ANNUAL REPORT | APRIL 2025

# BUTTE SUBBASIN (5-021.70) GROUNDWATER SUSTAINABILITY PLAN ANNUAL REPORT – 2024

SUBMITTED BY

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PREPARED UNDER CONTRACT WITH

BUTTE COUNTY DEPARTMENT OF WATER AND RESOURCE CONSERVATION

PREPARED BY

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Butte County CALIFORNIA

**BUTTE SUBBASIN GSAS**

BIGGS-WEST GRIDLEY WATER DISTRICT

BUTTE WATER DISTRICT

CITY OF BIGGS
WHERE THE PEOPLE OWN THE WATER AND POWER

Colusa Groundwater Authority
Groundwater Sustainability Agency

GRIDLEY
CALIFORNIA

Butte County
• CALIFORNIA •

COUNTY OF GLENN
STATE OF CALIFORNIA

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## LIST OF ACRONYMS AND ABBREVIATIONS

| Acronym | Meaning |
| --- | --- |
| µS/cm | micro siemens per centimeter |
| AF | acre-feet |
| AFY | acre-feet per year |
| AMSL | above mean sea level |
| BBGM | Butte Basin Groundwater Model |
| BWD | Butte Water District |
| BWGWD | Biggs-West Gridley Water District |
| DMS | data management system |
| DWR | Department of Water Resources |
| CDFW | California Department of Fish and Wildlife |
| eWRIMS | electronic water rights information management system |
| EC | electrical conductivity |
| GPS | global positioning system |
| GSP | groundwater sustainability plan |
| GSA | groundwater sustainability agency |
| GLWA | Gray Lodge Wildlife Area |
| IM | interim milestone |
| M&T | M&T Ranch |
| MO | measurable objective |
| MT | minimum/maximum threshold |
| PMA | projects and management actions |
| RID | Richvale Irrigation District |
| RMS | representative monitoring site |
| SI | sustainability indicator |
| SB | senate bill |
| SCADA | supervisory control and data acquisition |
| SGMA | Sustainable Groundwater Management Act |
| SMC | sustainable management criteria |
| Subbasin | Butte Subbasin |
| UBBWA | Upper Butte Basin Wildlife Area |
| WCWD | Western Canal Water District |
| WY | water year (October 1-September 30) |

# EXECUTIVE SUMMARY

The Butte Subbasin (Subbasin) (5-021.70) Annual Report (Annual Report) was prepared on behalf of the following groundwater sustainability agencies (GSAs): Biggs-West Gridley Water District GSA, Butte Water District GSA, City of Biggs GSA, City of Gridley GSA, Colusa Groundwater Authority GSA, County of Butte GSA, County of Glenn GSA, Reclamation District No. 1004 GSA, Reclamation District No. 2106 GSA, Richvale Irrigation District (RID) GSA, and Western Canal Water District GSA to fulfill the statutory requirements set by the Sustainable Groundwater Management Act (SGMA) legislation (§10728) and the Groundwater Sustainability Plan (GSP) regulations (§354.40 and §356.2) developed by the California Department of Water Resources (DWR). The regulations mandate the submission of an Annual Report to DWR by April 1st after the reporting year, which spans the water year (WY) from October 1st to September 30th. This Annual Report includes information from the recent WY 2024 (October 1, 2023, to September 30, 2024) for the Butte Subbasin, located within Butte, Glenn, and Colusa Counties, and shown in **Figure ES-1.**

Measured conditions in the Subbasin were in compliance with minimum/maximum thresholds (MTs) for all applicable sustainability indicators (SIs), with one exception, well 17N01W10A001M (Very Deep Aquifer); its electrical conductivity (EC) MT of 1,968 micro siemens per centimeter (µS/cm) was exceeded by 29 µS/cm. A minimum threshold is the quantitative value that represents the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the Subbasin per DWR's definition. Whether the MT represents a minimum or maximum value is dependent on the SI. As an example of a minimum, if groundwater levels are lower than the value of the measurable objective (MO) for that site, they are moving in the direction of the MT. As an example of a maximum, for the groundwater quality sustainable management criteria (SMC), as the value of the electrical conductivity concentrations increase from the MO established for that site, it is moving in the direction of the MT. The SIs and SMC, including MTs, are summarized in **Table ES-1**. Note that seawater intrusion is not an applicable SI in this Subbasin. Each SI is measured at representative monitoring sites (RMS).

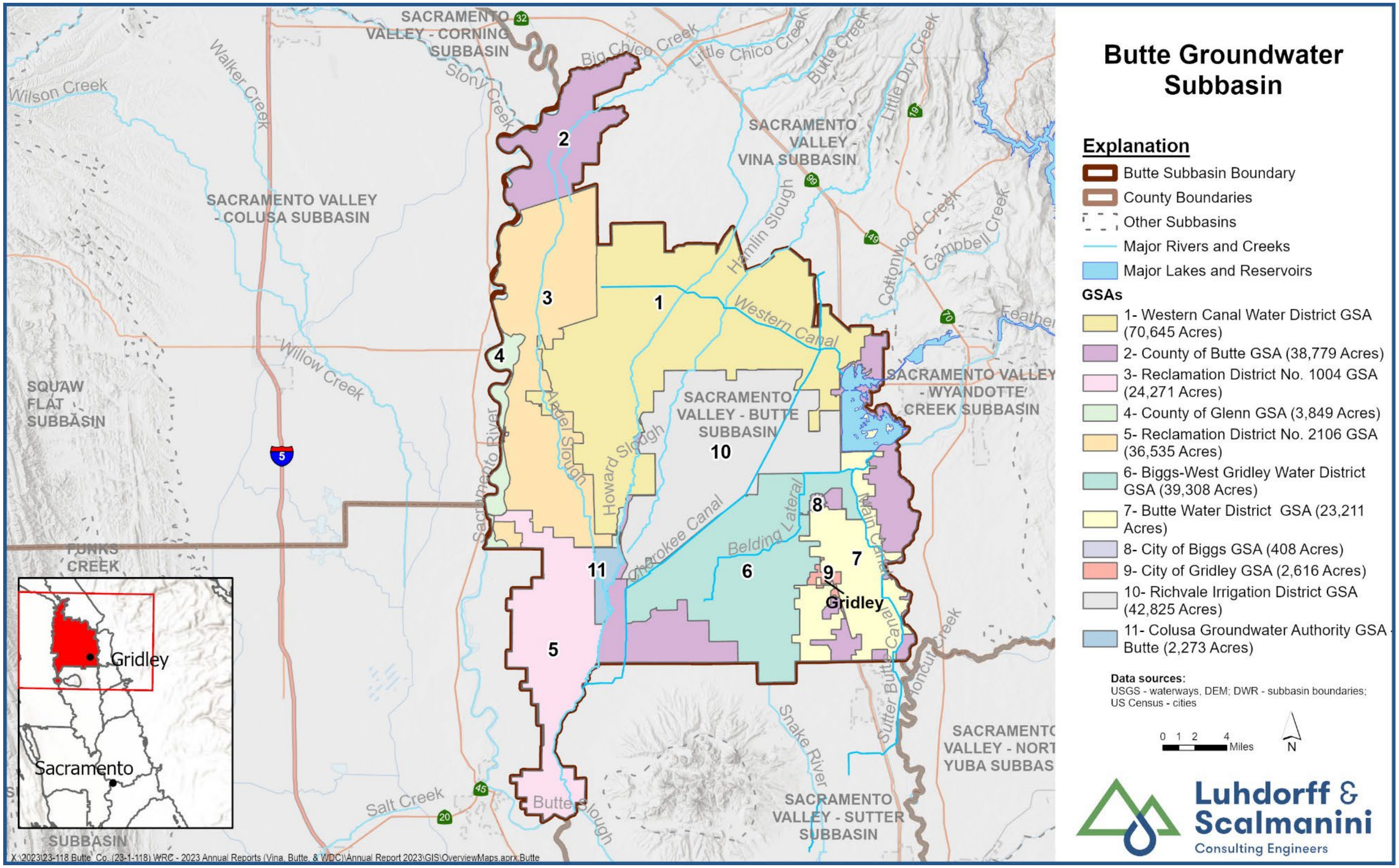


Figure ES-1. Butte Subbasin and Groundwater Sustainability Agency Boundaries

**Table ES-1. Butte Subbasin Sustainability Indicator Summary**

| 2024 Status | Undesirable Result Identification | MO Definition | MT Definition |
|---|---|---|---|
| **Chronic Lowering of Groundwater Levels** | | | |
| **No indication of undesirable results**<br>There were no RMS wells with spring or fall 2024 groundwater level measurements below the MT. | When 25% of each aquifer's RMS wells fall below their MTs for 24 consecutive months (11 of 41 wells in the Primary Aquifer and 3 of 10 in the Very Deep Aquifer) | Static 5-year average (generally 2012-2017) of measured groundwater level data for each RMS well | For each RMS well, the shallower of either:<br>i. the shallowest 7th percentile of nearby domestic wells, or<br>ii. the range of measured groundwater levels, or 20 feet (whichever is greater), below the observed historic low.<br>If the resulting value is shallower than the observed historic low, the MT is set 10 feet deeper than the observed historic low. |
| **Reduction of Groundwater Storage** | | | |
| **No indication of undesirable results**<br>There were no RMS wells with spring or fall 2024 groundwater level measurements below the MT. | Groundwater levels are a proxy. | Groundwater levels are a proxy. | Groundwater levels are a proxy. |
| **Degraded Water Quality** | | | |
| **No indication of undesirable results**<br>In August of 2024, 1 RMS well, 17N01W10A001M (Very Deep Aquifer) exceeded its electrical conductivity MT of 1,968 µS/cm by 29 µS/cm (one well represents 12.5% of RMS). | When 25% of RMS wells (2 of 8) exceed their MT for 24 consecutive months | Measured electrical conductivity less than or equal to 700 µS/cm at each RMS well | The higher of either 900 µS/cm or the measured historical high of electrical conductivity for each RMS well |

| Table ES-1. Butte Subbasin Sustainability Indicator Summary | | | |
|---|---|---|---|
| **2024 Status** | **Undesirable Result Identification** | **MO Definition** | **MT Definition** |
| **Land Subsidence** | | | |
| **No indication of undesirable results**<br>There were no subsidence monitoring sites with a subsidence rate greater than the MT over the past 5 years. | When 25% of DWR's monitoring network (8 of 31 benchmarks) measure a subsidence rate greater than the MT | Up to 0.25 foot of subsidence per 5-year period at each site (0.05 feet over 1 year; 1 foot over 20 years) | 0.5 foot of subsidence over a 5-year period at each site |
| **Depletion of Interconnected Surface Water** | | | |
| **No indication of undesirable results**<br>There were no RMS wells with spring or fall 2024 groundwater level measurements below the MT. | When 25% of RMS wells (3 of 12) fall below their MTs for 24 consecutive months, using groundwater levels as a proxy | Static 5-year average (generally 2012-2017) of measured groundwater level data for each RMS well | 10 feet below the measured historical low at each RMS well |

***Notes:***

*Salinity is the primary water quality constituent of concern, which is evaluated by measuring electrical conductivity (EC).*

*MO = measurable objective, MT = minimum/maximum threshold, RMS = representative monitoring site, µS/cm = micro siemens per centimeter.*

## Current Groundwater Level and Storage Conditions

The current groundwater conditions in the Subbasin are characterized by groundwater elevations that have remained consistently near or above the MO, remained well above the corresponding MTs, and remain within the Subbasin's established margin of operational flexibility for each RMS well. Importantly, none of the RMS wells experienced a decline below the MT for 24 consecutive months, hence avoiding undesirable results as defined in the GSP.

Generally, groundwater elevations are well above the MT throughout the Subbasin and, on average, 36 feet higher than their corresponding MTs, with elevations mostly near or slightly higher than those observed in recent years. This positive trend is influenced by the above-normal hydrologic conditions experienced in WY 2024, which resulted in increased surface water supplies available for irrigation despite increased groundwater extractions, which contributed to the recovery of groundwater conditions relative to the dry period from WY 2020 to WY 2022.

Fluctuations in groundwater levels and storage within the Subbasin are influenced by the balance between aquifer recharge and extraction. Groundwater levels serve as a proxy for estimating changes in groundwater storage, with observed patterns closely mirroring those in the broader Sacramento Valley. In years characterized by drought and low precipitation, diminished surface water supplies lead to increased extraction and reduced recharge, causing a decline in groundwater storage.

In contrast, WY 2024, classified as an above normal WY (CDEC, 2024), marked an increase in groundwater storage of approximately 12,700 acre-feet (AF) in the Primary Aquifer (an 88.5% change from the previous WY) and approximately 8 AF increase in the Very Deep Aquifer (a 37.5% change from the previous WY). For context, in the past 24 years, the largest one-year decrease in groundwater storage is estimated to be -93,800 AF, and the highest one-year increase was estimated to be 110,100 AF. **Figure ES-2** shows groundwater pumping, as well as an annual and cumulative change in groundwater storage from WY 2000 to WY 2024.

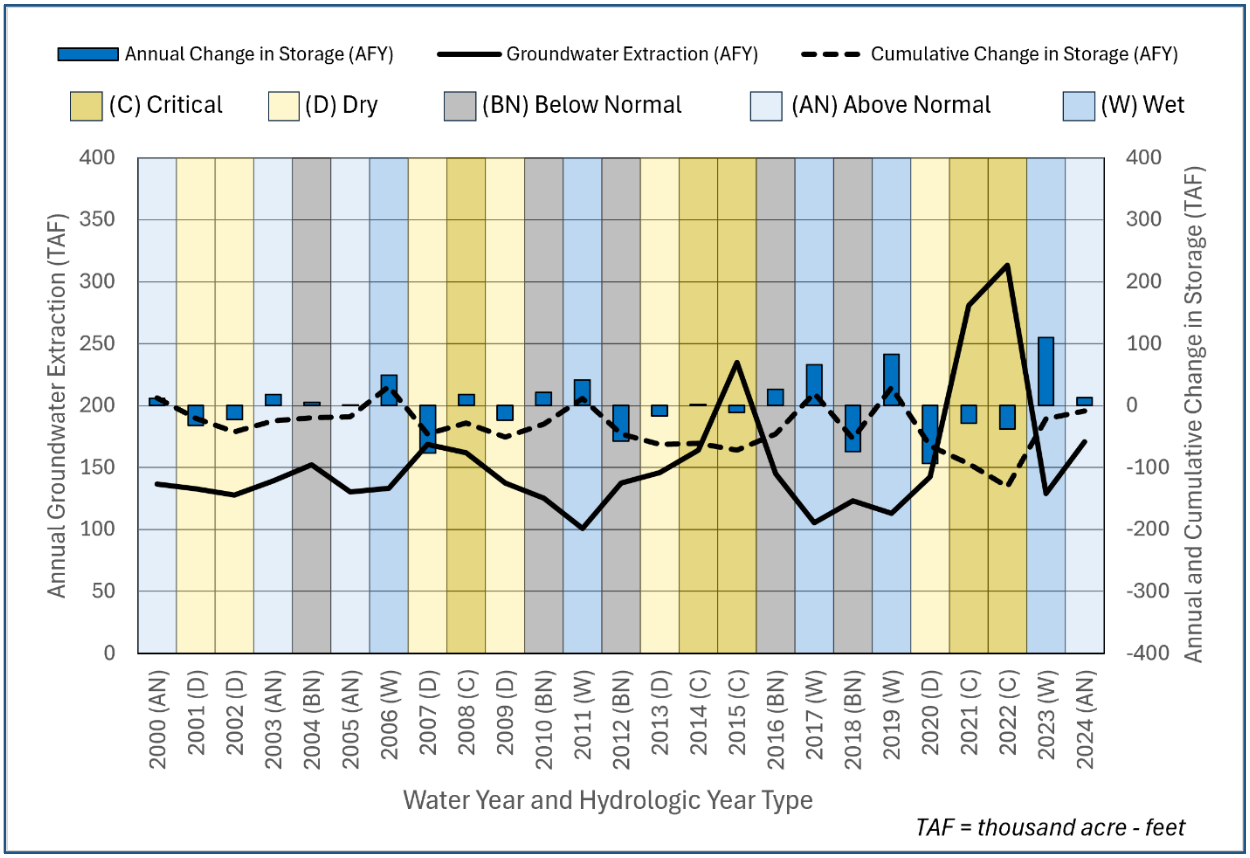


**Figure ES-2. Butte Subbasin Groundwater Pumping, Annual and Cumulative Change in Storage from WY 2000 to WY 2024**

## Water Use

The annual volume of surface water applied for use in the Subbasin from surface water features such as the Feather River, Sacramento River, and Butte Creek was about 824,700 AF in WY 2024, which was higher than the 786,500 AF applied in WY 2023. Groundwater extraction was approximately 170,600 AF in WY 2024, also higher than the 128,900 AF extracted in WY 2023.

Surface water provided the majority (83%) of the water for agriculture in the Subbasin, and groundwater was the source for the remainder in WY 2024. Groundwater also met the demand for municipal and rural residential users. The volume of groundwater and surface water used on an annual basis within the Subbasin is summarized directly from measured and reported groundwater pumping and surface water diversions when available; however, a water budget approach has been used to estimate the remaining unmeasured volume of groundwater extraction. Water use data is reported in **Appendix D**. The water use analysis methodology is discussed in **Appendix E. Table ES-2** provides a summary of water use by water source and sector. Numbers are rounded to the nearest 100.

| Table ES-2. Butte Subbasin Total Water Use by Water Use Sector | | | | |
|---|---|---|---|---|
| Sector | WY 2024 | | | |
| | Groundwater (AF) | Surface Water (AF) | Total (AF) | Total Sector Area (ac) |
| Agricultural | 151,200 | 724,400 | **875,600** | **152,100** |
| Municipal | 2,300 | -- | **2,300** | **20,900** |
| Rural Residential | 1,300 | -- | **1,300** | **n/a*** |
| Environmental (Managed Wetlands) | 15,800 | 100,300 | **116,100** | **18,400** |
| **Total** | **170,600** | **824,700** | **995,300** | **224,600** |

***Notes:***
**Rural Residential water use is calculated based on population from census data, not area.*

## GSP Implementation Progress

The main activities and updates since the previous Annual Report are as follows:

1. All sustainability indicators (SIs) are in compliance with their MTs with the exception of one water quality RMS well in exceedance of its MT; however, there were no undesirable results for this SMC and this area of the Subbasin is known to have historically high levels of electrical conductivity.
2. The GSAs funded the completion of the WY 2023 Annual Report, with Butte County serving as the fund administrator.
3. The GSA continued to engage in ongoing intra- and inter-basin coordination.
4. The GSAs completed other critical tasks, such as monitoring and recording groundwater levels and groundwater quality and maintaining and updating the data management system (DMS) with newly collected data.
5. Progress has been made on nine projects and management actions (PMAs) since the last annual report (**Tables 5-4 and 5-5**).

The GSP was approved in July of 2023, and DWR proposed three recommended corrective actions that will enhance the GSP:

1. Providing details into how proposed MTs for the chronic lowering of groundwater levels may impact beneficial uses, users, and other SIs.
2. Offering more information on SMC for land subsidence.
3. Closing data gaps, expanding monitoring efforts, and executing the current strategy to manage depletions of interconnected surface water while defining segments of interconnectivity and timing.

In 2024, the GSAs in the Butte Subbasin coordinated to implement a shared funding plan to address the identified corrective actions as part of the periodic evaluation of the GSP.

# 1. GENERAL INFORMATION §356.2(A)

The Annual Report for the Butte Subbasin (Subbasin) (5-021.70) was prepared on behalf of 11 groundwater sustainability agencies (GSAs), including Biggs-West Gridley Water District GSA, Butte Water District GSA, City of Biggs GSA, City of Gridley GSA, Colusa Groundwater Authority GSA, County of Butte GSA, County of Glenn GSA, Reclamation District No. 1004 GSA, Reclamation District No. 2106 GSA, Richvale Irrigation District (RID) GSA, and Western Canal Water District GSA, to fulfill the statutory requirements of the Sustainable Groundwater Management Act (SGMA) legislation (§10728) and regulatory requirements developed by the California Department of Water Resources (DWR) included in the Groundwater Sustainability Plan (GSP) regulations (§354.40 and §356.2). The regulations require the GSAs to submit an Annual Report to DWR by April 1st following the reporting year, which spans the water year (WY) from October 1st to September 30th. This Annual Report is the fourth annual report submitted on behalf of the Subbasin and includes data for the most recent WY 2024 (October 1, 2023 to September 30, 2024). Public seeking information on Butte Subbasin and GSP Implementation, Butte Advisory Board meeting schedules and recordings, and other resources should visit the **Butte Sustainable Groundwater website** (https://www.buttebasingroundwater.org/).

## 1.1 Report Contents

This report is the fourth annual report prepared for the adopted Butte Subbasin GSP submitted in January 2022. The first annual report included data elements for the first reporting year, WY 2021, as well as a "bridge year," WY 2020. The second and third annual reports contain data only for the current reporting year, WY 2022, and WY 2023, respectively. Data elements presented in this report refer to WY 2024, the 12-month period spanning October 2023 through September 2024 unless otherwise noted. Pursuant to GSP regulations, this Annual Report includes:

- Groundwater Elevation Data
- Water Supply and Use
- Change in Groundwater Storage
- GSP Implementation Progress

## 1.2 Subbasin Setting

The Subbasin is a 414 square mile (265,500 acre) area on the western side of Butte County and the eastern portions of Glenn and Colusa Counties. The Subbasin is managed by 11 GSAs, including Biggs-West Gridley Water District GSA, Butte Water District GSA, City of Biggs GSA, City of Gridley GSA, Colusa Groundwater Authority GSA, County of Butte GSA, County of Glenn GSA, Reclamation District No. 1004 GSA, Reclamation District No. 2106 GSA, Richvale Irrigation District GSA, and Western Canal Water District GSA. The 11 GSAs worked cooperatively to develop and submit a single GSP for the Subbasin and to submit Annual Reports every year.

The Subbasin is shown in **Figure 1-1** and **Figure 1-2**. The Subbasin lies in the eastern central portion of the Sacramento Groundwater Basin, **Figure 1-1**. The Subbasin's northern boundary is the Corning and Vina Subbasins, the western boundary is the Sacramento River and the Colusa Subbasin, the southern boundary is the Sutter Subbasin, and the eastern boundary is the Feather River and the Wyandotte Creek Subbasin (DWR, 2018), **Figure 1-2**. There are several surface water features in the Subbasin, including the Thermalito Afterbay and Butte Creek. Big Chico Creek flows along a portion of the Subbasin's northern border. Smaller local streams entering and traversing the Subbasin include Little Chico Creek, Little Dry Creek, and Angel Slough. Primary canals include the Western Main Canal, Western Lateral 374, Richvale Main Canal, Sutter Butte Canal, Biggs Extension Canal, Minderman Canal, and Biggs-West Gridley Main Canal. Groundwater generally flows from north to southwest.

Although management areas have not been delineated in the Subbasin at this time, the creation of management areas will be considered by the GSAs in the Subbasin as needed. The Butte Subbasin GSP estimates the sustainable yield of the Subbasin to be 208,500 acre-feet per year (AFY) based on projected long-term groundwater pumping averages of 210,500 AFY and an average annual decrease in storage of 2,000 AFY (Davids, 2021). Water use in the Subbasin in the 2024 WY is dominated (88%) by agricultural uses, including irrigation of nut and fruit trees, vineyards, row crops, grazing, and rice fields. Municipal and household water use accounts for less than 0.4% of total water used, with environmental water for managed wetlands making up the remaining 12%. Surface water constitutes the majority (83%) of the Subbasin's water supplies, with groundwater constituting the remaining portion (17%).

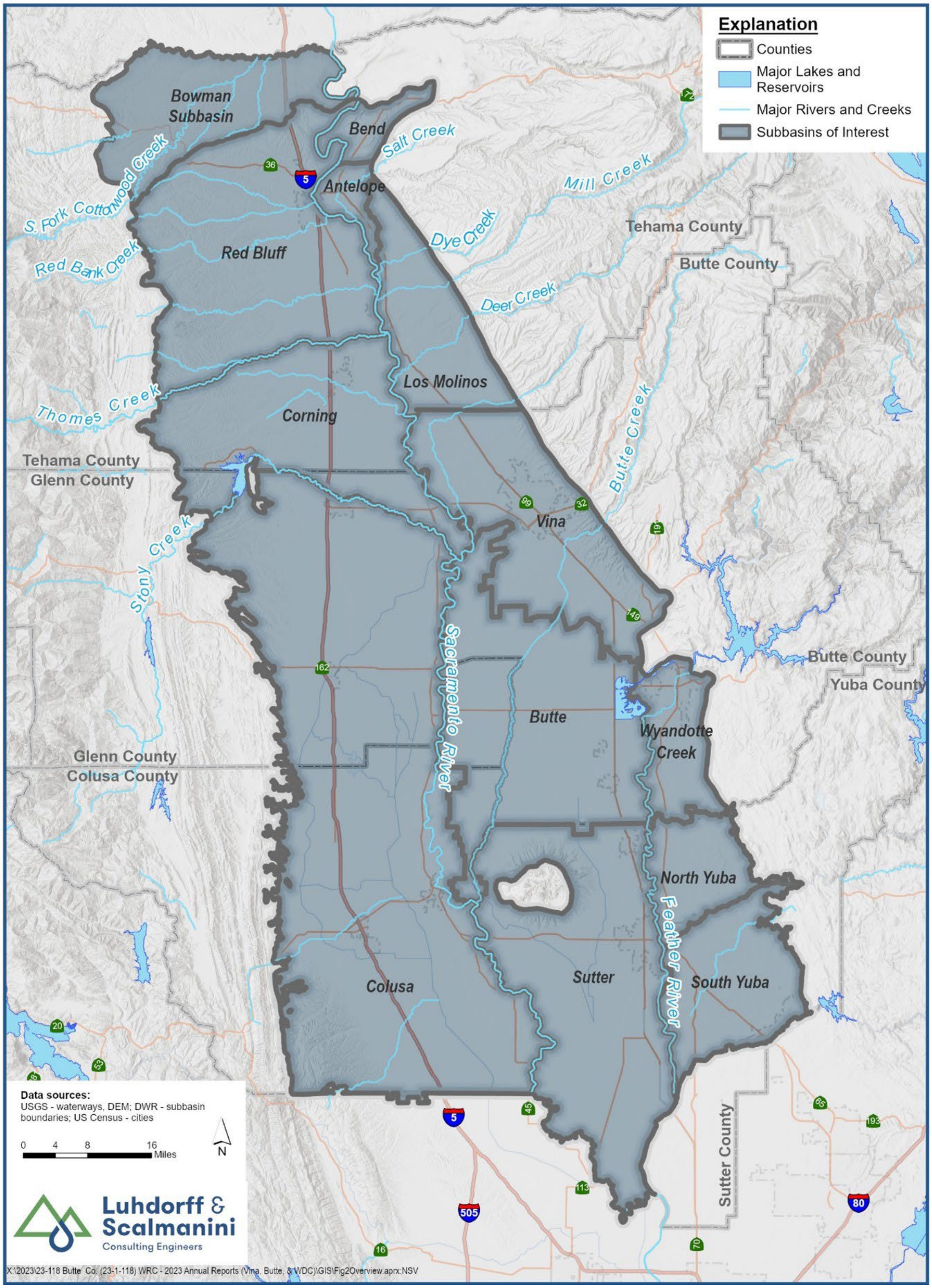


**Figure 1-1. Subbasins in the Northern Sacramento Valley**

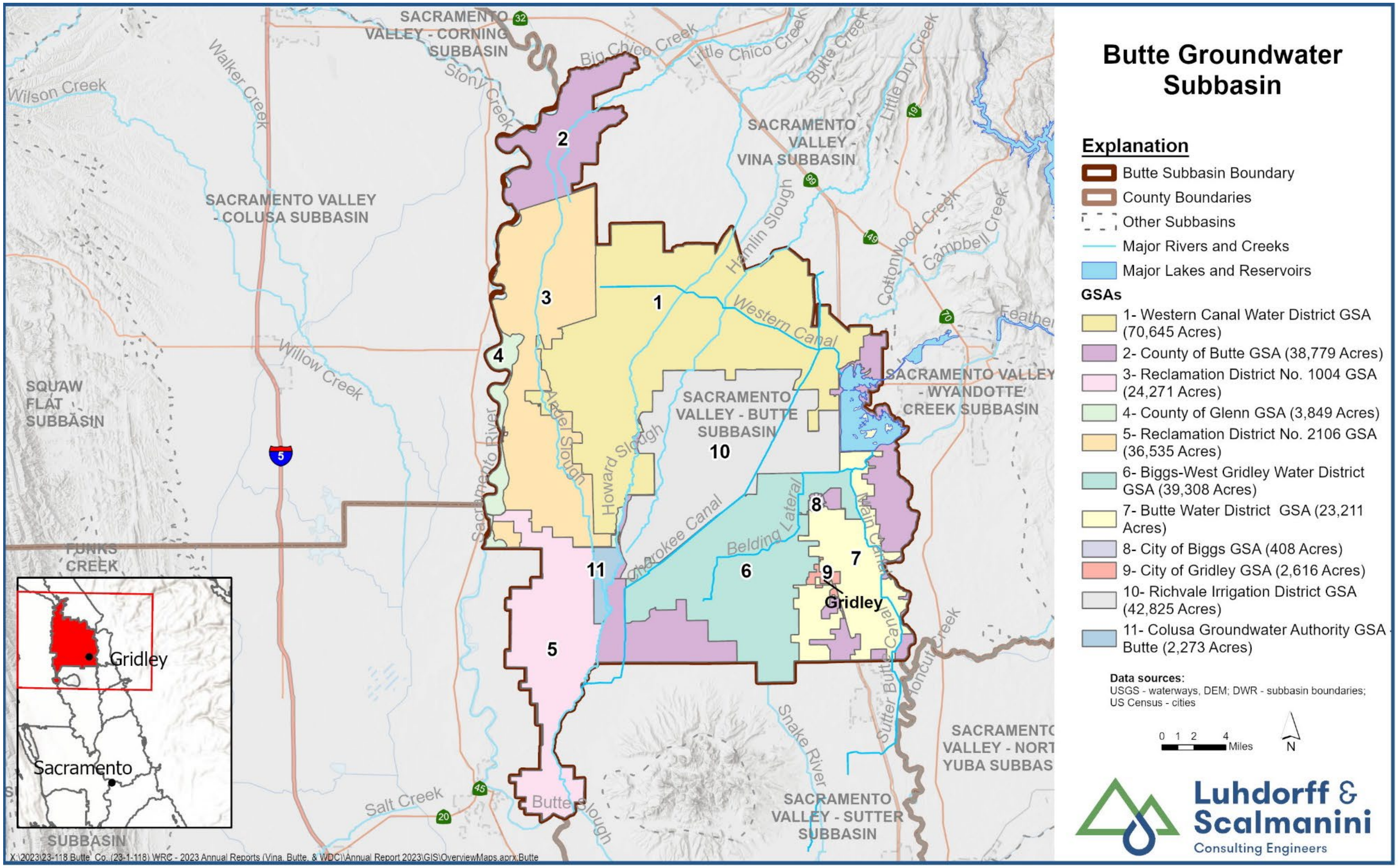


Figure 1-2. Butte Subbasin and Groundwater Sustainability Agency Boundaries

# 2. GROUNDWATER ELEVATIONS §356.2(b)(1)

Groundwater elevations in the Subbasin typically fluctuate seasonally between and within water years, particularly in groundwater-dependent areas or during drought years when groundwater is used to compensate for diminished surface water supplies. Seasonal fluctuations of groundwater levels occur in response to groundwater pumping and recovery, land and water use activities (such as rice flood-up), recharge, and natural discharge. Sources of recharge into the groundwater system include precipitation, applied irrigation water, and seepage from local creeks and rivers.

Groundwater pumping for irrigation typically occurs from April to September, although depending on the timing of rainfall, it may shift earlier and/or later into the season. Consequently, groundwater levels are usually highest in the spring and lowest during the irrigation season in the summer months. Fall groundwater measurements (typically measured in October) provide an indication of groundwater conditions after the primary irrigation season and usually before winter flood-up for rice decomposition and wetlands habitat. In rice growing areas, summer groundwater levels can be relatively high compared to spring and fall levels due to field flooding using surface water supplies (e.g., 18N01E35L001M flows as an artesian well in some years). Groundwater levels follow a variety of patterns in different areas of the Subbasin. However, in most years and as seen in the 2024 WY, groundwater is generally shallow (nearly all wells have groundwater at less than 40 feet below ground surface and many at less than 10 feet), and groundwater is relatively stable in most of the Subbasin.

Groundwater levels in the Subbasin are monitored in representative monitoring site (RMS) wells that were selected in the GSP to represent localized groundwater conditions for specified areas of the Subbasin. RMS wells include a mixture of domestic wells, irrigation wells, and dedicated observation wells. In total, 41 RMS wells are used to monitor conditions in the Primary Aquifer, and 10 RMS wells are used to monitor conditions in the Very Deep Aquifer. **Appendix A** includes a map of the approximate locations of the RMS wells and hydrographs depicting groundwater elevations in the RMS wells. Sustainable management criteria (SMC), described in **Appendix B**, are assigned for groundwater levels at the RMS wells.

Certain RMS wells measured by DWR and Butte County are equipped with data loggers and pressure transducers, which continuously monitor and record hourly changes in groundwater levels. These and the remaining wells in the network are measured by hand at least twice in spring and fall but up to four times each year in March, July, August, and October. Data from groundwater level monitoring wells is available from DWR's online SGMA Data Viewer tool
(https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer).

Spring and fall 2024 groundwater elevation measurements from RMS wells in the Primary and Very Deep Aquifer systems are summarized in **Table 5-2**. Groundwater elevation data in the Subbasin are collected by DWR and Butte County and are publicly available from DWR's online SGMA Data Viewer tool (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer). The groundwater level monitoring methods are consistent with the protocols described in the Butte Subbasin GSP. Depending on the well, groundwater elevations are measured using a steel tape, electric sounder, or pressure transducer. The accuracy of groundwater level measurements is typically either 0.01 feet or 0.1 feet, depending on the equipment used.

The following sections provide a summary of groundwater elevations and conditions during WY 2024 through the presentation and description of groundwater elevation contours (**Section 2.1**) and hydrographs of groundwater elevations (**Section 2.2; Appendix A**).

## 2.1 Groundwater Elevation Contour Maps – §356.2(b)(1)(A)

Groundwater elevation contour maps for spring and fall 2024 were prepared for the Primary Aquifer and the Very Deep Aquifer, as shown in **Figures 2-1** through **2-4**. Spring contours are intended to generally represent seasonal high groundwater elevations (shallower depth to water), and fall contours are intended to generally represent seasonal low groundwater elevations (a deeper depth to water). Groundwater elevation contours were developed by creating a continuous groundwater elevation surface based on available monitoring well data using the kriging interpolation method. Questionable groundwater elevation measurements were excluded, and minor adjustments to the contours were made based on professional judgment.

The contour maps of the Primary Aquifer (**Figures 2-1 and 2-2**) each show that groundwater elevations are generally higher in the northern and eastern areas of the Subbasin versus the southern and western areas, indicating a general gradient – and thus groundwater flow, from the northeast to the southwest. Because of the influence of the Thermalito Afterbay, groundwater elevations observed near this surface water feature are relatively stable between the spring and fall observation periods. In general, elevations in fall 2024 tend to be approximately ten feet lower than elevations in spring 2024 throughout the Subbasin.

The contour maps of the Very Deep Aquifer (**Figures 2-3** and **2-4**) show a relatively consistent groundwater gradient across the Subbasin with a similar groundwater flow direction as indicated by contours in the Primary Aquifer (generally from northeast to southwest). Similar to the Primary Aquifer, fall 2024 contours indicate that fall groundwater elevations in the Very Deep Aquifer were approximately six feet lower than elevations in spring 2024.

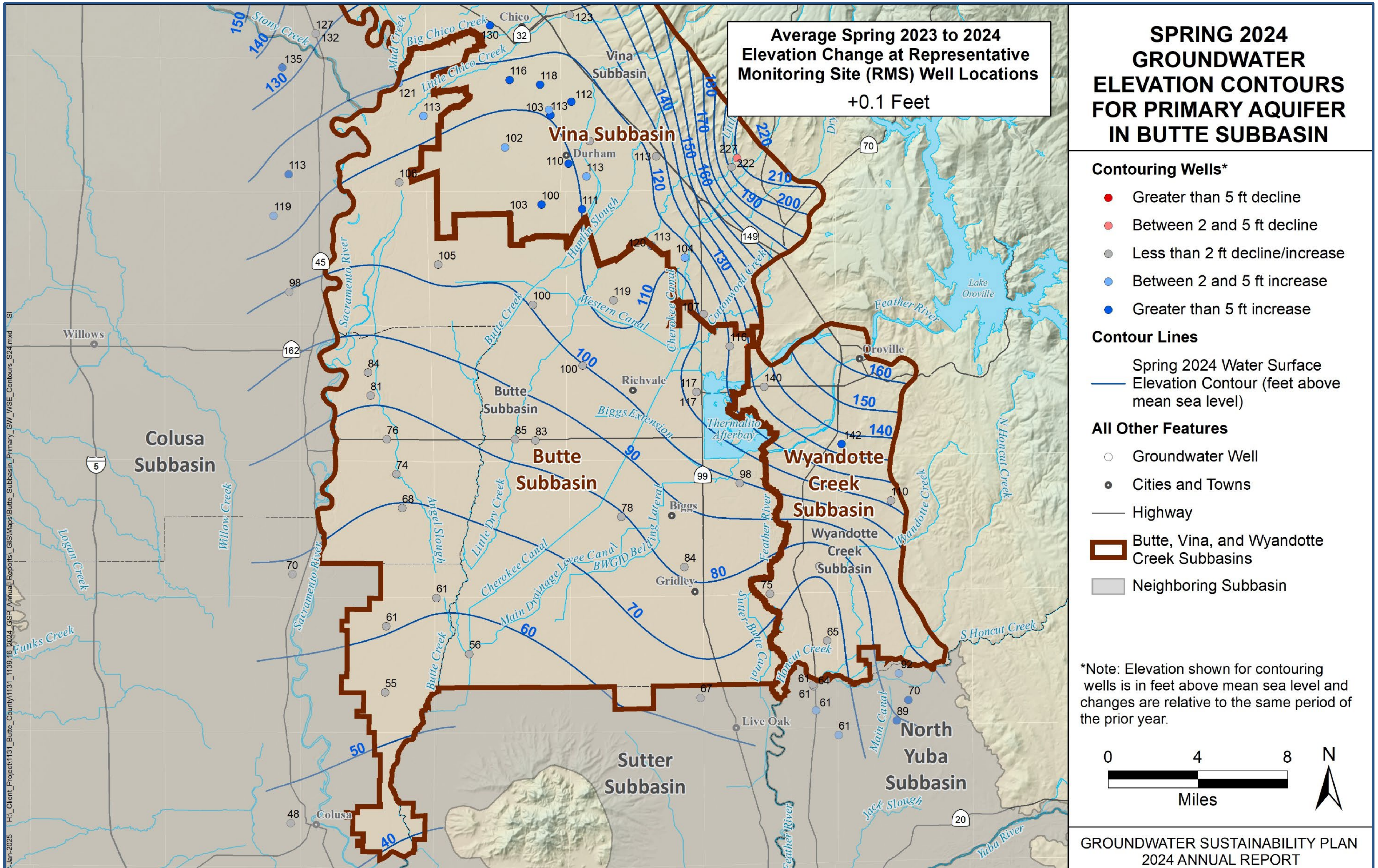


Figure 2-1. Butte Subbasin Contours of Equal Groundwater Elevation for the Primary Aquifer, Spring 2024 (Seasonal High)

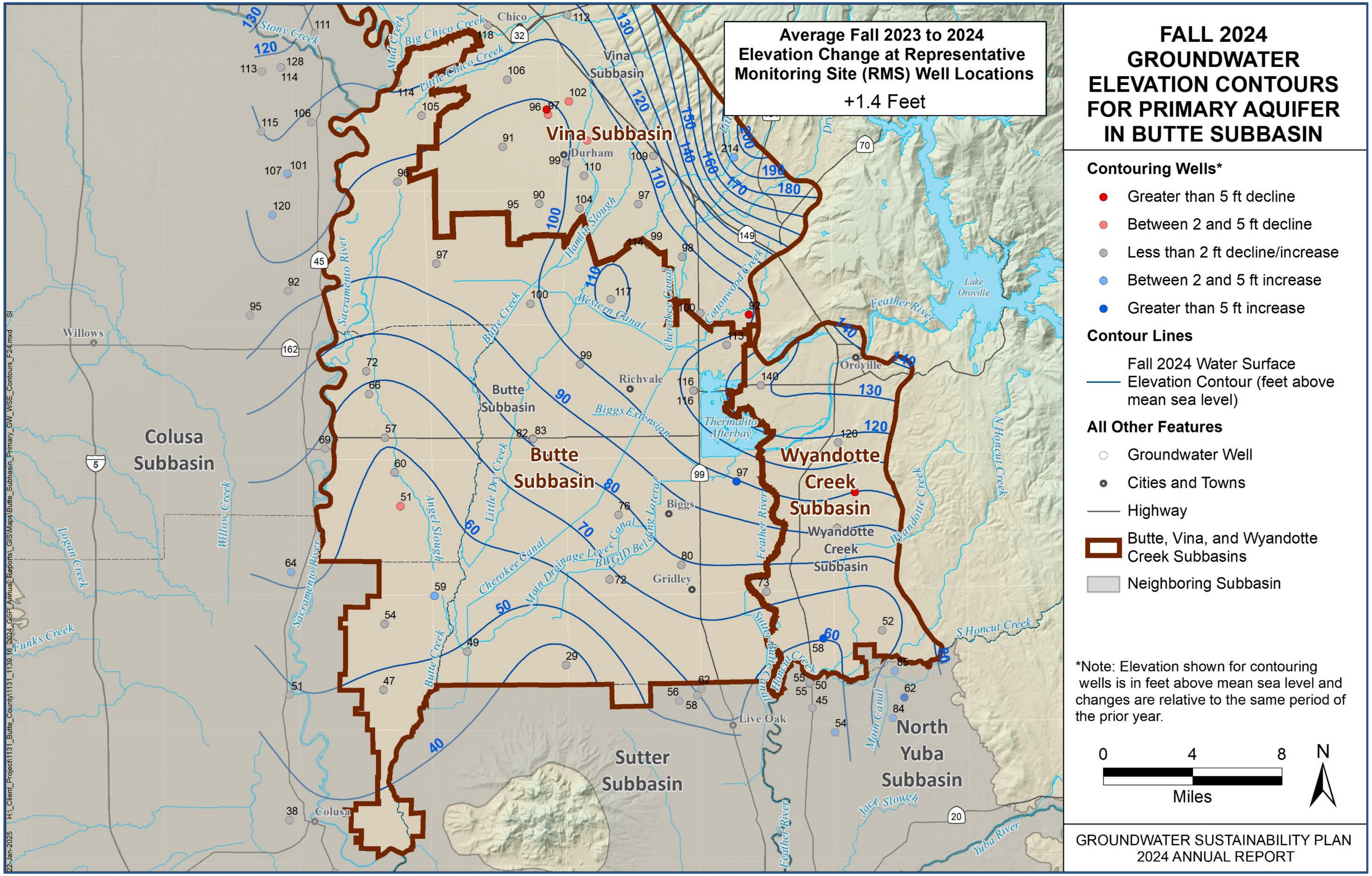


Figure 2-2. Butte Subbasin Contours of Equal Groundwater Elevation for the Primary Aquifer, Fall 2024 (Seasonal Low)

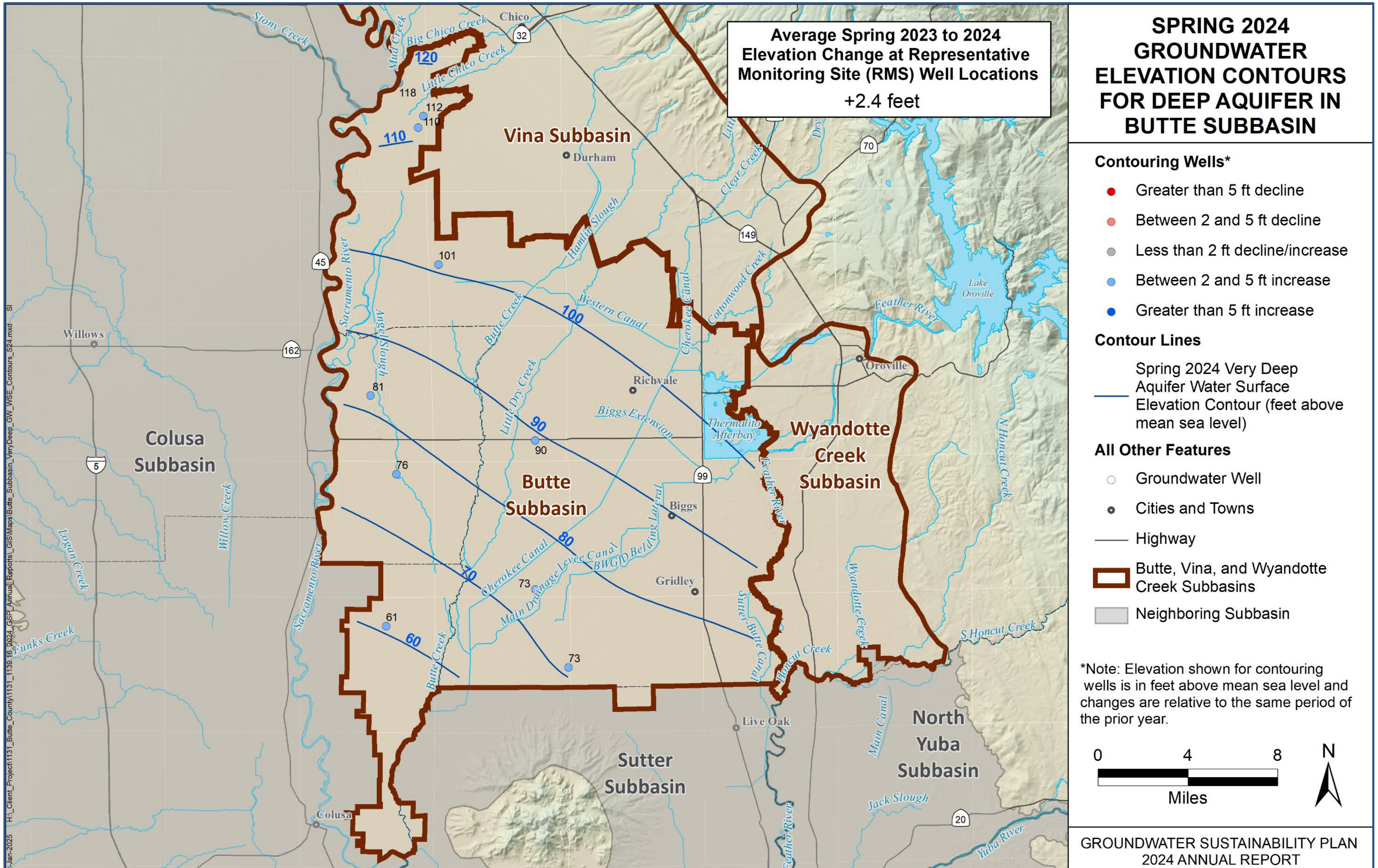


Figure 2-3. Butte Subbasin Contours of Equal Groundwater Elevation for the Very Deep Aquifer, Spring 2024 (Seasonal High)

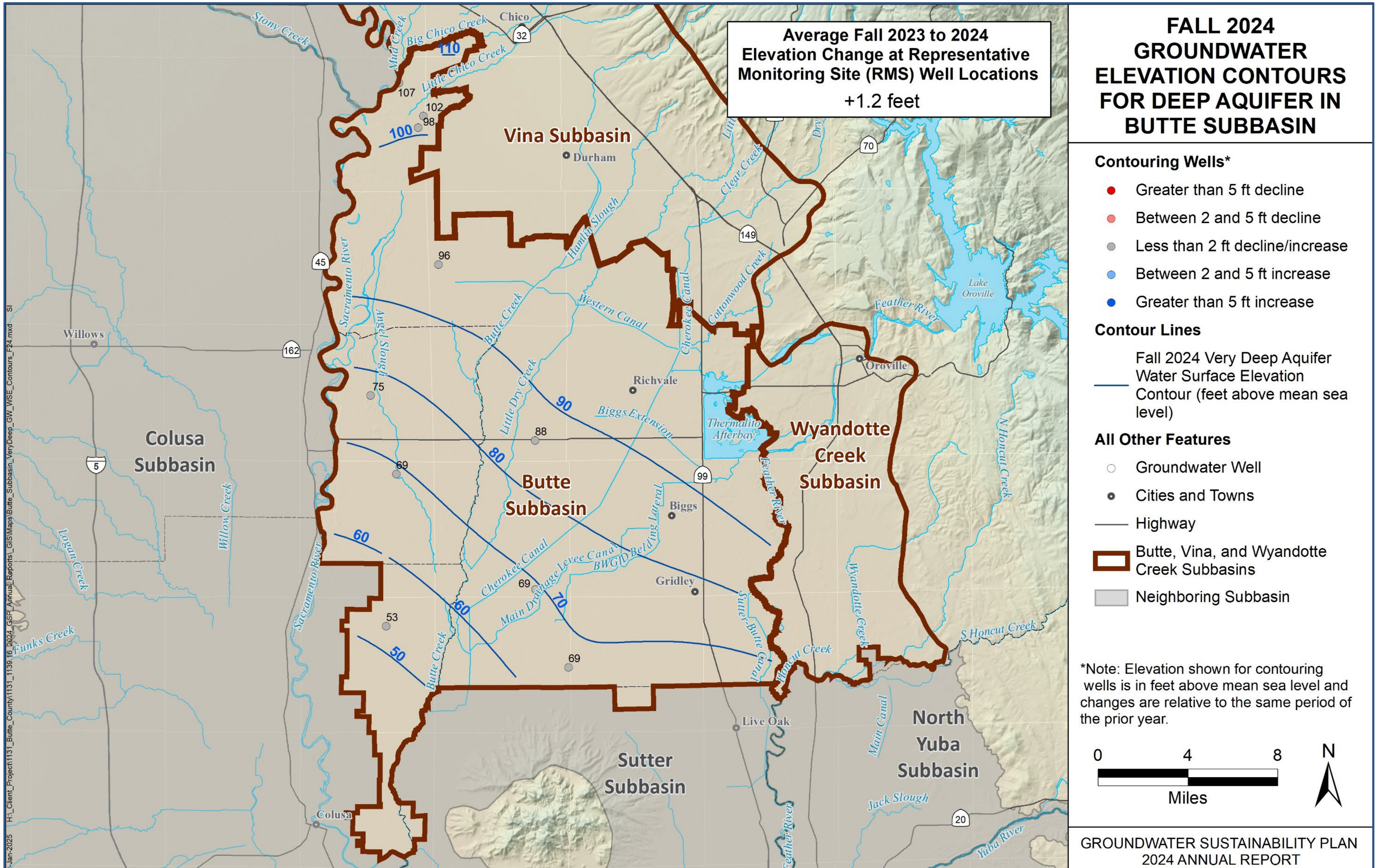


Figure 2-4. Butte Subbasin Contours of Equal Groundwater Elevation for the Very Deep Aquifer, Fall 2024 (Seasonal Low)

## 2.2 Hydrographs of Groundwater Elevations – §356.2(b)(1)(B)

Groundwater elevation hydrographs for each RMS well are presented in **Appendix A**. **Appendix B** provides an explanation of the SMC terminology defined in Section 3 of the GSP (e.g., minimum threshold [MT], measurable objective [MO], interim milestone [IM]). **Table 5-1** summarizes the MOs, MTs, and identification of undesirable results for all applicable SIs for WY 2024, and **Table 5-2** contains a summary of the spring 2024 (seasonal high) and fall 2024 (seasonal low) groundwater elevations measured at each RMS well. **Table 5-2** also summarizes the established MO and MT for groundwater elevations, the IM for 2027, the changes in groundwater elevations from WY 2023 to WY 2024, and the differences between the 2024 groundwater elevations and the MO for each RMS well.

Historically, groundwater levels have typically remained at or near their respective MOs in the Subbasin. If there is a decline in groundwater levels caused by increased groundwater extractions due to decreased surface water supplies, there is often a quick recovery of groundwater levels after the period of increased groundwater extractions has ended. The GSP established IMs equal to the MOs to provide numerical metrics for GSAs to track the Subbasin's conditions relative to the overall sustainability goal, ensuring that groundwater management in the Subbasin remains sustainable.

Spring and fall 2024 groundwater elevations were generally near or slightly higher than seasonal groundwater elevations in previous years. In WY 2024, the average seasonal high in the Primary Aquifer was 90 feet above mean sea level (AMSL), and the average seasonal low was 85 feet AMSL (roughly the same as those in WY 2023). The comparison of WY 2024 to WY 2023 in the Very Deep Aquifer yields similar results with slightly higher elevations observed in WY 2024 relative to WY 2023. Increases in groundwater levels are generally expected to result from recharge resulting from a wet WY 2023 and an above average WY 2024 for precipitation.

All 51 RMS wells were above the MO as of spring 2024 and, on average, approximately six feet above the MO. In fall 2024, 29 of the RMS wells were below the MO, and on average, groundwater levels were approximately one foot below the MO. It is anticipated that groundwater levels will rise above their respective MOs again in spring 2025. All measured groundwater elevations that fell below the MO in fall 2024 remained above the corresponding MT of that RMS well, avoiding undesirable results related to groundwater levels as defined in the GSP. On average, groundwater levels in RMS wells were roughly 33 feet higher than MT elevations in the fall of 2024. All WY 2024 measured groundwater levels remained within the Subbasin's margin of operational flexibility and above the MTs.

# 3. WATER SUPPLY AND USE

As required by §356.2, this section summarizes water supply and use in the Subbasin, categorized by groundwater supply, surface water supply, and total supply. The total water available for use in the Subbasin was tabulated from groundwater extraction volumes reported in **Table 3-1** and the surface water supply reported in **Table 3-2**. The total water available is summarized in **Table 3-3** for WY 2024. Groundwater extraction volumes are either based on measured data or are estimates from a water use analysis based on 2024 land use data and climate conditions. Water use data is reported in **Appendix D**. The water use analysis methodology is discussed in **Appendix E**. Surface water use was estimated using historic diversions when records were not available. Groundwater use data was supplied by water districts/municipalities when available.

## 3.1 Groundwater Extraction – §356.2(b)(2)

Groundwater extraction in the Subbasin is summarized in **Table 3-1**. Groundwater extraction is reported from pumping records where available, while the remaining groundwater extraction is estimated through the water use analysis approach described in the previous section and in **Appendix E**.

The majority of the Subbasin uses reliable surface water supplies for agricultural irrigation, although portions of the Subbasin rely on groundwater for irrigation. Typically, in years characterized by drought and low precipitation, reduced surface water supplies lead to increased groundwater extraction and reduced recharge, which can cause a decline in groundwater storage. Contrastingly, in wet and above normal years, such as WY 2023 and WY 2024, substantial surface water supplies are utilized, and less extraction occurs, resulting in an increase or relatively minimal change in groundwater storage. WY 2024 (which was classified as above normal) had less precipitation relative to WY 2023 (which was classified as wet) and subsequently had higher groundwater extraction relative to WY 2023. Groundwater supplied about 17% of the total water use in the 2024 WY in the Butte Subbasin.

Municipal water users extracted approximately 2,300 acre-feet (AF) in the Subbasin in WY 2024. Municipal water supplies are measured and provided by the City of Biggs and the City of Gridley. The record of municipal supplies does not distinguish between urban and industrial water uses.

Rural residential water users rely on private domestic wells to meet their household water needs and extract approximately 1,300 AF in WY 2024. Rural residential groundwater extraction was quantified based on average per capita water use and estimated population. The average per capita water use reported in the California Water Service Chico-Hamilton City District 2020 Urban Water Management Plan 2020 (Cal Water Chico, 2020) was 181 gallons per capita per day. This is considered representative of rural residential per capita water use in the region. Population estimates were based on average household sizes from the US census and aggregated to those living outside city water district boundaries. Population estimates were used to estimate residential groundwater pumping.

The total estimated groundwater extraction was approximately 170,600 AF in WY 2024, the majority of which was used to meet agricultural water demands (approximately 151,200 AF). The total groundwater extraction is about 17,300 AF greater than the historical (2000–2023) groundwater pumping average (153,400 AFY; **Table 4-1**). **Figure 3-1** shows the general areas and pumping rates where extraction occurs by sector. About 88% of the total groundwater extraction was used by the agricultural sector, while the remaining 12% was used for environmental (managed wetlands) water needs. A minimal amount was used for municipal and rural residential water needs.

| Table 3-1. Butte Subbasin Groundwater Use by Water Use Sector | |
|---|---|
| **Sector** | **WY 2024 (AF)** |
| Agricultural | 151,200 |
| Municipal | 2,300 |
| Rural Residential | 1,300 |
| Environmental (Managed Wetlands) | 15,800 |
| **Total** | **170,600** |

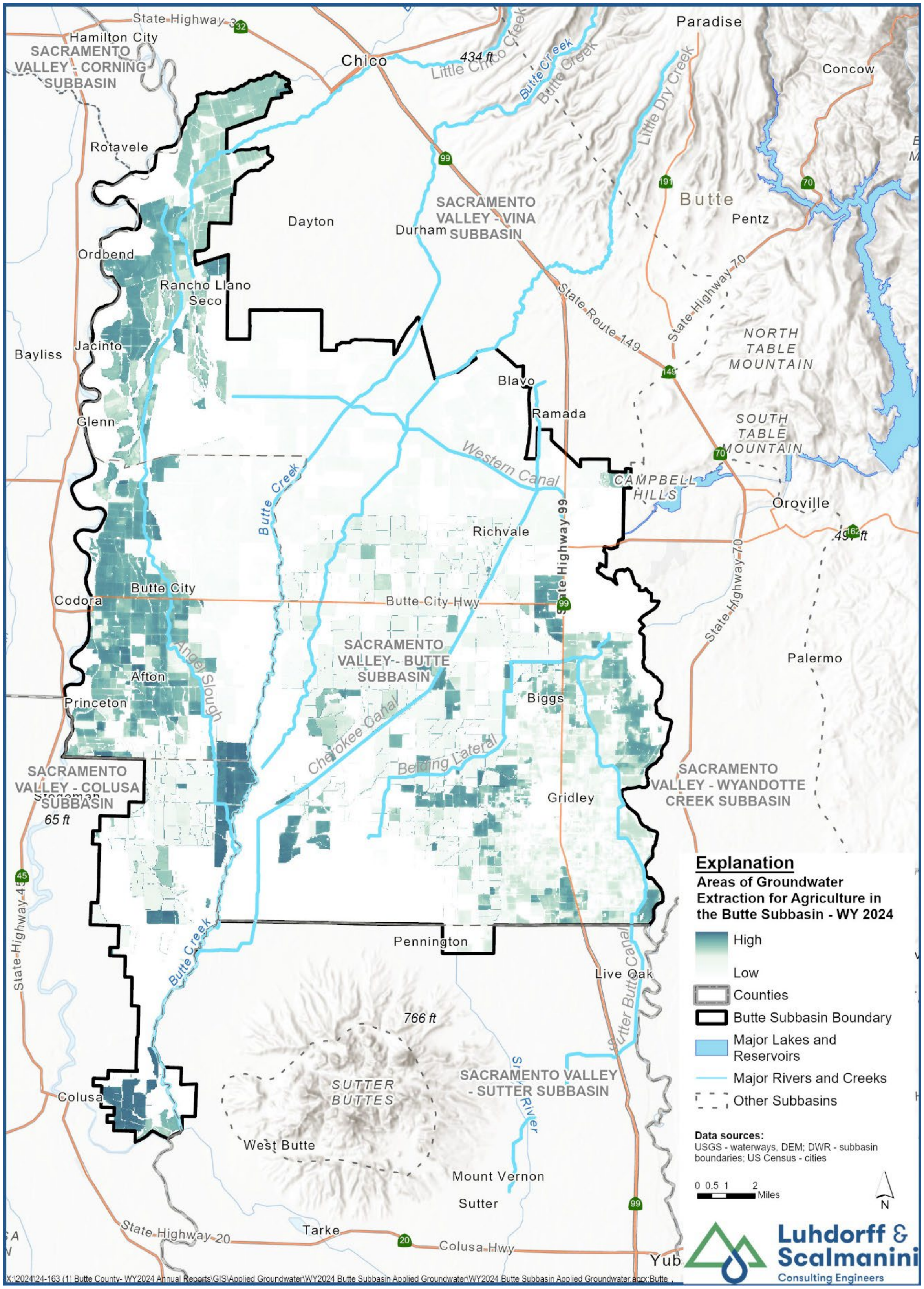


Figure 3-1. Butte Subbasin Areas of Groundwater Extraction for Agriculture – WY 2024

## 3.2 Surface Water Supply – §356.2(b)(3)

Surface water supplies used or available for use in the Subbasin are summarized in **Table 3-2** and account for approximately 83% of the total water use in the 2024 WY in the Butte Subbasin. Surface water supplies are reported directly from water supplier records or collected from publicly available sources (water rights diversion records, etc.) where available. Missing surface water supply data was estimated based on available historical diversions data in similar water years.

**Table 3-2. Butte Subbasin Surface Water Use by Water Use Sector for WY 2024**

| Sector | Diverted (AF) | Applied (AF) |
|---|---|---|
| Agricultural | 785,800 | 724,400 |
| Environmental (diversions for managed wetlands) | 80,200 | 100,300 |
| **Total** | **866,000** | **824,700** |

Irrigation and water districts deliver surface water to the majority of the agricultural lands and managed wetlands in the Subbasin. Some lands outside of district areas also have access to surface water supplies through appropriative water rights, contract water, or riparian rights. Surface water diversions for the Joint Water Districts (which includes Butte Water District, Richvale Irrigation District, and Biggs-West Gridley Water District within the Butte Subbasin) were available from Senate Bill (SB) 88 measurements and estimated for the Butte Subbasin portion of the service area based on the Joint Water District Diversion agreement. Diversions to the Western Canal Water District are also available from SB 88 measurements. Diversions to Reclamation District (RD) 1004, M&T Ranch (M&T), and Rancho Llano Seco were available from reported records and/or water rights reports on the Electronic Water Rights Information Management System (eWRIMS) (SWRCB, 2024). Deliveries to the Gray Lodge Wildlife Area (GLWA) and the Upper Butte Basin Wildlife Area (UBBWA) in WY 2024 were also available from records provided by the California Department of Fish and Wildlife (CDFW). Water diversions from riparian rights were estimated based on the average amount diverted during the 2018-2020 timeframe using the eWRIMS data**.** For the appropriative water rights outside of surface water suppliers, the face value of the water right was taken and multiplied by a local factor of 59%. The local factor is based on an overview of measured deliveries in the area.

In total, approximately 866,000 AF of surface water was diverted and 824,700 AF applied for beneficial uses in the Subbasin in WY 2024, approximately 88% of the delivered water was used for agriculture and 12% of the water was used for environmental purposes (i.e., managed wetlands). This includes surface water sourced from the Sacramento River, Butte Creek, and the Feather River. Surface water diversion volumes to managed wetland areas were provided by CDFW for GLWA and UBBWA and were equal to 80,200 AF in WY 2024. These volumes are not included in agricultural surface water supplies (even if they were provided by agricultural surface water suppliers). Note that the estimated applied water for managed wetlands exceeds the estimated diverted water. The applied water volume is modeled based on water demands within the managed wetland areas, while the diverted water volume is directly reported as deliveries from CDFW. The difference between these two volumes represents estimated conveyance losses between points of diversion and application, such as seepage, evaporation, or spillage. Demand exceeding deliveries is likely influenced by the reuse of water within managed wetlands areas.

This reuse can be both a direct reuse of delivered water to wetlands and a reuse of water that was initially applied for irrigation of up-gradient agriculture but serves as a supplemental water supply for downgradient managed wetlands at specific times (such as during draining of rice fields in preparation for harvest).

In contrast with the reduced surface water supplies and cutbacks experienced in WY 2022 (386,000 AF), WY 2024 was an above normal WY with full allocation of surface water supplies to each of the water districts (similar to WY 2023). These, combined with above normal precipitation, runoff, and increased stream flows, supported groundwater recharge and offset groundwater extraction volumes compared to WY 2022.

## 3.3 Total Water Use by Sector – §356.2(b)(4)

Total water demand in the subbasin for WY 2024 was divided between surface water (83%) and groundwater (17%). The total water available for use in the Subbasin was tabulated from groundwater extraction volumes reported in **Table 3-1** and the surface water supply reported in **Table 3-2**. The total water available is summarized in **Table 3-3** for WY 2024. The results are either based on measured data or estimates, as described in the previous two sections. **Table 3-3** also shows the total irrigated area in WY 2024 within the Subbasin.

**Table 3-3. Butte Subbasin Total Water Use by Water Use Sector**

| Sector | WY 2024 | | | |
|---|---|---|---|---|
| | Groundwater (AF) | Surface Water (AF) | Total (AF) | Total Sector Area (ac) |
| Agricultural | 151,200 | 724,400 | **875,600** | **152,100** |
| Municipal | 2,300 | -- | **2,300** | **20,900** |
| Rural Residential | 1,300 | -- | **1,300** | **n/a*** |
| Environmental (Managed Wetlands) | 15,800 | 100,300 | **116,100** | **18,400** |
| **Total** | **170,600** | **824,700** | **995,300** | **224,600** |

***Notes:***
**Rural Residential water use is calculated based on population from census data, not area.*

## 3.4 Uncertainties in Water Use Estimates

Estimated uncertainties in the water budget components are presented in **Table 3-4**. The uncertainty of these water budget components is based on typical accuracies given in technical literature and the cumulative estimated accuracy of all inputs used to calculate the components.

| Table 3-4. Butte Subbasin Estimated Uncertainty in Water Use Estimates | | | |
|---|---|---|---|
| **Water Budget Component** | **Data Source** | **Estimated Uncertainty (%)** | **Source** |
| **Groundwater** | | | |
| Agricultural | Measurement | 20% | Typical uncertainty from water balance calculation. |
| Municipal/Industrial | Measurement/ Estimate | 5% | Typical accuracy of municipal water system reporting. |
| Rural Residential | Calculation | 15% | Estimated from per capita water use and Census information. |
| Environmental – Managed Wetlands | Measured | 5% | Estimated based on typical flowmeter accuracy. |
| **Surface Water** | | | |
| Agricultural | Calculation | 10%[1] | Estimated from SB 88 measurement accuracy standards. |
| Environmental – Managed Wetlands | Measured | 10% | Estimated based on data source and typical flow meter accuracy |

[1] *Higher uncertainty of 10%-20% is typical for estimated surface water inflows, including un-gaged inflows from small watersheds into creeks that enter the subbasin.*

# 4. GROUNDWATER STORAGE

Long-term fluctuations in groundwater levels and groundwater in storage occur when there is an imbalance between the volume of water recharged into the aquifer and the volume of water removed from the aquifer, either by extraction or natural discharge to surface water bodies. If, over a period of years, the amount of water recharged into the aquifer exceeds the amount of water removed from the aquifer, then groundwater levels will increase and groundwater storage increases (i.e., positive change in storage). Conversely, if, over time, the amount of water removed from the aquifer exceeds the amount of water recharged, then groundwater levels decline, and groundwater storage decreases. These long-term changes can be linked to various factors, including increased or decreased groundwater extraction or variations in recharge associated with wet or dry hydrologic cycles.

A review of the RMS well hydrographs (**Appendix A**) indicates that groundwater elevations are relatively stable over time. Declines may be influenced by the significant percentage of water years since 2006 that have been dry (i.e., characterized as below normal, dry, or critical). Since groundwater storage is closely related to groundwater levels, measured changes in groundwater levels can serve as a proxy for, and be utilized to, estimate changes in groundwater storage. Changes in groundwater storage in portions of the Subbasin remain stable in most years due to high surface water availability and usage. In contrast, other portions of the Subbasin without surface water supplies follow a pattern typically seen in the majority of the Sacramento Valley. For portions of the Subbasin without surface water supplies, during normal to wet years, groundwater is withdrawn during the summer for irrigation and replenished during the winter through recharge of precipitation and surface water inflows, allowing groundwater storage to potentially rebound by the following spring. During dry years and drought conditions, this pattern is disrupted when more groundwater may be pumped to meet irrigation demand, and less recharge may occur due to reduced precipitation, diminished or curtailed surface water supplies, and lower stream levels. During dry years and drought conditions, when surface water supplies are cut back, there is typically a combination of increased groundwater pumping and land fallowing (e.g., not planting a percentage of rice fields) to account for reduced surface water supply availability.

In WY 2024 (an above-normal WY), groundwater storage increased by approximately 12,700 AF in the Primary Aquifer and 8 AF in the Very Deep Aquifer. Despite an increase in groundwater extraction compared to 2023, reliable surface water supplies, as well as increased recharge due to above normal precipitation, likely contributed to the increase in groundwater storage. These and related factors, such as increased stream flows, and reliable surface water supplies resulted in higher groundwater levels in spring 2024 compared to spring 2023.

The following sections present a summary of groundwater use and change in storage over time, along with a description of the uncertainty in storage change estimates.

## 4.1 Change in Groundwater Storage – §356.2(b)(5)(B)

Annual groundwater pumping, groundwater storage changes, and the cumulative change in storage over time are presented for WY 2000 through WY 2024 in **Table 4-1** and **Figure 4-1**. In contrast to the critically dry conditions of WY 2022, WY 2024 was an above normal WY and correspondingly saw an increase in groundwater storage of approximately 12,700 AF in the Primary Aquifer and approximately 8 AF in the Very Deep Aquifer. For context, in the past 24 years, the largest one-year decrease in groundwater storage is estimated to be -93,800 AF, and the highest one-year increase was estimated to be 110,100 AF.

**Table 4-1. Butte Subbasin Groundwater Extraction, Annual Groundwater Storage Change, and Cumulative Change in Storage**

| Water Year & Type | Groundwater Extraction[1] (AF) | Annual Change in Storage (AF) | Cumulative Change in Storage (AF) |
|---|---|---|---|
| 2000 (AN) | 136,500 | 12,100 | 12,100 |
| 2001 (D) | 132,800 | -32,300 | -20,200 |
| 2002 (D) | 127,800 | -22,400 | -42,600 |
| 2003 (AN) | 139,200 | 17,700 | -24,900 |
| 2004 (BN) | 152,100 | 5,400 | -19,500 |
| 2005 (AN) | 130,100 | 1,300 | -18,200 |
| 2006 (W) | 133,300 | 49,200 | 31,000 |
| 2007 (D) | 168,600 | -76,600 | -45,600 |
| 2008 (C) | 162,000 | 17,600 | -28,000 |
| 2009 (D) | 137,300 | -23,100 | -51,100 |
| 2010 (BN) | 125,300 | 21,100 | -30,000 |
| 2011 (W) | 100,900 | 41,200 | 11,200 |

| Table 4-1. Butte Subbasin Groundwater Extraction, Annual Groundwater Storage Change, and Cumulative Change in Storage | | | |
|---|---|---|---|
| Water Year & Type | Groundwater Extraction[1] (AF) | Annual Change in Storage (AF) | Cumulative Change in Storage (AF) |
| 2012 (BN) | 137,400 | -57,300 | -46,100 |
| 2013 (D) | 146,100 | -16,800 | -62,900 |
| 2014 (C) | 164,200 | 1,600 | -61,300 |
| 2015 (C)[2] | 234,700 | -10,900 | -72,200 |
| 2016 (BN) | 145,200 | 26,500 | -45,700 |
| 2017 (W) | 105,500 | 65,900 | 20,200 |
| 2018 (BN) | 123,000 | -73,800 | -53,600 |
| 2019 (W) | 113,200 | 82,600 | 29,000 |
| 2020 (D) | 142,500 | -93,800 | -64,800 |
| 2021 (C)[2] | 280,700 | -28,900 | -93,700 |
| 2022 (C)[2] | 313,100 | -37,500 | -131,200 |
| 2023 (W) | 128,900 | 110,100 | -21,100 |
| 2024 (AN) | 170,600 | 12,700 | -8,400 |
| **Historic Averages (2000 – 2023)[3]** | | | |
| 2000–2023 (24 years) | 153,400 | -900 | |
| W (4 years) | 116,400 | 69,800 | |
| AN (4 years) | 144,100 | 11,000 | |
| BN (5 years) | 136,600 | -15,600 | |
| D (6 years) | 142,500 | -44,200 | |
| C (5 years) | 230,900 | -11,600 | |

***Notes:***

*Positive values indicate inflows to the groundwater system, and negative values indicate outflows from the groundwater system. MOs/MTs have been recalculated based on DWR data retrieved from the California Natural Resource Agency Open Data Portal in February 2023.*

*AF = acre-feet, Water Year Types Classified According to the Sacramento Valley Water Year Index:*
*W = wet, AN = above normal, BN = below normal, D = dry, C = critical*

*[1] Groundwater extraction values from 2000 to 2018 were determined using BBGM (Davids, 2021). Values for 2019-2020 are averages from that period. Estimates for 2021 were based on a drought impact analysis (LSCE, 2022), while estimates for 2022-2024 are based on a GEEEO process (**Appendix E**).*

*[2] Indicates cutback year with reduced surface water supply allocations to water districts and users.*

*[3] The historical average calculation covers the period from 2000 to 2023, excluding the current water year.*

*Note: MOs/MTs have been recalculated based on DWR data retrieved from the California Natural Resource Agency Open Data Portal in February 2023.*

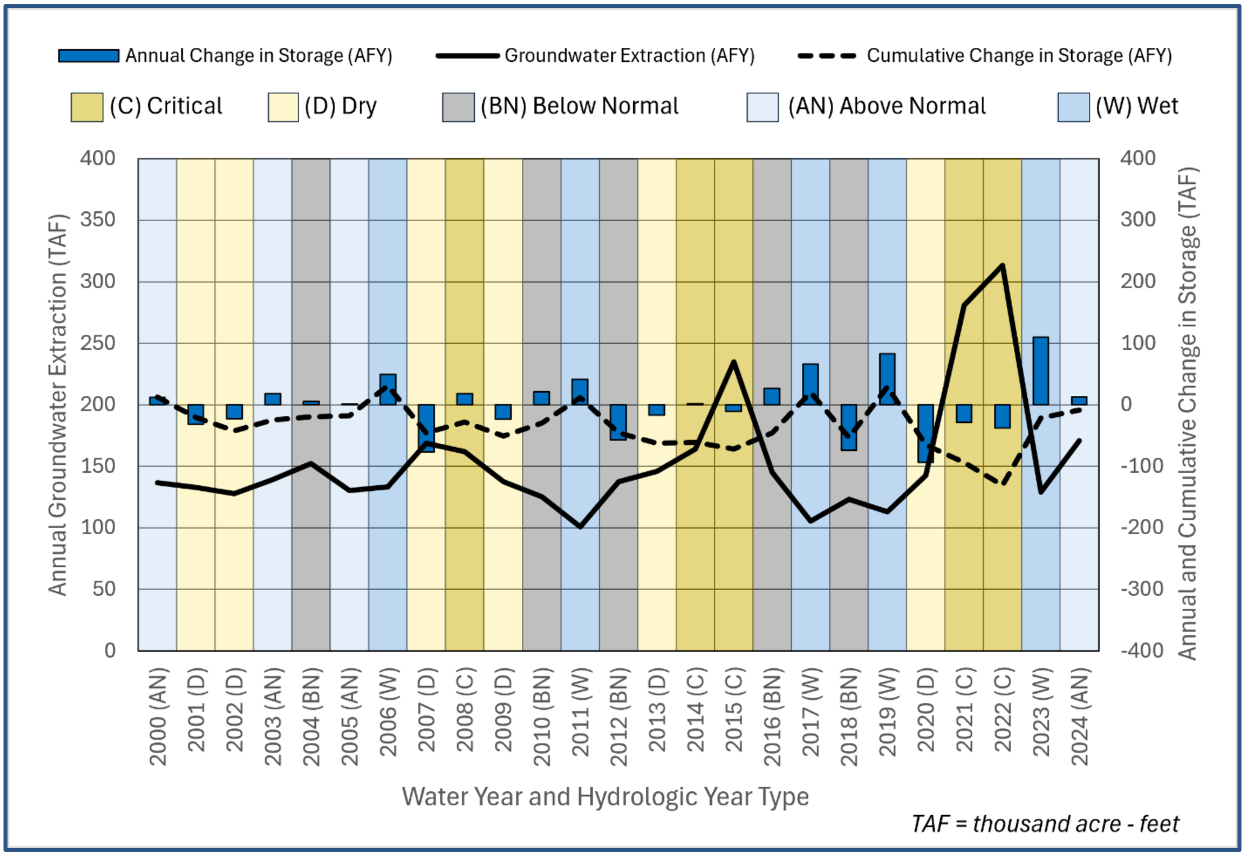


**Figure 4-1. Butte Subbasin Groundwater Pumping and Annual and Cumulative Change in Storage from WY 2000 to WY 2024**

The historical record since 2000 includes multiple data sources. Groundwater extractions for WY 2000 through WY 2018 were obtained from the Butte Basin Groundwater Model (BBGM) (BCDWRC, 2021), and the water budgets were prepared as part of the Butte Subbasin GSP (Davids, 2021). The WY 2019 and WY 2020 groundwater extraction values were calculated as the average based on the hydrologic year type from WY 2000 to WY 2018. The WY 2021 groundwater extraction estimates were based on a drought impact analysis conducted around the time of annual report development that year (LSCE, 2022). The WY 2022 and WY 2023 groundwater extraction values were obtained from prior annual reports and were developed using the same methods as WY 2024, as described in **Section 3** and **Appendix E**. Groundwater extractions for the entire period include pumping for agricultural, municipal, rural residential, and environmental purposes.

The annual and cumulative changes in groundwater storage are both calculated for the period from WY 2000 through WY 2024 based on the methodology described below in **Section 4.2**. This methodology differs from the change in groundwater storage estimates available through the BBGM. An evaluation of a total of 20 pairs of concurrent annual storage changes over the period from WY 1999 through WY 2018 was assembled from the BBGM, and the methodology described in **Section 4.2** was completed to evaluate the consistency of the new methodology with the BBGM results. Although groundwater storage changes differ in some cases, the general trends are similar, and there is agreement between the methodologies. It is anticipated that the methodology described in **Section 4.2** will be utilized for annual report updates until the BBGM model is updated from 2018 through the present (anticipated to be completed as part of the Periodic Evaluation of the GSP due in January 2027, if not sooner).

## 4.2 Groundwater Storage Maps – §356.2(b)(5)(A)

The spatial distribution of estimated changes in groundwater storage for the period from spring 2023 to spring 2024 are shown in **Figure 4-2** and **Figure 4-3** for the Primary Aquifer and Very Deep Aquifer, respectively. Since groundwater storage is closely related to groundwater levels, measured changes in groundwater levels can serve as a proxy for and be utilized to estimate changes in groundwater storage. Change in groundwater storage was estimated based on the change in measured spring-to-spring groundwater levels at each RMS well, multiplied by the area of a Thiessen polygon surrounding that RMS well (defining a representative area for each RMS well) and a representative storage coefficient of 0.1 for the Primary Aquifer.

Spring measurements used to calculate the change in groundwater storage were computed as the average of all available groundwater level measurements from March and April of the respective year. The representative storage coefficient was established by roughly calibrating the estimated change in storage based on changes in observed groundwater levels (i.e., calculated using groundwater level data, representative area, and a storage coefficient parameter) with estimated change in storage outputs from the BBGM, as reported in the GSP to aggregate characteristics across all zones of the Primary Aquifer system. A total of 20 pairs of concurrent annual storage changes assembled from both methods over the period from WY 1999 through WY 2018 were used for calibration. Determination of a representative storage coefficient allows for estimating the change in volume of groundwater storage based on the measured change in groundwater levels and known representative area (i.e., Thiessen polygon) associated with each groundwater level measurement.

Negative changes in storage values indicate lowering groundwater levels and depletion of groundwater storage, whereas positive changes in storage values represent rising groundwater levels and accretion of groundwater in storage. As shown in **Figure 4-2**, the change in storage for each representative area (i.e., Thiessen polygon) in the Primary Aquifer over the previous year ranged from a loss of roughly 400 AF to a gain of roughly 800 AF. The representative areas in the northern and western portion of the Subbasin in close vicinity to the Sacramento River and in the eastern portion adjacent to the Thermalito Afterbay and Feather River had a relatively larger positive change in storage compared to most other areas in the Subbasin. Total groundwater storage change in the Primary Aquifer was estimated to be approximately 12,700 AF between spring 2023 and spring 2024.

Although the GSP defines two principal aquifers, the Very Deep Aquifer is not considered to be isolated from the Primary Aquifer. Interconnection occurs via vertical leakage. Ultimately, a change in groundwater storage in the deeper portion of the system will be manifested in a change in the water table in the shallowest zone. Therefore, the same methodology used to estimate changes in groundwater storage in the Primary Aquifer (described above) is also used to estimate the overall change in storage of the Subbasin. **Figure 4-3** shows that the slight changes in head observed in the Very Deep Aquifer using a storage coefficient associated with confined aquifer conditions (consistent with the parameter used in the BBGM) results in a negligible change in storage (8 AF).

## 4.3 Uncertainty in Groundwater Storage Estimates

The uncertainty associated with the change in groundwater storage estimates depends in part on the underlying uncertainty of the groundwater level data, the representative area (i.e., Thiessen polygon), and the calibrated storage coefficient parameter used to calculate the change in groundwater storage. As described in **Section 4.2**, a calibration process was conducted to roughly align the estimated change in groundwater storage based on observed groundwater levels to the estimated change in groundwater storage outputs from the BBGM. Thus, the uncertainty of the estimated change in groundwater storage reported in **Table 4-1** and **Figure 4-2** is estimated to be approximately equal to the uncertainty of the estimated change in groundwater storage outputs from the BBGM (typically 20-30% for integrated hydrologic models).

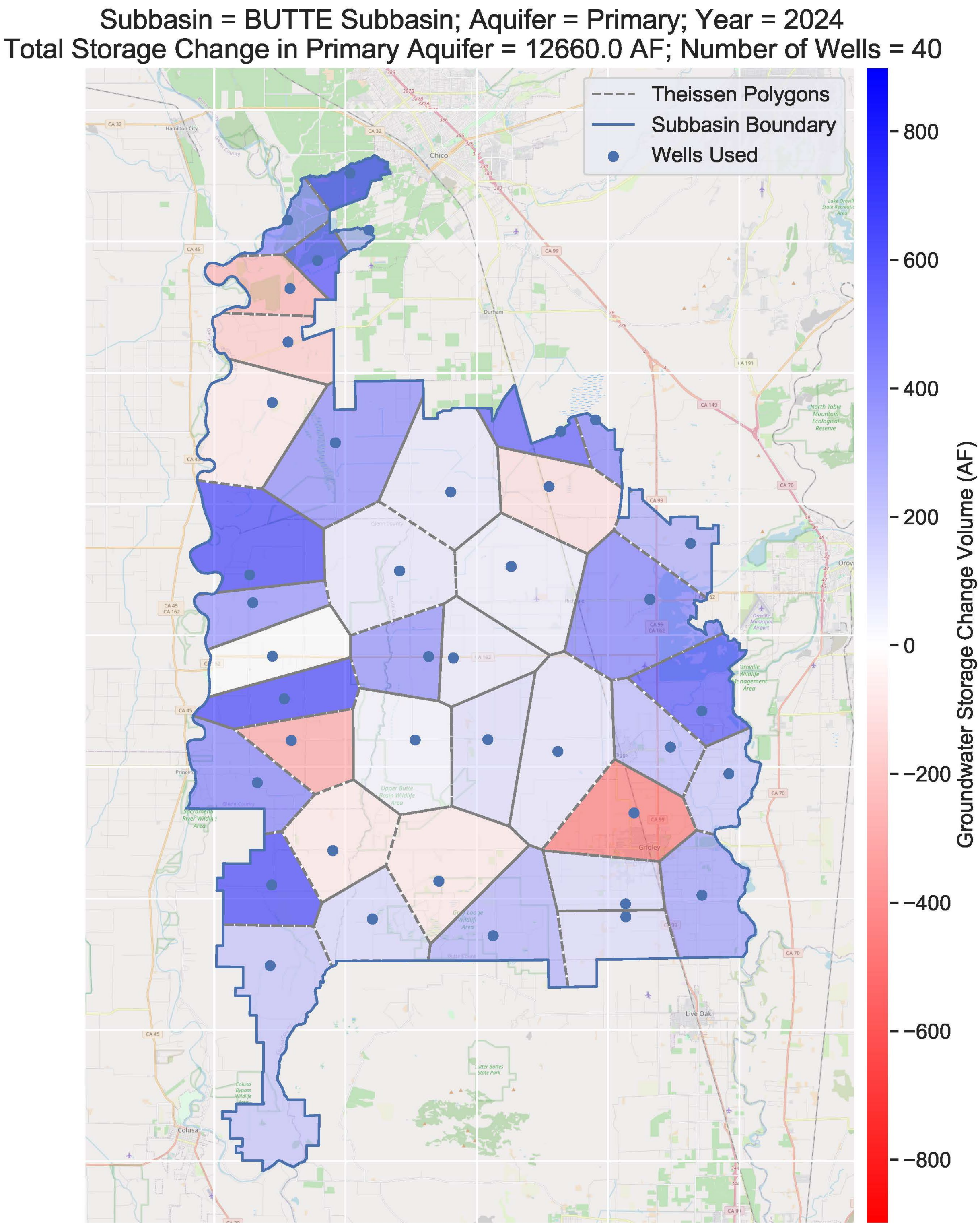


**Figure 4-2. Butte Subbasin Change in Groundwater Storage from Spring 2023 to Spring 2024 in the Primary Aquifer**

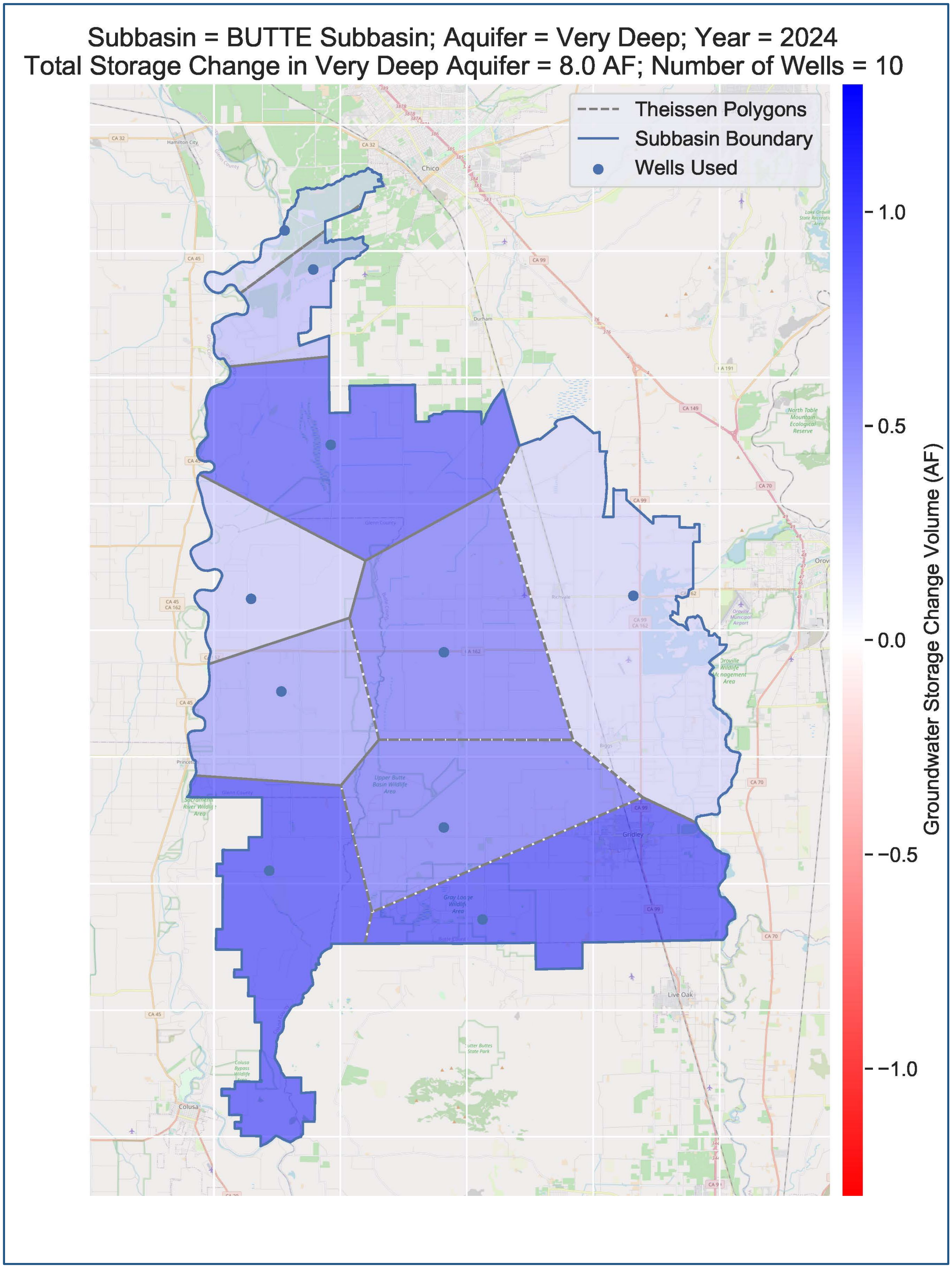


**Figure 4-3. Butte Subbasin Change in Groundwater Storage from Spring 2023 to Spring 2024 in the Very Deep Aquifer**

# 5. GSP IMPLEMENTATION PROGRESS – §356.2(B)(5)(C)

## 5.1 Main Activities of Water Year 2024

The main activities and updates from the previous Annual Report are as follows:

1. All sustainability indicators (SIs) are in compliance with their MTs with the exception of one water quality RMS well in exceedance of its MT; however, there were no undesirable results for this SMC and this area of the Subbasin is known to have historically high levels of electrical conductivity.
2. The GSAs funded the completion of the WY 2023 Annual Report, with Butte County serving as the fund administrator.
3. The GSA continued to engage in ongoing intra- and inter-basin coordination.
4. The GSAs completed other critical tasks, such as monitoring and recording groundwater levels and groundwater quality and maintaining and updating the data management system (DMS) with newly collected data.
5. Progress has been made on nine projects and management actions (PMAs) since the last annual report (**Tables 5-4 and 5-5**).

The GSP was approved in July of 2023, and DWR proposed three recommended corrective actions that will enhance the GSP:

4. Providing details into how proposed MTs for the chronic lowering of groundwater levels may impact beneficial uses, users, and other SIs.
5. Offering more information on SMC for land subsidence.
6. Closing data gaps, expanding monitoring efforts, and executing the current strategy to manage depletions of interconnected surface water while defining segments of interconnectivity and timing.

In 2024, the GSAs in the Butte Subbasin coordinated to implement a shared funding plan to address the identified corrective actions as part of the periodic evaluation of the GSP.

## 5.2 Progress Toward Achieving Interim Milestones

All SIs are in compliance with their MTs, with the exception of the water quality SI (see summary **Table 5-1**). An MT is a quantitative value that represents the groundwater conditions at an RMS that, when exceeded individually or in combination with MTs at other monitoring sites, may cause an undesirable result in the basin per DWR's definition. Whether the MT represents a minimum or maximum value is dependent on the SI. As an example of a minimum, if groundwater levels are lower than the value of the MO for that site, they are moving in the direction of the MT. As an example of a maximum, for the groundwater quality SMC, as the value of the electrical conductivity concentration increases from the MO established for that site, it is moving in the direction of the MT. The SIs and SMC, including MTs, are summarized in **Table 5-2**. Note that seawater intrusion is not an applicable SI in this Subbasin. Each SI is measured at representative monitoring sites (RMS).

| Table 5-1. Butte Subbasin Sustainability Indicator Summary | | | |
|---|---|---|---|
| **2024 Status** | **Undesirable Result Identification** | **MO Definition** | **MT Definition** |
| **Chronic Lowering of Groundwater Levels** | | | |
| **No indication of undesirable results**<br>There were no RMS wells with spring or fall 2024 groundwater level measurements below the MT. | When 25% of each aquifer's RMS wells fall below their MTs for 24 consecutive months (11 of 41 wells in the Primary Aquifer and 3 of 10 in the Very Deep Aquifer) | Static 5-year average (generally 2012-2017) of measured groundwater level data for each RMS well | For each RMS well, the shallower of either:<br>i. the shallowest 7th percentile of nearby domestic wells, or<br>ii. the range of measured groundwater levels, or 20 feet (whichever is greater), below the observed historic low.<br>If the resulting value is shallower than the observed historic low, the MT is set 10 feet deeper than the observed historic low. |
| **Reduction of Groundwater Storage** | | | |
| **No indication of undesirable results**<br>There were no RMS wells with spring or fall 2024 groundwater level measurements below the MT. | Groundwater levels are a proxy. | Groundwater levels are a proxy. | Groundwater levels are a proxy. |
| **Degraded Water Quality** | | | |
| **No indication of undesirable results**<br>In August of 2024, 1 RMS well, 17N01W10A001M (Very Deep Aquifer) exceeded its electrical conductivity MT of 1,968 µS/cm by 29 µS/cm (one well represents 12.5% of RMS). | When 25% of RMS wells (2 of 8) exceed their MT for 24 consecutive months | Measured electrical conductivity less than or equal to 700 µS/cm at each RMS well | The higher of either 900 µS/cm or the measured historical high of electrical conductivity for each RMS well |

| Table 5-1. Butte Subbasin Sustainability Indicator Summary | | | |
|---|---|---|---|
| **2024 Status** | **Undesirable Result Identification** | **MO Definition** | **MT Definition** |
| **Land Subsidence** | | | |
| **No indication of undesirable results**<br>There were no subsidence monitoring sites with a subsidence rate greater than the MT over the past 5 years. | When 25% of DWR's monitoring network (8 of 31 benchmarks) measure a subsidence rate greater than the MT | Up to 0.25 foot of subsidence per 5-year period at each site (0.05 feet over 1 year; 1 foot over 20 years) | 0.5 foot of subsidence over a 5-year period at each site |
| **Depletion of Interconnected Surface Water** | | | |
| **No indication of undesirable results**<br>There were no RMS wells with spring or fall 2024 groundwater level measurements below the MT. | When 25% of RMS wells (3 of 12) fall below their MTs for 24 consecutive months, using groundwater levels as a proxy | Static 5-year average (generally 2012-2017) of measured groundwater level data for each RMS well | 10 feet below the measured historical low at each RMS well |

***Notes:***

*Salinity is the primary water quality constituent of concern, which is evaluated by measuring electrical conductivity (EC).*

*MO = Measurable Objective, MT = Minimum/Maximum Threshold, RMS = representative monitoring site, µS/cm = micro siemens per centimeter*

### *5.2.1 Chronic Lowering of Groundwater Levels and Reduction in Groundwater Storage SMC*

Groundwater elevations have remained near or above their MOs and above their corresponding MTs (as indicated in **Table 5-2**) (DWR, 2024) in spring 2024 and, therefore, remained within the Subbasin's margin of operational flexibility established for each RMS well. In fall 2024, 29 of the RMS wells were below the MO, and on average, groundwater levels were approximately one foot below the MO. None of the RMS wells fell below the MT in 2024, nor for 24 consecutive months, hence avoiding undesirable results as defined in the GSP. **Table 5-2** shows measurements from 2024 for spring seasonal highs and fall seasonal lows, along with measurable objectives and minimum thresholds. It also compares the WY 2024 measurements to those from WY 2023 and to the measurable objectives. On average, higher water levels were observed in spring 2024 compared to spring 2023 in both aquifers due to above normal hydrologic conditions and a full surface water supply, which has helped to increase recharge and offset extraction, bolstering groundwater storage in the Subbasin.

In the Butte Subbasin, the Interim Milestones (IMs) for groundwater elevations are set equal to the MOs. Overall, groundwater conditions in the Subbasin are on track to meet the first 5-year 2027 IMs for groundwater elevations at each of the RMS wells. Groundwater elevations are mostly near or slightly higher than those observed in recent years (**Appendix A**). This positive trend is attributed to the ongoing recovery in groundwater conditions, facilitated by increased surface water supplies in WY 2023 and WY 2024 following two recent years of cutbacks in WY 2021 and WY 2022. Spring 2024 groundwater elevations were all above the established MOs, and although fall 2024 groundwater elevations were on average one-foot below the MOs (**Table 5-2**), spring 2025 groundwater conditions are expected to rebound.

The reduction in groundwater storage SMC utilizes the chronic lowering of groundwater levels SMC as a proxy (**Table 5-1**). Thus, groundwater conditions related to storage and the chronic lowering of groundwater levels are discussed together. Groundwater conditions in the Subbasin are on track to meet the first 5-year 2027 IMs for groundwater levels at each of the RMS wells.

**Table 5-2. Butte Subbasin Measurable Objectives, Minimum Thresholds, and Seasonal Groundwater Elevations of Representative Monitoring Site Wells**

| State Well Number | Groundwater Elevation (feet above mean sea level) | | | | Spring 2024 vs. MO (ft) | Fall 2024 vs. MO (ft) | Spring 2024 vs. Spring 2023 (ft) (seasonal high) | Fall 2024 vs. Fall 2023 (ft) (seasonal low) |
|---|---|---|---|---|---|---|---|---|
| | 2024 Measurements | | MO | MT | | | | |
| | Spring (seasonal high) | Fall (seasonal low) | | | | | | |
| **Primary Aquifer** | | | | | | | | |
| 17N01E06D001M | 60.8 | 56.97 | 59 | 28 | 1.8 | -2.03 | -2.3 | 9.27 |
| 17N01E10A001M | 60.14 | 51.24 | 58 | 31 | 2.14 | -6.76 | -0.06 | -5.46 |
| 17N01E17F001M | 56.49 | 48.82 | 52 | 25 | 4.49 | -3.18 | -1.31 | 1.02 |
| 17N01E24A006M | 68.85 | 67.3 | 67 | 44 | 1.85 | 0.3 | -0.85 | 1 |
| 17N01W10A004M | 60.34 | 60.12 | 60 | 34 | 0.34 | 0.12 | -2.26 | 0.92 |
| 17N01W27A003M | 55.06 | 55.73 | 54 | 27 | 1.06 | 1.73 | -2.34 | 1.83 |
| 17N02E14A001M | 82.19 | 75.89 | 78 | 50 | 4.19 | -2.11 | -0.61 | -1.81 |
| 17N02E14H001M | 80.99 | -- | 75 | 42 | 5.99 | -- | -0.91 | -- |
| 17N03E08K002M | 86.27 | 82.77 | 83 | 58 | 3.27 | -0.23 | 0.57 | 1.17 |
| 18N01E13A002M | 76.64 | 75.44 | 75 | 39 | 1.64 | 0.44 | 0.24 | 0.74 |
| 18N01E15D002M | 71.3 | 68.7 | 69 | 41 | 2.3 | -0.3 | 0 | 0.1 |
| 18N01W02E003M | 74.02 | 57.48 | 60 | 19 | 14.02 | -2.52 | -1.88 | 5.28 |
| 18N01W14B001M | 68.48 | 53.98 | 58 | 19 | 10.48 | -4.02 | -0.82 | -0.32 |
| 18N01W17G001M | -- | -- | 61 | 30 | -- | -- | -- | -- |
| 18N01W22L001M | 67.29 | -- | 62 | 33 | 5.29 | -- | 0.89 | -- |
| 18N02E16F001M | 78.22 | 75.82 | 77 | 53 | 1.22 | -1.18 | 0.12 | -0.28 |
| 18N02E25M001M | 84 | 80 | 81 | 51 | 3 | -1 | -0.8 | 0 |
| 18N03E08B003M | 98.1 | 97.1 | 93 | 60 | 5.1 | 4.1 | 1.3 | 10.5 |
| 18N03E18F001M | 95 | 89 | 89 | 67 | 6 | 0 | 0.6 | 0.1 |
| 18N03E21G001M | 88.18 | 85.78 | 84 | 70 | 4.18 | 1.78 | 0.58 | 1.58 |
| 19N01E09Q001M | 89.86 | 86.16 | 87 | 58 | 2.86 | -0.84 | 0.06 | -0.54 |
| 19N01E27Q001M | 85 | -- | 82 | 33 | 3 | -- | 0.9 | -- |
| 19N01E35B001M | 83.33 | 81.5 | 82 | 52 | 1.33 | -0.5 | 0.23 | 0 |
| 19N01W15D002M | 84 | -- | 72 | 40 | 12 | -- | 1.3 | -- |
| 19N01W22D007M | 80.53 | 65.78 | 68 | 33 | 12.53 | -2.22 | -0.77 | 8.18 |
| 19N01W27R001M | 75.78 | 58.08 | 62 | 22 | 13.78 | -3.92 | -0.02 | 0.18 |
| 19N02E07K004M | 100.11 | 98.14 | 99 | 68 | 1.11 | -0.86 | -0.69 | 1.04 |

**Table 5-2. Butte Subbasin Measurable Objectives, Minimum Thresholds, and Seasonal Groundwater Elevations of Representative Monitoring Site Wells**

| State Well Number | Groundwater Elevation (feet above mean sea level) | | | | Spring 2024 vs. MO (ft) | Fall 2024 vs. MO (ft) | Spring 2024 vs. Spring 2023 (ft) (seasonal high) | Fall 2024 vs. Fall 2023 (ft) (seasonal low) |
|---|---|---|---|---|---|---|---|---|
| | 2024 Measurements | | MO | MT | | | | |
| | Spring (seasonal high) | Fall (seasonal low) | | | | | | |
| 19N02E13Q001M | 117.49 | 116.13 | 114 | 88 | 3.49 | 2.13 | -0.01 | 0.53 |
| 19N03E05N002M | 115.61 | 113.31 | 114 | 65 | 1.61 | -0.69 | 0.91 | -0.29 |
| 20N01E18L003M | 104.55 | 100.26 | 102 | 79 | 2.55 | -1.74 | -0.55 | 0.46 |
| 20N01E35C001M | 100.45 | 99.65 | 99 | 75 | 1.45 | 0.65 | 0.05 | 1.75 |
| 20N01W11N002M | 100.37 | 91.32 | 93 | 70 | 7.37 | -1.68 | -0.13 | -0.38 |
| 20N02E15H001M | 112.89 | 99.06 | 100 | 41 | 12.89 | -0.94 | 2.19 | 4.86 |
| 20N02E16P001M | 118.13 | 110.13 | 107 | 16 | 11.13 | 3.13 | 2.73 | -- |
| 20N02E28N001M | 118.93 | 117.19 | 117 | 93 | 1.93 | 0.19 | -0.17 | -0.11 |
| 21N01E08K002M | 114.34 | 105.14 | 104 | 50 | 10.34 | 1.14 | 7.14 | 3.64 |
| 21N01W11A002M | 121.21 | 113.91 | 114 | 92 | 7.21 | -0.09 | -8.59 | 1.01 |
| 21N01W13J003M | 113.66 | 103.35 | 103 | 57 | 10.66 | 0.35 | 3.56 | 1.15 |
| 21N01W23J001M | 114.76 | 103.26 | 106 | 80 | 8.76 | -2.74 | -0.94 | -0.34 |
| 21N01W35K002M | 106.36 | 95.83 | 98 | 74 | 8.36 | -2.17 | -0.44 | -0.47 |
| 22N01E32E004M | 123.79 | 110.84 | 113 | 78 | 10.79 | -2.16 | 6.19 | 3.54 |
| **Very Deep Aquifer** | | | | | | | | |
| 17N01E24A003M | 73.1 | 69.05 | 70 | 39 | 3.1 | -0.95 | 2 | 0.65 |
| 17N01W10A001M | 62.1 | 52.86 | 55 | 4 | 7.1 | -2.14 | 2.9 | 1.46 |
| 18N01E35L001M | 73.51 | 67.3 | 69 | 34 | 4.51 | -1.7 | 1.71 | -2.1 |
| 18N01W02E001M | 76.64 | 68.74 | 68 | 20 | 8.64 | 0.74 | 1.74 | 2.34 |
| 19N01E35B002M | 90 | 87.53 | 87 | 54 | 3 | 0.53 | 1.7 | 0.63 |
| 19N01W22D004M | 81.38 | 75.54 | 76 | 40 | 5.38 | -0.46 | 2.48 | 3.24 |
| 19N02E13Q003M | 117.23 | 115.43 | 114 | 86 | 3.23 | 1.43 | 0.23 | 1.23 |
| 20N01E18L001M | 101.22 | 95.68 | 96 | 45 | 5.22 | -0.32 | 3.42 | 1.68 |
| 21N01W11A001M | 117.79 | 106.67 | 107 | 75 | 10.79 | -0.33 | 2.69 | 1.77 |
| 21N01W13J001M | 113.04 | 101.28 | 102 | 66 | 11.04 | -0.72 | 4.84 | 1.58 |

*MO = Measurable Objective, MT = Minimum/Maximum Threshold, -- = Indicates missing or questionable measurements.*

### 5.2.2 Degraded Water Quality SMC

The degraded water quality MT and MO are summarized in **Table 5-1**. Salinity is the main constituent of concern in the Subbasin and is evaluated by electrical conductivity (EC). Salinity (i.e., EC) is measured at RMS wells throughout the Subbasin, and data were collected by Butte County in WY 2024. In August of 2024, 1 RMS well 17N01W10A001M in the vicinity of the Sutter Buttes, an area with known high salinity in the Very Deep Aquifer, had an EC measurement of 1,997 µS/cm, which is above its MT of 1,968 µS/cm by 29 micro siemens per centimeter (µS/cm). In 2023, this same well measured 2,122 µS/cm, approximately 154 µS/cm above the MT. Since 2010, the well has had historic EC measurements no lower than 1,884 µS/cm. No other wells exceeded their MTs for water quality in WY 2024. A summary of groundwater quality monitoring data is available in **Appendix F**. Groundwater conditions are on track to avoid undesirable results related to water quality.

### 5.2.3 Land Subsidence SMC

The land subsidence MT and MO are summarized in **Table 5-1**. Only inelastic subsidence, solely due to lowered groundwater elevations, will be considered relevant to the SMC. Data from monuments in the Sacramento Valley Global Positioning System (GPS) Subsidence Monitoring Network were utilized to track cumulative subsidence in the area in 2008 and 2017 (DWR, 2024a) and were used for identifying undesirable results in the GSP; however, these sites have not been measured since then. Observations from the Sacramento Valley GPS Subsidence Monitoring Network are supplemented by Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR (DWR, 2024b) to assess this SMC. InSAR data was analyzed from October 2023 to October 2024 to track annual changes and from October 2019 to October 2024 to track net 5-year changes. In the Butte Subbasin, the MO is defined as observing up to 0.25 foot of subsidence per 5-year period at each site (0.05 feet over 1 year; 1 foot over 20 years). Subsidence measured by InSAR in WY 2024 (**Figure 5-1**) ranged from 0.034 feet of subsidence to 0.179 feet of uplift over a 1-year period, less than the MO.

The MT is reached if subsidence rates exceed 0.5 feet over a 5-year period. Subsidence measured by InSAR over the 5-year period from WY 2019 to WY 2024 (**Figure 5-2**) ranged from 0.12 feet of subsidence to 0.25 feet of uplift, less than the MT. Conditions indicate that there has not been any inelastic land subsidence historically or during the reporting periods.

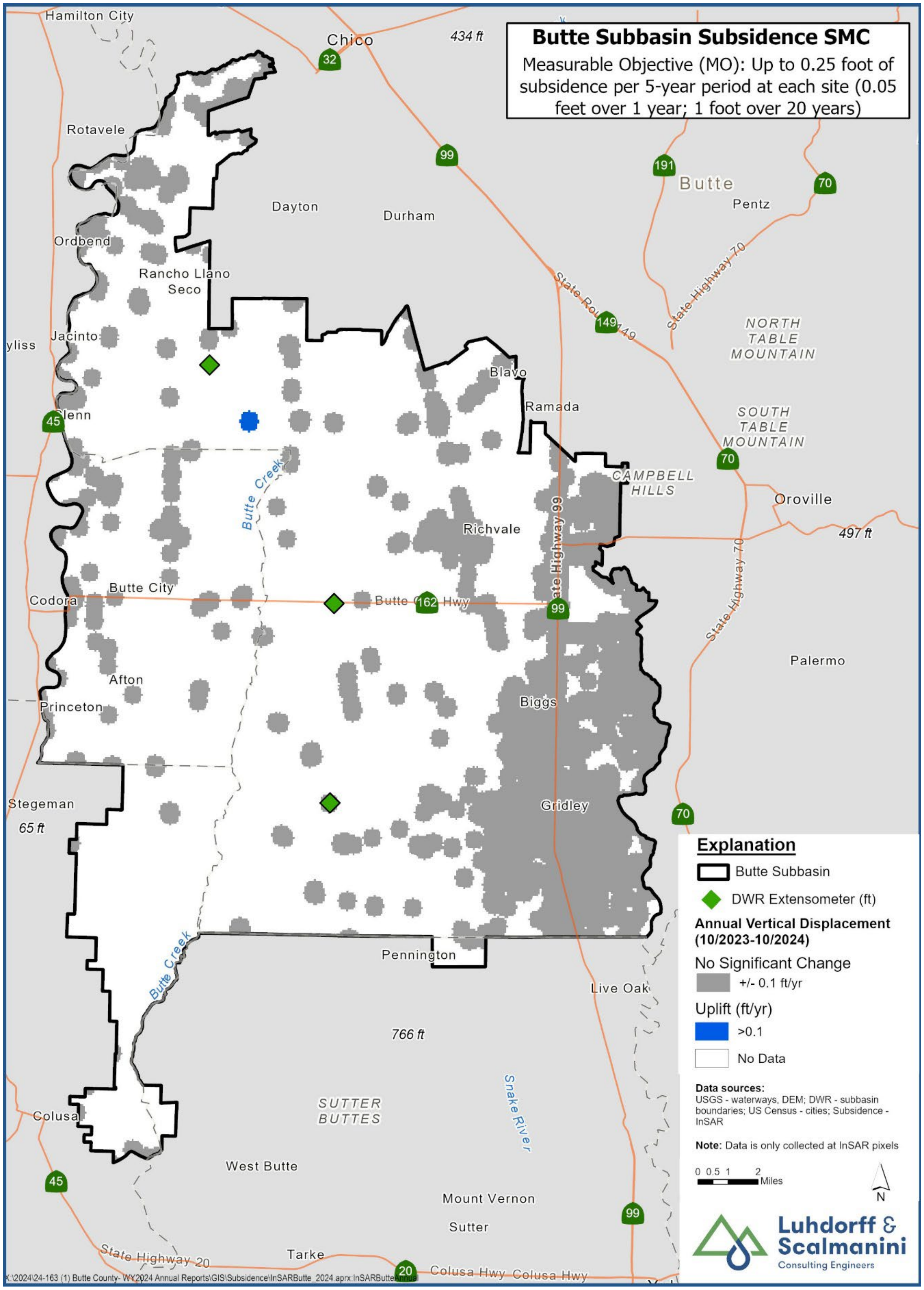


**Figure 5-1. Butte Subbasin Vertical Displacement from 10/2023 to 10/2024**

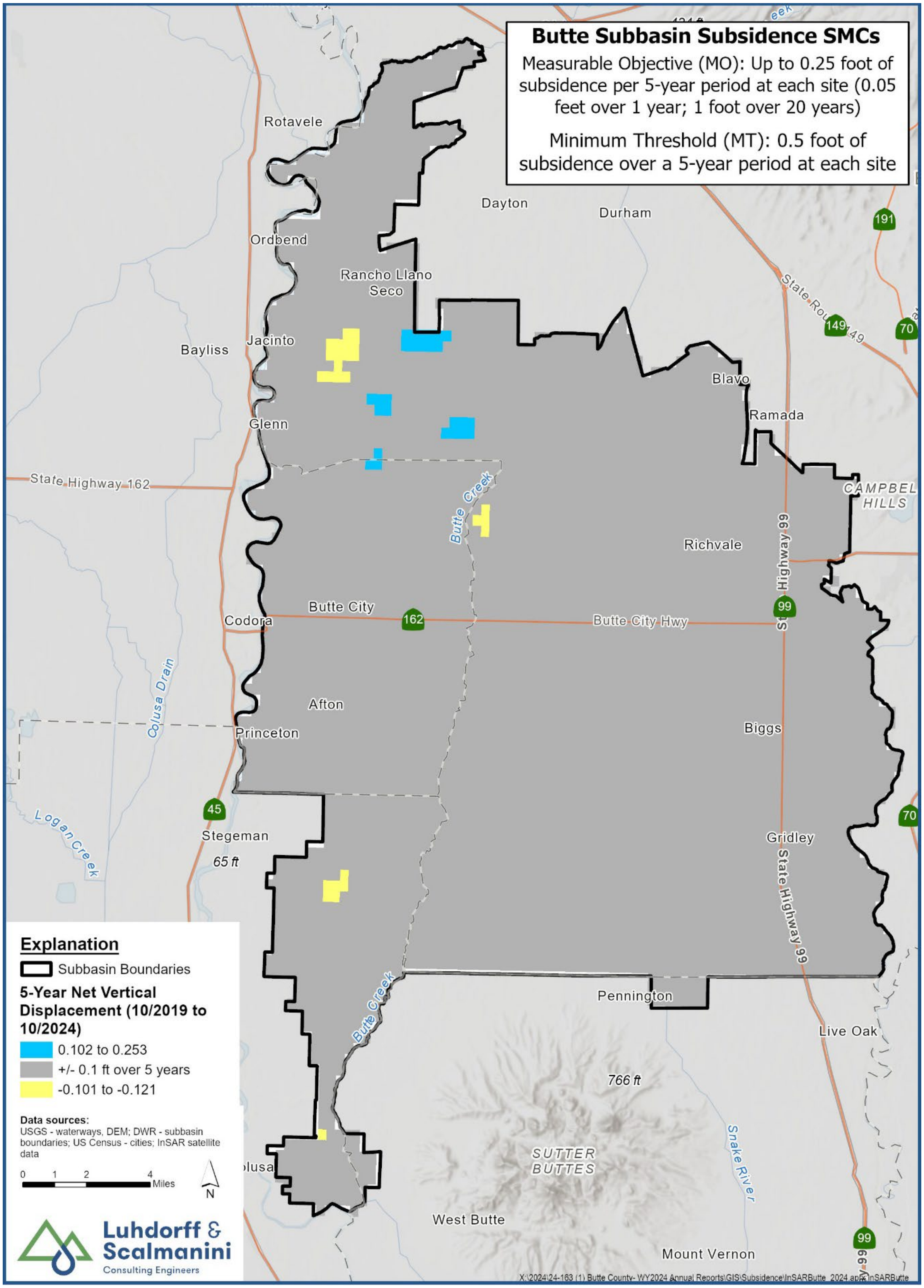


Figure 5-2. Butte Subbasin Net Vertical Displacement from 10/2019 to 10/2024

### *5.2.4 Depletion of Interconnected Surface Water SMC*

The groundwater level measurements at the interconnected surface water RMS wells during WY 2024 were all higher than their corresponding MTs, as summarized in **Table 5-3**. Groundwater conditions in the Subbasin are on track to meet the first 5-year 2027 IMs (which were set equal to MOs) and to avoid undesirable results for groundwater levels at each of the RMS wells.

**Table 5-3. Butte Subbasin Measurable Objectives, Minimum Threshold, Undesirable Results for Depletion of Interconnected Surface Water**

| State Well Number | Groundwater Elevation (feet above mean sea level) | | | | Spring 2024 vs. MO (ft) | Fall 2024 vs. MO (ft) |
|---|---|---|---|---|---|---|
| | 2024 Measurements | | MO | MT | | |
| | Spring (seasonal high) | Fall (seasonal low) | | | | |
| 17N03E05C003M | 91.78 | 83.68 | 80 | 47 | 11.78 | 3.68 |
| 17N03E16N001M | -- | 77.07 | 71 | 42 | -- | 6.07 |
| 18N01E05D002M | -- | -- | 71 | 53 | -- | -- |
| 18N01W14B001M | 68.48 | 53.98 | 58 | 28 | 10.48 | -4.02 |
| 18N01W17G001M | -- | -- | 61 | 44 | -- | -- |
| 18N02E16F001M | 78.22 | 75.82 | 77 | 63 | 1.22 | -1.18 |
| 18N03E21G001M | 88.18 | 85.78 | 84 | 68 | 4.18 | 1.78 |
| 19N01E35B001M | 83.33 | 81.5 | 82 | 62 | 1.33 | -0.5 |
| 19N01W22D007M | 80.53 | 65.78 | 68 | 47 | 12.53 | -2.22 |
| 19N01W27R001M | 75.78 | 58.08 | 62 | 34 | 13.78 | -3.92 |
| 20N01E35C001M | 100.45 | 99.65 | 99 | 85 | 1.45 | 0.65 |
| 20N02E15H002M | 120.3 | 114.37 | 121 | 105 | -0.7 | -6.63 |

*MO = Measurable Objective, MT = Minimum/Maximum Threshold, -- = Indicates missing or questionable measurements*

## 5.3 Progress Toward PMA Implementation

The following sections summarize the GSAs' progress in WY 2024 towards implementing PMAs that were developed to manage groundwater conditions in the Subbasin and achieve the groundwater sustainability objectives described in the GSP. Updates on projects described in the GSP are provided below and summarized in **Table 5-4**.

| Table 5-4. Butte Subbasin Summary of WY 2024 Project Implementation Progress | | | |
|---|---|---|---|
| **GSP Section Reference** | **Project (Proponent)** | **Current Status** | **Notable Progress Since Last Annual Report** |
| 5.4.2.1.1 | Specific Improvements in BWGWD (Biggs-West Gridley Water District) | Ongoing | • Progress was made on system modernization completion phase; it is anticipated this project will be completed in WY 2025. |
| 5.4.2.1.2 | Specific Improvements in RID (Richvale Irrigation District) | Completed / ongoing | • Project implementation was completed in fall 2024. Improvements are currently being implemented and providing surface water conservation benefits. |
| 5.5 | Boundary Flow and Primary Spill Measurement Projects (Western Canal Water District) | Completed / ongoing | • Boundary flow measurement and SCADA equipment were maintained at three key outflow sites in WY 2024, and a fourth outflow site was also seasonally monitored during WY 2024.<br>• Post-project completion, this project continues to provide surface water conservation benefits. |
| 5.9 | Installation of Additional Shallow Monitoring Wells (Multi-Agency) | Ongoing, seeking funding | • Planning and coordination meetings were held with the DWR Technical Support Services (TSS) program staff. |
| 5.10.2.2 | System Modernization (Butte Water District) | Ongoing, seeking funding | • Completion of modernization improvements along Sutter Butte Main Canal.<br>• Further project planning occurred to identify specific infrastructure improvements, set priorities, and identify potential funding sources. |
| 5.10.3.1 | M&T – Llano Seco Fish Screen Project (M&T Ranch, Rancho Llano Seco) | Completed / ongoing | • The project was completed in fall 2021. Post-project completion, it continues to provide increased surface water usage benefits. |
| 5.10.3.2 | Parrott Phelan Diversion Restoration Project (M&T Ranch, Rancho Llano Seco, Butte County Water Resource Conservation | Ongoing, seeking funding | • Project development efforts related to diversion restoration continued.<br>• Sediment was removed from the Butte Creek channel in WY 2024. |

| Table 5-4. Butte Subbasin Summary of WY 2024 Project Implementation Progress | | | |
|---|---|---|---|
| GSP Section Reference | Project (Proponent) | Current Status | Notable Progress Since Last Annual Report |
| 5.10.5.2 | Little Butte Creek Reservoir Main Canal Bypass Project (Western Canal Water District) | Ongoing, seeking funding | • The 60% designs were completed, and California Environmental Quality Act (CEQA) compliance expected in spring 2025. |
| New | M&T Ranch Pipeline (M&T Ranch) | Completed / ongoing | • Construction of a pipeline was completed in WY 2024 allowing M&T Ranch to use surface water in lieu of groundwater on 375 acres, providing direct and in-lieu recharge benefits. |

Groundwater users in the Subbasin benefit from generally stable and shallow groundwater levels supported by the substantial recharge resulting from large volumes of surface water supplied throughout the Subbasin. Surface water supplies available to the Joint Water Districts (Biggs-West Gridley Water District, Butte Water District, Richvale Irrigation District, and Sutter Extension Water District), Western Canal Water District, Reclamation District 1004, M&T Ranch, Rancho Llano Seco, Gorrill Ranch, and other diverters in the Subbasin are used, when available, for irrigation, agronomic practices, wetland habitat, and for the benefit of other recharge efforts and projects described in the GSP. Ongoing access to surface water supplies is crucial to maintaining groundwater sustainability in the Subbasin.

## 5.4 GSP Project Implementation Progress

### *5.4.1 Specific Improvements in BWGWD (Biggs-West Gridley Water District) (GSP Section 5.4.2.1.1)*

Notable progress has been made on this project since the 2023 Annual Report. Integration of monitoring sites into the Supervisory Control and Data Acquisition (SCADA) system is ongoing and is expected to be completed in spring 2025. Environmental permitting and selection of a contractor was completed in mid-2024. The implementation of the project will be completed in five phases (termed "Schedules"), with Schedules 1A and 1B (lift pumps) being completed in fall 2024, Schedules 1C and 1D completed in spring 2025, and Schedule 2 completed in fall 2025. At full implementation, the project is anticipated to conserve approximately 3,300 AFY of surface water that can be used for various beneficial purposes in the Subbasin.

### *5.4.2 Specific Improvements in RID (Richvale Irrigation District) (GSP Section 5.4.2.1.2)*

Notable progress has been made on this project since the 2023 Annual Report, with project completion occurring in fall 2024 shortly after the end of WY 2024. Environmental permits were successfully obtained, allowing infrastructure improvements to ten (10) Main Canal level control check structure gates and the construction of four flow measurement stations on the Main Canal. Project implementation is complete including SCADA integration and control programming for the project so RID staff can remotely view and control the automated gates and flow measurement sites. The project is estimated to conserve approximately 3,800 AFY of surface water that can be used for various beneficial purposes in the Subbasin.

### *5.4.3 Boundary Flow and Primary Spill Measurement Projects (Western Canal Water District) (GSP Section 5.5)*

Notable progress has been made on this project since the 2023 Annual Report. WCWD monitored three key outflow sites and maintained associated boundary flow measurement equipment. WCWD also completed seasonal monitoring of a different fourth boundary outflow location during the 2024 irrigation season. The project is estimated to conserve approximately 1,800 AFY or more of surface water that can be used for various beneficial purposes in the Subbasin.

### *5.4.4 Installation of Additional Shallow Monitoring Wells (GSP Section 5.9)*

Progress has been made on this project since the 2023 Annual Report. Planning and coordination to select the final monitoring well installation locations was completed, and staff from WCWD and County of Butte GSA continued coordination meetings with DWR regional planning staff to advance this project.

### *5.4.5 System Modernization (Butte Water District) (GSP Section 5.10.2.2)*

Progress has been made on this project since the 2023 Annual Report. In WY 2024, BWD completed modernization projects along the Sutter Butte Main Canal initiated in prior years, and operators are utilizing improvements to quickly respond to flow changes and match supplies more precisely with demands, thereby enhancing the beneficial use of surface water supplies delivered to both BWD and Sutter Extension Water District (SEWD). BWD also engaged in planning for other modernization efforts, including improved control and measurement at lateral headings and turnouts.

### *5.4.6 M&T – Llano Seco Fish Screen Project (M&T Ranch, Rancho Llano Seco) (GSP Section 5.10.3.1)*

The M&T - Llano Seco Fish Screen Project was completed in fall 2021 and continues to benefit the Butte Subbasin. The substantial volume of surface water that M&T Ranch and Rancho Llano Seco divert from the Sacramento River (nearly 40,000 AF in 2021, over 28,000 AF in 2022, over 20,000 AF in 2023, and over 30,000 AF in 2024) continues to offset this volume of groundwater from being pumped from the Subbasin.

### *5.4.7 Parrott Phelan Diversion Restoration Project (M&T Ranch, Rancho Llano Seco, Butte Creek Water Resource Conservation) (GSP Section 5.10.3.2)*

Progress has been made on this project since the 2023 Annual Report. M&T Ranch, Rancho Llano Seco, and project partners continued project development to provide restore the Parrott Phelan Diversion and provide a reliable surface water supply, improve delivery flexibility, reduce groundwater use in curtailment years, and support direct recharge from Comanche Creek. Sedimentation was removed from the Butte Creek Channel during WY 2024 to protect the functionality of the Butte Creek fish screens and fish ladder.

### *5.4.8 Little Butte Creek Front Slide Gates Project (Western Canal Water District) (GSP Section 10.2.5.2)*

Notable progress has been made on this project since the 2023 Annual Report. WCWD completed an options analysis to evaluate alternative replacement strategies for the Front Slide Gates to enhance operational flexibility, measurement and control of WCWD's diversions to the Main Canal and the Ward Canal. The 60% designs were completed in fall 2024 and CEQA compliance is expected in spring 2025. Additionally, a WaterSMART grant was obtained from the Bureau of Reclamation to support ongoing planning and project design efforts, and WCWD is pursuing grant opportunities to support construction. Final design drawings, engineering specifications, and environmental permits are expected to be completed by fall 2025, with construction planned for summer 2026.

### *5.4.9 M&T Ranch Pipeline (M&T Ranch) (New)*

This new project, not previously included in the GSP has had notable progress over the last WY. Pipeline construction was completed during the 2024 WY allowing use of either Butte Creek or Sacramento River surface water deliveries to 375 acres on the ranch that were previously reliant on groundwater, thereby providing direct and in lieu recharge benefits to the Subbasin.

# 6. Conclusions

The Butte Subbasin GSAs adopted and submitted the GSP to DWR in January 2022 and continue to work actively on sustainable groundwater management in the Subbasin. As presented in **Section 5** of this report, recent progress made on activities applicable to the GSAs demonstrates their commitment to implementing the GSP by allocating the necessary time and resources to achieve long-term sustainable management of the groundwater resources in the Butte Subbasin.

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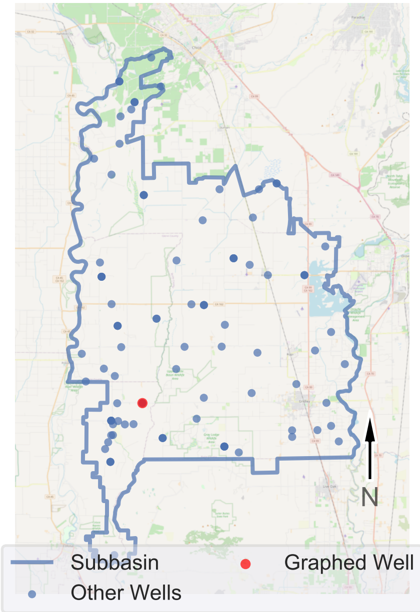
Water Year 2024 Annual Report

# Appendix A

## Characteristics and Hydrographs of Representative Monitoring Site (RMS) Wells

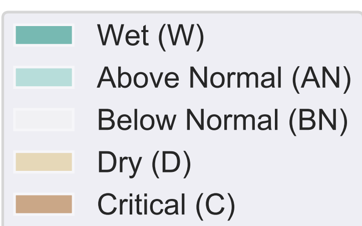
# BUTTE Subbasin - State Well Number (SWN): 17N01E06D001M

Well Location Map

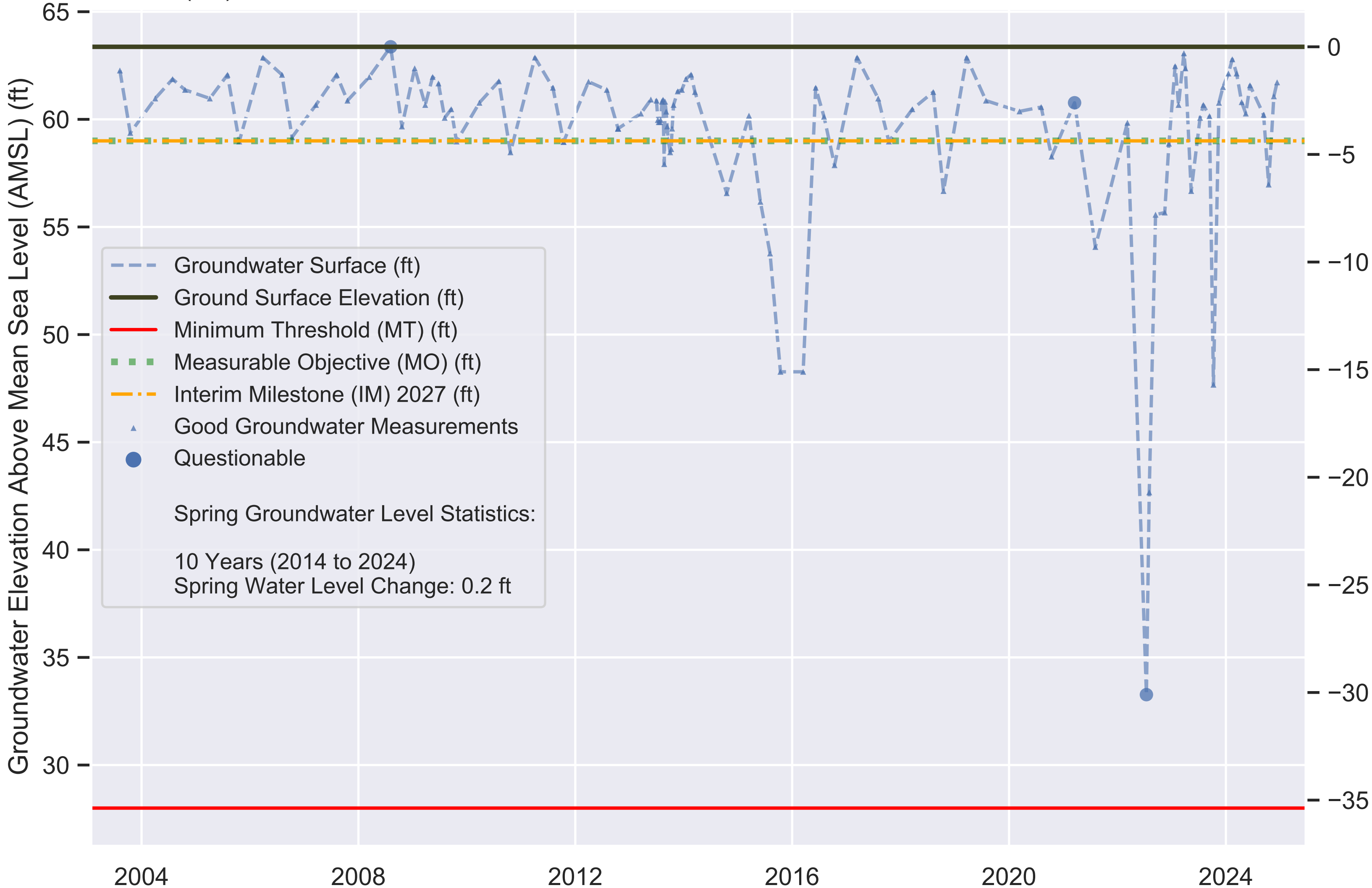


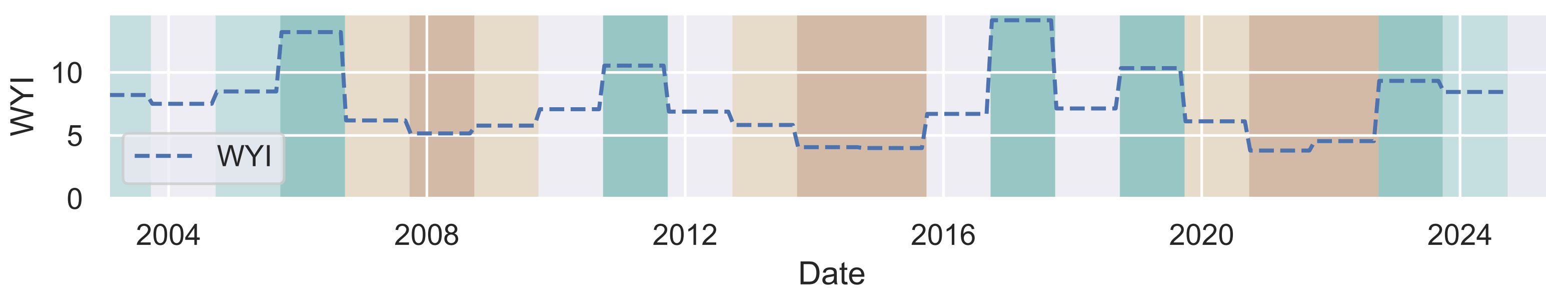

Sustainable Management Criteria:
IM (2027) = 59.0 ft AMSL
MO = 59.0 ft AMSL
MT = 28.0 ft AMSL

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



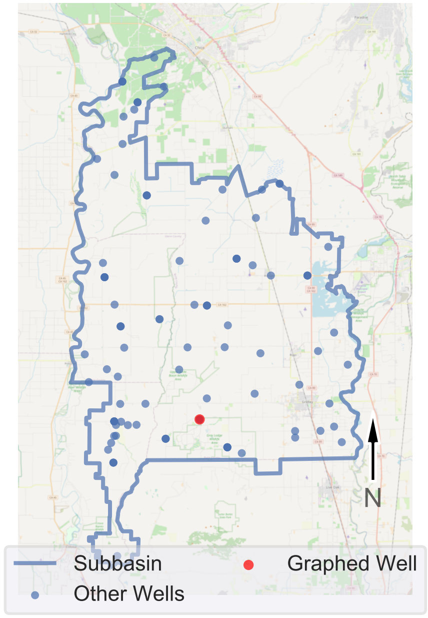

Perforation 1 (P1): 110.0 - 140.0; P2: 200.0 - 220.0; P3: 240.0 - 260.0; P4: 280.0 - 300.0; P5: 440.0 - 500.0 ft BGS



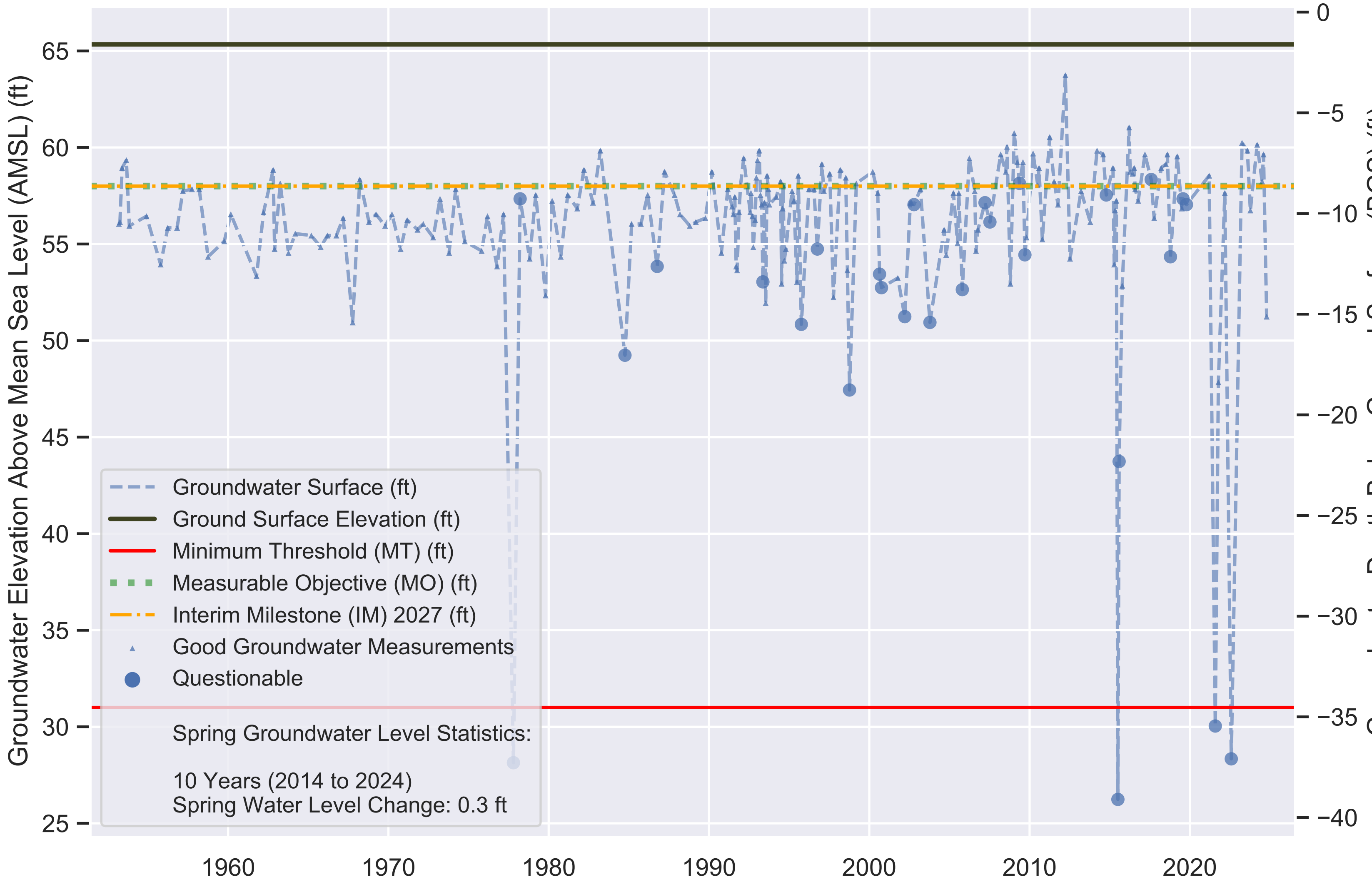



BUTTE Subbasin - State Well Number (SWN): 17N01E10A001M

Well Location Map



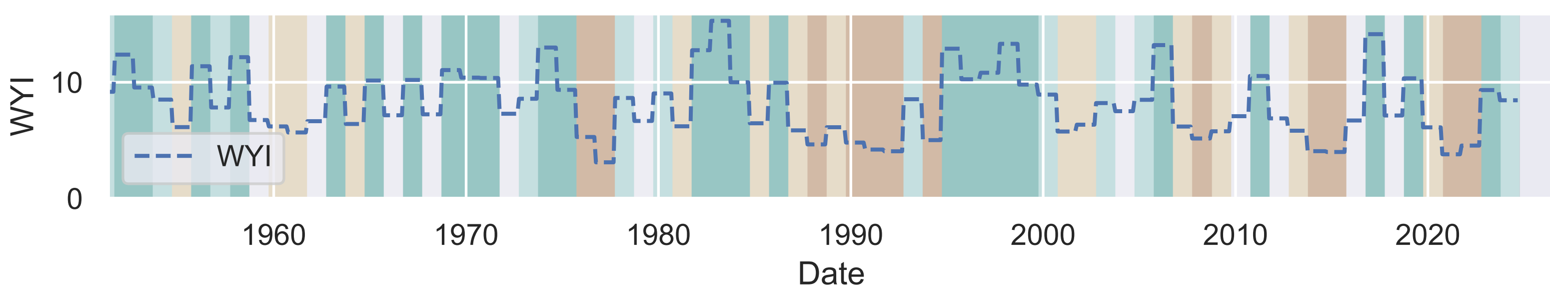

Perforation data not available.




Sustainable Management Criteria:
IM (2027) = 58.0 ft AMSL
MO = 58.0 ft AMSL
MT = 31.0 ft AMSL

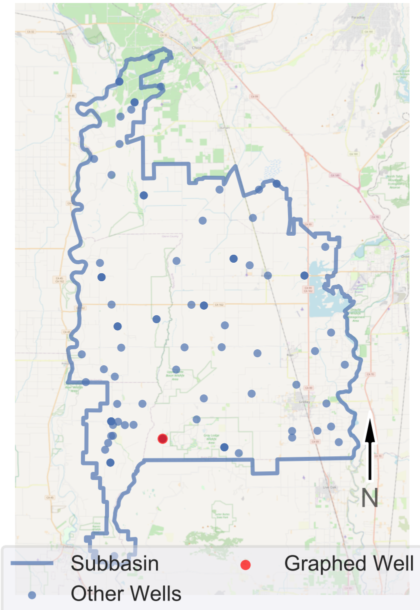
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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



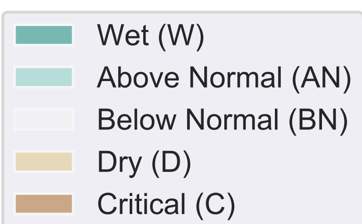
## BUTTE Subbasin - State Well Number (SWN): 17N01E17F001M

Well Location Map

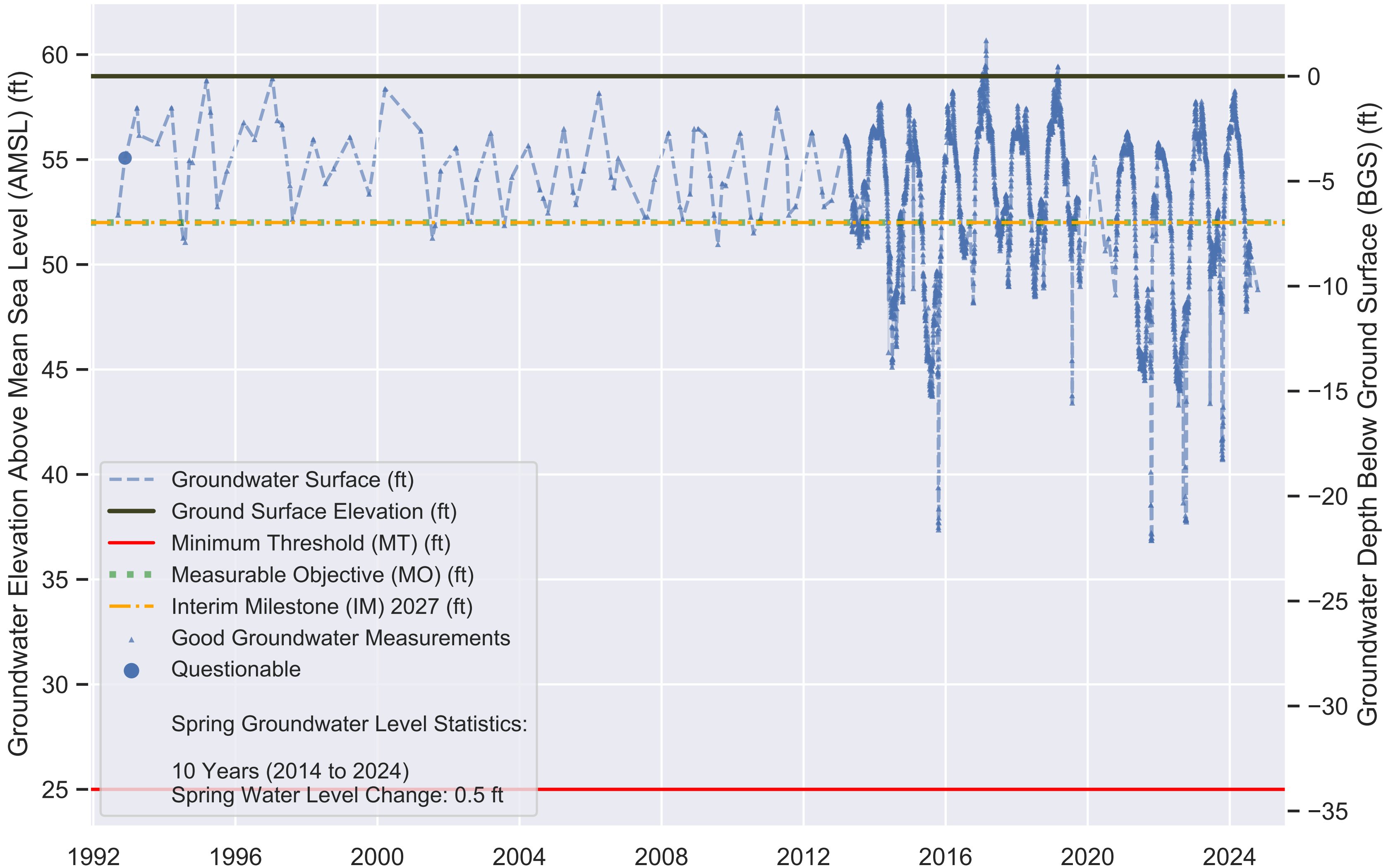


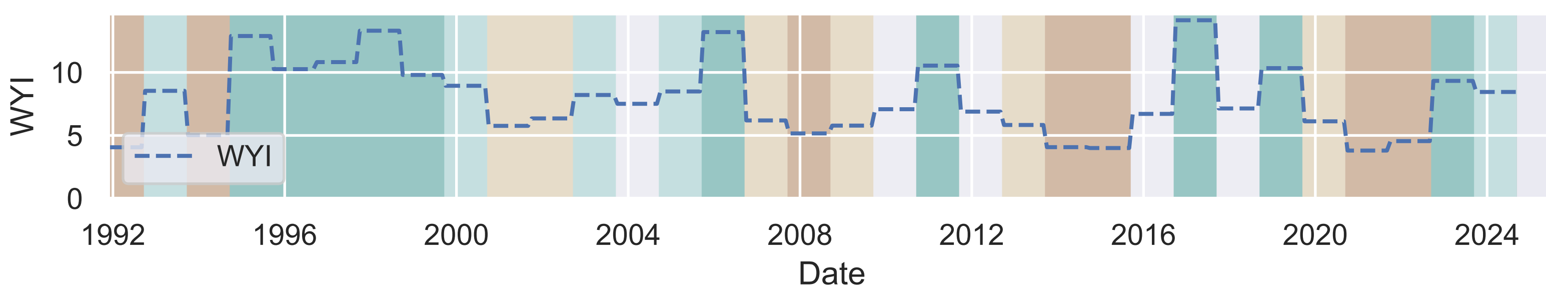

Sustainable Management Criteria:
IM (2027) = 52.0 ft AMSL
MO = 52.0 ft AMSL
MT = 25.0 ft AMSL

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



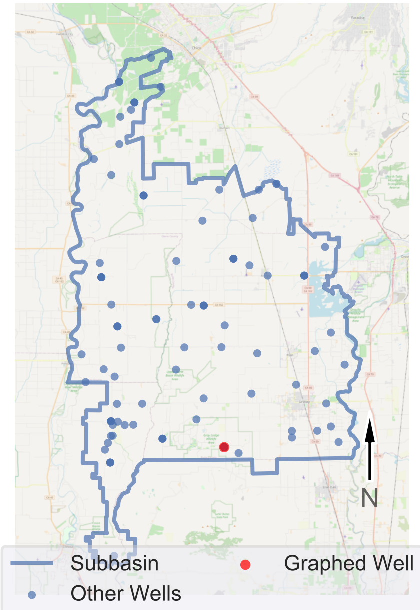

Perforation 1: 130.0 - 150.0 ft BGS



BUTTE Subbasin - State Well Number (SWN): 17N01E24A003M

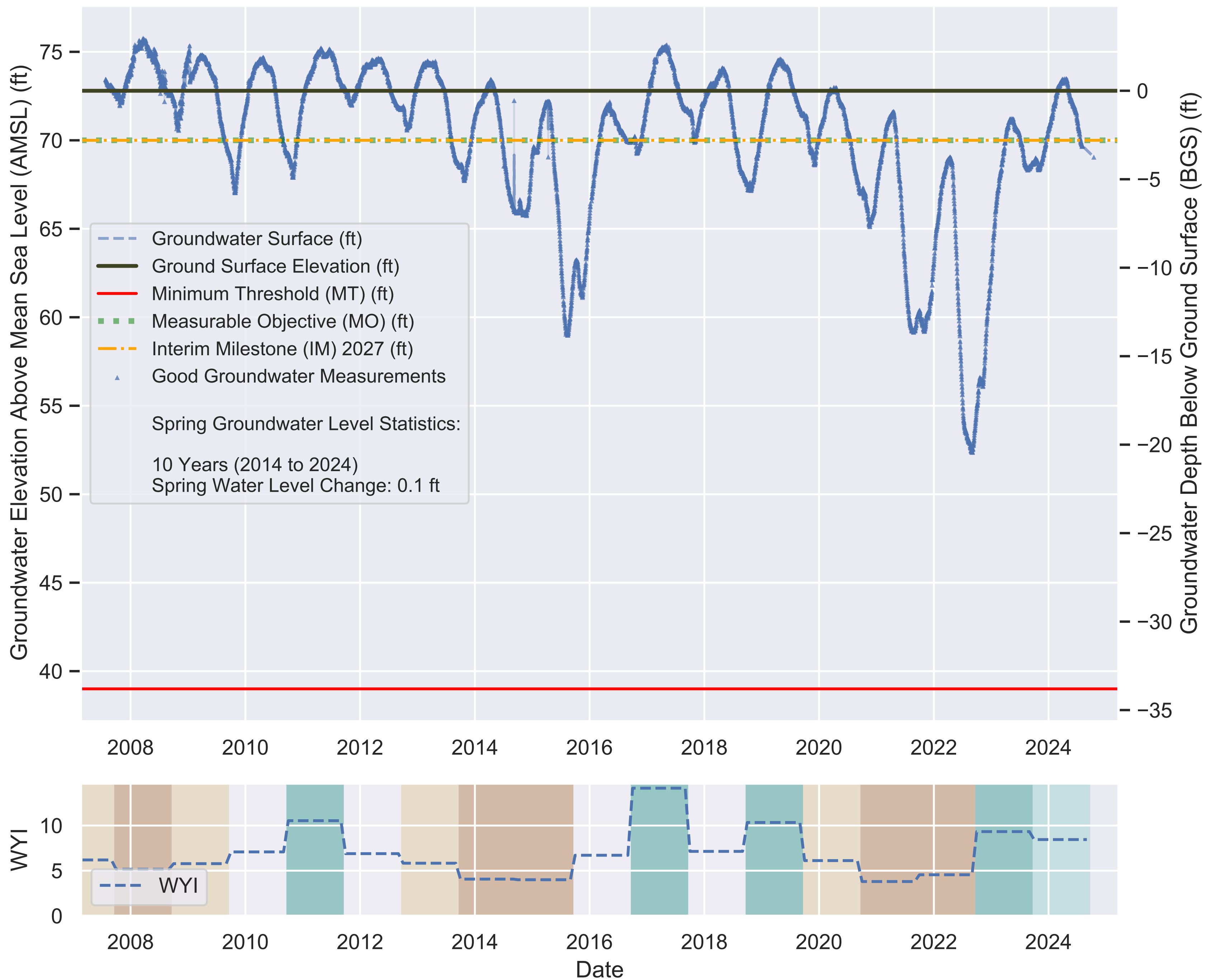
Well Location Map



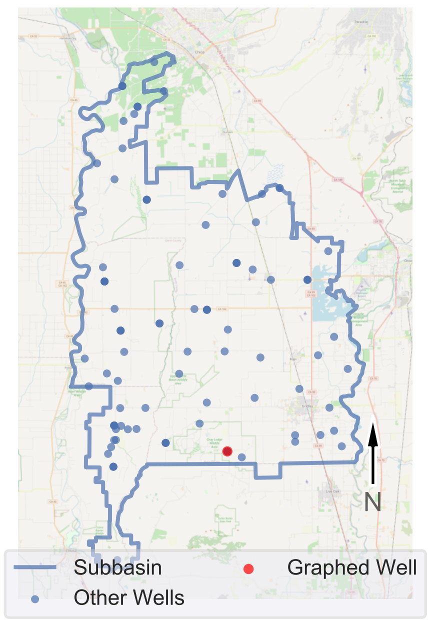

Sustainable Management Criteria:
IM (2027) = 70.0 ft AMSL
MO = 70.0 ft AMSL
MT = 39.0 ft AMSL

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

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

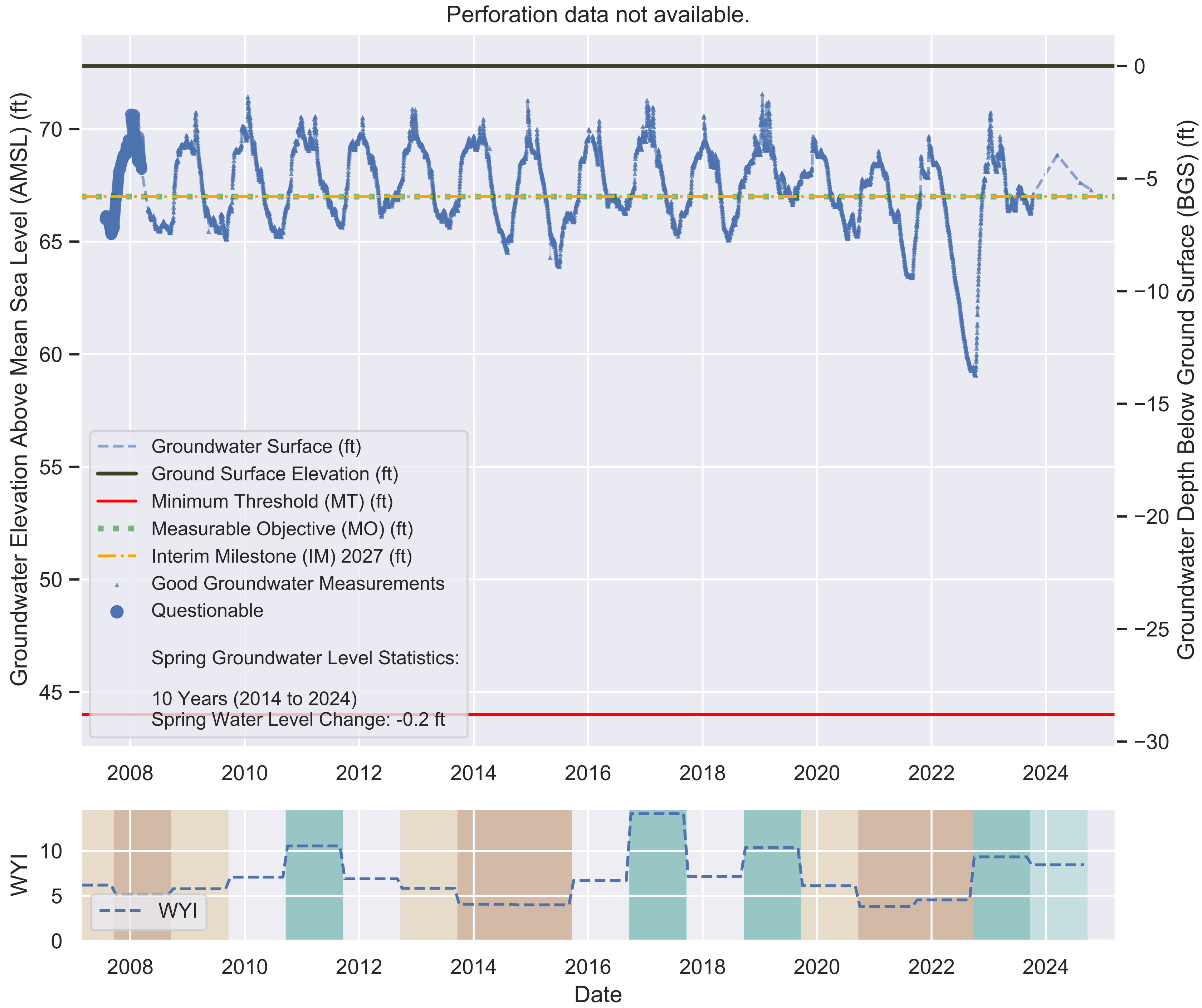


# BUTTE Subbasin - State Well Number (SWN): 17N01E24A006M



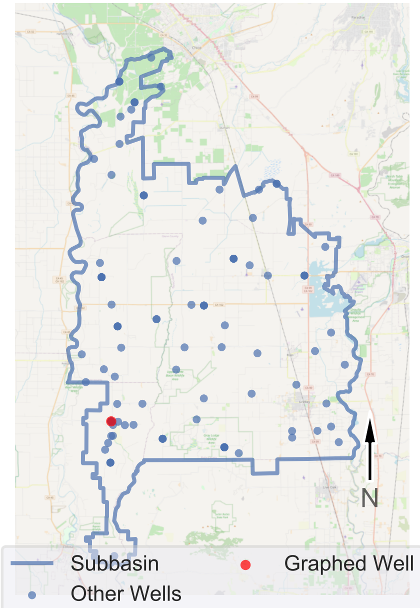

Sustainable Management Criteria:
IM (2027) = 67.0 ft AMSL
MO = 67.0 ft AMSL
MT = 44.0 ft AMSL

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



BUTTE Subbasin - State Well Number (SWN): 17N01W10A001M

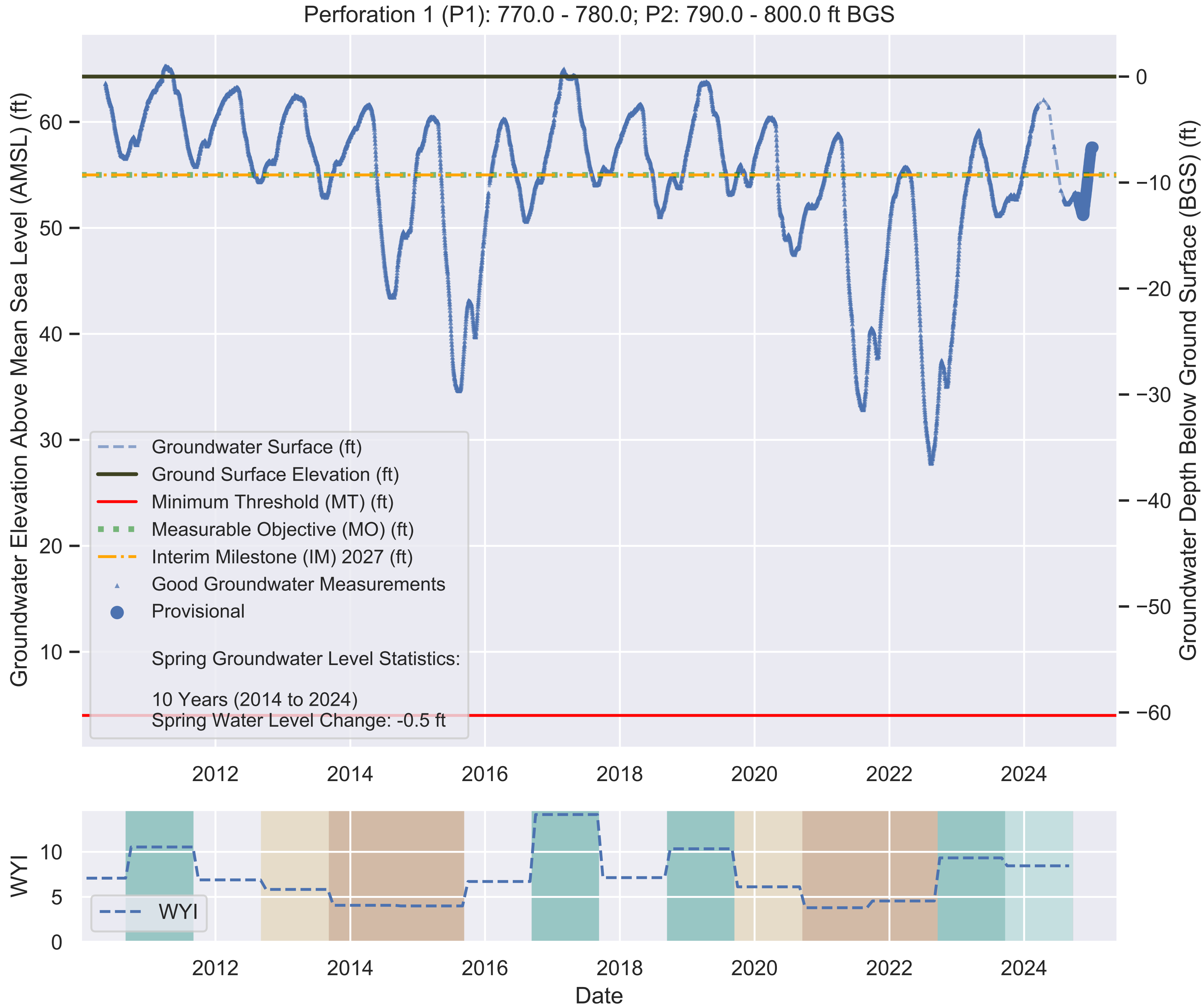
Well Location Map




Sustainable Management Criteria:
IM (2027) = 55.0 ft AMSL
MO = 55.0 ft AMSL
MT = 4.0 ft AMSL

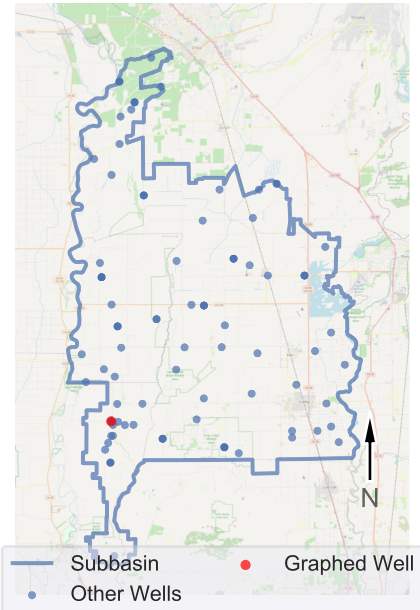
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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



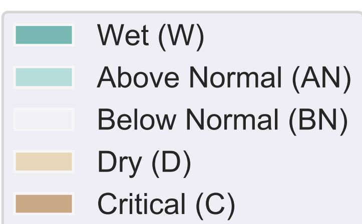
# BUTTE Subbasin - State Well Number (SWN): 17N01W10A004M

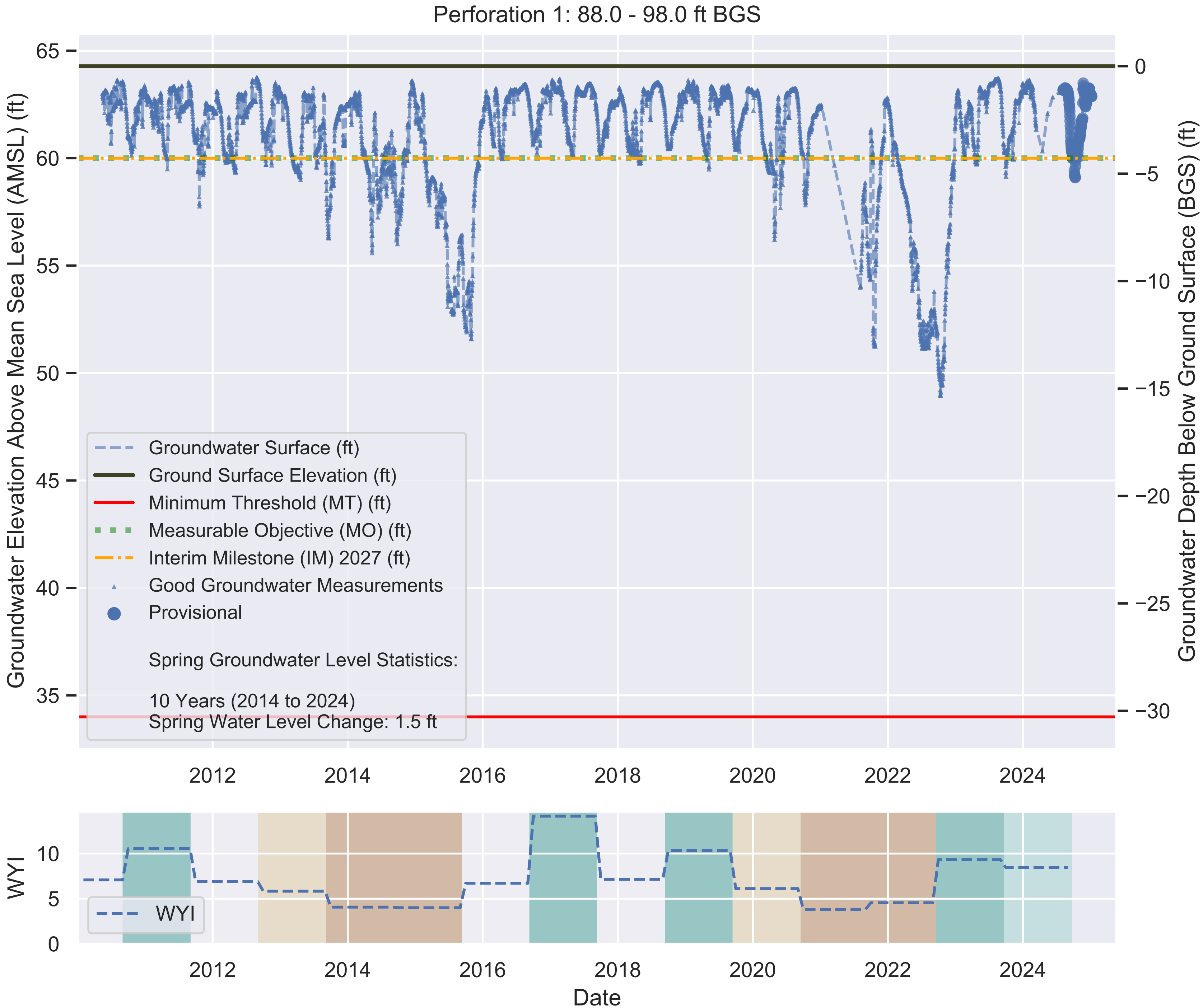
Well Location Map




Sustainable Management Criteria:
IM (2027) = 60.0 ft AMSL
MO = 60.0 ft AMSL
MT = 34.0 ft AMSL

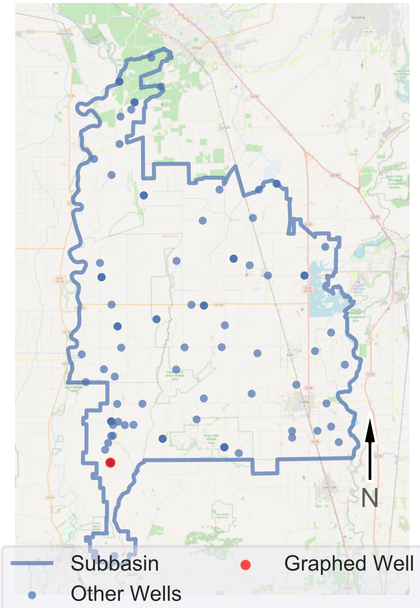
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



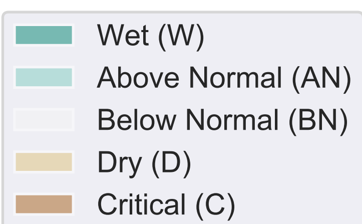
BUTTE Subbasin - State Well Number (SWN): 17N01W27A003M

Well Location Map

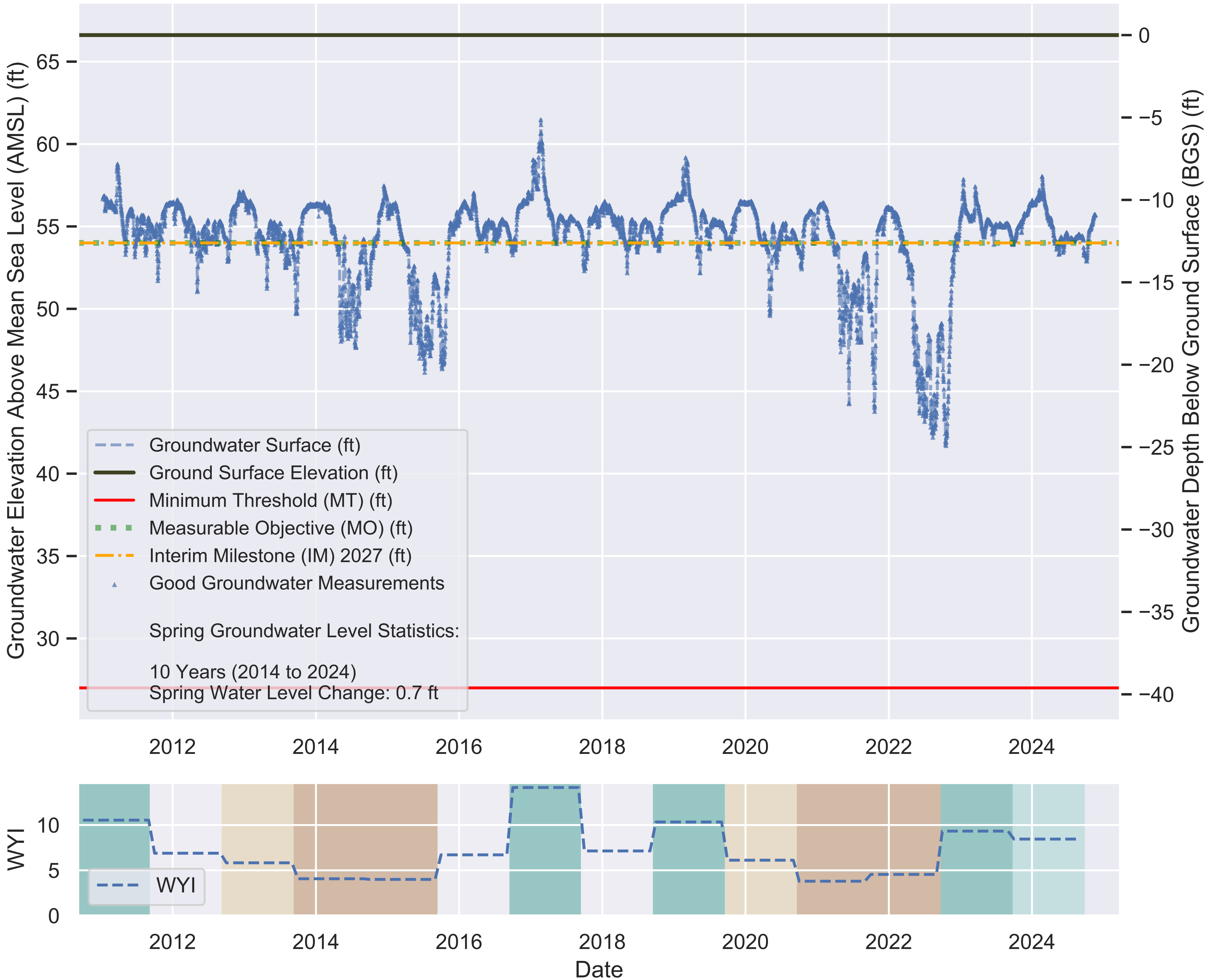



Sustainable Management Criteria:
IM (2027) = 54.0 ft AMSL
MO = 54.0 ft AMSL
MT = 27.0 ft AMSL

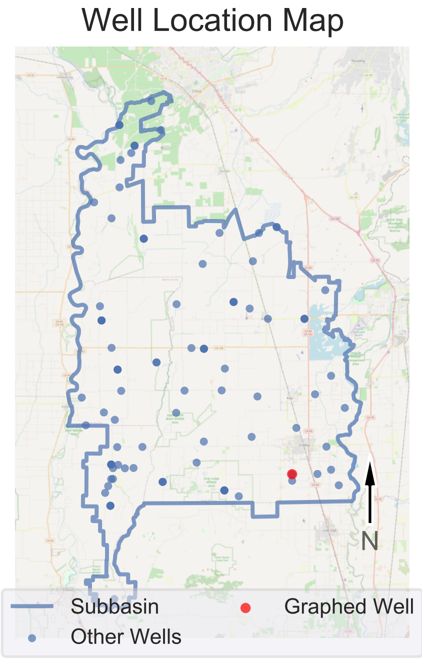
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.




Perforation 1: 160.0 - 170.0 ft BGS

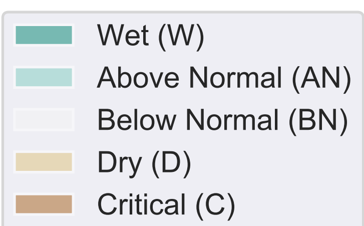


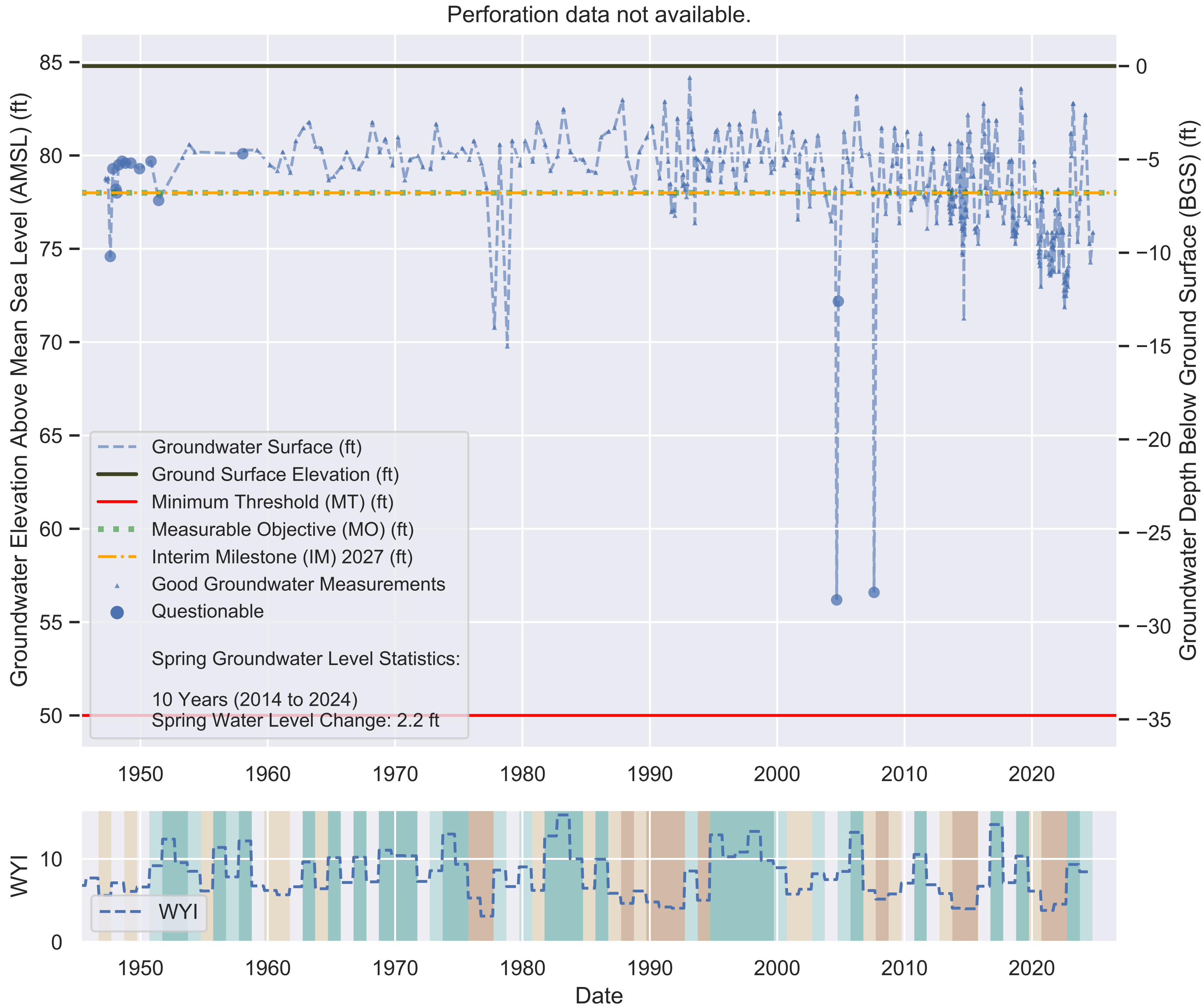
BUTTE Subbasin - State Well Number (SWN): 17N02E14A001M



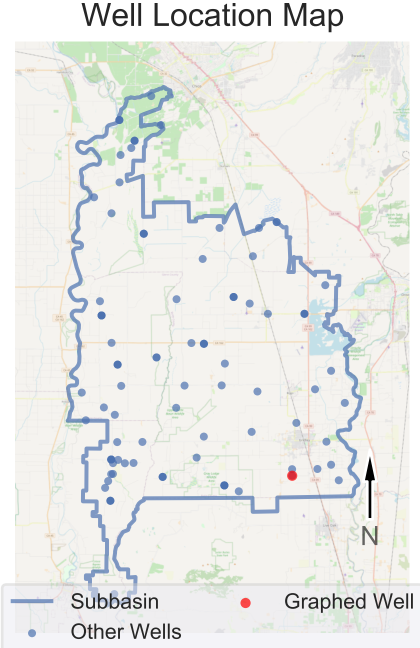

Sustainable Management Criteria:
IM (2027) = 78.0 ft AMSL
MO = 78.0 ft AMSL
MT = 50.0 ft AMSL

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



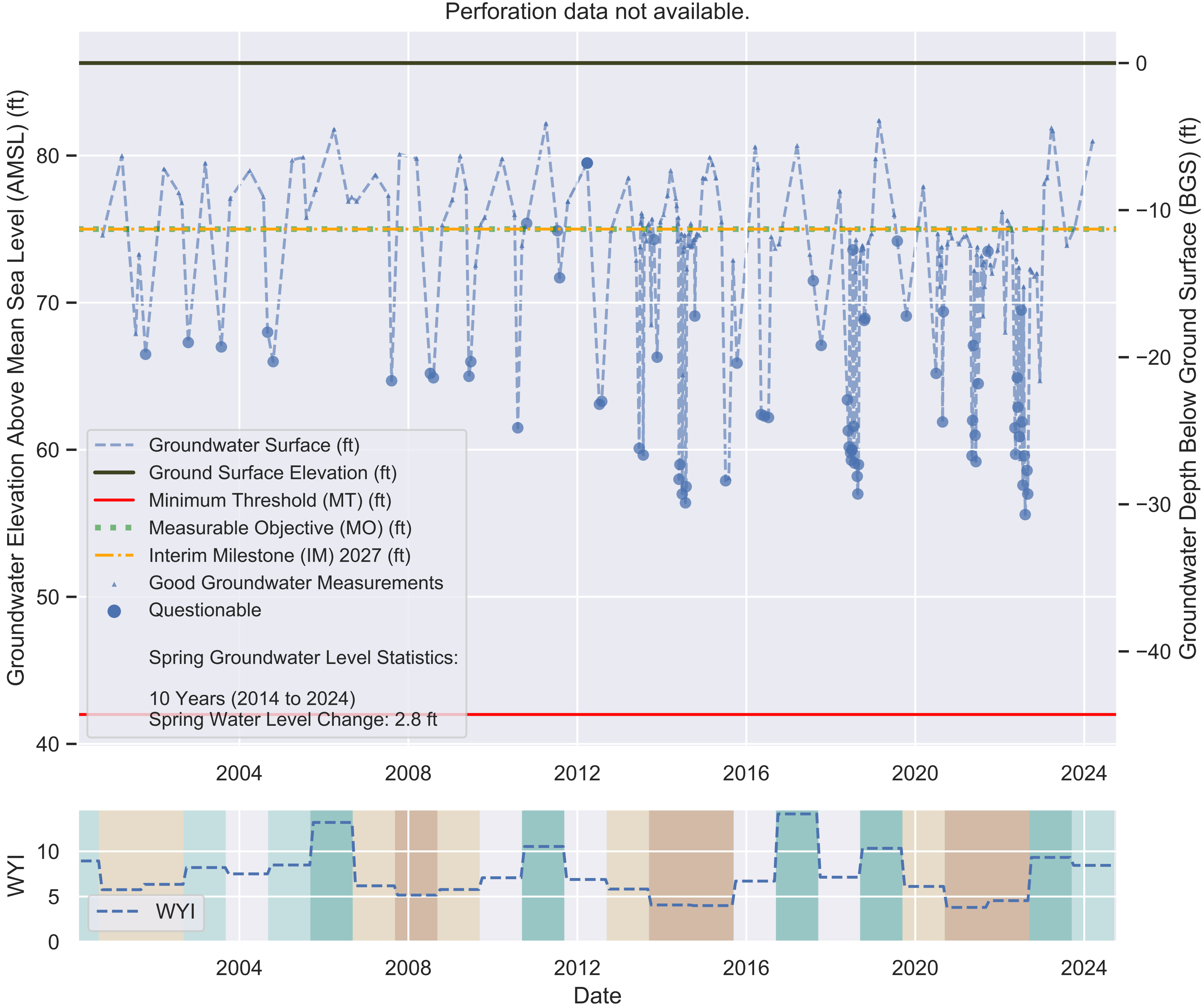



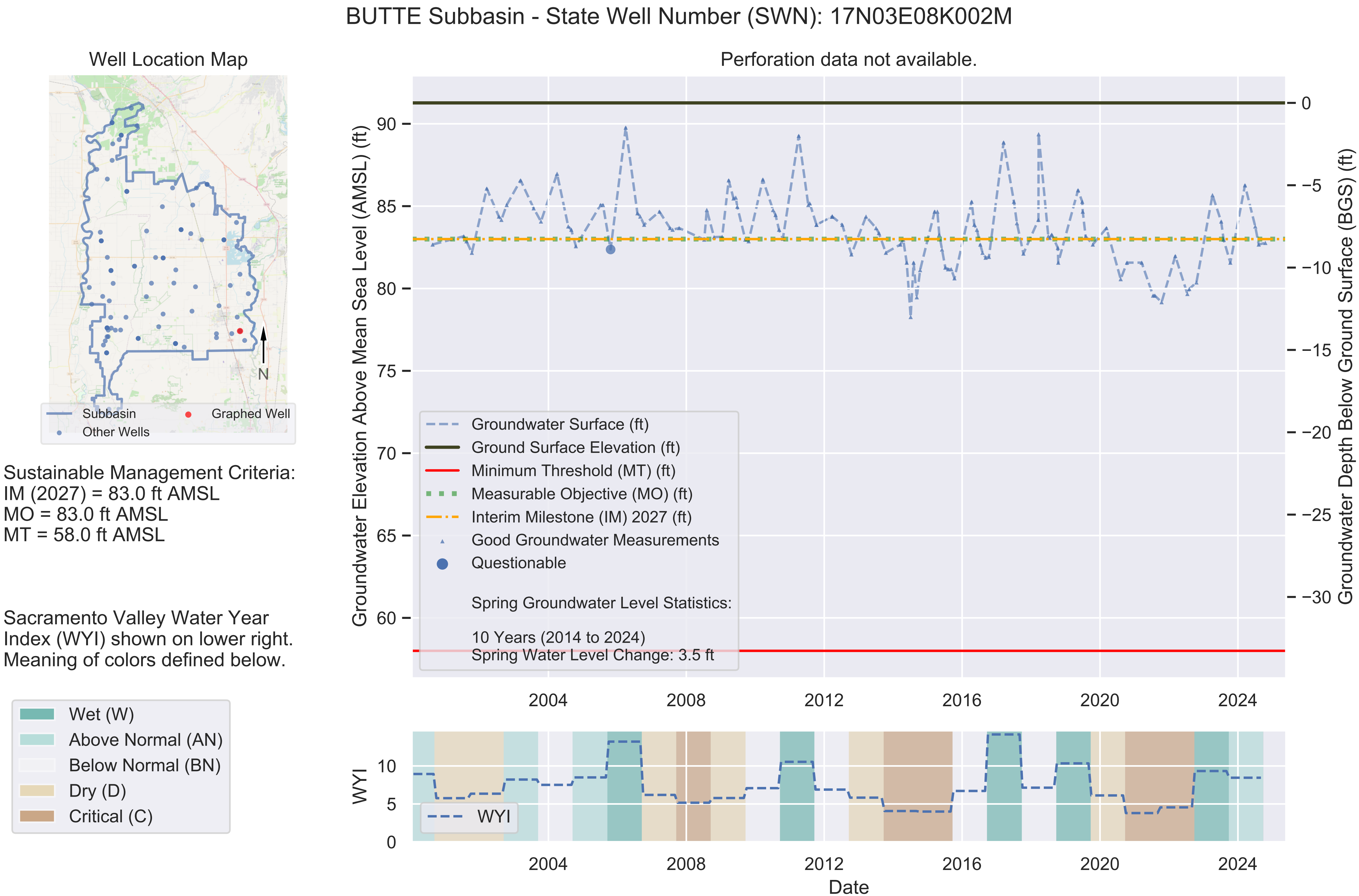
# BUTTE Subbasin - State Well Number (SWN): 17N02E14H001M




Sustainable Management Criteria:
IM (2027) = 75.0 ft AMSL
MO = 75.0 ft AMSL
MT = 42.0 ft AMSL

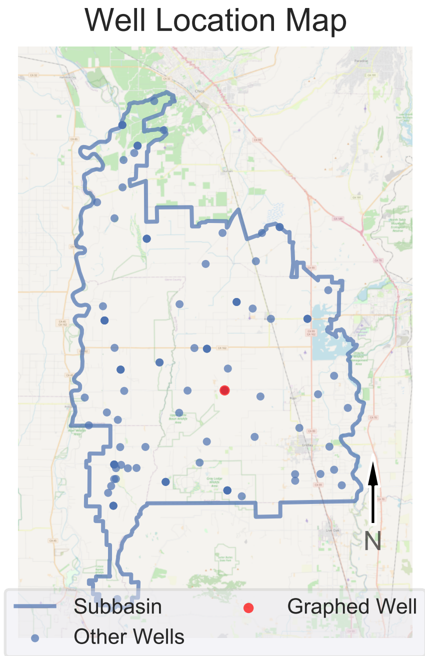
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





BUTTE Subbasin - State Well Number (SWN): 17N03E08K002M
Well Location Map
Subbasin
Graphed Well
Other Wells
N
Sustainable Management Criteria:
IM (2027) = 83.0 ft AMSL
MO = 83.0 ft AMSL
MT = 58.0 ft AMSL
Sacramento Valley Water Year
Index (WYI) shown on lower right.
Meaning of colors defined below.
Wet (W)
Above Normal (AN)
Below Normal (BN)
Dry (D)
Critical (C)
Perforation data not available.
Groundwater Elevation Above Mean Sea Level (AMSL) (ft)
Groundwater Depth Below Ground Surface (BGS) (ft)
90
85
80
75
70
65
60
0
−5
−10
−15
−20
−25
−30
Groundwater Surface (ft)
Ground Surface Elevation (ft)
Minimum Threshold (MT) (ft)
Measurable Objective (MO) (ft)
Interim Milestone (IM) 2027 (ft)
Good Groundwater Measurements
Questionable
Spring Groundwater Level Statistics:
10 Years (2014 to 2024)
Spring Water Level Change: 3.5 ft
2004
2008
2012
2016
2020
2024
WYI
10
5
0
WYI
Date

# BUTTE Subbasin - State Well Number (SWN): 18N01E13A002M

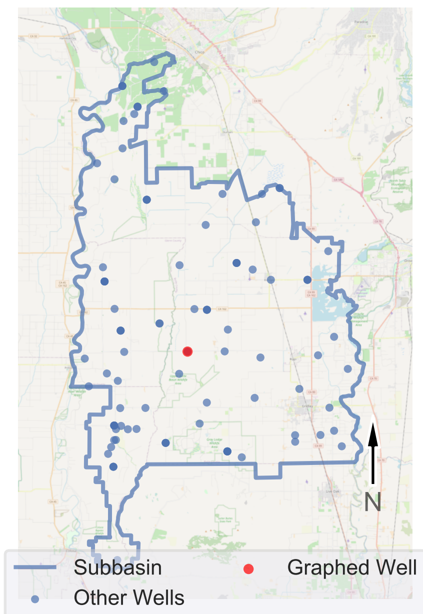



Sustainable Management Criteria:
IM (2027) = 75.0 ft AMSL
MO = 75.0 ft AMSL
MT = 39.0 ft AMSL

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


BUTTE Subbasin - State Well Number (SWN): 18N01E15D002M

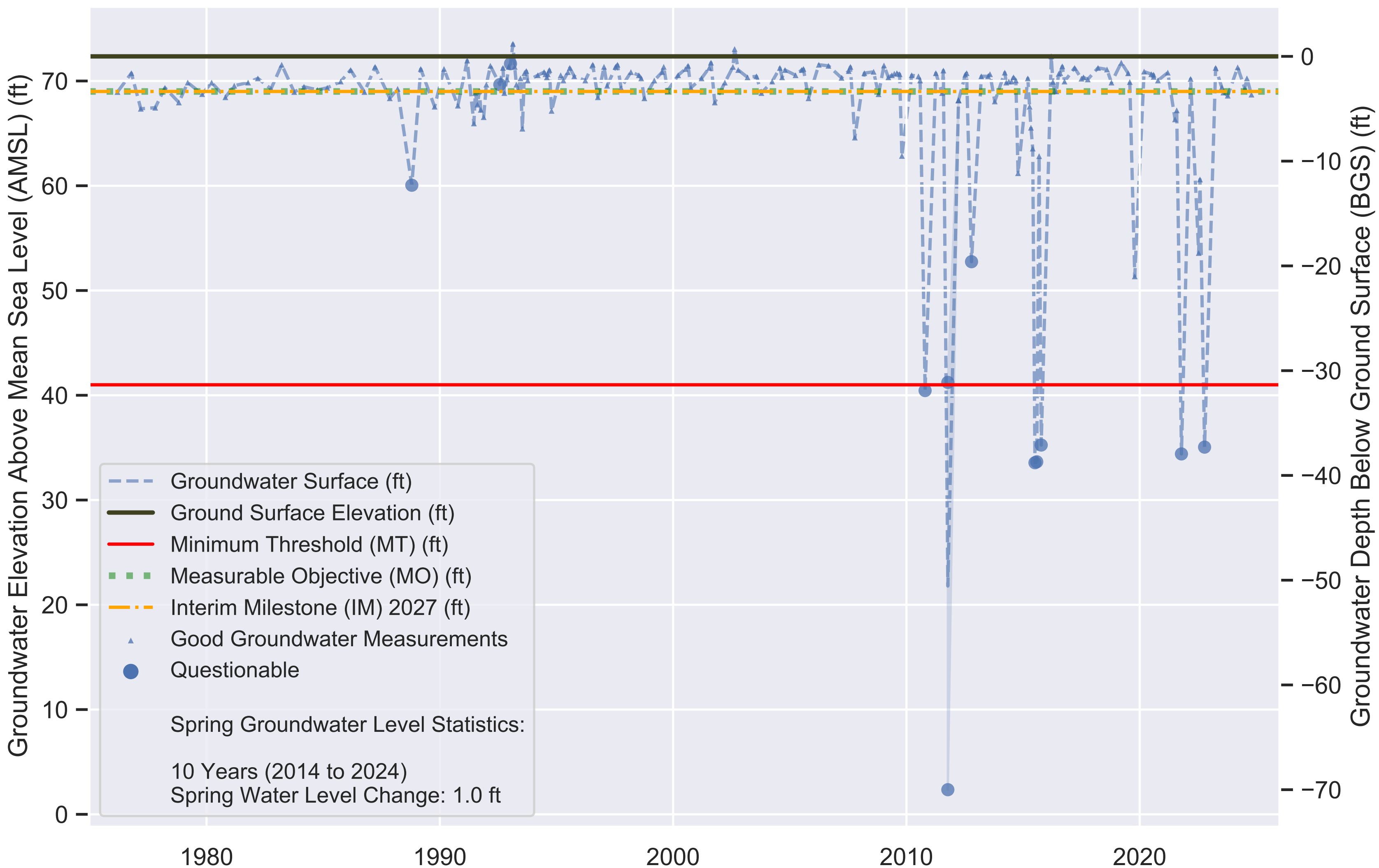
Well Location Map

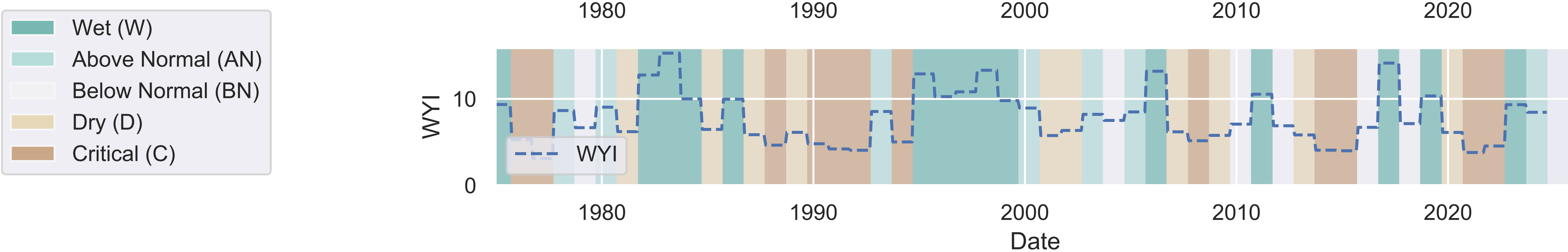



Sustainable Management Criteria:
IM (2027) = 69.0 ft AMSL
MO = 69.0 ft AMSL
MT = 41.0 ft AMSL

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

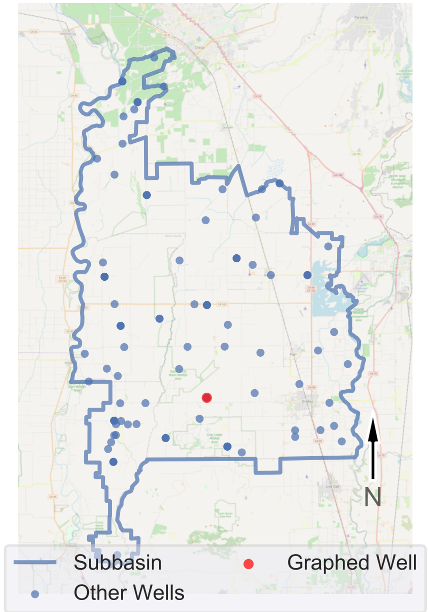
Perforation data not available.



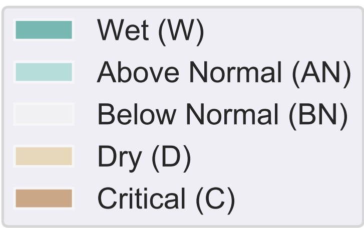
BUTTE Subbasin - State Well Number (SWN): 18N01E35L001M

Well Location Map

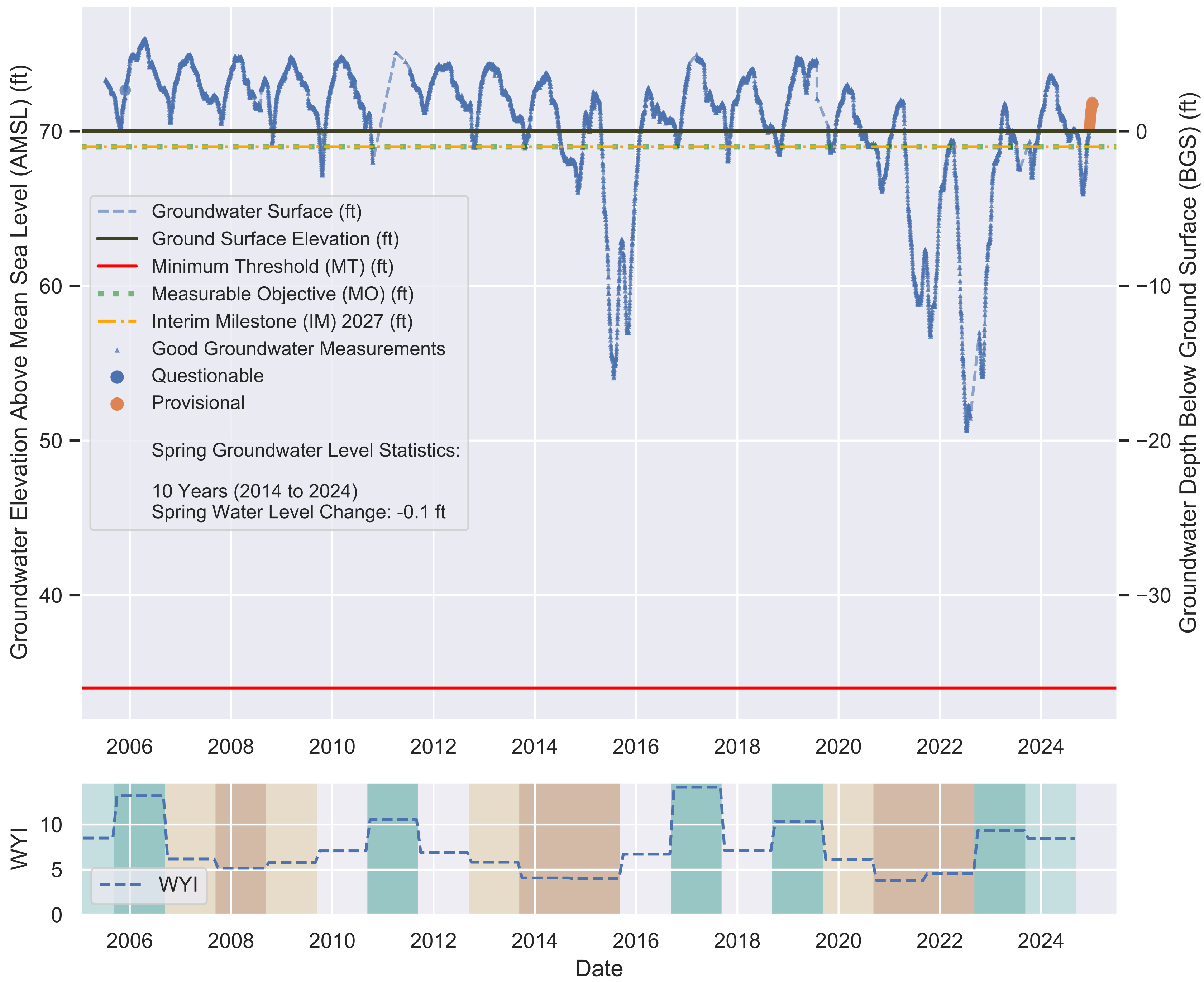



Sustainable Management Criteria:
IM (2027) = 69.0 ft AMSL
MO = 69.0 ft AMSL
MT = 34.0 ft AMSL

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

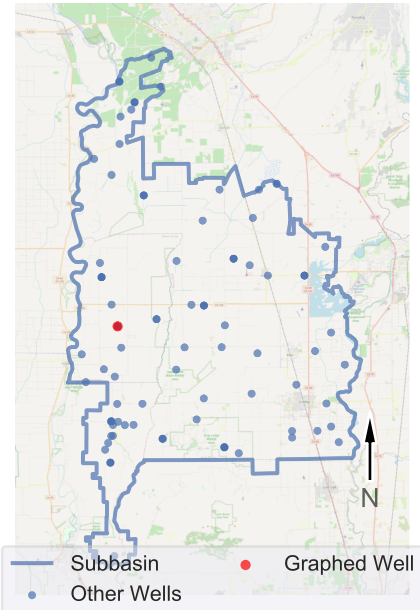



Perforation 1: 816.0 - 836.0 ft BGS



BUTTE Subbasin - State Well Number (SWN): 18N01W02E001M

Well Location Map

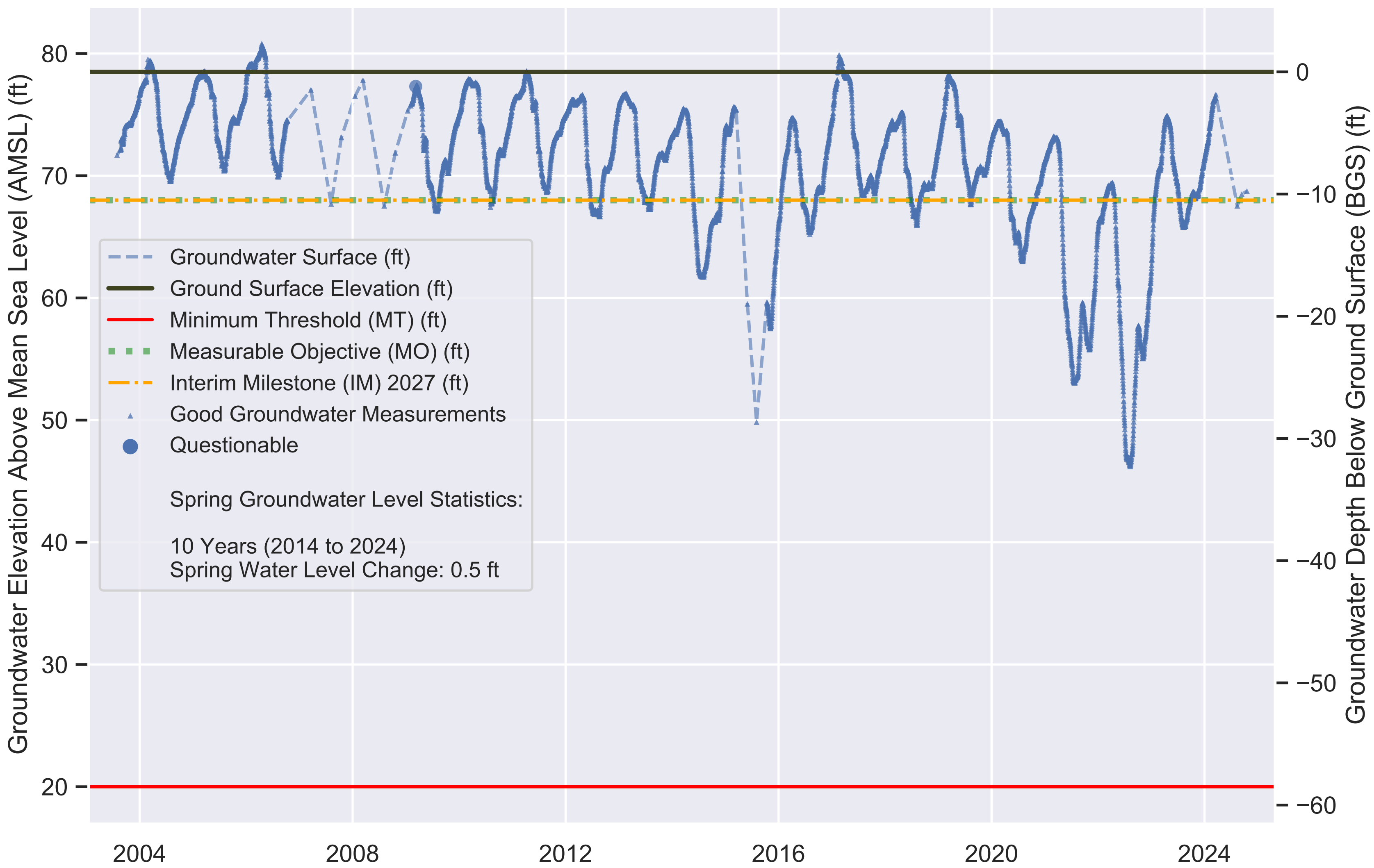


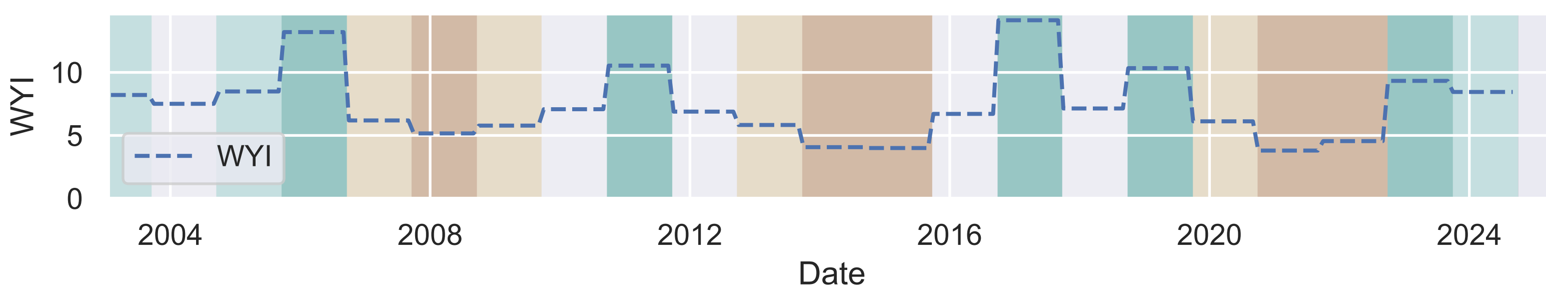

Sustainable Management Criteria:
IM (2027) = 68.0 ft AMSL
MO = 68.0 ft AMSL
MT = 20.0 ft AMSL

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

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

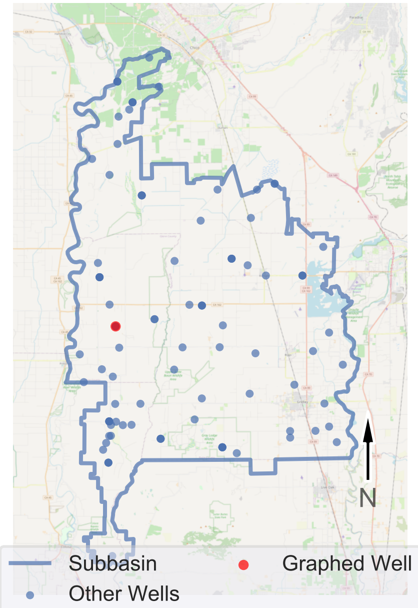
Perforation 1: 719.0 - 729.0 ft BGS



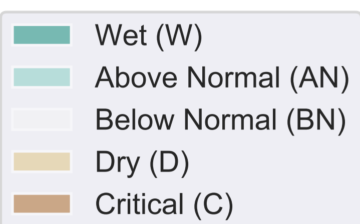
# BUTTE Subbasin - State Well Number (SWN): 18N01W02E003M

Well Location Map

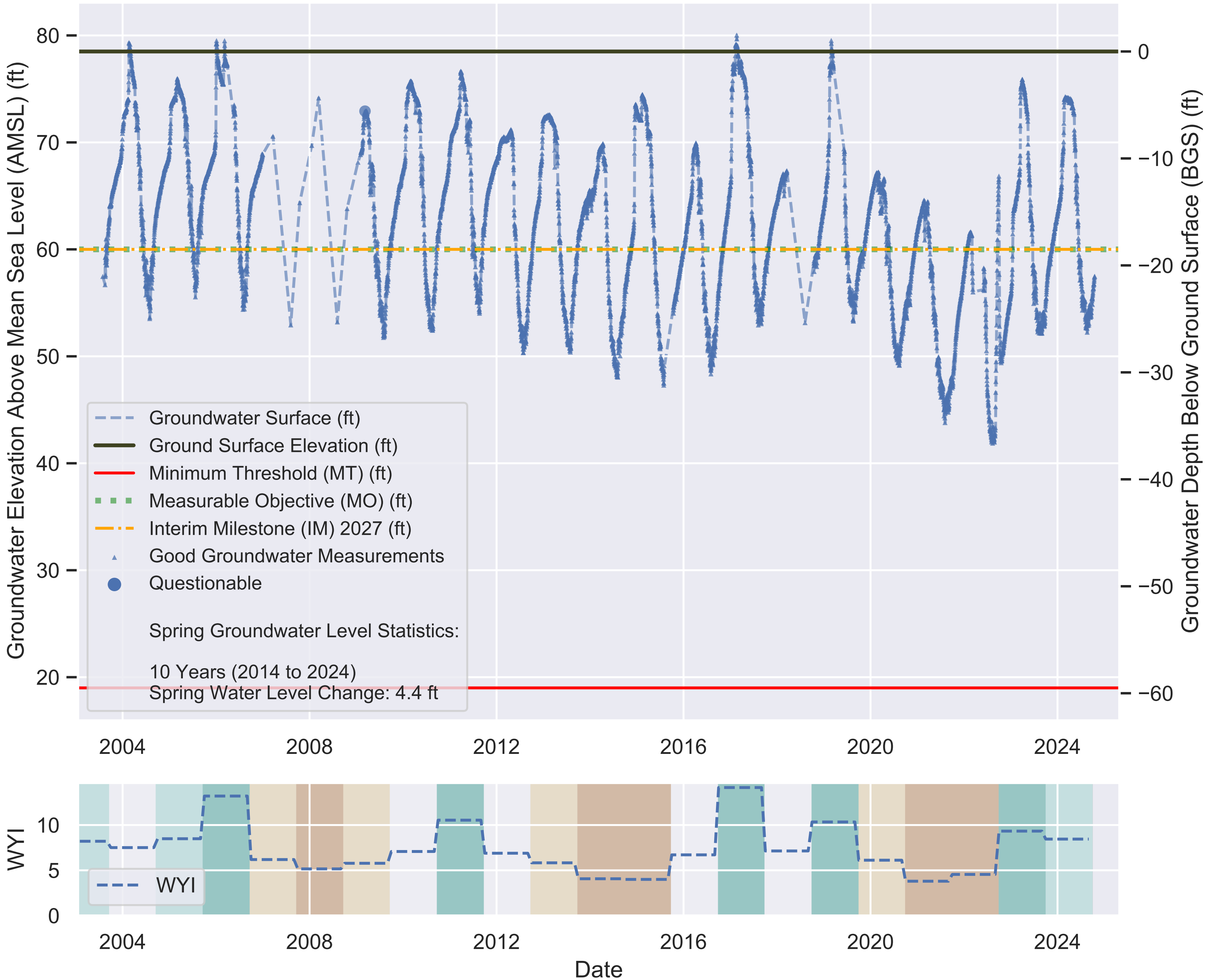



Sustainable Management Criteria:
IM (2027) = 60.0 ft AMSL
MO = 60.0 ft AMSL
MT = 19.0 ft AMSL

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

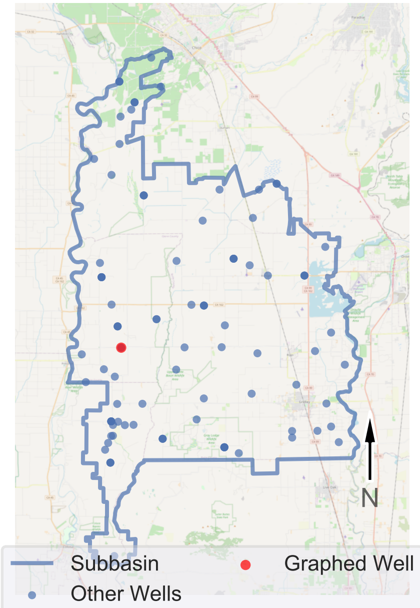



Perforation 1: 110.0 - 120.0 ft BGS



BUTTE Subbasin - State Well Number (SWN): 18N01W14B001M

Well Location Map

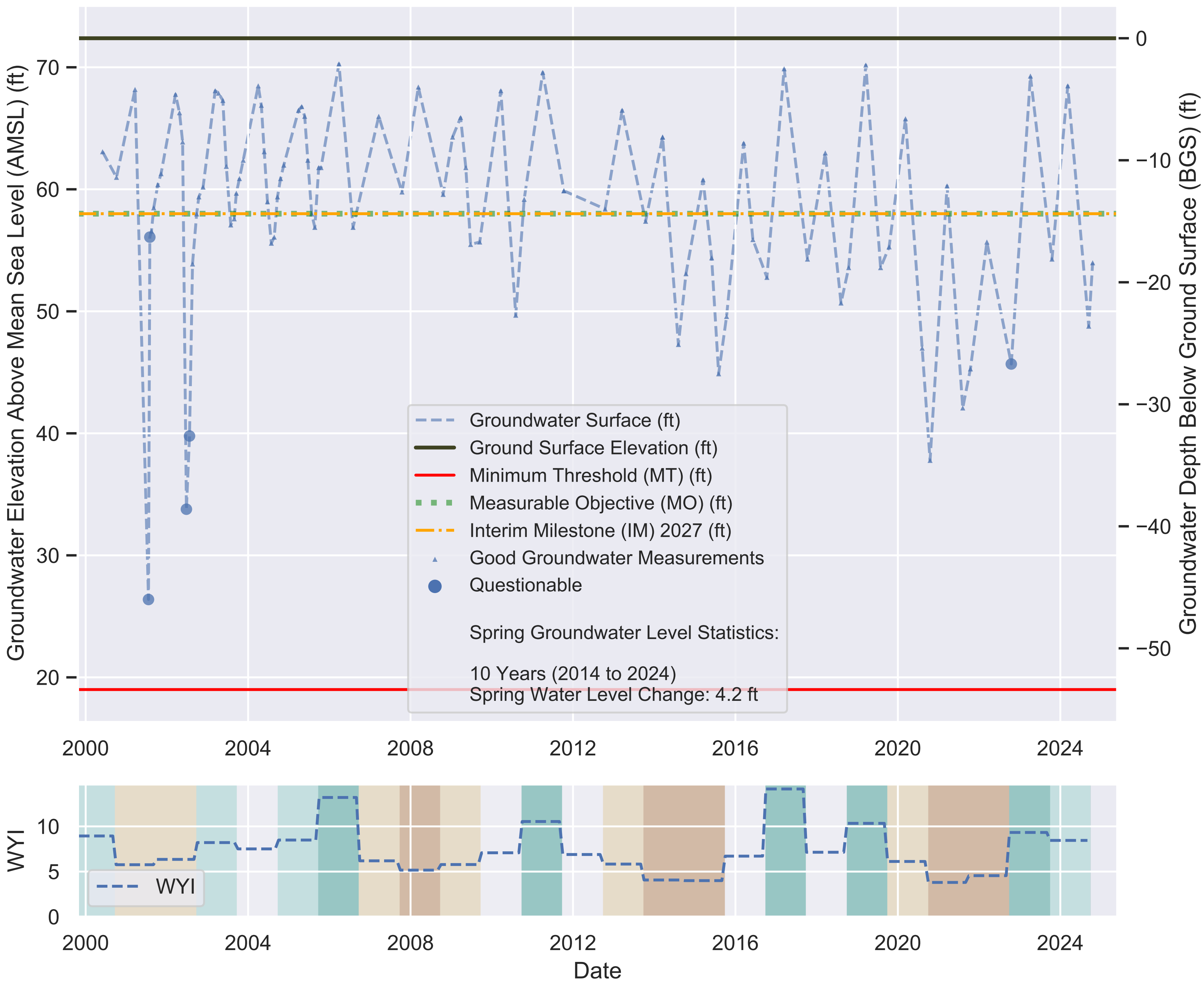



Sustainable Management Criteria:
IM (2027) = 58.0 ft AMSL
MO = 58.0 ft AMSL
MT = 19.0 ft AMSL

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

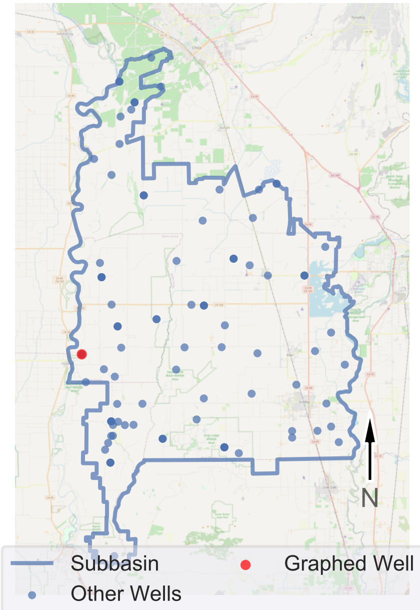
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1 (P1): 59.0 - 83.0; P2: 145.0 - 173.0 ft BGS



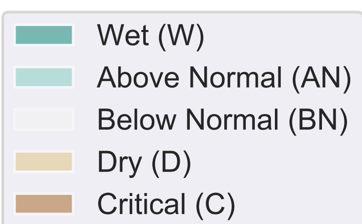
# BUTTE Subbasin - State Well Number (SWN): 18N01W17G001M

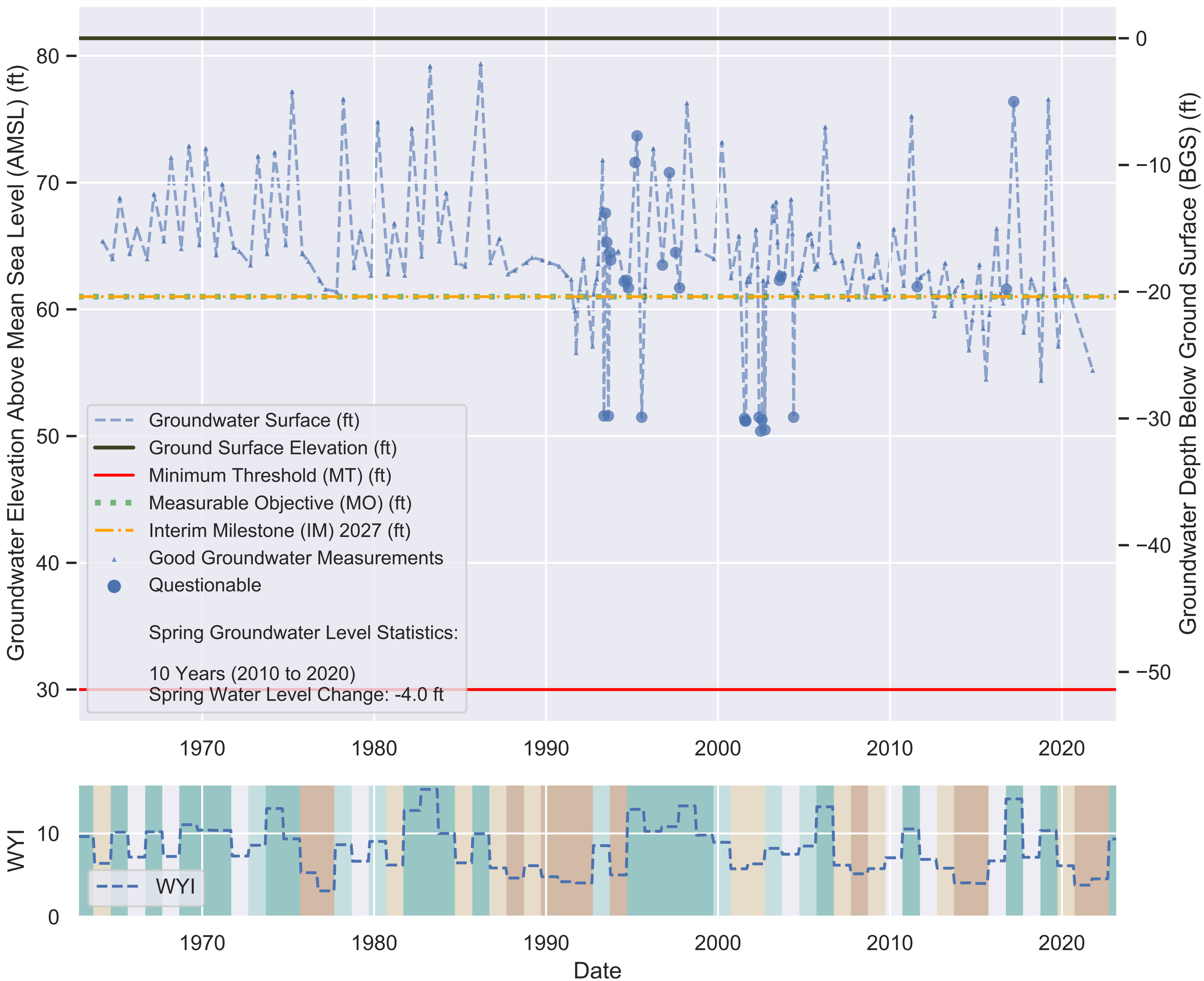
Well Location Map



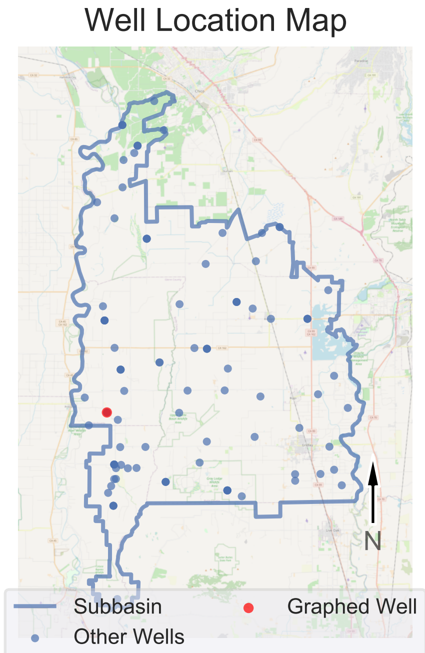

Sustainable Management Criteria:
IM (2027) = 61.0 ft AMSL
MO = 61.0 ft AMSL
MT = 30.0 ft AMSL

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



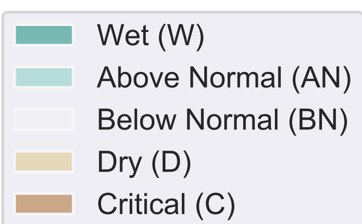



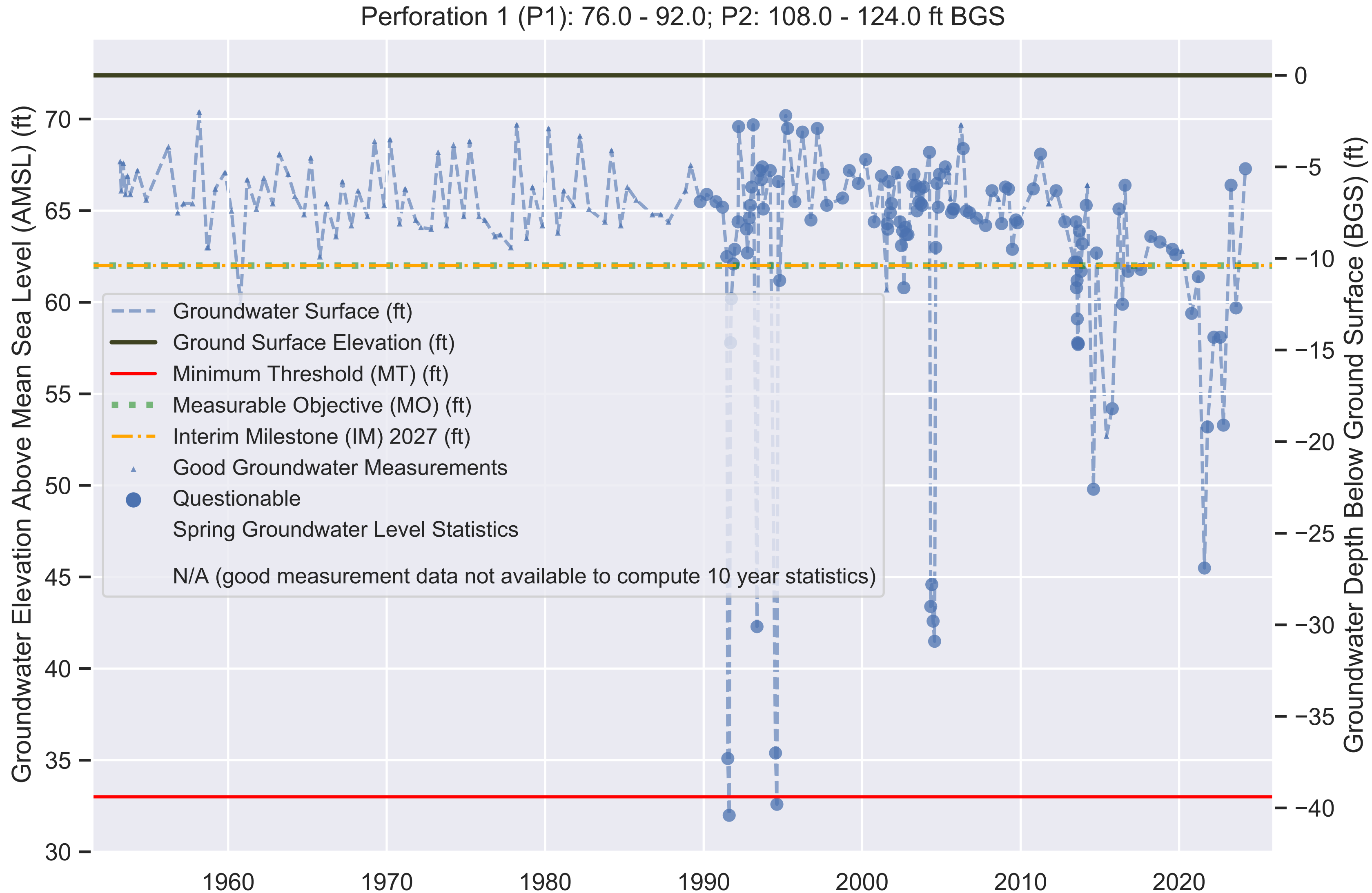
# BUTTE Subbasin - State Well Number (SWN): 18N01W22L001M

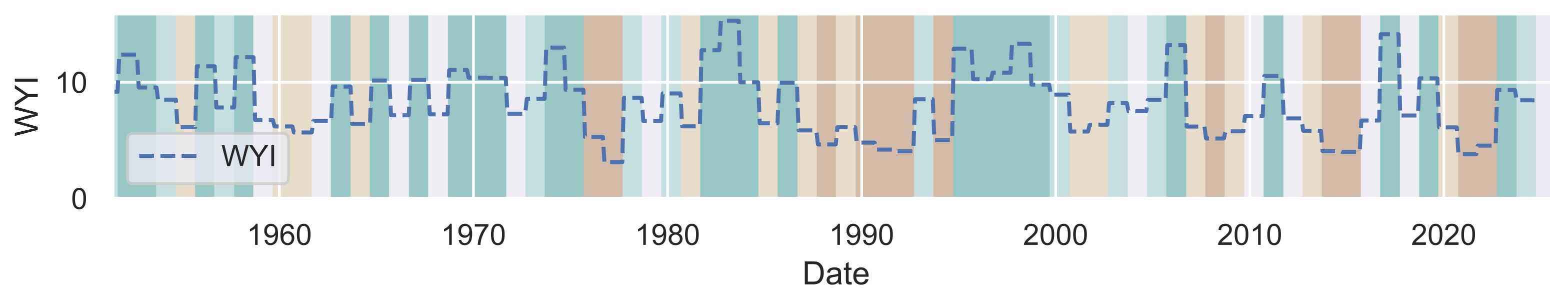



Sustainable Management Criteria:
IM (2027) = 62.0 ft AMSL
MO = 62.0 ft AMSL
MT = 33.0 ft AMSL

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

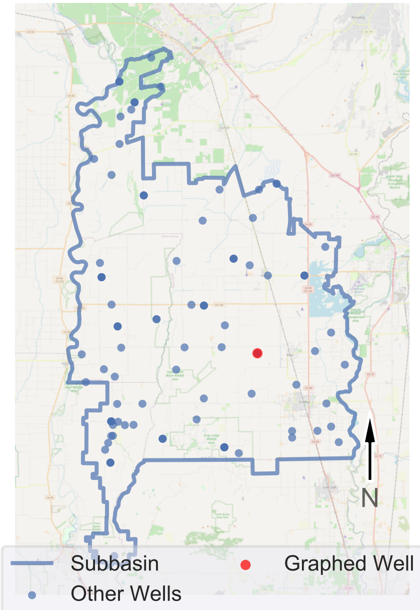


# BUTTE Subbasin - State Well Number (SWN): 18N02E16F001M

Well Location Map




Sustainable Management Criteria:
IM (2027) = 77.0 ft AMSL
MO = 77.0 ft AMSL
MT = 53.0 ft AMSL

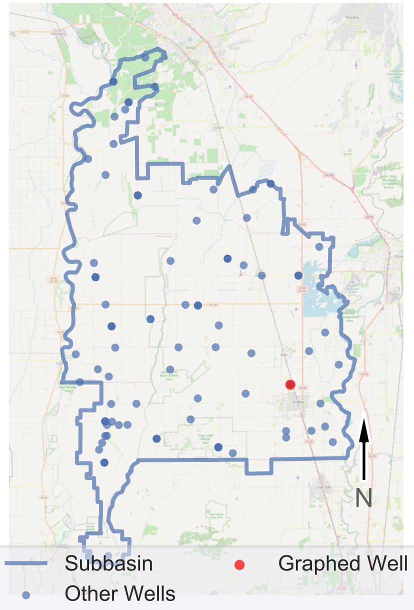
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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

Perforation 1: 20.0 - 60.0 ft BGS

## BUTTE Subbasin - State Well Number (SWN): 18N02E25M001M

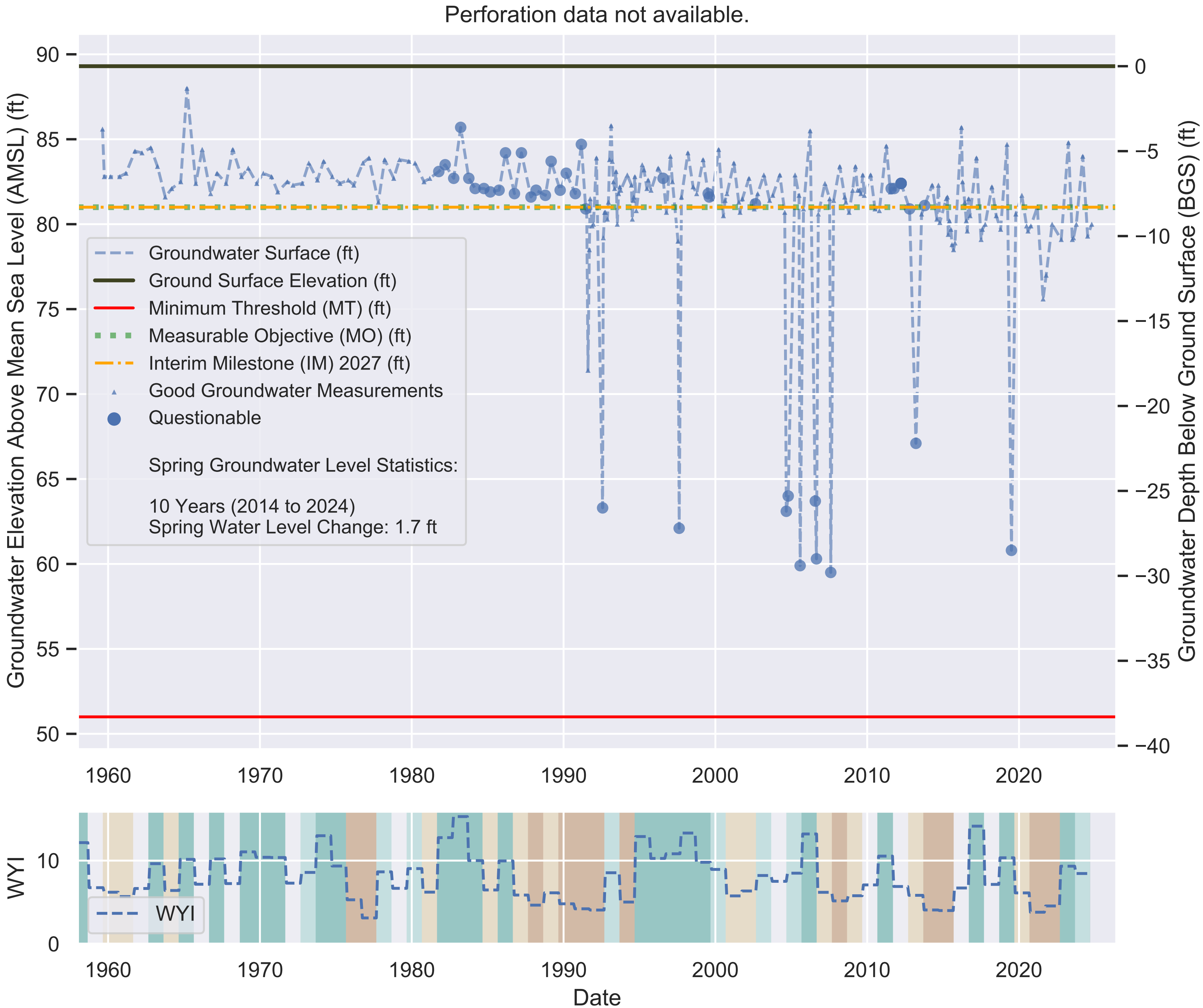
Well Location Map




Sustainable Management Criteria:
IM (2027) = 81.0 ft AMSL
MO = 81.0 ft AMSL
MT = 51.0 ft AMSL

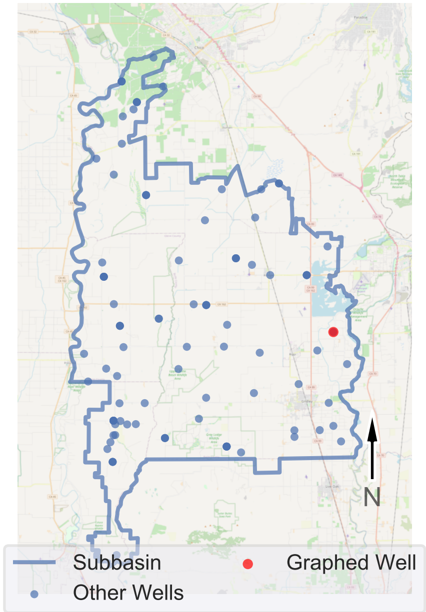
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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



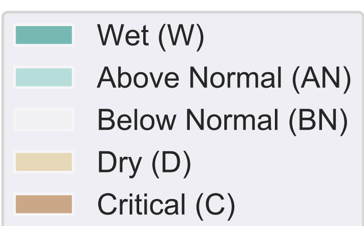
BUTTE Subbasin - State Well Number (SWN): 18N03E08B003M

Well Location Map

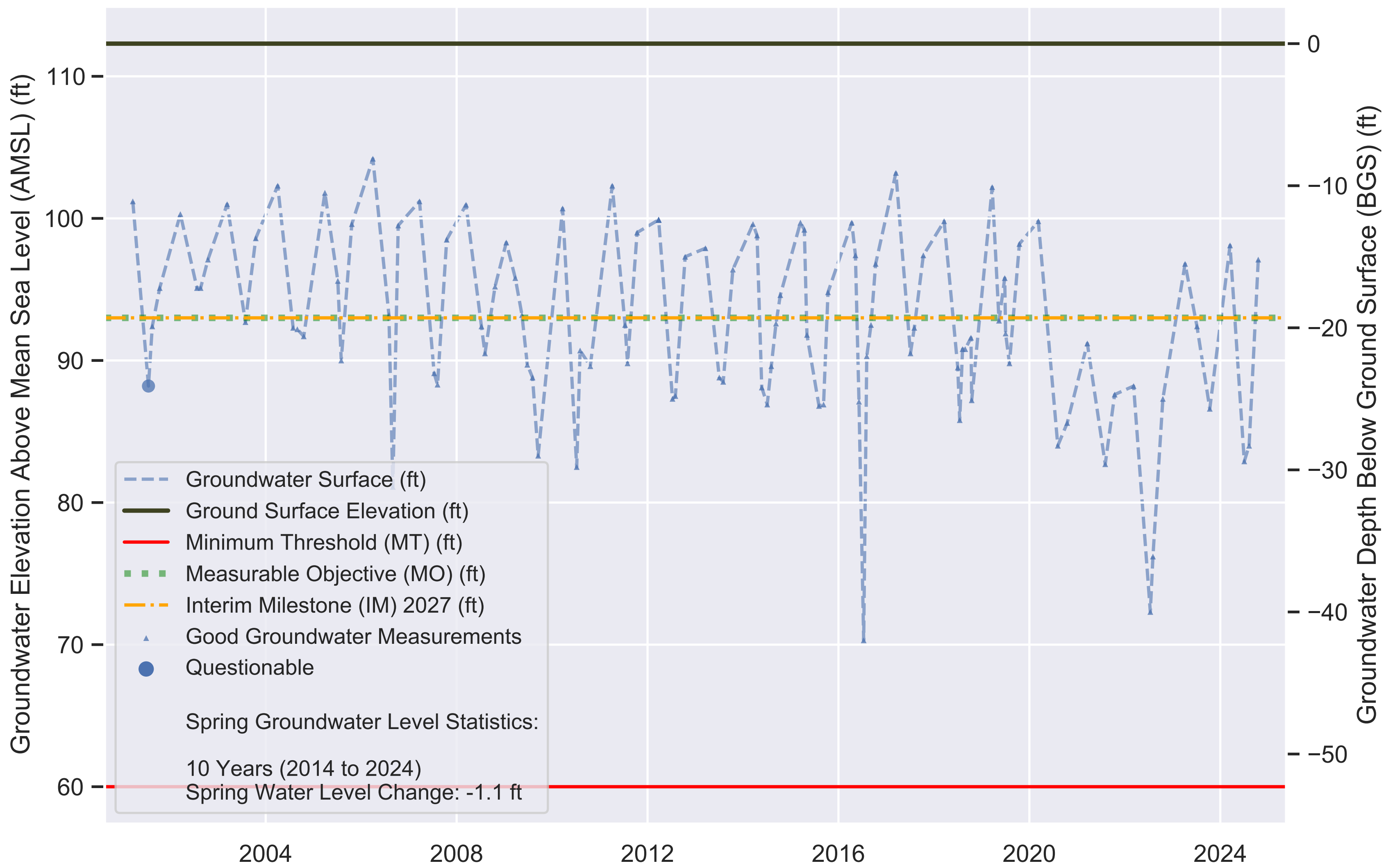


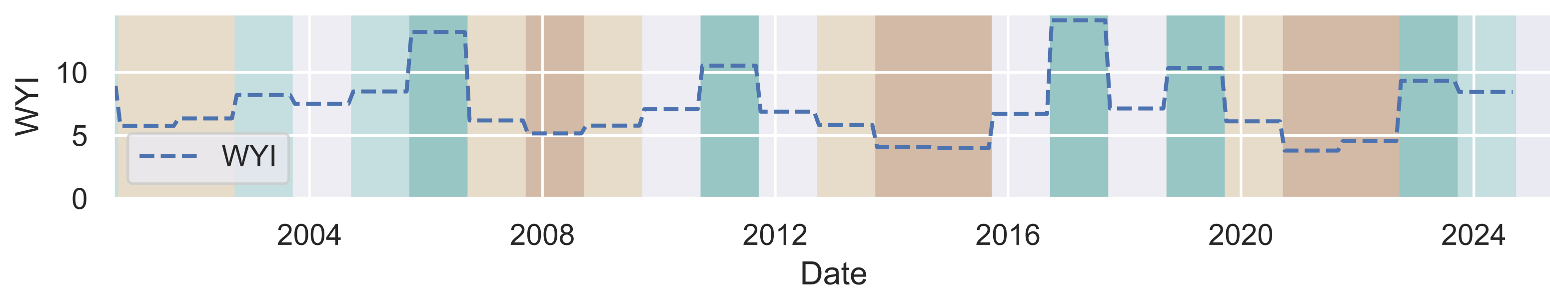

Sustainable Management Criteria:
IM (2027) = 93.0 ft AMSL
MO = 93.0 ft AMSL
MT = 60.0 ft AMSL

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



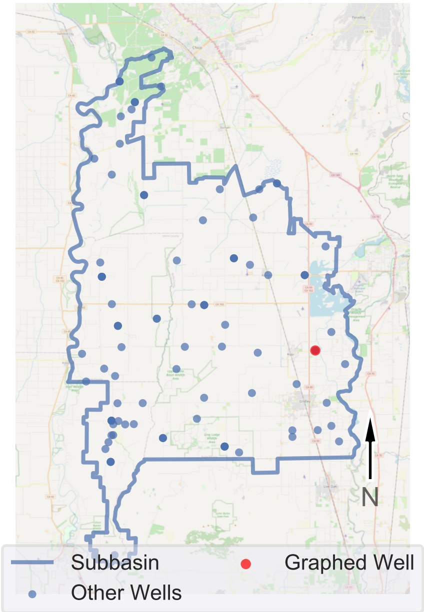

Perforation 1: 156.0 - 463.0 ft BGS



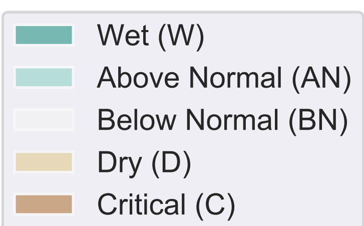
BUTTE Subbasin - State Well Number (SWN): 18N03E18F001M

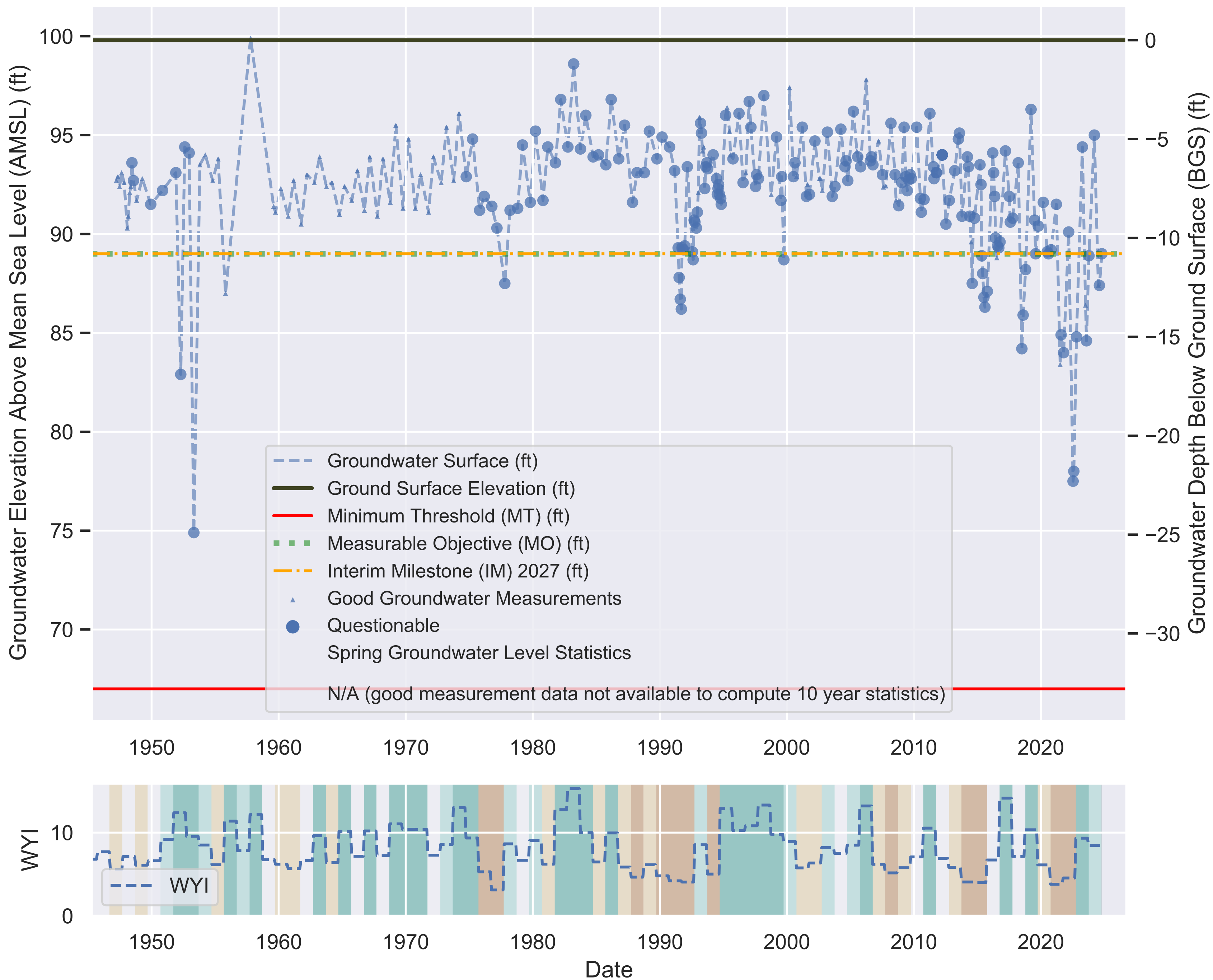
Well Location Map




Sustainable Management Criteria:
IM (2027) = 89.0 ft AMSL
MO = 89.0 ft AMSL
MT = 67.0 ft AMSL

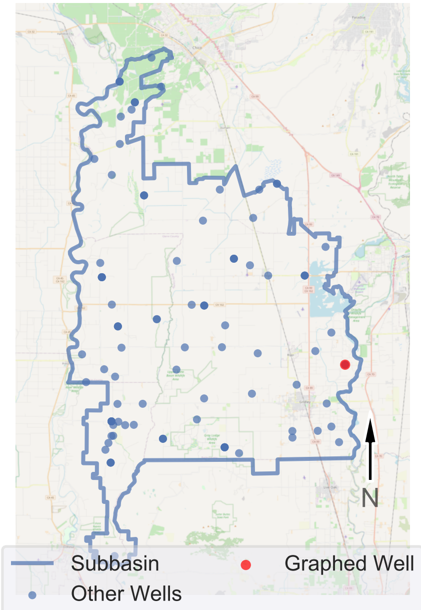
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



BUTTE Subbasin - State Well Number (SWN): 18N03E21G001M

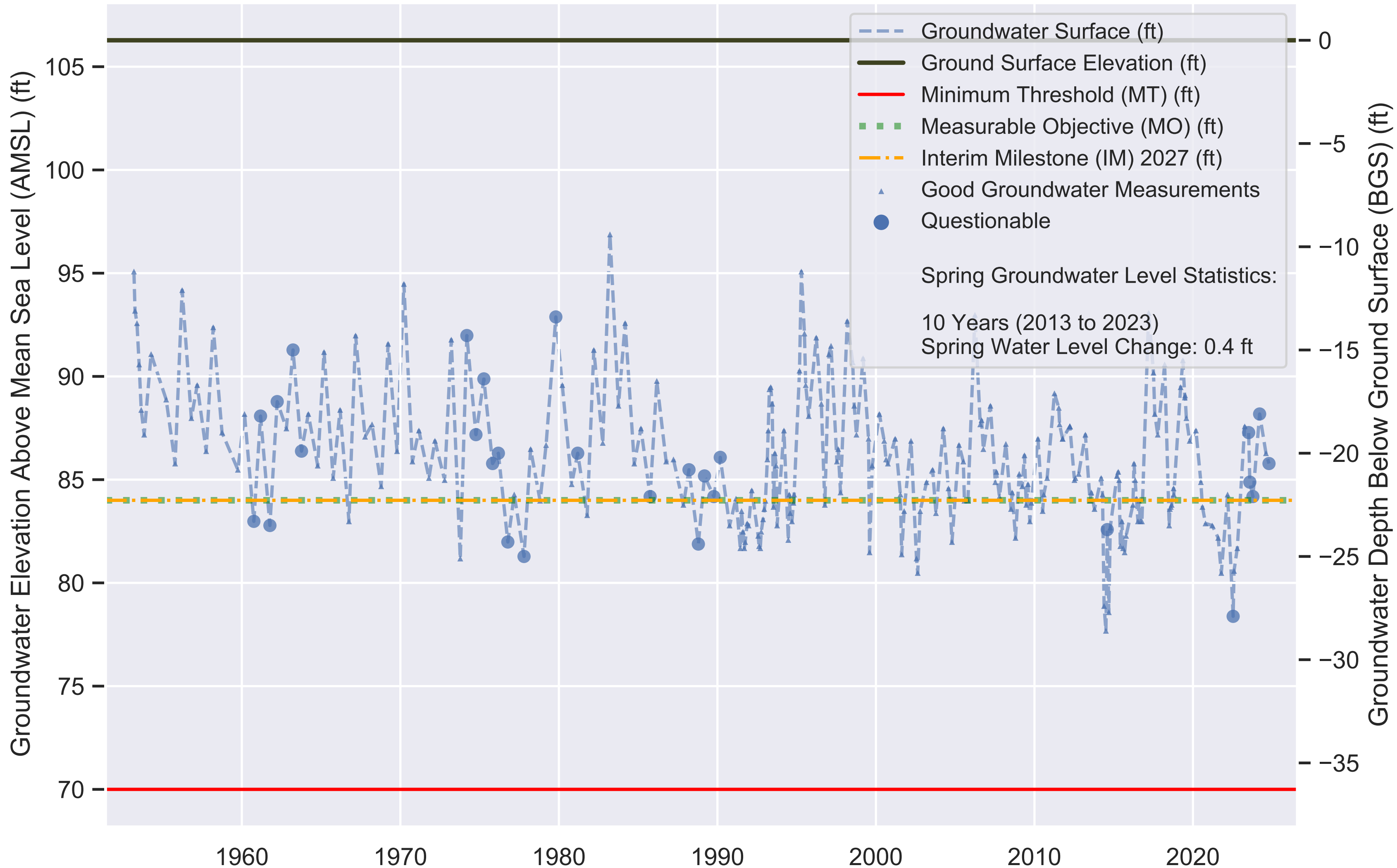
Well Location Map

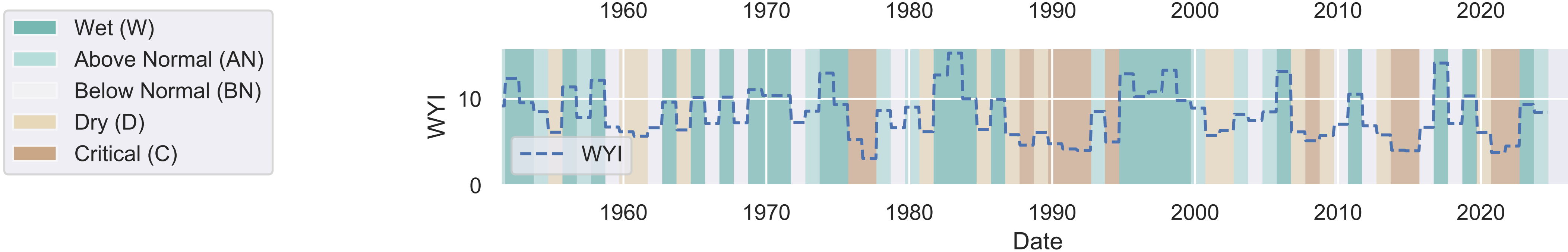



Sustainable Management Criteria:
IM (2027) = 84.0 ft AMSL
MO = 84.0 ft AMSL
MT = 70.0 ft AMSL

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

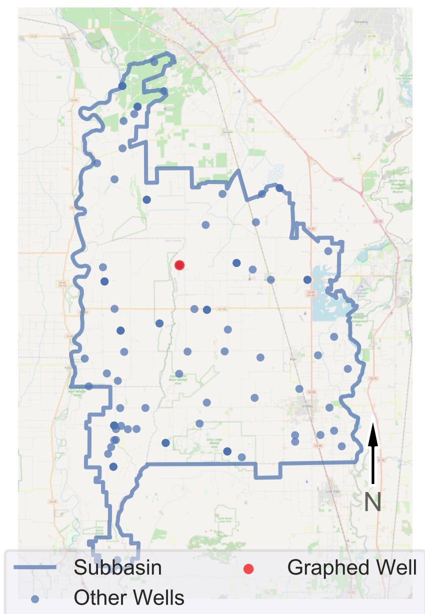
Perforation data not available.



# BUTTE Subbasin - State Well Number (SWN): 19N01E09Q001M

Well Location Map




Sustainable Management Criteria:
IM (2027) = 87.0 ft AMSL
MO = 87.0 ft AMSL
MT = 58.0 ft AMSL

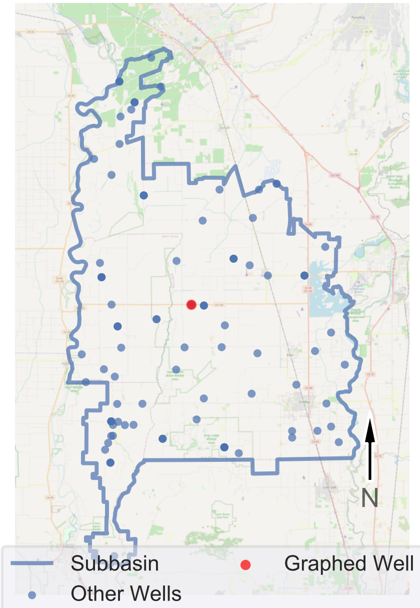
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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

Perforation data not available.

# BUTTE Subbasin - State Well Number (SWN): 19N01E27Q001M

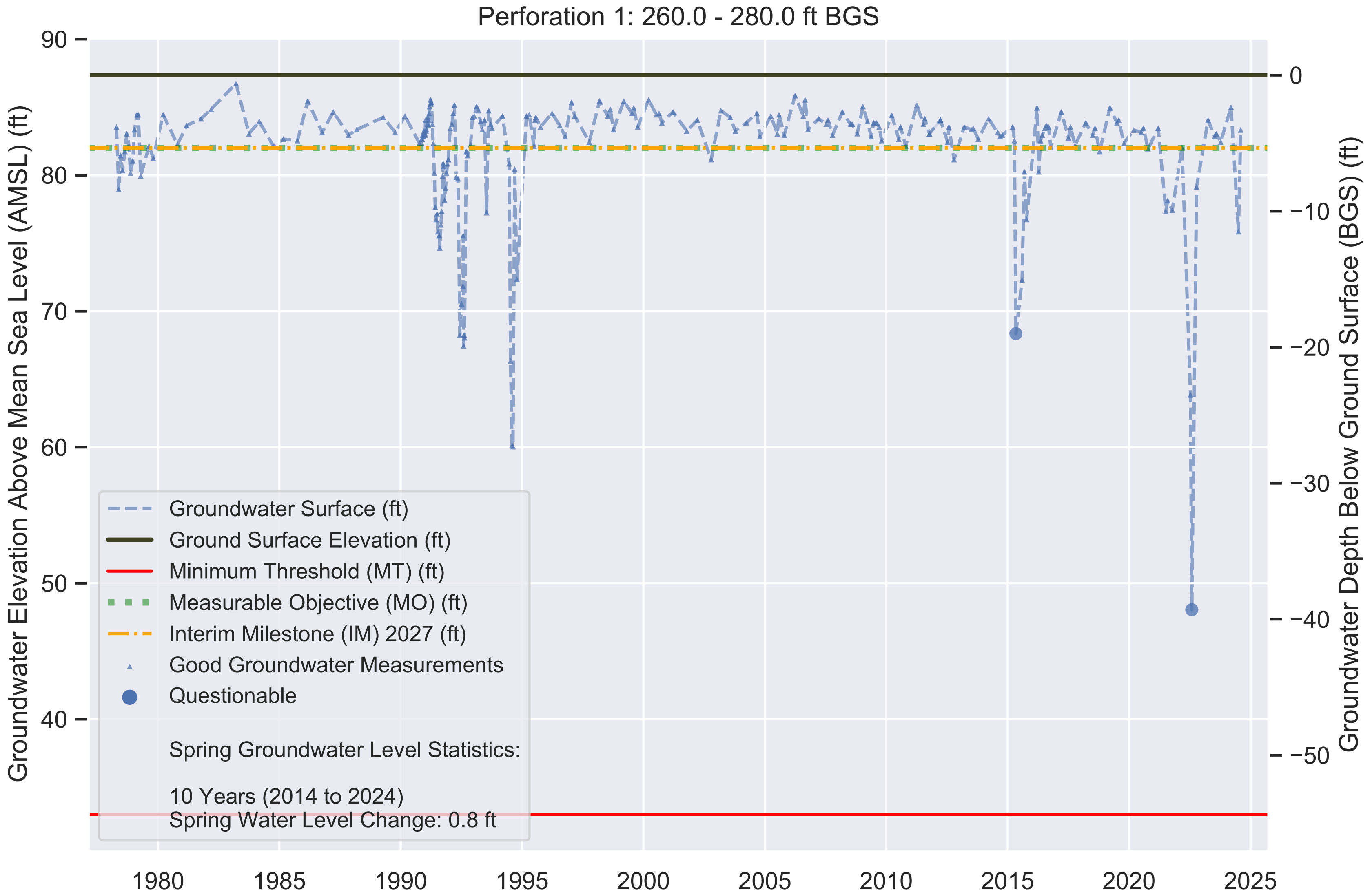
Well Location Map

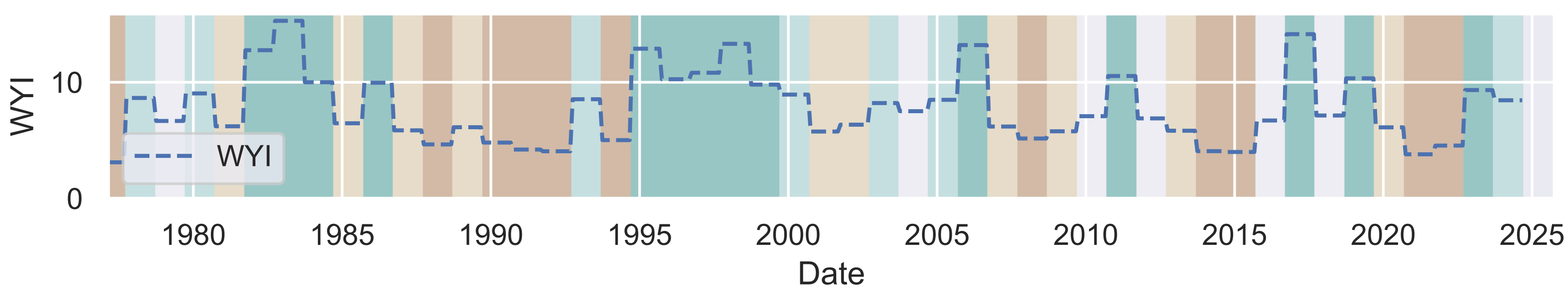



Sustainable Management Criteria:
IM (2027) = 82.0 ft AMSL
MO = 82.0 ft AMSL
MT = 33.0 ft AMSL

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

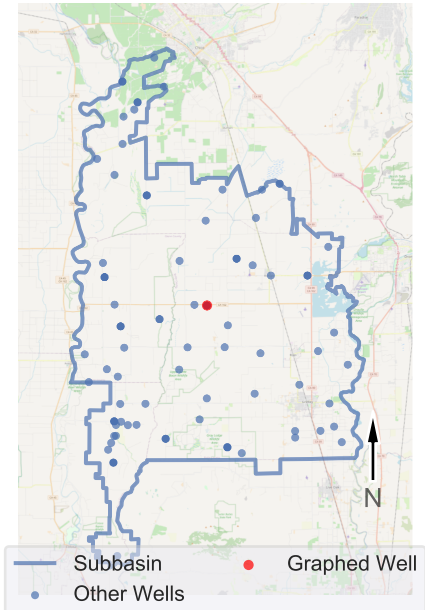
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)



# BUTTE Subbasin - State Well Number (SWN): 19N01E35B001M

Well Location Map

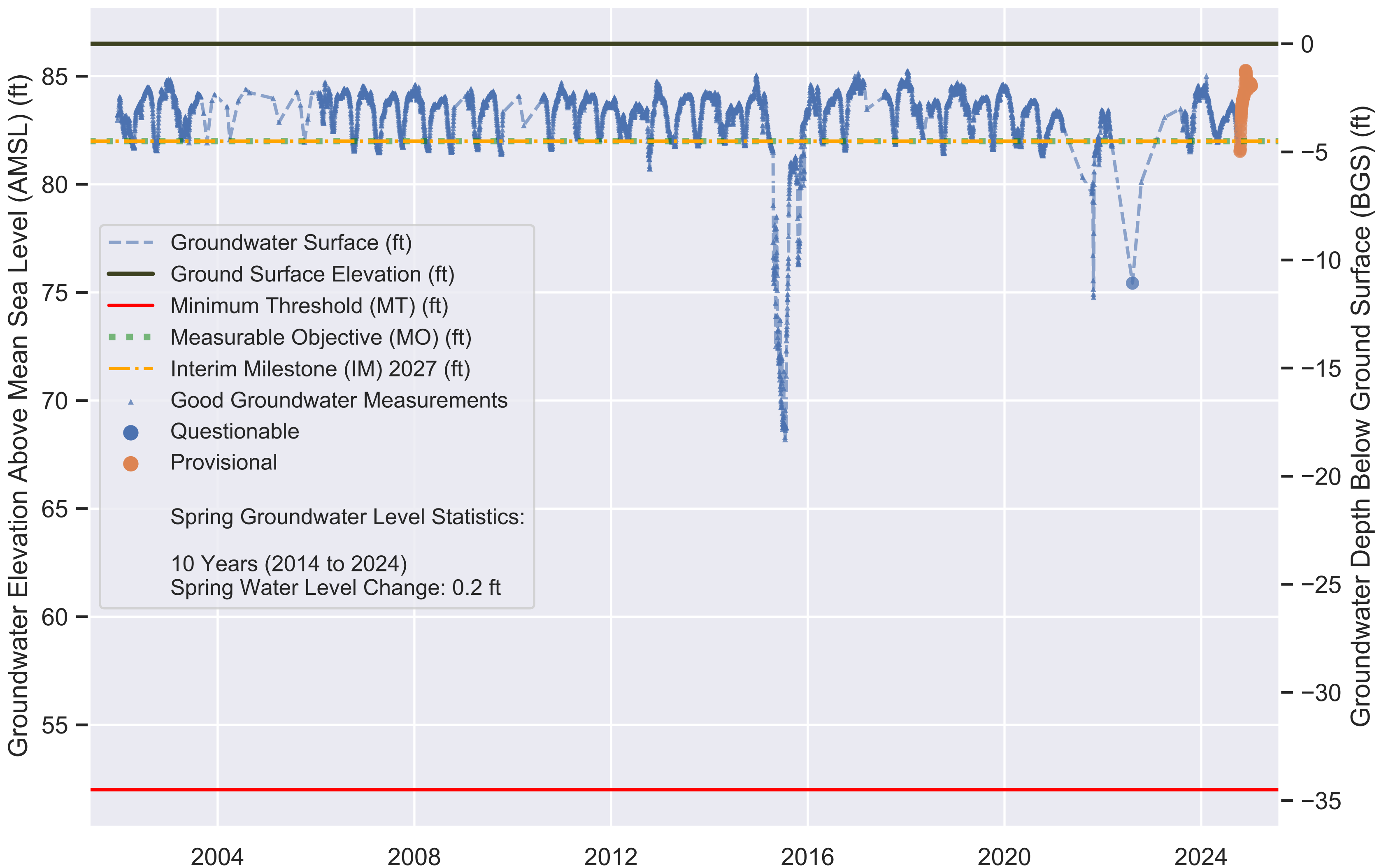


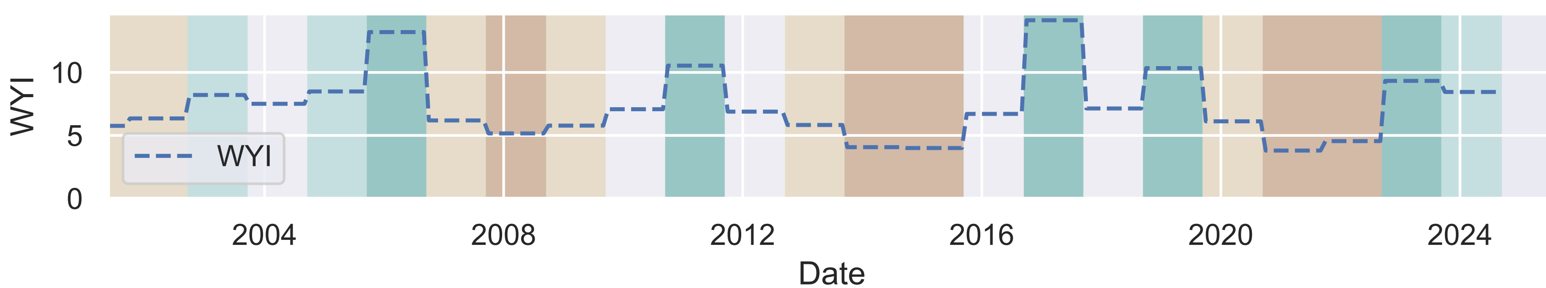

Sustainable Management Criteria:
IM (2027) = 82.0 ft AMSL
MO = 82.0 ft AMSL
MT = 52.0 ft AMSL

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

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

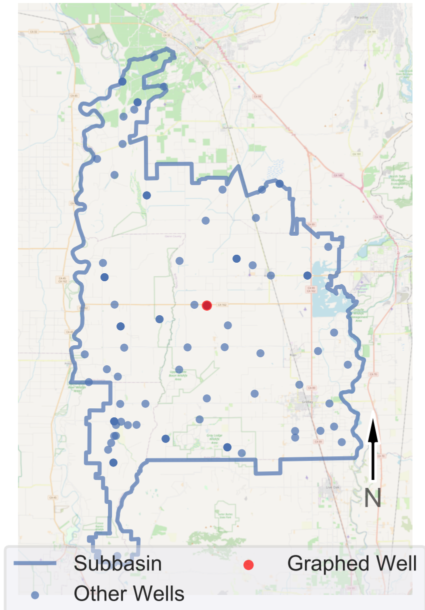
Perforation 1 (P1): 85.0 - 95.0; P2: 125.0 - 135.0 ft BGS



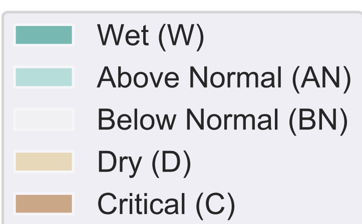
BUTTE Subbasin - State Well Number (SWN): 19N01E35B002M

Well Location Map

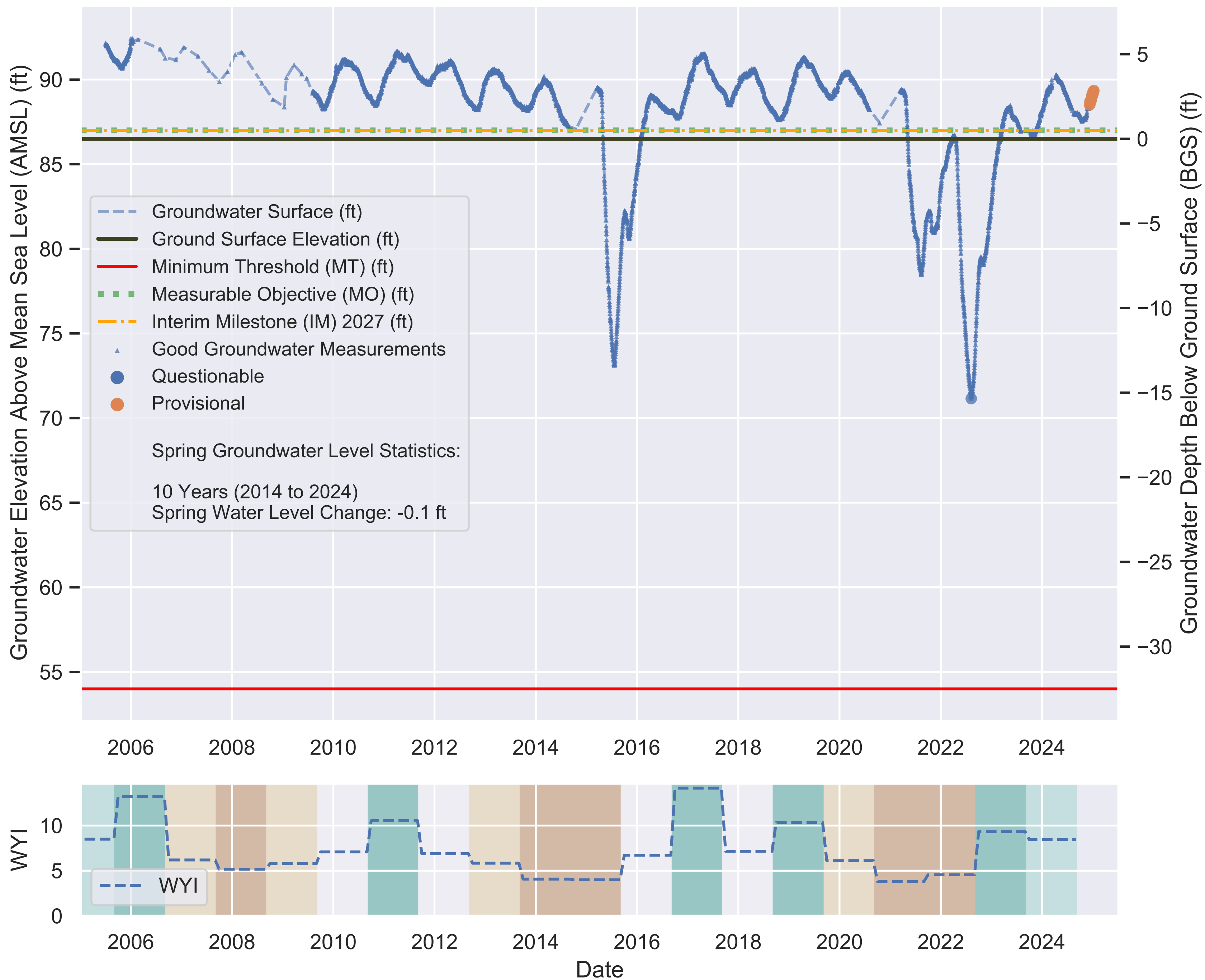



Sustainable Management Criteria:
IM (2027) = 87.0 ft AMSL
MO = 87.0 ft AMSL
MT = 54.0 ft AMSL

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

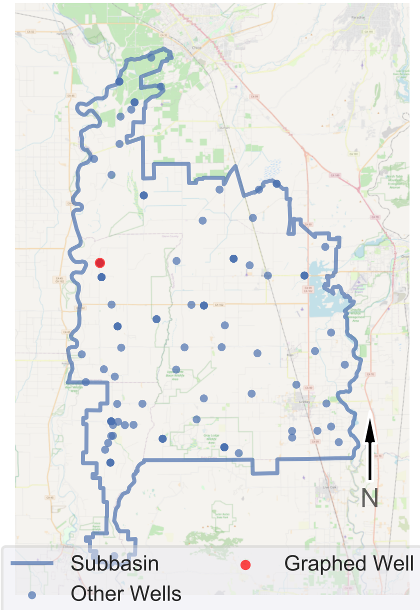



Perforation 1: 930.0 - 950.0 ft BGS



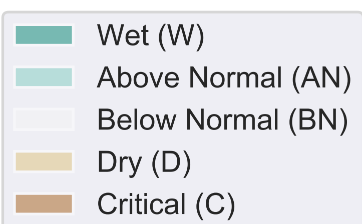
BUTTE Subbasin - State Well Number (SWN): 19N01W15D002M

Well Location Map

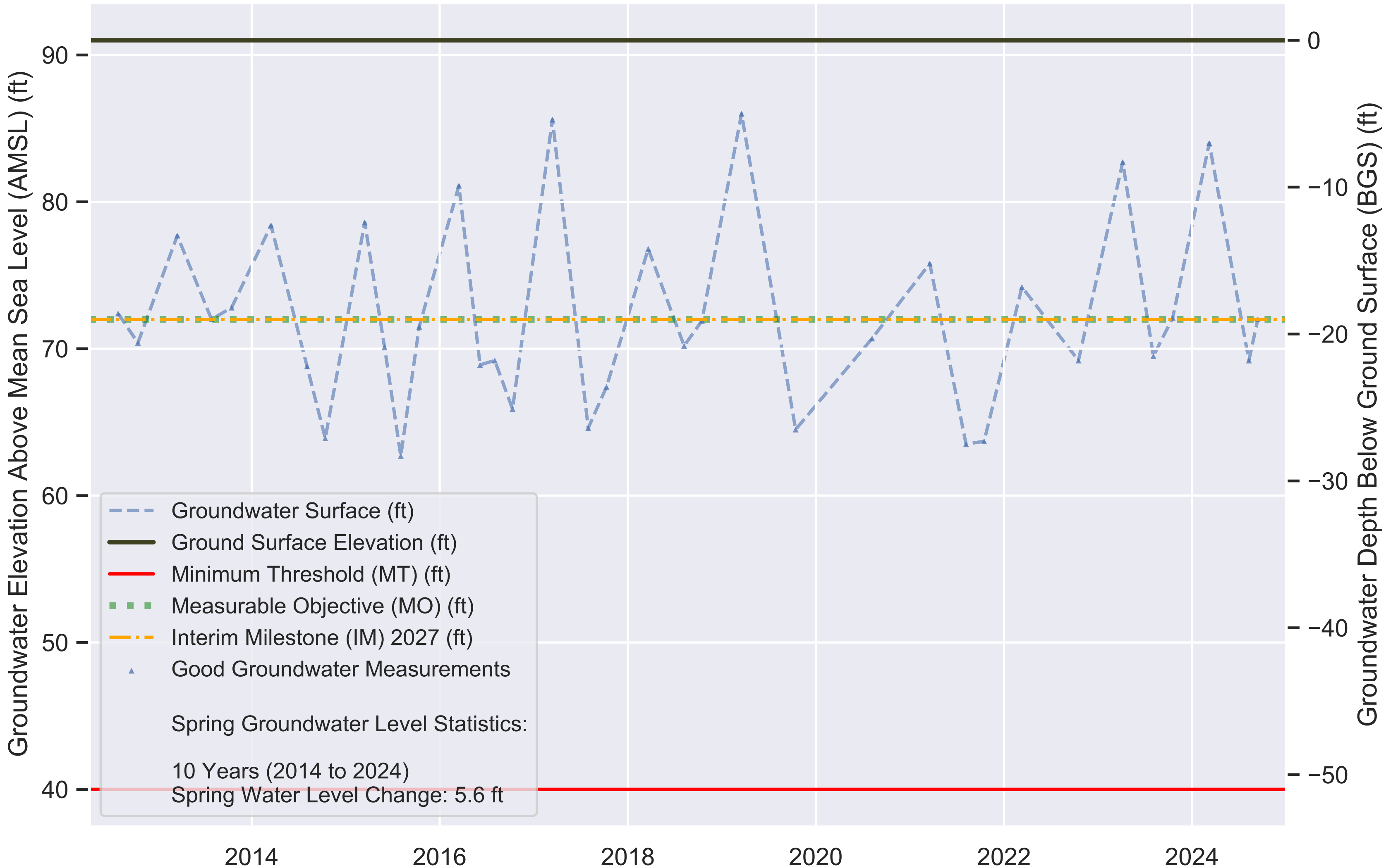


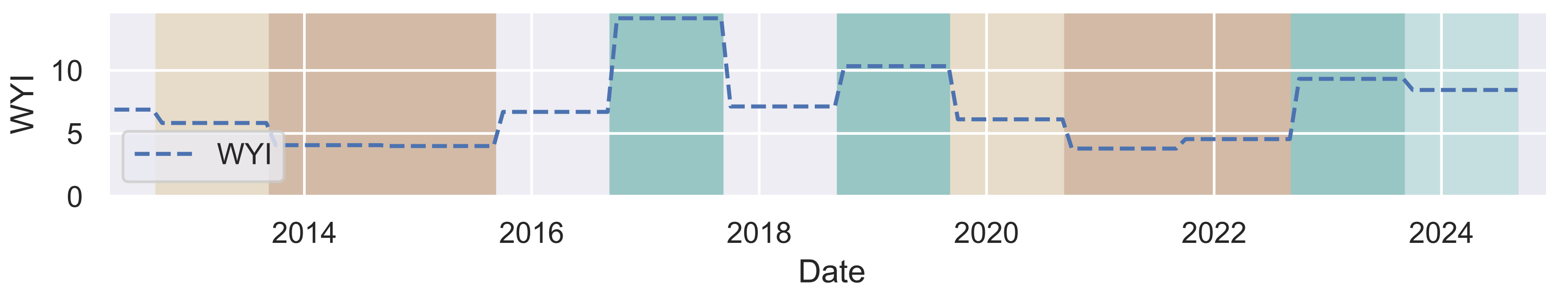

Sustainable Management Criteria:
IM (2027) = 72.0 ft AMSL
MO = 72.0 ft AMSL
MT = 40.0 ft AMSL

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



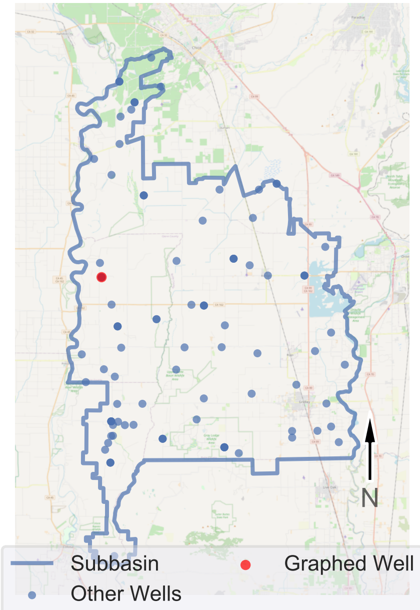

Perforation 1 (P1): 250.0 - 260.0; P2: 275.0 - 295.0 ft BGS



BUTTE Subbasin - State Well Number (SWN): 19N01W22D004M

Well Location Map

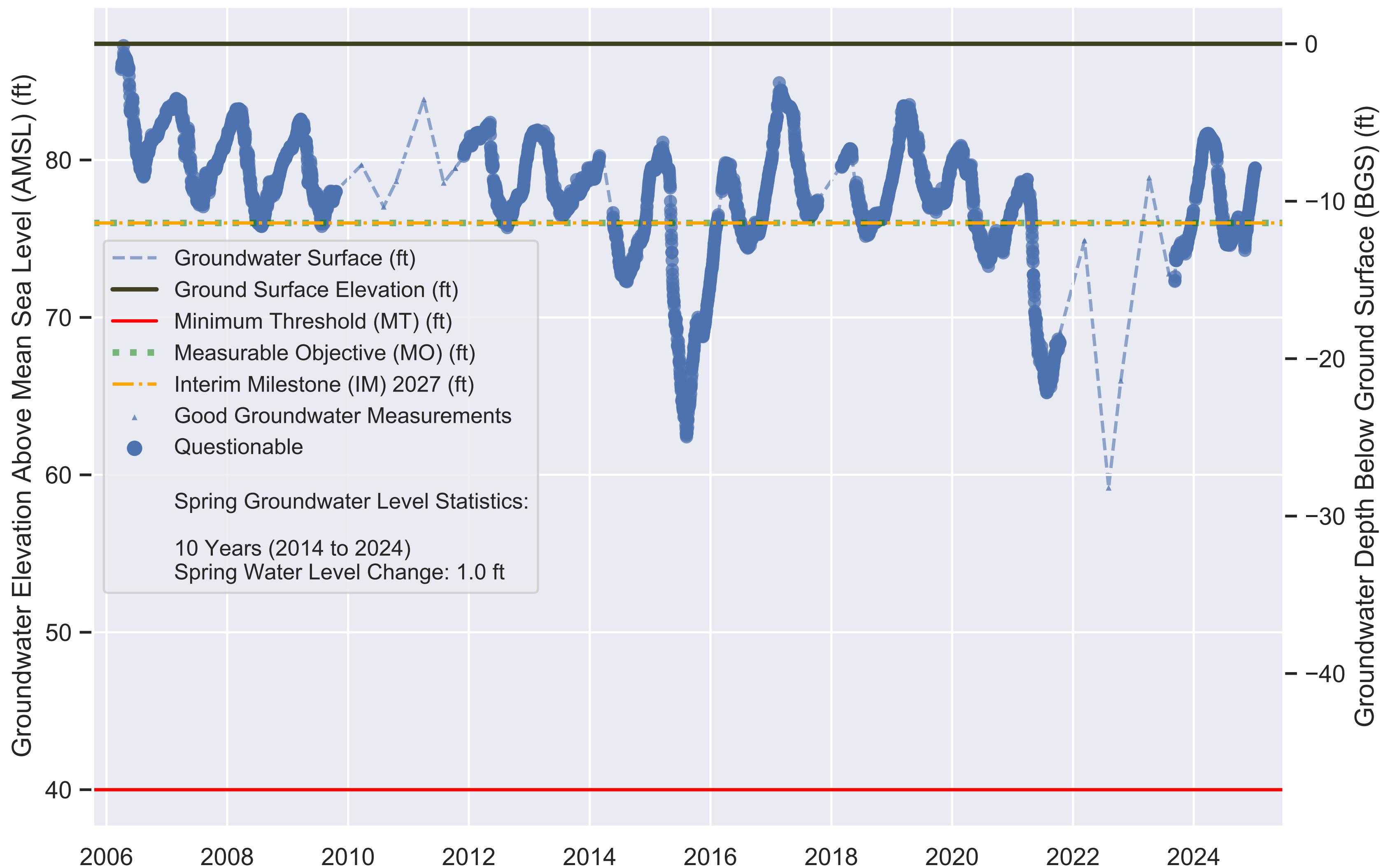


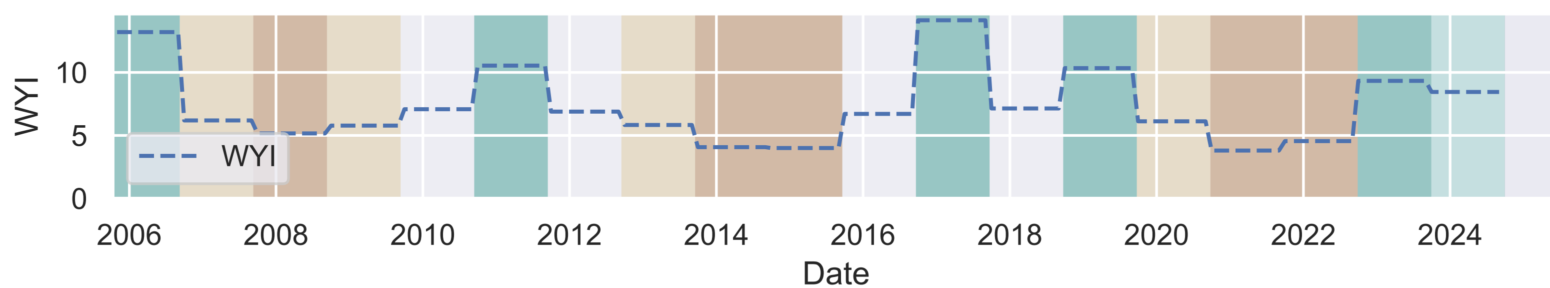

Sustainable Management Criteria:
IM (2027) = 76.0 ft AMSL
MO = 76.0 ft AMSL
MT = 40.0 ft AMSL

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

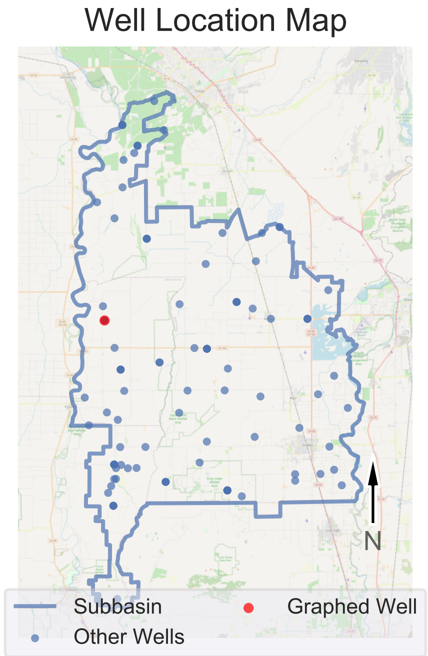
Wet (W)
Above Normal (AN)
Below Normal (BN)
Dry (D)
Critical (C)

Perforation 1: 780.0 - 790.0 ft BGS



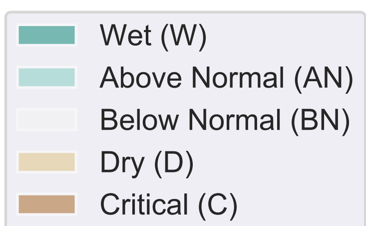



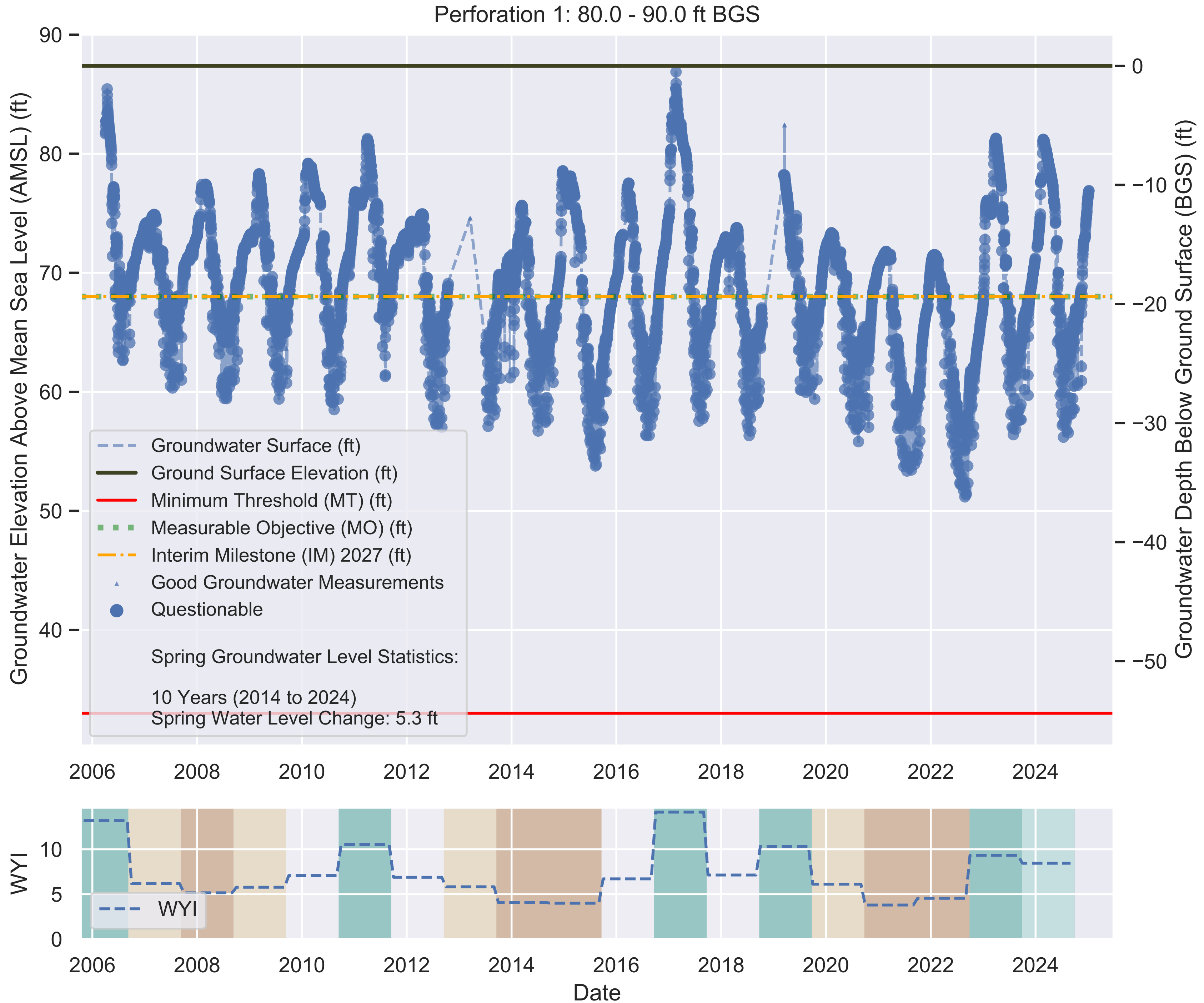
## BUTTE Subbasin - State Well Number (SWN): 19N01W22D007M




Sustainable Management Criteria:
IM (2027) = 68.0 ft AMSL
MO = 68.0 ft AMSL
MT = 33.0 ft AMSL

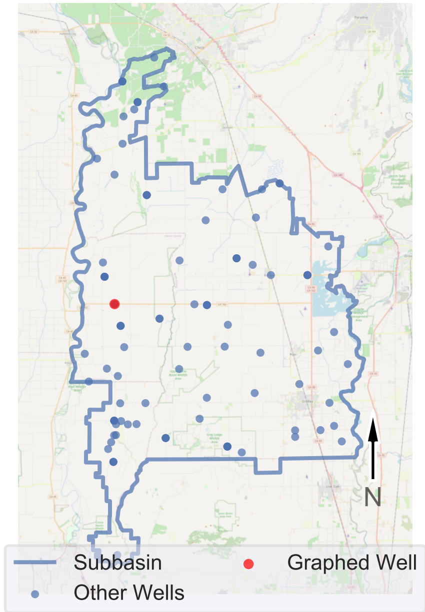
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



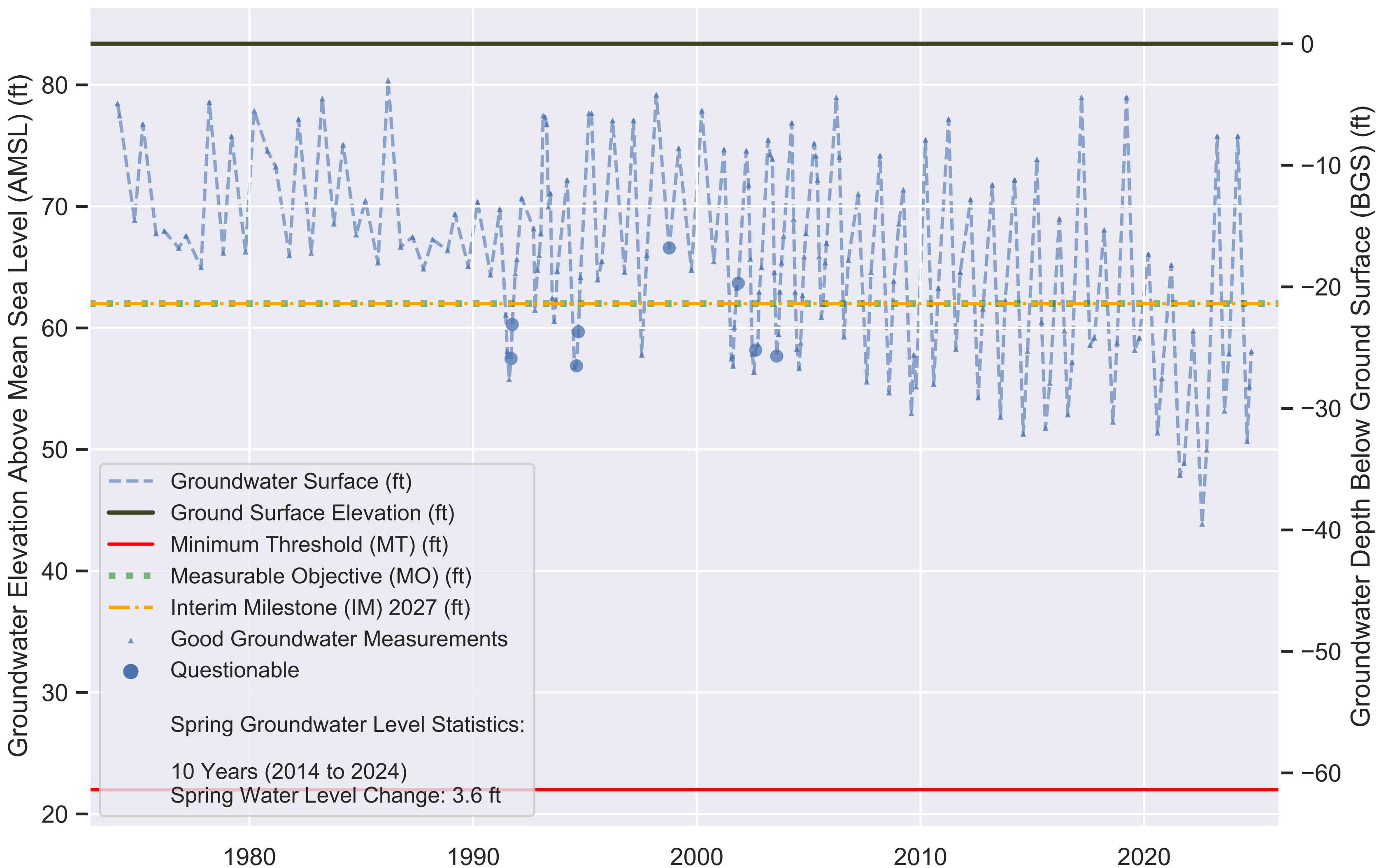



BUTTE Subbasin - State Well Number (SWN): 19N01W27R001M

Well Location Map

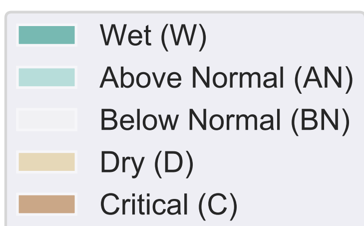


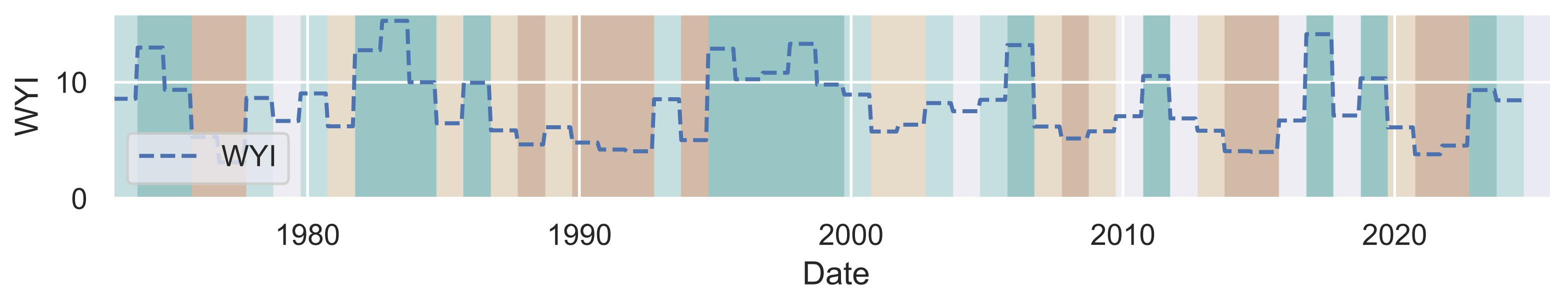

Perforation 1: 68.0 - 108.0 ft BGS




Sustainable Management Criteria:
IM (2027) = 62.0 ft AMSL
MO = 62.0 ft AMSL
MT = 22.0 ft AMSL

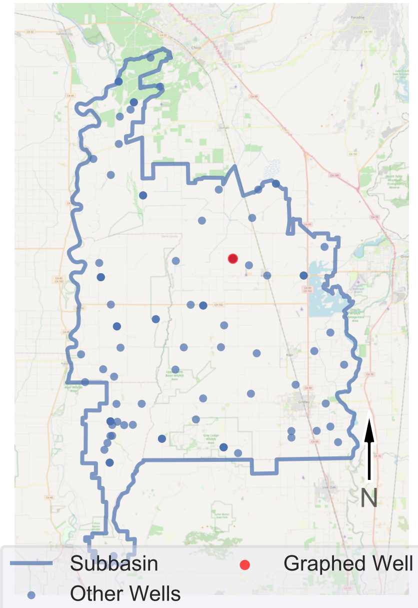
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



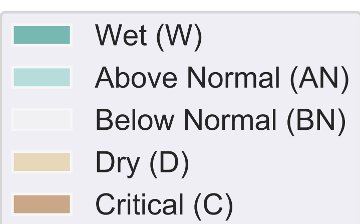
## BUTTE Subbasin - State Well Number (SWN): 19N02E07K004M

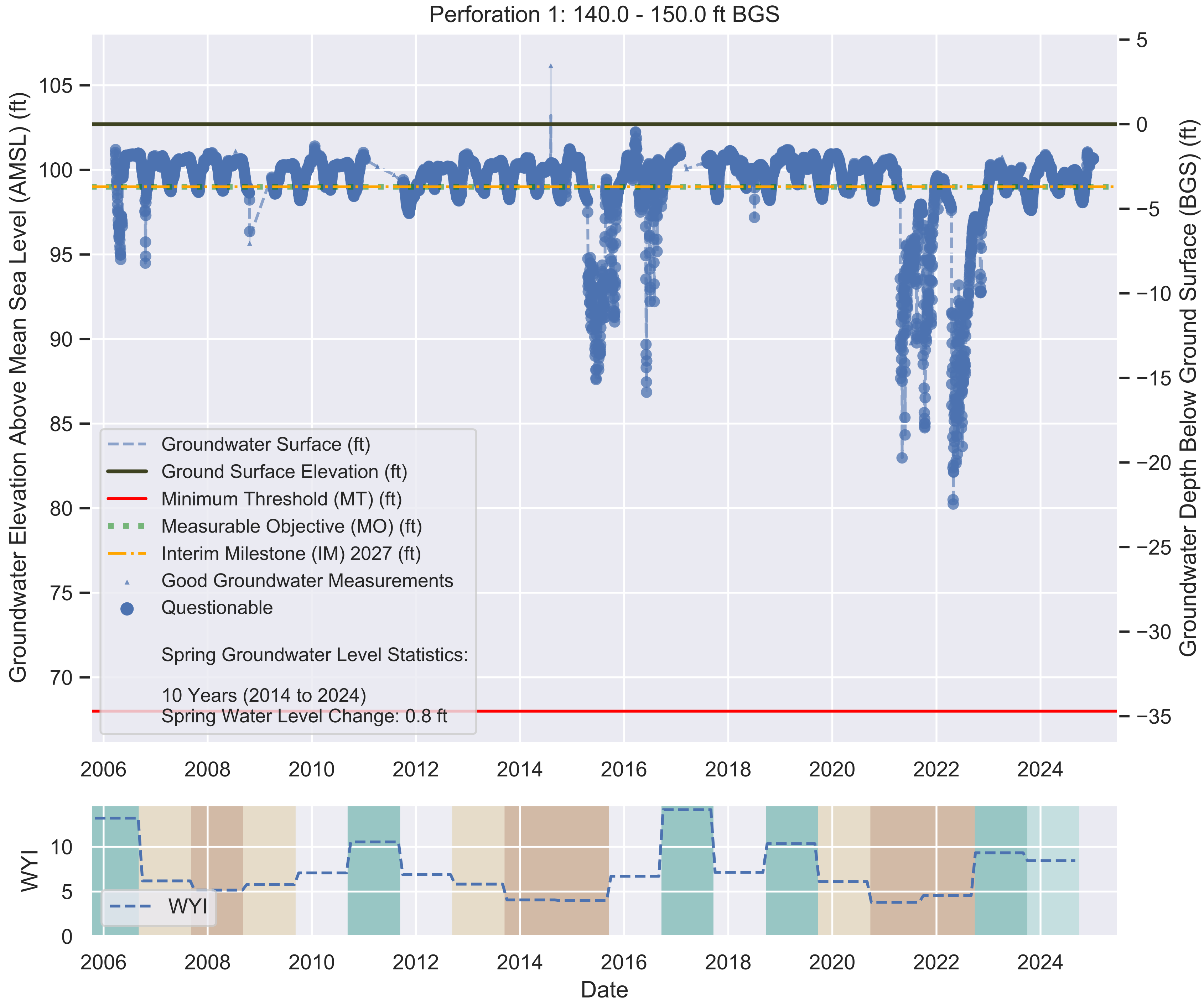
Well Location Map




Sustainable Management Criteria:
IM (2027) = 99.0 ft AMSL
MO = 99.0 ft AMSL
MT = 68.0 ft AMSL

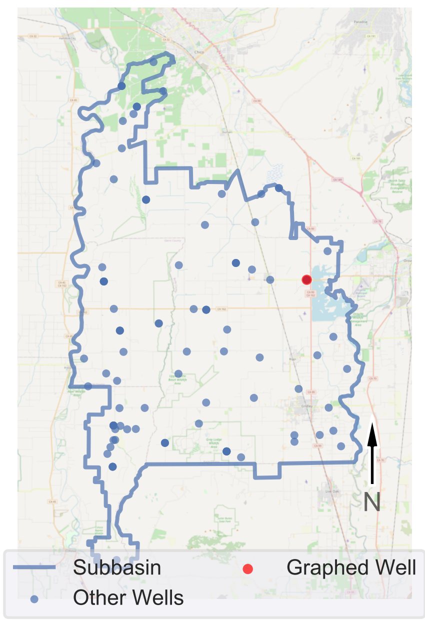
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



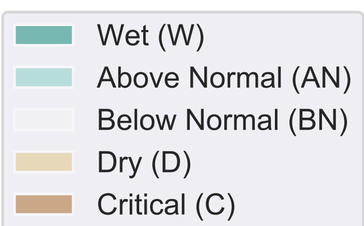
# BUTTE Subbasin - State Well Number (SWN): 19N02E13Q001M

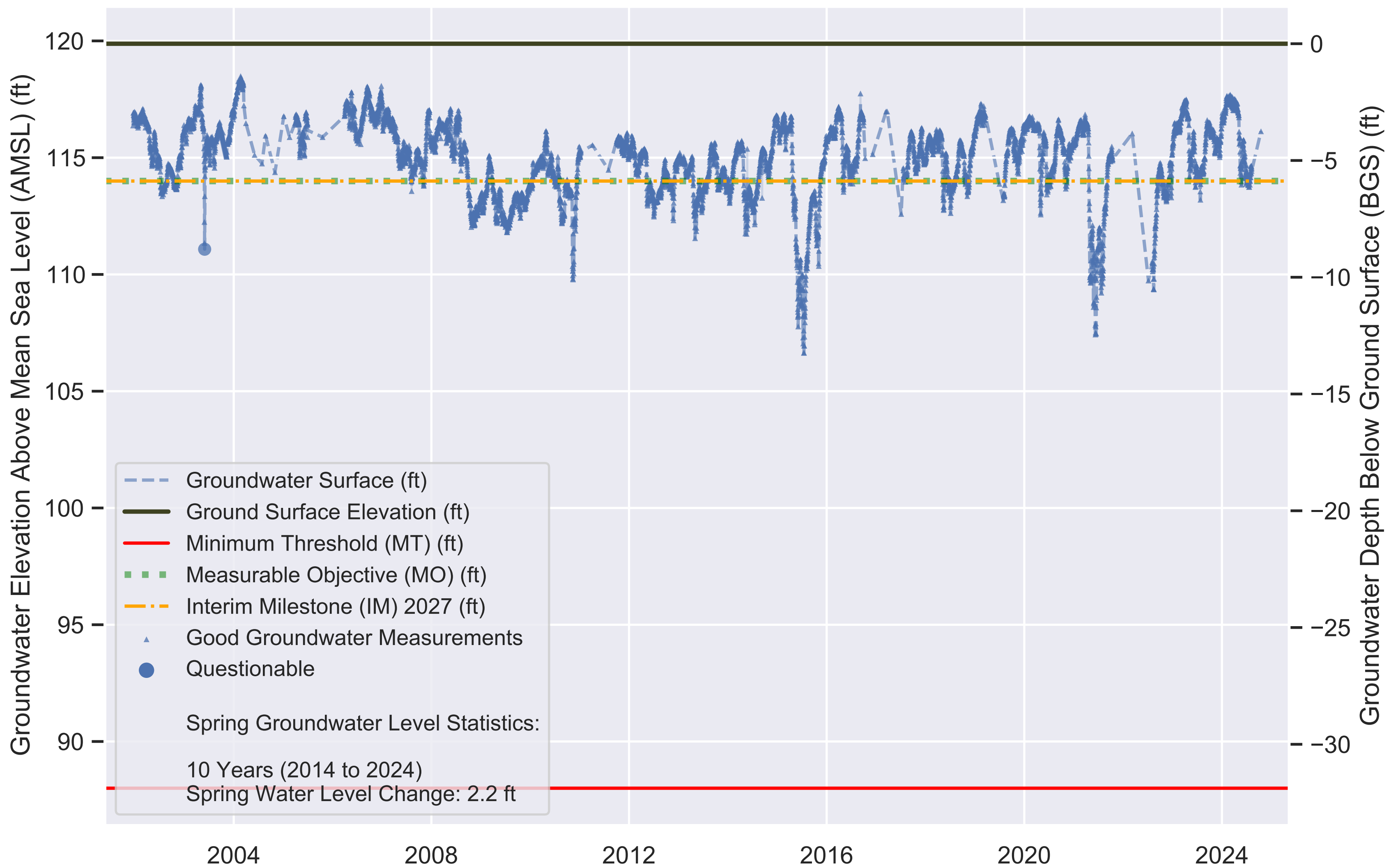
Well Location Map

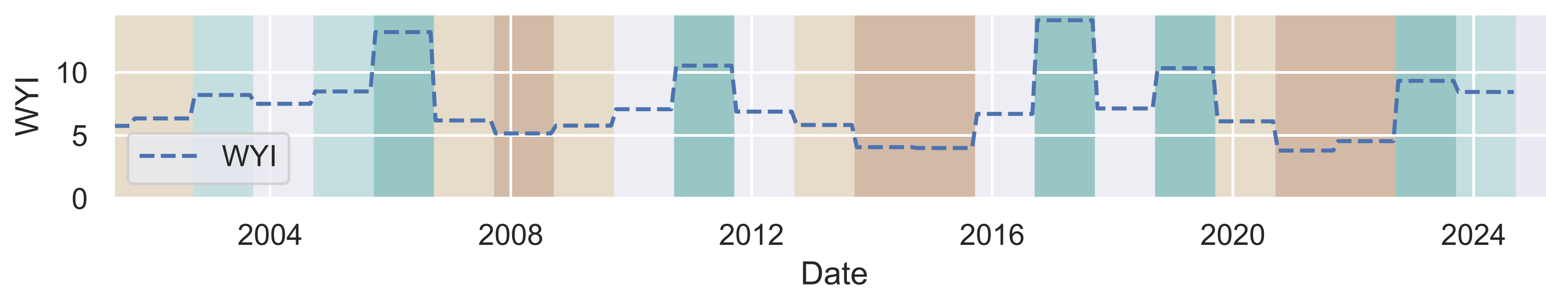



Sustainable Management Criteria:
IM (2027) = 114.0 ft AMSL
MO = 114.0 ft AMSL
MT = 88.0 ft AMSL

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

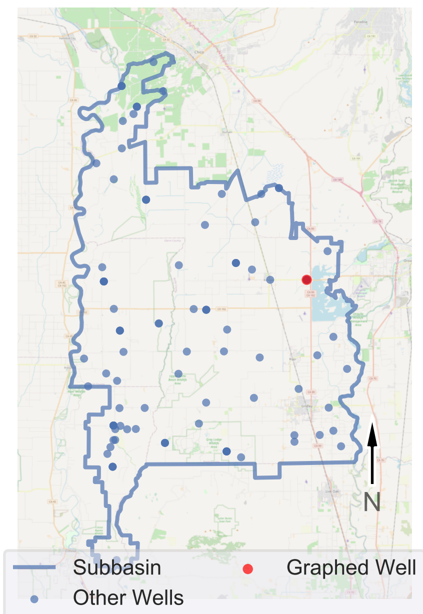


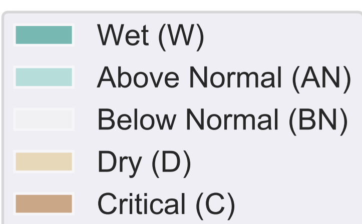
BUTTE Subbasin - State Well Number (SWN): 19N02E13Q003M

Well Location Map

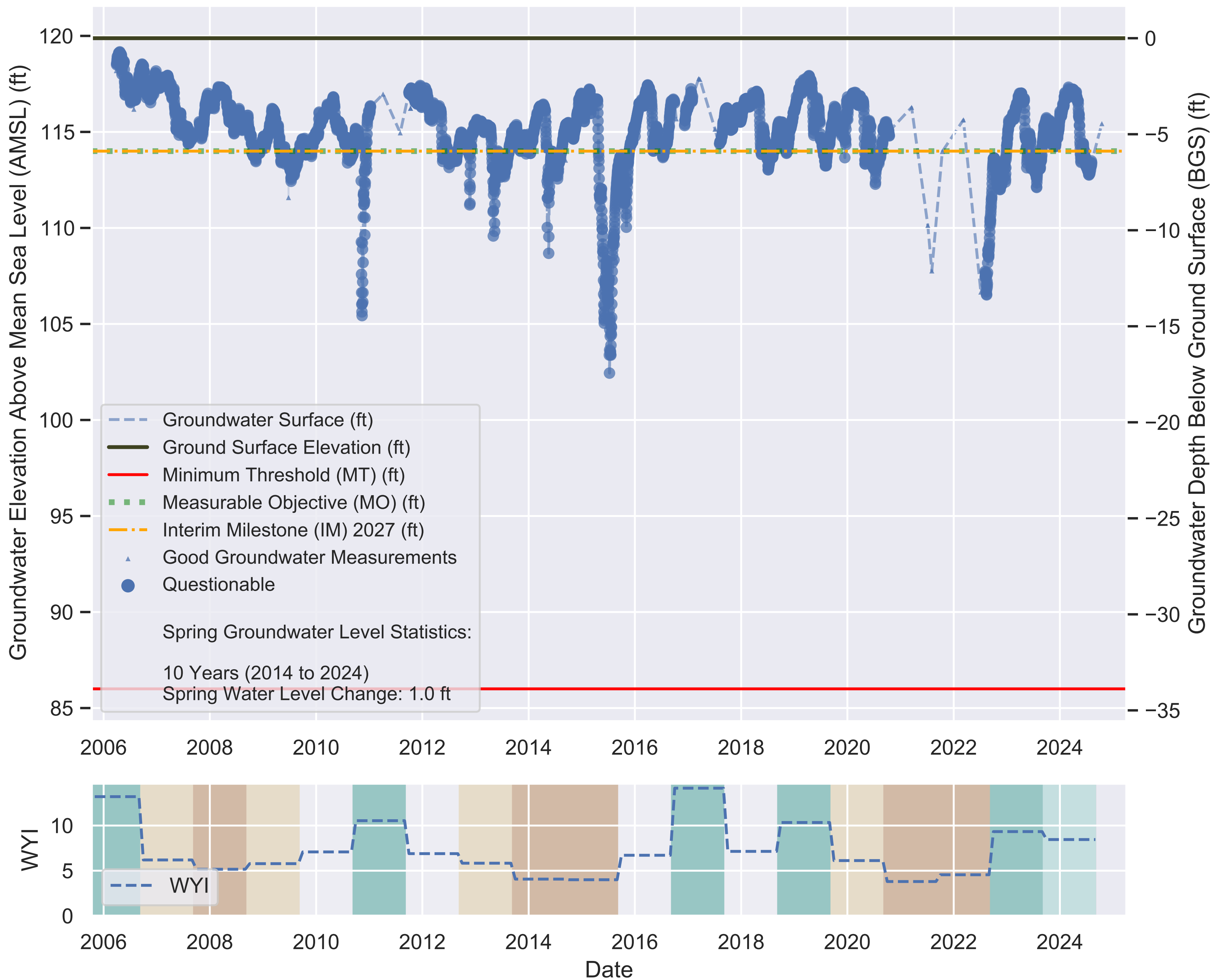



Sustainable Management Criteria:
IM (2027) = 114.0 ft AMSL
MO = 114.0 ft AMSL
MT = 86.0 ft AMSL

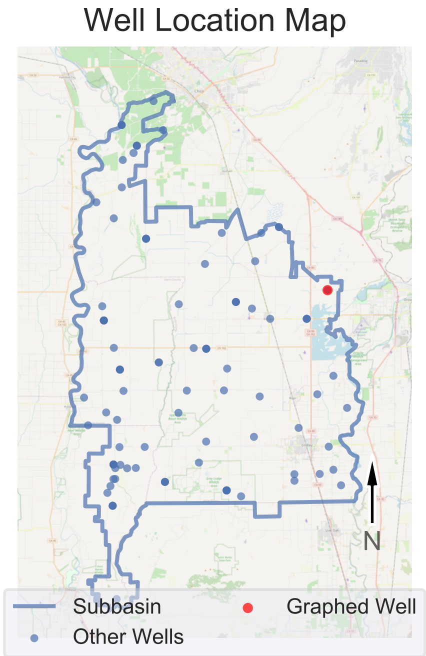
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.




Perforation 1: 670.0 - 680.0 ft BGS



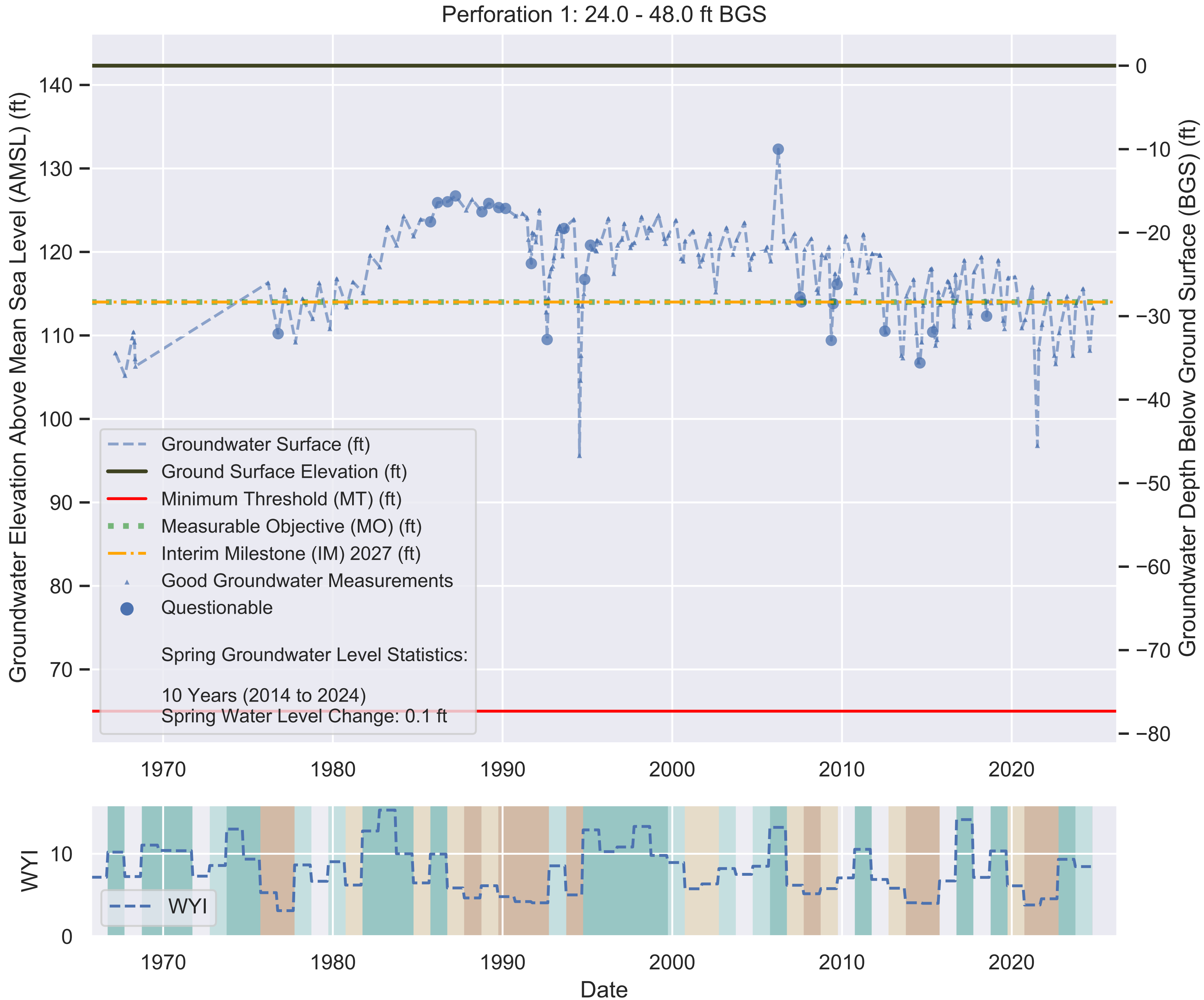
# BUTTE Subbasin - State Well Number (SWN): 19N03E05N002M




Sustainable Management Criteria:
IM (2027) = 114.0 ft AMSL
MO = 114.0 ft AMSL
MT = 65.0 ft AMSL

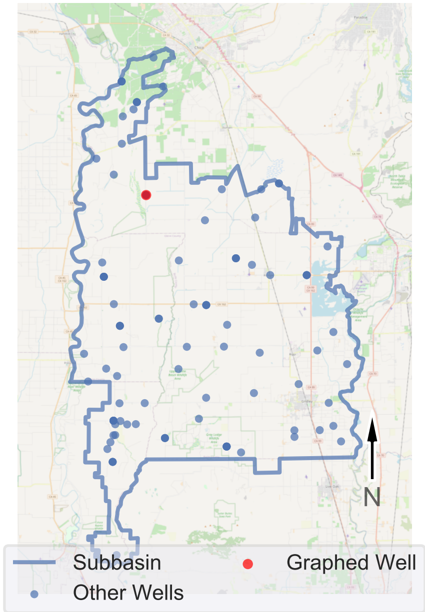
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

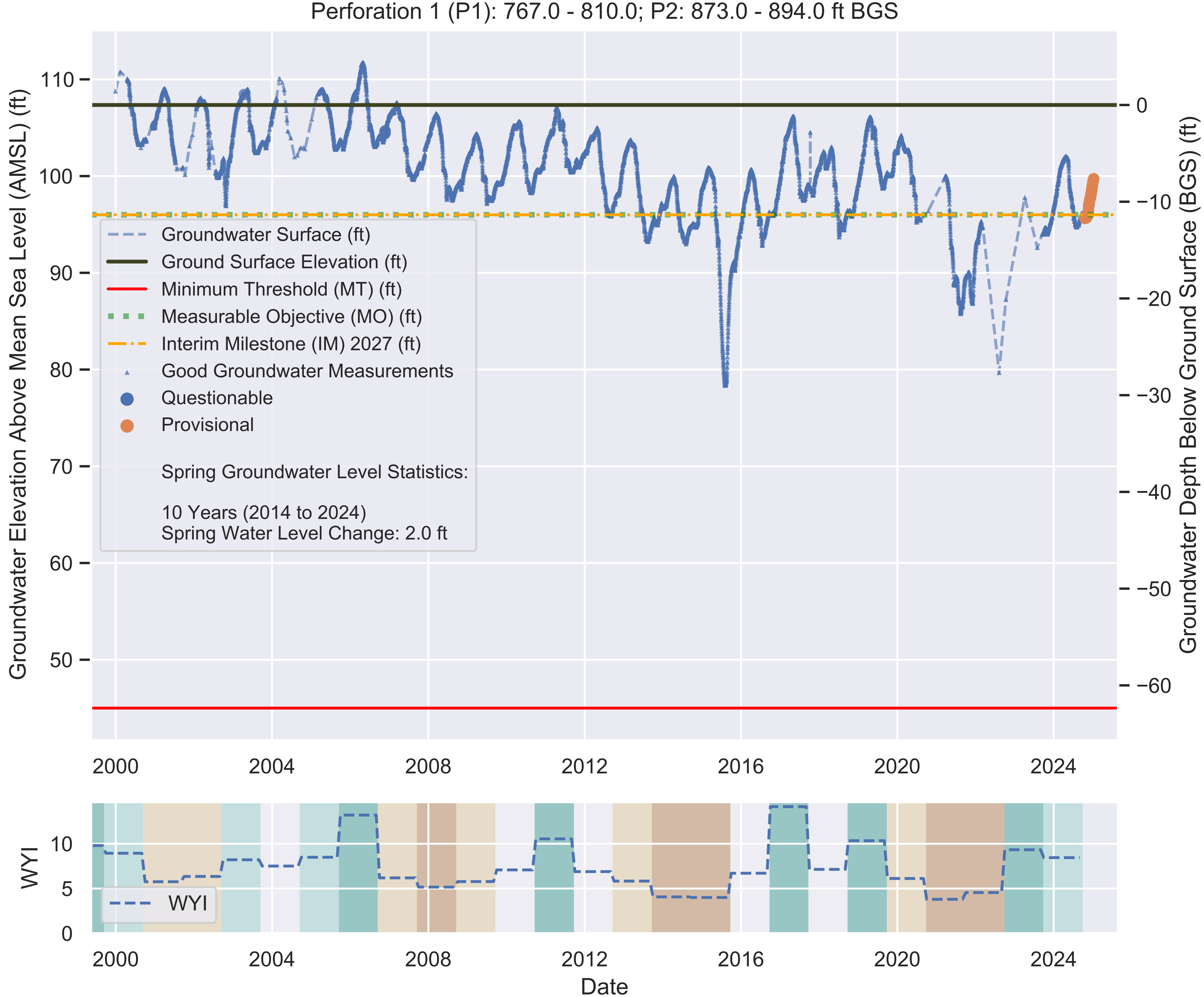
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)



# BUTTE Subbasin - State Well Number (SWN): 20N01E18L001M

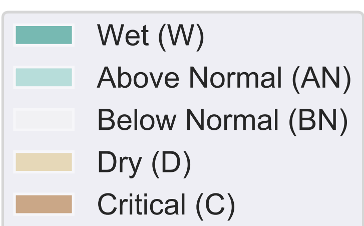
Well Location Map



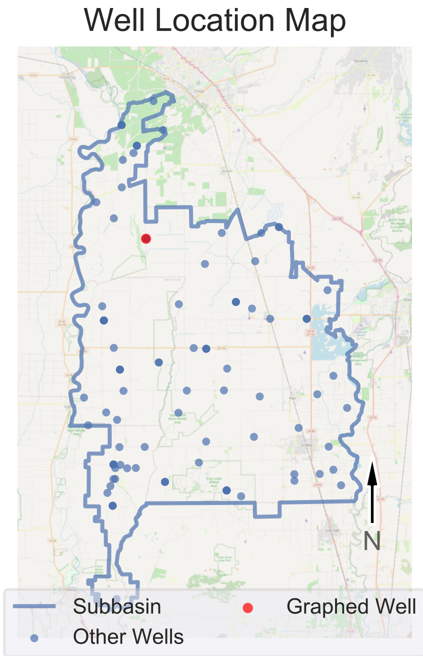




Sustainable Management Criteria:
IM (2027) = 96.0 ft AMSL
MO = 96.0 ft AMSL
MT = 45.0 ft AMSL

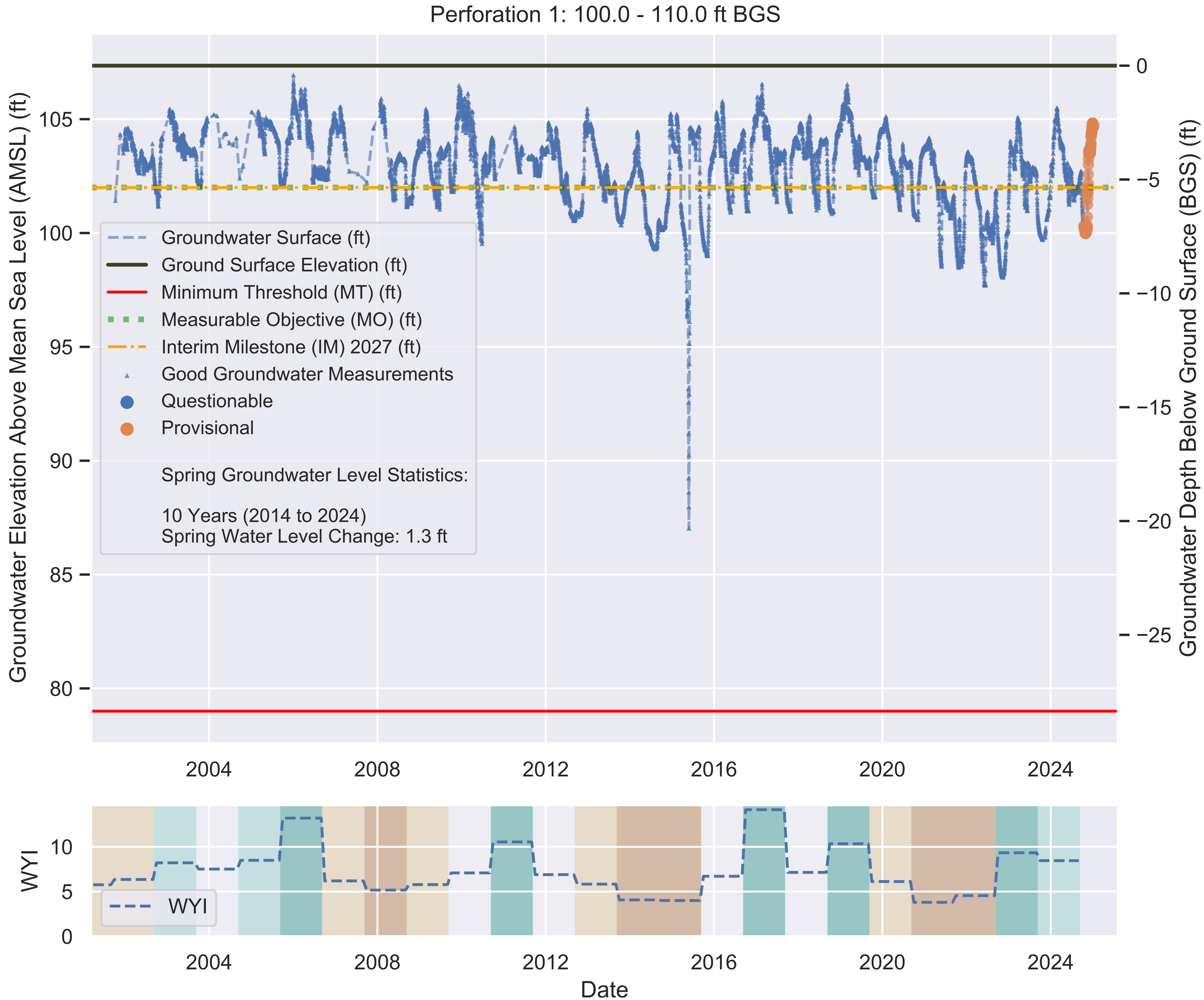
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



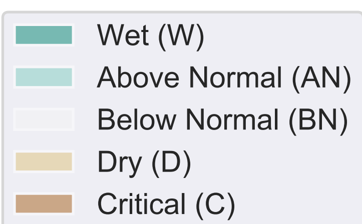
## BUTTE Subbasin - State Well Number (SWN): 20N01E18L003M




Sustainable Management Criteria:
IM (2027) = 102.0 ft AMSL
MO = 102.0 ft AMSL
MT = 79.0 ft AMSL

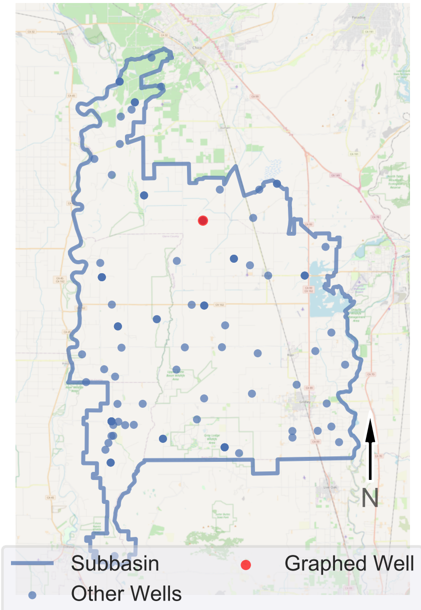



Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

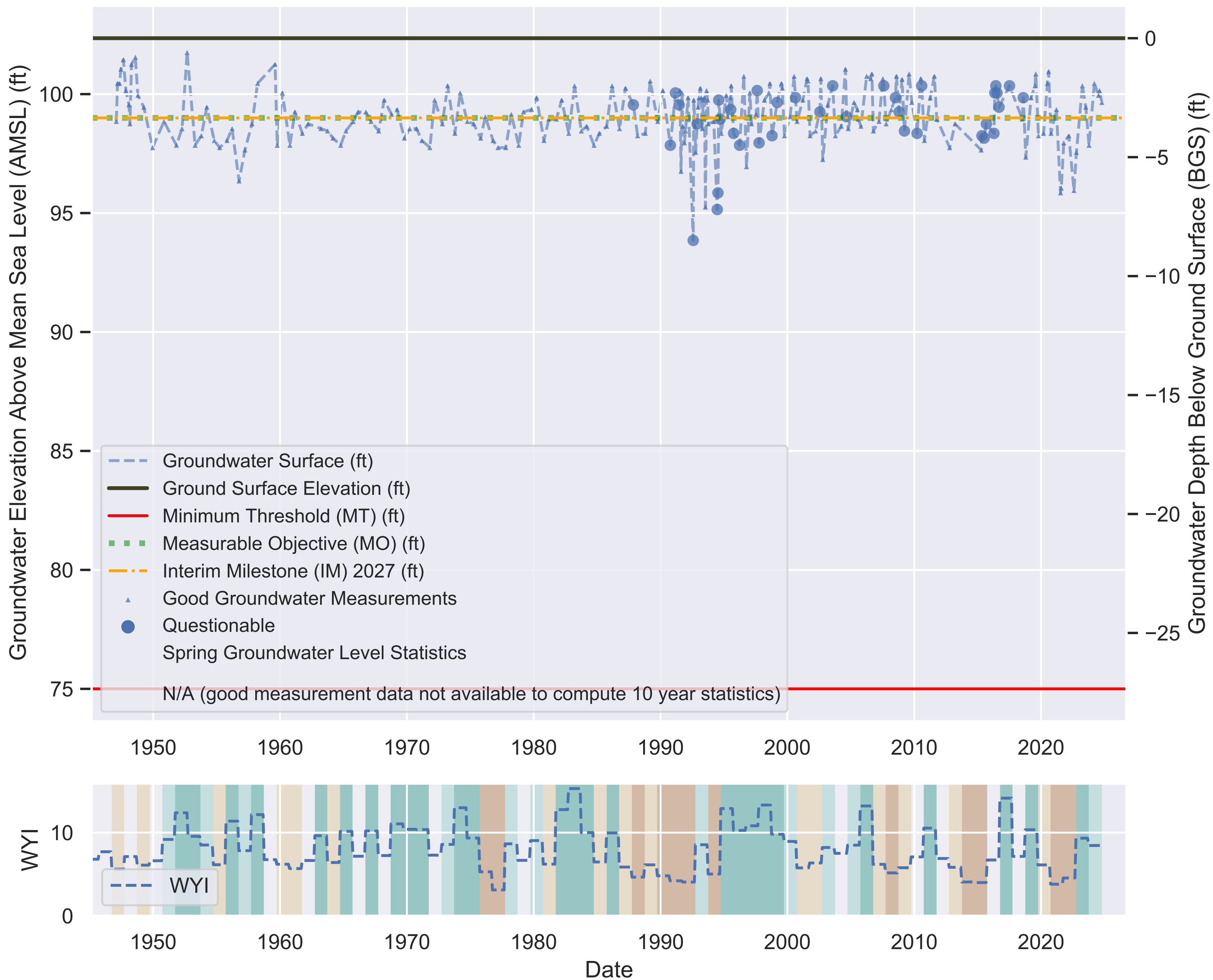


BUTTE Subbasin - State Well Number (SWN): 20N01E35C001M

Well Location Map

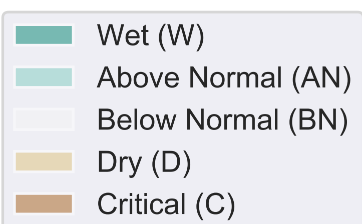



Perforation 1: 50.0 - 92.0 ft BGS



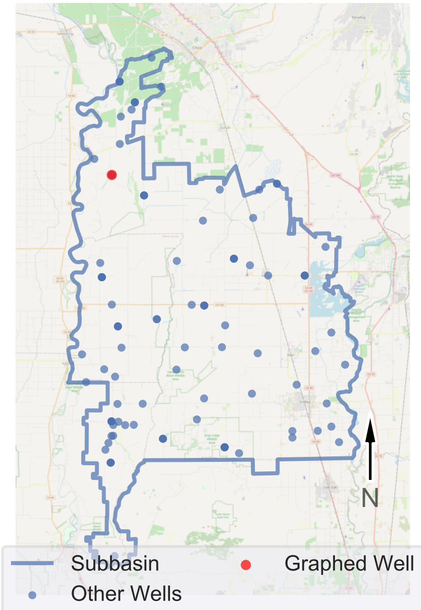

Sustainable Management Criteria:
IM (2027) = 99.0 ft AMSL
MO = 99.0 ft AMSL
MT = 75.0 ft AMSL

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



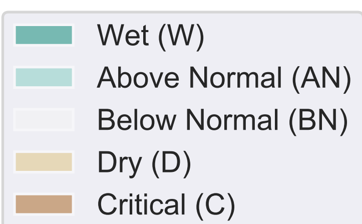
# BUTTE Subbasin - State Well Number (SWN): 20N01W11N002M

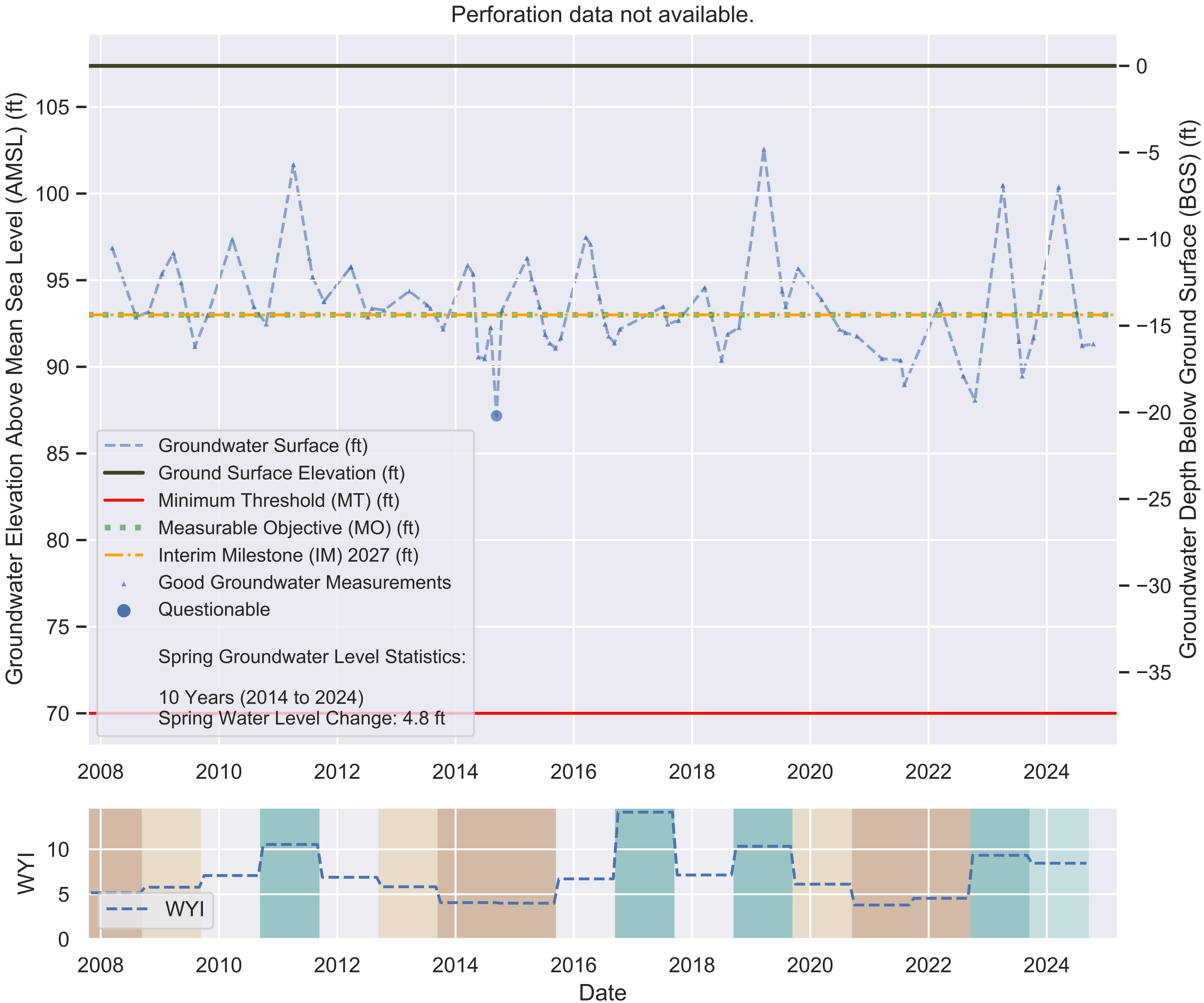
Well Location Map



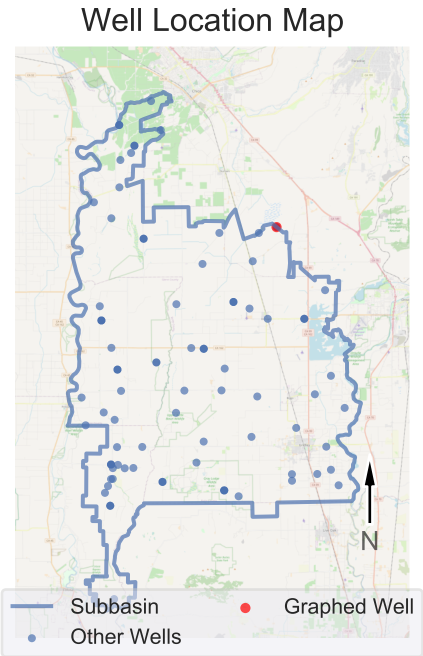

Sustainable Management Criteria:
IM (2027) = 93.0 ft AMSL
MO = 93.0 ft AMSL
MT = 70.0 ft AMSL

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



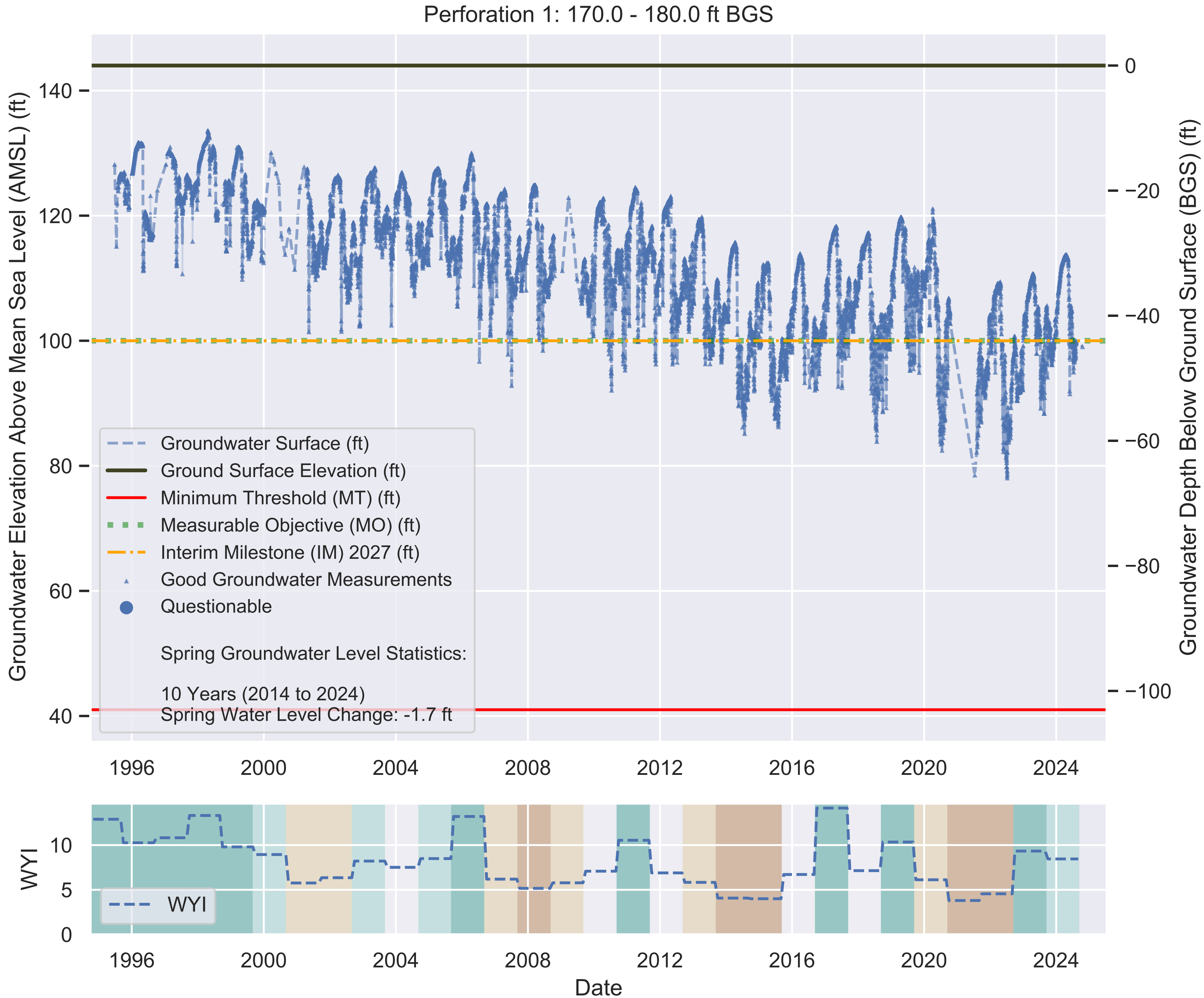
# BUTTE Subbasin - State Well Number (SWN): 20N02E15H001M




Sustainable Management Criteria:
IM (2027) = 100.0 ft AMSL
MO = 100.0 ft AMSL
MT = 41.0 ft AMSL

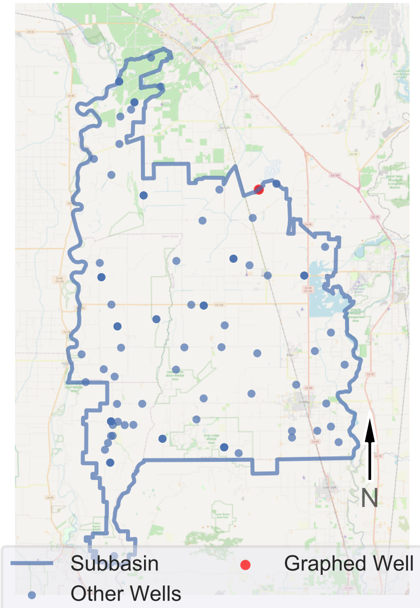
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

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



# BUTTE Subbasin - State Well Number (SWN): 20N02E16P001M

Well Location Map

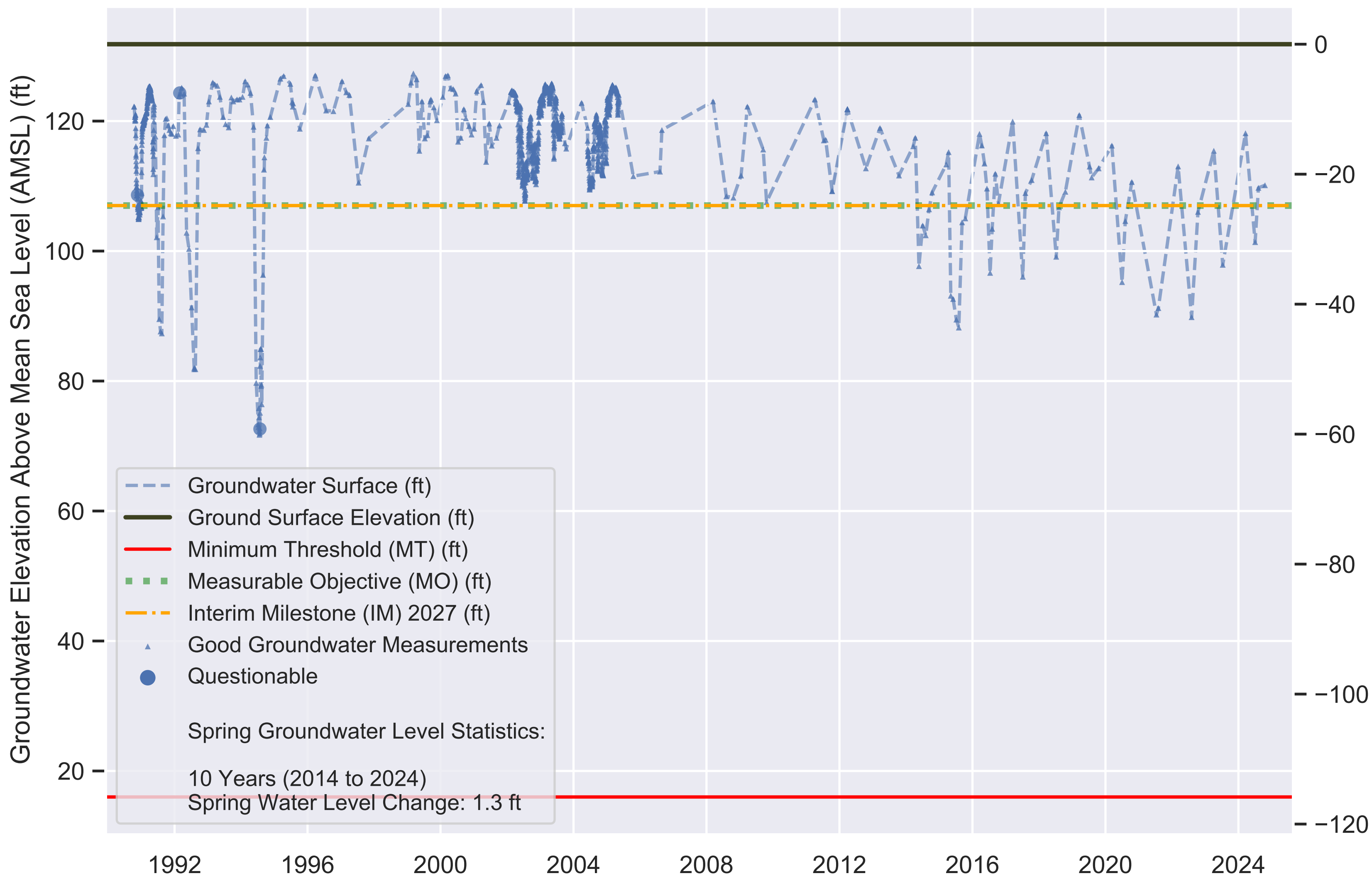


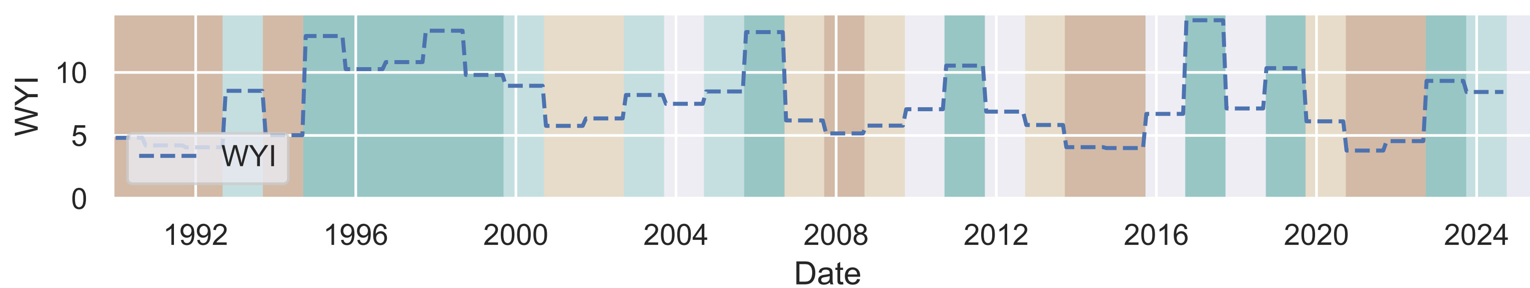

Sustainable Management Criteria:
IM (2027) = 107.0 ft AMSL
MO = 107.0 ft AMSL
MT = 16.0 ft AMSL

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

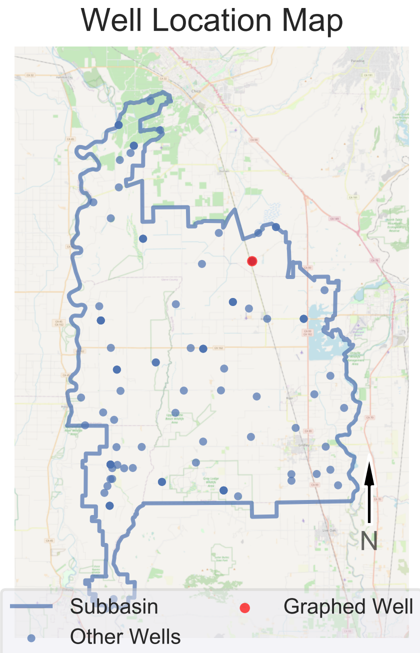
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation data not available.



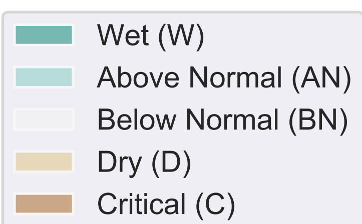



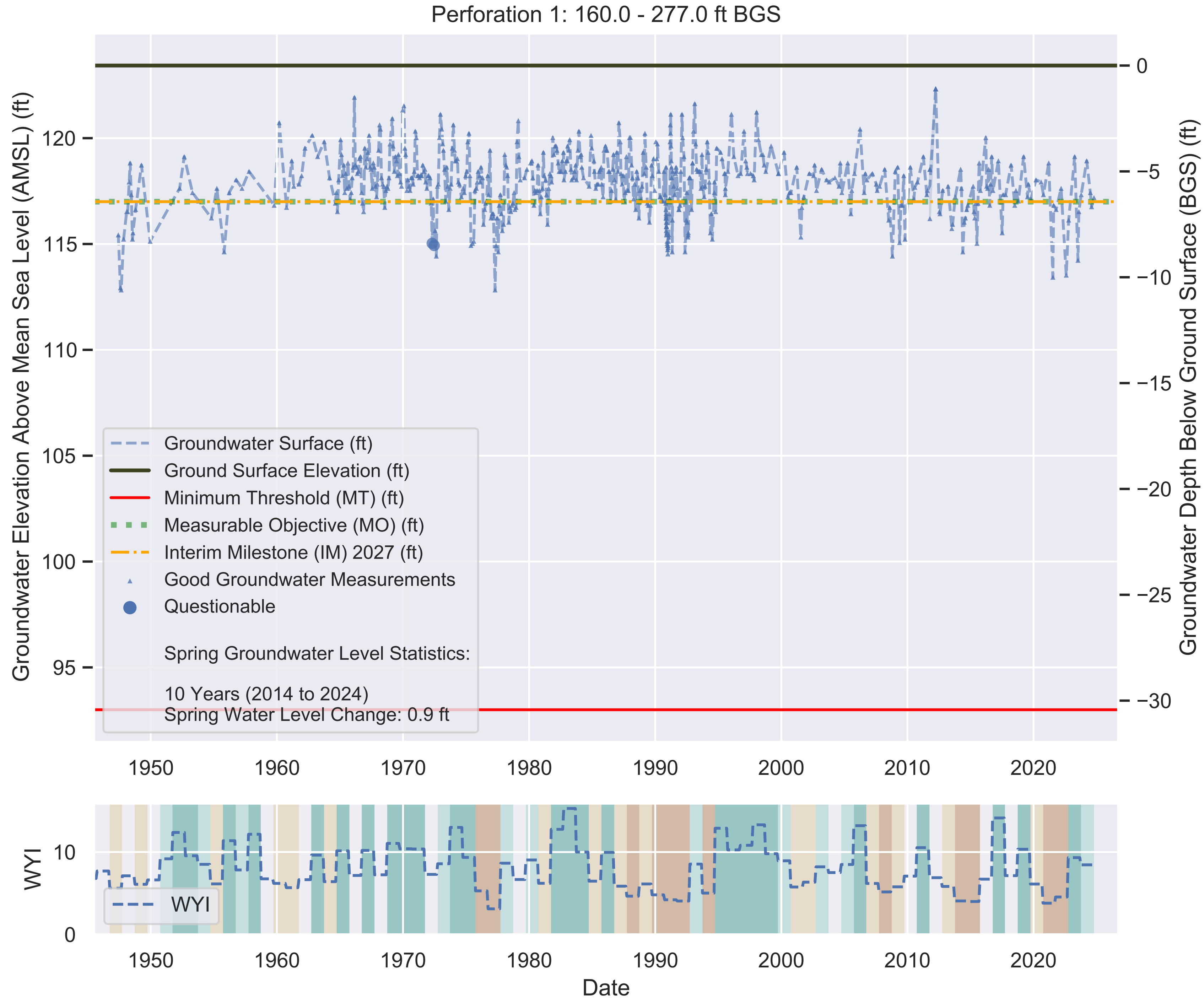
BUTTE Subbasin - State Well Number (SWN): 20N02E28N001M




Sustainable Management Criteria:
IM (2027) = 117.0 ft AMSL
MO = 117.0 ft AMSL
MT = 93.0 ft AMSL

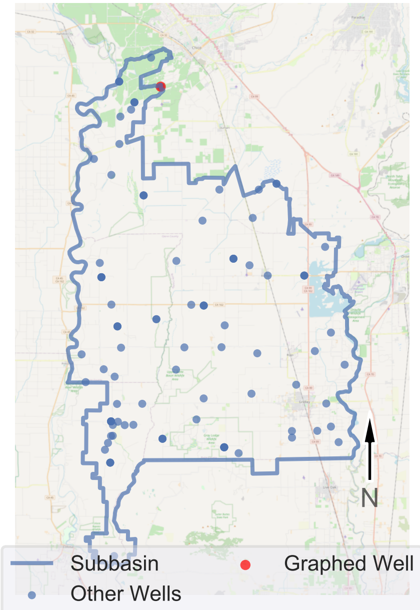
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



# BUTTE Subbasin - State Well Number (SWN): 21N01E08K002M

Well Location Map

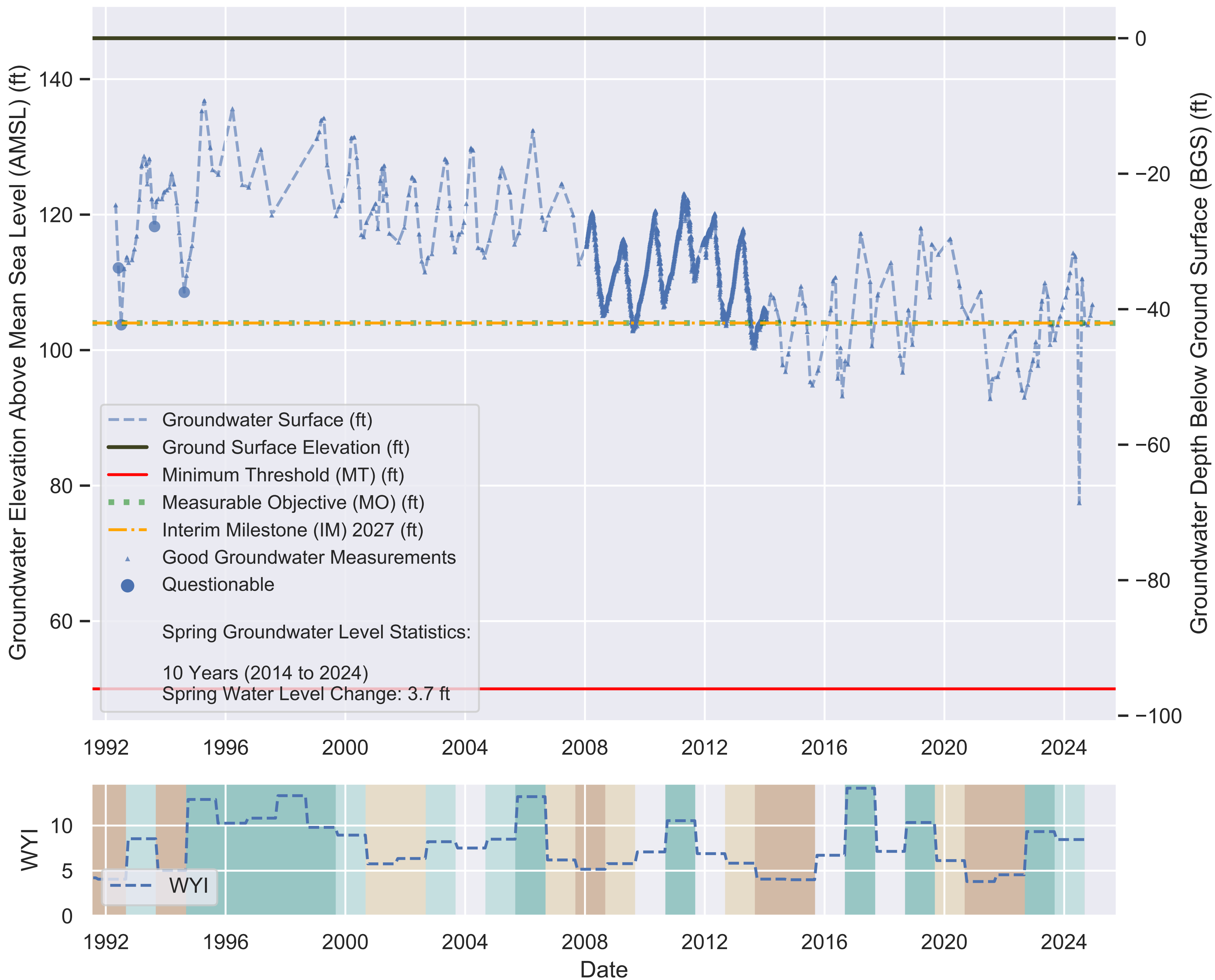



Sustainable Management Criteria:
IM (2027) = 104.0 ft AMSL
MO = 104.0 ft AMSL
MT = 50.0 ft AMSL

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

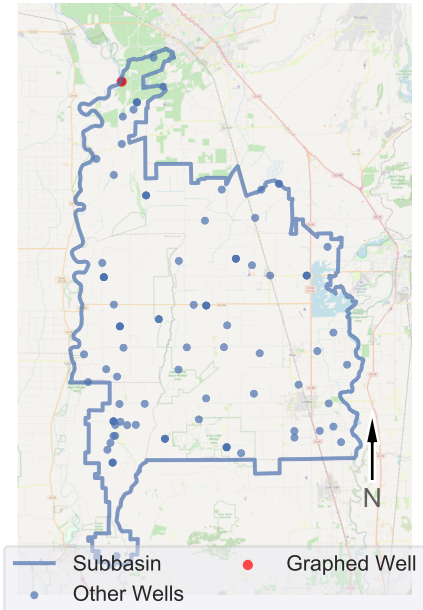
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation data not available.



BUTTE Subbasin - State Well Number (SWN): 21N01W11A001M

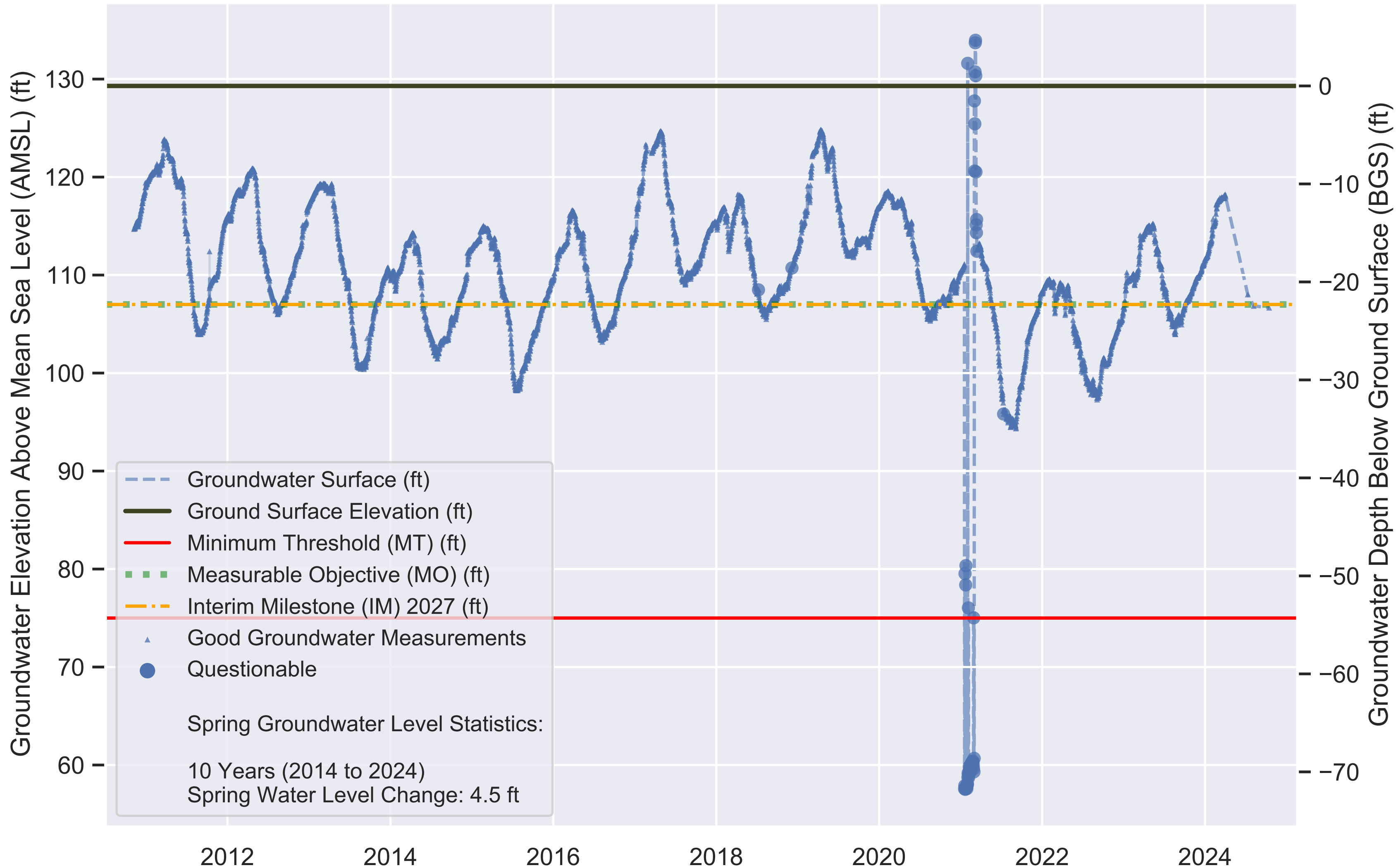
Well Location Map

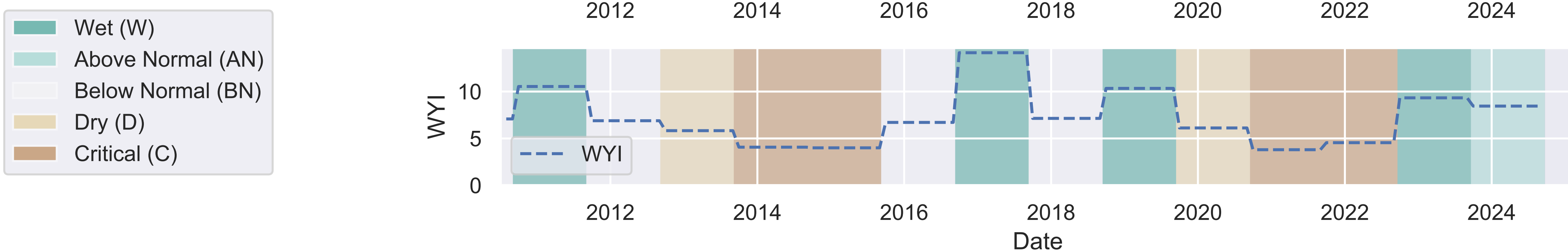



Sustainable Management Criteria:
IM (2027) = 107.0 ft AMSL
MO = 107.0 ft AMSL
MT = 75.0 ft AMSL

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

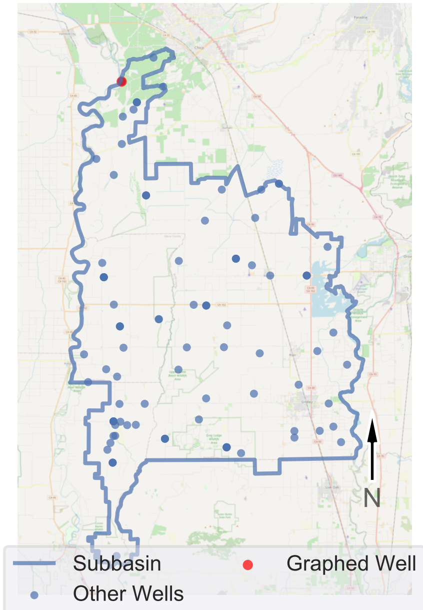
Perforation 1 (P1): 810.0 - 820.0; P2: 960.0 - 970.0; P3: 1050.0 - 1060.0; P4: 1270.0 - 1280.0 ft BGS



BUTTE Subbasin - State Well Number (SWN): 21N01W11A002M

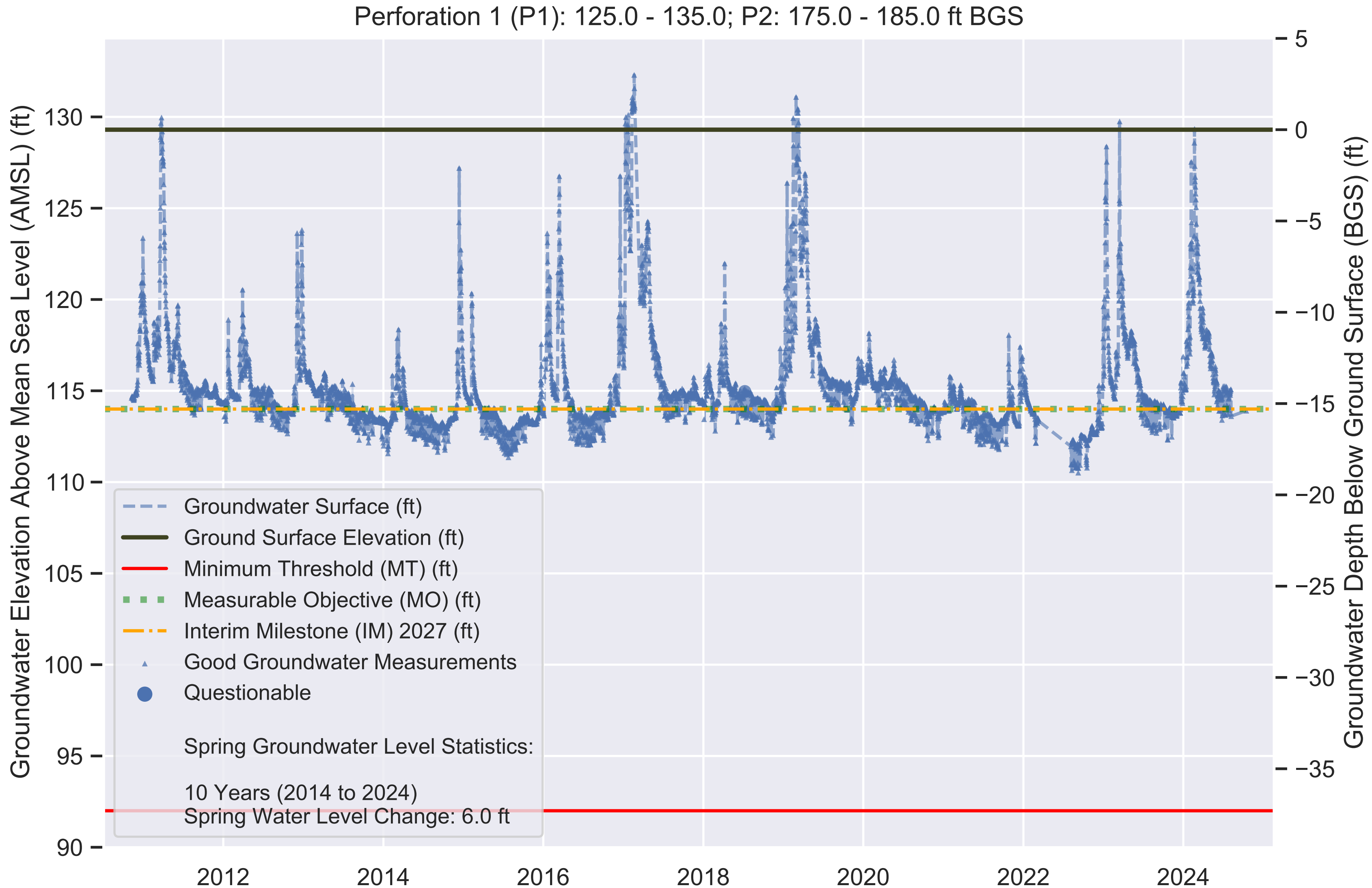
Well Location Map

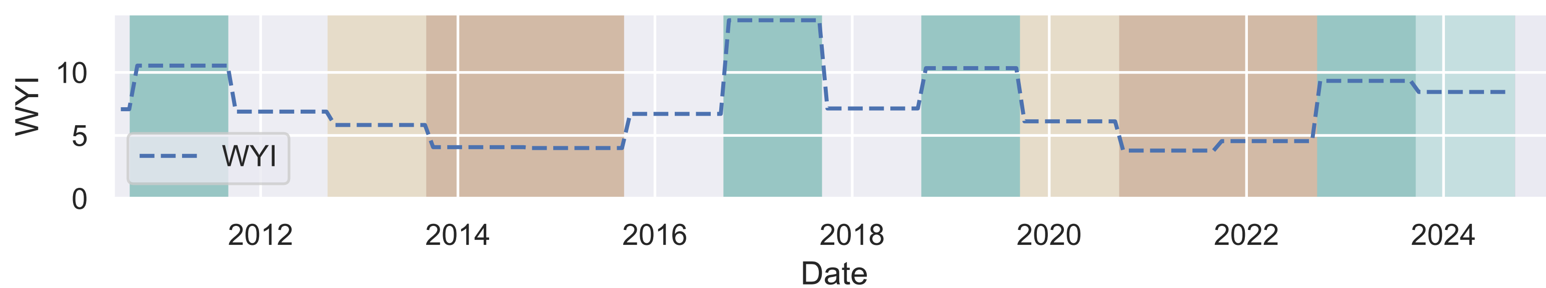



Sustainable Management Criteria:
IM (2027) = 114.0 ft AMSL
MO = 114.0 ft AMSL
MT = 92.0 ft AMSL

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

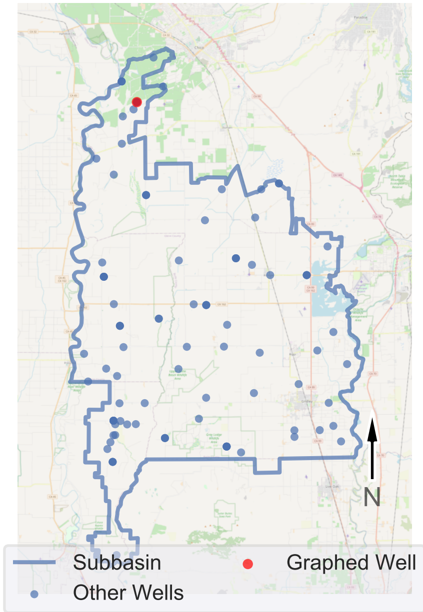
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)



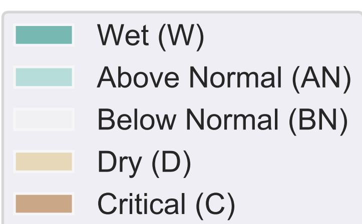
BUTTE Subbasin - State Well Number (SWN): 21N01W13J001M

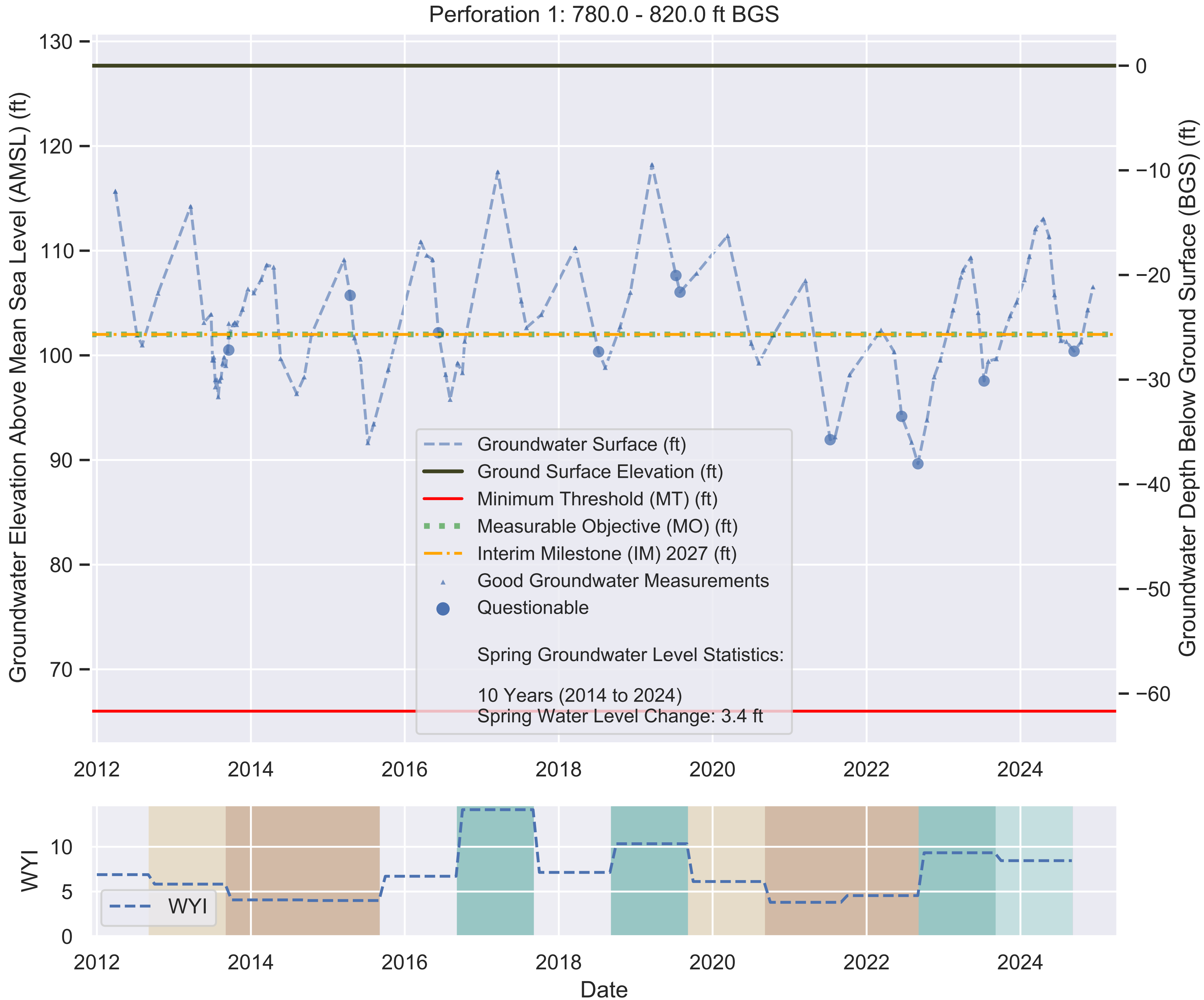
Well Location Map




Sustainable Management Criteria:
IM (2027) = 102.0 ft AMSL
MO = 102.0 ft AMSL
MT = 66.0 ft AMSL

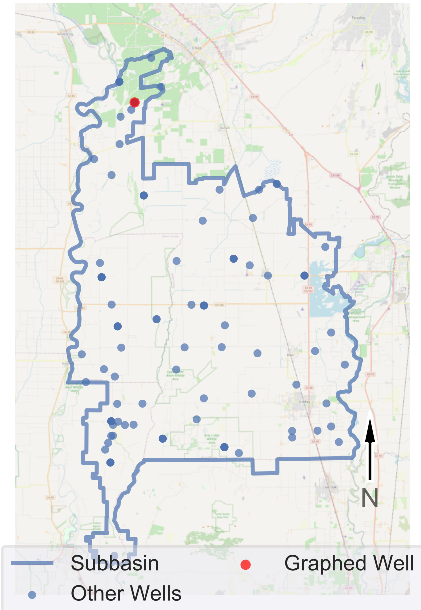
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



BUTTE Subbasin - State Well Number (SWN): 21N01W13J003M

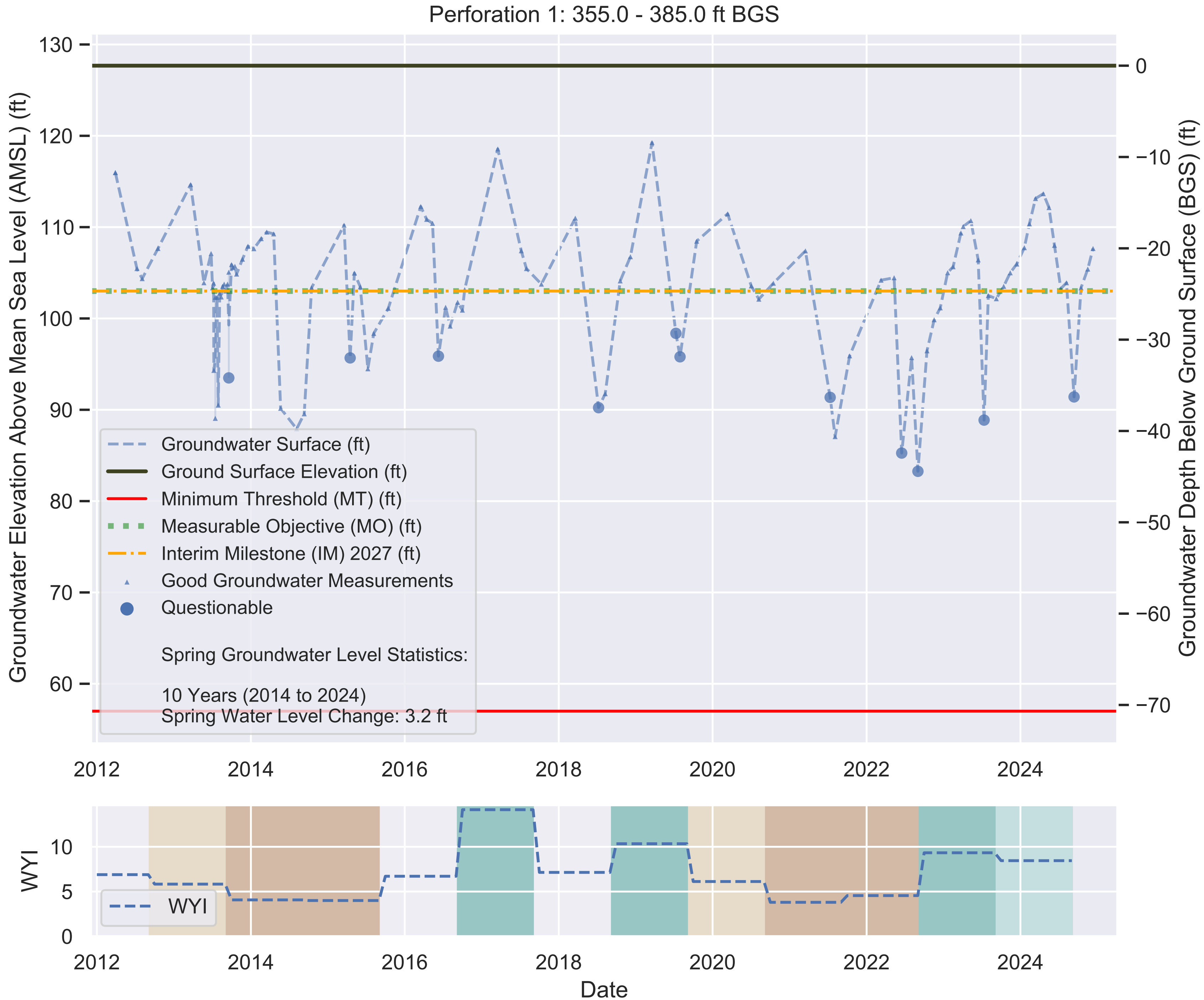
Well Location Map



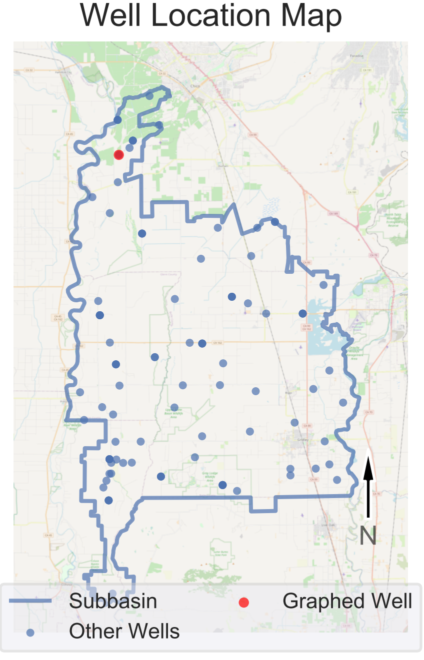

Sustainable Management Criteria:
IM (2027) = 103.0 ft AMSL
MO = 103.0 ft AMSL
MT = 57.0 ft AMSL

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

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

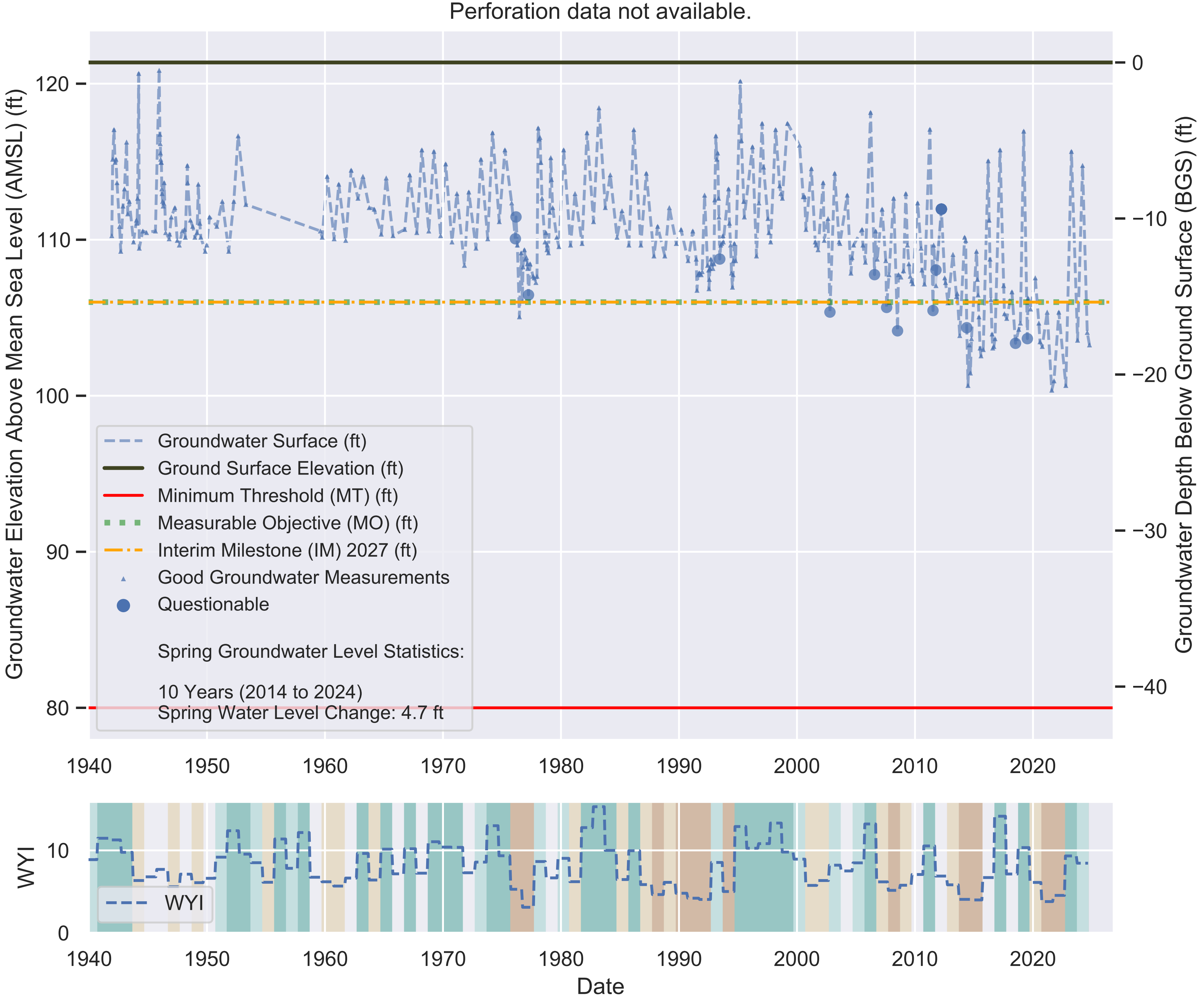


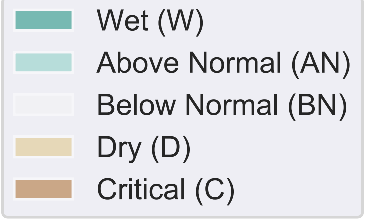
BUTTE Subbasin - State Well Number (SWN): 21N01W23J001M




Sustainable Management Criteria:
IM (2027) = 106.0 ft AMSL
MO = 106.0 ft AMSL
MT = 80.0 ft AMSL

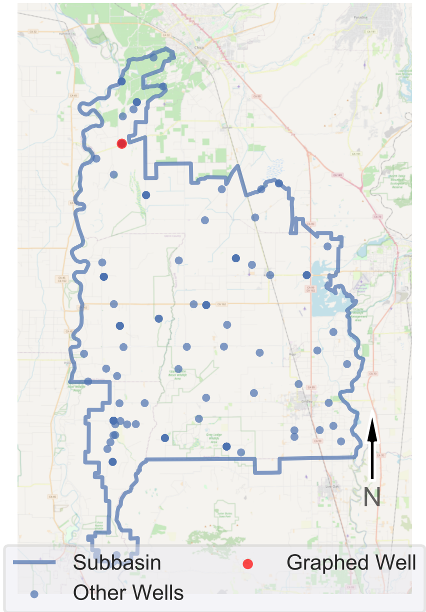
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



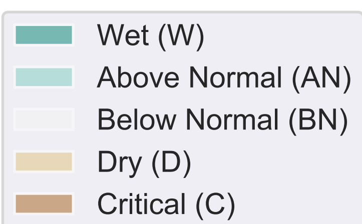
# BUTTE Subbasin - State Well Number (SWN): 21N01W35K002M

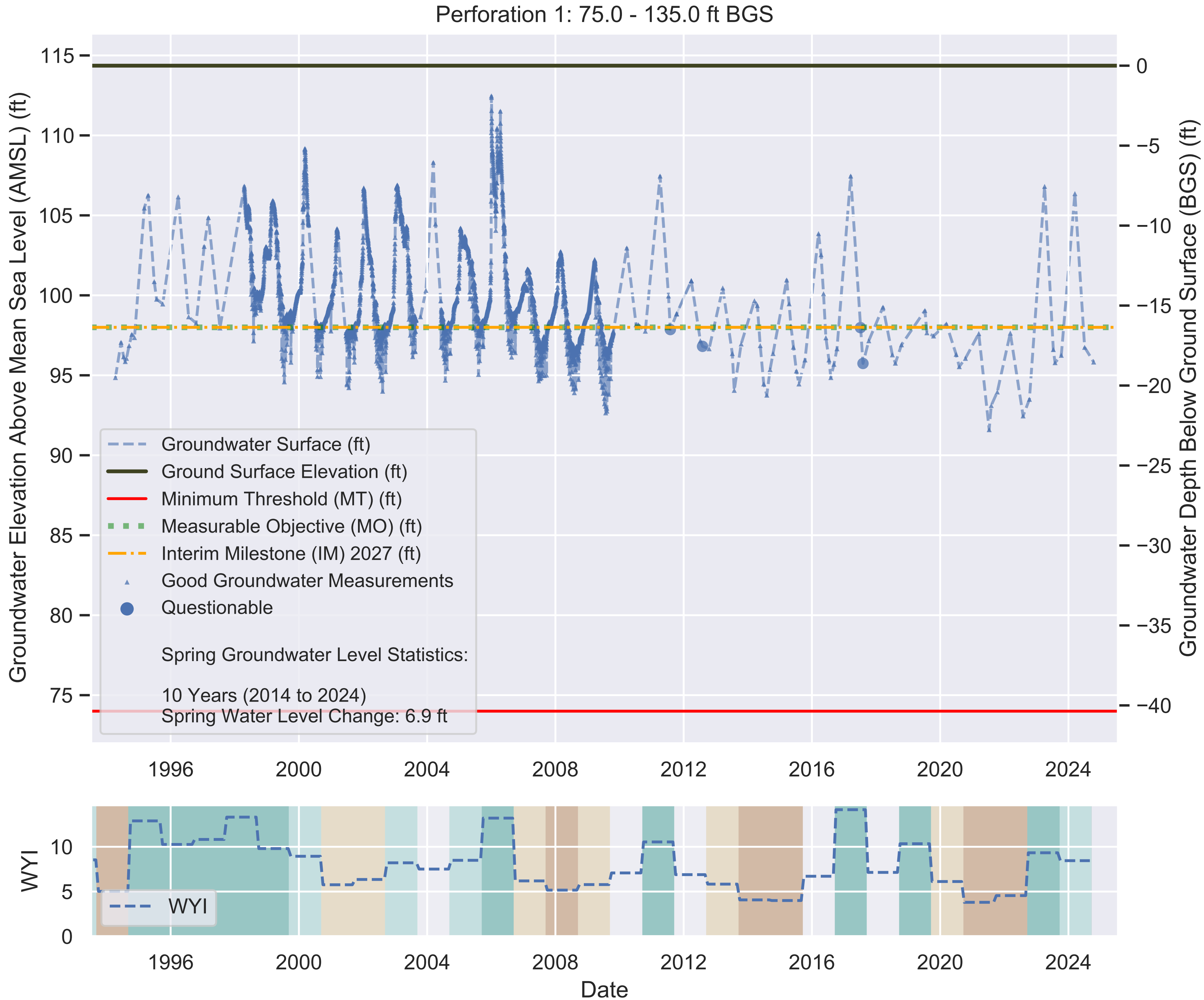
Well Location Map



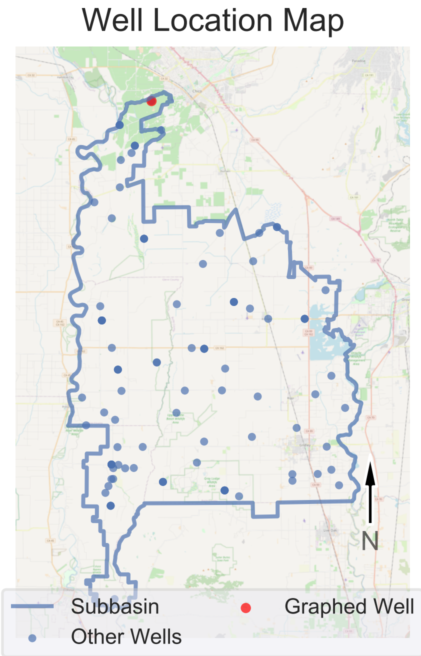

Sustainable Management Criteria:
IM (2027) = 98.0 ft AMSL
MO = 98.0 ft AMSL
MT = 74.0 ft AMSL

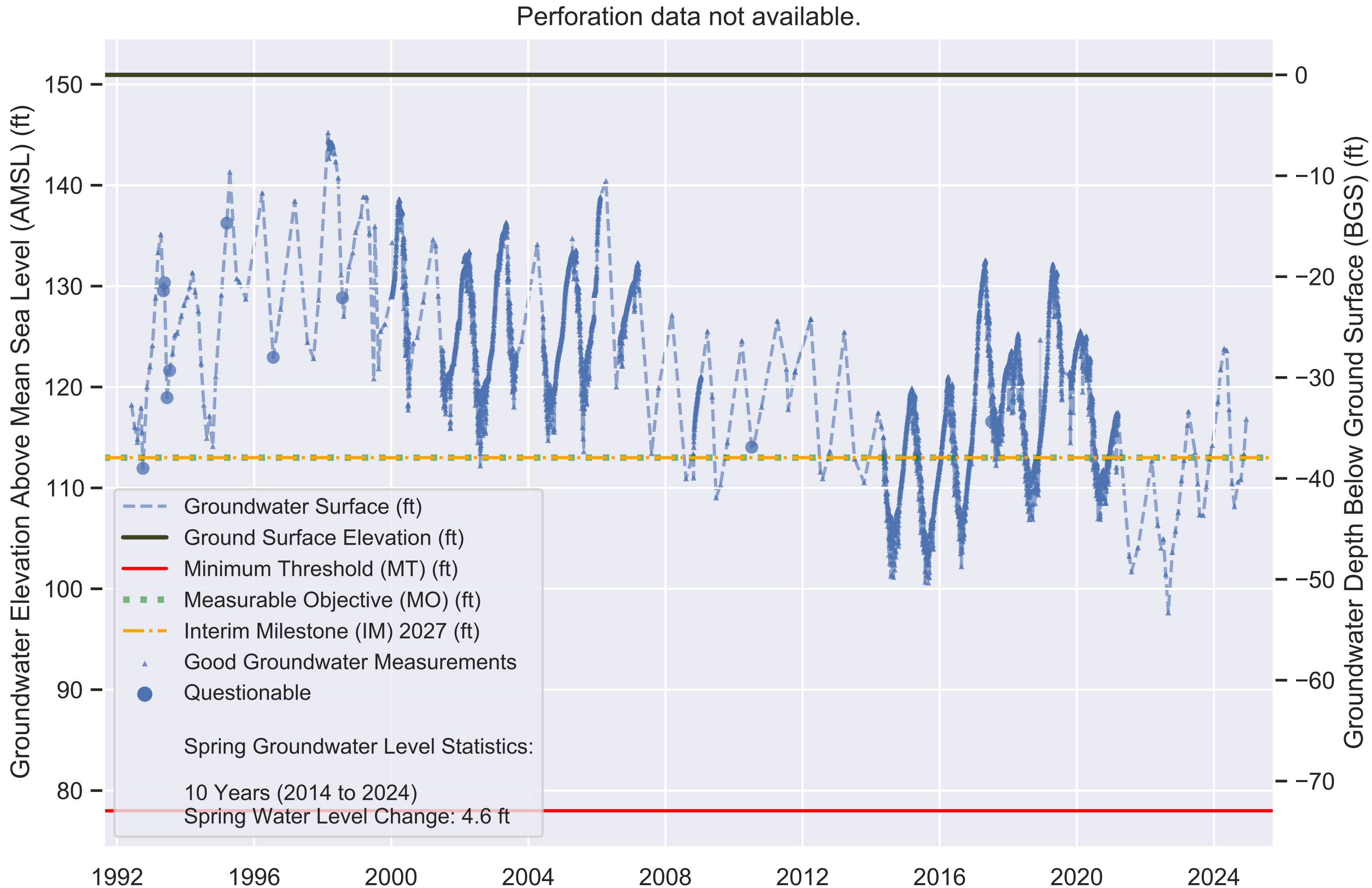
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.



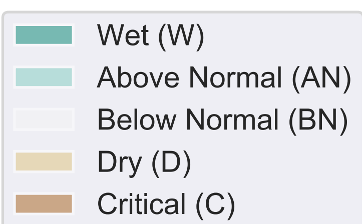
BUTTE Subbasin - State Well Number (SWN): 22N01E32E004M

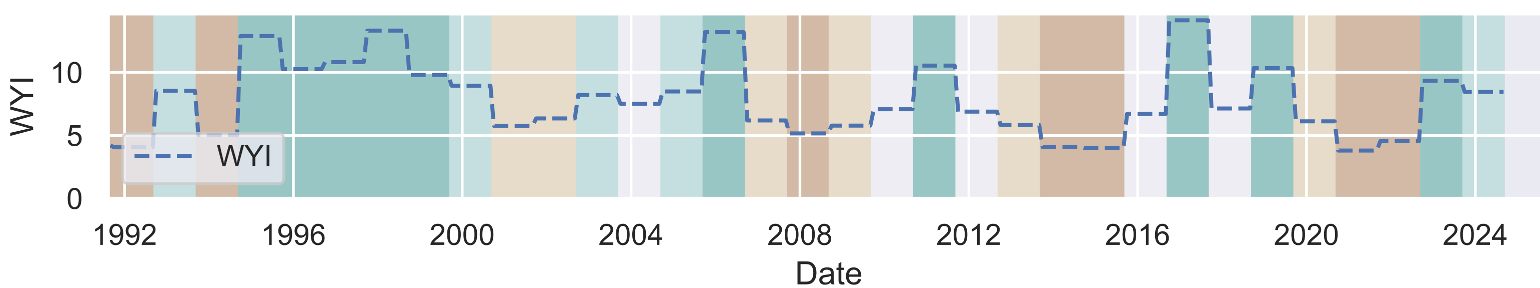



Sustainable Management Criteria:
IM (2027) = 113.0 ft AMSL
MO = 113.0 ft AMSL
MT = 78.0 ft AMSL

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



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# Appendix B

## Explanation of Sustainable Management Criteria

# Appendix B: Explanation of Sustainable Management Criteria

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

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


***SI and associated undesirable results, if significant and unreasonable***

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

The terminology for describing SMC is defined as follows:

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

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

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

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

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

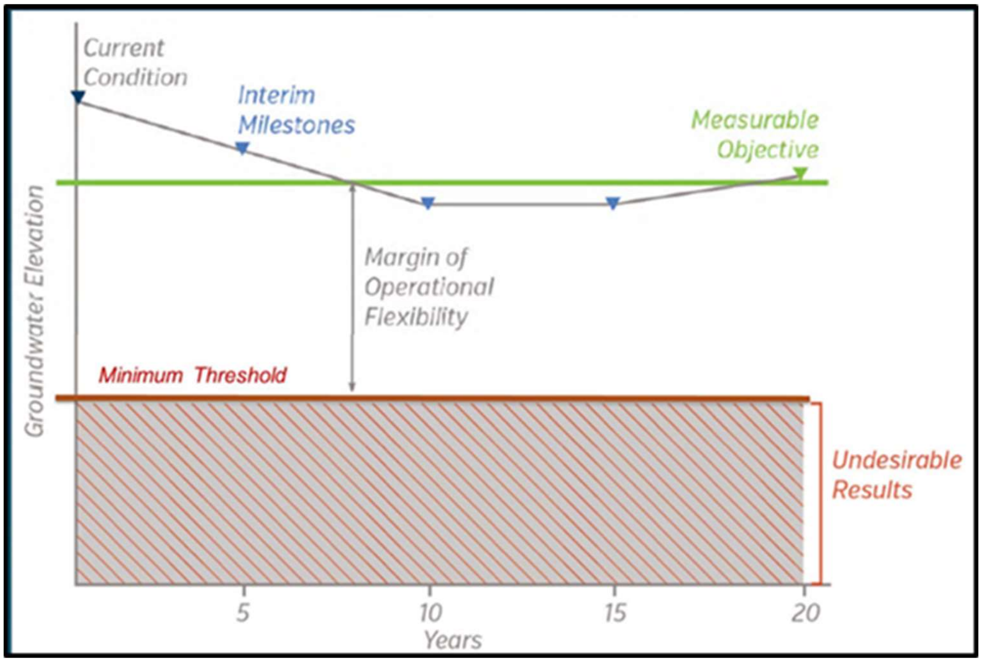


***Illustration of Terms Used for Describing Sustainable Management Criteria Using the Groundwater Level SI***

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

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

Determine compliance with the adopted GSP

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

Allow for course correction and adaptation in five-year updates

Facilitate understanding among diverse stakeholders

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

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

available here: https://sgma.water.ca.gov/portal/gsp/preview/98

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# Appendix C

## GSP Annual Reporting Elements Guide

# Groundwater Sustainability Plan Annual Report Elements Guide

| Basin Name | Butte | | |
|---|---|---|---|
| GSP Local ID | 5-021.70 | | |
| ***California Code of Regulations - GSP Regulation Sections*** | ***Groundwater Sustainability Plan Elements*** | **Document *page number(s) that address the applicable GSP element.*** | ***Notes: Briefly describe the GSP element does not apply.*** |
| **Article 5** | **Plan Contents** | | |
| ***Subarticle 4*** | ***Monitoring Networks*** | | |
| **§ 354.40** | **Reporting Monitoring Data to the Department** | | |
| | Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department. | 42-48; 123-148 | |
| | Note: Authority cited: Section 10733.2, Water Code. Reference: Sections 10728, 10728.2, 10733.2 and 10733.8, Water Code. | | |
| **Article 7** | **Annual Reports and Periodic Evaluations by the Agency** | | |
| **§ 356.2** | **Annual Reports** | | |
| | Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year: | | |
| | (a) General information, including an executive summary and a location map depicting the basin covered by the report. | 6-13 | |
| | (b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan: | | |
| | (1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows: | | |
| | (A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions. | 19-23 | |
| | (B) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year. | 54-105 | |
| | (2) Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions. | 25-27 | |
| | (3) Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year. | 28-29 | |
| | (4) Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year. | 29-30 | |
| | (5) Change in groundwater in storage shall include the following: | | |
| | (A) Change in groundwater in storage maps for each principal aquifer in the basin. | 36-37 | |
| | (B) A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year. | 33 | |
| | (c) A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report. | 38-52 | |

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# Appendix D

## DWR Upload Tables

**A. Groundwater Extractions**

| Total Groundwater Extractions (AF) | Water Use Sector Urban (AF) | Water Use Sector Industrial (AF) | Water Use Sector Agricultural (AF) | Water Use Sector Managed Wetlands (AF) | Water Use Sector Managed Recharge (AF) | Water Use Sector Native Vegetation (AF) | Water Use Sector Other (AF) | Water Use Sector Other Description |
|---|---|---|---|---|---|---|---|---|
| 170,600 | 2,300 | 0 | 151,200 | 15,800 | 0 | - | 1,300 | Rural Residential |

**B. Groundwater Extraction Methods**

| Meters Volume (AF) | Meters Description | Meters Type | Meters Accuracy (%) | Meters Accuracy Description | Electrical Records Volume (AF) | Electrical Records Description | Electrical Records Type | Electrical Records Accuracy (%) | Electrical Records Accuracy Description | Land Use Volume (AF) | Land Use Description | Land Use Type | Land Use Accuracy (%) | Land Use Accuracy Description | Groundwater Model Volume (AF) | Groundwater Model Description | Groundwater Model Type | Groundwater Model Accuracy (%) | Groundwater Model Accuracy Description | Other Method(s) Volume (AF) | Other Method(s) Description | Other Method(s) Type | Other Method(s) Accuracy (%) | Other Method(s) Accuracy Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,300 | Metered Municipal Wells | Direct | 5-10 % | Metered connection maintained by City of Biggs and City of Gridley | 0 | | | | | 151,200 | Land use estimates were derived from crop mapping and CropScape survey results | Estimate | 20-30 % | Typical uncertainty for water balance calculation | 0 | | | | | 1,300 | Rural residential groundwater extraction is estimated based on California Water Service Company's 2020 Urban Water Management Plan 2020 usage of an average per capita water use of 181 gallons per capita per day. Population data from the 2020 census was coupled with water district boundary data to identify total population not serviced by municipal supplies | Estimate | 10-20 % | Uncertainties are from population estimates and gallon per capita per day estimates |

**C. Surface Water Supply**

| Total Surface Water Supply (AF) | Methods Used To Determine | Water Source Type Central Valley Project (AF) | Water Source Type State Water Project (AF) | Water Source Type Colorado River Project (AF) | Water Source Type Local Supplies (AF) | Water Source Type Local Imported Supplies (AF) | Water Source Type Recycled Water (AF) | Water Source Type Desalination (AF) | Water Source Type Other (AF) | Water Source Type Other Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 824,700 | Diversions for local supplies are estimated based on historic State Water Resource Control Board eWRIMS (Electronic Water Rights Information Management System) data for total diversions. Surface water delivery estimates are based on historic deliveries in the area that have occurred in dry and critical years | 0 | 0 | 0 | 824,700 | 0 | 0 | 0 | 0 | |

**D. Total Water Use**

| Total Water Use (AF) | Methods Used To Determine | Water Source Type Groundwater (AF) | Water Source Type Surface Water (AF) | Water Source Type Recycled Water (AF) | Water Source Type Reused Water (AF) | Water Source Type Other (AF) | Water Source Type Other Description | Water Use Sector Urban (AF) | Water Use Sector Industrial (AF) | Water Use Sector Agricultural (AF) | Water Use Sector Managed Wetlands (AF) | Water Use Sector Managed Recharge (AF) | Water Use Sector Native Vegetation (AF) | Water Use Sector Other (AF) | Water Use Sector Other Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 995,300 | Methods used are a combination of estimates based on land use and population/ per capita water use, metered municipal water use, and estimates based on historic water rights data for dry and critical years | 154,800 | 824,700 | 0 | 0 | 0 | | 2,300 | 0 | 875,600 | 116,100 | 0 | - | 1,300 | Rural Residential |

Water Year 2024 Annual Report

# Appendix E

## Water Use Analysis Methodology

# TECHNICAL MEMORANDUM

**To:** Luhdorff and Scalmanini Consulting Engineers

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

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

[1] California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2. Groundwater Sustainability Plans.
[2] Water use sectors are identified in the GSP Regulations as "categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation" (23 CCR Section 351(al)).

# 2 GEEEO Process and Computational Approach

## 2.1 Computational Approach

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

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

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

## 2.2 Spatial Resolution

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

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

[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)

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[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.

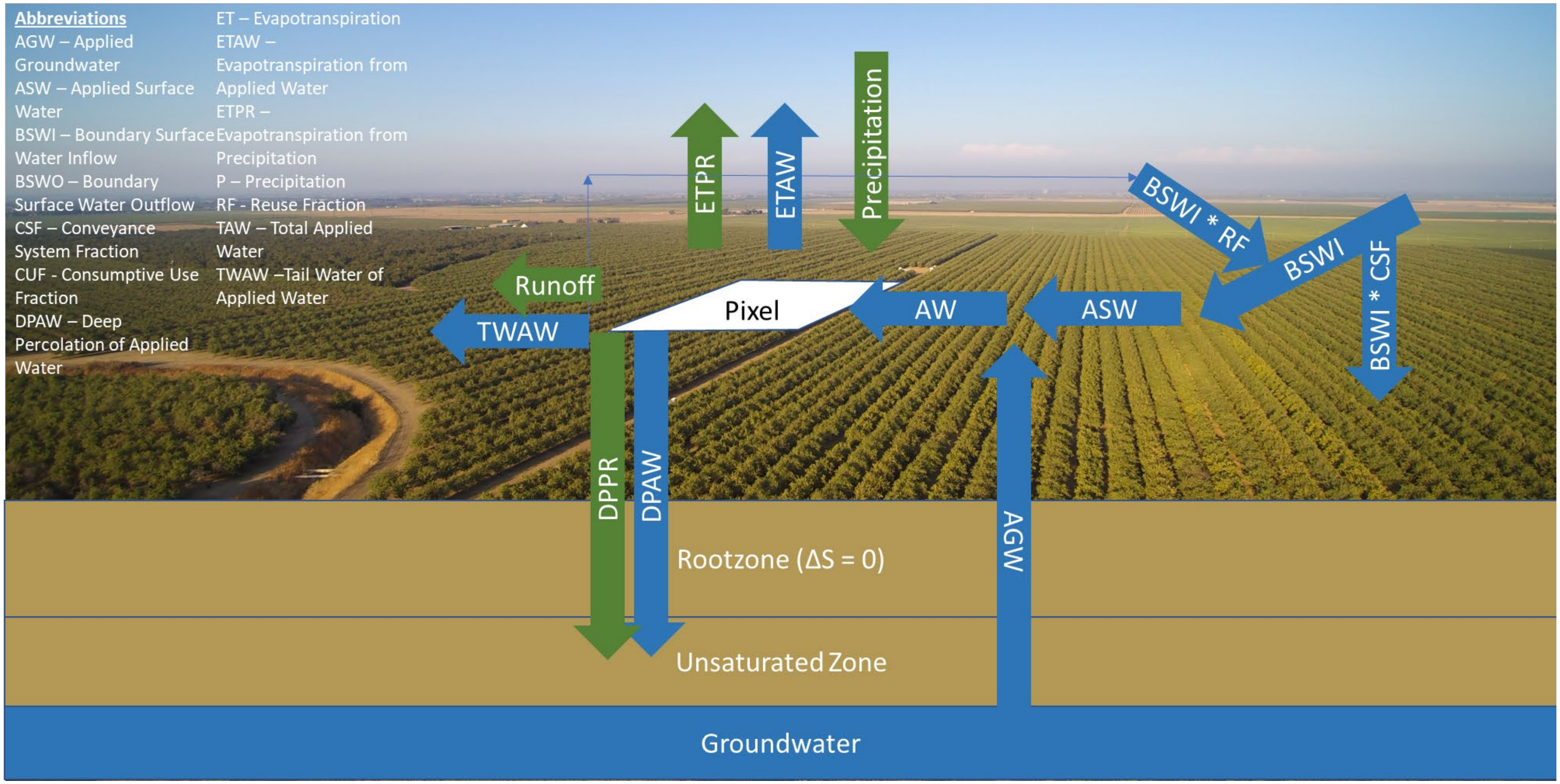


**Figure A-1. Inflows and Outflows to Each 30 m x 30 m Pixel in the GEEEO Process.**

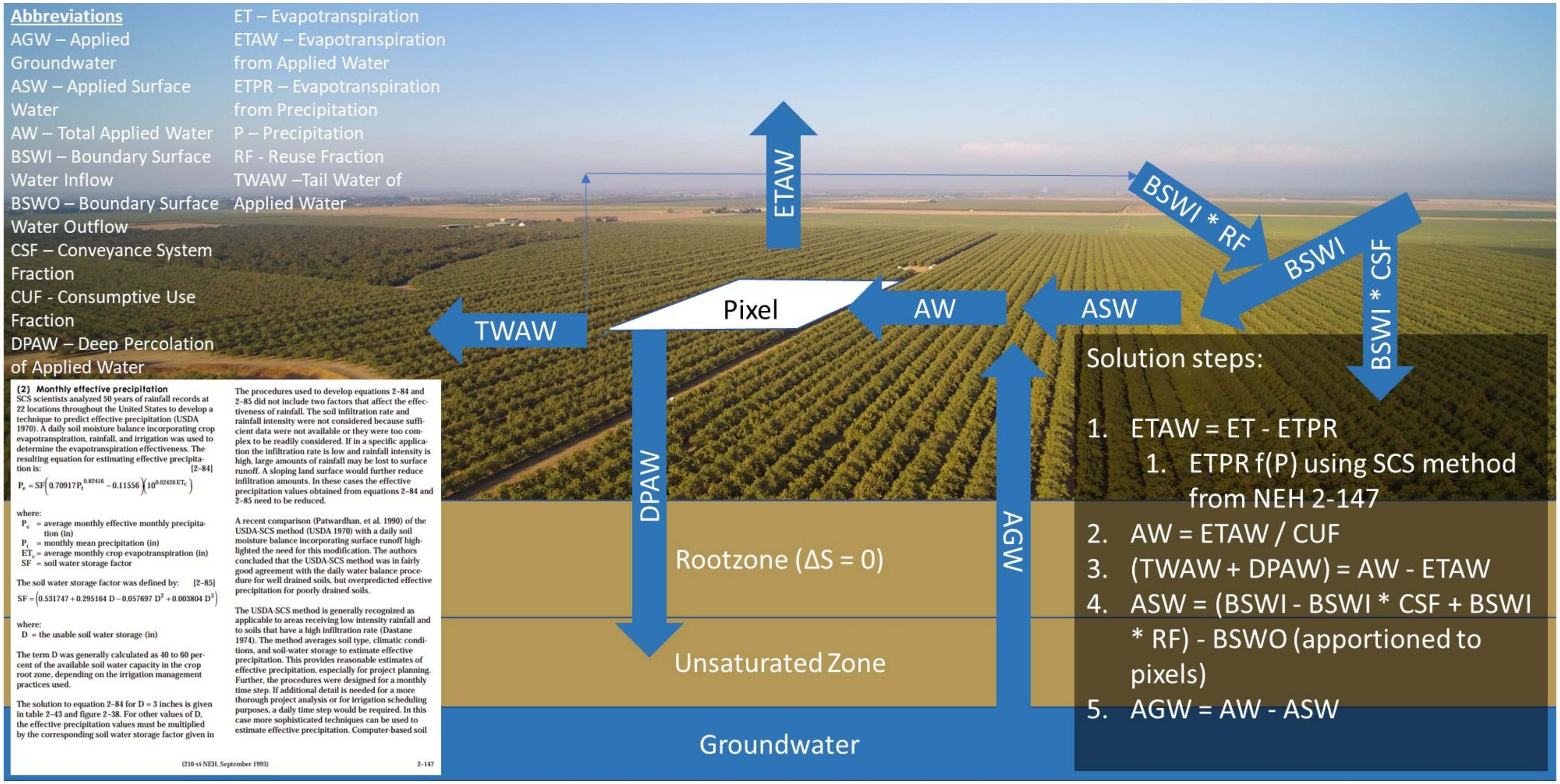


**Figure A-2. Solution Steps for Calculating Applied Groundwater (AGW) in Each 30 m x 30 m Pixel in the GEEEO Process.**

Water Year 2024 Annual Report

# Appendix F

## Water Quality

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TECHNICAL MEMORANDUM

2024 Groundwater Quality Monitoring Update

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

# Purpose

The purpose of this memo is to summarize the groundwater quality conditions for salinity, measured as electrical conductivity (EC) in the Butte, Vina and Wyandotte Creek Subbasins during the third year (2024) of groundwater quality monitoring related to their respective Groundwater Sustainability Plans (GSPs) per the Sustainable Groundwater Management Act (SGMA) of 2014.

# Background

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

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

## Methodology

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

In 2021, the Department purchased a Solinst 107 EC meter which includes a probe that measures EC in microsiemens (µs) / centimeter (cm), temperature and water level (similar to an electric sounder) on a 1,000-foot-long laser-marked flat tape with markings every 1/100$^{th}$ ft. This meter has been used since 2022 to conduct EC monitoring at various depths within the monitoring wells. The Solinst EC meter is only used in wells without pumping equipment i.e. multi-completion observation wells, in order to avoid potential damage to the equipment through entanglement in the wiring or pumps.

The meter was calibrated at the beginning of each monitoring day with known standard solutions according to the manufacturer's specifications. At each site, the probe is lowered to the water surface and a depth to water measurement is recorded. It is then lowered to the midpoint of each screened interval(s) within the well to record the EC of the water entering the well from that portion of the aquifer. In prior years, EC measurements from each screened interval was depicted in the graphs. Beginning this year, the average of the EC measurements collected at the midpoint of every screened interval within each well is displayed in the graphs within this report with the exception of 19D002M, a well in the Wyandotte Creek Subbasin with distinct difference in the EC values between screening intervals.

For most of the remaining wells in the monitoring network with pumps, a Hach brand portable water quality meter with a conductivity probe was used in the field to measure a water sample after the well was purged of standing water by pumping for at least 20 minutes. One exception is well 19N01W28A001M located in the Glenn County portion of the Butte Subbasin. This well was measured with a Hach Sension 156 meter by Glenn County staff after being purged and pumped for less than 20 minutes.

## Monitoring Network

The GSPs define the groundwater quality monitoring RMS networks to include wells distributed spatially throughout the Subbasins, focusing on the inclusion of wells screened deep enough to capture changes in EC in the deeper portions of the aquifer where any changes in EC would be expected to be detected first. While there are shallow RMS wells within some of the networks, as part of future GSP implementation, GSAs may consider modifications to the groundwater quality RMS networks as needed.

The Butte, Vina and Wyandotte Creek Subbasins groundwater quality monitoring networks were initially comprised of the eight individual groundwater quality monitoring RMS wells as described in each of the Subbasin's GSPs. Modifications to the RMS networks have been made since adoption of the GSP including the removal and addition for various reasons as described in more detail below.

In 2024 the overall revised monitoring network in the Vina Subbasin included seven of the original RMS sites. One RMS well, 28J005 was dropped in 2024 due an obstruction at around 300 feet below the ground surface within the well, which for the past three years has prevented the equipment from reaching the proper sampling depth of about 771 feet (the mid-point of the screening interval) to measure EC. Based on field observations, it is possible that RMS well 28J005, which was drilled in 1955, has filled in with materials due to a collapse of the walls above the screened interval of the well.

In 2024 the overall revised monitoring network in the Butte Subbasin included seven original RMS sites and one new site in the Butte Subbasin to replace one well which was dropped in 2024. Well 20N01E18L001M was dropped due to obstructions at various depths below the ground surface within the well in 2022 and 2023 preventing the equipment from reaching the proper depths of about 793 feet (the mid-point of the first screening interval) to measure EC. This multi-completion well is an extensometer site used to monitor potential inelastic subsidence. A downhole video survey was conducted in the fall of 2023 by DWR staff to inspect potential obstructions. Debris buildup was observed at casing joints and concentrated around extensometer elements at various depths causing partial and full obstructions. Another multi-completion well at the same location, 20N01E18L002M, which is not an extensometer well, was added in 2024 to this network to replace 20N01E18L001. Additionally, data collected for RMS well 18N01E35L001M was not reported in this year's report due to an obstruction this year within the well preventing the equipment from reaching the proper depths at the mid-point of the screening interval to measure EC. The cause for this may be investigated further in the future.

In 2024 the overall revised monitoring network in Wyandotte Creek Subbasin included four of the original RMS sites identified in the GSP. Four original RMS wells identified in the GSP were removed from the monitoring network for the following reasons:

- Two RMS wells were removed from the network per the request of the landowners, 28L001M in 2022 and 16Q001M in 2023.
- RMS well 13B002M was removed from the monitoring network in 2022 due to an inoperable pump.
- Well CWS-02 was removed in 2023 due to water quality issues at the well.

Well 06E002M was added in 2022. This well was historically measured for groundwater quality as part of the Butte County Basin Management Objective (BMO) program. One more additional well, 09N002M was added into the monitoring network in 2023. This well also serves as an existing RMS well for groundwater level monitoring in the Subbasin.

Some water quality monitoring sites do have historic intermittent EC data, however most sites do not. A map of each Subbasin and the revised network of 2024 groundwater quality sites is shown in **Figure 1.** As part of their GSP Periodic Evaluations (due in January 2027), the GSAs will continue to consider modifications to the groundwater quality RMS network.

The RMS well details including well type, monitoring equipment, total well depth and depth of the screened zones(s) in each well are provided in **Table 1.** The portion of the State Well Number in bold indicates the Representative Monitoring Site identification number for each well where applicable.

The RMS wells within the Butte Subbasin are predominantly multi-completion wells (multiple wells at a single location screened at different depths below the ground surface) with the exception of 18N01E35L001M, a single observation well and 19N01W28A001M, a shallow irrigation well. One RMS well in the Butte Subbasin 19N01E35B002M is also an extensometer site which continuously monitors for potential inelastic land subsidence. The RMS wells within the Vina Subbasin are all multi-completion wells sampling from the deepest completion at each location. In the Wyandotte Creek subbasin, there are a variety of well use types in the monitoring network including irrigation, municipal and observation wells.

**Figure 1. Groundwater Quality Representative Monitoring Site well locations in the Vina, Butte and Wyandotte Creek Subbasins in 2024**

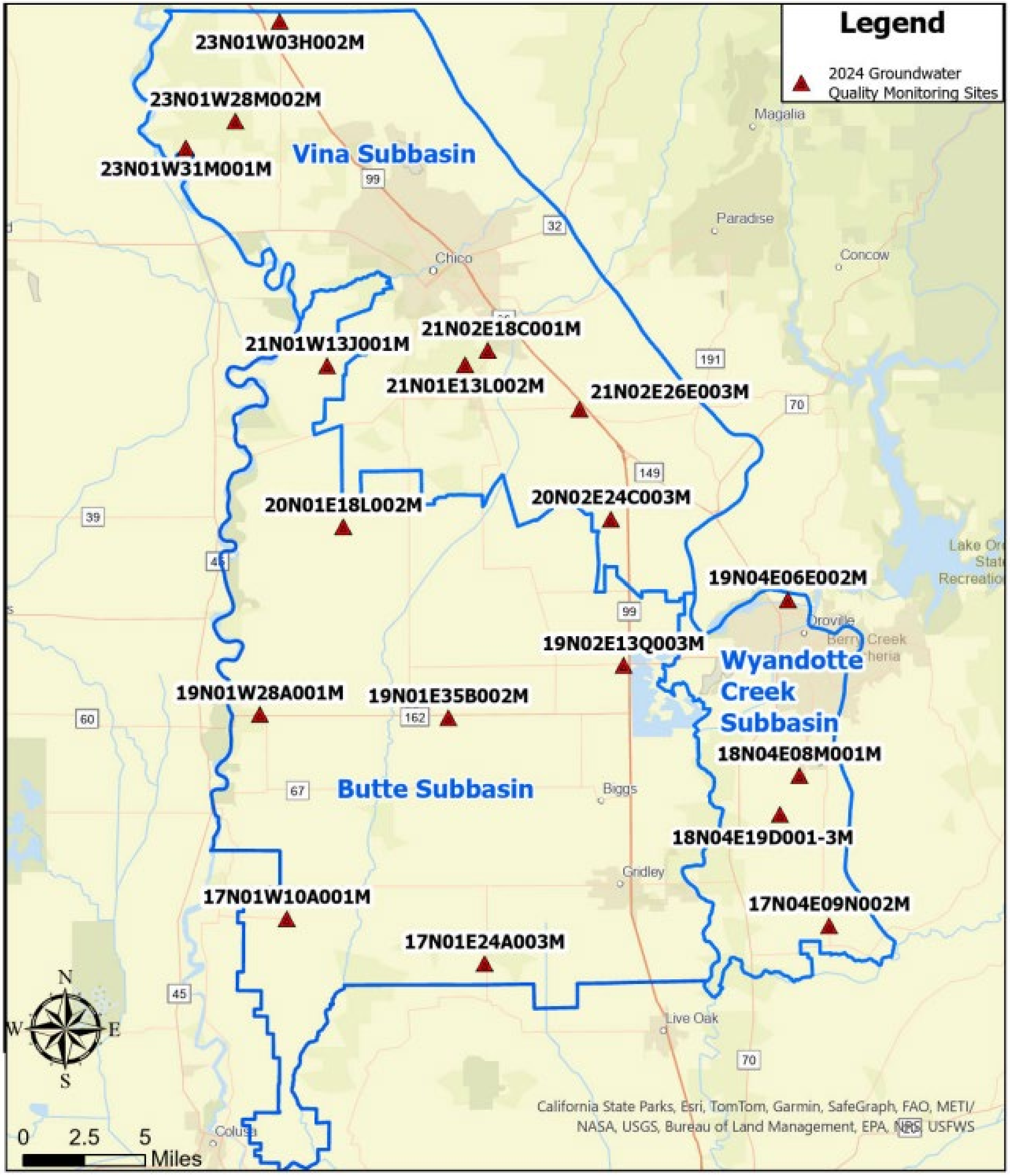


**Table 1. 2024 Revised Representative Groundwater Quality Monitoring Network Information**

| Subbasin | State Well Number | Well Type | Monitoring Equipment | Total Well Depth (feet) | Depth of Screened Zone(s) (feet) |
|---|---|---|---|---|---|
| Butte | **17N01E24A003M** | Observation | Solinst 107 | 833 | 770 - 790 |
| | **17N01W10A001M** | Observation | Solinst 107 | 820 | 770 – 780, 790 - 800 |
| | **19N01E35B002M*** | Observation | Solinst 107 | 980 | 930 - 950 |
| | **19N01W28A001M** | Irrigation | Hach Sension156 | 140 | 120 - 140 |
| | **19N02E13Q003M** | Observation | Solinst 107 | 690 | 670 - 680 |
| | **20N01E18L002M** | Observation | Solinst 107 | 581 | 510 – 530, 550-560 |
| | **21N01W13J001M** | Observation | Solinst 107 | 830 | 780 - 820 |
| Vina | 20N02E**24C003M** | Observation | Solinst 107 | 520 | 484 - 505 |
| | 21N01E**13L002M** | Observation | Solinst 107 | 771 | 735 - 760 |
| | 21N02E**18C001M** | Observation | Solinst 107 | 900 | 770 – 780, 800 – 810 830 – 840, 870 - 880 |
| | 21N02E**26E003M** | Observation | Solinst 107 | 640 | 610 - 620 |
| | 23N01W**03H002M** | Observation | Solinst 107 | 553 | 510 - 540 |
| | 23N01W**28M002M** | Observation | Solinst 107 | 1,031 | 791 – 801, 881 – 891, 951 – 961, 1,011 – 1,021 |
| | 23N01W**31M001M** | Observation | Solinst 107 | 1,055 | 969 – 979, 1,020 – 1,030 |
| Wyandotte Creek | 17N04E**09N002M** | Irrigation | Hach HQd | 325 | 100 – 112 |
| | 18N04E**08M001M** | Irrigation | Hach HQd | 656 | 168 – 204, 208 - 244 |
| | 18N04E**19D001M** 18N04E**19D002M** 18N04E**19D003M** | Observation | Solinst 107 | 744 | 700 - 720 |
| | | | | 594 | 430 – 450, 550 - 570 |
| | | | | 220 | 120 – 130, 190-200 |
| | 19N04**E06E002M** | Municipal | Hach HQd | 196 | 110 – 130, 164 – 174 |

*Also an extensometer site.

## Sustainable Management Criteria

In these three Subbasins, the groundwater quality Sustainable Management Criteria (SMC) are established to address degraded groundwater quality caused by groundwater pumping where the potential exists for movement of underlying brackish water from greater depths, upward into the freshwater aquifer where groundwater pumping for beneficial uses occurs. One objective of the groundwater quality monitoring program is to measure EC levels in the RMS wells and compare those to the Measurable Objectives (MO) and Minimum Thresholds (MT) set for each RMS well in the GSPs as a way to gauge whether undesirable results are occurring in the subbasin. In each Subbasin's GSP, MTs were established to be protective of water uses and users. When considering MTs, it is important to note that in the case of groundwater levels, exceedance of a MT is caused by groundwater levels dropping below the threshold. However, for groundwater quality, exceedance of a MT is counterintuitively caused by measuring levels higher than the threshold. The MT for groundwater quality is a highest allowable value, rather than lowest.

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

As shown in **Table 2**., in the Vina and Wyandotte Creek Subbasins, the MOs for salinity are set at 900 µs/cm and the MTs are 1,600 µs/cm, which is the upper limit of the Secondary Maximum Contaminant Level (SMCL) based on State Secondary Drinking Water Standards. Secondary Drinking Water Standards are set on the basis of aesthetic concerns, values exceeding this number are typically unacceptable for drinking water. The occurrence of an Undesirable Result occurs in the Vina and Wyandotte Creek Subbasins when two RMS wells within each Subbasin exceeds their MTs for two consecutive non-dry years.

**Table 2. Measurable Objectives, Minimum Thresholds for Electrical Conductivity [microsiemens (µs) / centimeter (cm)] and definition of Undesirable Results in each Subbasin**

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

# Results

In 2024, the second non-dry water year type in a row, the majority of all wells monitored within each Subbasin had groundwater quality conditions (measured as EC) that fell within the acceptable range of groundwater quality values set forth by the GSPs and described in Table 2. No major shifts occurred in the EC measurements in the sampled wells.  Details of the monitoring results for each Subbasin are described below.

Butte Subbasin

In the Butte Subbasin the majority of RMS wells measured in 2024 had EC values that were lower than the MO of 700 µS/cm and therefore lower than their specific MTs in 2024. The MTs vary per well since they are based on historic data, if there is any available. **Figure 2.** displays the overall results for the 2024 water quality wells within the Butte Subbasin. Graphs of historic data for individual wells for previous years can be found in **Appendix A.** Results from one RMS well, 17N01W10A001M, a deep multi-completion well located in Colusa County, had EC values higher than the well's MT in 2023 and 2024. Historic (DWR, 2020, DWR 2023a) and recent data for this well are shown in **Figure 3.** This well is near the Sutter Buttes mountain range in an area known for high concentrations of EC (Davids, 2021). Future plans of the GSAs may include the formation of the Sutter Buttes Water Quality Interbasin Working Group as described in more detail in section 6.1.2.2 of the Butte Subbasin GSP (Davids, 2021) to focus on collaborative discussions, consensus building and planning to address groundwater quality matters associated with the unique geology of the Sutter Buttes area.

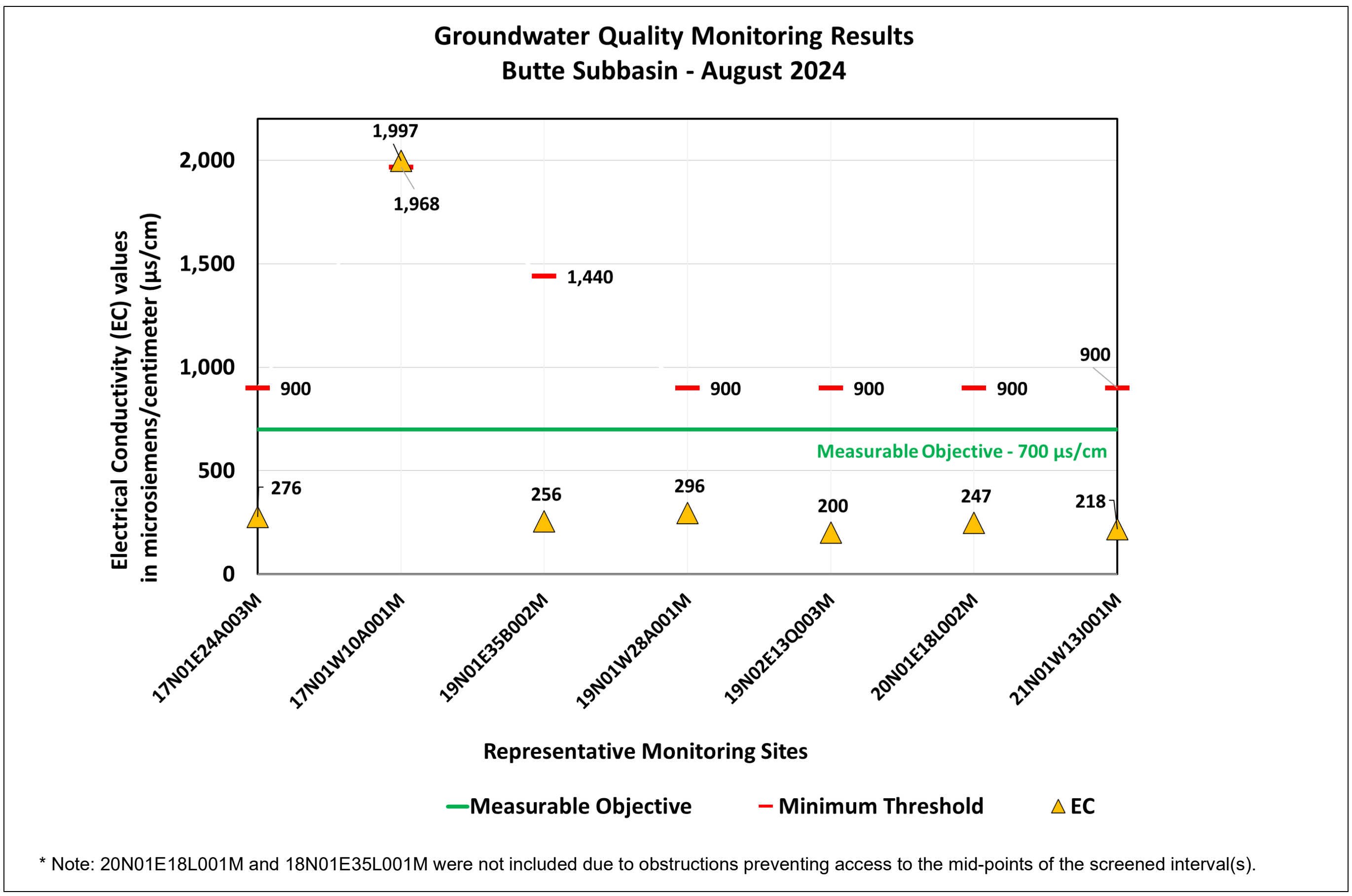



**Figure 2. Groundwater quality monitoring results in the Butte Subbasin for the 2024 water year**

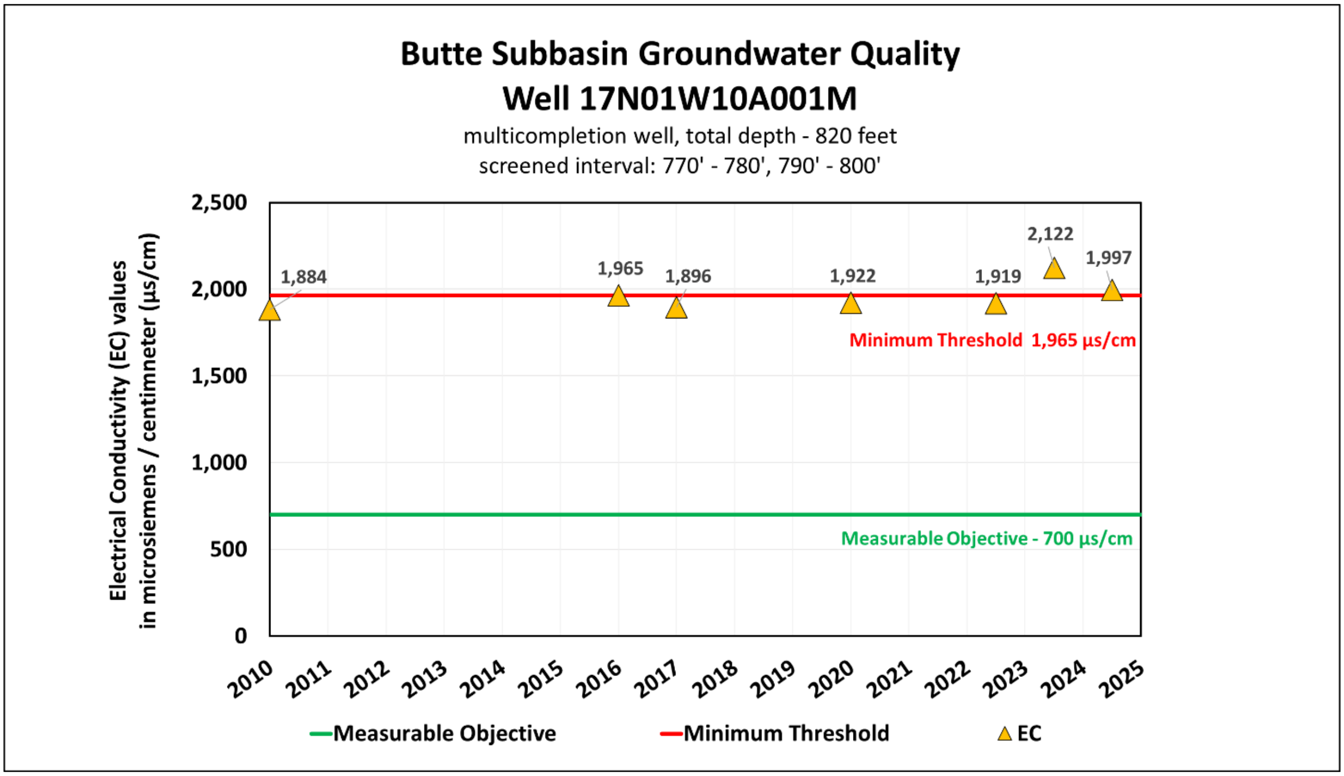



**Figure 3. Current and historic groundwater quality data for well 17N01W10A001M in the Butte Subbasin.**

## Vina Subbasin

In the Vina Subbasin all RMS wells measured in 2024 had EC values that were lower than the MO of 900 µS/cm and therefore lower than the MT of 1,600 µS/cm as shown in **Figure 4.**

## Wyandotte Creek Subbasin

In the Wyandotte Creek Subbasin the majority of RMS wells measured in 2024 had EC values that were lower than the MO of 900 µS/cm and therefore lower than the MT of 1,600 µS/cm as shown in **Figure 5.**

In the new multi-completion well drilled in 2021 by DWR through the Technical Support Services program to measure three distinct zones of the aquifer in one location, there were two zones, intermediate (19D002M) and deep (19D001M), which exhibited high EC levels in 2024, exceeding the MT depicted in **Figure 6**. This multicompletion well was constructed after the GSA set the sustainable management criteria for water quality. Both wells had high levels of EC greater than the MT when initially developed, prior to the adoption of the GSP and again when the wells were re-tested months after their initial development. Anecdotally, this general area of the Subbasin is known to have formations with groundwater bearing high concentrations of salinity and natural gas. Better characterization of naturally occurring salinity is needed to help improve appropriate monitoring and management of groundwater with respect to water quality in this Subbasin. The shallow well, 19D003M was not included in the graphs this year and was deemed to be a questionable measurement as the EC was not measured at the second screened interval. The Butte County Technical Advisory Committee may consider making recommendations regarding inclusion of additional wells and collection of additional long-term data in the future.

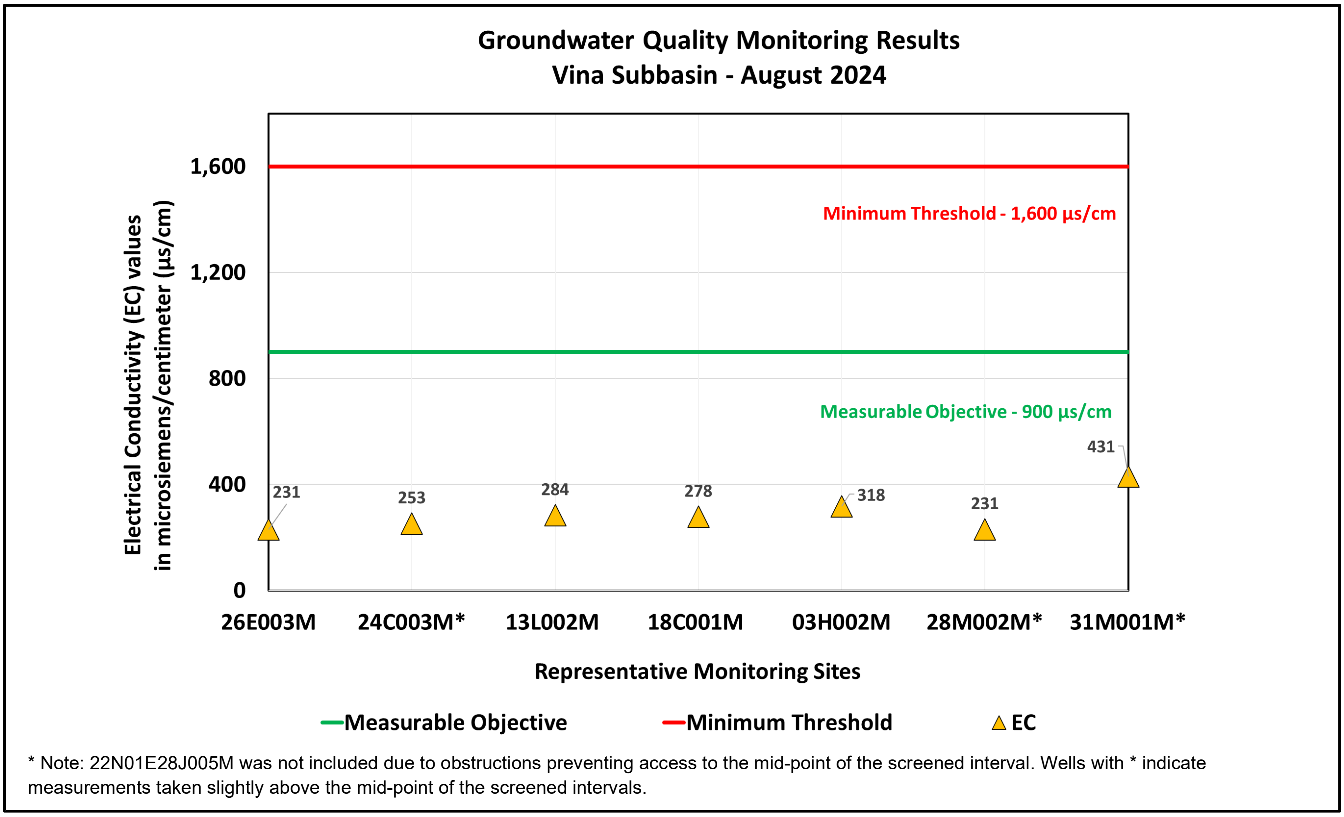



**Figure 4. Groundwater quality monitoring results in the Vina Subbasin for the 2024 water year**

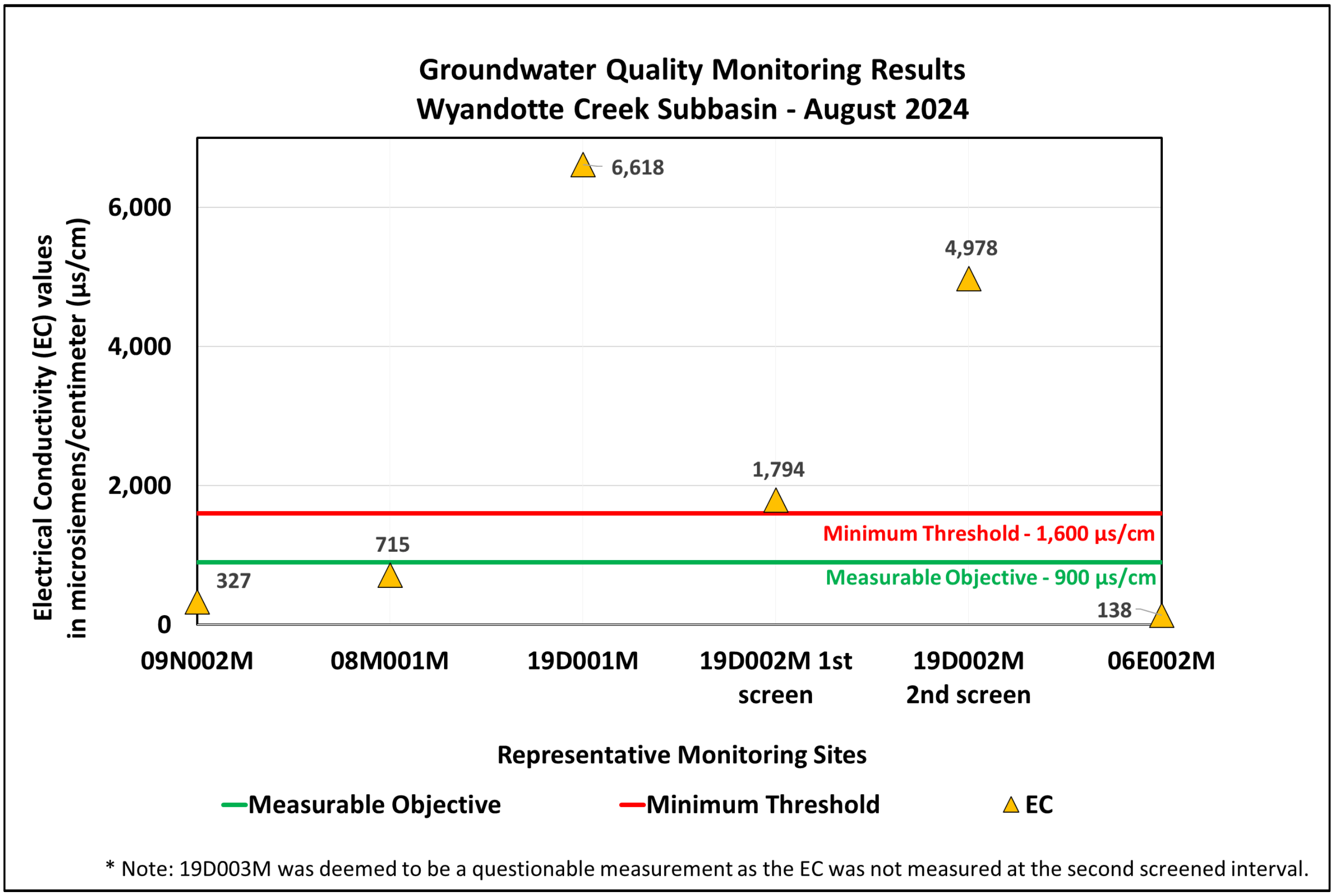



**Figure 5. Groundwater quality monitoring results in the Wyandotte Creek Subbasin for the 2024 water year**

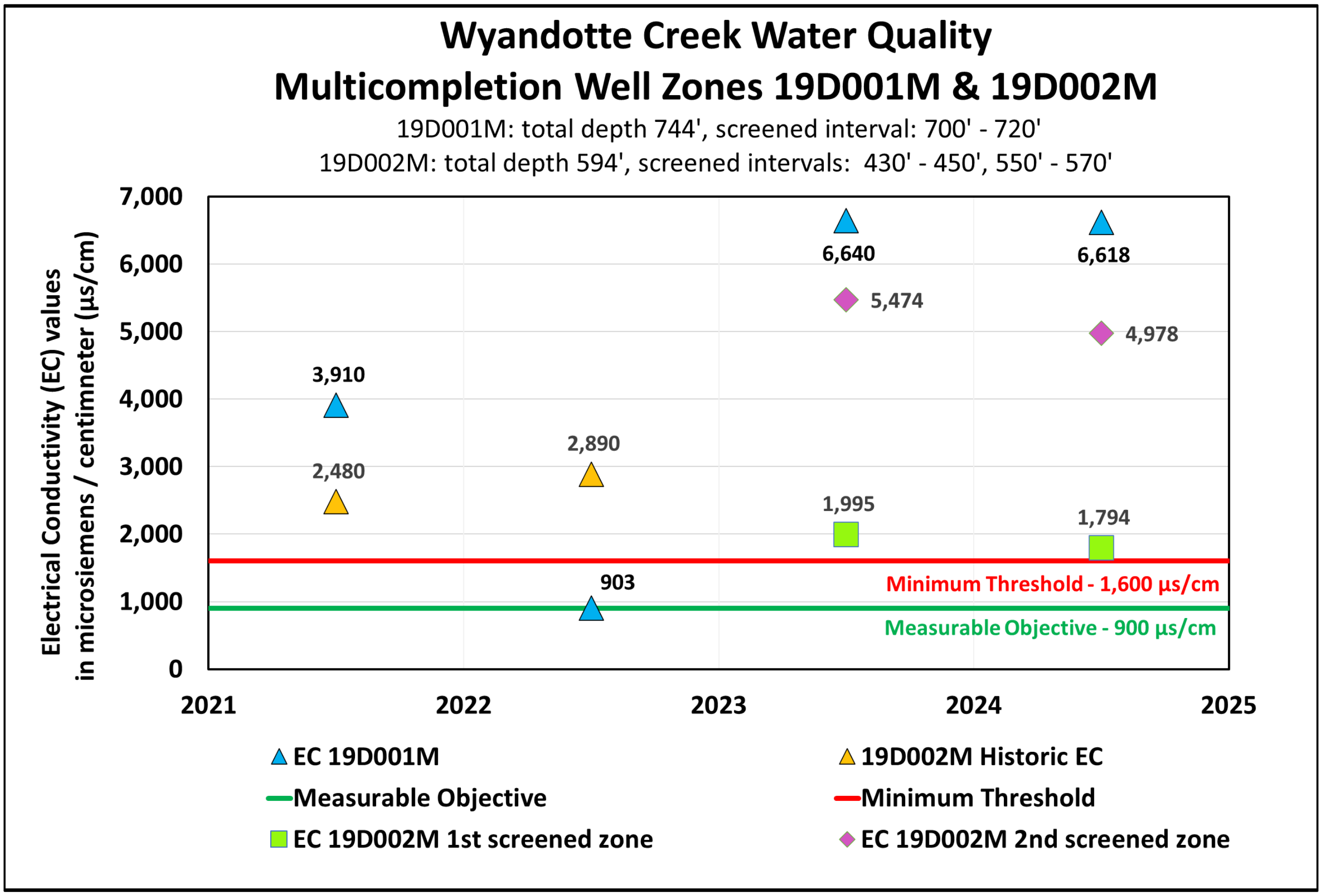



**Figure 6. Current and historic groundwater quality data for zones in RMS well 19D001-2M in the Wyandotte Creek Subbasin.**

# Discussion

Groundwater quality monitoring serves to establish baseline levels for EC throughout the Subbasins so that any future changes may be identified and further investigation and or additional monitoring can subsequently be developed. **Table 3** below summarizes the status of monitoring results in relation to exceedances of Undesirable Results. While there was one RMS well in exceedance of a MT for electrical conductivity within the Butte Subbasin over the past 24 months, this does not indicate the presence of Undesirable Results in the Subbasin for degraded water quality, as only one well exceeded the Minimum Threshold over 24 months, not two, as described in the GSP. Importantly, the observed EC in the well is in the range of previously observed historical levels and does not indicate a changed condition or upward trend.

**Table 3. Electrical conductivity monitoring results and the presence of Undesirable Results since 2022 in relation to each well's Minimum Thresholds in the Butte, Vina and Wyandotte Creek Subbasins.**

| Subbasin | State Well Number | 2022 Dry Year | 2023 Non-Dry Year | 2024 Non-Dry Year | Undesirable Result Identification | Indication of Undesirable Results? |
|---|---|---|---|---|---|---|
| | | Was the EC above the Measurable Threshold? | | | | |
| Butte | 17N01E24A003M | No | No | No | When 25% of RMS wells (2 of 8) exceed their MT for 24 consecutive months | No |
| | 17N01W10A001M | No | **Yes** | **Yes** | | |
| | 19N01E35B002M | No | No | No | | |
| | 19N01W28A001M | n/a | No | No | | |
| | 19N02E13Q003M | No | No | No | | |
| | 20N01E18L002M | n/a | n/a | No | | |
| | 21N01W13J001M | No | No | No | | |
| Vina | 20N02E**24C003M** | No | No | No | When 2 RMS wells exceed their MT for two consecutive non-dry years. | No |
| | 21N01E**13L002M** | No | No | No | | |
| | 21N02E**18C001M** | No | No | No | | |
| | 21N02E**26E003M** | No | No | No | | |
| | 23N01W**03H002M** | No | No | No | | |
| | 23N01W**28M002M** | No | No | No | | |
| | 23N01W**31M001M** | No | No | No | | |
| Wyandotte Creek | 17N04E**09N002M** | n/a | No | No | When 2 RMS wells exceed their MT for two consecutive non-dry years. | No |
| | 18N04E**08M001M** | QM | QM | No | | |
| | 18N04E**19D001-3M** | QM | **Yes** | **Yes** | | |
| | 19N04E**06E002M** | No | No | No | | |

Note: The portion of the State Well number in bold is the Representative Monitoring Site identification number. QM indicates a questionable measurement and n/a indicates the well was not measured.

There were no RMS wells in exceedance of any MTs in the Vina Subbasin in 2024 and therefore no indication of Undesirable Results as defined in the GSP.

There were two zones within the multicompletion well 18N04E19D001-3M in the Wyandotte Creek Subbasin in exceedance of the MTs in 2023 and 2024, (both non-dry water year types); however, this does not indicate the presence of Undesirable Results in the Subbasin for degraded water quality, as only one well exceeded the Minimum Threshold not two, as described in the GSP. These completions monitor the deep and intermediate zones in this new multi-completion well drilled in 2021 by DWR through their Technical Support Services program. When the well was first developed, the baseline EC was 3,910 µs/cm and 2,480 µs/cm respectively, roughly 1.5 and 2.5 times higher than the MT for these well. Approximately four months after initial development, DWR conducted additional water quality sampling after the well had time to settle.

Results indicated a drop in EC to 903 µs/cm for 19D001M but an increase in 19D002M to 2,890 µs/cm. Baseline conditions at these wells are not well understood but clearly exhibit naturally occurring high levels of EC. Revisiting the sustainable management criteria of this well seems appropriate. Additional characterization through additional data collection of naturally occurring salinity is needed to help improve appropriate monitoring and management of groundwater with respect to groundwater quality in this Subbasin.

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

The County will continue to work with the GSAs within the Butte, Vina and Wyandotte Creek Subbasins as available, to recommend modifications to the monitoring networks, to conduct monitoring to support data collection, and to ensure that electrical conductivity data is submitted to DWR as required by SGMA.

## References

California Department of Water Resources (DWR), Northern Regional Office. 2020. Northern Sacramento Valley Dedicated Monitoring Well Groundwater Quality Assessment Technical Information Record (TIR) NRO-2019-01. Red Bluff, CA

California Department of Water Resources (DWR). 2023a. Available at: https://wdl.water.ca.gov/waterdatalibrary/Map.aspx

Davids Engineering (Davids). 2021. Butte Subbasin Groundwater Sustainability Plan. Available at: https://sgma.water.ca.gov/portal/gsp/preview/98

Geosyntec Consultants, Inc. 2021a. Vina Groundwater Sustainability Plan. Available at: https://sgma.water.ca.gov/portal/gsp/preview/86.

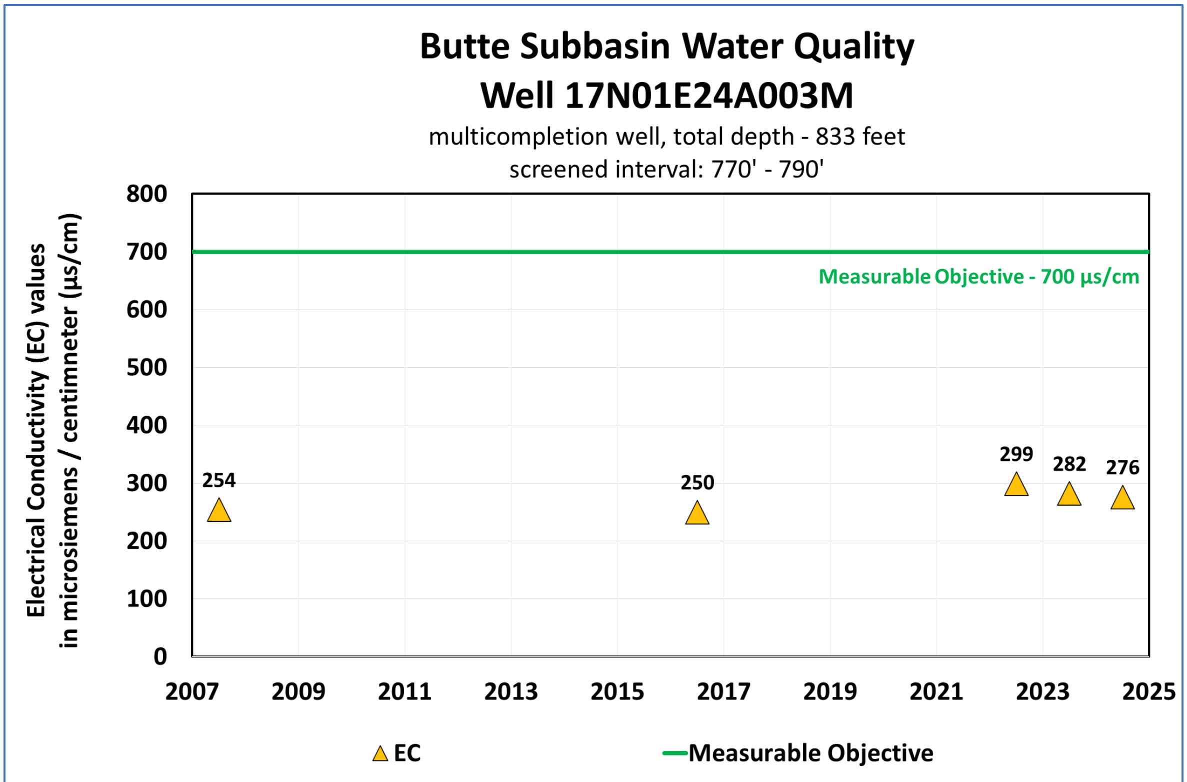
Geosyntec Consultants, Inc. 2021b. Wyandotte Creek Groundwater Sustainability Plan. Available at: https://sgma.water.ca.gov/portal/gsp/preview/99.

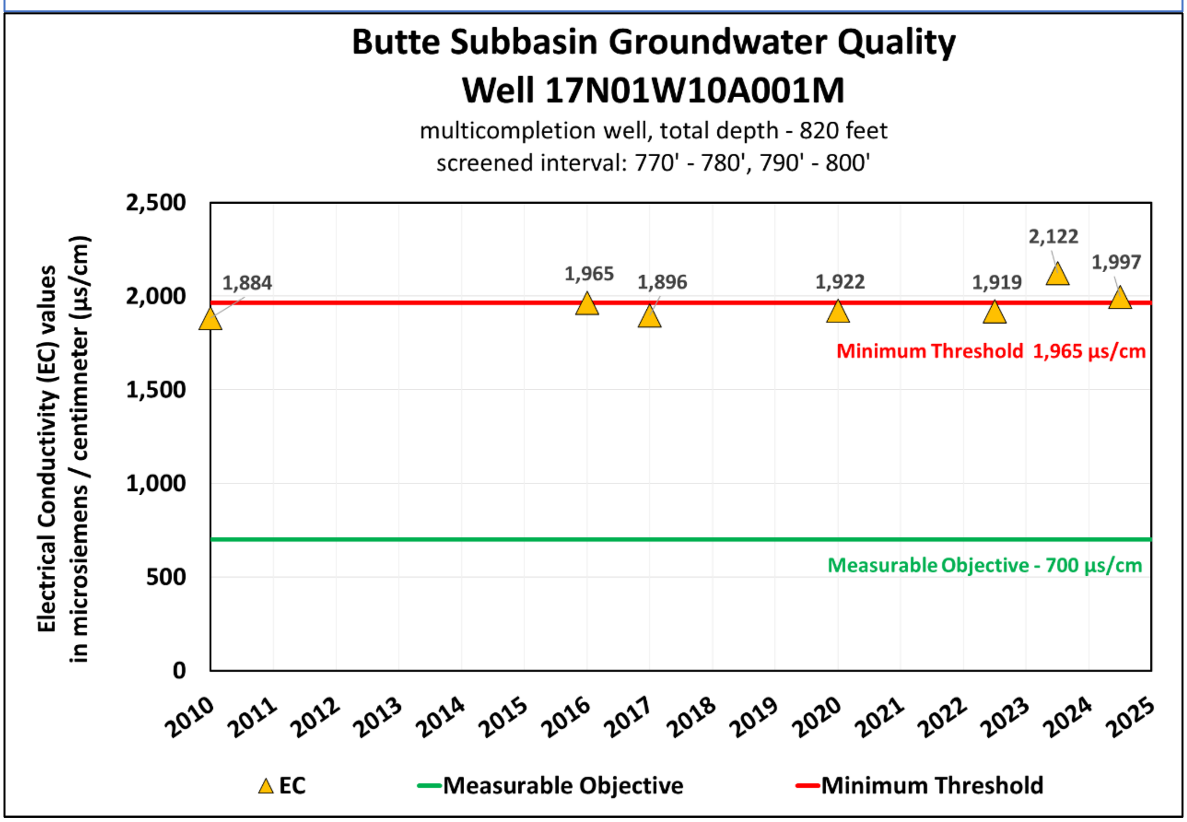
## Appendix A

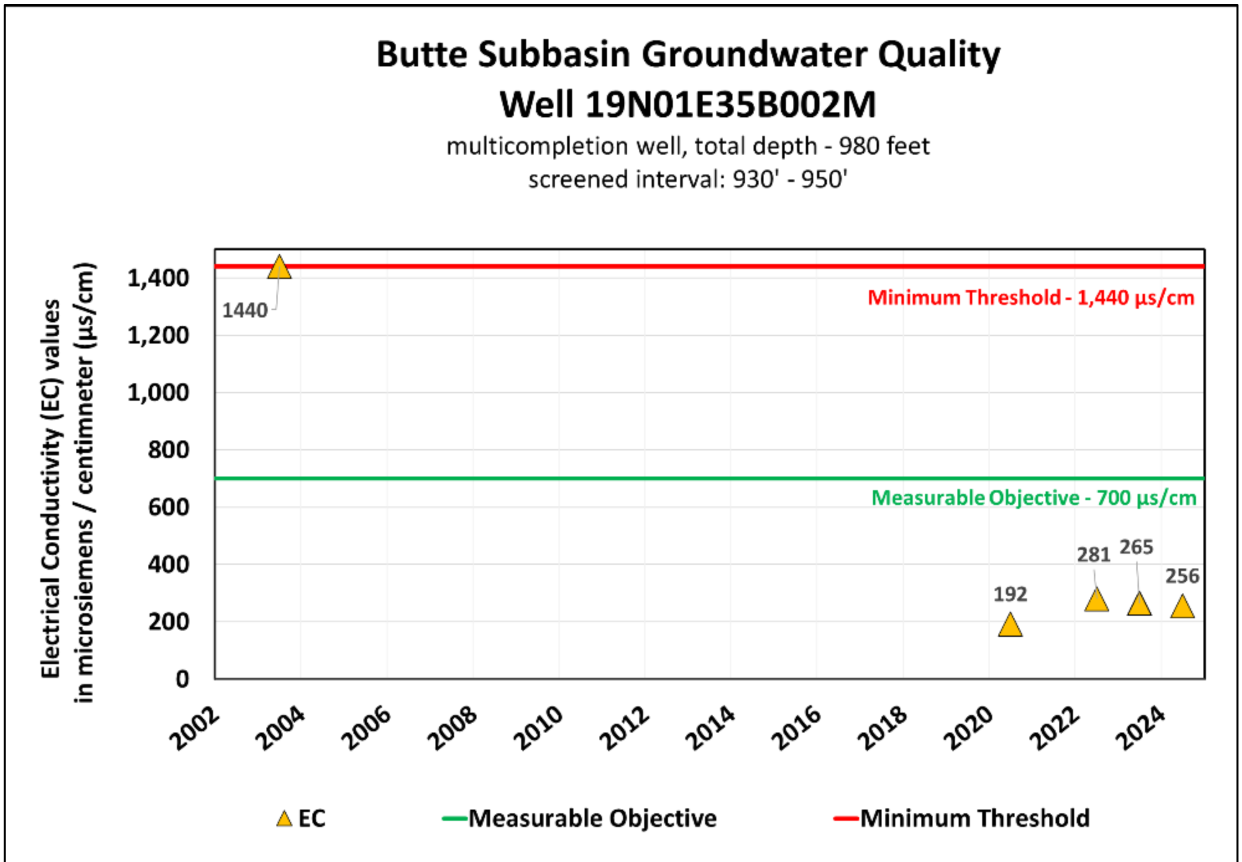
# 2024 Butte, Vina and Wyandotte Creek Subbasin Groundwater Quality Monitoring Results

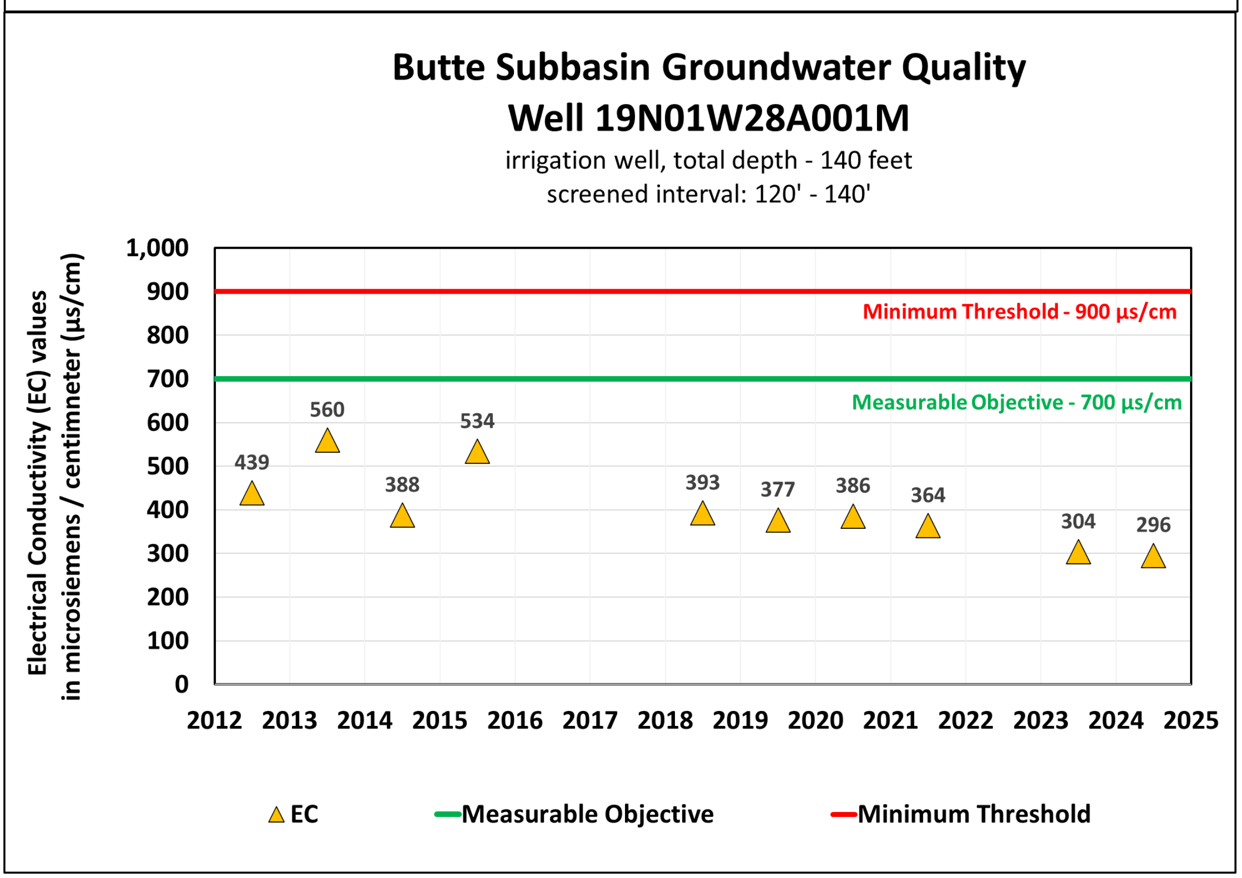
**Appendix A. Historical and current electrical conductivity data for individual wells in the Butte, Vina and Wyandotte Creek Subbasin's 2024 water quality monitoring network.**

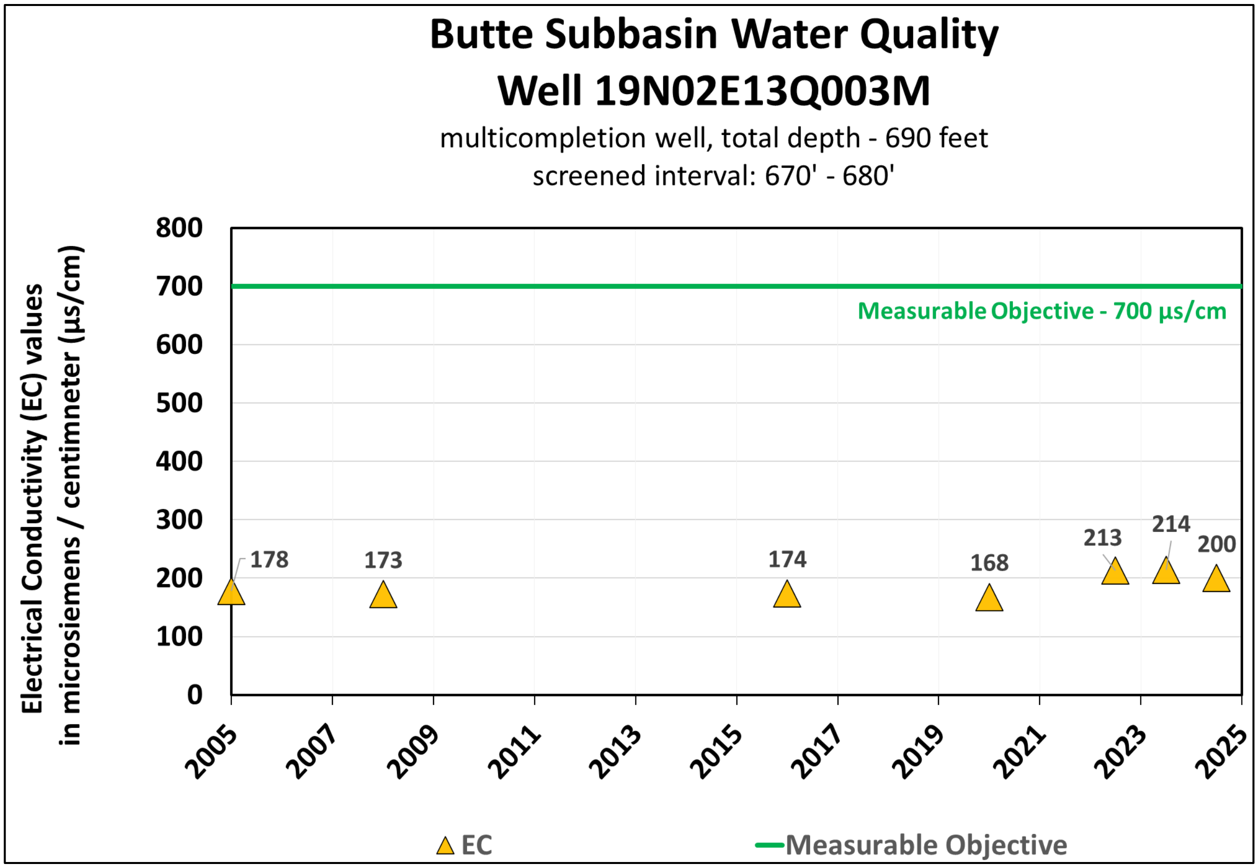
__Butte Subbasin__

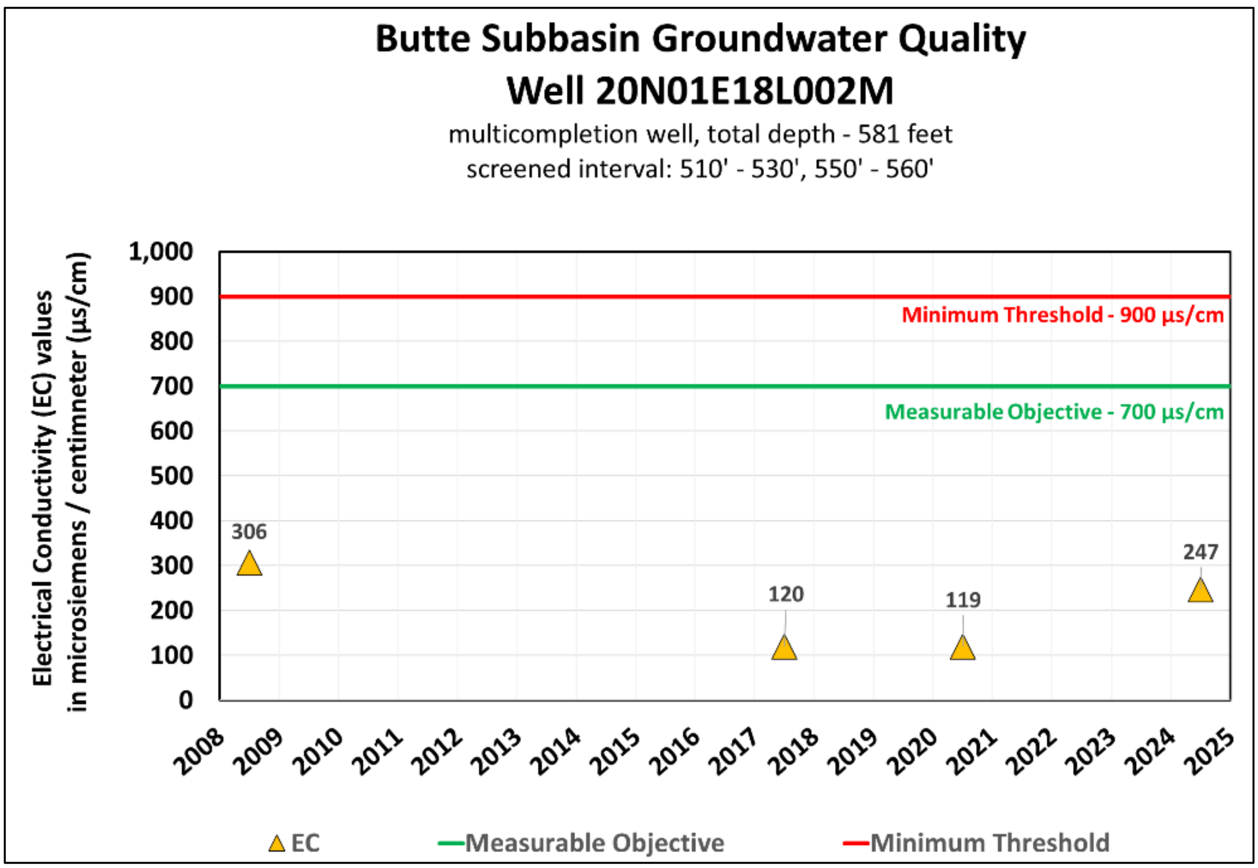


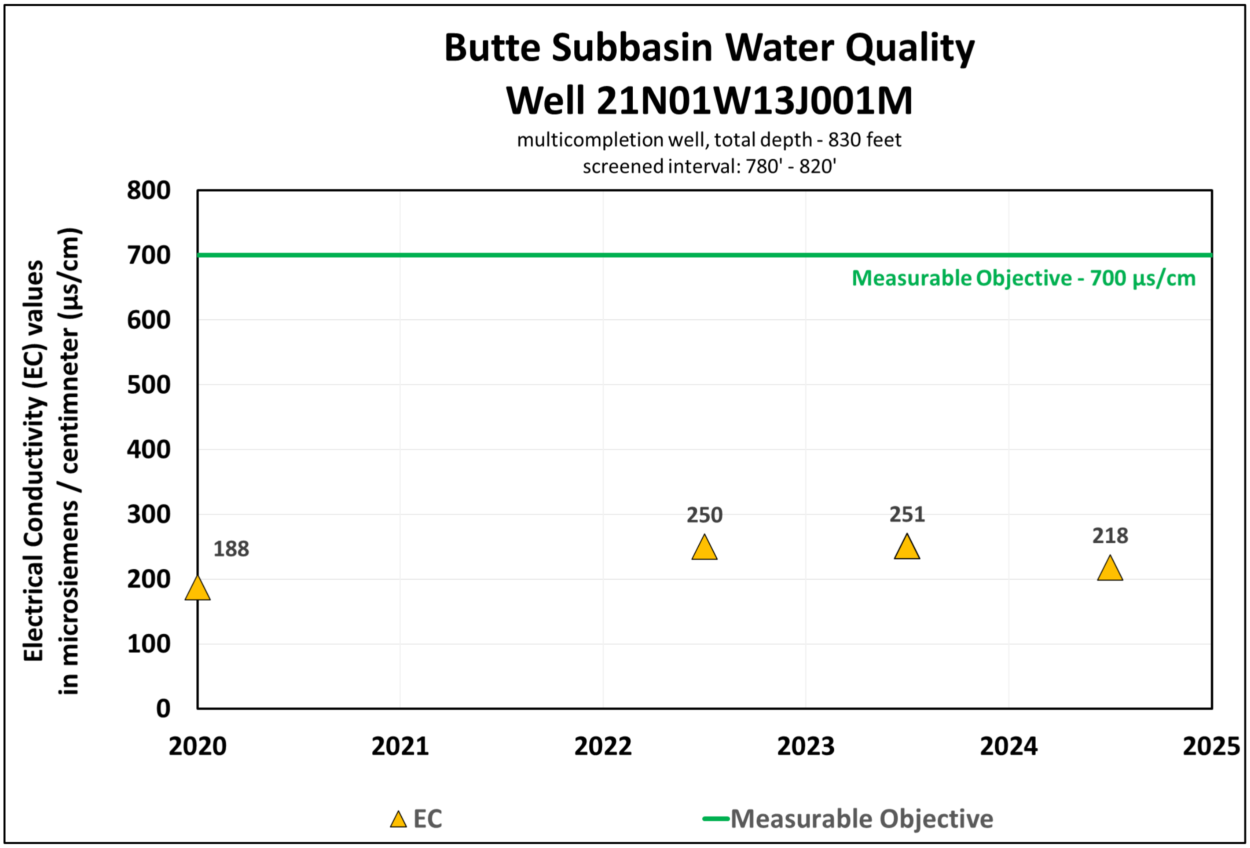




Butte Subbasin Groundwater Quality
Well 19N01E35B002M
multicompletion well, total depth - 980 feet
screened interval: 930' - 950'
Electrical Conductivity (EC) values in microsiemens / centimneter (µs/cm)
Minimum Threshold - 1,440 µs/cm
Measurable Objective - 700 µs/cm
1440
192
281
265
256
0
200
400
600
800
1,000
1,200
1,400
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
EC
Measurable Objective
Minimum Threshold


Butte Subbasin Groundwater Quality
Well 19N01W28A001M
irrigation well, total depth - 140 feet
screened interval: 120' - 140'
Electrical Conductivity (EC) values in microsiemens / centimneter (µs/cm)
Minimum Threshold - 900 µs/cm
Measurable Objective - 700 µs/cm
439
560
388
534
393
377
386
364
304
296
0
100
200
300
400
500
600
700
800
900
1,000
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
EC
Measurable Objective
Minimum Threshold

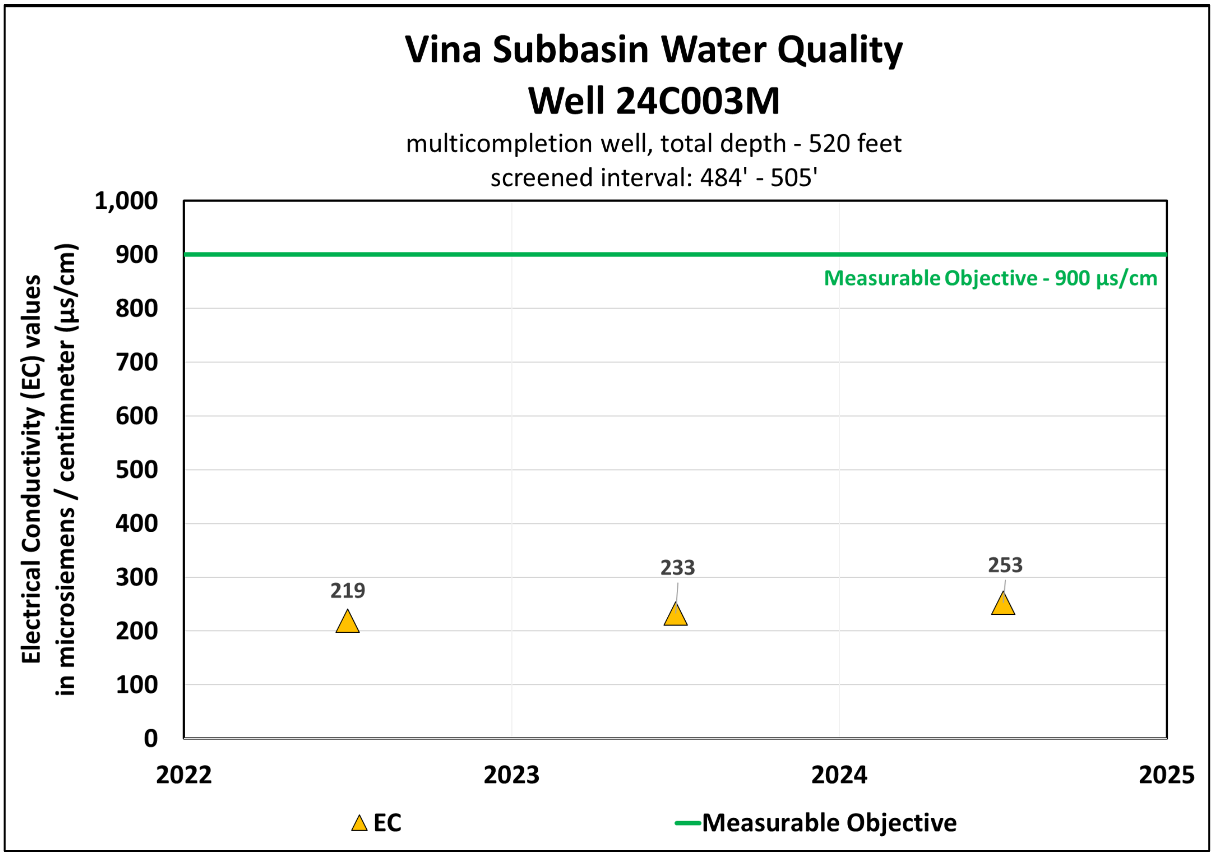

Butte Subbasin Water Quality
Well 19N02E13Q003M
multicompletion well, total depth - 690 feet
screened interval: 670' - 680'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
Measurable Objective - 700 µs/cm
178
173
174
168
213
214
200
0
100
200
300
400
500
600
700
800
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
2025
EC
Measurable Objective

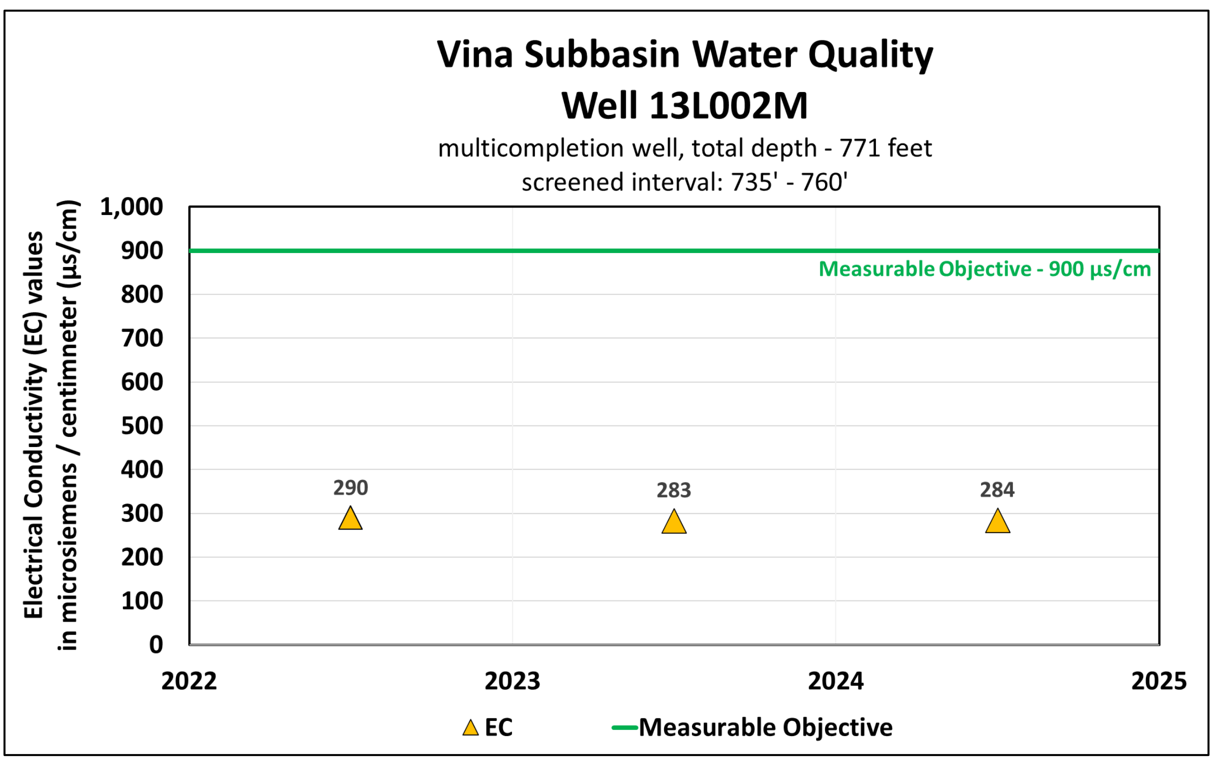

Butte Subbasin Groundwater Quality
Well 20N01E18L002M
multicompletion well, total depth - 581 feet
screened interval: 510' - 530', 550' - 560'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
Minimum Threshold - 900 µs/cm
Measurable Objective - 700 µs/cm
306
120
119
247
0
100
200
300
400
500
600
700
800
900
1,000
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
EC
Measurable Objective
Minimum Threshold

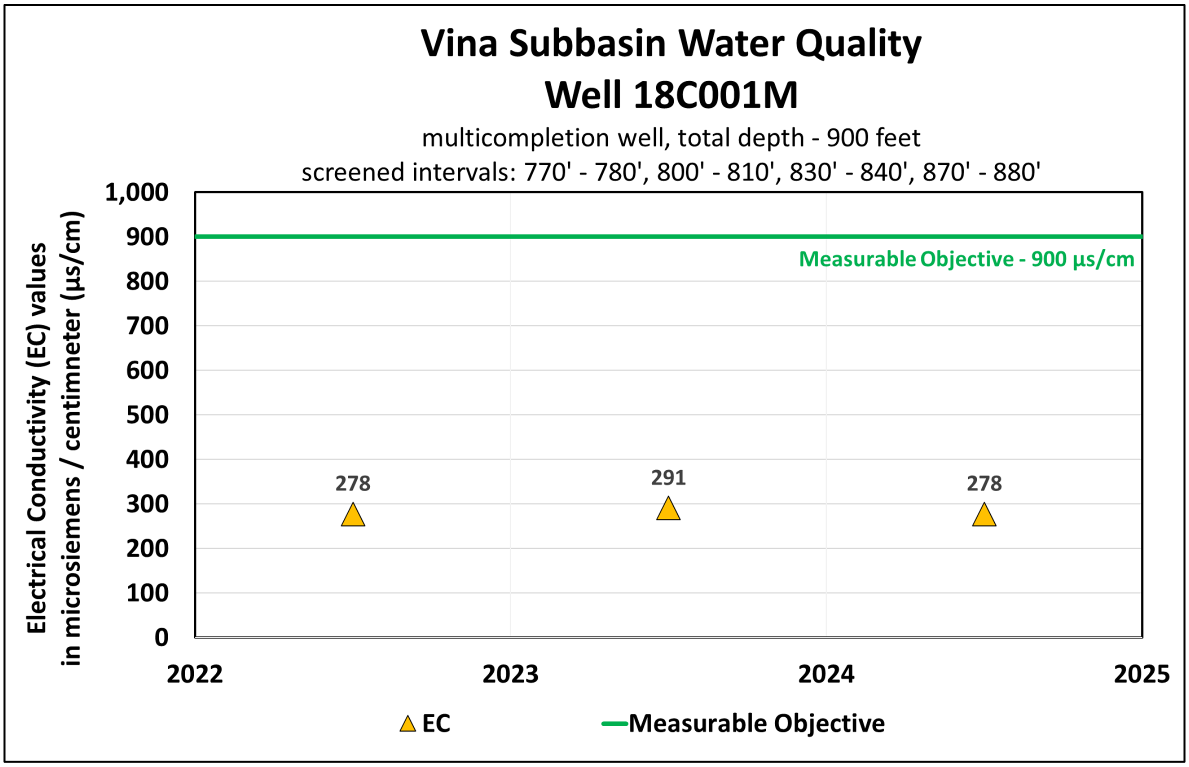


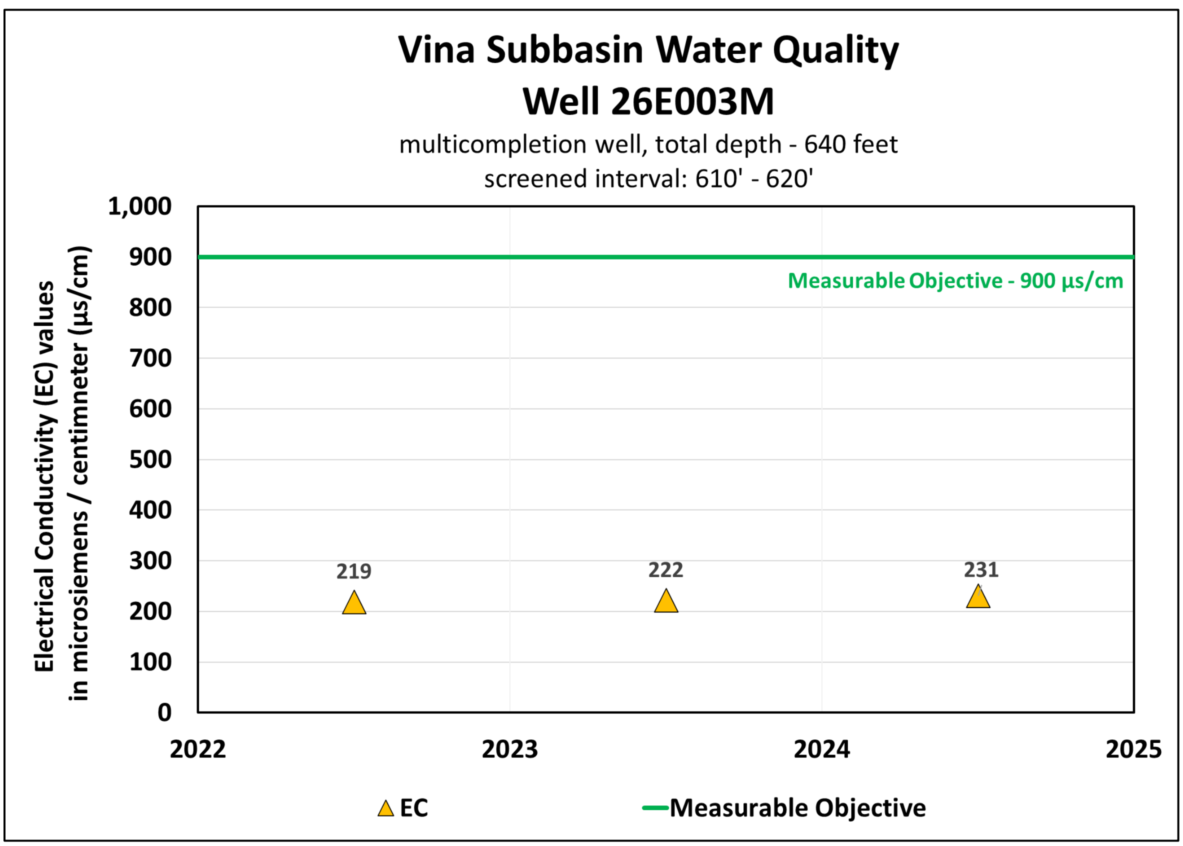
Butte Subbasin Water Quality
Well 21N01W13J001M
multicompletion well, total depth - 830 feet
screened interval: 780' - 820'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
800
700
600
500
400
300
200
100
0
2020
2021
2022
2023
2024
2025
Measurable Objective - 700 µs/cm
188
250
251
218
EC
Measurable Objective

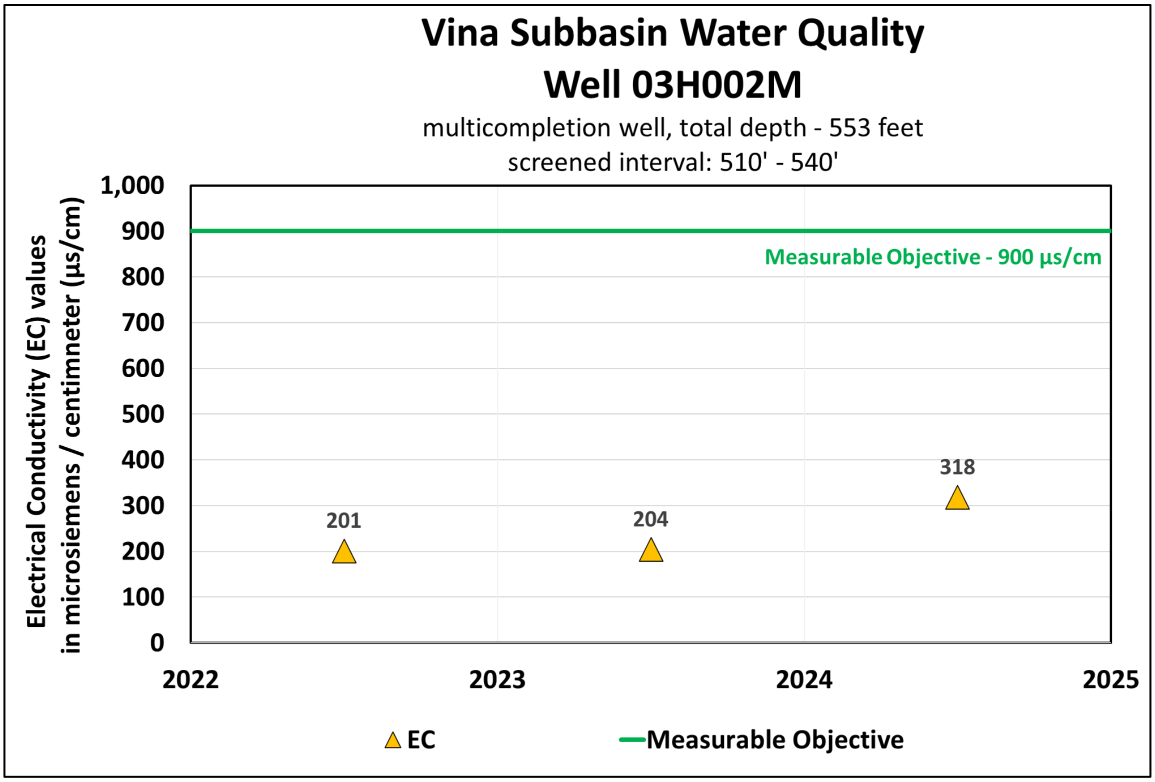
Vina Subbasin

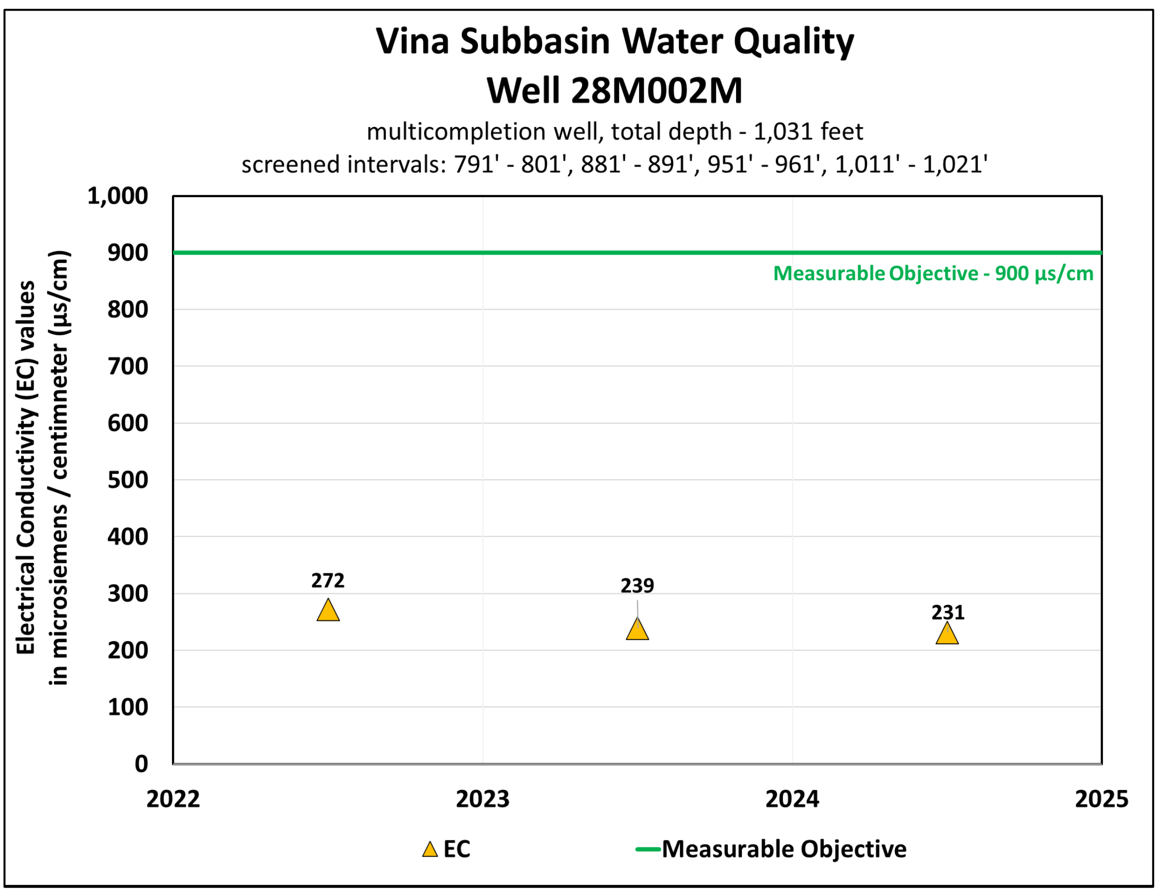


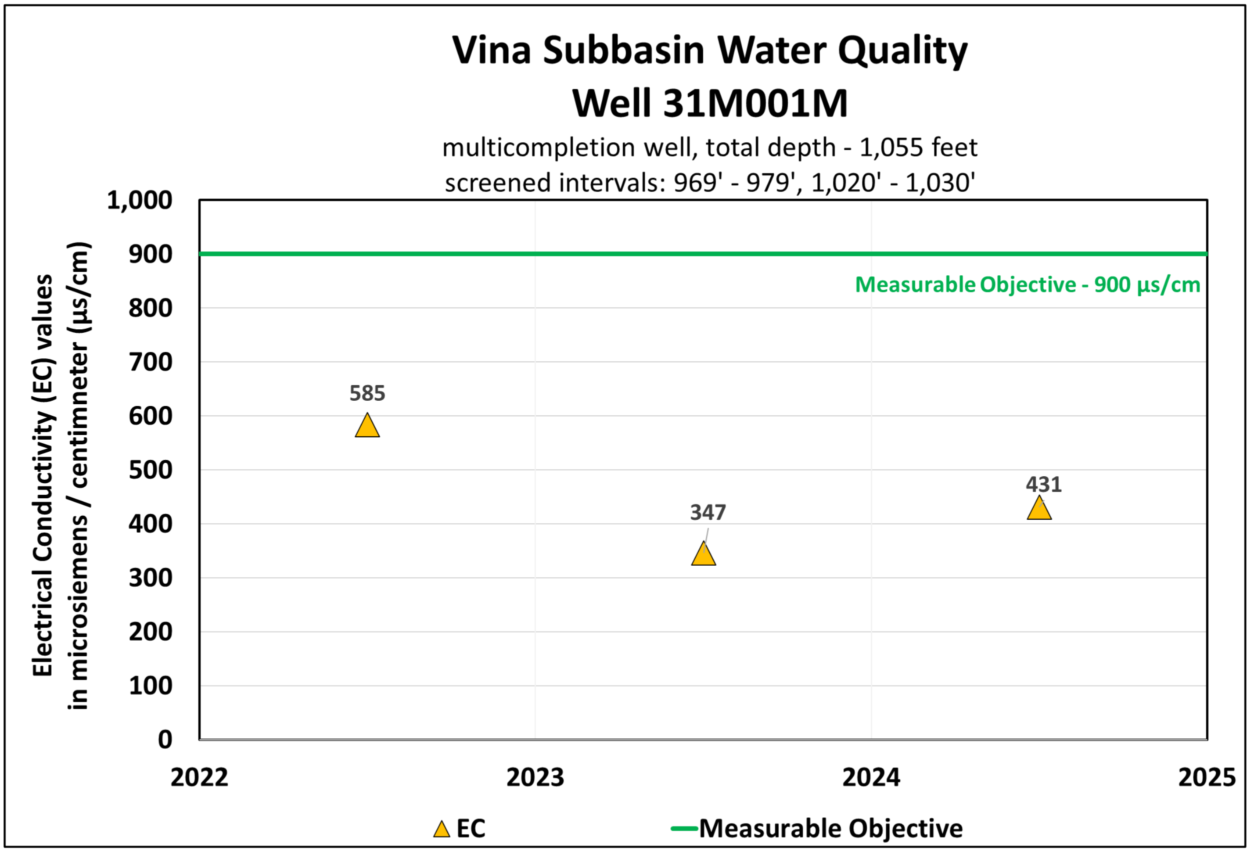




Vina Subbasin Water Quality
Well 18C001M
multicompletion well, total depth - 900 feet
screened intervals: 770' - 780', 800' - 810', 830' - 840', 870' - 880'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
1,000
900
800
700
600
500
400
300
200
100
0
2022
2023
2024
2025
Measurable Objective - 900 µs/cm
278
291
278
EC
Measurable Objective

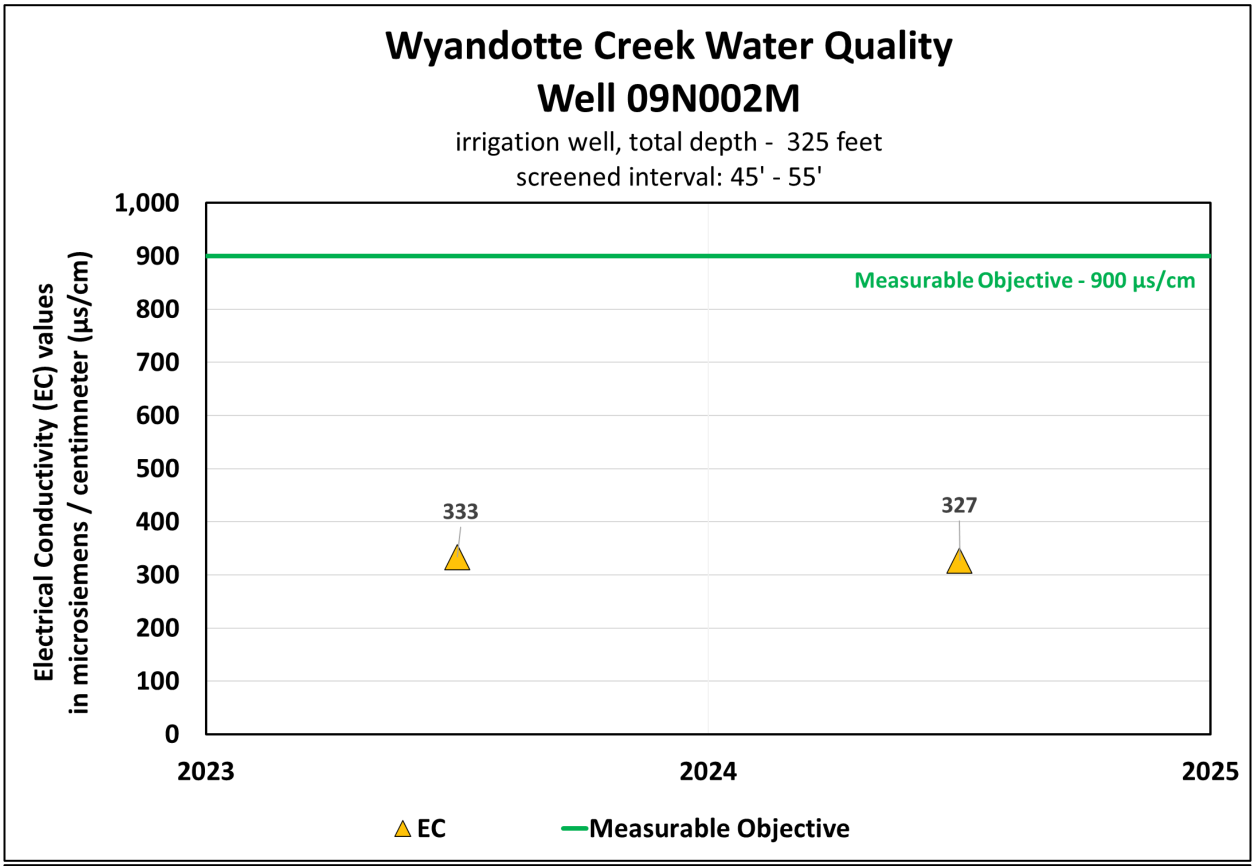

Vina Subbasin Water Quality
Well 26E003M
multicompletion well, total depth - 640 feet
screened interval: 610' - 620'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
1,000
900
800
700
600
500
400
300
200
100
0
2022
2023
2024
2025
Measurable Objective - 900 µs/cm
219
222
231
EC
Measurable Objective

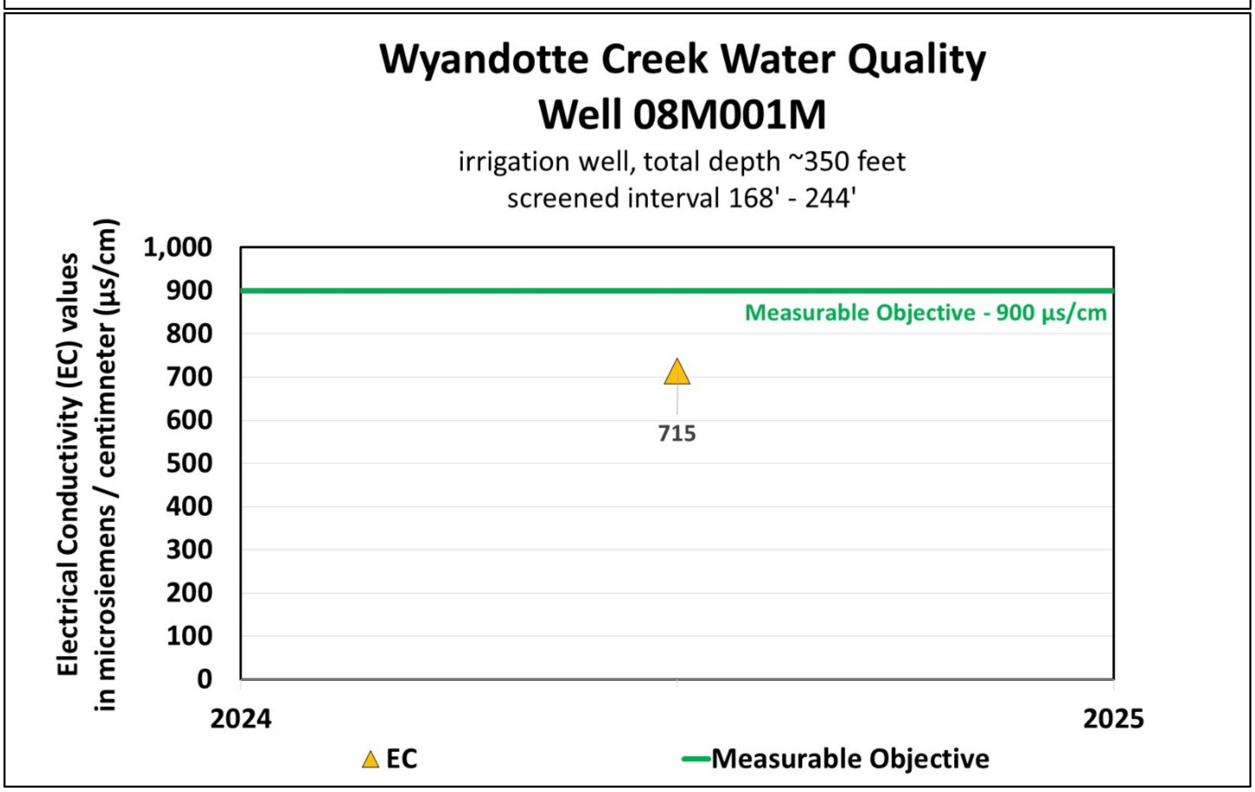

Vina Subbasin Water Quality
Well 03H002M
multicompletion well, total depth - 553 feet
screened interval: 510' - 540'
Electrical Conductivity (EC) values in microsiemens / centimneter (µs/cm)
1,000
900
800
700
600
500
400
300
200
100
0
Measurable Objective - 900 µs/cm
201
204
318
2022
2023
2024
2025
EC
Measurable Objective

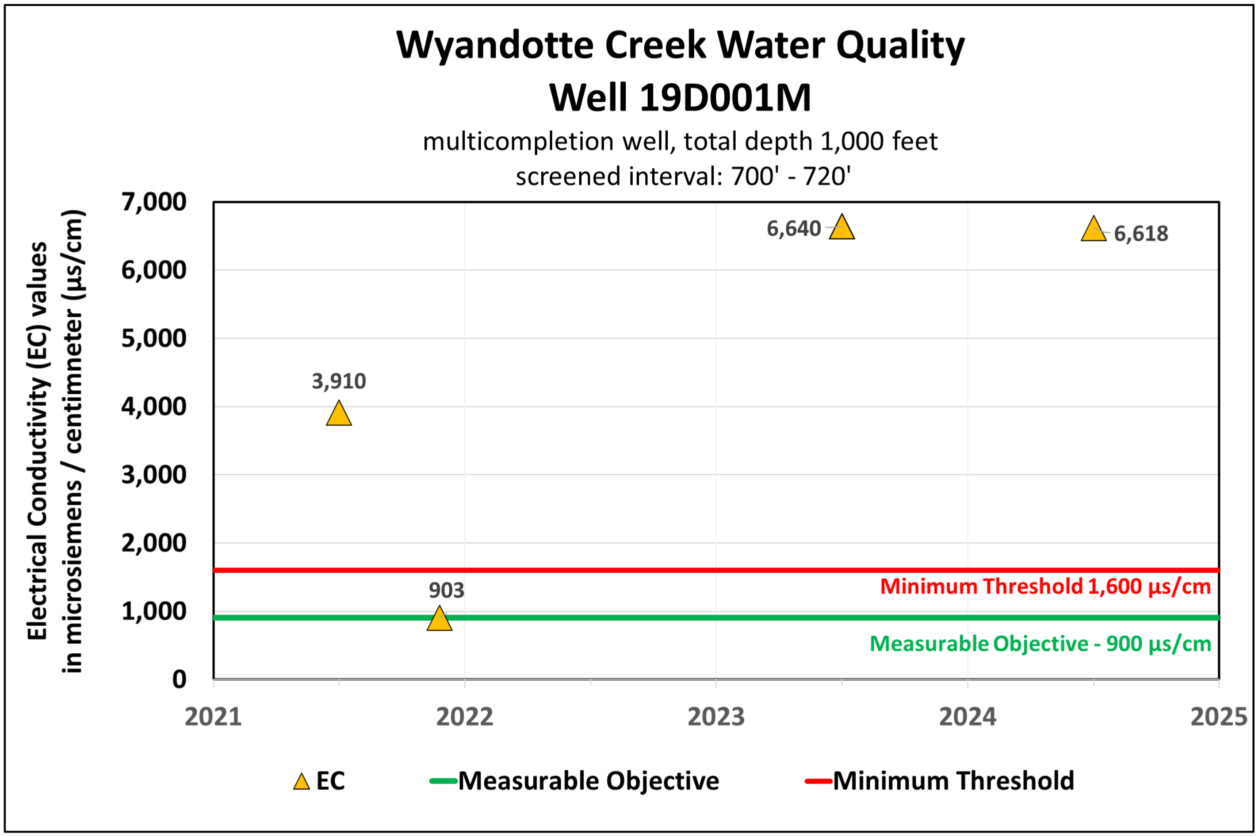

Vina Subbasin Water Quality
Well 28M002M
multicompletion well, total depth - 1,031 feet
screened intervals: 791' - 801', 881' - 891', 951' - 961', 1,011' - 1,021'
Electrical Conductivity (EC) values in microsiemens / centimneter (µs/cm)
1,000
900
800
700
600
500
400
300
200
100
0
Measurable Objective - 900 µs/cm
272
239
231
2022
2023
2024
2025
EC
Measurable Objective

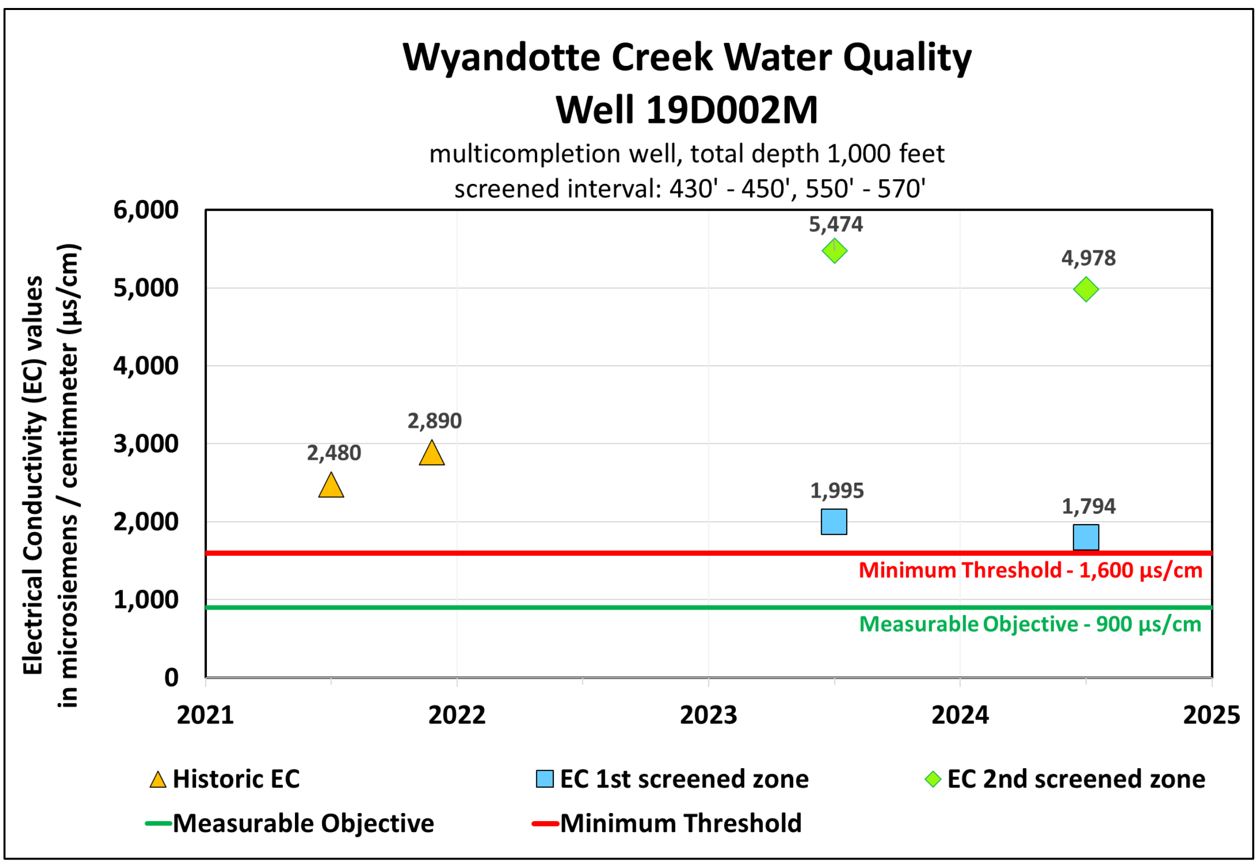

Vina Subbasin Water Quality
Well 31M001M
multicompletion well, total depth - 1,055 feet
screened intervals: 969' - 979', 1,020' - 1,030'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
1,000
900
800
700
600
500
400
300
200
100
0
2022
2023
2024
2025
Measurable Objective - 900 µs/cm
585
347
431
EC
Measurable Objective

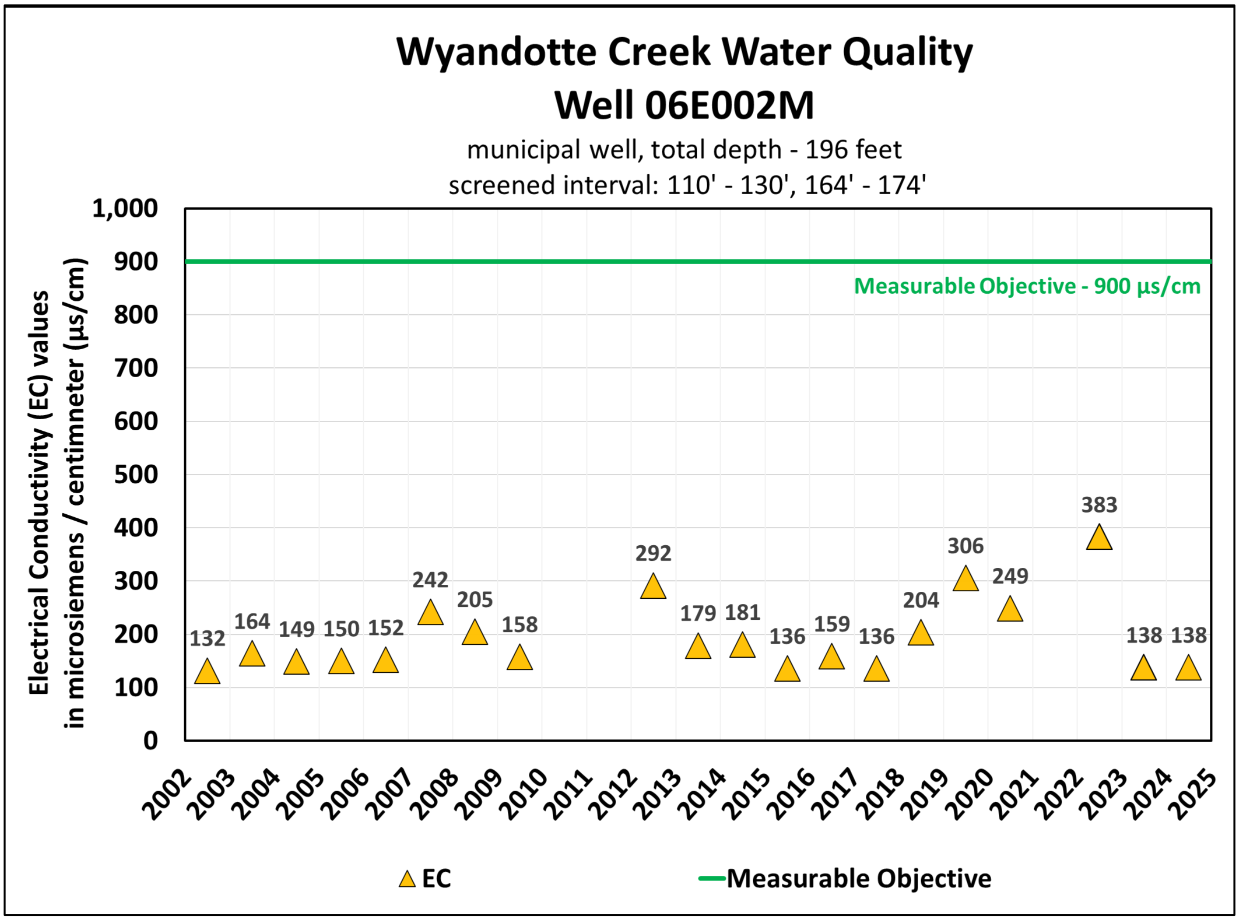
**Wyandotte Creek Subbasin**




Wyandotte Creek Water Quality
Well 19D001M
multicompletion well, total depth 1,000 feet
screened interval: 700' - 720'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2021
2022
2023
2024
2025
3,910
903
6,640
6,618
Minimum Threshold 1,600 µs/cm
Measurable Objective - 900 µs/cm
EC
Measurable Objective
Minimum Threshold


Wyandotte Creek Water Quality
Well 19D002M
multicompletion well, total depth 1,000 feet
screened interval: 430' - 450', 550' - 570'
Electrical Conductivity (EC) values
in microsiemens / centimneter (µs/cm)
6,000
5,000
4,000
3,000
2,000
1,000
0
2021
2022
2023
2024
2025
2,480
2,890
5,474
4,978
1,995
1,794
Minimum Threshold - 1,600 µs/cm
Measurable Objective - 900 µs/cm
Historic EC
EC 1st screened zone
EC 2nd screened zone
Measurable Objective
Minimum Threshold


Wyandotte Creek Water Quality
Well 06E002M
municipal well, total depth - 196 feet
screened interval: 110' - 130', 164' - 174'
Electrical Conductivity (EC) values in microsiemens / centimneter (µs/cm)
Measurable Objective - 900 µs/cm
1,000
900
800
700
600
500
400
300
200
100
0
132
164
149
150
152
242
205
158
292
179
181
136
159
136
204
306
249
383
138
138
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
EC
Measurable Objective