

Appendix A-7

Tule Subbasin Coordination Agreement

Attachment 7: Draft-Final Technical Memorandum Re: Technical Support for Addressing State Water Resources Control Board Comments Regarding Interconnected Surface Water in the Tule Subbasin

Technical Memorandum



To: Tule Subbasin Technical Advisory Committee

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Date: 10- Jul-24

Re: Technical Support for Addressing State Water Resources Control Board
Comments Regarding Interconnected Surface Water in the Tule Subbasin

1 Introduction

This technical memorandum (TM) summarizes an analysis and initial characterization of interconnected surface water (ISW) in the Tule Subbasin in Tulare County, California (see Figure A7-1). This analysis will be incorporated into the Tule Subbasin Setting and Groundwater Sustainability Plans (GSPs) to be submitted by the Groundwater Sustainability Agencies (GSAs).

1.1 Background

ISW is one of the six sustainability indicators defined in the Sustainable Groundwater Management Act (SGMA). In general, the GSPs submitted to the California Department of Water Resources (CDWR) in 2020 and 2022, stated that as depth to water is greater than 25 feet below ground surface (ft bgs) in average and dry conditions, ISW conditions do not exist in the Tule Subbasin.

The Undesirable Results section of the 2022 Coordination Agreement (Section 4.3.5) noted “No interconnected surface waters have been identified in any Tule Subbasin GSAs as described more thoroughly in relevant portions of the Basin Setting. Thus, no criteria need be established.”

In their review of the Tule Subbasin GSPs submitted in 2020¹ and 2022² the CDWR did not include deficiencies for interconnected surface water. However, the State Water Resources Control Board

¹ CDWR, 2022. Incomplete Determination of the 2020 Groundwater Sustainability Plans Submitted for the San Joaquin Valley – Tule Subbasin. Letter dated January 28, 2022.

² CDWR, 2023. Inadequate Determination of the Revised 2020 Groundwater Sustainability Plans Submitted for the San Joaquin Valley – Tule Subbasin. Letter dated March 2, 2023.

(SWRCB) Tule Subbasin Probationary Hearing Draft Staff Report³ identified two deficiencies and one conditional deficiency in the GSPs related to ISWs. The Draft Staff Report also identified potential actions to address the deficiencies. The deficiencies and potential actions are summarized below:

Deficiency Interconnected Surface Water (ISW)-1 – The 2022 GSPs claim that there is no ISW in the Tule basin, but the analysis is limited and relies on incomplete data.

Potential Action ISW-1a – Use the best available data for identifying interconnected surface waters in the subbasin.

Potential Action ISW-1b – Explain which groundwater level monitoring network was used to justify the absence of ISWs with the basin.

Deficiency ISW-2 – The 2022 GSPs do not correctly define Interconnected Surface Water.

Potential Action ISW-2a – Reevaluate ISWs within the basin using the understanding that ISWs may be intermittent.

Potential Action ISW-2b – Remove the reference to subterranean streams.

Conditional Deficiency ISW-3 – If depletions of Interconnected Surface Water occur in the subbasin, the GSAs must set Sustainable Management Criteria for depletions of Interconnected Surface Water and establish a shallow water monitoring network.

Potential Action ISW-3a – Create an ISW monitoring network near established surface monitoring stations to fill data gaps.

Potential Action ISW-3b – Use the ISW network to model surface water hydraulic connection to the underlying aquifer via a continuous saturated zone.

Potential Action ISW-3c – Identify wells where excessive groundwater pumping could lower the hydraulic gradient, reduce the surface water supply, and impact nearby vegetation and ecosystems.

Potential Action ISW-3d – Develop SMC for the depletion of interconnected surface water.

1.2 Purpose and Scope

In general, the purpose of this TM is to address the SWRCB Staff Report's Deficiencies 1 and 2 by identifying and characterizing areas of potential ISW and provide recommendations for future analysis to evaluate potential depletions of ISW and development of Sustainable Management

³ SWRCB, 2024. Tule Subbasin Probationary Hearing Draft Staff Report. March 2024.



Criteria for ISW which would address Conditional Deficiency 3. It is noted that Potential Action ISW-2b is specific to the Eastern Tule GSA GSP and is not addressed herein.

1.3 Sources of Data

The analysis presented herein is based on the best available data and background reports at the time of preparation. Sources of data used for this analysis include the following:

- Lithologic and well location data from:
 - Tule Subbasin Technical Advisory Committee
 - City of Porterville
 - Vandalia Irrigation District
 - Terra Bella Irrigation District
 - Monitoring wells accessed from California State Water Resources Control Board (SWRCB) GeoTracker database
 - Department of Drinking Water Public Water System Wells
 - CDWR Well Completion Reports (i.e. “Drillers Logs”)
 - United States Geological Survey (USGS) well completion database
- Groundwater levels from:
 - Tule Subbasin Technical Advisory Committee
 - Tule River Association
 - City of Porterville
 - Terra Bella Irrigation District
 - Monitoring wells accessed from California SWRCB GeoTracker database
- Groundwater pumping data from:
 - City of Porterville
 - Terra Bella Irrigation District
- Surface water flow data from:
 - Tule River Association
 - USGS
- Vegetation data from:
 - California Department of Fish and Wildlife (CDFW) Vegetation and Classification and Mapping Program (VegCAMP), accessed from <https://wildlife.ca.gov/Data/GIS/IMAPS>
 - DWR Natural Communities Commonly Associated with Groundwater, accessed from <https://gis.water.ca.gov/app/NCDatasetViewer/>
 - The Nature Conservancy GDE Pulse tool, accessed from <https://gde.codefornature.org>
- Remote sensing Landsat 7 data from:



- Sentinel Hub EO Browser accessed from <https://apps.sentinel-hub.com/eo-browser/>
- Land surface elevation data in the streambeds from:
 - USGS Digital Elevation Model (DEM) based on LiDAR data collected in 2021.

2 Approach

The approach to develop ISW SMCs will require a coordinated effort between technical consultants, agricultural stakeholders, and non-governmental organizations (NGOs). The analysis presented in this TM is meant to lay the groundwork for developing SMCs in the future by gathering available data, identifying areas of potential ISW, and recommending future work.

Key aspects of the process are summarized in Figure A7-2 and described below.

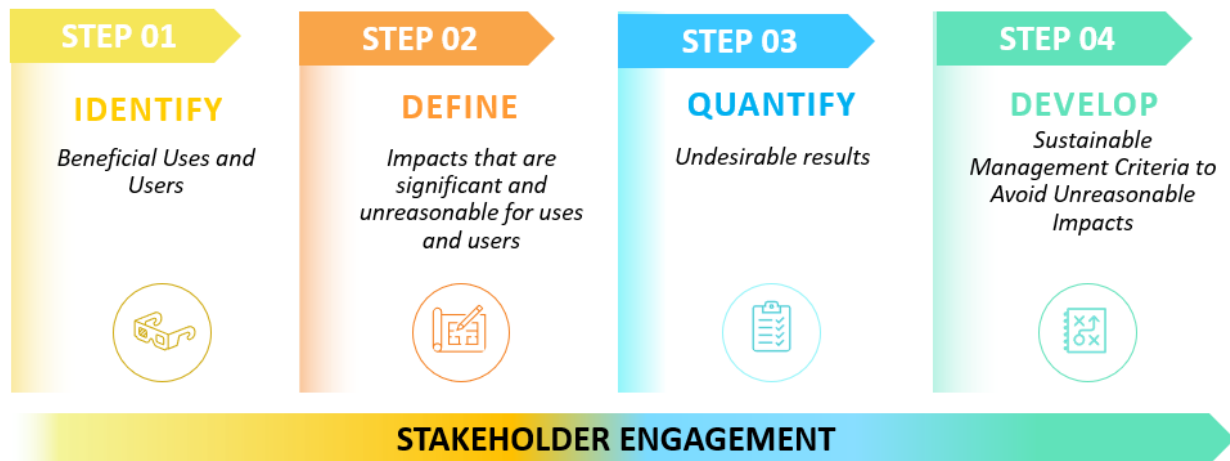


Figure A7-2. Approach for Determining Sustainable Management Criteria for Interconnected Surface Water in the Tule Subbasin.

STEP 01

IDENTIFY

Beneficial Uses and Users



Beneficial uses and users of groundwater in the Tule Subbasin include domestic supply, municipal supply, agricultural supply, industrial supply, and environmental. Agricultural supply (related to surface water supply) and environmental (e.g. groundwater dependent ecosystems) are the most applicable beneficial uses and uses related to Interconnect Surface Water.

STEP 02

DEFINE

Impacts that are significant and unreasonable for uses and users



A preliminary definition of significant and unreasonable impacts to beneficial uses and users has been included herein. As more information on ISW is obtained this definition may be refined.

STEP 03

QUANTIFY

Undesirable results



Quantification of undesirable results will require understanding the cause and effect of pumping on depletions of ISW. Estimating depletions will require additional data and analyses that is not available at this time. Further, the methodology to estimate depletions will rely on guidance from the DWR which is not yet published.

STEP 04

DEVELOP

Sustainable Management Criteria to Avoid Unreasonable Impacts



Development of Sustainable Management Criteria (SMC) including Minimum Thresholds (MTs) and Measurable Objectives (MOs) will be informed by the determination of undesirable results from the previous step.



3 Interconnected Surface Water Conditions

3.1 Definition

“Interconnected surface water refers to surface water that is hydrologically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted”

Title 23 California Code of Regulations § 351[o]

The interaction between surface water and groundwater can be summarized in three ways⁴:

1. Surface water gains water from groundwater (i.e. “gaining stream”).
2. Surface water loses water to groundwater (i.e. “losing stream”).
3. Both, gaining in some locations and losing in other locations or gaining at some times and losing at other times.

Changes in the relationship between surface water and groundwater can occur naturally from seasonal precipitation changes and seasonal pumping. In areas where groundwater naturally discharges at the land surface (gaining stream), lowering of groundwater levels from pumping near the discharge point can impact the flow in the stream. Other factors that can affect flow in the stream include releases of water from upstream reservoirs, managed recharge near the stream channel, and long-term precipitation trends. Also, it is noted that losing streams may be hydrologically connected to groundwater with a saturated zone or can be disconnected from groundwater by an unsaturated zone.

3.2 Initial Criteria for Identifying Areas of Potential ISW

To identify areas of potential ISWs for further study, an analysis was conducted consistent with method utilized by The Nature Conservancy’s ICON database of ISW in the Central Valley⁵. The method categorizes the likelihood of the ISW connection based on the minimum depth to groundwater and uses the following four categories:

- Likely Connected – Gaining: Groundwater elevation is equal to or greater than the surface water elevation and thus groundwater is likely flowing into the surface water body.
- Likely Connected – Losing: Groundwater elevation is between 0 and 20 feet below the surface water elevation and thus groundwater is likely receiving water from the surface water body through a continuous saturated zone.

⁴ CDWR, 2024. Depletions of Interconnected Surface Water, An Introduction. Draft, dated February 2024.

⁵ The Nature Conservancy. ICONS: Interconnected Surface Water In the Central Valley. Dated December 2021. https://www.groundwaterresourcehub.org/content/dam/tnc/nature/en/documents/groundwater-resource-hub/icons_readme.pdf



- Uncertain: Conditions where the groundwater elevation is between 20 and 50 feet below the surface water elevation are labeled as uncertain because the groundwater may or may not be connected to surface water.
- Likely Disconnected: Groundwater elevation is greater than 50 feet below the surface water elevation and thus is likely disconnected from the surface water body.

Based on the ICONS database⁶ and an initial review of available data, three areas of potential ISWs were identified in the Tule Subbasin:

- Upper Tule River from the Subbasin Boundary at Success Dam to Road 192
- Upper Deer Creek from the Subbasin Boundary to the Friant-Kern Canal
- Upper White River from the Subbasin Boundary to Highway 65

Together, these three areas are referred to herein as the Study Areas.

3.3 Definition of Significant and Unreasonable Impacts to Interconnected Surface Water

Impacts to ISW are considered significant and unreasonable when:

- GDE health has declined such that the ecosystem's recovery is non-recoverable. These fluctuations in GDE health are deemed significantly and unreasonably impacted due to groundwater pumping when a GDE cannot recover in seasonal high conditions.
- Surface water access for surface water rights holders or riparian rights holders of adjacent or downstream users has been reduced due to groundwater pumping extracting underflows.

4 Hydrogeologic Setting

Interconnected surface water in the Tule Subbasin occurs primarily along the upper reaches of the river and stream channels draining the Sierra Nevada Mountains. The sediments in the vicinity of these stream channels consist of recent fluvial (i.e. streambed deposits) consisting primarily of sand and gravel with some localized fine-grained overbank deposits. Holocene surficial deposits have been mapped as “Younger” and “Older” alluvial deposits (see Figure A7-3). Where saturated in the subsurface, the permeable sand and gravel layers beneath the stream channels form the uppermost part of the Upper Aquifer where the regional groundwater levels in this aquifer are near the land surface. In other areas where Upper Aquifer groundwater levels are deeper, saturated conditions beneath the stream channels may occur as a result of perched groundwater conditions.

⁶ The Nature Conservancy. ICONS: Interconnected Surface Water in the Central Valley. <https://icons.codefornature.org/> Accessed March 2024.



The depth to bottom of the Upper Aquifer is approximately 40 to 90 ft from Success Dam to east of the Friant-Kern Canal and deepens to over 120 ft west of the Friant-Kern Canal (see Figure A7-9). At this time, detailed maps of the bottom of the Upper Aquifer have not been prepared for the Upper Deer Creek or Upper White River Areas but in general the depth to the Upper Aquifer in these areas is on the order of 100 to 200 ft.

In general, groundwater in the Tule Subbasin flows from areas of natural recharge along major streams at the base of the Sierra Nevada Mountains on the eastern boundary towards the western-central portion of the subbasin.

Below these aquifer and aquitard units is the crystalline bedrock which forms the eastern Subbasin Boundary. Outcrops of this bedrock in the Porterville Area include Martin and Murray Hills (see Figure A7-4).

5 Surface Water Features Where Interconnected Surface Water Conditions May be Present

5.1 Lake Success and the Tule River

The Tule River is the largest natural drainage feature in the Tule Subbasin. From its headwaters in the Sierra Nevada Mountains, the Tule River flows first into Lake Success and then, through controlled releases at the dam, flows through the Porterville area, Porterville Irrigation District, and Lower Tule River Irrigation District where it is diverted at various points. During periods of above-normal hydrology flows out of the Tule Subbasin to Tulare Lake may occur.

Lake Success is a manmade reservoir created by the construction of Success Dam that was completed in 1961 and serves as a flood control and water conservation project for the Tule River. Success Dam and reservoir are managed by the United States Army Corps of Engineers (ACOE). Water storage in Lake Success is subject to the ACOE's flood control diagram and released as directed by the ACOE and downstream water rights holders as administered by the Tule River Association (TRA), in accordance with the Tule River Water Diversion Schedule and Storage Agreement.⁷

Releases of water from Lake Success are sent to either the Tule River channel (measured at the Below Success Dam gage) or directly into the Pioneer Ditch. Releases of water below Success Dam are diverted from the Tule River channel at various locations in accordance with TRA (1966). Diversion points along the river are located at the Porter Slough headgate, Campbell and Moreland Ditch Company, Vandalia Water District, Poplar Irrigation Company, Hubbs and Miner Ditch Company, and Woods-Central Ditch Company (see Figure A7-5). The lower portion of the Tule

⁷ Tule River Association, 1966. Tule River Water Diversion Schedule and Storage Agreement. Dated February 1, 1966; revised June 16, 1966.



River channel is also used as a conveyance mechanism to convey imported water from the Friant-Kern Canal to Porterville Irrigation District (PID) and Lower Tule River Irrigation District (LTRID). Within the PID and LTRID, a combination of natural stream flow and imported water are further diverted into unlined canals for distribution to artificial recharge basins and farmers.

From water years 1986/87 to 2022/23, releases from Lake Success to the Tule River channel (i.e. measured at Below Success Dam and without diversions to Pioneer Ditch), has ranged from 6,000 acre-ft in water year 2014/15 to 512,100 acre-ft in water year 2022/23 with an annual average during this time period of approximately 119,700 acre-ft (see Figure A7-5 and Table A7-1).

It is emphasized that flows into the Tule River below Success Dam, and therefore into the Tule Subbasin, are dependent on scheduled releases from Lake Success and diversions from the Tule River follow a system of surface water rights both of which are outside the control of GSA actions. As such, identifying the role that groundwater pumping may have on ISW conditions will also require identifying the cause-and-effect nature that releases and diversions to and from the Tule River have on ISW conditions.

5.2 Deer Creek

Deer Creek is an undammed stream that originates in the Sierra Nevada Mountains, flowing in a westerly direction north of Terra Bella and into Pixley (see Figure A7-6). Although the Deer Creek channel extends past Pixley, discharges rarely reach the historical Tulare Lakebed. Stream flow in Deer Creek has been measured at the USGS gaging station at Fountain Springs from 1968 to present time. Average annual flow at this gage between water year 1986/87 and 2022/23 was approximately 19,500 acre-ft/yr with a low of approximately 2,000 acre-ft in water year 2014/15 and a high of approximately 96,300 acre-ft in water year 2022/23 (see Figure A7-7 and Table A7-1).

In March of 2023, the USGS started collecting Deer Creek streamflow data at the Avenue 272 gaging station (Figure A7-7). Comparison of the Deer Creek flows at Fountain Springs versus at Avenue 272 from April 2023 through May 2024 shows that flows at Avenue 272 are approximately 56% of the those measured at Fountain Springs (Figure A7-8).

Further downstream, Friant-Kern Canal water is diverted into Deer Creek and total flows in the channel are also measured at Trenton Weir (see Figure A7-7) before being delivered to agricultural lands via unlined canals. During wet years, water that reaches the terminus of Deer Creek is discharged into the Homeland Canal.



5.3 White River

The White River drains out of the Sierra Nevada Mountains east of the community of Richgrove in the southern portion of the Tule Subbasin (see Figure A7-6). Stream flow in the White River was measured at the USGS gaging station near Ducor from 1972 to 2005. Data after 2005 has been interpolated based on data from Deer Creek. Average annual flow between water years 1986/87 and 2022/23 was approximately 5,800 acre-ft/yr with a low of approximately 300 acre-ft in water year 2014/15 and a high of approximately 36,800 acre-ft in 1997/98 (see Figure A7-9). The White River channel extends as far as State Highway 99 but flows rarely reaches the historical Tulare Lakebed.

6 Groundwater Levels

6.1 Groundwater Levels in the Upper Tule River Area

In the Upper Aquifer and near the Upper Tule River Area, groundwater levels in ETGSA-01 Upper, Bob's Petrol Station MW-2, City of Porterville MW03S, and City of Porterville MW101 (see Figure A7-11) in the Upper Tule River Area vary from approximately 5 to over 50 ft bgs (see Figures A7-12a through A7-16a). Groundwater levels in ETGSA-01 Upper varied from 50 ft bgs in May 2022 to 5 ft bgs throughout most of 2023 (see Figure A7-12a). Groundwater levels in Bob's Petrol Station MW-2 varied from 32 ft bgs in April 1999 to 52 ft bgs in July 2014 (see Figure A7-13a). In 2006 and from 2013 through 2023, groundwater levels in the City of Porterville monitoring well MW03S have generally varied from 41 ft bgs to 73 ft bgs though the 87 ft deep well was dry from July 2014 through January 2017 (see Figure A7-14a). Groundwater levels in the 66 ft-deep City of Porterville monitoring well MW101 have been typically near or below the bottom of the well since 2013 (see Figure A7-14).

Groundwater levels west of the Friant-Kern Canal, in City of Porterville R-11 (see Figure A7-10), which correlates well with the shallower Village Market MW-1, are typically 25 to 60 ft bgs but have varied from a high of 17 ft bgs in October 2023 to a low of 116 ft bgs in May 2016 (see Figure A7-15). It is noted that groundwater levels at these wells are influenced by native Tule River flows, diversions of Friant-Kern Canal water into the Tule River Channel, and recharge operations at the nearby Tule River- Friant Kern Canal Water Bank.

In the Lower Aquifer, groundwater levels in the Upper Tule River Area are lower than those in the Upper Aquifer and have varied from approximately 16 to over 150 ft bgs. Groundwater levels in ETGSA-01 Lower varied from 89 ft bgs in May 2022 to 17 ft bgs in March of 2023 and 2024. Groundwater levels can also vary by 10 to 20 ft over short (i.e. over a few days) time periods which is interpreted to be from pumping interference.

Comparison of daily groundwater elevations in ETGSA-01 Upper and releases from Lake Success shows a strong correlation, though the cause may be more dependent on recharge operations at the



Vandalia ID recharge basins located 100 ft away that recharge water diverted from the Tule River. From May 2022 to August 2022 groundwater levels rise from 50 to 22 ft bgs while releases from Lake Success increase from less than 10 cubic feet per second (cfs) to approximately 170 cfs. Groundwater levels and flows rise further in early 2023. However, groundwater levels stabilize at approximately 6 ft bgs for most of 2023. Groundwater elevations are roughly equal to the elevation of the Vandalia ID recharge basins. These high groundwater elevations are approximately 15 ft above the Tule River streambed elevation located 0.41 miles away.

Comparison of groundwater elevations in shallow wells to the Tule River streambed show groundwater elevations below, near, and above the Tule River at ETGSA-01 (see Figure A7-12b) and generally twenty to over 50 ft in Bob's Petrol Station MW-2, City of Porterville MW03S, City of Porterville MW101, and City of Porterville R-11 (see Figures A7-13b through A7-16b).

In the City of Porterville well R-11 near the Friant-Kern Canal, high groundwater elevations in 2012 were approximately 25 ft below the streambed but after recharge operations started nearby in 2017, groundwater elevations have risen to 10 to approximately 0 ft below the Tule River streambed during wet periods (see Figure A7-16b).

Comparison of Upper and Lower Aquifer groundwater levels shows that groundwater levels are higher in the Upper Aquifer than those in the Lower Aquifer. This indicates a downward hydraulic gradient.

6.2 Groundwater Levels in the Upper Deer Creek Area

Groundwater levels in Upper Aquifer Terra Bella Irrigation District wells in the Upper Deer Creek Area and near the eastern edge of the Subbasin in January 2023 were less than 15 ft bgs (see Figure A7-18). Groundwater elevations were within approximately 5 ft of the Deer Creek streambed elevation. Historical groundwater levels are not available at this time.

Upper Aquifer groundwater levels in the Upper Deer Creek Area in wells IR1071, D1053, and Sierra Mini Mart #4 MW-4 (see Figure A7-16) are greater than 110 ft bgs (see Figures A7-19 through A7-21). Comparison of groundwater elevations at these wells to the Deer Creek streambed elevation shows greater than 70 ft of difference.

Groundwater levels in shallow monitoring wells installed for the Deer Creek – Friant Kern Canal Water Bank, located at the western edge of the Upper Deer Creek Area, have varied from less than 10 ft bgs to greater than 50 ft bgs (see Figure A7-22). It is noted that groundwater levels at these wells are influenced by native Deer Creek flows, diversions of Friant-Kern Canal water into the Deer Creek Channel, and recharge operations at the water bank.



6.3 Groundwater Levels in the Upper White River Area

Recent groundwater levels in the Upper White River Area are not available at this time. The closest well with groundwater elevations available is 24S26E11 which is located approximately 4.5 miles west of Highway 65 (the western edge of the Upper White River Area). Depth to groundwater in 24S26E11 are approximately 250 ft bgs (Figure A7-23). Very few wells are located in the Upper White River Area and those that are generally perforated in the Lower Aquifer or the deeper Santa Margarita/Olcese Sands aquifers. The Upper Aquifer in this area has been conceptualized as dry.⁸

7 Groundwater Dependent Ecosystems

7.1 Definition

Groundwater dependent ecosystems (GDEs) refer to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater near the ground surface (Title 23 California Code of Regulations § 351[m]). GDEs may be related to ISWs in that ISW features (rivers and shallow groundwater) are hydrologic systems likely to host aquatic communities or species that may be dependent on groundwater.⁹

7.2 Vegetation Types in Potential Groundwater Dependent Ecosystems

Potential groundwater dependent ecosystems in the Study Areas were identified with California Department of Fish and Wildlife's (CDFW) Vegetation Classification and Mapping Program (VegCAMP) data^{10,11}. VegCAMP is one of the primary sources for the DWR's Natural Communities Commonly Associated with Groundwater ("Natural Communities") dataset.

Two habitat classes are included in the Natural Communities dataset: (1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions; and (2) vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes). In the Study Areas, dominant species mapped by VegCAMP, wetland vegetation consists of riparian mixed shrub while phreatophytes include Freemont

⁸ Lofgren, B.E., and Klausing, R.L., 1969. Land Subsidence Due to Ground-Water Withdrawal Tulare-Wasco Area California. USGS Professional Paper 437-B.

⁹ Klausmeyer K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. https://www.groundwaterresourcehub.org/content/dam/tnc/nature/en/documents/groundwater-resource-hub/iGDE_data_paper_20180423.pdf

¹⁰ California Department of Fish and Wildlife. Vegetation – Great Valley Ecoregion [ds2632]. Published 2018. <https://map.dfg.ca.gov/metadata/ds2632.html>

¹¹ California Department of Fish and Wildlife. Vegetation – Southern Sierra Nevada Foothills [ds3073]. Published 2023. <https://map.dfg.ca.gov/metadata/ds3073.html>



Cottonwood, Willow, California Sycamore, Hardwood, and Oak. Grasses and forbs (i.e. non-woody flowering plants) in the VegCAMP dataset were not included in this analysis.

In the Upper Tule River Area, the majority of potential GDEs are between Success Dam and Martin Hill (“Segment A”, see Figure A7-24), though some groves of trees are mapped in the Tule River channel between Martin Hill and the Friant-Kern Canal (“Segment B”). Vegetation types in Segment A are primarily Fremont Cottonwood and Willow with lesser amounts of Hardwood, California Sycamore, and Riparian Mixed Shrub. Vegetation has been mapped adjacent to and approximately one quarter to one half mile away from the Tule River, particularly south of Highway 190. In Segment B, vegetation types are primarily Fremont Cottonwood, Willow, and Riparian Mixed Shrub and are generally located within 200 ft from the Tule River.

Vegetation types in the Upper Deer Creek Area are primarily California Sycamore, Fremont Cottonwood, Willow, Hardwood, and Oak (see Figure A7-25). The majority of the vegetation is east of Highway 65. Small patches of Fremont Cottonwood and Willow have been mapped between Highway 65 and the Friant-Kern Canal.

Vegetation in the Upper White River Area is primarily located within 3 miles of the Subbasin boundary and consists primarily of Willow with lesser areas of Fremont Cottonwood, Oak, California Sycamore, and Riparian Mixed Shrub (see Figure A7-24)

7.3 Normalized Derived Vegetation Index (NDVI)

The health of GDEs are affected by a variety of factors, including climate, pests, land management, water quality, and their ability to access groundwater¹². For this analysis, the normalized derived vegetation index (NDVI) was calculated for the potential GDE areas described previously (see Figures A7-22 and A7-23), consistent with the Nature Conservancy GDE Pulse tool. NDVI estimates vegetation greenness with remote sensing (i.e. satellite) Landsat data, specifically from the near infrared and red band sensors.

NDVI values in Segment A of the Upper Tule River Area from 2013 to 2023 vary from approximately 0.35 in the fall to approximately 0.55 in the Spring (see Figure A7-27). NDVI values in Segment B of the Upper Tule River Area range from approximately 0.25 to 0.5 in the Fall and Spring, respectively. NDVI values in the Upper Deer Creek Area from 2013 through 2023 vary from 0.30 to 0.55 (see Figure A7-28). For the Upper White River Area, NDVI values range from 0.3 to 0.7 (see Figure A7-29).

NDVI trends generally are not well correlated to trends in the amount of flow in their respective streams. For example, in Segment A of the Upper Tule River Area, the NDVI values were higher

¹² The Nature Conservancy, California. 2024. GDE Pulse v2.2.0. San Francisco, California. <https://gde.codefornature.org>.



in 2014/15 than in 2013/14 even though the total releases from Lake Success were lower. Similarly, NDVI values were lower in 2017/18 than in 2019/20 even though the streamflow was higher. Further refinement and analysis of the data may be necessary to identify correlations between the various factors of GDE health, NDVI, streamflow, and, potentially, groundwater pumping.

8 Groundwater Pumping

8.1 Groundwater Pumping in the Upper Tule River Area

Groundwater pumping in the Upper Tule River Area is conducted by wells from the City of Porterville, Community Systems, Small Systems, Vandalia Water District, domestic users, and agricultural users (see Figure A7-30). As discussed previously (see Figure A7-10), the depth of bottom of the Upper Aquifer is approximately 50 to 90 ft bgs in the Upper Tule River Area and groundwater levels in the Upper Aquifer are approximately 5 to 50 ft bgs. As the saturated thickness of the Upper Aquifer is relatively thin, most production wells are perforated in the Lower Aquifer.

Wells in the Upper Tule River Area with known perforations east of Martin Hill are typically perforated in the Upper and Lower Aquifers (i.e. “composite”) (see Figure A7-30). The majority of these wells are domestic wells in the East Porterville area. Wells west and south of Martin Hill are typically perforated in the Lower Aquifer. Of the 35 active City of Porterville wells, 29 are aquifer are perforated in the Deep Aquifer and 6 are composite aquifer wells.

Based on the USGS Well Completion Database, over 300 wells, primarily domestic wells, are located in the East Porterville area. The majority of these wells with known perforations are upper or composite aquifer wells.

8.2 Groundwater Pumping in the Upper Deer Creek Area

Groundwater pumping in the Upper Deer Creek Area is conducted by agricultural users, domestic users, Terra Bella Irrigation District, Community Systems, and Small Systems. As discussed in Section 4.2, groundwater levels in the Upper Aquifer are generally greater than 100 ft bgs. Due to the deeper groundwater levels, the majority of wells with known perforation intervals are Deep or Composite Aquifer wells (see Figure A7-31). Likewise, due to low well yields in the sediments of the Dissected Uplands (see Figure A7-3), there is a lower concentration of wells in the Dissected Uplands compared to area north and west of them.

Terra Bella Irrigation District (TBID) operates 8 wells in the Upper Deer Creek Area, 6 near the eastern edge of the Subbasin and 2 near Highway 65. TBID’s primary source of water is imported water from the Friant-Kern Canal and uses the wells as supplemental supply when maintenance on the FKC is periodically conducted and is not available.



8.3 Groundwater Pumping in the Upper White River Area

In the Upper White River Area, the Upper Aquifer consists of low permeability continental sedimentary rocks of the dissected uplands. The Upper Aquifer in this area is conceptualized as being dry and therefore it is also assumed that groundwater pumping is very limited. One well in the USGS database in the area is less than 100 ft deep and is considered to be an Upper Aquifer well (see Figure A7-32). It is noted that some shallow pumping by domestic or agricultural users may occur but is unknown at this time.

8.4 Depletions of Interconnected Surface Water

Groundwater pumping near areas of ISW can result in reductions in stream flow or water levels referred to as stream depletion¹³. Pumping lowers groundwater levels, which results in a reduction in streamflow or volume of water in a surface water body in two ways: (1) a reduction of inflow to an ISW from groundwater (in the case of gaining streams) or (2) an increase in outflow from an ISW to groundwater (in the case of losing streams).

Streamflow is also affected by other factors including hydrology (e.g. drought), controlled releases (e.g. Tule River releases from Lake Success), surface water diversions, precipitation, and nearby recharge and return flow. The potential impacts of groundwater pumping, both from the Upper and Lower Aquifers, in the Study Areas are unknown at this time.

9 Conclusions

9.1 Upper Tule River Area

Evaluation of Upper Aquifer groundwater levels in the upper reaches of the Tule River (below Success Reservoir Dam) suggests that groundwater is periodically interconnected with surface water in this area. During wet hydrologic conditions, such as occurred during the 2022/23 water year, groundwater levels in some shallow wells near the river rose to within 20 feet of the land surface and, when compared to the streambed elevation of the river, were near the streambed elevation. At ETGSA-01, a nested monitoring well constructed in 2022 and located approximately 0.5-mile south of the river channel (see Figure A7-11), the groundwater level in the Upper Aquifer completion of the well rose to within 10 feet of the land surface during the above-normal precipitation and runoff conditions of winter and spring 2023 (see Figure A7-12). It is noted that this well is located adjacent to managed recharge basins operated by the Vandalia Water District and the groundwater levels may not be representative of groundwater levels beneath the Tule River channel. Nonetheless, the groundwater levels were above the streambed elevation and suggest that it is likely that groundwater levels closer to the river channel were also at or above the river channel. Similar conditions were observed at City of Porterville R-11 and Village Market

¹³ CDWR, 2024. Depletions of Interconnected Surface Water, An Introduction. Draft, dated February 2024.



monitoring well MW-1, located near the river and west of the Friant Kern Canal (see Figures A7-11 and A7-16). These wells are also located near managed recharge basins.

There are no monitoring wells located along the Tule River streambed that are constructed for the express purpose of monitoring interconnected surface water and groundwater. As such, this is a data gap that is noted herein and also addressed in Attachment 1 of the Coordination Agreement (Tule Subbasin Monitoring Plan). Until monitoring features are established, six existing Upper Aquifer monitoring wells have been identified to monitor shallow groundwater levels near the river (see Figure A7-33). In addition, stream flow at the Success Reservoir dam and at Rockford Station downstream of the dam will be monitored and reported (see Attachment 1 to the Coordination Agreement - Monitoring Plan).

9.2 Upper Deer Creek Area

Upper Aquifer wells near the Upper Deer Creek Area show groundwater elevations within 15 feet of the Deer Creek stream channel during high groundwater conditions (February 2023; see Figure A7-19). The alluvial aquifer system in this area is relatively thin and underlain by shallow granitic bedrock. Groundwater elevations in wells further west but still east of the Friant-Kern Canal are approximately 70 to over 100 ft below the Deer Creek streambed (see Figures A7-20 and A7-21). Groundwater levels in monitoring wells adjacent to recharge basins at the Deer Creek-Friant Kern Canal Water Bank range from 0 to greater than 50 ft below ground surface from 2019 through 2023 (see Figure A7-22). Groundwater levels at this location are influenced by native Deer Creek flows, which are relatively low, imported water from the Friant-Kern Canal released into the Deer Creek channel, and nearby recharge operations.

There are no monitoring wells located along the Deer Creek streambed that are constructed for the express purpose of monitoring interconnected surface water and groundwater. As such, this is a data gap that is noted herein and addressed in Attachment 1 of the Coordination Agreement (Tule Subbasin Monitoring Plan). Until monitoring features are established, six existing Upper Aquifer monitoring wells have been identified to monitor shallow groundwater levels near the river (see Figure A7-33). In addition, stream flow at Road 272 will be monitored and reported (see Attachment 1 to the Coordination Agreement - Monitoring Plan).

9.3 Upper White River Area

Upper Aquifer groundwater levels in the Upper White River Area are not available. Upper Aquifer groundwater levels in a well approximately 4.5 miles west of Highway 65 (the western edge of the Upper White River Area) show depth to groundwater of approximately 250 ft bgs (see Figure A7-2-23). Groundwater levels in this well will continue to be monitored (see Figure A7-33) until additional monitoring features specific to addressing ISW along White River can be established, per Attachment 1 of the Coordination Agreement (Tule Subbasin Monitoring Plan).



10 Recommended Future Work

The primary data gap in the ISW network is detailed shallow groundwater levels at and near the streambeds within the Study Areas. A secondary data gap is streamflow measurements of the Tule River west of Martin Hill and for the White River. In order to fill these data gaps, a proposed network of shallow monitoring wells and instream gages is proposed (see Figure A7-34).

The understanding of potential depletions of interconnected surface water in the Tule Subbasin is a data gap. To supplement the stream gages and interim monitoring wells shown on Figure A7-33, additional monitoring well locations have been preliminarily identified along the Tule River, Deer Creek and White River to enable the collection of groundwater level data to inform interconnected surface water conditions (see Figure A7-34). A total of 16 new monitoring well sites have preliminarily been identified (eight along the Tule River, six along Deer Creek, and two along the White River). The number and location of these new features may change depending on BMP guidance forthcoming from the CDWR.

Until the CDWR BMP for interconnected surface water is available, the Tule Subbasin has identified an interim monitoring network that includes a combination of surface water flow monitoring and groundwater level monitoring (see Figure A7-33). Stream flow and channel losses in the Tule River will continue to be monitored based on gaged flow below Success Dam and at Rockford Station downstream of Porterville. Stream flow will also continue to be monitored at the gage in Deer Creek at Road 272. Existing monitoring wells that will be used to inform the presence/absence of interconnected surface water are shown on Figure A7-33. None of these wells is ideally located or constructed for this purpose. However, until additional monitoring wells are constructed, these wells will be monitored and reported in the interim for this purpose. In addition to the proposed monitoring wells and stream gages, the following are recommendations to increase monitoring, data collection, and the hydrogeological conceptual model within the Study Areas:

- Prepare an inventory of wells within the Study Areas. Obtain or estimate monthly groundwater production for each well. Include in the inventory well construction information such as well depth and screen interval.
- Prepare a detailed hydrogeological evaluation of the Study Areas to refine the lateral and vertical extents of the Upper and Lower Aquifers.
- Refine the NDVI analysis spatially and temporally, based on best available data. Incorporate other remote sensing monitoring (i.e. Normalized Derived Moisture Index) methods if necessary.
- Conduct biological field surveys to refine the areas mapped as potential GDEs.

To address the Conditional Deficiency ISW-3, we recommend conducting the SWRCB's potential actions which are as follows:



- Potential Action ISW-3a – Create an ISW monitoring network near established surface monitoring stations to fill data gaps.
- Potential Action ISW-3b – Use the ISW network to model surface water hydraulic connection to the underlying aquifer via a continuous saturated zone.
- Potential Action ISW-3c – Identify wells where excessive groundwater pumping could lower the hydraulic gradient, reduce the surface water supply, and impact nearby vegetation and ecosystems.
- Potential Action ISW-3d – Develop SMC for the depletion of interconnected surface water.

A preliminary ISW monitoring network has been developed based on available data to address Potential Action ISW-3a. This preliminary network is incorporated into the 2024 Tule Subbasin Monitoring Plan. The monitoring network will be expanded and refined as more data is collected.

In order to address Potential Actions ISW-3b, 3c, and 3d, it is recommended to use numerical modeling. The DWR has released one of three papers on technical aspects of ISWs, Depletions of ISW: An Introduction. Papers 2 and 3 will cover techniques for estimating depletion of ISW and example approaches for estimating depletions of ISW. The papers are expected to be released in the Spring of 2024¹⁴. Based on the recommendations in the DWR guidance papers, future analysis will be refined to estimate depletions of ISW in the Study Areas.

¹⁴ <https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents>. Accessed May 2024.



**Tule River, Deer Creek and White River
Annual Streamflow**

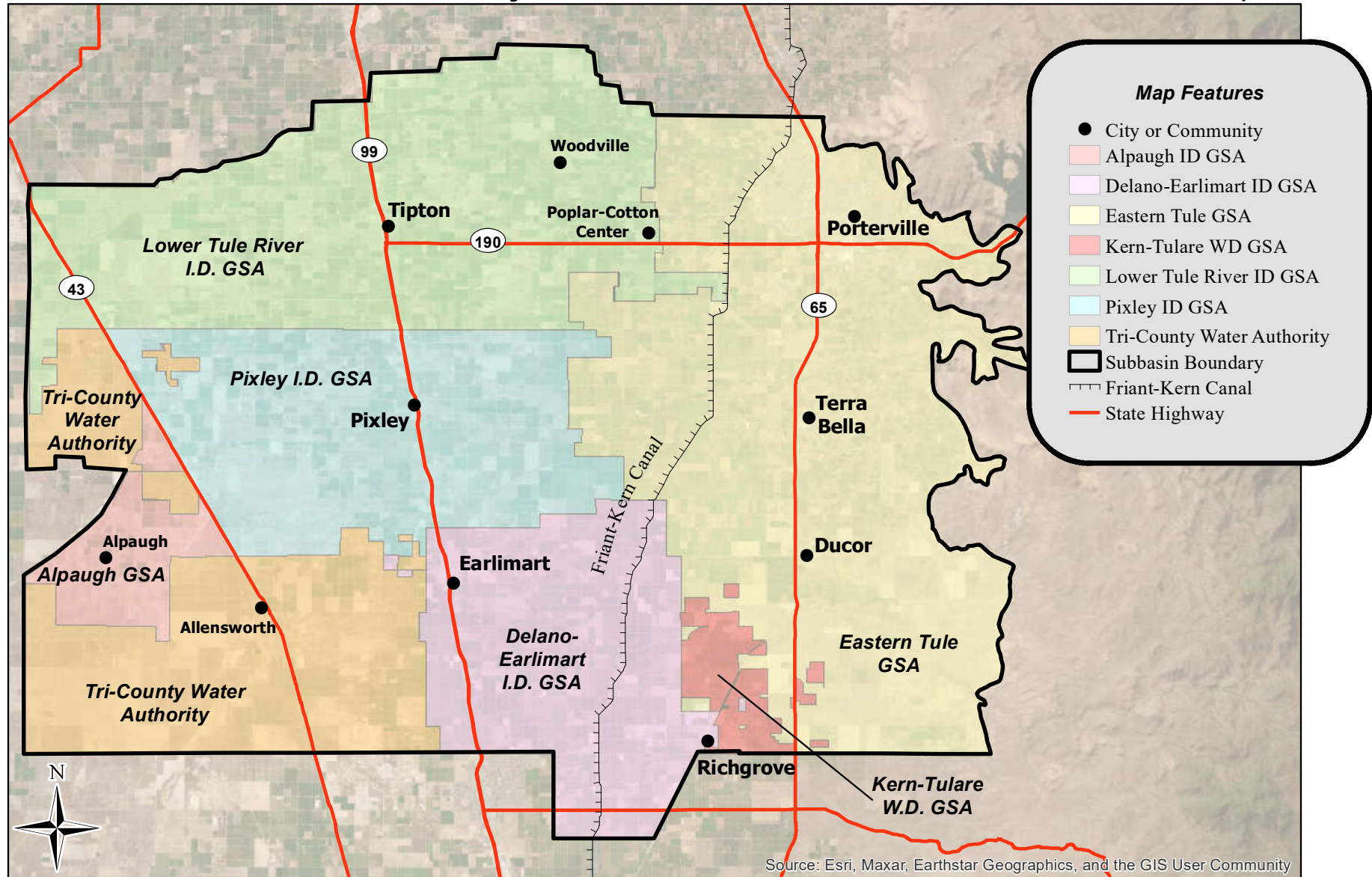
Water Year	Releases from Success to Tule River (acre-ft)	Deer Creek Gaged Flow at Fountain Springs ¹ (acre-ft)	White River near Ducor (acre-ft)
1986/87	64,500	8,400	2,500
1987/88	34,800	6,100	1,400
1988/89	44,100	7,800	1,900
1989/90	23,500	4,700	800
1990/91	45,900	7,300	1,400
1991/92	28,500	4,100	700
1992/93	110,100	15,100	3,600
1993/94	56,200	6,800	1,100
1994/95	213,500	32,200	10,600
1995/96	168,700	23,300	6,000
1996/97	348,500	58,800	12,900
1997/98	435,400	88,400	36,800
1998/99	103,500	18,400	7,500
1999/00	96,900	15,200	4,900
2000/01	50,200	7,000	4,700
2001/02	68,000	10,400	6,200
2002/03	120,600	15,700	5,900
2003/04	46,600	6,900	2,400
2004/05	168,900	22,700	6,500
2005/06	191,700	23,900	7,600
2006/07	34,000	6,900	1,800
2007/08	70,000	8,400	2,400
2008/09	50,000	6,600	1,800
2009/10	140,900	16,500	5,100
2010/11	262,800	44,900	15,000
2011/12	83,200	11,300	3,300
2012/13	26,500	4,800	1,100
2013/14	9,900	3,000	500
2014/15	6,000	2,000	300
2015/16	70,400	14,600	4,500
2016/17	353,000	65,000	22,100
2017/18	61,700	9,000	2,500
2018/19	218,200	32,600	10,700
2019/20	60,300	7,900	2,200
2020/21	16,900	3,000	600
2021/22	34,400	5,500	1,300
2022/23	512,100	96,300	13,200
Minimum	6,000	2,000	300
Maximum	512,100	96,300	36,800
Average	119,700	19,500	5,800

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SWRCB Comments Regarding
Interconnected Surface Water

July 2024

Tule Subbasin Technical Advisory Committee

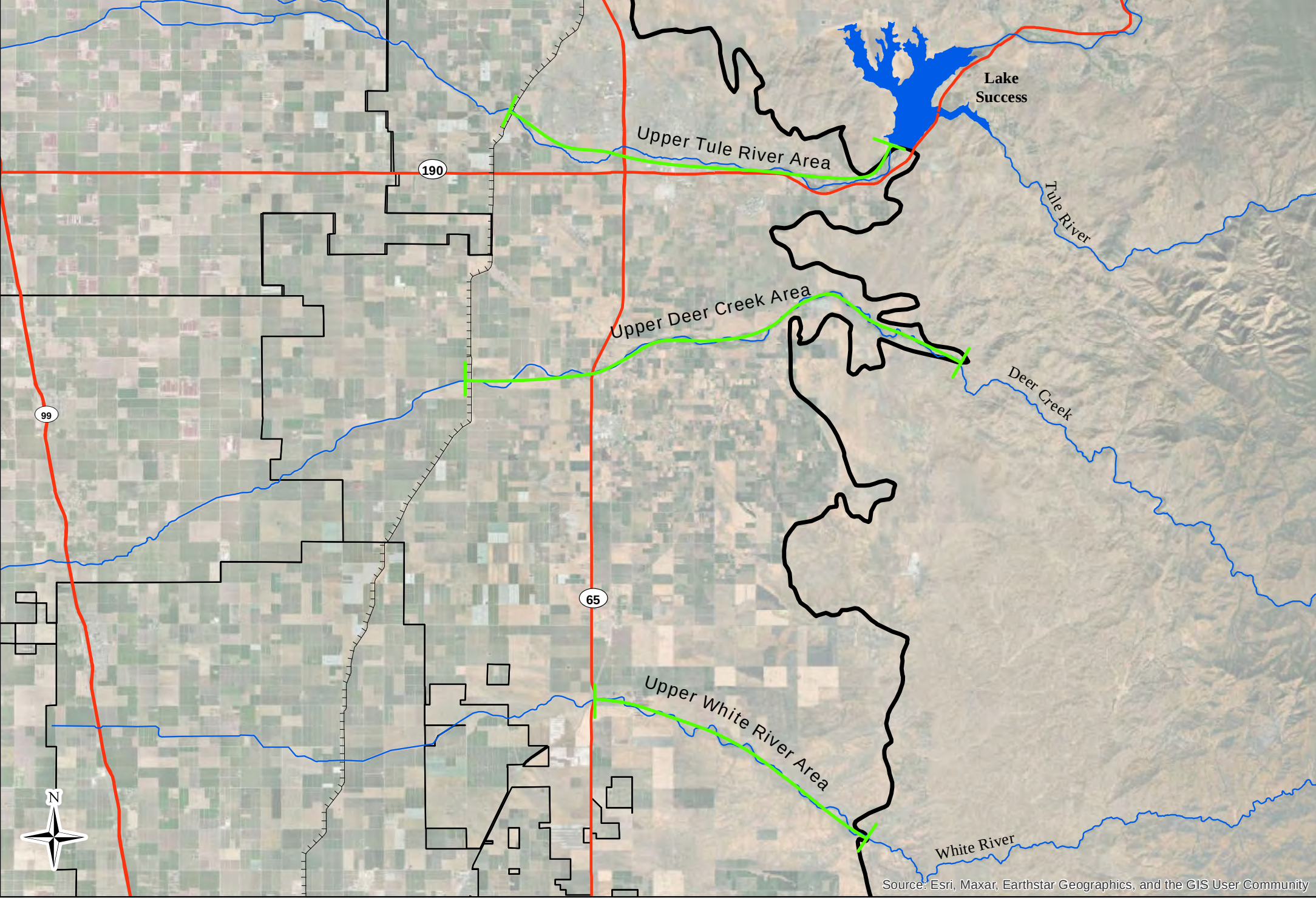


Thomas Harder & Co.
Groundwater Consulting

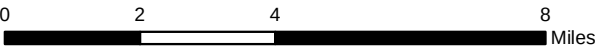


0 2 4 8
Miles
NAD 83 State Plane Zone 4

GSA Boundaries
Figure A7-1



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



NAD 83 State Plane Zone 4

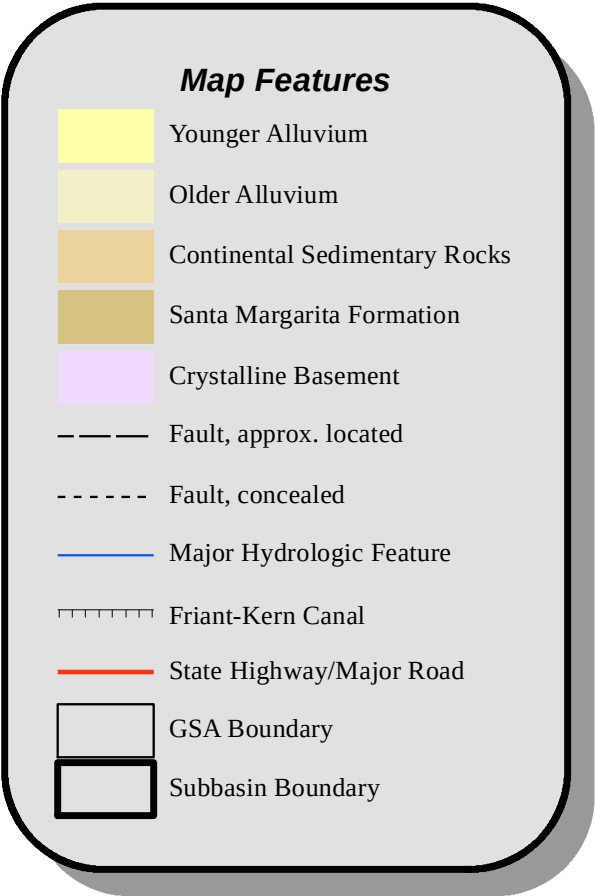
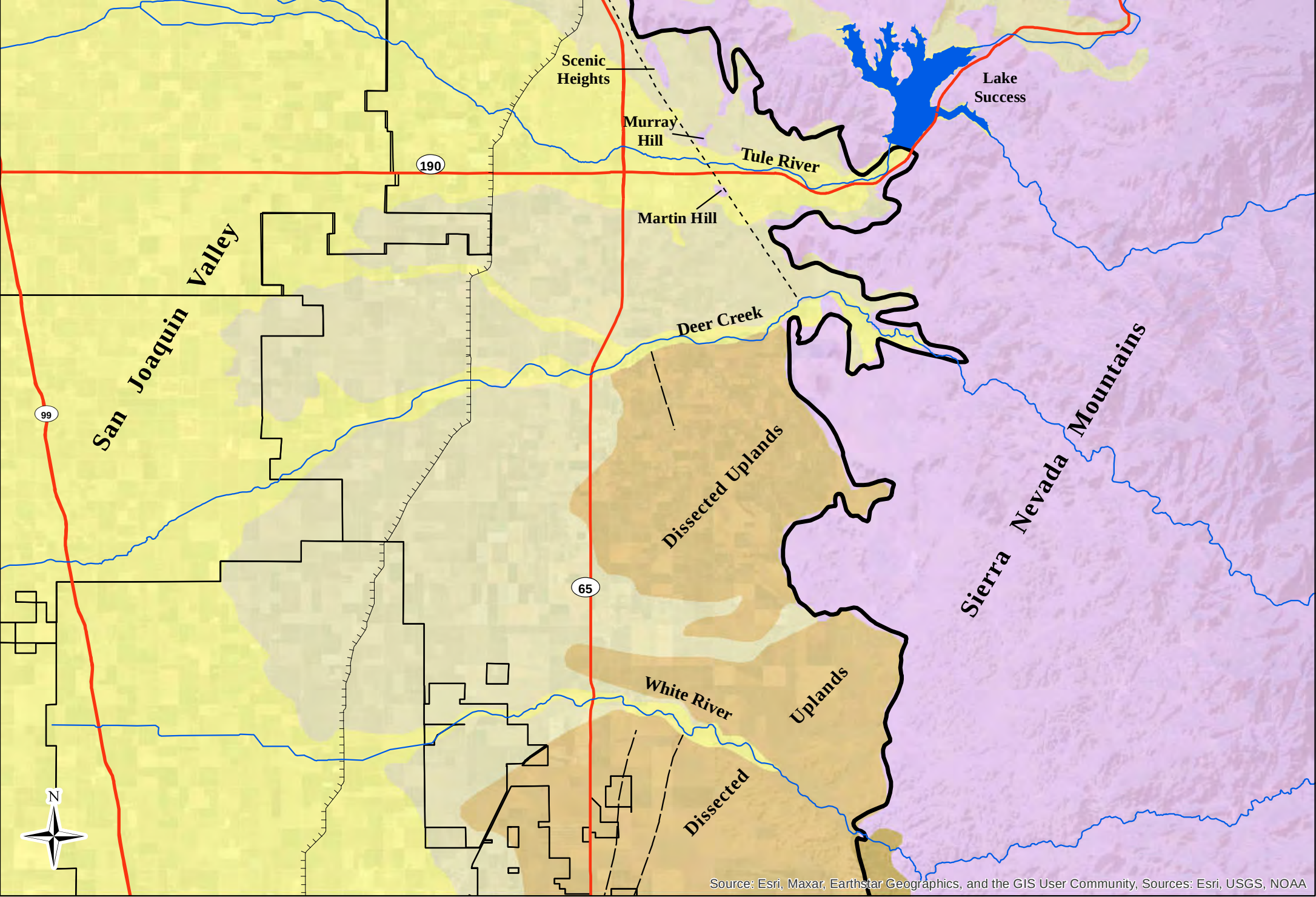
Map Features

- Area of Potential Interconnected Surface Water
- Major Hydrologic Feature
- Friant-Kern Canal
- State Highway/Major Road
- GSA Boundary
- Subbasin Boundary

Note: Areas of Potential Interconnected Surface Water identified after review of The Nature Conservancy's ICONS Dataset accessed from <https://icons.codefornature.org/> and review of other available data.

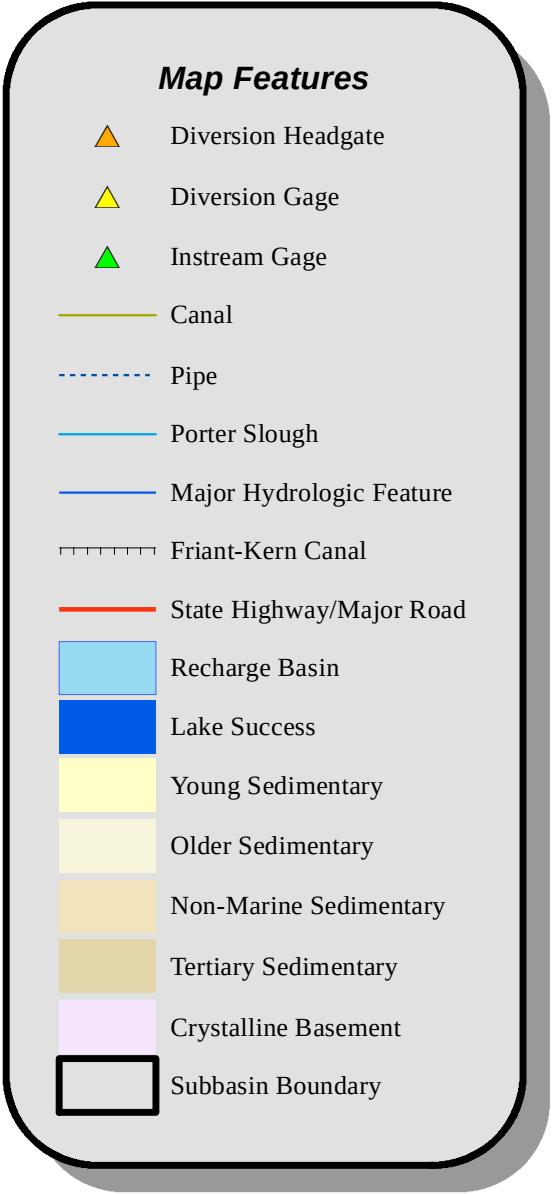
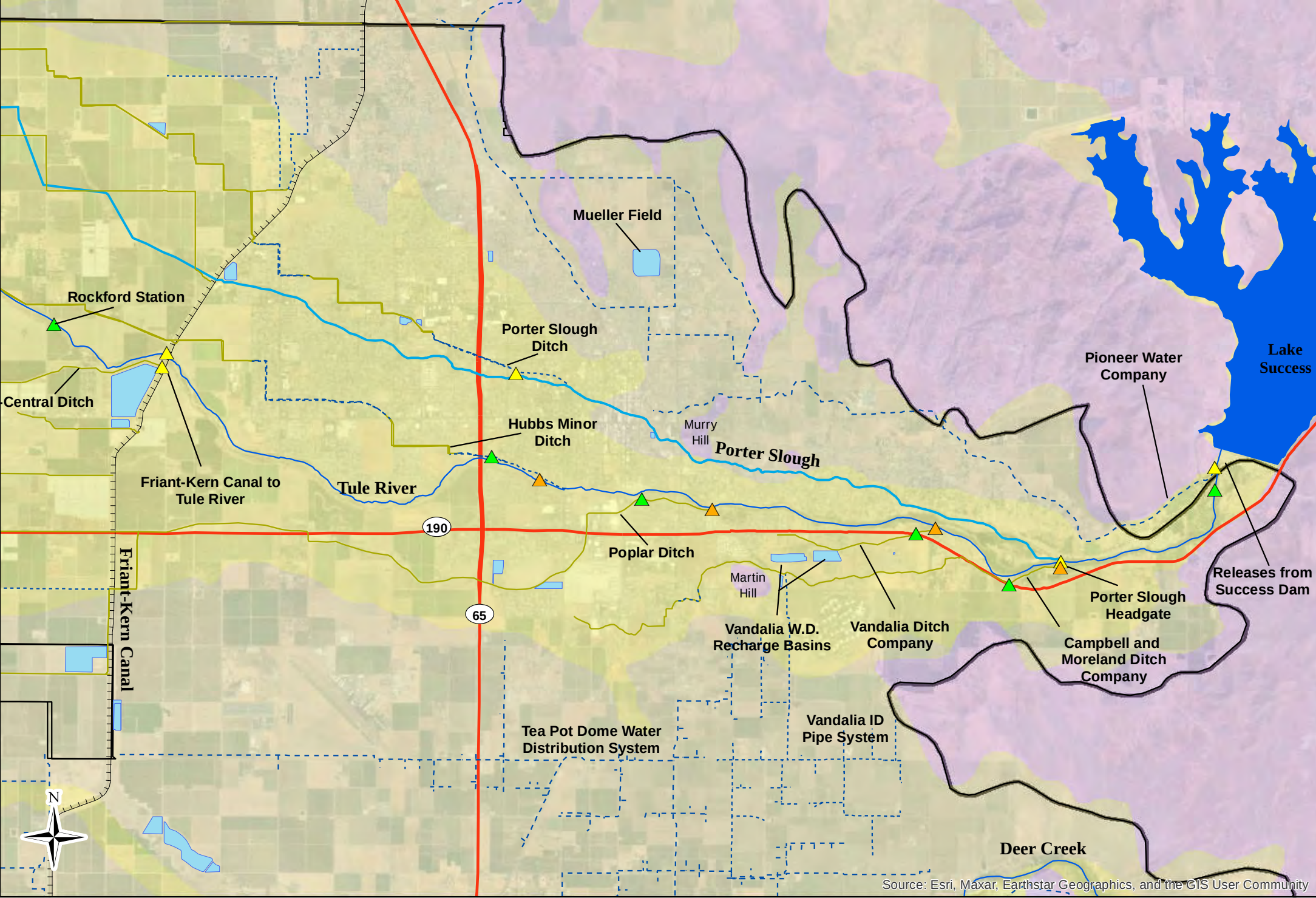
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**Areas of
Potential Interconnected
Surface Water**
Figure A7-2



Note: Geology modified from Jennings (2010),
[acchttps://www.conservation.ca.gov/cgs/publications/gmc](https://www.conservation.ca.gov/cgs/publications/gmc)

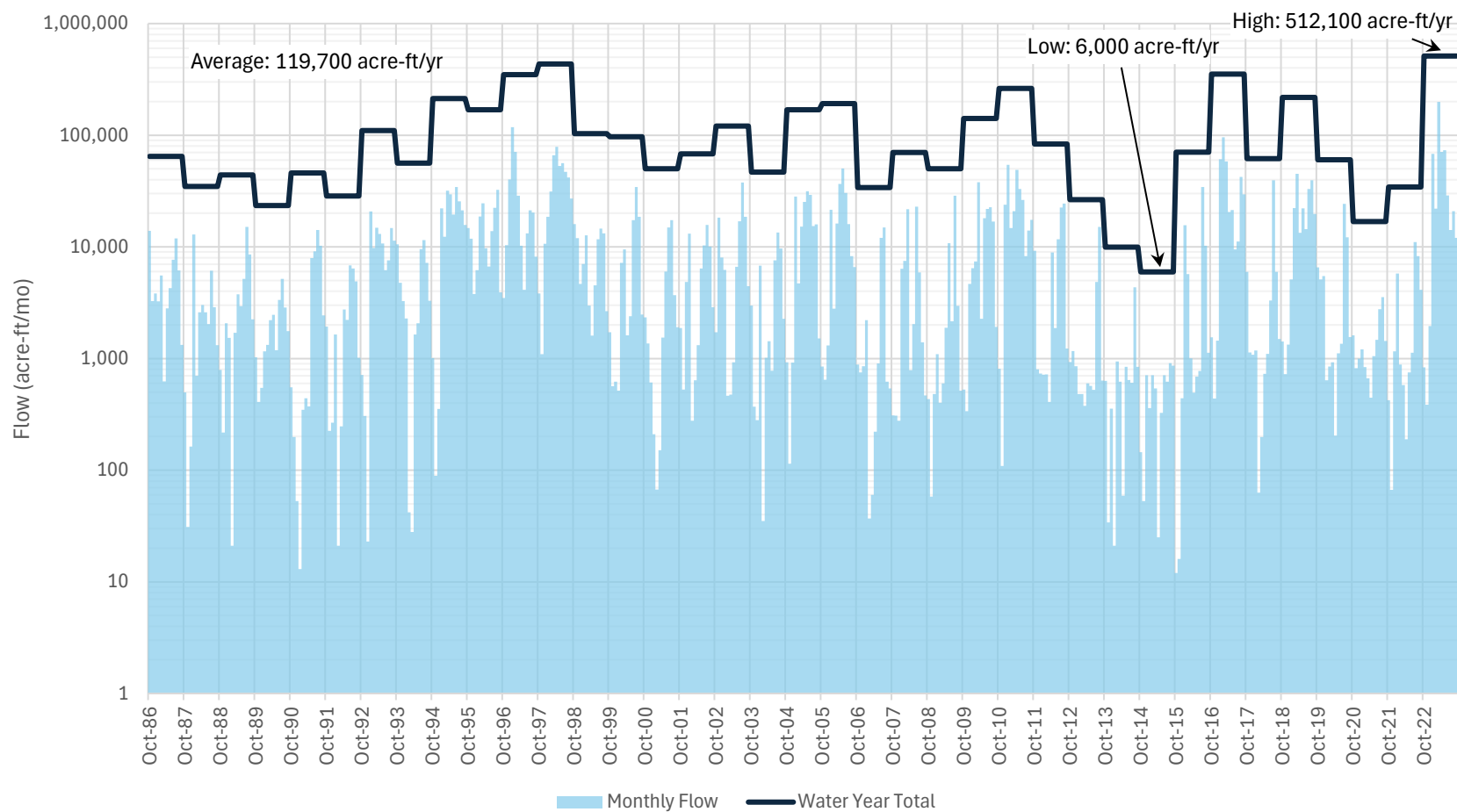
DRAFT-FINAL
Surface Geology



DRAFT-FINAL

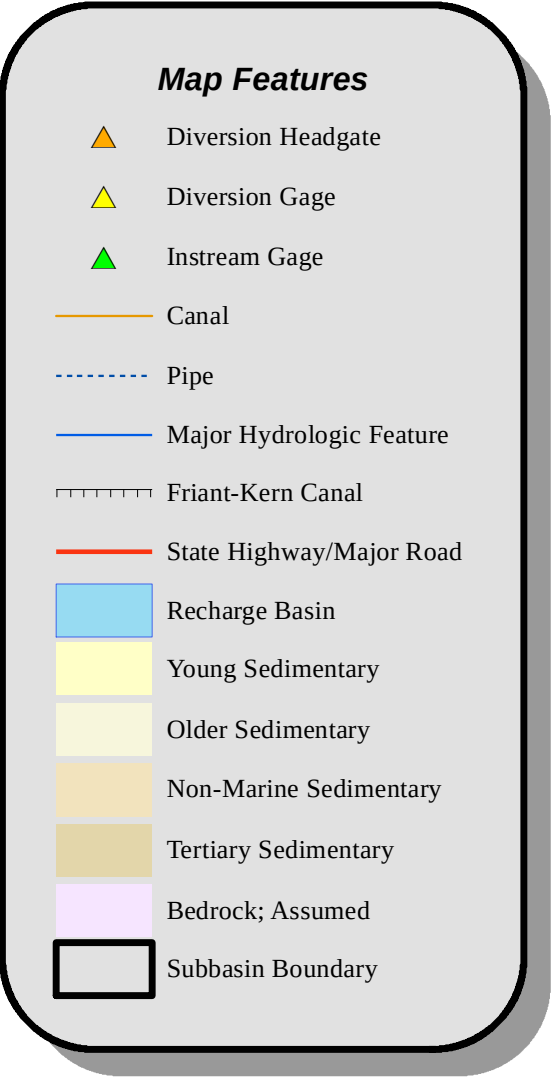
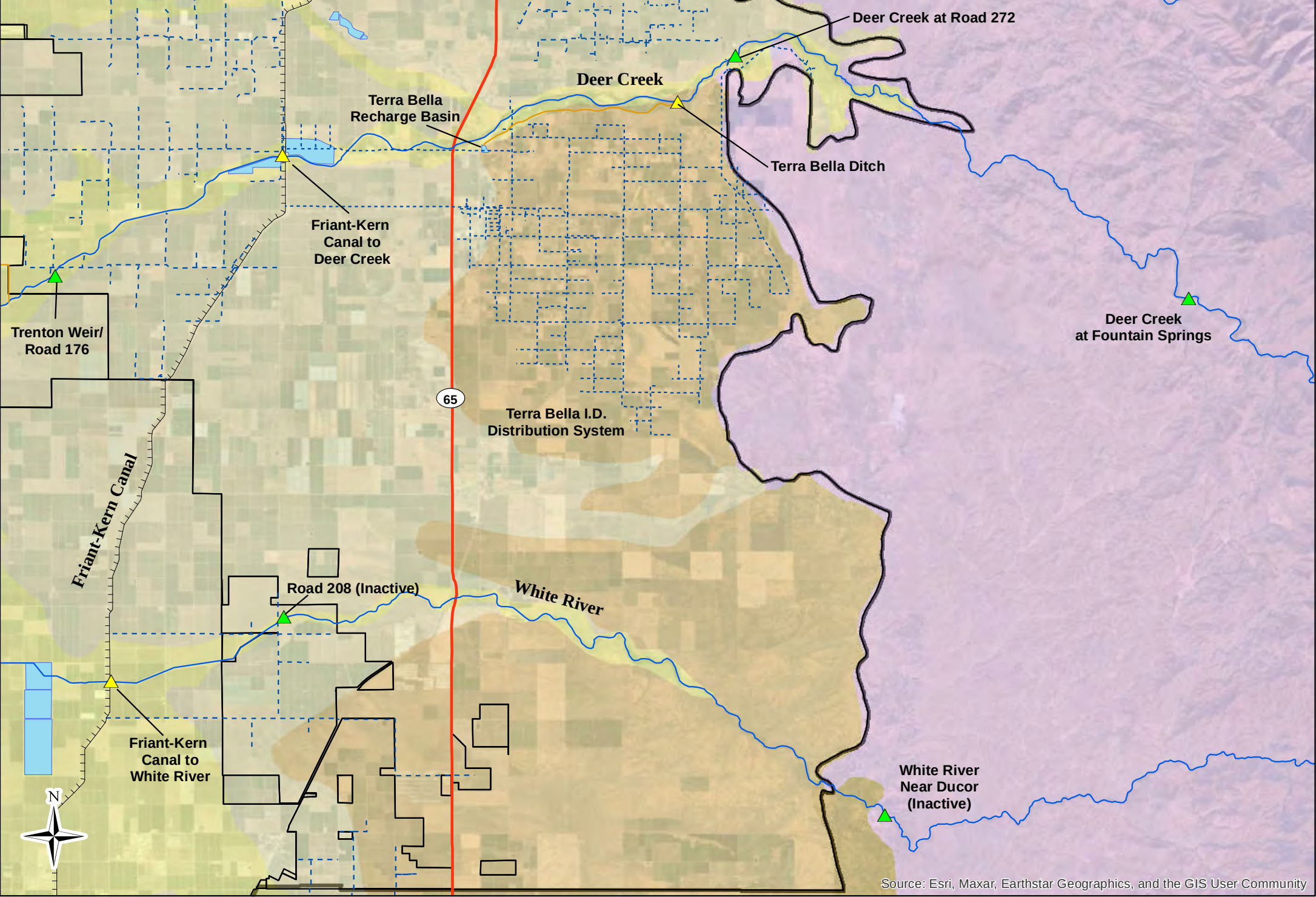
**Surface Water Features
Near Areas of Interest on
the Tule River**
Figure A7-4

Tule River below Success Dam Streamflow



Note:

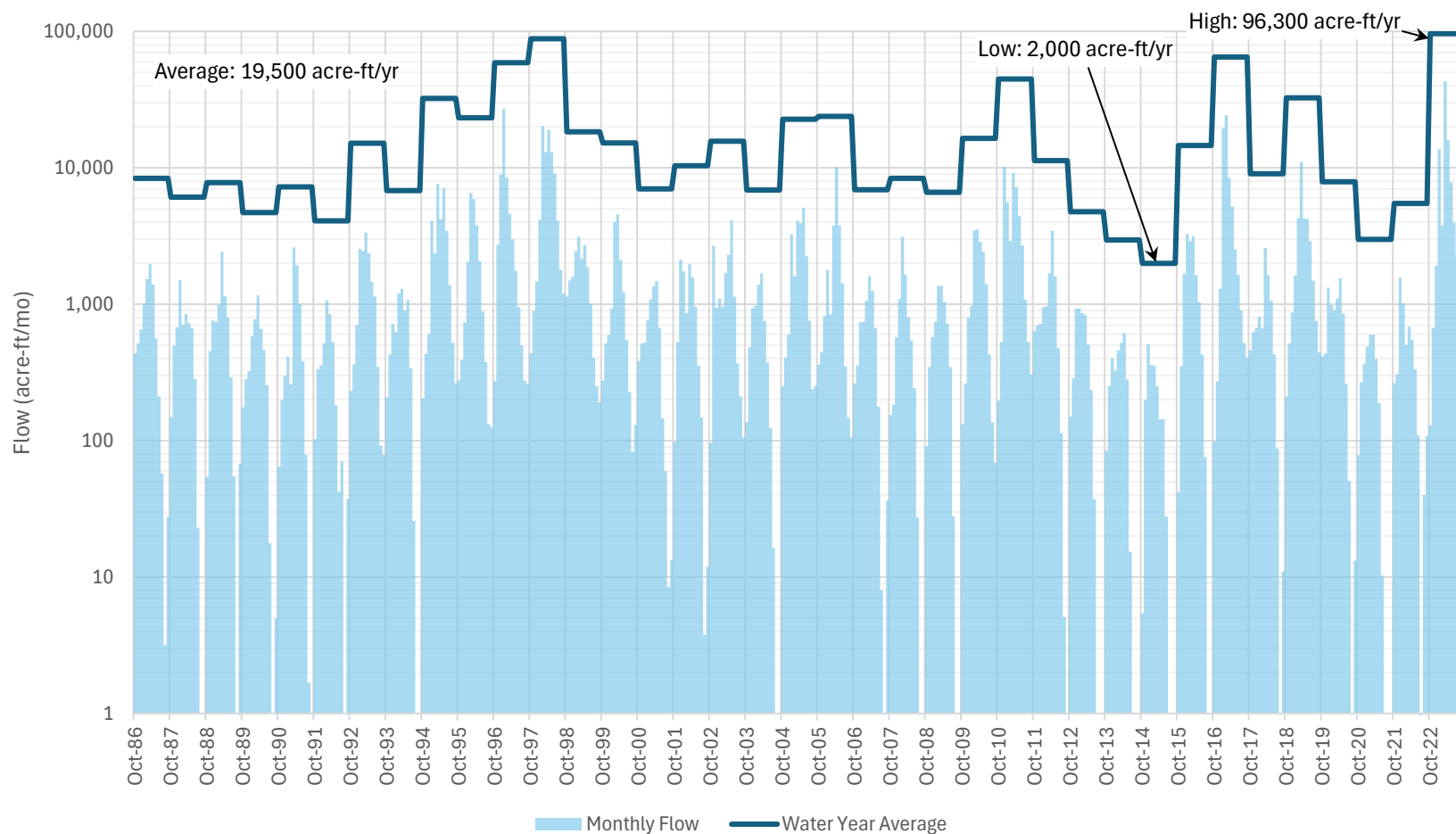
Data from Tule River Association. Flows in the Tule River channel, does not include diversions to Pioneer Ditch.



DRAFT-FINAL

**Surface Water Features
Near Areas of Interest on
Deer Creek and the White River**
Figure A7-6

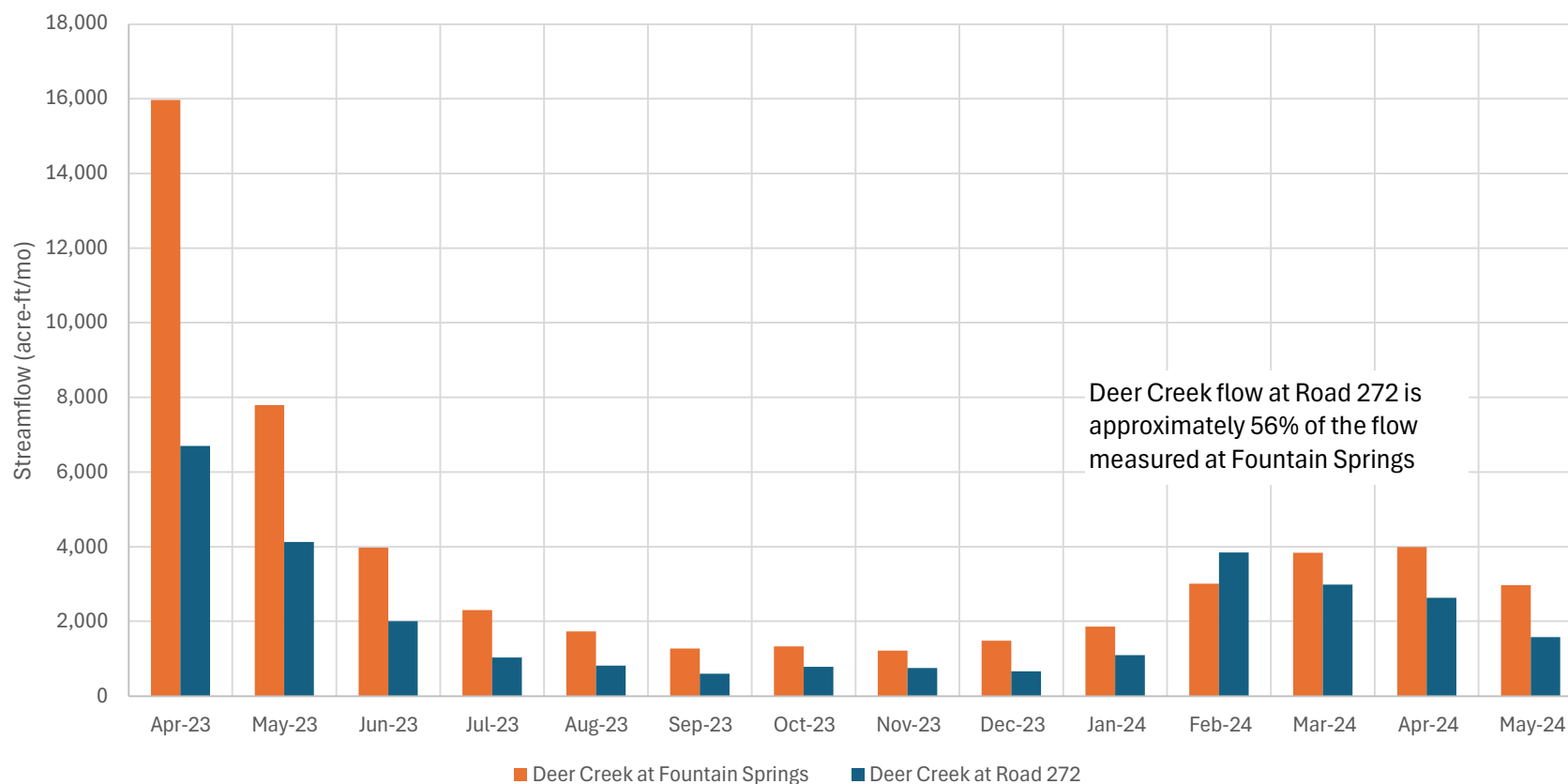
Deer Creek at Fountain Springs Streamflow



Note:

Data from <https://maps.waterdata.usgs.gov/mapper/index.html>

Deer Creek Streamflows
At Fountain Springs vs At Road 272



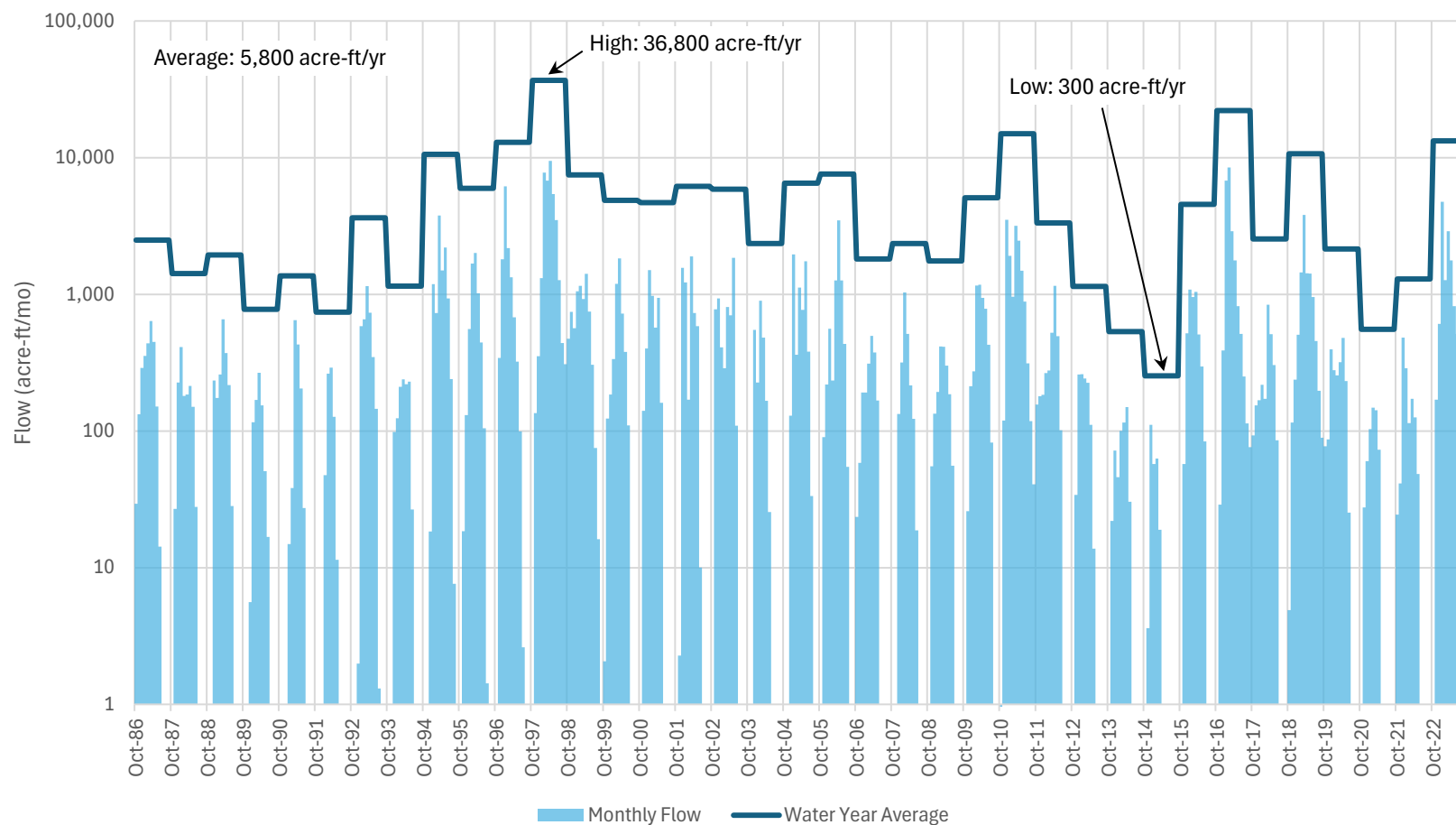
Notes:

Data from <https://maps.waterdata.usgs.gov/mapper/index.html>.

Deer Creek at Road 272 data started March 24, 2023. March data not shown.



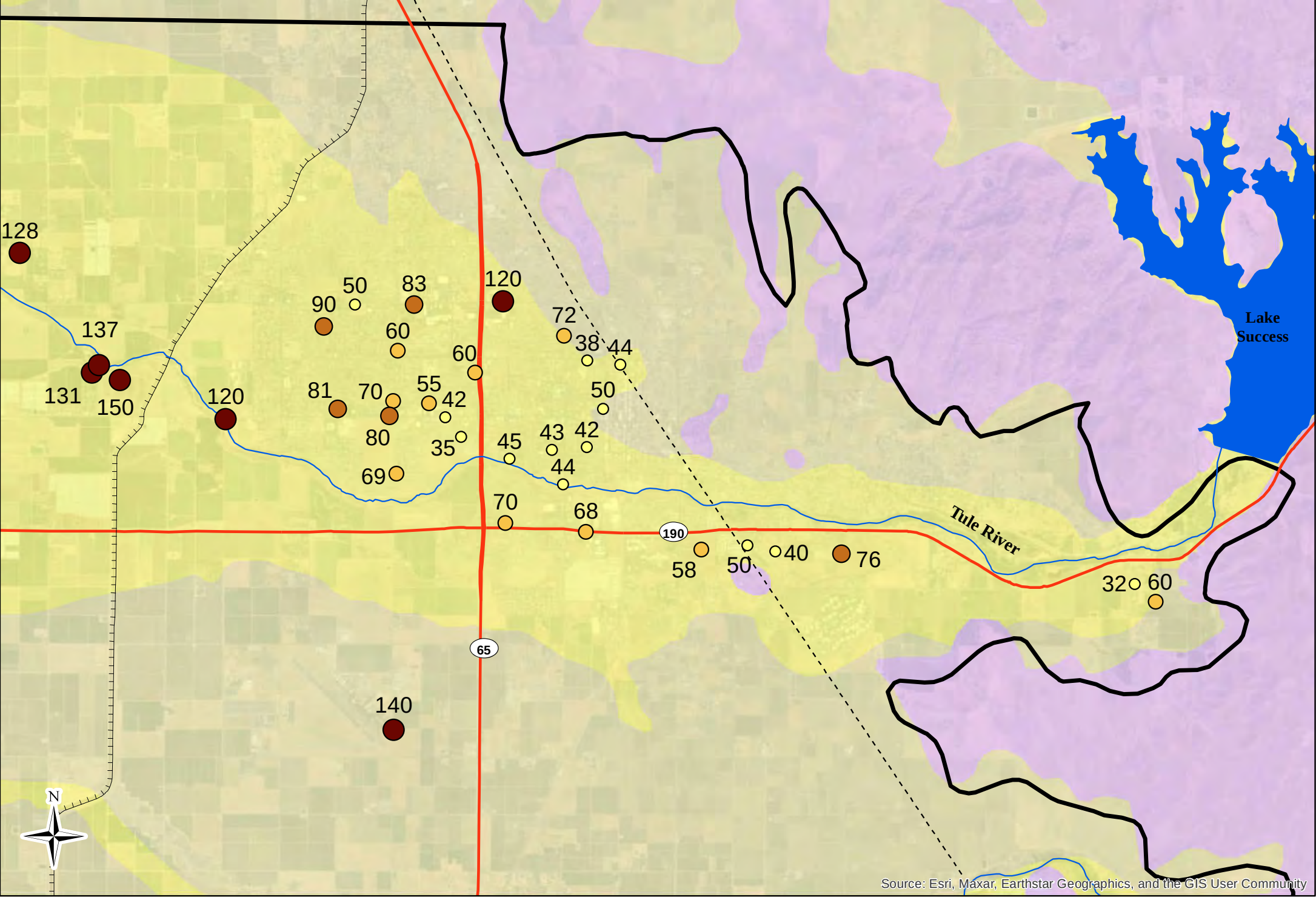
White River near Ducor Streamflow



Notes:

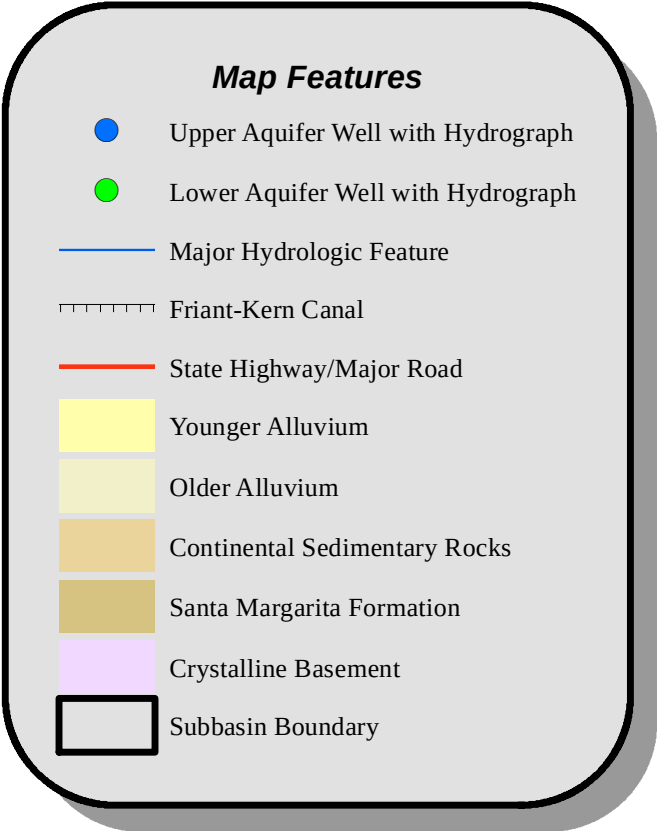
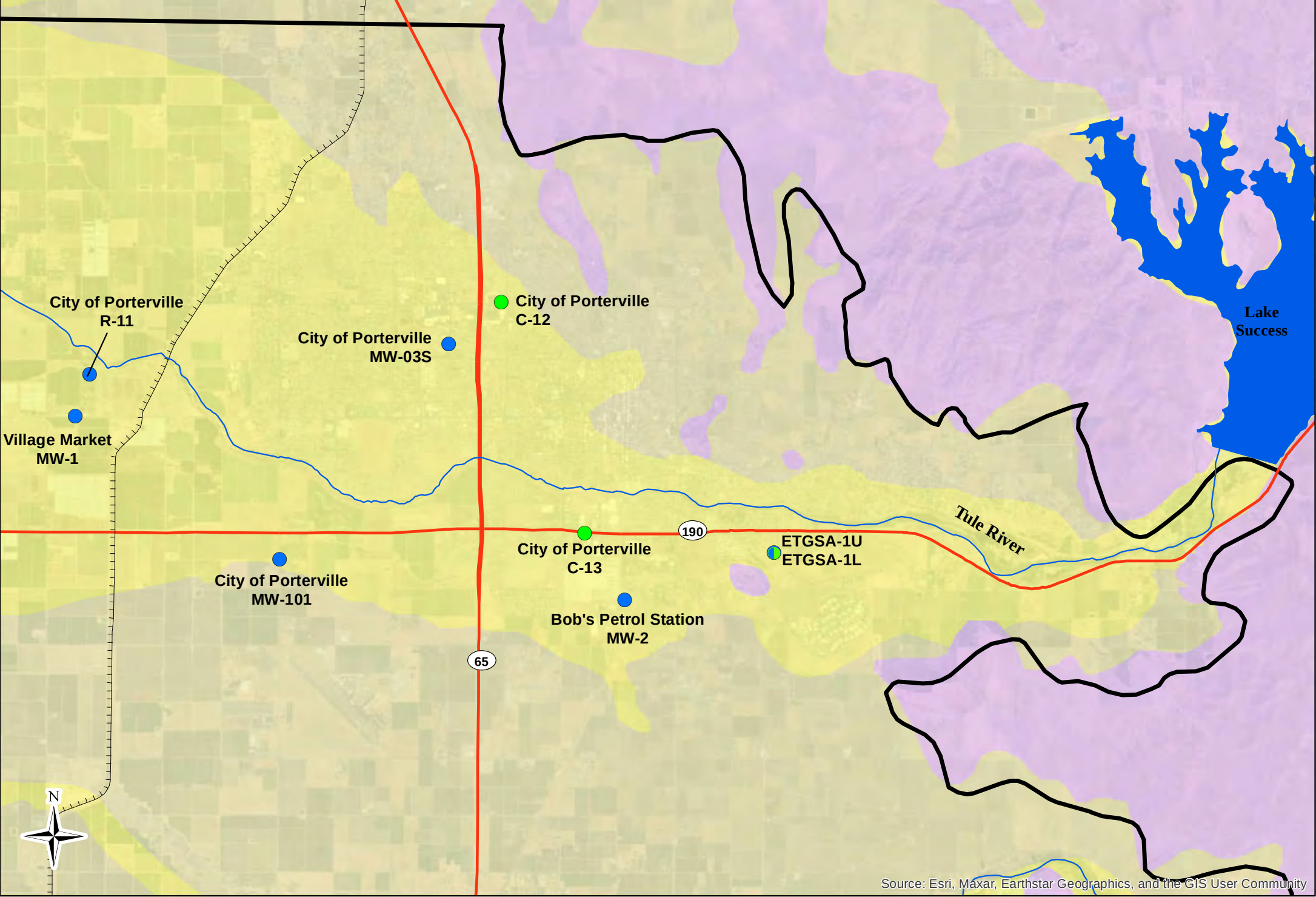
Data from Oct-86 through Oct-05 from <https://maps.waterdata.usgs.gov/mapper/index.html>.

Data from Nov-05 through Sep-23 estimated based on correlation with Deer Creek Flows.

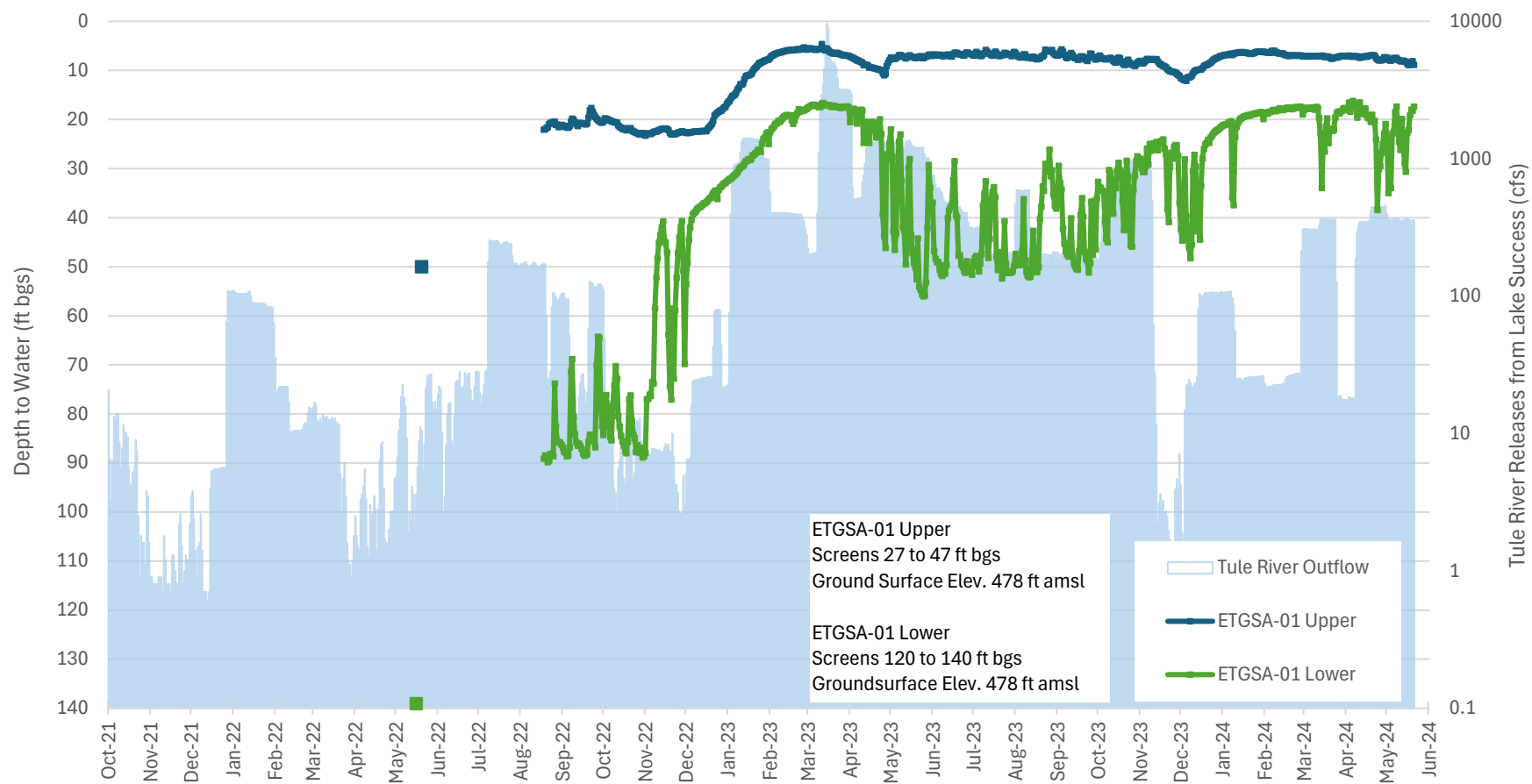


Note: Based on an analysis of data from lithologic logs, DWR Well Completion Reports ("Driller Logs"), and geophysical logs.

DRAFT-FINAL
Upper Tule River Area -
Upper Aquifer Bottom Depth
Figure A7-10



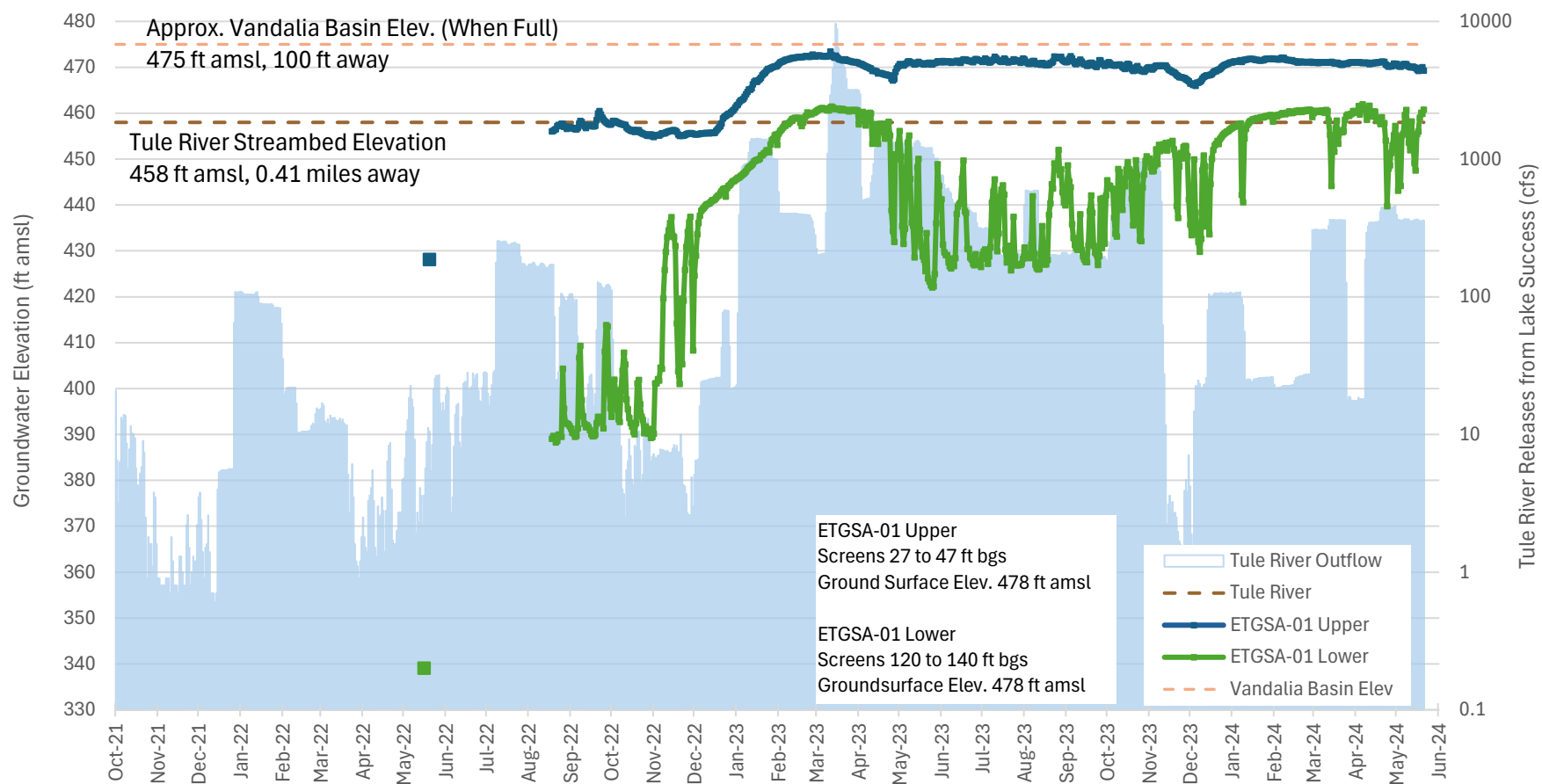
Upper vs Lower Aquifer Groundwater Levels (Depth)
ETGSA-01 Upper and ETGSA-01 Lower



Note:

Data from Tule Subbasin Technical Advisory Committee.

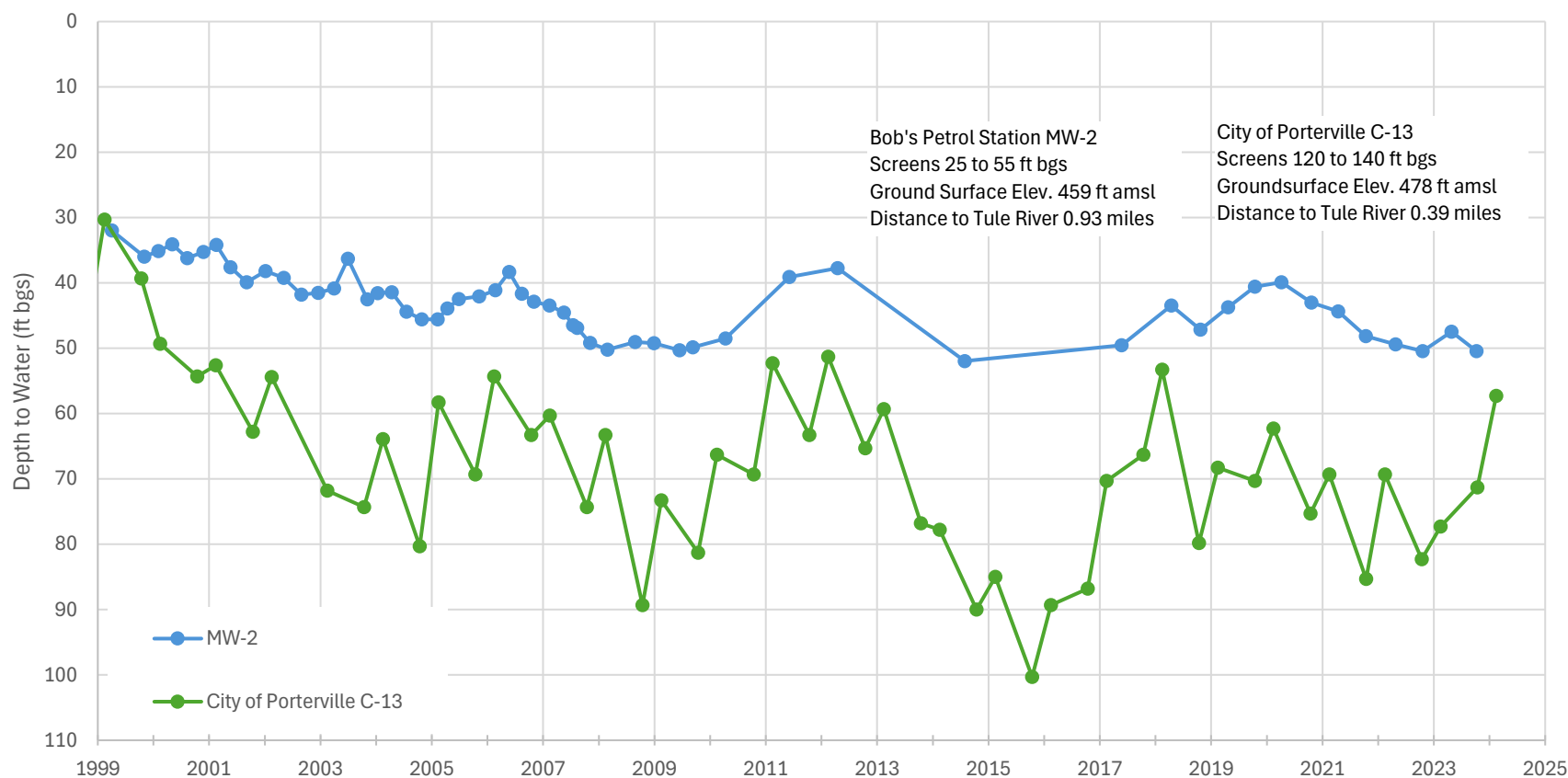
Upper vs Lower Aquifer Groundwater Levels (Elevation)
ETGSA-01 Upper and ETGSA-01 Lower



Note:

Data from Tule Subbasin Technical Advisory Committee.

Upper vs Lower Aquifer Groundwater Levels (Depth)
Bob's Petrol Station MW-2 vs City of Porterville C-13

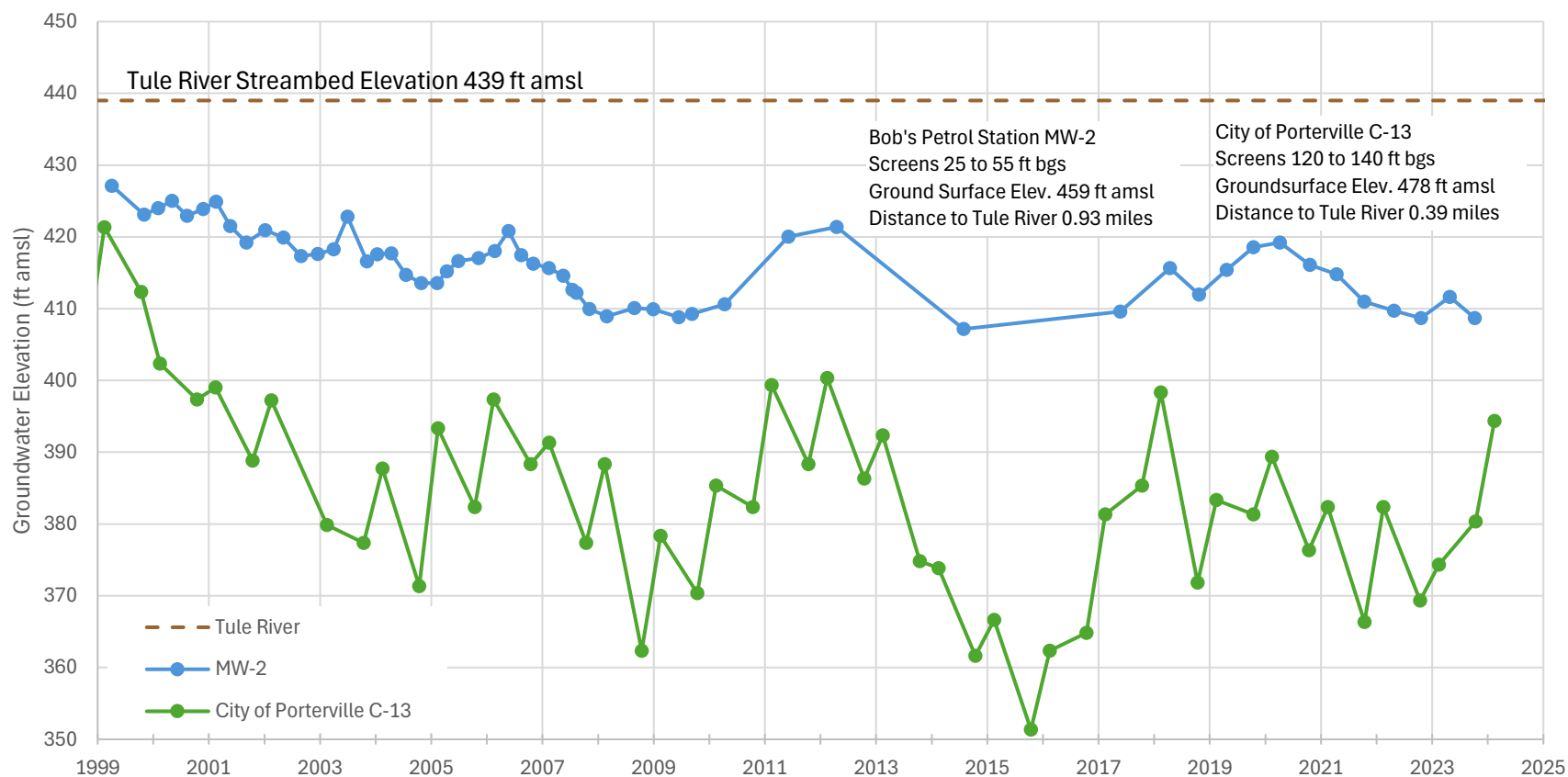


Notes:

Bob's Petrol Station data from https://geotracker.waterboards.ca.gov/profile_report?global_id=SL375384617

City of Porterville data from City of Porterville.

Upper vs Lower Aquifer Groundwater Levels (Elevation)
Bob's Petrol Station MW-2 vs City of Porterville C-13

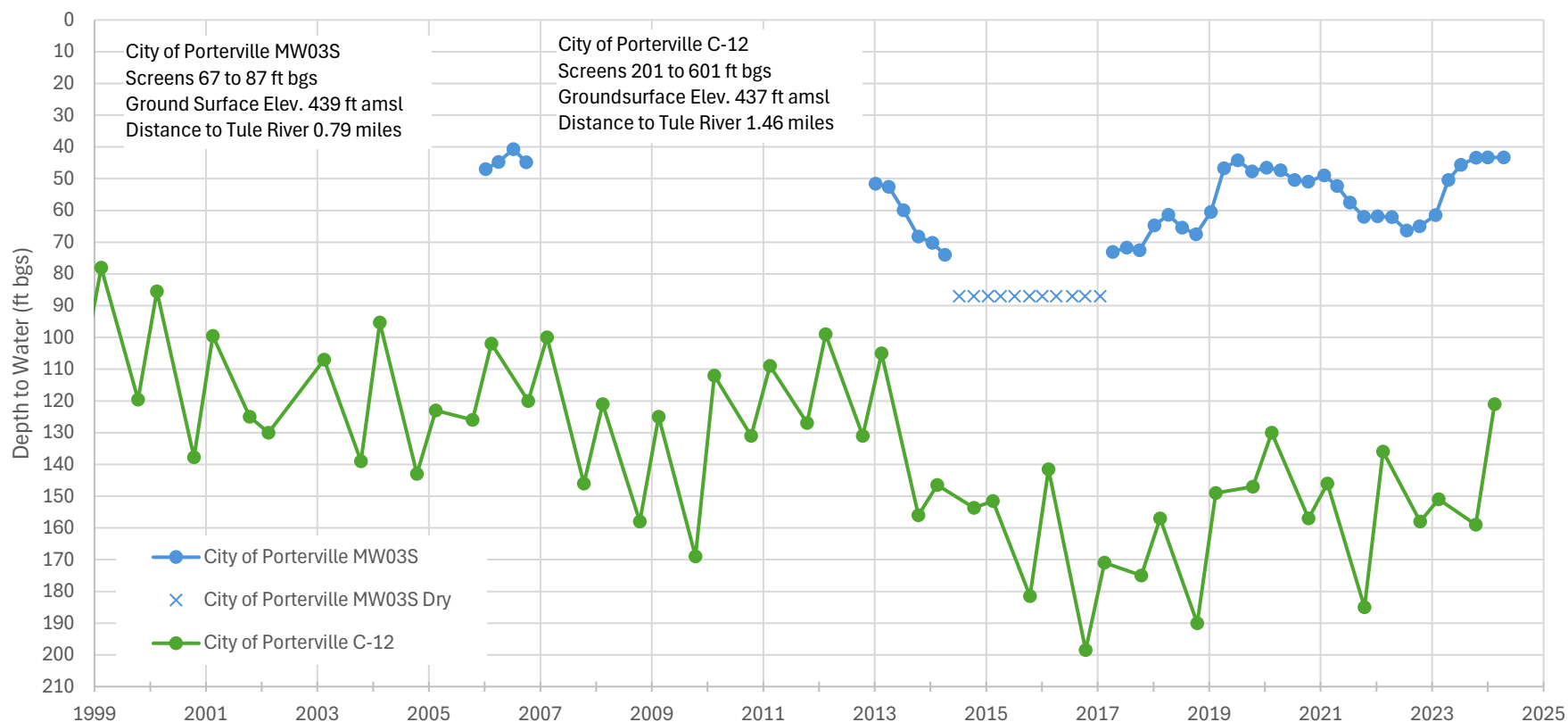


Notes:

Bob's Petrol Station data from https://geotracker.waterboards.ca.gov/profile_report?global_id=SL375384617

City of Porterville data from City of Porterville.

Upper vs Lower Aquifer Groundwater Levels (Depth)
City of Porterville MW03S and C-12

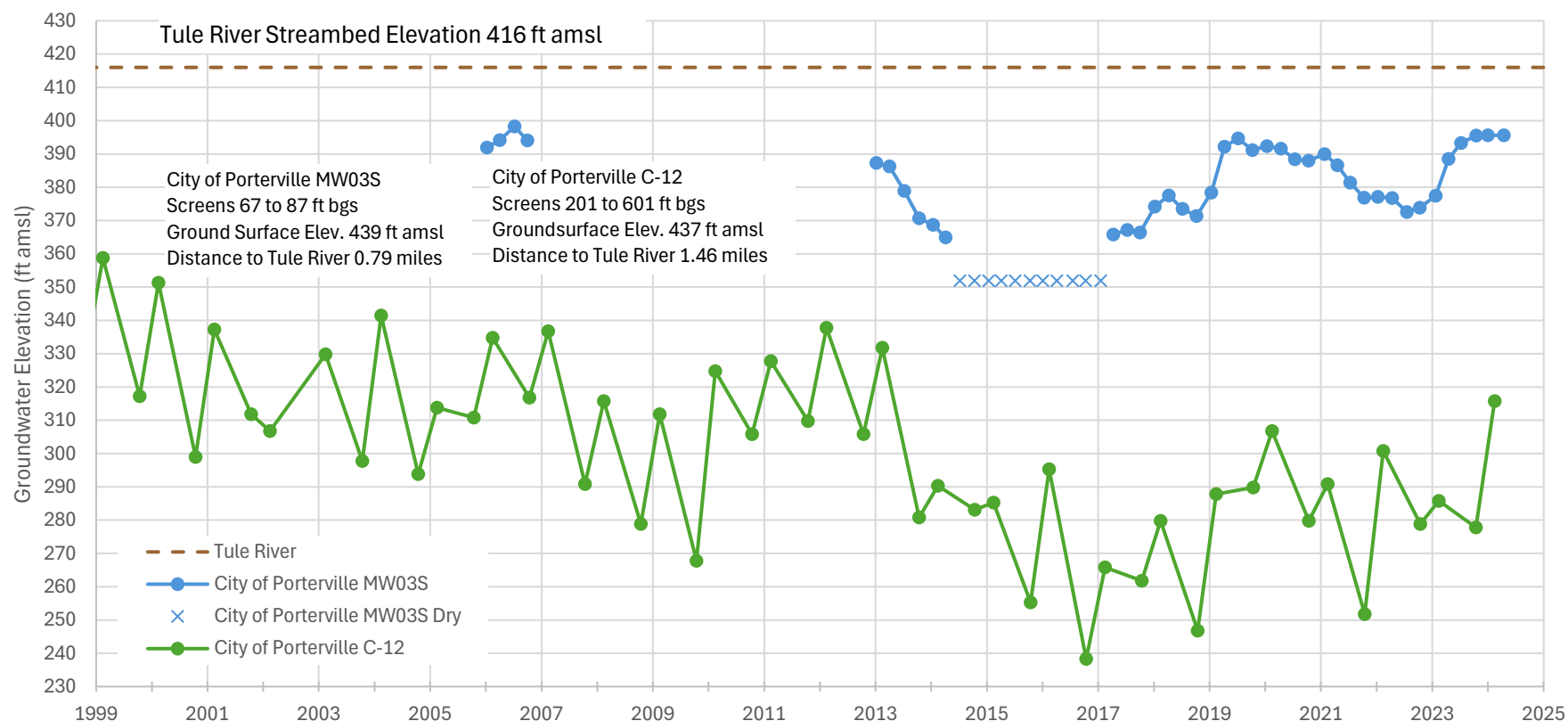


Notes:

Data from City of Porterville.

MW03 is located 600 ft from the unlined Porter Slough which may influence groundwater levels.

Upper vs Lower Aquifer Groundwater Levels (Elevation)
City of Porterville MW03S and C-12

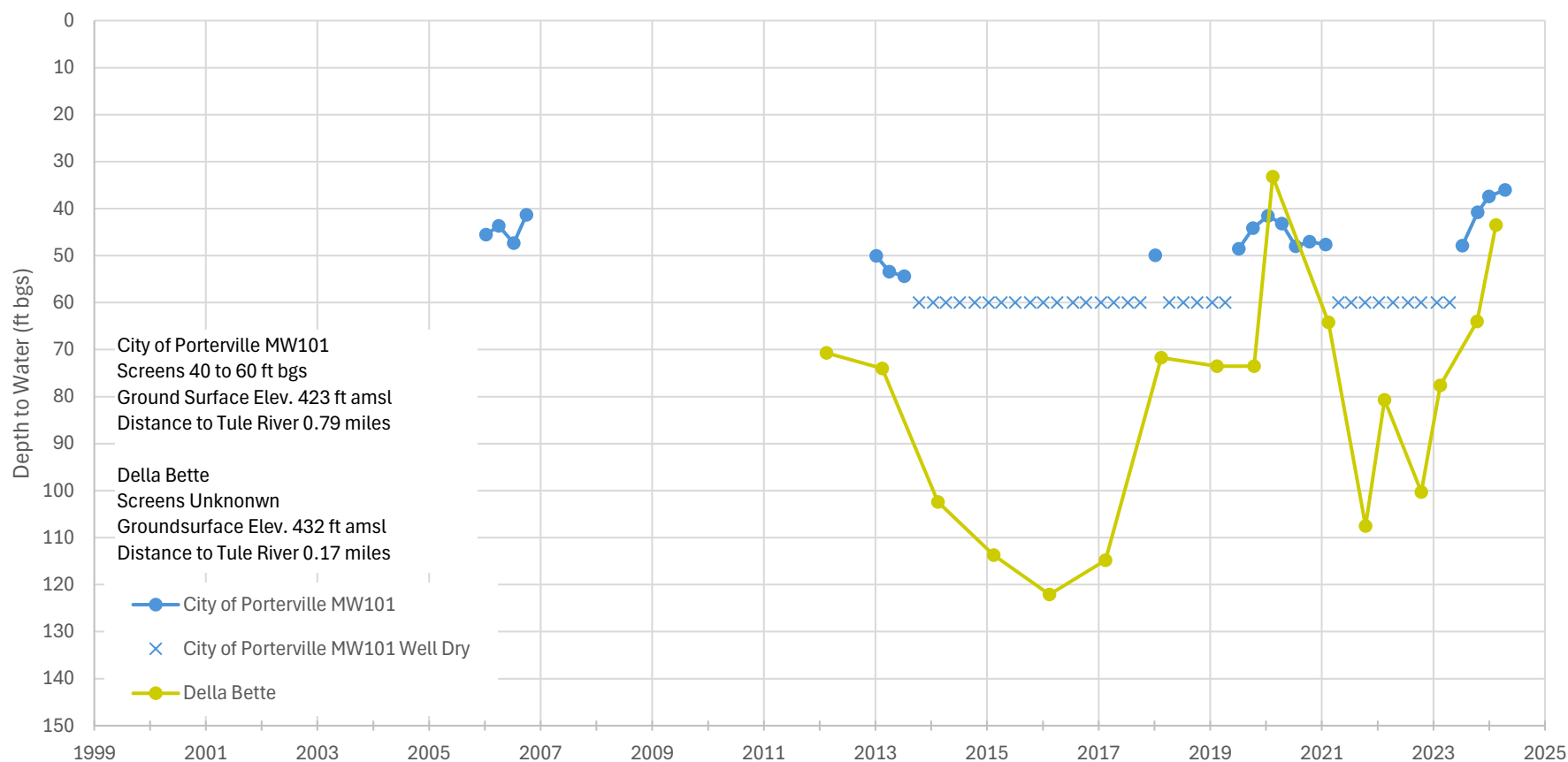


Notes:

Data from City of Porterville.

MW03 is located 600 ft from the unlined Porter Slough which may influence groundwater levels.

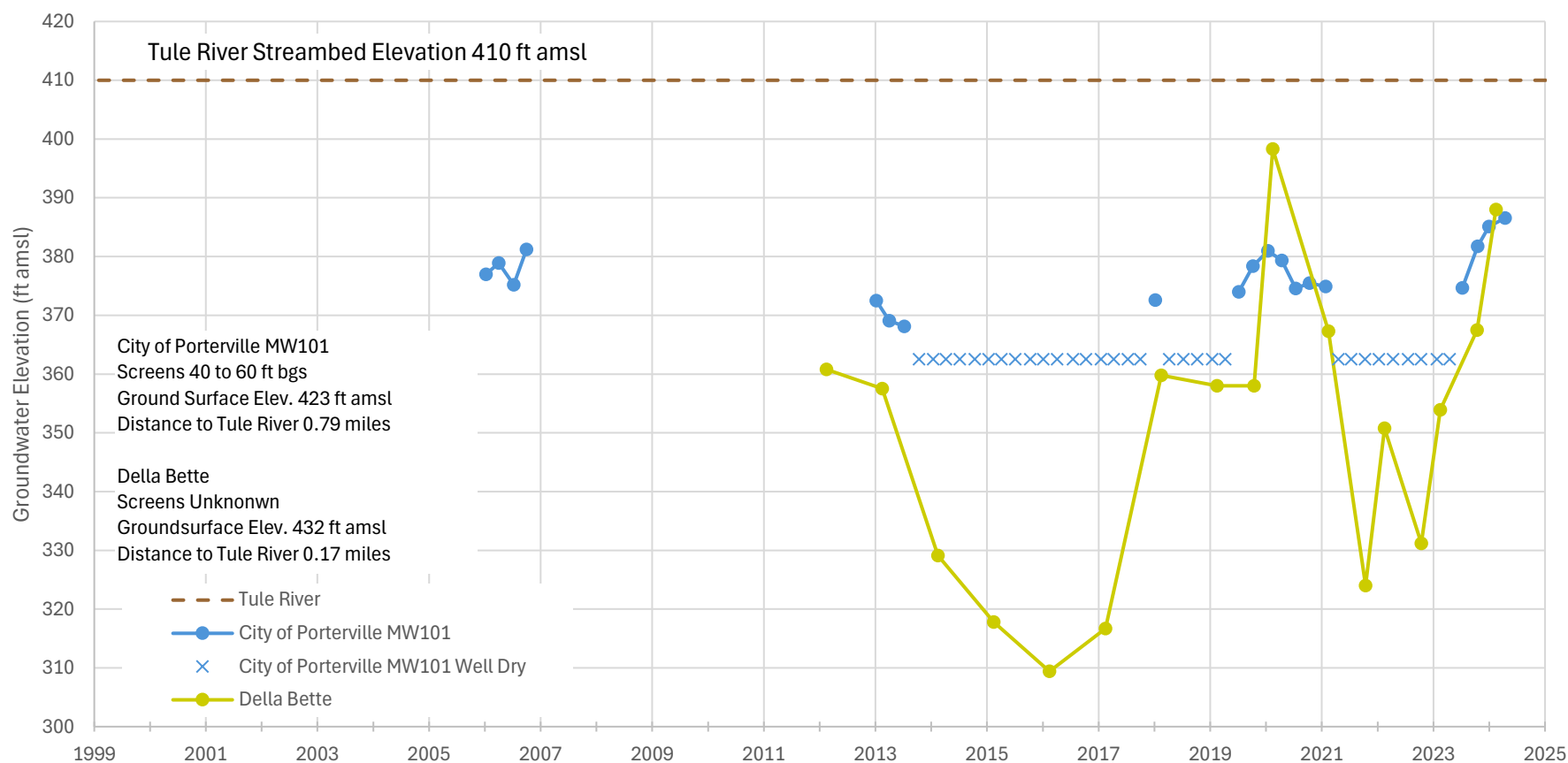
**Upper Aquifer Groundwater Levels (Depth)
 City of Porterville MW101 and Della Bette**



Notes:

MW1010 data from City of Porterville.
 Della Bette data from Tule River Association.

Upper Aquifer Groundwater Levels (Elevation)
City of Porterville MW101 and Della Bette

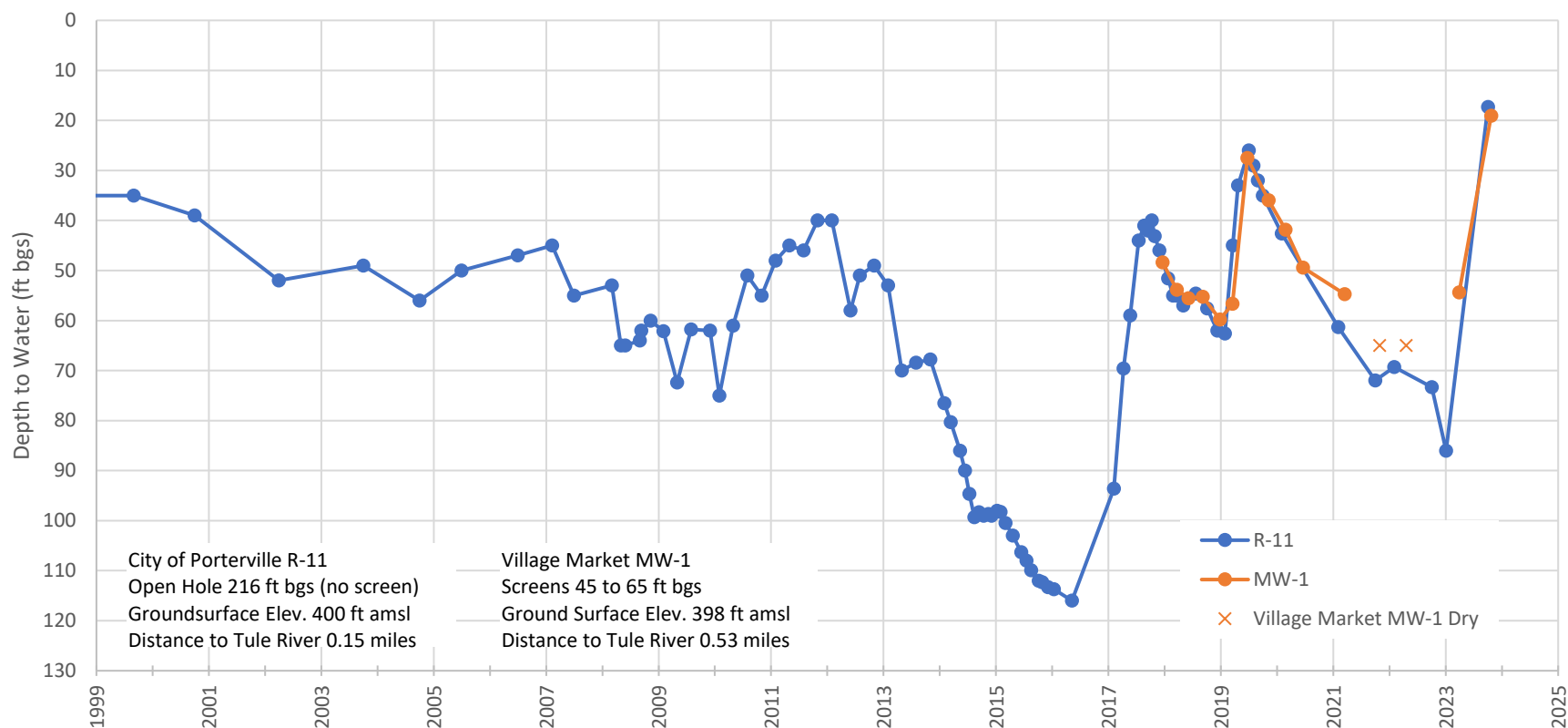


Notes:

MW1010 data from City of Porterville.

Della Bette data from Tule River Association.

**Upper Aquifer Groundwater Levels (Depth)
 City of Porterville R-11 and Village Market MW-1**



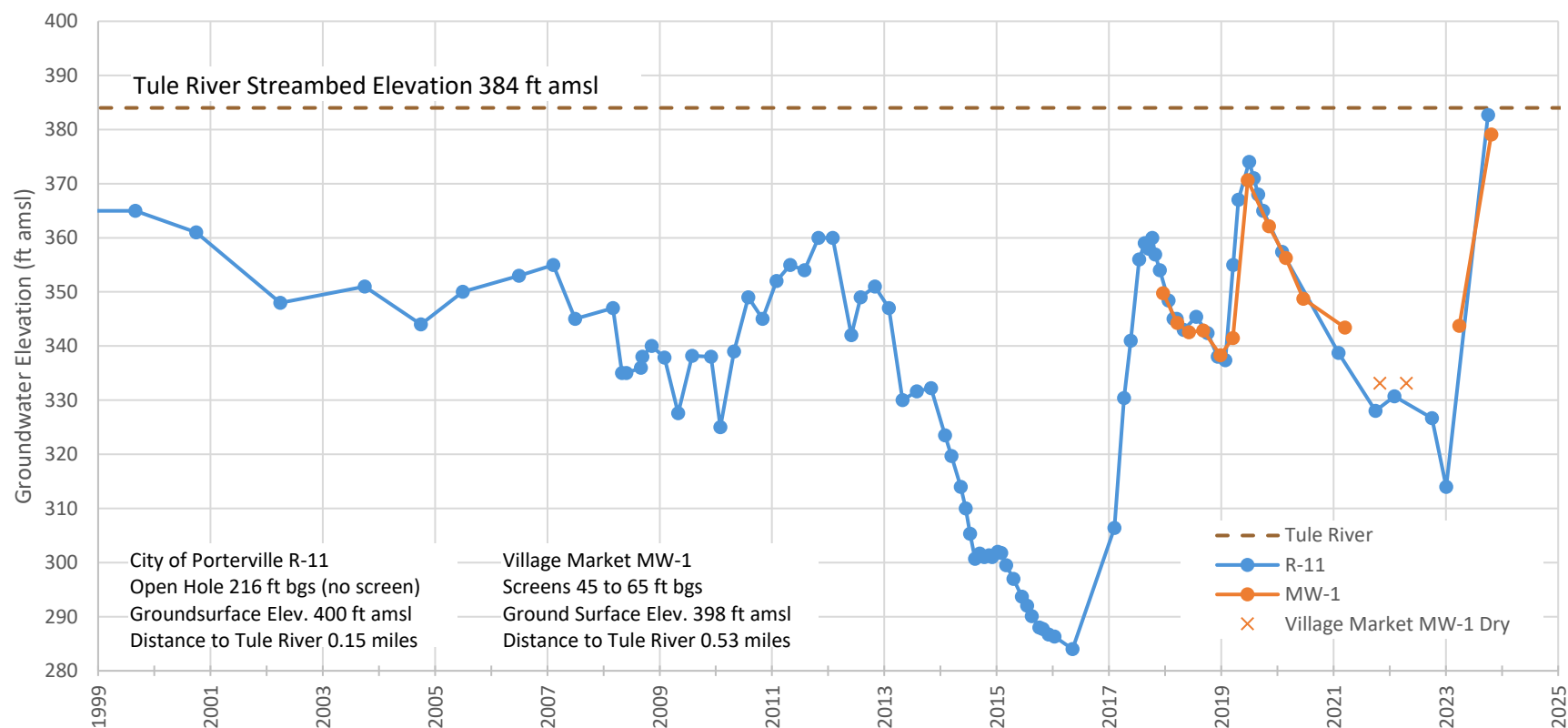
Notes:

R-11 data from City of Porterville

Village Market MW-1 data from https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T0610700099.

Wells located are less than 1,100 ft from the Tule River-Friant Kern Canal Water Bank basins which started recharge operations in 2017 may influence groundwater levels at the wells.

**Upper Aquifer Groundwater Levels (Elevation)
 City of Porterville R-11 and Village Market MW-1**

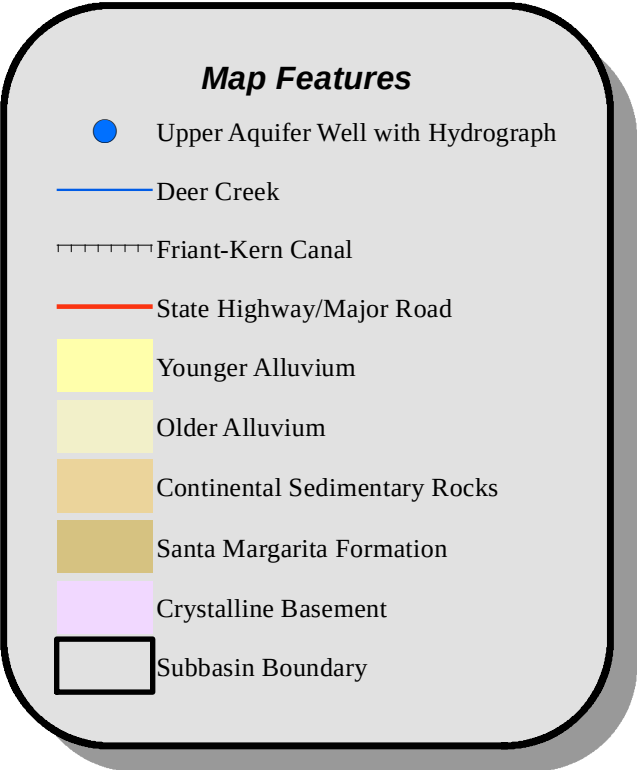
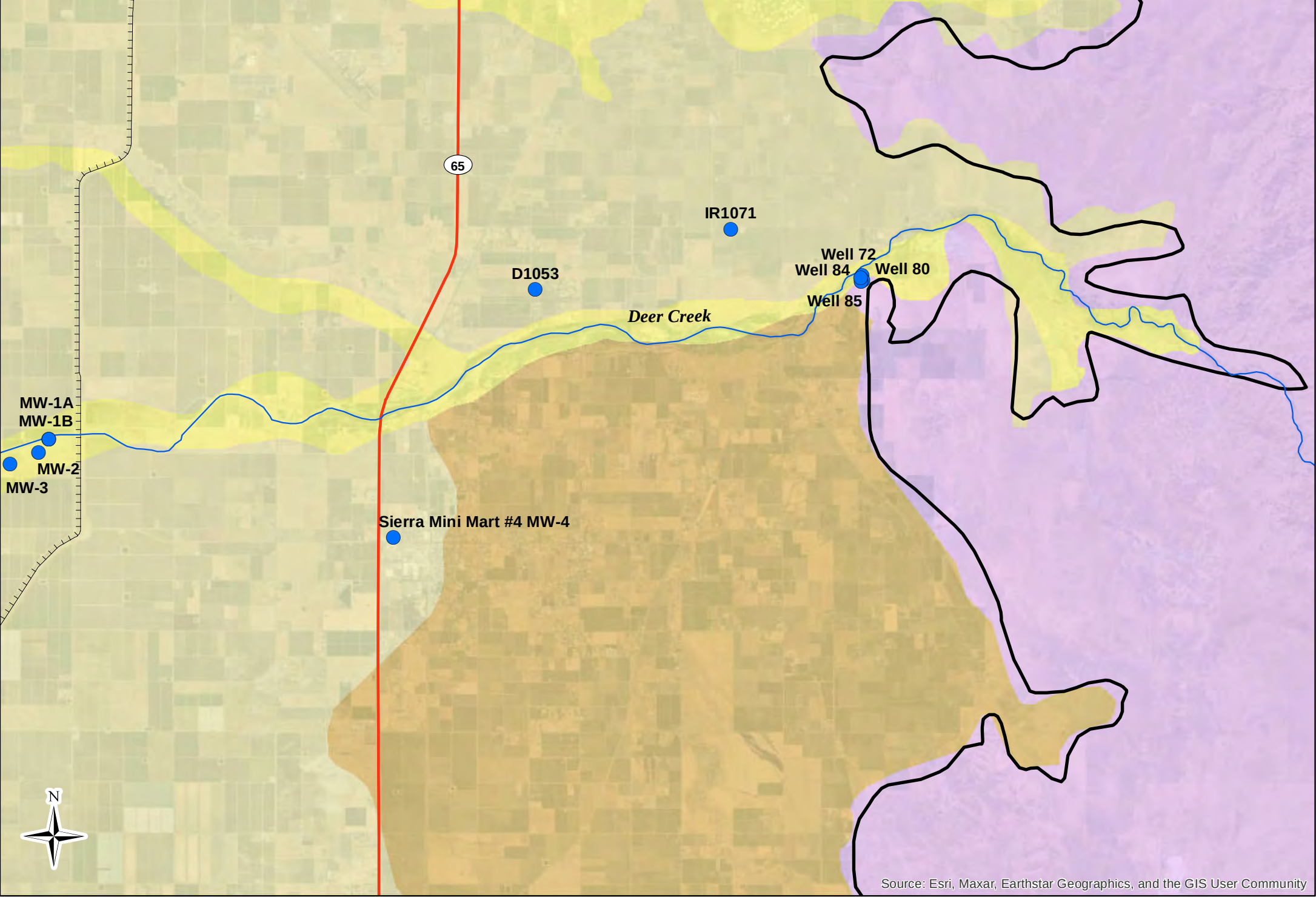


Notes:

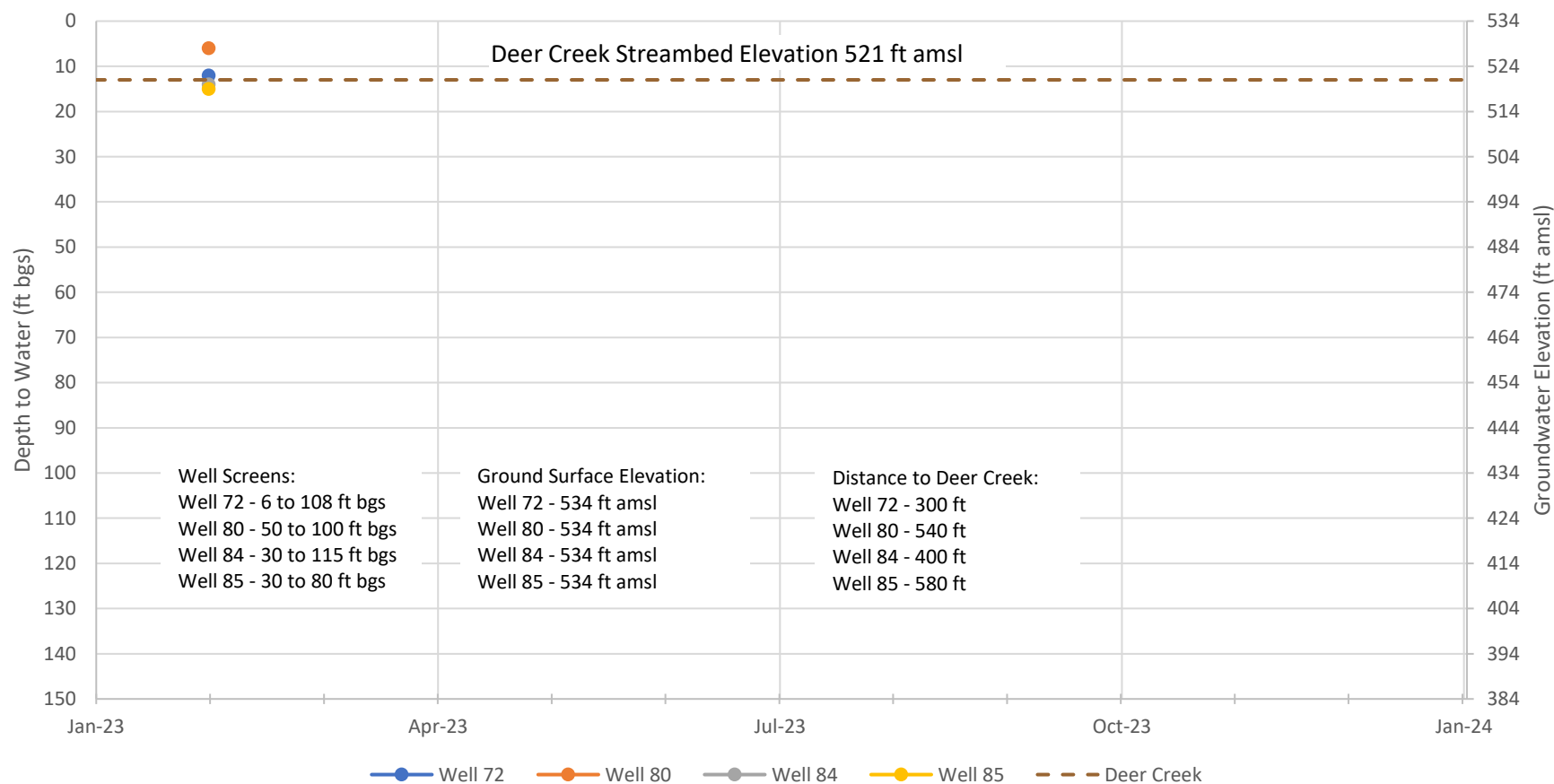
R-11 data from City of Porterville

Village Market MW-1 data from https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T0610700099.

Wells located are less than 1,100 ft from the Tule River-Friant Kern Canal Water Bank basins which started recharge operations in 2017 may influence groundwater levels at the wells.



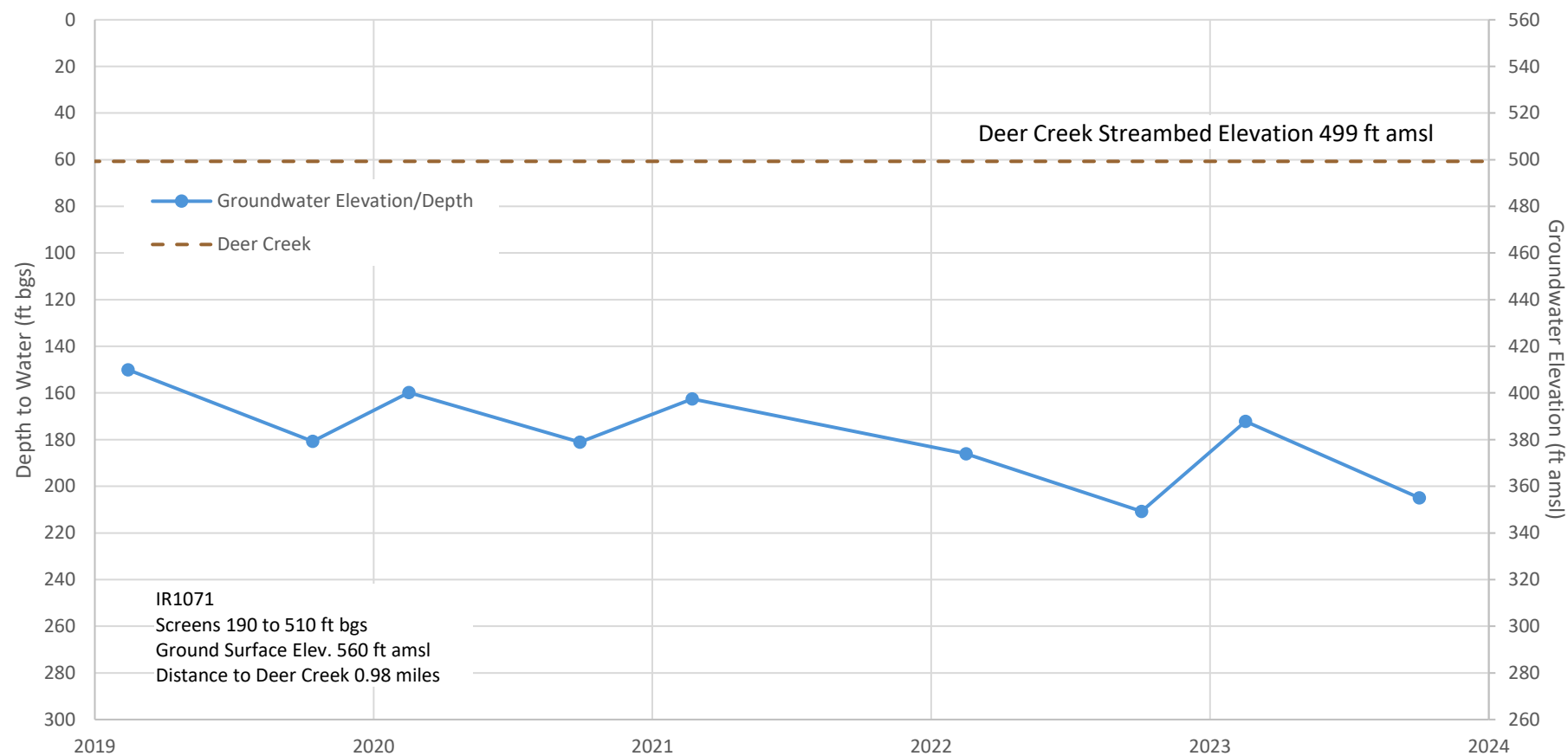
Terra Bella Irrigation District Wells Groundwater Levels



Notes:

Data from Terra Bella Irrigation District.

**Upper Aquifer Groundwater Levels
IR1071**

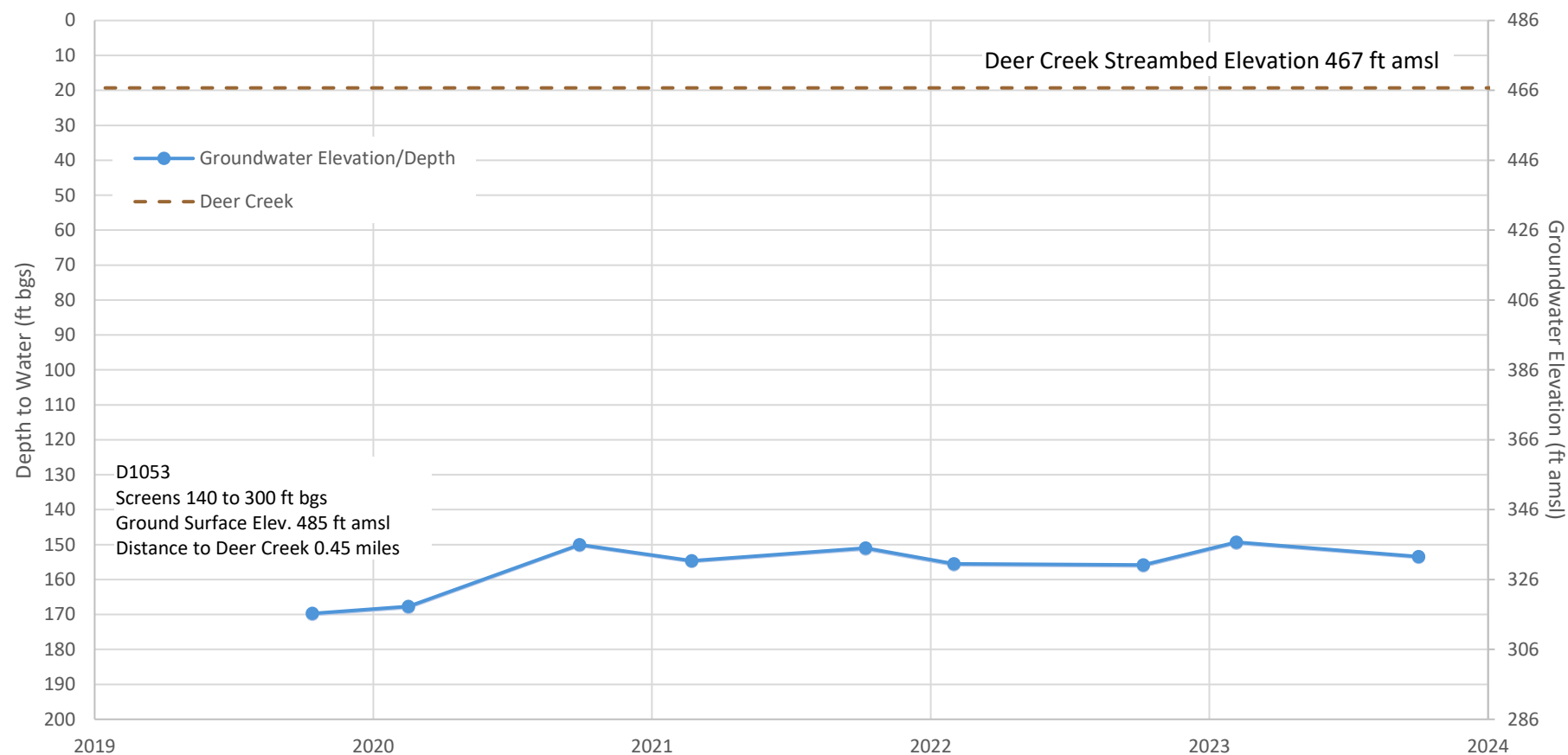


Notes:

Data from Tule Subbasin Technical Advisory Committee.



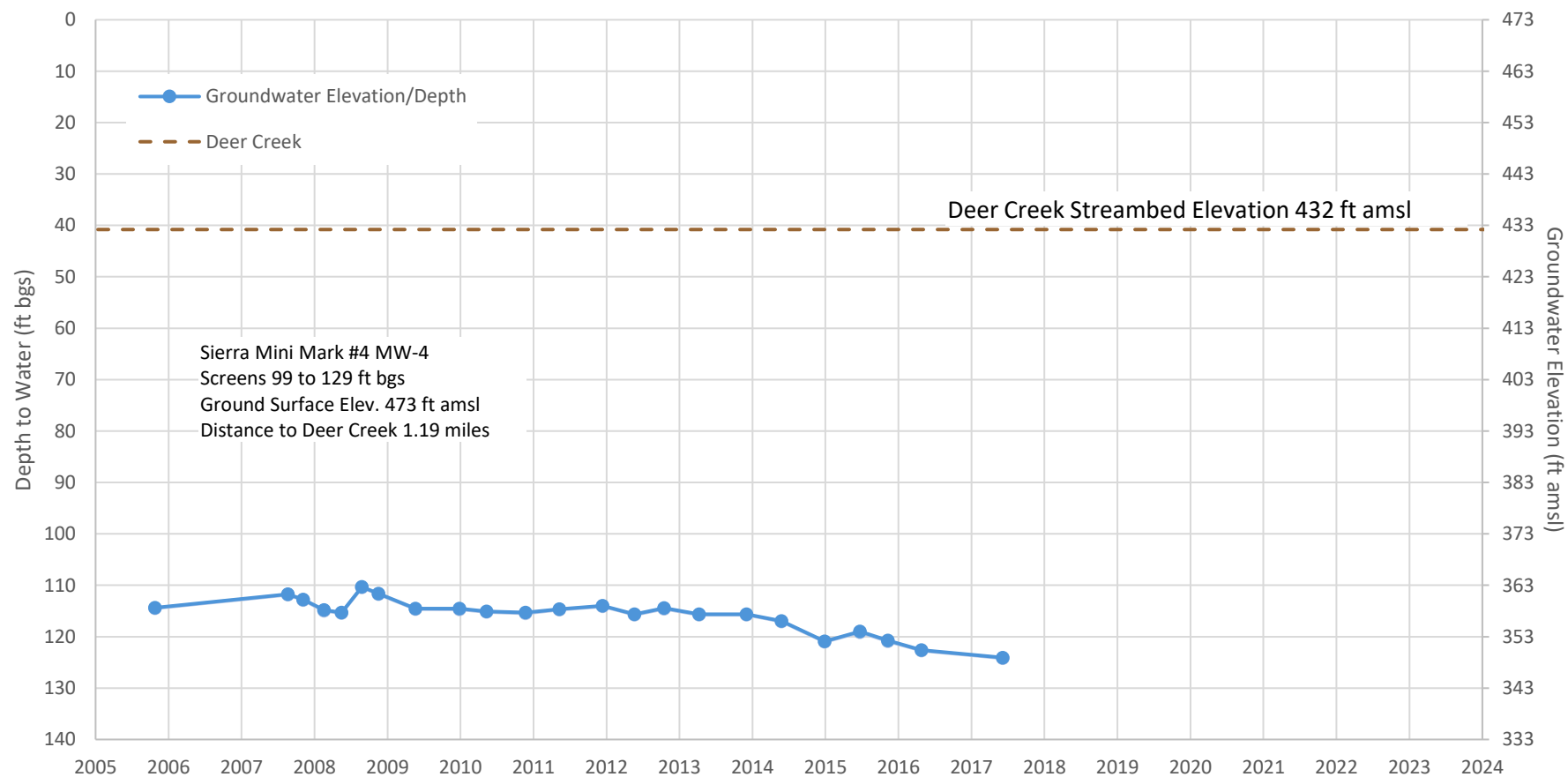
**Upper Aquifer Groundwater Levels
D1053**



Notes:

Data from Tule Subbasin Technical Advisory Committee.

Upper Aquifer Groundwater Levels
Sierra Mini Mart #4 MW-4

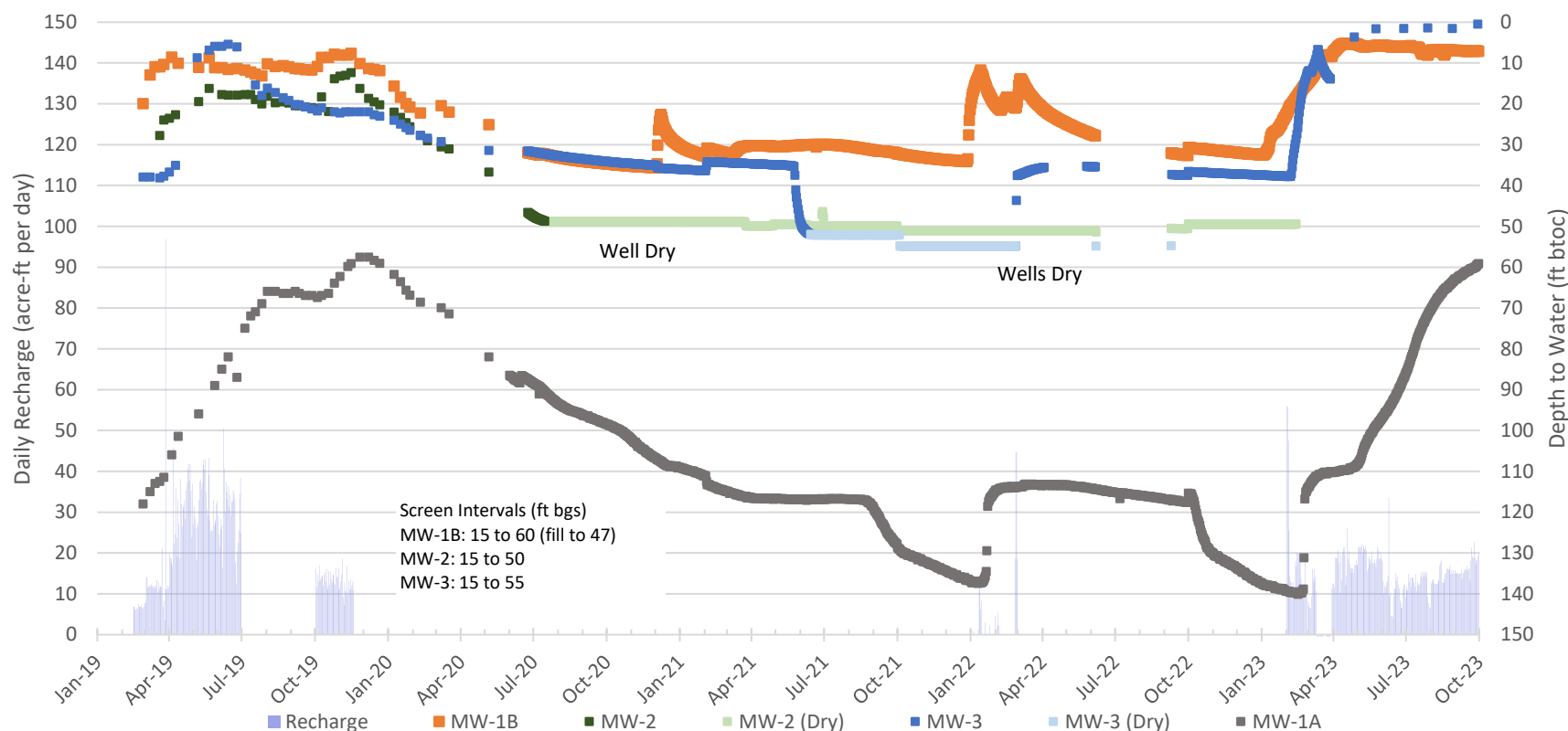


Notes:

Data from GeoTracker, https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T0610700430

Well destroyed in September of 2018.

Deer Creek - Friant Kern Canal Water Bank Groundwater Levels and Recharge

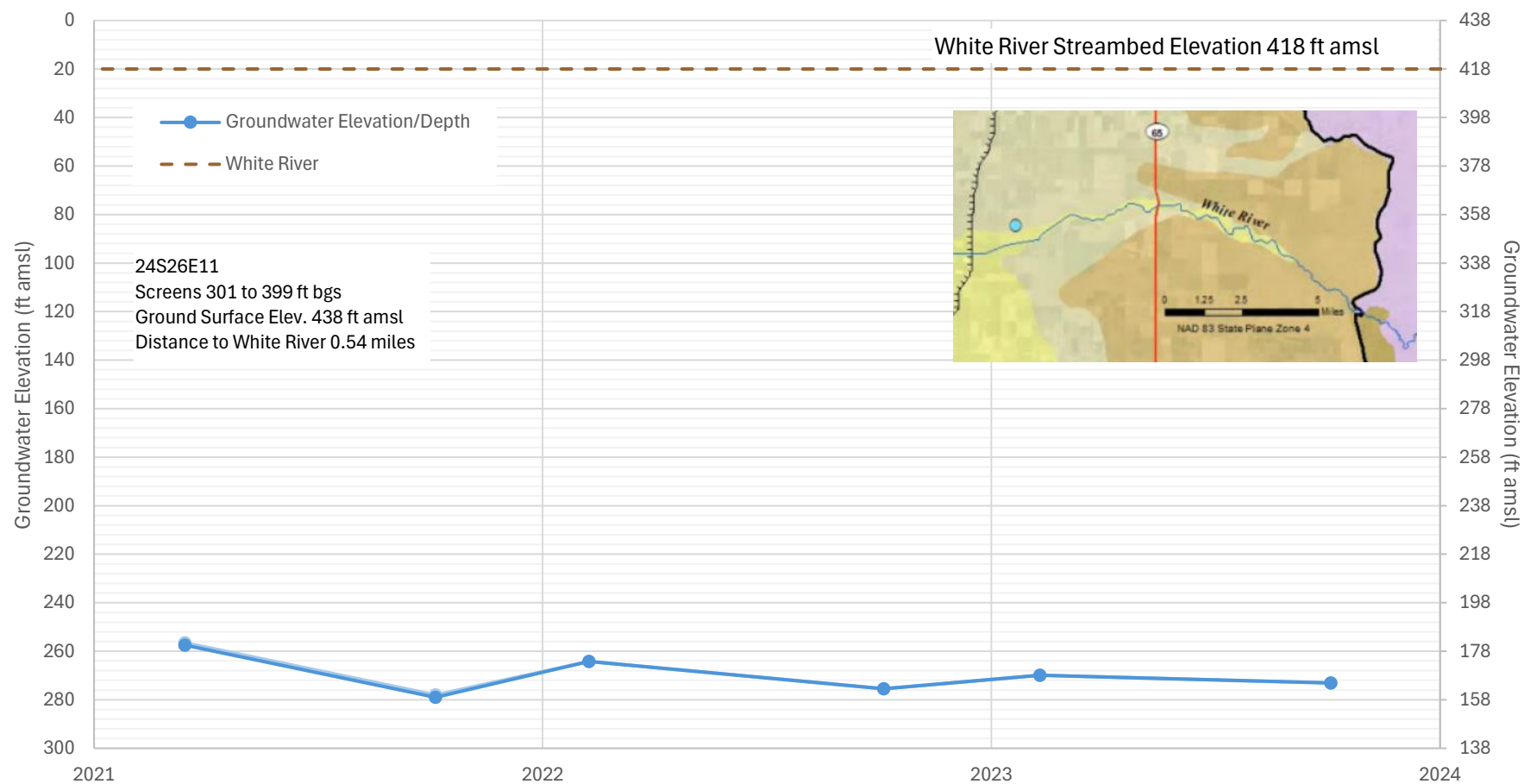


Notes:

Data from GSI Water Solutions, 2024. Deer Creek – Friant Kern Canal Water Bank Project 2023 Annual Report Monitoring and Operational Constraint Plan (MOCP). Prepared for Saucelito Irrigation District.

Groundwater levels may be influenced by other nearby recharge (e.g. native Deer Creek flows, imported water released into Deer Creek channel, and DKTRA recharge) and discharge (e.g. pumping) sources.

Upper Aquifer Groundwater Levels
24S26E11

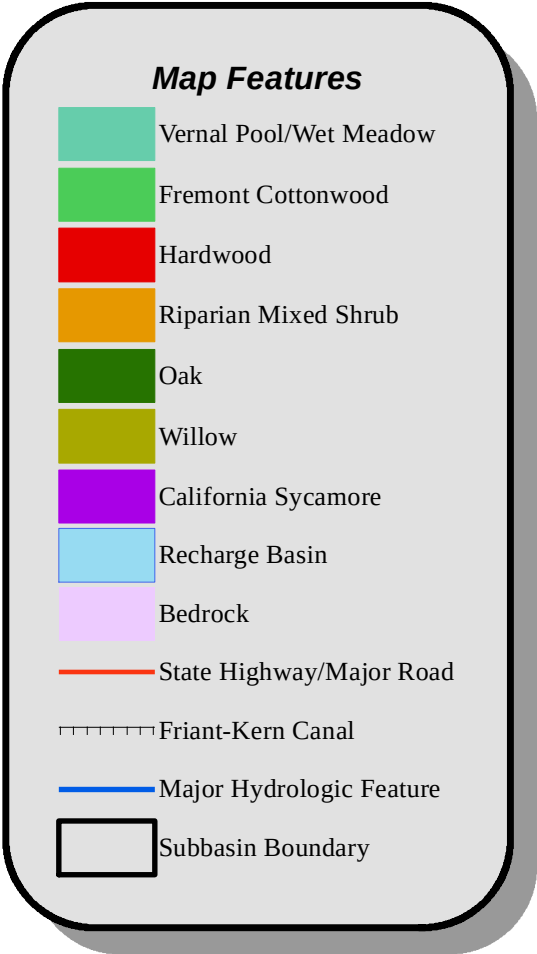
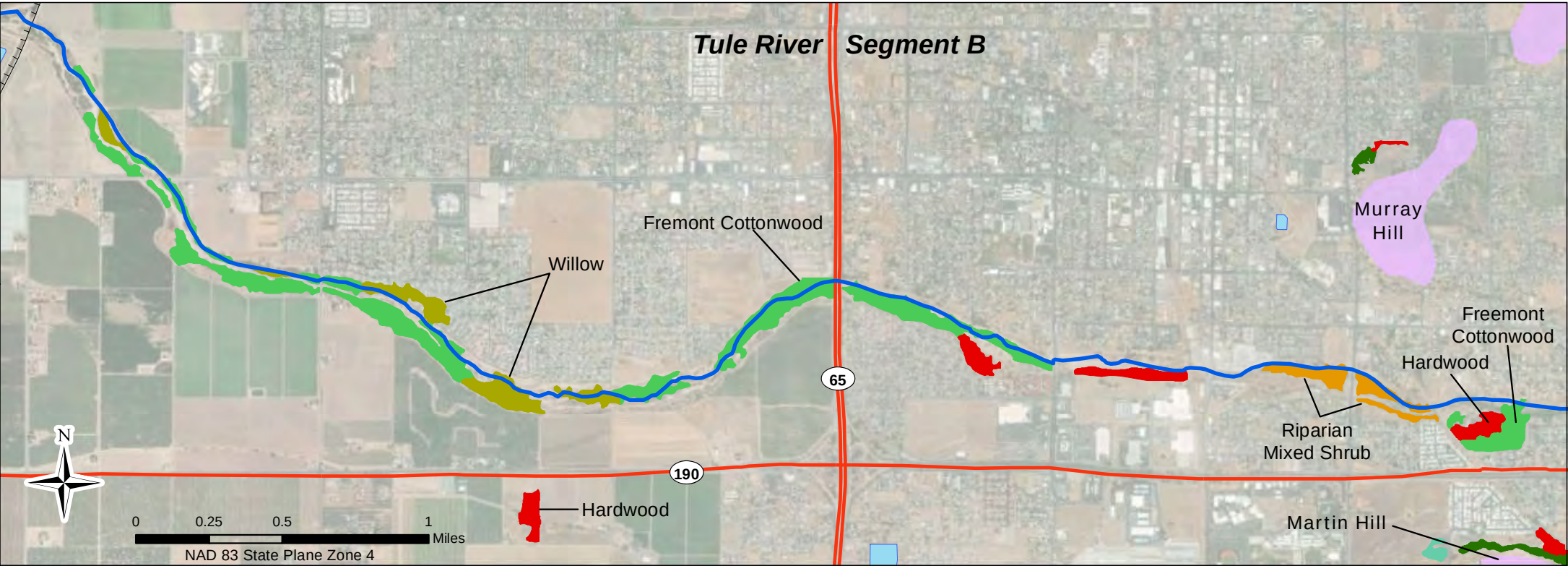
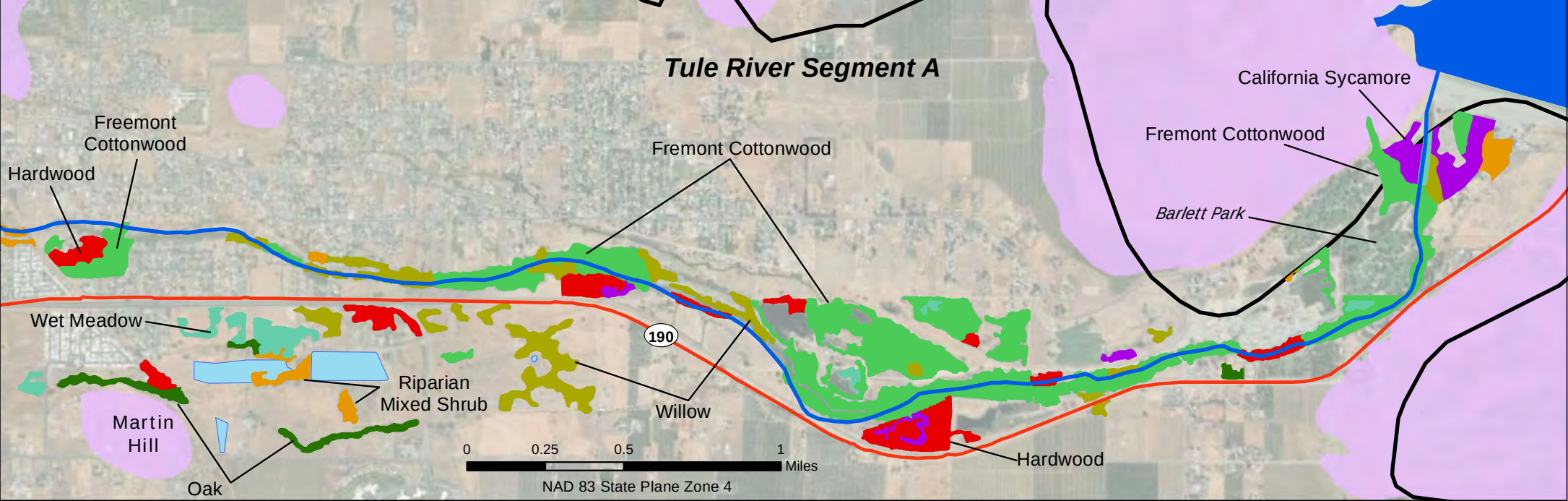


Notes:

Data from Tule Subbasin Technical Advisory Committee.

Tule Subbasin Technical Advisory Committee

Technical Support for Addressing
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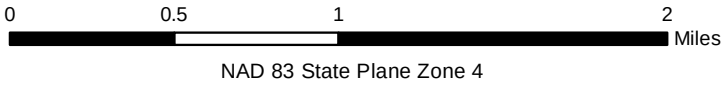
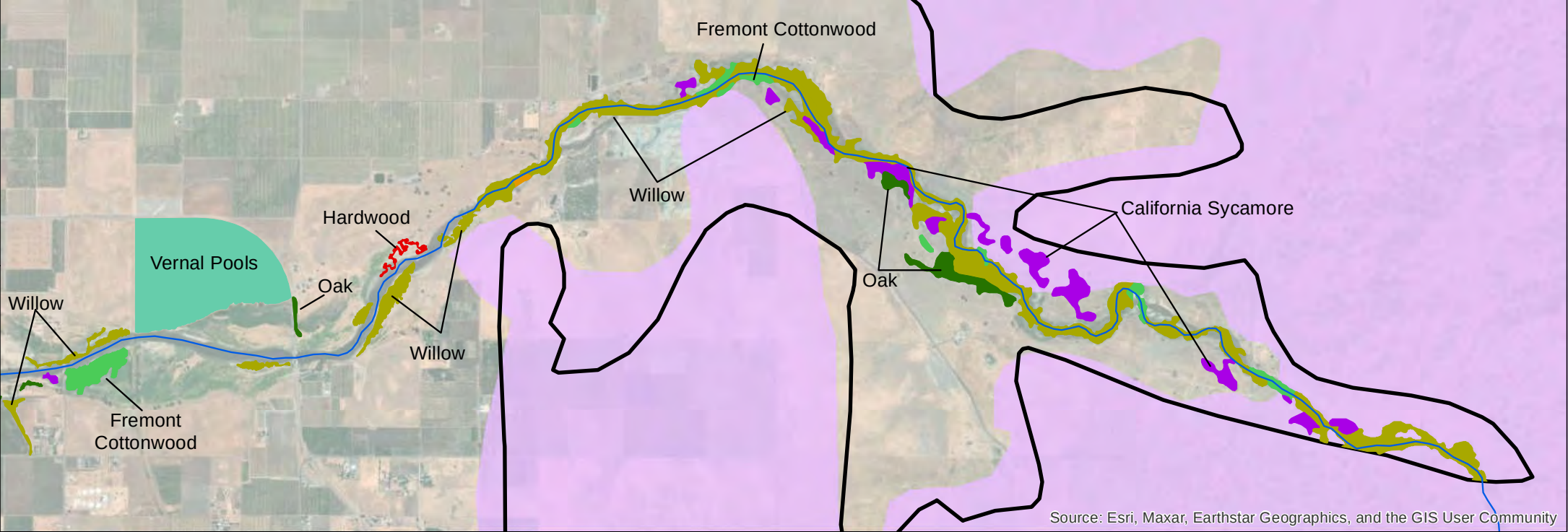
Notes:
Data Modified from VegCAMP Vegetation
Classification and Mapping Program,,
<https://map.dfg.ca.gov/metadata/ds2632.html>
<https://map.dfg.ca.gov/metadata/ds3073.html>

Grasses and Forbs not shown.

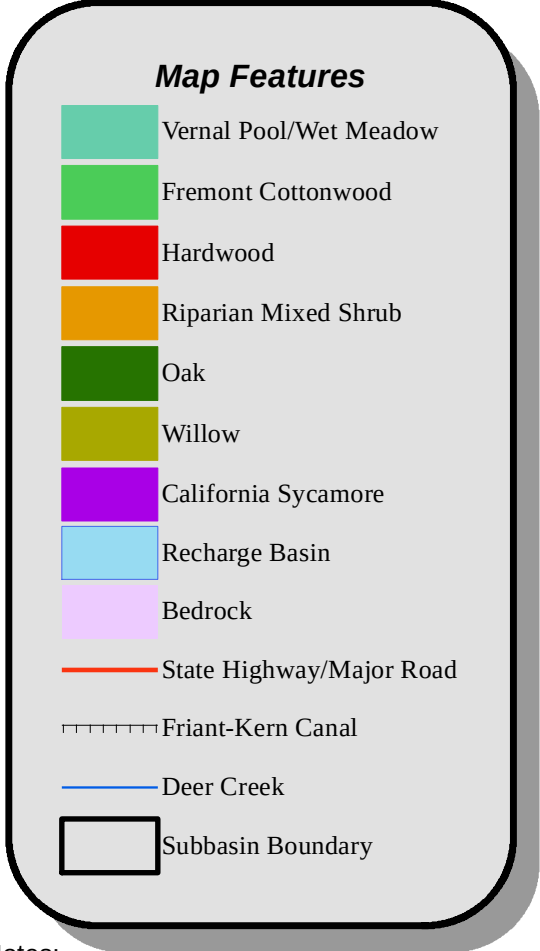
Vegetation outside Subbasin Boundary or on
mapped bedrock not shown

Tule Subbasin Technical Advisory Committee

July 2024



Technical Support for Addressing
SWRCB Comments Regarding
Interconnected Surface Water



Notes:
Data Modified from VegCAMP Vegetation
Classification and Mapping Program,,
<https://map.dfg.ca.gov/metadata/ds2632.html>
<https://map.dfg.ca.gov/metadata/ds3073.html>

Grasses and Forbs not shown.
Vegetation outside Subbasin Boundary or on
mapped bedrock not shown
Deer Creek Segment West of the Friant-Kern
Canal was not used in analysis

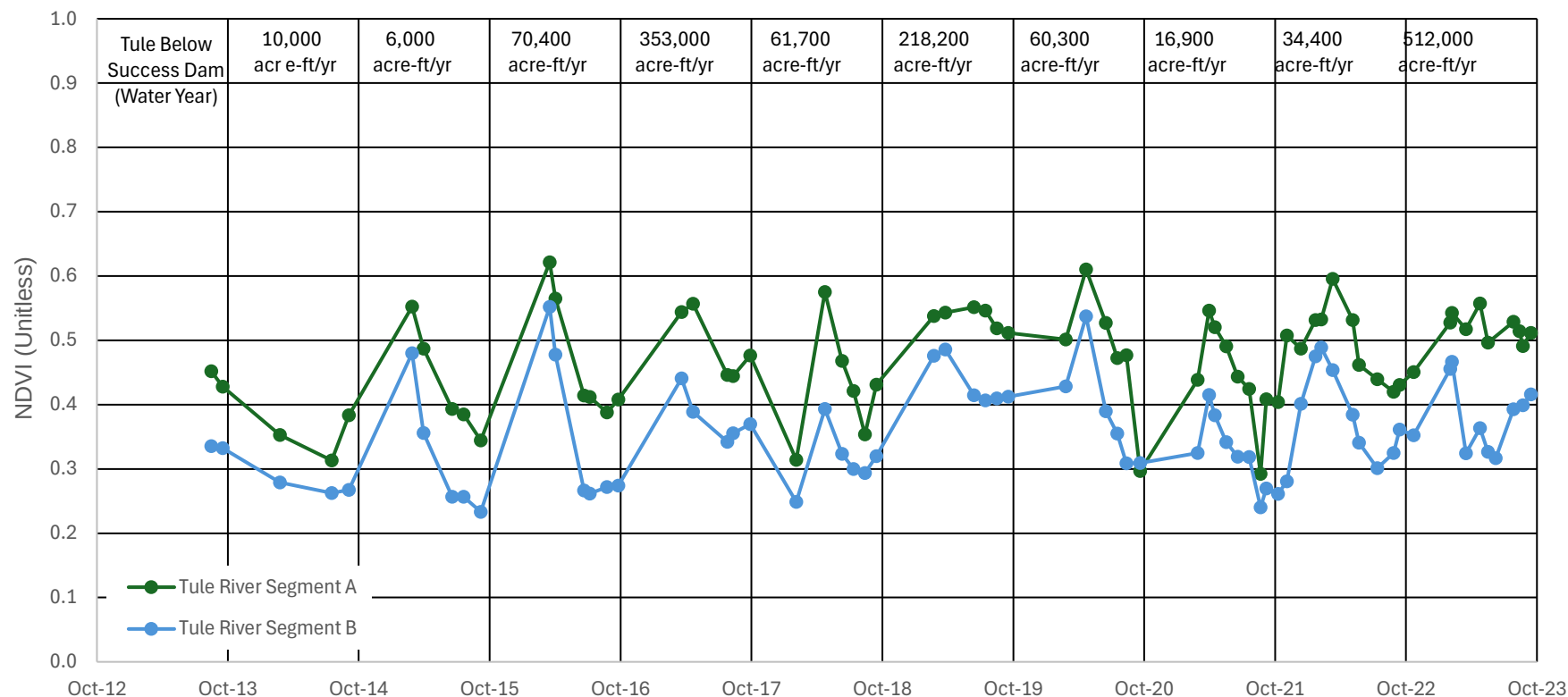


Map Features

- Vernal Pool/Wet Meadow
- Fremont Cottonwood
- Hardwood
- Riparian Mixed Shrub
- Oak
- Willow
- California Sycamore
- Bedrock
- State Highway/Major Road
- Friant-Kern Canal
- White River
- Subbasin Boundary

Notes:
Data Modified from VegCAMP Vegetation
Classification and Mapping Program,,
<https://map.dfg.ca.gov/metadata/ds2632.html>
<https://map.dfg.ca.gov/metadata/ds3073.html>
Grasses and Forbs not shown.

Normalized Difference Vegetation Index (NDVI) for
 Potential Groundwater Dependent Ecosystems (GDEs) within the Upper Tule River Area



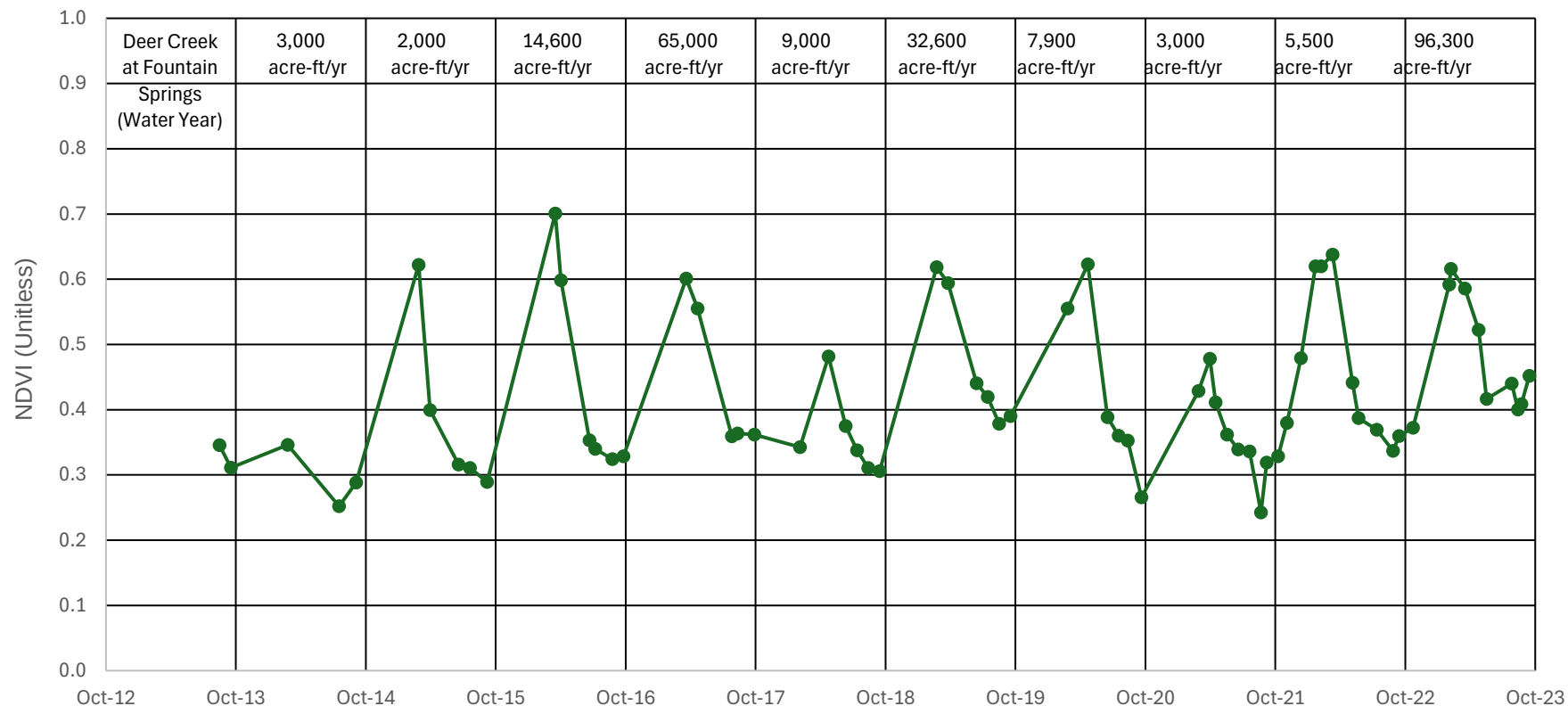
Notes:

Data for NDVI from the Landsat 7, accessed from <https://apps.sentinel-hub.com/eo-browser/>

NDVI analysis based on areas shown in Figure 24.

Tule Below Success Dam represent flows into the Tule River channel (does not include Pioneer Ditch).

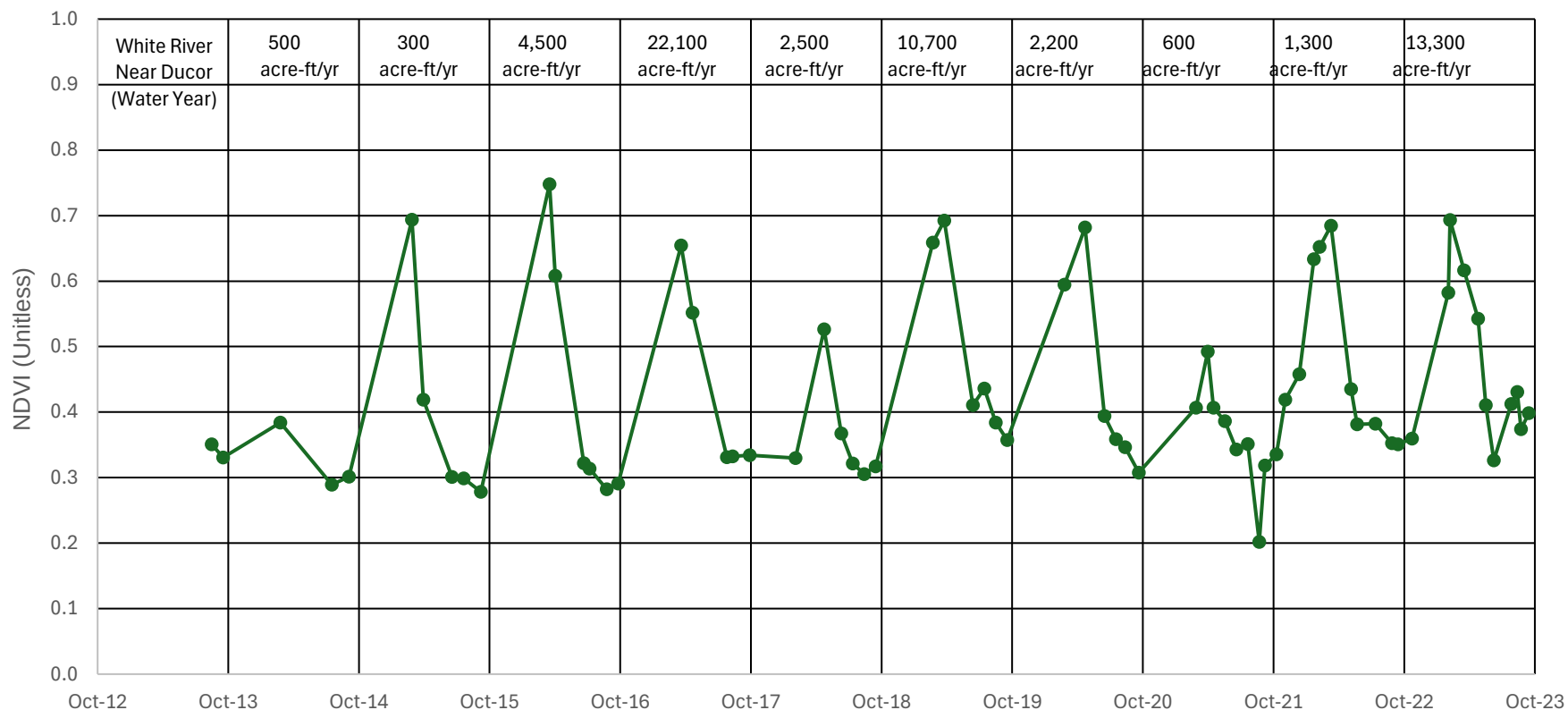
Normalized Difference Vegetation Index (NDVI) for
 Potential Groundwater Dependent Ecosystems (GDEs) within the Upper Deer Creek Area



Notes:

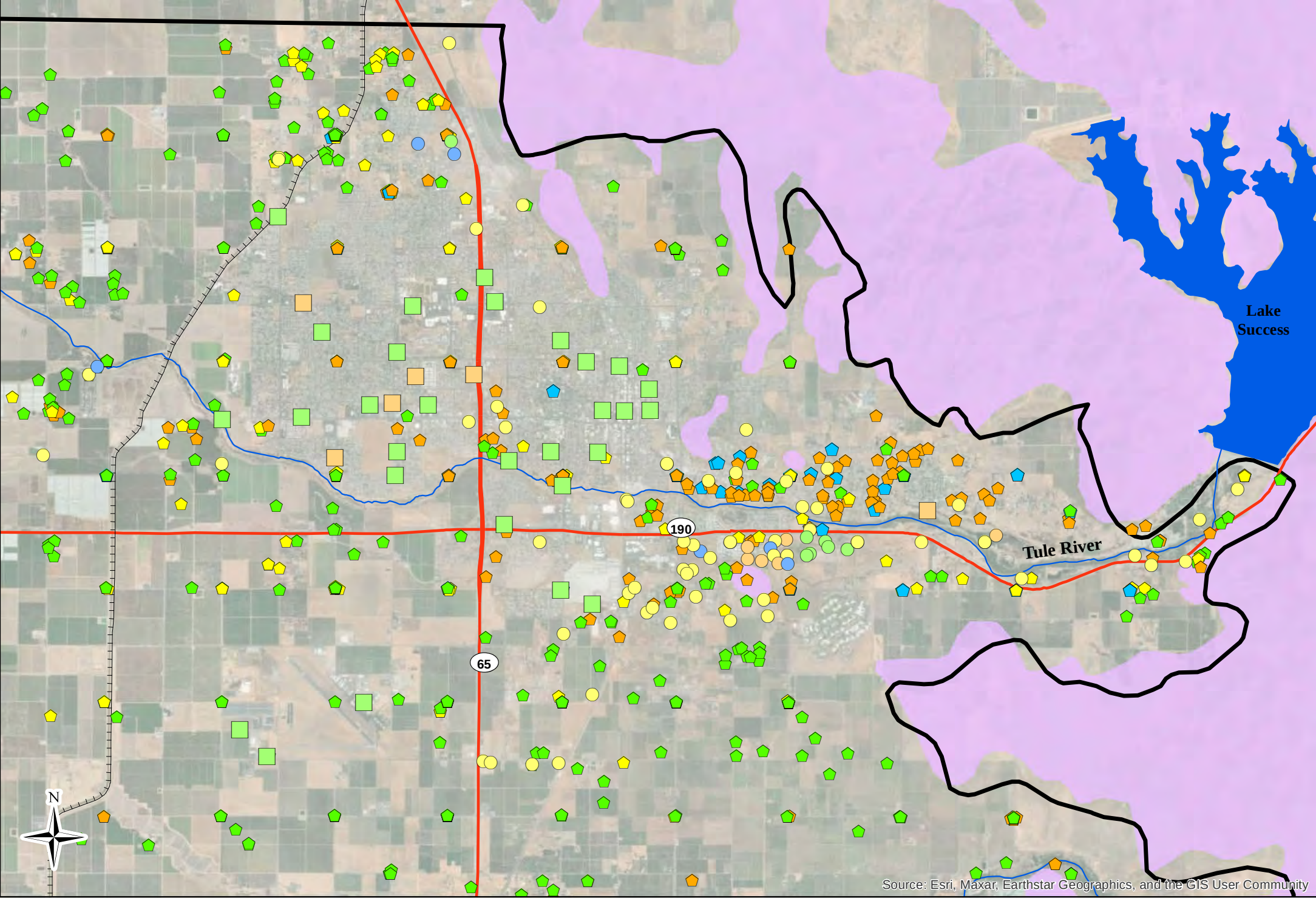
Data for NDVI from the Landsat 7, accessed from <https://apps.sentinel-hub.com/eo-browser/>
 NDVI analysis based on areas shown in Figure 25.

**Normalized Difference Vegetation Index (NDVI) for
 Potential Groundwater Dependent Ecosystems (GDEs) within the Upper White River Area**



Notes:

Data for NDVI from the Landsat 7, accessed from <https://apps.sentinel-hub.com/eo-browser/>
 NDVI analysis based on areas shown in Figure 26.



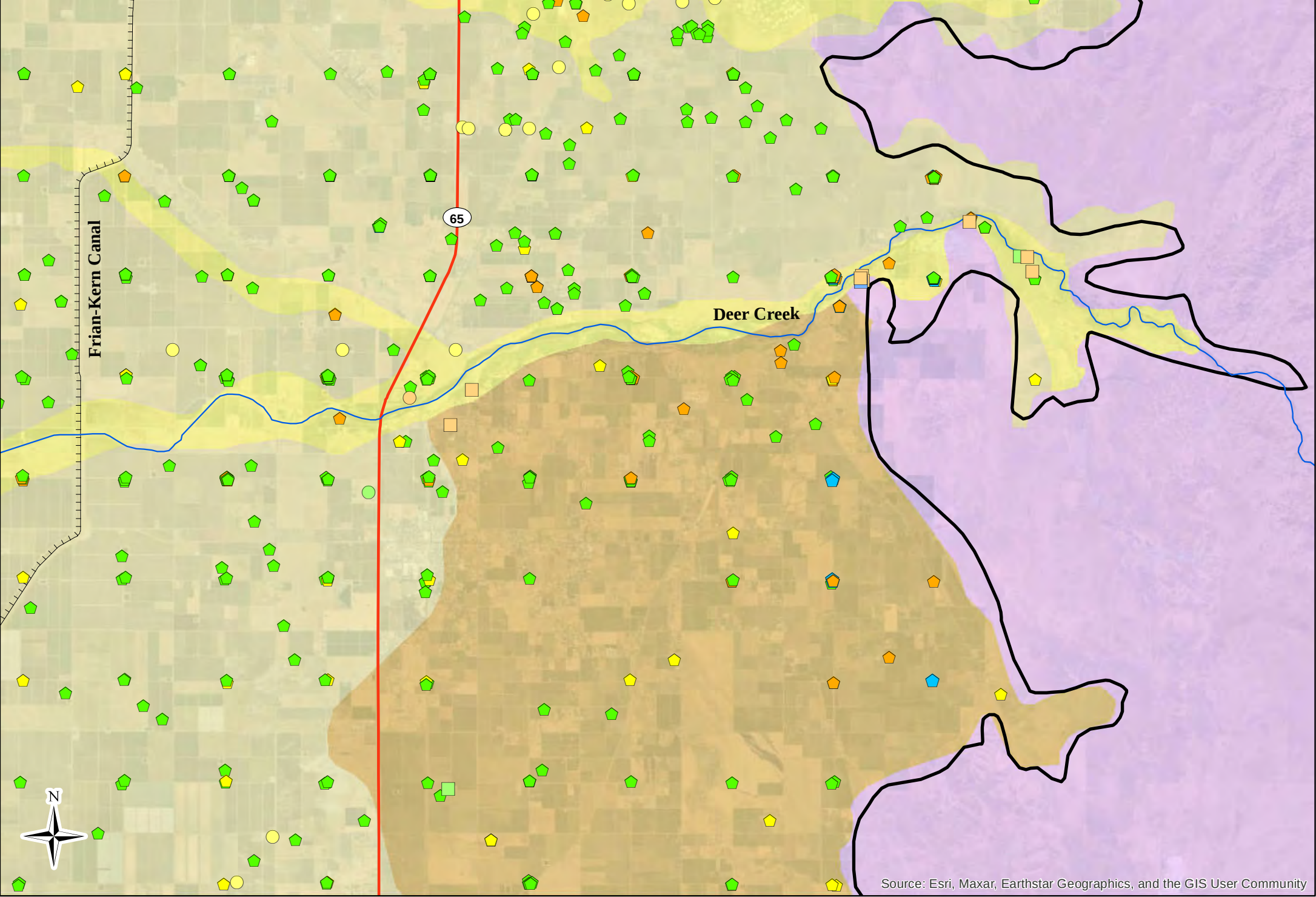
Map Features

- City of Porterville, Unknown Aquifer
- City of Porterville, Composite Aquifer
- City of Porterville, Lower Aquifer
- Community or Small System, Upper Aquifer
- Community or Small System, Unknown Aquifer
- Community or Small System, Composite Aquifer
- Community or Small System, Lower Aquifer
- Domestic or Agricultural, Upper Aquifer
- Domestic or Agricultural, Unknown Aquifer
- Domestic or Agricultural, Composite Aquifer
- Domestic or Agricultural, Lower Aquifer
- Major Hydrologic Feature
- Friant-Kern Canal
- State Highway/Major Road
- Bedrock
- Subbasin Boundary

Notes: Destroyed and inactive wells not shown.

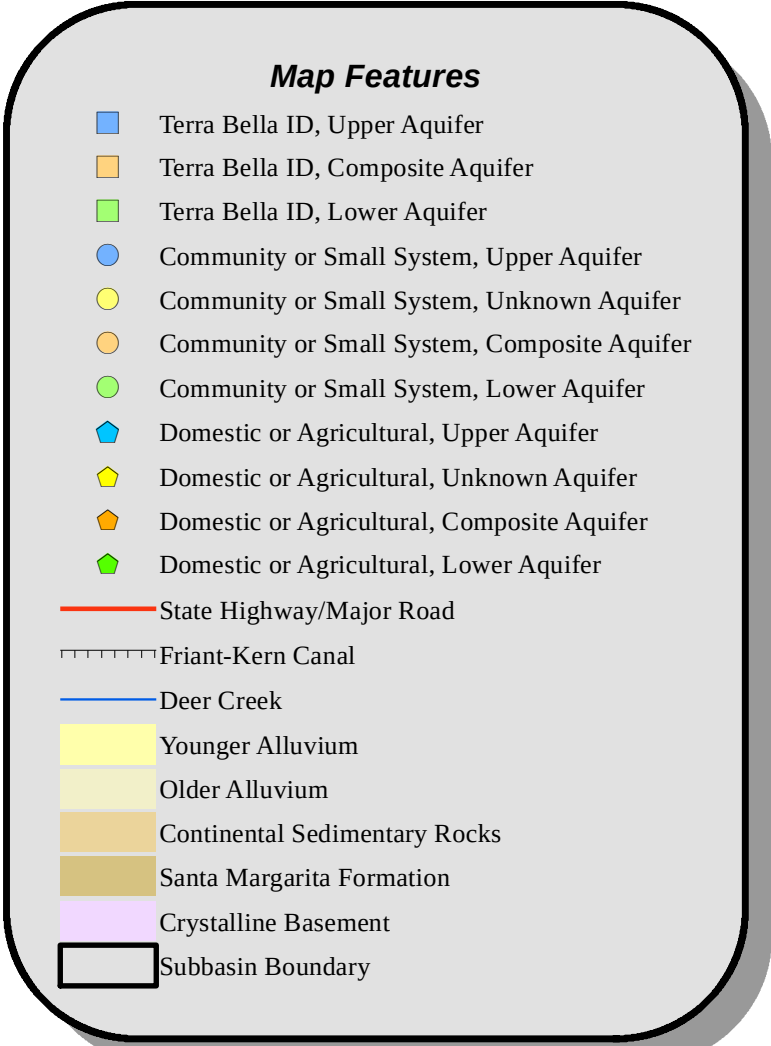
Community or Small System wells from DDW public wells database.

Domestic and agricultural well data from the USGS OSCWR Database (ver 3.0, July 2023)
<https://www.sciencebase.gov/catalog/item/64958d73d34ef77fcb01dc8f>



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

**Technical Support for Addressing
SWRCB Comments Regarding
Interconnected Surface Water**

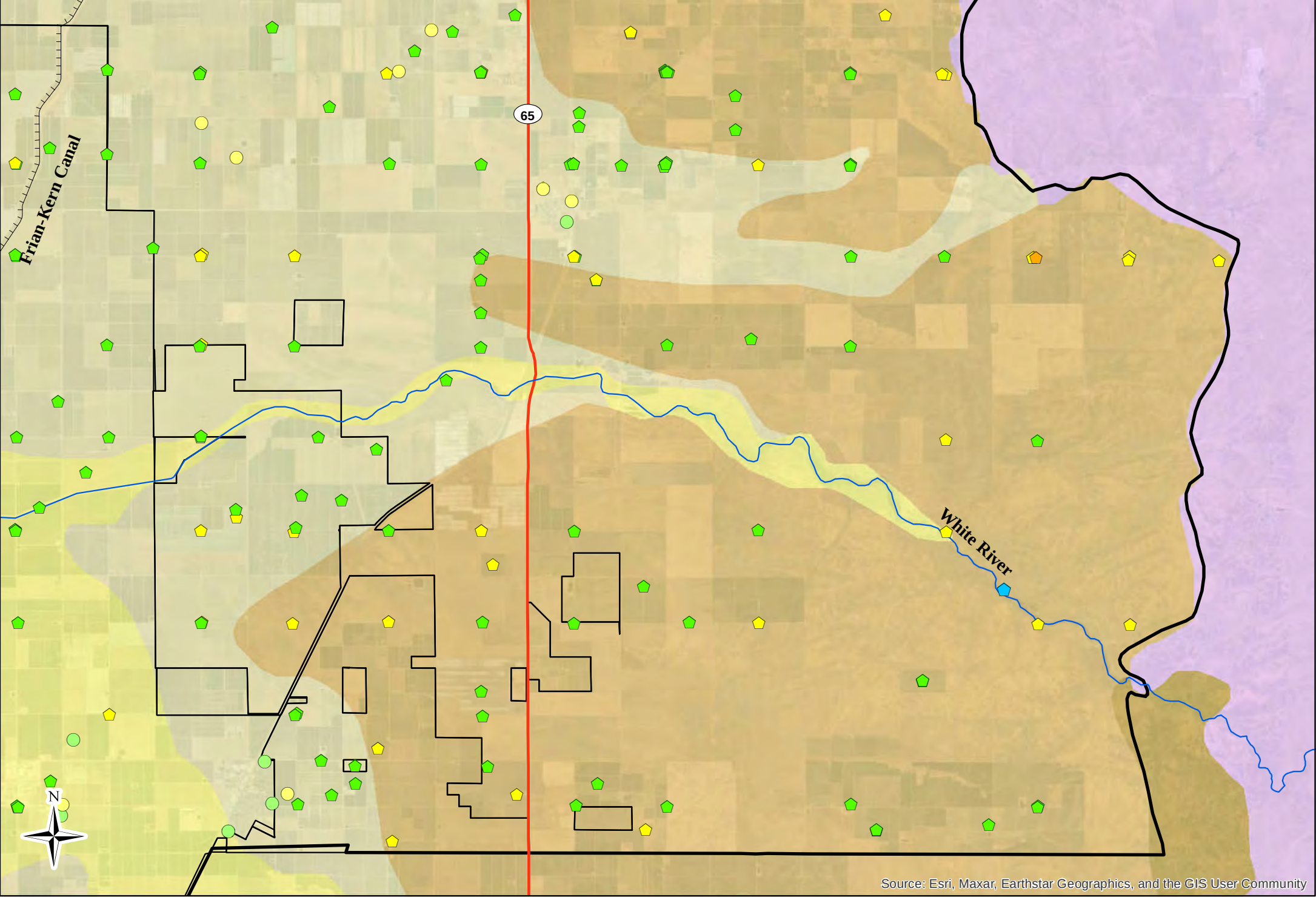


Notes: Terra Bella ID, Community System and Small System wells from DDW.

Destroyed and inactive wells not shown.

Domestic and agricultural well data from the USGS OSCWR Database (ver 3.0, July 2023) <https://www.sciencebase.gov/catalog/item/64958d73d34ef77fcb01dc8f>

Upper Aquifer assumed to be <120 ft bgs in Deer Creek and White River areas.



Technical Support for Addressing
SWRCB Comments Regarding
Interconnected Surface Water

Map Features

- Community or Small System, Unknown Aquifer
- Community or Small System, Lower Aquifer
- Domestic or Agricultural, Upper Aquifer
- Domestic or Agricultural, Unknown Aquifer
- Domestic or Agricultural, Composite Aquifer
- Domestic or Agricultural, Lower Aquifer
- State Highway/Major Road
- Friant-Kern Canal
- White River
- Younger Alluvium
- Older Alluvium
- Continental Sedimentary Rocks
- Santa Margarita Formation
- Crystalline Basement
- Subbasin Boundary

Notes: Community System and Small System wells from DDW.

Destroyed and inactive wells not shown.

Domestic and agricultural well data from the USGS OSCWR Database (ver 3.0, July 2023) <https://www.science.gov/catalog/item/64958d73d34ef77fcb01dc8f>

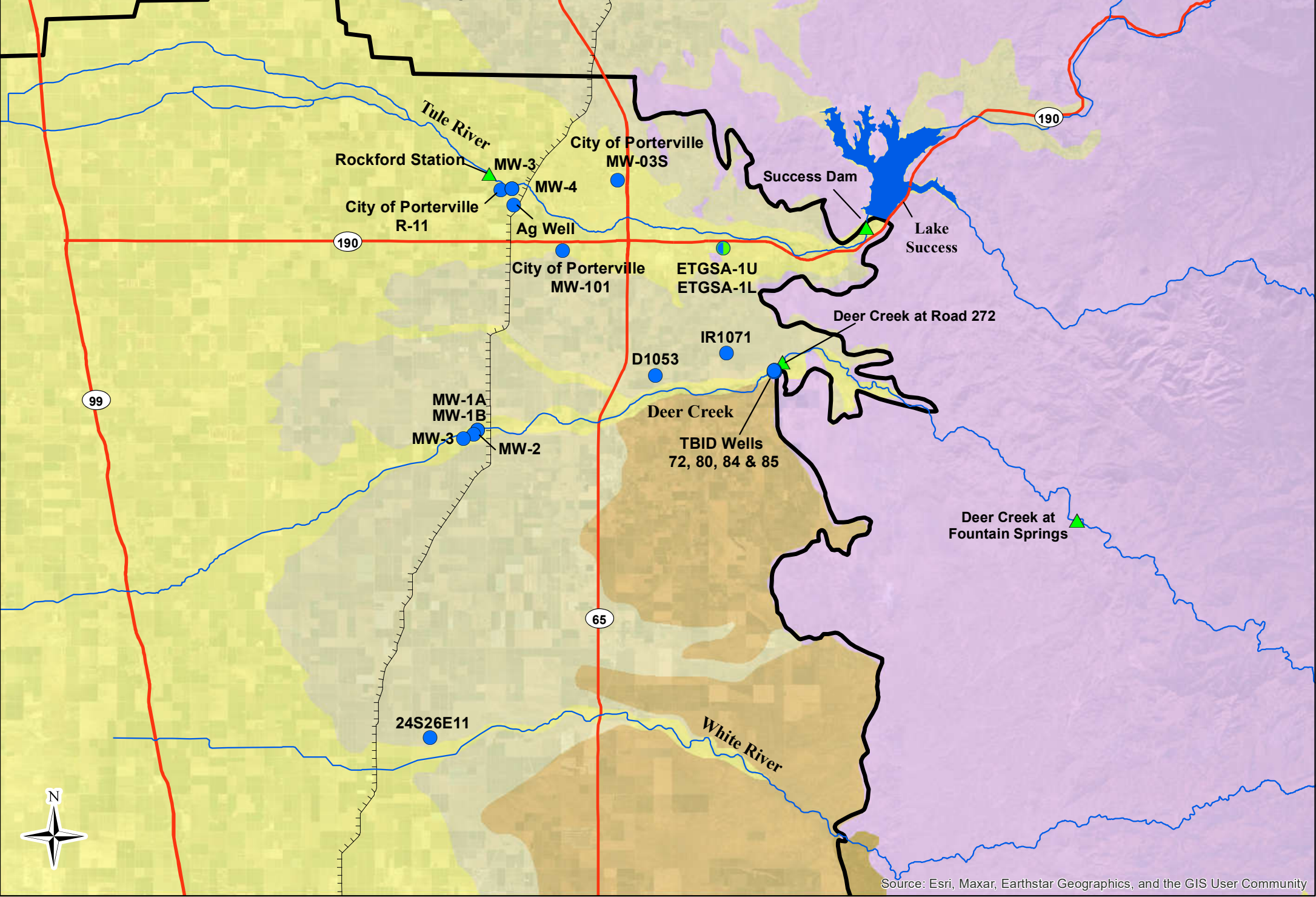
Upper Aquifer assumed to be <120 ft bgs in Deer Creek and White River areas.

DRAFT-FINAL
Upper White River Area -
Production Wells

Figure A7-32

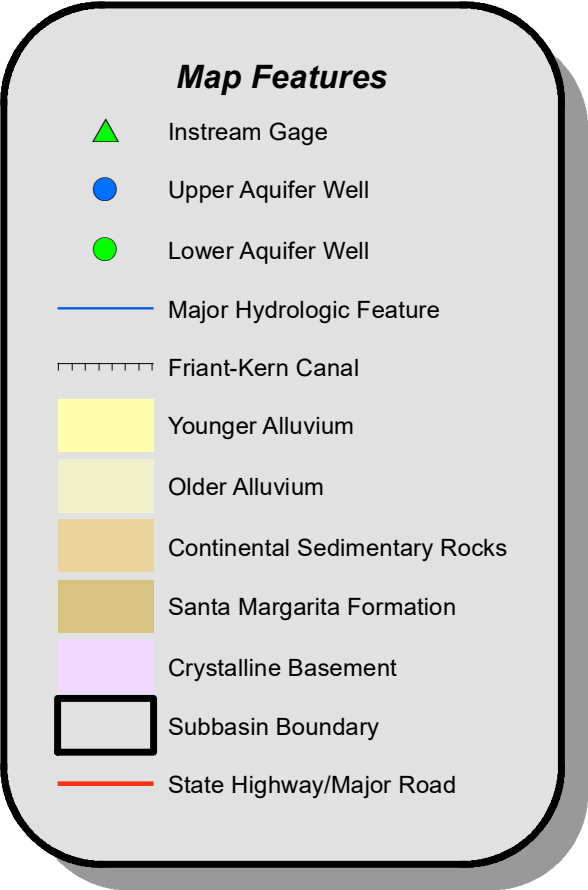
Tule Subbasin Technical Advisory Committee

July 2024



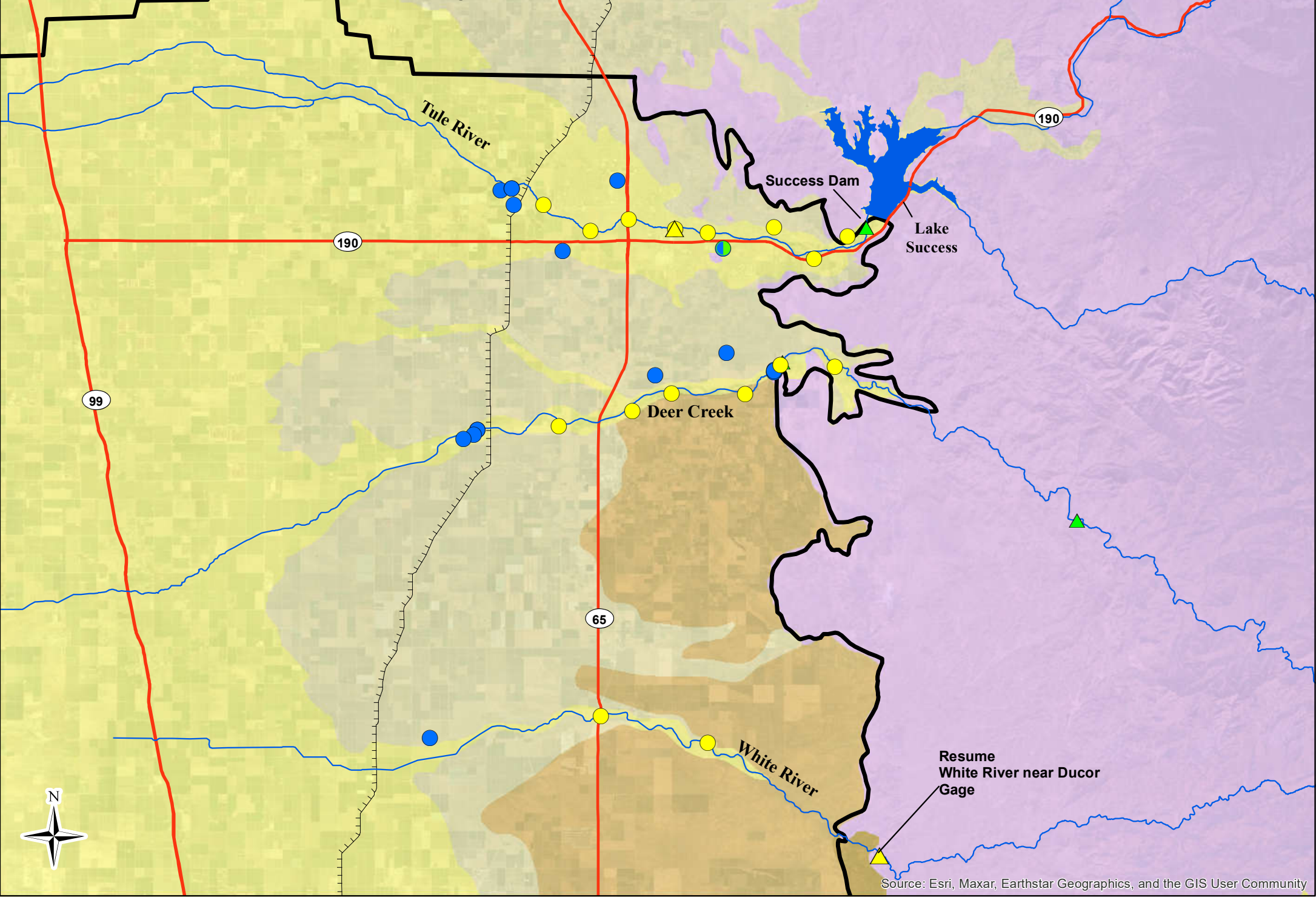
0 1.5 3 6 Miles
NAD 83 State Plane Zone 4

Technical Support for Addressing
SWRCB Comments Regarding
Interconnected Surface Water



Tule Subbasin Technical Advisory Committee

July 2024



0 1.5 3 6 Miles
NAD 83 State Plane Zone 4

