WATER YEAR 2023 ANNUAL REPORT

White Wolf Subbasin

March 2024
EKI C20014.02

EKI ENVIRONMENT & WATER, INC.

www.ekiconsult.com
2001 Junipero Serra Blvd, Suite 300 • Daly City, CA 94014

Water Year 2023 Annual Report

White Wolf Subbasin

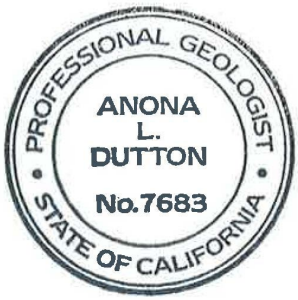
March 2024

Prepared for:

White Wolf Groundwater Sustainability Agency

Prepared by:

EKI Environment & Water, Inc.
2001 Junipero Serra Blvd., Suite 300
Daly City, California 94014
(650) 292-9100
www.ekiconsult.com
EKI C20014.02



Anona Dutton, PG (#7683), CHg (#841)
Vice President

Christina Lucero, PG (#9262)
Hydrogeologist
QA/QC Reviewer

Water Year 2023 Annual Report

White Wolf Subbasin

TABLE OF CONTENTS

TABLES (IN REPORT TEXT)

FIGURES (IN REPORT TEXT)

FIGURES (AT END OF REPORT)

APPENDICES

ABBREVIATIONS AND ACRONYMS

AEWSD	Arvin-Edison Water Storage District
AF	acre-feet
AFY	acre-feet per year
CCR	California Code of Regulation
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CVP	Central Valley Project
DTW	Depth to Water
DWR	Department of Water Resources
EAR	Electronic Annual Report
ET	evapotranspiration
ft	feet
ft bgs	feet below ground surface
ft NAVD 88	feet above the North American Vertica Datum of 1988
GDE	Groundwater Dependent Ecosystem
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWE	Groundwater Elevation
IM	Interim Milestone
ISW	Interconnected Surface Water
ITRC	Irrigation Training and Research Center
JPA	Joint Powers Agreement
KCWA	Kern County Water Agency
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MO	Measurable Objective
MT	Minimum Threshold
NA	Not Applicable
ND	Non-detect
P/MAs	Projects and Management Actions
POD	Point of Diversion
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RMW	Representative Monitoring Well
SDWIS	Safe Drinking Water Information System
SGMA	Sustainable Groundwater Management Act
SMB	Soil Moisture Budget Accounting Model
SMC	Sustainable Management Criteria
SWP	State Water Project

SWRCB	State Water Resources Control Board
TCWD	Tejon-Castac Water District
TRC	Tejon Ranch Company
TRCC	Tejon Ranch Commerce Center
TT	Trigger Threshold
USBR	United States Bureau of Reclamation
WRMWSD	Wheeler Ridge-Maricopa Water Storage District
WWB	White Wolf Basin
WWF	White Wolf Fault
WWGFM	White Wolf Groundwater Flow Model
WY	Water Year

EXECUTIVE SUMMARY

The San Joaquin Valley Groundwater Basin - White Wolf Subbasin (referred to herein as "the Basin"), California Department of Water Resources (DWR) Basin No. 5-022.18, is classified as a "medium priority" basin (DWR, 2019). To address the long-term reliability of groundwater within the Basin, the White Wolf Groundwater Sustainability Agency (GSA) developed a Groundwater Sustainability Plan (GSP), which was adopted by the White Wolf GSA Board on 25 January 2022, submitted to DWR on 28 January 2022, and approved by DWR on 26 October 2023.

This Water Year (WY) 2023 Annual Report for the Basin has been prepared in compliance with California Code of Regulations (CCR) Title 23 § 356.2 and is consistent with the DWR's October 2023 *GSP Implementation: A guide to Annual Reports, Periodic Evaluations, & Plan Amendments*[1]. WY 2023 includes the period from 1 October 2022 through 30 September 2023.

The White Wolf GSA is the exclusive GSA for the Basin and was formed in 2017 upon adoption of a Joint Powers Agreement (JPA). The White Wolf GSA is governed by a seven-member Board of Directors which includes two (2) representatives of each member district: Arvin-Edison Water Storage District (AEWSD), Tejon-Castac Water District (TCWD), and Wheeler Ridge-Maricopa Water Storage District (WRMWSD). Kern County is represented as the seventh, non-voting member of the Board.

The Basin encompasses 107,532 acres in the southernmost region of the San Joaquin Valley Groundwater Basin within Kern County, California, as shown on **Figure 1**. The Basin contains one principal aquifer, inclusive of the Shallow Alluvium, Kern River Formation, and Chanac Formation. South of the Springs Fault there is a shallow water-bearing zone that is partially hydraulically separated from the main portion of the principal aquifer.

The White Wolf GSA adopted the following Sustainability Goal for the Basin: *Cooperatively continue to maintain an economically-viable groundwater resource within the White Wolf Subbasin that supports the current and future beneficial uses and users of groundwater by utilizing the area's groundwater resources within the local sustainable yield and avoiding undesirable results*.

Groundwater elevation contours are shown on **Figure 2** for Fall 2022 (seasonal low) and on **Figure 3** for Spring 2023 (seasonal high). The contour maps show that groundwater generally flows from the southeast to the northwest and that the flow direction and magnitude did not vary greatly between the seasonal low to seasonal high periods in WY 2023.

The Basin currently has 14 Representative Monitoring Wells (RMWs) for Chronic Lowering of Groundwater Levels (RMW-WL). Hydrographs showing groundwater elevations for the RMW-WLs are shown on **Figure 4**. **Table 6** and **Figure 15** and **Figure 16** provide tabular comparisons of the water levels in the RMW-WLs to the SMCs. Seasonal groundwater levels in all viable RMW-WLs were above their MTs over the reporting period, with the exception of two RMW-WLs; RMW-WWB-010 exceeded its MT in both Fall 2022 and Spring 2023 and RMW-WWB-012 exceeded its MT in Fall 2022 and recovered above its MT by Spring 2023. Among the RMW-WLs that had at least one groundwater level measurement collected during WY 2023, seven RMW-WLs have groundwater levels above their Measurable Objectives (MOs),

[1] Groundwater Sustainability Plan Implementation: A Guide to Annual Reports, Periodic Evaluations, & Plan Amendments (ca.gov)

and therefore the Interim Milestones (IMs), for at least one seasonal (Spring or Fall) measurement. Based on the definition in the GSP, as shown on **Figure 17**, no Undesirable Results related to Chronic Lowering of Groundwater Levels (and Reduction of Groundwater Storage by proxy) are occurring in the Basin.

Groundwater and surface water uses in the Basin during WY 2023 are summarized in **Table 1** and **Table 3**, respectively. Total groundwater extractions were determined through a combination of metered data, where available, and calculated using the Soil Moisture Budget (SMB) model developed for the Basin as described in **Section 3**. Total pumpage in WY 2023 was approximately 22,600 acre-feet (AF), of which 94% (21,195 AF) was for the agricultural sector. General locations of groundwater extractions are shown on **Figure 6**. Groundwater and imported surface water were the major sources of water in the Basin during WY 2023; the WY 2023 water supply consisted of 17% groundwater, 83% surface water (imported 95% and stream diversions 5%), and less than 1% recycled water.

Changes in groundwater storage were estimated using the White Wolf Groundwater Flow Model (WWGFM), a three-dimensional numerical groundwater flow model, which was prepared to analyze water budget information for the Basin as part of the GSP. Modeled groundwater levels generally match the magnitude and trends of the measured water levels in Basin wells (**Figure 12**); thus, the Basin model is sufficiently accurate for reporting purposes. A map of the simulated water level difference and groundwater storage change in the Basin between WY 2022 and WY 2023, as calculated by the WWGFM, is shown on **Figure 13**. Generally, most of the Basin experienced an increase in groundwater storage over the WY due to wet hydrologic conditions and the abundance of surface water availability from the State Water Project (SWP) and Central Valley Project (CVP). **Figure 14** shows water year type, groundwater use, estimated annual change in groundwater storage, and the cumulative estimated change in groundwater storage for the Basin from WY 1995 to WY 2023. **Table 5** summarizes the estimated annual change in groundwater storage from WY 2015 to WY 2023. WY 2023 was a wet year, and the estimated change in groundwater storage for the Basin (50,200 AF) is greater than that observed during other recent wet years.

The Basin currently has four RMWs for Degraded Water Quality (RMW-WQ). Publicly available data for identified constituents of concern measured in RMW-WQs, and their various SMCs are provided in **Table 7**. All concentrations in the RMW-WQs for the three defined constituents of concern were below the Maximum Concentration Levels (MCLs) and therefore the MTs. Based on the definition in the GSP, no Undesirable Results related to Degraded Water Quality are occurring in the Basin.

Various vertical displacement data indicates very little land subsidence occurred in the Basin, averaging around 0.1 feet over WY 2023 (see **Figure 18**), which is within the measurement error of all applicable measurement methodologies. Based on the definition in the GSP, no Undesirable Results related to Land Subsidence are occurring in the Basin.

The Basin currently has three RMWs for Depletions of Interconnected Surface Waters (RMW-ISW). Hydrographs showing the depth to groundwater for the RMW-ISWs and SMCs are shown on **Figure 5**. **Table 9** provides a tabular comparison of the depths to groundwater in the RMW-ISWs, and their various SMCs. Seasonal high and low groundwater levels in all the RMW-ISWs were above MTs. Based on the definition in the GSP, no Undesirable Results related to Depletions of Interconnected Surface Waters are occurring in the Basin.

Finally, Seawater Intrusion is not present within the Basin, and is not anticipated to be present in the future, and therefore the Sustainability Indicator is not applicable to the Basin.

The GSP outlined 24 potential Projects and Management Actions (P/MAs) for the Basin. Implementation of several P/MAs have been initiated during this reporting period including recharging more than 23,000 AF into the Basin through augmented groundwater recharge projects. A brief description of each P/MA and their implementation status is listed in **Section 7.2** and on **Table 10**. Progress made towards addressing recommended DWR corrective actions is outlined in **Table 11**.

The GSA held a total of 12 public meetings over WY 2023 to disseminate information to stakeholders and report on the state of the Basin and progress on GSP and P/MA implementation, including seven GSA Board of Directors meetings and five P/MA Committee meetings. In January 2023, the GSA established the P/MA Committee, composed of a Board Ad-hoc and a Technical Advisory Committee (TAC), whose goal is to serve as a forum to receive public input from local groundwater users, landowners, non-profit organizations, and other interested parties on the initiation and implementation of P/MAs. Other successful efforts by the GSA include successfully obtaining $4.8 million in grant funds to fill key data gaps, conducting ongoing monitoring reporting, and initiating two construction projects**.**

1 GENERAL INFORMATION

☑ *§ 356.2 (a)*

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.

On 16 September 2014, the California legislature enacted the Sustainable Groundwater Management Act (SGMA) - the primary purpose of which is to achieve and/or maintain sustainability within the state's high and medium priority groundwater basins. The San Joaquin Valley Groundwater Basin - White Wolf Subbasin (referred to herein as "the Basin"), California Department of Water Resources (DWR) Basin No. 5-022.18, is classified as a "medium priority" basin (DWR, 2019). To address the long-term reliability of groundwater within the Basin, the White Wolf Groundwater Sustainability Agency (GSA) developed a Groundwater Sustainability Plan (GSP), which was adopted by the White Wolf GSA Board on 25 January 2022, submitted to DWR on 28 January 2022, and approved by DWR on 26 October 2023 (White Wolf GSA, 2021; DWR, 2023).

This Water Year (WY) 2023 Annual Report for the Basin has been prepared in compliance with California Code of Regulations (CCR) Title 23 § 356.2 and is consistent with the DWR's October 2023 *GSP Implementation: A guide to Annual Reports, Periodic Evaluations, & Plan Amendments* guidance document[2]. WY 2023 includes the period from 1 October 2022 through 30 September 2023. This Annual Report also contains available and appropriate historical information back to calendar year 2015, as required by CCR 23 §356.2 (b). The GSP Annual Report Element check list from DWR's guide is included as **Appendix A** and identifies where each Annual Report element is specifically addressed in this report.

The White Wolf GSA is the exclusive GSA for the Basin. The White Wolf GSA was formed in 2017 upon adoption of a Joint Powers Agreement (JPA) and is governed by a seven-member Board of Directors which includes two (2) representatives of each member district: Arvin-Edison Water Storage District (AEWSD), Tejon-Castac Water District (TCWD), and Wheeler Ridge-Maricopa Water Storage District (WRMWSD). Kern County is represented as the seventh, non-voting member of the Board.

The Basin encompasses 107,532 acres at the southern end of the San Joaquin Valley Groundwater Basin (see **Figure 1**) within Kern County. The Basin is bordered on the north by the Kern County Subbasin, with no adjacent basins located to the south, east, or west.

The White Wolf GSA adopted the following Sustainability Goal for the Basin: *Cooperatively continue to maintain an economically-viable groundwater resource within the White Wolf Subbasin that supports the current and future beneficial uses and users of groundwater by utilizing the area's groundwater resources within the local sustainable yield and avoiding undesirable results*.

[2] Groundwater Sustainability Plan Implementation: A Guide to Annual Reports, Periodic Evaluations, & Plan Amendments (ca.gov)

Available hydrogeologic information indicates that the Basin is bounded on the north by the White Wolf Fault (WWF) system, on the east and south by a crystalline basement complex of the Tehachapi Mountains, and on the west by Tertiary-age sedimentary rocks of the San Emigdio Mountains. The Basin contains one Principal Aquifer, consisting of the deposits of Shallow Alluvium, Kern River Formation, and Chanac Formation. The thickness of the Principal Aquifer ranges from 25 to 7,518 feet (ft) with an average thickness of 2,200 ft over the entire Basin. The Springs Fault lies subparallel to the WWF in the southeastern portion of the Basin and forms a partial barrier to groundwater flow, effectively separating the Principal Aquifer from a shallow water-bearing zone that supports the local occurrence of Groundwater Dependent Ecosystems (GDEs).

Sources of water to the Basin groundwater system include infiltration of applied water[3], precipitation, or infiltration from leaking distribution and conveyance channels, leakage from streams, and subsurface groundwater flow from the unpumped aquifer. Outflows from the Basin include groundwater pumping, evapotranspiration (ET) of shallow groundwater in the vicinity of the GDEs, and subsurface outflow to the Kern County Subbasin across the WWF.

[3] Applied water includes groundwater and imported surface water. Imported surface water can be a combination of contracted State Water Project (SWP) water, contracted Central Valley Project (CVP) water, transfer water, exchanged water, and/or banked water managed through the individual district's service area and water supply portfolio.

2 GROUNDWATER ELEVATION DATA

☑ *§ 356.2 (b) (1)*

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:

(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.

Groundwater elevation data was collected from accessible wells in the Representative Monitoring Network for the Chronic Lowering Groundwater Levels. Data was additionally provided by AEWSD, TCWD, and WRMWSD from wells within their respective supplemental groundwater monitoring networks. During WY 2023, three Representative Monitoring Wells (RMWs) partially collapsed and/or were no longer viable for groundwater level monitoring (RMW-WWB-005, RMW-WWB-007, and RMW-WWB-009). Two nearby surrogate wells were identified for ongoing groundwater level monitoring until dedicated replacement monitoring wells can be installed, anticipated by 2025.

2.1 Groundwater Elevation Contour Maps

Figure 2 and **Figure 3** present groundwater elevation contours in the Principal Aquifer based on data collected in Fall 2022 and Spring 2023, respectively. For the purposes of this Annual Report, Fall 2022 measurements were those collected between 4 October and 15 November 2022 and Spring 2023 measurements were those collected between 1 February and 27 April 2023.[4] **Figure 2** illustrates the WY 2023 seasonal low (Fall 2022) and **Figure 3** illustrates the WY 2023 seasonal high (Spring 2023) groundwater elevation contours in the Basin.

Figure 2 and **Figure 3** show that in WY 2023, groundwater elevations in the Basin generally are highest in the southeast in areas of higher topography and generally decrease to the northwest; therefore, groundwater flow directions are generally to the northwest. The groundwater elevation contours during WY 2023 are similar to the groundwater elevation contours in previous WYs.

2.2 Groundwater Hydrographs

Long-term hydrographs showing historical groundwater elevation data through WY 2023 for the Representative Monitoring Wells for Chronic Lowering of Groundwater Levels (RMW-WLs) are shown on

[4] When more than one measurement was taken within the time period, the earliest measurement was used unless it was obtained during a period when water levels may have been influenced (e.g., pumping).

Figure 4 and are included in **Appendix B**.[5] The Sustainable Management Criteria (SMC) including Measurable Objectives (MOs), Minimum Thresholds (MTs), and Interim Milestones (IMs) have been established for groundwater levels at the 14 RMW-WLs, based on a multi-step process that included evaluation of current and historical groundwater elevation data, projected trends, and analysis of potential impacts to existing wells (i.e., beneficial users).[6] The SMCs are depicted graphically on the hydrographs on **Figure 4** and are summarized in **Table 6**.[7] Seasonal water levels in all viable RMW-WLs were above their MTs over the reporting period, with the exception of RMW-WWB-010 and RMW-WWB-012. Water levels in RMW-WWB-010 exceeded (i.e., fell below) the MT value of 159 feet above mean sea level (ft msl) for the first time in Fall 2021 (152.09 ft msl) and remained below the MT during Spring 2023 (155.39 ft msl); however, water levels in RMW-WWB-010 continued to increase throughout the remainder of WY 2023 and by September 2023 the water level was above its MT, as shown in the hydrograph on **Figure 4**. Though water levels in RMW-WWB-012 exceeded the MT value of 123 ft msl in Fall 2022 (119.81 ft msl), the water levels recovered above the MT by Spring 2023.

The Representative Monitoring Wells for Depletions of Interconnected Surface Waters (RMW-ISWs) were installed in January 2021 to fill data gaps associated with the shallow water-bearing zone located upgradient of the Springs Fault that supports localized GDEs. Hydrographs showing the depth to groundwater data collected through WY 2023 for the RMW-ISWs are shown on **Figure 5**. Based on limited availability of shallow depth to groundwater data, preliminary MOs and MTs were established at the three RMW-ISWs using groundwater levels as proxy.[8] The preliminary MOs and MTs are depicted graphically on the hydrographs and are summarized in **Table 9**. Water levels were above their MTs over the reporting period for all three RMW-ISWs. Stable to increasing groundwater levels over the WY reflect the shallow alluvial aquifer's response to precipitation and ephemeral creek flows. To date, the high frequency depth to groundwater measurements in RMW-ISWs near GDEs have not shown a correlation to seasonal groundwater pumping. As such, there has not been any indication of depletions over time in response to pumping. The preliminary SMCs for Depletions of Interconnected Surface Waters will be assessed and re-evaluated once DWR's full guidance is released later this year (expected by late summer 2024).

[5] Hydrographs show static water levels. Erroneous groundwater elevation data or groundwater elevation data marked as questionable are excluded from the hydrographs.
[6] White Wolf GSA, 2021, Groundwater Sustainability Plan White Wolf Subbasin. Prepared by EKI Environment & Water Inc. for White Wolf Groundwater Sustainability Agency. December 2021.
[7] All RMW-WLs have at least a Fall 2022 and Spring 2023 measurement with the exception of RMW-WWB-009. where a measurement was not collected in Spring 2023 due to a potentially collapsed casing.
[8] Ibid [6]

3 GROUNDWATER EXTRACTION DATA

☑ *§ 356.2 (b) (2)*

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:

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(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.

Table 1 shows the WY 2023 groundwater extraction data by water use sector and measurement method. **Figure 6** shows the general location and volume of groundwater extractions and **Figure 7** shows the total estimated pumping since 2015 compared to the estimated sustainable yield range (i.e., 38,200 to 47,200 acre-feet per year [AFY]). Total pumping in WY 2023 was approximately 22,600 AF, of which 94% was for the agricultural sector. As shown in **Figure 7**, estimated WY 2023 pumping decreased by approximately 62% from WY 2022, and WY 2023 pumping was within the estimated sustainable yield.

There were not any new or improved measurement methods available in WY 2023.

Groundwater for agricultural irrigation is extracted from both WRMWSD-owned and privately-owned wells. WRMWSD-owned wells and wells that pump into the WRMWSD water distribution system have metered monthly pumping data. Wells that pump into the WRMWSD water distribution system were only active in October through December 2022. Between WY 2019 and WY 2020, AEWSD installed meters on five privately-owned wells. Metered data is reported in AF; reported data are assumed to have a high level of accuracy ranging from 0% to 5%, with a precision of 0.01 AF for WRMWSD meters and 0.001 AF for AEWSD meters. Other privately-owned agricultural pumping has been estimated by the Soil Moisture Budget (SMB) model developed for the Basin. The SMB estimates groundwater pumping by satisfying any unmet agricultural demand, as estimated by satellite ET data, after precipitation and applied surface water, and with consideration for irrigation efficiency.[9] Groundwater extractions estimated by the SMB have a lesser degree of accuracy ranging from 10% to 20%, with a precision of 100 AF to 1,000 AF, as they are estimated from other data inputs and calibrated model parameters.

Groundwater for urban use in developed areas is extracted from public water systems wells. Three public water systems were identified within the Basin: TCWD (CA1503341), Tut Brothers Farm #96 (CA1500516), and Cuyama Orchards (CA1503679). Public water system pumping was extracted from the State Board Electronic Annual Report (EAR) System[10]. Data was reported in either gallons or AF, with a precision of 10

[9] Details about the SMB can be found in the GSP and associated Appendix L. White Wolf GSA, 2021, Groundwater Sustainability Plan White Wolf Subbasin. Prepared by EKI Environment & Water Inc. for White Wolf Groundwater Sustainability Agency. December 2021.

[10] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/eardata.html

gallons or 0.001 AF. Electronic Annual Report (EAR) data were only available through calendar year 2022. January through September 2023 extractions for public water systems were estimated based on a repeat of calendar year 2022 values. Therefore, the public water system pumping for WY 2023 are estimates with an accuracy of 50% to 60%, and will be updated as additional data become available. Given that calendar year 2022 values are now available, the WY 2022 urban pumping has been reconciled and updated in **Table 1.**

Although other domestic wells exist within the Basin, these are assumed to be de minimis users [i.e., less than 2.0 AFY] and therefore are not estimated herein.

Finally, there is evaporation that occurs directly from the groundwater system in areas of shallow groundwater conditions. This primarily occurs in areas that support localized GDEs. The WWGFM simulates evaporation from the water table based on an assumed evaporation extinction depth of 7 ft and a monthly pan evaporation rate based on historical data from nearby stations. Groundwater use by native vegetation as estimated by the WWGFM has a medium level of accuracy, ranging from 40% to 50%, as they are estimated from calibrated model parameters and fault representation.

Table 1. Summary of Groundwater Extraction Data by Sector

Water Year	Pumping, Agricultural (AF)		Pumping, Urban (AF)	Pumping, Total[(d)] (AF)	Evaporation of Shallow Groundwater/GDEs (AF)
	Metered [(a)]	Groundwater Model Estimate [(b)]	Metered/Other [(c)]		Groundwater Model Estimate [(d)]
2021	21,009	51,476	619	**73,100**	1,700
2022	21,256	37,597	1,248	**60,100**	1,600
2023	3,516	17,679	1,405	**22,600**	1,600

Abbreviations:
AF = acre-feet
GDEs = groundwater dependent ecosystems

Notes:
(a) Metered data provided by WRMWSD and AEWSD. Values rounded to the nearest AF.
(b) Agricultural pumping is estimated by the Basin's Soil Moisture Budget (SMB) Accounting model and input into the White Wolf Groundwater Flow Model (WWGFM) domain. Approximately 5% of the SMB-calculated private irrigation well pumping is not represented in the WWGFM due to either the proximity of the well locations to the White Wolf Fault and fault geometry or to assumptions on screened interval placement within model layers which may go dry during the model simulation period. Estimated agricultural pumping reported is after the approximately 5% reduction and is rounded to the nearest hundred AF.
(c) Metered data compiled from the State Board Electronic Annual Report System. Estimated pumping for WY 2022 has been updated based on reported metered data. Pumping for January through September 2023 for the three public water systems are a repeat of 2022, as reported values were not yet available. Values rounded to the nearest AF.
(d) Pumping total does not include domestic de minimus [<2 acre-feet per year (AFY)] pumping.
(e) Evaporation as estimated by the WWGFM. Value is rounded to the nearest hundred AF.

4 SURFACE WATER SUPPLY

☑ *§ 356.2 (b) (3)*

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:

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(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.

Surface water supplies in the Basin include imported surface water[11], natural stream inflows, and recycled water. WY 2023 imported surface water data was provided by WRMWSD, AEWSD, and TCWD, as shown in **Table 2**. WY 2023 was a wet year;[12] AEWSD and WRMWSD received imported water contractual allocations to serve surface water in-lieu of landowners using groundwater, and conduct managed augmented recharge in the Basin for the first time.

The Basin contains 57,600 (38%) of the total 150,000 acres of service area covered by WRMWSD. WRMWSD imports State Water Project (SWP) water pursuant to its contractual agreement with the Kern County Water Agency (KCWA) for 197,088 AFY of Table A Allocation. WRMWSD delivers a combination of imported surface water and groundwater to the Basin. In WY 2023, WRMWSD delivered 63,430 AF of water to the Basin for agricultural use, based on metered deliveries by turnout. A portion of this water was groundwater, therefore imported surface water deliveries for agricultural use are assumed to be total delivered water minus groundwater pumped into the WRMWSD distribution system (60,149 AF). Similarly, in WY 2023, WRMWSD delivered 3,046 AF of water for industrial use, based on metered deliveries by turnout.[13] Finally, in WY 2023, WRMWSD delivered 22,220 AF of water for managed recharge to the Mettler Recharge Facility and through their landowner recharge incentive program Project (see **Figure 8**). All metered data was reported in AF; reported data are assumed to have a high level of accuracy ranging between 5% and 10%, with a precision of 0.01 AF.

The Basin contains 23,400 (17%) of the total 131,660 acres of service area covered by AEWSD. AEWSD contracts with the United States Bureau of Reclamation (USBR) for water service from the Central Valley Project (CVP). AEWSD's USBR contract provides for 40,000 AFY of Class 1 water and up to 311,675 AFY of

[11] Imported surface water is a combination of contracted SWP water, contracted CVP water, transfer water, exchanged water, and/or banked water managed through the individual district's service area and water supply portfolio.

[12] DWR-published Water Year (WY) type for the Basin's Hydrologic Unit Code (HUC) 8 watershed was not available at the time of drafting the WY 2023 Annual Report. As such, WY type for 2023 was calculated using the same methodology presented in DWR, 2021.

[13] Imported surface water delivered by WRMWSD to industrial users are not included in the Soil Moisture Balance Accounting model (SMB). 94% of the industrial water was delivered to Pastoria Energy Facility. It is assumed that these industrial deliveries contributions to the groundwater system are negligible.

Class 2 water from the Friant Division of the CVP. In WY 2023, AEWSD delivered 18,346 AF of water for agricultural use within the Basin, based on metered deliveries by turnout. AEWSD also delivered 771 AF of water for managed recharge through their landowner recharge incentive program Project (see **Figure 8**). Metered data was reported in AF; reported data are assumed to have a high level of accuracy ranging between 5% and 10%, with a precision of 1.0 AF.

The Basin contains 20,800 (34%) of the total 61,400 acres of service area covered by TCWD. TCWD provides water and wastewater service to the Tejon Ranch Commerce Center (TRCC), the only significant commercial development in the Basin. TCWD has rights to receive up to 5,278 AFY of SWP surface water supplies (62% designated for agricultural uses and 38% designated for urban uses) under contracts with KCWA. For WY 2023, TCWD provided a total of 471 AF in-District and/or transfer deliveries of SWP water. Data was reported in AF; reported data are assumed to have a high level of accuracy ranging between 5% and 10%, with a precision of 1.0 AF.

There are stream diversions at points of diversion (PODs) on El Paso, Grapevine, Tunis, Tejon, and Pastoria Creeks that are utilized for irrigation by the overlying landowner. Diversions are based on monthly reported stream diversion data, as uploaded to the Electronic Water Rights Information Management System (eWRIMs). Monthly diversion amounts are reported in AF based on flowmeters that record in either AF or cubic feet per second (cfs), that have been calibrated, and therefore have a high level of accuracy ranging between 5% and 10%, estimated at 0.1 AF. In WY 2023, stream diversions totaled 5,427 AF, as shown in **Table 2**. In WY 2023, diversions from all streams, with the exception of Grapevine Creek POD9, were diverted to storage.

Finally, at the TRCC small amounts of recycled water are used for irrigation and recharge the groundwater system from an unlined pond at their west Wastewater Treatment Plant. Recycled water used for landscape irrigation on the eastside of TRCC is recorded by TCWD based on consumer water meters that record in hundred cubic feet (ccf), and therefore have a high level of accuracy ranging between 5% and 10%, with a precision of 1.0 ccf. Similarly, recycled water inflows to the west Wastewater Treatment Plant are recorded by TCWD based on water meters at the east and west Wastewater Treatment Plants that record in gallons, and therefore have a high level of accuracy ranging between 0% and 5%, with a precision of 100 gallons.

Consistent with the surface water supply categories identified by DWR, **Table 3** and **Figure 9** summarize the surface water supply by sector based on a proportioning and combination of values from **Table 2**. These surface water supply sectors include: CVP supplies, SWP supplies, local supplies (i.e., stream diversions), local imported supplies (i.e., surface water from local sources or recovered water from AEWSD spreading works facilities imported from areas outside of the Basin), and recycled water.

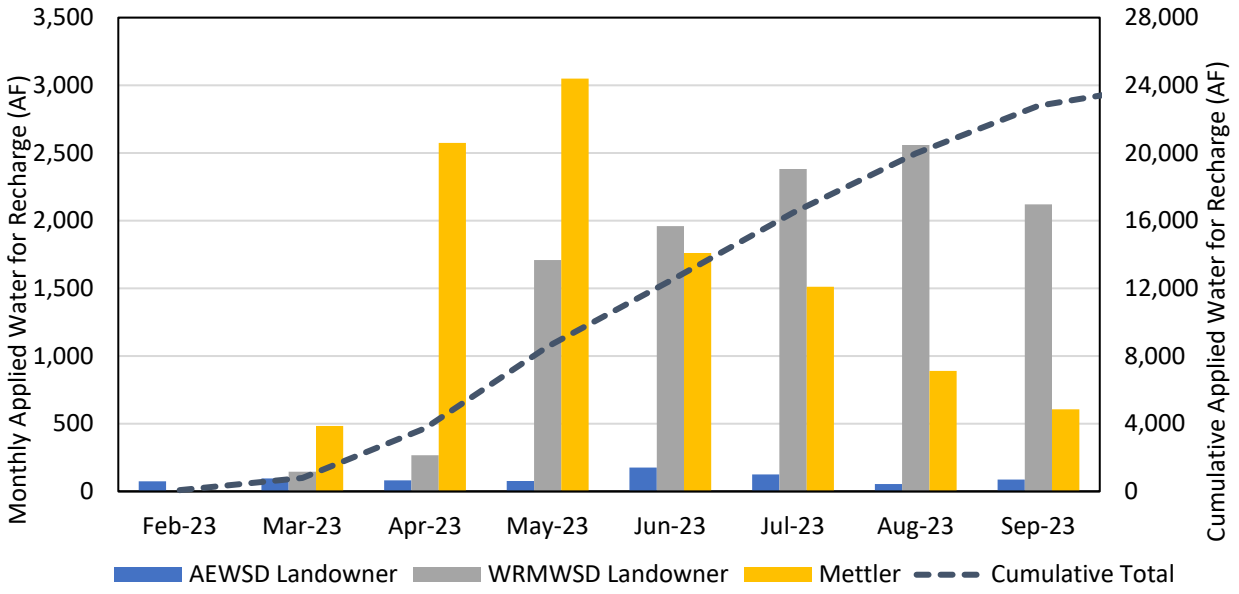


Figure 8. WY 2023 Applied Imported Water for Recharge

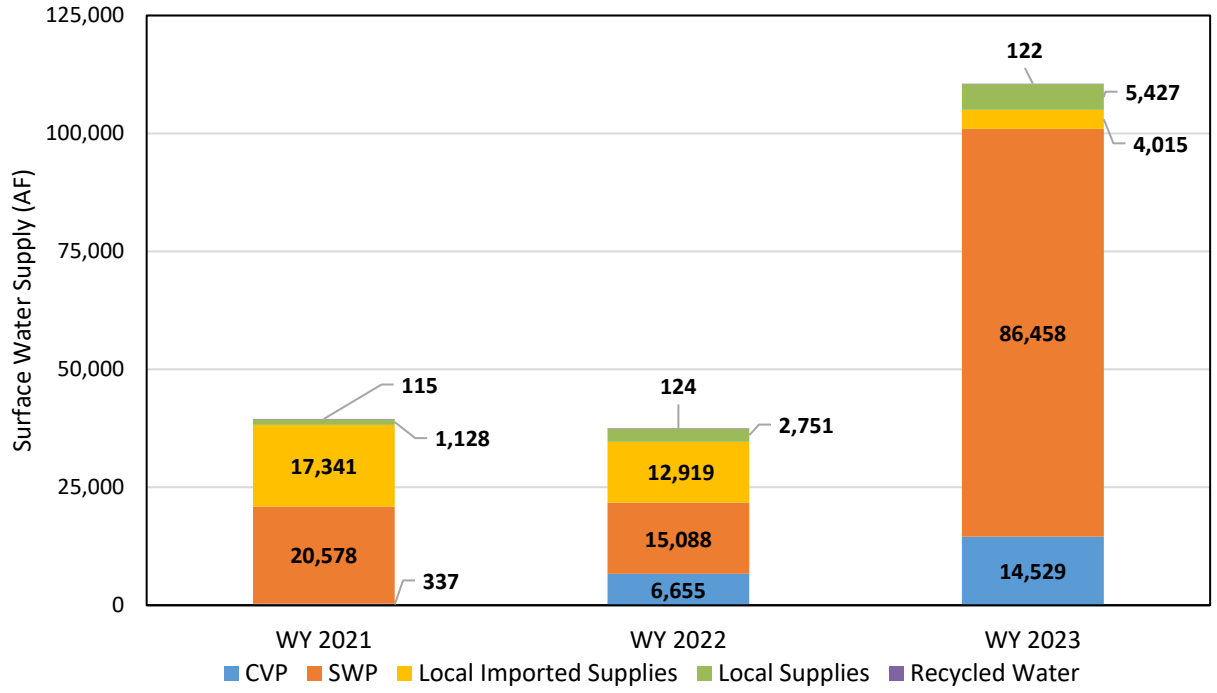


Figure 9. Surface Water Supply by Sector Over Time

Table 2. Summary of Surface Water Supply by Source

Water Year	WRMWSD Imports [a] (AF)			AEWSD Imports [a] (AF)		TCWD Imports (AF)	Stream Diversions [d] (AF)	Recycled Water [e] (AF)		Total (AF)
	Agricultural [b]	Industrial [c]	Recharge	Agricultural	Recharge	Urban	Agricultural	Urban	Recharge	
2021	15,670	3,251	0	18,849	0	526	1,128	77	38	39,539
2022	12,066	2,526	0	19,574	0	496	2,751	83	40	37,537
2023	60,149	3,046	22,220	18,346	771	471	5,427	88	34	110,551

Abbreviations:
AEWSD = Arvin-Edison Water Storage District
AF = acre-feet
TCWD = Tejon-Castac Water Storage District
WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Notes:
(a) Metered data provided by WRMWSD and AEWSD. Surface water imports are based on surface water deliveries to customers. Actual imports may be greater due to conveyance system losses.
(b) Agricultural deliveries are calculated based on the total water delivered by turnout, minus the total volume of metered groundwater pumped into the WRMWSD distribution system by both District-owned and privately-owned wells (see **Table 1**).
(c) Imported surface water delivered by WRMWSD to industrial users are not included in the Soil Moisture Balance Accounting model (SMB). 94% of the industrial water was delivered to Pastoria Energy Facility. It is assumed that these industrial deliveries contributions to the groundwater system are negligible.
(d) For WY 2023, all stream diversions except for Grapevine Creek POD9 were diverted to storage.
(e) Metered recycled water data provided by TCWD. Value is rounded to the nearest AF.

Table 3. Summary of Surface Water Supply by Sector

Surface Water Supply Sector	Water Use (AF) [(a)]	Methods Used to Determine [(a)]
Central Valley Project	14,529	Portion of total AEWSD imports sourced from the Friant-Kern Canal (76%)
State Water Project	86,458	All WRMWSD imports, all TCWD imports, and the portion of total AEWSD imports sourced from the California Aqueduct and Cross Valley Canal (3%)
Local Supplies	5,427	All stream diversions
Local Imported Supplies	4,015	Portion of total AEWSD imports sourced from the Kern River, Kern Delta Water District, or recovered from AEWSD spreading works facilities in the Kern County Subbasin (21%)
Recycled Water	122	TRCC eastside outdoor use and West wastewater treatment plant pond
Total	110,551	

Abbreviations:

AEWSD = Arvin-Edison Water Storage District
AF = acre-feet
WRMWSD = Wheeler Ridge Maricopa Water Storage District
TCWD = Tejon-Castac Water District
TRCC = Tejon Ranch Commerce Center

Notes:

(a) See **Table 2** for water use components. Values are rounded to the nearest AF.

5 TOTAL WATER SUPPLY

☑ *§ 356.2 (b) (4)*

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:

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(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.

As described above, surface water and groundwater extraction comprise the majority of water use in the Basin. The total water use is equal to the sum of total estimated groundwater extraction (**Table 1**)**,** the total surface water supplies (**Table 2** and **Table 3**), and total applied recycled water (**Table 2**). Total water use by water use sector (i.e., agricultural, industrial, urban, managed recharge, and native vegetation) and by water use source type (i.e., groundwater, surface water, and recycled water) is tabulated in **Table 4** and is shown graphically on **Figure 10** and **Figure 11**, respectively. Approximately 78% of the water was used for agriculture and 17% is from groundwater extractions.

Methods of measurement and accuracy of measurements for groundwater extraction and surface water data are summarized in **Section 4** and **Section 5** respectively.

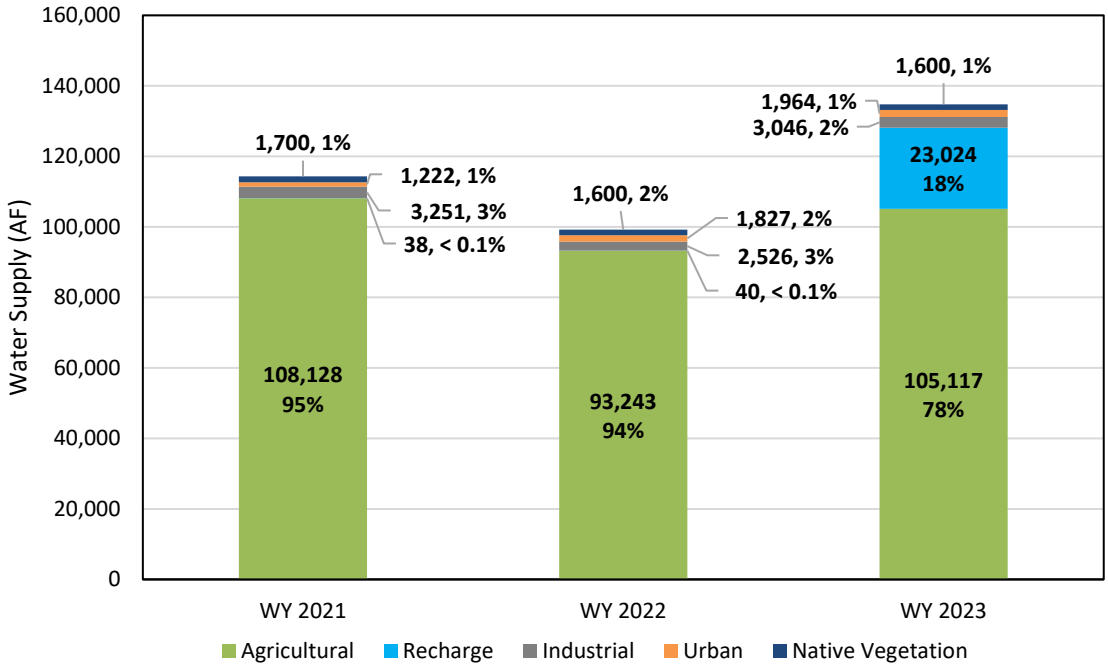


Figure 10. Total Water Use by Sector Over Time

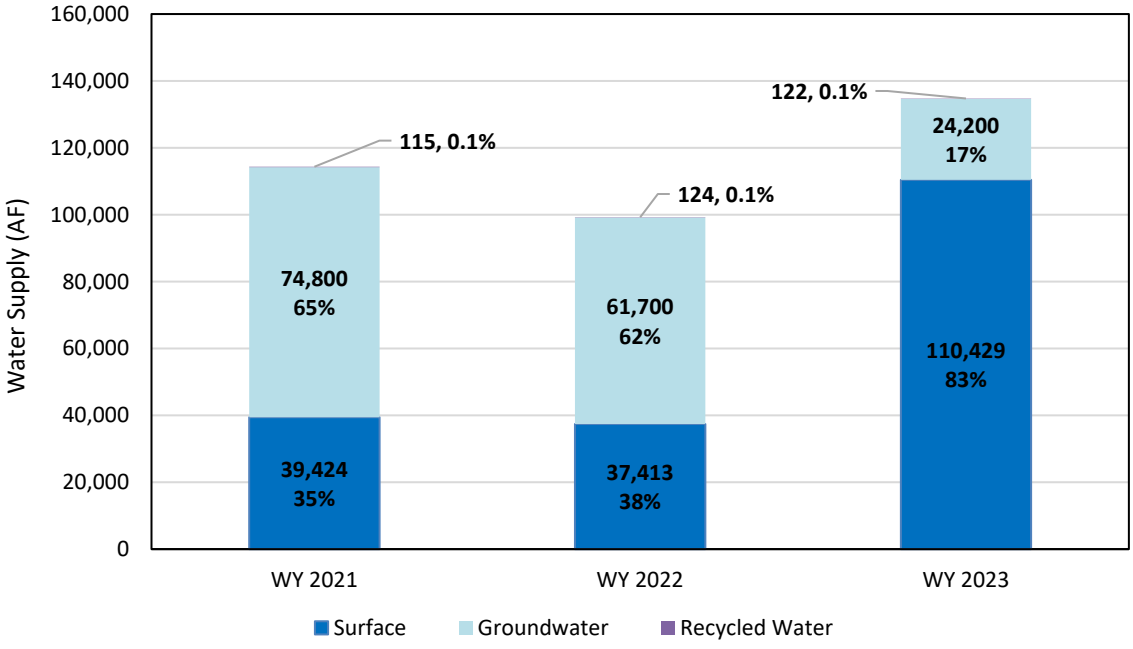


Figure 11. Total Water Use by Source Type Over Time

Table 4. Summary of Total Water Use by Sector and Source Type

Water Year	Agricultural (AF)			Industrial (AF)	Urban (AF)				Managed Recharge (AF)			Native Vegetation (AF)	Total Water Use
	Ground-water[a]	Surface Water[b]	Total	Surface Water[c]	Ground-water[a]	Surface Water[c]	Recycled Water[c]	Total	Surface Water[c]	Recycled Water[c]	Total	Ground-water[d]	
2021	72,481	35,647	108,128	3,251	619	526	77	1,222	0	38	38	1,700	114,339
2022	58,852	34,391	93,243	2,526	1,248	496	83	1,827	0	40	40	1,600	99,237
2023	21,195	83,922	105,117	3,046	1,405	471	88	1,964	22,990	34	23,024	1,600	134,751

Abbreviations:
AF = acre-feet

Notes:
(a) Combination of metered data when available, and estimated when unavailable. See **Table 1** for details. Values rounded to the nearest AF.
(b) Surface water includes both imported water and stream diversions based on metered data. See **Table 2** and **Table 3** for details. Values rounded to the nearest AF.
(c) Metered data. See **Table 2** for details. Values rounded to the nearest AF.
(d) Native vegetation represented by evaporation from shallow groundwater/GDEs estimated from the WWGFM. See **Table 1** for details. Values rounded to the nearest hundred AF.

6 CHANGE IN GROUNDWATER STORAGE

☑ *§ 356.2 (b) (4)*

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:

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(4) 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.

Changes in groundwater storage were estimated using the White Wolf Groundwater Flow Model (WWGFM), a three-dimensional numerical groundwater flow model based on the U.S. Geological Survey public-domain software package MODFLOW. The Basin-specific model was developed as part of the GSP to analyze water budget information and quantify the historical and current change in groundwater storage over the WY 1995-2019 time period. The WWGFM was extended through WY 2023 to support change in groundwater storage calculations for this Annual Report by extending:

- Daily precipitation data from Parameter-elevation Regressions on Independent Slopes Model (PRISM);
- Monthly satellite ET data from Land IQ;
- Daily reference ET Data from California Irrigation Management Information System (CIMIS) Arvin-Edison station #125;
- Monthly surface water imports/delivery records from AEWSD, WRMWSD, and TCWD internal operations records;
- Seasonal (Spring and Fall) land use from surveys conducted by AEWSD, WRMWSD, and TCWD;
- Monthly recycled water usage from TCWD internal operations records;
- Monthly pumping records including: (1) WRMWSD "pump in" records of privately pumped groundwater that has been added to the WRMWSD water distribution system from the District's internal operations records; (2) WRMWSD pumping volumes from District-owned wells from the District's internal operations records; (3) Public Water System pumping[14]; and (4) private agricultural pumping calculated by the SMB;

[14] Available online at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/eardata.html

- Monthly stream diversions at PODs on El Paso, Grapevine, Tunis, Tejon, and Pastoria Creeks and Reservoirs 1 and 2 as uploaded to eWRIMs; and
- Boundary conditions, including: (1) water level time series from wells located in Kern County Subbasin for simulating flow across the WWF, and (2) monthly stream inflows based on a watershed analysis.

As a check on model output, the groundwater elevations in wells predicted by the WWGFM during WY 2023 were compared to the groundwater elevations measured in wells during WY 2023. **Figure 12** shows a scatterplot of model-calculated vs. observed water levels. The coefficient of determination (R^2) of 0.98 indicates that there is a good match between model-calculated and observed water levels and that the model can be used to reasonably simulate water levels in the Basin, and thus changes in Basin groundwater storage.

Figure 13 is a map of model-calculated water level difference and model-estimated changes in groundwater storage within the Basin between WY 2022 and WY 2023. The WWGFM calculates the change in groundwater storage based on the change in water level and the calibrated storage properties of each model cell. **Figure 13** shows that simulated water levels in model layer 2 primarily increased in the central portions of the Basin and slightly decreased in the foothill portions of the Basin. Furthermore, groundwater storage in most areas of the Basin increased, with these increases estimated in the same areas of water level increases. The southeastern fringe areas experienced estimated groundwater storage declines due to drainage.

Figure 14 shows water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater storage for the Basin from WY 1995 to WY 2023. Change in storage since WY 2015 is also tabulated in **Table 5.** WY 2023 was a wet year[15] and the Basin experienced an increase in groundwater storage of 50,200 AF that was greater than storage changes observed in other recent wet years (e.g., 2011, 2017, and 2019). In fact, the WY 2023 Basin-wide change in storage was the largest estimated storage increase since 1998.

[15] DWR-published Water Year (WY) type for the Basin's Hydrologic Unit Code (HUC) 8 watershed was not available at the time of drafting the WY 2023 Annual Report. As such, WY type for 2023 was calculated using the same methodology presented in DWR, 2021.

Table 5. Annual Change in Storage by DWR Water Year Type

Water Year	Water Year Type	Change in Storage (AFY)
2015	Dry	-37,900
2016	Above Normal	-34,400
2017	Wet	17,500
2018	Below Normal	-40,900
2019	Wet	-3,300
2020	Above Normal	1,300
2021	Critical	-50,900
2022	Critical	-44,500
2023	Wet	50,200

Abbreviations
AFY = acre-feet per year
DWR = California Department of Water Resources
Notes:
(a) Change in storage values are rounded to the nearest hundred AFY.

7 PLAN IMPLEMENTATION

☑ *§ 356.2 (b) (4)*

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:

(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.

The following sections provide a description of progress on GSP implementation during WY 2023 including: a comparison of current conditions to the SMCs for each Sustainability Indicator, updates on Projects and Management Actions (P/MAs), progress on addressing DWR's recommended corrective actions, and other implementation progress such as stakeholder outreach and engagement, public comments, and anticipated implementation actions for WY 2024.

7.1 Current Conditions – Sustainability Indicators

The following sections describe how current conditions compare to the MTs, IMs, and MOs established for each applicable sustainability indicator in the GSP.

7.1.1 Chronic Lowering of Groundwater Levels

Table 6 compares the WY 2023 groundwater elevations to the IMs set at the RMW-WLs established for the Chronic Lowering of Groundwater Levels Sustainability Indicator. **Figure 15** and **Figure 16** show the Fall 2022 and Spring 2023 water levels measured at the RMW-WLs relative to their SMCs, respectively. The RMW-WL locations are indicated on the map, and the water levels at each RMW-WL relative to each MO and MT are indicated in the callout boxes. Seven RMW-WLs had groundwater levels above their MOs, and thus IMs, for at least one seasonal (Spring or Fall) groundwater level measurement. Five RMW-WLs had groundwater levels between their MTs and MOs for both Fall 2022 and Spring 2023. One RMW-WL (RMW-WWB-010) exceeded its MT in both Fall and Spring, while another well (RMW-WWB-012) exceeded its MT in Fall 2022 and recovered above the MT in Spring 2023.

In response to the MT exceedances, the Action Plan (see White Wolf Subbasin GSP *Chapter 16 Action Plan Related to Minimum Threshold Exceedances*) was initiated in WY 2022. Steps of the Action Plan included assessing the RMW area and evaluating outside contributing factors. The assessment most notably discovered that other wells in the immediate area were also experiencing declines, there had been a slight change in land use, and that there had been an increase in pumping between WY 2021 and WY 2020, due likely to on-going drought conditions in the Basin. As a result of this assessment, and per the recommendations of the Action Plan, a stakeholder workshop was held on the state of the Basin.

Further, in WY 2023, the GSA-member districts have continued monthly monitoring in the RMW-WLs, the WRMWSD user pump-in program was suspended in January 2023, and certain P/MAs were implemented on an accelerated timeline. Specifically, the AEWSD and WRMWSD landowner recharge incentive programs were activated in February 2023 and the Mettler recharge facility (constructed in 2019) received water for the first time in an effort to recharge surplus surface water and improve groundwater conditions (see **Figure 9**).

The Undesirable Result for Chronic Lowering of Groundwater Levels is defined in the GSP as follows: *Undesirable Results would be experienced if and when a chronic decline in groundwater levels in the Principal Aquifer negatively affects the reasonable and beneficial use of, and access to, groundwater for beneficial uses and users within the Basin. Significant and unreasonable effects associated with Undesirable Results would include complete dewatering of more than 25% of existing wells*. Criteria used to assess this definition is as follows: *Undesirable Results for Chronic Lowering of Groundwater Levels would be experienced in the Basin if and when groundwater levels in the Principal Aquifer decline below the established MTs in 40% or more of the RMW-WLs over four consecutive seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high groundwater level periods and two seasonal low groundwater level periods)*.

Although there were two RMW-WLs with an MT exceedance, no Undesirable Results associated with the Chronic Lowering of Groundwater Levels were experienced in WY 2023, as shown in **Figure 17**. Furthermore, no wells were reported dry to the DWR Dry Well Reporting System.

Table 6. Groundwater Elevations and Relevant Sustainable Management Criteria for Chronic Lowering of Groundwater Levels Sustainability Criteria

Well Name	Fall 2022 GWE (ft msl)	Spring 2023 GWE (ft msl)	MO (ft msl)	MT (ft msl)	IM-5 (ft msl)	IM-10 (ft msl)	IM-15 (ft msl)
RMW-WWB-001	809.64	798.14[a]	800	680	800	800	800
RMW-WWB-002	212.93	212.28	273	177	273	273	273
RMW-WWB-003	217.4	219.6	252	196	224	210	231
RMW-WWB-004	154.75	130.5[b]	151	103	127	115	133
RMW-WWB-005[c]	94.76	181.56	162	93	128	110	136
RMW-WWB-006	224.77	227.17	171	152	162	157	164
RMW-WWB-007[c]	394.37	394.37	180	123	151	137	159
RMW-WWB-008	138.91	136.45[b]	149	104	127	115	132
RMW-WWB-009	169.37	--[d]	160	130	145	137	148
RMW-WWB-010	**148.19**	**155.39**	181	159	181	181	181
RMW-WWB-011	427.72	430.02	433	380	433	433	433
RMW-WWB-012	**119.81**	131.81	161	123	142	133	147
RMW-WWB-013	302.5	154.5	181	92	136	114	147
RMW-WWB-014	116.2	127.2	151	96	124	110	130

Abbreviations:

ft msl = feet above mean sea level
GWE = groundwater elevation
IM = interim milestone
MO = measurable objective
MT = minimum threshold
NA = not available

Notes:

(a) Questionable measurement; oil or foreign substance in casing.
(b) Air or pressure gauge measurement.
(c) Questionable measurement; proxy well used. The White Wolf GSA is working to install dedicated monitoring wells to replace these wells.
(d) No measurement available; possible collapsed casing.
(e) Bold indicates measurement is below the MT.

7.1.2 Groundwater Storage

There are no groundwater storage IMs. As explained in the GSP, groundwater levels are a reasonable proxy for groundwater storage. The Undesirable Result for Reduction of Groundwater Storage is defined in the GSP as follows: *Undesirable Results would be experienced if and when a reduction in storage in the Principal Aquifer negatively affects the long-term viable access to groundwater for the beneficial uses and users within the Basin. Significant and unreasonable effects associated with Undesirable Results would include reduction in usable groundwater storage of more than 20% relative to the Fall 2015 usable groundwater storage volume*. Criteria used to assess this definition is as follows: *Undesirable Results for Reduction of Groundwater Storage would be experienced in the Basin if and when groundwater storage in the Principal Aquifer was to be reduced by an amount that would cause the groundwater levels in at least 40% of the RMW-WLs to exceed their MTs for Chronic Lowering of Groundwater Levels over four consecutive seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high groundwater level periods and two seasonal low groundwater level periods)*.

Progress made during the reporting period is represented by the discussion of water levels in **Section 7.1.1.** No Undesirable Results associated with the Reduction of Groundwater Storage were experienced during WY 2023.

7.1.3 Seawater Intrusion

Because significant and unreasonable effects from seawater intrusion are not present in the Basin and are not likely to occur, SMCs were not set for Seawater Intrusion. The Seawater Intrusion Sustainability Indicator is therefore not discussed herein.

7.1.4 Degraded Water Quality

Public water systems are required by the State Water Resources Control Board (SWRCB) Drinking Water Program to monitor water quality and report results where they are publicly available through the Safe Drinking Water Information System (SDWIS) Drinking Water Watch website.[16] All of the RMW-WQs established in the GSP for the Degraded Water Quality Sustainability Indicator are public water system wells and therefore available data were downloaded and compiled from the SDWIS Drinking Water Watch Website. For wells that do not require annual monitoring, samples were collected under direction of the White Wolf GSA staff and analyzed at an accredited laboratory following the protocols set forth in Section 17.2.2 *Protocols for Water Quality Sampling* of the GSP.

Table 7 compares the available WY 2023 water quality concentrations for Arsenic, Nitrate, and Selenium to their respective SMCs at the RMW-WQs. All of the RMW-WQs had concentrations for Arsenic, Nitrate, and Selenium below the Maximum Contaminant Levels (MCLs), and therefore the MTs.

The Undesirable Result for Degraded Water Quality as defined in the GSP as follows: *Undesirable Results for Degraded Water Quality would be experienced in the Basin if and when water quality conditions of the Principal Aquifer are degraded as a result of SGMA-related groundwater level management activities such that they negatively impact the long-term viability of the groundwater resource for beneficial users and uses. Significant and unreasonable effects associated with Undesirable Results would include an increase,*

[16] https://sdwis.waterboards.ca.gov/PDWW/index.jsp

on a regional basis, in concentrations of identified constituents of concern above state and federal regulatory thresholds, as a result of SGMA-related groundwater level management activities. Criteria used to assess this definition is as follows: *Undesirable Results for Degraded Water Quality are defined to occur within the Basin if and when MTs are exceeded for any of the identified constituents of concern in 25% or more of the RMW WQs at least two (2) consecutive years as a result of SGMA-related groundwater management activities*.

No Undesirable Results associated with Degraded Water Quality were experienced during WY 2023.

Table 7. Groundwater Quality and Sustainable Management Criteria

Well Name	Arsenic (mg/L)			Nitrate as N (mg/L)			Selenium (mg/L)		
	MO = 0.0075	MT = 0.01	TT = 0.005	MO = 7.5	MT = 10	TT = 5	MO= 0.0375	MT= 0.05	TT = 0.025
RMW-WWB-015	0.002			4.6			0.002		
RMW-WWB-016	0.002			5.1			0.001		
RMW-WWB-017	ND			0.32			ND		
RMW-WWB-018	ND			ND			ND		

Abbreviations:

mg/L = milligrams per liter
MO = Measurable Objective
MT = Minimum Threshold
N = Nitrogen
ND = non-detect
TT= Trigger Threshold

Notes:

(a) Trigger Thresholds are used in place of Interim Milestones.
(b) For all RMWs, Sustainable Management Criteria (SMCs) were set at the same level as state and federal standards.

7.1.5 Land Subsidence

There has been very little historical land subsidence measured across the Basin. Critical infrastructure, such as the California Aqueduct, is present in the Basin, so an on-going assessment of subsidence is included herein. The following describes the vertical displacement (i.e., subsidence) trends for WY 2023 in the Basin based on various datasets and from various collection methods (see **Figure 18**):

- Continuous vertical displacement data has been collected at two University NAVSTAR Consortium Global Positioning System (GPS) stations (WGPP and EDPP) located near the California Aqueduct since November 1999 (WGPP) and February 2000 (EDPP). For WY 2023, the displacement data indicates an average displacement of -0.10 ft and 0.53 ft for WGPP and EDPP, respectively.
- Subsidence data is collected annually by DWR staff at checkpoints along the California Aqueduct. Over the 34 checkpoints,[17] the average land surface elevation change measured from WY 2022 to WY 2023 was -0.10 ft, with a maximum difference of 0.13 ft (see **Figure 18**).

[17] Of the 34 DWR checkpoints, 14 sites did not have WY 2023 data collected as shown on **Figure 18**.

- TRE Altamira Interferometric Synthetic Aperture Radar (InSAR) data indicates the annual vertical displacement rate for the period 1 October 2022 through 1 October 2023 ranges from -0.1 ft to 0.1 ft throughout the Basin (see **Figure 18**).
- Two checkpoints were installed along the 850 Canal in WY 2021 to monitor subsidence along the 850 Canal. In May 2022 Checkpoint #2 was moved due to retirement of the equipment in which the previous benchmark was installed. In WY 2023, the checkpoints were vertically benchmarked to the NAVD-88 datum instead of the local datum that was used in WY 2021 and WY 2022 (see **Table 8**). Therefore, the difference in elevation will be calculated in WY 2024.

Table 8. Checkpoints along the 850 Canal

Water Year	Elevation (ft NAVD88)	
	Checkpoint #1	Checkpoint #2
2023[a]	856.374	854.409

Abbreviations:
ft msl = ft above mean sea level
WY = water year
Notes:
(a) In WY 2023, checkpoints were vertically benchmarked to the NAVD-88 datum instead of the local datum that was used in WY 2021 and WY 2022. Prior reported elevations are therefore not comparable.

As explained in the GSP, groundwater levels are a reasonable proxy for land subsidence. The Undesirable Result for Land Subsidence is defined in the GSP as follows: *Undesirable Results would be experienced if and when land subsidence due to groundwater level declines in the Principal Aquifer negatively affects the ability to use existing critical infrastructure within the Basin. Significant and unreasonable effects associated with Undesirable Results would include subsidence-related damage to critical water conveyance infrastructure (i.e., the California Aqueduct and the 850 Canal), resulting in a loss of functional capacity of the infrastructure that prevents conveyance of available volumes of water that could otherwise be conveyed if the subsidence had not occurred*.

Progress made during the reporting period is represented by the discussion of water levels in **Section 7.1.1.** No Undesirable Results associated with Land Subsidence were experienced during WY 2023.

7.1.6 Depletions of Interconnected Surface Water

Water levels in the RMW-ISWs are used as proxy to monitor the health of the GDEs identified south of the Springs Fault. **Table 9** compares the WY 2023 depth to water to the preliminary MOs and MTs set at the RMW-ISWs established for the Depletions of Interconnected Surface Water Sustainability Indicator.

The Undesirable Result for Depletions of Interconnected Surface Water is defined in the GSP as follows: *Undesirable Results would be experienced in the Basin if and when the health of the GDEs is adversely impacted by lowering of groundwater levels as a result of SGMA-related groundwater management activities in the Principal Aquifer, rather than effects of natural or climactic processes and/or unfavorable hydrologic conditions. Significant and unreasonable effects associated with Undesirable Results would*

include a 30% reduction of, or visual impact to, the health of GDEs based on their conditions observed during 2018 through 2020 that can be directly attributed to Principal Aquifer pumping-related lowering of groundwater levels rather than the effects of natural or climatic processes. Criteria used to assess this definition is as follows: *Undesirable Results for Depletion of Interconnected Surface Water would be experienced in the Basin if and when groundwater levels in one or more of the RMW-ISWs exceeds (falls below) their MTs over four consecutive seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high groundwater level periods and two seasonal low groundwater level periods) as a result of SGMA-related groundwater management activities.*

The WY 2023 depth to groundwater is above the preliminary MTs for all of the RMW-ISWs. Therefore, no Undesirable Results associated with the Depletions of Interconnected Surface Waters were experienced in WY 2023, as shown in **Figure 17**.

Finally, as part of ongoing data gap filling efforts, the GSA installed a stream data logger in El Paso Creek to improve estimates of stream inflows to the Basin. **Appendix C** provides details of the installation and ongoing data collection.

Table 9. Depth to Groundwater and Relevant Sustainable Management Criteria for Depletions of Interconnected Surface Water Sustainability Criteria

Well Name	Fall 2022 DTW [a] (ft bgs)	Spring 2023 DTW [b] (ft bgs)	MO [c] (ft bgs)	MT (ft bgs)	IM-5 [d] (ft bgs)	IM-10 [d] (ft bgs)	IM-15 [d] (ft bgs)
RMW-WWB-019	18.28	20.91	19	30	n/a	n/a	n/a
RMW-WWB-020	16.37	16.48	15	30	n/a	n/a	n/a
RMW-WWB-021	34.22	32.41	36	36	n/a	n/a	n/a

Abbreviations:

DTW = depth to water
ft bgs = feet below ground surface
IM = Interim Milestone
MO = Measurable Objective
MT = minimum threshold
n/a = not applicable

Notes:

(a) Fall 2022 measurements were recorded on 10/15/2022 for RMW-WWB-019 and RMW-WWB-021 and 10/28/2022 for RMW-WWB-020.
(b) Spring 2023 measurements were recorded on 3/15/2023.
(c) MOs have been corrected from those reported in the GSP.
(d) Given the preliminary nature of the data in which MOs and MTs were set, IMs were not established in the GSP.

7.2 Implementation of Projects and Management Actions (P/MAs)

The White Wolf Basin GSP outlined 24 potential P/MAs. The P/MA implementation progress described below represents activities that took place during WY 2023. A summary of P/MA status and implementation is included in below **Table 10**.

Table 10. Implementation of Projects and Management Actions

Project and Management Action	Status	Progress during Water Year	Observed Benefits	Observed adverse impacts to the various sustainability indicators, adjacent groundwater basins, or beneficial uses and users	Public Notice / Engagement	Anticipated Schedule	Description of Anticipated Benefits Within Next Water Year
#1 - Recharge from Grapevine Development	☐ Active ☐ Pre planning ☒ Conceptual ☐ Inactive	None.	None	None	Not applicable as P/MA has not been initiated.	Pending initiation of Grapevine construction.	None
#2 - Oilfield Reclaimed Water from the Tejon Oil Field	☐ Active ☐ Pre planning ☒ Conceptual ☐ Inactive	In December 2022 the GSA applied for DWR Round 2 SGMA implementation grant funds to fund P/MA #2. The P/MA was not selected for grant funding.	None	None	Infrastructure improvement, no public noticing necessary.	Pending grant funding.	TCWD will continue to seek funding for the phase 2 pilot treatment plant.
#3 - Oilfield Reclaimed Water in AEWSD	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None.	None	None	Not applicable as P/MA has not been initiated.	To be implemented upon agreement with partnering oil field.	None
#4 - Purchase Additional Surface Water Supplies	☒ Active ☐ Pre planning ☐ Conceptual ☐ Inactive	WRMWSD purchased an additional 145,000 AF for surface water delivery in both the Kern County Subbasin and the White Wolf Subbasin. Approximately 15% of these additional supplies were delivered within the Kern Subbasin, with the remainder delivered to the White Wolf Subbasin and various Kern Fan banking projects. AEWSD purchased an additional 60,176 AF for surface water delivery in both Kern County Subbasin and White Wolf Subbasin. TCWD did not purchase additional surface water supplies.	Reduction of groundwater pumping.	None	AEWSD and WRMWSD board meetings.	Ongoing, pending surface water supply availability.	AEWSD, TCWD, and WRMWSD will continue to seek out opportunities to purchase additional surface water supplies, as available, with out-of-basin entities to offset groundwater pumping.
#5 - WRMWSD "Thru Delta" Facility	☒ Active ☐ Pre planning ☐ Conceptual ☐ Inactive	WRMWSD continued to fund the planning phase of the Delta Conveyance Project (DCP).	None, as P/MA #5 is still in the planning phase.	None	Prop 218.	Ongoing, pending engineering, design, and permitting.	With DWR's recent approval of the Delta Conveyance Project: Final EIR Certified, engineering, design, and permitting will move forward.

Project and Management Action	Status	Progress during Water Year	Observed Benefits	Observed adverse impacts to the various sustainability indicators, adjacent groundwater basins, or beneficial uses and users	Public Notice / Engagement	Anticipated Schedule	Description of Anticipated Benefits Within Next Water Year
#6 - WRMWSD Desalination Facility	☐ Active ☐ Pre planning ☒ Conceptual ☐ Inactive	WRMWSD continued to explore ways to utilize desalination facilities and continued to hold discussions with proponents of certain potential desalination projects.	None	None	Not applicable as P/MA has not been initiated.	To be implemented as needed to meet milestones if other P/MAs are not successful as anticipated.	WRMWSD will continue to hold discussion with proponents of potential desalination projects.
#7 – Recapture of Basin Groundwater	☐ Active ☐ Pre planning ☒ Conceptual ☐ Inactive	Interbasin discussions with Kern County Subbasin to include White Wolf Subbasin flows in the Kern County Basin Study	None	None	Not applicable as the P/MA has not been initiated.	Basin Study completion at the end of 2024	None
#8 - WRMWSD Mettler Recharge Project	☒ Active ☐ Pre planning ☐ Conceptual ☐ Inactive	The Mettler Groundwater Recharge Facility received 11,077 AF via the 850 Canal.	11,077 AF of applied water.	None	WWGSA board meetings, WWGSA P/MA Committee meetings.	Ongoing, pending available water supply availability.	WRMWSD will continue to seek out opportunities to purchase and recharge additional surface water supplies, as available.
#9 - WRMWSD El Paso Creek Recharge Project	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented upon participant interest, grant funding, and permitting.	None
#10 - AEWSD In-Lieu Banking Program	☐ Active ☒ Pre planning ☐ Conceptual ☐ Inactive	In December 2022 the GSA applied for DWR Round 2 SGMA implementation grant funds to fund P/MA #10. The P/MA was selected for grant funding in September 2023. Grant agreement execution with DWR and contracting was initiated.	None as P/MA #10 was not yet funded during WY 2023.	None	Infrastructure improvement, no public noticing necessary. WWGSA Board meetings.	Pending executed grant agreement for DWR Round 2 SGMA implementation grant funds.	AEWSD will collaborate with other WWGSA member agencies to the planning, design, and environmental permitting documents for expansion of the in-lieu banking program.
#11 - AEWSD Private & Caltrans Basin Connections	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented upon participant interest, grant funding, and permitting.	None

Project and Management Action	Status	Progress during Water Year	Observed Benefits	Observed adverse impacts to the various sustainability indicators, adjacent groundwater basins, or beneficial uses and users	Public Notice / Engagement	Anticipated Schedule	Description of Anticipated Benefits Within Next Water Year
#12 - AEWSD South Canal WRMWSD 850 Canal Intertie	☐ Active ☒ Pre planning ☐ Conceptual ☐ Inactive	In December 2022 the GSA applied for DWR Round 2 SGMA implementation grant funds to fund P/MA #12. The P/MA was selected for grant funding in September 2023. Grant agreement execution with DWR and contracting was initiated.	None as P/MA #12 was not yet funded during WY 2023.	None	Infrastructure improvement, no public noticing necessary. WWGSA Board meetings.	Pending final contract for DWR Round 2 SGMA implementation grant funds.	AEWSD will work with WRMWSD to begin the planning, design, and environmental permitting documents required for the intertie.
#13 - AEWSD South Canal Balancing Reservoir Project	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented upon grant funding and South County flooding response	None
#14 - AEWSD Groundwater Subsidies for Land Conversion	☒ Active ☐ Pre planning ☐ Conceptual ☐ Inactive	The GSA applied for the Department of Conservation Multi-benefit Land Repurposing Program Round 2 funding. The project was not selected. Starting in March 2023, AEWSD provided financial incentives to landowners to conduct on-farm recharge.	10,333 AF of applied water (on-farm recharge): -771 AF to White Wolf Subbasin -9,562 AF to Kern County Subbasin	None	WWGSA board meetings, WWGSA P/MA Committee meetings, AEWSD board meetings, direct outreach to landowners via letters.	Ongoing, pending water supply availability.	Re-activate incentives, pending water supply availability. In March 2024, AEWSD initiated a preliminary analysis for developing strategies for demand management, including a potential land repurposing program.
AEWSD Exercising Existing Water Rights	☐ Active ☒ Pre planning ☐ Conceptual ☐ Inactive	United States Bureau of Reclamation, San Luis Delta Mendota Water Authority, Friant Water Authority, and San Joaquin River Exchange Contractors discussions on collectively identify projects and potential actions aimed at improving drought resiliency south of the Delta, including AEWSD deliveries from the Friant-Kern Canal	None	None	Not applicable as P/MA has not been initiated.	Memorandum of Understanding effective March 2024.	Increased reliability of AEWSD's CVP supplies.
#15 - WRMWSD Land Retirement and/or Conversion	☐ Active ☒ Pre planning ☐ Conceptual ☐ Inactive	The GSA applied for the Department of Conservation Multi-benefit Land Repurposing Program Round 2 funding. The project was not selected.	None	None	Not applicable as P/MA has not been initiated.	Ongoing, pending water supply availability.	WRMWSD will continue to submit bids to purchase irrigated property and continue to engage with sellers across the District when the opportunities arise.

Project and Management Action	Status	Progress during Water Year	Observed Benefits	Observed adverse impacts to the various sustainability indicators, adjacent groundwater basins, or beneficial uses and users	Public Notice / Engagement	Anticipated Schedule	Description of Anticipated Benefits Within Next Water Year
WRMWSD Incentives for Landowner Recharge	☒ Active ☐ Pre planning ☐ Conceptual ☐ Inactive	Starting in February 2023, the WRMWSD board initiated a new P/MA to provide financial incentives to landowners to conduct on-farm recharge.	11,142 AF of applied water (on-farm recharge)	None	WWGSA board meetings, WWGSA P/MA Committee meetings, WRMWSD board meetings, direct outreach to landowners via letters.	Ongoing, pending water supply availability.	Re-activate incentives, pending water supply availability.
#16 - AEWSD Groundwater Allocation per Acre	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented as needed to meet milestones if other new supplies are not developed as anticipated.	None
#17 - AEWSD Groundwater Fee Increase	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented as needed to meet milestones if other new supplies are not developed as anticipated.	None
#18 - AEWSD Groundwater Marketing & Trading	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	Contingent on P/MA #16 and P/MA #23.	None
#19 - WRMWSD Groundwater Allocation and Market	☐ Active ☒ Pre planning ☐ Conceptual ☐ Inactive	WRMWSD formed a P/MA Committee to begin exploring demand reduction options, including a potential groundwater allocation within the District. The P/MA Committee held several meetings to seek public input on a future policy for groundwater allocation. By the end of the water year, the allocation policy was in its early stages and subject to further discussion.	None	None	WRMWSD P/MA Committee meetings	TBD.	WRMWSD will continue to explore and potentially develop an allocation policy.
#20 - WRMWSD Voluntary Pumping Limitations: WRMWSD	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented as needed to meet milestones if other P/MAs are not successful as anticipated.	None

Project and Management Action	Status	Progress during Water Year	Observed Benefits	Observed adverse impacts to the various sustainability indicators, adjacent groundwater basins, or beneficial uses and users	Public Notice / Engagement	Anticipated Schedule	Description of Anticipated Benefits Within Next Water Year
#21 - WRMWSD Mandatory Pumping Limitations	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented as needed to meet milestones if other P/MAs are not successful as anticipated.	None
#22 - Improved Stormwater Management and Flood Control in AEWSD	☐ Active ☐ Pre planning ☐ Conceptual ☒ Inactive	None	None	None	Not applicable as P/MA has not been initiated.	To be implemented upon securing grant funding	None
#23 - AEWSD Groundwater Extraction Quantification Method	☒ Active ☐ Pre planning ☐ Conceptual ☐ Inactive	AEWSD completed their district-specific groundwater flow model and decision support tool. The GSA obtained satellite crop evapotranspiration (ET) data through LandIQ.	Approved method to quantify the individual and aggregate groundwater extractions for annual reporting purposes.	None	AEWSD board meetings	Ongoing	Continued refinements of the decision support tool. Incorporate information into WY 2024 Annual Report.
#24 - WRMWSD Acreage Assessment	☒ Active ☐ Pre planning ☐ Conceptual ☐ Inactive	WRMWSD approved a Groundwater Service Charge (GWSC) that will be levied on each acre-foot of groundwater extracted for consumptive use within WRMWSD boundaries, with the exception of de minimis and residential use, beginning in 2024.	None, as P/MA #24 was still under development in WY 2023.	None	Prop 218; WRMWSD P/MA Committee meetings; direct letters to landowners	Ongoing, pending modification of water service contracts.	During WY 2024, WRMWSD will implement the GWSC and evaluate / quantify the potential reduction in groundwater demands associated with these charges.

7.3 Progress Made on Addressing Recommended Corrective Actions in the Department's GSP Determination

The GSA received DWR's GSP determination on 26 October 2023, at the start of WY 2024. Included in the approval letter were four recommended corrective actions. **Table** 11 summarized the recommended corrective actions and identifies the relevant GSP sections. The GSA will develop approaches to address these corrective actions during WY 2024 and will report their progress on them in the WY 2024 Annual Report.

Table 11. Progress Made on Recommended Corrective Actions

Corrective Action	Related GSP Section
1 - Develop and incorporate a projected water budget for the surface water system as required by the GSP Regulations.	- Section 9: *Water Budget Information* - Appendix L: *White Wolf Groundwater Flow Model Documentation*
2 - Revise the sustainable management criteria to be based on seasonal low groundwater levels to ensure potential impacts to beneficial uses and users are considered.	- Section 13.1: *Undesirable Results for the Chronic Lowering of Groundwater Levels* - Section 14.1: *Minimum Thresholds for Chronic Lowering of Groundwater Levels* - Section 15.1: *Measurable Objectives and Interim Milestones for Chronic Lowering of Groundwater Levels*
3 - Establish sustainable management criteria for land subsidence based on direct measurements of land elevation changes to assess and confirm that no significant and unreasonable land subsidence is occurring.	- Section 13.5 *Undesirable Results for Land Subsidence*
4 - Expand the land subsidence monitoring network to provide sufficient coverage of the Subbasin. The GSA may consider the use of additional GPS stations, extensometers, or publicly available remote sensing data (e.g., InSAR) to expand the land subsidence monitoring network in the Subbasin.	- Section 17.1.5: *Monitoring Network for Land Subsidence*

7.4 Other Information on Implementation Progress

The following section describes other information on GSP implementation progress during WY 2023.

7.4.1 Stakeholder Outreach and Engagement

The White Wolf GSA practices stakeholder engagement through the GSA website (http://whitewolfgsa.org/), and public meetings and workshops held in a hybrid in person / online forum. Furthermore, in January 2023, the GSA established the P/MA Committee, whose goal is to serve as a forum to receive public input from local groundwater users, landowners, non-profit organizations, and other interested parties on the initiation and implementation of P/MAs. The P/MA Committee is comprised of a GSA Board Ad-hoc Committee and a Technical Advisory Committee (TAC). The GSA mailed invitations to landowners and key stakeholders within the Basin requesting participation.

During WY 2023, White Wolf GSA held 12 public meetings as summarized below:

- 6 October 2022 – Regular Board meeting
- 1 November 2022 – Regular Board meeting
- 3 January 2023 – Regular Board meeting
- 7 February 2023 – Regular Board meeting
- 9 February 2023 – P/MA TAC Committee meeting
- 7 March 2023 – Regular Board meeting
- 9 March 2023 – P/MA TAC Committee meeting
- 13 April 2023 – P/MA Board Ad-hoc and TAC Committee meeting
- 11 May 2023 – P/MA Board Ad-hoc and TAC Committee meeting
- 6 June 2023 – Regular Board meeting
- 1 August 2023 – Regular Board meeting
- 10 August 2023 – P/MA Board Ad-hoc and TAC Committee meeting

The GSA will continue to its stakeholder engagement and meet regularly in WY 2024.

7.4.2 Public Comments Received

No formal public comments were received by the GSA during WY 2023.

In January 2024 an article titled "Rapid groundwater decline and some cases of recovery in aquifers globally" published in Nature ranked 1,693 aquifer systems based on median annual change in groundwater levels through 2022 (Jasechko S, et al., 2024). Based on the limited data they analyzed for the Basin over the 2000 through 2022 time period (7 wells over a time period that included 11 dry or critically dry years), the article ranked the Basin's aquifer as the 52nd fastest declining globally. Even prior to this article, the GSA had taken significant actions to implement P/MAs including recharge projects in an effort to stabilize water levels. As reported above, the estimated groundwater storage increased substantially in WY 2023, groundwater pumping was substantially reduced compared to WY 2022, and groundwater levels were stable to increasing. Finally, the GSA recently received a grant award for two projects that will provide benefits to the groundwater system (see Section 7.4.3 below).

7.4.3 Additional Information or Accomplishments

The GSA successfully applied for funding through the DWR Sustainable Groundwater Management (SGM) Program SGMA Implementation Round 2 grant. In October 2023, $4.8 million was awarded to the GSA which will allow the GSA to fill important data gaps, continue conducting stakeholder engagement, recalibrate the WWGFM, conduct ongoing monitoring and reporting, and initiate the following two projects:

- The *In-lieu Banking Program Expansion* will connect AEWSD and WRMWSD's surface water distribution facilities to approximately 3,900 acres of irrigated agriculture in their groundwater service areas. Through expansion of the In-Lieu Banking Program, AEWSD and WRMWSD will offset groundwater pumping demands in wet years with imported surface water supply. The

awarded $1,345,000 will facilitate design and construction of 16 new AEWSD and three new WRMWSD metered irrigation landowner services (or turnouts). Design is anticipated to be completed by March 2025 and construction completed by October 2025.

- The "*South Canal" 850 Canal Intertie* involves the construction of a new intertie between AEWSD's "South Canal" and WRMWSD's 850 Canal. The "South Canal" 850 Canal Intertie facilities will allow for direct water exchanges between the districts and increase operational efficiency and flexibility. The awarded $925,000 will facilitate design and construction of an AEWSD intake piping upsize, new pipeline segment, and intertie into the 850 Canal. Design is anticipated to be completed by February 2025 and construction completed by September 2025.

7.4.4 Anticipated Implementation Activities

The GSA anticipates the following implementation activities and efforts to occur in WY 2024:

- Conduct monthly groundwater level monitoring, download data from transducers and stream flow meter, and update the Basin Data Management System (DMS).
- Create monthly SMC status maps and hydrographs.
- Submit Fall 2023 and Spring 2024 groundwater level data to DWR.
- Adopt Fiscal Year (FY) 2024-2025 Budget.
- Conduct ongoing stakeholder outreach including, but not limited to:
  - WWGSA website maintenance and email distributions,
  - Hold monthly GSA Board of Directors meetings, and
  - Hold monthly P/MA Committee meetings.
- Re-calibrate the WWGFM.
- Replacement dedicated monitoring well siting, design, and permitting.
- Grant administration, reporting, and invoicing.
- Continue active P/MA implementation.
- Design and permitting for the in-lieu banking program expansion and the "South Canal" 850 Canal intertie projects.
- Initiate management actions, including the WRMWSD groundwater service charge and the AEWSD demand management strategies technical analysis.
- Conduct additional technical analysis to support a leave behind percentage and landowner recharge policy.
- Prepare and submit the WY 2024 Annual Report.
- Develop approaches to address DWR corrective actions.
- Initiate Periodic Evaluation.

8 REFERENCES

DWR, 2019. Sustainable Groundwater Management Act 2019, Basin Prioritization Process and Results. April 2019, 64 pp.

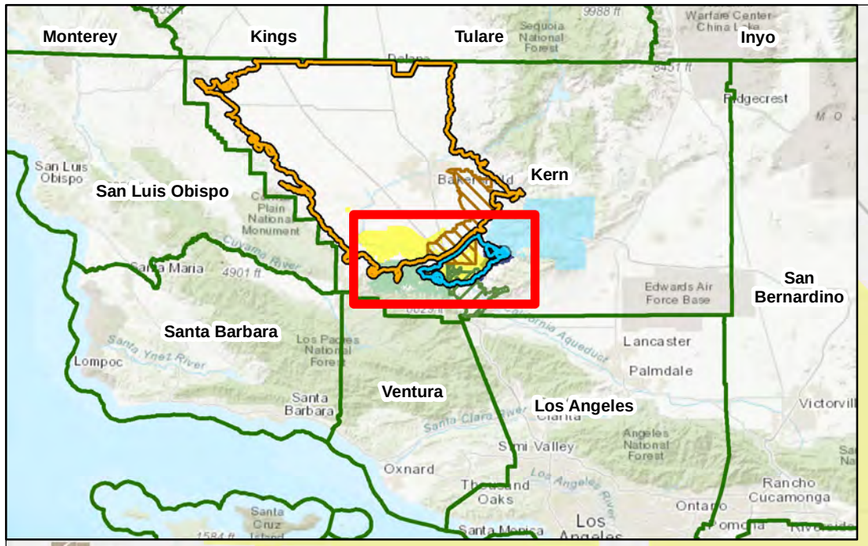
DWR, 2021. Sustainable Groundwater Management Act Water Year Type Data Set Development Report, January 2021, 17pp. https://data.cnra.ca.gov/dataset/sgma-water-year-type-dataset/resource/79c7b9c1-1203-4203-b956-844554fcec79

DWR, 2023. Determination Letter for the White Wolf Groundwater Sustainability Plan. October 2023.

Jasechko, S., Seybold, H., Perrone, D. et al., 2024. Rapid groundwater decline and some cases of recovery in aquifers globally. Nature 625, 715–721. https://doi.org/10.1038/s41586-023-06879-8

State Water Resources Control Board, 2023. Electronic Annual Report (EAR) Data from Public Drinking Water Systems. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/eardata.html

White Wolf GSA, 2021. Groundwater Sustainability Plan White Wolf Subbasin. Prepared by EKI Environment & Water Inc. for White Wolf Groundwater Sustainability Agency. December 2021.



Wheeler Ridge

Grapevine

Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)
- County Boundary
- Arvin-Edison Water Storage District
- Tejon-Castac Water District
- Wheeler Ridge-Maricopa Water Storage District
- Tehachapi - Cummings County Water District
- Federal Lands
- Conservation Easement Area
- Private Conservation

Abbreviations

CCED = California Conservation Easement Database
CPAD = California Protected Areas Database
DWR = California Department of Water Resources
GSA = Groundwater Sustainability Agency

Notes

1. All locations are approximate.
2. The enitre displayed area within Kern County is covered by the Kern County General Plan.
3. The White Wolf GSA covers the entire White Wolf Subbasin and is the exclusive GSA for the Subbasin.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 6 March 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. District boundaries acquired from respective District staff.
4. Federal Lands from CPAD 2017 - www.calands.org.
5. Private Conservation Lands from CPAD 2018 - www.calands.org.
6. Conservation Easement Area Lands from CCED -www.calands.org/CCED.

N

0 3 6

(Scale in Miles)

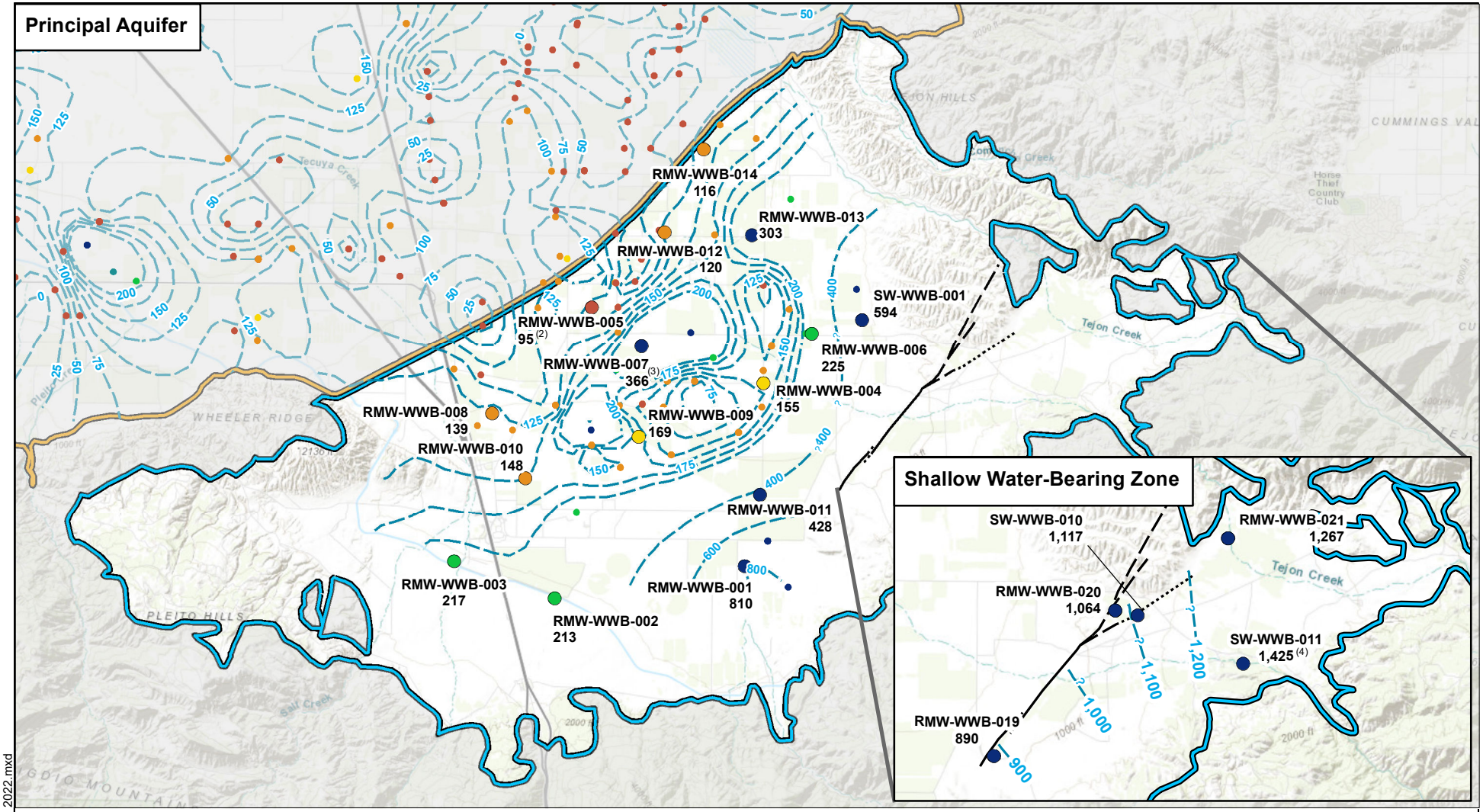
White Wolf Subbasin and Relevant Boundaries

White Wolf GSA
Kern County, California
March 2024
C20014.01

Figure 1

eki environment & water

Path: X:\C20014.01\Maps\2023\3\Figure 1. White Wolf Subbasin.mxd



Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)
- Springs Fault
- Fall 2022 Groundwater Elevation contour (ft NAVD88)

Fall 2022 Groundwater Elevation (ft NAVD88)

- NA
- < 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- > 300

Abbreviations

DTW	= Depth to groundwater
DWR	= California Department of Water Resources
ft NAVD88	= feet above the North American Vertical Datum of 1988
GSA	= Groundwater Sustainability Agency
NA	= not available

Notes

1. All locations are approximate.
2. Used proxy well, located in 11N/19W/10M.
3. Used proxy well, located in 11N/19W/14B.
4. Questionable measurement, pumping.
5. Wells with questionable measurements or flagged as pumping were excluded from the contours.
6. Contours are queried where uncertain.
7. Water level data collected between 4 October 2022 through 15 November 2022.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 March 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. Springs Fault trace from Bartow, 1984, Geological Map and Cross Sections of the Southeastern Margin of the San Joaquin Valley, California: U.S. Geological Survey Map I-1496.
4. Groundwater elevation data provided by the White Wolf GSA member Districts.

N

0 3 6

(Scale in Miles)

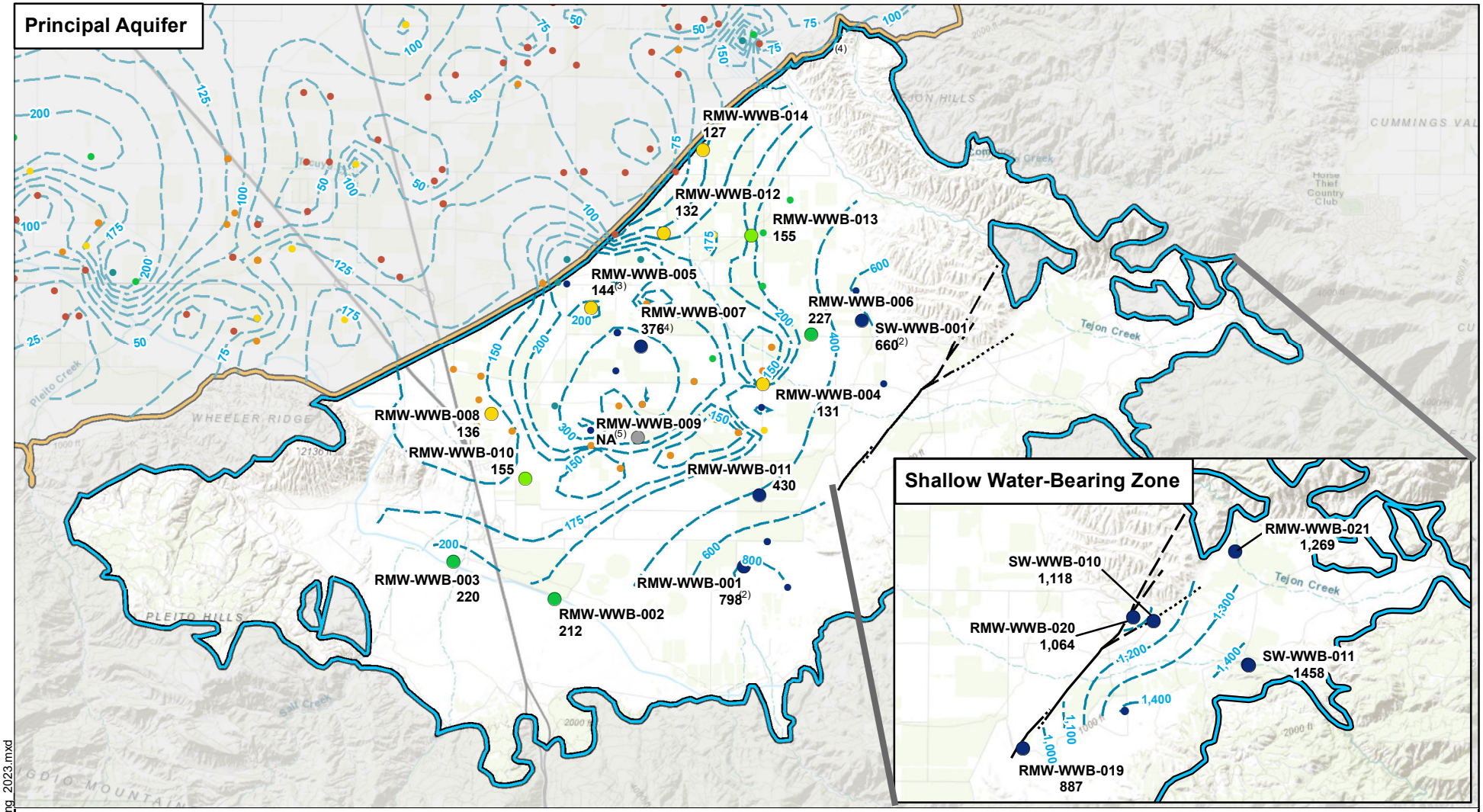
Groundwater Elevation Contours, Fall 2022

White Wolf GSA
Kern County, California
March 2024
C20014.02

Figure 2

eki environment & water

Path: X:\C20014.01\Maps\2024\03\Figure 2. WL Fall 2022.mxd



Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)
- Springs Fault
- Spring 2023 Groundwater Elevation contour (ft NAVD88)

Spring 2023 Groundwater Elevation (ft NAVD88)

- NA
- < 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- > 300

Abbreviations

DTW	= Depth to groundwater
DWR	= California Department of Water Resources
ft NAVD88	= feet above the North American Vertical Datum of 1988
GSA	= Groundwater Sustainability Agency
NA	= not available

Notes

1. All locations are approximate.
2. Questionable measurement; foreign substance in casing.
3. Used proxy well, located in 11N/19W/10M.
4. Used proxy well, located in 11N/19W/14B.
5. No measurement; surface water effects near well.
6. Wells with questionable measurements or flagged as pumping were excluded from the contours.
7. Contours are queried where uncertain.
8. Water level data collected between 1 February 2023 through 27 April 2023.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 18 March 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. Springs Fault trace from Bartow, 1984, Geological Map and Cross Sections of the Southeastern Margin of the San Joaquin Valley, California: U.S. Geological Survey Map I-1496.
4. Groundwater elevation data provided by the White Wolf GSA member Districts.

N

0 3 6

(Scale in Miles)

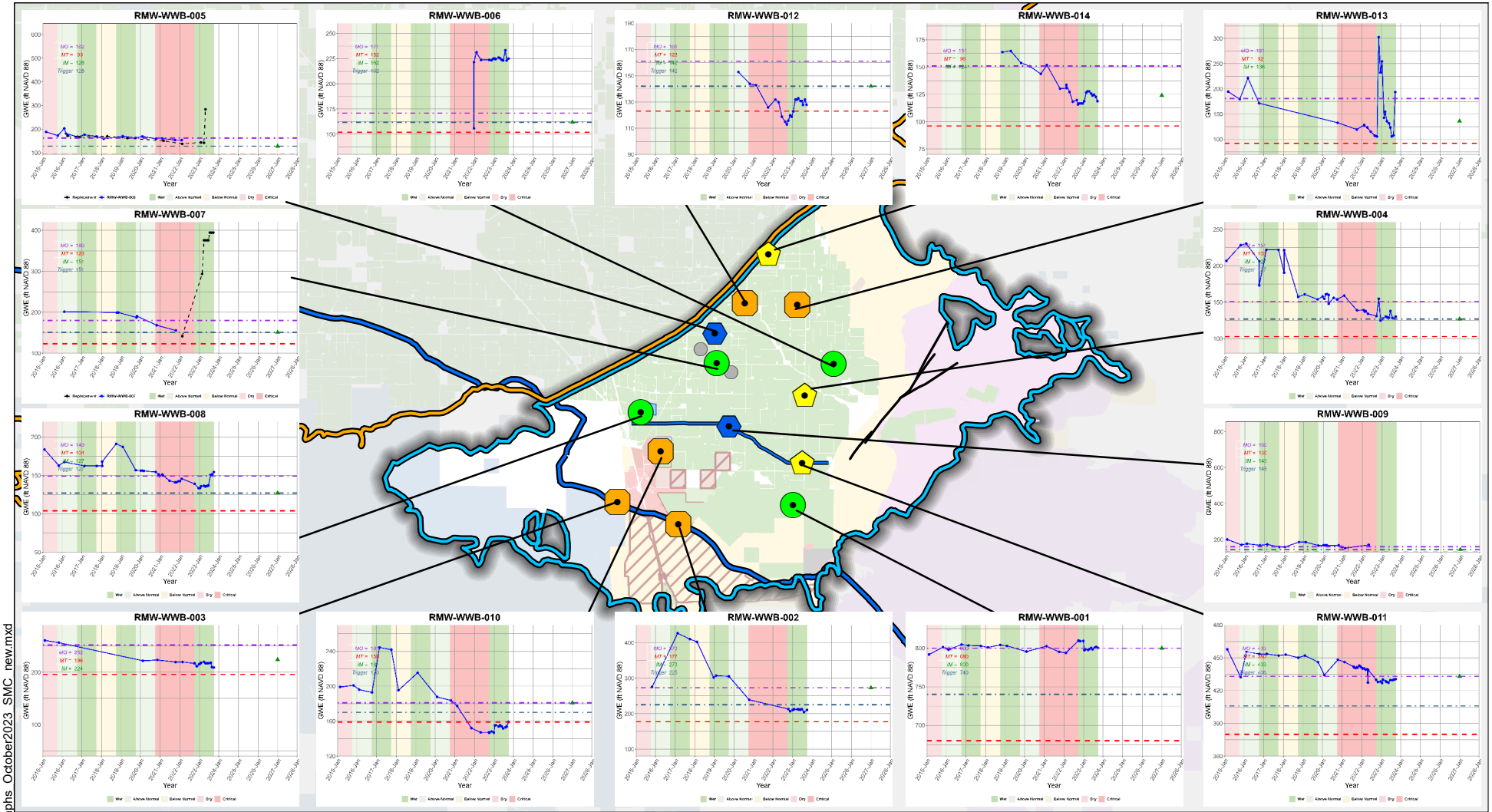
Groundwater Elevation Contours, Spring 2023

White Wolf GSA
Kern County, California
March 2024
C20014.02

Figure 3

eki environment & water

Path: X:\C20014.01\Maps\2024\01\Figure 3. WL_Spring_2023.mxd



Path: X:\C20014.01\Maps\2023\10\RMW WL Hydrographs_October2023_SMC_new.mxd

Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)
- Springs Fault
- California Aqueduct
- 850 Canal

Representative Monitoring Well Status as of October 2023

- Water Level above MO (4 or 29%)
- Water Level Between MO and MT but closet to MO (3 or 21%)
- Water Level Between MO and MT but closer to MT (5 or 36%)
- No Water Level Measurement (2 or 14%)

Land Use

- Agricultural Land
- Developed
- Grazing
- Mining
- Oil Field
- Conservation Easement
- California Protected
- Proposed Grapevine Development
- Mettler Recharge Project

- Measurable Objective
- Trigger Threshold
- Minimum Threshold
- Groundwater Elevation

Abbreviations

DWR	= California Department of Water Resources	MO	= Measurable Objective
ft msl	= feet above mean sea level	MT	= Minimum Threshold
GSA	= Groundwater Sustainability Agency	RMW-WL	= Representative Monitoring Well for Water Level

Notes

1. All locations are approximate.
2. RMW-WWB-006 has no prior historical data on record, nor a measurement obtained during WY 2022.
3. Hydrographs show static water levels. Erroneous datapoints have been excluded.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 March 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. Land Use simplified from Figure PA-3 and Figure PA-8 of the White Wolf Subbasin Groundwater Sustainability Plan.
4. Surface water features, watersheds, and springs from NHD (https://viewer.nationalmap.gov/basic/).
5. Springs Fault trace from Bartow, 1984, Geological Map and Cross Sections of the Southeastern Margin of the San Joaquin Valley, California: U.S. Geological Survey Map I-1496.

N

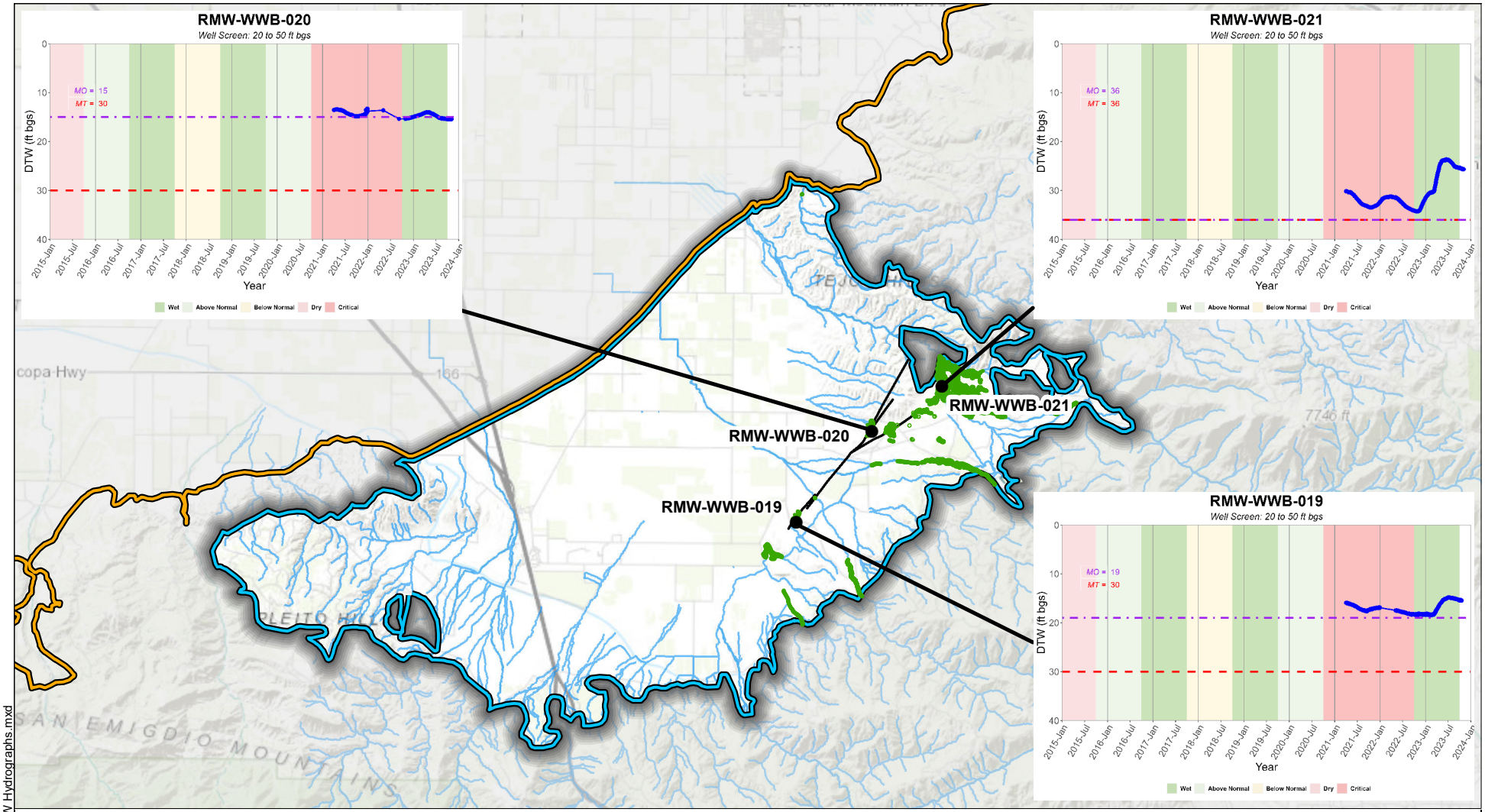
0 5 10

(Scale in Miles)

Hydrographs of Representative Monitoring Wells for Chronic Lowering of Groundwater Levels Sustainability Indicator

White Wolf GSA
Kern County, California
March 2024
C20014.02
Figure 4

eki environment & water



Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)
- GDEs of Interest
- Representative Monitoring Well
- Stream
- Springs Fault
- Measurable Objective
- Minimum Threshold
- Depth to Water (ft bgs)

Abbreviations

DTW	= depth to water
DWR	= California Department of Water Resources
ft bgs	= feet below ground surface
GDE	= Groundwater Dependent Ecosystem
MO	= Measurable Objective
MT	= Minimum Threshold

Notes

1. All locations are approximate.
2. MO values for RMW-WWB-019 and RMW-WWB-020 have been corrected.
3. GDEs of interest are those supported by the shallow water-bearing zone upgradient of the Springs Fault ("B") or the Regional Aquifer ("R").

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 6 December 2023.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. Surface water features from National Hydrography Dataset (https://viewer.nationalmap.gov/basic/).
4. GDEs of interest shapefile provided by GeoSystems Analysis, Inc., 7 October 2020.
6. Springs Fault trace from Bartow, 1984, Geological Map and Cross Sections of the Southeastern Margin of the San Joaquin Valley, California: U.S. Geological Survey Map I-1496.

N

0 4 8

(Scale in Miles)

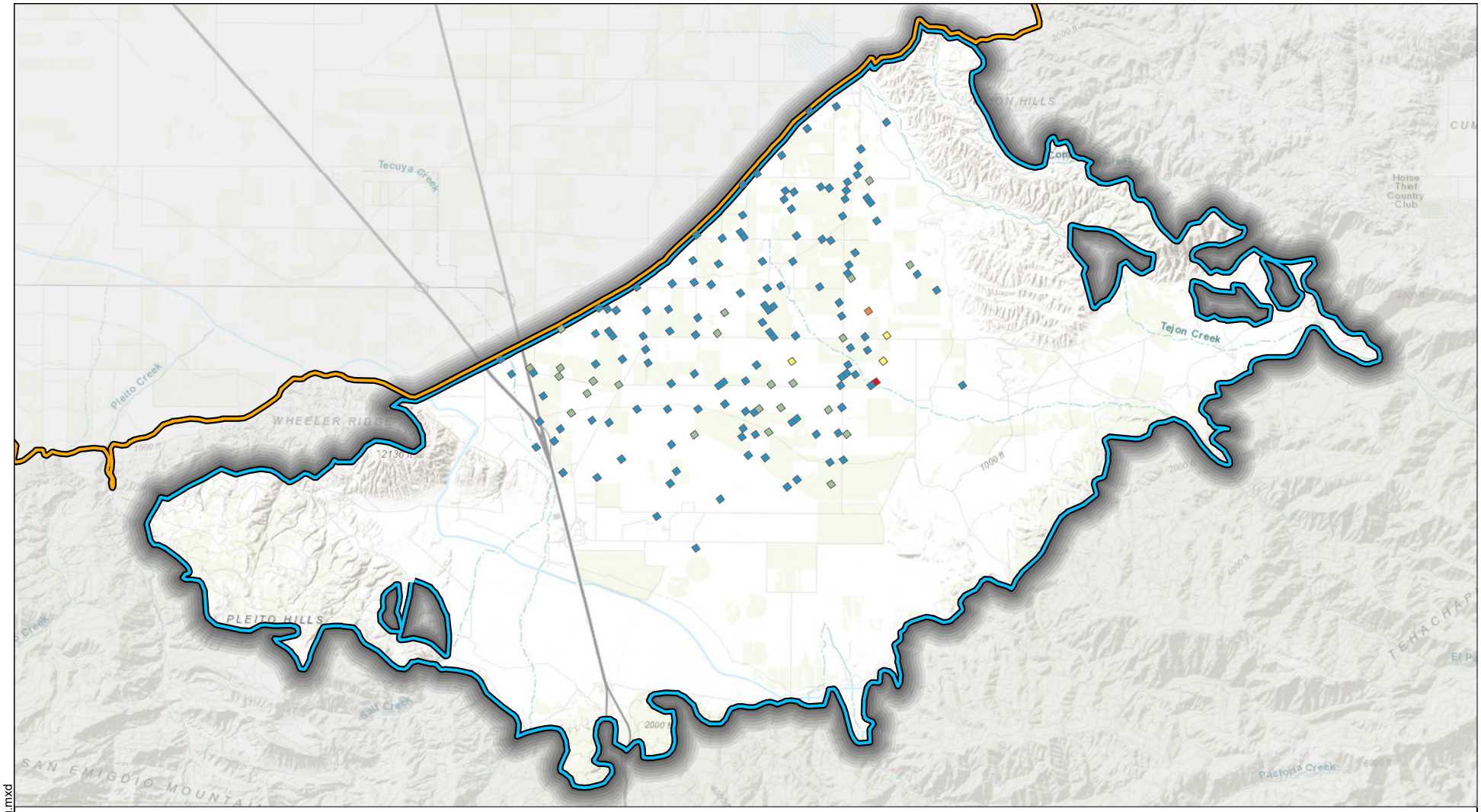
Hydrographs of Representative Monitoring Wells for Depletions of Interconnected Surface Water Sustainability Indicator

White Wolf GSA
Kern County, California
November 2023
C20014.01

Figure 5

eki environment & water

Path: X:\C20014.01\Maps\2023\11\Figure 5. RMW ISW Hydrographs.mxd



Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)

WY 2023 Groundwater Pumping (AF)

- < 250
- 250 - 500
- 500 - 750
- 750 - 1,000
- > 1,000

Abbreviations

AF = acre-feet
DWR = California Department of Water Resources
GSA = Groundwater Sustainability Agency
WY = Water Year

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 23 February 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. Groundwater pumping in the White Wolf Groundwater Flow Model is a combination of metered data where available and estimated using the Soil Moisture Budget where unavailable.

N

0 3 6

(Scale in Miles)

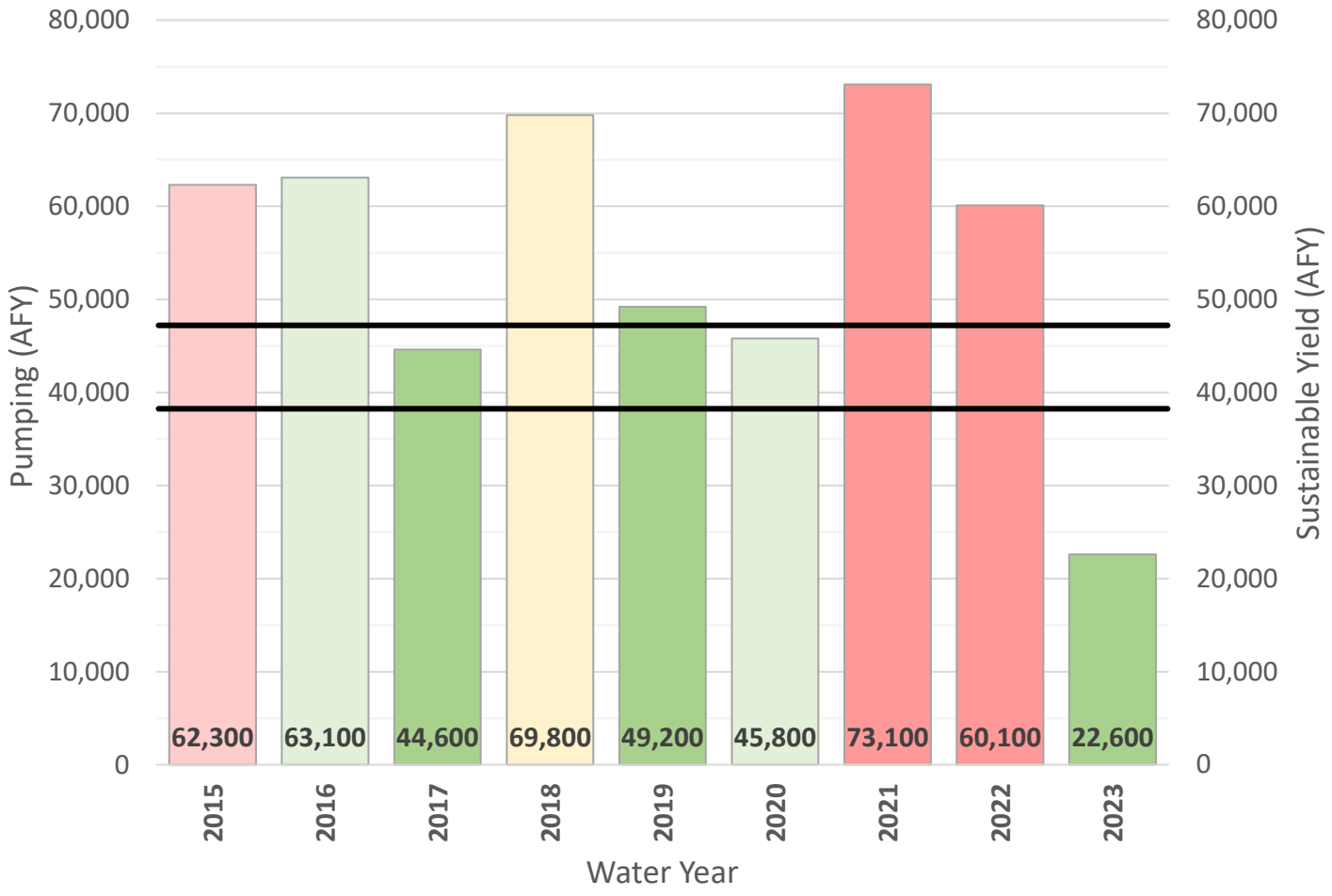
General Location of Groundwater Extractions, WY 2023

White Wolf GSA
Kern County, California
February 2024
C20014.02

eki environment & water

Figure 6

Path: X:\C20014.02\Maps\2024\02\Figure 6. Pumping.mxd



Legend

Change in Groundwater Storage

DWR Water Year Type

- Wet
- Above Normal
- Below Normal
- Dry
- Critical

Sustainable Yield Range:
Upper = 47,200 AFY
Lower = 38,200 AFY

Abbreviations

AF	= acre-feet
AFY	= acre-feet per year
DWR	= California Department of Water Resources
WY	= Water Year

Notes

1. Water Year is defined as the October of the previous year through September of the current year.
2. Water Year type for WY 2019, 2020, 2021, 2022, and 2023 calculated using same methodology as DWR, 2021.

Sources

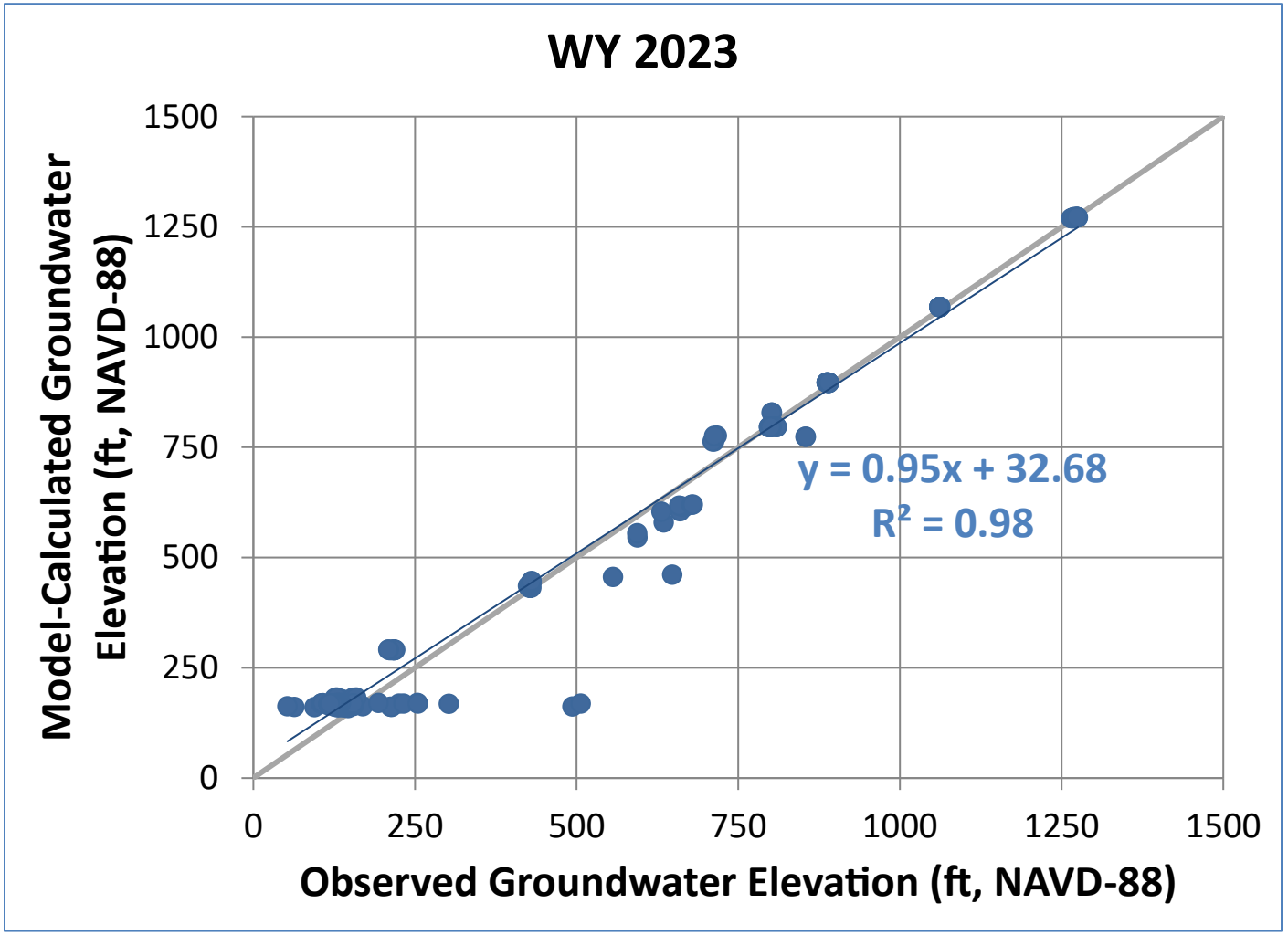
1. DWR Water Year type for WY 1995-2018 from (DWR, 2021).

Groundwater Extraction Compared to the Sustainable Yield

White Wolf GSA
Kern County, California
March 2024
C20014.02

eki environment & water

Figure 7



Legend

= Observed Groundwater Elevation

= 1 : 1

= Linear (Observed)

Abbreviations

ft	= acre-feet
NAVD-88	= North American Vertical Datum of 1988
WY	= water year

Notes

1. Wells plotted include calibration, verification, and representative monitoring wells with available water level data collected between 1 October 2022 and 30 September 2023.

Sources

1. White Wolf Groundwater Flow Model

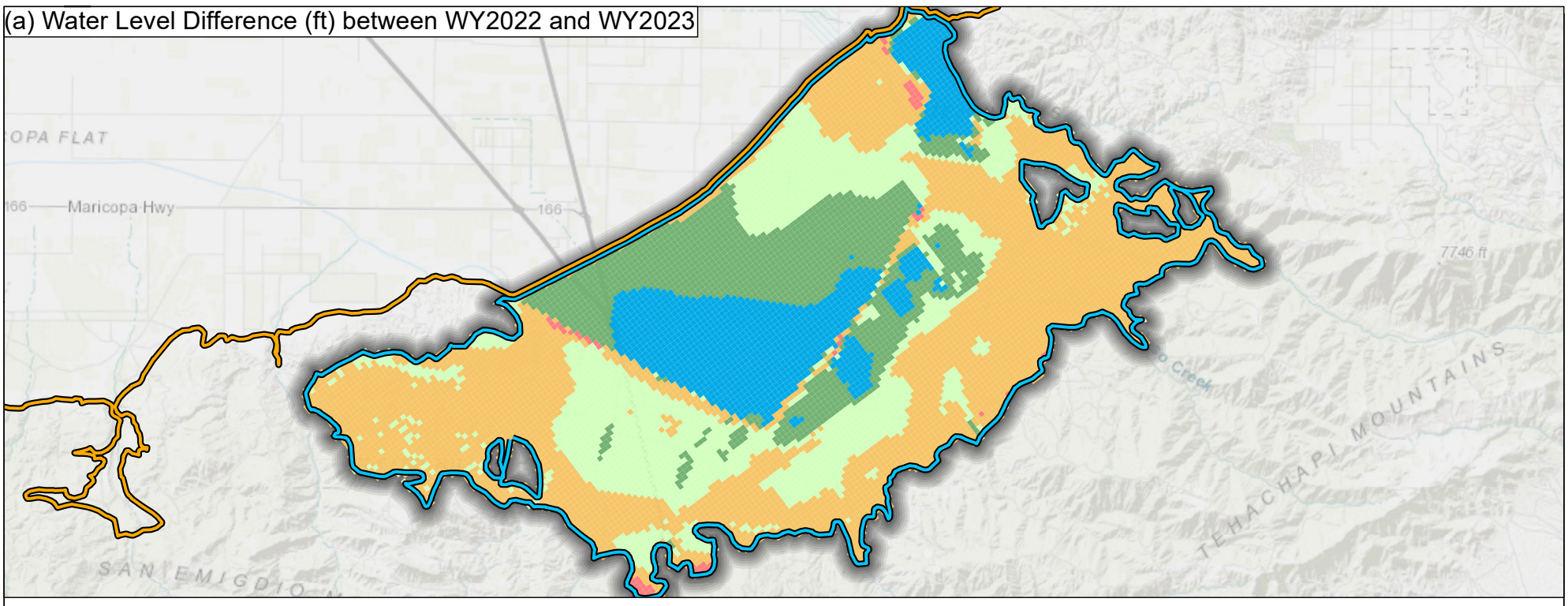
Model-Calculated versus Observed Groundwater Elevations in Wells, WY 2023

White Wolf GSA
Kern County, California
March 2024
C20014.01

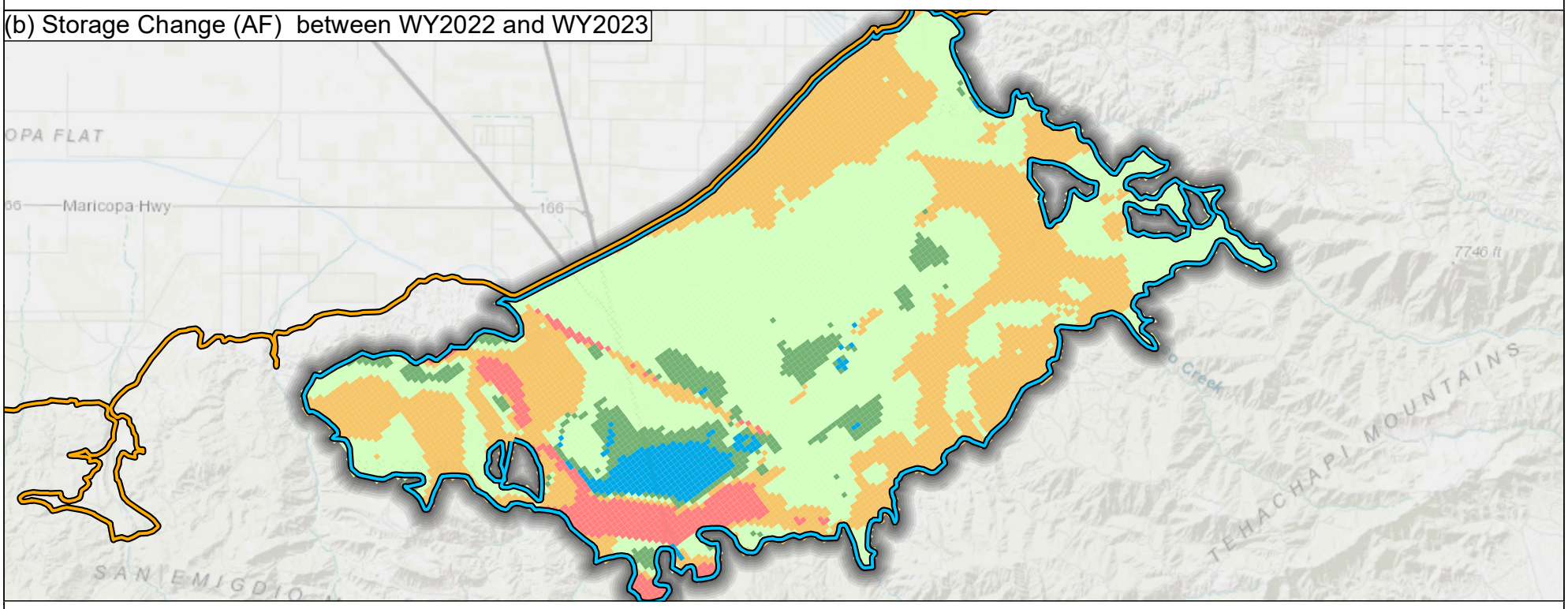
eki environment & water

Figure 12

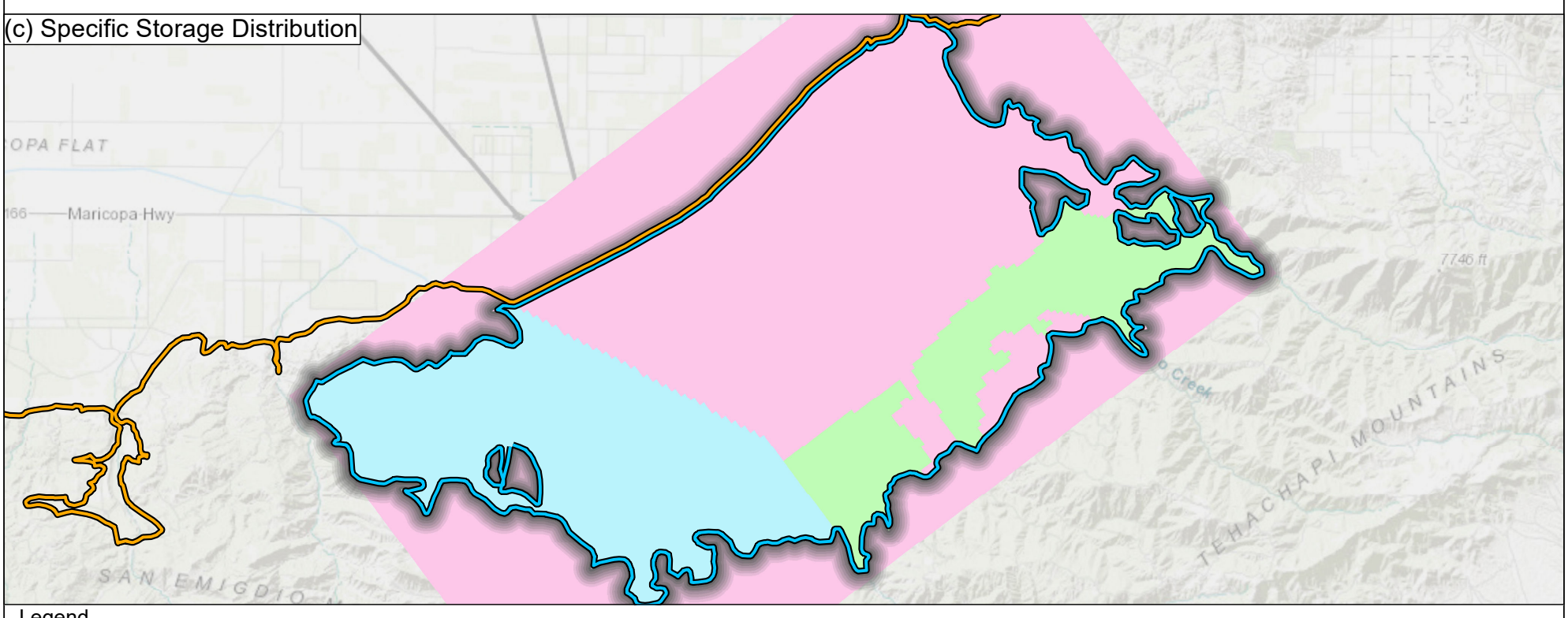
(a) Water Level Difference (ft) between WY2022 and WY2023



(b) Storage Change (AF) between WY2022 and WY2023



(c) Specific Storage Distribution



Legend

Water Level Difference (ft)
- -10 - -3
- -3 - 0
- 0 - 3
- 3 - 10
- >10

Specific Storage
- 0.000002
- 0.0015
- 0.002

Storage Change (AF)
- < -25
- -25 to 0
- 0 to 25
- 25 to 50
- >50

Groundwater Subbasin
- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)

Abbreviations
DWR = California Department of Water Resources
WY = Water Year Feet
AF = Acre Feet

Notes
1. All locations are approximate.
2. Water level difference and storage change are calculated as the difference between September 2023 and September 2022
3. Water level difference calculated as the difference in modeled layer 2 heads from the White Wolf Groundwater Flow Model.

N
0 4 8
(Scale in Miles)

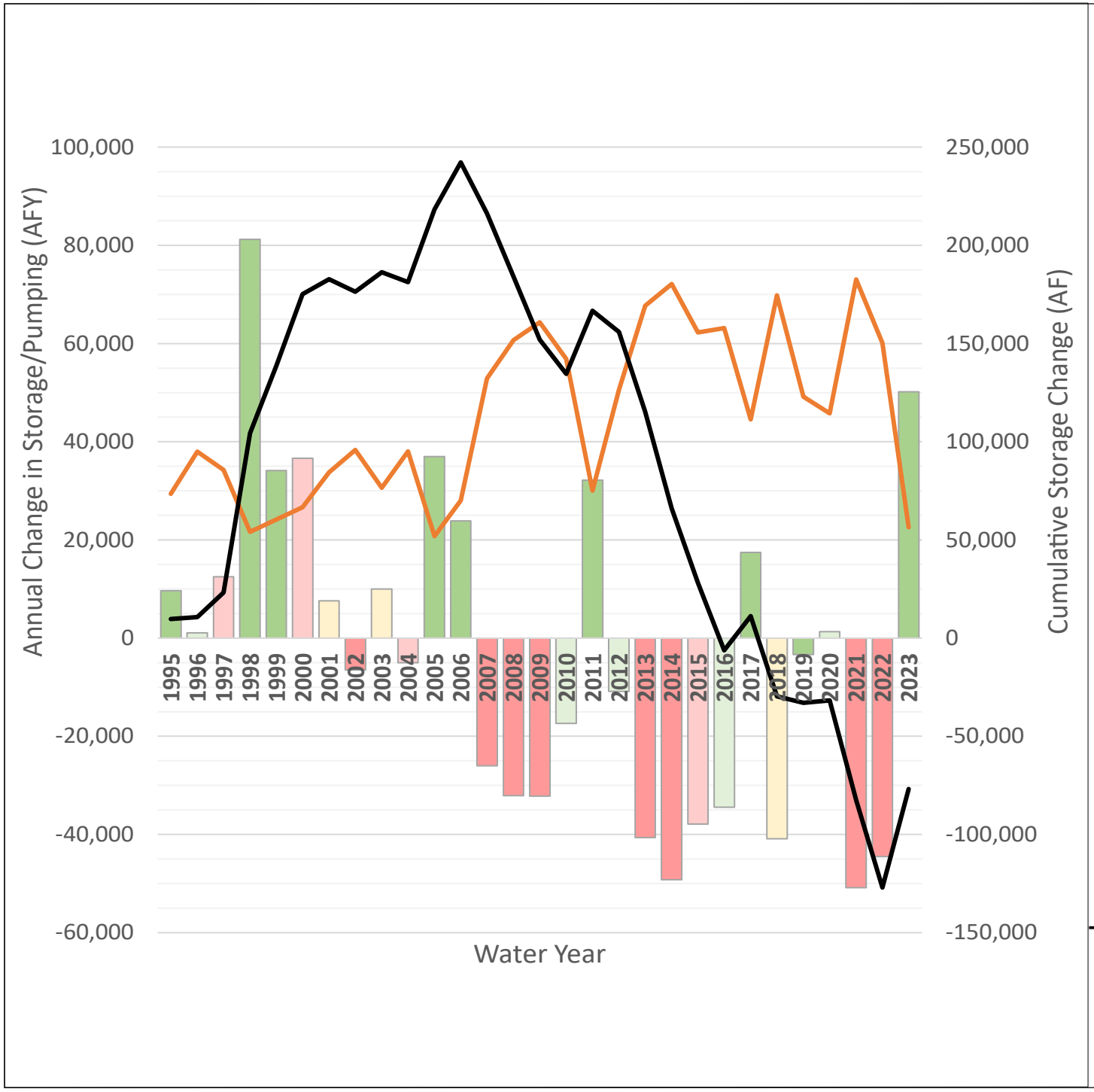
Model Estimated Groundwater Storage Change between WY 2022 and WY 2023

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 29 February 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. White Wolf Groundwater Flow Model

eki environment & water

White Wolf GSA
Kern County, California
March 2024
C20014.02
Figure 13

Path: X:\C20014.01\Maps\202402\Figure 8. Panel StorageChange_WLDifference_kr.mxd



Legend

Change in Groundwater Storage

DWR Water Year Type

- Wet
- Above Normal
- Below Normal
- Dry
- Critical

- Groundwater Use
- Cumulative Storage Change

Abbreviations

AF	= acre-feet
AFY	= acre-feet per year
DWR	= California Department of Water Resources
WY	= Water Year

Notes

1. Water Year is defined as the October of the previous year through September of the current year.
2. Water Year type for WY 2019, 2020, 2021, 2022, and 2023 calculated using same methodology as DWR, 2021.

Sources

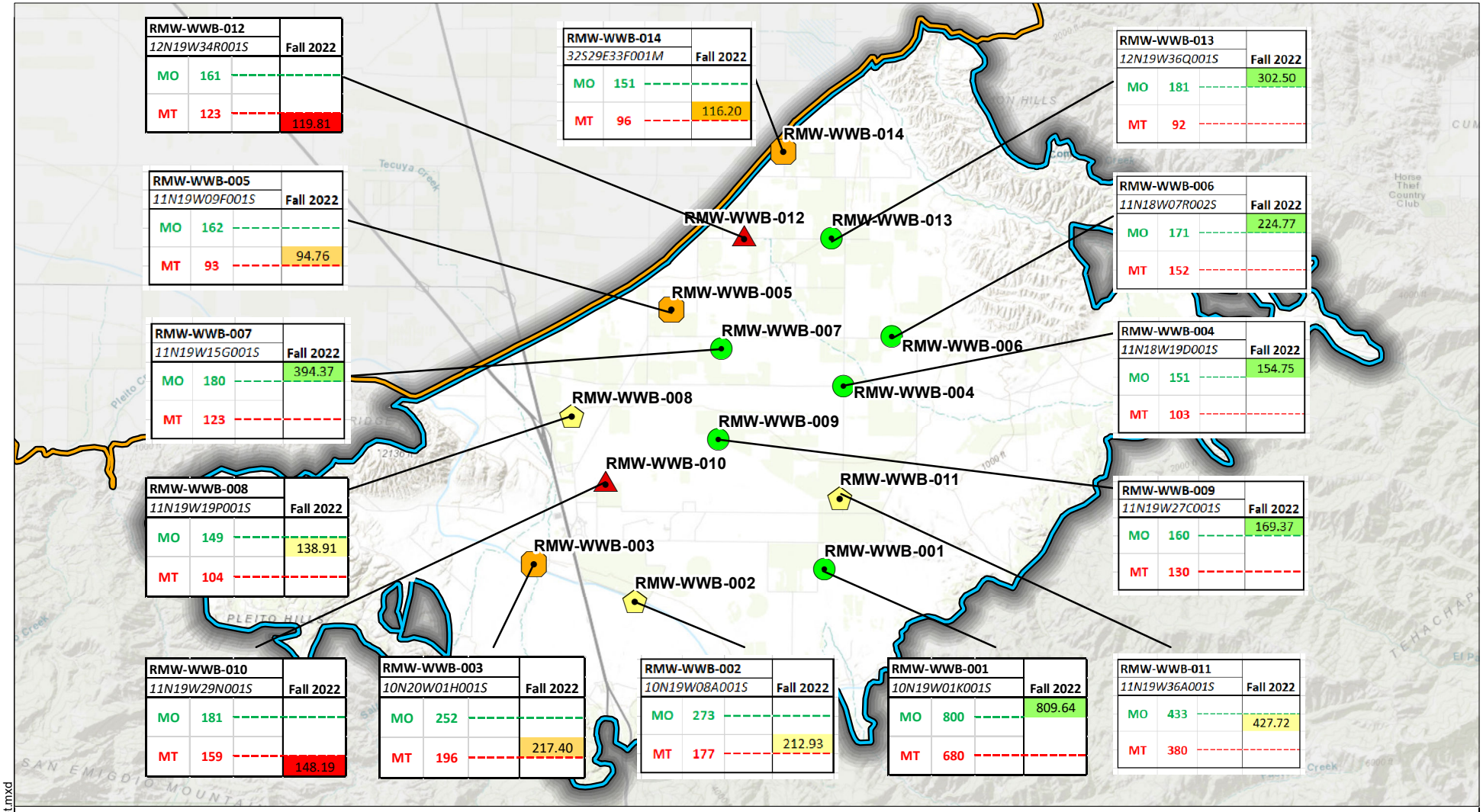
1. DWR Water Year type for WY 1995-2018 from (DWR, 2021).

Annual Change in Groundwater Storage and DWR Water Year Type

eki environment & water

White Wolf GSA
Kern County, California
March 2024
C20014.02

Figure 14



Legend

Representative Monitoring Well Status as of Fall 2022

- Water Level below MO (6 or 43%)
- Water Level between MO and MT but closer to MO (3 or 21.5 %)
- Water Level between MO and MT but closer to MT (3 or 21.5 %)
- Water Level below MT (2 or 14 %)

Groundwater Subbasin

- White Wolf (DWR 5-022.18) (1)
- Kern County (DWR 5-022.14) (1)

Abbreviations

DWR = California Department of Water Resources
RMW-WL = Representative Monitoring Well for Chronic Lowering of Groundwater Levels
SGMA = Sustainable Groundwater Management Act

Notes

1. All locations are approximate.
2. Well RMW-WWB-007 is a problematic well for water level measurements.
3. RMW-WLs are designated as the SGMA Monitoring Network. Water level data from RMW-WLs will be collected and submitted to DWR per California Code of Regulations Section 354.34(c)(1)(B) and 354.40.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 24 January 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. Land Use simplified from Figure PA-3 and Figure PA-8.

N

0 3 6

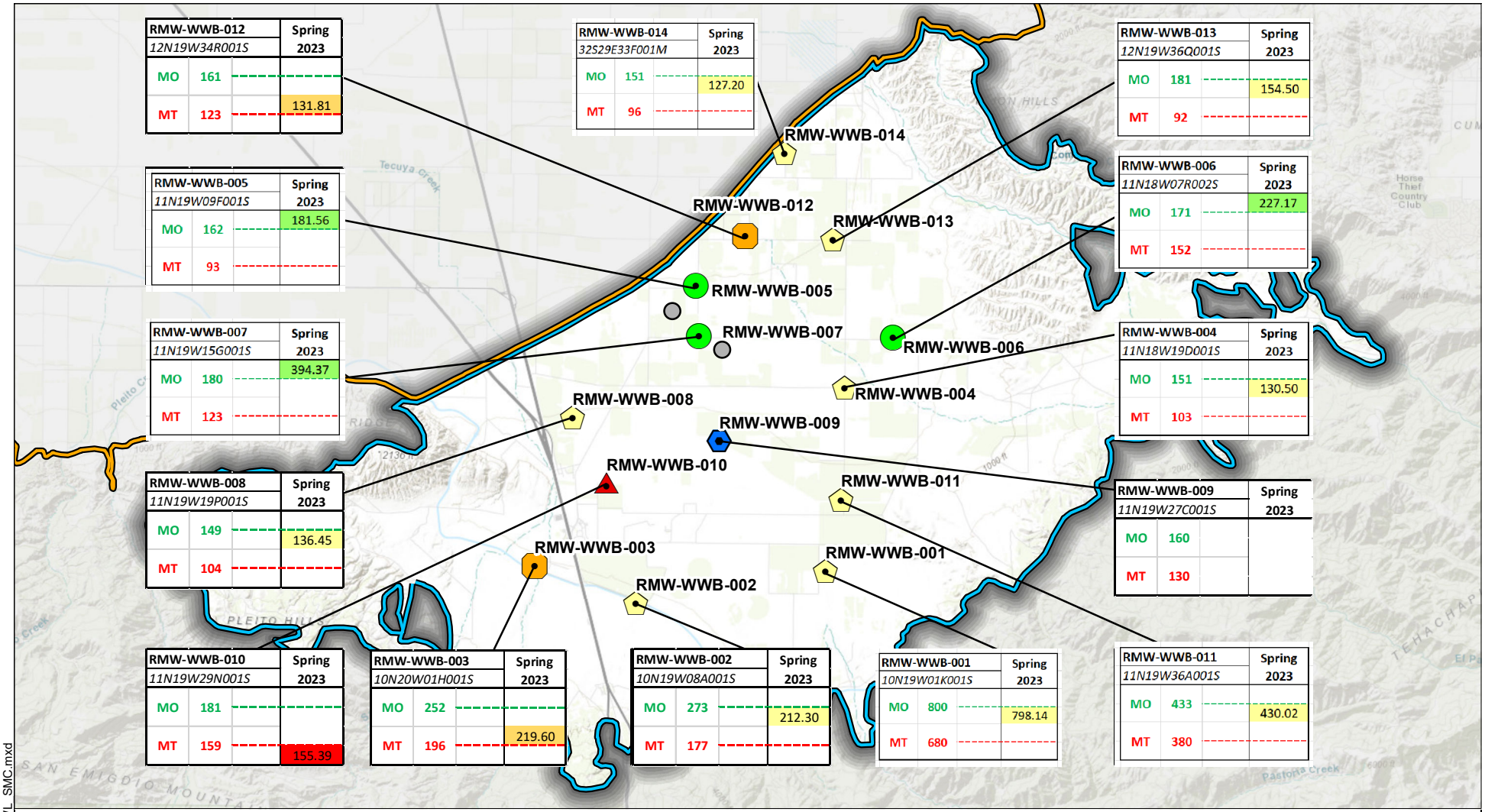
(Scale in Miles)

Fall 2022 Groundwater Levels Relative to SMCs

White Wolf GSA
Kern County, California
Fall 2022
C20014.00
Figure 15

eki environment & water

Path: X:\C20014.00\Maps\2022\11\Fig_Fall2022_inset.mxd



Legend

Representative Monitoring Well Status as of Spring 2023

- Water Level below MO (3 or 22%)
- Water Level Between MO and MT but closer to MO (7 or 50%)
- Water Level Between MO and MT but closer to MT (2 or 14%)
- No Water Level Measurement (1 or 7%)
- Water Level below MT (1 or 7%)
- Old RMW-WL

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)

Abbreviations

DWR	= California Department of Water Resources
RMW-WL	= Representative Monitoring Well for Chronic Lowering of Groundwater Levels
SGMA	= Sustainable Groundwater Management Act
MO	= Measurable Objective
MT	= Minimum Threshold

Notes

1. All locations are approximate.
2. Wells RMW-WWB-005 and RMW-WWB-007 were replaced by adjacent surrogate wells due to chronic problems obtaining reliable measurements and potential well collapse.
3. RMW-WWB-009 has collapsed.
4. RMW-WLs are designated as the SGMA Monitoring Network. Water level data from RMW-WLs will be collected and submitted to DWR per California Code of Regulations Section 354.34(c)(1)(B) and 354.40. Spring measurements were collected between 15 January 2022 and 4 May 2022.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 24 January 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.

N

0 3 6

(Scale in Miles)

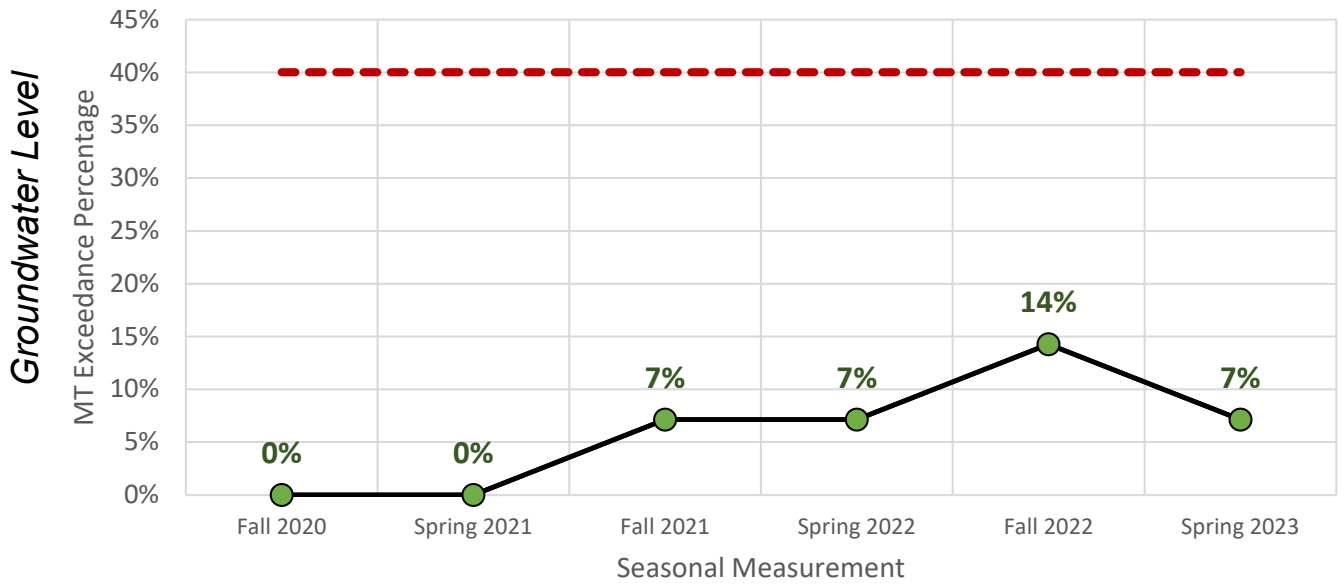
Spring 2023 Groundwater Levels Relative to Sustainable Management Criteria

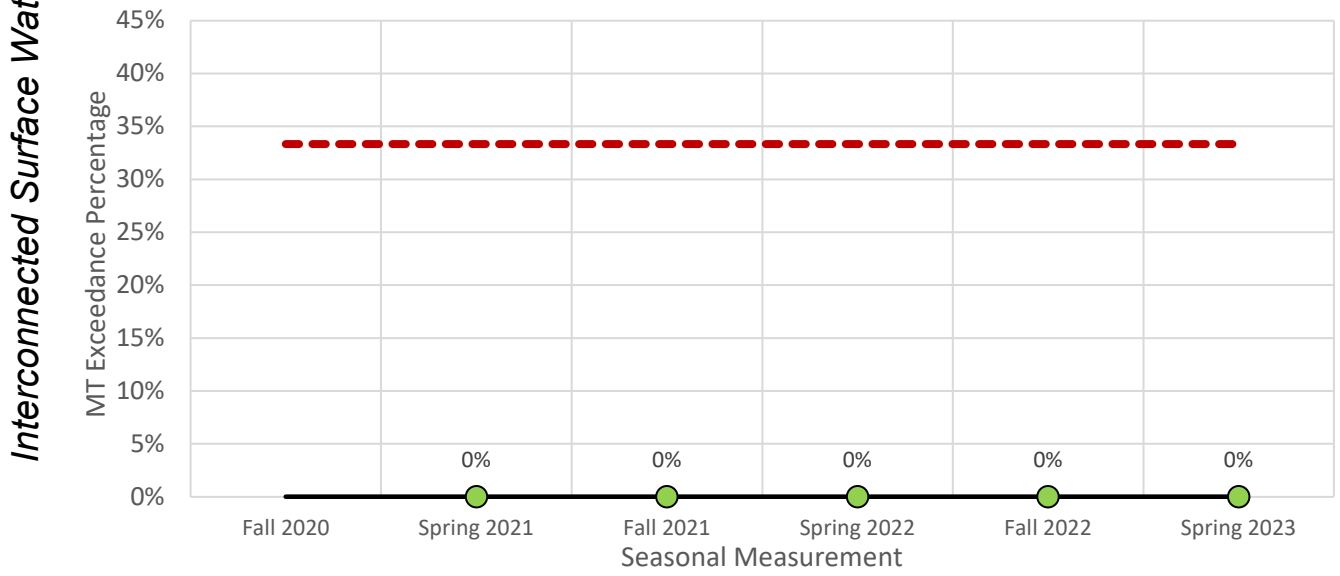
White Wolf GSA
Kern County, California
Spring 2023

Figure 16

eki environment & water

Path: X:\C20014.01\Maps\2023\4WW_March2023_WL_SMC.mxd





Legend

UR Threshold (see note #1)

RMW (see note #2)

- 0 consecutive seasonal measurements exceeding MT
- 1 - 3 consecutive seasonal measurements exceeding MT
- ≥ 4 consecutive seasonal measurements exceeding MT

Abbreviations

ISW	= Interconnected Surface Water
MT	= Minimum Threshold
RMW	= Representative Monitoring Well
UR	= Undesirable Result
WL	= Water Level

Notes

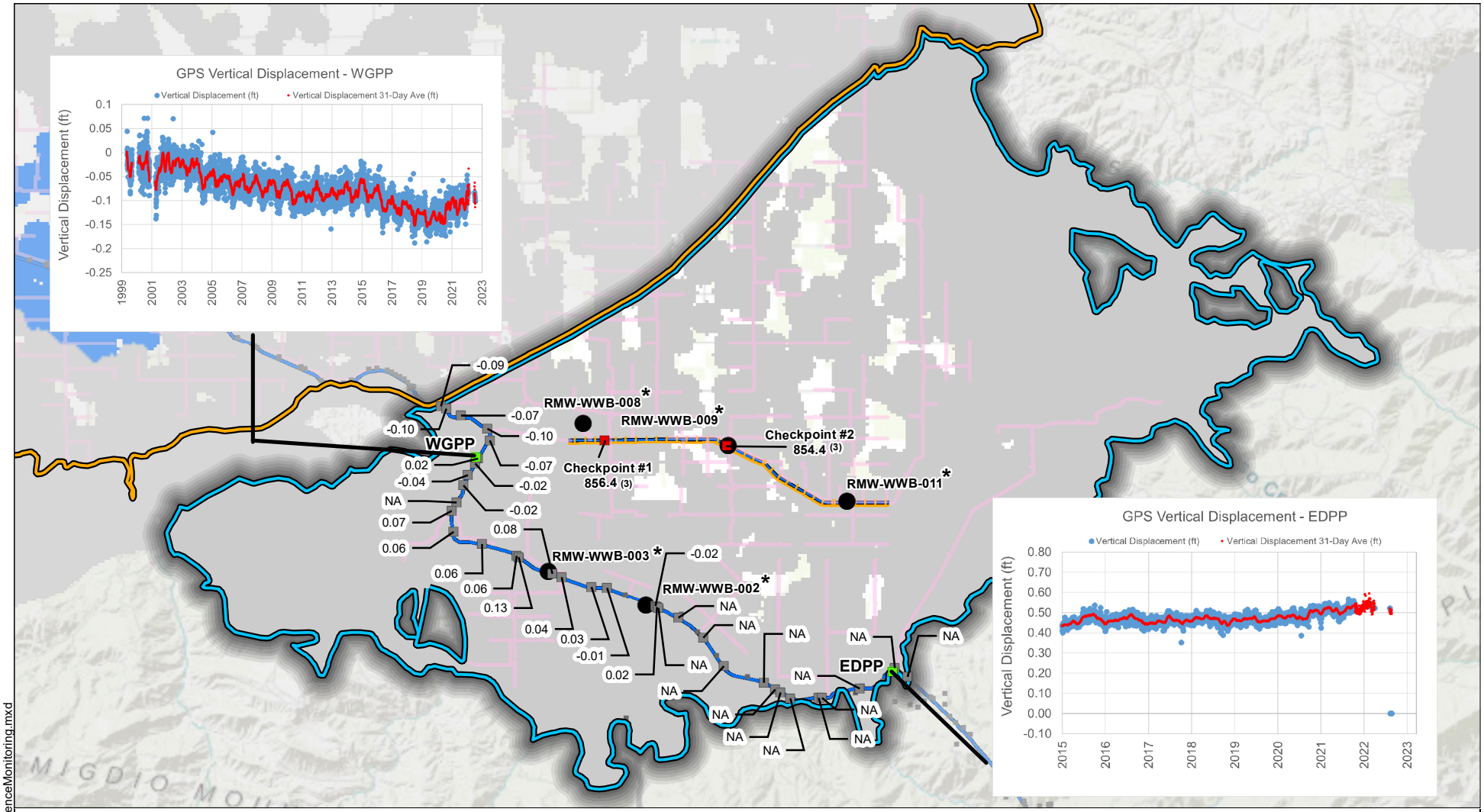
1. UR Threshold is set at greater than or equal to:
   40 % of RMW-WLs exceeding their MTs
   33 % of RMW-ISWs exceeding their MTs
2. Number shown indicates count of consecutive seasonal monitoring events above UR threshold. UR occurs after four consecutive seasonal monitoring events where MT exceedance percentage exceeds the UR threshold.
3. The RMW-ISWs were installed in January 2021 and thus do not have a Fall 2020 measurement available.

Undesirable Results Tracking

eki environment & water

White Wolf GSA
Kern County, California
March 2024
EKI C20014.02

Figure 17



Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)
- California Aqueduct
- 850 Canal
- Pipeline
- Representative Monitoring Well

Representative Monitoring Site

- Checkpoint
- GPS Subsidence Monitoring Station
- DWR Checkpoint

TRE Altamira InSAR Vertical Displacement WY 2023

- < - 1 ft
- - 1.0 to - 0.8 ft
- - 0.8 to - 0.6 ft
- - 0.6 to - 0.4 ft
- - 0.4 to - 0.2 ft
- - 0.2 to - 0.1 ft
- - 0.1 to 0.1 ft
- > 0.1 ft

Abbreviations

DWR = California Department of Water Resources
ft = feet
GPS = Global Positioning System
GSA = Sustainable Groundwater Management Ac
SGMA = Sustainable Groundwater Management Act
WY = Water Year
NA = Not available

Notes

1. All locations are approximate.
2. Asterisk (*) denotes wells that are also Representative Monitoring Wells for Chronic Lowering of Groundwater Levels.
3. Values displayed are surveyed elevation in NAVD88. Prior surveyor benchmarked to a local datum, so vertical displacement cannot be calculated for WY2023. NAVD88 will be used moving forward for constistency.
4. TRE Altamira InSAR data displayed shows October 2022 through October 2023.
5. Values displaced are the difference between WY 2022 elevation and WY 2023 elevation, where positive and negative values correlate to accretion and subsidence respectively.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 March 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. California Aqueduct location is from the National Hydrography Dataset.
4. GPS subsidence monitoring data and Vertical Displacement data are from the SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#currentconditions
5. Subsidence at DWR checkpoints received from DWR on 20 October 2023.

N

0 3 6

(Scale in Miles)

Subsidence Monitoring in the White Wolf Subbasin

White Wolf GSA
Kern County, California
March 2024
C20014.02

Figure 18

eki environment & water

Path: X:\C20014.01\Maps\2024\03Figure 17.2SubsidenceMonitoring.mxd

APPENDIX A

Annual Report Submittal Checklist

Groundwater Sustainability Plan Annual Report Elements Guide

Basin Name	White Wolf Subbasin		
GSP Local ID			
California Code of Regulations - GSP Regulation Sections	***Groundwater Sustainability Plan Elements***	**Document *page number(s) that address the applicable GSP element.***	***Notes: Briefly describe the GSP element does not apply.***
Article 5	**Plan Contents**		
Subarticle 4	***Monitoring Networks***		
§ 354.40	**Reporting Monitoring Data to the Department**		
	Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.	15, 20, 23, 28, 30, 32	
	Note: Authority cited: Section 10733.2, Water Code. Reference: Sections 10728, 10728.2, 10733.2 and 10733.8, Water Code.		
Article 7	**Annual Reports and Periodic Evaluations by the Agency**		
§ 356.2	**Annual Reports**		
	Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:		
	(a) General information, including an executive summary and a location map depicting the basin covered by the report.	7:11, 42	
	(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.	43:44	
	(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.	45:46, 58:86	
	(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.	14:15, 47:48	
	(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.	16:20	
	(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.	21:23	
	(5) Change in groundwater in storage shall include the following:		

California Code of Regulations - GSP Regulation Sections	*Groundwater Sustainability Plan Elements*	Document *page number(s) that address the applicable GSP element.*	*Notes: Briefly describe the GSP element does not apply.*
	(A) Change in groundwater in storage maps for each principal aquifer in the basin.	50	
	(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.	51	
	(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.	27:37	

APPENDIX B

Representative Monitoring Wells Data

Site Code: 349764N1188520W001 - White Wolf GSA

Site Code:
349764N1188520W001

Local Well Name:
RMW-WWB-001

Monitoring Network Type:
SGMA Representative

Station ID:
51673

Latitude:
34.9763

Longitude:
-118.853

Well Depth (feet bgs):
460.0

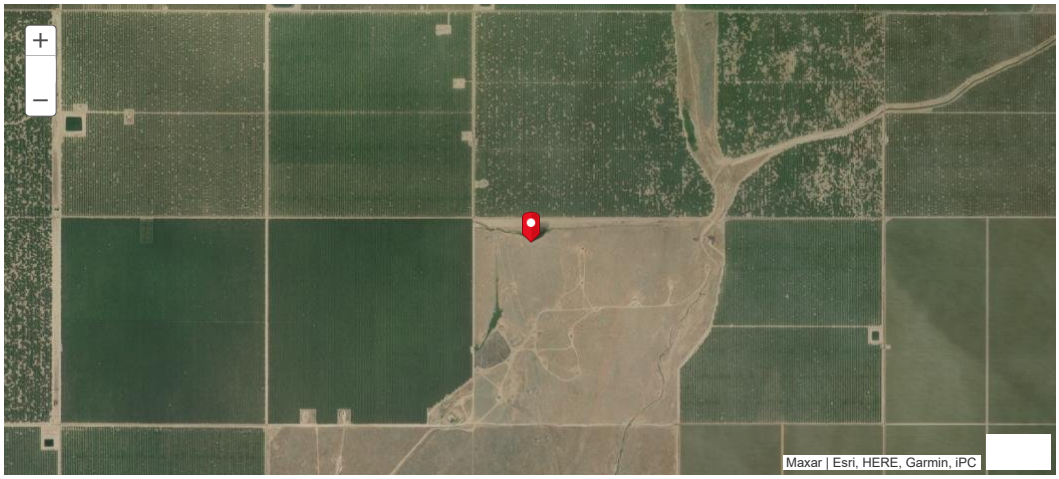
Top Perforation (feet bgs):
420.0

Bottom Perforation (feet bgs):
440.0

Ground Surface Elevation:
950.4

Reference Point Elevation:
951.74

Sustainability Indicators:
Groundwater Levels,Groundwater Storage



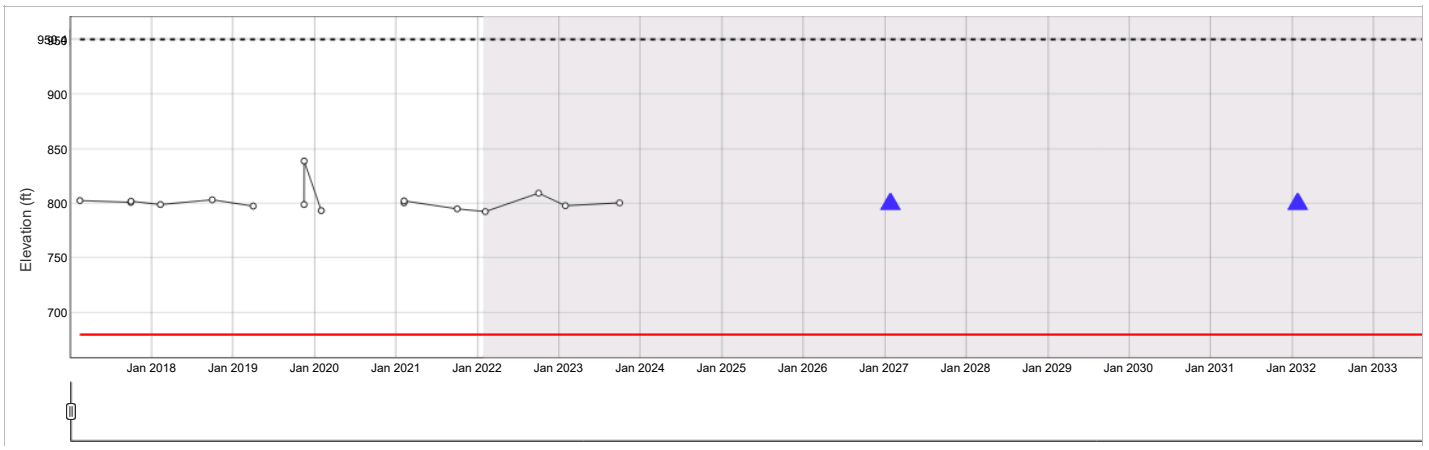
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Groundwater Elevations



Site Code: 349764N1188520W001 - White Wolf GSA

Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 680**
- **★ — Measurable Objective: 800**
- **▲ Interim Milestone**

5-Year : 800

10-Year : 800

15-Year : 800

— Minimum Threshold bgs: 270.40

★ Measurable Objective bgs: 150.40

▲ Interim Milestone

5-Year bgs : 150.40

10-Year bgs : 150.40

15-Year bgs : 150.40

Groundwater Elevations Table ›

Site Code: 349662N1189211W001 - White Wolf GSA

Site Code:
349662N1189211W001

Local Well Name:
RMW-WWB-002

Monitoring Network Type:
SGMA Representative

Station ID:
57817

Latitude:
34.9663

Longitude:
-118.921

Well Depth (feet bgs):
1765.0

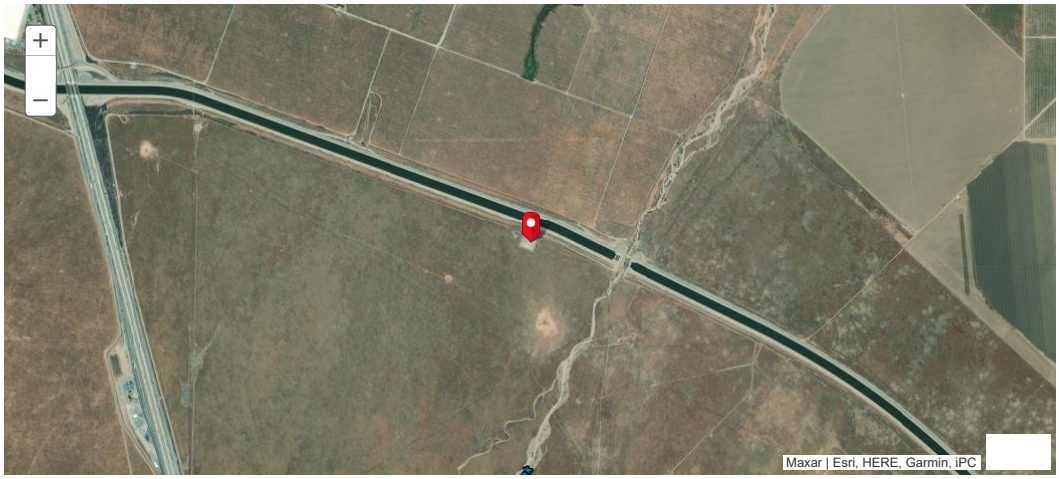
Top Perforation (feet bgs):
1100.0

Bottom Perforation (feet bgs):
1765.0

Ground Surface Elevation:
1250.2

Reference Point Elevation:
1251.93

Sustainability Indicators:
Groundwater Levels,Groundwater Storage,Land Subsidence



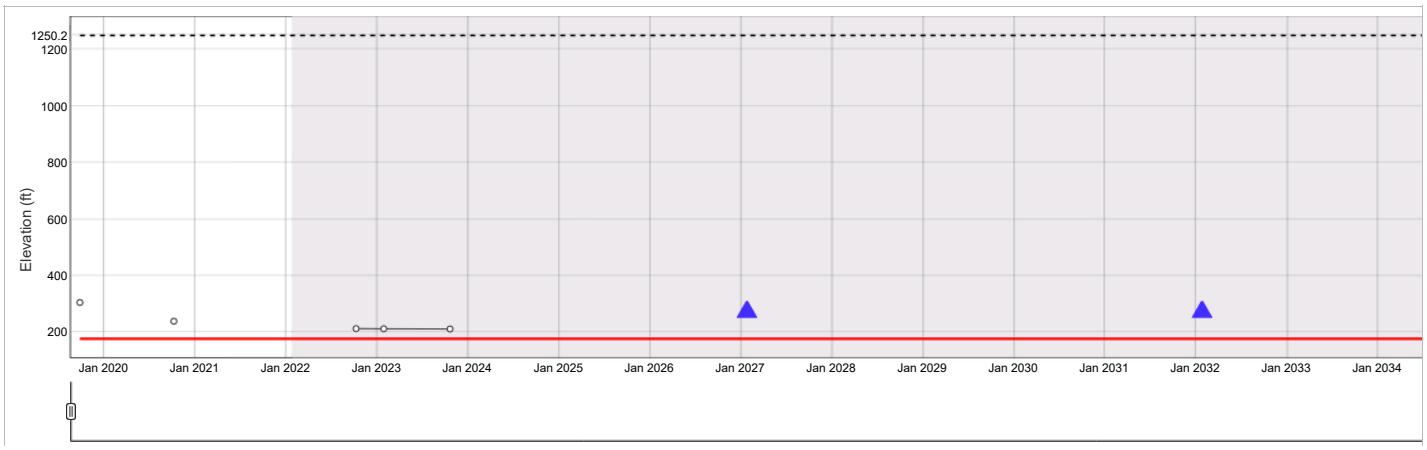
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Groundwater Elevations



Site Code: 349662N1189211W001 - White Wolf GSA

Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 177**
- **★ — Measurable Objective: 273**
- **▲ Interim Milestone**

5-Year : 273

10-Year : 273

15-Year : 273

— Minimum Threshold bgs: 1073.20

★ Measurable Objective bgs: 977.20

▲ Interim Milestone

5-Year bgs : 977.20

10-Year bgs : 977.20

15-Year bgs : 977.20

Groundwater Elevations Table ›

Site Code: 349836N1189228W001 - White Wolf GSA

Site Code:

349836N1189228W001

Local Well Name:

RMW-WWB-003

Monitoring Network Type:

SGMA Representative

Station ID:

32402

Latitude:

34.977

Longitude:

-118.958

Well Depth (feet bgs):

1765.0

Top Perforation (feet bgs):

1100.0

Bottom Perforation (feet bgs):

1765.0

Ground Surface Elevation:

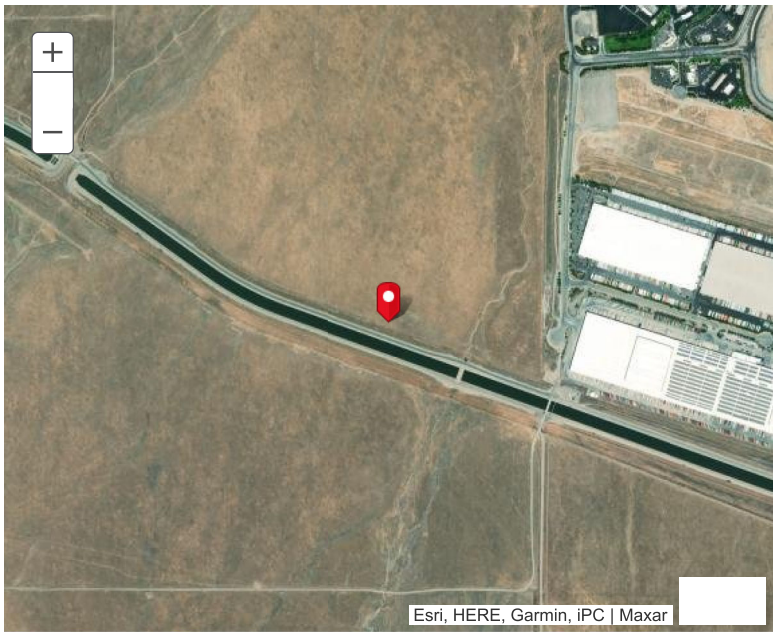
1239.98

Reference Point Elevation:

1240.7

Sustainability Indicators:

Groundwater Levels,Groundwater Storage,Land Subsidence



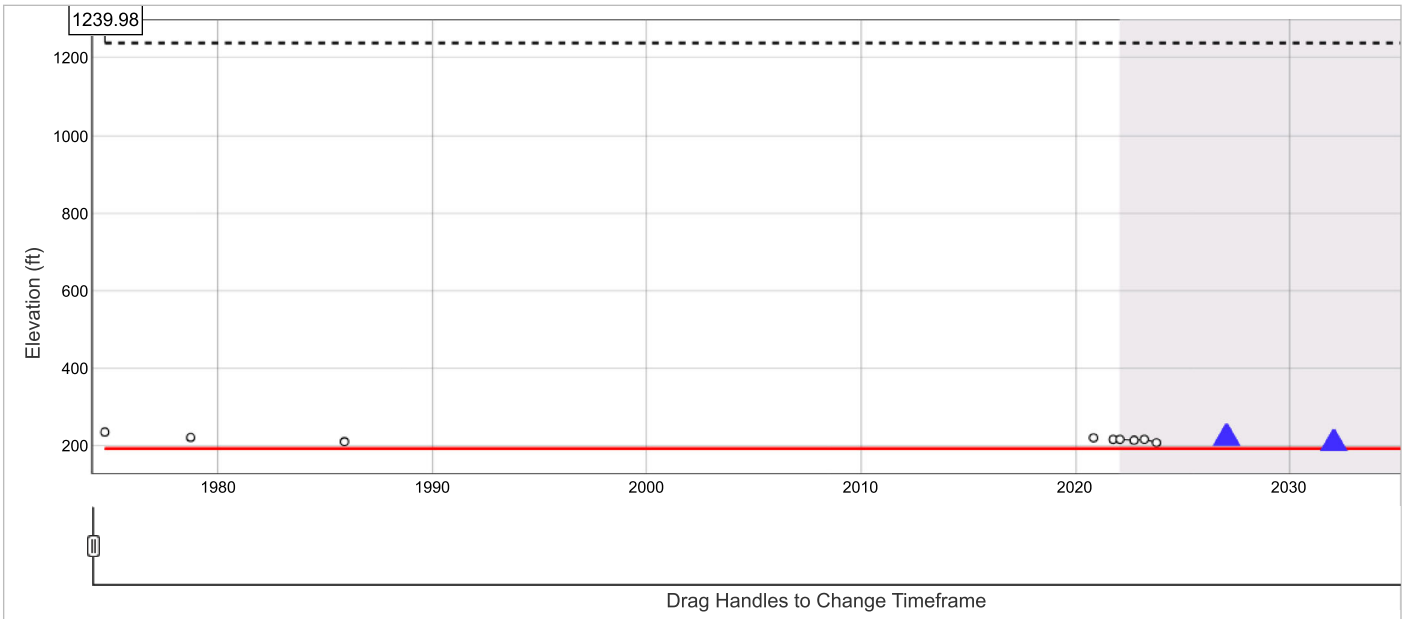
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 349836N1189228W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **Ground Surface:**
- **Groundwater Elevation:**
- **Depth to Groundwater:**
- **Minimum Threshold:** 196
- **Measurable Objective:** 252
- **Interim Milestone**

5-Year : 224
10-Year : 210
15-Year : 231

Minimum Threshold bgs: 1038.53
Measurable Objective bgs: 982.53
Interim Milestone
5-Year bgs : 1010.53
10-Year bgs : 1024.53
15-Year bgs : 1003.53

Groundwater Elevations Table

Site Code: 350308N1188465W001 - White Wolf GSA

Site Code:

350308N1188465W001

Local Well Name:

RMW-WWB-004

Monitoring Network Type:

SGMA Representative

Station ID:

10720

Latitude:

35.0307

Longitude:

-118.846

Well Depth (feet bgs):

984.0

Top Perforation (feet bgs):

432.0

Bottom Perforation (feet bgs):

978.0

Ground Surface Elevation:

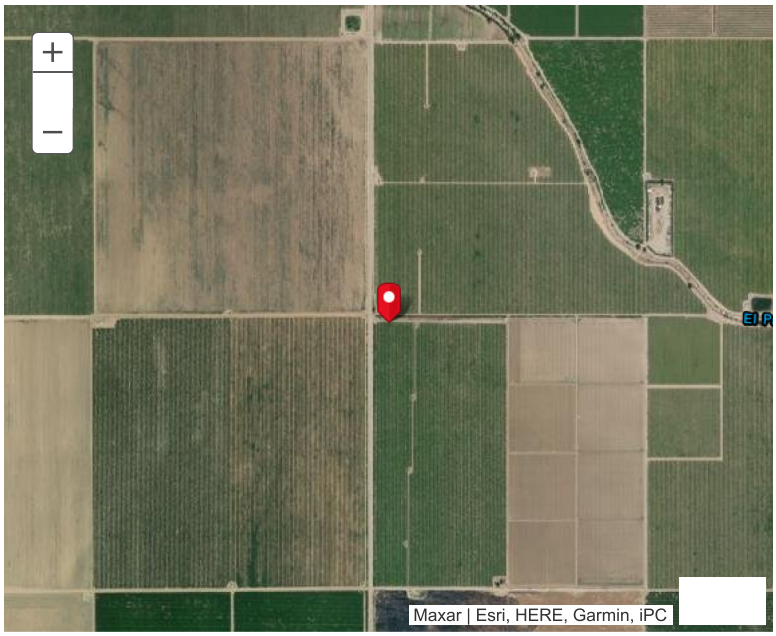
717.89

Reference Point Elevation:

720.1

Sustainability Indicators:

Groundwater Levels,Groundwater Storage



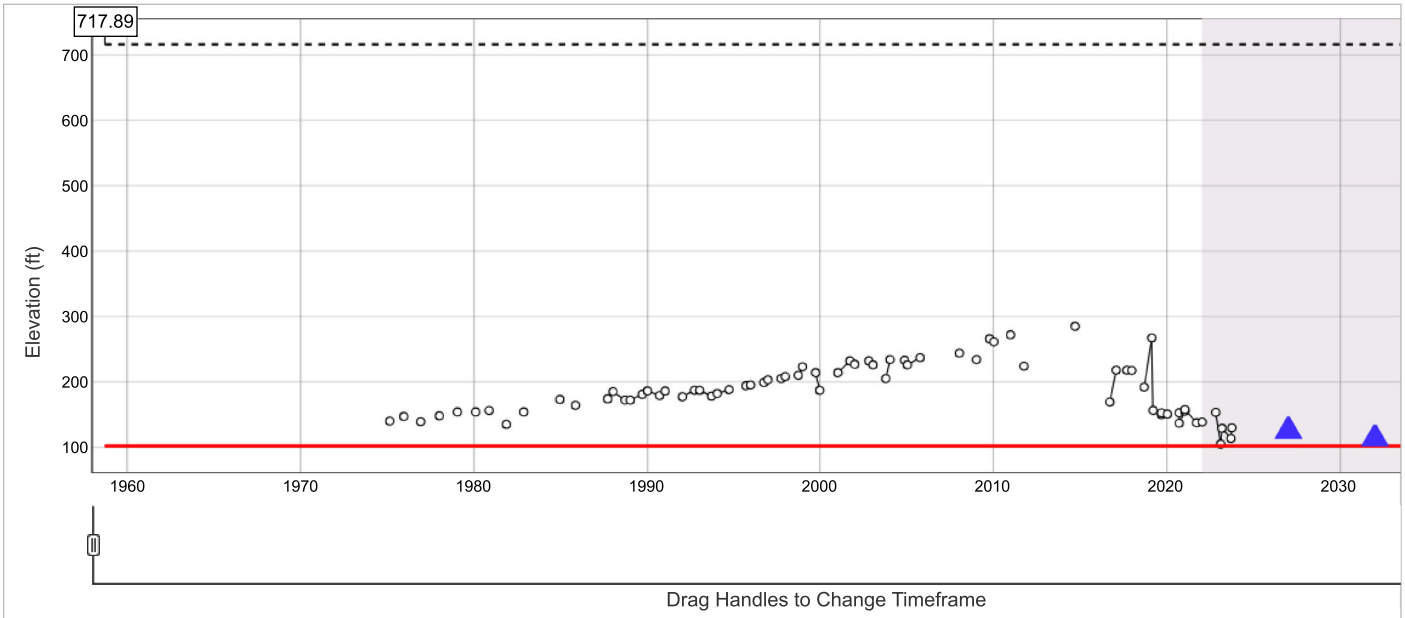
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 350308N1188465W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **Ground Surface:**
- **Groundwater Elevation:**
- **Depth to Groundwater:**
- **Minimum Threshold:** 103
- **Measurable Objective:** 151
- **Interim Milestone**

5-Year : 127
10-Year : 115
15-Year : 133

Minimum Threshold bgs: 613.52
Measurable Objective bgs: 565.52
Interim Milestone
5-Year bgs : 589.52
10-Year bgs : 601.52
15-Year bgs : 583.52

Groundwater Elevations Table

Site Code: 350527N1189099W001 - White Wolf GSA

Site Code:

350527N1189099W001

Local Well Name:

RMW-WWB-005

Monitoring Network Type:

SGMA Representative

Station ID:

11412

Latitude:

35.0529

Longitude:

-118.909

Well Depth (feet bgs):

1385.0

Top Perforation (feet bgs):

253.0

Bottom Perforation (feet bgs):

1385.0

Ground Surface Elevation:

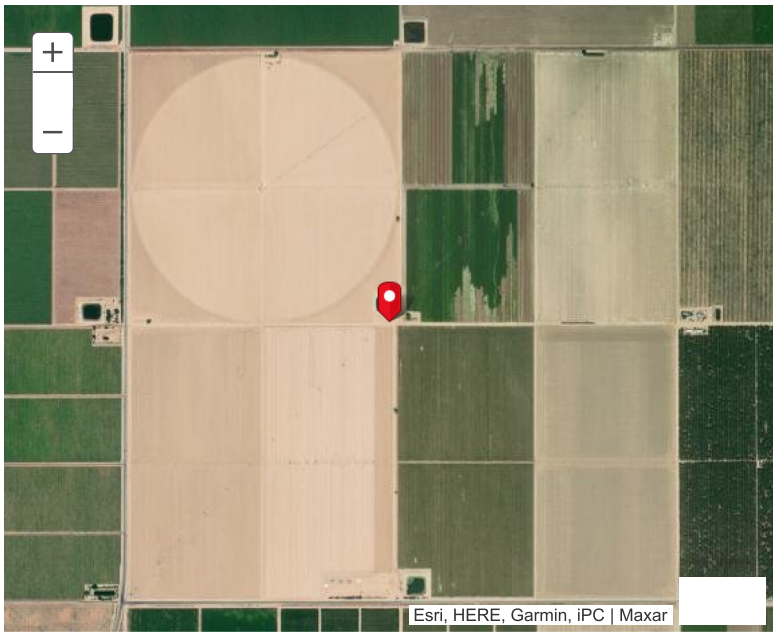
647.32

Reference Point Elevation:

648.56

Sustainability Indicators:

Groundwater Levels,Groundwater Storage



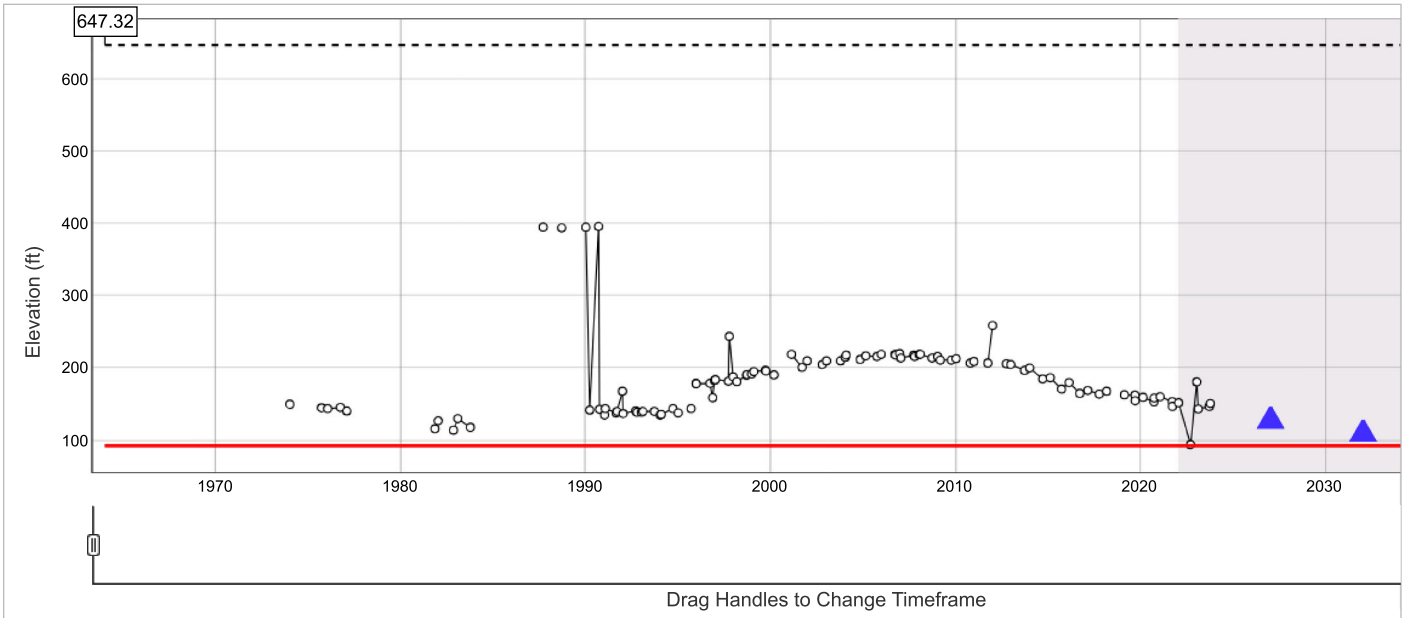
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 350527N1189099W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 93**
- **★ — Measurable Objective: 162**
- **▲ Interim Milestone**

5-Year : 128

10-Year : 110

15-Year : 136

— Minimum Threshold bgs: 553.54

★ Measurable Objective bgs: 484.54

▲ Interim Milestone

5-Year bgs : 518.54

10-Year bgs : 536.54

15-Year bgs : 510.54

Groundwater Elevations Table ›

Site Code: 350456N1188291W001 - White Wolf GSA

Site Code:
350456N1188291W001

Local Well Name:
RMW-WWB-006

Monitoring Network Type:
SGMA Representative

Station ID:
57818

Latitude:
35.0456

Longitude:
-118.829

Well Depth (feet bgs):
1020.0

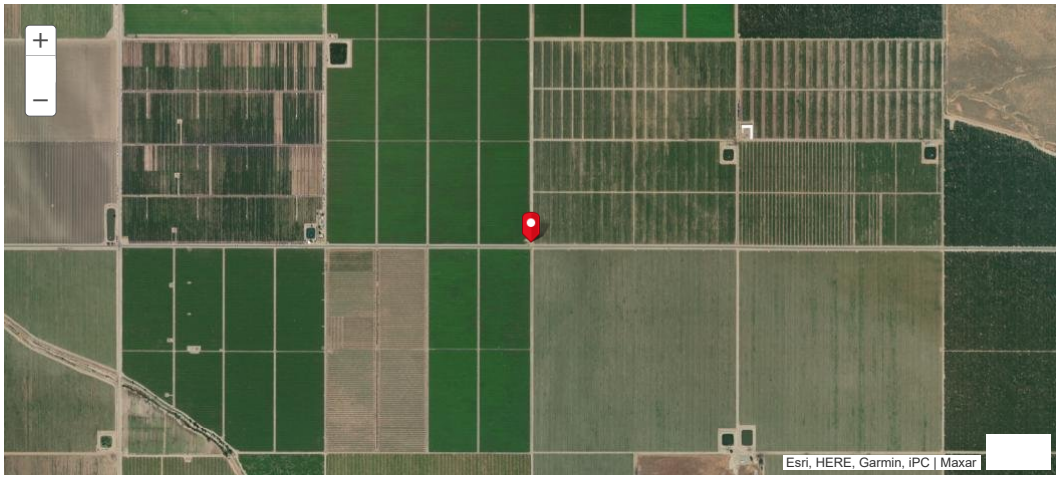
Top Perforation (feet bgs):
500.0

Bottom Perforation (feet bgs):
1000.0

Ground Surface Elevation:
713.67

Reference Point Elevation:
715.07

Sustainability Indicators:
Groundwater Levels,Groundwater Storage

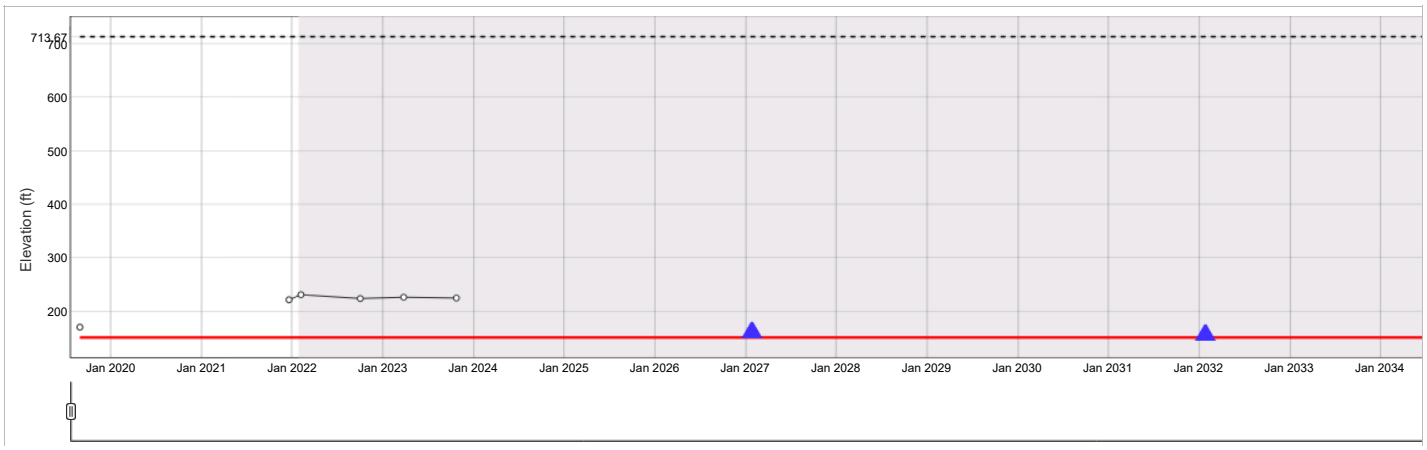


Download Well Data

Well Completion Report

No lithology data found.

Groundwater Elevations



Site Code: 350456N1188291W001 - White Wolf GSA

Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 152**
- **★ — Measurable Objective: 171**
- **▲ Interim Milestone**

5-Year : 162

10-Year : 157

15-Year : 164

— Minimum Threshold bgs: 561.67

★ Measurable Objective bgs: 542.67

▲ Interim Milestone

5-Year bgs : 551.67

10-Year bgs : 556.67

15-Year bgs : 549.67

Groundwater Elevations Table ›

Site Code: 350414N1188913W001 - White Wolf GSA

Site Code:

350414N1188913W001

Local Well Name:

RMW-WWB-007

Monitoring Network Type:

SGMA Representative

Station ID:

38978

Latitude:

35.0416

Longitude:

-118.891

Well Depth (feet bgs):

831.0

Top Perforation (feet bgs):

450.0

Bottom Perforation (feet bgs):

831.0

Ground Surface Elevation:

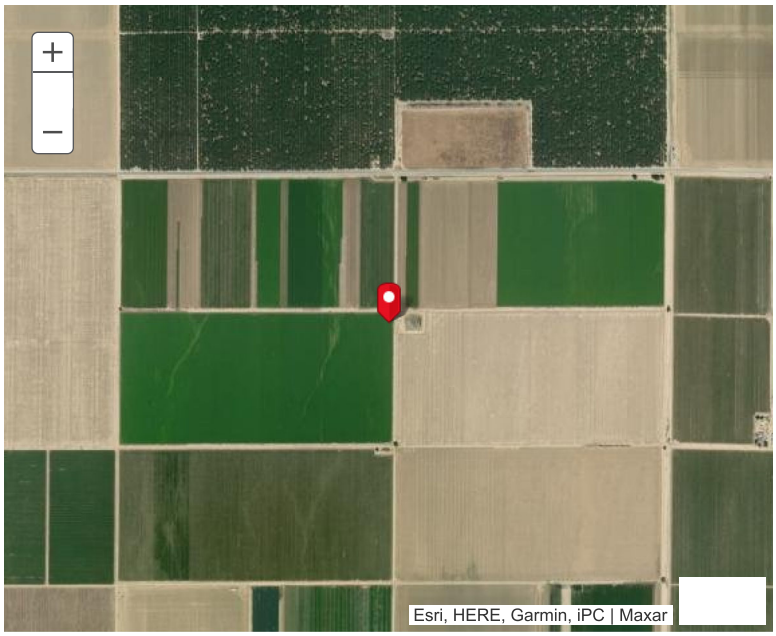
702.72

Reference Point Elevation:

706.37

Sustainability Indicators:

Groundwater Levels,Groundwater Storage



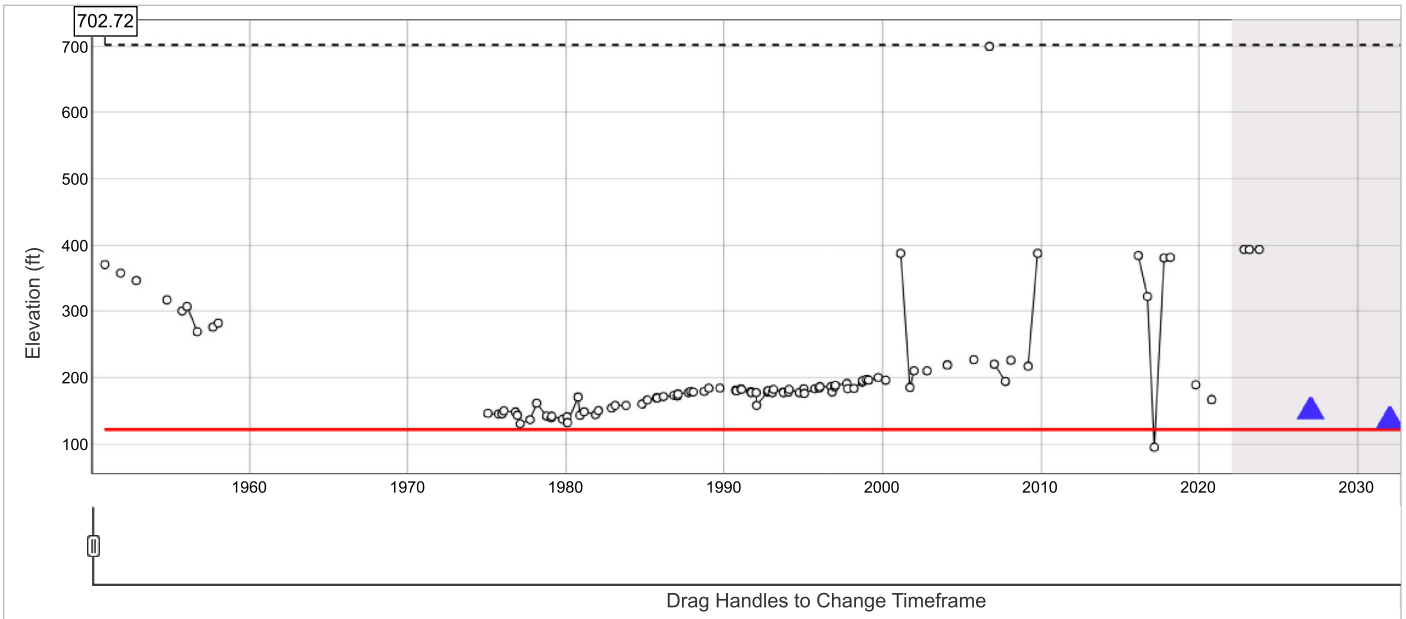
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 350414N1188913W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **Ground Surface:**
- **Groundwater Elevation:**
- **Depth to Groundwater:**
- **Minimum Threshold:** 123
- **Measurable Objective:** 180
- **Interim Milestone**

5-Year : 151
10-Year : 137
15-Year : 159

Minimum Threshold bgs: 577.53
Measurable Objective bgs: 520.53
Interim Milestone
5-Year bgs : 549.53
10-Year bgs : 563.53
15-Year bgs : 541.53

Groundwater Elevations Table

Site Code: 350211N1189452W001 - White Wolf GSA

Site Code:

350211N1189452W001

Local Well Name:

RMW-WWB-008

Monitoring Network Type:

SGMA Representative

Station ID:

30725

Latitude:

35.0211

Longitude:

-118.944

Well Depth (feet bgs):

1160.0

Top Perforation (feet bgs):

458.0

Bottom Perforation (feet bgs):

1160.0

Ground Surface Elevation:

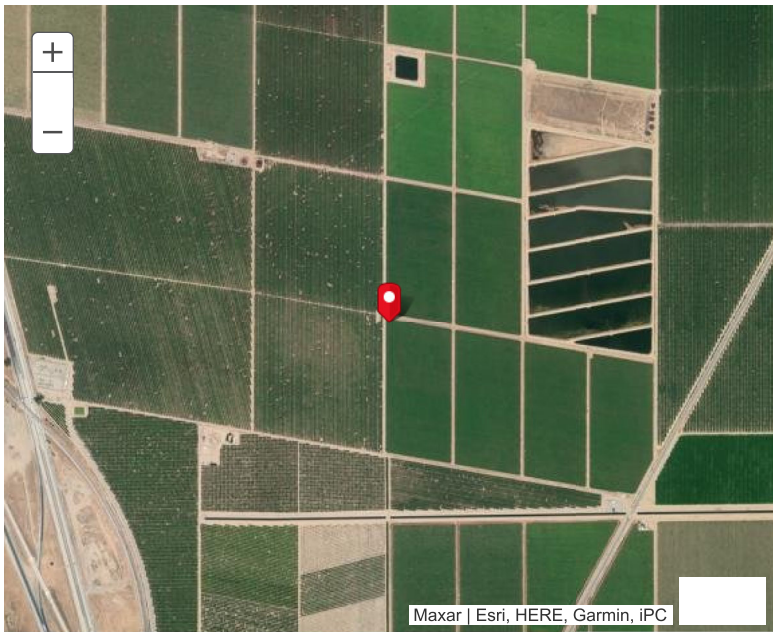
817.24

Reference Point Elevation:

818.11

Sustainability Indicators:

Groundwater Levels,Groundwater Storage,Land Subsidence



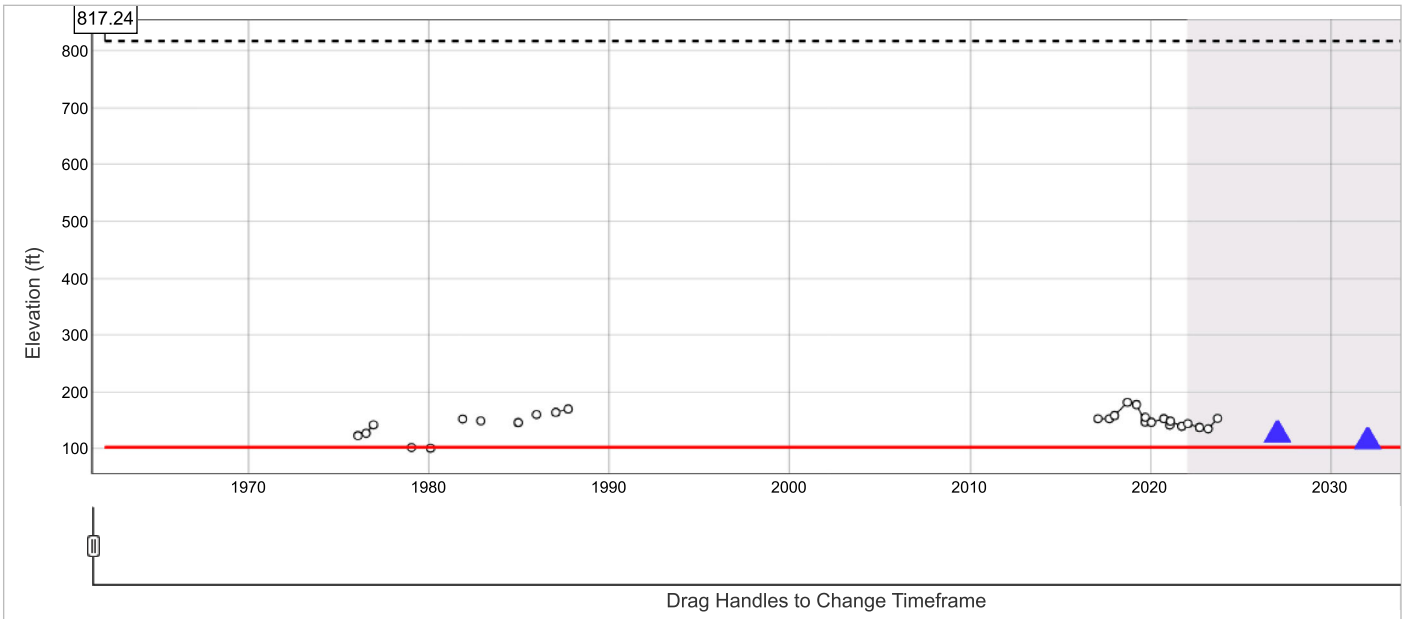
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 350211N1189452W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **Ground Surface:**
- **Groundwater Elevation:**
- **Depth to Groundwater:**
- **Minimum Threshold:** 104
- **Measurable Objective:** 149
- **Interim Milestone**

5-Year : 127
10-Year : 115
15-Year : 132

Minimum Threshold bgs: 711.53
Measurable Objective bgs: 666.53
Interim Milestone
5-Year bgs : 688.53
10-Year bgs : 700.53
15-Year bgs : 683.53

Groundwater Elevations Table

Site Code: 350144N1188901W001 - White Wolf GSA

Site Code:
350144N1188901W001

Local Well Name:
RMW-WWB-009

Monitoring Network Type:
SGMA Representative

Station ID:
51678

Latitude:
35.0145

Longitude:
-118.891

Well Depth (feet bgs):
1493.0

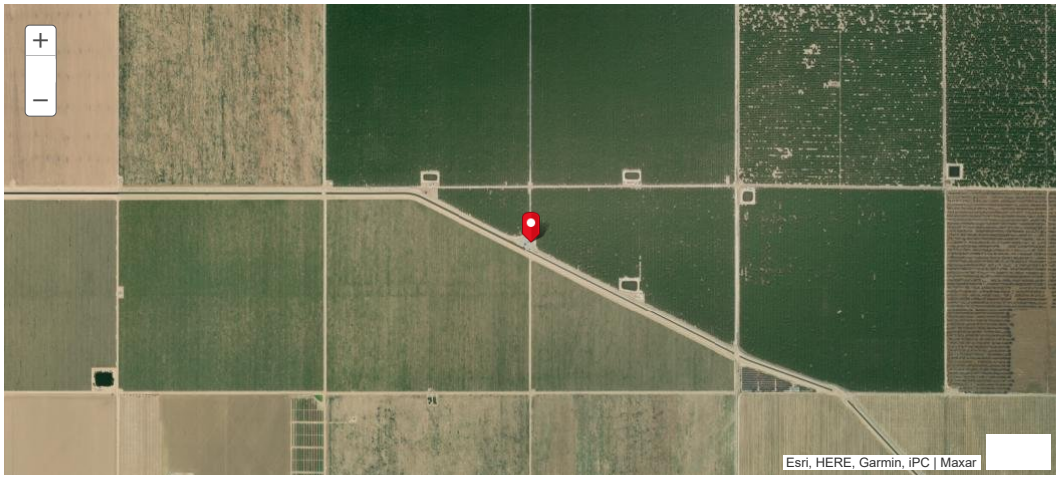
Top Perforation (feet bgs):
900.0

Bottom Perforation (feet bgs):
1483.0

Ground Surface Elevation:
855.86

Reference Point Elevation:
857.27

Sustainability Indicators:
Groundwater Levels,Groundwater Storage,Land Subsidence,Water Quality



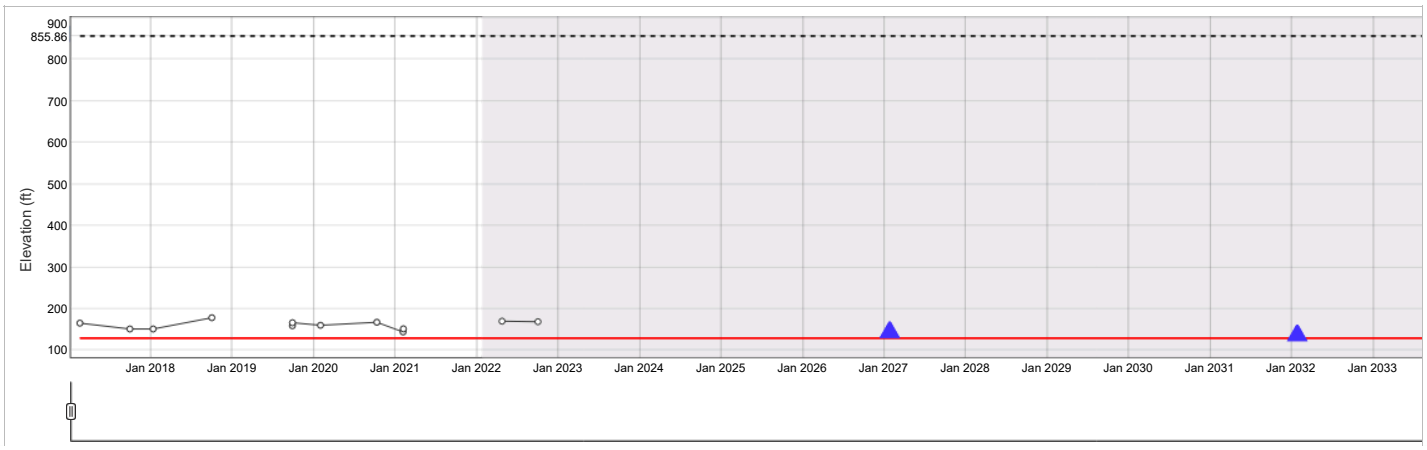
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Groundwater Elevations



Site Code: 350144N1188901W001 - White Wolf GSA

Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 130**
- **★ — Measurable Objective: 160**
- **▲ Interim Milestone**

5-Year : 145

10-Year : 137

15-Year : 148

— Minimum Threshold bgs: 725.86

★ Measurable Objective bgs: 695.86

▲ Interim Milestone

5-Year bgs : 710.86

10-Year bgs : 718.86

15-Year bgs : 707.86

Groundwater Elevations Table ›

Site Code: 350033N1189366W001 - White Wolf GSA

Site Code:

350033N1189366W001

Local Well Name:

RMW-WWB-010

Monitoring Network Type:

SGMA Representative

Station ID:

30732

Latitude:

35.0019

Longitude:

-118.932

Well Depth (feet bgs):

1220.0

Top Perforation (feet bgs):

651.0

Bottom Perforation (feet bgs):

1220.0

Ground Surface Elevation:

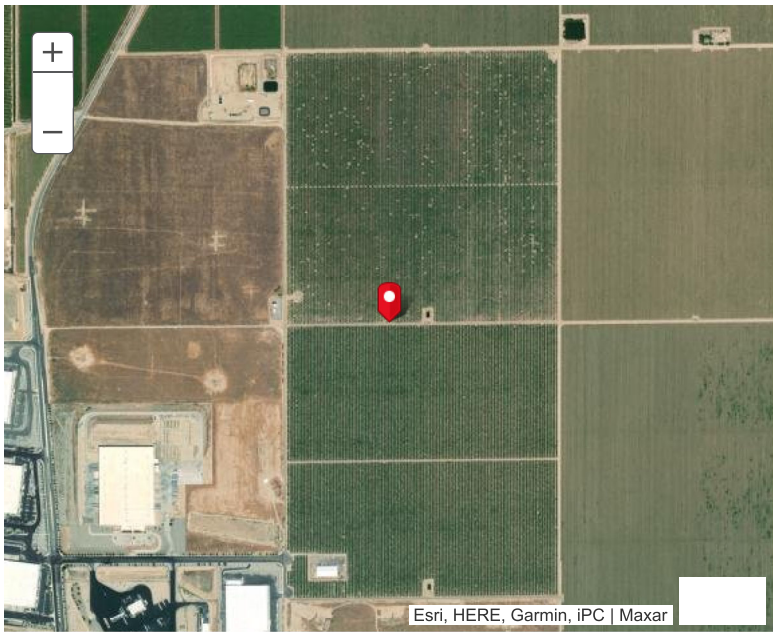
961.03

Reference Point Elevation:

961.19

Sustainability Indicators:

Groundwater Levels,Groundwater Storage



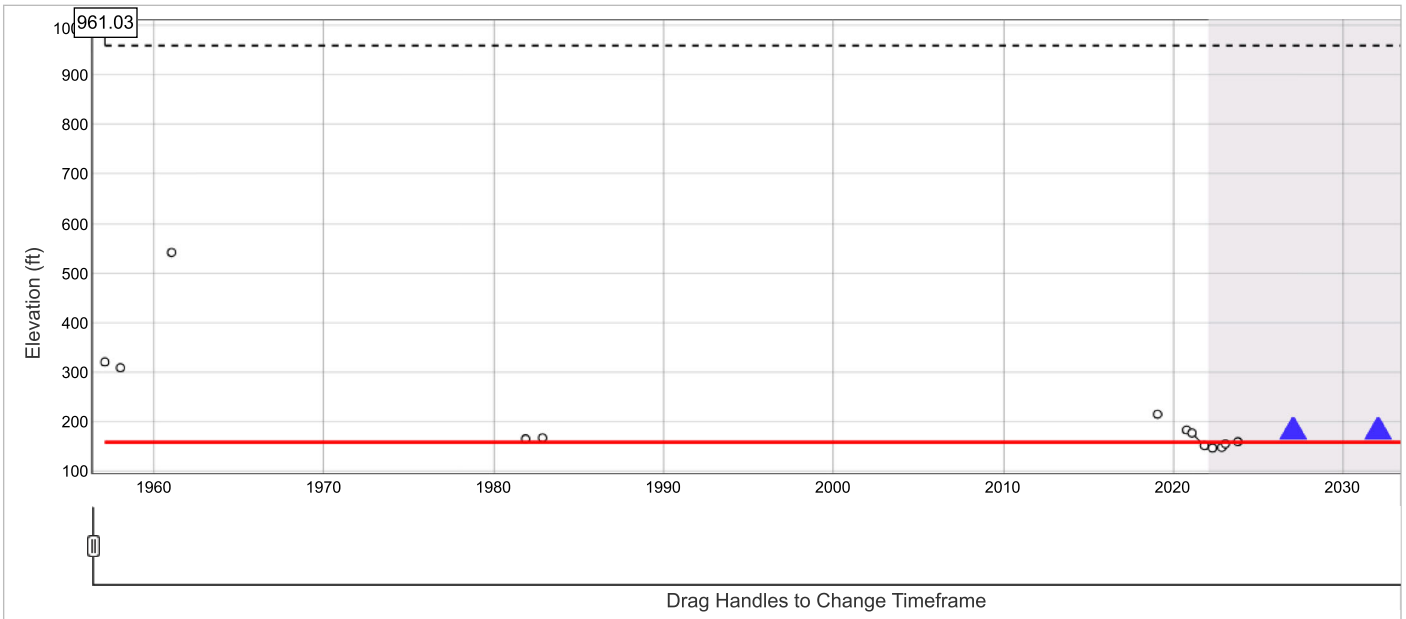
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 350033N1189366W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **Ground Surface:**
- **Groundwater Elevation:**
- **Depth to Groundwater:**
- **Minimum Threshold:** 159
- **Measurable Objective:** 181
- **Interim Milestone**

5-Year : 181
10-Year : 181
15-Year : 181

Minimum Threshold bgs: 803.52
Measurable Objective bgs: 781.52
Interim Milestone
5-Year bgs : 781.52
10-Year bgs : 781.52
15-Year bgs : 781.52

Groundwater Elevations Table

Site Code: 349976N1188463W001 - White Wolf GSA

Site Code:

349976N1188463W001

Local Well Name:

RMW-WWB-011

Monitoring Network Type:

SGMA Representative

Station ID:

51681

Latitude:

34.9975

Longitude:

-118.847

Well Depth (feet bgs):

1000.0

Top Perforation (feet bgs):

960.0

Bottom Perforation (feet bgs):

1000.0

Ground Surface Elevation:

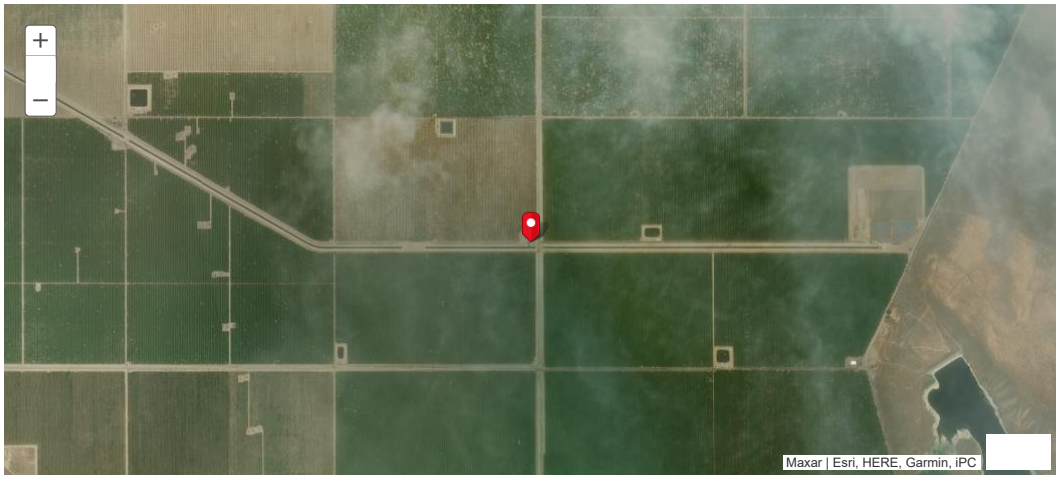
849.48

Reference Point Elevation:

849.52

Sustainability Indicators:

Groundwater Levels,Groundwater Storage,Land Subsidence



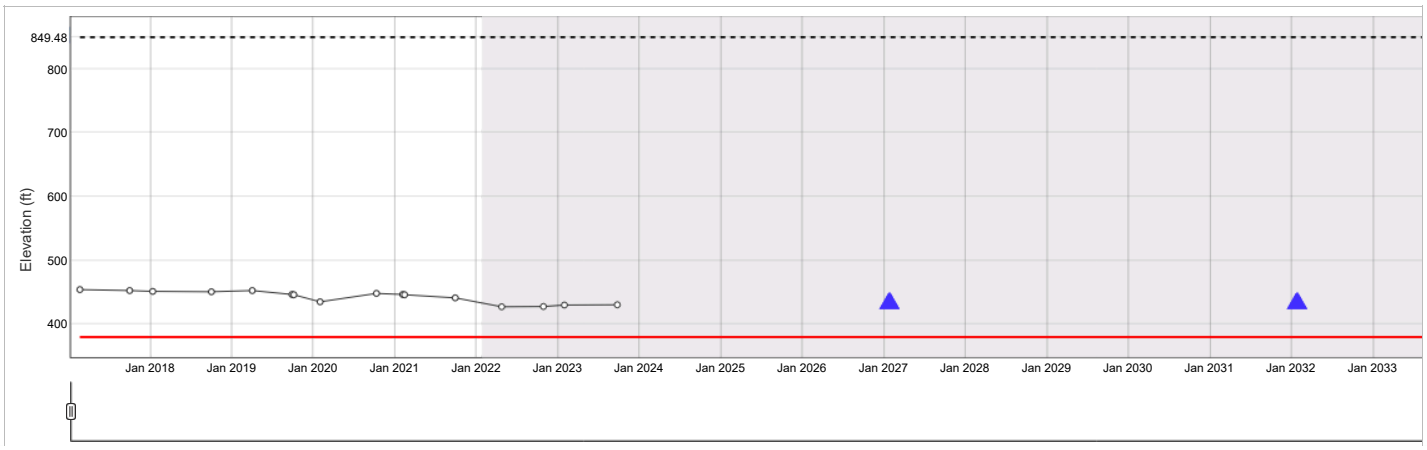
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Groundwater Elevations



Site Code: 349976N1188463W001 - White Wolf GSA

Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 380**
- **★ — Measurable Objective: 433**
- **▲ Interim Milestone**

5-Year : 433

10-Year : 433

15-Year : 433

— Minimum Threshold bgs: 469.48

★ Measurable Objective bgs: 416.48

▲ Interim Milestone

5-Year bgs : 416.48

10-Year bgs : 416.48

15-Year bgs : 416.48

Groundwater Elevations Table ›

Site Code: 350750N1188828W001 - White Wolf GSA

Site Code:

350750N1188828W001

Local Well Name:

RMW-WWB-012

Monitoring Network Type:

SGMA Representative

Station ID:

33852

Latitude:

35.0753

Longitude:

-118.883

Well Depth (feet bgs):

1206.0

Top Perforation (feet bgs):

240.0

Bottom Perforation (feet bgs):

1206.0

Ground Surface Elevation:

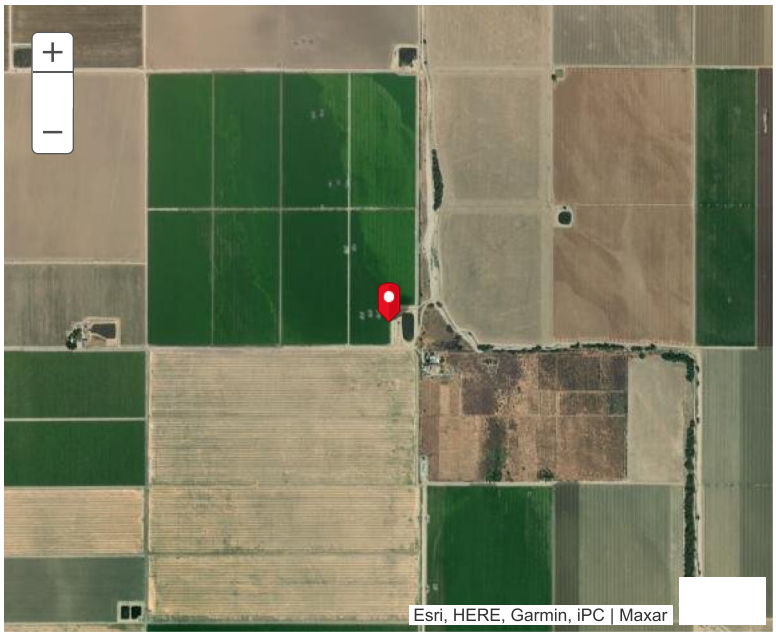
558.73

Reference Point Elevation:

560.81

Sustainability Indicators:

Groundwater Levels,Groundwater Storage



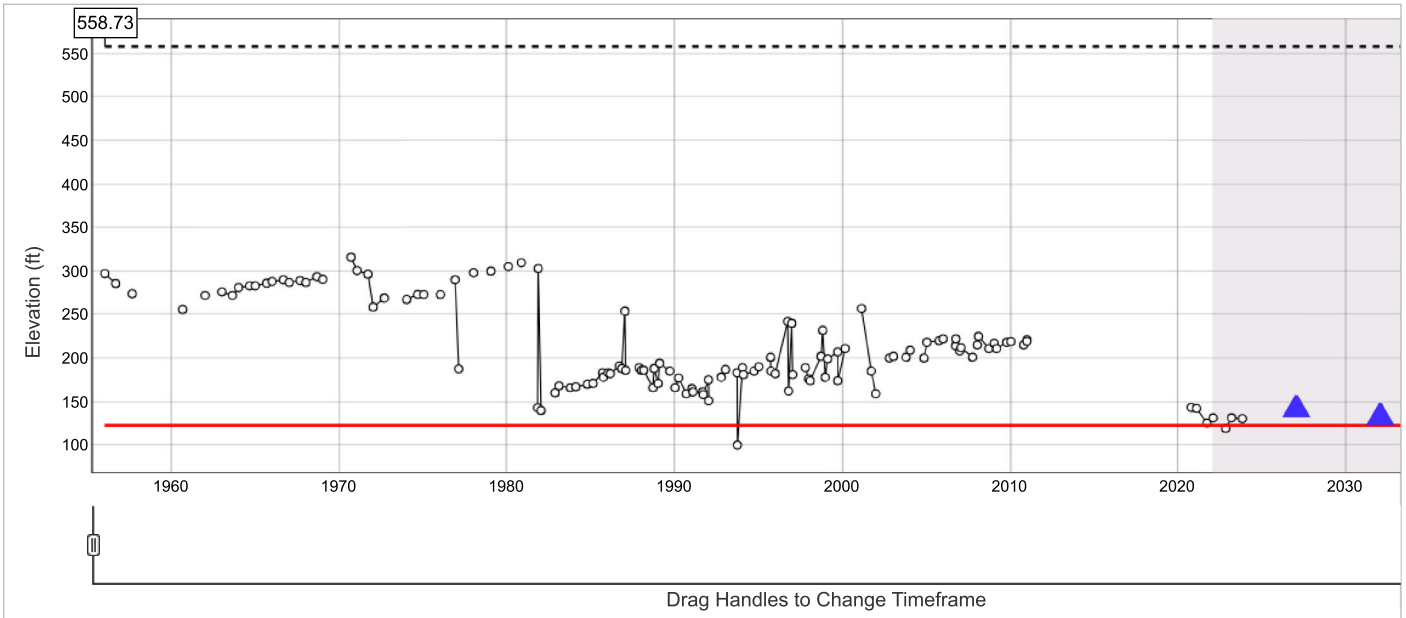
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 350750N1188828W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 123**
- **★ — Measurable Objective: 161**
- **▲ Interim Milestone**

5-Year : 142

10-Year : 133

15-Year : 147

— Minimum Threshold bgs: 439.54

★ Measurable Objective bgs: 401.54

▲ Interim Milestone

5-Year bgs : 420.54

10-Year bgs : 429.54

15-Year bgs : 415.54

Groundwater Elevations Table

Site Code: 350750N1188518W001 - White Wolf GSA

Site Code:

350750N1188518W001

Local Well Name:

RMW-WWB-013

Monitoring Network Type:

SGMA Representative

Station ID:

33853

Latitude:

35.0747

Longitude:

-118.851

Well Depth (feet bgs):

940.0

Top Perforation (feet bgs):

Bottom Perforation (feet bgs):

Ground Surface Elevation:

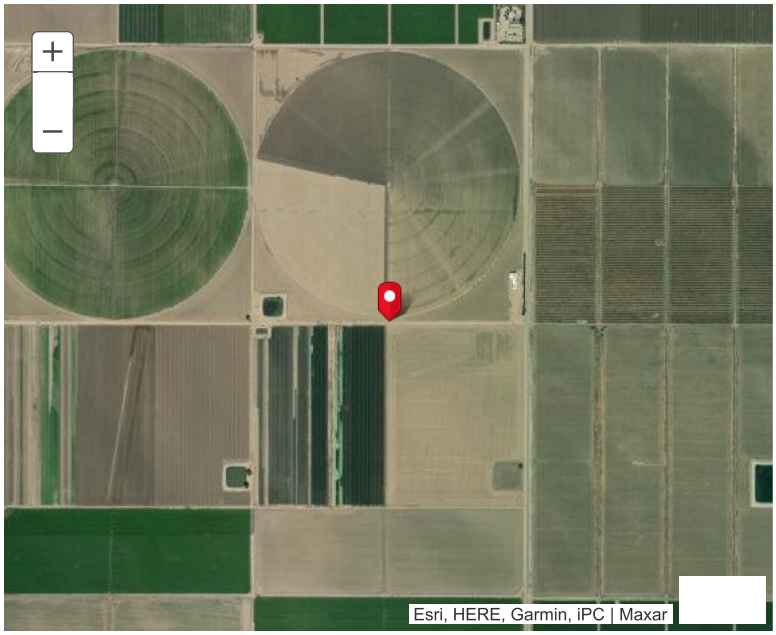
603.62

Reference Point Elevation:

604.5

Sustainability Indicators:

Groundwater Levels,Groundwater Storage



Topographic

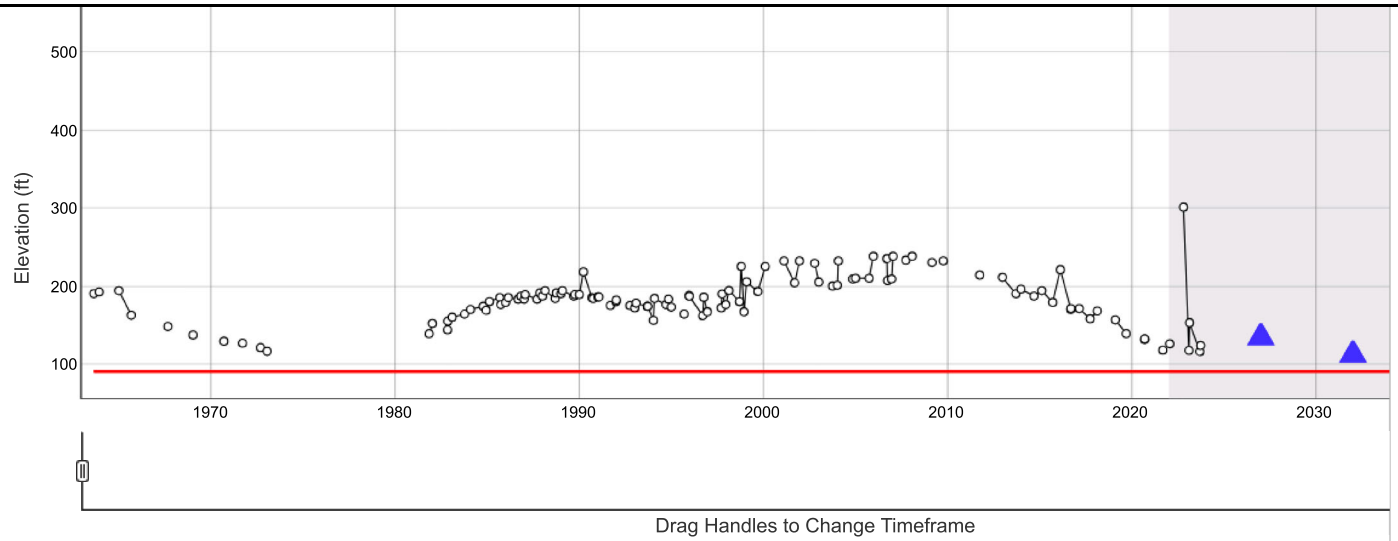
Download Well Data

Well Completion Report

No lithology data found.

Groundwater Elevations

Site Code: 350750N1188518W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **- - Ground Surface:**
- **— Groundwater Elevation:**
- **— Depth to Groundwater:**
- **— Minimum Threshold: 92**
- **★ — Measurable Objective: 181**
- **▲ Interim Milestone**

5-Year : 136

10-Year : 114

15-Year : 147

— Minimum Threshold bgs: 512.55

★ Measurable Objective bgs: 423.55

▲ Interim Milestone

5-Year bgs : 468.55

10-Year bgs : 490.55

15-Year bgs : 457.55

Groundwater Elevations Table ›

Site Code: 351036N1188640W001 - White Wolf GSA

Site Code:

351036N1188640W001

Local Well Name:

RMW-WWB-014

Monitoring Network Type:

SGMA Representative

Station ID:

23152

Latitude:

35.1002

Longitude:

-118.869

Well Depth (feet bgs):

1004.0

Top Perforation (feet bgs):

300.0

Bottom Perforation (feet bgs):

1000.0

Ground Surface Elevation:

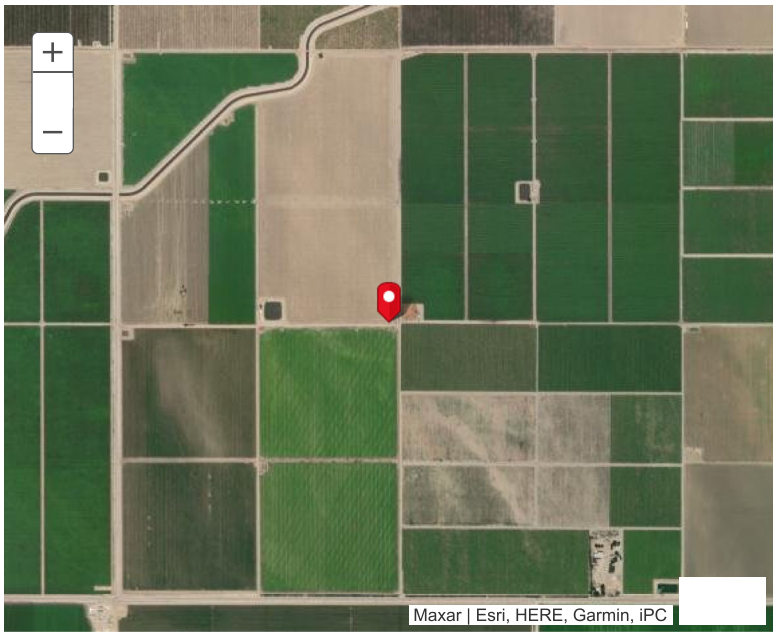
519.98

Reference Point Elevation:

520.2

Sustainability Indicators:

Groundwater Levels,Groundwater Storage,Water Quality



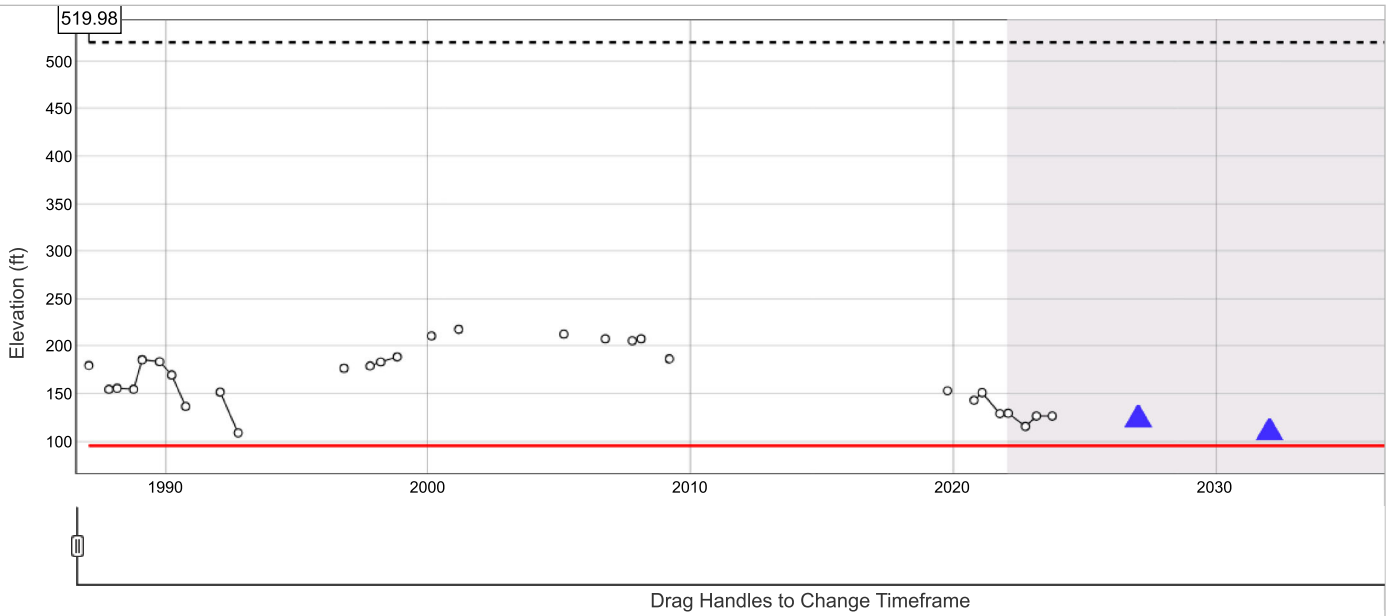
Topographic

Download Well Data

Well Completion Report

No lithology data found.

Site Code: 351036N1188640W001 - White Wolf GSA



Date: (hover to see values)

Sustainable Management Criteria
(Elevation, feet)
Sustainable Management Criteria
(Depth to Groundwater, feet below ground surface)

- **Ground Surface:**
- **Groundwater Elevation:**
- **Depth to Groundwater:**
- **Minimum Threshold:** 96
- ★ **Measurable Objective:** 151
- ▲ **Interim Milestone**

5-Year : 124
10-Year : 110
15-Year : 130

Minimum Threshold bgs: 418.36
★ **Measurable Objective bgs:** 363.36
▲ **Interim Milestone**
5-Year bgs : 390.36
10-Year bgs : 404.36
15-Year bgs : 384.36

Groundwater Elevations Table ›

APPENDIX C

Activities Supporting Interconnected Surface Water Monitoring

STREAMFLOW METER INSTALLATION AND DATA GAP FILLING EFFORTS

As discussed in Section 17.4 of the Groundwater Sustainability Plan (GSP) for the White Wolf Subbasin (Basin), there is limited quantification of stream inflows to the Basin. For the White Wolf Groundwater Flow Model (WWGFM) to quantify inflows from surrounding watersheds more accurately, streamflow data is needed. Therefore, the White Wolf Groundwater Sustainability Agency (GSA) installed a Pulsar Instruments 2.0 water level-velocity meter (streamflow meter) in El Paso creek to measure streamflow at the Basin boundary.

The White Wolf GSA submitted a Lake and Streambed Alteration (LSA) Application to California Department of Fish and Wildlife (CDFW) Region 4 on 4 November 2021. On 10 December 2021, CDFW determined an LSA Permit was not required for the installation. Pursuant to requirements of the LSA Application, a California Environmental Quality Act (CEQA) Notice of Exemption was posted by the Kern County Clerk on 30 July 2021 for the streamflow meter installation. The streamflow meter was installed on 3 May 2022 in El Paso Creek, upstream of Reservoir 2 (see **Figure 1**). A picture of the installed streamflow meter is shown in **Figure 2**.

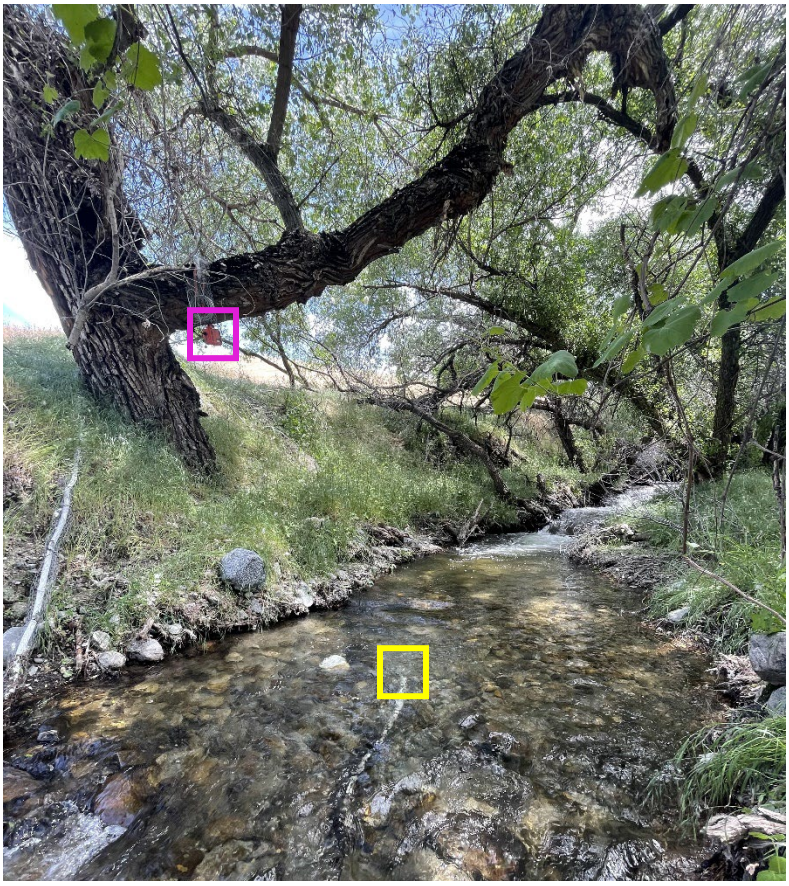


Figure 2. Pulsar Instruments Stingray 2.0 streamflow meter Installation on El Paso Creek. Yellow box indicates the location of the sensor collecting velocity and water level measurements. Pink square indicates the data logging system. Photo above is from 15 May 2023 (~roughly one year after install).

The streamflow meter records data every hour, including stream temperature in Celsius (°C), water level above the streamflow meter sensor in feet (ft), and velocity in feet per second (ft/s). Flow is calculated as velocity multiplied by a simplified trapezoidal cross sectional area over time (taking water level from the streamflow meter into account and the cross sectional area), and a scaling factor based on previously collected measurements of cross sectional flow.

During Water Year (WY) 2023, data was collected from the streamflow meter periodically and a measurement of cross sectional flow was taken. A graph of streamflow during WY 2023 is provided in **Figure 3**. Upon inspection in May 2023, the streamflow meter sensor (shown in the yellow box on **Figure 2**) was covered with large rocks

and streamflow measurements were not being collected. These rocks had been displaced from the upstream bed due to high volume streamflow through El Paso Creek. The rocks were removed, and functionality of the streamflow meter was restored on 1 November 2023.

In WY 2023, average daily streamflow in El Paso Creek ranged from an estimate of 0 cubic feet per second (cfs) to 16 cfs, with an average of 2 cfs (see **Figure 3**).

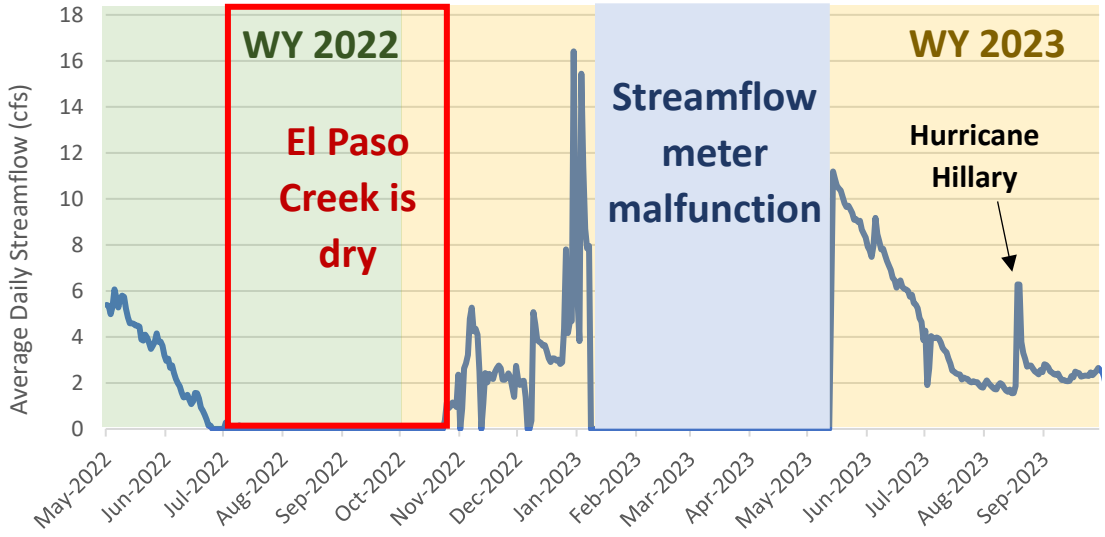


Figure 3. Average Daily Streamflow in El Paso Creek between May 2022 and September 2023.

During WY 2023, total monthly streamflow in El Paso Creek ranged from 0 AF to 411 AF with an average of 143 AF per month, as shown on **Figure 4** and in **Table 1**. In WY 2023, cumulative streamflow in El Paso Creek was 1,718 AF.[1]

[1] Data missing between 10 January 2023 through 15 May 2023 due to a streamflow meter malfunction.

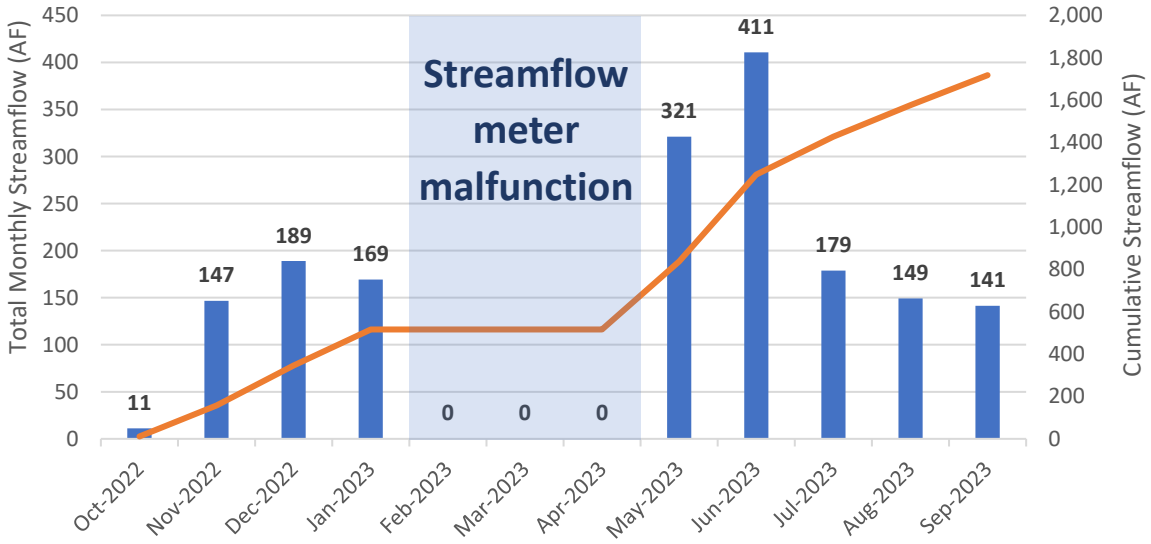


Figure 4. Monthly Streamflow in El Paso Creek between May 2022 and September 2023.

Table 1. Streamflow in El Paso Creek

Water Year	Total Monthly Streamflow (AF)			Cumulative Streamflow (AF)
	Minimum	Average	Maximum	
2022[a]	0	70	262	349
2023[b]	0	143	411	1,718

Abbreviations:

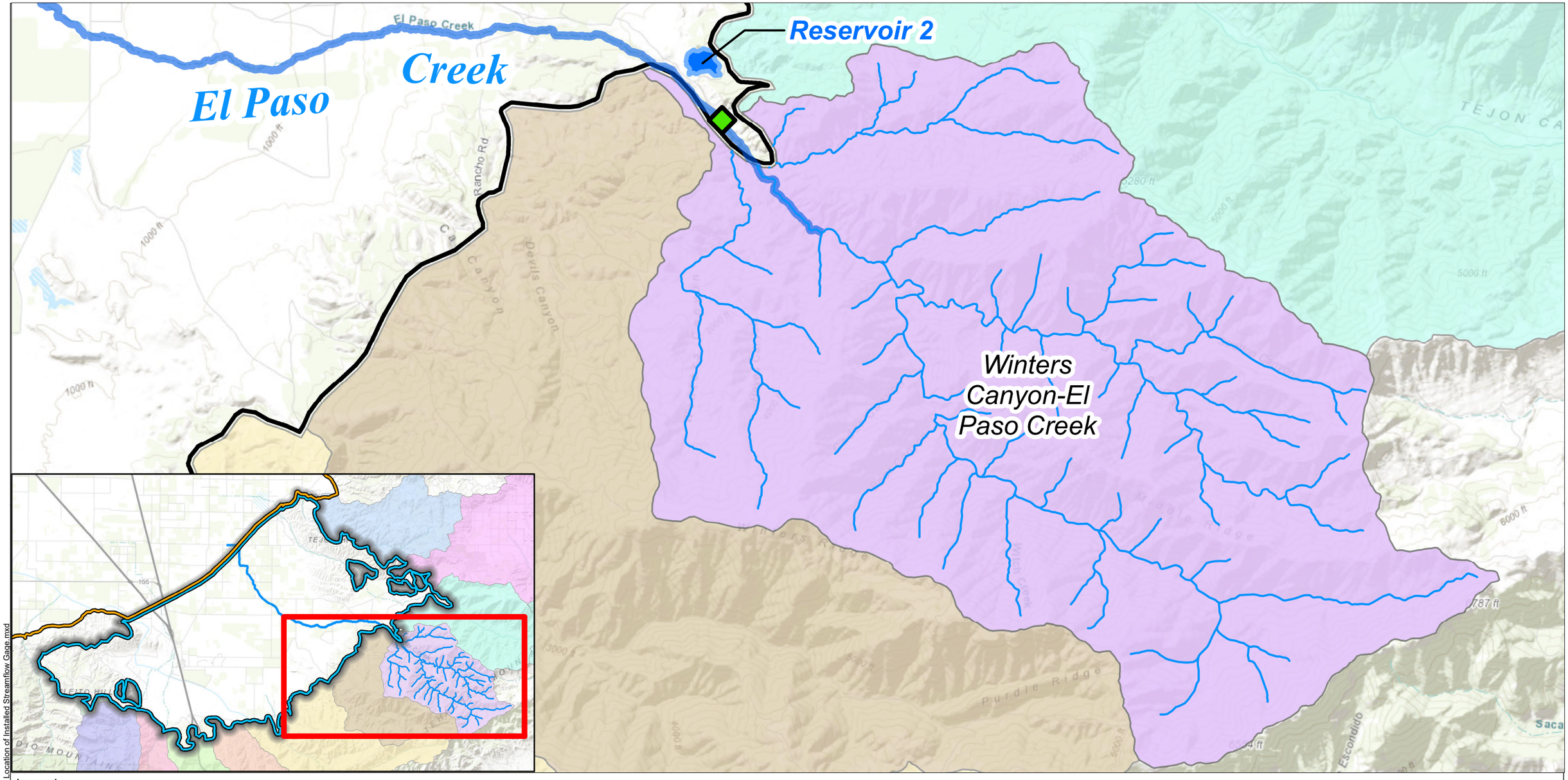
AF = acre-feet

Notes:

a) Streamflow meter was installed in May 2022 and thus only covers May 2022 through September 2022.

b) Data missing between 10 January 2023 through 15 May 2023 due to a streamflow meter malfunction discussed above.

During WY 2024, the White Wolf GSA will continue to periodically download data from the streamflow meter and conduct as needed operation and maintenance activities. In addition, the White Wolf GSA plans to measure the streamflow channel cross section, collect velocity measurements along different points of the stream channel for calculation of streamflow across the channel. Routine measurements of the cross-sectional area will be collected to record changes to stream channel geometry.



Legend

Groundwater Subbasin
- White Wolf (DWR 5-022.18)
- Streamflow Meter Installation Location
- Stream
- Reservoir

Watershed Name (HUC-12)
- Winters Canyon-El Paso Creek
- Grapevine Creek
- Chanac Creek
- Comanche Creek
- Liveoak Canyon
- Tejon Creek
- Pastoria Creek
- Salt Creek
- Tecuya Creek
- Telegraph Canyon
- Tunis Creek

Abbreviations
DWR = California Department of Water Resources
NHD = National Hydrography Dataset

Notes
1. All locations are approximate.
2. Pastel filled areas are watersheds draining into the White Wolf Subbasin.
3. Other points of diversion exisit in the White Wolf Subbasin, but were inactive during the histroical and current conditions.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 27 March 2024.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.
3. Surface water features, watersheds, and springs from NHD (https://viewer.nationalmap.gov/basic/).

N
0 1 2
(Scale in Miles)

Location of Installed Streamflow Gauge

eki environment & water

White Wolf GSA
Kern County, CA
March 2024
C20014.02
Figure 1

Path: \\Hq-svr-file\gis\C20014.01\Maps\20231\3\App B Figure 1_Location of Installed Streamflow Gage.mxd