Paso Robles Subbasin Water Year 2024 Annual Report

PUBLIC DRAFT

Paso Basin Cooperative Committee and the Groundwater Sustainability Agencies

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CONFLUENCE
ENGINEERING SOLUTIONS

Paso Robles Subbasin
Water Year 2024 Annual Report

This report was prepared by the staff of Confluence Engineering Solutions, Inc. under the supervision of professionals whose signatures appear below. The findings or professional opinions were prepared in accordance with generally accepted professional engineering and geologic practices.

Nate R. Page, PG, CHG
Senior Hydrogeologist

Daniel E. Heimel, PE, MS
President/Principal Engineer

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Annual Reports Elements Guide and Checklist

California Code of Regulations – GSP Regulation Sections	Annual Report Elements	Location in Annual Report
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.	Executive Summary (§356.2[a])
	(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:	Section 2.4 Monitoring Networks (§356.2[b])
	(1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:	Section 3.1 Groundwater Elevations (§356.2[b][1])
	(A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.	Section 3.1.3 Seasonal High and Low (Spring and Fall) (§356.2[b][1][A])
	(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.	Section 3.1.4 Hydrographs (§356.2[b][1][B], and Appendix E)
	(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.	Section 3.2 Groundwater Extractions (§356.2[b][2])
	(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.	Section 3.3 Surface Water Use (§356.2[b][3])

California Code of Regulations – GSP Regulation Sections	Annual Report Elements	Location in Annual Report
Article 7	Annual Reports and Periodic Evaluations by the Agency	
§ 356.2	Annual Reports	
	(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.	Section 3.4 Total Water Use (§356.2[b][4])
	(5) Change in groundwater in storage shall include the following:	Section 3.5 Change in Groundwater in Storage (§356.2[b][5])
	(A) Change in groundwater in storage maps for each principal aquifer in the basin.	Section 3.5.1 Annual Changes in Groundwater Elevation (§356.2[b][5][A])
	(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.	Section 3.5.2 Annual and Cumulative Change in Groundwater in Storage Calculations (§356.2[b][5][B])
	(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.	Section 4 Progress towards Basin Sustainability (§356.2[c])

Executive Summary

Introduction

This Water Year 2024 Annual Report for the Paso Robles Area Subbasin of the Salinas Valley Groundwater Basin (Paso Robles Subbasin or Subbasin) (see Figure 1) has been prepared in accordance with the Sustainable Groundwater Management Act (SGMA) regulations for Groundwater Sustainability Plans (GSPs). Pursuant to the SGMA regulations, a GSP Annual Report must be submitted to the California Department of Water Resources (DWR) by April 1 of each year following the adoption of the GSP.

With the submittal of the adopted Paso Robles Subbasin GSP on January 31, 2020, (M&A, 2020) the Groundwater Sustainability Agencies (GSAs) are required to submit an annual report for the preceding water year (WY) (October 1 through September 30) to DWR by April 1 of each subsequent year. These annual reports convey monitoring and water use data to DWR and Subbasin stakeholders on an annual basis to gauge performance of the Subbasin relative to the sustainability goals set forth in the GSP.

Sections of the WY 2024 Annual Report include the following:

Section 1. Introduction -- Paso Robles Subbasin Water Year 2024 Annual Report: A brief background of the formation and activities of the Paso Robles Subbasin GSAs and development and submittal of the GSP.

Section 2. Paso Robles Subbasin Setting and Monitoring Networks: A summary of the Subbasin setting, Subbasin monitoring networks, and ways in which data are used for groundwater management.

Section 3. 2024 Data and Subbasin Conditions

- **3.1 Groundwater Elevations (§356.2[b][1])**: A description of recent monitoring data with groundwater elevation contour maps for spring and fall monitoring events and representative hydrographs.
- **3.2 Groundwater Extractions (§356.2[b][2])**: A compilation of metered and estimated groundwater extractions by land use sector and location of extractions.
- **3.3 Surface Water Use (§356.2[b][3])**: A summary of reported surface water use.
- **3.4 Total Water Use (§356.2[b][4])**: A presentation of total water use by source and sector.
- **3.5 Change in Groundwater in Storage (§356.2[b][5])**: A description of the methodology and presentation of changes in groundwater in storage based on fall to fall groundwater elevation differences.
- **3.6 Additional Sustainability Indicators**: Descriptions of recent monitoring data with respect to land subsidence, interconnected surface water, and groundwater quality.
- **3.7 Summary of Changes in Subbasin Conditions**

Section 4. Progress towards Basin Sustainability (§356.2[c]): A summary of projects and management actions taken throughout the Subbasin by GSAs towards sustainability of the Subbasin.

Groundwater Elevations

Groundwater elevations observed in the Subbasin during WY 2024 are generally similar to those observed the previous year. Positive and negative changes in groundwater elevations from year to year are observed in various parts of the Subbasin, as has been observed historically. Seasonal trends of slightly higher spring groundwater elevations compared with fall levels are observed annually.

In response to the DWR May 31, 2024 letter, providing review of the WY 2023 Annual Report, this WY 2024 Annual Report includes groundwater contour maps for spring and fall in the Alluvial Aquifer.

Groundwater Extractions

Total groundwater extractions in the Subbasin for WY 2024 are estimated to be 75,100 acre-feet (AF). These totals include municipal and small public water systems[1] (PWSs) pumping, rural domestic pumping, and golf course and irrigated agricultural water demand. Table ES- 1 summarizes the groundwater extractions by water use sector for each water year. The values for WYs 2017–2023 (grayed out) are included for reference purposes. This convention is carried throughout the report.

Table ES- 1. Groundwater Extractions by Water Use Sector

Water Year	Groundwater Extractions by Water Use Sector			Total (AF)
	Municipal PWS[1] (AF)	Small PWS, Golf and Rural Domestic (AF)	Agriculture (AF)	
2017	1,626	3,058	65,300	**70,000**
2018	1,677	3,880	80,200	**85,800**
2019	1,729	3,243	68,800	**73,800**
2020	1,509	3,906	72,600	**78,000**
2021	1,553	4,364	74,800	**80,700**
2022	1,982	3,790	76,900	**82,700**
2023	1,134	2,876	59,600	**63,600**
2024	1,044	3,134	70,900	**75,100**
Method of Measure:	Metered	GSP Groundwater Model, varied by water year type	OpenET	---
Level of Accuracy:	high	low-medium	medium	---

Notes
[1] These volumes include any water produced as Salinas River underflow within the Paso Robles Subbasin.
— = not applicable
AF = acre-feet
PWS = public water system

[1] A PWS is defined as a system that provides water for human consumption to 15 or more connections or regularly serves 25 or more people daily for at least 60 days out of the year (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/waterpartnerships/what_is_a_public_water_sys.pdf).

Surface Water Use

The Subbasin currently can benefit from surface water entitlements from the Nacimiento Water Project (NWP) and the State Water Project to supplement municipal groundwater demands in the City of Paso Robles and the community of Shandon, respectively. In WY 2024, the City of Paso Robles used 2,148 AF of their NWP entitlement, but 487 AF of their NWP deliveries were recharged and extracted in the Atascadero Subbasin, so those volumes do not show up in this accounting. Locations of communities dependent on groundwater and with access to surface water are shown in Figure 11. There is currently no surface water available for agricultural or recharge project use within the Subbasin. A summary of total actual surface water use by source is provided in Table ES- 2.

Table ES- 2. Total Surface Water Use by Source

Water Year	Nacimiento Water Project (AF)	Imported Atascadero Basin Salinas River Underflow[1] (AF)	State Water Project (AF)	Total Surface Water Use (AF)
2017	1,650	2,609	42	**4,301**
2018	1,423	3,352	55	**4,829**
2019	1,142	3,075	43	**4,259**
2020	737	3,852	0	**4,589**
2021	1,250	3,612	0	**4,861**
2022	901	3,349	0	**4,250**
2023	1,432	3,130	0	**4,562**
2024	1,660	3,151	0	**4,811**

Notes

[1] The City of Paso Robles produces Salinas River underflow, regulated as surface water by the State Water Resources Control Board, from its Thunderbird Wells located in the adjacent Atascadero Subbasin.

AF = acre-feet

Total Water Use

For WY 2024, quantification of total water use was completed through reporting of metered water production data from municipal wells (including imported Salinas River underflow[2]) (see Section 3.3.3), from metered surface water use, and from models used to estimate agricultural crop water supply requirements, including evaporative losses from agricultural storage ponds. In addition, rural water use, golf course irrigation demand, and small commercial PWS use was estimated. Table ES- 3 summarizes the total annual water use in the Subbasin by source and water use sector.

[2] Salinas River underflow is regulated as surface water by the State Water Resources Control Board.

Table ES- 3. Total Water Use in the Subbasin by Source and Water Use Sector

Water Year	Municipal PWS (AF)		Small PWS, Golf and Rural Domestic (AF)	Agriculture (AF)	Total (AF)
Source:	**Groundwater**	**Surface Water[1]**	**Groundwater**	**Groundwater**	**---**
2017	1,626	4,301	3,058	65,300	**74,300**
2018	1,677	4,829	3,880	80,200	**90,600**
2019	1,729	4,259	3,243	68,800	**78,000**
2020	1,509	4,589	3,906	72,600	**82,600**
2021	1,553	4,861	4,364	74,800	**85,600**
2022	1,982	4,250	3,790	76,900	**86,900**
2023	1,134	4,562	2,876	59,600	**68,200**
2024	1,044	4,811	3,134	70,900	**79,900**
Method of Measure:	Metered	Metered	GSP Groundwater Model, varied by water year type	OpenET	---
Level of Accuracy:	high	high	low-medium	medium	---

Notes
[1] Includes imported Salinas River underflow, which is regulated as surface water by the State Water Resources Control Board.
— = not applicable
AF = acre-feet
PWS = public water system

Change in Groundwater in Storage

The calculation of change in groundwater in storage in the Subbasin was derived from comparison of fall groundwater elevation contour maps from one year to the next. For this analysis, the fall 2023 groundwater elevations were subtracted from the fall 2024 groundwater elevations resulting in maps depicting the changes in groundwater elevation that occurred during WY 2024 in both the Alluvial Aquifer and the Paso Robles Formation Aquifer. In response to the DWR May 31, 2024 letter, providing review of the WY 2023 Annual Report, this WY 2024 Annual Report includes a calculation of change in groundwater in storage for the Alluvial Aquifer.

The groundwater elevation change maps for WY 2024 (see Figure 14 and Figure 15) represent an overall moderate loss of groundwater in storage, with some areas showing higher elevation and other areas lower elevation compared to the previous fall.

The annual change of groundwater in storage calculated for WY 2024 is presented in Table ES- 4. Increases of groundwater in storage are presented as positive numbers and decreases of groundwater in storage are presented as negative numbers.

Table ES- 4. Annual Change of Groundwater in Storage

Water Year	Annual Change (AF)
2017	60,100
2018	6,400
2019	59,700
2020	-80,800
2021	-41,500
2022	-117,100
2023	120,700
2024	-25,500

Note
AF = acre-feet

Progress towards Meeting Basin Sustainability

Several projects and management actions are in process or have been recently implemented in the Subbasin to attain sustainability, many of these efforts are supported by the DWR Sustainable Groundwater Management (SGM) Grant Program – Implementation Round 1 grant funding. These projects and actions include capital projects as well as basin-wide initiatives intended to reduce or optimize local groundwater use. Some of these projects were described in concept in the GSP and some are new initiatives designed to make new water supplies available to the Subbasin to reduce pumping and partially mitigate the degree to which management actions would be needed. Some of the ongoing efforts include:

- Expansion of Monitoring Networks
- Non-De Minimus Metering and Reporting Program
- Multi-benefit Irrigated Land Repurposing Program
- Review of GSP Groundwater Model SFR Package
- Supplemental State Water Supply Feasibility Study
- Drinking Water Well Impact Mitigation Program
- Development of Joint Powers Authority
- Cost of Service Study
- GSP 5-Year Evaluation
- City of Paso Robles Recycled Water Program
- San Miguel Community Services District Recycled Water Project
- Blended Water Project

Since the publication of the GSP in 2020, there has been a mix of wet years, average years, and drought. Historical groundwater pumping in excess of the sustainable yield has created challenging conditions for sustainable management. Of particular concern are communities and rural residential areas that rely solely on groundwater for their water supply[3] (see Figure 11). During WY 2024, several dry wells were replaced, a direct result of declining water levels. The distribution of these dry well replacements that occurred during WY 2024 is shown in Figure 11.

Actions are underway to collect data, improve the monitoring and data collection networks, and coordinate with affected agencies and entities throughout the Subbasin to develop solutions that address the shared mutual interest in the Subbasin's overall sustainability goal.

Following two consecutive years of above average annual precipitation, groundwater elevations observed in the Subbasin during WY 2024 are generally similar to those observed in the previous year. However, three of the 22 Paso Robles Formation Aquifer representative monitoring site (RMS) wells in the Subbasin groundwater monitoring network exhibit groundwater elevations below the minimum threshold established in the GSP (M&A, 2020). In WY 2024, three RMS wells are exhibiting groundwater elevations below the minimum threshold for two or more consecutive years, each constituting an undesirable result as defined in the GSP (27S/13E-28F01 for the fifth consecutive year, 27S/13E-30J01 for the third consecutive year and 27S/12E-13N01 for the second consecutive year) (see Section 3.1). Although groundwater elevations in a few of the Paso Robles Formation Aquifer RMS wells are stable to slightly increasing during the past few years, groundwater elevations in several of the RMS wells are continuing to trend downward. Six of the 22 Paso Robles Formation Aquifer RMS wells have average WY 2024 groundwater elevations greater than the measurable objective for that RMS well.

Updated Interferometric Synthetic Aperture Radar (InSAR) data has been provided by DWR through October 2024. As discussed in the GSP (M&A, 2020), to minimize the influence of elastic subsidence, changes in ground level should be measured annually from June of one year to June of the following year (M&A, 2020). For this WY 2024 Annual Report, the single-year land subsidence was measured using InSAR from June 2023 through June 2024 and the 5-year land subsidence was measured from June 2019 through June 2024. Considering the range of potential error in the InSAR method (see Section 3.6.1), examination of the single-year change InSAR data from June 2023 to June 2024 show that zero land subsidence has occurred (Figure 18). Considering the same potential error for the 5-year cumulative change InSAR data from June 2019 to June 2024, it is apparent that as much as 0.20 feet of subsidence has occurred during this period (Figure 19). Although minor land subsidence is documented during the 5-year period, neither of these results indicate an undesirable result as specified by the land subsidence minimum thresholds. The GSAs will continue to monitor and report annual subsidence as more data become available.

At this time, there are insufficient data available to adequately assess the interconnectivity of surface water and groundwater and the potential depletion of interconnected surface water. Although there is at present only a single Alluvial Aquifer RMS well in the Subbasin, 11 existing alluvial wells are monitored including six wells along the Salinas River, two wells next to the Estrella River near Airport Road and Jardine Road, one well along Cholame Creek just upstream of the confluence with San Juan Creek in

[3] Affected communities may include Disadvantaged Communities (DACs), which are defined as: "the areas throughout California which most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes as well as high incidence of asthma and heart disease" (https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/disadvantaged-communities). DACs occurring within the Subbasin as identified by San Luis Obispo Council of Governments are included on Figure 11.

Shandon, and one well along Huer Huero Creek just upstream of the State Highway 41 bridge. Additional Alluvial Aquifer wells will need to be established in the monitoring network before groundwater/surface water interaction can be more robustly analyzed. Several new Alluvial Aquifer monitoring wells are in the process of being installed as part of the Recommended Expanded Groundwater Level Monitoring Network for the Paso Basin produced by the Expanded Monitoring Network Technical Advisory Committee (see Section 4.3.2.2).

Additional time will be necessary to judge the effectiveness and quantitative impacts of the projects and management actions now underway. However, it is clear that the actions in place and as described in this WY 2024 Annual Report are on track towards reaching the sustainability goals laid out in the GSP (M&A, 2020). The anticipated effects of the projects and management actions now underway are expected to significantly affect the ability of the Subbasin to reach the necessary sustainability goals.

1 Introduction – Paso Robles Subbasin Water Year 2024 Annual Report

The Water Year 2024 Annual Report for the Paso Robles Area Subbasin of the Salinas Valley Groundwater Basin (Paso Robles Subbasin or Subbasin) has been prepared for the Paso Basin Cooperative Committee (PBCC) and the Groundwater Sustainability Agencies (GSAs) in accordance with the Sustainable Groundwater Management Act (SGMA) regulations for Groundwater Sustainability Plans (GSPs) (§ 356.2. Annual Reports) (see Appendix A, SGMA Regulations for Annual Reports). Pursuant to the SGMA regulations, a GSP Annual Report must be submitted to the California Department of Water Resources (DWR) by April 1 of each year following the adoption of the GSP. Submittal of the adopted Paso Robles Subbasin GSP occurred on January 31, 2020. The GSAs are required to submit an annual report for the preceding water year (WY) (October 1 through September 30) to DWR by April 1 of each subsequent year. This WY 2024 Annual Report for the Paso Robles Subbasin documents groundwater production, water use data and water level data from October 1, 2023, through October 31, 2024.[4]

1.1 Setting and Background

The Paso Robles Subbasin GSP was prepared by Montgomery & Associates, Inc. (M&A, 2020), on behalf of and in cooperation with the PBCC and the Subbasin GSAs. The GSP, and subsequent annual reports including this WY 2024 Annual Report, covers the entire Paso Robles Subbasin (see Figure 1). The Subbasin lies in the northern portion of San Luis Obispo County. The majority of the Subbasin is comprised of gentle rolling topography and flatlands near the Salinas River Valley, ranging in elevation from approximately 450 to 2,400 feet above mean sea level (AMSL). The Subbasin is drained by the Salinas River and its tributaries, including the Estrella River, Huer Huero Creek, and San Juan Creek. Communities in the Subbasin are the City of Paso Robles and the communities of San Miguel, Creston, and Shandon. Highway 101 is the most significant north-south highway in the Subbasin, with Highways 41 and 46 running east-west across the Subbasin.

The GSP was jointly developed by four GSAs:

- City of Paso Robles GSA
- Paso Basin – County of San Luis Obispo GSA
- San Miguel Community Services District (CSD) GSA
- Shandon-San Juan GSA

The Estrella-El Pomar-Creston Water District (EPCWD) was formed in 2017 and was indirectly involved in development of the GSP through participation in public comment. On June 6, 2023, the EPCWD officially became a GSA in the Paso Robles Subbasin (EPCWD GSA).

The Paso Basin GSAs overlying the Subbasin entered into a Memorandum of Agreement (MOA) in September 2017. The purpose of the MOA was to establish a PBCC to develop a single GSP for the entire Subbasin to be considered for adoption by each GSA and subsequently submitted to DWR for approval. Under the framework of the original MOA, the GSAs engaged the public and coordinated to jointly develop the Paso Robles Subbasin GSP. At its November 20, 2019 meeting, in accordance with the MOA,

[4] The required timeframe of the annual reports, pursuant to the SGMA regulations, is by water year, which is October 1 through September 30 of any year. However, because the County of San Luis Obispo Groundwater Level Monitoring Program measures water levels in October, the October 2024 measurements, for instance, are used to reflect conditions at the end of WY 2024.

the PBCC voted unanimously to recommend that the GSAs adopt the GSP and submit it to DWR by the SGMA deadline. Subsequent actions by each GSA resulted in unanimous approval of the GSP and a joint submittal of the GSP to DWR.

The original MOA included provisions for automatic termination upon approval of the GSP by DWR. Resolutions adopted by each GSA during the GSP approval process included an amendment to the MOA that removed automatic termination language because the GSAs will continue cooperating on the GSP and its implementation until such time as the long-term governance structure for implementation of the GSP is developed. As of June 6, 2023, the EPCWD GSA is now also party to the MOA.

Each of the GSAs appointed a representative Member and Alternate to the PBCC to coordinate activities among the GSAs during the development of the GSP and the development and submittal of this WY 2024 Annual Report. The GSAs also agreed to designate the County of San Luis Obispo Director of Public Works as the Plan Manager with the authority to submit the GSP and annual reports and serve as the point of contact with DWR. However, on November 2, 2021, the County of San Luis Obispo filled a newly created position of Groundwater Sustainability Director, which reports directly to the County of San Luis Obispo Administrative Officer, and operates independently of the Public Works Department. The Groundwater Sustainability Director position has supplanted the Director of Public Works as the designated GSP Plan Manager.

1.2 Organization of this Report

The required contents of an annual report are provided in the SGMA Regulations (§ 356.2), included as Appendix A. Organization of the report is meant to follow the regulations where possible to assist in the review of the document. The sections are briefly described as follows:

Section 1. Introduction -- Paso Robles Subbasin Water Year 2024 Annual Report: A brief background of the formation and activities of the Paso Robles Subbasin GSAs and development and submittal of the GSP.

Section 2. Paso Robles Subbasin Setting and Monitoring Networks: A summary of the Subbasin setting, Subbasin monitoring networks, and ways in which data are used for groundwater management.

Section 3. 2024 Data and Subbasin Conditions

3.1 Groundwater Elevations (§356.2[b][1]): A description of recent monitoring data with groundwater elevation contour maps for spring and fall monitoring events and representative hydrographs.

3.2 Groundwater Extractions (§356.2[b][2]): A compilation of metered and estimated groundwater extractions by land use sector and location of extractions.

3.3 Surface Water Use (§356.2[b][3]): A summary of reported surface water use.

3.4 Total Water Use (§356.2[b][4]): A presentation of total water use by source and sector.

3.5 Change in Groundwater in Storage (§356.2[b][5]): A description of the methodology and presentation of changes in groundwater in storage based on fall to fall groundwater elevation differences.

3.6 Additional Sustainability Indicators: Descriptions of recent monitoring data with respect to land subsidence, interconnected surface water, and groundwater quality.

3.7 Summary of Changes in Subbasin Conditions

Section 4. Progress towards Basin Sustainability (§356.2[c]): A summary of projects and management actions taken throughout the Subbasin by GSAs towards sustainability of the Subbasin.

2 Paso Robles Subbasin Setting and Monitoring Networks

2.1 Introduction

This section provides a brief description of the basin setting and the groundwater management monitoring programs described in the GSP, as well as any notable events affecting monitoring activities or the quality of monitoring results in the reported WY 2024. Much of the background information reported on in this WY 2024 Annual Report was taken from the GSP prepared by Montgomery & Associates, Inc. (M&A, 2020).

2.2 Subbasin Setting

The Subbasin is a structural trough trending to the northwest filled with terrestrially derived sediments sourced from the surrounding mountains. The Subbasin is surrounded by relatively impermeable geologic formations, sediments with poor water quality, and structural faults. Land surface elevation ranges from approximately 2,000 feet AMSL in the southeast extent of the Subbasin to about 600 feet AMSL in the northwest extent, where the Salinas River exits the Subbasin. Agriculture is the dominant land use. The Subbasin includes the incorporated City of Paso Robles and unincorporated communities of San Miguel, Creston, and Shandon.

The Subbasin is the southernmost portion of the Salinas Valley Groundwater Basin. As originally defined by DWR (2003), the Subbasin was in both San Luis Obispo and Monterey counties. The 2019 DWR basin boundary modification process resulted in a revision of the northern boundary of the Paso Robles Subbasin to be coincident with the San Luis Obispo/Monterey county line, thereby placing the Subbasin entirely within San Luis Obispo County.

The top of the Subbasin is defined by land surface. The bottom of the Subbasin is defined by the base of the Paso Robles Formation. Sediments below the base of the Paso Robles Formation are typically much less permeable than the overlying sediments. Although the bedrock sediments often produce usable quantities of groundwater, the water is generally of poor quality, so they are not considered part of the Subbasin. As described in the GSP (M&A, 2020), the lateral boundaries of the Subbasin include the following:

- The western boundary is defined by the contact between the sediments in the Subbasin and the sediments of the Santa Lucia Range. A portion of the western boundary is defined by the Rinconada fault system, which separates the Paso Robles Subbasin from the Atascadero Subbasin.
- The eastern boundary of the Subbasin is defined by the contact between the sediments in the Subbasin and the sediments of the Temblor Range. The San Andreas Fault generally forms the eastern Subbasin boundary.
- The southern boundary of the Subbasin is defined by the contact between the sediments in the Subbasin and the sediments of the La Panza Range. To the southeast, a watershed and groundwater divide separates the Subbasin from the adjacent Carrizo Plain Basin; sedimentary layers are likely continuous across this divide.
- The northern boundary of the Subbasin is defined by the San Luis Obispo/Monterey county line.

Two principal aquifers exist in the Subbasin, including the Alluvial Aquifer and the Paso Robles Formation Aquifer. The Alluvial Aquifer is the youngest aquifer. It is unconfined and consists of predominantly coarse- grained sediments (sand and gravel) deposited along the Salinas River, Estrella River, Huer Huero Creek, and San Juan Creek. The Alluvial Aquifer varies in thickness but may be up to 100 feet thick along the channels. Much of the Alluvial Aquifer is characterized by relatively high transmissivity that may exceed 100,000 gallons per day per foot (gpd/ft). Wells screened in the Alluvial Aquifer can be very productive and may yield more than 1,000 gallons per minute (gpm).

The Paso Robles Formation Aquifer underlies the Alluvial Aquifer and outcrops in the Subbasin everywhere outside of the Holocene stream channels. The Paso Robles Formation represents the largest volume of sediments in the Subbasin, with a total thickness up to 3,000 feet in the northern Estrella area and up to 2,000 feet in the Shandon area. The Paso Robles Formation has a thickness of 700 to 1,200 feet throughout most of the Subbasin. It is generally characterized by interbedded, discontinuous lenses of sand and gravel that comprise the most productive strata within the aquifer, separated vertically by comparatively thick zones of fine-grained sediments (silts and clays). Well depths generally range from approximately 200 to 1,000 feet or more. As described in the GSP (M&A, 2020), reported aquifer transmissivity estimates in the Paso Robles Formation range from approximately 1,000 to 9,000 gpd/ft, and well yields generally range from approximately 150 to 850 gpm. Wells in certain parts of the Subbasin have been reported to be more productive (yielding upwards of 3,000 gpm).

The primary components of recharge to the Subbasin aquifers are percolation of precipitation and infiltration of surface water from rivers and streams. Natural discharge from the Subbasin aquifers occurs through springs and seeps, evapotranspiration (ET), and discharge to surface water bodies. The most significant component of discharge is pumping of groundwater from wells. The regional direction of groundwater flow is from the southeast to the northwest. As there is no hydrogeologic barrier to flow along the northern boundary of the Subbasin, groundwater exits the Subbasin along that boundary to the adjacent Salinas Valley Basin to the north.

2.3 Precipitation, Temperature and Climatic Periods

Annual precipitation recorded at the Paso Robles weather station (National Oceanic and Atmospheric Administration [NOAA] station 46730) is presented by water year in Figure 2. The total annual precipitation recorded at the Paso Robles weather station for WY 2024 is 21.18 inches. The long-term average annual precipitation for the period 1925 through 2024 is 14.7 inches per water year, as recorded at the Paso Robles weather station. The number of days with a maximum temperature above 100° Fahrenheit occurring each water year at the Paso Robles Municipal Airport are also shown in Figure 2. Daily temperature data from this site are only readily available since 1999. Climatic periods in the Subbasin have been determined based on analysis of data from the Paso Robles weather station using the Standardized Precipitation Index (SPI), which quantifies deviations from normal precipitation patterns. The WY 2024 SPI analysis uses a 24-month period instead of the 60-month period used in the GSP.[5] Climatic periods are categorized according to the following designations: wet, dry, and average/alternating wet and dry (see Figure 2). It is generally recognized that the eastern portion of the

[5] The 24-month period SPI analysis is considered an improvement over the 60-month period analysis because of its enhanced sensitivity to short-term climatic variations. The 24-month period SPI analysis provides insight into the relationship between water year type and groundwater elevation response (WMO, 2012).

Subbasin receives less annual rainfall than the rest of the Subbasin. Recently, the University of California Cooperative Extension (UCCE) installed a series of sophisticated weather stations across San Luis Obispo County and nine of these are now located in the Subbasin. Two California Irrigation Management Information System (CIMIS) stations were installed in the Subbasin during WY 2022. These new CIMIS stations include Paso Robles #265, located near the intersection of Wellsona and Airport Road at an elevation of 764 feet, and Shandon #266, located near the intersection of Starkey Road and Highway 41 at an elevation of 1,105 feet. CIMIS stations #265 and #266 began collecting data on March 1 and August 1, 2022, respectively. Station locations and rainfall totals for WY 2024 are presented in Figure 3, along with the spatial distribution of long-term average annual precipitation in the Paso Robles Subbasin.[6] Historical precipitation records for the Paso Robles weather station and monthly UCCE station records for WY 2024 are provided in Appendix B.

2.4 Monitoring Networks

This section provides a brief description of the monitoring programs currently in place and any notable events affecting monitoring activities or the quality of monitoring results. Monitoring networks are developed for each of the five sustainability indicators relevant to the Paso Robles Subbasin:

- Chronic lowering of groundwater levels
- Reduction of groundwater in storage
- Degraded water quality
- Land subsidence
- Depletion of interconnected surface water

Monitoring for the first two sustainability indicators (chronic lowering of water levels and reduction of groundwater in storage) is implemented using the representative monitoring sites (RMS), discussed in Section 2.4.1. Monitoring for the remaining three sustainability indicators (degraded water quality, land subsidence, and depletion of interconnected surface water) is discussed in Section 2.4.2.

2.4.1 Groundwater Elevation Monitoring Network (§ 356.2[b])

The GSP provided a summary of existing groundwater monitoring efforts currently promulgated under various existing local, state, and federal programs (M&A, 2020). SGMA requires that monitoring networks be developed in the Subbasin to provide sufficient data quality, frequency, and spatial distribution to evaluate changing aquifer conditions in response to GSP implementation.

The GSP identifies an existing network of 23 RMS wells for water level monitoring (M&A, 2020). Of these 23 wells, 22 are wells that are screened in the Paso Robles Formation[7], and one is an Alluvial Aquifer well. These RMS wells have been monitored biannually, in April and October, for various periods of record. The RMS groundwater monitoring network developed in the GSP is intended to support efforts to do the following:

[6] Average distribution of annual precipitation based on 30-year normal PRISM data calibrated to the Paso Robles Station (NOAA 46730).

[7] Since initial establishment of the monitoring well network, two of the 22 Paso Robles Formation Aquifer RMS wells (27S/13E-30N01 and 26S/12E-2607) have become either inactive or inaccessible.

- Monitor changes in groundwater conditions and demonstrate progress towards achieving measurable objectives and minimum thresholds documented in the GSP.
- Quantify annual changes in groundwater in storage
- Monitor impacts to the beneficial uses and users of groundwater.

The RMS wells are displayed in Figure 4, and a summary of information for each of the wells is included in Appendix C.

2.4.1.1 Monitoring Data Gaps

The GSP noted numerous data gaps in the current RMS network (M&A, 2020). Efforts are continuing during the implementation phase of the GSP to identify existing wells that can be added to the network, or to construct new wells for the network. As a start to this effort, the GSP identified nine additional wells that may be incorporated into the RMS network after the depth and screened aquifer are established. These wells are displayed in Figure 4, and a summary of available well information is included in Appendix D.

Expansion of the Subbasin monitoring networks is a major ongoing effort, which is described in detail in Section 4.3.2.

2.4.2 Additional Monitoring Networks

Evaluation of the water quality sustainability indicator is achieved through monitoring of an existing network of supply wells in the Subbasin. Constituents of concern (COCs) identified in the GSP that have the potential to impact suitability of water for public supply or agricultural use include salinity (as indicated by electrical conductivity), total dissolved solids (TDS), sodium, chloride, nitrate, sulfate, boron, and gross alpha.

COCs for drinking water are monitored at public water systems (PWSs),[8] including municipal and small PWSs. There are 41 PWSs in the Subbasin that serve potable water to small communities, schools, and rural businesses such as restaurants and wineries. PWSs constitute part of the monitoring network for water quality in the Subbasin. In addition, the GSP identified 28 agricultural supply wells that are monitored for COCs under the Irrigated Lands Regulatory Program (see GSP Figure 7-4 [M&A, 2020]).

Land subsidence in the Subbasin is monitored using Interferometric Synthetic Aperture Radar (InSAR) data collected using microwave satellite imagery provided by DWR. Available data to date indicate no significant subsidence in the Subbasin that impacts infrastructure. The GSAs will annually assess subsidence using the InSAR data provided by DWR.

A monitoring network to assess the sustainability indicator of groundwater/surface water interconnection is a current data gap that will be addressed during GSP implementation. There is at present only a single Alluvial Aquifer RMS well in the Subbasin. The revised GSP submitted to DWR in July 2022 includes an improved groundwater/surface water interaction discussion and identifies key data gaps that need to be filled before a sufficiently robust annual assessment of interconnected surface

[8] A PWS is defined as a system that provides water for human consumption to 15 or more connections or regularly serves 25 or more people daily for at least 60 days out of the year (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/waterpartnerships/what_is_a_public_water_sys.pdf).

water can occur. As a result of the combined efforts of the GSAs and local stakeholders, the PBCC has identified a greatly expanded monitoring network for the monitoring of conditions in the Alluvial Aquifer (GSI, 2025). The collection of data from these wells will allow for improved resolution of seasonal water level contour maps in the Alluvial Aquifer. In addition, streamflow conditions will be documented that correspond to coincident water level conditions in the aquifer. When this monitoring network is fully established and adequate data (at least 1 to 2 years) have been collected, sustainable management criteria (SMCs) will be determined, and the new Alluvial Aquifer wells will be added to the RMS groundwater level monitoring network.

3 2024 Data and Subbasin Conditions

3.1 Groundwater Elevations (§ 356.2[b][1])

3.1.1 Introduction

This section provides a detailed report on groundwater elevations in the Subbasin measured during spring and fall of 2024. These maps present the most up-to-date seasonal conditions in the Subbasin. Monitoring data is reviewed for quality and an appropriate time frame is chosen to provide the highest consistency in the wells used for each reporting period. Data quality is often difficult to ascertain when measurements are taken by other agencies or private well owners, and well construction information may be incomplete or unavailable. This means that a careful review of the data is required before uploading it to DWR's Monitoring Network Module[9] to verify whether measurements are trending consistent with trends of previous years and with the current year's hydrology and level of extractions.

3.1.2 Principal Aquifers

As discussed in Section 2, there are two principal aquifers in the Subbasin. The Paso Robles Formation Aquifer is several hundreds of feet thick, represents the greatest volume of saturated sediments in the Subbasin, and is the aquifer that is most utilized for supply. The Alluvial Aquifer is limited in extent to the active channels of the streams in the Subbasin and is generally less than 100 feet thick.

3.1.3 Seasonal High and Low Groundwater Elevations (Spring and Fall) (§ 356.2[b][1][A])

The assessment of groundwater elevation conditions in the Subbasin as described in the GSP (M&A, 2020) is largely based on data from the San Luis Obispo County Flood Control and Water Conservation District (SLOCFCWCD) groundwater monitoring program. Groundwater levels are measured by the SLOCFCWCD through a network of public and private wells in the Subbasin. Data from many of the wells in the monitoring program are collected subject to confidentiality agreements between the SLOCFCWCD and well owners. Consistent with the terms of such agreements, the well owner information and specific locations for these wells are not published in the GSP and that convention is continued in this WY 2024 Annual Report. Beginning in 2021, monitoring network expansion efforts by Shandon-San Juan GSA (SSJ GSA) and EPCWD GSA have resulted in water level data being available from several additional wells, located strategically in previous data gap areas. Groundwater level data from up to 65 wells were used to create the spring and fall 2024 groundwater elevation contour maps for the Paso Robles Formation Aquifer and groundwater level data from up to 11 wells were used to create spring and fall maps for the Alluvial Aquifer. The well locations and data points are not shown on the maps to preserve confidentiality of the data between the well owner and the SLOCFCWCD. The owners of 23 of these wells have agreed to allow public use of their well data. These 23 wells are used as RMS wells for the purpose of monitoring sustainability indicators. As implementation of the GSP progresses, it is anticipated that additional wells will be added to the data set and that many of the wells with current confidentiality agreements will be modified to allow for public use of the data.

In accordance with the SGMA regulations, the following information is presented based on available data:

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[9] The Paso Robles Subbasin is no longer in the California Statewide Groundwater Elevation Monitoring (CASGEM) program since implementation of the GSP. The GSAs are now responsible for monitoring and reporting of groundwater elevation data.

- Groundwater elevation contour maps for the seasonal high and seasonal low groundwater conditions for the previous water year. Groundwater elevation contour maps are presented for spring 2024 and fall 2024.
- A map depicting the change in groundwater elevation for the preceding water year. A change in groundwater elevation map is shown here for the period of fall 2023 to fall 2024 (see Section 3.5).
- Hydrographs for wells with publicly available data (Appendix E).

3.1.3.1 Alluvial Aquifer Groundwater Elevation Contours

Spring and fall 2024 (high and low) groundwater elevation data for the Alluvial Aquifer in the Subbasin were contoured to assess spatial variations, yearly fluctuations, trends in groundwater conditions, groundwater flow directions, and horizontal groundwater gradients. Contour maps were prepared for the seasonal high Alluvial Aquifer groundwater levels, which typically occur in the spring, and the seasonal low Alluvial Aquifer groundwater levels, which typically occur in the fall. In general, the spring groundwater data are for April and the fall groundwater data are for October. Information identifying the owner or detailed location of private wells is not shown on the maps to preserve confidentiality.

Figure 5 and Figure 6 show contours of groundwater elevations in the Alluvial Aquifer for spring 2024 and fall 2024, respectively. In general, groundwater elevations range from approximately 1,400 feet AMSL in the southeastern portion of the Subbasin to approximately 600 feet AMSL near San Miguel. Groundwater flow direction in the Alluvial Aquifer generally follows the alignment of the creeks and rivers. Overall, groundwater in the Alluvial Aquifer flows from southeast to northwest across the Subbasin. On a basin-wide scale, the average horizontal hydraulic gradient in the alluvium is about 0.004 feet per foot (ft/ft) from the southeastern portion of the Subbasin to San Miguel.

3.1.3.2 Paso Robles Formation Aquifer Groundwater Elevation Contours

Spring and fall 2024 (high and low) groundwater elevation data for the Paso Robles Formation Aquifer in the Subbasin were contoured to assess spatial variations, yearly fluctuations, trends in groundwater conditions, groundwater flow directions, and horizontal groundwater gradients. Contour maps were prepared for the seasonal high groundwater levels, which typically occur in the spring, and the seasonal low groundwater levels, which typically occur in the fall. In general, the spring groundwater data are for April and the fall groundwater data are for October. Information identifying the owner or detailed location of private wells is not shown on the maps to preserve confidentiality.

Figure 7 and Figure 8 show contours of groundwater elevations in the Paso Robles Formation Aquifer for spring 2024 and fall 2024, respectively. Overall, groundwater conditions in the Subbasin in the spring and fall of 2024 were similar, with groundwater elevations in the fall generally lower than in the spring, a typical seasonal trend for the Subbasin. Groundwater flow direction is generally to the northwest and west over most of the Subbasin. In general, groundwater flow in the western portion of the Subbasin tends to converge toward areas of low groundwater elevations. These areas of low groundwater elevation are in the area between the City of Paso Robles and the communities of San Miguel and Whitley Gardens. Horizontal groundwater gradients range from approximately 0.002 ft/ft in the southeast portion of the Subbasin to approximately 0.02 ft/ft in the area southeast of Paso Robles.

Groundwater elevations observed in the Subbasin during WY 2024 are generally similar to those observed during the previous year. Positive and negative changes in groundwater elevations from year to year are observed in various parts of the Subbasin, as has been observed historically. Seasonal trends of slightly higher spring groundwater elevations compared with fall levels are observed annually.

3.1.4 Hydrographs (§ 356.2[b][1][B])

Groundwater elevation hydrographs are used to evaluate aquifer behavior over time. Changes in groundwater elevation at a given point in the Subbasin can result from many influencing factors, with all or some occurring at any given time. Factors can include changing climatic trends, seasonal variations in precipitation, varying Subbasin extractions, changing inflows and outflows along boundaries, availability of recharge from surface water sources, and influence from localized pumping conditions. Climatic variation can be one of the most significant factors affecting groundwater elevations over time. For this reason, the hydrographs also display periods of climatic variation categorized as wet, dry, or average/alternating wet and dry (see Figure 2).

3.1.4.1 Hydrographs

Groundwater elevation hydrographs and associated location maps for the 22 RMS wells that are constructed in and extract groundwater from the Paso Robles Formation Aquifer and the single Alluvial Aquifer RMS well are presented in Appendix E. These hydrographs also include information on well screen interval (if available), reference point elevation, as well as measurable objectives, minimum thresholds and interim milestones for each well that were developed during the preparation of the GSP. Many of the hydrographs illustrate a condition of declining water levels since the late 1990s, although some indicate relative water level stability during the same period.

As described in the GSP for the Paso Robles Formation Aquifer RMS wells[10], an average of the 2017 non-pumping groundwater levels was selected as the measurable objectives and minimum thresholds are set below those levels (M&A, 2020). Going forward from 2017, the average of the spring and fall measurements in any one water year will be the benchmark against which trends are assessed.

Six of the 22 Paso Robles Formation Aquifer RMS wells have average WY 2024 groundwater elevations greater than the measurable objective for that RMS well. Although groundwater elevations in a few of the Paso Robles Formation Aquifer RMS wells are stable to slightly increasing during the past few years, groundwater elevations in several of the RMS wells are continuing to trend downward. Three of the 22 Paso Robles Formation Aquifer RMS wells in the Subbasin groundwater monitoring network exhibit groundwater elevations below the minimum threshold established in the GSP. In WY 2024, each of these three wells are exhibiting groundwater elevations below the minimum threshold for two or more consecutive years (27S/13E-28F01 for the fifth consecutive year, 27S/13E-30J01 for the third consecutive year and 27S/12E-13N01 for the second consecutive year). The condition exhibited in the three wells with groundwater elevations below the minimum threshold for two or more consecutive years constitutes a chronic lowering of groundwater elevation undesirable result as defined in the GSP. Based on initial observation this appears to be an isolated local issue. However, according to Section

[10] A measurable objective and minimum threshold were not set for the single Alluvial Aquifer monitoring network well because of a lack of available historical groundwater elevation data at the time of GSP submittal (M&A, 2020).

8.4.5.1 of the GSP,[11] the GSAs must initiate an investigation to determine if local or Subbasin-wide actions are required to address this undesirable result. Work continued on this investigation as part of monitoring network expansion efforts during 2024 (see Section 4.3.2) and will continue into 2025.

3.2 Groundwater Extractions (§ 356.2[b][2])

3.2.1 Introduction

This section presents the metered and estimated groundwater extractions from the Subbasin for WY 2024. The types of groundwater extraction described in this section include municipal PWSs (Table 1), agricultural (Table 3), rural domestic (Table 8), and golf courses and small PWSs[12] (Table 9). Each following subsection includes a description of the method of measurement and a qualitative level of accuracy for each estimate. The level of accuracy is rated on a qualitative scale of low, medium, and high. The annual groundwater extraction volumes for all water use sectors are shown in Table 10.

3.2.2 Municipal PWS Metered Well Production Data

The municipal PWS groundwater extractions documented in this report are metered data. Metered groundwater pumping extraction data are from the City of Paso Robles, San Miguel CSD, and the County of San Luis Obispo for Community Service Area (CSA) 16, providing service to the community of Shandon. The data shown in Table 1 reflect metered data reported by the respective agencies. The accuracy level rating of these metered data is high.

[11] Section 8.4.5.1 of the GSP – Criteria for Defining Undesirable Results includes the text: "A single monitoring well in exceedance for two consecutive years also represents an undesirable result for the area of the Basin represented by the monitoring well. Geographically isolated exceedances will require investigation to determine if local or Basin wide actions are required in response."

[12] Golf courses and small PWSs in the Subbasin generally serve water produced from their own private wells.

Table 1. Municipal PWS Groundwater Extractions

Water Year	Metered Groundwater Extractions			Total (AF)
	City of Paso Robles[1] (AF)	San Miguel CSD (AF)	CSA 16 (AF)	
2017	1,261	295	70	**1,626**
2018	1,302	325	50	**1,677**
2019	1,392	289	48	**1,729**
2020	1,121	297	91	**1,509**
2021	1,157	300	96	**1,553**
2022	1,617	279	86	**1,982**
2023	778	278	77	**1,134**
2024	690	269	84	**1,044**

Notes
[1] The City of Paso Robles produces water from wells located in both the Paso Robles Subbasin and the Atascadero Subbasin. Only the portion produced from within the Paso Robles Subbasin is included here. These volumes include any water produced as Salinas River underflow within the Paso Robles Subbasin.
AF = acre-feet
CSA = Community Service Area
CSD = Community Services District
PWS = public water system

3.2.3 Estimate of Agricultural Extraction

Agricultural water use constituted 94 percent of the total anthropogenic groundwater use in the Subbasin in WY 2024. Similar to other recent years, the WY 2024 growing season had a series of prolonged heat spells. There were 36 days with a maximum temperature above 100° Fahrenheit during the WY 2024 growing season, as recorded at the Paso Robles Municipal Airport (compared to only 24 days in WY 2023) (see Figure 2). Groundwater extraction for agricultural irrigation was estimated using a satellite-based method that measures actual ET at the field level as well as an estimation of evaporative losses associated with agricultural storage ponds. The actual ET measurements used in this analysis capture the spatial and temporal variability of ET throughout the Subbasin and throughout the year, thereby capturing nuances in crop irrigation practices including the application of additional water to mitigate heat spells. The method of irrigated agricultural water demand estimation uses a WY 2024-specific crop mapping dataset purchased from Land IQ, which represents actual planted acreage verified on the ground. Although not a significant factor in the Subbasin, the Land IQ dataset documents multi-cropping that occurs throughout the growing season.

Note that a 5-acre vineyard is irrigated with water supplied by the City of Paso Robles. The produced water associated with this vineyard is included in the total reported above in Section 3.2.2 and is omitted from the estimated agricultural irrigation analysis described here.

To estimate agricultural groundwater extraction, WY 2024 specific crop mapping data from Land IQ was used in conjunction with the OpenET ensemble model.[13] OpenET provides satellite-based estimates of the total amount of water that is transferred from the land surface to the atmosphere through the process of ET, otherwise known as consumptive crop water demand. The OpenET ensemble model uses Landsat satellite data to produce ET data, in inches, at a spatial resolution of 30 meters by 30 meters (0.22 acres per pixel). Additional inputs include gridded weather variables such as solar radiation, air temperature, humidity, wind speed, and precipitation (OpenET, 2024).

OpenET provides estimates of ET for the entire land surface, or in other words, “wall to wall”. To produce an estimate of consumptive crop water demand specific to the irrigated crop acreage in the Subbasin the OpenET ensemble model results are screened by the Land IQ crop mapping data set, thereby removing any potential estimated ET volumes associated with bare ground, non-irrigated crops, or native vegetation. A total of 17 irrigated crop types were identified in the WY 2024 Land IQ spatial dataset. These 17 crop types have been grouped into six basic crop groups: orchard, pasture, alfalfa, vegetable, vineyard and nursery which are shown in Figure 9. A summary of acreage by crop type is presented in Table 2. Irrigated crop types were identified by inspection of monthly ET for each mapped crop type versus reference monthly ET for fallow ground. Crop types are considered irrigated if monthly ET remains high throughout the latter part of the growing season as opposed to diminishing monthly ET following the rainy season exhibited on fallow ground. The mapped acreage of each irrigated crop type multiplied by inches of ET derived from the OpenET ensemble model results in estimated AF of consumptive crop water demand by crop type.

To isolate the volume of consumptive crop water demand associated with applied irrigation water, the portion of ET resulting from effective precipitation[14] was removed from the analysis using an analytical approach presented in FAO (1986). The remaining ET associated with applied irrigation water was then scaled up using crop-specific factors to account for minor irrigation system losses[15]. The resulting total is an estimate of total agricultural groundwater extraction. Deficit irrigation is captured through the measurement of actual ET. Groundwater extractions for frost protection or leaching of accumulated salts in the soil profile are captured to the extent that the produced water results in increased ET. It is assumed that the remainder of the water produced for frost protection or leaching remains within the

[13] OpenET uses reference ET data calculated using the American Society of Civil Engineers (ASCE) Standardized Penman-Monteith equation for a grass reference surface, and usually notated as ‘ETo’. For California, OpenET uses Spatial CIMIS meteorological datasets generated by the California DWR to compute ASCE grass reference ET. OpenET provides ET data from multiple satellite-driven models, and also calculates a single “ensemble value” from those models. The models currently included are ALEXI/DisALEXI, eeMETRIC, geeSEBAL, PT-JPL, SIMS, and SSEBop. More information about these models can be found at: https://openetdata.org/methodologies/. All of the models included in the OpenET ensemble have been used by government agencies with responsibility for water use reporting and management in the western U.S., and some models are widely used internationally (OpenET, 2024).

[14] Effective precipitation (the portion of rainfall that remains available to crops after runoff, evaporation, and deep percolation are removed) was calculated monthly for each field based on gridded precipitation values from gridMET using analytical formulas presented in FAO (1986). gridMET is a public domain dataset of daily high-spatial resolution (~4-km, 1/24th degree) surface meteorological data covering the contiguous United States from 1979-yesterday. The dataset is available through OpenET. The methodology behind gridMET is described in Abatzoglou (2013).

[15] Irrigation system efficiencies were assigned by crop type based on FAO (1989) and Martin (2011). Vineyard, the dominant crop in the Subbasin was assigned an irrigation efficiency of 90 percent.

Subbasin and percolates back to groundwater. The results of this analysis are presented in Table 2, broken out by basic crop group. The accuracy level rating of these estimated volumes is medium.

The soil-water balance model that was developed for the Paso Robles Groundwater Basin Model Update (Basin Model) (GSSI, 2014) was used to estimate agricultural water demands in the GSP and in several of the prior annual reports. In the WY 2022 Annual Report (GSI, 2023) agricultural water demand was estimated using both the Basin Model and the satellite-based method. As documented in the WY 2022 Annual Report, the satellite-based method is considered more accurate as it directly measures actual ET as it varies spatially and temporally throughout the Subbasin and throughout the year, thereby capturing nuances in crop irrigation practices, such as deficit irrigation. The Basin Model method uses a more rigid approach to capturing ET variability in the basin that does not fully capture the actual climatic variability or nuanced crop irrigation practices that may occur each year. Based on the benefits of the satellite-based method, the decision was made by the GSAs to retire the Basin Model method and use the satellite-based method exclusively going forward.

Evaporative losses associated with agricultural storage ponds was estimated based on the following assumptions: 1) the ponds are assumed to be full for April and May, and ¼ full from June through March, 2) the wetted area of the ponds at ¼ full is approximately 50 percent of the wetted area when the ponds are full. A review of recent aerial photography was completed to identify agricultural storage ponds in the Subbasin (see Figure 9). From this review it was determined that approximately 200 acres of wetted area is present in the Subbasin when the ponds are full (April and May) and approximately 100 acres of wetted area is present when the ponds are ¼ full (June through March). The total annual evaporative loss from agricultural storage ponds was calculated based on pan evaporation data from the Nacimiento Dam Station and the variable wetted acreage on a monthly time step. The estimated total evaporative loss from agricultural storage ponds is 470 AFY. This total is incorporated into the total estimated agricultural groundwater extraction numbers presented in Table 3.

Table 2. WY 2024 Irrigated Acreage, Estimated Agricultural Groundwater Extraction and Calculated Water Duty Factor by Basic Crop Group

Basic Crop Group	WY Irrigated Acreage	Agricultural Groundwater Extraction (AF)	Water Duty Factor (AF/acre)
Orchard	1,859	2,608	1.4
Pasture	705	1,952	2.8
Alfalfa	1,789	6,074	3.4
Vegetable	802	1,595	2.0
Vineyard	34,533	58,585 [1]	1.7
Nursery	86	96	1.1
Total	**39,774**	**70,900**	**Average: 1.8**

Notes
[1] This total include 470 AFY of estimated evaporative losses from agricultural storage ponds AF = acre-feet

Table 3. Estimated Annual Agricultural Groundwater Extractions

Water Year	Agricultural GW Extractions[1] (AF)	Irrigated Acres	Water Year Type[2]
2017	65,300	42,510 [3]	Wet/Hot
2018	80,200	42,510 [3]	Wet/Hot
2019	68,800	39,014 [4]	Avg/Avg
2020	72,600	39,014 [4]	Avg/Avg
2021	74,800	37,569 [5]	Dry/Hot
2022	76,900	37,569 [5]	Dry/Hot
2023	59,600	38,904 [6]	Wet/Avg
2024	70,900	39,774 [7]	Wet/Hot

Notes

[1] These totals include 470 AFY of estimated evaporative losses from agricultural storage ponds
[2] Water year types are based on 24-month period SPI analysis and number of days with a max temperature above 100F as recorded at the Paso Robles Municipal Airport (see Section 2.3).
[3] based on Land IQ land use data from 2018
[4] based on Land IQ land use data from 2019
[5] based on Land IQ land use data from 2022
[6] based on Land IQ land use data from 2023
[7] based on Land IQ land use data from 2024
— = not applicable
AF = acre-feet
SPI = Standardized Precipitation Index

3.2.4 Rural Domestic and Small Public Water System Extraction

Rural domestic and small PWS groundwater extractions in the Subbasin were estimated using the methods described here.

3.2.4.1 Rural Domestic Demand

The projected future water budget presented in the GSP (M&A, 2020) assumes water neutral growth in rural domestic water demand from WY 2016 going forward. Therefore, the rural domestic demand had been held constant at the WY 2016 volume estimated from the GSP groundwater model (3,530 AF). In WY 2023, rural domestic pumping was re-evaluated based on the assumption of water neutral growth since 2016, but with the modification of annual fluctuations in outdoor water use based on water year type (GSI, 2024).

Rural domestic demand has been completely reassessed in WY 2024 as part of the ongoing Cost of Service Study (see Section 4.3.9). Rural domestic water use was assessed for parcels that are not contained within a small PWS service area (see Section 3.2.4.2). The residential designated parcels in the County of San Luis Obispo parcel dataset (count = 4,156) were identified and an aerial photo review of each was performed to determine whether a residence is present (result = y/n). From this it was determined that there are 3,980 developed rural residential parcels in the Subbasin. A random selection tool was used to isolate 10% of the rural residential parcels, as a sample dataset (count = 398). Each parcel in the sample dataset was inspected in Google Earth using the most recently available summer/fall season aerial imagery and the visible extent of irrigated landscaping was digitized. It was found that 172 of the sample dataset parcels have no discernible irrigated landscaping. Including these parcels with zero irrigated acreage, inspection of the sample dataset reveals the information presented in Table 4 regarding average irrigated acreage, grouped by four parcel size categories.

Table 4. Rural Residential Parcels Sample Dataset Survey Results

Parcel Size (acres)	Average of Irrigated Acres	Count of Parcels
<1 - 2.5	0.03	139
2.5 - 20	0.07	177
20 - 40	0.10	36
>40	0.19	46
---	**0.07**	**398**

The average irrigated acreage by parcel size derived from the sample dataset was then applied to the entire rural residential parcel dataset (count = 3,980) to estimate the acreage of outdoor landscaping present on each parcel. During inspection of the sample dataset, it was observed that approximately 75 percent of the irrigated landscaping is lawn (turf) versus 25 percent garden/shrubs/trees. Reference ET (Eto) data from two nearby California Irrigation Management Information System (CIMIS) stations [Paso Robles (#265) and Shandon (#266)] were used to estimate an applied water amount based on irrigated acreage. The average Eto between these two CIMIS stations is 4.9 feet/yr. The crop coefficient for turf is 1.0 (unitless) and the crop coefficient for garden/shrubs/trees is assumed to be 0.65. The weighted average crop coefficient for the 75/25 percent crop type split is 0.91. Therefore, the estimated average applied water for rural residential landscape irrigation is 4.48 feet/yr. The total estimated applied water for rural residential landscape irrigation in an average water year (outdoor use) is presented in Table 5.

Table 5. Rural Residential Estimated Outdoor Water Use (Average Water Year)

Parcel Size (acres)	Count of Parcels	Estimated Outdoor Water Use (AFY)	AFY/Dwelling Unit (du)
<1 - 2.5	1,468	203	0.14
2.5 - 20	1,678	541	0.32
20 - 40	340	154	0.45
>40	494	431	0.87
---	**3,980**	**1,328**	**0.33**

Indoor water use was estimated using 0.29 AFY/du, the water duty factor presented in the Paso Robles Groundwater Basin Model Update (GSSI, 2014) and incorporated into the GSP groundwater model. The total estimated annual indoor water use is presented in Table 6.

Table 6. Rural Residential Estimated Indoor Water Use

Residential Units	Water Duty Factor (AFY/du)	Estimated Indoor Water Use (AFY)
3,980	**0.29**	**1,154**

The total estimated annual rural domestic water demand for an average water year is summarized in Table 7.

Table 7. Estimated Total Annual Rural Residential Water Demand (Average Water Year)

Outdoor Use (AFY)	Indoor Use (AFY)	Total (AFY)	AFY/du
1,328	**1,154**	**2,483**	**0.62**

For this WY 2024 Annual Report the reassessed total annual rural water demand for an average water year (2,483 AF) has been incorporated into the water neutral new development, varied by water year type model presented in the WY 2023 Annual Report (GSI, 2024). The resulting groundwater extractions for rural domestic demands are summarized in Table 8. The accuracy level rating of these estimated volumes is medium.

Table 8. Estimated Rural Domestic Groundwater Extractions

Water Year	Rural Domestic (AF)
2017	1,816
2018	2,460
2019	1,946
2020 [1]	2,483
2021	2,886
2022	2,383
2023	1,750
2024	1,868

Notes
[1] Representative average water year.
AF = acre-feet

3.2.4.2 Golf Course and Small Public Water System Extractions

The category of small PWSs includes a wide variety of establishments and facilities including small mutual water companies, golf courses, wineries, rural schools, and rural businesses. Various studies over the years used a mix of pumping data and estimates for type-specific water demand rates to estimate small PWS groundwater demand (Fugro, 2002; Todd Engineers, 2009). The 2012 San Luis Obispo County Master Water Report used the County of San Luis Obispo geographic information services mapping to define the distribution and number of commercial systems at the time and applied a single annual factor of 1.5 AFY per system (Carollo et al., 2012).

For the 2014 model update, actual pumping data were used as available to provide a monthly record over the study period (GSSI, 2014). Groundwater demand for four major golf courses (at the time) in the Subbasin (The Links, Hunter Ranch, Paso Robles, and River Oaks) was estimated using the following factors: reference evapotranspiration (ETo) data measured in Paso Robles, the crop coefficient for turf grass, monthly rainfall data, and golf course acreage (GSSI, 2014). Water use for wineries was estimated by identifying each winery and its permitted capacity and applying a water use rate of 5 gallons of water per gallon of wine produced. Minor landscaping, wine tasting/restaurant functions, and return flows were also accounted for (GSSI, 2014). Water use for several small commercial/institutional water systems was estimated using water duty factors specific to the water system type (i.e., camp, school, restaurant, and other uses) (GSSI, 2014).

The groundwater model update completed for the GSP (M&A, 2020) used a linear regression projection for the 2014 model update to estimate small PWS demand through WY 2016. The projected future water budget presented in the GSP (M&A, 2020) assumes water neutral growth in small PWS water demand from WY 2016 going forward. For this WY 2024 Annual Report, golf course and small PWS demand has been evaluated based on the assumption of water neutral growth since 2016, but with the modification of annual fluctuations based on water year type.

For the evaluation of golf course irrigation demand, annually estimated effective precipitation (see Section 3.2.3) was used to discount the volume of applied water. It is assumed that 25 percent of small PWS water use is used outdoors to irrigate minor landscaping. For the evaluation of small PWS water demand an estimation of effective precipitation for each water year was used to account for fluctuations in outdoor water use. These outdoor use totals were then summed with the non-fluctuating assumed 75 percent indoor water use for each year. The resulting groundwater extractions for golf course irrigation and small PWS demands are summarized in Table 9. The accuracy level rating of these estimated volumes is low-medium.

The total irrigated golf course acreage in the Subbasin is estimated to be 401 acres and the base water demand is assumed to be 4.0 AF/acre (Lyman, 2012). Each golf course is assumed to be deficit irrigated based on inspection of historical aerial photography and best management practices for water conservation on golf courses in California (Gross, 2012). The River Oaks Golf Course produces water from shallow alluvial wells accessing Salinas River underflow and likely also City of Paso Robles wastewater treatment plant effluent. River Oaks Golf Course pumping accounts for approximately 6 percent of the total annual golf course water demand.

Table 9. Estimated Golf Course and Small Public Water System Groundwater Extractions

Water Year	Small PWS (AF)	Golf Courses (AF)	Total Water Use (AF)
2017	295	947	1,242
2018	328	1,092	1,420
2019	302	996	1,297
2020	329	1,094	1,424
2021	350	1,129	1,478
2022	324	1,083	1,407
2023	292	835	1,126
2024	298	969	1,266

Notes
AF = acre-feet
PWS = public water system

3.2.5 Total Groundwater Extraction Summary

Total groundwater extractions in the Subbasin for WY 2024 are estimated to be 75,100 AF. Table 10 summarizes the total groundwater use by sector and indicates the method of measure and associated level of accuracy. Approximate points of extraction were spatially distributed and colored according to a grid system to represent the relative pumping across the Subbasin in terms of AF per acre (see Figure 10).

Table 10. Total Groundwater Extractions

Water Year	Groundwater Extractions by Water Use Sector			Total (AF)
	Municipal PWS[1] (AF)	Small PWS, Golf and Rural Domestic (AF)	Agriculture (AF)	
2017	1,626	3,058	65,300	**70,000**
2018	1,677	3,880	80,200	**85,800**
2019	1,729	3,243	68,800	**73,800**
2020	1,509	3,906	72,600	**78,000**
2021	1,553	4,364	74,800	**80,700**
2022	1,982	3,790	76,900	**82,700**
2023	1,134	2,876	59,600	**63,600**
2024	1,044	3,134	70,900	**75,100**
Method of Measure:	Metered	GSP Groundwater Model, varied by water year type	OpenET	---
Level of Accuracy:	high	low-medium	medium	---

Notes
— = not applicable
AF = acre-feet
PWS = public water system

3.3 Surface Water Use (§ 356.2[b][3])

3.3.1 Introduction

This section addresses the reporting requirement of providing surface water supplies used, or available for use, and describes the annual volume and sources for WY 2024. This section also reports quantities of Salinas River underflow, regulated as surface water by the SWRCB, produced and imported into the Subbasin by the City of Paso Robles from the adjacent Atascadero Subbasin. The method of measurement and level of accuracy is rated on a qualitative scale. The Subbasin has the potential to benefit from surface water entitlements from the Nacimiento Water Project (NWP) and the State Water Project to supplement municipal groundwater demands in the City of Paso Robles and the community of Shandon, respectively. Locations of communities dependent on groundwater and with access to surface water are shown in Figure 11.

3.3.2 Surface Water Available for Use

Table 11 provides a breakdown of surface water available for municipal use in the Subbasin based on contract annual entitlements. There is no guarantee that the full contract entitlement amount will be available to individual NWP or SWP subcontractors in any given year. There is currently no surface water available for agricultural or recharge project use within the Subbasin.

Table 11. Surface Water Available for Use

Water Year	Nacimiento Water Project[1] (AF)	State Water Project[2] (AF)	Total Available Surface Water (AF)
2017	6,488	100	**6,588**
2018	6,488	100	**6,588**
2019	6,488	100	**6,588**
2020	6,488	100	**6,588**
2021	6,488	100	**6,588**
2022	6,488	100	**6,588**
2023	6,488	100	**6,588**
2024	6,488	100	**6,588**

Notes
[1] Contract annual entitlement to the City of Paso Robles
[2] Contract annual entitlement to CSA 16
AF = acre-feet
CSA = Community Service Area

3.3.3 Imported Salinas River Underflow

Salinas River underflow, which is regulated as surface water by the SWRCB, is produced by the City of Paso Robles from the adjacent Atascadero Subbasin and imported into the Subbasin. These imported underflow volumes are integrated into the City of Paso Robles water distribution system and served to municipal customers located predominantly within the Subbasin.[16] The annual volumes of imported

[16] A minor portion of the City of Paso Robles municipal water supply is used by customers located outside of the Subbasin.

Salinas River underflow production are presented in Table 12. The accuracy level rating of these metered data is high.

Table 12. Imported Salinas River Underflow

Water Year	Imported Salinas River Underflow[1] (AF)
2017	2,609
2018	3,352
2019	3,075
2020	3,852
2021	3,612
2022	3,349
2023	3,130
2024	3,151

Notes
[1] The City of Paso Robles produces Salinas River underflow, regulated as surface water by the State Water Resources Control Board, from wells located in both the Paso Robles Subbasin and the Atascadero Subbasin. Only the portion produced from within the Atascadero Subbasin is included here.
AF = acre-feet

3.3.4 Total Surface Water Use

A summary of total actual surface water use by source is provided in Table 13. The accuracy level rating of these metered data is high.

Environmental uses of surface water are also recognized but not estimated due to insufficient data to make an estimate of surface water use. It is expected that environmental uses will be quantified in future annual reports as more data become available.

Table 13. Surface Water Use

Water Year	Nacimiento Water Project (AF)	Imported Salinas River Underflow[1] (AF)	State Water Project (AF)	Total Surface Water Use (AF)
2017	1,650	2,609	42	**4,301**
2018	1,423	3,352	55	**4,829**
2019	1,142	3,075	43	**4,259**
2020	737	3,852	0	**4,589**
2021	1,250	3,612	0	**4,861**
2022	901	3,349	0	**4,250**
2023	1,432	3,130	0	**4,562**
2024	1,660	3,151	0	**4,811**

Notes
[1] The City of Paso Robles produces Salinas River underflow, regulated as surface water by the State Water Resources Control Board, from its Thunderbird Wells located in the adjacent Atascadero Subbasin.
AF = acre-feet

3.4 Total Water Use (§ 356.2[b][4])

This section summarizes the total annual groundwater and imported surface water used to meet municipal, agricultural, and rural demands within the Subbasin. For WY 2024, the quantification of total water use was completed from reported metered municipal water production and metered surface water delivery, and from models used to estimate agricultural and rural water demand. Table 14 summarizes the total water use in the Subbasin by source and water use sector for WY 2024. Figure 12 and Figure 13 represent the WY 2024 total annual water use by water use sector and water source, respectively. The method of measurement and a qualitative level of accuracy for each estimate is rated on a qualitative scale of low, medium, and high.

Table 14. Total Water Use by Source and Water Use Sector

Water Year	Municipal PWS (AF)		Small PWS, Golf and Rural Domestic (AF)	Agriculture (AF)	Total (AF)
Source:	**Groundwater**	**Surface Water[1]**	**Groundwater**	**Groundwater**	**---**
2017	1,626	4,301	3,058	65,300	**74,300**
2018	1,677	4,829	3,880	80,200	**90,600**
2019	1,729	4,259	3,243	68,800	**78,000**
2020	1,509	4,589	3,906	72,600	**82,600**
2021	1,553	4,861	4,364	74,800	**85,600**
2022	1,982	4,250	3,790	76,900	**86,900**
2023	1,134	4,562	2,876	59,600	**68,200**
2024	1,044	4,811	3,134	70,900	**79,900**
Method of Measure:	Metered	Metered	GSP Groundwater Model, varied by water year type	OpenET	---
Level of Accuracy:	high	high	low-medium	medium	---

Notes
[1] Includes imported Salinas River underflow, which is regulated as surface water by the State Water Resources Control Board.
— = not applicable
AF = acre-feet
PWS = public water system

3.5 Change in Groundwater in Storage (§ 356.2[b][5])

3.5.1 Annual Changes in Groundwater Elevation (§ 356.2[b][5][A])

Annual changes in groundwater elevation in the Alluvial Aquifer and the Paso Robles Formation Aquifer for WY 2024 are derived from a comparison of fall groundwater elevation contour maps from one year to the next. For this analysis, fall 2023 groundwater elevations were subtracted from the fall 2024 groundwater elevations resulting in maps depicting the changes in groundwater elevations that occurred during WY 2024 (see Figure 14 [Alluvial Aquifer] and Figure 15 [Paso Robles Formation Aquifer]). The WY 2024 maps are based on data from 59 Paso Robles Formation wells and 9 Alluvial Aquifer wells.

The Alluvial Aquifer groundwater elevation change map for WY 2024 (see Figure 14) shows that compared to the previous fall, water levels were higher in the Huer Huero Creek drainage near Creston and were lower in the Estrella River drainage near Jardine Road and along the Salinas River.

The Paso Robles Formation Aquifer groundwater elevation change map for WY 2024 (see Figure 15) shows some areas of higher elevation and other areas of lower elevation compared to the previous fall.

The groundwater elevation change maps represent the difference in groundwater elevations between two snapshots in time, made approximately one year apart. Considering that groundwater elevations may fluctuate dynamically throughout each year in response to changing climatic conditions and groundwater pumping patterns, the specific patterns of 'higher' versus 'lower' water level areas shown on Figure 14 and Figure 15 may not necessarily be representative of conditions occurring throughout the entire water year.

3.5.2 Annual and Cumulative Change in Groundwater in Storage Calculation (§ 356.2[b][5][B])

The groundwater elevation change maps presented above represent a volume change within the Alluvial Aquifer (Figure 14) and the Paso Robles Formation Aquifer (Figure 15) for WY 2024. The volume change inferred from the groundwater elevation change maps represents a total volume, including the volume displaced by the aquifer material and the volume of groundwater stored within the void space of the aquifer. The portion of void space in the aquifer that can be used for groundwater storage is represented by the aquifer storage coefficient (S), a unitless factor, which is multiplied by the total volume change to derive the change in groundwater in storage. Based on work completed for the GSP, S is estimated to be 7 percent in the Paso Robles Formation Aquifer.[17] The aquifer storage coefficient value used for the Alluvial Aquifer is 20 percent.[18] The annual change of groundwater in storage calculated for WY 2024 is presented in Table 15 and the annual and cumulative change in groundwater in storage since 1981 are presented on Figure 16.

Table 15. Annual Change in Groundwater in Storage - Paso Robles Formation Aquifer

Water Year	Annual Change (AF)
2017	60,100
2018	6,400
2019	59,700
2020	-80,800
2021	-41,500
2022	-117,100
2023	120,700
2024	-25,500

Notes
AF = acre-feet

[17] Appendix G includes derivation of the S from the GSP groundwater model files and a sensitivity analysis.
[18] In the case of the alluvial aquifer, the aquifer storage coefficient is equivalent to the specific yield, a unitless factor, which is estimated to be 20 percent.

Historical comparison of annually tabulated precipitation, total groundwater extractions, and annual change in groundwater in storage reveals a close correlation between annual total precipitation and change in groundwater in storage (see Figure 17). Specifically, years with well above average precipitation (i.e., 1983, 1993, 1995, 1998, 2005, 2017, and 2023) are all associated with years of large increases in groundwater in storage. Conversely, nearly all[19] below average precipitation years are associated with years of decline in groundwater in storage. The influence of total annual groundwater extractions on annual change in groundwater in storage is also apparent, although to a lesser degree. The influence of groundwater extractions on annual changes in groundwater in storage is most apparent during the drought of the mid-1980s through the early 1990s, when below average precipitation prevailed, but a trend of decreasing groundwater extractions resulted in decreasing amounts of negative annual change of groundwater in storage.

Annual Change in Groundwater in Storage was calculated using the GSP groundwater model for WYs 1981 through 2016 and by groundwater elevation change maps for WYs 2017 through present. The groundwater elevation method has been calibrated to GSP groundwater model results (see Appendix F), however, some noteworthy differences between the methods remain. While the estimated value of S, used in the groundwater elevation change method, is based on sound science and using the best readily available information, it is necessary to acknowledge that the true value of S in the Paso Robles Formation Aquifer is spatially variable (as indicated in the GSP groundwater model) and ranges in value both above and below the estimated value of 7 percent. This, coupled with the necessity to rely on interpolated groundwater elevations through data gap areas in the groundwater level monitoring network (see Section 2.4.1), contributes to a moderate amount of method uncertainty. In addition, the groundwater elevation change method is susceptible to potential over- or under-estimation as a result of the method’s inability to account for groundwater in transit.[20] Regardless, the groundwater elevation change method is considered the best available tool for estimating annual change in groundwater in storage until the GSP groundwater model can be updated. Inclusion of newly available water level data from monitoring network expansion efforts begun in 2021 has significantly improved the accuracy of the groundwater elevation change method.

3.6 Additional Sustainability Indicators

3.6.1 Subsidence

Land subsidence is the lowering of the land surface. As described in the GSP, several human-induced and natural causes of subsidence exist, but the only process applicable to SGMA are those due to permanently lowered ground surface elevations caused by groundwater pumping (M&A, 2020). Historical subsidence can be estimated using InSAR data provided by DWR. InSAR measures ground elevation using microwave satellite imagery data. The GSP documents minor subsidence in the Subbasin

[19] The exception to this is WY 2018, which was a below average precipitation year associated with a minor increase in groundwater in storage. It should be noted that this change in groundwater in storage was calculated independently from the groundwater model using the groundwater elevation change map method described above.

[20] Groundwater in transit refers to recharged groundwater that is in the process of percolating downward through the unsaturated zone and is not yet contributing to a measurable change in groundwater elevation. The amount of groundwater in transit is assumed to be highly spatially and temporally variable in the Subbasin.

using data provided by DWR depicting the difference in InSAR measured ground surface elevations between June 2015 and June 2018. These data show that subsidence of up to 0.025 feet may have occurred during this 3-year period in a few small, isolated areas of the Subbasin (M&A, 2020). The GSP established minimum thresholds for InSAR measured land subsidence as "no more than 0.1 foot in any single year and a cumulative 0.5 foot in any five-year period", as measured using InSAR between June of one year and June of the following year (M&A, 2020).

Updated InSAR data has been provided by DWR through October 2024. As discussed in the GSP, to minimize the influence of elastic subsidence, changes in ground level should be measured annually from June of one year to June of the following year (M&A, 2020). For this WY 2024 Annual Report, the single-year land subsidence was measured using InSAR from June 2023 through June 2024 and the 5-year land subsidence land subsidence was measured from June 2019 through June 2024. According to Towill, Inc. (2024) there is a potential error of +/- 20 millimeters, or 0.066 feet associated with the InSAR measurement and reporting methods. Therefore, an InSAR measured land surface change of less than 0.066 feet is within the noise of the data and is equivalent to no evidence of subsidence. Considering this range of potential error, examination of the single-year change InSAR data from June 2023 to June 2024 shows that zero land subsidence has occurred (see Figure 18). Considering the same potential error for the 5-year cumulative change InSAR data from June 2019 to June 2024 it is apparent that as much as 0.20 feet of subsidence has occurred during this period (see Figure 19). Although minor land subsidence is documented during the 5-year period of June 2019 to June 2024, neither of these results indicate an undesirable result as specified by the land subsidence minimum thresholds. The GSAs will continue to monitor and report annual subsidence as more data become available.

3.6.2 Interconnected Surface Water

Ephemeral surface water flows in the Subbasin make it difficult to assess the interconnectivity of surface water and groundwater and to quantify the degree to which surface water depletion has occurred. The revised GSP submitted to DWR in July 2022 identifies potential surface water/alluvial groundwater connection along certain sections of the Salinas River, along the middle reach of the Estrella River (from Shedd Canyon to Martingale Circle) and along San Juan Creek upstream of Spring Creek (Paso Robles Subbasin GSAs, 2022). There is no evidence that the Salinas River surface water flows are connected to the underlying Paso Robles Formation Aquifer (Paso Robles Subbasin GSAs, 2022). The potential connection between the surface water system along the middle reach of the Estrella River (from Shedd Canyon to Martingale Circle) and along San Juan Creek upstream of Spring Creek, and the underlying Paso Robles Formation Aquifer is unknown but sufficient evidence exists that there could potentially be a connection, and therefore further investigation in these areas is recommended (Paso Robles Subbasin GSAs, 2022).

At this time, there are insufficient data available to adequately assess the interconnectivity of surface water and groundwater and the potential depletion of interconnected surface water. Although there is at present only a single Alluvial Aquifer RMS well in the Subbasin, 11 existing alluvial wells are monitored including six wells along the Salinas River, two wells next to the Estrella River near Airport Road and Jardine Road, one well along Cholame Creek just upstream of the confluence with San Juan Creek in Shandon, and one well along Huer Huero Creek just upstream of the State Highway 41 bridge. Additional Alluvial Aquifer wells will need to be established in the monitoring network before groundwater/surface water interaction can be more robustly analyzed. Several new Alluvial Aquifer monitoring wells are in the process of being installed as part of the Recommended Expanded Groundwater Level Monitoring Network for the Paso Basin produced by the Expanded Monitoring Network TAC (see Section 4.3.2.2).

3.6.3 Groundwater Quality

Although groundwater quality is not a primary focus of SGMA, actions or projects undertaken by GSAs to achieve sustainability cannot degrade water quality to the extent that they would cause undesirable results. As stated in the GSP, groundwater quality in the Subbasin is generally suitable for both drinking water and agricultural purposes (M&A, 2020). Eight COCs were identified and discussed in the GSP that have the potential to be impacted by groundwater management activities. These COCs identified in the GSP are salinity (as indicated by electrical conductivity), TDS, sodium, chloride, nitrate, sulfate, boron, and gross alpha. For this WY 2023 Annual Report, trends of concentrations of these eight COCs were analyzed through WY 2024 using data from the GeoTracker Groundwater Ambient Monitoring and Assessment (GAMA) database (GAMA, 2025). All COCs reviewed show a steady concentration trend since 2016.

Overall, there are no significant changes to groundwater quality since 2016, as documented in the GSP, preceding annual reports, and this WY 2024 Annual Report. Implementation of sustainability projects and/or management actions, as presented in the GSP, in this WY 2024 Annual Report, or in future reports or GSP updates, are not anticipated to result in degraded groundwater quality in the Subbasin. Any potential changes in groundwater quality will be documented in future annual reports and GSP updates.

3.7 Summary of Changes in Subbasin Conditions

Groundwater elevations observed in the Subbasin during WY 2024 are generally similar to those observed during the previous year. Although groundwater elevations in a few of the Paso Robles Formation Aquifer RMS wells are stable to slightly increasing during the past few years, groundwater elevations in several of the RMS wells are continuing to trend downward. Total groundwater pumping continues to exceed the estimated future sustainable yield[21] and the projects and management actions described in the GSP and in this WY 2024 Annual Report will be necessary to bring the Subbasin into sustainability.

[21] The GSP states that the future estimated long-term sustainable yield of the Subbasin under reasonable climate change assumptions is 61,100 AFY (M&A, 2020).

4 Progress towards Basin Sustainability (§ 356.2[c])

4.1 Introduction

This section describes several projects and management actions that are in process, have been initiated, or have been recently implemented in the Subbasin as a means to improve groundwater conditions, avoid potential undesirable results, attain subbasin sustainability, and improve understanding of the Subbasin groundwater dynamics as well as implications of GSP implementation. These projects and actions include capital projects and non-structural policies intended to reduce or optimize local groundwater use. Some of these projects were described in concept in the GSP; some of the actions described herein are new initiatives designed to make new water supplies available to the Subbasin that may be implemented by the GSAs to reduce pumping and partially mitigate the degree to which the management actions would be needed.

As described in the GSP (M&A, 2020), the need for projects and management actions is based on emerging Subbasin conditions, including the following:

- Groundwater levels are declining in some parts of the Subbasin, indicating that the amount of groundwater pumping is more than the natural recharge.
- The calculated water budget of the Paso Robles Formation aquifer indicates that the amount of groundwater in storage is in decline and will continue to decline if there is no net decrease in groundwater extractions.

To mitigate declines in groundwater levels in some parts of the Subbasin, achieve the Subbasin sustainability goal by 2040, and avoid undesirable results as required by SMGA regulations, new water supplies must be imported into the Subbasin [i.e., project(s)] and/or groundwater pumping must be reduced through management action(s).

In addition to project and management actions that address chronic declines in groundwater levels and depletion of groundwater in storage, this section also provides a brief discussion of land subsidence, potential depletion of interconnected surface waters, and groundwater quality trends that occurred during WY 2024.

The projects and management actions described in this section are all intended to help achieve groundwater sustainability in the Subbasin and avoid undesirable results.

4.2 Implementation Approach

As described in the GSP, the volume of annual groundwater pumping in the Subbasin is greater than the estimated sustainable yield and, as a result, groundwater levels are persistently declining in some parts of the Subbasin. In response, the GSAs have initiated several projects and management actions designed to address the impacts of the decline in groundwater levels and reductions of groundwater in storage. It is anticipated that additional new projects and management actions, some of which are described herein, will be implemented in the future to continue progress towards avoiding or mitigating undesirable results.

4.3 Basin-Wide Projects and Management Actions

4.3.1 Sustainable Groundwater Management Grant Program – Sustainable Groundwater Management Implementation Round 1

In February 2022, the County of San Luis Obispo Groundwater Sustainability Director submitted an application for DWR Sustainable Groundwater Management (SGM) Grant Program – Implementation Round 1 grant funding on behalf of the PBCC. The application was for $10 million, of which $7.6 million was awarded by DWR in July 2022. This grant includes funding for recycled water projects, expansion/improvement of existing monitoring networks to fill data gaps, implementation of a well verification program, groundwater extraction reporting program, drinking well mitigation program, and a multi-benefit irrigated lands repurposing program, and to complete engineering studies of supplemental water projects and a cost of service study.

In 2024, SGM Grant Program implementation included general grant oversight and management, ensuring invoicing, reporting, and deliverables were properly submitted to DWR, and oversight and coordination of numerous consultants and contractors hired to implement the Round 1 SGM Grant Program work plan.

4.3.2 Expansion of Monitoring Networks

4.3.2.1 SSJGSA and EPCWD GSA Programs to Expand the Monitoring Well Network

SSJ GSA and EPCWD GSA both separately initiated programs in WY 2020 to enlist member well owners to join a pilot study to measure water levels in wells throughout their respective districts. Between the two programs, approximately 100 wells have been measured multiple times per year since 2020. The water level data from these expanded monitoring networks has been incorporated into the annual groundwater elevation and change in groundwater in storage analyses, infilling several prior data gaps and substantially reducing the uncertainty in these analyses.

In WY 2024, EPCWD GSA established a continuous groundwater monitoring network. It is composed of EPCWD GSA members who are willing to share their existing continuous monitoring groundwater level data with the EPCWD GSA and/or members willing to have continuous monitoring devices installed in their wells. Access agreements have been signed. Currently five landowner monitoring devices are part of the network, providing groundwater level data to the EPCWD GSA (GSI, 2025).

4.3.2.2 Paso Robles Basin Groundwater Level Monitoring Network Expansion and Refinement

An Expanded Monitoring Network Technical Advisory Committee (Expanded Monitoring Network TAC) was formed by the PBCC in 2023 to spearhead the effort of expanding and refining the existing RMS groundwater level monitoring network. The purpose of expanding the monitoring network is to identify and address potential groundwater level impacts to domestic users, refine the hydrogeologic conceptual model, improve the GSP groundwater model which will allow the GSAs to improve tracking progress towards achieving sustainability, and to address several of the DWR recommended corrective actions presented in their June 20, 2023 GSP determination letter.

The Expanded Monitoring Network TAC drafted the Recommended Expanded Groundwater Level Monitoring Network for the Paso Basin, which was adopted by the PBCC at the October 25, 2023 board meeting. The adopted document details the recommendation to expand the existing 23-well RMS groundwater level monitoring network to 151 wells in the Subbasin. The work product of the Expanded

Monitoring Network TAC is a recommended list of existing and new wells which constitutes a 'wish list'[22] for the Expanded Groundwater Level Monitoring Network in the Subbasin. Also included in the work product are selections of up to two backup wells for each well in the 'wish list' to resort to if the preferred well is not available.

This monitoring well expansion program documents the administrative "next steps" required to implement this program. These are identified as:

1. Identify the current landowners where wells in the recommended list are located.
2. Concurrently, develop/adapt a well access and data sharing agreement that provides for public viewing of the well location, well completion information, and monitored groundwater level data.
3. Establish contact with the landowners.
    a. Verify well owners consent to include well in expanded monitoring network (execute monitoring agreement).
    b. Perform well site assessment and elevation survey, if well completion information is unknown, ask the well owner to provide well completion information.
    c. Perform feasible modifications to wellhead for monitoring, as necessary.
    d. Inquire if the well already has a private continuous monitoring device installed. If so, ask if well owner is willing to share the data.
4. If unsuccessful in establishing well owners' consent, iterate on the "B list" and "C list" backup wells.
5. For wells with unavailable well completion information, consider contracting a downhole camera operator to establish well completion details.
6. Finalize the expanded monitoring network list.
    a. Establish a subset of wells for continuous monitoring equipment and determine appropriate devices based on well site assessment.
    b. Purchase and install continuous monitoring equipment.
7. Establish wellhead monitoring point elevations accurate to 0.1 feet North American Vertical Datum 1988 (NAVD 88) as required by § 352.4.(a) of the GSP Regulations.
8. Develop monitoring protocol for:
    a. Wells equipped with continuous monitoring devices (what entity is responsible for maintaining these devices, and what are the data storage/curation protocols?).
    b. Wells that require manual measurement (what entity performs the monitoring, how often is monitoring performed, and what are the data storage/curation protocols?).
9. Develop and implement a Data Management System to host and view groundwater level measurements.
10. Determine the funding mechanism and monitoring network responsibilities.

[22] A majority of the wells in the recommended list are privately owned. A next step will be to approach the well owners and present the opportunity to have their well(s) included in the expanded monitoring network. It is expected that some portion of the well owners will not want their wells included in the expanded monitoring network.

a. Determine who will be responsible for setting up the expanded monitoring network (e.g. a consultant hired by the PBCC, or each GSA area managed by that GSA) which will inform how costs are shared.

11. Develop and formalize a comprehensive Groundwater Monitoring Plan.

Pertaining to existing wells, the GSAs published an RFP in the spring of 2024 and selected consultants to assist with the effort in two separate scopes of work. One scope is intended to address items 1 through 4 above. Well owners were identified through assessor's parcel information and other County of San Luis Obispo records. An access agreement was drafted in consultation with County of San Luis Obispo Legal Counsel that was designed to protect the well owner's data from being disclosed. As of October 2024, a sustained effort is being mounted through phone calls, mailers, and personal visits to make contact with well owners in the Subbasin to solicit their voluntary participation in this program. At the conclusion of that effort, a different consulting team is to visit each well identified in the first scope of work to assess the specifics of the wellhead plumbing, well pumps, access ports, and other logistical considerations that will determine what type of monitoring, if any, is appropriate for each individual well (i.e., manual water levels, pressure transducers, and sonic sounders).

The recommended list of 151 wells also includes 26 proposed new wells, including 10 additional wells identified under the Supplemental Environment Program (SEP) agreement (see Section 4.3.2.3), 8 wells identified for installation under the DWR Technical Support Services (TSS) program (see Section 4.3.2.4), and 8 Alluvial Aquifer wells recommended in the revised GSP (Paso Robles Subbasin GSAs, 2022).

After completion of a competitive bid process, a consultant team was selected in spring 2024 to design and install the 8 Alluvial Aquifer monitoring wells recommended in the revised GSP. The consultant performed stakeholder and landowner outreach to negotiate access to the selected sites and has initiated environmental permitting. It is anticipated that drilling and well installations will be completed in WY 2025. Updates on the proposed new SEP and TSS wells are provided in Sections 4.3.2.3 and 4.3.2.4, below.

At the conclusion of this program, it is envisioned that the water level monitoring network will be expanded significantly, and that a robust data collection program will be in place to support sustainable management of the Subbasin (GSI, 2025).

4.3.2.3 Supplemental Environmental Project

Under the terms of an agreement between the City of Paso Robles and the Central Coast Regional Water Quality Control Board (CCRWQCB), funding was made available through the City of Paso Robles for a Supplemental Environmental Project (SEP) that included the installation of additional monitoring wells and stream gages in the Subbasin. This has resulted in significant and ongoing efforts to improve the monitoring networks in the Subbasin.

In early 2021 two pairs of co-located, dedicated monitoring wells were installed at two separate locations: the City of Paso Robles 13th Street Bridge site and the Airport Road at Estrella Road site. The wells were designed as paired wells with one in the shallow Alluvial Aquifer and one in the deeper Paso Robles Formation aquifer. These paired well installations will collect important information describing the coincident groundwater elevations in both the alluvium and the deeper strata, which is important in characterizing the type of stream monitored (i.e., gaining, losing, disconnected), and in characterizing the vertical hydraulic gradient between formations.

In WY 2024 the Estrella River at Airport Road wells were outfitted with continuous monitoring transducers connected to the County of San Luis Obispo Public Works Live Water and Weather Data System. The 13th Street Bridge Salinas River site is anticipated to be monitored soon. No decisions have been made regarding installation of telemetry equipment at any new monitoring wells (GSI, 2025). Installation of the proposed additional SEP wells remains an ongoing initiative.

Three new stream gages were also installed in early 2021 under the provisions of the SEP agreement. These SEP stream gage stations have been discussed in detail in previous annual reports. Graphs depicting time-series stage data for the three radar-based stream flow gage stations are included in Appendix G.

4.3.2.4 DWR Technical Support Services

California DWR administers a program offering Technical Support Services (TSS) to GSAs during the implementation of their GSPs in the state. The goal of the TSS program is to provide technical services and educational tools at regional and statewide scales to develop the infrastructure required to achieve sustainability. Technical support services offered include monitoring well installation, groundwater monitoring training, video logging, and other field activities. The initial priority for funding under this program is focused on State-designated critically over-drafted basins, like the Paso Robles Subbasin.

In WY 2024, provisional funding was obtained under the TSS program for installation of 10 new monitoring wells located at three sites in the Subbasin. The TSS site in Whitley Gardens has 3 wells of varying depth that were installed between October and November 2024. A second TSS site in Creston has 4 wells of varying depths that were installed between November and December 2024. Co-located well clusters with wells screened at varying depths provide important data characterizing vertical gradients between aquifers and essential characterization of the type of stream (i.e., gaining, losing, disconnected) which did not exist at the time of the submitted GSP (GSI, 2025).

4.3.3 Non-De Minimus Metering and Reporting Program

Due to the expensive cost and logistics of installing meters on all non-de minimis extraction wells throughout the Subbasin, the GSAs voted in early 2024 and approved a contract with a consultant (Land IQ) to use ET and climatic data processing methods to estimate groundwater extraction on a field-by-field resolution in the Subbasin for each Water Year.

The GSAs are currently planning to create and implement a Well Verification and Registration Program and Extraction Reporting Program, to be funded by the SGMA Round 1 Grant. The estimated date for the technical memoranda submittals for program development is March 31, 2025 (GSI, 2025).

4.3.4 Multi-benefit Irrigated Land Repurposing Program

A Multi-benefit Irrigated Land Repurposing Program Technical Advisory Committee (MILR Program TAC) was formed by the PBCC in 2023. The combined impacts to groundwater resources from the multi-year drought and lack of available and reliable supplemental surface water supplies may increase the likelihood of requiring some irrigated agriculture in the Subbasin to temporarily come out of production. Statewide, extreme recent drought conditions have created momentum for new voluntary incentivized programs for growers facing the difficult decision of taking land out of production and to support some amount of continued farming even if in a smaller irrigated footprint. Typically called repurposing, these programs can provide a strategically designed way to approach fallowing decisions and potentially find new uses for areas taken out of production. As one of the high priority management actions funded by the SGM Grant Program – Implementation Round 1 (see Section 4.3.1) the MILR Program is expected to be a critical component in achieving long-term groundwater sustainability in the Subbasin.

To date, the MILR Program TAC has met to conceptualize the project based on other agencies' experiences of similar land repurposing programs. In the summer of 2024, the County of San Luis Obispo, acting as the lead Agency, issued an RFP for consultant facilitation to develop, implement, and administer the specifics of a MILR Program. A team led by Land IQ was selected for the development of this important program. This program is intended to identify eligible lands through creation of Farming Units. A Farming Unit is a collection of semicontiguous agricultural properties, which are greater than 5 acres in total, that are managed as a single irrigated farming operation (or planned for irrigation in the future). The consultant has preliminarily identified 566 farming units totaling approximately 39,000 irrigated acres that are eligible for this program.

The MILR Program has an approach consisting of the following four phases:

- Phase 1: Assess farm unit water use
- Phase 2: Farmers enroll in the program (online application process)
- Phase 3: Prioritize and implement sustainable measures
- Phase 4: Measure regional progress towards sustainability

The MILR Program is anticipated to be operational at the beginning of Water Year 2026 (GSI, 2025).

4.3.5 Review of GSP Groundwater Model SFR Package

In the spring of 2024, the County of San Luis Obispo sponsored a technical review of the GSP groundwater model, with the objective of evaluating the model parameters that are most sensitive to accurate representation of surface water/groundwater interactions in the model area, and to make recommendations to better represent these fluxes. The consultant report is included as Appendix H. This discussion summarizes the most significant findings of that review.

The GSP groundwater model uses the MODFLOW SFR Package in its representation of streamflow in the model domain. Stream channel geometry is represented in the SFR package as an 8-point cross section. The consultant evaluated the channel cross section geometry currently employed in the GSP groundwater model with cross sections generated from Digital Elevation Model (DEM) data at each coincident location. The evaluation indicates that the channel geometries currently employed in the GSP groundwater model provide a poor representation of actual channel geometries. Most of the current channel sections in the model are narrow steep 8-point profiles which do not reflect the realities of the existing floodplain. Most do not extend either high enough nor wide enough to represent conditions in the field. The fact that at higher flows the streamflow will spread out over a much larger lateral section than currently represented in the SFR Package suggests that percolation of streamflow will be underestimated during high flow events. Because the calculation of surface water/groundwater flux in the SFR Package, is a function of both the driving head (i.e., depth of water in the channel) and the wetted perimeter of flow, these comparisons indicate that the existing GSP groundwater model does not represent actual field conditions accurately, and therefore likely does not accurately represent surface water/groundwater fluxes. The existing SFR cross sections will not replicate floodplain recharge of the Alluvial Aquifer realistically. Incorporation of more realistic stream channel geometry would improve the representation of physical conditions during hi-flow events.

Another currently unutilized capability of the SFR package is the incorporation of rating curves that relate depth of flow to stream discharge into the parameter data. The consultant report presents current technical methods available to generate realistic synthetic rating curves for points along the creeks in the Subbasin. Utilization and incorporation of these synthetic rating curves will further enhance the GSP groundwater model's ability to accurately simulate surface water/groundwater fluxes.

4.3.6 Supplemental State Water Supply Feasibility Study

In April 2024, the County of San Luis Obispo sponsored a feasibility and engineering study to assess the feasibility of delivering water supplies from the State Water Project (SWP) to the Paso Robles Subbasin for various potential uses including recharge and/or for agricultural use as an in-lieu water supply to allow for reduced groundwater pumping in the Subbasin.

The County of San Luis Obispo currently has a maximum annual SWP allocation (Table A) of up to 25,000 AFY through the SLOCFCWCD, according to the 1963 long-term water supply contract with DWR. Eleven existing water purveyors in the County of San Luis Obispo currently have contracts to Table A SWP water through the SLOCFCWCD amounting to 4,830 AFY, plus an additional drought buffer of 5,707 AFY. Thus, at present, there is 14,463 AFY of excess allocation that represents an unsubscribed portion of the SLOCFCWCD's contracted (100 percent) allocation. It should be noted that state water deliveries are frequently less than the 100 percent contracted amount, based on statewide meteorological conditions, operational constraints, and other factors. However, considering the predicted future variability in SWP deliveries, the excess allocation could potentially provide an average of 8,858 AFY of water for the Paso Robles Subbasin.

This potential opportunity has a number of challenges, including existing conveyance infrastructure constraints (e.g., pipeline capacity, storage availability, treatment options), policy, regulatory, and legal issues that must be addressed if this supply opportunity is to be realized. The selected consultant will generate a study to assess the practicality of delivering water supplies from the SWP system to the Subbasin, when available. The study will provide schematic level designs of project infrastructure, engineering cost estimates, and supply and demand alternatives that include consideration of:

- SWP policies
- Contractual provisions
- State regulatory implications
- Physical infrastructure limitations
- Temporal variability in available supply
- Cultural resources
- Recharge facilities
- Treatment and blending
- Storage
- Pump stations
- Transmission
- Hydraulic analysis

This study was still in process at the conclusion of WY 2024.

4.3.7 Drinking Water Well Impact Mitigation Program

SGMA is intended to support and implement policies that support sustainable groundwater management for all beneficial uses and users. The human right to water is a foundational assumption of SGMA and previous California water law and policy that recognizes that all human beings have the right to safe, clean, and accessible water adequate for domestic purposes. This issue was included as a recommended corrective action in the DWR June 20, 2023 GSP determination letter:

RECOMMENDED CORRECTIVE ACTION 3

The GSAs should consider including mitigation strategies describing how drinking water impacts that may occur due to continued overdraft during the period between the start of Plan implementation and achievement of the Subbasin's sustainability goal will be addressed, or provide a thorough discussion, with supporting facts and rationale, explaining how and why the GSAs determined not to include specific actions or programs to monitor and mitigate drinking water impacts from continued groundwater lowering below 2015 levels. Department staff recommend that the GSAs review the Department's April 2023 guidance document titled Considerations for Identifying and Addressing Drinking Water Well Impacts guidance to assist its adaptive management efforts.

In March 2023, DWR published the guidance document "Considerations for Identifying and Addressing Drinking Water Well Impacts", to support the efforts of GSAs to address the issue of dry wells within their service areas. In the spring of 2024, the County of San Luis Obispo issued an RFP for support in developing a domestic well mitigation program (GSI, 2025).

4.3.8 Development of Joint Powers Authority

The MOA under which the PBCC has been operating since the development of the GSP was intended to be a temporary mechanism for cooperation between the member agencies. It was originally intended to terminate upon submission of the GSP but has been extended for the purposes of producing the Annual Reports required under SGMA, and administration of grant funded SGMA implementation actions since the GSP was submitted. It is recognized by the parties of the PBCC that a permanent governance structure is necessary to continue the work of SGMA implementation through the 20-year SGMA planning period. A Joint Powers Authority (JPA) agreement is the mechanism by which the member agencies are working to accomplish this objective.

JPAs are a legal mechanism designed for the member agencies to jointly share a common power, implement a program, build new facilities, or deliver a service. It is anticipated that the JPA will define the objective of the agreement, outline the voting shares and governance structure, allow for the raising of funds to implement required actions, and define a process for dispute resolution. Each member agency must agree on the final text of the JPA document, and have the contract approved by their respective Board of Directors (GSI, 2025).

Negotiations to develop a JPA agreement among the five member agencies of the PBCC and their legal counsels continued through the end of WY 2024. It is anticipated that this process will be completed sometime in early 2025.

4.3.9 Cost of Service Study

Since the award of the SGMA grant in July 2022, the SGMA implementation activities in the Subbasin have been mainly funded through administration of grant funds curated by the County of San Luis

Obispo GSA. In spring 2024, the PBCC commissioned a consultant study to evaluate potential options for a more permanent funding mechanism, ultimately to be administered by a yet to be established new governance structure in the Subbasin. A rate model using various assumptions with respect to cost apportionment and fee types is being developed. The cost of service study was still in process at the conclusion of WY 2024.

4.3.10 GSP 5-Year Evaluation

In June 2024 the Paso Basin GSAs retained a consultant to prepare the 5-Year Evaluation of the Paso Robles Basin GSP as required by SGMA. The 5-Year Evaluation was drafted during WY 2024 in accordance with the October 2023 GSP implementation guidance document for annual reports, periodic evaluations and plan amendments (DWR, 2023). Work on the 5-Year Evaluation, including stakeholder engagement, continued through the end of WY 2024. The 5-Year Evaluation was submitted to DWR in January 2025.

4.4 Area Specific Projects

4.4.1 City of Paso Robles Recycled Water Program

In 2016, the City of Paso Robles completed a major upgrade of its Wastewater Treatment Plant to remove harmful pollutants efficiently and effectively from the wastewater. The City's master plan is to produce tertiary-quality recycled water and distribute it to various locations within and adjacent to the City, where it may be used for irrigation of city parks, golf courses, and vineyards. The City of Paso Robles Recycled Water Program will reduce the need to pump groundwater from the Subbasin and will further improve the sustainability of the City's water supply. In 2019, the City completed an upgrade to full tertiary treatment and began producing high-quality recycled water. Design and environmental permitting of the recycled water distribution system are complete.

In 2022, the City received $3.5 million in SGM Grant Program – Implementation Round 1 grant funding, via the County of San Luis Obispo (see Section 4.3.1), for construction of a difficult 1,900 lineal foot segment of the distribution system under the Salinas River. This Salinas River segment of pipeline was installed and completed in 2024, within the $3.5 million allocated budget. The City of Paso Robles Recycled Water Program will have the capacity to use up to 2,200 AFY of tertiary quality recycled water for in-lieu recharge inside the City of Paso Robles and in the central portion of the Subbasin (see Section 4.4.3). Water that is not used for recycled water purposes may be discharged to surface infiltration facilities, such as Huer Huero Creek, with the possibility for additional recharge benefits.

The primary benefit from the City's Recycled Water Program is higher groundwater elevations in the central portion of the Subbasin due to in lieu recharge from the direct use of the recycled water and potential surface recharge opportunities. As presented in Figure 9-3 of the GSP, the expected groundwater level benefit predicted by the GSP model after the project is fully implemented and operated for 10 years is estimated to be an increase in groundwater elevations locally by up to 20 feet in the central portion of the Subbasin.

Planning and design work for ancillary pipelines and conveyance infrastructure to connect to the Salinas River segment are currently part of other ongoing projects to be able to deliver the City's recycled water to specific properties in this portion of the Subbasin.

4.4.2 San Miguel Community Services District Recycled Water Project

The San Miguel CSD Recycled Water Project will upgrade the CSD wastewater treatment plant to meet California Code of Regulations Title 22 criteria for disinfected tertiary recycled water for irrigation use by vineyards. Potential customers include a group of agricultural irrigators on the east side of the Salinas River, and a group of agricultural customers northwest of the wastewater treatment plant. The project could provide between 200 AFY and 450 AFY of additional water supplies. The primary benefit from the CSD's Recycled Water project is higher groundwater elevations in the vicinity of the community of San Miguel due to in lieu recharge from the direct use of the recycled water.

Work completed on the San Miguel CSD Recycled Water Project in WY 2024 includes:

- Finalized design plans and specifications for the recycled water pipeline.
- Completed California Environmental Quality Act documentation and environmental permitting
- Held a 30-day public review period for the Draft Initial Study and Mitigated Negative Declaration report
- Obtained encroachment permits from the County of San Luis Obispo, Caltrans, and the Union Pacific Railroad for a crossing
- Ongoing negotiations with nearby vineyards and wineries to obtain commitments for allowing an easement on their property and for receiving recycled water

4.4.3 Blended Water Project

Private entities and individuals are working actively with the City of Paso Robles and numerous agricultural irrigators to develop a project that can bring recycled water to the central portion of the Subbasin. As described above, the City estimates that as much as 2,200 AFY of recycled water will be available, and the volume will likely increase in the future as the City grows. The wastewater treatment plant is designed to process and deliver up to 4,000 AFY.

The goal of the Blended Water Project is to design and construct a pipeline system to connect to the City's Recycled Water Program and convey recycled water into the agricultural areas east of the City. Although there are many ways to use the Recycled Water Program water directly, certain challenges exist to make the water quality of the recycled water attractive to some agricultural users. Blending the recycled water with surplus NWP water, when available, may mitigate these challenges. The primary benefit from the Blended Water Project is higher groundwater elevations in the central portion of the Subbasin east of the City of Paso Robles due to reductions in groundwater pumping for irrigation and in-lieu recharge from the direct use of the blended water. Associated benefits may include improved groundwater quality from the use and recharge of high-quality irrigation water.

Round 1 SGM Grant Program funding was used to commission an engineering study to evaluate the feasibility of the Paso Basin Blended Water Supply Project (Project), which would deliver a blend of recycled water and Nacimiento project water to agricultural customers in the Subbasin. The Project is identified in the GSP. Water delivered by the Project would be used for agricultural irrigation in lieu of groundwater pumping to help achieve GSP objectives. The study assesses the project's feasibility and potential cost considering variations in the following project components:

- Water Availability
- Water Quality
- System Size
- Storage
- Blending Mechanisms
- Customer Level of Service
- Operational Approaches
- Pipeline Alignments
- Design Criteria

Three different sized project alternatives are considered: small system alternatives, medium system alternatives, and large system alternatives. Achieving sustainability in the Subbasin will rely on projects and management actions that reduce groundwater pumping. The Blended Water Project provides an opportunity to bring new surface water sources for use in lieu of groundwater pumping. The middle and upper end of alternatives (4,000 to 7,000 AFY) represents a significant portion of the historic annual average loss of groundwater in storage of 12,600 AFY. New sources of water have the potential to provide significant impacts within the SGMA planning horizon of 2040 (GSI, 2025). This engineering study was still in progress at the conclusion of WY 2024.

4.5 Summary of Impacts of Projects and Management Actions

Additional time will be necessary to judge the effectiveness and quantitative impacts of the projects and management actions now underway. However, the actions in place and as described in this WY 2024 Annual Report are assisting the Subbasin in reaching the sustainability goals laid out in the GSP.

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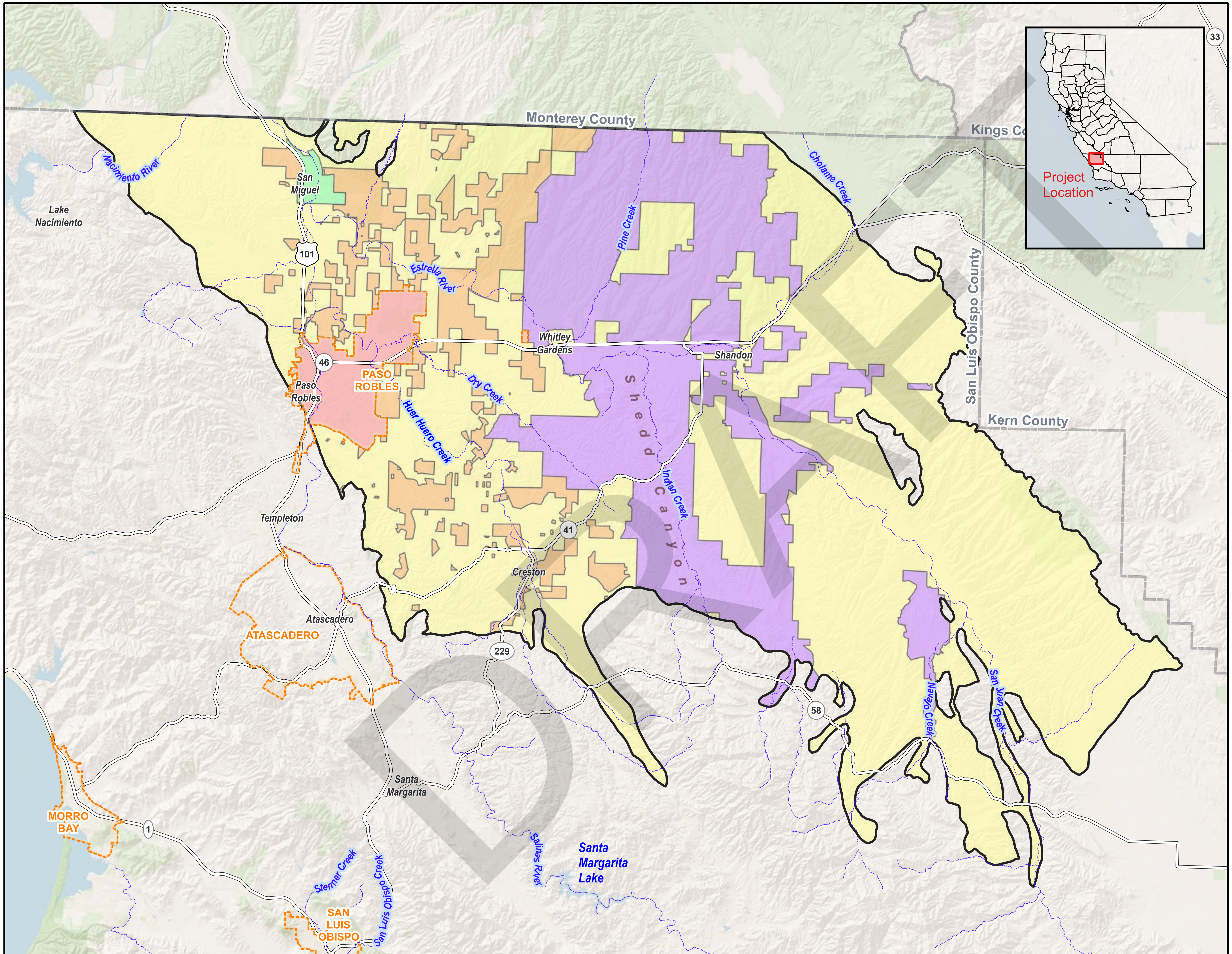
Figures

FIGURE 1

Extent of the Paso Robles Subbasin and Exclusive Groundwater Sustainability Agencies

Paso Robles Subbasin
Water Year 2024 Annual Report



LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads

Exclusive Groundwater Sustainability Agencies

- San Miguel Community Services District
- City of Paso Robles
- Shandon - San Juan Water District
- Estrella - El Pomar - Creston Water District
- Paso Basin - County of San Luis Obispo

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, ESRI

CONFLUENCE ENGINEERING SOLUTIONS

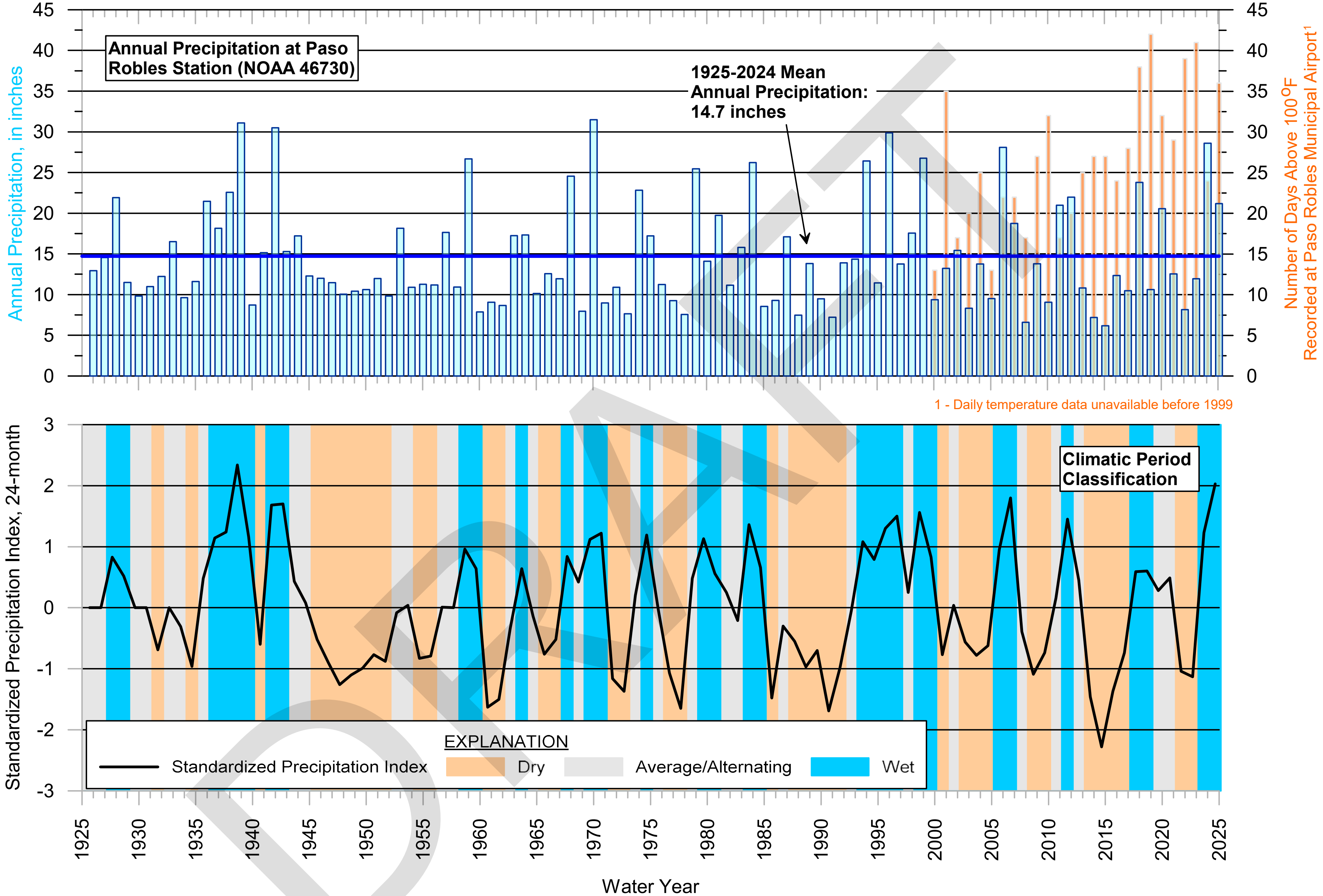


FIGURE 2

Annual Precipitation and Climatic Periods in the Paso Robles Subbasin

Paso Robles Subbasin Water Year 2024 Annual Report

C:\Users\NatePage\confluencees.com\ConfluenceES - Projects\Paso Basin GSAs\Paso WY24-AR\5_Working Files\Analysis\Climate\AnnualRpt_Avg Precip and Climatic Periods_SPI_1925_2024.gpj

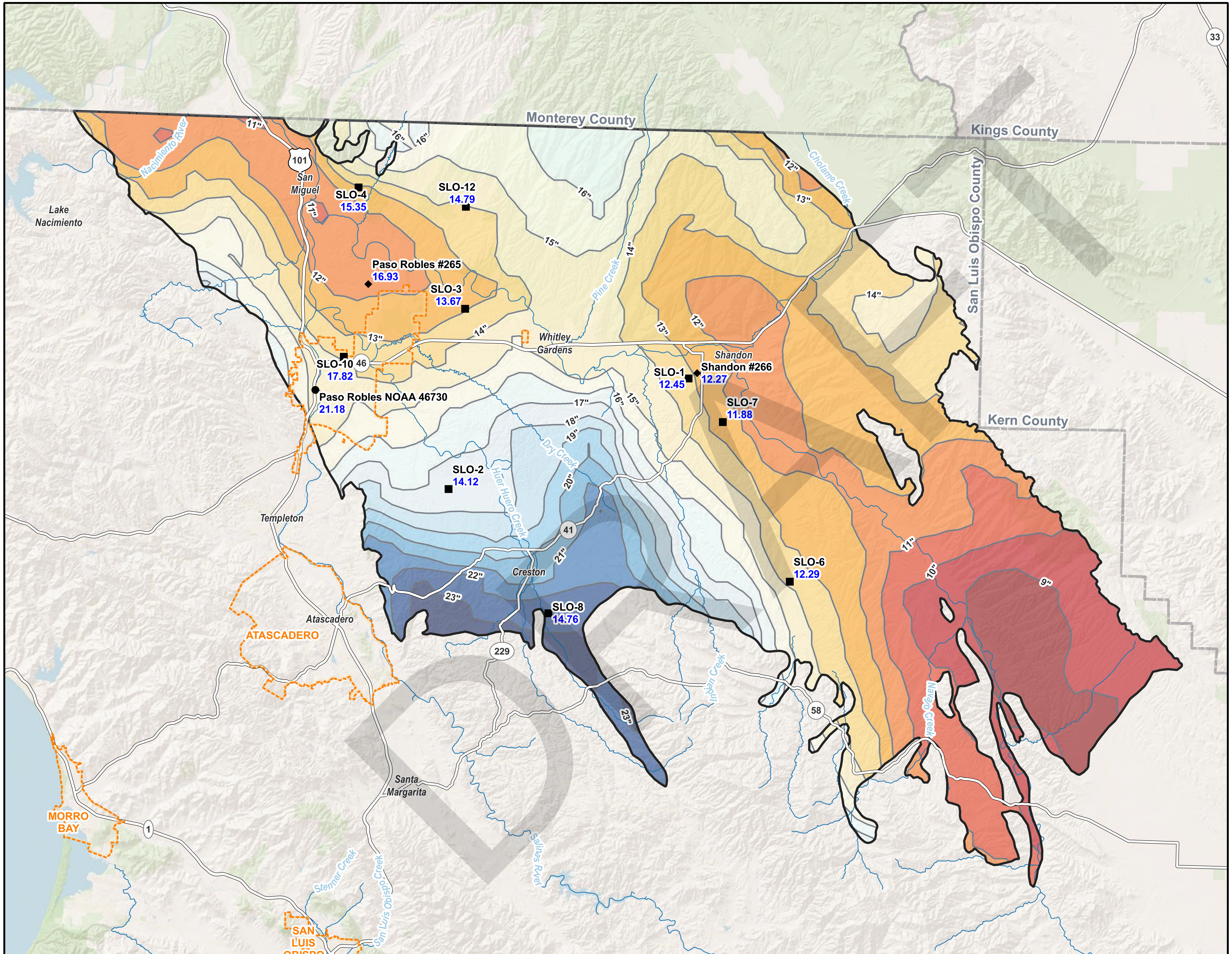


FIGURE 3

Water Year 2024 Precipitation Totals and Average Distribution of Annual Precipitation in the Paso Robles Subbasin

Paso Robles Subbasin
Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads
- 1 in. Precipitation Contour

Precipitation Station

WY 2024 Precipitation Total (inches)

- CIMIS Station
- Paso Robles NOAA Precipitation Station
- UCCE Precipitation Station

Annual Precipitation (in.)

8 - 9	16 - 17
9 - 10	17 - 18
10 - 11	18 - 19
11 - 12	19 - 20
12 - 13	20 - 21
13 - 14	21 - 22
14 - 15	22 - 23
15 - 16	23 - 24

NOTES:
Average distribution of annual precipitation based on 30-year normal PRISM data calibrated to the Paso Robles Station (NOAA 46730).

CIMIS: CA Irrigation Management Information System
UCCE University of California Cooperative Extension

N

0 2 4 6 mi
1" = 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLO Co., USGS, PRISM, NOAA, UCCE

CONFLUENCE ENGINEERING SOLUTIONS

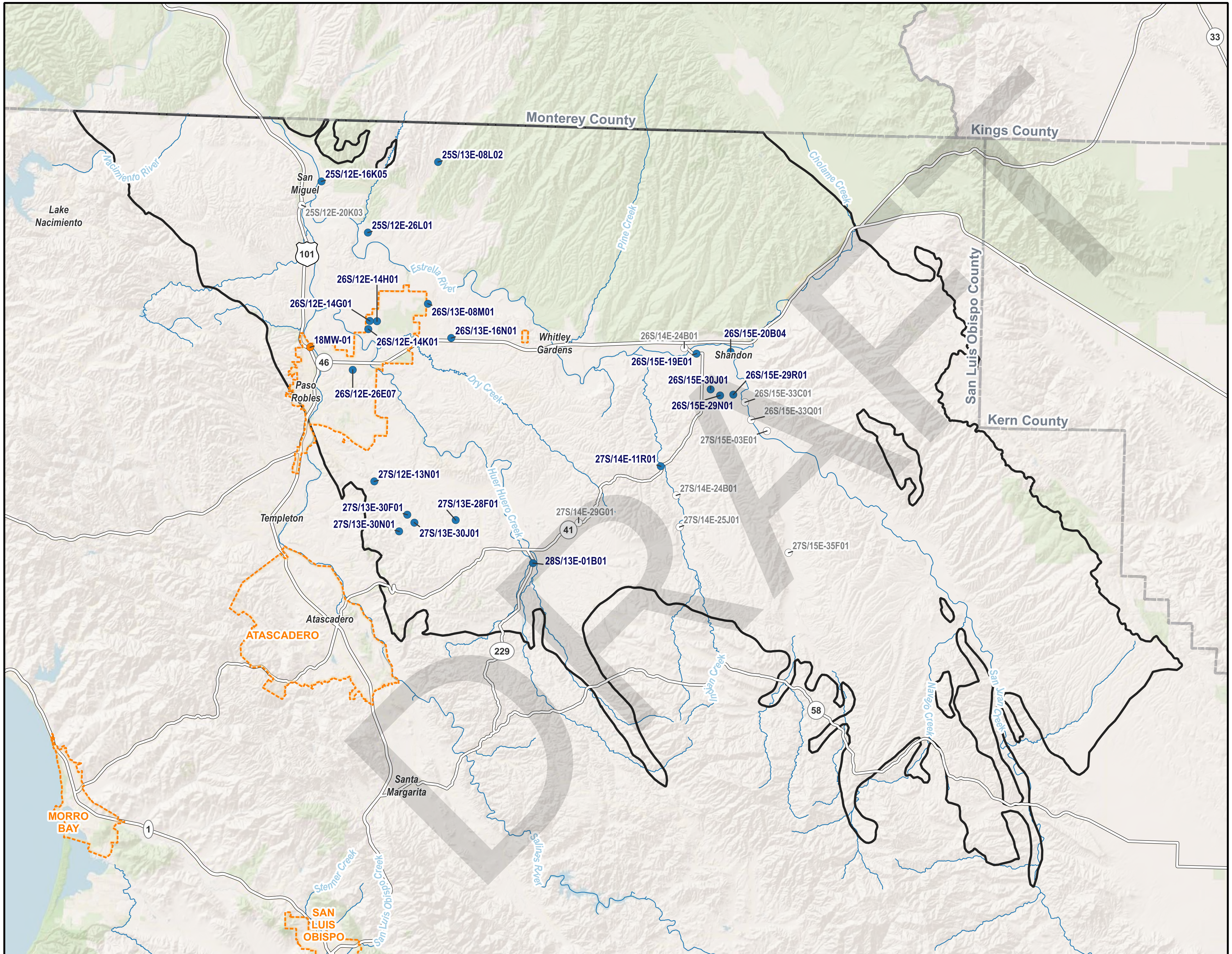


FIGURE 4

Groundwater Elevation Monitoring Well Network in the Paso Robles Subbasin

Paso Robles Subbasin Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads

Wells

- RMS Well - Alluvial Aquifer
- RMS Well - Paso Robles Formation
- Potential Future Monitoring Well

NOTES:
RMS: Representative Monitoring Site
CIMIS: CA Irrigation Management Information System
UCCE University of California Cooperative Extension

N

0 2 4 6 mi
1" = 4mi
0 10,000 20,000 30,000 ft

Date: 2025-03-05
Data Sources: CA DWR, SLOCO, ESRI

CONFLUENCE ENGINEERING SOLUTIONS

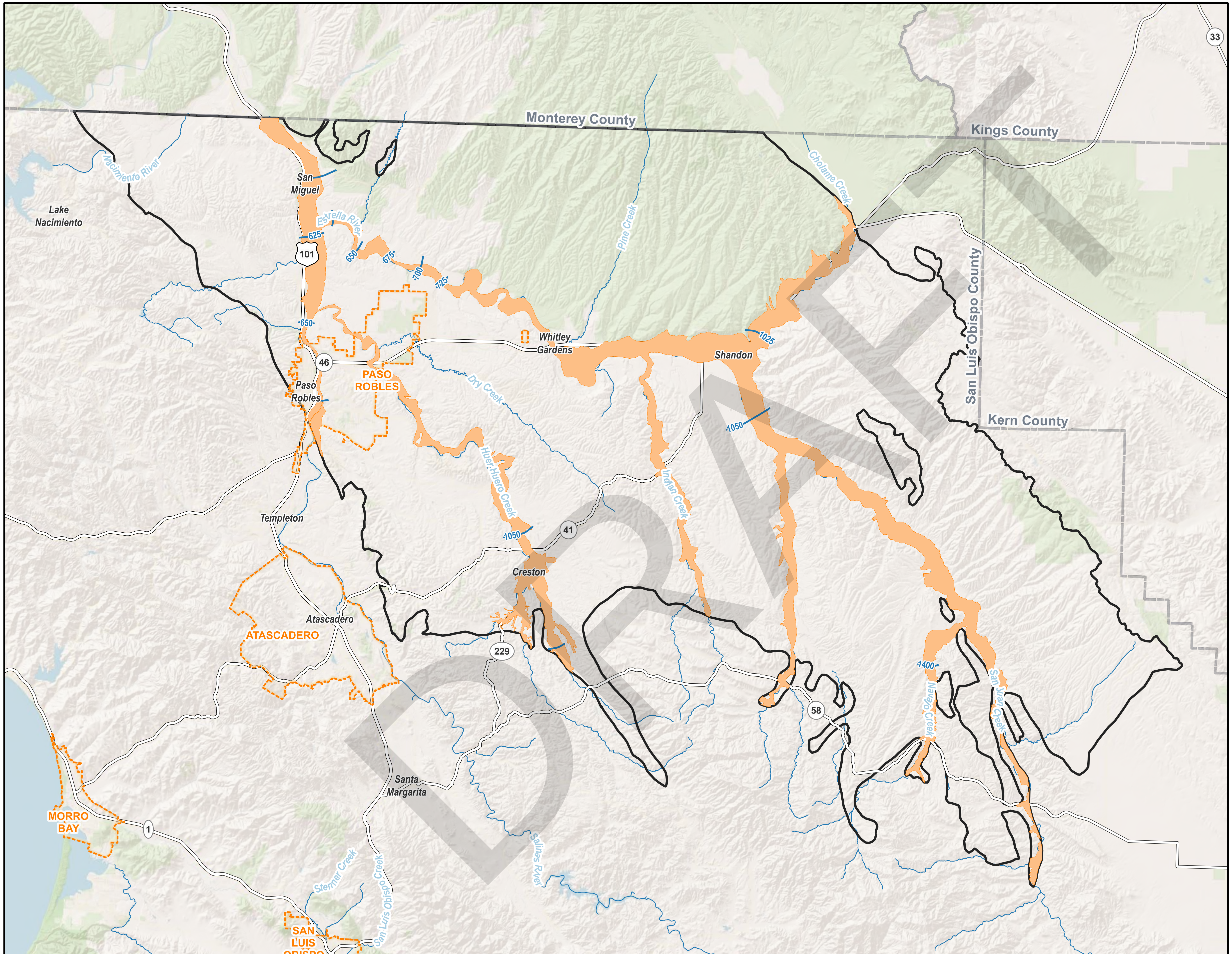


FIGURE 5

Alluvial Aquifer
Spring 2024
Groundwater Elevation Contours

Paso Robles Subbasin
Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads
- Qal: Alluvial Deposits
- Alluvial Groundwater Elevation Contour, in feet above mean sea level

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, ESRI

CONFLUENCE

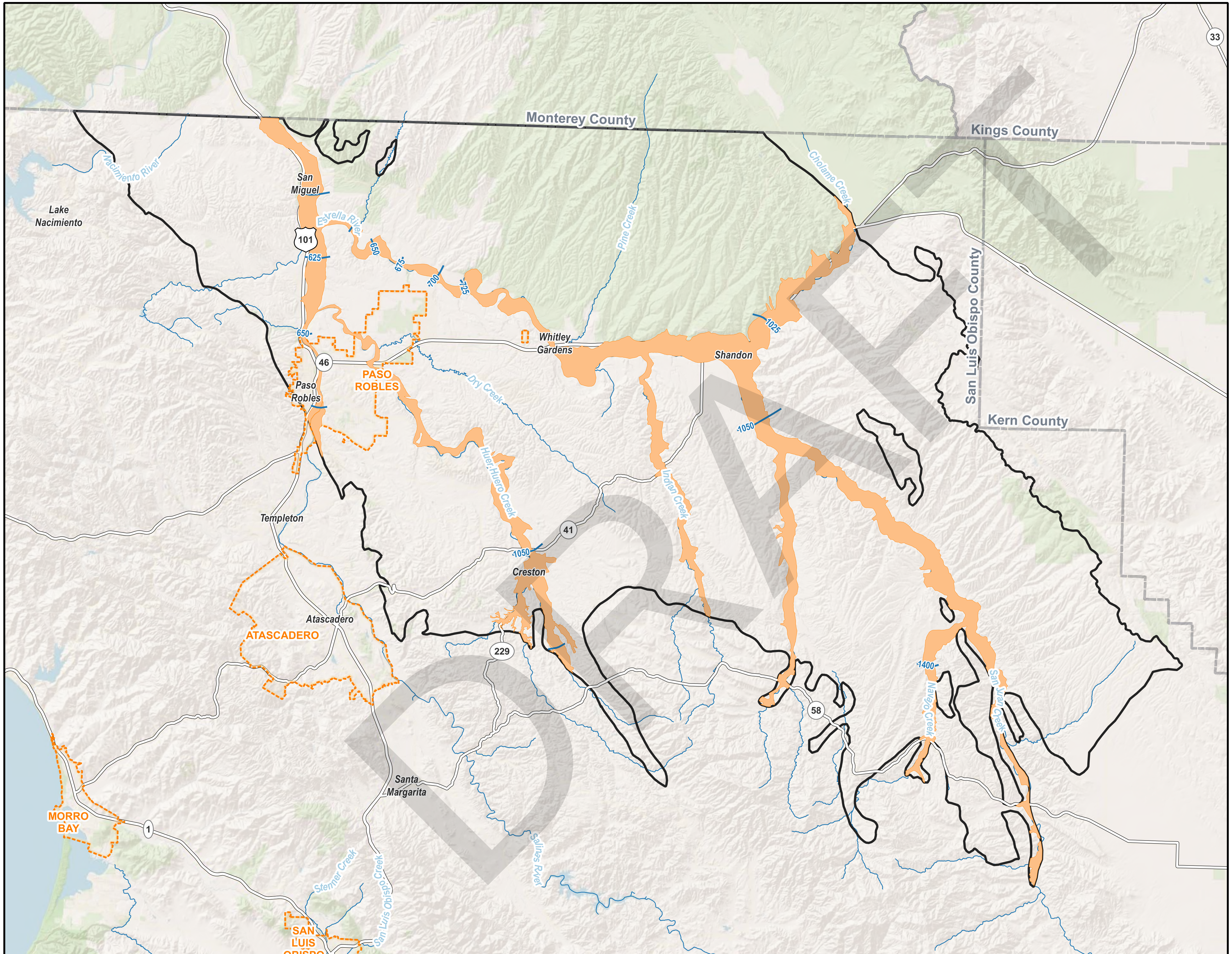


FIGURE 6

Alluvial Aquifer
Fall 2024
Groundwater Elevation Contours

Paso Robles Subbasin
Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads
- Qal: Alluvial Deposits
- Alluvial Groundwater Elevation Contour, in feet above mean sea level

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, ESRI

CONFLUENCE ENGINEERING SOLUTIONS

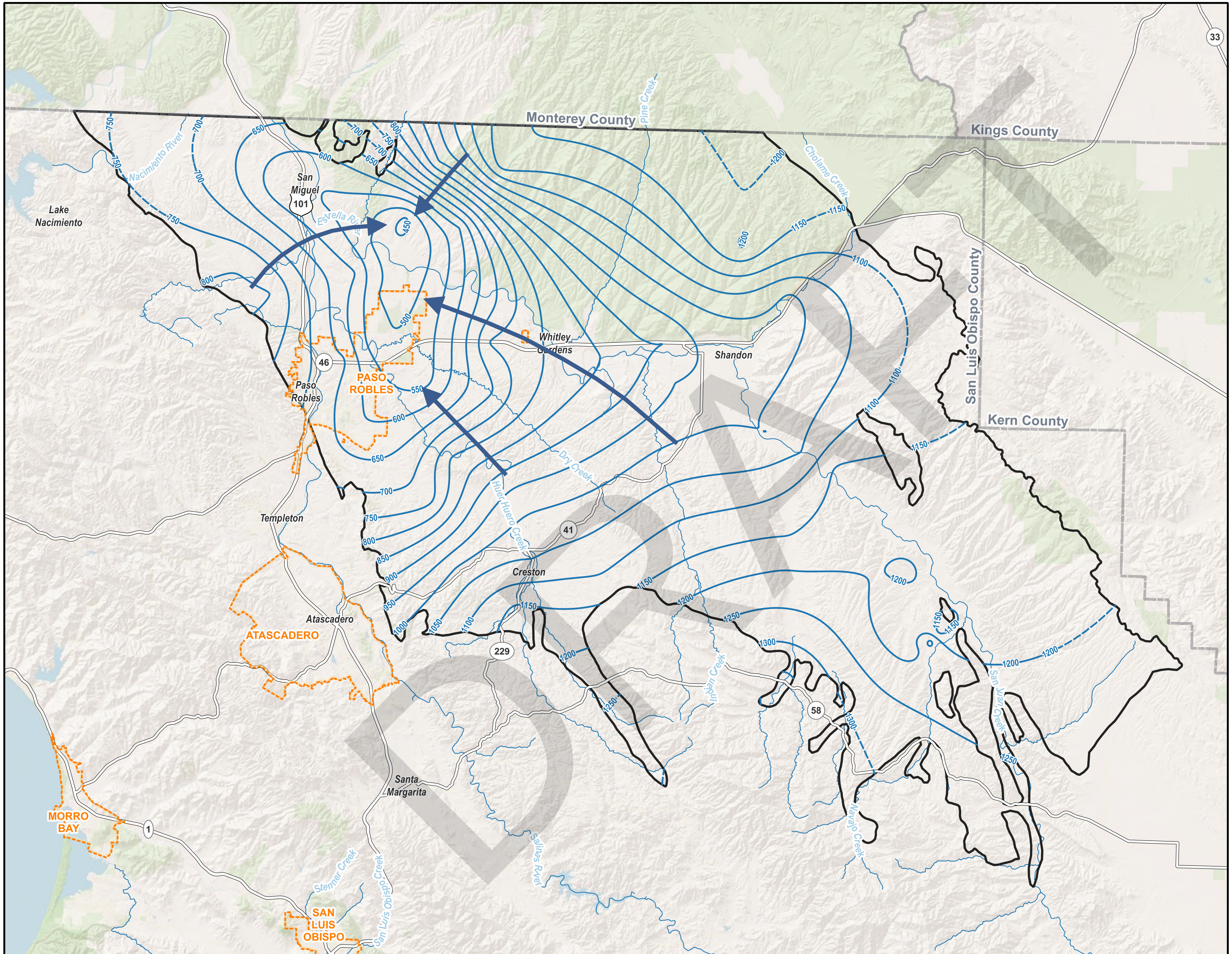


FIGURE 7

Paso Robles Formation
Spring 2024
Groundwater Elevation Contours

Paso Robles Subbasin
Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads
- Paso Robles Formatinon Groundwater Elevation Contour, in feet above mean sea level
- Inferred Groundwater Flow Direction

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, ESRI

CONFLUENCE

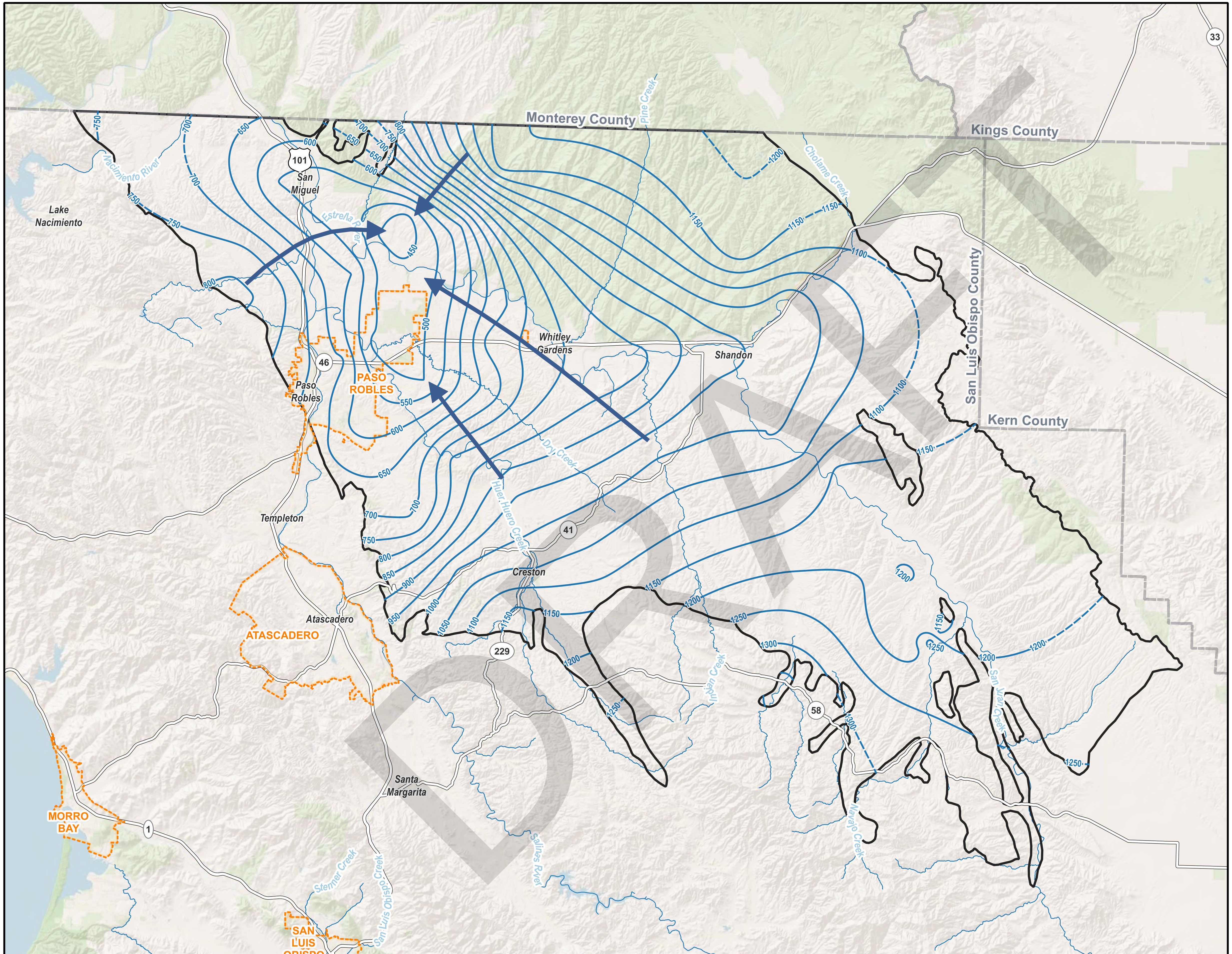


FIGURE 8

Paso Robles Formation
Fall 2024
Groundwater Elevation Contours

Paso Robles Subbasin
Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads
- Paso Robles Formatinon Groundwater Elevation Contour, in feet above mean sea level
- Inferred Groundwater Flow Direction

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

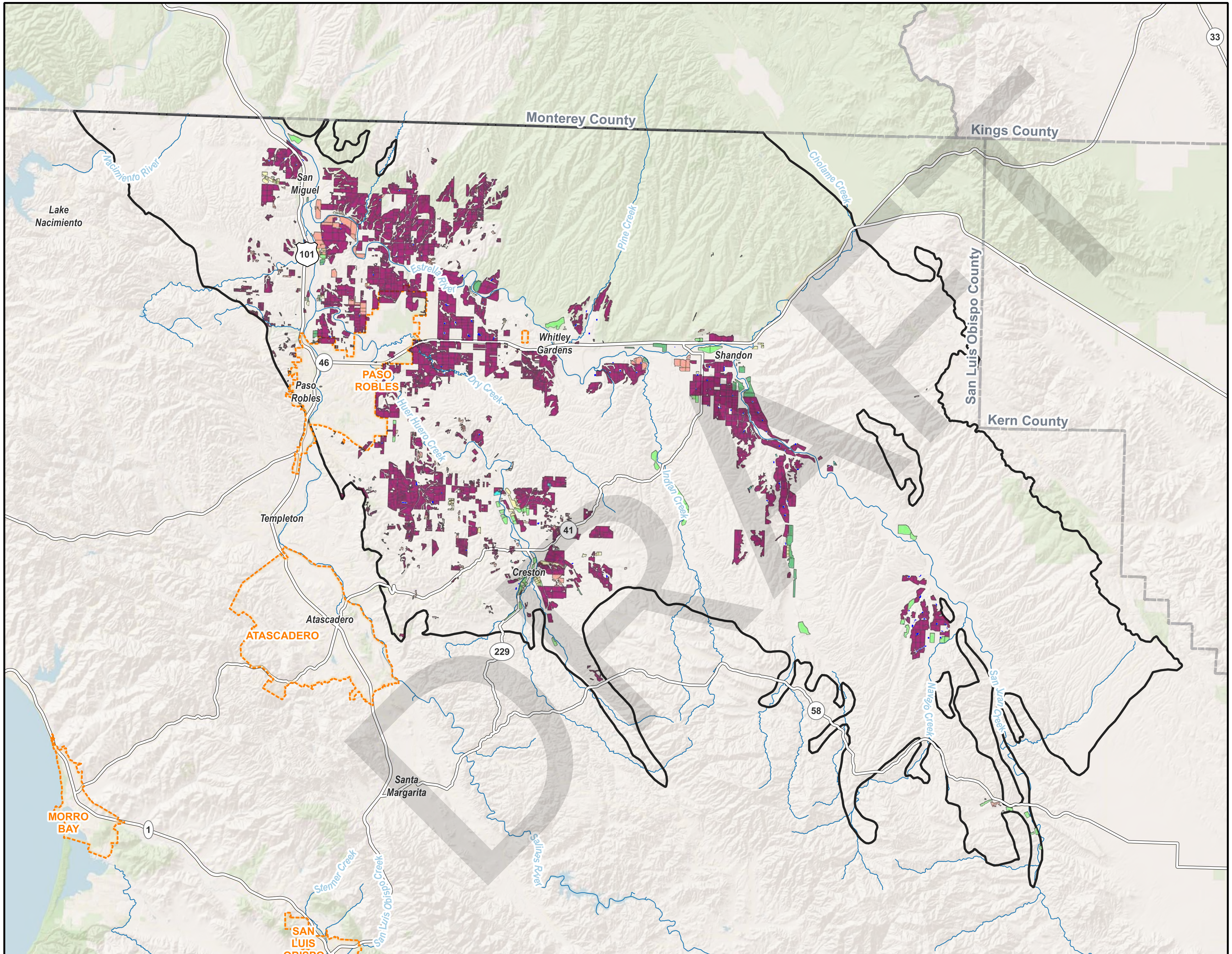
Date: 2025-02-18
Data Sources: CA DWR, SLOCO, ESRI

CONFLUENCE ENGINEERING SOLUTIONS

FIGURE 9

Irrigated Agriculture
Water Year 2024

Paso Robles Subbasin
Water Year 2024 Annual Report



LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads
- Agricultural Storage Pond

Irrigated Agriculture

- Orchard
- Pasture
- Alfalfa
- Vegetable
- Vineyard
- Nursery

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, LandIQ, ESRI

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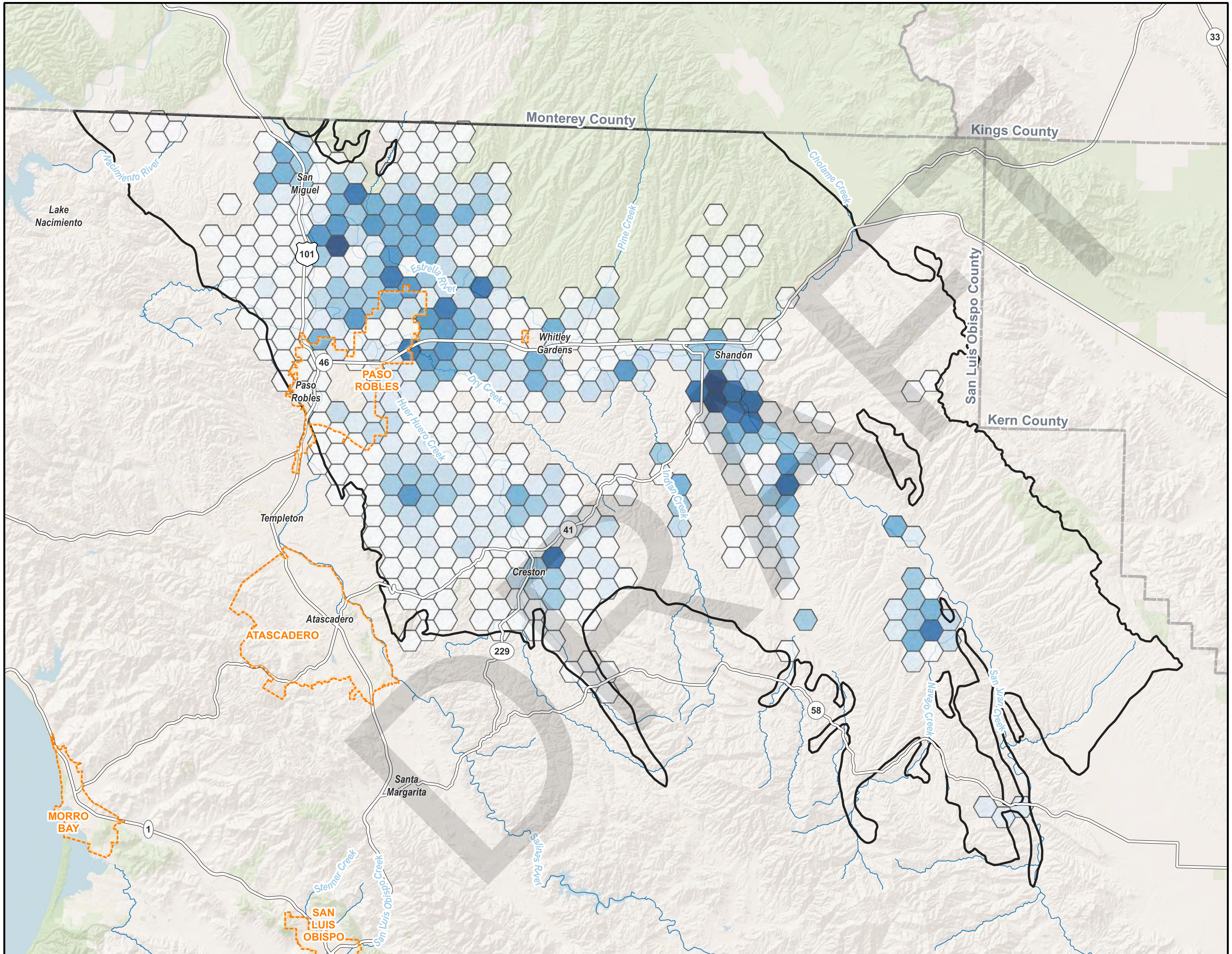
FIGURE 10

General Locations and Volumes of Groundwater Extraction

Paso Robles Subbasin
Water Year 2024 Annual Report



LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads

Water Year 2024 Groundwater Extraction (AFY)

- 1 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700
- 700 - 727

NOTE:
AFY: Acre-Feet per Year

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, LandIQ, ESRI

CONFLUENCE ENGINEERING SOLUTIONS

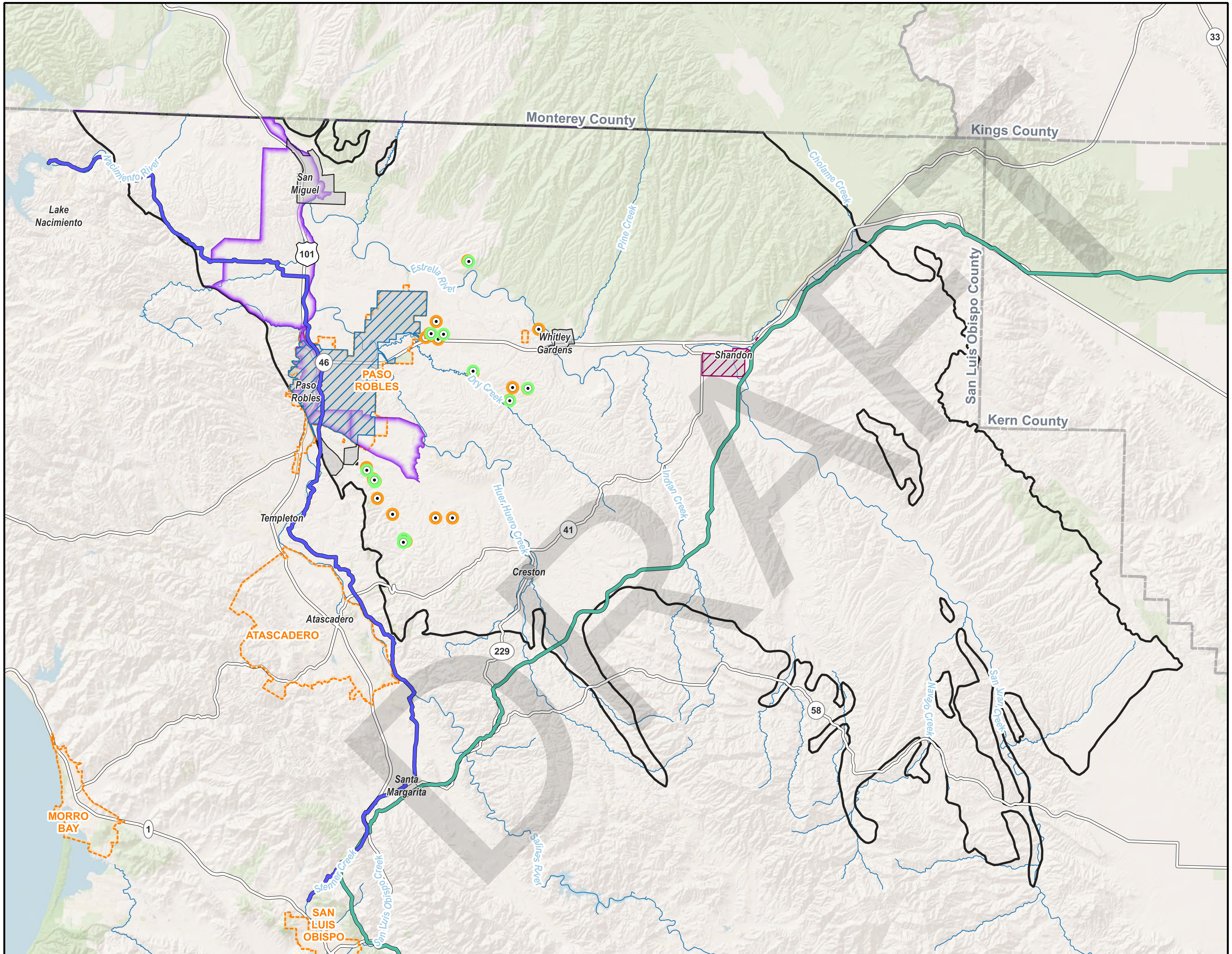


FIGURE 11

Communities Dependent on Groundwater and with Access to Surface Water

Paso Robles Subbasin Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads
- State Water Project Pipeline
- Nacimiento Water Project Pipeline
- Dry Well Replacements Completed in WY 2024
- Dry Wells Reported to DWR in WY 2024
- Disadvantaged Communities (DACs)
- Communities Dependent Solely on Groundwater
- Communities Served by Groundwater and Nacimiento Water Project
- Communities Served by Groundwater and State Water Project

N

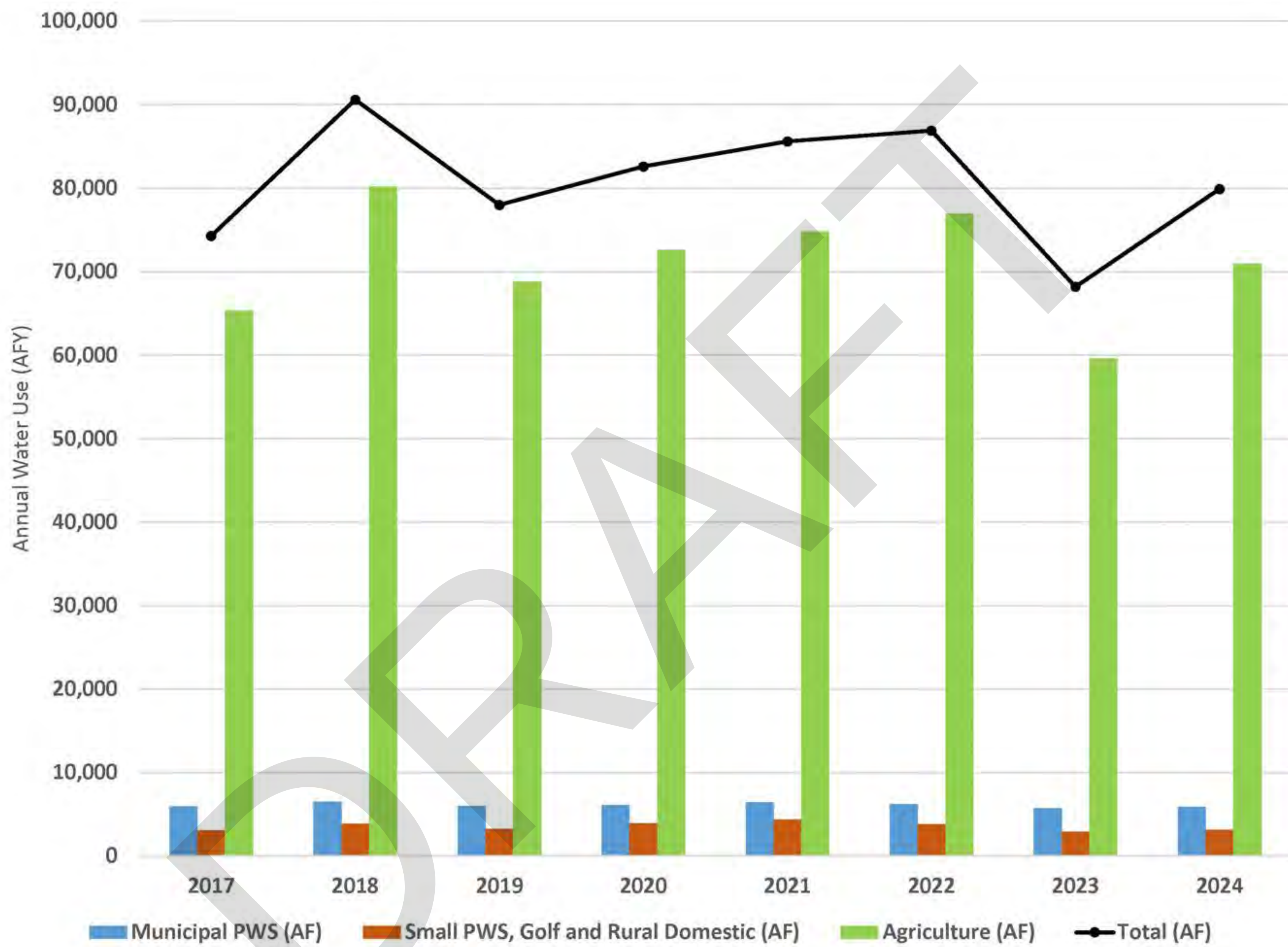
0 2 4 6 mi

1" = 4mi

0 10,000 20,000 30,000 ft

Date: 2025-03-07
Data Sources: CA DWR, SLOCO, ESRI, CA Energy Commission

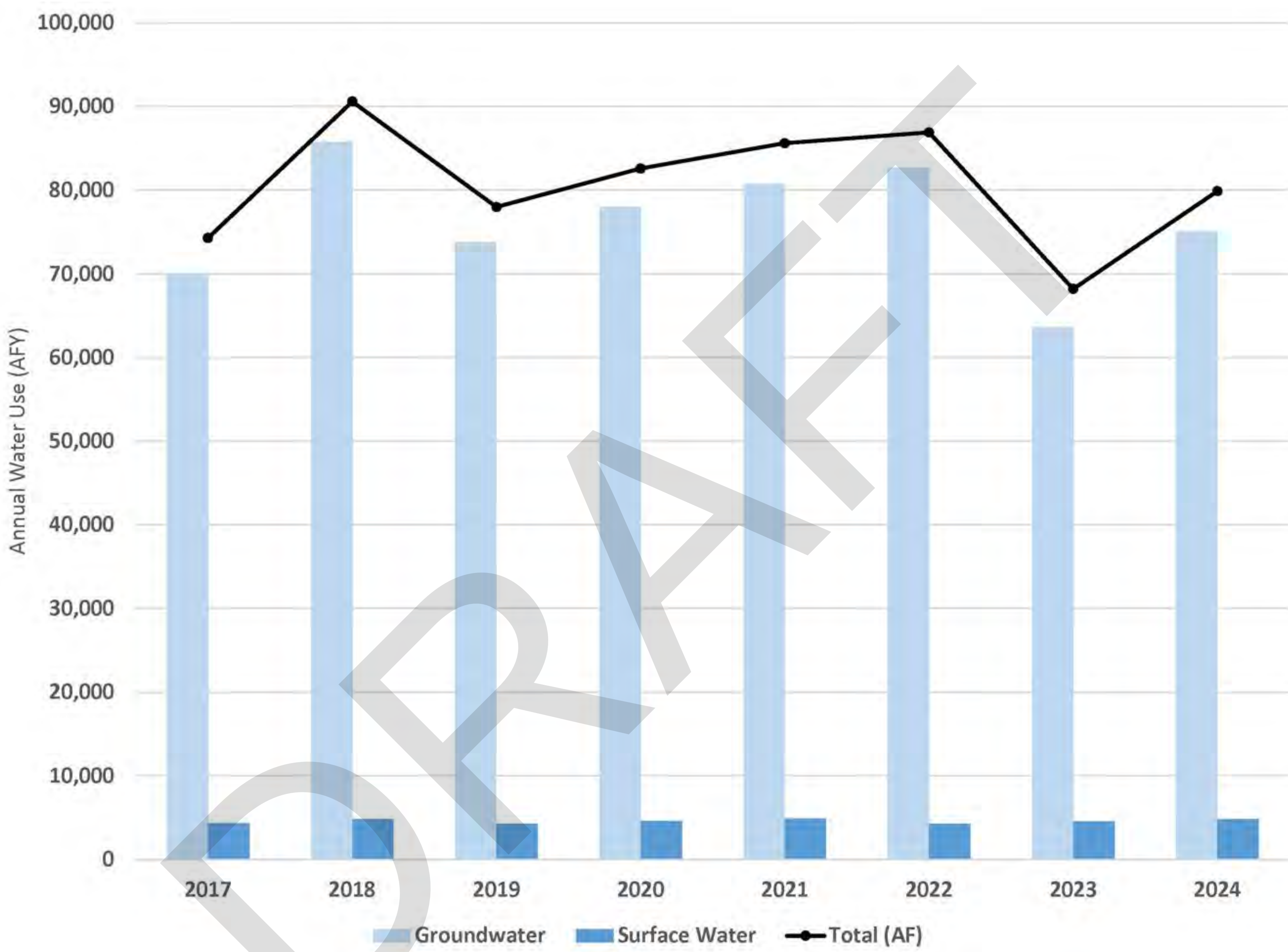
CONFLUENCE ENGINEERING SOLUTIONS



CONFLUENCE

FIGURE 12

Total Annual Water Use
by Water Use Sector
Paso Robles Subbasin Water Year 2024 Annual Report



CONFLUENCE ENGINEERING SOLUTIONS

FIGURE 13
Total Annual Water Use
by Water Source
Paso Robles Subbasin Water Year 2024 Annual Report

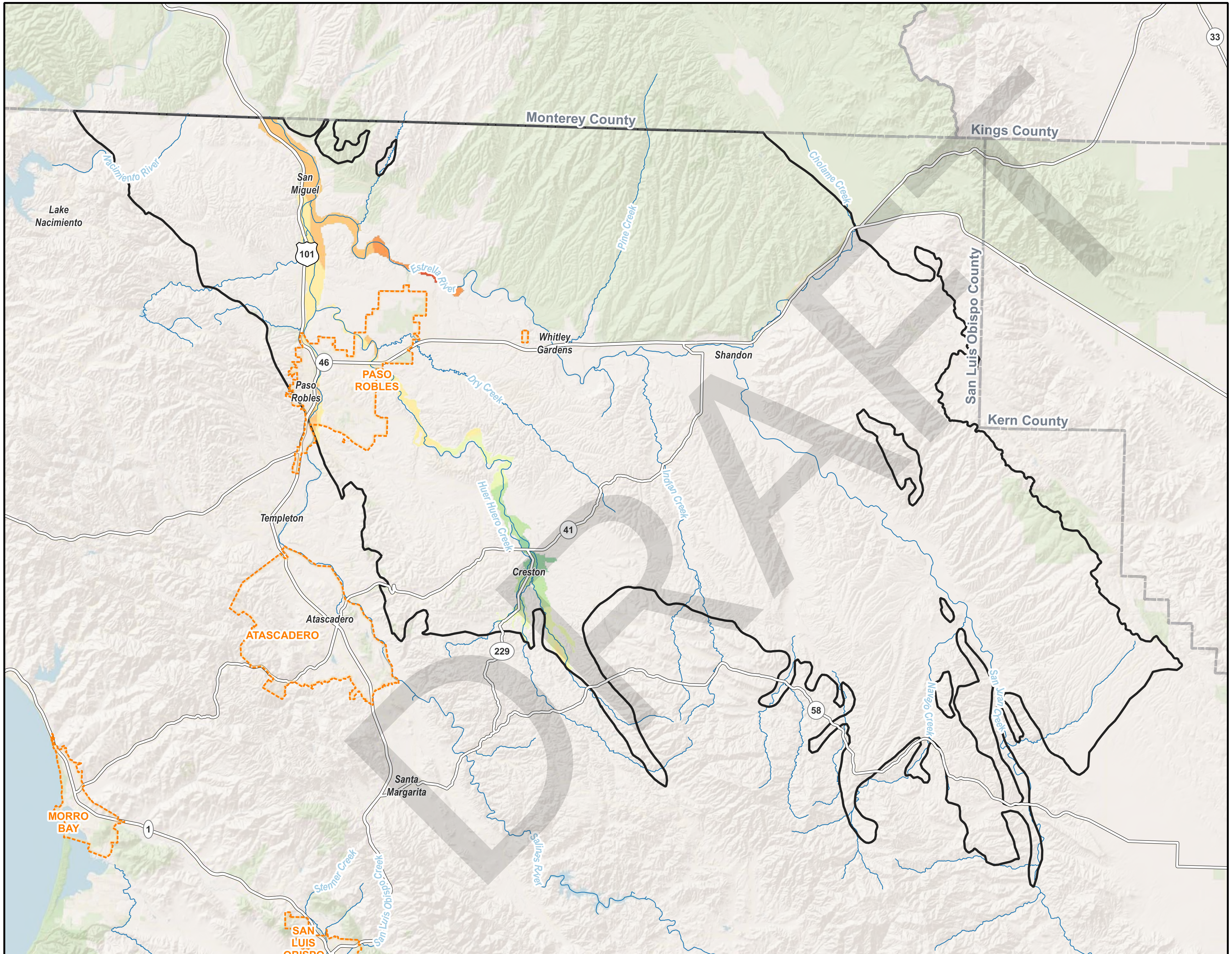


FIGURE 14

Alluvial Aquifer Change in Groundwater Elevation
Fall 2023 to Fall 2024

Paso Robles Subbasin
Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads

Fall 2023 to Fall 2024

- <= -4 feet
- -4 - -3 feet
- -3 - -2 feet
- -2 - -1 feet
- -1 - 0 feet
- 0 - 1 feet
- 1 - 2 feet
- 2 - 3 feet
- 3 - 4 feet
- > 4 feet

N

0 2 4 6 mi
1" = 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, ESRI

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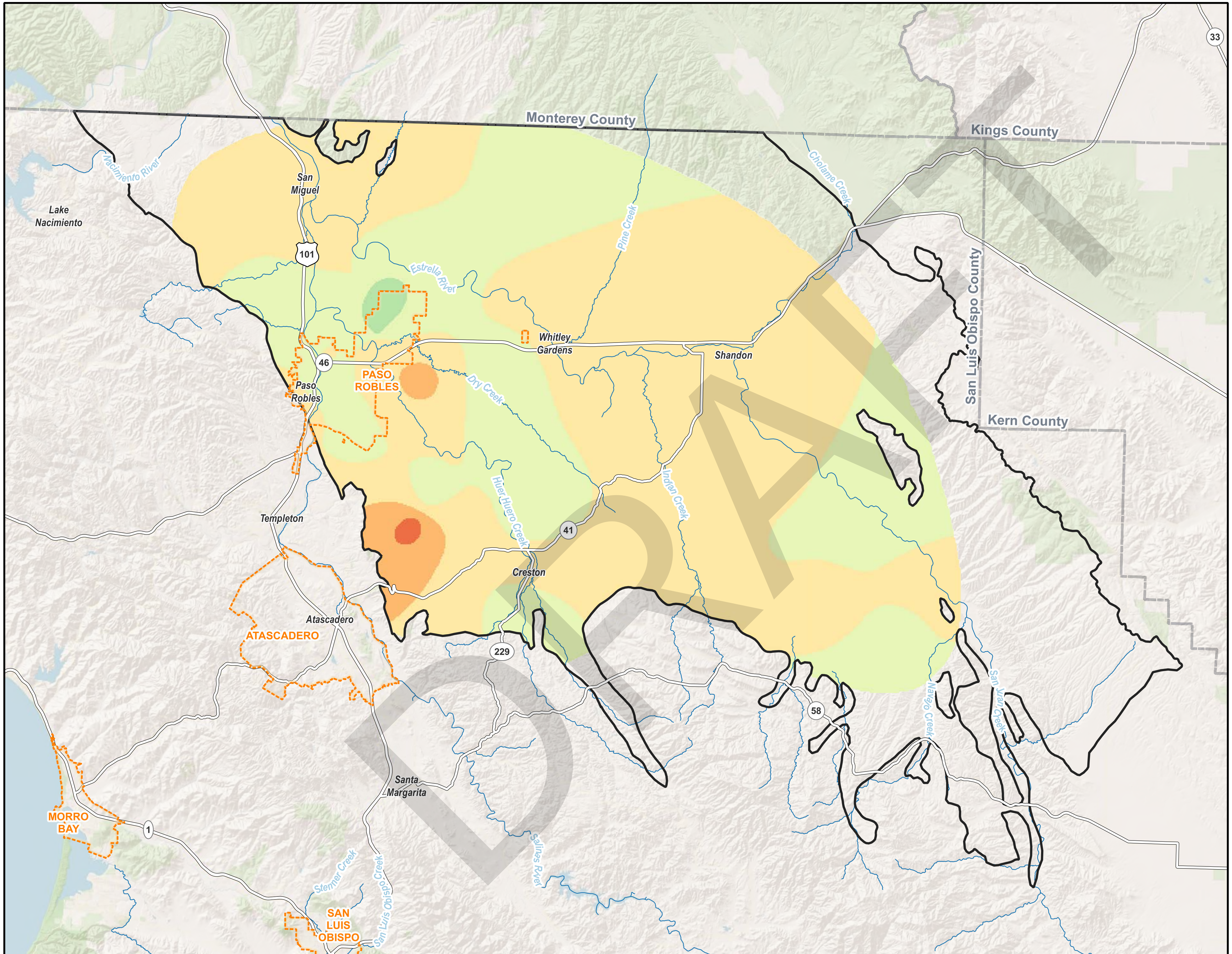
FIGURE 15

Paso Robles Formation Aquifer
Change in Groundwater Elevation
Fall 2023 to Fall 2024

Paso Robles Subbasin
Water Year 2024 Annual Report



LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads

Fall 2023 to Fall 2024

- <= -30 feet
- -30 - -20 feet
- -20 - -10 feet
- -10 - 0 feet
- 0 - 10 feet
- 10 - 20 feet
- 20 - 30 feet
- > 30 feet

NOTES:
CIMIS: CA Irrigation Management Information System
UCCE University of California Cooperative Extension

N

0 2 4 6 mi
1" = 4mi
0 10,000 20,000 30,000 ft

Date: 2025-02-18
Data Sources: CA DWR, SLOCO, ESRI

CONFLUENCE ENGINEERING SOLUTIONS

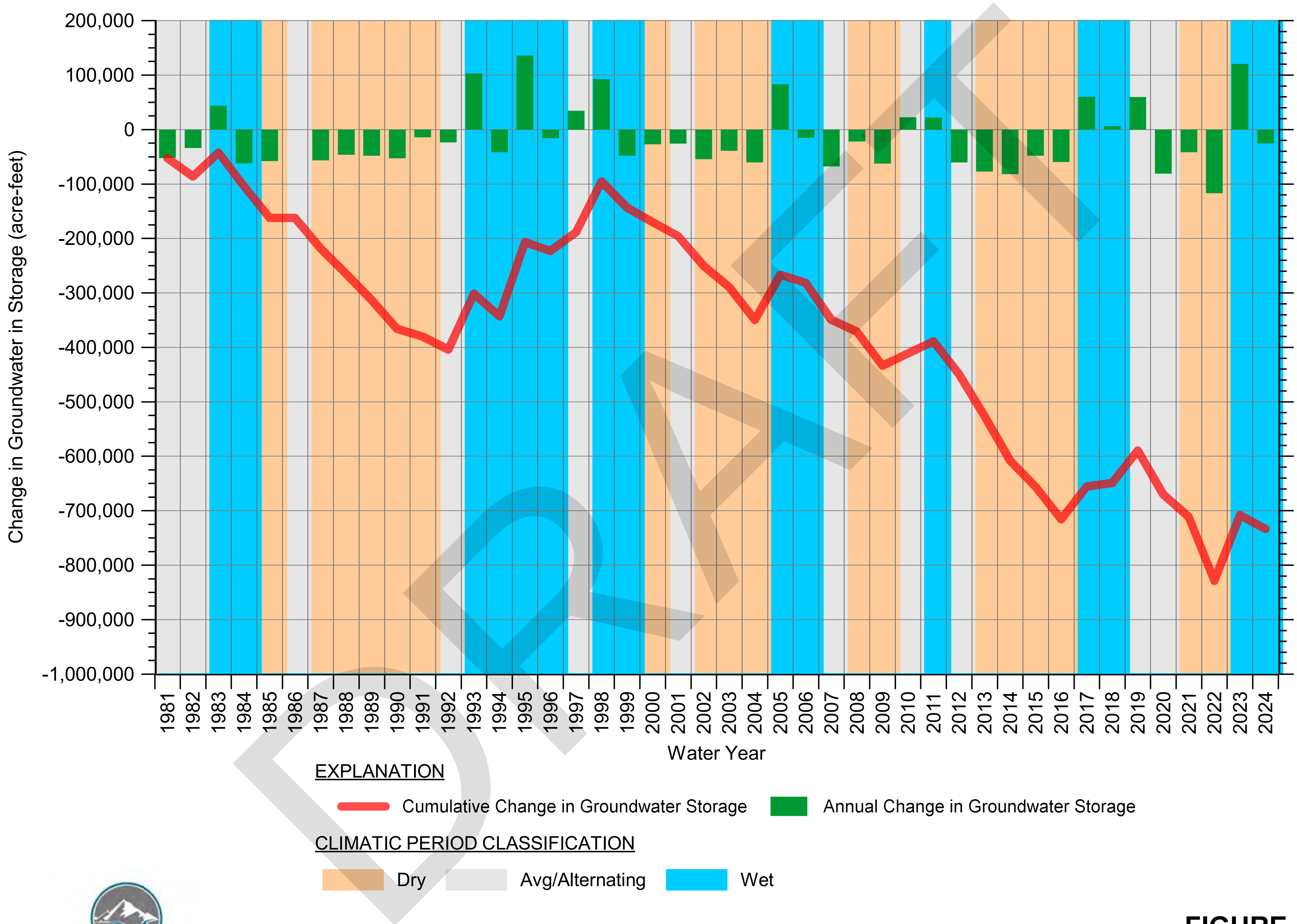


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FIGURE 16

Estimated Annual and Cumulative Change in Groundwater in Storage in the Paso Robles Subbasin

Paso Robles Subbasin Water Year 2024 Annual Report

C:\Users\NatePage\confluencees.com\ConfluenceES - Projects\Paso Basin GSAs\Paso WY24-AR\5_Working Files\Analysis\Change in Storage\Grapher\GW_CumulativeChangeGWStoragePRannual_wTitle.gpj

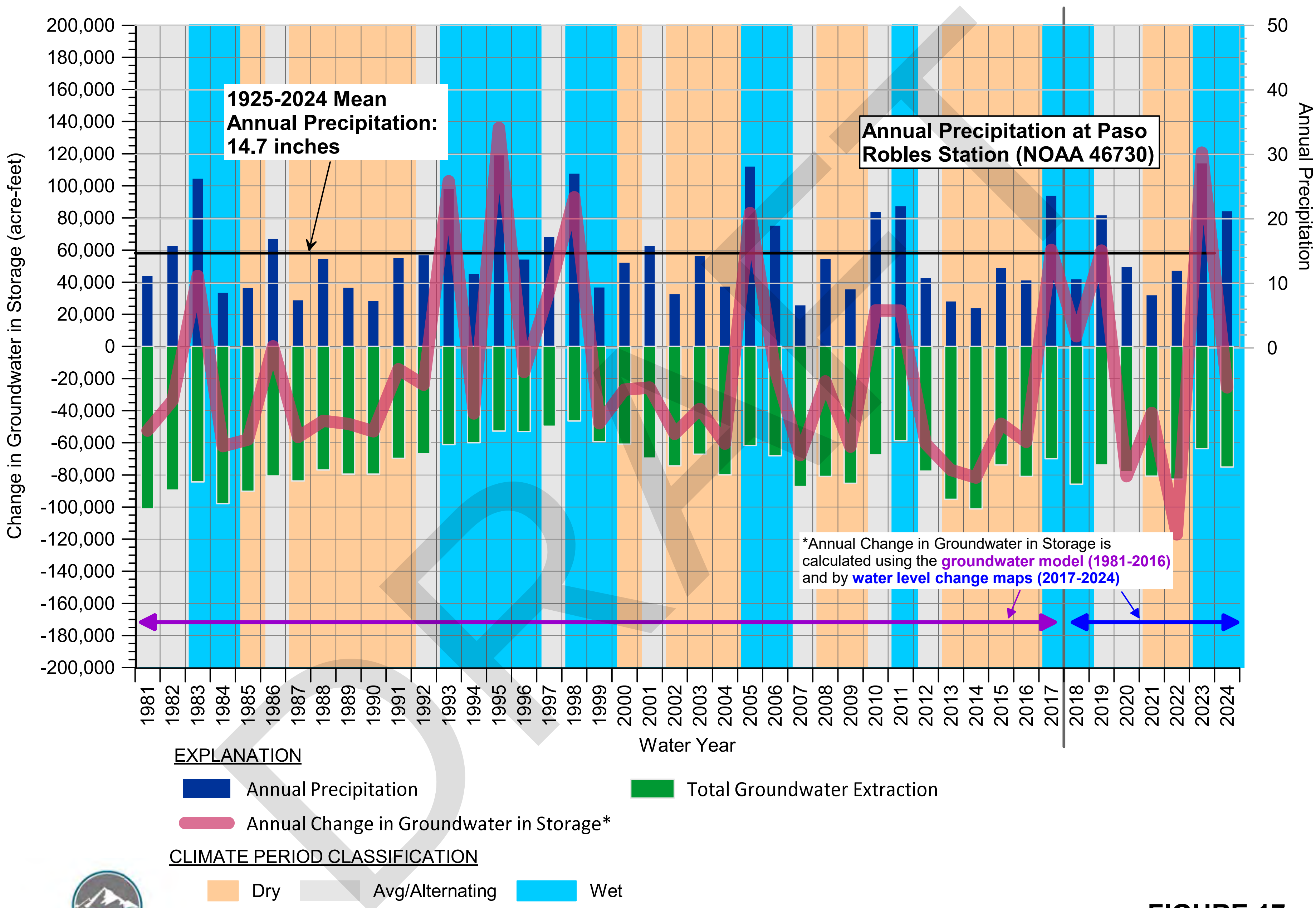

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FIGURE 17

Annual Precipitation and Groundwater Extraction vs Annual Change in Groundwater in Storage

Paso Robles Subbasin Water Year 2024 Annual Report

C:\Users\NatePage\confluencees.com\ConfluenceES - Projects\Paso Basin GSAs\Paso WY24-AR\5_Working Files\Analysis\Change in Storage\Grapher\Annual Precipitation and Groundwater Extraction vs Annual Change in Groundwater in Storage.gpj

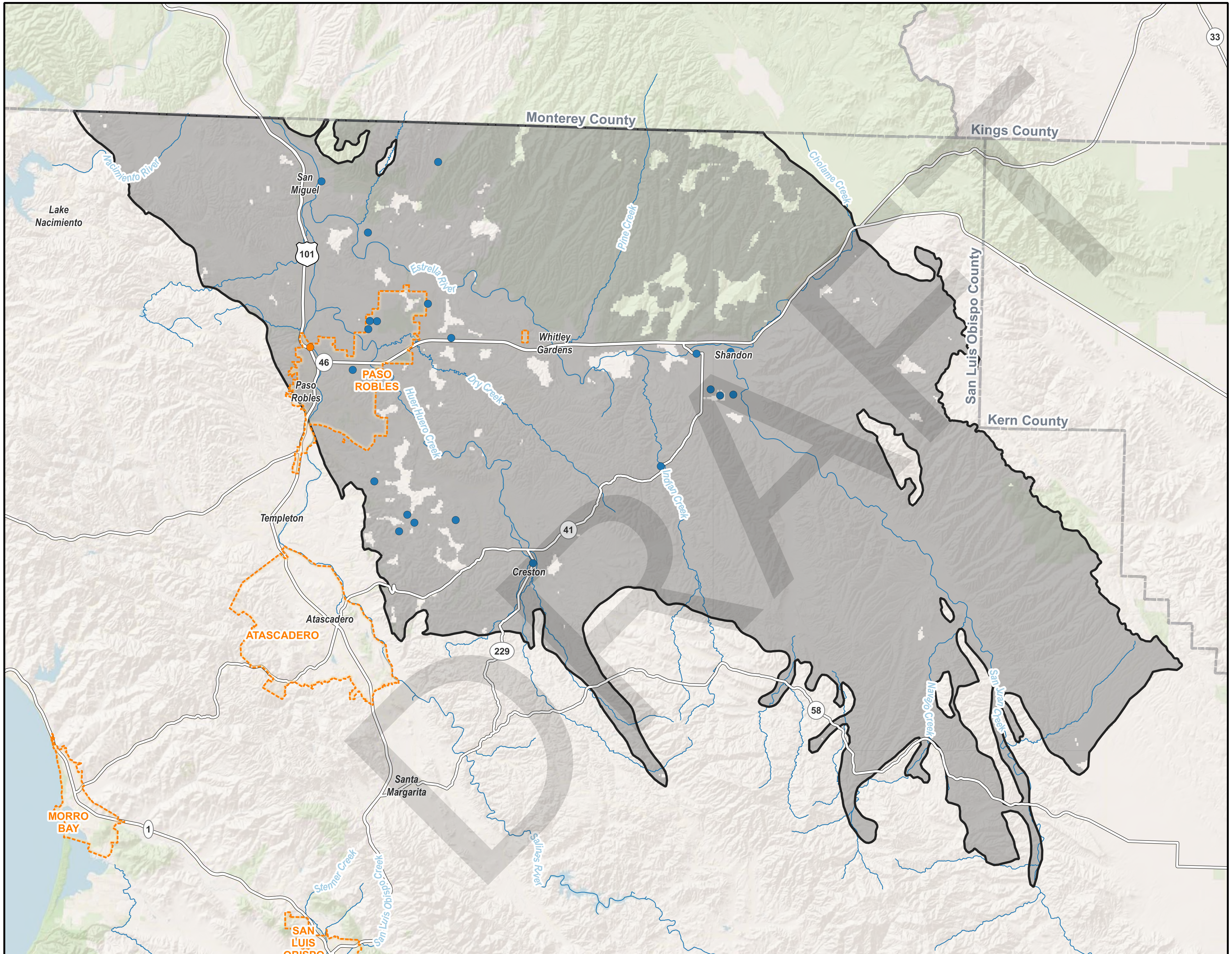


FIGURE 18

Single-Year Land Subsidence Measured by InSAR (June 2023 – June 2024)

Paso Robles Subbasin Water Year 2024 Annual Report

LEGEND

- County Boundary
- City Boundary
- Paso Robles Subbasin
- Major Creeks
- Major Roads

Wells

- RMS Well - Alluvial Aquifer
- RMS Well - Paso Robles Formation

Estimated Subsidence (decimal ft) June 2023 - June 2024

- Measurement within method error bars (+/- 0.066 feet)

NOTES:
RMS: Representative Monitoring Site
InSAR: Interferometric Synthetic Aperture Radar

N

0 2 4 6 mi
1" = 4mi
0 10,000 20,000 30,000 ft

Date: 2025-03-05
Data Sources: CA DWR, SLOCO, City of Paso Robles, TRE Altamira InSAR dataset

CONFLUENCE ENGINEERING SOLUTIONS

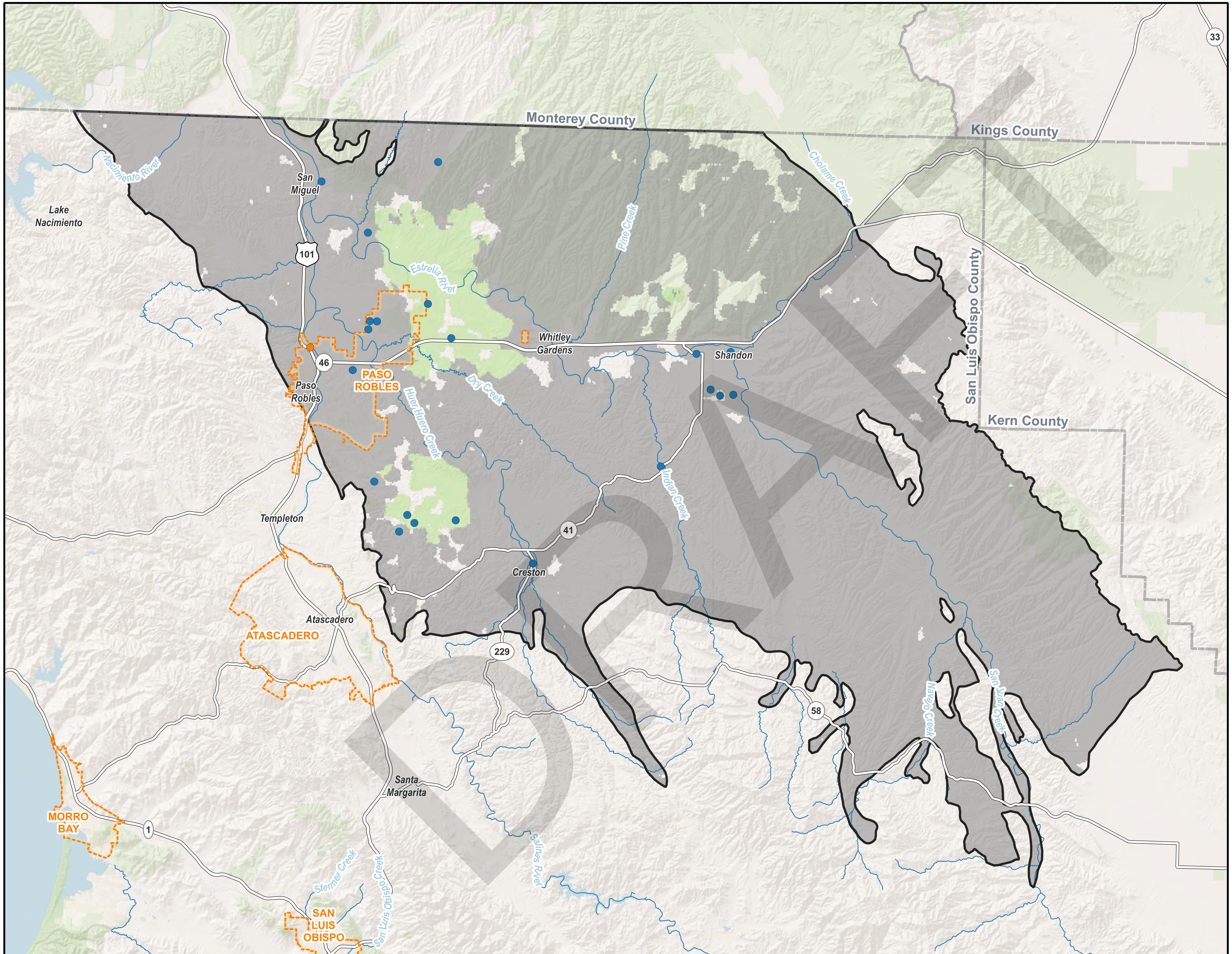


FIGURE 19

Five-Year Land Subsidence Measured by InSAR (June 2019 – June 2024)

Paso Robles Subbasin Water Year 2024 Annual Report

LEGEND

County Boundary

City Boundary

Paso Robles Subbasin

Major Creeks

Major Roads

Wells

RMS Well - Alluvial Aquifer

RMS Well - Paso Robles Formation

Estimated Subsidence (decimal ft) June 2019 - June 2024

Measurement within method error bars (+/- 0.066 feet)

Land Subsidence of less than 0.2 feet

NOTES:
RMS: Represenative Monitoring Site
InSAR: Interferometric Synthetic Aperture Radar

N

0 2 4 6 mi
1"= 4mi
0 10,000 20,000 30,000 ft

Date: 2025-03-05
Data Sources: CA DWR, SLOCO, City of Paso Robles, TRE Altamira InSAR dataset

CONFLUENCE ENGINEERING SOLUTIONS

Appendices

Appendix A: SGMA Regulations for Annual Reports

§ 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.

(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.

(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.

(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.

(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.

(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.

(5) Change in groundwater in storage shall include the following:

(A) Change in groundwater in storage maps for each principal aquifer in the basin.

(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.

(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.

Note: Authority cited: Section 10733.2, Water Code.

Reference: Sections 10727.2, 10728, and 10733.2, Water Code.

Appendix B: Precipitation Data

Monthly Precipitation at the Paso Robles Station (NOAA 46730)

(inches)

Source: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca6730
Source: https://www.prcity.com/462/Rainfall-Totals

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	WY Total
1925	0.34	2.44	2.57	2.01	2.41	0.08	0.09	0.12	0.02	0.17	0.21	1.98	**12.95**
1926	2.13	6.26	0.27	3.52	0.00	0.02	0.00	0.00	0.00	0.25	7.14	0.90	**14.56**
1927	1.84	9.04	1.45	1.27	0.00	0.02	0.00	0.00	0.00	1.33	2.02	1.63	**21.91**
1928	0.23	2.87	2.76	0.37	0.29	0.00	0.00	0.00	0.00	0.01	1.82	2.87	**11.50**
1929	1.27	1.65	1.22	0.49	0.00	0.49	0.00	0.00	-----	0.00	0.00	0.24	**9.82**
1930	4.32	1.80	3.00	0.54	1.01	0.04	0.00	0.00	0.04	0.00	1.64	0.16	**10.99**
1931	4.58	1.87	0.39	0.56	2.01	0.93	0.00	0.09	0.00	0.01	1.89	7.04	**12.23**
1932	2.74	3.89	0.50	0.30	0.13	0.00	0.00	0.00	0.00	0.04	0.11	1.28	**16.50**
1933	6.05	0.08	0.84	0.22	0.32	0.68	0.00	0.00	0.00	0.64	0.00	4.26	**9.62**
1934	2.06	3.75	0.04	0.00	0.12	0.75	0.00	0.00	0.00	1.56	2.61	2.66	**11.62**
1935	6.23	0.65	4.08	3.41	0.02	0.00	0.00	0.16	0.07	0.18	1.58	1.66	**21.45**
1936	0.61	11.07	1.24	1.52	0.01	0.04	0.25	0.00	0.00	1.93	0.00	6.10	**18.16**
1937	4.59	4.54	5.25	0.16	0.00	0.00	0.00	0.00	0.00	0.16	0.66	7.40	**22.57**
1938	1.73	12.74	6.77	0.93	0.30	0.00	0.00	0.00	0.41	0.23	0.33	1.45	**31.10**
1939	3.11	1.45	1.58	0.05	0.09	0.00	0.00	0.00	0.43	0.55	0.78	1.29	**8.72**
1940	5.28	5.57	1.13	0.54	0.00	0.00	0.00	0.00	0.00	0.19	0.13	8.18	**15.14**
1941	4.73	8.16	6.14	2.76	0.19	0.00	0.00	0.02	0.00	1.34	0.70	5.15	**30.50**
1942	2.40	0.76	1.77	3.01	0.15	0.00	0.00	0.00	0.00	0.58	1.01	1.64	**15.28**
1943	8.00	1.68	3.63	0.72	0.00	0.00	0.00	0.00	0.00	0.34	0.12	3.38	**17.26**
1944	0.94	5.96	0.64	0.65	0.13	0.00	0.00	0.00	0.00	0.26	2.64	1.38	**12.16**
1945	0.80	4.17	2.76	0.26	0.04	0.00	0.00	0.00	0.00	1.09	0.49	1.72	**12.31**
1946	0.31	1.64	3.01	0.05	0.72	0.00	0.26	0.00	0.10	0.00	4.57	2.17	**9.39**
1947	0.56	0.97	1.14	0.13	0.28	0.00	0.00	0.00	0.04	0.32	0.18	0.62	**9.86**
1948	0.00	1.85	3.51	3.50	0.45	0.00	0.00	0.00	0.00	0.06	0.00	3.04	**10.43**
1949	1.09	1.95	3.73	0.36	0.38	0.00	0.00	0.00	0.00	0.78	0.78	2.33	**10.61**
1950	2.39	2.43	1.65	0.89	0.05	0.00	0.68	0.00	0.00	1.24	1.18	2.50	**11.98**
1951	2.50	0.68	0.58	1.11	0.00	0.00	0.00	0.00	0.03	0.33	1.94	4.64	**9.82**
1952	5.54	0.20	3.92	1.50	0.03	0.00	0.07	0.00	0.02	0.02	1.76	4.78	**18.19**
1953	1.71	0.00	0.66	1.90	0.06	0.01	0.00	0.00	0.00	0.00	2.46	0.00	**10.90**
1954	3.06	1.89	3.12	0.64	0.10	0.00	0.00	0.00	0.00	0.00	1.29	1.51	**11.27**
1955	3.57	1.85	0.37	1.16	1.31	0.00	0.00	0.13	0.00	0.00	1.36	8.14	**11.19**
1956	3.82	1.00	0.01	1.87	1.45	0.00	0.00	0.00	0.00	1.07	0.00	0.17	**17.65**
1957	4.77	1.90	0.31	1.63	0.71	0.47	0.00	0.00	0.02	0.62	0.30	3.30	**11.05**
1958	2.93	6.02	6.35	5.22	0.37	0.00	0.00	0.38	1.20	0.00	0.13	0.48	**26.69**
1959	1.69	4.53	0.03	0.44	0.05	0.00	0.00	0.00	0.52	0.00	0.00	0.31	**7.87**
1960	2.42	4.20	0.70	1.40	0.04	0.00	0.00	0.00	0.00	0.10	3.63	1.17	**9.07**
1961	1.72	0.20	0.88	0.22	0.74	0.00	0.00	0.00	0.00	0.01	1.99	2.59	**8.66**
1962	2.05	8.49	1.98	0.00	0.12	0.00	0.00	0.00	0.00	0.79	0.01	2.52	**17.23**
1963	4.41	3.79	2.10	3.32	0.17	0.01	0.00	0.00	0.24	1.00	4.25	0.01	**17.36**
1964	1.87	0.15	1.46	0.68	0.55	0.06	0.00	0.08	0.03	1.05	2.27	2.37	**10.14**
1965	2.50	0.51	1.16	2.48	0.00	0.00	0.04	0.03	0.15	0.00	6.43	3.24	**12.56**
1966	1.17	0.68	0.08	0.00	0.01	0.14	0.08	0.00	0.11	0.00	2.43	8.60	**11.94**
1967	3.93	0.35	3.99	4.41	0.03	0.02	0.00	0.00	0.79	0.14	1.74	1.70	**24.55**
1968	1.19	0.68	1.76	0.70	0.04	0.00	0.00	0.00	0.00	1.83	1.14	3.13	**7.95**
1969	13.93	9.12	0.35	1.68	0.06	0.01	0.25	0.00	0.00	0.24	0.44	0.68	**31.50**
1970	3.71	1.66	1.83	0.37	0.00	0.04	0.00	0.00	0.00	0.08	3.14	4.56	**8.97**
1971	1.08	0.24	0.85	0.69	0.21	0.00	0.00	0.00	0.05	0.29	0.88	4.27	**10.90**

Monthly Precipitation at the Paso Robles Station (NOAA 46730)

(inches)

Source: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca6730
Source: https://www.prcity.com/462/Rainfall-Totals

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	WY Total
1972	1.35	0.30	0.00	0.53	0.00	0.00	0.00	0.00	0.03	1.68	4.14	0.85	**7.65**
1973	6.54	6.95	2.60	0.01	0.06	0.00	0.00	0.00	0.00	0.68	3.09	1.61	**22.83**
1974	6.39	0.05	4.56	0.91	0.00	0.00	0.00	0.00	0.00	0.64	0.43	2.33	**17.29**
1975	0.01	4.12	2.81	0.89	0.00	0.00	0.00	0.01	0.00	0.76	0.03	0.10	**11.24**
1976	0.00	2.61	1.09	0.66	0.00	0.08	0.00	1.02	2.90	0.58	0.55	1.80	**9.25**
1977	1.47	0.03	1.41	0.00	1.71	0.00	0.00	0.00	0.00	0.08	0.25	5.25	**7.55**
1978	5.77	7.31	3.10	2.77	0.00	0.00	0.00	0.00	0.92	0.00	2.47	1.04	**25.45**
1979	4.70	3.52	2.30	0.00	0.00	0.00	0.00	0.00	0.06	0.93	0.85	2.31	**14.09**
1980	4.47	8.05	1.88	0.65	0.24	0.00	0.35	0.00	0.00	0.00	0.02	0.44	**19.73**
1981	4.00	1.60	4.52	0.56	0.00	0.00	0.00	0.00	0.00	1.01	1.44	0.62	**11.14**
1982	2.65	0.88	5.10	3.05	0.00	0.02	0.00	0.00	1.04	0.90	3.98	1.96	**15.81**
1983	5.86	4.53	4.69	3.35	0.05	0.00	0.00	0.52	0.37	1.34	2.07	3.68	**26.21**
1984	0.20	0.24	0.66	0.35	0.00	0.00	0.00	0.00	0.00	0.38	2.10	3.01	**8.54**
1985	0.52	0.92	2.11	0.19	0.00	0.00	0.02	0.00	0.04	0.40	1.07	0.97	**9.29**
1986	2.11	6.73	4.64	0.32	0.00	0.00	0.03	0.00	0.62	0.02	0.15	0.64	**16.89**
1987	0.88	2.01	3.40	0.14	0.06	0.07	0.00	0.00	0.00	1.50	2.63	2.73	**7.37**
1988	1.94	2.54	0.10	2.02	0.21	0.14	0.00	0.00	0.00	0.00	1.16	2.87	**13.81**
1989	0.98	1.59	0.71	0.37	0.07	0.00	0.00	0.00	1.59	0.97	0.22	0.00	**9.34**
1990	3.02	1.48	0.24	0.12	0.66	0.00	0.00	0.00	0.51	0.00	0.14	0.20	**7.22**
1991	0.63	2.17	10.25	0.08	0.03	0.20	0.00	0.10	0.10	0.50	0.16	3.00	**13.90**
1992	1.44	6.09	2.99	0.10	0.00	0.03	0.03	0.00	0.01	0.79	0.00	3.59	**14.35**
1993	9.63	6.96	3.43	0.06	0.01	0.14	0.00	0.00	0.00	0.17	0.86	1.28	**24.61**
1994	1.90	3.37	1.16	0.49	1.05	0.00	0.00	0.00	1.17	0.70	2.32	0.93	**11.45**
1995	11.51	1.42	12.31	0.09	0.44	0.14	0.00	0.00	0.00	0.00	0.12	1.92	**29.86**
1996	1.84	6.52	2.03	0.72	0.55	0.00	0.00	0.00	0.00	1.78	1.52	5.78	**13.70**
1997	7.93	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.10	0.07	4.05	3.93	**17.17**
1998	2.99	9.06	2.71	1.96	2.05	0.11	0.00	0.00	0.08	0.21	0.99	0.73	**27.01**
1999	1.84	1.26	2.68	1.19	0.00	0.00	0.00	0.00	0.47	0.00	0.71	0.22	**9.37**
2000	3.16	5.89	1.55	1.56	0.05	0.04	0.00	0.00	0.03	1.34	0.05	0.16	**13.21**
2001	4.43	5.14	3.59	1.08	0.00	0.00	0.04	0.00	0.00	0.24	2.81	2.19	**15.83**
2002	0.87	0.33	1.40	0.23	0.25	0.00	0.00	0.00	0.00	0.00	2.54	4.52	**8.32**
2003	0.13	2.10	1.86	1.70	1.18	0.00	0.16	0.03	0.00	0.00	1.36	2.31	**14.22**
2004	0.91	4.31	0.30	0.32	0.00	0.00	0.00	0.00	0.00	5.11	1.39	6.75	**9.51**
2005	4.81	5.02	3.07	0.76	1.10	0.01	0.00	0.08	0.00	0.02	0.46	2.54	**28.10**
2006	5.78	1.23	4.50	2.92	1.48	0.00	0.00	0.00	0.00	0.61	0.28	1.13	**18.93**
2007	0.74	2.98	0.13	0.37	0.00	0.00	0.00	0.31	0.04	0.96	0.00	2.23	**6.59**
2008	8.44	1.83	0.00	0.33	0.01	0.00	0.00	0.00	0.00	0.14	1.26	1.13	**13.80**
2009	0.91	3.89	1.37	0.17	0.12	0.02	0.00	0.00	0.05	4.04	0.02	3.96	**9.06**
2010	6.09	3.38	0.64	2.75	0.12	0.00	0.03	0.00	0.00	1.06	1.57	7.14	**21.03**
2011	2.07	3.05	5.29	0.28	0.95	0.53	0.00	0.00	0.03	0.90	1.93	0.12	**21.97**
2012	2.38	0.25	2.44	2.60	0.18	0.00	0.00	0.00	0.00	0.28	0.75	3.94	**10.80**
2013	1.02	0.28	0.69	0.07	0.15	0.00	0.00	0.00	0.00	0.01	0.26	0.30	**7.18**
2014	0.00	2.75	1.96	0.85	0.00	0.00	0.03	0.00	0.00	0.00	1.00	5.48	**6.16**
2015	0.32	2.16	0.10	0.37	0.05	0.00	2.82	0.00	0.05	0.07	1.45	0.89	**12.35**
2016	4.13	0.85	2.92	0.15	0.00	0.00	0.00	0.00	0.00	1.61	1.46	1.80	**10.46**
2017	9.50	6.44	0.92	1.45	0.24	0.00	0.00	0.00	0.16	0.08	0.22	0.04	**23.58**
2018	2.08	0.25	7.74	0.21	0.00	0.00	0.00	0.00	0.00	0.28	3.23	1.12	**10.62**

Monthly Precipitation at the Paso Robles Station (NOAA 46730)

(inches)

Source: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca6730
Source: https://www.prcity.com/462/Rainfall-Totals

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	WY Total
2019	5.30	6.72	3.01	0.08	0.82	0.00	0.00	0.00	0.00	0.00	1.40	5.22	**20.56**
2020	0.65	0.00	3.53	1.59	0.03	0.00	0.00	0.11	0.00	0.00	0.29	0.89	**12.53**
2021	6.07	0.01	0.90	0.00	0.00	0.00	0.00	0.00	0.00	2.02	0.05	7.70	**8.16**
2022	0.11	0.11	1.25	0.42	0.00	0.00	0.00	0.00	0.29	0.00	0.89	6.77	**11.95**
2023	10.46	3.13	7.17	0.00	0.15	0.00	0.00	0.02	0.00	0.00	1.97	4.82	**28.59**
2024	3.14	5.93	2.99	2.25	0.08	0.00	0.00	0.00	0.00	0.00	1.97	0.73	**21.18**
												Water Year Average (1925 - 2024):	**14.71**

University of California Cooperative Extension Weather Stations in Paso Robles Subbasin
Total Monthly Precipitation for Water Year 2024
(inches)

Source: https://ucce-slo.westernweathergroup.com/

WY 2024	Shandon (SLO-1)	Creston Rd (SLO-2)	NE Paso Robles (SLO-3)	Cross Canyon Rd (SLO-4)	Shell Creek Rd (SLO-6)	South Shandon (SLO-7)	South Creston (SLO-8)	Experimental Station (SLO-10)	Von Dollen Road (SLO-12)
OCT	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOV	0.82	0.87	1.17	1.18	0.51	0.67	0.73	1.77	1.16
DEC	3.15	3.06	3.13	3.35	3.08	3.13	3.32	4.30	2.90
JAN	1.97	2.29	2.88	3.01	1.56	1.79	1.78	3.13	2.86
FEB	3.27	3.77	3.38	4.41	3.78	2.95	3.80	4.46	3.82
MAR	1.49	1.93	1.53	1.67	1.77	1.58	2.41	2.43	2.55
APR	1.52	2.03	1.50	1.62	1.47	1.66	2.53	1.68	1.39
MAY	0.13	0.17	0.06	0.10	0.10	0.10	0.16	0.05	0.11
JUN	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JUL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AUG	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SEP	0.04	0.00	0.02	0.01	0.02	0.00	0.03	0.00	0.00
WY Total	**12.45**	**14.12**	**13.67**	**15.35**	**12.29**	**11.88**	**14.76**	**17.82**	**14.79**

Appendix C: Groundwater Level and Groundwater Storage Monitoring Well Network

Table C-1 – Groundwater Level and Groundwater Storage Monitoring Well Network

Well ID (alt ID)	Well Depth (feet)	Screen Interval(s) (feet bls)	Reference Point Elevation (feet AMSL)	First Year of Data	Last Year of Data	Years Measured	Number of Measurement	Aquifer
18MW-0191[1]	50	10-50	672 (LSE)	2018	2018	<1	1	Qa
25S/12E-16K05 (PASO-0345)	350	300-310, 330-340	669.8	1992	2019	27	56	PR
25S/12E-26L01 (PASO-0205)	400	200-400	719.72	1970	2019	49	107	PR
25S/13E-08L02 (PASO-0195)	270	110-270	1,033.81	2012	2019	7	15	PR
26S/12E-14G01 (PASO-0048)	740	---	789.3	1969	2019	50	121	PR
26S/12E-14G02 (PASO-0017)	840	640-840	787	1993	2019	26	28	PR
26S/12E-14H01 (PASO-0184)	1230	180-?	790	1969	2019	50	48	PR
26S/12E-14K01 (PASO-0238)	1100	---	786	1979	2019	40	84	PR
26S/12E-26E07 (PASO-0124)	400	---	835	1958	2018	60	131	PR
26S/13E-08M01 (PASO-0164)	400	260-400	827.92	2013	2019	6	16	PR
26S/13E-16N01 (PASO-0282)	400	200-400	890.17	2012	2019	7	16	PR
26S/15E-19E01 (PASO-0073)	512	223-512	1,020	1987	2019	32	56	PR
26S/15E-20B04 (PASO-0401)	461	297-461	1,036.36	1984	2019	35	71	PR
26S/15E-29N01 (PASO-0226)	350	---	1,135	1958	2019	61	127	PR
26S/15E-29R01 (PASO-0406)	600	180-600	1,109.5	2012	2019	7	12	PR
26S/15E-30J01 (PASO-0393)	605	195-605	1,123.3	1970	2019	49	83	PR
27S/12E-13N01 (PASO-0223)	295	195-295	972.42	2012	2019	7	15	PR
27S/13E-28F01 (PASO-0243)	230	118-212	1,072	1969	2019	50	108	PR
27S/13E-30F01 (PASO-0355)	310	200-310	1,043.2	2012	2019	7	14	PR
27S/13E-30J01 (PASO-0423)	685	225-685	1,095	2012	2019	7	10	PR
27S/13E-30N01 (PASO-0086)	355	215-235, 275-355	1,086.73	2012	2016	4	6	PR
27S/14E-11R01 (PASO-0392)	630	180-630	1,160.5	1974	2019	45	75	PR
28S/13E-01B01 (PASO-0066)	254	154-254	1,099.93	2012	2019	7	17	PR

NOTES: New alluvial monitoring well information provided by City of Paso Robles; well not included in County database.

"—" = unknown; AMSL – above mean sea level; PR Paso Robles Formation Aquifer; Qa Alluvial Aquifer

Appendix D: Potential Future Groundwater Monitoring Wells

Table D-1 – Potential Future Groundwater Monitoring Wells

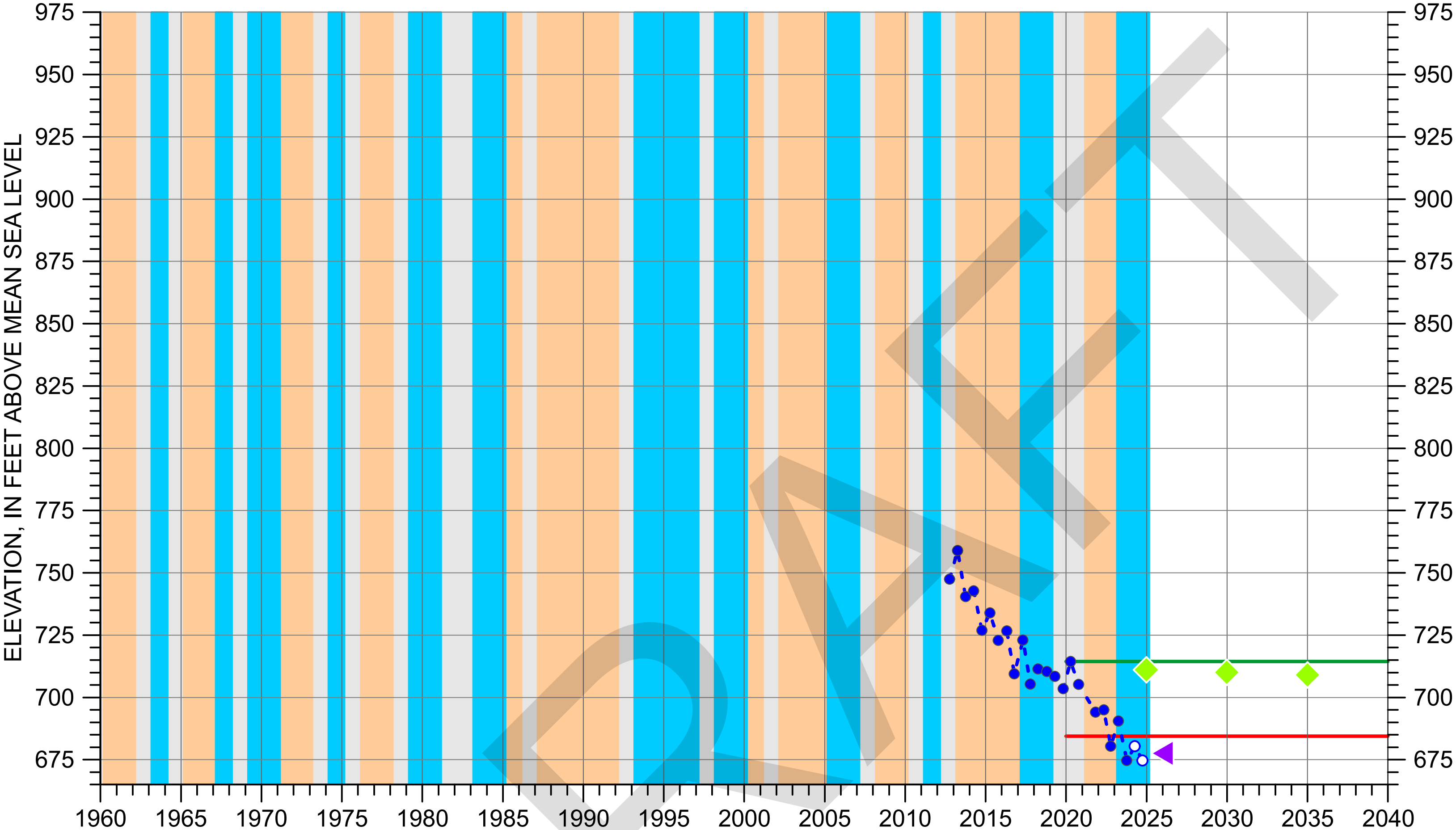
Well ID (alt ID)	Well Depth (feet)	Screen Interval(s) (feet bls)	Reference Point Elevation (feet AMSL)	First Year of Data	Last Year of Data	Years Measured (years)	Number of Measurements	Aquifer
25S/12E-20K03 (PASO-0304)	---	---	625	1974	2019	45	86	---
26S/14E-24B01 (PASO-0302)	---	---	1001	1962	2019	57	99	---
26S/15E-33C01 (PASO-0314)	---	---	1095	1973	2019	46	80	---
26S/15E-33Q01 (PASO-0381)	---	---	1102	1973	2019	46	82	---
27S/15E-03E01 (PASO-0277)	---	---	1120.8	1968	2019	51	109	---
27S/14E-24B01 (PASO-0391)	---	---	1180.5	1973	2019	46	74	---
27S/14E-25J01 (PASO-0074)	---	---	1,225.5	1972	2019	47	72	--
27S/14E-29G01 (PASO-0041)	---	---	1201.5	1974	2019	45	78	---
27S/15E-35F01 (PASO-0053)	---	---	1230	1965	2019	54	82	---

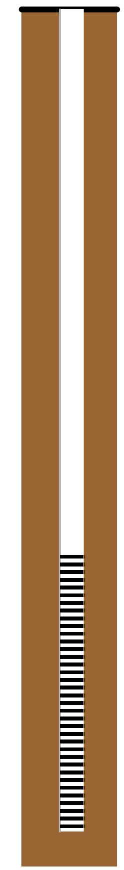
NOTES: "—" = unknown

Appendix E: Hydrographs

Paso Robles Formation Aquifer Hydrographs

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 27S/12E-13N01





EXPLANATION

Groundwater Elevation

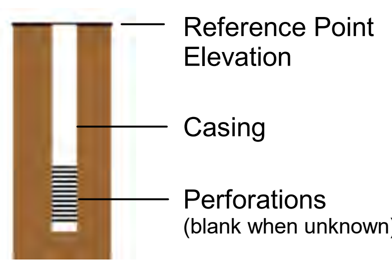
Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

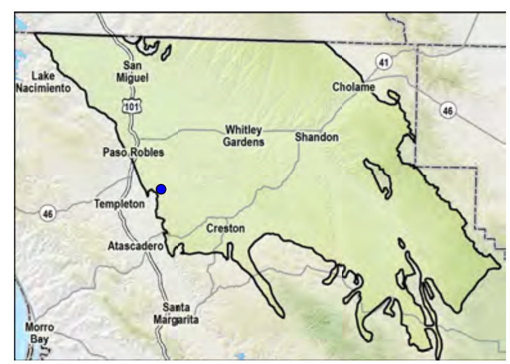
Interim Milestones



CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

Well Depth: 295 feet
Screened Interval: 195-295 feet below ground surface
Reference Point Elevation: 972.4 feet above mean sea level



Neal Springs Rd.

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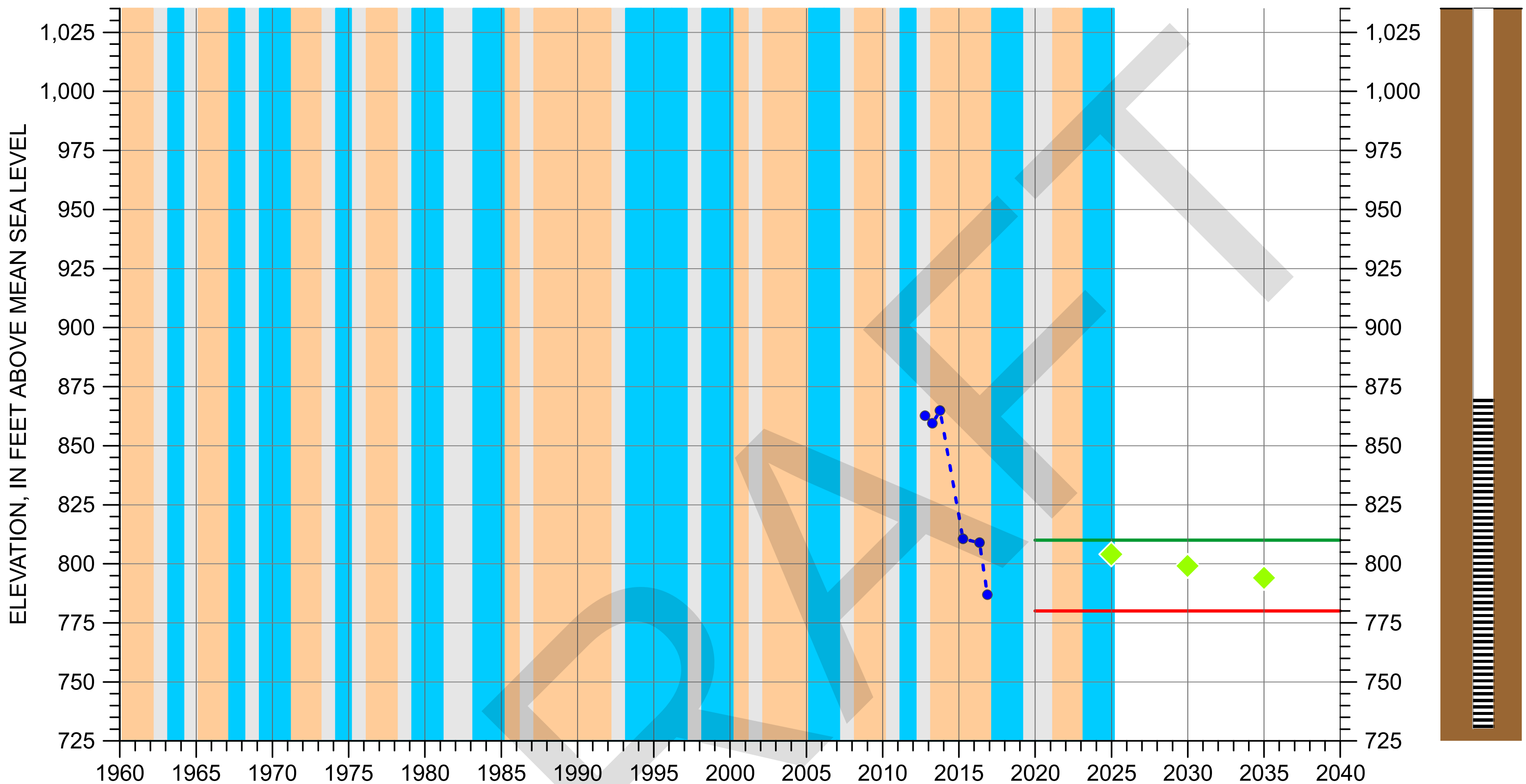
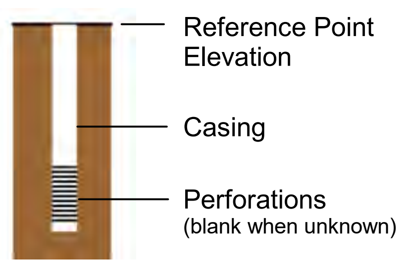
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 27S/13E-30N01



EXPLANATION

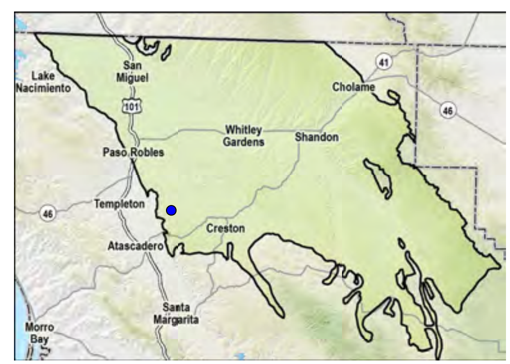
- Groundwater Elevation
- Measurement Not Verified
- Measurable Objective
- Minimum Threshold
- Interim Milestones



CLIMATE PERIOD CLASSIFICATION

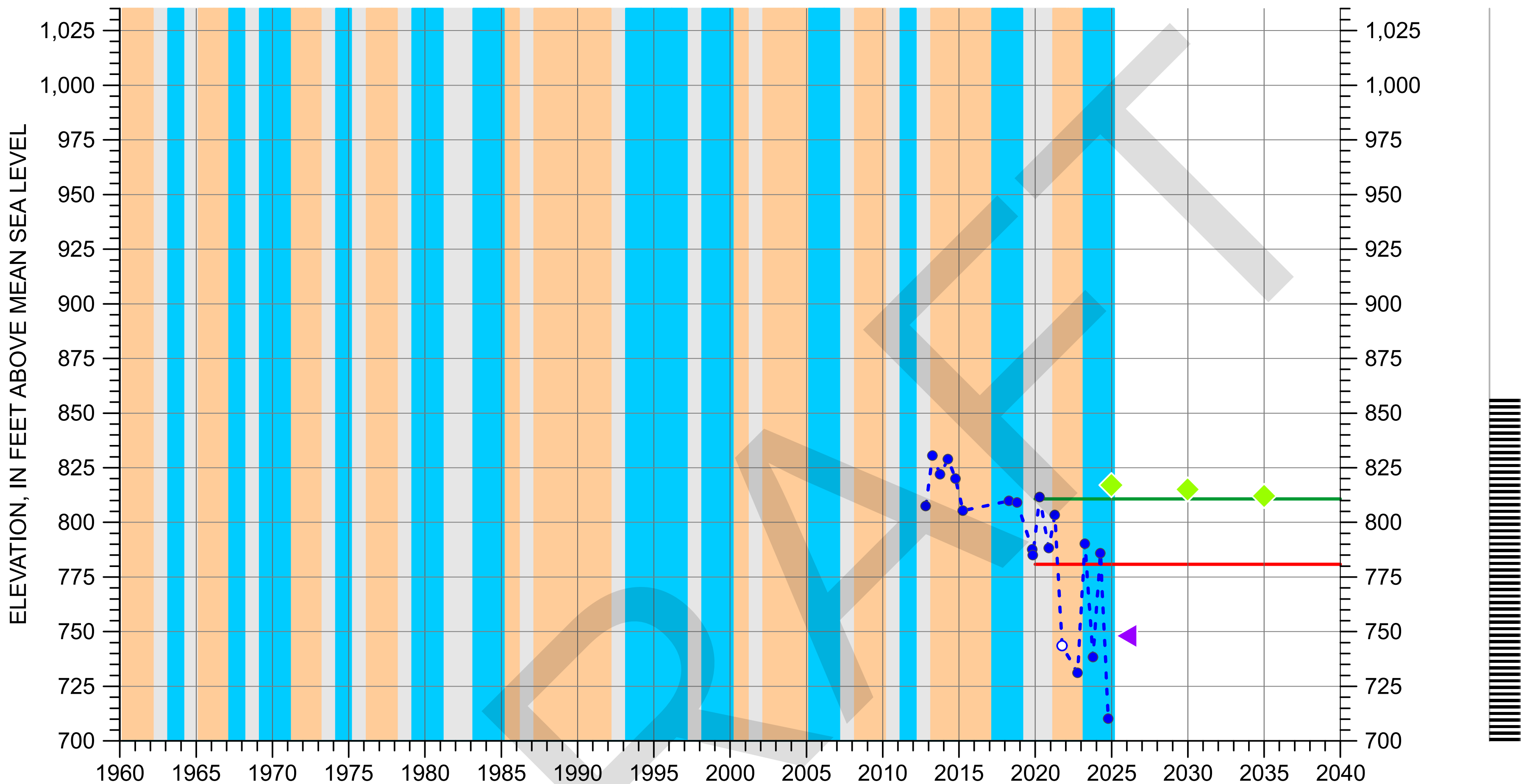
Dry | Avg/Alternating | Wet

Well Depth: 355 feet
Screened Interval: 215-235, 275-355 feet below ground surface
Reference Point Elevation: 1086.7 feet above mean sea level



Almond Dr.

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 27S/13E-30J01



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

Interim Milestones

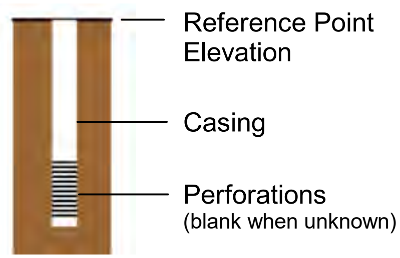
CLIMATE PERIOD CLASSIFICATION

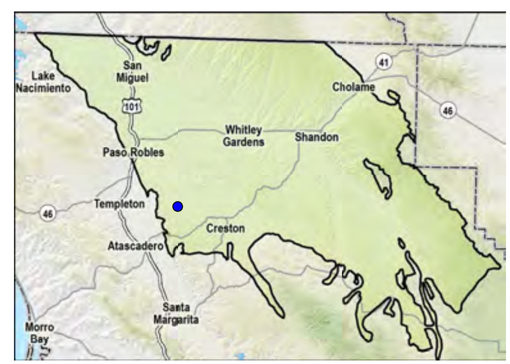
Dry

Avg/Alternating

Wet

Well Depth: 685 feet
Screened Interval: 225-685 feet below ground surface
Reference Point Elevation: 1095 feet above mean sea level





El Pomar Junction south

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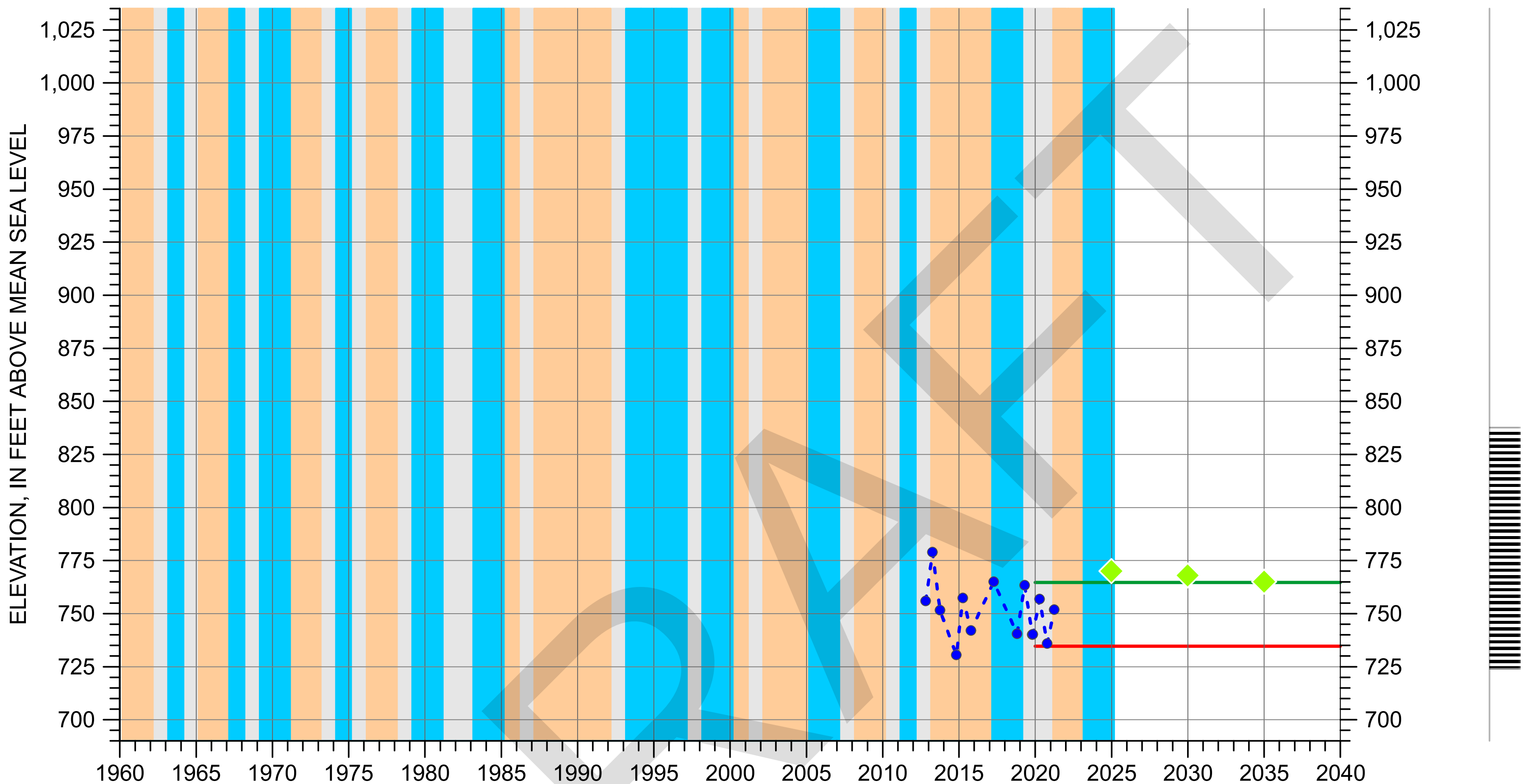
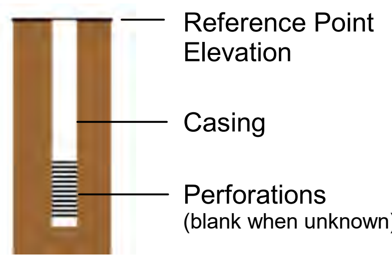
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 27S/13E-30F01



EXPLANATION

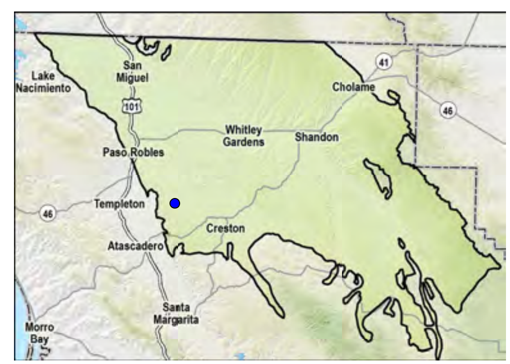
Groundwater Elevation
Measurement Not Verified
Measurable Objective
Minimum Threshold
Interim Milestones



CLIMATE PERIOD CLASSIFICATION

Dry
Avg/Alternating
Wet

Well Depth: 310 feet
Screened Interval: 200-310 feet below ground surface
Reference Point Elevation: 1043.2 feet above mean sea level



El Pomar Junction west

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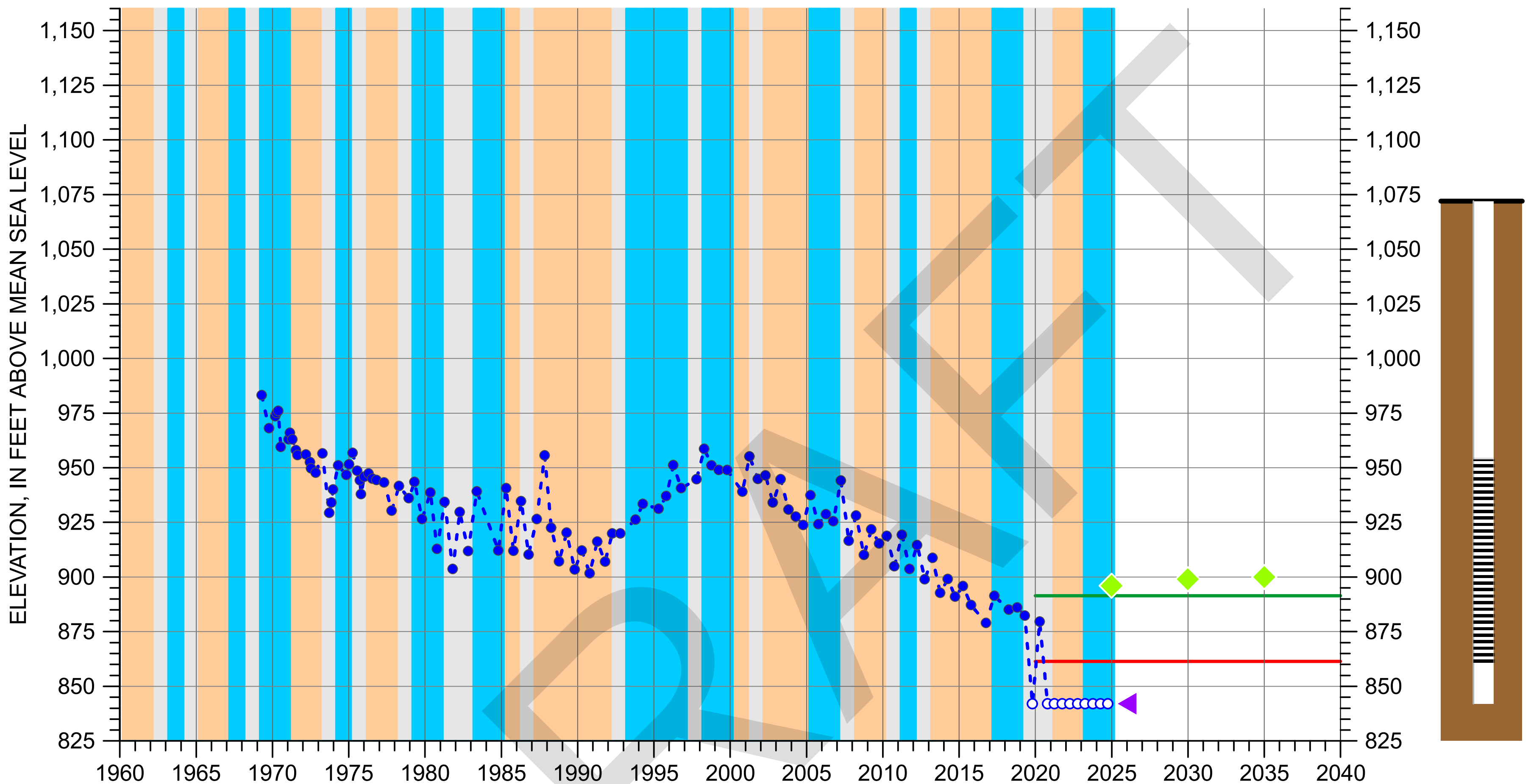
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 27S/13E-28F01



EXPLANATION

Groundwater Elevation

Measurement Not Verified*

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

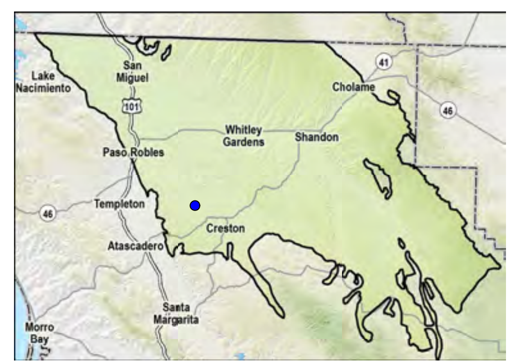
Interim Milestones

CLIMATE PERIOD CLASSIFICATION

Dry Avg/Alternating Wet

Well Depth: 212 feet
Screened Interval: 118-212 feet below ground surface
Reference Point Elevation: 1072 feet above mean sea level

* Measurement recorded at bottom of well (dry well). Actual elevation may be lower.



El Pomar Dr. east towards Cripple Creek Rd.

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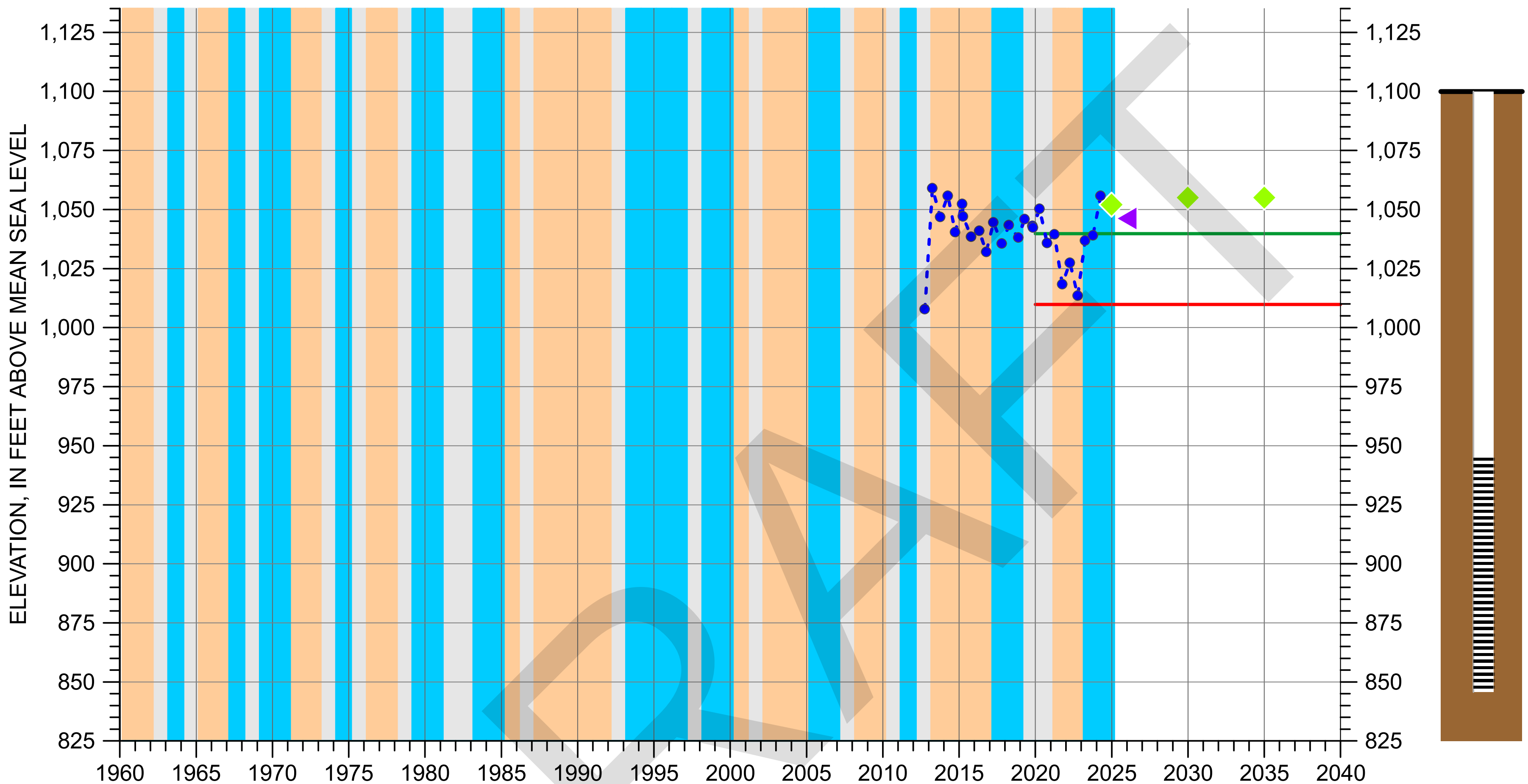
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 28S/13E-01B01



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

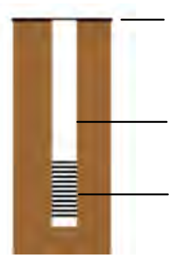
Average of spring and fall 2024 water elevations

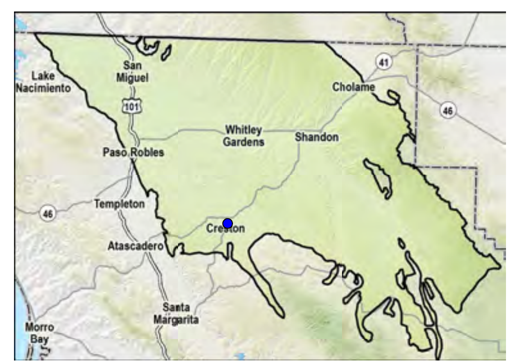
Interim Milestones

CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

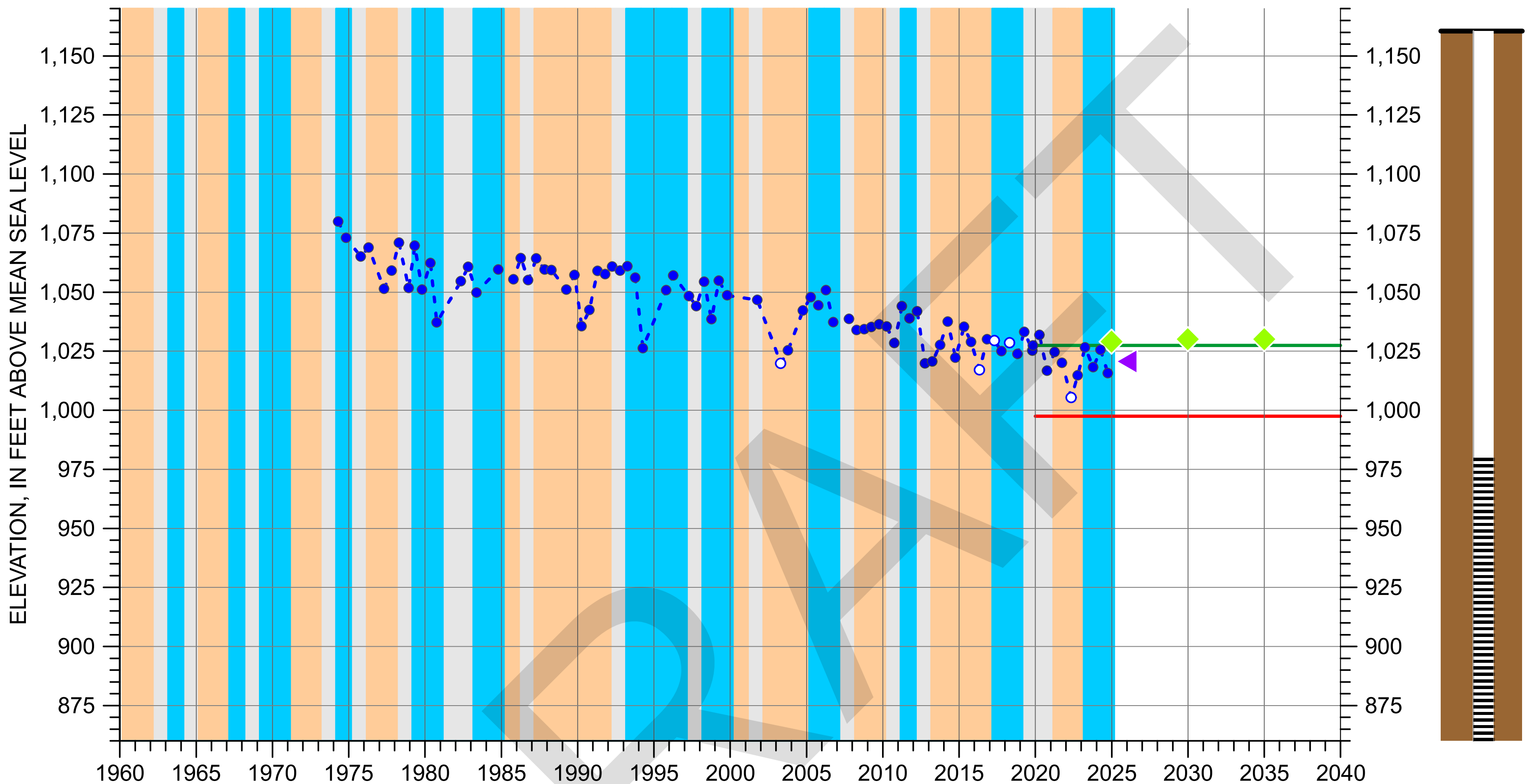
Well Depth: 254 feet
Screened Interval: 154-254 feet below ground surface
Reference Point Elevation: 1099.9 feet above mean sea level





Creston

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 27S/14E-11R01



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

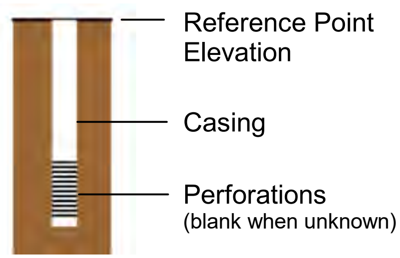
Average of spring and fall 2024 water elevations

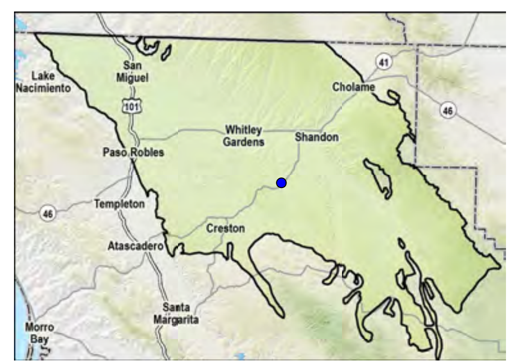
Interim Milestones

CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

Well Depth: 630 feet
Screened Interval: 180-630 feet below ground surface
Reference Point Elevation: 1160.5 feet above mean sea level

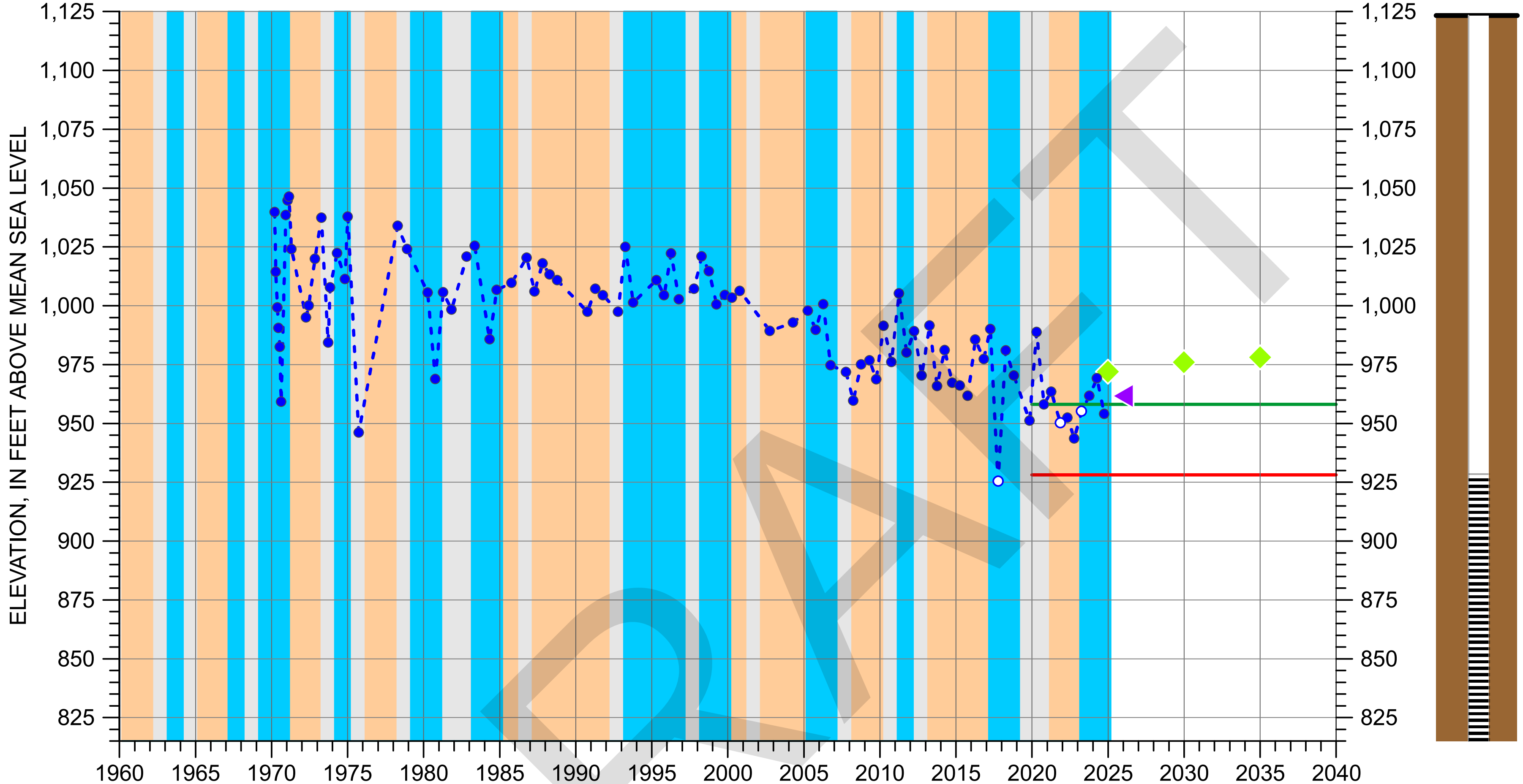




HWY 41 - Shedd Canyon

C:\Users\NatePage\confluencees.com\ConfluenceES - Projects\Paso Basin GSAs\Paso WY24-AR\5_Working Files\Analysis\Hydrograph\Grapher\07_Hydr_27S_14E-11R01.gpj

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/15E-30J01



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

Interim Milestones

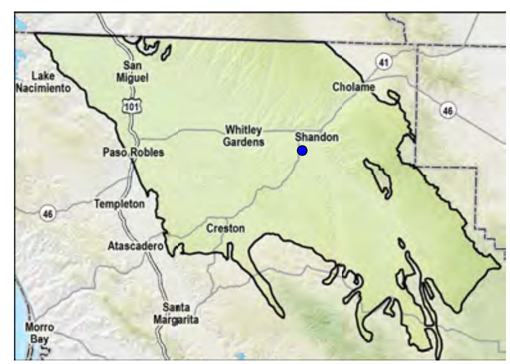
CLIMATE PERIOD CLASSIFICATION

Dry

Avg/Alternating

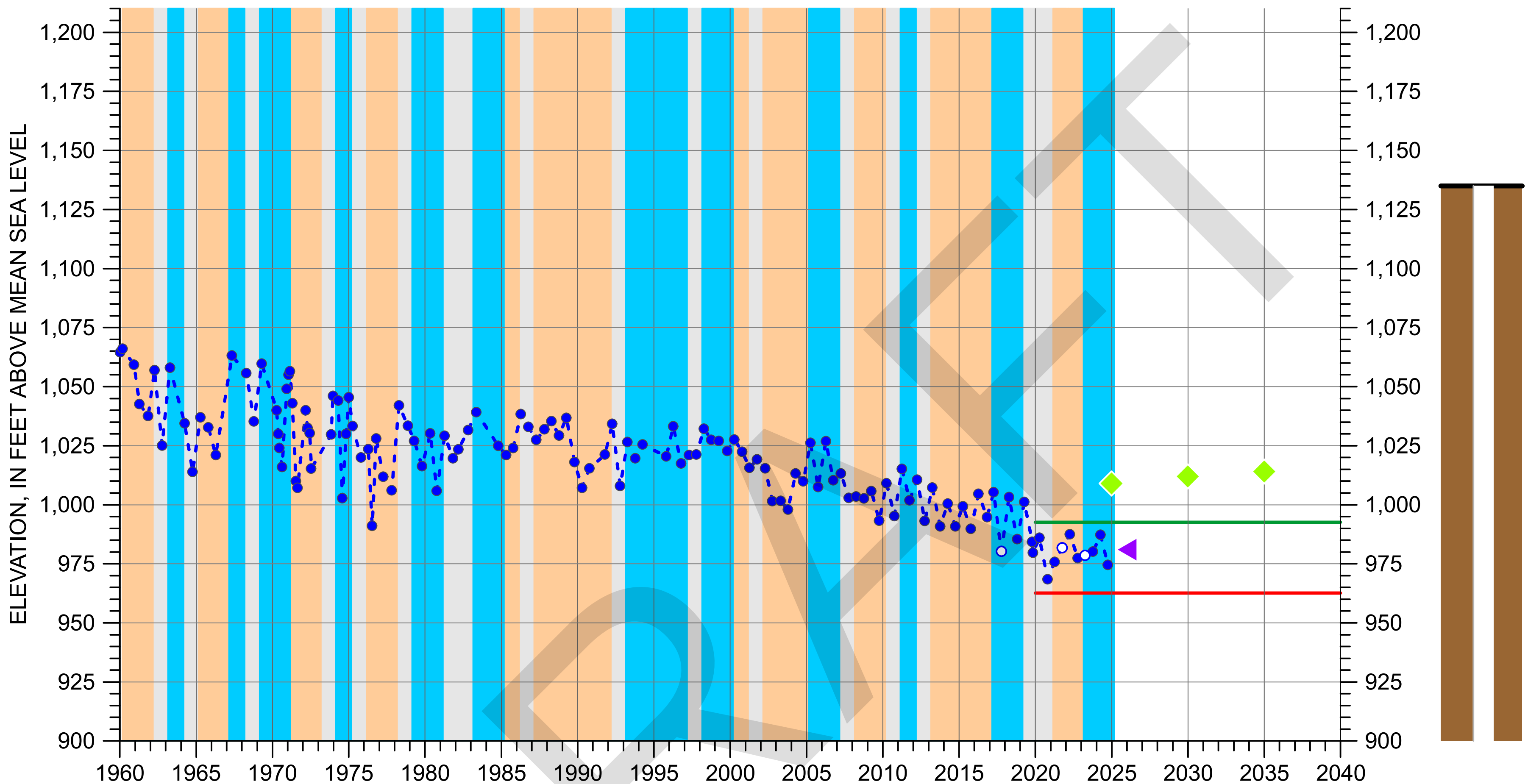
Wet

Well Depth: 605 feet
Screened Interval: 195-605 feet below ground surface
Reference Point Elevation: 1123.3 feet above mean sea level



HWY 41 and Clark Rd.

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/15E-29N01



EXPLANATION

Groundwater Elevation

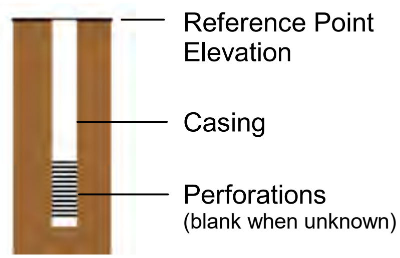
Measurement Not Verified

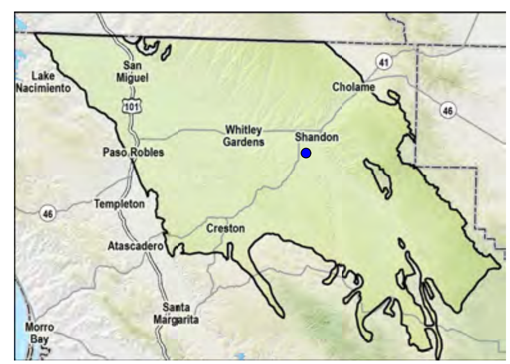
Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

Interim Milestones





Clark Rd.

CLIMATE PERIOD CLASSIFICATION

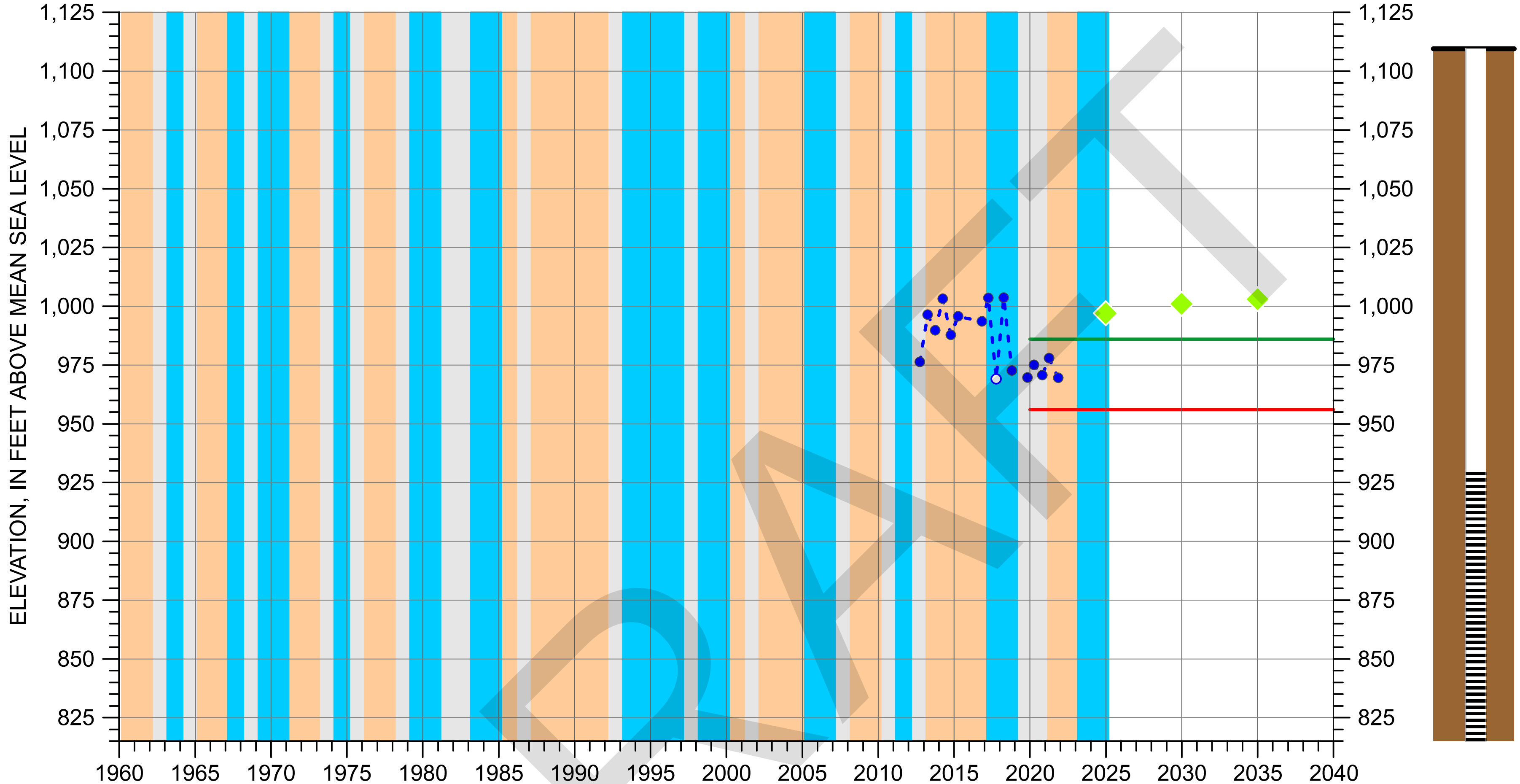
Dry

Avg/Alternating

Wet

Well Depth: 350 feet
Screened Interval: unknown
Reference Point Elevation: 1135 feet above mean sea level

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/15E-29R01



EXPLANATION

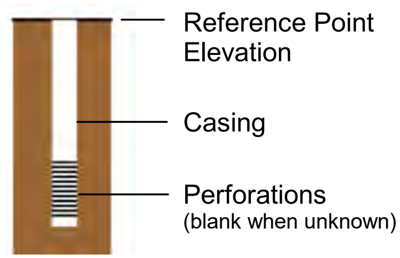
Groundwater Elevation

Measurable Objective

Interim Milestones

Measurement Not Verified

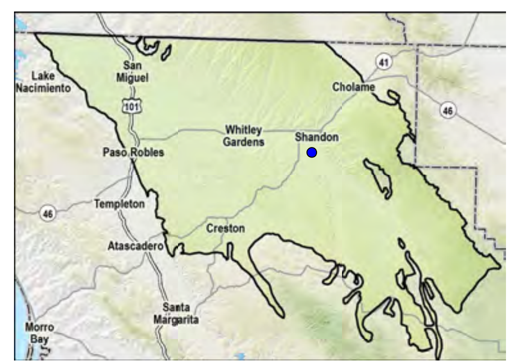
Minimum Threshold



CLIMATE PERIOD CLASSIFICATION

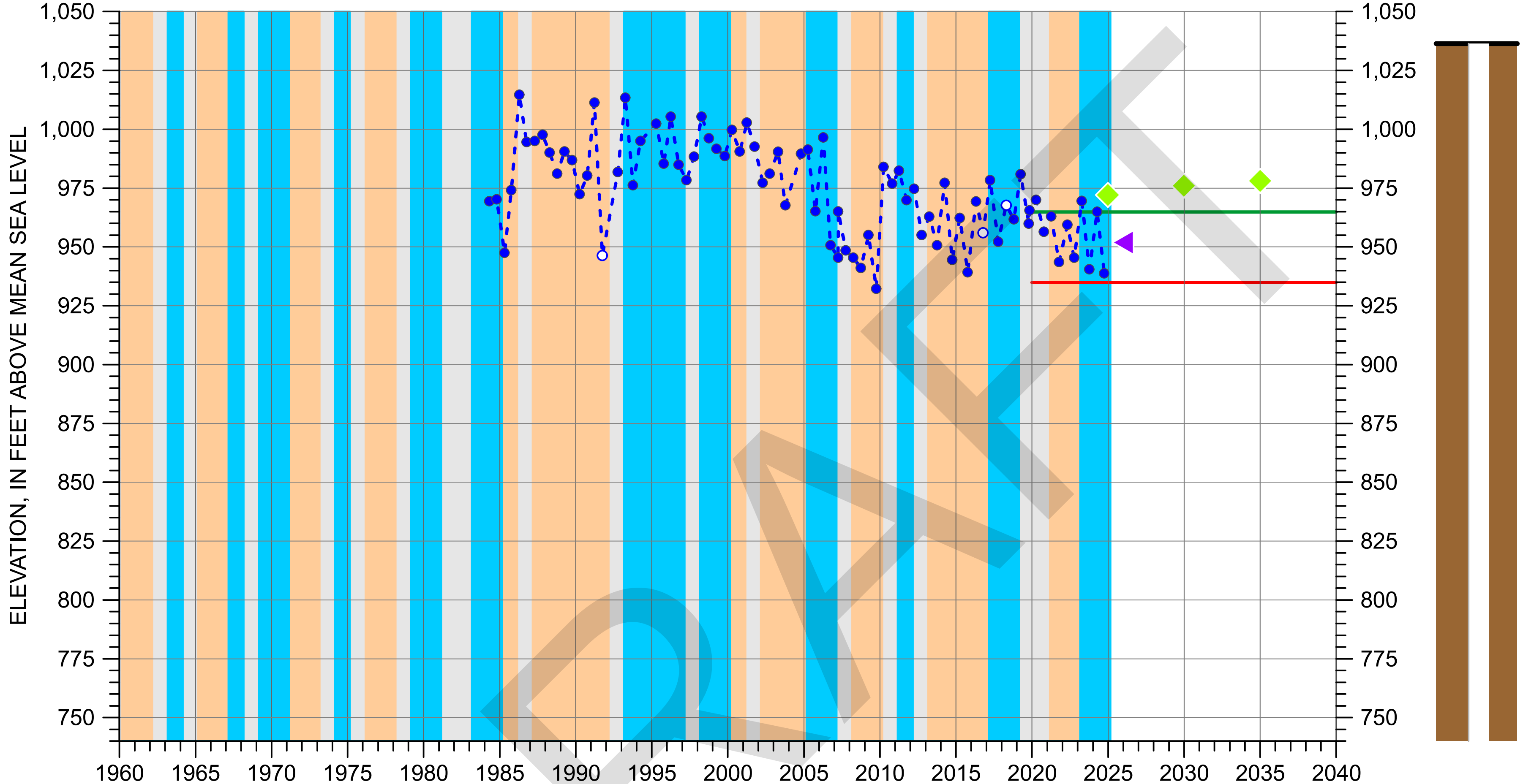
Dry Avg/Alternating Wet

Well Depth: 600 feet
Screened Interval: 180-600 feet below ground surface
Reference Point Elevation: 1109.5 feet above mean sea level



Clark Rd. east of Truesdale Rd.

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/15E-20B04



EXPLANATION

Groundwater Elevation

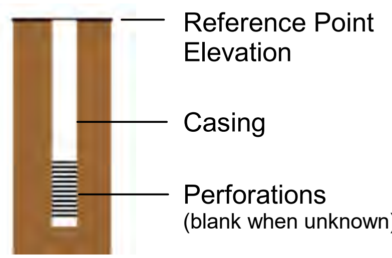
Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

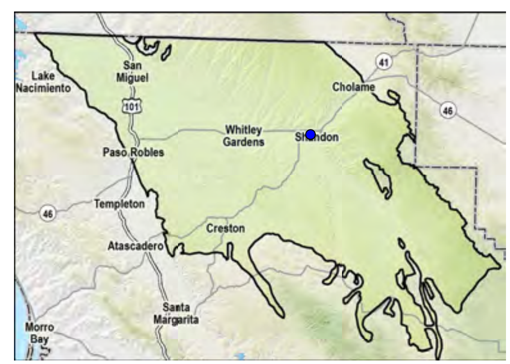
Interim Milestones



CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

Well Depth: 461 feet
Screened Interval: 297-461 feet below ground surface
Reference Point Elevation: 1036.36 feet above mean sea level



County CSA-13 Well

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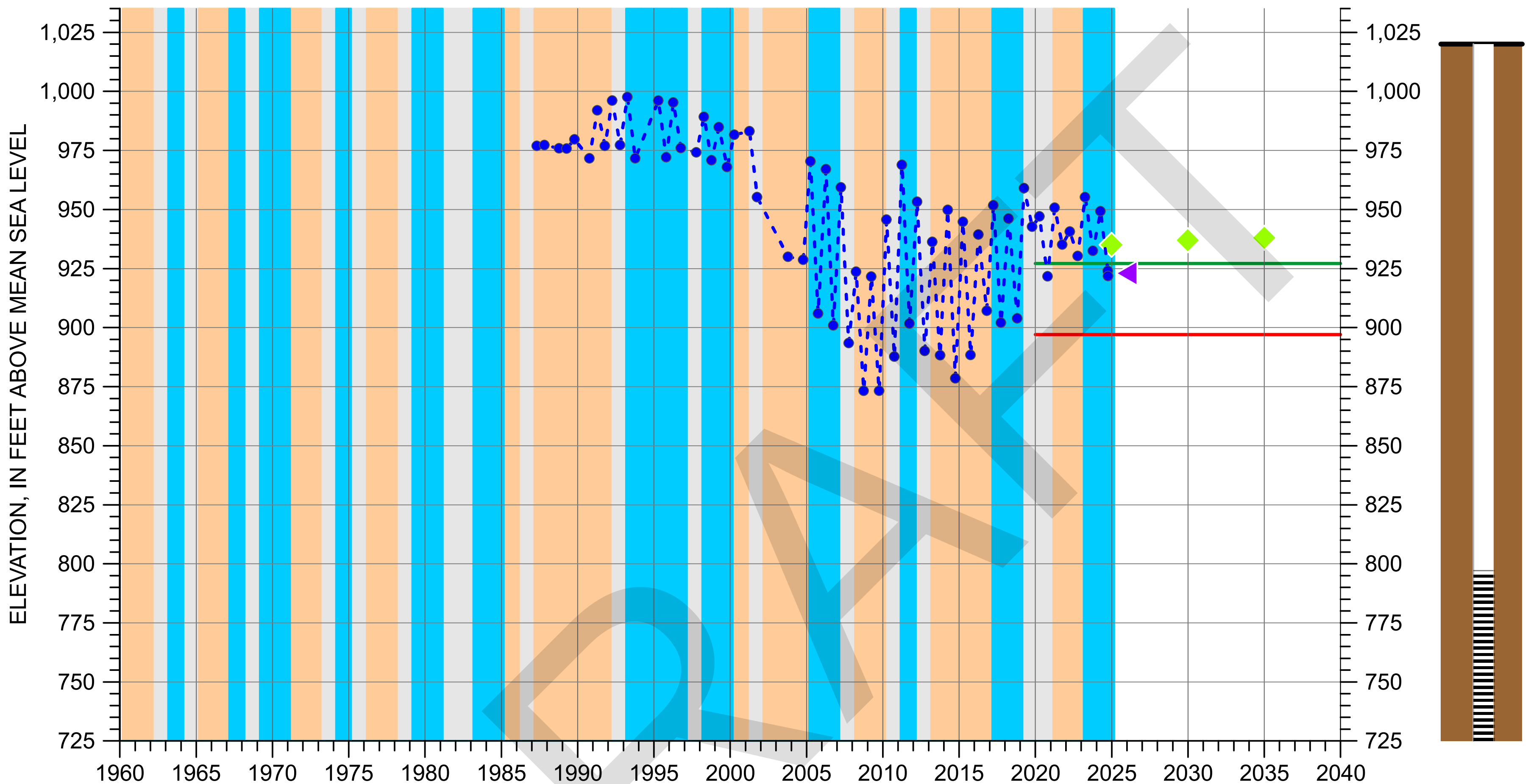
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/15E-19E01



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

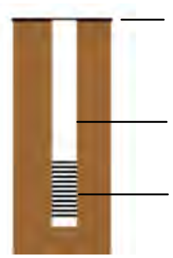
Average of spring and fall 2024 water elevations

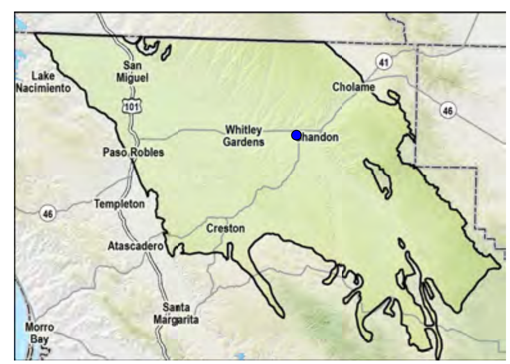
Interim Milestones

CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

Well Depth: 512 feet
Screened Interval: 223-512 feet below ground surface
Reference Point Elevation: 1020 feet above mean sea level

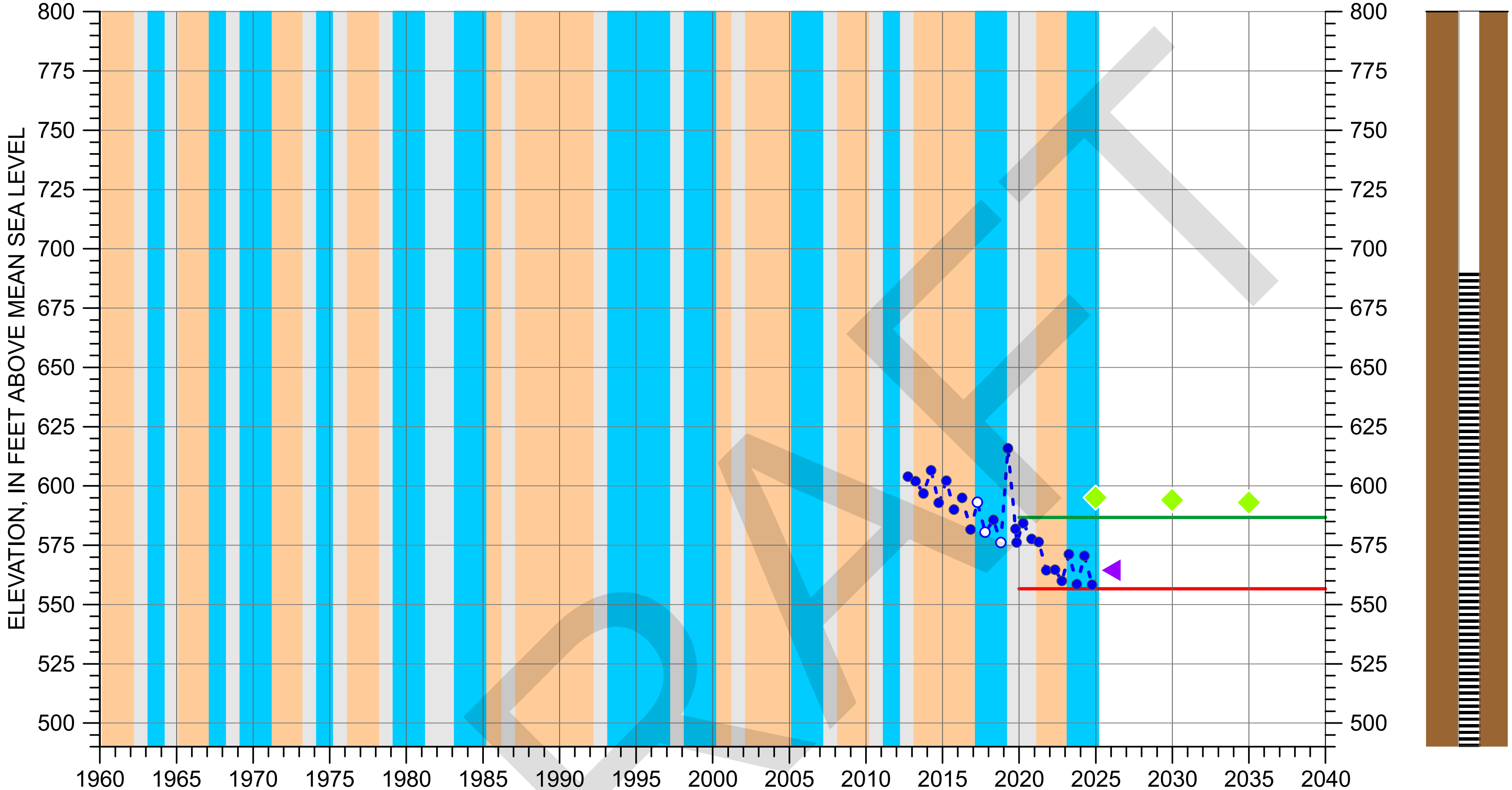




West Centre St.

C:\Users\NatePage\confluencees.com\ConfluenceES - Projects\Paso Basin GSAs\Paso WY24-AR\5_Working Files\Analysis\Hydrograph\Grapher\12_Hydr_26S_15E-19E01.gpj

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/13E-16N01



EXPLANATION

Groundwater Elevation

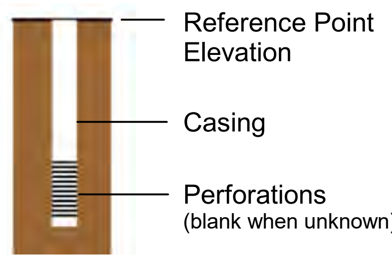
Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

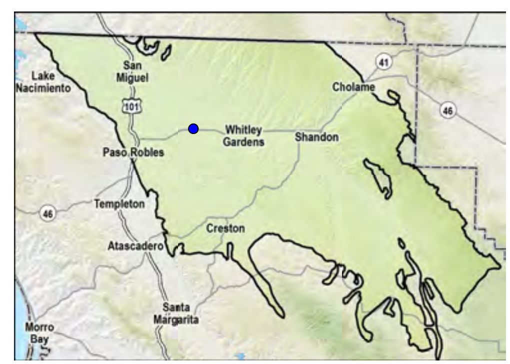
Interim Milestones



CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

Well Depth: 400 feet
Screened Interval: 200-400 feet below ground surface
Reference Point Elevation: 890.2 feet above mean sea level



HWY 46 and Branch Dr.

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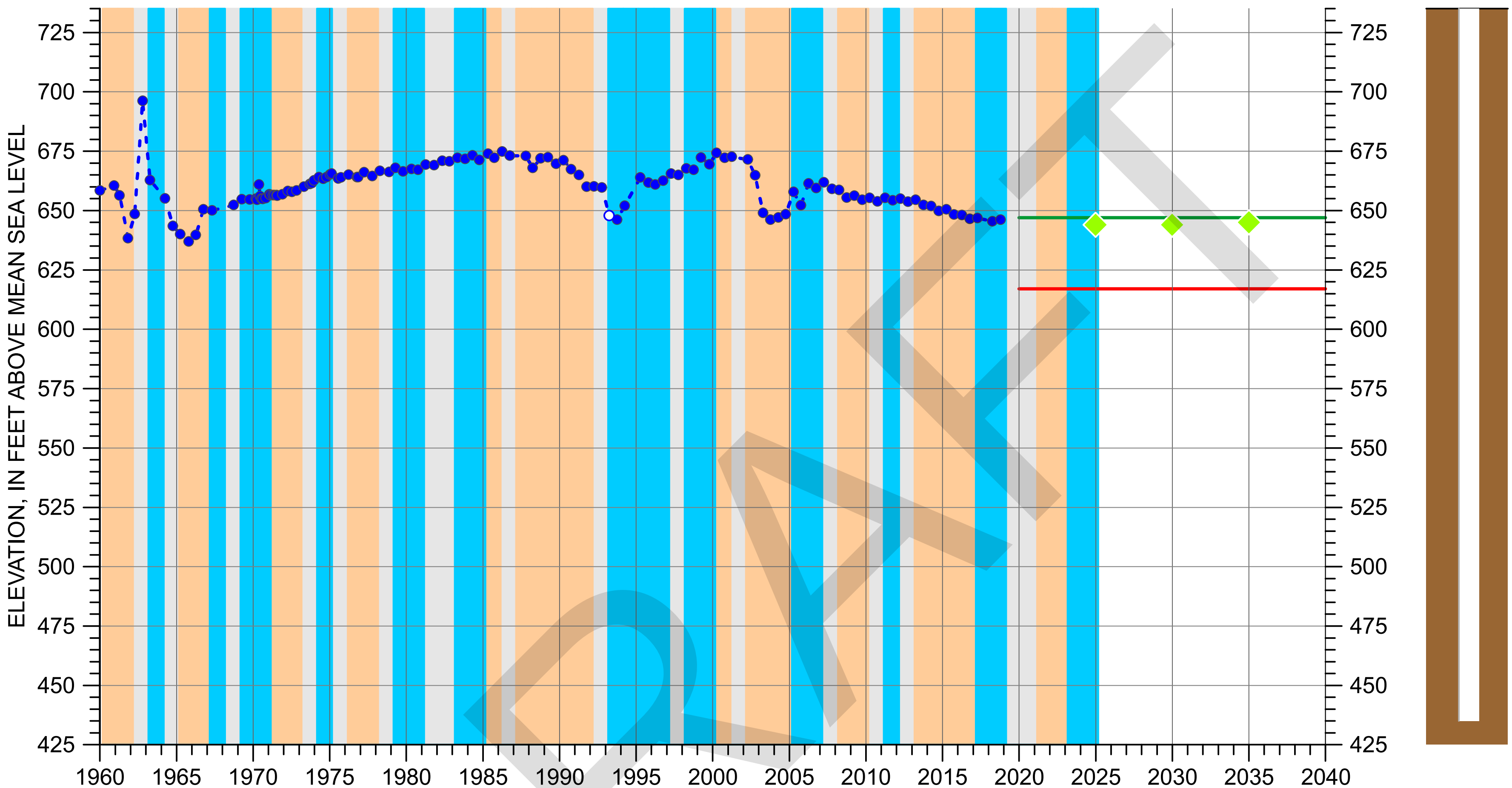
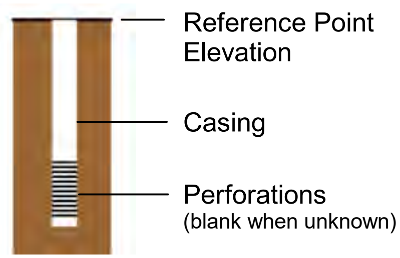
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/12E-26E07



EXPLANATION

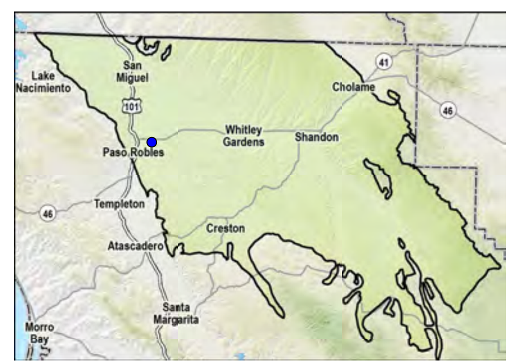
- Groundwater Elevation
- Measurement Not Verified
- Measurable Objective
- Minimum Threshold
- Interim Milestones



CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

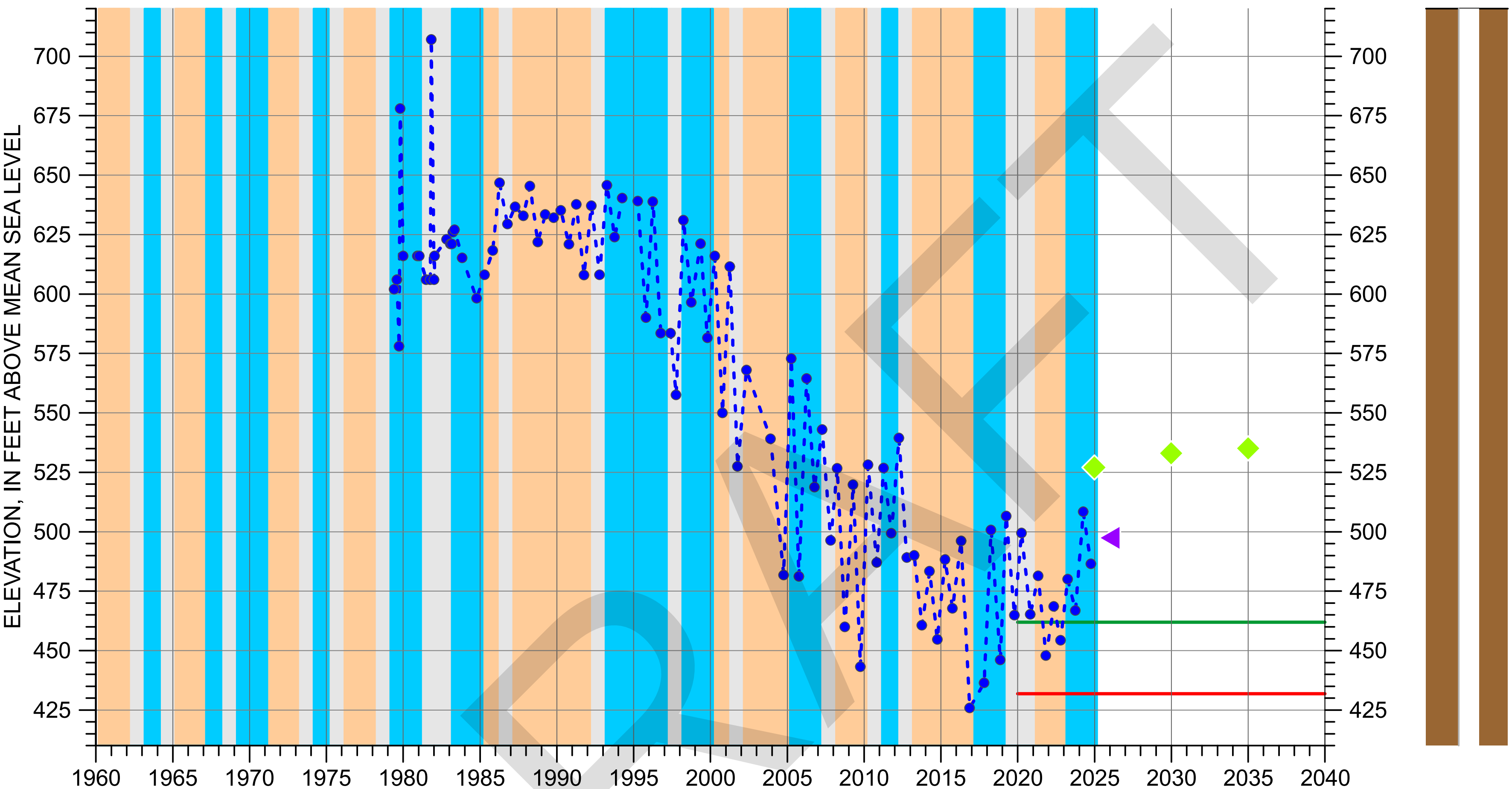
Well Depth: 400 feet
Screened Interval: unknown
Reference Point Elevation: 835 feet above mean sea level



Golden Hill Rd. and Union Rd.

C:\Users\NatePage\confluencees.com\ConfluenceES - Projects\Paso Basin GSAs\Paso WY24-AR\5_Working Files\Analysis\Hydrograph\Grapher\14_Hydr_26S_12E-26E07.gpj

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/12E-14K01



EXPLANATION

Groundwater Elevation

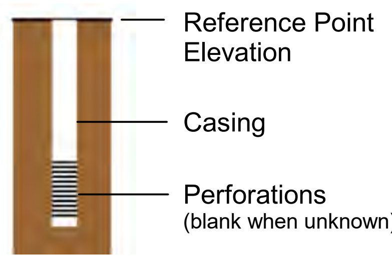
Measurement Not Verified

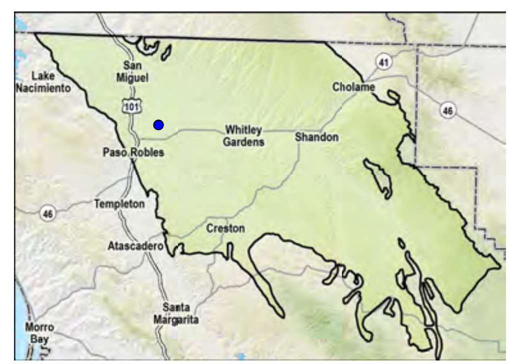
Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

Interim Milestones





CLIMATE PERIOD CLASSIFICATION

Dry

Avg/Alternating

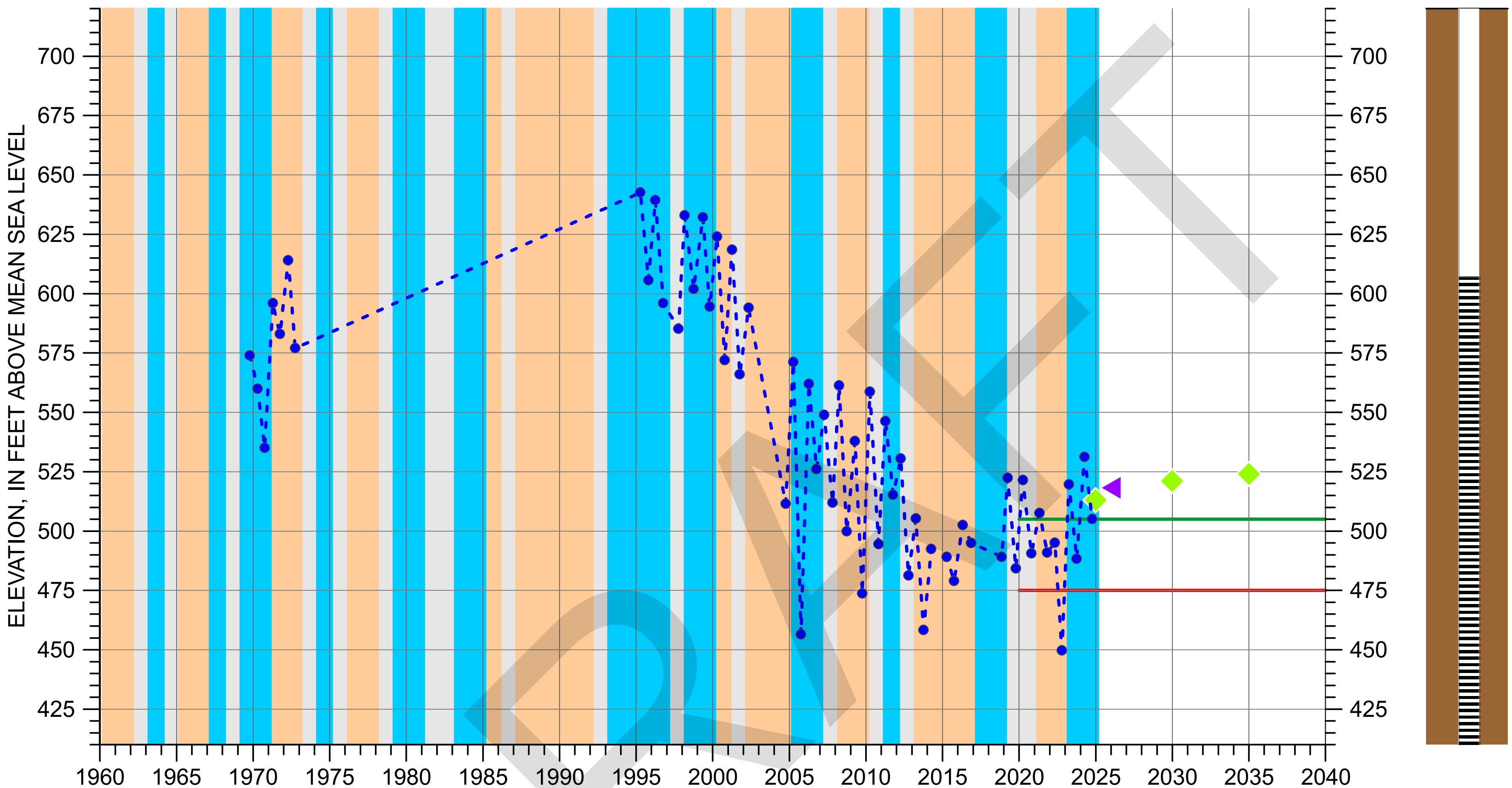
Wet

Well Depth: 1100 feet
Screened Interval: unknown
Reference Point Elevation: 786 feet above mean sea level

Youth Correctional Facility

C:\Users\NatePage\confluencees.com\ConfluenceES - Projects\Paso Basin GSAs\Paso WY24-AR\5_Working Files\Analysis\Hydrograph\Grapher\15_Hydr_26S_12E-14K01_v2.gpj

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/12E-14H01



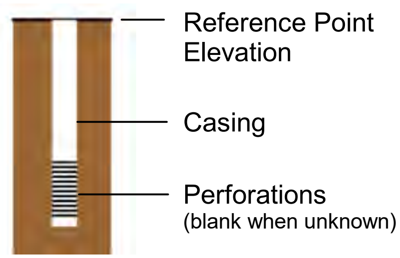
EXPLANATION

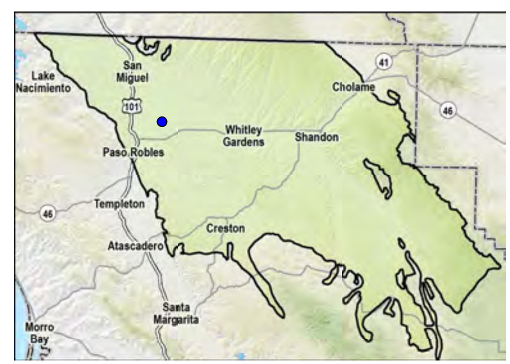
- Groundwater Elevation
- Measurement Not Verified
- Measurable Objective
- Minimum Threshold
- Average of spring and fall 2024 water elevations
- Interim Milestones

CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

Well Depth: 1230 feet
Screened Interval: 180-1230 feet below ground surface
Reference Point Elevation: 790 feet above mean sea level





Airport Rd. and Paso Robles Municipal Airport Rd.

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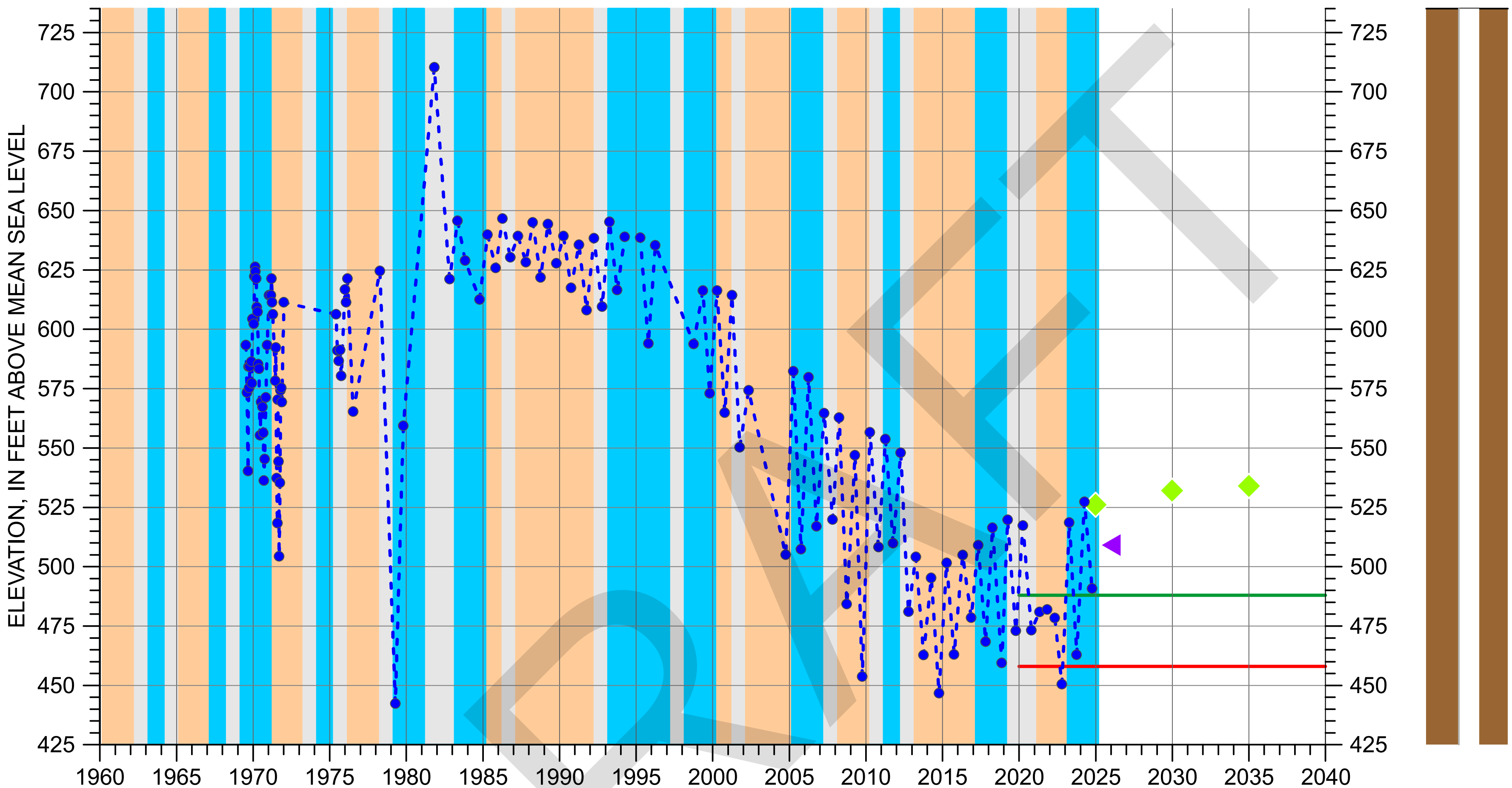
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/12E-14G01



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

Interim Milestones

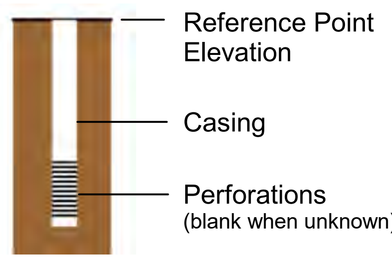
CLIMATE PERIOD CLASSIFICATION

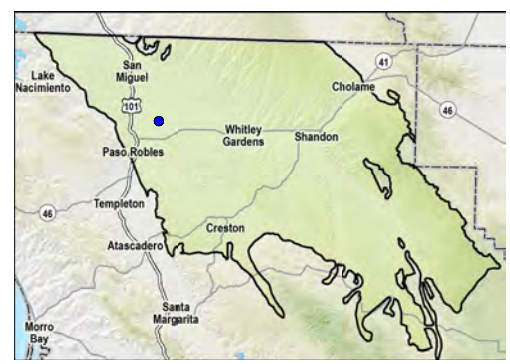
Dry

Avg/Alternating

Wet

Well Depth: 740 feet
Screened Interval: unknown
Reference Point Elevation: 789.3 feet above mean sea level





Paso Robles Municipal Airport Rd. west

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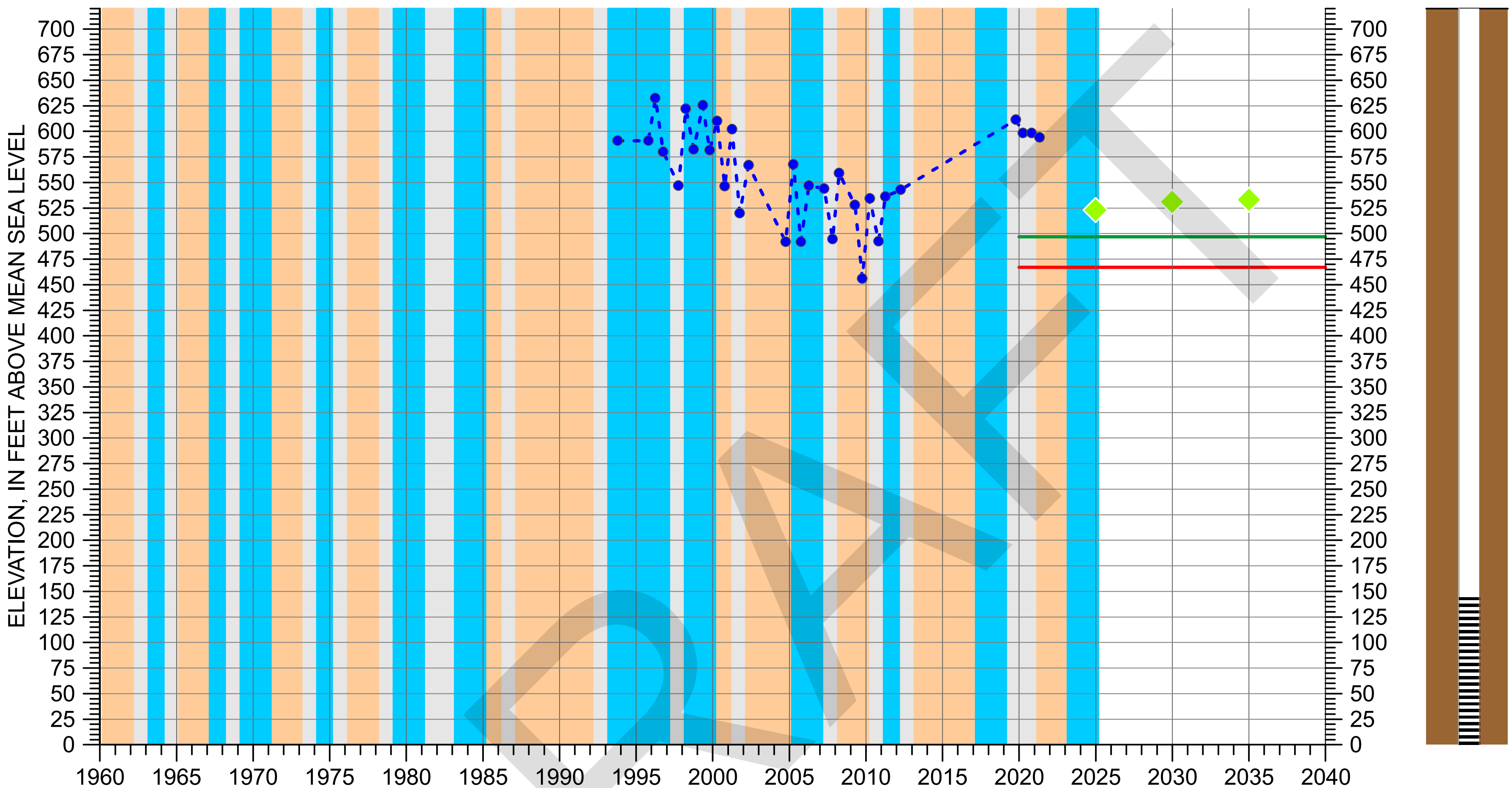
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/12E-14G02



EXPLANATION

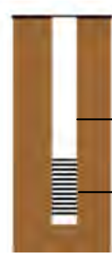
Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

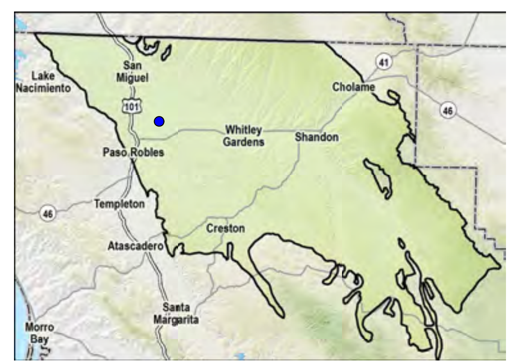
Interim Milestones



Reference Point Elevation

Casing

Perforations
(blank when unknown)



CLIMATE PERIOD CLASSIFICATION

Dry Avg/Alternating Wet

Well Depth: 840 feet
Screened Interval: 640-840 feet below ground surface
Reference Point Elevation: 787 feet above mean sea level

Paso Robles Municipal Airport Rd. west

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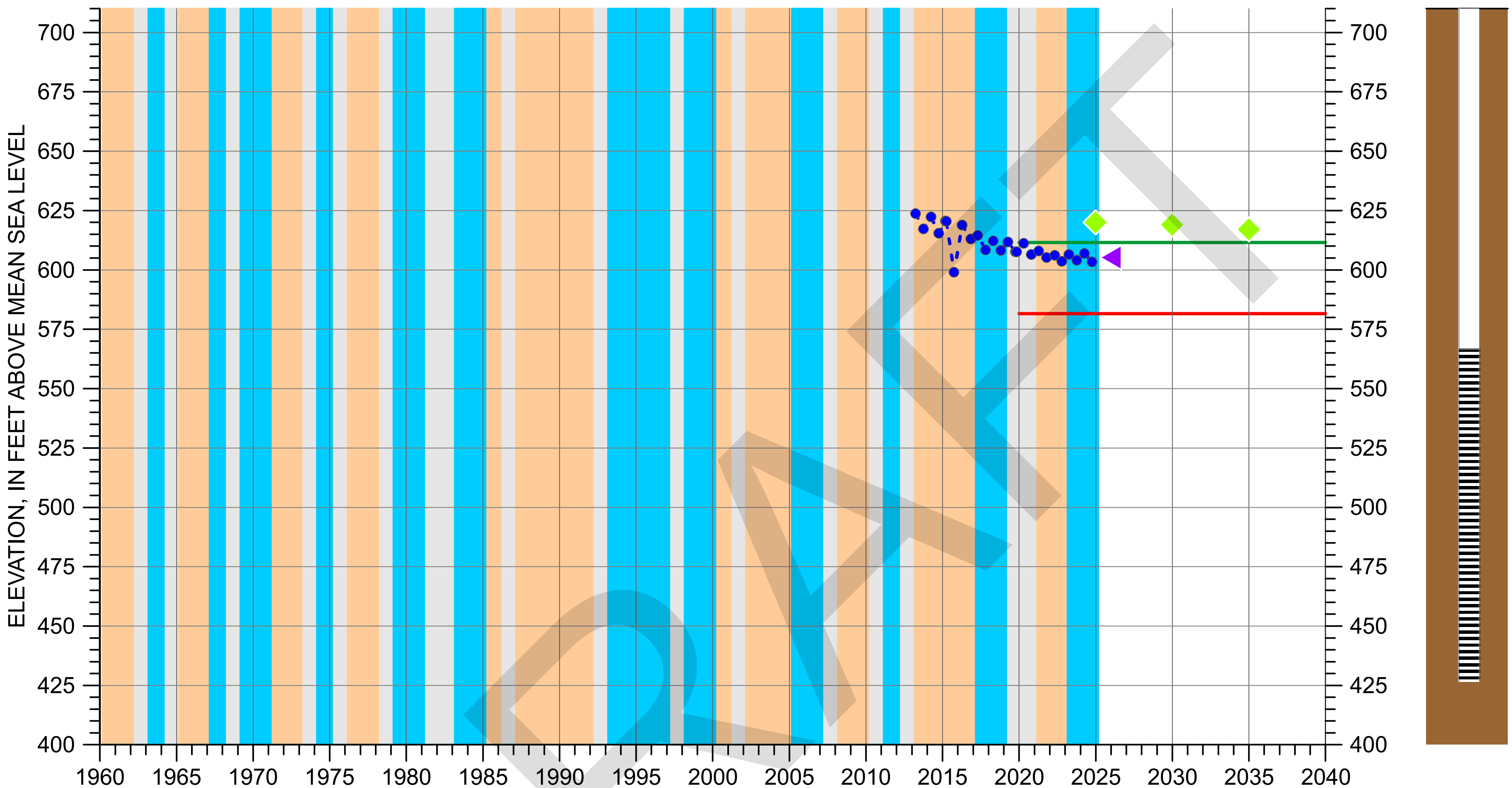
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 26S/13E-08M01



EXPLANATION

Groundwater Elevation

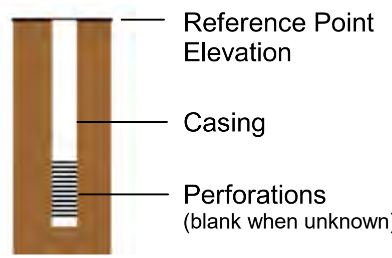
Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

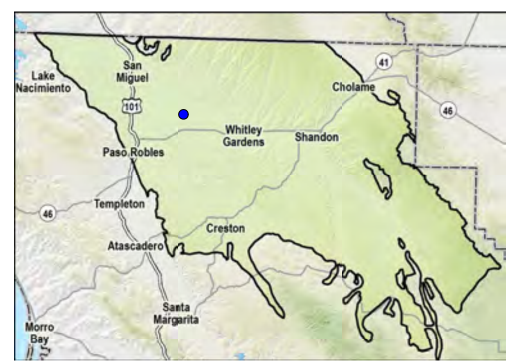
Interim Milestones



CLIMATE PERIOD CLASSIFICATION

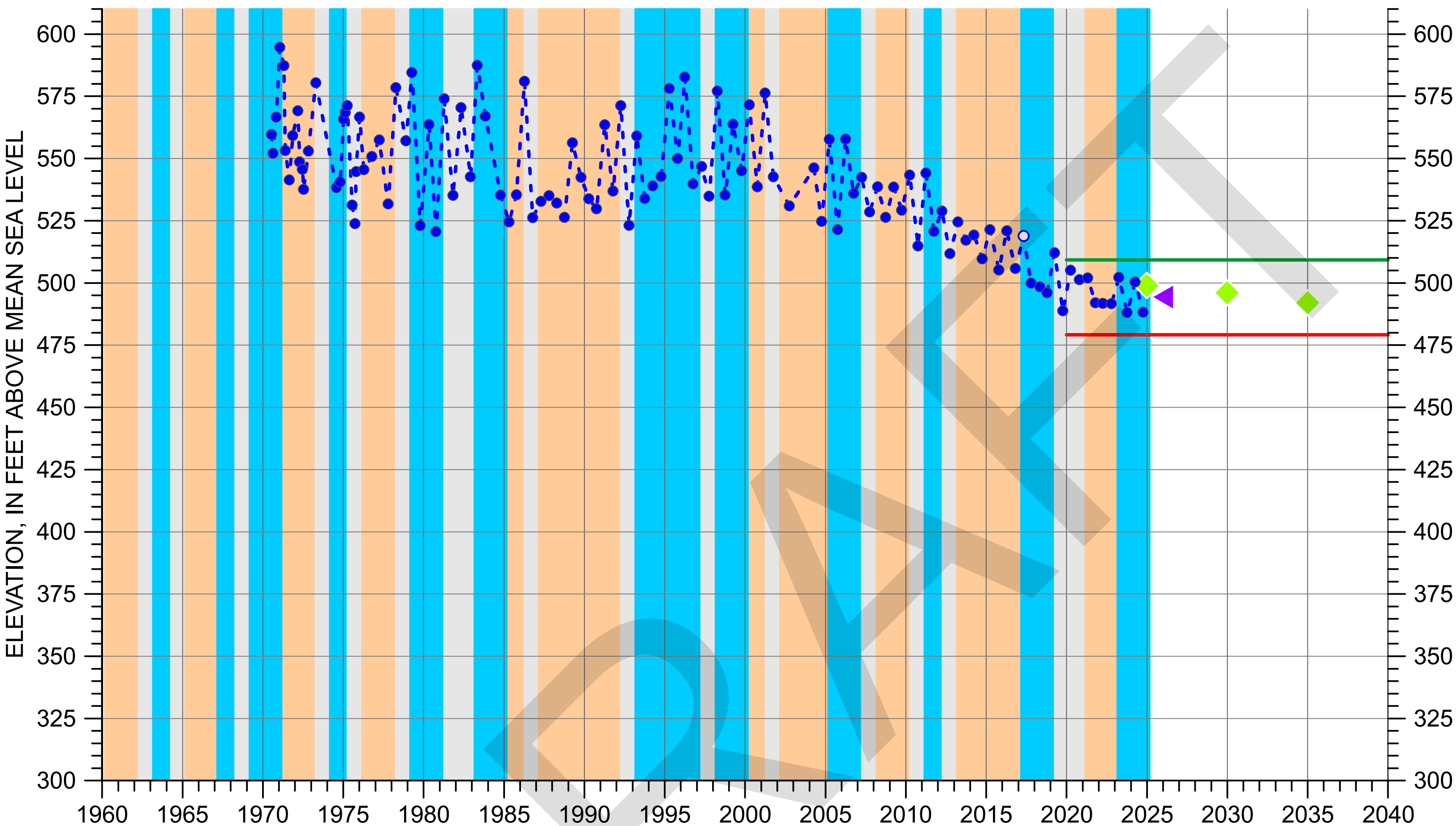
Dry Avg/Alternating Wet

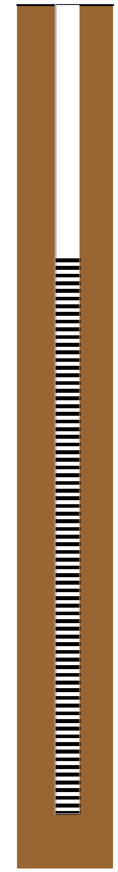
Well Depth: 400 feet
Screened Interval: 260-400 feet below ground surface
Reference Point Elevation: 827.9 feet above mean sea level



Jardine Rd.

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 25S/12E-26L01





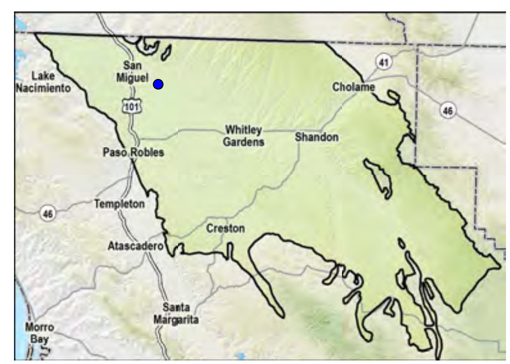
EXPLANATION

- Groundwater Elevation
- Measurement Not Verified
- Measurable Objective
- Minimum Threshold
- Average of spring and fall 2024 water elevations
- Interim Milestones

CLIMATE PERIOD CLASSIFICATION

Dry | Avg/Alternating | Wet

Well Depth: 400 feet
Screened Interval: 200-400 feet below ground surface
Reference Point Elevation: 719.7 feet above mean sea level



Estrella Rd. and Airport Rd.

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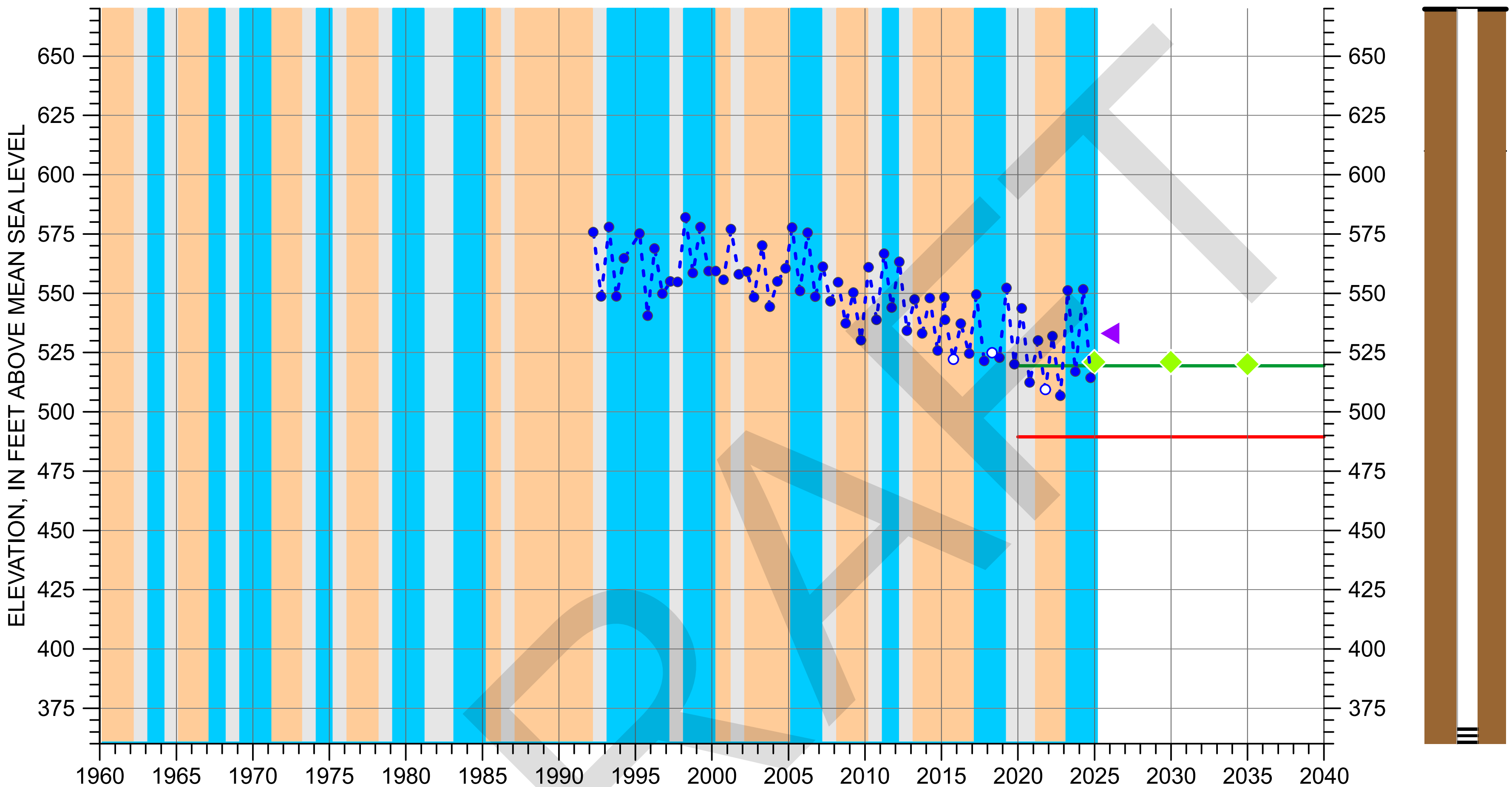
HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 25S/12E-16K05



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

Average of spring and fall 2024 water elevations

Interim Milestones

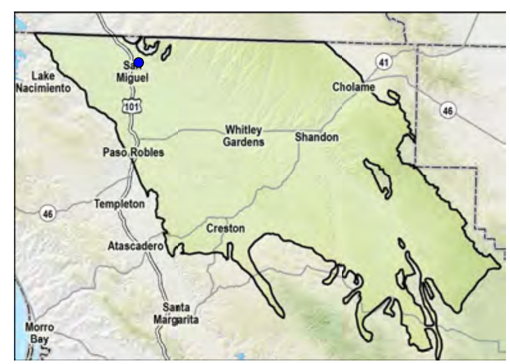
CLIMATE PERIOD CLASSIFICATION

Dry

Avg/Alternating

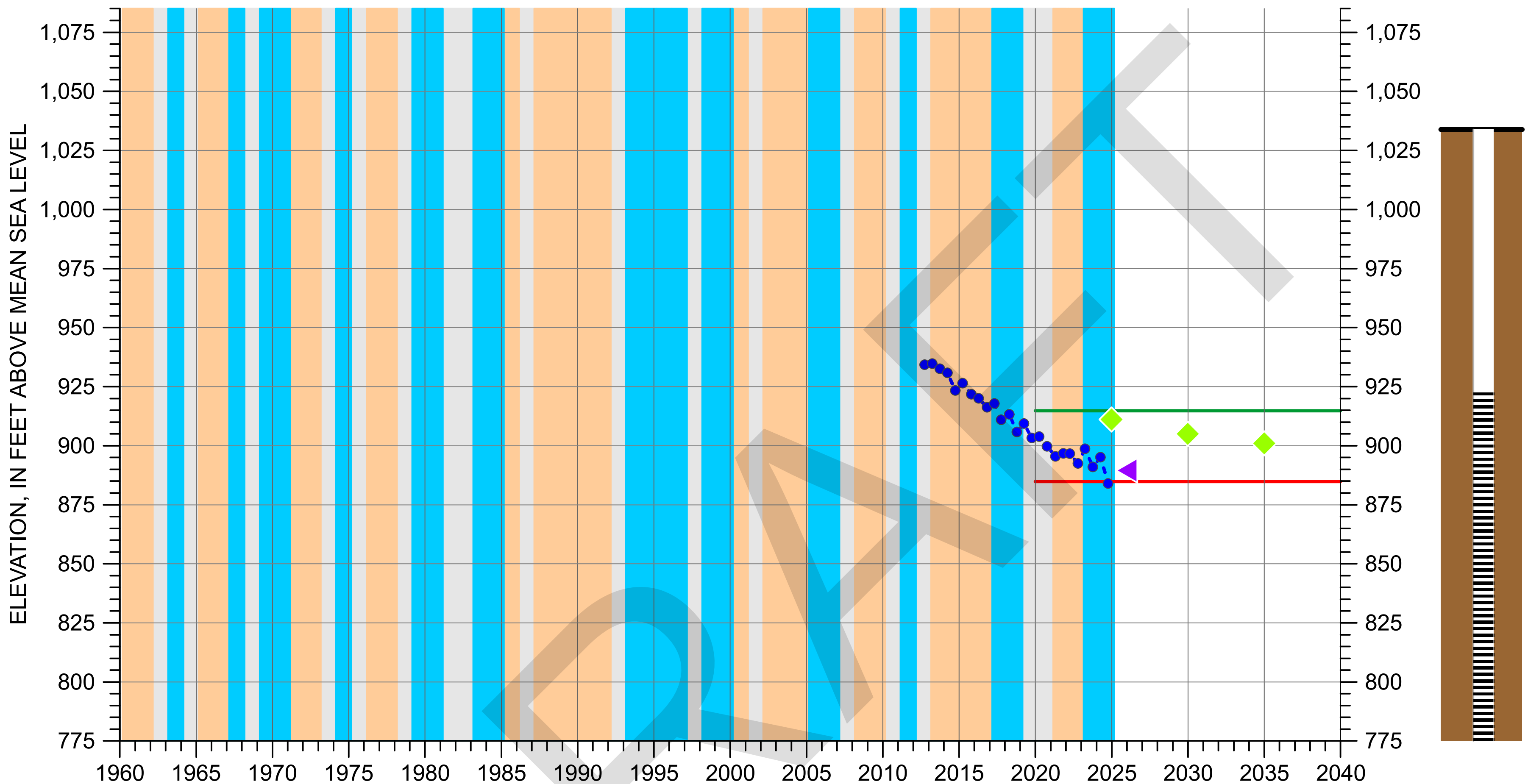
Wet

Well Depth: 350 feet
Screened Interval: 300-310, 330-340 feet below ground surface
Reference Point Elevation: 669.8 feet above mean sea level



North River Rd.

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 25S/13E-08L02



EXPLANATION

Groundwater Elevation

Measurement Not Verified

Measurable Objective

Minimum Threshold

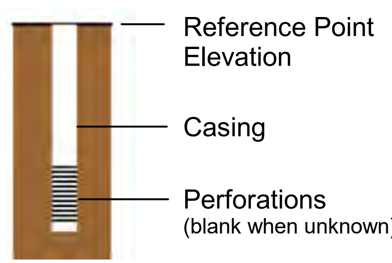
Average of spring and fall 2024 water elevations

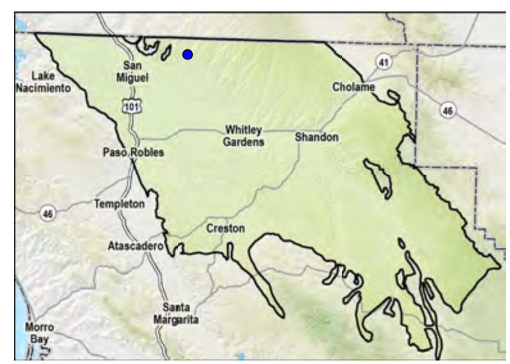
Interim Milestones

CLIMATE PERIOD CLASSIFICATION

Dry Avg/Alternating Wet

Well Depth: 270 feet
Screened Interval: 110-270 feet below ground surface
Reference Point Elevation: 1033.8 feet above mean sea level





Ranchita Canyon Rd.

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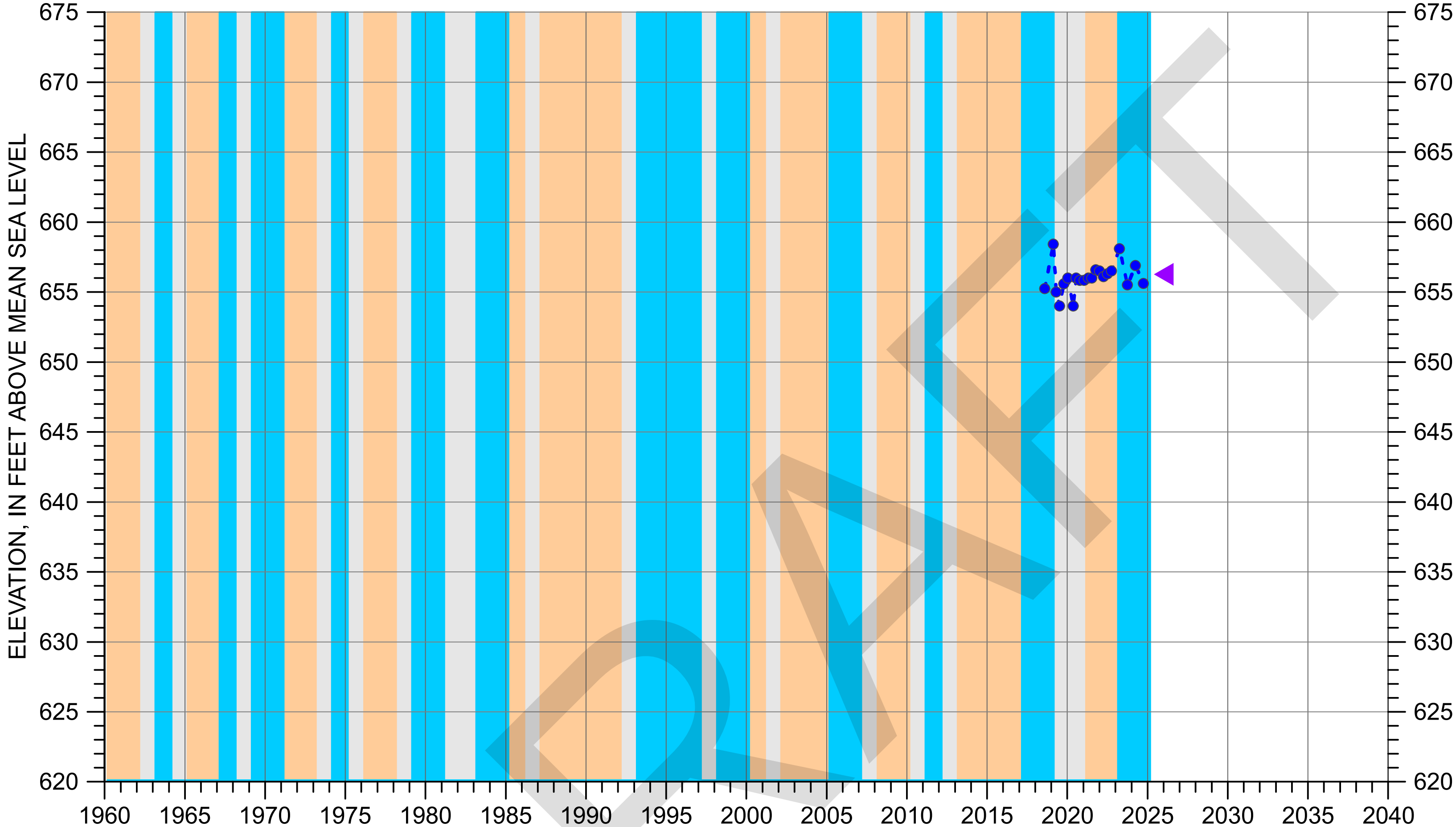
Alluvial Aquifer Hydrographs

HYDROGRAPH OF MEASURED GROUNDWATER ELEVATION FOR 18MW-0191



EXPLANATION

Groundwater Elevation

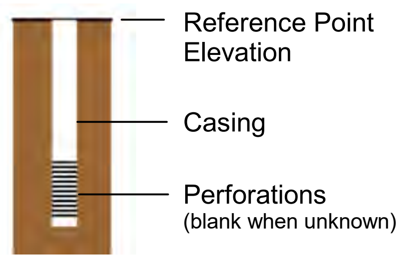
Average of spring and fall 2024 water elevations

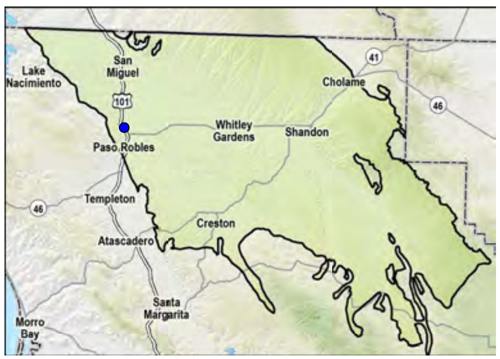
Measurement Not Verified

CLIMATE PERIOD CLASSIFICATION

Dry Avg/Alternating Wet

Well Depth: 50 feet
Screened Interval: 10-50 feet below ground surface
Reference Point Elevation: 672 feet above mean sea level





Salinas River
Alluvial Monitoring Well

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Appendix F: Paso Robles Formation Aquifer Storage Coefficient Derivation and Sensitivity Analysis

Paso Robles Formation Aquifer Storage Coefficient Derivation and Sensitivity Analysis

The annual changes in groundwater in storage calculated for water years 2017, 2018, and 2019 in the Paso Robles Formation Aquifer presented in this first annual report are based on a fixed storage coefficient (S) value derived from groundwater modeling and groundwater elevation data presented in the Groundwater Sustainability Plan (GSP) for water year 2016. The derivation of S for the Paso Robles Formation Aquifer and a sensitivity analysis are presented below. It should be noted that while the GSP groundwater model utilizes a spatially variable S (both laterally and vertically) the S value derived here and used in this first annual report is a single average value representing the Paso Robles Formation Aquifer within the Subbasin.

1.1 Derivation of the Storage Coefficient Term

Derivation of S was accomplished through a back calculation using the change in groundwater in storage in the Paso Robles Formation Aquifer determined from the GSP groundwater model for water year 2016 and the total volume change represented by a Paso Robles Formation Aquifer groundwater elevation change map prepared for water year 2016. The change in groundwater in storage for water year 2016 in the Paso Robles Formation Aquifer is -59,459 acre-feet (AF) based on the GSP groundwater model.

The Paso Robles Formation Aquifer groundwater elevation change map for water year 2016 was prepared for this annual report by comparing the fall 2015 groundwater elevation contour map to the fall 2016 groundwater elevation contour map. The fall 2015 groundwater elevations were subtracted from the fall 2016 groundwater elevations resulting in a map depicting the changes in groundwater elevations in the Paso Robles Formation Aquifer that occurred during the 2016 water year (not pictured, but similar to Figures 12, 13, and 14 in this first annual report).

The groundwater elevation change map for water year 2016 represents a total volume change within the Paso Robles Formation Aquifer of -807,490 AF. As described in Section 7.2 of this annual report, this total volume change includes the volume displaced by the aquifer material and the volume of groundwater stored within the void space of the aquifer. The portion of void space in the aquifer that can be utilized for groundwater storage is represented by S. The change in groundwater in storage is equivalent to the product of S and the total volume change, as shown here:

$$Change\ of\ Groundwater\ in\ Storage = S \times Total\ Volume\ Change$$

This equation can be re-arranged and solved for S:

$$S = \frac{Change\ of\ Groundwater\ in\ Storage}{Total\ Volume\ Change} = \frac{-59{,}459\ AF}{-807{,}490\ AF} = 0.07$$

Therefore, based on analysis of data for water year 2016, an average S value for the Paso Robles Formation Aquifer in the Paso Robles Subbasin is 0.07.

1.2 Sensitivity Analysis

The annual changes in groundwater in storage in the Paso Robles Formation Aquifer calculated for water years 2017, 2018, and 2019 presented in this first annual report are 60,106, 6,398, and 59,682 AF, respectively. These values, calculated using an S value of 0.07, appear reasonable when compared to historical changes in groundwater in storage (see Figure 15 in this first annual report). While the calculated value of S, presented above, is based on sound science and using the best readily available information, it is necessary to acknowledge that the true value of S in the Paso Robles Formation Aquifer is spatially variable (as indicated in the GSP groundwater model) and ranges in value both above and below the calculated value of 0.07. A sensitivity analysis was performed to demonstrate the range of annual changes in groundwater in storage that result from using a range of S values. Table F1 shows that the annual change in groundwater in storage volumes can range from 27 percent less to 27 percent more than presented in this first annual report based on S values ranging from 0.05 to 0.09. This shows the sensitivity of the S value to determination of annual change in groundwater in storage. However, neither the 27 percent lower nor the 27 percent higher annual change in groundwater in storage volumes seem reasonable when compared to historical changes in groundwater in storage (as shown in Figure 15 in this first annual report). Based on this sensitivity analysis, GSI believes that the calculated value of S (0.07) is reasonable and defensible for the purposes of this first annual report.

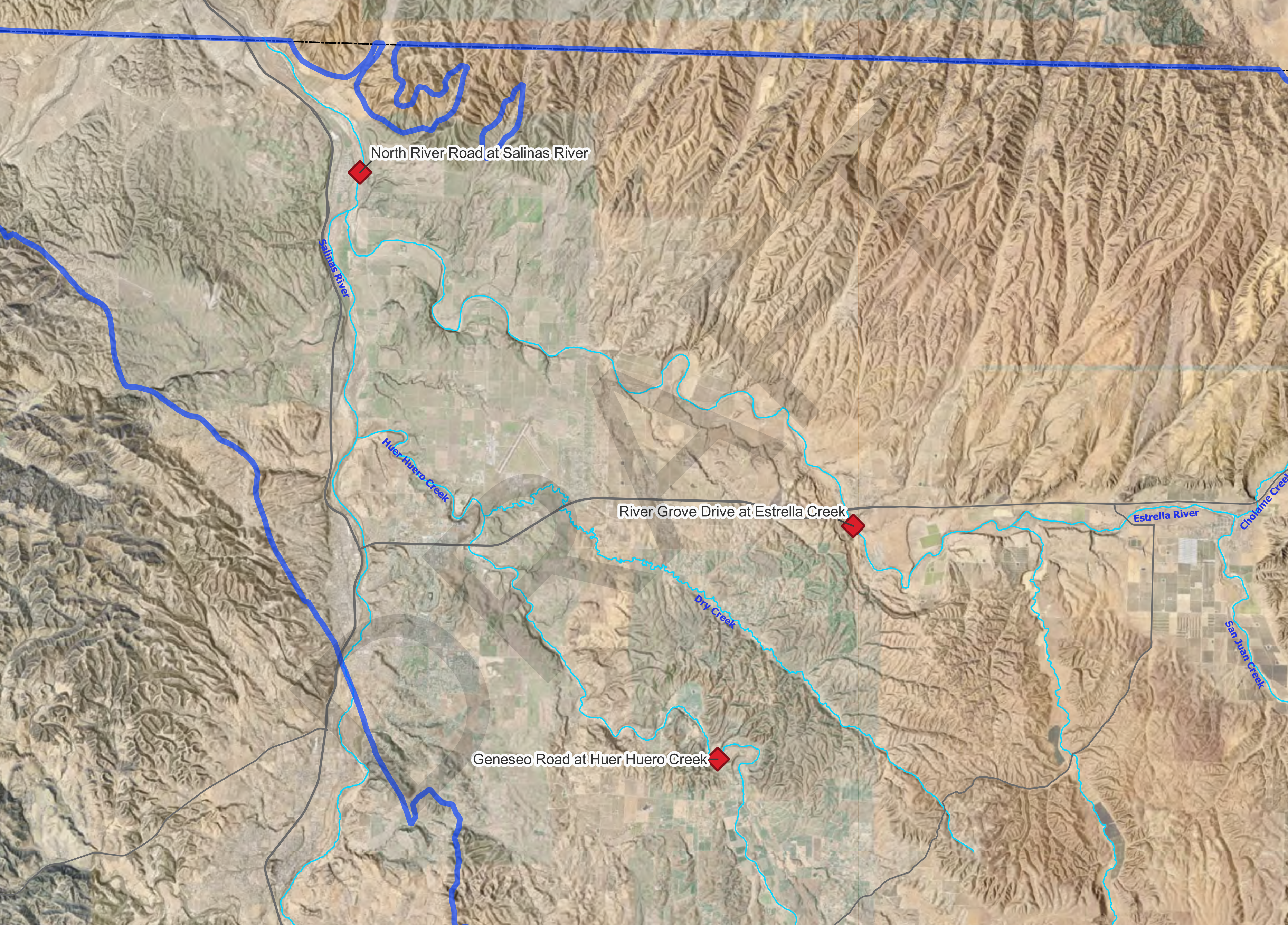
Table F 1. Change in Groundwater in Storage Sensitivity Analysis

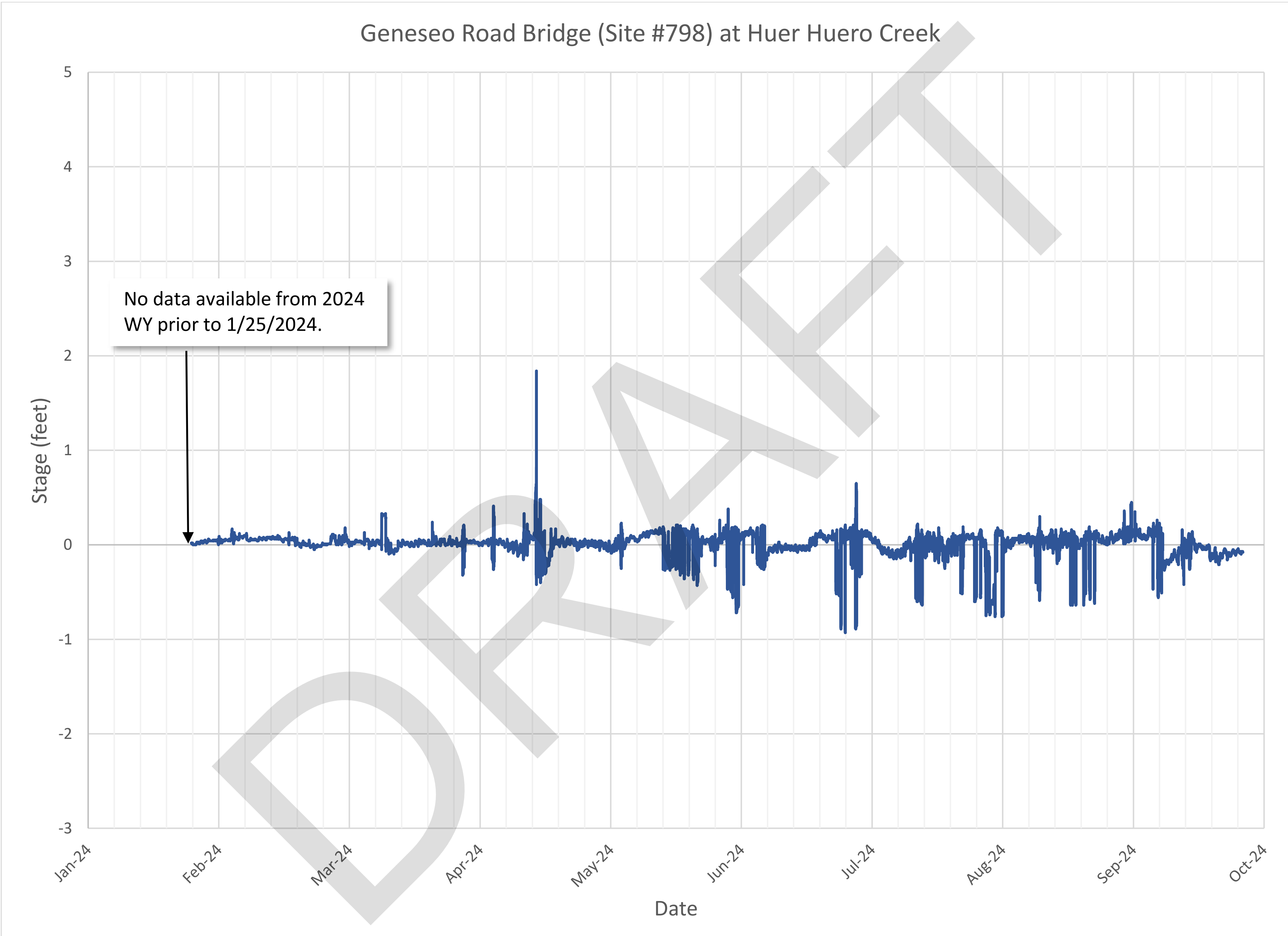
Water Year	Total Volume of Change (AF)	Change in Groundwater in Storage (AF), based on:							
		S = 0.05		S = 0.06		Calculated S [0.07]	S = 0.08		S = 0.09	
		(AF)	% Diff	(AF)	% Diff	(AF)	(AF)	% Diff	(AF)	% Diff
2017	816,274	43,781	-27%	51,943	-14%	60,106	68,269	14%	76,432	27%
2018	86,885	4,660		5,529		6,398	7,267		8,135	
2019	810,508	43,471		51,577		59,682	67,787		75,892	

notes:

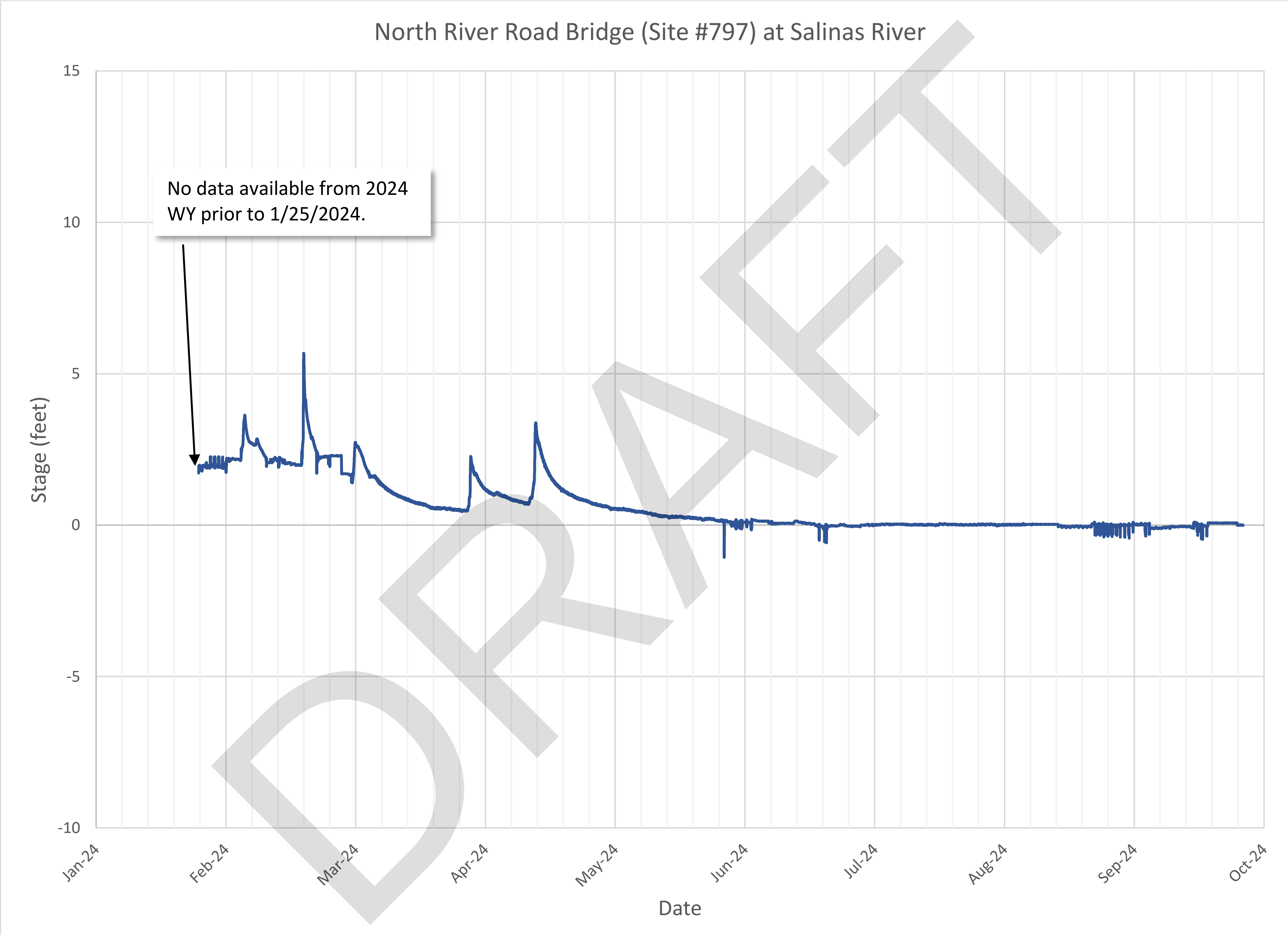
AF = acre-feet, S = storage coefficient, % Diff = percent difference from calculated S

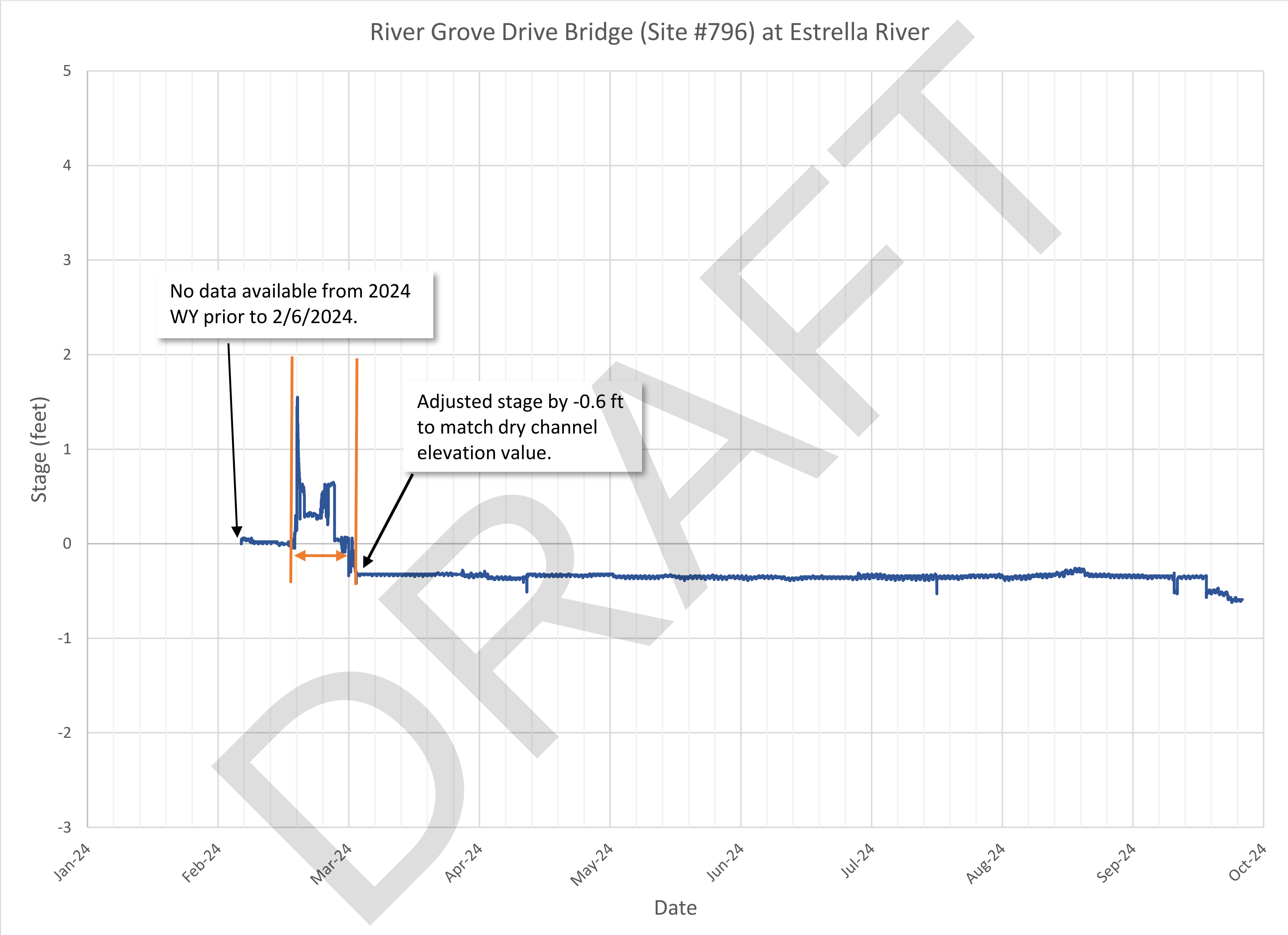
Appendix G: SEP Stream Gage Data


North River Road at Salinas River
Salinas River
Huer Huero Creek
River Grove Drive at Estrella Creek
Estrella River
Cholame Creek
Dry Creek
San Juan Creek
Geneseo Road at Huer Huero Creek



Geneseo Road Bridge (Site #798) at Huer Huero Creek
No data available from 2024 WY prior to 1/25/2024.
Stage (feet)
5
4
3
2
1
0
-1
-2
-3
Jan-24
Feb-24
Mar-24
Apr-24
May-24
Jun-24
Jul-24
Aug-24
Sep-24
Oct-24
Date
DRAFT


North River Road Bridge (Site #797) at Salinas River
No data available from 2024 WY prior to 1/25/2024.
Stage (feet)
15
10
5
0
-5
-10
Jan-24
Feb-24
Mar-24
Apr-24
May-24
Jun-24
Jul-24
Aug-24
Sep-24
Oct-24
Date
DRAFT



River Grove Drive Bridge (Site #796) at Estrella River
Stage (feet)
5
4
3
2
1
0
-1
-2
-3
No data available from 2024 WY prior to 2/6/2024.
Adjusted stage by -0.6 ft to match dry channel elevation value.
Jan-24
Feb-24
Mar-24
Apr-24
May-24
Jun-24
Jul-24
Aug-24
Sep-24
Oct-24
Date
DRAFT

Appendix H: Reviewing the Potential for Application of the USGS Paso Robles Basin Integrated Hydrologic Model for Evaluation of Floodwater Managed Aquifer Recharge Projects

29 April 2024

Blaine T. Reely, PhD, P.E.
Director, Groundwater Sustainability
San Luis Obispo County
1055 Monterey Street, STE D430
San Luis Obispo, CA 93408

RE: Reviewing the Potential for Application of the USGS Paso Robles Basin Integrated Hydrologic Model for Evaluation of Floodwater Managed Aquifer Recharge Projects

Dear Dr. Reely:

As requested, we are providing the subject model review in support of the Department of Groundwater Sustainability of San Luis Obispo (SLO) County in the practical application of the groundwater modeling tools being developed for the Sustainable Groundwater Management Act (SGMA) mandated groundwater sustainability planning. This technical memo focuses on the application of the most recent update of the Paso Robles Integrated Hydrologic Model (PRIHM) model for the Paso Robles Basin (**Fig. 1)**. Specifically, for this task, we undertook the following scope:

- Evaluate how the SFR (Stream Flow Routing) module is currently set up in the PRIHM, including the treatment of the channel cross-sections
- Compare the SFR channel sections to those developed from Flood Inundation Mapping (FIM) utilizing historical simulations of NOAA's National Water Model (NWM), and those sections obtained as part of seepage run data collected by GSI Water Solutions in April 2023
- Evaluate the PRIHM's ability to simulate the period of the GSI seepage runs, and develop conclusions and recommendations from these results and the above channel section comparisons.

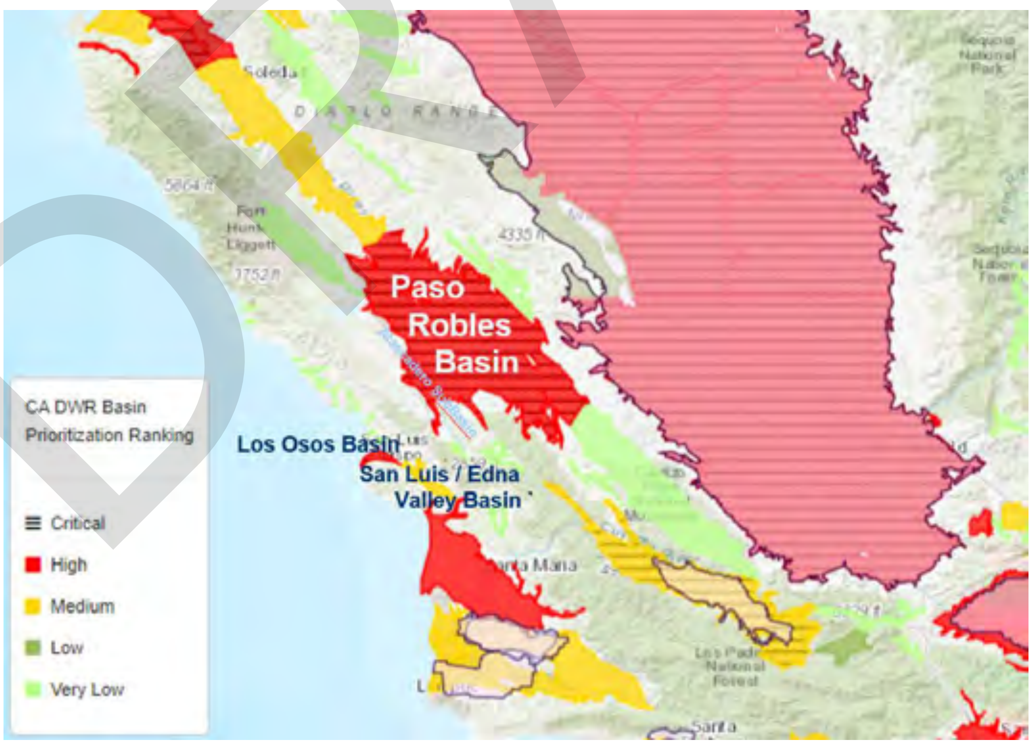


Figure 1. Groundwater basins (per DWR Bulletin 118) in San Luis Obispo county and adjacent counties.

Table of Contents

1. Background and Project Understanding

As shown in the map figure above (**Figure 1**), the Paso Robles Basin has been designated as high and medium priority by the DWR, and also identified to be in critical overdraft. Given that the Paso Robles regional economy includes a significant industry of high-quality wine production, with the wine grapes reliant on groundwater supplied irrigation, it is important that the critical overdraft issue be resolved to help assure long-term sustainability of the groundwater supplies for the Basin. As such, the PR Basin has been the subject of previous groundwater flow modeling efforts over the past 20 years.

1.1. MODFLOW Model Evolution 2002 - 2020

The original PR Basin model was developed by Fugro and Cleath (2002, 2005) in MODFLOW-96 (MF-96). The study area consists of the Paso Robles Groundwater Basin which encompasses 790 square miles in the upper Salinas River watershed in northern San Luis Obispo County and southern Monterey County. Development of the original Basin model involved definition of a four-layer geologic framework within the basin boundaries (as defined by DWR Bulletin 118; see **Figure 2**), representing the recent alluvial deposits and upper, middle, and lower zones of the Paso Robles formation. Inflows to the basin sediments from the watershed areas upgradient from the Bulletin 118 basin boundaries were treated using specified flow boundary conditions to represent inflows from “mountain from recharge” along those basin boundaries The original Basin model also included estimation and calibration of aquifer properties and evaluation of the water balance for water years 1981-1997.

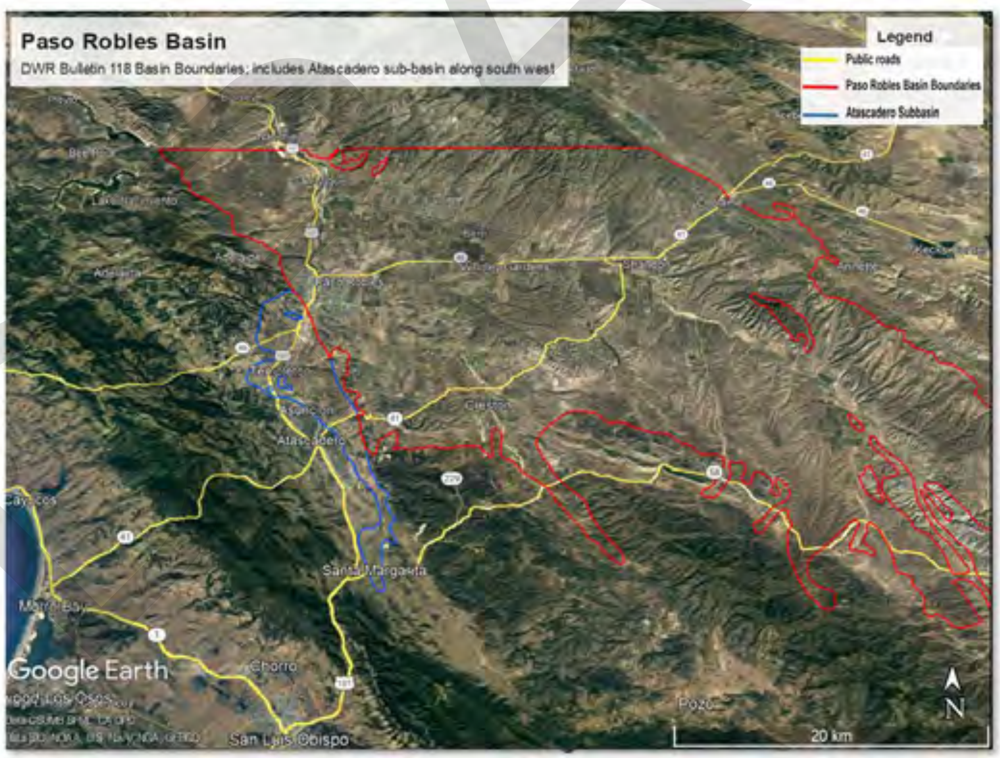


Figure 2. Google Earth oblique image of SLO county portion of the Paso Robles Basin as defined per DWR Bulletin 118 (including Atascadero subbasin along southwest portion in blue).

In 2014, the original model was updated by GeoScience Services Inc. and Todd Groundwater (GSSI and Todd, 2014). The updated model was converted from MF-96 to MODFLOW-2005 (MF-2005), yet it maintained the original model's four-layer hydrogeologic framework. Apart from converting the model to MF-2005, they enhanced the model to address (i) extending the water balance from the limits of the Bulletin 118 groundwater basin to the limits of surrounding surface watershed (Fig. 3), which (ii) required development of a basin watershed model (rainfall – runoff using HSPF) to simulate the inflows into the Basin from the areas beyond the groundwater basin boundaries, and (iii) Extending the end of the simulation period from 1997 through 2011 historical conditions, for a total historical simulation to cover water years 1981 through 2011.

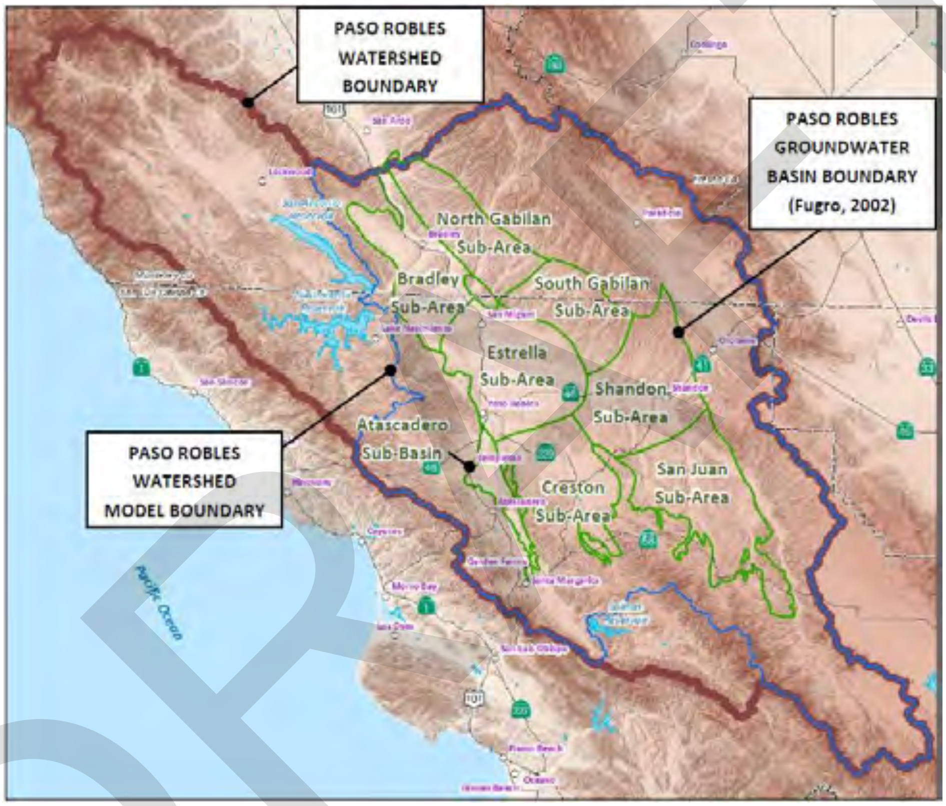


Figure 3. Model domain for updated GSSI (2012-2016) Paso Robles basin model, with the groundwater subbasins outlined in green and the contributing surface watershed (from GSSI and Todd, 2014) in blue.

Following release of the GSSI – Todd 2014 model, a peer review committee was convened, utilizing experts at GSSI and Todd Groundwater, as well as some of the original model developers at Fugro West and Cleath Associates. Based on the review and a facilitated post-review discussion, GSSI (2016) updated the model to address all the points and ran the updated model on a variety of future development and water management scenarios.

To support development of the SGMA-mandated Groundwater Sustainability Plan (GSP) for the Paso Robles Basin, Montgomery and Associates (M&A, 2020) reviewed, updated, modified, and applied the 2016 GSSI model. (i) The updating involved extending the input data sets through 2016 (the previous GSSI model simulation period extending only through water year 2011). (ii) The modifications to the GSSI model were made as M&A identified errors in the water flows between the SWB (Soil-Water Budget) model with the groundwater model, and similarly in the linkage between the HSPF watershed model and the inflows to the groundwater model at the Bulletin 118 basin boundaries. (iii) The updated and modified model was applied to develop a detailed comparison of groundwater basin water budgets computed by the old GSSI model and the corrected model for the historical period. No model re-calibration was attempted.

1.2. USGS Paso Robles Integrated Hydrologic Model Review

In 2017, the US Geological Survey (USGS) was awarded a Water Smart grant by the US Bureau of Reclamation ("Reclamation") to help develop integrated hydrologic models for Salinas and Carmel Rivers Basins Study (SCRBS). This resulted in multiple adjacent models that included the lower and upper Salinas valley (Hevesi et al., 2019, 2020; Henson et al., 2023). The upper reaches of the Salinas River watershed are underlain by the Paso Robles groundwater basin. Thus, at the outset of the SCRBS project, the USGS reviewed the GSSI (2016) model as a groundwater model candidate to integrate into the SCRBS integrated hydrologic model. Based on that review, the USGS determined that the GSSI (2016) Paso Basin model was not suitable for the SCRBS projects to assess climate change and alternate sustainability scenarios with climate change, and it would be better to develop an updated model within MODFLOW-OWHM (MF-One Water Hydrologic Model), henceforth referred to as MF-OWHM (Boyce et al., 2020).

In 2023, the USGS delivered to the County model files associated with the USGS's adaptation of the MF-OWHM version of the Paso Robles Basin that has been integrated into the SCRBS. The USGS refers to this model as the Paso Robles Basin Integrated Hydrologic Model (PRIHM), and we henceforth employ the same acronym to refer to that model. On behalf of the county, Lynker Corporation ("Lynker") performed a detailed review of the PRIHM, and issued a technical memo summarizing the review, findings, and recommendations (Lynker, 2023). Based on that review, a number of observations were made, as well as a series of recommendations on how to proceed with this model.

- In short, the overall spatial structure of the groundwater model appears unchanged from the original. For example, Review of the layering indicates that it is unchanged from the layering first defined in the original 2005 Fugro – Cleath model and maintained in the GSSI and M&A updates, despite the fact that significant more information of the geologic structure has been generated since 2005. An important change from previous versions was refining the stress period length to one month, while previously it was seasonal.
- Wells are simulated using the WEL package, but the well database from which the MF-OWHM input WEL file is developed had not been provided at the time of the review. Given that numerous wells existing in the basin likely penetrate more than one model layer, it was recommended that the MNW2 (Multi-Node Well) package be employed instead of the WEL package.
- Close inspection of the model layering in conjunction with the Active / Inactive cell delineation indicates that at several locations across the domain, layer pinch-outs are not correctly represented. This error could impact how the model simulates interaction of streamflows with groundwater.

In summary, despite some minor errors encountered and the fact that it currently does not cover a long historical period to permit model calibration, Lynker (2023) found that the new PRIHM develop by the USGS in MODFLOW-OWHM represents a great improvement over the previous older models. Among the advantages is the rigor in simulating irrigated agriculture and conjunctive water management via the FMP and SWO packages.

Based on these findings and from related discussions with Dr. Reely of SLO County during the model review process, the following recommendations are made at this time.

- Continue with development of the PRIHM by extending the transient data feed files to cover a long historical period to permit model calibration. The long-term transient data required includes a well database, and historical land use and cropping over the calibration period.
- Improve the 3D geology represented in the model. This would involve bringing new wellbore data that has been developed since 2005. That new wellbore data, together with the SkyTEM airborne geophysical survey results and interpretations, can be employed to improve our understanding of the basin's 3D hydrogeological structure. Depending on the geologic model updates, model layer refinements may be necessary, including adding new layers.
- QA current SFR2 setup, and if necessary, improve treatment of surface water – groundwater interactions.
    - This may require adding back in alluvium layers in some of the channels that are currently simulated to lie directly and unconformably atop deep geologic formations. Adding an alluvium layer may be particularly important for the Salinas River mainstems, as well as Huer Huero and Estrella Creeks which may be the targets of future floodwater managed aquifer recharge (FloodMAR) projects to improve basin supplies.
    - In addition to reviewing the need to account for alluvium beneath the channel, we recommend FIM (Flood Inundation Mapping) Proof-of-Concept for application to sites / stream segments that may be considered for FloodMAR projects.
- Improve treatment of wells in the basin. We recommend that the original well database be obtained and QA'd, and that the MNW2 package be employed to allow for vertical wellbore flows to occur where wells are completed across multiple hydrogeologic layers.
- The best available farm and ET / land use data should be integrated into the FMP package transient land use and climate data.

Once items 1 through 5 are completed, the model can be re-calibrated, and the new calibrated model can be employed for future simulations of management actions and alternatives.

1.3. Technical Memo Scope

As a follow-up to this review, the County requested Lynker to address recommendation #3b, evaluation of SFR treatment in the model compared Flood Inundation Mapping (FIM) and to recent seepage run data collected by GSI Water Solutions in April 2023. To achieve that goal, the following tasks and subtasks were undertaken and are described in the remainder of this memo:

- Evaluate the current model SFR setup, and channel section inputs
- Refine the Model SFR

  - Develop synthetic rating curves at Seepage Run locations along SFR reaches and segments using the FIM (Flood Inundation Mapping) method developed by NOAA Office of Water Prediction (OWP) with Lynker's support.
  - Compare FIM rating curves to 8-point channel sections in existing model
  - Use Seepage Run data collected by GSI in April 2023 during Atmospheric River period to evaluate model simulation
- Describe how the existing model may or may not be suited for evaluation of Flood MAR in the paso Basin

2. Current SFR Setup in the PRIHM

The PRIHM employs the MODFLOW Stream Flow Routing (SFR) process (Prudic et al., 2004; Niswonger and Prudic, 2005). The SFR package is used to simulate streams in a model and how the wetted perimeter of the stream channel interacts with the hydraulically connected groundwater system. The flow in a stream can either be routed instantaneously to downstream s stream reaches or other water bodies (which imposes minimum timestep considerations), or it can be routed using a kinematic wave equation (in MODFLOW-2005 or MODFLOW-LGR). Unsaturated flow beneath streams can be simulated using the UZF package (MODFLOW-NWT and MODFLOW-OWHM).

The SFR package requires as input:

- Define the Segment – Reach setup and connections, working from upstream to downstream (reach = cell, and a segment is a collection of connected reaches)
- Some sort of rating curve relating stream discharge to flow depth, and a channel x-sectional geometry to relate discharge to depth and wetted area
- Conductance properties of wetted channel materials
- Surface water inflows, which can vary over time

The current PRIHM files include values for each of these required inputs. **Figure 4** provides a map of major streams in the Paso Robles basin, with a zoomed detail how the SFR stream segment network currently in the PRIHM.

The model uses an eight-point channel geometry (ICALC=2 stream channel option) that varies with segments, with streambed conductance properties calibrated to historical streamflow data (GSSI, 2016). **Figure 5** shows a representative eight-point section as depicted in Prudic et al. (2004), and **Figure 6** presents a representative selection of the eight-point channel geometries in the current model. In **Figure 6**, the PRIHM channel geometry (in brown) is plotted together with stream channel geometry extracted from land surface DEM (in orange) and comparing these two clearly shows the current PRIHM channel geometries provide a poor representation of the true channel geometries. The impacts of these errors are further investigated in the following sections where flood inundation mapping (FIM) and synoptic streamflow measurements taken during an atmospheric river event in April 2023 are compared to PRIHM simulation results.

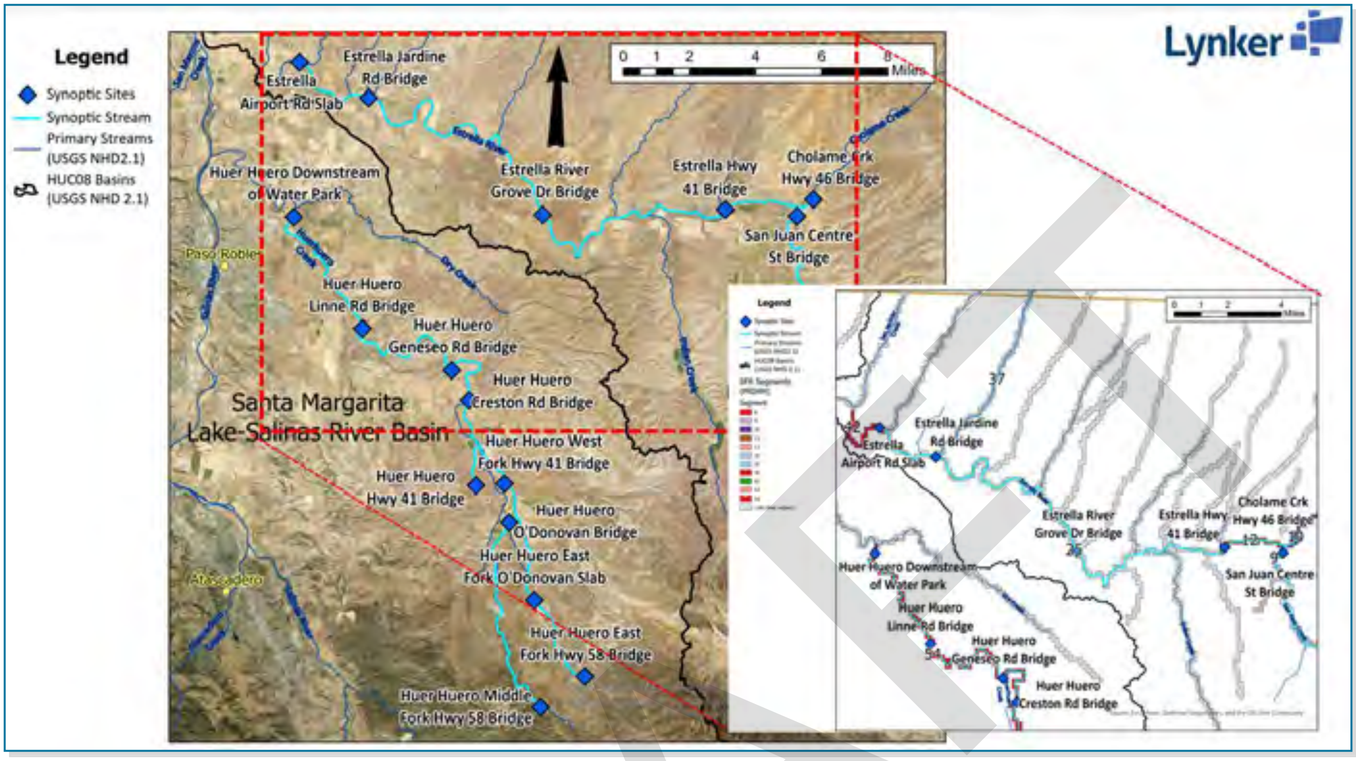


Figure 4. Stream network of Estrella River and Huer Huero Creek in the basin, and depiction of the SFR segment network in the that portion of the PRIHM model domain

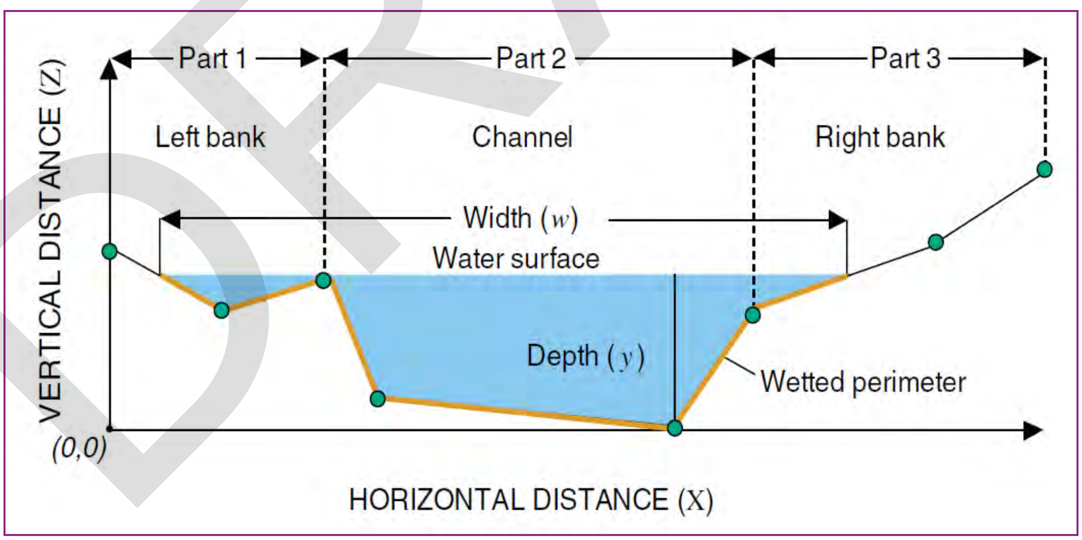


Figure 5. Representative eight-point channel section as implemented in MODFLOW SFR (Prudic et al., 2004)

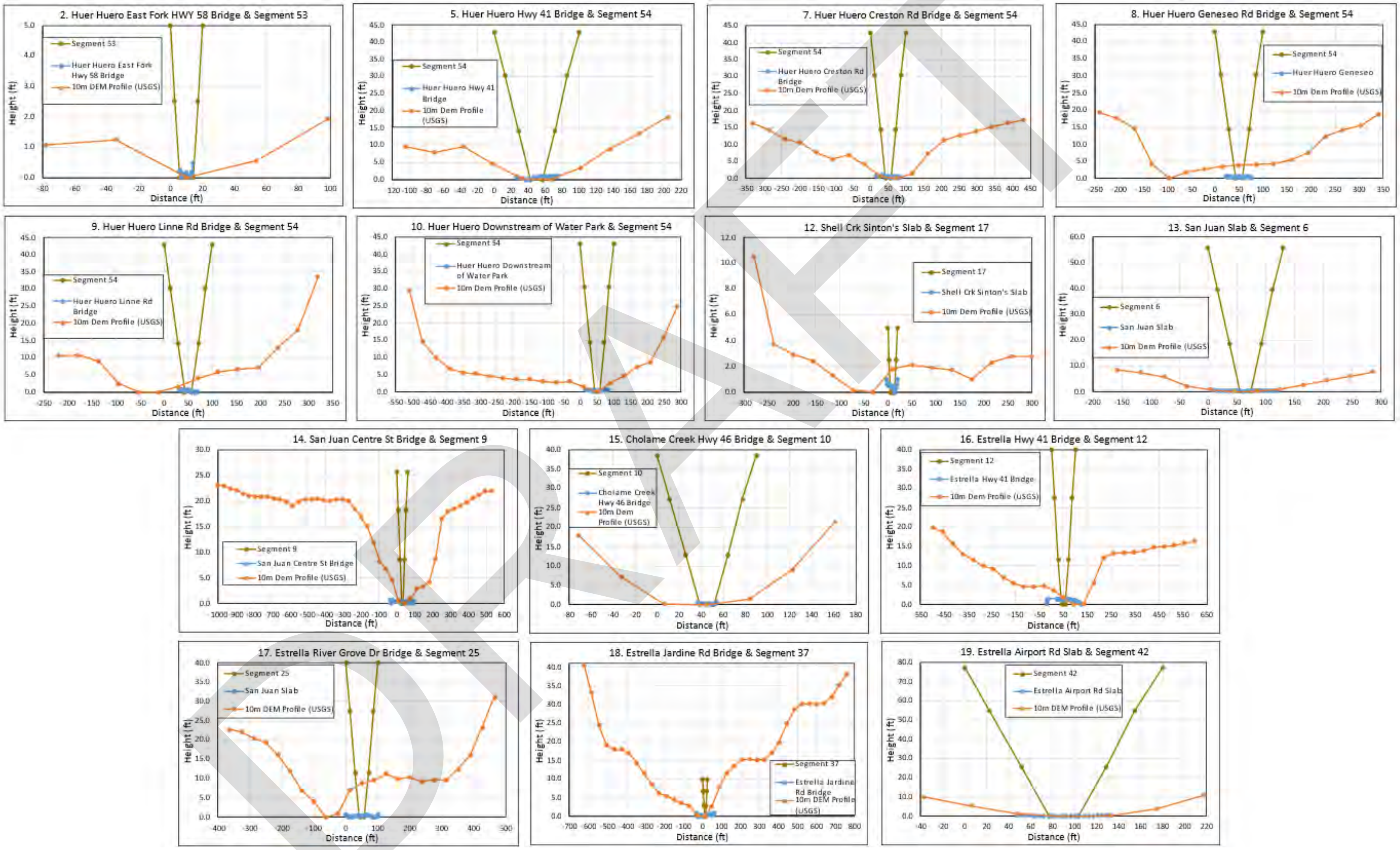


Figure 6. PRIHM eight-point channel sections (in brown) compared to stream channel geometry extracted from land surface DEM (in orange)

3. Independent Data to Evaluate Current SFR in PRIHM

The direct comparison of the PRIHM channel geometries to channel geometries extracted from the publicly available USGS 10-m DEM (Digital Elevation Map), indicates that the current model sections do not agree with available land surface data. Two additional independent data sets are reviewed below to suggest approaches to improve the current model setup.

3.1. 2023 Seepage Run / Synoptic Streamflow Measurements

The central coast of California, including the Paso Robles Basin, experienced a series of atmospheric river events between December 2022 and April 2023, causing the normally intermittently flowing stream in the Paso Robles basin to experience sustained surface flows over this period. To take advantage of these flows and develop a better understanding of surface water – groundwater interactions, the County contracted with GSI Water Solutions (2023) to perform a synoptic streamflow measurements survey on Huer Huero Creek and Estrella River on April 3 and 4, respectively. Also commonly known as seepage runs, these tests involve taking stream flow measurement at numerous locations along a stream, working from the most upstream cross section and progressively working your way downstream. If the field measurement team works their way downstream at approximately the same rate as the water velocity, then any difference in flows between two locations can be inferred to be due to groundwater gains or losses (also accounting for tributary inflows).

Using this methodology, GSI Water Solution (2023) developed a stream segment gain / loss map for those days of as shown in **Figure 7**. To obtain the streamflow measurements, GSI followed standard streamflow measurement protocols, taking water velocity and depth of flow measurements at regularly spaced locations across the stream channel section. **Figure 6** also shows the flow depth measurements (blue dots) obtained by GSI, again showing the poor representation of the stream channels in the current PRIHM.

3.2. Flood Inundation Mapping

A second potential dataset for SFR refinement and calibration involved application of Flood Inundation Mapping (FIM). Working with NOAA's Office of Water Prediction (OWP), Lynker developed a methodology for quickly developing FIMs utilizing retrospective results from NOAA's National Water Model (NWM) to estimate flood flow discharges for recurrence intervals of 2, 5, 10, 25, 50, and 100 years (in essence synthetic rating curves) at locations and reaches of interest. **Figure 8** shows results from FIM analyses for the Paso Robles Basin (DWR Bulletin 118 groundwater basin boundary in black), with the GSI seepage run measurement locations indicated by red dots. This figure shows the FIM results at all those recurrence intervals, but at this scale for most of the segments it is difficult to distinguish between the various inundation extents. So, to better illustrate the refined results that can be obtained from FIM, **Figures 9** through 11 provide "zoomed in" views of the areas outlined by blue and red rectangles.

Figure 7. Synoptic streamflow measurements gain / loss estimates (GSI Water Solutions, 2023)

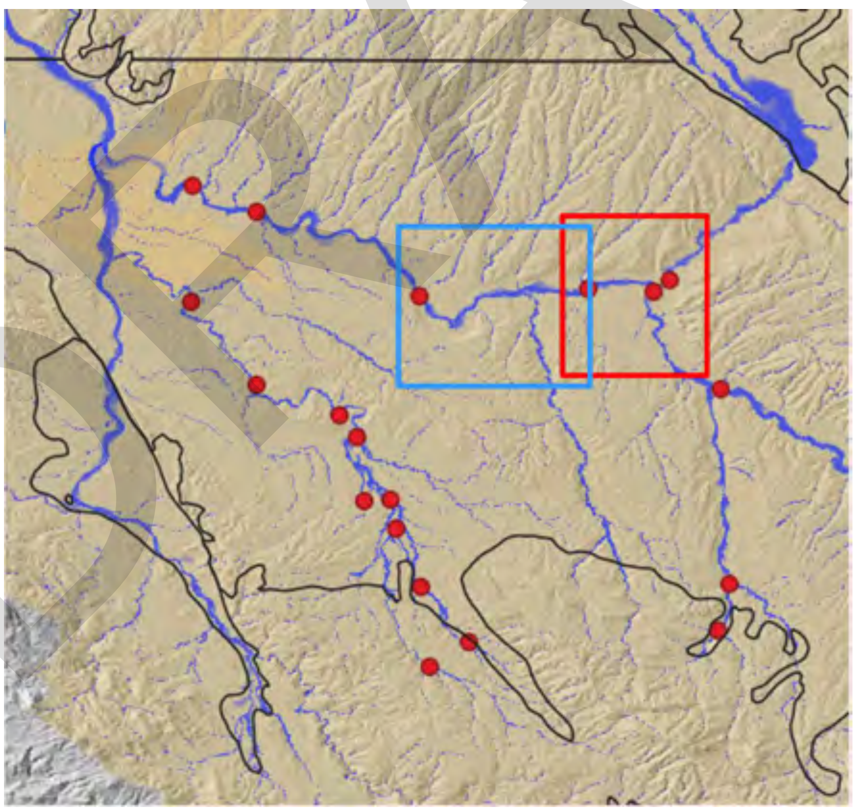


Figure 8. Flood Inundation Map for the Paso Robles basin, with seepage run measurement location shown as red dots and blue and red rectangles are index maps for Figures 9 through 11, and 12, respectively

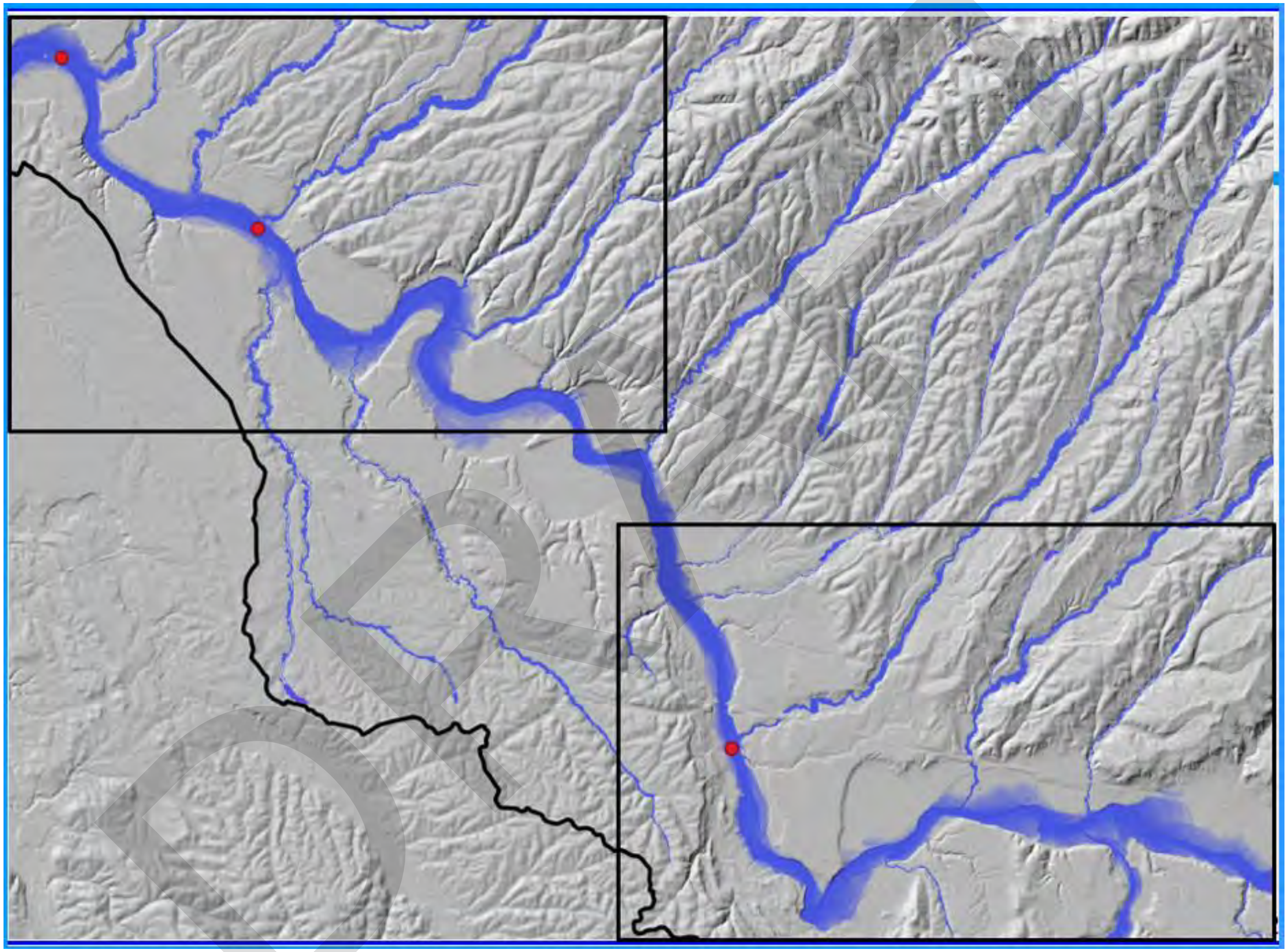


Figure 9. Flood Inundation Map for the portion of the Paso Robles basin indicated by a blue rectangle in Figure 8, all recurrence intervals with lighter-color indicates less frequent flows (rectangles are index maps for Figures 10 and 11)

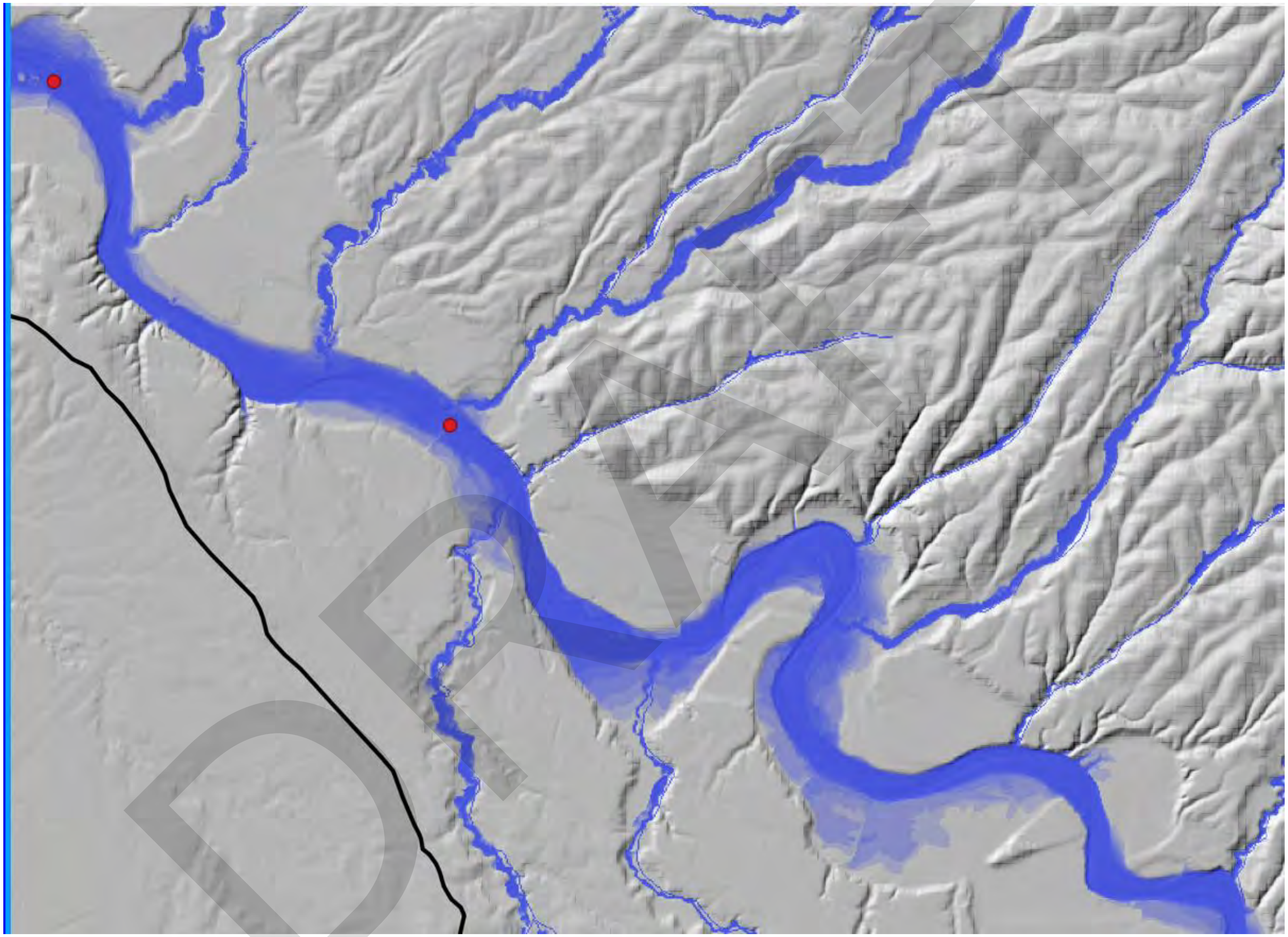


Figure 10. Flood Inundation Map for the portion of the Paso Robles basin indicated by the northwest rectangle in Figure 9, all recurrence intervals with lighter-color indicates less frequent flows (lightest blue = 100-yr flood zone from FIM)

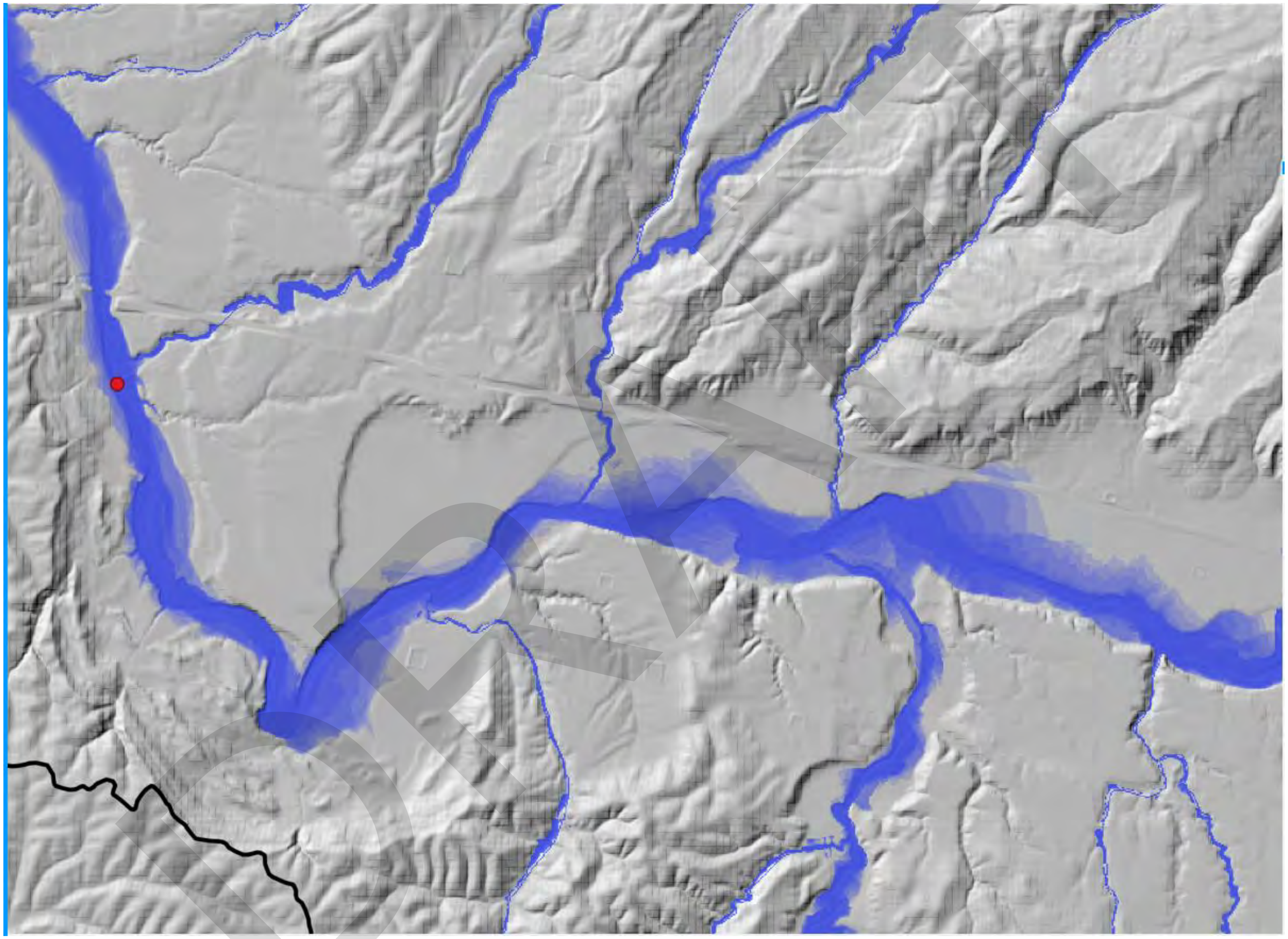


Figure 11. Flood Inundation Map for the portion of the Paso Robles basin indicated by the southeast rectangle in Figure 9, all recurrence intervals shown, those with lighter-color indicates less frequent flows (lightest blue = 100-yr flood zone from FIM)

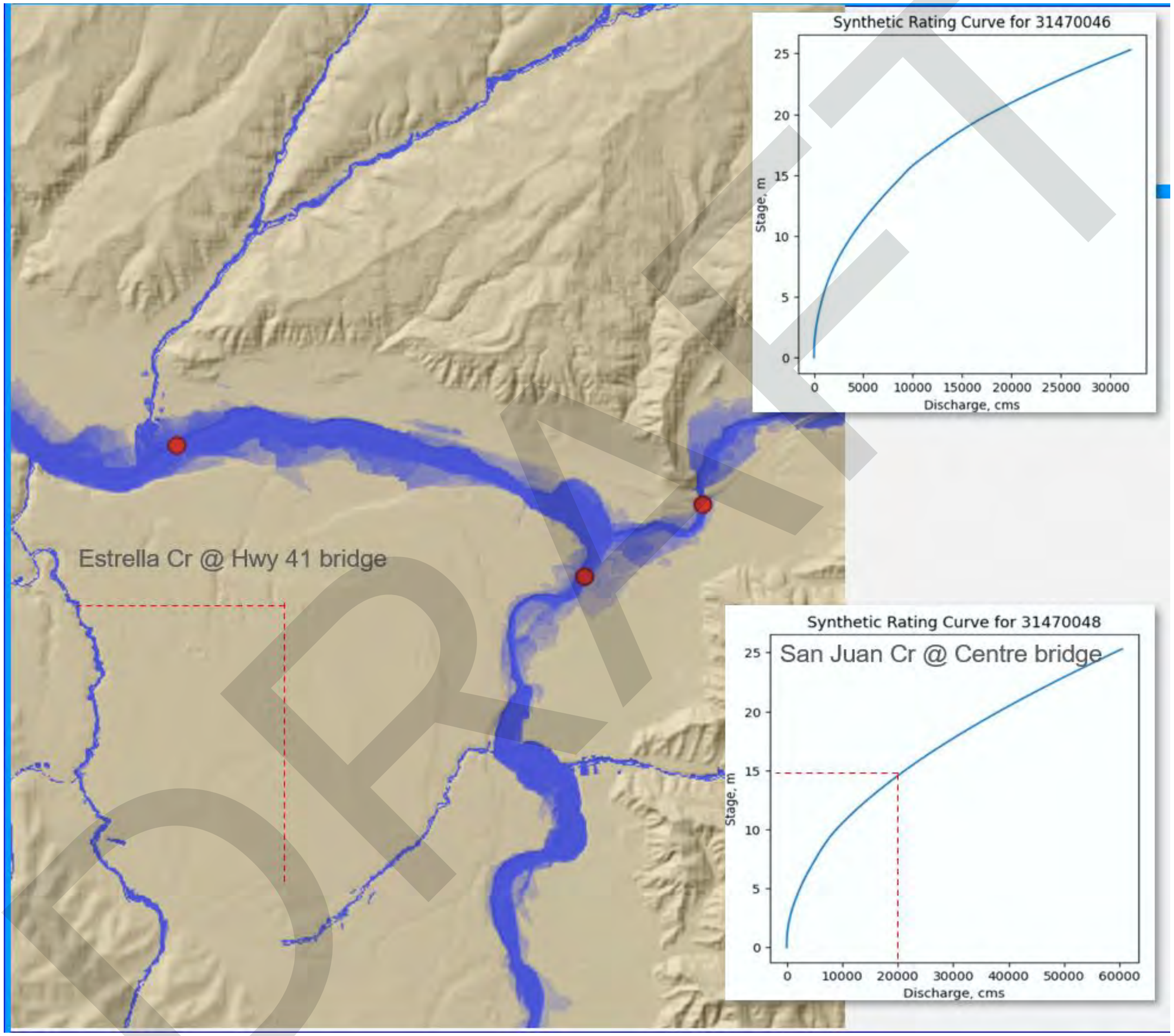


Figure 12. Flood Inundation Map for the portion of the Paso Robles basin indicated by a RED rectangle in Figure 8, and show synthetic rating curves developed for two locations based on the FIM results and retrospective data from NOAA's National Water Model

Utilizing the channel sections presented in **Figure 6** above in conjunction with the FIM results, one can look at the inundated cross section, as shown for four locations in **Figure 13**. This illustrates again the poor representation of the channel sections in the current PRIHM yet points to a method for obtaining new eight-point sections, and also the rating curves for ~1,000-ft river segments along which these sections were extracted.

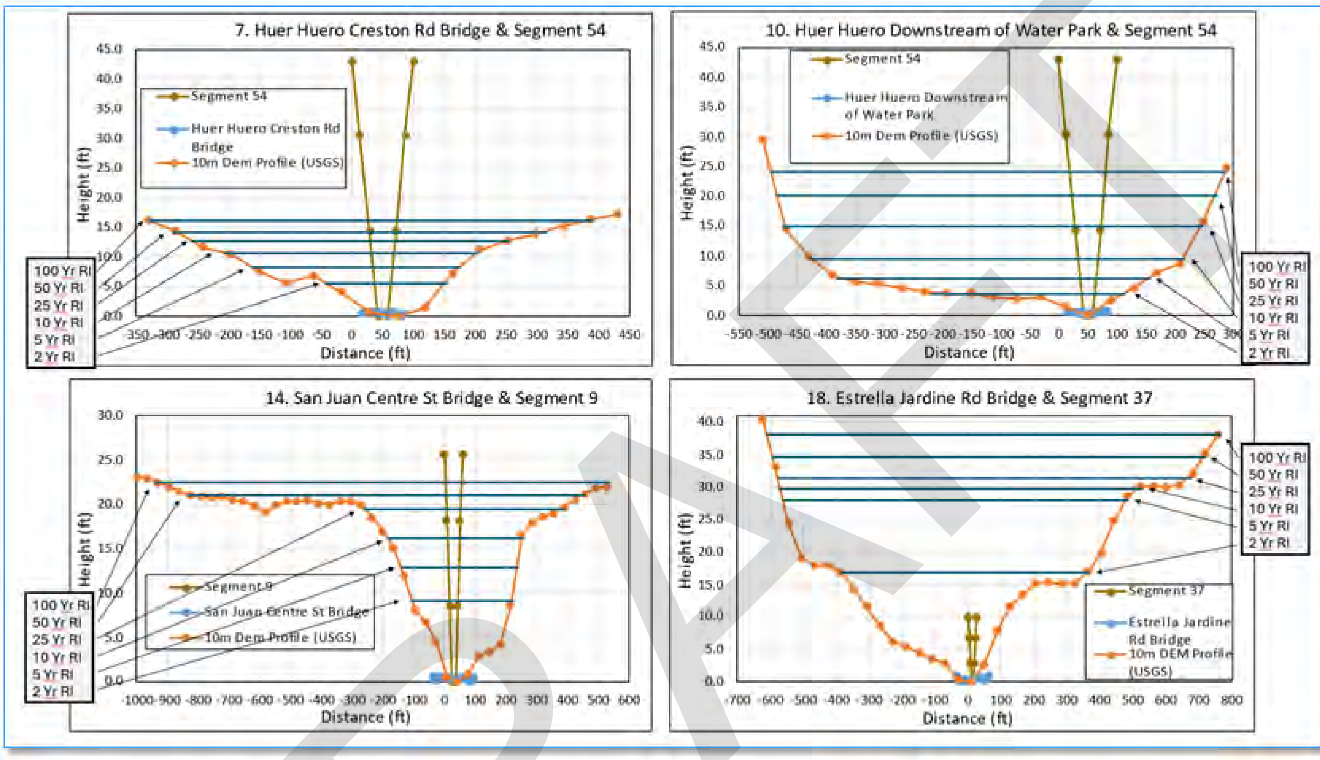


Figure 13. Inundated channel cross-sections for flows at various return intervals at four selected locations

3.3. Comparison of PRIHM SFR Rating Curves to Actual USGS Data

As part of our review, we also downloaded the USGS manual flow measurement data that is used for monitoring and updating the rating curves at USGS streamflow gaging stations. **Figures 14 and 15** present the streamflow versus depth rating curve and the streamflow versus width rating curve for USGS gage No.11147500; the measured data points are shown as blue crosses while the PRIHM SFR rating curve is shown as orange dots. In both cases, the actual data significantly deviates from the model representation. Recognizing that the transfer of water between the stream channel and the groundwater system is a

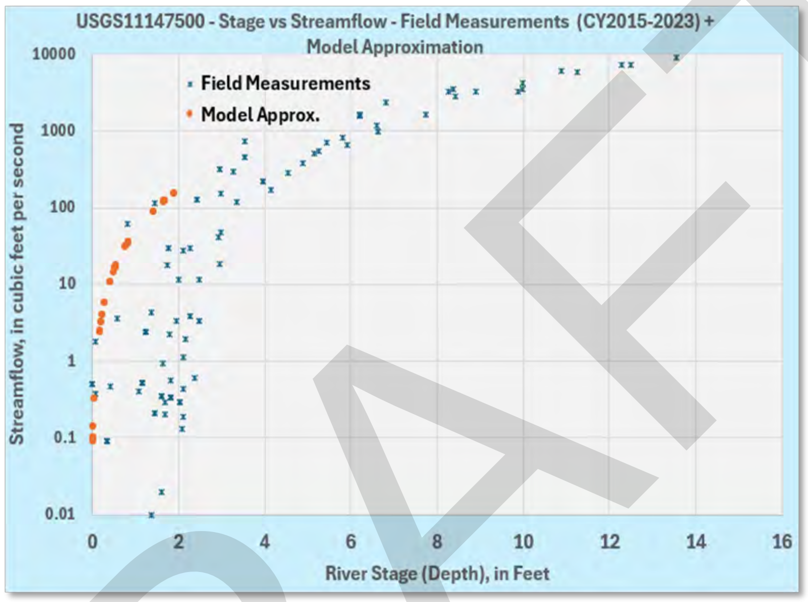


Figure 14. Stage vs streamflow rating curve for USGS 11147500, data blue crosses and PRIHM orange dots

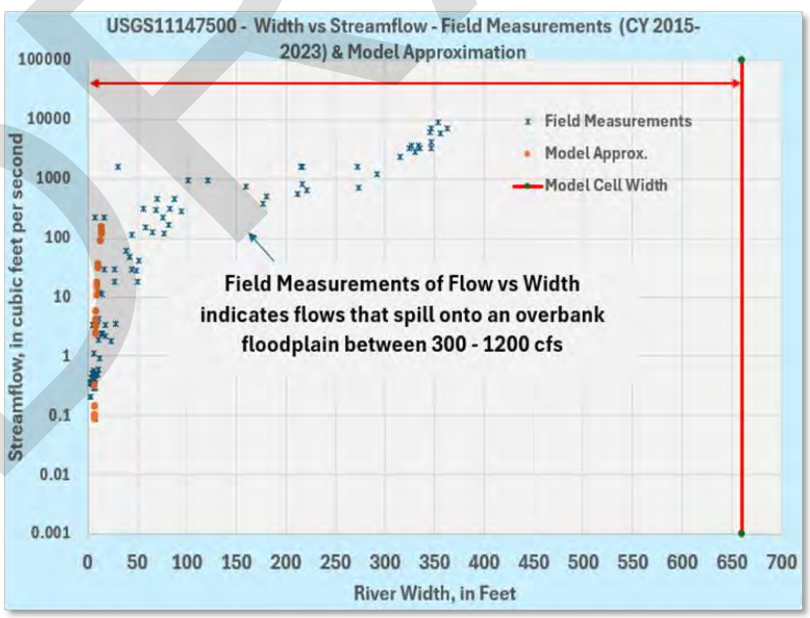


Figure 15. Wetted width vs streamflow rating curve for USGS 11147500, data blue crosses and PRIHM orange dots

function of the driving head (depth of water in the channel) and the wetted width, these comparisons suggest that the current model does not accurately represent the actual field conditions. For example, the current model rating curve indicates a very narrow, steep walled channel (**Fig. 15**), yet the data shows that at flows above 100 cfs, the stream “jumps its banks” and inundates an area much wider than the model represents. This will significantly impact stream – aquifer interaction calculations.

Given that the current scope did not include modifying / correcting the model based on our review findings, the recommended changes to the channel sections and SFR rating curves were not made at this time. Nonetheless, as a confirmation test, we developed a transient model driven by the winter 2022-2023 transient climate series to assess the current PRIHM ability to simulate the stream flows observed by GSI in their seepage run analyses, as well as simulated flow at two gages in the model domain. In short, the current model was unable to reproduce observed streamflows even approximately at those locations.

4. Closing

In conclusion, our diagnostic of the current SFR model setup in the PRIHM revealed that it is currently not a reliable tool for simulating stream – aquifer interactions. This finding presents opportunities for updating the model to improve its ability to simulate stream-aquifer interactions, needed updates include:

- More refined treatment of the eight-point channel geometry
- Development of SFR segment rating curves using the Flood Inundation Mapping (FIM) tool
- Utilization of seepage run data developed by GSI for transient calibration, particularly of SFR parameters

To facilitate a more rigorous evaluation of potential FloodMAR projects in the Paso Basin, we recommend that the current version of the model in MF-OWHM be enhanced with the SFR changes recommended above. Specifically, the PRIHM needs to be updated to correct cited issues with the SFR set-up as well as other issues cited in Lynker (2023) overall model review, before any model re-calibration efforts are undertaken. A model recalibration will be required to yield a robust and reliable modeling tool for evaluation of management alternatives that involve managed aquifer recharge in the Paso Robles Basin.

We appreciate the opportunity to develop and present this model review. We hope it meets your current needs, and Lynker can continue to provide the expert groundwater modeling support needed to help advance long-term groundwater sustainability in SLO county. We acknowledge the review, suggestions, and support provided by Mr. Randy Hanson of One-Water Hydrologic in the analyses presented in the technical memo, and to Dr. Mathew Luck, Senior Hydrologist with Lynker who developed the Flood Inundation Maps. Please let us know if you have any follow-up questions or need additional information.

Sincerely,

James T. McCord

James T. “Jim” McCord, PhD, PE
Principal Water Resource Engineer / Groundwater Lead
+1-505-261-0837 | jtmccord@lynker.com

Justin A. Clark

Justin Clark, MS
Senior Hydrogeologist
+1-520-990-0899 | juclark@lynker.com

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