

6.1.4 Land Subsidence

During development of the April 2024 Revised Colusa Subbasin GSP, the GSAs determined that an undesirable result for land subsidence in the Subbasin is experienced if groundwater withdrawal causes inelastic land subsidence that substantially interferes with the condition or functionality of critical infrastructure or land uses within the Subbasin over the planning and implementation horizon of this GSP. Critical infrastructure, the potential impacts of inelastic land subsidence, and the extent to which they are considered significant and unreasonable were evaluated by the GSAs with input from local stakeholders and members of the public. Agencies with infrastructure in the Subbasin were contacted in early 2024 to identify their critical infrastructure, document observed and possible impacts attributable to inelastic land subsidence, and assess the potential future impacts of inelastic land subsidence (see Section 5.3.1 and Table 5-1 of the April 2024 Revised Colusa Subbasin GSP).

The findings from these stakeholder discussions were directly used to revise the land subsidence URs definition for the Subbasin, which are determined to occur when either:

- Cumulative subsidence averaged over one (1) Public Land Survey System (PLSS) section exceeds two (2) feet from January 2024, or
- The average rate of subsidence in ten (10) or more contiguous PLSS sections, in any configuration, exceeds 0.1 feet per year (ft/yr) in two (2) consecutive years.

Exceedance of either this cumulative subsidence or this annual rate of subsidence are estimated to lead to undesirable results, negatively impacting beneficial users and uses within the Subbasin. Consequently, the GSAs defined both a cumulative subsidence MT (2 ft from January 2024) and a rate of subsidence MT (0.1 ft/yr) to represent the subsidence conditions at which URs may occur. In addition to the MT revisions, the MOs were revised to 0 ft/yr, representing sustainable conditions with no long-term subsidence, and the IMs were revised to provide a realistic path from current conditions to the MOs, given the groundwater level SMC and the GSAs' planned PMAs, including demand management (see **Section 6.2**). The revised subsidence SMC are summarized in **Table 6-1**.

Land subsidence conditions are evaluated from InSAR data each year, averaged over PLSS sections, to provide for more frequent monitoring and comparison to the land subsidence SMC while adjusting for InSAR spatial data gaps and uncertainty. Maps and subsidence results in this Annual Report are summarized from InSAR data and compared to the revised SMC. The GSAs made these revisions in an effort to quantify and monitor the spatial extent, rate, and cumulative amounts of subsidence in the Subbasin to be protective of critical infrastructure and avoid URs for beneficial users and uses within the Subbasin.

During development of the April 2024 Revised Colusa Subbasin GSP, the GSAs also defined two trigger levels for guiding review and response to subsidence conditions, with the overarching goal of responding to issues swiftly and to avoid undesirable results (see Section 5.4.5 of the April 2024 Revised Colusa Subbasin GSP):

- "Yellow light" threshold, which occurs when either cumulative subsidence due to groundwater withdrawal exceeds one foot averaged over any one single PLSS section (1 square mile or 640 acres) from January 2024, or the average rate of subsidence in ten or more contiguous PLSS sections, in any configuration, exceeds 0.1 ft/yr in the previous WY. Conditions meeting the "yellow light" threshold criteria prompt: (1) focused discussions of subsidence impacts with stakeholders in the Critical Infrastructure Working Group, and (2) prioritization of PMAs in the impacted PLSS section(s).
- "Red light" limit, which occurs when either cumulative subsidence due to groundwater withdrawal exceeds two feet averaged over any one single PLSS section from January 2024, or the average rate of subsidence in ten or more contiguous PLSS sections, in any

configuration, exceeds 0.1 ft/yr in the previous two consecutive WYs. Meeting either of the "red light" conditions will trigger an undesirable result, at which point the GSAs will convene the Critical Infrastructure Working Group to follow actions outlined under "yellow light" conditions, and initiate immediate action initiate (or increase focus) of PMAs targeting the impacted PLSS section(s), including demand management and enforced groundwater allocation.

There are two general areas where subsidence has occurred within the Subbasin: the first area is located in the southern portion of the Subbasin near Arbuckle and College City, and the second area is located north of Willows and south of Orland. **Figure 6-1** presents the annual vertical displacement measured by InSAR for WY 2024 (from October 2023 through October 2024), averaged over each PLSS section in the Subbasin. Negative vertical displacement values depict a decrease in land surface elevation (i.e., land subsidence), and positive values depict an uplift in the land surface. Land subsidence is represented by negative vertical displacement values. During this period, there were three PLSS sections north and west of Arbuckle that experienced subsidence in excess of 0.1 ft/yr (i.e., average annual vertical displacement of less than -0.1 ft/yr), although those sections were non-contiguous. No sections elsewhere in the Subbasin experienced subsidence exceeding 0.1 ft/yr. Thus, conditions in the Subbasin as observed from InSAR data do not indicate a UR with respect to the annual rate of subsidence, as of WY 2024. However, a number of contiguous sections north and west of Arbuckle (28 PLSS sections) and south of Orland (eight PLSS sections) experienced more than 0.05 ft/yr but less than 0.1 ft/yr of subsidence in WY 2024.

Figure 6-2 presents the cumulative vertical displacement measured by InSAR from January 2024 through October 2024, averaged by PLSS section. Negative vertical displacement values depict a decrease in land surface elevation (i.e., land subsidence), and positive values depict an uplift in land surface. Land subsidence is represented by negative vertical displacement values. In the southern region, a maximum vertical displacement of approximately -0.21 feet occurred near Arbuckle during WY 2024, and in the northern region, a maximum vertical displacement of approximately -0.13 feet occurred during WY 2024. Thus, conditions in the Subbasin as observed from InSAR data do not indicate a UR with respect to the cumulative subsidence, as of WY 2024.

Subsidence conditions in the Subbasin in WY 2024 do not currently elevate the Subbasin to "yellow light" threshold conditions. Nevertheless, the GSAs took action in early 2025 to solicit input from members of the Critical Infrastructure Working Group, including the critical infrastructure owners and operators identified in Table 5-1 of the April 2024 Revised Colusa Subbasin GSP. No subsidence impacts were reported as of early 2025[6], although the GSAs will continue to monitor groundwater and subsidence conditions and will solicit additional updates from the Critical Infrastructure Working Group before the next Annual Report. In the meantime, the GSAs are working diligently to develop the demand management program, consistent with the terms and timeline expressed in the MOU signed and included in the April 2024 Revised Colusa Subbasin GSP. Additional details on this process are provided in **Section 6.2**.

[6] The only reported incidents in 2024 were two small erosional features near the City of Orland (one less than approximately 0.25 acre, one less than approximately one square yard), similar to those discussed in prior Annual Reports. Based on visual inspection, these erosional features have occurred in surficial soils and extend from the land surface to depths of a few feet. While the causes of these erosional features are undetermined, DWR Northern District and County staff visited similar sites in the area in 2021-2022 and DWR staff found soils in the area of concern to be predominantly clay with sand and shallow gravel layers.

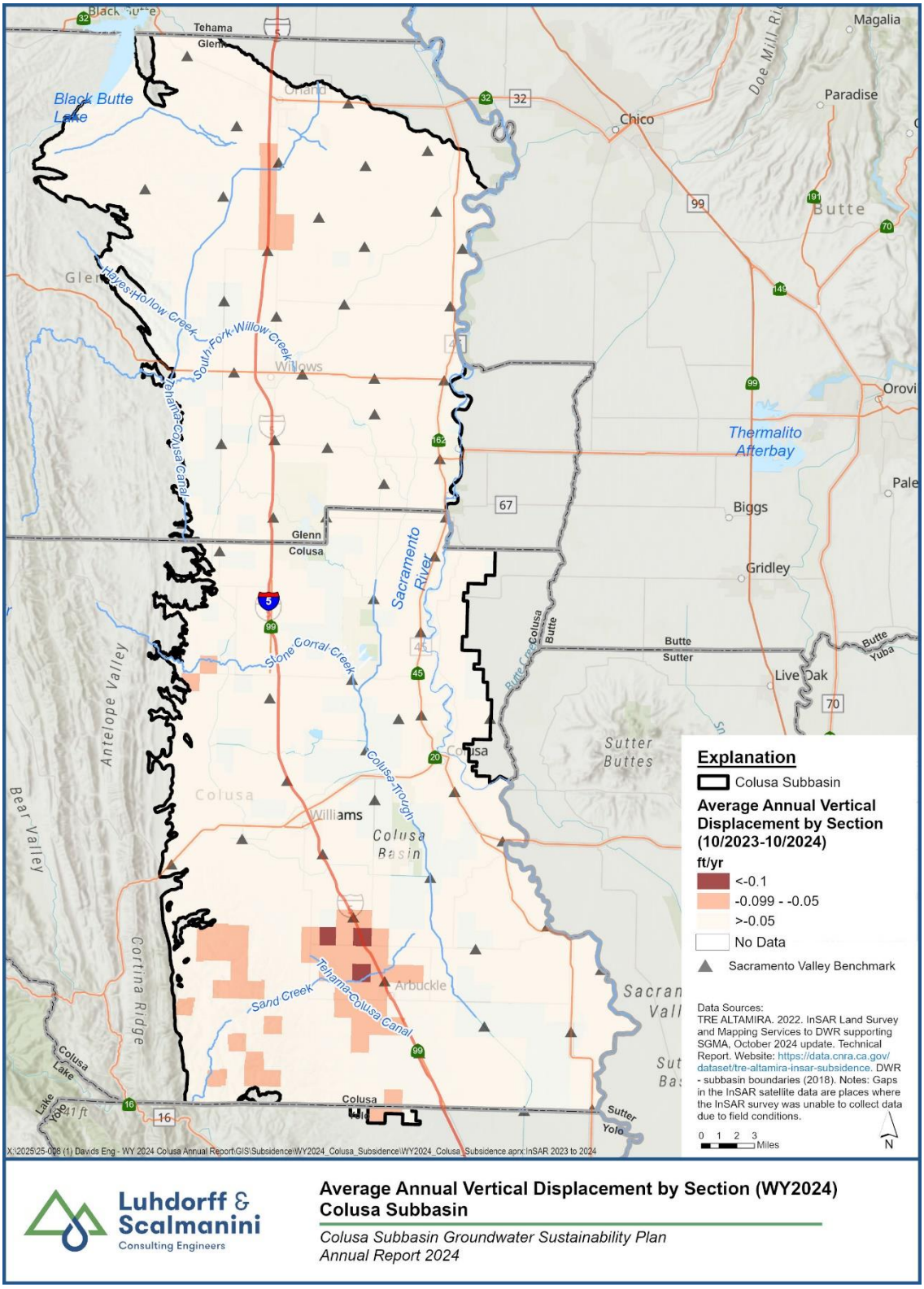

Figure 6-1. Average Annual Vertical Displacement by Section – Water Year 2024.*

**Negative vertical displacement values depict a decrease in land surface elevation, i.e., land subsidence.*

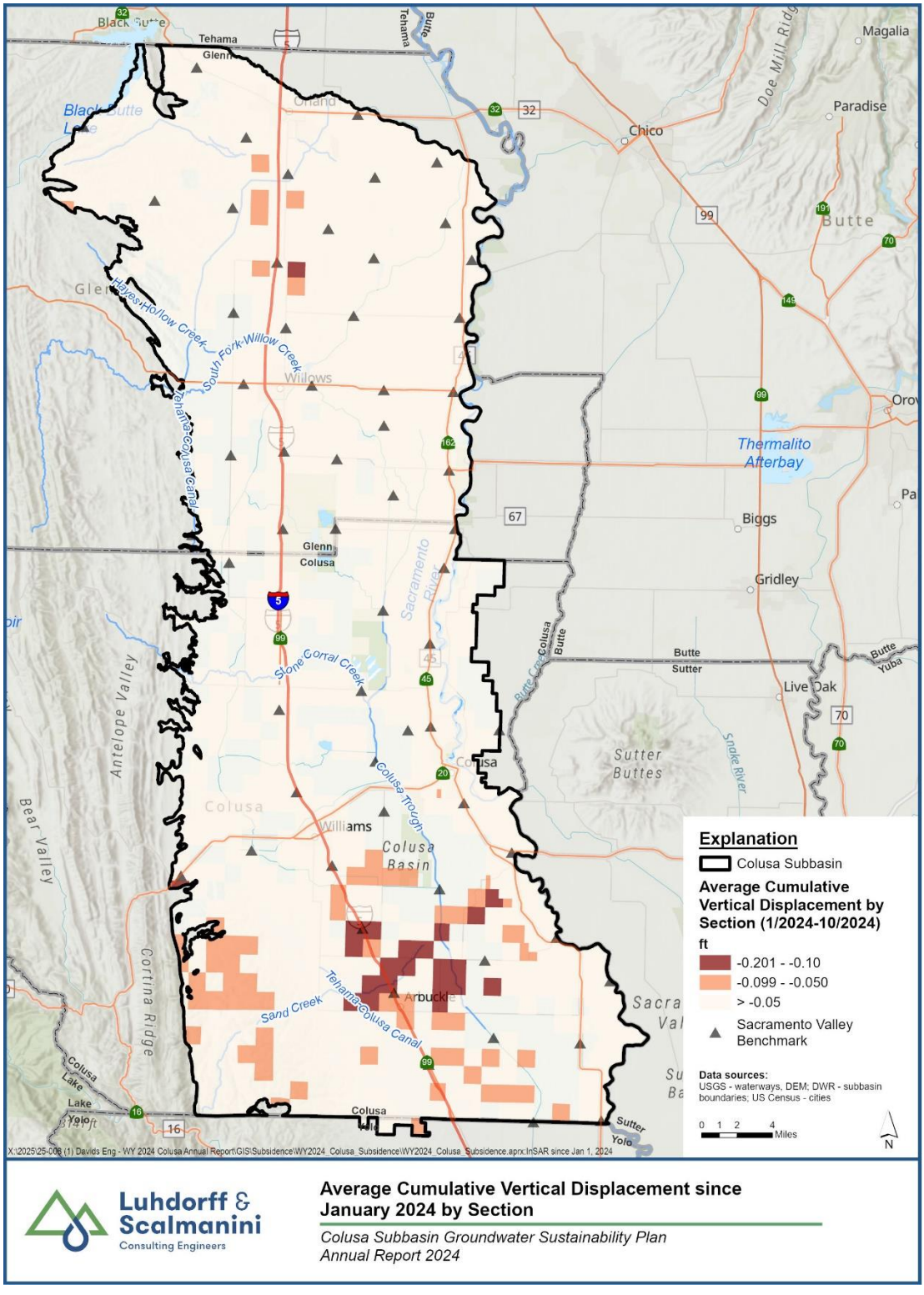

Figure 6-2. Average Cumulative Vertical Displacement by Section – January 2024 through October 2024.*

**Negative vertical displacement values depict a decrease in land surface elevation, i.e., land subsidence.*

6.1.5 Depletions of Interconnected Surface Water

The undesirable result for depletions of interconnected surface water (ISW) is a result that causes significant and unreasonable adverse effects on beneficial uses and users of ISW within the Subbasin over the planning and implementation horizon of this GSP. During development of the initial GSP, potential undesirable results identified by stakeholders included:

- Significant and unreasonable impacts to stream flows
- Significant and unreasonable impact to riparian and riverine habitat
- Significant and unreasonable impacts to GDEs
- Significant and unreasonable impacts to springs

The undesirable result for depletions of ISW is considered to occur during GSP implementation when 25% of RMS wells (3 of 12) fall below their MT for 24 consecutive months. The three wells must be the same subset of wells, not any combination of three wells. The subset of wells is not predetermined; rather, it is delineated only as wells that collectively fall below their minimum threshold levels. **Table 6-4** provides a comparison of Spring and Fall 2024 groundwater levels to the established MT, MO, and IM groundwater elevations for ISW. In Spring 2024, the groundwater elevation at RMS wells ranged between 10.7 ft AMSL and 213.1 ft AMSL. In Fall 2024, water levels range between -3.8 ft AMSL and 207.0 ft AMSL.

Of the 12 RMS wells for ISW, one was unable to be measured in fall. For Spring and Fall 2024 measurements, groundwater elevations at the majority of RMS wells were above the MO and the IM. No RMS wells exceeded their MT in 2024.

Table 6-4. Summary of Groundwater Levels Relative to Sustainable Management Criteria at Interconnected Surface Water Representative Monitoring Sites.

Representative Monitoring Site State Well Number (SWN)	Measurable Objective and Interim Milestone (MO, IM) (feet AMSL)	Minimum Threshold (MT) (feet AMSL)	Seasonal High (Spring)			Seasonal Low (Fall)		
			2024 (feet AMSL, rounded)	Difference (feet AMSL, rounded) MO, IM	Difference (feet AMSL, rounded) MT	2024 (feet AMSL)	Difference (feet AMSL, rounded) MO, IM	Difference (feet AMSL, rounded) MT
13N01E11A001M	22	13	27.1	5.1	14.1	25.0	3.0	12.0
13N01W07G001M	-10	-19	10.7	20.7	29.7	-3.8	6.2	15.2
14N01W04K003M	12	3	33.5	21.5	30.5	Not Available	Not Available	Not Available
15N01W05G001M	27	19	43.0	16.0	24.0	35.4	8.4	16.4
17N02W30J002M	44	26	59.5	15.5	33.5	47.7	3.7	21.7
20N02W11A001M	119	106	119.4	0.4	13.4	119.4	0.4	13.4
20N02W25F004M	97	87	98.3	1.3	11.3	97.6	0.6	10.6
21N02W01F004M	126	105	135.5	9.5	30.5	128.7	2.7	23.7
21N02W05M003M	148	125	160.5	12.5	35.5	145.7	-2.3	20.7
21N02W36A002M	91	59	112.6	21.6	53.6	107.6	16.6	48.6
22N02W30H004M	179	161	188.0	9.0	27.0	180.4	1.4	19.4
22N03W24E003M	208	194	213.1	5.1	19.1	207.0	-1.0	13.0

6.2 IMPLEMENTATION OF PROJECTS AND MANAGEMENT ACTIONS (§356.2.C)

Implementation of projects and management actions (PMAs) is critical to achieving groundwater sustainability and avoiding undesirable results. As described in the GSP, PMAs proposed in the GSP were conceptualized and categorized in three groups: planned PMAs, ongoing PMAs, and potential PMAs. The estimated costs, timing, and benefits (i.e., increased groundwater recharge or reduced groundwater use) of the PMAs at full implementation are described in the GSP.

The GSAs have identified a range of PMAs to achieve the sustainability goal for the Subbasin, including PMAs to address and mitigate existing issues with respect to overdraft, groundwater level decline, and subsidence concerns in the Subbasin, as well as PMAs to respond to changing conditions. Among these PMAs are planned recharge projects that will provide direct and in-lieu recharge benefits targeted to areas of the Subbasin where undesirable results have occurred, particularly in the areas around Orland-Artois and Arbuckle-College City. Additionally, the planned PMAs include a demand management program and a domestic well mitigation program. The GSAs have expressed a clear and firm commitment to develop and implement these programs on a clear and specific timeline to address and prevent overdraft, groundwater level decline, and subsidence and to mitigate potential undesirable results for drinking water well users during the GSP implementation period. Updates on these programs are provided in **Section 6.2.2.**

As described in Section 6.1 of the GSP, ongoing management of the Subbasin under the GSP will follow an "adaptive management" strategy that involves active monitoring of groundwater conditions and addressing any challenges related to maintaining groundwater sustainability by scaling and implementing PMAs in a targeted and proportional manner in accordance with the needs of the Subbasin. The CGA and GGA GSAs are committed to adaptive management of groundwater resources in the Subbasin through the suite of PMAs identified in the GSP. As PMAs are implemented and monitored, the project timelines and consequential effects on the Subbasin will be reviewed. If adjustments are needed to meet the sustainability objectives identified in the GSP, project timelines will be evaluated and adjusted. In addition to continuous monitoring and review of PMA implementation, each Annual Report represents an opportunity to review the status of GSP implementation efforts.

This section describes progress that has been made toward implementation of the GSP and specific PMAs since the previous Annual Report. First, a brief overview is given regarding the GSAs' efforts in 2023-2024 to revise the GSP to address deficiencies identified by DWR, followed by updates regarding the development of the demand management program and a domestic well mitigation program. The remainder of this section describes progress made toward implementation of other PMAs.

6.2.1 GSP Revisions

In October 2023, DWR completed their initial evaluation of the GSP and determined the GSP to be "incomplete" pursuant to 23 CCR §355.2(e)(2), initiating a 180-day period for the GSAs to revise the GSP to address the identified deficiencies by April 23, 2024. In this determination, DWR identified three deficiencies:

- DWR found that the GSP did not include a reasonable assessment of overdraft conditions and a reasonable means to mitigate overdraft,
- DWR found that the SMC for chronic lowering of groundwater levels were not substantially compliant with the GSP regulations, and
- DWR found that the SMC for subsidence were not substantially compliant with the GSP regulations.

Since the previous Annual Report, the GSAs completed technical analyses and GSP revisions to address the three deficiencies. The April 2024 Revised Colusa Subbasin GSP was adopted and submitted to DWR for evaluation ahead of the April 23, 2024 deadline.

On February 27, 2025, DWR notified the GSAs that DWR had completed their review of the April 2024 Revised Colusa Subbasin GSP and determined the GSP is approved. In their letter, DWR also identified certain recommended corrective actions to further improve the GSP, fill data gaps, and support implementation and achievement of the Subbasin sustainability goal. The GSAs are reviewing these recommended corrective actions and plan to substantively address these in the upcoming Periodic Evaluation and Annual Reports, as applicable.

6.2.2 Domestic Well Mitigation and Demand Management Programs

As part of the GSP revision process, on April 19, 2024, the GSAs approved two memoranda of understanding (MOUs): the first establishing a domestic well mitigation program for the Subbasin, and the second establishing a demand management program for the Subbasin. According to the MOUs, the domestic well mitigation program shall be developed and implemented by January 1, 2026, and the demand management program shall be developed and implementation shall begin no later than January 1, 2027.

Implementation of these programs is expected to provide the GSAs with additional means of mitigating overdraft, subsidence, and groundwater level decline in the Subbasin and of mitigating undesirable results that may occur to domestic well users during GSP implementation while other projects and management actions are being developed, prior to achieving sustainable groundwater conditions (no later than 2042).

Since adoption of the MOUs and submittal of the April 2024 Revised Colusa Subbasin GSP, the GSAs have made significant strides in GSP implementation and to ensure that the domestic well mitigation program and demand management program for the Subbasin are developed according to the timeline and provisions agreed upon during the GSP revisions process. The formal agreements developed and signed by the GSAs are provided in the April 2024 Revised Colusa Subbasin GSP (described in Sections 6.3.6 and 6.3.7 and provided in Appendices 6E and 6F).

The GSAs each appointed a Domestic Well Mitigation Program Ad Hoc Committee and a Demand Management Program Ad Hoc Committee. The GSAs have provided direction for each program to hold joint ad hoc committee meetings to foster a basin-wide approach for discussing program development and provide recommendations to the GSAs.

Since summer 2024, the GSAs have regularly met (through ad hoc committee meetings and GSA Board meetings) to continue discussing an approach to develop both programs. Steps taken since the previous Annual Report include, but are not limited to:

- Regular meetings of both ad hoc committees since summer-fall 2024.
- Contracting with a consultant team in fall 2024 to support the GSAs in navigating the program development process and decisions. An initial meeting was facilitated by the consultant in October 2024 to review the commitments made in the April 2024 Revised Colusa Subbasin GSP and the timeline for program development tasks. Since then, GSA staff have worked closely with the consultant team to coordinate demand management and well mitigation program development. The team has begun coordinating regular Joint Board meetings and workshops, in addition to ad hoc committee meetings, to provide targets and milestones in order to make significant progress in program development in 2025. The workshops are focused on various aspects of developing these programs, supporting policy discussions, and hearing public input.

- Presentations and discussions of other active groundwater demand management and domestic well mitigation programs in California, to review and discuss the decisions and processes that led to successful implementation of those programs. These have included direct discussions with representatives of other GSAs that have developed and/or implemented such programs.
- Focused discussion of a groundwater demand management (GDM) framework at meetings in December 2024-February 2025.
- Focused discussion of a domestic well mitigation program framework in February 2025.

The GSAs are continuing regular discussions to inform decision making processes in 2025. The GSAs remain on track to develop and begin implementation of both programs according to their proposed timelines. Updates will be provided in the next Annual Report.

6.2.3 Overview of Projects and Management Actions

Table 6-5 summarizes the implementation status of PMAs from the GSP as well as major updates to PMAs since the previous Annual Report. The status of PMAs is generally defined as follows:

- **Implemented/Implementation Ongoing**: Active efforts to operate the project or management action have begun, though benefits may or may not have been achieved.
- **In Progress**: Active efforts needed to initiate the project or management action have begun (e.g., permitting), though development has not reached the point of operability.
- **Planned**: Early conceptual development is still in progress, though active efforts to initiate or operate the project or management action have not begun.

Table 6-6 provides further updates on the benefits of PMAs since GSP development, in comparison with the anticipated benefits presented in the GSP.

This Annual Report covers WY 2024. Similar to 2023, relatively wet conditions and full allocations of surface water supplies in 2024 allowed the GSAs to achieve substantial recharge benefits in the Subbasin through irrigation with surface water in lieu of groundwater, following on the heels of the 2020-2022 drought and associated surface water curtailments. The GSAs have also continued to make progress implementing existing PMAs, as well as developing and implementing new PMAs. As of early 2025, progress has been made in developing or implementing approximately 16 PMAs since adoption of the initial GSP, including 15 direct or in-lieu recharge projects and one ongoing management action for urban water conservation. As noted in **Section 6.2.2,** the GSAs are also in the process of developing a domestic well mitigation program and demand management program to provide a backstop for other PMAs and to address undesirable results in the Subbasin. Updates on these programs will be provided in future Annual Reports, along with an assessment of the response of PMA activities on achieving the sustainability goal for the Subbasin.

In total, approximately 33,000 af of PMA-specific benefits to the Subbasin were achieved in 2024, not including the substantial recharge benefits of surface water supplies accounted for in the Subbasin water use estimates (see **Sections 2 through 4**). This represents approximately 40% of the estimated 83,000 af in total anticipated benefits of all planned PMAs at full implementation (GSP Table 6-3), although it is noted that many of the planned PMAs are currently being actively developed and have not achieved their full anticipated benefits as of early 2025. Wet and above normal hydrologic conditions experienced in 2023-2024, together with implementation of PMAs, has facilitated substantial recovery of groundwater levels at RMS wells across the Subbasin (**Section 1**) and has helped to lower the rate of subsidence observed in both the Orland-Artois and Arbuckle-College City areas (**Section 6.1.4**). As of WY 2024, there are no undesirable results and no known adverse impacts to adjacent groundwater basins, although the GSAs will continue to monitor conditions in the Subbasin.

The CGA and GGA GSAs are committed to adaptive management to respond to changing hydrologic, climate, and groundwater conditions in the Subbasin through this suite of identified PMAs and the demand management program currently in development. As PMAs are implemented and monitored, the timelines of other PMAs and volume of demand management necessary to achieve sustainable groundwater conditions in the Subbasin will be reviewed. If adjustments are needed to meet the sustainability goal for the Subbasin, timelines for implementation of these efforts will be evaluated and adjusted. Importantly, the GSAs are committed to actively refining and preparing to implement a demand management program alongside other PMA efforts, ensuring that there is a backstop and a means of mitigating overdraft and addressing undesirable results in the Subbasin if other PMAs are unable to sufficiently address groundwater sustainability issues in the Subbasin. Through their adaptive management approach, the GSAs have a clear and direct strategy for addressing overdraft, groundwater level decline, and subsidence in the Subbasin, and a plan for adapting and responding to any future changes to groundwater conditions in the Subbasin.

Table 6-5. Updates to Projects and Management Actions Since GSP Development.

Category (from GSP)	Project/Management Action Name	Proponent	Year Planned (from GSP)	Status	Brief Description (from GSP)	Updates Since GSP
Planned	Colusa County Water District (CCWD) In-Lieu Groundwater Recharge	CCWD	2021	In Progress	CCWD will utilize 30,000 af of additional surface water for irrigation in all years but Shasta Critical years for in-lieu recharge. The additional surface water will be made available through full use of the district's existing CVP contract and annual and multi-year water purchase and transfer agreements. Additional surface water deliveries are estimated to be 27,000 acre-feet per year (af/yr), enabling reduction of groundwater pumping by a like amount.	District implemented a policy to encourage surface water use over groundwater. More surface water was applied in the past year compared to recent years.
Planned	Colusa Drain MWC (CDMWC) In-Lieu Groundwater Recharge	CDMWC	2021	Planned	CDMWC diverters use both ground and surface water because Colusa Drain supplies are insufficient to satisfy all irrigation requirements. This project would provide additional surface supplies averaging approximately 28,000 af/yr in the Drain allowing CDMWC diverters to increase their diversions of surface water to provide in lieu groundwater recharge of a like amount.	*No change in implementation noted since GSP development.* *Project planning is still underway, and surface water use has continued in CDMWC.*
Planned	Colusa Subbasin Multi-Benefit Groundwater Recharge	CGA, GGA and TNC	2021	Implemented	The Nature Conservancy (TNC) is partnering with entities for an on-farm, multi benefit groundwater recharge incentive program. The pilot program was initiated in Colusa County in 2018 and concluded in the spring of 2021, with plans to expand and continue into the future. DWR is a partner in the Colusa Subbasin Multi-Benefit Groundwater Recharge project as it moves into the expanded program.	The pilot program was completed in 2021, and the grant-funded project concluded in January 2022. Ongoing multi-benefit recharge work is occurring through separate projects, including the Spring Valley Multi-Benefit Project (described below).

Category (from GSP)	Project/Management Action Name	Proponent	Year Planned (from GSP)	Status	Brief Description (from GSP)	Updates Since GSP
Planned	Orland-Artois Water District (OAWD) Land Annexation and Groundwater Recharge	OAWD	2020	In Progress	OAWD is planning to annex approximately 12,000 acres of groundwater dependent agricultural lands. Additional direct recharge may be considered on suitable annexed lands. The project is an area where groundwater levels have been in decline in recent years. It is estimated that a long-term average of approximately 23,000 af/yr of surface water would be available, reducing groundwater pumping by approximately 23,000 af/yr.	Annexation of 10,308 acres was completed in March 2025. A Finding of No Significant Impact was made by USBR in May 2024, which clears the way for infrastructure construction to begin. The project received up to $300,000 for design and $3.8 million for construction in WaterSMART grants from USBR. With existing infrastructure, approximately 3,300 acres can begin receiving surface water in 2025. Deliveries to the remaining area will occur after completion of ongoing permitting (2-4 years) and construction of delivery infrastructure.
Planned	Sycamore Slough Groundwater Recharge Pilot Project	Landowner	2021	Implementation Ongoing	Proctor and Gamble and Davis Ranches have entered into an agreement to implement a 10-year groundwater recharge pilot project. A 66-acre field on Davis Ranches will receive surface water for groundwater recharge and provide habitat for migrating shorebirds. Water would be diverted from the Sacramento River during fall/winter months using existing riparian rights or would be available from settlement contract supplies (should the project begin before November 1). An expansion of the project is planned for recharge and revegetation in the neighboring Sycamore and Dry Sloughs.	Davis Ranches applied surface water for recharge and habitat benefits in December 2023-January 2024, with recharge benefits of approximately 380 af. Project implementation continued in 2024, although no specific updates are noted.

Category (from GSP)	Project/Management Action Name	Proponent	Year Planned (from GSP)	Status	Brief Description (from GSP)	Updates Since GSP
Planned *(Proposed since Initial GSP)*	GGA Recharge Project	GGA	2022	Implementation Ongoing	The GGA is planning, designing, implementing, and monitoring multi-benefit, direct and in-lieu groundwater recharge projects to alleviate critical drought conditions. This Project will provide habitat for migratory shorebirds and enhance groundwater dependent ecosystems supporting the region's objective to implement multi-benefit projects. Recharge will occur across GGA's service area focusing on areas to maximize urban and environmental benefits.	The GGA has partnered with local water districts, including OAWD (see below), to implement more than 20 groundwater recharge projects in the last two years to achieve approximately 3,500 af of groundwater recharge, including approximately 1,400 af of recharge in 2024. GGA completed a long-term groundwater recharge options report and a short-term pilot test report. In 2024, GGA also initiated discussions with USBR to explore surface water opportunities to augment groundwater recharge, and (together with Corning Sub-basin GSA (CSGSA)) applied for and secured a temporary permit to divert and recharge water from Stony Creek in Glenn County.
Ongoing	Reclamation District 108 (RD108) and CCWD Agreement for Five-Year In-Lieu Groundwater Recharge Project	RD108 and CCWD	N/A (Ongoing)	On Hold	CCWD (and Dunnigan Water District [DWD]) purchases surface water from RD108 for distribution within its service area. The agreement expires in 2022. This project supplies additional surface water to CCWD (and DWD) that provides in lieu recharge.	Agreement expired as of 2023 and has been put on hold temporarily due to wet conditions in 2023-2024, CVP 215 water availability, and Voluntary Agreement efforts. However, CCWD plans to re-initiate discussions with RD108 shortly.
Ongoing	Glenn-Colusa Irrigation District (GCID) Strategic Winter Water Use for Groundwater Recharge and Multiple Benefits	GCID	N/A (Ongoing)	Implementation Ongoing	GCID holds a water right for winter water. This project will increase the groundwater recharge and habitat enhancement benefits of winter water use by increasing use for rice straw decomposition, irrigation, and frost control provided that certain constraints can be alleviated.	GCID continues to deliver winter water to users, including those outside GCID. In WY 2024, GCID reported approximately 136,000 af of winter surface water use (November 2023 through March 2024). This water was used for a variety of purposes in GCID, including straw decomposition and habitat.

Category (from GSP)	Project/Management Action Name	Proponent	Year Planned (from GSP)	Status	Brief Description (from GSP)	Updates Since GSP
Ongoing	Sycamore Marsh Farm Direct Recharge Project	Landowner	N/A (Ongoing)	Implementation Ongoing	Sycamore Marsh Farm is developing a groundwater recharge plan to store groundwater. The plan provides for 205 acres of year-round recharge basins and 163 additional acres for winter recharge.	*No change in implementation noted since GSP development. Project is still ongoing.*
Ongoing	GCID Expansion of In-Basin Program for In-lieu Groundwater Recharge	GCID	N/A (Ongoing)	Implementation Ongoing	GCID has developed arrangements to supply district surface water to neighboring non-district agricultural lands that primarily use groundwater. These temporary arrangements expired in 2020. There is interest in continuing and expanding this in basin surface water use for in lieu groundwater recharge. Supplies would potentially be available only in Shasta Non-Critical years.	Project is ongoing. GCID is working with neighboring non-district lands to supply water for in-lieu recharge.
Ongoing	Orland Unit Water Users' Association (OUWUA) Irrigation Modernization for Increased Surface Water Delivery and Reduced Groundwater Pumping	OUWUA	N/A (Ongoing)	Implementation Ongoing	Modernization of OUWUA southside system for more reliable and flexible farm deliveries that will provide incentive for growers to use more surface water and less groundwater.	OUWUA continues to promote and support efficient on-farm irrigation systems. In most cases, groundwater pumping is offset by using Orland Project water for pressurized sprinkler/drip/micro-sprinkler applications. Efficient on-farm irrigation systems have increased in recent years, driven by drought conditions. One new modified delivery system came online in 2023. No updates to delivery systems were noted in 2024.
Ongoing	Urban Water Conservation in Willows	California Water Service – Willows District	N/A (Ongoing)	Implementation Ongoing	This project includes urban water conservation measures through water waste prevention ordinances, metering, conservation pricing, public education, and outreach programs to assess and manage distribution system real loss, water conservation program coordination and staffing support, and other demand management measures.	Implementation of urban water conservation measures continued in 2024.

Category (from GSP)	Project/Management Action Name	Proponent	Year Planned (from GSP)	Status	Brief Description (from GSP)	Updates Since GSP
Potential	GCID In-Lieu Groundwater Recharge	GCID	N/A (Potential)	In Progress	GCID will investigate, develop, and implement measures to incentivize growers in the GCID service area that currently rely on groundwater to instead utilize surface water supplied by GCID, which will provide in-lieu recharge through reduced groundwater pumping.	GCID is continuing to work with landowners to incentivize utilization of all available surface water supplies, in coordination with GCID's efforts to strategically expand winter water use. There remain about 4,200 acres within the GCID boundary (approximately 5%) that are primarily irrigated with groundwater pumped from private wells.
Potential	Tehama-Colusa Canal Trickle Flow to Ephemeral Streams	CCWD	N/A (Potential)	Implementation Ongoing	Operate Tehama-Colusa Canal (TCC) existing gates for discharge into ephemeral streams at a rate where they do not flow out of the Subbasin but recharge the groundwater system.	CCWD is currently setting temporary pumps to discharge excess flows (e.g., 3F water) into streams beginning in February 2025. Voluntary well monitoring network has been developed to help measure recharge efforts.
Potential	GCID Water Transfers to TCCA CVP Contractors	GCID	N/A (Potential)	In Progress	GCID is exploring the possibility of transferring surface water to CVP contractors served by the TCC to provide in-lieu groundwater recharge and reduce groundwater pumping through increased CVP water utilization. Priority would be placed on transfers to CVP contractors in areas where groundwater level declines have been observed, particularly in the areas around the cities of Orland and Arbuckle.	Project is ongoing. GCID is continuing discussions with the TCCA. GCID is also identifying opportunities for partnerships with other districts in the Subbasin. Updates will be provided in future years.
Potential *(Proposed since Initial GSP)*	Spring Valley Recharge Project – Phase 1	T&M King Farms LLC	2023	In Progress	The Spring Valley Multi-Benefit Project focuses on achieving four goals of increasing groundwater recharge, restoring wetland habitat, sequestering carbon and increasing the sustainability of domestic wells, many of which serve local disadvantaged communities.	This project was included in the SGMA Implementation Round 2 grant application, although funding was not awarded. Phase 1 of this project is projected to last for two years once funding is secured.

Category (from GSP)	Project/Management Action Name	Proponent	Year Planned (from GSP)	Status	Brief Description (from GSP)	Updates Since GSP
Potential *(Proposed since Initial GSP)*	Sycamore Slough Reconnection and Recharge	Davis Ranches	2023	Implementation Ongoing	The Sycamore Slough Reconnection and Recharge project would divert surface water from the Sacramento River and/or the Colusa Basin Drain to flood fields and the slough itself to provide groundwater recharge, create habitat for migrating shorebirds/waterfowl, and provide essential support for groundwater dependent ecosystems along the path of Sycamore Slough.	Davis Ranches has completed work on the slough reconnection, began conservation and rehabilitation improvements to approx. 2,000-3,000 feet of channels, and organized with neighboring landowners and a neighboring RCD to join together in recharge and conservation efforts.
Potential *(Proposed since Initial GSP)*	GCID Recharge Basin	GCID	2023	Planned	GCID is planning to install a turnout to a gravel pond that will supply available surface water for groundwater recharge.	GCID is currently developing this project.
Potential *(Proposed since Initial GSP)*	OAWD Direct Groundwater Recharge Project	OAWD	2024	Implementation Ongoing	Deliver surface water for groundwater recharge in OAWD and collaborate with landowners to implement, monitor, and pay the cost of water for recharge projects.	From March 2024 to February 2025, OAWD oversaw the delivery of over 2,500 af of water for groundwater recharge on private lands within the District. The District collaborates with landowners to provide expertise on project implementation, monitor the sites, and pay the cost of water for recharge projects.
Potential	*All Others Listed in GSP*	-	-		-	*No change in implementation noted since GSP development.*

Table 6-6. Anticipated Benefits and Actual Benefits of Projects and Management Actions.

Category (from GSP)	Project/Management Action Name	Proponent	Anticipated or Reported Benefits from GSP		Actual/Approximate Benefits		Note
			Average Annual Benefits from GSP (af/yr)	Refined Average Annual Benefits Since GSP (af/yr)	Benefits in 2024 (af/yr)	Actual Average Annual Benefits Since GSP (af/yr)*	
Planned	CCWD In-Lieu Groundwater Recharge	CCWD	27,000	-	9,000	9,000	Increased surface water usage in 2024 compared to recent years. An estimated 9,000 af of benefits occurred (additional surface water supply used in 2024 versus 2023, with no reported Subbasin outflows)
Planned	CDMWC In-Lieu Groundwater Recharge	CDMWC	28,000	-	-	-	No update since GSP development.
Planned	Colusa Subbasin Multi-Benefit Groundwater Recharge	CGA, GGA and TNC	5,200	-	-	220	Grant-funded project concluded in January 2022. Ongoing multi-benefit recharge work is occurring through other projects.
Planned	OAWD Land Annexation and Groundwater Recharge	OAWD	23,000	14,000	(*Benefits reported under the OAWD Direct Groundwater Recharge Project, see below)*	(*Benefits reported under the OAWD Direct Groundwater Recharge Project, see below)*	Annexation of 10,308 acres was completed in March 2025. With existing infrastructure, approximately 3,300 acres can begin receiving surface water in 2025. Deliveries to the remaining area will occur after completion of ongoing permitting (2-4 years) and construction of delivery infrastructure. Recharge in 2024 occurred under the OAWD Direct Groundwater Recharge Project (Benefits accounted below).
Planned	Sycamore Slough Groundwater Recharge Pilot Project	Landowner	500	-	300	350	Recharge occurred in December 2023-January 2024. Estimated benefits in 2024 are similar to 2023, in round numbers. Project is continuing through 2030.

Category (from GSP)	Project/Management Action Name	Proponent	Anticipated or Reported Benefits from GSP		Actual/Approximate Benefits		Note
			Average Annual Benefits from GSP (af/yr)	Refined Average Annual Benefits Since GSP (af/yr)	Benefits in 2024 (af/yr)	Actual Average Annual Benefits Since GSP (af/yr)*	
Planned *(Proposed since Initial GSP)*	GGA Recharge Project	GGA	-	7,500	1,400	1,400	The GGA has partnered with local water districts, including OAWD (see below), to implement more than 20 groundwater recharge projects in the last two years to achieve approximately 3,500 af of groundwater recharge, including approximately 1,400 af of recharge in 2024.
Ongoing	RD108 and CCWD Agreement for Five-Year In-Lieu Groundwater Recharge Project	RD108 and CCWD	8,000	-	-	450	Agreement on hold in 2023-2024 due to wet conditions, CVP 215 water availability, and Voluntary Agreement efforts. Anticipate re-initiating discussions shortly.
Ongoing	GCID Strategic Winter Water Use for Groundwater Recharge and Multiple Benefits	GCID	*TBD*	-	20,000	20,000	Benefits in 2024 are estimated to be approximately the same as benefits in 2023 (similar water supply; recharge benefit estimated for typical recharge of ponding in Nov-Mar for rice decomposition).
Ongoing	Sycamore Marsh Farm Direct Recharge Project	Landowner	*TBD*	-	-	-	No update since GSP development.
Ongoing	GCID Expansion of In-Basin Program for In-lieu Groundwater Recharge	GCID	*TBD*	-	-	-	GCID is working with neighboring non-district lands to supply water for in-lieu recharge. However, no recharge benefits noted in 2024.
Ongoing	OUWUA Irrigation Modernization for Increased Surface Water Delivery and Reduced Groundwater Pumping	OUWUA	*TBD*	-	-	-	OUWUA continues to promote and support efficient on-farm irrigation systems. However, no recharge benefits noted in 2024.

Category (from GSP)	Project/Management Action Name	Proponent	Anticipated or Reported Benefits from GSP		Actual/Approximate Benefits		Note
			Average Annual Benefits from GSP (af/yr)	Refined Average Annual Benefits Since GSP (af/yr)	Benefits in 2024 (af/yr)	Actual Average Annual Benefits Since GSP (af/yr)*	
Ongoing	Urban Water Conservation in Willows	California Water Service – Willows District	2	-	80	80	Implementation of urban water conservation measures continued in 2024.
Potential	GCID In-Lieu Groundwater Recharge	GCID	-	-	-	-	GCID is continuing to work with landowners to incentivize utilization of all available surface water supplies. There remain about 4,200 acres within the GCID boundary (approx. 5%) that still rely on private wells.
Potential	Tehama-Colusa Canal Trickle Flow to Ephemeral Streams	RD108, CCWD	-	-	-	-	Project development continued, although no recharge benefits noted in 2024. Recharge is anticipated in early 2025
Potential	GCID Water Transfers to TCCA CVP Contractors	GCID	-	-	-	-	GCID is continuing discussions with the TCCA and identifying opportunities for partnerships with other districts in the Subbasin.
Potential *(Proposed since Initial GSP)*	Spring Valley Recharge Project – Phase 1	T&M King Farms LLC	*5,400*	-	-	-	No recharge benefits noted in 2024.
Potential *(Proposed since Initial GSP)*	Sycamore Slough Reconnection and Recharge	Davis Ranches	-	-	-	-	No recharge benefits noted in 2024, although conservation and rehabilitation improvements are ongoing.
Potential *(Proposed since Initial GSP)*	OAWD Direct Groundwater Recharge Project	OAWD	-	-	2,500	2,500	From March 2024 to February 2025, OAWD oversaw the delivery of over 2,500 acre-feet of water for groundwater recharge on private lands within the District.

Category (from GSP)	Project/Management Action Name	Proponent	Anticipated or Reported Benefits from GSP		Actual/Approximate Benefits		Note
			Average Annual Benefits from GSP (af/yr)	Refined Average Annual Benefits Since GSP (af/yr)	Benefits in 2024 (af/yr)	Actual Average Annual Benefits Since GSP (af/yr)*	
Potential	*All Others Listed in GSP*	-	-	-	-	-	*No update since GSP development.*

**In years with recharge benefits.*

6.2.4 Updates to Planned Projects and Management Actions

This section describes updates to planned PMAs as of early 2025. Descriptions are provided only for those PMAs with noted updates during GSP implementation.

6.2.4.1 CCWD In-Lieu Groundwater Recharge

In this project, Colusa County Water District (CCWD) will utilize additional surface water for irrigation in-lieu of groundwater, targeting a long-term average annual use of 27,000 af/yr. The additional surface water will be made available through full use of the district's existing CVP contract and annual and multi-year water purchase and transfer agreements. The additional water will be conveyed through the existing Tehama-Colusa Canal (TCC) and CCWD facilities and will be used primarily on existing district lands, resulting in in-lieu groundwater recharge through reduction of groundwater pumping. As an optional component of this project, CCWD is considering relatively small annexations of lands adjoining the district and supplying surface water to these lands in-lieu of groundwater pumping. If these annexations proceed, the additional water may also be used on the newly annexed lands that are currently dependent on groundwater and require construction of additional infrastructure for surface water delivery.

Use of additional surface water within CCWD requires a combination of incentivizing additional use of CCWD existing CVP supplies and transfer arrangements with other districts. As of 2024, CCWD has surface water available for customers, and the district has implemented a policy to encourage surface water versus groundwater. CCWD reports more surface water application in WY 2024 compared to recent years, pointing to an increase in in-lieu groundwater recharge through changes in grower water use practices. Nevertheless, further efforts may still help to continue incentivizing surface water use. In 2024, CCWD continued working with others in the CGA on a rate structure that could incorporate fees for groundwater extraction, thereby disincentivizing groundwater pumping and making surface water a more economical option. Those efforts are ongoing.

6.2.4.2 OAWD Land Annexation and Groundwater Recharge

Orland-Artois Water District (OAWD), a CVP water contractor, is working with a group of neighboring non-district landowners to annex land into the district service area. These lands are already developed agricultural properties that currently rely solely on groundwater for irrigation water supplies. Supplemental surface water for the annexed lands would be secured through annual and multi-year purchase or transfer agreements with willing sellers, conveyed through the existing Tehama-Colusa Canal (TCC), and distributed to the annexed lands through existing OAWD facilities and new distribution facilities. New facilities include turnouts off the TCC, pipelines, pumping plants, and metered farm turnouts. This project is described in greater detail in Section 6.3.4 of the GSP. This project is of key interest, as it would directly address groundwater conditions in an area of the Subbasin that has experienced land subsidence, providing surface water to irrigators and reducing agricultural groundwater pumping by 10,000 to 20,000 af/yr. This project is actively being developed and is planned for implementation as soon as possible.

Since GSP development, planning efforts and discussions have continued with OAWD, the Tehama-Colusa Canal Authority (TCCA), the Glenn Local Agency Formation Commission (LAFCO), and USBR. While the SGMA Implementation Round 2 grant application was unsuccessful, this will only slow project implementation, not stop it.

Annexation of 10,308 acres was completed in March 2025 following approval by OAWD, the Glenn LAFCO, and USBR. A Finding of No Significant Impact was made by USBR in May 2024, which clears the way for infrastructure construction to begin. The project received up to $300,000 for design and $3.8 million for construction in WaterSMART grants from USBR.

With existing infrastructure, approximately 3,300 acres can begin receiving surface water in 2025 . Deliveries to the remaining area will occur after completion of ongoing permitting (2-4 years) and construction of delivery infrastructure.

From March 2024 to February 2025, OAWD also oversaw the delivery of over 2,500 acre-feet of water for groundwater recharge on private lands within the District. The District collaborates with landowners to provide expertise on project implementation, monitor the sites, and pay the cost of water for recharge projects. The focus of the pilot project was geographic areas affected by land subsidence and/or areas experiencing a high concentration of dry domestic wells. With a budget of $50,000, the District offered to cover the cost of recharge water and connections for water recharged by District landowners. All of the water delivered for recharge was CVP 3F water. District staff measured groundwater conditions at multiple wells – including domestic, agricultural, and monitoring wells – which all showed some improvement in groundwater levels. As part of this project, the GGA and OAWD also examined the potential for future recharge opportunities at multiple sites in OAWD. The Vereschagin site, a ¼-acre pond with an observed infiltration rate of 10 feet per day, demonstrated immense potential for scaling future groundwater recharge projects to address overdraft. A 10-acre site at this location could provide 12,600 af of groundwater recharge in just three months in future wet years. Other sites where recharge occurred included old recirculation sumps, ditches, landscape ponds, and pasture.

Combined, the in-lieu recharge from the OAWD annexation project and the direct groundwater recharge potential demonstrated by OAWD pilot groundwater recharge project show that it is feasible to reduce groundwater demand and increase groundwater supply to eliminate groundwater overdraft in the area.

6.2.4.3 Sycamore Slough Groundwater Recharge Pilot Project

Proctor and Gamble and Davis Ranches entered into a cooperative agreement to implement a 10-year groundwater recharge pilot project from fall 2021 through 2030. The project plans to apply surface water diverted from the Sacramento River to a 66-acre field on Davis Ranches for 30 to 45 days each fall or winter, providing multiple benefits to the Subbasin through groundwater recharge and creation of habitat for migrating birds. This project is described in greater detail in Section 6.3.5 of the GSP.

Since GSP development, Davis Ranches has continued with project development and planning and has begun project implementation with field flooding and monitoring. Surface water was applied to the field in three consecutive flooding events between December 2023 and January 2024. Applied water and groundwater recharge benefits are being monitored through a combination of existing and newly installed data collectors in the field. Project implementation continued in 2024. Although no specific updates were noted in early 2025, estimated benefits are approximately the same as 2023, in round numbers. The project is expected to continue through 2030.

6.2.4.4 GGA Recharge Project

Since GSP implementation, the GGA began work on a recharge project with the goal of immediately addressing unprecedented drought conditions impacting communities and domestic well users in Glenn County. The project objective is to plan, design, implement, and monitor multi-benefit, direct and in-lieu groundwater recharge projects in a unified approach and demonstrate that groundwater recharge is a viable tool to immediately alleviate critical drought conditions. This Project will provide habitat for migratory shorebirds and enhance groundwater dependent ecosystems supporting the region's objective to implement multi-benefit projects. The Project will utilize (when available) CVP Section 215 water, excess CVP contract water, purchased water from senior water right holders, and high stormflows from Stony Creek and other streams, as

feasible. Recharge will occur across GGA's service area focusing on areas to maximize urban and environmental benefits.

The GGA has partnered with local water districts, including OAWD (see **Section 6.2.4.2** and **Table 6-5**), to implement more than 20 groundwater recharge projects in the last two years to achieve approximately 3,500 acre-feet of groundwater recharge. These projects made use of winter flows on the Sacramento River, known as Section 215 or 3F water. These winter flows—which are available at reduced pricing and do not reduce the amount of water available to local water districts—have been critical to implementing GGA's recharge programs. GGA has also partnered with OUWUA on two groundwater recharge projects during their irrigation season.

In 2023, the GGA conducted two pilot projects in collaboration with OAWD and OUWUA, completing over 15 groundwater recharge projects in Glenn County and recharging approximately 2,100 af of water. These efforts are discussed in the previous Annual Report. The pilot projects were successful in facilitating groundwater recharge, gathering data, building relationships, and providing community outreach.

In 2024, the GGA discussed several options for pursuing recharge pilot projects during the irrigation season. There was consensus among the Recharge Pilot Project Ad Hoc Committee and GGA Board to repeat the two pilot projects within the OUWUA boundary during the 2024 irrigation season in addition to potentially exploring other options to diversify projects into other areas and/or other water providers or whether to continue focusing only in priority areas.

Following these discussions, the GGA worked closely with pilot program participants to conduct five pilot test groundwater recharge projects at five locations across the GGA, including sites in the City of Orland, OUWUA, and OAWD. The purpose of these efforts was to assess overall potential for groundwater recharge and assess potential groundwater flow pathways for recharged water. In total, approximately 1,400 af of water was recharged through these efforts in 2024. The GGA completed a short-term pilot test report to document the pilot program efforts and benefits through 2024. In March 2024, the GGA and its consultant team also worked with OAWD and landowners participating in recharge efforts to install three pressure transducers to record water levels at two sites within OAWD.

As of early 2025, the GGA and its consultant team have completed a report on options for long-term groundwater recharge, including an analysis of pros and cons such as capital and upfront costs, operating and ongoing costs, potential for grant funding, level of certainty, partnerships, permitting, other benefits such as flood control and habitat, impacts to shallow wells, impacts to deep wells, impacts to domestic wells, and ability to slow land subsidence. Projects prioritized for future recharge efforts that are analyzed in the report include (1) existing basins with local creek winter flows, (2) winter water, (3) Black Butte water storage and releases, (4) Stony Creek section 215 designation water, (5) on-farm system modernization, and (6) water right application.

In late 2024, the GGA and Corning Sub-Basin Groundwater Sustainability Agency (CSGSA) also prepared a joint application for a 180-day permit for diversion and groundwater recharge off Stony Creek and submitted the application to the SWRCB in December 2024. The final permit application was for a maximum of 4,999 acre-feet at a diversion rate not to exceed 51.2 cubic feet per second per day. In January 2025, the SWRCB issued Temporary Permit 21470 To Appropriate Water From Stony Creek in Glenn County. Subsequent efforts have been made by the GGA and CSGSA to complete remaining tasks necessary for diversion and recharge (e.g., executing an MOU between the GSAs related to water accounting for diversions, preparing landowner agreements, and procurement of equipment and materials).

Also in 2024, the GGA sent a letter to USBR expressing its interest in engaging and meeting with USBR staff to explore surface water opportunities to augment groundwater recharge. In particular,

GGA expressed interest in opportunities to develop an option similar to 3F or Section 215 water on Stony Creek when water is being released from Black Butte to maintain flood control levels.

6.2.5 Updates to Ongoing Projects and Management Actions

This section describes updates to ongoing PMAs as of early 2025. Descriptions are provided only for those ongoing PMAs with noted updates during GSP implementation.

6.2.5.1 RD108 and CCWD Agreement for Five-Year In-Lieu Groundwater Recharge Project

RD108 and CCWD (and Dunnigan Water District [DWD] located in the neighboring Yolo Subbasin) entered into a five-year agreement (which ended in 2022) that provided for the purchase of water by CCWD (and DWD) from RD108. The purchased water was available to RD108 through contractual rights under Sacramento River Settlement Contract 14-06-200-876A between RD108 and the Bureau of Reclamation. Under the five-year agreement, 10,000 af was purchased by and transferred to CCWD and DWD, with 80 percent of the 10,000 af going to CCWD and 20 percent to DWD. The project has provided in-lieu recharge by supplying surface water to meet irrigation demands that otherwise would be met through groundwater pumping. At the time of GSP development, it was expected that the five-year agreement would be extended with the price schedule potentially renegotiated.

The agreement with RD108 expired in 2023 and has not yet been renewed due to the wet conditions in 2023-2024, the extended availability of CVP 215 water, and efforts by the Settlement contractors working on Voluntary Agreements. While all parties opted to put agreement on hold at this time, CCWD plans to re-initiate the in-lieu recharge discussions with RD108 shortly, when time and conditions permit. CCWD has also continued its efforts to implement policies to encourage more surface water use and decrease private groundwater pumping in the district when surface supplies are available (see **Section 6.2.4.1**).

6.2.5.2 GCID Strategic Winter Water Use for Groundwater Recharge and Multiple Benefits

In addition to the water supply available to Glenn-Colusa Irrigation District (GCID) under its settlement contract with USBR, GCID holds a 1999 water right permit to divert Sacramento River water between November 1 and March 31 each year. Water used under the permit is referred to as “winter water.” Winter water use is beneficially used in GCID for rice straw decomposition, habitat enhancement for Pacific Flyway migrating waterfowl, groundwater recharge, frost control, and for irrigating crops. Under this project, working in collaboration with partners within the Subbasin and with environmental advocacy groups, GCID is investigating opportunities to increase winter water use by alleviating constraints on winter water supplies (i.e., cost, labor and management effort, conflicts with GCID system construction and maintenance, and water supply constraints during dry periods). Objectives of the project are to incentivize growers to: 1) maximize winter water use on rice land including targeting rice lands with highest recharge potential, 2) expand use of winter water for irrigation and frost control where groundwater would otherwise be used, and 3) encourage temporary flooding of permanent and annual crop lands including targeting lands with the highest recharge potential.

Since GSP development, GCID filed a new winter water right permit with the State Water Resources Control Board (SWRCB). GCID currently diverts winter water under an amended permit that limits annual diversions of winter water to 182,900 af (approximately 1,068 cubic feet per second (cfs)).

GCID continues to deliver winter water to GCID customers and users outside the District. In WY 2024, GCID reported approximately 136,000 af of surface water use in the winter (November 2023 through March 2024), which was used for a variety of beneficial purposes throughout GCID in the Subbasin, including straw decomposition and habitat. The estimated benefits of winter water use for decomposition and habitat benefits was approximately 20,000 af in 2024

(approximately similar to reported benefits in 2023, in round numbers, representing typical recharge of ponding for rice decomposition). Additional recharge also occurred due to application of winter water for irrigation on other lands, although those benefits are accounted for in the Subbasin water use estimates (see **Sections 2 through 4**).

6.2.5.3 OUWUA Irrigation Modernization for Increased Surface Water Delivery and Reduced Groundwater Pumping

The Orland Unit Water Users' Association (OUWUA) flood water conveyance project is proposed to modernize the OUWUA's southside irrigation conveyance and distribution system to provide for groundwater recharge through deliveries of flood water to customers and regulating reservoirs. Infrastructure improvements are expected to include delivery infrastructure and recharge basins as well as expanded and improved flow measurement and water level control, system interties, and expansion and upgrading of the existing supervisory control and data acquisition (SCADA) system. These improvements are expected to result in more reliable and flexible farm deliveries that will provide incentives for growers to use more surface water and pump less groundwater. In-lieu recharge is expected to increase groundwater levels within and neighboring the OUWUA service area.

OUWUA continues to promote and support efficient on-farm irrigation systems. In most cases, groundwater pumping is offset by using Orland Project water for pressurized sprinkler/drip/micro-sprinkler applications. In the past several years, efficient on-farm irrigation systems have increased, driven by drought conditions. One new modified delivery system came online in 2023; no updates to delivery systems were noted in 2024.

6.2.5.4 Urban Water Conservation in Willows

The California Water Service – Willows District is implementing urban water conservation measures through water waste restrictions, conservation pricing, public education and outreach, programs to assess and manage distribution system real loss, water conservation program coordination and staffing support, and other demand management measures. These are described in greater detail in Chapter 9 of the 2020 Urban Water Management Plant (UWMP) for the California Water Service, and are described in the GSP.

In WY 2024, the California Water Service – Willows District continued implementation of these many measures with similar benefits reported in the previous Annual Report (approximately 80 af).

6.2.6 Updates to Potential Projects and Management Actions

This section describes updates to potential PMAs as of early 2025. Descriptions are provided only for those potential PMAs with noted updates during GSP implementation.

6.2.6.1 GCID In-Lieu Groundwater Recharge

Despite GCID having highly reliable surface water supplies, a small percentage of district lands rely primarily on groundwater for irrigation supply. In this project, GCID plans to investigate, develop, and implement measures to incentivize associated growers to utilize surface water supplied by GCID, which will provide in-lieu recharge through reduced groundwater pumping.

GCID is continuing to work with landowners to incentivize utilization of all available surface water supplies, in coordination with GCID's efforts to strategically expand winter water use (**Section 6.2.5.2**). There remain about 4,200 acres within the GCID boundary that are primarily irrigated with groundwater pumped from private wells. Approximately 90% of these lands are in Glenn County. These represent approximately 5% of District lands in a full surface water supply allocation year, but more lands may rely on groundwater during years with curtailments. Hence, sustained access to contract surface water supplies is critical and inextricably tied to groundwater sustainability, and is necessary for the ongoing vitality of the Subbasin and its communities.

6.2.6.2 Tehama-Colusa Canal Trickle Flow to Ephemeral Streams

The Tehama-Colusa Canal (TCC) has existing gates that are used to dewater sections of the canal into ephemeral streams that intersect the canal. In the GSP, a potential recharge project concept was proposed in which water could be discharged from the TCC into these streams at a rate where they do not flow out of the Subbasin but recharge the groundwater system. Flow measurement devices would need to be added to the gates for project implementation. Surface water for recharge would be sourced from the Sacramento River under existing USBR water supply contracts held by TCC contractors, existing water rights settlement contracts, and annual Section 215 contracts. A summary of the project is provided in Section 6.5.1.8 of the GSP.

Further conceptual development of this project has occurred since the GSP, with identification of potential streams, water sources, and operating strategies to most effectively conduct recharge. CCWD is leading the development of this project. The District has installed three discharge sites and has coordinated with several landowners willing to participate in the project monitoring network. The voluntary well monitoring network will help to measure recharge efforts. CCWD has also been working with on a mapping project that will include mapping for the project monitoring network, including DWR monitoring wells and private wells.

To assist with implementation costs of the project, CCWD applied for grant funding through the Integrated Regional Water Management (IRWM) Grant Program, as well as other DWR grant funding requests. The project has successfully received funding for infrastructure development through an IRWM grant being administered by Sutter County. Work has begun on landowner access agreements, installing the project monitoring network (including efforts described above), and completing the project infiltration study. CCWD is also looking at installing stream flow gauges to monitor flows in ephemeral streams following high rain events, and in turn monitor “natural recharge” to the aquifer.

As of early 2025, CCWD is currently setting temporary pumps to discharge excess flows (e.g., USBR Section 3F water) into streams for recharge beginning in February 2025.

CCWD has also filed a temporary water right application for winter water that would provide the project with lower-cost water for recharge.

Once the project is implemented, CCWD plans to quantify project benefits through the monitoring network and confirm prior studies of natural recharge within District. This monitoring will help to identify areas where surface water may be used for recharge with the greatest benefit to bolster groundwater levels and reduce or halt subsidence.

6.2.6.3 GCID Water Transfers to TCCA CVP Contractors

GCID is exploring the possibility of transferring surface water to CVP contractors served by the TCC to provide in-lieu groundwater recharge and reduce groundwater pumping through increased CVP water utilization. The water to be transferred would be Sacramento River water available to GCID under its water rights settlement contract that is temporarily surplus to GCID's needs under certain conditions. Transferred water would be diverted into the Tehama-Colusa Canal at the Red Bluff Pumping Plant and Fish Screen facility rather than at the GCID pumping plant and fish screen facility north of Hamilton City. Priority would be placed on transfers to CVP contractors in areas where groundwater levels have been declining over the past approximately 20 years, particularly in the areas around the cities of Orland and Arbuckle.

This project is in progress. GCID is continuing discussions with the TCCA. GCID is also identifying opportunities for partnerships with other districts in the Subbasin. Importantly, GCID and other districts in the Subbasin together recognize that sustained access to contract surface water supplies is critical and inextricably tied to groundwater sustainability in the Subbasin.

Updates on these discussions and efforts will be provided in future Annual Reports.

6.2.6.4 Spring Valley Recharge Project – Phase 1

The Spring Valley Multi-Benefit Project focuses on achieving four goals of increasing groundwater recharge, restoring wetland habitat, sequestering carbon and increasing the sustainability of domestic wells, many of which serve local disadvantaged communities. Phase 1 will focus on 646 acres along the Colusa Drain and directly north of College City.

This phase includes implementing a restored wetland, in-lieu recharge almond blocks, and a recharge basin. The project will result in both direct and in lieu recharge. An estimated 3,376 af/yr of excess area water will infiltrate and recharge the underlying aquifer. In-lieu recharge in the amount of 1,360 af/yr will occur on 340 acres of almonds, reducing groundwater pumping and area demand. Lastly, a small recharge basin will provide an additional 150 af/yr in groundwater recharge. Total direct and in lieu recharge associated with the project are calculated as approximately 5,400 af/yr during wet years.

This project was included in the SGMA Implementation Round 2 grant application, although funding was not awarded. Phase 1 of this project is projected to last for two years once funding is secured.

6.2.6.5 Sycamore Slough Reconnection and Recharge

In this project, Davis Ranches would divert surface water from the Sacramento River and/or the Colusa Basin Drain to flood fields and the slough itself to provide groundwater recharge, create habitat for migrating shorebirds/waterfowl, and provide essential support for groundwater dependent ecosystems along the path of Sycamore Slough.

It is anticipated that this project would benefit groundwater levels, groundwater storage, ISW, and groundwater dependent ecosystems. Recharge benefits would be calculated through a mass balance calculation, similar to the monitoring program already in place at Davis Ranches. Sacramento River pumps would track the total acre feet of surface water applied to recharge fields and along the Sycamore Slough channel. The existing monitoring well field would be expanded to capture the interaction between applied surface water and groundwater levels along the slough. All monitoring wells would have data loggers installed that are compatible with the Colusa Subbasin Well Monitoring Pilot Program. Benefits to the groundwater dependent ecosystems would be documented through the help of The Nature Conservancy.

Davis Ranches has completed efforts on the slough reconnection, spanning approximately 2,000-3,000 feet of channels that are now connected back to the Sacramento River. Davis Ranches is working on conservation and rehabilitation improvements to the channel. Davis Ranches is also organizing with neighboring landowners and a neighboring RCD to join together in recharge and conservation efforts.

6.3 OTHER INFORMATION ON IMPLEMENTATION PROGRESS

In addition to the PMAs described above, the CGA and the GGA have also continued other efforts toward GSP implementation:

- As described further in **Section 6.2.1**, the CGA and GGA completed GSP revisions in 2023-2024 and adopted and submitted the Revised Colusa Subbasin GSP in April 2024. On February 27, 2025, DWR formally approved the April 2024 Revised Colusa Subbasin GSP and identified certain recommended corrective actions to further improve the GSP. The CGA and GGA are continuing forward with GSP implementation and will plan to substantively address DWR's recommended corrective actions in the upcoming Periodic Evaluation and Annual Reports, as applicable.
- As described further in **Section 6.2.2**, the CGA and GGA have made many concrete steps toward implementation of the domestic well mitigation program and demand management programs for the Subbasin in 2024 and early 2025. Specific activities are listed in **Section 6.2.2.** The GSAs remain on track to develop and begin implementation of both programs according to their proposed timelines.
- While both the CGA and GGA both have initial funding in place, each GSA continuing their efforts to secure updated long-term funding and financing for GSP implementation, including projects and management actions. These efforts have involved development of a rate analysis and evaluation of approaches for establishing and administering fees, including public workshops. As of early 2025, the GGA has completed their SGMA Fee process and the CGA process is ongoing.
- Throughout 2024, both the CGA and GGA continued coordination efforts among their respective counties, member agencies, and other interested parties in the Subbasin to strategically coordinate on efforts to support the sustainability goal of the Subbasin.
- Both the CGA and GGA continued to notice and hold public meetings throughout the year, providing stakeholders the opportunity to learn and engage with the GSA Boards on topics related to GSP implementation. Public meetings in 2024 and early 2025 have also been added to facilitate discussions and solicit public input to development of the domestic well mitigation program and demand management programs for the Subbasin (described further in **Section 6.2.2**).
- The CGA and GGA jointly held a stakeholder outreach webinar in 2024 where they presented on groundwater conditions in the Subbasin in WY 2023.
- The GGA continued work on the GGA Recharge Project (described in **Section 6.2.4.4**). These efforts have resulted in numerous outcomes including, but not limited to:
    - Successful recharge in WYs 2023-2024 (approximately 3,500 af total across both years),
    - Public outreach about the importance of recharge efforts and groundwater sustainability,
    - Completion of a short term pilot test report,
    - Completion of a report on options for long-term groundwater recharge, and
    - GGA's joint application (in partnership with CBGSA) for a 180-day permit for diversion and groundwater recharge off Stony Creek, and SWRCB's subsequent issuance of a temporary permit to appropriate water from Stony Creek in Glenn County.
- Certain CGA member agencies have coordinated together with certain agencies in the Yolo Subbasin to coordinate SGMA implementation efforts and analyses for the South Colusa – North Yolo (SCNY) region.
- Glenn County Resource Conservation District, in partnership with the GGA, is in the process of initiating the Glenn County Recharge Plan and pilot, which will help to evaluate,

prioritize, and guide development of future recharge projects in Glenn County. Efforts on the Glenn County Recharge Plan will be funded through a grant.

- Glenn County Resource Conservation District, contracted by Community Alliance with Family Farmers (CAFF), is providing outreach assistance, particularly as it relates to small farmers.

7 References

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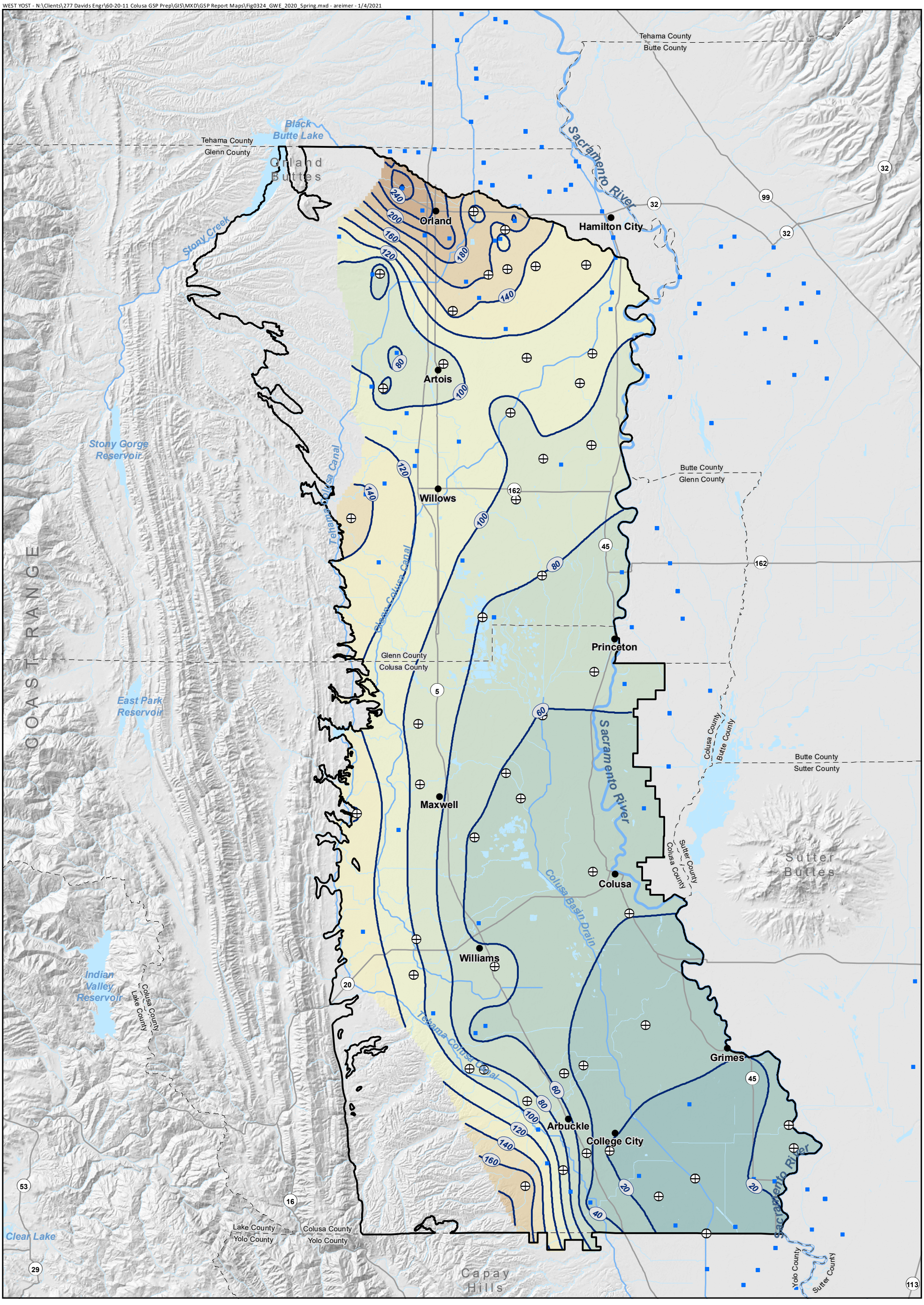
Appendix A. Groundwater Elevation Contour Maps – Spring/Fall 2020 through 2024.



Groundwater Elevation (ft)

260 - 280	140 - 160	20 - 40
240 - 260	120 - 140	0 - 20
220 - 240	100 - 120	-20 - 0
200 - 220	80 - 100	-40 - -20
180 - 200	60 - 80	
160 - 180	40 - 60	

- Well Used for Contouring
- Monitoring Network Wells
- Groundwater Elevation Contour (20-Foot Interval)
- Colusa Subbasin

Horizontal Datum: North American Datum of 1983 (NAD 83), California State Plane Zone II, feet.

Vertical Datum: North American Vertical Datum of 1988, feet (NAVD 88).

N

0 2.5 5

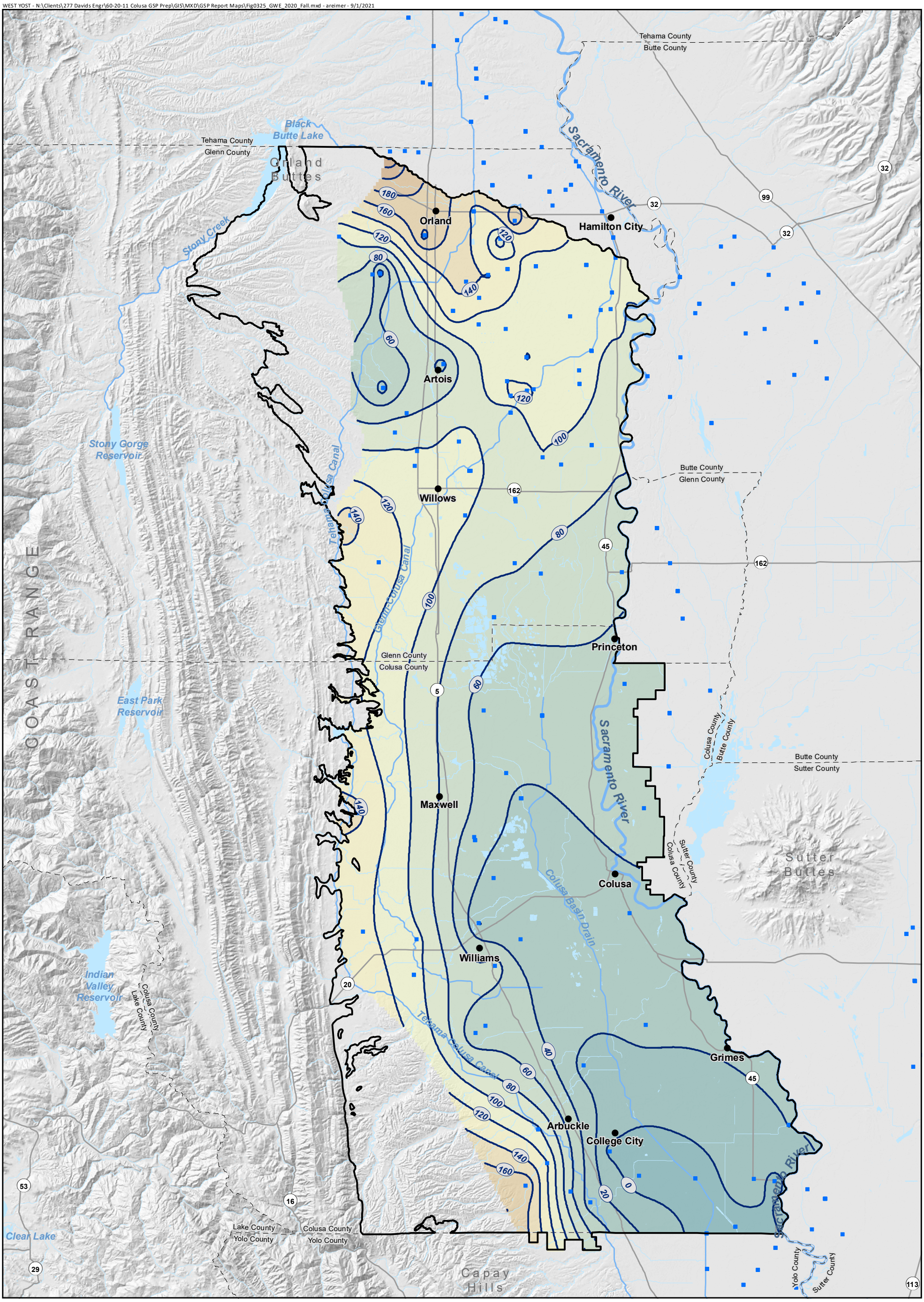
Scale in Miles

Figure A-1

Groundwater Elevation Contours Spring 2020

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin

WEST YOST - N:\Clients\277 Davids Engr\60-20-11 Colusa GSP Prep\GIS\MXD\GSP Report Maps\Fig0325_GWE_2020_Fall.mxd - areimer - 9/1/2021



Groundwater Elevation (ft)

260 - 280	140 - 160	20 - 40
240 - 260	120 - 140	0 - 20
220 - 240	100 - 120	-20 - 0
200 - 220	80 - 100	-40 - -20
180 - 200	60 - 80	
160 - 180	40 - 60	

Well Used for Contouring

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin

Horizontal Datum: North American Datum of 1983 (NAD 83), California State Plane Zone II, feet.

Vertical Datum: North American Vertical Datum of 1988, feet (NAVD 88).

N

0 2.5 5

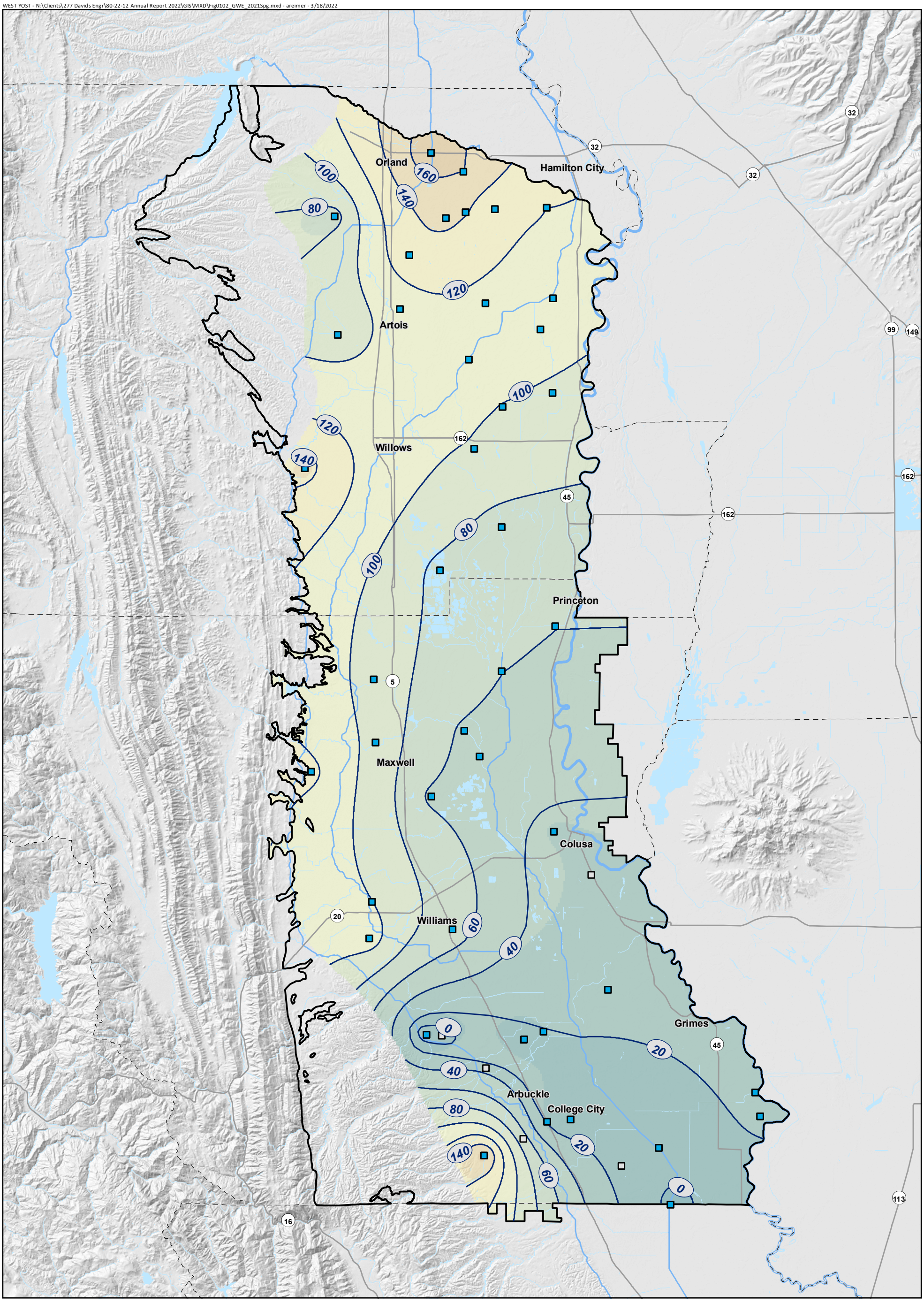
Scale in Miles

Figure A-2

Groundwater Elevation Contours Fall 2020

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin

WEST YOST - N:\Clients\277 Davids Engr\80-22-12 Annual Report 2022\GIS\MXD\Fig0102_GWE_2021Spg.mxd - areimer - 3/18/2022



Groundwater Elevation Representative Monitoring Well Used for Contouring

Groundwater Elevation Representative Monitoring Well Not Used for Contouring

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin

Groundwater Elevation (feet)

160 - 180	80 - 100	0 - 20
140 - 160	60 - 80	-20 - 0
120 - 140	40 - 60	
100 - 120	20 - 40	

N

0 2.5 5

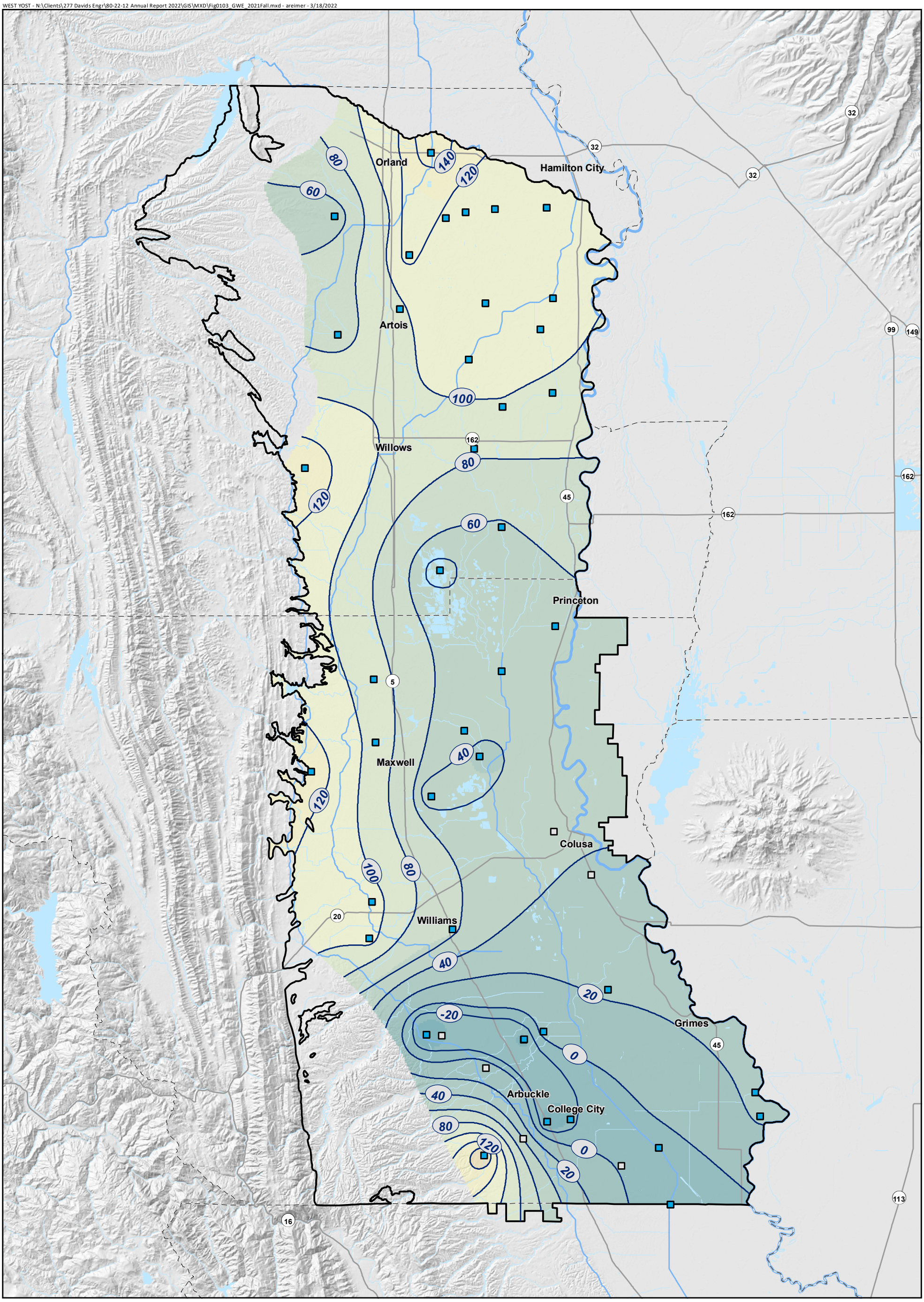
Scale in Miles
1 inch = 5 miles

Datum: NAD1983 California State Plane Zone II, feet. North American Vertical Datum 1988, feet.

Figure A-3

Groundwater Elevation Contours Spring 2021

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin



Groundwater Elevation Representative Monitoring Well Used for Contouring

Groundwater Elevation Representative Monitoring Well Not Used for Contouring

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin

Groundwater Elevation (feet)

160 - 180	80 - 100	0 - 20
140 - 160	60 - 80	-20 - 0
120 - 140	40 - 60	-40 - -20
100 - 120	20 - 40	

N

0 2.5 5

Scale in Miles
1 inch = 5 miles

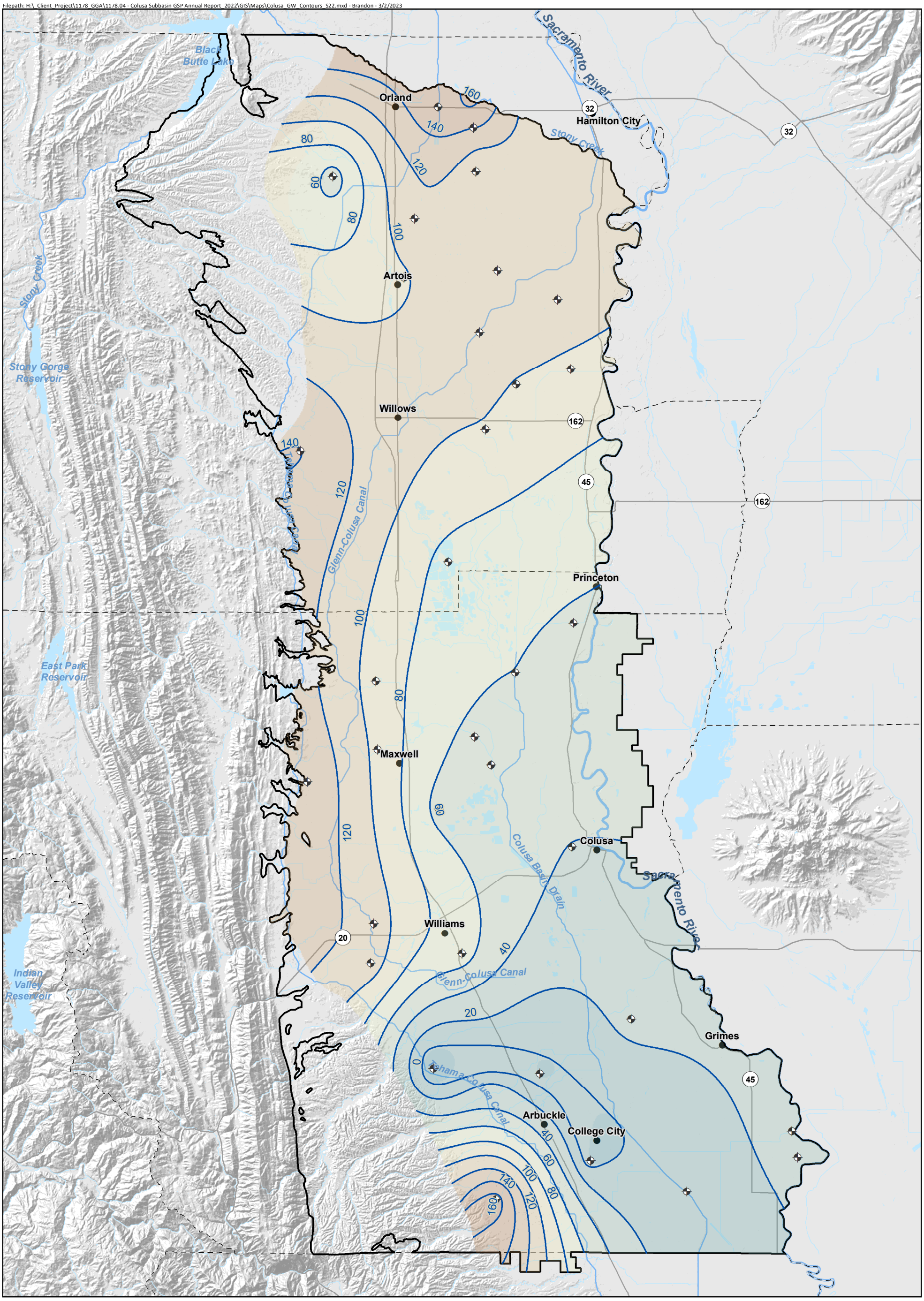
Datum: NAD1983 California State Plane Zone II, feet. North American Vertical Datum 1988, feet.

Figure A-4

Groundwater Elevation Contours Fall 2021

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin

Filepath: H:_Client_Project\1178_GGA\1178.04 - Colusa Subbasin GSP Annual Report_2022\GIS\Maps\Colusa_GW_Contours_S22.mxd - Brandon - 3/2/2023



Groundwater Elevation Measurement (Well Used for Contouring)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

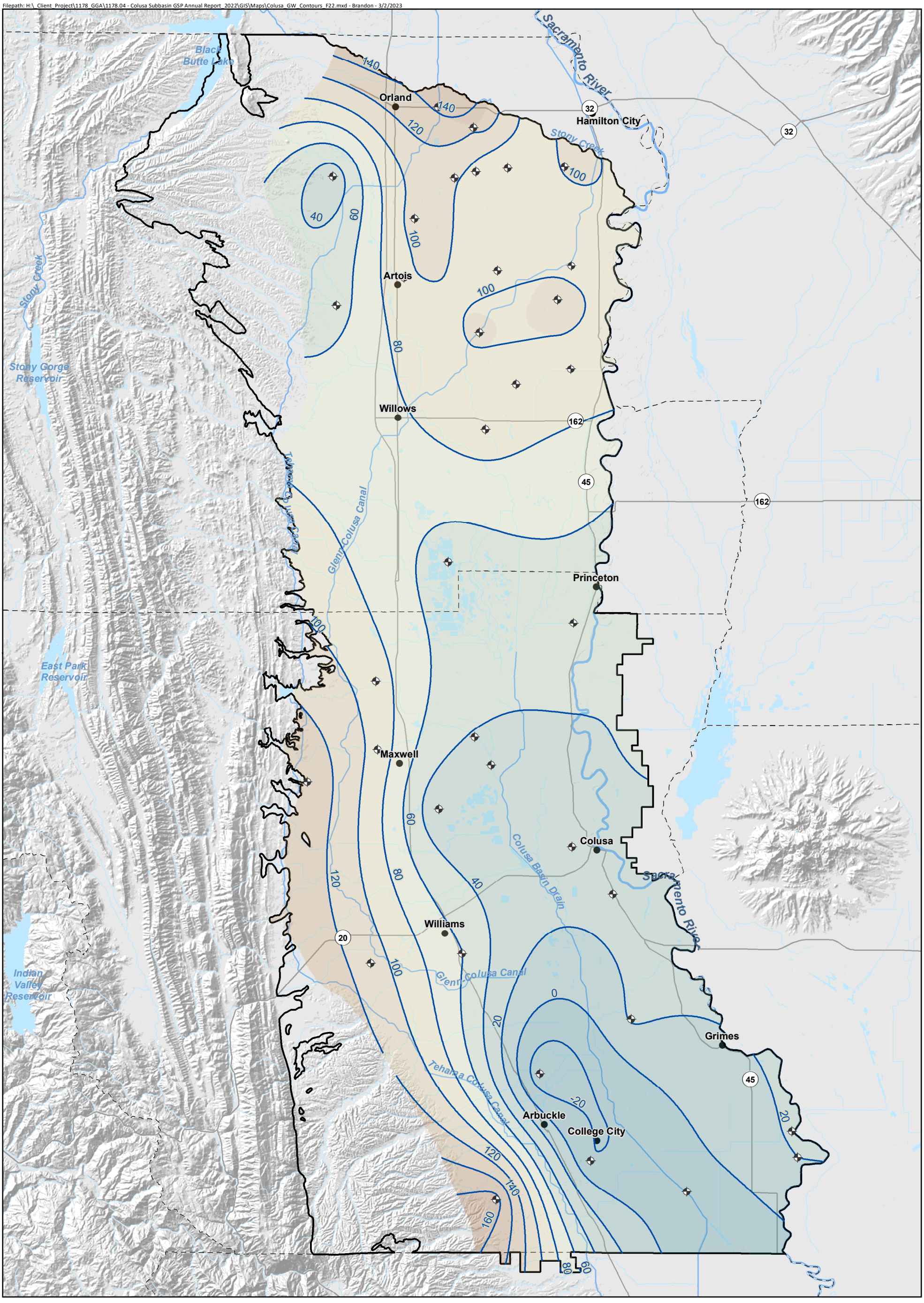
Scale in Miles

Figure A-5

Groundwater Elevation Contours Spring 2022

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2023

Filepath: H:_Client_Project\1178_GGA\1178.04 - Colusa Subbasin GSP Annual Report_2022\GIS\Maps\Colusa_GW_Contours_F22.mxd - Brandon - 3/2/2023



Groundwater Elevation Measurement (Well Used for Contouring)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

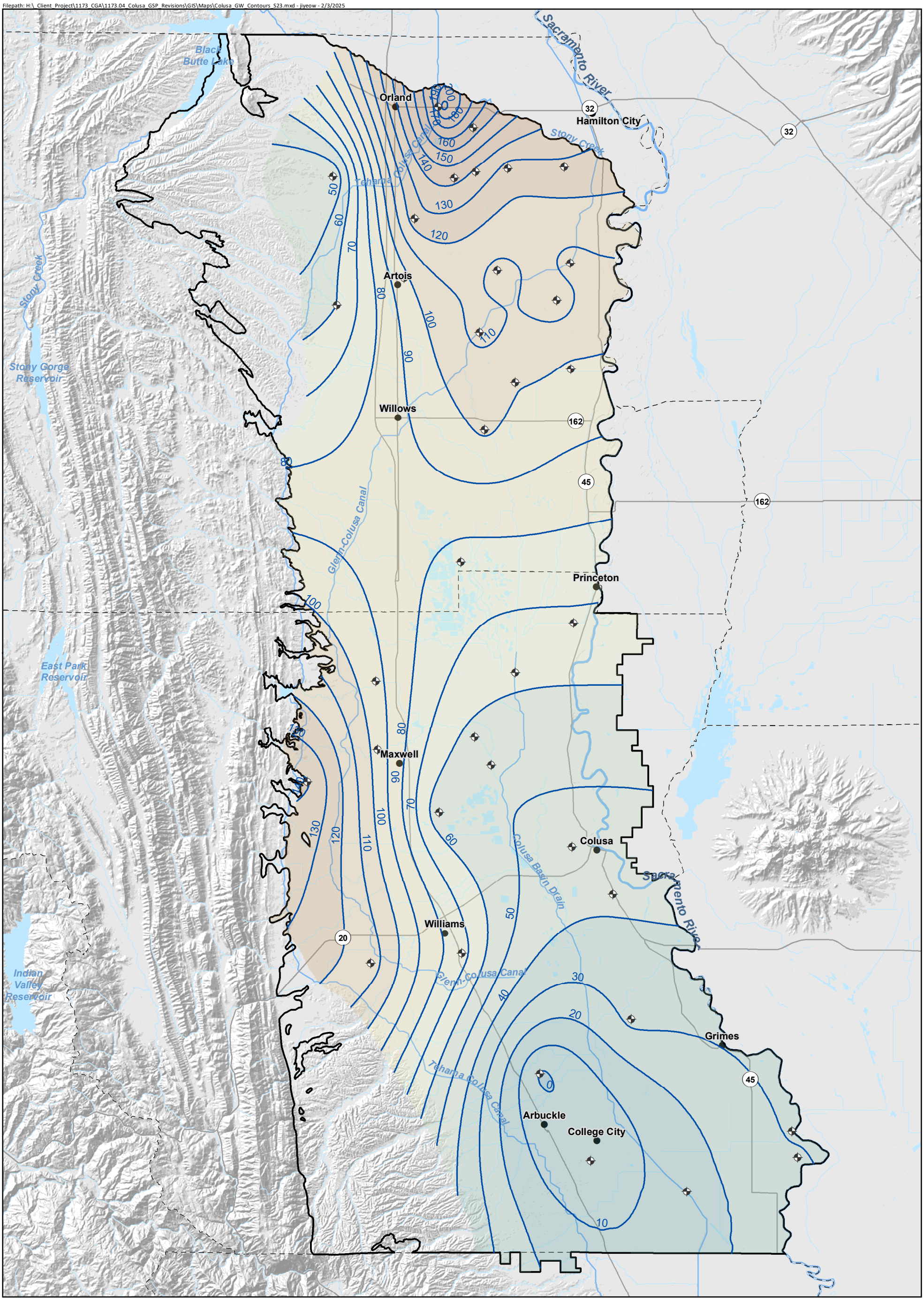
Scale in Miles

Figure A-6

Groundwater Elevation Contours
Fall 2022

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2023

Filepath: H:_Client_Project\1173_CGA\1173.04_Colusa_GSP_Revisions\GIS\Maps\Colusa_GW_Contours_S23.mxd - jiyeow - 2/3/2025



Groundwater Elevation Measurement (Well Used for Contouring)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

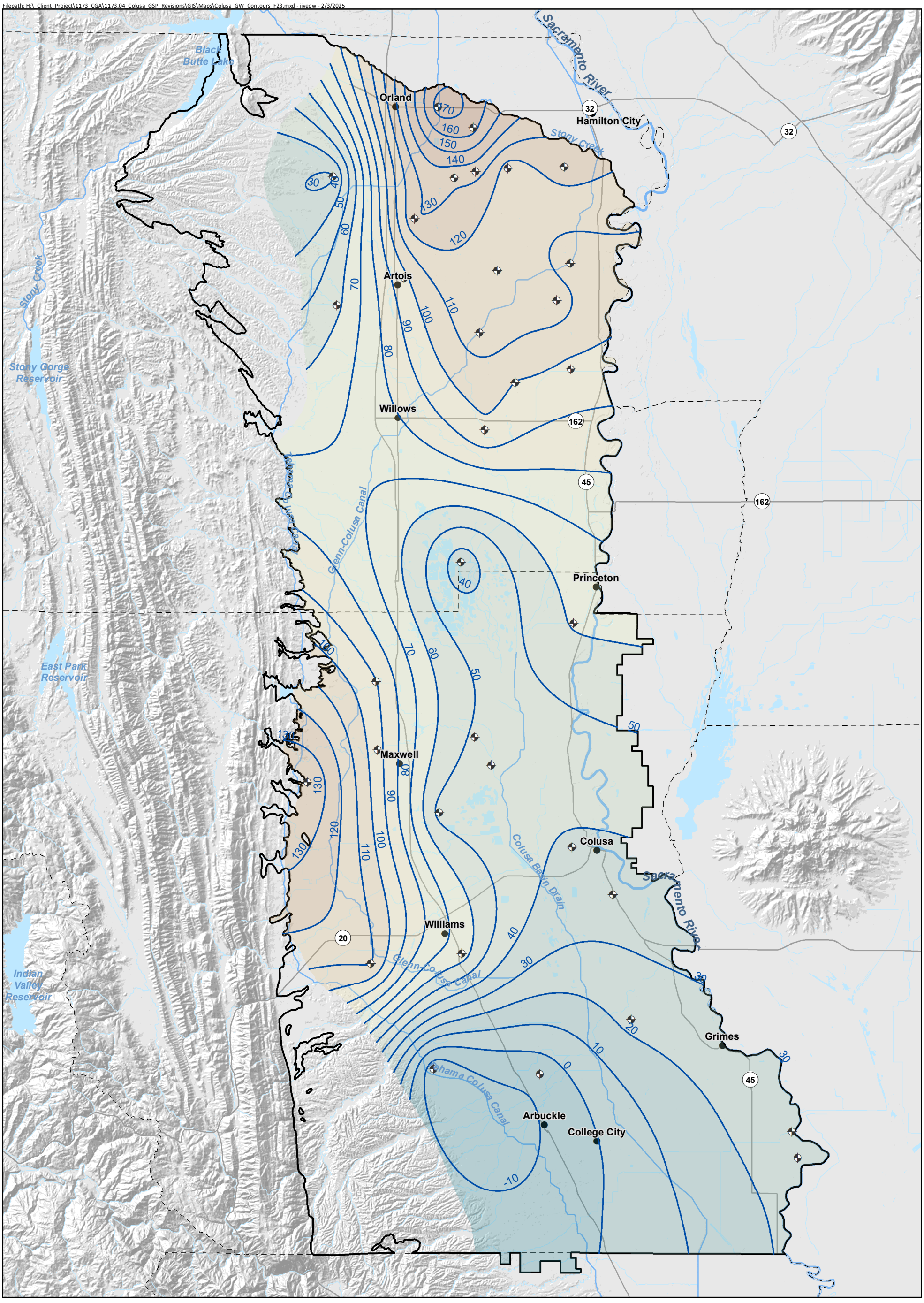
Scale in Miles

Figure A-7

Groundwater Elevation Contours Spring 2023

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2023

Filepath: H:_Client_Project\1173_CGA\1173.04_Colusa_GSP_Revisions\GIS\Maps\Colusa_GW_Contours_F23.mxd - jiyeow - 2/3/2025



Groundwater Elevation Measurement (Well Used for Contouring)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

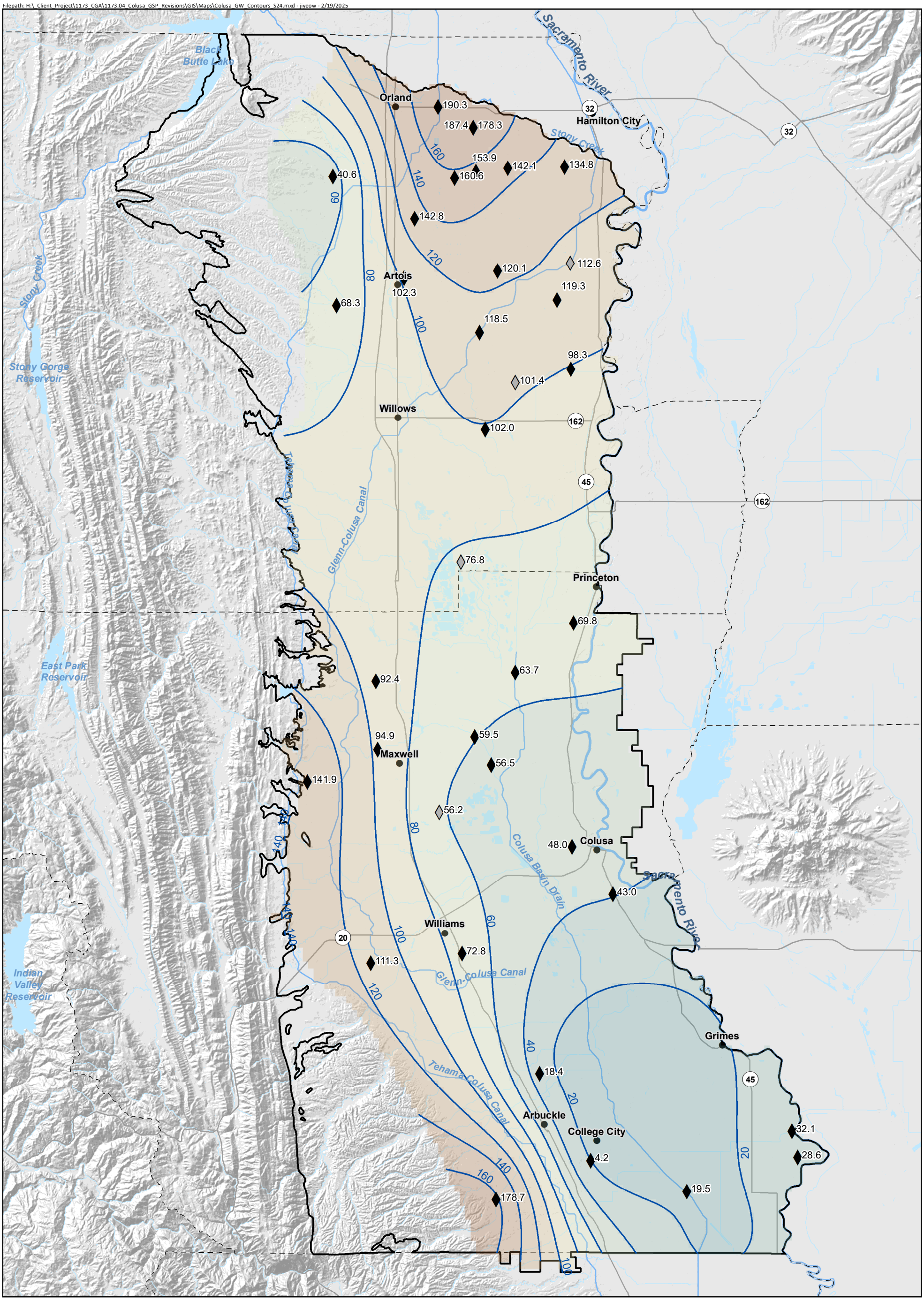
Scale in Miles

Figure A-8

Groundwater Elevation Contours
Fall 2023

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2023

Filepath: H:_Client_Project\1173_CGA\1173.04_Colusa_GSP_Revisions\GIS\Maps\Colusa_GW_Contours_S24.mxd - jiyeow - 2/19/2025



Groundwater Elevation Measurement (RMS Well Used for Contouring) (ft)

Groundwater Elevation Measurement (non RMS Well Used for Contouring) (ft)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

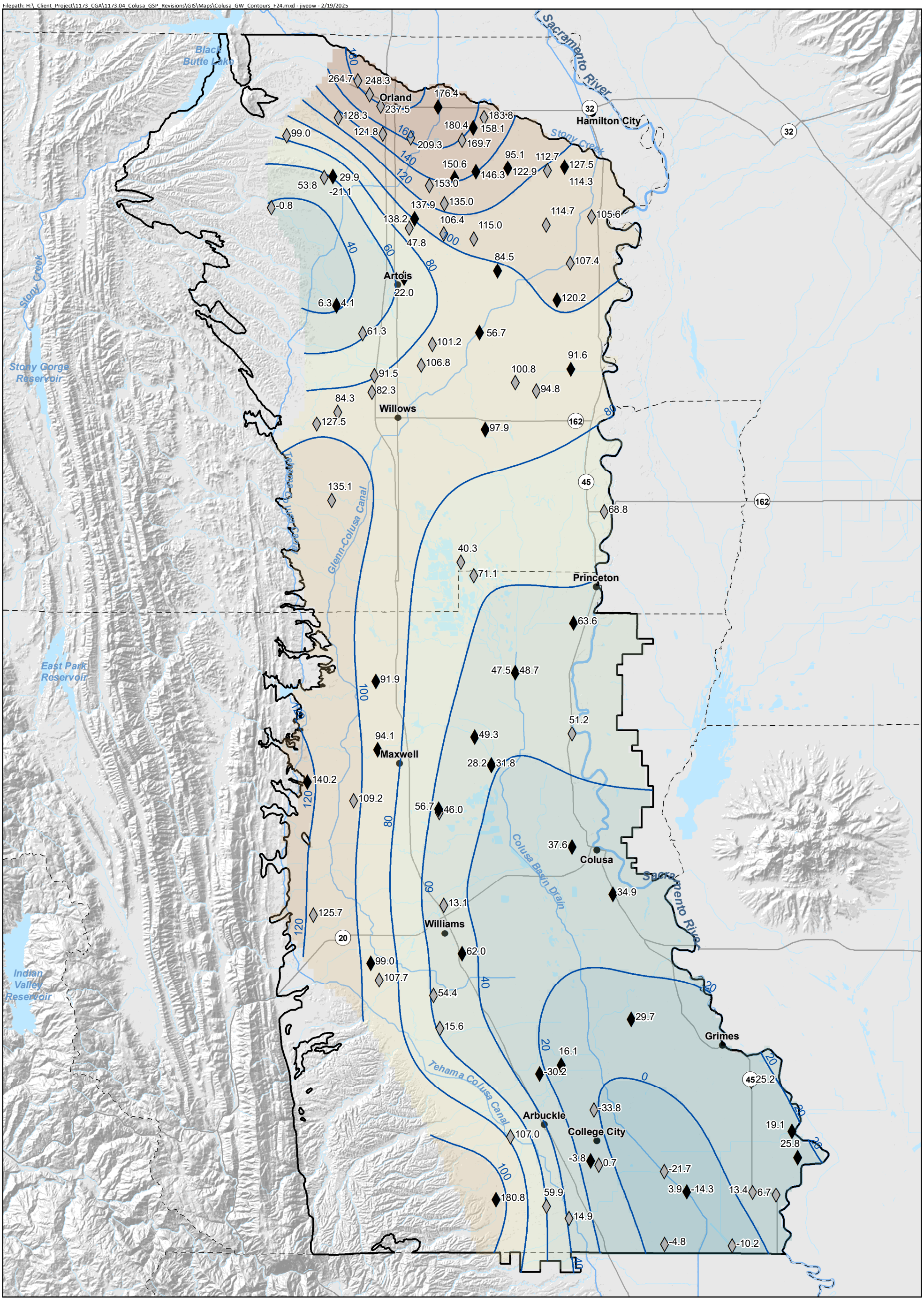
Scale in Miles

Figure A-9

Groundwater Elevation Contours Spring 2024

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2024

Filepath: H:_Client_Project\1173_CGA\1173.04_Colusa_GSP_Revisions\GIS\Maps\Colusa_GW_Contours_F24.mxd - jiyeow - 2/19/2025



Groundwater Elevation Measurement (RMS Well Used for Contouring) (ft)

Groundwater Elevation Measurement (Non RMS Well Used for Contouring) (ft)

Groundwater Elevation Contour (20-Foot Interval)

Colusa Subbasin Boundary

Groundwater Elevation (feet above mean sea level)

-20 - 0	80 - 100
0 - 20	100 - 120
20 - 40	120 - 140
40 - 60	140 - 160
60 - 80	160 - 180

N

0 2.5 5

Scale in Miles

Figure A-10

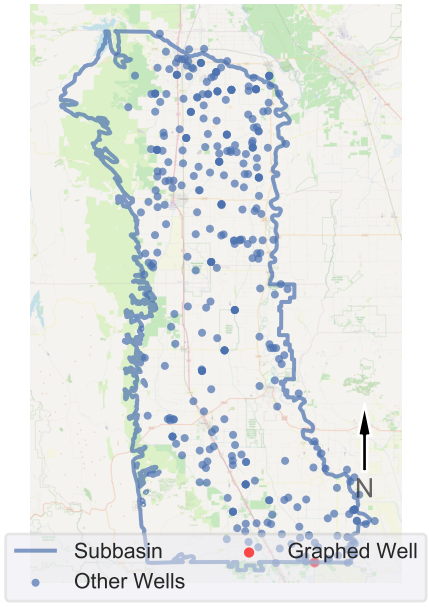
Groundwater Elevation Contours Fall 2024

Colusa Groundwater Authority
Glenn Groundwater Authority
Colusa Subbasin Annual Report 2024

Appendix B. Groundwater Elevation Hydrographs for Groundwater Level RMS Wells.

COLUSA Subbasin - State Well Number (SWN): 12N01E06D004M (Non-Focus RMS Well)

Well Location Map



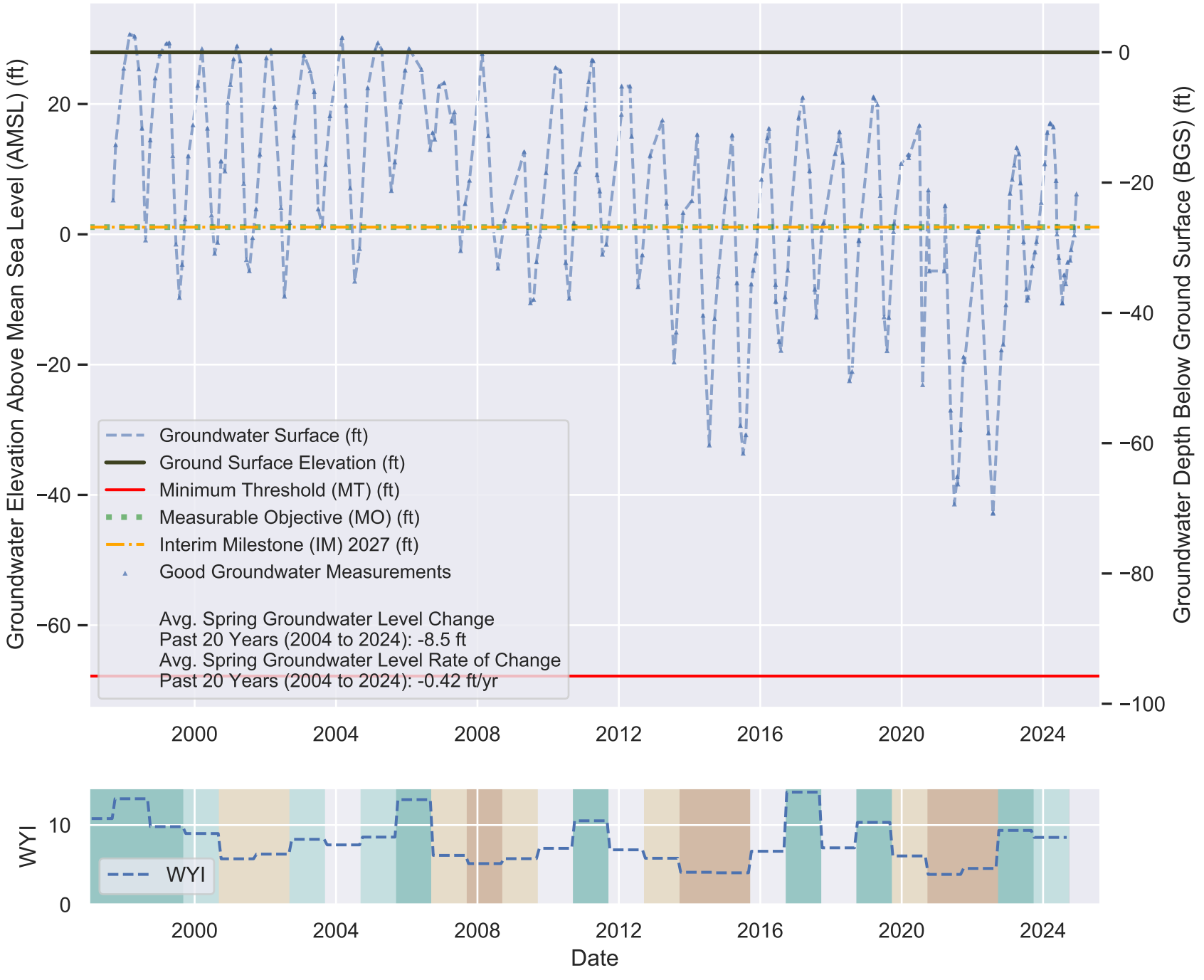
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 1.1 ft AMSL
MO = 1.1 ft AMSL
MT = -67.8 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

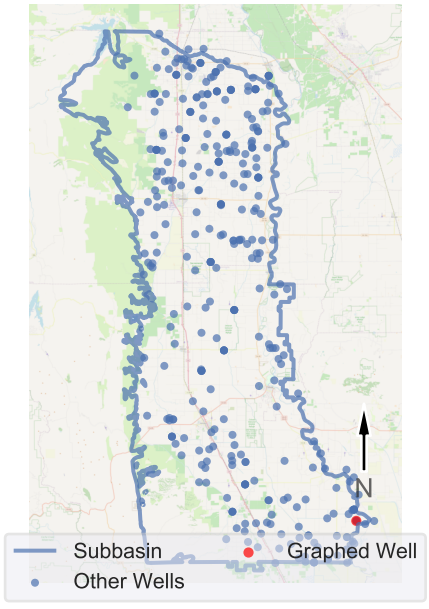
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 275.0 - 285.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 13N01E11A001M (Non-Focus RMS Well)

Well Location Map



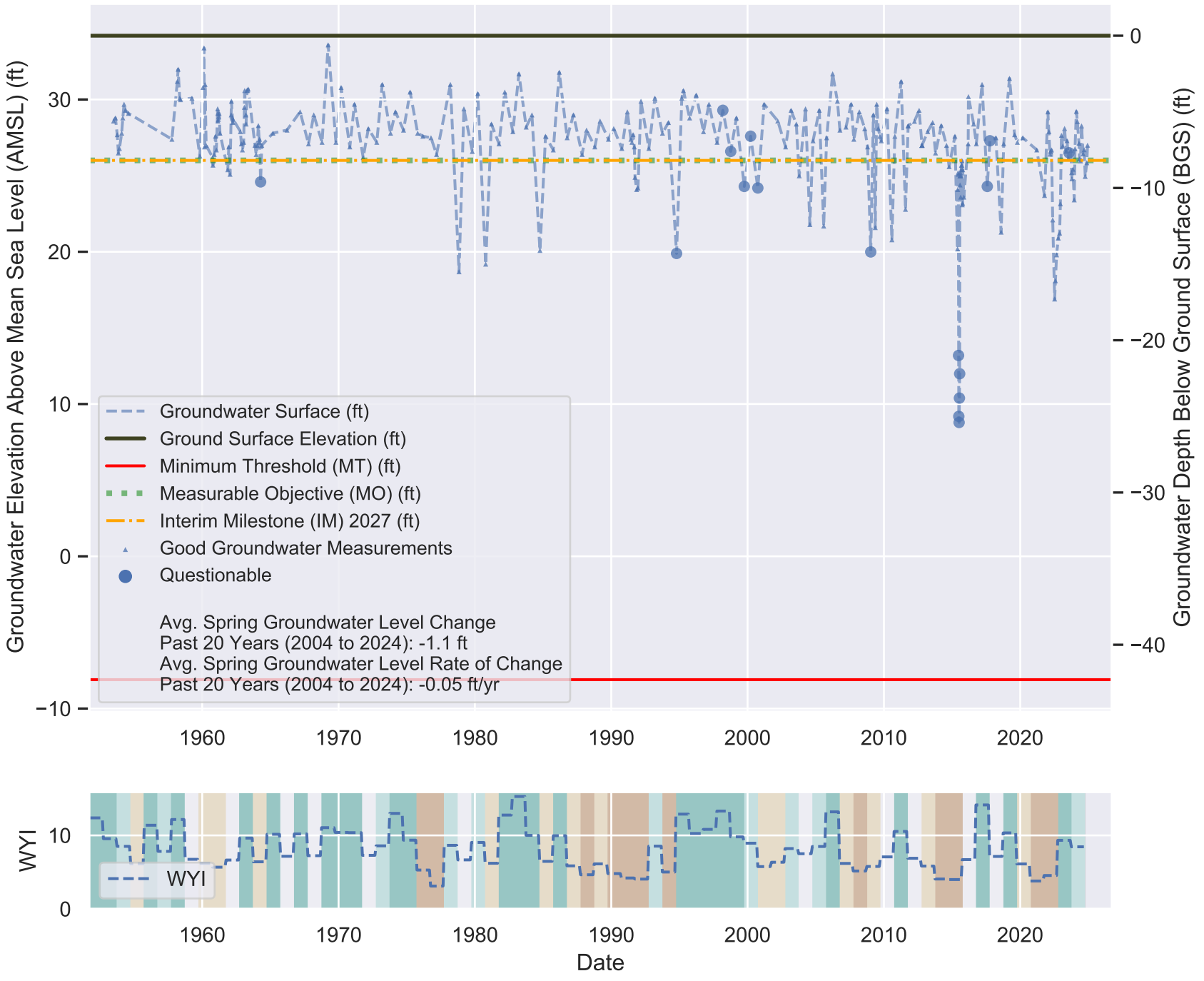
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 26.0 ft AMSL
MO = 26.0 ft AMSL
MT = -8.1 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

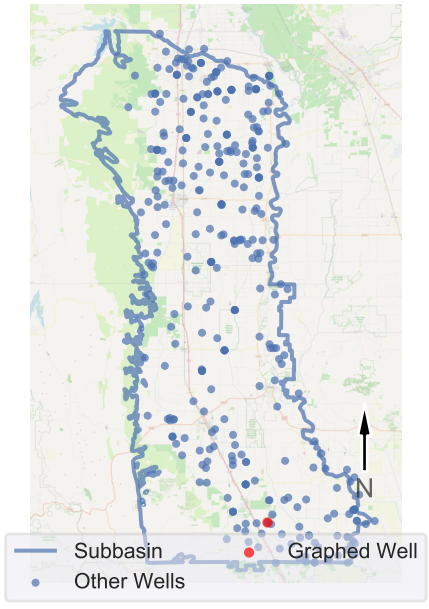
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 136.0 - 158.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 13N01W07G001M (Focus RMS Well)

Well Location Map



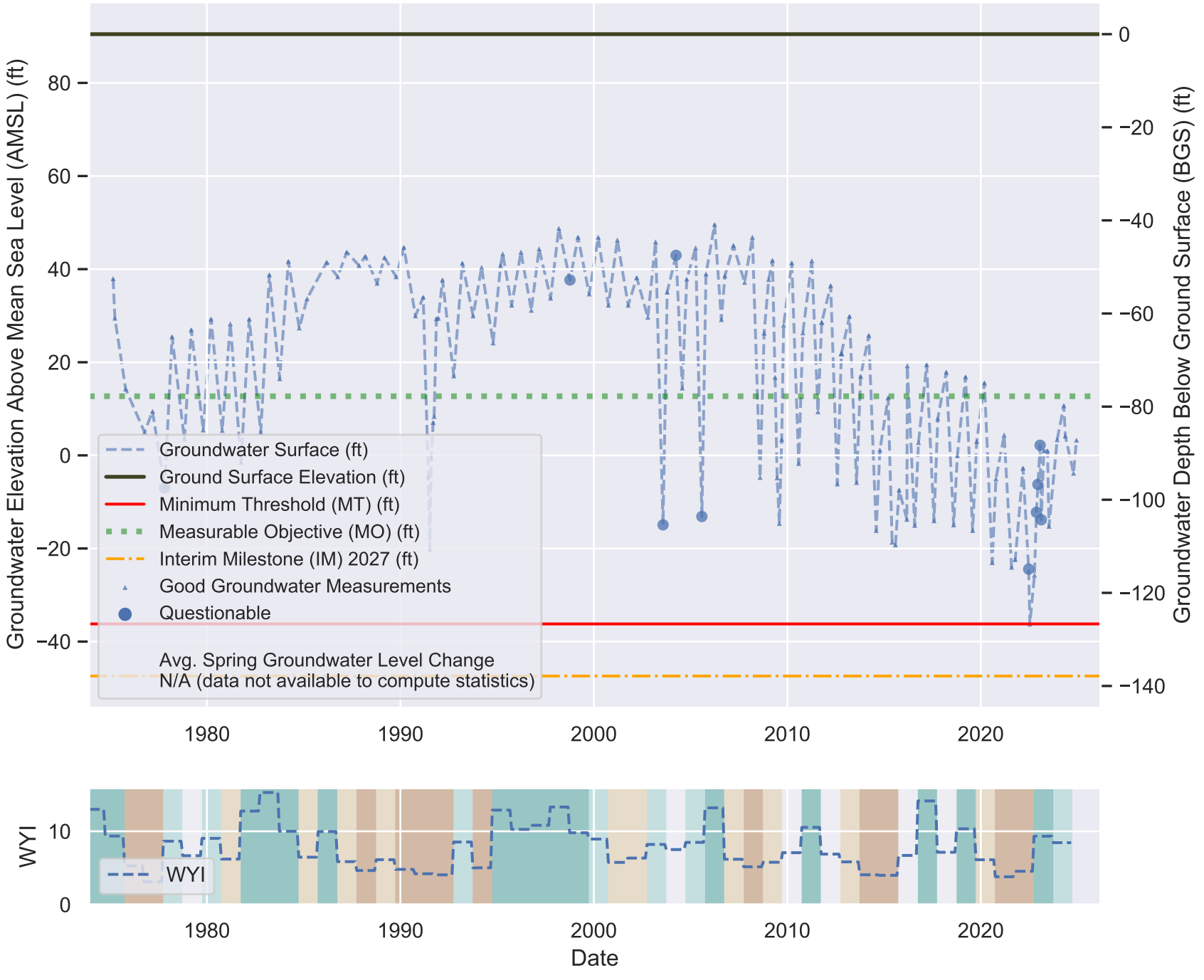
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = -47.4 ft AMSL
MO = 12.7 ft AMSL
MT = -36.2 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

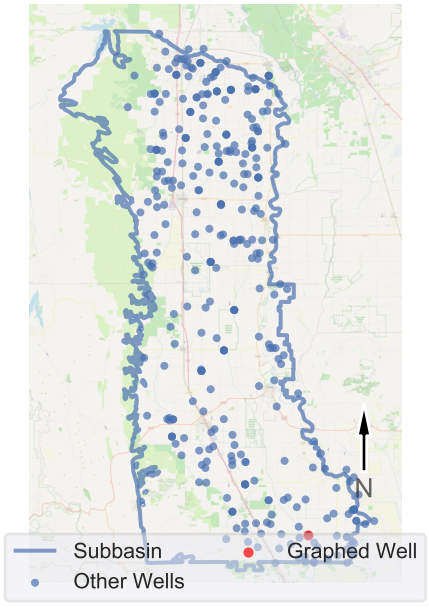
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 108.0 - 180.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 13N01W13P003M (Non-Focus RMS Well)

Well Location Map



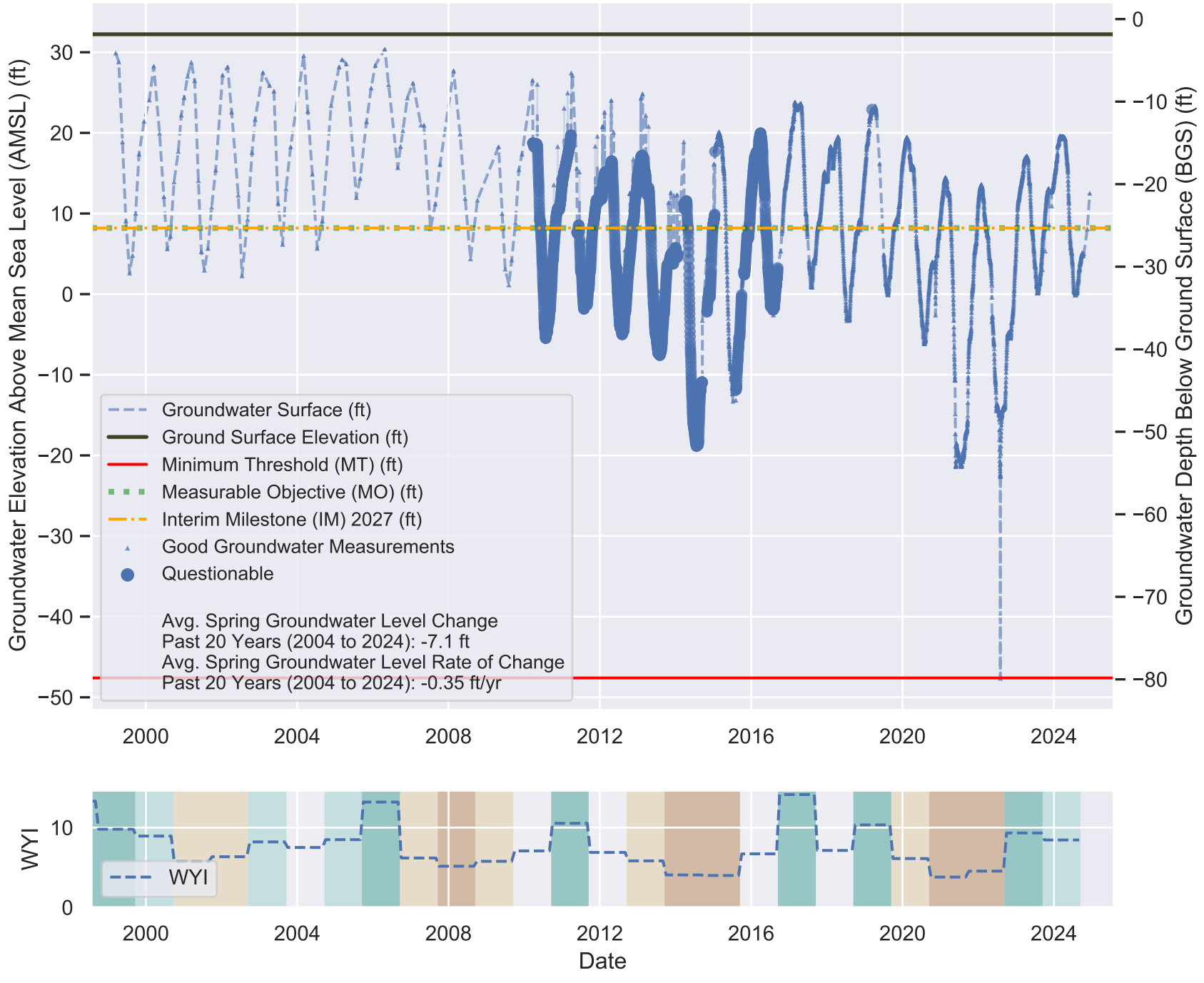
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 8.2 ft AMSL
MO = 8.2 ft AMSL
MT = -47.6 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

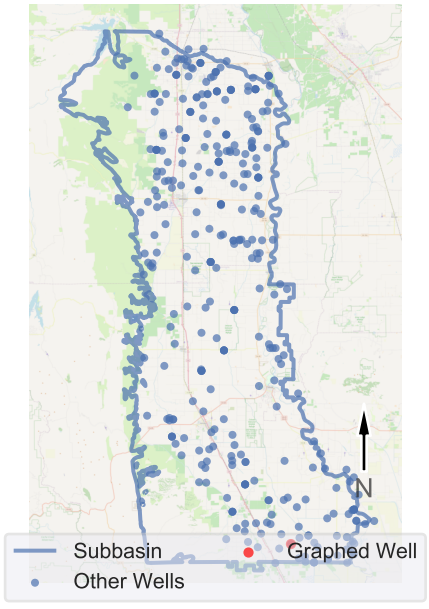
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 271.0 - 281.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 13N01W22P002M (Non-Focus RMS Well)

Well Location Map



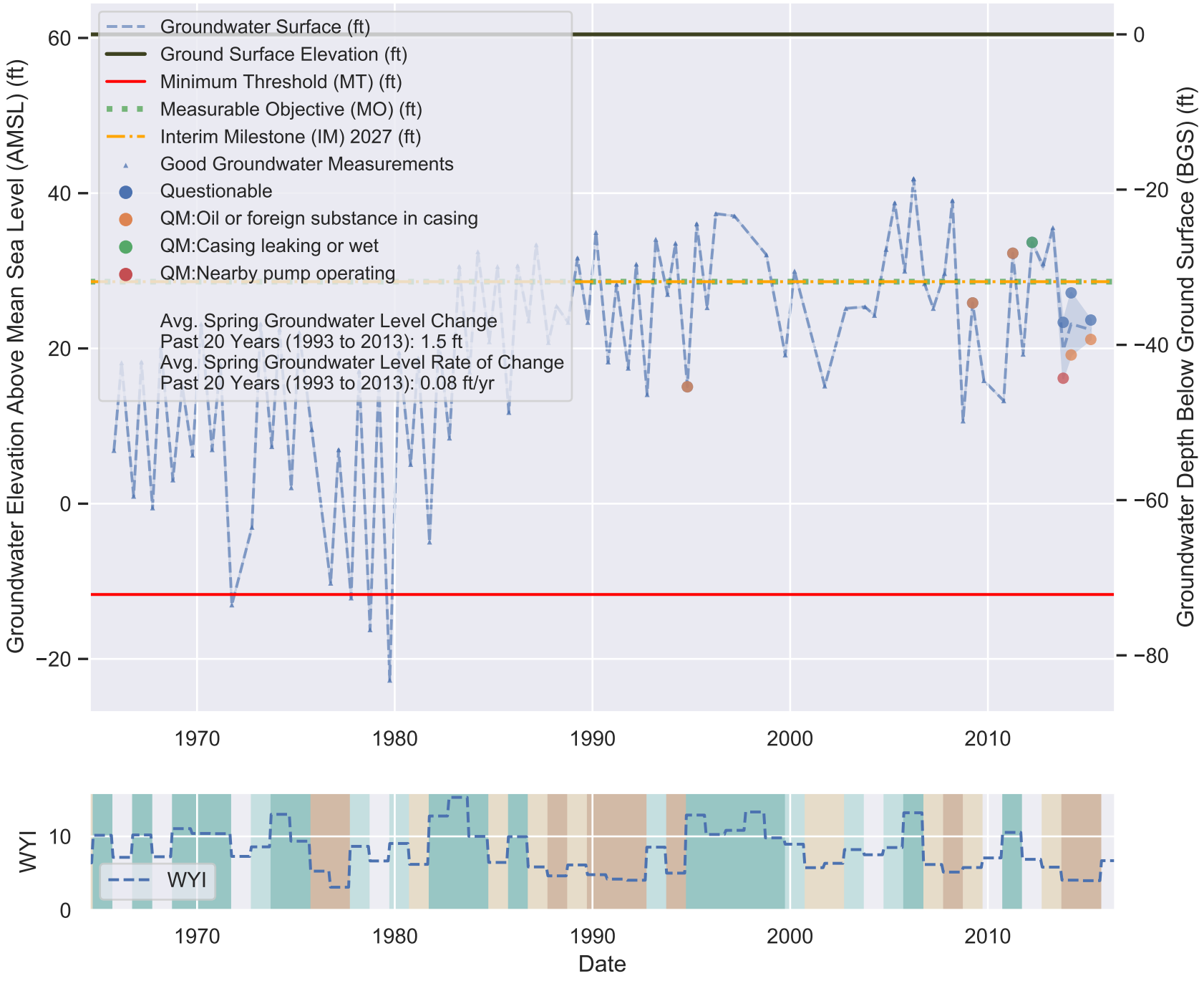
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 28.6 ft AMSL
MO = 28.6 ft AMSL
MT = -11.7 ft AMSL

Minimum Threshold is the 2010-2022 low minus a margin (25.0 FT).

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

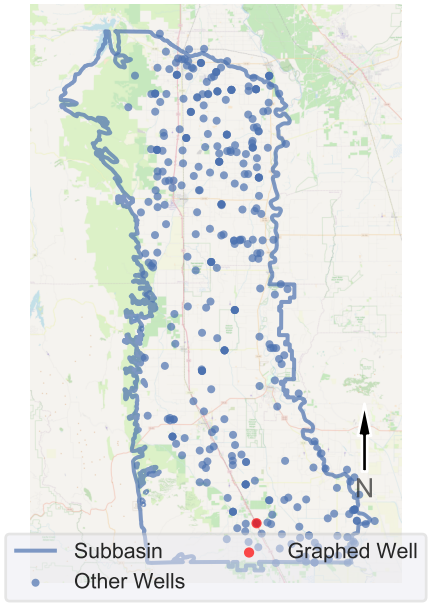
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 196.0 - 236.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 13N02W12L001M (Focus RMS Well)

Well Location Map



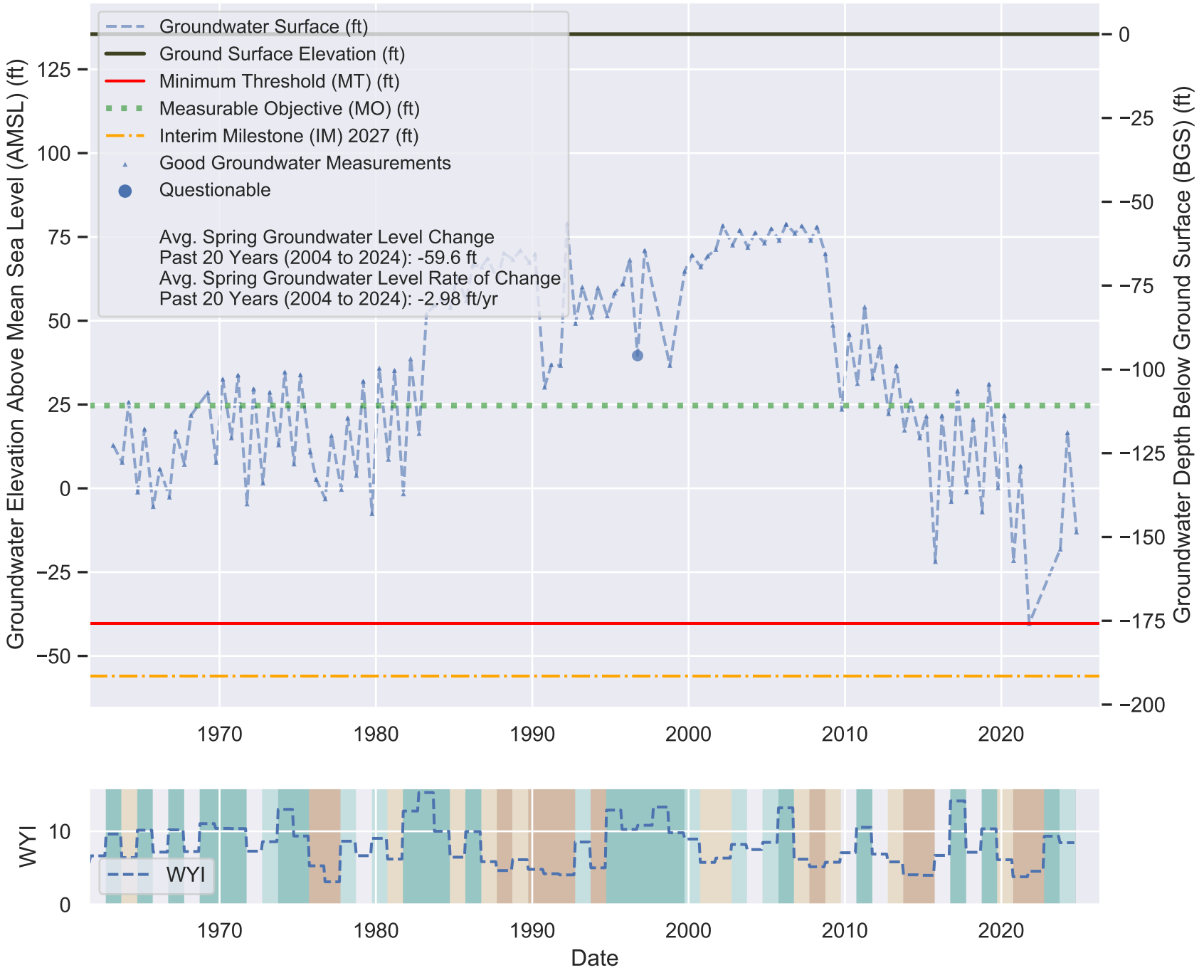
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = -56.0 ft AMSL
MO = 24.7 ft AMSL
MT = -40.3 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

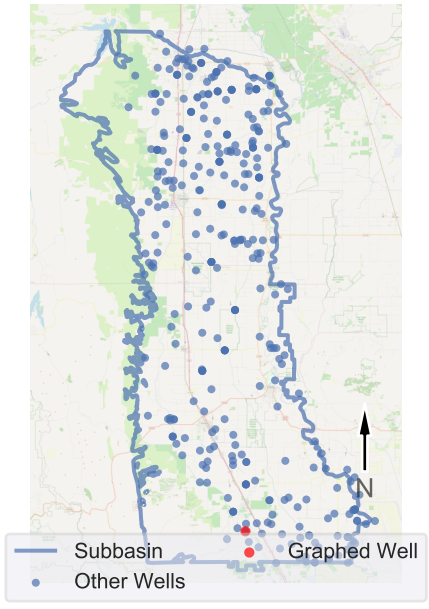
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation data not available.



COLUSA Subbasin - State Well Number (SWN): 13N02W15J001M (Focus RMS Well)

Well Location Map



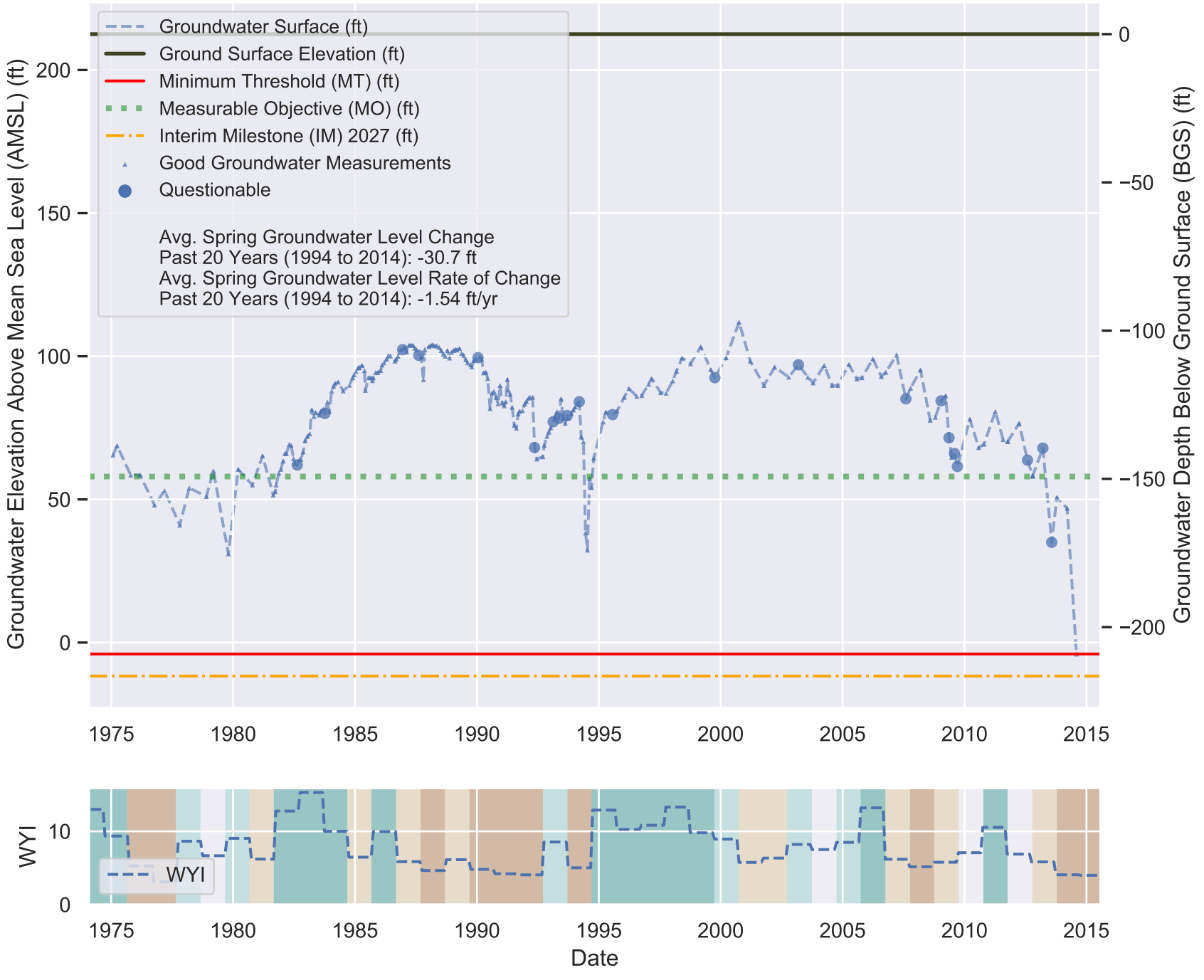
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = -11.7 ft AMSL
MO = 58.0 ft AMSL
MT = -4.0 ft AMSL

Minimum Threshold is the 2010-2022 low.

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

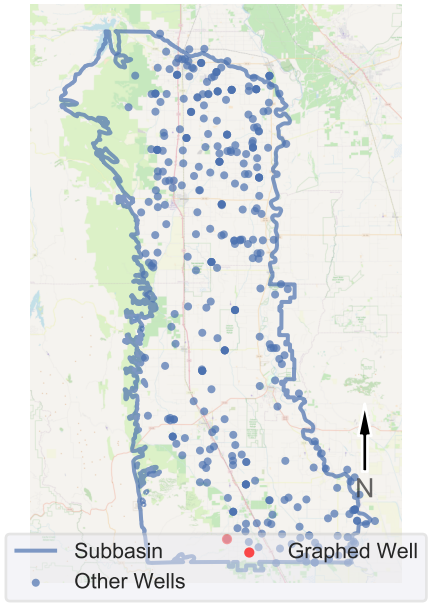
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 270.0 - 362.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 13N02W20H002M (Focus RMS Well)

Well Location Map



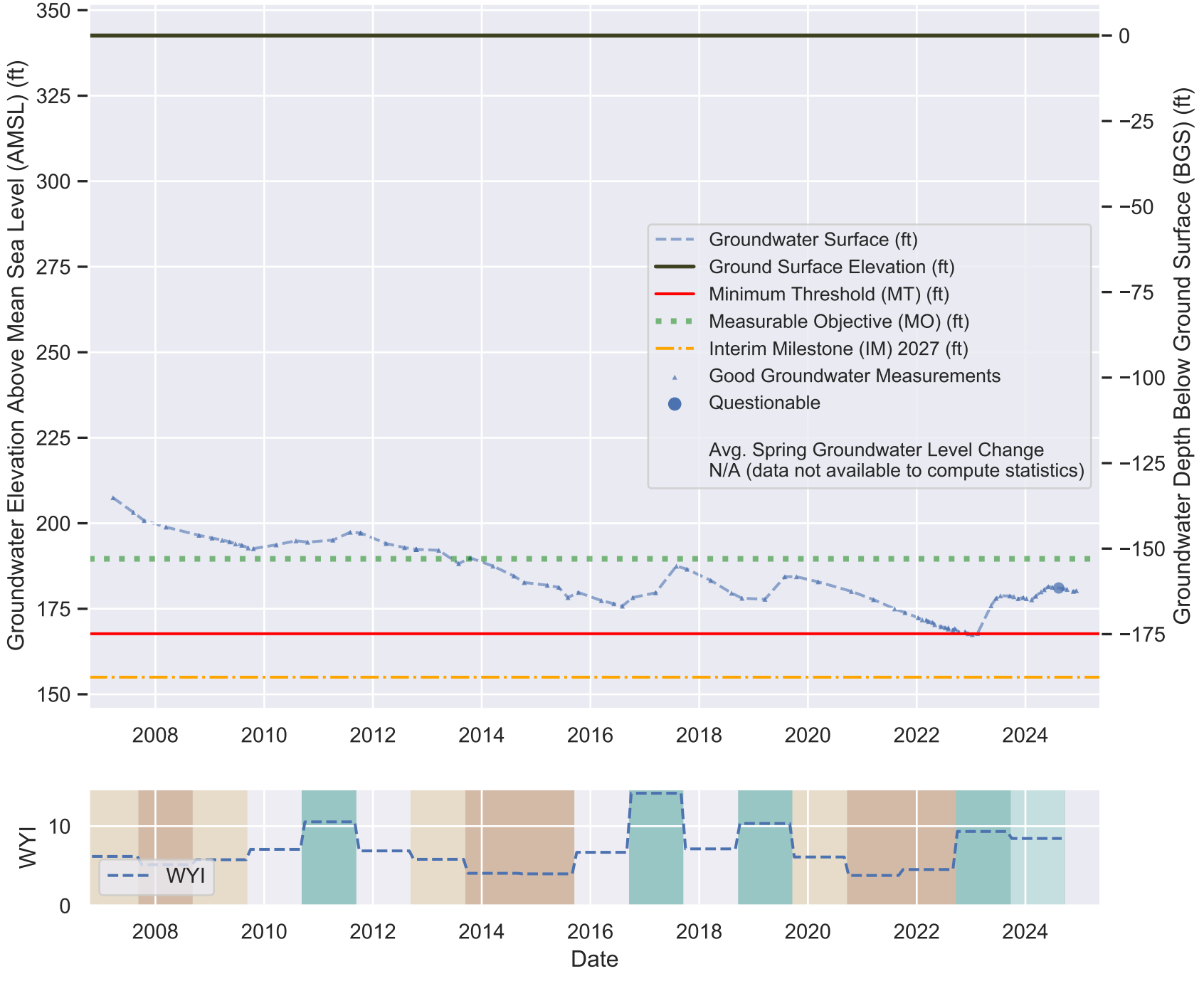
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 155.0 ft AMSL
MO = 189.6 ft AMSL
MT = 167.7 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

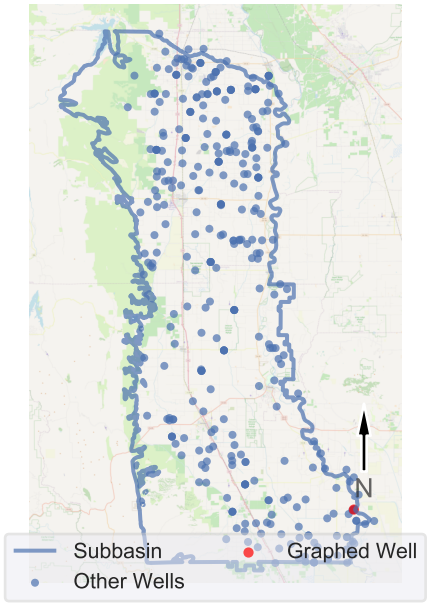
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 200.0 - 260.0; P2: 300.0 - 320.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 14N01E35P003M (Non-Focus RMS Well)

Well Location Map



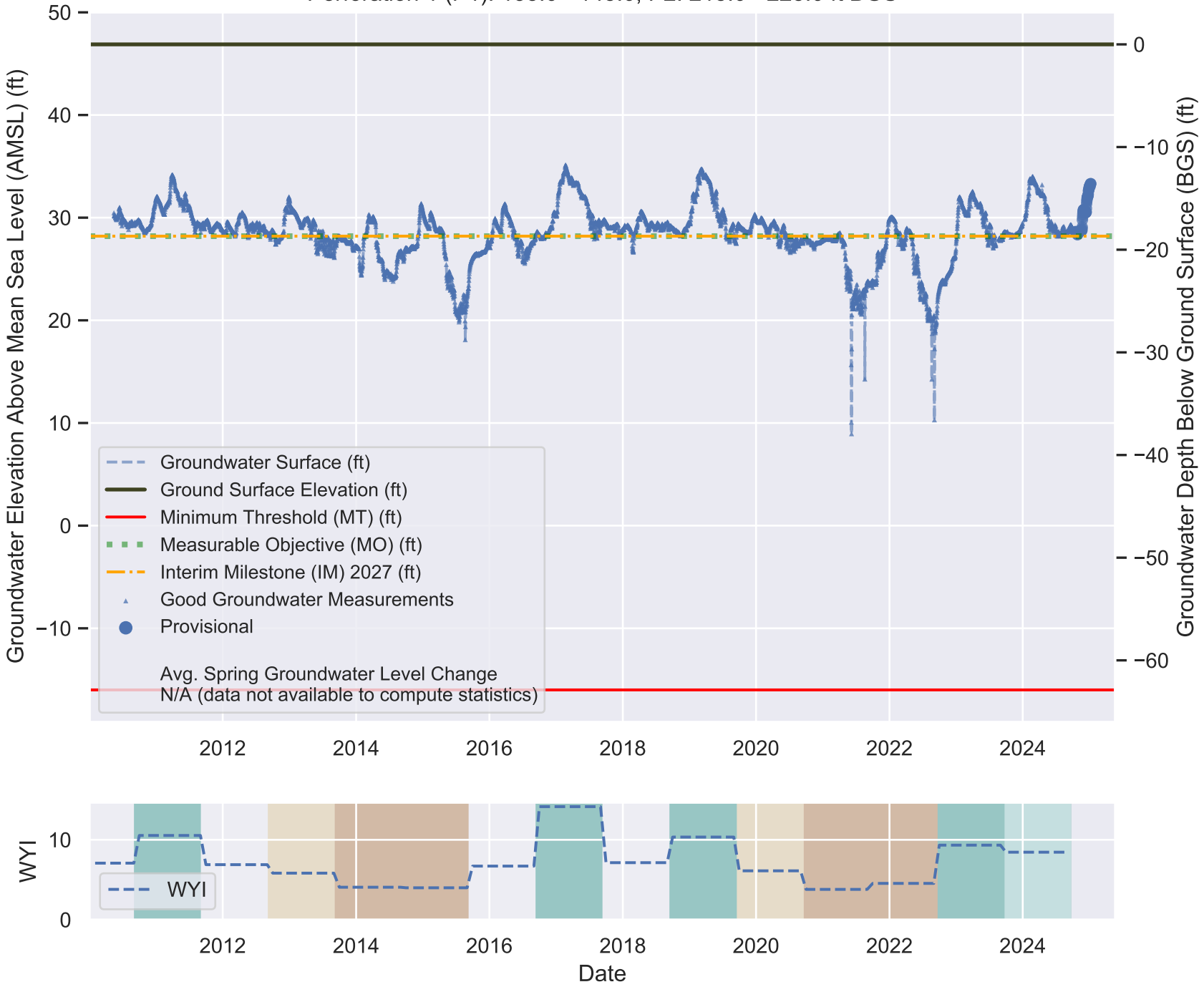
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 28.2 ft AMSL
MO = 28.2 ft AMSL
MT = -16.0 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

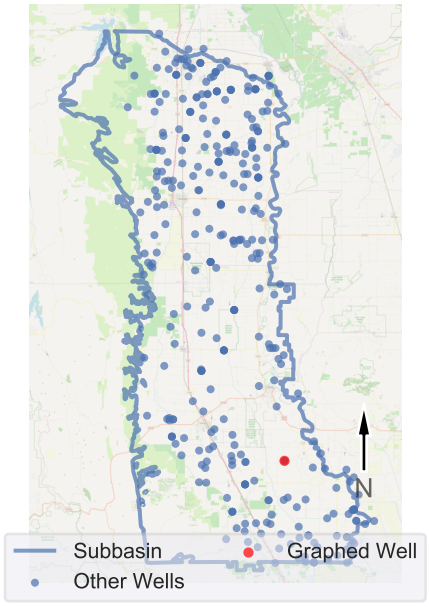
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 135.0 - 145.0; P2: 215.0 - 225.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 14N01W04K003M (Non-Focus RMS Well)

Well Location Map



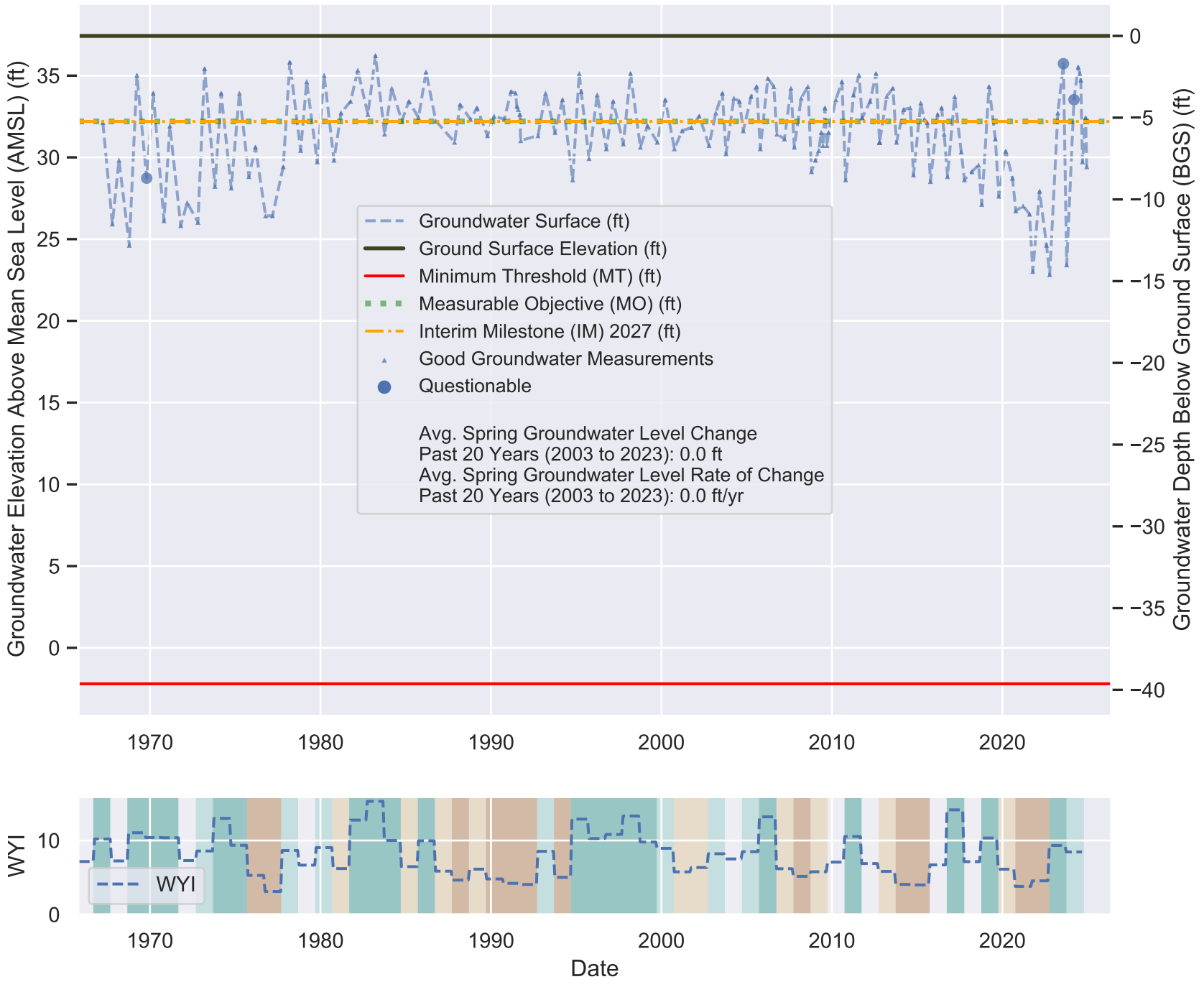
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 32.2 ft AMSL
MO = 32.2 ft AMSL
MT = -2.2 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

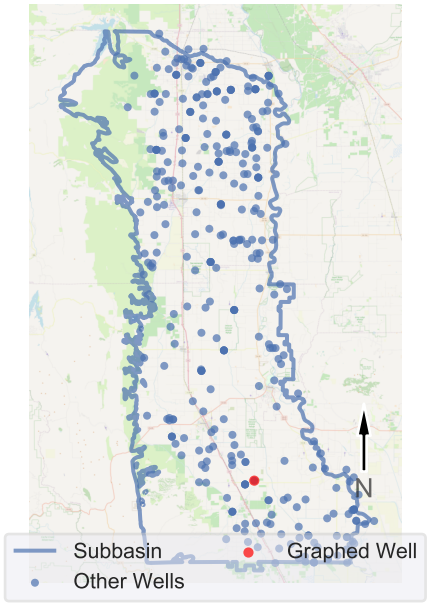
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 46.0 - 70.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 14N02W13N001M (Focus RMS Well)

Well Location Map



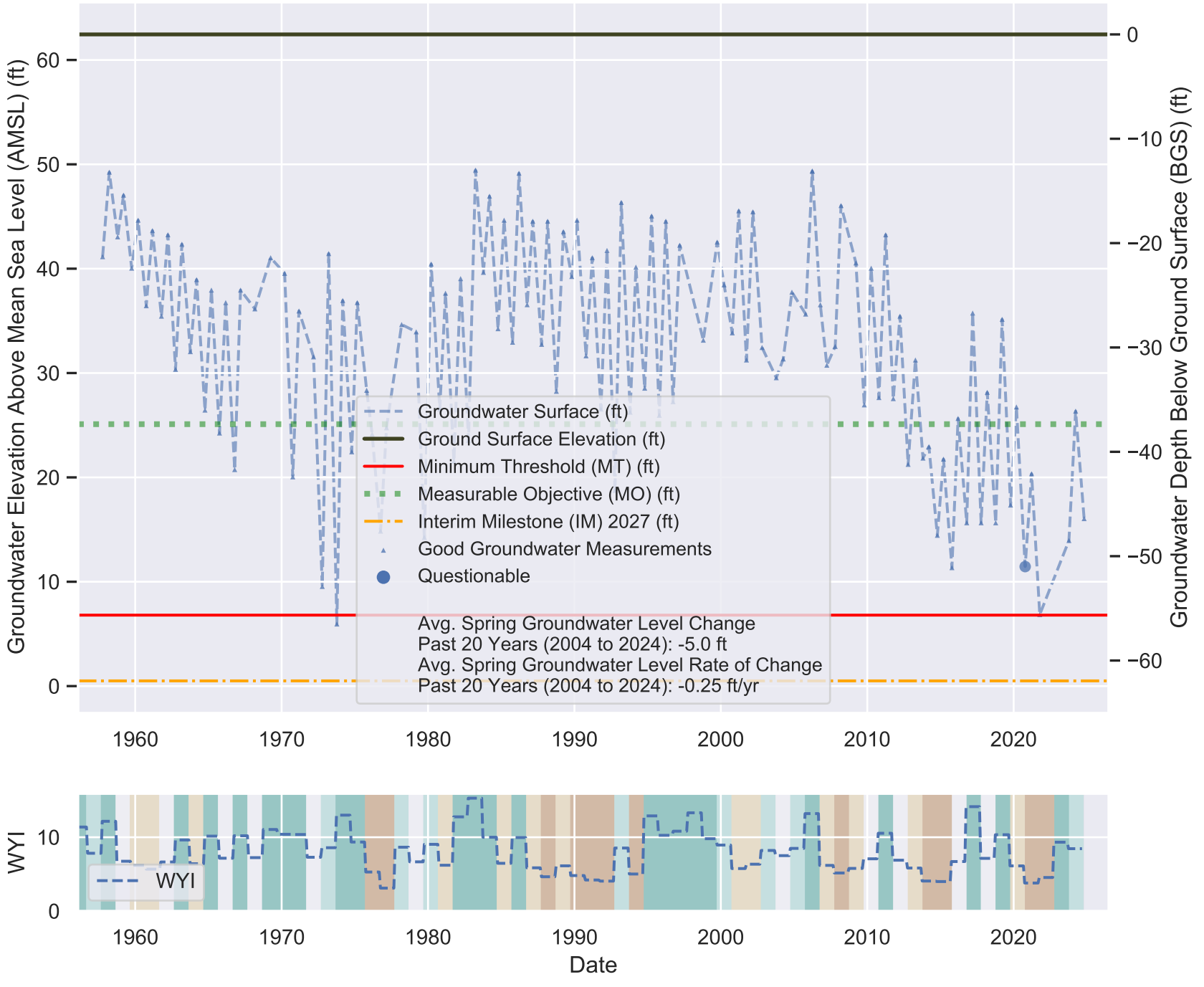
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 0.5 ft AMSL
MO = 25.1 ft AMSL
MT = 6.8 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

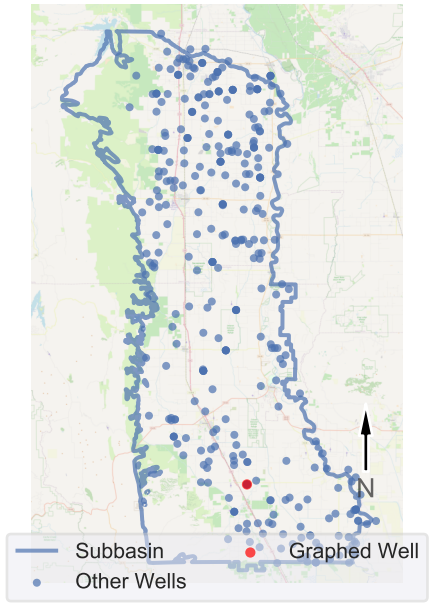
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 104.0 - 392.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 14N02W22A005M (Focus RMS Well)

Well Location Map



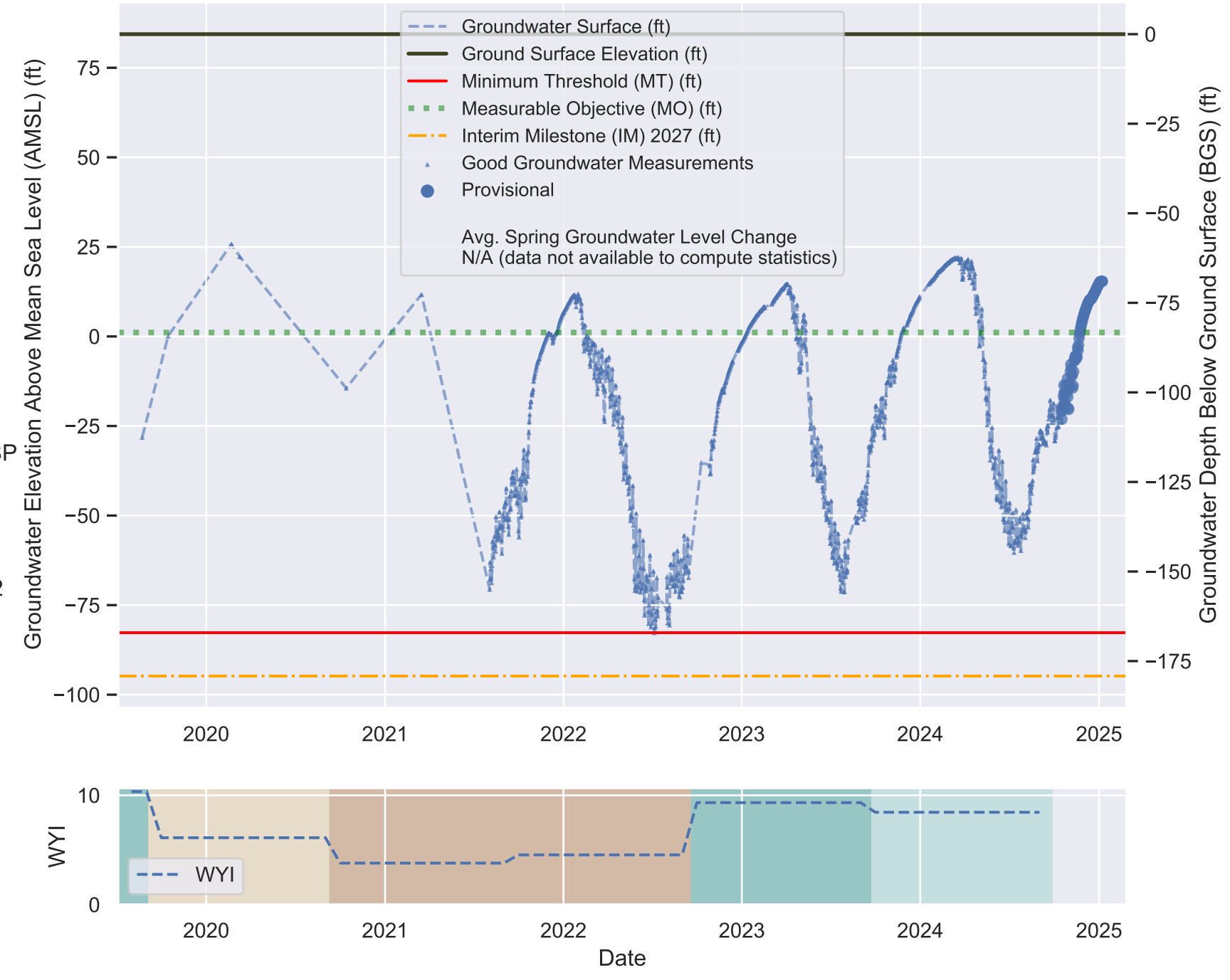
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = -94.8 ft AMSL
MO = 1.1 ft AMSL
MT = -82.7 ft AMSL

Minimum Threshold is the 2020-2022 low.

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)

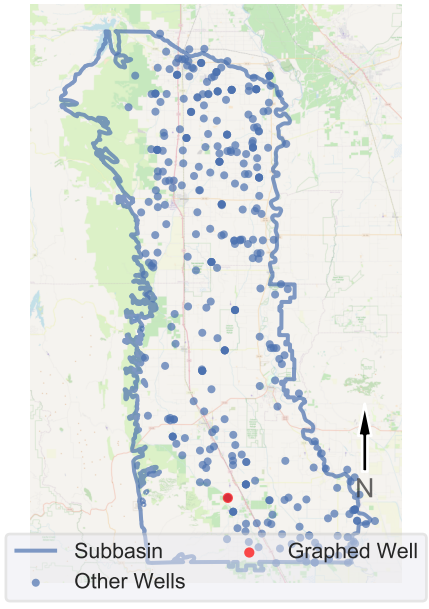
Perforation 1: 290.0 - 300.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 14N02W29J001M (Focus RMS Well)

Perforation 1 (P1): 119.0 - 143.0; P2: 152.0 - 158.0; P3: 176.0 - 182.0; P4: 198.0 - 208.0; P5: 215.0 - 239.0; P6: 264.0 - 276.0; P7: 307.5 - 319.5; P8: 334.5 - 349.5 ft BGS

Well Location Map

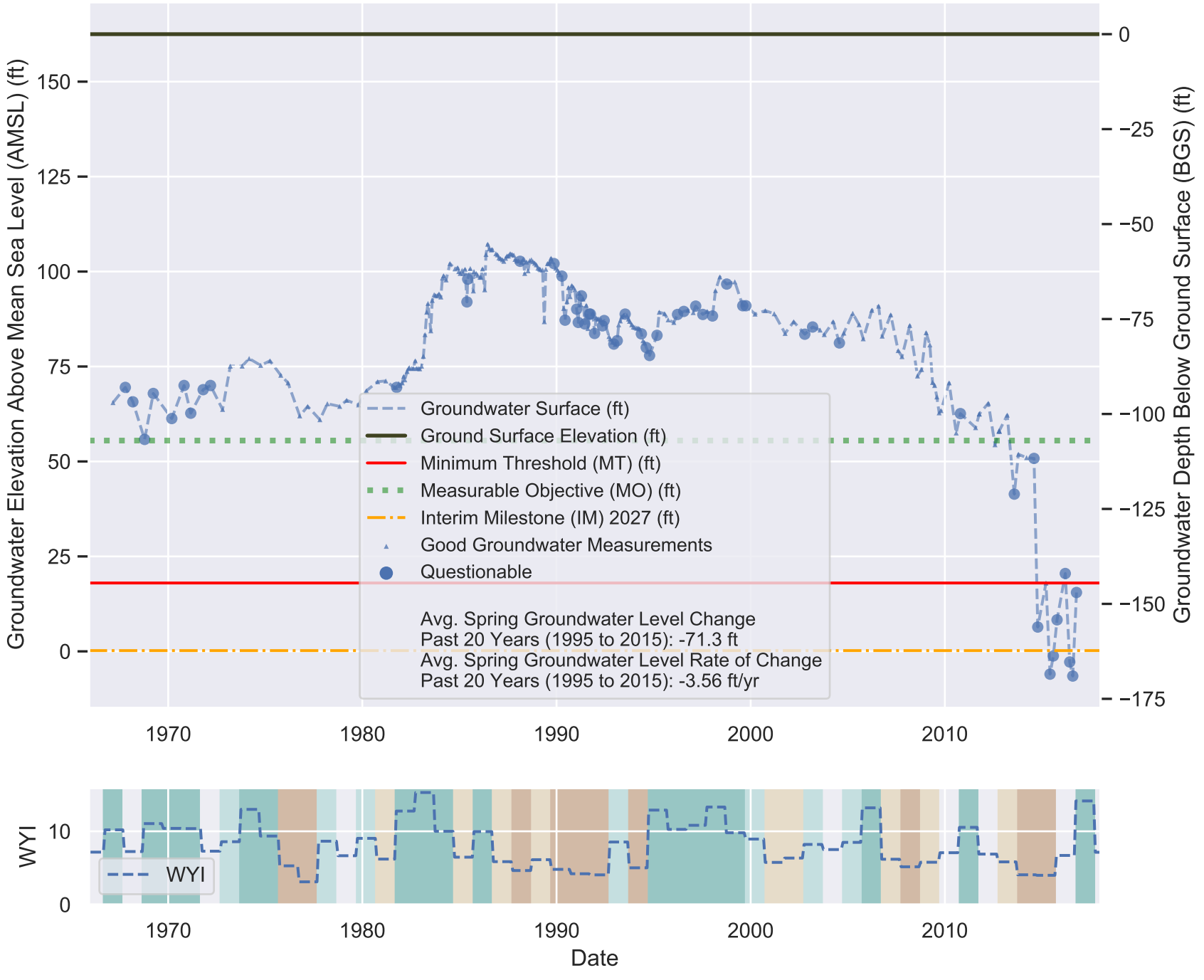


GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 0.2 ft AMSL
MO = 55.5 ft AMSL
MT = 18.0 ft AMSL

Minimum Threshold is the 2015-2022 low.

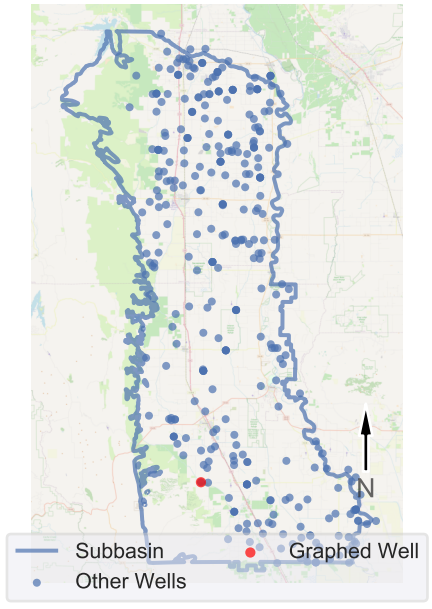
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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



COLUSA Subbasin - State Well Number (SWN): 14N03W14Q003M (Focus RMS Well)

Well Location Map



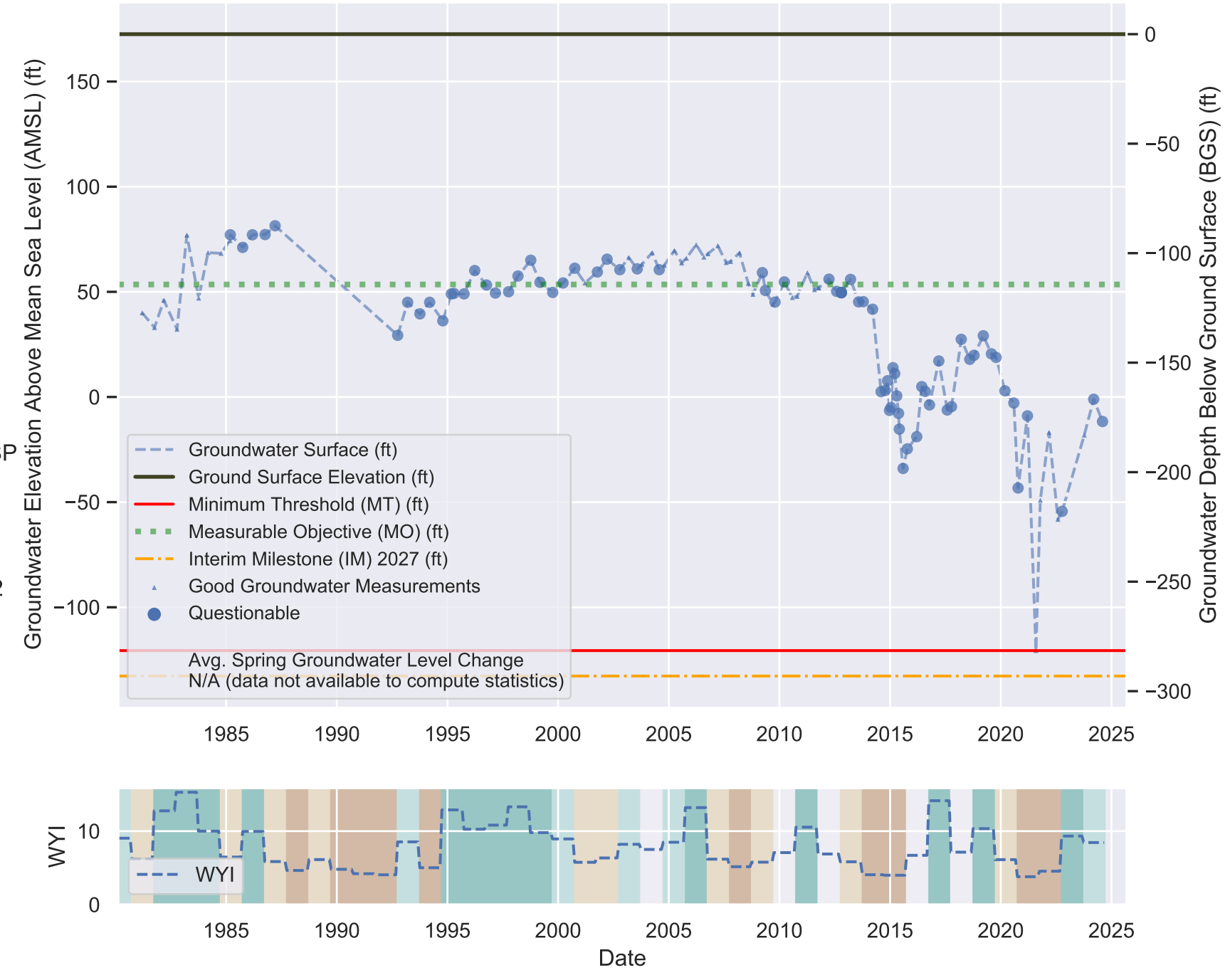
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = -132.7 ft AMSL
MO = 53.5 ft AMSL
MT = -120.6 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

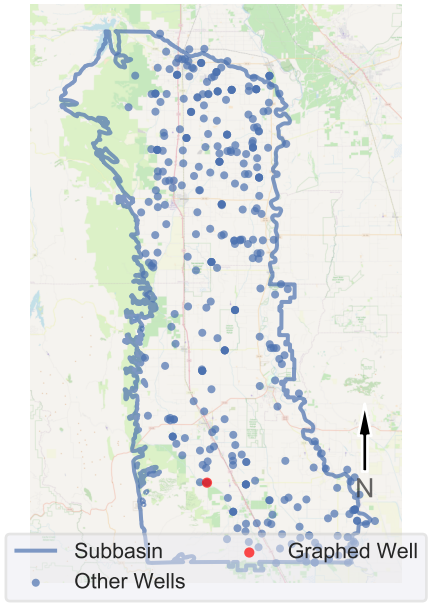
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 390.0 - 480.0; P2: 500.0 - 590.0; P3: 614.0 - 685.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 14N03W24C001M (Focus RMS Well)

Well Location Map



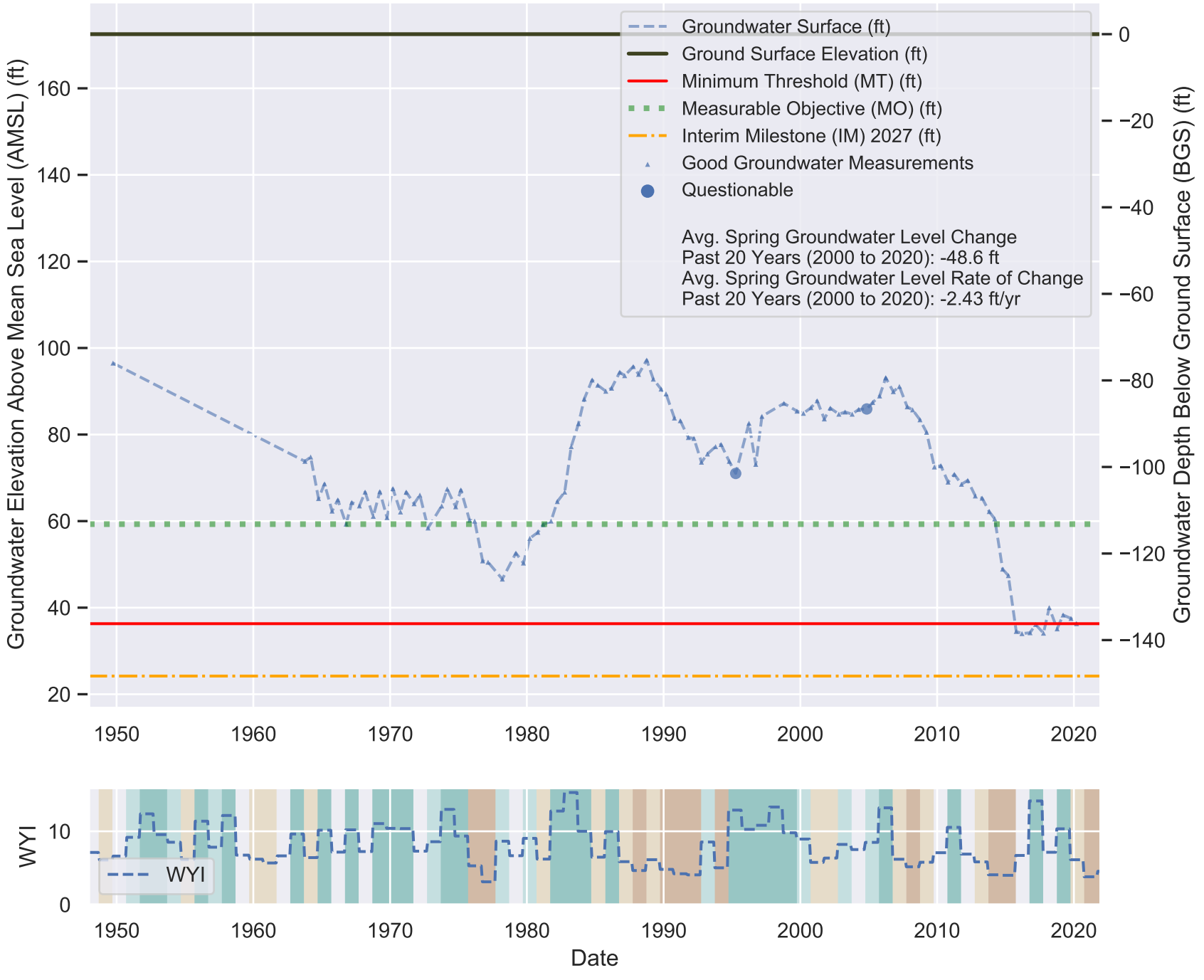
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 24.2 ft AMSL
MO = 59.3 ft AMSL
MT = 36.3 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

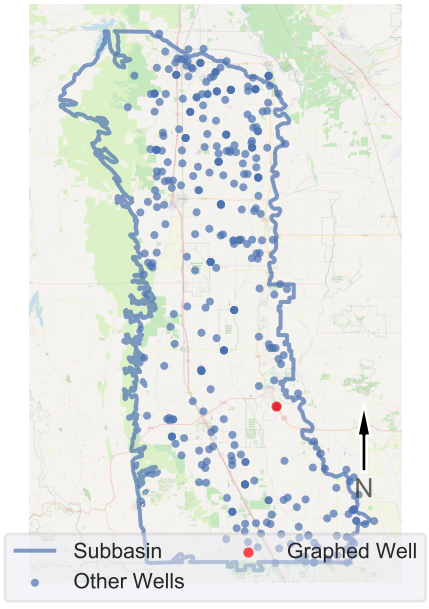
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 292.0 - 312.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 15N01W05G001M (Non-Focus RMS Well)

Well Location Map



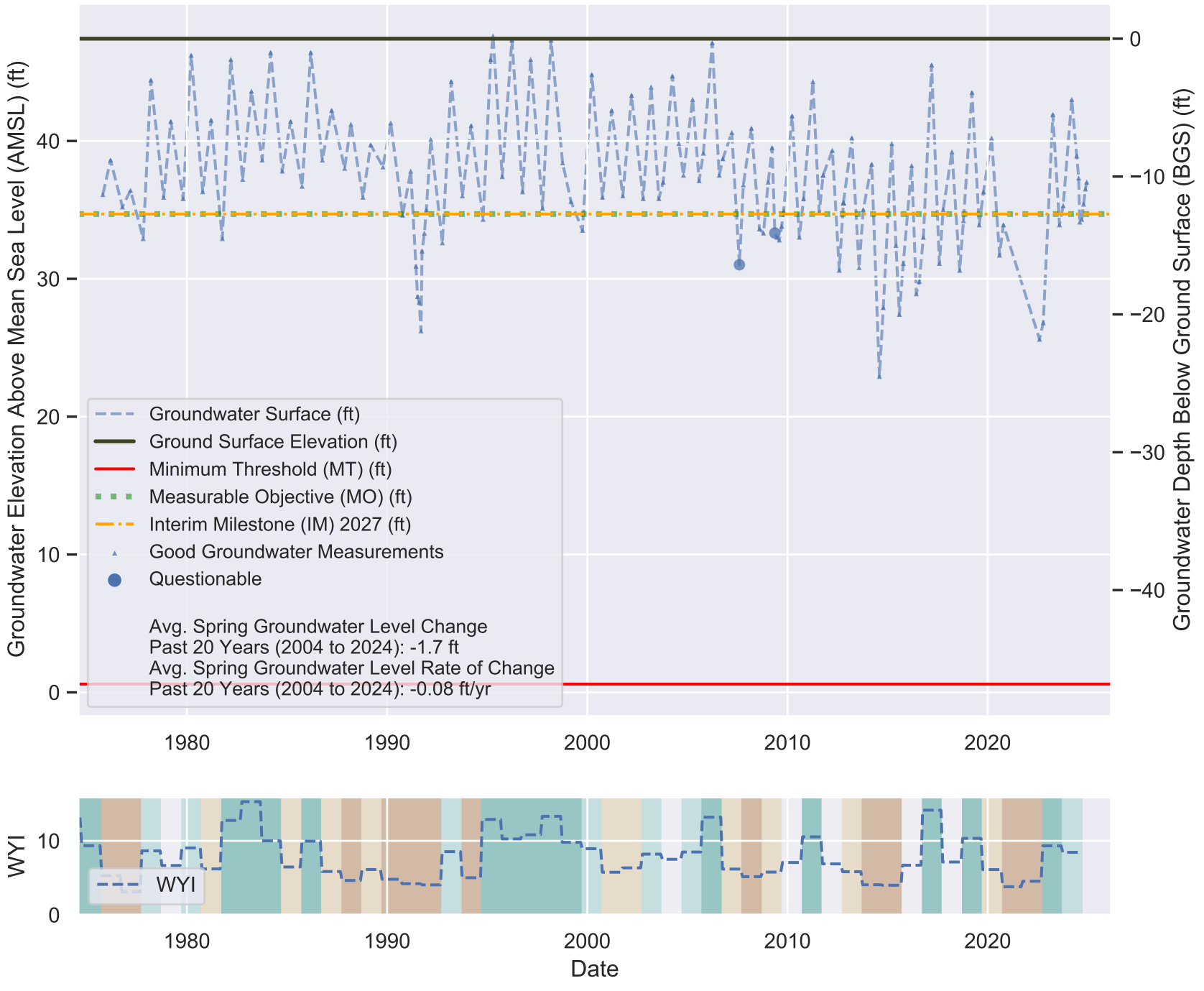
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 34.7 ft AMSL
MO = 34.7 ft AMSL
MT = 0.6 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

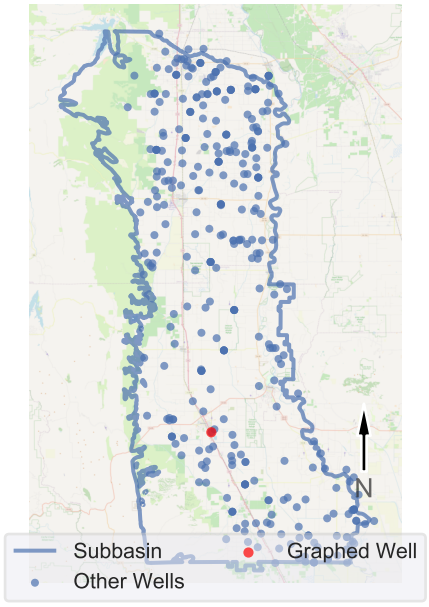
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 75.0 - 140.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 15N02W19E001M (Non-Focus RMS Well)

Well Location Map



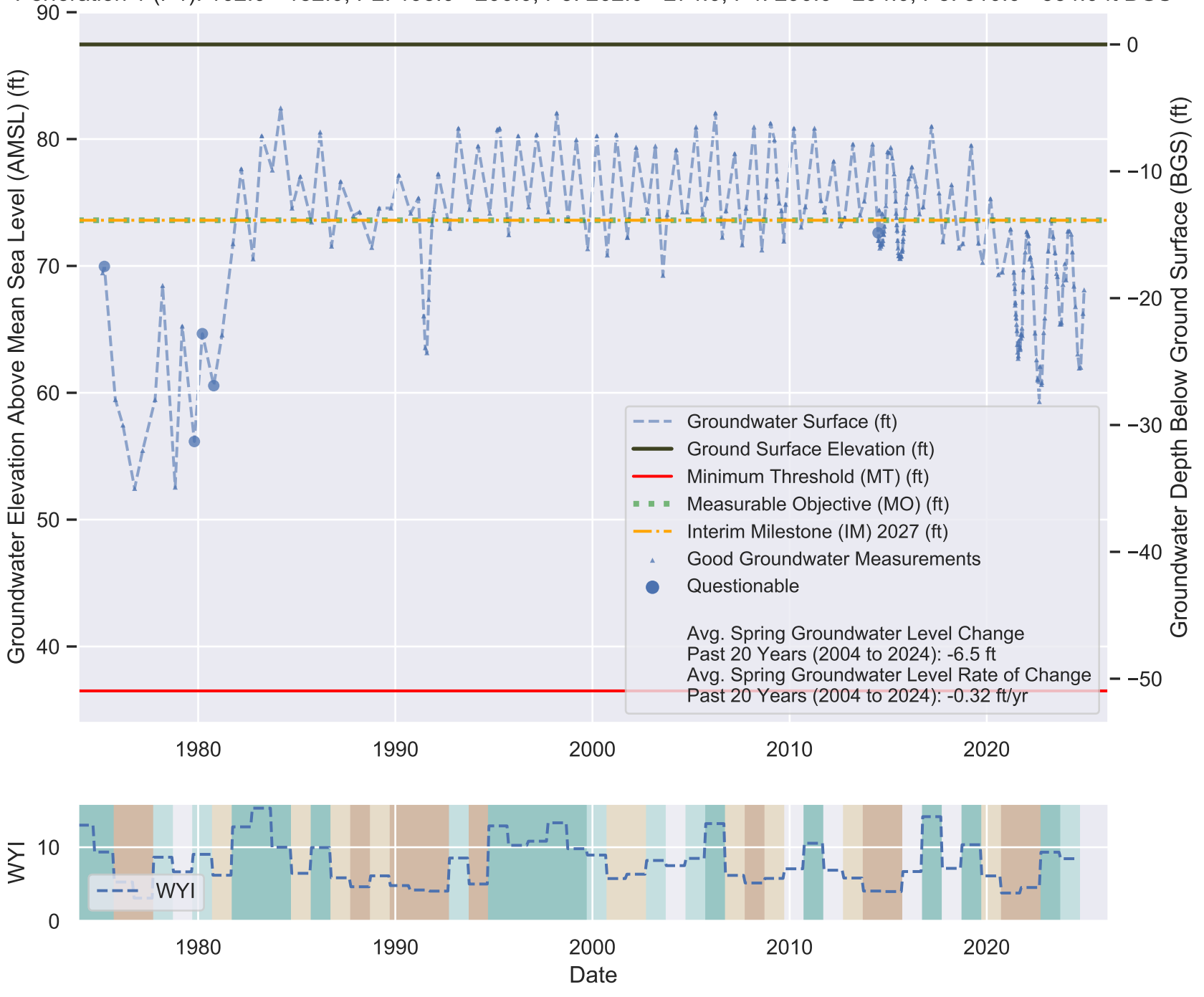
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 73.6 ft AMSL
MO = 73.6 ft AMSL
MT = 36.5 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (22.8 FT).

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

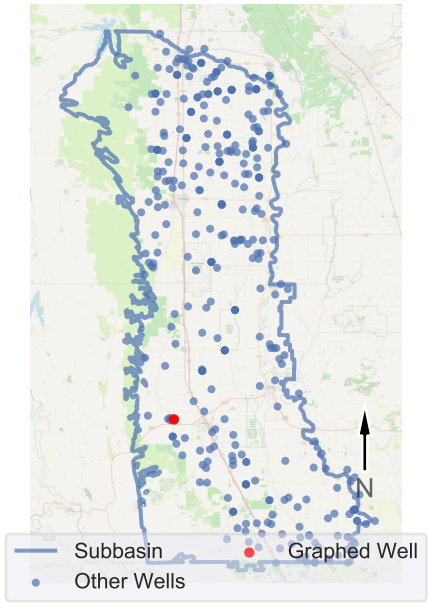
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 162.0 - 182.0; P2: 198.0 - 206.0; P3: 262.0 - 274.0; P4: 290.0 - 294.0; P5: 310.0 - 334.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 15N03W08Q001M (Non-Focus RMS Well)

Well Location Map



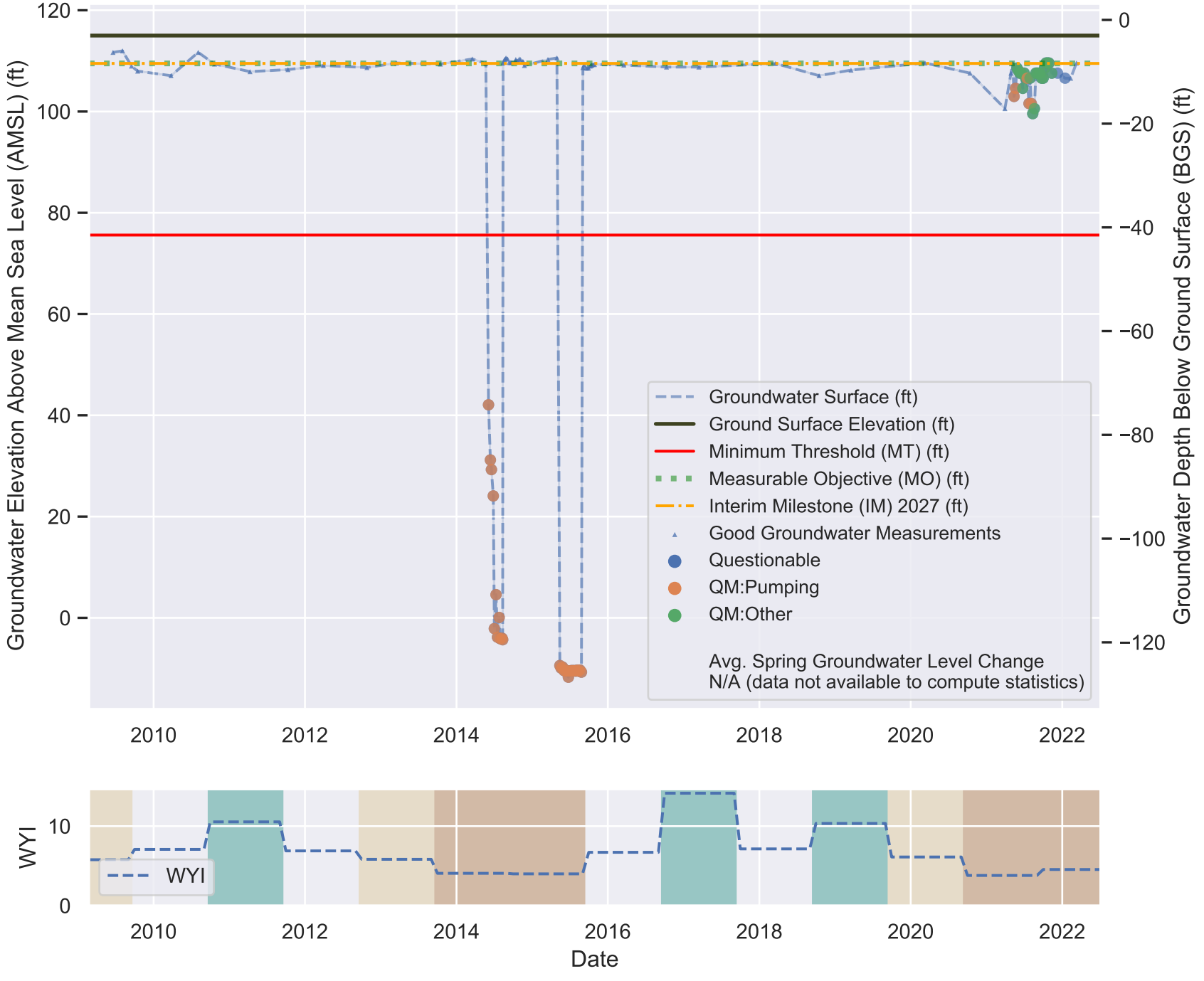
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 109.5 ft AMSL
MO = 109.5 ft AMSL
MT = 75.6 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

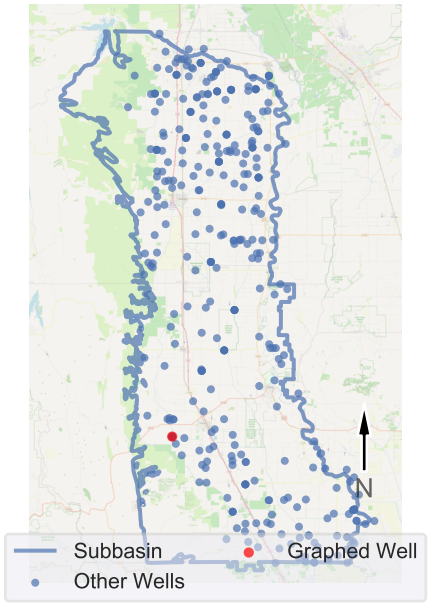
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 30.0 - 130.0; P2: 250.0 - 350.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 15N03W20Q002M (Non-Focus RMS Well)

Well Location Map



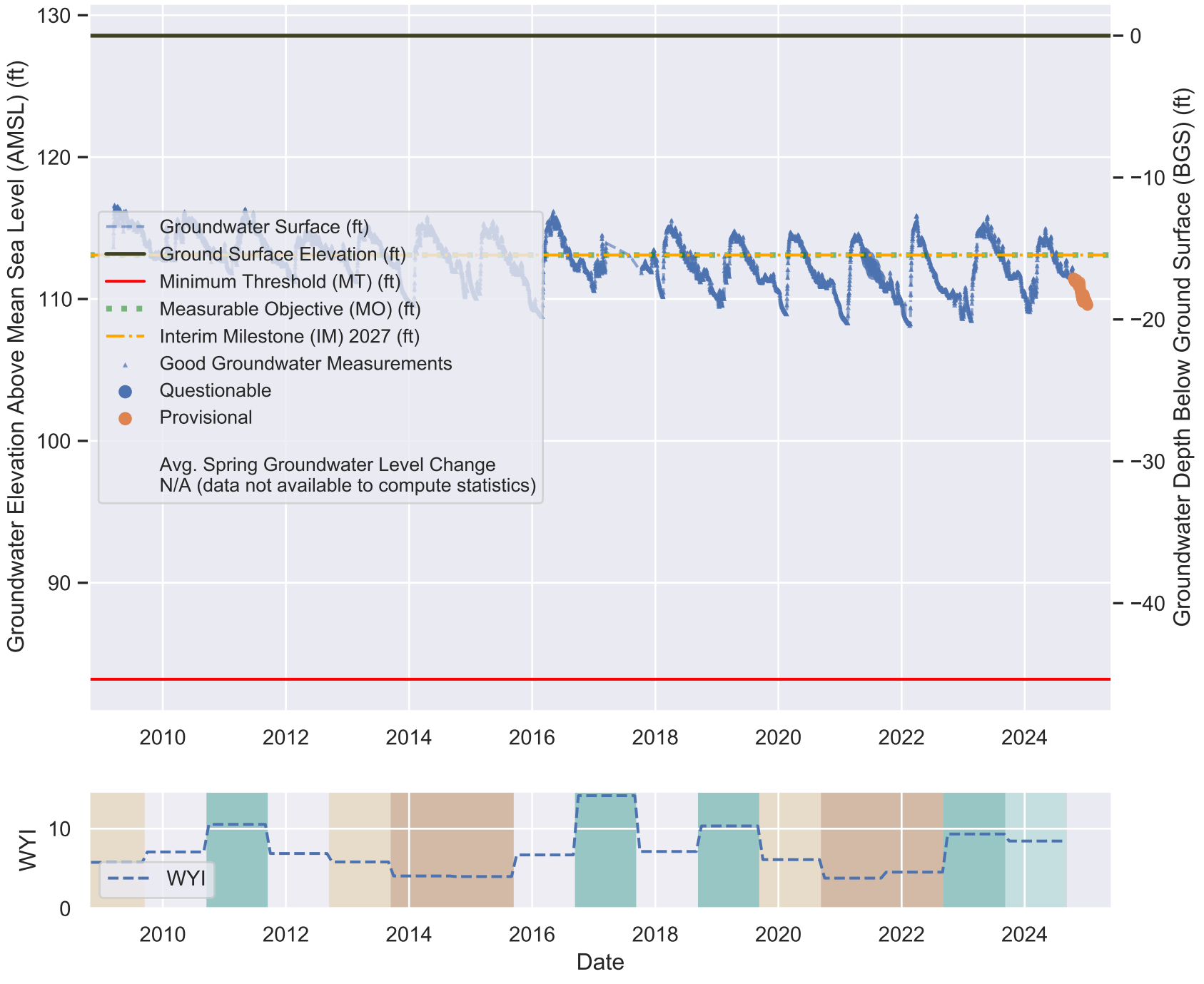
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 113.1 ft AMSL
MO = 113.1 ft AMSL
MT = 83.2 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

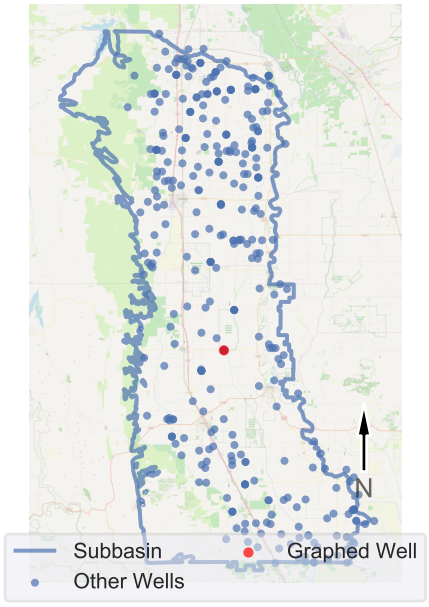
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 130.0 - 160.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 16N02W05B003M (Non-Focus RMS Well)

Well Location Map



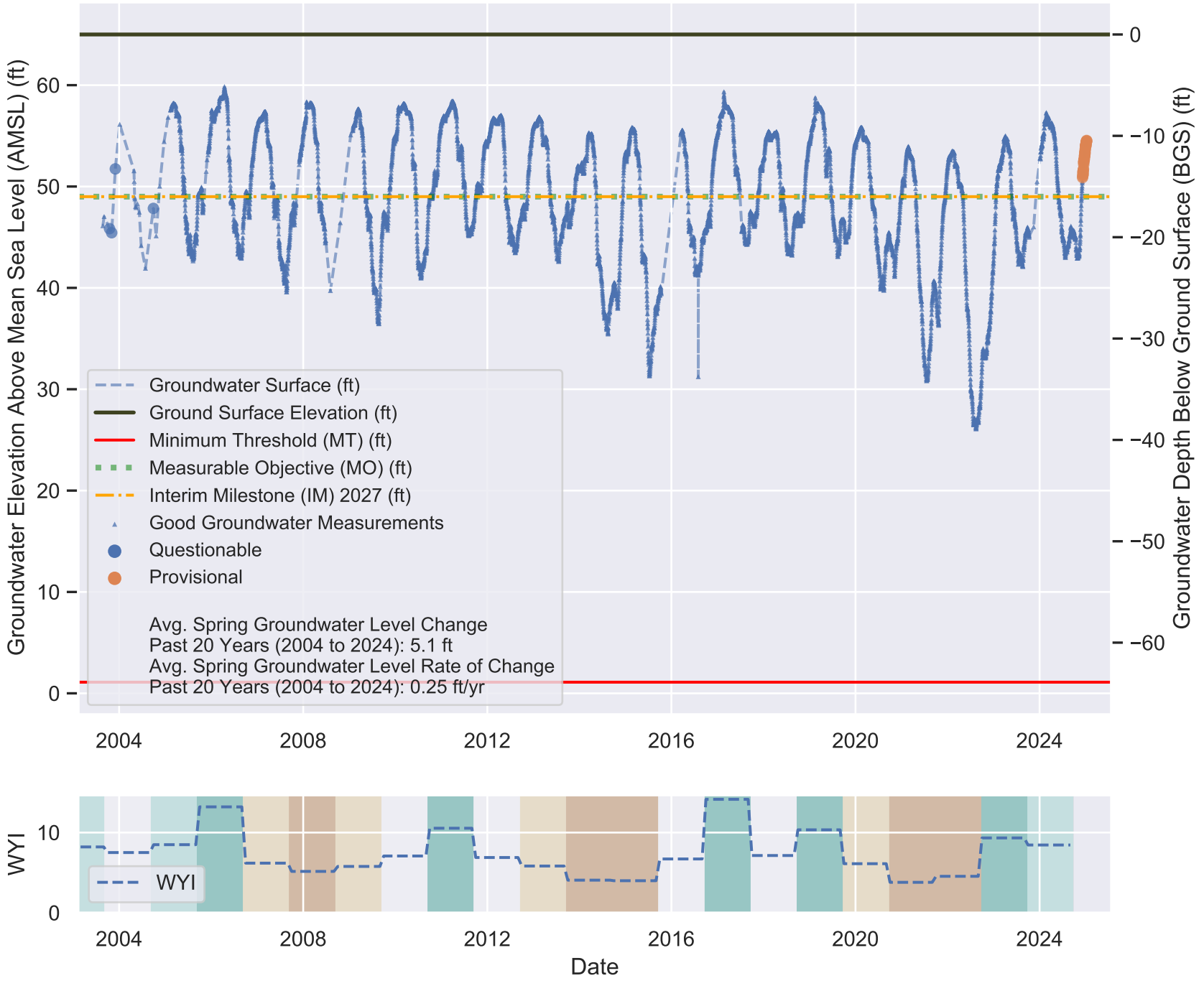
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 49.0 ft AMSL
MO = 49.0 ft AMSL
MT = 1.1 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

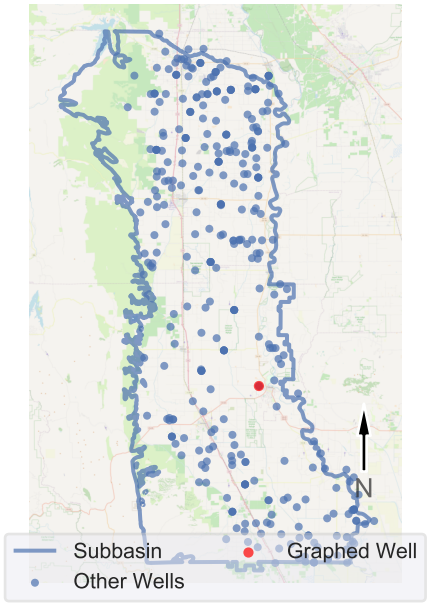
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 174.0 - 184.0; P2: 246.0 - 256.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 16N02W25B002M (Non-Focus RMS Well)

Well Location Map



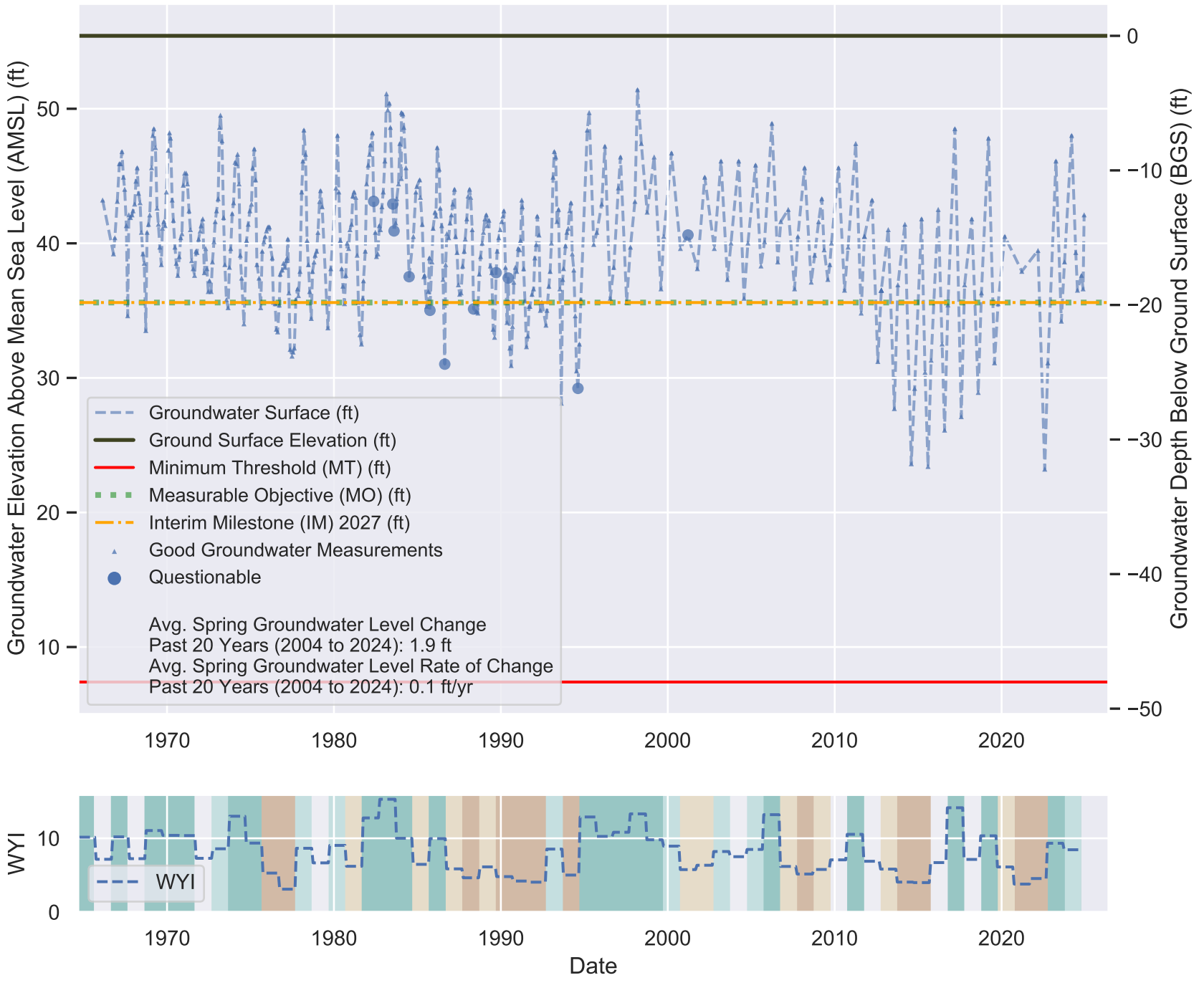
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 35.6 ft AMSL
MO = 35.6 ft AMSL
MT = 7.4 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (15.8 FT).

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

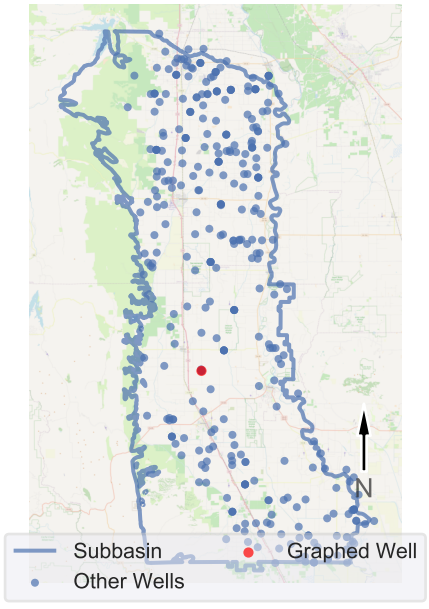
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 254.0 - 274.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 16N03W14H006M (Non-Focus RMS Well)

Well Location Map



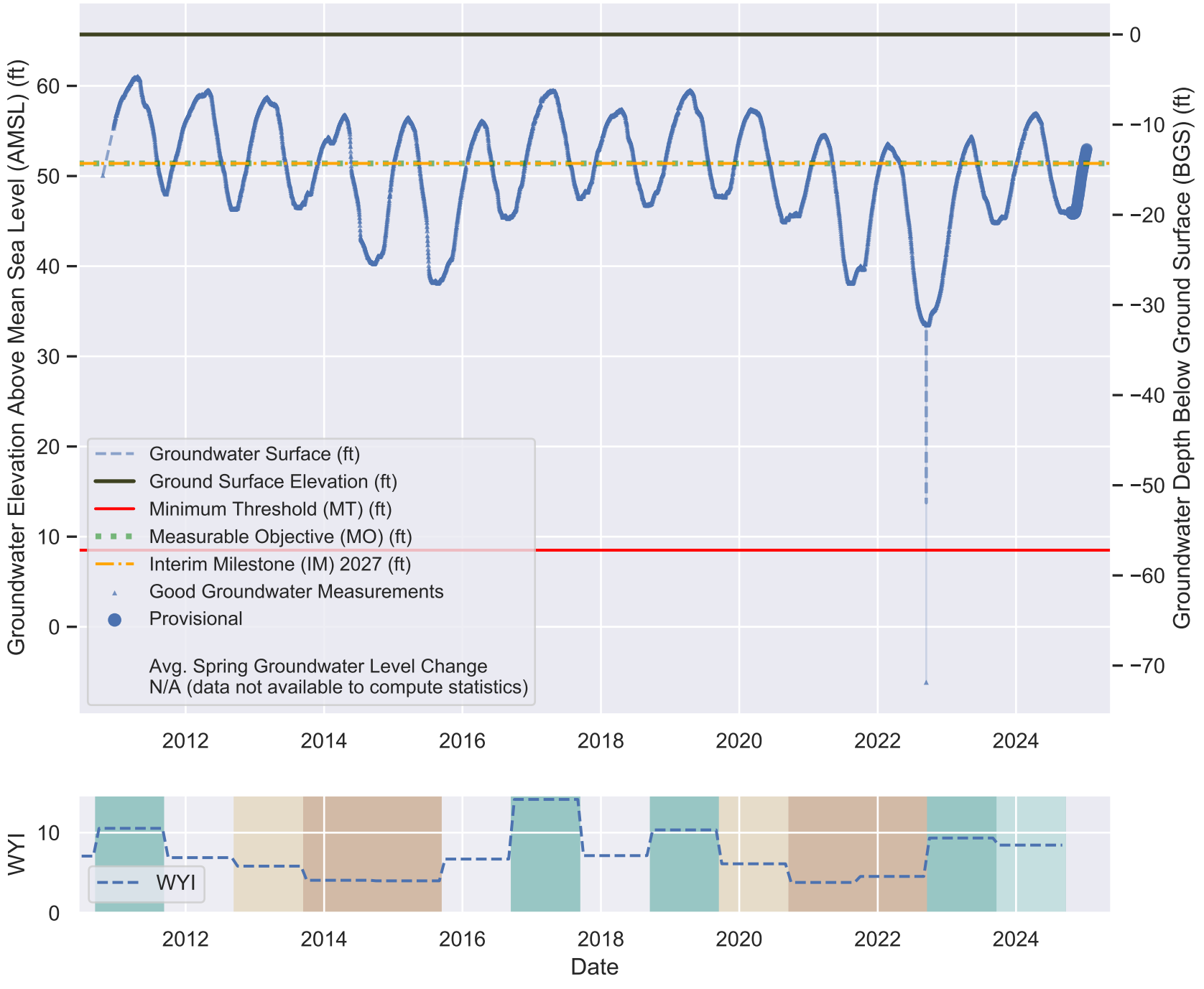
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 51.4 ft AMSL
MO = 51.4 ft AMSL
MT = 8.5 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

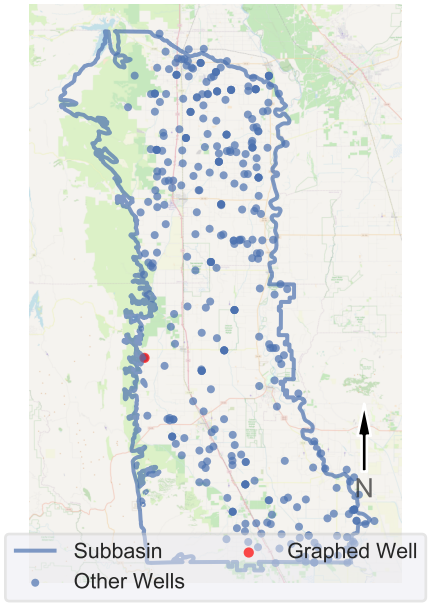
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 295.0 - 305.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 16N04W02P001M (Non-Focus RMS Well)

Well Location Map



GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 144.3 ft AMSL
MO = 144.3 ft AMSL
MT = 101.2 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

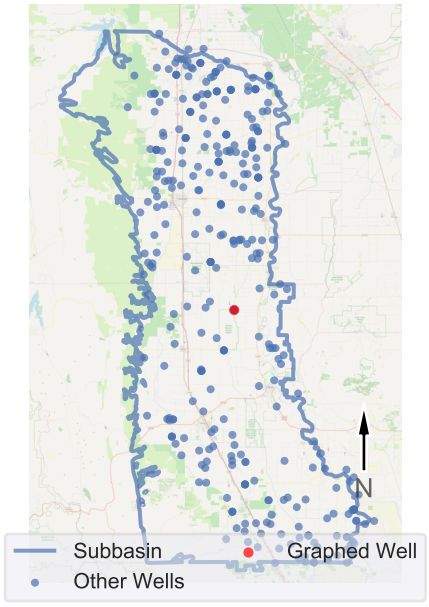
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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

Perforation 1: 112.0 - 203.0 ft BGS

COLUSA Subbasin - State Well Number (SWN): 17N02W09H004M (Non-Focus RMS Well)

Well Location Map



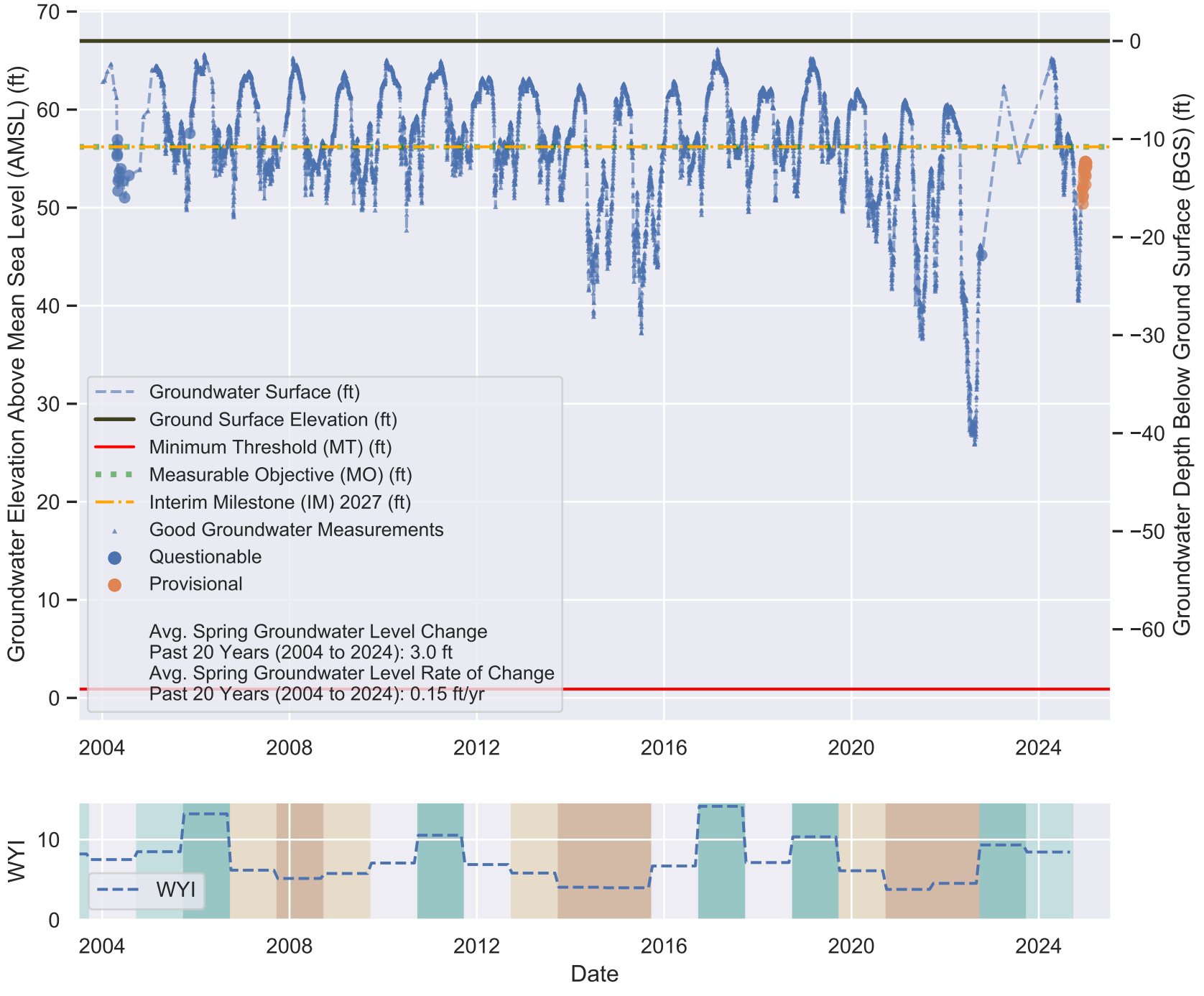
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 56.2 ft AMSL
MO = 56.2 ft AMSL
MT = 0.9 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

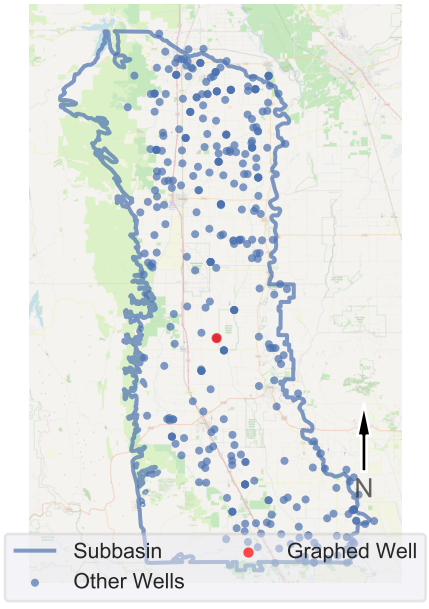
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 250.0 - 260.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 17N02W30J002M (Non-Focus RMS Well)

Well Location Map



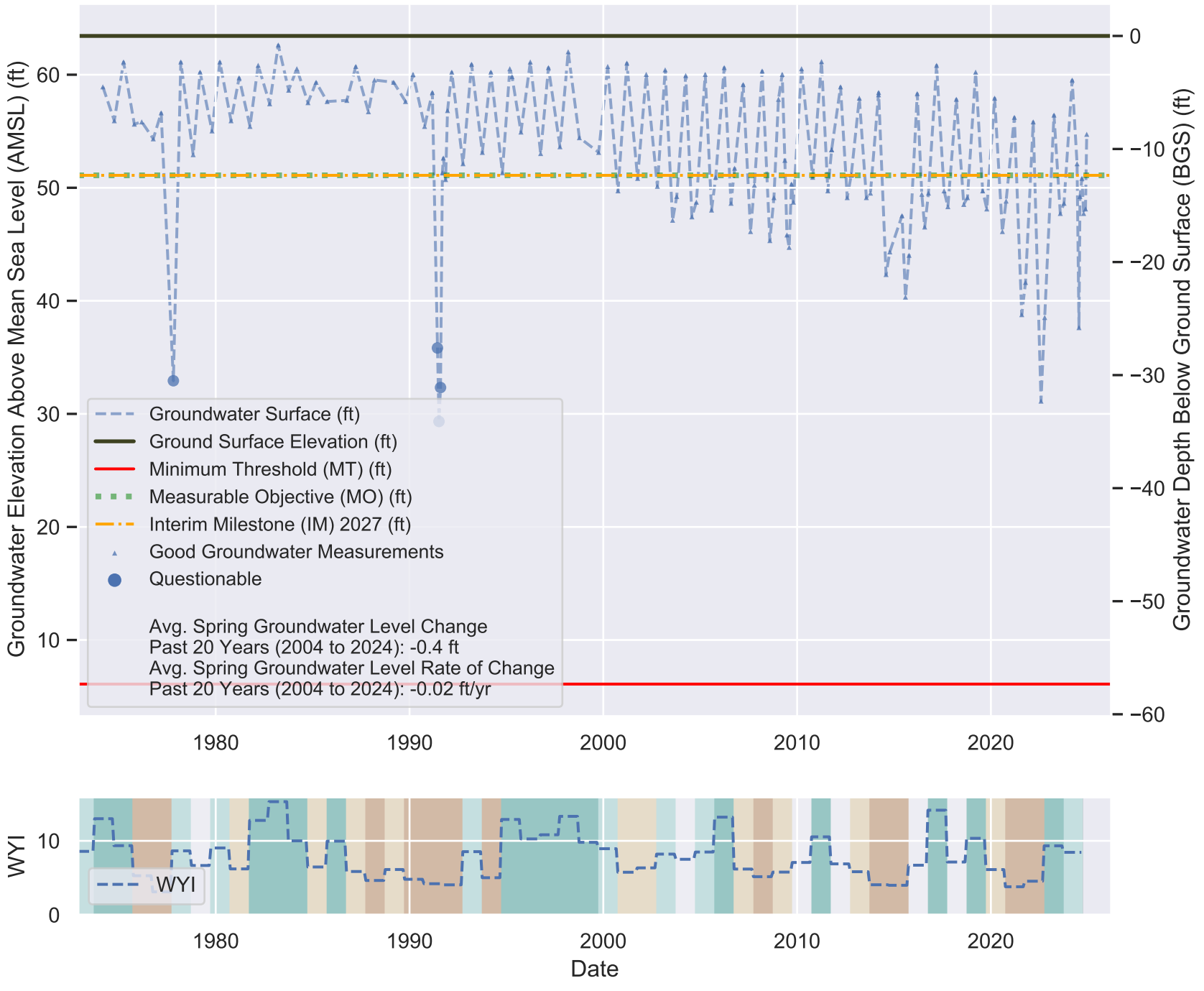
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 51.1 ft AMSL
MO = 51.1 ft AMSL
MT = 6.1 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

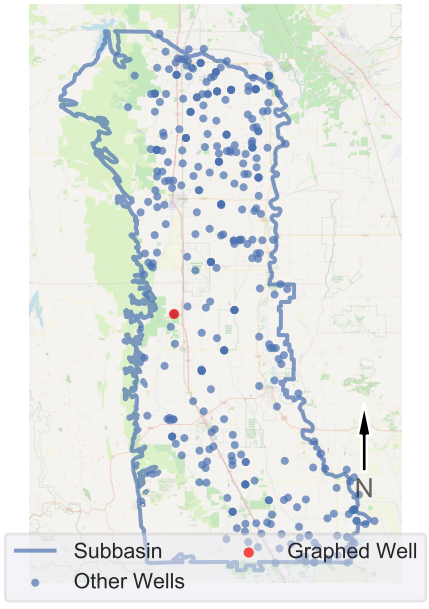
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 157.0 - 159.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 17N03W08R001M (Non-Focus RMS Well)

Well Location Map



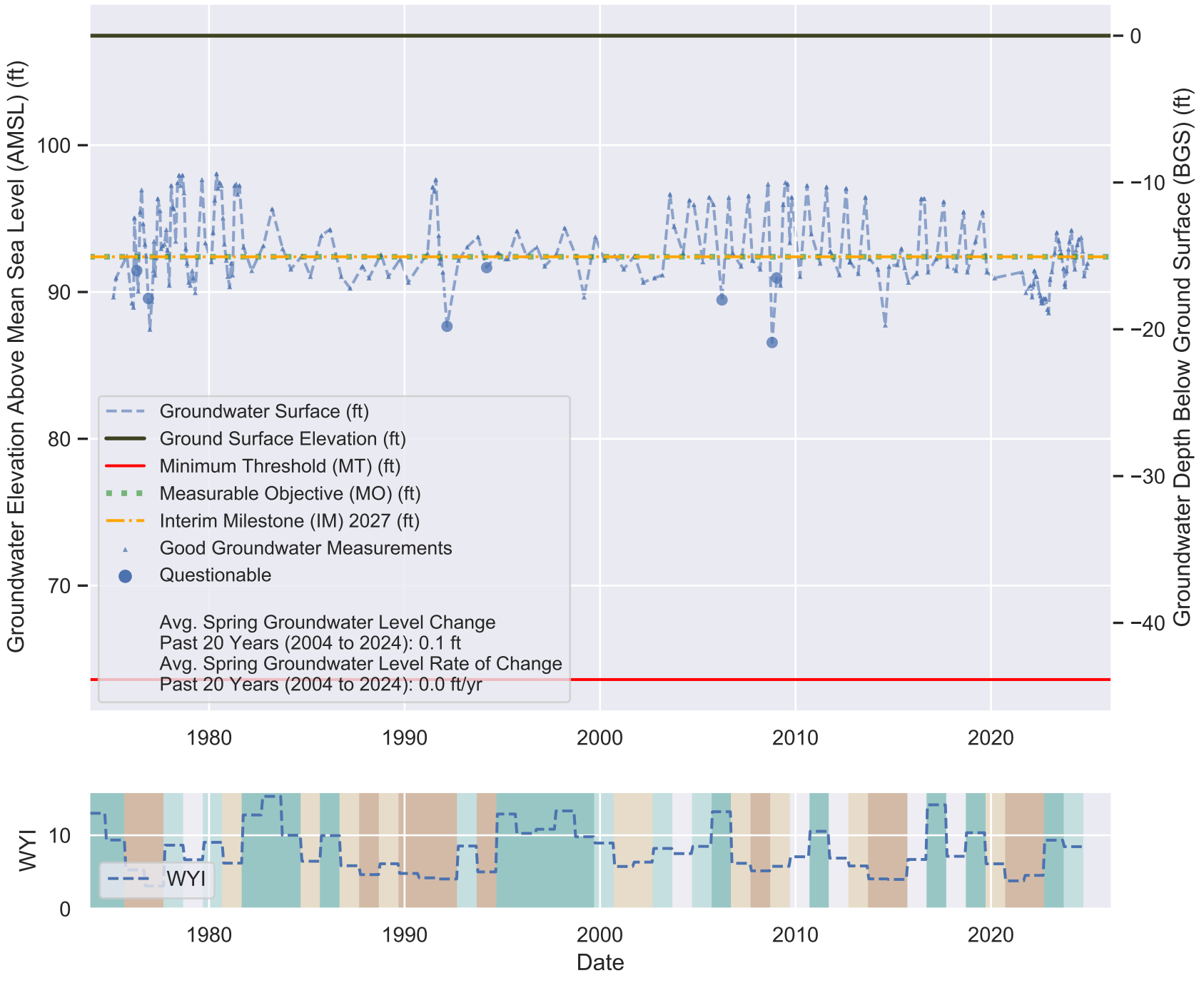
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 92.4 ft AMSL
MO = 92.4 ft AMSL
MT = 63.6 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

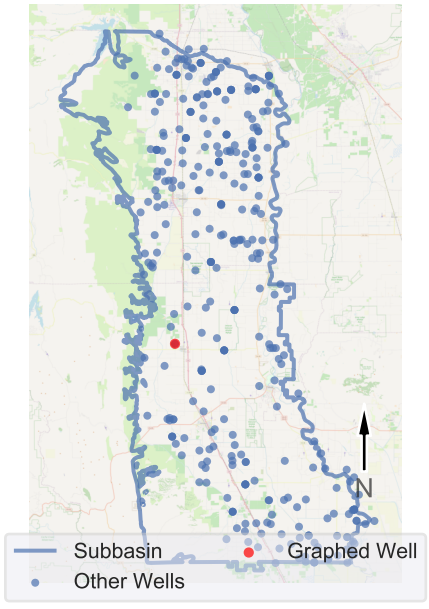
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 125.0 - 130.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 17N03W32H001M (Non-Focus RMS Well)

Well Location Map



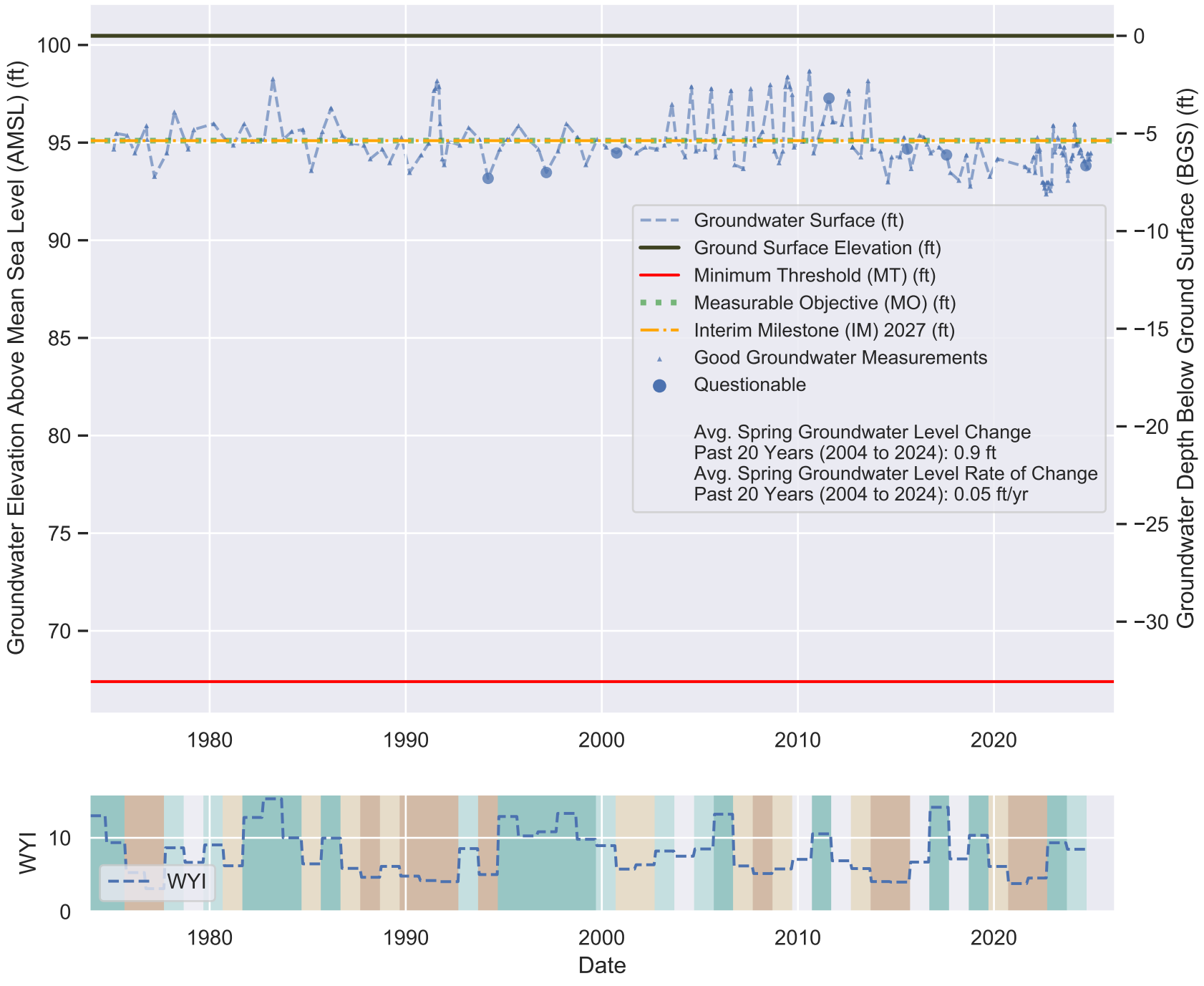
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 95.1 ft AMSL
MO = 95.1 ft AMSL
MT = 67.4 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

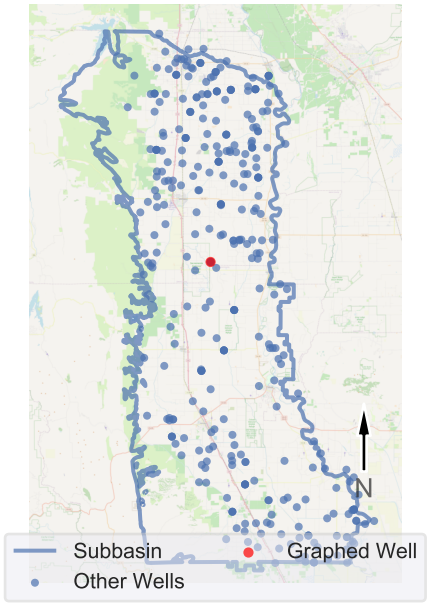
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 68.0 - 72.0; P2: 104.0 - 112.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 18N02W18D004M (Non-Focus RMS Well)

Well Location Map



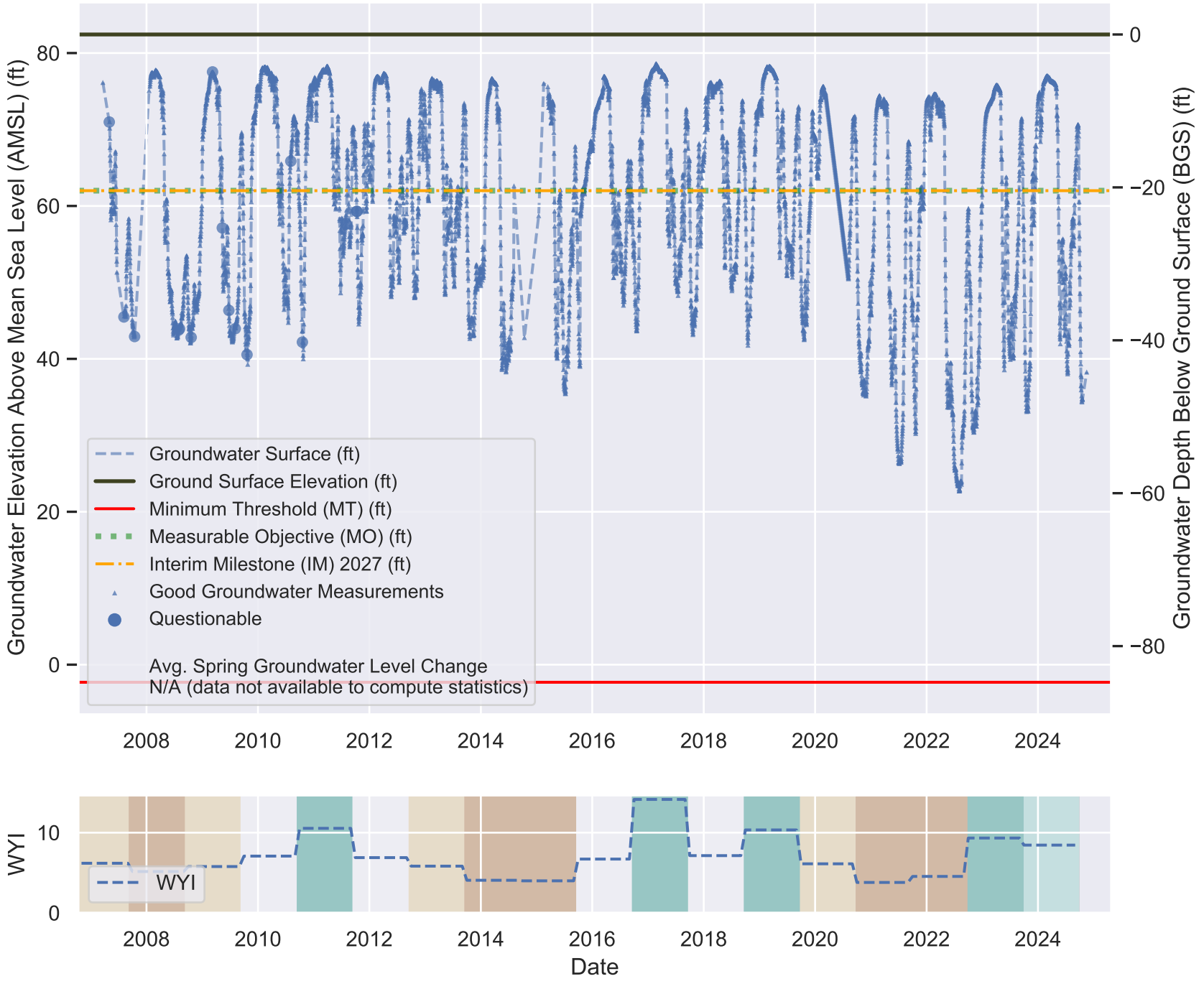
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 62.0 ft AMSL
MO = 62.0 ft AMSL
MT = -2.3 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

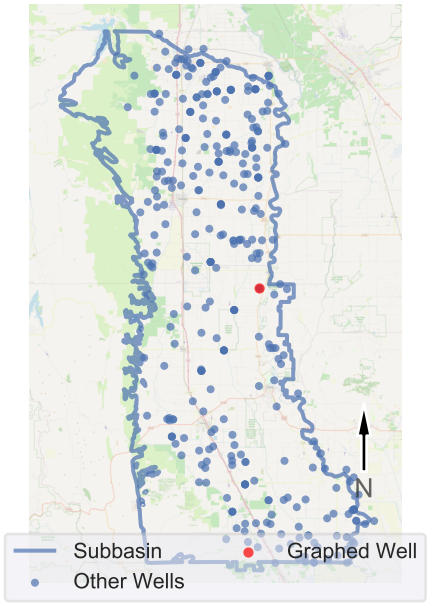
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 246.0 - 256.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 18N02W36B001M (Non-Focus RMS Well)

Well Location Map



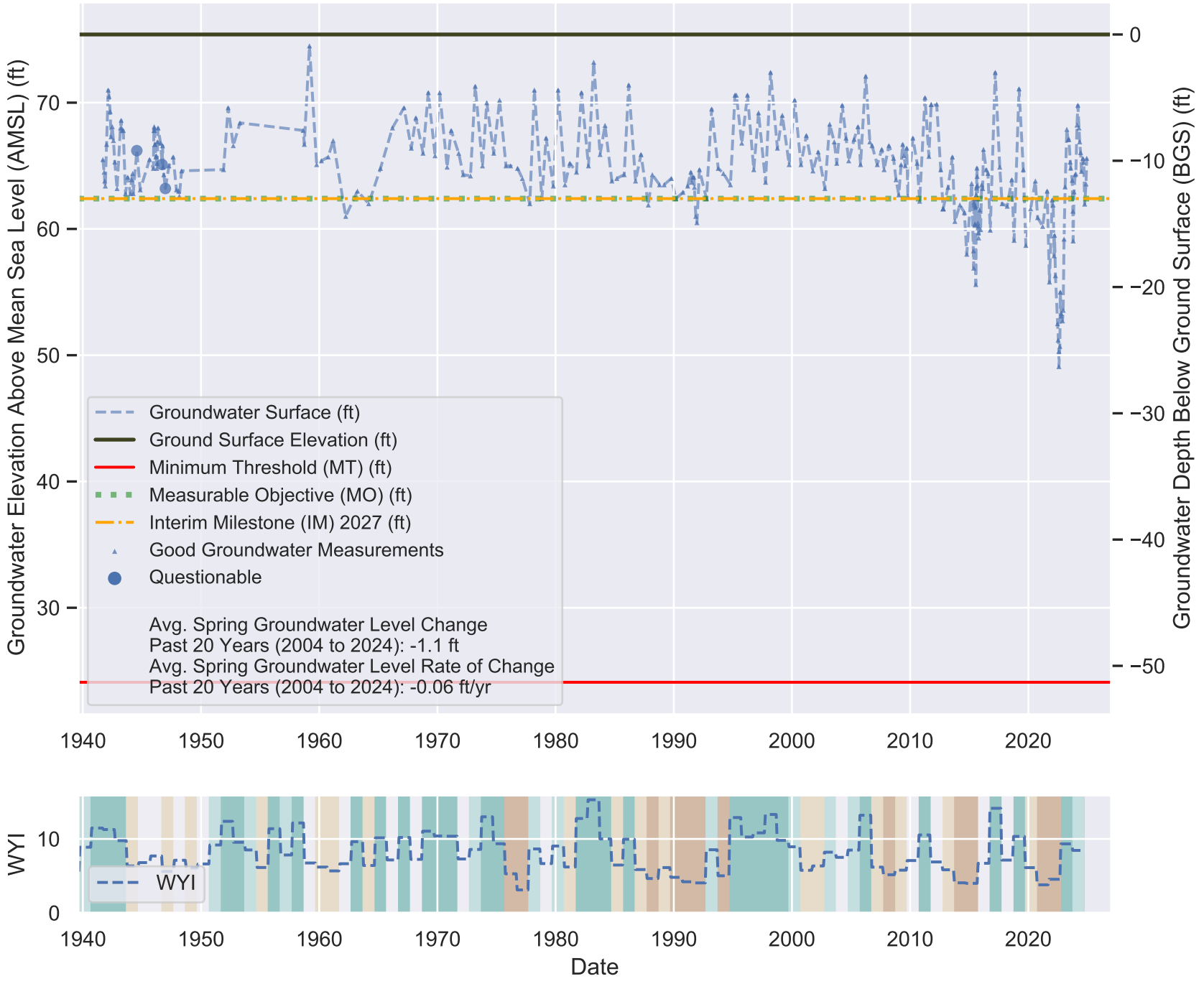
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 62.4 ft AMSL
MO = 62.4 ft AMSL
MT = 24.1 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

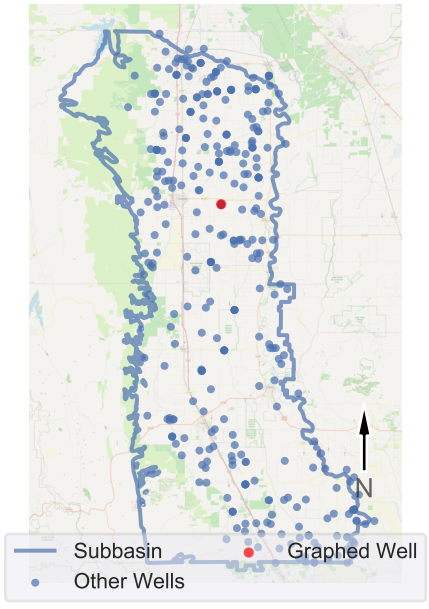
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 88.0 - 128.0; P2: 195.0 - 225.0; P3: 240.0 - 340.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 19N02W08Q002M (Non-Focus RMS Well)

Well Location Map



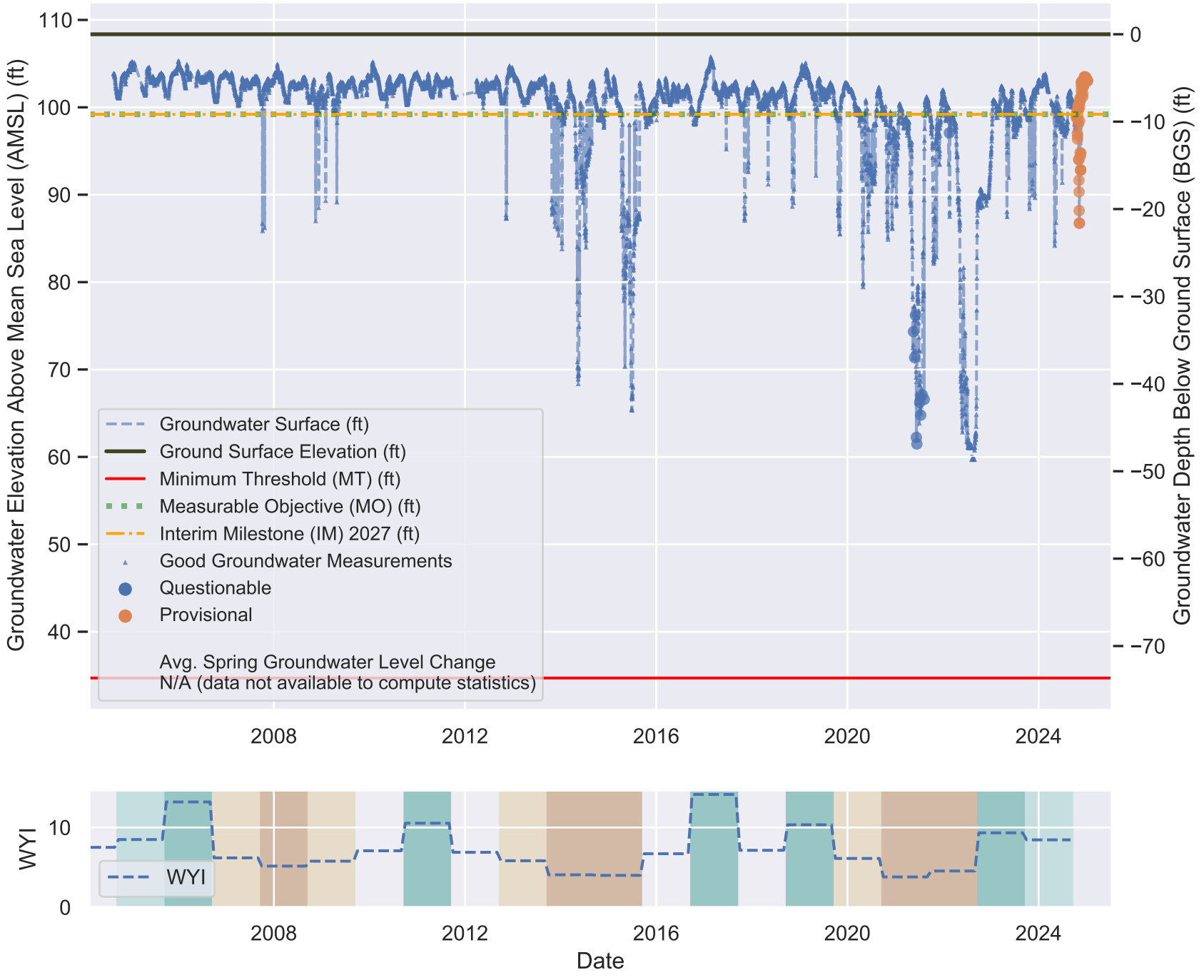
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 99.2 ft AMSL
MO = 99.2 ft AMSL
MT = 34.7 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

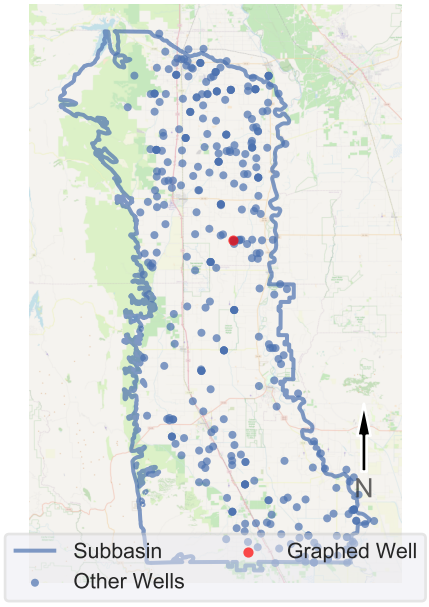
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 208.0 - 218.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 19N02W33K001M (Non-Focus RMS Well)

Well Location Map



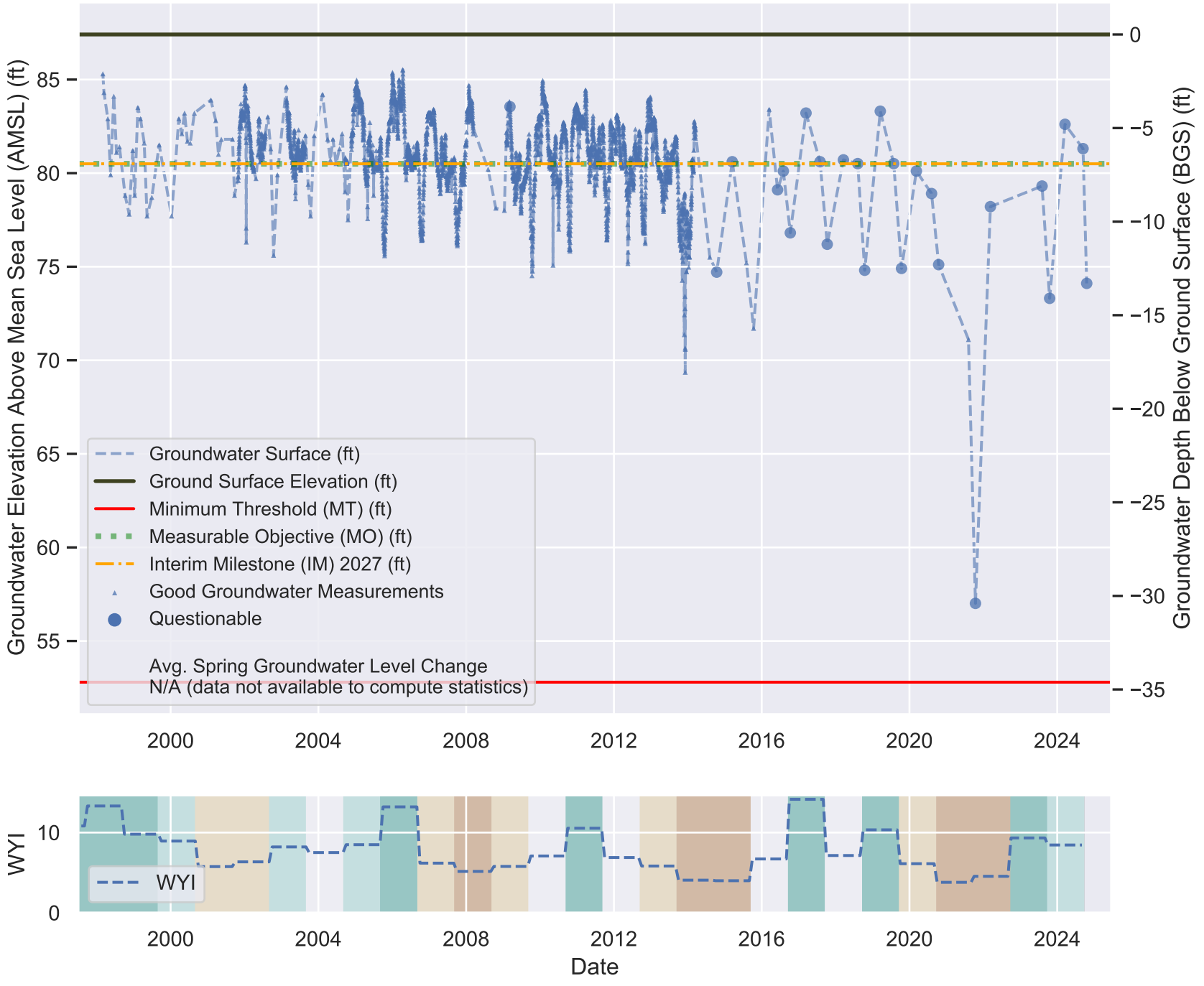
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 80.5 ft AMSL
MO = 80.5 ft AMSL
MT = 52.8 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (18.3 FT).

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

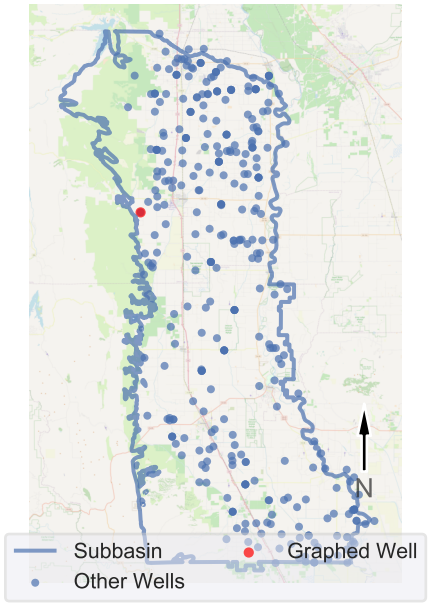
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 160.0 - 260.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 19N04W14M002M (Non-Focus RMS Well)

Well Location Map



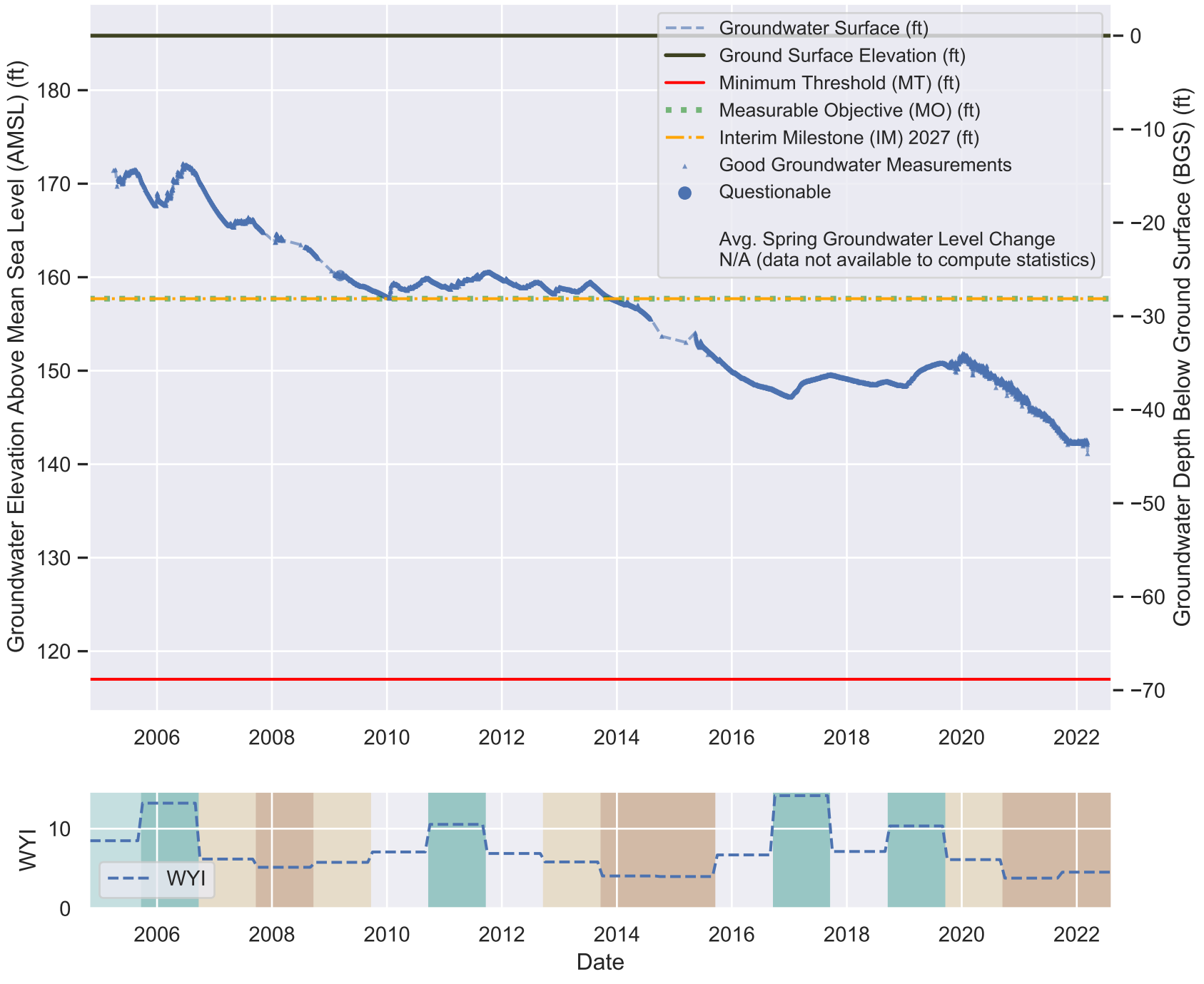
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 157.7 ft AMSL
MO = 157.7 ft AMSL
MT = 117.0 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

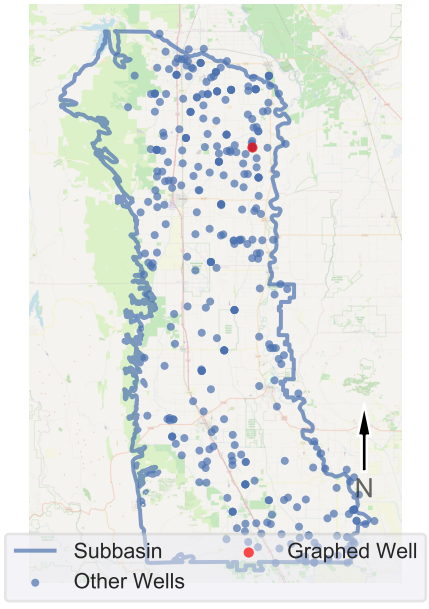
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 45.0 - 55.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 20N02W11A001M (Non-Focus RMS Well)

Well Location Map



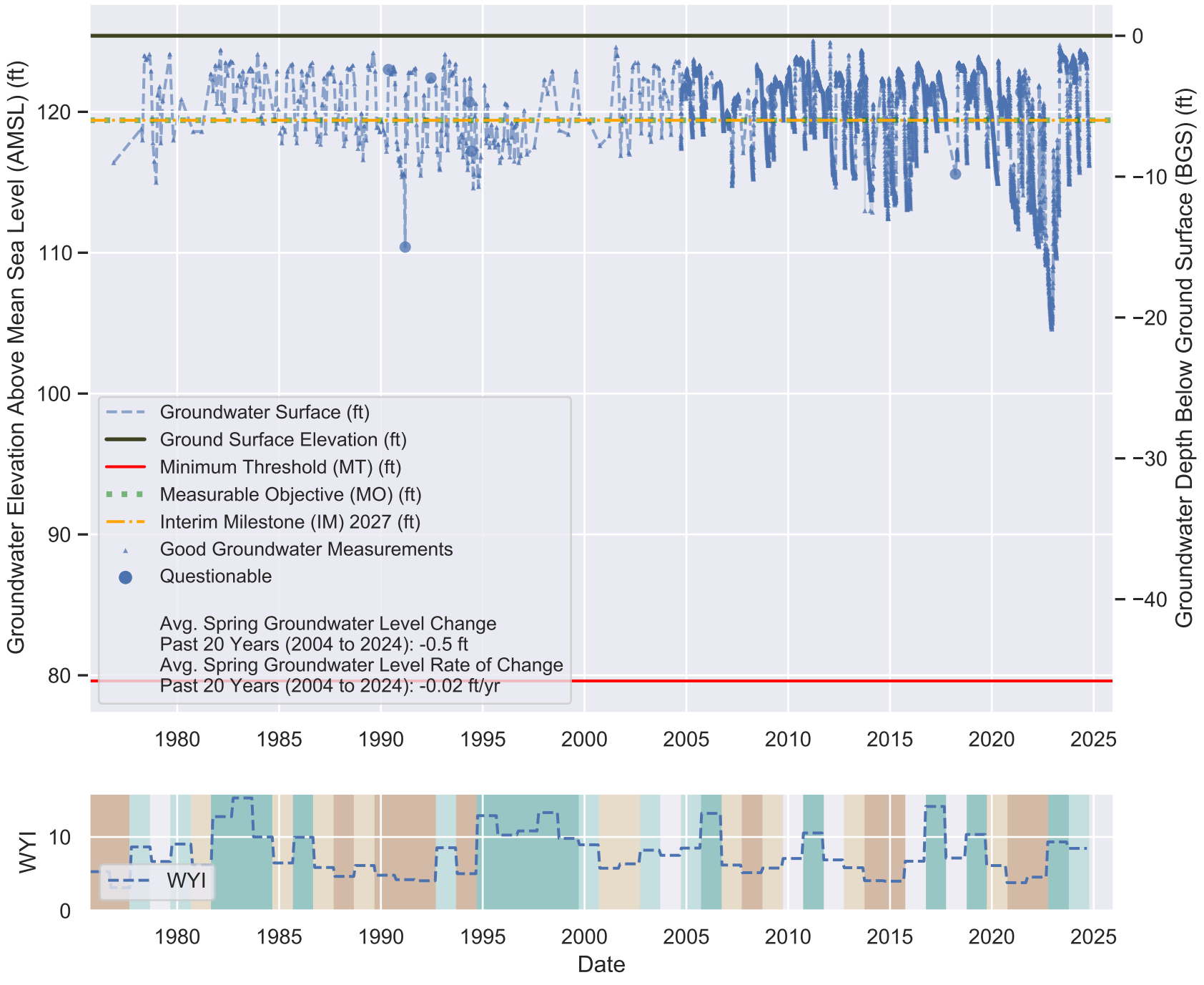
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 119.4 ft AMSL
MO = 119.4 ft AMSL
MT = 79.6 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

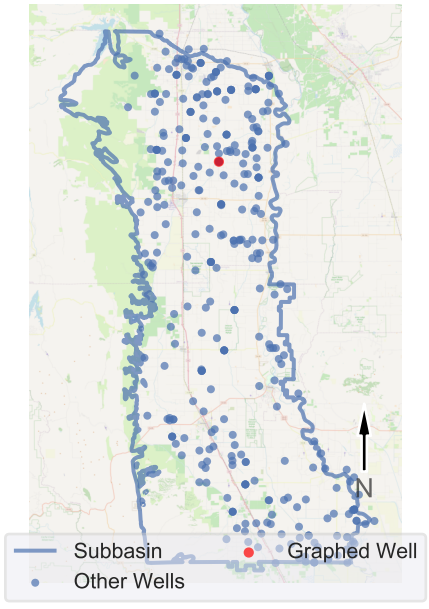
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 70.0 - 90.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 20N02W18R008M (Non-Focus RMS Well)

Well Location Map



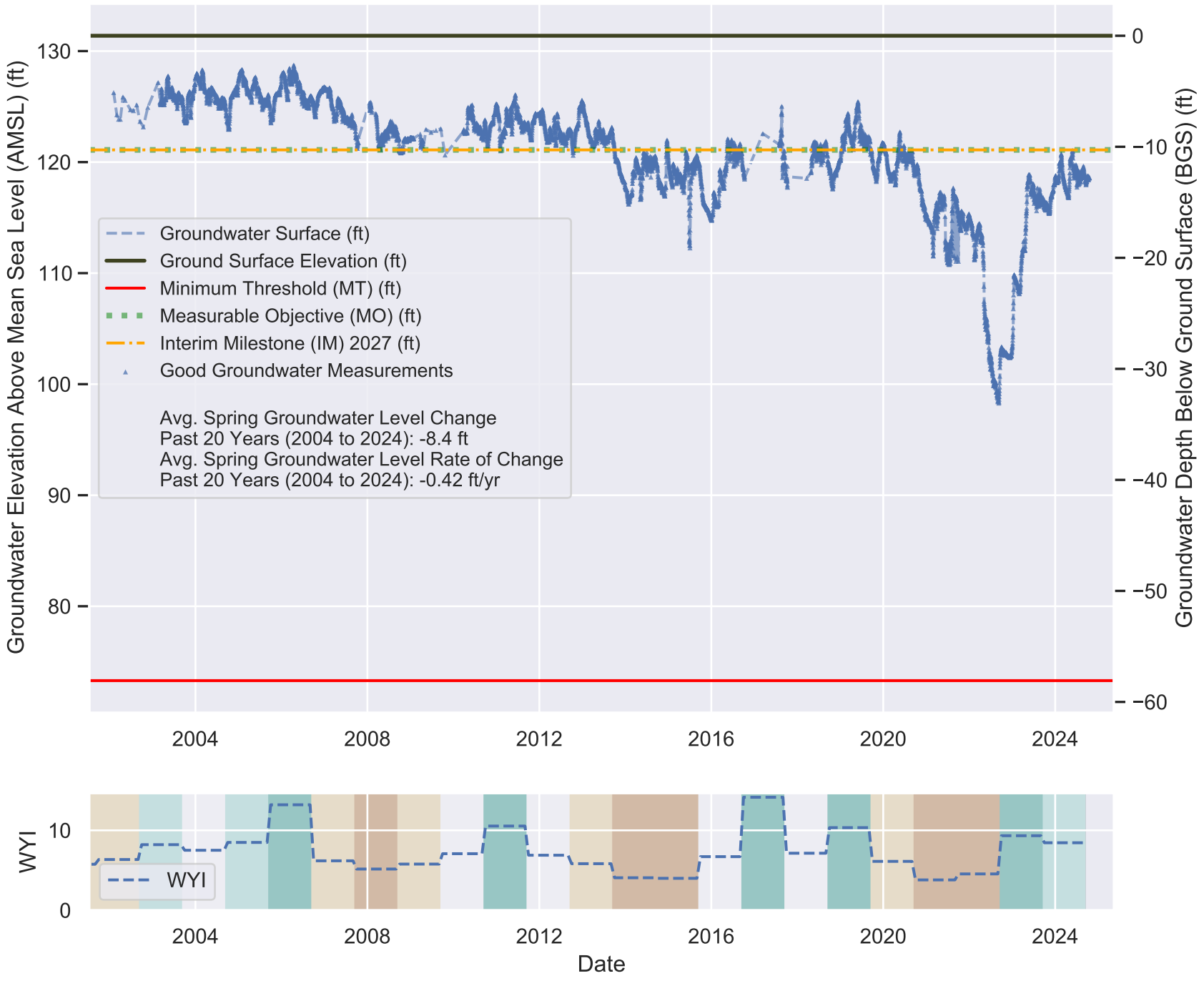
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 121.1 ft AMSL
MO = 121.1 ft AMSL
MT = 73.3 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

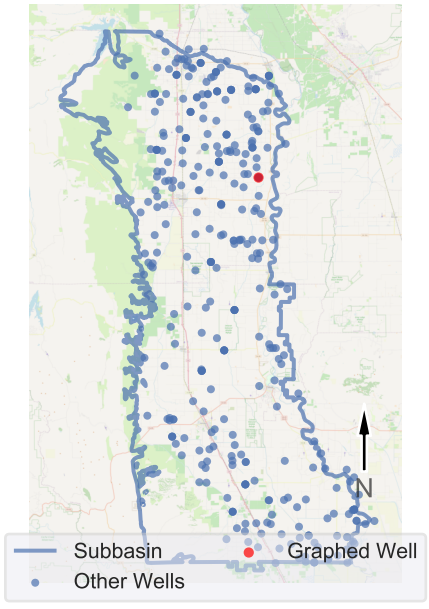
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 140.0 - 150.0; P2: 170.0 - 180.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 20N02W25F004M (Non-Focus RMS Well)

Well Location Map



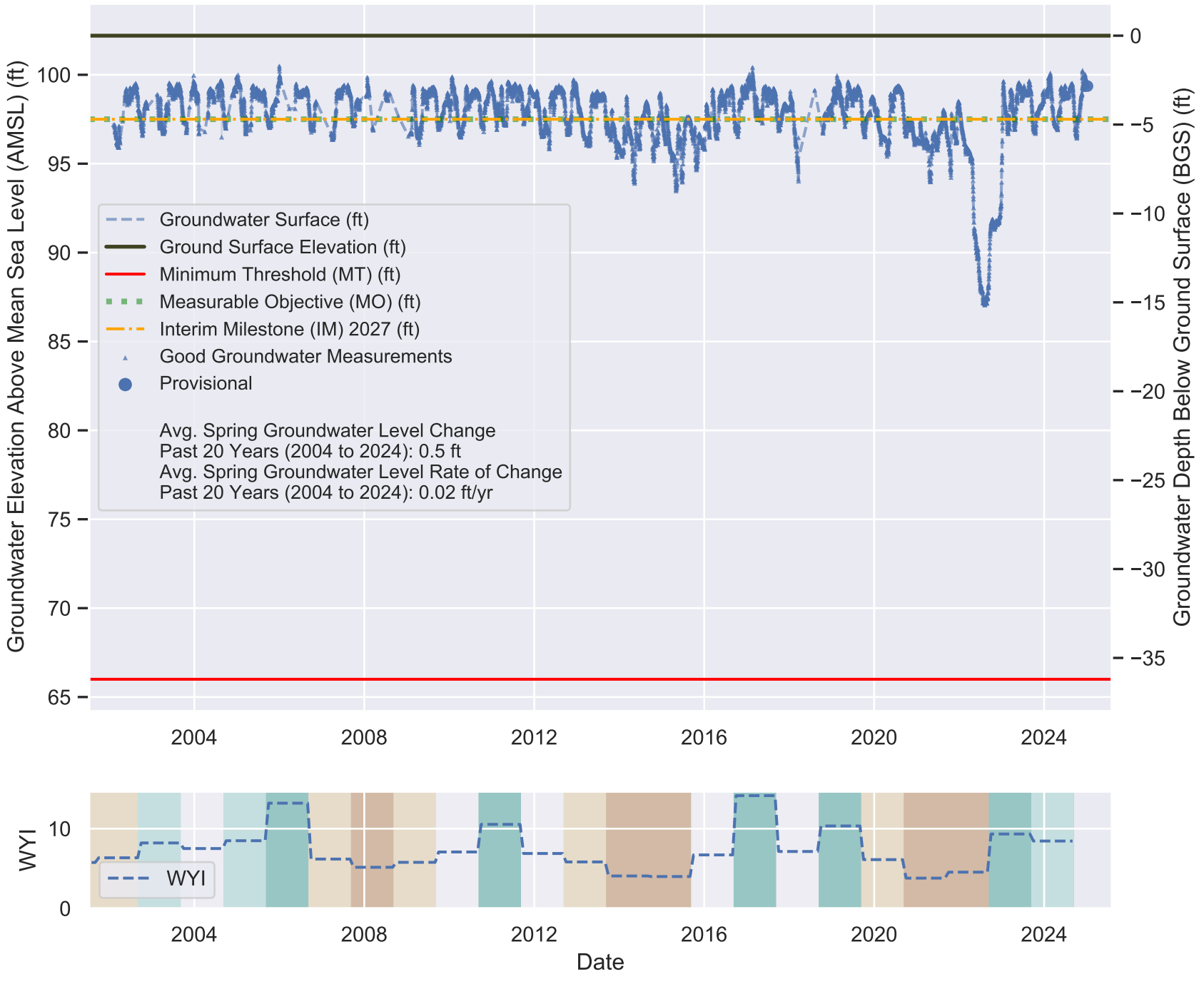
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 97.5 ft AMSL
MO = 97.5 ft AMSL
MT = 66.0 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (21.0 FT).

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

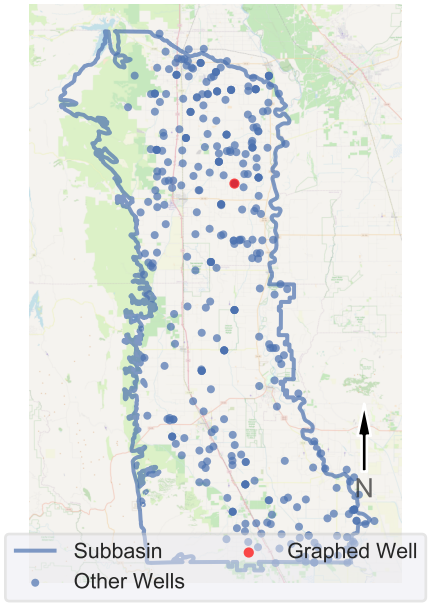
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 55.0 - 65.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 20N02W33B001M (Non-Focus RMS Well)

Well Location Map



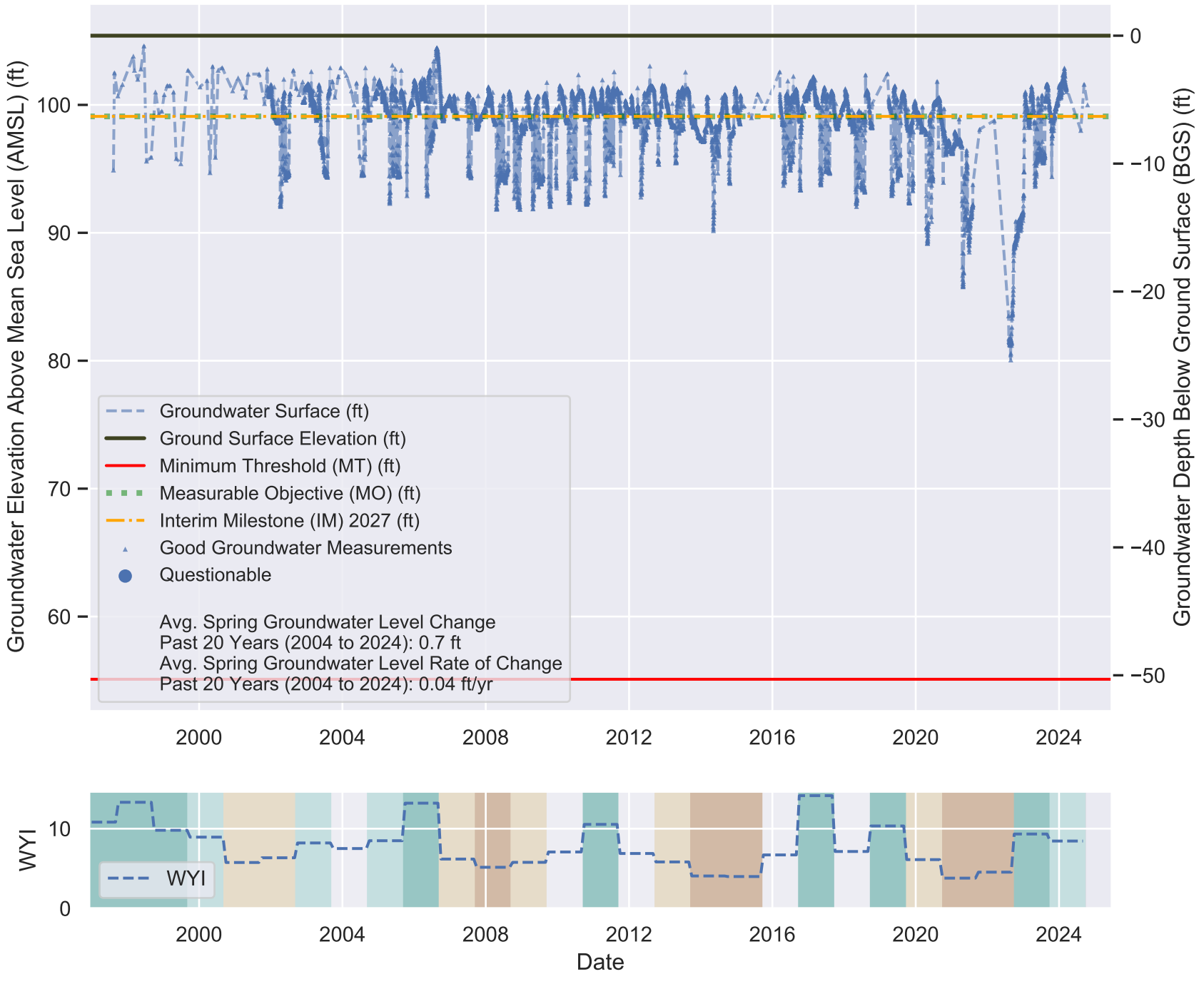
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 99.1 ft AMSL
MO = 99.1 ft AMSL
MT = 55.1 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

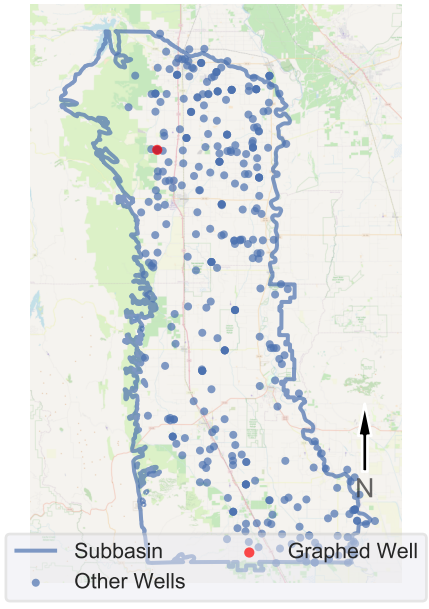
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 100.0 - 120.0; P2: 200.0 - 320.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 20N03W07E004M (Focus RMS Well)

Well Location Map



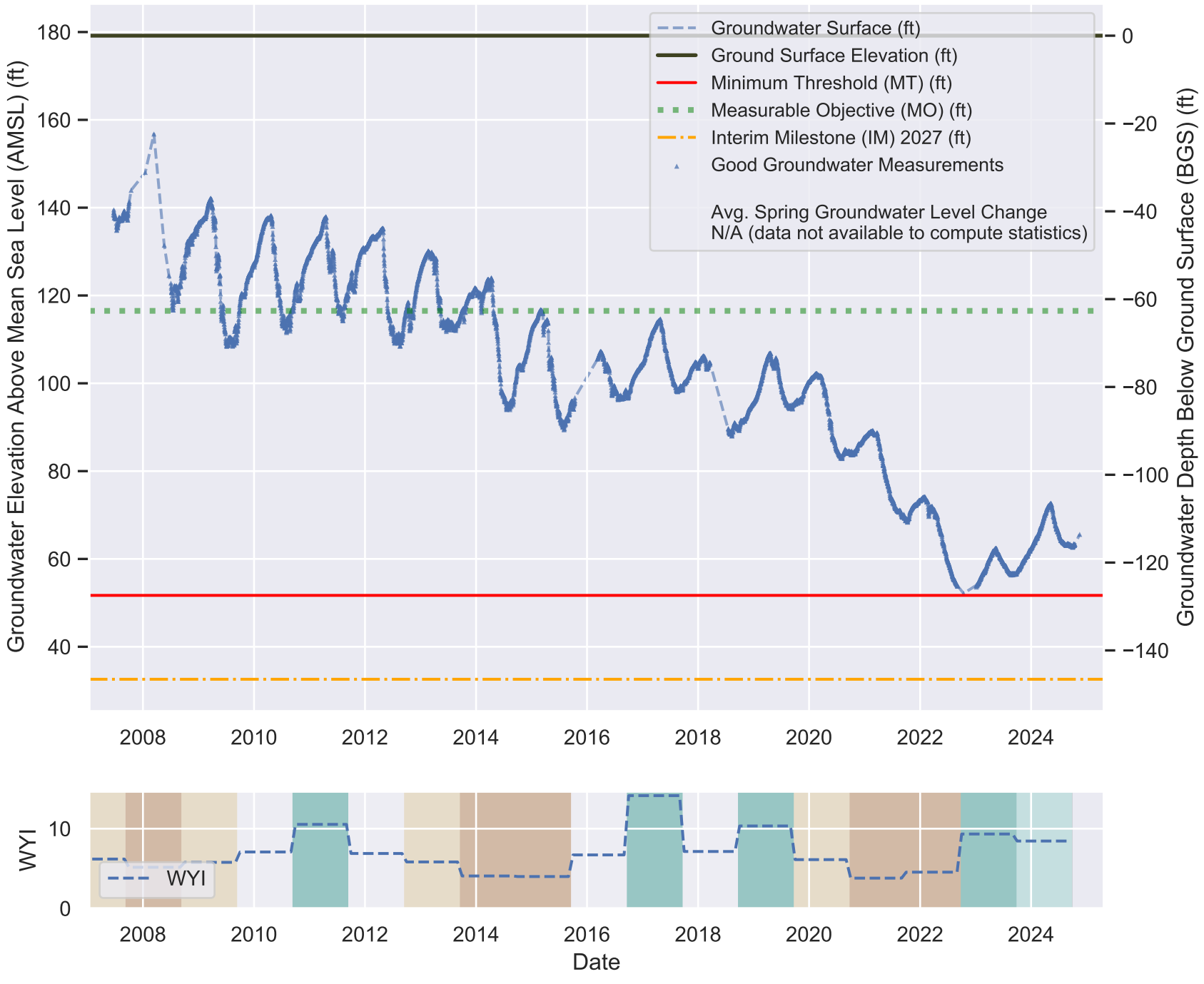
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 32.6 ft AMSL
MO = 116.5 ft AMSL
MT = 51.7 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

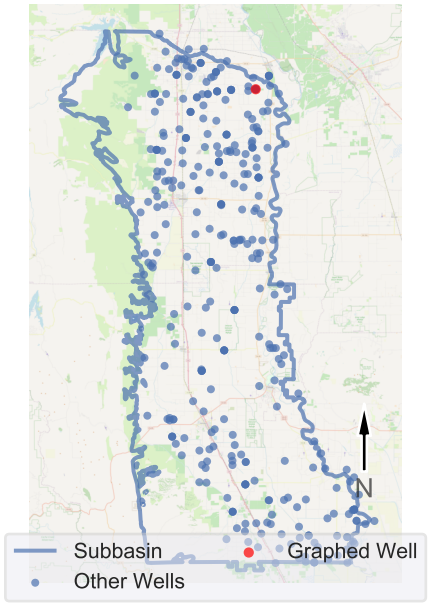
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 118.0 - 128.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N02W01F003M (Non-Focus RMS Well)

Well Location Map



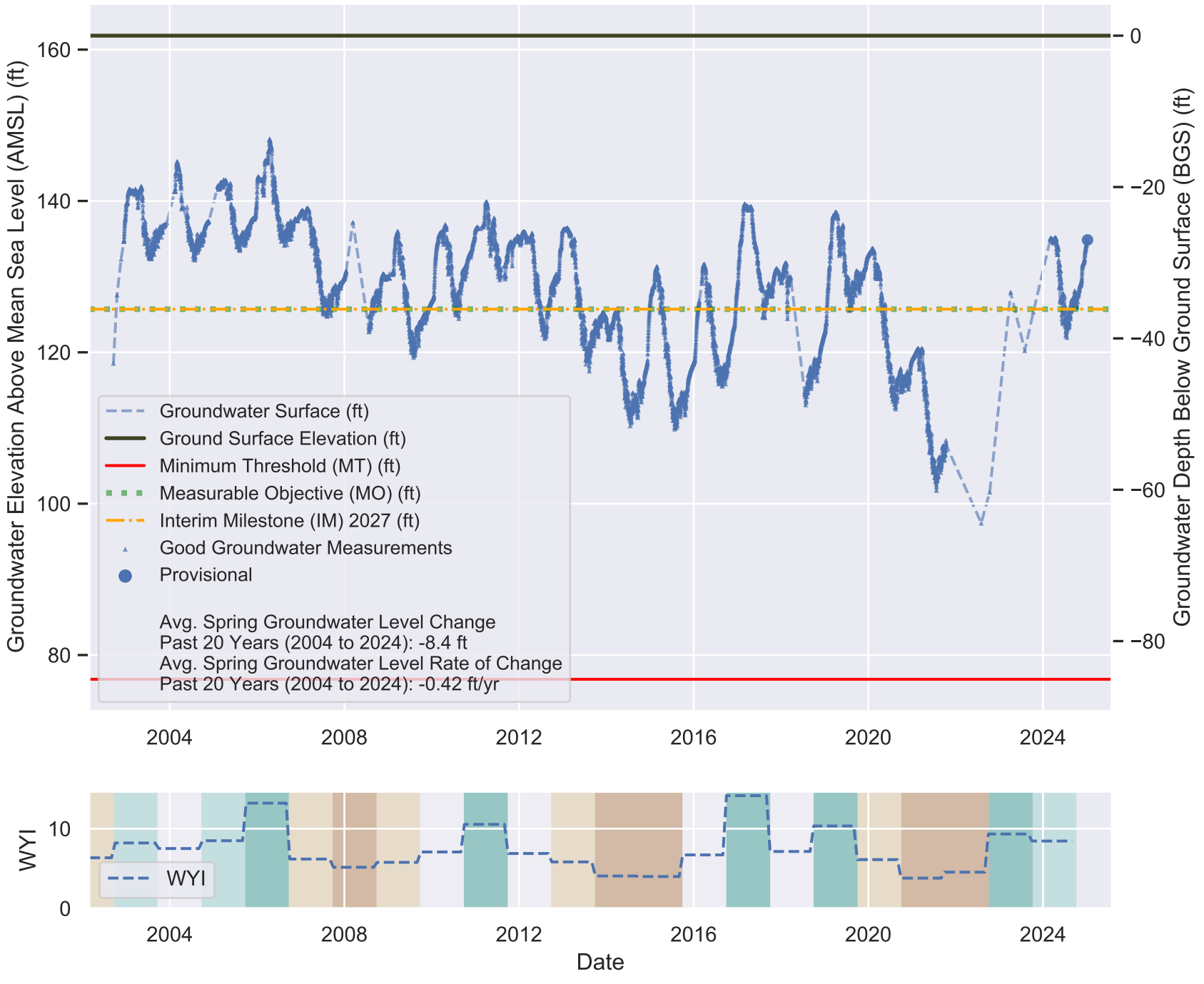
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 125.7 ft AMSL
MO = 125.7 ft AMSL
MT = 76.8 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

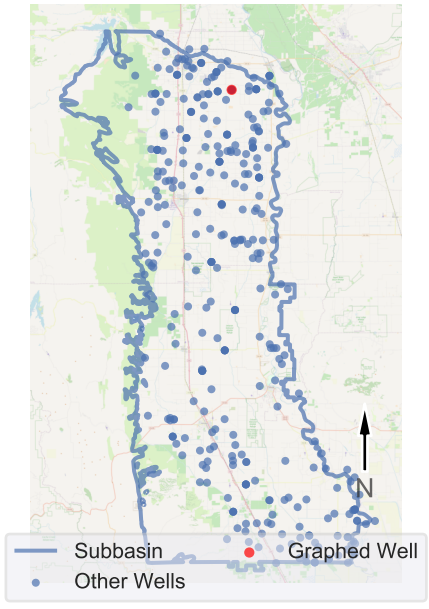
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 109.0 - 119.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N02W04G004M (Focus RMS Well)

Well Location Map



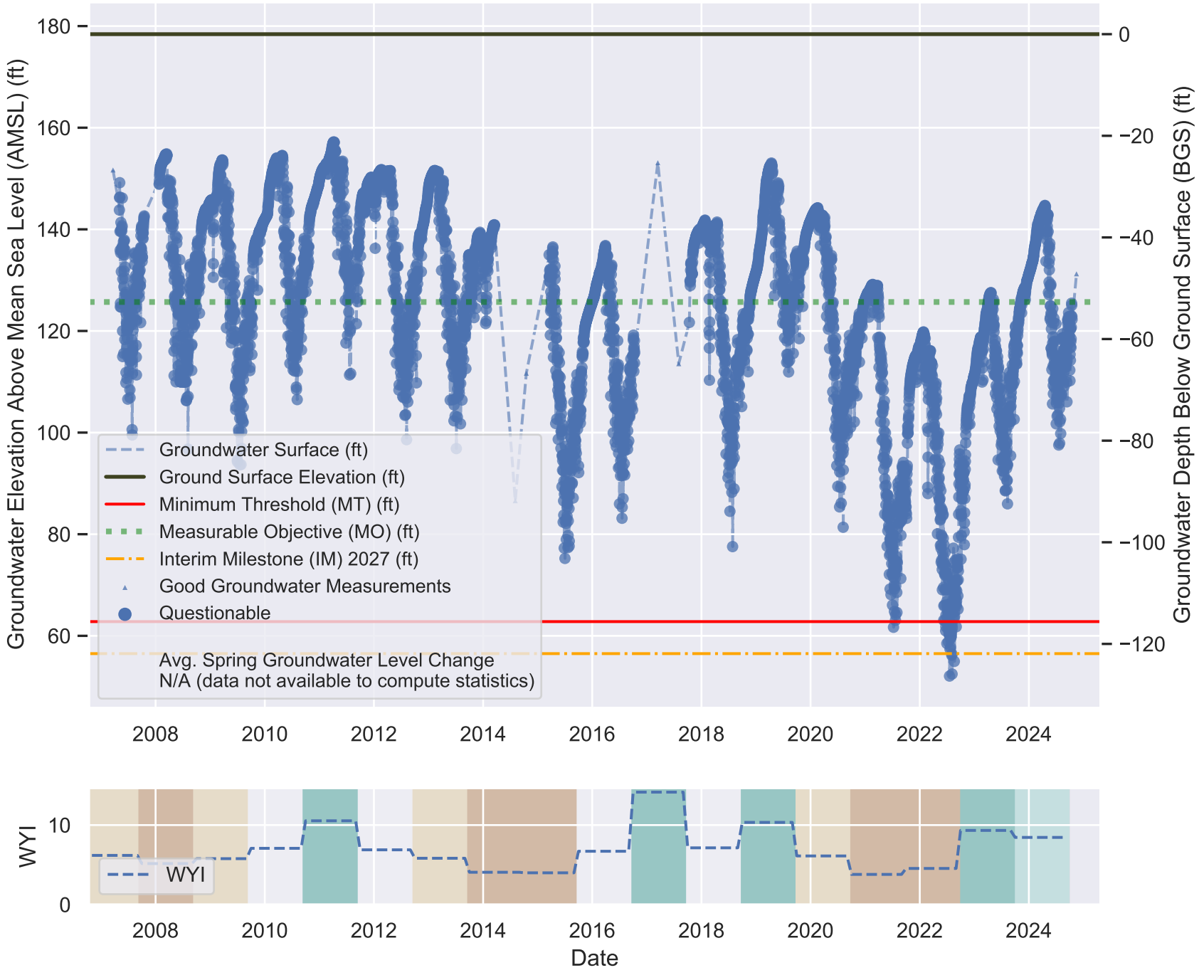
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 56.5 ft AMSL
MO = 125.7 ft AMSL
MT = 62.8 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

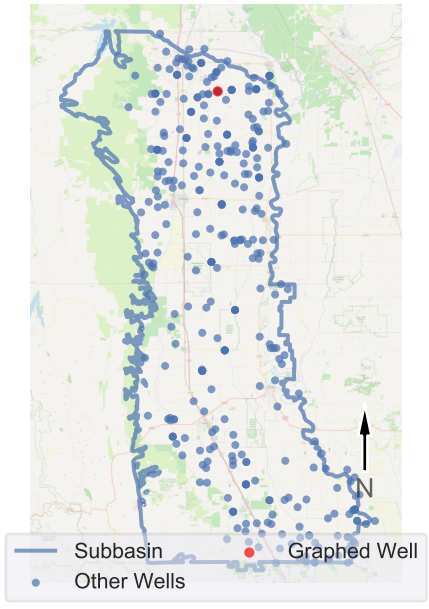
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 165.0 - 175.0; P2: 269.0 - 279.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N02W05M002M (Focus RMS Well)

Well Location Map



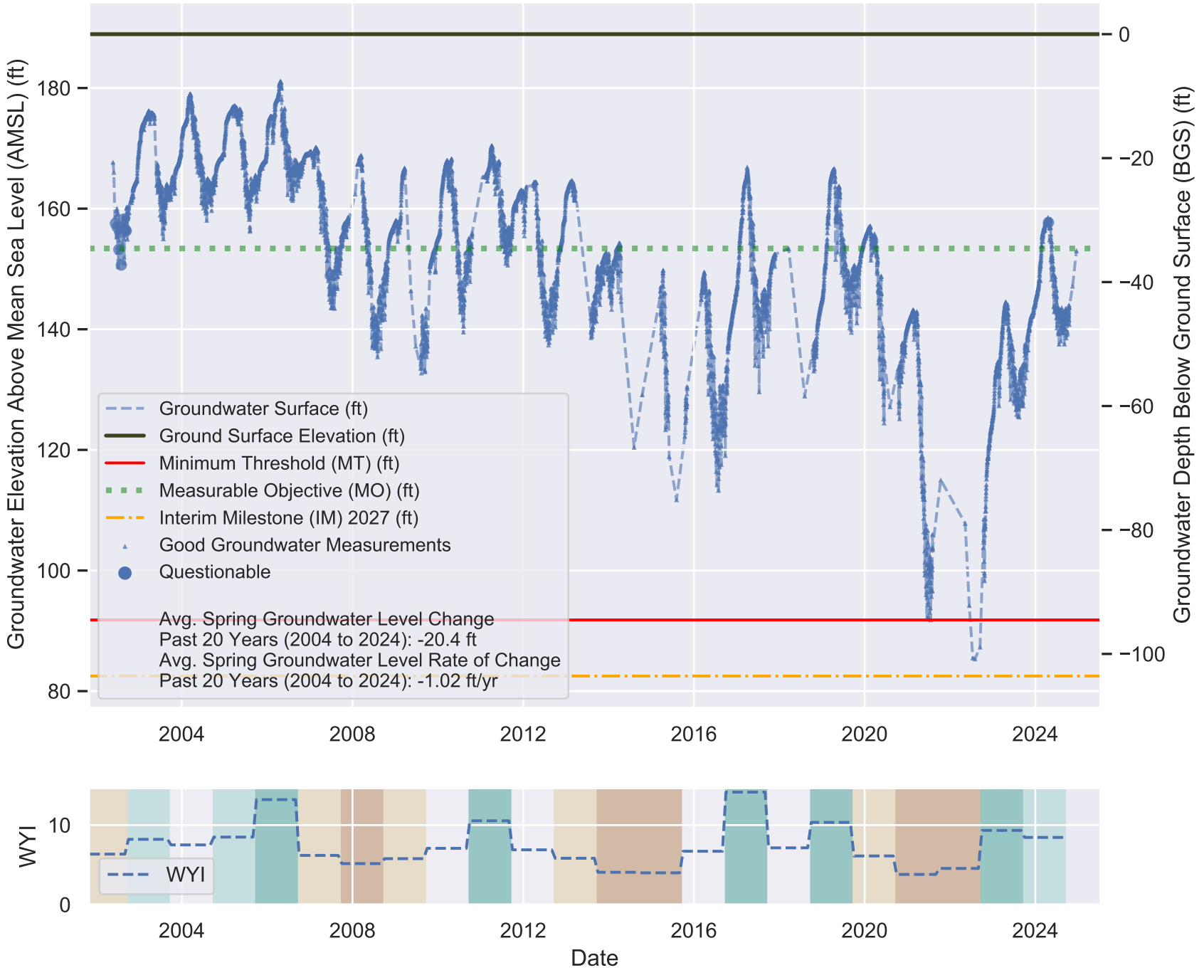
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 82.5 ft AMSL
MO = 153.4 ft AMSL
MT = 91.8 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

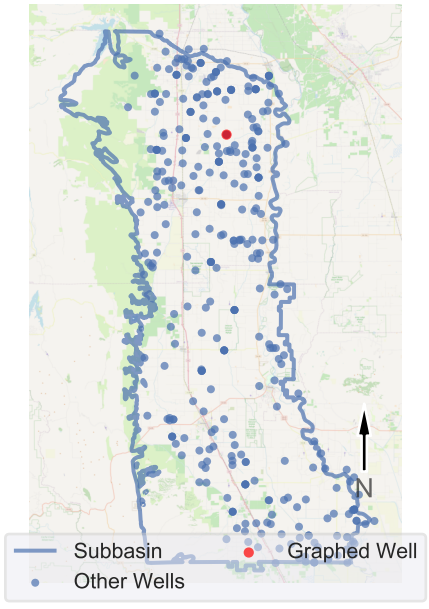
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 122.0 - 132.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N02W33M003M (Non-Focus RMS Well)

Well Location Map



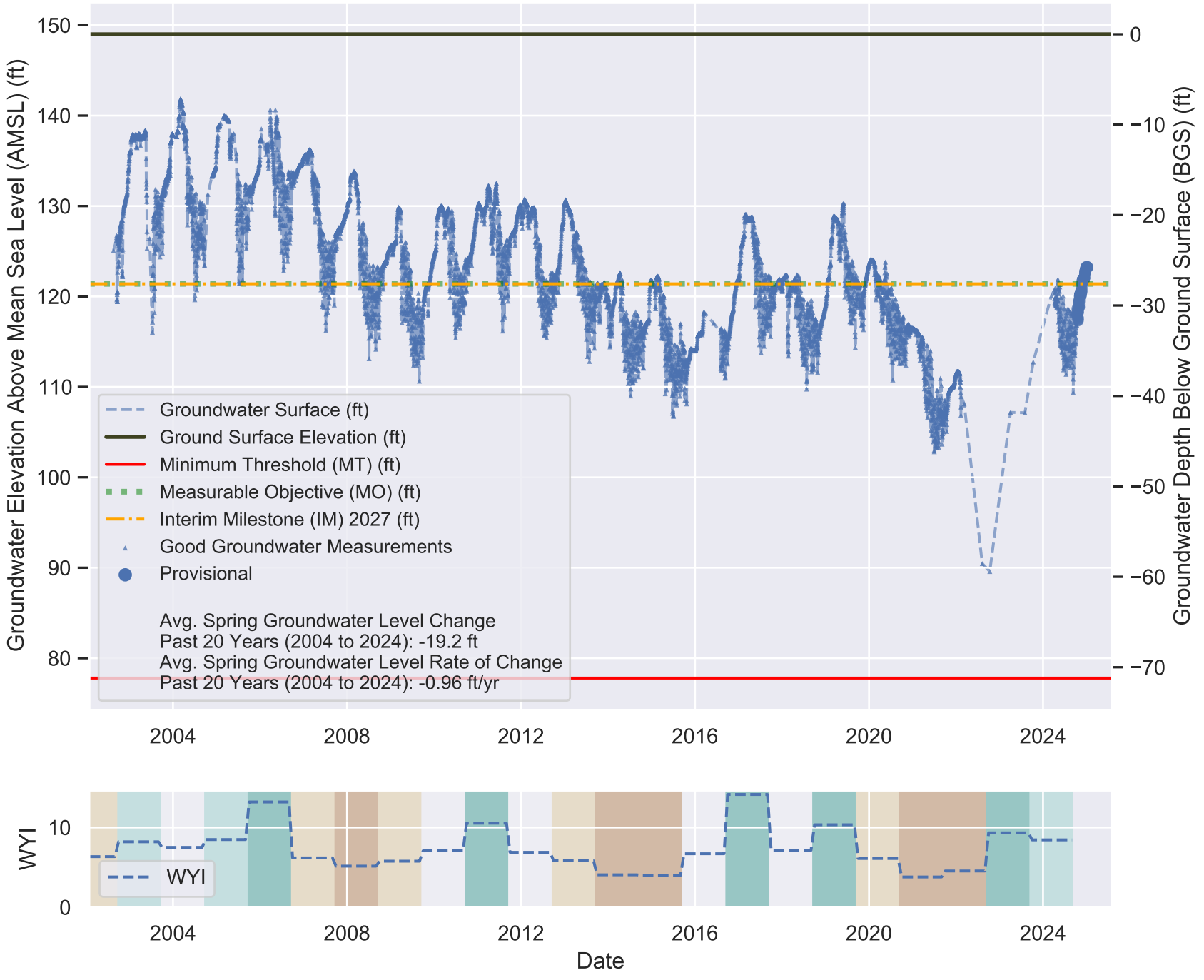
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 121.4 ft AMSL
MO = 121.4 ft AMSL
MT = 77.8 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (25.0 FT).

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

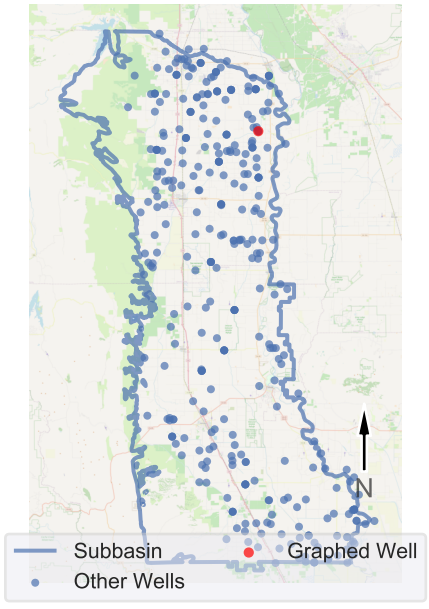
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 140.0 - 150.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N02W36A002M (Non-Focus RMS Well)

Well Location Map



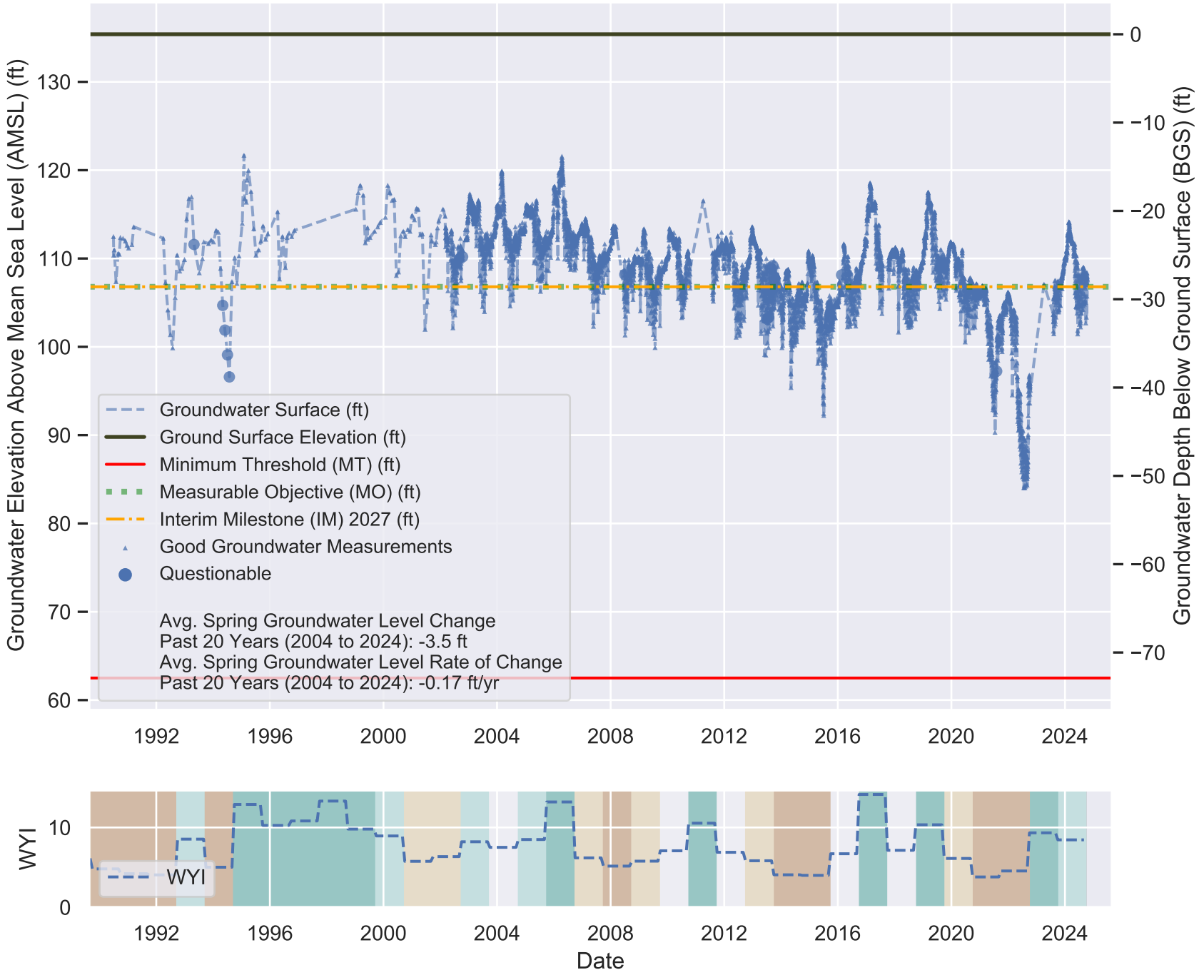
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 106.8 ft AMSL
MO = 106.8 ft AMSL
MT = 62.5 ft AMSL

Minimum Threshold is the 2020-2022 low minus a margin (21.6 FT).

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

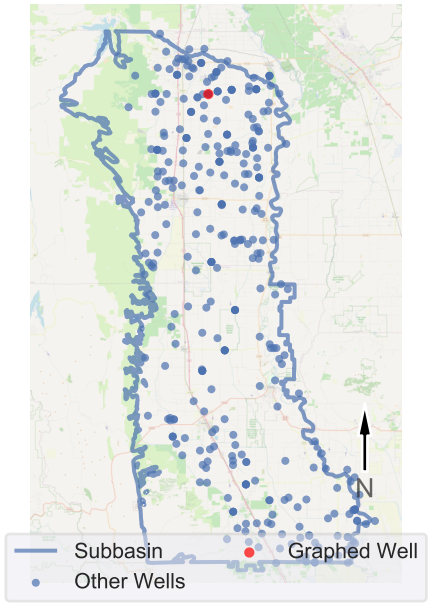
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 120.0 - 140.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N03W01R002M (Focus RMS Well)

Well Location Map



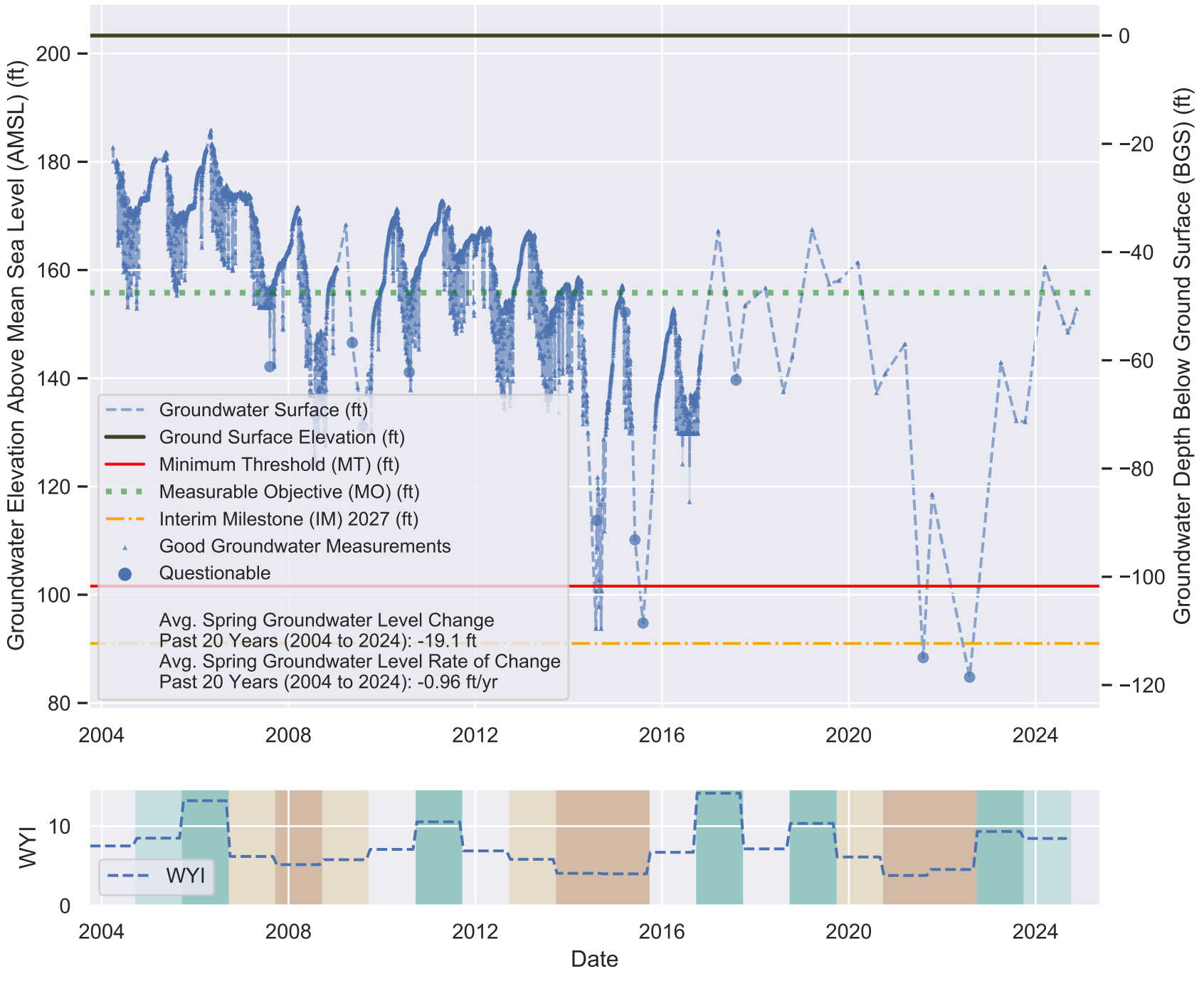
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 91.0 ft AMSL
MO = 155.8 ft AMSL
MT = 101.6 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

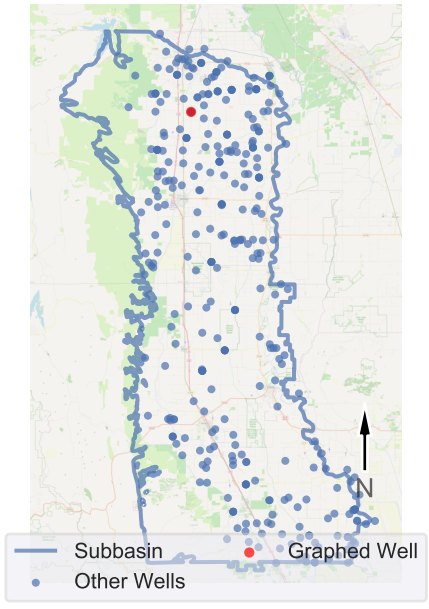
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 235.0 - 245.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N03W23D002M (Focus RMS Well)

Well Location Map



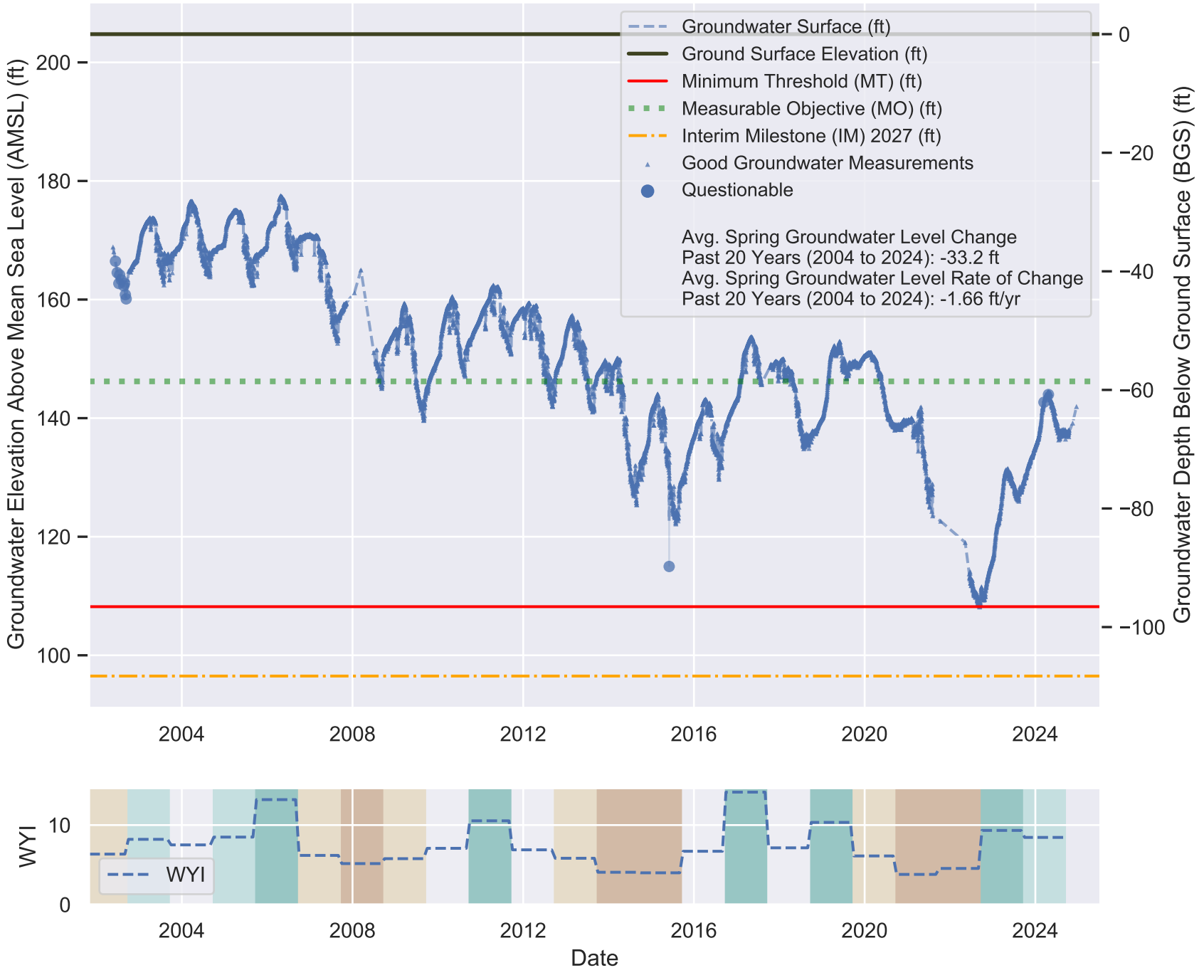
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 96.5 ft AMSL
MO = 146.2 ft AMSL
MT = 108.2 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

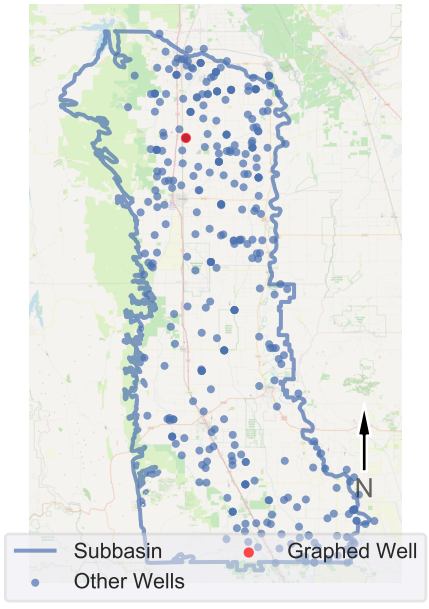
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 142.0 - 152.0; P2: 160.0 - 170.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N03W34Q004M (Focus RMS Well)

Well Location Map



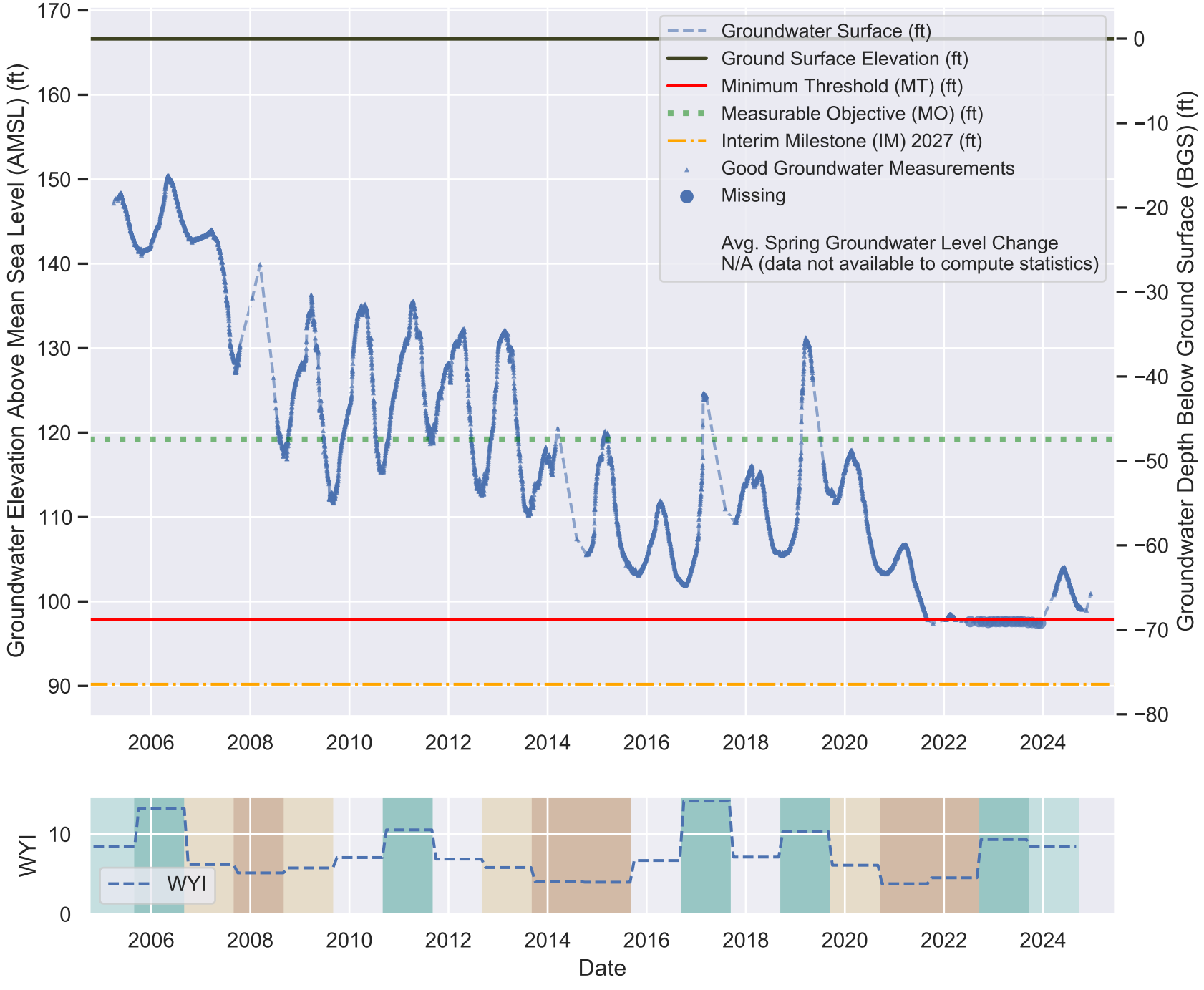
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 90.2 ft AMSL
MO = 119.2 ft AMSL
MT = 97.9 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

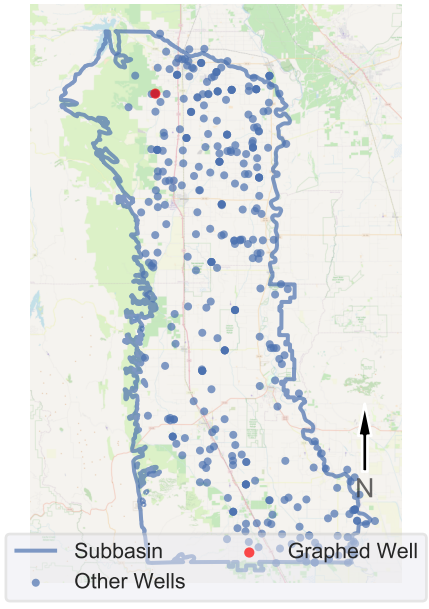
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 60.0 - 70.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 21N04W12A002M (Focus RMS Well)

Well Location Map



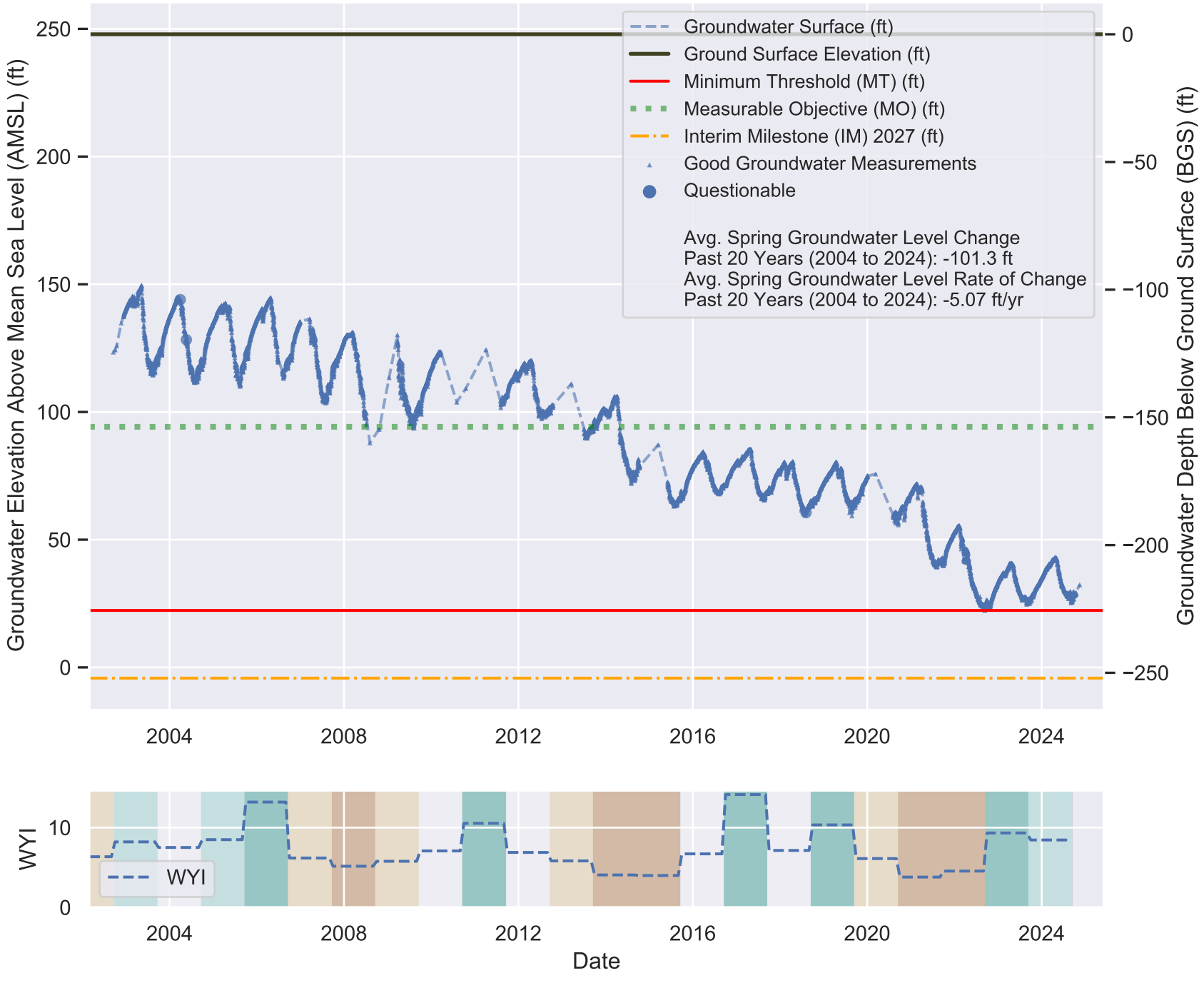
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = -4.2 ft AMSL
MO = 94.2 ft AMSL
MT = 22.3 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

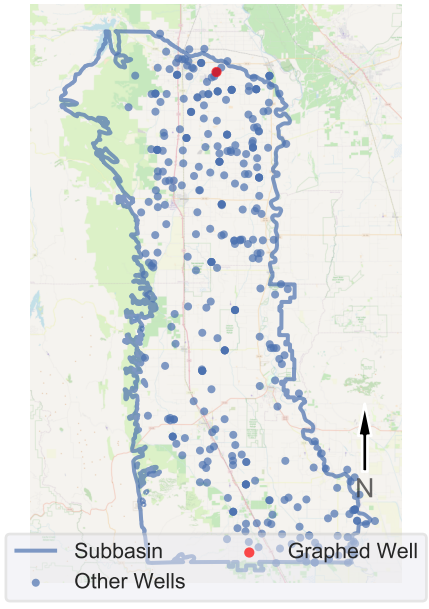
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 247.0 - 257.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 22N02W30H003M (Focus RMS Well)

Well Location Map



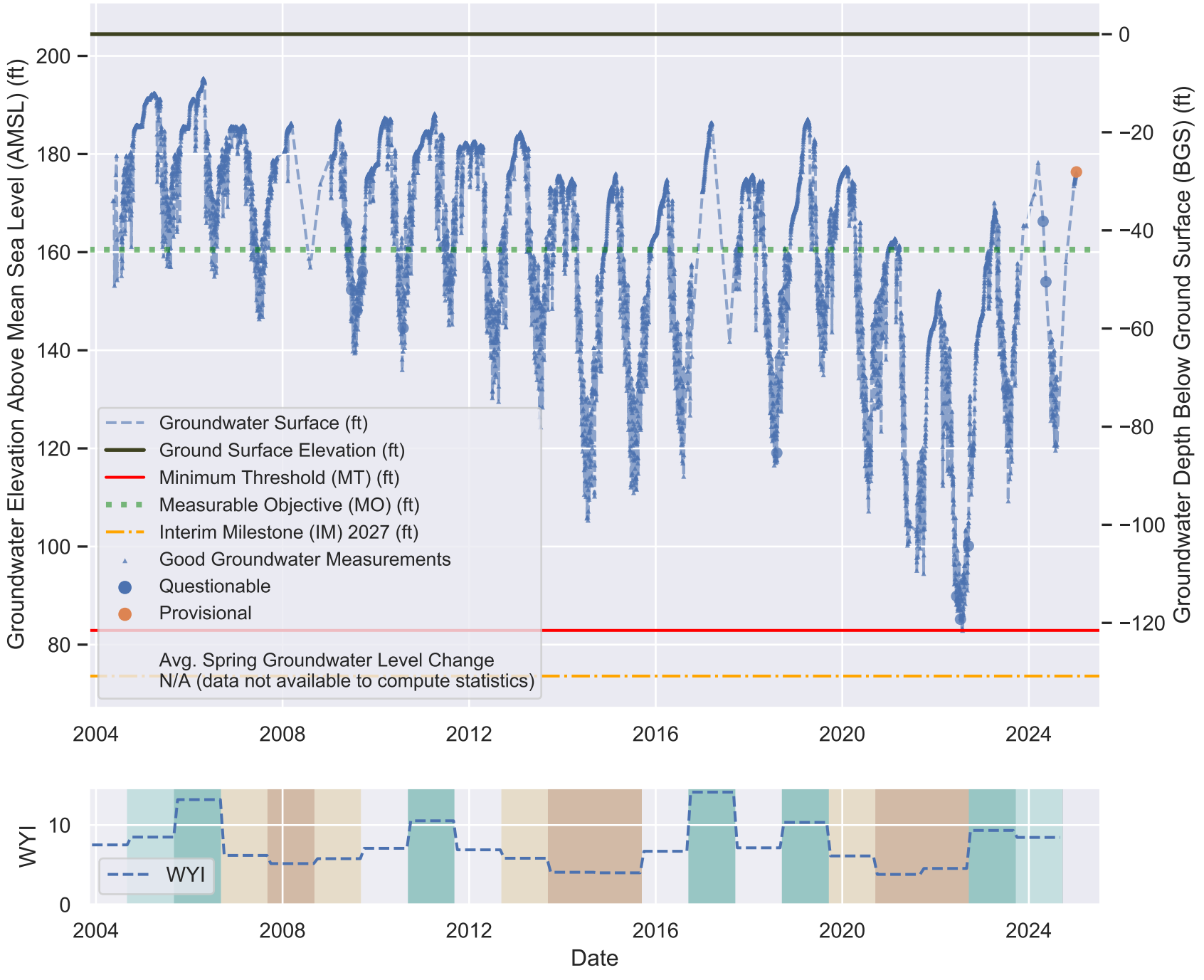
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 73.6 ft AMSL
MO = 160.5 ft AMSL
MT = 82.9 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

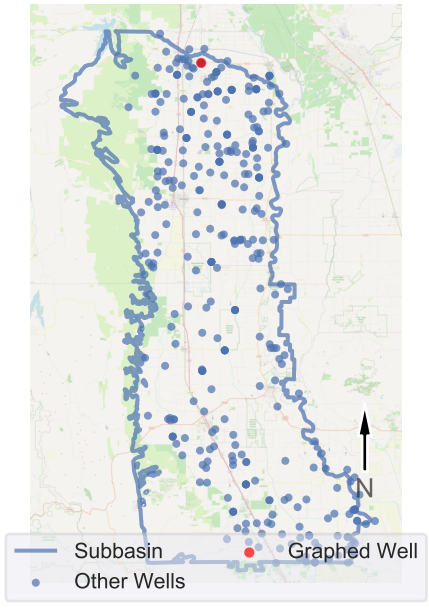
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 130.0 - 140.0; P2: 150.0 - 160.0; P3: 250.0 - 260.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 22N03W24E002M (Focus RMS Well)

Well Location Map



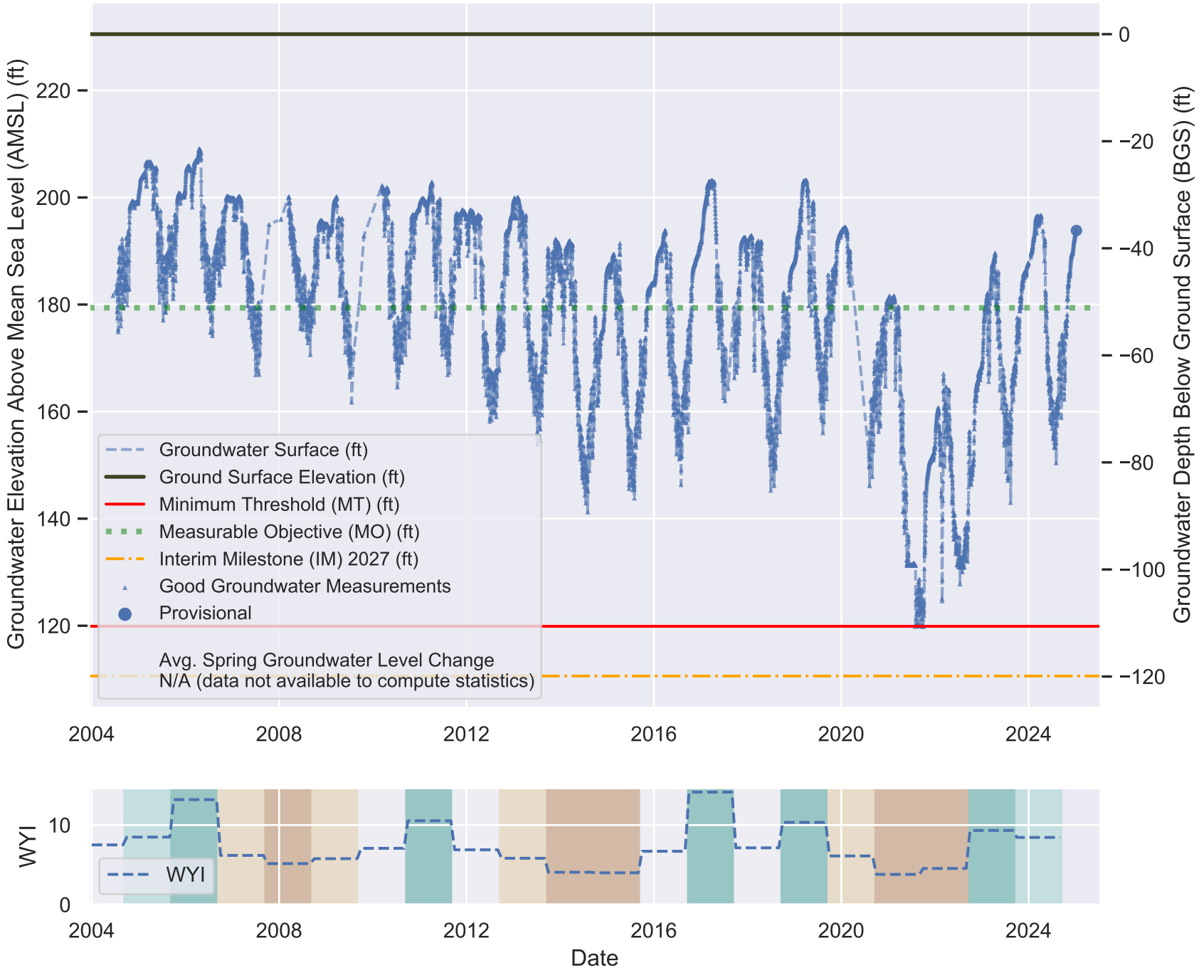
GSP Version: April 2024 Revised GSP
Sustainable Management Criteria:
IM (2027) = 110.6 ft AMSL
MO = 179.4 ft AMSL
MT = 119.9 ft AMSL

Minimum Threshold is the 2020-2022 low.

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

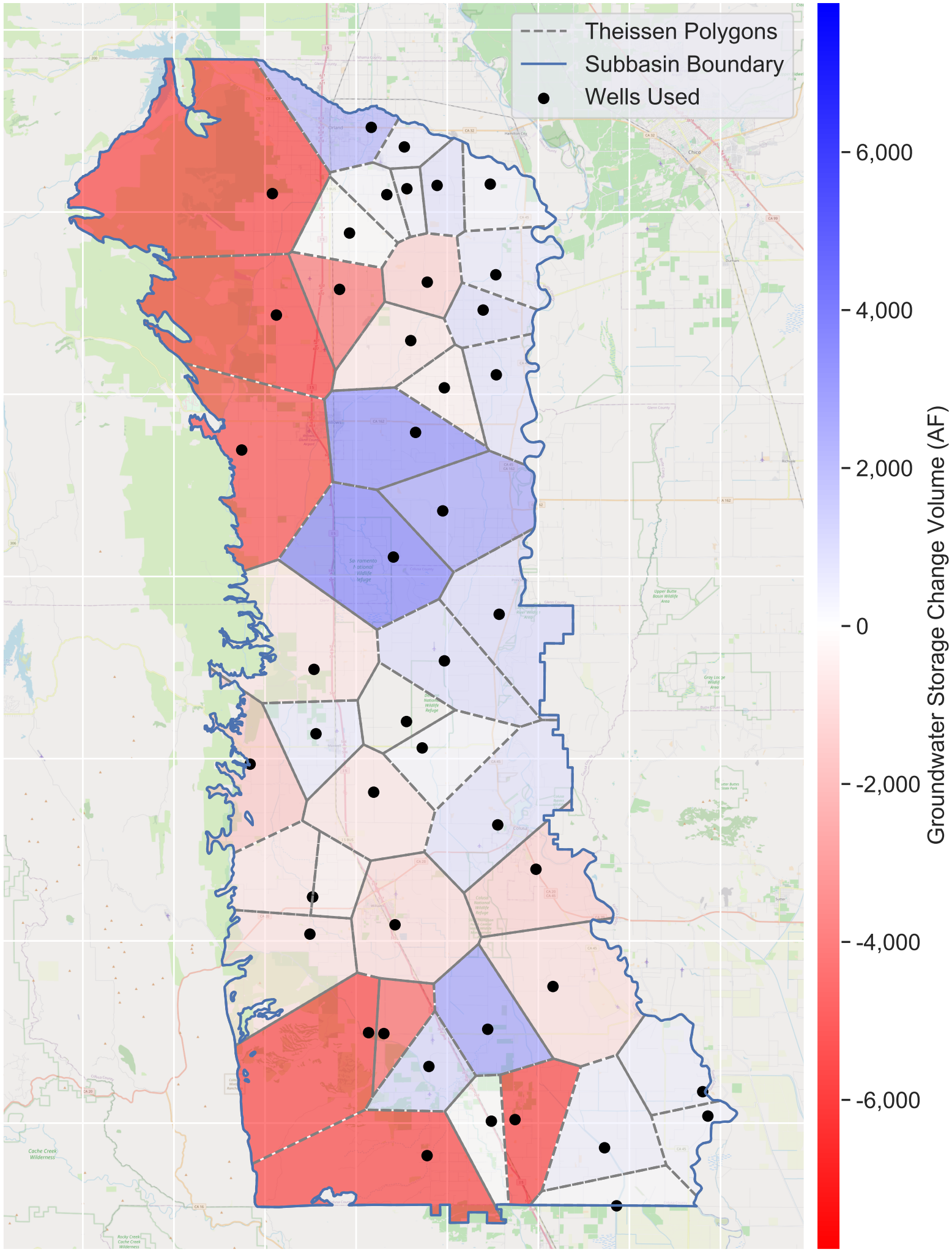
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 130.0 - 150.0; P2: 170.0 - 180.0 ft BGS

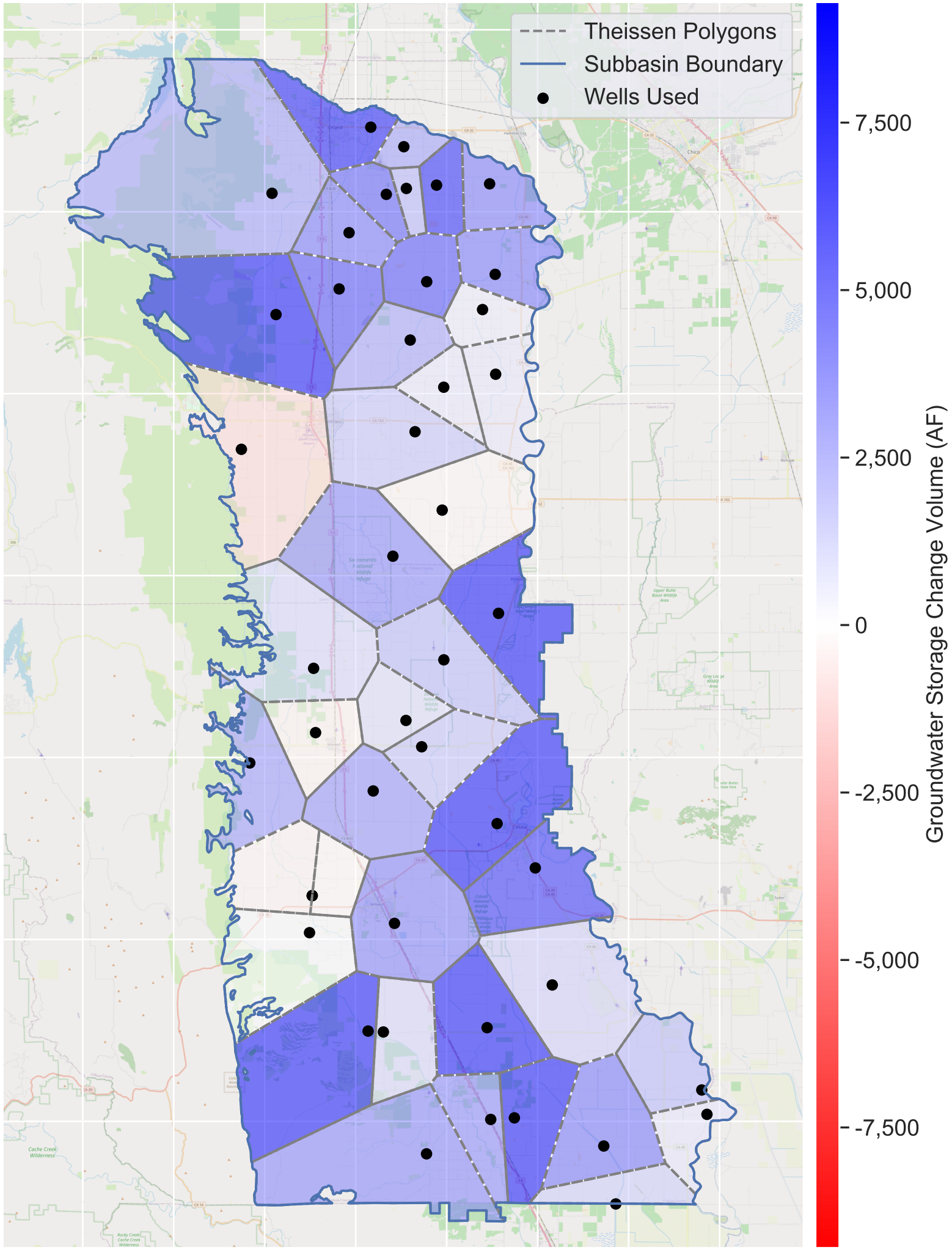


Appendix C. Maps of Annual Change in Groundwater Storage – Spring 2015-2016 through Spring 2023-2024.

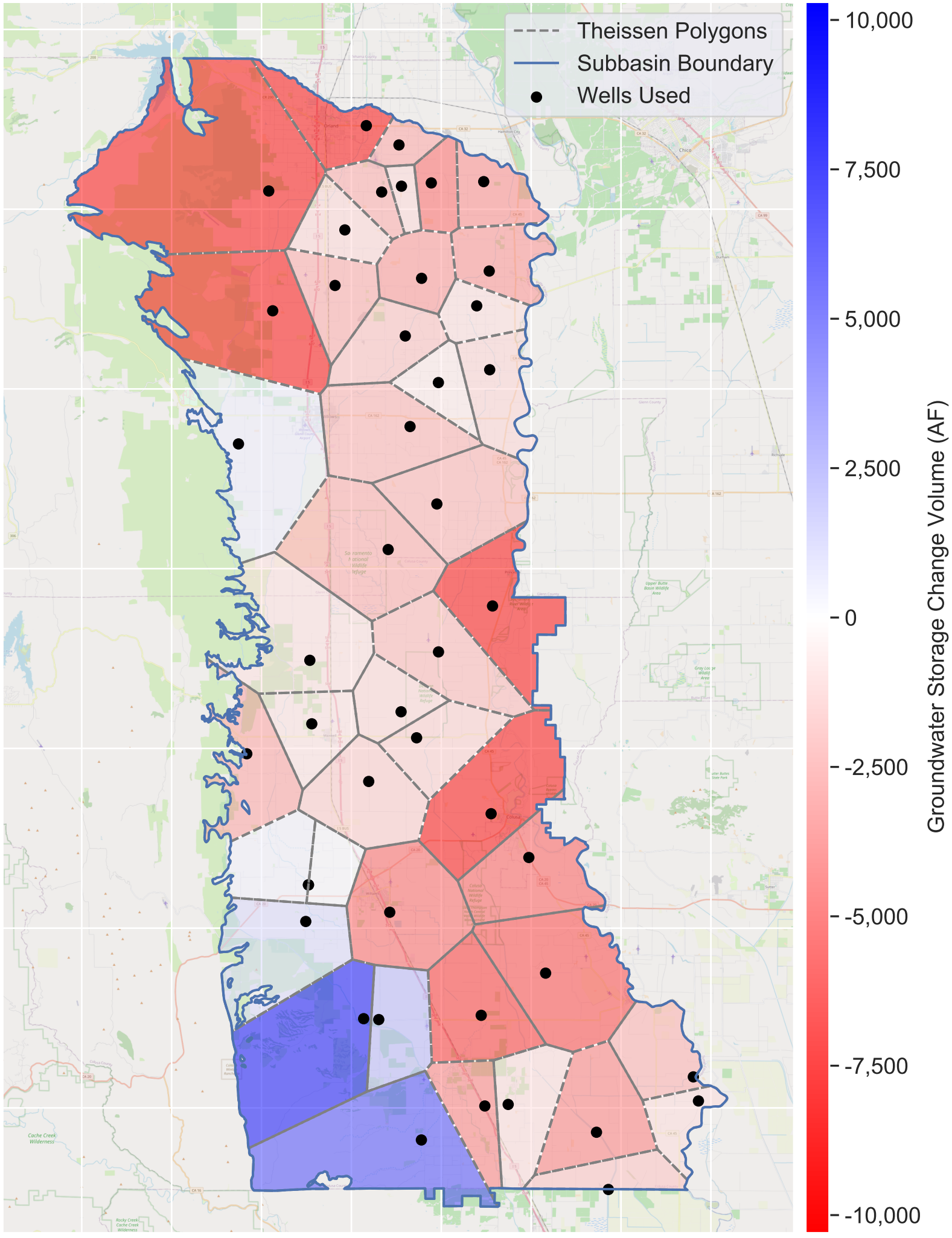
Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2016
Total Storage Change in Primary Aquifer = -106,040 AF; Number of Wells = 45



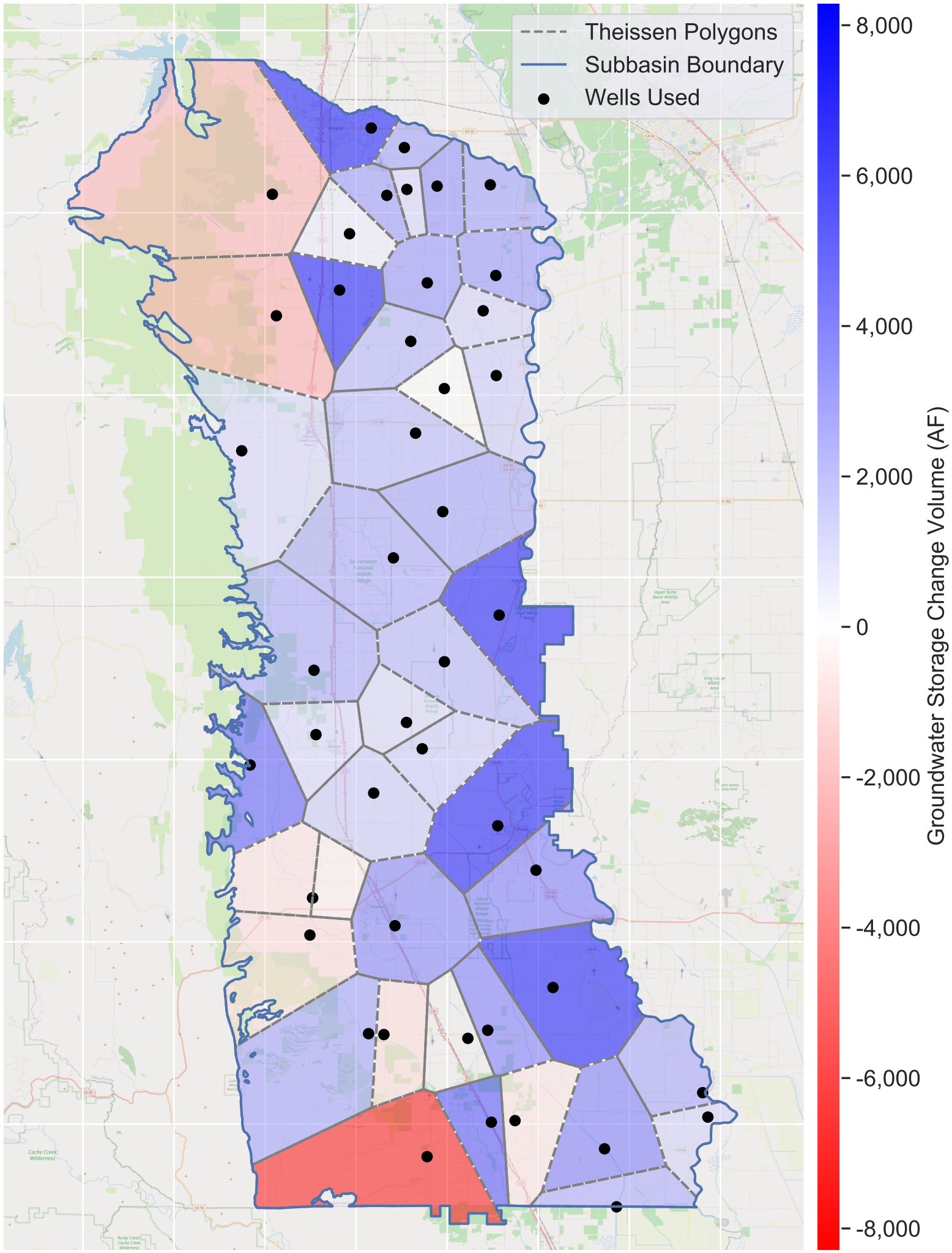
Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2017
Total Storage Change in Primary Aquifer = 258,610 AF; Number of Wells = 44



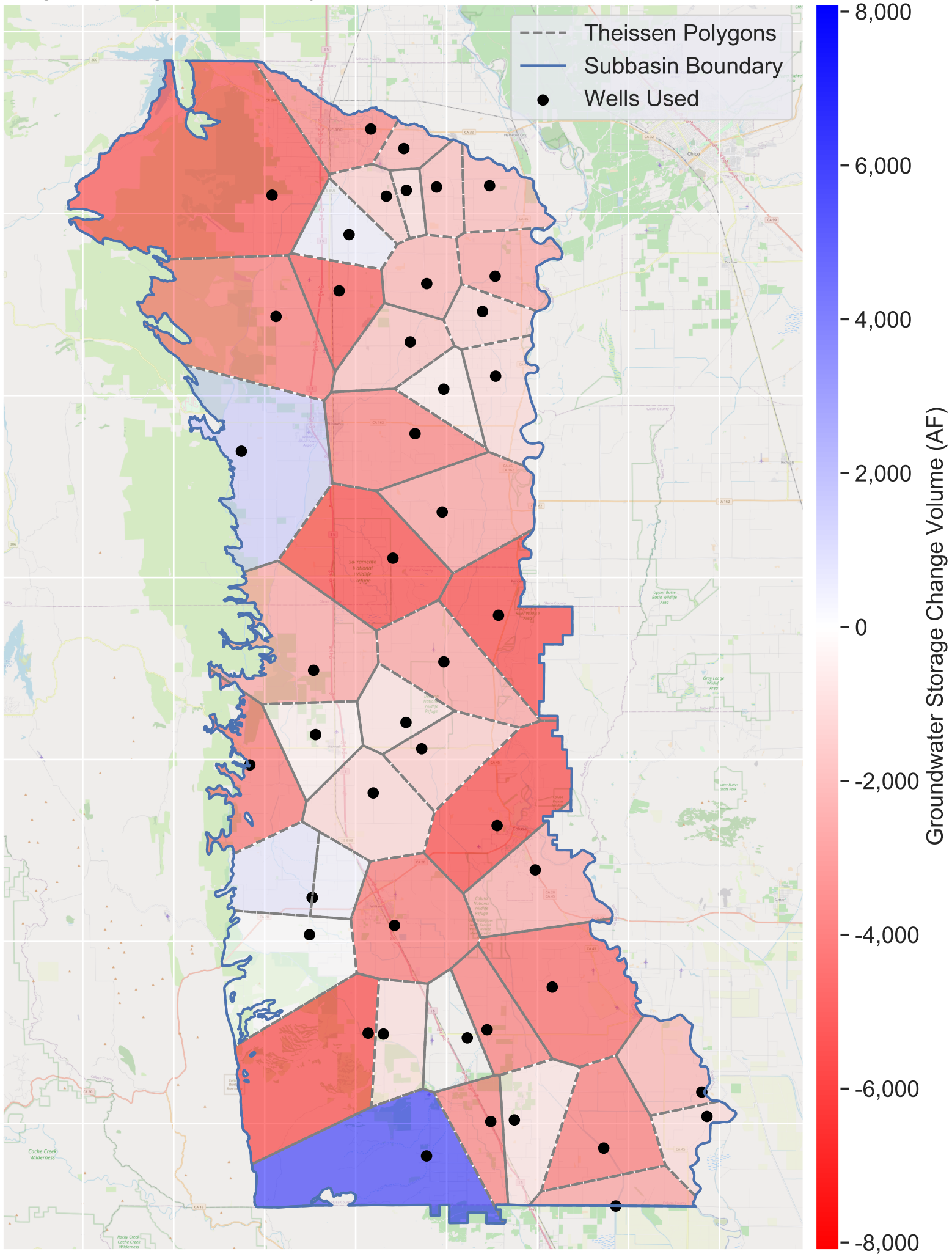
Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2018
Total Storage Change in Primary Aquifer = -148,750 AF; Number of Wells = 44



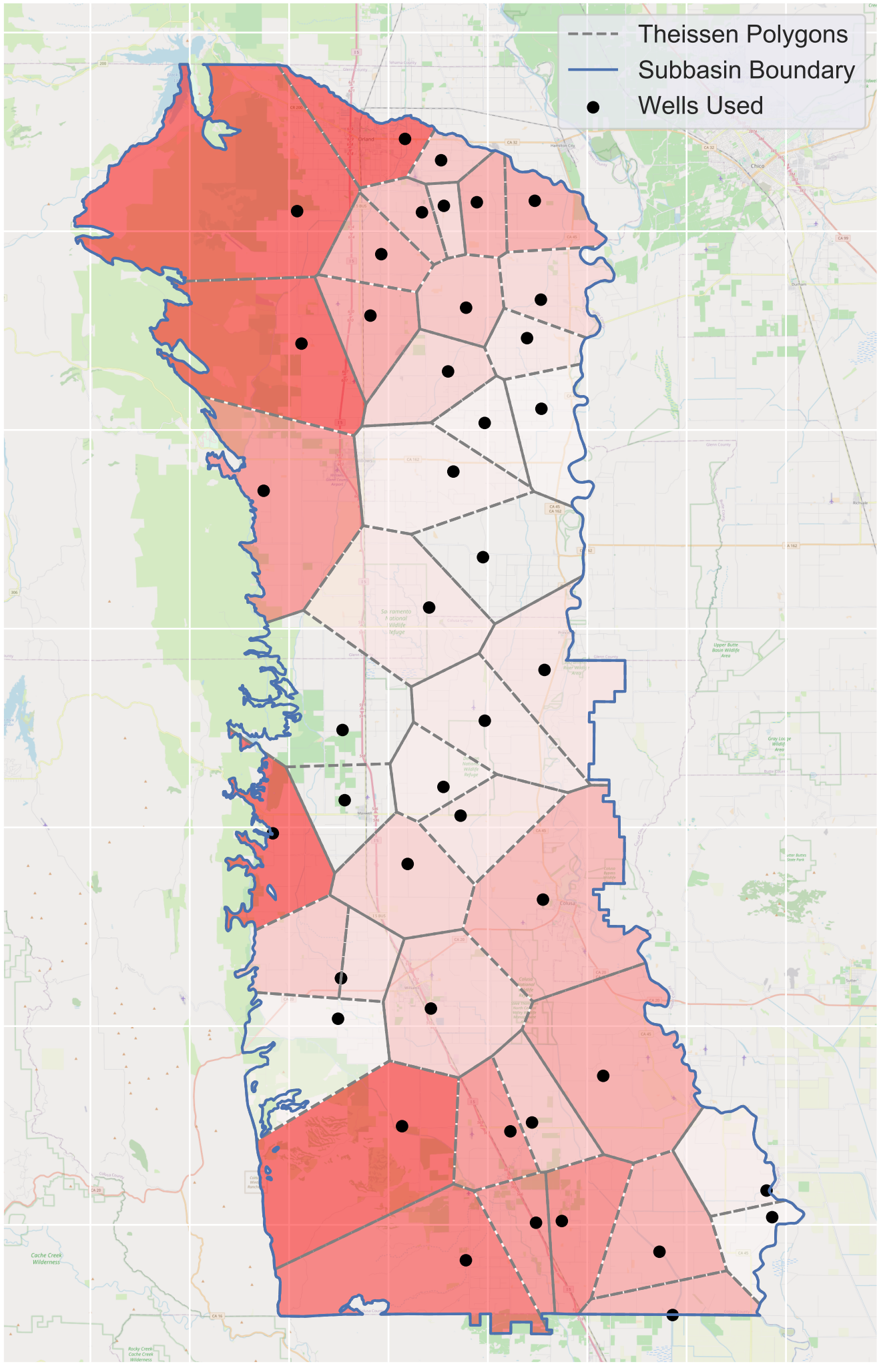
Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2019
Total Storage Change in Primary Aquifer = 119,150 AF; Number of Wells = 45



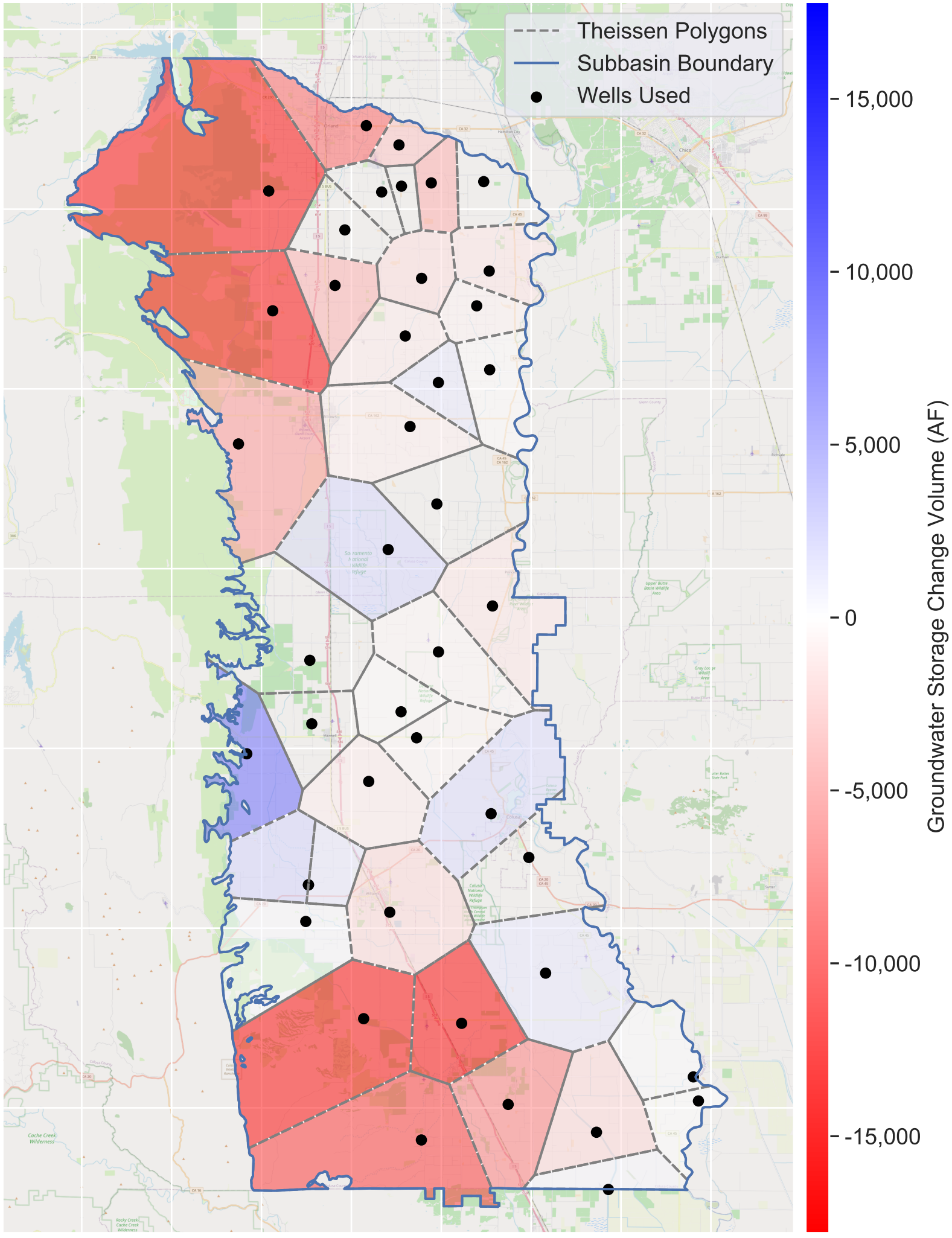
Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2020
Total Storage Change in Primary Aquifer = -195,520 AF; Number of Wells = 45



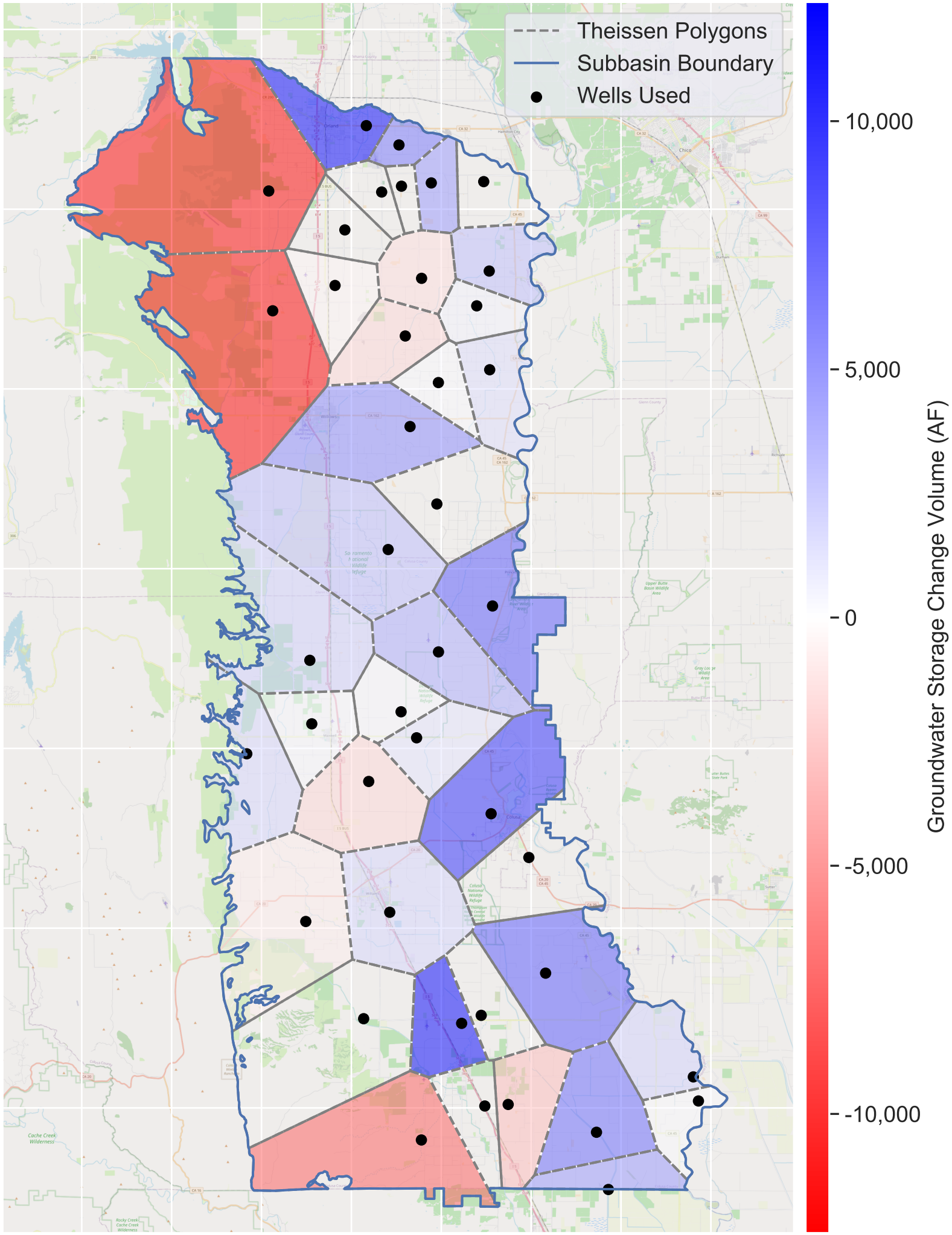
Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2021
Total Storage Change in Primary Aquifer = -268,380 AF; Number of Wells = 43



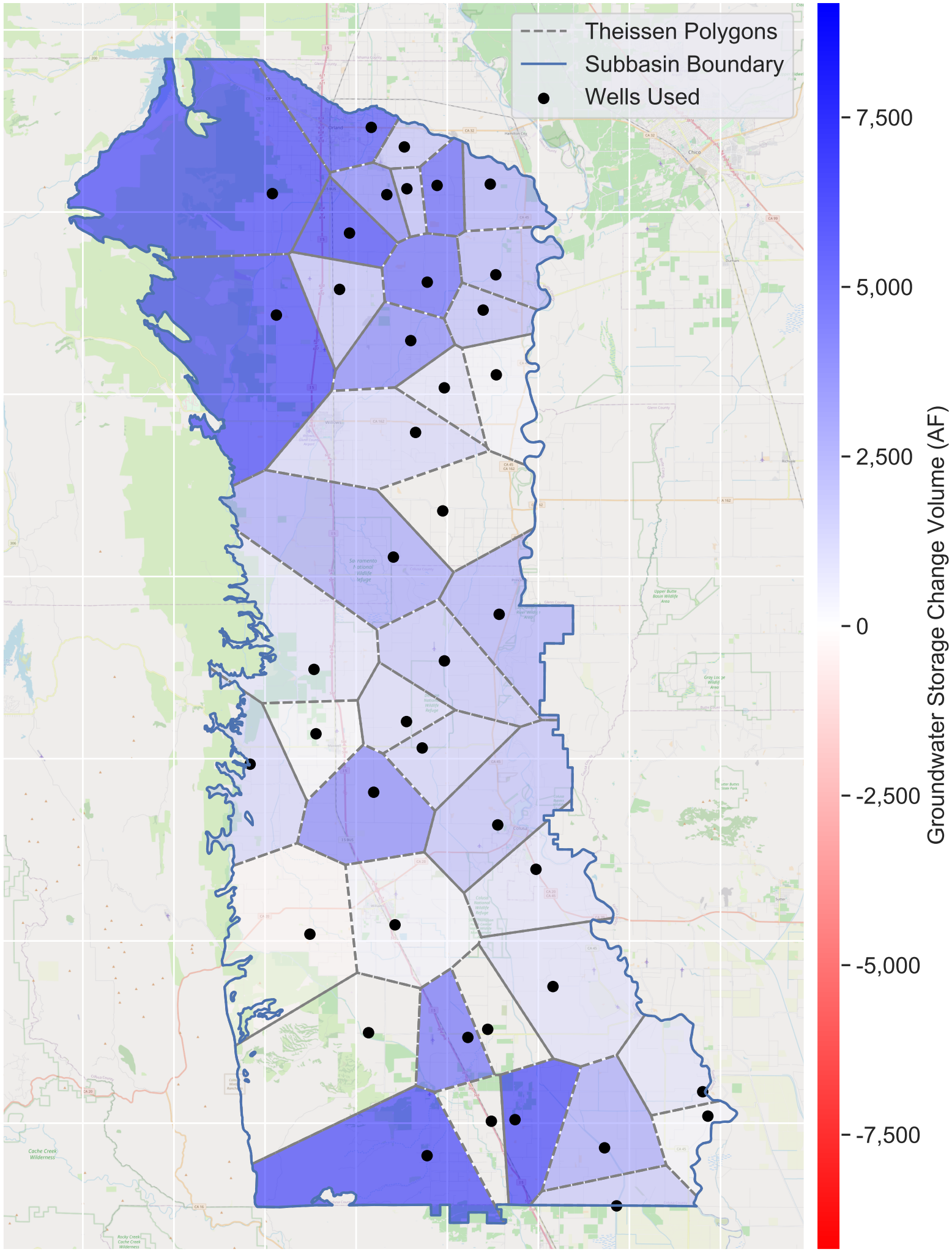
Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2022
Total Storage Change in Primary Aquifer = -203,840 AF; Number of Wells = 42



Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2023
Total Storage Change in Primary Aquifer = 19,510 AF; Number of Wells = 42



Subbasin = COLUSA Subbasin; Aquifer = Primary; Year = 2024
Total Storage Change in Primary Aquifer = 187,820 AF; Number of Wells = 42



Appendix D. Approach for Estimating Groundwater Extraction in the Colusa Subbasin GSP Annual Report.

TECHNICAL MEMORANDUM

To: Colusa Groundwater Authority and Glenn Groundwater Authority

From: Davids Engineering, Inc.

Date: March 3, 2025

Subject: **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 Colusa 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 Colusa Subbasin Annual Report (Annual Report), the approach used to estimate unmeasured groundwater extraction for the agricultural water use sector 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 C2VSimFG-Colusa groundwater model 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.

[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.

To calculate effective precipitation and, subsequently, evapotranspiration from precipitation (ETPR), PRISM precipitation data, estimated crop rooting depths, and soil property information are used as inputs. Estimated rooting depths are taken from the ranges listed in Appendix B of ASCE 70 (2016). For crops not listed in ASCE 70, rooting depths are based on the rooting depths of similar crops and professional judgement. Relevant soil properties include total soil depth, depth to restrictive layer, and available water holding capacity. Estimated soil properties are aggregated from the USDA soil survey geographic database (SSURGO) (Soil Survey Staff, 2025). ETPR is computed using the input parameters

(soil, precipitation, and rooting depth) and either the U.S. Bureau of Reclamation (USBR) method (Stamm, 1967) or the National Engineering Handbook Part 623 method (USDA, 1993), depending on local data availability, results, and conditions. For the USBR method, the effective precipitation bins have been modified from the original bins outlined in the USBR method documentation to match regional hydrology patterns..

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. Where field-scale delivery measurements are available, the water supply volume delivered was distributed evenly across all irrigated areas of that field. Where field-scale delivery measurements are not available and only diversion volumes or aggregated delivery volumes for a larger area are available, water supply data is distributed evenly over the area where that water can be delivered for irrigation (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. At the most detailed possible level, these include field-scale volumetric delivery measurements taken by Water or Irrigation District water operators, as required per the Water Conservation Act of 2009.

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

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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.

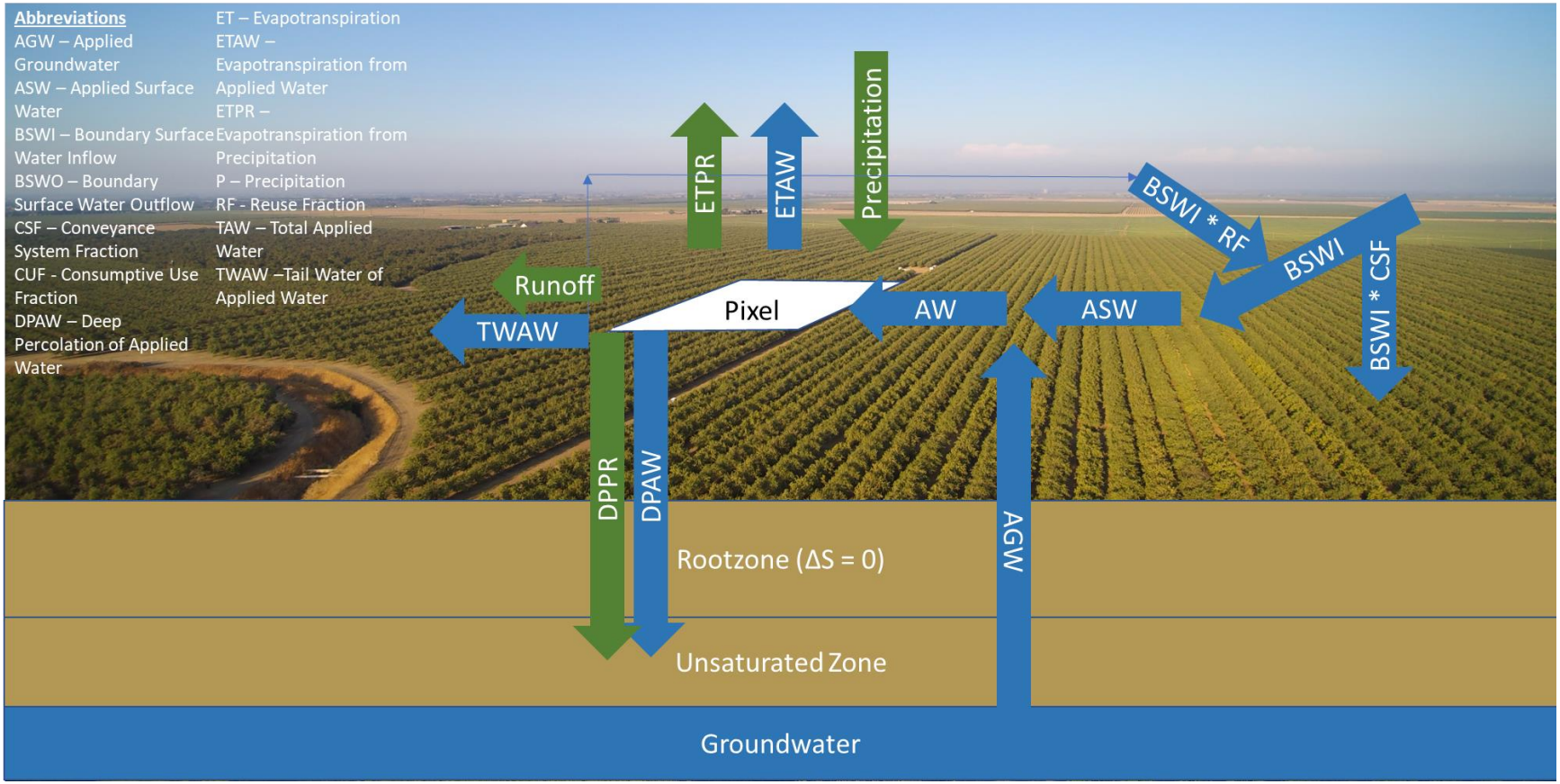

Figure A-1. Inflows and Outflows to Each 30 m x 30 m Pixel in the GEEEO Process.

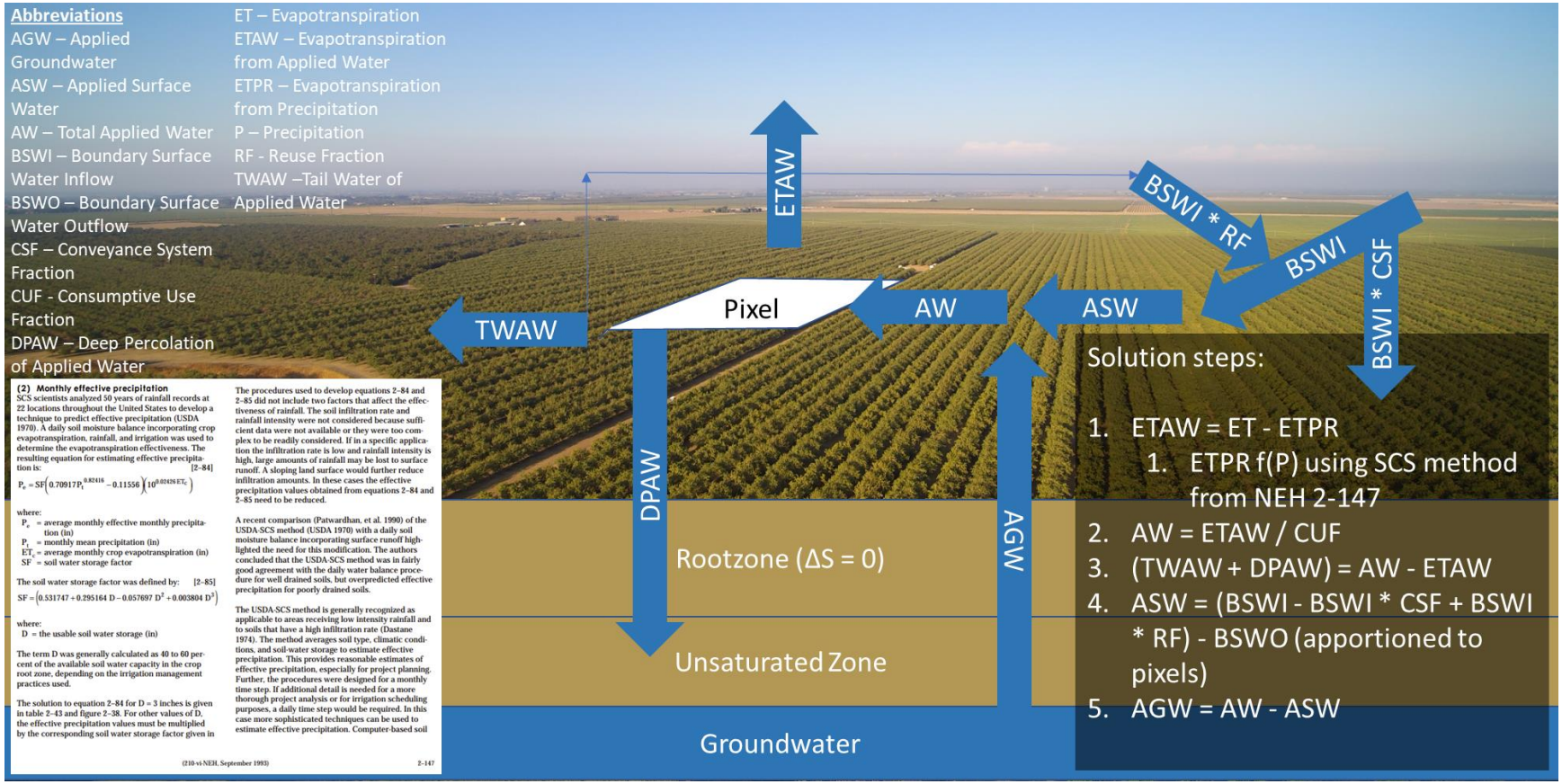

Figure A-2. Solution Steps for Calculating Applied Groundwater (AGW) in Each 30 m x 30 m Pixel in the GEEEO Process.

Appendix E. Approved Determination of the 2024 Groundwater Sustainability Plan Submitted for the Sacramento Valley – Colusa Subbasin.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE
715 P Street, 8th Floor | Sacramento, CA 95814 | P.O. Box 942836 | Sacramento, CA 94236-0001

February 27, 2025

Lisa Hunter
County of Glenn Groundwater Sustainability Agency
225 North Tehama Street
Willows, CA 95988
lhunter@countyofglenn.net

RE: Approved Determination of the 2024 Groundwater Sustainability Plan Submitted for the Sacramento Valley – Colusa Subbasin

Dear Lisa Hunter,

The Department of Water Resources (Department) has evaluated the 2024 groundwater sustainability plan (GSP or Plan) for the Sacramento Valley – Colusa Subbasin in response to the Department's Incomplete Determination on October 26, 2023, and has determined the GSP is approved. The approval is based on recommendations from the Staff Report, included as an exhibit to the attached Statement of Findings, which describes that the Sacramento Valley – Colusa Subbasin GSP has taken sufficient action to correct deficiencies identified by the Department, satisfies the objectives of the Sustainable Groundwater Management Act (SGMA), and substantially complies with the GSP Regulations. The Staff Report also proposes recommended corrective actions that the Department believes will enhance the GSP and facilitate future evaluation by the Department. The Department strongly encourages the recommended corrective actions be given due consideration and suggests incorporating all resulting changes to the GSP in future updates.

Recognizing SGMA sets a long-term horizon for groundwater sustainability agencies (GSAs) to achieve their basin sustainability goals, monitoring progress is fundamental for successful implementation. GSAs are required to evaluate their GSPs at least every five years and whenever the Plan is amended, and to provide a written assessment to the Department. Accordingly, the Department will evaluate approved GSPs and issue an assessment at least every five years. The GSAs are required to submit their periodic evaluation of the Sacramento Valley – Colusa Subbasin GSP no later than January 28, 2027.

Please contact Sustainable Groundwater Management staff by emailing sgmps@water.ca.gov if you have any questions related to the Department's assessment or implementation of your GSP.

Thank You,

Paul Gosselin

Paul Gosselin
Deputy Director
Sustainable Groundwater Management

Attachment:

1. Statement of Findings Regarding the Determination of Approval of the Sacramento Valley – Colusa Subbasin 2024 Groundwater Sustainability Plan

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

STATEMENT OF FINDINGS REGARDING THE APPROVAL OF THE SACRAMENTO VALLEY – COLUSA SUBBASIN 2024 GROUNDWATER SUSTAINABILITY PLAN

Under the Sustainable Groundwater Management Act (SGMA or Act), the Department of Water Resources (Department) is required to evaluate whether a submitted groundwater sustainability plan (GSP or Plan) conforms to specific requirements of the SGMA, is likely to achieve the sustainability goal for the basin covered by the Plan, and whether the Plan adversely affects the ability of an adjacent basin to implement its GSP or impedes achievement of sustainability goals in an adjacent basin.[1] The Department is directed to issue an assessment of the Plan within two years of its submission.[2] If a Plan is determined to be Incomplete, the Department must identify deficiencies that preclude approval of the Plan and identify corrective actions required to make the Plan substantially compliant with SGMA and the GSP Regulations. The Groundwater Sustainability Agency (GSA or Agency) has up to 180 days from the date the Department issues its assessment to make the necessary corrections and submit a revised Plan.[3] When evaluating a revised GSP that was determined to be incomplete, the Department reviews the materials provided by the GSA (e.g., revised or amended GSP) to address the deficiencies by the submission deadline. Part of the Department's review focuses on how the Agency addressed the deficiencies that precluded approval of the Plan. The Department shall find a Plan previously determined to be incomplete to be either:

1. Approved, if the Department determines the Agency has sufficiently addressed those deficiencies, the Department may evaluate other components of the Plan, particularly to assess whether and, if so, how revisions to address deficiencies may have affected other components of a Plan or its likelihood of achieving sustainable groundwater management.

2. Inadequate if, after consultation with the State Water Resources Control Board, the Agency has not taken sufficient action to correct the deficiencies previously identified by the Department.

This Statement of Findings explains the Department's determination regarding the revised Plan for the Sacramento Valley – Colusa Subbasin (Basin No. 5-021-52) by the

[1] Water Code § 10733.
[2] Water Code § 10733.4.
[3] 23 CCR § 355.2(e)(2).

Colusa Groundwater Authority GSA and Glenn Groundwater Authority GSA (GSAs or Agencies) submitted on April 22, 2024 (referred to as the 2024 GSP or 2024 Plan).

Department management have discussed the 2024 Plan with Department staff and have reviewed the written assessment titled Sustainable Groundwater Management Program Assessment of Incomplete Groundwater Sustainability Plan 2025 Staff Report (Staff Report), attached as Exhibit A, which recommends approval of the 2024 GSP. Department management are satisfied that staff have conducted a thorough evaluation and assessment of the 2024 Plan and concur with staff's recommendations and all the recommended corrective actions. The Department therefore **APPROVES** the 2024 Plan and makes the following findings:

A. On January 28, 2022, the GSAs submitted a GSP (referred to as the 2022 GSP or 2022 Plan) for the Department's evaluation.

B. On October 26, 2023, the Department issued a Staff Report (referred to as the 2023 Incomplete Determination) and Findings determining the 2022 GSP to be incomplete, because the 2022 GSP did not satisfy the requirements of SGMA, nor did it substantially comply with the GSP Regulations. The Department's 2023 Incomplete Determination identified the following deficiencies that precluded approval and provided the GSAs with corrective actions that were intended to address the deficiencies.

    1. Deficiency 1: The 2022 GSP did not include a reasonable assessment of overdraft conditions and reasonable means to mitigate overdraft.

    2. Deficiency 2: The 2022 GSP did not establish sustainable management criteria for chronic lowering of groundwater levels in a manner substantially compliant with the GPS Regulations.

    3. Deficiency 3: The 2022 GSP did not establish sustainable management criteria for land subsidence in a manner substantially compliant with the GSP Regulations.

    The Department provided the Agencies with 180 days to address the deficiencies.[4]

C. On April 22, 2024, the GSAs submitted a revised Plan (the 2024 GSP) to the Department. After staff's thorough evaluation of the 2024 Plan, the Department finds:

    1. The Agencies have taken sufficient actions to correct Deficiency 1, such that, at this time, the Department no longer finds this deficiency to preclude approval. The 2024 GSP includes an improved assessment of the amount

[4] 23 CCR § 355.2(e)(2).

of overdraft that more accurately reflects conditions experienced in the Subbasin and revised their suite of projects to provide a feasible means to mitigate the identified overdraft. The 2024 GSP also includes additional details on the demand management program to mitigate the overdraft and provides a Resolution to show commitment to implementing the program.

2. The Agencies have taken sufficient actions to correct Deficiency 2, such that, at this time, the Department no longer finds this deficiency to preclude approval. The 2024 GSP has sufficiently identified the impacts to beneficial uses and users that would occur at an undesirable condition through a well impacts analysis and has provided management criteria to identify the undesirable conditions that reflect the identified impacts. The 2024 GSP also includes additional details on the well mitigation program to assist well owners that may be impacted and provides a Resolution to show commitment to implementing the program.

3. The Agencies have taken sufficient action to correct Deficiency 3, such that, at this time, the Department no longer finds this deficiency to preclude approval. The 2024 GSP has selected sufficient subsidence monitoring and has established sustainable management criteria that are well explained and justified through the best available data and science and considers beneficial uses and users.

The 2024 Plan satisfies the required conditions as outlined in § 355.4(a) of the GSP Regulations[5]:

1. The Plan was complete, meaning it generally appeared to include the information required by the Act and the GSP Regulations sufficient to warrant a thorough evaluation and issuance of an assessment by the Department.[6]

2. The Plan, either on its own or in coordination with other Plans, appears to cover the entire Basin sufficient to warrant a thorough evaluation.[7]

D. The general standards the Department applied in its evaluation and assessment of the Plan are: (1) “conformance” with the specified statutory requirements, (2) “substantial compliance” with the GSP Regulations, (3) whether the Plan is likely to achieve the sustainability goal for the Subbasin within 20 years of the implementation of the Plan, and (4) whether the Plan adversely affects the ability of an adjacent basin to implement its GSP or impedes achievement of

[5] 23 CCR § 350 et seq.
[6] 23 CCR § 355.4(a)(2).
[7] 23 CCR § 355.4(a)(3).

sustainability goals in an adjacent basin.[8] Application of these standards requires exercise of the Department's expertise, judgment, and discretion when making its determination of whether a Plan should be deemed "approved," "incomplete," or "inadequate."

The statutes and GSP Regulations require Plans to include and address a multitude and wide range of informational and technical components. The Department has observed a diverse array of approaches to addressing these technical and informational components being used by GSAs in different basins throughout the state. The Department does not apply a set formula or criterion that would require a particular outcome based on how a Plan addresses any one of SGMA's numerous informational and technical components. The Department finds that affording flexibility and discretion to local GSAs is consistent with the standards identified above; the state policy that sustainable groundwater management is best achieved locally through the development, implementation, and updating of local plans and programs[9]; and the Legislature's express intent under SGMA that groundwater basins be managed through the actions of local governmental agencies to the greatest extent feasible, while minimizing state intervention to only when necessary to ensure that local agencies manage groundwater in a sustainable manner.[10] The Department's final determination is made based on the entirety of the Plan's contents on a case-by-case basis, considering and weighing factors relevant to the particular Plan and basin under review.

E. In making these findings and Plan determination, the Department also recognized that: (1) the Department maintains continuing oversight and jurisdiction to ensure the Plan is adequately implemented; (2) the Legislature intended SGMA to be implemented over many years; (3) SGMA provides Plans 20 years of implementation to achieve the sustainability goal in a basin (with the possibility that the Department may grant GSAs an additional five years upon request if the GSAs have made satisfactory progress toward sustainability); and, (4) local agencies acting as GSAs are authorized, but not required, to address undesirable results that occurred prior to enactment of SGMA.[11]

F. The Plan conforms with Water Code §§ 10727.2 and 10727.4, substantially complies with 23 CCR § 355.4, and appears likely to achieve the sustainability goal for the Subbasin. It does not appear at this time that the Plan will adversely affect the ability of adjacent basins to implement their GSPs or impede achievement of sustainability goals.

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[8] Water Code § 10733.
[9] Water Code § 113.
[10] Water Code § 10720.1(h).
[11] Water Code §§ 10721(r); 10727.2(b); 10733(a); 10733.8.

1. The sustainable management criteria and the Plan's goal to preserve and enhance the economic viability, social well-being and culture of all beneficial uses and users of locally managed groundwater resources through a cooperative and partnered approach, without experiencing undesirable results, is sufficiently justified and explained. The Plan relies on credible information and science to quantify the groundwater conditions that the Plan seeks to avoid and provides an objective way to determine whether the Subbasin is being managed sustainably in accordance with SGMA.[12]

2. The Plan identifies addressing data gaps related to hydrogeological conceptual model, groundwater conditions, and water budgets, incorporating new information into the numerical model, and expanding monitoring networks as areas of improvement. Filling these known data gaps should increase GSAs' understanding of the Subbasin and will lead to refinement of the GSP's sustainable management criteria and water budget.[13]

3. The projects and management actions proposed are designed to increase direct and in-lieu groundwater recharge and perform demand management and mitigate overdraft, groundwater level decline, and subsidence. They include well mitigation to address dry wells. The projects and management actions are reasonable and commensurate with the level of understanding of the Subbasin setting. The projects and management actions described in the Plan provide a feasible approach to achieving the Subbasin's sustainability goal and should provide the GSAs with greater versatility to adapt and respond to changing conditions and future challenges during GSP implementation.[14]

4. The Plan provides a detailed explanation of how the varied interests of groundwater uses and users in the Subbasin were considered in developing the sustainable management criteria and how those interests, including domestic wells, would be impacted by the chosen minimum thresholds.[15]

5. The Plan's projects and management actions appear feasible at this time and capable of preventing undesirable results and ensuring that the Subbasin is operated within its sustainable yield within 20 years. The Department will continue to monitor Plan implementation and reserves the right to change its determination if projects and management actions are

[12] 23 CCR § 355.4(b)(1).
[13] 23 CCR § 355.4(b)(2).
[14] 23 CCR § 355.4(b)(3).
[15] 23 CCR § 355.4(b)(4).

not implemented or appear unlikely to prevent undesirable results or achieve sustainability within SGMA timeframes.[16]

6. The Plan includes a reasonable assessment of overdraft conditions and includes reasonable means to mitigate overdraft, if present.[17]

7. At this time, it does not appear that the Plan will adversely affect the ability of an adjacent basin to implement its GSP or impede achievement of sustainability goals in an adjacent basin. The Plan states the Subbasins' GSAs have coordinated with the four adjacent basin's GSAs during development of their respective GSPs to develop sustainable management criteria and will continue to coordinate during plan implementation.[18]

8. Because a single plan was submitted for the Subbasin, a coordination agreement was not required.[19]

9. The GSAs' member agencies, the Colusa Groundwater Authority and Glenn Groundwater Authority, have historically relied on an adaptive management approach applied towards the development of project and management actions, informed by continued monitoring of groundwater conditions using the monitoring network and methods, evaluation of groundwater conditions relative to the sustainable management criteria, and implementation of projects and management actions described in the Plan. The GSAs' member agencies and their history of groundwater management provide a reasonable level of confidence that the GSAs have the legal authority and financial resources necessary to implement the Plan.[20]

10. Through review of the Plan and consideration of public comments, the Department determines that the GSAs adequately responded to comments that raised credible technical or policy issues with the Plan, sufficient to warrant approval of the Plan at this time. The Department has also provided recommended corrective actions in the Staff Report which are important in addressing certain technical or policy issues that were raised. Failure to address these recommended corrective actions before future, subsequent plan evaluations, may preclude approval of the Plan in those future evaluations.[21]

G. In addition to the grounds listed above, DWR also finds that:

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[16] 23 CCR § 355.4(b)(5).
[17] 23 CCR § 355.4(b)(6).
[18] 23 CCR § 355.4(b)(7).
[19] 23 CCR § 355.4(b)(8).
[20] 23 CCR § 355.4(b)(9).
[21] 23 CCR § 355.4(b)(10).

1. The Department developed its GSP Regulations consistent with and intending to further the State's human right to water policy through implementation of SGMA and the Regulations, primarily by achieving sustainable groundwater management in a basin. By ensuring substantial compliance with the GSP Regulations, the Department has considered the state policy regarding the human right to water in its evaluation of the Plan.[22]

2. The Plan acknowledges and identifies interconnected surface waters within the Subbasin. The GSAs propose initial sustainable management criteria to manage this sustainability indicator and measures to improve understanding and management of interconnected surface water. The GSAs acknowledge, and the Department agrees, many data gaps related to interconnected surface water exist. The GSAs should continue filling data gaps, collecting additional monitoring data, and coordinating with resources agencies and interested parties to understand beneficial uses and users that may be impacted by depletions of interconnected surface water caused by groundwater pumping. Future periodic evaluations of the Plan and amendments to the Plan should aim to improve the initial sustainable management criteria as more information and improved methodology becomes available.

3. Projections of future Subbasin extractions are likely to stay within current and historic ranges, at least until the next periodic evaluation by the GSAs and the Department. Subbasin groundwater levels and other SGMA sustainability indicators appear unlikely to substantially deteriorate while the GSA implements the Department's recommended corrective actions.

4. The California Environmental Quality Act[23] does not apply to the Department's evaluation and assessment of the Plan.

[22] Water Code § 106.3; 23 CCR § 350.4(g).
[23] Public Resources Code § 21000 *et seq*.

Accordingly, the 2024 GSP submitted by the Agencies for the Sacramento Valley – Colusa Subbasin is hereby **APPROVED**. The recommended corrective actions identified in the Staff Report will assist the Department's future review of the Plan's implementation for consistency with SGMA and the Department therefore recommends the Agenciesaddress them in the next Periodic Evaluation, which is set to be submitted by January 28, 2027, as required by Water Code § 10733.8. Failure to address the Department's recommended corrective actions before future, subsequent plan evaluations, may lead to a Plan being determined incomplete or inadequate.

Signed:

Karla Nemeth

Karla Nemeth, Director
Date: February 27, 2025

Exhibit A: Groundwater Sustainability Plan Assessment Staff Report – Sacramento Valley – Colusa Subbasin

State of California
Department of Water Resources
Sustainable Groundwater Management Program
Reassessment of Incomplete
Groundwater Sustainability Plan
2025 Staff Report

Groundwater Basin Name:	Sacramento Valley – Colusa Subbasin (No. 5-021.52)
Submitting Agency:	Colusa Groundwater Authority Groundwater Sustainability Agency and Glenn Groundwater Authority Groundwater Sustainability Agency
Submittal Type:	Revised Plan in Response to Incomplete Determination
Submittal Date:	April 22, 2024
Recommendation:	Approve
Date:	February 27, 2025

On April 22, 2024, the Colusa Groundwater Authority Groundwater Sustainability Agency (GSA) and Glenn Groundwater Authority GSA (collectively referred to as the GSAs or Agencies) resubmitted the Colusa Subbasin Groundwater Sustainability Plan (2024 GSP or 2024 Plan) [1] for the Colusa Subbasin (Subbasin) to the Department of Water Resources (Department or DWR) for evaluation and assessment as required by the Sustainable Groundwater Management Act (SGMA)[2] and the GSP Regulations.[3] This was in response to the Department's Incomplete Determination[4] of the initial GSP (2022 GSP or 2022 Plan)[5] on October 26, 2023.[6]

After evaluation and assessment, Department staff conclude the GSAs have taken sufficient actions to correct deficiencies identified by the Department; however, Department staff have provided additional corrective actions which will be required to be addressed by the Plan's periodic evaluation.

Overall, Department staff believe the Plan contains the required components of a GSP, demonstrates a thorough understanding of the Subbasin based on what appears to be the best available science and information, sets well explained, supported, and reasonable sustainable management criteria to prevent undesirable results as defined in the Plan, and proposes a set of projects and management actions that, if successfully

[1] 2024 Colusa GSP, https://sgma.water.ca.gov/portal/service/gspdocument/download/10061.
[2] Water Code § 10720 *et seq*.
[3] 23 CCR § 350 *et seq*.
[4] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[5] 2022 Colusa GSP, https://sgma.water.ca.gov/portal/service/gspdocument/download/6881.
[6] Water Code § 10733.4(b); 23 CCR § 355.4(a)(4).

implemented, are likely to achieve the sustainability goal defined for the Subbasin.[7] Department staff will continue to monitor and evaluate the Subbasin's progress toward achieving the sustainability goal through annual reporting and future periodic evaluations of the GSP and its implementation.

- ***Based on the evaluation of the 2024 Plan, Department staff recommend the Plan be approved.***

This assessment includes six sections:

- **Section 1 – Summary**: Overview of the Department Staff's assessment and recommendation.
- **Section 2 – Evaluation Criteria**: Describes the legislative requirements and the Department's evaluation criteria.
- **Section 3 – Required Conditions**: Describes the submission requirements of an incomplete resubmittal to be evaluated by the Department.
- **Section 4 – Deficiency Evaluation**: Provides an assessment of whether and how the contents included in the GSP resubmittal addressed the deficiencies identified by the Department in the initial incomplete determination.
- **Section 5 – Plan Evaluation**: Provides a detailed assessment of the contents included in the GSP organized by each Subarticle outlined in the GSP Regulations.
- **Section 6 – Staff Recommendation**: Includes the staff recommendation for the 2024 Plan.

[7] 23 CCR § 354.24.

1 SUMMARY

Department staff recommend **approval** of the 2024 Colusa GSP and have identified recommended corrective actions designed to address shortcomings of the Plan described in this Staff Report. In Section 4 of this report, Department staff reviewed how the 2022 Plan was updated in the 2024 Plan by comparing content from each plan in order to determine if sufficient action was taken in response to deficiencies identified in the 2022 Plan. In Section 5, Department staff reviewed content in the GSP for its substantial compliance with GSP Regulations, and have provided recommended corrective actions for components of the plan that need improvement to support substantial compliance with GSP Regulations and for Subbasin sustainability.

The GSAs have identified areas for improvement of their Plan (e.g., addressing data gaps related to hydrogeological conceptual model, groundwater conditions, and water budgets, incorporating new information into the numerical model, and expanding monitoring networks). Department staff concur that those items are important and recommend the GSAs address them as soon as possible. Department staff have also identified additional recommended corrective actions that the GSAs should consider for the first periodic evaluation of the Plan (see Section 6). Addressing these recommended corrective actions will be important to demonstrate, on an ongoing basis, that implementation of the Plan is likely to achieve the sustainability goal. The recommended corrective actions generally focus on the following:

1) Updating the water budget to account for revised overdraft estimates.
2) Providing details of projects and management actions needed for sustainability.
3) Fully identifying the locations of and considering groundwater dependent ecosystems in sustainable management criteria and describing the processes used to delineate spatial extent of focus areas.
4) Considering how levels at interim milestones will avoid causing undesirable results for other sustainability indicators.
5) Providing clear information about and considering the beneficial uses and users considered for subsidence sustainable management criteria.
6) Providing point of contact information.
7) Including constituents of concern in groundwater quality monitoring and sustainable management criteria and coordinating with users of groundwater and regulatory agencies understand and reduce the migration of constituents of concern.
8) Fully identifying interconnected surface waters and updating monitoring and sustainable management criteria.

2 EVALUATION CRITERIA

The Department evaluates whether a Plan conforms to the statutory requirements of SGMA[8] and is likely to achieve the basin's sustainability goal,[9] whether evaluating a basin's first Plan,[10] a Plan previously determined incomplete,[11] an amended Plan,[12] or a GSA's periodic evaluation to an approved Plan.[13] To achieve the sustainability goal, each version of the Plan must demonstrate that implementation will lead to sustainable groundwater management, which means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.[14] The Department is also required to evaluate, on an ongoing basis, whether the Plan will adversely affect the ability of an adjacent basin to implement its groundwater sustainability program or achieve its sustainability goal.[15]

The Plan evaluated in this Staff Report was previously determined to be incomplete. An incomplete Plan is one which had one or more deficiencies that precluded its initial approval, may not have had supporting information that was sufficiently detailed or analyses that were sufficiently thorough and reasonable, or Department staff determined it was unlikely the GSAs in the basin could achieve the sustainability goal. After a GSA has been afforded up to 180 days to address the deficiencies and based on the GSA's efforts, the Department can either approve[16] the Plan or determine the Plan inadequate.[17]

The Department's evaluation and assessment of a Plan previously determined to be incomplete, as presented in this Staff Report, continues to follow Article 6 of the GSP Regulations[18] to determine whether the Plan, with revisions or additions prepared by the GSA, complies with SGMA and substantially complies with the GSP Regulations.[19] As stated in the GSP Regulations, "substantial compliance means that the supporting information is sufficiently detailed and the analyses sufficiently thorough and reasonable, in the judgment of the Department, to evaluate the Plan, and the Department determines that any discrepancy would not materially affect the ability of the Agency to achieve the sustainability goal for the basin, or the ability of the Department to evaluate the likelihood of the Plan to attain that goal."[20]

[8] Water Code §§ 10727.2, 10727.4, 10727.6.
[9] Water Code § 10733; 23 CCR § 354.24.
[10] Water Code § 10720.7.
[11] 23 CCR § 355.2(e)(2).
[12] 23 CCR § 355.10.
[13] 23 CCR § 355.6.
[14] Water Code § 10721(v).
[15] Water Code § 10733(c).
[16] 23 CCR §§ 355.2(e)(1).
[17] 23 CCR §§ 355.2(e)(3).
[18] 23 CCR § 355 *et seq*.
[19] 23 CCR § 350 *et seq*.
[20] 23 CCR § 355.4(b).

The recommendation to approve a Plan previously determined to be incomplete does not signify that Department staff, were they to exercise the professional judgment required to develop a Plan for the basin, would make the same assumptions and interpretations as those contained in the revised Plan, but simply that Department staff have determined that the modified assumptions and interpretations relied upon by the submitting GSA(s) are supported by adequate, credible evidence, and are scientifically reasonable. The assessment of a Plan previously determined to be incomplete may involve the review of new information presented by the GSAs, including models and assumptions, and an evaluation of that information based on scientific reasonableness. In conducting its assessment, Department staff does not recalculate or reevaluate technical information or perform its own geologic or engineering analysis of that information.

The recommendation to not approve a Plan previously determined to be incomplete and instead determine it to be inadequate signifies that the resubmitted Plan contains significant deficiencies based on one or more of the criteria identified in 23 CCR § 355.4(b), or the GSAs in the basin have not taken sufficient actions to correct the deficiencies previously identified by the Department when it found the Plan incomplete. The Department engages in consultation with the State Water Resources Control Board before finding a Plan inadequate. A Plan determined to be inadequate is subject to the state intervention provisions contained in Chapter 11 of SGMA.[21]

[21] Water Code § 10735 *et seq*.

3 REQUIRED CONDITIONS

For a Plan that the Department previously determined to be incomplete, the Department provided required corrective actions that address minor or potentially significant deficiencies that the Department identified in the initially submitted Plan. The GSA(s) in a basin, whether developing a single GSP covering the basin or multiple GSPs, must attempt to sufficiently address those required corrective actions within the time provided, not to exceed 180 days, for the Plan to be reevaluated by the Department and potentially approved.

3.1 INCOMPLETE RESUBMITTAL

GSP Regulations specify that the Department shall evaluate a resubmitted GSP in which the GSA has taken corrective actions within 180 days from the date the Department issued an incomplete determination to address deficiencies.[22]

The Department issued the incomplete determination on October 26, 2023.[23] The GSAs resubmitted the GSP to the Department on April 22, 2024, in compliance with the 180-day deadline.

The GSAs have provided a redline/strikeout version of the resubmitted GSP. The redline/strikeout version highlights the changes made from the initial 2022 submission to the 2024 submission.[24]

[22] 23 CCR § 355.4(a)(4).
[23] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[24] https://sgma.water.ca.gov/portal/service/gspdocument/download/10040.

4 DEFICIENCY EVALUATION

As stated in Section 355.4 of the GSP Regulations, a basin "shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act." The Department's assessment is based on a number of related factors including whether the elements of a GSP were developed in the manner required by the GSP Regulations, whether the GSP was developed using appropriate data and methodologies and whether its conclusions are scientifically reasonable, and whether the GSP, through the implementation of clearly defined and technically feasible projects and management actions, is likely to achieve a tenable sustainability goal for the basin.

In its initial incomplete determination, the Department identified three deficiencies in the Plan related to the Plan's assessment of overdraft conditions, the sustainable management criteria for groundwater levels, and the sustainable groundwater management criteria for land subsidence, which precluded approval of the 2022 Plan.[25] The GSAs were given 180 days to take corrective actions to remedy the identified deficiencies. Consistent with the GSP Regulations, Department staff are providing an evaluation of the resubmitted Plan to determine if the GSAs have taken sufficient actions to correct the deficiencies identified in the 2022 Plan. For each deficiency, the corrective actions are repeated, the 2022 Plan content is summarized, the 2024 Plan is then described, followed by Department staff's evaluation.

As part of the 2024 GSP, the GSAs provided documentation of the revisions made to the Plan in Enclosure 1, "Colusa Subbasin Revised Groundwater Sustainability Plan (GSP) Summary of Changes in the Revised GSP."[26] The summary provided by the GSAs includes information on which section(s) the specified deficiency was primarily addressed in the 2024 GSP, how the deficiency was primarily addressed, and information learned from consultation meetings with the Department.

4.1 DEFICIENCY 1. THE GSP DOES NOT INCLUDE A REASONABLE ASSESSMENT OF OVERDRAFT CONDITIONS AND REASONABLE MEANS TO MITIGATE OVERDRAFT.

4.1.1 Corrective Action 1

The GSAs should revise the GSP to provide a reasonable assessment of overdraft conditions using the best available information and describe a reasonable means to mitigate overdraft. Specifically, the Plan must be amended as follows:

a) Reevaluate the assessment of overdraft conditions in the Subbasin. Specifically, the GSAs should examine the assumptions that were used to develop the current overdraft, and the projected overdraft estimates in the projected water budget considering the results vary greatly from the values reported in the recent annual

[25] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[26] 2024 Colusa GSP, Enclosure 1, pp. 13-16.

report data. The assessment should include the latest information for the Subbasin to ensure the GSP includes the required projects and management actions to mitigate overdraft in the Subbasin.

b) Develop and describe a reasonable means to mitigate the overdraft that is continuing to occur in the Subbasin. Specifically, the GSAs should describe proposed management actions that are commensurate with the level of understanding of groundwater conditions in the Subbasin and provide sufficient details for Department staff to be able to clearly understand how the Plan's projects and management actions will mitigate overdraft in the Subbasin under different climate scenarios.

4.1.2 Evaluation of Resubmitted Plan

4.1.2.1 Corrective Action 1a – Overdraft Conditions

The Department's Incomplete Determination directed the GSAs that the Plan did not provide a reasonable assessment of overdraft because the projected overdraft varied greatly from recent changes in groundwater storage data.[27] In response, the GSAs updated and revised their analysis of overdraft.

The 2022 GSP presented a historical water budget, which reflected the period from 1990 to 2015, that estimated an average change in groundwater storage of -28,000 acre-feet per year (AFY).[28] Data from the 2006 to 2015 period showed annual overdraft has increased recently resulting in an overdraft of approximately 1,000,000 acre-feet (AF).[29] However, the 2022 GSP's water budget, which utilized the Fine-Grid California Central Valley Groundwater - Surface Water Simulation-Colusa Model (C2VsimFG-Colusa model or model), showed an increase in groundwater storage of 1,000 AFY.[30] The projected water budget with future land use and climate change anticipated an increase in groundwater pumping by 58,000 AFY yet presented a lower value of overdraft of 7,300 AFY (cumulative change in groundwater storage of -365,000 AF) over the 50-year implementation horizon.[31] Department staff also noted the overdraft reported in the annual reports for water year 2021 and 2022 was documented at -418,000 AF and -377,170 AF, respectively.[32] Accordingly, the Department asked for the GSAs to reevaluate the assessment of overdraft conditions in the Subbasin.

To address the deficiency, the 2024 GSP reevaluated overdraft conditions in the Subbasin using more recent data. The 2024 GSP selects the 2016 to 2022 period to quantify the average annual current overdraft because "it is a recent period during which

[27] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[28] 2022 Colusa GSP, Table 3-12, p. 215.
[29] 2022 Colusa GSP, Figure 3-29, p. 184.
[30] 2022 Colusa GSP, Table 3-12, p. 215.
[31] 2022 Colusa GSP, Section 3.3.6, p. 229.
[32] Department of Water Resources, SGMA Portal, Annual Report Module, Water Year 2021 and Water Year 2022 Data, Reported Overdraft, Colusa Subbasin.

both water year conditions and water supply conditions are closely similar, on average, to longer-term average conditions."[33]

The 2024 GSP uses the change in groundwater storage as a measure of overdraft. The 2024 GSP utilizes "empirical observation of groundwater levels change at the groundwater levels Representative Monitoring Site (RMS) wells."[34] The annual change in groundwater storage was calculated by constructing Thiessen polygons at each RMS well with consecutive spring-to-spring groundwater elevation measurements and multiplying the elevation change at each RMS well by the area of the corresponding Thiessen polygon and storage coefficient.[35] The storage coefficient utilized in this analysis has been "estimated based on information about the Subbasin's hydrogeologic characteristics… and is considered reasonable given the depositional history, sediment types, and aquifer characteristics of the Primary Aquifer."[36] Department staff believe that the GSAs have provided a sufficient explanation of their use of this methodology. Staff note the GSAs' revised approach to reevaluate overdraft in the Subbasin using the change in groundwater storage addresses the shortcomings in the model's overdraft estimates and actively improves the overdraft estimate.

The 2024 GSP's improved approach to assessing overdraft conditions has resulted in a projected overdraft estimate that seems to align with the recent changes in groundwater storage data and is a significant change from the estimated net gain of 1,000 AFY proposed in the 2022 GSP. Based on the methodology described above, the 2024 GSP identifies the current overdraft estimate as approximately -62,000 AFY.[37] The 2024 GSP indicates that "the GSAs are planning to complete a recurring evaluation of overdraft conditions in the Subbasin as part of the annual report" and "plan to quantify and report the 5-10 year rolling average overdraft."[38] Department staff are encouraged by the GSAs' efforts to reevaluate overdraft conditions and report the 5 to 10 year rolling average overdraft to reflect the most recent available data and look forward to the GSAs improving their calibration using the empirical data used to support the 2024 GSP's calculations and full updates to the water budget section. However, the 2024 GSP is ambiguous on how the specified 5 to 10 year rolling average overdraft will be used by the GSAs to guide implementation toward sustainability and recommend the GSAs provide additional information regarding how the 5 to 10 year rolling average overdraft will be used by the GSAs.

The 2024 GSP notes that the water budget section of the GSP has not been updated to reflect the changes in the GSA's understanding of overdraft conditions. The 2024 GSP states, "the GSAs recognize that persistent groundwater level decline and groundwater storage reduction have occurred in parts of the Subbasin in recent years that may not be

[33] 2024 Colusa GSP, Section 3.3.6, p. 287.
[34] 2024 Colusa GSP, Section 3.3.6, p. 287.
[35] 2024 Colusa GSP, Section 3.3.6, p. 287.
[36] 2024 Colusa GSP, Section 3.3.6, p. 287.
[37] 2024 Colusa GSP, Section 3.3.6, p. 288.
[38] 2024 Colusa GSP, Section 3.3.6, p. 288.

fully represented in the C2VsimFG-Colusa model assumptions, calibration, and results."[39] Department staff also note that the majority of the water budget section was not updated, meaning that the 2024 GSP's water budget currently lacks accuracy. This appears to also be the case for the Subbasin's sustainable yield and Appendix 3.D ("Model Development and Calibration Technical Memorandum").[40] The GSP Regulations require the water budget to include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.[41] Although the GSAs have acknowledged the fact that neither the water budget nor sustainable yield have been updated to reflect the 2024 GSP's updated overdraft assessment, the 2024 GSP states that the GSAs "will consider incorporating new data into the modeled water budgets as part of future GSP evaluations and revisions, and plan to continue their evaluations of annual water supply and water use in GSP annual reports."[42] In order to provide an accurate water budget, staff recommend the GSAs update the Plan's water budget and include the overdraft estimates provided in the 2024 GSP by the next periodic evaluation (see Recommended Corrective Action 1a).

Despite the recommendation to update the Plan's water budget, the 2024 GSP includes updated estimates of overdraft using empirical data that more accurately reflects conditions based on recent declines in groundwater levels. Staff conclude that the GSAs have sufficiently responded to the request to reevaluate the assessment of overdraft conditions in the Subbasin. Based on a review of the information found in the 2024 GSP and Annual Reports, staff conclude the GSAs will have sufficiently addressed corrective action 1a once the recommended corrective action is addressed.

4.1.2.2 Corrective Action 1b – Means to Mitigate Overdraft

The Department's Incomplete Determination found that that the Plan did not provide a reasonable means to mitigate overdraft and advised the GSAs to explain how the Plan's projects and management actions will mitigate overdraft in the Subbasin under different climate scenarios.[43] In response, the GSAs expanded the 2024 GSP's projects and management actions to address overdraft.

The 2022 GSP proposed an adaptive management approach to mitigate declining groundwater levels in the Orland and Arbuckle areas with other ongoing and potential projects to achieve sustainability.[44] The expected benefits of all planned projects would provide more than 80,000 AFY to the Subbasin at full implementation; however, Department staff noted there were limitations to the full implementation of projects and management actions.[45] Staff noted the 2022 GSP stated that certain projects will not be available for implementation during critically dry years and two of the projects described

[39] 2024 Colusa GSP, Section 3.3.6, p. 287.
[40] 2024 Colusa GSP, Appendix 3.D, pp. 2366-2425.
[41] 23 CCR § 354.18(b)(5).
[42] 2024 Colusa GSP, Section 3.3, p. 257.
[43] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[44] 2022 Colusa GSP, Chapter 6, p. 301.
[45] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.

as ongoing are described as having expiring contracts so the actual benefits of these projects may be lower than the projected values.[46] Additionally, the determination noted groundwater storage was reduced by 795,000 AF in the last two years.[47] Staff note that that the expected benefits of full implementation would amount to 20 percent of that decline if implemented over the same time frame.

To mitigate overdraft, the 2024 GSP has added two recharge projects and a demand management program. The 2024 GSP states that the planned recharge projects are "expected to provide more than 80,000 AFY in gross average annual benefits at full implementation by offsetting groundwater pumping, providing direct recharge, and otherwise supporting groundwater sustainability."[48]

The 2024 GSP has added two direct recharge projects to the Plan's ongoing projects. The Tehama-Colusa Canal (TCC) Trickle Flow to Ephemeral Streams, which was identified as a potential project in the 2022 GSP, "is being developed to operate existing gates of the TCC for discharge into ephemeral streams at a rate where they do not flow out of the Subbasin but instead recharge the groundwater system."[49] Since 2021, the GSAs have identified "potential streams, water sources, and operating strategies to most effectively conduct recharge" and "a proof-of-concept test of the trickle flow project was conducted when a portion of the TCC was dewatered."[50] Additionally, the GSAs have installed three discharge sites and identified several landowners willing to participate in the project monitoring network.[51] The 2024 GSP does not clearly identify where the three discharge sites are located, or the extent of the project monitoring network; however, the GSAs are working on generating maps for the project monitoring network which includes DWR monitoring wells and private wells.[52] The 2024 GSP states, "The expected yield of this project is currently being determined and will be reported in GSP annual reports and five-year periodic evaluations when known."[53] The GSAs have "successfully received funding for infrastructure development through an Integrated Regional Water Management (IRWM) grant being administered by Sutter County" and plan to initiate the TCC Trickle Flow to Ephemeral Streams in the winter of 2023/2024 after agreements are developed.[54]

The second ongoing direct recharge project is the Glenn Groundwater Authority (GGA) Recharge Project, which was not previously identified in the 2022 GSP. The objective of the GGA Recharge Project "is to plan, design, implement, and monitor multi-benefit, direct and in-lieu groundwater recharge projects in a unified approach and demonstrate that groundwater recharge is a viable tool to immediately alleviate critical drought conditions"

[46] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[47] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[48] 2024 Colusa GSP, Section 6.2.2, p. 399.
[49] 2024 Colusa GSP, Section 6.4.1.6, Table 6-26, p. 465.
[50] 2024 Colusa GSP, Section 6.4.1.6, p. 464.
[51] 2024 Colusa GSP, Section 6.4.1.6, p. 464.
[52] 2024 Colusa GSP, Section 6.4.1.6, p. 464.
[53] 2024 Colusa GSP, Section 6.4.1.6, Table 6-26, p. 465.
[54] 2024 Colusa GSP, Section 6.4.1.6, p. 464.

and "will provide habitat for migratory shorebirds and enhance groundwater dependent ecosystems supporting the region's objective to implement multi-benefit projects."[55] The GGA Recharge Project is actively being developed and is expected to be ongoing whenever surface water is available for recharge.[56] Since 2023, "the GGA conducted two pilot projects in collaboration with [Orland-Artois Water District] OAWD and [Orland Unit Water Users Association] OUWUA, completing over 15 groundwater recharge projects in Glenn County and recharging more approximately 2,100 AF of water."[57] These project sites are both located in Orland, which is where several domestic wells went dry during the 2020 to 2022 drought.[58] Additionally, as of early 2024, the GGA is "completing an initial evaluation of potential projects for long term groundwater recharge, including an analysis of pros and cons such as capital and upfront costs, operating and ongoing costs, potential for grant funding, level of certainty, partnerships, permitting, other benefits such as flood control and habitat, impacts to shallow wells, impacts to deep wells, impacts to domestic wells, and ability to slow land subsidence."[59] This project is currently estimated to cost approximately $2 million and funding sources are being identified, which may include grants, fees, loans, and other assessments.[60] Department staff note that the success of recharge projects rely upon future availability of surface water, which is uncertain due to hydrologic, regulatory, and other factors. Staff encourage the GSAs to continue to monitor and adjust their approach in response to changing conditions as surface water availability changes in the future.

Another significant addition to the 2024 GSP was the identification of a demand management program. The 2024 GSP provides a resolution of intent to implement the demand management program, included in an appendix.[61] The demand management program describes voluntary and adaptive mandatory measures and their schedule for implementation. The schedule for voluntary measures is for "immediate implementation" at the program start date which is January 1, 2027.[62] The 2024 Plan commits to refining and preparing to implement mandatory measures between April 17, 2024[63] and the program start date which is January 1, 2027.[64] However, the 2024 GSP indicates the GSAs will not commit to implementing mandatory measures unless an undesirable result is still occurring in the Subbasin.[65] Voluntary measures include "best management

[55] 2024 Colusa GSP, Section 6.4.1.7, p. 466.
[56] 2024 Colusa GSP, Section 6.4.1.7, Table 6-27, p. 467.
[57] 2024 Colusa GSP, Section 6.4.1.7, p. 466.
[58] 2024 Colusa GSP, Section 6.4.1.7, p. 466.
[59] 2024 Colusa GSP, Section 6.4.1.7, pp. 466-467.
[60] 2024 Colusa GSP, Section 6.4.1.7, Table 6-27, p. 468.
[61] 2024 Colusa GSP, Appendix 6.E, pp. 2860-2870. The resolutions contain statements that characterize the local agencies' understanding of the law and regulations and appear intended to limit GSAs liability, which statements have been the focus of public comments. The Department takes no position and offers no comments on those statements, which are not material to determining the adequacy of the Plan in terms of its compliance with SGMA and the GSP Regulations.
[62] 2024 Colusa GSP, Appendix 6.E, p. 2865.
[63] 2024 Colusa GSP, Appendix 6.E, p. 2861.
[64] 2024 Colusa GSP, Appendix 6.E, p. 2865.
[65] 2024 Colusa GSP, Appendix 6.E, p. 2863.

practices, water conservation, encouraging surface water use in lieu of groundwater pumping, multi-benefit land repurposing, incentivized land use changes, and fallowing."[66] Adaptive mandatory measures include "groundwater consumptive use restrictions, well extraction restrictions, water markets, trading, and/or penalties and fee structures."[67]

Department staff note that the 2024 GSP's intent to delay implementation of the adaptive mandatory demand management components until undesirable results are detected is problematic because the 2024 GSP states the sustainability goal for the Subbasin is "… to maintain, through a cooperative and partnered approach, locally managed sustainable groundwater resources to preserve and enhance the economic viability, social well-being and culture of all Beneficial Uses and Users, without experiencing undesirable results."[68] Furthermore, GSP Regulations require a GSP to establish a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline.[69] Therefore, staff note the fact that the 2024 GSP requires undesirable results be present in order to implement mandatory overdraft mitigation measures does not seem to align with the 2024 GSP's sustainability goal nor GSP Regulations, both of which seek to avoid undesirable results from occurring.

Additionally, the 2024 GSP identifies in its groundwater level sustainable management criteria that the GSAs intend to cease the chronic lowering of groundwater by 2027, as indicated in the 2024 Plan's interim milestones.[70] Based on information presented in the 2024 GSP, it appears that in order to achieve meeting the interim milestone and to comply with the 2024 GSP's sustainability goal, the GSAs must generate benefits by implementing projects and management actions that mitigate the overdraft occurring in the Subbasin. Department staff note that GSP Regulations require a plan to describe project and management actions to mitigate overdraft, including a quantification of demand reduction or other methods.[71] Therefore, Department staff recommend the GSAs provide a timeline, criteria, and quantified benefits of the implementation of the demand management program in annual reports and in the next periodic evaluation. Staff recommend that the GSAs track conditions and update projects and management actions as necessary to achieve the plans sustainability goal of avoiding undesirable results and the interim milestone goals of stopping the chronic lowering of groundwater by 2027 (see Recommended Corrective Action 1b).

Department staff are encouraged by the GSAs efforts to mitigate overdraft through the addition of two ongoing projects and a demand management program. Based on a review of the information found in the 2024 Plan and Annual Reports, staff conclude that if the

[66] 2024 Colusa GSP, Appendix 6.E, p. 2863.
[67] 2024 Colusa GSP, Appendix 6.E, p. 2863.
[68] 2024 Colusa GSP, Section 1.2, p. 114.
[69] 23 CCR § 354.24.
[70] 2024 Colusa GSP, Table 5-3, p. 364.
[71] 23 CCR § 354.44(b)(2).

GSAs address the recommended corrective action sufficiently, the GSAs will have sufficiently addressed corrective action 1b.

4.1.3 Conclusion

Overall, Department staff believe the GSAs have taken sufficient action to address the identified deficiencies by reevaluating the assessment of overdraft conditions and developing reasonable means to mitigate the overdraft that is occurring in the Subbasin. The overdraft assessment presented in the 2024 GSP appears to be reasonable and supported with sufficiently detailed information. Staff are also encouraged by the projects and management actions to mitigate continuing overdraft. Despite the recommended corrective actions, staff conclude that the 2024 GSP's assessment of overdraft conditions and means to mitigate overdraft substantially complies with the GSP Regulations.

4.2 Deficiency 2. The GSP does not establish sustainable management criteria for chronic lowering of groundwater levels in a manner substantially compliant with the GSP Regulations.

4.2.1 Corrective Action 2

The GSAs must provide a more detailed explanation and justification regarding the selection of the sustainable management criteria for groundwater levels, particularly minimum thresholds, and quantitatively describe the effects of those criteria on the interests of beneficial uses and users of groundwater. Department staff recommend the GSAs consider and address the following:

a) Refine the description of undesirable results to clearly describe the significant and unreasonable conditions the GSAs are managing the Subbasin to avoid. This must include a quantitative description of the negative effects to beneficial uses and users that would be experienced at undesirable result conditions. The GSAs should fully disclose and describe and explain the rationale for determining the number of wells that may be dewatered and the level of impacts to groundwater dependent ecosystems that may occur without rising to significant and unreasonable levels constituting undesirable results. Lastly, the GSAs should explain how potential alternate supplies of water or well mitigation will be considered by the GSAs during management of the Subbasin in a project or management action as part of the GSP. Department staff also encourage the GSAs to review the Department's April 2023 guidance document titled Considerations for Identifying and Addressing Drinking Water Well Impacts.

b) Revise minimum thresholds to be set at the level where the depletion of supply across the Subbasin may lead to undesirable results and provide the criteria used to establish and justify minimum thresholds. Fully document the analysis and justifications performed to establish the criteria used to establish minimum thresholds. Clearly show each step of the analysis and provide supporting information used in the analysis.

c) Provide an evaluation of how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests. Identify the number and location of wells that may be negatively affected when minimum thresholds are reached. Compare well infrastructure for all well types in the Subbasin with minimum thresholds at nearby, suitably representative, monitoring sites. Document all assumptions and steps clearly so that it will be understood by readers of the GSP. Include maps of potentially affected well locations, identify the number of potentially affected wells by well type, and provide a supporting discussion of the effects.

d) Analyze how groundwater level minimum thresholds, which allow continued declines in the Subbasin, may impact land subsidence conditions.

4.2.2 Evaluation of Resubmitted Plan

4.2.2.1 Corrective Action 2a – Undesirable Results

The Department's Incomplete Determination directed the GSAs that the Plan's definition of undesirable results lacked specificity and did not include a quantitative description of the negative effects to beneficial uses and users that would be experienced at undesirable result conditions.[72] In response, the GSAs provided a more detailed description of the negative effects that would be experienced at undesirable results.

As noted in the Department's Incomplete Determination, the 2022 GSP did not clearly define or describe undesirable result conditions and did not sufficiently explain whether observed impacts would be considered significant and unreasonable.[73] The GSP Regulations require agencies to describe the processes and criteria relied upon to define undesirable results applicable to the basin and identify significant and unreasonable effects that would lead to undesirable result conditions.[74] The 2022 GSP defined undesirable results as "a result that would cause significant and unreasonable reduction in the long-term viability of beneficial uses and users over the planning and implementation horizon of this GSP" and aims to prevent "…levels [that] are too low to reasonably satisfy beneficial uses and users within the Subbasin."[75] Department staff noted the 2022 GSP did not define or describe these conditions, or explain who would make this determination.[76] Additionally, without a quantitative definition or clear description of the qualifier "reasonably", the 2022 GSP was ambiguous on how the GSAs would identify whether observed impacts would be considered significant and unreasonable.[77]

The 2024 GSP describes undesirable results as drinking water well impacts that are unmitigated, adverse impacts to land subsidence, impacts to environmental uses and

[72] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[73] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[74] 23 CCR § 354.26(a).
[75] 2022 Colusa GSP, Section 5.3.1.1, p. 269.
[76] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[77] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.

users of groundwater, and adverse impacts for the agricultural economy.[78] The 2024 GSP supports its definition of undesirable results by providing a map in its well impact analysis that shows the number of wells that may be dry if an RMS reaches its minimum threshold or the 2027 interim milestone.[79] The 2024 GSP also defines an undesirable result as "when 12.5 percent or more of the RMS wells (i.e. 6 of 48 RMS wells) in the Subbasin fall below their minimum threshold for two (2) consecutive fall measurements."[80]

Department staff conclude the definition of undesirable results the GSAs are managing the Subbasin to avoid are clearly defined and described in the 2024 GSP. Staff note the 2024 GSP includes quantitative description of the impacts to beneficial uses and users at the undesirable result and the GSAs have demonstrated the understanding that current groundwater level conditions are leading to significant and unreasonable conditions of domestic wells going dry and are causing adverse impacts to land subsidence conditions.

The Department's Incomplete Determination also directed the GSAs to fully disclose and describe and explain the rationale for determining the number of wells that may be dewatered and the level of impacts to groundwater dependent ecosystems.[81] In response, the GSAs provided new rationale.

The 2022 GSP did not provide a quantitative definition to clearly identify whether observed impacts would be considered significant and unreasonable, as required by the GSP Regulations.[82] The Department's Incomplete Determination also noted that the GSAs' quantification of undesirable results as 25 percent or more of the representative monitoring wells (i.e., 12 of 48 wells) in the Subbasin falling below their minimum groundwater elevation threshold levels for 24 consecutive months was unsupported, because the Plan did not explain why this threshold would avoid effects the GSAs have determined to be significant and unreasonable and appeared to be an arbitrary value selected by the GSAs.[83]

The 2024 GSP provides a clear description of the quantitative combination of minimum threshold exceedances[84] needed to identify the groundwater levels when undesirable results would occur. The 2024 GSP states, "An undesirable result is considered to occur for the chronic lowering of groundwater levels during GSP implementation when 12.5 percent or more of the RMS wells (i.e., 6 of 48 RMS wells) in the Subbasin fall below their minimum threshold for two (2) consecutive fall measurements (representing the seasonal lows, from the minimum of data collected between September 1 and November 30). The 6 wells must be the same subset of wells, not any combination of 6 wells. The subset of wells is not predetermined; rather, it is delineated only as wells collectively fall below their

[78] 2024 Colusa GSP, Section 5.3.1.1, p. 333.
[79] 2024 Colusa GSP, Appendix 5.E, Figure 4, p. 2727.
[80] 2024 Colusa GSP, Section 5.3.1.2, p. 337.
[81] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[82] 23 CCR § 354.26(b)(2).
[83] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[84] 23 CCR § 354.26(b)(2).

minimum threshold levels."[85] The GSAs have determined six wells to be symbolic of the wells the GSAs are concerned going dry; as more than six RMS wells are present in each area the GSAs consider most vulnerable.[86]

The 2024 GSP connects the quantitative combination of minimum threshold exceedances it uses to define an undesirable result to the number of wells that may be impacted and has plans to mitigate wells that may be impacted. The 2024 GSP provides a map showing the number of wells that may be dry for each individual RMS that reaches its minimum threshold or the 2027 interim milestone. [87] The 2024 GSP identifies that up to 99 drinking water wells may be impacted should levels reach the minimum thresholds and 67 additional drinking water wells should levels reach interim milestones across the Subbasin for a total of 166 wells potentially impacted.[88] The well mitigation program in the 2024 GSP indicates that the GSAs are planning for a budget of between $3.5 and $6 million for mitigation measures,[89] which is projected to provide benefits for an estimated 166 drinking water wells.[90]

Department staff note that the estimate of 99 wells impacted would be if all RMS wells reached the 2027 minimum thresholds and note the undesirable result is defined as when 6 of the 48 RMS wells are below minimum thresholds; therefore, it is likely that this number is higher than the actual number of dry wells at a detected the undesirable result. Staff are pleased that the GSAs have conservatively estimated impacts, and have thoroughly connected their undesirable results definition, well impacts analysis, and well mitigation efforts. Staff conclude that the GSAs have sufficiently responded to this portion of the corrective action.

Department staff note that SGMA requires GSAs to consider impacts to groundwater dependent ecosystems; [91] however, the 2024 GSP does not include a discussion considering impacts to groundwater dependent ecosystems, despite identifying reductions in groundwater available to root zones of groundwater dependent ecosystems as a part of its undesirable result description.[92] Department staff recommend the GSP include a discussion considering impacts to groundwater dependent ecosystems as part of the next periodic evaluation of the GSP (see Recommended Corrective Action 2a).

Lastly, the Department's Incomplete Determination noted the Subbasin has already experienced 102 dry wells according to the Household Dry Well Reporting System,[93] and indicated that the GSAs should explain how potential alternate supplies of water or well

[85] 2024 Colusa GSP, Section 5.3.1.2, p. 337.
[86] 2024 Colusa GSP, Section 5.3.1.2, p. 337.
[87] 2024 Colusa GSP, Appendix 5.E, Figure 4, p. 2727.
[88] 2024 Colusa GSP, Section 5.4.1.1, Table 5-4, p. 366.
[89] 2024 Colusa GSP, Appendix 6.F, p. 2876.
[90] 2024 Colusa GSP, Section 6.3.7.9, p. 452.
[91] CWC § 10727.4(i).
[92] 2024 Colusa GSP, Section 5.3.1.1, p. 334.
[93] 2022 Colusa GSP, Section 2.1.2.4, p. 88.

mitigation would be considered.[94] In response, the GSAs provided details of a well mitigation program.

The 2022 GSP alluded to a domestic well mitigation program but did not present details regarding the action's implementation timeline, criteria for implementation, benefits, or costs and funding; therefore, Department staff were unable to evaluate when and how the well mitigation program would be implemented or evaluate its potential feasibility and effectiveness.[95]

The 2024 GSP explains how well mitigation will be considered. The 2024 GSP includes in its definition of an undesirable result that "[g]roundwater level decline [resulting] in drinking water well impacts that are unmitigated"[96] are undesirable and provides a commitment to mitigate drinking water well impacts.[97] To mitigate dry wells, the GSAs have committed to implementing a well mitigation program no later than January 2026.[98] While the program will be implemented by January 2026, the GSP discusses wells that have gone dry since 2015, particularly during the 2020-2022 drought, and there may be wells that do dry between now and the 2026 implementation date, and the GSP is unclear or ambiguous as to whether these wells would be covered by the program when it comes online. Department staff assume that the mitigation program will do so, but if not staff recommend the GSAs explain how it will address impacted wells during this period.

The 2024 GSP includes significantly more information about well mitigation efforts than the 2022 GSP. The 2024 GSP discusses the well mitigation program in the GSP[99] and in an appendix that includes a Memorandum of Understanding (MOU) resolution to perform well mitigation called the "Colusa Subbasin Domestic Well Mitigation Program Memorandum of Understanding."[100] The well mitigation program prepares to address up to 166 drinking water wells. The GSAs estimate the cost for the well mitigation program to range between $3.5 and $6 million, which will be funded through reserve funds, GSA fees and assessment, fund generated through implementation of other projects and management actions, and county, state, and federal funding, as available.[101] Department staff appreciate the GSAs' commitment to mitigate the 166 drinking water wells potentially impacted at both revised minimum thresholds and the revised interim milestones.

By establishing a well mitigation program, the GSAs have sufficiently explained how alternate supplies or mitigation will be considered by the GSAs. The GSAs have provided

[94] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[95] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[96] 2024 Colusa GSP, Section 5.3.1.1, p. 333.
[97] 2024 Colusa GSP, Table ES-5, p. 109.
[98] 2024 Colusa GSP, Appendix 6.F, p. 2877.
[99] 2024 Colusa GSP, Section 6.3.7, pp. 446-453.
[100] 2024 Colusa GSP, Appendix 6.F, pp. 2871-2882. The resolutions contain statements that characterize the local agency's understanding of the law and regulations and appear intended to limit GSAs liability, which and those statements have been the focus of public comments. The Department takes no position and offers no comments on those statements, which are not material to determining the adequacy of the Plan in terms of its compliance with SGMA and the GSP Regulations.
[101] 2024 Colusa GSP, Appendix 6.F, pp. 2876-2877.

a schedule for implementation, a MOU resolution showing commitment to the program, an estimated budget, and provided a number of wells anticipated to be mitigated. These actions show the GSAs have taken significant actions to develop the program.

Department staff also note that the program is under development and look forward to seeing details about what processes the GSAs may use to establish eligibility. Staff note that the initial well evaluation has a cost that the well owner appears to bear that may be reimbursed, [102] and are concerned that up-front costs may prevent economically disadvantaged owners of dry wells from being able to apply for the program. Staff recommend the GSAs find ways to remove barriers for applicants to seek mitigation for dry wells where possible.

4.2.2.2 Corrective Action 2b – Minimum Thresholds

The Department's Incomplete Determination informed the GSAs that the Plan did not set minimum thresholds for chronic lowering of groundwater levels at a level where the depletion of supply across the Subbasin may lead to undesirable results.[103] In response, the GSAs revised their minimum threshold criteria.

In the 2022 GSP, the minimum threshold for the chronic lowering of groundwater levels was set as the deeper value of the 20th percentile of shallowest domestic well depths in the monitoring well's Thiessen polygon, or 50 percent of historical range below the historical low groundwater elevation.[104] Thus, the minimum threshold definition resulted in several wells with minimum thresholds greater than 50 feet below historic lows. Department staff noted the GSAs acknowledged some of the minimum thresholds were not developed to represent a depletion of supply that would lead to undesirable results (as required by the regulations),[105] but instead developed to "protect the conjunctive use of groundwater for agricultural production."[106] The 2022 GSP did not adequately describe the information used to develop the criteria to establish this minimum threshold, nor explain how managing the Subbasin to this minimum threshold would avoid the undesirable results it described and defined.[107]

The 2024 GSP provides a robust set of criteria used to establish its minimum thresholds. The 2024 GSP begins by identifying "a need to spatially refine how minimum thresholds are defined in different portions of the Subbasin, with consideration of the varied conditions in those regions," and to address the varying conditions in the Subbasin, the 2024 GSP has defined Focus and Non-Focus areas.[108] The 2024 GSP provides a map of the Focus and Non-Focus areas and their RMS.[109] Focus areas include what the 2024 GSP defines as "RMS wells that are in close proximity to areas where undesirable results

[102] 2024 Colusa GSP, Appendix 6.G, p. 2884.
[103] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[104] 2022 Colusa GSP, Section 5.4.1.1, p. 284.
[105] 23 CCR § 354.28(c)(1).
[106] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[107] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[108] 2024 Colusa GSP, Section 5.3.1.2, p. 337.
[109] 2024 Colusa GSP, Section 5.4.1.1, Figure 5-4, p. 361.

have occurred with respect to chronic lowering of groundwater levels."[110] The GSAs have identified 18 focus area RMS wells, with nine RMS wells located in the Orland-Artois area and the other nine located in the Arbuckle-College City area.[111] The 30 Non-Focus RMS wells are "[a]ll other RMS wells within the Subbasin that are not in close proximity to areas where undesirable results have occurred with respect to chronic lowering of groundwater levels."[112] Department staff note the 2024 GSP identifies that the Orland-Artois and Arbuckle-College City focus areas are where majority of groundwater pumping occurs,[113] and these areas have experienced dry wells[114] and subsidence.[115] Staff note that by defining Focus and Non-Focus RMS wells, the GSAs are attempting to manage areas that are more susceptible to undesirable results more aggressively.

The 2024 GSP has redefined minimum thresholds based on minimum groundwater elevations during the 2020 to 2022 period.[116] The GSAs have established minimum thresholds for Focus RMS wells and Non-Focus RMS wells. The 2024 GSP defines the minimum thresholds as the 2020-2022 minimum groundwater elevation as that RMS well for Focus RMS wells and the 2020-2022 minimum groundwater elevation at each Non-Focus RMS well, minus a margin of 15-25 feet.[117]

The 2024 GSP defines interim milestones that include a 2027 milestone that is lower than the minimum threshold.[118] The 2024 GSP states that its interim milestones are "intended to provide a glidepath towards sustainability over the implementation horizon by providing progressive targets for groundwater levels every five years after GSP submittal."[119] The 2024 has established interim milestones for both Focus and Non-Focus RMS wells to achieve the 2024 GSP's measurable objective. As stated, "[t]he measurable objective for all RMS wells is the 2011-2015 average groundwater elevation at that RMS well."[120] For Focus RMS wells, the 2024 GSP has established interim milestones in a ramp down approach to allow time for groundwater levels to decline until 2027 before project and management action implementation is planned to raise water levels to the minimum thresholds by 2032 and the measurable objectives by 2042.[121] The Focus RMS wells interim milestones are defined as:

- "2027: A level below the minimum threshold determined by the last 20-year rate of groundwater elevation change at the RMS well (i.e., minimum threshold – 5 years x (2004-2023 average feet/year)). If 20 years of data is not available at the RMS

[110] 2024 Colusa GSP, Section 5.3.1.2, p. 337.
[111] 2024 Colusa GSP, Section 5.3.1.2, p. 337.
[112] 2024 Colusa GSP, Section 5.3.1.2, p. 337.
[113] 2024 Colusa GSP, Section 2.1.3, p. 140.
[114] 2024 Colusa GSP, Section 5.4.1.1, p. 361.
[115] 2024 Colusa GSP, Section 3.2.6, Figure 3-31, p. 247.
[116] 2024 Colusa GSP, Section 5.4.1, pp. 359-371.
[117] 2024 Colusa GSP, Section 5.4.1.1, pp. 360 and 362.
[118] 2024 Colusa GSP, Section 5.4.1.1, Table 5-3, pp. 364-365; Section 5.4.1.4, pp. 370-371.
[119] 2024 Colusa GSP, Section 5.4.1.4, p. 370.
[120] 2024 Colusa GSP, Section 5.4.1.2, p. 370.
[121] 2024 Colusa GSP, Section 5.4.1.4, p. 371.

well, the 2027 interim milestone is calculated using the average 20-year rate of groundwater change for surrounding RMS wells.

- 2032: Interim milestone is equal to the minimum threshold.
- 2037: Interim milestone is 50% between the minimum threshold and the measurable objective."[122]

For Non-Focus RMS wells, the GSAs have set interim milestones based on "[g]roundwater levels at the Non-Focus RMS wells [remaining] generally stable over time, which is attributed to the historical availability and reliability of substantial surface water supplies available to water districts and other water rights holders in the Subbasin."[123] For Non-Focus RMS wells, "the 2027, 2032, and 2037 interim milestones for all Non-Focus RMS wells have been defined as equal to the measurable objectives at each RMS well."[124] The 2024 GSP shows the minimum thresholds and measurable objectives for all 48 RMS wells on hydrographs in Appendix 3.A.[125]

To successfully implement such a management program, GSAs are required to fully and thoroughly describe undesirable results that may occur prior to achieving sustainability, implement necessary projects and management actions to eliminate those undesirable results, and show measurable progress in annual reporting. The 2024 GSP provides information detailing how the proposed management of lowering groundwater levels below minimum thresholds for an extended period will affect the interests of beneficial uses and users of groundwater in the Subbasin. As discussed in Section 4.2.2.1, during the period when interim milestones exceed minimum thresholds, the GSAs plan to implement a domestic well mitigation program to assist impacted users that effectively manages the effects of the undesirable results that are expected to occur.

Based on a review of the information found in the 2024 GSP and Annual Reports, Department staff conclude that at this time the GSAs have sufficiently addressed corrective action 2b. Staff concur with the 2024 GSP's decision to set minimum thresholds at the 2020 to 2022 minimum groundwater elevations. Empirical data from the Subbasin shows the Subbasin experienced relatively large groundwater level declines in focus areas during the 2020 to 2022 period. By setting minimum thresholds at these lows, the GSAs have demonstrated efforts to minimize the chronic lowering of groundwater.

Department staff note that the GSAs have not described their process to delineate focus areas clearly, but do note the 2024 GSP states that "the boundary does not intend to delineate the extents of focus areas, but instead was used to select Focus and Non-Focus RMS wells."[126] Staff appreciate the intent behind the statement, but note that the spatial nature of Focus and Non-Focus areas may be used in the future to qualify sustainable

[122] 2024 Colusa GSP, Section 5.4.1.4, p. 371.
[123] 2024 Colusa GSP, Section 5.4.1.4, p. 371.
[124] 2024 Colusa GSP, Section 5.4.1.4, p. 371.
[125] 2024 Colusa GSP, Appendix 3.A, pp. 2294-2341.
[126] 2024 Colusa GSP, Section 5.4.1.1, p. 360.

management criteria on newly selected RMS wells. Because focus areas drive the selection of minimum thresholds and interim milestones, their delineation must consider the beneficial uses and users of groundwater in the Subbasin, as required by the GSP Regulations.[127] Staff recommend the GSAs clearly delineate the criteria used to establish boundaries of focus areas with consideration of beneficial uses and users, so that the GSAs may use them to inform minimum threshold development on future representative monitoring wells as they are established (See Recommended Corrective Action 2b).

4.2.2.3 Corrective Action 2c – Interests of Beneficial Uses and Users

The Department's Incomplete Determination directed the GSAs that the Plan did not provide an evaluation of how minimum thresholds may affect the interests of beneficial uses and users of groundwater and did not provide a clear description of the circumstances under which such impacts would become significant and unreasonable to particular beneficial uses and users.[128] In response, the GSAs provided a detailed well impacts analysis.

To address this corrective action, the 2024 GSP included a well impacts analysis for both the 2022 and 2024 minimum thresholds.[129] The information and rationale relied upon to complete the well impact analysis is provided in an Appendix.[130] The table below provides the results of the analysis.

Table 1. Well Impacts Analysis at the 2022 and 2024 Minimum Thresholds[131]

Minimum Threshold Analysis	Total Wells Impacted, out of 6,347 total wells	Domestic Wells Impacted, out of 3,638 domestic wells
2022	721	589
2024	121	99

The impact analysis explained its approach to estimate potential impacts.[132] The analysis compared well completion report data to minimum thresholds at RMS wells. Well completion report data was aggregated by location into thiessen polygons around each RMS well. The analysis then compared an elevation 20 feet above the bottom of the perforation of each well if available or the bottom of the well if perforation information was not available to an estimated groundwater elevation based on a raster analysis of minimum threshold elevations.

In addition to the wells impacted at the 2024 GSP minimum thresholds, the analysis considered conditions at the 2027 interim milestone. The analysis estimates that an additional 67 drinking water wells to be potentially impacted at the 2027 interim milestones.[133] The GSAs depict the potentially impacted wells in a map which shows

[127] 23 CCR § 354.28(b)(4).
[128] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[129] 2024 Colusa GSP, Section 5.4.1.1, p. 366.
[130] 2024 Colusa GSP, Appendix 5.E, pp. 2708-2779.
[131] 2024 Colusa GSP, Appendix 5.E, p. 2710.
[132] 2024 Colusa GSP, Appendix 5.E, p. 2714.
[133] 2024 Colusa GSP, Appendix 5.E, p. 2718.

domestic wells potential impacts at Focus and Non-Focus RMS wells and all domestic wells.[134] The analysis summarizes potential impacts to different well types under different scenarios can be found in Table 3 and Figure 1 of Appendix 5.E.[135]

Department staff appreciate the GSAs' efforts to quantify and identity potentially impacted wells at minimum thresholds and interim milestones. The well impact analysis for both the 2022 and 2024 minimum thresholds shows significant reduction in potentially affected wells. Staff note that the GSAs have used the analysis to inform the 2024 GSP's well mitigation program, and this demonstrates the GSAs' commitment to mitigate potentially dry wells at the revised 2024 minimum thresholds and interim milestones.

Based on a review of the information found in the 2024 GSP and Annual Reports, Department staff conclude that the GSAs have sufficiently addressed corrective action 2c. The 2024 GSP includes a detailed analysis of potential impacts at the minimum threshold and interim milestones, provides a thorough description of the analysis performed, and presents the results of the analysis, which were used to inform the projects and management actions and undesirable result descriptions in the 2024 GSP.

4.2.2.4 Corrective Action 2d – Impacts to Land Subsidence

The Department's Incomplete Determination concluded that the 2022 GSP did not provide sufficient discussion on the relationship between the sustainable management criteria for the chronic lowering of groundwater levels and land subsidence.[136]

The 2022 GSP proposed minimum thresholds for the chronic lowering of groundwater levels included setting groundwater levels in several monitoring wells at levels greater than 50 feet below historic lows. The 2022 GSP stated, "[t]he minimum thresholds for groundwater levels are not expected to contribute to undesirable results for inelastic land subsidence, as they are protective of a range around historical groundwater elevations." [137] However, the incomplete determination noted the proposed 2022 minimum thresholds will likely lead to ongoing and potentially worsening land subsidence as water levels decline deeper than historic lows during plan implementation.[138]

The 2024 GSP has revised the minimum thresholds for the chronic lowering of groundwater levels "to be protective of groundwater conditions at 2020-2022 groundwater elevations… or near recent historical groundwater elevations with consideration of avoiding subsidence risk."[139] Groundwater levels in the Subbasin experienced declines during the 2020 to 2022 period, subsequently the Subbasin experienced subsidence in the Orland-Artois and Arbuckle-College City areas. By raising the minimum thresholds to

[134] 2024 Colusa GSP, Appendix 5.E, Figure 4, p. 2727.
[135] 2024 Colusa GSP, Appendix 5.E, Table 3, p. 2718 and Figure 1, p. 2719.
[136] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[137] 2022 Colusa GSP, Section 5.4.1.1.1, p. 286.
[138] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[139] 2024 Colusa GSP, Section 5.4.1.1, p. 369.

the lowest levels of groundwater elevations reported during the 2020 to 2022 period, the focus areas in the Subbasin should not experience new inelastic subsidence.

Department staff concur with the GSAs' rationale to reduce new inelastic subsidence from occurring by raising groundwater minimum thresholds to the minimum groundwater elevations reported during the 2020 to 2022 period. However, the GSAs have not considered how allowing water levels to drop below minimum thresholds to reach the 2027 interim milestones may affect other sustainability indicators (see Recommended Corrective Action 2c). A more detailed discussion on land subsidence can be found in Section 4.3 of this Staff Report.

Based on a review of the information found in the 2024 GSP and Annual Reports, Department staff conclude that at this time the GSAs have sufficiently addressed corrective action 2d, despite the recommended corrective action being provided.

4.2.3 Conclusion

Overall, Department staff believe the GSAs have taken sufficient action to address the identified deficiencies by refining the description of undesirable results, revising minimum thresholds and evaluating the effects to beneficial uses and users, and assessing how groundwater level minimum thresholds will impact land subsidence conditions. The undesirable result reflects a quantitative description of the depletion of supply. The well impact analysis presented in the 2024 GSP appears to be reasonable and supported with sufficiently detailed information, and the proposed well mitigation program is planned to address dry wells identified in the impact analysis. Despite the recommended corrective actions, staff conclude that the 2024 GSP's sustainable management criteria for lowering of groundwater levels sufficiently meets the requirements of the GSP Regulations.

4.3 Deficiency 3. The GSP does not establish sustainable management criteria for land subsidence in a manner substantially compliant with the GSP Regulations.

4.3.1 Corrective Action 3

The GSAs must provide a more detailed explanation and justification regarding the selection of the sustainable management criteria, monitoring method, and projects or management actions related to land subsidence. Department staff recommend the GSAs consider and address the following:

a) Identify facilities and/or structures, land uses and property interests that may be susceptible to impacts from land subsidence and should quantify the amount of land subsidence that would result in functional impacts to that infrastructure. The GSAs should describe the rationale and any analysis performed to inform the quantification of undesirable results in these areas. Provide maps and graphs

showing the extent and rate of land subsidence in the basin at the minimum threshold.[140]

b) Provide the information and criteria relied upon to establish and justify the minimum threshold.[141] Describe how the interests of beneficial uses and users may be affected if conditions reach minimum thresholds.[142]

c) Revise the individual minimum thresholds to identify the rate and extent of land subsidence that substantially interferes with surface land uses and may lead to undesirable results. Identify a cumulative amount of tolerable subsidence that, if exceeded, would substantially interfere with groundwater and land surface beneficial uses and users in the Subbasin. The GSAs should also explain how the rate and extent of any future subsidence permitted in the Subbasin may interfere with surface land uses.

d) Provide a clear schedule for more frequent land subsidence monitoring using the best available data and describe how the monitoring data will be evaluated to determine if undesirable results are occurring in the Subbasin. If the GSAs determine not to use available Interferometric Synthetic Aperture Radar (InSAR) data, the GSAs should provide support and justification for why an alternative approach that excludes InSAR data is reasonable and uses the best available information.

e) Provide specific details and schedule for projects or management actions that will be implemented to minimize or eliminate subsidence. The projects or management actions must be supported by best available information and science[143] and take into account the level of uncertainty associated with the Subbasin.[144]

4.3.2 Evaluation of Resubmitted Plan

4.3.2.1 Corrective Action 3a – Identify Facilities and Quantify the Amount of Subsidence Leading to Functional Impacts, Document the Extent and Rate of Subsidence at Minimum Thresholds

The Department's Incomplete Determination required the GSAs to identify facilities and/or structures, land uses and property interests that may be susceptible to impacts from land subsidence and quantify the amount of land subsidence that would result in functional impacts to that infrastructure as well as describing the rationale and any analysis performed to inform the quantification of undesirable results in these areas. In response, the GSAs developed an estimate of the amount of subsidence that would impact infrastructure.

[140] 23 CCR § 354.28(c)(5) et seq.
[141] 23 CCR § 354.28(b)(1).
[142] 23 CCR § 354.28(b)(4).
[143] 23 CCR § 354.44(c).
[144] 23 CCR § 354.44(d).

The 2022 GSP states that an undesirable result is "a result that would cause significant and unreasonable impacts to critical infrastructure over the planning and implementation horizon of this GSP."[145] Department staff found this undesirable results definition for land subsidence to be problematic as the 2022 GSP did not identify specific infrastructure that the GSAs deem "critical" or indicate what effect subsidence would have on that infrastructure and did not explain the point at which those impacts would become "significant and unreasonable."[146]

To address Department staff's concerns, the 2024 GSP has identified specific infrastructure that the GSAs deem critical. The 2024 GSP documents the process used to establish undesirable results, which included contacting agencies with critical infrastructure in the Subbasin. The results of the interviews are documented in Table 5-1 of the 2024 GSP, which provides the name of the agency contacted, identifies the agency's critical infrastructure, reports impacts, and identifies possible impacts reported from the interviews.[147] The GSAs interviewed public utility districts, counties, cities, irrigation districts, Pacific Gas and Electric, California Department of Transportation, and the Tehama Colusa Canal Authority. The 2024 GSP does not include formal correspondence from the contacted agencies indicating their infrastructure's susceptibility or lack of susceptibility to subsidence.

In response to the direction to identify facilities and/or structures, land uses and property interests that may be susceptible to impacts from land subsidence, the 2024 GSP provides a series of maps that show the extent of subsidence for water years 2021 to 2022 and 2022 to 2023.[148] However, the maps in the 2024 GSP do not depict the location of critical infrastructure identified by the GSAs that would be susceptible to subsidence. Critical infrastructure is identified in a separate table, but the location of that infrastructure is not shown in relation to areas of recent subsidence.[149]

Department staff recognize that the GSAs have made improvements to the GSP in terms of identifying critical infrastructure in the Subbasin and considering current and potential subsidence-induced impacts to that infrastructure; however, the Plan still does not directly identify the location of the critical infrastructure in relation to areas of subsidence. GSP Regulations require GSAs to describe potential effects on beneficial uses and users, land uses and property interests that may occur from undesirable results.[150] Without clear indication of the location of infrastructure that may experience functional impacts, it is unclear what infrastructure the GSAs have considered. The GSAs should clearly indicate the location of the specific infrastructure they have considered as part of their undesirable results. Department staff note the Department received a public comment that expressed concern over potential impacts to flood control facilities, and staff note that flood control

[145] 2022 Colusa GSP, Section 5.3.5.1, p. 278.
[146] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[147] 2024 Colusa GSP, Section 5.3.5.1, Table 5-1, pp. 347-348.
[148] 2024 Colusa GSP, Figure 5-1, p. 349.
[149] 2024 Colusa GSP, Figure 5-1, p. 349.
[150] 23 CCR § 354.26(b)(3).

does not appear to have been considered in the interviews, and recommend the GSAs consider all potentially affected infrastructure, and staff recommend the GSA consider flood infrastructure. Lastly, the GSP's focus on "critical" infrastructure is not necessarily in alignment with the statutory and regulatory scope of potential effects of subsidence that need to be considered, which broadly includes "land uses and property interests"[151] (see Recommended Corrective Action 3a).

Critical infrastructure certainly comes within this definition, but other factors such as flood frequency, flood patterns and flows, and flood depths also can be impacted by subsidence and may affect land uses and property interests. Accordingly, the GSAs should provide more details regarding how they determined certain infrastructure was or was not critical and broaden its consideration, analysis, and disclosure of how any further subsidence in parts of the Subbasin may affect land and surface uses (e.g., flood flows, etc.). If further analysis establishes that other land uses or property interests may be affected by subsidence, the GSAs should include a discussion of this and any changes to their proposed management of the Subbasin in the next periodic evaluation or annual reports (if earlier). Conversely, if additional land use and property interests are not implicated and the GSAs conclude that no management changes are necessary, the GSAs should include and support that conclusion in the next periodic evaluation (or annual reports if earlier).

The 2024 GSP provides the GSAs' rationale for the selection of their undesirable result identification criteria. The 2024 GSP indicates that the interviewed agencies agreed that cumulative land subsidence of two feet over any Public Land Survey System (PLSS) section after January 2024 would be an undesirable result.[152] A more detailed discussion on the information and criteria used to justify the amount of tolerable subsidence can be found in Section 4.3.2.3 of this Staff Report.

The 2024 GSP provides an updated definition of when an undesirable result related to subsidence is present. The 2024 GSP identifies that an undesirable result is considered to exist when either of the following occurs:

- "More than two feet of cumulative subsidence minimum threshold from January 2024 for any single PLSS section (i.e., one square mile or 640 acres), or"[153]
- "Ten or more contiguous PLSS sections in any configuration exceed the average rate of subsidence minimum threshold of 0.1 feet per year in two consecutive years."[154]

Department staff appreciate the GSAs' efforts to establish an undesirable result that includes a quantitative combination of minimum threshold exceedances. Staff recognize that selecting the spatial extent and rate or cumulative amount of subsidence that

[151] 23 CCR § 354.28(c)(5)(A).
[152] 2024 Colusa GSP, Section 5.3.5.1, p. 352.
[153] 2024 Colusa GSP, Section 5.3.5.1, p. 352.
[154] 2024 Colusa GSP, Section 5.3.5.1, p. 353.

represents an undesirable result is challenging and note that the GSAs have made considerable progress in their efforts to identify undesirable results related to subsidence in the Subbasin and that this is a significant action towards achieving sustainability. However, staff are concerned that the use of PLSS sections to identify the undesirable result for land subsidence is problematic, as PLSS sections are not associated with hydrogeologic conditions nor beneficial uses and users. Staff are not confident that using PLSS sections, which were established historically to divide and define land in an area, is an adequate approach to define an area of potential subsidence impacts in the Subbasin. GSP Regulations require GSAs to consider potential effects on beneficial uses and users, land uses and property interests that may occur from undesirable results,[155] yet the proposed PLSS section methods do not consider the locations of beneficial uses and users. Staff recommend the GSAs revise the definition of undesirable results to be based on the locations and scale of the beneficial uses and users, including the proximity to the locations of critical infrastructure as the GSAs have defined it, that the GSAs are considering while defining undesirable results (see Recommended Corrective Action 3b).

Department staff conclude that the 2024 GSP has shown sufficient action to respond to corrective action 3a. Staff are encouraged by the GSAs' efforts to quantify the spatial extent, rate, and cumulative amounts of subsidence. The GSAs have conducted interviews with local agencies to identify infrastructure and the amount of subsidence that would cause functional impacts to that infrastructure. Staff have provided corrective actions to the GSAs to clarify the locations of infrastructure that may be affected by subsidence and to refine the spatial extent of subsidence that is considered an undesirable result to consider beneficial uses and users.

4.3.2.2 Corrective Action 3b – Minimum Thresholds

The Department's Incomplete Determination required the GSAs to provide the information and criteria relied upon to establish and justify the minimum threshold for land subsidence,[156] and to describe how the interests of beneficial uses and users may be affected if conditions reach minimum thresholds.[157] In response, the GSAs developed criteria and considered beneficial uses and users to establish a rate and cumulative amount of subsidence for the minimum threshold.

The 2022 GSP relied upon the survey from 63 benchmarks in DWR's Sacramento Valley Monitoring Benchmark Network.[158] The minimum thresholds for land subsidence were not well supported by the best available data, as DWR's Sacramento Valley Monitoring Benchmark Network is not measured regularly. The 2022 GSP identified the minimum threshold was set at 0.5 feet per five years but did not provide criteria relied upon to establish the minimum threshold.[159]

[155] 23 CCR § 354.26(b)(3).
[156] 23 CCR § 354.28(b)(1).
[157] 23 CCR § 354.28(b)(4).
[158] 2022 Colusa GSP, Executive Summary, p. 49.
[159] 2022 Colusa GSP, Section 5.4.5.1, pp. 292-293.

The 2024 GSP now relies on InSAR data supplemented by additional subsidence monitoring. The GSAs have established minimum thresholds "based on consideration of historical subsidence using data available from DWR InSAR data and the Sacramento Valley Height Modernization Project" and "calculated as the maximum rate of subsidence due to groundwater withdrawal… above which conditions could collectively generate undesirable results in the Subbasin."[160] The 2024 GSP includes a new figure that depicts InSAR data from the 2018 to 2023 period, which appears to accurately depict subsidence in the Subbasin.[161] A more detailed discussion regarding the minimum thresholds for land subsidence and the information and criteria relied upon to establish those minimum thresholds can be found in the following section (Section 4.3.2.3).

4.3.2.3 Corrective Action 3c – Interests of Beneficial Uses and Users

The Department's Incomplete Determination advised the GSAs to identify the rate and extent of land subsidence that would substantially interfere with beneficial uses and users and lead to undesirable results and use that to revise minimum thresholds.[162] The GSAs should also explain how the rate and extent of any future subsidence permitted in the Subbasin may interfere with surface land uses and property interests. In response, the GSAs identified a rate, extent, and cumulative amount of tolerable subsidence that they used to inform minimum thresholds.

The 2022 GSP did not identify the rate, extent or cumulative amount of subsidence that would interfere with beneficial uses and users. In the Department's Incomplete Determination, Department staff noted the Subbasin has experienced significant recent subsidence and the areas that experienced subsidence contain infrastructure that the GSP identifies as susceptible to subsidence.[163]

The 2024 GSP has defined the minimum thresholds for the rate and extent of land subsidence as "[t]he average rate of subsidence in ten or more contiguous PLSS sections, in any configuration, exceeds 0.1 foot per year in two consecutive years."[164] The rate of subsidence was established based on "measured rates of subsidence and measured cumulative subsidence at two representative monitoring sites for groundwater levels in the Arbuckle and Artois areas, where InSAR has shown extensive inelastic subsidence since June 2015."[165] The GSAs provide the measured subsidence and sustainable management criteria for wells in Artois and Arbuckle in Figure 5-2 and Figure 5-3, respectively.[166] The historic rates of subsidence in these areas were greater than 0.1 foot per year, in 2021 and 2022. During this time, the Subbasin experienced an increase in subsidence with rates decreasing after the 2023 wet year.[167] The GSAs have set the

[160] 2024 Colusa GSP, Section 5.4.5.1, p. 374.
[161] 2024 Colusa GSP, Section 3.2.6, Figure 3-32, p. 248.
[162] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[163] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[164] 2024 Colusa GSP, Section 5.4.5.1, p. 375.
[165] 2024 Colusa GSP, Section 5.4.5.1, p. 376.
[166] 2024 Colusa GSP, Section 5.3.5.1, Figure 5-2 and Figure 5-3, pp. 350-351.
[167] 2024 Colusa GSP, Section 5.4.5.1, p. 376.

minimum threshold for the rate of subsidence at 0.1 foot per year as it "is determined to be appropriate to protect critical infrastructure and land uses, and beneficial users and uses from ongoing land subsidence due to groundwater withdrawal" and set the time period at two years based on the "rapid reduction in subsidence rates to pre-drought conditions after the 2020 to 2022 drought."[168] The 2024 GSP supports the criteria it uses for minimum thresholds by providing a table of feedback from local agencies that oversee infrastructure in the Subbasin.[169] This information is further described in Section 4.3.2.1 in this report.

While the GSAs have provided justification for the rate of subsidence, Department staff note the GSAs have not sufficiently explained why PLSS sections are being used to define the extent of land subsidence in the minimum threshold. Staff note that GSP Regulations require GSAs to describe how minimum thresholds shall affect the interests of beneficial uses and users[170] and to explain how the agency has considered those uses and interests in the agency's rational for establishing minimum thresholds.[171] As mentioned in Section 4.3.2.1 of this Staff Report, PLSS sections are not related to hydrogeology and do not consider the beneficial uses and users in the Subbasin. Additionally, staff are concerned that the established "ten or more contiguous PLSS sections in any configuration" in the definition may lead to an infinite number of configurations for the Subbasin to experience land subsidence that, if not contiguous, would not lead to a minimum threshold exceedance. Staff recommend the GSAs revise the minimum threshold for the extent of subsidence to refine the spatial extent to consider beneficial uses and users and infrastructure in the Subbasin (see Recommended Corrective Action 3c).

Department staff additionally note two consecutive years is not protective of beneficial uses and users, as subsidence impacts occur within a single year. Staff note that rates were over 2 inches per year in the 2018 to 2019 period[172] and over 2 feet over 10 years from 2008 to 2017[173] and if that subsidence occurred in a non-annually consecutive way, could lead to impacts to beneficial uses and users that is not considered an undesirable result by the GSAs. Staff note that the legislative intent of SGMA is to avoid or minimize subsidence[174] and requiring two years of consecutive subsidence does not meet that intent (see Recommended Corrective Action 3d).

The Department's Incomplete Determination also advised the GSAs to identify the total cumulative amount of subsidence that can occur without causing significant and unreasonable impacts to the beneficial uses and users of groundwater, surface land uses, and property interests, all of which must be clearly defined.[175]

[168] 2024 Colusa GSP, Section 5.4.5.1, p. 376.
[169] 2024 Colusa GSP, Figure 5-1, p. 349.
[170] 23 CCR § 354.28(b)(4).
[171] 23 CCR § 354.28(c)(5)(A).
[172] 2024 Colusa GSP, Figure 3-32, p. 248.
[173] 2024 Colusa GSP, Figure 3-31, p. 247.
[174] CWC § 10720(e).
[175] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.

To define a cumulative amount of tolerable subsidence, the 2024 GSP has set the minimum threshold as: "The average cumulative subsidence exceeds two feet over a single PLSS section starting from January 2024."[176] The cumulative rate of subsidence "is based on information provided by local water agencies and irrigation districts."[177] As stated, "According to [Tehama-Colusa Canal Authority] TCCA, 2 ft of additional subsidence is estimated to lead to loss of capacity or risk of collapse within the Tehama-Colusa Canal (a lined canal critical to surface water supply)."[178] Department staff note that key projects and management actions the 2024 GSP plans to implement to mitigate overdraft rely upon the Tehama Colusa Canal and that if subsidence were to reduce the capacity of the Tehama Colusa Canal, the GSAs may not be able to reach the 2024 GSP's sustainability goal or manage the Subbasin sustainably.

The 2024 GSP is ambiguous on using this information to set allowable or tolerable (i.e., not significant and unreasonable so as to constitute an undesirable result) rates or amounts of additional future subsidence under the apparent assumption or understanding that the TCC can withstand this amount of additional subsidence throughout its length and course in the Subbasin. However, the 2024 GSP does not include further information confirming or identifying the specific contact or source of this information and the time any such assessment was made or its intended scope or longevity. Staff recommend the GSAs collect formal correspondence from the agencies they contacted indicating the infrastructure's susceptibility or lack of susceptibility to subsidence as discussed in Section 4.3.2.1.

Department staff conclude that the GSAs have sufficiently responded to corrective action 3c. Based on a review of the information found in the 2024 GSP and Annual Reports, staff conclude that at this time the GSAs have sufficiently addressed components b and c of the third corrective action. Additional recommended corrective actions have been provided.

4.3.2.4 Corrective Action 3d – Land Subsidence Monitoring

The Department's Incomplete Determination informed the GSAs that the 2022 GSP did not provide a clear schedule for land subsidence monitoring and did not appear to be using the best available data when evaluating land subsidence conditions in the Subbasin.[179] In response, the 2024 GSP plans to use InSAR to monitor for subsidence.

The 2022 GSP relied upon DWR's Sacramento Valley Monitoring Benchmark Network,[180] which does not monitor frequently enough for the GSAs to understand subsidence in the Subbasin. The Sacramento Valley Monitoring Benchmark Network is not measured regularly, and the most recent survey from DWR's Sacramento Valley Monitoring

[176] 2024 Colusa GSP, Section 5.4.5.1, p. 375.
[177] 2024 Colusa GSP, Section 5.4.5.1, p. 376.
[178] 2024 Colusa GSP, Section 5.4.5.1, p. 376.
[179] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[180] 2022 Colusa GSP, Section 4.2.3.2, p. 251.

Benchmark Network is from 2017, which does not capture the land subsidence that occurred during the 2020 to 2022 drought.[181]

To address this corrective action, the 2024 GSP indicates land subsidence will be evaluated using InSAR data and will fill data gaps through the supplemental monitoring and resurvey at benchmarks, extensometers, and continuously operating global positioning system (CGPS) sites.[182] Department staff support this effort and encourage the GSAs to ensure there is adequate monitoring around critical infrastructure. The GSAs also plan to "monitor land subsidence to identify potential undesirable results as part of GSP annual reports and five-year periodic evaluations, and adapt GSP implementation, as needed, to avoid undesirable results."[183]

The GSAs have identified gaps in the InSAR data that will need to be supplemented "with measurements collected via installed monitoring sites" and the "supplemental measurements will provide information where InSAR is unable to measure subsidence due to impacts from agriculture or lack of reliable reflectors."[184] Data gaps occur when "[r]epeat measurements…impacted by disturbances to land surface from agricultural practices, areas with heavy vegetation, or loss of reflectors from which remote sensing can capture data" cannot be collected.[185] Locations where data gaps exist can be found in Figure 3-32[186] which "mostly coincide with the locations of wildlife refuges, waterway corridors, and ponded and permanent agriculture."[187]

The 2024 GSP provides detailed discussions on the land subsidence monitoring network and how the supplemental date will be evaluated to fill data gaps.[188] The GSAs provide descriptions of the land subsidence monitoring network and includes a table that shows the supplemental land subsidence monitoring sites in the Subbasin.[189] The table provides the monitoring site station identification with latitude and longitude coordinates, the monitoring frequency, the monitoring agency, and the monitoring site type. The supplemental land subsidence monitoring site locations in the Subbasin are also depicted in Figure 4-4.[190] Department staff recommend the GSAs' endeavor to fully monitor the Subbasin for subsidence and encourage the GSA's efforts to identify and fill data gaps in land subsidence monitoring, so that the GSA has sufficient monitoring to identify subsidence near critical infrastructure.

The 2024 GSP has additionally proposed a study "as one measure to close data gaps related to subsidence and its potential effects on beneficial uses and users in the

[181] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[182] 2024 Colusa GSP, Section 5.3.5.1, p. 352.
[183] 2024 Colusa GSP, Section 5.3.5.5, p. 354.
[184] 2024 Colusa GSP, Section 4.2.3.2, p. 311.
[185] 2024 Colusa GSP, Section 4.2.3.4, p. 317.
[186] 2024 Colusa GSP, Section 3.2.6, Figure 3-32, p. 248.
[187] 2024 Colusa GSP, Section 4.2.3.4, p. 317.
[188] 2024 Colusa GSP, Section 4.2.3, pp. 310-317.
[189] 2024 Colusa GSP, Section 4.2.3.2, Table 4-5, pp. 313-314.
[190] 2024 Colusa GSP, Section 4.2.3.2, Figure 4-4, p. 315.

Subbasin" and "would provide the GSAs better understanding of the infrastructure that is most at risk of interference from potential subsidence, and the possible impacts of interference on social, economic, transportation, and other activities in the Subbasin."[191] This study will be carried out in addition to the formation of the Critical Infrastructure Working Group as described in the following section (Section 4.3.2.5).

Department staff are encouraged by the GSAs utilizing InSAR data to evaluate land subsidence in the Subbasin instead of surveys from DWR's Sacramento Valley Subsidence Monitoring Benchmark Network. By opting to use InSAR data, the GSAs appear to be using the best available data and have an accurate understanding of current subsidence conditions in the Subbasin. Staff conclude that the GSAs have sufficiently addressed corrective action 3d.

4.3.2.5 Corrective Action 3e – Projects and Management Actions

The Department's Incomplete Determination informed the GSAs that Department staff identified deficiencies related to the projects and management actions that will be implemented to minimize or eliminate subsidence, and directed the GSAs to provide specific details and schedule for projects or management actions that will be implemented to minimize or eliminate subsidence. [192] The GSAs did not specify what actions would be taken to mitigate subsidence in the 2022 GSP.

The 2024 GSP explains how the GSAs will implement projects to minimize or eliminate subsidence. The 2024 GSP identified the establishment of a Colusa Subbasin Critical Infrastructure Working Group, and established trigger levels to take additional actions to slow down or stop the progression of further subsidence beyond what has been prescribed through defined projects and management actions.

The Colusa Subbasin Critical Infrastructure Working Group will "be open to entities owning or operating critical infrastructure in the Subbasin."[193] The Critical Infrastructure Working Group will "report on suspected impacts to critical infrastructure and land uses suspected to be due to land subsidence caused by groundwater withdrawal, report on progress of [projects and management actions] and GSP Study implementation, and provide information vital for refining subsidence sustainable management criteria."[194] The 2024 GSP commits the Critical Infrastructure Working Group to "meet at least annually at the conclusion of the water year to assess critical infrastructure in the Subbasin" with additional meetings based on subsidence conditions[195] and will include infrastructure assessments in the GSP annual reports and five-year periodic evaluations.[196]

In addition to implementing the demand management program discussed in Section 4.1.2, the 2024 GSP has established trigger levels based on the minimum thresholds for

[191] 2024 Colusa GSP, Section 7.1.2.15, pp. 525-526.
[192] https://sgma.water.ca.gov/portal/service/gspdocument/download/9960.
[193] 2024 Colusa GSP, Section 7.1.2.15, p. 526.
[194] 2024 Colusa GSP, Section 7.1.2.15, p. 526.
[195] 2024 Colusa GSP, Section 7.1.2.15, p. 526.
[196] 2024 Colusa GSP, Section 5.3.5.5, p. 354.

both the annual rate of subsidence and the maximum amount of cumulative subsidence.[197] The trigger levels are in addition to sustainable management criteria, and are defined by the 2024 GSP as "Yellow Light" and "Red Light." Yellow Light conditions are defined as:

- "Cumulative subsidence due to groundwater withdrawal exceeding one foot averaged over any one single PLSS section… from January 2024 or
- [A]verage rate of subsidence in ten or more contiguous PLSS sections…, in any configuration, exceeds 0.1 foot per year in the previous water year."[198]

When Yellow Light conditions are triggered, the Critical Infrastructure Working group will meet to

- "[A]ssess what factors may be contributing to land subsidence, and
- [T]ake additional actions to slow down or stop the progression of further subsidence beyond what has been prescribed through defined [projects and management actions] and implementation actions defined in Chapters 6 and 7."[199]

Red Light conditions are defined as:

- "Cumulative subsidence due to groundwater withdrawal exceeding two feet averaged over any one single PLSS section… from January 2024 or
- [A]verage rate of subsidence in ten or more contiguous PLSS sections… in any configuration, exceeds 0.1 foot per year in the previous two consecutive water years."[200]

When Red Light conditions are triggered, the GSAs will initiate a meeting of the Critical Infrastructure Working Group "to follow actions outlined under Yellow Light conditions, and initiate immediate action," which will "include initiation (or increased focus) of projects and management actions targeting the impacted PLSS sections, including demand management and enforced groundwater allocation, as described in the Demand Management Program in Section."[201]

Department staff appreciate the GSAs' efforts to mitigate land subsidence by establishing trigger levels; however, staff note the trigger levels allow undesirable result conditions to occur before the GSAs take firm actions to mitigate land subsidence. Staff note the 2024 GSP states the sustainability goal for the Subbasin is "… to maintain, through a cooperative and partnered approach, locally managed sustainable groundwater resources to preserve and enhance the economic viability, social well-being and culture

[197] 2024 Colusa GSP, Section 5.4.5.1, pp. 375-376.
[198] 2024 Colusa GSP, Section 5.4.5.1, p. 375.
[199] 2024 Colusa GSP, Section 5.4.5.1, p. 376.
[200] 2024 Colusa GSP, Section 5.4.5.1, p. 376.
[201] 2024 Colusa GSP, Section 5.4.5.1, p. 376.

of all Beneficial Uses and Users, without experiencing undesirable results." [202] Undesirable results, per GSP Regulations, occur when significant and unreasonable effects are caused by groundwater conditions occurring throughout the basin. [203] Furthermore, the GSP Regulations require the numeric value used to define minimum thresholds to represent a point in the basin that, if exceeded, may cause undesirable results. [204] Therefore, allowing minimum thresholds to occur, which may cause undesirable results through significant and unreasonable effects from land subsidence, before implementing mitigation measures does not align with the 2024 GSP's sustainability goal or GSP Regulations, both of which aim to avoid undesirable results. The GSAs should not wait until minimum thresholds are experienced to begin taking action to mitigate land subsidence. Staff recommend the GSAs redefine conditions for Yellow- and Red-Light Triggers to take action so that the actions feasibly may prevent reaching an undesirable result condition (see Recommended Corrective Action 3e).

Department staff also note that the trigger levels rely upon PLSS sections to trigger a "yellow light" or "red light" condition. Staff note that PLSS sections may not represent beneficial uses and users accurately as described in Section 4.3.2.1. However, staff additionally note that trigger levels are not regulatorily-required sustainable management criteria and GSAs may choose how they wish to implement their projects and management actions using non-regulatorily driven methods. Therefore, staff recommend the GSAs consider revising the spatial area used to inform trigger levels to be consistent with the sustainable management criteria and consider beneficial uses and users, but this recommendation is not a recommended corrective action.

Based on a review of the information found in the 2024 GSP and Annual Reports, Department staff conclude that at this time the GSAs have sufficiently addressed corrective action 3e, if the GSAs sufficiently address the corrective actions identified.

4.3.3 Conclusion

Overall, Department staff believe the GSAs have taken sufficient action to address the identified deficiencies by explaining and justifying the selection of the sustainable management criteria, monitoring method, and projects or management actions related to land subsidence. The sustainable management criteria for land subsidence are well explained and justified through the best available data and science. Staff are also encouraged by GSAs efforts to slow or stop land subsidence and fill data gaps. Despite the recommended corrective actions, staff conclude that the 2024 GSP's sustainable management criteria for land subsidence, monitoring methods, and projects and management actions related to land subsidence sufficiently meet the requirements of the GSP Regulations.

[202] 2024 Colusa GSP, Section 1.2, p. 114.
[203] 23 CCR § 354.26(a).
[204] 23 CCR § 354.28(a).

5 PLAN EVALUATION

As stated in Section 355.4 of the GSP Regulations, a basin "shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act." The Department's assessment is based on a number of related factors including whether the elements of a GSP were developed in the manner required by the GSP Regulations, whether the GSP was developed using appropriate data and methodologies and whether its conclusions are scientifically reasonable, and whether the GSP, through the implementation of clearly defined and technically feasible projects and management actions, is likely to achieve a tenable sustainability goal for the basin.

The Department staff's evaluation of the likelihood of the Plan to attain the sustainability goal for the Subbasin is provided below. Department staff consider the information presented in the Plan to satisfy the general requirements of the GSP Regulations.

5.1 ADMINISTRATIVE INFORMATION

The GSP Regulations require each Plan to include administrative information identifying the submitting Agency, its decision-making process, and its legal authority;[205] a description of the Plan area and identification of beneficial uses and users in the Plan area;[206] and a description of the ability of the submitting Agency to develop and implement a Plan for that area.[207]

The 2024 GSP provides a description of the Colusa Subbasin plan area as being in the Sacramento Valley Groundwater Basin and has been identified by the Department as a high priority basin. The Subbasin is bounded by Stony Creek to the north, the Coast Ranges to the west, the Sacramento River to the east, and the Colusa-Yolo County boundary and the Colusa County Water District to the south.[208] The Subbasin has publicly owned and tribal lands, shown in Figure 2-5 of the 2024 GSP.[209] Majority of the communities in the Subbasin are either disadvantaged or severely disadvantaged communities, with nearly the entire Subbasin being considered an economically distressed area.[210]

The 2024 GSP identifies the submitting agencies for the Colusa Subbasin. The Subbasin is managed by two GSAs, the Colusa and Glenn Groundwater Authority GSAs, who have collaboratively developed a single GSP for the Subbasin.[211] The Colusa Groundwater Authority (CGA) GSA covers the Colusa County portion of the Subbasin and is a Joint Powers Authority (JPA) comprised of 12 member agency representatives/Directors

[205] 23 CCR § 354.6 *et seq*.
[206] 23 CCR § 354.8 *et seq*.
[207] 23 CCR § 354.6(e).
[208] 2024 Colusa GSP, Section 2.1.1, p. 126.
[209] 2024 Colusa GSP, Figure 2-5, p. 137.
[210] 2024 Colusa GSP, Section 2.1.2.3, Figure 2-6, p. 138.
[211] 2024 Colusa GSP, ES, p. 82.

seats.[212] Similarly, the Glenn Groundwater Authority GSA is a JPA for the Glenn County portion of the Subbasin and includes ten member agency representatives.[213] The Subbasin is served by cities, special districts, mutual water companies, reclamation districts, and investor-owned water utilities who provide water for urban, agricultural, and environmental resource uses.[214]

A map showing the Subbasin and adjacent subbasins is shown in Figure 1 below.

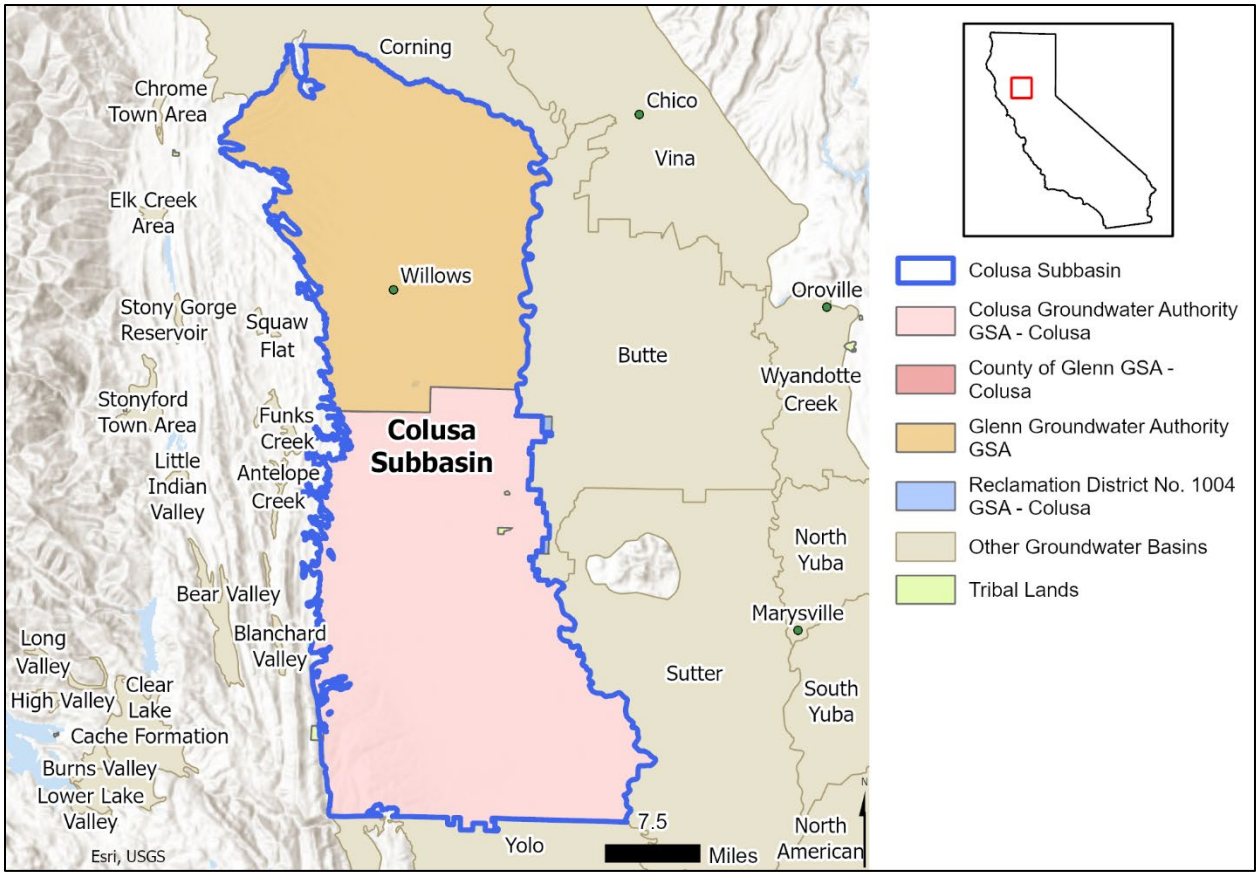

Figure 1: Colusa Subbasin Location Map.

The land use areas in the Subbasin are broadly classified across three sectors: agricultural, urban, and native vegetation.[215] The 2024 GSP includes a table showing land use classes by water use sector.[216]

The 2024 Plan includes maps that depict the density of wells (domestic, agricultural, and public supply) for the entire Subbasin in Figure 2-7 prepared from the Department's Online System of Well Completion Reports (OWSCR) database.[217] The 2024 GSP states:

[212] 2024 Colusa GSP, Section 2.1.2, Figure 2-3, p. 131.
[213] 2024 Colusa GSP, Section 2.1.2, p. 129.
[214] 2024 Colusa GSP, Section 2.1.2.1, Table 2-2, p. 133 and Table 2-3, p. 135.
[215] 2024 Colusa GSP, Section 2.1.3, Figure 2-8, p. 141.
[216] 2024 Colusa GSP, Appendix 3.D., Table 2-2, p. 2380.
[217] 2024 Colusa GSP, Section 2.1.2.4, Figure 2-7, p. 140.

"Public water supply wells are mostly concentrated in urban areas near cities and towns. Domestic water supply wells are more spread out throughout the Subbasin but occur in higher numbers surrounding urban areas and along the Sacramento River. The densest square mile concentration of domestic wells exceeds 100 wells and occurs near Orland. Agricultural wells are more widespread than public wells and tend to be concentrated outside the urban areas. The densest square mile concentration of agricultural wells exceeds 10 wells, an order of magnitude less than that of domestic wells."[218]

The 2024 GSP provides a discussion on the legal authority of the GSAs in the Subbasin and provides an estimate of the annual costs of implementing the GSP. The 2024 GSP states, "On May 14, 2018, the CGA and GGA notified DWR of their intent to prepare a GSP for the Subbasin (5-021.52)" and "[t]he preparation of the GSP is being coordinated and overseen by the GSAs."[219] The total cost estimated for implementing the Plan from 2022-2027 is $45,699,400.[220] This estimate includes GSA administrative costs, technical studies for annual updates, five-year reporting requirements, and project and management actions – a significant portion of the project operations and maintenance cost is due to water purchasing.[221] The 2024 GSP explains that funding for GSP implementation will come from fees, assessments, taxes, grants, and low-interest borrowing.[222] The 2024 GSP states, "The Subbasin GSAs will develop a financing plan for the overall implementation of the GSP that will specify funding sources and cost-allocation approaches across entities for the different GSP implementation activities."[223]

The 2024 GSP describes the existing water resource monitoring and management programs in the Subbasin, their incorporation into the GSP or monitoring network, and the possible effect on operational flexibility. The 2024 GSP provides discussion and or lists over twenty water planning documents, including Regional Water Plans, Water Management Plans, Urban Water Management Plans, Groundwater Management Plans, Drought Management Plans, General Plans, and Municipal Service Reviews.[224] Surface water monitoring and management programs include (1) Federal, State, and Regional Programs (e.g., National Water Information System, Water Data Library); Local Programs (e.g., Colusa County Water District's Supervisory Control and Data Acquisition); Efficient Water Management Practices; and the Irrigated Lands Regulatory Program.[225] Groundwater monitoring and management programs include monitoring of levels (e.g., National Water Information System, California's Statewide Groundwater Elevation Monitoring Program), and quality (e.g., National Water Information System, Water Data Library, Public Water Agencies and Municipalities, GeoTracker and GeoTracker

[218] 2024 Colusa GSP, Section 2.1.2.4, p. 139.
[219] 2024 Colusa GSP, Section 1.3.2, p. 116.
[220] 2024 Colusa GSP, Section 1.3.3, p. 116, Table 1-1 117.
[221] 2024 Colusa GSP, Section 1.3.3, p., Appendix 7A, pp. 2889-2900.
[222] 2024 Colusa GSP, Section 1.3.3, p. 117.
[223] 2024 Colusa GSP, Section 1.3.3, p. 117.
[224] 2024 Colusa GSP, Section 2.2.1.1, pp. 142-145.
[225] 2024 Colusa GSP, Section 2.2.1,2, pp. 146-147.

Groundwater Ambient Monitoring and Assessment).[226] Numerous networks monitor land subsidence, including Interferometric Synthetic Aperture Radar, Continuous Global Positioning System Benchmarks, Extensometers, and the Sacramento Valley Height-Modernization Project.[227] The 2024 GSP identifies conjunctive water use programs that support groundwater management throughout the Subbasin (e.g., agricultural water purveyors with highly reliable and adequate surface water supplies, Central Valley Project Water Service Contractors along the Tehama Colusa Canal, and transfers of temporarily available excess surface water from some agricultural water purveyors to others who desire to use more surface water to conserve groundwater supplies).[228] The 2024 GSP declares that existing water resource monitoring and management programs may limit operational flexibility, including design criteria, flood control programs, groundwater pumping, and surface water supply – coordination with the entities and their programs will support GSP implementation.[229]

The 2024 GSP's discussion and presentation of administrative information covers some of the items listed in the GSP Regulations in an understandable format using appropriate data. However, the content provided for GSP Regulations does not contain pertinent information for the following: (1) the name and contact information, including the phone number, mailing address, and electronic mail address, of the plan manager; and (2) the legal authority of the Agencies, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agencies, demonstrating that the Agencies have the legal authority to implement the Plan (see Recommended Corrective Action 4). Department staff conclude that despite the corrective action, the administrative information included in the Plan substantially complies with the requirements outlined in the GSP Regulations.

5.2 Basin Setting

GSP Regulations require information about the physical setting and characteristics of the basin and current conditions of the basin, including a hydrogeologic conceptual model; a description of historical and current groundwater conditions; and a water budget accounting for total annual volume of groundwater and surface water entering and leaving the basin, including historical, current, and projected water budget conditions.[230]

5.2.1 Hydrogeologic Conceptual Model

The hydrogeologic conceptual model is a non-numerical model of the physical setting, characteristics, and processes that govern groundwater occurrence within a basin, and represents a local agency's understanding of the geology and hydrology of the basin that support the geologic assumptions used in developing mathematical models, such as

[226] 2024 Colusa GSP, Section 2.2.1.3, pp. 148-149.
[227] 2024 Colusa GSP, Section 2.2.1.3, p. 150.
[228] 2024 Colusa GSP, Section 2.2.4, p. 151.
[229] 2024 Colusa GSP, Section 2.2.2, p. 150.
[230] 23 CCR § 354.12 *et seq*.

those that allow for quantification of the water budget.[231] The GSP Regulations require a descriptive hydrogeologic conceptual model that includes a written description of geologic conditions, supported by cross sections and maps,[232] and includes a description of basin boundaries and the bottom of the basin,[233] and data gaps.[234]

The 2024 GSP provides a description of the Subbasin's hydrogeologic conceptual model and provides a summary of the geologic history of the region. The Colusa Subbasin is located in the northern Sacramento Valley, which began as a marine basin in the Late Jurassic and experienced a series of mountain building events before reaching its current form after the uplift of the Coast Ranges in the Pliocene.[235] The Great Valley Sequence comprises the structural base of the Subbasin which is overlain by groundwater-bearing units that contain either fresh or brackish water depending on depositional environment.[236] The Subbasin contains many north-south trending faults and folds due to the transition from a subduction zone to a transform zone during the Eocene.[237]

The 2024 GSP describes geologic conditions and states that stratigraphic and structural features of the aquifer have the potential to affect groundwater flow in the Subbasin.[238] For example, the Willows and Corning faults may be impeding or enabling groundwater flow in the aquifer system.[239] Folds in the Subbasin, such as the Zamora Syncline, can also indicate areas of increased or decreased permeability in the aquifer. However, changes in permeability and aquifer connectivity associated with specific faults or folds in the Subbasin have not been quantified.[240]

The 2024 GSP includes five cross sections that display the major stratigraphic and structural features in the Subbasin, including the geometry of the significant geologic units and a map showing cross-section locations.[241] The 2024 Plan states that the cross sections are based on a 2014 DWR report focused on the geology of the Northern Sacramento Valley[242] and have been revised, added, and/or extended by incorporating additional land surface information, well completion reports, and other geologic references specific to the Subbasin.[243] The five cross sections depict pre-Paleogene and

[231] DWR Best Management Practices for the Sustainable Management of Groundwater: Hydrogeologic Conceptual Model, December 2016: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-3-Hydrogeologic-Conceptual-Model_ay_19.pdf.
[232] 23 CCR §§ 354.14(a), 354.14 (c).
[233] 23 CCR § 354.14(b)(4) *et seq.*
[234] 23 CCR § 354.14(b)(5).
[235] 2024 Colusa GSP, Section 3.1.7.1, pp. 189 and 198.
[236] 2024 Colusa GSP, Section 3.1.7.1, p. 189.
[237] 2024 Colusa GSP, Section 3.1.7.1, p. 198.
[238] 2024 Colusa GSP, Section 3.1.9, p. 208.
[239] 2024 Colusa GSP, Section 3.1.9.2, p. 208.
[240] 2024 Colusa GSP, Section 3.1.9.3, p. 208.
[241] 2024 Colusa GSP, Figures 3-10 to 3-13, pp. 191-194.
[242] 2024 Colusa GSP, Section 3.1.7.1, p. 189 and DWR, 2014, Geology of the Northern Sacramento Valley, California Department of Water Resources Northern Region Office.
[243] 2024 Colusa GSP, Section 3.1.7.1, p. 189 and Figure 3-10, p. 191.

Cretaceous rocks, including the Great Valley Sequence, as "a major component of the structural base of the subbasin."[244] Groundwater-bearing formations overlie this structural base and include the Tehama Formation, Tuscan Formation, Ione Formation, Lovejoy Basalt, and Upper and Lower Princeton Valley Fills.[245] Department staff note the Plan provides sufficiently detailed cross-sections that display the information required by GSP Regulations and are sufficient to depict major stratigraphic and structural features in the Subbasin.

The 2024 GSP describes the Subbasin's lateral boundaries and describes the bottom of the Subbasin. The 2024 GSP states that the Subbasin is bounded by the Colusa-Yolo County line to the south, Stony Creek and the Coast Ranges to the west, and the Sacramento River to the east, except for some land that is within Colusa County but east of the Sacramento River.[246] The northern boundary of the Subbasin is defined by Stony Creek in the Glenn County portion of the Subbasin and the Glenn-Tehama County line where Stony Creek is within Tehama County.[247] The 2024 GSP explains that the bottom of the Subbasin can be defined either physically or chemically. Physically, it can be delineated by the elevation contours of Cretaceous-age igneous crystalline and metasedimentary rocks where data are available and the top of Cretaceous rocks in locations where data are limited.[248] Chemically, it can be delineated by the base of fresh water which is determined by specific conductance values in exceedance of 3,000 microohms or 2,000 milligrams per liter [mg/L] total dissolved solids [TDS].[249] The 2024 GSP recognizes that different TDS values are used to define the "base of fresh water" in different studies, and this inconsistency represents a data gap that will be addressed in the future.[250] Department staff conclude that the 2024 GSP's discussion and presentation of information of the regional and structural setting and lateral boundaries as it pertains to major geologic features that affect groundwater flow covers the specific items listed in the regulations in an understandable format using appropriate data.

The 2024 GSP states that the Subbasin has one principal aquifer that contains unconfined, semiconfined, and confined zones that are interconnected.[251] The unconfined to semi-confined portion of the principal aquifer is approximately 200 feet thick and contains unconsolidated to semi-consolidated sediments of the Riverbank and Modesto Formations.[252] The confined portion of the principal aquifer contains the Tehama Formation, the Tuscan Formation, and part of the Upper Princeton Valley Fill.[253] The

[244] 2024 Colusa GSP, Section 3.1.7.1, p. 189.
[245] 2024 Colusa GSP, Figures 3-10 to 3-13, pp. 191-194.
[246] 2024 Colusa GSP, Section 3.1.8.1, p. 205.
[247] 2024 Colusa GSP, Section 3.1.8.1, p. 205.
[248] 2024 Colusa GSP, Section 3.1.8.2, pp. 205-206 and Harwood and Helley, 1987. Late Cenozoic Tectonism of the Sacramento Valley, California., U.S. Geological Survey Professional Paper 1359.
[249] 2024 Colusa GSP, Section 3.1.8.2, p. 206 and Olmsted and Davis, 1961, Geologic Features and Ground-Water Storage Capacity of the Sacramento Valley, California, U.S. Geological Survey.
[250] 2024 Colusa GSP, Section 3.1.8.2, p. 206.
[251] 2024 Colusa GSP, Section 3.1.10, p. 209.
[252] 2024 Colusa GSP, Section 3.1.10.1, p. 210.
[253] 2024 Colusa GSP, Section 3.1.10.1, p. 210.

majority of the fresh groundwater in the Subbasin is contained within the Tehama Formation which consists of discontinuous sand and gravel lenses and can be up to 2,000 feet thick.[254] In the northeastern portion of the Subbasin, the Tuscan Formation is prevalent in an area referred to as the "Tehama-Tuscan Transition Zone." The two formations interface in this area which likely allows hydraulic connection between these two formations, but this transition is not well documented.[255] The 2024 Plan states that the Subbasin does not contain any principal aquitards that separate the system into multiple aquifers.[256] However, the Plan notes that both the Tehama and Tuscan Formations contain low-permeability sediments that may impede vertical groundwater flow within the single principal aquifer.[257]

The Plan identifies numerous data gaps in the hydrogeologic conceptual model including the lateral and vertical extent of freshwater-bearing geologic formations and the principal aquifer, hydraulic parameters of the principal aquifer, and the vertical extent of the base of fresh water.[258] The 2024 GSP states that additional subsurface data will be collected to better delineate the geologic formations including geophysical well logs, aeromagnetic and other geophysical investigation surveys, and evaluation of well completion reports.[259] Additionally, DWR's forthcoming analysis of the base of freshwater in the Central Valley (based on a TDS concentration of 1,000 mg/L) will be used to further refine the hydrogeologic conceptual model.[260] To fill data gaps in hydraulic parameters, the Plan states that additional pumping tests will be performed.[261] Department staff note that while the Plan discusses specific areas where there is uncertainty in the extent of geologic formations, it does not propose specific project and management actions that will be needed to address these needs.[262] Staff recommend the GSA include clear measures to address data gaps in identified in the hydrogeologic conceptual model (see Recommended Corrective Action 5).

Overall, Department staff believe the 2024 GSP sufficiently describes the hydrogeologic conceptual model for the Subbasin. Despite the recommended corrective action, staff conclude that the information included in the Plan substantially complies with the requirements outlined in the GSP Regulations.

5.2.2 Groundwater Conditions

The GSP Regulations require a written description of historical and current groundwater conditions for each of the applicable sustainability indicators and groundwater dependent ecosystems that includes the following: groundwater elevation contour maps and

[254] 2024 Colusa GSP, Section 3.1.10, p. 209.
[255] 2024 Colusa GSP, Section 3.1.10, p. 209.
[256] 2024 Colusa GSP, Section 3.1.10, p. 209.
[257] 2024 Colusa GSP, Section 3.1.10, p. 209.
[258] 2024 Colusa GSP, Section 3.1.12, p. 221.
[259] 2024 Colusa GSP, Section 3.1.12.1, p. 223.
[260] 2024 Colusa GSP, Section 3.1.12.1, p. 223.
[261] 2024 Colusa GSP, Section 3.1.12.2, p. 223.
[262] 2024 Colusa GSP, Section 3.1.12.1, p. 223 and Section 6.2.1, pp. 391-399.

hydrographs,[263] a graph depicting change in groundwater storage,[264] maps and cross-sections of the seawater intrusion front,[265] maps of groundwater contamination sites and plumes,[266] maps depicting total subsidence,[267] identification of interconnected surface water systems and an estimate of the quantity and timing of depletions of those systems,[268] and identification of groundwater dependent ecosystems.[269]

The 2024 GSP provides a description of current and historical groundwater elevation conditions within the Colusa Subbasin.[270] Groundwater data from 1974 through 2020 with contour maps of current groundwater elevation and elevation changes and hydrographs depicting long-term groundwater elevations are provided in the 2024 GSP.[271] The Plan also includes groundwater elevation contour maps for spring and fall of 2006, 2015, 2017, and 2020,[272] as well as a contour map showing the change in groundwater elevation from spring 2006 to spring 2017.[273] Department staff note the 2024 GSP states, "The rainy season is interpreted to be October through April" but does not indicate months associated with seasonal highs and lows for groundwater elevations.[274]

In total, the 2024 GSP provides 50 hydrographs that depict long-term groundwater elevations.[275] Hydrographs depict stable or declining elevations depending on their locations within the Subbasin. The 2024 GSP also includes several hydrographs where droughts and apparent recovery periods are labelled.[276]

The 2024 GSP includes a description of the change in groundwater storage and graphs demonstrating the annual and cumulative change in volume of groundwater storage between seasonal high groundwater conditions for the period of water years 1990 through 2015.[277] The 2024 GSP describes the change in storage as being generally negative during dry years and does not consistently increase during wet years.[278] The 2024 GSP states that the estimated maximum storage capacity in the Subbasin is approximately 140,000,000 AF, of which 13,000,000 AF is estimated within the upper 200 feet, with a total average estimated groundwater storage loss of approximately 28,000 AFY during water years 1990 through 2015.[279] Department staff note that this value is different than

[263] 23 CCR §§ 354.16(a)(1-2).
[264] 23 CCR § 354.16(b).
[265] 23 CCR § 354.16(c).
[266] 23 CCR § 354.16(d).
[267] 23 CCR § 354.16(e).
[268] 23 CCR § 354.16(f).
[269] 23 CCR § 354.16(g).
[270] 2024 Colusa GSP, Section 3.2.2, pp. 225-235.
[271] 2024 Colusa GSP, Section 3.2.2, Figures 3-22 to 3-28, pp. 227, 229-234.
[272] 2024 Colusa GSP, Appendix 3.B, pp. 2342-2355.
[273] 2024 Colusa GSP, Section 3.2.2, p. 229.
[274] 2024 Colusa GSP, Section 3.1.3, p. 174.
[275] 2024 Colusa GSP, Appendix 3.A, pp. 2290-2341.
[276] 2024 Colusa GSP, Section 3.2.2, Figures 3-22, 26:28, pp. 227, 232-234.
[277] 2024 Colusa GSP, Section 3.2.3, pp. 235-237.
[278] 2024 Colusa GSP, Section 3.2.3, pp. 235-236.
[279] 2024 Colusa GSP, Section 3.2.3, p. 235.

the overdraft estimate provided in response to Deficiency 1a because it is an estimate of a different time period, and that the estimated overdraft provided by the GSAs in response to Deficiency 1a is approximately -62,000 AFY for the 2016-2022 time period,[280] as discussed in Section 4.1.2.1 of this Staff Report. Staff note that all groundwater storage analysis is based on the basin boundary as modified in 2019, although staff find no explicit statement of this decision in the 2024 GSP or its appendices.

The 2024 GSP includes a discussion on groundwater conditions as it relates to water quality. The 2024 GSP identifies "salinity, TDS, adjusted sodium absorption ratio, arsenic, boron, hexavalent chromium, iron, manganese, and nitrate" as "constituents of concern" in the Subbasin.[281] The 2024 GSP provides maps of TDS measurements throughout the Subbasin in Figure 3-30, which show measurements mostly lower than 500 mg/L with an area of high TDS in the Maxwell-Colusa-Williams area.[282] The area between Williams and Colusa has elevated TDS, hexavalent chromium, iron, manganese, and sulfate.[283] The 2024 GSP states, "TDS concentrations in the shallow wells southwest of Colusa have consistently been greater than 2,000 mg/L over a 20-year period."[284]

The 2024 GSP also identifies areas in the Subbasin where constituents of concern with elevated concentrations have been reported. Arsenic has exceeded the federal and state Maximum Contaminant Level (MCL) of 10 micrograms per liter (µg/L) in Grimes and Princeton, and elevated concentrations appear to be localized around the Sutter Buttes.[285] Nitrate is elevated near Willows and in northern Glenn County with 2 percent of wells exceeding the 45-mg/L MCL.[286] Boron has locally elevated concentrations near the Maxwell-Willliams area, in the southern Glenn-Colusa Irrigation District service area.[287]

The 2024 GSP does not list sulfate as a constituent of concern but states, "Sulfate concentrations in [the Maxwell-Colusa-Williams] area have been measured above the 250-mg/L recommended secondary MCL, with the southern wells showing a long-term increasing trend in sulfate concentrations."[288] Department staff are unable to find an explanation of why sulfate is not considered by the GSAs to be a constituent of concern under these circumstances (see Recommended Corrective Action 6a).

GSP Regulations require GSAs to provide a map showing the location of contaminated sites. [289] The 2024 GSP provides a description of several active groundwater

[280] 2024 Colusa GSP, Section 3.3.6, p. 288.
[281] 2024 Colusa GSP, Section 3.2.5, p. 238.
[282] 2024 Colusa GSP, Section 3.2.5, Figure 3-30, p. 239.
[283] 2024 Colusa GSP, Section 3.2.5, pp. 239-242 and Figure 3-30, p. 239.
[284] 2024 Colusa GSP, Section 3.2.5, p. 240.
[285] 2024 Colusa GSP, Section 3.2.5, p. 241.
[286] 2024 Colusa GSP, Section 3.2.5, p. 243.
[287] 2024 Colusa GSP, Section 3.2.5, pp. 241-242.
[288] 2024 Colusa GSP, Section 3.2.5, p. 241; State Water Resources Control Board. 2020a. GeoTracker Groundwater Ambient Monitoring and Assessment (GAMA): California State Water Resources Control Board. Accessed at http://geotracker.waterboards.ca.gov/gama.
[289] 23 CCR § 354.16(d).

contamination cleanup sites, the largest of which is a 2-mile plume of perchloroethylene (PCE) in Orland; however, Department staff note that a map of groundwater contamination sites is not provided.[290] Staff recommend the GSAs provide a map showing the locations and extent of contaminant sites and plumes as part of the next periodic evaluation. A more detailed evaluation of water quality conditions as it relates to sustainable management criteria can be found in Section 5.3.2.4 of this Staff Report.

The 2024 GSP discussion on groundwater conditions provides information on land subsidence in the Subbasin. Land subsidence conditions in the Subbasin are monitored and evaluated using surveys from the Sacramento Valley Monitoring Benchmark Network and InSAR data, as discussed in Section 4.3.2.4. Land subsidence monitoring data from the Sacramento Valley Monitoring Benchmark Network during the 2008 to 2017 period is depicted in Figure 3-31.[291] Based on the data presented in the 2024 GSP, land subsidence has been reported near the Orland-Artois and Arbuckle-College City areas at an average annual rate of 0.14 ft/yr and 0.30 ft/yr, respectively.[292] Land subsidence monitoring InSAR data during the 2018 to 2023 period is depicted in Figure 3-32.[293] Based on the data presented in the 2024 GSP, land subsidence increased near the Orland-Artois and Arbuckle-College City areas during the 2019 to 2023 period with the highest rates coinciding with the 2020 to 2022 drought.[294] During the 2020 to 2022 drought, the annual rates in the Orland-Artois and Arbuckle-College City areas have been reported at 0.62 ft/yr and 0.88 ft/yr, respectively.[295]

The 2024 GSP provides some information about interconnected surface water, but Department staff note that this information appears incomplete.[296] GSP Regulations require GSAs to identify interconnected surface water systems within the basin and provide an estimate of the quantity and timing of depletions of those systems,[297] and should provide a map showing surface water bodies that are significant to the management of the basin.[298] The 2024 GSP provides a map and description of creeks in the Subbasin,[299] but does not provide information about the quantity and timing of depletions of those streams, and instead provides that information for three water bodies. The 2024 GSP uses the C2VsimFG-Colusa model to “analyze historical stream gains… and losses… in waterways that flow within or along the boundaries of the Subbasin” and modeled the Sacramento River, Stoney Creek, and the Colusa Drain.[300] The 2024 GSP provides a table showing gains in flow for the Colusa Drain and Sacramento River and

[290] 2024 Colusa GSP, Section 3.2.5.3, p. 243.
[291] 2024 Colusa GSP, Section 3.2.6, Figure 3-31, p. 247.
[292] 2024 Colusa GSP, Section 3.2.6, p. 246.
[293] 2024 Colusa GSP, Section 3.2.6, Figure 3-32, p. 248.
[294] 2024 Colusa GSP, Section 3.2.6, p. 246.
[295] 2024 Colusa GSP, Section 3.2.6, p. 246.
[296] 2024 Colusa GSP, Section 3.2.7, pp 249-253.
[297] 23 CCR § 354.16(f).
[298] 23 CCR § 354.14(d)(5).
[299] 2024 Colusa GSP, Figure 3-5, p. 179; Section 3.1.5.1, pp. 180-185.
[300] 2024 Colusa GSP, Section 3.2.7.1, p. 250.

losses in flow on the Stoney Creek.[301] However, the 2024 GSP does not discuss timing and location of other potential interconnected surface water that may occur elsewhere in the Subbasin. Department staff note that the GSAs appear to have chosen to analyze only a subset of surface water bodies in the Subbasin, but did not provide the rationale for that selection. Staff additionally note that without a clear understanding of which streams are interconnected and estimates of the quantity and timing of depletions of those systems, the GSAs may not be able to manage interconnected surface water sustainably and recommend the GSAs expand their analysis to include any stream that is depleted in the Subbasin (See Recommended Corrective Action 6b).

The 2024 GSP discusses groundwater dependent ecosystems which are displayed on a map.[302] The groundwater dependent ecosystem assessment was developed using the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset.[303] The 2024 GSP describes the pre-screening process used to rate areas according to likelihood of being a groundwater dependent ecosystem and includes maps of factors used in the pre-screening process, including proximity to surface water or cropland, and a map of the determined groundwater dependent ecosystem likelihood scores.[304] Department staff note that the 2024 GSP does not provide a figure showing which groundwater dependent ecosystems (GDEs) were removed from consideration. Areas that the GSAs determined to be likely groundwater dependent ecosystems are mostly located along the Sacramento River corridor or in three wildlife refuges.[305] The 2024 GSP acknowledges data gaps west of Orland and west of Arbuckle and that additional studies and data is recommended to better define groundwater dependent ecosystems in the Subbasin.[306] Department staff agree with the GSAs that additional studies to identify groundwater dependent ecosystems is warranted, and note that the 2024 GSP includes a “Development of a Dedicated Network of Shallow Monitoring Wells for GDE Monitoring” management action as a potential management action that would be implemented if ‘determined to be necessary’.[307] Staff note that the action is described as in its early conceptual stage and start dates, benefits, and costs are not known.[308] Staff encourage the GSAs to fully identify the locations of groundwater dependent ecosystems within the Subbasin as required by GSP Regulations,[309] provide figures showing groundwater dependent ecosystems removed from consideration, and note that understanding the location of GDEs is necessary to manage the Subbasin sustainably for all beneficial uses and users in the Subbasin (see Recommended Corrective Action 6c).

[301] 2024 Colusa GSP, Section 3.2.7.1, Table 3-6, p. 250 and Table 3-7, p.251.
[302] 2024 Colusa GSP, Section 3.2.8, pp. 254-257.
[303] 2024 Colusa GSP, Section 3.2.8, pp. 254-257.
[304] 2024 Colusa GSP, Section 3.2.8, pp. 254-257 and Figure 3-36, p. 256.
[305] 2024 Colusa GSP, Section 3.2.8, pp. 255-256 and Figure 3-36, p. 256.
[306] 2024 Colusa GSP, Section 3.2.8, pp. 254-255.
[307] 2024 Colusa GSP, Section 6.2.1, Table 6-1, p. 399; Section 6.5.2, p. 501.
[308] 2024 Colusa GSP, Section 6.5.2.6, and Table 6-56, pp. 508-509.
[309] 23 CCR § 354.16(g).

Overall, Department staff believe the 2024 GSP sufficiently describes the historical and current groundwater conditions throughout the Subbasin. Despite the recommended corrective actions, staff conclude that the information included in the Plan substantially complies with the requirements outlined in the GSP Regulations.

5.2.3 Water Budget

GSP Regulations require a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical; current; and projected water budget conditions,[310] and the sustainable yield.[311]

The 2024 GSP includes a historical, current, and projected water budget and an estimated sustainable yield. Department staff note that many of the numbers in the water budget section of the 2024 GSP are now inconsistent with other sections of the 2024 GSP because the GSA has provided updates to overdraft estimates in response to Deficiency 1 as discussed above in Section 4.1. Department staff note the 2024 GSP states, "GSAs will consider incorporating new data into the modeled water budgets as part of future GSP evaluations and revisions, and plan to continue their evaluations of annual water supply and water use in GSP annual reports"[312] and plan to refine the "sustainable yield estimates early in the GSP implementation period during development of the Subbasin demand management program in 2024-2026."[313] Department staff expect the inconsistencies in the water budget section to be rectified as part of the periodic evaluation of the GSP.

5.2.4 Management Areas

The GSP Regulations provide the option for one or more management areas to be defined within a basin if the GSA has determined that the creation of the management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives, provided that undesirable results are defined consistently throughout the basin.314

No management areas were designated per the information provided in the Plan.[315]

5.3 Sustainable Management Criteria

GSP Regulations require each Plan to include a sustainability goal for the basin and to characterize and establish undesirable results, minimum thresholds, and measurable objectives for each applicable sustainability indicator, as appropriate. The GSP Regulations require each Plan to define conditions that constitute sustainable

[310] 23 CCR §§ 354.18(a), 354.18 (c) *et seq*.
[311] 23 CCR § 354.18(b)(7).
[312] 2024 Colusa GSP, Section 3.3, p. 257.
[313] 2024 Colusa GSP, Section 3.3.7, p. 289.
[314] 23 CCR § 354.20.
[315] 2024 Colusa GSP, Section 3.4, p. 289.

groundwater management for the basin including the process by which the GSA characterizes undesirable results and establishes minimum thresholds and measurable objectives for each applicable sustainability indicator.316

5.3.1 Sustainability Goal

GSP Regulations require that GSAs establish a sustainability goal for the basin. The sustainability goal should be based on information provided in the GSP's basin setting and should include an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation.[317]

The 2024 GSP states, "The sustainability goal for the Subbasin is to maintain, through a cooperative and partnered approach, locally managed sustainable groundwater resources to preserve and enhance the economic viability, social well-being and culture of all Beneficial Uses and Users, without experiencing undesirable results."[318] The 2024 GSP relies on an adaptive management approach to implement projects and management actions that ensure the Subbasin is operated sustainably.[319] The GSAs plan to reach sustainability by using "a range of projects and management actions [that] are needed to achieve the sustainability goal for the Subbasin, including projects and management actions to address and mitigate existing issues with respect to overdraft, groundwater level decline, and subsidence concerns in the Subbasin, as well as [projects and management actions] to respond to changing conditions."[320]

5.3.2 Sustainability Indicators

Sustainability indicators are defined as any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results.[321] Sustainability indicators thus correspond with the six undesirable results – chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon, significant and unreasonable reduction of groundwater storage, significant and unreasonable seawater intrusion, significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies, land subsidence that substantially interferes with surface land uses, and depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water[322] – but refer to groundwater conditions that are not, in and of themselves, significant and unreasonable. Rather, sustainability indicators refer to the effects caused by changing groundwater conditions that are monitored, and for which criteria in the form

316 23 CCR § 354.22 *et seq*.
317 23 CCR § 354.24.
318 2024 Colusa GSP, Section 5.2, p. 331.
319 2024 Colusa GSP, Section 5.2.1, p. 331.
320 2024 Colusa GSP, Section 5.2.1, p. 331.
321 23 CCR § 351(ah).
322 Water Code § 10721(x).

of minimum thresholds are established by the agency to define when the effect becomes significant and unreasonable, producing an undesirable result.

GSP Regulations require that GSAs provide descriptions of undesirable results including defining what are significant and unreasonable potential effects to beneficial uses and users for each sustainability indicator.[323] GSP Regulations also require GSPs provide the criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.[324]

GSP Regulations require that the description of minimum thresholds include the information and criteria relied upon to establish and justify the minimum threshold for each sustainability indicator.[325] GSAs are required to describe how conditions at minimum thresholds may affect beneficial uses and users,[326] and the relationship between the minimum thresholds for each sustainability indicator, including an explanation for how the GSA has determined conditions at each minimum threshold will avoid causing undesirable results for other sustainability indicators.[327]

GSP Regulations require that GSPs include a description of the criteria used to select measurable objectives, including interim milestones, to achieve the sustainability goal within 20 years.[328] GSP Regulations also require that the measurable objectives be established based on the same metrics and monitoring sites as those used to define minimum thresholds.[329]

The following subsections thus consolidate three facets of sustainable management criteria: undesirable results, minimum thresholds, and measurable objectives. Information, as presented in the Plan, pertaining to the processes and criteria relied upon to define undesirable results applicable to the Subbasin, as quantified through the establishment of minimum thresholds, are addressed for each applicable sustainability indicator. A submitting agency is not required to establish criteria for undesirable results that the agency can demonstrate are not present and are not likely to occur in a basin.[330]

5.3.2.1 Chronic Lowering of Groundwater Levels

In addition to components identified in 23 CCR §§ 354.28 (a-b), for the chronic lowering of groundwater, the GSP Regulations require the minimum threshold for chronic lowering of groundwater levels to be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results that is supported by information

[323] 23 CCR §§ 354.26(a), 354.26(b)(c).
[324] 23 CCR § 354.26(b)(2).
[325] 23 CCR § 354.28(b)(1).
[326] 23 CCR § 354.28(b)(4).
[327] 23 CCR § 354.28(b)(2).
[328] 23 CCR § 354.30(a).
[329] 23 CCR § 354.30(b).
[330] 23 CCR § 354.26(d).

about groundwater elevation conditions and potential effects on other sustainability indicators.[331]

The 2024 GSP includes many revisions related to the sustainable management criteria for the chronic lowering of groundwater levels in response to Deficiency 1 identified with the 2022 GSP. For more information related to undesirable results, minimum thresholds, interim milestones, and impacts to beneficial uses and users please refer to the discussion in Section 4.2.

The 2024 GSP describes the information and criteria relied upon to establish and justify the measurable objectives for the chronic lowering of groundwater levels.[332] The 2024 GSP states, "The measurable objective for all RMS wells is the 2011-2015 average groundwater elevation at that RMS well."[333] The 2024 GSP indicates that for wells where data was not available during the 2011 to 2015 period, "the minimum threshold was calculated following the same method using available data from an alternate period representing recent average historical conditions prior to, or leading up to, the 2020- 2022 period."[334]

The sustainable management criteria for the chronic lowering of groundwater levels section included in the 2024 GSP will be considered substantially compliant with the requirements outlined in the GSP Regulations once the GSAs have responded to recommended corrective actions listed in Section 4.2.

5.3.2.2 Reduction of Groundwater Storage

In addition to components identified in 23 CCR §§ 354.28 (a-b), for the reduction of groundwater storage, the GSP Regulations require the minimum threshold for the reduction of groundwater storage to be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.[335]

The 2024 GSP defines the undesirable result for reduction of groundwater storage as "a result that would cause significant and unreasonable reduction in the long-term viability of beneficial uses and users over the planning and implementation horizon of this GSP" and "is experienced if storage volumes are insufficient to reasonably satisfy beneficial uses and users within the Subbasin over the planning and implementation horizon of this

[331] 23 CCR § 354.28(c)(1) *et seq*.
[332] 2024 Colusa GSP, Section 5.4.1.2, pp. 369-370.
[333] 2024 Colusa GSP, Section 5.4.1.2, p. 370.
[334] 2024 Colusa GSP, Section 5.4.1.2, p. 370.
[335] 23 CCR § 354.28(c)(2).

GSP."[336] To identify undesirable results, "the reduction of groundwater storage [will be] monitored by proxy using groundwater levels."[337]

The 2024 GSP justifies using levels as a proxy, and states, "Based on the estimated range of current storage volume in the Subbasin and the small percentage changes in storage estimated to occur over groundwater levels ranging from historical lows to the groundwater levels minimum thresholds, undesirable results due to decreases in groundwater levels would occur before undesirable results due to a significant reduction of groundwater storage."[338] The 2024 GSP also states, "The limiting factor to storage use is existing well infrastructure (depth of wells) and near surface conditions, not the volume of groundwater in storage."[339]

Department staff agree with the GSAs' assessment that levels are more limiting than storage in the Subbasin and concur with the decision to use levels as a proxy for storage. Staff will evaluate and compare the groundwater level conditions and reduction of storage in Annual Reports submitted to the Department.

5.3.2.3 Seawater Intrusion

In addition to components identified in 23 CCR §§ 354.28 (a-b), for seawater intrusion, the GSP Regulations require the minimum threshold for seawater intrusion to be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results.[340]

The 2024 GSP does not establish sustainable management criteria for seawater intrusion as it "is not applicable to the Subbasin due to the distances between the Subbasin and the Pacific Ocean, bays, deltas, or inlets ranging from about 30 to 60 miles."[341] Department staff concur with the rationale for not setting sustainable management criteria for seawater intrusion for the Subbasin.

5.3.2.4 Degraded Water Quality

In addition to components identified in 23 CCR §§ 354.28 (a-b), for degraded water quality, the GSP Regulations require the minimum threshold for degraded water quality to be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin.

[336] 2024 Colusa GSP, Section 5.3.2.1, p. 339.
[337] 2024 Colusa GSP, Section 5.3.2.3, p. 341.
[338] 2024 Colusa GSP, Section 5.3.2.4, p. 341.
[339] 2024 Colusa GSP, Section 5.4.2.1, p. 372.
[340] 23 CCR § 354.28(c)(3).
[341] 2024 Colusa GSP, Section 5.1.1, p. 331.

In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.[342]

The 2024 GSP establishes sustainable management criteria for degraded water quality based solely on salinity measured by electrical conductivity (EC). As discussed in Section 5.2.2, the 2024 GSP identifies "salinity, TDS, adjusted sodium absorption ratio, arsenic, boron, hexavalent chromium, iron, manganese, and nitrate" as constituents of concern in the Subbasin but does not establish sustainable management criteria for these constituents.[343] Despite the presence of various constituents of concern, the GSAs established sustainable management criteria only for salinity and do not intend to manage other constituents of concern because "groundwater management through coordination with existing regulatory and monitoring programs with respect to this minimum threshold will ensure that degradation of groundwater quality does not exceed historical levels as a result of Subbasin groundwater management activities pursuant to the GSP."[344]

Department staff note that SGMA specifies that undesirable results for degraded water quality are to be defined by a GSA in terms of significant and unreasonable effects caused by groundwater conditions occurring throughout the basin,[345] which focuses attention on degradation caused by groundwater extraction, but does not limit the scope of contaminants that a GSA should consider. The GSA must effectively consider local, state, and federal water quality standards, when setting minimum thresholds and measurable objectives, including potentially coordinating with the agencies governing water quality standards and programs, which are set for constituents whether they are naturally occurring or not.[346] Department staff recommend that the GSAs either provide additional information to demonstrate that TDS is the Subbasin's only constituent of concern or establish sustainable management criteria applicable to all constituents of concern in the Subbasin (see Recommended Corrective Action 7a).

The 2024 GSP defines an undesirable result for degraded water quality as "a result that would cause a significant and unreasonable reduction in the long-term viability of beneficial uses and users, including domestic, agricultural, municipal, environmental, or other beneficial uses and users over the planning and implementation horizon of this is GSP" and "is experienced if, as the result of projects and management actions implemented under the GSP or other groundwater development (such as groundwater extraction or groundwater recharge), groundwater quality for regulated constituents is degraded to levels exceeding historical levels existing prior to January 1, 2015, or applicable water quality objectives, including drinking water standards, whichever are greater over the planning and implementation horizon of this GSP."[347] The 2024 GSP does not describe a process that would be used to determine if GSP implementation is

[342] 23 CCR § 354.28(c)(4).
[343] 2024 Colusa GSP, Section 3.2.5, p. 238.
[344] 2024 Colusa GSP, Section 5.4.4.1, p. 373.
[345] CWC § 10721(x).
[346] 23 CCR § 354.28(c)(4).
[347] 2024 Colusa GSP, Section 5.3.4.1, p. 342.

the cause of the exceedance. The 2024 GSP quantifies the undesirable result for degraded water quality "when 25 percent of representative monitoring sites (i.e., 6 of 25 wells) exceed their minimum thresholds for two consecutive years. The six sites must be the same subset of sites, not any combination of six sites. The subset of sites is not predetermined; rather, it is delineated only as sites collectively exceed their minimum threshold values."[348]

The 2024 GSP's definition of undesirable results is problematic. GSP regulations require that the definition of undesirable results be a quantitative combination of minimum threshold exceedances that cause significant and unreasonable effects in the Subbasin.[349] Department staff note that an undescribed process to establish that GSP implementation is the cause of the exceedance is not a quantitative combination of minimum threshold exceedances. Additionally, the 2024 GSP's description of significant and unreasonable conditions and definition for undesirable results for degraded water quality, which solely focus on water quality impacts caused directly by the GSAs implementing an action, represents an improperly narrow reading of SGMA. SGMA includes in its definition of undesirable results the "significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies."[350] SGMA specifies that the significant and unreasonable effects are those "caused by groundwater conditions occurring throughout the basin,"[351] which does not limit them to only impacts directly caused by a GSA's implementation of physical projects or actions in the basin. Staff consider this to be inconsistent with the intent of SGMA, which requires the GSAs to ensure management of groundwater conditions in the Subbasin, including any action taken by the GSAs, will not significantly and unreasonably degrade water quality. Therefore, degraded water quality caused by groundwater pumping, changes in groundwater levels, changes in the direction of groundwater flow, or changes in horizontal or vertical movement of groundwater within the Subbasin, whether the GSAs have implemented pumping regulations or not, should be considered in the assessment of undesirable results in the Subbasin. Department staff recommend the GSAs revise the description of significant and unreasonable conditions and undesirable results such that groundwater pumping and other factors, whether due to action or inaction of the GSAs with respect to Subbasin management, are considered and not excluded (see Recommended Corrective Action 7b).

The 2024 GSP defines the minimum threshold for degraded water quality "as the higher of either 900 microSiemens per centimeter (µS/cm) EC, which is consistent with the recommended California Secondary Maximum Contaminant Level (SMCL), or the pre-2015 historical maximum recorded EC value."[352]

[348] 2024 Colusa GSP, Section 5.2.4.2, pp. 343-344.
[349] 23 CCR § 354.26(b)(2).
[350] CWC § 10721(x)(4).
[351] 23 CCR 354.26(a).
[352] 2024 Colusa GSP, Section 5.4.4.1, p. 373.

The 2024 GSP states the minimum threshold for degraded water quality considers "beneficial uses of groundwater as a drinking water supply and as an agricultural supply" and the "potential adverse effects to drinking water addressed in the State's commitment to Human Right to Water as codified in California Water Code Section 106.3."[353] The minimum threshold for degraded water quality has been established to allow "adequate flexibility within the pre-2015 historical maximum EC level, to compensate for changing groundwater conditions during drought periods, while protecting [Secondary Maximum Contaminant Levels] SMCLs established for aesthetic reasons, such as taste, odor, and color."[354] The 2024 GSP also notes, "[e]xceedance of these minimum threshold values may…cause undesirable results for domestic well users related to non-health related concerns at wells where the pre-2015 historical maximum EC level did not exceed the SMCL" and for wells "where the pre-2015 historical maximum EC level exceeded the California recommended SMCL, groundwater management through coordination with existing regulatory and monitoring programs with respect to this minimum threshold will ensure that degradation of groundwater quality does not exceed historical levels as a result of Subbasin groundwater management activities pursuant to the GSP."[355]

The 2024 GSP defines the measurable objective for degraded water quality as "700 µS/cm EC, which is consistent with the agricultural water quality objective providing for no yield reduction for crops commonly grown in the Subbasin."[356] Therefore, the measurable objective for degraded water quality "supports ongoing sustainability by protecting water quality within levels that are suitable for drinking water use and agricultural water use, among other beneficial uses."[357] The 2024 defines the interim milestone for degraded water quality as "consistent with the measurable objective, and is set at 700 µS/cm, and states, "This interim milestone is also consistent with the GSAs' role in working with the State of California to guarantee the Human Right to Water to the residents of the Subbasin."[358]

Department staff note the 2024 GSP does not describe how the data collected by others is to be used by the GSAs aside from a general description in the Monitoring Protocols section stating, "Data will either be obtained from the agencies that are responsible for managing the monitoring sites within the groundwater quality monitoring network or downloaded from dataset host websites."[359] Staff note there is no discussion of data management and use, roles and responsibilities, concrete actions that are to be taken by the GSAs (i.e. data collected are compiled into a database, quality controlled, and used for annual reporting of trends, identification and mapping of groundwater quality degradation, analyzed for exceedances of SMCLs, and other concrete actions such as coordination and communication with regulatory agencies), or water quality data

[353] 2024 Colusa GSP, Section 5.4.4.1, p. 373.
[354] 2024 Colusa GSP, Section 5.4.4.1, p. 373.
[355] 2024 Colusa GSP, Section 5.4.4.1, p. 373.
[356] 2024 Colusa GSP, Section 5.4.4.2, p. 373.
[357] 2024 Colusa GPS, Section 5.4.4.2, p. 373.
[358] 2024 Colusa GSP, Section 5.4.4.4, p. 374.
[359] 2024 Colusa GSP, section 4.2.2.3, p. 308.

management in the Data Management System section.[360] The GSAs should not assume that another regulatory program or responsible agency will analyze these data in the context of SGMA and groundwater basin management as these remain the responsibility of the GSAs. Department staff recommend that the GSAs coordinate with the appropriate water quality regulatory programs and agencies in the Subbasin to understand and develop a process for determining when groundwater management and extraction is resulting in degraded water quality in the Subbasin (see Recommended Corrective Action 7c).

Despite the recommended corrective actions, staff conclude that the information included in the Plan substantially complies with the requirements outlined in the GSP Regulations.

5.3.2.5 Land Subsidence

In addition to components identified in 23 CCR §§ 354.28 (a-b), the GSP Regulations require the minimum threshold for land subsidence to be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results.[361] Minimum thresholds for land subsidence shall be supported by identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects and maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum thresholds and measurable objectives.[362]

The 2024 GSP includes many revisions related to the sustainable management criteria for the subsidence in response to Deficiency 3 identified with the 2022 GSP. For more information related to undesirable results, minimum thresholds, and impacts to beneficial uses and users please refer to the discussion in Section 4.3.

In order to achieve sustainability in the Subbasin, the 2024 GSP establishes a measurable objective of 0 feet of subsidence per year by 2042. The 2024 GSP has defined interim milestones to reach the measurable objective. The interim milestones are defined as follows:

- "January 2027: 0.3 feet per year (maximum rate of subsidence averaged over 2015-2023)
- January 2032: 0.1 feet per year ([Minimum Threshold])
- January 2037: 0.08 feet per year (75 percent of the [Minimum Threshold]))"[363]

The interim milestones have been established "to ensure subsidence rates remain in the Subbasin's margin of operational flexibility as established by the minimum thresholds and

[360] 2024 Colusa GSP, Section 7.9, pp. 538-539.
[361] 23 CCR § 354.28(c)(5).
[362] 23 CCR §§ 354.28(c)(5)(A-B).
[363] 2024 Colusa GSP, Section 5.4.5.4, p. 378.

measurable objectives" and allows "future projected land subsidence rates [to] fluctuate above and below the minimum threshold for the rate of subsidence because it will take time to implement [projects and management actions]."[364] The 2024 GSP states, "The GSAs are committed to developing and implementing [projects and management actions] over the next three years to achieve the first interim milestone by 2027 and subsequent interim milestones."[365] Measured subsidence and the sustainable management criteria for subsidence near Artois and Arbuckle are provided in Figure 5-2 and Figure 5-3, respectively.[366]

In the October 2023 Incomplete Determination, the Department identified deficiencies related to the sustainable management criteria for land subsidence. The GSAs revised this portion of the Plan and Department staff provide evaluation for this sustainability indicator in Section 4.3 of this Staff Report. The sustainable management criteria for subsidence included in the 2024 GSP will be considered substantially compliant with the requirements outlined in the GSP Regulations once the GSAs have responded to the recommended corrective actions listed in Section 4.3.

5.3.2.6 Depletions of Interconnected Surface Water

SGMA defines undesirable results for the depletion of interconnected surface water as those that have significant and unreasonable adverse impacts on beneficial uses of surface water and are caused by groundwater conditions occurring throughout the basin.[367] The GSP Regulations require that a Plan identify the presence of interconnected surface water systems in the basin and estimate the quantity and timing of depletions of those systems.[368] The GSP Regulations further require that minimum thresholds be set based on the rate or volume of surface water depletions caused by groundwater use, supported by information including the location, quantity, and timing of depletions, that adversely impact beneficial uses of the surface water and may lead to undesirable results.[369]

The 2024 GSP indicates that the GSAs plan to use groundwater levels as a proxy for monitoring for depletions of interconnected surface water.[370] The 2024 GSP states, "The use of groundwater elevation as a proxy metric for this sustainability indicator is necessary because the network of existing stream gages is not adequate to measure changes in stream accretions and depletions as related to the Subbasin."[371] The 2024 GSP claims that changes in streamflow associated with changes in groundwater conditions cannot be accurately quantified, and states that modeling of groundwater levels would be more accurate, however the current groundwater model used by the

[364] 2024 Colusa GSP, Section 5.4.5.4, p. 378.
[365] 2024 Colusa GSP, Section 5.4.5.4, p. 378.
[366] 2024 Colusa GSP, Section 5.3.5.1, Figures 5-2, p. 351 and Figure 5-3, p.352.
[367] Water Code § 10721(x)(6).
[368] 23 CCR § 354.16(f).
[369] 23 CCR § 354.28(c)(6).
[370] 2024 Colusa GSP, Section 5.3.6.2, pp. 354-355.
[371] 2024 Colusa GSP, Section 5.3.6.2, p. 354.

GSAs has too many uncertainties to be relied upon for sufficiently reliable estimates.[372] The 2024 GSP proposes using shallow wells less than 200 feet deep and within 5 miles of surface water features as representative groundwater level wells to be used as a proxy for surface water depletion.[373]

Department staff note that this approach is problematic. GSP Regulations indicate that an agency may use groundwater levels as a proxy where the agency has demonstrated that the representative value is a reasonable proxy and is supported by adequate evidence.[374] In order to use groundwater as a proxy, the GSP needs to provide sufficient evidence to show the connection between surface water and groundwater using a statistical method. The justification provided in the 2024 GSP is that monitoring for interconnected surface water is insufficient, and the groundwater model has too many uncertainties to be accurate to perform the analysis.[375] The provided justification is not a demonstration that the representative value is a reasonable proxy supported by evidence. Department staff conclude that the supporting information provided by the 2024 GSP is not sufficient to justify using groundwater elevations as a proxy for depletions of interconnected surface water (see Recommended Corrective Action 8a).

The 2024 GSP defines an undesirable result for depletions of interconnected surface water as "a result that causes significant and unreasonable adverse effects on beneficial uses and users of interconnected surface waters within the Subbasin over the planning and implementation horizon of this GSP."[376] The 2024 GSP quantifies the undesirable result for depletions of interconnected surface water "when 25 percent of representative monitoring wells (i.e., 3 of 12 wells) fall below their minimum groundwater elevation thresholds for 24 consecutive months. The three wells must be the same subset of wells, not any combination of three wells. The subset of wells is not predetermined; rather, it is delineated only as wells collectively fall below their minimum threshold levels."[377]

The minimum thresholds established in the 2024 GSP "were determined based on evaluation of historical data from the monitoring network for interconnected surface water, which is composed of 12 shallow groundwater wells located proximate to interconnected streams in the Subbasin" and "were calculated by finding the groundwater elevations in Fall of 2015 and adding 10 feet to that depth."[378] Fall of 2015 was selected as it was considered the lowest groundwater elevation of the last drought.[379] In support of this criteria, the 2024 GSP, states that it used the GSAs' model, the C2Vsim-FG-Colusa model to estimate depletions at the minimum thresholds and states, "Results of these analyses indicate that streamflow gain and loss do not appear to be strongly affected by

[372] 2024 Colusa GSP, Section 5.3.6.2 pp. 354-355.
[373] 2024 Colusa GSP, Section 3.2.7.2, p. 251.
[374] 23 CCR § 354.28(e).
[375] 2024 Colusa GSP, Section 5.3.6.2, pp. 354-355.
[376] 2024 Colusa GSP, Section 5.3.6.1, p. 354.
[377] 2024 Colusa GSP, Section 5.3.6.3, p. 355.
[378] 2024 Colusa GSP, Section 5.4.6.1, p. 378.
[379] 2024 Colusa GSP, Section 5.4.6.1, p. 379.

increases in groundwater pumping needed to satisfy increased irrigation requirements resulting from potential future climate change, or by recharge projects than could be implemented in the Subbasin" and, "[t]herefore, it is concluded, on a provisional basis, that the effects of groundwater management in the Subbasin will not have significant and unreasonable effects on beneficial uses and users of surface water."[380]

Department staff note that the C2Vsim-FG-Colusa model was described as having levels of uncertainty "currently too great to allow sufficiently reliable quantification of the rates and volume of stream depletions"[381] in the 2024 GSP. Staff note that this use of the model appears to not represent the best available science, as the GSAs are aware it is not sufficiently reliable for estimates.

The 2024 GSP defines measurable objectives for the 12 wells in the monitoring network and provides these measurable objectives in Table 5-5.[382] The measurable objectives have been "calculated for each well using the average of the most recent five years of available groundwater level measurements" which is "consistent with that used in setting the measurable objectives for the chronic lowering of groundwater levels measurable objectives."[383] The 2024 GSP defines interim milestones for the 12 wells in the monitoring network and provides the interim milestones in Table 5-5.[384] The interim milestones have been established to "maintain water levels within the Subbasin's margin of operational flexibility as set by the minimum thresholds and measurable objectives."[385] Department staff note that all sustainable management criteria, including the undesirable results, minimum thresholds, measurable objectives and interim milestones will need to be updated as part of the GSAs' response to recommended corrective actions.

Department staff understand that quantifying depletions of surface water from groundwater extractions is a complex task that likely requires developing new, specialized tools, models, and methods to understand local hydrogeologic conditions, interactions, and responses. During the initial review of GSPs, Department staff have observed that most GSAs have struggled with this new requirement of SGMA. However, staff believe that most GSAs will more fully comply with regulatory requirements after several years of Plan implementation that include projects and management actions to address the data gaps and other issues necessary to understand, quantify, and manage depletions of interconnected surface waters. Accordingly, Department staff believe that affording GSAs adequate time to refine their Plans to address interconnected surface waters is appropriate and remains consistent with SGMA's timelines and local control preferences.

The Department will continue to support GSAs in this regard by providing, as appropriate, financial and technical assistance to GSAs, including the development of guidance

[380] 2024 Colusa GSP, Section 5.4.6.1, p. 379.
[381] 2024 Colusa GSP, Section 5.3.6.2 pp. 354-355.
[382] 2024 Colusa GSP, Section 5.4.6.1, Table 5-5, p. 381.
[383] 2024 Colusa GSP, Section 5.4.6.2, p. 383.
[384] 2024 Colusa GSP, Section 5.4.6.1, Table 5-5, p. 381.
[385] 2024 Colusa GSP, Section 5.4.6.4, p. 383.

describing appropriate methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water caused by groundwater extractions. Once the Department's guidance related to depletions of interconnected surface water is publicly available, the GSAs, where applicable, should consider incorporating appropriate guidance approaches into their future periodic evaluations to the GSP (see Recommended Corrective Action 8b). GSAs should consider availing themselves of the Department's financial or technical assistance, but in any event must continue to fill data gaps, collect additional monitoring data, and implement strategies to better understand and manage depletions of interconnected surface water caused by groundwater extractions and define segments of interconnectivity and timing within their jurisdictional area (see Recommended Corrective Action 8c). Furthermore, GSAs should coordinate with local, state, and federal resources agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion (see Recommended Corrective Action 8d).

5.4 Monitoring Network

The GSP Regulations describe the monitoring network that must be developed for each sustainability indicator including monitoring objectives, monitoring protocols, and data reporting requirements. Collecting monitoring data of sufficient quality and quantity is necessary for the successful implementation of a groundwater sustainability plan. The GSP Regulations require a monitoring network of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.[386] Specifically, a monitoring network must be able to monitor impacts to beneficial uses and users,[387] monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds,[388] capture seasonal low and high conditions,[389] include required information such as location and well construction and include maps and tables clearly showing the monitoring site type, location, and frequency.[390] Department staff encourage GSAs to collect monitoring data as specified in the GSP, follow SGMA data and reporting standards,[391] fill data gaps identified in the GSP prior to the first periodic evaluation,[392] update monitoring network information as needed, follow monitoring best management practices,[393] and submit all monitoring data to the Department's Monitoring Network Module immediately after collection including any additional groundwater monitoring data that is collected within the Plan area that is used for groundwater management decisions. Department staff note that if GSAs do not fill their identified data

[386] 23 CCR § 354.32.
[387] 23 CCR § 354.34(b)(2).
[388] 23 CCR § 354.34(b)(3).
[389] 23 CCR § 354.34(c)(1)(B).
[390] 23 CCR §§ 354.34(g-h).
[391] 23 CCR § 352.4 *et seq*.
[392] 23 CCR § 354.38(d).
[393] Department of Water Resources, 2016, Best Management Practices and Guidance Documents.

gaps, the GSAs' basin understanding may not represent the best available science for use to monitor basin conditions.

The 2024 GSP includes monitoring networks for the chronic lowering of groundwater levels, degraded water quality, land subsidence, and surface water. The 2024 GSP uses the groundwater level monitoring network as a proxy for the reduction of groundwater storage and depletion of interconnected surface water sustainability indicators.

The 2024 GSP defines the monitoring network for the chronic lowering of groundwater levels sustainability indicator as "a combination of pre-SGMA Colusa County groundwater monitoring wells and pre-SGMA Glenn County dedicated groundwater monitoring wells (Glenn County wells that are dedicated observation wells and not used for supply)" and are shown on Figure 4-1.[394] The 2024 GSP identifies "104 completions in 48 wells in the Subbasin groundwater level monitoring network" and are all "currently included in the California Statewide Groundwater Elevation Monitoring Program (CASGEM) database and are monitored by DWR."[395] The current groundwater monitoring network is provided in Table 4-2 and provides information on State Well Numbers (SWNs), CASGEM Identifications (IDs), well completion report IDs, well status and use, location information, reference point information, construction, principal aquifer designations, and quality assessment categories.[396]

As stated in the 2024 GSP, "The groundwater monitoring network has a lateral density of approximately 9.2 completions per 100 square miles and 4.2 well boreholes per 100 square miles in the principal aquifer, averaged over the entire subbasin" and has "sufficient depth-specific wells located throughout the subbasin to evaluate groundwater elevation trends, groundwater storage, surface water connectivity, and aquifer characteristics with depth."[397] The 2024 GSP provides an estimate of which geologic formation each well's completion is monitoring.[398] Department staff encourage the GSAs to update the monitoring network as part of GSP implementation to ensure that monitoring sites are included both spatially and at depths similar to beneficial uses and users, and to sufficiently monitor the deeper aquifers in the Subbasin.

The 2024 GSP proposes "[m]anual water level measurements shall be collected twice annually, at a minimum, to ensure seasonal trends are well accounted for" and "should be collected in the spring and fall, at a minimum, unless more frequent measurements are required to characterize changes in groundwater levels."[399] Department staff note that the frequency of monitoring for the chronic lowering of groundwater levels monitoring network may not be sufficient to demonstrate short-term and seasonal trends in groundwater conditions or monitor impacts to beneficial uses and users of groundwater.

[394] 2024 Colusa GSP, Section 4.2.1.2, p. 292 and Figure 4-1, p. 293.
[395] 2024 Colusa GSP, Section 4.2.1.2, p. 294.
[396] 2024 Colusa GSP, Section 4.2.1.2, Table 4-2, pp. 296-299.
[397] 2024 Colusa GSP, Section 4.2.1.2, p. 295.
[398] 2024 Colusa GSP, Section 4.2.1.2, Table 4-2, pp. 296-299.
[399] 2024 Colusa GSP, Section 4.2.1.3, p. 302.

Given the unprecedented drought conditions, a proposed semi-annual monitoring frequency for the monitoring network is likely not sufficient for the GSAs to understand how groundwater levels change during the peak irrigation season and how those changes may impact beneficial uses and users of groundwater. Staff recommend the GSAs include more information in the GSP to justify how a semi-annual monitoring frequency is sufficient to meet the requirements of the GSP Regulations[400] or if the frequency should be increased to better define groundwater level conditions throughout the year especially during the timing of peak groundwater use to monitor and identify potential impacts to beneficial uses and users of groundwater.

The 2024 GSP recognizes "that a number of wells included within the groundwater monitoring network have not been consistently monitored every spring and fall, including eleven of the 48 RMS wells (23%) in 2023" and that "[l]imitations in data availability may impact the GSAs' ability to monitor groundwater conditions with sufficient resolution (spatially and temporally) to meaningfully inform groundwater management decisions in the Subbasin, particularly in areas experiencing undesirable results." [401] The Plan proposes to add existing wells to the groundwater monitoring network and provides the proposed existing wells in Table 4-3.[402] The GSAs plan to evaluate the adequacy of the monitoring network during the next periodic evaluation and anticipates that "groundwater monitoring network wells with severe data gaps will be prioritized for replacement at that time with alternate sites that are routinely monitored and that have more recent data."[403] Department staff support the 2024 GSP's plan to evaluate the adequacy of the monitoring network and fill data gaps as identified through periodic evaluations and annual reports, and encourage the GSAs to ensure they are monitoring the spatial locations and depths that beneficial uses and users are accessing for their supply.

The 2024 GSP proposes to use the groundwater level monitoring network as a proxy for the groundwater storage monitoring network because changes in groundwater storage are directly dependent on changes in groundwater levels.[404] As such, the network of wells providing groundwater level data (and the associated data gaps) are the same as for the reduction in groundwater storage sustainability indicator. As detailed in this determination's review of sustainable management criteria for reduction in groundwater storage in Section 5.3.2.2, the 2024 GSP generally indicates that it plans to use groundwater levels as a proxy for storage.

The 2024 GSP states the seawater intrusion sustainability indictor is not applicable to this Subbasin; therefore, no monitoring network is proposed.[405] Department staff agree the

[400] 23 CCR § 354.34(f).
[401] 2024 Colusa GSP, Section 4.2.1.4, p. 303.
[402] 2024 Colusa GSP, Section 4.2.1.5, Table 4-3, p. 304.
[403] 2024 Colusa GSP, Section 4.2.1.5, p. 304.
[404] 2024 Colusa GSP, Section 5.3.2.3, p. 341.
[405] 2024 Colusa GSP, Section 3.2.3, p. 235.

sustainability indicator for seawater intrusion is not present in the Subbasin and therefore, the monitoring of seawater intrusion is not required.

The 2024 GSP provides a description of its degraded water quality monitoring network. The 2024 GSP states, "Groundwater quality monitoring network locations for the Subbasin include wells identified and currently being monitored for salinity under existing regulatory programs" and includes "groundwater monitoring conducted by coalitions formed under Irrigated Lands Regulatory Program (ILRP) and public drinking water supply communities regulated by the State Water Resources Control Board (SWRCB) Division of Drinking Water."[406] The groundwater quality monitoring network programs is provided in Table 4-4.[407] The monitoring network for the degraded water quality sustainability indicator includes 54 monitoring sites and is depicted in Figure 4-3.[408]

The 2024 GSP states, "The sole groundwater quality concern not addressed by the existing groundwater quality regulatory programs is mobilization of saline water from deeper parts of the aquifer along faults, other geologic structures, or other naturally-occurring zones with high salinity as a result of GSP [projects and management actions] and other groundwater development."[409] Therefore, the Plan proposes to only establish monitoring networks and sustainable management criteria for groundwater salinity concentrations. As discussed in Section 5.3.2.4 of this Staff Report, Department staff note that the GSA is responsible for the sustainable management of degraded water quality, not other regulatory agencies. Staff are concerned that the 2024 GSP identifies salinity, TDS, adjusted sodium absorption ratio, arsenic, boron, hexavalent chromium, iron, manganese, and nitrate as constituents of concern but does not establish sustainable management criteria or monitoring networks for these constituents.[410] Staff note the 2024 GSP does not discuss how the potential impacts to domestic wells associated with the other identified constituents had been considered and addressed as part of the monitoring network analysis (see Recommended Corrective Action 9a).

GSP Regulations require GSAs to determine the frequency of measurements required to demonstrate short-term, seasonal, and long-term trends.[411] Department staff note the description of the groundwater quality monitoring network does not include a description of the frequency of monitoring for quality,[412] except where it indicates that some of its monitoring frequency for some wells is a data gap.[413] The frequency of water quality monitoring is needed so that the GSAs may understand groundwater quality trends and manage them sustainably. Staff recommend the GSAs provide the frequency of

[406] 2024 Colusa GSP, Section 4.2.2.2, p. 305.
[407] 2024 Colusa GSP, Section 4.2.2.2, Table 4-4, p. 306.
[408] 2024 Colusa GSP, Section 4.2.2.2, Figure 4-3, p. 307.
[409] 2024 Colusa GSP, Executive Summary, p. 97.
[410] 2024 Colusa GSP, Section 3.2.5, p. 238.
[411] 23 CCR § 354.34(f).
[412] 2024 Colusa GSP, Section 4.2.2, pp. 304-310.
[413] 2024 Colusa GSP, Section 4.2.2.4, p. 310.

groundwater quality for all constituents monitored (see Recommended Corrective Action 9b).

The 2024 GSP states that data gaps for the degraded water quality monitoring network included spatial distribution of monitoring sites and frequency of monitoring.[414] To address these data gaps, the GSAs "will consider coordinating with the [Sacramento Valley Water Quality Coalition] SVWQC, Northern California Water Association (NCWA), and the California Rice Commission in the establishment and ongoing evaluation of these groundwater quality monitoring network sites with the goal of using data collected under the [Irrigated Lands Regulatory Program] ILRP for SGMA compliance."[415] The 2024 GSP also proposes adding wells identified from the groundwater level monitoring network that "would be good potential sites to add to the groundwater quality monitoring network in areas with identified salinity and upwelling concerns."[416] Department staff encourage the GSAs to fill data gaps identified in the monitoring network for the degraded water quality sustainability indicator and note that GSP Regulations require GSAs to fill data gaps prior to the next periodic evaluation.[417]

The discussion of the monitoring network related to land subsidence in the 2022 GSP was corrected based on deficiencies identified in the Department's Incomplete Determination. An assessment of the corrected information, and corrective actions taken by the GSAs is provided in Section 4.3.2.4 of this Staff Report.

The 2024 GSP monitoring network for the interconnected surface water sustainability indicator "includes stream gages placed on rivers, streams, and canals" and "shallow groundwater level monitoring wells from which water levels will be used as a proxy for evaluating surface water depletions."[418] The 2024 GSP shows the surface water monitoring network stream gages in Figure 4-5 and provides the monitoring network, locations, and monitoring frequency in Table 4-6.[419] Department staff note that several of the identified gages are located outside the Subbasin and 10 of the 15 gages are on the Sacramento River.

The 2024 GSP also relies on 12 shallow wells from the groundwater level monitoring network to serve as a proxy for depletion of surface water and interconnected surface waters.[420] The Plan establishes the following criteria to determine shallow wells that should be included in the monitoring network that are "less than 200 feet deep, and more than 2,000 feet and less than 5 miles from the surface water feature of concern."[421] Department staff note that the 2024 GSP does not sufficiently justify using levels as a proxy for depletions of interconnected surface water, as discussed in Section 5.3.2.6 of

[414] 2024 Colusa GSP, Section 4.2.2.4, pp. 309-310.
[415] 2024 Colusa GSP, Section 4.2.2.5, p. 310.
[416] 2024 Colusa GSP, Section 4.2.2.5, p. 310.
[417] 23 CCR 354.38(d).
[418] 2024 Colusa GSP, Section 4.2.4, p. 317.
[419] 2024 Colusa GSP, Section 4.2.4.2, Table 4-6, p. 319 and Figure 4-5, p. 320.
[420] 2024 Colusa GSP, Section 4.2.5.4, p. 326.
[421] 2024 Colusa GSP, Section 4.2.5.4, p. 326.

this Staff Report, and that the monitoring network will need to be revised as well so that the GSAs can characterize the spatial and temporal exchanges between surface water and groundwater and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions[422] (see Recommended Corrective Action 9c).

The 2024 GSP states that "the network of existing stream gages is not adequate to measure changes in stream accretions and depletions as related to the Subbasin."[423] The 2024 GSP also notes that for the interconnected surface water monitoring network "significant data gaps exist, which need to be addressed during implementation of this GSP."[424] The 2024 GSP formally notes that the interconnected surface water monitoring network has three data gaps: (1) temporal changes in ephemeral and intermittent stream stage and flow, (2) Colusa Drain outflows are not monitored, and (3) no active stream gages on Stoney Creek.[425]

The 2024 GSP discusses proposed actions to fill data gaps.[426] The 2024 GSP plans to participate in a surface water monitoring network data gap assessment and fulfillment in cooperation with neighboring GSAs,[427] but does not provide the timing or expected outcome of the coordination. The 2024 GSP indicates the GSAs are considering monitoring Willow and Walker Creeks to be representative monitoring of other ephemeral and intermittent creeks, but only "if necessary",[428] and does not provide the schedule of when the GSAs would determine its necessity or to install monitoring to fill this data gap. The 2024 GSP promises that "[t]he need for additional monitoring wells to assist in the monitoring of stream-aquifer interactions will be assessed during implementation of this GSP,"[429] but does not provide other details of when this would occur.

GSP Regulations require GSAs to describe steps that will be taken to fill data gaps before the next periodic evaluation, including the location and purpose of newly added or installed monitoring sites.[430] Department staff note that the 2024 GSP does not provide enough detail in its plan to fill data gaps or provide the steps taken to fill identified data gaps, as the location and purpose of installed sites was not discussed. The GSAs should provide a detailed plan to fill data gaps so that the GSAs are sufficiently monitoring for depletions of interconnected surface water and may characterize the spatial and temporal exchanges between surface water and groundwater and to calibrate and apply the tools

[422] 23 CCR § 354.34(c)(6).
[423] 2024 Colusa GSP, Section 5.3.6.2, p. 354.
[424] 2024 Colusa GSP, Section 4.2.4.1, p. 318.
[425] 2024 Colusa GSP, Section 4.2.4.4, p. 321.
[426] 2024 Colusa GSP, Section 4.2.4.5, pp. 321-322.
[427] 2024 Colusa GSP, Section 4.2.4.5, p. 321.
[428] 2024 Colusa GSP, Section 4.2.4.5, pp. 321-322.
[429] 2024 Colusa GSP, Section 4.2.4.5, p. 322.
[430] 23 CCR § 354.38(d).

and methods necessary to calculate depletions of surface water caused by groundwater extractions[431] (see Recommended Corrective Action 9d).

Lastly, Department staff note the 2024 GSP states that monitoring data shall be stored in the C2VsimFG-Colusa model and will be provided to DWR.[432] However, Department staff note the 2024 GSP does not define when data collected from the monitoring networks will be uploaded to the Department. Staff note data should be submitted to the Department immediately following collection as recommended in the Department's Best Management Practices.

Despite the recommended corrective actions, Department staff conclude that the GSP's monitoring network for the applicable sustainable management criteria sufficiently meets the requirements of the GSP Regulations.

5.5 Projects and Management Actions

The GSP Regulations require a description of the projects and management actions the submitting Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.[433] Each Plan's description of projects and management actions must include details such as: how projects and management actions in the GSP will achieve sustainability, the implementation process and expected benefits, and prioritization and criteria used to initiate projects and management actions.[434]

The 2024 GSP relies on an adaptive management approach applied towards the development of project and management actions, informed by continued monitoring of groundwater conditions using the monitoring network and methods, evaluation of groundwater conditions relative to the sustainable management criteria, and implementation of projects and management actions described in the Plan.[435] The GSAs have identified five planned projects, two planned management actions, seven ongoing projects, one ongoing management action, 18 potential projects, and six potential management actions.[436]

The five planned projects and two planned management actions "are expected to be implemented primarily to address current groundwater sustainability issues, particularly in the Orland-Artois and Arbuckle-College City areas."[437] These projects are discussed in Section 4.1.2.2 of this Staff Report.

[431] 23 CCR § 354.34(c)(6).
[432] 2024 Colusa GSP, Section 7.9, pp. 538-540.
[433] 23 CCR § 354.44(a).
[434] 23 CCR § 354.44(b) *et seq.*
[435] 2024 Colusa GSP, Section 6.1.1, p. 386.
[436] 2024 Colusa GSP, Section 6.2.1, Table 6-1, pp. 393-399.
[437] 2024 Colusa GSP, Section 6.1.1, p. 387.

The 2024 GSP explains ongoing projects and management actions "will continue to be implemented and may be adapted, as needed, to address changing groundwater conditions in the Subbasin."[438] The potential projects and management actions "will be further evaluated and implemented if established measurable objectives cannot be maintained and minimum thresholds are being approached."[439]

The GSAs provide general timelines for expected initiation and gross average annual benefits for planned and ongoing projects and management actions.[440] Potential projects and management actions "are still under development and require additional information that would be developed under future monitoring, and as the GSAs continue to identify and fill data gaps."[441]

Staff conclude the 2024 GSP's projects and management actions will be substantially compliant once the GSAs have sufficiently responded to corrective actions in Section 4.1.2.2 of this Staff Report.

5.6 Consideration of Adjacent Basins/Subbasins

SGMA requires the Department to "…evaluate whether a groundwater sustainability plan adversely affects the ability of an adjacent basin to implement their groundwater sustainability plan or impedes achievement of sustainability goals in an adjacent basin."[442] Furthermore, the GSP Regulations state that minimum thresholds defined in each GSP be designed to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.[443]

The Colusa Subbasin is bound by four adjacent basins: the Corning Subbasin to the north, the Butte Subbasin and Sutter Subbasin to the east, and the Yolo Subbasin to the south. All four of the adjacent basins are high-priority basins with GSP deadlines in January 2022. The 2024 GSP does not anticipate minimum thresholds to contribute to undesirable results in the Subbasin and the adjacent basins.[444] As stated, "The Subbasin GSAs and the GSAs in the adjacent subbasins have coordinated their approaches to developing sustainable management criteria during development of their respective GSPs and will continue to coordinate their efforts during plan implementation."[445]

[438] 2024 Colusa GSP, Section 6.1.1, p. 387.
[439] 2024 Colusa GSP, Section 6.1.1, p. 387.
[440] 2024 Colusa GSP, Section 6.3, Table 6-3, p. 405; Section 6.4.1, Table 6-20, pp. 455-456.
[441] 2024 Colusa GSP, Section 6.5, p. 470.
[442] Water Code § 10733(c).
[443] 23 CCR § 354.28(b)(3).
[444] 2024 Colusa GSP, Section 5.4.7, p. 384.
[445] 2024 Colusa GSP, Section 5.4.7, p. 384.

5.7 Consideration of Climate Change and Future Conditions

The GSP Regulations require a GSA to consider future conditions and project how future water use may change due to multiple factors including climate change.[446]

Since the GSP was adopted and submitted, climate change conditions have advanced faster and more dramatically. It is anticipated that the hotter, drier conditions will result in a loss of 10 percent of California's water supply. As California adapts to a hotter, drier climate, GSAs should be preparing for these changing conditions as they work to sustainably manage groundwater within their jurisdictional areas. Specifically, the Department encourages GSAs to:

1) Explore how their proposed groundwater level thresholds have been established in consideration of groundwater level conditions in the basin based on current and future drought conditions.
2) Explore how groundwater level data from the existing monitoring network will be used to make progress towards sustainable management of the basin given increasing aridification and effects of climate change, such as prolonged drought.
3) Take into consideration changes to surface water reliability and that impact on groundwater conditions.
4) Evaluate updated watershed studies that may modify assumed frequency and magnitude of recharge projects, if applicable, and
5) Continually coordinate with the appropriate groundwater users, including but not limited to domestic well owners and state small water systems, and the appropriate overlying county jurisdictions developing drought plans and establishing local drought task forces to evaluate how their Plan's groundwater management strategy aligns with drought planning, response, and mitigation efforts within the basin.

[446] 23 CCR § 354.18.

6 STAFF RECOMMENDATION

Department staff believe sufficient action has been taken by the GSAs to address the deficiencies identified. Department staff recommend **APPROVAL** of the Plan with the required and recommended corrective actions listed below. The Plan conforms with Water Code Sections 10727.2 and 10727.4 of SGMA and substantially complies with the GSP Regulations. Implementation of the Plan will likely achieve the sustainability goal for the Colusa Subbasin. The GSAs have identified several areas for improvement of their Plan and Department staff concur that those items are important and should be addressed as soon as possible. Department staff have also identified additional recommended corrective actions that should be considered by the GSAs for the first periodic evaluation of their GSP. Addressing these recommended corrective actions will be important to demonstrate that implementation of the Plan is likely to achieve the sustainability goal. The recommended corrective actions include:

RECOMMENDED CORRECTIVE ACTION 1

The GSAs should update the GSP to address the following:

a) The GSAs should update the Plan's water budget and include the overdraft estimates provided in the 2024 GSP by the next periodic evaluation.

b) The GSAs should provide a timeline, criteria, and quantified benefits for when the implementation of their projects and management actions will accrue to offset overdraft. The timeline should show how the GSAs will reach the 2024 GSP's sustainability goal[447] and GSP Regulations requirement[448] of avoiding undesirable results, in coordination with the 2024 GSP's interim milestone goal of ceasing the chronic lowering of groundwater by 2027. [449] This should include a revision to the demand management program to quantify its benefits and describe how it will be used to fully mitigate overdraft as required by GSP Regulations. [450] The adaptive mandatory components should be developed and implemented to provide overdraft mitigations if planned supply projects do not mitigate overdraft by 2027, regardless of whether an undesirable result is present or not. The GSAs should provide updates on their progress addressing this item in annual reports and in the next periodic evaluation.

[447] 2024 Colusa GSP, Section 1.2, p. 114.
[448] 23 CCR § 354.24.
[449] 2024 Colusa GSP, Table 5-3, pp. 364-365.
[450] 23 CCR § 354.44(b)(2).

RECOMMENDED CORRECTIVE ACTION 2

The GSAs should address the following recommended corrective actions for the sustainable management criteria for the chronic lowering of groundwater levels by the next periodic evaluation:

a) The California Water Code (CWC) requires GSAs to consider impacts to groundwater dependent ecosystems,[451] and Department staff recommend the GSP include a discussion considering impacts to groundwater dependent ecosystems as part of the next periodic evaluation of the GSP.

b) The GSAs should provide the criteria and processes used to delineate spatial areas of the focus areas used to establish minimum thresholds,[452] which should consider the potential effects on beneficial uses and users.[453]

c) The GSAs should revise the GSP to include an analysis describing whether or how managing the Subbasin to allow groundwater levels to drop to interim milestone levels that are below the established minimum thresholds will avoid causing undesirable results for other sustainability indicators.

RECOMMENDED CORRECTIVE ACTION 3

The GSAs should address the following recommended corrective actions for the sustainable management criteria for subsidence by the next periodic evaluation:

a) GSP Regulations require GSAs to describe potential effects on land uses and property interests that may occur from undesirable results.[454] The GSAs should provide clear and detailed information showing and describing the infrastructure it has considered while establishing the undesirable result. Department staff recommend providing this information with maps and tables that identify specific infrastructure the GSAs have considered. Staff also recommend the GSAs collect formal correspondence from the agencies they contacted indicating the infrastructure's susceptibility or lack of susceptibility to subsidence. The GSAs should provide an explanation of how the Agencies have determined and considered land uses and property interests.[455]

b) Identify the spatial extent and rate with the spatial extent and cumulative limit of subsidence that represents an undesirable result in a manner that considers the beneficial uses and users,[456] including the functional impacts to infrastructure.

c) Identify the spatial extent and rate with the spatial extent and cumulative limit of subsidence that represents the minimum threshold in a manner that considers the

[451] CWC § 10727.4(i).
[452] 23 CCR § 354.28(b)(1).
[453] 23 CCR § 354.28(b)(4).
[454] 23 CCR § 354.26(b)(3).
[455] 23 CCR § 354.28(c)(5)(A).
[456] 23 CCR § 354.26(b)(3).

beneficial uses and users [457] and shows how the Agencies' rationale has considered those uses and interests, [458] including the functional impacts to infrastructure.

d) Redefine undesirable results conditions so that they occur with subsidence that substantially interferes with surface land uses and may lead to undesirable results,[459] and manages the Subbasin to minimize or avoid subsidence.[460]

e) Redefine conditions for Yellow- and Red-Light Triggers to take action so that the actions feasibly may prevent reaching an undesirable result condition, so that the GSAs may manage the Subbasin to minimize or avoid subsidence.[461]

RECOMMENDED CORRECTIVE ACTION 4

The GSAs should provide the name and contact information, including the phone number, mailing address, and electronic mail address, of the plan manager; and a discussion on the legal authority of the Agencies, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agencies, demonstrating that the Agencies have the legal authority to implement the Plan.[462]

RECOMMENDED CORRECTIVE ACTION 5

The GSAs should identify, describe, and begin implementing measures that will be taken to address data gaps in the hydrogeological conceptual model (e.g., aquifer properties, hydrostratigraphy, and other properties that relate to the hydrogeologic characterization of the principal aquifer in the Subbasin) to reduce uncertainty.[463]

RECOMMENDED CORRECTIVE ACTION 6

The GSAs should address the following related to groundwater conditions:

a) Consider sulfate a constituent of concern in future GSP updates or provide additional reasoning for excluding it as a constituent of concern.

b) Provide an estimate of the quantity and timing of the depletion of interconnected surface water for surface water bodies in the Subbasin.[464] Provide the reasoning and analysis that was used if any surface water bodies are excluded from this analysis.

[457] 23 CCR § 354.28(b)(4).
[458] 23 CCR § 354.28(c)(5)(A).
[459] 23 CCR § 354.28(c)(5).
[460] CWC § 10720(e).
[461] CWC § 10720(e).
[462] 23 CCR § 354.6(c) and (d).
[463] 23 CCR § 354.38(d).
[464] 23 CCR § 354.16(f).

c) Identify groundwater dependent ecosystems throughout the Subbasin.[465] Include figures showing the areas in the NCCAG dataset that were removed from consideration. This may be accomplished by implementing the "Development of a Dedicated Network of Shallow Monitoring Wells for GDE Monitoring" management action or other means as determined by the GSAs.

RECOMMENDED CORRECTIVE ACTION 7

The GSAs should address the following related to the sustainable management criteria for degraded water quality:

a) Revise the sustainable management criteria for degraded water quality to include constituents of concern in the basin identified in the GSP or demonstrate how total dissolved solids as a representative value is a reasonable proxy for other constituents as supported by adequate evidence.[466]

b) Revise the description of degraded water quality sustainable management criteria so that groundwater conditions, whether caused by direct actions by the GSAs to implement this GSP or not, are considered in the assessment of significant and unreasonable conditions in the Subbasin.

c) Coordinate with the appropriate groundwater users, including drinking water, environmental, and irrigation users as identified in the Plan, and water quality regulatory agencies and programs in the Basin to understand and develop a process for monitoring and determining if groundwater management and extraction is resulting in migration of constituents of concern or degraded water quality in the Basin.

RECOMMENDED CORRECTIVE ACTION 8

Department staff understand that estimating the location, quantity, and timing of stream depletion due to ongoing, Subbasin-wide pumping is a complex task and that developing suitable tools may take additional time; however, it is critical for the Department's ongoing and future evaluations of whether GSP implementation is on track to achieve sustainable groundwater management. The Department plans to provide guidance on methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water and support for establishing specific sustainable management criteria in the near future. This guidance is intended to assist GSAs to sustainably manage depletions of interconnected surface water. In addition, the GSAs should work to address the following items by the first periodic evaluation:

a) Revise sustainable management criteria to meet GSP regulatory requirements. Establish sustainable management criteria that considers the location, quantity,

[465] 23 CCR § 354.16(g).
[466] 23 CCR § 354.28(e).

and timing of depletions of interconnected surface water.[467] Do not use groundwater levels as a proxy for depletions of interconnected surface water without demonstrating that the representative value is a reasonable proxy as supported by adequate evidence.[468]

b) Consider utilizing the interconnected surface water guidance, as appropriate, when issued by the Department to establish quantifiable minimum thresholds, measurable objectives, and management actions.

c) Continue to fill data gaps, collect additional monitoring data, and implement the current strategy to manage depletions of interconnected surface water and define segments of interconnectivity and timing.

d) Prioritize collaborating and coordinating with local, state, and federal regulatory agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion within the GSAs' jurisdictional area.

RECOMMENDED CORRECTIVE ACTION 9

The GSAs should address the following related to the monitoring networks and provide updates on progress in annual reports:

a) Revise the monitoring network for degraded water quality to include constituents of concern in the Subbasin identified in the GSP or demonstrate how total dissolved solids as a representative value is a reasonable proxy for other constituents as supported by adequate evidence.[469]

b) Update the degraded water quality monitoring network and representative monitoring network to include the sampling frequency and data review frequency for each of the wells identified. The frequency of monitoring must collect sufficient spatial and temporal data to determine groundwater quality trends for water quality indicators, as determined by the Agencies, to address known water quality issues.[470] Department staff recommend the GSP includes the monitoring data collection frequency in tabular format as required by the GSP Regulations.[471]

c) Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions, so that the GSAs may characterize flow conditions, ephemeral or

[467] 23 CCR § 354.28(c)(6)(A).
[468] 23 CCR § 354.28(e).
[469] 23 CCR § 354.28(e).
[470] 23 CCR § 354.34(c)(4).
[471] 23 CCR § 354.34(h).

intermittent streams, and temporal changes in regional conditions due to groundwater extraction.[472]

d) Provide a detailed plan to fill data gaps so that the GSAs are sufficiently monitoring for depletions of interconnected surface water and may characterize the spatial and temporal exchanges between surface water and groundwater and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions.[473]

[472] 23 CCR § 354.34(c)(6) *et seq*.
[473] 23 CCR § 354.34(c)(6).