2.3.4. Historical Water Budget §354.18 (c)(2)

> § 354.18. (c) (2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:
>
> (A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.
>
> (B) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.
>
> (C) A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.

The historical surface water and groundwater budgets for the Tule Subbasin are shown in Tables 2-2a, 2-2b, and 2-3 and described in Sections 2.3.1 and 2.3.2. Historical surface water and groundwater budgets for each of the six GSAs in the subbasin are provided in:

- Appendix A - LTRID GSA.
- Appendix B – ETGSA
- Appendix C – DEID GSA
- Appendix D – Pixley GSA
- Appendix E – Tri-County Water Authority GSA
- Appendix F – Alpaugh GSA

Sources of surface water supply to agriculture in the Tule Subbasin include diverted stream flow from the Tule River and Deer Creek and imported supplies delivered via the Friant-Kern Canal, State Water Project, and other diverted streamflow from streams located outside the subbasin (i.e. King’s River). A comparison of water rights and annual water deliveries for the 10-yr period from 2007/08 to 2016/17 is provided for the Tule River and Friant-Kern Canal in Table 2-5. As shown, total Tule River water diversions during the 10-yr period are approximately 90 percent of the sum of diversion rights over that period. The primary reason for this is that the 10-yr period from 2007/08 to 2016/17 was relatively dry with precipitation approximately 69 percent of long-term average (see Figure 2-28). Friant-Kern Canal deliveries to agencies with contracts within the Tule Subbasin have also been below the sum of Class I and Class II contract amounts for most of the 10-yr period. However, many contractors sell a portion of their available supply from the canal to other agencies. Likewise, some contractors (e.g. Kern-Tulare Water District) purchase additional supplies from the canal from other contractors. Thus, while precipitation trends do effect the volume of water available to Friant-Kern Canal contractors (the precipitation amounts during the 10-yr period from 2007/08 to 2016/17 are below average), it is difficult to compare planned versus actual deliveries based on these data.

The primary surface water supply issue affecting the ability of agencies to operate within the Sustainable Yield of the subbasin is reduced delivery capacity in the Friant-Kern Canal due to land subsidence. Land subsidence has lowered the canal elevation in certain areas resulting in a reduction in downstream canal delivery capacity. Reduced deliveries due to land subsidence can result in greater groundwater pumping to meet agricultural water demand. While the reduced supply capacity of the Friant-Kern Canal is not the primary reason for the overdraft observed in the Tule Subbasin from 1986/87 to 2016/17, it is a contributing factor.

2.3.5. Projected Water Budget §354.18 (c)(3)

A projected water budget for the Tule Subbasin has been developed to incorporate the planned projects and management actions of each of the six GSAs for achieving sustainability (see Tables 2-6 and 2-7). The projects and management actions were incorporated into the groundwater flow model of the Tule Subbasin for the projected time period from 2020 to 2070 in order to assess the sustainability of the planned actions, assess the interaction of the planned actions on groundwater levels between the GSAs, and estimate the Sustainable Yield of the subbasin. The model projection also incorporated adjustments to the hydrology and water deliveries to account for potential climate change. The final projected water budget is the one that produced the 50th percentile Sustainable Yield estimate (see Section 2.3.2.7 herein). The projected surface water and groundwater budgets are shown in Tables 2-8a, 2-8b, and 2-9. Projected water budgets for each of the six GSAs are provided in Appendices A through F.

Baseline Tule River flows, Friant-Kern Canal deliveries, and the State Water Project's California Aqueduct deliveries used in the future projection for the model were adjusted to account for projections of future climate change. Adjustments were applied based on output from the DWR's CalSim-II model, which provided adjusted historical hydrology for major drainages and imported supplies based on scenarios recommended by the DWR Climate Change Technical Advisory Group.[1] Climate change adjustments to hydrology and surface water deliveries were applied over two time periods within the SGMA planning horizon, as defined by California Water Commission (2016)[2]:

1. A 2030 central tendency time period, which provides near-term projections of potential climate change impacts on hydrology, centered on the year 2030, and

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[1] DWR Climate Change Technical Advisory Group, 2015. Perspectives and Guidance for Climate Change Analysis. DWR Technical Information Record.

[2] California Water Commission, 2016. Technical Reference – Water Storage Investment Program. Dated November 2016.

2. A 2070 central tendency time period, which provides long-term projections of potential climate change impacts on hydrology, centered on the year 2070.

For imported water supplies from the Friant-Kern Canal, TH&Co utilized projected delivery schedules from the Friant Water Authority (Friant Water Authority, 2018). The projected water deliveries include adjustments to supplies associated with the planned San Joaquin River Restoration Project (SJRRP). Adjustments to Friant-Kern Canal supplies to account for climate change and SJRRP were applied beginning in 2025. The adjustments were applied incrementally between 2025 and 2030 such that the full adjustments were in effect in 2030. TH&Co applied the 2070 central tendency time period climate-related adjustments to imported water deliveries in the Tule Subbasin model projection for the period from 2050 to 2070.

2.4 Management Areas §354.20

> § 354.20. Management Areas
>
> (a) Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.

Of the six GSAs within the Tule Subbasin, five have identified separate management areas within their boundaries (see Figure 2-33). The management areas are as follows:

LTRID GSA

Agricultural Management Area
Municipal Management Area
Tulare County MOU Management Area

ETGSA

Porterville Community Management Area
Terra Bella Community Management Area
Ducor Community Management Area
Kern-Tulare Management Area
Greater Eastern Tule Management Area

DEID GSA

Delano-Earlimart Irrigation District Management Area
Western Management Area
Richgrove Community Services District Management Area

Earlimart Public Utilities District Management Area

Pixley GSA

Pixley Irrigation District Management Area
Pixley Public Utilities District Management Area
Teviston Management Area

Tri-County Water Authority GSA

North Management Area
Southeast Management Area

In addition to the management areas identified for each GSA, a separate ETGSA Land Subsidence Monitored Area (ETGSA Monitored Area) has been identified for the eastern portion of the subbasin in the vicinity of the Friant-Kern Canal (see Figure 2-36; TH&Co, 2021). This ETGSA Monitored Area was developed based on the extent of historical land subsidence observed along the Friant-Kern Canal, including model results of cumulative land subsidence calibrated to historical land subsidence rates measured from InSAR satellite data. The ETGSA Monitored Area covers most of the ETGSA. The basis for the eastern and northern boundaries of the ETGSA Monitored Area is the limit of land subsidence detected by the 2015 – 2018 InSAR land subsidence map. This area is considered recently active and prone to continued subsidence in the future. These boundaries are approximately two to three miles east of the communities of Ducor and Terra Bella and approximately one mile north of the Tule River at the FKC. The western and southern boundaries of the ETGSA Monitored Area are the western and southern boundaries of the ETGSA. Also, the southeast portion of the Pixley Irrigation District GSA is included in the monitored area based on an agreement with the Friant Water Authority and ETGSA.

It is also noted that a portion of the ETGSA Monitored Area has been set aside as the ETGSA Managed Area (see Figure 2-36) where more urgent management actions may be needed to meet the land subsidence management goals. The ETGSA Managed Area was identified based on InSAR satellite data and groundwater flow model analysis of land subsidence. The ETGSA Managed Area extends two miles on either side of the Friant-Kern Canal from the Tule River to the southern boundary of the ETGSA. Management actions within this area will be separate from, and may be different than, planned management actions published in the ETGSA GSP for the greater ETGSA.

2.4.1 Criteria for Management Areas §354.20 (b)(1)

§ 354.20. (b) A basin that includes one or more management areas shall describe the following in the Plan:

(1) The reason for the creation of each management area.

The majority of the management areas are associated with communities that provide municipal water supply. These communities have been delineated separately because the beneficial use of the groundwater produced within the management areas (municipal supply) is different than the beneficial use of groundwater across the majority of the subbasin (agriculture). Other management areas were identified for portions of the subbasin with unique hydrogeology and areas where access to imported water is different than other portions of the GSA in which they are located.

Management Areas categorized under the Community Management Area Type have been created to specifically address the needs of the Tule Subbasin's population centers and communities. Future projects and management actions focused in these areas will seek to achieve the Tule Subbasin sustainability goal and improve access to safe, reliable drinking water supplies. The boundaries for each Community Management Area consider existing County and/or City adopted Urban Development Boundaries, as well as the service area boundaries of the public water suppliers providing services to residents within these areas.

In addition to community management areas, LTRID GSA has delineated a management area, the Tulare County MOU Management Area, associated with lands outside and to the southwest of the LTRID service area that were annexed to the LTRID GSA (see Figure 2-33). This management area was formed because it does not have the same access to surface water deliveries as the LTRID service area and, therefore, will require separate management actions than the rest of the GSA.

ETGSA has delineated a separate management area for the Kern-Tulare Water District (Kern-Tulare Management Area). Wells from this area produce groundwater primarily from a deeper and separate aquifer system (i.e. Pliocene Marine and Santa Margarita Formation) than other parts of the ETGSA. Groundwater level conditions in wells in this area are different than other areas of the ETGSA. Additionally, the service area of Kern-Tulare Water District is divided between the Tule and Kern County Subbasins. Future projects and management actions in this Management Area will focus on enabling Kern-Tulare Water District to achieve the sustainability goals of both the Tule and Kern County Subbasins while minimizing the need to alter its operations. As such, Kern-Tulare Water District has developed their own monitoring plan for their service area.

DEID GSA has delineated a management area, the Western Management Area, associated with lands outside and to the west of the DEID service area. These lands were annexed to the DEID GSA. This Western Management Area was formed because it does not have the same access to surface water deliveries from the Friant-Kern Canal as the DEID service area and, therefore, will require separate management actions than the rest of the GSA.

TCWA GSA has delineated two separate management areas, the North and Southeast Management Areas. The North Management Area receives surface water and groundwater on the lands located within the Angiola Water District. It is noted that some areas within the North Management Area are outside the Angiola Water District but are included in the management area due to their proximity to Angiola Water District. The Southeast Management area is an undistracted area dependent on groundwater.

2.4.2 Minimum Thresholds and Measurable Objectives §354.20 (b)(2)

> § 354.20. (b) (2) The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.

2.4.2.1 Minimum Thresholds

Minimum thresholds and measurable objectives for each groundwater level and land subsidence representative monitoring site in each GSA are shown on the hydrographs and in the tables provided in Appendices A through F. The rational for determining the minimum thresholds and measurable objectives are not different by management area within a GSA.

2.4.3 Monitoring Plan §354.20 (b)(3)

> § 354.20. (b) (3) The level of monitoring and analysis appropriate for each management area.

The Tule Subbasin Technical Advisory Committee has developed a subbasin-wide monitoring plan, which describes the monitoring network and monitoring methodologies to be used to collect the data to be included in Tule Subbasin GSPs and annual reports. The subbasin-wide monitoring plan is included as Attachment 1 to the Coordination Agreement. Separate monitoring networks have been established for groundwater levels (see Figure 2-34), groundwater quality (see Figure 2-35), land subsidence (see Figure 2-36) and surface water (see Figure 2-7). For each monitoring network, the monitoring plan describes the monitoring features included in the plan, the monitoring procedure to be followed to collect the data, and the monitoring frequency. The monitoring plan also includes an assessment of data gaps and a data management plan.

A subset of groundwater level monitoring features in the monitoring plan have been identified as representative monitoring sites to be relied on for the purpose of assessing progress with respect to groundwater level sustainability in the subbasin. The representative groundwater level monitoring sites are shown on Figure 2-34. At least one representative groundwater level monitoring site has been identified within each management area. Where possible based on available wells, representative monitoring sites have been chosen with perforations exclusively in either the Upper or Lower Aquifer. To provide adequate spatial coverage of the subbasin, some representative monitoring sites include perforations across multiple aquifers until new monitoring features can be constructed. Representative groundwater level monitoring wells will be equipped with pressure transducers to measure groundwater levels on a daily basis.

A land surface elevation monitoring network has also been established and is shown on Figure 2-36. The monitoring network consists of 94 benchmarks installed in 2020 and 2021. Each benchmark is a representative monitoring site for land subsidence. The elevations of the benchmarks are surveyed annually..

2.4.4 Coordination with Adjacent Areas §354.20 (b)(4)

> § 354.20. (b) (4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.

The minimum thresholds described in each GSA's GSP have been informed through an analysis of potential future groundwater levels in the subbasin using a numerical groundwater flow model that incorporates future planned projects and management actions of each of the GSAs. The minimum thresholds have been developed such that maintenance of groundwater levels above those levels should preserve beneficial uses of the groundwater and prevent undesirable results with respect to groundwater levels, groundwater storage, and land subsidence within the management area, GSA and adjacent areas. Management of the Tule Subbasin is adaptive. As management actions and projects are implemented throughout the subbasin and as additional data are collected through the Tule Subbasin Monitoring Plan, minimum threshold values and measurable objectives may change. Changes to basin management to address undesirable results will be conducted through the Tule Subbasin TAC in accordance with the Tule Subbasin Coordination Agreement.

2.5 References

California Department of Water Resources, 2016. Final 2016 Bulletin 118 Groundwater Basin Boundaries shapefile. http://www.water.ca.gov/groundwater/sgm/basin_boundaries.cfm

California Energy Commission, 2006. PIER Project Report: Estimating Irrigation Water Use for California Agriculture: 1950s to Present. May 2006.

California Regional Water Quality Control Board, 2008. Order No. R5-2008-0034 Waste Discharge Requirements for City of Porterville Wastewater Treatment Facility Tulare County. Dated March 2008.

California State Water Resources Control Board, 2017. Resolution 2017-0048 Approving an Amendment to the Water Quality Control Plan for the Tulare Lake Basin to Remove the Municipal and Domestic Supply (MUN) and Agricultural Supply (AGR) Beneficial Uses from Groundwater within a Designated Horizontal and Vertical Portion of the Tulare Lake Bed. Adopted September 6, 2017.

City of Porterville, 2014. Draft Urban Water Management Plan. Dated August 2014.

Croft, M.G., 1972. Subsurface Geology of the Late Tertiary and Quaternary Water-Bearing Deposits of the Southern Part of the San Joaquin Valley, California. USGS Water-Supply Paper 1999-H.

Davis, G.H., Green, J.H, Olmsted, F.H., and Brown, D.W., 1959. Ground-Water Conditions and Storage Capacity of the San Joaquin Valley, California. USGS Water-Supply Paper 1469, 287 p.

Faunt, C.C., 2009. *Groundwater Availability of the Central Valley Aquifer, California*. USGS Professional Paper 1766.

Fetter, C. W., 1994. Applied Hydrogeology. 3rd Edition. Macmillan College Publishing, New York.

Friant Water Authority, 2018. Technical Memorandum: Estimate of Future Friant Division Supplies for Use in Groundwater Sustainability Plans.

Frink, J.W., and Kues, H.A., 1954. *Corcoran Clay – A Pleistocene Lacustrine Deposit in San Joaquin Valley, California*. American Association of Petroleum Geologists Bulletin Vol. 38, No. 11, pgs. 2357 – 2371.

Ireland, R.L., Poland, J.F., and Riley, F.S., 1984. Land Subsidence in the San Joaquin Valley, California, as of 1980. U.S. Geological Survey Professional Paper 437-I.

ITRC, 2003. California Crop and Soil Evapotranspiration for Water Balances and Irrigation Scheduling/Design. ITRC No. 03-001, dated January 2003.

Kern-Tulare Water District, 2018. 2018 Groundwater Monitoring Report.

Leenhouts, J.M., Stromberg, J.C., and Scott R.L., 2005. *Hydrologic Requirements of and Consumptive Ground-Water Use by Riparian Vegetation along the San Pedro River, Arizona*. USGS Scientific Investigations Report 2005-5163.

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

Luhdorff and Scalmanini, 2014. Land Subsidence from Groundwater Use in California. Prepared in Cooperation with the California Water Foundation.

Page, R.W., 1973. Base of Fresh Ground Water in the San Joaquin Valley, California. USGS Hydrologic Investigations Atlas HA-489.

Planert, M. and Williams, J.S., 1995. Ground Water Atlas of the United States, Segment 1 – California and Nevada. USGS Hydrologic Investigations Atlas 730-B.

Schmidt, K., 2009. *Groundwater Conditions within the City of Porterville Urban Area Boundary*. Prepared for the City of Porterville, dated October 2009.

Schmidt, K., 2011. Groundwater Conditions in the Angiola Area. Prepared for the Angiola Water District, dated July 2011.

Schmidt, K., 2018. Hydrogeologic Conceptual Model and Groundwater Conditions for the Tri-County WA GSP. Prepared for Tri-County Water Authority. Dated September 2018.

Theis, C.V., Brown, R.H., Myer, R.R., 1963. Estimating the Transmissivity of a Water-table Aquifer from the Specific Capacity of a Well. USGS Water Supply Paper 1536-1, p 331-336.

Thomas Harder & Co., 2017. Hydrogeological Conceptual Model and Water Budget of the Tule Subbasin. Prepared for the Tule Subbasin MOU Group.

Thomas Harder & Co., 2020. Groundwater Flow Model of the Tule Subbasin. Prepared for the Tule Subbasin MOU Group.

Thomas Harder & Co., 2021. Eastern Tule Groundwater Sustainability Agency, Land Subsidence Monitoring Plan. Prepared for the Eastern Tule Groundwater Sustainability Agency.

Tule Basin Water Quality Coalition, 2017. Groundwater Quality Trend Monitoring Work Plan. Dated January 6, 2017.

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

Williamson, A.K., Prudic, D.E., and Swain, L.A., 1989. Ground-Water Flow in the Central Valley, California. USGS Professional Paper 1401-D.

Tables

Table 2-1

Summary of Active Cleanup Sites Within the Tule Subbasin

Geotracker Global ID	Site Type	Status	Constituent of Concern
60001606	School	Active	Metals, Pesticides, Petroleum
54360008	State Response or NPL	Active	Freon 113, Lead, VOCs
54070051	State Response or NPL	Active	Herbicides, Pesticides, Lead, VOCs
60002076	State Response or NPL	Active	Cyanide, PAHS, SVOCs
54070296	Voluntary Cleanup	Active	Pesticides
60001216	Evaluation	Active	PCE
54070288	Evaluation	Inactive - Needs Evaluation	Zinc
54280106	Evaluation	Inactive - Needs Evaluation	Pesticides/Herbicides
T10000010424	Cleanup Program Site	Open - Active	NA
T0610740454	LUST Cleanup Site	Open - Assessment & Interim Remedial Action	Gasoline
T0610700023	Cleanup Program Site	Open - Assessment & Interim Remedial Action	Gasoline, Benzene
T0610700454	LUST Cleanup Site	Open - Eligible for Closure	Gasoline
T10000010850	LUST Cleanup Site	Open - Eligible for Closure	Gasoline, MTBE, TBA, other fuel oxygenates
T0610700430	LUST Cleanup Site	Open - Eligible for Closure	Gasoline
T0610700127	LUST Cleanup Site	Open - Eligible for Closure	Gasoline
SLT5FS354453	Cleanup Program Site	Open - Inactive	Nitrate, other Petroleum
SL375384617	Cleanup Program Site	Open - Remediation	Gasoline, Diesel, other Petroleum
SL205734285	Cleanup Program Site	Open - Remediation	VOCs
T0610700216	LUST Cleanup Site	Open - Remediation	Gasoline
T0610700256	LUST Cleanup Site	Open - Site Assessment	Kerosene
T0610700058	LUST Cleanup Site	Open - Site Assessment	Gasoline
SLT5FU104564	Cleanup Program Site	Open - Site Assessment	Pesticides/Herbicides
T0610793749	LUST Cleanup Site	Open - Site Assessment	Gasoline

Summary of Active Cleanup Sites Within the Tule Subbasin

Geotracker Global ID	Site Type	Status	Constituent of Concern
T0610700064	LUST Cleanup Site	Open - Site Assessment	Gasoline
T0610700099	LUST Cleanup Site	Open - Site Assessment	Gasoline
T0610700469	LUST Cleanup Site	Open - Verification Monitoring	Gasoline

Notes:

LUST = Leaky underground storage tank
NPL = National Priorities List
VOCs = Volatile Organic Compounds
PAHS = Polynuclear aromatic hydrocarbons
SVOCs = Semi-Volatile Organics
PCE = Perchloroethylene
MTBE = Methyl tert-butyl ether
TBA = Tertiary Butyl Alcohol
Source = https://geotracker.waterboards.ca.gov
NA = Not available

Table 2-2a

Tule Subbasin Historical Surface Water Budget

		Surface Water Inflow (acre-ft)																	
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
Water Year	Water Year Type	Precipitation	Stream Inflow			Imported Water											Discharge from Wells		Total In
			Tule River	Deer Creek	White River	Saucelito ID	Terra Bella ID	Kern-Tulare WD	Porterville ID	Tea Pot Dome WD	LTRID	Pixley ID	Delano-Earlimart ID	Angiola WD	Alpaugh ID	Atwell Island WD	Agriculture Pumping	Municipal Pumping	
1986 - 1987	Below Average	219,000	70,029	8,389	2,496	23,879	13,136	10,899	15,337	5,490	89,541	9,356	114,782	7,278	794	1,109	724,000	13,500	1,329,000
1987 - 1988	Average	315,000	39,842	6,095	1,420	19,666	21,961	12,210	13,067	5,493	64,654	0	110,345	3,530	0	0	768,000	15,100	1,396,000
1988 - 1989	Below Average	254,000	49,667	7,795	1,942	22,426	22,561	11,991	13,106	6,226	63,922	5,289	105,980	6,026	0	0	728,000	15,700	1,315,000
1989 - 1990	Below Average	245,000	29,342	4,706	778	16,166	23,159	11,371	11,520	6,193	24,325	0	83,837	3,847	0	0	838,000	16,300	1,315,000
1990 - 1991	Average	331,000	51,275	7,247	1,362	19,848	18,725	9,762	11,322	5,636	71,430	0	106,877	925	0	0	799,000	16,700	1,451,000
1991 - 1992	Below Average	285,000	34,325	4,080	739	21,336	20,743	11,700	15,569	6,607	51,949	0	92,567	1,611	0	0	817,000	17,000	1,380,000
1992 - 1993	Above Average	462,000	115,640	15,422	3,623	41,261	18,180	12,357	12,310	6,968	321,973	96,890	133,359	3,420	12,219	6,423	496,000	17,200	1,775,000
1993 - 1994	Below Average	293,000	61,313	6,908	1,148	22,064	18,740	14,255	12,895	6,526	71,784	7,793	92,394	3,640	3,605	2,000	791,000	17,600	1,427,000
1994 - 1995	Above Average	610,000	218,480	32,053	10,596	37,477	16,186	11,681	9,455	6,562	229,683	55,365	124,388	8,918	8,263	5,395	574,000	17,600	1,976,000
1995 - 1996	Average	321,000	174,473	23,095	5,957	48,924	21,617	15,415	13,808	7,993	236,845	60,931	144,069	12,551	11,130	5,267	508,000	17,800	1,629,000
1996 - 1997	Above Average	450,000	353,968	58,781	12,920	40,908	20,158	15,736	13,379	7,298	192,934	37,048	153,967	12,383	0	0	567,000	18,700	1,955,000
1997 - 1998	Above Average	728,000	439,125	88,360	36,764	28,221	13,165	11,745	10,159	4,913	101,180	41,823	119,815	7,460	0	0	630,000	17,900	2,279,000
1998 - 1999	Above Average	373,000	108,466	18,410	7,469	37,062	17,567	14,527	16,107	9,218	183,971	34,736	124,051	9,778	0	0	620,000	18,000	1,592,000
1999 - 2000	Average	354,000	102,354	15,230	4,878	39,734	19,200	16,476	15,545	7,191	177,192	40,076	134,272	8,118	0	253	651,000	18,900	1,604,000
2000 - 2001	Below Average	265,000	55,249	7,016	4,695	25,252	19,194	17,550	15,436	6,456	83,405	9,098	117,746	3,824	0	0	719,000	19,100	1,368,000
2001 - 2002	Below Average	252,000	73,206	10,370	6,176	26,131	20,234	15,088	13,628	6,388	78,511	13,588	126,747	2,932	0	0	713,000	20,900	1,379,000
2002 - 2003	Below Average	247,000	125,004	15,678	5,875	33,692	18,356	14,591	14,646	5,844	131,470	32,195	121,277	4,728	104	0	610,000	20,600	1,401,000
2003 - 2004	Below Average	207,000	51,738	6,882	2,350	26,988	20,352	15,755	14,698	6,913	71,472	9,839	127,364	3,434	0	0	656,000	21,700	1,242,000
2004 - 2005	Above Average	395,000	172,558	22,758	6,502	42,840	15,266	13,495	14,748	5,217	247,595	59,211	119,847	11,741	14,490	0	479,000	20,600	1,641,000
2005 - 2006	Above Average	401,000	195,667	23,868	7,588	45,106	21,763	14,507	13,251	6,436	194,019	60,634	121,005	10,909	16,112	0	490,000	21,600	1,643,000
2006 - 2007	Below Average	170,000	38,587	6,901	1,815	16,280	20,797	15,133	9,775	5,489	33,174	7,200	79,111	6,641	0	0	746,000	22,700	1,180,000
2007 - 2008	Below Average	189,000	74,030	8,411	2,355	24,083	18,192	17,689	12,988	6,894	71,872	12,243	106,470	2,165	0	0	637,000	23,000	1,206,000
2008 - 2009	Below Average	203,000	54,737	6,620	1,751	31,282	19,701	15,524	18,000	6,165	113,189	23,620	111,556	191	2,131	0	660,000	22,500	1,290,000
2009 - 2010	Average	325,000	144,778	16,470	5,080	42,855	17,574	14,027	14,335	5,845	200,064	32,972	118,671	3,243	2,671	0	483,000	21,800	1,448,000
2010 - 2011	Above Average	479,000	266,473	44,873	14,997	46,733	16,381	13,405	9,387	6,105	229,763	48,391	127,447	6,476	10,951	0	514,000	21,800	1,856,000
2011 - 2012	Below Average	302,000	87,533	11,311	3,334	19,189	19,757	14,309	9,318	4,680	67,684	5,914	114,108	3,156	943	0	730,000	22,500	1,416,000
2012 - 2013	Below Average	139,000	30,283	4,777	1,145	14,102	20,628	14,955	10,298	4,354	37,073	5,012	87,302	1,492	0	0	790,000	22,700	1,183,000
2013 - 2014	Below Average	99,000	13,171	2,957	535	5,724	12,390	9,986	178	1,030	0	0	38,106	1,048	0	0	900,000	21,900	1,106,000
2014 - 2015	Below Average	142,000	8,820	1,994	253	1,503	12,012	5,438	114	260	0	0	18,591	575	0	0	890,000	19,700	1,101,000
2015 - 2016	Below Average	217,000	74,330	14,559	4,547	20,049	14,357	11,805	13,271	4,627	73,382	3,442	93,806	587	0	0	614,000	19,700	1,179,000
2016 - 2017	Below Average	227,000	352,963	51,145	17,241	51,137	16,089	14,203	21,651	6,694	273,151	82,363	137,773	12,146	2,367	0	429,000	20,100	1,715,000
86/87-16/17 Avg		306,000	118,300	17,800	5,800	28,800	18,300	13,500	12,600	5,900	122,200	25,600	109,900	5,300	2,800	700	664,000	19,400	1,477,000

Table 2-2b

Tule Subbasin Historical Surface Water Budget

Water Year	Water Year Type	Surface Water Outflow (acre-ft)																		
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
		Areal Recharge of Precipitation	Streambed Infiltration					Canal Loss			Recharge in Basins				Deep Percolation of Applied Water					
			Tule River		Native Deer Creek		White River	Tule River	Deer Creek	Imported Water	Tule River	Deer Creek	Imported Water	Recycled Water	Tule River	Deer Creek	Imported Water	Recycled Water	Agricultural Pumping	Municipal Pumping
			Success to Oettle Bridge	Oettle Bridge to Turnbull Weir	Before Trenton Weir	Trenton Weir to Homeland Canal														
1986 - 1987	Below Average	0	11,600	1,100	8,100	0	2,400	20,700	0	52,500	5,400	0	0	2,600	8,500	0	56,100	200	169,900	5,200
1987 - 1988	Average	4,000	8,000	900	5,800	0	1,300	8,800	0	32,700	5,000	0	0	3,200	5,500	0	48,100	200	183,200	5,400
1988 - 1989	Below Average	0	8,700	0	7,500	0	1,800	7,400	0	20,500	6,200	0	0	3,400	6,100	0	51,800	200	172,100	5,600
1989 - 1990	Below Average	0	5,000	0	4,400	0	700	2,900	0	7,400	3,700	0	0	3,600	2,700	0	36,200	200	199,700	5,700
1990 - 1991	Average	7,000	6,400	300	6,900	0	1,300	6,800	0	24,300	5,200	0	0	3,700	5,900	0	46,900	200	190,300	5,800
1991 - 1992	Below Average	1,000	4,300	0	3,800	0	700	3,100	0	16,100	3,700	0	0	3,800	3,500	0	44,700	200	194,900	5,900
1992 - 1993	Above Average	57,000	18,500	3,000	15,100	0	3,500	27,800	0	184,400	8,200	0	5,600	3,900	16,800	0	118,000	200	111,300	6,000
1993 - 1994	Below Average	2,000	6,100	200	6,600	0	1,100	14,200	0	35,600	5,000	0	700	4,000	8,700	0	51,800	200	187,400	6,100
1994 - 1995	Above Average	144,000	36,400	10,400	21,200	1,000	10,500	39,500	3,800	128,500	7,800	1,800	10,400	3,900	34,600	1,000	88,900	200	130,900	6,100
1995 - 1996	Average	5,000	20,700	4,000	13,700	700	5,800	26,200	2,800	87,600	21,200	700	39,500	3,900	31,800	1,200	119,000	200	115,700	6,200
1996 - 1997	Above Average	50,000	34,600	9,700	45,100	1,800	12,800	47,300	6,900	64,200	25,300	1,900	14,100	4,300	31,400	700	117,300	200	130,700	6,300
1997 - 1998	Above Average	219,000	41,100	9,000	14,900	12,700	36,600	79,100	48,800	54,100	32,000	900	16,200	3,900	41,100	3,100	65,200	200	143,800	6,300
1998 - 1999	Above Average	18,000	14,300	2,800	13,300	600	7,300	19,500	2,500	58,200	17,600	400	19,800	3,900	14,100	300	88,700	200	143,200	6,400
1999 - 2000	Average	12,000	16,900	2,900	10,100	600	4,800	11,100	2,400	64,400	8,900	500	13,000	4,200	15,200	300	93,200	200	152,400	6,500
2000 - 2001	Below Average	0	12,300	0	6,700	0	4,600	7,000	0	28,500	5,000	0	2,700	4,300	7,800	0	61,700	200	169,600	6,600
2001 - 2002	Below Average	0	14,800	700	10,100	0	6,100	13,400	0	24,800	5,800	0	100	4,900	9,000	0	65,200	300	169,100	6,900
2002 - 2003	Below Average	0	19,700	3,700	13,600	100	5,800	22,800	400	53,600	12,200	300	5,000	4,800	11,500	200	65,700	200	123,200	6,900
2003 - 2004	Below Average	0	9,900	300	6,600	0	2,300	7,700	0	19,600	3,900	0	0	5,100	6,200	0	57,800	200	134,000	7,100
2004 - 2005	Above Average	26,000	24,200	4,700	14,400	400	6,400	22,900	1,500	91,200	19,000	2,900	32,000	2,400	15,300	700	89,700	500	92,600	7,100
2005 - 2006	Above Average	28,000	28,100	7,200	14,400	900	7,500	40,500	3,400	78,000	23,300	3,200	26,600	2,000	29,300	400	91,000	700	95,700	7,300
2006 - 2007	Below Average	0	6,200	1,500	6,600	0	1,700	5,100	0	15,500	4,300	0	100	2,000	4,800	0	36,000	700	151,600	7,500
2007 - 2008	Below Average	0	11,700	1,100	8,100	0	2,300	15,900	0	22,100	6,900	0	1,600	2,000	7,800	0	45,500	800	129,700	7,600
2008 - 2009	Below Average	0	9,500	1,400	6,300	0	1,600	7,100	0	43,800	5,200	0	8,100	2,000	7,600	0	57,400	700	135,300	7,600
2009 - 2010	Average	6,000	25,600	4,500	16,100	0	5,000	34,600	0	72,700	14,300	0	29,900	2,000	19,200	0	77,700	600	93,900	7,500
2010 - 2011	Above Average	65,000	37,100	7,500	24,400	1,300	14,800	82,400	5,000	89,500	39,000	9,700	45,700	2,000	30,300	1,400	84,700	600	101,900	7,600
2011 - 2012	Below Average	3,000	13,600	300	11,000	0	3,200	17,800	0	23,100	8,100	0	7,000	2,000	11,900	0	46,200	700	151,300	7,700
2012 - 2013	Below Average	0	4,900	0	4,500	0	1,000	4,400	0	13,000	5,300	0	100	2,000	3,400	0	35,000	700	165,100	7,800
2013 - 2014	Below Average	0	2,300	0	2,700	0	400	0	0	0	3,800	0	0	2,000	1,000	0	13,000	600	183,400	7,700
2014 - 2015	Below Average	0	1,000	0	1,800	0	200	0	0	0	3,600	0	0	2,000	1,100	0	5,600	500	178,800	7,500
2015 - 2016	Below Average	0	16,000	5,500	14,300	0	4,400	11,400	0	28,600	6,600	0	3,700	2,000	5,900	0	35,300	400	123,500	7,600
2016 - 2017	Below Average	0	42,100	15,900	37,000	800	17,100	82,600	3,100	133,700	37,300	3,700	61,000	2,000	41,400	1,400	99,000	500	83,300	7,700
86/87-16/17 Avg		21,000	16,500	3,200	12,100	700	5,600	22,300	2,600	50,600	11,600	800	11,100	3,200	14,200	300	64,300	400	145,400	6,700

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Table 2-2b

Tule Subbasin Surface Water Budget

Water Year	Water Year Type	Surface Water Outflow (acre-ft)													Total Out
		T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	
		Evapotranspiration											Surface Outflow		
		Precipitation Crops/Native	Tule River		Deer Creek		White River	Imported Water	Ag. Cons. Use from Pumping	Recycled Water		Municipal (Landscape ET)	Tule River	Deer Creek	
			Agricultural Cons. Use	Stream Channel	Agricultural Cons. Use	Stream Channel	Stream Channel	Agricultural Cons. Use		Recharge in Basins	Agricultural Cons. Use				
1986 - 1987	Below Average	219,000	24,700	800	0	300	100	183,000	553,900	50	700	4,800	0	0	1,332,000
1987 - 1988	Average	311,000	13,800	400	0	300	100	170,100	584,700	50	900	5,300	0	0	1,399,000
1988 - 1989	Below Average	254,000	17,600	400	0	300	100	185,200	556,200	50	1,000	5,500	0	0	1,312,000
1989 - 1990	Below Average	245,000	8,800	400	0	300	100	136,700	638,100	50	1,000	5,700	0	0	1,308,000
1990 - 1991	Average	324,000	16,800	500	0	300	100	173,300	608,700	50	1,000	5,900	0	0	1,442,000
1991 - 1992	Below Average	284,000	10,800	400	0	300	100	161,300	622,000	50	1,100	6,000	0	0	1,372,000
1992 - 1993	Above Average	406,000	34,900	800	0	400	100	357,500	385,000	50	1,100	6,100	0	0	1,771,000
1993 - 1994	Below Average	291,000	21,100	500	0	300	100	167,600	603,800	50	1,100	6,200	0	0	1,421,000
1994 - 1995	Above Average	466,000	71,600	900	2,900	400	100	285,600	442,700	50	1,100	6,200	25,000	0	1,983,000
1995 - 1996	Average	316,000	62,600	1,000	3,600	400	100	332,300	392,200	50	1,100	6,300	7,000	0	1,629,000
1996 - 1997	Above Average	399,000	57,100	1,000	2,000	400	100	298,200	436,100	50	1,200	6,600	121,000	0	1,927,000
1997 - 1998	Above Average	509,000	98,000	1,000	9,100	400	200	203,000	485,800	50	1,100	6,300	132,000	0	2,274,000
1998 - 1999	Above Average	354,000	37,700	1,000	1,000	400	200	280,600	477,200	50	1,100	6,300	0	0	1,591,000
1999 - 2000	Average	342,000	39,200	700	900	400	100	286,800	498,600	50	1,200	6,600	5,000	0	1,601,000
2000 - 2001	Below Average	264,000	21,900	700	0	300	100	205,000	548,900	50	1,200	6,700	0	0	1,366,000
2001 - 2002	Below Average	252,000	22,600	700	0	300	100	213,200	543,800	50	1,400	7,400	0	0	1,373,000
2002 - 2003	Below Average	247,000	37,500	700	700	400	100	252,500	487,300	50	1,400	7,300	5,000	0	1,390,000
2003 - 2004	Below Average	207,000	18,200	600	0	300	100	219,400	522,200	50	1,500	7,700	1,000	0	1,239,000
2004 - 2005	Above Average	369,000	43,800	800	2,500	400	100	322,200	386,800	50	3,300	7,300	22,000	0	1,612,000
2005 - 2006	Above Average	373,000	58,800	800	1,300	400	100	308,200	394,100	50	4,000	7,600	11,000	0	1,647,000
2006 - 2007	Below Average	170,000	14,200	400	0	300	100	142,000	594,200	50	4,400	8,000	0	0	1,177,000
2007 - 2008	Below Average	189,000	24,300	600	0	300	100	203,400	507,600	50	4,500	8,100	1,000	0	1,202,000
2008 - 2009	Below Average	203,000	22,300	500	0	300	100	233,000	524,600	50	4,200	7,900	0	0	1,290,000
2009 - 2010	Average	320,000	45,400	800	0	400	100	275,700	388,600	50	3,900	7,700	0	0	1,452,000
2010 - 2011	Above Average	414,000	65,300	800	4,700	400	200	295,900	412,300	50	3,800	7,700	8,000	0	1,863,000
2011 - 2012	Below Average	299,000	33,800	600	0	300	100	182,700	578,500	50	4,100	7,900	10,000	0	1,424,000
2012 - 2013	Below Average	139,000	10,300	500	0	300	100	147,100	625,000	50	4,200	8,000	0	0	1,182,000
2013 - 2014	Below Average	99,000	2,400	300	0	300	100	55,500	716,500	50	3,800	7,700	0	0	1,103,000
2014 - 2015	Below Average	142,000	2,300	300	0	200	100	32,900	711,500	50	2,700	7,000	0	0	1,101,000
2015 - 2016	Below Average	217,000	19,400	500	0	300	100	167,700	490,200	50	2,700	7,000	0	0	1,170,000
2016 - 2017	Below Average	227,000	67,100	900	4,800	400	200	323,800	345,900	50	2,800	7,100	71,000	0	1,721,000
86/87-16/17 Avg		286,000	33,000	700	1,100	300	100	219,400	518,200	50	2,200	6,800	14,000	0	1,474,000

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Table 2-3

Tule Subbasin Historical Groundwater Budget

		Groundwater Inflows (acre-ft)																						
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
			Tule River Infiltration					Deer Creek Infiltration						Imported Water Deliveries				Municipal Pumping						
																			Recycled Water					
Water Year	Water Year Type	Areal Recharge from Precipitation	Success to Oettle Bridge Infiltration	Oettle Bridge to Turnbull Weir Infiltration	Canal Loss	Recharge in Basins	Return Flow	Before Trenton Weir Infiltration	Trenton Weir to Homeland Canal Infiltration	Canal Loss	Recharge in Basins	Return Flow	White River Infiltration	Canal Loss	Recharge in Basins	Return Flow	Agricultural Pumping Return Flow	Return Flow	Agricultural Return Flow	Artificial Recharge	Release of Water from Compression of Aquitards	Sub-surface Inflow	Mountain-Block Recharge	Total In
1986 - 1987	Below Average	0	11,600	1,100	20,700	5,400	8,500	8,100	0	0	0	0	2,400	52,500	0	56,100	169,900	5,200	200	2,600	120,000	113,000	28,000	605,000
1987 - 1988	Average	4,000	8,000	900	8,800	5,000	5,500	5,800	0	0	0	0	1,300	32,700	0	48,100	183,200	5,400	200	3,200	88,000	131,000	29,000	560,000
1988 - 1989	Below Average	0	8,700	0	7,400	6,200	6,100	7,500	0	0	0	0	1,800	20,500	0	51,800	172,100	5,600	200	3,400	71,000	131,000	29,000	522,000
1989 - 1990	Below Average	0	5,000	0	2,900	3,700	2,700	4,400	0	0	0	0	700	7,400	0	36,200	199,700	5,700	200	3,600	132,000	133,000	29,000	566,000
1990 - 1991	Average	7,000	6,400	300	6,800	5,200	5,900	6,900	0	0	0	0	1,300	24,300	0	46,900	190,300	5,800	200	3,700	126,000	144,000	29,000	610,000
1991 - 1992	Below Average	1,000	4,300	0	3,100	3,700	3,500	3,800	0	0	0	0	700	16,100	0	44,700	194,900	5,900	200	3,800	143,000	140,000	30,000	599,000
1992 - 1993	Above Average	57,000	18,500	3,000	27,800	8,200	16,800	15,100	0	0	0	0	3,500	184,400	5,600	118,000	111,300	6,000	200	3,900	44,000	93,000	30,000	746,000
1993 - 1994	Below Average	2,000	6,100	200	14,200	5,000	8,700	6,600	0	0	0	0	1,100	35,600	700	51,800	187,400	6,100	200	4,000	85,000	123,000	30,000	568,000
1994 - 1995	Above Average	144,000	36,400	10,400	39,500	7,800	34,600	21,200	1,000	3,800	1,800	1,000	10,500	128,500	10,400	88,900	130,900	6,100	200	3,900	33,000	101,000	30,000	845,000
1995 - 1996	Average	5,000	20,700	4,000	26,200	21,200	31,800	13,700	700	2,800	700	1,200	5,800	87,600	39,500	119,000	115,700	6,200	200	3,900	19,000	95,000	27,000	647,000
1996 - 1997	Above Average	50,000	34,600	9,700	47,300	25,300	31,400	45,100	1,800	6,900	1,900	700	12,800	64,200	14,100	117,300	130,700	6,300	200	4,300	19,000	111,000	28,000	763,000
1997 - 1998	Above Average	219,000	41,100	9,000	79,100	32,000	41,100	14,900	12,700	48,800	900	3,100	36,600	54,100	16,200	65,200	143,800	6,300	200	3,900	17,000	126,000	30,000	1,001,000
1998 - 1999	Above Average	18,000	14,300	2,800	19,500	17,600	14,100	13,300	600	2,500	400	300	7,300	58,200	19,800	88,700	143,200	6,400	200	3,900	18,000	122,000	30,000	601,000
1999 - 2000	Average	12,000	16,900	2,900	11,100	8,900	15,200	10,100	600	2,400	500	300	4,800	64,400	13,000	93,200	152,400	6,500	200	4,200	20,000	131,000	30,000	601,000
2000 - 2001	Below Average	0	12,300	0	7,000	5,000	7,800	6,700	0	0	0	0	4,600	28,500	2,700	61,700	169,600	6,600	200	4,300	42,000	142,000	30,000	531,000
2001 - 2002	Below Average	0	14,800	700	13,400	5,800	9,000	10,100	0	0	0	0	6,100	24,800	100	65,200	169,100	6,900	300	4,900	59,000	135,000	30,000	555,000
2002 - 2003	Below Average	0	19,700	3,700	22,800	12,200	11,500	13,600	100	400	300	200	5,800	53,600	5,000	65,700	123,200	6,900	200	4,800	42,000	123,000	29,000	544,000
2003 - 2004	Below Average	0	9,900	300	7,700	3,900	6,200	6,600	0	0	0	0	2,300	19,600	0	57,800	134,000	7,100	200	5,100	70,000	127,000	29,000	487,000
2004 - 2005	Above Average	26,000	24,200	4,700	22,900	19,000	15,300	14,400	400	1,500	2,900	700	6,400	91,200	32,000	89,700	92,600	7,100	500	2,400	26,000	96,000	29,000	605,000
2005 - 2006	Above Average	28,000	28,100	7,200	40,500	23,300	29,300	14,400	900	3,400	3,200	400	7,500	78,000	26,600	91,000	95,700	7,300	700	2,000	16,000	97,000	29,000	630,000
2006 - 2007	Below Average	0	6,200	1,500	5,100	4,300	4,800	6,600	0	0	0	0	1,700	15,500	100	36,000	151,600	7,500	700	2,000	78,000	125,000	29,000	476,000
2007 - 2008	Below Average	0	11,700	1,100	15,900	6,900	7,800	8,100	0	0	0	0	2,300	22,100	1,600	45,500	129,700	7,600	800	2,000	96,000	113,000	30,000	502,000
2008 - 2009	Below Average	0	9,500	1,400	7,100	5,200	7,600	6,300	0	0	0	0	1,600	43,800	8,100	57,400	135,300	7,600	700	2,000	125,000	108,000	30,000	557,000
2009 - 2010	Average	6,000	25,600	4,500	34,600	14,300	19,200	16,100	0	0	0	0	5,000	72,700	29,900	77,700	93,900	7,500	600	2,000	70,000	83,000	29,000	592,000
2010 - 2011	Above Average	65,000	37,100	7,500	82,400	39,000	30,300	24,400	1,300	5,000	9,700	1,400	14,800	89,500	45,700	84,700	101,900	7,600	600	2,000	34,000	93,000	29,000	806,000
2011 - 2012	Below Average	3,000	13,600	300	17,800	8,100	11,900	11,000	0	0	0	0	3,200	23,100	7,000	46,200	151,300	7,700	700	2,000	86,000	123,000	29,000	545,000
2012 - 2013	Below Average	0	4,900	0	4,400	5,300	3,400	4,500	0	0	0	0	1,000	13,000	100	35,000	165,100	7,800	700	2,000	145,000	130,000	29,000	551,000
2013 - 2014	Below Average	0	2,300	0	0	3,800	1,000	2,700	0	0	0	0	400	0	0	13,000	183,400	7,700	600	2,000	186,000	132,000	30,000	565,000
2014 - 2015	Below Average	0	1,000	0	0	3,600	1,100	1,800	0	0	0	0	200	0	0	5,600	178,800	7,500	500	2,000	189,000	124,000	30,000	545,000
2015 - 2016	Below Average	0	16,000	5,500	11,400	6,600	5,900	14,300	0	0	0	0	4,400	28,600	3,700	35,300	123,500	7,600	400	2,000	140,000	112,000	30,000	547,000
2016 - 2017	Below Average	0	42,100	15,900	82,600	37,300	41,400	37,000	800	3,100	3,700	1,400	17,100	133,700	61,000	99,000	83,300	7,700	500	2,000	61,000	95,000	29,000	855,000
86/87-16/17 Avg		21,000	16,500	3,200	22,300	11,600	14,200	12,100	700	2,600	800	300	5,600	50,600	11,100	64,300	145,400	6,700	400	3,200	77,000	118,000	29,000	617,000

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Tule Subbasin Groundwater Budget

		Groundwater Outflows (acre-ft)						
		W	X	Y	Z	AA		
		Groundwater Pumping						
Water Year	Water Year Type	Municipal	Irrigated Agriculture	Exports	Groundwater Banking Extraction	Sub-surface Outflow	Total Out	Change in Storage (acre-ft)
1986 - 1987	Below Average	13,500	724,000	6,550	0	61,000	805,000	-200,000
1987 - 1988	Average	15,100	768,000	34,180	0	53,000	870,000	-310,000
1988 - 1989	Below Average	15,700	728,000	38,290	0	51,000	833,000	-311,000
1989 - 1990	Below Average	16,300	838,000	50,430	0	53,000	958,000	-392,000
1990 - 1991	Average	16,700	799,000	46,300	0	61,000	923,000	-313,000
1991 - 1992	Below Average	17,000	817,000	41,250	0	52,000	927,000	-328,000
1992 - 1993	Above Average	17,200	496,000	14,550	0	73,000	601,000	145,000
1993 - 1994	Below Average	17,600	791,000	11,220	0	59,000	879,000	-311,000
1994 - 1995	Above Average	17,600	574,000	1,320	0	61,000	654,000	191,000
1995 - 1996	Average	17,800	508,000	0	0	65,000	591,000	56,000
1996 - 1997	Above Average	18,700	567,000	0	0	65,000	651,000	112,000
1997 - 1998	Above Average	17,900	630,000	0	0	62,000	710,000	291,000
1998 - 1999	Above Average	18,000	620,000	0	0	62,000	700,000	-99,000
1999 - 2000	Average	18,900	651,000	7,720	0	60,000	738,000	-137,000
2000 - 2001	Below Average	19,100	719,000	30,600	0	60,000	829,000	-298,000
2001 - 2002	Below Average	20,900	713,000	44,520	0	58,000	836,000	-281,000
2002 - 2003	Below Average	20,600	610,000	33,660	0	55,000	719,000	-175,000
2003 - 2004	Below Average	21,700	656,000	37,790	0	55,000	770,000	-283,000
2004 - 2005	Above Average	20,600	479,000	11,720	0	66,000	577,000	28,000
2005 - 2006	Above Average	21,600	490,000	150	0	64,000	576,000	54,000
2006 - 2007	Below Average	22,700	746,000	49,500	0	54,000	872,000	-396,000
2007 - 2008	Below Average	23,000	637,000	50,090	0	68,000	778,000	-276,000
2008 - 2009	Below Average	22,500	660,000	48,860	550	78,000	810,000	-253,000
2009 - 2010	Average	21,800	483,000	28,530	70	92,000	625,000	-33,000
2010 - 2011	Above Average	21,800	514,000	8,060	0	86,000	630,000	176,000
2011 - 2012	Below Average	22,500	730,000	43,570	3,860	76,000	876,000	-331,000
2012 - 2013	Below Average	22,700	790,000	63,640	5,990	68,000	950,000	-399,000
2013 - 2014	Below Average	21,900	900,000	58,030	5,590	69,000	1,055,000	-490,000
2014 - 2015	Below Average	19,700	890,000	53,270	1,150	64,000	1,028,000	-483,000
2015 - 2016	Below Average	19,700	614,000	50,000	70	70,000	754,000	-207,000
2016 - 2017	Below Average	20,100	429,000	11,330	0	90,000	550,000	305,000
		19,400	664,000	28,200	600	65,000	777,000	-160,000

Cummulative Change in Storage -4,948,000

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Projected Future Tule Subbasin Sustainable Yield

	Groundwater Inflows (acre-ft)										Groundwater Outflow (acre-ft)	
	A	B	C	D	E	F	G	H	I	J	K	
Water Year	Areal Recharge from Precipitation	Streambed Infiltration					Return Flow		Sub-surface Inflow	Mountain-Block Recharge	Sub-surface Outflow	Sustainable Yield
		Tule River		Deer Creek		White River	Irrigated Agriculture	Municipal				
		Success to Oettle Bridge	Oettle Bridge to Turnbull Weir	Before Trenton Weir Infiltration	Trenton Weir to Homeland Canal Infiltration							
2040 - 2041	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	51,000	32,000	90,000	127,700
2041 - 2042	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	52,000	32,000	90,000	128,700
2042 - 2043	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	52,000	32,000	90,000	128,700
2043 - 2044	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	52,000	32,000	90,000	128,700
2044 - 2045	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	52,000	32,000	90,000	128,700
2045 - 2046	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	53,000	32,000	89,000	130,700
2046 - 2047	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	53,000	32,000	89,000	130,700
2047 - 2048	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	53,000	32,000	89,000	130,700
2048 - 2049	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	53,000	32,000	89,000	130,700
2049 - 2050	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	53,000	32,000	88,000	131,700
40/41-49/50 Avg	21,000	17,900	3,900	11,600	600	6,200	64,100	9,400	52,000	32,000	89,000	129,700

Table 2-5

Historical Planned versus Actual Water Deliveries
2007/08 - 2016/17

Water Year	Water Year Type	Tule River			Friant-Kern Canal								
					Saucelito ID			Terra Bella ID			Kern-Tulare WD		
		Total Diversion Right	Total Delivered	Percent of Diversion Right (%)	Contract Amount[1]	Total Delivered[2]	Percent of Contract (%)	Contract Amount[1]	Total Delivered[2]	Percent of Contract (%)	Contract Amount[1]	Total Delivered[2]	Percent of Contract (%)
2007 - 2008	Below Average	57,100	41,974	74%	54,300	24,083	44%	29,000	18,192	63%	5,000	17,689	354%
2008 - 2009	Below Average	57,100	32,290	57%	54,300	31,282	58%	29,000	19,701	68%	5,000	15,524	310%
2009 - 2010	Average	57,100	60,570	106%	54,300	42,855	79%	29,000	17,574	61%	5,000	14,027	281%
2010 - 2011	Above Average	57,100	106,619	187%	54,300	46,733	86%	29,000	16,381	56%	5,000	13,405	268%
2011 - 2012	Below Average	57,100	66,992	117%	54,300	19,189	35%	29,000	19,757	68%	5,000	14,309	286%
2012 - 2013	Below Average	57,100	23,406	41%	54,300	14,102	26%	29,000	20,628	71%	5,000	14,955	299%
2013 - 2014	Below Average	57,100	9,747	17%	54,300	5,724	11%	29,000	12,390	43%	5,000	9,986	200%
2014 - 2015	Below Average	57,100	6,417	11%	54,300	1,503	3%	29,000	12,012	41%	5,000	5,438	109%
2015 - 2016	Below Average	57,100	36,752	64%	54,300	20,049	37%	29,000	14,357	50%	5,000	11,805	236%
2016 - 2017	Below Average	57,100	128,361	225%	54,300	51,137	94%	29,000	16,089	55%	5,000	14,203	284%
	Total:	571,000	513,128	90%	543,000	256,657	47%	290,000	167,081	58%	50,000	131,341	263%

Water Year	Water Year Type	Friant-Kern Canal											
		LTRID			Delano-Earlimart ID			Porterville ID			Tea Pot Dome WD		
		Contract Amount[1]	Total Delivered[2]	Percent of Contract (%)	Contract Amount[1]	Total Delivered[2]	Percent of Contract (%)	Contract Amount[1]	Total Delivered[2]	Percent of Contract (%)	Contract Amount[1]	Total Delivered[2]	Percent of Contract (%)
2007 - 2008	Below Average	299,200	71,872	24%	183,300	106,470	58%	45,000	12,988	29%	7,200	6,894	96%
2008 - 2009	Below Average	299,200	113,189	38%	183,300	111,556	61%	45,000	18,000	40%	7,200	6,165	86%
2009 - 2010	Average	299,200	200,064	67%	183,300	118,671	65%	45,000	14,335	32%	7,200	5,845	81%
2010 - 2011	Above Average	299,200	229,763	77%	183,300	127,447	70%	45,000	9,387	21%	7,200	6,105	85%
2011 - 2012	Below Average	299,200	67,684	23%	183,300	114,108	62%	45,000	9,318	21%	7,200	4,680	65%
2012 - 2013	Below Average	299,200	37,073	12%	183,300	87,302	48%	45,000	10,298	23%	7,200	4,354	60%
2013 - 2014	Below Average	299,200	0	0%	183,300	38,106	21%	45,000	178	0%	7,200	1,030	14%
2014 - 2015	Below Average	299,200	0	0%	183,300	18,591	10%	45,000	114	0%	7,200	260	4%
2015 - 2016	Below Average	299,200	73,382	25%	183,300	93,806	51%	45,000	13,271	29%	7,200	4,627	64%
2016 - 2017	Below Average	299,200	273,151	91%	183,300	137,773	75%	45,000	21,651	48%	7,200	6,694	93%
	Total:	2,992,000	1,066,178	36%	1,833,000	953,830	52%	450,000	109,540	24%	72,000	46,654	65%

Notes:
[1] Sum of Class 1 and Class 2 Fraint-Kern Canal Contract Amount
[2] Total delivered water may include 16B water and water purchased from other Friant-Kern Canal contractors.
Likewise, delivered water may not reflect available supplies as contractors periodically sell water under their contract.

Summary of Projects Exclusive of Transitional Pumping

Eastern Tule GSA

No.	Lead Entity	Project Name	Description	Timeframe	Annual Volume	Water Source	Confidence
1	City of Porterville	Population Increase	Increase GW Production	2.5%/yr 2020-2040	9,500 af/yr by 2040	N/A	High
2	City of Porterville	Recycling Increase	Increase RW Applied to Ag	2.5%/yr 2020-2040	1,900 af/yr by 2040	Recycled Water	High
3	City of Porterville	Recycling Increase	Increase RW Recharge	2.5%/yr 2020-2040	1,600 af/yr by 2040	Recycled Water	High
4	City of Porterville	Tule River Recharge	Recharge Project	Starting 2019/20	900 af/yr	Tule River	High
5	City of Porterville	FKC Recharge	Recharge Project	Starting 2020/21	1,100 af/yr	FKC via Porterville ID	High
6	Porterville ID	SA 1 & 2	Expand distribution system	Starting 2018/19	3,200 af/yr	Tule River and FKC	High
7	Porterville ID	Falconer Bank	Develop water bank	Starting 2020/21	3,300 af/yr of leave-behind	FKC and others	High
8	Porterville ID	Recharge Policy	On-Farm recharge	Starting 2019/20	3,000 af/yr	Tule River and FKC	High
9	Saucelito ID	Conway Bank	Develop water bank	Starting 2020/21	1,100 af/yr of leave-behind	FKC and others	High
10	Saucelito ID	Recharge Policy	On-Farm recharge	Starting 2019/20	2,000 af/yr	FKC	High
11	Kern-Tulare WD	In-District Pricing	Pricing change	Starting 2020/21	2,600 af/yr	N/A	High
12	Kern-Tulare WD	Reservoir Storage	Surface water storage	Starting 2029/30	500 af/yr	FKC and others	Medium
13	Kern-Tulare WD	CRC Pipeline	Deliver produced water	Starting 2024/25	680 af/yr	CRC Produced water	High
14	Terra Bella ID	Deer Creek Recharge	Divert and recharge DC	Starting 2017/18	800 af/yr	Deer Creek	High
15	PWC, VWD, & CMDC	SREP	Success Dam Enlargement	Starting 2024/25	400 af/yr	Tule River	High
16	Hope WD	In-District Recharge	Recharge Project	Starting 2022/23	5,000 af/yr every 3 years	FKC and others / unknown	Medium
17	Ducor ID	In-District Recharge	Pipeline and Recharge Project	Starting 2023/24	4,000 af/yr	FKC and others / unknown	High

LTRID GSA

No.	Project Name	Description	Timeframe	Annual Volume	Water Source	Confidence
1	Creighton Ranch	Groundwater exports	Unknown	Unknown	Not applicable	N/A
2	LTRID - Pixley ID FKC	Continue FKC transfers to Pixley ID	Ongoing	13,670 af/yr	FKC	N/A
3	SREP	Success Dam Enlargement	Starting 2024/25	2,600 af/yr	Tule River	N/A

Pixley GSA

No.	Project Name	Description	Timeframe	Annual Volume	Water Source	Confidence
1	LTRID - Pixley ID FKC	Continue FKC transfers from LTRID	Ongoing	13,670 af/yr	FKC	N/A

DEID GSA

No.	Project Name	Description	Timeframe	Annual Volume	Water Source	Confidence
N/A	No planned projects	N/A	N/A	N/A	N/A	N/A

Tri-County GSA

No.	Project Name	Description	Timeframe	Annual Volume	Water Source	Confidence
1	Deep Pumping Reduction	Replace deep pumping with 24 new shallow wells	Start in 2019/20, completed in 2023/24	24,000 af/yr	Not applicable	High
2	Duck Club Project	Duck Club water transferred to farms	2019/20	5,400 af every 7 years	Unknown	High
3	Liberty Project	Participation in the Liberty Project surface water storage	Start in 2019/20, completed in 2022/23	5,000 af/yr	FID, FKC, KR, TR, KW, SWP	High
4	Recharge Scenario	Confidential. Capture and recharge flood water	Unknown	1,200 to 1,800 af/yr	Unknown	N/A

Alpaugh GSA

No.	Project Name	Description	Timeframe	Annual Volume	Water Source	Confidence
1	Water Capture	Deer Creek flood capture	Starting in 2022/23	1,100 af 2.5x per yr every 2 yrs	Deer Creek	N/A
2	Cropping Changes	Install drip irrigation on 1,900 acres	Starting 2019/20	Not applicable	Not applicable	N/A

Summary of Projects Exclusive of Transitional Pumping

Notes:

N/A= Not Available
af/yr = acre-foot per year
ID = Irrigation District
GW = Groundwater
RW = Recycled water
Ag = Agricultural
DC = Deer Creek
FKC = Friant-Kern Canal
SA = Service Area
CRC = California Resources Corporation
PWC = Pioneer Water Company
VMD = Vandalia Water District
CMDC = Campbell Moreland Ditch Company
SREP = Success Reservoir Enlargement Project
WD = Water District
MA = Management Area
FID = Fresno Irrigation District (Fresno Slough)
KR = Kaweah River
TR = Tule River
KW = Kaweah River
SWP = State Water Project

Table 2-7

Planned Transitional Pumping by GSA

	Eastern Tule GSA	LTRID GSA	Pixley ID GSA	DEID-District Area	DEID White Lands Area	Tri-Co GSA	Alpaugh GSA
2020-2025	90% of over-pumping[1]	2.0 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining no change	No Change/ Sustainable	100% of over-pumping	100% of over-pumping	Reduce cropped area by 880 acres; 80% of overpumping
2025-2030	80% of over-pumping	1.5 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining 1.5 af/ac Over Cons. Use Target[2]		Linear Transitional Pumping	Reduce pumping 10,000 af/yr	
2030-2035	30% of over-pumping	1.0 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining 1.0 af/ac Over Cons. Use Target				50% of overpumping
2035-2040	Sustainable	0.5 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining 0.5 af/ac Over Cons. Use Target		Sustainable	Sustainable	20% of overpumping
2040+		Sustainable	Sustainable				Sustainable

Notes:

[1] Over-pumping means pumping in excess of the consumptive use target

[2] Over consumptive use target means over pumping

Table 2-8a

Projected Future Tule Subbasin Surface Water Budget

Water Year	Surface Water Inflow (acre-ft)																					Total In
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	
	Precipitation	Stream Inflow			Imported Water															Discharge from Wells		
		Tule River	Deer Creek	White River	Saucelito ID	Terra Bella ID	Kern-Tulare WD	Porterville ID	Tea Pot Dome WD	City of Porterville	Hope WD	Ducor ID	LTRID	Pixley ID	Delano-Earlimart ID	Angiola WD	Alpaugh ID	Atwell Island WD	Private	Agriculture Pumping	Municipal Pumping	
2017 - 2018	306,000	131,258	19,410	6,347	34,567	18,786	15,335	19,803	6,528	0	0	0	143,186	31,763	116,902	5,911	3,680	0	0	549,000	21,700	1,430,000
2018 - 2019	306,000	131,258	19,410	6,347	34,567	18,786	15,335	19,803	6,528	0	0	0	143,186	31,763	116,902	5,911	3,680	0	0	548,000	23,400	1,431,000
2019 - 2020	306,000	131,258	19,410	6,347	34,567	18,786	15,335	23,103	6,528	0	0	0	143,186	31,763	116,902	7,961	3,680	0	0	529,000	25,000	1,419,000
2020 - 2021	306,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	0	0	143,186	31,763	116,902	9,211	3,680	0	0	526,000	25,400	1,422,000
2021 - 2022	306,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	0	0	143,186	31,763	116,902	10,461	3,680	0	0	524,000	25,700	1,422,000
2022 - 2023	306,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	1,667	0	143,186	31,763	116,902	13,590	3,680	0	0	523,000	26,100	1,426,000
2023 - 2024	306,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	1,667	4,000	143,186	31,763	116,902	18,926	3,680	0	0	522,000	26,500	1,435,000
2024 - 2025	306,000	134,258	19,410	6,347	34,893	20,304	18,229	24,339	6,594	1,100	1,667	4,000	135,513	31,763	117,661	24,261	3,680	0	1,500	494,000	26,900	1,412,000
2025 - 2026	306,000	134,258	19,410	6,347	34,118	21,823	17,843	25,575	6,661	1,100	1,667	4,000	127,841	31,763	118,420	29,597	4,813	0	1,500	487,000	27,400	1,407,000
2026 - 2027	306,000	134,258	19,410	6,347	33,343	23,341	17,458	26,812	6,727	1,100	1,667	4,000	120,168	31,763	119,180	34,933	4,751	0	1,500	481,000	27,800	1,402,000
2027 - 2028	306,000	134,258	19,410	6,347	32,568	24,860	17,072	28,048	6,793	1,100	1,667	4,000	112,496	31,763	119,939	40,268	4,689	0	1,500	474,000	28,200	1,395,000
2028 - 2029	306,000	134,258	19,410	6,347	31,794	26,378	16,687	29,285	6,860	1,100	1,667	4,000	104,823	31,763	120,698	43,725	4,627	0	1,500	468,000	28,700	1,388,000
2029 - 2030	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	4,565	0	1,500	412,000	29,200	1,328,000
2030 - 2031	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	5,737	0	1,500	413,000	29,600	1,331,000
2031 - 2032	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	5,737	0	1,500	410,000	30,100	1,328,000
2032 - 2033	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	5,737	0	1,500	407,000	30,600	1,326,000
2033 - 2034	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	5,737	0	1,500	405,000	31,100	1,324,000
2034 - 2035	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	5,737	0	1,500	345,000	31,700	1,265,000
2035 - 2036	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	6,970	0	1,500	344,000	32,200	1,266,000
2036 - 2037	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	6,970	0	1,500	344,000	32,800	1,266,000
2037 - 2038	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	6,970	0	1,500	344,000	33,300	1,267,000
2038 - 2039	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	6,970	0	1,500	344,000	33,900	1,267,000
2039 - 2040	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	6,970	0	1,500	303,000	34,500	1,227,000
2040 - 2041	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2041 - 2042	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2042 - 2043	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2043 - 2044	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2044 - 2045	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2045 - 2046	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2046 - 2047	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2047 - 2048	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2048 - 2049	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2049 - 2050	306,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,151	31,763	121,457	43,430	7,793	0	1,500	302,000	34,500	1,227,000
2050 - 2051	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2051 - 2052	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2052 - 2053	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2053 - 2054	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2054 - 2055	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2055 - 2056	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2056 - 2057	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2057 - 2058	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2058 - 2059	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2059 - 2060	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2060 - 2061	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2061 - 2062	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2062 - 2063	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2063 - 2064	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2064 - 2065	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2065 - 2066	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2066 - 2067	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2067 - 2068	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	43,209	7,793	0	1,500	297,000	34,500	1,189,000
2068 - 2069	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	45,214	7,793	0	1,500	297,000	34,500	1,191,000
2069 - 2070	306,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	84,084	31,763	112,046	24,476	7,793	0	1,500	297,000	34,500	1,170,000
17/18-69/70 Avg	306,000	132,500	19,200	6,300	31,200	25,700	17,800	28,300	6,700	1,000	1,500	3,500	100,500	31,800	117,100	37,800	6,600	0	1,300	361,000	32,000	1,268,000

Projected Future Tule Subbasin Surface Water Budget

Water Year	Surface Water Outflow (acre-ft)																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
		Streambed Infiltration					Canal Loss			Recharge in Basins				Deep Percolation of Applied Water					
		Tule River		Native Deer Creek															
	Areal Recharge of Precipitation	Success to Oettle Bridge	Oettle Bridge to Turnbull Weir	Before Trenton Weir	Trenton Weir to Homeland Canal	White River	Tule River	Deer Creek	Imported Water	Tule River	Deer Creek	Imported Water	Recycled Water	Tule River	Deer Creek	Imported Water	Recycled Water	Agricultural Pumping	Municipal Pumping
2017 - 2018	21,000	17,900	3,900	11,600	600	6,200	17,000	2,100	65,200	12,200	1,300	15,900	2,000	15,500	800	66,900	600	110,400	7,900
2018 - 2019	21,000	17,900	3,900	11,600	600	6,200	17,000	2,100	65,200	12,200	1,300	15,900	2,000	15,500	800	66,900	700	110,300	8,100
2019 - 2020	21,000	17,900	3,900	11,600	600	6,200	17,000	2,100	65,200	13,100	1,300	19,200	2,500	15,500	800	68,100	400	106,600	8,300
2020 - 2021	21,000	17,900	3,900	11,600	600	6,200	17,000	2,100	65,200	13,100	1,300	21,400	2,600	15,500	800	68,700	400	106,000	8,300
2021 - 2022	21,000	17,900	3,900	11,600	600	6,200	17,000	2,100	65,200	13,100	1,300	21,400	2,600	15,500	800	68,900	400	105,700	8,400
2022 - 2023	21,000	17,900	3,900	11,600	600	6,200	17,000	2,100	65,200	13,100	1,300	23,000	2,700	15,500	800	69,100	500	105,400	8,400
2023 - 2024	21,000	17,900	3,900	11,600	600	6,200	17,000	2,100	65,200	13,100	1,300	27,000	2,800	15,500	800	69,100	500	105,300	8,500
2024 - 2025	21,000	17,900	3,900	11,600	600	6,200	18,200	2,100	62,400	13,700	1,300	27,900	2,800	15,800	800	69,600	500	100,200	8,500
2025 - 2026	21,000	17,900	3,900	11,600	600	6,200	18,400	2,100	59,600	13,700	1,300	27,300	2,900	15,800	1,100	70,200	500	98,900	8,600
2026 - 2027	21,000	17,900	3,900	11,600	600	6,200	18,700	2,100	56,800	13,700	1,300	26,700	3,000	15,800	1,100	70,500	500	98,000	8,600
2027 - 2028	21,000	17,900	3,900	11,600	600	6,200	19,000	2,100	53,900	13,700	1,300	26,100	3,100	15,800	1,100	70,900	500	97,000	8,700
2028 - 2029	21,000	17,900	3,900	11,600	600	6,200	19,300	2,100	51,100	13,700	1,300	25,500	3,100	15,800	1,100	71,300	500	96,000	8,700
2029 - 2030	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,200	15,500	1,100	71,800	500	86,900	8,800
2030 - 2031	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,300	15,500	1,100	72,100	600	86,900	8,800
2031 - 2032	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,400	15,500	1,100	72,100	600	86,400	8,900
2032 - 2033	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,500	15,500	1,100	72,100	600	85,900	8,900
2033 - 2034	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,500	15,500	1,100	72,100	600	85,400	9,000
2034 - 2035	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,600	15,500	1,100	72,100	600	74,000	9,100
2035 - 2036	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,700	15,500	1,100	72,400	600	73,700	9,100
2036 - 2037	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,800	15,500	1,100	72,400	700	73,700	9,200
2037 - 2038	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	3,900	15,500	1,100	72,400	700	73,700	9,300
2038 - 2039	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,000	15,500	1,100	72,400	700	73,700	9,300
2039 - 2040	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,400	700	64,300	9,400
2040 - 2041	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2041 - 2042	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2042 - 2043	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2043 - 2044	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2044 - 2045	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2045 - 2046	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2046 - 2047	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2047 - 2048	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2048 - 2049	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2049 - 2050	21,000	17,900	3,900	11,600	600	6,200	19,400	2,100	48,300	13,600	1,300	24,900	4,100	15,500	1,100	72,600	700	64,100	9,400
2050 - 2051	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2051 - 2052	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2052 - 2053	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2053 - 2054	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2054 - 2055	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2055 - 2056	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2056 - 2057	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2057 - 2058	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2058 - 2059	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2059 - 2060	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2060 - 2061	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2061 - 2062	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2062 - 2063	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2063 - 2064	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2064 - 2065	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2065 - 2066	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2066 - 2067	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2067 - 2068	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2068 - 2069	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
2069 - 2070	21,000	17,400	3,800	11,300	500	6,000	19,300	2,100	43,500	12,900	1,300	23,800	4,100	15,400	1,100	68,400	700	62,400	9,400
17/18-69/70 Avg	21,000	17,700	3,900	11,500	600	6,100	19,000	2,100	49,500	13,200	1,300	24,100	3,700	15,500	1,100	70,200	600	75,300	9,100

Projected Future Tule Subbasin Surface Water Budget

Water Year	Surface Water Outflow (acre-ft)													Total Out
	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	
	Evapotranspiration											Surface Outflow		
	Precipitation Crops/Native	Tule River		Deer Creek		White River	Imported Water	Ag. Cons. Use from Pumping	Recycled Water		Municipal (Landscape ET)	Tule River	Deer Creek	
		Agricultural Cons. Use	Stream Channel	Agricultural Cons. Use	Stream Channel	Stream Channel	Agricultural Cons. Use		Recharge in Basins	Agricultural Cons. Use				
2017 - 2018	285,000	47,400	700	2,900	300	100	250,700	438,600	50	3,500	7,700	15,000	0	1,431,000
2018 - 2019	285,000	47,400	700	2,900	300	100	250,700	437,800	50	4,300	8,200	8,000	0	1,425,000
2019 - 2020	285,000	47,400	700	2,900	300	100	254,400	420,400	50	2,600	11,200	8,000	0	1,414,000
2020 - 2021	285,000	47,400	700	2,900	300	100	257,400	417,300	50	2,600	11,400	8,000	0	1,417,000
2021 - 2022	285,000	47,400	700	2,900	300	100	258,200	416,100	50	2,700	11,600	8,000	0	1,417,000
2022 - 2023	285,000	47,400	700	2,900	300	100	259,000	414,900	50	2,800	11,800	8,000	0	1,418,000
2023 - 2024	285,000	47,400	700	2,900	300	100	259,000	414,500	50	2,800	12,000	8,000	0	1,422,000
2024 - 2025	285,000	48,500	700	2,900	300	100	262,700	392,000	50	2,900	12,200	8,000	0	1,400,000
2025 - 2026	285,000	48,500	700	3,800	300	100	266,800	385,800	50	3,000	12,400	8,000	0	1,396,000
2026 - 2027	285,000	48,500	700	3,800	300	100	269,800	380,300	50	3,000	12,600	8,000	0	1,390,000
2027 - 2028	285,000	48,500	700	3,800	300	100	272,900	374,800	50	3,100	12,800	7,000	0	1,383,000
2028 - 2029	285,000	48,600	700	3,800	300	100	276,000	369,300	50	3,200	13,100	7,000	0	1,378,000
2029 - 2030	285,000	47,400	700	3,800	300	100	280,300	322,400	50	3,300	13,300	7,000	0	1,322,000
2030 - 2031	285,000	47,400	700	3,800	300	100	281,200	323,200	50	3,400	13,600	7,000	0	1,325,000
2031 - 2032	285,000	47,400	700	3,800	300	100	281,200	321,100	50	3,400	13,800	7,000	0	1,323,000
2032 - 2033	285,000	47,400	700	3,800	300	100	281,200	319,000	50	3,500	14,100	7,000	0	1,321,000
2033 - 2034	285,000	47,400	700	3,800	300	100	281,200	316,900	50	3,600	14,300	7,000	0	1,318,000
2034 - 2035	285,000	47,400	700	3,800	300	100	281,200	268,900	50	3,700	14,600	7,000	0	1,260,000
2035 - 2036	285,000	47,400	700	3,800	300	100	282,200	267,800	50	3,800	14,900	7,000	0	1,260,000
2036 - 2037	285,000	47,400	700	3,800	300	100	282,200	267,700	50	3,900	15,200	7,000	0	1,261,000
2037 - 2038	285,000	47,400	700	3,800	300	100	282,200	267,600	50	4,000	15,500	7,000	0	1,261,000
2038 - 2039	285,000	47,400	700	3,800	300	100	282,200	267,500	50	4,100	15,800	7,000	0	1,261,000
2039 - 2040	285,000	47,400	700	3,800	300	100	282,200	236,000	50	4,200	16,100	7,000	0	1,221,000
2040 - 2041	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2041 - 2042	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2042 - 2043	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2043 - 2044	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2044 - 2045	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2045 - 2046	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2046 - 2047	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2047 - 2048	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2048 - 2049	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2049 - 2050	285,000	47,400	700	3,800	300	100	282,800	235,400	50	4,200	16,100	7,000	0	1,221,000
2050 - 2051	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2051 - 2052	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2052 - 2053	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2053 - 2054	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2054 - 2055	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2055 - 2056	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2056 - 2057	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2057 - 2058	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2058 - 2059	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2059 - 2060	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2060 - 2061	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2061 - 2062	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2062 - 2063	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2063 - 2064	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2064 - 2065	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2065 - 2066	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2066 - 2067	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2067 - 2068	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2068 - 2069	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
2069 - 2070	285,000	45,800	700	3,700	300	100	264,400	232,300	50	4,200	16,100	6,000	0	1,183,000
86/87-16/17 Avg	285,000	46,900	700	3,600	300	100	270,800	283,800	50	3,800	14,700	7,000	0	1,262,000

Table 2-9

Projected Future Tule Subbasin Groundwater Budget

	Groundwater Inflows (acre-ft)																						
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
Water Year	Areal Recharge from Precipitation	Tule River Infiltration					Deer Creek Infiltration					White River Infiltration	Imported Water Deliveries			Agricultural Pumping Return Flow	Municipal Pumping			Release of Water from Compression of Aquitards	Sub-surface Inflow	Mountain-Block Recharge	Total In
																		Recycled Water					
		Success to Oettle Bridge Infiltration	Oettle Bridge to Turnbull Weir Infiltration	Canal Loss	Recharge in Basins	Return Flow	Before Trenton Weir Infiltration	Trenton Weir to Homeland Canal Infiltration	Canal Loss	Recharge in Basins	Return Flow		Canal Loss	Recharge in Basins	Return Flow		Return Flow	Agricultural Return Flow	Artificial Recharge				
2017 - 2018	21,000	17,900	3,900	17,000	12,200	15,500	11,600	600	2,100	1,300	800	6,200	65,200	15,900	66,900	110,400	7,900	600	2,000	52,000	73,000	33,000	537,000
2018 - 2019	21,000	17,900	3,900	17,000	12,200	15,500	11,600	600	2,100	1,300	800	6,200	65,200	15,900	66,900	110,300	8,100	700	2,000	56,000	71,000	33,000	539,000
2019 - 2020	21,000	17,900	3,900	17,000	13,100	15,500	11,600	600	2,100	1,300	800	6,200	65,200	19,200	68,100	106,600	8,300	400	2,500	58,000	68,000	33,000	540,000
2020 - 2021	21,000	17,900	3,900	17,000	13,100	15,500	11,600	600	2,100	1,300	800	6,200	65,200	21,400	68,700	106,000	8,300	400	2,600	60,000	64,000	33,000	541,000
2021 - 2022	21,000	17,900	3,900	17,000	13,100	15,500	11,600	600	2,100	1,300	800	6,200	65,200	21,400	68,900	105,700	8,400	400	2,600	62,000	60,000	33,000	539,000
2022 - 2023	21,000	17,900	3,900	17,000	13,100	15,500	11,600	600	2,100	1,300	800	6,200	65,200	23,000	69,100	105,400	8,400	500	2,700	64,000	57,000	33,000	539,000
2023 - 2024	21,000	17,900	3,900	17,000	13,100	15,500	11,600	600	2,100	1,300	800	6,200	65,200	27,000	69,100	105,300	8,500	500	2,800	66,000	55,000	33,000	543,000
2024 - 2025	21,000	17,900	3,900	18,200	13,700	15,800	11,600	600	2,100	1,300	800	6,200	62,400	27,900	69,600	100,200	8,500	500	2,800	61,000	51,000	33,000	530,000
2025 - 2026	21,000	17,900	3,900	18,400	13,700	15,800	11,600	600	2,100	1,300	1,100	6,200	59,600	27,300	70,200	98,900	8,600	500	2,900	59,000	50,000	33,000	524,000
2026 - 2027	21,000	17,900	3,900	18,700	13,700	15,800	11,600	600	2,100	1,300	1,100	6,200	56,800	26,700	70,500	98,000	8,600	500	3,000	59,000	50,000	33,000	520,000
2027 - 2028	21,000	17,900	3,900	19,000	13,700	15,800	11,600	600	2,100	1,300	1,100	6,200	53,900	26,100	70,900	97,000	8,700	500	3,100	59,000	50,000	33,000	516,000
2028 - 2029	21,000	17,900	3,900	19,300	13,700	15,800	11,600	600	2,100	1,300	1,100	6,200	51,100	25,500	71,300	96,000	8,700	500	3,100	59,000	51,000	33,000	514,000
2029 - 2030	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	71,800	86,900	8,800	500	3,200	52,000	51,000	33,000	495,000
2030 - 2031	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,100	86,900	8,800	600	3,300	50,000	50,000	33,000	492,000
2031 - 2032	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,100	86,400	8,900	600	3,400	49,000	51,000	33,000	492,000
2032 - 2033	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,100	85,900	8,900	600	3,500	48,000	51,000	33,000	490,000
2033 - 2034	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,100	85,400	9,000	600	3,500	47,000	51,000	33,000	489,000
2034 - 2035	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,100	74,000	9,100	600	3,600	38,000	50,000	33,000	468,000
2035 - 2036	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,400	73,700	9,100	600	3,700	35,000	50,000	33,000	465,000
2036 - 2037	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,400	73,700	9,200	700	3,800	34,000	50,000	32,000	463,000
2037 - 2038	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,400	73,700	9,300	700	3,900	33,000	51,000	32,000	463,000
2038 - 2039	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,400	73,700	9,300	700	4,000	32,000	53,000	32,000	465,000
2039 - 2040	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,400	64,300	9,400	700	4,100	23,000	51,000	32,000	444,000
2040 - 2041	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	21,000	51,000	32,000	442,000
2041 - 2042	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	20,000	52,000	32,000	442,000
2042 - 2043	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	19,000	52,000	32,000	441,000
2043 - 2044	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	19,000	52,000	32,000	441,000
2044 - 2045	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	18,000	52,000	32,000	440,000
2045 - 2046	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	17,000	53,000	32,000	440,000
2046 - 2047	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	17,000	53,000	32,000	440,000
2047 - 2048	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	16,000	53,000	32,000	439,000
2048 - 2049	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	16,000	53,000	32,000	439,000
2049 - 2050	21,000	17,900	3,900	19,400	13,600	15,500	11,600	600	2,100	1,300	1,100	6,200	48,300	24,900	72,600	64,100	9,400	700	4,100	16,000	53,000	32,000	439,000
2050 - 2051	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	16,000	52,000	31,000	423,000
2051 - 2052	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	16,000	52,000	32,000	424,000
2052 - 2053	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	16,000	53,000	31,000	424,000
2053 - 2054	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	15,000	53,000	31,000	423,000
2054 - 2055	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	15,000	53,000	31,000	423,000
2055 - 2056	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	15,000	53,000	32,000	424,000
2056 - 2057	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	14,000	53,000	31,000	422,000
2057 - 2058	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	14,000	53,000	31,000	422,000
2058 - 2059	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	14,000	53,000	31,000	422,000
2059 - 2060	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	14,000	54,000	31,000	423,000
2060 - 2061	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	13,000	54,000	31,000	422,000
2061 - 2062	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	13,000	54,000	31,000	422,000
2062 - 2063	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	13,000	54,000	31,000	422,000
2063 - 2064	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	13,000	54,000	31,000	422,000
2064 - 2065	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	12,000	54,000	31,000	421,000
2065 - 2066	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	12,000	54,000	31,000	421,000
2066 - 2067	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	12,000	54,000	31,000	421,000
2067 - 2068	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	12,000	55,000	31,000	422,000
2068 - 2069	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	11,000	55,000	31,000	421,000
2069 - 2070	21,000	17,400	3,800	19,300	12,900	15,400	11,300	500	2,100	1,300	1,100	6,000	43,500	23,800	68,400	62,400	9,400	700	4,100	11,000	55,000	31,000	421,000
17/18-69/70 Avg	21,000	17,700	3,900	19,000	13,200	15,500	11,500	600	2,100	1,300	1,100	6,100	49,500	24,100	70,200	75,300	9,100	600	3,700	30,000	54,000	32,000	462,000

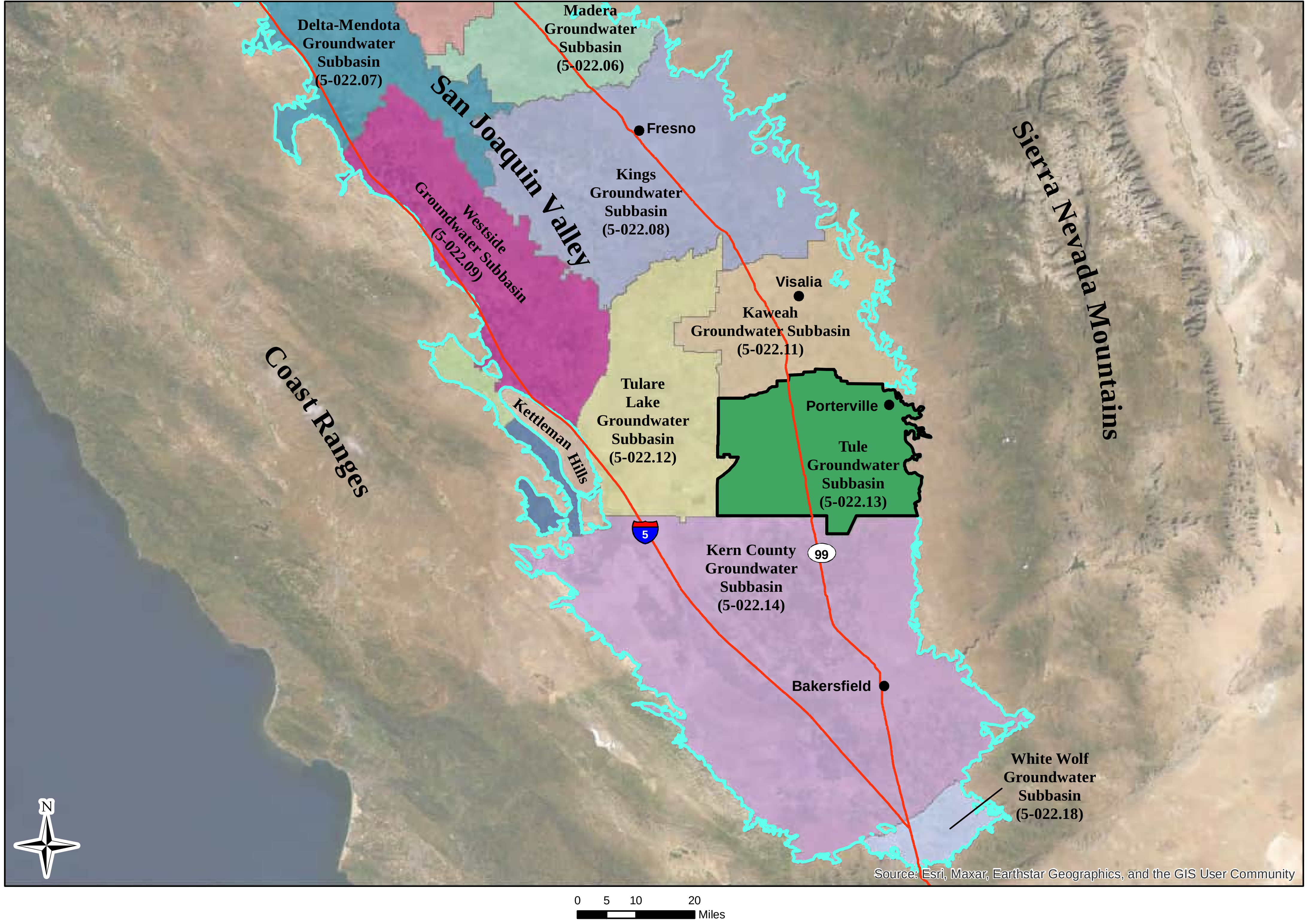
Projected Future Tule Subbasin Groundwater Budget

	Groundwater Outflows (acre-ft)						
	W	X	Y	Z	AA		
	Groundwater Pumping						
Water Year	Municipal	Irrigated Agriculture	Exports	Groundwater Banking Extraction	Sub-surface Outflow	Total Out	Change in Storage (acre-ft)
2017 - 2018	21,700	549,000	22,920	2,200	83,000	679,000	-142,000
2018 - 2019	23,400	548,000	22,920	2,200	82,000	679,000	-140,000
2019 - 2020	25,000	529,000	22,920	2,200	83,000	662,000	-122,000
2020 - 2021	25,400	526,000	22,920	2,200	83,000	660,000	-119,000
2021 - 2022	25,700	524,000	22,920	2,200	84,000	659,000	-120,000
2022 - 2023	26,100	523,000	22,920	2,200	85,000	659,000	-120,000
2023 - 2024	26,500	522,000	22,920	2,200	85,000	659,000	-116,000
2024 - 2025	26,900	494,000	22,920	2,200	86,000	632,000	-102,000
2025 - 2026	27,400	487,000	20,010	2,200	90,000	627,000	-103,000
2026 - 2027	27,800	481,000	20,010	2,200	92,000	623,000	-103,000
2027 - 2028	28,200	474,000	20,010	2,200	94,000	618,000	-102,000
2028 - 2029	28,700	468,000	20,010	2,200	96,000	615,000	-101,000
2029 - 2030	29,200	412,000	20,010	2,200	94,000	557,000	-62,000
2030 - 2031	29,600	413,000	17,100	2,200	95,000	557,000	-65,000
2031 - 2032	30,100	410,000	17,100	2,200	94,000	553,000	-61,000
2032 - 2033	30,600	407,000	17,100	2,200	93,000	550,000	-60,000
2033 - 2034	31,100	405,000	17,100	2,200	92,000	547,000	-58,000
2034 - 2035	31,700	345,000	17,100	2,200	93,000	489,000	-21,000
2035 - 2036	32,200	344,000	14,190	2,200	93,000	486,000	-21,000
2036 - 2037	32,800	344,000	14,190	2,200	91,000	484,000	-21,000
2037 - 2038	33,300	344,000	14,190	2,200	89,000	483,000	-20,000
2038 - 2039	33,900	344,000	14,190	2,200	88,000	482,000	-17,000
2039 - 2040	34,500	303,000	11,280	2,200	90,000	441,000	3,000
2040 - 2041	34,500	302,000	11,280	2,200	90,000	440,000	2,000
2041 - 2042	34,500	302,000	11,280	2,200	90,000	440,000	2,000
2042 - 2043	34,500	302,000	11,280	2,200	90,000	440,000	1,000
2043 - 2044	34,500	302,000	11,280	2,200	90,000	440,000	1,000
2044 - 2045	34,500	302,000	11,280	2,200	90,000	440,000	0
2045 - 2046	34,500	302,000	11,280	2,200	89,000	439,000	1,000
2046 - 2047	34,500	302,000	11,280	2,200	89,000	439,000	1,000
2047 - 2048	34,500	302,000	11,280	2,200	89,000	439,000	0
2048 - 2049	34,500	302,000	11,280	2,200	89,000	439,000	0
2049 - 2050	34,500	302,000	11,280	2,200	88,000	438,000	1,000
2050 - 2051	34,500	297,000	11,280	2,200	88,000	433,000	-10,000
2051 - 2052	34,500	297,000	11,280	2,200	88,000	433,000	-9,000
2052 - 2053	34,500	297,000	11,280	2,200	87,000	432,000	-8,000
2053 - 2054	34,500	297,000	11,280	2,200	87,000	432,000	-9,000
2054 - 2055	34,500	297,000	11,280	2,200	87,000	432,000	-9,000
2055 - 2056	34,500	297,000	11,280	2,200	87,000	432,000	-8,000
2056 - 2057	34,500	297,000	11,280	2,200	86,000	431,000	-9,000
2057 - 2058	34,500	297,000	11,280	2,200	86,000	431,000	-9,000
2058 - 2059	34,500	297,000	11,280	2,200	86,000	431,000	-9,000
2059 - 2060	34,500	297,000	11,280	2,200	86,000	431,000	-8,000
2060 - 2061	34,500	297,000	11,280	2,200	85,000	430,000	-8,000
2061 - 2062	34,500	297,000	11,280	2,200	85,000	430,000	-8,000
2062 - 2063	34,500	297,000	11,280	2,200	85,000	430,000	-8,000
2063 - 2064	34,500	297,000	11,280	2,200	85,000	430,000	-8,000
2064 - 2065	34,500	297,000	11,280	2,200	85,000	430,000	-9,000
2065 - 2066	34,500	297,000	11,280	2,200	84,000	429,000	-8,000
2066 - 2067	34,500	297,000	11,280	2,200	84,000	429,000	-8,000
2067 - 2068	34,500	297,000	11,280	2,200	84,000	429,000	-7,000
2068 - 2069	34,500	297,000	11,280	2,200	84,000	429,000	-8,000
2069 - 2070	34,500	297,000	11,280	2,200	84,000	429,000	-8,000
17/18-69/70 Avg	32,000	361,000	14,600	2,200	88,000	498,000	-36,000

Figures

Tule Subbasin

July 2022



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

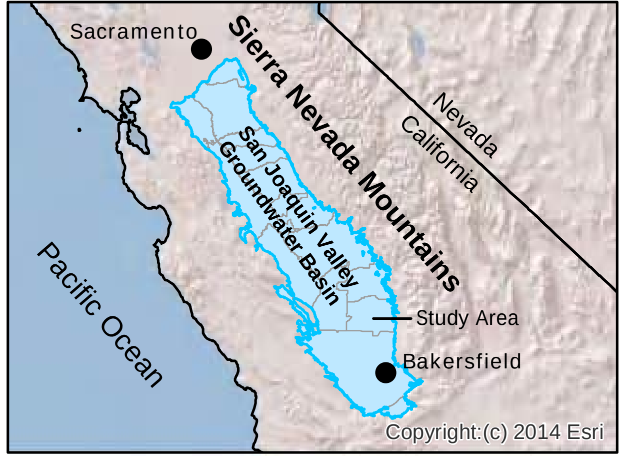
NAD 83 State Plane Zone 4

Map Features

▢ San Joaquin Groundwater Basin
● Major City
— Freeway/State Highway

Note: Groundwater basins from Bulletin 118,
California Department of Water Resources
Rev. 2016

Regional Location



Copyright:(c) 2014 Esri

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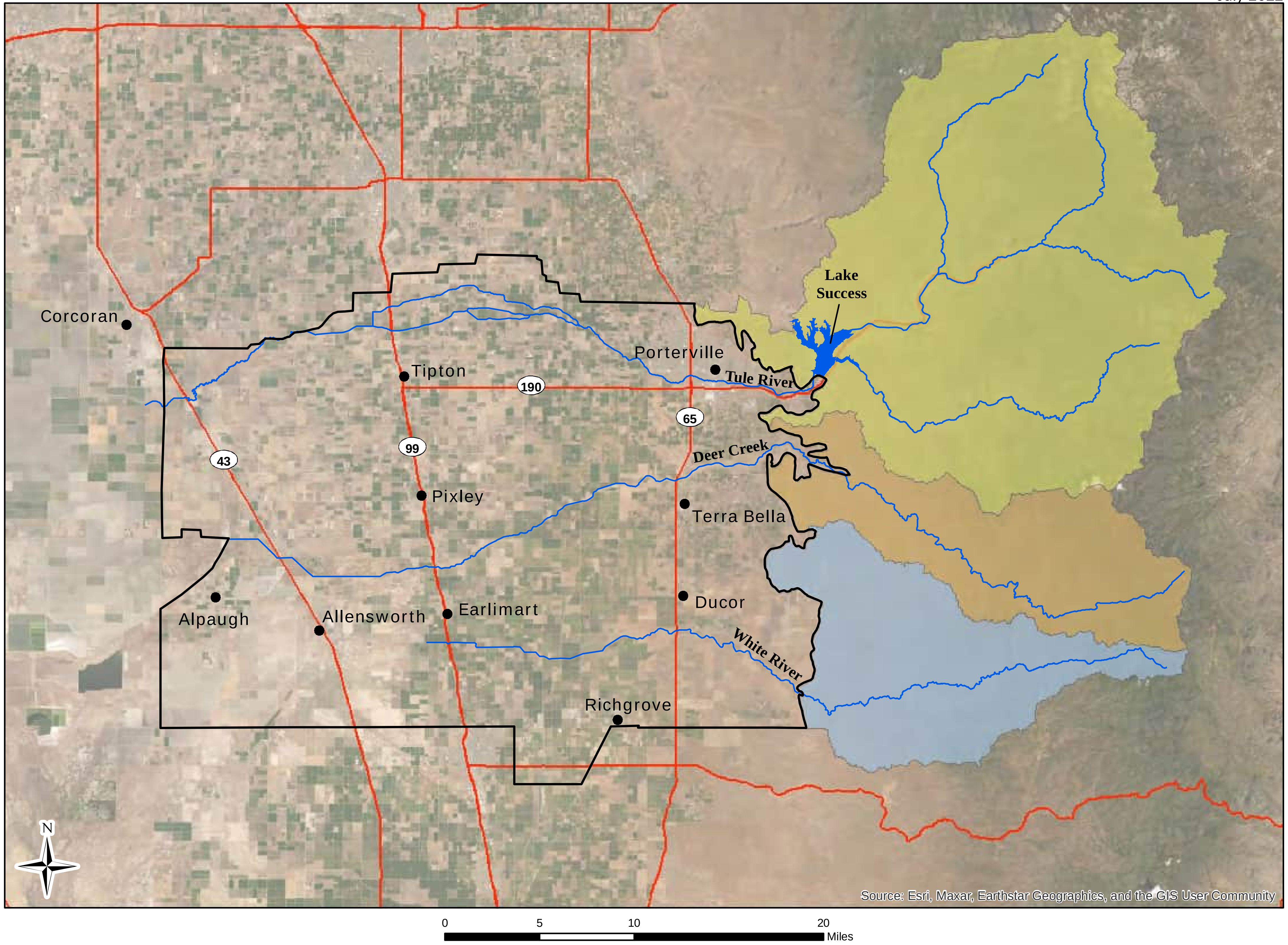
Regional Map

Figure 2-1

Tule Subbasin

July 2022



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

NAD 83 State Plane Zone 4

Map Features

- ☐ Tule Subbasin
- 🟨 Tule River Drainage Basin
- 🟫 California Hot Springs Drainage Basin
- 🟦 White River Drainage Basin
- ● City or Community
- — Major Hydrologic Feature
- — State Highway/Major Road

Notes: Drainage basins from California Interagency Watershed Map of 1999, California Department of Water Resources.

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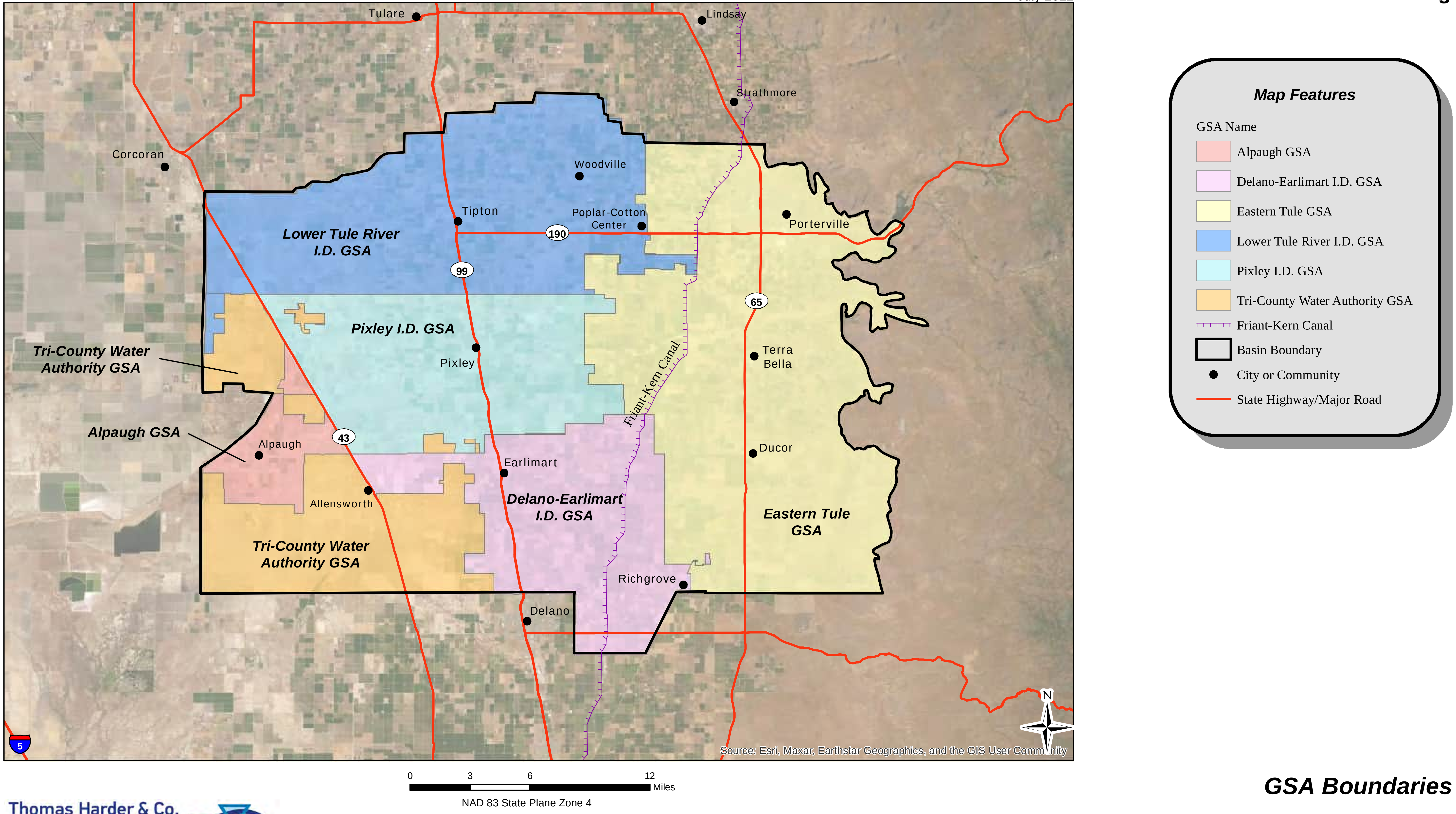
Tule Subbasin Area

Figure 2-2

Tule Subbasin

July 2022



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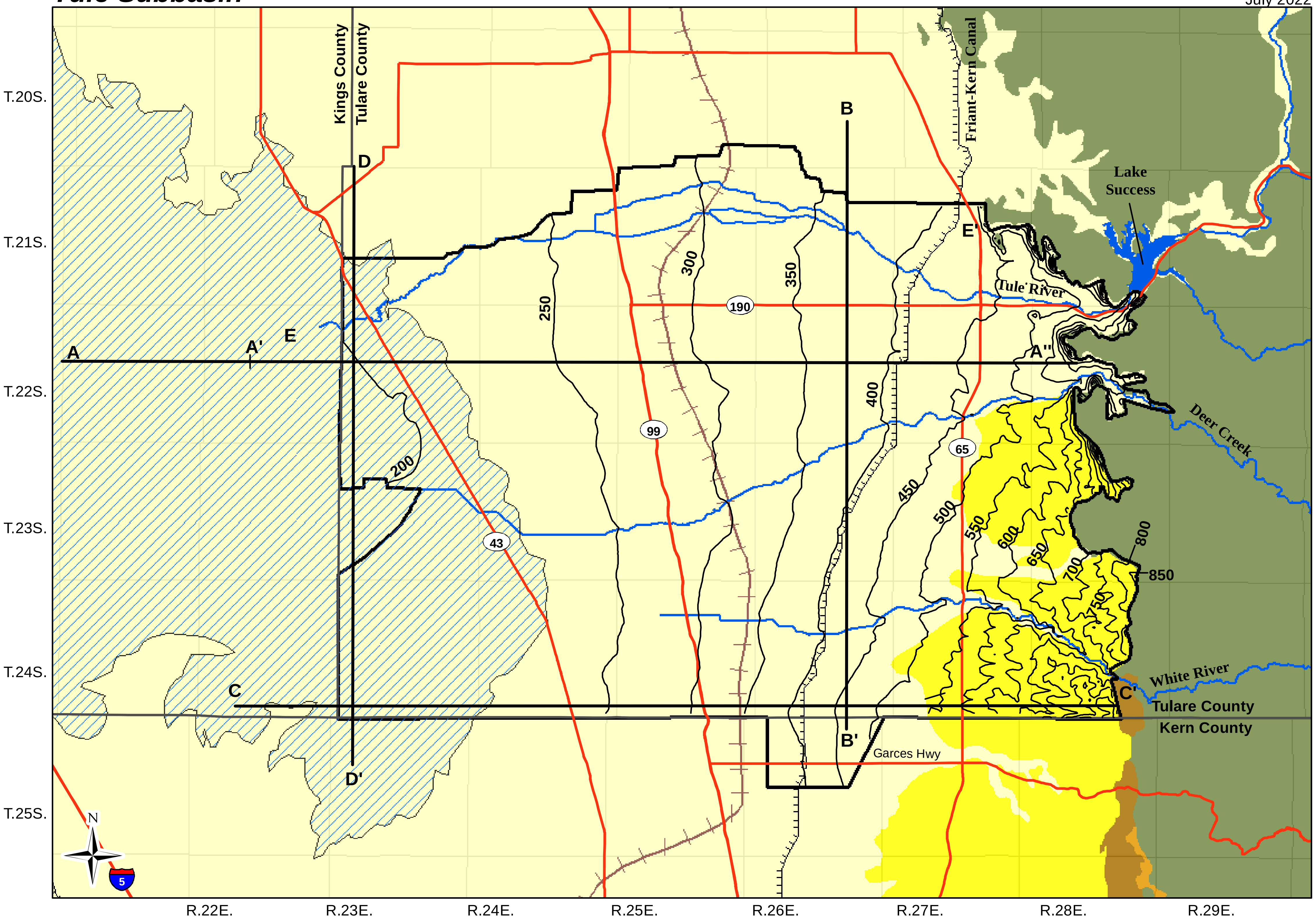
GSA Boundaries

Figure 2-3

Tule Subbasin

July 2022



0 3 6 12 Miles
NAD 83 State Plane Zone 4

Map Features

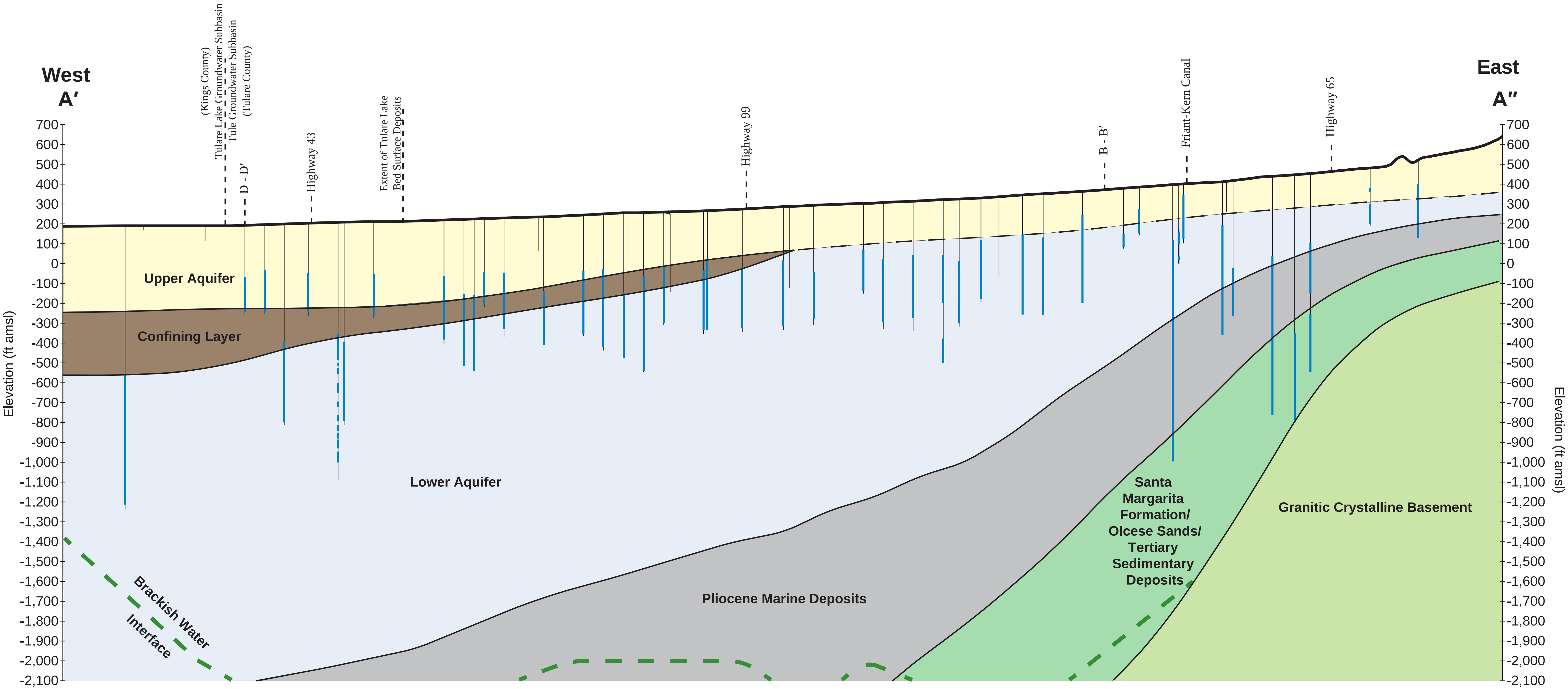
- ― Land Surface Elevation Contour (ft amsl)
- ━ Cross Sections
- ☐ County Boundary
- 🟨 Surficial Deposits
- 🟨 Tertiary Loosely Consolidated Deposits
- 🟧 Non-Marine Sedimentary Rocks
- 🟫 Marine Sedimentary Rocks
- 🟩 Crystalline Basement
- ☐ Approximate Eastern Extent of the Corcoran Clay
- ▨ Tulare Lake Surface Deposits
- ┼ Friant-Kern Canal
- ☐ Basin Boundary
- ― Major Hydrologic Feature
- ― State Highway/Major Road

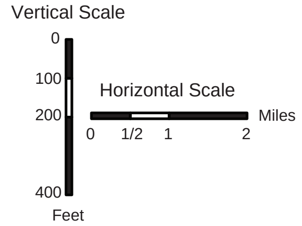
Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Geologic units modified from USGS Open-File
Report 2005-1305

Lake Deposits from California Geological Survey
Geologic Atlas of California Map No. 002
1:250,000 scale, Compiled by A.R. Smith, 1964
and Geologic Atlas of California Map No. 005,
1:250,000 scale, Compiled by: R.A. Matthews and J.L. Burnett

Geology and
Cross Section Locations
Figure 2-4





Notes: Lithologic data from Department of Water Resources Well Compeletion Reports.
Wells within one half mile from cross section line unless otherwise noted by " * ".
Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Brackish Water Interface based on Planert and Williams, 1995 and Page, 1973 USGS Atlas HA-489

| = Indicates well perforation interval

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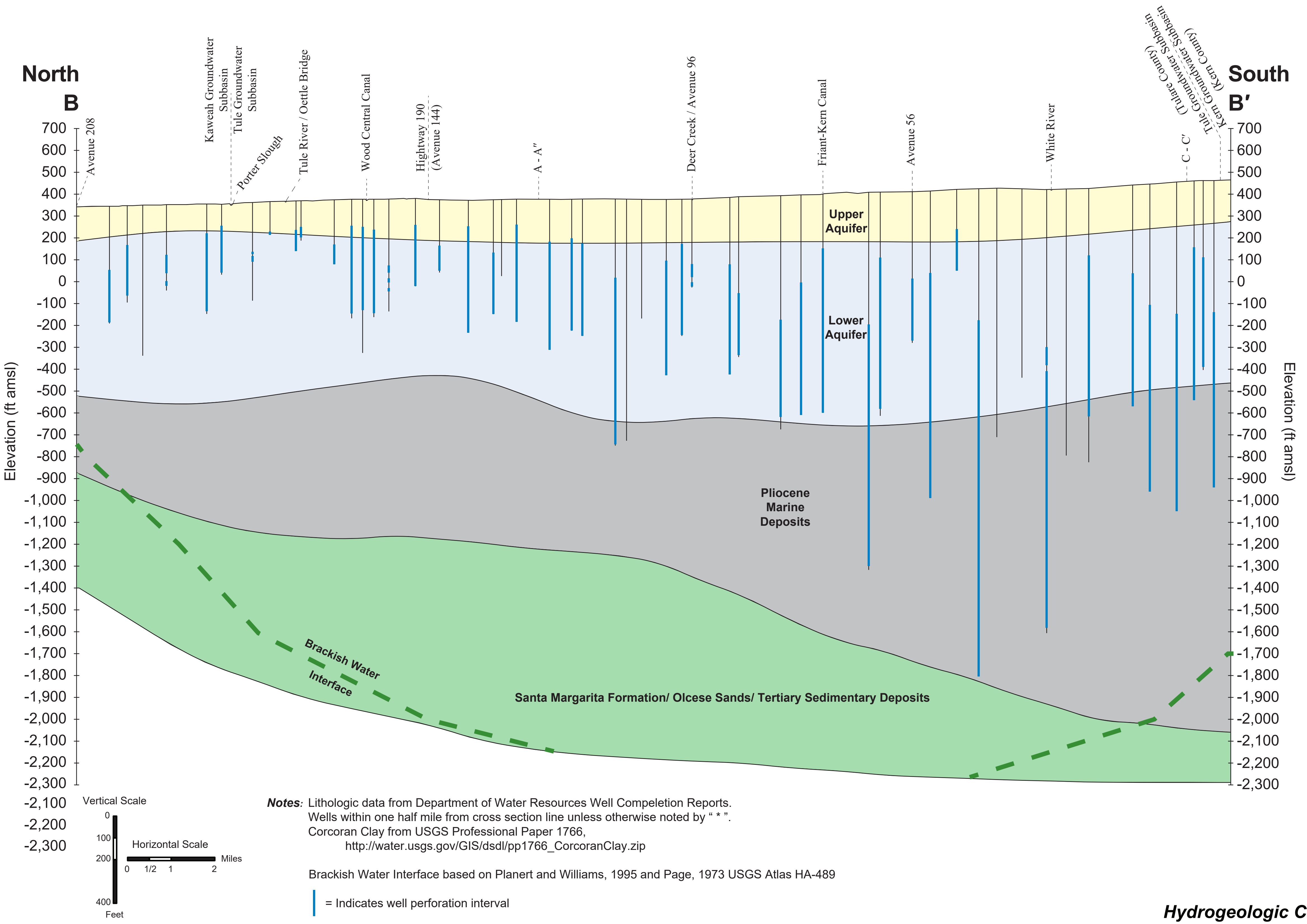
Hydrogeologic Cross Section A'-A"
Tule Groundwater Subbasin
Figure 2-5
July 2022



Notes: Lithologic data from Department of Water Resources Well Compeletion Reports.
Wells within one half mile from cross section line unless otherwise noted by " * ".
Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Brackish Water Interface based on Planert and Williams, 1995 and Page, 1973 USGS Atlas HA-489

| = Indicates well perforation interval

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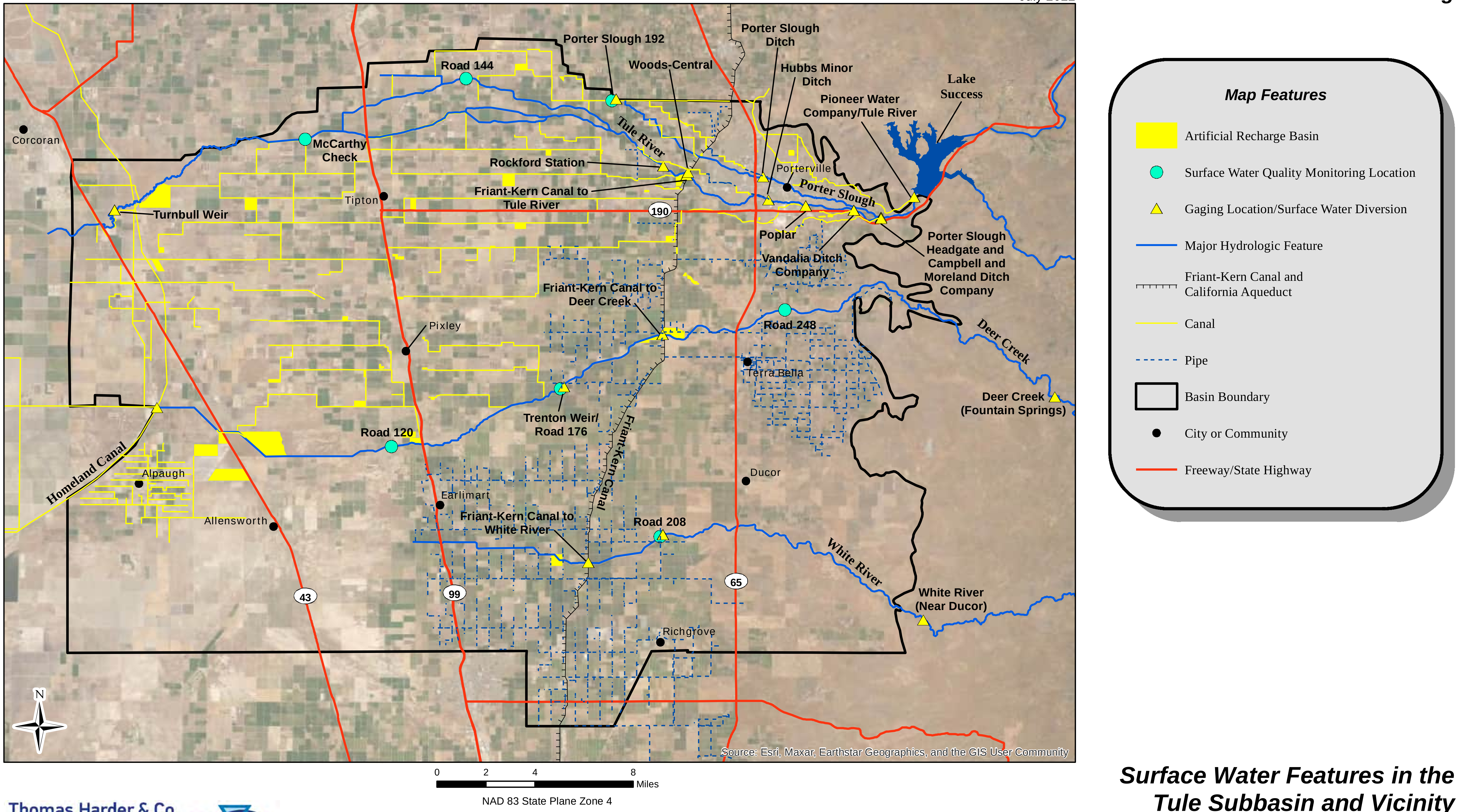
Hydrogeologic Cross Section B-B′
Tule Groundwater Subbasin

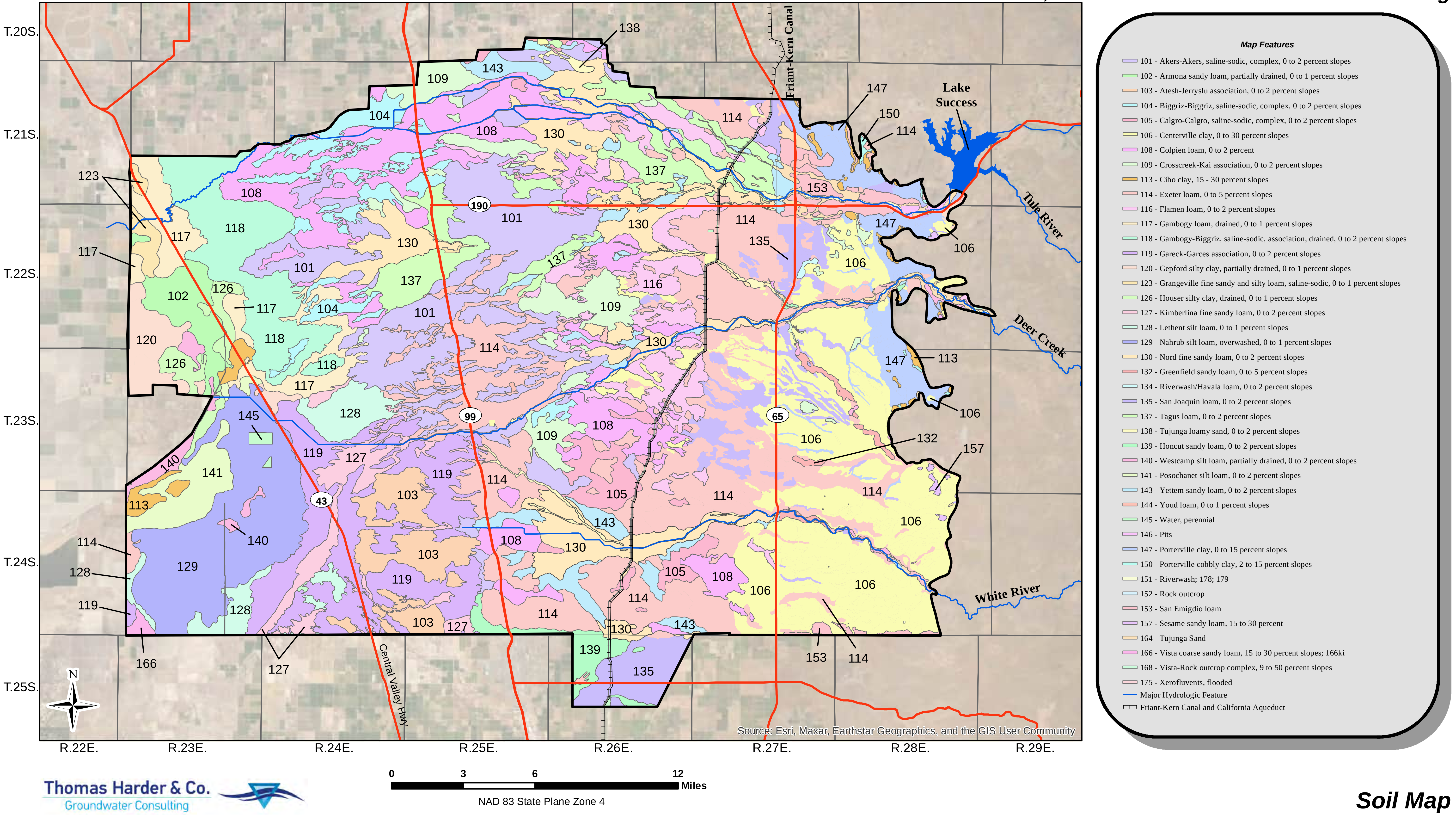
Figure 2-6
July 2022



Surface Water Features in the Tule Subbasin and Vicinity
Figure 2-7

Tule Subbasin

July 2022



NAD 83 State Plane Zone 4

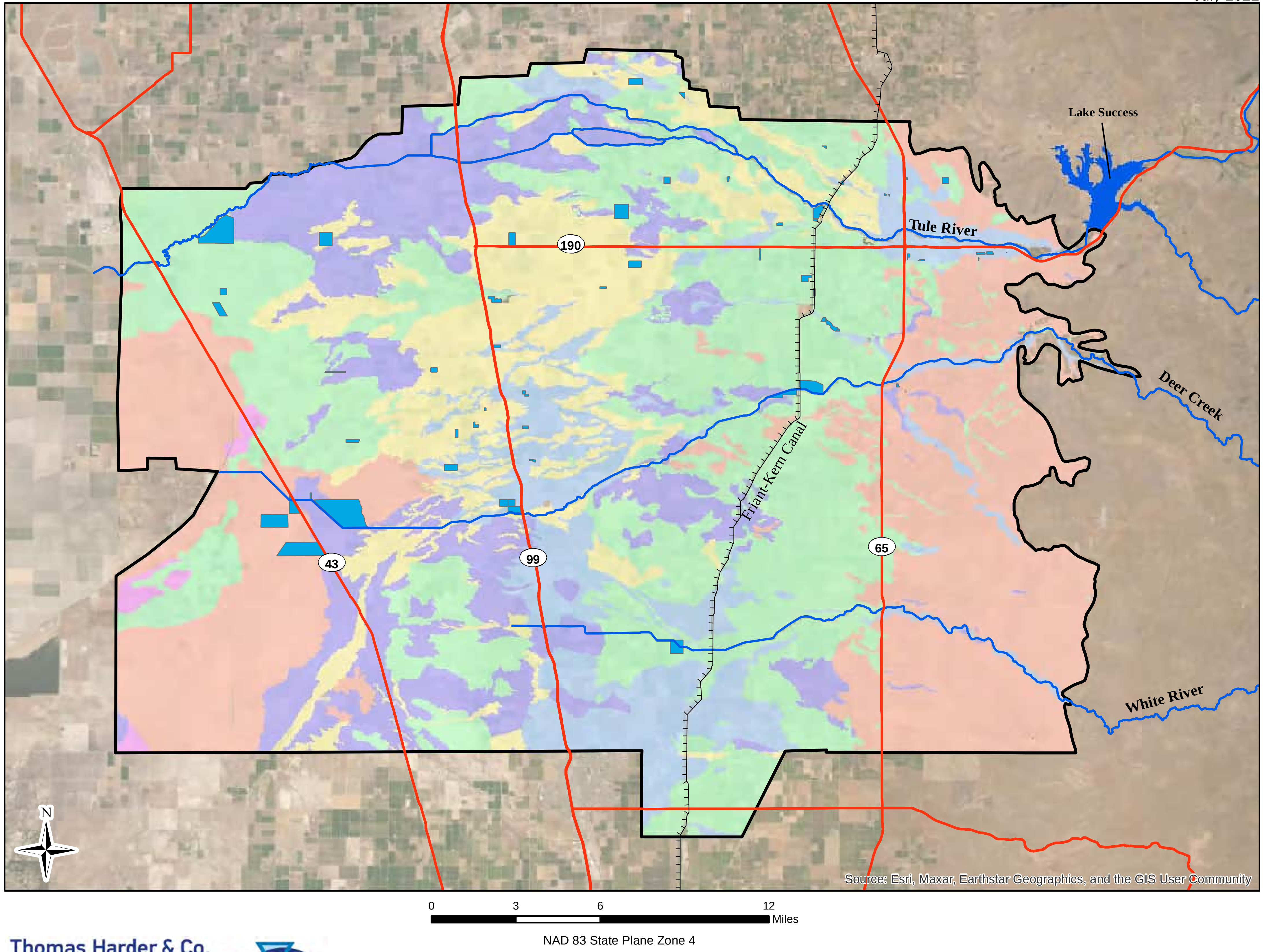
Source: USDA National Resources Conservation Service Soils - Web Soil Survey.
Associated reports inclued: USDA; Soil Survey of Tulare County, California, Western Part.
USDA; Soil Survey of Tulare County, California, Central Part.
and USDA; Soil Survey of Kern County, Northeastern Part, and Southeastern Part of Tulare County, California.

Soil Map

Figure 2-8

Tule Subbasin

July 2022



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

Map Features

SAGBI Index

- Excellent
- Good
- Moderately Good
- Moderately Poor
- Poor
- Very Poor
- Basin Boundary
- Artificial Recharge Basin
- Friant-Kern Canal
- Major Hydrologic Feature
- State Highway/Major Road

The Soil Agricultural Groundwater Banking Index (SAGBI) is a suitability index for groundwater recharge on agricultural land. It is based on five factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface condition.

Source: SAGBI | Soil Agricultural Groundwater Banking Index interactive map.
https://casoilresource.lawr.ucdavis.edu/sagbi/

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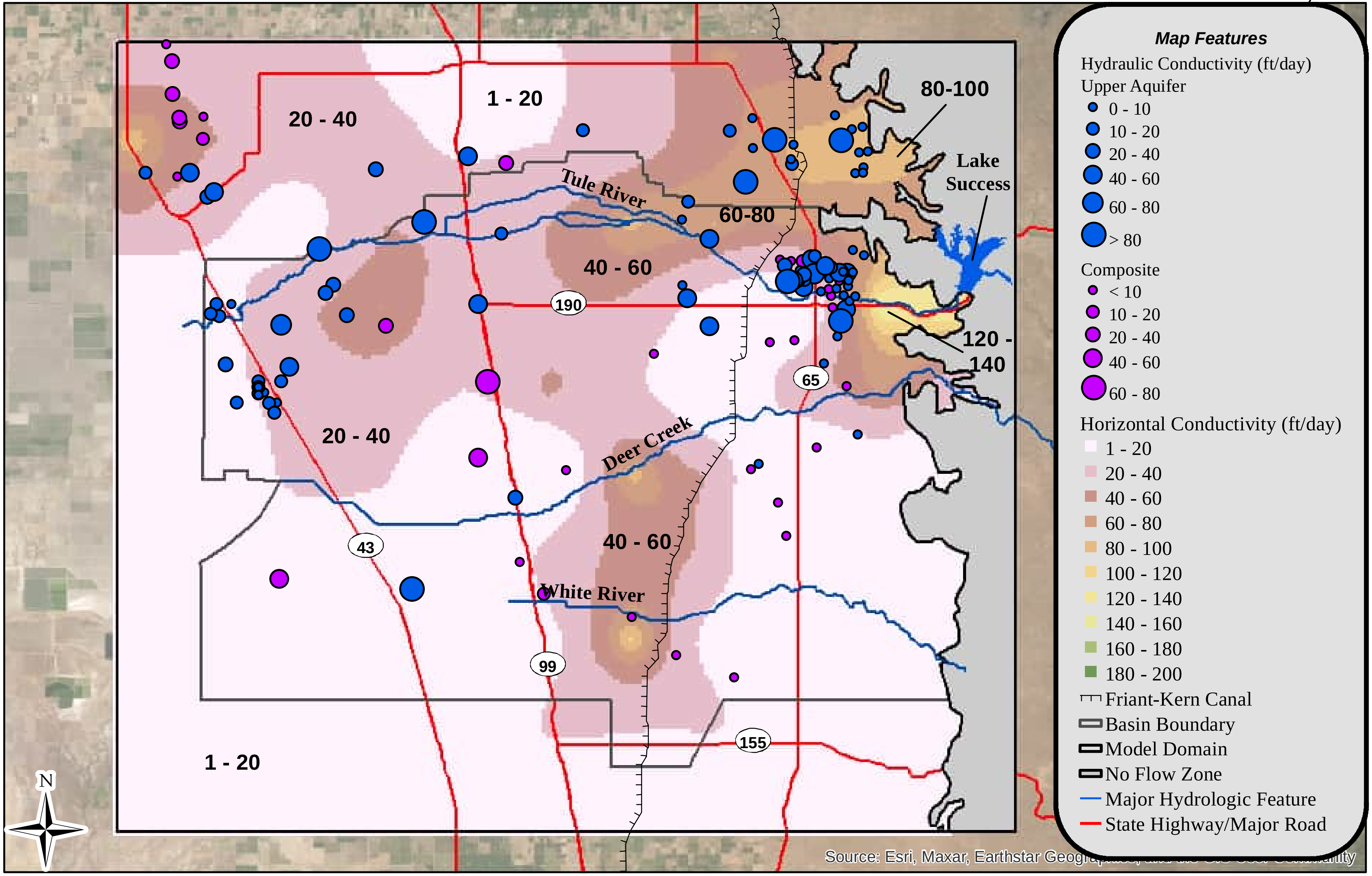
Recharge Basins and Favorable Areas for Recharge

Figure 2-9



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

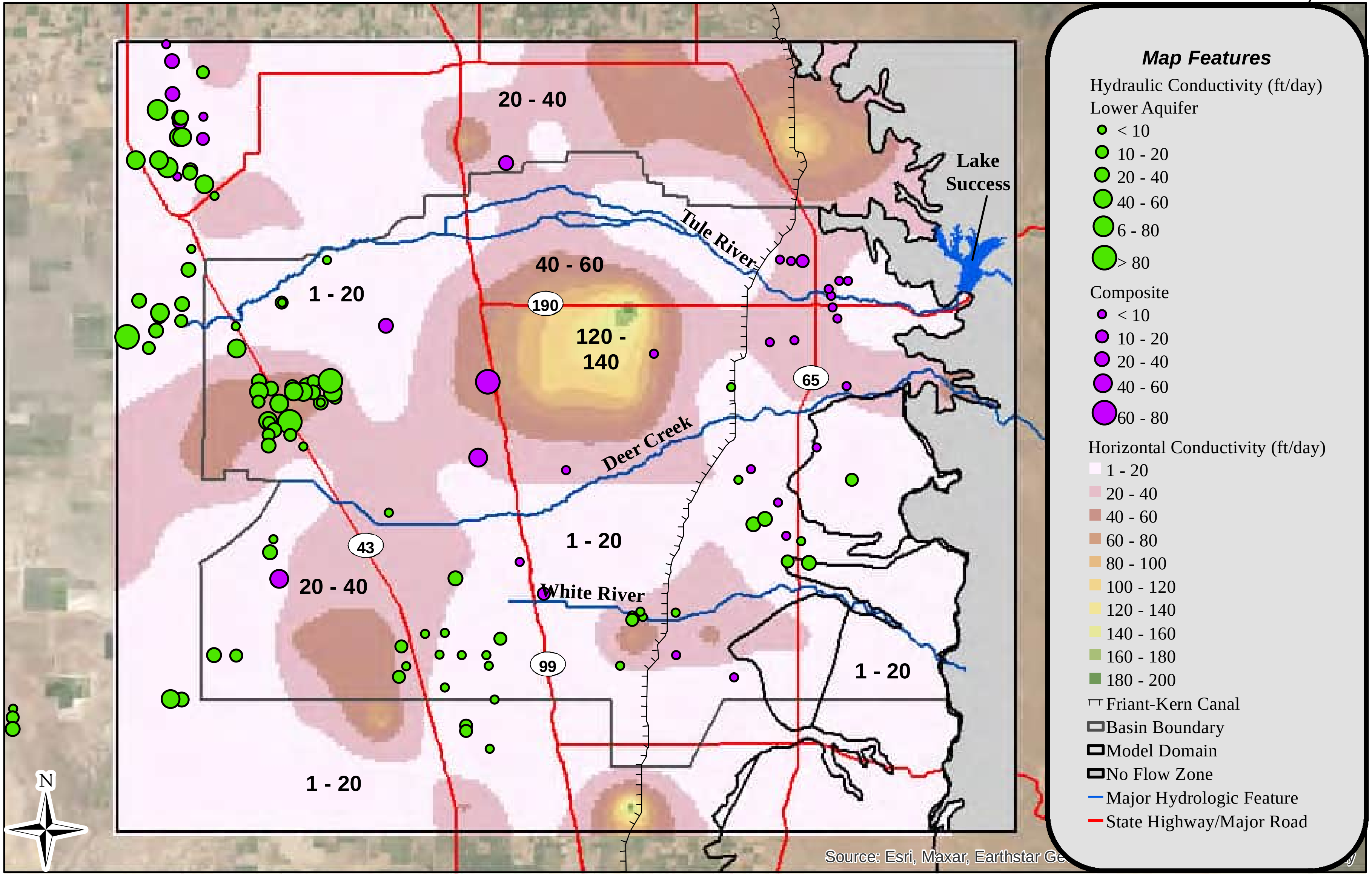
0 3 6 12 Miles

NAD 83 State Plane Zone 4

Upper Aquifer Horizontal Hydraulic Conductivity

Figure 2-10

Tule Subbasin



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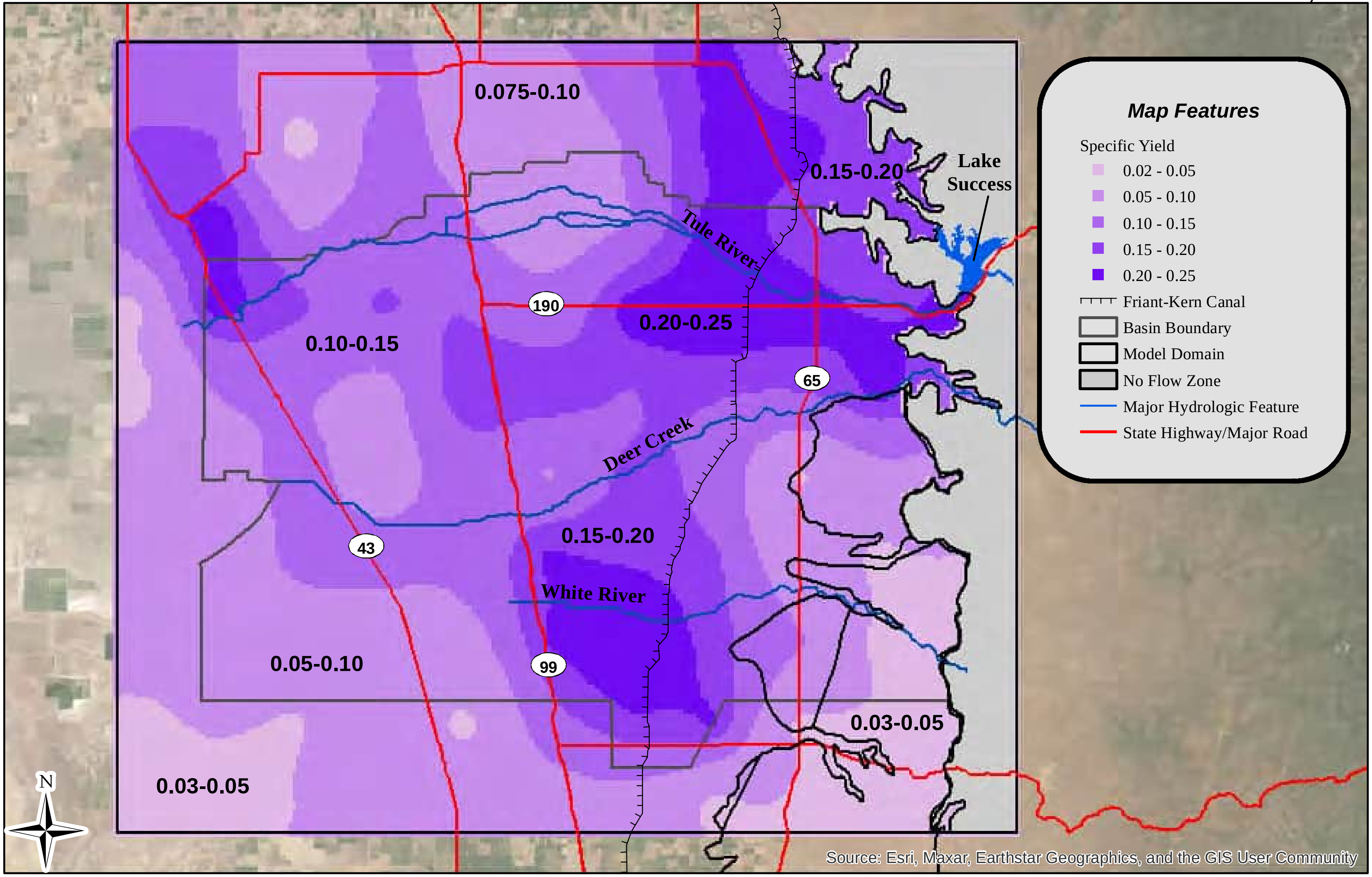
Lower Aquifer Horizontal Hydraulic Conductivity
Figure 2-11



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

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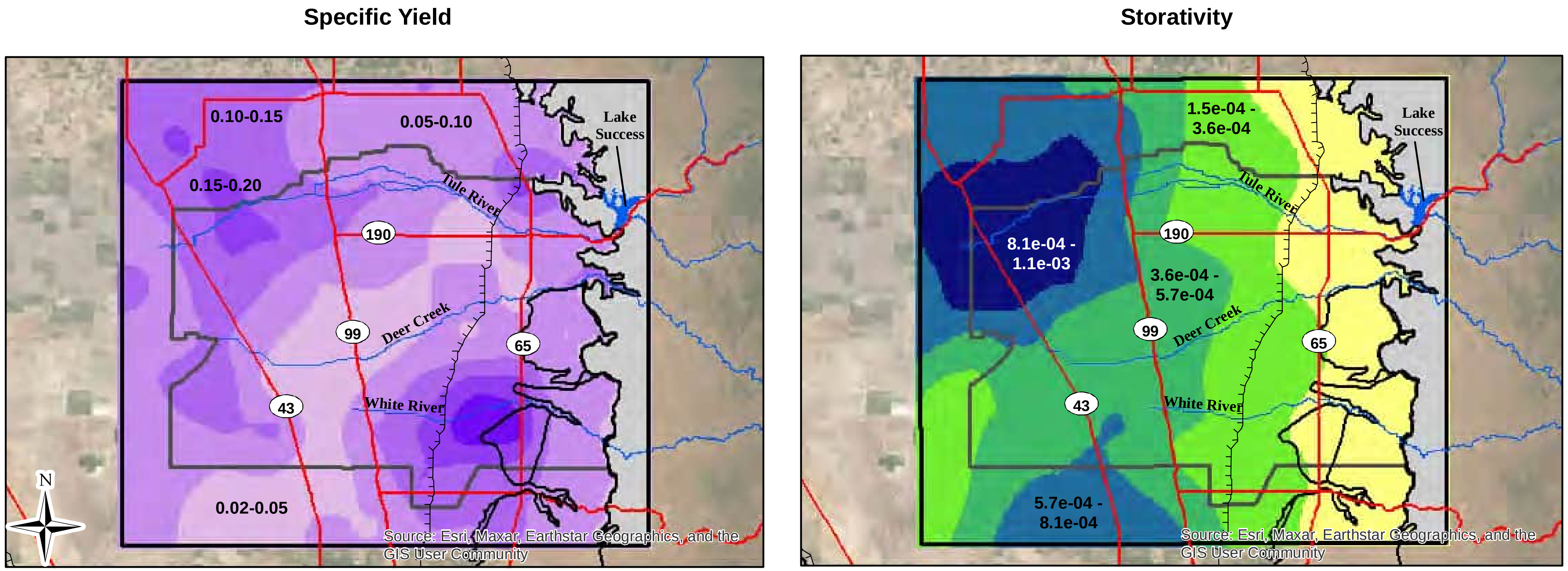
Upper Aquifer Specific Yield

Figure 2-12



Note: Specific Yield values apply to areas of the subbasin where groundwater levels are below the top of the aquifer (primarily the east side of the subbasin).Storativity values apply to areas of the subbasin where groundwater levels are confined beneath the Corcoran clay or other confining beds.

Map Features

Specific Yield (Under Unconfined Conditions)

- ■ 0.02 - 0.05
- ■ 0.05 - 0.10
- ■ 0.10 - 0.15
- ■ 0.15 - 0.20
- ■ 0.20 - 0.25

Storativity (Under Confined Conditions)

- ■ 8.0e-06 - 1.5e-04
- ■ 1.5e-04 - 3.6e-04
- ■ 3.6e-04 - 5.7e-04
- ■ 5.7e-04 - 8.1e-04
- ■ 8.1e-04 - 1.1e-03
- ┼┼┼ Friant-Kern Canal
- ▢ Basin Boundary
- ▢ Model Domain
- ▨ No Flow Zone
- — State Highway/Major Road
- — Major Hydrologic Feature

0 5 10 20 Miles

NAD 83 State Plane Zone 4

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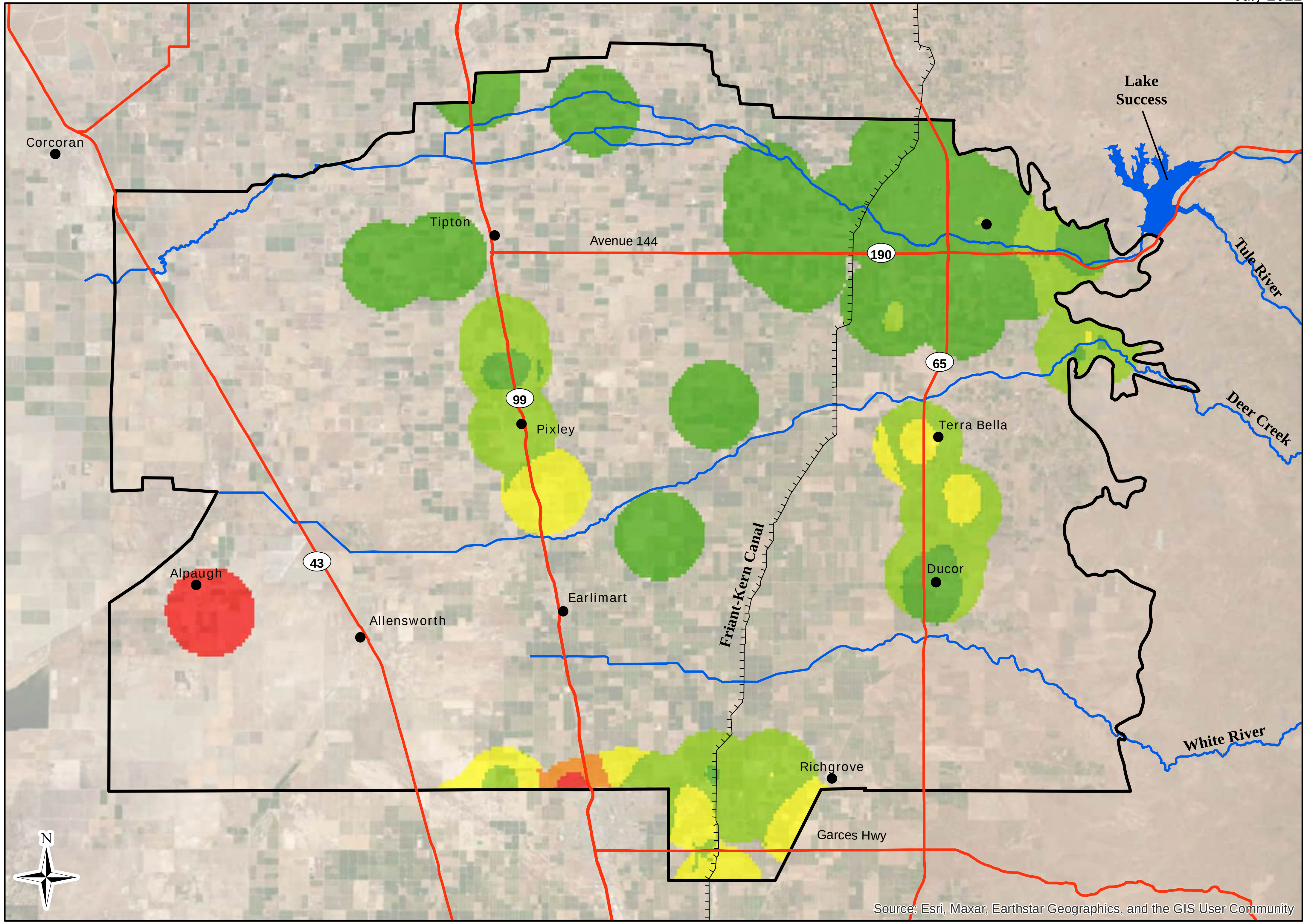
Lower Aquifer Storage Properties

Figure 2-13

Tule Subbasin

July 2022



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

Map Features

Ambient Arsenic Concentration, 2017 - 2022 (µg/L)

- 🟩 0 - 2.5
- 🟩 2.5 - 5.0
- 🟨 5.0 - 7.5
- 🟧 7.5 - 10
- 🟥 10+
- ● City or Community
- ┬┬┬ Friant-Kern Canal
- ☐ Basin Boundary
- — Major Hydrologic Feature
- — State Highway/Major Road

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

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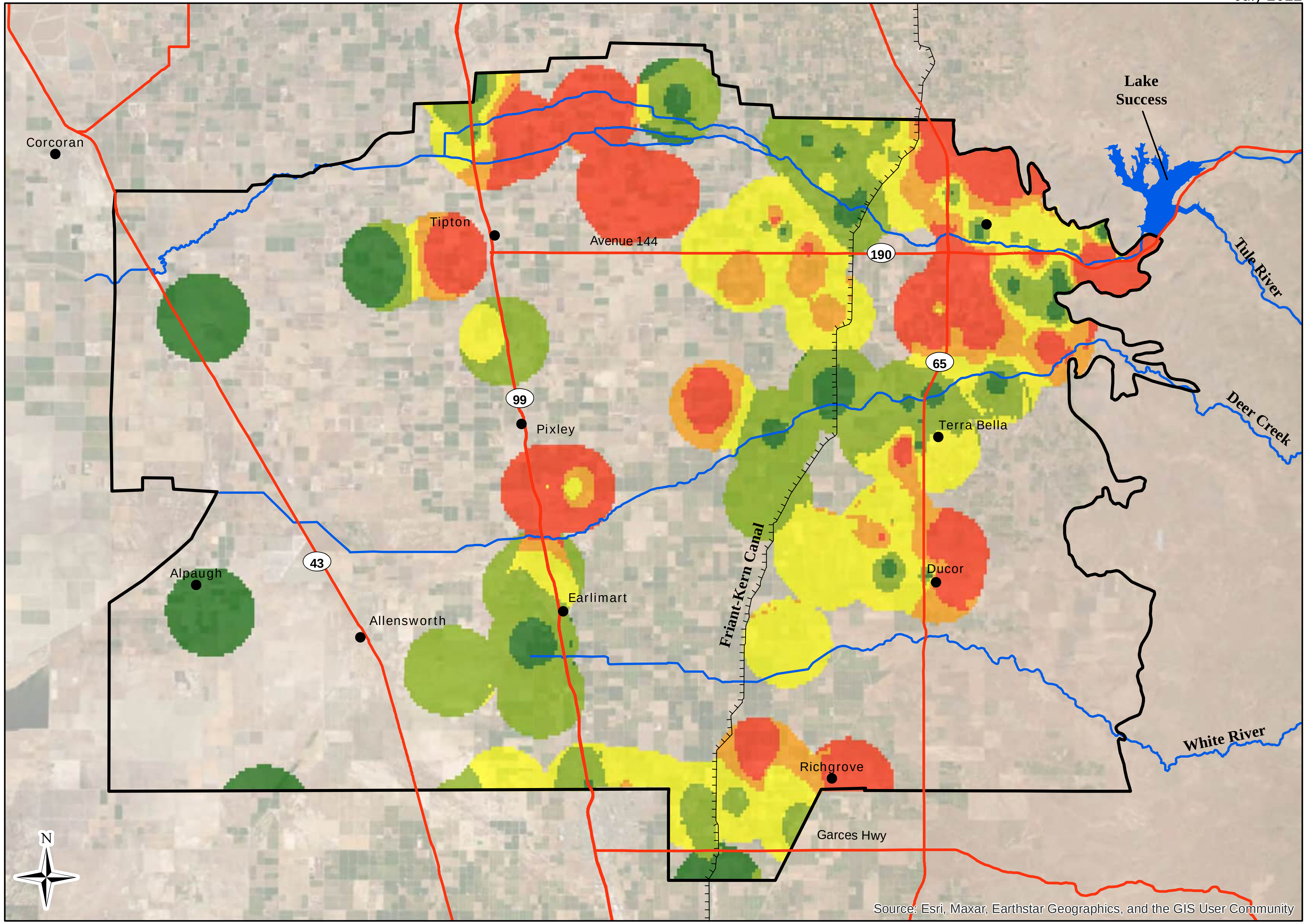
0 2.5 5 10 Miles
NAD 83 State Plane Zone 4

Arsenic Concentrations

Figure 2-14a

Tule Subbasin

July 2022



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

Map Features

Ambient Nitrate Concentration, 2017 - 2022 (µg/L)

🟩	0 - 2.5
🟩	2.5 - 5.0
🟨	5.0 - 7.5
🟧	7.5 - 10
🟥	10+
●	City or Community
┬┬┬	Friant-Kern Canal
☐	Basin Boundary
—	Major Hydrologic Feature
—	State Highway/Major Road

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

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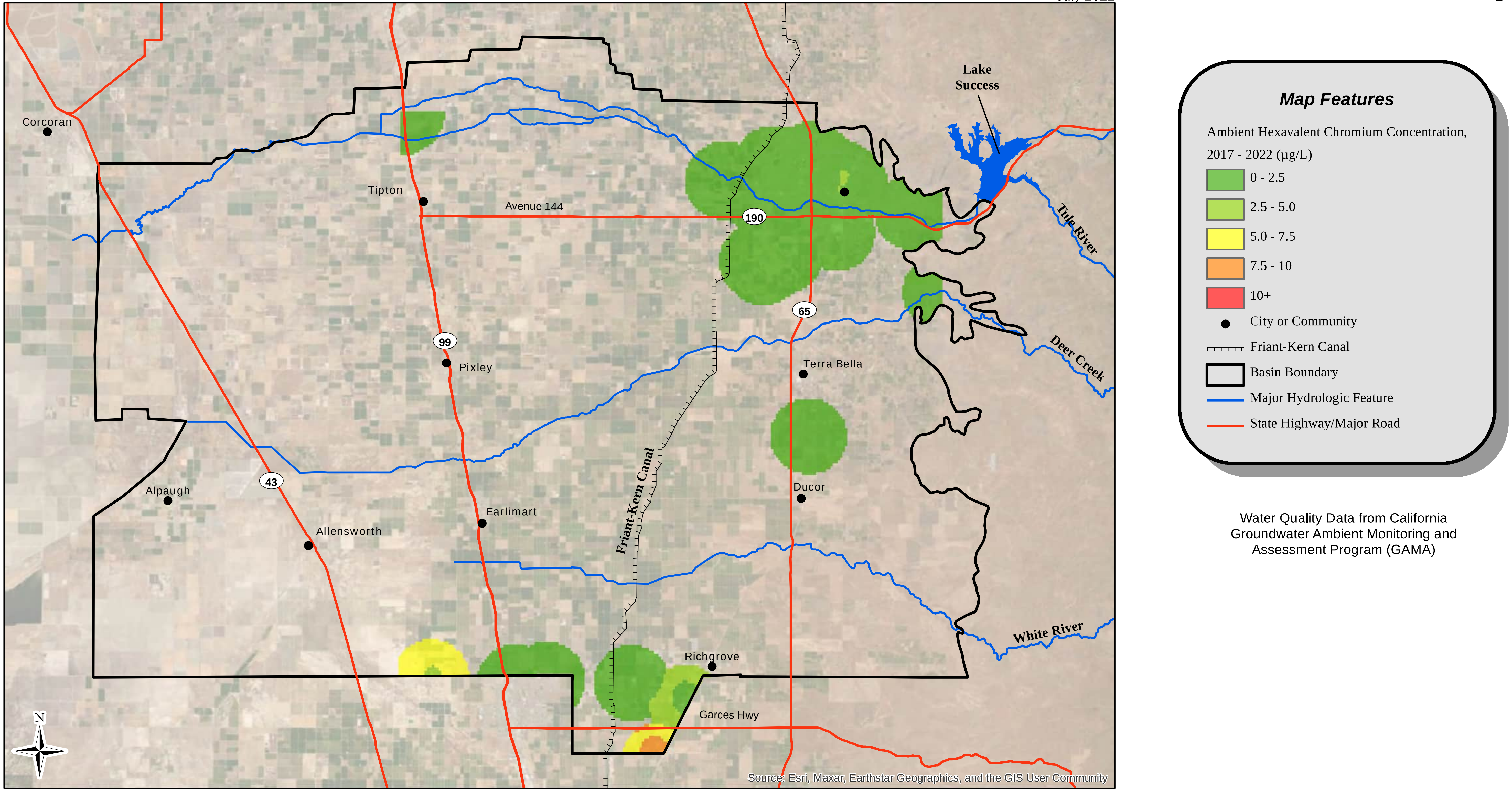
0 2.5 5 10 Miles
NAD 83 State Plane Zone 4

Nitrate as N Concentrations

Figure 2-14b

Tule Subbasin

July 2022



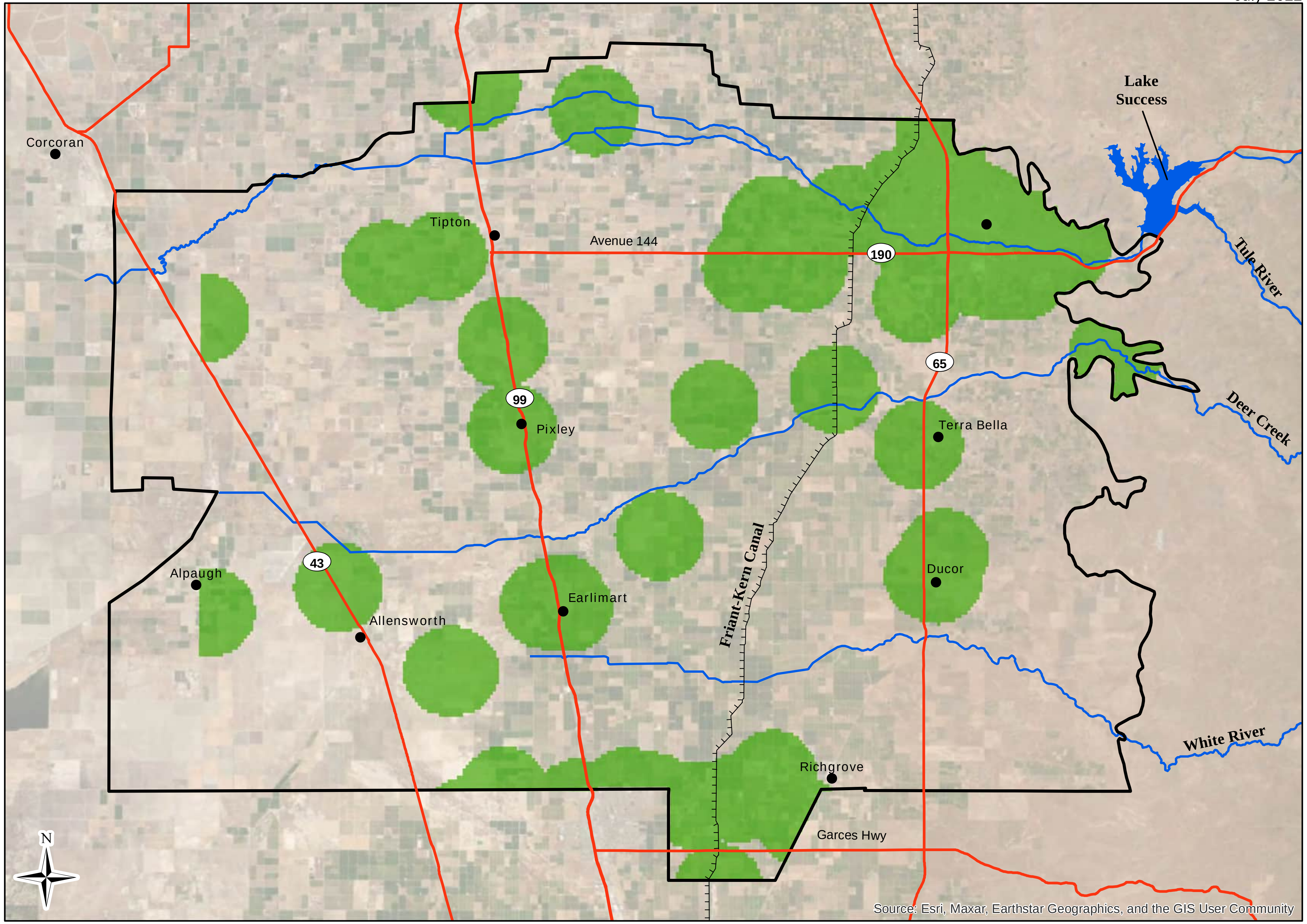
Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

Hexavalent Chromium Concentrations

Figure 2-14c

Tule Subbasin

July 2022



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

Map Features

Ambient Dibromochloropropane Concentration, 2017 - 2022 (µg/L)

- 🟩 0 - 0.05
- 🟩 0.05 - 0.10
- 🟨 0.10 - 0.15
- 🟧 0.15 - 0.20
- 🟥 0.20+
- ● City or Community
- ┬┬┬ Friant-Kern Canal
- ▭ Basin Boundary
- — Major Hydrologic Feature
- — State Highway/Major Road

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

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0 2.5 5 10 Miles

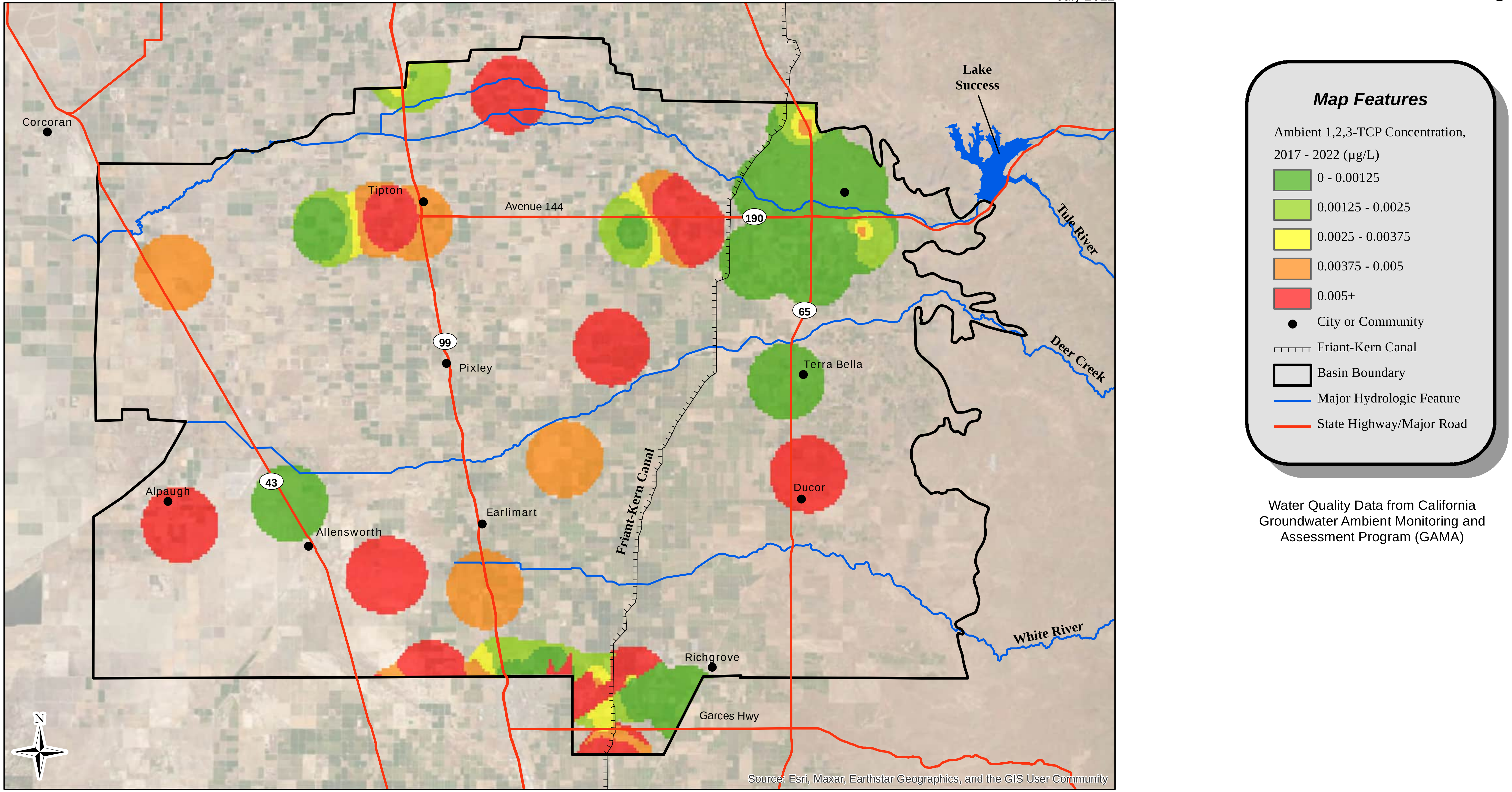
NAD 83 State Plane Zone 4

Dibromochloropropane Concentrations

Figure 2-14d

Tule Subbasin

July 2022



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

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

0 2.5 5 10 Miles

NAD 83 State Plane Zone 4

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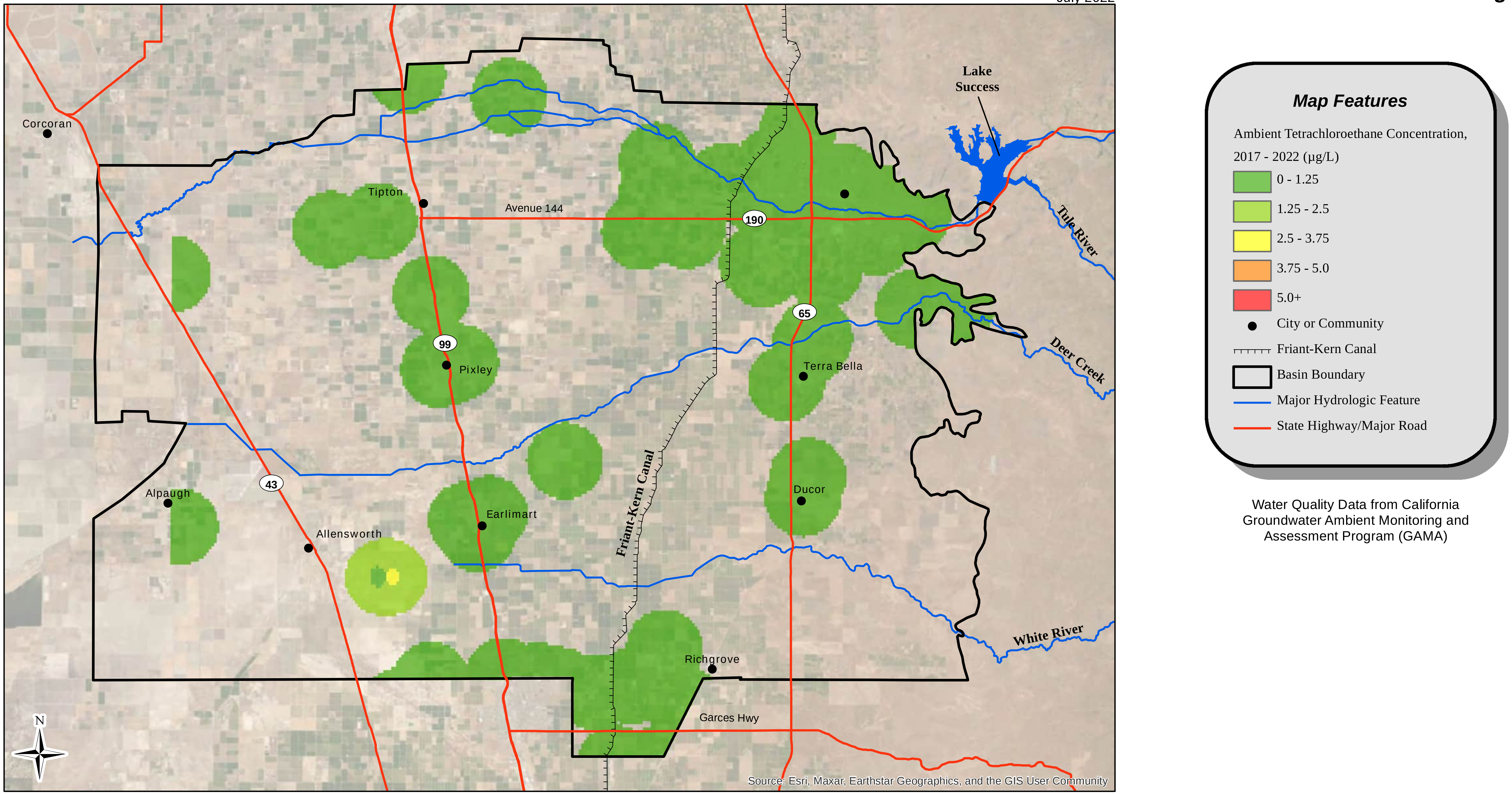
1,2,3-Trichloropropane (TCP) Concentrations

Figure 2-14e

Tule Subbasin

July 2022



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

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

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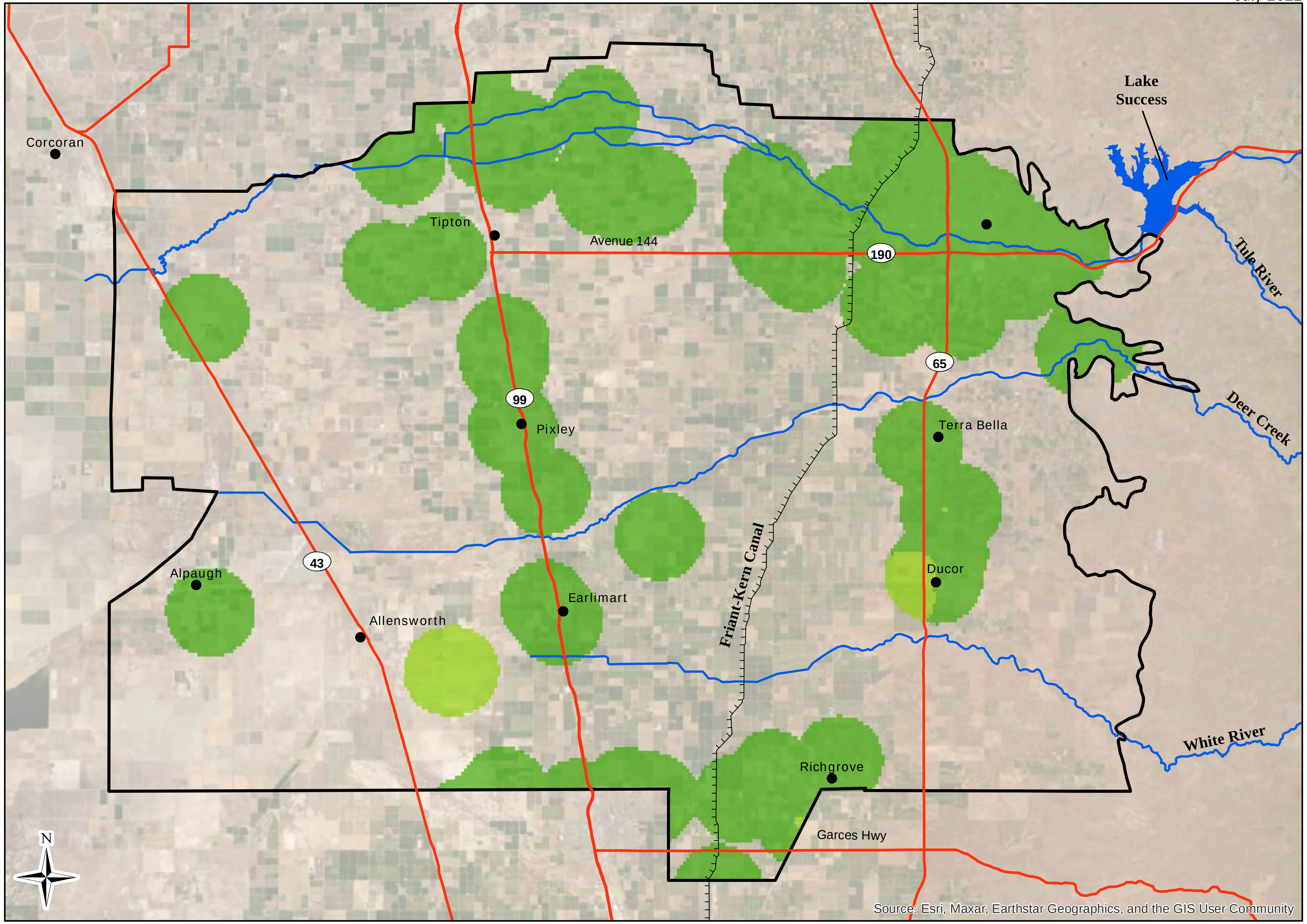
0 2.5 5 10 Miles
NAD 83 State Plane Zone 4

Tetrachloroethane (PCE) Concentrations

Figure 2-14f

Tule Subbasin

July 2022



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

Map Features

Ambient Chloride Concentration, 2017 - 2022 (μg/L)

- 🟩 0 - 125
- 🟩 125 - 250
- 🟨 250 - 375
- 🟧 375 - 500
- 🟥 500+
- ● City or Community
- Friant-Kern Canal
- Basin Boundary
- Major Hydrologic Feature
- State Highway/Major Road

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

0 2.5 5 10 Miles

NAD 83 State Plane Zone 4

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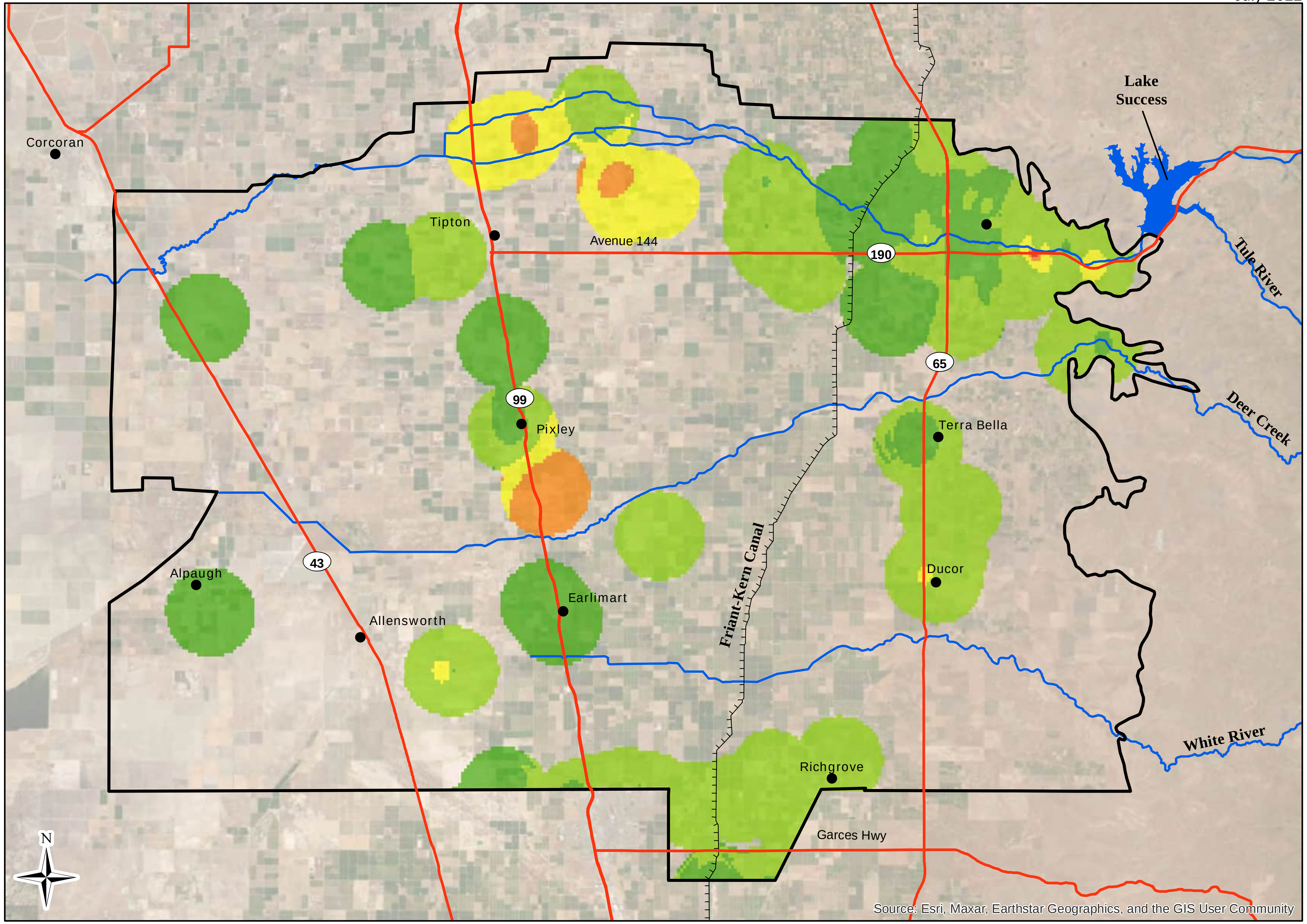
Chloride Concentrations

Figure 2-14g

Tule Subbasin

July 2022



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

Map Features

Ambient TDS Concentration,
2017 - 2022 (µg/L)

- 🟩 0 - 250
- 🟩 250 - 500
- 🟨 500 - 750
- 🟧 750 - 1,000
- 🟥 1,000+
- ● City or Community
- ┴┴┴┴ Friant-Kern Canal
- ☐ Basin Boundary
- — Major Hydrologic Feature
- — State Highway/Major Road

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

0 2.5 5 10
Miles

NAD 83 State Plane Zone 4

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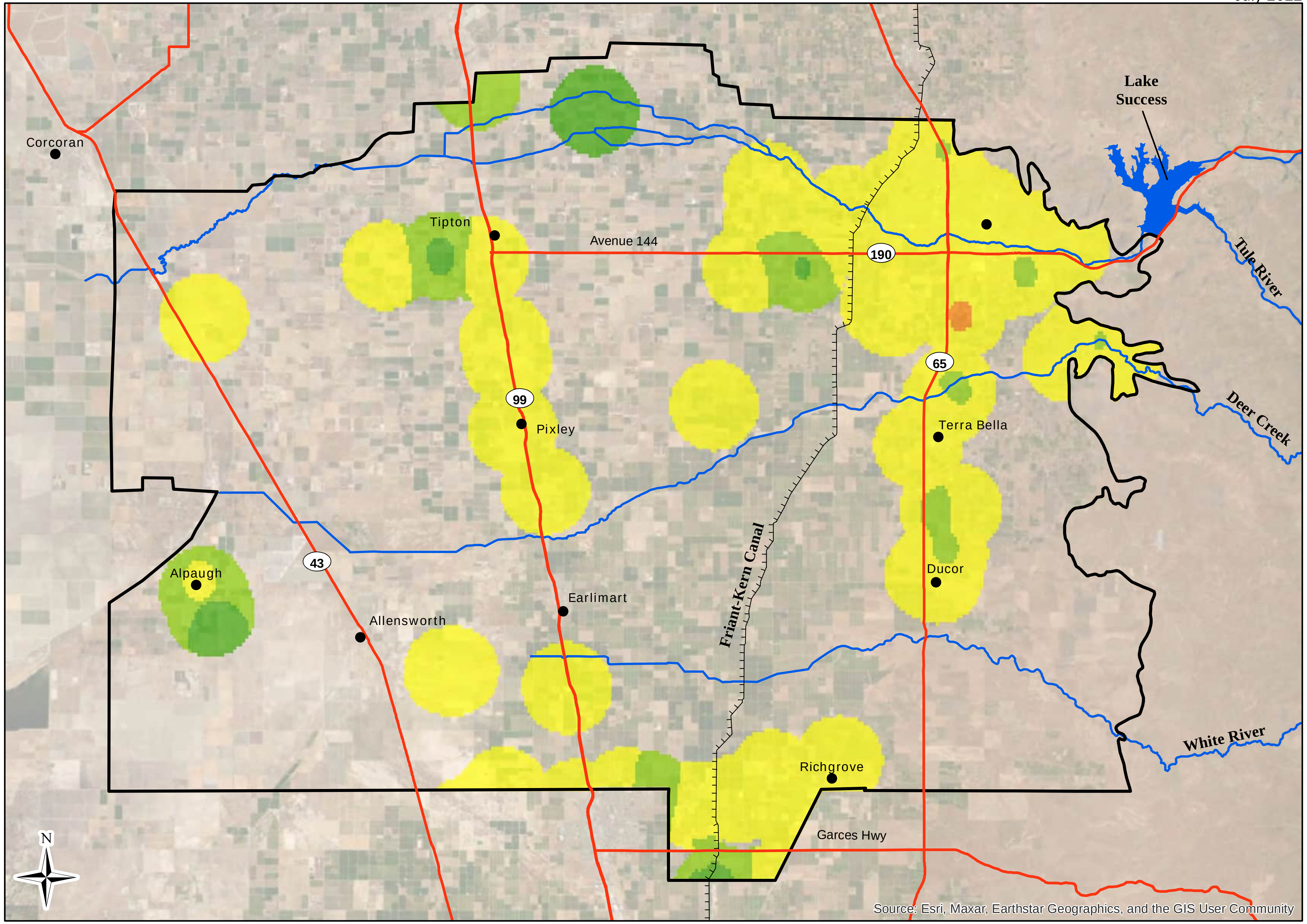
Total Dissolved Solids Concentrations

Figure 2-14h

Tule Subbasin

July 2022



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

Map Features

Ambient Perchlorate Concentration, 2017 - 2022 (µg/L)

- 🟩 0 - 1.5
- 🟩 1.5 - 3.0
- 🟨 3.0 - 4.5
- 🟧 4.5 - 6.0
- 🟥 6.0+
- ● City or Community
- ┬┬┬┬ Friant-Kern Canal
- ☐ Basin Boundary
- — Major Hydrologic Feature
- — State Highway/Major Road

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

Thomas Harder & Co.
Groundwater Consulting

0 2.5 5 10 Miles

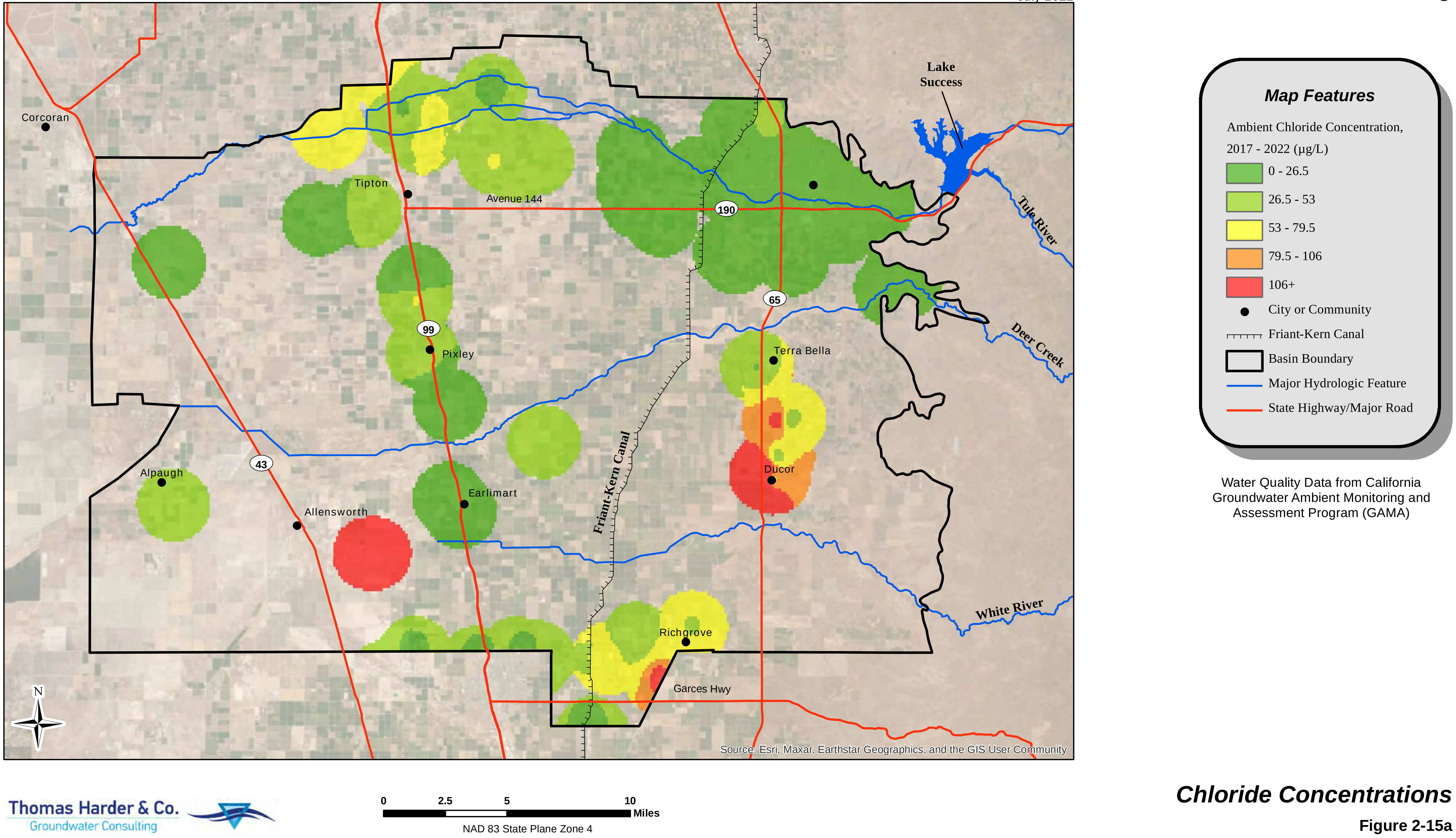
NAD 83 State Plane Zone 4

Perchlorate Concentrations

Figure 2-14i

Tule Subbasin

July 2022



Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

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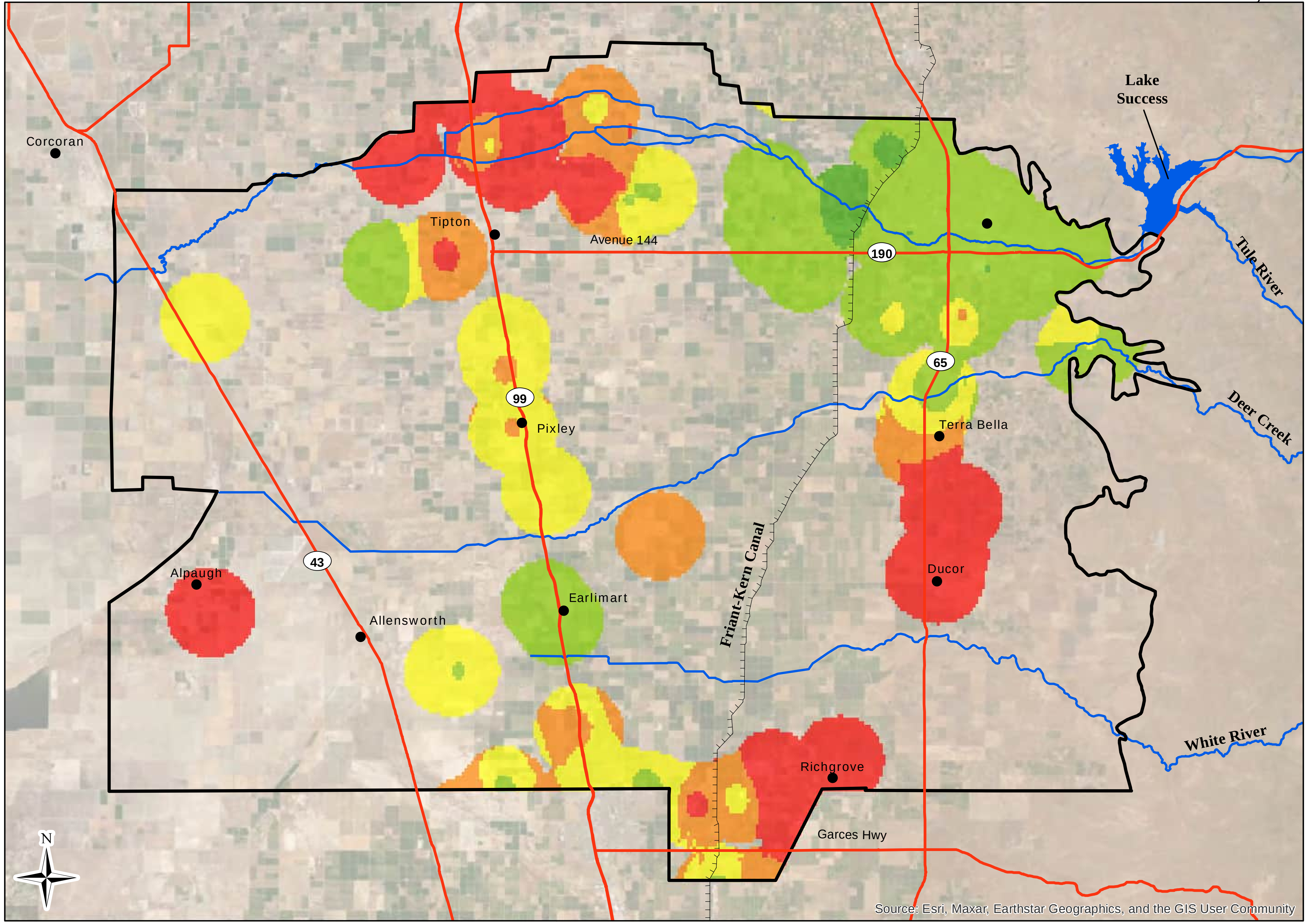
Groundwater Consulting

Chloride Concentrations

Figure 2-15a

Tule Subbasin

July 2022



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

Map Features

Ambient Sodium Concentration, 2017 - 2022 (µg/L)

🟩 0 - 17.25
🟩 17.25 - 34.5
🟨 34.5 - 51.75
🟧 51.75 - 69
🟥 69.0+
● City or Community
┼┼┼┼ Friant-Kern Canal
☐ Basin Boundary
— Major Hydrologic Feature
— State Highway/Major Road

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

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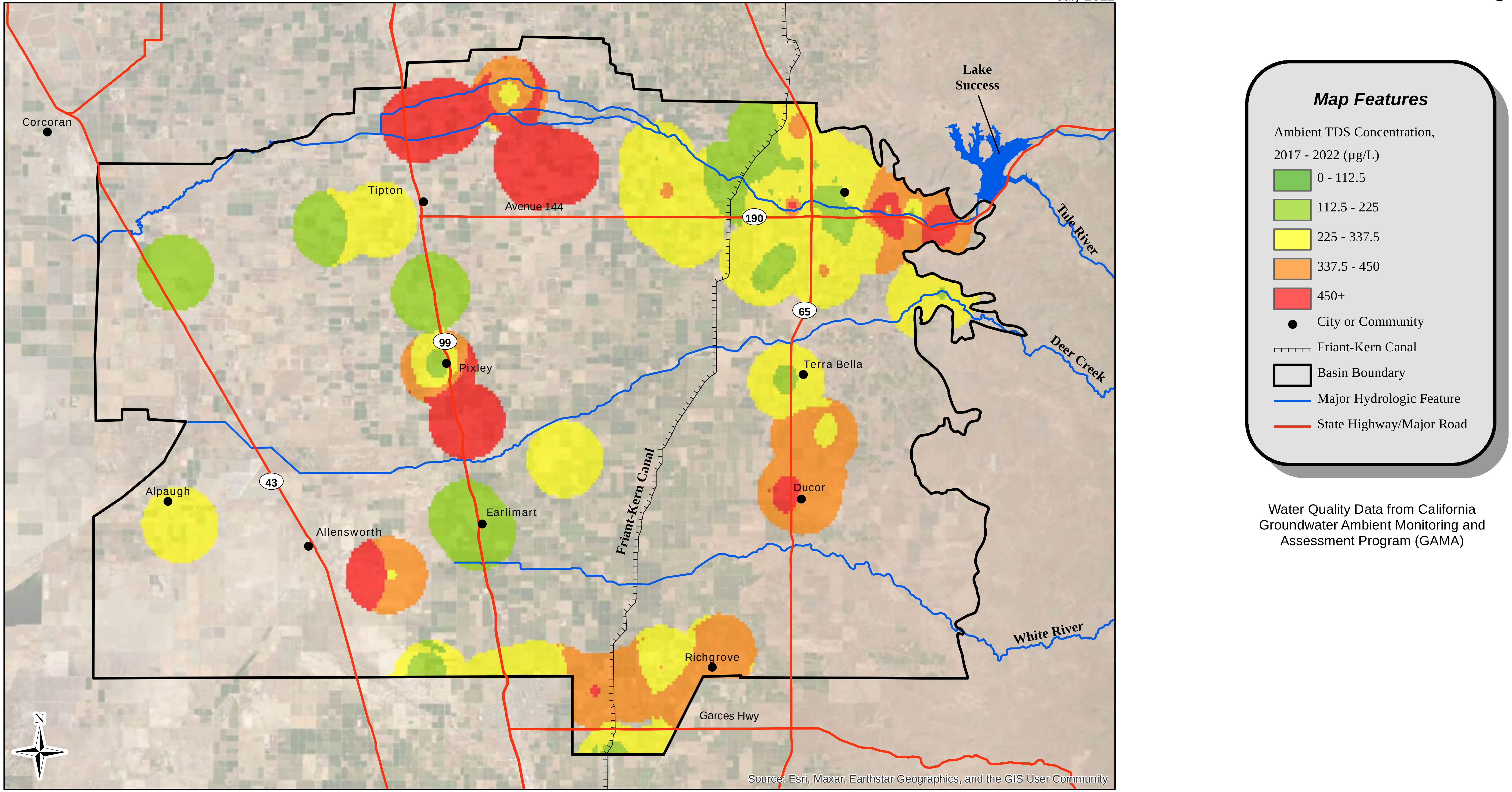
0 2.5 5 10 Miles
NAD 83 State Plane Zone 4

Sodium Concentrations

Figure 2-15b

Tule Subbasin

July 2022



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

Water Quality Data from California Groundwater Ambient Monitoring and Assessment Program (GAMA)

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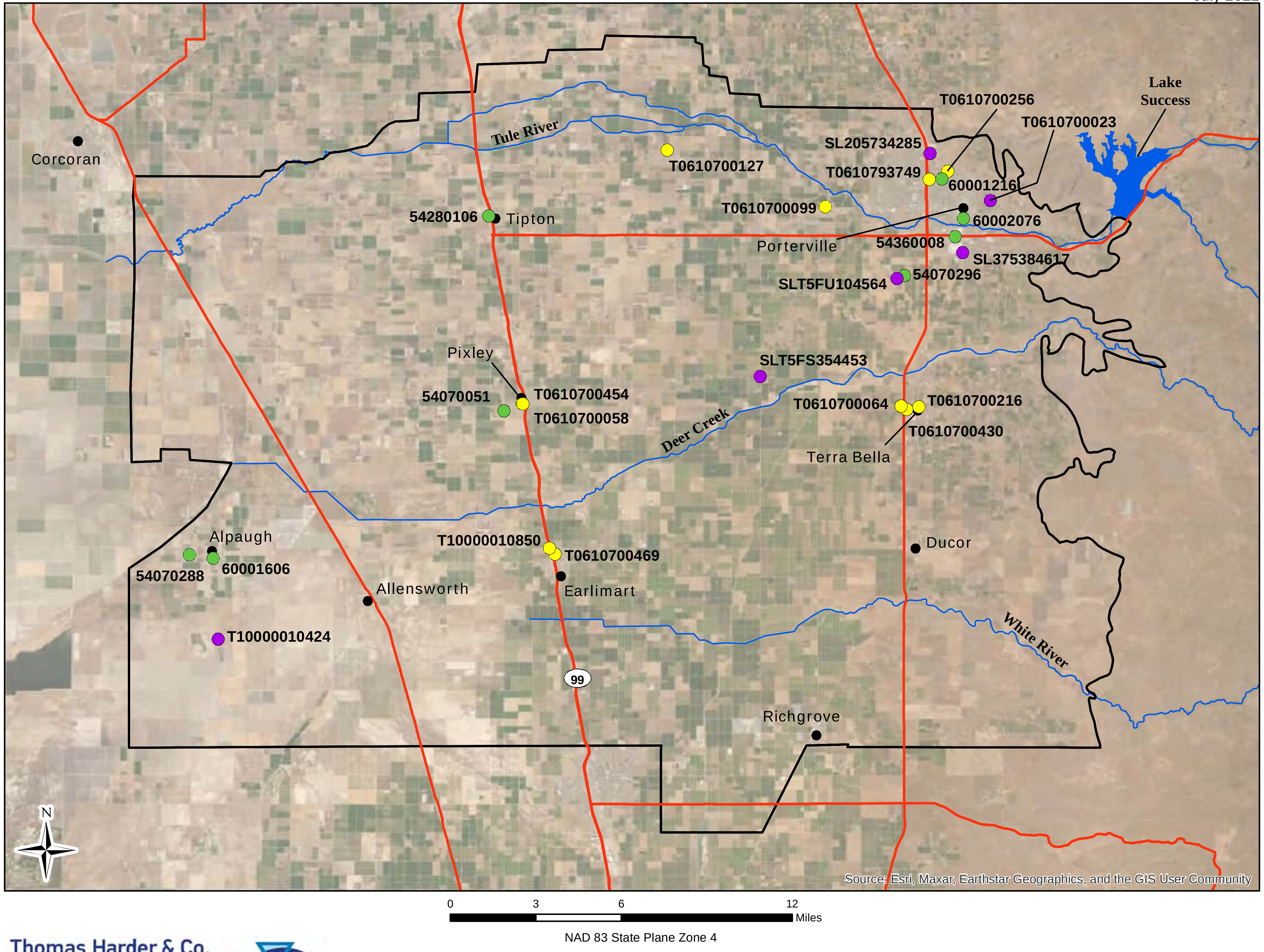
Total Dissolved Solids Concentrations

Figure 2-15c

Tule Subbasin

July 2022



Map Features

Active Cleanup Site

- ● Cleanup Program Site
- ● DTSC
- ● LUST Cleanup Site
- — Freeway/State Highway
- ☐ Tule Subbasin
- ● City or Community
- — Major Hydrologic Feature

Source: https://geotracker.waterboards.ca.gov

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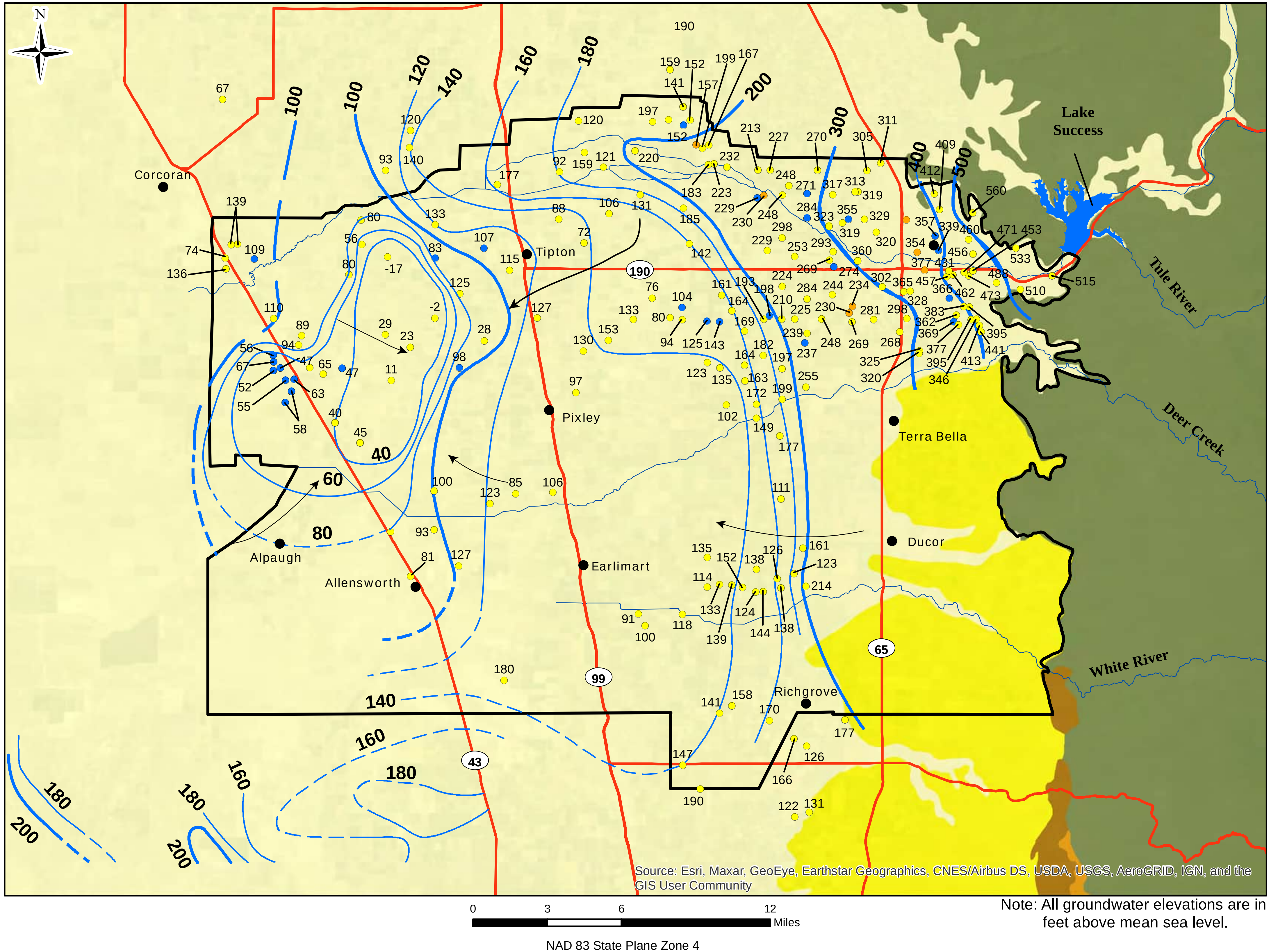
Active Cleanup Sites within the Tule Subbasin

Figure 2-16

Tule Subbasin

July 2022



Map Features

- **140** Groundwater Elevation Contour, dashed where approximate (ft amsl)
- ← Groundwater Flow Direction
- ● Groundwater Elevations from Well with Unknown Perforation Interval
- ● Groundwater Elevations from Well with Perforations in the Upper and Lower Aquifer
- ● Groundwater Elevations from Well with Perforations in the Upper Aquifer
- ▭ Tule Subbasin
- ● City or Community
- — Major Hydrologic Feature
- — State Highway/Major Road
- ▨ Surficial Deposits
- ▨ Tertiary Loosely Consolidated Deposits
- ▨ Non-Marine Sedimentary Rocks
- ▨ Marine Sedimentary Rocks
- ▨ Crystalline Basement

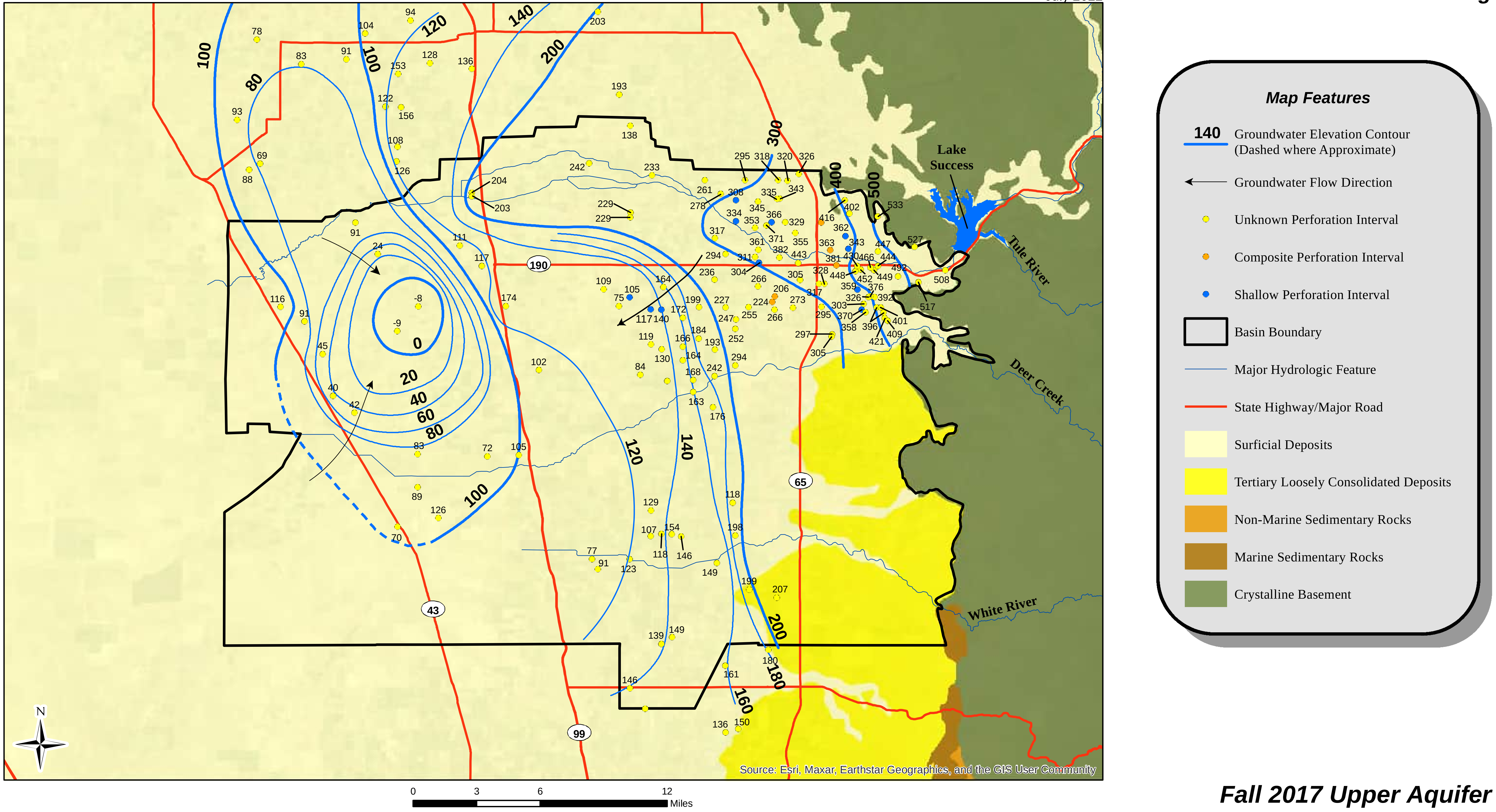
Groundwater contours shown south of the Tule Subbasin and west of Highway 43 are depicted based on Water-Level Elevations And Direction of Groundwater Flow For the Upper Zone (Spring 2017)

Note: All groundwater elevations are in feet above mean sea level.

Groundwater Elevations are measured from January to May.

Spring 2017 Upper Aquifer Groundwater Elevation Contours

Figure 2-17



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

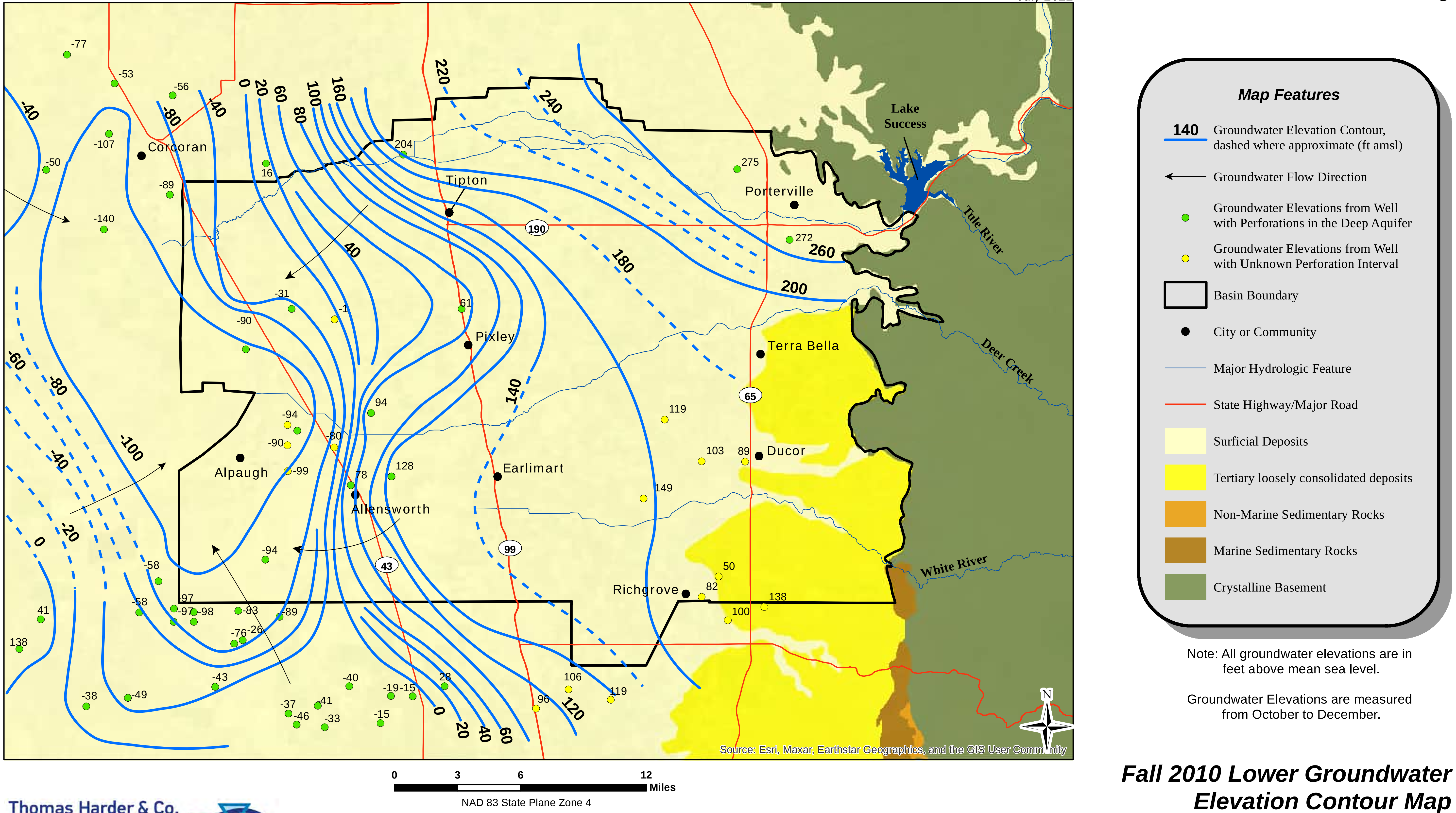
NAD 83 State Plane Zone 4

Fall 2017 Upper Aquifer Groundwater Elevation Contours

Figure 2-18

Tule Subbasin

July 2022



Note: All groundwater elevations are in feet above mean sea level.

Groundwater Elevations are measured from October to December.

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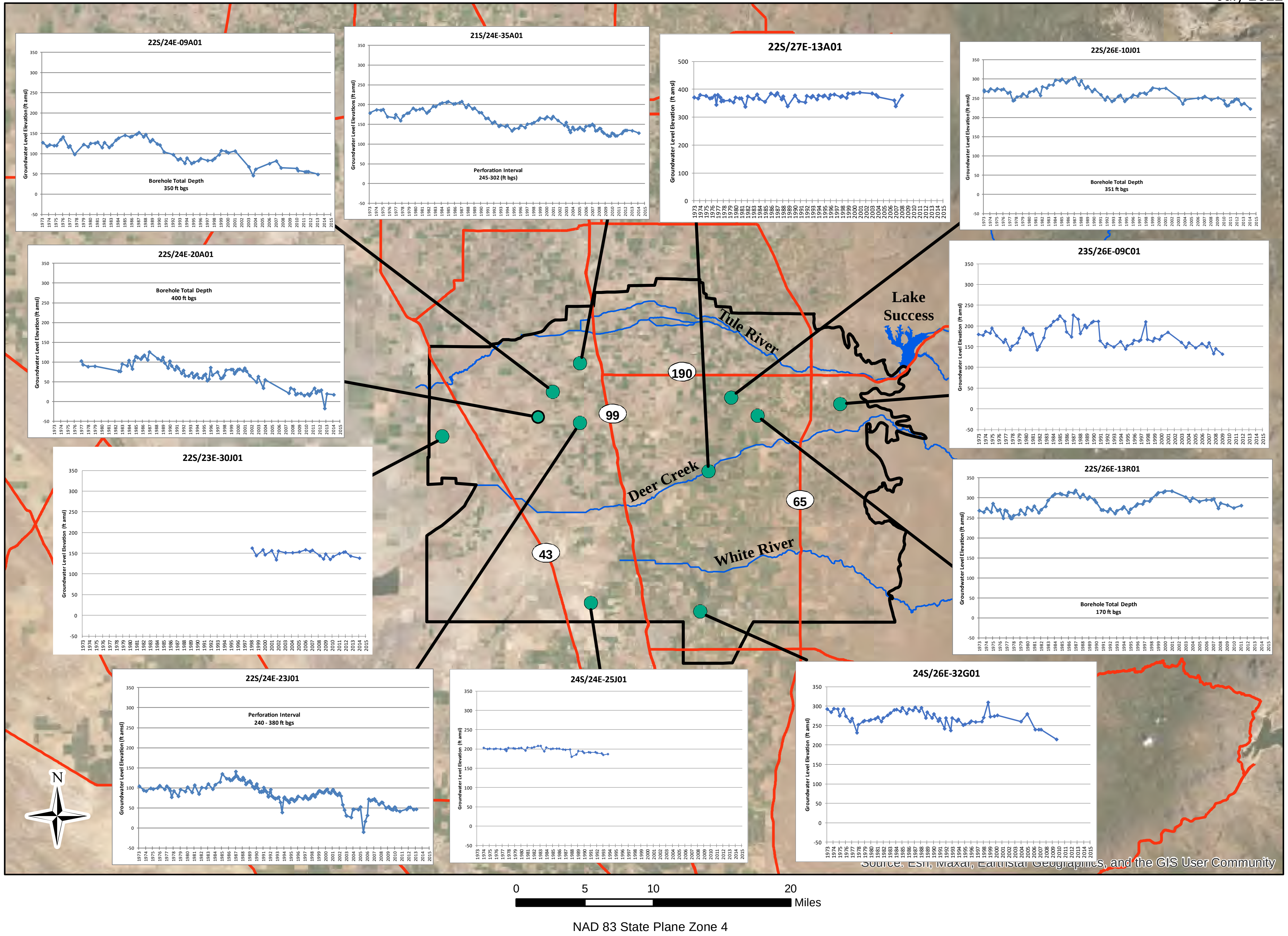
Fall 2010 Lower Groundwater Elevation Contour Map

Figure 2-19

Tule Subbasin

July 2022



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

Map Features

- ● Hydrograph Well
- ☐ Tule Subbasin
- — Major Hydrologic Feature
- — State Highway/Major Road

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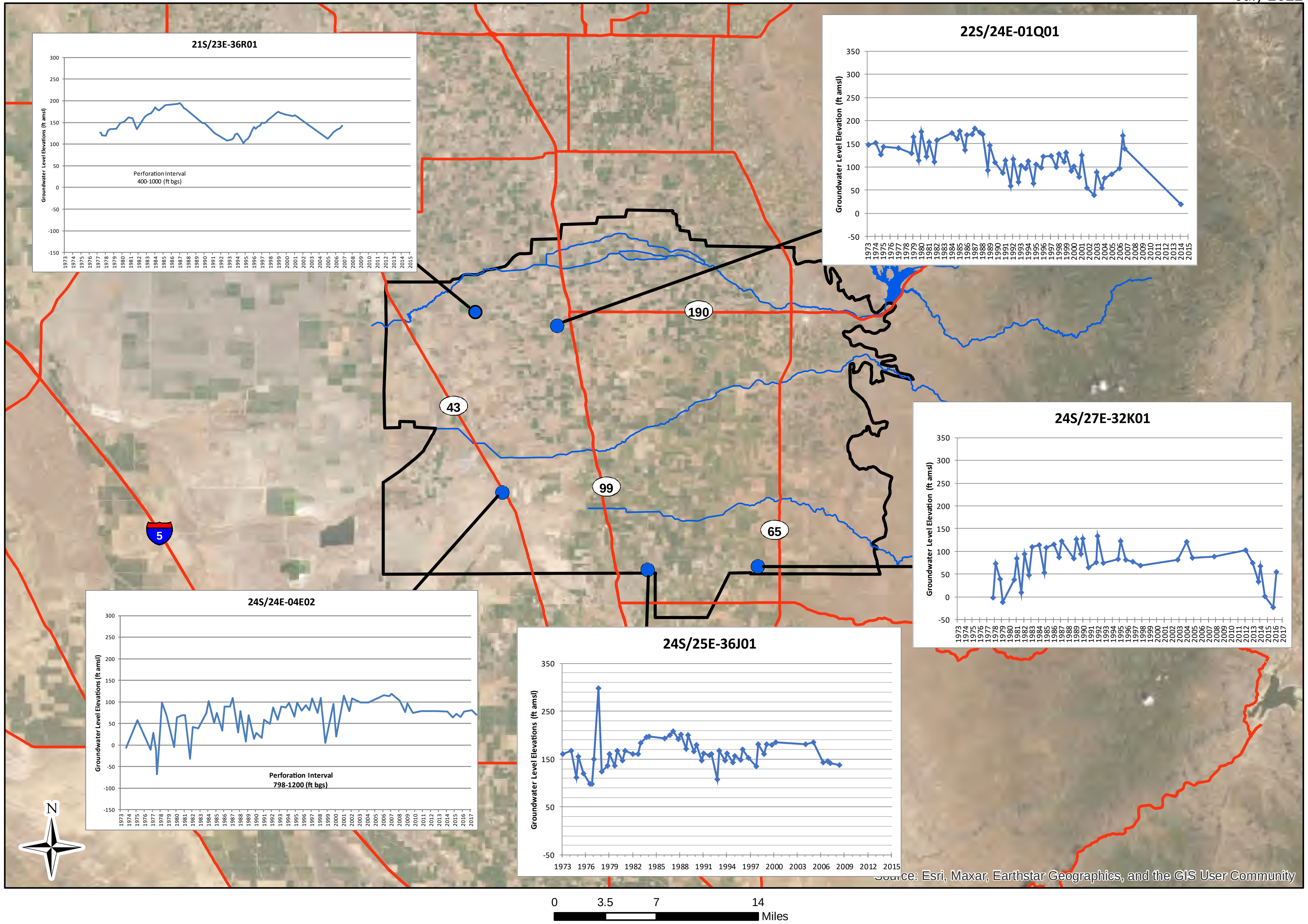
Upper Aquifer Groundwater Level Hydrographs

Figure 2-20

Tule Subbasin

July 2022



NAD 83 State Plane Zone 4

Map Features

● Hydrograph Well

▭ Basin Boundary

— Major Hydrologic Feature

— State Highway/Major Road

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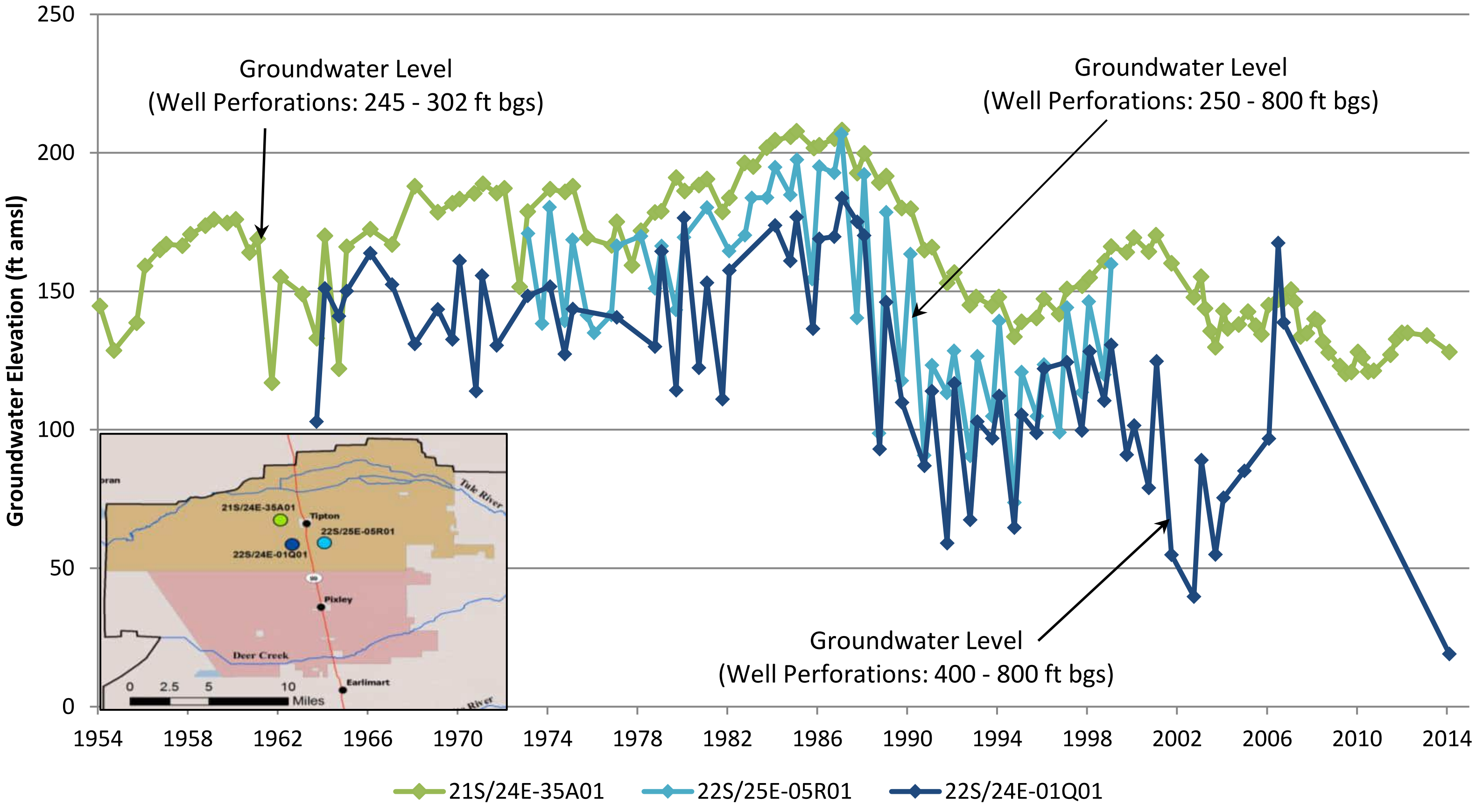
Lower Aquifer Groundwater Level Hydrographs

Figure 2-21

Figure 2-22

Groundwater Levels Near Tipton

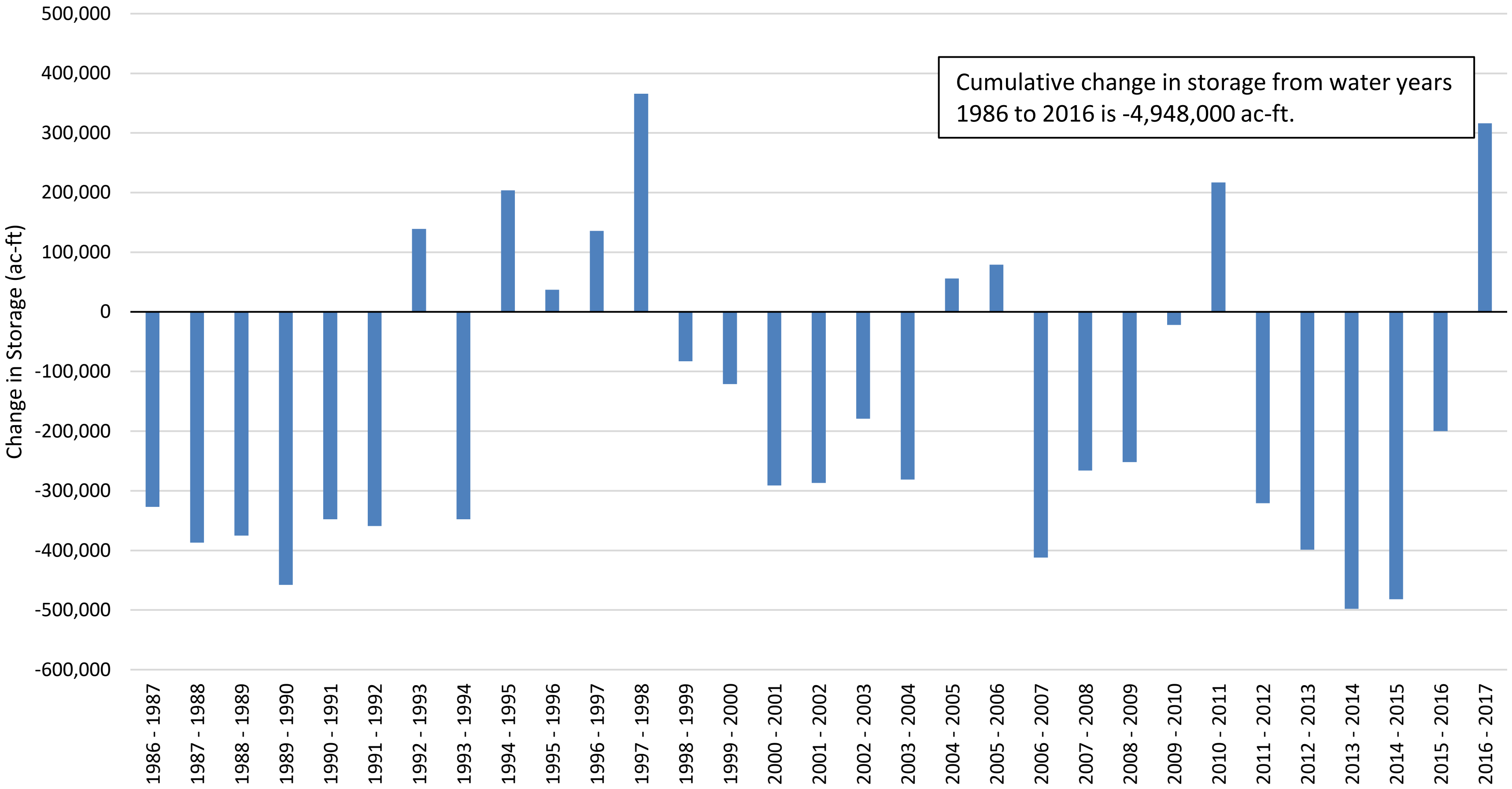


Note:

ft bgs = feet below ground surface.

Figure 2-23

Change in Groundwater Storage (acre-ft) from 1986/87 to 2016/17

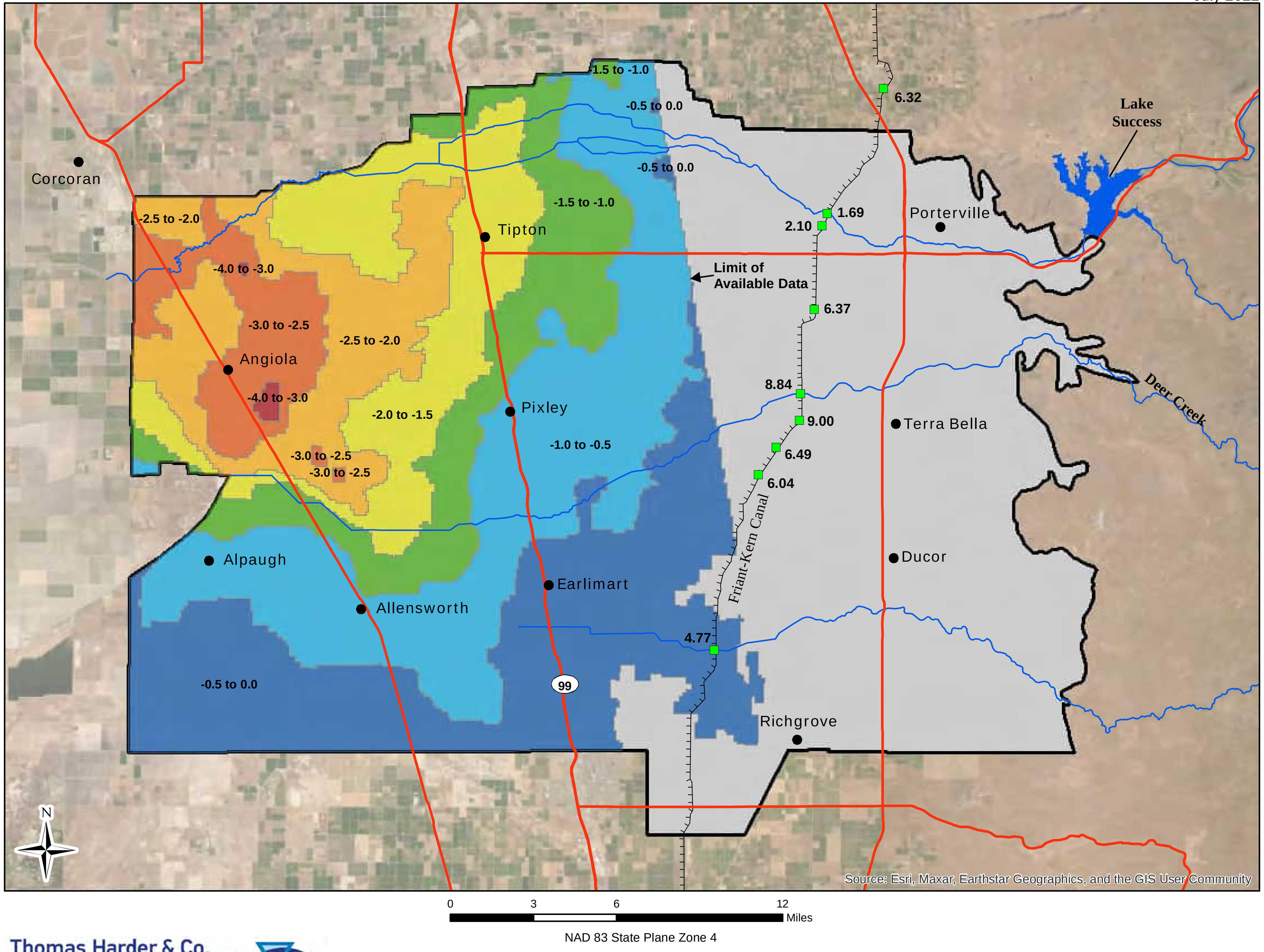


Cumulative change in storage from water years 1986 to 2016 is -4,948,000 ac-ft.

Note: Data in water years (October 1 to September 30).

Tule Subbasin

July 2022



Map Features

2007 - 2011 Land Surface Subsidence* (ft)

- 🟥 -4.0 to -3.0
- 🟧 -3.0 to -2.5
- 🟧 -2.5 to -2.0
- 🟨 -2.0 to -1.5
- 🟩 -1.5 to -1.0
- 🟦 -1.0 to -0.5
- 🟦 -0.5 to 0.0
- 🟩 Measured Subsidence Points along the Friant-Kern Canal (ft) 1959-2017
- Friant-Kern Canal
- ☐ Basin Boundary
- ● City or Community
- Major Hydrologic Feature
- Freeway/State Highway

*From LSCE, 2014

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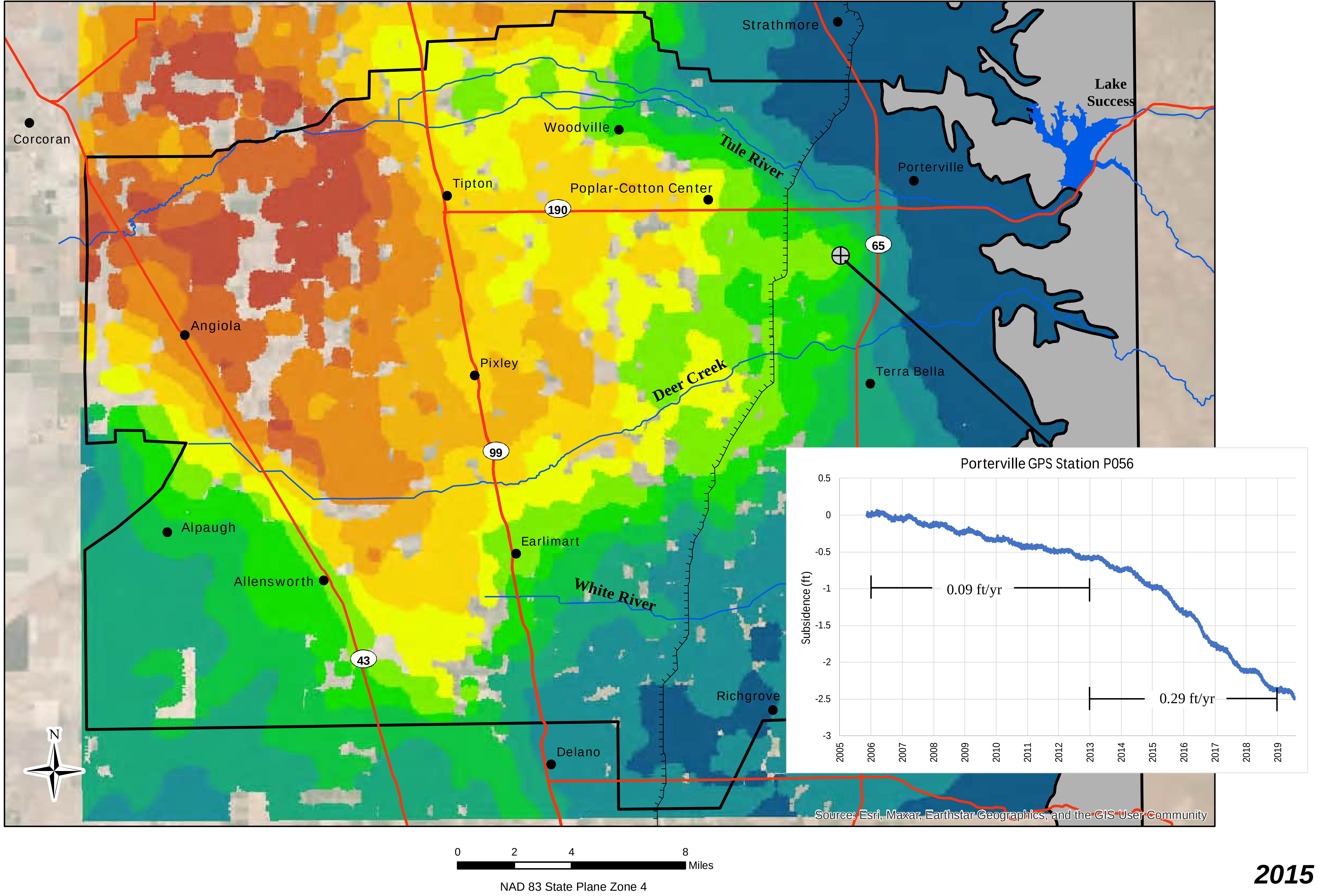
2007 to 2011 Land Subsidence

Figure 2-24

Tule Subbasin

July 2022



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

Map Features

InSAR Subsidence from 2015 to 2018 (ft)

- -2.75 to -2.50
- -2.50 to -2.25
- -2.25 to -2.00
- -2.00 to -1.75
- -1.75 to -1.50
- -1.50 to -1.25
- -1.25 to -1.00
- -1.00 to -0.75
- -0.75 to -0.50
- -0.50 to -0.25
- -0.25 to 0
- 0 to 0.25
- 0.25 to 0.50

Friant-Kern Canal

▨ No Flow Boundary

☐ Basin Boundary

● City or Community

Major Hydrologic Feature

State Highway/Major Road

2015 to 2018 Land Subsidence

Figure 2-25

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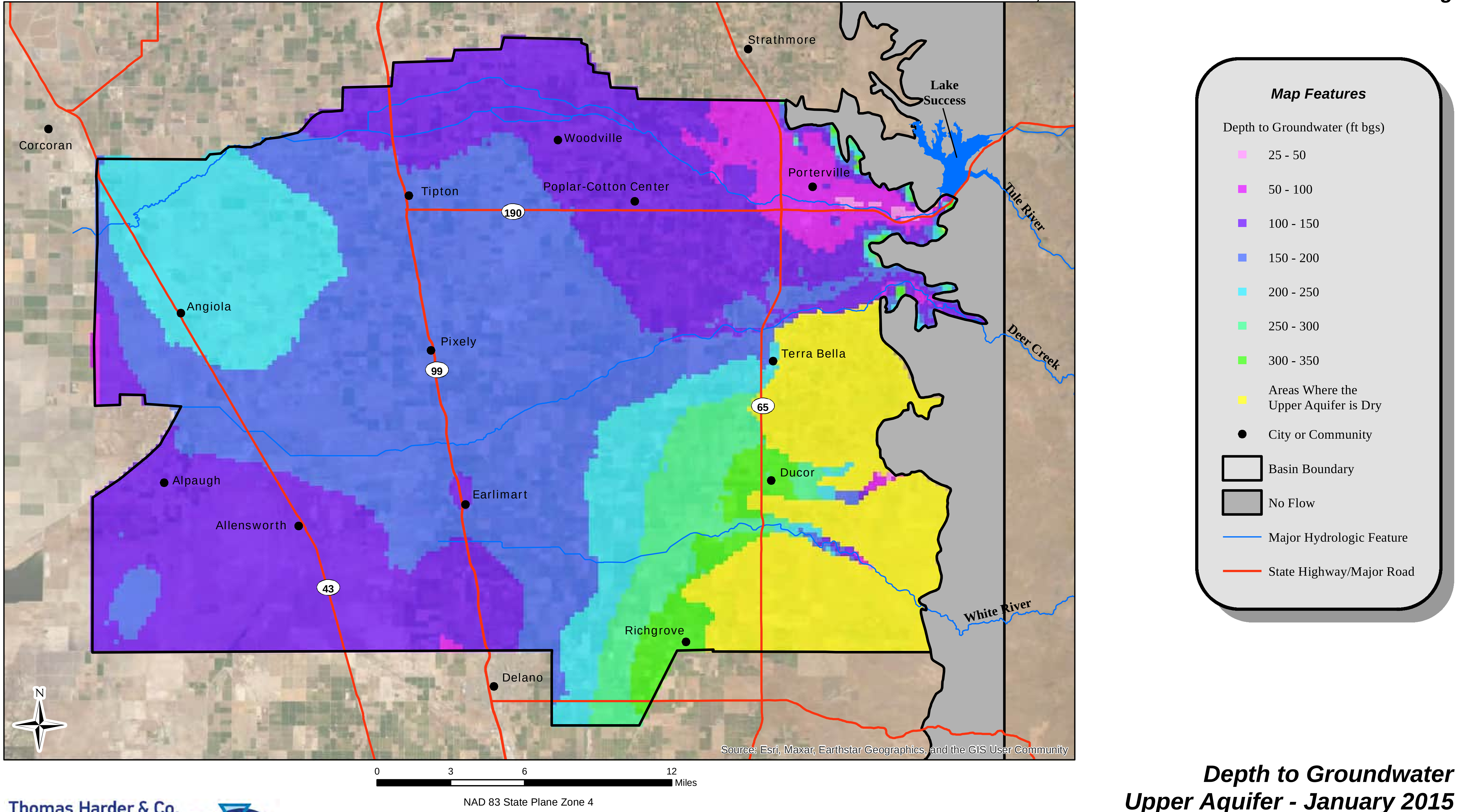
Tule Subbasin

July 2022



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

NAD 83 State Plane Zone 4

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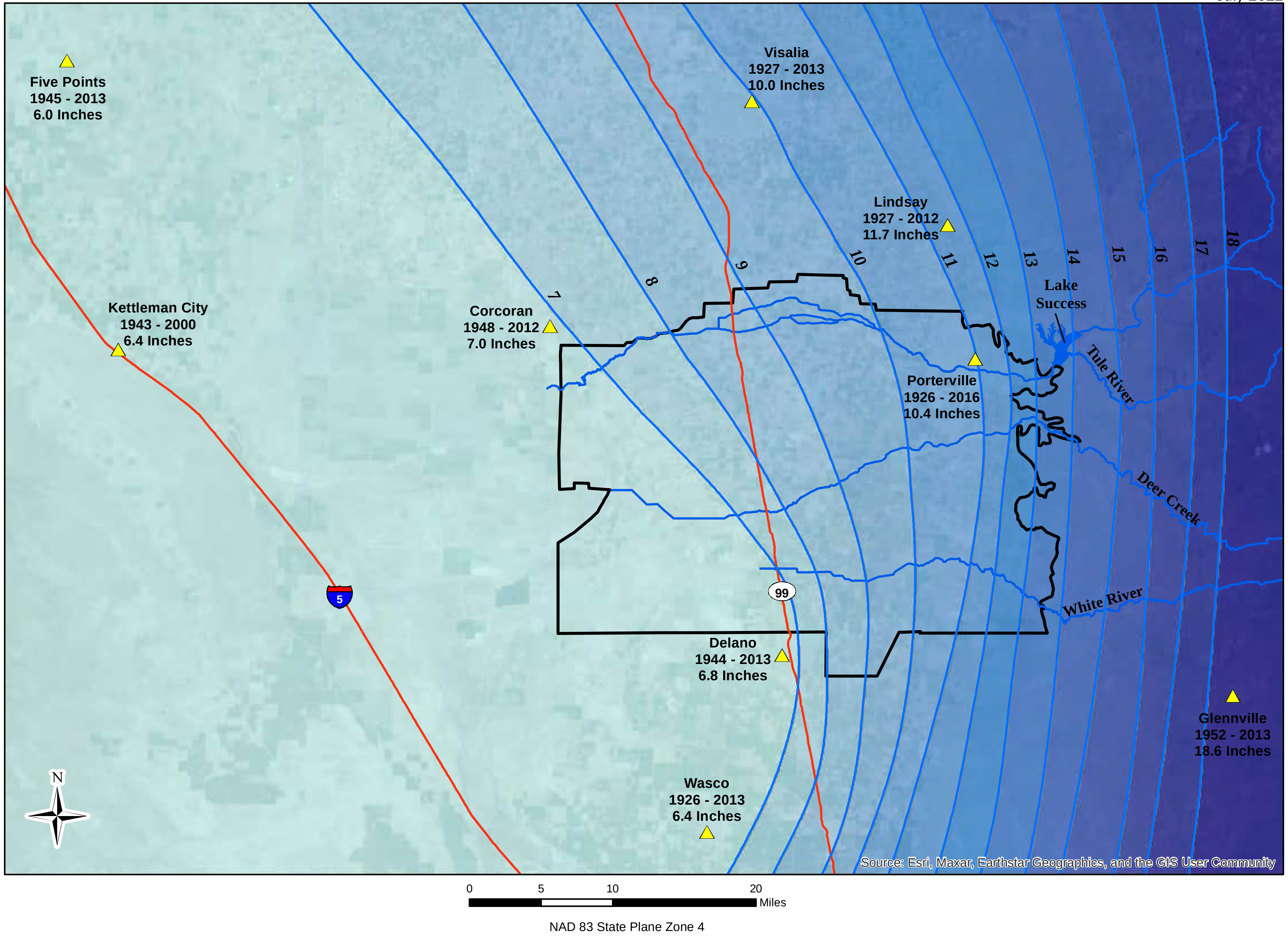
Depth to Groundwater
Upper Aquifer - January 2015

Figure 2-26

Tule Subbasin

July 2022



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

NAD 83 State Plane Zone 4

Map Features

Lindsay
1927 - 2012
11.7 Inches
△ Precipitation Station, Period of Record, and Average Annual Precipitation

Average Annual Precipitation Inches Per Year

Basin Boundary

Major Hydrologic Feature

Freeway/State Highway

Notes: Precipitation station data from Western Regional Climate Center (www.wrcc.dri.edu) and California Irrigation Management Information System.

Isohyetal data from Average Annual Precipitation Zones from the California Department of Forestry and Fire Protection (1998). Data for 1900 through 1960.

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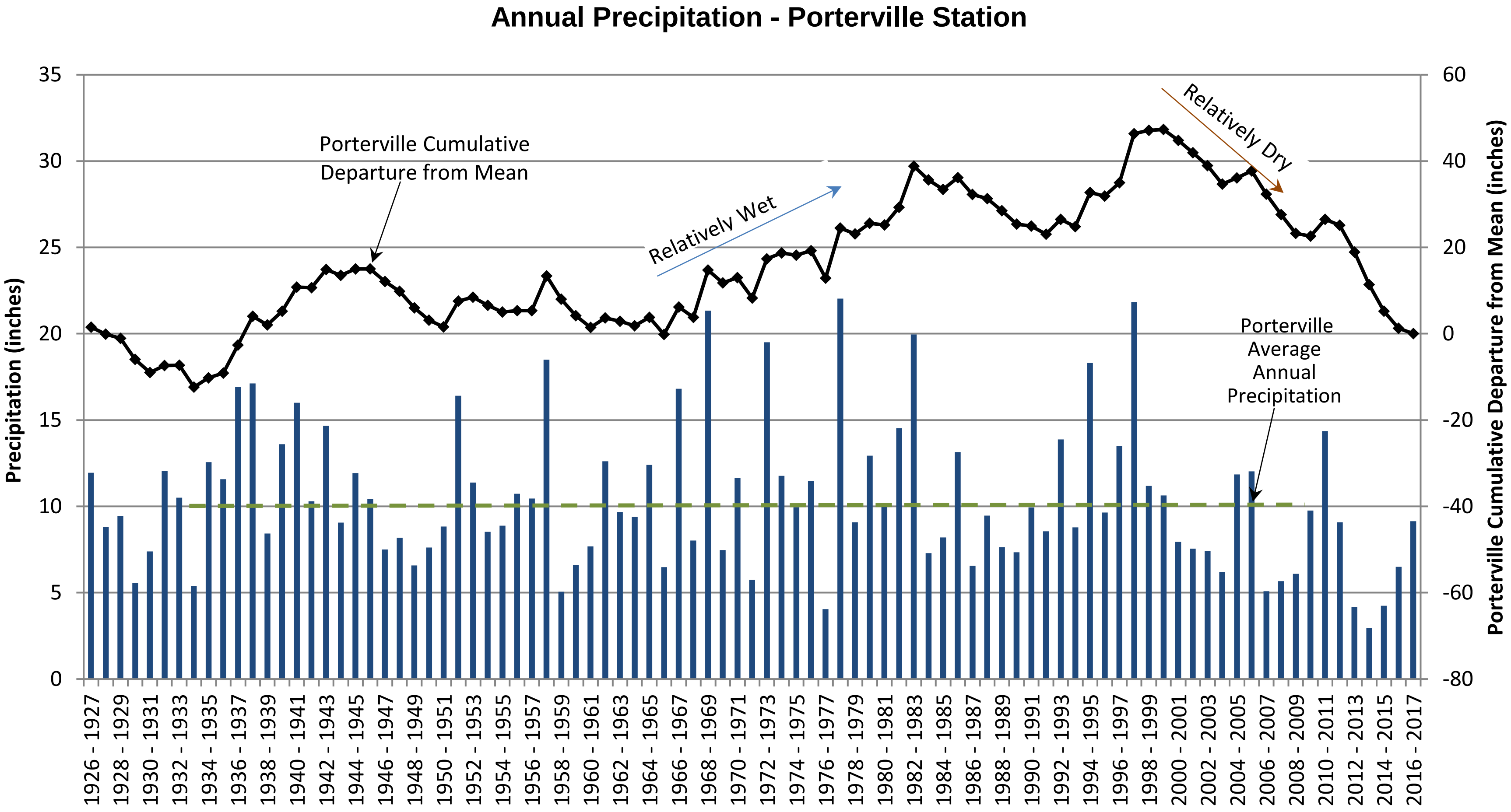
Isohyetal Map

Figure 2-27

Figure 2-28



Notes:

Data in water years (October 1 to September 30).
Data from Western Regional Climate Center (1926-2001), California Irrigation Management Information System (2002-2016).

Deer Creek versus White River Monthly Streamflow
1971 - 2005

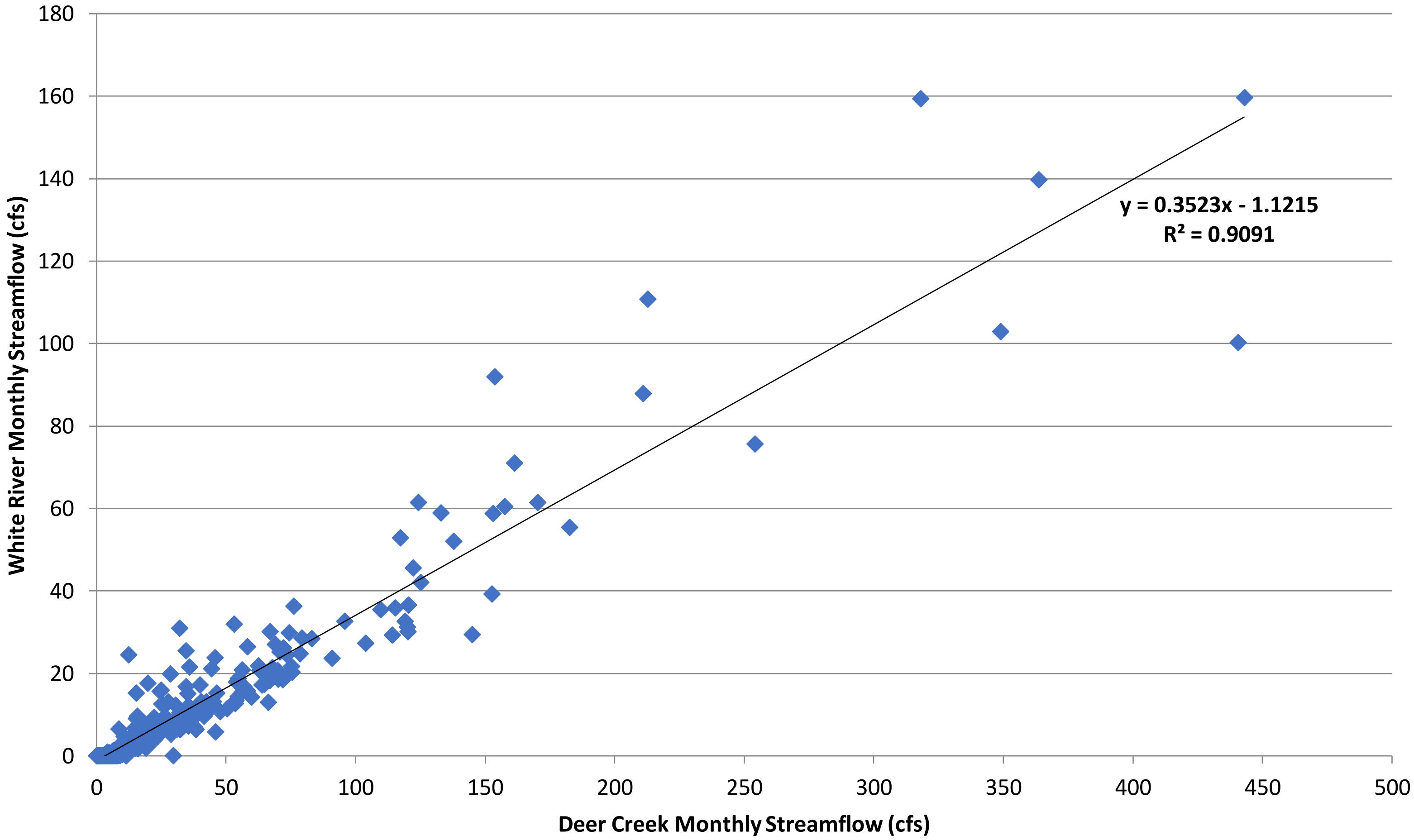
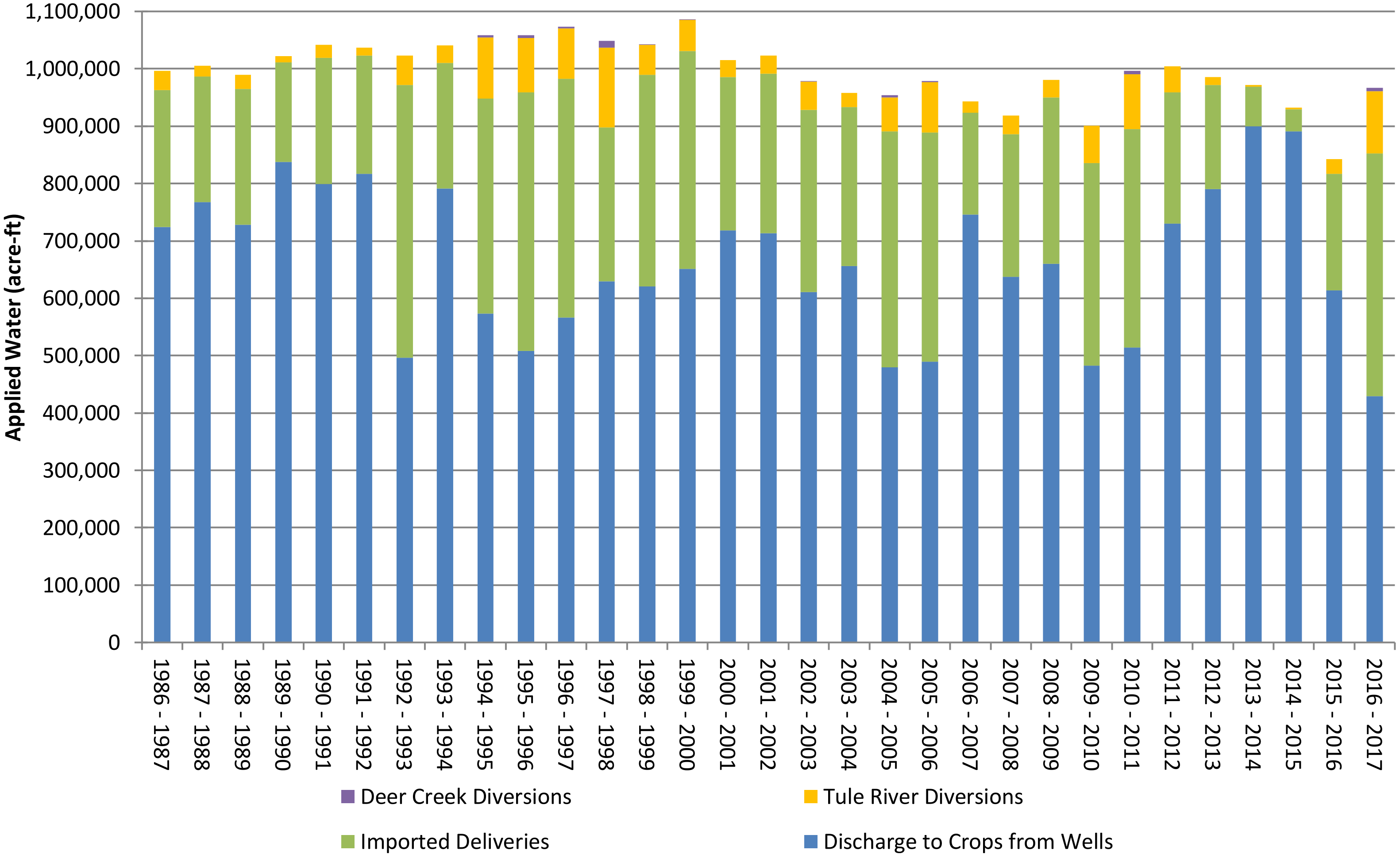


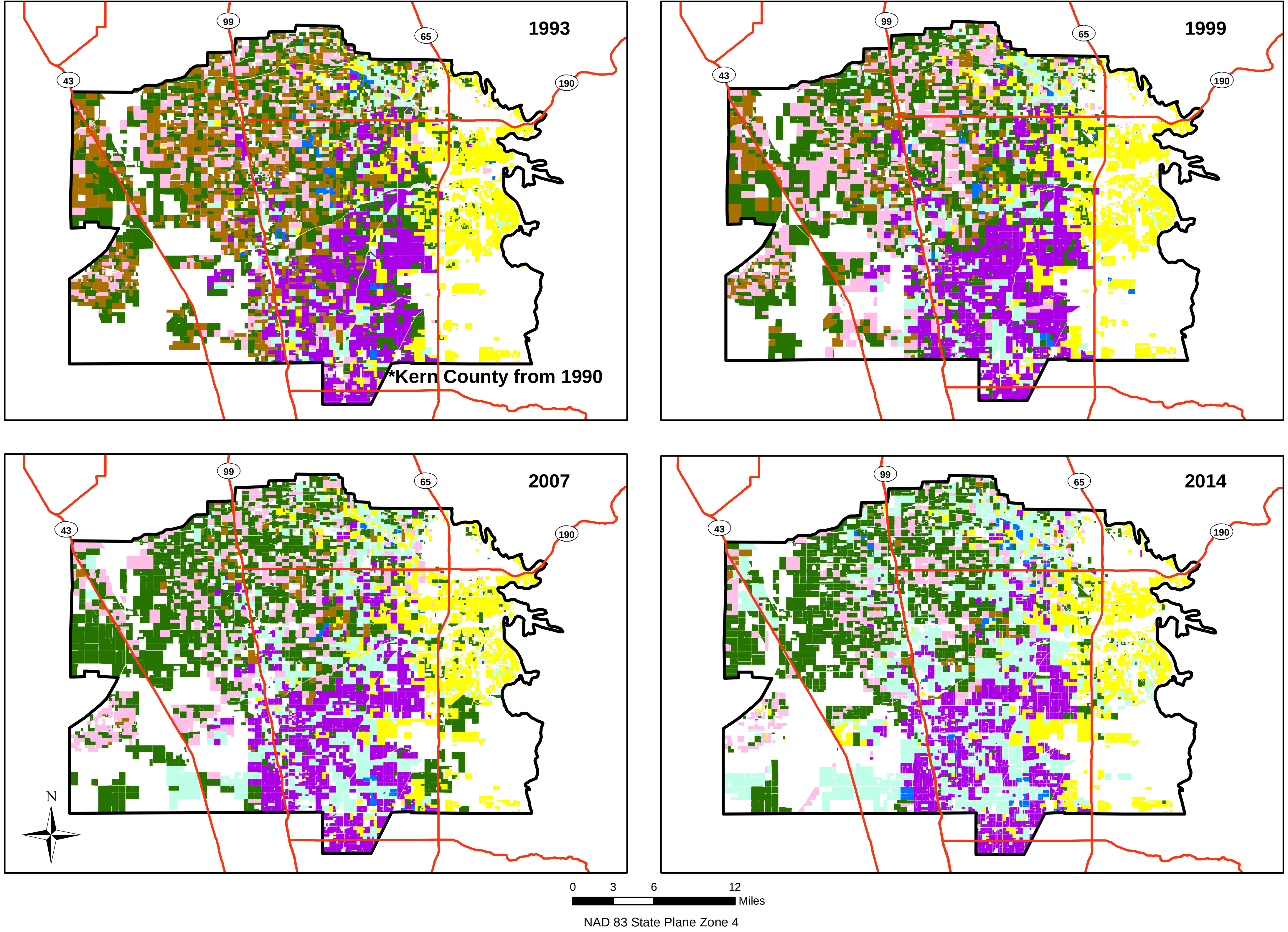
Figure 2-30

Applied Water to Irrigated Agriculture by Source



Tule Subbasin

July 2022



Map Features

☐ Tule Groundwater Subbasin
🟥 Alfalfa, Pasture
🟩 Corn, Grain, Grain Hay, and Misc. Field Crops
🟫 Cotton
🟨 Deciduous & Fruit Trees
🟪 Grapes
⬜ Nuts
🟦 Truck Crops
— Major Road

Notes: Data from California Department of Water Resources and Kern County Department of Agriculture and Measurement Standards

Irrigated crops only.

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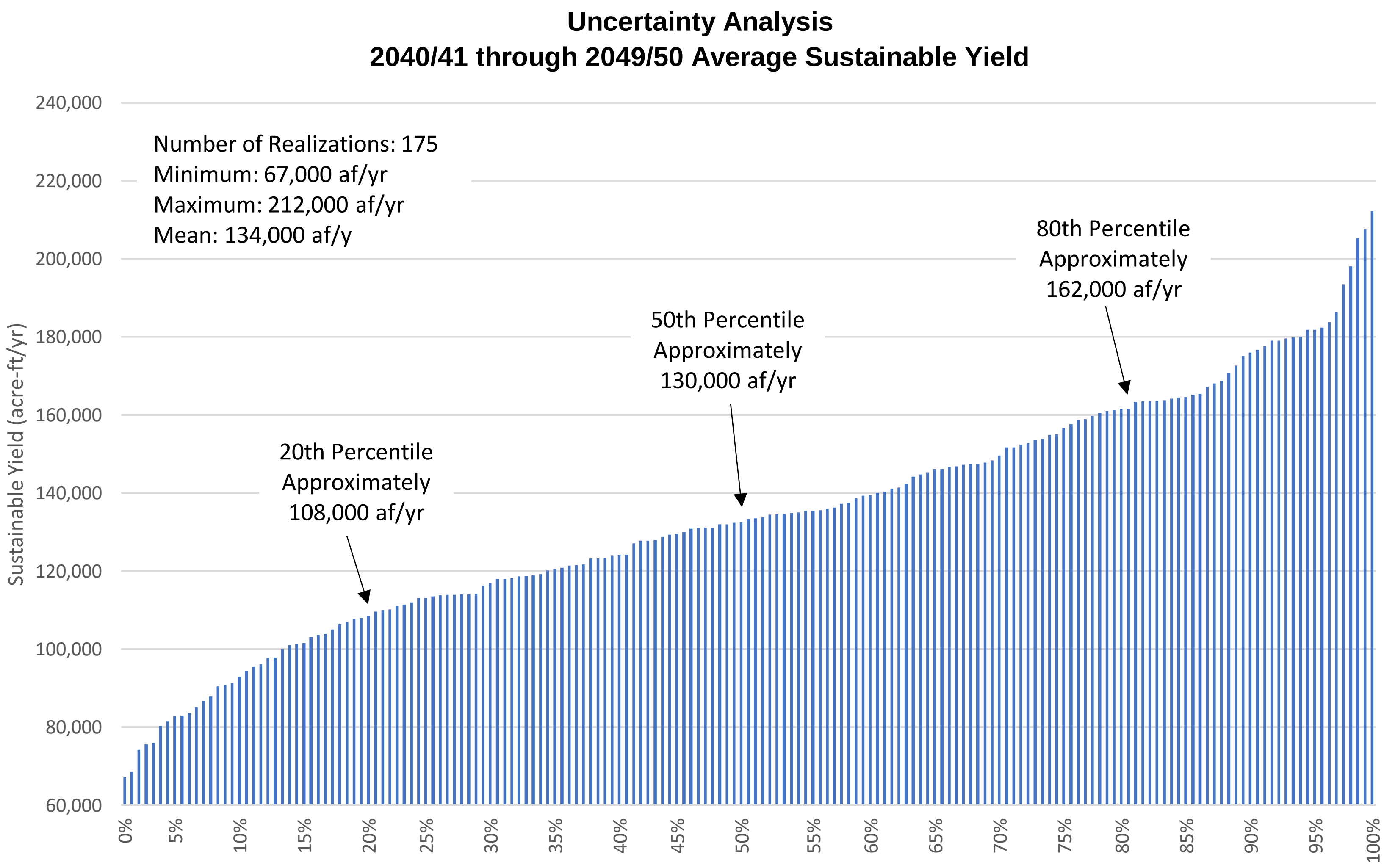
Tule Groundwater Subbasin Historical Crop Patterns

Figure 2-31

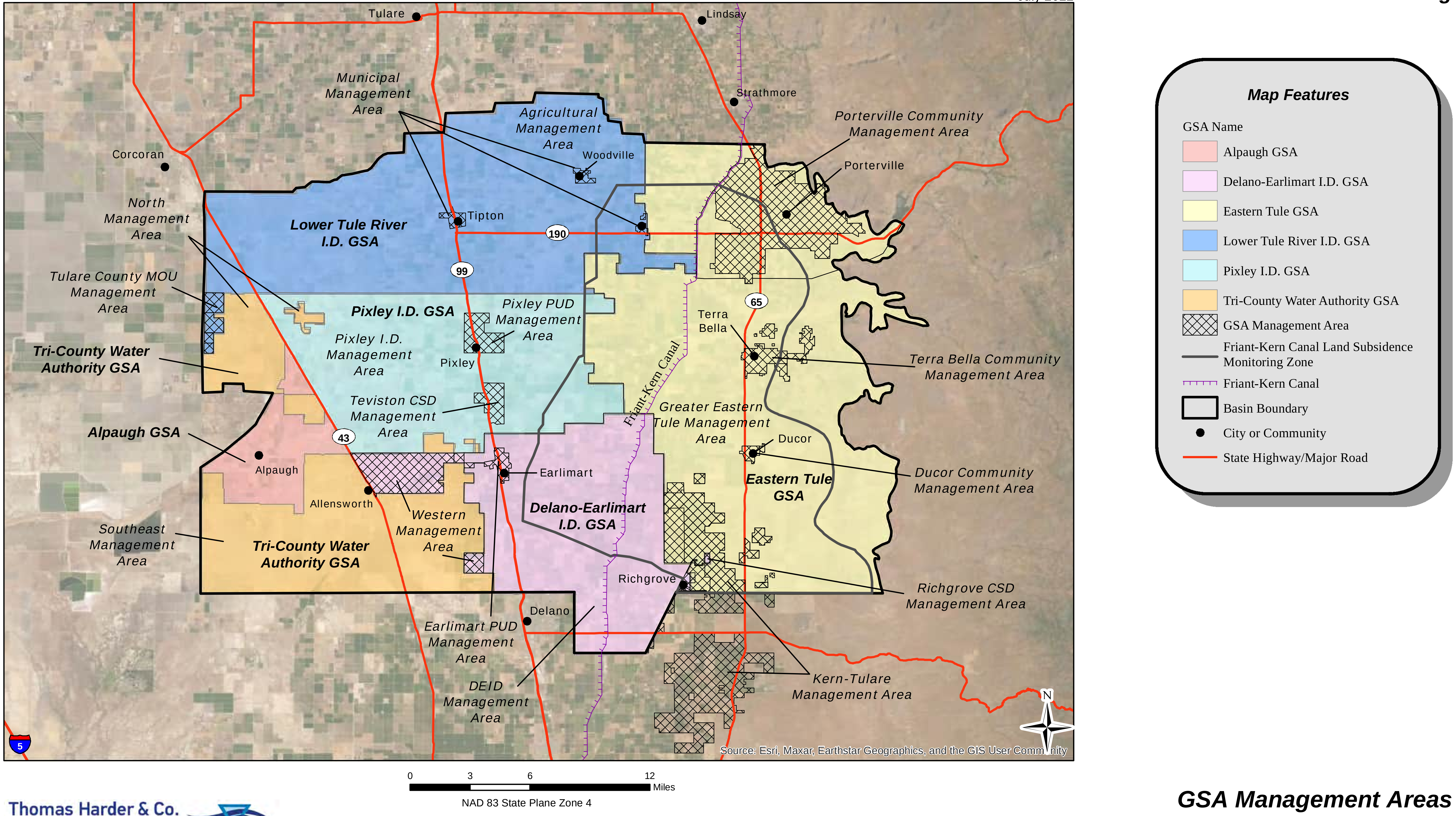
Figure 2-32



*Realizations with a storage change of -5,000 af/yr or greater

Tule Subbasin

July 2022



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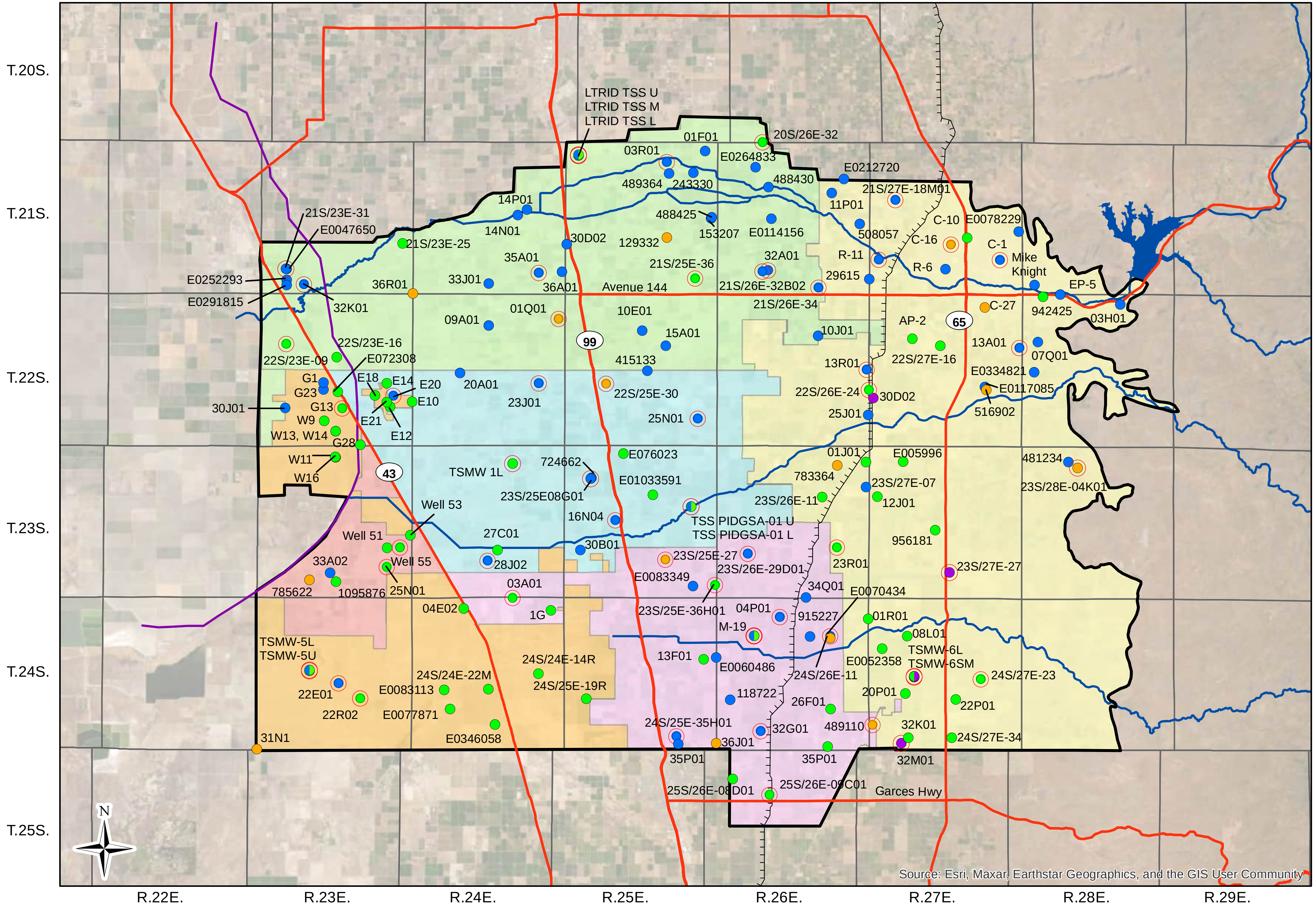
GSA Management Areas

Figure 2-33

Tule Subbasin

July 2022



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

0 2.5 5 10 Miles

NAD 83 State Plane Zone 4

Map Features

- ● Upper Aquifer Well
- ◉ Upper Aquifer RMS Well
- ● Lower Aquifer Well
- ◉ Lower Aquier RMS Well
- ● Composite Aquifer Well
- ◉ Composite Aquifer RMS Well
- ● Santa Margarita Well
- ◉ Santa Margarita RMS Well
- 🟥 Alpaugh GSA
- 🟪 Delano-Earlimart I.D. GSA
- 🟨 Eastern Tule GSA
- 🟩 Lower Tule River I.D. GSA
- 🟦 Pixley I.D. GSA
- 🟧 Tri-County Water Authority GSA
- ☐ Basin Boundary
- — Canal
- ┬┬┬ Friant-Kern Canal
- — State Highway
- — Major Hydrologic Feature

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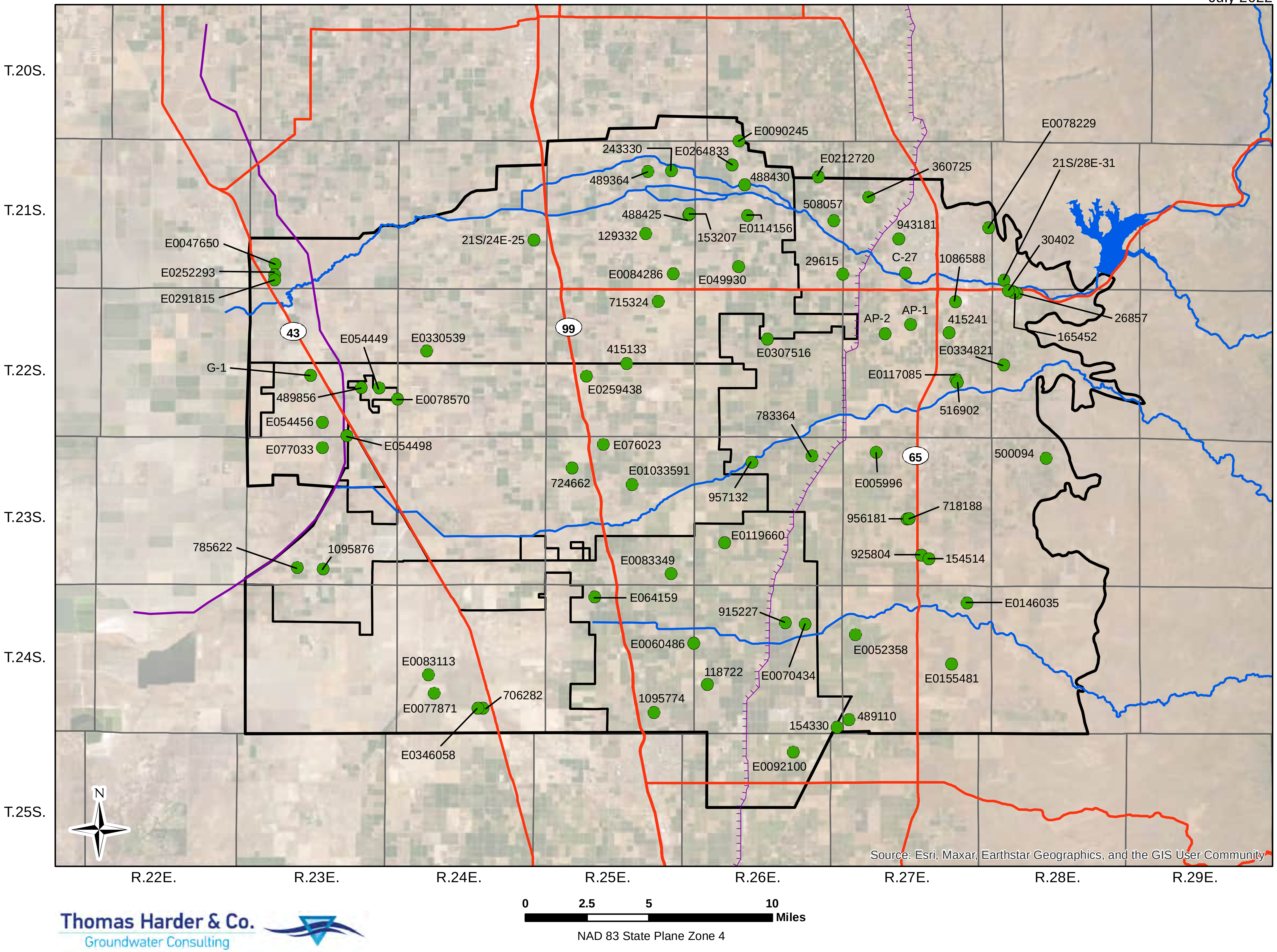
Groundwater Level Monitoring Network

Figure 2-34

Tule Subbasin

July 2022



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Map Features

- ● Groundwater Quality Well Location
- ― Canal
- ┬┬┬ Friant-Kern Canal
- ☐ Basin Boundary
- ☐ GSA Boundaries
- ― State Highway/Major Road

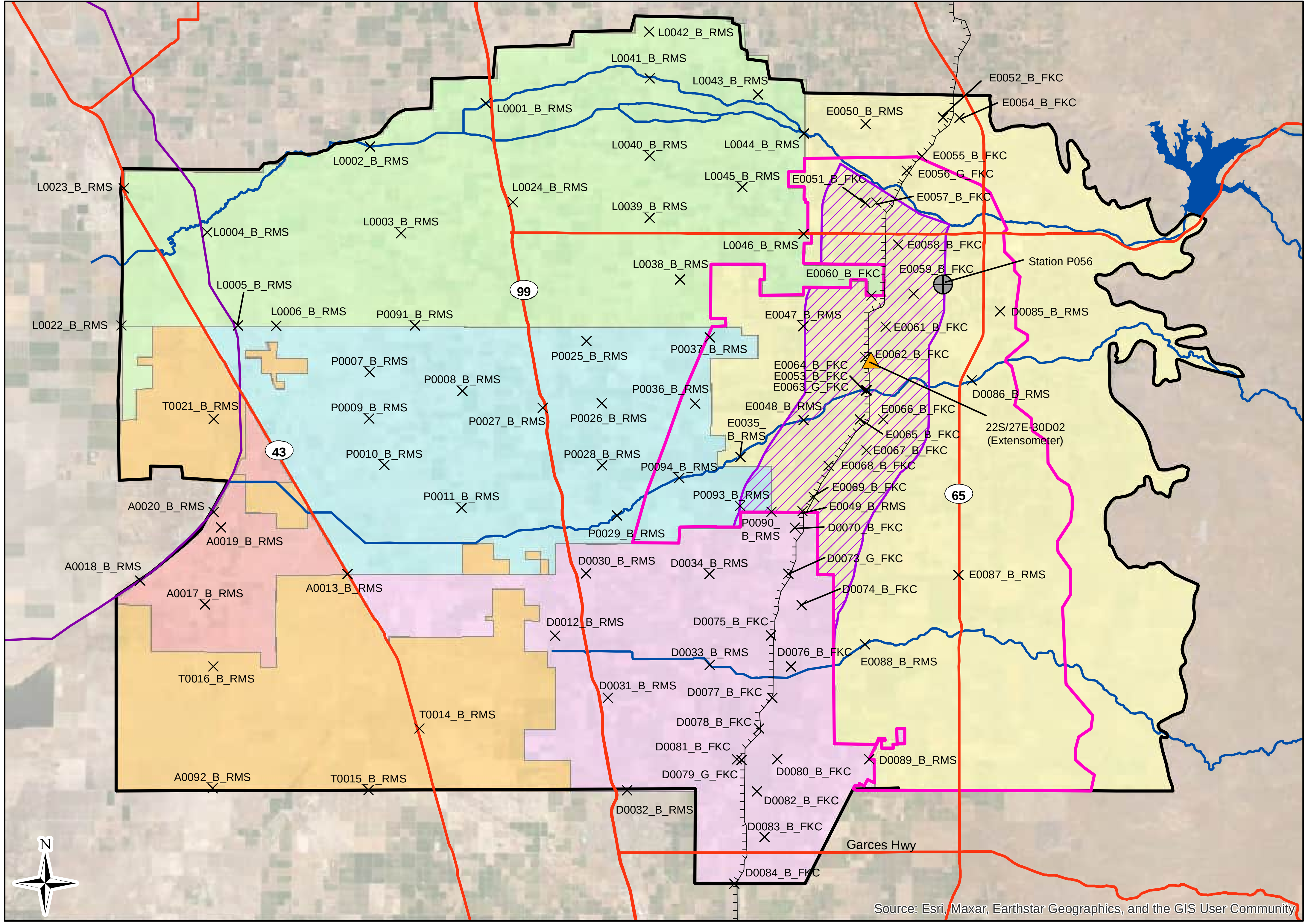
Well Location data from:
Tule Basin Water Quality Coalition, 2017

Groundwater Quality Monitoring Network

Figure 2-35

Tule Subbasin

July 2022



Map Features

- × Land Surface Elevation RMS
- ▲ Extensometer
- ⊕ GPS Station
- 🟥 Alpaugh GSA
- 🟪 Delano-Earlimart I.D. GSA
- 🟨 Eastern Tule GSA
- 🟩 Lower Tule River I.D. GSA
- 🟦 Pixley I.D. GSA
- 🟧 Tri-County Water Authority GSA
- ┼┼┼ Friant-Kern Canal and California Aqueduct
- — Canal
- ☐ ETGSA Monitored Area
- ▨ ETGSA Management Area
- ☐ Basin Boundary
- — State Highway

0 2 4 8 Miles

NAD 83 State Plane Zone 4

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Land Surface Elevation Monitoring Network

Figure 2-36

Appendix A

Lower Tule River Irrigation District GSA

Water Budgets, Land Surface Elevations at Representative Monitoring Sites, and RMS Groundwater Elevation Hydrographs

Appendix A
Table 1a

Lower Tule River Irrigation District GSA
Historical Surface Water Budget 1986/87 to 2016/17

	Surface Water Inflow (acre-ft)					
Water Year	Precipitation	Stream Inflow	Imported Water	Discharge from Wells		Total In
		Tule River	LTRID	Agricultural	Municipal	
1986 - 1987	46,000	40,421	89,541	224,000	1,400	401,000
1987 - 1988	66,000	14,702	64,654	261,000	1,400	408,000
1988 - 1989	53,000	22,873	63,922	224,000	1,400	365,000
1989 - 1990	51,000	7,103	24,325	276,000	1,400	360,000
1990 - 1991	69,000	22,727	71,430	253,000	1,400	418,000
1991 - 1992	60,000	9,869	51,949	277,000	1,400	400,000
1992 - 1993	97,000	57,632	321,973	94,000	1,400	572,000
1993 - 1994	61,000	31,263	71,784	246,000	1,400	411,000
1994 - 1995	128,000	142,879	229,683	129,000	1,400	631,000
1995 - 1996	67,000	105,949	236,845	107,000	1,400	518,000
1996 - 1997	94,000	250,253	192,934	116,000	1,400	655,000
1997 - 1998	152,000	286,694	101,180	135,000	1,400	676,000
1998 - 1999	78,000	70,954	183,971	127,000	1,400	461,000
1999 - 2000	74,000	64,026	177,192	158,000	1,400	475,000
2000 - 2001	55,000	27,525	83,405	196,000	1,400	363,000
2001 - 2002	53,000	32,853	78,511	207,000	1,500	373,000
2002 - 2003	52,000	77,642	131,470	143,000	1,500	406,000
2003 - 2004	43,000	24,494	71,472	204,000	1,600	345,000
2004 - 2005	83,000	91,549	247,595	96,000	1,600	520,000
2005 - 2006	84,000	129,184	194,019	93,000	1,700	502,000
2006 - 2007	35,000	19,981	33,174	231,000	1,800	321,000
2007 - 2008	39,000	42,745	71,872	183,000	1,800	338,000
2008 - 2009	42,000	29,196	113,189	200,000	1,900	386,000
2009 - 2010	68,000	82,489	200,064	74,000	1,800	426,000
2010 - 2011	100,000	191,791	229,763	116,000	1,900	639,000
2011 - 2012	63,000	58,763	67,684	228,000	1,900	419,000
2012 - 2013	29,000	14,374	37,073	255,000	1,800	337,000
2013 - 2014	21,000	0	0	280,000	1,800	303,000
2014 - 2015	30,000	0	0	243,000	1,800	275,000
2015 - 2016	45,000	35,381	73,382	152,000	1,800	308,000
2016 - 2017	47,000	187,807	273,151	82,000	1,900	592,000
86/87-16/17 Avg	64,000	70,100	122,200	181,000	1,600	439,000

Appendix A
Table 1b

Lower Tule River Irrigation District GSA
Historical Surface Water Budget 1986/87 to 2016/17

	Surface Water Outflow (acre-ft)																	
Water Year	Areal Recharge of Precipitation	Streambed Infiltration	Canal Loss		Recharge in Basins		Deep Percolation of Applied Water				Evapotranspiration						Surface Outflow	Total Out
		Tule River	Tule River	Imported Water	Tule River	Imported Water	Tule River	Imported Water	Agricultural Pumping	Municipal Pumping	Precipitation Crops/Native	Tule River		Imported Water	Ag. Cons. Use from Pumping	Municipal (Landscape ET)	Tule River	
		Oettle Bridge to Turnbull Weir Infiltration										Agricultural Cons. Use	Stream Channel	Agricultural Cons. Use				
1986 - 1987	0	1,100	20,700	44,200	0	0	5,200	12,700	62,800	900	46,000	13,400	400	32,600	161,000	500	0	402,000
1987 - 1988	0	900	8,800	32,700	0	0	1,400	9,000	73,200	900	66,000	3,600	100	23,000	187,000	500	0	407,000
1988 - 1989	0	0	7,400	18,800	0	0	4,400	12,700	62,900	900	53,000	11,200	100	32,400	161,000	500	0	365,000
1989 - 1990	0	0	2,900	7,400	0	0	1,200	4,700	77,600	900	51,000	3,000	0	12,100	199,000	500	0	360,000
1990 - 1991	0	300	6,800	24,300	0	0	4,400	13,200	71,200	900	69,000	11,200	200	33,900	182,000	500	0	418,000
1991 - 1992	0	0	3,100	16,100	0	0	1,900	10,100	77,800	900	60,000	4,900	100	25,800	199,000	500	0	400,000
1992 - 1993	9,000	3,000	27,800	141,000	0	0	7,900	53,300	26,500	900	88,000	18,900	400	127,600	68,000	500	0	573,000
1993 - 1994	0	200	14,200	27,800	0	0	4,700	12,400	69,200	900	61,000	12,100	200	31,600	177,000	500	0	412,000
1994 - 1995	28,000	10,400	39,500	108,800	0	0	19,300	34,400	36,100	900	100,000	48,500	500	86,500	92,000	500	25,000	630,000
1995 - 1996	0	4,000	26,200	69,600	13,400	33,800	15,800	37,700	30,000	900	67,000	40,000	600	95,600	77,000	500	7,000	519,000
1996 - 1997	7,000	9,700	47,300	51,200	19,900	7,000	16,700	43,000	32,700	900	87,000	35,600	600	91,700	84,000	500	121,000	656,000
1997 - 1998	44,000	9,000	79,100	39,200	28,000	10,800	29,100	14,400	37,900	900	109,000	74,400	600	36,800	97,000	500	95,000	706,000
1998 - 1999	1,000	2,800	19,500	45,800	11,400	15,800	10,500	34,400	35,800	900	77,000	26,800	600	88,100	92,000	500	0	463,000
1999 - 2000	0	2,900	11,100	51,300	3,400	8,000	12,000	32,900	44,400	900	74,000	30,700	300	84,300	113,000	500	5,000	475,000
2000 - 2001	0	0	7,000	25,900	200	2,000	5,700	15,600	55,100	900	55,000	14,600	300	39,900	141,000	500	0	364,000
2001 - 2002	0	700	13,400	20,800	0	0	5,300	16,200	58,100	1,000	53,000	13,500	300	41,500	149,000	500	0	373,000
2002 - 2003	0	3,700	22,800	42,700	5,900	3,300	9,700	20,600	34,500	1,000	52,000	30,500	300	64,800	108,000	500	5,000	405,000
2003 - 2004	0	300	7,700	16,600	0	0	3,800	13,100	48,500	1,000	43,000	12,100	200	41,800	155,000	600	1,000	345,000
2004 - 2005	2,000	4,700	22,900	76,200	11,800	23,500	9,400	33,000	23,000	1,100	80,000	30,000	400	105,500	73,000	600	22,000	519,000
2005 - 2006	3,000	7,200	40,500	62,500	16,500	17,000	13,800	29,500	22,200	1,100	81,000	39,900	400	85,000	71,000	600	11,000	502,000
2006 - 2007	0	1,500	5,100	12,700	0	0	3,200	4,900	55,100	1,100	35,000	10,200	100	15,600	176,000	600	0	321,000
2007 - 2008	0	1,100	15,900	18,200	900	600	5,700	12,600	43,500	1,200	39,000	18,300	300	40,400	139,000	600	1,000	338,000
2008 - 2009	0	1,400	7,100	36,400	400	4,300	4,900	17,500	47,600	1,200	42,000	15,600	100	56,000	152,000	700	0	387,000
2009 - 2010	0	4,500	34,600	61,600	5,800	15,100	10,200	33,500	17,500	1,200	68,000	27,400	400	89,800	56,000	600	0	426,000
2010 - 2011	11,000	7,500	82,400	80,300	31,800	27,700	15,500	30,400	27,500	1,200	89,000	46,600	400	91,300	88,000	700	8,000	639,000
2011 - 2012	0	300	17,800	21,200	1,500	4,200	10,100	10,900	54,300	1,200	63,000	29,100	200	31,400	174,000	700	0	420,000
2012 - 2013	0	0	4,400	11,400	0	0	2,400	6,100	60,800	1,100	29,000	7,600	200	19,600	195,000	600	0	338,000
2013 - 2014	0	0	0	0	0	0	0	0	66,700	1,200	21,000	0	0	0	213,000	600	0	303,000
2014 - 2015	0	0	0	0	0	0	0	0	57,900	1,200	30,000	0	0	0	185,000	600	0	275,000
2015 - 2016	0	5,500	11,400	27,400	800	0	4,200	11,000	36,200	1,200	45,000	13,500	200	35,100	116,000	600	0	308,000
2016 - 2017	0	15,900	82,600	113,100	28,400	34,000	14,500	30,400	19,500	1,200	47,000	46,400	500	95,600	62,000	700	71,000	663,000
86/87-16/17 Avg	3,000	3,200	22,300	42,100	5,800	6,700	8,200	19,700	47,300	1,000	61,000	22,200	300	53,400	134,000	600	12,000	443,000

🟦 Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪 Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨 Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Appendix A
Table 2

Lower Tule River Irrigation District GSA
Historical Groundwater Budget 1986/87 to 2016/17

	Groundwater Inflows (acre-ft)														Groundwater Outflows (acre-ft)						
Water Year	Areal Recharge from Precipitation	Tule River				Imported Water Deliveries			Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow		Total In	Groundwater Pumping			Sub-surface Outflow		Total Out	Change in Storage (acre-ft)
		Oettle Bridge to Turnbull Weir Infiltration	Canal Loss	Recharge in Basins	Return Flow	Canal Loss	Recharge in Basins	Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Muni-cipal	Agri-cultural	Exports	To Outside Subbasin	To Other GSAs		
1986 - 1987	0	1,100	20,700	0	5,200	44,200	0	12,700	62,800	900	27,000	76,000	39,000	290,000	1,400	224,000	0	16,000	115,000	356,000	-66,000
1987 - 1988	0	900	8,800	0	1,400	32,700	0	9,000	73,200	900	26,000	90,000	38,000	281,000	1,400	261,000	15,940	16,000	108,000	402,000	-121,000
1988 - 1989	0	0	7,400	0	4,400	18,800	0	12,700	62,900	900	13,000	90,000	37,000	247,000	1,400	224,000	26,160	16,000	107,000	375,000	-128,000
1989 - 1990	0	0	2,900	0	1,200	7,400	0	4,700	77,600	900	38,000	87,000	39,000	259,000	1,400	276,000	26,590	16,000	97,000	417,000	-158,000
1990 - 1991	0	300	6,800	0	4,400	24,300	0	13,200	71,200	900	42,000	95,000	38,000	296,000	1,400	253,000	28,190	17,000	104,000	404,000	-108,000
1991 - 1992	0	0	3,100	0	1,900	16,100	0	10,100	77,800	900	53,000	97,000	38,000	298,000	1,400	277,000	17,420	17,000	101,000	414,000	-116,000
1992 - 1993	9,000	3,000	27,800	0	7,900	141,000	0	53,300	26,500	900	15,000	62,000	30,000	376,000	1,400	94,000	7,940	28,000	127,000	258,000	118,000
1993 - 1994	0	200	14,200	0	4,700	27,800	0	12,400	69,200	900	24,000	79,000	33,000	265,000	1,400	246,000	0	24,000	107,000	378,000	-113,000
1994 - 1995	28,000	10,400	39,500	0	19,300	108,800	0	34,400	36,100	900	9,000	62,000	33,000	381,000	1,400	129,000	0	26,000	123,000	279,000	102,000
1995 - 1996	0	4,000	26,200	13,400	15,800	69,600	33,800	37,700	30,000	900	2,000	53,000	30,000	316,000	1,400	107,000	0	30,000	126,000	264,000	52,000
1996 - 1997	7,000	9,700	47,300	19,900	16,700	51,200	7,000	43,000	32,700	900	1,000	60,000	31,000	327,000	1,400	116,000	0	28,000	132,000	277,000	50,000
1997 - 1998	44,000	9,000	79,100	28,000	29,100	39,200	10,800	14,400	37,900	900	0	72,000	32,000	396,000	1,400	135,000	0	26,000	134,000	296,000	100,000
1998 - 1999	1,000	2,800	19,500	11,400	10,500	45,800	15,800	34,400	35,800	900	2,000	73,000	30,000	283,000	1,400	127,000	0	28,000	139,000	295,000	-12,000
1999 - 2000	0	2,900	11,100	3,400	12,000	51,300	8,000	32,900	44,400	900	2,000	80,000	30,000	279,000	1,400	158,000	2,820	26,000	129,000	317,000	-38,000
2000 - 2001	0	0	7,000	200	5,700	25,900	2,000	15,600	55,100	900	6,000	94,000	31,000	243,000	1,400	196,000	17,290	22,000	119,000	356,000	-113,000
2001 - 2002	0	700	13,400	0	5,300	20,800	0	16,200	58,100	1,000	15,000	89,000	32,000	252,000	1,500	207,000	25,590	20,000	110,000	364,000	-112,000
2002 - 2003	0	3,700	22,800	5,900	9,700	42,700	3,300	20,600	34,500	1,000	10,000	75,000	29,000	258,000	1,500	143,000	20,610	22,000	117,000	304,000	-46,000
2003 - 2004	0	300	7,700	0	3,800	16,600	0	13,100	48,500	1,000	27,000	78,000	31,000	227,000	1,600	204,000	17,440	20,000	95,000	338,000	-111,000
2004 - 2005	2,000	4,700	22,900	11,800	9,400	76,200	23,500	33,000	23,000	1,100	9,000	56,000	27,000	300,000	1,600	96,000	7,720	26,000	107,000	238,000	62,000
2005 - 2006	3,000	7,200	40,500	16,500	13,800	62,500	17,000	29,500	22,200	1,100	2,000	53,000	27,000	295,000	1,700	93,000	0	29,000	115,000	239,000	56,000
2006 - 2007	0	1,500	5,100	0	3,200	12,700	0	4,900	55,100	1,100	24,000	71,000	30,000	209,000	1,800	231,000	27,930	22,000	85,000	368,000	-159,000
2007 - 2008	0	1,100	15,900	900	5,700	18,200	600	12,600	43,500	1,200	36,000	74,000	29,000	239,000	1,800	183,000	26,140	23,000	93,000	327,000	-88,000
2008 - 2009	0	1,400	7,100	400	4,900	36,400	4,300	17,500	47,600	1,200	47,000	74,000	31,000	273,000	1,900	200,000	21,470	24,000	96,000	343,000	-70,000
2009 - 2010	0	4,500	34,600	5,800	10,200	61,600	15,100	33,500	17,500	1,200	18,000	48,000	27,000	277,000	1,800	74,000	10,770	30,000	122,000	239,000	38,000
2010 - 2011	11,000	7,500	82,400	31,800	15,500	80,300	27,700	30,400	27,500	1,200	6,000	55,000	28,000	404,000	1,900	116,000	3,880	31,000	125,000	278,000	126,000
2011 - 2012	0	300	17,800	1,500	10,100	21,200	4,200	10,900	54,300	1,200	22,000	79,000	31,000	254,000	1,900	228,000	21,600	24,000	109,000	385,000	-131,000
2012 - 2013	0	0	4,400	0	2,400	11,400	0	6,100	60,800	1,100	53,000	88,000	33,000	260,000	1,800	255,000	39,910	25,000	88,000	410,000	-150,000
2013 - 2014	0	0	0	0	0	0	0	0	66,700	1,200	71,000	91,000	32,000	262,000	1,800	280,000	37,120	25,000	81,000	425,000	-163,000
2014 - 2015	0	0	0	0	0	0	0	0	57,900	1,200	74,000	83,000	31,000	247,000	1,800	243,000	33,170	24,000	84,000	386,000	-139,000
2015 - 2016	0	5,500	11,400	800	4,200	27,400	0	11,000	36,200	1,200	53,000	70,000	27,000	248,000	1,800	152,000	28,300	27,000	90,000	299,000	-51,000
2016 - 2017	0	15,900	82,600	28,400	14,500	113,100	34,000	30,400	19,500	1,200	16,000	55,000	24,000	435,000	1,900	82,000	6,810	33,000	112,000	236,000	199,000
36/87-16/17 Avg	3,000	3,200	22,300	5,800	8,200	42,100	6,700	19,700	47,300	1,000	24,000	74,000	32,000	289,000	1,600	181,000	15,200	24,000	110,000	332,000	-43,000

Cumulative Change in Storage -1,290,000

🟦	Groundwater Inflows or Outflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Groundwater Outflows Not Included in Sustainable Yield Estimates

Appendix A
Table 3a

Projected Future Lower Tule River Irrigation District GSA Surface Water Budget

	Surface Water Inflow (acre-ft)					
Water Year	Precipitation	Stream Inflow	Imported Water	Discharge from Wells		Total In
		Tule River	LTRID	Agricultural	Municipal	
2017 - 2018	65,000	79,995	143,186	149,000	1,900	439,000
2018 - 2019	65,000	79,995	143,186	149,000	1,900	439,000
2019 - 2020	65,000	79,995	143,186	149,000	1,900	439,000
2020 - 2021	65,000	79,995	143,186	149,000	1,900	439,000
2021 - 2022	65,000	79,995	143,186	149,000	1,900	439,000
2022 - 2023	65,000	79,995	143,186	149,000	1,900	439,000
2023 - 2024	65,000	79,995	143,186	149,000	1,900	439,000
2024 - 2025	65,000	82,595	135,513	151,000	1,900	436,000
2025 - 2026	65,000	82,595	127,841	155,000	1,900	432,000
2026 - 2027	65,000	82,595	120,168	159,000	1,900	429,000
2027 - 2028	65,000	82,595	112,496	164,000	1,900	426,000
2028 - 2029	65,000	82,595	104,823	168,000	1,900	422,000
2029 - 2030	65,000	81,976	97,151	172,000	1,900	418,000
2030 - 2031	65,000	81,976	97,151	172,000	1,900	418,000
2031 - 2032	65,000	81,976	97,151	172,000	1,900	418,000
2032 - 2033	65,000	81,976	97,151	172,000	1,900	418,000
2033 - 2034	65,000	81,976	97,151	172,000	1,900	418,000
2034 - 2035	65,000	81,976	97,151	171,000	1,900	417,000
2035 - 2036	65,000	81,976	97,151	171,000	1,900	417,000
2036 - 2037	65,000	81,976	97,151	171,000	1,900	417,000
2037 - 2038	65,000	81,976	97,151	171,000	1,900	417,000
2038 - 2039	65,000	81,976	97,151	171,000	1,900	417,000
2039 - 2040	65,000	81,976	97,151	152,000	1,900	398,000
2040 - 2041	65,000	81,976	97,151	152,000	1,900	398,000
2041 - 2042	65,000	81,976	97,151	152,000	1,900	398,000
2042 - 2043	65,000	81,976	97,151	152,000	1,900	398,000
2043 - 2044	65,000	81,976	97,151	152,000	1,900	398,000
2044 - 2045	65,000	81,976	97,151	152,000	1,900	398,000
2045 - 2046	65,000	81,976	97,151	152,000	1,900	398,000
2046 - 2047	65,000	81,976	97,151	152,000	1,900	398,000
2047 - 2048	65,000	81,976	97,151	152,000	1,900	398,000
2048 - 2049	65,000	81,976	97,151	152,000	1,900	398,000
2049 - 2050	65,000	81,976	97,151	152,000	1,900	398,000
2050 - 2051	65,000	79,772	84,084	141,000	1,900	372,000
2051 - 2052	65,000	79,772	84,084	141,000	1,900	372,000
2052 - 2053	65,000	79,772	84,084	141,000	1,900	372,000
2053 - 2054	65,000	79,772	84,084	141,000	1,900	372,000
2054 - 2055	65,000	79,772	84,084	141,000	1,900	372,000
2055 - 2056	65,000	79,772	84,084	141,000	1,900	372,000
2056 - 2057	65,000	79,772	84,084	141,000	1,900	372,000
2057 - 2058	65,000	79,772	84,084	141,000	1,900	372,000
2058 - 2059	65,000	79,772	84,084	141,000	1,900	372,000
2059 - 2060	65,000	79,772	84,084	141,000	1,900	372,000
2060 - 2061	65,000	79,772	84,084	141,000	1,900	372,000
2061 - 2062	65,000	79,772	84,084	141,000	1,900	372,000
2062 - 2063	65,000	79,772	84,084	141,000	1,900	372,000
2063 - 2064	65,000	79,772	84,084	141,000	1,900	372,000
2064 - 2065	65,000	79,772	84,084	141,000	1,900	372,000
2065 - 2066	65,000	79,772	84,084	141,000	1,900	372,000
2066 - 2067	65,000	79,772	84,084	141,000	1,900	372,000
2067 - 2068	65,000	79,772	84,084	141,000	1,900	372,000
2068 - 2069	65,000	79,772	84,084	141,000	1,900	372,000
2069 - 2070	65,000	79,772	84,084	141,000	1,900	372,000
17/18-69/70 Avg	65,000	80,900	100,500	152,000	1,900	400,000

Projected Future Lower Tule River Irrigation District GSA Surface Water Budget

	Surface Water Outflow (acre-ft)																	
Water Year	Areal Recharge of Precipitation	Streambed Infiltration	Canal Loss		Recharge in Basins		Deep Percolation of Applied Water				Evapotranspiration						Surface Outflow	Total Out
		Tule River										Tule River		Imported Water	Ag. Cons. Use from Pumping	Municipal (Landscape ET)		
		Oettle Bridge to Turnbull Weir Infiltration	Tule River	Imported Water	Tule River	Imported Water	Tule River	Imported Water	Agricultural Pumping	Municipal Pumping	Precipitation Crops/Native	Agricultural Cons. Use	Stream Channel	Agricultural Cons. Use			Tule River	
2017 - 2018	3,000	3,900	17,000	52,400	6,400	11,400	10,800	19,400	35,400	1,200	61,000	33,500	300	59,900	113,000	700	15,000	444,000
2018 - 2019	3,000	3,900	17,000	52,400	6,400	11,400	10,800	19,400	35,400	1,200	61,000	33,500	300	59,900	113,000	700	8,000	437,000
2019 - 2020	3,000	3,900	17,000	52,400	6,400	11,400	10,800	19,400	35,400	1,200	61,000	33,500	300	59,900	113,000	700	8,000	437,000
2020 - 2021	3,000	3,900	17,000	52,400	6,400	11,400	10,800	19,400	35,400	1,200	61,000	33,500	300	59,900	113,000	700	8,000	437,000
2021 - 2022	3,000	3,900	17,000	52,400	6,400	11,400	10,800	19,400	35,400	1,200	61,000	33,500	300	59,900	113,000	700	8,000	437,000
2022 - 2023	3,000	3,900	17,000	52,400	6,400	11,400	10,800	19,400	35,400	1,200	61,000	33,500	300	59,900	113,000	700	8,000	437,000
2023 - 2024	3,000	3,900	17,000	52,400	6,400	11,400	10,800	19,400	35,400	1,200	61,000	33,500	300	59,900	113,000	700	8,000	437,000
2024 - 2025	3,000	3,900	18,200	49,600	6,600	10,800	11,200	18,400	35,900	1,200	61,000	34,600	300	56,700	115,000	700	8,000	435,000
2025 - 2026	3,000	3,900	18,400	46,800	6,600	10,200	11,200	17,300	36,900	1,200	61,000	34,600	300	53,500	118,000	700	8,000	432,000
2026 - 2027	3,000	3,900	18,700	44,000	6,600	9,600	11,200	16,300	37,900	1,200	61,000	34,600	300	50,300	121,000	700	8,000	428,000
2027 - 2028	3,000	3,900	19,000	41,200	6,600	8,900	11,200	15,300	38,900	1,200	61,000	34,500	300	47,000	125,000	700	7,000	425,000
2028 - 2029	3,000	3,900	19,300	38,400	6,600	8,300	11,200	14,300	40,000	1,200	61,000	34,500	300	43,800	128,000	700	7,000	422,000
2029 - 2030	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,200	40,900	1,200	61,000	34,200	300	40,600	131,000	700	7,000	417,000
2030 - 2031	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,200	40,900	1,200	61,000	34,200	300	40,600	131,000	700	7,000	417,000
2031 - 2032	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,200	40,900	1,200	61,000	34,200	300	40,600	131,000	700	7,000	417,000
2032 - 2033	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,200	40,900	1,200	61,000	34,200	300	40,600	131,000	700	7,000	417,000
2033 - 2034	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,200	40,900	1,200	61,000	34,200	300	40,600	131,000	700	7,000	417,000
2034 - 2035	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	40,700	1,200	61,000	34,200	300	40,600	130,000	700	7,000	416,000
2035 - 2036	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	40,700	1,200	61,000	34,200	300	40,600	130,000	700	7,000	416,000
2036 - 2037	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	40,700	1,200	61,000	34,200	300	40,600	130,000	700	7,000	416,000
2037 - 2038	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	40,700	1,200	61,000	34,200	300	40,600	130,000	700	7,000	416,000
2038 - 2039	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	40,700	1,200	61,000	34,200	300	40,600	130,000	700	7,000	416,000
2039 - 2040	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2040 - 2041	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2041 - 2042	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2042 - 2043	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2043 - 2044	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2044 - 2045	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2045 - 2046	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2046 - 2047	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2047 - 2048	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2048 - 2049	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2049 - 2050	3,000	3,900	19,400	35,600	6,500	7,700	11,200	13,300	36,200	1,200	61,000	34,200	300	40,600	116,000	700	7,000	398,000
2050 - 2051	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2051 - 2052	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2052 - 2053	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2053 - 2054	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2054 - 2055	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2055 - 2056	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2056 - 2057	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2057 - 2058	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2058 - 2059	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2059 - 2060	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2060 - 2061	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2061 - 2062	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2062 - 2063	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2063 - 2064	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2064 - 2065	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2065 - 2066	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2066 - 2067	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2067 - 2068	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2068 - 2069	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
2069 - 2070	3,000	3,800	19,300	30,800	6,300	6,700	10,900	11,500	33,600	1,200	61,000	33,300	300	35,100	108,000	700	6,000	372,000
17/18-69/70 Avg	3,000	3,900	19,000	36,800	6,400	8,000	11,000	13,700	36,100	1,200	61,000	33,800	300	42,000	116,000	700	6,900	400,000

Appendix A
Table 4

Projected Future Lower Tule River Irrigation District GSA Groundwater Budget

	Groundwater Inflows (acre-ft)														Groundwater Outflows (acre-ft)						
Water Year	Areal Recharge from Precipitation	Tule River				Imported Water Deliveries			Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow		Total In	Groundwater Pumping			Sub-surface Outflow		Total Out	Change in Storage (acre-ft)
		Oettle Bridge to Turnbull Weir Infiltration	Canal Loss	Recharge in Basins	Return Flow	Canal Loss	Recharge in Basins	Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Muni-cipal	Agri-cultural	Exports	To Outside Subbasin	To Other GSAs		
2017 - 2018	3,000	3,900	17,000	6,400	10,800	52,400	11,400	19,400	35,400	1,200	10,000	44,000	42,000	257,000	1,900	149,000	11,640	41,000	98,000	302,000	-45,000
2018 - 2019	3,000	3,900	17,000	6,400	10,800	52,400	11,400	19,400	35,400	1,200	12,000	43,000	43,000	259,000	1,900	149,000	11,640	41,000	96,000	300,000	-41,000
2019 - 2020	3,000	3,900	17,000	6,400	10,800	52,400	11,400	19,400	35,400	1,200	14,000	41,000	44,000	260,000	1,900	149,000	11,640	41,000	93,000	297,000	-37,000
2020 - 2021	3,000	3,900	17,000	6,400	10,800	52,400	11,400	19,400	35,400	1,200	16,000	39,000	44,000	260,000	1,900	149,000	11,640	41,000	92,000	296,000	-36,000
2021 - 2022	3,000	3,900	17,000	6,400	10,800	52,400	11,400	19,400	35,400	1,200	17,000	37,000	45,000	260,000	1,900	149,000	11,640	41,000	91,000	295,000	-35,000
2022 - 2023	3,000	3,900	17,000	6,400	10,800	52,400	11,400	19,400	35,400	1,200	18,000	35,000	45,000	259,000	1,900	149,000	11,640	42,000	90,000	295,000	-36,000
2023 - 2024	3,000	3,900	17,000	6,400	10,800	52,400	11,400	19,400	35,400	1,200	19,000	33,000	46,000	259,000	1,900	149,000	11,640	42,000	89,000	294,000	-35,000
2024 - 2025	3,000	3,900	18,200	6,600	11,200	49,600	10,800	18,400	35,900	1,200	20,000	32,000	46,000	257,000	1,900	151,000	11,640	43,000	85,000	293,000	-36,000
2025 - 2026	3,000	3,900	18,400	6,600	11,200	46,800	10,200	17,300	36,900	1,200	20,000	31,000	47,000	254,000	1,900	155,000	8,730	43,000	83,000	292,000	-38,000
2026 - 2027	3,000	3,900	18,700	6,600	11,200	44,000	9,600	16,300	37,900	1,200	22,000	31,000	48,000	253,000	1,900	159,000	8,730	43,000	80,000	293,000	-40,000
2027 - 2028	3,000	3,900	19,000	6,600	11,200	41,200	8,900	15,300	38,900	1,200	23,000	31,000	48,000	251,000	1,900	164,000	8,730	43,000	78,000	296,000	-45,000
2028 - 2029	3,000	3,900	19,300	6,600	11,200	38,400	8,300	14,300	40,000	1,200	24,000	32,000	49,000	251,000	1,900	168,000	8,730	42,000	75,000	296,000	-45,000
2029 - 2030	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,200	40,900	1,200	24,000	32,000	50,000	249,000	1,900	172,000	8,730	42,000	70,000	295,000	-46,000
2030 - 2031	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,200	40,900	1,200	23,000	31,000	51,000	248,000	1,900	172,000	5,820	42,000	68,000	290,000	-42,000
2031 - 2032	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,200	40,900	1,200	23,000	32,000	51,000	249,000	1,900	172,000	5,820	42,000	67,000	289,000	-40,000
2032 - 2033	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,200	40,900	1,200	22,000	32,000	52,000	249,000	1,900	172,000	5,820	41,000	65,000	286,000	-37,000
2033 - 2034	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,200	40,900	1,200	22,000	32,000	52,000	249,000	1,900	172,000	5,820	41,000	64,000	285,000	-36,000
2034 - 2035	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	40,700	1,200	20,000	31,000	53,000	247,000	1,900	171,000	5,820	42,000	56,000	277,000	-30,000
2035 - 2036	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	40,700	1,200	18,000	31,000	53,000	245,000	1,900	171,000	2,910	42,000	54,000	272,000	-27,000
2036 - 2037	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	40,700	1,200	17,000	31,000	53,000	244,000	1,900	171,000	2,910	41,000	52,000	269,000	-25,000
2037 - 2038	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	40,700	1,200	16,000	31,000	53,000	243,000	1,900	171,000	2,910	41,000	50,000	267,000	-24,000
2038 - 2039	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	40,700	1,200	16,000	31,000	53,000	243,000	1,900	171,000	2,910	41,000	48,000	265,000	-22,000
2039 - 2040	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	12,000	29,000	53,000	232,000	1,900	152,000	0	42,000	47,000	243,000	-11,000
2040 - 2041	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	10,000	30,000	53,000	231,000	1,900	152,000	0	42,000	46,000	242,000	-11,000
2041 - 2042	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	10,000	30,000	53,000	231,000	1,900	152,000	0	42,000	45,000	241,000	-10,000
2042 - 2043	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	9,000	30,000	53,000	230,000	1,900	152,000	0	42,000	44,000	240,000	-10,000
2043 - 2044	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	8,000	30,000	53,000	229,000	1,900	152,000	0	42,000	43,000	239,000	-10,000
2044 - 2045	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	8,000	31,000	53,000	230,000	1,900	152,000	0	42,000	42,000	238,000	-8,000
2045 - 2046	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	7,000	31,000	53,000	229,000	1,900	152,000	0	41,000	42,000	237,000	-8,000
2046 - 2047	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	7,000	31,000	53,000	229,000	1,900	152,000	0	41,000	41,000	236,000	-7,000
2047 - 2048	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	7,000	31,000	54,000	230,000	1,900	152,000	0	41,000	41,000	236,000	-6,000
2048 - 2049	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	6,000	31,000	54,000	229,000	1,900	152,000	0	41,000	41,000	236,000	-7,000
2049 - 2050	3,000	3,900	19,400	6,500	11,200	35,600	7,700	13,300	36,200	1,200	6,000	32,000	54,000	230,000	1,900	152,000	0	41,000	40,000	235,000	-5,000
2050 - 2051	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	6,000	31,000	54,000	218,000	1,900	141,000	0	41,000	41,000	225,000	-7,000
2051 - 2052	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	6,000	31,000	54,000	218,000	1,900	141,000	0	41,000	41,000	225,000	-7,000
2052 - 2053	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	6,000	31,000	54,000	218,000	1,900	141,000	0	41,000	41,000	225,000	-7,000
2053 - 2054	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	6,000	31,000	54,000	218,000	1,900	141,000	0	41,000	40,000	224,000	-6,000
2054 - 2055	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	5,000	31,000	54,000	217,000	1,900	141,000	0	41,000	40,000	224,000	-7,000
2055 - 2056	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	5,000	32,000	54,000	218,000	1,900	141,000	0	41,000	40,000	224,000	-6,000
2056 - 2057	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	5,000	32,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2057 - 2058	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	5,000	32,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2058 - 2059	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	5,000	32,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2059 - 2060	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	5,000	32,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2060 - 2061	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	4,000	32,000	54,000	217,000	1,900	141,000	0	41,000	39,000	223,000	-6,000
2061 - 2062	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	4,000	33,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2062 - 2063	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	4,000	33,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2063 - 2064	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	4,000	33,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2064 - 2065	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	4,000	33,000	54,000	218,000	1,900	141,000	0	41,000	39,000	223,000	-5,000
2065 - 2066	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	4,000	33,000	54,000	218,000	1,900	141,000	0	41,000	38,000	222,000	-4,000
2066 - 2067	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	4,000	33,000	54,000	218,000	1,900	141,000	0	41,000	38,000	222,000	-4,000
2067 - 2068	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	3,000	33,000	54,000	217,000	1,900	141,000	0	41,000	39,000	223,000	-6,000
2068 - 2069	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	3,000	33,000	54,000	217,000	1,900	141,000	0	41,000	38,000	222,000	-5,000
2069 - 2070	3,000	3,800	19,300	6,300	10,900	30,800	6,700	11,500	33,600	1,200	3,000	33,000	54,000	217,000	1,900	141,000	0	41,000	38,000	222,000	-5,000
17/18-69/70 Avg	3,000	3,900	19,000	6,400	11,000	36,800	8,000	13,700	36,100	1,200	11,000	33,000	52,000	235,000	1,900	152,000	3,300	41,000	55,000	253,000	-18,000

Lower Tule River Irrigation District GSA
Land Surface Elevations at Representative Monitoring Sites

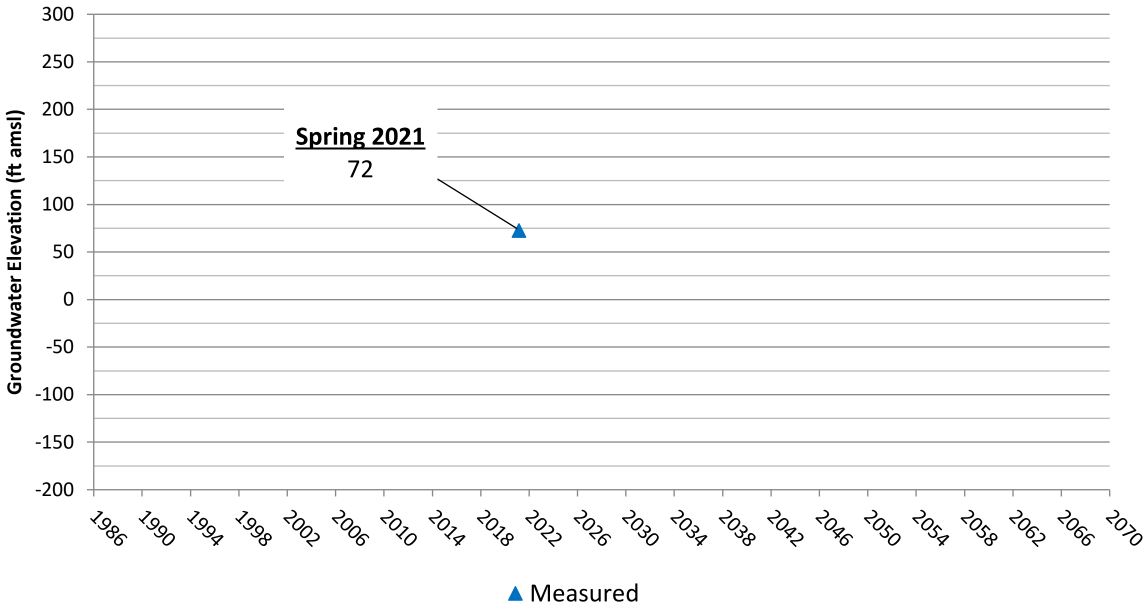
Site	Land Surface Elevation (ft amsl)[1]			
	2020 (Baseline)	2021	Measurable Objective	Minimum Threshold
L0001_B_RMS	253.0	252.4	238.7	237.8
L0002_B_RMS	228.9	227.9	222.2	220.8
L0003_B_RMS	228.7	227.8	223.5	221.5
L0004_B_RMS	197.3	197.7	193.1	192.1
L0005_B_RMS	190.2	189.6	182.5	181.5
L0006_B_RMS	192.3	191.6	184.5	183.5
L0022_B_RMS	180.0	179.7	170.3	169.3
L0023_B_RMS	190.8	190.1	185.1	184.1
L0024_B_RMS	254.9	254.3	249.8	248.8
L0038_B_RMS	321.6	321.1	319.5	318.1
L0039_B_RMS	307.5	306.9	304.4	303.3
L0040_B_RMS	309.0	308.4	304.4	303.4
L0041_B_RMS	307.3	306.9	302.8	301.8
L0042_B_RMS	306.5	305.8	301.6	300.6
L0043_B_RMS	348.6	348.5	346.4	345.4
L0044_B_RMS	370.6	370.3	370.1	368.9
L0045_B_RMS	346.3	346.0	343.7	342.6
L0046_B_RMS	371.0	370.7	370.0	369.0

Note:

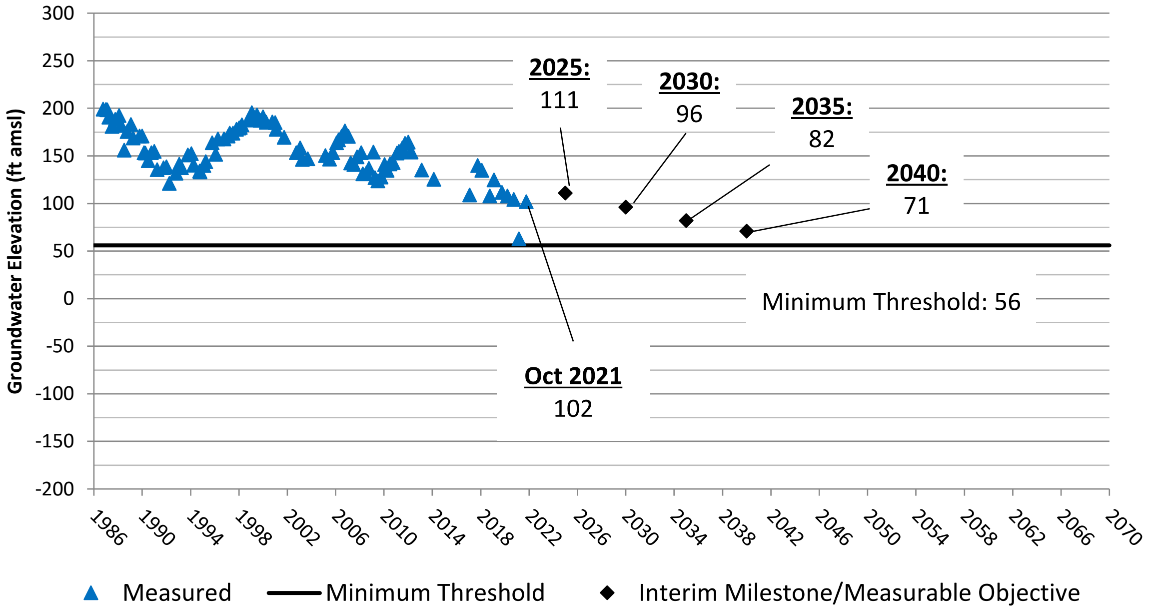
[1] Benchmarks surveyed in July and August of each year.

Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs

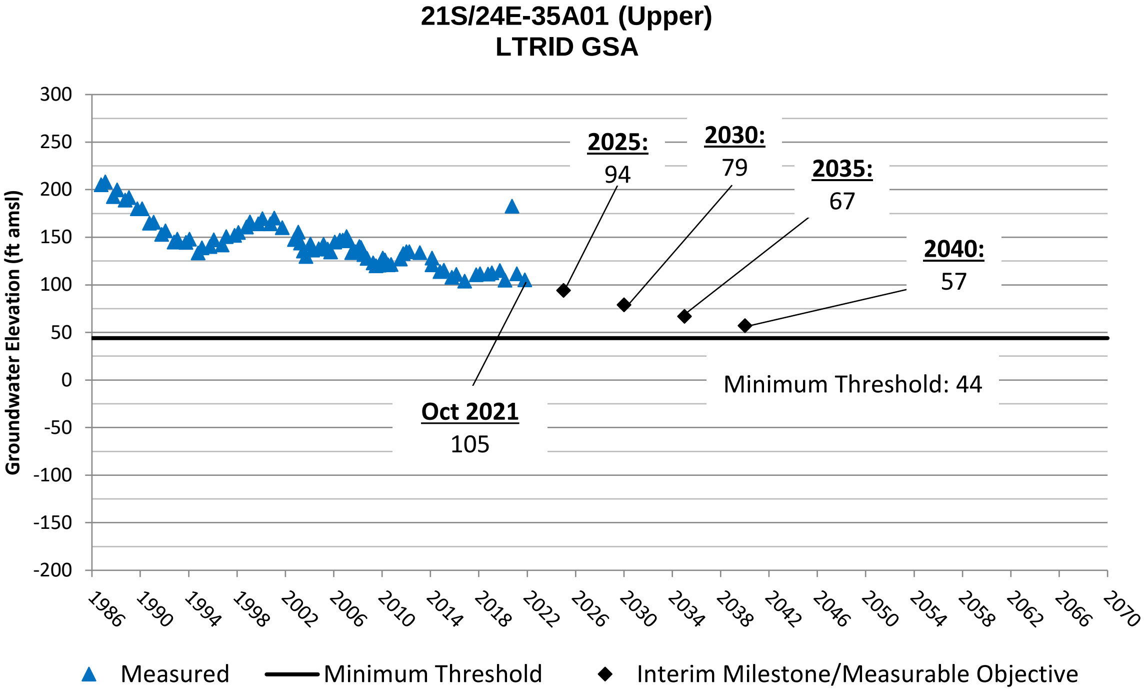
21S/23E-31 (Upper)
LTRID GSA

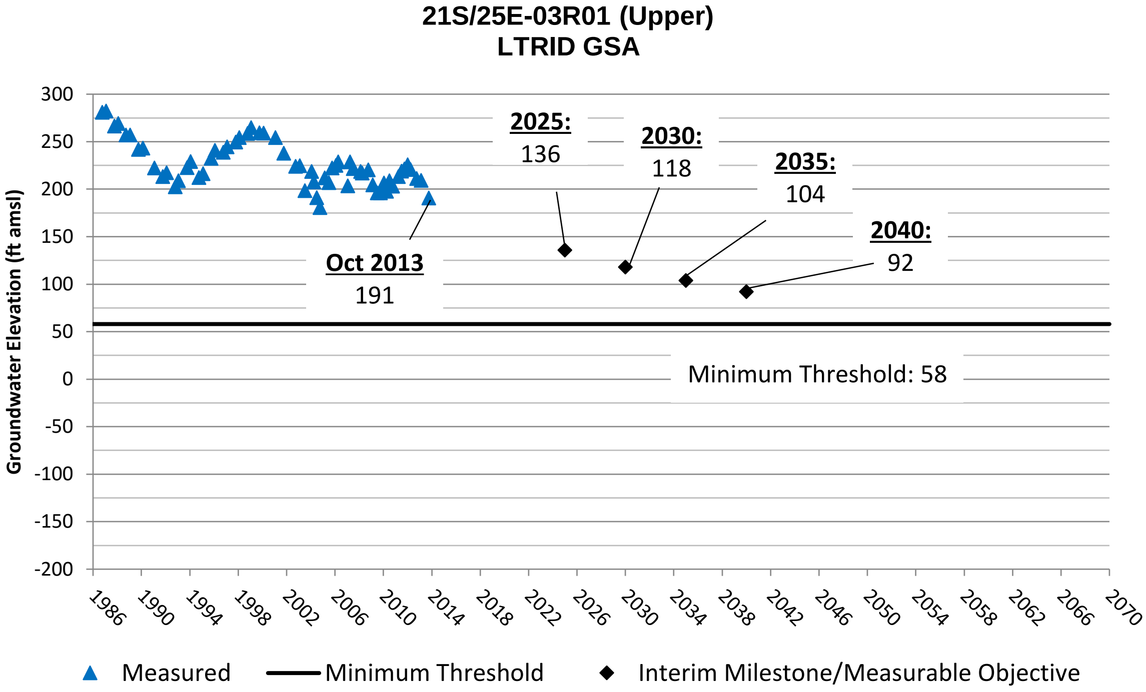


21S/23E-32K01 (Upper)
LTRID GSA



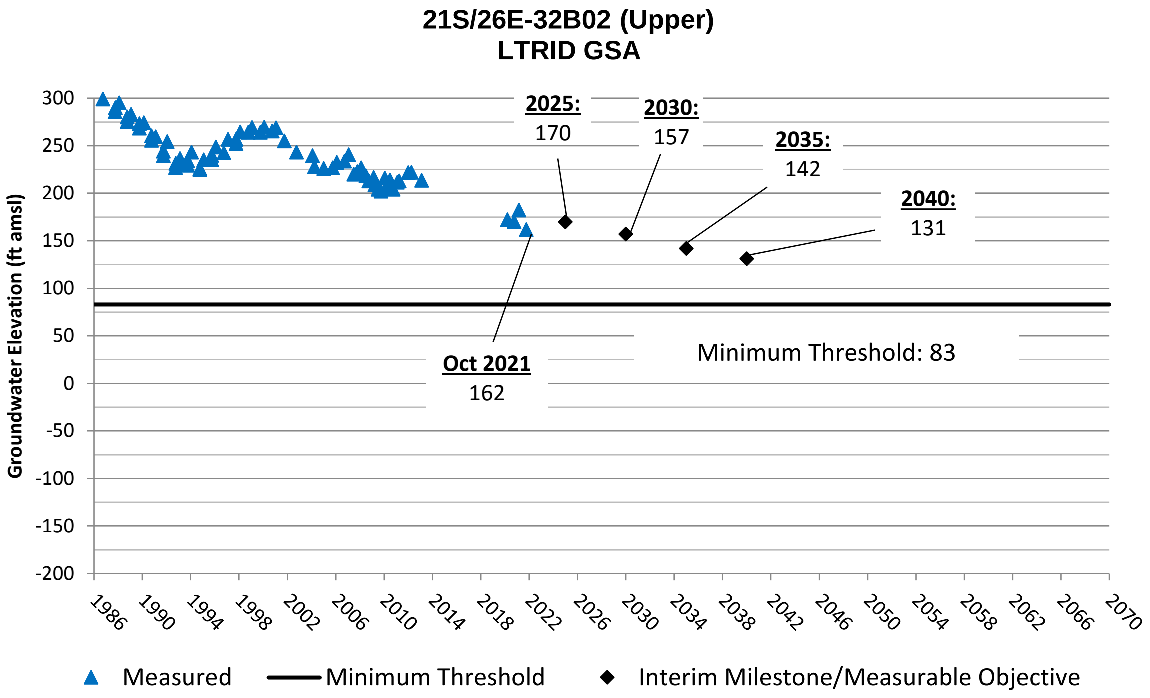
Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs

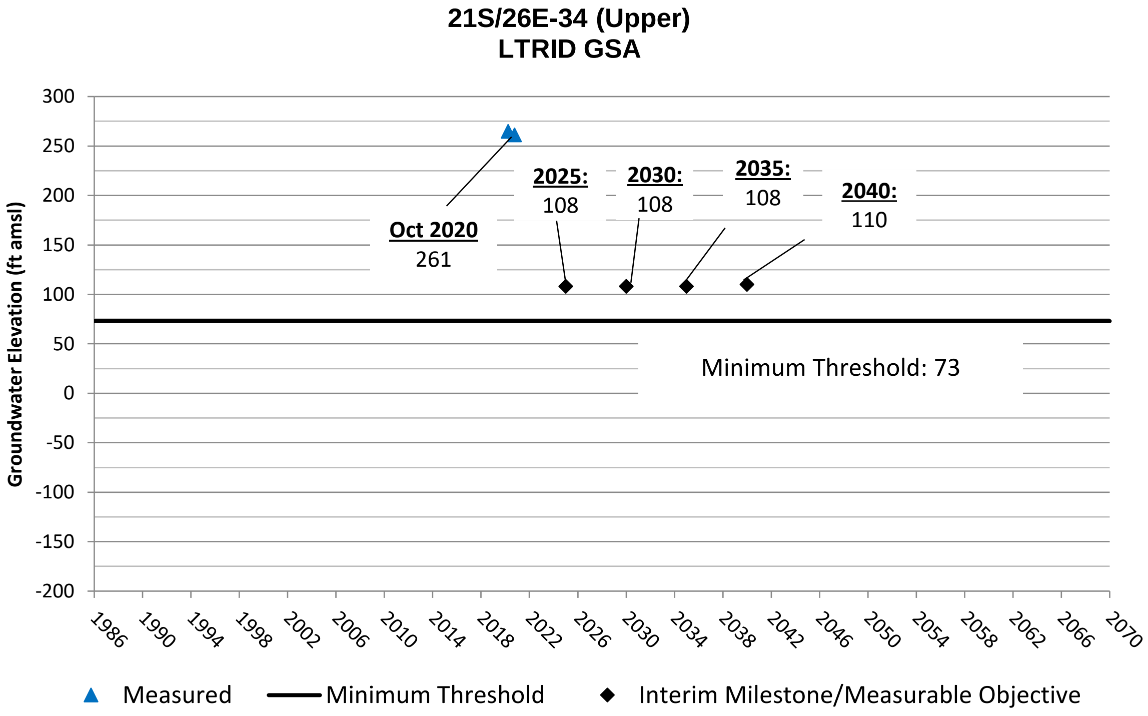




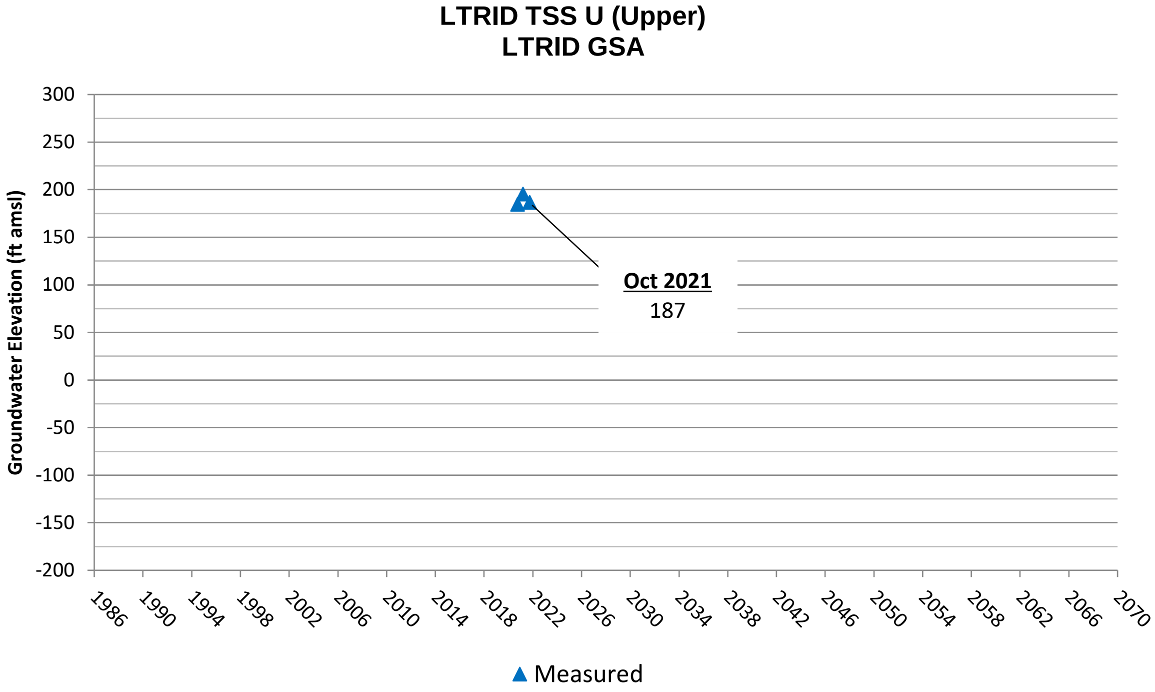
Appendix A
Figure 3

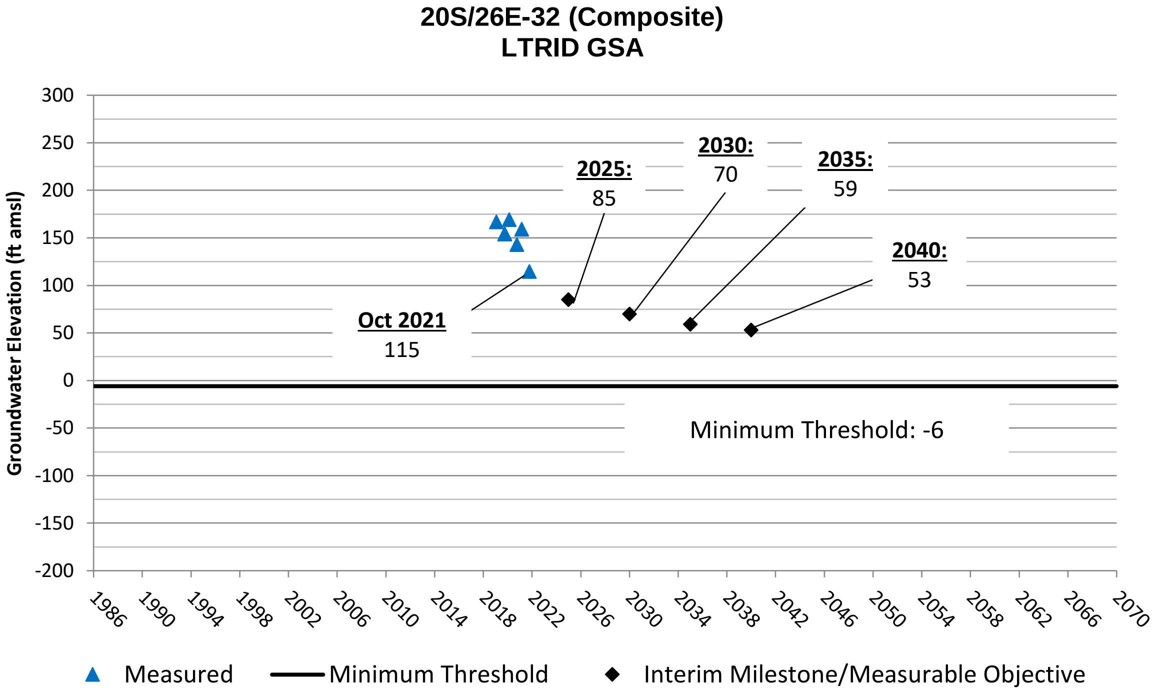
Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs



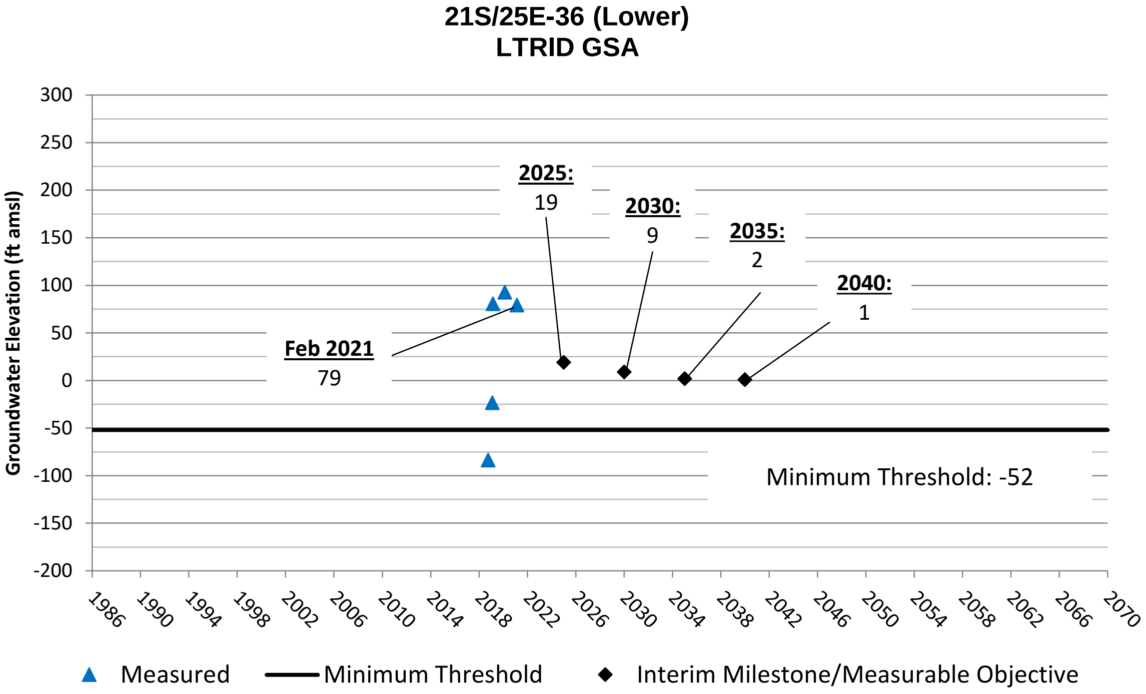


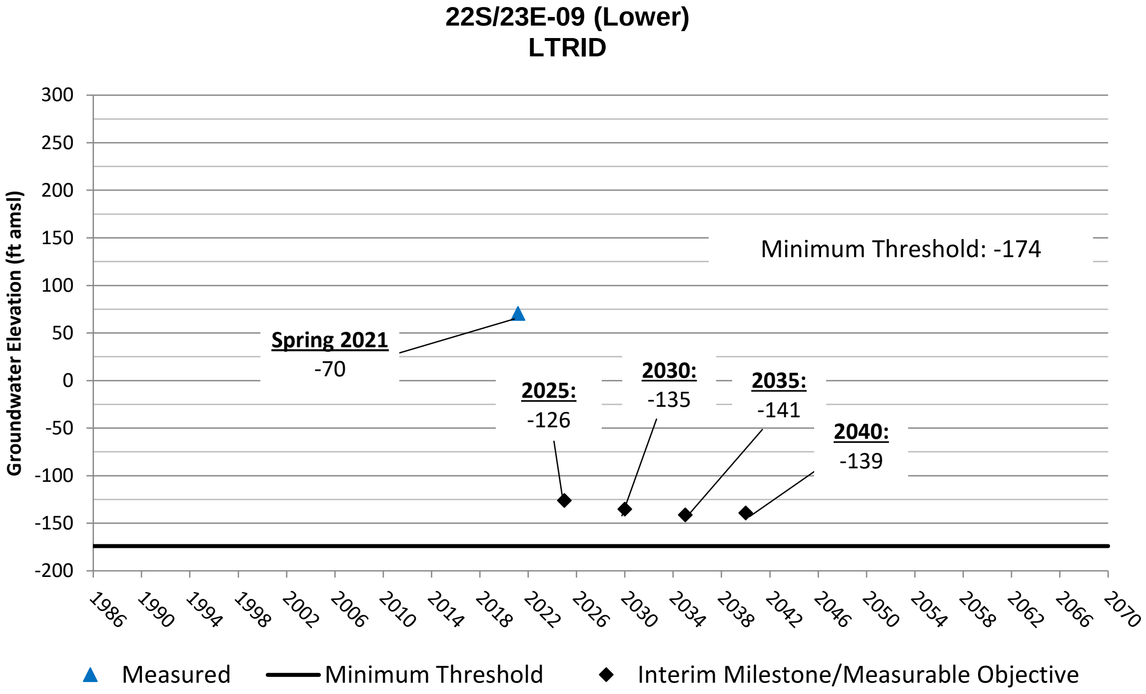
Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs



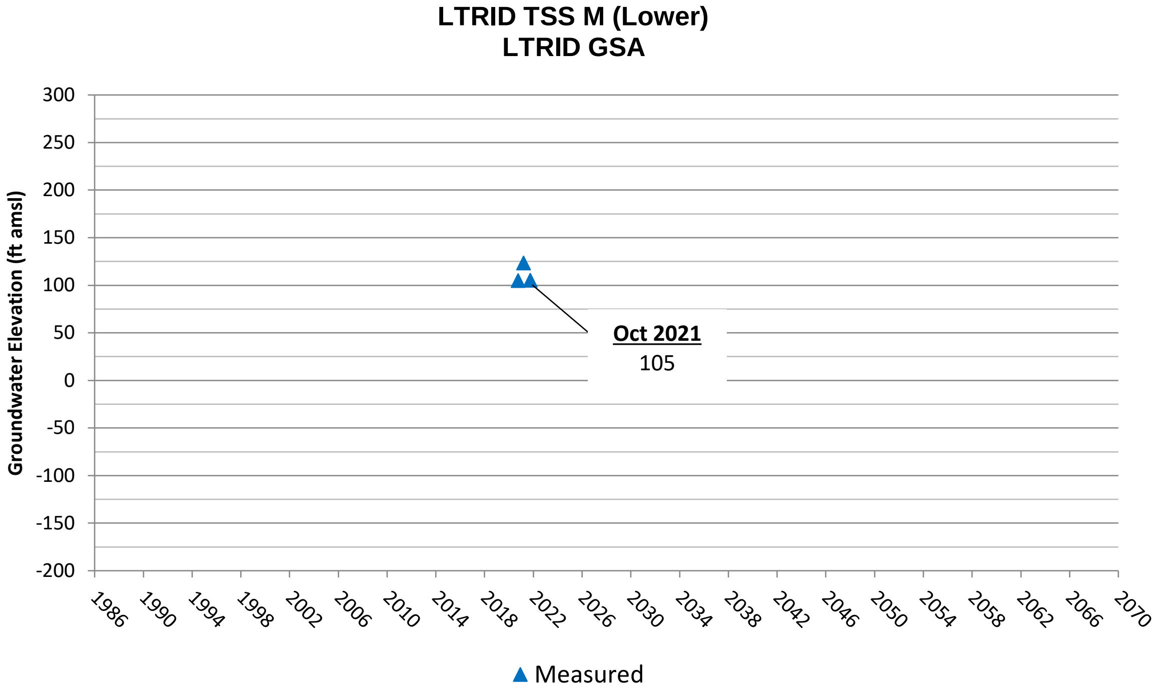


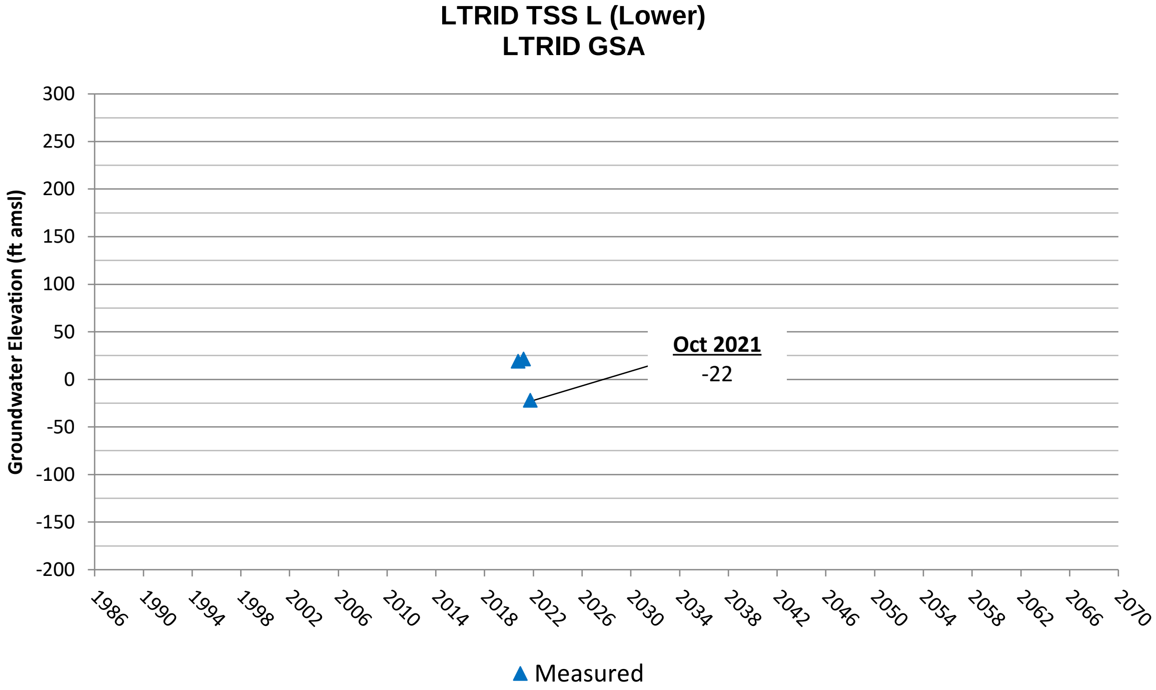
Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs



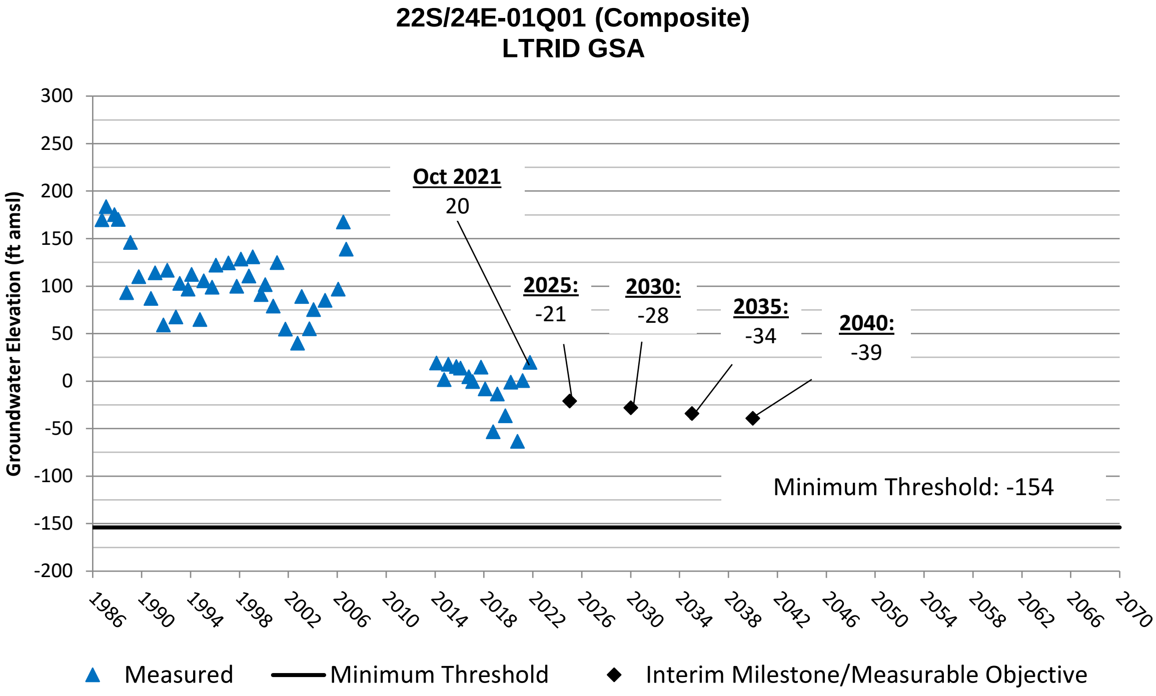


Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs





Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs



Appendix B

Eastern Tule GSA

Water Budgets, Land Surface Elevations at Representative Monitoring Sites, and RMS Groundwater Elevation Hydrographs

Eastern Tule GSA
Historical Surface Water Budget 1986/87 to 2016/17

Water Year	Surface Water Inflow (acre-ft)											Total In
	Precip-itation	Stream Inflow			Imported Water					Discharge from Wells		
		Tule River	Deer Creek	White River	Saucelito ID	Terra Bella ID	Kern-Tulare WD	Porterville ID	Tea Pot Dome WD	Agricultural	Municipal	
1986 - 1987	92,000	70,029	8,389	2,496	23,879	13,136	10,899	15,337	5,490	207,000	9,600	458,000
1987 - 1988	132,000	39,842	6,095	1,420	19,666	21,961	12,210	13,067	5,493	207,000	11,100	470,000
1988 - 1989	107,000	49,667	7,795	1,942	22,426	22,561	11,991	13,106	6,226	206,000	11,700	460,000
1989 - 1990	103,000	29,342	4,706	778	16,166	23,159	11,371	11,520	6,193	215,000	12,200	433,000
1990 - 1991	139,000	51,275	7,247	1,362	19,848	18,725	9,762	11,322	5,636	218,000	12,600	495,000
1991 - 1992	120,000	34,325	4,080	739	21,336	20,743	11,700	15,569	6,607	207,000	12,900	455,000
1992 - 1993	194,000	115,640	15,422	3,623	41,261	18,180	12,357	12,310	6,968	181,000	13,100	614,000
1993 - 1994	123,000	61,313	6,908	1,148	22,064	18,740	14,255	12,895	6,526	206,000	13,500	486,000
1994 - 1995	256,000	218,480	32,053	10,596	37,477	16,186	11,681	9,455	6,562	180,000	13,400	792,000
1995 - 1996	135,000	174,473	23,095	5,957	48,924	21,617	15,415	13,808	7,993	163,000	13,600	623,000
1996 - 1997	189,000	353,968	58,781	12,920	40,908	20,158	15,736	13,379	7,298	172,000	14,500	899,000
1997 - 1998	305,000	439,125	88,360	36,764	28,221	13,165	11,745	10,159	4,913	195,000	13,700	1,146,000
1998 - 1999	156,000	108,466	18,410	7,469	37,062	17,567	14,527	16,107	9,218	185,000	13,700	584,000
1999 - 2000	149,000	102,354	15,230	4,878	39,734	19,200	16,476	15,545	7,191	186,000	14,600	570,000
2000 - 2001	111,000	55,249	7,016	4,695	25,252	19,194	17,550	15,436	6,456	200,000	14,700	477,000
2001 - 2002	106,000	73,206	10,370	6,176	26,131	20,234	15,088	13,628	6,388	201,000	16,400	495,000
2002 - 2003	104,000	125,004	15,678	5,875	33,692	18,356	14,591	14,646	5,844	190,000	16,000	544,000
2003 - 2004	87,000	51,738	6,882	2,350	26,988	20,352	15,755	14,698	6,913	191,000	17,000	441,000
2004 - 2005	166,000	172,558	22,758	6,502	42,840	15,266	13,495	14,748	5,217	172,000	15,800	647,000
2005 - 2006	168,000	195,667	23,868	7,588	45,106	21,763	14,507	13,251	6,436	159,000	16,600	672,000
2006 - 2007	71,000	38,587	6,901	1,815	16,280	20,797	15,133	9,775	5,489	207,000	17,500	410,000
2007 - 2008	79,000	74,030	8,411	2,355	24,083	18,192	17,689	12,988	6,894	192,000	17,700	453,000
2008 - 2009	85,000	54,737	6,620	1,751	31,282	19,701	15,524	18,000	6,165	181,000	17,000	437,000
2009 - 2010	136,000	144,778	16,470	5,080	42,855	17,574	14,027	14,335	5,845	165,000	16,300	578,000
2010 - 2011	201,000	266,473	44,873	14,997	46,733	16,381	13,405	9,387	6,105	154,000	16,200	790,000
2011 - 2012	127,000	87,533	11,311	3,334	19,189	19,757	14,309	9,318	4,680	195,000	16,800	508,000
2012 - 2013	58,000	30,283	4,777	1,145	14,102	20,628	14,955	10,298	4,354	199,000	17,100	375,000
2013 - 2014	41,000	13,171	2,957	535	5,724	12,390	9,986	178	1,030	233,000	16,100	336,000
2014 - 2015	59,000	8,820	1,994	253	1,503	12,012	5,438	114	260	243,000	13,900	346,000
2015 - 2016	91,000	74,330	14,559	4,547	20,049	14,357	11,805	13,271	4,627	194,000	13,700	456,000
2016 - 2017	95,000	352,963	51,145	17,241	51,137	16,089	14,203	21,651	6,694	144,000	14,000	784,000
86/87-16/17 Avg	129,000	118,300	17,800	5,800	28,800	18,300	13,500	12,600	5,900	192,000	14,600	557,000

Appendix B
Table 1b

Eastern Tule GSA
Historical Subbasin Surface Water Budget 1986/87 to 2016/17

	Surface Water Outflow (acre-ft)																									
Water Year	Areal Recharge of Precip-itation	Streambed Infiltration			Recharge in Basins		Deep Percolation of Applied Water					Evapotranspiration										Surface Outflow				Total Out
		Tule River	Deer Creek	White River	Tule River	Recyled Water	Tule River	Imported Water	Recycled Water	Agri-cultural Pumping	Muni-cipal Pumping	Precipitation Crops/Native	Tule River		Deer Creek	White River	Imported Water	Ag. Cons. Use from Pumping	Recycled Water		Municipal (Landscape ET)	Tule River		Deer Creek	White River	
		Success to Oettle Bridge Infiltration	Before Trenton Weir Infiltration										Agricultural Cons. Use	Stream Channel	Stream Channel	Stream Channel	Agricultural Cons. Use		Agricultural Cons. Use	Recharge in Basins		To LTIRD GSA	To FKC	To Pixley GSA	To DEID GSA	
1986 - 1987	0	11,600	8,100	2,400	5,400	2,600	3,200	13,400	200	36,000	2,700	92,000	11,300	400	300	100	55,300	171,000	700	50	3,400	40,400	0	0	0	659,000
1987 - 1988	4,000	8,000	5,800	1,300	5,000	3,200	4,100	15,000	200	37,100	2,900	128,000	10,200	300	300	100	57,400	170,000	900	50	3,900	14,700	0	0	0	709,000
1988 - 1989	0	8,700	7,500	1,800	6,200	3,400	1,700	14,300	200	37,000	3,000	107,000	6,500	300	300	100	62,000	169,000	1,000	50	4,100	22,900	0	0	0	673,000
1989 - 1990	0	5,000	4,400	700	3,700	3,600	1,500	12,500	200	39,100	3,100	103,000	5,800	400	300	100	55,900	175,000	1,000	50	4,300	7,100	0	0	0	634,000
1990 - 1991	7,000	6,400	6,900	1,300	5,200	3,700	1,500	12,500	200	39,200	3,200	132,000	5,500	300	300	100	52,800	179,000	1,000	50	4,500	22,700	0	0	0	719,000
1991 - 1992	1,000	4,300	3,800	700	3,700	3,800	1,600	14,300	200	37,100	3,200	118,000	5,900	400	300	100	61,600	170,000	1,100	50	4,500	9,900	0	0	0	672,000
1992 - 1993	41,000	18,500	15,100	3,500	8,200	3,900	8,900	20,000	200	30,600	3,300	153,000	16,000	400	400	100	71,100	150,000	1,100	50	4,600	57,600	0	0	0	882,000
1993 - 1994	2,000	6,100	6,600	1,100	5,000	4,000	4,000	15,700	200	36,900	3,400	121,000	8,900	300	300	100	58,800	169,000	1,100	50	4,800	31,300	0	0	0	710,000
1994 - 1995	81,000	36,400	21,200	6,600	7,800	3,900	15,400	17,600	200	30,200	3,400	175,000	23,100	400	400	100	63,800	150,000	1,100	50	4,700	142,900	0	10,400	3,900	1,096,000
1995 - 1996	5,000	20,700	13,700	4,600	7,800	3,900	16,100	27,100	200	27,000	3,500	130,000	22,600	400	400	100	80,700	136,000	1,100	50	4,800	105,900	0	9,000	1,300	887,000
1996 - 1997	37,000	34,600	45,100	6,100	5,400	4,300	14,700	23,300	200	29,200	3,600	151,000	21,500	400	400	100	74,200	143,000	1,200	50	5,100	250,300	36,400	13,300	6,700	1,188,000
1997 - 1998	112,000	41,100	14,900	9,500	4,100	3,900	12,000	14,400	200	33,000	3,600	193,000	23,600	400	400	200	53,800	162,000	1,100	50	4,800	286,700	0	74,600	27,100	1,384,000
1998 - 1999	17,000	14,300	13,300	7,100	6,200	3,900	3,600	19,700	200	32,000	3,600	139,000	10,900	400	400	200	74,800	153,000	1,100	50	4,800	71,000	0	4,800	200	843,000
1999 - 2000	12,000	16,900	10,100	4,100	5,500	4,200	3,200	21,500	200	32,500	3,700	137,000	8,500	400	400	100	76,700	154,000	1,200	50	5,100	64,000	0	4,800	600	826,000
2000 - 2001	0	12,300	6,700	4,300	4,800	4,300	2,100	16,700	200	35,800	3,800	111,000	7,300	300	300	100	67,100	164,000	1,200	50	5,200	27,500	0	0	300	701,000
2001 - 2002	0	14,800	10,100	5,000	5,800	4,900	3,800	17,300	300	36,000	4,000	106,000	9,100	400	300	100	64,100	165,000	1,400	50	5,800	32,900	0	0	1,100	708,000
2002 - 2003	0	19,700	13,600	5,100	6,300	4,800	1,800	15,800	200	30,000	3,900	104,000	6,900	400	400	100	71,400	160,000	1,400	50	5,600	77,600	0	1,700	600	748,000
2003 - 2004	0	9,900	6,600	2,300	3,900	5,100	2,400	14,600	200	30,100	4,100	87,000	6,100	400	300	100	70,100	160,000	1,500	50	6,000	24,500	0	0	0	633,000
2004 - 2005	23,000	24,200	14,400	5,100	7,300	2,400	5,900	16,900	500	26,200	3,900	143,000	13,900	400	400	100	74,700	146,000	3,300	50	5,600	91,500	0	8,000	1,300	881,000
2005 - 2006	24,000	28,100	14,400	5,100	6,900	2,000	15,500	21,000	700	24,200	4,000	144,000	18,900	400	400	100	80,000	135,000	4,000	50	5,800	129,200	0	9,200	2,400	947,000
2006 - 2007	0	6,200	6,600	1,700	4,300	2,000	1,700	11,600	700	33,300	4,100	71,000	4,000	300	300	100	55,900	174,000	4,400	50	6,200	20,000	0	0	0	577,000
2007 - 2008	0	11,700	8,100	2,300	6,000	2,000	2,100	13,800	800	30,500	4,200	79,000	6,000	300	300	100	66,000	162,000	4,500	50	6,200	42,700	0	0	0	635,000
2008 - 2009	0	9,500	6,300	1,600	4,800	2,000	2,700	16,500	700	28,400	4,100	85,000	6,700	400	300	100	74,200	153,000	4,200	50	6,000	29,200	0	0	0	635,000
2009 - 2010	6,000	25,600	16,100	5,000	8,500	2,000	9,000	18,600	600	24,900	4,000	131,000	18,100	400	400	100	76,100	140,000	3,900	50	5,800	82,500	0	0	0	834,000
2010 - 2011	45,000	37,100	24,400	8,300	7,200	2,000	14,700	18,500	600	23,400	4,000	156,000	18,800	400	400	200	73,500	131,000	3,800	50	5,700	191,800	10,000	20,200	6,500	1,080,000
2011 - 2012	3,000	13,600	11,000	3,200	6,600	2,000	1,800	11,600	700	31,500	4,100	124,000	4,700	400	300	100	55,700	163,000	4,100	50	5,900	58,800	0	0	0	727,000
2012 - 2013	0	4,900	4,500	1,000	5,300	2,000	1,100	10,900	700	32,300	4,100	58,000	2,700	400	300	100	53,400	167,000	4,200	50	6,000	14,400	0	0	0	525,000
2013 - 2014	0	2,300	2,700	400	3,800	2,000	1,000	5,100	600	37,900	4,000	41,000	2,400	300	300	100	24,200	195,000	3,800	50	5,700	0	0	0	0	443,000
2014 - 2015	0	1,000	1,800	200	3,600	2,000	1,100	2,600	500	39,400	3,700	59,000	2,300	300	200	100	16,700	203,000	2,700	50	4,900	0	0	0	0	467,000
2015 - 2016	0	16,000	14,300	4,400	5,800	2,000	1,700	10,600	400	30,700	3,700	91,000	5,900	300	300	100	53,500	163,000	2,700	50	4,800	35,400	0	0	0	632,000
2016 - 2017	0	42,100	37,000	6,900	8,900	2,000	26,900	29,300	500	21,400	3,700	95,000	20,700	400	400	200	80,500	122,000	2,800	50	4,900	187,800	0	13,800	10,200	940,000
86/87-16/17 Avg	14,000	16,500	12,100	3,600	5,800	3,200	6,000	15,900	400	32,000	3,700	115,000	10,800	400	300	100	63,100	160,000	2,200	50	5,100	70,100	1,500	5,500	2,000	775,000

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Thomas Harder & Co.
Groundwater Consulting

Appendix B
Table 2

Eastern Tule GSA
Historical Groundwater Budget 1986/87 to 2016/17

Water Year	Groundwater Inflows (acre-ft)															Total In	Groundwater Outflows (acre-ft)				Total Out	Change in Storage (acre-ft)
	Areal Recharge from Precip-itation	Tule River			Deer Creek	White River	Imported Water Deliveries	Agricultural Pumping	Municipal Pumping			Release of Water from Compression of Aquitards	Sub-surface Inflow		Mountain-Block Recharge		Groundwater Pumping		Sub-surface Outflow			
										Recycled Water												
		Success to Oettle Bridge Infiltration	Recharge in Basins	Return Flow	Infiltration Before Trenton Weir	Infiltration Before DEID	Return Flow	Irrigated Agriculture	Return Flow	Agricultural Return Flow	Artificial Recharge		From Outside Subbasin	From Other GSAs			Muni-cipal	Agri-culture	To Outside Subbasin	To Other GSAs		
1986 - 1987	0	11,600	5,400	3,200	8,100	2,400	13,400	36,000	2,700	200	2,600	36,000	9,000	37,000	28,000	196,000	9,600	207,000	4,000	74,000	295,000	-99,000
1987 - 1988	4,000	8,000	5,000	4,100	5,800	1,300	15,000	37,100	2,900	200	3,200	15,000	10,000	36,000	29,000	177,000	11,100	207,000	4,000	73,000	295,000	-118,000
1988 - 1989	0	8,700	6,200	1,700	7,500	1,800	14,300	37,000	3,000	200	3,400	12,000	11,000	45,000	29,000	181,000	11,700	206,000	3,000	72,000	293,000	-112,000
1989 - 1990	0	5,000	3,700	1,500	4,400	700	12,500	39,100	3,100	200	3,600	15,000	10,000	39,000	29,000	167,000	12,200	215,000	4,000	79,000	310,000	-143,000
1990 - 1991	7,000	6,400	5,200	1,500	6,900	1,300	12,500	39,200	3,200	200	3,700	16,000	10,000	45,000	29,000	187,000	12,600	218,000	4,000	77,000	312,000	-125,000
1991 - 1992	1,000	4,300	3,700	1,600	3,800	700	14,300	37,100	3,200	200	3,800	15,000	10,000	41,000	30,000	170,000	12,900	207,000	4,000	78,000	302,000	-132,000
1992 - 1993	41,000	18,500	8,200	8,900	15,100	3,500	20,000	30,600	3,300	200	3,900	10,000	9,000	54,000	30,000	256,000	13,100	181,000	4,000	59,000	257,000	-1,000
1993 - 1994	2,000	6,100	5,000	4,000	6,600	1,100	15,700	36,900	3,400	200	4,000	14,000	8,000	36,000	30,000	173,000	13,500	206,000	5,000	70,000	295,000	-122,000
1994 - 1995	81,000	36,400	7,800	15,400	21,200	6,600	17,600	30,200	3,400	200	3,900	8,000	8,000	51,000	30,000	321,000	13,400	180,000	6,000	65,000	264,000	57,000
1995 - 1996	5,000	20,700	7,800	16,100	13,700	4,600	27,100	27,000	3,500	200	3,900	7,000	7,000	49,000	27,000	220,000	13,600	163,000	6,000	56,000	239,000	-19,000
1996 - 1997	37,000	34,600	5,400	14,700	45,100	6,100	23,300	29,200	3,600	200	4,300	5,000	7,000	46,000	28,000	290,000	14,500	172,000	6,000	58,000	251,000	39,000
1997 - 1998	112,000	41,100	4,100	12,000	14,900	9,500	14,400	33,000	3,600	200	3,900	7,000	6,000	49,000	30,000	341,000	13,700	195,000	7,000	58,000	274,000	67,000
1998 - 1999	17,000	14,300	6,200	3,600	13,300	7,100	19,700	32,000	3,600	200	3,900	6,000	6,000	49,000	30,000	212,000	13,700	185,000	6,000	58,000	263,000	-51,000
1999 - 2000	12,000	16,900	5,500	3,200	10,100	4,100	21,500	32,500	3,700	200	4,200	5,000	8,000	45,000	30,000	202,000	14,600	186,000	5,000	58,000	264,000	-62,000
2000 - 2001	0	12,300	4,800	2,100	6,700	4,300	16,700	35,800	3,800	200	4,300	8,000	8,000	42,000	30,000	179,000	14,700	200,000	5,000	61,000	281,000	-102,000
2001 - 2002	0	14,800	5,800	3,800	10,100	5,000	17,300	36,000	4,000	300	4,900	10,000	8,000	43,000	30,000	193,000	16,400	201,000	5,000	63,000	285,000	-92,000
2002 - 2003	0	19,700	6,300	1,800	13,600	5,100	15,800	30,000	3,900	200	4,800	10,000	8,000	48,000	29,000	196,000	16,000	190,000	4,000	56,000	266,000	-70,000
2003 - 2004	0	9,900	3,900	2,400	6,600	2,300	14,600	30,100	4,100	200	5,100	11,000	8,000	40,000	29,000	167,000	17,000	191,000	4,000	57,000	269,000	-102,000
2004 - 2005	23,000	24,200	7,300	5,900	14,400	5,100	16,900	26,200	3,900	500	2,400	9,000	7,000	49,000	29,000	224,000	15,800	172,000	5,000	49,000	242,000	-18,000
2005 - 2006	24,000	28,100	6,900	15,500	14,400	5,100	21,000	24,200	4,000	700	2,000	5,000	7,000	47,000	29,000	234,000	16,600	159,000	6,000	52,000	234,000	0
2006 - 2007	0	6,200	4,300	1,700	6,600	1,700	11,600	33,300	4,100	700	2,000	11,000	7,000	35,000	29,000	154,000	17,500	207,000	6,000	59,000	290,000	-136,000
2007 - 2008	0	11,700	6,000	2,100	8,100	2,300	13,800	30,500	4,200	800	2,000	12,000	7,000	42,000	30,000	173,000	17,700	192,000	5,000	57,000	272,000	-99,000
2008 - 2009	0	9,500	4,800	2,700	6,300	1,600	16,500	28,400	4,100	700	2,000	14,000	7,000	39,000	30,000	167,000	17,000	181,000	5,000	60,000	263,000	-96,000
2009 - 2010	6,000	25,600	8,500	9,000	16,100	5,000	18,600	24,900	4,000	600	2,000	12,000	6,000	47,000	29,000	214,000	16,300	165,000	6,000	52,000	239,000	-25,000
2010 - 2011	45,000	37,100	7,200	14,700	24,400	8,300	18,500	23,400	4,000	600	2,000	5,000	6,000	47,000	29,000	272,000	16,200	154,000	6,000	55,000	231,000	41,000
2011 - 2012	3,000	13,600	6,600	1,800	11,000	3,200	11,600	31,500	4,100	700	2,000	10,000	7,000	39,000	29,000	174,000	16,800	195,000	6,000	63,000	281,000	-107,000
2012 - 2013	0	4,900	5,300	1,100	4,500	1,000	10,900	32,300	4,100	700	2,000	13,000	7,000	37,000	29,000	153,000	17,100	199,000	5,000	64,000	285,000	-132,000
2013 - 2014	0	2,300	3,800	1,000	2,700	400	5,100	37,900	4,000	600	2,000	22,000	7,000	35,000	30,000	154,000	16,100	233,000	6,000	65,000	320,000	-166,000
2014 - 2015	0	1,000	3,600	1,100	1,800	200	2,600	39,400	3,700	500	2,000	24,000	7,000	33,000	30,000	150,000	13,900	243,000	6,000	63,000	326,000	-176,000
2015 - 2016	0	16,000	5,800	1,700	14,300	4,400	10,600	30,700	3,700	400	2,000	18,000	6,000	35,000	30,000	179,000	13,700	194,000	6,000	54,000	268,000	-89,000
2016 - 2017	0	42,100	8,900	26,900	37,000	6,900	29,300	21,400	3,700	500	2,000	13,000	5,000	42,000	29,000	268,000	14,000	144,000	7,000	45,000	210,000	58,000
86/87-16/17 Avg	14,000	16,500	5,800	6,000	12,100	3,600	15,900	32,000	3,700	400	3,200	12,000	8,000	43,000	29,000	205,000	14,600	192,000	5,000	62,000	274,000	-69,000

Cummulative Change in Storage | -2,132,000

🟦 Groundwater Inflows or Outflows to be Included in Sustainable Yield Estimates
🟪 Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨 Groundwater Outflows Not Included in Sustainable Yield Estimates

Appendix B
Table 3a

Projected Future Eastern Tule GSA Surface Water Budget

Water Year	Surface Water Inflow (acre-ft)														Total In
	Precip-itation	Stream Inflow			Imported Water								Discharge from Wells		
		Tule River	Deer Creek	White River	Saucelito ID	Terra Bella ID	Kern-Tulare WD	Porterville ID	Tea Pot Dome WD	City of Porterville	Hope WD	Ducor ID	Agricultural	Municipal	
2017 - 2018	128,000	131,258	19,410	6,347	34,567	18,786	15,335	19,803	6,528	0	0	0	158,000	14,700	553,000
2018 - 2019	128,000	131,258	19,410	6,347	34,567	18,786	15,335	19,803	6,528	0	0	0	157,000	16,400	553,000
2019 - 2020	128,000	131,258	19,410	6,347	34,567	18,786	15,335	23,103	6,528	0	0	0	151,000	18,000	552,000
2020 - 2021	128,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	0	0	148,000	18,400	555,000
2021 - 2022	128,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	0	0	148,000	18,800	555,000
2022 - 2023	128,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	1,667	0	148,000	19,100	557,000
2023 - 2024	128,000	131,258	19,410	6,347	35,667	18,786	17,935	23,103	6,528	1,100	1,667	4,000	148,000	19,500	561,000
2024 - 2025	128,000	134,258	19,410	6,347	34,893	20,304	18,229	24,339	6,594	1,100	1,667	4,000	138,000	20,000	557,000
2025 - 2026	128,000	134,258	19,410	6,347	34,118	21,823	17,843	25,575	6,661	1,100	1,667	4,000	138,000	20,400	559,000
2026 - 2027	128,000	134,258	19,410	6,347	33,343	23,341	17,458	26,812	6,727	1,100	1,667	4,000	136,000	20,800	559,000
2027 - 2028	128,000	134,258	19,410	6,347	32,568	24,860	17,072	28,048	6,793	1,100	1,667	4,000	134,000	21,300	559,000
2028 - 2029	128,000	134,258	19,410	6,347	31,794	26,378	16,687	29,285	6,860	1,100	1,667	4,000	132,000	21,700	559,000
2029 - 2030	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	92,000	22,200	523,000
2030 - 2031	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	97,000	22,700	529,000
2031 - 2032	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	96,000	23,100	528,000
2032 - 2033	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	96,000	23,600	529,000
2033 - 2034	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	96,000	24,200	529,000
2034 - 2035	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	70,000	24,700	504,000
2035 - 2036	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	70,000	25,200	504,000
2036 - 2037	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	70,000	25,800	505,000
2037 - 2038	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	26,300	504,000
2038 - 2039	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	26,900	505,000
2039 - 2040	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2040 - 2041	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2041 - 2042	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2042 - 2043	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2043 - 2044	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2044 - 2045	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2045 - 2046	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2046 - 2047	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2047 - 2048	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2048 - 2049	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2049 - 2050	128,000	134,258	19,410	6,347	31,019	27,897	18,039	30,521	6,926	1,100	1,667	4,000	69,000	27,500	506,000
2050 - 2051	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2051 - 2052	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2052 - 2053	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2053 - 2054	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2054 - 2055	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2055 - 2056	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2056 - 2057	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2057 - 2058	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2058 - 2059	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2059 - 2060	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2060 - 2061	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2061 - 2062	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2062 - 2063	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2063 - 2064	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2064 - 2065	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2065 - 2066	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2066 - 2067	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2067 - 2068	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2068 - 2069	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
2069 - 2070	128,000	130,581	18,943	6,143	29,378	26,278	18,039	28,441	6,524	1,100	1,667	4,000	68,000	27,500	495,000
17/18-69/70 Avg	128,000	132,500	19,200	6,300	31,200	25,700	17,800	28,300	6,700	1,000	1,500	3,500	88,000	25,000	515,000

Appendix B
Table 3b

Projected Future Eastern Tule GSA Subbasin Surface Water Budget

Water Year	Surface Water Outflow (acre-ft)																											Total Out
	Areal Recharge of Precip-itation	Streambed Infiltration			Recharge in Basins				Deep Percolation of Applied Water					Evapotranspiration										Surface Outflow				
		Tule River	Deer Creek	White River	Tule River	Deer Creek	Import ed Water	Recycled Water	Tule River	Imported Water	Recycled Water	Agri-cultural Pumping	Muni-cipal Pumping	Precipitation Crops/Native	Tule River		Deer Creek	White River	Imported Water	Ag. Cons. Use from Pumping	Recycled Water		Municipal (Landscape ET)	Tule River		Deer Creek	White River	
		Success to Oettle Bridge Infiltration	Before Trenton Weir Infiltration												Agricultural Cons. Use	Stream Channel	Stream Channel	Stream Channel	Agricultural Cons. Use		Agricultural Cons. Use	Recharge in Basins		To LTIRD GSA	To FKC	To Pixley GSA	To DEID GSA	
2017 - 2018	14,000	17,900	11,600	4,000	5,800	800	0	2,000	4,600	19,700	600	24,300	3,400	115,000	13,900	300	300	100	75,400	133,000	3,500	50	5,200	80,000	0	6,700	2,200	544,000
2018 - 2019	14,000	17,900	11,600	4,000	5,800	800	0	2,000	4,600	19,700	700	24,200	3,600	115,000	13,900	300	300	100	75,400	133,000	4,300	50	5,800	80,000	0	6,700	2,200	546,000
2019 - 2020	14,000	17,900	11,600	4,000	6,700	800	3,300	2,500	4,600	20,600	400	23,200	3,800	115,000	13,900	300	300	100	77,700	125,000	2,600	50	8,700	80,000	0	6,700	2,200	546,000
2020 - 2021	14,000	17,900	11,600	4,000	6,700	800	5,500	2,600	4,600	21,000	400	22,800	3,800	115,000	13,900	300	300	100	80,000	123,000	2,600	50	8,900	80,000	0	6,700	2,200	549,000
2021 - 2022	14,000	17,900	11,600	4,000	6,700	800	5,500	2,600	4,600	21,000	400	22,800	3,800	115,000	13,900	300	300	100	80,000	123,000	2,700	50	9,100	80,000	0	6,700	2,200	549,000
2022 - 2023	14,000	17,900	11,600	4,000	6,700	800	7,200	2,700	4,600	21,000	500	22,800	3,900	115,000	13,900	300	300	100	80,000	123,000	2,800	50	9,300	80,000	0	6,700	2,200	551,000
2023 - 2024	14,000	17,900	11,600	4,000	6,700	800	11,200	2,800	4,600	21,000	500	22,800	3,900	115,000	13,900	300	300	100	80,000	123,000	2,800	50	9,500	80,000	0	6,700	2,200	556,000
2024 - 2025	14,000	17,900	11,600	4,000	7,100	800	11,200	2,800	4,600	21,400	500	21,300	4,000	115,000	14,000	300	300	100	81,900	114,000	2,900	50	9,700	82,600	0	6,700	2,200	551,000
2025 - 2026	14,000	17,900	11,600	4,000	7,100	800	11,200	2,900	4,600	21,700	500	21,200	4,000	115,000	14,000	300	300	100	83,200	114,000	3,000	50	9,900	82,600	0	6,700	2,200	553,000
2026 - 2027	14,000	17,900	11,600	4,000	7,100	800	11,200	3,000	4,600	22,000	500	20,900	4,100	115,000	14,000	300	300	100	84,600	113,000	3,000	50	10,100	82,600	0	6,700	2,200	554,000
2027 - 2028	14,000	17,900	11,600	4,000	7,100	800	11,200	3,100	4,600	22,300	500	20,600	4,100	115,000	14,000	300	300	100	86,000	111,000	3,100	50	10,400	82,600	0	6,700	2,200	554,000
2028 - 2029	14,000	17,900	11,600	4,000	7,100	800	11,200	3,100	4,500	22,600	500	20,300	4,200	115,000	14,000	300	300	100	87,300	110,000	3,200	50	10,600	82,600	0	6,700	2,200	554,000
2029 - 2030	14,000	17,900	11,600	4,000	7,100	800	11,200	3,200	4,300	23,200	500	14,300	4,200	115,000	13,200	300	300	100	90,100	75,000	3,300	50	10,800	82,000	0	6,700	2,200	515,000
2030 - 2031	14,000	17,900	11,600	4,000	7,100	800	11,200	3,300	4,300	23,200	600	15,100	4,300	115,000	13,200	300	300	100	90,100	79,000	3,400	50	11,100	82,000	0	6,700	2,200	521,000
2031 - 2032	14,000	17,900	11,600	4,000	7,100	800	11,200	3,400	4,300	23,200	600	15,100	4,400	115,000	13,200	300	300	100	90,100	79,000	3,400	50	11,300	82,000	0	6,700	2,200	521,000
2032 - 2033	14,000	17,900	11,600	4,000	7,100	800	11,200	3,500	4,300	23,200	600	15,100	4,400	115,000	13,200	300	300	100	90,100	79,000	3,500	50	11,600	82,000	0	6,700	2,200	522,000
2033 - 2034	14,000	17,900	11,600	4,000	7,100	800	11,200	3,500	4,300	23,200	600	15,100	4,500	115,000	13,200	300	300	100	90,100	79,000	3,600	50	11,900	82,000	0	6,700	2,200	522,000
2034 - 2035	14,000	17,900	11,600	4,000	7,100	800	11,200	3,600	4,300	23,200	600	11,000	4,500	115,000	13,200	300	300	100	90,100	56,000	3,700	50	12,100	82,000	0	6,700	2,200	496,000
2035 - 2036	14,000	17,900	11,600	4,000	7,100	800	11,200	3,700	4,300	23,200	600	11,000	4,600	115,000	13,200	300	300	100	90,100	56,000	3,800	50	12,400	82,000	0	6,700	2,200	496,000
2036 - 2037	14,000	17,900	11,600	4,000	7,100	800	11,200	3,800	4,300	23,200	700	10,900	4,700	115,000	13,200	300	300	100	90,100	56,000	3,900	50	12,700	82,000	0	6,700	2,200	497,000
2037 - 2038	14,000	17,900	11,600	4,000	7,100	800	11,200	3,900	4,300	23,200	700	10,900	4,700	115,000	13,200	300	300	100	90,100	56,000	4,000	50	13,000	82,000	0	6,700	2,200	497,000
2038 - 2039	14,000	17,900	11,600	4,000	7,100	800	11,200	4,000	4,300	23,200	700	10,900	4,800	115,000	13,200	300	300	100	90,100	56,000	4,100	50	13,300	82,000	0	6,700	2,200	498,000
2039 - 2040	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2040 - 2041	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2041 - 2042	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2042 - 2043	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2043 - 2044	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2044 - 2045	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2045 - 2046	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2046 - 2047	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2047 - 2048	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2048 - 2049	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2049 - 2050	14,000	17,900	11,600	4,000	7,100	800	11,200	4,100	4,300	23,200	700	10,900	4,900	115,000	13,200	300	300	100	90,100	56,000	4,200	50	13,600	82,000	0	6,700	2,200	498,000
2050 - 2051	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2051 - 2052	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2052 - 2053	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2053 - 2054	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2054 - 2055	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2055 - 2056	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2056 - 2057	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2057 - 2058	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2058 - 2059	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2059 - 2060	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2060 - 2061	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2061 - 2062	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2062 - 2063	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2063 - 2064	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2064 - 2065	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2065 - 2066	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2066 - 2067	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2067 - 2068	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2068 - 2069	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
2069 - 2070	14,000	17,400	11,300	3,900	6,600	800	11,200	4,100	4,500	22,200	700	10,800	4,900	115,000	12,500	300	300	100	85,400	54,000	4,200	50	13,600	79,800	0	6,500	2,200	486,000
17/18-69/70 Avg	14,000	17,700	11,500	4,000	6,800	800	10,300	3,700	4,400	22,400	600	13,800	4,600	115,000	13,100	300	300	100	86,300	72,000	3,800	50	12,200	81,000	0	6,600	2,200	508,000

Appendix B
Table 4

Projected Future Eastern Tule GSA Groundwater Budget

	Groundwater Inflows (acre-ft)																		Groundwater Outflows (acre-ft)					
		Tule River			Deer Creek		White River	Imported Water Deliveries		Agricultural Pumping	Municipal Pumping			Release of Water from Compression of Aquitards	Sub-surface Inflow		Mountain-Block Recharge	Total In	Groundwater Pumping		Sub-surface Outflow		Total Out	Change in Storage (acre-ft)
												Recycled Water												
Water Year	Areal Recharge from Precip-itation	Success to Oettle Bridge Infiltration	Recharge in Basins	Return Flow	Infiltration Before Trenton Weir	Recharge in Basins	Infiltration Before DEID	Return Flow	Recharge in Basins	Irrigated Agriculture	Return Flow	Agricultural Return Flow	Artificial Recharge		From Outside Subbasin	From Other GSAs			Muni-cipal	Agri-culture	To Outside Subbasin	To Other GSAs		
2017 - 2018	14,000	17,900	5,800	4,600	11,600	800	4,000	19,700	0	24,300	3,400	600	2,000	9,000	6,000	36,000	33,000	193,000	14,700	158,000	7,000	51,000	231,000	-38,000
2018 - 2019	14,000	17,900	5,800	4,600	11,600	800	4,000	19,700	0	24,200	3,600	700	2,000	9,000	6,000	36,000	33,000	193,000	16,400	157,000	7,000	51,000	231,000	-38,000
2019 - 2020	14,000	17,900	6,700	4,600	11,600	800	4,000	20,600	3,300	23,200	3,800	400	2,500	9,000	6,000	36,000	33,000	197,000	18,000	151,000	6,000	51,000	226,000	-29,000
2020 - 2021	14,000	17,900	6,700	4,600	11,600	800	4,000	21,000	5,500	22,800	3,800	400	2,600	8,000	5,000	35,000	33,000	197,000	18,400	148,000	7,000	51,000	224,000	-27,000
2021 - 2022	14,000	17,900	6,700	4,600	11,600	800	4,000	21,000	5,500	22,800	3,800	400	2,600	8,000	5,000	35,000	33,000	197,000	18,800	148,000	7,000	50,000	224,000	-27,000
2022 - 2023	14,000	17,900	6,700	4,600	11,600	800	4,000	21,000	7,170	22,800	3,900	500	2,700	8,000	5,000	35,000	33,000	199,000	19,100	148,000	7,000	50,000	224,000	-25,000
2023 - 2024	14,000	17,900	6,700	4,600	11,600	800	4,000	21,000	11,170	22,800	3,900	500	2,800	8,000	5,000	35,000	33,000	203,000	19,500	148,000	7,000	50,000	225,000	-22,000
2024 - 2025	14,000	17,900	7,100	4,600	11,600	800	4,000	21,400	11,170	21,300	4,000	500	2,800	6,000	5,000	34,000	33,000	199,000	20,000	138,000	6,000	49,000	213,000	-14,000
2025 - 2026	14,000	17,900	7,100	4,600	11,600	800	4,000	21,700	11,170	21,200	4,000	500	2,900	6,000	5,000	33,000	33,000	198,000	20,400	138,000	6,000	49,000	213,000	-15,000
2026 - 2027	14,000	17,900	7,100	4,600	11,600	800	4,000	22,000	11,170	20,900	4,100	500	3,000	6,000	5,000	32,000	33,000	198,000	20,800	136,000	6,000	49,000	212,000	-14,000
2027 - 2028	14,000	17,900	7,100	4,600	11,600	800	4,000	22,300	11,170	20,600	4,100	500	3,100	5,000	4,000	32,000	33,000	196,000	21,300	134,000	7,000	49,000	211,000	-15,000
2028 - 2029	14,000	17,900	7,100	4,500	11,600	800	4,000	22,600	11,170	20,300	4,200	500	3,100	5,000	4,000	31,000	33,000	195,000	21,700	132,000	7,000	49,000	210,000	-15,000
2029 - 2030	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	14,300	4,200	500	3,200	2,000	4,000	28,000	33,000	183,000	22,200	92,000	4,000	49,000	167,000	16,000
2030 - 2031	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	15,100	4,300	600	3,300	2,000	4,000	27,000	33,000	183,000	22,700	97,000	4,000	49,000	173,000	10,000
2031 - 2032	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	15,100	4,400	600	3,400	2,000	4,000	26,000	33,000	183,000	23,100	96,000	4,000	49,000	172,000	11,000
2032 - 2033	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	15,100	4,400	600	3,500	2,000	4,000	25,000	33,000	182,000	23,600	96,000	4,000	49,000	173,000	9,000
2033 - 2034	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	15,100	4,500	600	3,500	2,000	4,000	25,000	33,000	182,000	24,200	96,000	3,000	49,000	172,000	10,000
2034 - 2035	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	11,000	4,500	600	3,600	1,000	4,000	22,000	33,000	174,000	24,700	70,000	2,000	49,000	146,000	28,000
2035 - 2036	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	11,000	4,600	600	3,700	1,000	4,000	21,000	33,000	173,000	25,200	70,000	2,000	49,000	146,000	27,000
2036 - 2037	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,700	700	3,800	1,000	4,000	20,000	32,000	171,000	25,800	70,000	2,000	50,000	148,000	23,000
2037 - 2038	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,700	700	3,900	0	4,000	20,000	32,000	170,000	26,300	69,000	2,000	50,000	147,000	23,000
2038 - 2039	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,800	700	4,000	0	4,000	19,000	32,000	169,000	26,900	69,000	2,000	51,000	149,000	20,000
2039 - 2040	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	19,000	32,000	170,000	27,500	69,000	1,000	50,000	148,000	22,000
2040 - 2041	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	18,000	32,000	169,000	27,500	69,000	1,000	50,000	148,000	21,000
2041 - 2042	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	18,000	32,000	169,000	27,500	69,000	1,000	50,000	148,000	21,000
2042 - 2043	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	17,000	32,000	168,000	27,500	69,000	1,000	50,000	148,000	20,000
2043 - 2044	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	17,000	32,000	168,000	27,500	69,000	1,000	51,000	149,000	19,000
2044 - 2045	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	17,000	32,000	168,000	27,500	69,000	1,000	51,000	149,000	19,000
2045 - 2046	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	16,000	32,000	167,000	27,500	69,000	1,000	52,000	150,000	17,000
2046 - 2047	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	16,000	32,000	167,000	27,500	69,000	1,000	52,000	150,000	17,000
2047 - 2048	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	16,000	32,000	167,000	27,500	69,000	1,000	53,000	151,000	16,000
2048 - 2049	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	16,000	32,000	167,000	27,500	69,000	1,000	53,000	151,000	16,000
2049 - 2050	14,000	17,900	7,100	4,300	11,600	800	4,000	23,200	11,170	10,900	4,900	700	4,100	0	4,000	16,000	32,000	167,000	27,500	69,000	1,000	54,000	152,000	15,000
2050 - 2051	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	4,000	16,000	31,000	163,000	27,500	68,000	1,000	55,000	152,000	11,000
2051 - 2052	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	4,000	15,000	32,000	163,000	27,500	68,000	1,000	55,000	152,000	11,000
2052 - 2053	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	4,000	15,000	31,000	162,000	27,500	68,000	1,000	56,000	153,000	9,000
2053 - 2054	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	4,000	15,000	31,000	162,000	27,500	68,000	1,000	56,000	153,000	9,000
2054 - 2055	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	4,000	15,000	31,000	162,000	27,500	68,000	1,000	57,000	154,000	8,000
2055 - 2056	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	4,000	15,000	32,000	163,000	27,500	68,000	1,000	58,000	155,000	8,000
2056 - 2057	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	58,000	155,000	5,000
2057 - 2058	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	58,000	155,000	5,000
2058 - 2059	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	59,000	156,000	4,000
2059 - 2060	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	59,000	156,000	4,000
2060 - 2061	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	59,000	156,000	4,000
2061 - 2062	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	60,000	157,000	3,000
2062 - 2063	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	60,000	157,000	3,000
2063 - 2064	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	60,000	157,000	3,000
2064 - 2065	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	60,000	157,000	3,000
2065 - 2066	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	61,000	158,000	2,000
2066 - 2067	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	61,000	158,000	2,000
2067 - 2068	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	61,000	158,000	2,000
2068 - 2069	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	61,000	158,000	2,000
2069 - 2070	14,000	17,400	6,600	4,500	11,300	800	3,900	22,200	11,170	10,800	4,900	700	4,100	0	3,000	14,000	31,000	160,000	27,500	68,000	1,000	62,000	159,000	1,000
17/18-69/70 Avg	14,000	17,700	6,800	4,400	11,500	800	4,000	22,400	10,300	13,800	4,600	600	3,700	2,000	4,000	21,000	32,000	174,000	25,000	88,000	3,000	53,000	169,000	5,000

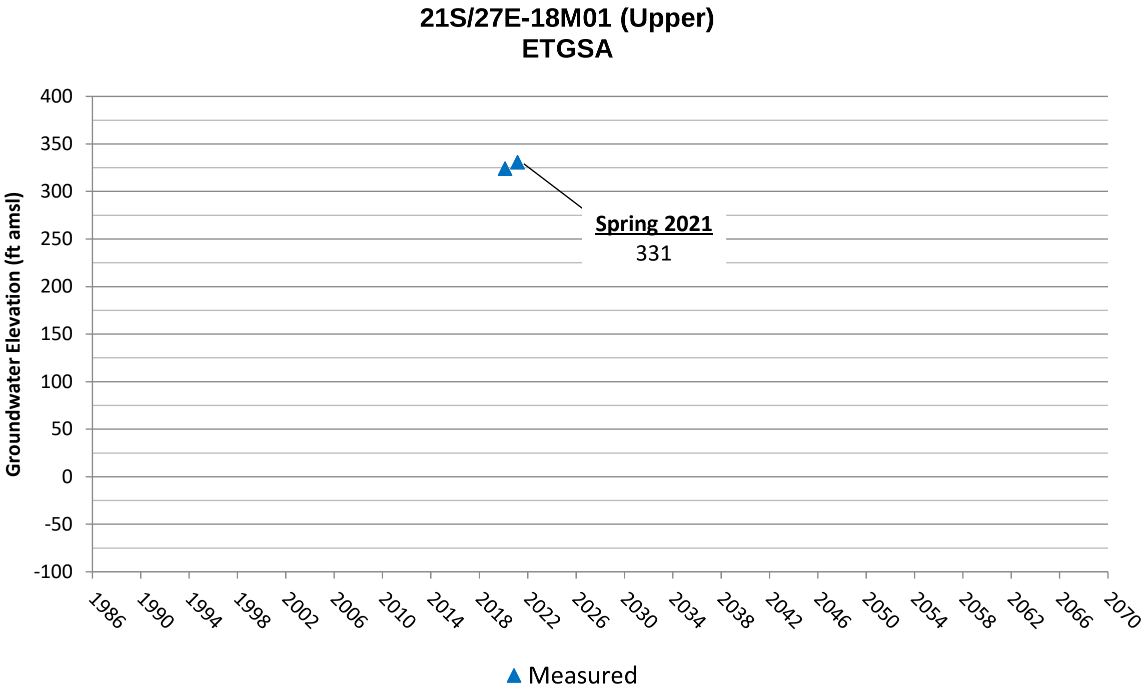
Eastern Tule GSA
Land Surface Elevations at Representative Monitoring Sites

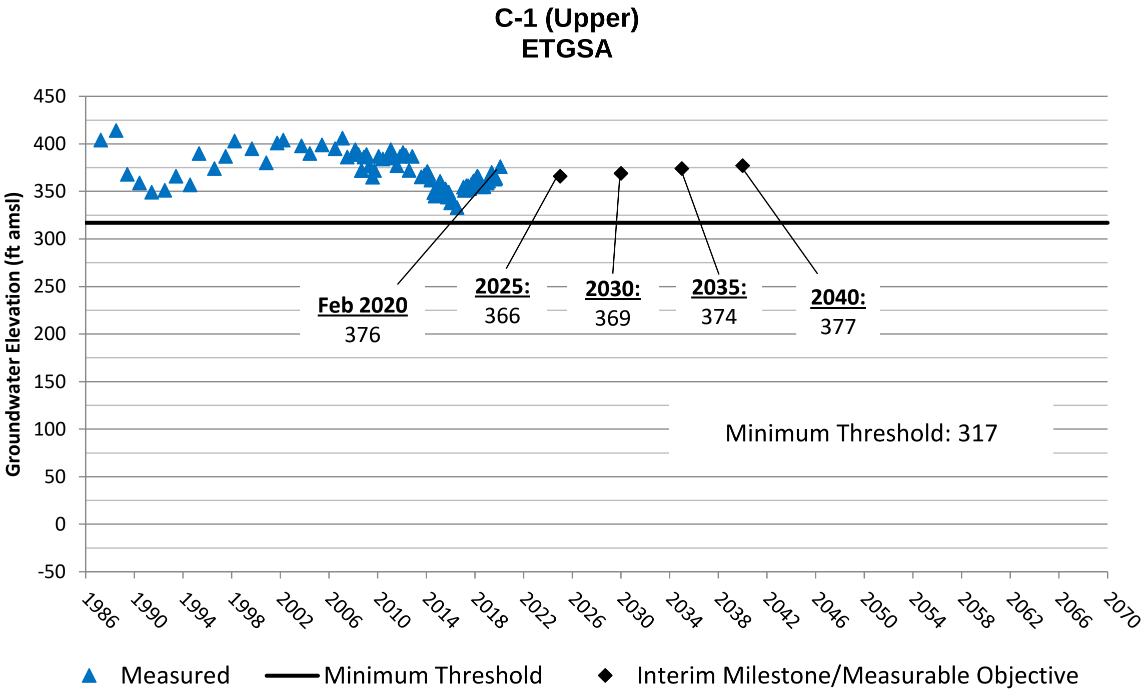
Site	Land Surface Elevation (ft amsl)[1]			
	2020 (Baseline)	2021	Measurable Objective	Minimum Threshold
E0035_B_RMS	342.1	341.4	340.5	339.5
E0047_B_RMS	366.2	365.7	365.2	363.4
E0048_B_RMS	370.5	369.9	369.5	366.5
E0049_B_RMS	403.2	402.6	402.7	401.8
E0050_B_RMS	386.6	386.6	386.5	385.5
E0051_B_FKC	397.3	397.1	397.3	396.3
E0052_B_FKC	405.7	404.7	405.7	404.7
E0053_B_FKC	399.8	399.3	399.7	398.3
E0054_B_FKC	412.5	412.6	412.4	411.0
E0055_B_FKC	409.1	409.2	409.0	408.0
E0056_G_FKC	406.7	406.8	406.7	405.7
E0057_B_FKC	399.3	399.1	399.3	398.3
E0058_B_FKC	407.8	407.7	407.1	406.0
E0059_B_FKC	418.0	417.7	416.9	415.9
E0060_B_FKC	393.6	393.4	392.8	391.7
E0061_B_FKC	403.8	403.5	402.7	401.7
E0062_B_FKC	403.6	403.2	402.9	401.9
E0063_G_FKC	403.2	402.9	403.2	402.1
E0064_B_FKC	400.8	400.6	400.7	399.4
E0065_B_FKC	393.7	400.1	392.6	389.9
E0066_B_FKC	411.9	411.6	410.2	409.1
E0067_B_FKC	408.0	407.5	407.0	404.7
E0068_B_FKC	391.2	390.7	390.9	389.0
E0069_B_FKC	397.4	397.1	397.4	396.4
E0087_B_RMS	531.1	530.9	531.2	530.2
E0088_B_RMS	457.5	457.2	456.8	455.8

Note:

[1] Benchmarks surveyed in July and August of each year.

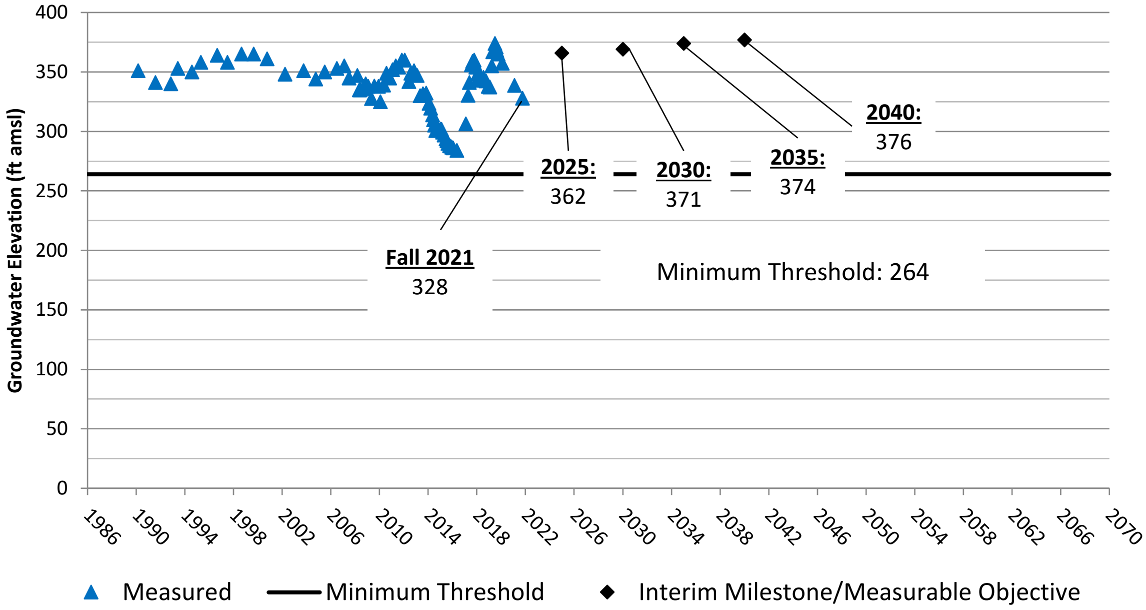
Eastern Tule GSA
RMS Groundwater Elevation Hydrographs





Eastern Tule GSA
RMS Groundwater Elevation Hydrographs

R-11 (Upper)
ETGSA



22S/26E-13R01 (Upper)
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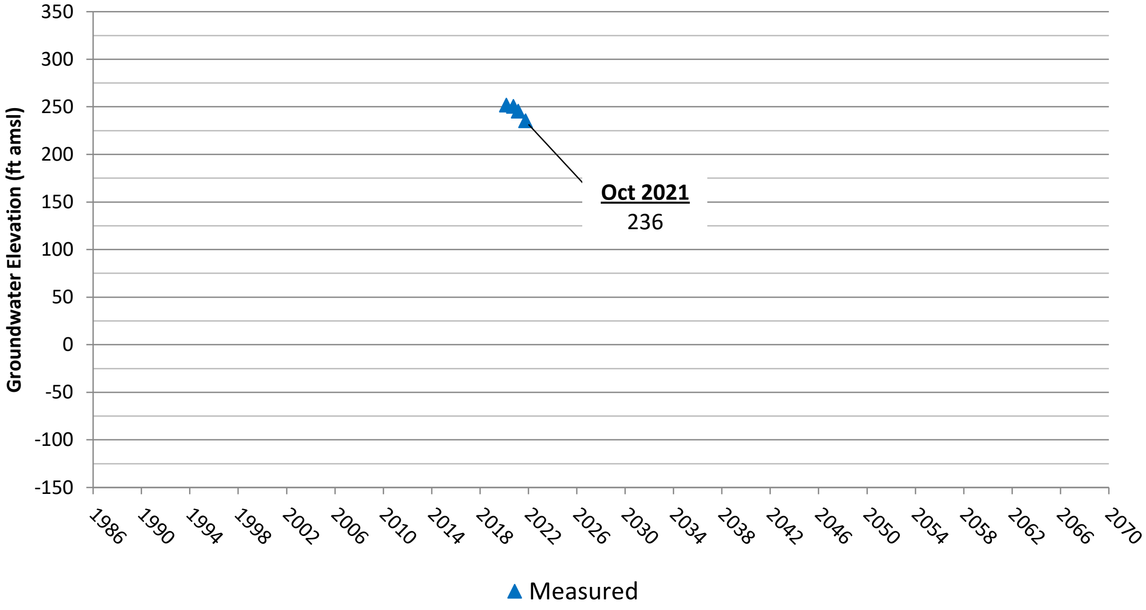
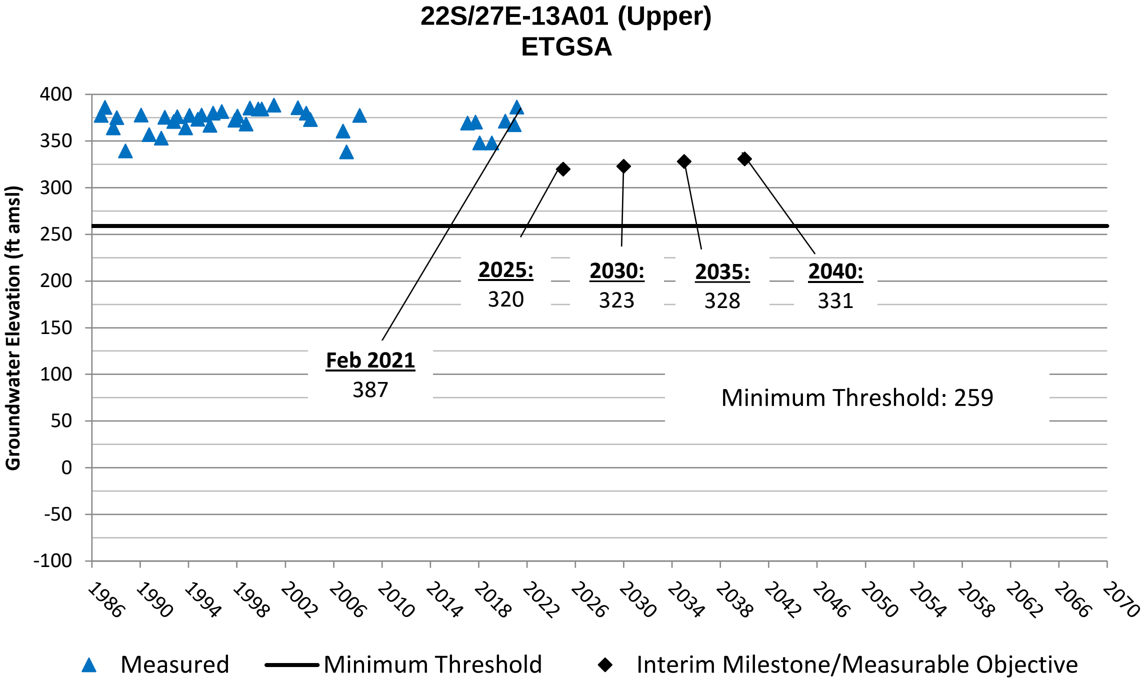
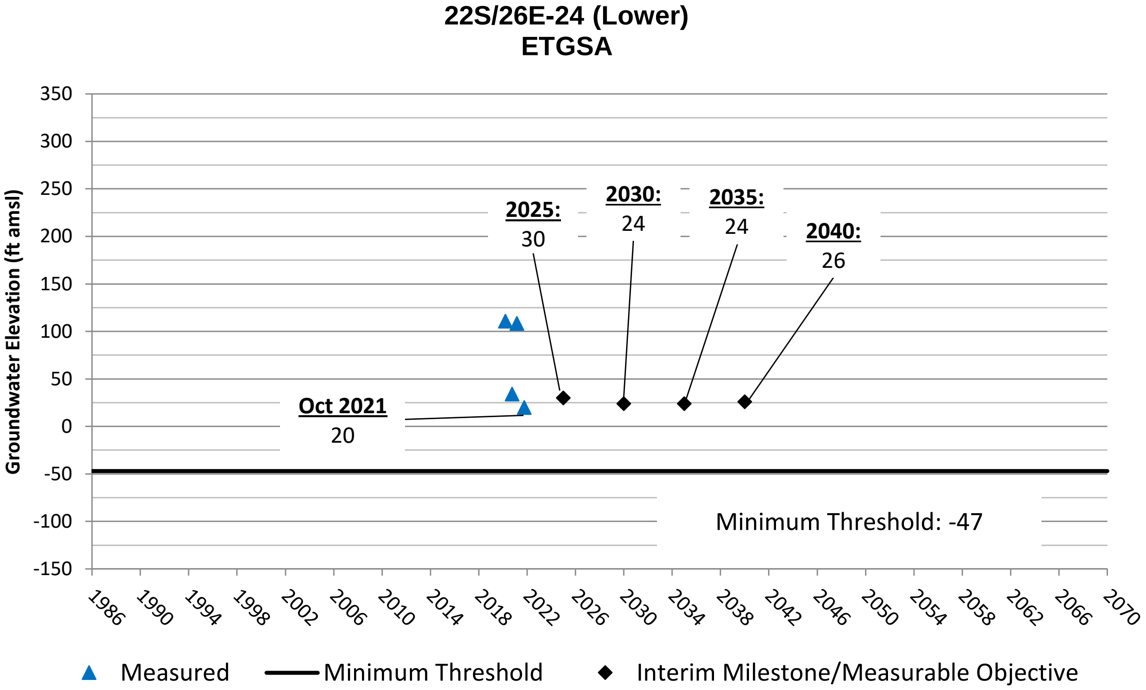
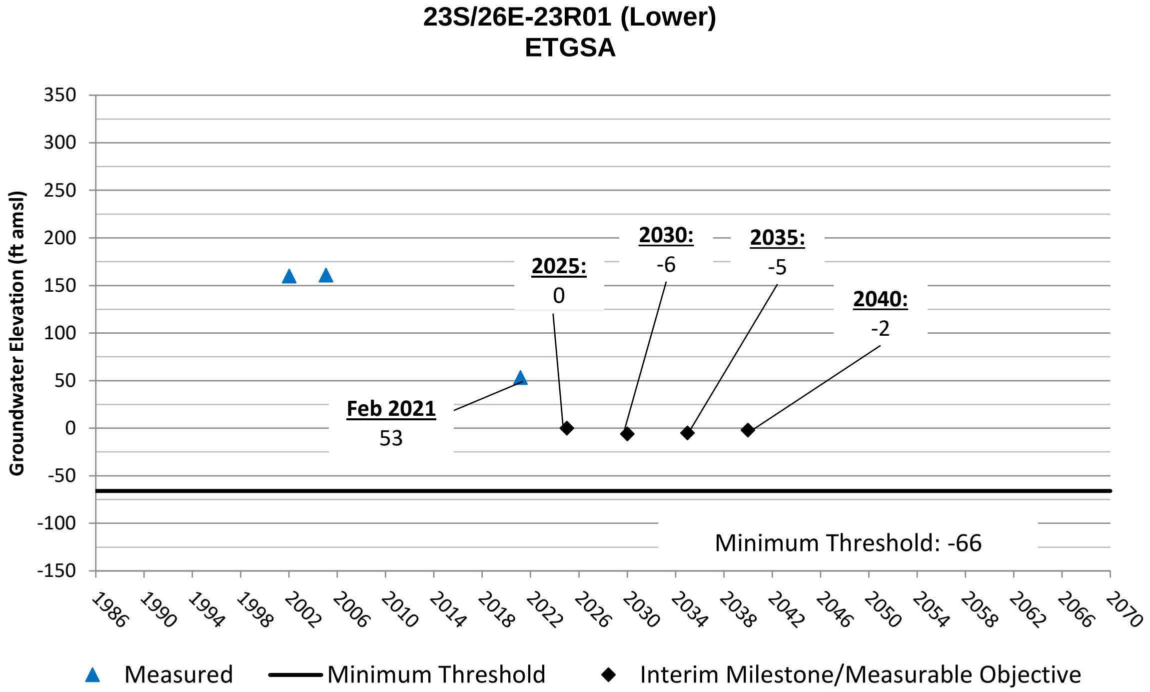


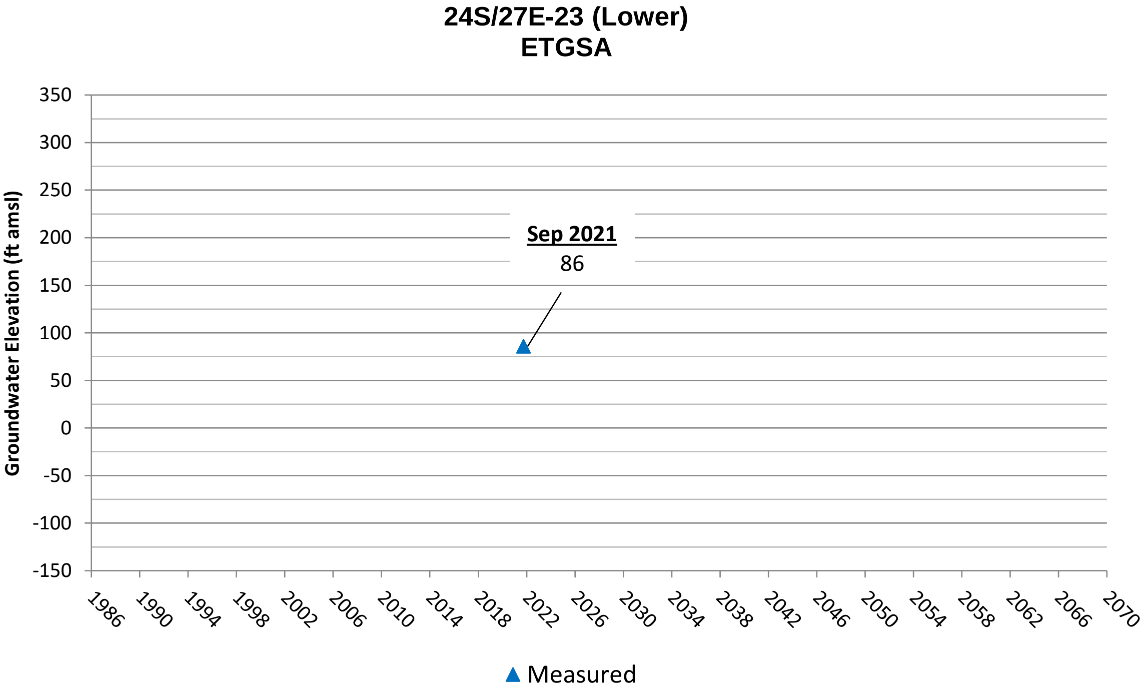
Eastern Tule GSA
RMS Groundwater Elevation Hydrographs



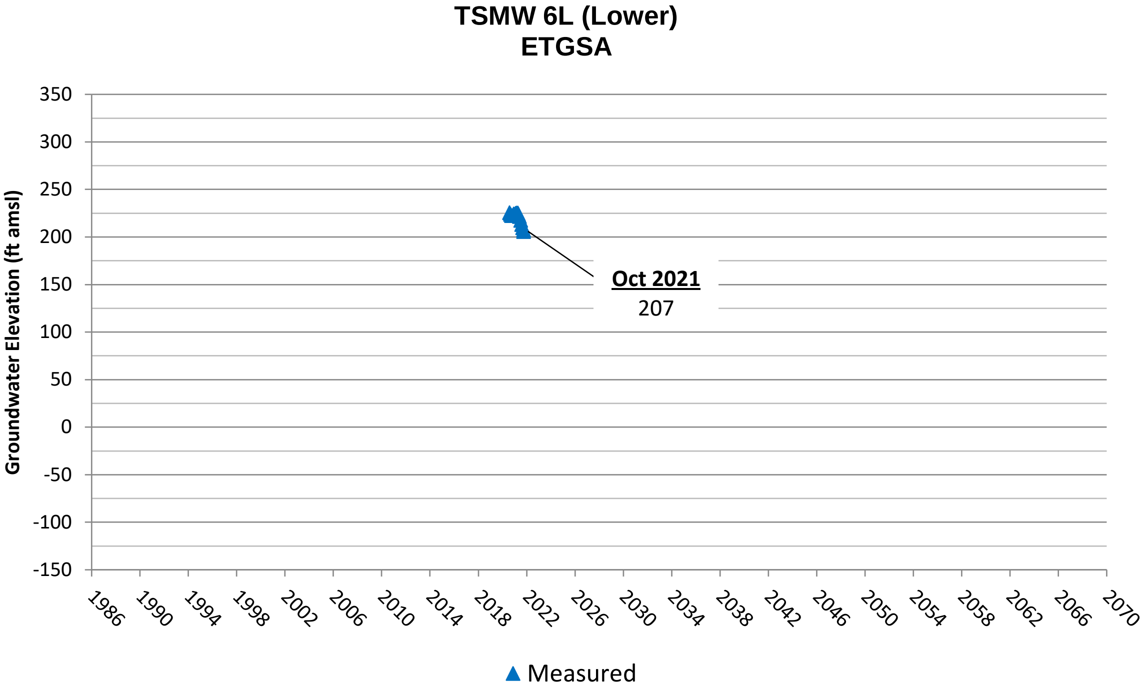


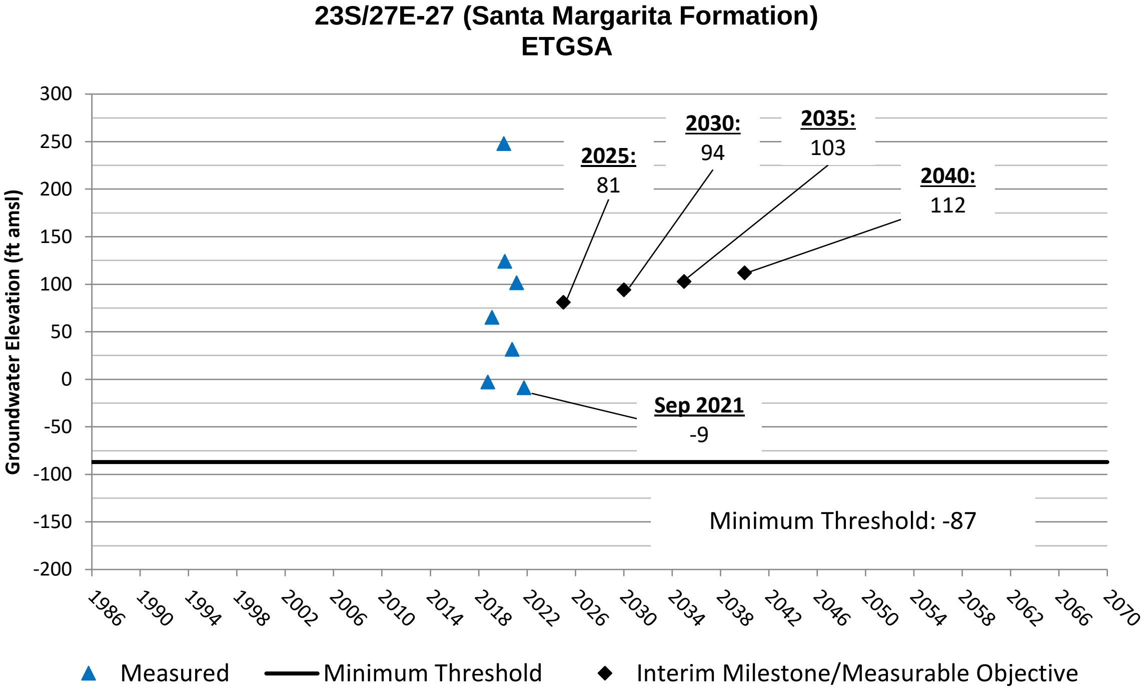
Eastern Tule GSA
RMS Groundwater Elevation Hydrographs





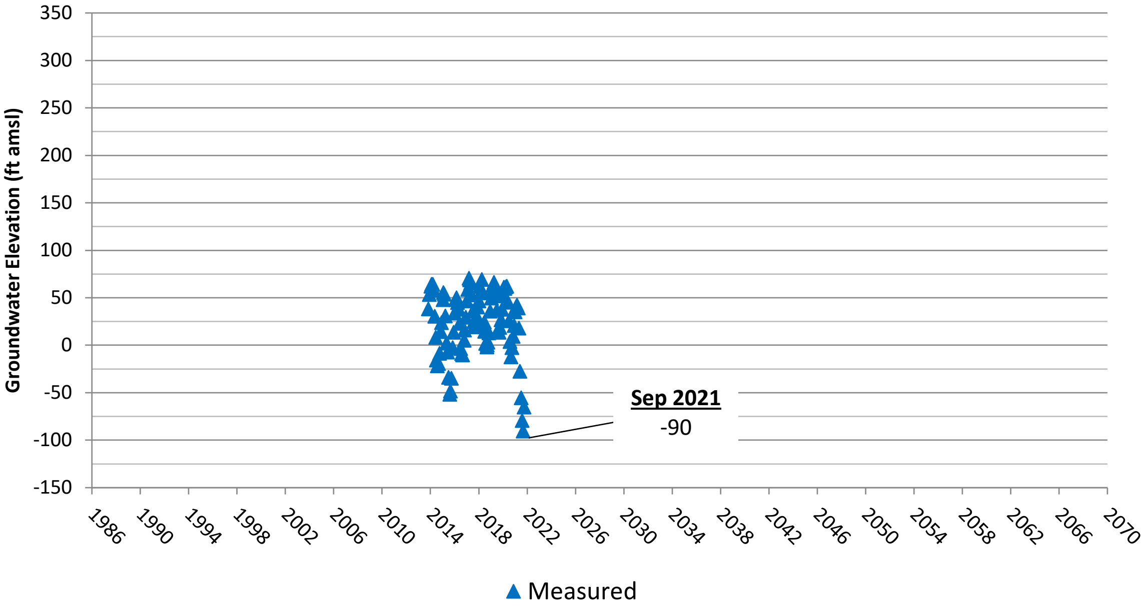
Eastern Tule GSA
RMS Groundwater Elevation Hydrographs





Eastern Tule GSA
RMS Groundwater Elevation Hydrographs

24S/27E-32M01 (Santa Margarita Formation)
ETGSA



TSMW 6SM (Santa Margarita Formation)
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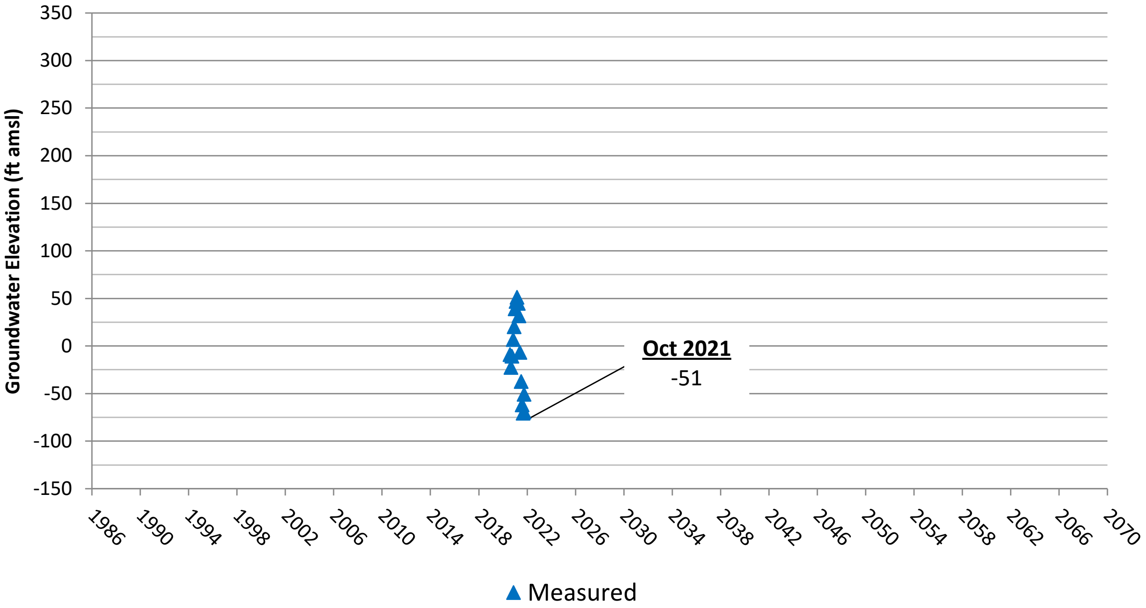
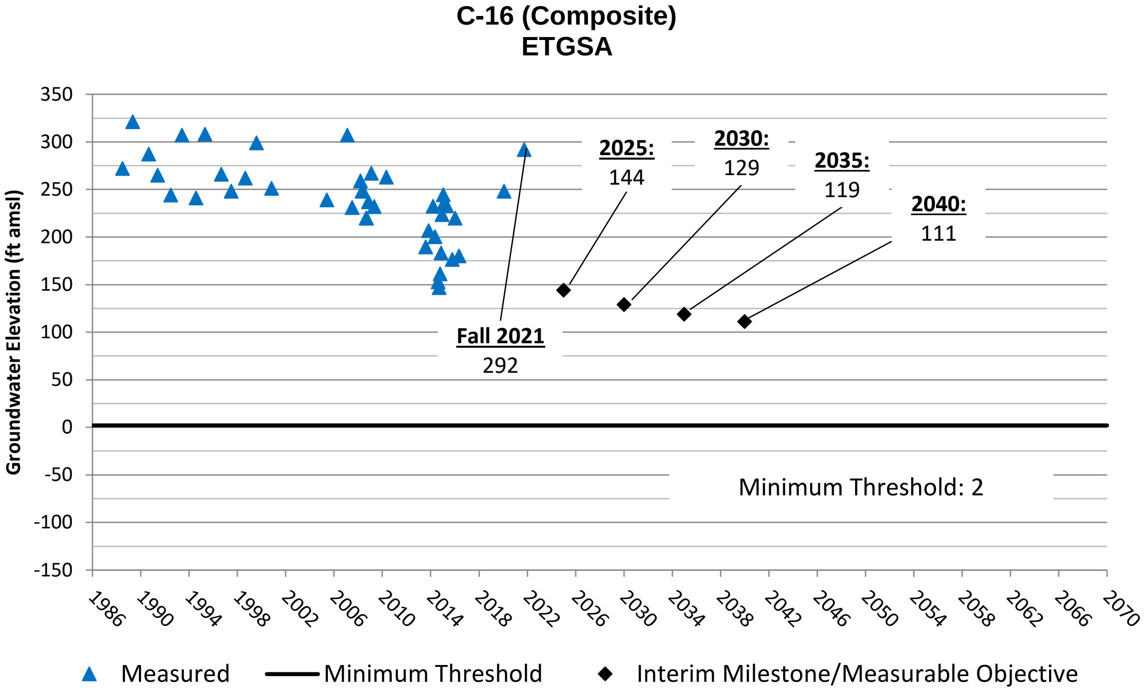
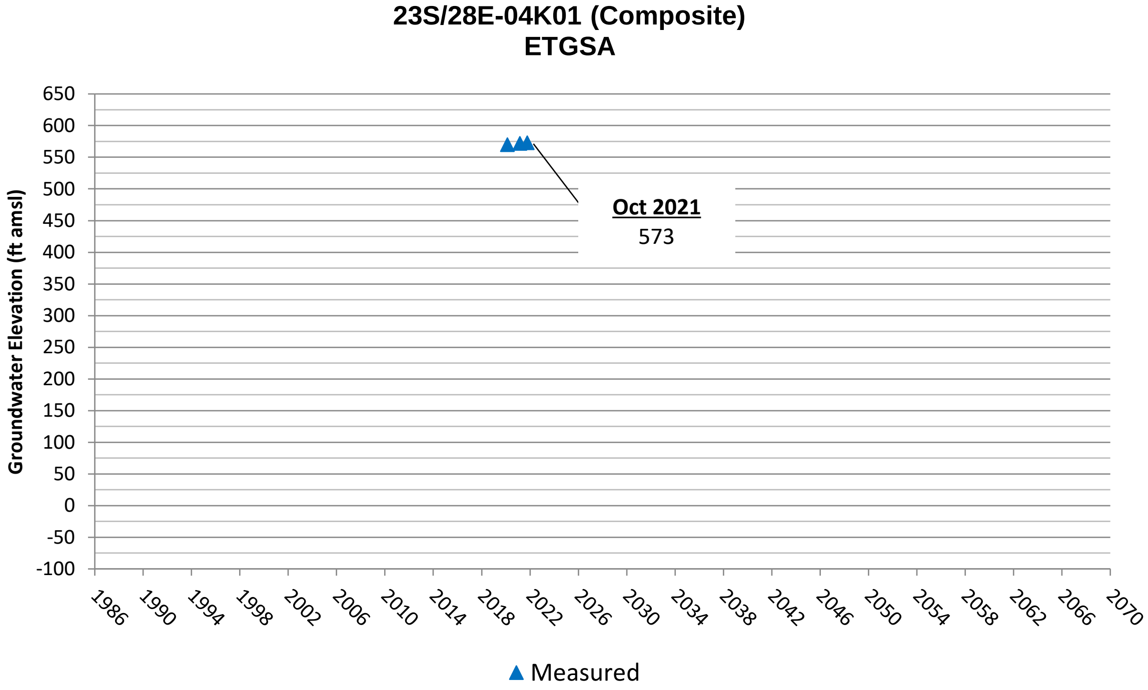


Eastern Tule GSA
RMS Groundwater Elevation Hydrographs





Appendix C

Delano-Earlimart Irrigation District GSA

Water Budgets, Land Surface Elevations at Representative Monitoring Sites, and RMS Groundwater Elevation Hydrographs

Appendix C
Table 1a

Delano-Earlimart Irrigation District GSA
Historical Surface Water Budget 1986/87 to 2016/17

	Surface Water Inflow (acre-ft)					
Water Year	Precipitation	Stream Inflow	Imported Water	Discharge from Wells		Total In
		White River	Delano-Earlimart ID	Agricultural	Municipal	
1986 - 1987	27,000	0	114,782	51,000	1,600	194,000
1987 - 1988	39,000	0	110,345	52,000	1,600	203,000
1988 - 1989	32,000	0	105,980	56,000	1,700	196,000
1989 - 1990	30,000	0	83,837	78,000	1,700	194,000
1990 - 1991	41,000	0	106,877	53,000	1,700	203,000
1991 - 1992	36,000	0	92,567	70,000	1,700	200,000
1992 - 1993	58,000	0	133,359	33,000	1,700	226,000
1993 - 1994	36,000	0	92,394	72,000	1,800	202,000
1994 - 1995	76,000	3,867	124,388	40,000	1,800	246,000
1995 - 1996	40,000	1,276	144,069	35,000	1,800	222,000
1996 - 1997	56,000	6,659	153,967	34,000	1,800	252,000
1997 - 1998	91,000	27,100	119,815	56,000	1,800	296,000
1998 - 1999	46,000	205	124,051	48,000	1,900	220,000
1999 - 2000	44,000	626	134,272	42,000	1,900	223,000
2000 - 2001	33,000	296	117,746	53,000	1,900	206,000
2001 - 2002	31,000	1,067	126,747	44,000	2,000	205,000
2002 - 2003	31,000	646	121,277	43,000	2,000	198,000
2003 - 2004	26,000	0	127,364	35,000	2,100	190,000
2004 - 2005	49,000	1,298	119,847	39,000	2,100	211,000
2005 - 2006	50,000	2,384	121,005	38,000	2,200	214,000
2006 - 2007	21,000	0	79,111	77,000	2,200	179,000
2007 - 2008	24,000	0	106,470	46,000	2,300	179,000
2008 - 2009	25,000	0	111,556	47,000	2,400	186,000
2009 - 2010	41,000	0	118,671	43,000	2,400	205,000
2010 - 2011	60,000	6,543	127,447	36,000	2,500	232,000
2011 - 2012	38,000	0	114,108	39,000	2,500	194,000
2012 - 2013	17,000	0	87,302	64,000	2,600	171,000
2013 - 2014	12,000	0	38,106	111,000	2,600	164,000
2014 - 2015	18,000	0	18,591	129,000	2,700	168,000
2015 - 2016	27,000	0	93,806	57,000	2,800	181,000
2016 - 2017	28,000	10,216	137,773	34,000	2,800	213,000
86/87-16/17 Avg	38,000	2,000	109,900	53,000	2,100	205,000

Appendix C
Table 1b

Delano-Earlimart Irrigation District GSA
Historical Surface Water Budget 1986/87 to 2016/17

Water Year	Surface Water Outflow (acre-ft)										Total Out
	Areal Recharge of Precipitation	Streambed Infiltration	Recharge in Basins	Deep Percolation of Applied Water			Evapotranspiration				
		White River	Imported Water	Imported Water	Agricultural Pumping	Municipal Pumping	Precipitation Crops/Native	Imported Water Agricultural Cons. Use	Ag. Cons. Use from Pumping	Municipal (Landscape ET)	
1986 - 1987	0	0	0	27,100	10,200	1,100	27,000	87,600	41,000	600	195,000
1987 - 1988	0	0	0	23,200	10,300	1,100	39,000	87,100	41,000	600	202,000
1988 - 1989	0	0	0	22,400	11,200	1,100	32,000	83,600	45,000	600	196,000
1989 - 1990	0	0	0	18,000	15,200	1,100	30,000	65,900	63,000	600	194,000
1990 - 1991	0	0	0	20,900	10,600	1,100	41,000	86,000	43,000	600	203,000
1991 - 1992	0	0	0	19,900	13,700	1,100	36,000	72,700	56,000	600	200,000
1992 - 1993	4,000	0	5,600	25,400	6,800	1,100	53,000	102,400	26,000	600	225,000
1993 - 1994	0	0	700	21,400	14,100	1,100	36,000	70,300	58,000	600	202,000
1994 - 1995	15,000	3,900	4,500	23,700	8,100	1,200	61,000	96,300	32,000	600	246,000
1995 - 1996	0	1,300	1,300	37,100	7,700	1,200	40,000	105,800	27,000	600	222,000
1996 - 1997	4,000	6,700	5,300	42,100	7,600	1,200	52,000	106,500	26,000	600	252,000
1997 - 1998	25,000	27,100	2,900	28,200	11,700	1,200	66,000	88,700	44,000	700	296,000
1998 - 1999	0	200	2,700	26,600	10,300	1,200	46,000	94,700	38,000	700	220,000
1999 - 2000	0	600	4,400	29,900	9,100	1,200	44,000	100,000	33,000	700	223,000
2000 - 2001	0	300	600	26,800	11,300	1,200	33,000	90,400	42,000	700	206,000
2001 - 2002	0	1,100	0	28,400	9,500	1,300	31,000	98,300	34,000	700	204,000
2002 - 2003	0	600	0	23,800	7,500	1,300	31,000	97,500	35,000	700	197,000
2003 - 2004	0	0	0	27,700	6,300	1,300	26,000	99,700	29,000	700	191,000
2004 - 2005	1,000	1,300	100	23,700	6,900	1,400	48,000	96,100	32,000	800	211,000
2005 - 2006	1,000	2,400	1,200	23,200	6,800	1,400	49,000	96,700	32,000	800	215,000
2006 - 2007	0	0	100	15,800	12,400	1,500	21,000	63,200	65,000	800	180,000
2007 - 2008	0	0	0	16,500	7,900	1,500	24,000	90,000	38,000	800	179,000
2008 - 2009	0	0	2,500	19,500	7,900	1,500	25,000	89,600	39,000	800	186,000
2009 - 2010	0	0	5,800	20,200	7,400	1,600	41,000	92,600	36,000	900	206,000
2010 - 2011	5,000	6,500	9,400	22,100	6,300	1,600	54,000	96,000	30,000	900	232,000
2011 - 2012	0	0	1,100	21,000	6,800	1,600	38,000	92,000	32,000	900	193,000
2012 - 2013	0	0	0	16,300	10,400	1,700	17,000	71,000	54,000	900	171,000
2013 - 2014	0	0	0	7,100	17,100	1,700	12,000	31,000	94,000	900	164,000
2014 - 2015	0	0	0	2,700	19,700	1,700	18,000	15,900	109,000	1,000	168,000
2015 - 2016	0	0	3,600	13,000	9,400	1,800	27,000	77,100	48,000	1,000	181,000
2016 - 2017	0	10,200	16,400	23,100	6,000	1,800	28,000	98,200	28,000	1,000	213,000
86/87-16/17 Avg	2,000	2,000	2,200	22,500	9,900	1,400	36,000	85,300	44,000	700	206,000

🟦 Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪 Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨 Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Appendix C
Table 2

Delano-Earlimart Irrigation District GSA
Historical Groundwater Budget 1986/87 to 2016/17

	Groundwater Inflows (acre-ft)										Groundwater Outflows (acre-ft)						
Water Year	Areal Recharge from Precipitation	White River	Imported Water Deliveries		Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow		Total In	Groundwater Pumping			Sub-surface Outflow		Total Out	Change in Storage (acre-ft)
		Streambed Infiltration	Recharge in Basins	Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Municipal	Agricultural	Groundwater Banking Extraction	To Outside Subbasin	To Other GSAs		
1986 - 1987	0	0	0	27,100	10,200	1,100	11,000	3,000	23,000	75,000	1,600	51,000	0	23,000	47,000	123,000	-48,000
1987 - 1988	0	0	0	23,200	10,300	1,100	8,000	3,000	26,000	72,000	1,600	52,000	0	19,000	50,000	123,000	-51,000
1988 - 1989	0	0	0	22,400	11,200	1,100	8,000	4,000	26,000	73,000	1,700	56,000	0	18,000	51,000	127,000	-54,000
1989 - 1990	0	0	0	18,000	15,200	1,100	18,000	5,000	27,000	84,000	1,700	78,000	0	20,000	47,000	147,000	-63,000
1990 - 1991	0	0	0	20,900	10,600	1,100	8,000	5,000	29,000	75,000	1,700	53,000	0	22,000	52,000	129,000	-54,000
1991 - 1992	0	0	0	19,900	13,700	1,100	12,000	7,000	29,000	83,000	1,700	70,000	0	16,000	49,000	137,000	-54,000
1992 - 1993	4,000	0	5,600	25,400	6,800	1,100	2,000	5,000	30,000	80,000	1,700	33,000	0	17,000	52,000	104,000	-24,000
1993 - 1994	0	0	700	21,400	14,100	1,100	12,000	8,000	27,000	84,000	1,800	72,000	0	13,000	44,000	131,000	-47,000
1994 - 1995	15,000	3,900	4,500	23,700	8,100	1,200	3,000	6,000	26,000	91,000	1,800	40,000	0	13,000	47,000	102,000	-11,000
1995 - 1996	0	1,300	1,300	37,100	7,700	1,200	2,000	6,000	34,000	91,000	1,800	35,000	0	14,000	50,000	101,000	-10,000
1996 - 1997	4,000	6,700	5,300	42,100	7,600	1,200	2,000	6,000	33,000	108,000	1,800	34,000	0	17,000	51,000	104,000	4,000
1997 - 1998	25,000	27,100	2,900	28,200	11,700	1,200	3,000	7,000	37,000	143,000	1,800	56,000	0	14,000	48,000	120,000	23,000
1998 - 1999	0	200	2,700	26,600	10,300	1,200	2,000	6,000	37,000	86,000	1,900	48,000	0	14,000	47,000	111,000	-25,000
1999 - 2000	0	600	4,400	29,900	9,100	1,200	2,000	6,000	35,000	88,000	1,900	42,000	0	15,000	50,000	109,000	-21,000
2000 - 2001	0	300	600	26,800	11,300	1,200	6,000	6,000	36,000	88,000	1,900	53,000	0	17,000	50,000	122,000	-34,000
2001 - 2002	0	1,100	0	28,400	9,500	1,300	5,000	6,000	36,000	87,000	2,000	44,000	0	18,000	55,000	119,000	-32,000
2002 - 2003	0	600	0	23,800	7,500	1,300	4,000	6,000	34,000	77,000	2,000	43,000	0	15,000	52,000	112,000	-35,000
2003 - 2004	0	0	0	27,700	6,300	1,300	5,000	6,000	30,000	76,000	2,100	35,000	0	17,000	51,000	105,000	-29,000
2004 - 2005	1,000	1,300	100	23,700	6,900	1,400	4,000	6,000	33,000	77,000	2,100	39,000	0	16,000	49,000	106,000	-29,000
2005 - 2006	1,000	2,400	1,200	23,200	6,800	1,400	3,000	7,000	29,000	75,000	2,200	38,000	0	13,000	44,000	97,000	-22,000
2006 - 2007	0	0	100	15,800	12,400	1,500	18,000	7,000	32,000	87,000	2,200	77,000	0	14,000	40,000	133,000	-46,000
2007 - 2008	0	0	0	16,500	7,900	1,500	8,000	6,000	36,000	76,000	2,300	46,000	0	20,000	51,000	119,000	-43,000
2008 - 2009	0	0	2,500	19,500	7,900	1,500	10,000	6,000	35,000	82,000	2,400	47,000	600	21,000	54,000	125,000	-43,000
2009 - 2010	0	0	5,800	20,200	7,400	1,600	7,000	6,000	39,000	87,000	2,400	43,000	100	21,000	56,000	123,000	-36,000
2010 - 2011	5,000	6,500	9,400	22,100	6,300	1,600	5,000	6,000	33,000	95,000	2,500	36,000	0	18,000	52,000	109,000	-14,000
2011 - 2012	0	0	1,100	21,000	6,800	1,600	9,000	6,000	29,000	75,000	2,500	39,000	3,900	19,000	50,000	114,000	-39,000
2012 - 2013	0	0	0	16,300	10,400	1,700	18,000	6,000	31,000	83,000	2,600	64,000	6,000	17,000	49,000	139,000	-56,000
2013 - 2014	0	0	0	7,100	17,100	1,700	26,000	7,000	35,000	94,000	2,600	111,000	5,600	17,000	44,000	180,000	-86,000
2014 - 2015	0	0	0	2,700	19,700	1,700	20,000	7,000	38,000	89,000	2,700	129,000	1,200	15,000	40,000	188,000	-99,000
2015 - 2016	0	0	3,600	13,000	9,400	1,800	11,000	7,000	41,000	87,000	2,800	57,000	100	16,000	45,000	121,000	-34,000
2016 - 2017	0	10,200	16,400	23,100	6,000	1,800	6,000	6,000	37,000	107,000	2,800	34,000	0	16,000	51,000	104,000	3,000
86/87-16/17 Avg	2,000	2,000	2,200	22,500	9,900	1,400	8,000	6,000	32,000	86,000	2,100	53,000	600	17,000	49,000	122,000	-36,000

Cumulative Change in Storage | -1,109,000

🟦 Groundwater Inflows or Outflows to be Included in Sustainable Yield Estimates
🟪 Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨 Groundwater Outflows Not Included in Sustainable Yield Estimates

Projected Future Delano-Earlimart Irrigation District GSA Surface Water Budget

Water Year	Surface Water Inflow (acre-ft)						Total In
	Precipitation	Stream Inflow	Imported Water	Discharge from Wells			
		White River	Delano-Earlimart ID	Agricultural	Municipal	Water Bank	
2017 - 2018	38,000	2,224	116,902	36,000	3,700	2,200	197,000
2018 - 2019	38,000	2,224	116,902	36,000	3,700	2,200	197,000
2019 - 2020	38,000	2,224	116,902	36,000	3,700	2,200	197,000
2020 - 2021	38,000	2,224	116,902	36,000	3,700	2,200	197,000
2021 - 2022	38,000	2,224	116,902	36,000	3,700	2,200	197,000
2022 - 2023	38,000	2,224	116,902	36,000	3,700	2,200	197,000
2023 - 2024	38,000	2,224	116,902	36,000	3,700	2,200	197,000
2024 - 2025	38,000	2,224	117,661	33,000	3,700	2,200	195,000
2025 - 2026	38,000	2,224	118,420	31,000	3,700	2,200	193,000
2026 - 2027	38,000	2,224	119,180	29,000	3,700	2,200	192,000
2027 - 2028	38,000	2,224	119,939	27,000	3,700	2,200	191,000
2028 - 2029	38,000	2,224	120,698	25,000	3,700	2,200	190,000
2029 - 2030	38,000	2,224	121,457	23,000	3,700	2,200	188,000
2030 - 2031	38,000	2,224	121,457	21,000	3,700	2,200	186,000
2031 - 2032	38,000	2,224	121,457	20,000	3,700	2,200	185,000
2032 - 2033	38,000	2,224	121,457	18,000	3,700	2,200	183,000
2033 - 2034	38,000	2,224	121,457	17,000	3,700	2,200	182,000
2034 - 2035	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2035 - 2036	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2036 - 2037	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2037 - 2038	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2038 - 2039	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2039 - 2040	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2040 - 2041	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2041 - 2042	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2042 - 2043	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2043 - 2044	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2044 - 2045	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2045 - 2046	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2046 - 2047	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2047 - 2048	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2048 - 2049	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2049 - 2050	38,000	2,224	121,457	15,000	3,700	2,200	180,000
2050 - 2051	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2051 - 2052	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2052 - 2053	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2053 - 2054	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2054 - 2055	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2055 - 2056	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2056 - 2057	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2057 - 2058	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2058 - 2059	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2059 - 2060	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2060 - 2061	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2061 - 2062	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2062 - 2063	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2063 - 2064	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2064 - 2065	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2065 - 2066	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2066 - 2067	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2067 - 2068	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2068 - 2069	38,000	2,152	112,046	25,000	3,700	2,200	181,000
2069 - 2070	38,000	2,152	112,046	25,000	3,700	2,200	181,000
17/18-69/70 Avg	38,000	2,200	117,100	23,000	3,700	2,200	184,000

Projected Future Delano-Earlimart Irrigation District GSA Surface Water Budget

Water Year	Surface Water Outflow (acre-ft)										Total Out
	Areal Recharge of Precipitation	Streambed Infiltration	Recharge in Basins	Deep Percolation of Applied Water			Evapotranspiration				
		White River	Imported Water	Imported Water	Agricultural Pumping	Municipal Pumping	Precipitation Crops/Native	Imported Water Agricultural Cons. Use	Ag. Cons. Use from Pumping	Municipal (Landscape ET)	
2017 - 2018	2,000	2,200	2,200	21,400	6,300	2,400	36,000	95,500	29,000	1,300	198,000
2018 - 2019	2,000	2,200	2,200	21,400	6,300	2,400	36,000	95,500	29,000	1,300	198,000
2019 - 2020	2,000	2,200	2,200	21,400	6,300	2,400	36,000	95,500	29,000	1,300	198,000
2020 - 2021	2,000	2,200	2,200	21,400	6,300	2,400	36,000	95,500	29,000	1,300	198,000
2021 - 2022	2,000	2,200	2,200	21,400	6,300	2,400	36,000	95,500	29,000	1,300	198,000
2022 - 2023	2,000	2,200	2,200	21,400	6,300	2,400	36,000	95,500	29,000	1,300	198,000
2023 - 2024	2,000	2,200	2,200	21,400	6,300	2,400	36,000	95,500	29,000	1,300	198,000
2024 - 2025	2,000	2,200	2,200	21,500	5,900	2,400	36,000	96,100	28,000	1,300	198,000
2025 - 2026	2,000	2,200	2,200	21,600	5,500	2,400	36,000	96,800	26,000	1,300	196,000
2026 - 2027	2,000	2,200	2,200	21,700	5,100	2,400	36,000	97,400	24,000	1,300	194,000
2027 - 2028	2,000	2,200	2,200	21,800	4,700	2,400	36,000	98,100	22,000	1,300	193,000
2028 - 2029	2,000	2,200	2,200	22,000	4,200	2,400	36,000	98,700	20,000	1,300	191,000
2029 - 2030	2,000	2,200	2,200	22,100	3,800	2,400	36,000	99,400	19,000	1,300	190,000
2030 - 2031	2,000	2,200	2,200	22,100	3,500	2,400	36,000	99,400	18,000	1,300	189,000
2031 - 2032	2,000	2,200	2,200	22,100	3,200	2,400	36,000	99,400	16,000	1,300	187,000
2032 - 2033	2,000	2,200	2,200	22,100	2,900	2,400	36,000	99,400	15,000	1,300	186,000
2033 - 2034	2,000	2,200	2,200	22,100	2,600	2,400	36,000	99,400	14,000	1,300	184,000
2034 - 2035	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2035 - 2036	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2036 - 2037	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2037 - 2038	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2038 - 2039	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2039 - 2040	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2040 - 2041	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2041 - 2042	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2042 - 2043	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2043 - 2044	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2044 - 2045	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2045 - 2046	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2046 - 2047	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2047 - 2048	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2048 - 2049	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2049 - 2050	2,000	2,200	2,200	22,100	2,300	2,400	36,000	99,400	13,000	1,300	183,000
2050 - 2051	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2051 - 2052	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2052 - 2053	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2053 - 2054	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2054 - 2055	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2055 - 2056	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2056 - 2057	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2057 - 2058	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2058 - 2059	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2059 - 2060	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2060 - 2061	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2061 - 2062	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2062 - 2063	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2063 - 2064	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2064 - 2065	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2065 - 2066	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2066 - 2067	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2067 - 2068	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2068 - 2069	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
2069 - 2070	2,000	2,200	2,200	20,700	3,700	2,400	36,000	91,300	21,000	1,300	183,000
17/18-69/70 Avg	2,000	2,200	2,200	21,400	3,700	2,400	36,000	95,600	19,000	1,300	186,000

Projected Future Delano-Earlimart Irrigation District GSA Groundwater Budget

	Groundwater Inflows (acre-ft)										Groundwater Outflows (acre-ft)						
Water Year	Areal Recharge from Precipitation	White River	Imported Water Deliveries		Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow		Total In	Groundwater Pumping			Sub-surface Outflow		Total Out	Change in Storage (acre-ft)
		Streambed Infiltration	Recharge in Basins	Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Municipal	Agricultural	Groundwater Banking Extraction	To Outside Subbasin	To Other GSAs		
2017 - 2018	2,000	2,200	2,200	21,400	6,300	2,400	6,000	5,000	28,000	76,000	3,700	36,000	2,200	19,000	52,000	113,000	-37,000
2018 - 2019	2,000	2,200	2,200	21,400	6,300	2,400	7,000	5,000	28,000	77,000	3,700	36,000	2,200	19,000	50,000	111,000	-34,000
2019 - 2020	2,000	2,200	2,200	21,400	6,300	2,400	7,000	5,000	28,000	77,000	3,700	36,000	2,200	19,000	49,000	110,000	-33,000
2020 - 2021	2,000	2,200	2,200	21,400	6,300	2,400	7,000	5,000	28,000	77,000	3,700	36,000	2,200	19,000	48,000	109,000	-32,000
2021 - 2022	2,000	2,200	2,200	21,400	6,300	2,400	7,000	5,000	27,000	76,000	3,700	36,000	2,200	18,000	47,000	107,000	-31,000
2022 - 2023	2,000	2,200	2,200	21,400	6,300	2,400	7,000	5,000	26,000	75,000	3,700	36,000	2,200	18,000	45,000	105,000	-30,000
2023 - 2024	2,000	2,200	2,200	21,400	6,300	2,400	8,000	5,000	26,000	76,000	3,700	36,000	2,200	17,000	46,000	105,000	-29,000
2024 - 2025	2,000	2,200	2,200	21,500	5,900	2,400	7,000	5,000	25,000	73,000	3,700	33,000	2,200	17,000	43,000	99,000	-26,000
2025 - 2026	2,000	2,200	2,200	21,600	5,500	2,400	6,000	5,000	22,000	69,000	3,700	31,000	2,200	16,000	40,000	93,000	-24,000
2026 - 2027	2,000	2,200	2,200	21,700	5,100	2,400	6,000	5,000	20,000	67,000	3,700	29,000	2,200	16,000	39,000	90,000	-23,000
2027 - 2028	2,000	2,200	2,200	21,800	4,700	2,400	5,000	5,000	18,000	63,000	3,700	27,000	2,200	16,000	37,000	86,000	-23,000
2028 - 2029	2,000	2,200	2,200	22,000	4,200	2,400	5,000	5,000	16,000	61,000	3,700	25,000	2,200	15,000	36,000	82,000	-21,000
2029 - 2030	2,000	2,200	2,200	22,100	3,800	2,400	4,000	5,000	15,000	59,000	3,700	23,000	2,200	14,000	32,000	75,000	-16,000
2030 - 2031	2,000	2,200	2,200	22,100	3,500	2,400	4,000	5,000	14,000	57,000	3,700	21,000	2,200	14,000	31,000	72,000	-15,000
2031 - 2032	2,000	2,200	2,200	22,100	3,200	2,400	3,000	5,000	13,000	55,000	3,700	20,000	2,200	14,000	31,000	71,000	-16,000
2032 - 2033	2,000	2,200	2,200	22,100	2,900	2,400	3,000	4,000	12,000	53,000	3,700	18,000	2,200	13,000	30,000	67,000	-14,000
2033 - 2034	2,000	2,200	2,200	22,100	2,600	2,400	3,000	4,000	12,000	53,000	3,700	17,000	2,200	13,000	31,000	67,000	-14,000
2034 - 2035	2,000	2,200	2,200	22,100	2,300	2,400	2,000	5,000	12,000	52,000	3,700	15,000	2,200	13,000	29,000	63,000	-11,000
2035 - 2036	2,000	2,200	2,200	22,100	2,300	2,400	2,000	5,000	13,000	53,000	3,700	15,000	2,200	13,000	28,000	62,000	-9,000
2036 - 2037	2,000	2,200	2,200	22,100	2,300	2,400	2,000	5,000	13,000	53,000	3,700	15,000	2,200	13,000	28,000	62,000	-9,000
2037 - 2038	2,000	2,200	2,200	22,100	2,300	2,400	2,000	5,000	13,000	53,000	3,700	15,000	2,200	13,000	27,000	61,000	-8,000
2038 - 2039	2,000	2,200	2,200	22,100	2,300	2,400	2,000	5,000	14,000	54,000	3,700	15,000	2,200	13,000	27,000	61,000	-7,000
2039 - 2040	2,000	2,200	2,200	22,100	2,300	2,400	2,000	5,000	14,000	54,000	3,700	15,000	2,200	13,000	25,000	59,000	-5,000
2040 - 2041	2,000	2,200	2,200	22,100	2,300	2,400	2,000	5,000	14,000	54,000	3,700	15,000	2,200	12,000	25,000	58,000	-4,000
2041 - 2042	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	14,000	53,000	3,700	15,000	2,200	12,000	24,000	57,000	-4,000
2042 - 2043	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	14,000	53,000	3,700	15,000	2,200	12,000	24,000	57,000	-4,000
2043 - 2044	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	14,000	53,000	3,700	15,000	2,200	12,000	24,000	57,000	-4,000
2044 - 2045	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	15,000	54,000	3,700	15,000	2,200	12,000	24,000	57,000	-3,000
2045 - 2046	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	15,000	54,000	3,700	15,000	2,200	12,000	24,000	57,000	-3,000
2046 - 2047	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	15,000	54,000	3,700	15,000	2,200	12,000	24,000	57,000	-3,000
2047 - 2048	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	15,000	54,000	3,700	15,000	2,200	12,000	24,000	57,000	-3,000
2048 - 2049	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	15,000	54,000	3,700	15,000	2,200	12,000	24,000	57,000	-3,000
2049 - 2050	2,000	2,200	2,200	22,100	2,300	2,400	1,000	5,000	15,000	54,000	3,700	15,000	2,200	12,000	24,000	57,000	-3,000
2050 - 2051	2,000	2,200	2,200	20,700	3,700	2,400	2,000	5,000	16,000	56,000	3,700	25,000	2,200	11,000	23,000	65,000	-9,000
2051 - 2052	2,000	2,200	2,200	20,700	3,700	2,400	2,000	5,000	17,000	57,000	3,700	25,000	2,200	11,000	22,000	64,000	-7,000
2052 - 2053	2,000	2,200	2,200	20,700	3,700	2,400	2,000	5,000	17,000	57,000	3,700	25,000	2,200	11,000	22,000	64,000	-7,000
2053 - 2054	2,000	2,200	2,200	20,700	3,700	2,400	2,000	5,000	17,000	57,000	3,700	25,000	2,200	11,000	22,000	64,000	-7,000
2054 - 2055	2,000	2,200	2,200	20,700	3,700	2,400	2,000	5,000	17,000	57,000	3,700	25,000	2,200	11,000	22,000	64,000	-7,000
2055 - 2056	2,000	2,200	2,200	20,700	3,700	2,400	2,000	5,000	18,000	58,000	3,700	25,000	2,200	11,000	21,000	63,000	-5,000
2056 - 2057	2,000	2,200	2,200	20,700	3,700	2,400	2,000	5,000	18,000	58,000	3,700	25,000	2,200	11,000	21,000	63,000	-5,000
2057 - 2058	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	18,000	57,000	3,700	25,000	2,200	10,000	21,000	62,000	-5,000
2058 - 2059	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	18,000	57,000	3,700	25,000	2,200	10,000	21,000	62,000	-5,000
2059 - 2060	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	18,000	57,000	3,700	25,000	2,200	10,000	21,000	62,000	-5,000
2060 - 2061	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2061 - 2062	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2062 - 2063	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2063 - 2064	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2064 - 2065	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2065 - 2066	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2066 - 2067	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2067 - 2068	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2068 - 2069	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
2069 - 2070	2,000	2,200	2,200	20,700	3,700	2,400	1,000	5,000	19,000	58,000	3,700	25,000	2,200	10,000	21,000	62,000	-4,000
17/18-69/70 Avg	2,000	2,200	2,200	21,400	3,700	2,400	3,000	5,000	18,000	60,000	3,700	23,000	2,200	13,000	29,000	71,000	-11,000

Appendix C
Table 5

Delano-Earlimart Irrigation District GSA
Land Surface Elevations at Representative Monitoring Sites

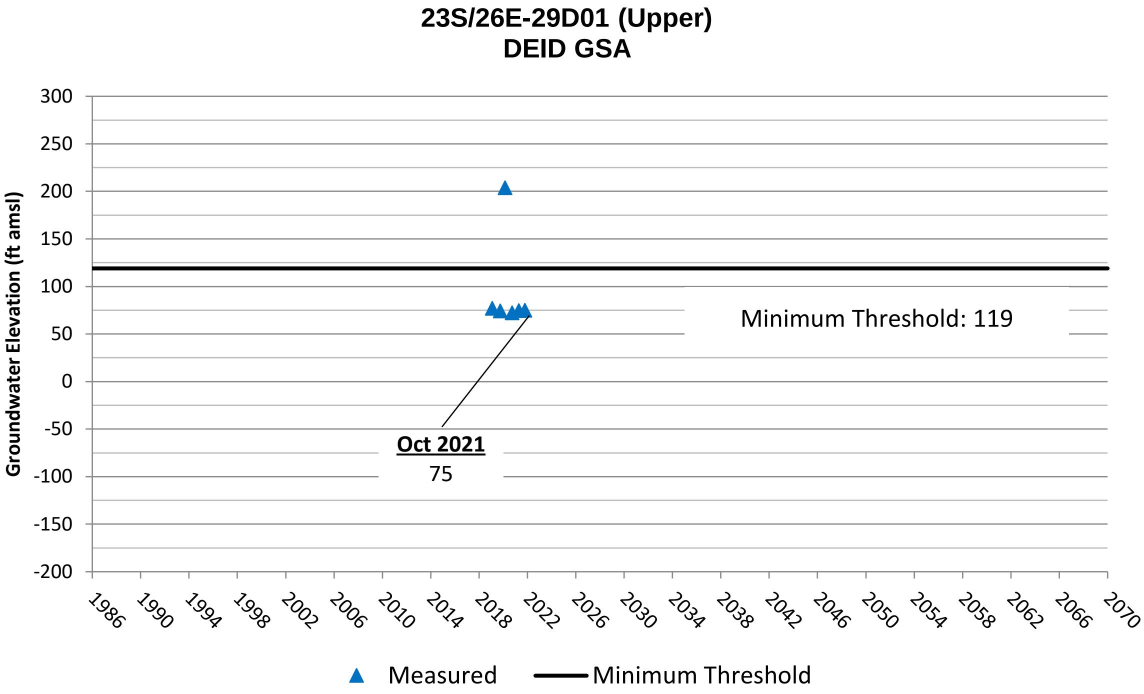
Site	Land Surface Elevation (ft amsl)[1]			
	2020 (Baseline)	2021	Measurable Objective	Minimum Threshold
D0012_B_RMS	267.1	266.8	263.3	262.1
D0030_B_RMS	272.8	272.3	270.3	269.2
D0031_B_RMS	296.7	296.2	294.9	293.9
D0032_B_RMS	316.7	316.6	316.7	315.7
D0033_B_RMS	366.1	365.6	365.1	364.0
D0034_B_RMS	340.8	340.0	338.8	337.8
D0070_B_FKC	389.4	389.0	389.2	388.2
D0071_B_FKC	N/A	N/A	N/A	N/A
D0072_B_FKC	N/A	N/A	N/A	N/A
D0073_G_FKC	406.2	405.9	405.0	404.0
D0074_B_FKC	415.5	415.3	413.8	412.8
D0075_B_FKC	403.2	402.9	401.7	400.7
D0076_B_FKC	408.9	408.2	408.4	407.4
D0077_B_FKC	401.9	401.6	401.4	400.4
D0078_B_FKC	406.1	405.6	405.6	404.6
D0079_G_FKC	407.1	407.4	406.9	405.9
D0080_B_FKC	433.1	432.9	432.5	431.5
D0081_B_FKC	399.5	399.4	399.3	398.3
D0082_B_FKC	423.4	423.4	423.1	422.1
D0083_B_FKC	419.5	419.4	418.8	417.8
D0084_B_FKC	407.3	407.0	405.9	404.9
D0085_B_RMS	480.6	480.5	480.6	479.6
D0086_B_RMS	447.7	447.3	447.7	446.2
D0089_B_RMS	498.2	498.1	497.3	496.3

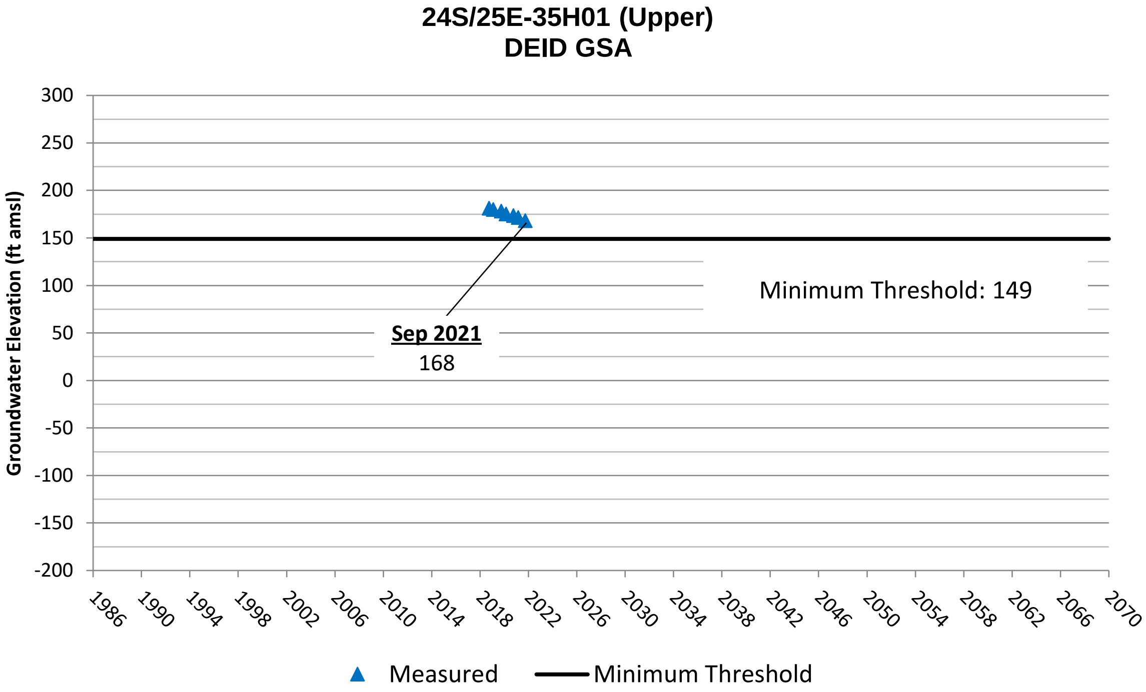
Notes:

N/A = Not available

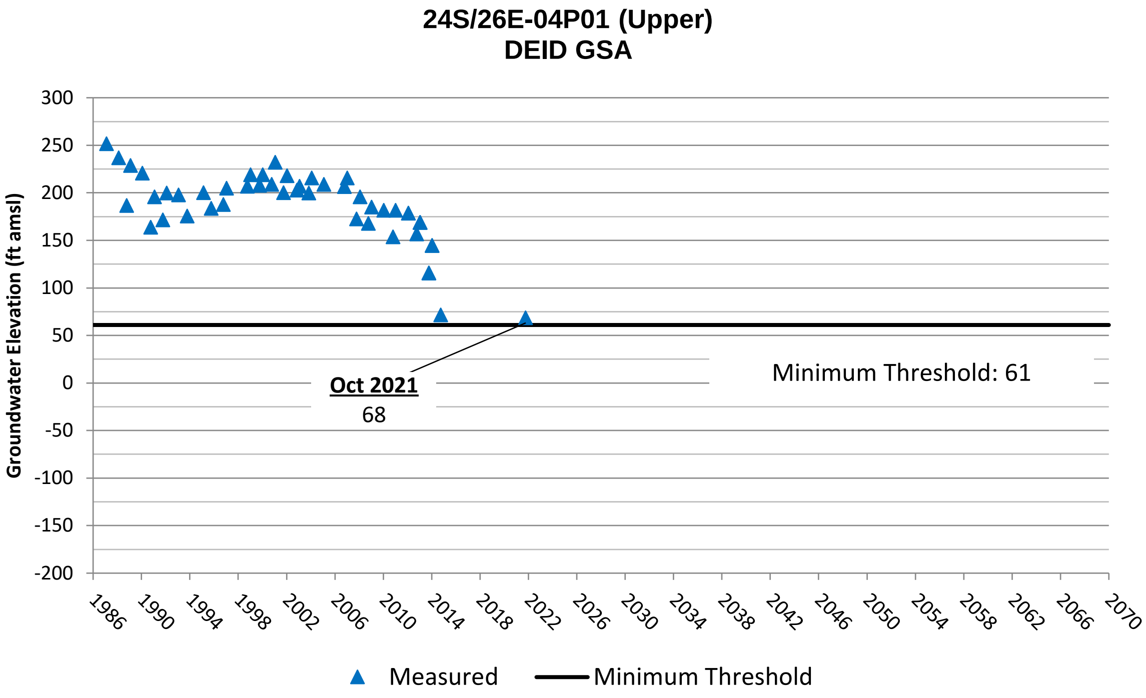
[1] Benchmarks surveyed in July and August of each year.

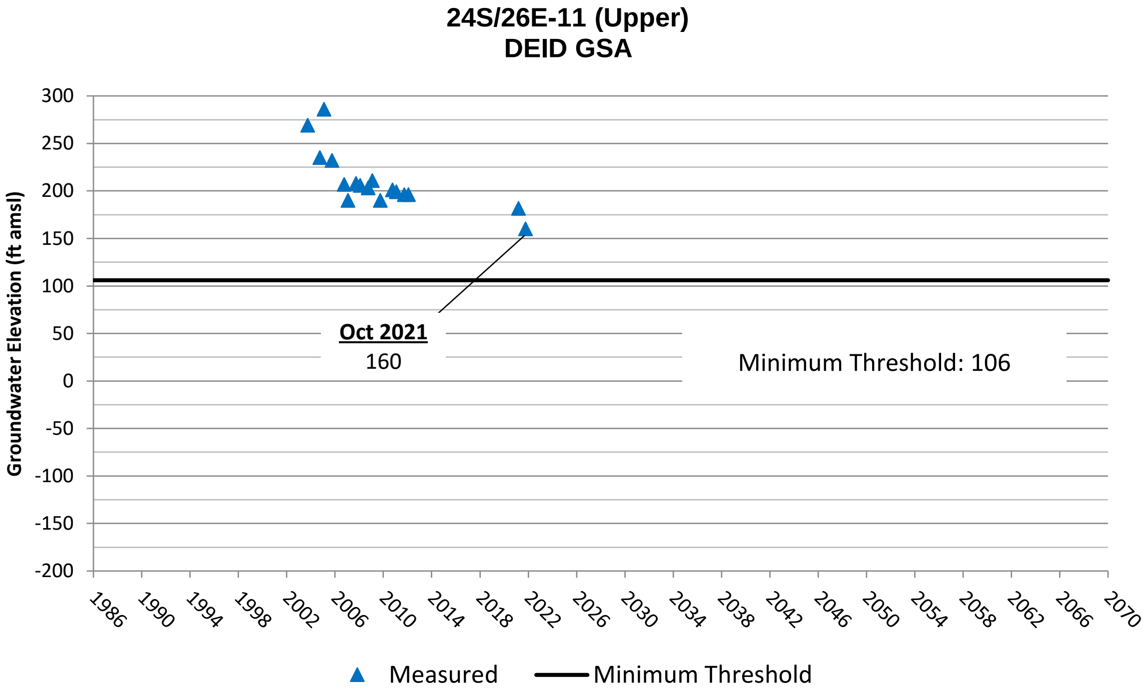
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs



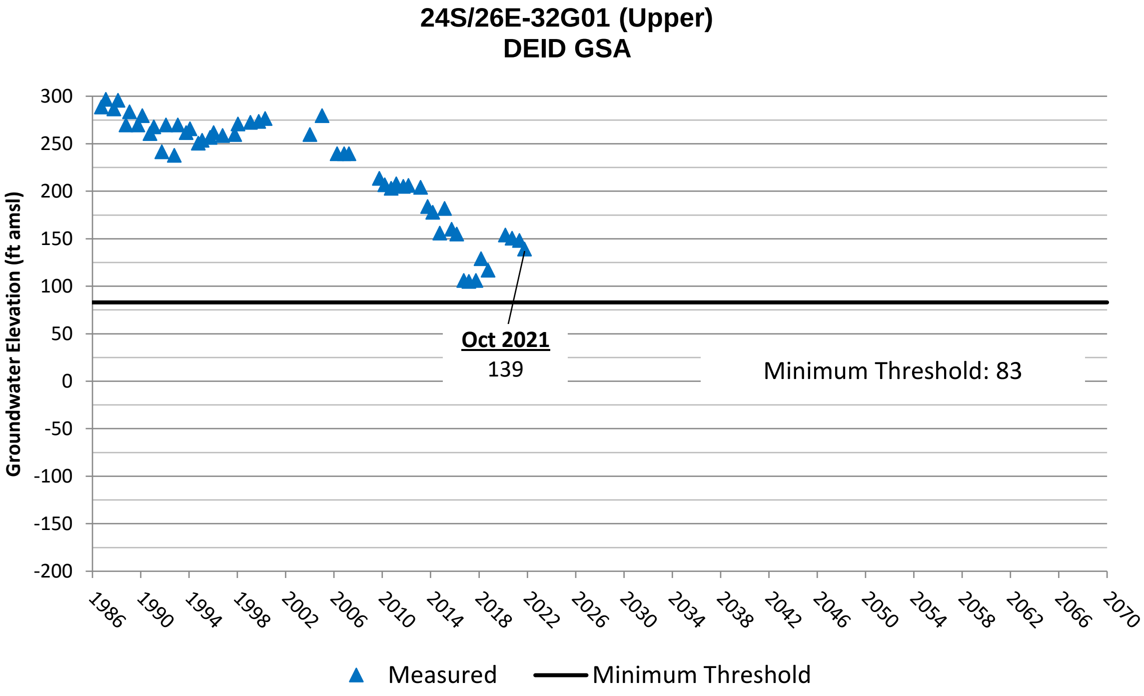


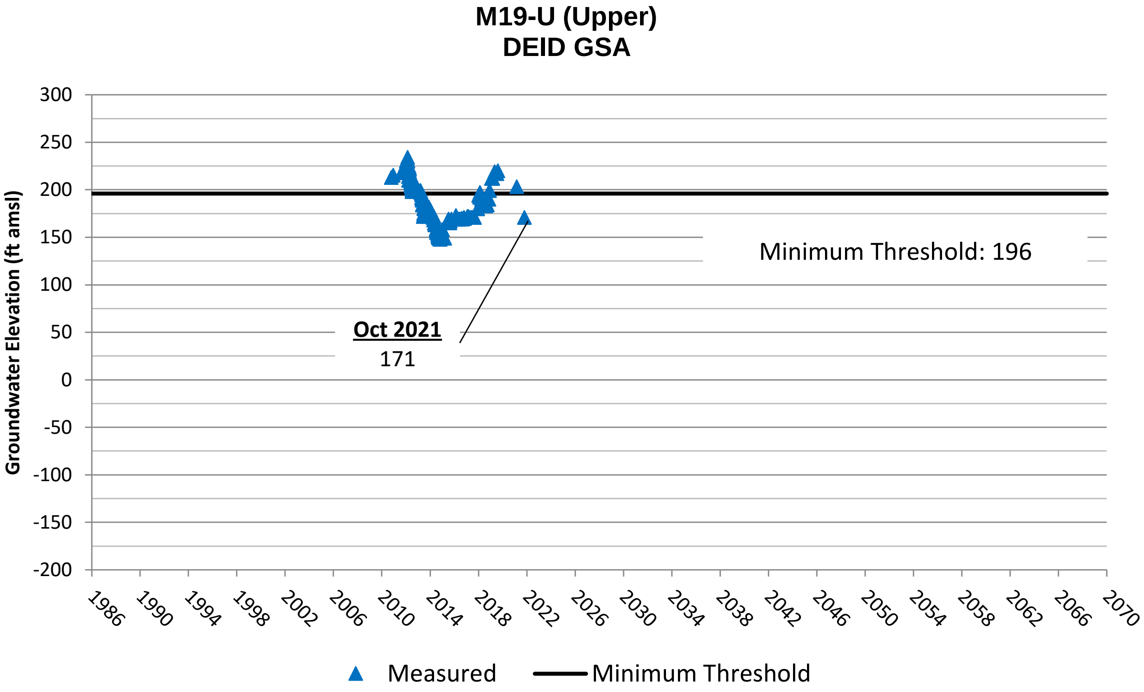
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs





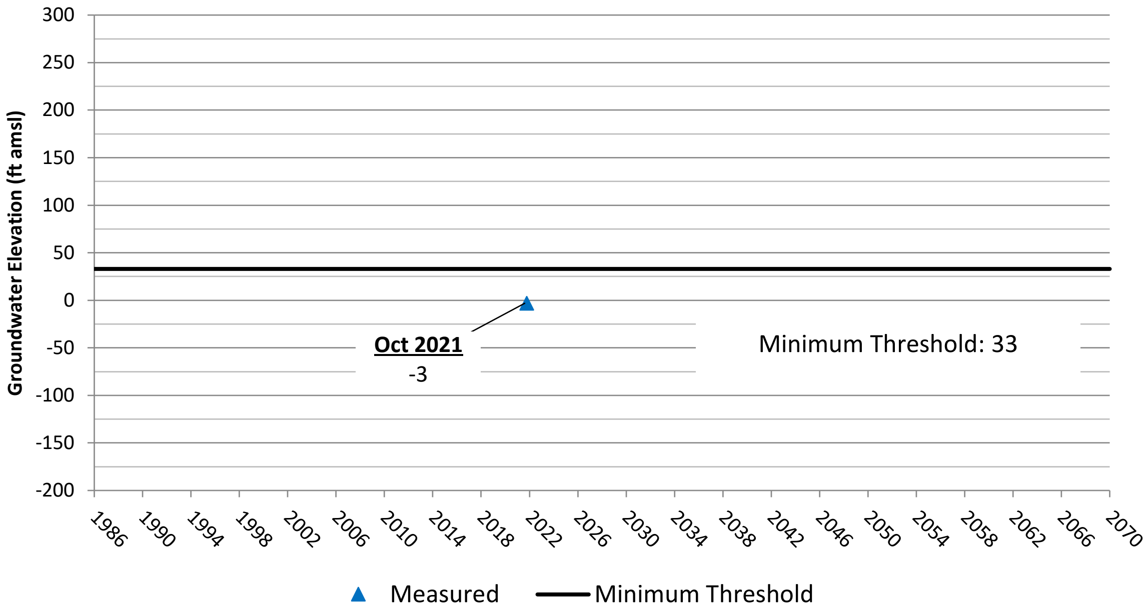
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs





Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs

23S/25E-36H01 (Lower)
DEID GSA



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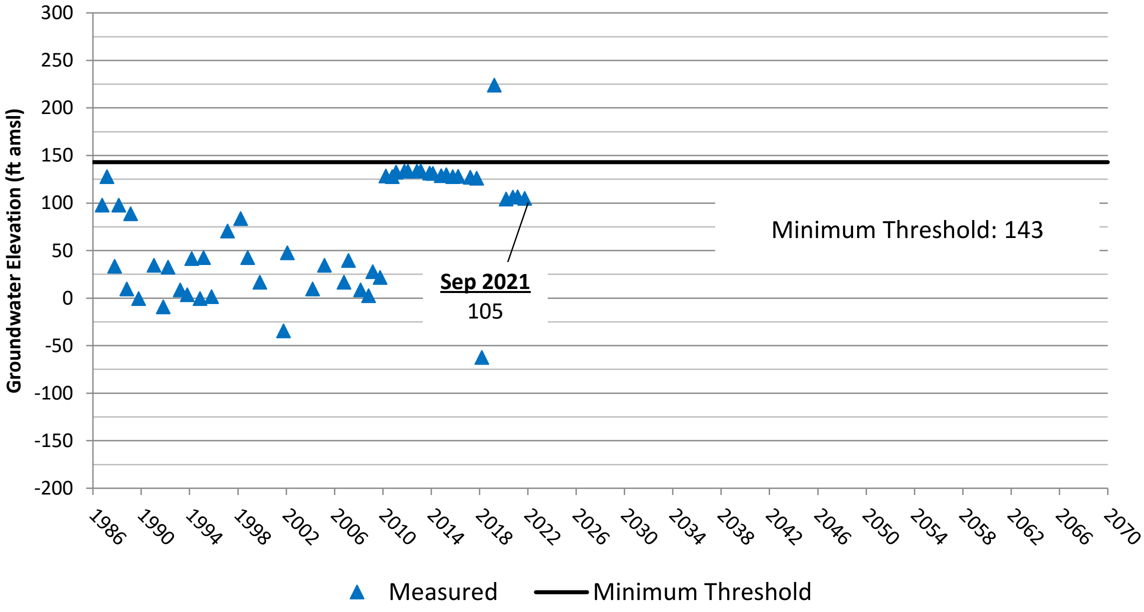
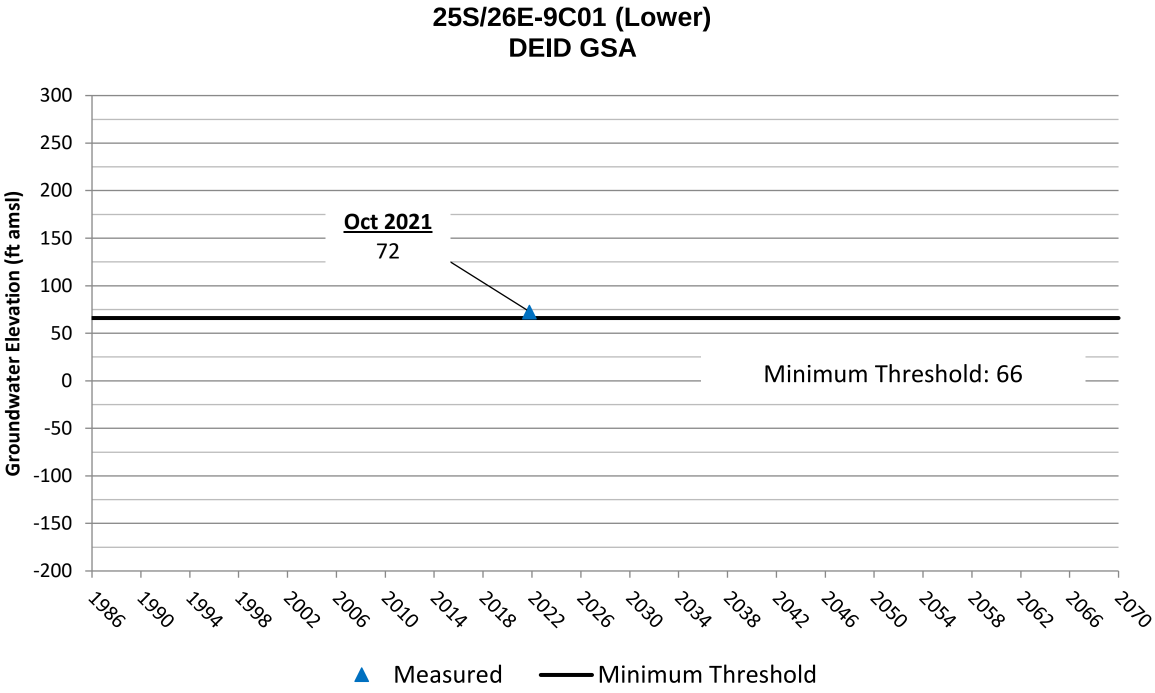
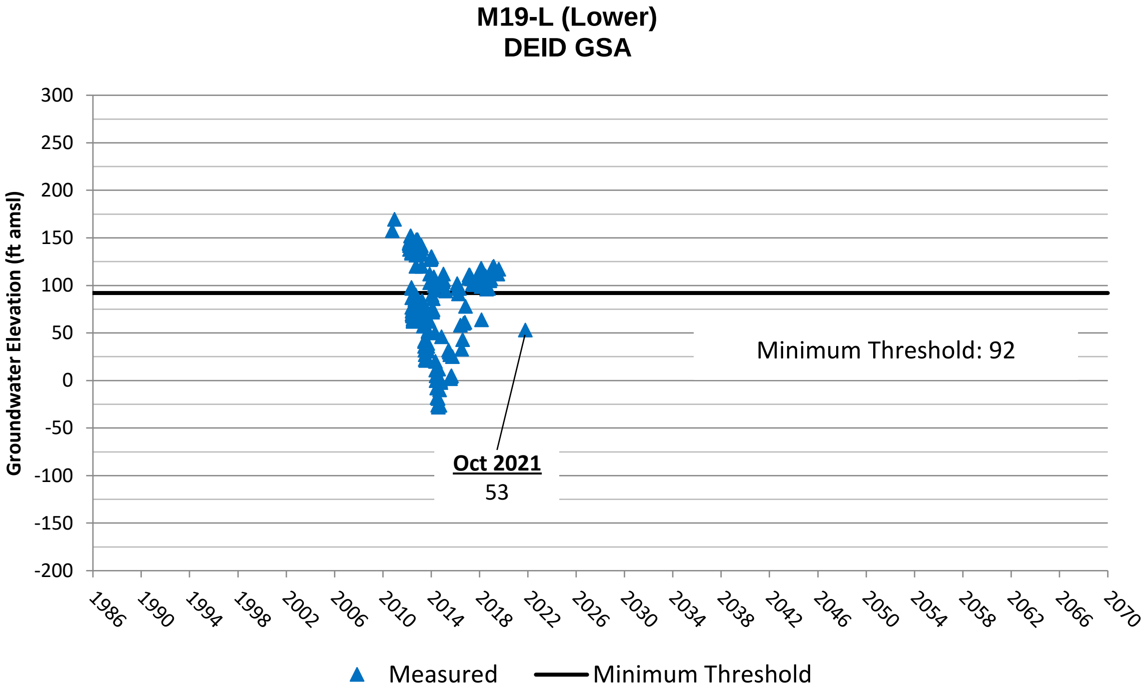
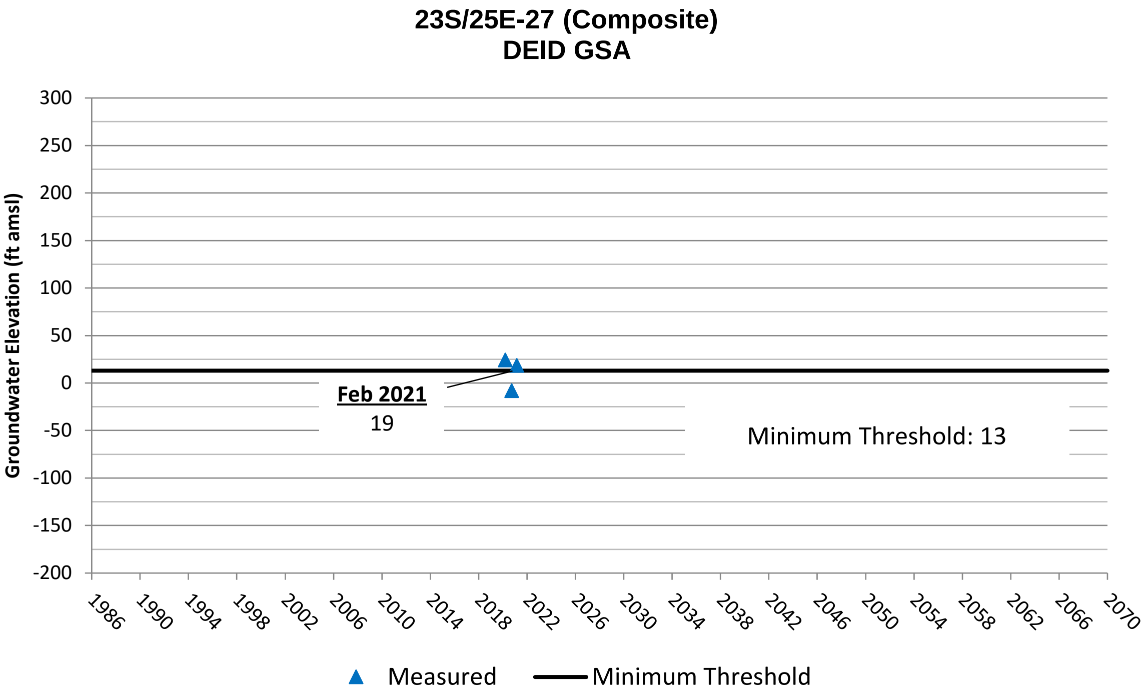


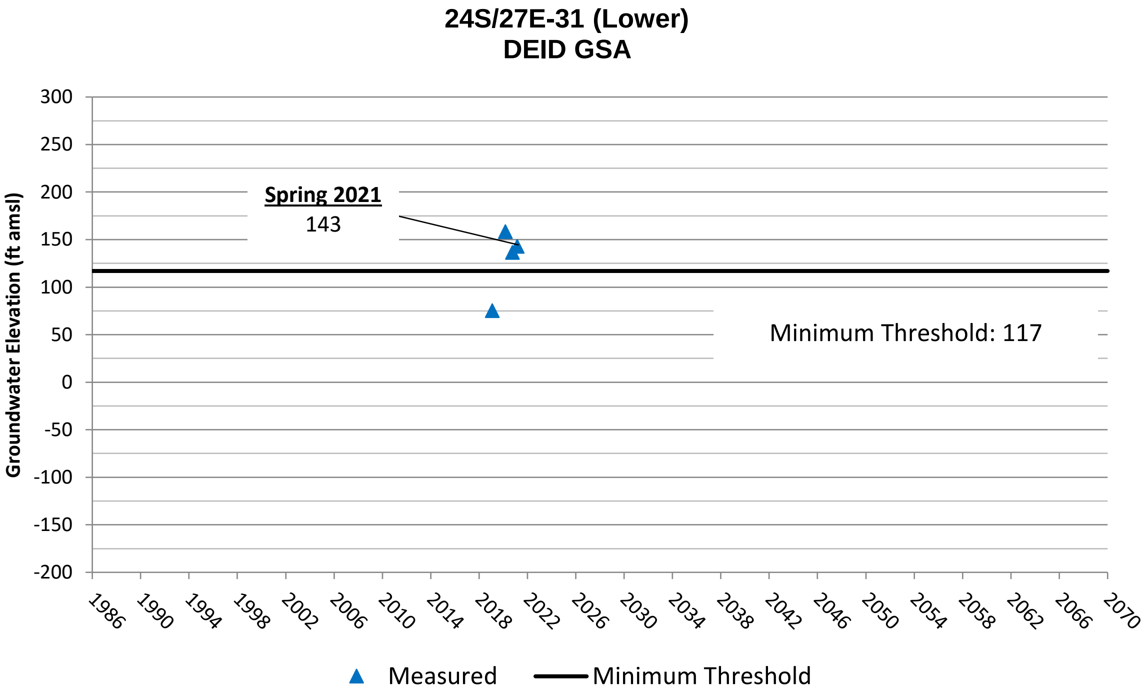
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs





Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs





Appendix D

Pixley Irrigation District GSA

Water Budgets, Land Surface Elevations at Representative Monitoring Sites, and RMS Groundwater Elevation Hydrographs

Appendix D
Table 1a

Pixley Irrigation District GSA
Historical Surface Water Budget 1986/87 to 2016/17

	Surface Water Inflow (acre-ft)					
Water Year	Precipitation	Stream Inflow	Imported Water	Discharge from Wells		Total In
		Deer Creek	Pixley ID	Agricultural	Municipal	
1986 - 1987	28,000	0	9,356	153,000	700	191,000
1987 - 1988	40,000	0	0	154,000	700	195,000
1988 - 1989	32,000	0	5,289	150,000	700	188,000
1989 - 1990	31,000	0	0	174,000	700	206,000
1990 - 1991	42,000	0	0	177,000	700	220,000
1991 - 1992	36,000	0	0	167,000	700	204,000
1992 - 1993	58,000	0	96,890	112,000	700	268,000
1993 - 1994	37,000	0	7,793	177,000	700	222,000
1994 - 1995	77,000	10,445	55,365	148,000	700	292,000
1995 - 1996	41,000	8,989	60,931	120,000	700	232,000
1996 - 1997	57,000	13,322	37,048	143,000	700	251,000
1997 - 1998	92,000	74,587	41,823	138,000	700	347,000
1998 - 1999	47,000	4,770	34,736	156,000	700	243,000
1999 - 2000	45,000	4,791	40,076	160,000	700	251,000
2000 - 2001	33,000	0	9,098	159,000	700	202,000
2001 - 2002	32,000	0	13,588	150,000	800	196,000
2002 - 2003	31,000	1,697	32,195	131,000	800	197,000
2003 - 2004	26,000	0	9,839	137,000	800	174,000
2004 - 2005	50,000	7,994	59,211	104,000	800	222,000
2005 - 2006	51,000	9,156	60,634	132,000	900	254,000
2006 - 2007	21,000	0	7,200	143,000	900	172,000
2007 - 2008	24,000	0	12,243	126,000	900	163,000
2008 - 2009	26,000	0	23,620	142,000	900	193,000
2009 - 2010	41,000	0	32,972	115,000	900	190,000
2010 - 2011	61,000	20,157	48,391	132,000	1,000	263,000
2011 - 2012	38,000	0	5,914	179,000	1,000	224,000
2012 - 2013	18,000	0	5,012	179,000	1,000	203,000
2013 - 2014	12,000	0	0	184,000	1,000	197,000
2014 - 2015	18,000	0	0	184,000	1,000	203,000
2015 - 2016	27,000	0	3,442	119,000	1,100	151,000
2016 - 2017	29,000	13,754	82,363	92,000	1,100	218,000
86/87-16/17 Avg	39,000	5,500	25,600	146,000	800	217,000

Appendix D
Table 1b

Pixley Irrigation District GSA
Historical Surface Water Budget 1986/87 to 2016/17

Water Year	Surface Water Outflow (acre-ft)																Total Out
	Areal Recharge of Precipitation	Streambed Infiltration	Canal Loss		Recharge in Basins		Deep Percolation of Applied Water				Evapotranspiration					Surface Outflow	
		Deer Creek	Deer Creek	Imported Water	Deer Creek	Imported Water	Deer Creek	Imported Water	Agricultural Pumping	Municipal Pumping	Precipitation Crops/Native	Deer Creek	Imported Water	Ag. Cons. Use from Pumping	Municipal (Landscape ET)	Deer Creek	
		Trenton Weir to Homeland Canal Infiltration										Agricultural Cons. Use	Agricultural Cons. Use				
1986 - 1987	0	0	0	8,200	0	0	0	300	38,900	500	28,000	0	900	114,000	200	0	191,000
1987 - 1988	0	0	0	0	0	0	0	0	39,200	500	40,000	0	0	115,000	200	0	195,000
1988 - 1989	0	0	0	1,700	0	0	0	900	38,300	500	32,000	0	2,700	112,000	200	0	188,000
1989 - 1990	0	0	0	0	0	0	0	0	44,400	500	31,000	0	0	130,000	200	0	206,000
1990 - 1991	0	0	0	0	0	0	0	0	45,000	500	42,000	0	0	132,000	300	0	220,000
1991 - 1992	0	0	0	0	0	0	0	0	42,500	500	36,000	0	0	124,000	300	0	203,000
1992 - 1993	3,000	0	0	43,400	0	0	0	13,600	28,400	500	56,000	0	39,900	83,000	300	0	268,000
1993 - 1994	0	0	0	7,800	0	0	0	0	45,100	500	37,000	0	0	132,000	300	0	223,000
1994 - 1995	13,000	1,000	3,800	19,700	1,800	5,900	1,000	7,600	37,800	500	64,000	2,900	22,200	111,000	300	0	293,000
1995 - 1996	0	700	2,800	18,100	700	4,500	1,200	9,800	30,700	500	41,000	3,600	28,600	90,000	300	0	233,000
1996 - 1997	2,000	1,800	6,900	12,900	1,900	1,900	700	5,700	36,500	500	55,000	2,000	16,600	107,000	300	0	252,000
1997 - 1998	23,000	12,700	48,800	14,900	900	2,400	3,100	6,200	35,300	500	69,000	9,100	18,200	103,000	300	0	347,000
1998 - 1999	0	600	2,500	12,300	400	1,200	300	5,400	39,700	500	47,000	1,000	15,800	116,000	300	0	243,000
1999 - 2000	0	600	2,400	13,000	500	700	300	6,700	40,800	500	45,000	900	19,600	119,000	300	0	250,000
2000 - 2001	0	0	0	2,600	0	100	0	1,600	40,500	500	33,000	0	4,800	119,000	300	0	202,000
2001 - 2002	0	0	0	4,000	0	0	0	2,400	38,300	500	32,000	0	7,100	112,000	300	0	197,000
2002 - 2003	0	100	400	10,900	300	1,700	200	4,400	29,500	500	31,000	700	15,200	102,000	300	0	197,000
2003 - 2004	0	0	0	3,000	0	0	0	1,500	30,500	500	26,000	0	5,300	107,000	300	0	174,000
2004 - 2005	0	400	1,500	14,900	2,900	8,400	700	8,000	23,200	500	50,000	2,500	27,900	81,000	300	0	222,000
2005 - 2006	0	900	3,400	15,400	3,200	8,500	400	8,200	29,300	600	50,000	1,300	28,500	102,000	300	0	252,000
2006 - 2007	0	0	0	2,800	0	0	0	1,000	31,800	600	21,000	0	3,500	111,000	300	0	172,000
2007 - 2008	0	0	0	3,800	0	1,000	0	1,700	28,100	600	24,000	0	5,800	98,000	300	0	163,000
2008 - 2009	0	0	0	7,400	0	1,300	0	3,300	31,700	600	26,000	0	11,600	111,000	300	0	193,000
2009 - 2010	0	0	0	11,000	0	9,000	0	3,700	25,600	600	41,000	0	12,900	89,000	300	0	193,000
2010 - 2011	4,000	1,300	5,000	9,200	9,700	8,500	1,400	7,000	29,300	600	57,000	4,700	24,300	102,000	300	0	264,000
2011 - 2012	0	0	0	1,800	0	1,800	0	500	39,900	600	38,000	0	1,800	139,000	300	0	224,000
2012 - 2013	0	0	0	1,700	0	100	0	700	39,900	600	18,000	0	2,500	139,000	400	0	203,000
2013 - 2014	0	0	0	0	0	0	0	0	41,000	700	12,000	0	0	143,000	400	0	197,000
2014 - 2015	0	0	0	0	0	0	0	0	41,000	700	18,000	0	0	143,000	400	0	203,000
2015 - 2016	0	0	0	1,200	0	100	0	500	26,500	700	27,000	0	1,700	92,000	400	0	150,000
2016 - 2017	0	800	3,100	20,600	3,700	10,600	1,400	11,400	20,600	700	29,000	4,800	39,800	72,000	400	0	219,000
36/87-16/17 Avg	1,000	700	2,600	8,500	800	2,200	300	3,600	35,100	600	37,000	1,100	11,500	111,000	300	0	216,000

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Appendix D
Table 2

Pixley Irrigation District GSA
Historical Groundwater Budget 1986/87 to 2016/17

Water Year	Groundwater Inflows (acre-ft)														Total In	Groundwater Outflows (acre-ft)				Total Out	Change in Storage (acre-ft)
	Areal Recharge from Precipitation	Native Deer Creek				Imported Water Deliveries			Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow			Groundwater Pumping		Sub-surface Outflow			
		Trenton Weir to Homeland Canal Infiltration	Canal Loss	Recharge in Basins	Return Flow	Canal Loss	Recharge in Basins	Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Municipal	Agricultural	To Outside Subbasin	To Other GSAs		
1986 - 1987	0	0	0	0	0	8,200	0	300	38,900	500	23,000	0	136,000	207,000	700	153,000	0	54,000	208,000	-1,000
1987 - 1988	0	0	0	0	0	0	0	0	39,200	500	21,000	0	131,000	192,000	700	154,000	0	62,000	217,000	-25,000
1988 - 1989	0	0	0	0	0	1,700	0	900	38,300	500	22,000	0	128,000	191,000	700	150,000	0	64,000	215,000	-24,000
1989 - 1990	0	0	0	0	0	0	0	0	44,400	500	39,000	0	124,000	208,000	700	174,000	0	60,000	235,000	-27,000
1990 - 1991	0	0	0	0	0	0	0	0	45,000	500	39,000	0	134,000	219,000	700	177,000	0	65,000	243,000	-24,000
1991 - 1992	0	0	0	0	0	0	0	0	42,500	500	39,000	0	132,000	214,000	700	167,000	0	70,000	238,000	-24,000
1992 - 1993	3,000	0	0	0	0	43,400	0	13,600	28,400	500	4,000	0	144,000	237,000	700	112,000	0	78,000	191,000	46,000
1993 - 1994	0	0	0	0	0	7,800	0	0	45,100	500	20,000	0	135,000	208,000	700	177,000	0	62,000	240,000	-32,000
1994 - 1995	13,000	1,000	3,800	1,800	1,000	19,700	5,900	7,600	37,800	500	4,000	0	146,000	242,000	700	148,000	0	62,000	211,000	31,000
1995 - 1996	0	700	2,800	700	1,200	18,100	4,500	9,800	30,700	500	1,000	0	144,000	214,000	700	120,000	0	72,000	193,000	21,000
1996 - 1997	2,000	1,800	6,900	1,900	700	12,900	1,900	5,700	36,500	500	3,000	0	154,000	228,000	700	143,000	0	72,000	216,000	12,000
1997 - 1998	23,000	12,700	48,800	900	3,100	14,900	2,400	6,200	35,300	500	0	0	150,000	298,000	700	138,000	0	81,000	220,000	78,000
1998 - 1999	0	600	2,500	400	300	12,300	1,200	5,400	39,700	500	2,000	0	159,000	224,000	700	156,000	0	82,000	239,000	-15,000
1999 - 2000	0	600	2,400	500	300	13,000	700	6,700	40,800	500	3,000	0	156,000	225,000	700	160,000	0	79,000	240,000	-15,000
2000 - 2001	0	0	0	0	0	2,600	100	1,600	40,500	500	8,000	0	147,000	200,000	700	159,000	0	82,000	242,000	-42,000
2001 - 2002	0	0	0	0	0	4,000	0	2,400	38,300	500	14,000	0	144,000	203,000	800	150,000	0	85,000	236,000	-33,000
2002 - 2003	0	100	400	300	200	10,900	1,700	4,400	29,500	500	7,000	0	146,000	201,000	800	131,000	0	82,000	214,000	-13,000
2003 - 2004	0	0	0	0	0	3,000	0	1,500	30,500	500	17,000	0	130,000	183,000	800	137,000	0	68,000	206,000	-23,000
2004 - 2005	0	400	1,500	2,900	700	14,900	8,400	8,000	23,200	500	1,000	0	129,000	191,000	800	104,000	0	67,000	172,000	19,000
2005 - 2006	0	900	3,400	3,200	400	15,400	8,500	8,200	29,300	600	1,000	0	138,000	209,000	900	132,000	0	58,000	191,000	18,000
2006 - 2007	0	0	0	0	0	2,800	0	1,000	31,800	600	14,000	0	115,000	165,000	900	143,000	0	61,000	205,000	-40,000
2007 - 2008	0	0	0	0	0	3,800	1,000	1,700	28,100	600	23,000	0	122,000	180,000	900	126,000	0	82,000	209,000	-29,000
2008 - 2009	0	0	0	0	0	7,400	1,300	3,300	31,700	600	33,000	0	128,000	205,000	900	142,000	0	86,000	229,000	-24,000
2009 - 2010	0	0	0	0	0	11,000	9,000	3,700	25,600	600	14,000	0	143,000	207,000	900	115,000	0	94,000	210,000	-3,000
2010 - 2011	4,000	1,300	5,000	9,700	1,400	9,200	8,500	7,000	29,300	600	7,000	0	146,000	229,000	1,000	132,000	0	77,000	210,000	19,000
2011 - 2012	0	0	0	0	0	1,800	1,800	500	39,900	600	27,000	0	141,000	213,000	1,000	179,000	0	71,000	251,000	-38,000
2012 - 2013	0	0	0	0	0	1,700	100	700	39,900	600	40,000	0	126,000	209,000	1,000	179,000	0	70,000	250,000	-41,000
2013 - 2014	0	0	0	0	0	0	0	0	41,000	700	45,000	0	116,000	203,000	1,000	184,000	0	68,000	253,000	-50,000
2014 - 2015	0	0	0	0	0	0	0	0	41,000	700	47,000	0	115,000	204,000	1,000	184,000	0	69,000	254,000	-50,000
2015 - 2016	0	0	0	0	0	1,200	100	500	26,500	700	35,000	0	115,000	179,000	1,100	119,000	0	79,000	199,000	-20,000
2016 - 2017	0	800	3,100	3,700	1,400	20,600	10,600	11,400	20,600	700	11,000	0	130,000	214,000	1,100	92,000	0	78,000	171,000	43,000
86/87-16/17 Avg	1,000	700	2,600	800	300	8,500	2,200	3,600	35,100	600	18,000	0	136,000	209,000	800	146,000	0	72,000	219,000	-10,000

Cumulative Change in Storage | -306,000

🟦 Groundwater Inflows or Outflows to be Included in Sustainable Yield Estimates
🟪 Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨 Groundwater Outflows Not Included in Sustainable Yield Estimates

Projected Future Pixley Irrigation District GSA Surface Water Budget

	Surface Water Inflow (acre-ft)					
Water Year	Precipitation	Stream Inflow	Imported Water	Discharge from Wells		Total In
		Deer Creek	Pixley ID	Agricultural	Municipal	
2017 - 2018	39,000	6,678	31,763	130,000	1,100	209,000
2018 - 2019	39,000	6,678	31,763	130,000	1,100	209,000
2019 - 2020	39,000	6,678	31,763	119,000	1,100	198,000
2020 - 2021	39,000	6,678	31,763	119,000	1,100	198,000
2021 - 2022	39,000	6,678	31,763	119,000	1,100	198,000
2022 - 2023	39,000	6,678	31,763	119,000	1,100	198,000
2023 - 2024	39,000	6,678	31,763	119,000	1,100	198,000
2024 - 2025	39,000	6,678	31,763	108,000	1,100	187,000
2025 - 2026	39,000	6,678	31,763	108,000	1,100	187,000
2026 - 2027	39,000	6,678	31,763	108,000	1,100	187,000
2027 - 2028	39,000	6,678	31,763	108,000	1,100	187,000
2028 - 2029	39,000	6,678	31,763	108,000	1,100	187,000
2029 - 2030	39,000	6,678	31,763	97,000	1,100	176,000
2030 - 2031	39,000	6,678	31,763	97,000	1,100	176,000
2031 - 2032	39,000	6,678	31,763	97,000	1,100	176,000
2032 - 2033	39,000	6,678	31,763	97,000	1,100	176,000
2033 - 2034	39,000	6,678	31,763	97,000	1,100	176,000
2034 - 2035	39,000	6,678	31,763	67,000	1,100	146,000
2035 - 2036	39,000	6,678	31,763	67,000	1,100	146,000
2036 - 2037	39,000	6,678	31,763	67,000	1,100	146,000
2037 - 2038	39,000	6,678	31,763	67,000	1,100	146,000
2038 - 2039	39,000	6,678	31,763	67,000	1,100	146,000
2039 - 2040	39,000	6,678	31,763	45,000	1,100	124,000
2040 - 2041	39,000	6,678	31,763	45,000	1,100	124,000
2041 - 2042	39,000	6,678	31,763	45,000	1,100	124,000
2042 - 2043	39,000	6,678	31,763	45,000	1,100	124,000
2043 - 2044	39,000	6,678	31,763	45,000	1,100	124,000
2044 - 2045	39,000	6,678	31,763	45,000	1,100	124,000
2045 - 2046	39,000	6,678	31,763	45,000	1,100	124,000
2046 - 2047	39,000	6,678	31,763	45,000	1,100	124,000
2047 - 2048	39,000	6,678	31,763	45,000	1,100	124,000
2048 - 2049	39,000	6,678	31,763	45,000	1,100	124,000
2049 - 2050	39,000	6,678	31,763	45,000	1,100	124,000
2050 - 2051	39,000	6,517	31,763	45,000	1,100	123,000
2051 - 2052	39,000	6,517	31,763	45,000	1,100	123,000
2052 - 2053	39,000	6,517	31,763	45,000	1,100	123,000
2053 - 2054	39,000	6,517	31,763	45,000	1,100	123,000
2054 - 2055	39,000	6,517	31,763	45,000	1,100	123,000
2055 - 2056	39,000	6,517	31,763	45,000	1,100	123,000
2056 - 2057	39,000	6,517	31,763	45,000	1,100	123,000
2057 - 2058	39,000	6,517	31,763	45,000	1,100	123,000
2058 - 2059	39,000	6,517	31,763	45,000	1,100	123,000
2059 - 2060	39,000	6,517	31,763	45,000	1,100	123,000
2060 - 2061	39,000	6,517	31,763	45,000	1,100	123,000
2061 - 2062	39,000	6,517	31,763	45,000	1,100	123,000
2062 - 2063	39,000	6,517	31,763	45,000	1,100	123,000
2063 - 2064	39,000	6,517	31,763	45,000	1,100	123,000
2064 - 2065	39,000	6,517	31,763	45,000	1,100	123,000
2065 - 2066	39,000	6,517	31,763	45,000	1,100	123,000
2066 - 2067	39,000	6,517	31,763	45,000	1,100	123,000
2067 - 2068	39,000	6,517	31,763	45,000	1,100	123,000
2068 - 2069	39,000	6,517	31,763	45,000	1,100	123,000
2069 - 2070	39,000	6,517	31,763	45,000	1,100	123,000
17/18-69/70 Avg	39,000	6,600	31,800	68,000	1,100	147,000

Projected Future Pixley Irrigation District GSA Surface Water Budget

Water Year	Surface Water Outflow (acre-ft)																Total Out
	Areal Recharge of Precipitation	Streambed Infiltration	Canal Loss		Recharge in Basins		Deep Percolation of Applied Water				Evapotranspiration					Surface Outflow	
		Deer Creek Trenton Weir to Homeland Canal Infiltration	Deer Creek	Imported Water	Deer Creek	Imported Water	Deer Creek	Imported Water	Agricultural Pumping	Municipal Pumping	Precipitation Crops/Native	Deer Creek Agricultural Cons. Use	Imported Water Agricultural Cons. Use	Ag. Cons. Use from Pumping	Municipal (Landscape ET)	Deer Creek	
2017 - 2018	1,000	600	2,100	12,700	500	2,300	800	3,700	28,900	700	37,000	2,700	13,000	101,000	400	0	207,000
2018 - 2019	1,000	600	2,100	12,700	500	2,300	800	3,700	28,900	700	37,000	2,700	13,000	101,000	400	0	207,000
2019 - 2020	1,000	600	2,100	12,700	500	2,300	800	3,700	26,400	700	37,000	2,700	13,000	92,000	400	0	196,000
2020 - 2021	1,000	600	2,100	12,700	500	2,300	800	3,700	26,400	700	37,000	2,700	13,000	92,000	400	0	196,000
2021 - 2022	1,000	600	2,100	12,700	500	2,300	800	3,700	26,400	700	37,000	2,700	13,000	92,000	400	0	196,000
2022 - 2023	1,000	600	2,100	12,700	500	2,300	800	3,700	26,400	700	37,000	2,700	13,000	92,000	400	0	196,000
2023 - 2024	1,000	600	2,100	12,700	500	2,300	800	3,700	26,400	700	37,000	2,700	13,000	92,000	400	0	196,000
2024 - 2025	1,000	600	2,100	12,700	500	2,300	800	3,700	24,000	700	37,000	2,700	13,000	84,000	400	0	186,000
2025 - 2026	1,000	600	2,100	12,700	500	2,300	800	3,700	24,000	700	37,000	2,700	13,000	84,000	400	0	186,000
2026 - 2027	1,000	600	2,100	12,700	500	2,300	800	3,700	24,000	700	37,000	2,700	13,000	84,000	400	0	186,000
2027 - 2028	1,000	600	2,100	12,700	500	2,300	800	3,700	24,000	700	37,000	2,700	13,000	84,000	400	0	186,000
2028 - 2029	1,000	600	2,100	12,700	500	2,300	800	3,700	24,000	700	37,000	2,700	13,000	84,000	400	0	186,000
2029 - 2030	1,000	600	2,100	12,700	500	2,300	800	3,700	21,500	700	37,000	2,700	13,000	75,000	400	0	174,000
2030 - 2031	1,000	600	2,100	12,700	500	2,300	800	3,700	21,500	700	37,000	2,700	13,000	75,000	400	0	174,000
2031 - 2032	1,000	600	2,100	12,700	500	2,300	800	3,700	21,500	700	37,000	2,700	13,000	75,000	400	0	174,000
2032 - 2033	1,000	600	2,100	12,700	500	2,300	800	3,700	21,500	700	37,000	2,700	13,000	75,000	400	0	174,000
2033 - 2034	1,000	600	2,100	12,700	500	2,300	800	3,700	21,500	700	37,000	2,700	13,000	75,000	400	0	174,000
2034 - 2035	1,000	600	2,100	12,700	500	2,300	800	3,700	15,000	700	37,000	2,700	13,000	52,000	400	0	145,000
2035 - 2036	1,000	600	2,100	12,700	500	2,300	800	3,700	15,000	700	37,000	2,700	13,000	52,000	400	0	145,000
2036 - 2037	1,000	600	2,100	12,700	500	2,300	800	3,700	15,000	700	37,000	2,700	13,000	52,000	400	0	145,000
2037 - 2038	1,000	600	2,100	12,700	500	2,300	800	3,700	15,000	700	37,000	2,700	13,000	52,000	400	0	145,000
2038 - 2039	1,000	600	2,100	12,700	500	2,300	800	3,700	15,000	700	37,000	2,700	13,000	52,000	400	0	145,000
2039 - 2040	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2040 - 2041	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2041 - 2042	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2042 - 2043	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2043 - 2044	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2044 - 2045	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2045 - 2046	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2046 - 2047	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2047 - 2048	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2048 - 2049	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2049 - 2050	1,000	600	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	123,000
2050 - 2051	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2051 - 2052	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2052 - 2053	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2053 - 2054	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2054 - 2055	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2055 - 2056	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2056 - 2057	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2057 - 2058	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2058 - 2059	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2059 - 2060	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2060 - 2061	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2061 - 2062	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2062 - 2063	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2063 - 2064	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2064 - 2065	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2065 - 2066	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2066 - 2067	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2067 - 2068	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2068 - 2069	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
2069 - 2070	1,000	500	2,100	12,700	500	2,300	800	3,700	10,000	700	37,000	2,700	13,000	35,000	400	0	122,000
17/18-69/70 Avg	1,000	600	2,100	12,700	500	2,300	800	3,700	15,100	700	37,000	2,700	13,000	53,000	400	0	146,000

Projected Future Pixley Irrigation District GSA Groundwater Budget

Water Year	Groundwater Inflows (acre-ft)														Groundwater Outflows (acre-ft)					Change in Storage (acre-ft)
	Areal Recharge from Precipitation	Native Deer Creek				Imported Water Deliveries			Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow		Total In	Groundwater Pumping		Sub-surface Outflow		Total Out	
		Trenton Weir to Homeland Canal Infiltration	Canal Loss	Recharge in Basins	Return Flow	Canal Loss	Recharge in Basins	Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Municipal	Agricultural	To Outside Subbasin	To Other GSAs		
2017 - 2018	1,000	600	2,100	500	800	12,700	2,300	3,700	28,900	700	9,000	0	123,000	185,000	1,100	130,000	0	70,000	201,000	-16,000
2018 - 2019	1,000	600	2,100	500	800	12,700	2,300	3,700	28,900	700	11,000	0	121,000	185,000	1,100	130,000	0	69,000	200,000	-15,000
2019 - 2020	1,000	600	2,100	500	800	12,700	2,300	3,700	26,400	700	12,000	0	116,000	179,000	1,100	119,000	0	70,000	190,000	-11,000
2020 - 2021	1,000	600	2,100	500	800	12,700	2,300	3,700	26,400	700	13,000	0	114,000	178,000	1,100	119,000	0	69,000	189,000	-11,000
2021 - 2022	1,000	600	2,100	500	800	12,700	2,300	3,700	26,400	700	14,000	0	112,000	177,000	1,100	119,000	0	69,000	189,000	-12,000
2022 - 2023	1,000	600	2,100	500	800	12,700	2,300	3,700	26,400	700	15,000	0	111,000	177,000	1,100	119,000	0	68,000	188,000	-11,000
2023 - 2024	1,000	600	2,100	500	800	12,700	2,300	3,700	26,400	700	16,000	0	110,000	177,000	1,100	119,000	0	69,000	189,000	-12,000
2024 - 2025	1,000	600	2,100	500	800	12,700	2,300	3,700	24,000	700	14,000	0	104,000	166,000	1,100	108,000	0	68,000	177,000	-11,000
2025 - 2026	1,000	600	2,100	500	800	12,700	2,300	3,700	24,000	700	13,000	0	102,000	163,000	1,100	108,000	0	65,000	174,000	-11,000
2026 - 2027	1,000	600	2,100	500	800	12,700	2,300	3,700	24,000	700	13,000	0	99,000	160,000	1,100	108,000	0	63,000	172,000	-12,000
2027 - 2028	1,000	600	2,100	500	800	12,700	2,300	3,700	24,000	700	13,000	0	98,000	159,000	1,100	108,000	0	61,000	170,000	-11,000
2028 - 2029	1,000	600	2,100	500	800	12,700	2,300	3,700	24,000	700	13,000	0	95,000	156,000	1,100	108,000	0	59,000	168,000	-12,000
2029 - 2030	1,000	600	2,100	500	800	12,700	2,300	3,700	21,500	700	11,000	0	90,000	147,000	1,100	97,000	0	58,000	156,000	-9,000
2030 - 2031	1,000	600	2,100	500	800	12,700	2,300	3,700	21,500	700	11,000	0	89,000	146,000	1,100	97,000	0	57,000	155,000	-9,000
2031 - 2032	1,000	600	2,100	500	800	12,700	2,300	3,700	21,500	700	11,000	0	88,000	145,000	1,100	97,000	0	56,000	154,000	-9,000
2032 - 2033	1,000	600	2,100	500	800	12,700	2,300	3,700	21,500	700	11,000	0	87,000	144,000	1,100	97,000	0	55,000	153,000	-9,000
2033 - 2034	1,000	600	2,100	500	800	12,700	2,300	3,700	21,500	700	11,000	0	87,000	144,000	1,100	97,000	0	55,000	153,000	-9,000
2034 - 2035	1,000	600	2,100	500	800	12,700	2,300	3,700	15,000	700	7,000	0	78,000	124,000	1,100	67,000	0	57,000	125,000	-1,000
2035 - 2036	1,000	600	2,100	500	800	12,700	2,300	3,700	15,000	700	6,000	0	77,000	122,000	1,100	67,000	0	56,000	124,000	-2,000
2036 - 2037	1,000	600	2,100	500	800	12,700	2,300	3,700	15,000	700	6,000	0	76,000	121,000	1,100	67,000	0	56,000	124,000	-3,000
2037 - 2038	1,000	600	2,100	500	800	12,700	2,300	3,700	15,000	700	6,000	0	75,000	120,000	1,100	67,000	0	55,000	123,000	-3,000
2038 - 2039	1,000	600	2,100	500	800	12,700	2,300	3,700	15,000	700	6,000	0	75,000	120,000	1,100	67,000	0	55,000	123,000	-3,000
2039 - 2040	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	3,000	0	70,000	107,000	1,100	45,000	0	57,000	103,000	4,000
2040 - 2041	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	3,000	0	68,000	105,000	1,100	45,000	0	56,000	102,000	3,000
2041 - 2042	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	3,000	0	67,000	104,000	1,100	45,000	0	56,000	102,000	2,000
2042 - 2043	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	3,000	0	67,000	104,000	1,100	45,000	0	56,000	102,000	2,000
2043 - 2044	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	3,000	0	66,000	103,000	1,100	45,000	0	56,000	102,000	1,000
2044 - 2045	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	3,000	0	66,000	103,000	1,100	45,000	0	56,000	102,000	1,000
2045 - 2046	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	3,000	0	65,000	102,000	1,100	45,000	0	55,000	101,000	1,000
2046 - 2047	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2047 - 2048	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2048 - 2049	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2049 - 2050	1,000	600	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2050 - 2051	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2051 - 2052	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2052 - 2053	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2053 - 2054	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2054 - 2055	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2055 - 2056	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	65,000	101,000	1,100	45,000	0	55,000	101,000	0
2056 - 2057	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2057 - 2058	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2058 - 2059	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2059 - 2060	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2060 - 2061	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2061 - 2062	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2062 - 2063	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2063 - 2064	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2064 - 2065	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2065 - 2066	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2066 - 2067	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2067 - 2068	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2068 - 2069	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
2069 - 2070	1,000	500	2,100	500	800	12,700	2,300	3,700	10,000	700	2,000	0	64,000	100,000	1,100	45,000	0	54,000	100,000	0
17/18-69/70 Avg	1,000	600	2,100	500	800	12,700	2,300	3,700	15,100	700	6,000	0	78,000	124,000	1,100	68,000	0	58,000	127,000	-3,000

Appendix D
Table 5

Pixley Irrigation District GSA
Land Surface Elevations at Representative Monitoring Sites

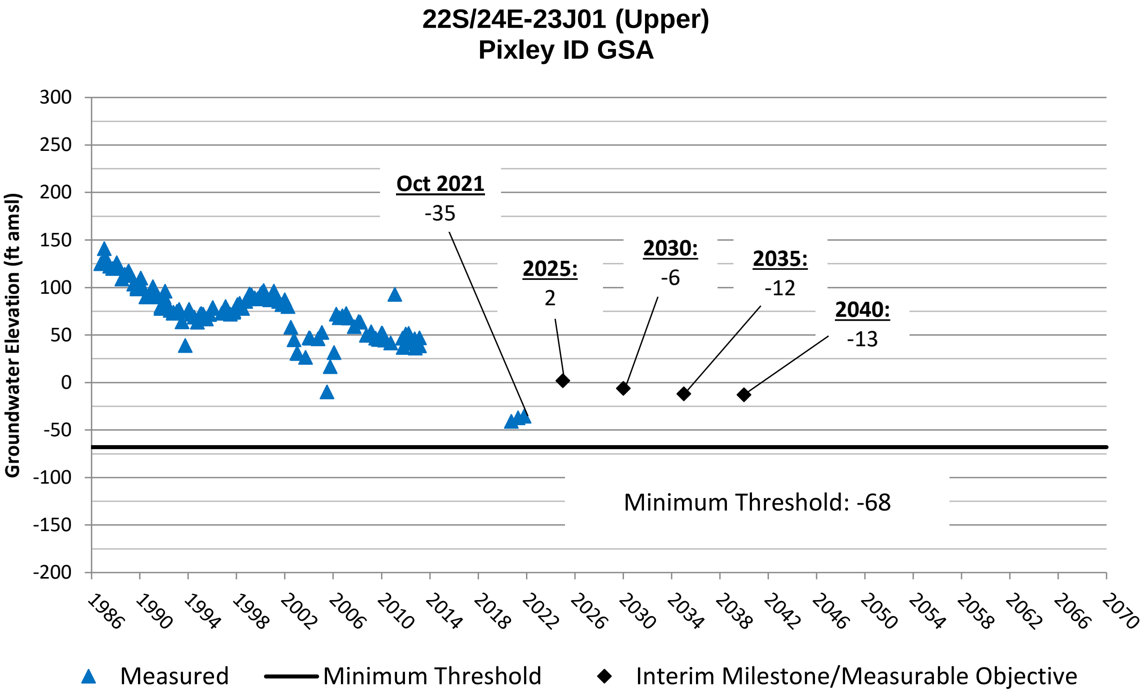
Site	Land Surface Elevation (ft amsl)[1]			
	2020 (Baseline)	2021	Measurable Objective	Minimum Threshold
P0007_B_RMS	210.0	209.3	203.4	200.6
P0008_B_RMS	229.1	228.6	225.8	223.7
P0009_B_RMS	205.2	204.5	197.8	195.2
P0010_B_RMS	202.4	201.9	195.9	192.8
P0011_B_RMS	218.5	217.8	212.4	210.0
P0025_B_RMS	273.4	273.0	270.6	269.6
P0026_B_RMS	277.2	276.4	276.0	274.9
P0027_B_RMS	255.3	254.8	253.1	252.1
P0028_B_RMS	278.0	277.4	276.9	275.9
P0029_B_RMS	283.5	283.5	282.2	280.9
P0036_B_RMS	323.6	323.1	322.1	321.1
P0037_B_RMS	324.6	324.1	323.0	322.0
P0090_B_RMS	N/A	386	N/A	N/A
P0091_B_RMS	N/A	225	N/A	N/A
P0093_B_RMS	N/A	350	N/A	N/A
P0094_B_RMS	N/A	311	N/A	N/A

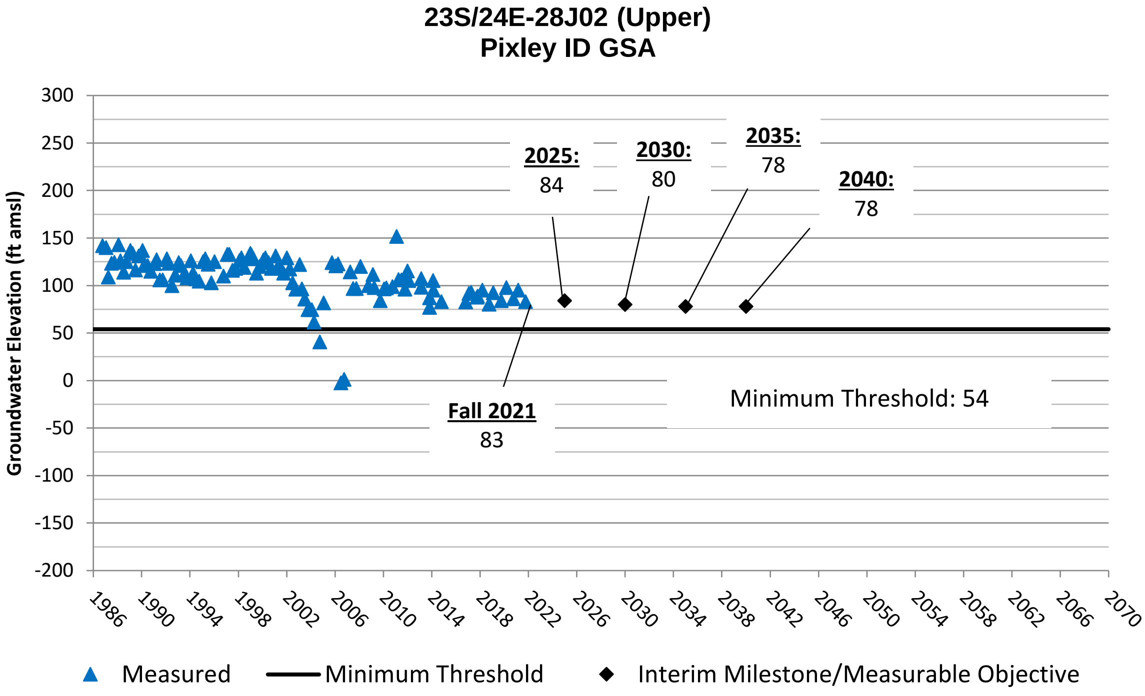
Note:

N/A = Not available

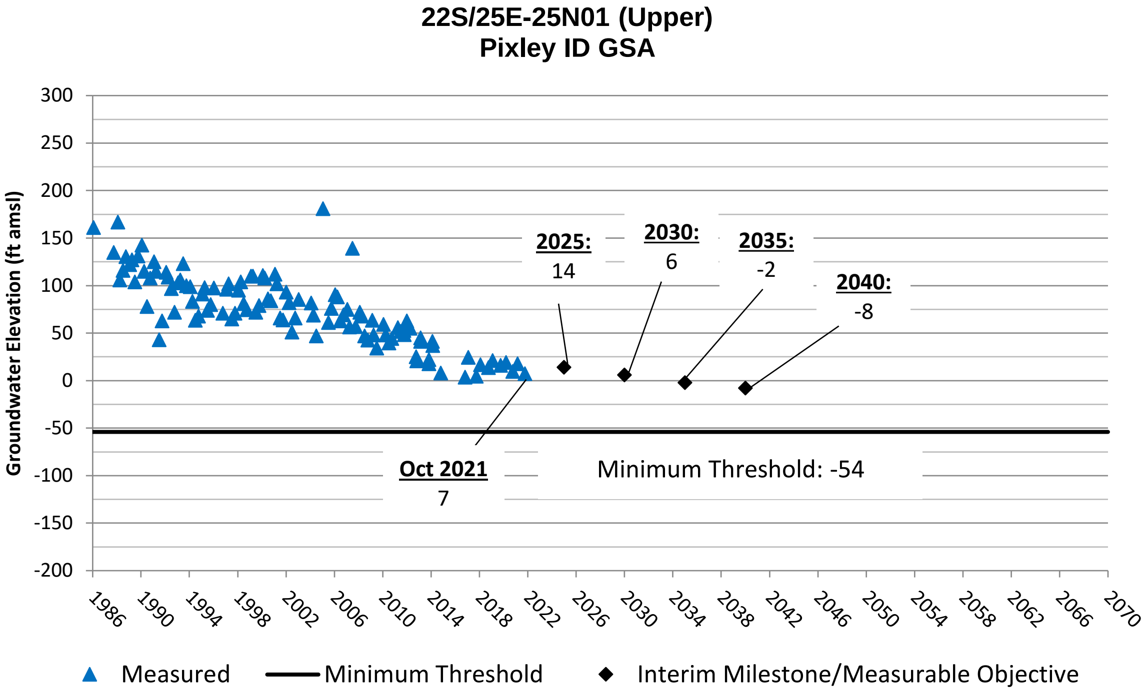
[1] Benchmarks surveyed in July and August of each year.

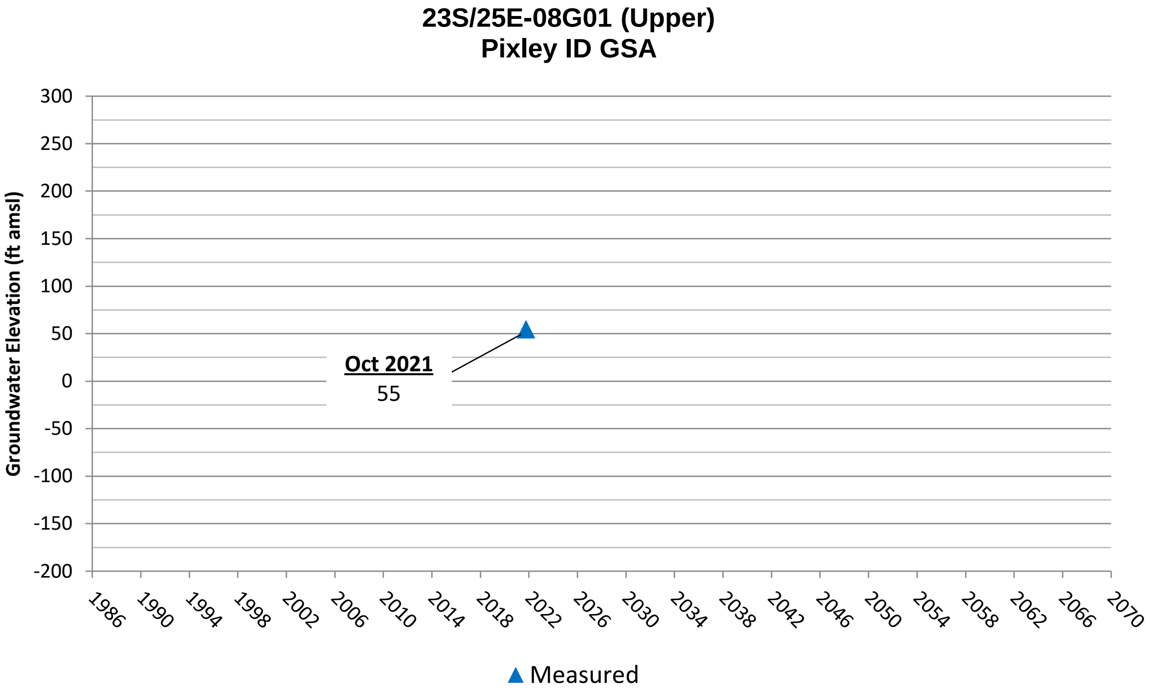
Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs



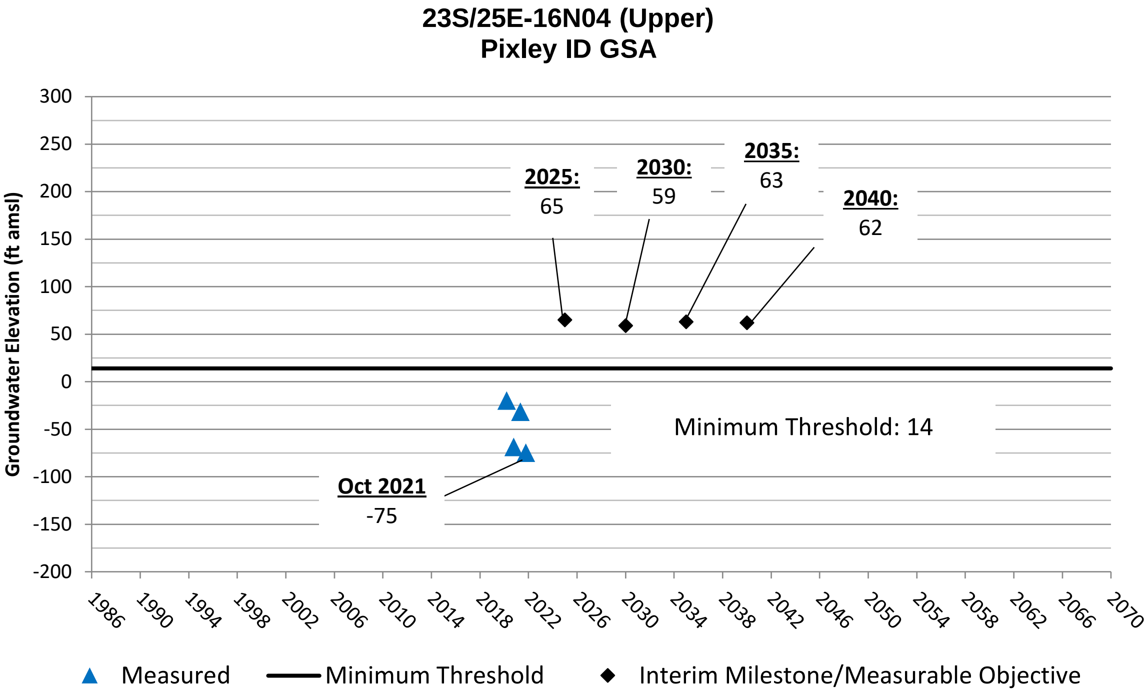


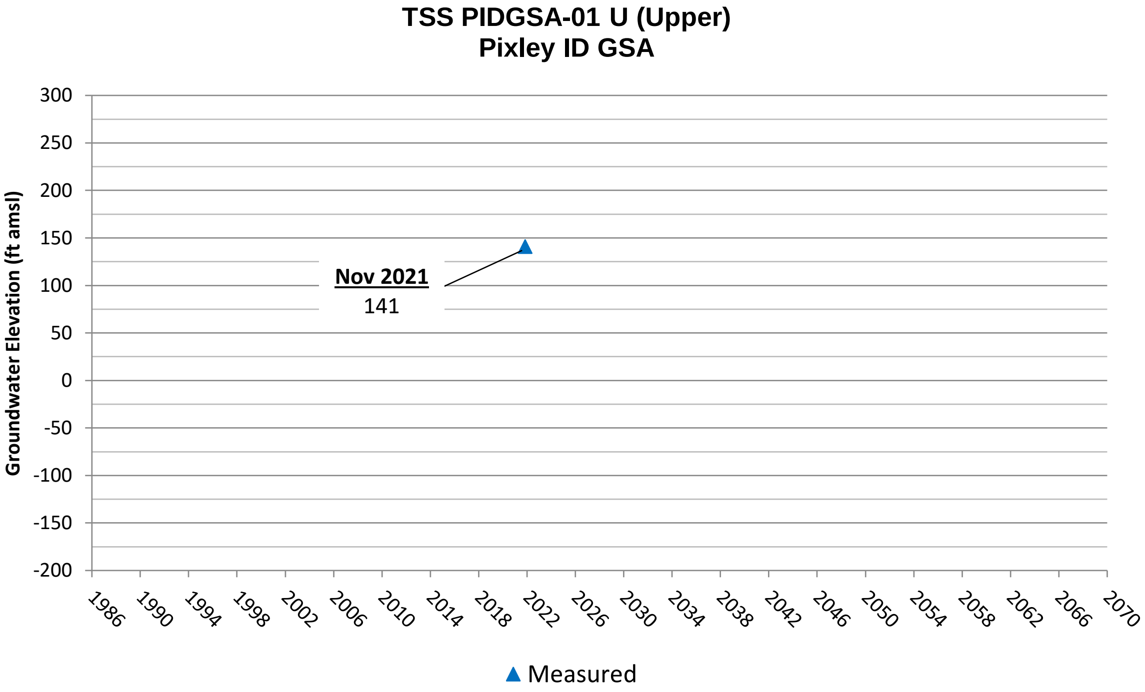
Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs



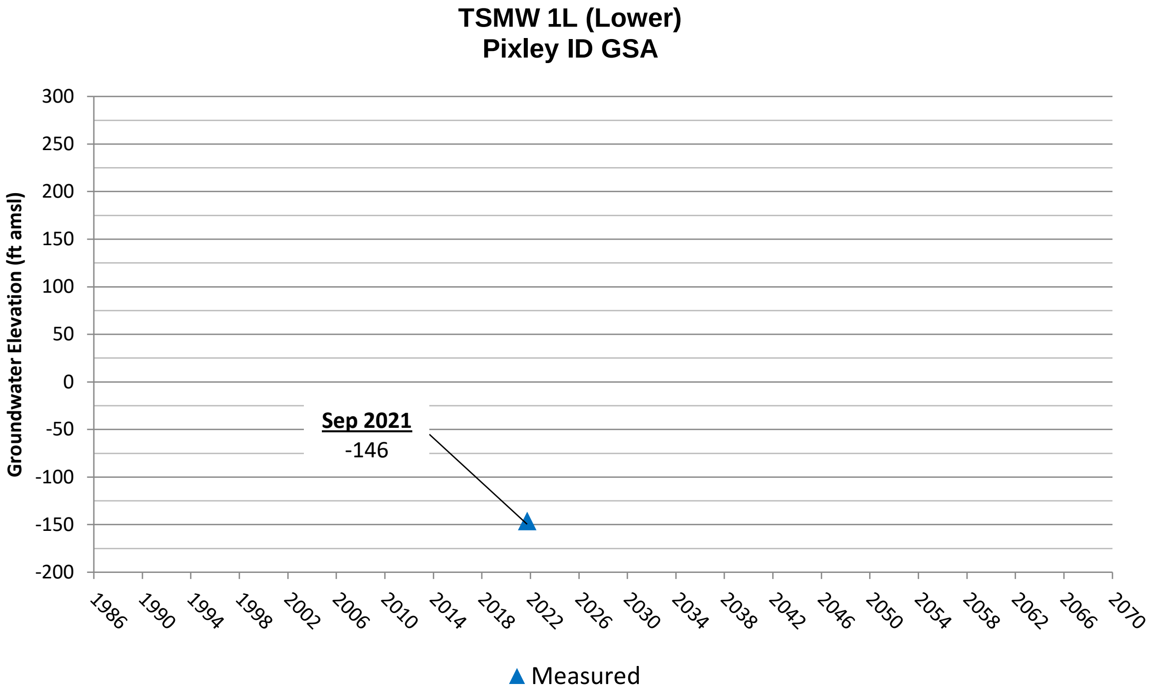


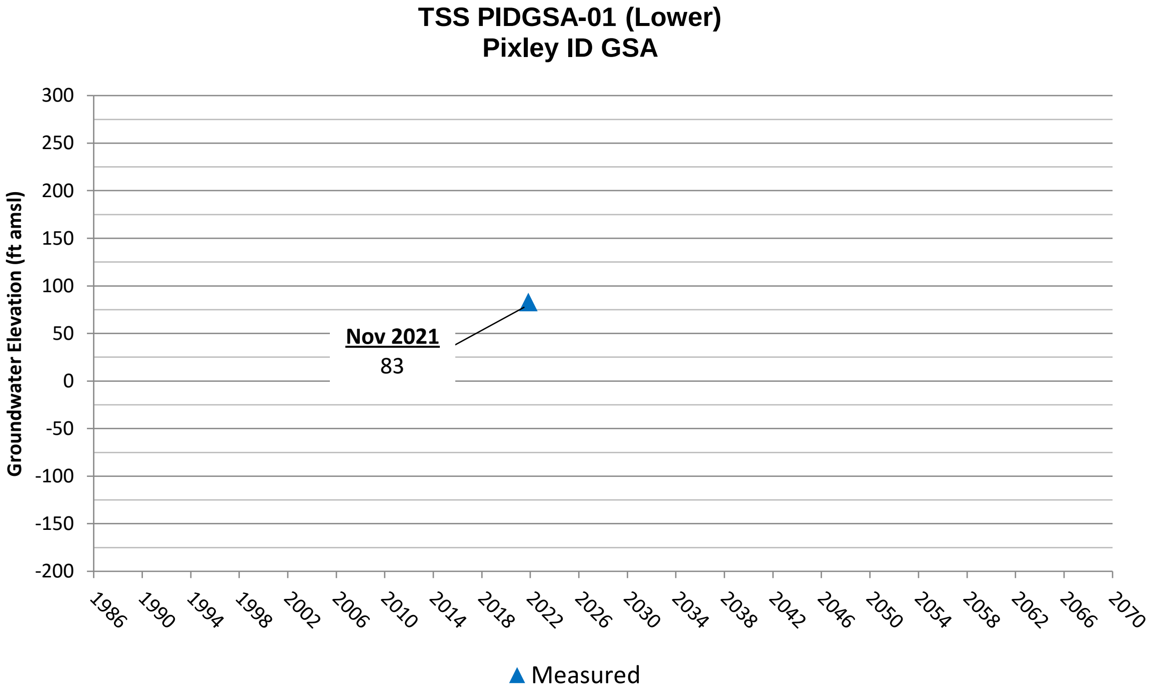
Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs



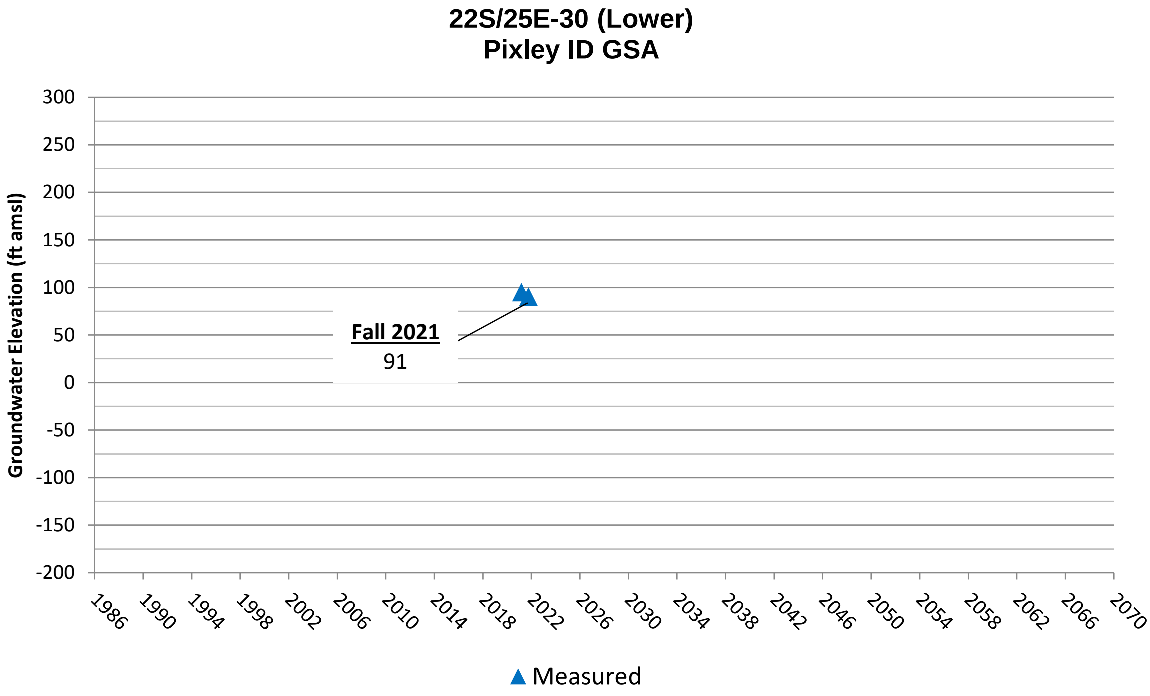


Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs





Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs



Appendix E

Tri-County Water Authority GSA

Water Budgets, Land Surface Elevations at Representative Monitoring Sites, and RMS Groundwater Elevation Hydrographs

Tri-County Water Authority GSA
Historical Surface Water Budget 1986/87 to 2016/17

	Surface Water Inflow (acre-ft)					
Water Year	Precipitation	Imported Water			Discharge from Wells Agricultural	Total In
		Atwell Island WD	Alpaugh ID	Angiola WD		
1986 - 1987	21,000	711	45	7,278	49,000	78,000
1987 - 1988	30,000	0	0	3,530	53,000	87,000
1988 - 1989	24,000	0	0	6,026	51,000	81,000
1989 - 1990	23,000	0	0	3,847	53,000	80,000
1990 - 1991	31,000	0	0	925	56,000	88,000
1991 - 1992	27,000	0	0	1,611	55,000	84,000
1992 - 1993	44,000	4,121	700	3,420	49,000	101,000
1993 - 1994	28,000	1,283	206	3,640	51,000	84,000
1994 - 1995	57,000	3,462	473	8,918	44,000	114,000
1995 - 1996	30,000	3,379	637	12,551	57,000	104,000
1996 - 1997	42,000	0	0	12,383	63,000	117,000
1997 - 1998	69,000	0	0	7,460	68,000	144,000
1998 - 1999	35,000	0	0	9,778	66,000	111,000
1999 - 2000	33,000	162	0	8,118	67,000	108,000
2000 - 2001	25,000	0	0	3,824	72,000	101,000
2001 - 2002	24,000	0	0	2,932	73,000	100,000
2002 - 2003	23,000	0	6	4,728	67,000	95,000
2003 - 2004	19,000	0	0	3,434	58,000	80,000
2004 - 2005	37,000	0	830	11,741	48,000	98,000
2005 - 2006	38,000	0	923	10,909	49,000	99,000
2006 - 2007	16,000	0	0	6,641	55,000	78,000
2007 - 2008	18,000	0	0	2,165	59,000	79,000
2008 - 2009	19,000	0	122	191	60,000	79,000
2009 - 2010	31,000	0	153	3,243	57,000	91,000
2010 - 2011	45,000	0	627	6,476	63,000	115,000
2011 - 2012	28,000	0	54	3,156	67,000	98,000
2012 - 2013	13,000	0	0	1,492	70,000	84,000
2013 - 2014	9,000	0	0	1,048	70,000	80,000
2014 - 2015	13,000	0	0	575	70,000	84,000
2015 - 2016	20,000	0	0	587	70,000	91,000
2016 - 2017	21,000	0	136	12,146	58,000	91,000
86/87-16/17 Avg	29,000	400	200	5,300	60,000	95,000

Appendix E
Table 1b

Tri-County Water Authority GSA
Historical Surface Water Budget 1986/87 to 2016/17

	Surface Water Outflow (acre-ft)						
Water Year	Areal Recharge of Precipitation	Deep Percolation of Applied Water		Evapotranspiration			Total Out
		Imported Water	Agricultural Pumping	Precipitation Crops/Native	Imported Water Agricultural Cons. Use	Ag. Cons. Use from Pumping	
1986 - 1987	0	2,300	11,700	21,000	5,800	37,000	78,000
1987 - 1988	0	900	12,900	30,000	2,600	40,000	86,000
1988 - 1989	0	1,600	12,300	24,000	4,500	38,000	80,000
1989 - 1990	0	1,000	12,800	23,000	2,800	40,000	80,000
1990 - 1991	0	300	13,700	31,000	600	42,000	88,000
1991 - 1992	0	400	13,300	27,000	1,200	42,000	84,000
1992 - 1993	0	2,200	11,800	44,000	6,000	37,000	101,000
1993 - 1994	0	1,300	12,400	28,000	3,800	39,000	85,000
1994 - 1995	5,000	3,300	10,500	52,000	9,500	33,000	113,000
1995 - 1996	0	4,200	13,700	30,000	12,300	44,000	104,000
1996 - 1997	0	3,200	15,100	42,000	9,200	48,000	118,000
1997 - 1998	12,000	1,900	16,400	56,000	5,500	52,000	144,000
1998 - 1999	0	2,500	15,800	35,000	7,300	50,000	111,000
1999 - 2000	0	2,100	16,200	33,000	6,200	51,000	109,000
2000 - 2001	0	1,000	17,300	25,000	2,800	54,000	100,000
2001 - 2002	0	800	17,600	24,000	2,200	55,000	100,000
2002 - 2003	0	1,100	13,200	23,000	3,600	54,000	95,000
2003 - 2004	0	1,000	11,200	19,000	2,400	46,000	80,000
2004 - 2005	0	4,500	9,100	37,000	8,000	39,000	98,000
2005 - 2006	0	4,300	9,100	38,000	7,500	40,000	99,000
2006 - 2007	0	2,700	11,600	16,000	3,900	43,000	77,000
2007 - 2008	0	900	12,500	18,000	1,200	46,000	79,000
2008 - 2009	0	100	12,900	19,000	200	47,000	79,000
2009 - 2010	0	1,100	11,800	31,000	2,300	45,000	91,000
2010 - 2011	0	3,500	12,200	45,000	3,600	51,000	115,000
2011 - 2012	0	1,900	13,800	28,000	1,300	53,000	98,000
2012 - 2013	0	900	16,600	13,000	600	54,000	85,000
2013 - 2014	0	800	15,600	9,000	200	54,000	80,000
2014 - 2015	0	300	15,700	13,000	300	54,000	83,000
2015 - 2016	0	300	15,700	20,000	300	54,000	90,000
2016 - 2017	0	4,200	11,300	21,000	8,000	46,000	91,000
86/87-16/17 Avg	1,000	1,800	13,400	28,000	4,100	46,000	94,000

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Appendix E
Table 2

Tri-County Water Authority GSA
Historical Groundwater Budget 1986/87 to 2016/17

	Groundwater Inflows (acre-ft)							Groundwater Outflows (acre-ft)					
Water Year	Areal Recharge from Precipitation	Imported Water Deliveries	Agricultural Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow		Total In	Groundwater Pumping		Sub-surface Outflow		Total Out	Change in Storage (acre-ft)
		Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Agricultural	Exports	To Outside Subbasin	To Other GSAs		
1986 - 1987	0	2,300	11,700	19,000	10,000	79,000	122,000	49,000	6,550	16,000	47,000	119,000	3,000
1987 - 1988	0	900	12,900	15,000	12,000	89,000	130,000	53,000	18,240	12,000	48,000	131,000	-1,000
1988 - 1989	0	1,600	12,300	13,000	12,000	85,000	124,000	51,000	12,130	11,000	51,000	125,000	-1,000
1989 - 1990	0	1,000	12,800	17,000	14,000	85,000	130,000	53,000	23,840	11,000	49,000	137,000	-7,000
1990 - 1991	0	300	13,700	18,000	15,000	90,000	137,000	56,000	18,120	16,000	50,000	140,000	-3,000
1991 - 1992	0	400	13,300	18,000	13,000	95,000	140,000	55,000	23,840	13,000	56,000	148,000	-8,000
1992 - 1993	0	2,200	11,800	10,000	9,000	100,000	133,000	49,000	6,610	16,000	58,000	130,000	3,000
1993 - 1994	0	1,300	12,400	12,000	14,000	91,000	131,000	51,000	11,220	12,000	58,000	132,000	-1,000
1994 - 1995	5,000	3,300	10,500	8,000	13,000	83,000	123,000	44,000	1,320	13,000	54,000	112,000	11,000
1995 - 1996	0	4,200	13,700	5,000	15,000	94,000	132,000	57,000	0	12,000	54,000	123,000	9,000
1996 - 1997	0	3,200	15,100	7,000	20,000	97,000	142,000	63,000	0	12,000	60,000	135,000	7,000
1997 - 1998	12,000	1,900	16,400	6,000	20,000	105,000	161,000	68,000	0	12,000	61,000	141,000	20,000
1998 - 1999	0	2,500	15,800	6,000	20,000	101,000	145,000	66,000	0	12,000	63,000	141,000	4,000
1999 - 2000	0	2,100	16,200	6,000	20,000	101,000	145,000	67,000	4,900	11,000	63,000	146,000	-1,000
2000 - 2001	0	1,000	17,300	11,000	17,000	105,000	151,000	72,000	13,310	11,000	63,000	159,000	-8,000
2001 - 2002	0	800	17,600	12,000	17,000	109,000	156,000	73,000	18,930	11,000	65,000	168,000	-12,000
2002 - 2003	0	1,100	13,200	8,000	19,000	100,000	141,000	67,000	13,050	10,000	64,000	154,000	-13,000
2003 - 2004	0	1,000	11,200	9,000	18,000	89,000	128,000	58,000	20,360	11,000	56,000	145,000	-17,000
2004 - 2005	0	4,500	9,100	4,000	13,000	86,000	117,000	48,000	4,000	15,000	51,000	118,000	-1,000
2005 - 2006	0	4,300	9,100	3,000	17,000	77,000	110,000	49,000	150	12,000	49,000	110,000	0
2006 - 2007	0	2,700	11,600	9,000	19,000	82,000	124,000	55,000	21,570	11,000	49,000	137,000	-13,000
2007 - 2008	0	900	12,500	14,000	13,000	100,000	140,000	59,000	23,950	16,000	59,000	158,000	-18,000
2008 - 2009	0	100	12,900	18,000	13,000	112,000	156,000	60,000	27,390	18,000	66,000	171,000	-15,000
2009 - 2010	0	1,100	11,800	15,000	13,000	119,000	160,000	57,000	17,760	24,000	71,000	170,000	-10,000
2010 - 2011	0	3,500	12,200	10,000	15,000	110,000	151,000	63,000	4,180	18,000	63,000	148,000	3,000
2011 - 2012	0	1,900	13,800	14,000	18,000	103,000	151,000	67,000	21,980	15,000	60,000	164,000	-13,000
2012 - 2013	0	900	16,600	17,000	19,000	93,000	147,000	70,000	23,730	9,000	59,000	162,000	-15,000
2013 - 2014	0	800	15,600	18,000	18,000	89,000	141,000	70,000	20,900	9,000	60,000	160,000	-19,000
2014 - 2015	0	300	15,700	20,000	18,000	88,000	142,000	70,000	20,100	9,000	60,000	159,000	-17,000
2015 - 2016	0	300	15,700	18,000	20,000	99,000	153,000	70,000	21,690	10,000	61,000	163,000	-10,000
2016 - 2017	0	4,200	11,300	12,000	17,000	107,000	152,000	58,000	4,520	17,000	69,000	149,000	3,000
36/87-16/17 Avg	1,000	1,800	13,400	12,000	16,000	96,000	140,000	60,000	13,000	13,000	58,000	144,000	-4,000
												Cumulative Change in Storage	-140,000

🟦	Groundwater Inflows or Outflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Groundwater Outflows Not Included in Sustainable Yield Estimates

Projected Future Tri-County Water Authority GSA Surface Water Budget

	Surface Water Inflow (acre-ft)						
Water Year	Precipitation	Imported Water				Discharge from Wells Agricultural	Total In
		Atwell Island WD	Alpaugh ID	Angiola WD	Private		
2017 - 2018	29,000	0	0	5,911	0	63,000	98,000
2018 - 2019	29,000	0	0	5,911	0	63,000	98,000
2019 - 2020	29,000	0	0	7,961	0	61,000	98,000
2020 - 2021	29,000	0	0	9,211	0	60,000	98,000
2021 - 2022	29,000	0	0	10,461	0	59,000	98,000
2022 - 2023	29,000	0	0	13,590	0	58,000	101,000
2023 - 2024	29,000	0	0	18,926	0	58,000	106,000
2024 - 2025	29,000	0	0	24,261	1,500	52,000	107,000
2025 - 2026	29,000	0	0	29,597	1,500	45,000	105,000
2026 - 2027	29,000	0	0	34,933	1,500	39,000	104,000
2027 - 2028	29,000	0	0	40,268	1,500	32,000	103,000
2028 - 2029	29,000	0	0	43,725	1,500	26,000	100,000
2029 - 2030	29,000	0	0	43,430	1,500	20,000	94,000
2030 - 2031	29,000	0	0	43,430	1,500	19,000	93,000
2031 - 2032	29,000	0	0	43,430	1,500	18,000	92,000
2032 - 2033	29,000	0	0	43,430	1,500	17,000	91,000
2033 - 2034	29,000	0	0	43,430	1,500	15,000	89,000
2034 - 2035	29,000	0	0	43,430	1,500	14,000	88,000
2035 - 2036	29,000	0	0	43,430	1,500	14,000	88,000
2036 - 2037	29,000	0	0	43,430	1,500	14,000	88,000
2037 - 2038	29,000	0	0	43,430	1,500	14,000	88,000
2038 - 2039	29,000	0	0	43,430	1,500	14,000	88,000
2039 - 2040	29,000	0	0	43,430	1,500	14,000	88,000
2040 - 2041	29,000	0	0	43,430	1,500	14,000	88,000
2041 - 2042	29,000	0	0	43,430	1,500	14,000	88,000
2042 - 2043	29,000	0	0	43,430	1,500	14,000	88,000
2043 - 2044	29,000	0	0	43,430	1,500	14,000	88,000
2044 - 2045	29,000	0	0	43,430	1,500	14,000	88,000
2045 - 2046	29,000	0	0	43,430	1,500	14,000	88,000
2046 - 2047	29,000	0	0	43,430	1,500	14,000	88,000
2047 - 2048	29,000	0	0	43,430	1,500	14,000	88,000
2048 - 2049	29,000	0	0	43,430	1,500	14,000	88,000
2049 - 2050	29,000	0	0	43,430	1,500	14,000	88,000
2050 - 2051	29,000	0	0	43,209	1,500	13,000	87,000
2051 - 2052	29,000	0	0	43,209	1,500	13,000	87,000
2052 - 2053	29,000	0	0	43,209	1,500	13,000	87,000
2053 - 2054	29,000	0	0	43,209	1,500	13,000	87,000
2054 - 2055	29,000	0	0	43,209	1,500	13,000	87,000
2055 - 2056	29,000	0	0	43,209	1,500	13,000	87,000
2056 - 2057	29,000	0	0	43,209	1,500	13,000	87,000
2057 - 2058	29,000	0	0	43,209	1,500	13,000	87,000
2058 - 2059	29,000	0	0	43,209	1,500	13,000	87,000
2059 - 2060	29,000	0	0	43,209	1,500	13,000	87,000
2060 - 2061	29,000	0	0	43,209	1,500	13,000	87,000
2061 - 2062	29,000	0	0	43,209	1,500	13,000	87,000
2062 - 2063	29,000	0	0	43,209	1,500	13,000	87,000
2063 - 2064	29,000	0	0	43,209	1,500	13,000	87,000
2064 - 2065	29,000	0	0	43,209	1,500	13,000	87,000
2065 - 2066	29,000	0	0	43,209	1,500	13,000	87,000
2066 - 2067	29,000	0	0	43,209	1,500	13,000	87,000
2067 - 2068	29,000	0	0	43,209	1,500	13,000	87,000
2068 - 2069	29,000	0	0	45,214	1,500	13,000	89,000
2069 - 2070	29,000	0	0	24,476	1,500	13,000	68,000
17/18-69/70 Avg	29,000	0	0	37,800	1,300	22,000	90,000

Projected Future Tri-County Water Authority GSA Surface Water Budget

	Surface Water Outflow (acre-ft)							
Water Year	Areal Recharge of Precipitation	Recharge in Basins	Deep Percolation of Applied Water		Evapotranspiration			Total Out
		Imported Water	Imported Water	Agricultural Pumping	Precipitation Crops/Native	Imported Water Agricultural Cons. Use	Ag. Cons. Use from Pumping	
2017 - 2018	1,000	0	1,900	12,200	29,000	4,000	50,000	98,000
2018 - 2019	1,000	0	1,900	12,200	29,000	4,000	50,000	98,000
2019 - 2020	1,000	0	2,200	11,900	29,000	5,400	49,000	99,000
2020 - 2021	1,000	0	2,400	11,700	29,000	6,200	48,000	98,000
2021 - 2022	1,000	0	2,600	11,500	29,000	7,000	47,000	98,000
2022 - 2023	1,000	0	2,700	11,300	29,000	7,800	47,000	99,000
2023 - 2024	1,000	0	2,700	11,300	29,000	7,800	47,000	99,000
2024 - 2025	1,000	2,000	3,700	10,100	29,000	12,100	41,000	99,000
2025 - 2026	1,000	2,000	4,700	8,900	29,000	16,500	36,000	98,000
2026 - 2027	1,000	2,000	5,700	7,800	29,000	20,900	31,000	97,000
2027 - 2028	1,000	2,000	6,700	6,600	29,000	25,200	26,000	97,000
2028 - 2029	1,000	2,000	7,600	5,400	29,000	29,600	20,000	95,000
2029 - 2030	1,000	2,000	8,600	4,300	29,000	33,700	15,000	94,000
2030 - 2031	1,000	2,000	8,600	4,100	29,000	33,700	15,000	93,000
2031 - 2032	1,000	2,000	8,600	3,900	29,000	33,700	14,000	92,000
2032 - 2033	1,000	2,000	8,600	3,700	29,000	33,700	13,000	91,000
2033 - 2034	1,000	2,000	8,600	3,500	29,000	33,700	12,000	90,000
2034 - 2035	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2035 - 2036	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2036 - 2037	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2037 - 2038	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2038 - 2039	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2039 - 2040	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2040 - 2041	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2041 - 2042	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2042 - 2043	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2043 - 2044	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2044 - 2045	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2045 - 2046	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2046 - 2047	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2047 - 2048	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2048 - 2049	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2049 - 2050	1,000	2,000	8,600	3,300	29,000	33,700	11,000	89,000
2050 - 2051	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2051 - 2052	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2052 - 2053	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2053 - 2054	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2054 - 2055	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2055 - 2056	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2056 - 2057	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2057 - 2058	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2058 - 2059	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2059 - 2060	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2060 - 2061	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2061 - 2062	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2062 - 2063	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2063 - 2064	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2064 - 2065	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2065 - 2066	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2066 - 2067	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2067 - 2068	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2068 - 2069	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
2069 - 2070	1,000	2,000	8,500	3,000	29,000	33,500	10,000	87,000
17/18-69/70 Avg	1,000	2,000	7,500	4,800	29,000	28,800	18,000	91,000

Appendix E
Table 4

Projected Future Tri-County Water Authority GSA Groundwater Budget

	Groundwater Inflows (acre-ft)								Groundwater Outflows (acre-ft)					
Water Year	Areal Recharge from Precipitation	Imported Water Deliveries		Agricultural Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow		Total In	Groundwater Pumping		Sub-surface Outflow		Total Out	Change in Storage (acre-ft)
		Return Flow	Recharge in Basins	Return Flow		From Outside Subbasin	From Other GSAs		Agricultural	Exports	To Outside Subbasin	To Other GSAs		
2017 - 2018	1,000	1,900	0	12,200	13,000	14,000	99,000	141,000	63,000	11,280	13,000	61,000	148,000	-7,000
2018 - 2019	1,000	1,900	0	12,200	13,000	14,000	96,000	138,000	63,000	11,280	13,000	61,000	148,000	-10,000
2019 - 2020	1,000	2,200	0	11,900	13,000	13,000	96,000	137,000	61,000	11,280	13,000	62,000	147,000	-10,000
2020 - 2021	1,000	2,400	0	11,700	13,000	12,000	94,000	134,000	60,000	11,280	13,000	62,000	146,000	-12,000
2021 - 2022	1,000	2,600	0	11,500	13,000	10,000	93,000	131,000	59,000	11,280	13,000	61,000	144,000	-13,000
2022 - 2023	1,000	2,700	0	11,300	13,000	10,000	91,000	129,000	58,000	11,280	14,000	61,000	144,000	-15,000
2023 - 2024	1,000	2,700	0	11,300	13,000	10,000	92,000	130,000	58,000	11,280	14,000	61,000	144,000	-14,000
2024 - 2025	1,000	3,700	1,500	10,100	12,000	8,000	90,000	126,000	52,000	11,280	15,000	61,000	139,000	-13,000
2025 - 2026	1,000	4,700	1,500	8,900	11,000	8,000	86,000	121,000	45,000	11,280	18,000	60,000	134,000	-13,000
2026 - 2027	1,000	5,700	1,500	7,800	10,000	8,000	84,000	118,000	39,000	11,280	20,000	60,000	130,000	-12,000
2027 - 2028	1,000	6,700	1,500	6,600	10,000	8,000	82,000	116,000	32,000	11,280	22,000	61,000	126,000	-10,000
2028 - 2029	1,000	7,600	1,500	5,400	9,000	8,000	81,000	114,000	26,000	11,280	24,000	62,000	123,000	-9,000
2029 - 2030	1,000	8,600	1,500	4,300	8,000	9,000	82,000	114,000	20,000	11,280	25,000	64,000	120,000	-6,000
2030 - 2031	1,000	8,600	1,500	4,100	8,000	9,000	81,000	113,000	19,000	11,280	25,000	66,000	121,000	-8,000
2031 - 2032	1,000	8,600	1,500	3,900	8,000	9,000	82,000	114,000	18,000	11,280	25,000	67,000	121,000	-7,000
2032 - 2033	1,000	8,600	1,500	3,700	8,000	9,000	82,000	114,000	17,000	11,280	24,000	69,000	121,000	-7,000
2033 - 2034	1,000	8,600	1,500	3,500	7,000	9,000	83,000	114,000	15,000	11,280	23,000	71,000	120,000	-6,000
2034 - 2035	1,000	8,600	1,500	3,300	6,000	9,000	86,000	115,000	14,000	11,280	24,000	72,000	121,000	-6,000
2035 - 2036	1,000	8,600	1,500	3,300	6,000	9,000	85,000	114,000	14,000	11,280	23,000	73,000	121,000	-7,000
2036 - 2037	1,000	8,600	1,500	3,300	6,000	10,000	84,000	114,000	14,000	11,280	22,000	73,000	120,000	-6,000
2037 - 2038	1,000	8,600	1,500	3,300	6,000	10,000	84,000	114,000	14,000	11,280	21,000	74,000	120,000	-6,000
2038 - 2039	1,000	8,600	1,500	3,300	6,000	11,000	83,000	114,000	14,000	11,280	20,000	74,000	119,000	-5,000
2039 - 2040	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	75,000	121,000	-6,000
2040 - 2041	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	74,000	120,000	-5,000
2041 - 2042	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	74,000	120,000	-5,000
2042 - 2043	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	74,000	120,000	-5,000
2043 - 2044	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	74,000	120,000	-5,000
2044 - 2045	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	74,000	120,000	-5,000
2045 - 2046	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	74,000	120,000	-5,000
2046 - 2047	1,000	8,600	1,500	3,300	5,000	11,000	84,000	114,000	14,000	11,280	21,000	74,000	120,000	-6,000
2047 - 2048	1,000	8,600	1,500	3,300	5,000	11,000	85,000	115,000	14,000	11,280	21,000	74,000	120,000	-5,000
2048 - 2049	1,000	8,600	1,500	3,300	4,000	11,000	84,000	113,000	14,000	11,280	21,000	73,000	119,000	-6,000
2049 - 2050	1,000	8,600	1,500	3,300	4,000	11,000	84,000	113,000	14,000	11,280	21,000	73,000	119,000	-6,000
2050 - 2051	1,000	8,500	1,500	3,000	4,000	11,000	83,000	112,000	13,000	11,280	21,000	73,000	118,000	-6,000
2051 - 2052	1,000	8,500	1,500	3,000	4,000	11,000	83,000	112,000	13,000	11,280	21,000	73,000	118,000	-6,000
2052 - 2053	1,000	8,500	1,500	3,000	4,000	11,000	83,000	112,000	13,000	11,280	21,000	72,000	117,000	-5,000
2053 - 2054	1,000	8,500	1,500	3,000	4,000	11,000	82,000	111,000	13,000	11,280	21,000	72,000	117,000	-6,000
2054 - 2055	1,000	8,500	1,500	3,000	4,000	11,000	82,000	111,000	13,000	11,280	20,000	72,000	116,000	-5,000
2055 - 2056	1,000	8,500	1,500	3,000	4,000	11,000	82,000	111,000	13,000	11,280	21,000	72,000	117,000	-6,000
2056 - 2057	1,000	8,500	1,500	3,000	4,000	11,000	82,000	111,000	13,000	11,280	20,000	72,000	116,000	-5,000
2057 - 2058	1,000	8,500	1,500	3,000	4,000	11,000	82,000	111,000	13,000	11,280	20,000	72,000	116,000	-5,000
2058 - 2059	1,000	8,500	1,500	3,000	4,000	11,000	82,000	111,000	13,000	11,280	20,000	72,000	116,000	-5,000
2059 - 2060	1,000	8,500	1,500	3,000	4,000	12,000	82,000	112,000	13,000	11,280	20,000	72,000	116,000	-4,000
2060 - 2061	1,000	8,500	1,500	3,000	4,000	11,000	82,000	111,000	13,000	11,280	20,000	72,000	116,000	-5,000
2061 - 2062	1,000	8,500	1,500	3,000	4,000	12,000	82,000	112,000	13,000	11,280	20,000	71,000	115,000	-3,000
2062 - 2063	1,000	8,500	1,500	3,000	4,000	12,000	82,000	112,000	13,000	11,280	20,000	71,000	115,000	-3,000
2063 - 2064	1,000	8,500	1,500	3,000	4,000	12,000	82,000	112,000	13,000	11,280	20,000	72,000	116,000	-4,000
2064 - 2065	1,000	8,500	1,500	3,000	4,000	12,000	81,000	111,000	13,000	11,280	20,000	71,000	115,000	-4,000
2065 - 2066	1,000	8,500	1,500	3,000	4,000	12,000	81,000	111,000	13,000	11,280	20,000	71,000	115,000	-4,000
2066 - 2067	1,000	8,500	1,500	3,000	4,000	12,000	81,000	111,000	13,000	11,280	20,000	71,000	115,000	-4,000
2067 - 2068	1,000	8,500	1,500	3,000	4,000	12,000	81,000	111,000	13,000	11,280	20,000	71,000	115,000	-4,000
2068 - 2069	1,000	8,500	1,500	3,000	4,000	12,000	81,000	111,000	13,000	11,280	19,000	71,000	114,000	-3,000
2069 - 2070	1,000	8,500	1,500	3,000	4,000	12,000	81,000	111,000	13,000	11,280	19,000	71,000	114,000	-3,000
17/18-69/70 Avg	1,000	7,500	1,300	4,800	7,000	11,000	85,000	118,000	22,000	11,300	20,000	69,000	122,000	-4,000

Tri-County Water Authority GSA
Land Surface Elevations at Representative Monitoring Sites

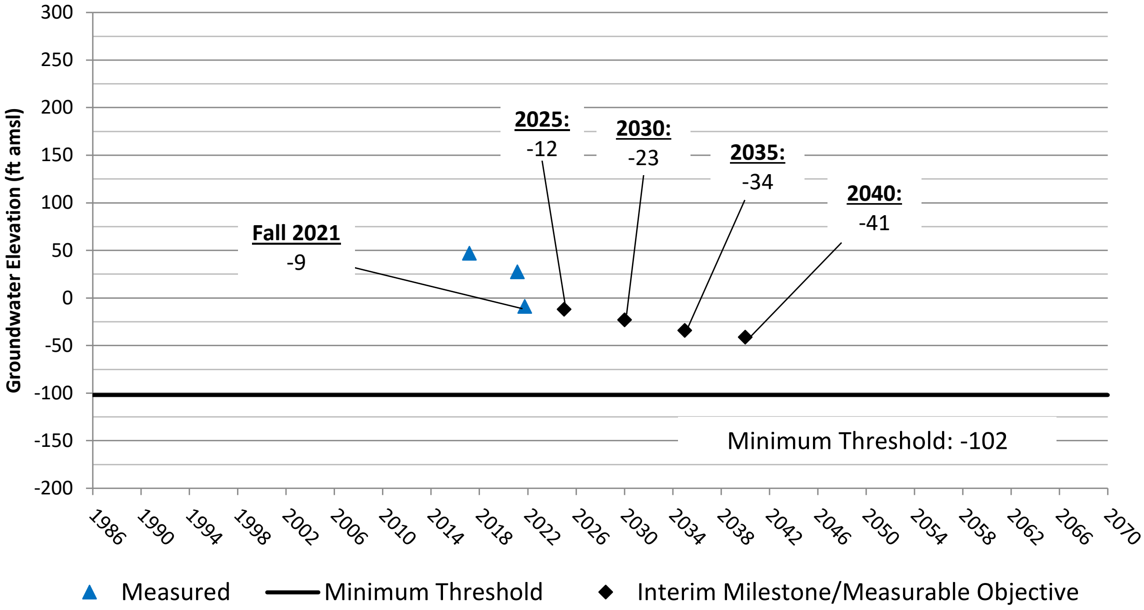
Site	Land Surface Elevation (ft amsl)[1]			
	2020 (Baseline)	2021	Measurable Objective	Minimum Threshold
T0014_B_RMS	219.4	219.0	212.6	211.6
T0015_B_RMS	217.1	216.8	211.3	210.3
T0016_B_RMS	201.3	200.9	195.4	194.4
T0021_B_RMS	183.0	182.4	175.1	174.1

Note:

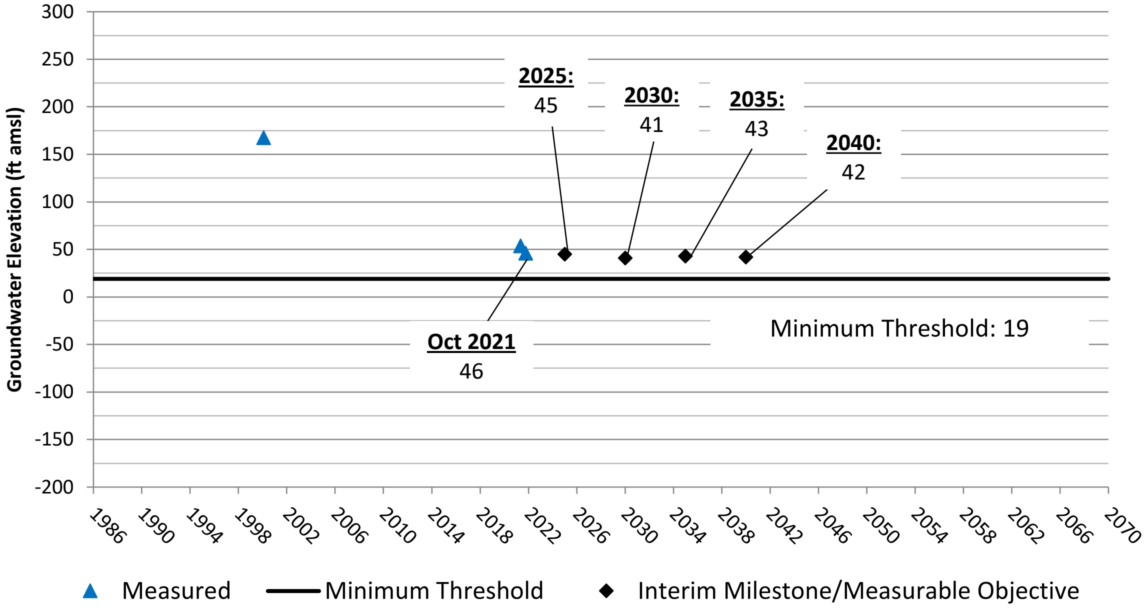
[1] Benchmarks surveyed in July and August of each year.

Tri-County Water Authority GSA
RMS Groundwater Elevation Hydrographs

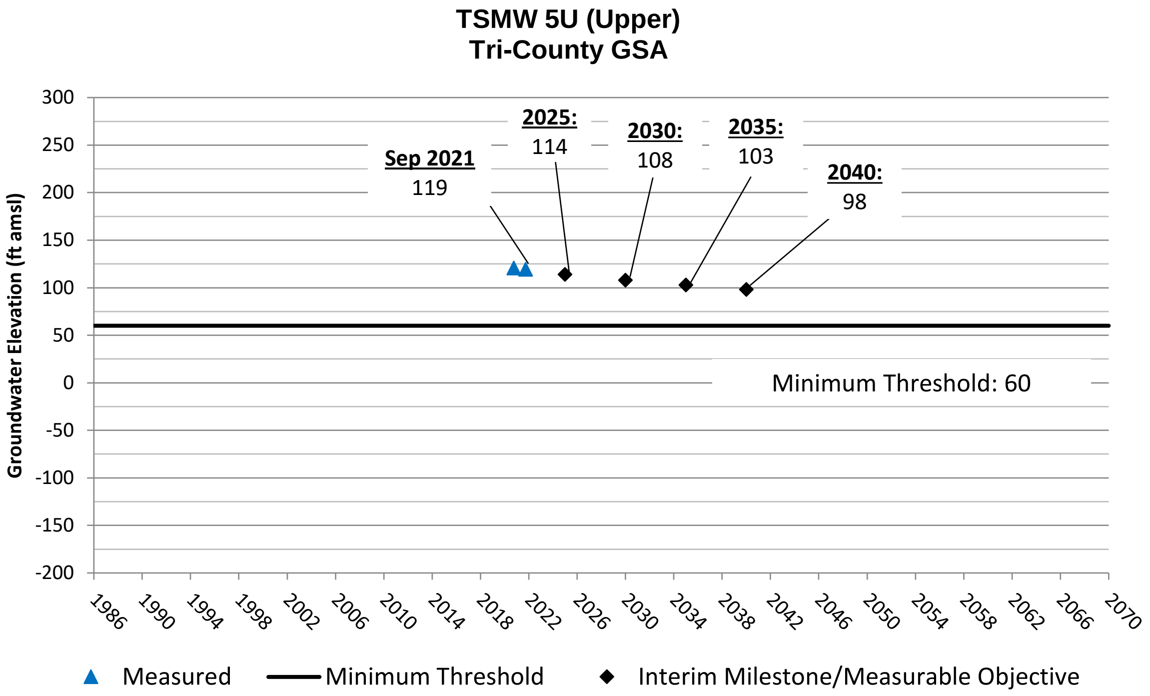
22S/23E-25C01 (E20) (Upper)
Tri-County GSA

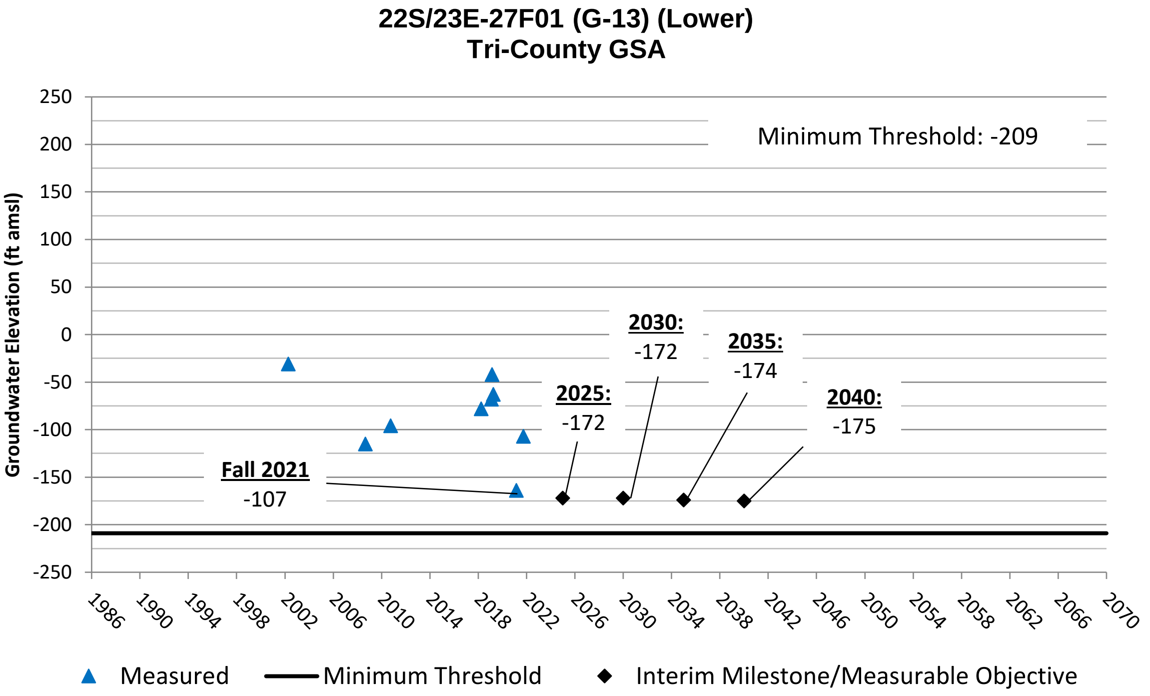


24S/23E-22E01 (Upper)
Tri-County GSA



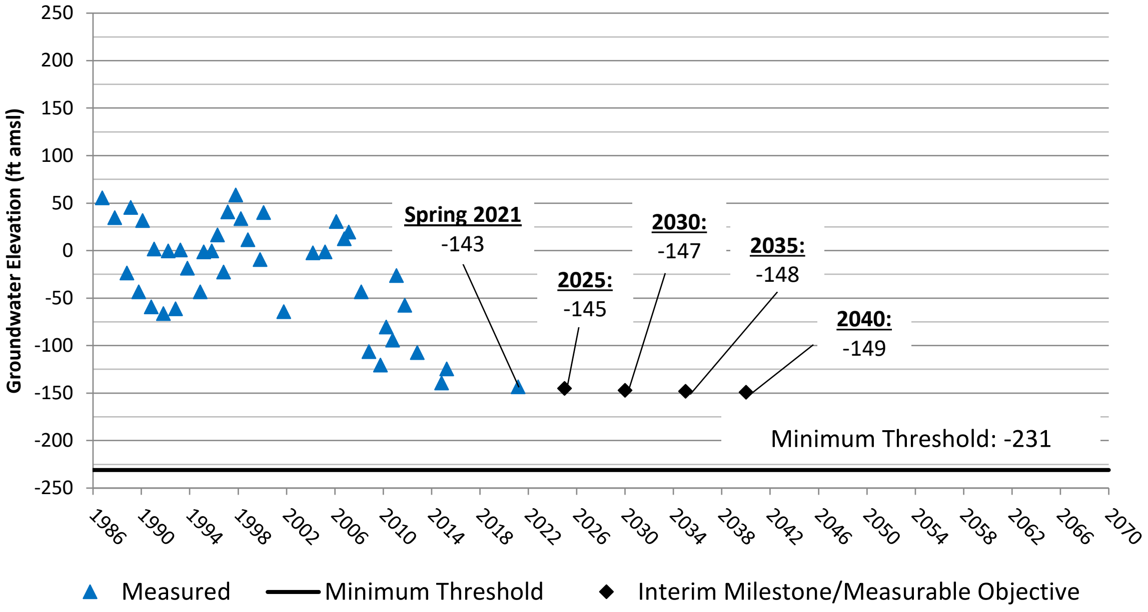
Tri-County Water Authority GSA
RMS Groundwater Elevation Hydrographs



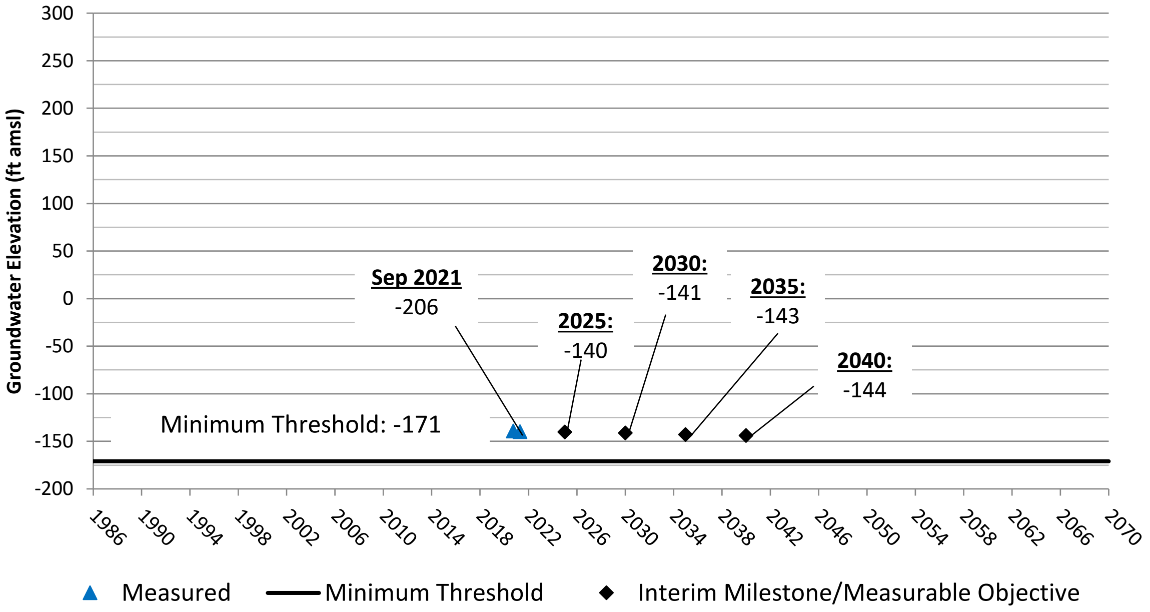


Tri-County Water Authority GSA
RMS Groundwater Elevation Hydrographs

24S/23E-22R02 (Lower)
Tri-County GSA



TSMW 5L (Lower)
Tri-County GSA



Appendix F

Alpaugh Irrigation District GSA

Water Budgets, Land Surface Elevations at Representative Monitoring Sites, and RMS Groundwater Elevation Hydrographs

Appendix F
Table 1a

Alpaugh GSA
Historical Surface Water Budget 1986/87 to 2016/17

	Surface Water Inflow (acre-ft)					
Water Year	Precipitation	Imported Water		Discharge from Wells		Total In
		Alpaugh ID	Atwell Island WD	Agricultural	Municipal	
1986 - 1987	5,000	748	397	35,000	200	41,000
1987 - 1988	7,000	0	0	36,000	200	43,000
1988 - 1989	6,000	0	0	36,000	200	42,000
1989 - 1990	6,000	0	0	36,000	200	42,000
1990 - 1991	7,000	0	0	36,000	200	43,000
1991 - 1992	6,000	0	0	36,000	200	42,000
1992 - 1993	10,000	11,519	2,302	22,000	200	46,000
1993 - 1994	7,000	3,398	717	32,000	200	43,000
1994 - 1995	14,000	7,790	1,934	26,000	200	50,000
1995 - 1996	7,000	10,493	1,888	21,000	200	41,000
1996 - 1997	10,000	0	0	33,000	200	43,000
1997 - 1998	16,000	0	0	33,000	200	49,000
1998 - 1999	8,000	0	0	33,000	200	41,000
1999 - 2000	8,000	0	91	33,000	200	41,000
2000 - 2001	6,000	0	0	33,000	200	39,000
2001 - 2002	6,000	0	0	33,000	200	39,000
2002 - 2003	6,000	98	0	33,000	200	39,000
2003 - 2004	5,000	0	0	30,000	200	35,000
2004 - 2005	9,000	13,660	0	17,000	300	40,000
2005 - 2006	9,000	15,189	0	16,000	300	40,000
2006 - 2007	4,000	0	0	30,000	300	34,000
2007 - 2008	4,000	0	0	30,000	300	34,000
2008 - 2009	5,000	2,009	0	28,000	300	35,000
2009 - 2010	7,000	2,518	0	27,000	300	37,000
2010 - 2011	11,000	10,324	0	10,000	300	32,000
2011 - 2012	7,000	889	0	18,000	300	26,000
2012 - 2013	3,000	0	0	19,000	300	22,000
2013 - 2014	2,000	0	0	19,000	300	21,000
2014 - 2015	3,000	0	0	19,000	300	22,000
2015 - 2016	5,000	0	0	19,000	300	24,000
2016 - 2017	5,000	2,232	0	16,000	300	24,000
86/87-16/17 Avg	7,000	2,600	200	27,000	200	37,000

Appendix F
Table 1b

Alpaugh GSA
Historical Surface Water Budget 1986/87 to 2016/17

Water Year	Surface Water Outflow (acre-ft)								Total Out
	Areal Recharge of Precip-itation	Deep Percolation of Applied			Evapotranspiration				
		Imported Water	Agri-cultural Pumping	Municipal Pumping	Precipitation Crops/Native	Imported Water Agricultural Cons. Use	Ag. Cons. Use from Pumping	Municipal (Landscape ET)	
1986 - 1987	0	300	8,600	100	5,000	900	26,000	100	41,000
1987 - 1988	0	0	8,900	100	7,000	0	27,000	100	43,000
1988 - 1989	0	0	8,900	100	6,000	0	27,000	100	42,000
1989 - 1990	0	0	8,900	100	6,000	0	27,000	100	42,000
1990 - 1991	0	0	8,900	100	7,000	0	27,000	100	43,000
1991 - 1992	0	0	8,900	100	6,000	0	27,000	100	42,000
1992 - 1993	0	3,500	5,500	100	10,000	10,400	16,000	100	46,000
1993 - 1994	0	1,000	7,900	100	7,000	3,100	24,000	100	43,000
1994 - 1995	1,000	2,400	6,500	100	12,000	7,300	20,000	100	49,000
1995 - 1996	0	3,100	5,300	100	7,000	9,300	16,000	100	41,000
1996 - 1997	0	0	8,400	100	10,000	0	25,000	100	44,000
1997 - 1998	3,000	0	8,400	100	13,000	0	25,000	100	50,000
1998 - 1999	0	0	8,400	100	8,000	0	25,000	100	42,000
1999 - 2000	0	0	8,300	100	8,000	100	25,000	100	42,000
2000 - 2001	0	0	8,400	100	6,000	0	25,000	100	40,000
2001 - 2002	0	0	8,400	100	6,000	0	25,000	100	40,000
2002 - 2003	0	0	7,500	200	6,000	100	25,000	100	39,000
2003 - 2004	0	0	6,900	200	5,000	0	23,000	100	35,000
2004 - 2005	0	3,700	3,900	200	9,000	10,000	13,000	100	40,000
2005 - 2006	0	4,700	3,700	200	9,000	10,500	13,000	100	41,000
2006 - 2007	0	0	6,800	200	4,000	0	23,000	100	34,000
2007 - 2008	0	0	6,800	200	4,000	0	23,000	100	34,000
2008 - 2009	0	500	6,400	200	5,000	1,500	21,000	100	35,000
2009 - 2010	0	600	6,200	200	7,000	1,900	21,000	100	37,000
2010 - 2011	0	3,100	2,400	200	11,000	7,200	8,000	100	32,000
2011 - 2012	0	400	4,100	200	7,000	500	14,000	100	26,000
2012 - 2013	0	0	4,200	200	3,000	0	14,000	100	22,000
2013 - 2014	0	0	4,200	200	2,000	0	14,000	100	21,000
2014 - 2015	0	0	4,200	200	3,000	0	14,000	100	22,000
2015 - 2016	0	0	4,200	200	5,000	0	14,000	100	24,000
2016 - 2017	0	500	3,700	200	5,000	1,700	13,000	100	24,000
86/87-16/17 Avg	0	800	6,600	100	7,000	2,100	21,000	100	38,000

🟦	Groundwater Inflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Surface Water or ET Outflows Not Included in Groundwater Recharge or Sustainable Yield Estimates

Alpaugh GSA
Historical Groundwater Budget 1986/87 to 2016/17

Water Year	Groundwater Inflows (acre-ft)							Total In	Groundwater Outflows (acre-ft)				Total Out	Change in Storage (acre-ft)
	Areal Recharge from Precipitation	Imported Water Deliveries	Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow			Groundwater Pumping		Sub-surface Outflow			
		Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Municipal	Agricultural	To Outside Subbasin	To Other GSAs		
1986 - 1987	0	300	8,600	100	3,000	10,000	32,000	54,000	200	35,000	2,000	12,000	49,000	5,000
1987 - 1988	0	0	8,900	100	3,000	9,000	35,000	56,000	200	36,000	2,000	14,000	52,000	4,000
1988 - 1989	0	0	8,900	100	3,000	9,000	38,000	59,000	200	36,000	2,000	15,000	53,000	6,000
1989 - 1990	0	0	8,900	100	3,000	9,000	35,000	56,000	200	36,000	2,000	15,000	53,000	3,000
1990 - 1991	0	0	8,900	100	4,000	10,000	36,000	59,000	200	36,000	2,000	17,000	55,000	4,000
1991 - 1992	0	0	8,900	100	4,000	8,000	40,000	61,000	200	36,000	3,000	18,000	57,000	4,000
1992 - 1993	0	3,500	5,500	100	2,000	5,000	36,000	52,000	200	22,000	5,000	22,000	49,000	3,000
1993 - 1994	0	1,000	7,900	100	3,000	8,000	37,000	57,000	200	32,000	3,000	20,000	55,000	2,000
1994 - 1995	1,000	2,400	6,500	100	2,000	8,000	32,000	52,000	200	26,000	3,000	20,000	49,000	3,000
1995 - 1996	0	3,100	5,300	100	1,000	10,000	29,000	49,000	200	21,000	2,000	23,000	46,000	3,000
1996 - 1997	0	0	8,400	100	1,000	14,000	36,000	60,000	200	33,000	2,000	24,000	59,000	1,000
1997 - 1998	3,000	0	8,400	100	1,000	15,000	38,000	66,000	200	33,000	2,000	26,000	61,000	5,000
1998 - 1999	0	0	8,400	100	1,000	13,000	38,000	61,000	200	33,000	2,000	24,000	59,000	2,000
1999 - 2000	0	0	8,300	100	1,000	13,000	38,000	60,000	200	33,000	2,000	24,000	59,000	1,000
2000 - 2001	0	0	8,400	100	2,000	11,000	40,000	62,000	200	33,000	3,000	24,000	60,000	2,000
2001 - 2002	0	0	8,400	100	2,000	9,000	41,000	61,000	200	33,000	3,000	25,000	61,000	0
2002 - 2003	0	0	7,500	200	2,000	9,000	40,000	59,000	200	33,000	3,000	24,000	60,000	-1,000
2003 - 2004	0	0	6,900	200	2,000	11,000	33,000	53,000	200	30,000	2,000	21,000	53,000	0
2004 - 2005	0	3,700	3,900	200	0	11,000	26,000	45,000	300	17,000	2,000	26,000	45,000	0
2005 - 2006	0	4,700	3,700	200	0	11,000	25,000	45,000	300	16,000	2,000	25,000	43,000	2,000
2006 - 2007	0	0	6,800	200	1,000	14,000	29,000	51,000	300	30,000	1,000	21,000	52,000	-1,000
2007 - 2008	0	0	6,800	200	3,000	7,000	38,000	55,000	300	30,000	3,000	24,000	57,000	-2,000
2008 - 2009	0	500	6,400	200	4,000	5,000	42,000	58,000	300	28,000	6,000	26,000	60,000	-2,000
2009 - 2010	0	600	6,200	200	3,000	6,000	45,000	61,000	300	27,000	6,000	28,000	61,000	0
2010 - 2011	0	3,100	2,400	200	2,000	8,000	33,000	49,000	300	10,000	6,000	31,000	47,000	2,000
2011 - 2012	0	400	4,100	200	3,000	8,000	32,000	48,000	300	18,000	6,000	26,000	50,000	-2,000
2012 - 2013	0	0	4,200	200	3,000	6,000	33,000	46,000	300	19,000	6,000	24,000	49,000	-3,000
2013 - 2014	0	0	4,200	200	4,000	5,000	32,000	45,000	300	19,000	6,000	23,000	48,000	-3,000
2014 - 2015	0	0	4,200	200	4,000	5,000	31,000	44,000	300	19,000	6,000	23,000	48,000	-4,000
2015 - 2016	0	0	4,200	200	3,000	6,000	33,000	46,000	300	19,000	5,000	25,000	49,000	-3,000
2016 - 2017	0	500	3,700	200	2,000	8,000	37,000	51,000	300	16,000	6,000	29,000	51,000	0
36/87-16/17 Avg	0	800	6,600	100	2,000	9,000	35,000	54,000	200	27,000	3,000	23,000	53,000	1,000
												Cumulative Change in Storage		31,000

🟦	Groundwater Inflows or Outflows to be Included in Sustainable Yield Estimates
🟪	Groundwater Inflows to be Excluded from the Sustainable Yield Estimates
🟨	Groundwater Outflows Not Included in Sustainable Yield Estimates

Appendix F
Table 3a

Projected Future Alpaugh GSA Surface Water Budget

Water Year	Surface Water Inflow (acre-ft)						Total In
	Precipitation	Stream Inflow	Imported Water		Discharge from Wells		
		Deer Creek	Alpaugh ID	Atwell Island WD	Agricultural	Municipal	
2017 - 2018	7,000	280	3,680	0	15,000	300	26,000
2018 - 2019	7,000	280	3,680	0	15,000	300	26,000
2019 - 2020	7,000	280	3,680	0	15,000	300	26,000
2020 - 2021	7,000	280	3,680	0	15,000	300	26,000
2021 - 2022	7,000	280	3,680	0	14,000	300	25,000
2022 - 2023	7,000	280	3,680	0	14,000	300	25,000
2023 - 2024	7,000	280	3,680	0	13,000	300	24,000
2024 - 2025	7,000	280	3,680	0	13,000	300	24,000
2025 - 2026	7,000	1,380	4,813	0	10,000	300	23,000
2026 - 2027	7,000	1,380	4,751	0	10,000	300	23,000
2027 - 2028	7,000	1,380	4,689	0	10,000	300	23,000
2028 - 2029	7,000	1,380	4,627	0	9,000	300	22,000
2029 - 2030	7,000	1,380	4,565	0	9,000	300	22,000
2030 - 2031	7,000	1,380	5,737	0	8,000	300	22,000
2031 - 2032	7,000	1,380	5,737	0	8,000	300	22,000
2032 - 2033	7,000	1,380	5,737	0	8,000	300	22,000
2033 - 2034	7,000	1,380	5,737	0	8,000	300	22,000
2034 - 2035	7,000	1,380	5,737	0	8,000	300	22,000
2035 - 2036	7,000	1,380	6,970	0	7,000	300	23,000
2036 - 2037	7,000	1,380	6,970	0	7,000	300	23,000
2037 - 2038	7,000	1,380	6,970	0	7,000	300	23,000
2038 - 2039	7,000	1,380	6,970	0	7,000	300	23,000
2039 - 2040	7,000	1,380	6,970	0	7,000	300	23,000
2040 - 2041	7,000	1,380	7,793	0	6,000	300	22,000
2041 - 2042	7,000	1,380	7,793	0	6,000	300	22,000
2042 - 2043	7,000	1,380	7,793	0	6,000	300	22,000
2043 - 2044	7,000	1,380	7,793	0	6,000	300	22,000
2044 - 2045	7,000	1,380	7,793	0	6,000	300	22,000
2045 - 2046	7,000	1,380	7,793	0	6,000	300	22,000
2046 - 2047	7,000	1,380	7,793	0	6,000	300	22,000
2047 - 2048	7,000	1,380	7,793	0	6,000	300	22,000
2048 - 2049	7,000	1,380	7,793	0	6,000	300	22,000
2049 - 2050	7,000	1,380	7,793	0	6,000	300	22,000
2050 - 2051	7,000	1,380	7,793	0	6,000	300	22,000
2051 - 2052	7,000	1,380	7,793	0	6,000	300	22,000
2052 - 2053	7,000	1,380	7,793	0	6,000	300	22,000
2053 - 2054	7,000	1,380	7,793	0	6,000	300	22,000
2054 - 2055	7,000	1,380	7,793	0	6,000	300	22,000
2055 - 2056	7,000	1,380	7,793	0	6,000	300	22,000
2056 - 2057	7,000	1,380	7,793	0	6,000	300	22,000
2057 - 2058	7,000	1,380	7,793	0	6,000	300	22,000
2058 - 2059	7,000	1,380	7,793	0	6,000	300	22,000
2059 - 2060	7,000	1,380	7,793	0	6,000	300	22,000
2060 - 2061	7,000	1,380	7,793	0	6,000	300	22,000
2061 - 2062	7,000	1,380	7,793	0	6,000	300	22,000
2062 - 2063	7,000	1,380	7,793	0	6,000	300	22,000
2063 - 2064	7,000	1,380	7,793	0	6,000	300	22,000
2064 - 2065	7,000	1,380	7,793	0	6,000	300	22,000
2065 - 2066	7,000	1,380	7,793	0	6,000	300	22,000
2066 - 2067	7,000	1,380	7,793	0	6,000	300	22,000
2067 - 2068	7,000	1,380	7,793	0	6,000	300	22,000
2068 - 2069	7,000	1,380	7,793	0	6,000	300	22,000
2069 - 2070	7,000	1,380	7,793	0	6,000	300	22,000
17/18-69/70 Avg	7,000	1,200	6,600	0	8,000	300	23,000

Projected Future Alpaugh GSA Surface Water Budget

	Surface Water Outflow (acre-ft)										
		Deep Percolation of Applied Water				Evapotranspiration					
Water Year	Areal Recharge of Precip-itation	Imported Water	Deer Creek	Agri-cultural Pumping	Municipal Pumping	Precipitation Crops/Native	Imported Water	Deer Creek	Ag. Cons. Use from Pumping	Municipal (Landscape ET)	Total Out
							Agricultural Cons. Use				
2017 - 2018	0	800	100	3,300	200	7,000	2,800	200	11,000	100	26,000
2018 - 2019	0	800	100	3,300	200	7,000	2,800	200	11,000	100	26,000
2019 - 2020	0	800	100	3,300	200	7,000	2,800	200	11,000	100	26,000
2020 - 2021	0	800	100	3,300	200	7,000	2,800	200	11,000	100	26,000
2021 - 2022	0	800	100	3,200	200	7,000	2,800	200	11,000	100	25,000
2022 - 2023	0	800	100	3,200	200	7,000	2,800	200	11,000	100	25,000
2023 - 2024	0	800	100	3,100	200	7,000	2,800	200	10,000	100	24,000
2024 - 2025	0	800	100	3,000	200	7,000	2,800	200	10,000	100	24,000
2025 - 2026	0	1,100	300	2,400	200	7,000	3,700	1,100	8,000	100	24,000
2026 - 2027	0	1,100	300	2,300	200	7,000	3,700	1,100	8,000	100	24,000
2027 - 2028	0	1,100	300	2,200	200	7,000	3,600	1,100	7,000	100	23,000
2028 - 2029	0	1,100	300	2,100	200	7,000	3,600	1,100	7,000	100	23,000
2029 - 2030	0	1,000	300	2,100	200	7,000	3,500	1,100	7,000	100	22,000
2030 - 2031	0	1,300	300	1,800	200	7,000	4,400	1,100	6,000	100	22,000
2031 - 2032	0	1,300	300	1,800	200	7,000	4,400	1,100	6,000	100	22,000
2032 - 2033	0	1,300	300	1,800	200	7,000	4,400	1,100	6,000	100	22,000
2033 - 2034	0	1,300	300	1,800	200	7,000	4,400	1,100	6,000	100	22,000
2034 - 2035	0	1,300	300	1,800	200	7,000	4,400	1,100	6,000	100	22,000
2035 - 2036	0	1,600	300	1,500	200	7,000	5,400	1,100	5,000	100	22,000
2036 - 2037	0	1,600	300	1,500	200	7,000	5,400	1,100	5,000	100	22,000
2037 - 2038	0	1,600	300	1,500	200	7,000	5,400	1,100	5,000	100	22,000
2038 - 2039	0	1,600	300	1,500	200	7,000	5,400	1,100	5,000	100	22,000
2039 - 2040	0	1,600	300	1,500	200	7,000	5,400	1,100	5,000	100	22,000
2040 - 2041	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2041 - 2042	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2042 - 2043	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2043 - 2044	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2044 - 2045	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2045 - 2046	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2046 - 2047	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2047 - 2048	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2048 - 2049	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2049 - 2050	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2050 - 2051	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2051 - 2052	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2052 - 2053	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2053 - 2054	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2054 - 2055	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2055 - 2056	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2056 - 2057	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2057 - 2058	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2058 - 2059	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2059 - 2060	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2060 - 2061	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2061 - 2062	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2062 - 2063	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2063 - 2064	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2064 - 2065	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2065 - 2066	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2066 - 2067	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2067 - 2068	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2068 - 2069	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
2069 - 2070	0	1,800	300	1,400	200	7,000	6,000	1,100	5,000	100	23,000
17/18-69/70 Avg	0	1,500	300	1,800	200	7,000	5,100	1,000	6,000	100	23,000

Projected Future Alpaugh GSA Groundwater Budget

Water Year	Groundwater Inflows (acre-ft)								Total In	Groundwater Outflows (acre-ft)				Total Out	Change in Storage (acre-ft)
	Areal Recharge from Precipitation	Imported Water Deliveries	Deer Creek	Agricultural Pumping	Municipal Pumping	Release of Water from Compression of Aquitards	Sub-surface Inflow			Groundwater Pumping		Sub-surface Outflow			
		Return Flow	Return Flow	Return Flow	Return Flow		From Outside Subbasin	From Other GSAs		Municipal	Agricultural	To Outside Subbasin	To Other GSAs		
2017 - 2018	0	800	100	3,300	200	3,000	5,000	29,000	41,000	300	15,000	3,000	25,000	43,000	-2,000
2018 - 2019	0	800	100	3,300	200	3,000	4,000	29,000	40,000	300	15,000	4,000	24,000	43,000	-3,000
2019 - 2020	0	800	100	3,300	200	3,000	4,000	28,000	39,000	300	15,000	4,000	23,000	42,000	-3,000
2020 - 2021	0	800	100	3,300	200	3,000	3,000	28,000	38,000	300	15,000	4,000	22,000	41,000	-3,000
2021 - 2022	0	800	100	3,200	200	3,000	3,000	27,000	37,000	300	14,000	4,000	21,000	39,000	-2,000
2022 - 2023	0	800	100	3,200	200	3,000	3,000	27,000	37,000	300	14,000	5,000	21,000	40,000	-3,000
2023 - 2024	0	800	100	3,100	200	3,000	2,000	27,000	36,000	300	13,000	5,000	20,000	38,000	-2,000
2024 - 2025	0	800	100	3,000	200	3,000	2,000	27,000	36,000	300	13,000	5,000	20,000	38,000	-2,000
2025 - 2026	0	1,100	300	2,400	200	3,000	2,000	25,000	34,000	300	10,000	6,000	19,000	35,000	-1,000
2026 - 2027	0	1,100	300	2,300	200	3,000	2,000	26,000	35,000	300	10,000	7,000	19,000	36,000	-1,000
2027 - 2028	0	1,100	300	2,200	200	3,000	2,000	26,000	35,000	300	10,000	8,000	19,000	37,000	-2,000
2028 - 2029	0	1,100	300	2,100	200	3,000	2,000	27,000	36,000	300	9,000	8,000	19,000	36,000	0
2029 - 2030	0	1,000	300	2,100	200	3,000	2,000	30,000	39,000	300	9,000	9,000	20,000	38,000	1,000
2030 - 2031	0	1,300	300	1,800	200	2,000	2,000	30,000	38,000	300	8,000	10,000	21,000	39,000	-1,000
2031 - 2032	0	1,300	300	1,800	200	2,000	2,000	32,000	40,000	300	8,000	10,000	22,000	40,000	0
2032 - 2033	0	1,300	300	1,800	200	2,000	2,000	33,000	41,000	300	8,000	11,000	23,000	42,000	-1,000
2033 - 2034	0	1,300	300	1,800	200	2,000	2,000	35,000	43,000	300	8,000	11,000	24,000	43,000	0
2034 - 2035	0	1,300	300	1,800	200	2,000	2,000	36,000	44,000	300	8,000	12,000	24,000	44,000	0
2035 - 2036	0	1,600	300	1,500	200	2,000	2,000	37,000	45,000	300	7,000	12,000	25,000	44,000	1,000
2036 - 2037	0	1,600	300	1,500	200	2,000	2,000	37,000	45,000	300	7,000	12,000	26,000	45,000	0
2037 - 2038	0	1,600	300	1,500	200	2,000	2,000	38,000	46,000	300	7,000	13,000	26,000	46,000	0
2038 - 2039	0	1,600	300	1,500	200	2,000	2,000	38,000	46,000	300	7,000	13,000	26,000	46,000	0
2039 - 2040	0	1,600	300	1,500	200	1,000	2,000	39,000	46,000	300	7,000	13,000	26,000	46,000	0
2040 - 2041	0	1,800	300	1,400	200	1,000	2,000	39,000	46,000	300	6,000	13,000	27,000	46,000	0
2041 - 2042	0	1,800	300	1,400	200	1,000	2,000	39,000	46,000	300	6,000	13,000	27,000	46,000	0
2042 - 2043	0	1,800	300	1,400	200	1,000	2,000	39,000	46,000	300	6,000	13,000	26,000	45,000	1,000
2043 - 2044	0	1,800	300	1,400	200	1,000	2,000	39,000	46,000	300	6,000	13,000	27,000	46,000	0
2044 - 2045	0	1,800	300	1,400	200	1,000	2,000	39,000	46,000	300	6,000	13,000	26,000	45,000	1,000
2045 - 2046	0	1,800	300	1,400	200	1,000	1,000	39,000	45,000	300	6,000	13,000	26,000	45,000	0
2046 - 2047	0	1,800	300	1,400	200	1,000	1,000	39,000	45,000	300	6,000	13,000	26,000	45,000	0
2047 - 2048	0	1,800	300	1,400	200	1,000	1,000	39,000	45,000	300	6,000	13,000	26,000	45,000	0
2048 - 2049	0	1,800	300	1,400	200	1,000	1,000	39,000	45,000	300	6,000	13,000	26,000	45,000	0
2049 - 2050	0	1,800	300	1,400	200	1,000	1,000	39,000	45,000	300	6,000	13,000	26,000	45,000	0
2050 - 2051	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	26,000	45,000	-1,000
2051 - 2052	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	26,000	45,000	-1,000
2052 - 2053	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	26,000	45,000	-1,000
2053 - 2054	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	26,000	45,000	-1,000
2054 - 2055	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	26,000	45,000	-1,000
2055 - 2056	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	26,000	45,000	-1,000
2056 - 2057	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2057 - 2058	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2058 - 2059	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2059 - 2060	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2060 - 2061	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2061 - 2062	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2062 - 2063	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2063 - 2064	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2064 - 2065	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2065 - 2066	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2066 - 2067	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2067 - 2068	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2068 - 2069	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
2069 - 2070	0	1,800	300	1,400	200	1,000	1,000	38,000	44,000	300	6,000	13,000	25,000	44,000	0
17/18-69/70 Avg	0	1,500	300	1,800	200	2,000	2,000	35,000	43,000	300	8,000	11,000	24,000	43,000	0

Alpaugh Irrigation District GSA
Land Surface Elevations at Representative Monitoring Sites

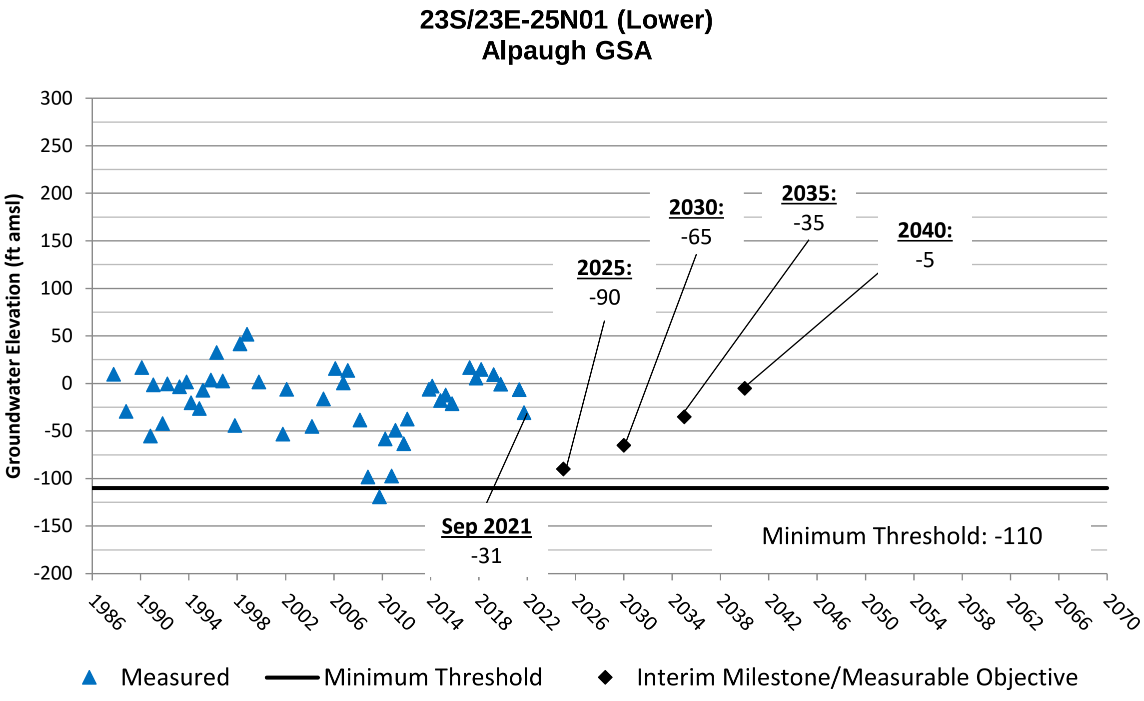
Site	Land Surface Elevation (ft amsl)[1]			
	2020 (Baseline)	2021	Measurable Objective	Minimum Threshold
A0013_B_RMS	196.814	196.338	189.645	187.876
A0017_B_RMS	204.396	204.137	199.110	197.996
A0018_B_RMS	196.141	195.977	192.203	191.153
A0019_B_RMS	192.326	191.857	186.921	185.921
A0020_B_RMS	195.065	191.08	189.463	188.463
A0092_B_RMS	N/A	200.37	N/A	N/A

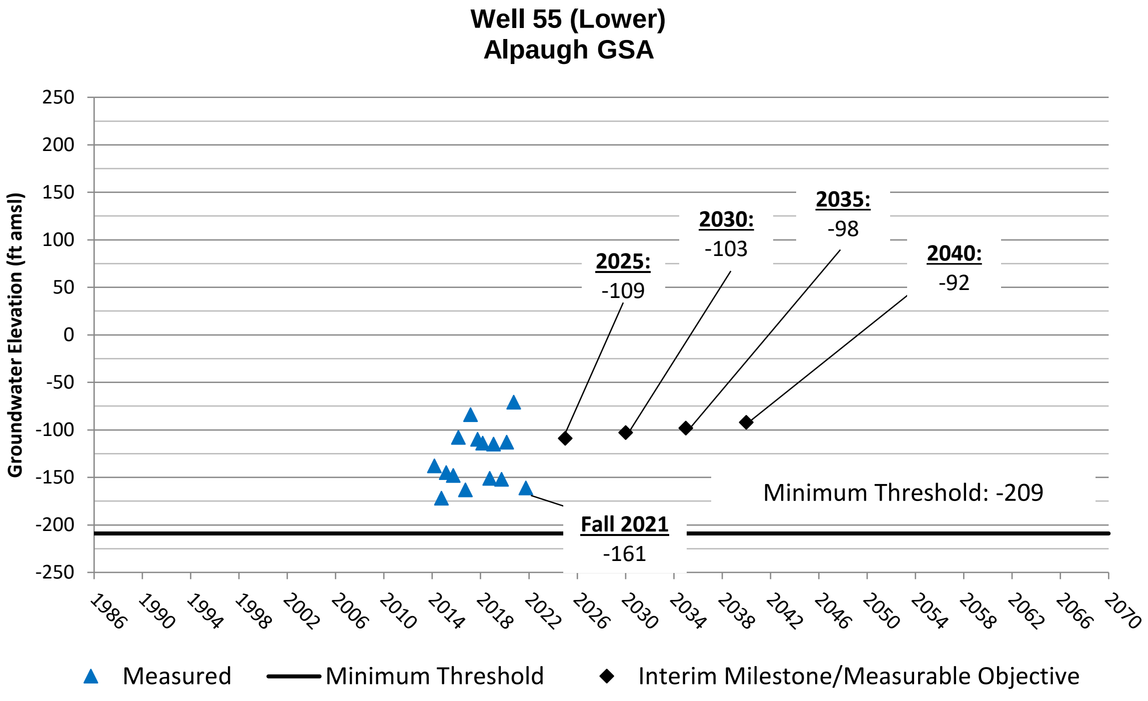
Notes:

N/A = Not available

[1] Benchmarks surveyed in July and August of each year.

Alpaugh Irrigation District GSA
RMS Groundwater Elevation Hydrographs





Groundwater Flow Model of the Tule Subbasin

January 2020

Prepared for

Tule Subbasin MOU Group

CERTIFIED HYDROGEOLOGIST • STATE OF CALIFORNIA
THOMAS E. HARDER
No: 588

Prepared by

Thomas Harder

Thomas Harder, PG, CHG
Principal Hydrogeologist

Benjamin Lewis, PG, CHG
Senior Hydrogeologist

CERTIFIED HYDROGEOLOGIST • STATE OF CALIFORNIA
BENJAMIN TRENT LEWIS
No: 1047

Jim Van de Water

Jim Van de Water, PG, CHG
Principal Hydrogeologist

CERTIFIED HYDROGEOLOGIST • STATE OF CALIFORNIA
JAMES VAN DE WATER
No: 508

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Acronyms

AFY – Acre-ft per year

ASTM – American Society for Testing and Materials

AWD – Angiola Water District

BGS - Below Ground Surface

BMP – Best Management Practices

CASGEM – California Statewide Groundwater Elevation Monitoring

CDWR – Department of Water Resources (California)

CGS – California Geological Survey

CHB - Constant Head Boundary

CIMIS – California Irrigation Management Information System

DCTRA- Deer Creek and Tule River Authority

DEID – Delano-Earlimart Irrigation District

DEM – Digital Elevation Model

DOGGR – California Division of Oil, Gas and Geothermal Resources

ET- Evapotranspiration

ET_o – Reference Evapotranspiration

FMP – Farm Process Package of MODFLOW

FWA – Friant Water Authority

GFM – Tule Subbasin Groundwater Flow Model

GIS – Geographic Information System

GPM - Gallons per Minute

GPS – Global Positioning System

GSA – Groundwater Sustainability Agency

GSP – Groundwater Sustainability Plan

InSAR – Interferometric Synthetic Aperture Radar

ITRC – Irrigation Training and Research Center

JPL – Jet Propulsion Laboratory

KTWD – Kern-Tulare Water District

LPF – Layer Property Flow Package of MODFLOW

LTRID – Lower Tule River Irrigation District

MNWD2 – Multi-Node Well Package of Modflow

MOU – Memorandum of Understanding

NASA – National Aeronautics and Space Administration

NRMSE – Normalized Root Mean Squared Error

RMS - Root Mean Squared

SGMA – Sustainable Groundwater Management Act

SUB – Land Subsidence Simulation Package of MODFLOW

SWP – State Water Project

TAC – Tule Subbasin Technical Advisory Committee

TH&Co - Thomas Harder & Company

TRA – Tule River Association

USBR – United States Bureau of Reclamation

USGS – United States Geological Survey

UWMP - Urban Water Management Plan

WBA – Water Budget Area

1.0 Introduction

1.1 Background

In order to assist in groundwater basin management planning and inform the preparation of Groundwater Sustainability Plans (GSPs) as required by the Sustainable Groundwater Management Act (SGMA), the Tule Subbasin Technical Advisory Committee (TAC) commissioned the preparation of a numerical groundwater flow model (GFM) of the Tule Subbasin. The Tule Subbasin is approximately 733 square miles located in the southwestern portion of Tulare County within the southern San Joaquin Valley Groundwater Basin (CDWR, 2003; see Figure 1). The Subbasin is divided into seven Groundwater Sustainability Agencies (GSAs):

1. Lower Tule River Irrigation District GSA
2. Pixley Irrigation District GSA
3. Eastern Tule GSA
4. Delano-Earlimart Irrigation District GSA
5. Tri-County Water Authority GSA
6. Alpaugh Irrigation District GSA
7. County of Tulare GSA - Tule

It is noted that the entire geographic area of the Subbasin is covered and managed by the first six GSAs. While the County of Tulare GSA is responsible for some lands within the Tule Subbasin, these areas are managed by the other GSAs through agreements. As such, this report presents results relating to the areas of the first six GSAs listed above.

Utilization of a calibrated groundwater flow model is a CDWR Best Management Practice (BMP) for developing GSPs to comply with SGMA. A BMP "*… refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.*" (GSP Regulations, §351[i]). Prior to preparing the GFM, TH&Co prepared a detailed hydrogeologic conceptual model (BMP No. 3) and water budget (BMP No. 4) of the Tule Subbasin. These documents provide the foundational information on which the GFM is based.

1.2 Groundwater Flow Model Objectives

The GFM was prepared to address the following:

- Validate the preliminary Subbasin-wide groundwater and surface water budget and, as necessary, refine the least-known elements of the water budget via model calibration;
- Evaluate the Subbasin-wide Sustainable Yield estimate based on a future projection of groundwater projects, management actions, and climate change;
- Develop water budget estimates for each of the six GSAs of the Subbasin, which incorporates historical hydrological data, surface water rights specific to the individual GSAs, and future projections of groundwater pumping and imported water; and
- Evaluate historical land subsidence in the Subbasin and predict future land subsidence in areas of critical infrastructure.

1.3 Model Domain

The model domain is the three-dimensional volume of hydrogeologic media evaluated by the model. Based on the objectives of the GFM, and in consideration of potential impacts of pumping and recharge outside the Tule Subbasin boundaries on the water budget within the Tule Subbasin, the lateral model area was selected as shown on Figure 2. This model area extends approximately five to ten miles north of the northern Tule Subbasin boundary, four miles west of the western boundary, three to six miles south of the southern Tule Subbasin boundary, and a few miles into the Sierra Nevada Mountains on the east. The area of the Sierra Nevada Mountains between the alluvial/bedrock interface and eastern model boundary is inactive. The total model area is 1,472 square miles and the active model area is approximately 1,320 square miles (i.e., approximately 845,000 acres).

The vertical model domain was developed to simulate groundwater flow in the primary aquifers and aquitards that were identified in the conceptual model of the Tule Subbasin. Accordingly, the model consists of five layers of variable thickness throughout the model domain based on cross-sections developed from the conceptual model. The layers are described as follows:

- Layer 1 simulates groundwater flow in the upper unconfined aquifer;
- Layer 2 is an underlying comparatively low permeability unit separating the upper and lower aquifers and generally coincides with the Corcoran Clay west of Highway 99;
- Layer 3 simulates groundwater flow in the lower aquifer. This layer is semi-confined in the east and confined below the Corcoran Clay in the west;
- Layer 4 simulates groundwater flow in the Pliocene marine deposits between the overlying lower aquifer and, in the eastern portion of the Subbasin, the underlying Santa Margarita Formation aquifer;
- Layer 5 simulates groundwater flow in the Santa Margarita Formation aquifer in the eastern portion of the Subbasin.

1.4 Model Development Approach

The process for developing the groundwater flow model was consistent with standard procedures outlined in literature and other guidelines (Anderson and Woessner, 1992; ASTM, 1993; CDWR, 2016). The process is outlined in Figure 3 and included:

1. **Identification of the Model Domain**. The model domain was selected to encompass the entire Tule Subbasin as described in Section 1.3 (see Figure 2). The model domain was presented to the Tule Subbasin TAC in TH&Co (2017a).

2. **Identification of the Model Software.** TH&Co selected a model code with capabilities to address the modeling objectives and provide a foundation for future model updates and applications. A detailed description of the model code and suite of modeling tools selected for the Tule Subbasin groundwater flow model are provided in Section 3.1 of this report. Selection of the model software was presented to the Tule Subbasin TAC in TH&Co (2017a).

3. **Data Compilation and Review.** It was necessary to compile and review geological, hydrological, hydrogeological, and other data (see Section 1.5) to develop the hydrogeologic conceptual model and provide data for calibration targets and boundary conditions. Compiled data was organized and stored in a database for easy access and analysis.

4. **Hydrogeologic Conceptual Model Development.** The conceptual model was developed through the generation of hydrogeologic cross sections, groundwater contour maps, hydrographs, pumping test data, and groundwater quality data. The data analyses resulted in determination of model boundary conditions, layers, initial groundwater levels, and an initial aquifer parameter distribution. The hydrogeologic conceptual model was presented to the Tule Subbasin TAC in TH&Co (2017b).

5. **Development of Preliminary Surface Water and Groundwater Budgets.** Streamflow, surface water imports, evapotranspiration data, land use, groundwater underflow, groundwater pumping, and other hydrogeologic data were compiled into comprehensive surface water and groundwater budgets. The water budgets provided initial flux estimates for input into the groundwater flow model. The preliminary detailed historical surface water

and groundwater budgets were presented to the Tule Subbasin TAC in TH&Co (2017b), prior to development of the numerical model.

6. **Selection of the Calibration Period.** The model calibration period was selected based on the quality and quantity of data available for development of the conceptual model and preliminary water budget. Using this criterion, the transient period for calibration was selected to be October 1986 through September 2017.

7. **Numerical Model Development.** Data and analyses from the conceptual model were converted into a form suitable for input into the numerical model. This included designing the model grid, determining the simulation stress periods, importing layer boundaries, developing model input files for the various hydrogeological stresses (e.g. groundwater production and recharge), and importing initial aquifer parameter zones.

8. **Model Calibration.** The process of model calibration involved adjusting aquifer properties and stresses until an acceptable match was obtained between measured groundwater levels and simulated groundwater levels. Simulated changes in land surface elevation were also calibrated to data from Global Positioning System (GPS) stations and satellite data.

9. **Sensitivity Analysis.** A sensitivity analysis was conducted to assess the impact of varying aquifer properties and stresses on the model calibration.

10. **Uncertainty Analysis.** Using Sustainable Yield as the metric for evaluating model uncertainty, TH&Co developed a range in potential Sustainable Yield values from over 200 calibrated realizations of the model. The range in potential Sustainable Yield represented the uncertainty in the model.

1.5 Types and Sources of Data

Compilation, review and analysis of multiple types of data were necessary to develop the groundwater flow model. The various types of data are summarized in Figure 4 and include geology, soils/lithology, hydrogeology, surface water hydrology, climate, crop types/land use, topography, and groundwater recharge and recovery. Groundwater levels, well construction information, groundwater quality, and pumping test data were stored in a relational database. Other types of data necessary for analysis were compiled into spreadsheets.

Data for the development of the groundwater flow model were obtained from multiple sources:

Geological Data including geologic maps and cross sections were obtained from the United States Geological Survey (USGS) and the California Geological Survey (CGS).

Soils/Lithological Data including detailed lithologic logs from wells and test boreholes, geophysical logs, and driller's logs from wells and test boreholes from the CDWR, the USGS, the City of Porterville, the California Division of Oil, Gas and Geothermal Resources (DOGGR), and various local irrigation districts.

Hydrogeologic Data including groundwater levels and pumping tests were obtained from the CDWR, Lower Tule River Irrigation District (LTRID), Deer Creek and Tule River Authority (DCTRA), Angiola Water District (AWD), the City of Porterville, Kern-Tulare Water District (KTWD), DEID, and the California Statewide Groundwater Elevation Monitoring (CASGEM) website.

Groundwater Recharge and -Pumping Data including spreading basin locations and dimensions, artificial recharge, water well construction, well locations, groundwater production, surface water diversions, canal losses, and river losses were obtained from LTRID, Pixley Irrigation District, DEID, AWD, CDWR, Porterville Irrigation District, Tule River Association (TRA) annual reports, and DCTRA annual reports.

Hydrological (i.e., Surface Water) Data consisted of stream gage data along the Tule River, Deer Creek, and White River were obtained from the USGS, DCTRA reports and TRA annual reports. Imported water deliveries were obtained from LTRID, Pixley ID, DEID, KTWD, AWD, and the United States Bureau of Reclamation (USBR).

Climate Data was acquired from CDWR's California Irrigation Management Information System (CIMIS), TRA reports, and the Western Regional Climate Center website.

Land Use Data was obtained from the CDWR, LTRID, Pixley ID, Porterville ID, Saucelito ID, and the USGS Earth Resources Observation and Science Center. Political boundaries were obtained from the California Cal-Atlas Geospatial Clearinghouse and the LTRID.

Topographical Data including Digital Elevation Models (DEMs), topographical maps, GPS data, and Interferometric Synthetic Aperture Radar (InSAR) satellite data were acquired from the USGS, CDWR, and National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL).

In addition to the various types of data, TH&Co reviewed numerous historical reports on the geology, hydrogeology and groundwater management of the model area. These reports included

USGS publications, CDWR reports and bulletins, consultant reports and academic publications. Publications relied on for the model preparation are summarized in the References (Section 7).

2.0 Hydrogeologic Conceptual Model

The hydrogeologic conceptual model is a description of the groundwater flow system of the Tule Subbasin and how it interacts with surface water and land use of the area. The conceptual model includes a description of the geologic setting, boundary conditions, principal aquifers, and aquitards. The hydrogeologic conceptual model for the GFM domain is addressed in detail in TH&Co (2017b). This section presents a summary of the hydrogeologic conceptual model from that report.

2.1 Geology

Geologic formations observed at the land surface and in the subsurface beneath the Tule Subbasin can be grouped into five generalized geologic units, described below in order of increasing age:

> **Unconsolidated Continental Deposits** – These sediments consist of alluvial, fluvial (i.e., streambed deposits), flood plain, and lacustrine (i.e., lakebed) deposits (labeled “surficial deposits” on Figure 5). The unconsolidated continental deposits range in thickness from 0 ft at the eastern contact with the Sierra Nevada Mountains to more than 3,000 ft near the margins of Tulare Lake in the western part of the Subbasin (see Figure 5; Lofgren and Klausing, 1969). Subsurface alluvial sediments consist of highly stratified layers of more permeable sand and gravel interbedded with lower permeability silt and clay. Clear correlation of individual sand or clay layers laterally across the Tule Subbasin is difficult due to the interbedded nature of the sediments. However, it is noted that the thickness of clay sediments in the upper 1,000 ft below ground surface (bgs) generally increases in the western portion of the Subbasin in the vicinity of Tulare Lake. The unconsolidated continental deposits form the primary groundwater reservoir in the Tule Subbasin.
>
> The lowermost portion of unconsolidated continental deposits is generally correlated with the Tulare Formation. The Tulare Formation is notable in that it includes the Corcoran Clay, a regionally extensive confining layer that has also been referred to as the “E-Clay” (see Figure 5) (Frink and Kues, 1954). The Corcoran Clay consists of a Pleistocene diatomaceous fine-grained lacustrine deposit (primarily clay; Faunt, 2009). In the Tule Subbasin, the Corcoran Clay is as much as 150 ft thick beneath the Tulare Lake lakebed but becomes progressively thinner to the east, eventually pinching out immediately east of Highway 99 (Lofgren and Klausing, 1969).
>
> **Pliocene Marine Deposits** – These sediments underlie the continental deposits and consist of consolidated to loosely consolidated marine siltstone with minor interbedded sandstone beds. The marine siltstone unit thickens to the west, ranging from approximately 500 ft thick near State Highway 65 to more than 1,600 ft beneath Highway 99 (Lofgren and

Klausing, 1969; see Figures 2-5 and 2-6). The marine siltstone beds dip sharply from the base of the Sierra Nevada Mountains on the east to the central portion of the valley in the west. The Pliocene marine strata have relatively low permeability and do not yield significant water to wells.

Santa Margarita Formation – This formation occurs beneath the Pliocene marine strata and consists of Miocene (approximately 5.3 to 23 million years before present) sand and gravel that is relatively permeable and yields water to wells. The formation is approximately 150 to 520 feet thick and occurs at depths ranging from 1,200 feet near State Highway 65 to greater than 3,000 feet beneath State Highway 99. This formation is a significant source of groundwater to wells in the southeastern portion of the Tule Subbasin near the community of Richgrove (Lofgren and Klausing, 1969).

Tertiary Sedimentary Deposits – Beneath the Santa Margarita Formation exists an interbedded assemblage of semi-consolidated to consolidated sandstone, siltstone and claystone of Tertiary age (approximately 2.6 to 66 million years before present). Some irrigation wells in the southeastern part of the Tule Subbasin are known to produce fresh water from the Olcese Sand Formation, which is in the uppermost portion of the unit (Ken Schmidt, 2019. Personal Communication). The water quality of the groundwater in the Tertiary sedimentary deposits becomes increasingly saline to the southwest and most of the groundwater in the unit is not useable for crop irrigation or municipal supply except near Highway 65 (Lofgren and Klausing, 1969).

Granitic Crystalline Basement – Sedimentary deposits beneath the Tule Subbasin are underlain by a basement consisting of Mesozoic granitic rocks that compose the Sierra Nevada batholith (Faunt, 2009). At depth, the basement rocks are assumed to be relatively impermeable.

There are no significant faults mapped in the Tule Subbasin that would form a groundwater flow barrier or affect groundwater flow.

2.2 Hydrology

The hydrology of the model domain includes five significant surface water features (see Figure 6):

Tule River and Lake Success

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. Lake Success is a manmade reservoir created by the construction of Success Dam (see Figure 6). Success Dam controls and measures releases of the Tule River. Lake Success is not explicitly included in the model although releases from the reservoir to the Tule River and Pioneer Canal, as recorded in TRA reports, are the basis for inflows to these surface water features.

Downstream of Lake Success, the Tule River flows through the City of Porterville where it is diverted at various points before flowing into the LTRID. A significant diversion point is the Porter Slough, which flows to the north and semi-parallel to the main river channel and is used to convey surface water to various recharge facilities and canals. Downstream of Porterville, the Tule River ultimately discharges onto the Tulare Lakebed during periods of above-normal precipitation. Stream flow is measured via gages located below Success Dam, at Rockford Station downstream of Porterville, and at Turnbull Weir (see Figure 6).

Releases of water below Lake Success dam are diverted from the Tule River channel at various locations. 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. In the water budget, infiltration that occurs in the Porter Slough is included as infiltration from the Tule River. Downstream of the Friant-Kern Canal the Tule River channel is also used as a conveyance mechanism to convey imported water to the Porterville Irrigation District (Porterville ID), LTRID and AWD. Within the Porterville ID and LTRID, a combination of natural stream flow and imported water are further diverted into unlined canals for distribution to artificial recharge basins and farms. Any residual stream flow left in the Tule River after diversions is measured at the Turnbull Weir, located at the west end of the LTRID (see Figure 6).

As streambed infiltration in the Tule River is measured between the various stream gages by the TRA, the Tule River is incorporated into the GFM as part of the recharge package with separate zones delineated between the stream gages where streambed infiltration has been measured.

Deer Creek

Deer Creek is a natural drainage that originates in the Sierra Nevada Mountains, flowing in a westerly direction north of Terra Bella and into Pixley (see Figure 6). Although the Deer Creek channel extends past Pixley, discharges rarely reach the Tulare Lake lakebed. Stream flow in Deer Creek has been measured at the USGS gaging station at Fountain Springs from 1968 to present time. Friant-Kern Canal water is also diverted into the Deer Creek channel and again measured at Trenton Weir before being delivered to riparian lands via unlined canals (see Figure 6). During wet years, water that reaches the terminus of Deer Creek is discharged into the Homeland Canal.

Deer Creek is included in the GFM as part of the recharge package, with separate zones delineated between stream gages where streambed infiltration has been estimated.

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 6). Stream flow in the White River has been measured at the USGS gaging station near Ducor from 1972 to 2005. Data after 2005 has been extrapolated. The White River channel extends as far as State Highway 99 but does not reach the Tulare Lake lakebed. All streamflow in the White River that is not lost to evaporation is assumed to become groundwater recharge.

The White River is included in the Tule Subbasin model as part of the recharge package.

Tulare Lake

During the calibration period (1986 through 2017), Tulare Lake has been a dry lakebed except for localized residual marshes and wetlands and occasional flooding. This surface water feature is not explicitly included in the model.

2.3 Hydrogeology

In general, five aquifer/aquitard units comprise the Tule Subbasin:

1. Upper Aquifer (Model Layer 1)
2. The Corcoran Clay Confining Unit and Other Confining Units (Model Layer 2)
3. Lower Aquifer (Model Layer 3)
4. Pliocene Marine Deposits (generally considered an aquitard) (Model Layer 4)
5. Santa Margarita and Olcese Formations of the Southeastern Subbasin (Model Layer 5)

Detailed descriptions of these aquifers/aquitards are provided in TH&Co (2017b) and TH&Co (2020).

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 a groundwater pumping depression in the west-central portion of the Subbasin (see Figures 7, 8 and 9). The pumping depression has reversed the natural groundwater flow direction in the western portion of the Subbasin, inducing subsurface inflow across the southern and western boundaries. Recharge from the Tule River results in a groundwater flow divide in the upper aquifer along the northern boundary of the Tule Subbasin. As such, upper aquifer groundwater on the north side of the river flows to the north and out of the Subbasin. Groundwater flow patterns in the upper aquifer have generally not changed significantly since the late 1980s (see Figures 7 and 8).

In the lower aquifer, groundwater flows to the southwest toward a pumping depression in the western portion of the Subbasin (see Figure 9). This pumping depression extends from west of Corcoran in the northwest to the Alpaugh area in the southwestern Tule Subbasin west of Highway 43.

Groundwater level changes over time can be observed from hydrographs for wells monitored in the Tule Subbasin. Despite a relatively wet hydrologic period between 1995 and 1999 and periodic wet years (2005 and 2011), groundwater levels in upper aquifer wells show a persistent downward trend between approximately 1987 and 2017 (see Figure 10). Groundwater level trends in wells perforated exclusively in the lower aquifer vary depending on location in the Subbasin (see Figure 11). In the northwestern part of the Subbasin, lower aquifer groundwater levels have shown a persistent downward trend from 1987 to 2017. In the southern part of the Subbasin, groundwater levels were relatively stable between 1987 and 2007 but began declining after 2007.

Comparisons of hydrographs for wells perforated in the upper aquifer with nearby wells perforated predominantly in the lower aquifer show that groundwater levels in the upper aquifer are higher than groundwater levels in the lower aquifer (see Figure 12). This indicates a downward hydraulic gradient and indicates that the upper aquifer is recharging the lower aquifer of the Tule Subbasin. Faunt (2009) has suggested that the recharge of the lower aquifer via wells that are perforated across both aquifers has increased with the number of deep wells constructed in the San Joaquin Valley.

2.4 Land Subsidence

Land subsidence in the Tule Subbasin as a result of lowering the groundwater level due to groundwater production has been well documented (Ireland et al., 1984; Faunt, 2009; Luhdorff and Scalmanini, 2014). Prior to 1970, as much as 12 ft of land surface subsidence was documented for the area immediately south of Pixley (Ireland et al., 1984). As groundwater levels stabilized in the area throughout the 1970s and early 1980s, land subsidence was largely arrested. During this time, monitoring for land subsidence that had previously been conducted along the portion of the Friant-Kern Canal that is within the Tule Subbasin was discontinued.

From the late 1980s into the 2000s, it is suspected that land subsidence in the Tule Subbasin was reactivated as groundwater levels declined. Groundwater flow model simulations of land subsidence in the Central Valley by Faunt et al. (2009), which were calibrated to historical land subsidence that occurred in the 1960s, simulated an additional two to four feet of land subsidence between 1986 and 2003.

The reactivation of land subsidence in the Subbasin was confirmed in the late 2000s based on data from InSAR satellites and one GPS station located in Porterville, California. InSAR data showed as much as four feet of additional land subsidence occurring in the northwestern portion of the Tule Subbasin between 2007 and 2011 (see Figure 13) (Luhdorff and Scalmanini, 2014). The GPS data showed that approximately 0.4 ft of land subsidence occurred in the Porterville area between 2007 and 2011. From 2015 through 2018, land subsidence in the Tule Subbasin, as observed from InSAR data, continued with as much as 2.75 ft of additional land subsidence in the northwest portion of the Subbasin and as much as 0.75 ft of additional land subsidence at the Porterville GPS station (see Figure 14). GPS data from the Delano, California station, located outside the Subbasin, showed approximately 1 ft of subsidence between 2012 and 2016. Based on benchmarks located along the Friant-Kern Canal and monitored by the Friant Water Authority (FWA), cumulative land subsidence along the canal between 1959 and 2017 has ranged from approximately 1.7 ft in the Porterville area to 9 feet in the vicinity of Deer Creek (see Figure 13).

The rate of land subsidence in the Tule Subbasin varies both spatially, according to the geology of the subsurface sediments and scale of groundwater level declines, and temporally with changes in groundwater levels associated with wet and dry periods. The average rate of change in land surface elevation between 1987 and 2018 for the area of maximum subsidence was estimated to be approximately 12 feet over the 32-year period for a rate of 0.4 ft/yr. At the Porterville GPS station, the annual rate of subsidence between 2006 and 2013 was approximately 0.1 ft/yr but increased to approximately 0.3 ft/yr between 2013 and 2019 (see Figure 14).

3.0 Groundwater Flow Model

3.1 Description of Model Codes

The Tule Subbasin groundwater flow model was developed using the numerical groundwater flow model code MODFLOW. MODFLOW is a block centered, finite difference groundwater flow modeling code developed by the USGS for simulating groundwater flow (McDonald and Harbaugh, 1988). MODFLOW is one of the most widely used and critically accepted model codes available (Anderson and Woessner, 1992).

In order to simulate surface water and groundwater interaction, land surface subsidence, and agricultural water budget components in the Tule Subbasin, TH&Co utilized the MODFLOW variant One-Water Hydrologic-Flow Model or MODFLOW-OWHM (Hanson et al.,2014, Boyce et al., 2018, and Boyce et al., in review). Specifically listed in CDWR (2016), this model code is designed to simulate the use and movement of water in irrigated agricultural areas with unmetered pumping and is particularly applicable to the Tule Subbasin where the majority of surface water and groundwater use is for agricultural irrigation.

3.2 Model Size and Grid Geometry

The GFM domain is approximately 41 miles in the east-west direction and 36 miles in the north-south direction and encompasses approximately 1,472 square miles at the western base of the Sierra Nevada Mountains in the south-central portion of the San Joaquin Valley Groundwater Basin (see Figures 1 and 2).

The model domain is discretized into 216 columns and 190 rows with 1,000 ft by 1,000 ft cells (see Figure 15). Each model layer is divided into 41,040 cells with a total of 205,200 cells in the entire five-layer model. The site coordinate system for the model was established in NAD 83 State Plane CA Zone 4.

3.3 Temporal Discretization

Both recharge and discharge were applied to the GFM in monthly stress periods for the calibration period (October 1986 through September 2017). October 1986 was selected as the starting time to include multiple dry and wet hydrologic periods and to avail the analysis of a previous water budget conducted by TH&Co (2015) that accounts back to 1986. The model period ended in September 2017 which corresponds to the end of the 2016/17 water year because that was the last month of complete surface water data.

3.4 Water Budget Areas

The Farm Process Package of MODFLOW accounts for the application, consumption and movement of water at the land surface in irrigated agricultural areas. The surface water budget is coupled with the groundwater flow system in the sense that the applied water demand of any given agricultural area that is not met by surface water supplies (i.e., imported water, diverted streamflow, or precipitation) is assumed to be supplied by pumped groundwater. In the Farm Process Package, agricultural areas can be subdivided to account for differences in crop type, e.g., irrigation efficiency, and available surface water supply, among others. To account for these unique water budget areas, the Farm Process Package (FMP) for the Tule Subbasin model was divided into agricultural water budget areas (referred to as “Farms” in Schmid and Hanson, 2009 and “water budget areas” (WBAs) in subsequent publications [Boyce et al., in review]).

The water budget areas assigned to the GFM are shown on Figure 16. Some of the water budget areas in the Tule Subbasin were delineated to match, or at least resemble, established irrigation districts or GSA political boundaries (e.g., WBAs 9, 11 and 12, which represent LTRID, Pixley Irrigation District and DEID, respectively). Other WBAs were identified for areas of similar crop types or areas not specifically identified with an agency. Agricultural water budgets were developed for each WBA in accordance with the land use and surface water supply data available for those areas.

3.5 Agricultural Water Use

Agricultural water use is simulated in the GFM using the FMP. Agricultural water use is a function of the total water demand of any given water budget zone, which is supplied through a combination of precipitation, surface water supplies, and groundwater pumping.

3.5.1 Estimates of Total Agricultural Irrigation Demand

Total agricultural irrigation demand is the total water demand necessary to sustain a crop in any given area. It is estimated based on land use data showing the types and areas of crops grown, evapotranspiration estimates for the individual crop types, and assumptions for irrigation efficiency based on the types of irrigation used to supply water to the crops (e.g., spray, drip, row and furrow, etc.).

Information on the types and areas of crops for the LTRID, Pixley Irrigation District, Porterville Irrigation District, and Saucelito Irrigation District were obtained from annual crop surveys from each respective district. The types and areas of crops in other parts of the Tule Subbasin were estimated from land use maps and associated data published by the CDWR for 1993, 1999, 2007 and 2014 (see Figure 17). For the portion of the model in Kern County, land use maps were obtained from CDWR (1990 and 2014) and Kern County Department of Agriculture and

Measurement Standards (1999 and 2007). For the portion of the model in Kings County, land use maps were obtained from CDWR for 1991, 1996, 2003, and 2014.

Consumptive use estimates for the various crop types were based on demands specific to the crops in the Tule Subbasin area, as published in ITRC (2003). The crop consumptive use estimates took into account effective precipitation (i.e. consumptive use associated with precipitation was removed from the total demand resulting in consumptive use associated with irrigation only). Crop types were grouped into the following categories (see Table 1):

- Grain and Grain Hay
- Truck
- Corn and Silage
- Miscellaneous Field Crops
- Grapes
- Cotton
- Deciduous and Fruit Trees
- Alfalfa and Pasture
- Nuts

Where appropriate, crop consumptive use estimates for any given area accounted for double cropping.

Deep percolation of applied irrigation water (i.e., return flow) was estimated based on the irrigation method for each land use type reported in CDWR land use maps. Irrigation efficiencies were applied to the different irrigation methods based on tables reported in California Energy Commission (2006). The irrigation types and their respective efficiencies are as follows:

- Border Strip Irrigation – 77.5 percent
- Micro Sprinkler – 87.5 percent
- Surface Drip Irrigation – 87.5 percent
- Furrow Irrigation – 67.5 percent

TH&Co assigned a single crop consumptive use and irrigation efficiency estimate to each water budget zone for any given time period. Each was area-weighted according to the land use in that zone (see Table 2). In order to simulate changes in cropping patterns over time, TH&Co relied on CDWR land use maps for 1993, 1999, 2007, and 2014. TH&Co estimated area-weighted irrigation efficiencies for two time periods: 1986 to 2002 and 2003 to 2017.

Total estimated agricultural irrigation demand for any given time period was based on the area-weighted consumptive use estimate multiplied by the area of the water budget zone divided by the irrigation efficiency.

3.5.2 Estimates of Individual Water Supplies to Meet Irrigation Demand

Agricultural irrigation demand is met from three sources: precipitation, surface water deliveries, and groundwater pumping. Consumptive use estimates from ITRC accounted for effective precipitation (see Section 3.5.1). Thus, irrigation demand in the WBAs of the model was met from surface water supplies and groundwater pumping.

Surface water deliveries to crops occur via imported water from the Friant-Kern Canal and other canals in the Subbasin as well as diverted streamflow from the Tule River and Deer Creek. Monthly imported surface water deliveries for WBAs covering Porterville ID, Saucelito Irrigation District, Tea Pot Dome Water District, Alpaugh Irrigation District, Atwell Island Irrigation District, and Terra Bella Irrigation District were obtained from United States Bureau of Reclamation (USBR) Central Valley Operation Annual Reports. Monthly imported water data for LTRID and other agencies was provided by the respective agencies. Monthly surface water deliveries of diverted streamflow from the Tule River are based on TRA annual reports. Monthly surface water deliveries of diverted streamflow from Deer Creek were provided by agencies that divert the water.

Groundwater pumping is estimated in each water budget zone as the balance of the total water demand not met from precipitation and surface water supplies.

Historical agricultural water demand by source is summarized in Appendix A.

3.6 Boundary Conditions

Boundary conditions specify groundwater elevations (head boundaries) or flows (flux boundaries, for example pumping wells) near the perimeter and/or within the model domain. Functionally speaking, boundary conditions add or remove water from the groundwater system and can be specified anywhere in the model.

3.6.1 Lateral Model Boundaries

Boundary conditions applied near the perimeter of the model domain include no-flow cells (inactive), recharge points along the base of the Sierra Nevada Mountains, and time-varying specified head cells (see Figure 15). Due to the uncertainty of groundwater flow in the fractured bedrock of the Sierra Nevada Mountains, the portion of the model domain overlying the surface expression of the bedrock in this area was designated as “inactive” and assigned with “no-flow” cells. Groundwater recharge attributed to subsurface inflow from the mountain-block to the alluvial aquifer system was addressed using recharge points (i.e. injection wells) placed at the base of the mountains within the active model area. Groundwater levels at the north, west and southern Subbasin boundaries are constrained to measured groundwater levels in 29 wells located near the model boundary; 15 wells perforated in the upper aquifer and 14 wells perforated in the lower aquifer (see Figure 15). Groundwater levels in between the control wells were spatially and temporally interpolated for any given monthly stress period. Hydrographs for boundary control wells are provided in Appendix B.

3.6.2 Layer Elevations

Model layers were developed based on analysis of five hydrogeologic cross sections extended through the model domain (see Figures 5, 18, and 19; Plates 1 through 5). The cross sections were developed based on driller's logs, geophysical logs, and well construction information. The top of Layer 1 is the ground surface as imported from USGS DEMs with a horizontal 1 arc-second (approximately 10-meter) resolution and vertical accuracy of approximately 3 meters; these values were averaged for each 1,000 ft x 1,000 ft cell. The boundaries between each model layer were contoured using ESRI ArcMap v. 10.6.1 based on the layer top and bottom elevations from the cross sections and other control points from well logs and geophysical logs.

Model Layer 1 corresponds to the Upper Aquifer. The bottom of Layer 1 was selected to correlate with the top of the Corcoran Clay, where it exists, and is generally shallower than the top of perforations for most wells in the eastern part of the Tule Subbasin. The thickness of Layer 1 ranges from less than 50 feet in an area north of Porterville to approximately 450 feet near Corcoran (see Figure 20). This layer was designated as convertible (i.e., variably unconfined/confined) although given that groundwater levels are always below the land surface, this layer is always unconfined.

Layer 2 corresponds to the Corcoran Clay, where it exists, primarily west of Highway 99 (see Figure 18). The thickness of Layer 2 ranges from approximately 50 feet at the base of the Sierra Nevada Mountains in the eastern model domain to approximately 500 feet in the western part of the model domain (see Figure 21). This layer was designated as convertible such that when groundwater levels are above the top of the model layer, storage properties associated with confined conditions were applied and when groundwater levels are below the top of the model layer, storage properties associated with unconfined conditions were applied.

Layer 3 generally corresponds to the Lower Aquifer. This aquifer ranges in thickness from less than 250 feet at the base of the Sierra Nevada Mountains to approximately 2,000 feet in the northwest model domain (see Figure 22). Like the overlying layers, Layer 3 was designated as convertible.

Layer 4 generally correlates to Pliocene marine sedimentary deposits in the eastern portion of the Tule Subbasin. This layer is generally considered an aquitard separating the overlying Lower Aquifer (Layer 3) from the underlying Santa Margarita Formation aquifer (Layer 5). The thickness of Layer 4 ranges from less than 250 feet along the model edges to greater than 1,700 feet in the south-central model area (see Figure 23). This layer is modeled as confined.

Layer 5 represents the Santa Margarita Formation and upper portion of the Olcese Formation in the eastern part of the Tule Subbasin. The thickness of this layer ranges from 0 to 1,000 feet thick (see Figure 24). The bottom of Layer 5 is a no flow boundary. This layer is modeled as confined.

3.6.3 Groundwater Level Initial Conditions

The initial groundwater level conditions for the start of the model transient period was based on a groundwater contour map of the model domain generated from groundwater levels measured in from October 1986 to March 1990 (see Figure 7).

3.6.4 Groundwater Recharge

3.6.4.1 Agricultural Return Flow – Farm Process Package

Deep percolation and groundwater recharge of applied water from agricultural irrigation (i.e., return flow) was addressed using the FMP. Return flow was simulated using FMP based on the average consumptive use and irrigation efficiency assigned to each water budget zone.

3.6.4.2 Mountain-Block Recharge – Well Package

Subsurface inflow to the alluvial aquifer system from the fractured bedrock along the base of the Sierra Nevada Mountains was simulated using the Well Package (WEL). Thirty-seven injection wells were placed at the base of the Sierra Nevada Mountains along the bedrock alluvial interface to simulate the recharge (see Figure 15). Recharge was directed into Layer 3 of the model. As the contribution of recharge to the alluvial aquifer system from the mountain block is one of the least known aspects of the water budget, recharge rates in the injection wells were varied across a wide range during the calibration process in order to find the optimum recharge rate to achieve model calibration.

3.6.4.3 Subsurface Inflow in the Alluvial Channel of the Tule River

Some subsurface inflow of groundwater is expected in the Tule River channel at the eastern boundary of the active model area. This inflow was simulated with a time-varying specified head cell placed at the location of Well 22S/28E-03H01. The specified heads were fixed at the groundwater levels measured in this well for its period of record from October 1986 to February

2008 (see Appendix B). The flows from this boundary condition are represented as the Mountain Block Recharge in the water budget.

3.6.4.4 Other Recharge

For all other recharge in the Tule Subbasin Model, recharge was applied to the uppermost active model layer within 71 individual recharge zones using the MODFLOW Recharge Package (RCH). The following sources of groundwater recharge were simulated in the model using the Recharge Package:

- Deep percolation of precipitation
- Streambed infiltration and recharge in the Tule River (including Porter Slough), Deer Creek, and White River channels
- Artificial recharge in basins
- Infiltration in unlined canals
- Areas of septic return flow and urban landscape return flow

3.6.5 Groundwater Pumping

Groundwater pumping was simulated using the MODFLOW Multi-Node Well Package (MNW2). For agricultural groundwater production, pumping was assigned to individual wells based on the required pumping demand estimated from the FMP. For most areas of the model, representative wells were placed at mile-square centers and perforated in accordance with the average perforation interval of wells in their respective water budget zone from driller’s logs in the CDWR driller’s log database (see Figure 25). In the 10-mile corridor centered on the Friant-Kern Canal, a more detailed accounting of actual pumping wells was input with reported perforation intervals in order to provide for a more detailed analysis of land subsidence along the canal. A total of 1406 agricultural wells were included in the model.

For municipal pumping (e.g., City of Porterville) and agency pumping (e.g., Angiola Water District) where the locations and depth intervals of the wells were known or inferred, the wells were included in the model explicitly. A total of 273 municipal or irrigation district wells were included in the model (see Figure 25)

Groundwater production was assigned to each well in the model in monthly stress periods. Agricultural pumping was assigned to individual wells based on the required pumping demand estimated from the FMP. Annual agricultural and municipal groundwater pumping for the period of the model is shown in Figure 26.

3.7 Aquifer Characteristics

The propensity of aquifer sediments to transmit and store water is described in terms of transmissivity, hydraulic conductivity, and storativity. The aquifer system of the Tule Subbasin is highly heterogeneous and aquifer permeability and storage characteristics vary greatly both laterally and vertically. Where possible, TH&Co relied on long-term pumping test data to develop initial ranges of aquifer parameter estimates for input to the model (see Table 3). In the absence of this type of test, aquifer parameter estimates were also obtained from analysis of short-term pumping tests, textural analysis obtained from Faunt et al. (2009), and/or assignment of literature values based on the soil types observed in driller's logs. This section describes the aquifer parameters used in the GFM.

3.7.1 Transmissivity and Hydraulic Conductivity

Transmissivity is a measure of the propensity for groundwater to flow within an aquifer and was primarily developed for analysis of well hydraulics in confined aquifers (Freeze and Cherry, 1979). Multiple sources of data for estimating transmissivity were obtained, reviewed, and analyzed, including previous modeling efforts (Faunt et al., 2009), other technical reports, and pumping test data from local agencies (Schmidt, 2018). Transmissivity estimates were obtained from pumping test data for 225 wells, 29 of which were perforated only within the Upper Aquifer, 70 of which were perforated only within the Lower Aquifer, and 126 of which were perforated across multiple aquifers. Of the available pumping test data, 43 tests were known to be long-term tests (i.e., 24 hours or greater) and 55 tests were known to be short-term specific capacity tests (see Table 3). Details on the test duration for the remaining 125 wells was unknown.

The permeability of the sediments with respect to a given fluid (in this case, groundwater) in each layer of the model is expressed as hydraulic conductivity. Horizontal hydraulic conductivity is related to transmissivity through the following relationship:

$$K = \frac{T}{b}$$

Where:

K = Horizontal hydraulic conductivity (ft/day);
T = Transmissivity (ft/day); and
b = Aquifer thickness (ft)

Given our configuration of MODFLOW-OWHM, hydraulic conductivity was an input to the GFM whereas transmissivity was not. The distribution of horizontal hydraulic conductivity in each layer of the model was initially developed based on pumping test data and associated transmissivity estimates, supplemented with interpretation of soil properties through texture analysis, and finalized through the calibration process described in Section 3.8. The initial horizontal hydraulic conductivity distribution of each model layer was developed as a map that included pumping test-derived values overlaid on a visualization of percent coarse sediment by layer from soil textural analysis obtained from Faunt et al. (2009). Higher percentages of coarse-grained sediment were correlated with higher hydraulic conductivity values.

Hydraulic communication between adjacent model layers was addressed through vertical hydraulic conductivity. Because sediments are generally deposited in layers in alluvial/fluvial environments, horizontal hydraulic conductivity is often significantly greater than vertical hydraulic conductivity. Such sediments are said to be vertically anisotropic. Quantification of vertical hydraulic conductivity was accomplished via model calibration as described in Section 3.8. Similarly, the sediments may also be horizontally anisotropic as noted in Neuman et al. (1984) and more recently in Gianni et al. (2019). Like the vertical hydraulic conductivity, horizontal anisotropy was also quantified through model calibration.

3.7.2 Storage Properties

The release and uptake of water to and from storage was simulated using specific yield, specific storage, the elastic storage coefficient, and the inelastic storage coefficient. Specific yield and the elastic storage coefficient govern the reversible release and uptake of water whereas the inelastic storage coefficient governs the irreversible release of water due to compaction of porous media.

- Specific yield represents unconfined storage associated with draining or filling of porous media due to changes in the water table. It is defined as the difference between porosity and specific retention, where porosity is associated with the pore space volume and specific retention is associated with that portion of the pore space volume that does not drain.
- Specific storage represents confined storage associated with expansion or compression of both water and soil 'skeleton'. These processes are simulated within MODFLOW-OWHM by considering both elastic (reversible) compression and expansion of the soil skeleton and inelastic (irreversible) compression of the soil skeleton. As the term is used here, inelastic compression is the irreversible reduction in pore space that results in land subsidence.

The values of these storage properties were quantified through model calibration as described in Section 3.8.

3.7.2.1 Specific Yield

Layers 1, 2, and 3 of the GFM may be unconfined or confined (i.e., they are specified to be ‘convertible’ as noted above) depending on groundwater level conditions, which vary transiently throughout the model simulation. The specific yield values for these three uppermost model layers are specified exclusively in the LPF package. Conversely, being specified as confined layers, values of specific yield are not assigned to Layers 4 and 5.

Although previous model studies of the Tule Subbasin provided estimates of specific yield (Ruud et el, 2003; Faunt et al., 2009), to date, there are no measured data with which to estimate specific yield.

3.7.2.2 Specific, Elastic, and Inelastic Storage

In MODFLOW, the layer property flow package (LPF) is linked to the subsidence package (SUB) displacements through changes in the elevations of cell-by-cell layer boundaries. Given this linkage, parameters associated with the elastic and inelastic storage are specified in both packages. Specifically, subsidence is computed using the values for specific storage in the LPF package (which have dimensions of 1/ft) and the dimensionless elastic and inelastic storage coefficients in the SUB package. The portion of elastic and inelastic storage associated with the compressibility of water is specified in the LPF package as the ‘specific storage’ whereas the portion associated with compressibility of the soil skeleton were assigned in the MODFLOW subsidence package. Elastic storage is associated with the reversible compressibility of the soil skeleton whereas inelastic storage is associated with the irreversible compressibility of the soil skeleton.

3.7.3 Critical Hydraulic Head

Land subsidence in the SUB package of the model is a function of the effective stress of the aquifer system and changes in hydraulic head.

Non-recoverable (i.e., irreversible or inelastic) land subsidence occurs in the SUB package when the change in effective stress under a given hydraulic head condition exceeds the previous maximum effective stress (or pre-consolidation stress) of the aquifer system. This maximum effective stress can generally be defined by the previous lowest groundwater level (Sneed, 2001), herein referred to as the “critical head.”

In order to define the critical head in the Tule Subbasin groundwater model, TH&Co analyzed the previous lowest groundwater level in the Tule Subbasin prior to the start of the model transient period in 1986. In general, this groundwater level condition is indicative of the early to mid-1960s, as documented in Ireland et al., 1984. The historical low groundwater level prior to 1986 in each calibration target well was used to provide an initial estimate of critical head, which was refined through model calibration.

3.8 Model Calibration

As noted in CDWR (2016), model calibration is required by the GSP Regulations (§352.4(f)(2)). Calibration is performed to demonstrate that the model can reasonably reproduce (simulate) historical measurements (e.g., groundwater elevations and land subsidence measurements). Calibration generally involves iterative adjustments of various model parameters until the simulated results reasonably match historical measurements. As their precise values are unknown, aquifer characteristics such as those described in the previous subsection are commonly modified during model calibration. Adjustment of parameter values is constrained within a range of reasonable values through review of aquifer test data, borehole data, hydrographs, and literature data.

The precise values of the numerous aquifer characteristics described in the previous subsection (i.e., horizontal hydraulic conductivity, vertical hydraulic conductivity, horizontal anisotropy, specific yield, specific storage, elastic storage, inelastic storage, and critical head) vary laterally and vertically throughout the Subbasin and are unknown. Therefore, these characteristics were quantified through calibration. Given the functionality provided by MODFLOW-OWHM, consumptive use and mountain block recharge were refined from initial values through calibration.

Given the large number of these 'calibration parameters', their spatial variability within and across model layers, the interconnection between water levels and land subsidence, and the goal of conducting a predictive uncertainty analysis as described in CDWR (2016), 'trial-and-error' calibration (as described in Anderson and Woessner, 1992) was largely abandoned in favor of automated calibration using PEST (Doherty, 2003 and 2015). The GFM was calibrated to both measured groundwater levels and measured changes in land surface elevation.

3.8.1 Calibration Targets for Groundwater Levels

Simulated groundwater levels were calibrated to measured data collected between October 1986 and September 2017 in selected monitoring wells throughout the Tule Subbasin. The 32 target wells for the model calibration are shown on Figure 27. The model was specifically calibrated to groundwater level observations from wells perforated exclusively in either model Layers 1, 3, or 4. Calibration to observed groundwater levels in Layer 2 was not conducted due to a lack of observation wells perforated in this layer. Groundwater level data specific to Layer 5 is not available. Other criteria for selection of calibration target wells included:

1. Adequate historical groundwater level record.

2. Relative assurance that the measured data were indicative of static groundwater level conditions.

3.8.2 Calibration Targets for Land Subsidence

Land subsidence was calibrated at 45 target locations to Interferometric Synthetic Aperture Radar (InSAR) satellite data (see Figure 28). InSAR is a technique for measuring changes in land surface elevation using two or more radar images of the earth's surface to determine any change in land surface elevation. TH&Co obtained historical InSAR land subsidence data for the 45 target locations from the Jet Propulsion Laboratory (JPL). The 45 target calibration locations are generally evenly space across the Tule Subbasin area at 3- to 4-mile spacings. Data were available for the following periods of time:

- 2007 - 2011
- 2014 - 2015
- 2015 - 2017

TH&Co was also able to calibrate land subsidence to land surface elevation data from two Global Positioning Stations (GPS) located near the Porterville Airport and the City of Delano. Land surface elevation data was available for both stations for the period from November 2005 to May 2018 (see Figure 14).

Calibration of changes in land surface elevation was conducted based on relative changes in land surface elevation rather than actual elevation. Land surface elevation datum was not available at an accuracy that would provide a meaningful reference for calibrating actual land surface elevation. The top of the model is defined based on the USGS DEM, which has a vertical accuracy of plus/minus 3 meters (see Section 3.6.2). In addition, it is possible that the elevation defined by the DEM, which is based on NAVD 88, changed between the time the reference was defined and 1986 (the start of the transient model period). Given these limitations, TH&Co instead calibrated land subsidence based on relative change in land surface elevation indicated by the InSAR data for the three time periods indicated above and the data from the Porterville and Delano GPS stations.

3.8.3 Calibration Process

The general calibration process for the GFM included the following steps:

1. A plausible range of values for each of the 41 parameters was assigned to each of 109 pilot points evenly spaced within Layers 1 through 4 and 53 pilot points evenly spaced within

Layer 5 (see Figure 27). The magnitude of the range assigned to each parameter at each pilot point varied based on the quality of the data in the vicinity of the pilot point. For example, pilot points near wells with controlled pumping test data were given a smaller range than those in areas with no available pumping test data. The input parameter groupings that were adjusted during the calibration process included:

- Horizontal hydraulic conductivity (‘kh’);
- Vertical hydraulic conductivity (‘kv’);
- Horizontal anisotropy (‘hani’);
- Specific yield (‘sy’);
- Specific storage(‘ss’);
- Elastic storage (‘ske’);
- Inelastic storage (‘skv’);
- Critical head (‘ch’);
- Mountain block recharge (MBR; ‘wm’);
- Crop consumptive use (‘um’); and
- Well radius (‘rad’).

2. Some parameters are expected to be correlated with horizontal hydraulic conductivity (‘kh’). Therefore, they were expressed as functions of ‘kh’ based on literature values and professional judgment within PEST to maintain a reasonable degree of consistency among such parameters. For example, soils with high ‘kh’ values generally have high ‘sy’ values; conversely, soils with high ‘kh’ values generally have low ‘ske’ values.
3. Given the number of pilot points and associated calibration parameters, several thousand MODFLOW-OWHM runs through PEST and its utility programs were required to calibrate the GFM, complete the sensitivity analysis, and provide the information needed for the predictive uncertainty analysis.
4. The calibration parameters most sensitive parameters to model outcome (defined as the change to the objective function) are horizontal hydraulic conductivity of Layers 1 through 4 (kh1 through kh4) and specific yield of Layer 1 (sy1).

3.8.4 Calibration Results

Using PEST and its associated utility programs, over 200 calibrated models were generated. That is, owing to the non-uniqueness of the solution to hydrogeologic models in general, over 200 different spatial configurations of the calibration parameters that resulted in a calibrated model were generated. Additional calibrated models could have been generated but given the ultimate objective of quantifying the sustainable yield and its uncertainty, having over 200 calibrated models was deemed sufficient. Plan-view plots showing the spatial distribution of the calibration parameters for all five model layers for one of these calibrated models are provided in Appendix C. Visual inspection of these plots shows the calibrated values to be reasonable given the available Subbasin-specific and literature data (e.g., the calibrated values of horizontal hydraulic conductivity are in generally good agreement with those obtained from pumping tests as shown on the plan-view plots). The range of values for the most sensitive parameter groups (i.e., hydraulic conductivity and specific yield) are as follows:

	Horizontal Hydraulic Conductivity; kh (ft/day)*			**Specific Yield; sy (unitless)**		
Model Layer	**Minimum**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**
1	2	20	160	0.001	0.09	0.25
2	0.01	9	120	0.007	0.06	0.25
3	1	20	200	0.01	0.1	0.25
4	0.1	2	20	Not applicable for confined layer		
5	3	4	5	Not applicable for confined layer		

* The anisotropy ratio is the ratio of horizontal hydraulic conductivity along model columns to that along model rows. It ranged from 0.3 to 3.0.

The range of values for elastic and inelastic storage are provided in the table below.

	Elastic Storage, S_e (unitless)			**Inelastic Storage, S_i (unitless)**		
Model Layer	**Minimum**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**
1	1.00 x 10^{-5}	4.92 x 10^{-5}	2.68 x 10^{-4}	1.00 x 10^{-3}	4.49 x 10^{-3}	6.77 x 10^{-2}
2	1.00 x 10^{-5}	4.71 x 10^{-4}	1.00 x 10^{-3}	1.00 x 10^{-3}	5.17 x 10^{-2}	1.00 x 10^{-1}
3	1.00 x 10^{-5}	6.82 x 10^{-5}	4.61 x 10^{-4}	1.00 x 10^{-3}	5.33 x 10^{-3}	3.57 x 10^{-2}
4	1.27 x 10^{-5}	1.29 x 10^{-4}	6.62 x 10^{-4}	1.00 x 10^{-3}	2.61 x 10^{-2}	1.00 x 10^{-1}
5	1.20 x 10^{-5}	8.53 x 10^{-5}	3.17 x 10^{-4}	1.14 x 10^{-3}	9.74 x 10^{-3}	4.65 x 10^{-2}

Model calibration is typically judged using qualitative and quantitative methods. At first, a qualitative visual comparison of simulated groundwater elevations and subsidence rates to measured values was performed. Upon achieving visually acceptable results, quantitative methods as presented in the subsections below were applied to further evaluate the quality of the calibration. Finally, from a water accounting perspective, water budget errors are expected to be less than 1 percent (Hill and Tiedeman, 2007; Anderson and Woessner, 1992). The numerical water budget error for the final calibration was 0.1 percent, which is within the limits of acceptable error.

3.8.4.1 Groundwater Elevations

Calibration hydrographs showing both measured and model-generated groundwater elevations are provided in Appendix D. The simulated groundwater elevations reasonably match the measured elevations at most of the target wells in the model. A scatter plot of simulated versus measured groundwater elevations for the 1,371 groundwater level observations in the calibration is shown in Figure 29. The correlation coefficient between the simulated and measured values is 0.95, which is an acceptably large value that exceeds the benchmark value of 0.90 noted in CDWR (2016) and Hill and Tiedemann (2007).

Another common measure of model calibration is the normalized root mean squared error (NRMSE). The 'error' is the difference between the simulated head value and the measured head value. The error is referred to as the 'residual' and the RMSE, which is normalized by the measured range of groundwater elevations in the model ('range').

$$NRMSE = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n} R_i^2}}{range}$$

Where:

n = Number of observations; and

R = Residual (ft).

The NRMSE is expressed as a percent with results less than 10 percent generally considered to be acceptable. The NRMSE for the GFM with respect to groundwater elevations is at an acceptably low value of 6.6 percent (see Figure 29).

3.8.4.2 Land Subsidence

Calibration graphs showing both measured and simulated subsidence are provided in Appendix E. The simulated land subsidence reasonably matches that measured at the Porterville and Delano GPS stations and via satellite at most of the target locations. A scatter plot of simulated versus measured land subsidence for the 2,616 observations in the calibration is shown in Figure 30. The correlation coefficient between the simulated and measured values is at an acceptably large value of 0.94 and the NRMSE for the GFM with respect to land subsidence is at an acceptably low value of 6.5 percent (see Figure 30).

Given the nature of the subsidence data to which the GFM is calibrated, simulated land subsidence by the model is acceptably calibrated to enable projections of relative change in land surface elevation in the future (e.g. 2.1 feet of subsidence). It is not recommended to determine absolute values of projected land surface elevation.

3.8.4.3 Calibration Summary

Based on the acceptably low water budget error and NRMSE values along with the acceptably high correlation coefficients, the GFM is acceptable for its intended use to estimate the future water budget, project future groundwater level changes, and estimate relative changes in future land elevation for evaluating projects and managements actions and estimating the Sustainable Yield of the Subbasin.

The resulting surface and groundwater budgets produced by the calibrated model are presented in Tables 4a, 4b, and 5. A detailed description of the individual water budget items can be found in the Tule Subbasin Setting document (TH&Co, 2020).

4.0 Future Subbasin Management Scenario for Analysis with the Model

In order to evaluate planned projects and management actions of each of the six GSAs within the Tule Subbasin, refine the sustainable yield and develop a future water budget for inclusion in the Subbasin Setting document of the GSPs, TH&Co analyzed a future subbasin management scenario with the calibrated GFM. The future scenario began in October 2017 (the end of the model calibration period) and extended through September 2070 and utilized yearly (i.e., water year) stress periods. Projects and management actions were incorporated into the GFM starting in 2020. The purpose for analyzing the scenario was to assess the sustainability of the planned actions, assess the interaction of the planned actions on groundwater levels between the GSAs, and estimate the sustainable yield of the Subbasin.

4.1 Projects and Management Actions

Projects for incorporation in the future scenario were provided by basin managers from each of the six Tule Subbasin GSAs (see Table 6). Most of the projects involve increases in recycled water recharge, increased basin recharge, changes in water deliveries, capture of flood water, and water banking operations.

Management actions for incorporation into the model were focused on the reduction in crop consumptive use necessary to achieve sustainability (see Table 7). The reduction in crop consumptive use is directly correlated to a reduction in irrigated water demand and groundwater pumping. Each GSA provided a schedule to reduce consumptive use, starting in 2020, in order to achieve sustainable groundwater pumping by 2040. As the availability of surface water supplies from imported water and diverted streamflow is different between the GSAs, each GSA established a different consumptive use reduction, or “transitional pumping,” schedule (see Table 7).

4.2 Assumptions for Municipal Pumping

Future projections for municipal pumping were applied to the City of Porterville. Other cities and communities (e.g., Tipton, Richgrove, etc.) were assumed to continue 2017 pumping rates into the future.

4.3 Assumptions for Hydrology and Surface Water Deliveries on Major Streams

Baseline stream flow hydrology for the Tule River, Deer Creek and White River for the future projection model was based on the 20-yr average of historical stream flows measured or estimated between water years 1990/91 and 2009/10. This base period approximates the 115-year average surface water flow within the Tule River between 1903/04 and 2016/17 (TRA 2018 Annual Report, Appendix). Baseline surface water deliveries to agencies with diversion rights in the future projection were also based on the 20-yr average of deliveries for the period 1990/91 to 2009/10.

The baseline streamflow on the major streams used in the future projection for the model were adjusted to account for projections of future climate change. Adjustments were applied based on output from the DWR's CalSim-II model, which provided adjusted historical hydrology for major drainages based on scenarios recommended by the California Department of Water Resources Climate Change Technical Advisory Group (2015). Climate change adjustments to hydrology and surface water deliveries were applied over two time periods within the SGMA planning horizon, as defined by California Water Commission (2016):

1. A 2030 central tendency time period, which provides near-term projections of potential climate change impacts on hydrology, centered on the year 2030, and
2. A 2070 central tendency time period, which provides long-term projections of potential climate change impacts on hydrology, centered on the year 2070.

Change factors for the 2030 and 2070 central tendency time periods are shown for the hydrology associated with the Tule River historical baseline time period of 1990/91 to 2009/10 on Figure 31. Both the annual change factors and weighted average change factors are shown. In the future projection scenario for the model, TH&Co used the average 2030 change factor for each major stream providing water within the model domain (see Figure 32). The climate adjusted hydrology for these major streams after applying the 2030 change factors ranges from 98 percent to 101 percent of the historical baseline average. The climate adjusted hydrology after applying the 2070 change factors ranges from 95 percent to 101 percent of the historical baseline average. The 2030 central tendency change factors were applied to the future projection scenario from 2025 to 2049. The 2070 central tendency change factors were applied to the future projection from 2050 to 2070.

4.4 Assumptions for Friant-Kern Canal Deliveries

Projected surface water deliveries from the Friant-Kern Canal were based on climate adjusted historical average deliveries from 1990/91 to 2009/10 provided by the Friant Water Authority (FWA, 2018 and supporting Excel files). It is noted that the climate adjusted historical FWA data extended only to 2002/03. Thus, it was necessary to estimate the climate adjusted deliveries for 2003/04 through 2009/10 based on proxy years according to the following schedule:

- 2003/04 – 1946/47
- 2004/05 – 1935/36
- 2005/06 – 1939/40
- 2006/07 – 1975/76

- 2007/08 – 2001/02
- 2008/09 – 1963/64
- 2009/10 – 1950/51

The proxy years were selected based on years when the inflow to Success Reservoir was as close as possible.

The climate adjusted deliveries to each agency included Class I, Class II, and 16B deliveries. Climate adjusted deliveries were also adjusted to account for impacts to deliveries as a result of the San Joaquin River Restoration Project (SJRRP) implementation. All climate change and SJRRP adjustments were applied starting in 2025. Deliveries from the Friant-Kern Canal between 2020 and 2025 were based on the 20-year historical baseline based on 1990/91 to 2009/10. Climate change and SJRRP adjustments were phased in between 2025 and 2030 through a linear interpolation between 2025 baseline deliveries and full application of FWA adjusted deliveries in 2030. TH&Co applied the 2070 central tendency time period climate-related adjustments to imported water deliveries in the Tule Subbasin model projection for the period from 2050 to 2070.

Results of the climate adjustments show that future water deliveries are projected to be generally comparable to historical water deliveries for DEID, KTWD, and Tea Pot Dome WD. Future water deliveries for Porterville ID and Terra Bella ID are projected to increase relative to historical deliveries primarily due to a reduction or elimination of sales and/or transfers that historically occurred. Future water deliveries for LTRID are projected to decrease relative to historical deliveries due to the high proportion of Class 2 supplies which are most impacted by the FWA analysis. Finally, future water deliveries for Saucelito ID are projected to decrease relative to historical deliveries due to changes in sales and/or transfers. Results of the analysis are summarized on Figure 33.

5.0 Analysis of the Future Subbasin Management Scenario

TH&Co used the calibrated GFM to analyze the consumptive use that can be accommodated in the future, given each GSA's planned projects and management actions, without a long-term, subbasin-wide net negative change in groundwater storage. Consumptive use is linked to groundwater pumping (and, therefore, change in groundwater storage) as described in Section 3.5.

While the projects and management actions developed for the future projection scenario provided a conceptual schedule for reduction in consumptive use, they cannot provide the consumptive use necessary to make the Subbasin sustainable. Through an iterative process, the consumptive use in the future projection of the model was adjusted until there was no net negative change in groundwater storage from 2040 to 2050[1]. During this process, neither streamflow diversions nor imported water deliveries were modified from their projected values; the only changes were consumptive use and associated groundwater pumping. In order to maximize the available consumptive use in the Subbasin while avoiding a net negative change in storage, the target consumptive use in all WBAs, and therefore the transitional pumping schedule, was incrementally reduced from an initial condition that resulted in a negative change in storage to one that resulted in no net negative change in storage. The resulting sustainable level of consumptive use was estimated to be approximately 65,000 acre-ft/year. Additional consumptive use can be supported in any given area of the Subbasin by streamflow diversions and imported water supplies, where available.

5.1 Projected Groundwater Budget

The projected surface water and groundwater budgets, based on the future basin management scenario and sustainable consumptive use target for the Tule Subbasin, are shown in Tables 8a, 8b, and 9. The tables are based on the 50th percentile sustainable yield representation of the calibrated GFM. As shown in Table 9 the average annual projected change in groundwater storage between 2040 and 2050, after full implementation of transitional pumping, is positive 900 acre-ft/yr.

5.2 Projected Groundwater Levels

Projected groundwater level trends at calibration target wells within the Tule Subbasin are provided in Appendix F. All projected groundwater levels were generated using the 50th percentile sustainable yield representation of the calibrated GFM. As shown, groundwater levels simulated after 2040 level out for most of the upper and lower aquifer wells relative to their historical and transitional pumping downward trends. Exceptions are upper aquifer wells in the western part of

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[1] Stress periods in the future projection portion of the GFM are based on water years (i.e. October 1 through September 30) and all results are presented as water years (i.e. 2020 is October 1, 2019 through September 30, 2020).

the Subbasin (e.g., Angiola G1 and 32K01) where downward groundwater level trends continue beyond 2040.

5.2.1 2020 – 2040 Transitional Pumping Period

Projected changes in groundwater levels in the upper aquifer (Layer 1) for the transitional pumping time period from 2020 to 2040 are shown on Figure 34. As shown, groundwater levels are below the bottom of Layer 1 throughout much of the eastern portion of the Subbasin, except in the Porterville area where groundwater levels are above the bottom of the layer and projected to remain relatively stable during the transitional pumping period. Groundwater levels in this layer are projected to decline another 100 to 120 feet in the central portion of the Subbasin during the transitional pumping period. Layer 1 groundwater levels in the western portion of the Subbasin are projected to decline another 40 to 80 feet during the transitional pumping period.

Projected changes in groundwater levels in the lower aquifer (Layer 3) for the transitional pumping period from 2020 to 2040 are shown on Figure 35. Layer 3 groundwater levels in the eastern and southeastern parts of the Subbasin are projected to rise. Groundwater levels in the central and northwest parts of the Subbasin are projected to decline another 20 to 40 feet in Layer 3.

5.2.2 2040 – 2050 Sustainability Period

Projected changes in groundwater levels in the upper aquifer (Layer 1) for the time period from 2040 to 2050 are shown on Figure 36. Groundwater levels in Layer 1 during this time period are relatively stable throughout the Tule Subbasin, with slight groundwater level rise predicted for the Porterville area. In Layer 3 (Figure 37), groundwater levels show increases of 20 to 40 feet in the eastern portion of the Subbasin and stable to slightly decreasing groundwater levels in the western portion of the Subbasin.

5.2.3 2050 – 2070 Sustainability Period with Extended Climate Adjustments

Projected changes in groundwater levels in the upper aquifer (Layer 1) for the time period from 2050 to 2070 are shown on Figure 38. Groundwater levels in Layer 1 during this time period trend downward again in the central portion of the Tule Subbasin, with slight groundwater level rise predicted for the Porterville area. In Layer 3 (Figure 39), groundwater levels are predicted to remain stable during this time period with increases of 20 to 40 feet in the eastern portion of the Subbasin. It is noted that the 2070 central tendency climate adjustments were applied during this time period, which reduce the amount of surface water deliveries available to the GSAs and result in downward trends in groundwater levels in Layer 1.

5.3 Projected Land Subsidence

Projected groundwater level trends at calibration target wells within the Tule Subbasin are provided in Appendix G. As land subsidence is correlated with groundwater level decline, continued land subsidence is expected during the transitional pumping period from 2020 to 2040 as groundwater levels continue to drop in the central and northwest parts of the Subbasin (see Figure 40). As much as eight feet (average of 0.4 ft/yr) of additional land subsidence is predicted in the northern Tri-County Water Agency GSA, western Pixley Irrigation District GSA, and northern LTRID GSA. Up to four feet (average of 0.2 ft/yr) of land subsidence is also predicted beneath the Friant-Kern Canal between Deer Creek and White River (see Figure 40).

Between 2040 and 2050, the rate of land subsidence decreases as groundwater levels stabilize throughout most of the Subbasin (see Figure 41). Up to three feet (average of 0.3 ft/yr) of land subsidence is still predicted to occur in isolated areas of the northern Tri-County Water Agency GSA, western Pixley Irrigation District GSA, and northern LTRID GSA. Less than 0.5 feet (average of 0.05 ft/yr) of land subsidence is predicted in the vicinity of the Friant-Kern Canal during this time period.

Land subsidence between 2050 and 2070 is predicted to continue in the western part of the Tule Subbasin as a result of declining groundwater levels in Layer 1 in this area (see Figure 42). Up to four feet (average of 0.2 ft/yr) of land subsidence is predicted during this time period for the northern Tri-County Water Agency GSA at the western boundary of the Subbasin. Up to three feet (average of 0.15 ft/yr) of additional land subsidence is predicted for the southern Tri-County Water Agency GSA and Alpaugh Irrigation District GSA areas.

5.4 Sustainable Yield

The sustainable yield of the Tule Subbasin is a function of the overall water balance of the area. Changes in surface water/groundwater inflow to the basin and surface water/groundwater outflow from the basin impact the sustainable yield. As groundwater management and land use changes impact the water balance, they also impact the sustainable yield. A generalized expression of the water balance is as follows:

$$\text{Inflow} - \text{Outflow} = +/- \text{ Change in Storage} \qquad (1)$$

The water balance equation for pre-developed conditions (prior to human occupation) can be further expressed as:

$$(I_{pr} + I_{str} + I_{ss} + I_{mb}) - (O_{ss} + O_{et}) = \Delta S \qquad (2)$$

Where:

I_{pr} = Inflow from Areal Recharge of Precipitation

I_{str} = Inflow from Infiltration of Runoff in Stream Beds

I_{ss} = Inflow from Subsurface Underflow

I_{mb} = Inflow from Mountain-Block Recharge

O_{ss} = Subsurface Outflow

O_{et} = Evapotranspiration

ΔS = Change in Groundwater Storage

Under pre-developed conditions, the Subbasin would be in a state of equilibrium such that the inflow and outflow would balance and there would be no significant long-term change in storage assuming a static climatic condition. Under this condition, groundwater levels would be relatively stable.

Under developed land use conditions, the water balance changes as groundwater is pumped from the basin for irrigation and municipal supply, diversions of streamflow occur, and imported water is delivered to the Subbasin. Lowering of the groundwater table resulting from pumping reduces the amount of groundwater that would otherwise leave the Subbasin and reduces evapotranspiration losses in areas of shallow groundwater (e.g., Tulare Lake). Some of the pumped groundwater used for irrigation infiltrates past the roots of the plants and returns to the groundwater as return flow. Water imported into the area is applied to crops but some is lost as infiltration in unlined canals and as return flow. Groundwater return flow also occurs as a result of discharges from individual septic systems. Inflow from the compression of aquitards as a result of subsidence also contributes water to the aquifer system. Other sources of recharge to the groundwater under developed land use include wastewater treatment plant discharges and artificial recharge in spreading basins.

The water balance equation for developed land use conditions can be modified as follows (flows in **bold** are not included in the sustainable yield):

$$(I_{pr} + I_{str} + \mathbf{I_{can}} + \mathbf{I_{ar}} + \mathbf{I_{rfgw}} + \mathbf{I_{rfimp}} + \mathbf{I_{com}} + I_{ss} + I_{mb}) - (O_{ss} + O_{et} + \mathbf{O_{p}}) = \Delta S \qquad (3)$$

Where:

I_{can} = Inflow from Canal Losses

I_{ar} = Inflow from Artificial Recharge

I_{rfgw} = Inflow from Return Flow of Applied Water from Groundwater Pumping
I_{rfimp} = Inflow from Return Flow of Applied Water from Imported Water
I_{com} = Inflow of Water Released from Compression of Aquitards
O_p = Outflow from Groundwater Pumping

If the inflow terms exceed the outflow terms, then the groundwater in storage increases (become positive) and groundwater levels rise. If the outflow terms exceed the inflow, then the groundwater in storage decreases (become negative) and groundwater levels drop. It is assumed that the sustainable yield of the Tule Subbasin is the long-term average groundwater pumping rate, under projected land use conditions, that results in no significant long-term net negative change in groundwater storage in the basin. Based on this premise, the water balance equation can be rearranged and simplified to estimate sustainable yield:

$$\text{Sustainable Yield} = \Delta S + \mathbf{O_p} - \mathbf{I_{can}} - \mathbf{I_{ar}} - \mathbf{I_{rfimp}} - \mathbf{I_{com}} \qquad (4)$$

Thus, if the change in groundwater storage over the planning period is zero and there is no imported water or release of water from compression of aquitards, then the sustainable yield is equal to the pumping. This relationship is valid if the following conditions are met:

1. The sustainable yield incorporates a hydrology that is representative of a relatively long period of record that includes multiple wet and dry hydrologic cycles.
2. The land use conditions are representative of the time period.

The sustainable yield can also be expressed as all of the components of the water balance not explicitly expressed in Equation 4:

$$\text{Sustainable Yield} = I_{pr} + I_{str} + I_{rfgw} + I_{ss} + I_{mb} - O_{ss} \qquad (5)$$

It is noted that the Tule Subbasin Technical Advisory Committee has determined that recharge to the Tule Subbasin associated with the delivery of imported water and the diversion of water from the Tule River and Deer Creek associated with Pre-1914 water rights will not be included in the sustainable yield of the Subbasin. This includes canal losses from delivery of imported water and diverted stream flow, deep percolation of applied imported water and diverted stream flow, and managed recharge in basins.

Applying Equations 4 and 5 to the historical water budget of the Tule Subbasin does not result in a representative sustainable yield because the Subbasin was in overdraft during the historical water budget period. Groundwater pumping depressions that have developed in the western portion of the Subbasin have historically captured groundwater that would have otherwise left the Subbasin. This increase in groundwater inflow and decrease in groundwater outflow resulted in an apparent sustainable yield that was higher than was actually sustainable. Further, some of the return flow associated with historical overdraft contributed to the unrealistically high historical sustainable yield. The apparent sustainable yield based on the water budget from water year 1990/91 to 2009/10 was reported to be approximately 258,000 acre-ft/yr (TH&Co, 2017b). However, since the downward groundwater trends that resulted in this condition are not sustainable, the associated sustainable yield from this water budget is not representative.

The sustainable yield of the Tule Subbasin will change in the future as a result of changes in groundwater levels and flows associated with planned projects and management actions and changes in deep percolation of applied water (i.e., return flow) from reduced groundwater pumping. This necessary action will change the water budget by not only decreasing outflow from groundwater pumping but also reducing deep percolation of applied water (return flow) and changing the dynamics of inflow and outflow at the Subbasin boundaries. This new water budget regime will result in a sustainable yield that is different from what was realized historically. The projected groundwater budget from the analysis of the future basin management scenario using the calibrated groundwater flow model was the basis for the sustainable yield estimate of the Tule Subbasin. This analysis resulted in a sustainable yield of 130,000 acre-ft/yr.

5.5 Uncertainty Analysis

To paraphrase from CDWR (2016), gaining a sense of the magnitude of the uncertainty in model predictions allows decision makers to accommodate the reality that model results are imperfect forecasts and actual subbasin responses to management actions will vary from those predicted by modeling. To this end, output from PEST and its associated utility programs were used to address the uncertainty in estimates of sustainable yield for the Subbasin and subsidence along the Friant-Kern Canal. This approach provided 240 calibrated versions (‘realizations’) of the GFM. Each realization was comprised of different configurations of aquifer parameters, consumptive use, and mountain block recharge.

5.5.1 Uncertainty in Sustainable Yield Estimate

The future water budgets from each of the 240 calibrated realizations of the model were processed, based on Equation 5 in Section 5.4, to produce sustainable yield estimates for each year of the 50-yr implementation and planning horizon (2020 to 2070). Of the original 240 model realizations, 175 resulted in a projected average annual change in groundwater storage greater than -5,000 acre-ft/yr. The 50th percentile sustainable yield for the time period from 2040 to 2050 was used as the sustainable yield for the 175 model realizations resulting in greater than -5,000 acre-ft/yr of annual storage change. The 175 estimates of sustainable yield are normally distributed (see Figure 43). The time period from 2040 to 2050 was selected because it occurs after all planned projects and management actions have been implemented but before the time when the less reliable long-term climate change adjustments to hydrology and water deliveries are applied to the projected water budget (2050).

The projected future sustainable yield of the Tule Subbasin, which is the 50th percentile of the distribution of estimates derived from the uncertainty analysis, is estimated to be approximately 130,000 acre-ft/yr (see Table 10). The plausible range of sustainable yield was selected as the values between the 20th and 80th percentile, resulting in a range of approximately 108,000 to 162,000 acre-ft/yr (see Figure 43). The projected sustainable yield does not include:

- Diverted Tule River water canal losses, recharge in basins, and deep percolation of applied water,
- Diverted Deer Creek water canal losses, recharge in basins, and deep percolation of applied water,
- Imported water canal losses, recharge in basins, and deep percolation of applied water, and
- Deep percolation of applied recycled water and recycled water recharge in basins.

As the groundwater model predicts some continued land subsidence in the Tule Subbasin between 2040 and 2050, there is a contribution of approximately 18,000 acre-ft/yr of water to the aquifer from the compression of aquitards during this time period (see Table 9). This contribution is included in the water budget that results in no net negative change in groundwater storage over the time period. The implication for this is that the sustainable yield for the Subbasin is somewhat lower than reported because the contribution of water to the aquifer from compression of aquitards is not sustainable. Nonetheless, given the uncertainty in model results, the current estimate of 130,000 acre-ft/yr is recommended until more data are collected and the model is updated.

5.5.2 Uncertainty in Friant-Kern Canal Subsidence

The 240 realizations of the GFM were also used to assess the uncertainty in simulated land subsidence along the Friant-Kern Canal for the future subbasin management scenario. The target period for this assessment is the 2020 to 2040 transitional pumping period. Figure 44 displays the uncertainty in simulated subsidence at various milepost locations along the Canal using ‘box-and-whisker’ diagrams. These diagrams show various statistics for simulated subsidence. Specifically, the top of the ‘box’ portion (the brown-shaded, vertically-oriented rectangle) is the 25th percentile whereas the bottom is the 75th percentile. Within the box is a horizontal line (i.e., the 50th percentile or ‘median’) and an ‘X’, which identifies the arithmetic average (i.e. ‘mean’) value. The top and bottom of each whisker represents the ‘local minimum’ and ‘local maximum’ values. These ‘local’ statistics are those associated with the simulated values after outliers are removed. Outliers are defined as those values less than or greater than 1.5 times the interquartile range (i.e., 1.5 times the difference between the 25th and 75th percentile values).

Considering the simulated subsidence shown on Figure 44 for the two locations between Milepost 106 and 108, the plot shows the simulated values to range from 1.0 to 5.1 feet and 1.6 to 4.6 feet for the northern and southern locations, respectively.

For comparison, the simulated land subsidence associated with the realization for the 50th percentile sustainable yield (shown as the continuous thick black line extending from left to right across the figure) is approximately 3.2 feet at both locations. Considering the southern location (i.e., closer to Milepost 108), this value roughly corresponds to the 75th percentile. That is, the simulated subsidence for 25 percent of the 240 realizations (60 realizations) for this location exceed 3.2 feet. The simulated subsidence associated with the realization for the 50th percentile sustainable yield exceeds the median subsidence value at those locations with the highest simulated medians (i.e., those located between Milepost 105 and Milepost 108).

6.0 Summary of Findings

A calibrated numerical groundwater flow model has been developed for the Tule Subbasin in support of informing GSPs for the six GSAs within the Subbasin. The model has been calibrated to industry standards with respect to both groundwater levels and land subsidence and is sufficient for informing future potential groundwater level and land surface elevation changes associated with planned projects and management actions. The calibrated groundwater flow model was used to assess a future groundwater budget and determine a sustainable yield for the Tule Subbasin based on planned projects and management actions that resulted in no net negative change in groundwater storage for the ten-year period after the 2040 SGMA sustainability deadline.

The following summarizes the findings from the model analysis:

- The sustainable yield of the Tule Subbasin is estimated to be approximately 130,000 acre-ft/yr. The sustainable yield does not include recharge from imported water delivery losses, recharge in basins and return flow; recharge from surface water diversion from the Tule River and Deer Creek associated with delivery losses, recharge in basins and return flow; and recharge of recycled water return flow and recharge in basins.
- Uncertainty analysis indicates that the plausible range of sustainable yield is approximately 108,000 to 162,000 acre-ft/yr.
- The future sustainable yield of the Subbasin is lower than the historical sustainable yield as a result of reduced irrigation return flow, reduced subsurface inflow, and increased subsurface outflow along the subbasin boundaries.
- The amount of crop consumptive use that can be supported by the sustainable yield is estimated to be approximately 65,000 acre-ft/yr with additional consumptive use supported by streamflow diversions and imported water supplies, where available.
- Although the overall water budget for the Tule Subbasin is projected to be in balance between 2040 and 2050, there are areas of the Subbasin where groundwater levels are still projected to decline through the planning horizon. It is anticipated that these localized areas of recharge and discharge imbalance can be addressed through basin management actions in the individual GSAs in which they occur.
- As much as approximately four feet of additional land subsidence is projected to occur beneath the Friant-Kern Canal during the transitional pumping period from 2020 to 2040. The greatest land subsidence is projected to occur in the area of the canal between Deer Creek and White River.
- Land subsidence is projected to be arrested after 2040 throughout most of the Tule Subbasin as a result of projected stabilizing of groundwater levels. Continued land subsidence is projected in the northwestern portion of the Subbasin and in the northern