WATER YEAR 2022 ANNUAL REPORT

White Wolf Subbasin

March 2023
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Water Year 2022 Annual Report

White Wolf Subbasin

March 2023

Prepared for:

White Wolf Groundwater Sustainability Agency

Prepared by:

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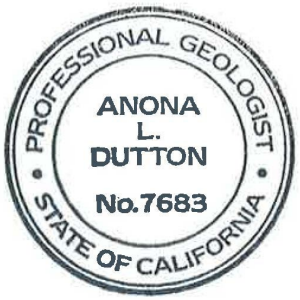

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Water Year 2022 Annual Report

White Wolf Subbasin

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ABBREVIATIONS AND ACRONYMS

AEWSD	Arvin-Edison Water Storage District
AF	acre-feet
AFY	acre-feet per year
CCR	California Code of Regulation
CEQA	California Environmental Quality Act
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
M&I	municipal and industrial
METRIC	Mapping of Evapotranspiration with Internal Calibration
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 and submitted to DWR on 28 January 2022.

This Water Year (WY) 2022 Annual Report for the Basin has been prepared in compliance with California Code of Regulations (CCR) 23 § 356.2. WY 2022 includes the period from 1 October 2021 through 30 September 2022.

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.

Groundwater elevation contours are shown on **Figure 2** for Fall 2021 (seasonal low) and on **Figure 3** for Spring 2022 (seasonal high). Flow direction and magnitude indicated by the groundwater elevation contours did not vary greatly between the seasonal low to seasonal high periods in WY 2022. Both contour maps show that groundwater generally flows from the southeast to the northwest.

The Basin currently has 14 Representative Monitoring Wells (RMWs) for Chronic Lowering of Groundwater Levels (RMW-WL) and three RMWs for Depletions of Interconnected Surface Water (RMW-ISW). Hydrographs showing groundwater elevations for the RMW-WLs or depth to groundwater for the RMW-ISWs and Sustainable Management Criteria (SMC) are shown on **Figure 4** and **Figure 5**, respectively. Groundwater levels in all RMW-WLs, except for one (RMW-WWB-010), were above their Minimum Thresholds (MTs) during both the Fall 2021 and Spring 2022 seasonal monitoring events. Among the RMW-WLs that had at least one groundwater level measurement collected during WY 2022, three RMW-WLs have groundwater levels above their Measurable Objectives (MOs) for at least one seasonal (Spring or Fall) measurement. All three RMW-ISWs have seasonal groundwater levels above their MOs.

Groundwater and imported surface water uses in the Basin during WY 2022 are summarized in **Table 1** and **Table 2,** respectively. Total groundwater extractions were determined through a combination of metered data, where available, and calculated using the Soil Moisture Budget (SMB) Accounting model developed for the Basin as described in **Section 3**. Total pumpage was approximately 60,200 acre-feet (AF), of which 99.1% (59,631 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 2022; the WY 2022 water supply consisted of 60% groundwater, 37% imported water, 3% stream diversions, 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 7**); 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 2021 and WY 2022, as calculated by the WWGFM, is shown on **Figure 8**. Generally, most of the Basin experienced a decrease in groundwater storage over the WY due to critically dry hydrologic conditions and the lack of surface water deliveries from the State Water Project (SWP) and Central Valley Project (CVP). **Figure 9** 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 2022. WY 2022 was a critically dry year, and the estimated change in groundwater storage for the Basin (-44,300 AF) is similar to that observed during other recent critically dry years.

Table 4, Figure 10, and **Figure 11** summarize the water levels in RMW-WLs, and their various SMCs. **Table 7** summarizes the depths to water in RMW-ISWs, and their various SMCs. Seasonal high and low groundwater levels in all of the RMWs, except two (RMW-WWB-010 and RMW-WWB-021), were above MTs. Undesirable results, as defined in the GSP, are not occurring as shown on **Figure 12**.

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 5**. All available data were below the MTs and no available concentrations exceeded the trigger threshold.

Finally, various vertical displacement data indicates very little land subsidence occurred in the Basin, averaging around 0.1 feet over WY 2022 (see **Figure 13**).

The GSP outlined 24 potential Projects and Management Actions (P/MAs) for the Basin. Implementation of select P/MAs have been initiated during this reporting period. A brief description of each P/MA and their implementation status is listed in **Section 7.7**.

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 (also 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 and submitted to DWR on 28 January 2022 (White Wolf GSA, 2021).

This Water Year (WY) 2022 Annual Report for the Basin has been prepared in compliance with California Code of Regulations (CCR) 23 § 356.2. WY 2022 includes the period from 1 October 2021 through 30 September 2022. This Annual Report also contains available and appropriate historical information back to calendar year 2015, as required by CCR 23 §356.2 (b), in order to provide information and data related to Basin conditions through the current reporting year.

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.

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 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 distinct partial barrier to groundwater flow, effectively separating the Principal Aquifer from a shallow water-bearing zone that supports Groundwater Dependent Ecosystems (GDEs).

Sources of water to the Basin groundwater system include infiltration of applied water[1], 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 GDEs, and subsurface outflow to the Kern County Subbasin across the WWF.

[1] 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.

2.1 Groundwater Elevation Contour Maps

Figure 2 and **Figure 3** map groundwater elevation contours in the Principal Aquifer for data collected in Fall 2021 and Spring 2022, respectively. The contours and posted groundwater elevations in Representative Monitoring Wells (RMWs) indicate seasonal high and low groundwater conditions for WY 2022. For the purposes of this Annual Report, Fall 2021 measurements were those collected between 1 October and 15 November 2021 and Spring 2022 measurements were those collected between 2 February and 27 April 2022.[2] **Figure 2** illustrates the WY 2022 seasonal low (Fall 2021) and **Figure 3** illustrates the WY 2022 seasonal high (Spring 2022) groundwater elevation contours in the Basin.

Figure 2 and **Figure 3** show that in WY 2022, 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.

2.2 Groundwater Hydrographs

Long-term hydrographs showing historical groundwater elevation data through WY 2022 for the RMW-WLs are shown on **Figure 4**.[3] Sustainable Management Criteria (SMC) including Measurable Objectives (MOs) and Minimum Thresholds (MTs) 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).[4] The SMC

[2] 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 or prior to well development).
[3] Hydrographs show static water levels. Erroneous groundwater elevation data or groundwater elevation data marked as questionable are excluded from the hydrographs.
[4] White Wolf GSA, 2021, Groundwater Sustainability Plan White Wolf Subbasin. Prepared by EKI Environment & Water Inc. for White Wolf Groundwater Sustainability Agency. December 2021.

are depicted graphically on the hydrographs on **Figure 4**, and are summarized in **Table 4**. Seasonal water levels in all RMW-WLs were above their MTs over the reporting period, with the exception of RMW-WWB-010. Water levels in RMW-WWB-10 exceeded the MT (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 2022 (147.09 ft msl). Water levels in this well have been in decline since Fall 2020.

The RMW-ISWs were installed in January 2021 to fill data gaps associated with the shallow water-bearing zone upgradient of the Springs Fault in areas supporting GDEs. Hydrographs showing depth to groundwater data collected through WY 2022 for the RMW-ISWs are shown on **Figure 5**. The transducer deployed in RMW-WWB-019 was destroyed by livestock in December 2021 causing a gap in water level data from January 2022 to May 2022. Due to equipment malfunction, data from RMW-WWB-020 could not be recovered for the period January 2022 through September 2022. Both transducers have been replaced as of October 2022. 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.[5] These are depicted graphically on the hydrographs and are summarized in **Table 7**. Water levels were above their MTs over the reporting period for all three RMW-ISWs.

[5] Ibid [4]

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 2022 groundwater extraction data by water use sector and measurement method. **Figure 6** shows the general location and volume of groundwater extractions. Total pumping was approximately 60,200 acre-feet (AF), of which 99% was for the agricultural sector.

Table 1. Summary of Groundwater Extraction Data by Sector

Water Year	Pumping, Agricultural (AF)		Pumping, Municipal & Industrial (AF)	Pumping, Total (AF)
	Metered [a]	Estimated [b]	Metered/Estimated [c]	
2021	21,627	50,954	619	73,200
2022	19,412	40,219	569	60,200

Abbreviations:
AF = acre-feet

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 and as provided by TCWD. Estimated pumping for WY 2021 has been updated based on reported metered data. Pumping for January through September 2022 for two of the three public water systems are estimated, as reported values were not yet available. Values rounded to the nearest AF.

Groundwater for 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. Between WY 2019 and WY 2020, AEWSD installed meters on five privately-owned

wells. Metered data was reported in AF; reported data are assumed to have a high level of accuracy, 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) Accounting 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.[6] Groundwater extractions estimated by the SMB have a lesser degree of accuracy, with a precision of 100 AF to 1,000 AF, as they are estimated from other data inputs and calibrated model parameters.

Groundwater for municipal and industrial (M&I) use in developed areas is extracted from public water systems wells and domestic 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[7]. Data was reported in either gallons or AF, with a precision of 10 gallons or 0.001 AF. Electronic Annual Report (EAR) data were only available through calendar year 2021. Additionally, TCWD provided metered data reported in 1,000 gallons through September 2021. January through September 2022 extractions for Tut Brothers Farm #96 and Cuyama Orchards were estimated based on a repeat of calendar year 2021 values. Therefore, public water system pumping for WY 2022 are estimates and will be updated as additional data becomes available. Given that calendar year 2021 values were available, WY 2021 M&I 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 acre-feet per year (AFY)] and therefore are not estimated herein.

[6] 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.
[7] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/eardata.html

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 inflows to the Basin include imported surface water[8] and natural stream inflows. In WY 2022, imported surface water was provided by WRMWSD, AEWSD, and TCWD, as shown in **Table 2**.

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 2022, WRMWSD delivered 31,815 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 (13,909 AF). Similarly, in WY 2022, WRMWSD delivered 2,526 AF of water for M&I use, based on metered deliveries by turnout.[9] All metered data was reported in AF; reported data are assumed to have a high level of accuracy, 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 Class 2 water from the Friant Division of the CVP. In WY 2022, AEWSD delivered 19,574 AF of water to the Basin, based on metered deliveries by turnout. Metered data was reported in AF; reported data are assumed to have a high level of accuracy, 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 M&I uses) under contracts with

[8] 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.

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

KCWA. For WY 2022, TCWD provided a total of 496 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, with a precision of 1.0 AF.

Finally, 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. Applied 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), and therefore have a high level of accuracy, estimated at 0.01 to 0.1 AF. However, diversion data were unavailable for POD6 (El Paso Creek) and POD8 (Pastoria Creek) for the entire water year, and POD12 for October 2021 through May 2022. POD9 (Grapevine Creek) recorded negative diversions for January through April 2022, signifying the diversion was less than the recorded overflow; therefore, a diversion value of zero was assumed. In WY 2022, stream diversions totaled 2,751 AF, as shown in **Table 2**.

Table 2. Summary of Surface Water Supply by Source and Sector

Water Year	WRMWSD Imports [a] (AF)		AEWSD Imports [a] (AF)	TCWD Imports (AF)	Total Imports (AF)		Stream Diversions[c] (AF)
	Agricultural [b]	M&I	Agricultural	M&I	Agricultural	M&I	Agricultural
2021	15,670	3,251	18,849	526	34,519	3,777	1,128
2022	13,909	2,526	19,574	496	33,483	3,022	2,751

Abbreviations:
AEWSD = Arvin-Edison Water Storage District
AF = acre-feet
M&I = municipal and industrial
TCWD = Tejon-Castac Water Storage District
WRMWSD = Wheeler Ridge-Maricopa Water Storage District

Notes:
(a) 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) Stream diversions were unavailable from POD6 (El Paso Creek) and POD8 (Pastoria Creek) for the entire water year, and POD12 for October 2021 through May 2022. Additionally, January through April 2022 diversions from Grapevine Creek POD9 were assumed zero as diversions were less than recorded overflow.

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. Additionally, small amounts of recycled water are used for irrigation at the TRCC. Therefore, the total water use is equal to the sum of total estimated groundwater extraction (**Table 1**)**,** the total surface water supplies (**Table 2**), and total applied recycled water. **Table 3** summarizes the total water use by water use sector and water use type. Approximately 96% of water was used for agriculture and 60% 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. Recycled non-potable 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 at 1.0 ccf.

Table 3. Summary of Total Water Use by Sector and Source

Water Year	Agricultural (AF)					M&I (AF)				Total Water Use
	Pumping		Imported Water[c]	Stream Diversions[e]	Total	Pumping	Imported Water[c]	Recycled Water[g]	Total	
	Metered[a]	Estimated[b]	Metered[d]	Metered		Metered/ Estimated[f]	Metered	Metered		
2021	21,627	50,954	34,519	1,128	108,228	619	3,777	77	4,473	112,701
2022	19,412	40,219	33,483	2,751	95,865	569	3,022	83	3,675	99,540

Abbreviations:

AF = acre-feet

M&I = municipal and industrial

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) Surface water imports are based on surface water deliveries to customers. Actual imports may be greater due to conveyance system losses.

(d) See **Table 2** notes regarding calculation for agricultural deliveries.

(e) Stream diversions were unavailable from POD6 and POD9 for the entire water year, and POD12 for October 2021 through May 2022.

(f) Metered data compiled from the State Board Electronic Annual Report System and as provided by TCWD. Pumping for Water Year 2021 has been updated based on reported data. M&I pumping for January through September 2022 for two of the three public water systems are estimated, as reported values were not yet available. Values rounded to the nearest AF.

(g) Metered recycled water data provided by TCWD. Value is rounded to the nearest 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 WY 1995-2019. The WWGFM was extended through WY 2022 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[10], including TCWD metered readings; and (4) private agricultural pumping calculated by the SMB;

[10] 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 from Tejon Ranch Company (TRC) internal records and 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, groundwater elevations in wells predicted by the WWGFM during WY 2022 were compared to groundwater elevations measured in wells during WY 2022. **Figure 7** shows a scatterplot of model-calculated vs. observed water levels. The coefficient of determination (R^2) of 0.99 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 8 is a map of model-calculated water level difference and model-estimated changes in groundwater storage within the Basin between WY 2021 and WY 2022. 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 8** shows that water levels primarily decreased in the central portions of the Basin and slightly increased in the foothills portions of the Basin. Furthermore, groundwater storage also decreased in most areas of the Basin, with increases seen in the same areas of water level increases. The southeastern fringe areas also experienced groundwater storage declines due to drainage from lack of precipitation.

Figure 9 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 2022. WY 2022 was a critically dry year[11]; the Basin experienced a decrease in groundwater storage of 44,300 AF, which is comparable to storage changes observed in other recent critically dry years (e.g., 2013, 2014, and 2021).

[11] 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 2022 Annual Report. As such, WY type for 2022 was calculated using the same methodology presented in DWR, 2021.

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.

7.1 Progress Towards Interim Milestones for Chronic Lowering of Groundwater Levels

Table 4 compares WY 2022 groundwater elevations to interim milestones set at RMW-WLs established for the Chronic Lowering of Groundwater Levels Sustainability Indicator in the White Wolf Basin GSP. **Figure 10** and **Figure 11** show Fall 2021 and Spring 2022 water levels measured at RMW-WLs relative to their SMCs, respectively. RMW-WL locations are indicated on the map, and water levels relative to each RMW-WL's MO and MT are indicated in the callout boxes. Three RMW-WLs have groundwater levels above their MOs for at least one seasonal (Spring or Fall) groundwater level measurement. One RMW-WL (RMW-WWB-010) exceeded its MT in both Fall and Spring.

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. Steps of the plan included assessing the RMW area and evaluating outside contributing factors. The assessment most notably discovered that other wells in the immediate area are experiencing decline, there has been a slight change in land use, and that there has 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, GSA-member districts have initiated monthly monitoring in RMW-WLs, and P/MAs have been placed on an accelerated timeline.

Although there was one RMW-WL with an MT exceedance, Undesirable Results associated with the Chronic Lowering of Groundwater Levels sustainability indicator are not yet occurring, based on the definition in the GSP, and as shown in **Figure 12**.

Table 4. Groundwater Elevations and Relevant Sustainable Management Criteria for Chronic Lowering of Groundwater Levels Sustainability Criteria

Well Name	Fall 2021 GWE (ft msl)	Spring 2022 GWE (ft msl)	MO (ft msl)	MT (ft msl)	IM-5 (ft msl)	IM-10 (ft msl)	IM-15 (ft msl)
RMW-WWB-001	795.24	792.74	800	680	800	800	800
RMW-WWB-002	NA[a]	NA[a]	273	177	273	273	273
RMW-WWB-003	219.4	219.5	252	196	224	210	231
RMW-WWB-004	138.90	139.9	151	103	127	115	133
RMW-WWB-005	154.16	152.56	162	93	128	110	136
RMW-WWB-006	221.37	230.8	171	152	162	157	164
RMW-WWB-007	NA[b]	NA[b]	180	123	151	137	159
RMW-WWB-008	140.81	145.71	149	104	127	115	132
RMW-WWB-009	NA[c]	170.67	160	130	145	137	148
RMW-WWB-010	**152.09**	**147.09**	181	159	181	181	181
RMW-WWB-011	441.25	427.32	433	380	433	433	433
RMW-WWB-012	125.81	131.81	161	123	142	133	147
RMW-WWB-013	119.50	127.5	181	92	136	114	147
RMW-WWB-014	130.21	130.71	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) No measurement as pump house was locked.
(b) No measurement available; well was temporarily inaccessible.
(c) No measurement due to inability to place tape in the well.
(d) Bold indicates measurement is below the MT.

7.2 Progress Towards Interim Milestones for Groundwater Storage

There are no groundwater storage IMs for WY 2022. As explained in the GSP, groundwater levels are a reasonable proxy for groundwater storage. Progress made during the reporting period is therefore represented by the discussion of water levels in **Section 7.1**

7.3 Progress Towards Interim Milestones for 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.

7.4 Progress Towards Interim Milestones for 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.[12] All RMW-WQs established in the GSP for the Degraded Water Quality Sustainability Indicator are public water systems and therefore available data was downloaded and compiled from the SDWIS Drinking Water Watch Website.

Table 5 compares available WY 2022 water quality concentrations for Arsenic, Nitrate, and Selenium to their respective SMCs at the RMW-WQs. All available data did not exceed the MTs and no available concentrations exceeded the trigger threshold. Because water quality results represent conditions prior to GSP implementation, there are no IMs for WY 2022.

Table 5. 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[(a)]	--			0.6			--		
RMW-WWB-016	ND			2.8			ND		
RMW-WWB-017[(a)]	--			1.2			--		
RMW-WWB-018	0.002			1.1			ND		

Abbreviations:

mg/L = milligrams per liter
MO = Measurable Objective
MT = Minimum Threshold
N = Nitrogen
ND = non-detect
TT= Trigger Threshold
-- = not collected

Notes:

(a) Water quality samples for Arsenic and Selenium were not collected from RMW-WWB-015 and RMW-WWB-017 under the required monitoring schedule from the California Division of Drinking Water.
(b) Trigger Thresholds are used in place of Interim Milestones.
(c) For all RMWs, Sustainable Management Criteria (SMCs) were set at the same level as state and federal standards.

7.5 Progress Towards Interim Milestones for Land Subsidence

There has been very little historical land subsidence measured across the Basin; however, as critical infrastructure, such as the California Aqueduct, is present in the Basin, an on-going assessment of subsidence is included herein. The following describes the vertical displacement (i.e., subsidence) trends for WY 2022 in the Basin (see **Figure 13**):

- Continuous vertical displacement data has been collected at two University NAVSTAR Consortium Global Positioning System stations (WGPP and EDPP) located near the California Aqueduct since November 1999 (WGPP) and February 2000 (EDPP). For WY 2022, the displacement data indicates an average displacement of -0.11 ft and 0.52 ft for WGPP and EDPP, respectively.
- Subsidence data is collected annually by DWR staff at checkpoints along the California Aqueduct. Over the 34 checkpoints, cumulative vertical displacement from the late 1960s/early 1970s through WY 2022 varied from -1.20 ft to 0.19 ft with an average vertical displacement of -0.31 ft.

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

The land surface elevation change measured from WY 2021 to WY 2022 was on average -0.03 ft with a maximum difference of -0.13 ft (see **Figure 13**).

- TRE Altamira Interferometric Synthetic Aperture Radar (InSAR) data indicates the annual vertical displacement rate for the period 1 October 2021 through 1 October 2022 ranges from -0.1 ft to 0.1 ft throughout the Basin.
- 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. The difference in elevation between WY 2021 and WY 2022 is shown in **Table 6** and on **Figure 13**.

As explained in the GSP, groundwater levels are a reasonable proxy for land subsidence, and progress made during the reporting period is therefore represented by the discussion of water levels in Section **7.1**.

Table 6. Checkpoints along the 850 Canal

Benchmark	WY 2021 (ft msl)	WY 2022 (ft msl)	Difference
Checkpoint #1	858.42	858.59	-0.17
Checkpoint #2	--	856.66	--

Abbreviations:
ft msl = ft above mean sea level
WY = water year
Notes:
(a) Checkpoint #2 was moved in May 2022 due to retirement of pump where previous benchmark was placed.

7.6 Progress Towards Interim Milestones for Depletions of Interconnected Surface Water

Water levels in RMW-ISWs are used as proxy to monitor the health of the GDEs identified south of the Springs Fault. **Table 7** compares WY 2022 depth to water to the preliminary MOs and MTs set at the RMW-ISWs established for the Depletions of Interconnected Surface Water Sustainability Indicator. Depth to water is above the preliminary MTs throughout WY 2022 for all RMW-ISWs, therefore Undesirable Results are not occurring based on the definition of an Undesirable Result as outlined in the GSP, and as shown in **Figure 12**.

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 B** provides details of the installation.

Table 7. Depth to Groundwater and Relevant Sustainable Management Criteria for Depletions of Interconnected Surface Water Sustainability Criteria

Well Name	Fall 2021 DTW [a] (ft bgs)	Spring 2022 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	17.25	17.46	19	30	n/a	n/a	n/a
RMW-WWB-020	14.80	13.61	15	30	n/a	n/a	n/a
RMW-WWB-021	33.45	31.57	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 2021 measurement was recorded on 10/15/2021.
(b) Spring 2022 measurement was recorded on 5/4/2022.
(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.

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

The White Wolf Basin GSP outlined 24 potential P/MAs. A brief description and progress towards implementation of these is provided below.

- P/MA #1 - Recharge from Grapevine Development: The Grapevine Development will be annexed into and receive water and wastewater treatment service from TCWD. The California Environmental Quality Act (CEQA) process has been completed.
- P/MA #2 - Oilfield Reclaimed Water from the Tejon Oil Field: This project consists of reclaiming water from oil production facilities in the TCWD area. Tejon Oil Field has a yield of approximately 20,000 barrels per day of produced water, or approximately 940 AFY (1.3 cfs), that it is available year-round irrespective of climatic conditions. Negotiations with oil producer are ongoing. A desktop feasibility assessment for a recharge facility to which the reclaimed water would be delivered was completed. Work is ongoing to secure funding, including formalizing the phase 2 pilot treatment plant as a component in the GSA's application for the DWR Round 2 SGMA Implementation grant.
- P/MA #3 - Oilfield Reclaimed Water in AEWSD: This project involves reclaiming water from oil production facilities for irrigation purposes in AEWSD. After treatment and cooling, water could be pumped into AEWSD facilities to serve irrigation demands in-lieu of groundwater pumping. P/MA #3 has not yet been initiated.
- P/MA #4 - Purchase Additional Surface Water Supplies: All White Wolf GSA member districts continually seek to purchase additional surface water supplies, as available, including unused allocation of wet year CVP water, SWP water, or high flow Kern River supplies or transfer/exchange agreement with out-of-basin entities. P/MA #4 has been initiated and work is ongoing. During WY 2022, WRMWSD purchased an additional 9,138 AF for surface delivery in

WRMWSD (including both the Kern County Subbasin and the White Wolf Subbasin). In addition, WRMWSD recovered approximately 64,100 AF of banked water from its out of District banking projects for delivery in the District.

- P/MA #5 - WRMWSD "Thru Delta" Facility: WRMWSD is actively participating in planning efforts surrounding a "Thru Delta" Facility. This is a State-led effort to increase SWP water reliability with a projected supply benefit for WRMWSD of up to 25,000 AF per year upon Cal WaterFix Project completion (anticipated 2035). In 2022, the WRMWSD Board of Directors approved Amendment No. 1 to the Delta Conveyance Project Member Unit Funding Agreement. This Amendment re-confirmed the District's participation (at 32% of its State Water Project entitlement, 63,100 AF) for the 2023-2024 planning phase of the Delta Conveyance Project. P/MA #5 has been initiated and work continues to fund the planning phase in WY 2022.
- P/MA #6 - WRMWSD Desalination Facility: WRMWSD is planning to develop a facility whereby poor-quality groundwater (i.e., high in total dissolved solids) that is encountered in areas of poor water quality for beneficial use will be treated to a point where it is usable for agricultural purposes and can be used to supplement irrigation supply. P/MA #6 has not yet been initiated.
- P/MA #7 - Recapture of Basin Groundwater: To recapture the surface water imported into the Basin, the GSA will consider either installing a line of pumping wells along the WWF or increasing the use of existing private pumping wells along the WWF. P/MA #7 has not yet been initiated.
- P/MA #8 - WRMWSD Mettler Recharge Project: This project entails the operation and maintenance of a 60-acre groundwater recharge facility for the artificial recharge of available surface water to groundwater for later use by WRMWSD. The Mettler Groundwater Recharge Project was constructed in 2019 and is connected to the 850 Canal near the existing PA-1 pumping plant. The facility did not receive water in WY 2022.
- P/MA #9 - WRMWSD El Paso Creek Recharge Project: This project is an artificial recharge project along El Paso Creek in which water would be gravity fed through mostly existing conveyance infrastructure to conduct in-stream and off-stream recharge on adjacent native vegetation lands. P/MA #9 has not yet been initiated.
- P/MA #10 - AEWSD In-Lieu Banking Program: AEWSD will supply surface water when available through new facilities to the Groundwater Service Area within AEWSD with the intent of reducing AEWSD-wide groundwater use. However, when surface water is in short supply and under agreement, the landowners could recover and return groundwater from their own wells to the AEWSD canal system through new pipelines once they have satisfied their own water needs. AEWSD has completed preliminary design for two (2) additional in-lieu units on the north side of the District (Frick and Panama Units). Development of a potential hybrid In-lieu and temporary water service contract is underway in order to begin landowner outreach for the two areas. AEWSD has completed a preliminary alternatives analysis, developed plans for expansion of other in-lieu areas, and begun developing a district-specific coupled groundwater flow model and decision support tool to inform operational decisions. WRMWSD has agreed to collaborate on the in-lieu banking to greater expand their combined surface water service areas in the Basin. The districts are formalizing the target areas for in-lieu expansion as a component in the GSA's application for the DWR Round 2 SGMA Implementation grant.

- P/MA #11 - AEWSD Private & Caltrans Basin Connections: This Project involves connecting multiple on-farm private basins and some Caltrans sumps near AEWSD facilities by gravity pipeline and utilizing for groundwater recharge and floodwater capture. P/MA #11 has not yet been initiated.
- P/MA #12 - AEWSD South Canal WRMWSD 850 Canal Intertie: This project involves either improving existing interties and/or construct new interties between AEWSD's South Canal or distribution system and WRMWSD's 850 Canal to facilitate water exchanges between AEWSD and WRMWSD. AEWSD and WRMWSD have developed a two-phase plan for upsizing AEWSD's S73-P4 Lateral and connecting it to WRMWSD's 850 Canal. The districts plan to include the intertie as a component in the GSA's application for the DWR Round 2 SGMA Implementation grant to secure funding in 2023. Final designs and permitting are expected to be completed by spring 2024 with construction scheduled to be finished spring 2025.
- P/MA #13 - AEWSD South Canal Balancing Reservoir Project: AEWSD is in need of additional infrastructure to allow water storage and regulation of flow mismatches in its canal system during operation or emergencies. P/MA #13 has not yet been initiated.
- P/MA #14 - AEWSD Groundwater Subsidies for Land Conversion: AEWSD may adopt a management action to provide subsidies to incentivize groundwater users to convert land to alternative land uses and reduce groundwater extractions. The GSA applied for the Round 1 Department of Conservation (DOC) Multi-benefit Land Repurposing Program (MLRP) grant to secure grant funding to initiate P/MA #14 but was unsuccessful. The GSA plans to re-apply in Round 2.
- P/MA #15 - WRMWSD Land Retirement and/or Conversion: WRMWSD may purchase and permanently fallow previously irrigated acreage within the WRMWSD service area to reduce overall water demand and groundwater extractions. The District has unsuccessfully submitted bids to purchase irrigated property and continues to engage with sellers across the District when the opportunity arises. The GSA applied for the Round 1 DOC MLRP grant to secure grant funding to initiate P/MA #15 but was unsuccessful. The GSA plans to re-apply in Round 2..
- P/MA #16 - AEWSD Groundwater Allocation per Acre: AEWSD may adopt a program which provides a finite groundwater allocation on a per acre basis. P/MA #16 has not yet been initiated.
- P/MA #17 - AEWSD Groundwater Fee Increase: AEWSD may adopt a management action to increase Groundwater Service Area costs to incentivize groundwater users to reduce groundwater extractions and take surface water when available. P/MA #17 has not yet been initiated.
- P/MA #18 - AEWSD Groundwater Marketing & Trading: AEWSD would pursue a groundwater market and trading program once P/MA #16 and P/MA #17 have been adopted to provide users and beneficial users more flexibility in utilizing their allocation. Trading may be executed through short-and long-term leases, permanent transfers, inter-annual water exchanges, or dry-year option contracts. P/MA #18 has not yet been initiated.
- P/MA #19 - WRMWSD Groundwater Allocation and Market: WRMWSD may develop a groundwater pumping allocation methodology, including a market system for the trading and/or transferring of allocations between water users. P/MA #19 has not yet been initiated.

- P/MA #20 - WRMWSD Voluntary Pumping Limitations: WRMWSD may set non-binding pumping limitations in conjunction with a fee for pumping above limits. P/MA #20 has not yet been initiated.
- P/MA #21 - WRMWSD Mandatory Pumping Limitations: WRMWSD may set binding pumping limitations in conjunction with a fee for pumping above limits. P/MA #21 has not yet been initiated.
- P/MA #22 - Improved Stormwater Management and Flood Control in AEWSD: AEWSD's canal system requires modifications/improvements to comply with storm runoff pollution prevention. Additionally, there is a need to modify old and build new facilities for flood protection from intermittent creeks (e.g., Tejon Creek, El Paso Creek, their tributaries and others). P/MA #22 has not yet been initiated.
- P/MA #23 - AEWSD Groundwater Extraction Quantification Method: AEWSD may adopt a policy to specify the approved method or methods to quantify the individual and aggregate groundwater extractions for the required SGMA annual reporting. AEWSD completed installation of groundwater pumping meters at 50 sites under its existing Groundwater Metering grant program, with five meters located in the Basin. AEWSD has also contracted with LandIQ to obtain satellite ET data and has initiated development of a district-specific coupled groundwater flow model and decision support tool.
- P/MA #24 - WRMWSD Acreage Assessment: WRMWSD may set a policy to implement an acreage assessment to fund purchases of additional supplies, purchase land for fallowing, and other investments to support SGMA compliance. The funds generated from this assessment could be used to finance other P/MAs. WRMWSD has initiated a study to analyze possible assessments or groundwater pumping charges that could both fund future P/MAs and provide financial incentives to limit pumping from the groundwater basin. It is anticipated that these analyses will be complete in early 2023.

7.8 Stakeholder Engagement

The White Wolf GSA practices stakeholder engagement through the GSA website (http://whitewolfgsa.org/), public meetings and workshops presented in person prior to the current global COVID-19 pandemic, and presented online while health-protective restrictions are in force. During the reporting period, White Wolf GSA held public meetings on:

- 6 December 2021 – Regular Board meeting
- 25 January 2022 – Public Hearing to Adopt the GSP
- 1 March 2022 – Regular Board meeting
- 23 March 2022 – Special Board meeting
- 7 June 2022 – Regular Board meeting
- 6 September 2022 – Regular Board meeting

Furthermore, the White Wolf GSA held a stakeholder workshop entitled "State of the White Wolf Subbasin: Declining Water Levels" on 27 September 2022. The GSA mailed and emailed flyer notices to all landowners requesting attendance.

The GSA will continue to meet regularly in WY 2023.

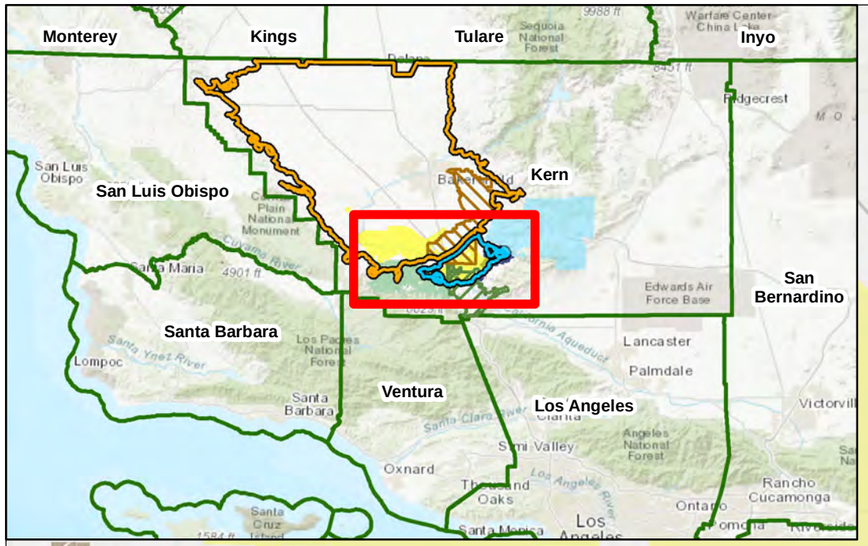
8 REFERENCES

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

State Water Resources Control Board, 2022. 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.



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 15 March 2023.
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)

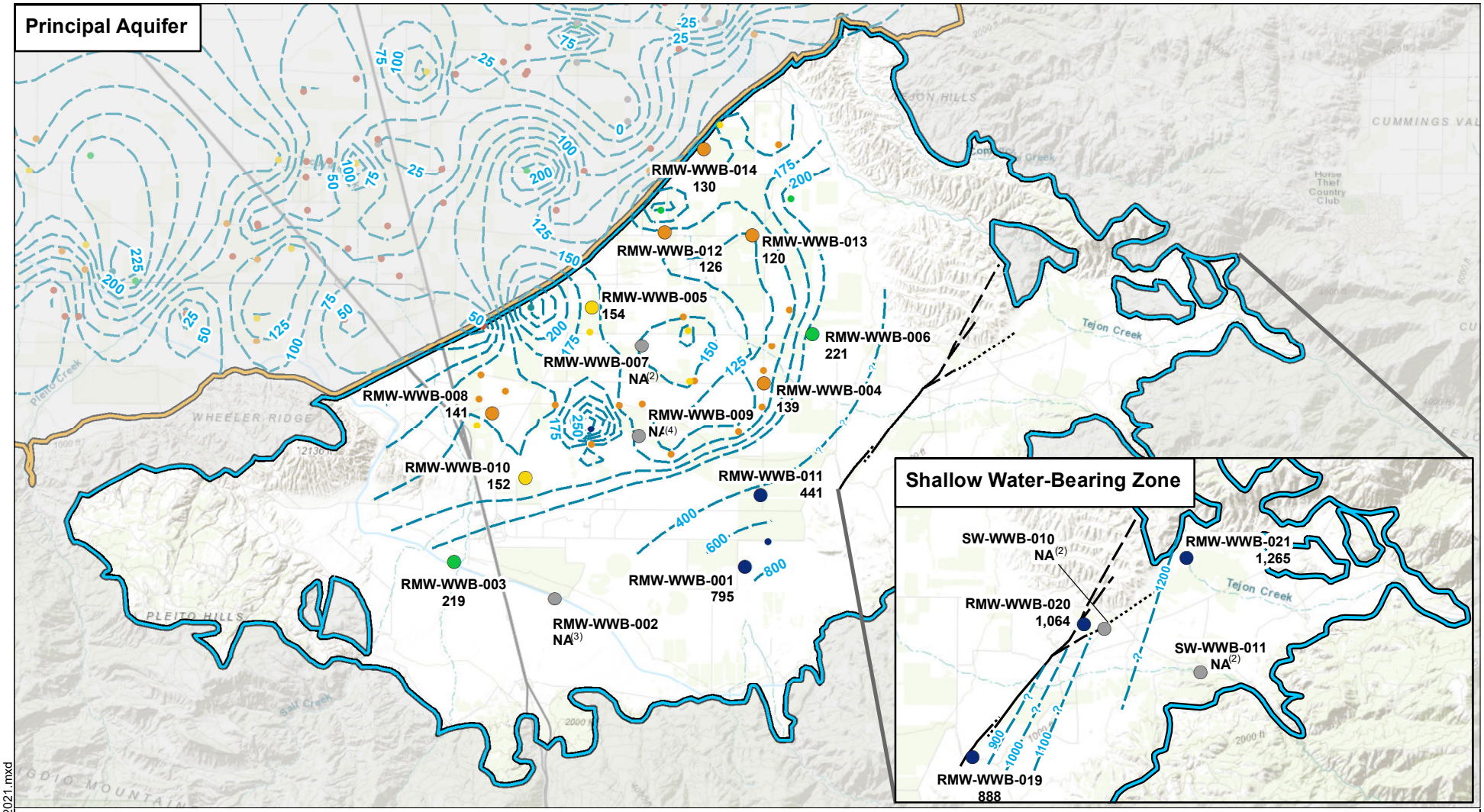
White Wolf Subbasin and Relevant Boundaries

White Wolf GSA
Kern County, California
March 2023
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 2021 Groundwater Elevation contour (ft NAVD88)

Fall 2021 Groundwater Elevation (ft NAVD88)

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

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. No measurement available; well was temporarily inaccessible.
3. No measurement available; pump house locked.
4. No measurement available; could not get tape in.
5. Wells with questionable measurements or flagged as pumping were excluded from the contours.
6. Contours are queried where uncertain.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 March 2023.
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 2021

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

Figure 2

eki environment & water

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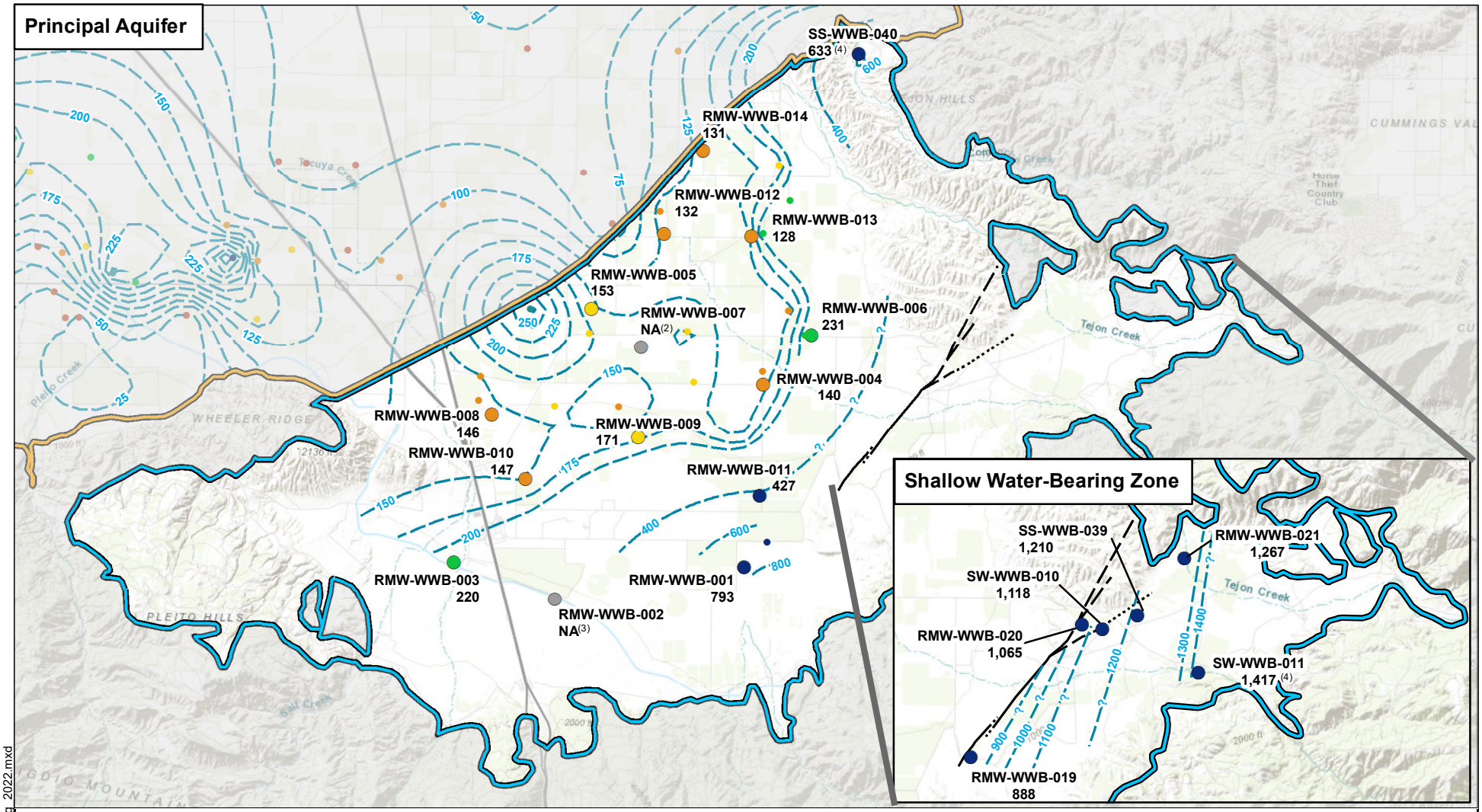


Legend

Groundwater Subbasin

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

Spring 2022 Groundwater Elevation (ft NAVD88)

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

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. No measurement available; well was temporarily inaccessible.
3. No measurement available; pump house locked.
4. Water level elevation assumed as reference point elevation as the artesian pressure head was unknown.
5. Wells with questionable measurements or flagged as pumping were excluded from the contours.
6. Contours are queried where uncertain.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 March 2023.
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)

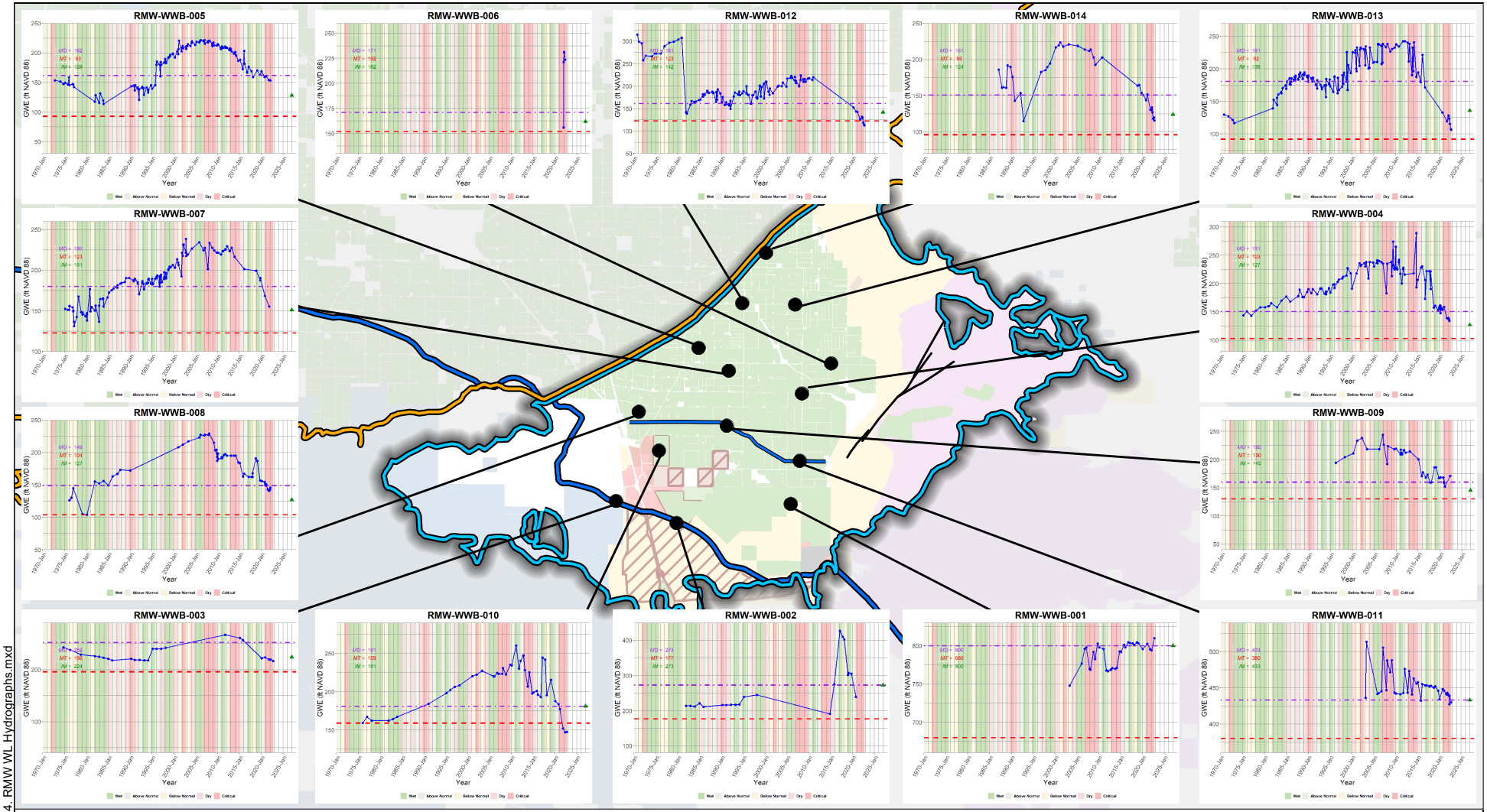
Groundwater Elevation Contours, Spring 2022

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

Figure 3

eki environment & water

Path: X:\C20014.01\Maps\2023\3\Figure 3. WL Spring 2022.mxd



Path: \\Hq-svr-file\gis\C20014.01\Maps\2023\3\Figure 4. RMW WL Hydrographs.mxd

Legend

Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)
- RMW-WL
- Springs Fault
- California Aqueduct
- 850 Canal
- Measurable Objective
- Minimum Threshold
- Groundwater Elevation
- Ground Surface Elevation
- Interim Milestone

Land Use

- Agricultural Land
- Developed
- Grazing
- Mining
- Oil Field
- Conservation Easement
- California Protected Areas
- Proposed Grapevine Development

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. Hydrographs show static water levels. Erroneous datapoints have been excluded.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 March 2023.
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

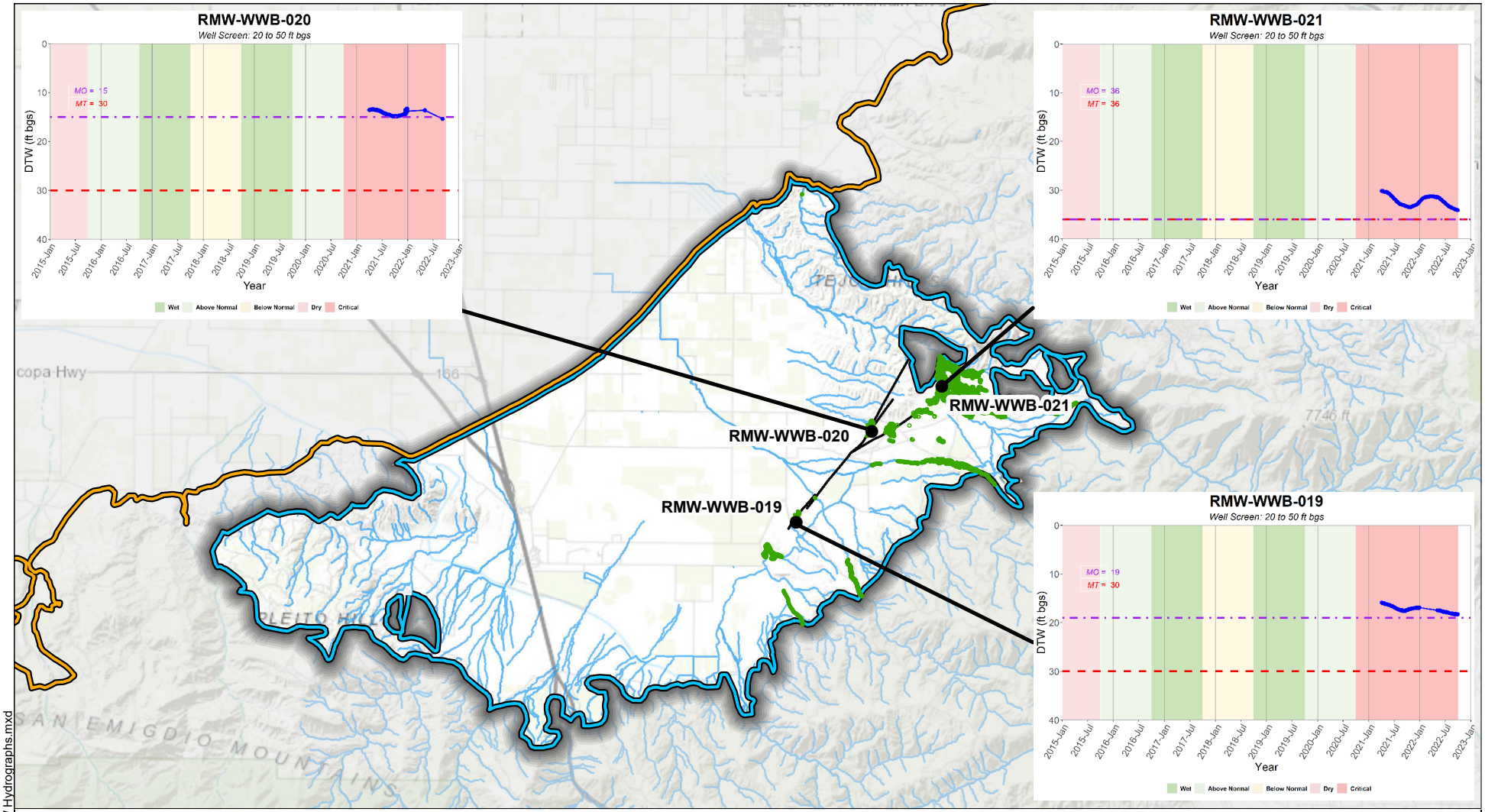
0 5 10

(Scale in Miles)

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

White Wolf GSA
Kern County, California
March 2023
C20014.01
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 27 March 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)

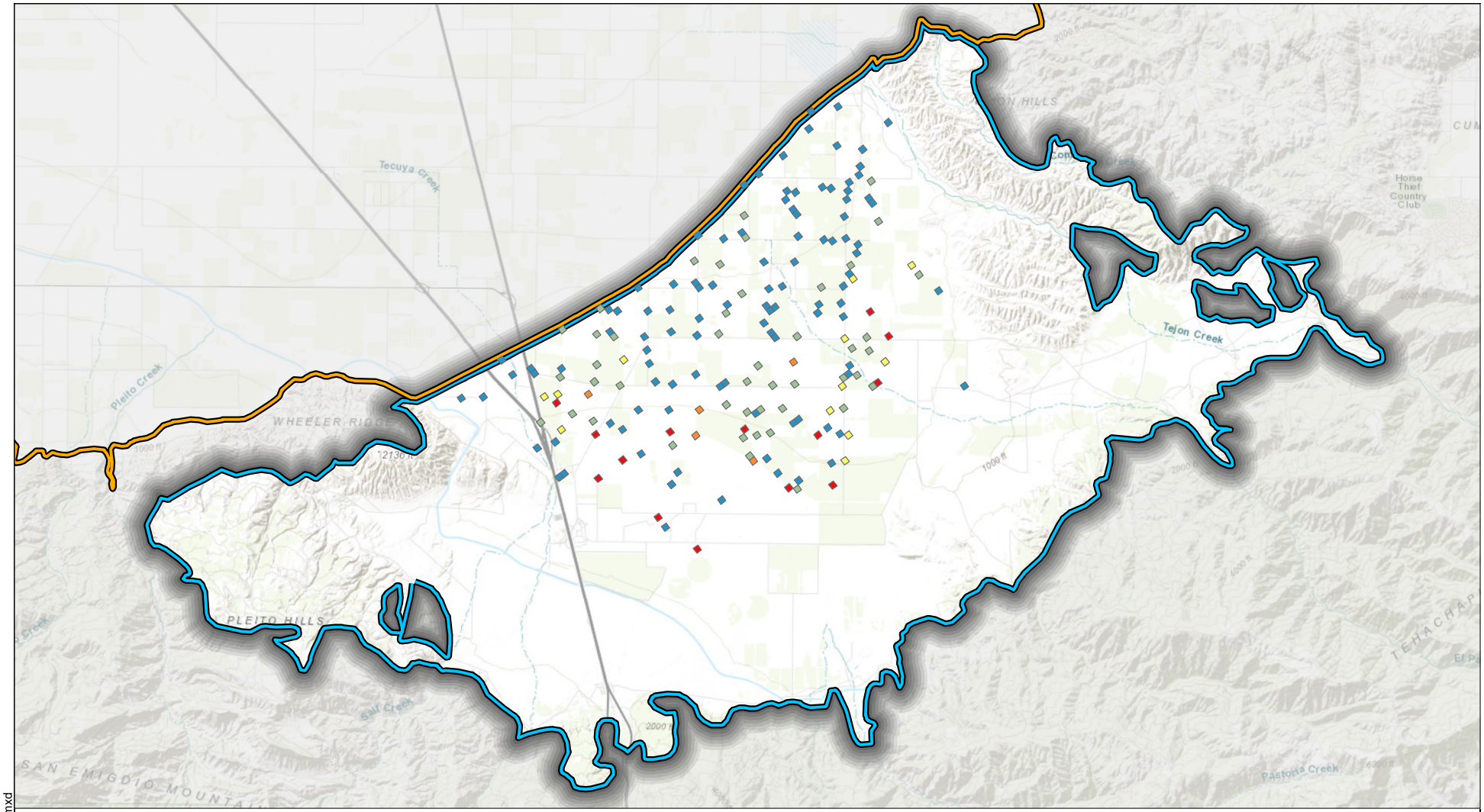
Hydrographs of Representative Monitoring Wells for Depletions of Interconnected Surface Water Sustainability Indicator

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

Figure 5

eki environment & water

Path: X:\C20014.01\Maps\2023\3\Figure 5. RMW ISW Hydrographs.mxd



Legend

Groundwater Subbasin

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

WY 2022 Groundwater Pumping

- < 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 22 March 2023.
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 2022

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

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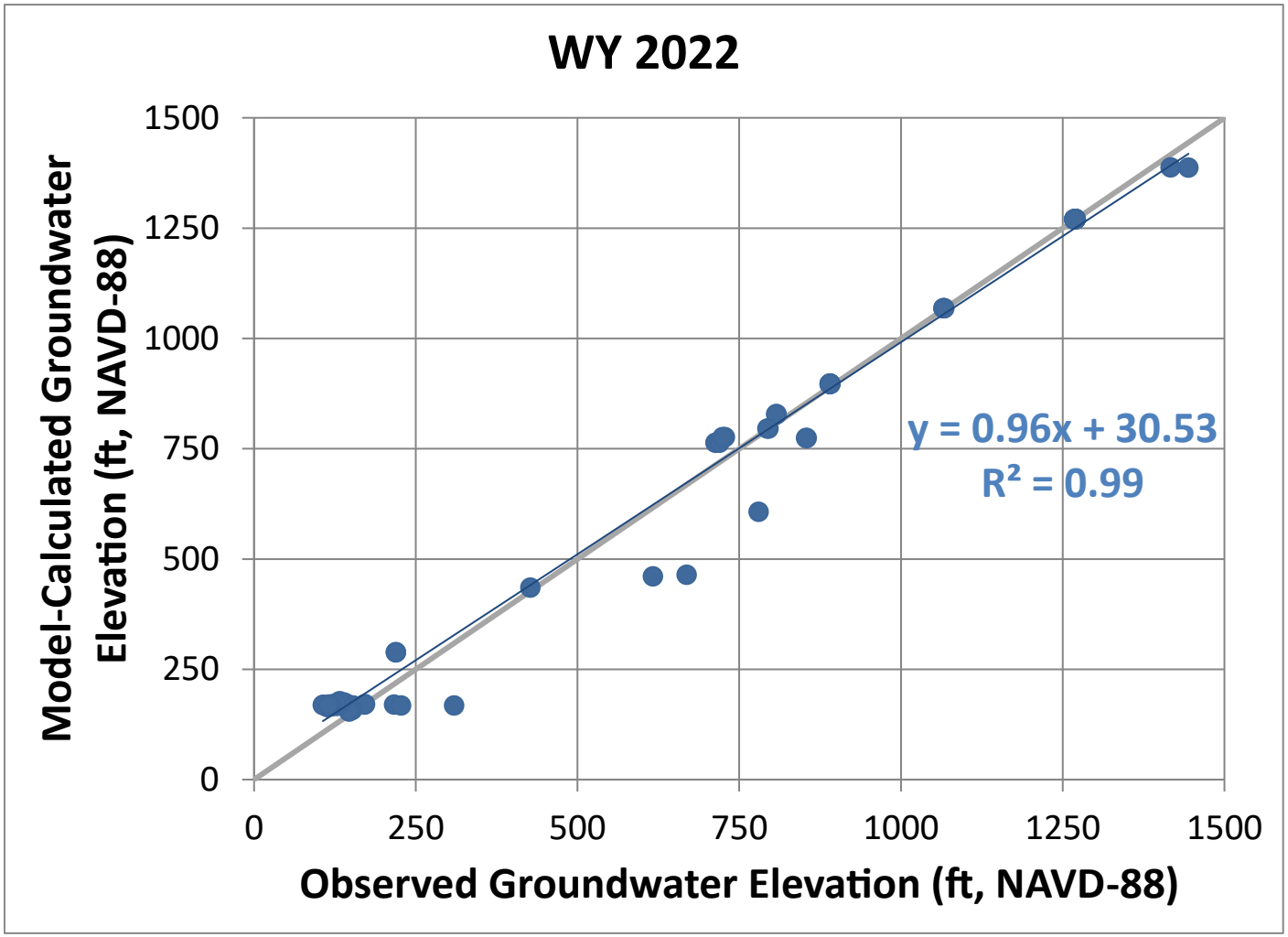
Figure 6

Path: X:\C20014.01\Maps\2023\3\Figure 6_Pumping.mxd



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 2021 and 30 September 2022.

Sources

1. White Wolf Groundwater Flow Model

Model-Calculated versus Observed Groundwater Elevations in Wells, WY 2022

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

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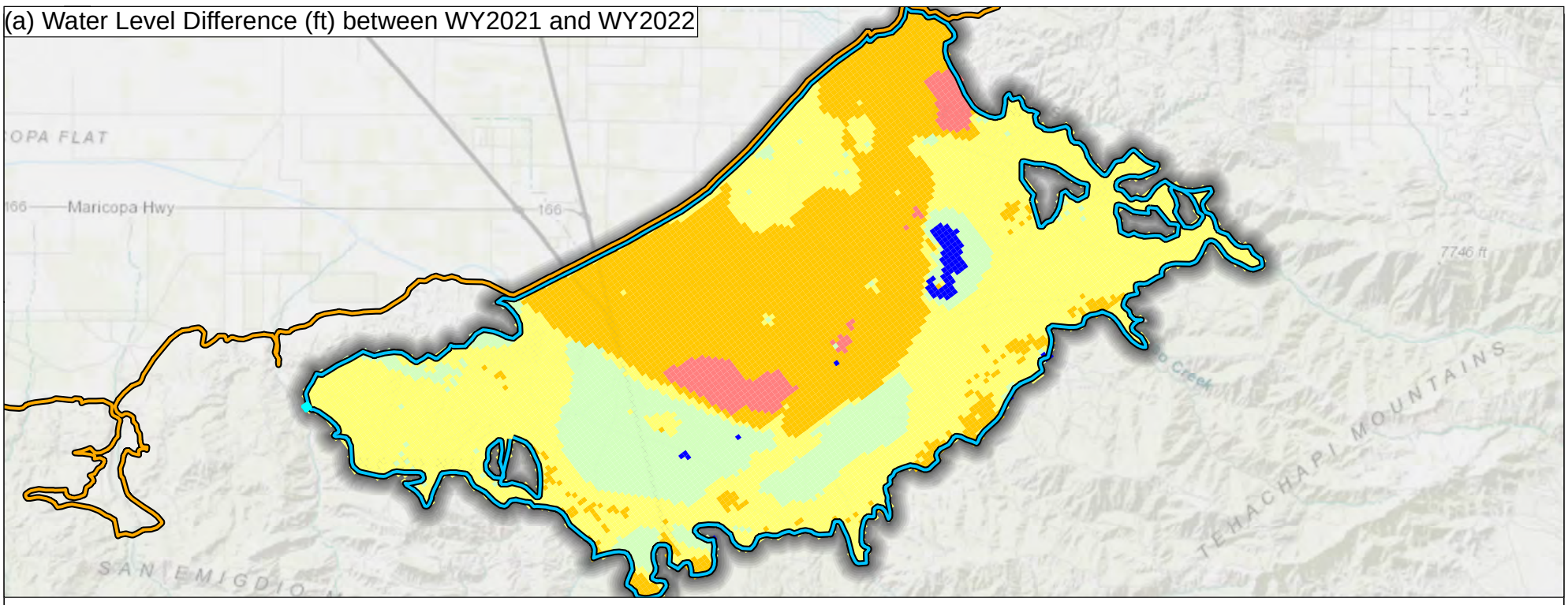
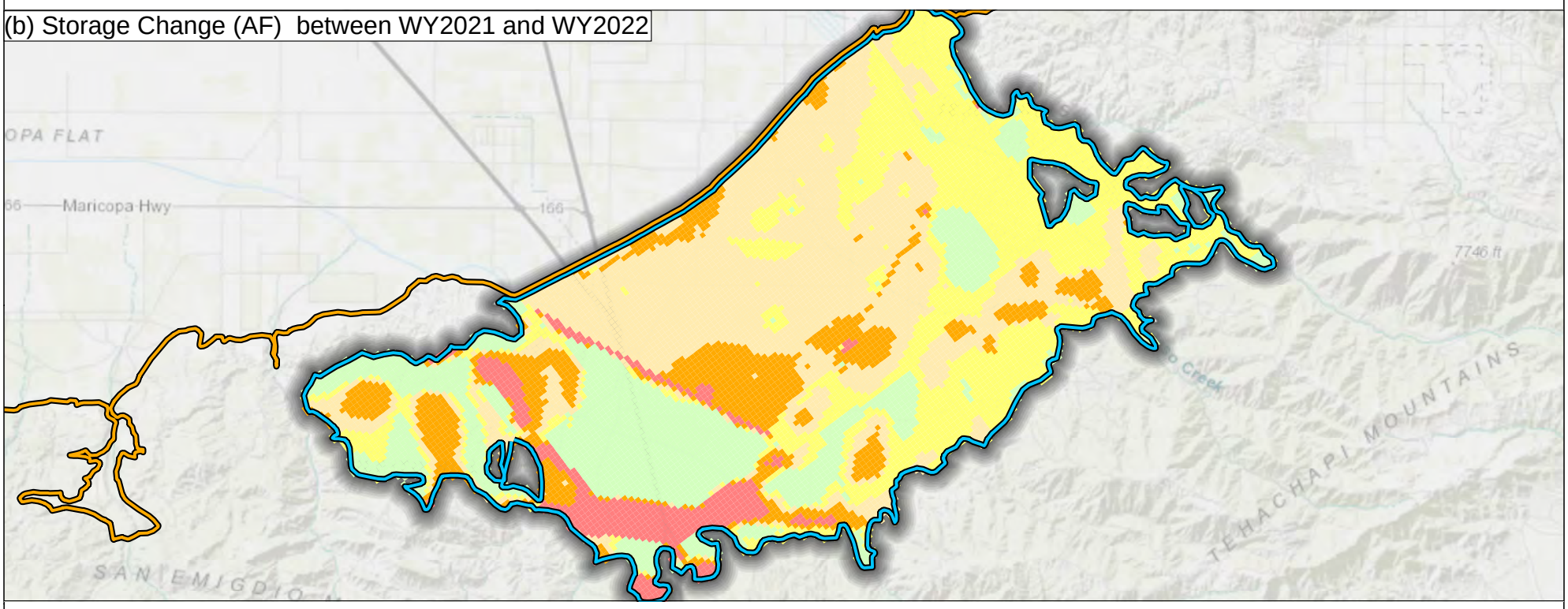
Figure 7

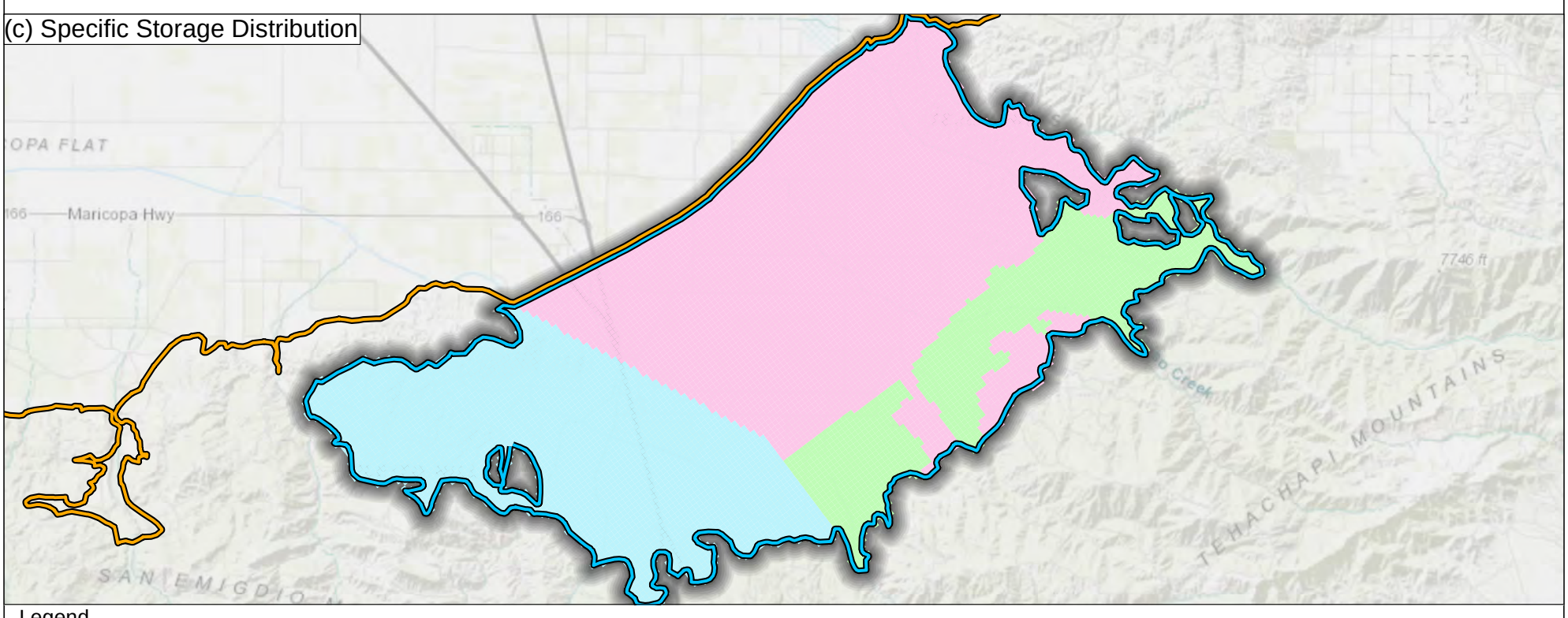
(a) Water Level Difference (ft) between WY2021 and WY2022



(b) Storage Change (AF) between WY2021 and WY2022



(c) Specific Storage Distribution



Legend

Water Level Difference (ft)
- <-10
- -10 - -2
- -2 - 0
- 0 - 3
- >3

Specific Storage
- 0.000002
- 0.0015
- 0.002

Storage Change (AF)
- <-25
- -25 - 10
- -10 - -5
- -5 - 0
- >0

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

N

0 4 8
(Scale in Miles)

Notes

1. All locations are approximate.
2. Water level difference and storage change are calculated as the difference between September 2022 and September 2021
3. Negative differences in water level/storage indicate receding water level/ storage betweenSeptember 2022 and September 2021.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 23 March 2023.
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

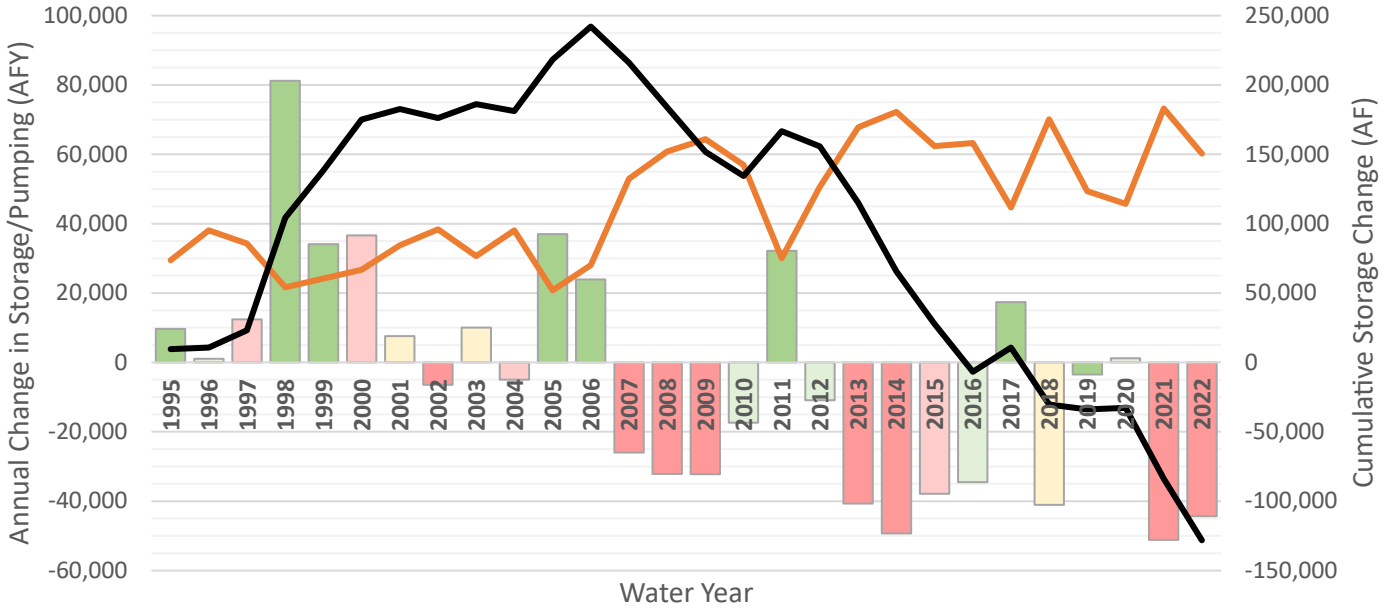
Model Estimated Groundwater Storage Change between WY 2021 and WY 2022

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

Figure 8

eki environment & water

Path: X:\C20014.01\Maps\2023\3\Figure 8. Panel_StorageChange_WLDifference.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, and 2022 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

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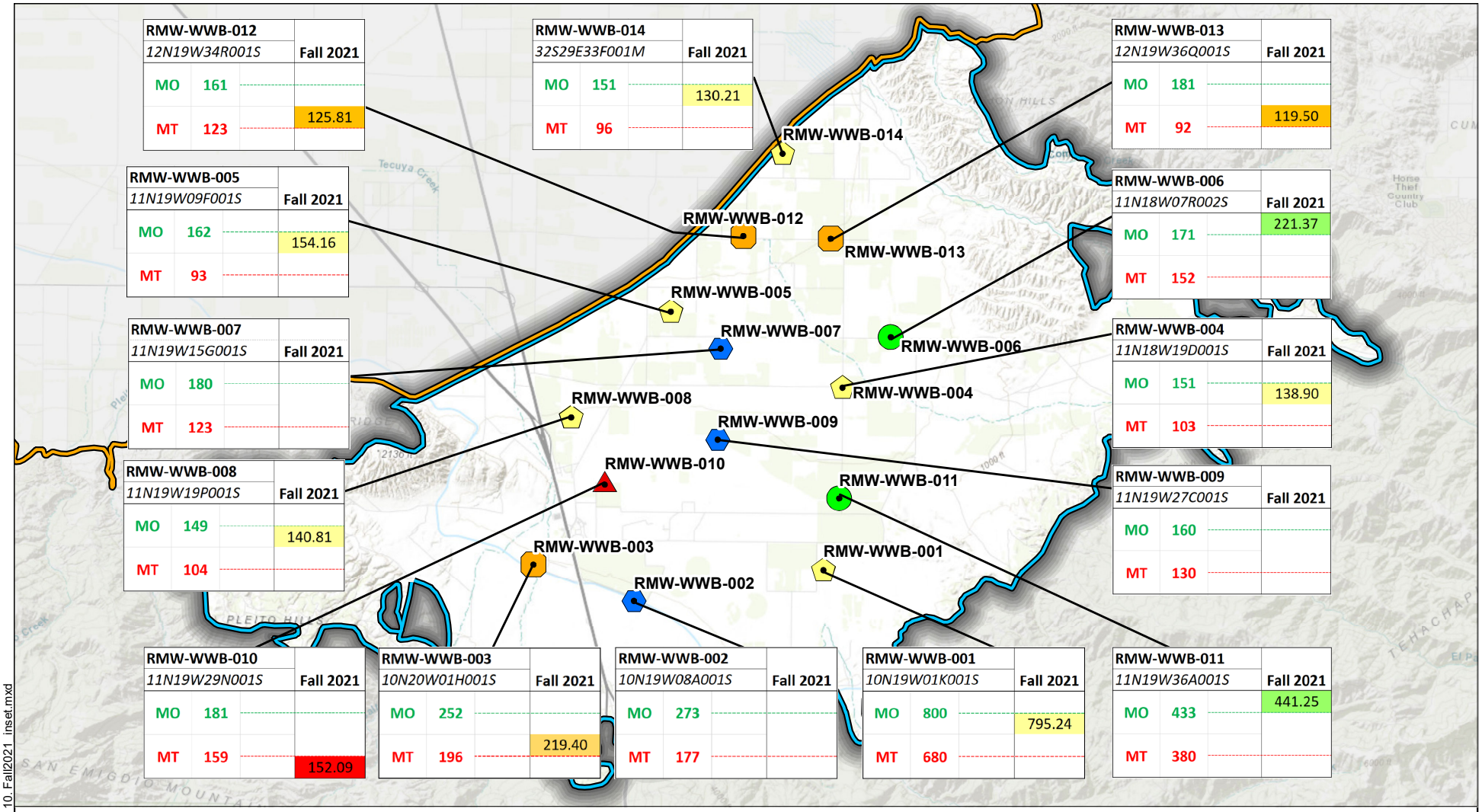
White Wolf GSA
Kern County, California
March 2023
C20014.01

Figure 9



Legend

- Water Level Above MO (2 or 14%)
- Water Level Between MO and MT but closer to MO (5 or 36%)
- Water Level Between MO and MT but closer to MT (3 or 21%)
- Water Level below MT (1 or 7%)
- No Water Level Measurement (3 or 22%)

Groundwater Subbasin

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

Abbreviations

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

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 March 2023.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.

Notes

1. All locations are approximate.
2. Well RMW-WWB-007 is a problematic well for water level measurements. Both RMW-WWB-002, RMW-WWB-007, and RMW-WWB-009 were inaccessible for measurement.
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. Fall measurements were collected between 1 October 2021 and 15 November 2021.

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0 3 6

(Scale in Miles)

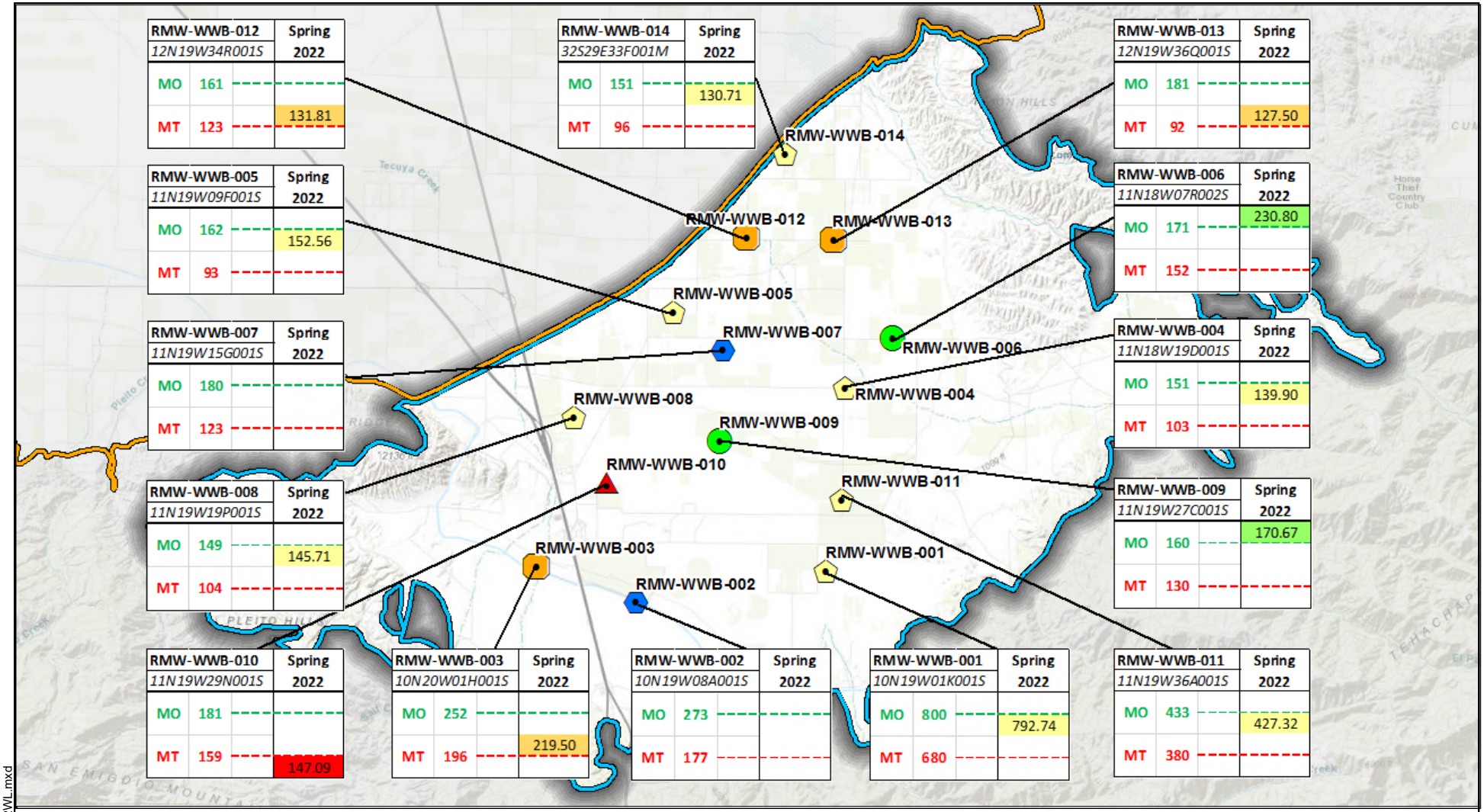
Fall 2021 Groundwater Levels Relative to Sustainable Management Criteria

White Wolf GSA
Kern County, California
March 2023
C20014.00

Figure 10

eki environment & water

Path: \\Hq-svr-file\gis\C20014.01\Maps\2023\3\Figure 10_Fall2021_inset.mxd



Legend

- Water Level Above MO (2 or 14%)
- Water Level Between MO and MT but closer to MO (6 or 43%)
- Water Level Between MO and MT but closer to MT (3 or 22%)
- Water Level below MT (1 or 7%)
- No Water Level Measurement (2 or 14%)

Groundwater Subbasin

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

Abbreviations

DWR = California Department of Water Resources
GSA = Groundwater Sustainability Agency
MO = Measurable Objective
MT = Minimum Threshold
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. Both RMW-WWB-002 and RMW-WWB-007 were inaccessible at the time of measurement.
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. Spring measurements were collected between 15 January 2022 and 4 May 2022.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 March 2023.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - Final Prioritization, dated February 2019.

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(Scale in Miles)

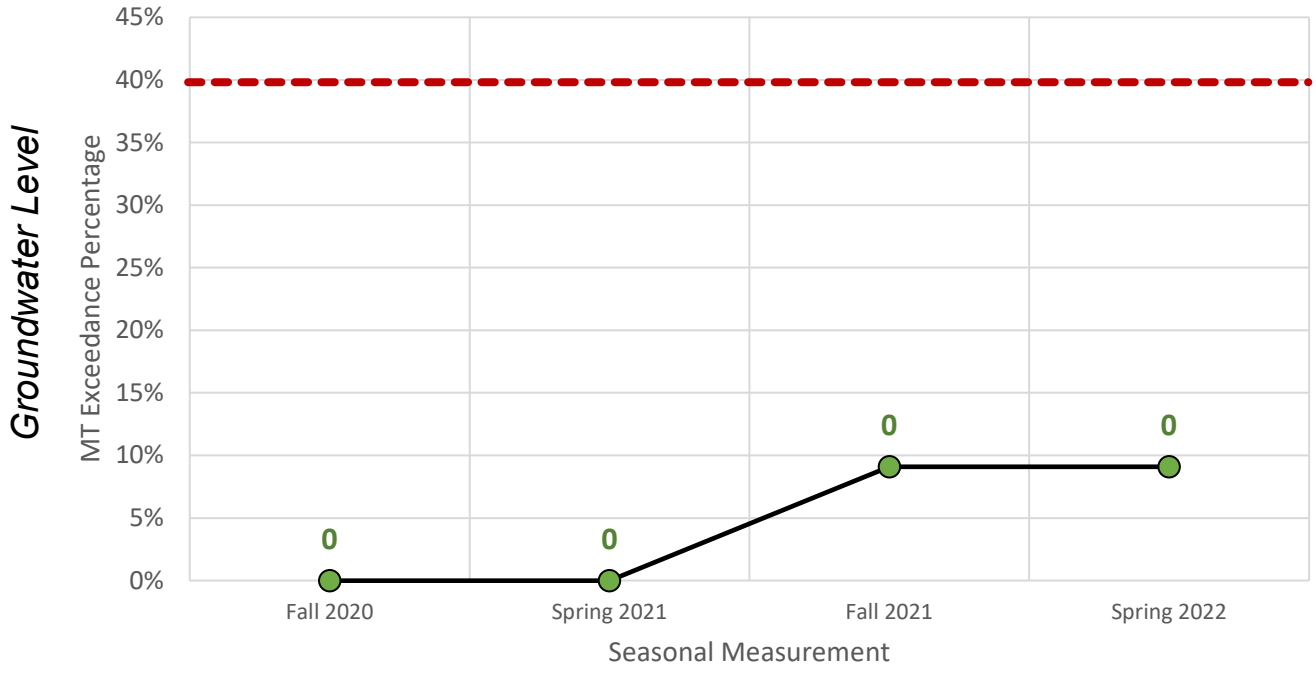
Spring 2022 Groundwater Levels Relative to Sustainable Management Criteria

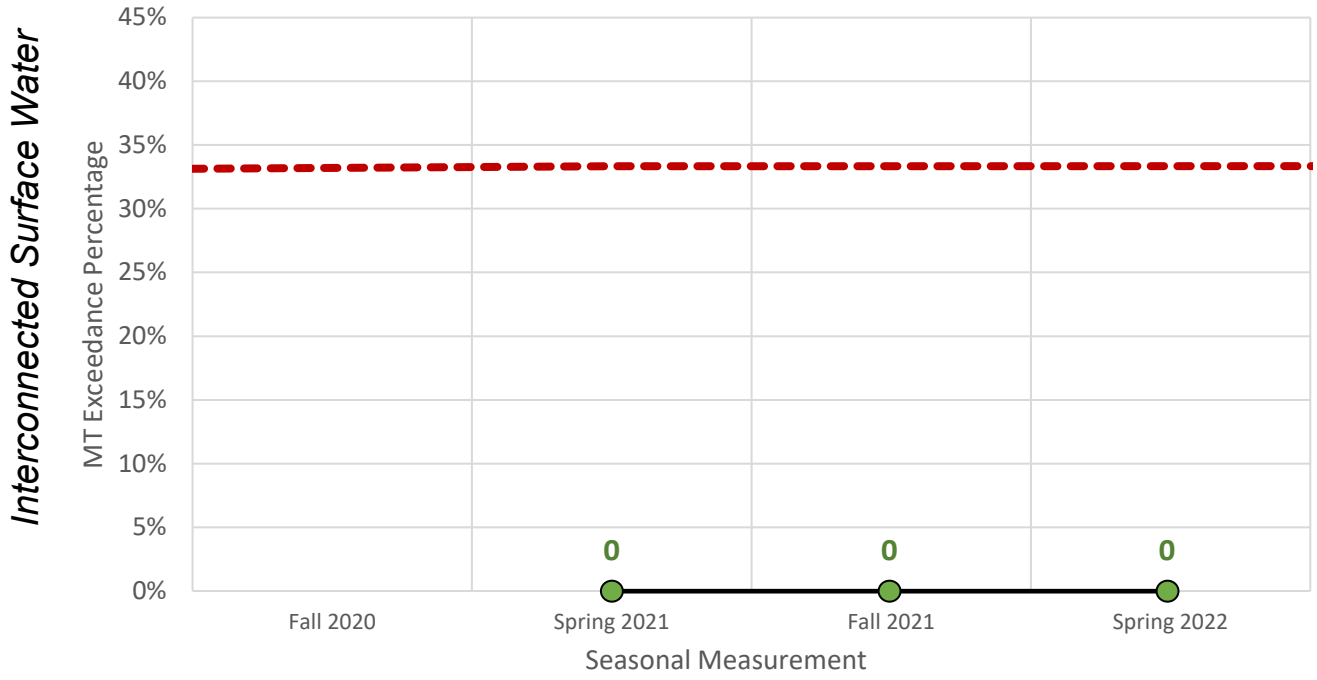
White Wolf GSA
Kern County, California
March 2023
C20014.01

Figure 11

eki environment & water

Path: X:\C20014.01\Maps\2023\3\Figure 11. Spring22WL.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

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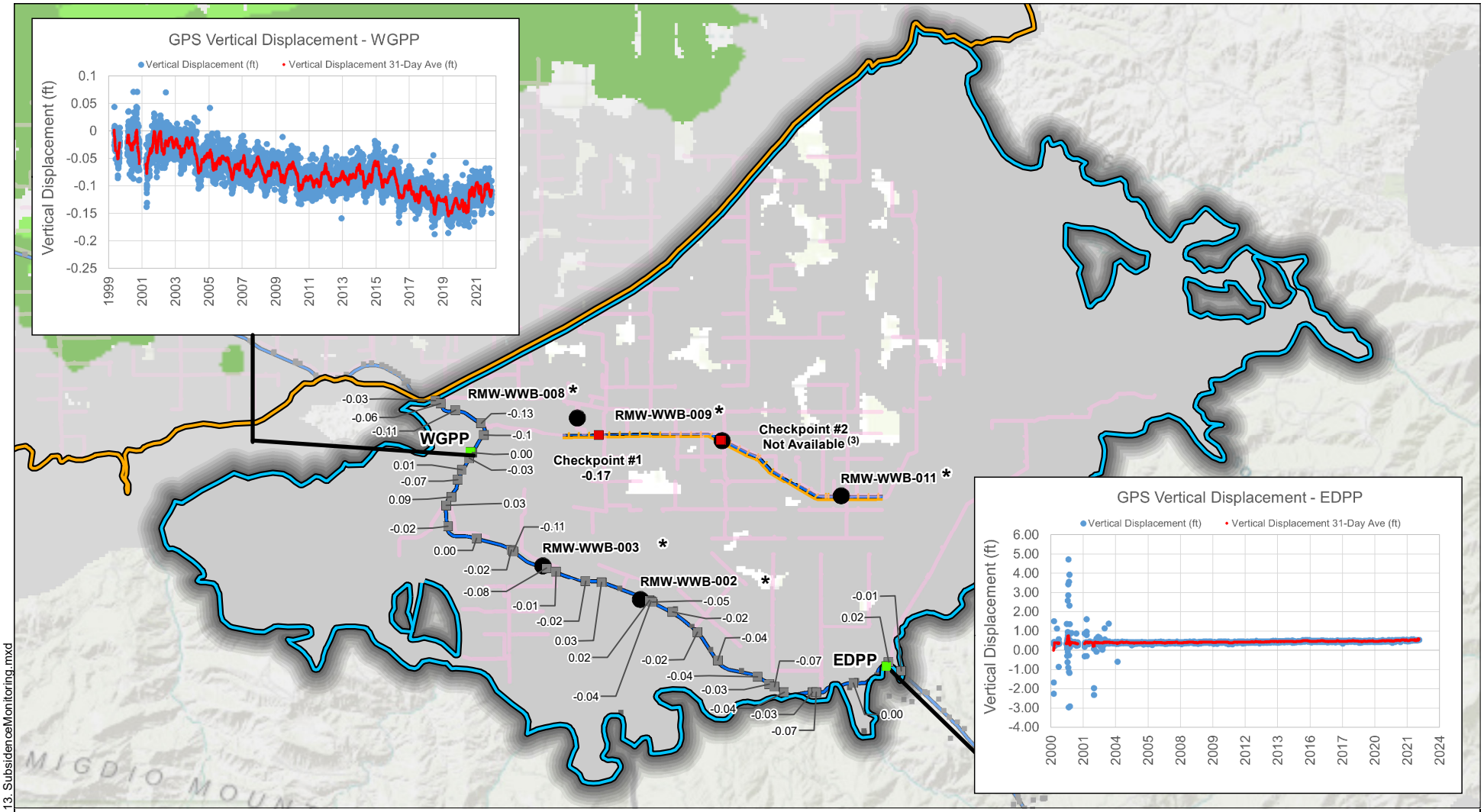
White Wolf GSA
Kern County, California
March 2023
EKI C20014.01

Figure 12



Legend

Groundwater Subbasin

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

Representative Monitoring

- Checkpoint
- GPS Subsidence Monitoring Station
- DWR Checkpoint

TRE Altamira InSAR Vertical Displacement WY 2022

- < - 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

Notes

1. All locations are approximate.
2. Asterisk (*) denotes wells that are also Representative Monitoring Wells for Chronic Lowering of Groundwater Levels.
3. Checkpoint #2 was moved in May 2022 due to retirement of pump where previous benchmark was placed. Difference could not be calculated.
4. TRE Altamira InSAR data displayed shows October 2021 through October 2022.
5. Values displaced are the difference between WY 2021 elevation and WY 2022 elevation.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 23 March 2023.
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 22 June 2022.

N

0 3 6

(Scale in Miles)

Subsidence Monitoring in the White Wolf Subbasin

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

Figure 13

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Path: \\Hq-svr-file\gis\C20014.01\Maps\2023\3\Figure 13. SubsidenceMonitoring.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.	12, 15, 17, 21:22	
	Note: Authority cited: Section 10733.2, Water Code. Reference: Sections 10728, 10728.2, 10733.2 and 10733.8, Water Code.		
Article 7	**Annual Reports and Periodic Evaluations by the Agency**		
§ 356.2	**Annual Reports**		
	Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:		
	(a) General information, including an executive summary and a location map depicting the basin covered by the report.	6:7, 30	
	(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.	31:32	
	(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.	33:34	
	(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.	12:13, 35	
	(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.	14:15	

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.*
	(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.	16:17	
	(5) Change in groundwater in storage shall include the following:		
	(A) Change in groundwater in storage maps for each principal aquifer in the basin.	37	
	(B) A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.	38	
	(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.	20:28	

APPENDIX B

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 flowmeter (flowmeter) 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 flowmeter installation.

The flowmeter was installed on 3 May 2022 in El Paso Creek, upstream of Reservoir 2 (see **Figure 1**). A picture of the installed flowmeter is shown in **Figure 2**.

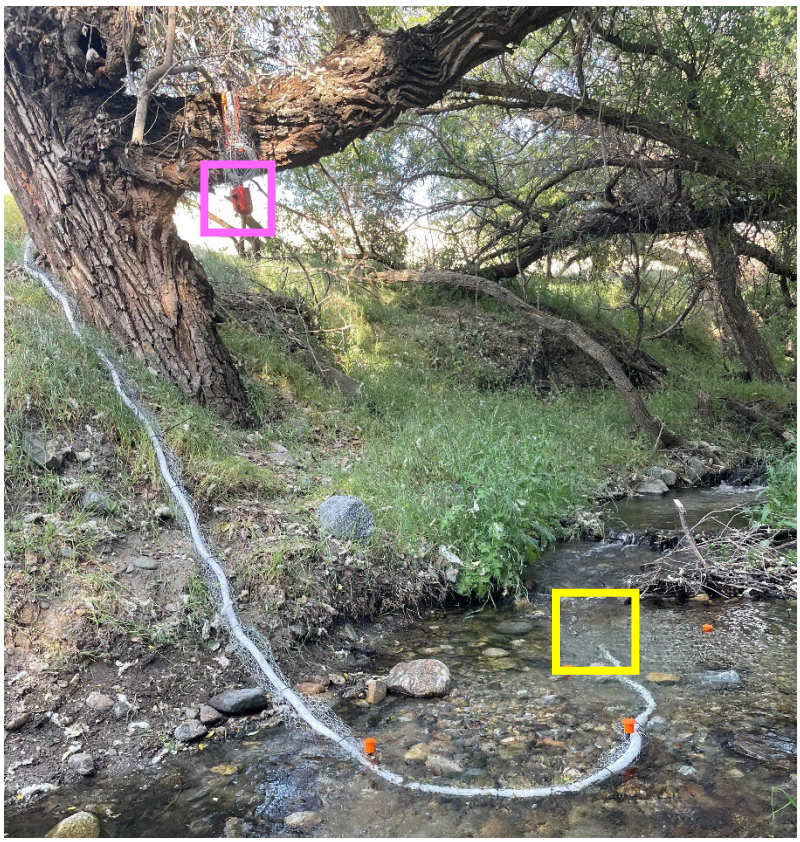
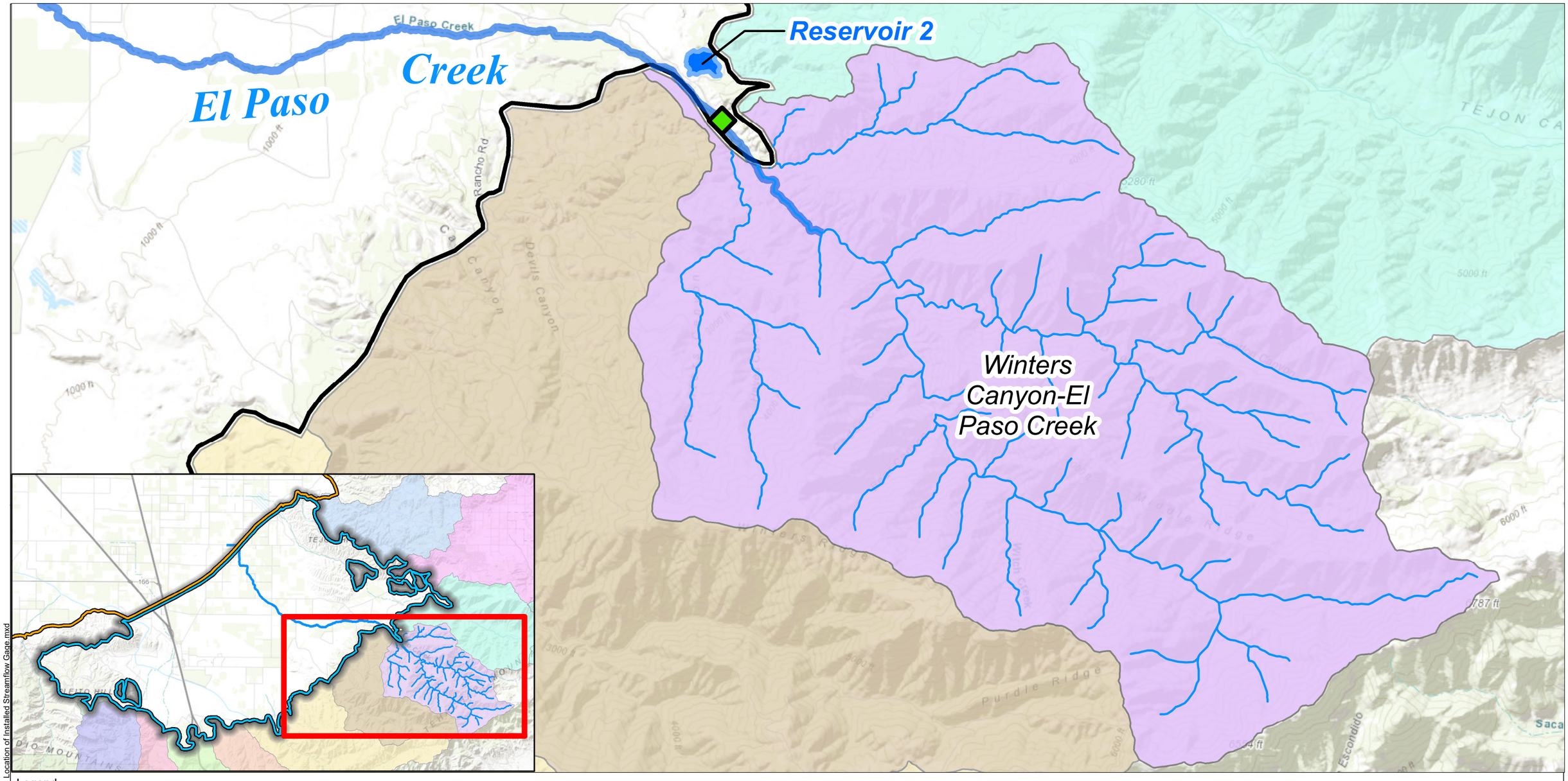


Figure 2. Pulsar Instruments Stingray 2.0 Flowmeter Installation on El Paso Creek. Yellow box indicates the location of the sensor collecting velocity and water level measurements. Pink square indicates the data logging system. The flowmeter was installed on 3 May 2022.

The flowmeter records data every hour, including stream temperature in Celsius (°C), water level above the flowmeter sensor in feet (ft), and velocity in feet per second (ft/s).

A graph of water level and velocity recorded during Water Year 2022 is provided in **Figure 3**.

During Water Year 2023, the White Wolf GSA will continue to periodically download data from the flowmeter 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, and develop a methodology for calculating 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
HUC = Hydrologic Unit Code
NHD = National Hydrography Dataset

Notes
1. All locations are approximate.
2. Pastel filled areas are watersheds draining into the White Wolf Subbasin.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 27 March 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 and watersheds from NHD (https://viewer.nationalmap.gov/basic/).

N

0 1 2
(Scale in Miles)

Location of Installed Streamflow Meter

eki environment & water

White Wolf GSA
Kern County, CA
March 2023
C20014.01
Figure 1

Path: \\Hq-svr-file\gis\C20014.01\Maps\2023\3\App B Figure 1. Location of Installed Streamflow Gage.mxd

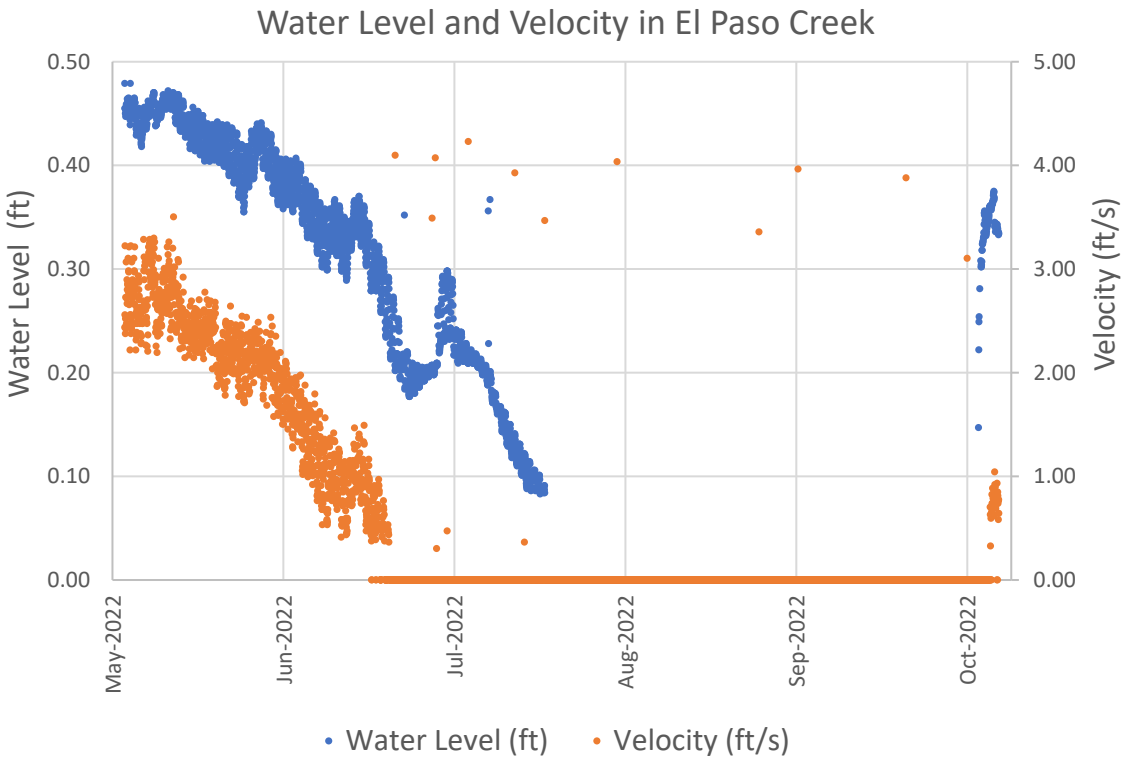


Figure 3. Water level and Velocity in El Paso Creek, 3 May 2022 to 29 October 2022.