Tule Lake Subbasin

Groundwater Sustainability Plan

Revised Groundwater Sustainability Plan

Tulelake Subbasin
GROUNDWATER
Sustainability Agency

TID

CITY OF TULELAKE
Established 1937

COUNTY OF MODOC
CALIFORNIA
1874

COUNTY OF SISKIYOU
CALIFORNIA
1852

MBK ENGINEERS
455 UNIVERSITY AVE. SUITE 100
SACRAMENTO, CA 95825

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List of Acronyms and Abbreviations

1902 Act	1902 Reclamation Act	MOU	Memorandum of Understanding
2017 Standard Criteria	Water Management Plan 2017 Standard Criteria	MT	Minimum Threshold
AB	Assembly Bill	NCCAG	Natural Communities Commonly Associated with Groundwater
AEM	Airborne Electromagnetic	NGS	National Geodetic Survey
BMP	Best Management Practices	NOI	Notice of Intent
CASGEM	California Statewide Groundwater Elevation Monitoring	PWS	Public Water System
CDFW	California Department of Fish and Wildlife	Reclamation	U.S. Bureau of Reclamation
Core Team	Tulelake Subbasin GSP Core Team	SB	Senate Bill
DWR	California Department of Water Resources	SGMA	Sustainable Groundwater Management Act
ESA	Endangered Species Act	SMC	Sustainable Management Criteria
GAMA	Groundwater Ambient Monitoring and Assessment Program	SMCL	Secondary Maximum Containment Level
GDE	Groundwater Dependent Ecosystems	SNMP	Salt and Nutrient Management Plans
GPS	Global Positioning System	SWN	State Well Number
GSA	Groundwater Sustainability Agency	SWRCB	State Water Resources Control Board
GSP or Plan	Groundwater Sustainability Plan	TDS	Total Dissolved Solids
GWMP	Groundwater Management Plan	TID	Tulelake Irrigation District
HCM	Hydrogeologic Conceptual Model	TLNWR	Tule Lake National Wildlife Refuge
ILRP	Irrigated Land Regulatory Program	TNC	The Nature Conservancy
InSAR	Interferometric Synthetic Aperture Radar	TSS	Technical Support Services
KID	Klamath Irrigation District	UKL	Upper Klamath Lake
KPDRA	Klamath Project Drought Response Agency	USGS	U.S. Geological Survey
KWAPA	Klamath Water and Power Agency	UTM	Universal Transverse Mercator
LKNWR	Lower Klamath National Wildlife Refuge	VOC	Volatile Organic Compounds
LRDC	Lost River Diversion Channel	WDL	Water Data Library
MCL	Maximum Containment Level	WMP	Water Management Plan
MCLG	Maximum Containment Level Goal	WUMP	Water User Mitigation Program

Executive Summary

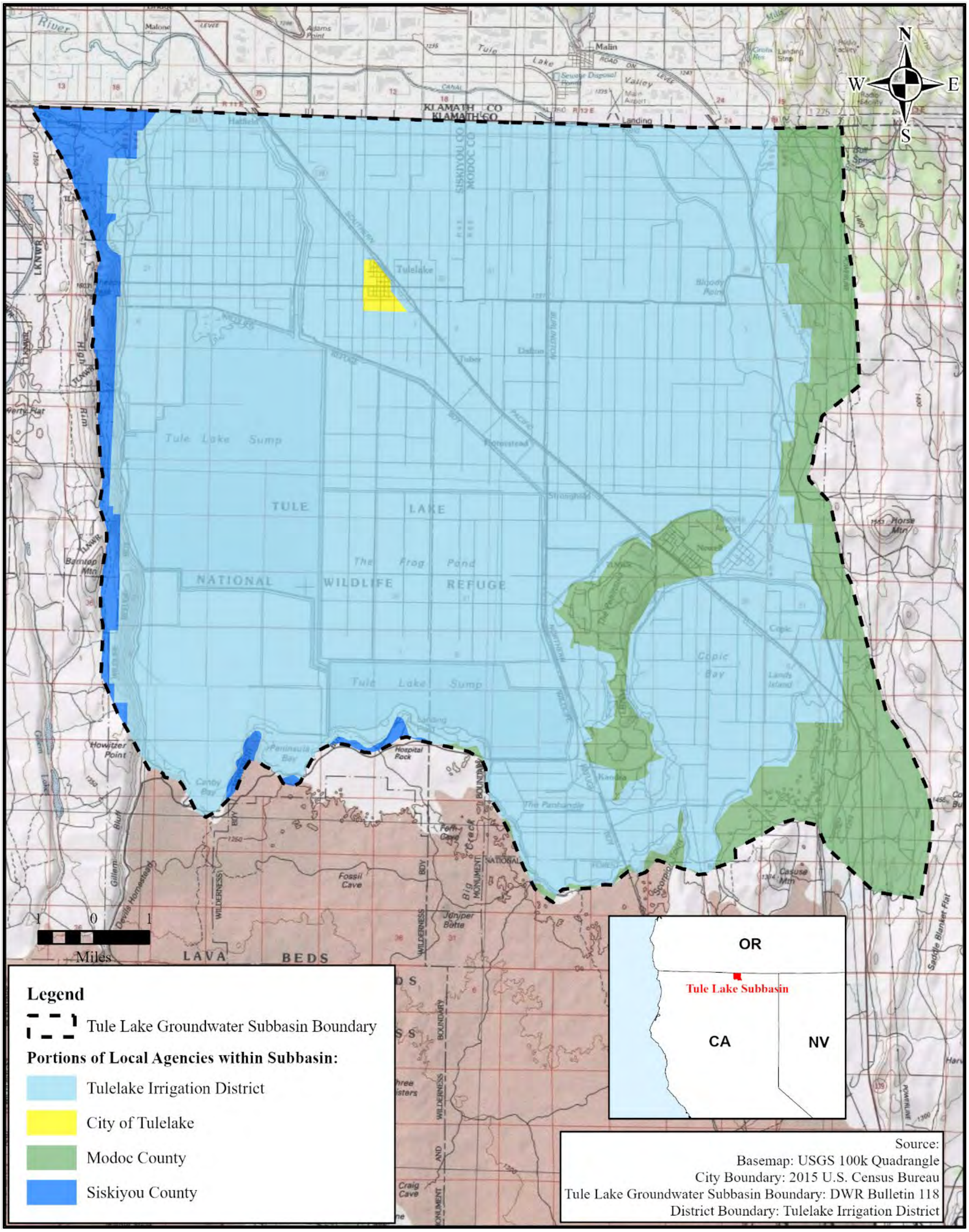
Introduction

On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative package, composed of Assembly Bill (AB) 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (SGMA), which is codified in Section 10720 et seq. of the California Water Code. The purpose of this Groundwater Sustainability Plan (GSP or Plan) is to bring the Klamath River Valley – Tule Lake Subbasin (Tule Lake Subbasin or Subbasin), a medium priority basin, into sustainable groundwater management by 2042, which would meet the requirements of SGMA.

Sustainability Goal and Agency Information

The sustainability goal for the Tule Lake Subbasin is to ensure that by 2042 the Subbasin is being locally managed and operated in order to maintain a reliable water supply for current and future beneficial uses, without causing undesirable results.

There are four GSAs in the Tule Lake Subbasin: the Tulelake Irrigation District (TID) GSA, the Modoc County GSA, the Siskiyou County GSA, and the City of Tulelake GSA. Collectively, these four GSAs will be referred to as “GSAs”. Figure ES-1 shows the location of the Tule Lake Subbasin and the GSAs.



Source:
Basemap: USGS 100k Quadrangle
City Boundary: 2015 U.S. Census Bureau
Tule Lake Groundwater Subbasin Boundary: DWR Bulletin 118
District Boundary: Tulelake Irrigation District

Figure ES-1. Location of the Groundwater Sustainability Agencies within the Tule Lake Subbasin

Plan Area

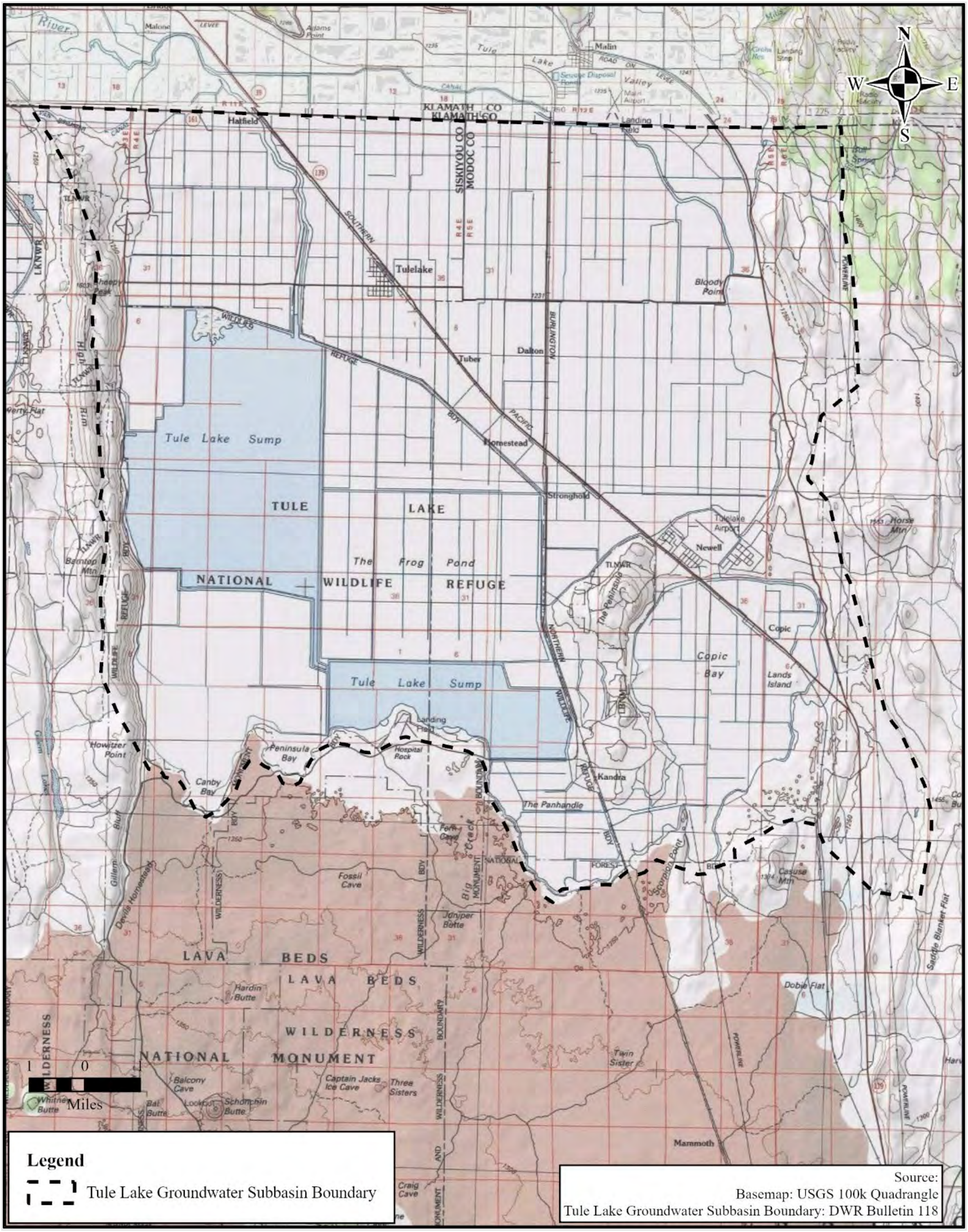
This GSP covers the entire Tule Lake Subbasin, which comprises approximately 64,000 acres of irrigated land near the California-Oregon border. The Subbasin is part of the larger Upper Klamath Basin, which extends into Oregon, and is located within the North Coast Hydrologic Region. The Subbasin is within Modoc County and Siskiyou County, which have been respectively identified as "severely disadvantaged" and "disadvantaged" communities. The majority of land in the Subbasin is also in TID, which covers approximately 84% of the Subbasin. As the most prominent public agency within the Subbasin, TID has been the primary GSA responsible for recent planning activities.

TID provides surface water to its customers; however, both TID and many landowners also have private irrigation wells which are used when surface water is limited. The City of Tulelake and the Town of Newell (served by the Newell County Water District) rely exclusively upon groundwater to serve their customers, while residents outside of the City of Tulelake and Newell County Water District service areas rely upon domestic wells for their water supply. Therefore, the entire population of approximately 2,400 people are dependent on groundwater for domestic purposes.

Hydrogeologic Conceptual Model

The Tule Lake Subbasin is located within the Upper Klamath Groundwater Basin, which is approximately 8,000 square miles, and is located in South Central Oregon and northeastern California on the east side of the Cascade Mountain Range. The Subbasin is bounded to the east and west by fault zones, to south by low-lying volcanic fields, and to the north by faults along a mountain block. For the purposes of SGMA and this GSP, the Subbasin is bounded to the north by the state boundary of Oregon and California, as shown in Figure ES-2.

In general, two aquifer systems have been identified in the Subbasin – the alluvial aquifer system and the volcanic aquifer system. The alluvial aquifer system (primary aquifer) consists of surficial deposits that extend to over 1,000 feet deep in the center of the basin. The volcanic aquifer system consists of the Upper, Intermediate, and Lower basalt units, as well as pyroclastic and tuffaceous deposits. The volcanic units of the Subbasin comprise the bedrock and produce groundwater through fractures and voids. In locations throughout the Subbasin, the volcanic units may be interbedded with basin fill deposits (DWR 2002).



Source:
Basemap: USGS 100k Quadrangle
Tule Lake Groundwater Subbasin Boundary: DWR Bulletin 118

Figure ES-2. Tule Lake Subbasin Boundary

Groundwater Conditions

The main source of water within the Subbasin is surface water from the Klamath River. The water is made available to TID from the Klamath Reclamation Project for irrigation purposes through an intertie between the Klamath River and the Lost River. TID also receives tailwater from Klamath River water users located north of the California-Oregon Stateline. At times, the Lost River provides some surface water to TID. Groundwater is pumped for uses other than irrigation, and to meet irrigation demands when not enough surface water supply is available. Groundwater levels within the Subbasin fluctuate partially as a result of the amount of surface water delivered to TID. Since 2001, the reduction in available surface water supplies has resulted in an increase in groundwater extraction within the Klamath Reclamation Project, including the GSP area. As a result, recent trends in groundwater elevation are reflective of not only climatic conditions and surface water recharge, but also the generally increased (although varying) levels of annual groundwater extraction.

The quality of groundwater in the Subbasin is suitable for current uses. Public Water Suppliers rely on groundwater as it is their water source in the Subbasin. Therefore, it is important to note that the groundwater supply meets drinking water standards without treatment.

There has been no documented inelastic subsidence within the Subbasin to date. However, some elastic subsidence is noted annually in response to seasonal groundwater level fluctuations.

Surface water presence in the Subbasin is dependent upon deliveries of water by the U. S. Bureau of Reclamation (Reclamation) from the Klamath Project. Within the Subbasin, surface water systems include the small reach of the Lost River which extends into the Tulelake area and the “Sumps”. As part of Reclamation’s Klamath Project this system is highly regulated, and flows in the Lost River and water levels within the Sumps are dependent on surface water deliveries made available by Reclamation from the Klamath Project. The section of the Lost River within the Subbasin is referred to as the lower Lost River Improved Channel. Flow in this section is dependent on spill of Klamath Project water at the Anderson-Rose Dam during the irrigation season. Therefore, it is generally considered an irrigation channel and not a natural river channel.

The Natural Communities Commonly Associated with Groundwater (NCCAG) database was used to identify plants commonly associated with groundwater use and determine potential groundwater dependent ecosystems (GDE). Most NCCAGs are located adjacent to canals or other water delivery facilities and assumed to be dependent on surface water; however, remaining assumed GDEs will be verified through field investigations.

Monitoring Networks

Groundwater levels and water quality in the Subbasin have been monitored by the GSAs and other local, state, and federal agencies. Beginning in the 1980s, groundwater elevation data have been collected by DWR and the USGS within the GSP area. Prior to 1999, DWR monitored groundwater elevations in five wells twice each year (spring and fall). In 1999, an expanded groundwater monitoring program was developed through a contract with Reclamation to increase the monitoring well network from five wells to thirty-five (35) wells. By the mid-2000s the monitoring well network had expanded to an average of seventy (70) wells monitored on a monthly basis within the Subbasin and an adjacent subbasin (the Lower Klamath Subbasin).

A total of 15 wells were selected for the representative groundwater level monitoring network based on their spatial distribution throughout the Subbasin and their construction/screening details. The representative groundwater level monitoring network is the network that is used to monitor chronic lowering of groundwater levels, changes in storage, and land subsidence. Because there are no known areas of degraded water quality or contaminant plumes which need to be actively monitored, the water quality monitoring network relies on existing wells used for monitoring water quality within the Subbasin, which are public water supply wells.

The data from the wells within the monitoring networks will continue to build on existing data to track short-term, seasonal, and long-term trends in groundwater and related surface conditions. The monitoring network, through evaluation of changes in groundwater levels, will support estimates of annual changes in water budget components.

Water Budget Information

To prepare water budgets for the Subbasin, an integrated groundwater/surface water flow model of the area encompassing the Subbasin in portions of Siskiyou and Modoc counties in California, and extending to the north of the Subbasin within Klamath County, Oregon, was developed. The model integrates the three-dimensional groundwater and surface-water systems, land surface processes, and water management operations. Development of this model included the assimilation of information on land use, water infrastructure, hydrogeologic conditions, and agricultural water demands and supplies.

Table ES.1 presents the groundwater budget for the historical, current, projected baseline, and projected with climate change scenarios. Based on information from the historical water budget, the sustainable yield of the Subbasin is estimated to be approximately 48,000 acre-feet. The Subbasin is known to experience annual fluctuations in groundwater levels which generally depend on hydrology and surface water supply available from the Klamath Project. This will continue into the future; however, current projections indicate that the Subbasin will remain sustainable.

Table ES.1. Water Budget Summary

Groundwater Budget Term	Historical	Current	Projected Baseline	Projected w/ Climate Change
	2000 - 2018 Avg (TAF)	2018 (TAF)	2019 - 2071 Avg (TAF)	2019 - 2071 Avg (TAF)
Groundwater Recharge from Precipitation & Applied Water	59	80	59	63
Canal Laterals Leakage	92	93	93	93
Tulelake Sumps Leakage	5	7	6	6
Main Canals and Lost River Leakage	63	72	66	66
Subsurface Flow Into Subbasin	17	17	15	14
Total Inflow	**236**	**268**	**238**	**242**
Irrigation & M&I Groundwater Pumping	42	27	42	42
Private Groundwater Pumping	6	5	6	6
Groundwater Discharge to Drains	171	192	165	165
Shallow Groundwater Evapotranspiration	5	4	5	5
Groundwater Discharge to Tulelake Sumps	0	0	0	0
Groundwater Discharge to Main Canals and Lost Rivers	2	2	1	1
Subsurface Flow Out of Subbasin	14	21	20	22
Total Outflow	**240**	**251**	**238**	**242**
Change in Storage	-4	17	0	0

Sustainable Management Criteria and Sustainability Goal

The GSPs sustainable management criteria is used to define conditions that constitute sustainable groundwater management for the Subbasin, which includes the sustainability goal, undesirable results, and the minimum thresholds for each applicable sustainability indicator. The entirety of Subbasin is identified as either a Disadvantaged Community or a Severely Disadvantaged Community, and the primary use of water in the Subbasin is for agricultural purposes. Therefore, the sustainability goal for the Tule Lake Subbasin is to maintain a locally governed, economically viable, reliable, and sustainable groundwater subbasin for current and future beneficial uses, without causing undesirable results.

Undesirable Results, Measurable Objectives, and Minimum Thresholds were defined for each of the Sustainability Indicators:

- Chronic Lowering of Groundwater Levels
- Depletion of Interconnected Surface Water
- Degraded Water Quality
- Land Subsidence

- Seawater Intrusion (not applicable to Tule Lake Subbasin)
- Reduction in Groundwater Storage

Sustainable Management Criteria established for chronic lowering of groundwater levels will be used as a proxy for depletion of interconnected surface water, land subsidence, and reduction in groundwater storage.

Projects and Management Actions

The Tule Lake Subbasin is currently being sustainably managed. Therefore, no projects or management actions are required to achieve sustainability; however, the Tule Lake Subbasin GSAs have identified projects and management actions that can improve their understanding of the groundwater subbasin. Due to the standing of the subbasin, these projects and management actions are intended to help reduce or eliminate data gaps identified throughout this GSP and will be implemented based on the availability of resources and funding.

Projects and management actions currently proposed include development of a well inventory, construction of dedicated groundwater monitoring wells, expansion of the water quality monitoring network to include additional wells, potential groundwater dependent ecosystems field investigations, groundwater recharge, domestic well assistance program, and an adaptive management strategy.

Plan Implementation

Implementation of this GSP includes consideration of the implementation costs, the schedule of implementation, reporting, and periodic evaluations. These considerations cover both the projects and the management actions, as well as non-project and non-management actions that are required in order to successfully implement the Plan. The final Plan will be submitted to DWR no later than January 31, 2022. Following the submittal, there are reporting and periodic evaluation requirements. On at least a quarterly basis, the GSAs plan to hold public meetings in order to discuss the status of the reporting requirements, and the projects and management actions. These meetings will help to ensure that the GSP is implemented, and that the sustainability goal is maintained.

1 Introduction

1.1 Purpose of the Groundwater Sustainability Plan

On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative package, composed of Assembly Bill (AB) 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (SGMA), which is codified in Section 10720 et seq. of the California Water Code. The purpose of this Groundwater Sustainability Plan (GSP or Plan) is to bring the Klamath River Valley – Tule Lake Subbasin (Tule Lake Subbasin or Subbasin), a medium priority basin, into sustainable groundwater management by 2042, which would meet the requirements of SGMA. A GSP is required to be prepared in order to manage a medium-priority basin by January 31, 2022, and to achieve sustainable groundwater management within the subbasin by 2042. Under SGMA, a GSP is prepared and implemented by a Groundwater Sustainability Agency (GSA).

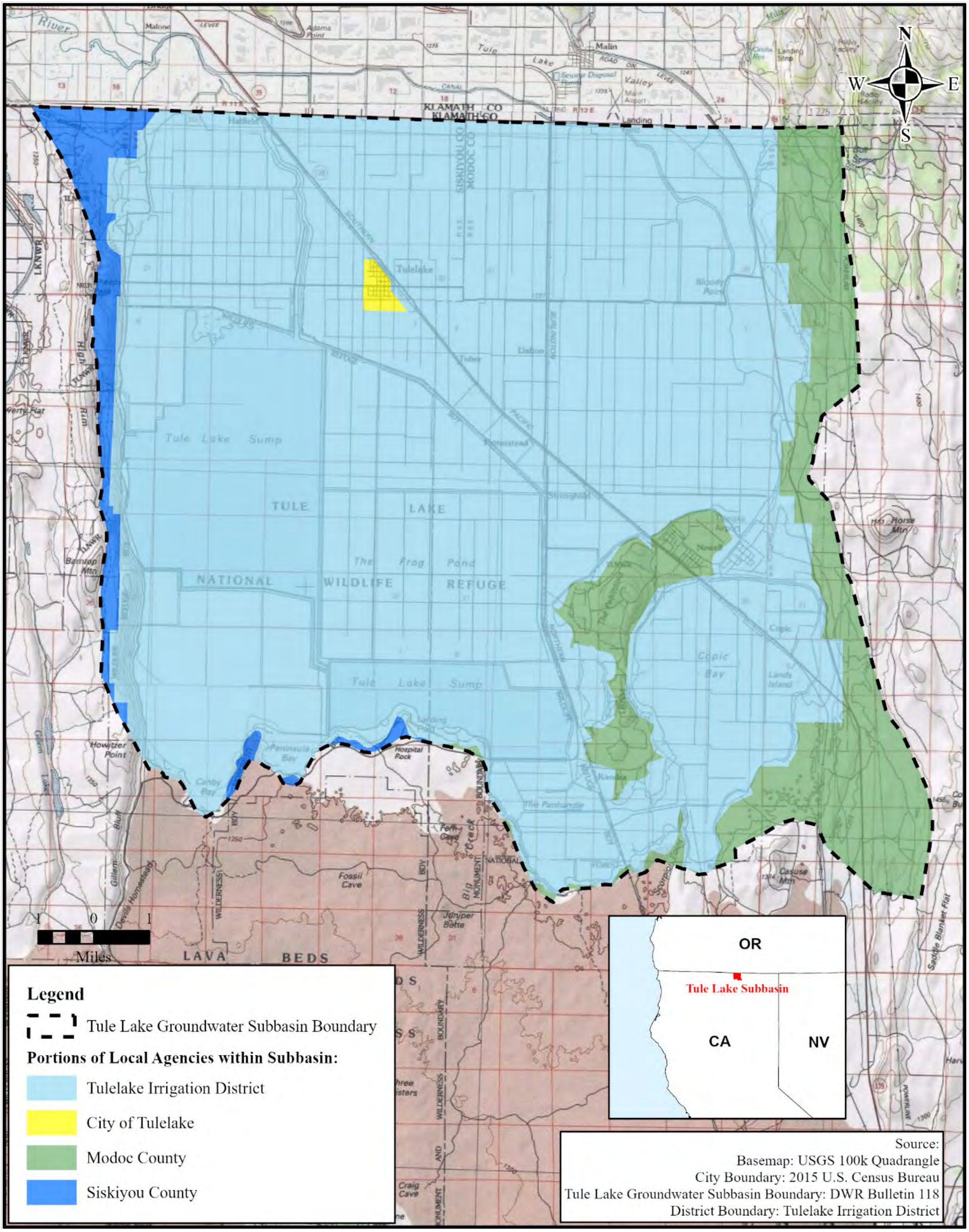
In SGMA, sustainable groundwater management is defined as management of groundwater supplies in a manner that can be maintained in planning and implementation phases without causing undesirable results. Undesirable results include significant and unreasonable chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and depletions of interconnected surface waters.

1.2 Sustainability Goal

The sustainability goal for the Tule Lake Subbasin is to ensure that by 2042 the Subbasin is being locally managed and operated to maintain a reliable water supply for current and future beneficial uses, without causing undesirable results. More information regarding the Sustainability Goal and the Quantitative Sustainable Management Criteria (SMC) for the Subbasin is in Section 5.

1.3 Agency Information (Reg. § 354.6)

There are four GSAs in the Tule Lake Subbasin: the Tulelake Irrigation District (TID) GSA, the Modoc County GSA, the Siskiyou County GSA, and the City of Tulelake GSA. Collectively, these four GSAs will be referred to as “GSAs”, all of which are shown in Figure 1-1.



Source:
Basemap: USGS 100k Quadrangle
City Boundary: 2015 U.S. Census Bureau
Tule Lake Groundwater Subbasin Boundary: DWR Bulletin 118
District Boundary: Tulelake Irrigation District

Figure 1-1. Location of the Groundwater Sustainability Agencies within the Tule Lake Subbasin

A copy of the Initial Notification to develop a Groundwater Sustainability Plan filed by the TID GSA on behalf of the Tule Lake Subbasin is included in Appendix A. Similarly, the Notices of Intent filed by the GSAs to adopt the GSP and the revised GSP are included in Appendix A.

The contact information for each of the GSAs and the GSP Plan Manager is listed below:

Tulelake Irrigation District GSA

The Tulelake Irrigation District GSA consists of the portion of the Subbasin within the boundary of Tulelake Irrigation District. The mailing address for the Tulelake Irrigation District GSA is:

Tulelake Irrigation District GSA
P.O. Box 699
Tulelake, CA 96134

Modoc County GSA

The Modoc County GSA consists of the portion of the Subbasin within the jurisdictional boundary of Modoc County, and outside the boundary of TID. Modoc County meets the requirements of a severely disadvantaged community. The mailing address for the Modoc County GSA is:

Clerk of the Board
204 S. Court Street
Alturas, CA 96101

Siskiyou County

The Siskiyou County GSA consists of the portion of the Subbasin within the jurisdictional boundary of Siskiyou County, and outside the boundary of TID. Siskiyou County meets the requirements of a disadvantaged community. The mailing address for the Siskiyou County GSA is:

County Clerk
510 North Main St.
Yreka, CA 96097

City of Tulelake

The City of Tulelake GSA consists of the portion of the Subbasin within the jurisdictional boundary of the City of Tulelake. The mailing address for the City of Tulelake GSA is:

City Clerk
P.O. Box 847
Tulelake, CA 96134

Tule Lake Subbasin GSP Plan Manager

SGMA Regulation § 354.6(c) requires that the GSP provide the contact information for the Plan Manager. The contact information for the Tule Lake Subbasin GSP is:

Brad Kirby
Tulelake Irrigation District GSA
P.O. Box 699
Tulelake, CA 96134
Phone: (530) 667-2249
Email: bkirby@tulelakeid.com

1.3.1 Organization & Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

During August 2017, the GSAs executed a "Memorandum of Understanding Regarding Development and Implementation of a Groundwater Sustainability Plan for the Tulelake Groundwater Subbasin" (MOU). The MOU is provided as Appendix B to this document. The MOU established the Tule Lake Subbasin GSP's Core Team (Core Team), comprised of representatives from each GSA and responsible for directing and coordinating the development, financing, and implementation of the GSP, and satisfying the requirements of SGMA. In addition, a diverse group of advisory members, who were selected through an application process, informed the Core Team during GSP development. The advisory members consist of an environmental conservation water user, a residential domestic water user, an agricultural groundwater/surface water user, and an Oregon groundwater/surface water user. See Appendix C for a list of the advisory members.

1.3.2 Legal Authority of the GSA

Tulelake Irrigation District, Modoc County, Siskiyou County, and the City of Tulelake are local public agencies with existing statutory authorities that each decided to form a GSA. The MOU (Appendix B) between the four GSAs describes the additional authorities provided to the GSAs by SGMA. In addition, the MOU memorialized the GSAs' intent to exercise their existing authorities, and those provided by SGMA, in order to develop and implement this GSP.

1.3.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

Development of this GSP was substantially funded through a Proposition 1 Sustainable Groundwater Planning Grant. The implementation of the GSP and future SGMA compliance will be highly dependent upon management actions, if necessary. Costs for management actions will be shared by the GSAs based on action beneficiaries. The primary ongoing cost will be for GSP administration, which includes the development of annual reports and 5-year updates. These costs will be shared by the GSAs in accordance with the budget proportions outlined in the MOU. Implementation of the GSP is estimated to cost from $50,000 to greater than $150,000 per year, depending on the need for projects and management actions.

1.4 GSP Organization

This GSP is organized in a manner consistent with the California Department of Water Resources' (DWR) "Groundwater Sustainability Plan (GSP) Annotated Outline". In addition, during the preparation of this GSP, DWR's "Preparation Checklist for GSP Submittal" was utilized. A completed checklist is provided as Appendix D.

2 Plan Area

2.1 Description of the Plan Area (Reg. § 354.8)

This GSP covers the entire Tule Lake Subbasin which comprises approximately 64,000 acres of irrigated land near the California-Oregon border. The Subbasin is part of the larger Upper Klamath Basin, which extends into Oregon, and is located within the North Coast Hydrologic Region. The Subbasin is within Modoc County and Siskiyou County. The region is similar to much of the northeastern Plateau area of the State characterized by sparsely populated towns and little industry other than those related to forestry and agriculture. The majority of land in the Subbasin is also in TID, which covers approximately 84% of the Subbasin. As the most prominent public agency within the Subbasin, TID has been the primary GSA responsible for recent planning activities as further described below. Figure 1-1 shows the location of the GSAs within the Subbasin.

2.1.1 Summary of Jurisdictional Areas and Other Features (Reg. § 354.8b)

Jurisdictional areas and other features, with the exception of the GSAs, include an agricultural water purveyor; a city; an unincorporated town; and public lands. There are no areas within the Subbasin covered by an Alternative Plan.

2.1.1.1 Adjudicated Areas

The Subbasin is located within the southeastern region of the Upper Klamath Basin hydrogeologic region (see Figure 2-1). Currently, the Klamath River water rights for the Klamath Project are being adjudicated by the State of Oregon.

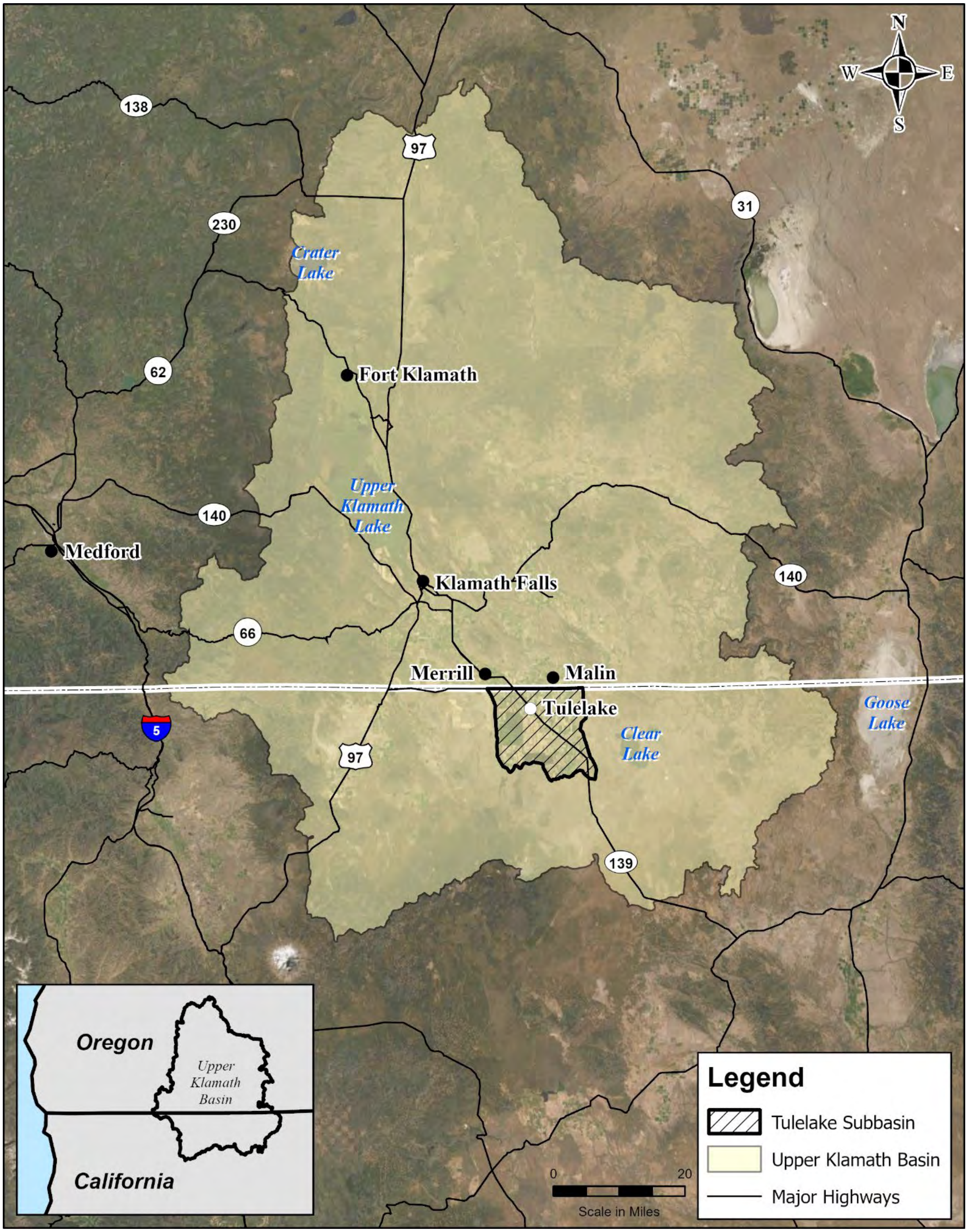


Figure 2-1. Upper Klamath Basin Boundary and Tule Lake Subbasin Boundary

In 1902, Congress enacted the Reclamation Act (1902 Act). Construction of the Klamath Reclamation Project began in 1906. Prior to construction of the Klamath Project, most of the lands located within the current boundary of the TID were submerged during certain times of the year, depending upon hydrologic conditions. The submergence of this land created a body of water known as Tule Lake. In October 1909, two outlets were constructed at the southern end of Tule Lake, and the reclamation of lands submerged by Tule Lake began. The draining of Tule Lake continued until 1912 when the level of the lake became too low to continue utilizing the outlets.

Construction of the Klamath Basin Project continued during the early 1900s, and by 1910 Clear Lake Dam was completed. By the spring of 1912, the Lost River Diversion Dam and Channel were complete. These facilities diverted water from the Lost River to the Klamath River and reduced flows into Tule Lake. In 1916, work began on the Tule Lake unit with the construction of distribution and drainage systems for exposed lands along the northern portion of Tule Lake. By 1916, approximately 5,900 acres within the previously submerged region of Tule Lake had been exposed. In 1917, the first Tule Lake lands opened to homestead entry. In 1920, Anderson-Rose Dam was constructed. Work also began on the J-Canal, which was completed in 1923. During the 1920s and 1930s, work on the distribution and drainage systems continued within the Tule Lake area. By 1923, the continued diversion of Lost River water into the Klamath River and diversion for irrigation resulted in approximately 85,000 acres of the previously submerged 90,000 acres of Tule Lake being made available for farming. During the late 1920s, as much as 50,000 acres were being farmed.

Reclaimed lands were made available to settlers and homesteaded under public notices issued from the 1920s to 1940s. Lands were typically leased to private individuals, prior to homestead entry. In 1940, work began on the D-Pumping Plant. This pumping plant and the Tule Lake Tunnel were completed in November 1941. During World War II, about 44,000 acres owned by the United States within Tulelake were leased for farming. The Copic Bay region of Tulelake was opened to homesteading in 1947 and 1948. By the 1950s, about 44,000 acres had been homesteaded.

In 1950, the U.S. Bureau of Reclamation (Reclamation) required the organization of an irrigation district in the Tulelake area. By 1952, Tulelake Irrigation District had been formed and was holding regular meetings. On September 10, 1956, TID entered into a contract with Reclamation for repayment of the construction charges, and to transfer to TID the operation and maintenance of the facilities used to deliver water to lands within the irrigation district. Following the formation of TID and the execution of Contract No. 14-06-200-5954 between TID and the United States, the Tulelake Irrigation District began providing water service to lands within its boundary. Contractually, Reclamation recognizes certain lands within TID as having a higher priority to Klamath Project supplies than other lands. The Tulelake Irrigation District is an active participant in the ongoing Klamath River Adjudication.

Two contracts with irrigation districts in the Klamath Project were made, pursuant to the 1902 Act, and related authority to serve lands in the “Main Division” and “Modoc Division” of the Klamath Project. The “Modoc Division” is in the Tulelake Division, and the contract with TID was made pursuant to the 1902 Act and Section 9(d) of the Reclamation Project Act of 1939, and other legislation. TID’s contract does not specify a duty or rate of diversion. Rather, it provides for the repayment of the construction costs of the Klamath Project by TID, in consideration for the right to divert and deliver to their members that amount of water which can be applied to the crops beneficially and without waste.

The State of Oregon’s water rights were issued through the Final Order of Determination of the Klamath Adjudication. The Final Order of Determination was issued in 2013, with amendments and corrections incorporated during 2014. Following the release of the Final Order of Determination, the adjudicatory judicial process will continue with an uncertain end date. The Tulelake Irrigation District was associated with the consolidated claim (Claim Nos. 321-17, 293, 323-3), and Claims 312 and 317. The claim numbers, description, and associated acreages are summarized in Table 2.1.

Table 2.1. Claims Associated with the Final Order of Determination of the Klamath Adjudication

Claim #	Description/Acres
293	215,559.4 acres agriculture & refuge lands + 15,659.00 acres of inchoate lands
312	35,000 acre-feet of water per year for irrigation of up to a maximum of 10,000 acres per year within a place of use totaling 25,881.7 acres within Lower Klamath National Wildlife Refuge
317	49,902.3 acre-feet of water per year for irrigation of up to a maximum of 16,000 acres per year within a place of use totaling 17,967.3 acres within Tule Lake National Wildlife Refuge (TLNWR)
321-17	178,857.81 acres 3280 cfs from Upper Klamath Lake (UKL), Lake Ewauna, Link River, & Klamath River including the Lost River Diversion Channel (LRDC) & all tributaries to Klamath River
323-3	735,500 acre-feet of storage in UKL, Agency Lake, & Lake Ewauna 18,500 acre-feet

The water rights acquired for the Klamath Project are for the benefit of all Klamath Project lands, including those lands within the Tulelake Irrigation District and the other entities served by the Klamath Project canal system, which are operated and maintained by Klamath Project districts.

As part of the Final Order of Determination, the total amount of water that could be diverted by the combined irrigation system of the Klamath Irrigation District (KID) and the TID was estimated based on the history of the use of water from the combined KID/TID system between 1961 and 2000. The total quantity of water for the KID/TID system includes water delivered to federal lands, namely Tule Lake National Wildlife Refuge, under Claim 317. This estimate includes the March 1 through October 31 season, and the February 15 through November 15 season, recognized for use of water from Station 48 and the No. 1 Drain Gate.

2.1.1.2 Other Agencies Within the Basin and Areas Covered by an Alternative Plan (Reg. § 354.8a)

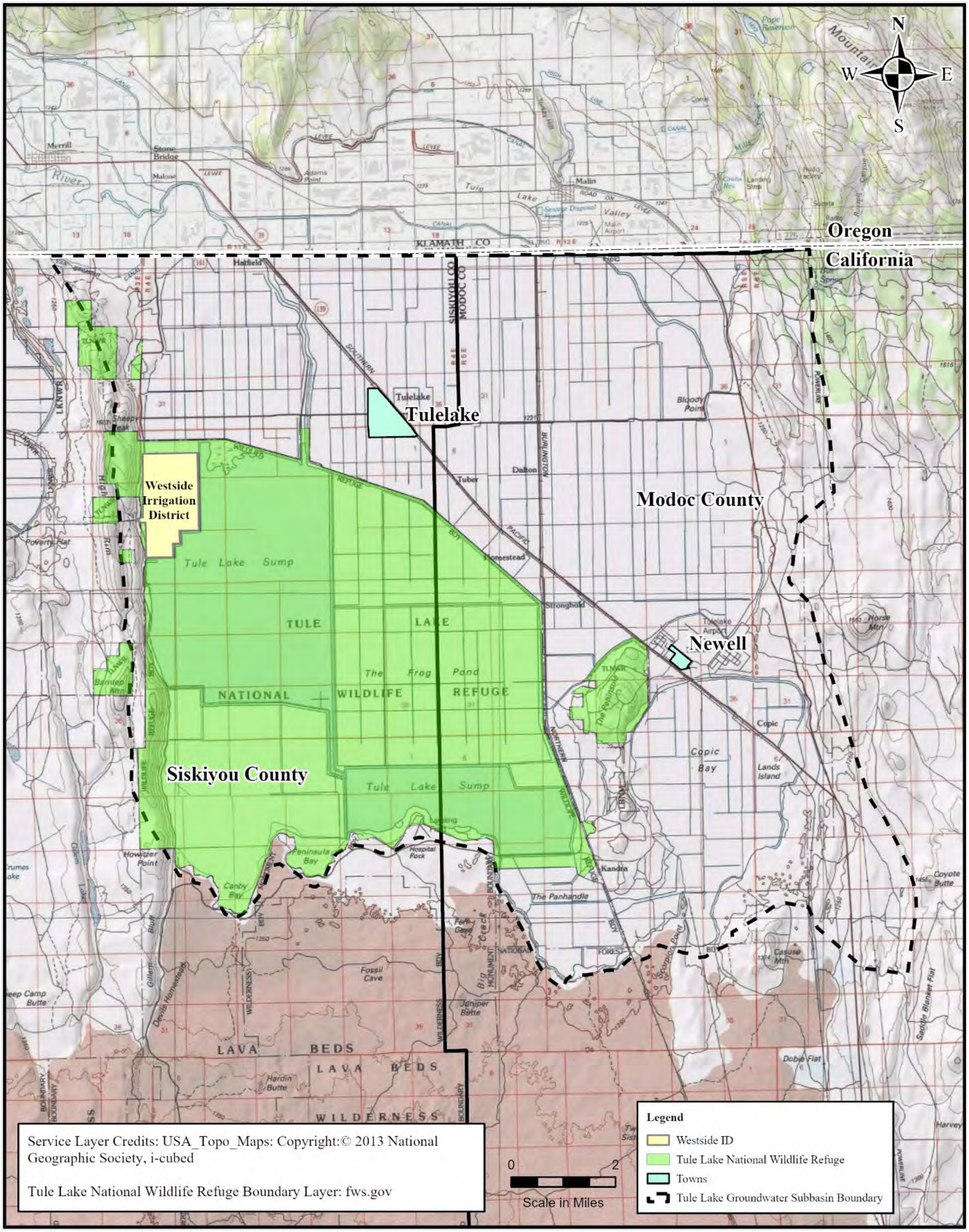
This GSP, prepared with input from all GSAs within the Subbasin, covers the entirety of the Subbasin. The Subbasin is an isolated basin, not immediately adjoined to any other subbasins in California; therefore, no alternative plans have been submitted for any part of the Subbasin or any immediately surrounding subbasin. A map is not included with this section because there are not any other Agencies or alternative plans within the Subbasin.

2.1.1.3 Jurisdictional Boundaries of Federal or State Land (Reg. § 354.8a)

Figure 2-2 shows jurisdictional boundaries of Modoc County, Siskiyou County, the City of Tulelake, and the Unincorporated Community of Newell within the Subbasin. In addition, Westside Irrigation District is identified, which receives delivered water via TID conveyance facilities.

Figure 2-2 also shows the Tulelake National Wildlife Refuge (TLNWR) within the Subbasin. The TLNWR is located within the southwest portion of the TID boundary and totals approximately 40,000 acres, of which approximately 17,300 acres are leased to farmers or farmed by refuge permit holders. Grain, row crop, and alfalfa are typically produced on these lands. These crops, together with the waste grain from the lease program, are a major food source for migrating and wintering waterfowl. The remaining acreage is open water in Sumps 1A and 1B or permanent or seasonal wetlands, or areas of emergent vegetation. The refuge, along with the Lower Klamath National Wildlife Refuge, is located at the downgradient end of Reclamation’s Klamath Project. Excess water not used on the refuges is ultimately pumped back into the Klamath River through the Klamath Straights Drain.

Management of the TLNWR is guided by Federal legislation which requires a coexistence of wetland wildlife habitat and commercial agriculture (USFW, 2013). Klamath Project and other facilities are used to deliver water to LKNWR’s and TLNWR’s wetlands (including seasonal wetlands, permanent vegetation, and open water areas), sumps, cooperative farming lands, and lease lands, and to walking wetlands within the Klamath Reclamation Project. Walking wetlands are part of a Refuge-approved program that incorporates managed wetlands into agricultural crop rotations on the TLNWR (KBRA, 2010). This program is designed to facilitate mutual benefit between wildlife and agriculture by providing habitat for wildlife during wet years, which also improves soil conditions for cropping years.



Service Layer Credits: USA_Topo_Maps: Copyright:© 2013 National Geographic Society, i-cubed

Tule Lake National Wildlife Refuge Boundary Layer: fws.gov

Figure 2-2. Jurisdictional boundaries within the Tule Lake Subbasin

2.1.1.4 Existing Land Use Designations (Reg. § 354.8a)

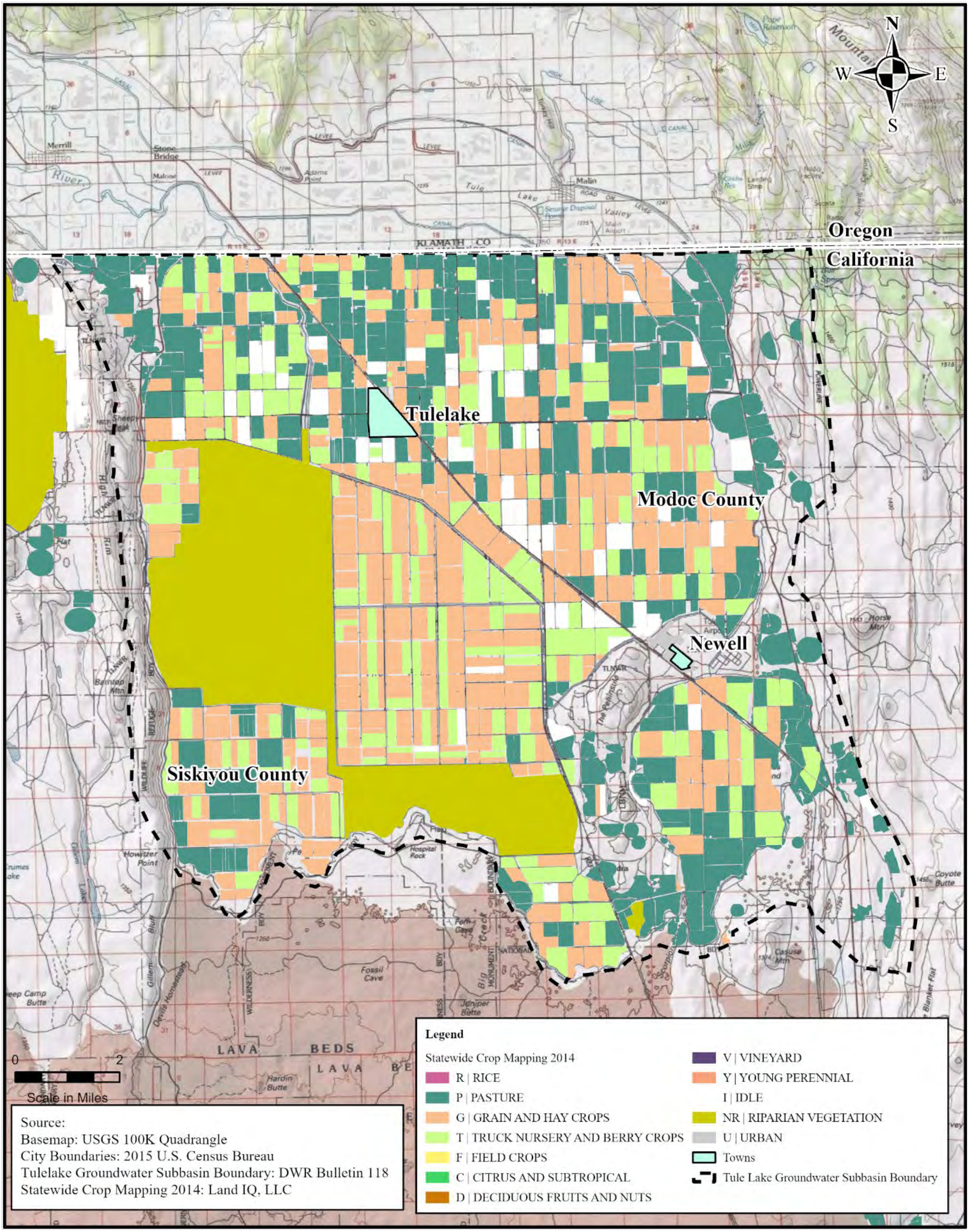
In 2014, DWR contracted with Land IQ to conduct statewide land use surveys using satellite imagery. Based on these data, the Subbasin was approximately 58% agriculture, 12% managed wetlands, and less than 1% urban (Land IQ, 2014). An additional 29% of the land was unclassified. The acreage associated with each land use category is shown in Table 2.2.

Table 2.2. Land Use Summary for 2014

Land Use	Acres
Urban	**627**
Urban	627
Managed Wetland	**13,607**
Managed Wetland	13,607
Agriculture	**64,287**
Alfalfa and Alfalfa Mixtures	20,725
Idle	4,035
Miscellaneous Grain and Hay	24,143
Miscellaneous Grasses	430
Miscellaneous Truck Crops	2,244
Mixed Pasture	1,185
Onions and Garlic	2,632
Potatoes and Sweet Potatoes	8,793
Strawberries	101
Unclassified Areas	**32,000**
Sub-basin Acres	**110,521**

The population within the Subbasin is projected to increase by 1% from 2,407 people in 2010 to 2,434 people in 2030 (DWR, 2020a). This minimal increase in population will not result in an appreciable change in urban/domestic water demand in the area.

The plan area consists of approximately 64,000 acres of irrigated land. Crop types within the Subbasin are relatively consistent on a year-to-year basis and include alfalfa, cereal grains, mint, onions, pasture, potatoes, and other miscellaneous crops. Figure 2-3 identifies the cropping pattern from these surveys within the plan area, which provides a general idea of existing land use. These categorizations were focused on distinguishing cropland from other land uses, with less focus on specific subcategories for managed wetlands or other habitats. More information on groundwater dependent ecosystems can be found in Section 2.2.2.9.



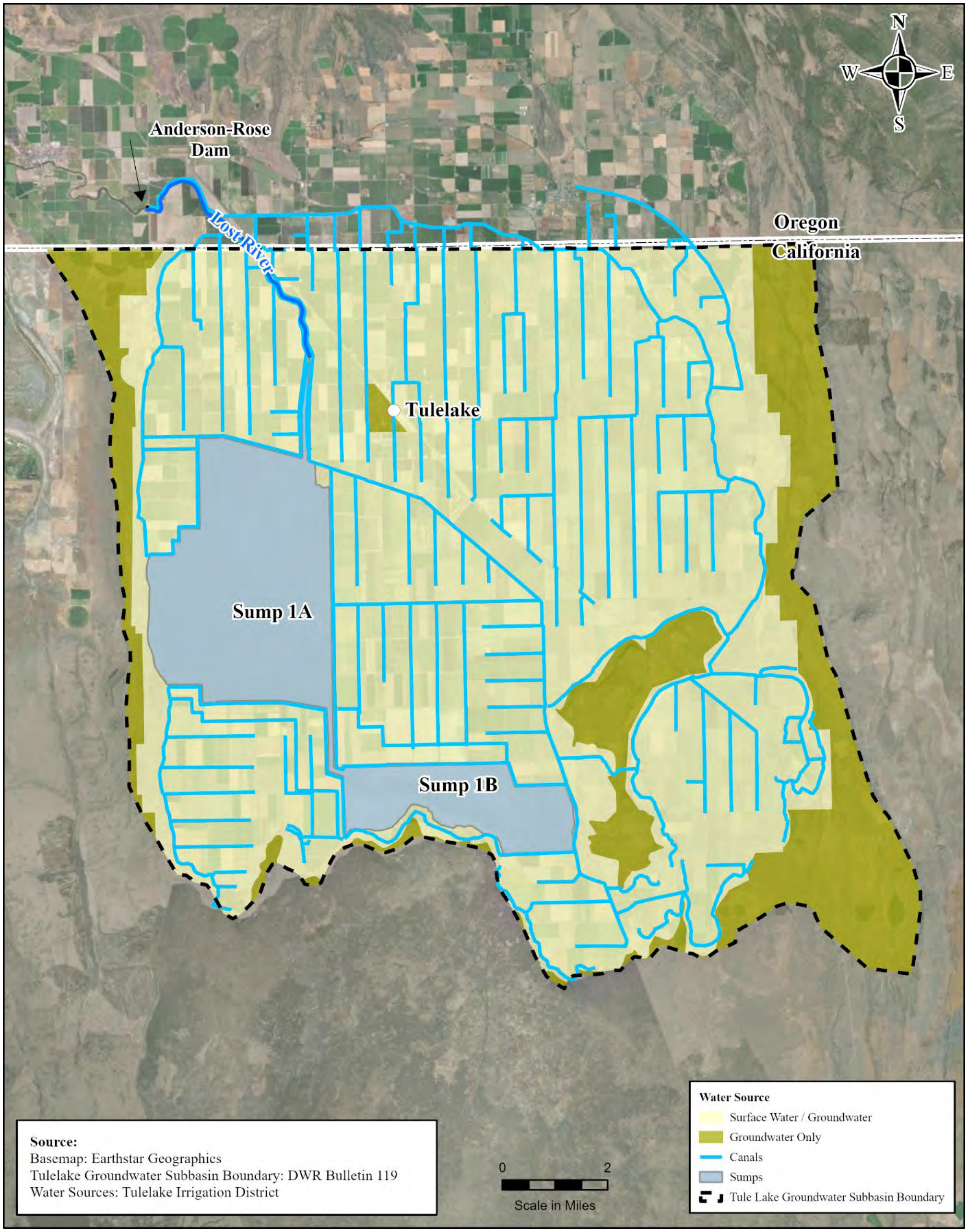
Source:
Basemap: USGS 100K Quadrangle
City Boundaries: 2015 U.S. Census Bureau
Tulelake Groundwater Subbasin Boundary: DWR Bulletin 118
Statewide Crop Mapping 2014: Land IQ, LLC

Figure 2-3. Tule Lake Subbasin 2014 Crop Map

2.1.1.5 Identification of Water Use Sector and Water Source Type (Reg. § 354.8a)

As previously stated, the majority of the Subbasin is also located within TID. TID provides surface water to its customers; however, many landowners also have private irrigation wells which are used when surface water is limited. Both the City of Tulelake and the Town of Newell (served by the Newell County Water District) rely exclusively upon groundwater to serve their customers. In addition, residents outside the City of Tulelake and Newell County Water District service areas rely upon domestic wells for their water supply. Figure 2-4 shows the areas and water source types within the Subbasin.

As mentioned in Section 1.3, the portion of the Subbasin within Modoc County is identified as a severely disadvantaged community and the portion within Siskiyou County is identified as a disadvantaged community. Therefore, the entire population of approximately 2,400 people within the Subbasin are located within these designations. Figure 2-5 shows the disadvantaged community areas.



Source:
Basemap: Earthstar Geographics
Tulelake Groundwater Subbasin Boundary: DWR Bulletin 119
Water Sources: Tulelake Irrigation District

Figure 2-4. Water Source Types

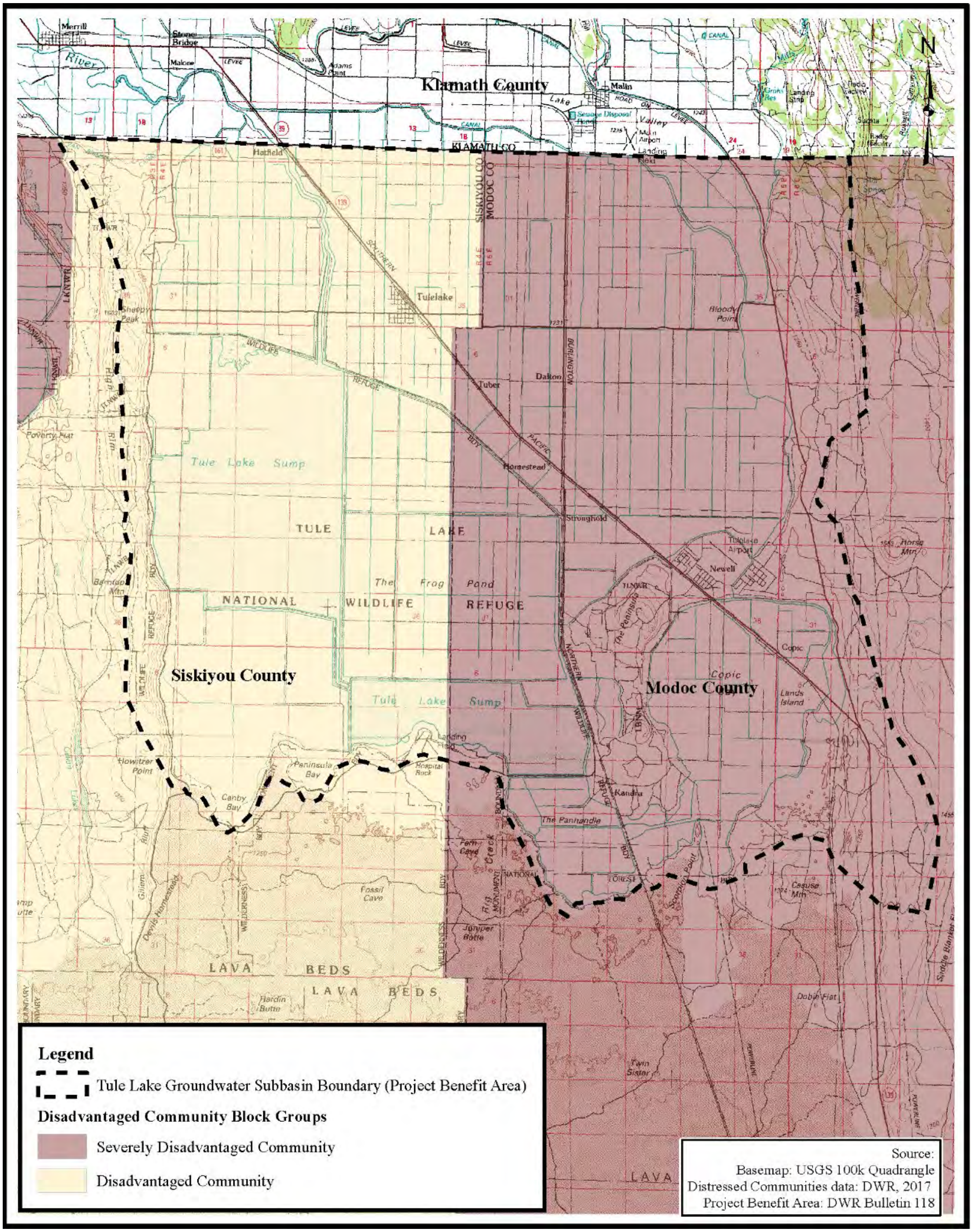


Figure 2-5. Disadvantaged Communities within Tule Lake Subbasin

The majority of Tulelake Irrigation District's surface water supply is from the Klamath River, and is directed to the District through an intertie between the Klamath River and the Lost River, known as the Lost River Diversion Channel (LRDC). Klamath River water is diverted at locations on the LRDC known as Station 48 and the No. 1 Drain during the irrigation season. These diversions provide Klamath River flows to the TID and other water users. TID also receives tailwater from Klamath River water users located north of the California-Oregon State Line, including lands within the Klamath Irrigation District. At times, the Lost River provides some surface water supply during the irrigation season to the TID. The Lost River supply is infrequent and unreliable for irrigation needs.

The Tulelake Irrigation District operates and maintains a diversion dam on the lower Lost River Improved Channel, known as the Anderson-Rose Dam, located less than one-mile north of the California-Oregon State Line. The Anderson-Rose Dam is operated to deliver surface water into the TID's J-Canal, which distributes water to more than one-half of the TID's irrigated lands through turnouts and lateral canals. The J-Canal also conveys water to other canal systems for delivery to additional lands within the TID. Water not diverted by TID at Anderson-Rose Dam flows through the lower Lost River Improved Channel and into the Tule Lake Sumps. Water regulated and stored within the Tule Lake Sumps may be diverted or re-diverted for irrigation within TID or discharged by TID's D-Pumping Plant to the P-Canal. This water then becomes available to the Lower Klamath National Wildlife Refuge (LKNWR) and the water users on the P-Canal system of the Klamath Project. The operational spills and tailwater resulting from irrigation within the Tulelake Irrigation District are conveyed through the TID's extensive drainage system, which utilizes gravity and pumped discharge into portions of the canal system or into the Tule Lake Sumps.

Figure 2-6 identifies the major water conveyance system facilities within the Klamath Project.

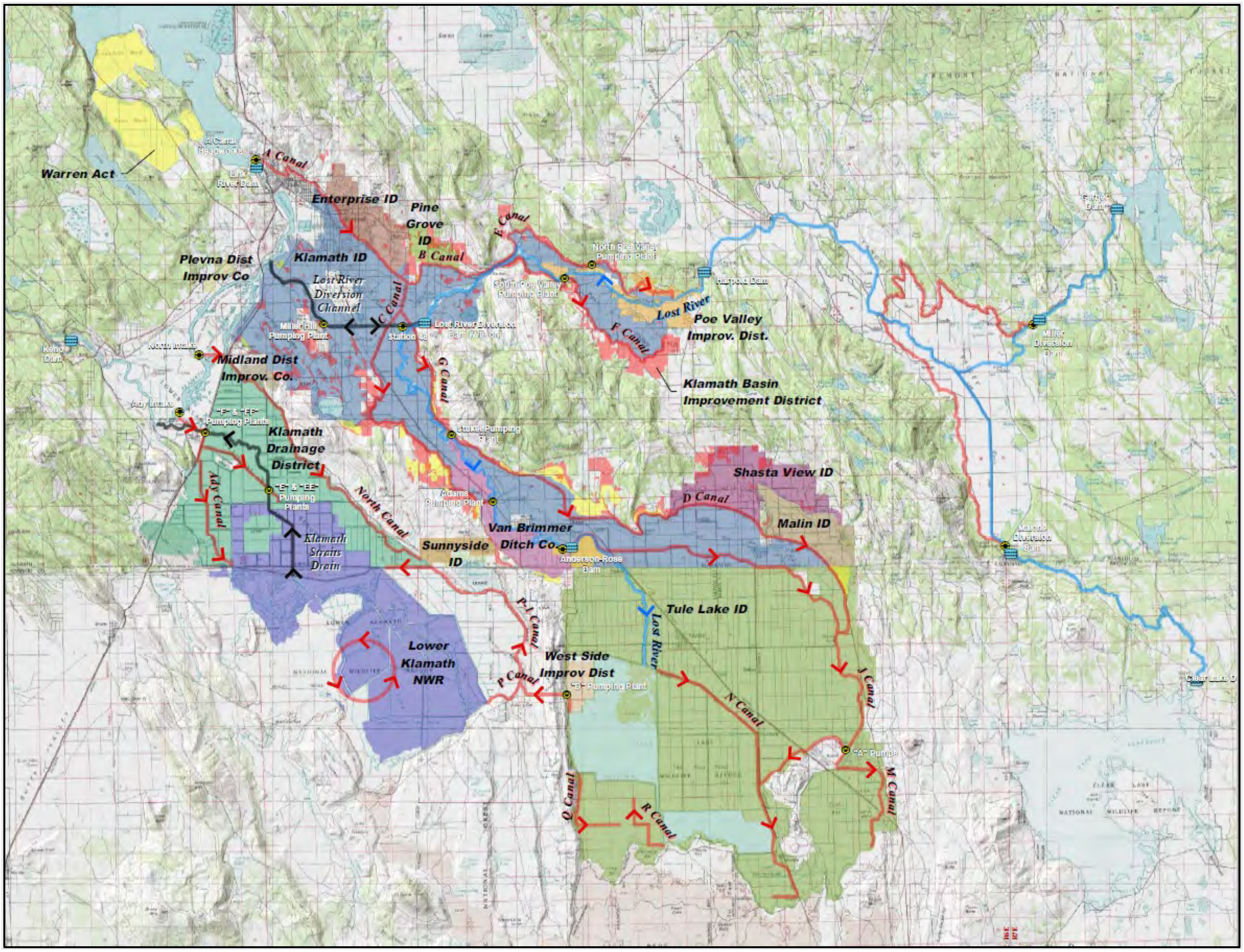


Figure 2-6. Klamath Project Conveyance Facilities

Figure 2-7 identifies the major facilities within the Tulelake Irrigation District, including the conveyance and drainage system.

Figure 2-7. District Conveyance and Drainage Facilities

Most of the areas of TID conjunctively use surface water and groundwater. Therefore, in addition to the surface water supply discussed previously, many private landowners within TID own and operate private groundwater wells. In addition, in 2001, TID constructed 10 groundwater wells to provide supplemental water supplies during drier years. Typically, groundwater is only utilized within TID during years where surface water supplies do not meet agricultural demands and represents a small portion of the total water supplies available in any given year.

2.1.1.6 Inventory and Density of Wells per Square Mile (Reg. § 354.8a)

Table 2.3 below provides an inventory of wells within the Tule Lake Subbasin by county and type. DWR maintains a well completion report database, which was utilized to prepare this table.

Table 2.3. Well Inventory

Type of Well	Modoc County Total Wells	Siskiyou County Total Wells
Agricultural	94	16
Industrial	1	4
Monitoring	13	58
Miscellaneous[1]	11	36
Domestic & Public Supply	108	41
Total	227	155

Source: DWR Well Completion Report Database, downloaded January 2021

[1] This category includes the following planned uses identified in the DWR Well Completion Report Database: Other, Other Destroyed, Other Not Specified, Other Unknown, Injection, Sparging, Test Well, Vapor Extraction

Based on the data from the DWR Well Completion Report Database, there are 382 wells in the Subbasin, and 311 of those are assumed to be production wells (i.e., not monitoring wells). It is unknown how many of these wells are actively used or how many of these wells have been abandoned and/or destroyed as this information is not always reported.

Using the information from Table 2.3, Figure 2-8; Figure 2-9; and Figure 2-10 identify the density of wells per square mile for agricultural wells, industrial/monitoring/miscellaneous wells, and domestic wells, respectively. Each of the squares on the figures represent approximately one square mile of land. The color of each square indicates the number of wells within the square.

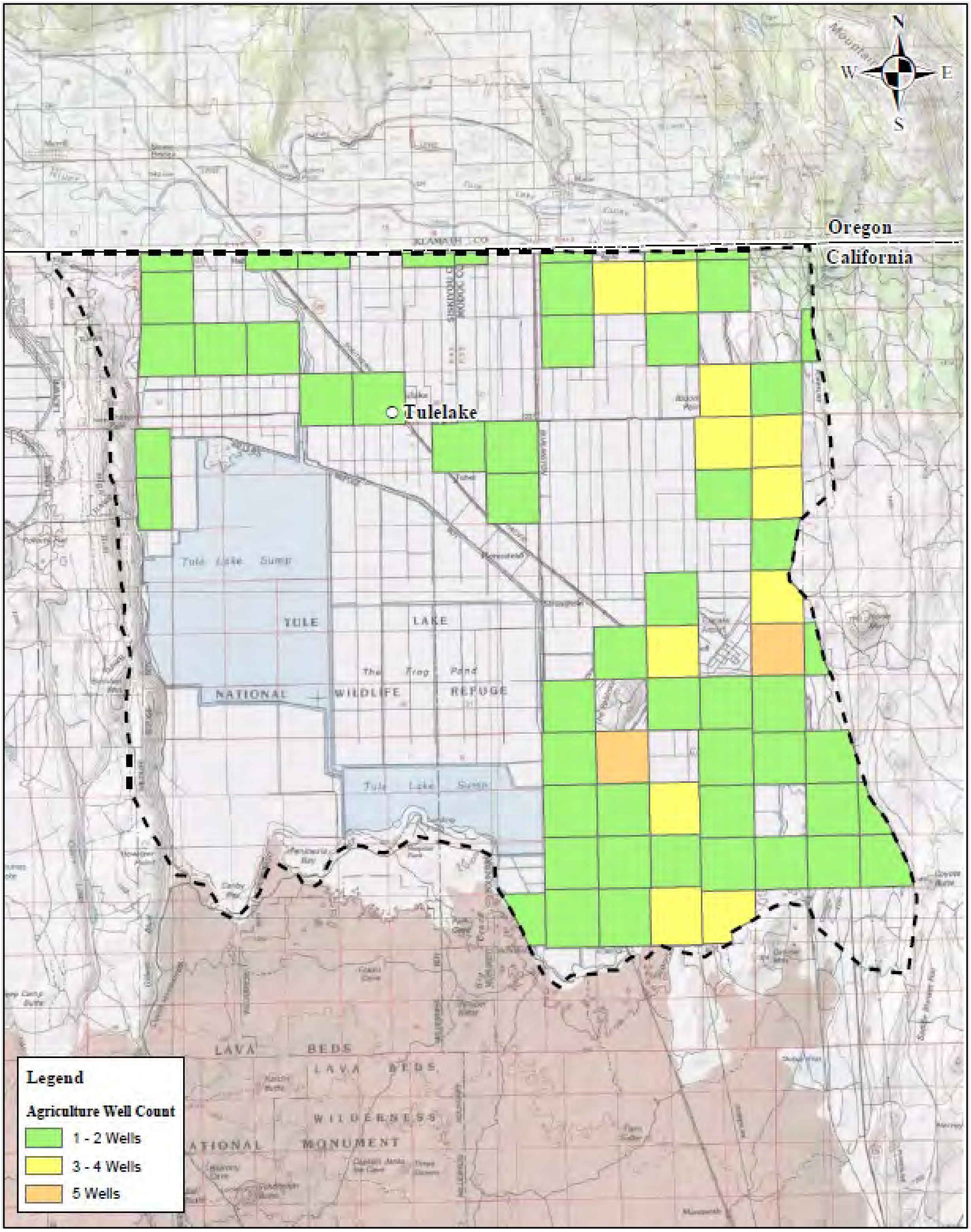


Figure 2-8. Density of Agricultural Wells per Square Mile

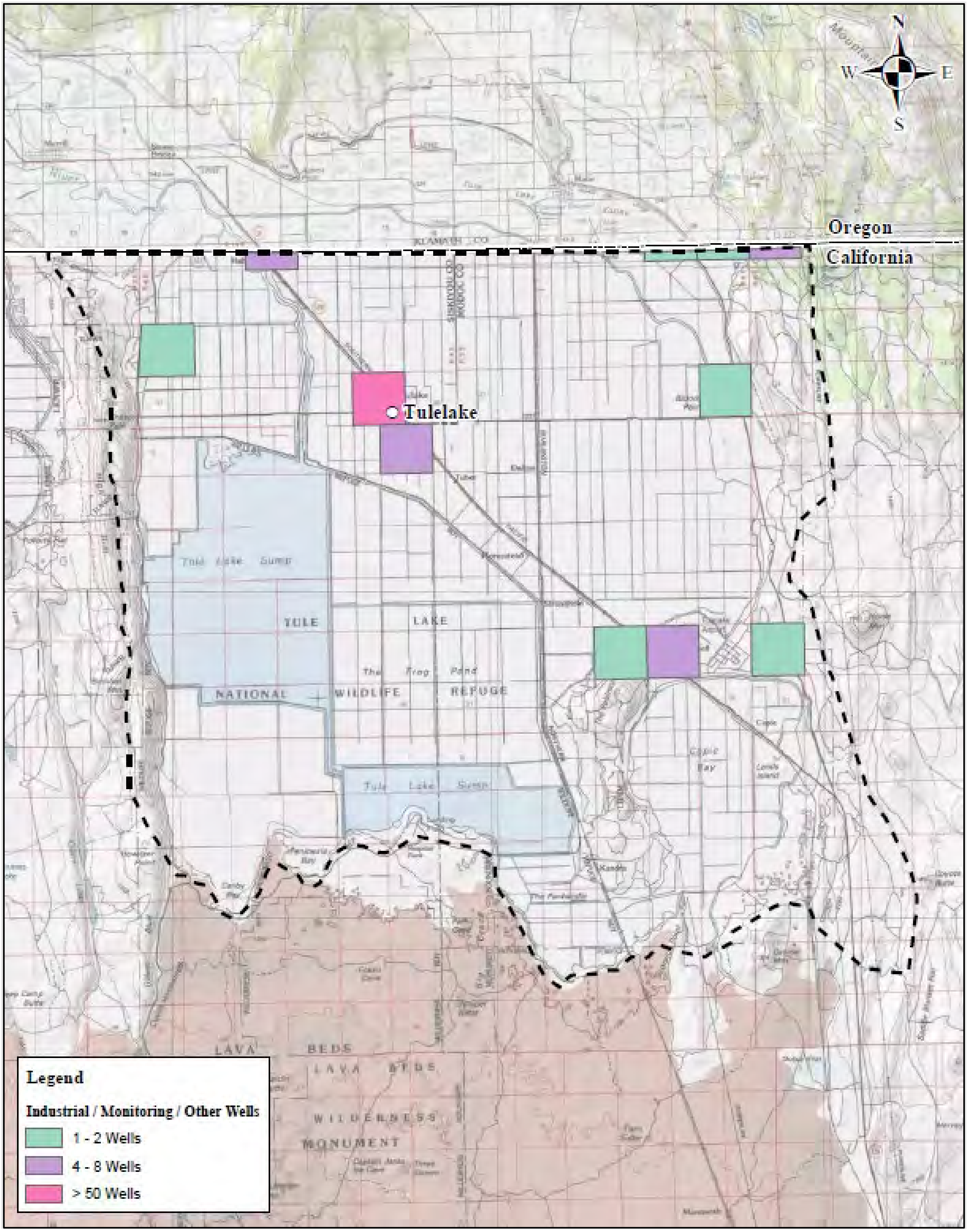


Figure 2-9. Density of Industrial/Monitoring/Miscellaneous Wells per Square Mile

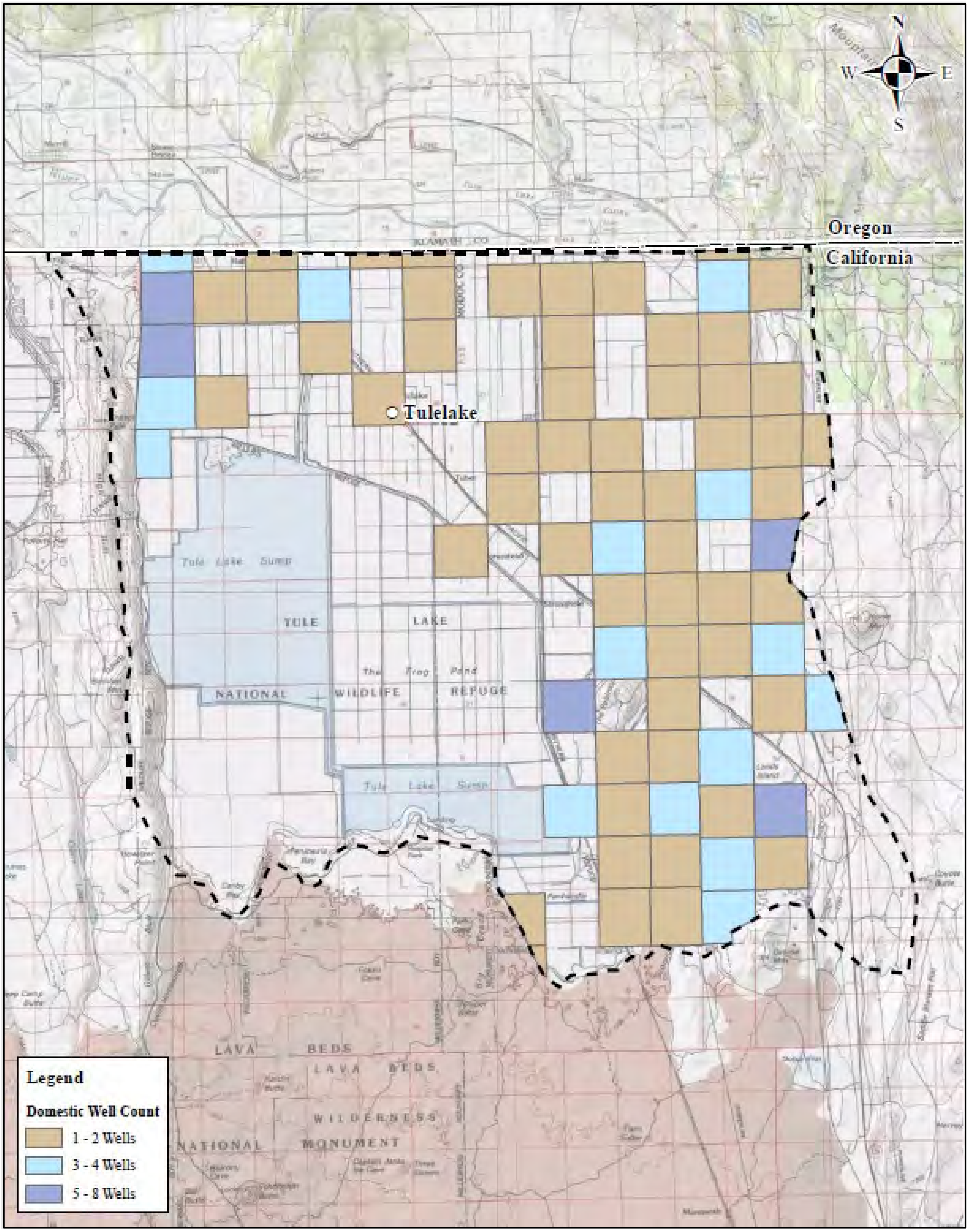


Figure 2-10. Density of Domestic and Public Supply Wells per Square Mile

2.1.2 Water Resources Monitoring and Management Programs (Reg. § 354.8 c, d, e)

The following section provides information, relative to various water resources monitoring and management programs, within the Subbasin. These programs provide valuable information that assisted with the development of this GSP and will also help with implementation of the GSP. These existing programs support water management in the Subbasin and do not limit operational flexibility.

2.1.2.1 Groundwater Management Plan (2013)

In 2013, TID prepared and adopted a Groundwater Management Plan (GWMP), as authorized by sections 10753 – 10753.11 of the California Water Code. The preparation of the GWMP included the development of appropriate groundwater "Management Objectives" within the GWMP area (District boundary), and the corresponding monitoring to ensure that the Management Objectives are being met. The primary goal in developing the GWMP was to work cooperatively with landowners within TID to more efficiently monitor the groundwater resources, and to continue with an efficient and effective conjunctive use operation during years where surface water supplies are limited or not available.

The 2013 GWMP provides valuable information and a framework of management objectives that align with the goals of this GSP.

2.1.2.2 Water Management Plan (2017)

In 2017, TID prepared and adopted a Water Management Plan (WMP) in compliance with U.S. Bureau of Reclamation's Water Management Plan 2017 Standard Criteria (2017 Standard Criteria). As part of the WMP preparation process, implementation of Critical Best Management Practices (Critical BMPs) was required. The WMP helped ensure TID practices efficient water management practices, which in this case are identified as Critical BMPs. The Critical BMPs include:

- Measure the volume of water delivered by TID to each turnout with devices that are operated and maintained to a reasonable degree of accuracy, under most conditions, to ± 6%
- Designate a water conservation coordinator to develop and implement the Plan and develop progress reports
- Provide or support the availability of water management services to water users
- Pricing structure – based at least in part on quantity delivered
- Evaluate and improve efficiencies of TID pumps

In addition to the aforementioned Critical BMPs, the 2017 Standard Criteria identified Exemptible BMPs which are required, unless an exemption from Reclamation is approved. The Exemptible BMPs include:

- Facilitate alternative land use
- Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not cause harm to crops or soils
- Facilitate the financing of capital improvements for on-farm irrigation systems

- Incentive pricing
- Canal lining/piping and regulatory reservoirs
- Increase flexibility in water ordering by, and delivery to, water users (within operational limits)
- Construct and operate contractor spill and tailwater recovery systems
- Plan to measure outflow
- Optimize conjunctive use
- Automate distribution and/or drainage system structures
- Facilitate or promote water user pump testing and evaluation
- Mapping

The 2017 WMP provides valuable information and a framework of best management practices that align with the goals of this GSP.

2.1.2.3 CASGEM Monitoring

The California Statewide Groundwater Elevation Monitoring program (CASGEM) is a statewide initiative to collect groundwater elevations and facilitate collaboration between local monitoring entities and DWR. TID enrolled in the CASGEM program on behalf of its landowners in 2010. Participation by TID includes working cooperatively with DWR in order to monitor groundwater elevations within the groundwater well monitoring network. TID plans to import the wells identified in Section 3 into DWR's GSP Reporting System and Monitoring Network Module, which along with TID's internal data management system, will serve as the GSAs Data Management System. This centralized groundwater level data storage platform will assist with collection, reporting, and sharing with DWR.

2.1.2.4 Groundwater Extraction Monitoring

TID monitors groundwater extractions from TID-operated wells on a monthly basis while the wells are in operation. These records are maintained by TID, and the City of Tulelake monitors groundwater extractions from its wells. During the water bank programs discussed in Section 2.1.2.10, participating wells, which include both TID-operated wells and private wells, are monitored on a monthly basis. The data collected as part of these monitoring efforts was utilized in the development of this GSP. Similarly, future data collected as part of these monitoring efforts will be utilized for updates to this GSP.

2.1.2.5 Groundwater Quality Monitoring

The State Water Resource Control Board's (SWRCB) 2009 Recycled Water Policy (amended in 2013) required that local water and wastewater entities in priority basins develop Salt and Nutrient Management Plans (SNMPs). The Tule Lake Subbasin was classified as a "Low Use" basin under this policy and therefore did not have to prepare a plan.

The U.S. Geological Survey (USGS) collects groundwater quality data on a regular basis under the Groundwater Ambient Monitoring and Assessment Program (GAMA). These data are stored in the GAMA online database.

The data collected as part of these monitoring efforts was utilized in the development of this GSP. Similarly, future data collected as part of these monitoring efforts will be utilized for updates to this GSP.

The GSAs are not aware of any contaminated groundwater in the Subbasin. Therefore, migration of contaminated groundwater is not an issue in the Subbasin.

2.1.2.6 Irrigated Lands Regulatory Program

The Irrigated Land Regulatory Program (ILRP) was initiated in 2003 to regulate agricultural runoff to surface waters and groundwater. The North Coast Regional Water Quality Control Board is currently working on an approach to address discharges of waste associated with agricultural lands in the Tule Lake Subbasin.

2.1.2.7 Land Subsidence Monitoring

Monitoring of land subsidence within the Upper Klamath Basin and the Tule Lake Subbasin has been limited. Historically, land subsidence was monitored along transects by comparing periodic spirit level surveys conducted by the USGS and the National Geodetic Survey (NGS). In the mid-1980s, a transition was made from the spirit level surveys to global positioning system (GPS) surveys. Like spirit level transects, GPS monitoring of subsidence relies on periodic resurveying of a network of monuments. In 2001, DWR defined a network of 23 stations. In 2011, DWR re-surveyed 6 of the 23 monuments along the east and southeast portion of the Subbasin to identify any potential land subsidence. Results from the 2011 survey indicate that there has been no noticeable subsidence on the east side of the Subbasin. Most recently, as part of DWR’s SGMA technical assistance, a statewide Interferometric Synthetic Aperture Radar (InSAR) dataset was acquired which currently provides data for 2015 through 2019.

2.1.2.8 Surface Water Diversion Monitoring

TID, along with other water users in the Klamath Project, and in coordination with Reclamation, monitors surface water diversions within the Klamath Project. Reclamation maintains historical diversion information for the Klamath Project. In addition, the TID maintains similar records for its diversions. The data collected as part of these monitoring efforts was utilized in the development of this GSP. Similarly, future data collected as part of these monitoring efforts will be utilized for updates to this GSP.

2.1.2.9 County Ordinances and Permitting

Siskiyou and Modoc counties have provisions in their ordinances for groundwater management and use. In general, these county ordinances which outline a permit process for groundwater extraction for use outside of each respective county do not apply to TID and the GSP area. There are specific provisions in each county ordinance that allow for the use of water within the boundaries of a district which is in part located within one county and in part in another county (or counties), where such extraction quantities and use are consistent with the historical practices of a district. These provisions are consistent with current TID operations.

Well construction permitting within the Subbasin is administered by the Modoc and Siskiyou county health departments, which effectively implemented the California Well Standards for water wells and monitoring wells. Permitting of municipal supply wells is also within the purview of the State Department of Public Health. *DWR Bulletin 74: California Well Standards* (Bulletin 74), establishes the minimum standards for groundwater well construction with the purpose of protecting groundwater quality. Bulletin 74 includes requirements for well construction (surface seals and construction, well development, rehabilitation, and deepening) and destruction of wells, among other things.

2.1.2.10 Water Bank Programs

Water banks were initiated in the Klamath Project based on a variety of needs. Reclamation was the original facilitating entity for the water bank programs. Following the formation of the Klamath Water and Power Agency (KWAPA) in 2008, a cooperative agreement between Reclamation and KWAPA was initiated, resulting in the Water User Mitigation Program (WUMP). KWAPA dissolved in 2016, and the Klamath Project Drought Response Agency (KPDRA) was formed in 2018 to facilitate future programs. The goal of the implementation of the water bank programs was to develop a market-based approach in which water was purchased by a single buyer (Reclamation/KWAPA/KPDRA) from multiple sellers for Endangered Species Act (ESA) needs in the Klamath River. The amount of water acquired during each water bank program was based on the estimate of the water demand reduction needed in order to meet delivery objectives and ESA requirements.

During the water bank programs, up to three water management strategies were utilized to decrease Project demand and provide additional water supplies: 1) cropland idling/dryland farming, 2) groundwater substitution (direct and indirect), and 3) storage. In addition, domestic well mitigation programs were offered during several years. Water bank programs changed from year to year based on demand and lessons learned through the implementation of water management strategies.

The official name of each water bank program for a specific year, along with the facilitating entity are identified in Table 2.4. Years during which a domestic well mitigation program was offered are also indicated.

Table 2.4. Water Bank Programs

Year	Official Name of the Water Bank Program	Facilitating Entity
2001	Pilot Irrigation Demand Reduction Program (Cropland Idling) Groundwater Acquisition Program (Groundwater Substitution)	Reclamation
2002	No Program	Reclamation
2003	Klamath Basin Pilot Water Bank	Reclamation
2004	Klamath Basin Pilot Water Bank	Reclamation
2005	Klamath Basin Pilot Water Bank	Reclamation
2006	Klamath Basin Pilot Water Bank	Reclamation
2007	Water Supply Enhancement Study	Reclamation
2008	No Program	KWAPA

Year	Official Name of the Water Bank Program	Facilitating Entity
2009	No Program	KWAPA
2010	Water User Mitigation Program (WUMP)*	KWAPA
2011	No Program	KWAPA
2012	Water User Mitigation Program (WUMP)	KWAPA
2013	Water User Mitigation Program (WUMP)*	KWAPA
2014	Water User Mitigation Program (WUMP)*	KWAPA
2015	Water User Mitigation Program (WUMP)*	KWAPA
2016	No Program	KWAPA
2017	No Program	N/A
2018	Groundwater Program & Land Idling Program	KPDRA
2019	No Program	KPDRA
2020	Groundwater Program & Land Idling Program*	KPDRA

* Domestic Well Mitigation Program offered.

2.1.3 Land Use Elements or Topic Categories of Applicable General Plans (Reg. § 354.8 f)

The Subbasin is located within Modoc County and Siskiyou County, both of which have jurisdiction over land use planning. All long-term land use planning decisions that would affect the Subbasin are also under the jurisdiction of Modoc County and Siskiyou County. Therefore, any implementation of the GSP will be affected by the policies and regulations outlined by Modoc County and Siskiyou County's respective General Plans. In addition, implementation of these plans may change water demands in the Subbasin or could influence the GSP's ability to achieve sustainable groundwater use. Conversely, the GSP may affect implementation of the land use policies outlined in these plans.

2.1.3.1 Modoc County General Plan

The Land Use Element of the General Plan prepared by Modoc County identifies policies and an action program to meet the primary goal of protecting and supporting the agricultural economy of Modoc County.

2.1.3.2 Siskiyou County General Plan

Siskiyou County's General Plan serves as a guide for land use decisions within their county, ensuring alignment with community objectives and policies. While the General Plan does not prescribe land uses to parcels of land, it does identify areas that are not suitable for specific uses. The components of the General Plan with the most relevance to the GSP include the Conservation Element and the Open Space Element. Many of the objectives and policies within the General Plan align with the aims of the GSP and significant changes to water supply assumptions within these plans are not anticipated.

The *Conservation Element of the General Plan* (County of Siskiyou, 1973) recognizes the importance of water resources in Siskiyou County, and outlines objectives for the conservation and protection of these resources to ensure continued beneficial uses for people and wildlife. Methods for achieving these objectives include local legislation such as flood plain zoning and mandatory setbacks, subdivision regulations, grading ordinances and publicly managed lands to ensure preservation of open spaces for recreational use. The importance of water resources is clearly noted in section G, Paragraph 1 where it states: “Groundwater resources, water quality and flood control remain the most important land use determinants within the county” (County of Siskiyou, 1973). Specific topics addressed in the Conservation Element section include preventing pollution from industrial and agricultural waste, maintaining water supply and planning for future expansion, reclaiming and recycling wastewater, and protecting watershed or recharge lands from development. These objectives in the Conservation Element mirror the objectives of the GSP, namely ensuring a sustainable water supply; the protection and preservation of watershed and water recharge land; and prevention of degradation of water quality.

The Open Space Element of the General Plan includes, in its definition of open space, watershed and groundwater recharge land (County of Siskiyou, 1972). The importance of protecting these lands is recognized for maintaining water quality and quantity. Mechanisms to preserve these spaces include maintaining or creating scenic easement agreements, preserves, open space agreements and designation of lands for recreational or open space purposes. A policy for open space requirements is included with minimum thresholds of 15% of proposed developments as open space. Protection of open space for habitat, water quality and water quantity align with the objectives of the GSP.

2.1.3.3 Siskiyou County Zoning Plan

The Siskiyou County Zoning Plan (Zoning Plan) is codified in Title 10 (DWR, n.d.) Chapter 6 of the County Code. The Siskiyou County Zoning Ordinance outlines the permitted types of land use within each zoning district. Zoning categories include residential, commercial, industrial, agricultural, forestry, open space, and flood plains. Many of the purposes and policies of the Zoning Plan align with the objectives of the GSP. In particular, “[the] wise use, conservation, development, and protection” of the County’s natural resources, protection of wildlife and prevention of pollution support the objectives of the GSP. Mechanisms to achieve these goals include permitted and restricted uses for land parcels, requirements and stipulations for land use and development.

2.1.3.4 Land Use Plans Outside the Subbasin

As identified in Section 2.1.1.1, the Subbasin is located within the southeastern region of the Upper Klamath Basin. Adjacent to the northern boundary of the Subbasin is Klamath County. A comprehensive plan for Klamath County was prepared and identifies an agricultural land primary objective of economically stabilizing the agricultural community in Klamath County. Land use decisions in Klamath County are likely to affect groundwater conditions in the Subbasin, which is why the GSAs included a Core Team Advisory Member from Klamath County.

2.1.3.5 Groundwater Sustainability Plan Implementation

Because the Subbasin is already operated sustainably, implementation of this GSP will not change the water demands nor the water supply assumptions of the previously identified land use plans.

2.1.4 Additional GSP Elements (Reg. § 354.8 g)

The following topics are required to be addressed in the GSP. The references for each topic have also been included.

- Control of saline water intrusion
  - See Section 5.2.6 "Seawater Intrusion" for an explanation as to why the saline water intrusion sustainability indicator does not apply to the Subbasin.
- Wellhead protection
  - See information provided under Section 2.1.2.9 "County Ordinances and Permitting"
- Migration of contaminated groundwater
  - See Section 2.1.2.5 "Groundwater Quality Monitoring" for details on migration of contaminated groundwater
- Well abandonment and well destruction program
  - See information provided under Section 2.1.2.9 "County Ordinances and Permitting"
- Replenishment of groundwater extractions
  - See Section 2.1.2.4 "Groundwater Extraction Monitoring" for details on groundwater extractions
- Conjunctive use and underground storage
  - See Section 4 for details on conjunctive use and underground storage, and see information provided under Section 2.1.2.1 "Groundwater Management Plan (2013)"
- Well construction policies
  - See information provided under Section 2.1.2.9 "County Ordinances and Permitting"
- Groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects
  - There are no active or planned projects of this nature in the Tule Lake Subbasin. Therefore, a section covering these types of projects has not been included.
- Efficient water management practices
  - See information provided under Section 2.1.2.2 "Agricultural Water Management Plan (2017)"
- Relationships with state and federal regulatory agencies

  - See Section 2.1.1.1 for details on relationships with state and federal regulatory agencies
- Land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity
  - See information provided under Section 2.1.3
- Impacts on groundwater dependent ecosystems
  - See Section 2.2.2.9 "Identification of Groundwater-Dependent Ecosystems" for details on groundwater dependent ecosystems

2.1.5 Notice and Communication (Reg. § 354.10)

Development and implementation of the GSP takes beneficial uses and users of groundwater into consideration, including agricultural water users, SDAC and DAC users, public water suppliers, groundwater dependent ecosystems and other environmental uses, and other stakeholders. A list of beneficial users is included in Appendix C.

See Appendix C for the GSAs Communications and Engagement Plan, which includes details on the GSAs decision making process, goals, stakeholder identification process, venues for engagement, and implementation timeline. Appendix C also includes comments received regarding the GSP, a list of the meetings held to date, a list of the advisory team members, and a list of the interested persons.

2.2 Basin Setting

The following section provides a brief background of the geology and hydrology of the Upper Klamath Basin and the portion of the Upper Klamath Basin that is covered by the GSP area (Tule Lake Subbasin).

2.2.1 Hydrogeologic Conceptual Model (Reg. § 354.14)

This Hydrogeologic Conceptual Model (HCM) is prepared pursuant to California Code of Regulations Section 344.12. In general, this follows the description of the Tule Lake Subbasin prepared by DWR for the 2003 update to Bulletin 118, and the changes which were made through the 2016 Basin Boundary Modification.

2.2.1.1 Basin Boundaries and Hydrology

The Upper Klamath Groundwater Basin is approximately 8,000 square miles and is located in south central Oregon and northeastern California on the east side of the Cascade Mountain Range. Figure 2-1 identifies the location of the Upper Klamath Groundwater Basin. As further described in this section, the Tule Lake Subbasin is located in the southeastern portion of the Upper Klamath Basin.

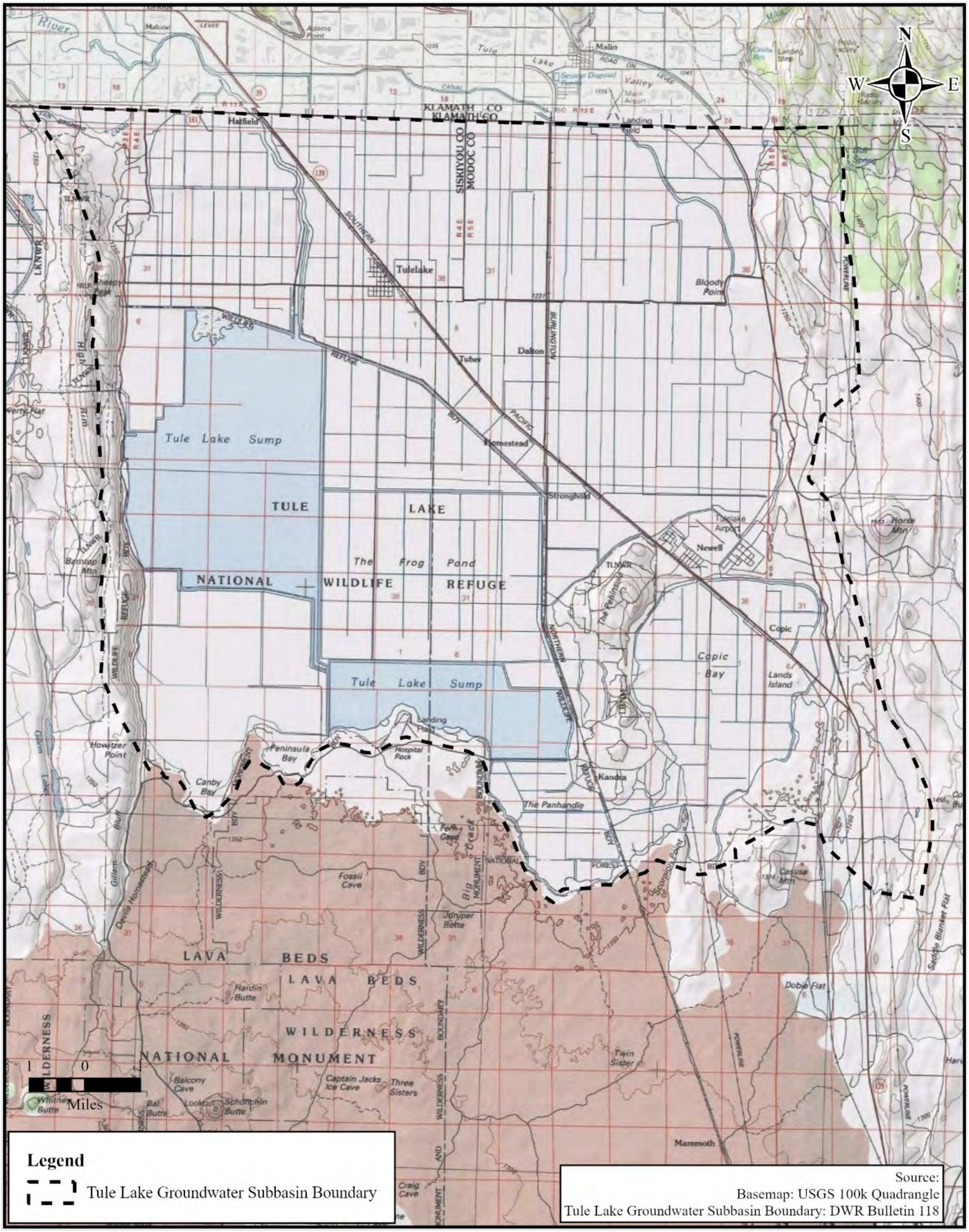
The Subbasin is bounded to the west by the Gillems Bluff Fault which extends beneath and is a major structural feature of the Medicine Lake volcanic highlands (Lavine, 1994). The fault forms the steep eastern escarpment of Sheepy Ridge, which separates the Tule Lake and Lower Klamath subbasins (DWR, 2003). The basin boundary extends to the fault-controlled drainage divide between the Tule Lake and Lower Klamath Lake subbasins (the crest of Sheepy Ridge). Volcanic deposits extend eastward from the crest beneath the Quaternary sediment, and are penetrated by wells, which are producing from the volcanic deposits on the west margin of the basin (Gannett, 2016).

The Subbasin is bounded to the east by the Saddle Blanket Fault Zone, a north-trending normal fault, which forms the western edge of the block faulted mountains between Tule Lake and Clear Lake Reservoir. The Subbasin extends to a portion of the Quaternary volcanic deposits which includes irrigation wells (Gannett et al., 2010). Clear Lake Reservoir is the headwaters of Lost River. Lost River flows north into Oregon, and meanders through the Poe and Langell valleys before it flows south into California, and ends at the Tule Lake Sump (DWR, 2003).

The Subbasin is bounded to the south by the low-lying volcanic fields on the north slope of the Medicine Lake Highlands. Medicine Lake occupies the crater at the peak of this large, relatively young shield volcano. The Subbasin includes the Peninsula and extends to the east to the Saddle Blanket Fault Zone. Wells in these areas where the volcanics are exposed mostly produce from the surficial volcanic deposits, but some wells penetrate through the surficial deposits and underlying basin-filling sediments to the underlying volcanic strata (Gannett, 2016).

To the north, the basin extends into Oregon and is bounded by northwest trending normal faults on the south side of the mountain block dividing Poe Valley from the Tule Lake Subbasin. Approximately two-thirds of the Subbasin are in California. For the purposes of SGMA, the Subbasin is bounded to the north by the state boundary of Oregon and California.

A map of the Tule Lake Subbasin is provided as Figure 2-11.

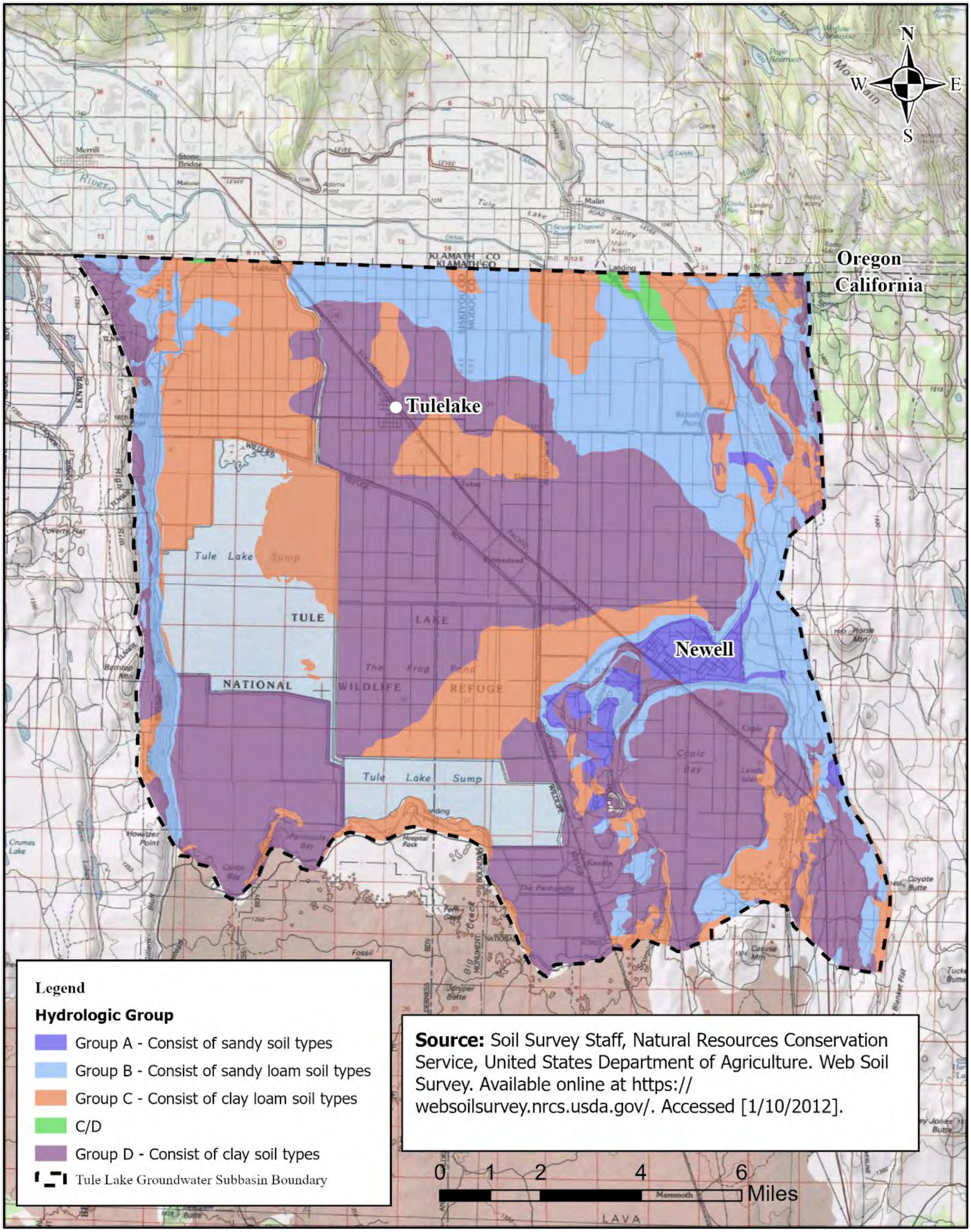


Source:
Basemap: USGS 100k Quadrangle
Tule Lake Groundwater Subbasin Boundary: DWR Bulletin 118

Figure 2-11. Tule Lake Subbasin Boundary

Figure 2-5 identifies the Klamath Project surface water bodies and conveyance facilities that are significant to the management of the Subbasin. Figure 2-6 identifies surface water bodies and conveyance facilities within TID, which are significant to the management of the Subbasin.

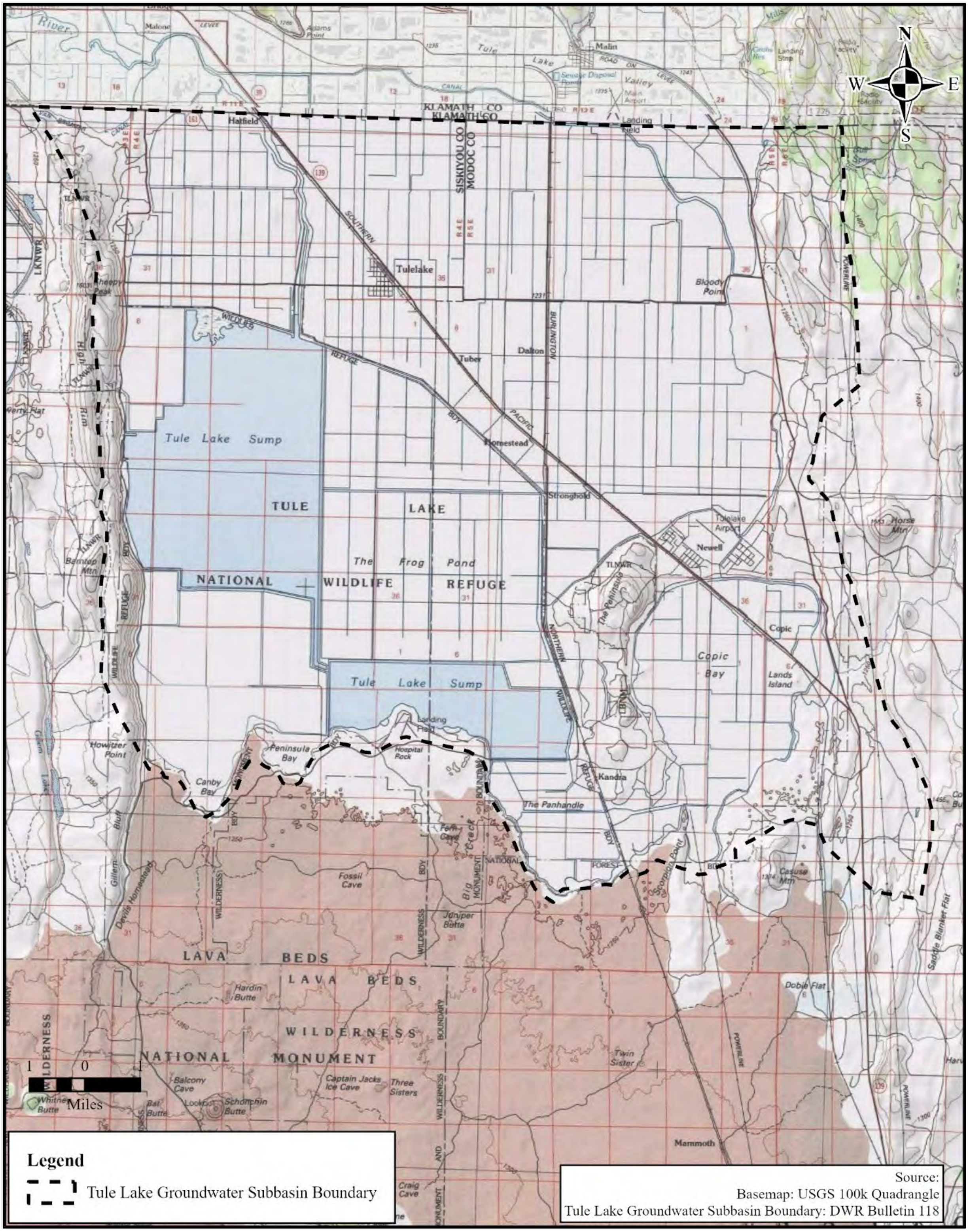
A map identifying the soil characteristics of the Tule Lake Subbasin is provided as Figure 2-12.



Source: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at https://websoilsurvey.nrcs.usda.gov/. Accessed [1/10/2012].

Figure 2-12. Tule Lake Subbasin Soil Characteristics

A topographic map using scanned images of USGS paper topographic maps of the Tule Lake Subbasin is provided as Figure 2-13.



Legend

▭ Tule Lake Groundwater Subbasin Boundary

Source:
Basemap: USGS 100k Quadrangle
Tule Lake Groundwater Subbasin Boundary: DWR Bulletin 118

Figure 2-13. Tule Lake Subbasin Topography

2.2.1.2 Hydrogeologic Information

Water-Bearing Formations. The principal water-bearing formations in the subbasin include Tertiary to Quaternary lake deposits and volcanics. In general, two systems have been identified in the Subbasin, the alluvial aquifer system (primary aquifer) and the volcanic aquifer system. The alluvial aquifer system consists of the surficial deposits that extend to over 1,000 feet deep in the center of the basin. The volcanic aquifer system consists of the Upper, Intermediate, and Lower basalt units, as well as pyroclastic and tuffaceous deposits. Groundwater in the surficial deposits and Upper Basalt is unconfined. The Intermediate Basalt and scoraceous deposits are predominantly unconfined in the southern portion of the basin where they exist at or near the surface and become confined as they deepen beneath the lake sediments in a northward direction. The Lower Basalt is confined in the center of the basin where it underlies surficial deposits but is unconfined or semi-confined where it crops out at the edges of the basin. The tuffaceous deposits are predominantly confined except where they crop out on the west side of the Subbasin and on portions of the Peninsula (DWR, 2002).

Pliocene to Miocene Lower Basalt. This Lower Basalt is a primary water-bearing deposit for irrigation, public, and municipal wells. The older basalt ranges from green-black ophitic olivine basalt to a gray-black porphyritic basalt. It often exhibits weak columnar jointing and fracturing in surface exposures. This is typically a highly permeable aquifer that is commonly confined within the Subbasin where it underlies lake sediments (DWR, 2003). At the edges of the basin at the north, east, and west, the Lower Basalt acts more unconfined or semi-confined (DWR, 2002). Where volcanic rocks are exposed at the surface, the area is likely underlain by an unconfined aquifer body (Hotchkiss, 1968). Surface exposure of the unit occurs east and west of the Subbasin. For the purposes of sustainable groundwater management and based on known areas of groundwater use, the unconfined aquifer of the Lower Basalt is assumed to extend to the east where surface exposure occurs. Review of hydrographs show that these wells reflect similar stresses to wells located throughout the Tule Lake Subbasin, which indicates a hydrogeologic connection and possible interbedding of basalt layers with lake deposits (Gannett, 2016; DWR, 2002). Where exposed in the uplands surrounding the basin, the unit is an important source of recharge.

The depth of the older basalt beneath the lake sediments varies due to the region’s extensive block faulting. New deep irrigation wells drilled in 2001 on the California/Oregon border show that the basalt is encountered at depths ranging from 810 feet on the east side of the basin, to 1,190 feet several miles to the west, and to 190 feet on the far west side. These differing depths likely represent individual blocks offset by steep, normal faults. The Lower Basalt can yield large quantities of water suitable for irrigation purposes (DWR, 2002). The depth to good production zones in these wells varies from 800 feet to 1,200 feet to 245 feet in the same east to west order. On the east side of the Subbasin well yields range from 4,000- to 7,000-gpm, whereas yields mid-basin and on the west side range from 9,000- to 12,000-gpm (DWR, 2003).

Pleistocene Intermediate Basalt. This unit is a series of reddish-brown to black, thin bedded flows of Pleistocene diabasic olivine basalt. These rocks border the surficial alluvium to the south and east and interfinger with lakebed deposits at the edge of the basin. These rocks are generally highly permeable due to well-developed columnar jointing and the abundance of bedding planes. Wells developed in these rocks will often yield moderate to large quantities of water ranging from 2,000- to 4,000-gpm with specific capacities of 50- to 250-gpm per foot of drawdown if sufficient fractures, fracture interconnections, and saturated depths are encountered (Hotchkiss, 1968).

This unit is exposed at the surface in the southern portion of the Subbasin and crops out on the eastern and western ridges (DWR, 2002). Along the southern edge, this Quaternary basalt overlies and is interbedded with basin-filling sediments (Gannett et al., 2012). This is evidenced in the Peninsula region and southeast of Copic Bay where groundwater pumping occurs for irrigation. Analysis of available hydrographs indicates that groundwater levels in this area reflect similar stresses as those seen elsewhere in the basin, suggesting that the surficial basalt and deeper volcanics are in hydraulic connection (Gannett, 2016).

Some well yields in this unit are low where extensive cross faulting has created barriers to groundwater recharge and flow. In the Panhandle region, the thickness of the unit is greater than 400 feet, with well yields ranging up to 9,500 gpm with a specific capacity of up to 395 gpm per foot of drawdown. In the vicinity of Prisoners Rock and the Peninsula, the unit reaches a thickness of at least 400 feet with estimated well yields of 500- to 3,100-gpm (DWR, 2003).

Pleistocene Upper Basalt. This unit is an unweathered, vesicular, olivine basalt that is generally highly permeable due to extensive fracturing. The basalt flows of this unit are generally above the saturated zone in upland areas, but serve as recharge areas where fractured. Some areas have exposures of massive, unfractured flows. The fractured flows readily yield water to wells. These flows border the Subbasin on the south (to the west of the Peninsula), and outcrop as a Subbasin boundary to the southeast of Copic Bay along the north flank of the Medicine Lake Highlands (DWR, 2003).

Pliocene to Holocene Lake Deposits. The surficial deposits, consisting mostly of fluvial and lacustrine sediments are unconsolidated to semi-consolidated (DWR, 2002). The lake deposits consist of sand, silt, clay, ash, lenses of diatomaceous earth, and semi-consolidated shale. Poorly sorted deposits have very low permeability and may act as a confining layer where interfingered with basalts. Wells developed in the sedimentary deposits are usually less than 150 feet deep and yield only small quantities of water in the range of 30 gpm (Hotchkiss, 1968). Isotopic analysis of groundwater in aquifers supplying deep irrigation wells in the Subbasin suggest a hydraulic connection between the shallow (alluvial) aquifer and deep (volcanic) aquifer (Pischel and Gannett, 2015).

2.2.1.3 Restrictive Structures

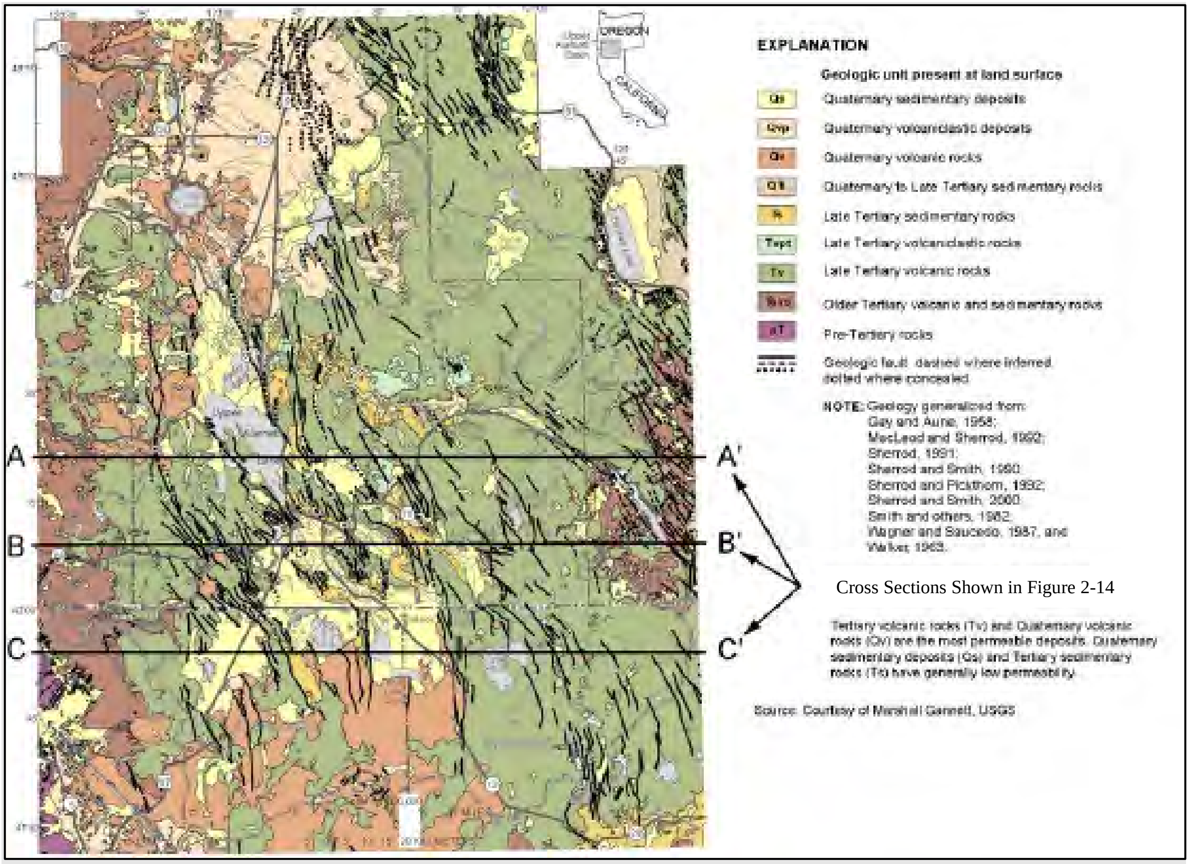
The western boundary of Tule Lake is marked by a prominent north-south trending normal fault, downthrown to the east. The displacement is unknown but is probably in the range of several hundred feet. The east side of the Tule Lake Subbasin is bounded by a normal fault downthrown to the west. Subsurface block faulting can also cause boundaries or conduits to groundwater flow. It is assumed a buried horst may exist, extending from Turkey Hill in the north to the Peninsula to the south (DWR, 2002).

The water-transmitting properties of these faults are not fully understood.

2.2.1.4 Bottom of Subbasin

The volcanic units of the Subbasin comprise the bedrock and produce groundwater through fractures and voids. In locations throughout the Subbasin, the volcanic units may be interbedded with basin fill deposits (DWR, 2002). Due to the interaction between the volcanic aquifer and alluvial aquifer, it is difficult to define the bottom of the Subbasin.

A review of cross sections incorporated into USGS models identifies the bottom of the basin at approximately 1,500 – 2,000 feet above mean sea level (Gannett et al., 2012; Wagner and Gannett, 2014). This corresponds to the assumed location of contact between the regional groundwater flow system and underlying rock with very low permeability (Gannett et al., 2012). Figure 2-14 identifies the location of the cross sections and Figure 2-15 provides the cross sections.



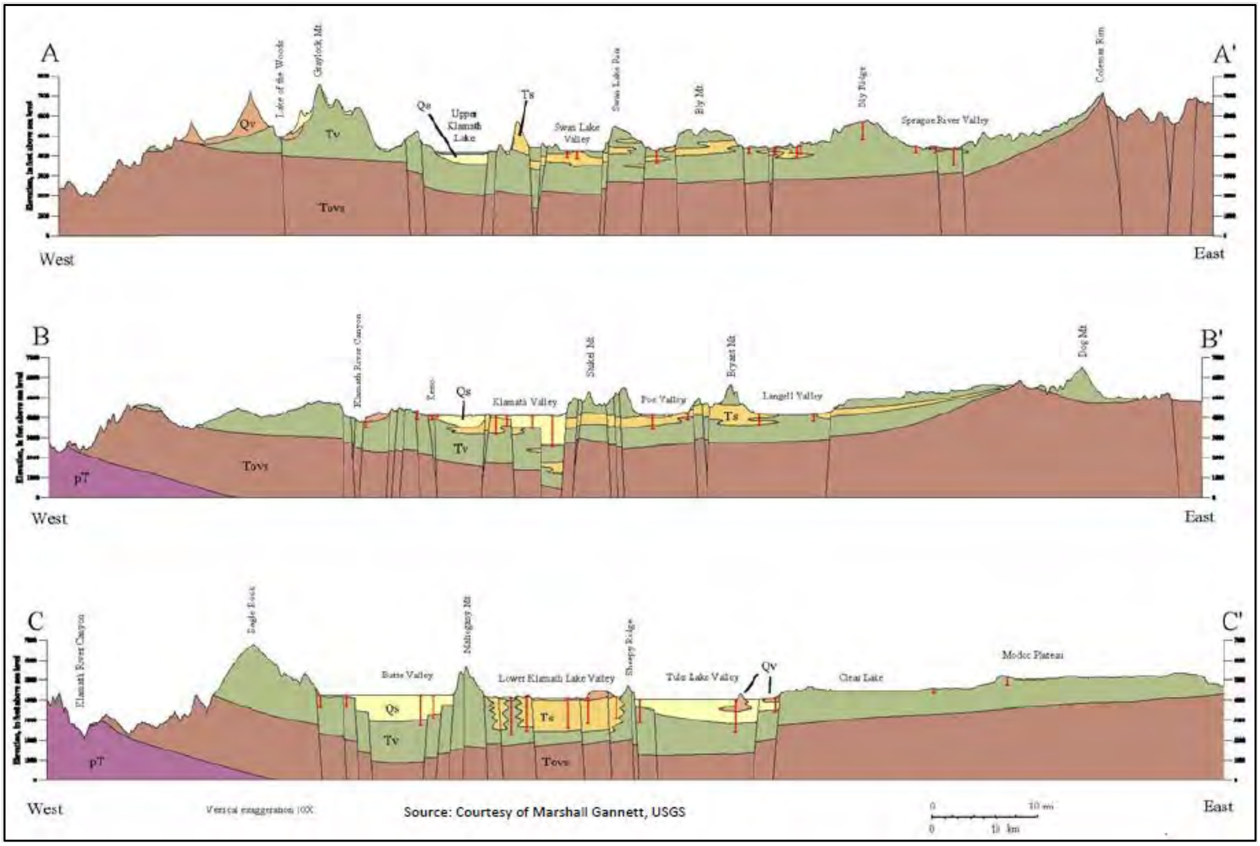
NOTE: Geology generalized from:
Gay and Aune, 1958;
MacLeod and Sherrod, 1992;
Sherrod, 1991;
Sherrod and Smith, 1990;
Sherrod and Pickthorn, 1992;
Sherrod and Smith, 2000;
Smith and others, 1982;
Wagner and Saucedo, 1987, and
Walker, 1963.

Cross Sections Shown in Figure 2-14

Tertiary volcanic rocks (Tv) and Quaternary volcanic rocks (Qv) are the most permeable deposits. Quaternary sedimentary deposits (Qs) and Tertiary sedimentary rocks (Ts) have generally low permeability.

Source: Courtesy of Marshall Gannett, USGS

Figure 2-14. Hydrologic Units of the Upper Klamath Basin, Oregon, and California

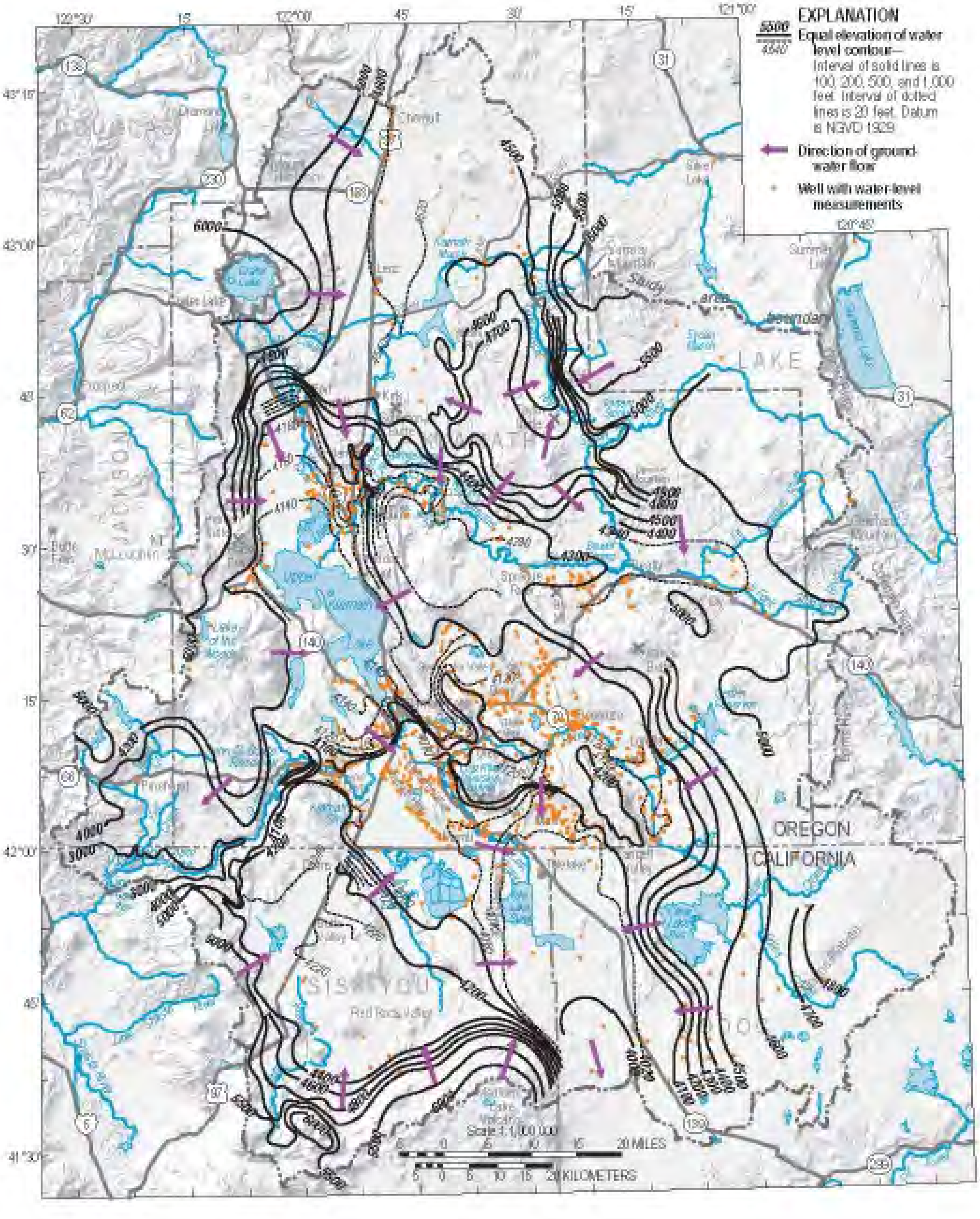


Source: Courtesy of Marshall Gannett, USGS

Figure 2-15. Series of West-to-East Geologic Cross Sections through the Central Part of the Upper Klamath Basin

The findings by the USGS correlate to cross sections developed by DWR, which identify interbedded volcanics, and fill deposits occurring at varying depths (DWR, 2002). Appendix E provides the plate showing locations of the DWR cross sections and the plate of the DWR cross sections.

The location and quantity of groundwater movement, including migration and recharge within any groundwater basin, is difficult to quantify. This is because there are various factors that affect each of the components. In many cases, limited data regarding one aspect of the movement of groundwater can make it difficult to develop a comprehensive understanding of the groundwater basin. In order to better understand groundwater in the Upper Klamath Basin, a groundwater simulation and management model (Model) was developed by the USGS, in collaboration with Oregon Water Resources Department and Reclamation. This Model provides improved understanding of how the groundwater and surface-water system responds to varying hydrologic conditions and groundwater pumping within the Upper Klamath Basin. In order to develop this Model, the USGS relied on countless reports compiled within the Upper Klamath Basin relative to surface and groundwater. One of these reports, *Ground-water Hydrology of the Upper Klamath Basin, Oregon and California (*Gannett et al., 2010), states that groundwater flow in the Upper Klamath Basin is influenced by topography, geologic composition, stream system geometry, recharge of precipitation and applied water, and groundwater production from wells. The groundwater flow system receives large amounts of recharge from deep percolation of precipitation, snowmelt in the Cascades Range, and upland areas within and on the eastern margins of the basin. The primary components of groundwater discharge include discharge to streams through a complex of springs within the Upper Klamath Basin interior, and discharge to wells at various locations and depths. Groundwater in the Upper Klamath Basin generally flows toward Upper Klamath Lake, the Klamath River Canyon, and the Tule Lake Subbasin (see Figure 2-16; Gannett et al., 2010).



Gannett, Marshall W., Kenneth E. Lite, Jr., Jonathan L. LaMarche, Bruce F. Fisher, and Daniel J. Polette. 2007. *Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California.* USGS. Scientific Investigations Report 2007-5050, Version 1.1.

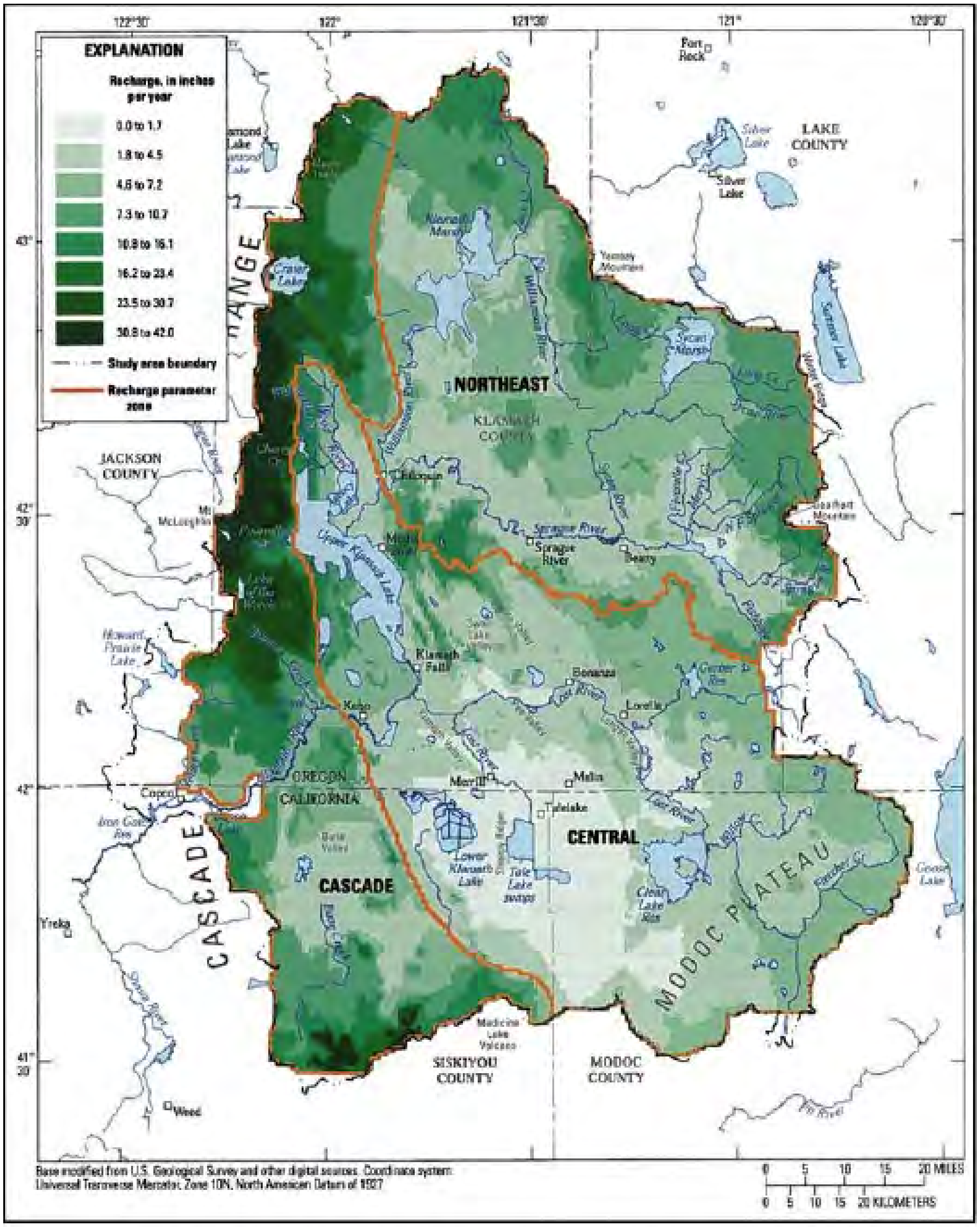
Figure 2-16. Generalized Water-Level Contours and Approximate Directions of Regional Groundwater Flow within the Upper Klamath Basin, Oregon, and California

2.2.1.5 Recharge Areas

Local precipitation and infiltration of surface water from the channels, lakes, and Sumps of the Lower Klamath and Tule Lake subbasins provide recharge for the alluvial aquifer system. Water levels in the alluvial aquifer fluctuate seasonally in response to canal and irrigation operations (DWR, 2002). Surface water supplies available to the Tulelake Irrigation District provide an unknown amount of groundwater recharge. These surface water supplies include natural flow from the Klamath River, stored water from Upper Klamath Lake and Lake Ewauna, return flows from upstream irrigation, and flow from the Lost River.

Underflow from the adjacent, rapidly-replenished volcanic rocks are probably the principal sources of recharge in this basin. Because infiltration rates are very slow in the sedimentary deposits, underflow from adjacent volcanics is probably of major significance (DWR, 2003). Where the volcanic units are at or near the surface and are unconfined, water can percolate into fractures and vesicles that lead to lower units (DWR, 2002). The area surrounding this basin, and its extension into Oregon, primarily consists of Holocene to Miocene volcanic rocks that capture most of the incipient precipitation and intermittent streamflow by infiltration through fractures. Within the Tule Lake Subbasin, the exposed volcanic recharge areas are between the surficial alluvium and the boundaries of the basin at the eastern and western edges. These rocks probably function as a single, continuous, water-table aquifer that extends across faults and surrounds the basin. Hence, the two principal sources of recharge are underflow from the rapidly replenished and permeable unconfined system of the adjacent volcanic rocks; and less significantly, the very-slow vertical infiltration of surface water through marginally permeable sedimentary deposits (DWR, 2003). The general pattern of groundwater movement is from the north to the south.

During the development of the Model, the quantity and location of groundwater recharge was estimated within the Upper Klamath Basin, based on representative parameter values applied to the Model. Figure 2-17 identifies the estimated quantity and distribution of recharge in the Upper Klamath Basin, Oregon, and California. The average annual recharge from precipitation is estimated to be approximately 2.6 million acre-feet per year within the Upper Klamath Basin (Gannett et al., 2012).



Source: Gannett et al. *Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California*, 2012.

Figure 2-17. Estimated Mean Annual Groundwater Recharge from Precipitation in the Upper Klamath Basin, Oregon, and California, 1970-2004, in inches, and Recharge Parameter Zones

2.2.1.6 Discharge

Aquifer discharge occurs when groundwater is extracted by wells, discharges to streams, evapotranspired by phreatophytes, or flows out of the groundwater basin in the subsurface (DWR, 2002). Most groundwater production in the Tule Lake Subbasin is from the underlying volcanic strata, volcanic deposits on the periphery of the basin, and volcanic deposits that partly overlie basin-filling sediment in the Peninsula area. However, wells in any of these areas may produce from surficial volcanic deposits, basin filling sediments, or underlying volcanic strata (Pischel and Gannett, 2015). In general, inter-basin groundwater flow from the Tule Lake Subbasin is southward (Gannett et al., 2010).

The primary components of groundwater discharge include discharge to streams through a complex of springs within the Upper Klamath Basin interior, and discharge to wells at various locations and depths. Groundwater in the Upper Klamath Basin generally flows toward Upper Klamath Lake, the Klamath River Canyon, and the Tule Lake Subbasin (Figure 2-15; Gannett et al., 2010).

2.2.1.7 HCM Data Gaps

The HCM was collaboratively developed by multiple entities using the best available data. As appropriate, new data collected via the monitoring and management programs identified in Section 2.1.2, will be incorporated into the HCM for future GSP updates.

2.2.1.8 References

A full list of references used in the creation of this GSP are included in Section 8.

2.2.2 Current and Historical Groundwater Conditions (Reg. § 354.16)

The main source of water within the Subbasin is surface water from the Klamath River. The water is made available to TID from the Klamath Reclamation Project for irrigation purposes through an intertie between the Klamath River and the Lost River. TID also receives tailwater from Klamath River water users located north of the California-Oregon Stateline. At times, the Lost River provides some surface water to TID. Groundwater is pumped for uses other than irrigation, and to meet irrigation demands when not enough surface water supply is available. Groundwater levels within the Subbasin fluctuate partially as a result of the amount of surface water delivered to TID.

In 2001, TID constructed 10 groundwater wells to provide supplemental water supplies during dry years. TID only operated these wells during dry years and generally represents a small portion of the total water supply in a given year. However, landowners within TID may operate private wells at any time. Beginning in 2001, reduction in available surface water supplies resulted in an increase in groundwater extraction.

Larger scale pumping in the Subbasin has been due to participation in water bank programs during years when surface water supplies have been limited. DWR has estimated that groundwater pumping during the 2001 through 2009 period ranged from approximately 10,000 acre-feet to 70,000 acre-feet within the Subbasin (DWR, 2011). Similar programs were also established in 2012, 2013, 2014, 2015, 2018, and 2020. This pumping estimate includes the 8,500 acre-feet of estimated pumping for domestic, stockwatering, and municipal supplies.

2.2.2.1 Historic Groundwater Elevations

Beginning in the 1980s, groundwater elevation data have been collected by DWR and the USGS within the GSP area. Prior to 1999, DWR monitored groundwater elevations in five wells twice each year (spring and fall). In 1999, an expanded groundwater monitoring program was developed through a contract with Reclamation to increase the monitoring well network from five wells to thirty-five (35) wells. By the mid-2000s the monitoring well network had expanded to an average of seventy (70) wells monitored on a monthly basis within the Subbasin and an adjacent subbasin (the Lower Klamath Subbasin).

The groundwater elevation data collected by DWR and other entities, including the District, are uploaded to the DWR Water Data Library (WDL). Table 2.5 identifies the State Well Number (SWN), location, depth, depth of perforations, use type, and period of monitoring of the approximately 70 wells monitored within the Subbasin.

Table 2.5. Wells Monitored for Groundwater Elevations within the Plan Area

State Well Number	Well Location		Well Depth (ft)	Perforations (ft)		Well Use	Period of Record	
	UTM East	UTM North		Top	Bottom		Begin	End
48N05E36K001M	636857	4646373	66	21	66	Stock	11/9/2001	Present
48N05E36A002M	637472	4646826	528	-	-	Irrigation	9/16/1998	Present
48N05E35F001M	634950	4646522	32	25	32	Domestic	8/22/1987	Present
48N05E33H001M	632533	4646676	57	-	-	Irrigation	9/10/1998	Present
48N05E26D001M (TID Well No. 8)	634823	4648412	1810	1250	1802	Irrigation	9/12/2001	Present
48N05E25Q002M	637118	4647239	-	-	-	Domestic	11/9/2001	10/25/2017
48N05E24P001M	636676	4649183	112	-	-	Domestic	9/9/1998	Present
48N05E22L001M	633295	4649188	65	-	-	Stock	9/10/1998	Present
48N05E22H001M	634129	4649916	203	36	203	Irrigation	7/23/2002	8/27/2013
48N05E16P001M (TID Well No. 6)	631643	4650575	2600	823	2358	Irrigation	8/10/2001	Present
48N05E14R001M (TID Well No. 7)	635760	4650660	2030	814	2020	Irrigation	8/16/2001	Present
48N05E13R003M	637344	4650713	-	-	-	Domestic	4/25/2002	3/25/2014
48N04E35C001M	625776	4646739	2790	2561	2761	Municipal	12/22/2003	Present
48N04E35G001M	626538	4646542	220	-	-	Irrigation	8/13/1998	Present
48N05E36D001M (TID Well No. 9)	636270	4647161	2043	-	-	Irrigation	9/05/2001	Present
48N04E31N002M	618801	4645596	337	292	337	Domestic	10/17/1995	Present
48N04E31M001M	618885	4645689	40	-	-	Domestic	8/20/1998	Present
48N04E30F004M	619471	4647993	-	-	-	Domestic	11/7/2001	Present
48N04E30F002M (TID Well No. 1)	619583	4647681	740	260	700	Irrigation	6/27/2001	Present
48N04E30F001M	619526	4647740	142	-	-	Industrial	8/20/1998	Present

State Well Number	Well Location		Well Depth (ft)	Perforations (ft)		Well Use	Period of Record	
	UTM East	UTM North		Top	Bottom		Begin	End
48N04E30E001M	619060	4647474	185	19	185	Domestic	9/30/1998	4/27/2011
48N04E30C002M	619503	4648378	84	69	74	Domestic	11/2/2001	Present
48N04E28D001M	622541	4648128	140	-	-	Irrigation	8/20/1998	Present
48N04E22M001M	623798	4649129	135	31	135	Domestic	11/8/2001	Present
48N04E19C001M	619377	4649996	38	22	38	Domestic	11/7/2001	Present
48N04E18L003M	619372	4650598	110	98	110	Domestic	8/19/1998	Present
48N04E18J001M (TID Well No. 2)	620463	4650579	1550	1260	1540	Irrigation	8/27/2001	Present
48N04E17C001M	621254	4650589	159	89	129	Domestic	11/8/2007	Present
48N04E16M001M (TID Well No. 3)	622152	4650599	1710	1053	1681	Irrigation	8/16/2001	Present
48N04E16L002M	623088	4650624	150	50	150	Industrial	8/1/1998	Present
48N04E15K001M (TID Well No. 4)	624805	4650629	1440	1212	1433	Irrigation	8/10/2001	Present
48N04E14M001M	625532	4650579	127	-	-	Stock	9/16/1998	Present
48N04E13K001M (TID Well No. 5)	628217	4650610	1570	935	1557	Irrigation	8/12/2001	Present
48N03E34N001M	614107	4645584	262	-	-	Stock	9/1/1998	Present
48N03E14M001M	615964	4650542	454	-	-	Irrigation	9/11/1998	11/23/2009
48N02E14J001M	607580	4650361	203	21	200	Domestic	8/17/1998	2/25/2010
47N06E30H001M	639048	4638513	680	198	650	Irrigation	9/15/1998	Present
47N06E19D002M	637956	4640502	245	-	-	Irrigation	9/3/1998	Present
47N06E06N002M	637707	4644032	1575	-	-	Irrigation	9/3/1998	Present
47N06E06N001M	637714	4644033	85	-	-	Irrigation	9/3/1998	Present
47N05E33F001M	631976	4637066	54	-	-	Industrial	8/18/1998	Present
47N05E26F001M	635184	4638313	105	78	98	Irrigation	8/18/1998	Present
47N05E04M001M	631148	4644392	71	68	72	Industrial	10/28/1987	Present
47N05E01N001M	636509	4643988	65	49	65	Domestic	10/28/1987	Present
47N05E01H001M	637501	4644971	1000	-	-	Stock	3/18/1999	Present
47N04E07Q001M	619097	4642356	1170	146	289	Irrigation	9/2/1998	Present

State Well Number	Well Location		Well Depth (ft)	Perforations (ft)		Well Use	Period of Record	
	UTM East	UTM North		Top	Bottom		Begin	End
46N06E08E001M	639424	4633481	213	-	-	Irrigation	9/8/1998	Present
46N06E07K002M	638839	4633192	101	-	-	Domestic	9/8/1998	Present
46N05E24P002M	636799	4629838	188	140	188	Irrigation	8/18/1998	Present
46N05E23G002M	635418	4630333	209	150	190	Irrigation	8/14/1998	Present
46N05E22D001M (TID Well No. 14)	633266	4630751	571	114	554	Irrigation	7/31/2001	Present
46N05E21M001M	631682	4630060	325	32	100	Irrigation	7/24/2002	Present
46N05E21J001M	632719	4630034	32	-	-	Domestic	11/9/2001	Present
46N05E16N001M	631419	4631249	-	-	-	Domestic	11/9/2001	10/31/2018
46N05E09J003M	632842	4633205	132	-	-	Industrial	8/18/1998	Present
46N05E03P001M	633424	4634509	173	10	89	Monitoring	9/3/1998	Present
46N05E03M003M	633203	4634749	-	-	-	Irrigation	7/23/2008	Present
46N05E03M002M	632965	4635144	252	-	-	Irrigation	9/4/1998	Present
46N05E03M001M	632976	4635138	126	-	-	Irrigation	9/4/1998	Present
46N05E01P001M	636763	4634300	101	87	101	Domestic	10/25/1994	Present
46N05E01B001M	636943	4635559	140	-	-	Irrigation	5/24/2001	Present
41S12E23H001W	634935	4651610	150	-	-	Industrial	11/9/2001	Present
41S12E22Q001W	632785	4650754	600	-	-	Industrial	11/8/2001	Present
41S12E21Q001W	631062	4651080	-	-	-	Domestic	11/8/2001	Present
41S12E19Q001W	627992	4650692	65	-	-	Domestic	11/8/2001	Present
41S12E16J001W	631556	4652891	380	-	-	Municipal	11/8/2001	Present
41S12E15M002W	631946	4652420	84	-	-	Municipal	11/8/2001	9/4/2019
41S11E16R002W	622342	4650776	70	-	-	Industrial	8/28/2002	Present
41S11E16R001W	622046	4650694	70	-	-	Domestic	11/8/2001	Present
TL-T3 GP	627056	4633043	500	-	-	Monitoring	1/10/2011	Present
TL-T1 Q3B	621062	4632384	500	-	-	Monitoring	1/10/2011	Present

Note: Information was obtained from DWR's Water Data Library. As additional information becomes available, this table will be updated.

Figure 2-18 identifies the distribution of groundwater wells actively monitored for groundwater elevations within and near the GSP area. The wells shown on this figure include groundwater wells drilled to depths such that extraction may occur from the alluvial aquifer or from the deeper, more productive volcanic aquifer. For the purposes of this GSP, wells that most likely pump from the alluvial aquifer (those with shallow perforation and depths less than 500 feet) are described as “shallow groundwater wells”. Wells with depths greater than 500 feet and deep perforations most likely pump from the deeper volcanic aquifer and are described as “deep groundwater wells”. Well depth and construction information, including perforations, are not available for all groundwater wells monitored for water elevation within the GSP area. Some wells with unknown depths are also shown on Figure 2-18.

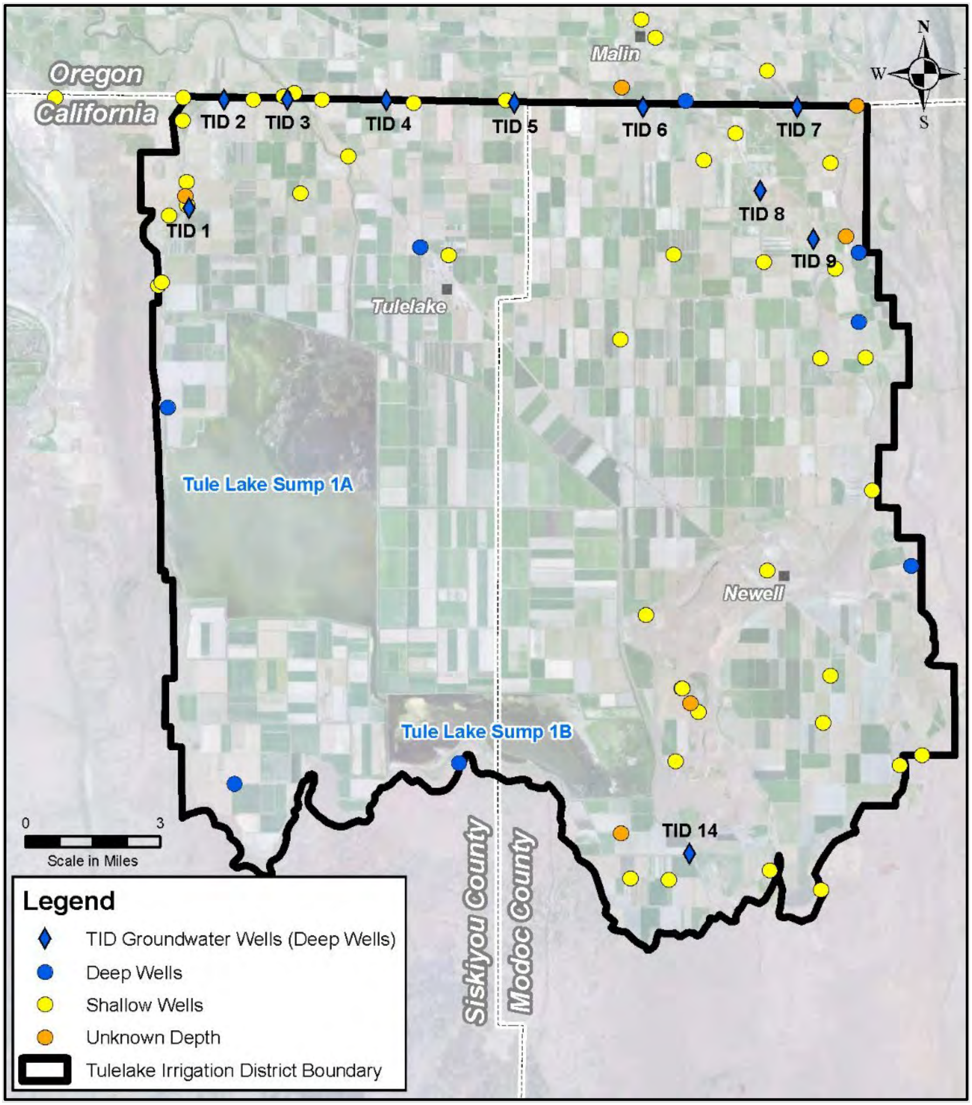


Figure 2-18. Wells Monitored for Groundwater Elevations within and near the GSP Area

Beginning in 2001, the reduction in available surface water supplies has resulted in an increase in groundwater extraction within the Klamath Reclamation Project, including the GSP area. As a result, recent trends in groundwater elevation are reflective of not only climatic conditions and surface water recharge, but also the generally increased (although varying) levels of annual groundwater extraction. Figure 2-19 identifies the location of the wells where static groundwater elevation data was reviewed and represented in hydrographs (Figure 2-20 through Figure 2-28).

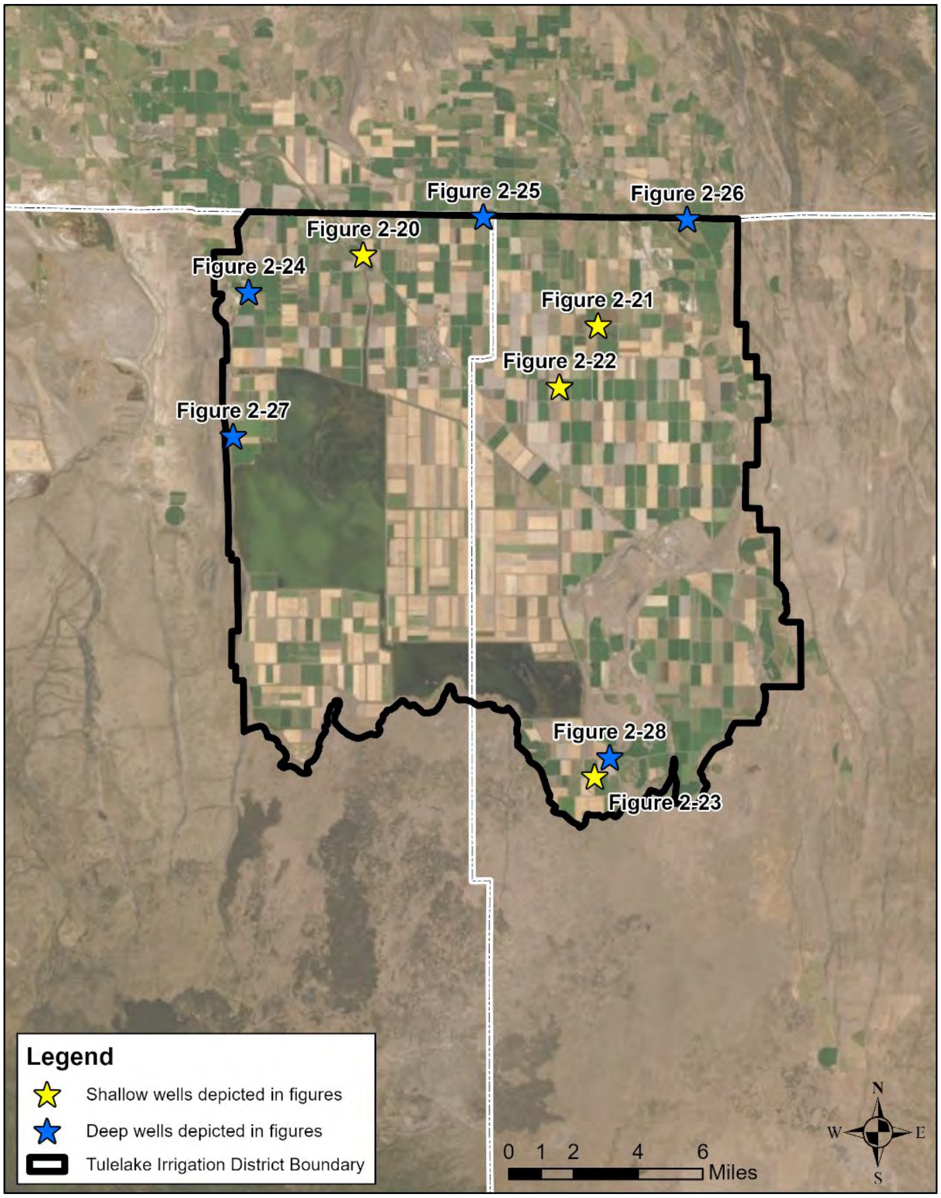


Figure 2-19. Wells Monitored for Groundwater Elevations within and near the GSP Area Represented in Figure 2-20 through Figure 2-28

Figure 2-20 through Figure 2-23 include wells described previously as relatively shallow groundwater wells, those with drilling depths of less than 500 feet. Figure 2-24 through Figure 2-28 include wells described as deep groundwater wells, i.e., those with well depths greater than 500 feet.

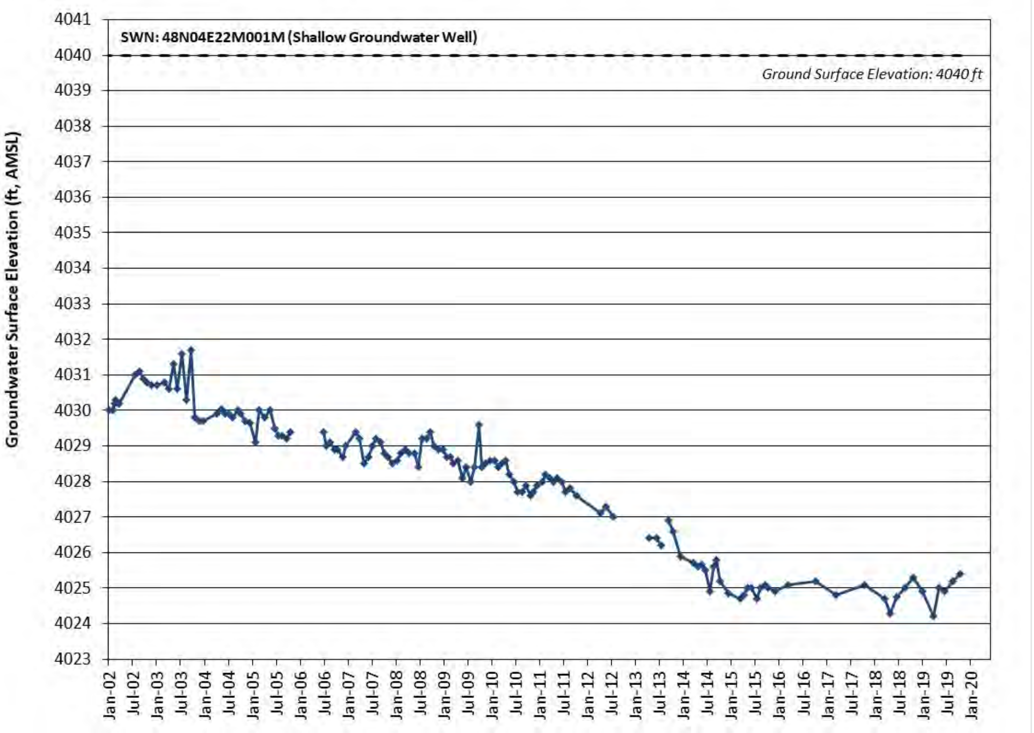


Figure 2-20. Groundwater Hydrograph for SWN: 48N04E22M001M

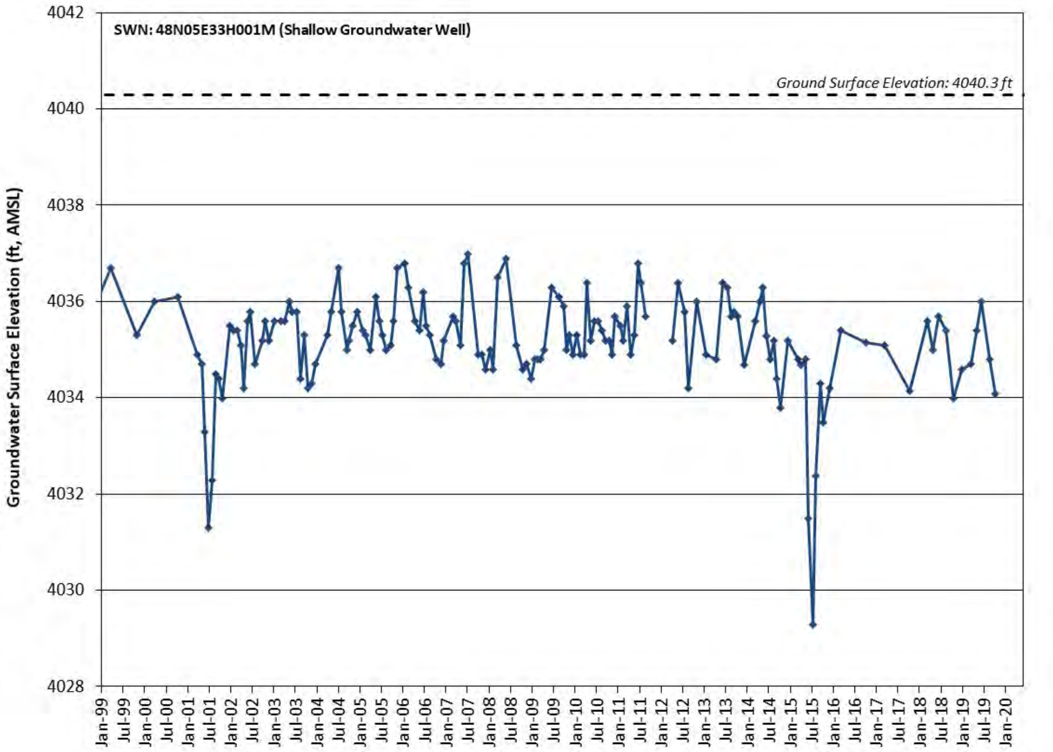


Figure 2-21. Groundwater Hydrograph for SWN: 48N05E33H001M

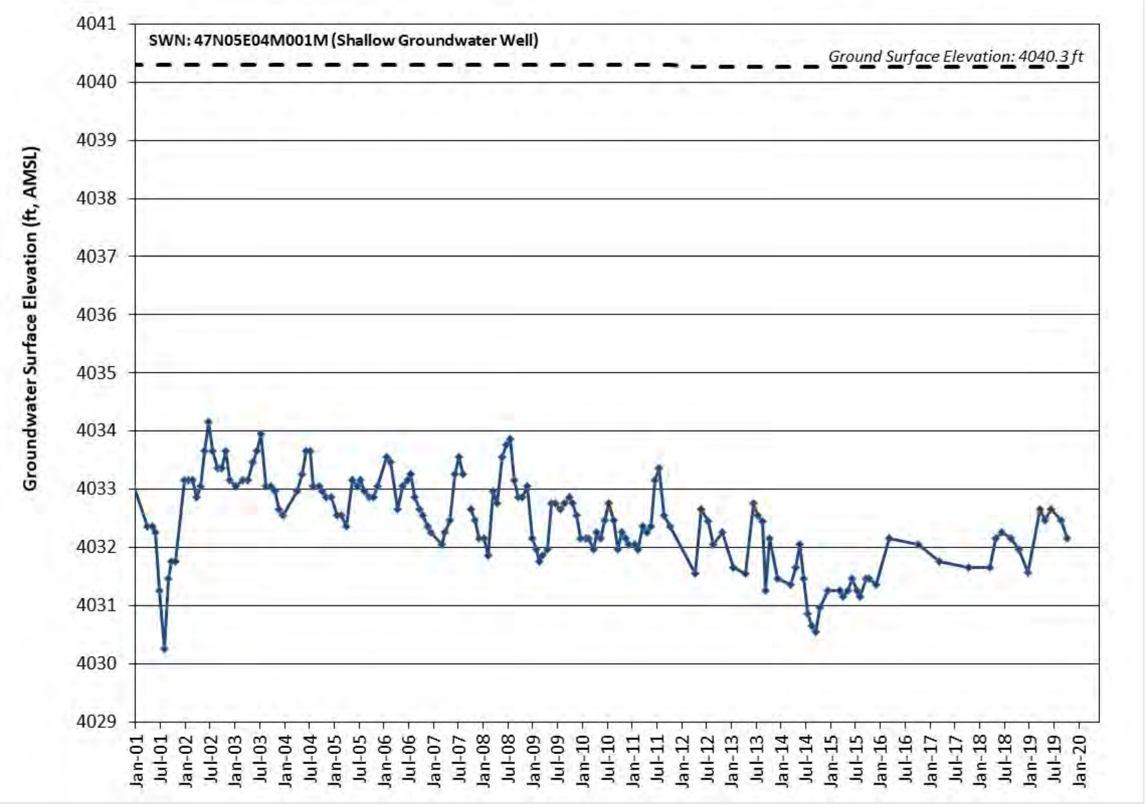


Figure 2-22. Groundwater Hydrograph for SWN: 47N05E04M001M

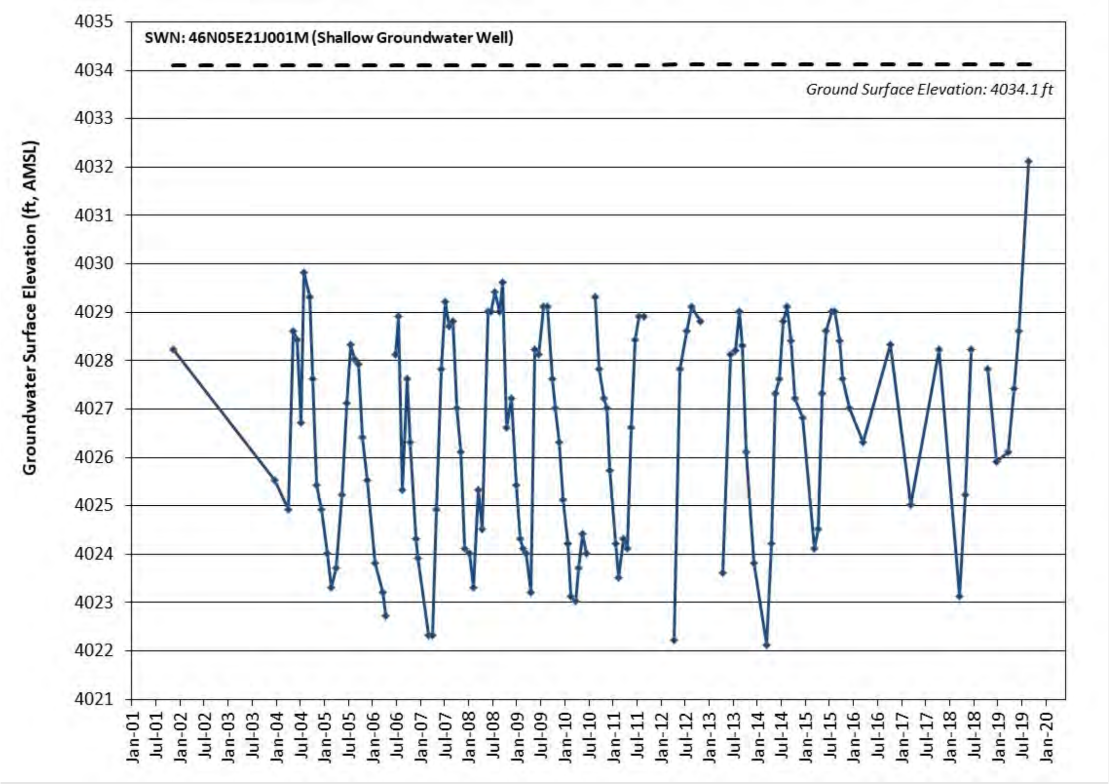


Figure 2-23. Groundwater Hydrograph for SWN: 46N05E21J001M

As shown on Figure 2-20 through Figure 2-23, relatively shallow groundwater wells within the GSP area show minimal changes (less than 1 foot) in groundwater elevations when comparing spring 2015 to spring 2019 groundwater elevations. This is indicative of these wells pumping from the alluvial (shallow) aquifer which is likely recharged through local precipitation, deep percolation of irrigation flows, and canal seepage. Hydrographs of shallow wells throughout the GSP area identify a similar (minimal) change in groundwater elevations during this time period.

Figure 2-24 through Figure 2-28 show hydrographs for deeper wells within the alluvial aquifer (drilled deeper than 500 feet).

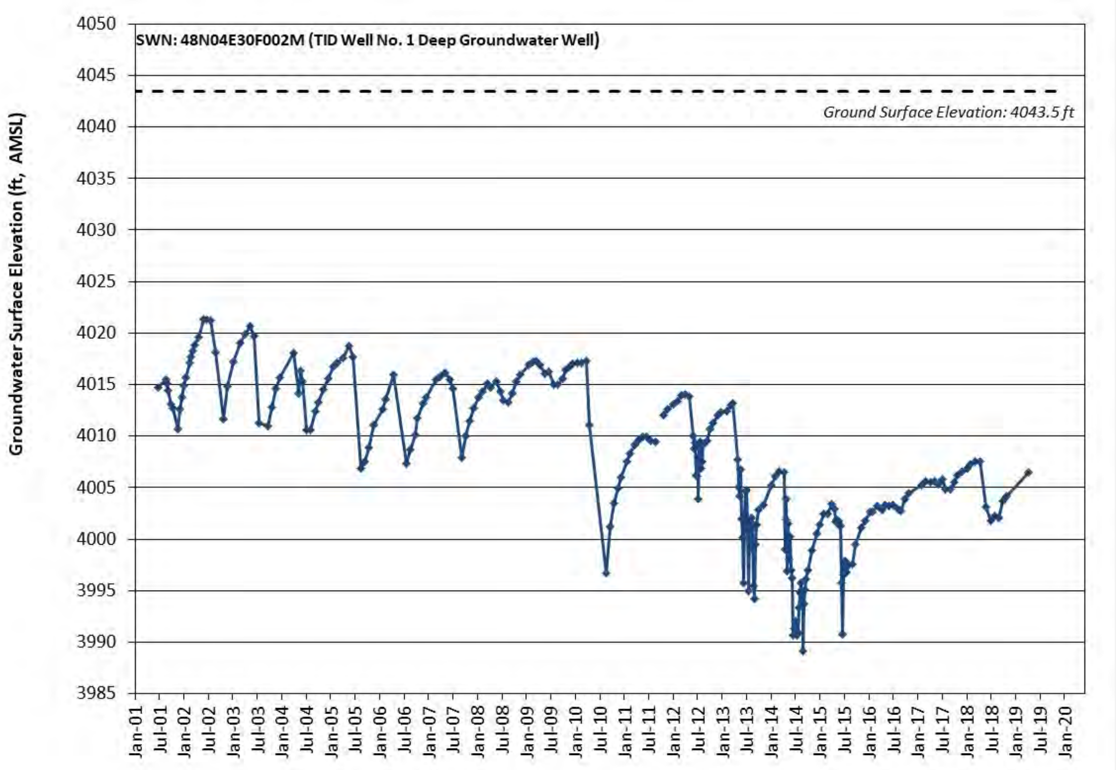


Figure 2-24. Groundwater Hydrograph for SWN: 48N04E30F002M (TID Well No. 1)

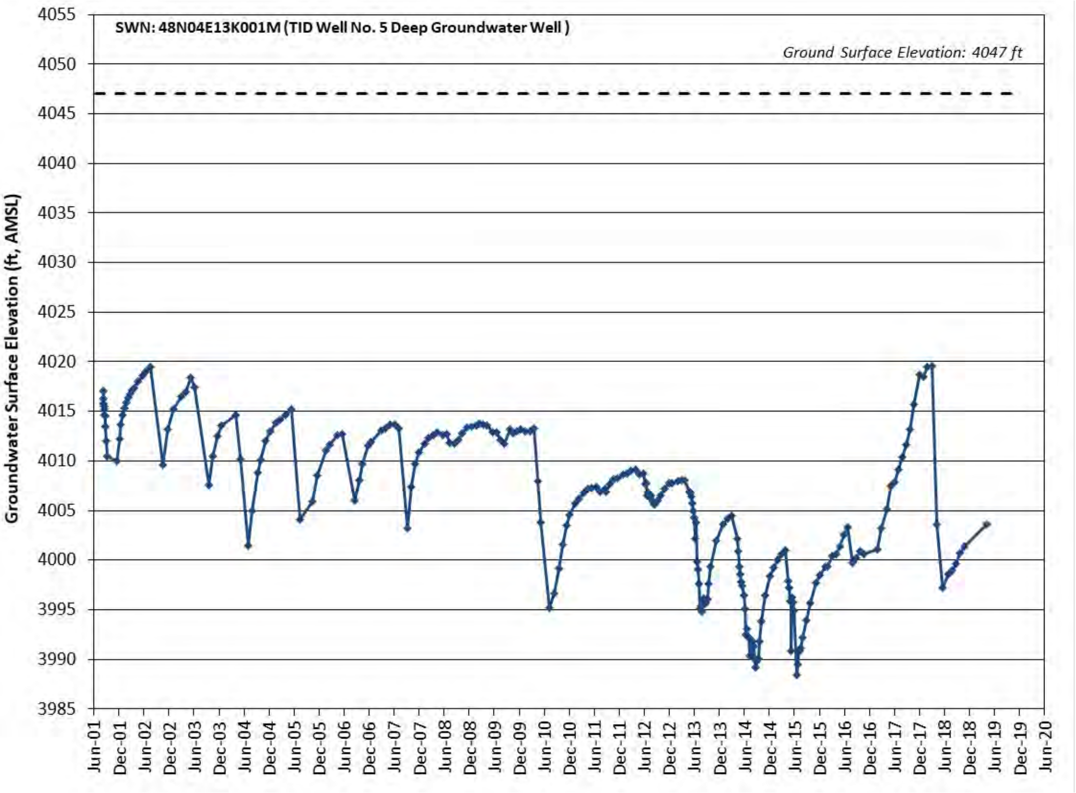


Figure 2-25. Groundwater Hydrograph for SWN: 48N04E13K001M (TID Well No. 5)

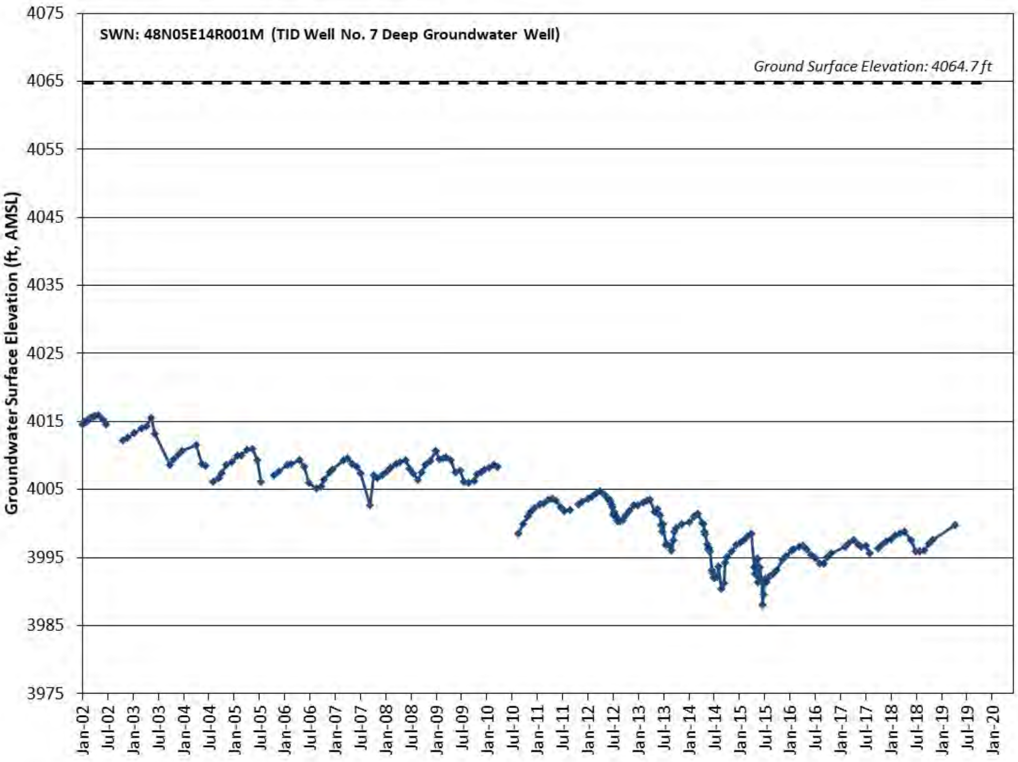


Figure 2-26. Groundwater Hydrograph for SWN: 48N05E14R001M (TID Well No. 7)

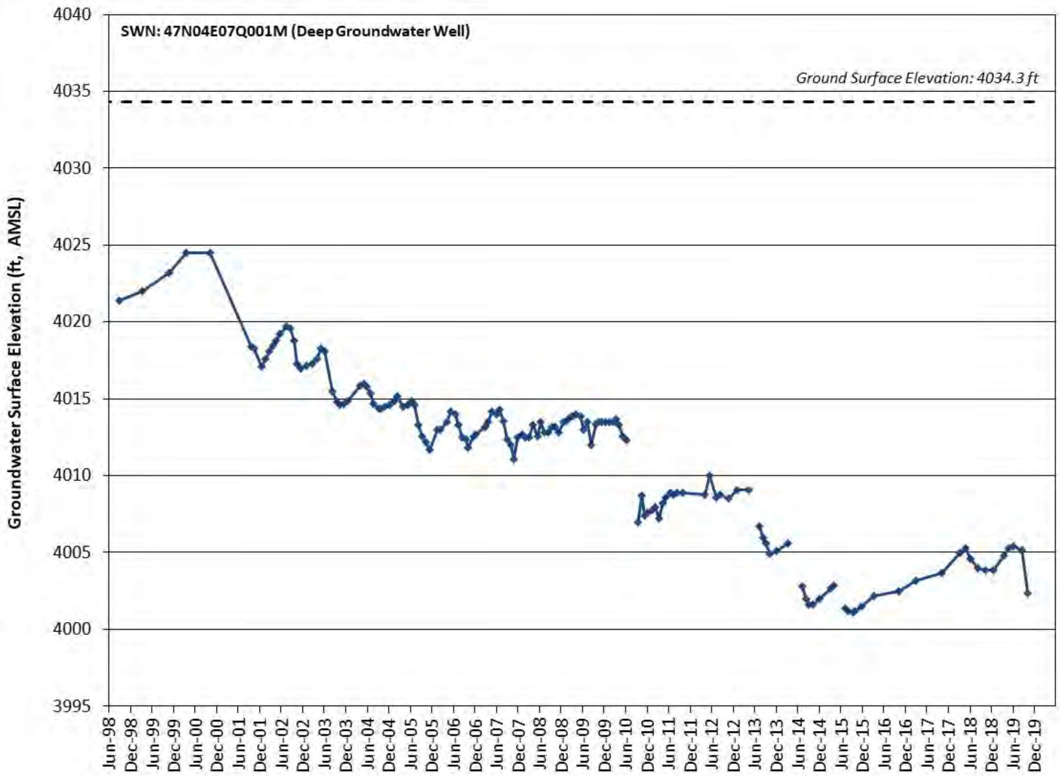


Figure 2-27. Groundwater Hydrograph for SWN: 47N04E07Q001M

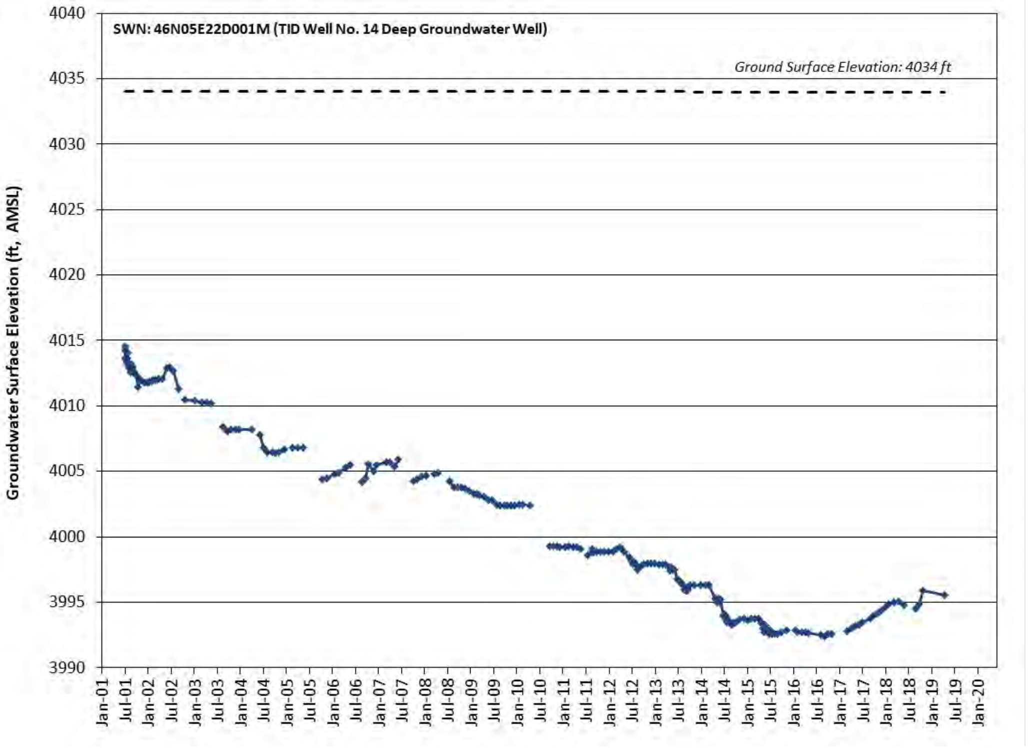


Figure 2-28. Groundwater Hydrograph for SWN: 46N05E22D001M (TID Well No. 14)

The hydrographs for deeper groundwater wells show a greater change in the groundwater elevations from spring 2015 to spring 2019, as compared to the hydrographs for the shallow groundwater wells. This deeper portion of the alluvial aquifer appears to be primarily recharged through precipitation and the groundwater movement of flows from north to south within the Upper Klamath Basin. It may also be influenced by the underlying volcanic aquifer, which is not considered a primary aquifer in the Subbasin. The change in spring 2015 to spring 2019 elevation at these groundwater wells ranges from approximately -2 feet to approximately +4 feet.

2.2.2.2 Current Groundwater Elevations

The following figures represent groundwater elevation data from deep groundwater wells (deeper than 500 feet), as these wells indicate the potential effects from both dry hydrologic conditions and groundwater pumping within the deeper portion of the alluvial aquifer.

Figure 2-29 and Figure 2-30 identify groundwater elevations and contours within the GSP area[1] for spring 2015 and spring 2019, respectively, prior to the groundwater pumping during the subsequent irrigation season (ft, AMSL).

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[1] The groundwater elevation contours were created using available groundwater measurement data in the GSP area. However, the extent of the contours is limited because there are no wells with groundwater level measurements located immediately outside the Tule Lake Subbasin.

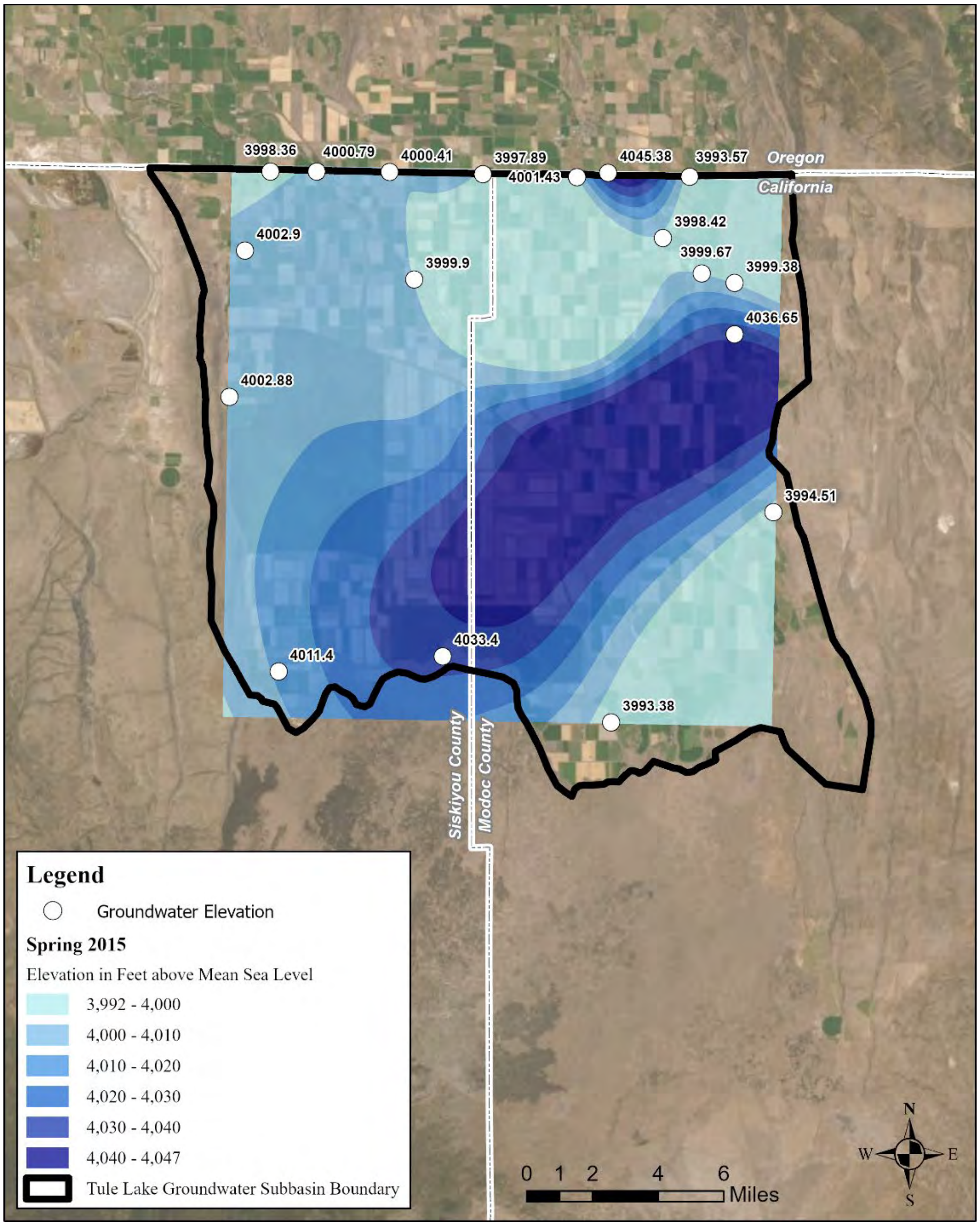


Figure 2-29. Spring 2015 Groundwater Surface Elevations

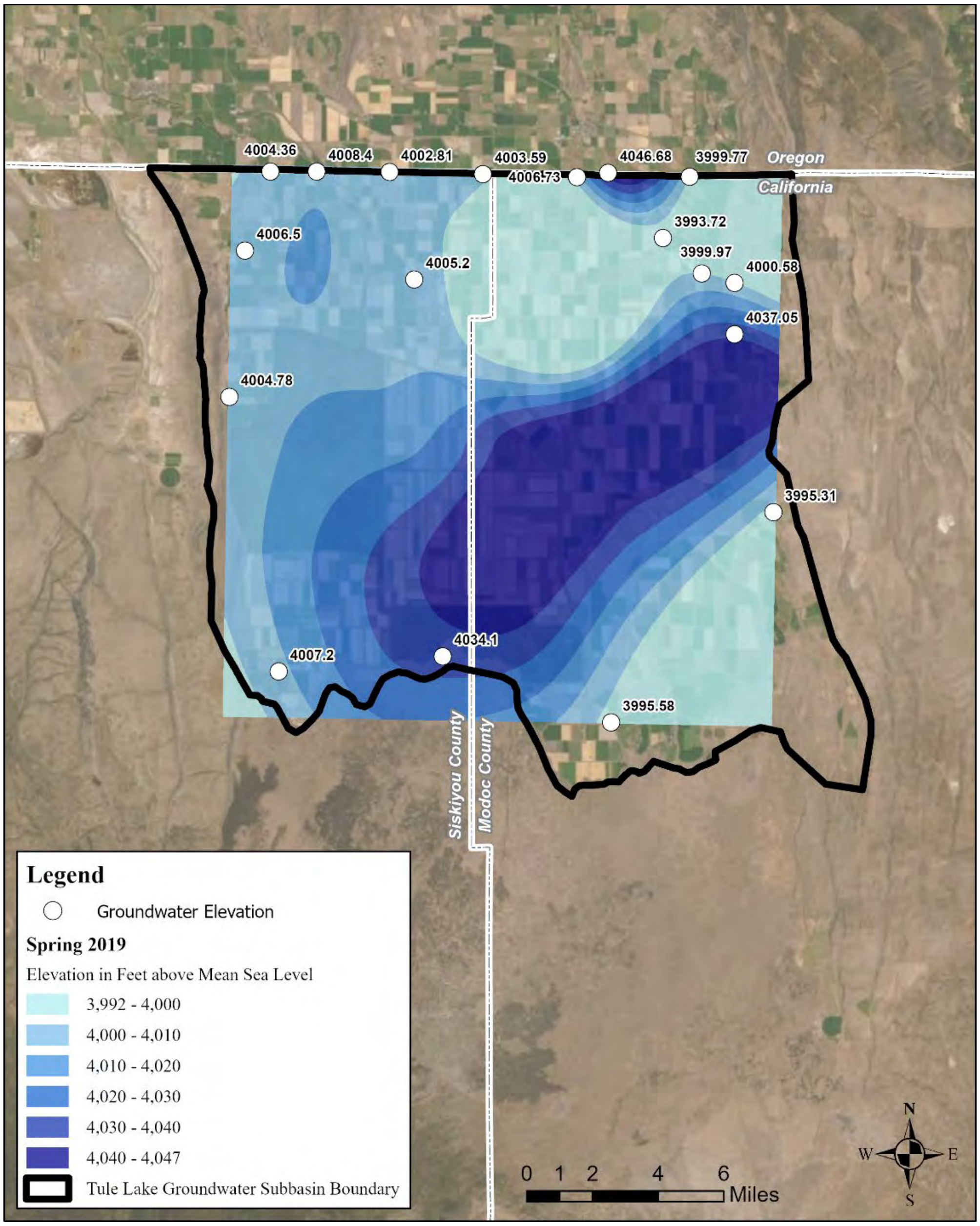


Figure 2-30. Spring 2019 Groundwater Surface Elevations

Figure 2-31 and Figure 2-32 identify groundwater elevations and contours within the GSP area for fall 2015 and fall 2019, respectively, after the groundwater pumping during the most recent irrigation season (ft, AMSL).

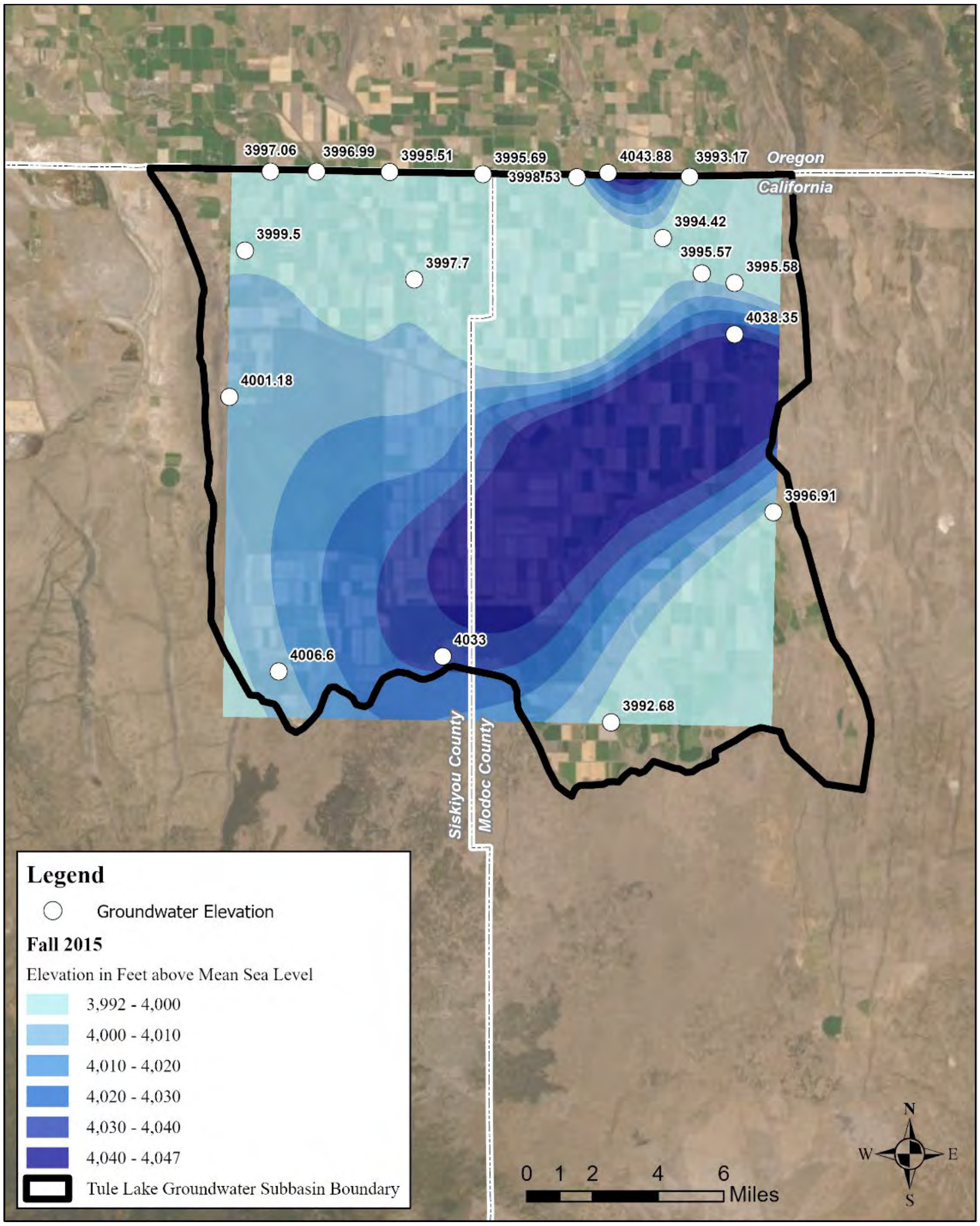


Figure 2-31. Fall 2015 Groundwater Surface Elevations

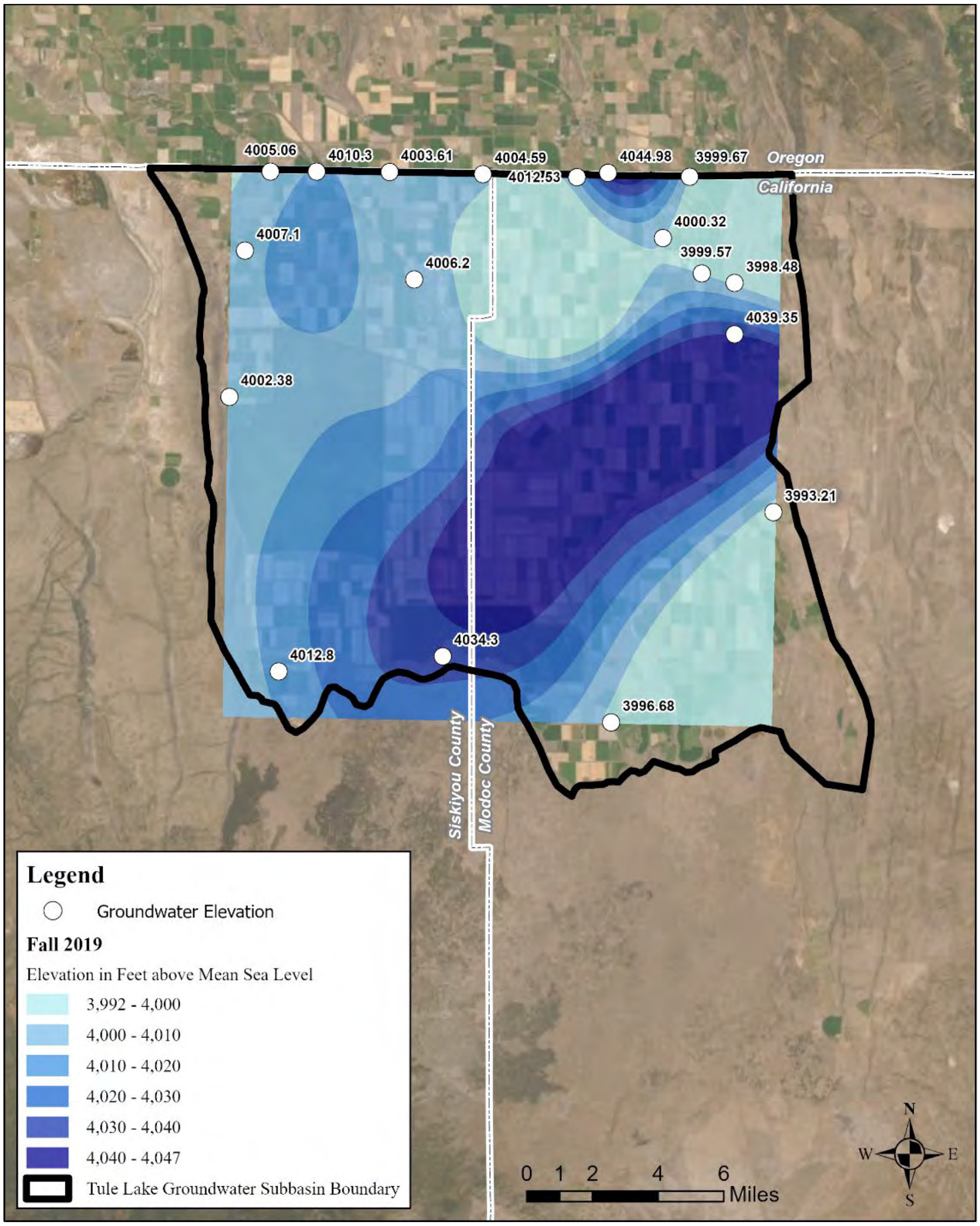


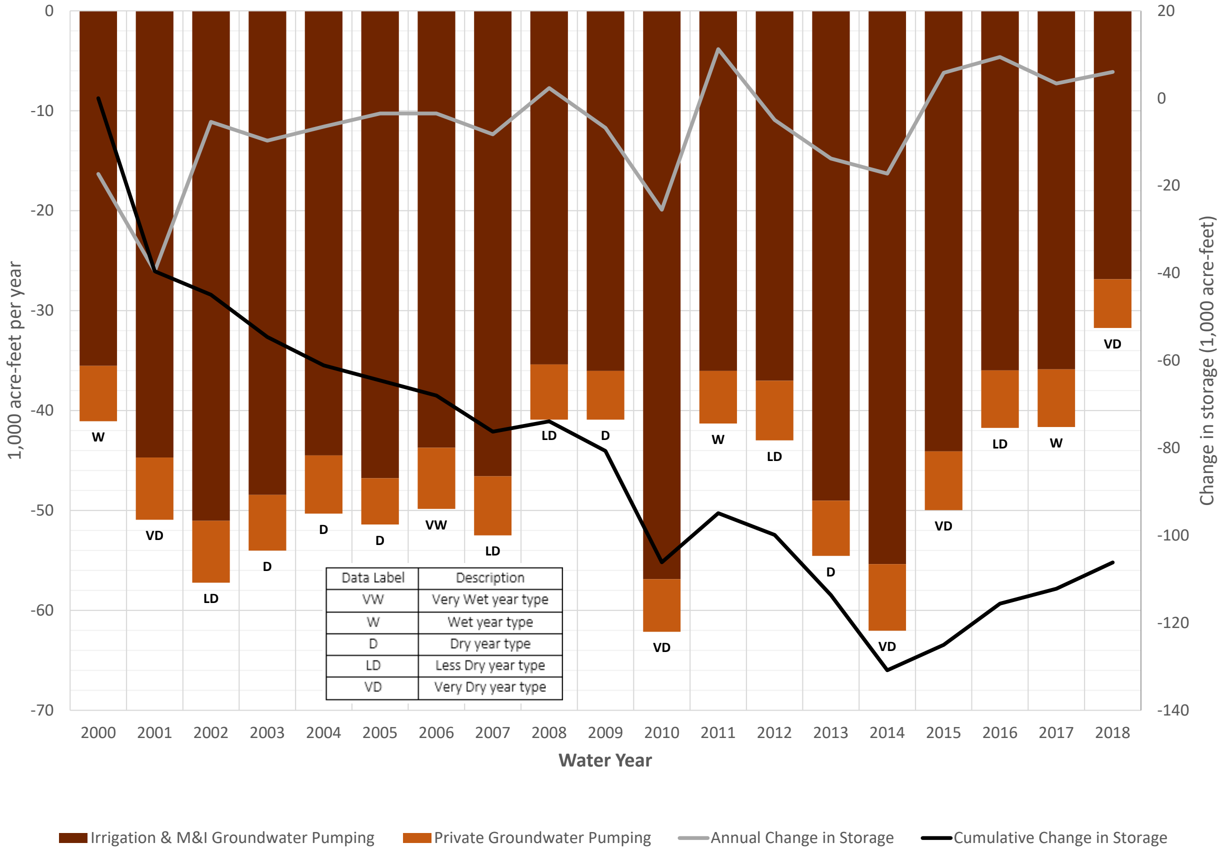
Figure 2-32. Fall 2019 Groundwater Surface Elevations

2.2.2.3 Vertical Gradients

Vertical gradients can be used to describe the vertical movement of groundwater. Typically, vertical gradients are measured by comparing the elevations of groundwater in a well with multiple completions at different depths (multi-completion well). There are zero multi-completion wells located in the Tule Lake Subbasin. While the existing monitoring network is considered appropriate to monitor for trends, additional monitoring wells, including a multi-completion well(s) would help improve the understanding of the characteristics of the groundwater basin.

2.2.2.4 Groundwater Storage

Output from the model developed for this GSP was used to estimate the historical change in groundwater storage for the Subbasin. Additional detail on use of the model for water budgeting purposes is further discussed in Section 4. Figure 2-33 shows the annual change in storage and cumulative change in storage along with an indication of the water year type[2]. In addition, the annual estimated groundwater usage by users within the District service area (Irrigation & M&I Groundwater Pumping) and users outside of the District service area (Private Groundwater Pumping) is shown in Figure 2-33.



Data Label	Description
VW	Very Wet year type
W	Wet year type
D	Dry year type
LD	Less Dry year type
VD	Very Dry year type

Figure 2-33. Estimated Groundwater Pumping and Change in Storage

2.2.2.5 Seawater Intrusion

Due to its geographic location, seawater intrusion is not a concern for the Tule Lake Subbasin.

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[2] Water year types provide an indication of hydrology and are described in the technical memorandum provided in Appendix F.

2.2.2.6 Groundwater Quality

Limited groundwater quality monitoring data are available within Tule Lake Subbasin. In most instances, many of the groundwater wells have not been monitored frequently, with many wells being sampled only once during the period of record for a parameter. However, the quality of groundwater in the Subbasin is suitable for current uses. Public Water Suppliers rely on groundwater as it is their water source in the Subbasin. Therefore, it is important to note that the groundwater supply meets drinking water standards without treatment.

DWR Bulletin 118 generally describes the water quality of the groundwater within the Tule Lake Subbasin as ranging widely in response to the source and proximity to sources of surface and subsurface impairment. Water quality for wells constructed in the unconfined volcanic rocks within and adjacent to the Tule Lake Subbasin is good with a sodium-bicarbonate character and a total dissolved solids (TDS) ranging from 150 to 270 mg/L. A shift in water quality is observed with the unconfined volcanics that are proximate to lake sediments. The character shifts to a sodium/calcium/magnesium-bicarbonate/sulfate water that is much higher in total dissolved solids (600 to 800 mg/L), which generally increases in proportion to the penetrated thickness of interfingering lake deposits (DWR, 2004).

The State Water Resources Control Board's GAMA Program has created tools to analyze groundwater throughout the State. Appendix G includes water quality information obtained from GAMA. A summary of key constituents in all wells monitored in the subbasin, identified that major ions, volatile organic compounds (VOCs), trace elements, and TDS can be found in high concentrations throughout the subbasin. However, radionuclides, pesticides, and nutrients are typically only detected at low concentrations.

The SWRCB performed an analysis of domestic well water throughout the state. Data were collected over two years (summer 2017 – summer 2019) for chemical constituents that have an established maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) along with several other constituents. The top six constituents were represented in the analysis: nitrate, arsenic, hexavalent chromium, uranium, 1,2,3 trichloropropane (1234 TCP), and perchlorate. The results of this study show that only arsenic exceeded the MCL of 10 micrograms per liter. However, the areas were all determined to be a Water Quality Grade 5 which indicates there are no recent exceedances (see Appendix G). Hexavalent chromium is identified as unknown for the area. It is assumed that this constituent was not tested for in the subbasin. The remaining four constituents did not exceed the established MCL or SMCL.

2.2.2.7 Land Subsidence Conditions

Land subsidence is the lowering of the ground surface through compaction of compressible, fine-grained strata. Compaction can be fully reversible (elastic) or permanent (inelastic). Elastic compaction and expansion generally occur in response to seasonal groundwater level fluctuations. Inelastic compaction is more likely to occur when prolonged dewatering of clay units occurs during periods when the aquifer is not fully recharged and groundwater levels reach historic lows.

Historically, land subsidence was monitored along transects by comparing periodic spirit level surveys conducted by the USGS and the NGS. In the mid-1980s, a transition was made from the spirit level surveys to GPS surveys. Like spirit level transects, GPS monitoring of subsidence relies on periodic resurveying of a network of monuments. In 2001, DWR defined a network of monuments and preformed a GPS survey of the ground surface elevation. In 2011, DWR re-surveyed 6 of the 23 monuments along the east and southeast portion of the Subbasin to identify any potential land subsidence. Results from the 2011 survey indicate that there has been no noticeable subsidence on the east side of the Subbasin (DWR, 2015).

As part of DWR's SGMA technical assistance, a statewide Interferometric Synthetic Aperture Radar dataset was acquired. InSAR is a satellite-based remote sensing technique that measures vertical ground surface displacement. TRE ALTIMIRA has processed the InSAR data, and DWR has made available vertical displacement raster data. Analysis of these images from 2015 through 2019 show that the Subbasin has not experienced noticeable subsidence during recent years. TRE ALTIMIRA data for 2015 to 2016, and 2018 to 2019 are shown in Figure 2-34 and Figure 2-35, respectively.

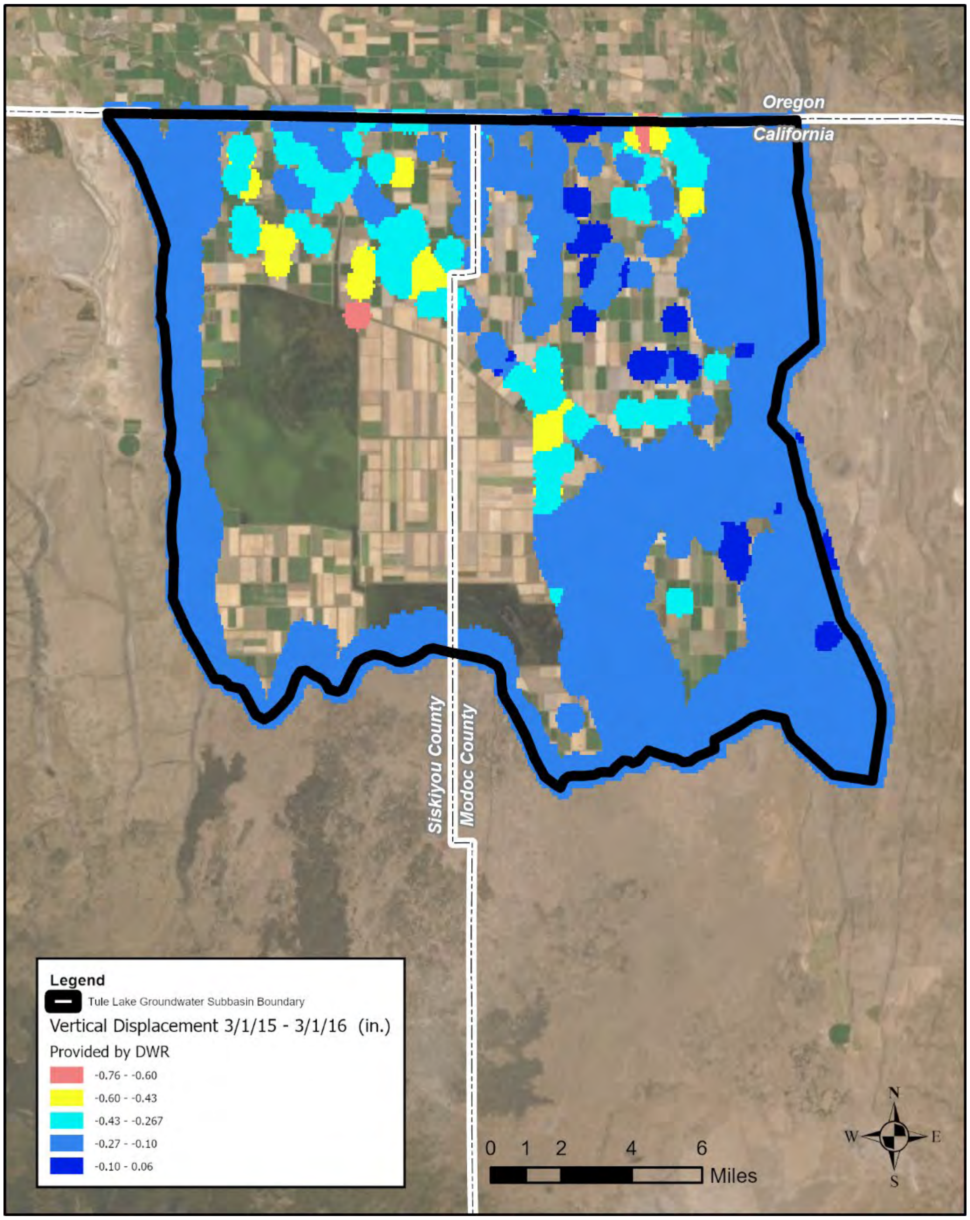

Figure 2-34. Tule Lake Subbasin 2015-2016 Land Surface Displacement

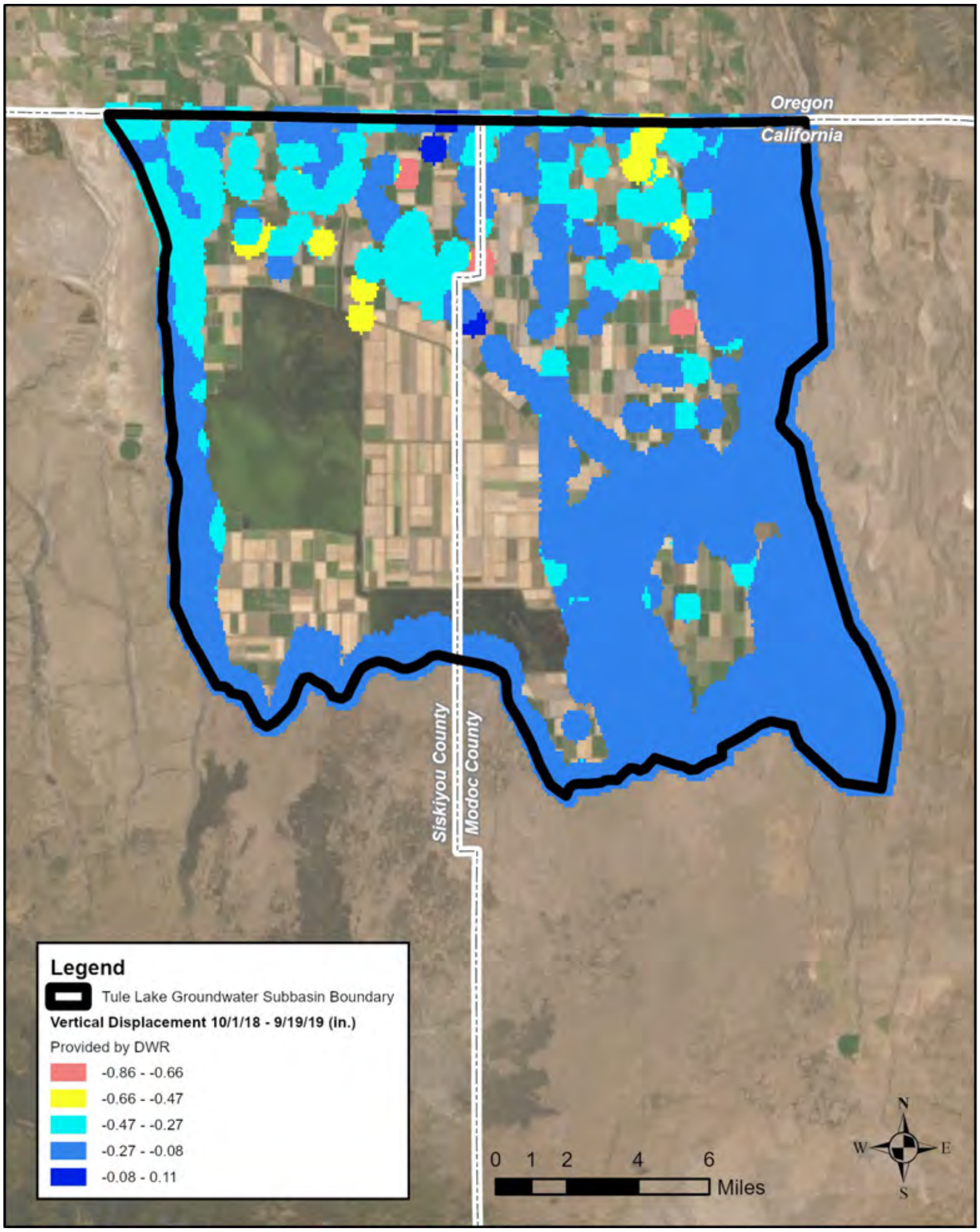

Figure 2-35. Tule Lake Subbasin 2018-2019 Land Surface Displacement

2.2.2.8 *Identification of Interconnected Surface Water Systems*

Interconnected surface water systems exist where there is a hydraulic connection between water flowing in surface water streams and water in the adjacent aquifers. The relative difference between the water surface elevation in the stream and aquifer determines the direction of flow. Flow from the aquifer to the stream creates a “gaining stream” and occurs in areas where near-stream groundwater elevations are higher than stream water surfaces. Areas where adjacent groundwater elevations are lower than stream water surfaces indicate flow from the stream to the aquifer or a “losing stream”. Figure 2-35 is a conceptual illustration of these two conditions. The direction of the flow between a stream and aquifer can vary spatially along the length of the stream where there can be gaining reaches and losing reaches. The direction can also vary through time with a stream gaining during some months or years and losing at other times.

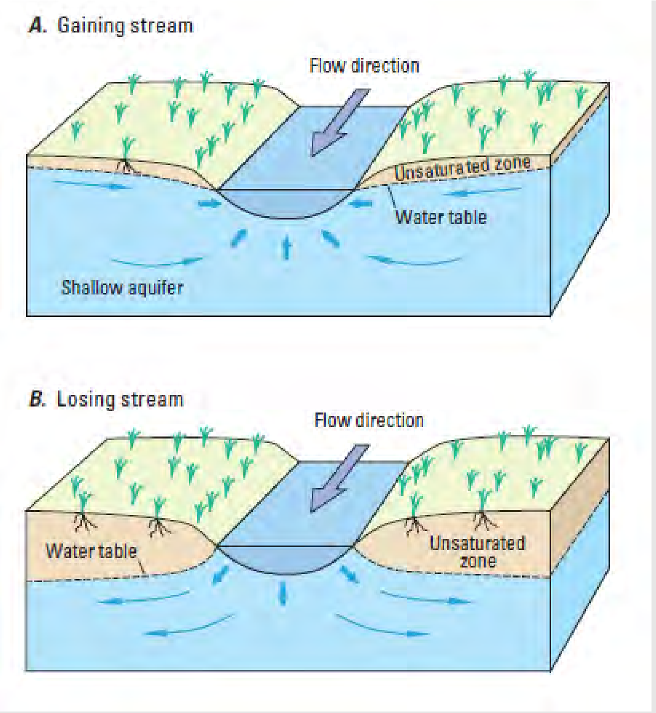

Figure 2-36. Gaining and Losing Streams (reproduced from USGS Circular 1376)

Interaction between groundwater and surface water in the Subbasin was analyzed through the use of the model. Direct measurement of the gain or loss from surface water to groundwater in the area is not feasible; however, the model provides sufficient information to characterize interconnected surface water systems. The model was used to develop estimates of timing and volume of gains and losses. Within the Subbasin, surface water systems include the small reach of the lower Lost River Improved Channel which extends into the Tulelake area and the “Sumps”. This system is highly regulated as part of Reclamation’s Klamath Project, and flows in the Lost River and water levels within the Sumps are dependent on surface water deliveries made available by Reclamation from the Klamath Project. The section of the Lost River within the Subbasin is referred to as the lower Lost River Improved Channel. Flow in this section is dependent on spill of Klamath Project water at the Anderson-Rose Dam during the irrigation season. Therefore, it is generally considered an irrigation channel and not a natural river channel.

The Tule Lake National Wildlife Refuge is located within the Subbasin and primarily consists of four “Sumps,” two of which act as regulating reservoir within TID (Sumps 1A and 1B). The other two Sumps (Sumps 2 and 3) have been reclaimed and are farmed as lease and co-op lands. The operational spills and tailwater resulting from irrigation within TID are conveyed through TID’s extensive drainage system, which utilizes gravity and pumped discharge into portions of the canal system or into the Tule Lake Sumps. Water regulated and stored within the Tule Lake Sumps may be diverted or rediverted for irrigation within TID or discharged by TID’s D-Pumping Plant to the P-Canal, which serves the Lower Klamath National Wildlife Refuge and the water users on the P-Canal system of the Project.

The Sumps are operated by TID, and the surface water level must be maintained at specified elevations throughout the year. Based on the Biological Opinion to protect the endangered sucker fish, the Sumps must be maintained at an elevation of at least 4,034.60 feet during April 1 through September 30; and, based on the Rules and Regulations relative to flood control, the elevation is maintained at 4,034.00 feet the remainder of the year.

2.2.2.9 Identification of Groundwater-Dependent Ecosystems

Groundwater Dependent Ecosystems (GDE) are defined in the SGMA Regulations as, "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface", (23 CCR § 351[m]). Identification of GDEs under SGMA is important because SGMA requires that all beneficial uses and users be considered in the development of GSPs.

The Natural Communities Commonly Associated with Groundwater (NCCAG) database was used to identify plants commonly associated with groundwater use. The NCCAG was developed by a working group comprised of DWR, the California Department of Fish and Wildlife (CDFW), and The Nature Conservancy (TNC), which reviewed publicly available datasets of mapped seeps, springs, vegetation, and wetlands, and conducted a screening process to exclude types less likely to be associated with groundwater and retain types commonly associated with groundwater. Two habitat classes are included in the NCCAG dataset: 1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions; and 2) vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes). Figure 2-37 shows the wetland features and vegetation areas identified in the NCCAG database.

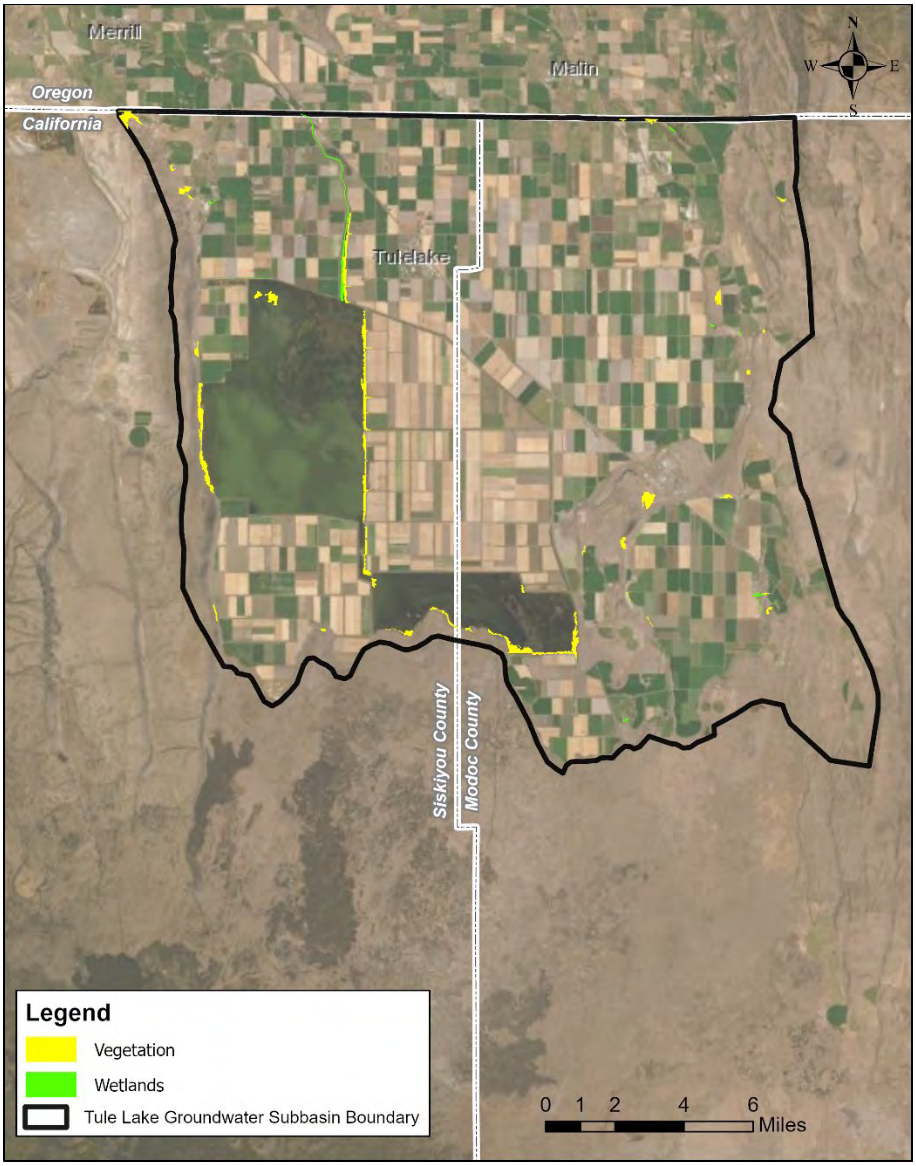

Figure 2-37. Natural Communities Commonly Associated with Groundwater

However, identification as a NCCAG is not the same as being a GDE. An analysis was performed to evaluate each NCCAG against criteria to determine if it is a GDE. The criteria listed below identify characteristics which would result in a NCCAG not being classified as a GDE.

1. Areas with a depth to groundwater greater than 30 feet – Oak trees are considered the deepest-rooted plant in California with typical root zone depth of 25 feet. TNC has developed guidance documents to help GSAs identify GDEs (TNC, 2018). These guidance documents suggest that depth to groundwater greater than 30 feet would not support a GDE. NCCAGs in areas with depth to groundwater greater than 30 feet are assumed to not access groundwater and are represented as “Areas with Depth to Groundwater > 30 feet” in Figure 2-38.

2. Areas adjacent to agricultural surface water – The majority of the Subbasin is agricultural land and intersected by a system of irrigation canals, ditches, and drains. The irrigation system brings in surface water which is available to the NCCAGs. NCCAGs adjacent to irrigation conveyance facilities are assumed to access the available surface water and are represented as “Areas Adjacent to Agricultural Surface Water” in Figure 2-38.
3. Areas adjacent to irrigated fields – Similar to areas adjacent to irrigation water conveyance facilities, areas near irrigated fields benefit from the irrigation water used to support crops. Irrigated fields are consuming the water that is applied and, therefore, less water is available to adjacent ecosystems as compared to the conveyance facilities. NCCAGs adjacent to irrigated fields are assumed to access the available surface water and are represented as “Areas Adjacent to Irrigated Fields” in Figure 2-38.
4. Areas adjacent to the Sumps – As described in Section 2.2.2.8, water levels are maintained in the Sumps year-round. The Sumps provide water for adjacent ecosystems. NCCAGs adjacent to the Sumps are assumed to access the available surface water and are represented as “Areas Adjacent to Tule Lake Sumps” in Figure 2-38.

The majority of the wetlands and vegetation shown are located along the perimeter of the Sumps or are adjacent to other surface water features. Areas remaining after the four criteria above were applied have been identified as a data gap and are discussed further in Section 6.1.4. Appendix H is a technical memorandum describing this process in further detail and includes additional maps at a larger scale.

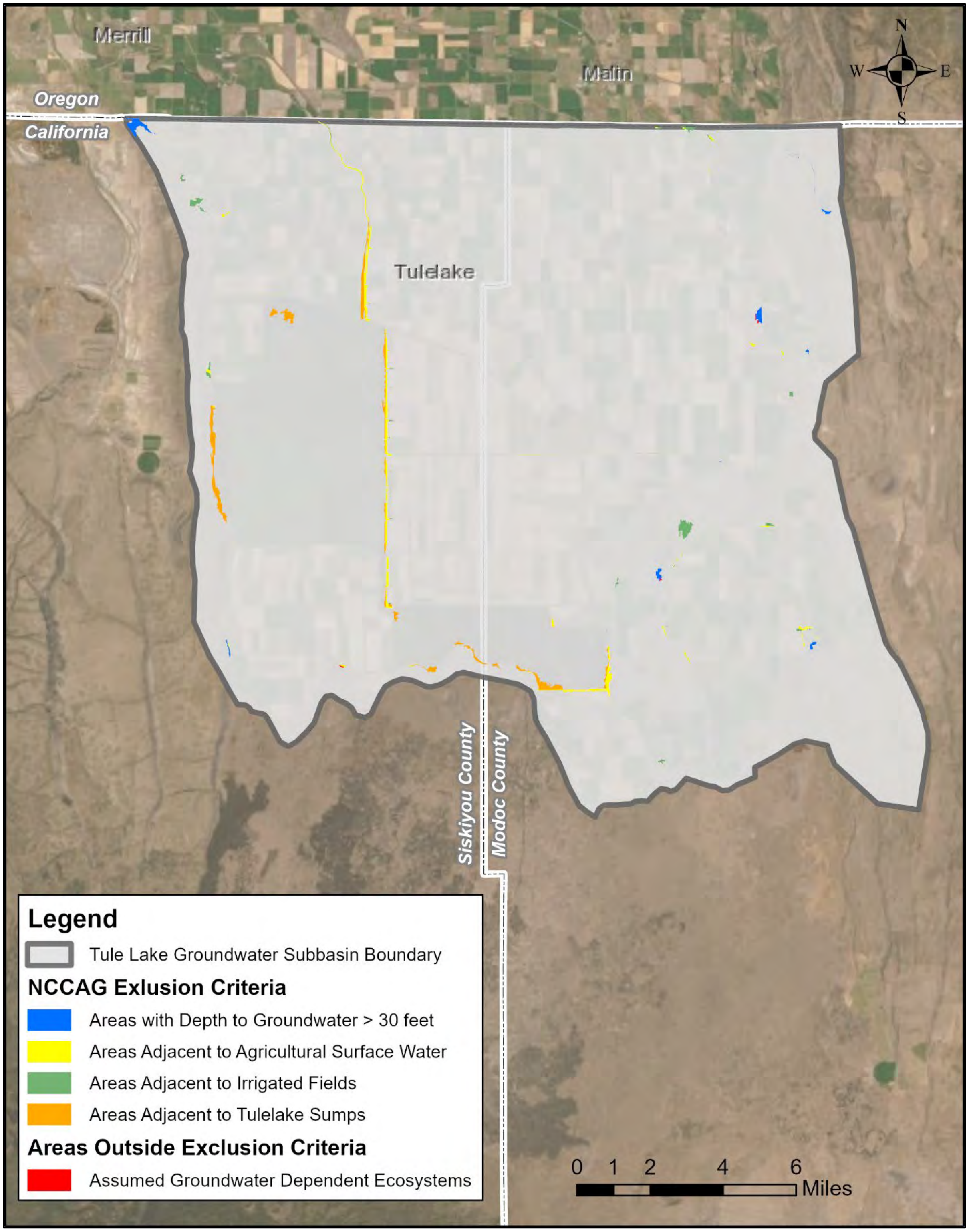

Figure 2-38. Assumed Groundwater Dependent Ecosystems

3 Monitoring Network

3.1 Description of the Monitoring Network (Reg. § 354.34)

This section discusses the monitoring networks identified to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface water conditions. In addition, these networks assist with the evaluation of changing conditions that occur through implementation of the Plan. A groundwater level monitoring network has been identified to avoid the undesirable result of chronic lowering of groundwater levels. Monitoring of groundwater levels will support the understanding of groundwater storage and be used as a proxy for the change-in-storage and land subsidence undesirable results. A groundwater quality monitoring network has been identified to avoid the undesirable result of degraded water quality. As discussed in Section 2.2.2.5, due to its geographic location, seawater intrusion is not a concern for the Tule Lake Subbasin. Therefore, a monitoring network for seawater intrusion has not been identified. As discussed in Section 2.2.2.9, the lower Lost River Improved Channel and Tule Lake Sumps are surface water systems within the Tule Lake Subbasin. See Section 3.3.1.5 for additional information on the monitoring network for these surface water systems.

3.2 Monitoring Networks Objective

The objective of the monitoring networks is to identify a sufficient number of wells that provide data to demonstrate measured progress toward achievement of the Subbasin's sustainability goal. In addition, the monitoring networks are intended to support subbasin management actions and future updates to this Plan.

The data from the wells within the monitoring network will continue to build on existing data to track short-term, seasonal, and long-term trends in groundwater and related surface conditions. The monitoring network, through evaluation of changes in groundwater levels, will support estimates of annual changes in water budget components.

3.3 Monitoring Networks

The existing groundwater level monitoring network described in Section 2.2.2.1, was used to develop the monitoring networks for this Plan. The monitoring networks for groundwater levels and groundwater quality were selected to provide an adequate amount of spatial density and temporal frequency to detect trends in groundwater conditions. The monitoring networks are described in the following sections.

3.3.1 Groundwater Level Monitoring Network

As discussed in Section 2.2.2.1, groundwater elevations in the Tule Lake Subbasin are monitored monthly by DWR and other entities, including TID. Figure 2-17 identifies the distribution of groundwater wells actively monitored for groundwater elevations within and near the GSP area.

3.3.1.1 Representative Groundwater Level Monitoring Network

A subset of the groundwater level monitoring network was identified as the representative groundwater level monitoring network based on their historical record of monitoring data and ability to represent local, regional, and long-term trends in the Subbasin. The wells in the representative groundwater level monitoring network were also selected based on their spatial distribution throughout the Subbasin and their construction/screening details. The representative groundwater level monitoring network is the network that is used to monitor chronic lowering of groundwater levels, changes in storage, and land subsidence. Measurable objectives and minimum thresholds for monitoring sustainability have been identified for each of the wells within this network. Table 3.1 identifies the wells within the representative groundwater level monitoring network, including the construction details, current use, monitoring agency, and monitoring frequency. Figure 3-1 shows the location of each of these wells which are distributed throughout the Subbasin and located in proximity to groundwater production wells. In addition, Appendix I includes the available well completion reports for each of these wells.

Table 3.1. Representative Groundwater Level Monitoring Network

State Well Number	Well Location		Well Depth (ft)	Perforations (ft)		Well Use	Monitoring Agency	Approximate Monitoring Frequency
	UTM East	UTM North		Top	Bottom			
48N05E35F001M	634950	4646826	32	25	32	Domestic	DWR	Bimonthly
48N04E22M001M	623798	4649129	135	32	135	Domestic	DWR	Bimonthly
48N04E31M001M	618885	4645689	40	-	-	Domestic	DWR	Bimonthly
48N04E19C001M	619377	4649996	38	22	38	Domestic	DWR	Bimonthly
47N05E04M001M	631148	4644392	71	68	72	Industrial	DWR	Bimonthly
47N05E01N001M	636509	4643988	65	49	65	Domestic	DWR	Bimonthly
46N05E21J001M	632719	4630034	32	-	-	Domestic	DWR	Bimonthly
46N05E01P001M	636763	4634300	101	87	101	Domestic	DWR	Bimonthly
41S12E19Q001W	627992	4650692	65	-	-	Domestic	DWR	Bimonthly
48N04E30F002M (TID Well 1)	619583	4647681	740	260	700	Irrigation	TID	Monthly
48N04E13K001M (TID Well 5)	628217	4650610	1570	935	1557	Irrigation	TID	Monthly
48N05E26D001M (TID Well 8)	634823	4648412	1810	1250	1802	Irrigation	TID	Monthly
46N05E22D001M (TID Well 14)	633266	4630751	571	114	554	Irrigation	TID	Monthly
TL-T1 Q3B	621062	4632384	500	-	-	Monitoring	TID	Monthly
TL-T3 GP	627056	4633043	500	-	-	Monitoring	TID	Monthly

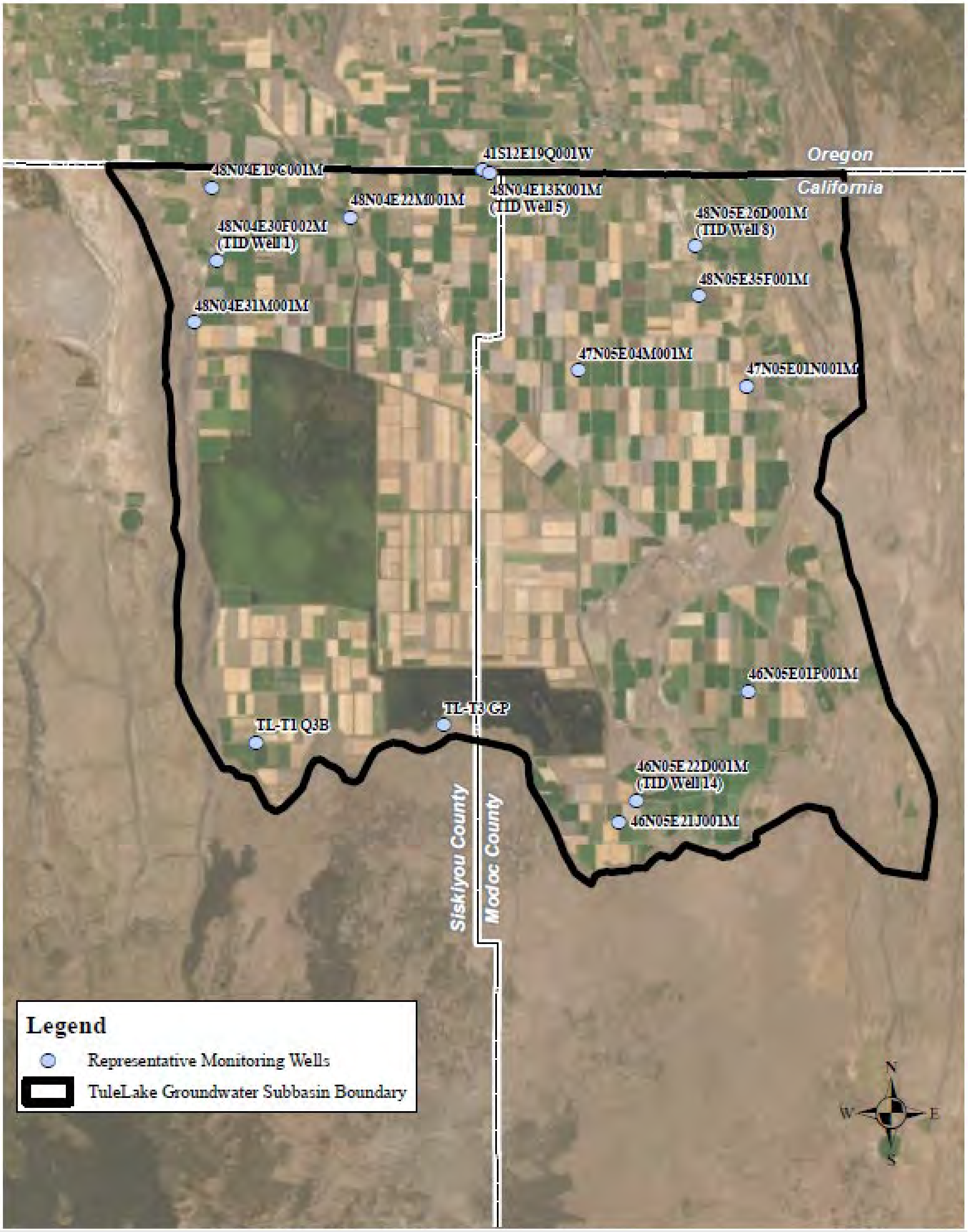

Figure 3-1. Representative Groundwater Level Monitoring Network

3.3.1.2 Spatial Density of Groundwater Level Monitoring Network

The Tule Lake Subbasin covers approximately 110,500 acres (approximately 172 square miles). As described in Section 2.2.2.1 Historic Groundwater Elevations, there are approximately 70 groundwater wells monitored in the Subbasin (see Figure 2-17). Therefore, the spatial density is approximately 40 wells per 100 square miles, which is more robust than the spatial density guidelines recommended by DWR in their best management practices (DWR, 2016). These recommendations from DWR are summarized in Table 3.2. Of these wells, 15 have been included in the representative groundwater level monitoring network. This spatial density of the representative monitoring network is approximately eight wells per 100 square miles.

Table 3.2. Monitoring Network Density Recommendations

Reference	Monitoring Well Density (wells per 100 miles^2)
Heath (1976)	0.2-10
Sophocleous (1983)	6.3
Hopkins (1984)	
Basins pumping more than 10,000 AFY per 100 miles^2	4.0
Basins pumping between 1,000 and 10,000 AFY per 100 miles^2	2.0
Basins pumping between 250 and 1,000 AFY per 100 miles^2	1.0
Basins pumping between 100 and 250 AFY per 100 miles^2	0.7

3.3.1.3 Groundwater Level Monitoring Protocols

In regard to TID monitored groundwater wells, TID monitors on a monthly basis during the year and on a weekly basis when the pumps are operating. TID enrolled in the CASGEM program and prepared and submitted a groundwater monitoring plan to DWR (See Appendix J). Monitoring will be performed following the protocols described in that plan. DWR typically measures monitoring wells in the Subbasin on a bimonthly basis. For implementation of the GSP, static groundwater level measurements will continue to be obtained at each of the representative monitoring wells at least twice per year during the spring and fall to represent seasonal high and low conditions.

The monitoring frequencies, primarily monthly or bimonthly, allow for short-term and long-term evaluation of trends and conditions. Monthly/bimonthly measurements are adequate for evaluation of measurable objectives and minimum thresholds, while also showing fluctuations which may result from storm events, droughts, seasonal variation, and groundwater pumping.

3.3.1.4 Subsidence Monitoring

Groundwater levels will be used as a proxy for monitoring of subsidence. Subsidence is the compaction of soils in some aquifer systems as a result of groundwater being withdrawn. As mentioned in Section 2.2.2.7, there has been no noticeable subsidence within the Subbasin. Using groundwater levels as a proxy for subsidence monitoring is adequate because subsidence will only occur if groundwater levels are drawn below historical lows, if it occurs at all.

Although the Groundwater Level Monitoring Network will be used to monitor potential subsidence, the GSAs will also review DWR's active subsidence network. This network includes InSAR data for the

Subbasin. However, the data needs to be processed and is not made available in real time. The data will be reviewed as it becomes available in order to confirm the adequacy of the Groundwater Level Monitoring Network. Monthly data for January 2015 through September 2019 were published in March 2020. It is unknown when additional data will be provided. If subsidence data relative to the Subbasin are made available from other sources, this information will also be reviewed.

3.3.1.5 Depletion of Interconnected Surface Water

As previously stated, the only surface water within the Subbasin is a small portion of the lower Lost River Improved Channel which terminates in the Tule Lake Sumps and the Sumps themselves. This system is highly regulated as part of Reclamation's Klamath Project and flows in the lower Lost River Improved Channel and water levels within the Sumps are dependent on surface water deliveries made available by Reclamation from the Klamath Project. Flows in the section of the lower Lost River Improved Channel within the Tulelake Subbasin are limited to spills at Anderson-Rose Dam. Any flow in this section of the lower Lost River Improved Channel goes into the Sumps. Due to the nature of the lower Lost River Improved Channel and Sumps, a separate monitoring network for groundwater-surface water interaction has not been developed. However, DWR Monitoring Well No. 48N04E22M001M is located adjacent to the lower Lost River Improved Channel and is included in the Groundwater Level Monitoring Network.

3.3.1.6 Data Gaps

The existing groundwater level monitoring network is sufficient to meet the requirements necessary for implementing the GSP; however, the GSAs will continue to review the monitoring network and the collected data to improve the understanding of the Subbasin and reduce uncertainty in collected data. Specifically, additional wells can be added to the representative monitoring network to improve the density and spatial distribution of wells throughout the Subbasin. In addition, there is a lack of dedicated monitoring wells within the Subbasin. The GSAs will evaluate potential grant funding, including DWR's Technical Support Services, available to fund the construction of dedicated monitoring wells. One or more multi-completion monitoring wells would provide valuable data for the Subbasin.

Currently, there are no monitoring wells located in the middle of the Subbasin; however, groundwater pumping in this area (referred to as the Lease Lands) is also limited. In addition, shallow monitoring wells in the vicinity of surface water in the Subbasin are limited, and the construction of dedicated monitoring wells near the Sumps would provide information regarding surface water interaction and potential GDEs. The GSAs will evaluate potential grant funding, including DWR's Technical Support Services, available to fund the construction of monitoring wells in these areas. Construction of a monitoring well will also be dependent on cooperation from a willing landowner.

3.3.2 Groundwater Quality Monitoring Network

As discussed in Section 2.2.2.6, there is limited groundwater quality monitoring within the Subbasin. Because there are no known areas of degraded water quality or contaminant plumes which need to be actively monitored, this monitoring network will rely on existing wells used for monitoring water quality within the Subbasin, which are public water supply wells. Other than the water quality study performed by SWRCB, there is currently no groundwater quality monitoring being performed by agencies within the Subbasin. Figure 3-2 shows the Groundwater Quality Monitoring Network which includes the public water supply wells.

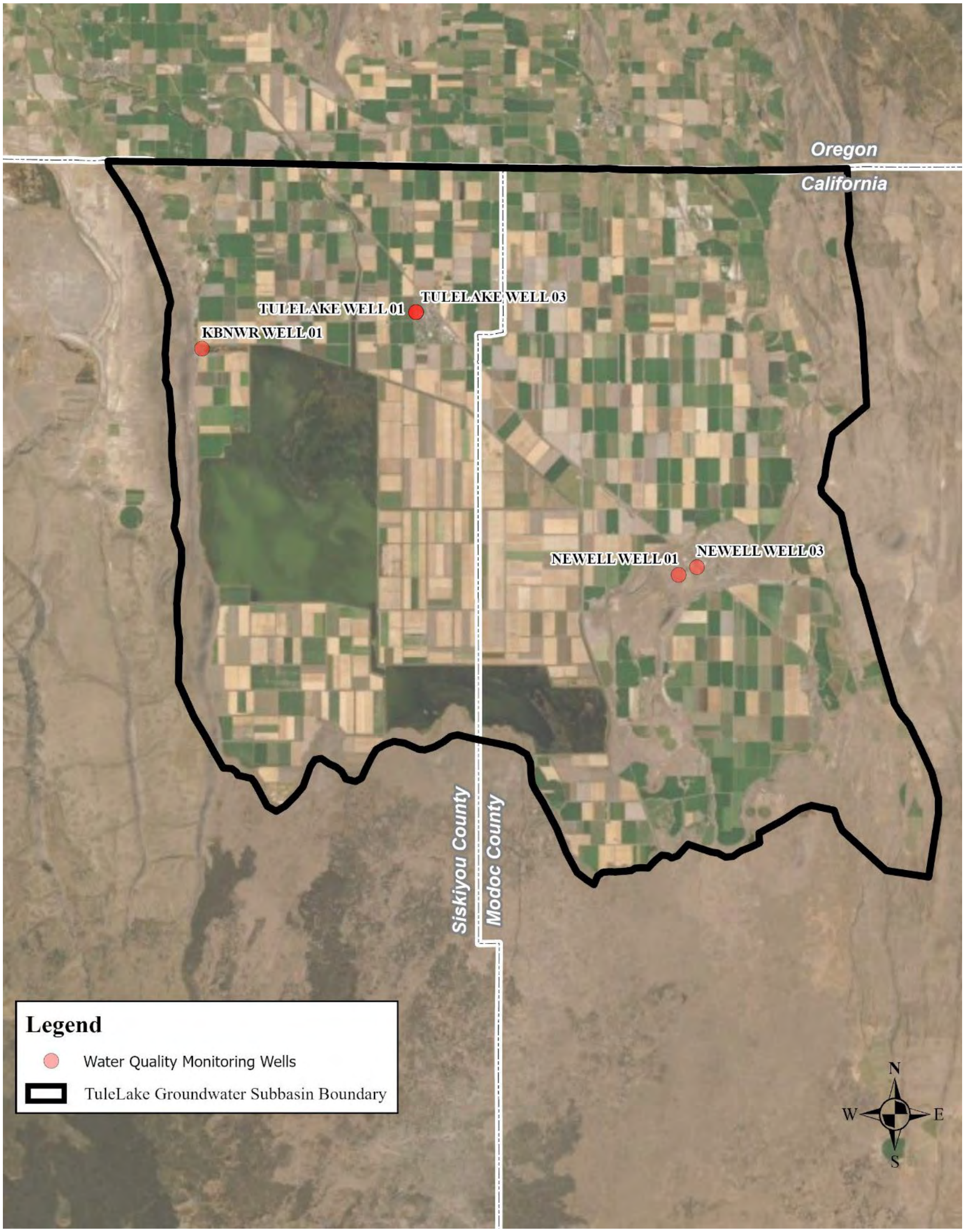

Figure 3-2. Groundwater Quality Monitoring Network

3.3.2.1 Representative Monitoring Network

The representative monitoring network includes all wells which are identified in the Degraded Groundwater Quality Network. The representative network is used to evaluate nitrate and total dissolved solids thresholds, and not other constituents. Table 3.3 summarizes the monitoring frequency of the constituents, for which sustainable management criteria have been established within the Subbasin.

Table 3.3. Groundwater Quality Monitoring Network

Agency	Number of Wells	Constituent	Monitoring Frequency
City of Tulelake	2	Nitrate	Every year
		TDS	Every 3 years
Newell County Water District	2	Nitrate	Every year
		TDS	Every 3 years
Klamath Basin National Wildlife Refuge	1	Nitrate	Every year
		TDS	Not monitored

While only nitrate and TDS have established SMCs within the Subbasin, the GSAs will review data for other constituents (e.g., chloride, copper, lead, sodium, hardness, coliform, arsenic) monitored at the public supply wells to track long-term trends. If increasing trends emerge for these constituents, the GSAs will evaluate development of SMCs in future updates to the GSP.

3.3.2.2 Spatial Density

The groundwater quality monitoring network provides a spatial density of 2.9 wells per 100 square miles.

3.3.2.3 Monitoring Protocols and Frequency

Water quality data collection protocols and frequency is established by the requirements of the Public Water Suppliers within the Subbasin. The City of Tulelake GSA will provide its water quality monitoring data as it becomes available. Monitoring data for the Newell County Water District and the Klamath Basin National Wildlife Refuge will be obtained from the Drinking Water Watch website[3].

3.3.2.4 Data Gaps

Groundwater quality monitoring gaps are the result of the need for denser and more frequent monitoring, potential access issues, and areal coverage. The spatial density of the wells in the groundwater quality monitoring network is less than what is recommended by DWR in their best management practices. Based on information in Table 3.2, an additional two (2) wells should be added to supplement the monitoring network.

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[3] https://sdwis.waterboards.ca.gov/PDWW/

Wells located in the northeast and southwest areas of the Subbasin will be evaluated for potential inclusion in future monitoring network development. If possible, wells included in the groundwater level monitoring network will be evaluated for potential benefits to the groundwater quality monitoring network.

3.3.3 Sustainability Indicators

Table 3.4 summarizes the representative monitoring networks' individual contributions to monitoring each Sustainability Indicator. Seawater Intrusion is not applicable to the Tule Lake Subbasin, and therefore is not included.

Table 3.4. Summary of Groundwater Sustainability Indicators

Monitoring Well	Chronic Lowering of Groundwater Levels	Depletion of Interconnected Surface Water	Degraded Water Quality	Land Subsidence	Reduction in Groundwater Storage
48N05E35F001M	✓			✓	✓
48N04E22M001M	✓	✓		✓	✓
48N04E31M001M	✓			✓	✓
48N04E19C001M	✓			✓	✓
47N05E04M001M	✓			✓	✓
47N05E01N001M	✓			✓	✓
46N05E21J001M	✓			✓	✓
46N05E01P001M	✓			✓	✓
41S12E19Q001W	✓			✓	✓
48N04E30F002M (TID Well 1)	✓			✓	✓
48N04E13K001M (TID Well 5)	✓			✓	✓
48N05E26D001M (TID Well 8)	✓			✓	✓
46N05E22D001M (TID Well 14)	✓			✓	✓
TL-T1 Q3B	✓			✓	✓
TL-T3 GP	✓			✓	✓
TULELAKE WELL 03			✓		
TULELAKE WELL 01			✓		
KBNWR WELL 01			✓		
NEWELL WELL 01			✓		
NEWELL WELL 03			✓		

4 Water Budget Information (Reg. § 354.18)

The hydrologic cycle shown in Figure 4-1, describes how Earth's water is moved, stored, and exchanged between the atmosphere, land surface, and the subsurface.

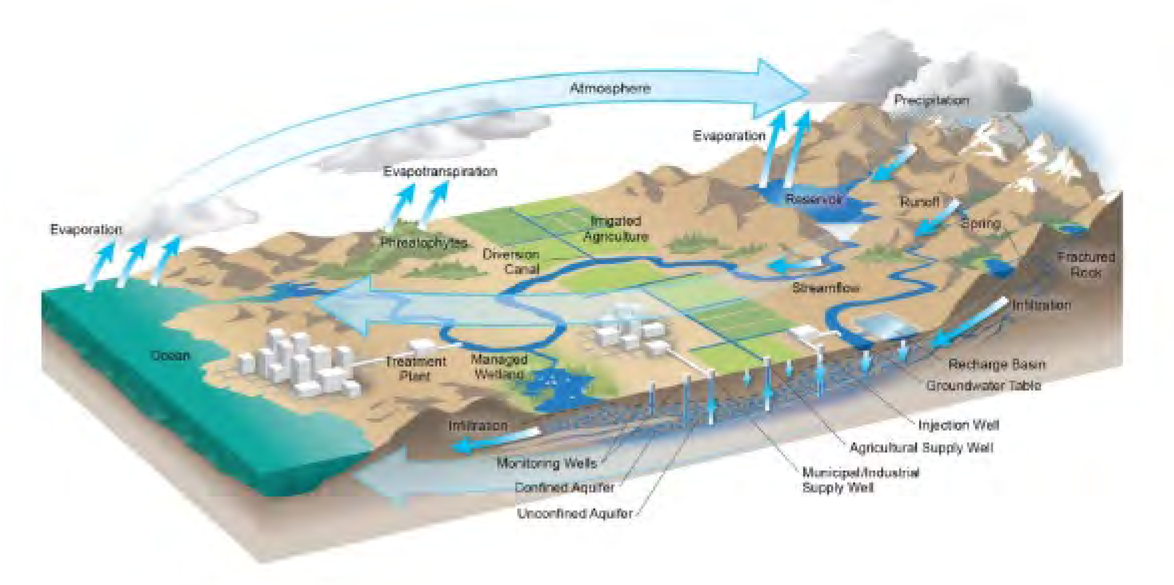

Figure 4-1. The Hydrologic Cycle (Source DWR 2016)

A water budget takes into account the storage and movement of water between the four physical systems of the hydrologic cycle. For the Tule Lake Subbasin these four systems are the atmospheric system, land surface system, surface water system, and the groundwater system. A water budget is a tool to compile and compare inflows and outflows, the difference being the change in the amount of water stored. Figure 4-2 identifies the specific components of a water budget and their interactions. Inflows are shown with blue arrows and outflows are shown with orange arrows. Flows between the systems are shown with purple arrows.

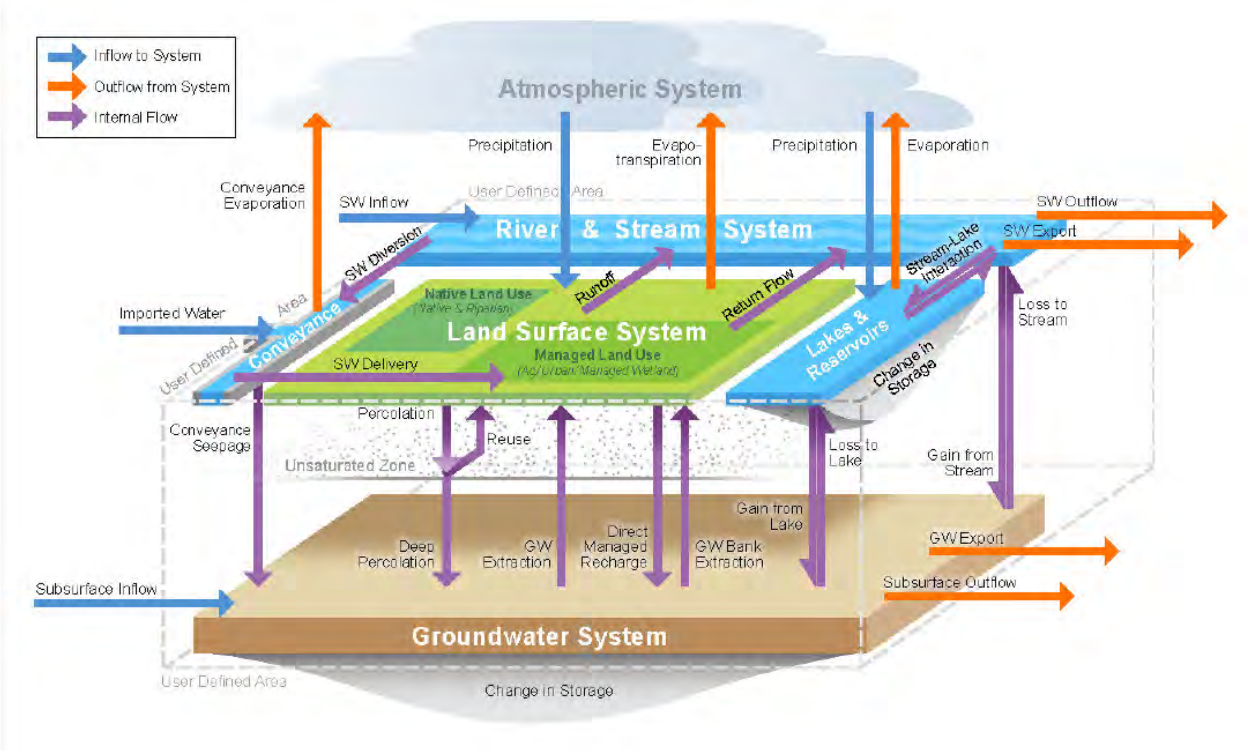

Figure 4-2. Water Budget Schematic (Source DWR 2016)

To prepare water budgets for the Subbasin, an integrated groundwater/ surface water flow model of the area encompassing the Subbasin in portions of Siskiyou and Modoc Counties, California and extending to the north of the Subbasin within Klamath County, Oregon was developed. The Model integrates the three-dimensional (3D) groundwater and surface-water systems, land surface processes, and water management operations. Development of this model included the assimilation of information on land use, water infrastructure, hydrogeologic conditions, and agricultural water demands and supplies. The model was built upon two existing numerical groundwater flow models for the region developed by the United States Geological Survey (USGS) (Gannett et al., 2012; and Pischel and Gannett, 2015). The model is based upon the best available data and information as of January 2020. It is expected that this model will be updated as additional monitoring data are collected and analyzed and as knowledge of the hydrogeologic conceptual model evolves during implementation of the GSP.

4.1 Water Budget Data Sources

Due to the complexity of some of the components, precise and accurate quantification of each component of the water budget was not possible. Each component was estimated using readily available data; however, nearly all involved some level of assumption. In some cases, components were roughly estimated to ensure that the budget was balanced, and that both the budget and components were deemed reasonable. Over time, with additional and improved data, a budget that more closely reflects actual conditions will result in an improved tool for the Tule Lake Subbasin. Appendix K identifies the components of the water budget, data source(s), and assumptions. The following sections describe water budgets for each of the systems shown in Figure 4-2: the groundwater system, the land surface system, and the surface water system (i.e., Tule Lake Sumps).

4.1.1 Historical Water Budget

SGMA regulations require a 20-year historical period. Therefore, water years 1998 through 2018 were used for the historical model simulation period for the Tule Lake Subbasin. However, water years 2000 through 2018 are relied upon for the historical water budget due to the availability of data. Table 4.1 summarizes the historical groundwater budget[4]. SGMA regulations also require quantification of overdraft, which is identified at the bottom of Table 4.1 as an average annual reduction in groundwater storage of 4 thousand acre-feet (TAF), which is a small amount relative to the magnitude of the total inflows and outflows. However, there is no clear evidence of recent overdraft since SGMA implementation in 2015.

Over the 20-year, historical model simulation, groundwater storage declined by about 4 TAF per year, which is approximately 1.7% of the average total inflows and outflows of the system. Based on water levels shown in the hydrographs in Section 2.2.2.1 and the historical change in groundwater storage depicted in Figure 2-32, conditions within the basin have been fairly constant since 2015. This is further supported by the current water budget described below.

Although the historical water budget covers the period of water years 2000 through 2018, as defined in the SGMA regulations, GSPs are not required to address undesirable results that occurred before and have not been corrected by January 1, 2015. Therefore, this Plan is not required to address overdraft or other undesirable results that occurred prior to January 1, 2015. In addition, DWR's 2020 Update to Bulletin 118[5] identifies the Tule Lake Subbasin as medium priority, meaning the Subbasin is not in a state of overdraft.

Table 4.1. Historical Groundwater Budget (Water Years 2000 – 2018)

Groundwater Budget Term	**Water Year Type - Historical (2000 - 2018 Avg [TAF])**					
	Very Dry	**Less Dry**	**Dry**	**Wet**	**Very Wet**	**Average**
Groundwater Recharge from Precipitation & Applied Water	54	56	55	66	90	62
Canal Laterals Leakage	66	104	97	98	101	97
Tulelake Sumps Leakage	6	5	5	5	5	6
Main Canals and Lost River Leakage	57	65	68	62	71	67
Subsurface Flow Into Subbasin	17	17	16	15	18	18
Total Inflow	**200**	**248**	**242**	**246**	**284**	**249**
Irrigation & M&I Groundwater Pumping	45	44	40	36	44	45
Private Groundwater Pumping	6	5	6	6	6	6
Groundwater Discharge to Drains	139	181	177	183	216	181

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[4] Additional details regarding the water budgets, including Water Budget Terms presented in this Section, are provided in Appendix K.

[5] https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118#

Groundwater Budget Term	Water Year Type - Historical (2000 - 2018 Avg [TAF])					
	Very Dry	Less Dry	Dry	Wet	Very Wet	Average
Shallow Groundwater Evapotranspiration	3	5	5	5	6	5
Groundwater Discharge to Tulelake Sumps	0	0	0	0	0	0
Groundwater Discharge to Main Canals and Lost Rivers	2	2	1	1	2	2
Subsurface Flow Out of Subbasin	16	13	13	13	12	15
Total Outflow	**211**	**251**	**243**	**244**	**285**	**253**
Change in Storage	-11	-3	-2	2	-1	-4

The groundwater system budget includes interactions between canals and drains with shallow groundwater. Groundwater discharge to drains is the largest outflow component. This component includes water that is applied to agricultural fields and then leaches or drains through the soil to a drainage canal adjacent to the field to ensure suitable rootzone moisture content for growing various crops. The model considers the portion of applied water which is not used by the crop and flows from the field to a drain as "groundwater discharge to drains." While groundwater discharge to drains is the largest outflow component of the groundwater system, it is important to note that the majority of drain flows remain within the Subbasin as recirculated water for irrigation or flows to the Sumps.

There are not active groundwater recharge projects in the Tule Lake Subbasin; however, the Tule Lake Sumps and the District's conveyance facilities are unlined, which led to groundwater recharge shown in Table 4.1. In addition, with rising power costs, TID has minimized D-Plant pumping, which has led to increased surface water recirculation and increased groundwater recharge.

Similar to the aforementioned Groundwater Budget, a Land System Water Budget was prepared to analyze and compare inflows and outflows for that system. The historical water budget for the land system is included in Table 4.2.

Table 4.2. Land System Water Budget (Water Years 2000 – 2018)

Land System Water Budget Term	Water Year Type - Historical (2000 - 2018 Avg [TAF])					
	Very Dry	Less Dry	Dry	Wet	Very Wet	Average
Precipitation	85	89	78	98	121	94
Water into the Rootzone	3	5	5	5	6	5
Surface Water Deliveries	92	100	106	101	112	105
Groundwater Deliveries	6	5	6	6	6	6
Total Inflow	**186**	**200**	**196**	**209**	**245**	**211**
Evapotranspiration of Precipitation	41	38	29	34	23	38
Evapotranspiration of Applied Water	84	90	96	91	101	95
Runoff From Farm	8	10	10	13	25	12
Groundwater Recharge from Precipitation & Applied Water	50	56	55	66	90	61
Shallow Groundwater Evapotranspiration	3	5	5	5	6	5
Total Outflow	**186**	**200**	**196**	**210**	**245**	**211**

The water budget for the Tule Lake Sumps is included in Table 4.3. TID estimates D-Plant pumping, which is the only point of surface water outflow from the Subbasin. The D-Plant is operated, as needed, to maintain water levels in the Tule Lake Sumps. Therefore, water budget for the Sumps was prepared. Inflows to the Tule Lake Sumps include surface water from irrigation drains, gains from groundwater, and precipitation. Outflows from the Tule Lake Sumps include irrigation diversions and D-Plant pumping. As shown in Table 4.3, the Sump Imbalance is positive in 18 of the 19 years analyzed. Therefore, the Tule Lake Sumps water budget is showing excess water in all but one year, which indicates a conservative analysis.

Table 4.3. Tule Lake Sumps Water Budget (Water Years 2000-2018)

Water Year	Water Year Type*	Total Inflow (TAF)	Total Outflow (TAF)	Sump Imbalance (TAF)
2000	W	200,769	-166,265	34,503
2001	VD	122,063	-94,333	27,730
2002	LD	211,597	-202,924	8,672
2003	LD	215,909	-183,788	32,121
2004	LD	206,934	-176,427	30,507
2005	LD	209,341	-189,378	19,963
2006	VW	230,467	-234,395	-3,928
2007	D	206,443	-148,007	58,436
2008	D	205,470	-173,810	31,660
2009	LD	182,202	-150,586	31,616
2010	VD	134,796	-95,164	39,632
2011	W	160,246	-134,203	26,043
2012	D	147,647	-136,494	11,154
2013	LD	145,763	-144,957	806
2014	VD	131,172	-127,752	3,420
2015	VD	150,191	-128,587	21,604
2016	LD	168,178	-143,164	25,014
2017	W	183,967	-149,009	34,958
2018	VD	166,696	-126,694	40,001

*Where VW = Very Wet, W = Wet, D = Dry, LD = Less Dry, VD = Very Dry

4.1.2 Current Water Budget

The current groundwater budget and land system budget is based on water year 2018, which is the most recent year analyzed in the historical water budget and is included in Table 4.4 and Table 4.5. As shown, inflows to the groundwater system exceeded outflows during water year 2018, which resulted in a positive change in storage of approximately 17 TAF. The current water budget for the Tule Lake Sumps is included in Table 4.3.

Table 4.4. Current Groundwater Budget (Water Year 2018)

Groundwater Budget Term	Water Year Type - Current (2018 Avg [TAF])
	Very Dry
Groundwater Recharge from Precipitation & Applied Water	80
Canal Laterals Leakage	93
Tulelake Sumps Leakage	7
Main Canals and Lost River Leakage	72
Subsurface Flow Into Subbasin	17
Total Inflow	**268**
Irrigation & M&I Groundwater Pumping	27
Private Groundwater Pumping	5
Groundwater Discharge to Drains	192
Shallow Groundwater Evapotranspiration	4
Groundwater Discharge to Tulelake Sumps	0
Groundwater Discharge to Main Canals and Lost Rivers	2
Subsurface Flow Out of Subbasin	21
Total Outflow	**251**
Change in Storage	17

Table 4.5. Current Land System Water Budget (Water Year 2018)

Land System Water Budget Term	Water Year Type – Current (2018 Avg [TAF])
	Very Dry
Precipitation	116
Water into the Rootzone	4
Surface Water Deliveries	89
Groundwater Deliveries	5
Total Inflow	**214**
Evapotranspiration of Precipitation	59
Evapotranspiration of Applied Water	80
Runoff From Farm	10
Groundwater Recharge from Precipitation & Applied Water	61
Shallow Groundwater Evapotranspiration	4
Total Outflow	**214**

4.1.3 Projected Water Budget

SGMA Regulations require the preparation of a projected water budget, which must be based on at least 50 years of historic climate data along with estimates of future land and water use. In addition, the SGMA regulations require an analysis of future conditions with potential climate change incorporated. As previously stated, the historical period is 20 years long (water years 1999-2018). Therefore, the climate data from that period was repeated 2.5 times to achieve a 50-year period for projections. These data were used to develop the projected water budget baseline (i.e., without climate change). See Appendix K for further discussion on this topic.

Table 4.6 summarizes the projected groundwater budget baseline, which projects an average annual change in storage of 0 acre-feet. This appears to be reasonable, as there is no assumed change to current crop patterns (which accounts for 55 percent of the land within the Subbasin) nor expected population growth within the Subbasin. The Subbasin is known to experience annual fluctuations depending on hydrology and surface water supply available from the Klamath Project; however, groundwater levels in the Subbasin have remained relatively stable over the last six years, with seasonal fluctuations.

Table 4.6. Projected Groundwater Budget Baseline

Groundwater Budget Term	Projected Baseline
	WY 2019 - 2071 Avg (TAF)
Groundwater Recharge from Precipitation & Applied Water	59
Canal Laterals Leakage	93
Tulelake Sumps Leakage	6
Main Canals and Lost River Leakage	66
Subsurface Flow Into Subbasin	15
Total Inflow	**238**
Irrigation & M&I Groundwater Pumping	42
Private Groundwater Pumping	6
Groundwater Discharge to Drains	165
Shallow Groundwater Evapotranspiration	5
Groundwater Discharge to Tulelake Sumps	0
Groundwater Discharge to Main Canals and Lost Rivers	1
Subsurface Flow Out of Subbasin	20
Total Outflow	**238**
Change in Storage	0

Figure 4-3 shows the complete water budget (water years 2019 – 2071) without climate change. The gray line on the figure shows the annual change in groundwater storage which fluctuates based on the balance of inflows. The black line is the cumulative of the annual change in groundwater storage over the length of the model period.

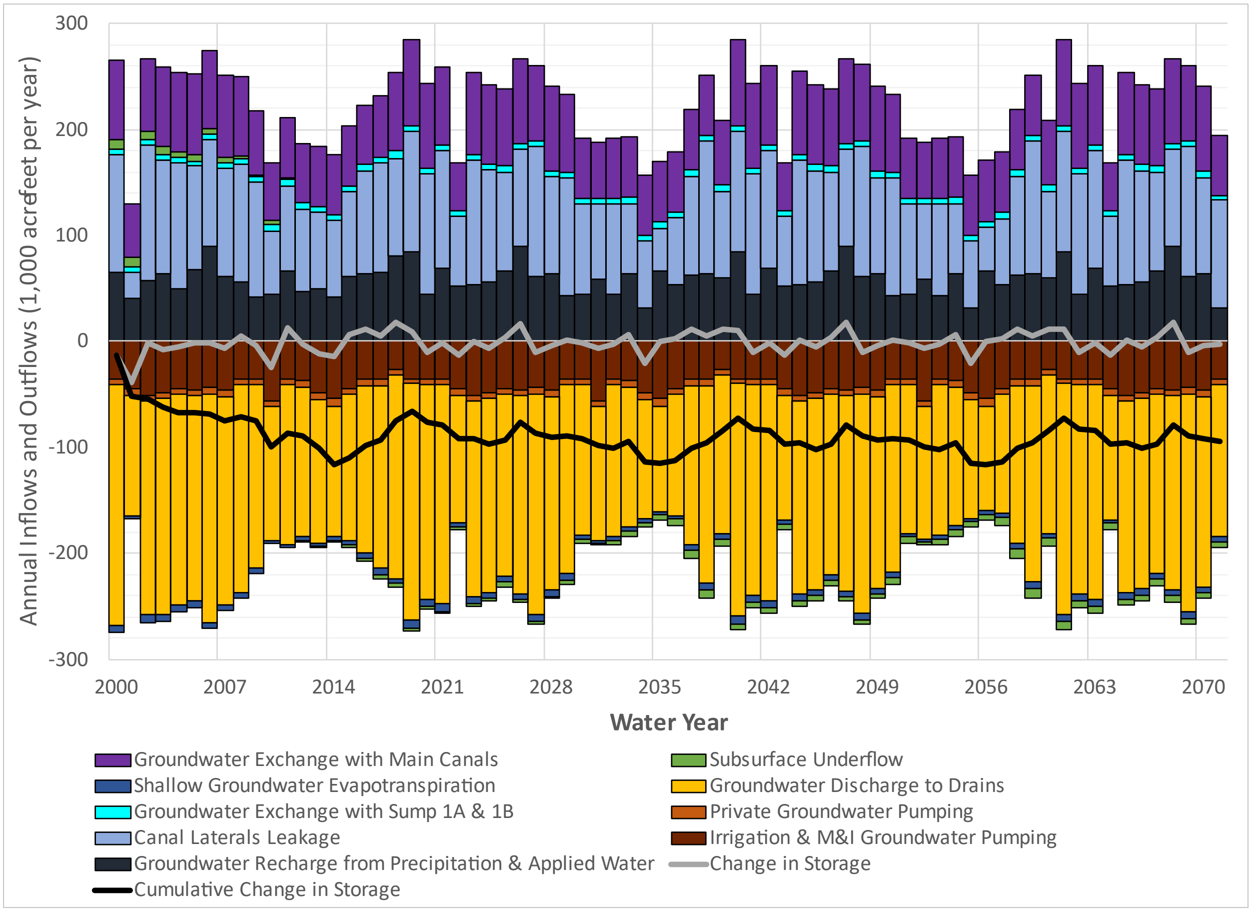

Figure 4-3. Water Budget – Future with no Climate Change

For the projected water budget with climate change, DWR provided alternatives for use by GSAs, which included climate change factors. Reclamation, in coordination with DWR and the Oregon Water Resources Department, released the Klamath River Basin Study in 2019 (Study) (USBR, 2016). The Study evaluated water supply and demand including projected impacts of climate change. The Tule Lake Subbasin selected the 2070 central tendency alternative based on knowledge of Reclamation modeling efforts for the Klamath Project. Information from the Study provided estimated impacts to mean Project Supply based on the 2070 central tendency which were incorporated into the water budget model. In addition, 2070 central tendency climate change factors for temperature and rainfall, developed and provided by DWR, were applied to the 50 years of projected climate data. See Appendix K for additional information on this topic.

Table 4.7 summarizes the projected groundwater budget baseline, which projects an average annual change in storage of 0 acre-feet. As with the projection without climate change, this projection is likely reasonable as the 2070 central tendency scenario projects increased temperatures and increased precipitation during the irrigation season. In addition, the Study projected little to no change in mean Project Supply under this climate change scenario.

Table 4.7. Projected Groundwater Budget with Climate Change Incorporated

Groundwater Budget Term	Projected Baseline w/ Climate Change
	WY 2019 - 2071 Avg (TAF)
Groundwater Recharge from Precipitation & Applied Water	63
Canal Laterals Leakage	93
Tulelake Sumps Leakage	6
Main Canals and Lost River Leakage	66
Subsurface Flow Into Subbasin	14
Total Inflow	**242**
Irrigation & M&I Groundwater Pumping	42
Private Groundwater Pumping	6
Groundwater Discharge to Drains	165
Shallow Groundwater Evapotranspiration	5
Groundwater Discharge to Tulelake Sumps	0
Groundwater Discharge to Main Canals and Lost Rivers	1
Subsurface Flow Out of Subbasin	22
Total Outflow	**242**
Change in Storage	0

Figure 4-4 shows the complete water budget (WY 2000 – 2071) with climate change. The gray line on the figure shows the annual change in groundwater storage which fluctuates based on the balance of inflows. The black line is the cumulative of the annual change in groundwater storage over the length of the model period.

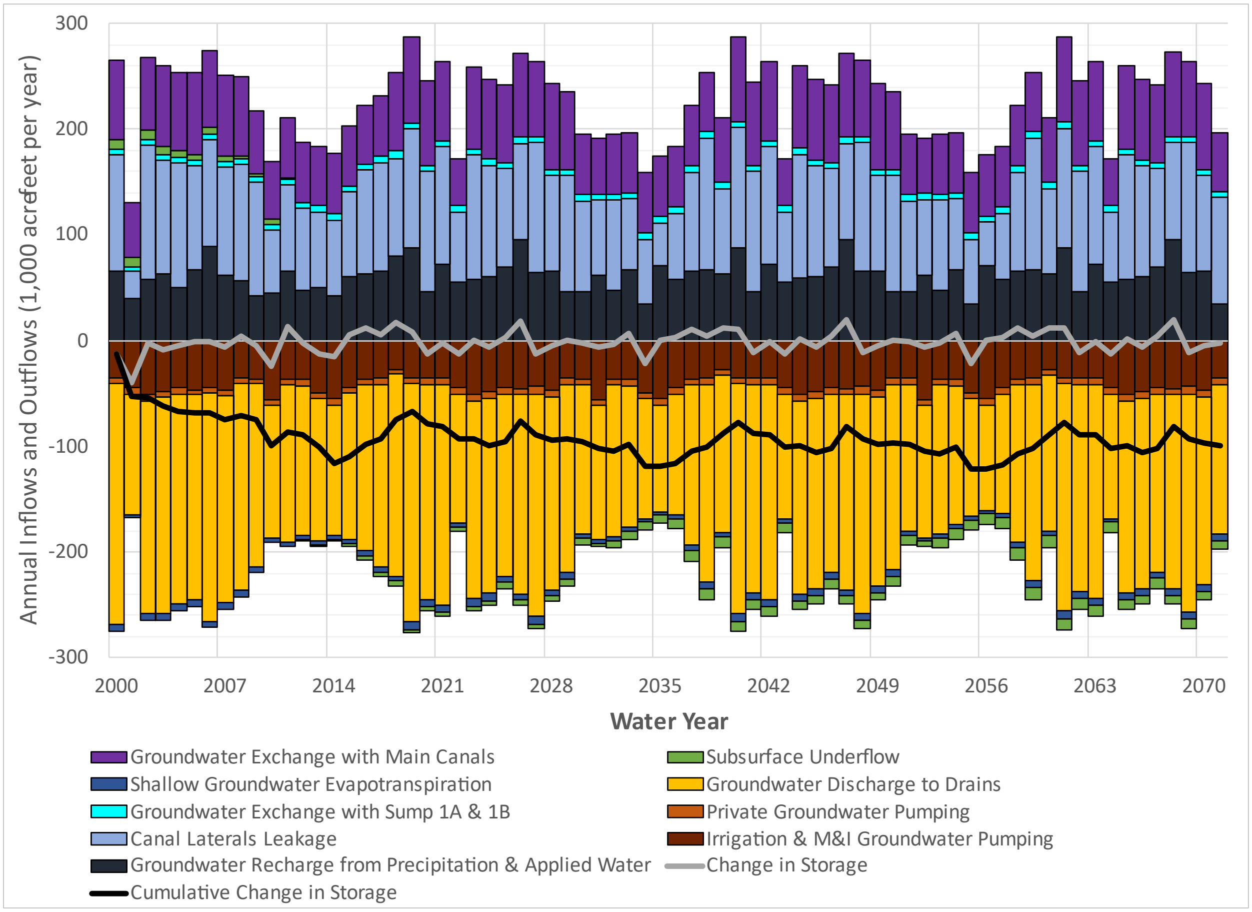

Figure 4-4. Water Budget - Future with Climate Change

The SGMA Regulations require Plans to identify an estimate of the sustainable yield for the subbasin. This requirement is interpreted as the average annual groundwater pumping that can occur, which does not lead to overdraft of the groundwater resource. As shown in Table 4.7 and Figure 4-4, the projected average annual long term groundwater pumping is approximately 48,000 acre-feet. The Tule Lake Subbasin has historically demonstrated that the Subbasin can accommodate that level of groundwater pumping, which is further confirmed through the projected water budgets. Therefore, the estimated sustainable yield for the Tule Lake Subbasin is 48,000 acre-feet. The estimate of sustainable yield will be re-evaluated in future updates to this GSP as additional information becomes available.

5 Sustainable Management Criteria (Reg. § 354.22-30)

This section of the Plan describes the sustainable management criteria for the Tule Lake Subbasin. The SMCs define conditions that constitute sustainable groundwater management for the Subbasin, which includes the sustainability goal, undesirable results, and minimum thresholds for each applicable sustainability indicator. Below are definitions of key terms described in the GSP Regulations.

Sustainability Goal: GSAs' objectives and desired conditions of the groundwater basin, how the basin will get to that condition, and why the measures planned will lead to success.

Sustainability Indicator: Sustainability indicators are the six effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, are undesirable results. The sustainability indicators are listed below:

- Chronic Lowering of Groundwater Levels
- Depletion of Interconnected Surface Water
- Degraded Water Quality
- Land Subsidence
- Seawater Intrusion (not applicable to Tule Lake Subbasin)
- Reduction in Groundwater Storage

Undesirable Results: Undesirable results occur when conditions related to any of the six sustainability indicators become significant and unreasonable.

Measurable Objective (MO): A measurable objective is a quantitative goal that reflects the desired groundwater conditions and allow the GSAs to achieve the sustainability goal within 20 years.

Interim Milestones: Interim milestones are set to guide conditions during implementation of the GSP to define a pathway to reach sustainability within 20 years. In the Tule Lake Subbasin, the interim milestones are currently assumed to not be needed as implementation activities are not required to achieve the measurable objectives. However, for the purpose of the GSP, the interim milestones are set at the same levels as the measurable objectives.

Minimum Threshold (MT): A minimum threshold is the quantitative value that represents the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the basin.

Figure 5-1 illustrates the relationship between the sustainability indicators, SMCs, MTs, and undesirable results.

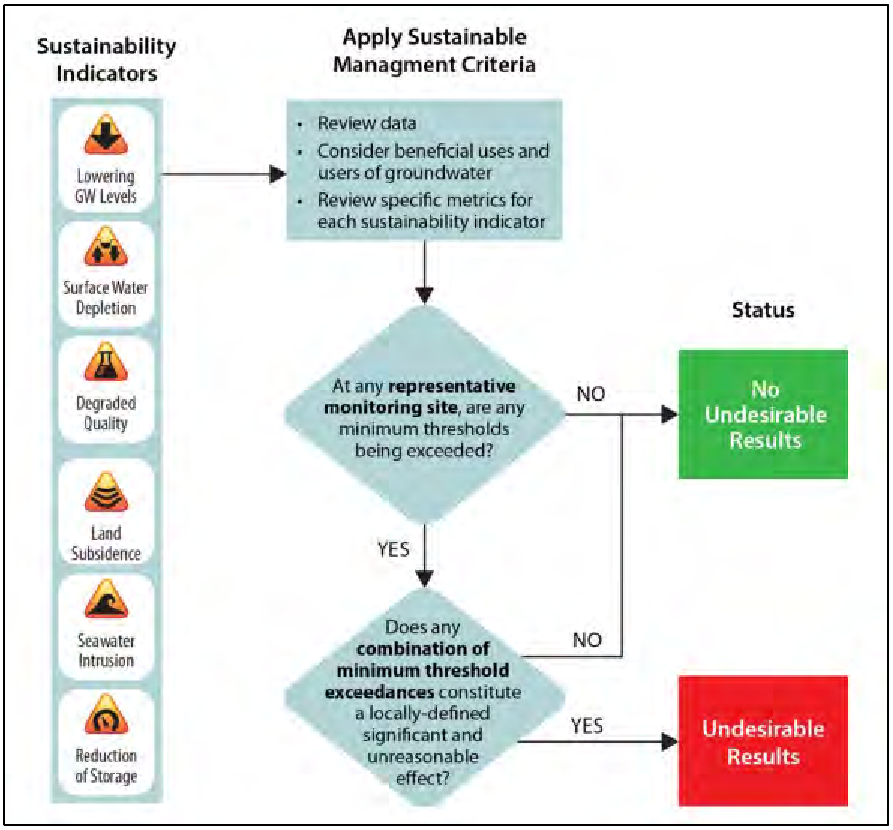

Figure 5-1. Relationship of Sustainability Indicators, SMCs, MTs, and Undesirable Results (DWR)

5.1 Sustainability Goal

As described in this Plan, the primary use of water in the Subbasin is for agricultural purposes. In addition, Modoc County meets the requirements of a severely disadvantaged community (SDAC). Similarly, Siskiyou County meets the requirements of a disadvantaged community (DAC). These communities are reliant upon the local forestry and agriculture industries. Therefore, the sustainability goal for the Tule Lake Subbasin is to maintain a locally governed, economically viable, reliable, and sustainable groundwater subbasin for current and future beneficial uses, without causing undesirable results.

The water budgets included in Section 4 of this Plan show that the Subbasin is currently, and is projected to remain, sustainably managed. Therefore, the sustainability goal is achieved through continued local management of the Subbasin. In addition, implementation of measures to operate within the sustainable yield are not necessary. However, as described in Section 6.1.7 of this Plan, adaptive management will be utilized if necessary.

5.2 Undesirable Results

SGMA Regulations require undesirable results definitions for each applicable sustainability indicator. In addition, GSPs are required to identify potential causes that would lead to undesirable results, criteria to define undesirable results based on MTs, and the potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results. MTs have been established for each representative monitoring site and are described in Section 5.3.

5.2.1 Chronic Lowering of Groundwater Levels

The following subsections describe the undesirable result of chronic lowering of groundwater levels in more detail.

5.2.1.1 Description of the Chronic Lowering of Groundwater Levels

The undesirable result of the chronic lowering of groundwater levels is a result that would cause significant and unreasonable impacts to beneficial uses and users of groundwater over the implementation period of this GSP.

5.2.1.2 Potential Causes and Effects of the Chronic Lowering of Groundwater Levels

As shown in Section 6 of this Plan, the Tule Lake Subbasin is currently being sustainably managed. The primary land use is agriculture and the GSAs do not anticipate changes in agricultural cropping patterns. Thus, even when the effects of climate change are considered, water demand is not projected to significantly increase. The primary water source in the Subbasin is surface water deliveries via Reclamation. Therefore, if surface water supply were to decrease, groundwater extractions would likely increase potentially leading to the chronic lowering of groundwater levels. Lowering of groundwater levels would result in increased power costs to extract groundwater and potentially impact users of groundwater. In extreme cases, groundwater levels may decrease to an extent where it becomes necessary to lower pump bowls and/or deepen the well. Chronic lowering of groundwater levels may also affect GDEs as described in Appendix M. However, further identification of potential GDEs and groundwater level monitoring near potential GDEs have been identified as data gaps.

5.2.1.3 Criteria Used to Define Chronic Lowering of Groundwater Levels

The GSAs elected to form an Ad Hoc Committee to discuss and define undesirable results and MTs. A meeting summary is included in Appendix L. The undesirable result definition for chronic lowering of groundwater levels is provided below.

> *Groundwater elevations dropping below the Minimum Threshold criteria at four representative monitoring locations over three consecutive spring measurements.*

The Ad Hoc Committee agreed to use a combination of shallowest domestic wells depths within a 3-mile radius of representative monitoring wells or the historical low groundwater level measurement at the representative monitoring well plus a 10% buffer. A summary of the methodology for determination of MTs and additional information relative to the undesirable result definition is included in Appendix M. The undesirable result definition above identifies spring groundwater level measurements; however, as described in this Plan, many of the wells within the groundwater monitoring network for the Tule Lake Subbasin are monitored on a quarterly or more frequent basis. The groundwater data collected as part of the monitoring effort will be reviewed during the GSA coordination meetings. Therefore, the GSAs will be monitoring conditions on a more frequent basis.

5.2.2 Reduction in Groundwater Storage

The following subsections describe the undesirable result of reduced groundwater storage in more detail.

5.2.2.1 Description of the Reduction in Groundwater Storage

The undesirable result of the reduction in groundwater storage is a result of groundwater extraction that would cause significant and unreasonable impacts to beneficial uses and users of groundwater over the implementation period of this GSP. Reduction in groundwater storage is related to lowering of groundwater levels. Reduction in groundwater storage would occur when outflows from the groundwater system exceed inflows. This may occur on a short-term basis (e.g., during dry hydrologic conditions), but is defined significant and unreasonable when groundwater levels are below the MT for three consecutive spring measurements.

5.2.2.2 Potential Causes and Effects of Reduction in Groundwater Storage

As shown in Section 6 of this Plan, the Tule Lake Subbasin is currently being sustainably managed. The primary land use is agriculture and the GSAs do not anticipate changes in agricultural cropping patterns. Thus, even when the effects of climate change are considered, water demand is not projected to significantly increase. The primary water source in the Subbasin is surface water deliveries via Reclamation. Therefore, if surface water supply were to decrease, groundwater extractions would likely increase potentially leading to the reduction of groundwater storage. Reduction in groundwater storage would result in increased power costs to extract groundwater. In extreme cases, groundwater levels may decrease to an extent where the cost to pump water exceeds the value of the agriculture or potentially effects domestic wells as described in Appendix M.

5.2.2.3 Criteria Used to Define Reduction in Groundwater Storage

The GSAs elected to form an Ad Hoc Committee to discuss and define undesirable results and MTs. In regard to reduction in groundwater storage, groundwater levels were identified as a proxy metric. The use of groundwater levels as a proxy for this sustainability indicator is justified due to the correlation between groundwater levels and groundwater storage (i.e., as groundwater levels decline, there is a decrease in groundwater storage). The MTs for groundwater levels were developed based on considerations for historical uses and users of water as well as historical groundwater levels. Although annual fluctuations in groundwater storage are anticipated as shown in Figure 4-3 and Figure 4-4, the MTs are intended to ensure that there will be no long-term decline in groundwater storage.

5.2.3 Land Subsidence

The following subsections describe the undesirable result of land subsidence and its potential effects in more detail.

5.2.3.1 Description of Land Subsidence

The undesirable result of land subsidence is a result of groundwater extraction that would cause significant and unreasonable impacts to infrastructure, including water conveyance facilities, over the implementation period of this GSP. As described in Section 2.2.2.7, there has been no noticeable subsidence within the subbasin since at least 2001. Because of this experience, with no known subsidence even during periods of decreasing groundwater levels, it is assumed that there are not soils susceptible to compression within the subbasin.

5.2.3.2 Potential Causes and Effects of the Land Subsidence

As shown in Section 4 of this Plan, the Tule Lake Subbasin is currently being sustainably managed. The primary land use is agriculture and the GSAs do not anticipate changes in agricultural cropping patterns. Thus, even when the effects of climate change are considered, water demand is not projected to significantly increase. The primary water source in the Subbasin is surface water deliveries via Reclamation. Therefore, if surface water supply were to decrease, groundwater extractions would likely increase, potentially leading to land subsidence.

Subsidence is known to cause damage to water conveyance facilities and flood control facilities. This could potentially impact the canals and drains within the Tulelake Irrigation District and result in surface water delivery inefficiencies and subsequent increases in groundwater use. Subsidence within the vicinity of the Tule Lake Sumps could impact the levees and flood control structures.

5.2.3.3 Criteria Used to Define Land Subsidence

The GSAs elected to form an Ad Hoc Committee to discuss and define undesirable results and MTs. In regard to Land Subsidence, groundwater levels were identified as a proxy metric. The use of groundwater levels as a proxy for this sustainability indicator is justified due to the correlation between groundwater levels and land subsidence. Although the Groundwater Level Monitoring Network will be used to monitor potential subsidence, the GSAs will also review DWR’s active subsidence network. This network includes InSAR data for the Subbasin. However, the data need to be processed and are not made available in real time. The data will be reviewed as it becomes available to confirm the adequacy of the Groundwater Level Monitoring Network.

5.2.4 Depletion of Interconnected Surface Water

The following subsections describe the undesirable result of the depletion of interconnected surface water in more detail.

5.2.4.1 Description of Depletion of Interconnected Surface Water

Shallow groundwater and surface water systems can be hydraulically connected. The surface water bodies can either be gaining (receiving water from the groundwater system) or losing (losing water to the groundwater system). As shown in the water budgets (see Section 4), there is interaction between the groundwater system and the land system within the Tule Lake Subbasin. However, the majority of surface water in the Subbasin consists of water within the Tulelake Irrigation District canals, drains, and the Tule Lake Sumps as a result of deliveries from the Klamath Project.

5.2.4.2 Potential Causes and Effects of Depletion of Interconnected Surface Water

Because chronic lowering of groundwater levels is used as a proxy for depletion of interconnected surface water, the causes of this undesirable result are the same as those for groundwater levels. Lowering groundwater levels in the vicinity of the lower Lost River Improved Channel and the Tule Lake Sumps may result in increased depletions from the surface water to the groundwater system. The lower Lost River Improved Channel does not have minimum flow requirements and flows intermittently.

However, the water surface elevations in the Tule Lake Sumps will continue to be met as required by the Biological Opinion.

5.2.4.3 Criteria Used to Define Depletion of Interconnected Surface Water

In regard to depletion of interconnected surface water, groundwater levels were identified as a proxy metric. The use of groundwater levels as a proxy for this sustainability indicator is justified due to the correlation between shallow groundwater levels and surface water. As identified in Section 3, the only surface water within the Subbasin, including the lower Lost River Improved Channel and the Sumps, is highly regulated as part of the US Bureau of Reclamation's Klamath Project. Therefore, a separate monitoring network for groundwater-surface water interaction has not been developed. However, DWR Monitoring Well No. 48N04E22M001M is located adjacent to the lower Lost River Improved Channel and is included in the Groundwater Level Monitoring Network. The Ad Hoc Committee identified the following definition:

> *Groundwater elevations dropping below the Minimum Threshold criteria at this representative monitoring location over three consecutive spring measurements.*

The model used to develop the water budgets presented in Section 4 includes surface water components, including the Sumps. As described in Section 3.3.1.6, monitoring of shallow groundwater wells in the vicinity of the sumps is identified as a data gap, and the construction of dedicated monitoring wells near the Sumps would provide information regarding surface water interaction. Assuming construction of a monitoring well in this area, groundwater level measurements would be obtained, along with other observations, to be incorporated into the model through SGMA implementation. Through implementation, the model may be used as a tool for evaluating potential depletion of interconnected surface water and incorporated into the criteria used to define depletion of interconnected surface water.

5.2.5 Degraded Water Quality

The following subsections describe the undesirable result degraded water quality in more detail.

5.2.5.1 Description of the Degraded Water Quality

The undesirable result of degraded water quality is a result of groundwater management activities (such as groundwater extraction and groundwater recharge) and groundwater quality that cause significant and unreasonable reductions in the long-term viability of domestic, agricultural, municipal, and environmental uses over the planning and implementation horizon of this GSP.

5.2.5.2 Potential Causes and Effects of Degraded Water Quality

There are no anticipated changes in water quality, and specifically, no anticipated changes in water quality due to groundwater management actions. Potential causes of degraded water quality could be the result of significant increases in groundwater pumping, which is not projected to occur, as described in Section 4. In addition, there are no known significant water quality issues or contaminant plumes that could spread through additional groundwater pumping.

If groundwater quality degraded to an undesirable result level, then the water may not be usable for beneficial uses within the Subbasin (domestic and agriculture) without treatment. This would lead to an economic burden on water users. Additionally, changes in water quality could impact GDEs, damage crops and/or result in changes to the crops grown, and cause other economic effects.

5.2.5.3 Criteria Used to Define Degraded Water Quality

The GSAs elected to form an Ad Hoc Committee to discuss and define undesirable results and MTs. Below is the undesirable result definition for degraded water quality.

> *Changes in groundwater quality due to groundwater management activities (such as groundwater extraction and groundwater recharge) and groundwater quality that causes significant and unreasonable reductions in long-term viability of domestic, agricultural, municipal, and environmental uses over the planning and implementation horizon of this GSP as indicated by water quality data measured in at least 50% of representative monitoring wells exceeding the minimum thresholds for a groundwater quality constituent for two consecutive measurements at each location during non-drought years.*

5.2.6 Seawater Intrusion (not applicable to Tule Lake Subbasin)

The Tule Lake Subbasin is not located near an ocean. Therefore, seawater intrusion is not present and not likely to occur. Thus, SMCs are not required for seawater intrusion.

5.3 Quantitative Sustainable Management Criteria

The sustainability goal and undesirable results are qualitative descriptions of basin conditions which are supported by quantitative criteria. The Minimum Thresholds and Measurable Objectives provide quantitative criteria to allow the GSAs to clearly demonstrate sustainability.

Measurable Objectives are the quantitative goals that reflect the desired groundwater conditions. The Subbasin is currently, and is projected to remain, sustainably managed and meeting its sustainability goal, as demonstrated by the water budgets in Section 4. Therefore, the MOs established for each applicable sustainability indicator are intended to continue meeting the sustainability goal. There is a margin of operational flexibility between the MOs and MTs to accommodate droughts, climate change, conjunctive use operations, and other groundwater management activities that may occur in the Subbasin.

Minimum Thresholds are the quantitative values that represent the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the basin. MTs (which consider beneficial uses and users of groundwater, land uses, and property interests) have been established for each representative monitoring site using the same metrics as the measurable objectives.

5.3.1 Groundwater Level Quantitative Sustainable Management Criteria

This section establishes the MOs and MTs for the four applicable sustainability indicators related to groundwater levels: chronic lowering of groundwater levels, reduction in groundwater storage, land subsidence, and interconnected surface water.

5.3.1.1 Groundwater Level Measurable Objectives

Groundwater level MOs were established based on average spring groundwater levels obtained since 2015 at each representative monitoring well. These values generally represent recent sustainable conditions since SGMA implementation and under which there were no reported negative impacts on beneficial uses and users. In the case that negative impacts to domestic wells caused by groundwater management activities are reported to the GSAs, then the GSAs will provide assistance as described in Section 6.1.6, and MOs will be re-evaluated in a future 5-year update or amendment, as appropriate.

5.3.1.2 Groundwater Level Minimum Thresholds

The groundwater level MTs were determined by considering historical basin conditions, and are based on considerations for beneficial users and uses of groundwater. Two different sets of criteria were developed to establish groundwater level MTs for the representative monitoring wells, which are identified below and in Appendix M.

1. Representative monitoring wells that are used for irrigation have MTs set to the well's lowest static groundwater level measurement recorded plus a 10 percent buffer.
2. The "Near" function in ArcGIS Pro software was used to associate each WCR with the closest representative monitoring well. All representative monitoring wells that are not an irrigation well have MTs set to either the shallowest or second shallowest well within its Near grouping. However, if there are not any wells within a representative monitoring well's Near grouping, then the MT is equal to the well's lowest static groundwater level measurement recorded plus a 10 percent buffer.

Table 5.1 shows the MO and MT established for each representative groundwater level monitoring well. Hydrographs showing historical groundwater level measurement along with the MO and MT for each representation groundwater level monitoring well are included in Appendix M.

Table 5.1. Groundwater Level Minimum Thresholds

State Well Number	Historic Low (ft bgs)	Min. Domestic Well Depth (ft bgs)	Minimum Threshold (ft bgs)	Measurable Objective (ft bgs)
48N05E35F001M	11	29	29	8
48N04E22M001M	29	120	120	15
48N04E31M001M	31	29	29	23
48N04E19C001M	15	28	28	11
47N05E04M001M	10	33	33	9
47N05E01N001M	22	42	42	15
46N05E21J001M	12	32	32	10
46N05E01P001M	13	24	24	11
41S12E19Q001W	14	50	50	6

State Well Number	Historic Low (ft bgs)	Min. Domestic Well Depth (ft bgs)	Minimum Threshold (ft bgs)	Measurable Objective (ft bgs)
48N04E30F002M (TID Well 1)	72	-	79	38
48N04E13K001M (TID Well 5)	82	-	90	42
48N05E26D001M (TID Well 8)	67	-	74	48
46N05E22D001M (TID Well 14)	48	-	54	40
TL-T1 Q3B	31	-	35	27
TL-T3 GP	14	-	16	12

5.3.2 Water Quality Quantitative Sustainable Management Criteria

This section establishes MOs and MTs for the wells in the representative water quality monitoring network. Each of these wells is operated and monitored by a public water system (PWS). MOs and MTs have been developed for two water quality constituents – nitrate and TDS – based on federal- and state-established goals and standards.

5.3.2.1 Water Quality Measurable Objectives

The water quality MOs reflect the desired conditions and are based on maintaining the current water quality in the Subbasin. The MOs are established based on the average of measurements obtained for these constituents since 2015. For nitrate, where the average levels have recently been below 1.0 mg/L, the MO was established at 2.0 mg/L which is well below the maximum contaminant level goal.

5.3.2.2 Water Quality Minimum Thresholds

The MTs for nitrate and TDS have been set equal to 10% less than the federal and/or state established goals. For nitrate, the MT is equal 9.0 milligrams per liter (mg/L), which is less than the maximum contaminant level goal (MCLG) of 10 milligrams per liter (mg/L). This MT allows for continued use of groundwater as a drinking water supply without local public water suppliers needing to invest in systems for nitrate removal. For TDS, the MT is equal to 900 mg/L which is less than the State of California secondary drinking water standard upper limit of 1,000 mg/L. This MT is protective of the secondary standard for drinking water and water quality needed for irrigation purposes. These MTs are applied to all representative water quality monitoring wells.

5.3.2.3 Water Quality Quantitative Summary

Table 5.2 shows the MO and MT established for each representative groundwater level monitoring well.

Table 5.2. Water Quality Quantitative Sustainable Management Criteria

WQ Monitoring Well	Nitrate (mg/L)		Total Dissolved Solids (mg/L)	
	MO	MT	MO	MT
TULELAKE WELL 03	2	9	205	900
TULELAKE WELL 01	2	9	190	900
KBNWR WELL 01	2	9	n/a	900
NEWELL WELL 01	2	9	540	900
NEWELL WELL 03	2	9	610	900
Note: There have been no measurements of TDS at KBNWR Well 01 since 2015.				

6 Projects and Management Actions to Maintain Sustainability (Reg. § 354.44)

The projects and management actions identified in this section allow for continued sustainability in the Tule Lake Subbasin. In addition, they promote better understanding of the subbasin through additional collected information, which will assist to fill data gaps previously identified in this plan. As shown in prior sections of this plan, the Tule Lake Subbasin is currently being sustainably managed. Therefore, no projects or management actions are required to achieve sustainability; however, the Tule Lake Subbasin GSAs have identified the projects and management actions below to improve their understanding of the groundwater subbasin. The completion of projects and management actions will help ensure the sustainable management of the Subbasin. The GSAs will incorporate information obtained from the actions below into future iterations of this GSP which will likely result in new projects and management actions being developed in the future. Due to the standing of the subbasin, these projects and management actions will be implemented based on the availability of resources and funding.

6.1 Projects and Management Actions

The GSAs have identified the following projects and management actions for the Tule Lake Subbasin, which are in addition to ongoing water use efficiency projects undertaken by Tulelake Irrigation District and the City of Tulelake. These projects do not rely on additional water from outside the jurisdiction of the GSAs. The GSAs have taken into account the level of uncertainty associated with the basin setting when developing these projects and management actions. Estimated costs of these projects range from less than $50,000 to greater than $150,000, which is discussed in Section 7.1 of this Plan.

6.1.1 Well Inventory

Section 2.1.1.6 identified the inventory of wells within the Tule Lake Subbasin by county and type. DWR’s well completion report database was utilized to prepare the inventory. As noted in that section of the Plan, it is unknown how many of these wells are actively used or how many of these wells have been abandoned and/or destroyed as this information is not always reported. The GSAs have identified a review of these reports as a project that will provide a better understanding of existing wells. This review is scheduled to be completed within the first 5 years of implementation.

6.1.2 Groundwater Level Monitoring Wells

Section 2.2.2.3 identified a lack of multi-completion wells within the Tule Lake Subbasin, which if present, would improve understanding of vertical movement of groundwater. The GSAs have identified this as a data gap, which can be addressed with the installation of one or more multi-completion wells. DWR’s Technical Support Services (TSS) office assists with this type of project. Therefore, the GSAs plan to file an application with TSS for a monitoring well installation within the first year of implementation.

Section 3.3.1.6 also identified a lack of dedicated monitoring wells within the Subbasin. Therefore, the installation of a multi-completion monitoring well and one or more shallow monitoring wells in the vicinity of the Sumps will provide valuable data for the Subbasin.

6.1.3 Water Quality Monitoring Network

Section 3.3.2.4 identified a need for denser and more frequent monitoring of water quality. Therefore, the GSAs plan to identify a minimum of two additional wells which will be added to the water quality monitoring network. This process is scheduled to be completed within the first year of implementation.

6.1.4 Groundwater Dependent Ecosystems

Section 2.2.2.9 identified areas that remained after filtering criteria were applied to the NCCAG dataset. The GSAs have identified this as a data gap, which can be addressed with field inspections of these areas to better understand if there is vegetation present and if so, analyze the availability of non-groundwater sources. These field inspections and follow-up reviews are scheduled to be completed within the first 5 years of implementation. In addition, pending availability of resources and funding, the GSAs plan to expand this project such that a field inspection is conducted to view each potential GDE identified in the NCCAG dataset.

6.1.5 Groundwater Recharge Projects

The GSAs are interested in, and will continue to investigate, potential groundwater recharge projects in the Subbasin. They anticipate the data collected by DWR’s airborne electromagnetic (AEM) surveys of the Subbasin will assist with this effort by providing a greater understanding of the Subbasin characteristics and identifying locations which may be suitable for groundwater recharge projects (DWR, 2020b). The GSAs’ understanding is that DWR will conduct the AEM surveys during 2021. Following the release of the data collected during the AEM surveys the GSAs will perform a review of the data within the first 3 years of implementation.

In addition, Tulelake Irrigation District intends to coordinate flows in order to allow lower Lost River Improved Channel water to flow into the Subbasin as it naturally did prior to construction of the Klamath Project. This operation will allow TID to charge irrigation canals and drains with water for recharge purposes and will occur on an annual basis as lower Lost River Improved Channel water flows allow.

6.1.6 Domestic Well Assistance

During 2021 and some prior years, domestic wells within the Subbasin have experienced issues where the supply has gone dry. As identified in section 2.1.2.10 of the GSP, domestic well assistance efforts have occurred during these prior years. During each of those years the District coordinated with the entity administering the domestic well assistance program. This has occurred primarily during years of low surface water supply from the Klamath Project. If TID and other Klamath Project water users receive a water supply consistent with the historical pattern of surface water deliveries, then domestic well issues are not expected to occur. The GSAs are aware of current (2021) efforts and similar to prior years will continue to coordinate with local agencies, such as the Klamath Water Users Association; the Klamath Project Drought Response Agency; and local, state, county, and city agencies to address domestic well issues. During years of low surface water supply, the GSAs will investigate the availability of federal, state, and/or local funding to assist impacted well owners. As identified in this GSP, Modoc County meets the requirements of a severely disadvantaged community and Siskiyou County meets the requirements of a disadvantaged community. Therefore, assistance by the GSAs will likely require grant funding. The result of this investigation may include a program that assists with the deepening or replacement of wells impacted during the implementation period of this GSP. Due to these factors, details of this type of domestic well assistance will be developed on a case-by-case basis.

6.1.7 Adaptive Management Strategy

The GSAs intend to use an adaptive management strategy to investigate a MT exceedance at a single representative monitoring location. As discussed in Section 5 of this Plan, the GSAs have defined undesirable results for the Subbasin, which include meeting or exceeding the MT at multiple representative monitoring locations. If a MT exceedance is observed at a single location, it will be brought to the attention of the GSAs to determine if additional monitoring at or around the site is needed to understand the exceedance. The GSAs will also determine if additional actions are needed to be implemented to ensure the levels at the monitoring location recover to above the MT. As identified in this plan, the Subbasin is currently and projected to be sustainably managed. Therefore, details of this type of adaptive management strategy will be developed on a case-by-case basis as appropriate.

6.1.8 Summary

A summary of projects and management actions following the implementation of the GSP is provided in Table 6.1.

Table 6.1. Summary of Projects and Management Actions

Project or Management Action	Start Date	Timeline	Completion Date Goal
Perform Well Inventory	Implementation of GSP	5 years	2027
File for well installation application with TSS	Implementation of GSP	1 year	2023
Add 2 wells to WQ Monitoring Network	Implementation of GSP	1 year	2023
Complete field inspections of GDEs	Implementation of GSP	5 years	2027
Review AEM survey data	Release of data	3 years	2025
Recharge via Operation of Station 48	Implementation of GSP	Ongoing (Yearly)	Ongoing (Yearly)
Provide Domestic Well Assistance	Implementation of GSP	Ongoing (As needed)	Ongoing (As needed)
Adaptive Management Strategy	Implementation of GSP	Ongoing (As needed)	Ongoing (As needed)

6.2 Public Noticing

The purpose of the projects and management actions identified above is to improve the understanding of the Tule Lake Subbasin. These activities do not require public notice and outreach; however, the GSAs plan to provide updates during Core Team meetings to allow for public comment. Updates on the status of these activities will be provided in the annual reports.

6.3 Legal Authority, Permitting and Regulatory Process

The purpose of the projects and management actions identified above is to improve the understanding of the Tule Lake Subbasin. As identified in Section 1.3 of this Plan, the GSAs have the legal authority and resources to implement this GSP. Except for monitoring well installation, these activities do not have permitting requirements. The GSAs will coordinate with DWR and local regulatory agency(s) for the monitoring well installation.

6.4 Expected Benefits

The purpose of the projects and management actions identified above is to improve the understanding of the Tule Lake Subbasin. Therefore, the benefits from these activities will be continuous throughout GSP implementation.

7 Plan Implementation

Implementation of this GSP includes consideration of the implementation costs, the schedule of implementation, reporting, and periodic evaluations. These considerations cover both the projects and management actions described in Section 6 as well as non-project and non-management actions that are required in order to successfully implement the Plan.

7.1 Estimate for GSP Implementation Costs

This section provides an overview of the estimated costs to implement this Plan and generally describes how the Tule Lake Subbasin GSAs plan to meet those costs.

Table 7.1 below provides a summary of the estimated costs for implementation of this Plan. These cost estimates will be refined during implementation as more information becomes available. The MOU, described in Section 1.3.1 and included in Appendix B, identifies the financial responsibilities of each GSA. As identified in Section 1.3 of this Plan, Modoc County meets the requirements of a severely disadvantaged community. Similarly, Siskiyou County meets the requirements of a disadvantaged community. Therefore, the GSAs will pursue grant funding as available and as appropriate to assist with implementation. In the case that sufficient grant funding is unavailable to assist with implementation, the GSAs may consider imposing fees.

Table 7.1. Summary of Estimated Costs for Implementation

Description	<$50,000	$50,000-$150,000	>$150,000
Annual Reports	X		
5-Year Plan Updates		X	
Projects & Management Actions			
Well Inventory	X		
Groundwater Level Monitoring Wells1	X	X	
Water Quality Monitoring Network	X		
Groundwater Dependent Ecosystems	X		
Groundwater Recharge Project(s)	X	X	X
Domestic Well Assistance1	X	X	X
Adaptive Management Strategy1	X	X	X
[1] Cost is dependent on the size of the project. As appropriate, these costs will be further defined.			

7.2 Schedule for Implementation

The final Plan will be submitted to DWR no later than January 31, 2022. Following the submittal there are reporting and periodic evaluation requirements, as described in Section 7.3. In addition, the GSAs plan to hold at least quarterly public meetings to discuss the status of the reporting requirements, the projects, and management actions described in Section 6, and ongoing public outreach and education. These meetings will help to ensure that the GSP is implemented, and that the sustainability goal is maintained.

7.3 Reporting and Periodic Evaluations

The section below describes the reporting and periodic evaluations part of Plan Implementation.

7.3.1 Annual Reports

SGMA Regulations require submittal of annual reports by April 1st of each year following GSP adoption, except for those years when 5-Year Plan updates are submitted. Annual Reports will be prepared and submitted to DWR under the guidance of the GSAs and Plan Manager.

The Annual Reports will be prepared consistent with the Annual Report's Elements Guide, provided by DWR, which requires the following components be reported for the preceding water year:

- General information, including an executive summary and a location map depicting the basin covered by the report.
- A detailed description and graphical representation of the following conditions of the basin managed in the Plan:
    - Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:
        - Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.
        - Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year.
- Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.
- Surface water supply used or available for use, for groundwater recharge or in lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year.

- Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year.
- Change in groundwater in storage shall include the following:
  - Change in groundwater in storage maps for each principal aquifer in the basin.
  - A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.
- A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.

7.3.2 5-Year Plan Updates

The GSP Regulations require evaluation of the GSP at least every five years and with every amendment and provide a written assessment to DWR, the first of which is to be submitted to DWR by January 31, 2027. Assessments will be prepared and submitted to DWR under the guidance of the GSAs and Plan Manager.

The assessments will be prepared consistent with the GSP Regulations, which require the following components:

- A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones, and minimum thresholds.
- A description of the implementation of any projects or management actions, and the effect on groundwater conditions resulting from those projects or management actions.
- Elements of the GSP, including the Basin setting, management areas, or the identification of undesirable results and the setting of minimum thresholds and measurable objectives, shall be reconsidered and revisions proposed, if necessary.
- An evaluation of the Basin setting in light of significant new information or changes in water use, and an explanation of any significant changes. If the GSAs' evaluation shows that the Basin is experiencing overdraft conditions, the GSAs shall include an assessment of measures to mitigate that overdraft.
- A description of the monitoring network within the Basin, including whether data gaps exist, or any areas within the Basin are represented by data that does not satisfy the

requirements of Sections 352.4 and 354.34(c). The description shall include the following:

  - An assessment of monitoring network function with an analysis of data collected to date, identification of data gaps, and the actions necessary to improve the monitoring network, consistent with the requirements of Section 354.38.
  - If the GSA’s identify data gaps, the Plan shall describe a program for the acquisition of additional data sources, including an estimate of the timing of that acquisition, and for incorporation of newly obtained information into the Plan.
  - The Plan shall prioritize the installation of new data collection facilities and analysis of new data based on the needs of the basin.

- A description of significant new information that has been made available since Plan adoption or amendment, or the last five-year assessment. The description shall also include whether new information warrants changes to any aspect of the Plan, including the evaluation of the basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results.
- A description of relevant actions taken by the GSAs, including a summary of regulations or ordinances related to the Plan.
- Information describing any enforcement or legal actions taken by the GSAs in furtherance of the sustainability goal for the basin.
- A description of completed or proposed Plan amendments.
- Where appropriate, a summary of coordination that occurred between multiple agencies in a single basin, agencies in hydrologically connected basins, and land use agencies.
- Other information the GSAs deem appropriate, along with any information required by the DWR to conduct a periodic review as required by Water Code Section 10733.

8 References

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Appendix A.
GSA Notices

August 12, 2021

Modoc County Supervisors
c/o Clerk of the Board
294 S. Court Street
Alturas, CA 96101

Planning Director
Sean Curtis
203 W 4th Street
Alturas, CA 96101

Health Services Director
Stacy Sphar
441 N Main Street
Alturas, CA 96101

Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Groundwater Sustainability Plan

To whom it may concern:

In accordance with California Water Code (CWC) §10728.4, the Tulelake Core Team (which consists of members of the Tulelake Irrigation District Groundwater Sustainability Agency (GSA), Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA) is hereby providing notice to the cities and counties within the geographic area covered by the Tulelake Groundwater Subbasin Groundwater Sustainability Plan (Tulelake GSP) that it intends to adopt the Tulelake GSP no earlier than 90 days after your receipt of this notice. Public hearings will be held by each GSA to consider adoption of the Tulelake GSP. Once adopted, the Tulelake GSP will govern sustainable groundwater management actions within the Tulelake Subbasin.

The Tulelake Core Team will review and consider the comments on the Tulelake GSP from the recipients of this notice and will consult with a city or county that requests consultation within 30 days of receipt of this notice.

The GSP will be available for download at the Tulelake Irrigation District website at the following link:
https://tulelakeid.com/tulelake-subbasin-groundwater-sustainability-plan/

Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

August 12, 2021

Siskiyou County Supervisors
c/o Clerk of the Board
PO Box 750
Yreka, CA 96097

Planning Department
Kirk Skierski
806 S Main Street
Yreka, CA 96097

Community Development
Rick Dean
806 S Main Street
Yreka, CA 96097

Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Groundwater Sustainability Plan

To whom it may concern:

In accordance with California Water Code (CWC) §10728.4, the Tulelake Core Team (which consists of members of the Tulelake Irrigation District Groundwater Sustainability Agency (GSA), Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA) is hereby providing notice to the cities and counties within the geographic area covered by the Tulelake Groundwater Subbasin Groundwater Sustainability Plan (Tulelake GSP) that it intends to adopt the Tulelake GSP no earlier than 90 days after your receipt of this notice. Public hearings will be held by each GSA to consider adoption of the Tulelake GSP. Once adopted, the Tulelake GSP will govern sustainable groundwater management actions within the Tulelake Subbasin.

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Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

August 12, 2021

City of Tulelake
Mayor Ebinger
PO Box 847
Tulelake, CA 96134

Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Groundwater Sustainability Plan

Dear Mayor Ebinger:

In accordance with California Water Code (CWC) §10728.4, the Tulelake Core Team (which consists of members of the Tulelake Irrigation District Groundwater Sustainability Agency (GSA), Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA) is hereby providing notice to the cities and counties within the geographic area covered by the Tulelake Groundwater Subbasin Groundwater Sustainability Plan (Tulelake GSP) that it intends to adopt the Tulelake GSP no earlier than 90 days after your receipt of this notice. Public hearings will be held by each GSA to consider adoption of the Tulelake GSP. Once adopted, the Tulelake GSP will govern sustainable groundwater management actions within the Tulelake Subbasin.

The Tulelake Core Team will review and consider the comments on the Tulelake GSP from the recipients of this notice and will consult with a city or county that requests consultation within 30 days of receipt of this notice.

The GSP will be available for download at the Tulelake Irrigation District website at the following link: https://tulelakeid.com/tulelake-subbasin-groundwater-sustainability-plan/

Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

August 12, 2021

Newell County Water District
John Sanders
405 5th Avenue
Tulelake, CA 96134

Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Groundwater Sustainability Plan

Dear Mr. Sanders:

In accordance with California Water Code (CWC) §10728.4, the Tulelake Core Team (which consists of members of the Tulelake Irrigation District Groundwater Sustainability Agency (GSA), Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA) is hereby providing notice to the cities and counties within the geographic area covered by the Tulelake Groundwater Subbasin Groundwater Sustainability Plan (Tulelake GSP) that it intends to adopt the Tulelake GSP no earlier than 90 days after your receipt of this notice. Public hearings will be held by each GSA to consider adoption of the Tulelake GSP. Once adopted, the Tulelake GSP will govern sustainable groundwater management actions within the Tulelake Subbasin.

The Tulelake Core Team will review and consider the comments on the Tulelake GSP from the recipients of this notice and will consult with a city or county that requests consultation within 30 days of receipt of this notice.

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https://tulelakeid.com/tulelake-subbasin-groundwater-sustainability-plan/

Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

Tulelake Irrigation District

P. O. Box 699 * 2717 Havlina Road * Tulelake, CA 96134
Phone: 530-667-2249 * Fax: 530-667-4228 * Email: tid@cot.net

Brad C. Kirby, **Manager**
Kraig D. Beasly, **Assistant Manager**
Earl C. Danosky, **Senior Advisor**
Kacie A.Fields, **Office Mgr.**
John F. Crawford, **President**
James E. Havlina, **V. President**
William J. Heiney, **Director**
Marc Staunton, **Director**
Gary A. Wright, **Director**

June 5, 2018

Mr. Trevor Joseph
Sustainable Groundwater Management Section Chief
Department of Water Resources

Subject: Initial Notification of Groundwater Sustainability Plan Development for the Tulelake Sub Basin.

Mr. Joseph,

This letter is to notify you that the Tulelake Irrigation District (TID) will be acting as the Groundwater Sustainability Agency (GSA) for the Tulelake Sub Basin (Basin number 1-002.1) pursuant to Water Code Section 10727.8. TID intends to develop a Groundwater Sustainability Plan (GSP) that is required by the Sustainable Groundwater Management Act (SGMA).

The GSP will be developed and coordinated through a Core team that has been formed under the MOU #17-139 between Tulelake Irrigation District, City of Tulelake, Siskiyou County and Modoc County. The Core team consists of a representative from each entity. Advisory positions have also been created to bring more input to the Core team.

We will be working with a qualified consultant in developing budgets, models and the GSP. We look forward to working through this process with DWR and others to get a plan in place. If you have any questions please contact Kraig Beasly, Assistant Manager Tulelake Irrigation District, at tid@cot.net or (530) 667-2249.

Sincerely,

Brad Kirby
Manager
Tulelake Irrigation District

TULELAKE SUBBASIN GROUNDWATER CORE TEAM

CORE TEAM MEMBERS
Gary Wright, Tulelake Irrigation District
Kraig Beasly, Tulelake Irrigation District
Henry Ebinger, City of Tulelake
Matt Parker, Siskiyou County
Tiffany Martinez, Modoc County

Kraig Beasly
Chairperson

Tiffany Martinez
Clerk of the Core Team

February 29, 2024

City of Tulelake
c/o Mayor Penny Velador
PO Box 847
Tulelake, CA 96134

Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Amended Groundwater Sustainability Plan

Dear Mayor Velador:

In accordance with California Water Code (CWC) §10728.4, the Tulelake Core Team (which consists of members of the Tulelake Irrigation District Groundwater Sustainability Agency (GSA), Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA) is hereby providing notice to the cities and counties within the geographic area covered by the Tulelake Groundwater Subbasin Groundwater Sustainability Plan (Tulelake GSP) that it intends to adopt an amended Tulelake GSP no earlier than 90 days after your receipt of this notice. Public hearings will be held by each GSA to consider adoption of the amended Tulelake GSP. Once adopted, the amended Tulelake GSP will govern sustainable groundwater management actions within the Tulelake Subbasin.

The Tulelake Core Team will review and consider the comments on the amended Tulelake GSP from the recipients of this notice and will consult with a city or county that requests consultation within 30 days of receipt of this notice.

The GSP will be available for download at the Tulelake Irrigation District website at the following link: https://tulelakeid.com/tulelake-subbasin-groundwater-sustainability-plan/

Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

TULELAKE SUBBASIN GROUNDWATER CORE TEAM

CORE TEAM MEMBERS
Gary Wright, Tulelake Irrigation District
Kraig Beasly, Tulelake Irrigation District
Henry Ebinger, City of Tulelake
Matt Parker, Siskiyou County
Tiffany Martinez, Modoc County

Kraig Beasly
Chairperson

Tiffany Martinez
Clerk of the Core Team

February 29, 2024

Siskiyou County Supervisors
c/o Clerk of the Board
PO Box 750
Yreka, CA 96097

Planning Department
Kirk Skierski
806 S Main Street
Yreka, CA 96097

Community Development
Rick Dean
806 S Main Street
Yreka, CA 96097

Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Amended Groundwater Sustainability Plan

To whom it may concern:

In accordance with California Water Code (CWC) §10728.4, the Tulelake Core Team (which consists of members of the Tulelake Irrigation District Groundwater Sustainability Agency (GSA), Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA) is hereby providing notice to the cities and counties within the geographic area covered by the Tulelake Groundwater Subbasin Groundwater Sustainability Plan (Tulelake GSP) that it intends to adopt an amended Tulelake GSP no earlier than 90 days after your receipt of this notice. Public hearings will be held by each GSA to consider adoption of the amended Tulelake GSP. Once adopted, the amended Tulelake GSP will govern sustainable groundwater management actions within the Tulelake Subbasin.

The Tulelake Core Team will review and consider the comments on the amended Tulelake GSP from the recipients of this notice and will consult with a city or county that requests consultation within 30 days of receipt of this notice.

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Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

TULELAKE SUBBASIN GROUNDWATER CORE TEAM

CORE TEAM MEMBERS
Gary Wright, Tulelake Irrigation District
Kraig Beasly, Tulelake Irrigation District
Henry Ebinger, City of Tulelake
Matt Parker, Siskiyou County
Tiffany Martinez, Modoc County

Kraig Beasly
Chairperson

Tiffany Martinez
Clerk of the Core Team

February 29, 2024

Newell County Water District
John Sanders
405 5th Avenue
Tulelake, CA 96134

Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Amended Groundwater Sustainability Plan

Dear Mr. Sanders:

In accordance with California Water Code (CWC) §10728.4, the Tulelake Core Team (which consists of members of the Tulelake Irrigation District Groundwater Sustainability Agency (GSA), Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA) is hereby providing notice to the cities and counties within the geographic area covered by the Tulelake Groundwater Subbasin Groundwater Sustainability Plan (Tulelake GSP) that it intends to adopt an amended Tulelake GSP no earlier than 90 days after your receipt of this notice. Public hearings will be held by each GSA to consider adoption of the amended Tulelake GSP. Once adopted, the amended Tulelake GSP will govern sustainable groundwater management actions within the Tulelake Subbasin.

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Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

TULELAKE SUBBASIN GROUNDWATER CORE TEAM

CORE TEAM MEMBERS
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Matt Parker, Siskiyou County
Tiffany Martinez, Modoc County

Kraig Beasly
Chairperson

Tiffany Martinez
Clerk of the Core Team

February 29, 2024

Modoc County Supervisors
c/o Clerk of the Board
294 S. Court Street
Alturas, CA 96101

Planning Director
Sean Curtis
203 W 4th Street
Alturas, CA 96101

Health Services Director
Stacy Sphar
441 N Main Street
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Subject: Notice of Intent to Adopt Tulelake Groundwater Subbasin Amended Groundwater Sustainability Plan

To whom it may concern:

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The Tulelake Core Team will review and consider the comments on the amended Tulelake GSP from the recipients of this notice and will consult with a city or county that requests consultation within 30 days of receipt of this notice.

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Requests for consultation and/or comments should be submitted to Kraig Beasly, Chair, Tulelake Core Team.

Sincerely,

Kraig Beasly

Kraig Beasly, Tulelake Core Team Chair

RESOLUTION NO. 24-08

RESOLUTION ADOPTING THE TULE LAKE SUBBASIN AMENDED GROUNDWATER SUSTAINABILITY PLAN

A. **WHEREAS,** the Sustainable Groundwater Management Act ("SGMA") "provide[s] local groundwater sustainability agencies with the authority and technical and financial assistance necessary to sustainably manage groundwater" (Wat. Code, § 10720(d));

B. **WHEREAS,** SGMA requires sustainable management through the development of groundwater sustainability plans ("GSPs"), which can be a single plan developed by one or more groundwater sustainability agencies ("GSAs") (Wat. Code, § 10727);

C. **WHEREAS,** SGMA requires a GSA to be formed to manage groundwater in all basins designated by the California Department of Water Resources ("DWR") as medium or high priority, including the Tule Lake Subbasin;

D. **WHEREAS,** Tulelake Irrigation District, City of Tulelake, Siskiyou County, and Modoc County decided to become GSAs for the purpose of sustainably managing groundwater in the Tule Lake Subbasin within their jurisdictional boundaries, pursuant to the requirements of SGMA;

E. **WHEREAS,** each GSA has the authority to draft, adopt, and implement a GSP (Wat. Code, § 10725 *et seq.*);

F. **WHEREAS,** in August 2017, the GSAs executed a Memorandum of Understanding ("MOU") to guide development and implementation of a single GSP to ensure sustainable groundwater management in the Tule Lake Subbasin (Wat. Code, § 10727(a)(2));

G. **WHEREAS,** the MOU established the "Core Team" comprised of representatives of each GSA, to direct and coordinate the development, financing, and implementation of the Tule Lake Subbasin GSP;

H. **WHEREAS,** after proper notice, and with input from advisory members, the Core Team developed a single GSP for the Tule Lake Subbasin;

I. **WHEREAS,** following receipt of comments on the draft GSP, the Core Team released a final GSP for adoption by the GSAs;

J. **WHEREAS,** during December 2021, each GSA adopted the Tule Lake Subbasin GSP, and on January 31, 2022, the GSAs submitted the Tule Lake Subbasin GSP to DWR;

K. **WHEREAS,** by letter dated January 18, 2024, DWR determined that the Tule Lake Subbasin GSP was "incomplete" pursuant to Section 355.2(e)(2) of the GSP regulations, and notified the GSAs that failure to address the deficiencies by July 16, 2024, could result in a determination that the GSP is "inadequate";

L. WHEREAS, the Core Team has amended the Tule Lake Subbasin GSP to address DWR's determination, and on June 19, 2024, the Core Team reviewed the amended GSP and recommended that the GSAs adopt the amended GSP, which is attached to this resolution as Exhibit A.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Tulelake, acting as a GSA:

1. Approves and adopts the amended GSP as attached in Exhibit A for the area within the Tule Lake Subbasin in which the City of Tulelake has jurisdiction.
2. Delegates to the Core Team, the responsibility and the authority to take such other actions on its behalf as may be reasonably necessary to submit the amended GSP to DWR by July 16, 2024.

PASSED, APPROVED, AND ADOPTED this 2nd day of July, 2024 by the following vote:

AYES: 3 Mayor Cordonier, Council Members Ebinger and Williams
NAYS: 0
ABSTAIN: 0
ABSENT: 2 Council Members Pena-Larsen and Hendricks

Thomas L Cordonier
Thomas L. Cordonier, Mayor

Attest: Aissa Martinez
Aissa Martinez, City Clerk

Date: 7/2/24

RESOLUTION # 2024-37

A RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF MODOC ACTING AS THE GROUNDWATER SUSTAINABILITY AGENCY, FOR ALL THOSE PORTIONS OF THE TULE LAKE SUBBASIN LOCATED WITHIN MODOC COUNTY, TO ADOPT THE AMENDED TULE LAKE SUBBASIN GROUNDWATER SUSTAINABILITY PLAN (GSP) IN COORDINATION WITH THE TULELAKE IRRIGATION DISTRICT, CITY OF TULELAKE, AND SISKIYOU COUNTY SUSTAINABILITY AGENCIES AND DIRECT STAFF TO SUBMIT THE REVISED GSP TO THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

WHEREAS, the Sustainable Groundwater Management Act ("SGMA") provides local groundwater sustainability agencies with the authority and technical and financial assistance necessary to sustainably manage groundwater" (Wat. Code, § 10720(d)); and

WHEREAS, SGMA requires sustainable management through the development of groundwater sustainability plans ("GSPs"), which can be a single plan developed by one or more groundwater sustainability agencies ("GSAs") (Wat. Code, § 10727); and

WHEREAS, SGMA requires a GSA to be formed to manage groundwater in all basins designated by the California Department of Water Resources ("DWR") as medium or high priority, including the Tule Lake Subbasin; and

WHEREAS, Tulelake Irrigation District, City of Tulelake, Siskiyou County, and Modoc County decided to become GSAs for the purpose of sustainably managing groundwater in the Tule Lake Subbasin within their jurisdictional boundaries, pursuant to the requirements of SGMA; and

WHEREAS, each GSA has the authority to draft, adopt, and implement a GSP (Wat. Code, § 10725 *et seq.*); and

WHEREAS, in August 2017, the GSAs executed a Memorandum of Understanding ("MOU") to guide development and implementation of a single GSP to ensure sustainable groundwater management in the Tule Lake Subbasin (Wat. Code, § 10727(a)(2)); and

WHEREAS, the MOU established the "Core Team" comprised of representatives of each GSA, to direct and coordinate the development, financing, and implementation of the Tule Lake Subbasin GSP; and

WHEREAS, after proper notice, and with input from advisory members, the Core Team developed a single GSP for the Tule Lake Subbasin; and

WHEREAS, following receipt of comments on the draft GSP, the Core Team released a final GSP for adoption by the GSAs; and

WHEREAS, during December 2021, each GSA adopted the Tule Lake Subbasin GSP, and on January 31, 2022, the GSAs submitted the Tule Lake Subbasin GSP to DWR; and

WHEREAS, by letter dated January 18, 2024, DWR determined that the Tule Lake Subbasin GSP was "incomplete" pursuant to Section 355.2(e)(2) of the GSP regulations, and notified the GSAs that failure to address the deficiencies by July 16, 2024, could result in a determination that the GSP is "inadequate"; and

WHEREAS, the Core Team has amended the Tule Lake Subbasin GSP to address DWR's determination, and on June 19, 2024, the Core Team reviewed the amended GSP and recommended that the GSAs adopt the amended GSP, which is attached to this resolution as **Exhibit A.**

NOW, THEREFORE, BE IT RESOLVED that the Modoc County Board of Supervisors acting as a Modoc County GSA:

1. Approves and adopts the amended GSP as attached in Exhibit A for the area within the Tule Lake Subbasin in which the Modoc County GSA has jurisdiction.
2. Delegates to the Core Team, the responsibility and the authority to take such other actions on its behalf as may be reasonably necessary to submit the amended GSP to DWR by July 16, 2024.

NOW, THEREFORE, BE IT FURTHER RESOLVED that this Resolution shall take full force and effect immediately.

PASSED AND ADOPTED by the Board of Supervisors of the County of Modoc, State of California, on the 9th day of July, 2024 by the following vote:

Motion Approved:

RESULT: **APPROVED [UNANIMOUS]**
MOVER: Geri Byrne, Supervisor District V
SECONDER: Elizabeth Cavasso, Supervisor District IV
AYES: Ned Coe, Supervisor District I, Shane Starr, Supervisor District II, Kathie Rhoads, Supervisor District III, Elizabeth Cavasso, Supervisor District IV, Geri Byrne, Supervisor District V

BOARD OF SUPERVISORS
OF THE COUNTY OF MODOC

Shane Starr, Chair
Modoc County Board of Supervisors

ATTEST:

Tiffany Martinez

Tiffany Martinez
Clerk of the Board

RESOLUTION NO. 24-126

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SISKIYOU ADOPTING THE TULE LAKE SUBBASIN AMENDED GROUNDWATER SUSTAINABILITY PLAN

A. **WHEREAS,** the Sustainable Groundwater Management Act ("SGMA") "provide[s] local groundwater sustainability agencies with the authority and technical and financial assistance necessary to sustainably manage groundwater" (Wat. Code, § 10720(d));

B. **WHEREAS,** SGMA requires sustainable management through the development of groundwater sustainability plans ("GSPs"), which can be a single plan developed by one or more groundwater sustainability agencies ("GSAs") (Wat. Code, § 10727);

C. **WHEREAS,** SGMA requires a GSA to be formed to manage groundwater in all basins designated by the California Department of Water Resources ("DWR") as medium or high priority, including the Tule Lake Subbasin;

D. **WHEREAS,** Tulelake Irrigation District, City of Tulelake, Siskiyou County, and Modoc County decided to become GSAs for the purpose of sustainably managing groundwater in the Tule Lake Subbasin within their jurisdictional boundaries, pursuant to the requirements of SGMA;

E. **WHEREAS,** each GSA has the authority to draft, adopt, and implement a GSP (Wat. Code, § 10725 *et seq.*);

F. **WHEREAS,** in August 2017, the GSAs executed a Memorandum of Understanding ("MOU") to guide development and implementation of a single GSP to ensure sustainable groundwater management in the Tule Lake Subbasin (Wat. Code, § 10727(a)(2));

G. **WHEREAS,** the MOU established the "Core Team" comprised of representatives of each GSA, to direct and coordinate the development, financing, and implementation of the Tule Lake Subbasin GSP;

H. **WHEREAS,** after proper notice, and with input from advisory members, the Core Team developed a single GSP for the Tule Lake Subbasin;

I. **WHEREAS,** following receipt of comments on the draft GSP, the Core Team released a final GSP for adoption by the GSAs;

J. **WHEREAS,** during December 2021, each GSA adopted the Tule Lake Subbasin GSP, and on January 31, 2022, the GSAs submitted the Tule Lake Subbasin GSP to DWR;

K. **WHEREAS,** by letter dated January 18, 2024, DWR determined that the Tule Lake Subbasin GSP was "incomplete" pursuant to Section 355.2(e)(2) of the GSP regulations, and notified the GSAs that failure to address the deficiencies by July 16, 2024, could result in a determination that the GSP is "inadequate";

SISKIYOU COUNTY
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L. **WHEREAS,** the Core Team has amended the Tule Lake Subbasin GSP to address DWR's determination, and on June 19, 2024, the Core Team reviewed the amended GSP and recommended that the GSAs adopt the amended GSP, which is attached to this resolution as Exhibit A.

NOW, THEREFORE, BE IT RESOLVED that the Siskiyou County Board of Supervisors of the Tulelake GSA,:

1. Approves and adopts the amended GSP as attached in Exhibit A for the area within the Tule Lake Subbasin in which the County of Siskiyou has jurisdiction.
2. Delegates to the Core Team, the responsibility and the authority to take such other actions on its behalf as may be reasonably necessary to submit the amended GSP to DWR by July 16, 2024.

PASSED, APPROVED, AND ADOPTED by the Siskiyou County Board of Supervisors at a meeting of said board held on July 9th, 2024 by the following vote:

AYES: Supervisors Valenzuela, Criss, Ogren and Kobseff
NOES: None
ABSTAIN: None
ABSENT: Supervisor Haupt

Michael N. Kobseff
Chair, Siskiyou County Board of Supervisors

Attest: Laura Bynum, Clerk

By ______________ Deputy

RESOLUTION NO. 2024-2

RESOLUTION ADOPTING THE TULE LAKE SUBBASIN AMENDED GROUNDWATER SUSTAINABILITY PLAN

A. **WHEREAS,** the Sustainable Groundwater Management Act ("SGMA") "provide[s] local groundwater sustainability agencies with the authority and technical and financial assistance necessary to sustainably manage groundwater" (Wat. Code, § 10720(d));

B. **WHEREAS**, SGMA requires sustainable management through the development of groundwater sustainability plans ("GSPs"), which can be a single plan developed by one or more groundwater sustainability agencies ("GSAs") (Wat. Code, § 10727);

C. **WHEREAS**, SGMA requires a GSA to be formed to manage groundwater in all basins designated by the California Department of Water Resources ("DWR") as medium or high priority, including the Tule Lake Subbasin;

D. **WHEREAS**, Tulelake Irrigation District, City of Tulelake, Siskiyou County, and Modoc County decided to become GSAs for the purpose of sustainably managing groundwater in the Tule Lake Subbasin within their jurisdictional boundaries, pursuant to the requirements of SGMA;

E. **WHEREAS**, each GSA has the authority to draft, adopt, and implement a GSP (Wat. Code, § 10725 *et seq.*);

F. **WHEREAS**, in August 2017, the GSAs executed a Memorandum of Understanding ("MOU") to guide development and implementation of a single GSP to ensure sustainable groundwater management in the Tule Lake Subbasin (Wat. Code, § 10727(a)(2));

G. **WHEREAS,** the MOU established the "Core Team" comprised of representatives of each GSA, to direct and coordinate the development, financing, and implementation of the Tule Lake Subbasin GSP;

H. **WHEREAS**, after proper notice, and with input from advisory members, the Core Team developed a single GSP for the Tule Lake Subbasin;

I. **WHEREAS**, following receipt of comments on the draft GSP, the Core Team released a final GSP for adoption by the GSAs;

J. **WHEREAS,** during December 2021, each GSA adopted the Tule Lake Subbasin GSP, and on January 31, 2022, the GSAs submitted the Tule Lake Subbasin GSP to DWR;

K. **WHEREAS**, by letter dated January 18, 2024, DWR determined that the Tule Lake Subbasin GSP was "incomplete" pursuant to Section 355.2(e)(2) of the GSP regulations, and notified the GSAs that failure to address the deficiencies by July 16, 2024, could result in a determination that the GSP is "inadequate";

L. WHEREAS, the Core Team has amended the Tule Lake Subbasin GSP to address DWR's determination, and on June 19, 2024, the Core Team reviewed the amended GSP and recommended that the GSAs adopt the amended GSP, which is attached to this resolution as Exhibit A.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Tulelake Irrigation District, acting as a GSA:

1. Approves and adopts the amended GSP as attached in Exhibit A for the area within the Tule Lake Subbasin in which the Tulelake Irrigation District has jurisdiction.
2. Delegates to the Core Team, the responsibility and the authority to take such other actions on its behalf as may be reasonably necessary to submit the amended GSP to DWR by July 16, 2024.

PASSED, APPROVED, AND ADOPTED this 8th day of July, 2024 by the following vote:

AYES: John Crawford, Scott Seus, Walter Woodhouse
NAYS: None.
ABSTAIN: None.
ABSENT: Ed Staunton, Gary Wright

John Crawford
John Crawford, President

Attest:
Brad Kirby, Secretary

Date: 07/08/2024

Appendix B.
Memorandum of Understanding

CONTRACT
17-139

Memorandum of Understanding Regarding Development and Implementation of a Groundwater Sustainability Plan for the Tule Lake Groundwater Subbasin

This Memorandum of Understanding (MOU) for the Development of a Groundwater Sustainability Plan (Plan) for the Tule Lake Groundwater Subbasin is entered into and effective as of the Effective Date, by and between the County of Modoc (Modoc County), the County of Siskiyou (Siskiyou County), the City of Tulelake (City), and the Tulelake Irrigation District (TID). Hereinafter, Modoc County, Siskiyou County, the City, and TID may individually be referred to as a "Party" and may collectively be referred to as the "Parties."

RECITALS

WHEREAS, the Sustainable Groundwater Management Act (Act) seeks to: ensure the sustainable management of groundwater and groundwater basins throughout the State of California; enhance local government and agency management of groundwater and groundwater basins; establish minimum standards for sustainable management of groundwater and groundwater basins; and provide local governments and agencies the authority and the technical and financial assistance necessary to sustainably manage groundwater and groundwater basins;

WHEREAS, the Act requires that all basins and subbasins designated as high- or medium-priority basins and subbasins by the California Department of Water Resources (Department) be managed according to a groundwater sustainability plan (GSP) or coordinated GSPs prepared by one or more local agencies that decide to be a groundwater sustainability agency (GSA) under the Act;

WHEREAS, the Act requires all basins and subbasins designated as high- or medium-priority basins by the Department be managed under a GSP or coordinated GSPs by January 31, 2022;

WHEREAS, the Department has designated as a medium-priority basin the Tule Lake Groundwater Subbasin (Subbasin) located within the Klamath River Valley Basin (identified in the Department's Bulletin 118 as Subbasin ID No. 1-002.1 and Basin ID No. 1-002, respectively);

WHEREAS, on October 18, 2016, the California Water Commission approved a boundary modification for the Subbasin;

WHEREAS, each Party has decided to be a GSA for a portion of the Subbasin underlying their respective jurisdictional boundaries;

WHEREAS, each Party has statutory authorities that are essential to groundwater management and compliance with the Act;

WHEREAS, the Parties intend to satisfy the requirements of the Act by collectively developing and implementing a single GSP to sustainably manage the Subbasin and its groundwater resources;

WHEREAS, the Parties wish to execute this MOU to memorialize how they will use their existing statutory authorities and those additional authorities provided to them by the Act to develop and implement a single GSP to sustainably manage the Subbasin and its groundwater resources; and

WHEREAS, the Parties intend to develop and implement a single GSP for the Subbasin and its groundwater resources as expeditiously as possible but not later than January 31, 2022, to satisfy the requirements of the Act and in furtherance of this MOU.

NOW, THEREFORE, in consideration of the promises, terms, conditions, and covenants contained herein, the Parties hereby agree as follows:

I. Definitions

Unless context requires otherwise, the following terms shall have the following meanings when used in this MOU:

A. The term "Act" shall refer to the Sustainable Groundwater Management Act, Water Code section 10720 et seq., and its implementing regulations as may be amended from time to time.

B. The term "Annual GSP Budget" shall refer to the budget to be adopted annually by each Governing Body pursuant to Article III.B.6.

C. The term "Annual GSP Work Plan and Schedule" shall refer to the work plan and schedule to be adopted annually by each Governing Body pursuant to Article III.B.5.

D. The term "City" shall refer to the City of Tulelake, a municipal corporation located in Siskiyou County, California and a Party to this MOU.

E. The term "Core Team" shall refer to the group of representatives designated by each Party responsible for directing and coordinating the development, financing, and implementation of the Tule Lake Subbasin GSP and satisfying the requirements of the Act as provided in Article III.B.

F. The term "Department" shall refer to the California Department of Water Resources.

G. The term "Effective Date" shall mean the date on which the last Party executes this MOU.

H. The term "Governing Body" shall refer to the legislative body of each Party.

I. The terms "Groundwater Sustainability Plan" and "GSP" shall have the same meaning as defined in Water Code section 10727.

J. The term "Management Area" shall refer to the portions of the Subbasin where each Party is responsible for developing, and implementing the GSP as provided in Article III.A and subject to Article III.H.1 of this MOU.

K. The term "Management Authority" shall refer to each Party's existing statutory authorities and the additional authorities available to each Party under the Act for the development, financing, and implementation of the Tule Lake Subbasin GSP for the Subbasin and to satisfy the requirements of the Act.

L. The terms "Memorandum of Understanding" and "MOU" shall mean and refer to this agreement entered into on the Effective Date by the Parties.

M. The term "Modoc County" shall refer to the County of Modoc, a political subdivision of the State of California and a Party to this MOU.

N. The term "Siskiyou County" shall refer to the County of Siskiyou, a political subdivision of the State of California and a Party to this MOU.

O. The term "State" shall mean the State of California.

P. The term "State Water Board" shall mean the California State Water Resources Control Board.

Q. The term "TID" shall refer to the Tulelake Irrigation District, an irrigation district formed and operating under the provisions of the California Irrigation District Law, California Water Code section 20500 et seq., and a Party to this MOU.

R. The terms "Tule Lake Subbasin GSP" shall refer to the GSP that the Parties intend to develop and implement for the sustainable management of the Subbasin and its groundwater resources and to satisfy the requirements of the Act.

II. MOU Purpose; Authorities of Parties

A. Purpose

This MOU is entered into by the Parties for the purpose of establishing a cooperative effort to develop and implement the Tule Lake Subbasin GSP - a single GSP to sustainably manage the Subbasin and its groundwater resources and to satisfy the requirements of the Act - as further provided in Article III.D.

B. Authorities

The Parties recognize and agree that each Party's existing statutory authorities are necessary to develop and implement the Tule Lake Subbasin GSP. The Parties further recognize and agree that the Act provides the Parties with authorities in addition to their existing statutory authorities upon deciding to become a GSA. This MOU memorializes the Parties' intent to exercise their existing authorities and those provided by the Act to develop and implement the Tule Lake Subbasin GSP.

III. Agreement

A. Tule Lake Subbasin GSP Management Areas

The following management areas are created within the boundaries of the Subbasin:

1. The "TID Management Area" is hereby created. The TID Management Area shall consist of and be coextensive with that portion of the Subbasin within the boundary of TID, as that boundary is defined by order of the Modoc County Board of Supervisors, dated March 24, 1952.[1] The TID Management Area is set forth in the map attached hereto as Exhibit A. TID shall, upon recommendation by the Core Team, exercise its management authorities, as necessary, to develop, and implement the Tule Lake Subbasin GSP in the TID Management Area consistent with the goals and objectives of the Annual GSP Work Plan and Schedule and Annual GSP Budget recommended by the Core Team and adopted by the respective Governing Body of each member.

2. The "Western Modoc County Management Area" is hereby created. The Western Modoc County Management Area shall consist of and be coextensive with that portion of the Subbasin within the jurisdictional boundary of Modoc County and outside the boundary of the TID. The Western Modoc County Management Area is set forth in the map attached hereto as Exhibit A. Modoc County shall, upon recommendation by the Core Team, and subject to Article III.H.1. exercise its management authorities to develop and implement the Tule Lake Subbasin GSP within the Western Modoc County Management Area consistent with the goals and objectives of the Annual GSP Work Plan and Schedule and Annual GSP Budget recommended by the Core Team and adopted by the respective Governing Body of each member.

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[1] The full title of the order is "In the Matter of the Tulelake Irrigation District, Order Declaring Results of Formation Election, Declaring the District Formed and Setting Forth the Boundaries Thereof."

3. The "Eastern Siskiyou County Management Area" is hereby created. The Eastern Siskiyou County Management Area shall consist of and be coextensive with that portion of the Subbasin within the jurisdictional boundary of Siskiyou County that is outside the boundary of the TID Management Area and outside the Tulelake Management Area. The Eastern Siskiyou County Management Area is set forth in the map attached hereto as Exhibit A. Siskiyou County shall, upon recommendation by the Core Team, and subject to Article III.H.1., exercise its management authorities to develop and implement the Tule Lake Subbasin GSP within the Eastern Siskiyou County Management Area consistent with the goals and objectives of the Annual GSP Work Plan and Schedule and Annual GSP Budget recommended by the Core Team and adopted by the respective Governing Body of each member.

4. The "Tulelake Management Area" is hereby created. The Tulelake Management Area shall consist of and be coextensive with that portion of the Subbasin within the jurisdictional boundary of the City as of the Effective Date. The Tulelake Management Area is set forth in the map attached hereto as Exhibit A. The City shall, upon recommendation by the Core Team, and subject to Article III.H.1., exercise its management authorities to develop and implement the Tule Lake Subbasin GSP within the Tulelake Management Area consistent with the goals and objectives of the Annual GSP Work Plan and Schedule and Annual GSP Budget recommended by the Core Team and adopted by the respective Governing Body of each member.

B. <u>Establishment and Responsibilities of the Core Team</u>

1. The Parties hereby establish the Tule Lake Subbasin GSP Core Team. The Core Team will be responsible for establishing a process to direct and coordinate the Parties' actions and activities in developing and implementing the Tule Lake Subbasin GSP and taking action in furtherance of the purposes of this MOU. As further provided herein, the Core Team will direct and coordinate the development, financing, and implementation of the Tule Lake Subbasin GSP.

2. Core Team Membership. The Core Team shall be composed as follows:

TID member(s): 2
Siskiyou County member(s): 1
City member(s): 1
Modoc County member(s): 1

Each member of the Core Team shall serve at the pleasure of the appointing Party, and may be removed from the Core Team by the appointing Party at any time. An appointing Party must notify all other

Parties in writing if that appointing Party has replaced its member of the Core Team.

Each Party may appoint an alternate to the Core Team. Alternates shall be identified to the Parties at the same time as Core Team appointments, and any modifications to a Party's alternate as soon as practicable after such modification has been made. Alternates may vote on all matters before the Core Team in the absence of the appointed member. Each alternate shall be informed of the business of the Core Team and the actions to be taken when acting on behalf of a member.

Each member of the Core Team shall inform the Governing Body of his/her appointing Party of progress made and issues/concerns related to the development and implementation of the Tule Lake Subbasin GSP so that issues/concerns may be addressed timely and efficiently and not unreasonably delay the development and implementation of the Tule Lake Subbasin GSP.

3. Core Team Meeting Schedule. Within 30 days of the Effective Date, the Core Team shall hold its first meeting at place and time mutually agreed to by the Parties.

   The Core Team will establish a meeting schedule, with regular times and locations, to discuss activities, assignments, and progress in developing, financing, and implementing the Tule Lake Subbasin GSP. The Core Team shall meet at least quarterly, but may meet more frequently as the Core Team deems necessary.

   Members' attendance at Core Team meetings may be augmented to include staff members of the Parties and consultants to ensure the appropriate expertise is available to report on and assist the Core Team in developing, financing, and implementing the Tule Lake Subbasin GSP.

4. Core Team Committees. The Core Team may establish committees and subcommittees comprised of Core Team members and staff of the Parties as necessary to assist in any aspect of the development, financing and implementation of the Tule Lake Subbasin GSP or in furtherance of the purposes of this MOU.

5. Annual GSP Work Plan and Schedule. Within three (3) months of the Effective Date and every year thereafter, the Core Team shall recommend, by a majority vote of its members, an Annual GSP Work Plan and Schedule that lists the goals and objectives to be achieved by the Core Team within the 12 months following adoption of the Annual GSP Work Plan and Schedule for the development, financing, and

implementation of the Tule Lake Subbasin GSP. The Annual GSP Work Plan and Schedule shall include an estimated cost (or estimated cost range) and deadline for completing each goal and objective included in the Annual GSP Work Plan and Schedule.

The Annual GSP Work Plan and Schedule may be amended from time to time by a majority vote of the members of the Core Team to conform with new information and developments related to the Subbasin and the development, financing, and implementation of the Tule Lake Subbasin GSP.

For the Annual GSP Work Plan and Schedule, or any amendment thereto, to take effect, the Governing Body of each Core Team member must adopt it.

6. Annual GSP Budget. Within three (3) months of the Effective Date and every year thereafter, the Core Team shall recommend, by a majority vote of its members, an Annual GSP Budget.

The Annual GSP Budget shall include a list of goods and services, or categories of goods and services, necessary for and related to the development, financing, monitoring, and implementation of the Annual GSP Work Plan and Schedule and Tule Lake Subbasin GSP for the 12 months following the adoption of the Annual GSP Work Plan and Schedule and Annual GSP Budget.

For the Annual GSP Budget to take effect, the Governing Body of each Core Team member must adopt it.

Each Party shall pay for those expenses set forth and approved in the Annual GSP Budget in the proportions set forth below:

A. TID	84.0 %
B. Modoc County	7.5 %
C. City	1.0 %
D. Siskiyou County	7.5 %

7. Contracting and Expenditure of Funds.

TID, on behalf of all Parties, shall hire staff and consultants, as necessary, to develop and implement required components of the Tule Lake Subbasin GSP. TID shall execute contracts and expend funds only for goods and services necessary to achieve the goals and objectives included in an adopted Annual GSP Work Plan and Schedule. TID's expenditure of funds shall be consistent with, and shall not exceed, the amounts authorized by each Party in the Annual GSP Budget adopted consistent with Article III.B.6. The total amount of a contract may be greater than the total amount authorized by the Parties in an Annual GSP Budget; however, the Core Team shall not expend funds on any contract during a given year greater than the amount approved by the Parties in an Annual GSP Budget authorizing the Core Team to expend funds for the goods and services included in the contract.

C. Governance of the Core Team

1. Quorum. A majority of the Core Team with at least three of the GSA Parties represented shall constitute a quorum for the transaction of Core Team business. In the absence of a quorum, any meeting of the Core Team may be adjourned from time to time by a majority present, but no other business may be transacted.

2. Voting. Each member of the Core Team shall have one (1) vote. Except as otherwise specified in this MOU, all decisions shall be made by the affirmative vote of a majority of the members of the Core Team present.

3. Voting on Adoption of Tule Lake Subbasin GSP. The Tule Lake Subbasin GSP shall be presented to each Party's Governing Body only upon the affirmative vote of all members of the Core Team.

4. Voting on Annual GSP Work Plans and Schedules. Annual GSP Work Plans and Schedules shall be approved only upon the affirmative vote of all members of the Core Team and adoption by the Governing Body of each Core Team member.

5. Voting on Annual GSP Budgets. Annual GSP Budgets shall be approved only upon the affirmative vote of all members of the Core Team and adoption by the Governing Body of each Core Team member.

D. Development and Implementation of the Tule Lake Subbasin GSP

1. The development and implementation of the Tule Lake Subbasin GSP shall include the research, preparation, and long-term implementation of a GSP that provides for the sustainable management of the Subbasin and its groundwater resources and satisfies the requirements of the Act, as further provided in this Article III.D.

2. The Tule Lake Subbasin GSP shall include a description of the physical setting overlying the Subbasin and the aquifer system underlying the Subbasin; measureable objectives to implement sustainable groundwater management and operations consistent with the Subbasin's sustainable yield; a planning and implementation horizon; components related to the monitoring and management of groundwater levels and quality in the

Subbasin; a summary of monitoring measures and protocols designed to detect changes in the Subbasin's groundwater resources; and any other applicable measure or requirement provided in Water Code sections 10727.3 and 10727.4 necessary for the Tule Lake Subbasin GSP to satisfy the requirements of the Act.

3. The Tule Lake Subbasin GSP shall also include a detailed description and map of the Subbasin and the management areas assigned to each Party.

E. Approval of the Tule Lake Subbasin GSP

1. The Parties agree to exercise their best efforts to adhere to the Annual GSP Work Plan and Schedule prepared by the Core Team pursuant to Article III.B.5 so that the final Tule Lake Subbasin GSP may be approved by the Parties' governing bodies for subsequent submission to the Department for evaluation as provided for in the Act.

2.
    a. The Parties agree that following approval of the Tule Lake Subbasin GSP by the Core Team, the Governing Body of each member of the Core Team will consider adoption of the Tule Lake Subbasin GSP.

    b. Each Party's Governing Body will review the Tule Lake Subbasin GSP as approved by the Core Team and propose amendments, if desired. The Core Team will incorporate any amendments proposed by a Governing Body and prepare the final Tule Lake Subbasin GSP. Each Party's Governing Body will then review the final Tule Lake Subbasin GSP, at which time each Governing Body will consider adoption of the final Tule Lake Subbasin GSP. The Tule Lake Subbasin GSP shall be effective in each Management Area where the Governing Body for the Management Area has adopted the Tule Lake Subbasin GSP.

3. Each Party's Governing Body may reject the final Tule Lake Subbasin GSP. The Parties agree that any Party that rejects the Tule Lake Subbasin GSP shall withdraw from this MOU pursuant to Article IX, and the remaining Parties to this MOU will not implement the Tule Lake Subbasin GSP in the Management Area of any withdrawing Party.

4. Notwithstanding the foregoing, all Parties recognize and agree that the failure to adopt and submit a GSP or GSPs for the sustainable management of the entire Subbasin and its groundwater resources to the Department by January 31, 2022, may result in all or a portion of the Subbasin being designated a "probationary basin" by the State Water

Board pursuant to Water Code sections 10735-10736.6.

5. The Parties agree that they will use their good-faith efforts to resolve any disputes, issues, or concerns regarding the final Tule Lake Subbasin GSP held by the Governing Body of any Party in a timely manner so as to avoid the risk of intervention by the State Water Board pursuant to Water Code sections 10735-10736.6.

F. Roles and Responsibilities of the Parties

1. The Parties shall work jointly, cooperatively, and in good faith to develop the Tule Lake Subbasin GSP by January 31, 2022.

2. Each Party shall appoint a representative(s) to serve as a member(s) of the Core Team created in Article III.B.1. Each Party may also appoint an alternate to the Core Team. Each Party will be responsible for compensating the member(s) and alternate it appoints for his/her service on the Core Team.

G. Inter-Party Communication; Notice

1. Each Party agrees that the member it appoints to serve on the Core Team shall be the Party's primary point of contact on matters relating to the Tule Lake Subbasin GSP and the purposes of this MOU. The Parties may appoint additional representatives to serve as points of contact for specific actions and issues.

2. Each Party agrees that the person(s) they appoint to the Core Team shall not communicate with the Department or the State Water Board without the prior written approval of the Core Team. This is not intended to discourage informal communications between the Parties and the Department or the State Water Board.

H. Staffing

1. The Parties recognize that the TID Management Area, as described in Article III.A, represents the largest Management Area in the Subbasin and the Management Area. The Parties further recognize that TID employs staff with the technical expertise and experience relevant and applicable to the development, and implementation of the Tule Lake Subbasin GSP. Accordingly, the Parties agree that TID will, in most cases, provide the resources necessary to develop and implement the Tule Lake Subbasin GSP, and the Parties other than TID anticipate that they will provide any necessary further authorizations or delegations to TID at the time of approval of the GSP or otherwise. TID may staff these efforts directly or hire consultants. TID agrees to undertake these

efforts on behalf of all Parties throughout the TID Management Area, Western Modoc County Management Area, Eastern Siskiyou County Management Area and Tulelake Management Area. TID will endeavor to undertake efforts using resources that are used in the TID Management Area, but will request payment from the other Parties if, in order to accomplish such efforts on behalf of all Parties, it is necessary for TID to incur increments of increased cost including staff time, reasonable overhead, or consultant costs. To the extent TID requests payment for these services, the Parties will incorporate these expenses into the Annual GSP Budget, and each Party shall pay TID for its relative share of these costs in the proportion set forth in Article III.B.6.

2. Nothing in Article III.H.1 shall limit a Party from providing staff resources and other guidance on those matters for which it has specific expertise or experience so long as those resources and guidance do not unreasonably delay the development or implementation of the Tule Lake Sub basin GSP.

3. Notwithstanding Article III.H.1, each Party agrees to devote the staff resources necessary, as determined by the Core Team, to timely develop and implement the Tule Lake Subbasin GSP.

4. Nothing in this Article III.H shall eliminate or reduce any Party's obligation to carry out its responsibilities under any other article or provision of this MOU.

IV. <u>Incidental Costs and Cash Management</u>

A. Unless otherwise changed by a majority vote of the Core Team, each Party shall annually deposit (March 1) $200 with TID. TID shall serve as Treasurer to cover the costs of the Core Team including but not limited to, public outreach, meeting notices, and incidental meeting costs.

B. TID shall be the depository of and have custody of all funds paid by each Party from whatever source. TID shall also perform all duties required to be performed by an auditor. TID shall:

1. Receive and receipt all money paid by each Party and place it in the treasury of TID to the credit of each Party.
2. Be responsible for the safekeeping and disbursement of all funds held on behalf of each Party.
3. Pay, when due, all sums payable by the TID on behalf of the Parties.
4. Report in writing to the Core Team quarterly the amount of receipts since the last report and the amount paid out since the last report as well as fund balances; and

5. Invest funds according to the policies and procedures of the TID. Interest derived from deposited funds shall accrue to each Party in proportion to their respective share in the account.

V. Indemnification/Defense

A. Claims Arising from Acts or Omissions.

No Party, nor any officer or employee of a Party, shall be responsible for any damage or liability occurring by reason of anything done or omitted to be done by another Party under or in connection with this MOU. The Parties further agree, pursuant to California Government Code section 895.4, that each Party shall fully indemnify and hold harmless each other Party and its agents, officers, employees and contractors from and against all claims, damages, losses, judgements, liabilities, expenses, and other costs, including litigation costs and attorney fees, arising out of, resulting from, or in connection with any work delegated to or action taken or omitted to be taken by such Party under this MOU.

B. Joint Defense.

In cases where the Parties agree in writing to a joint defense, the Parties may appoint joint defense counsel to defend the claim, action, or proceeding arising out of the concurrent acts or omissions of Parties. Joint defense counsel shall be selected by mutual agreement of the Parties. The Parties agree to share the costs of such joint defense and any agreed settlement in equal amounts, except as provided in Article V. The Parties further agree that no Party may bind any other Party to a settlement agreement without the written consent of all Parties.

C. Reimbursement and/or Reallocation.

Where a trial verdict or arbitration award allocates or determines the comparative fault of the parties to the litigation or arbitration, the Parties may seek reimbursement and/or reallocation of defense costs, settlement payments, judgments and awards, consistent with such comparative fault.

VI. Litigation

In the event that any lawsuit is brought by a third party against any Party based upon or arising out of the terms of this MOU, the Parties shall cooperate in the defense of the action. Each Party shall bear its own legal costs associated with such litigation.

VII. Books and Records

Each Governing Body will be entitled to receive copies of documents, records, historical data, data compiled through consultants and any and all information related to groundwater within the Tule Lake Subbasin developed pursuant to this MOU; provided that nothing in this paragraph shall be construed to operate as a waiver of any right to assert any privilege that might apply to protect the disclosure to information or materials subject to the attorney-client privilege, attorney work product privilege, or other applicable privilege or exception to disclosure. TID will provide an annual financial report to each Governing Body.

VIII. Notice

All notices required by this MOU will be deemed to have been given when made in writing and delivered or mailed to the respective representative of the Parties at their respective addresses as follows:

For the County of Modoc:

Clerk of the Board
204 S. Court Street
Alturas, CA 96101

With a copy to:

Margaret Long
Prentice, Long & Epperson
1716 Court Street, Suite B
Redding, CA 96001

For the County of Siskiyou:

County Clerk
510 North Main St.
Yreka, CA 96097

With a copy to:

County Counsel
County of Siskiyou
P.O. Box 659
Yreka, CA 96097

For the City of Tulelake:

City Clerk
P.O. Box 847
Tulelake, CA 96134

With a copy to:

Megan Annand
Law Office of Megan B. Annand
6101 Griffin Lane
Medford, OR 97501

For Tulelake Irrigation District:	With a copy to:
Manager Tulelake Irrigation District P.O. Box 699 Tulelake, CA 96134	Somach Simmons & Dunn 500 Capitol Mall, Suite 1000 Sacramento, CA 95814

Any Party may change the address or facsimile number to which such communications are to be given by providing the other Parties with written notice of such change at least fifteen (15) calendar days prior to the Effective Date of the change.

All notices will be effective upon receipt and will be deemed received through delivery if personally served or served using facsimile machines, or on the fifth (5th) day following deposit in the mail if sent by first class mail.

IX. Withdrawal.

A Party may withdraw from this MOU subject to the following:

A. Any Party may withdraw from this MOU by delivery of written notice to withdraw to each remaining Party at least sixty (60) days prior to the date of withdrawal (Withdrawal Notice Period).

B. The withdrawal of a party shall have no effect on the continuance of this MOU among the remaining Parties. After providing written notice of withdrawal, the withdrawing Party shall neither be entitled nor obligated to participate in a vote on any matter before the Core Team.

C. Any Party that withdraws as provided herein shall remain financially liable for its proportionate share of any costs that are incurred consistent with the Annual GSP Work Plan and Schedule and Annual GSP Budget, or agreed to by the Parties, and accrued prior to the commencement of the Withdrawal Notice Period. Any deposits made by the withdrawing Party pursuant to Article IV.A shall not be returned to the withdrawing Party.

D. The withdrawing Party will remain obligated for a period of four years to contribute their proportionate share, including without limitation legal defense costs, for any liability that arises during the Party's participation in this MOU, but not presented as a claim against the remaining Parties until after the Party's withdrawal.

E. Upon withdrawal of any Party, the remaining Parties agree to meet and confer in good faith to revise the proportionate financial contribution of each Party set forth in Article III.B.6.

X. Miscellaneous

A. Term of Agreement.

This MOU shall remain in full force and effect until the date upon which all Parties have executed a document terminating the provisions of this MOU.

B. No Third-Party Beneficiaries.

This MOU is not intended and will not be construed to confer a benefit or create any right on any third party, or the power or right to bring an action to implement any of its terms.

C. Amendments.

This MOU may be amended only by written instrument duly signed and executed by all Parties.

D. Compliance with Law.

In performing their respective obligations under this MOU, the Parties shall comply with and conform to all applicable laws, rules, regulations and ordinances.

E. Construction of Agreement.

This MOU shall be construed and enforced in accordance with the laws of the United States and the State of California.

F. Jurisdiction and Venue.

Any suit, action, or proceeding challenging this MOU, or any provision or responsibility of any Party included herein, shall be brought and maintained to the extent allowed by law in the California Superior Court of the County of Modoc.

G. Waiver.

The waiver by any Party or any of its officers, agents or employees, or the failure of any party or its officers, agents or employees to take action with respect to any right conferred by, or any breach of any obligation or responsibility of this MOU, will not be deemed to be a waiver of such obligation or responsibility, or subsequent breach of the same, or of any terms, covenants, or conditions of this MOU, unless such waiver is expressly set forth in writing in a document signed and executed by the appropriate authority of the Parties.

H. Authorized Representatives.

The persons executing this MOU on behalf of the Parties affirmatively represent that each has the requisite legal authority to enter into this MOU on behalf of their respective Party and to bind their respective Party to the terms and conditions of this MOU. The persons executing this MOU on behalf of their respective Party understand that the Parties are relying on these representations when entering into this MOU.

I. Successors in Interest.

The terms of this MOU will be binding on all successors in interest of each Party.

J. Severability.

The provisions of this MOU are severable, and the adjudicated invalidity of any provision or portion of this MOU shall not in and of itself affect the validity of any other provision or portion of this MOU, and the remaining provisions of the MOU shall remain in full force and effect, except to the extent that the invalidity of the severed provisions would result in a failure of consideration or would materially adversely affect any Party's benefit of bargain. If a court of competent jurisdiction were to determine that a provision of this MOU is invalid or unenforceable and results in a failure of consideration or materially adversely affects any Party's benefit of the bargain, the Parties agree to promptly use good faith efforts to amend this MOU to reflect the original intent of the parties in the changed circumstances.

K. Entire Agreement.

1. This MOU constitutes the entire agreement between Modoc County, Siskiyou County, the City, and TID and supersedes all prior negotiations, representations, or other agreements, whether written or oral.

2. In the event of a dispute between the Parties as to the language of this MOU or the construction or meaning of any term hereof, this MOU will be deemed to have been drafted by the Parties in equal parts so that no presumptions or inferences concerning its terms or interpretation may be construed against any Party to this MOU.

IN WITNESS WHEREOF, the Parties hereto have set their hand.

COUNTY OF MODOC,
a political subdivision of
the State of California

By: Geri Byrne
Geri Byrne
Chair of the Board of Supervisors

Dated: AUG 0 8 2017

Attest: Tiffany Martinez
Tiffany Martinez
Deputy Clerk of the Board

COUNTY OF SISKIYOU,
a political subdivision of
the State of California

By:
Michael N. Kobseff
Chair of the Board of Supervisors

Dated: 8/8/17

See next page for
accounting info

Attest:
Colleen Setzer
Clerk

CITY OF TULELAKE,
a municipal corporation

Dated: Aug. 14, 2017

By:
Henry A. Ebinger
Mayor of the City Council

Attest:
Iva Rogers
Clerk

TULELAKE IRRIGATION DISTRICT,
an irrigation district formed under the California
Irrigation Law

By: John F. Crawford
John F. Crawford
President

Dated: 8/14/17

Attest:
Brad C. Kirby
Manager

Appendix C.
Communication and Engagement

Tulelake Subbasin

Communication and Engagement Plan for the Groundwater Sustainability Plan

May 2019

1.0 INTRODUCTION

1.1 SGMA OVERVIEW

The Sustainable Groundwater Management Act (SGMA) is a combination of three bills signed by California Governor Jerry Brown in 2014: Assembly Bill (AB) 1739, Senate Bill (SB) 1168, and SB 1319. SGMA provides local agencies with the framework to manage groundwater basins in a sustainable manner. The legislation recognizes that groundwater is most effectively managed at the local level, and local agencies will need to achieve groundwater sustainability by 2040.

In SGMA, sustainable groundwater management is defined as management of groundwater supplies in a manner that can be maintained in planning and implementation phases without causing undesirable results. Undesirable results include significant and unreasonable chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and interconnected surface waters.

1.2 DESCRIPTION OF TULELAKE SUBBASIN GROUNDWATER SUSTAINABILITY AGENCIES

Tulelake Irrigation District ("TID" or "District") was formed in 1952 to construct, maintain, and operate surface water irrigation supplies to the Tulelake Region. On September 10, 1956 the District entered into a contract with U.S. Bureau of Reclamation (Reclamation) for repayment of the construction charges and transfer of the District operation and maintenance of the facilities used to deliver water to the District lands. Since entering into the contract with Reclamation in 1956 the basins surface and groundwater supplies and have been carefully managed in cooperation with Reclamation.

In addition to TID, the City of Tulelake, Siskiyou County, and Modoc County are jointly participating in communication and engagement for the Tulelake Subbasin. Each entity has formed its own GSA and will be responsible for GSP implementation within their respective jurisdictions.

The Tulelake Subbasin agencies have been working proactively to manage the region's surface and groundwater supplies for decades. As a result of declining surface water supplies, in 2001 TID constructed 10 groundwater wells to provide supplemental water supplies during dry years. In addition to the wells operated by the district, privately owned irrigation and domestic wells are located throughout the district. For years, the district has employed the help of landowners with irrigation wells to institute a conjunctive use program to supplement surface water supplies to the basin in dry years.

SGMA requires the formation of a Groundwater Sustainability Agency (GSA) to manage local groundwater basins, which includes the development of a Groundwater Sustainability Plan (GSP) by 2022. Given its longstanding history as an effective surface and groundwater supplier, TID submitted to become the GSA for its service area in April 2017.

1.3 DESCRIPTION OF THE TULELAKE SUBBASIN GSAs

The TID GSA is one of four GSAs in the Tulelake Subbasin: TID GSA, Modoc County GSA, Siskiyou County GSA, and City of Tulelake GSA, as shown in Exhibit 1 below. The four GSAs are closely coordinating to prepare a single GSP for the Tulelake Subbasin. TID was authorized by the Tulelake Subbasin GSAs to submit the GSP Initial Notification to the Department of Water Resources (DWR). The Initial Notification was filed in June 2018.

1.4 DECISION MAKING PROCESS

In the Tulelake Subbasin, the four GSAs will work together to develop the GSP. Throughout development and implementation of the GSP, the four GSAs will solicit feedback from stakeholders and interested parties, particularly at key decision points. The TID GSA has authority to make decisions on GSP-related implementation actions identified during GSP development within its management area. Similarly, the other GSAs retain the authority to make decisions on GSP-related implementation actions within their respective management areas. Stakeholders and interested parties that specifically request to be engaged within each management area will be notified prior to public meetings involving decisions regarding the GSA or GSP.

1.5 COMMUNICATION AND ENGAGEMENT PLAN

As required by SGMA, GSAs must consider the interests of all beneficial uses and users of groundwater and include them in the GSP development process. The TID Communication & Engagement Plan (Plan) is intended to provide a high-level overview of how stakeholders within the coverage area will be engaged through outreach, education, and opportunities for input during the development and implementation of the GSP.

2.0 GOALS AND DESIRED OUTCOMES

2.1 GOALS OF GSP DEVELOPMENT

The goal of TID is to establish and execute a GSP that will sustain and manage groundwater within the Tulelake Subbasin in a way that is cost-effective, avoids undesirable results, and is beneficial, with minimal negative impacts, to the beneficial uses and users.

2.2 COMMUNICATION OBJECTIVES

The objectives of this Plan are to provide stakeholders and interested parties clear, consistent, and unified information and opportunities to engage and provide input throughout the GSP process.

2.3 COMMUNICATION AND PUBLIC PARTICIPATION GOALS

The specific communication and public participation goals are to:

- Provide the public with comprehensive, clear, balanced, and objective information to assist in understanding the effort and associated alternatives, opportunities, and/or solutions.
- Utilize effective communication methods and tools.
- Provide information in sufficient frequency so that stakeholders feel adequately engaged and informed of material in a timely manner.
- Obtain positive media coverage.
- Solicit public feedback throughout development and implementation of the GSP, particularly at key decision points.
- Ensure public concerns and interests are understood and considered.
- Provide methods for the public to be involved in the GSP development and implementation stages.

- Document and provide access to information, presentations, and comments received to provide clarity regarding the decision-making process.
- Coordinate any necessary communication activities in line with the Tulelake Subbasin.

2.4 OVERRIDING CONCERNS AND CHALLENGES

Through preliminary discussions and stakeholder engagement efforts, one major concern identified is the potential impact to the environmental, recreational, and agricultural beneficiaries of available water in the TSb.

3.0 STAKEHOLDER IDENTIFICATION

3.1 PRIMARY STAKEHOLDERS

Primary stakeholder groups are the GSA members, the local land use and water authorities that will be making decisions about groundwater management and whose participation is mandatory for the GSP process to occur.

3.2 SECONDARY STAKEHOLDERS

Secondary stakeholder groups are those that have been identified in SGMA, Section 10723.2, "Consideration of All Beneficial Uses and Users of Groundwater". These will include organizations, agencies, or individuals that have an interest in groundwater, such as the agriculture community, well owners, military, tribes, state and federal agencies, and environmental groups and agencies. Although the law clearly states that these interests are to be considered, the extent of engagement with the stakeholders is left to the GSAs to determine. TID will maintain and periodically review the list of secondary stakeholders specific to its management area to ensure that other interested persons or groups are identified and added to the list as needed. Each GSA in the Tulelake Subbasin will also maintain a list specific to its stakeholders and regularly share the list with the other Tulelake Subbasin GSAs.

3.3 INTERESTED PERSONS LIST

Establishment and ongoing maintenance of an interested party database is required by SGMA during GSA formation and GSP development and implementation. Chaptered in Water Code §10723.4, this section states that any person may request, in writing, to be placed on a list to receive notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents. To comply with this section, forms available at the TID office provide a means for the public to request and receive notifications related to GSP development.

4.0 VENUES FOR ENGAGING

To effectively inform, educate, and engage audiences regarding milestones, meeting dates and times, and other pertinent information about the development of the GSP, the GSAs will conduct the following activities to notify the public of engagement opportunities.

4.1 NOTIFICATIONS

TID, the City of Tulelake, Modoc, and Siskiyou Counties will use a multi-layered approach to effectively inform interested parties of upcoming opportunities to engage in the GSP. The four GSAs formed a Core

Team with representatives from each GSA to meet quarterly in order to coordinate GSP related activities. The multi-layered approach to inform interested parties includes:

- **Email blast** using an established interested party email list. Maintain a list of interested stakeholder email database updated frequently based on interest and sign-ups of submitted forms, at TID board meetings, at Core Team meetings and other venues.
- **Website postings** with agendas, meeting minutes, and presentations.
- **Newspaper media** including calendar notices for publication.

4.2 ENGAGEMENT METHODS

The GSAs will use a variety of methods and venues to engage stakeholders throughout GSP development and implementation.

- **Quarterly public meetings of the Core Team:** Conduct public GSA meetings, as needed, to encourage input on items associated with the development of the Groundwater Sustainability Plan and to garner general feedback for consideration. Each meeting will include a set agenda with opportunities to comment on agenda items as well as a public comment period for items not agendized.

5.0 IMPLEMENTATION TIMELINE

SGMA statute and regulations define key phases in which stakeholder engagement is required. The timelines for implementing this Plan are broken down by task; however, this timeline is tentative and subject to change with the progression of GSP development, public review, and implementation phases.

5.1 TASK 1: PROJECT MANAGEMENT AND ADMINISTRATION – 2017

Prior to filing of the Initial Notification, the Core Team held meetings to update interested parties on the SGMA process.

5.2 TASK 2: PUBLIC NOTICE AND COMMUNICATION – 2017 THROUGH 2021

SGMA requires and/or encourages stakeholder input during specific activities in this phase (listed below).

- GSP Initial Notification: TID filed the required Initial Notification to the DWR in April 2017. The GSAs will inform the public via:
    - Public Meetings: The Core Team used it public meetings to update interested parties, informing them of the key information from the Initial Notification such as the process for developing the GSP and how interested parties can be involved.
    - Notifications: The public received a notification containing the same information via the Notification methods described above.
- GSP Preparation: The Tulelake Subbasin GSAs will encourage active involvement through the methods described above, and beneficial uses and users will be considered as the GSP is developed and public input will be considered. Stakeholders and interested parties will be notified during development of key sections including, but not limited to, Administrative Information, Basin Setting, Management Criteria, Monitoring Networks, and Projects/Management Action.

- GSP Public Notice and Adoption: SGMA Section 10728.4 requires 90-day public notice prior to adoption of a GSP. The GSAs will work together to fulfill this noticing requirement. Noticing will occur using the paper of record that comprises each GSA service area.
- GSP Submittal: SGMA regulations Section 354.10 requires a summary of communications including description of beneficial users, list of public meetings, and comments/responses received will be provided as part of the GSP submittal. The TID GSA will maintain an administrative record of all communication actions and will use that for submission purposes.

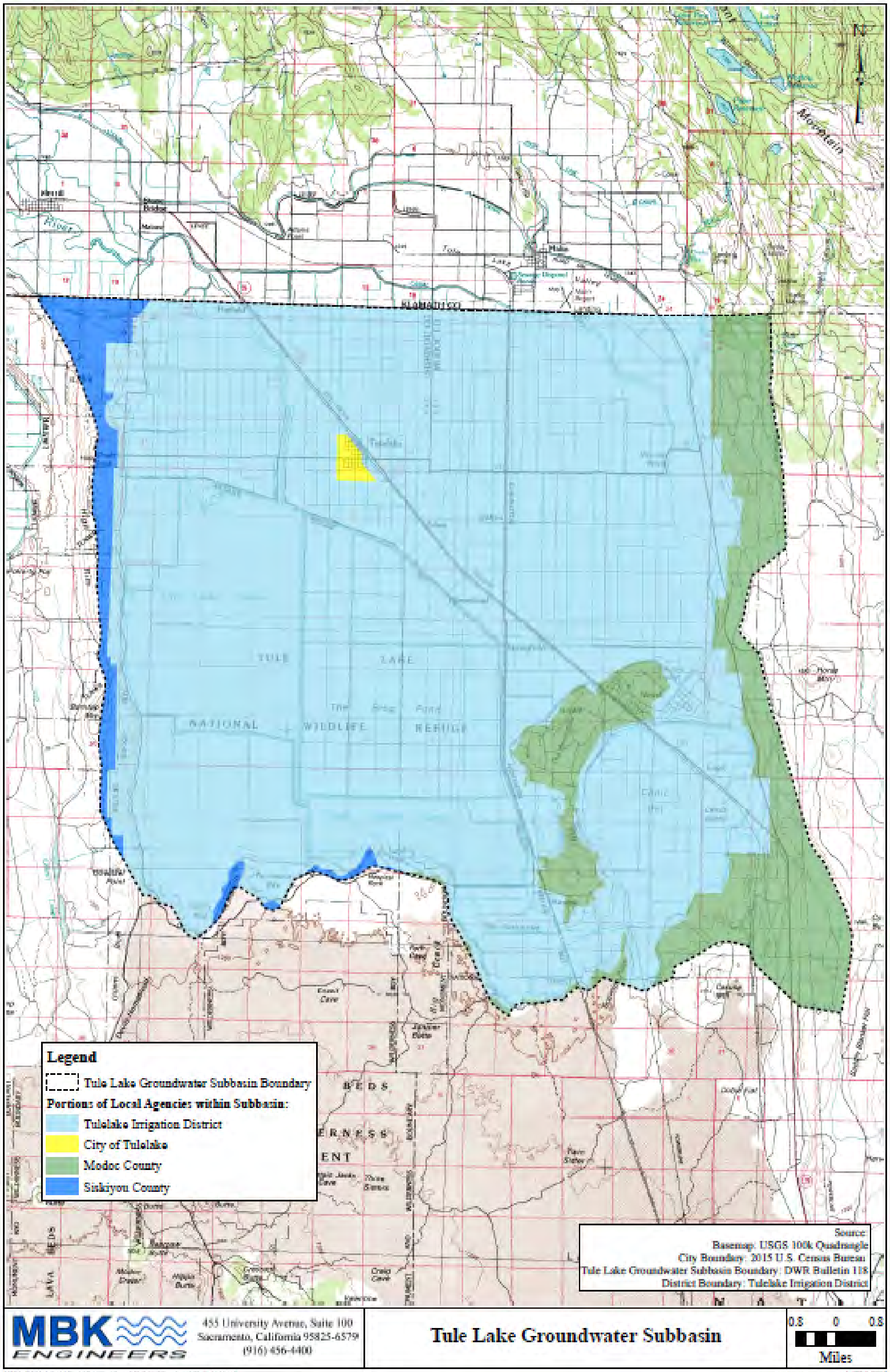
5.3 FUTURE PHASES

As mentioned, this Plan identifies the communication and engagement efforts planned for Phase II of GSP implementation, GSP Preparation and Submission (2018-2022). The Plan will be updated as part of phases 3 (GSP Review and Evaluation) and 4 (Implementation and Reporting) of the SGMA GSP process.

###

EXHIBITS

EXHIBIT 1



Tule Lake Groundwater Subbasin

Source:
Basemap: USGS 100k Quadrangle
City Boundary: 2015 U.S. Census Bureau
Tule Lake Groundwater Subbasin Boundary: DWR Bulletin 118
District Boundary: Tulelake Irrigation District

List of Public Tulelake Subbasin GSA Meetings and other SGMA Related Meetings Held to Date

Meeting Type	**Date**	**Location**	**Key Topics**
TID Board Meeting	01/10/2017	Tulelake District Office	Update on SGMA
Westside Improvement District Meeting	01/10/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	02/14/2017	Tulelake District Office	Update on SGMA
Tulelake Irrigation District Public SGMA Meeting	3/30/2017	Tulelake Voluntary Fire Department Hall	Introduction to SGMA
Tulelake Irrigation District Public SGMA Meeting	3/30/2017	Macy's Flying Service	Introduction to SGMA
TID Board Meeting	04/11/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	05/08/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	06/12/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	07/10/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	08/14/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	09/11/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	11/14/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	12/11/2017	Tulelake District Office	Update on SGMA
TID Board Meeting	01/09/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	02/13/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	03/13/2018	Tulelake District Office	Update on SGMA
Westside Improvement District Meeting	03/13/2018	Tulelake District Office	Update on SGMA
GSA Meeting	4/18/2018	Tulelake City Hall	Update on DWR Grant Agreement; Discussion of Advisory Committee
TID Board Meeting	05/15/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	06/11/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	07/09/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	08/13/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	09/10/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	10/09/2018	Tulelake District Office	Update on SGMA
GSA Meeting	10/17/2018	Tulelake City Hall	
TID Board Meeting	11/15/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	12/20/2018	Tulelake District Office	Update on SGMA
TID Board Meeting	01/15/2019	Tulelake District Office	Update on SGMA
GSA Meeting	02/06/2019	Tulelake City Hall	Update on DWR Grant Agreement; Discussion of Advisory Committee
Westside Improvement District Meeting	02/12/2019	Tulelake District Office	Update on SGMA

TID Board Meeting	02/12/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	03/12/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	04/09/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	05/13/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	06/10/2019	Tulelake District Office	Update on SGMA
GSA Meeting	06/12/2019	Tulelake City Hall	Update on DWR Grant Agreement; Discussion of Advisory Committee
TID Board Meeting	07/08/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	08/12/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	09/09/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	10/15/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	11/12/2019	Tulelake District Office	Update on SGMA
TID Board Meeting	12/10/2019	Tulelake District Office	Update on SGMA
GSA Meeting	01/08/2020	Tulelake City Hall	Update on DWR Grant Agreement; Discussion of Advisory Committee; Discussion of Chapters 1-3 (Introduction, Plan Area, and Basin Setting)
Westside Improvement District Meeting	01/14/2020	Tulelake District Office	Update on SGMA
TID Board Meeting	01/14/2020	Tulelake District Office	Update on SGMA
GSA Meeting	02/05/2020	Tulelake City Hall	Update on DWR Grant Agreement; Discussion of Advisory Committee; Discussion of Chapters 1-3 (Introduction, Plan Area, and Basin Setting)
TID Board Meeting	03/10/2020	Tulelake District Office	Update on SGMA
GSA Meeting	03/18/2020	Tulelake City Hall	Update on DWR Grant Agreement; Discussion of Advisory Committee; Discussion of Chapters 1-3 (Introduction, Plan Area, and Basin Setting)
TID Board Meeting	04/14/2020	Teleconference & Tulelake District Office	Update on SGMA
GSA Meeting	05/28/2020	Remote (Zoom)	Update on DWR Grant Agreement; Discussion of Advisory Committee; Discussion of Chapters 1-3 (Introduction, Plan Area, and Basin Setting)
TID Board Meeting	06/08/2020	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	06/16/2020	Remote (Zoom)	Discussion of Advisory Committee; Discussion of Chapters 1-3 (Introduction, Plan Area, and Basin Setting)

TID Board Meeting	07/13/2020	Remote (Zoom) & Tulelake District Office	Update on SGMA
TID Board Meeting	08/10/2020	Remote (Zoom) & Tulelake District Office	Update on SGMA
TID Board Meeting	09/14/2020	Remote (Zoom) & Tulelake District Office	Update on SGMA
TID Board Meeting	10/13/2020	Remote (Zoom) & Tulelake District Office	Update on SGMA (Labeled 10/08 on TID Agenda list)
GSA Meeting	10/29/2020	Remote (Zoom)	Discussion of Advisory Committee; Discussion of GSP and model efforts
TID Board Meeting	11/10/2020	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	11/18/2020	Remote (Zoom)	Discussion of Advisory Committee; Overview of GSP preparation schedule
Ad Hoc Committee Meeting	12/01/2020	Remote (Zoom)	Discussion of Advisory Committee;
TID Board Meeting	12/15/2020	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	12/16/2020	Remote (Zoom)	Discussion of Advisory Committee; Overview of GSP preparation schedule
TID Board Meeting	01/12/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
Westside Improvement District Meeting	01/12/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	01/20/2021	Remote (Zoom)	Introduce Chapters 1-4 (Introduction, Plan Area, Basin Setting, and Groundwater Conditions); Overview of GSP preparation schedule
TID Board Meeting	02/09/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	02/17/2021	Remote (Zoom)	Review of Revised Chapters 1-4 (Introduction, Plan Area, Basin Setting, and Groundwater Conditions); Discussion of Chapters 5 & 6
TID Board Meeting	03/09/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	03/19/2021	Remote (Zoom)	Discussion of Chapters 5 & 6
TID Board Meeting	04/12/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	04/21/2021	Remote (Zoom)	Introduce Chapters 5 & 6
TID Board Meeting	05/10/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA

GSA Meeting	05/19/2021	Remote (Zoom)	Set aside Chapters 5 & 6; Discussion of Sustainable Management Criteria, Projects & Management Actions
TID Board Meeting	06/14/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	06/16/2021	Remote (Zoom) & Tulelake City Hall	Ad Hoc Committee Meeting Report; Overview of GSP preparation schedule
TID Board Meeting	07/12/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
Siskiyou County Board of Supervisors	07/13/2021	Remote (Zoom) & Siskiyou Board of Supervisors Room	Overview of GSP development
GSA Meeting	07/21/2021	Remote (Zoom) & Tulelake City Hall	Introduce Chapters 7 (Sustainable Management Criteria) & 8 (Projects & Management Actions)
Modoc County Board of Supervisors	07/27/2021	Remote (Zoom) & Modoc Board of Supervisors Room	Overview of GSP development
City of Tulelake Board of Directors	08/03/2021	Tulelake City Hall	Overview of GSP development
TID Board Meeting	08/09/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	08/18/2021	Remote (Zoom) & Tulelake City Hall	Introduce Revised Chapters 7 (Sustainable Management Criteria) & 8 (Projects & Management Actions)
TID Board Meeting	09/13/2021	Remote (Zoom) & Tulelake District Office	Update on SGMA
GSA Meeting	09/21/2021	Remote (Zoom) & Tulelake City Hall	Introduce Public Draft GSP
TID Board Meeting	10/12/2021	Remote (Zoom) & Tulelake District Office	Overview of Public Draft GSP
City of Tulelake Board of Directors	10/19/2021	Tulelake City Hall	Overview of Public Draft GSP
Modoc County Board of Supervisors	10/25/2021	Remote (Zoom) & Modoc Board of Supervisors Room	Overview of Public Draft GSP
Siskiyou County Board of Supervisors	11/02/2021	Remote (Zoom) & Modoc Board of Supervisors Room	Overview of Public Draft GSP
GSA Meeting	11/17/2021	Remote (Zoom) & Tulelake City Hall	Review comments received to Public Draft GSP
GSA Meeting	12/08/2021	Remote (Zoom) & Tulelake City Hall	Approve Final GSP

Siskiyou County Board of Supervisors	12/14/2021	Remote (Zoom) & Modoc Board of Supervisors Room	Overview and Adoption of the GSP
Modoc County Board of Supervisors	12/14/2021	Remote (Zoom) & Modoc Board of Supervisors Room	Overview and Adoption of the GSP
City of Tulelake Board of Directors	12/21/2021	Tulelake City Hall	Overview and Adoption of the GSP
Tulelake Irrigation District	12/14/2021	Remote (Zoom) & Tulelake District Office	Overview and Adoption of the GSP

List of Tulelake Subbasin Core Team Advisory Members

1. Environmental Conservation Water User – Mike Byrne
2. Residential Domestic Water User – Matt Huffman
3. Agricultural Groundwater/Surface Water user – David King
4. Oregon Groundwater/Surface Water User – Ken Masten

First Name	Last Name	Organization
Greg	Austin	Department of Fish and Wildlife Service
DFW Groundwater		Department of Fish and Wildlife Service
Jennie	Land	Bureau of Reclamation
Mike	Neuman	Bureau of Reclamation
Rick	Carlson	Bureau of Reclamation
Michelle	Dooley	Cal Department of Water Resources
Bill	Ehorn	Cal Department of Water Resources
Kari	Northcutt	City of Merrill
Tiffany	Martinez	County of MODOC (Administration Department)
Gary	Fensler	County of MODOC (Agricultral Department)
Janae	Scruggs	Department of Fish and Wildlife
Gene	Lewis	DWR
Patricia	Vellines	DWR
Rhonda	Hemphill	Hemphill Ranch
Sean	Culkin	Integral Consulting Inc.
Susan	Fricke	Karuk Tribe
Sandra	Cox	Klamath County
Kenneth	Masten	Klamath SWCD
Angela	Bezzone	MBK Engineers
Kyle	Knutson	MBK Engineers
Donald	Flickinger	National Oceanic and Atmospheric Administration (NOAA)
Chris	Watt	North Coast Regional Water Quality Control Board
David	King	Oregon Hay and Forage Association
Dani	Watson	Oregon Water Resources Department
Ivan	Gall	Oregon Water Resources Department
Justin	Iverson	Oregon Water Resources Department
Michael	Thoma	Oregon Water Resources Department
Scott	Seus	Seus Family Farms
Matt	Parker	Siskiyou County
Brad	Kirby	Tulelake Irrigation District (TID)
Gary	Wright	Tulelake Irrigation District (TID)
Kraig	Beasly	Tulelake Irrigation District (TID)
Jacqui	Krizo	
Marcia	Walker	
Michael	Byrne	
Rob	Wilson	University of California Agriculture and Natural Resources
Allison	West	USDA
Henry	Ebinger	City of Tulelake
Matt	Huffman	
TNC Groundwater		The Nature Conservancy
Felice	Pace	

Tulelake Irrigation District (TID) in coordination with Siskiyou and Modoc Counties and the City of Tulelake will consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans. These interests include, but are not limited to, all of the following:

a) **Holders of overlying groundwater rights, including:**

   1) **Agricultural Users** – TID will work with landowners, irrigation well owners and agricultural water users within the Tule Lake Subbasin. TID will consider their interests and conduct outreach via direct notifications and public meetings in development of a GSP and governing a GSA.

   2) **Domestic Well Owners –** TID will engage domestic well owners through direct notifications and public meetings in development of a GSP and governing a GSA.

b) **Municipal Well Operators –** The City of Tulelake and the Newell County Water District.

c) **Public Water Systems –** The City of Tulelake and the Newell County Water District.

d) **Local Land Use Planning Agencies –** Siskiyou and Modoc Counties and the City of Tulelake.

e) **Environmental Users of Groundwater –** TID will work with any agencies proposing environmental uses of the groundwater within the Tule Lake Subbasin.

f) **Surface Water Users –** Tulelake Irrigation District and patrons, Fish and Wildlife Service and Bureau of Reclamation.

g) **Federal Government –** TID will work with the appropriate federal government agencies in development of a GSP and governing a GSA.

h) **California Native American Tribes –** There are no known California Native American Tribes within the boundaries of the boundaries of the Tule Lake Subbasin that utilize groundwater. TID will work with Siskiyou and Modoc Counties and the City of Tulelake to address tribal interest if or where appropriate.

i) **Disadvantaged Communities –** TID will work with agencies within the Tule Lake Subbasin to collaborate with and consider the disadvantaged communities in the subbasin during development of a GSP and governing a GSA.

j) **Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency –** Tulelake Irrigation District and California Department of Water Resources.

Responses to Public Comments

Comment #	Date Received	Commenter	Commenter Organization	GSP Section	Response
1	6/2021	Doreen Smith			No action required. The items noted in the comment letter were considered during development of the GSP.
2	6/16/2021	Doreen Smith			No action required. Tulelake Irrigation District noted the comment.
3(a)	6/16/2021	Doreen Smith			Table 1-1 has been removed from that section of the GSP and a completed version has been added as Appendix D of the GSP. MOU is attached as Appendix B of the GSP.
3(b)	6/16/2021	Doreen Smith			Comment noted; however, no action required.
3(c)	6/16/2021	Doreen Smith			City of Merrill and Malin are within Oregon. Therefore, no action required.
4	7/18/2021	Felice Pace		Section 5 Sustainable Management Criteria	The discussion referenced in the comment has been changed to section 5.3.1.2 and Table 5.1. As noted in this section and Appendix M of the GSP, the Minimum Thresholds and Measurable Objectives have been set to be protective of domestic wells. As discussed in Section 6.1.1, the GSAs have identified "Well Inventory" as a project during implementation of the GSP. See Section 6.1.1 for additional information on this project.
5.1	9/21/2021	Felice Pace		-	The GSAs relied upon historical groundwater level data during the development of this GSP, which did show groundwater level declines over the historical record. However, as stated in the SGMA Regulations and in Section 4.1.1 of the Tule Lake Subbasin GSP, GSAs are not required to address undesirable results that occured before and have not been corrected by January 1, 2015.
5.2	9/21/2021	Felice Pace		-	No action required. The GSAs have not identified using Klamath River water for recharge purposes.
6	11/9/2021	Jim Cook	Newell County Water District	-	Comment noted; however, no action required.
7	11/9/2021	Jim Cook	Newell County Water District	Section 6 Projects and Management Actions to Maintain Sustainability	Comment noted and the GSAs plan to coordinate with Mr. Cook and the Newell County Services District in regard to the items discussed in the comment letter.
8.1	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	-	As identified in Section 2.2.2.8 of the GSP, the Tule Lake Sumps are operated pursuant to the Biological Opinion and impacted by Reclamation's operation of the Klamath Project. Therefore, operation of the Sumps and protection of beneficial users of the Sumps is outside the jurisdiction of this GSP.
8.2(a)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.8 Identification of Interconnected Surface Waters	Sections 3.3.1.6 and 6.1.2 of the GSP identifies a lack of multi-completion wells within the Subbasin. Installation of these wells, pending funding, will provide a better understanding of the interaction between groundwater and surface water. Sections 3.3.1.6 and 6.1.2 of the GSP have been updated. Section 5.2.4.3 has also been updated in regard to this topic.
8.2(b)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.8 Identification of Interconnected Surface Waters	Section 2.2.2.8 identified that there are no known interconnected surface waters within the Subbasin that are not regulated by other entities (e.g. Reclamation's regulation of the Sumps). However, per Section 6.1.2 of the GSP, the GSAs intend to pursue assistance to improve the existing monitoring network, which will provide a better understanding of the Subbasin. Section 5.2.4.3 has also been updated in regard to this topic.
8.2(c)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.8 Identification of Interconnected Surface Waters	Per Section 6.1.2 of the GSP, the GSAs intend to pursue assistance to improve the existing monitoring network, which will provide a better understanding of the Subbasin. Section 6.1.2 of the GSP has been updated.
8.3(a)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.9 Identification of Groundwater-Dependent Ecosystems	Section 6.1.4 of the GSP has been updated.
8.3(b)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.9 Identification of Groundwater-Dependent Ecosystems	Section 6.1.4 of the GSP has been updated.
8.3(c)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.9 Identification of Groundwater-Dependent Ecosystems	Section 6.1.4 of the GSP has been updated. In addition, Appendix H has been updated, which includes zoomed in versions of Figures 2-36 and 2-37.

8.3(d)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.9 Identification of Groundwater-Dependent Ecosystems	Section 6.1.4 of the GSP has been updated. In addition, Appendix H has been updated, which includes zoomed in versions of Figures 2-36 and 2-37.
8.3(e)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.9 Identification of Groundwater-Dependent Ecosystems	Section 6.1.4 of the GSP has been updated. In addition, Appendix H has been updated, which includes zoomed in versions of Figures 2-36 and 2-37.
8.3(f)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.2.9 Identification of Groundwater-Dependent Ecosystems	Section 6.1.4 of the GSP has been updated.
8.4(a)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.1 Hydrogeologic Conceptual Model	The HCM described in Section 2.2.1 of the GSP, was developed based on information from DWR and USGS. Section 2.2. and 2.2.1.4 describe the two aquifers, the alluvial aquifer system and the volcanic system aquifer; however, the alluvial aquifer is considered to be the primary aquifer. Figure 2-19 through Figure 2-27 include hydrographs for a select number of wells within the Subbasin. A criteria of 500 foot depth was applied to these wells to separate them into relatively shallow and deep groundwater wells. The GSAs have identified projects in Section 6.1.1 and 6.1.5 of the GSP, which will improve understanding of the Subbasin
8.4(b)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.1 Hydrogeologic Conceptual Model	The HCM described in Section 2.2.1 of the GSP, was developed based on information from DWR and USGS. Section 2.2.1.2 and 2.2.1.4 describe the two aquifers, the alluvial aquifer system and the volcanic system aquifer; however, the alluvial aquifer is considered to be the primary aquifer. Figure 2-19 through Figure 2-27 include hydrographs for a select number of wells within the Subbasin. A criteria of 500 foot depth was applied to these wells to separate them into relatively shallow and deep groundwater wells. The GSAs have identified projects in Section 6.1.1 and 6.1.5 of the GSP, which will improve understanding of the Subbasin.
8.4(c)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.1 Hydrogeologic Conceptual Model	Section 2.2.2.8 identified that there are no known interconnected surface waters within the Subbasin that are not regulated by other entities (e.g. Reclamation's regulation of the Sumps). However, per Section 6.1.2 of the GSP, the GSAs intend to pursue assistance to improve the existing monitoring network, which will provide a better understanding of the Subbasin. Section 3.3.1.6 has been updated.
8.4(d)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 2.2.1 Hydrogeologic Conceptual Model	Comment noted. No action required.
8.5(a)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 5 Sustainable Management Criteria	As identified in the GSP, the Subbasin is currently and projected to be sustainably managed. Therefore, MTs for groundwater levels were developed based on considerations for historical uses and users of water as well as historical groundwater levels.
8.5(b)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 5 Sustainable Management Criteria	As identified in the GSP, the Subbasin is currently and projected to be sustainably managed. Therefore, MTs for groundwater levels were developed based on considerations for historical uses and users of water as well as historical groundwater levels.
8.6(a)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 4 Water Budget	Appendix K identifies data sources for the numerical model, which was used to produce the water budgets. Best available current information will be utilized for future updates to the G
8.6(b)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 4 Water Budget	It is the GSAs understanding that not all of the acres within the Tule Lake National Wildlife Refuge are wetlands, which could be the primary reason for the difference in acres. See Figure 2-2. Section 2.1.1.3 has been updated.
8.7	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 6 Projects and Management Actions to Maintain Sustainability	Section 6.1.2 of the GSP identifies a lack of multi-completion wells within the Subbasin. Installation of these wells, pending assistance and funding from DWR, will provide a better understanding of shallow groundwater.
8.8	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 6 Projects and Management Actions to Maintain Sustainability	Section 6.1.4 has been updated with additional efforts. Section 6.1.7 has been finalized as drafted; however, as identified in that section it will be updated on a case-by-case basis as appropriate.
8.9(a)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 6 Projects and Management Actions to Maintain Sustainability	Sections 6.1.2 and 6.1.4 have been updated.
8.9(b)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	Section 6 Projects and Management Actions to Maintain Sustainability	Section 6.1.7 provides the framework for the GSAs to work with on an as needed and case-by-case basis.
8.9(c)	11/9/2021	Department of Fish and Wildlife	Department of Fish and Wildlife	-	As identified in Section 2.2.2.8 of the GSP, the Tule Lake Sumps are operated pursuant to the Biological Opinion and impacted by Reclamation's operation of the Klamath Project. Therefore, operation of the Sumps and protection of beneficial users of the Sumps is outside the jurisdiction of this GSP.

9.1(a)	11/12/2021	NGO Consortium	NGO Consortium	-	**Disadvantaged Communities and Drinking Water Uses:** Section 2.1.1.5 identifies that these communities rely upon groundwater and the section has been updated with additional information, and Figure 2-5 has been added to the GSP. Figures 2-10 and M-1 provide additional information about domestic wells within the Subbasin. **Interconnected Surface Waters:** Section 2.2.2.8 identified that there are no known interconnected surface waters within the Subbasin that are not regulated by other entities (e.g. Reclamation's regulation of the Sumps). However, per Section 6.1.2 of the GSP, the GSAs intend to pursue assistance to improve the existing monitoring network, which will provide a better understanding of the Subbasin. Also, see Section 5.2.4.3 for additional information about how the model will be utilized to better understand surface water interaction. Groundwater elevation data and well construction information was obtained from DWR's Water Data Library. **Groundwater Dependent Ecosystems:** Section 6.1.4 has been updated. **Native Vegetation and Managed Wetlands** the Sumps are the primary area with native vegetation and are a managed wetland within the Subbasin and were included in Section 4. Water budgets derived from the GSA Model account for the evapotranspiration of precipitation and shallow groundwater from native and riparian vegetation within the Tulelake Subbasin through the Farm Process Package. Evapotranspiration volumes associated with these land use categories are lumped into the respective water budget terms presented in the water budget sections of the GSP and associated modeling appendix. Additional discussion has been added to Section 3.3.4.1 of the modeling appendix (Appendix K) to highlight the inclusion of native and riparian vegetation as specific land use categories simulated in the GSA Model.
9.1(b)	11/12/2021	NGO Consortium	NGO Consortium	Appendix C	Appendix C identifies the extensive amount of public meetings that were held throughout the GSP development process, list of interested persons that signed up to stay informed, and the advisory members. Public outreach will continue throughout implementation of the GSP.
9.1(c)	11/12/2021	NGO Consortium	NGO Consortium	-	**Disadvantaged Communities and Drinking Water Uses:** As shown in Figure 2-5 all areas within the Subbasin are either DAC or SDAC; therefore, the entire GSP is based on this consideration. **Groundwater Dependent Ecosystems and Interconnected Surface Waters:** Section 2.2.2.8 identified that there are no known interconnected surface waters within the Subbasin that are not regulated by other entities (e.g. Reclamation's regulation of the Sumps). However, per Section 6.1.2 of the GSP, GSAs intend to pursue assistance to improve the existing monitoring network, which will provide a better understanding of the Subbasin. As identified in the GSP, the Subbasin is currently and projected to be sustainably managed. Therefore, MT groundwater levels were developed based on considerations for historical uses and users of water as well as historical groundwater levels.
9.2	11/12/2021	NGO Consortium	NGO Consortium		**Climate Change:** As noted in the comment the GSP included a projected water budget with climate change based on information from DWR. In addition, a projected water budget without climate change was prepared, which is not required by the SGMA Regulations. As identified in Appendix K Section 5.1.2, projected surface water availability with climate change considered was based on information from Reclamation, which is considered to be the best information available.
9.3	11/12/2021	NGO Consortium	NGO Consortium		**Data Gaps** were identified throughout the GSP and projects and management actions (for example, Section 6.1.1 through 6.1.4) were developed based on them. Future updates to this plan will incorporate new information.
9.4	11/12/2021	NGO Consortium	NGO Consortium	Section 6 Projects and Management Actions to Maintain Sustainability	**Addressing Beneficial Users in Projects and Management Actions:** As identified in the Plan, the Subbasin is currently being sustainably managed. Therefore, no projects or management actions are required to achieve sustainability; however, the Plan identified projects and management actions to improve understanding of the Subbasin. Improved understanding of the Subbasin will be beneficial for all beneficial users. As shown in Figure 2-5 all areas within the Subbasin are either DAC or SDAC; therefore, the entire GSP is based on this consideration.

Comment #1

FROM: DOREEN SMITH

Elevation of Each well
Well capacity / holding level
how far down — pumps — get to water
How much water is used each well
→ — use —
How many acres —
10 well District — all monitoring
DWR → quality → table —
5 — Tulelake · City — !
2 — pvt. Wells Copic Bay — ~~[illegible]~~ What they test —
2 — Tulelake Wildlife Districts

Domestic / Seasonal —

Surface water — levels — flow —
Rivers. —

~~[illegible]~~ Crops — farming

pumping effects soil

Comment #2

Kyle Knutson

From: Kraig Beasly <kbeasly.tid@cot.net>
Sent: Thursday, June 17, 2021 8:01 AM
To: Kyle Knutson
Subject: Fw: GSMP

From: Doreen SmithPower
Sent: Wednesday, June 16, 2021 3:40 PM
To: Kraig Beasly ; bkirby.tid@cot.net
Subject: GSMP

There is one area off of 139 that is very close to the Siskiyou boundary and there is a Forest Service office on the right of the highway. Just past that there is a reclaimed area. This could be part of the "water budget" or chapter 8 "projects" . The industry the reclaimation is occuring under should be named and the crop identified and tested. If the reclaimed area is part of the State plan then SHOP (funding set aside through the State Mining and Geology Board specifically for reclaimation) funding can be applied for and become part of the "water budget" and or become part of the "projects listed in chapter 8". The bulletin 118 states it is a challenge to identify contaminated surface waters that become part of the groundwater. Not all together. If the specific areas are defined by industry and then "reclaimed" and tested by the appropriate oversight agency such as the SMGB then that area no longer needs to be "avoided" as far as groundwater management. Nor is it a concern when development or FFA is concerned. Other crops than what is currently planted may be ready to grow. Surface waters need to be linked somewhat because the DWR has identified those as our drinking water and we use them before we use well water to grow healthy crops.

Finally I had the opportunity to ride the Malin/Tulelake ride over Memorial day. I I'm not positive but along County road 104 two canals were dry after Mica and appeared to be pumping from the wells. Along the same county road was a very light green dust on the land ... it looked like mold. HOWEVER the potatoes at the end of the ride were AWESOME!!! I continued to ride 115 miles over Memorial Day between Modoc and Tulelake. It was nice to enjoy the outdoors. It was fun to ride through your crops!
Doreen SmithPower

Comment #3

Kyle Knutson

From: Kraig Beasly <kbeasly.tid@cot.net>
Sent: Thursday, June 17, 2021 8:01 AM
To: Kyle Knutson
Subject: Fw: GSP

From: Doreen SmithPower
Sent: Wednesday, June 16, 2021 3:04 PM
To: Kraig Beasly ; bkirby.tid@cot.net
Subject: GSP

Hi Kraig and Brad:

a. I reviewed the Draft GSP on line that you have as of today 6/16/21. Table 1-1 is not complete. The MOU is stated it will be attached as appendix B to the plan so if it was listed under your publications and documents it would be readily available when you need it.

b. 2.1.1 The description should be clarified " an agricultural water purveyor, a City and unincorporated town and public lands" later in section

c. 2.1.1.3 you clarify with Modoc County, Siskiyou County and City of Tulelake, the unincorporated community of Newal within the subbasin. In addition the Westside Irrigation District which receives water via District conveyance facilities.

The descriptions leave out the City of Merrill and Malin, the Tulelake Irrigation District and the Tule Lake National Refuge.

I will be commenting in segments. There is one area off of 139 that is very close to the Siskiyou boundary and there is a Forest Service office on the right of the highway. Just past that there is a reclaimed area. This could be part of the "water budget" or chapter 8 "projects" . The industry the reclaimation is occuring under should be named and the crop identified and tested. Then the State Mining and Geology Board

Comment #4

Kyle Knutson

From: Felice Pace <unofelice@gmail.com>
Sent: Sunday, July 18, 2021 2:04 PM
To: Angela Bezzone
Cc: Kyle Knutson
Subject: Re: Tulelake Subbasin Webpage - New Document Added

Angela and Kyle,

I will be off in the wilderness when the GSA meeting takes place. Therefore, please share the following comment with the GSA members:

"DRAFT GSP July 16, 2021 Table 7-1 says that the minimum threshold for domestic wells will be set at the depth of the domestic wells. That will assure that those domestic wells are no longer providing water before any action is taken. That should be changed. Irrigation with well water should not be allowed to dewater domestic wells."

Thank you.

Felice Pace, Coordinator

Unofelice@gmail.com

707-954-6588

www.grazingreform.org

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On Fri, Jul 16, 2021 at 4:14 PM Angela Bezzone <bezzone@mbkengineers.com> wrote:

Update: The attached agenda packet for the Wednesday, July 21, 2021, Meeting of the Tulelake Subbasin Groundwater Sustainability Agency Core Team at 1:00pm was uploaded to the webpage (www.tulelakeid.com). This meeting will be hosted on Zoom and there is call-in information on the attached agenda and below. Please monitor the website for updates.

Topic: Tulelake Core Team Meeting
Time: July 21, 2021 01:00 PM Pacific Time (US and Canada)

Join Zoom Meeting

https://us02web.zoom.us/j/82796918418?pwd=VytPR3NaL0JWWFg2MFdBemRINGVFdz09

Meeting ID: 827 9691 8418

Passcode: 051920

1-669-900-9128,,82796918418#,,,,*051920# One tap mobile

You are receiving this email because you signed up for the Tulelake Subbasin Interested Persons list.

Angela Bezzone, P.E.

MBK Engineers

455 University Ave Suite 100

Sacramento, CA 95825

(916) 456-4400 – Phone

(775) 450-6408 – Cell

(916) 456-0253 – Fax

Comment #5

Kyle Knutson

From: Felice Pace <unofelice@gmail.com>
Sent: Tuesday, September 21, 2021 12:17 PM
To: Craig Beasley, TID; Angela Bezzone; Kyle Knutson; Chris Connor
Cc: Gene Lewis, DWR Tule Lake GSP contact; Craig Tucker; Toz Soto; NGO Groundwater Collaborative; NCSFC_list; Mark Nordberg - DWR G'wtr Replenishment; Amy Cordalis - Yurok Tribal Attorney; Barry McCovey; Mike Orcutt; Susan Fricke - Karuk Tribe; Don Gentry, Chairman, Klamath Tribes; Angelina Cooke-Rernew Siskiyou; Janae Scruggs_DFW SisCoG'wtr; Briana Seapy_DFW SGMA Coord
Subject: The Tule Lake Basin GSP must address falling groundwater levels & no recharge with Klamath River water
Attachments: DWR Spring 2020 Groundwater Report w trends.pdf

This is input to Tulelake Irrigation District as lead GSA member for the Tule Lake Basin for the GSP currently under development.

1. You must acknowledge and deal in the GSP with the fact that, as documented in DWRs database of wells with over ten years of groundwater elevation data (choose "DWR GW Level Percentile Statistics from the menu to the left), groundwater elevations are and have been falling, indicating that extraction is outpacing recharge. Even most of the wells just south of the Oregon border, gifted to TID by California taxpayers in 2001, show declining groundwater elevations. Most wells in the basin that are monitored show a decline in groundwater elevation of up to 25% over the past ten and twenty years. In this regard see also the attached DWR Spring 2020 Groundwater Update which documents declining groundwater elevations in the Tule lake Basin.

2. You should recognize that using Klamath River Water, even in winter and early spring, to recharge the groundwater to make up for excessive groundwater withdrawal is not an option. If you try to use Klamath River water and US Government canals to make up for the excess of extraction over recharge there will be major opposition and you will fail.

Please make these comments part of the record for development of the Tule Lake Basin GSP.

Felice Pace

Unofelice@gmail.com

707-954-6588

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STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY Gavin Newsom, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

California Groundwater Conditions Update – Spring 2020

Groundwater levels and a dry 2020 Water Year

Groundwater provides an average of 40 percent of California's water supply in normal years and as much as 60 percent in dry years. Snowpack and reservoir storage also contribute a large percentage to the State's water supply, and is summarized on the DWR Current Conditions website. Other important factors enhancing California's water supply portfolio include conservation, desalination, and water reuse.

About 85 percent of Californians depend on groundwater for some portion of their water supply. Some communities rely entirely on groundwater for drinking water, and it is a critical resource for many farmers, urban areas, and ecosystems across the State. Groundwater basins act as a buffer between wet and dry periods, balancing out the variability in annual snowpack and reservoir storage by providing additional storage in wet years and additional supply in dry years.

Precipitation drives the hydrologic system and California's climate is the most variable of any state. In three of the last five water years, which begin on October 1, statewide precipitation was well above normal. Water Years 2017 and 2019 stand out as some of the wettest on record. Water Year 2020 began with robust reservoir storage and improved groundwater storage because of those wet years. However, Water Year 2020 ended dryer statewide than previous years, and is comparable to the drought years of 2013 and 2015 (**Figure 1**). The precipitation information provided in **Figure 1** is a summary that demonstrates the annual statewide variability in precipitation, although local conditions might tell a different story.

Changes in groundwater levels and groundwater trends

Data on groundwater levels show seasonal fluctuations and long-term changes or trends in groundwater storage. Groundwater levels are measured from a variety of groundwater wells located throughout the state. The data is collected by the Department of Water Resources (DWR) and also reported to DWR by CASGEM Monitoring Entities, Groundwater Sustainability Agencies implementing the Sustainable Groundwater Management Act, local agencies, and private well owners.

The changes in groundwater levels in this report illustrate how groundwater storage varies over selected time periods. In addition to precipitation, there are many factors that influence groundwater level changes and the data presented here does not distinguish the specific causes of these changes. The goal of this report is to assess groundwater level changes and trends by comparing California groundwater levels over time.

Groundwater Level Change Maps (**Figures 2-5**) give a snapshot of the physical change in groundwater levels between two periods of time, which can relate to the change in groundwater storage. Comparing various intervals of years can provide different information on groundwater storage. For example, a one-year comparison of groundwater levels provides information about the possible short-term effects of a single wet or dry year, while a multi-year comparison provides information about long term changes in groundwater storage.

Trend analysis, shown in the Groundwater Trend Map (**Figure 6**), illustrates the statistical magnitude and direction of groundwater level change. The trend map depicts whether groundwater levels are decreasing or increasing rather than how much higher or lower groundwater levels are. The trend map analyzes and incorporates data from the most recent 20-year period, whereas the change maps only compare the data from the first and last year of each analysis.

Both types of maps allow for the depiction of spatial patterns in groundwater level variability over time. These maps are simple, powerful tools for informing the story of groundwater conditions from local to regional scales.

By the numbers

In this report, groundwater level change values compare spring 2020 to spring 2019, 2017, 2015, and 2010. The information is summarized in **Table 1**. Spring groundwater level data is an important indicator of groundwater conditions because spring generally corresponds to the pre-irrigation season. This time period is representative of the water year's peak groundwater levels. Associated maps display groundwater level increases and decreases and summarize data by hydrologic region.

The one-year change map (**Figure 2**) shows that approximately 63 percent of the statewide well measurements indicate stable conditions between the two years compared with net water level changes of +/- 5 feet, while 22 percent show a decrease in water levels. The remaining 15 percent show an increase in groundwater levels. Of note, groundwater level increases occurred in the Tulare Lake Hydrologic Region, which is typically associated with decreasing groundwater levels.

The three-year change map (**Figure 3)** follows the pattern of the one-year change map and shows that approximately 53 percent of the well measurements indicate net water level changes of +/- 5 feet. A cluster of well measurements with increased groundwater levels stretch from the Tulare Lake Hydrologic Region into the western portion of the San Joaquin River Hydrologic Region. Approximately 45 percent of groundwater measurements show a decrease in groundwater levels in the Sacramento Hydrologic Region.

The five-year change map (**Figure 4**) shows groundwater levels following the end of the latest drought and depicts a different story about the changes of groundwater levels. Forty-eight percent of groundwater measurements are stable with +/- 5 ft of change, and over 35 percent of groundwater measurements show an increase in groundwater levels statewide.

Conversely, the 10-year change map (**Figure 5**) illustrates how some groundwater basins have not fully recovered to pre-drought conditions, specifically in the Central Valley, Sacramento River, San Joaquin River, and Tulare Lake hydrologic regions where 40 to 70 percent, respectively, of well measurements show a decrease in groundwater levels.

Figures 6 shows the trend of change, which is the magnitude of decreasing or increasing groundwater levels, – over 20 years. Water Years 2000 to 2020 are summarized in **Table 2**, which includes droughts from 2001 to 2002, 2007 to 2009, and the most recent from 2012 to 2016. During this period of stressed water resources, more than 50 percent of statewide wells demonstrated a decreasing trend and less than 10 percent demonstrated an increasing trend.

Groundwater level trends were more pronounced in the southern Central Valley and less pronounced in the north end of the valley. There were several clusters of wells with steep groundwater level declines across the state during this period, including the western edge of the Sacramento Valley in the Sacramento River Hydrologic Region, the southeastern area of the San Joaquin Valley in the San Joaquin River Hydrologic Region, and the majority of groundwater basins within the Tulare Lake Hydrologic Region. There were also notable increases in groundwater levels in the basins in the southeastern portion of the Sacramento Valley in an area roughly overlying Sacramento County. San Francisco Bay observes the most stable groundwater levels of all regions. The Central Coast and Colorado River Hydrologic Regions show the highest overall percentage of wells with groundwater level increases, however, there were relatively few wells analyzed in these regions.

Closing thoughts

Groundwater levels are still recovering from the last drought as shown in the five-year change map. However, runoff resulting from a wet 2019 water year filled reservoirs and contributed to recovering groundwater levels when compared to the previous year's levels (2019 Seasonal Groundwater Report). Spring 2020 groundwater measurements have shown that groundwater levels are lower in general than the previous year. Furthermore, groundwater levels in many regions of California have not fully recovered to pre-drought conditions as shown in the 10-year change map with trends continuing to show a majority of groundwater levels decreasing over a 20-year time period.

DWR assessments of California's water conditions tell a story that is comprehensive and dynamic for the state's 515 groundwater basins (California's Groundwater). Moving forward, DWR will continue to provide seasonal groundwater reports and is working towards automating the analysis of groundwater level data to improve timely access of this information and data. Additional information and groundwater level change and trend maps for previous time periods can be found on the DWR Groundwater Management Data Tools Website under the Mapping Tab. Geospatial datasets of the groundwater level data used to develop this report can be viewed and downloaded from the SGMA Data Viewer.

Table 1: Statistical Summary of Groundwater Level Change Maps (**Figures 2-5**)

Period	**Total Well Count**	**Decrease > 25 ft**	**Decrease 5 to 25 ft**	**Change +/- 5 ft**	**Increase 5 to 25 ft**	**Increase >25 ft**
1-Year Change: 2020 levels compared to 2019 levels	5,023	2.7%	19.6%	63.4%	11.1%	3.1%
3-Year Change: 2020 levels compared to 2017 levels	4,776	2.9%	20.8%	53.2%	16.9%	6.3%
5-Year Change: 2020 levels compared to 2015 levels	4,492	3.3%	11.8%	48.5%	27.2%	9.2%
10-Year Change: 2020 levels compared to 2010 levels	2,289	9.6%	28.4%	47.1%	11.0%	3.8%

Table 2: Statistical Summary of Groundwater Level Trend Map (**Figure 6**)

Period	**Total Well Count**	**Decrease > 2.5 ft**	**Decrease 0.01 - 2.5 ft**	**Change +/- .01 ft**	**Increase 0.01 - 2.5 ft**	**Increase > 2.5 ft**
20-Year Trend: 2000 to 2020	3781	17.1%	41.4%	34.5%	5.7%	0.7%

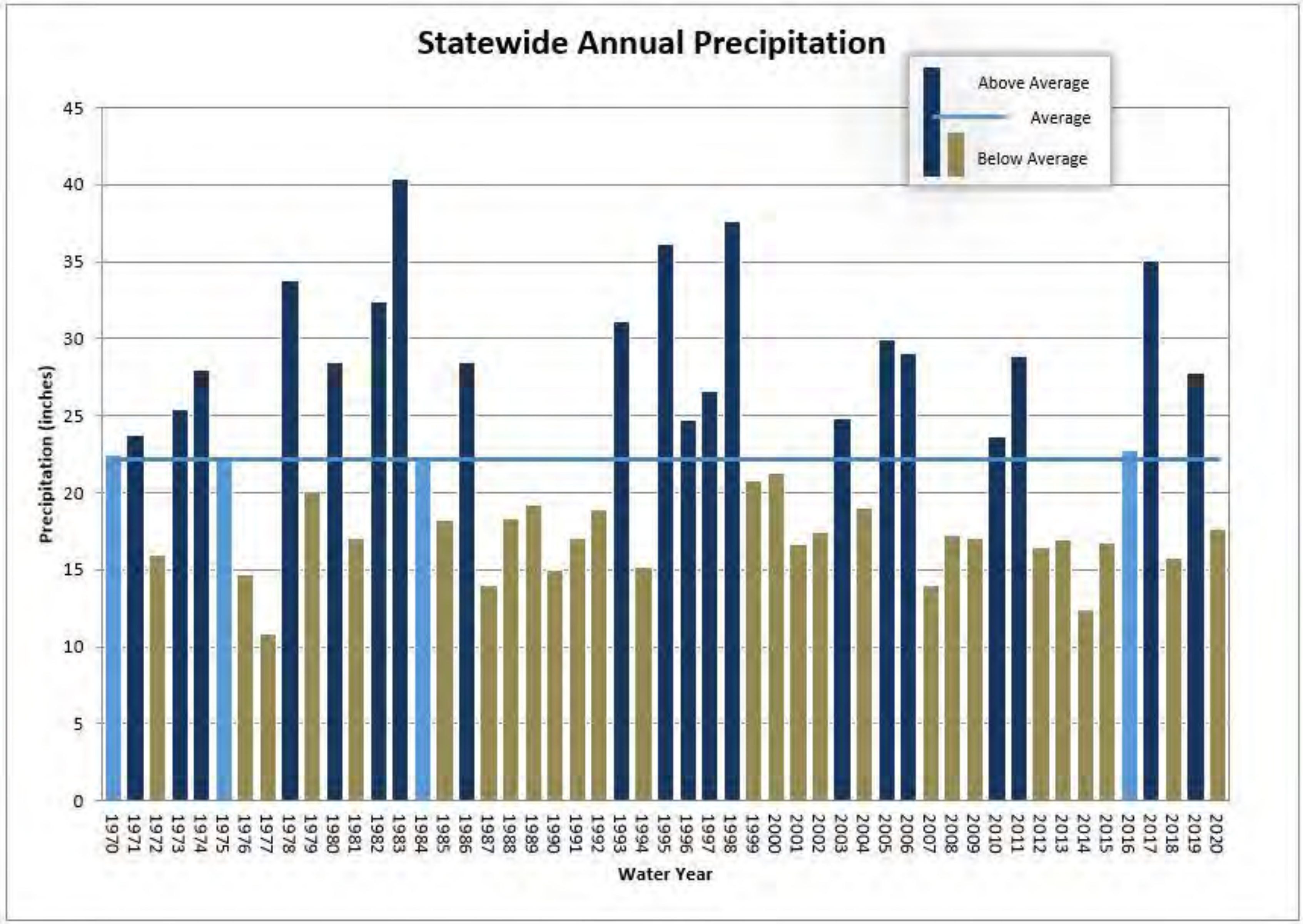
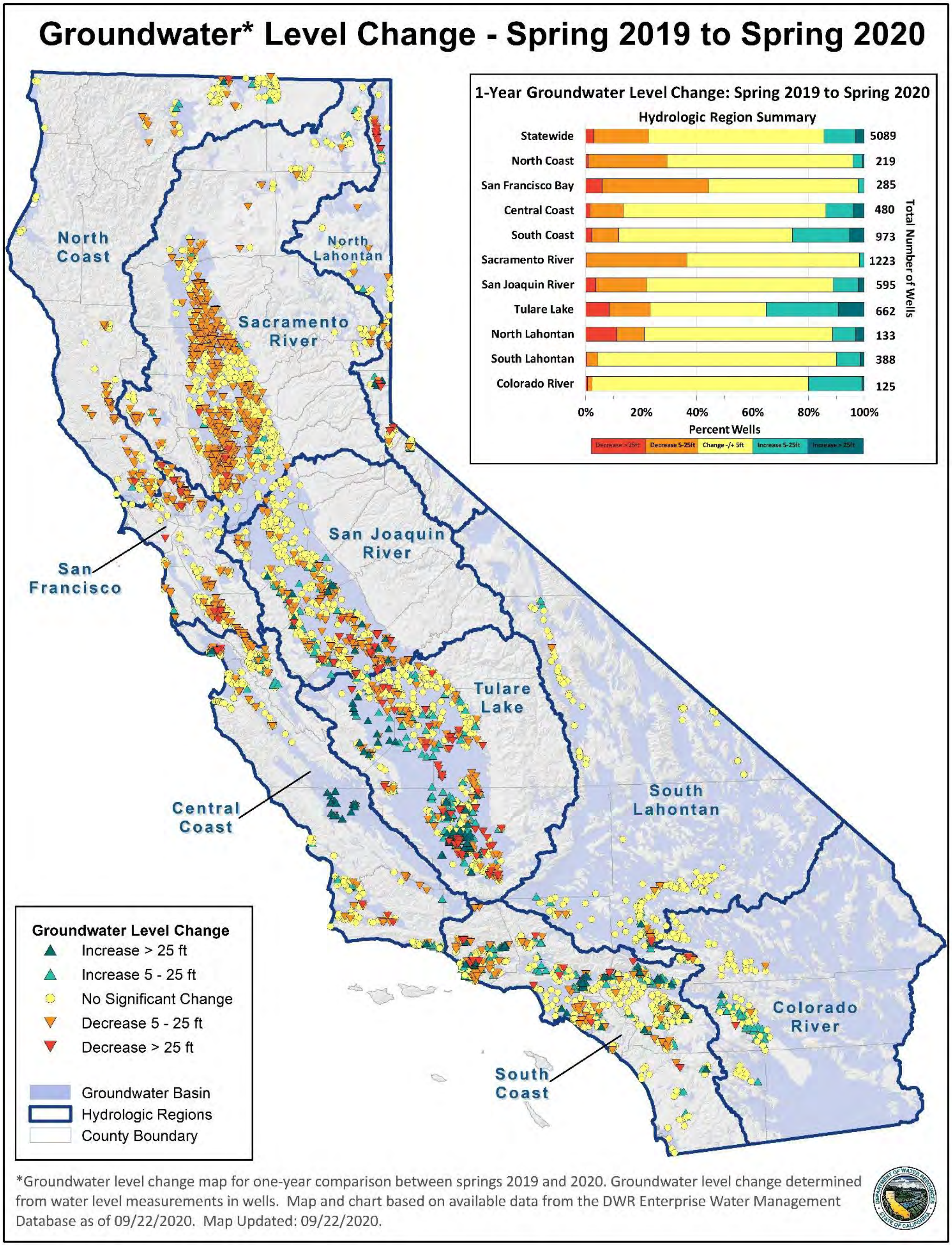


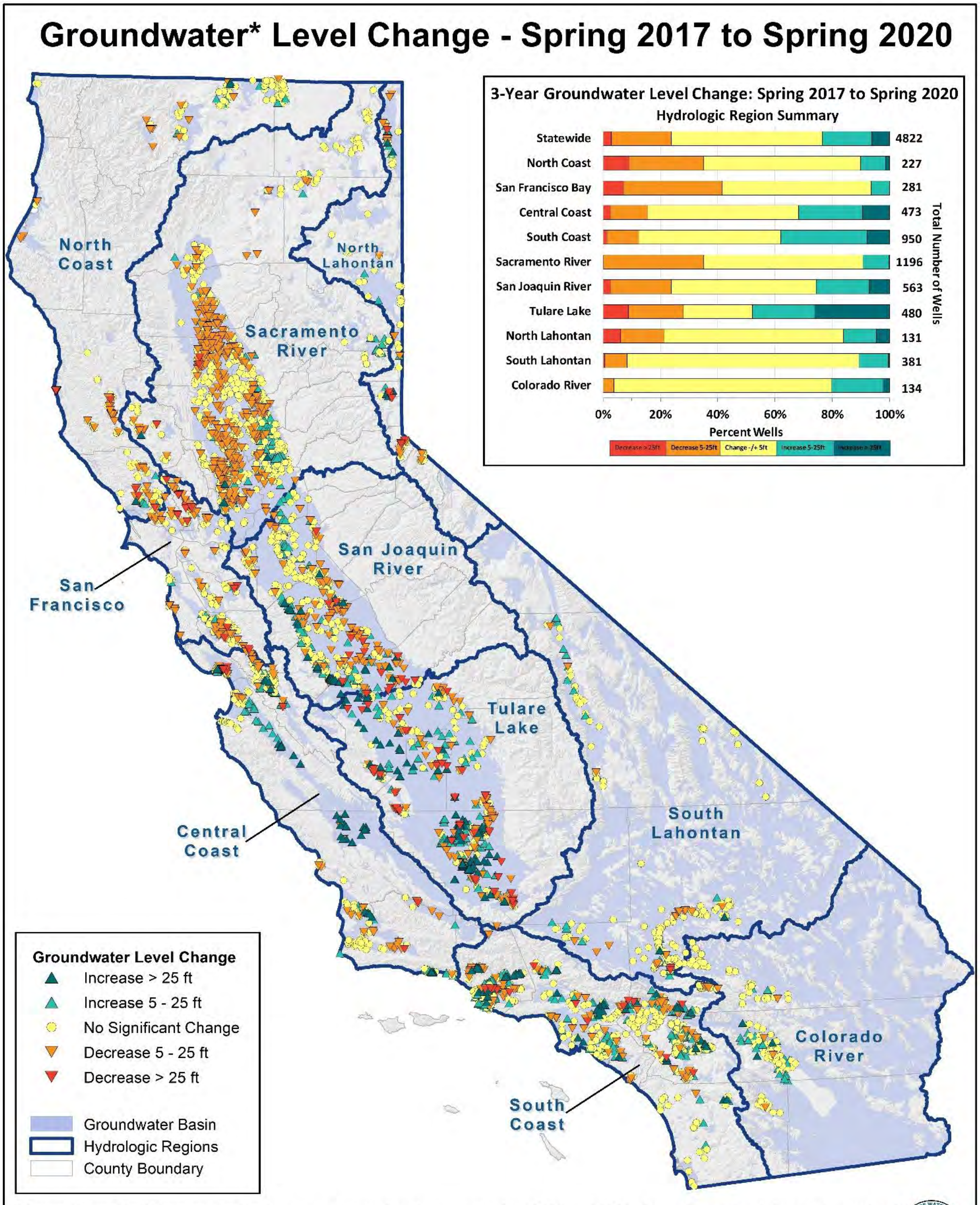
Figure 1: Statewide Annual Precipitation, NOAA National Centers for Environmental Information,(Climate at Glance: U.S. Time Series, Precipitation)



Groundwater* Level Change - Spring 2019 to Spring 2020

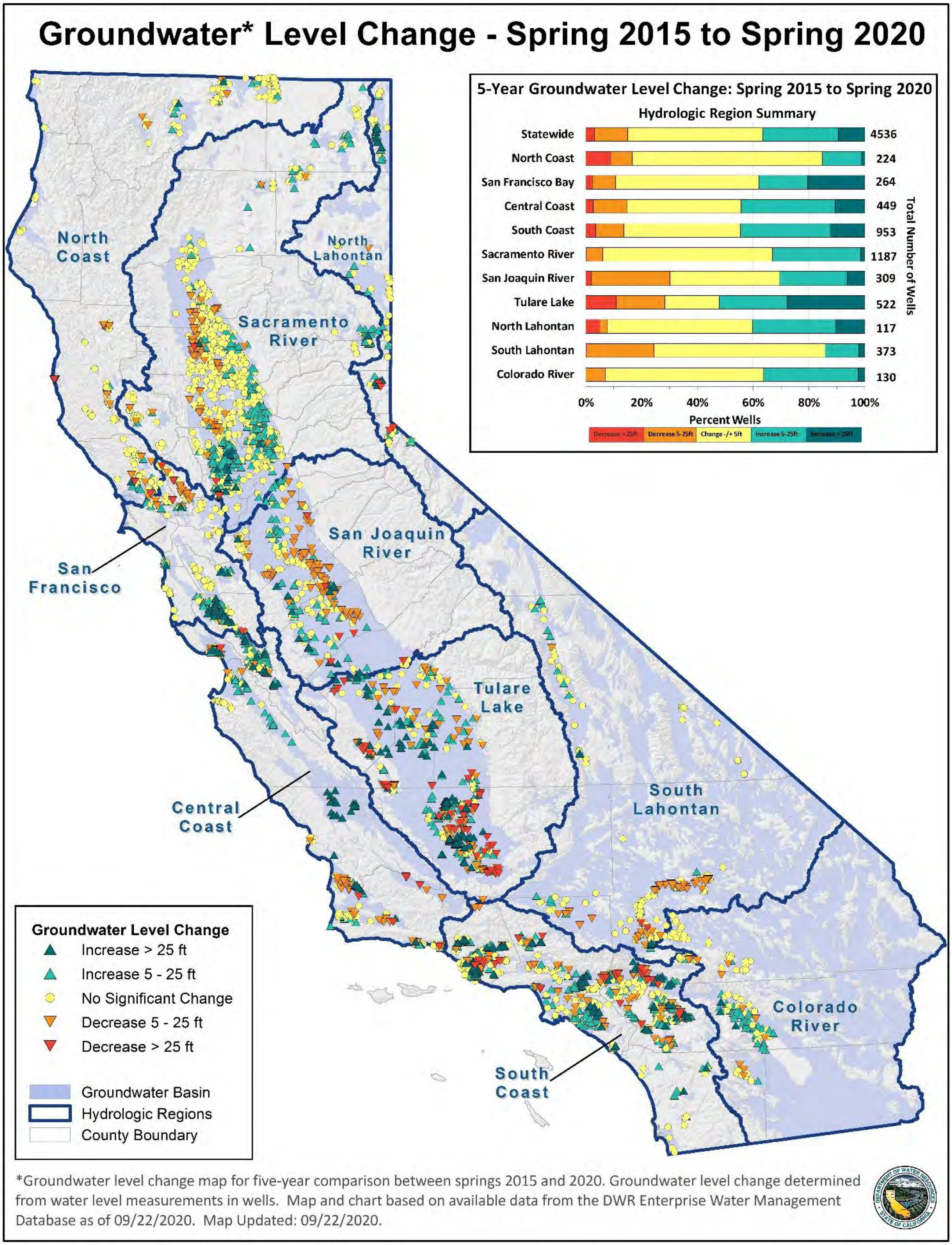
*Groundwater level change map for one-year comparison between springs 2019 and 2020. Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Enterprise Water Management Database as of 09/22/2020. Map Updated: 09/22/2020.

Figure 2: Statewide and Hydrologic Region groundwater level change map for one-year period between 2019 and 2020. Map and charts based on available data for the DWR Water Data Library as of 09/22/2020.



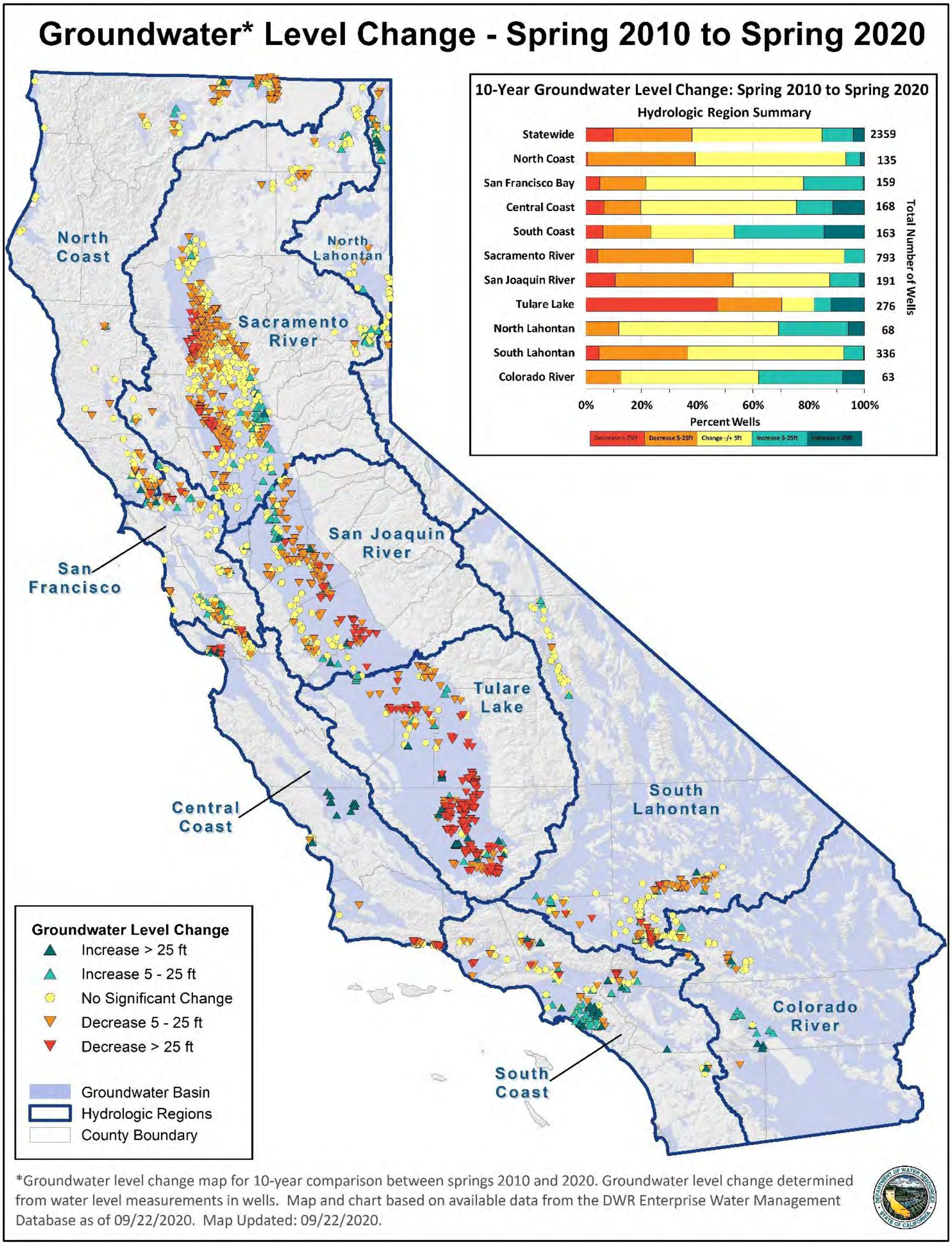
*Groundwater level change map for three-year comparison between springs 2017 and 2020. Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Enterprise Water Management Database as of 09/22/2020. Map Updated: 09/22/2020.

Figure 3: Statewide and Hydrologic Region groundwater level change map for three-year period between 2017 and 2020. Map and charts based on available data for the DWR Water Data Library as of 09/22/2020.



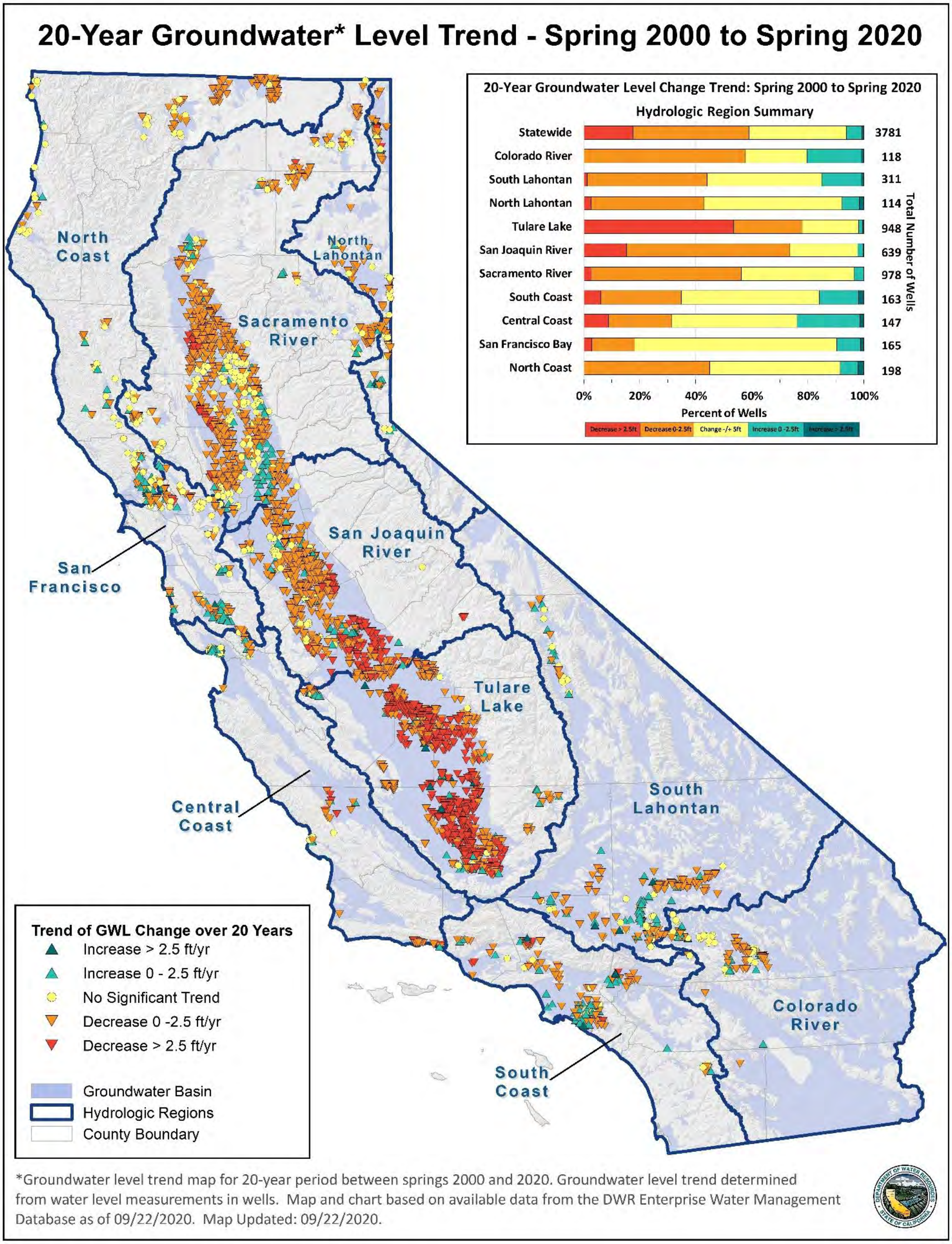
*Groundwater level change map for five-year comparison between springs 2015 and 2020. Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Enterprise Water Management Database as of 09/22/2020. Map Updated: 09/22/2020.

Figure 4: Statewide and Hydrologic Region groundwater level change map for five-year period between 2015 and 2020. Map and charts based on available data for the DWR Water Data Library as of 9/22/2020.



*Groundwater level change map for 10-year comparison between springs 2010 and 2020. Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Enterprise Water Management Database as of 09/22/2020. Map Updated: 09/22/2020.

Figure 5: Statewide and Hydrologic Region groundwater level change map for 10-year period between 2010 and 2020. Map and charts based on available data for the DWR Water Data Library as of 09/22/2020.



*Groundwater level trend map for 20-year period between springs 2000 and 2020. Groundwater level trend determined from water level measurements in wells. Map and chart based on available data from the DWR Enterprise Water Management Database as of 09/22/2020. Map Updated: 09/22/2020.

Figure 6: Statewide and Hydrologic Region groundwater level trend analysis map for Water Years 2000-2020. Map and charts based on available data for the DWR Water Data Library as of 09/22/2020.

Comment #6

From: Tulelake SGMA
To: Kyle Knutson
Subject: Fwd: Comments on Groundwater sustainability plan
Date: Wednesday, November 10, 2021 7:05:20 AM

---------- Forwarded message ---------
From: <jimcook@snowcrest.net>
Date: Tue, Nov 9, 2021 at 11:40 AM
Subject: Comments on Groundwater sustainability plan
To: <tulelakesgma@gmail.com>
Cc: <bkirby.tid@cot.net>, Geri Byrne <geribyrne@co.modoc.ca.us>, <mparker@co.siskiyou.ca.us>, <tiffanymartinez@co.modoc.ca.us>

Related to the Groundwater Sustainability Plan (GSP)

I will be submitting 2 emails related to the GSP. This first will be personal comments

I distinctly remember meeting with the TID Board when it became apparent that the State of California would be getting into the groundwater management business and I also distinctly remember being impressed that the Board members had immediately grasped the importance of the TID taking a leading role in development of a plan. At that time it was a very new concept in the western States and it was clear that people in this State were looking to the north corner to begin this process.

I have just completed reading the draft plan and I would like to commend the Groundwater Sustainability Agency on the excellent work done by MBK Engineers and the Core Team along with the people of the basin in preparing this draft.

I have read various iterations of ground water plans since 2010 for basins in our region of California and I would like to thank the staff and members for this effort.

Jim Cook

Former Siskiyou County Supervisor

P.O. Box 522

Dunsmuir, CA. 96025

(530) 598-5693

Comment #7

From: Tulelake SGMA
To: Kyle Knutson
Subject: Fwd: Comments on Groundwater sustainability plan
Date: Wednesday, November 10, 2021 7:05:33 AM

You don't often get email from tulelakesgma@gmail.com. Learn why this is important

---------- Forwarded message ---------
From: <jimcook@snowcrest.net>
Date: Tue, Nov 9, 2021 at 12:01 PM
Subject: RE: Comments on Groundwater sustainability plan
To: <tulelakesgma@gmail.com>, NCWD <ncwd@cot.net>, John Sanders <john.sanders@fleetpride.com>
Cc: <bkirby.tid@cot.net>, Geri Byrne <geribyrne@co.modoc.ca.us>, <mparker@co.siskiyou.ca.us>, <tiffanymartinez@co.modoc.ca.us>

Related to the Ground Water Sustainability Plan:

I am currently working with the Newell County Water District, as you know they supply the drinking water for the community of Newell.

During the past couple of drought years the community has come close to having their drinking water wells go dry. The District is in the process of applying for drought grant funds to assist them in drilling a new deeper well and will soon be looking to the GSA for support in those grant applications as alluded to in the GSP section 6.1.6.

In addition, it would be appropriate for the Agency and the Core team to expand portions of the plan that might deal with the drinking water needs of Newell and the surrounding community.

Thank you

Jim Cook

Community Development on Call

P.O. Box 522

Dunsmuir, CA. 96025

(530) 598-5693

From: jimcook@snowcrest.net <jimcook@snowcrest.net>
Sent: Tuesday, November 9, 2021 11:40 AM
To: 'tulelakesgma@gmail.com' <tulelakesgma@gmail.com>
Cc: 'bkirby.tid@cot.net' <bkirby.tid@cot.net>; 'Geri Byrne' <geribyrne@co.modoc.ca.us>; 'mparker@co.siskiyou.ca.us' <mparker@co.siskiyou.ca.us>; 'tiffanymartinez@co.modoc.ca.us' <tiffanymartinez@co.modoc.ca.us>
Subject: Comments on Groundwater sustainability plan

Related to the Groundwater Sustainability Plan (GSP)

I will be submitting 2 emails related to the GSP. This first will be personal comments

I distinctly remember meeting with the TID Board when it became apparent that the State of California would be getting into the groundwater management business and I also distinctly remember being impressed that the Board members had immediately grasped the importance of the TID taking a leading role in development of a plan. At that time it was a very new concept in the western States and it was clear that people in this State were looking to the north corner to begin this process.

I have just completed reading the draft plan and I would like to commend the Groundwater Sustainability Agency on the excellent work done by MBK Engineers and the Core Team along with the people of the basin in preparing this draft.

I have read various iterations of ground water plans since 2010 for basins in our region of California and I would like to thank the staff and members for this effort.

Jim Cook

Former Siskiyou County Supervisor

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(530) 598-5693

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Northern Region
601 Locust Street
Redding, CA 96001
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

November 9, 2021

Via Electronic Mail tulelakesgma@gmail.com

Brad Kirby, Manager
Tulelake Irrigation District
2717 Havlina Road
Tulelake, CA 96134
bkirby.tid@cot.net

SUBJECT: CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE COMMENTS ON THE TULE LAKE BASIN DRAFT GROUNDWATER SUSTAINABILITY PLAN

Dear Brad Kirby:

The California Department of Fish and Wildlife (Department) appreciates the opportunity to provide comments on the Tule Lake Groundwater Sustainability Agency (GSA) Tule Lake Basin (Basin) Draft Groundwater Sustainability Plan (GSP) prepared pursuant to the Sustainable Groundwater Management Act (SGMA). The Basin is designated as medium priority under SGMA and must be managed under a GSP by January 31, 2022.

The Department is writing to support ecosystem preservation and enhancement in compliance with SGMA and its implementing regulations based on Department expertise and best available information and science. As trustee agency for the State's fish and wildlife resources, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species. (Fish & Game Code §§ 711.7 and 1802.)

Development and implementation of GSPs under SGMA represents a new era of California groundwater management. The Department has an interest in the sustainable management of groundwater, as many sensitive ecosystems, species, and public trust resources depend on groundwater and interconnected surface waters (ISWs).

SGMA and its implementing regulations afford ecosystems and species specific statutory and regulatory consideration, including the following as pertinent to GSPs:

- GSPs must consider impacts to groundwater dependent ecosystems (GDEs) (Water Code § 10727.4(l); *see also* 23 CCR § 354.16(g));
- GSPs must consider the interests of all beneficial uses and users of groundwater, including environmental users of groundwater (Water Code § 10723.2) and GSPs must identify and consider potential effects on all beneficial uses and users of

groundwater (23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3));

- GSPs must establish sustainable management criteria that avoid undesirable results within 20 years of the applicable statutory deadline, including depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water (23 CCR § 354.22 *et seq*. and Water Code §§ 10721(x)(6) and 10727.2(b)) and describe monitoring networks that can identify adverse impacts to beneficial uses of interconnected surface waters (23 CCR § 354.34(c)(6)(D)); and
- GSPs must account for groundwater extraction for all water use sectors, including managed wetlands, managed recharge, and native vegetation. (23 CCR §§ 351(al) and 354.18(b)(3).)

Furthermore, the Public Trust Doctrine imposes a related but distinct obligation to consider how groundwater management affects public trust resources, including navigable surface waters and fisheries. Groundwater hydrologically connected to surface waters is also subject to the Public Trust Doctrine to the extent that groundwater extractions or diversions affect or may affect public trust uses. (*Environmental Law Foundation v. State Water Resources Control Board* (2018), 26 Cal. App. 5th 844; *National Audubon Society v. Superior Court* (1983), 33 Cal. 3d 419.) The GSA has "an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible." (*National Audubon Society*, *supra*, 33 Cal. 3d at 446.) Accordingly, groundwater plans should consider potential impacts to and appropriate protections for ISWs and their tributaries, and ISWs that support fisheries, including the level of groundwater contribution to those waters.

In the context of SGMA statutes and regulations, and Public Trust Doctrine considerations, groundwater planning should carefully consider and protect environmental beneficial uses and users of groundwater, including fish and wildlife and their habitats, GDEs, and ISWs.

The Department recognizes and appreciates the effort of the GSA to consider all beneficial users of groundwater in the basin, and the Draft GSP's use of modeled scenarios to evaluate the proposed sustainable management criteria. However, the Department believes the GSP could improve and clarify its methods for identifying beneficial users and its methods and data for developing basin-wide models and monitoring networks to ensure its proposed sustainable management criteria are adequately protective of habitats, GDEs, ISWs, and species within the Department's jurisdiction. These include populations of Lost River sucker (California Endangered Species Act [CESA] endangered and fully protected species), shortnose sucker (CESA endangered and fully protected species), bald eagle (CESA endangered), greater sandhill crane (CESA threatened and fully protected species), Swainson's hawk (CESA threatened), tricolored blackbird (CESA threatened), western pond turtle (State species of special concern), and other fish and wildlife species that rely on habitats supported and supplemented by groundwater and interconnected surface water.

The Department is providing additional comments and recommendations as notated in Attachment A.

The Department appreciates the opportunity to provide comments on the Draft GSP. For questions, please contact the Northern Region SGMA Coordinator, Curt Babcock, at Curt.Babcock@wildlife.ca.gov. Additionally, you can contact the Klamath Watershed Coordinator, Janae Scruggs, at Janae.Scruggs@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Curt Babcock
974D273FEE784E2...
Tina Bartlett, Regional Manager
Northern Region

Enclosures (Attachment A)

ec: California Department of Water Resources

Craig Altare, Supervising Engineering Geologist
Sustainable Groundwater Management Program
Craig.Altare@water.ca.gov

Pat Vellines, Senior Engineering Geologist
Sustainable Groundwater Management Program
Patricia.Vellines@water.ca.gov

Groundwater Sustainability Agencies

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Brad Kirby, Manager
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Natalie Stork, Chief
Groundwater Management Program
Natalie.Stork@waterboards.ca.gov

California Department of Fish and Wildlife

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Water Branch
Joshua.Grover@wildlife.ca.gov

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Angela Murvine, Statewide SGMA Coordinator
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Curt Babcock, Environmental Program Manager
Region 1 – Habitat Conservation Program
Curt.Babcock@wildlife.ca.gov

Joe Croteau, Environmental Program Manager
Region 1 – Klamath Watershed Program
Joe.Croteau@wildlife.ca.gov

Janae Scruggs, Senior Environmental Scientist (Specialist)
Region 1 – Klamath Watershed Program
Janae.Scruggs@wildlife.ca.gov

Jason Roberts, Environmental Program Manager
Region 1 – Fisheries Program
Jason.Roberts@wildlife.ca.gov

Attachment A

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE COMMENTS ON THE TULE LAKE BASIN (BASIN) DRAFT GROUNDWATER SUSTAINABILITY PLAN (DRAFT GSP)

COMMENTS AND RECOMMENDATIONS

The Department's comments are as follows:

1. Comment #1, Beneficial Uses and Users: The Draft GSP does not identify and consider all environmental beneficial uses and users of groundwater in the Basin.
    a. Issue 1: The Draft GSP indicates that the Federal Endangered Species Act (ESA) lists two species of suckers, the endangered Lost River sucker and the shortnose sucker, protected under an existing National Marine Fisheries Service (NMFS) Biological Opinion (p. 2-58). Because of limited data and modeling it is unclear if or how these species depend on groundwater. The Draft GSP should identify where these species of suckers are found in the Basin, areas where groundwater exists that they may be dependent on at certain life stages, and how these species of suckers may be impacted by groundwater pumping and other measures in the Draft GSP. Additionally, the Draft GSP does not identify or consider other species in the Basin that depend on groundwater, including species listed under CESA, ESA, and other special-status species. These species include the following: bald eagle (CESA endangered), greater sandhill crane (CESA threatened and fully protected species), Swainson's hawk (CESA threatened), tricolored blackbird (CESA threatened), and western pond turtle (State species of special concern).
    Recommendation 1: The Department recommends revising the description of beneficial uses and users to accurately describe all groundwater users in the Basin. The Draft GSP should include the following: information on species' location in the Basin, the groundwater sources on which they depend, and identify how the Draft GSP will meet their needs.

2. Comment #2, Interconnected Surface Waters (ISWs) and Groundwater Depletion: The Draft GSP does not evaluate ISWs and ensure avoidance of significant and unreasonable ISW depletions. The Draft GSP may also lack sufficient information to evaluate groundwater depletions and avoid significant and unreasonable depletions.
    a. Issue 2(a), ISW Identification: The Draft GSP may fail to identify ISWs in the Basin. As the Draft GSP notes on page 3-5, a "monitoring network for groundwater-surface water interaction has not been developed." In the absence of a monitoring network, the Draft GSP cannot ensure avoidance of significant and unreasonable depletions of ISW.
    Recommendation 2(a): The Department encourages expediting the process of developing a science-based method to identify the ISWs and the monitoring network to better understand the interaction between groundwater and surface water.

   b. Issue 2(b), Streamflow Depletion: In the absence of a groundwater-surface water relationship network or complete basin-wide model, the Draft GSP may not have sufficient information to accurately determine the surface water depletion rate. This makes it difficult for the Department or others to assess if the Draft GSP has avoided depletions of ISWs that may have significant and unreasonable adverse impacts on beneficial users.
   Recommendation 2(b): The Department urges the GSA to complete the necessary tasks to determine a surface water depletion rate and then assess if additional steps are needed to avoid significant and unreasonable adverse impacts on beneficial users of the ISWs.
   c. Issue 2(c), Groundwater Depletion: As noted above, a good monitoring network is not currently available for the GSA to accurately assess groundwater depletion, and thus the GSA may not have sufficient information to assess whether it will avoid the undesirable result of chronic lowering of groundwater levels that would indicate a significant and unreasonable depletion of groundwater supply.
   Recommendation 2(c): The Department recommends establishing the monitoring network for groundwater-surface water relationships to complete this component of the model, and further address the potential impacts of groundwater pumping on groundwater levels in the Basin. See further comments on the model under Comment #4 below.

3. Comment #3, Identification and Consideration of Groundwater Dependent Ecosystems (GDEs): Methods used for GDE identification are unclear and risk exclusion of ecosystems that may depend on groundwater.
   a. Issue 3(a), GDE Identification Methods: The Draft GSP does not provide sufficient detail when describing the methods used for GDE classification and mapping in the Draft GSP and the rationale for the methods used. Specific examples are included below in Issues 3(b)-3(g).
   Recommendation 3(a): The Department recommends utilizing best-available science-based standards for vegetation classification and mapping, such as the Department's *Survey of California Vegetation Classification and Mapping Standards.*[1] The Draft GSP's GDE classification and mapping should be revised if necessary after utilizing these methods. A clear description of the methods used will help ensure consistency in GDE identification during future GSP updates and effective monitoring.
   b. Issue 3(b), Field Verification: The Draft GSP does not include field verification or quality assurance/quality control measures to validate GDE classifications and mapping. Without these means of verification, the Department cannot evaluate or comment on the accuracy of the GSP's GDE classification or mapping.

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[1] https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=102342&inline.

Recommendation 3(b): The Department recommends including information on how vegetation and wetlands polygons were depicted or verified in the field.

c. Issue 3(c), Unclear Mapping/Classification for Certain Areas: Table 2.2 includes 32,000 acres of "unclassified areas" as a land use classification. In addition, the Department finds Figures 2-36 and 2-37 difficult to read. It is unclear whether the "unclassified areas" or areas depicted in Figures 2-36 and 2-37 may contain GDEs, and how the GSA verified classification and mapping for these areas.
   Recommendation 3(c): The Department recommends providing a clearer description of "unclassified areas" in Table 2.2, including acreages of different types of communities in these areas, verification of whether these areas contain GDEs, and support for these conclusions with field verification measures. The Department recommends clarifying how Figure 2-36, was developed, including acres of each type of community in the legend, and describing the vegetation mapping methods used. The GSA should indicate whether the mapping was ground-verified for accuracy and whether the Tule Lake sumps support phreatophyte or wetland vegetation. Additionally, the Department requests the resolution in Figure 2-37 is improved and updated to account for acreages for potential GDEs and include areas with missing GDE mapping/classification data, location(s) and acreage of data gap areas.

d. Issue 3(d), Data Gaps: The Draft GSP states, "Section identified areas that remained after filtering criteria were applied to the NCCAG dataset. The GSAs have identified this as a data gap, which can be addressed with field inspections of these areas to better understand if there is vegetation present and if so, analyze the availability of non-groundwater sources. These field inspections and follow-up reviews are scheduled to be completed within the first 5 years of implementation" (Section 6.1.4). The Department finds that this statement is unclear as the section does not provide any additional information to indicate specific data gaps.
   Recommendation 3(d): The Department suggests the GSP includes a figure or map along with a description of the data gap areas to provide additional clarity on data gaps in GDE identification, including locations of missing mapping/classification data (data gap areas), total acreage of data gap areas throughout the Basin, and characterization of vegetation types and other ecological information pertaining to data gap areas. If data gap areas contain GDEs, those GDEs must be identified and considered in the Draft GSP.

e. Issue 3(e), Exclusion of Potential GDEs: Assessment of Groundwater Dependent Ecosystems for the Basin's (GDE) identification, required by 23 CCR § 354.16(g), is based on methods that risk exclusion of ecosystems that may depend on groundwater. Section 2.2.2.9 of the Draft GSP concludes that areas adjacent to irrigation fields, sumps, and those near areas intersected by irrigation canals, ditches, and drains do not qualify as GDEs under groundwater-surface water model due to proximity of surface water. Similarly, Appendix H states that Natural Communities Commonly Associated with Groundwater (NCCAGs) within 150 feet of any surface water source

cannot be GDEs. This GDE-elimination method may disregard a GDE's adaptability and opportunistic approach to accessing water in which the vegetation may rely on both surface water and groundwater across seasons and years. Without additional analysis that compares the potential rooting depths of groundwater dependent vegetation with the depth to groundwater below the ground surface, there is insufficient information to categorize these potential GDE non-GDE areas.
<u>Recommendation 3(e)</u>: The Department requests clarification on the basis for the GSA's determination that areas described in Issue 3(e) are not GDEs. The Basin is known to exhibit shallow groundwater, and it is possible that areas adjacent to surface water may still be dependent on groundwater. The Draft GSP should clarify methods used to evaluate potential GDEs that receive ground water contributions, and the basis for excluding certain areas from consideration as GDEs. See further comments on the water budget under Comment #6 below.

f. <u>Issue 3(f), Depth to Groundwater</u>: Appendix H of the Draft GSP provides the data processing approach for the identification of the GDEs but does not identify the acres or percentage of the Basin with a depth to groundwater greater than 30 feet. Several community types listed in Appendix H that represent shallow groundwater are not mentioned elsewhere in the GSP (e.g., greasewood, wet meadows, riverine, seep or spring). These community types and locations are not provided in the Basin. In addition, criteria (1-3) may have excluded wetlands and other hydrophytic vegetation communities like those mentioned above from GDE consideration.
<u>Recommendation 3(f)</u>: The Department suggests that the GSP clarifies, describes community types, and updates methods used to be similar to Recommendation 3(a) above. For example, the Draft GSP should use depth to groundwater thresholds that are appropriate for each specific vegetation type within the Basin and explain the reasoning for excluding any areas from GDE consideration. An exhibit or figure depicting the location of these communities in the Basin would be recommended.

4. Comment #4, Hydrogeologic Conceptual Model: It is unclear whether the Draft GSP's hydrogeologic conceptual model (HCM) of the Basin accurately characterizes the physical components as required by SGMA regulations. (23 CCR § 354.14.)
   a. <u>Issue 4(a), Identification and Characterization of Aquifers and Aquitards</u>: The HCM used in the GSP does not properly identify and characterize the principal aquifers and confining units within the Basin as required by applicable SGMA regulations. (23 CCR §354.14 (b)(4)(B) and (C).) The Draft GSP provides a regional description of the principal water-bearing formations within the subbasin without specifying the principal aquifer(s) system. The Draft GSP distinguishes the 500-foot depth interval separating the shallow well system from the deeper well system within the Basin, but the basis for this distinction is unclear. The hydrographs provided by the GSA indicate a difference in water levels between the two identified systems. However, the Draft GSP does not indicate what mechanisms (i.e., confining layers) are in

place that would facilitate different hydraulic head levels within these alluvial aquifer sequences that are being defined as unconfined to a depth of approximately 1,000 feet.

Recommendation 4(a): The Department recommends revising the HCM to clearly identify and characterize the physical components of the Basin as required under SGMA. The Department requests clarification on the criteria utilized to distinguish the 500-foot depth interval separating the shallow well system from the deeper well system. The Draft GSP provides well completion reports and lithologic data set within Appendix I that indicate that a volcanic unit and/or ash deposit exist at a depth of approximately 500 feet which may act as a confining layer between the shallow and deeper well systems. Additionally, within Appendix E, the GSP provides several cross sections (Plate 1 & 2) that indicate an ash deposit beginning at a depth of approximately 500 feet (i.e., red-dashed line), consistent with the lithologic records for the Basin. The Department recommends that the GSA conduct a more in-depth analysis utilizing the available lithologic dataset from the well completion reports in conjunction with the information and cross-sections provided within Appendix E to provide a more refined representation of the hydrogeologic framework within the Basin.

b. Issue 4(b), Current and Historical Water Level Trends: SGMA requires that the Draft GSP describe historic and current water level trends within the Basin, including groundwater elevation contour maps depicting current seasonal highs and lows and hydrographs depicting historical highs and lows (among other information) for each principal aquifer. (23 CCR §354.16(a).) The Draft GSP provides groundwater elevation contour maps for the spring and fall of 2015 and 2018 for the locations designated as part of the unconfined aquifer system. However, as discussed above, the available lithologic data set and information provided within Appendix E may indicate the presence of additional principal aquifers within the Basin. The Draft GSP must designate these principal aquifers and describe current and historical water level trends for each.

   Recommendation 4(b): The Draft GSP should provide groundwater level elevation contour maps depicting the groundwater table or potentiometric surface associated with current seasonal highs and seasonal lows and hydraulic gradients between principal aquifers. The Department requests that the GSA provide additional discussion of vertical groundwater gradients and the interactions between principal aquifers and provide groundwater contour maps to meet the requirements of applicable SGMA regulations. (23 CCR §354.16 (a)(1) and (2).)

c. Issue 4(c), Groundwater-Surface Water Interactions: The Draft GSP on page 3-5 states that a "monitoring network for groundwater-surface water interaction has not been developed". The Draft GSP also references the Lost River being highly regulated as part of the United States Bureau of Reclamation's Klamath Project. The Draft GSP goes on to state the flows in Lost River and Tule Lake Sumps are dependent on surface water deliveries from the Klamath Project. The GSP does not describe when Lost River goes dry, and to the

degree Lost River is dependent on groundwater. This information is critical to the groundwater-surface water model.
Recommendation 4(c): The Department recommends that the GSP continues efforts to develop a monitoring network which illustrates flows to Lost River and Tule Lake Sumps deliveries from the Klamath Project. In addition, illustrate the degree to which Lost River and Tule Lake Sumps are dependent on groundwater. The Department requests that the GSP includes the season or conditions in which Lost River goes dry, to better clarify groundwater-surface water interactions.

d. Issue 4(d), Data Gaps: The Draft GSP indicates that there are no multiple completion monitoring wells within the Basin. In Section 6.1.2, the GSA indicates that the GSA will seek funding to install monitoring well observations points within the first year of GSP implementation.
Recommendation 4(d): The Department encourages expediting the process of installing monitoring wells, as information from these wells will be critical to addressing data gaps and more clearly defining the vertical groundwater gradient and interactions between aquifer assemblages.

5. Comment #5, Sustainable Management Criteria: The Draft GSP's interconnected surface water model may not accurately represent the surface water depletion rate and may not protect against undesirable results for fish and wildlife beneficial uses and users of interconnected surface water.

   a. Background to Issue 5(a): SGMA regulations require the GSP to include numeric minimum thresholds to define and avoid undesirable results, which must be explained and justified based on basin-specific information and other data or models as appropriate, with appropriate accounting for any uncertainty in the understanding of the basin setting. (23 CCR § 354.28(a)-(b).) The GSP must explain the relationship between the minimum thresholds and the relevant sustainability indicator, how the minimum thresholds will avoid causing undesirable results, how the minimum thresholds may affect the interests of beneficial uses and users of groundwater, and how each minimum threshold will be quantitatively measured consistent with SGMA monitoring network requirements. (*Id.*)
   Issue 5(a), Minimum Thresholds: The minimum threshold is not met when "three consecutive spring measurements" at the representative monitoring locations have dropped below the groundwater elevation in the minimum threshold criterion. The Draft GSP uses this criterion for groundwater levels as a proxy for groundwater storage, land subsidence, and ISW levels. In the absence of additional monitoring such as the groundwater-surface water interaction network, it is unclear how this method is suitable for other undesirable results without greater explanation. Furthermore, the Department cannot assess how this criterion may or may not impact beneficial users.
   Recommendation 5(a): The Department recommends that the Draft GSP clarify how the minimum thresholds were developed, how they relate to the relevant sustainability indicators, and how the criteria may affect the interests of beneficial users, including CESA-listed species.

b. Background to Issue 5(b): SGMA regulations require minimum thresholds related to depletions of ISW to be "the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." (23 CCR § 354.28(c)(6).) These minimum thresholds must be supported by the "location, quantity, and timing of depletions of interconnected surface water" and "a description of the groundwater and surface water model used to quantify surface water depletion." (*Id*. at § 354.28(c)(6)(A)-(B).) If a numerical groundwater-surface water model is not used to quantify surface water depletion, the GSP must identify and describe an equally effective method, tool, or analytical model to be used for this purpose.
   Issue 5(b), Depletions of ISW: The minimum threshold is not met when "three consecutive spring measurements" at the representative monitoring locations have dropped below the groundwater elevation in the minimum threshold criterion. The GSP is unclear on how this correlation can be made in the absence of a groundwater-surface interaction monitoring network and if the minimum threshold is appropriate. The Draft GSP does not set minimum thresholds for surface water depletions based on the rate or volume of surface water depletions caused by groundwater use, and it does not utilize a basin-wide groundwater-surface water model or equally effective method, tool, or model to quantify such depletions.
   Recommendation 5(b): The Department requests revisions to the Draft GSP to clarify how the sustainable management criteria were developed, how these criteria relate to the relevant sustainability indicators, and how the criteria may affect the interests of beneficial users, including CESA-listed species.

6. Comment #6, Water Budget: The Draft GSP's water budget is inconsistent in addressing data gaps and accounting for managed wetlands.
   a. Background to Issue 6(a): Per SGMA regulations, each GSP "shall rely on the best available information and best available science to quantify the water budget for the Basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow." (23 CCR § 354.18€.)
      Issue 6(a), Data Gaps: The GSA relies on an integrated groundwater/surface water model to prepare the water budget for the Draft GSP. The Department acknowledges that SGMA allows the use of models to prepare the water budget in GSPs. (23 CCR § 354.18(e).) However, reliable data sets increase the accuracy of the model's output. The Draft GSP's groundwater/surface water model may be inaccurate because it relies on the limited set of groundwater extraction information that is available for wells within the Basin. As such, the modeling description document utilizes evapotranspiration estimates to determine rates of aquifer pumping to quantify groundwater extraction values for development of the water budget. The Department understands that this method may be utilized when a limited data set is available. However, the Draft GSP does not identify the data gaps noted

above, or reasonable measures and schedules to eliminate these data gaps as required by SGMA regulations. (23 CCR § 355.4(b)(2).)
<u>Recommendation 6(a)</u>: The Department recommends that the GSA address data gaps regarding the water budget (including groundwater usage) and provide data sets necessary to adequately characterize groundwater in storage, changes in storage, and safe yield criteria within the Basin. (23 CCR §354.18.) For example, the Draft GSP should include discussion of current versus historic surface water extractions, release of water from Klamath River, agriculture ditch losses and gains, and new or improved wells in the Basin to ensure the model is considering all relevant groundwater pumping and related impacts in the Basin.

b. <u>Issue 6(b), Managed Wetlands</u>: The Draft GSP does not identify or appropriately consider all managed wetlands within the Basin, including United State Fish and Wildlife Service's Tule Lake National Wildlife Refuge (Tule Lake Refuge), which is within the Basin and contains over 16,000 acres of managed wetlands. Table 2.2 of the Draft GSP identifies 13,607 acres of managed wetlands but does not identify any managed wetlands within Tule Lake Refuge. Managed wetlands in Tule Lake Refuge provide for both waterfowl management and agricultural uses. (Executive Summary, Final Comprehensive Conservation Plan for Klamath Basin National Wildlife Refuges.)
<u>Recommendation 6(b)</u>: The Department recommends that the Draft GSP identify all managed wetlands within the Basin and appropriately account for these managed wetlands within the Draft GSP's water budget. Per SGMA regulations, GSPs must account for groundwater extraction for all water use sectors, including managed wetlands, managed recharge, and native vegetation. (23 CCR §§ 351(al) and 354.18(b)(3).)

7. Comment #7, Monitoring Network and Well Information: The Draft GSP's monitoring networks do not provide for basin-wide shallow groundwater monitoring, and as such the GSA is unable to properly identify adverse impacts to beneficial users of surface water as required by SGMA regulations. (23 CCR § 354.34(c)(6)(D).)
    a. <u>Issue 7</u>: The Department acknowledges that the GSA has identified data gaps in the monitoring network. However, the Draft GSP does not include basin-wide shallow groundwater monitoring which is necessary to adequately characterize groundwater surface water interactions.
    <u>Recommendation 7</u>: The Department recommends that the GSA develop a specific plan and timeline for the construction of monitoring wells capable of characterizing shallow groundwater/surface water interactions. The GSP indicates within Section 6.1.2 that it will seek funding to install multiple completion monitoring wells within the first year of implementation. The Department would encourage that the GSA also seek the necessary funding to develop a shallow groundwater monitoring network. If the GSA intends to rely on basin-specific data, the Draft GSP should develop and describe a monitoring network capable of collecting sufficient data to demonstrate

short-term, seasonal, and long-term trends in groundwater and related surface water conditions as required by SGMA regulations. (23 CCR §354.34.)

8. Comment #8, Projects and Management Actions (PMAs): PMAs identified in the Draft GSP lack specificity and may not adequately protect GDEs and beneficial users.
    a. Issue 8: The Draft GSP identifies certain PMAs in Table 6.1, but these appear to be limited to PMAs to address data gaps or comply with SGMA regulatory requirements, including completion of field inspections of GDEs within the next 5 years. The Adaptive Management Strategy appears to be on a "case-by-case basis."
    Recommendation 8: The Department recommends identifying additional projects and management actions (PMAs) to protect GDEs and beneficial users in the Basin. The Department recommends the Draft GSP includes a description of potential management actions under the Adaptive Management Strategy. Additional, PMAs to consider are groundwater recharge in other areas of the Basin, strategic groundwater pumping reductions, instream flow leases, conservation easements and voluntary managed land repurposing.

9. Comment #9, Public Trust Doctrine and CESA: It is unclear whether the Draft GSP has appropriately considered and addressed impacts to special-status species and public trust resources in the Basin, including wetlands.
    a. Issue 9(a), Data Gaps: It is unclear if the GSA has undertaken the analysis and consideration required under the Public Trust Doctrine to support the proposed PMAs and management criteria. The Department finds that the Draft GSP has not yet resolved significant data gaps relevant to the surface water depletion rate, basin-wide groundwater levels, and the presence and needs of GDEs and beneficial users of ISWs.
    Recommendation 9(a): The Department recommends addressing all data gaps identified above to ensure appropriate consideration of the needs of public trust resources as required under the Public Trust Doctrine.
    b. Issue 9(b), Consideration of Public Trust and CESA-listed Species: It is unclear if the GSA has appropriately considered the special-status and public trust species found within the Basin, including the Lost River sucker and shortnose sucker, both of which are CESA endangered and fully protected species that may be impacted by groundwater pumping. For example, the Lost River sucker utilizes the Lost River and the Tule Lake Refuge for different life stages. The Draft GSP does not indicate whether the GSA has appropriately considered impacts of groundwater pumping on these resources and considered measures to protect them as required under the Public Trust Doctrine. For example, the Draft GSP does not identify PMAs for protection of these public trust resources or clearly explain why such PMAs are infeasible.
    Recommendation 9(b): The Department recommends that the GSA conduct a robust analysis that considers the needs of public trust resources and impacts to those resources due to the proposed groundwater management practices, consistent with *Audubon* and *Environmental Law Foundation*.

Based on an accurate understanding of public trust resource needs and impacts, the GSA should assess a range of potential protective measures to address impacts of groundwater extractions. These measures may need to go beyond the PMAs identified in the Draft GSP and may include pumping limits or alternative supply options to address existing, new, and expanded extractions. Given the ongoing drought, it is critical to plan for such eventualities in the Draft GSP. Before rejecting such measures, the GSA should engage in a balancing of competing interests that illustrates why protecting species and habitat though contingent pumping limits, use of supply alternatives, or equivalent protective measures would be infeasible. The GSA should also evaluate potential impacts on special-status species and determine if additional measures should be implemented to avoid, minimize, or mitigate such impacts.

c. Issue 9(c), Consideration of Tule Lake Refuge:

It is unclear whether the GSA has appropriately considered potential impacts to *all* public trust resources in the basin, including Tule Lake Refuge. The Refuge provides 16,000 acres of farmland that rotates between seasonal wetlands and farm fields, and an additional 3,100 acres of wetland habitat (https://www.fws.gov/refuge/Tule_Lake/habitat.html). The joint habitat is used by migrating waterfowl as a staging location. Other migrating species that benefit from the wetlands including CESA-listed bald eagle, greater sandhill crane, and Swainson's hawk. The wetland habitat and Lost River is known habitat for the CESA-listed Lost River sucker and shortnose sucker.

Case law recognizes that ecological uses of wetlands are subject to the Public Trust Doctrine. In *Marks v. Whitney* (1971) 6 Cal. 3d 251, 259-260, the California Supreme Court recognized that the Public Trust Doctrine extends to preservation of wetlands "…in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments which provide food and habitat for birds and marine life…" More recently, the same court in *Audubon* recognized applicability of the Public Trust Doctrine to non-navigable tributaries to Mono Lake that supported a variety of bird species. (33 Cal. 3d 419, 436-437.) In *Environmental Law Foundation*, *supra*, 26 Cal. App. 5th 859-860, the Court applied the Public Trust Doctrine to groundwater extractions from tributaries that adversely impact public trust uses in interconnected surface waters, noting that the key factor is not the nature of the activity, but whether the activity results in harm to public trust resources. Many state policies and orders recognize the importance of wetlands, including the following:

- Executive Order W-59-93, California Wetlands Conservation Policy, commonly referred to as the "No Net Loss Policy" for wetlands, which aims to "[e]nsure no overall net loss and achieve a long-term net gain in the quantity, quality, and permanence of wetlands acreage and values in California in a manner that fosters creativity, stewardship and respect for private property";

- SWRCB Resolution No. 2019-0015 ("State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State"), which affirms the SWRCB and Regional Water Boards' commitment to increasing the quantity, quality, and diversity of wetlands in California; and
- The Fish and Game Commission's Wetlands Resources policy, which recognizes that wetlands "provide significant and essential habitat for a wide variety of important resident and migratory fish and wildlife species" and that the quality and quantity of wetlands habitat in California has been significantly reduced. The Commission's policy is to ensure that proposed projects will result in no net loss of wetland or riparian habitat or acreage, and to seek to provide for the protection, preservation, restoration, enhancement, and expansion of wetland habitat in California.
- Recommendation 9(c): Consistent with the case law and policies described above, the Department suggests that the GSA manage groundwater use to ensure wetlands continue to receive groundwater inputs necessary to support habitat and ecological uses, if feasible.

CONCLUSION

In conclusion, though the Tule Lake Basin Draft GSP discusses GDEs, characterizes groundwater conditions in the Basin based on available data, and provides modeling for portions of the Basin, the Draft GSP does not comply with all aspects of SGMA statutes and regulations, and the Department deems the Draft GSP insufficient in its consideration of fish and wildlife beneficial uses and users of groundwater and ISWs. The Department recommends that the Tule Lake Basin GSA address the above comments before GSP submission to DWR to best prepare for the following regulatory criteria for plan evaluation:

1. The assumptions, criteria, findings, and objectives, including the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are not reasonable and/or not supported by the best available information and best available science. (23 CCR § 355.4(b)(1).) (See Comments #5 and 6.)
2. The GSP does not identify reasonable measures and schedules to eliminate data gaps. (23 CCR § 355.4(b)(2).) (See Comments #3, 4, 6, 7, and 9.)
3. The interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected by the use of groundwater in the basin, have not been considered. (23 CCR § 355.4(b)(4).) (See Comments #1, 2, 5, 8, and 9.)

The Nature Conservancy
Audubon | CALIFORNIA
Local Government Commission
Leaders for Livable Communities
Union of Concerned Scientists
Science for a healthy planet and safer world
CLEAN WATER ACTION | CLEAN WATER FUND

November 12, 2021

Tulelake Subbasin GSA
2717 Havlina Rd
Tulelake, CA 96134

Submitted via email: tulelakesgma@gmail.com

Re: Public Comment Letter for Tulelake Subbasin Draft GSP

Dear Kraig Beasly,

On behalf of the above-listed organizations, we appreciate the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the Tulelake Subbasin being prepared under the Sustainable Groundwater Management Act (SGMA). Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is critical for the resilience of California's water portfolio, particularly in light of changing climate. Under the requirements of SGMA, Groundwater Sustainability Agencies (GSAs) must consider the interests of all beneficial uses and users of groundwater, such as domestic well owners, environmental users, surface water users, federal government, California Native American tribes and disadvantaged communities (Water Code 10723.2).

As stakeholder representatives for beneficial users of groundwater, our GSP review focuses on how well disadvantaged communities, drinking water users, tribes, climate change, and the environment were addressed in the GSP. While we appreciate that some basins have consulted us directly via focus groups, workshops, and working groups, we are providing public comment letters to all GSAs as a means to engage in the development of 2022 GSPs across the state. Recognizing that GSPs are complicated and resource intensive to develop, the intention of this letter is to provide constructive stakeholder feedback that can improve the GSP prior to submission to the State.

Based on our review, we have significant concerns regarding the treatment of key beneficial users in the Draft GSP and consider the GSP to be **insufficient** under SGMA. We highlight the following findings:

1. Beneficial uses and users **are not sufficiently** considered in GSP development.
    a. Human Right to Water considerations **are not sufficiently** incorporated.
    b. Public trust resources **are not sufficiently** considered.
    c. Impacts of Minimum Thresholds, Measurable Objectives and Undesirable Results on beneficial uses and users **are not sufficiently** analyzed.
2. Climate change **is not sufficiently** considered.

3. Data gaps **are not sufficiently** identified and the GSP **does not have a plan** to eliminate them.
4. Projects and Management Actions **do not sufficiently consider** potential impacts or benefits to beneficial uses and users.

Our specific comments related to the deficiencies of the Tulelake Subbasin Draft GSP along with recommendations on how to reconcile them, are provided in detail in **Attachment A.**

Please refer to the enclosed list of attachments for additional technical recommendations:

Attachment A	GSP Specific Comments
Attachment B	SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users
Attachment C	Freshwater species located in the basin
Attachment D	The Nature Conservancy's "Identifying GDEs under SGMA: Best Practices for using the NC Dataset"
Attachment E	Maps of representative monitoring sites in relation to key beneficial users

Thank you for fully considering our comments as you finalize your GSP.

Best Regards,

Ngodoo Atume
Water Policy Analyst
Clean Water Action/Clean Water Fund

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Western States Climate and Water Scientist
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Attachment A

Specific Comments on the Tulelake Subbasin Draft Groundwater Sustainability Plan

1. Consideration of Beneficial Uses and Users in GSP development

Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes,[1] groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine.

A. Identification of Key Beneficial Uses and Users

Disadvantaged Communities and Drinking Water Users

The identification of Disadvantaged Communities (DACs) and drinking water users is **insufficient**. We note the following deficiencies with the identification of these key beneficial users.

- While the GSP implies that the whole subbasin qualifies as a DAC or SDAC, the GSP fails to identify, name and map each DAC or SDAC. It also fails to provide the population of each DAC within the subbasin.
- The GSP provides a density map of domestic wells in Figure 2-9, but fails to include the depth of these wells (such as minimum well depth, average well depth, or depth range) within the subbasin. This information is necessary to understand the distribution of shallow and vulnerable drinking water wells within the basin.
- While Figure 2-4 identifies the water source types for the subbasin, the GSP fails to explicitly identify the populations dependent on groundwater as their source of drinking water. Specifics are not provided on how much each DAC community relies on a particular water supply (e.g., what percentage is supplied by groundwater).

These missing elements are required for the GSA to fully understand the specific interests and water demands of these beneficial users, and to support the consideration of beneficial users in the development of sustainable management criteria and selection of projects and management actions.

RECOMMENDATIONS
● Describe and map the locations of DACs and provide the population of each DAC. The DWR DAC mapping tool can be used for this purpose.[2] Identify the sources of drinking water for DAC members, including an estimate of how many people rely on

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[1] Our letter provides a review of the identification and consideration of federally recognized tribes (Data source: SGMA Data viewer) within the GSP from non-tribal members and NGOs. Based on the likely incomplete information available to our organizations for this review, we recommend that the GSA utilize the California Department of Water Resources' "Engagement with Tribal Governments" Guidance Document (https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents) to comprehensively address these important beneficial users in their GSP.

[2] The DWR DAC mapping tool is available online at: https://gis.water.ca.gov/app/dacs/.

groundwater (e.g., domestic wells, state small water systems, and public water systems).

- Include a map showing domestic well locations and average well depth across the subbasin.

Interconnected Surface Waters

The identification of Interconnected Surface Waters (ISW) is **insufficient**, due to lack of supporting information provided for the ISW analysis. The GSP describes the use of a groundwater model (referred to as the GSA Model in Appendix K) to analyze the interaction between groundwater and surface water within the subbasin. While the Appendix gives a detailed description of the model, the GSP could be improved by including a summary in the main GSP text. This information should include groundwater level monitoring well data and stream gauge data that were incorporated into the model, the screening depths of wells used in the groundwater model, and description of the temporal (seasonal and interannual) variability of the data used to calibrate the model.

The GSP states (p. 2-58): *"The model was used to develop estimates of timing and volume of gains and losses."* However, it is not clear where this information is presented. No overall map of stream reaches showing interconnected reaches in the subbasin is presented in the main GSP text or the model appendix.

RECOMMENDATIONS

- Provide a map showing all the stream reaches in the subbasin, with reaches clearly labeled as interconnected (gaining/losing) or disconnected. Consider any segments with data gaps as potential ISWs and clearly mark them as such on maps provided in the GSP.

- Further describe the groundwater elevation data, including well screen depth interval, and stream flow data used in the GSA Model.

- To confirm and illustrate the results of the groundwater modeling, overlay the subbasin's stream reaches on depth-to-groundwater contour maps to illustrate groundwater depths and the groundwater gradient near the stream reaches. Show the location of groundwater wells used in the analysis.

- For the depth-to-groundwater contour maps, use the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a Digital Elevation Model (DEM) to estimate depth-to-groundwater contours across the landscape. This will provide accurate contours of depth to groundwater along streams and other land surface depressions where GDEs are commonly found.

Groundwater Dependent Ecosystems

The identification of Groundwater Dependent Ecosystems (GDEs) is **insufficient**. The GSP took initial steps to identify and map GDEs using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset). However, we found that some mapped features in the NC dataset were improperly disregarded. NC dataset polygons were incorrectly removed in areas adjacent to irrigated fields or due to the presence of surface water supplies (including Tule Lake Sumps). However, this removal criteria is flawed since GDEs can rely on multiple water sources – including shallow groundwater receiving inputs from surface water supplies or irrigation return flow from nearby irrigated fields – simultaneously and at different temporal/spatial scales. NC dataset polygons adjacent to irrigated land or surface water supplies can still potentially be reliant on shallow groundwater aquifers, and therefore should not be removed solely based on their proximity to irrigated fields or surface water supplies.

The GSP uses depth-to-groundwater data from Spring 2019 to characterize areas where the depth to groundwater was greater than 30 feet. We recommend using groundwater data from multiple seasons and water year types to determine the range of depth to groundwater around NC dataset polygons. Using seasonal groundwater elevation data over multiple water year types is an essential component of identifying GDEs and is necessary to capture the variability in groundwater conditions inherent in California's Mediterranean climate.

Appendix H (Technical Memorandum – GDE Identification Data Processing Approach) presents a summary table of the vegetation and wetland classifications present in the NC Dataset. However, the GSP does not provide an inventory of the subbasin's fauna or acknowledge endangered, threatened, or special status species in the subbasin.

RECOMMENDATIONS

- Re-evaluate the NC dataset polygons that are adjacent to irrigated fields or surface water supplies. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.

- Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types.

- If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as "Potential GDEs" in the GSP until data gaps are reconciled in the monitoring network.

- Include an inventory of the fauna and flora present within the subbasin's GDEs (see Attachment C of this letter for a list of freshwater species located in the Tulelake Subbasin). Note any threatened or endangered species.

Native Vegetation and Managed Wetlands

Native vegetation and managed wetlands are water use sectors that are required to be included in the water budget.[3,4] The integration of these ecosystems into the water budget is **insufficient**. The water budget did not include the current, historical, and projected demands of native

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[3] "'Water use sector' refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation." [23 CCR §351(al)]

[4] "The water budget shall quantify the following, either through direct measurements or estimates based on data: (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow." [23 CCR §354.18]

vegetation and managed wetlands. The GSP states that 12% of the subbasin is comprised of managed wetlands (p. 2-7). The omission of explicit water demands for native vegetation and managed wetlands is problematic because key environmental uses of groundwater are not being accounted for as water supply decisions are made using this budget, nor will they likely be considered in project and management actions.

RECOMMENDATION

- Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation and managed wetlands.

B. Engaging Stakeholders

Stakeholder Engagement During GSP Development

Stakeholder engagement during GSP development is **insufficient**. SGMA's requirement for public notice and engagement of stakeholders is not fully met by the description in the Communication and Engagement Plan (Appendix C).[5]

For environmental stakeholders, the GSP notes inclusion of environmental stakeholder representation during the GSP development and implementation phases through the Tulelake Subbasin Core Advisory Team.

However, we note the following deficiencies with the overall stakeholder engagement process. Engagement opportunities listed for subbasin stakeholders are described in very general terms and include: emails sent to an established interested party email list, maintaining a list of interested stakeholder email database, website postings with agendas, meeting minutes, and presentations, and newspaper media.

The plan fails to provide information on outreach and engagement activities that are specifically targeted to DACs and domestic well owners. The GSP should be explicit in terms of how the GSA is *directly* engaging with stakeholders in a manner that recognizes the specific challenges and needs of DAC residents in the subbasin.

RECOMMENDATIONS

- In the Communication and Engagement Plan, describe active and targeted outreach to engage DACs and domestic well owners throughout the GSP development and implementation phases. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process.

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[5] "A communication section of the Plan shall include a requirement that the GSP identify how it encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin." [23 CCR §354.10(d)(3)]

- Utilize DWR's tribal engagement guidance to comprehensively address all tribes and tribal interests in the subbasin within the GSP.[6]

C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users

The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is **insufficient**. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results and establishing minimum thresholds.[7,8,9]

Disadvantaged Communities and Drinking Water Users

For chronic lowering of groundwater levels, the GSP states (p. 5-8): *"If the monitoring well is screened within the shallow aquifer and within three miles of a domestic well or wells, then the MT is defined as the minimum domestic well depth."* Table 5.1 (Groundwater Level Minimum Thresholds) provides the minimum thresholds and each well's historic low, represented at feet below ground surface. In all cases, the minimum threshold is deeper than the historic low groundwater depth, and for five of nine wells is at least twenty feet deeper than historic groundwater lows. The GSP does not sufficiently describe whether minimum thresholds will avoid significant and unreasonable loss of drinking water to domestic well users that are not protected by the minimum threshold, and whether the undesirable results are consistent with the Human Right to Water policy.[10] In addition, the GSP does not sufficiently describe or analyze direct or indirect impacts on DACs or drinking water users when defining undesirable results, nor does it describe how the groundwater levels minimum thresholds are consistent with Human Right to Water policy and will avoid significant and unreasonable impacts on beneficial users.

For degraded water quality, SMC are established for nitrate and total dissolved solids (TDS). The GSP states (p. 5-9): *"The MTs for nitrate and TDS have been set equal to 10% less than the federal and/or state established goals. For nitrate, the MT is equal to 9.0 milligrams per liter (mg/L), which is less than the maximum contaminant level goal (MCLG) of 10 milligrams per liter (mg/L). This MT allows for continued use of groundwater as a drinking water supply without local public water suppliers needing to invest in systems for nitrate removal. For TDS, the MT is equal to 900 mg/L which is less than the State of California secondary drinking water standard upper limit of 1,000 mg/L. This MT is protective of the secondary standard for drinking water and water quality needed for irrigation purposes. These MTs are applied to all representative water quality monitoring wells."* Section 2.2.2.6 (Groundwater Quality) states that arsenic concentrations in groundwater have exceeded the MCL of 10 micrograms per liter in the Subbasin. The GSP has

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[6] Engagement with Tribal Governments Guidance Document. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Guidance-Doc-for-SGM-Engagement-with-Tribal-Govt_ay_19.pdf

[7] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." [23 CCR §354.26(b)(3)]

[8] "The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[9] "The description of minimum thresholds shall include [...] how state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the agency shall explain the nature of and the basis for the difference." [23 CCR §354.28(b)(5)]

[10] California Water Code §106.3. Available at: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT&sectionNum=106.3

not established minimum thresholds for arsenic, however. SMC should be established for all COCs in the subbasin impacted or exacerbated by groundwater use and/or management.

RECOMMENDATIONS

Chronic Lowering of Groundwater Levels

- Describe direct and indirect impacts on DACs and drinking water users when describing undesirable results and defining minimum thresholds for chronic lowering of groundwater levels.

- Consider and evaluate the impacts of selected minimum thresholds and measurable objectives on DACs and drinking water users within the subbasin. Further describe the impact of passing the minimum threshold for these users. For example, provide the number of domestic wells that would be fully or partially de-watered at the minimum threshold.

Degraded Water Quality

- Describe direct and indirect impacts on DACs and drinking water users when defining undesirable results for degraded water quality.[11] For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."[12]

- Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on DACs and drinking water users.

- Set minimum thresholds and measurable objectives for all water quality constituents within the subbasin that are impacted or exacerbated by groundwater use and/or management.

Groundwater Dependent Ecosystems and Interconnected Surface Waters

Sustainable management criteria for chronic lowering of groundwater levels provided in the GSP do not consider potential impacts to environmental beneficial users. The GSP neither describes nor analyzes direct or indirect impacts on environmental users of groundwater when defining undesirable results. This is problematic because without identifying potential impacts on GDEs, minimum thresholds may compromise, or even destroy, these environmental beneficial users. Since GDEs are present in the subbasin, they must be considered when developing SMC.

Sustainable management criteria for depletion of interconnected surface water are established by proxy using groundwater elevations. The undesirable result is set as follows: *"Groundwater elevations dropping below the Minimum Threshold criteria at this representative monitoring location* [DWR Monitoring Well No. 48N04E22M001M located adjacent to the Lost River] *over three consecutive spring measurements."* It should be noted that the minimum threshold at this well, as presented in Table 5-1 and set to the minimum domestic well depth, is set at 48 feet below ground surface, which is 19 feet *lower* than the historic groundwater low. No analysis or

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[11] "Degraded Water Quality [...] collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues." [23 CCR §354.34(c)(4)]

[12] Guide to Protecting Water Quality under the Sustainable Groundwater Management Act https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

discussion is presented to describe how the SMC will affect beneficial users, and more specifically GDEs, or the impact of these minimum thresholds on GDEs in the subbasin. Furthermore, the GSP makes no attempt to evaluate how the proposed minimum thresholds and measurable objectives avoid significant and unreasonable effects on surface water beneficial users in the subbasin (see Attachment C for a list of environmental users in the subbasin), such as increased mortality and inability to perform key life processes (e.g., reproduction, migration).

RECOMMENDATIONS

- When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the subbasin.[13] Defining undesirable results is the crucial first step before the minimum thresholds can be determined.[14]

- When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the subbasin are reached.[15] The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts on environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.[6,16]

- When establishing SMC for the subbasin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs shall include "impacts on groundwater dependent ecosystems".

2. Climate Change

The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations require integration of climate change into the projected water budget to ensure that projects and management actions sufficiently

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[13] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results". [23 CCR §354.26(b)(3)]

[14] The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[15] "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." [23 CCR §354.28(c)(6)]

[16] Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/Critical_Species_LookBook_91819.pdf

account for the range of potential climate futures.[17] The effects of climate change can intensify the impacts of water stress on GDEs, making available shallow groundwater resources more critical for their survival. Research shows that GDEs are more likely to succumb to water stress and rely more on groundwater during times of drought.[18] When shallow groundwater is unavailable, riparian forests can die off and key life processes (e.g., migration and spawning) for aquatic organisms, such as steelhead, can be impeded.

The integration of climate change into the projected water budget is **insufficient**. The GSP incorporates climate change into the projected water budget using DWR change factors for 2070. However, the plan does not consider multiple climate scenarios (e.g., the 2070 extremely wet and extremely dry climate scenarios) in the projected water budget. The GSP would benefit from clearly and transparently incorporating the extremely wet and dry scenarios provided by DWR into projected water budgets or select more appropriate extreme scenarios for the subbasin. While these extreme scenarios may have a lower likelihood of occurring, their consequences could be significant and their inclusion can help identify important vulnerabilities in the subbasin's approach to groundwater management.

The GSP integrates climate change into key inputs (e.g., changes in precipitation and evapotranspiration) of the projected water budget. However, the plan fails to include surface water flow inputs for the projected water budget and incorporate the effects of climate change on these flows. The sustainable yield is calculated based on the projected water budget with climate change incorporated. However, if the water budgets are incomplete, including the omission of extremely wet and dry scenarios and the omission of projected climate change effects on surface water flow inputs, then there is increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not adequately include climate change projections may underestimate future impacts on vulnerable beneficial users of groundwater such as DACs, ecosystems, and domestic well owners.

RECOMMENDATIONS

- Integrate climate change, including extremely wet and dry scenarios, into all elements of the projected water budget to form the basis for development of sustainable management criteria and projects and management actions.
- Include surface water flow inputs in the projected water budget and incorporate climate change effects on these flows.
- Incorporate climate change scenarios into projects and management actions.

3. Data Gaps

The consideration of beneficial users when establishing monitoring networks is **insufficient**, due to lack of specific plans to increase the Representative Monitoring Wells (RMWs) in the monitoring network that represent water quality conditions and shallow groundwater elevations around DACs, domestic wells,

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[17] “Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow.” [23 CCR §354.18(e)]

[18] Condon et al. 2020. Evapotranspiration depletes groundwater under warming over the contiguous United States. Nature Communications. Available at: https://www.nature.com/articles/s41467-020-14688-0

GDEs, and ISWs in the subbasin. These beneficial users may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network.[19]

Figure 3-1 (Representative Groundwater Level Monitoring Network) shows insufficient representation of drinking water users and DACs for groundwater elevation monitoring. Figure 3-2 (Groundwater Quality Monitoring Network) shows insufficient representation of drinking water users and DACs for water quality monitoring. Refer to Attachment E for maps of these monitoring sites in relation to key beneficial users of groundwater.

The GSP provides some discussion of data gaps for GDEs and ISWs in Section 6.1.4 (Projects and Management Actions - Groundwater Dependent Ecosystems), but does not provide specific plans, such as locations or a timeline, to fill the data gaps.

RECOMMENDATIONS

- Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, GDEs, and ISWs to clearly identify monitored areas.
- Increase the number of RMWs in the shallow aquifer across the subbasin as needed to adequately monitor all groundwater condition indicators across the subbasin and at appropriate depths for *all* beneficial users. Prioritize proximity to DACs, domestic wells, GDEs, and ISWs when identifying new RMWs.
- Ensure groundwater elevation and water quality RMWs are monitoring groundwater conditions spatially and at the correct depth for *all* beneficial users - especially DACs, domestic wells, and GDEs.

4. Addressing Beneficial Users in Projects and Management Actions

The consideration of beneficial users when developing projects and management actions is **insufficient** due to the failure to completely identify benefits or impacts of identified projects and management actions, including water quality impacts, to key beneficial users of groundwater such as GDEs, aquatic habitats, surface water users, DACs, and drinking water users. Therefore, potential project and management actions may not protect these beneficial users. Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for *all* beneficial users.

While Section 6.1.5 documents the GSA's interest in groundwater recharge projects, the GSP fails to provide details or describe these projects' explicit benefits or impacts to beneficial users, including the environment and DACs. The GSP includes a domestic well assistance program. However, the program is described as a potential project to be implemented on an as-needed basis instead of a proposed project that will be implemented within the GSP planning horizon. We strongly recommend inclusion of a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation.

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[19] "The monitoring network objectives shall be implemented to accomplish the following: [...] (2) Monitor impacts to the beneficial uses or users of groundwater." [23 CCR §354.34(b)(2)]

RECOMMENDATIONS

- For DACs and domestic well owners, provide specific plans for implementation of a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.

- For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSAs plans to mitigate such impacts.

- Recharge ponds, reservoirs, and facilities for managed aquifer recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document."[20]

- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

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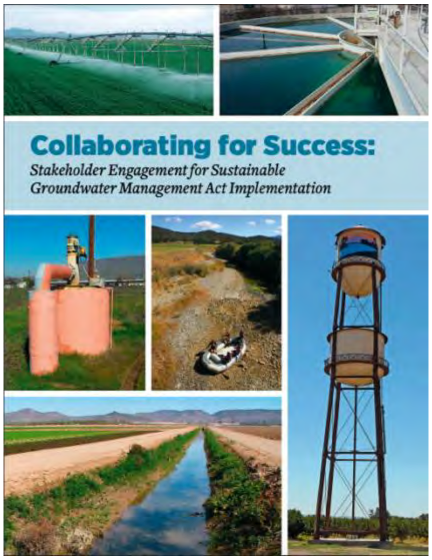
[20] The Nature Conservancy. 2021. Multi-Benefit Recharge Project Methodology for Inclusion in Groundwater Sustainability Plans. Sacramento. Available at: https://groundwaterresourcehub.org/sgma-tools/multi-benefit-recharge-project-methodology-guidance/

Attachment B

SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

Stakeholder Engagement and Outreach



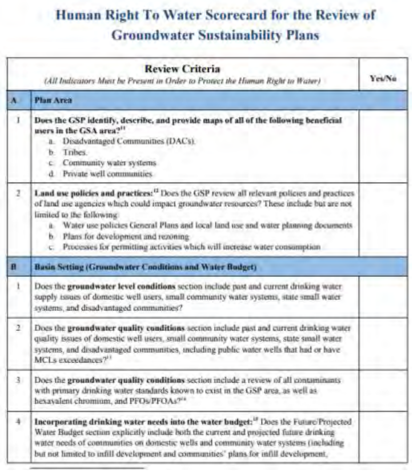
Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.

- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.

- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

The Human Right to Water

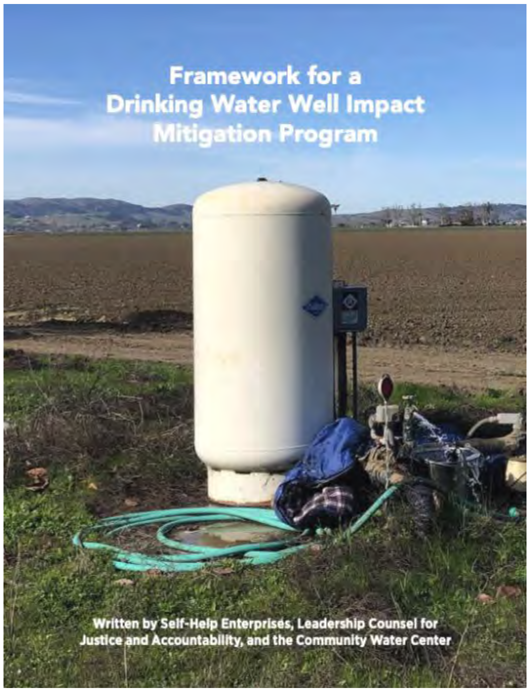


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	**Yes/No**
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[11] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems d. Private well communities	
2	**Land use policies and practices:**[12] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning c. Processes for permitting activities which will increase water consumption	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[13]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[14]	
4	**Incorporating drinking water needs into the water budget:**[15] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development,	

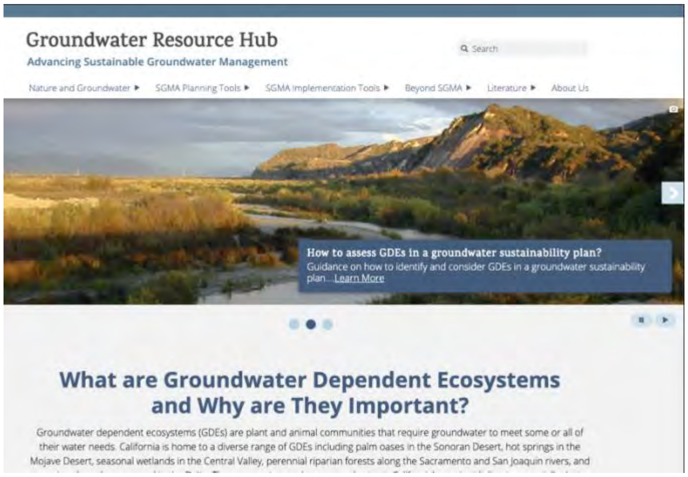
The Human Right to Water Scorecard was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



The Drinking Water Well Impact Mitigation Framework was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

Groundwater Resource Hub



How to assess GDEs in a groundwater sustainability plan?
Guidance on how to identify and consider GDEs in a groundwater sustainability plan... Learn More

What are Groundwater Dependent Ecosystems and Why are They Important?

Groundwater dependent ecosystems (GDEs) are plant and animal communities that require groundwater to meet some or all of their water needs. California is home to a diverse range of GDEs including palm oases in the Sonoran Desert, hot springs in the Mojave Desert, seasonal wetlands in the Central Valley, perennial riparian forests along the Sacramento and San Joaquin rivers, and

The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database

The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

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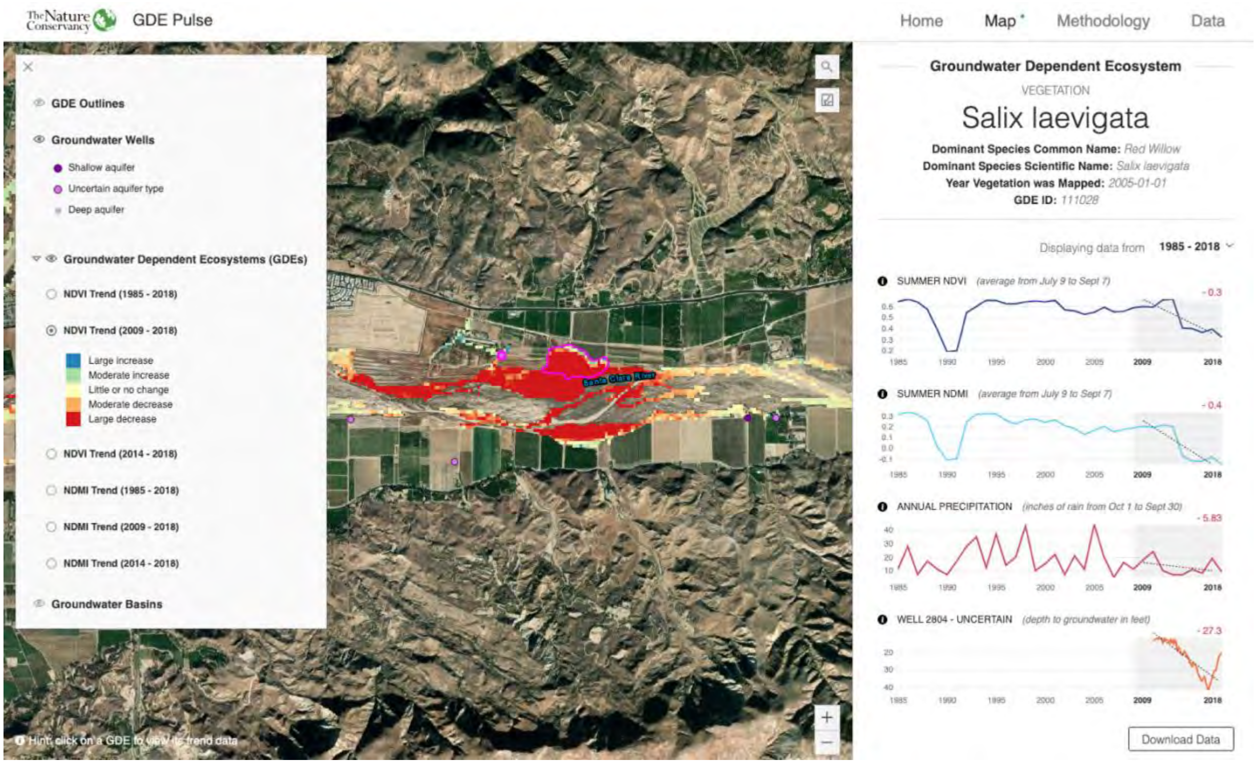
[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



Groundwater Dependent Ecosystem

VEGETATION

Salix laevigata

Dominant Species Common Name: *Red Willow*
Dominant Species Scientific Name: *Salix laevigata*
Year Vegetation was Mapped: *2005-01-01*
GDE ID: *111028*

Displaying data from **1985 - 2018**

[GDE Pulse](#) is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

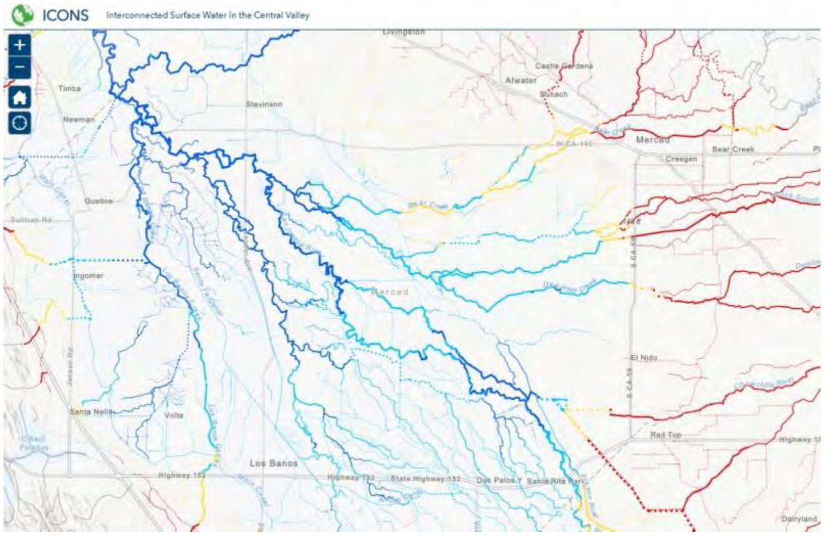
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



ICONS maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

Freshwater Species Located in the Tulelake Basin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the Tulelake Basin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[1]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[2] as well as on The Nature Conservancy's science website[3].

Scientific Name	Common Name	Legal Protected Status		
		Federal	**State**	**Other**
BIRDS				
Actitis macularius	Spotted Sandpiper			
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Aix sponsa	Wood Duck			
Anas acuta	Northern Pintail			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas cyanoptera	Cinnamon Teal			
Anas discors	Blue-winged Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Anser albifrons	Greater White-fronted Goose			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya affinis	Lesser Scaup			

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[1] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710

[2] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[3] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Aythya americana	Redhead		Special Concern	BSSC - Third priority
Aythya collaris	Ring-necked Duck			
Aythya marila	Greater Scaup			
Aythya valisineria	Canvasback		Special	
Botaurus lentiginosus	American Bittern			
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			
Calidris alpina	Dunlin			
Calidris mauri	Western Sandpiper			
Calidris minutilla	Least Sandpiper			
Chen caerulescens	Snow Goose			
Chen rossii	Ross's Goose			
Chlidonias niger	Black Tern		Special Concern	BSSC - Second priority
Chroicocephalus philadelphia	Bonaparte's Gull			
Cinclus mexicanus	American Dipper			
Cistothorus palustris palustris	Marsh Wren			
Cygnus columbianus	Tundra Swan			
Egretta thula	Snowy Egret			
Empidonax traillii	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Geothlypis trichas trichas	Common Yellowthroat			
Grus canadensis	Sandhill Crane			
Haliaeetus leucocephalus	Bald Eagle	Bird of Conservation Concern	Endangered	
Himantopus mexicanus	Black-necked Stilt			
Limnodromus scolopaceus	Long-billed Dowitcher			
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus merganser	Common Merganser			
Mergus serrator	Red-breasted Merganser			

Numenius americanus	Long-billed Curlew			
Numenius phaeopus	Whimbrel			
Nycticorax nycticorax	Black-crowned Night-Heron			
Oxyura jamaicensis	Ruddy Duck			
Pelecanus erythrorhynchos	American White Pelican		Special Concern	BSSC - First priority
Phalacrocorax auritus	Double-crested Cormorant			
Phalaropus tricolor	Wilson's Phalarope			
Plegadis chihi	White-faced Ibis		Watch list	
Pluvialis squatarola	Black-bellied Plover			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Recurvirostra americana	American Avocet			
Riparia riparia	Bank Swallow		Threatened	
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa semipalmata	Willet			
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
FISH				
Chasmistes brevirostris	Shortnose sucker	Endangered	Endangered	Endangered - Moyle 2013
Gila coerulea	Blue chub		Special Concern	Near-Threatened - Moyle 2013
HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Lithobates pipiens	Northern Leopard Frog		Special Concern	ARSSC
Pseudacris regilla	Northern Pacific Chorus Frog			
Rana pretiosa	Oregon Spotted Frog	Proposed Threatened	Special Concern	ARSSC

Spea intermontana	Great Basin Spadefoot			ARSSC
Thamnophis sirtalis sirtalis	Common Gartersnake			
INSECTS & OTHER INVERTS				
Sympetrum corruptum	Variegated Meadowhawk			
MAMMALS				
Castor canadensis	American Beaver			Not on any status lists
Neovison vison	American Mink			Not on any status lists
Ondatra zibethicus	Common Muskrat			Not on any status lists
Sorex palustris	American Water Shrew			Not on any status lists
MOLLUSKS				
Anodonta californiensis	California Floater		Special	
PLANTS				
Potentilla newberryi	Newberry's Cinquefoil		Special	CRPR - 2B.3
Rorippa columbiae	Columbia Yellowcress		Special	CRPR - 1B.2
Alopecurus pratensis	NA			
Lemna turionifera	Turion Duckweed			
Persicaria lapathifolia				Not on any status lists
Potamogeton richardsonii	Richardson's Pondweed			
Schoenoplectus acutus occidentalis	Hardstem Bulrush			
Stuckenia pectinata				Not on any status lists
Symphyotrichum frondosum	Alkali Aster			

Attachment D

July 2019

IDENTIFYING GDEs UNDER SGMA

Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

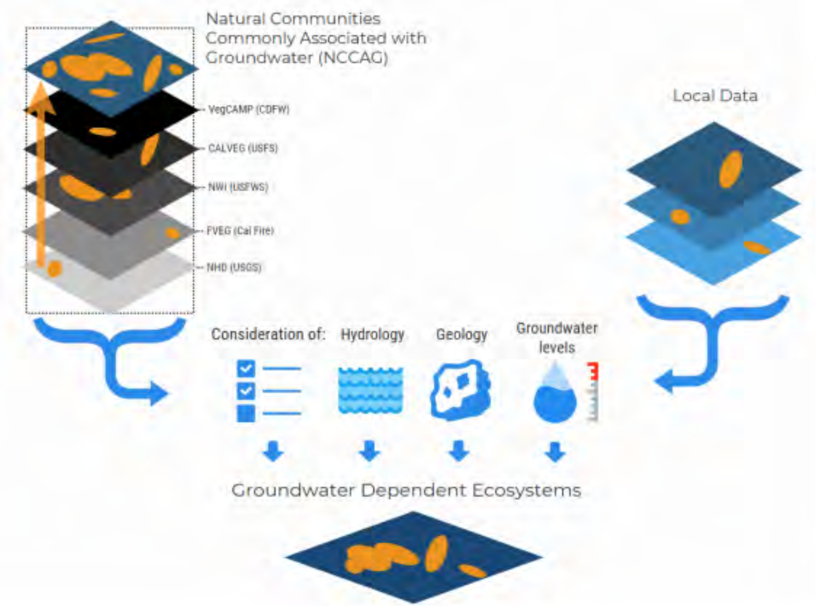

Figure 1. Considerations for GDE identification.
Source: DWR[2]

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[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/

[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[3]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[4] on the Groundwater Resource Hub[5], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

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[3] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf

[4] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/

[5] The Groundwater Resource Hub: www.GroundwaterResourceHub.org

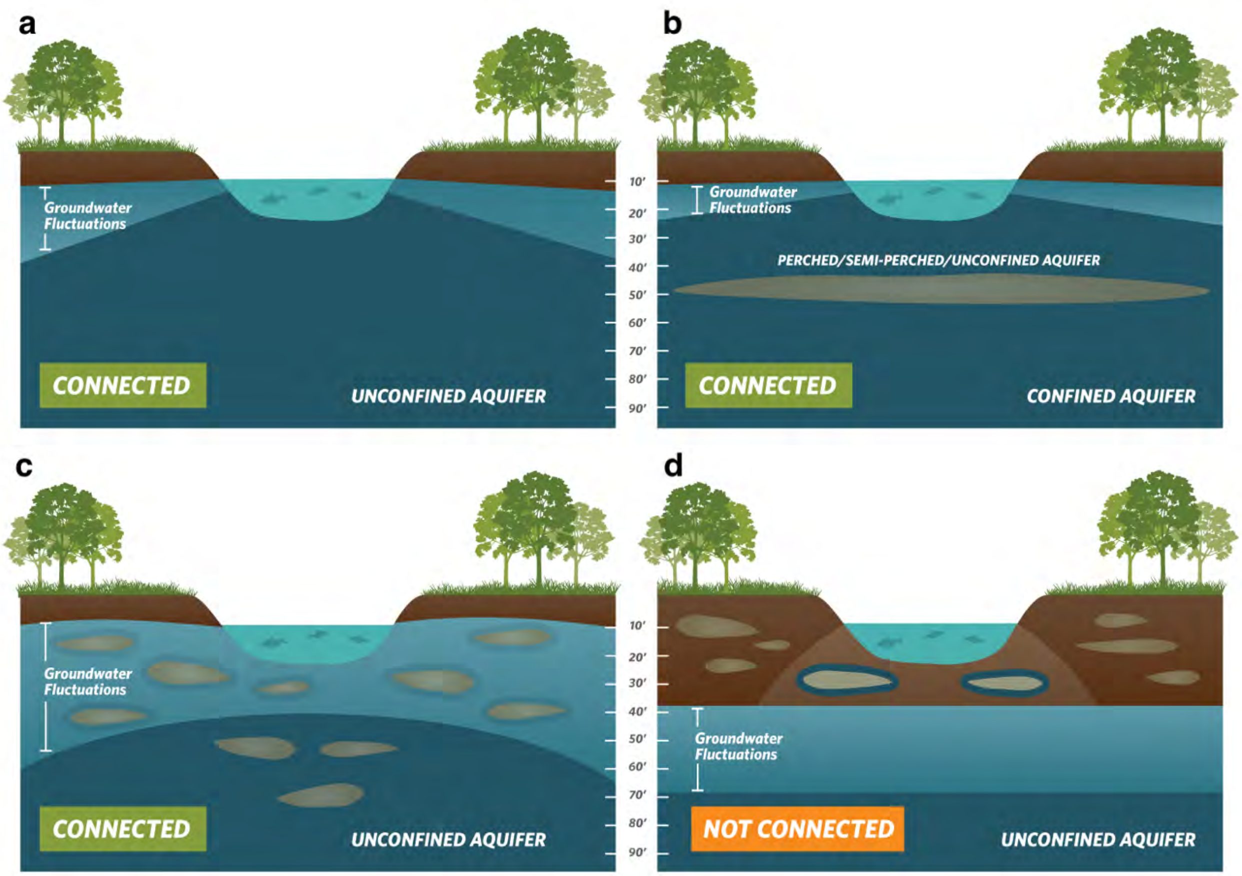

Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. (b) Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. Bottom: (c) Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. (d) Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[6] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[7] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[8] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[9]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).

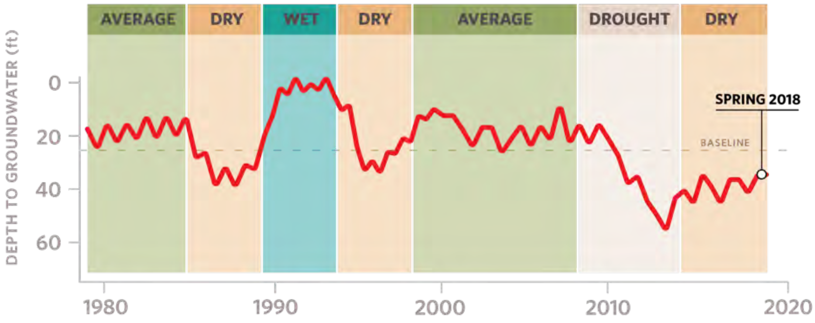

Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

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[6] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[7] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]

[8] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[9] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[10], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

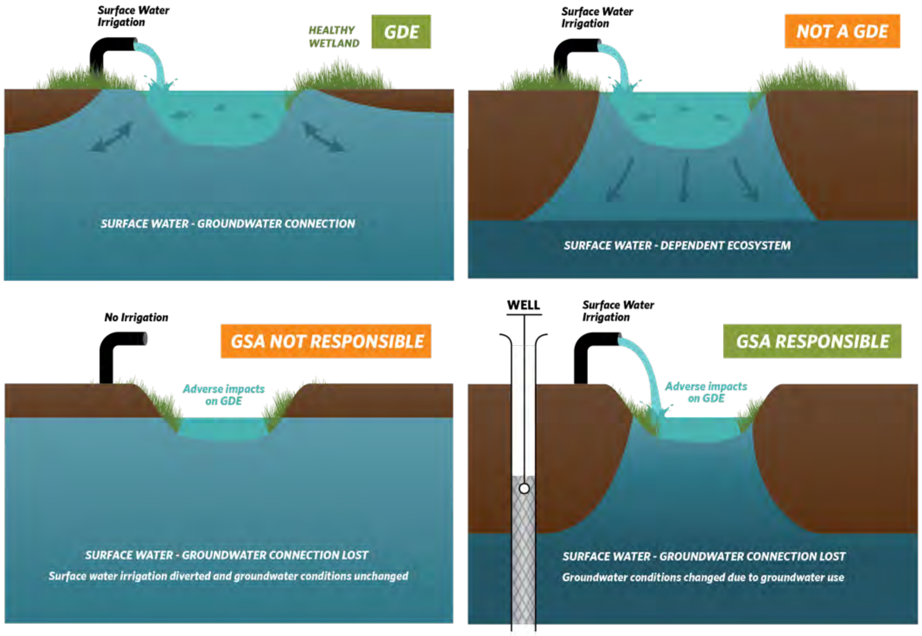

Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. (Right) Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. Bottom: (Left) An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. (Right) Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

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[10] For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

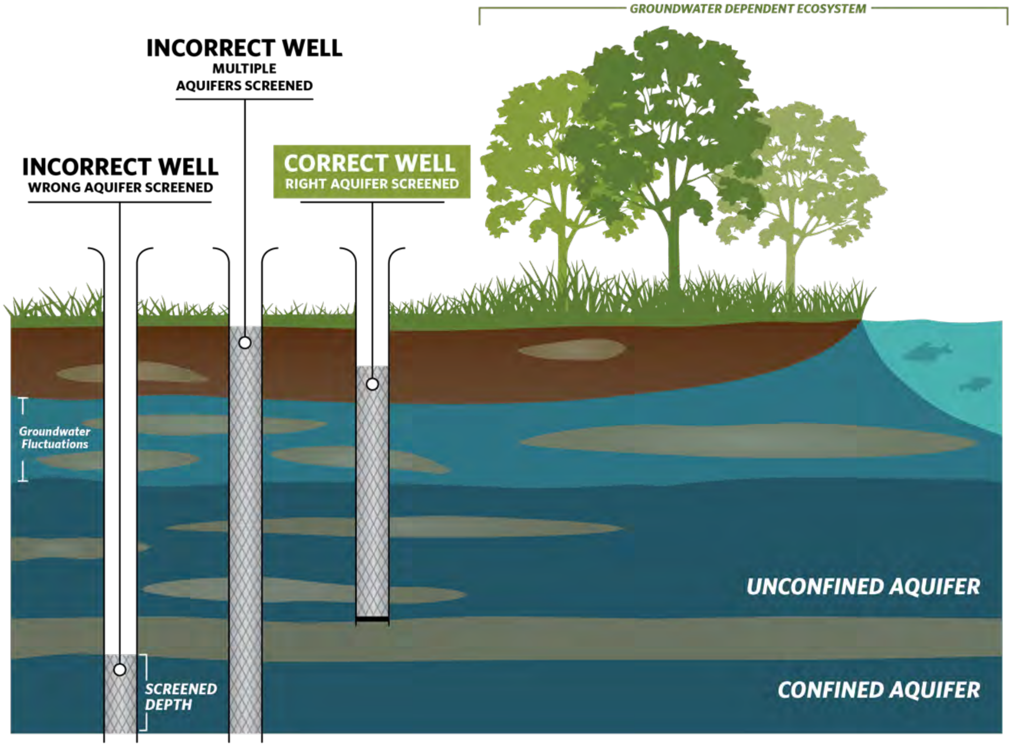

Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[11] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

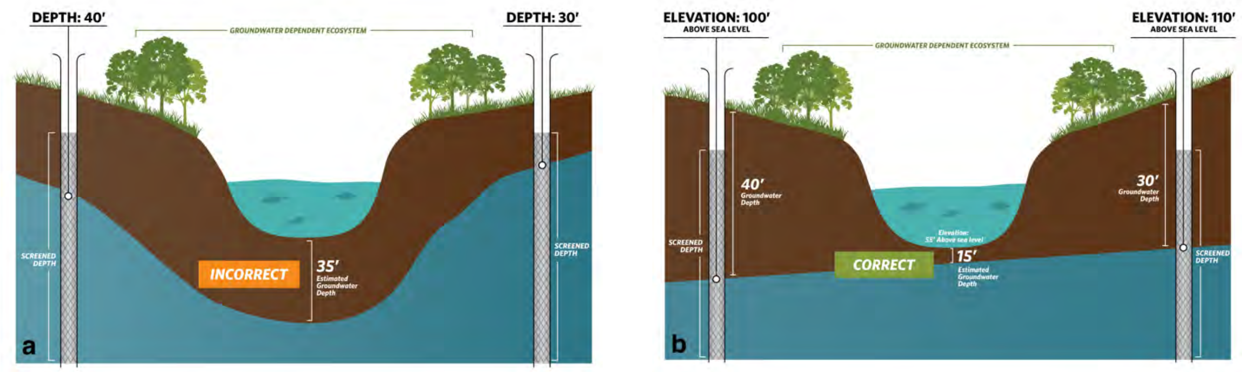

Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. (b) Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

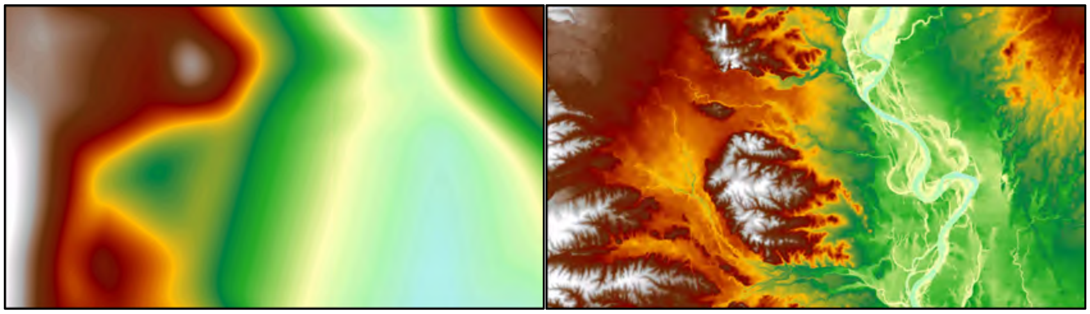

Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. (Right) Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

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[11] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network. Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

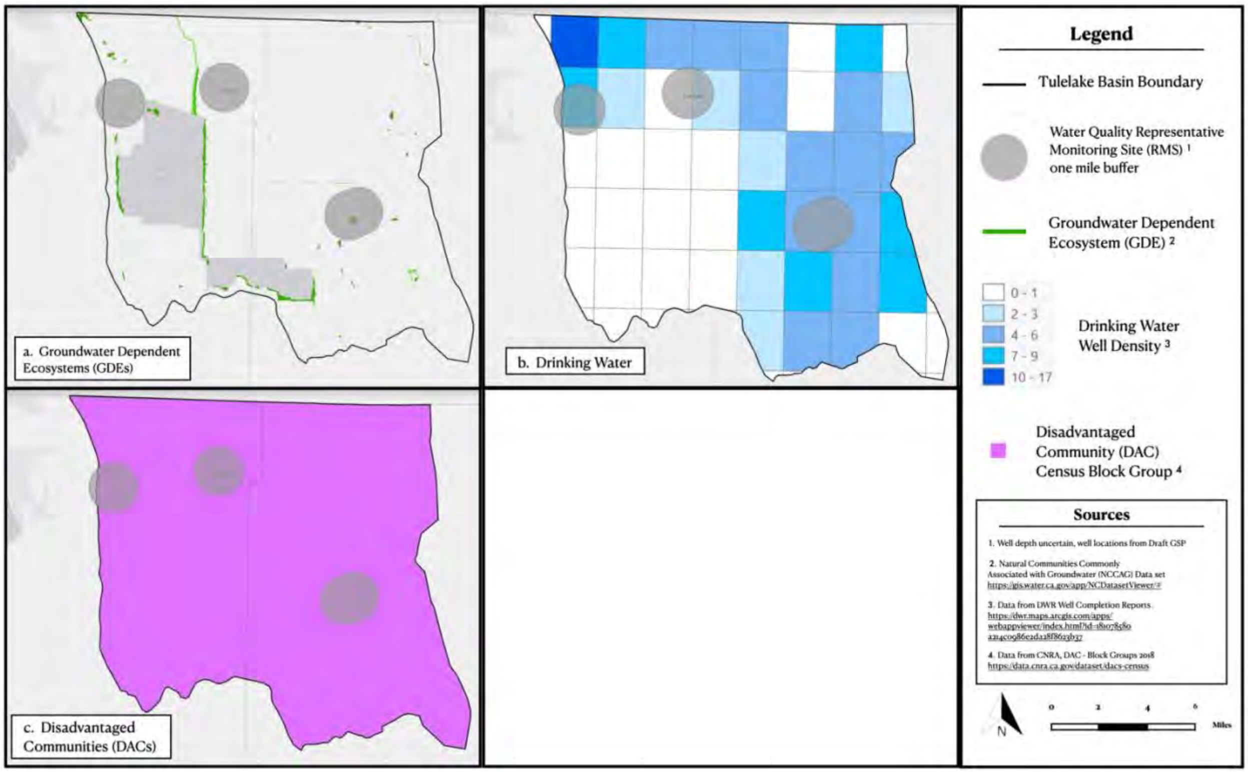
ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Attachment E

Maps of representative monitoring sites in relation to key beneficial users

Figure 1. Groundwater elevation representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.



Sources

1. Well depth uncertain, well locations from Draft GSP

2. Natural Communities Commonly Associated with Groundwater (NCCAG) Data set https://gis.water.ca.gov/app/NCDatasetViewer/#

3. Data from DWR Well Completion Reports https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37

4. Data from CNRA, DAC - Block Groups 2018 https://data.cnra.ca.gov/dataset/dacs-census

Figure 2. Groundwater quality representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.

Appendix D.
Element Checklist

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.			**Introduction to Plan Contents**					
			This Article describes the required contents of Plans submitted to the Department for evaluation, including administrative information, a description of the basin setting, sustainable management criteria, description of the monitoring network, and projects and management actions.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
SubArticle 1.			**Administrative Information**					
§ 354.2.			**Introduction to Administrative Information**					
			This Subarticle describes information in the Plan relating to administrative and other general information about the Agency that has adopted the Plan and the area covered by the Plan.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.4.			**General Information**					
			Each Plan shall include the following general information:					
(a)			An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.	8:15				
(b)			A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.	120	8			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10733.2 and 10733.4, Water Code.					
§ 354.6.			**Agency Information**					
			When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:					
(a)			The name and mailing address of the Agency.	18	1.3.1:1.3.4			
(b)			The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.	19				
(c)			The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.	19	1.3			
(d)			The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.	19	1.3.2			
(e)			An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.	19	1.3.3			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.8, 10727.2, and 10733.2, Water Code.					
§ 354.8.			**Description of Plan Area**					
			Each Plan shall include a description of the geographic areas covered, including the following information:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(a)			One or more maps of the basin that depict the following, as applicable:					
	(1)		The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.	21:22	2.1	1-1		
	(2)		Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.	21, 24	2.1.1.1:2.1.1.2			
	(3)		Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.	24:25	2.1.1.3			
	(4)		Existing land use designations and the identification of water use sector and water source type.	27, 29	2.1.1.4:2.1.1.5			
	(5)		The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.	35:38	2.1.1.6	2-8,2-9,2-10	2.2	
(b)			A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.	21	2.1,2.1.1			
(c)			Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.	39:42	2.1.2,2.1.2.1-2.1.2.10			
(d)			A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.	39	2.1.2			
(e)			A description of conjunctive use programs in the basin.	39	2.1.2.1:2.1.2.2			
(f)			A plain language description of the land use elements or topic categories of applicable general plans that includes the following:					
	(1)		A summary of general plans and other land use plans governing the basin.	43	2.1.3			
	(2)		A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects	43	2.1.3			
	(3)		A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.	43	2.1.3			
	(4)		A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.	41:42	2.1.2.9			

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(5)		To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.	44	2.1.3.4			
(g)			A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.	45	2.1.4			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10720.3, 10727.2, 10727.4, 10733, and 10733.2, Water Code.					
§ 354.10.			**Notice and Communication**					
			Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:					
(a)			A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.	46, 80:83, 163	2.2.2.9	2-37,2-38		Additional Information available in Appendix C
(b)			A list of public meetings at which the Plan was discussed or considered by the Agency.	46, 156:160				Additional Information available in Appendix C
(c)			Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.	46, 163:238	2.1.5			Additional Information available in Appendix C - Comments addressed on page 237 and 238
(d)			A communication section of the Plan that includes the following:					
	(1)		An explanation of the Agency’s decision-making process.	46, 150	2.1.5			Additional Information available in Appendix C
	(2)		Identification of opportunities for public engagement and a discussion of how public input and response will be used.	151:153	2.1.5			Additional Information available in Appendix C
	(3)		A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.	46, 236	2.1.5			Additional Information available in Appendix C
	(4)		The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.	46, 152:153				Additional Information available in Appendix C
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.8, 10728.4, and 10733.2, Water Code					
SubArticle 2.			**Basin Setting**					
§ 354.12.			**Introduction to Basin Setting**					
			This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.					
			Note: Authority cited: Section 10733.2, Water Code.					

Article 5.			**Plan Contents for Sample Basin**	**GSP Document References**				
				Page Numbers of Plan	**Or Section Numbers**	**Or Figure Numbers**	**Or Table Numbers**	**Notes**
			Reference: Section 10733.2, Water Code.					
§ 354.14.			**Hydrogeologic Conceptual Model**					
(a)			Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.	46:59	2.2.1:2.2.1.8			
(b)			The hydrogeologic conceptual model shall be summarized in a written description that includes the following:					
	(1)		The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.	52:58	2.2.1.1:2.2.1.6			
	(2)		Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.	45:53	2.2.1.1, 2.2.1.3			
	(3)		The definable bottom of the basin.	53	2.2.1.4			
	(4)		Principal aquifers and aquitards, including the following information:					
		(A)	Formation names, if defined.	52	2.2.1.2			
		(B)	Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.	52	2.2.1.2			
		(C)	Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.	54	2.2.1.3			
		(D)	General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.	57, 76	2.2.1.5, 2.2.2.6			
		(E)	Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.	43:44, 104	2.1.3.1, 2.1.3.4, 5.1			
	(5)		Identification of data gaps and uncertainty within the hydrogeologic conceptual model	55, 59	2.2.1.4, 2.2.1.7			
(c)			The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.	54,55	2.2.1.1:2.2.1.5			
(d)			Physical characteristics of the basin shall be represented on one or more maps that depict the following:					
	(1)		Topographic information derived from the U.S. Geological Survey or another reliable source.	51, 59	2.2.1.8, 2.2.1.1			
	(2)		Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.	54	2.2.1.4			
	(3)		Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.	50	2.2.1.1			

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(4)		Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.	57	2.2.1.5	2-16		
	(5)		Surface water bodies that are significant to the management of the basin.	47	2.2.1.1	2-5		
	(6)		The source and point of delivery for imported water supplies.	N/A				There is no imported water in the Subbasin.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10733, and 10733.2, Water Code.					
§ 354.16.			**Groundwater Conditions**					
			Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:					
(a)			Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:					
	(1)		Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.	71:74	2.2.2.2			
	(2)		Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.	65:69	2.2.2.1			
(b)			A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.	75	2.2.2.4			
(c)			Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.	75	2.2.2.5			Due to its geographic location, seawater intrusion is not a concern.
(d)			Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.	76, 88	2.2.2.6, 3.3.2			No known contaminant plumes exist, therefore no map of contamination sites is provided
(e)			The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	76:78	2.2.2.7	2-35, 2-36		
(f)			Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	78:80	2.2.2.8			
(g)			Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	80:83	2.2.2.9	2-37,2-38		
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, and 10733.2, Water Code.					
§ 354.18.			**Water Budget**					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(a)			Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.	92:101	4.1.1:4.1.3	4-3,4-4		Additional Information availabe in Appendix K
(b)			The water budget shall quantify the following, either through direct measurements or estimates based on data:					
	(1)		Total surface water entering and leaving a basin by water source type.	94:96	4.1.1:4.1.2			Additional Information availabe in Appendix K
	(2)		Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.	94:96	4.1.1:4.1.2			Additional Information availabe in Appendix K
	(3)		Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.	94:96	4.1.1:4.1.2			Additional Information availabe in Appendix K
	(4)		The change in the annual volume of groundwater in storage between seasonal high conditions.	96	4.1.2		4-4	Additional Information availabe in Appendix K
	(5)		If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.	94	4.1.1			No overdraft conditions exist, Additional Information availabe in Appendix K
	(6)		The water year type associated with the annual supply, demand, and change in groundwater stored.	75	2.2.2.4	2-31		Additional Information availabe in Appendix K
	(7)		An estimate of sustainable yield for the basin.	100:101	4.1.3	4-4	4.7	Additional Information availabe in Appendix K
(c)			Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:					
	(1)		Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.	94:96	4.1.1:4.1.2			Additional Information availabe in Appendix K
	(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.	94:96	4.1			Additional Information availabe in Appendix K

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				Page Numbers of Plan	**Or Section Numbers**	**Or Figure Numbers**	**Or Table Numbers**	**Notes**
		(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.	94:96	4.1.1			Additional Information availabe in Appendix K
		(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.	94	4.1.1			Additional Information availabe in Appendix K
	(3)		Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:					
		(A)	Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.	97:101	4.1.3		4-6	Additional Information availabe in Appendix K
		(B)	Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.	27:28, 97	2.1.1.4, 4.1.3			Additional Information availabe in Appendix K
		(C)	Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.	97:101	4.1.3			Additional Information availabe in Appendix K
(d)			The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:					
	(1)		Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.	75:76, 97, 105	2.2.2.4, 2.2.2.5, 5.2.2.2, 4.1.3			Additional Information availabe in Appendix K

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(2)		Current water budget information for temperature, water year type, evapotranspiration, and land use.	104:106	5.2.1.2, 5.2.2.2, 5.2.3.2			Additional Information availabe in Appendix K
	(3)		Projected water budget information for population, population growth, climate change, and sea level rise.	97	4.1.3			Sea level rise is not applicable.
(e)			Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.	59, 94, 97	4.1.1:4.1.3, 2.2.1.8			Additional Information availabe in Appendix K
(f)			The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.	93	N/A			Additional Information availabe in Appendix K
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10727.6, 10729, and 10733.2, Water Code.					
§ 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.	N/A				There are no management areas defined in the GSP
(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.	N/A				There are no management areas defined in the GSP
	(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.	N/A				There are no management areas defined in the GSP
	(3)		The level of monitoring and analysis appropriate for each management area.	N/A				There are no management areas defined in the GSP
	(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.	N/A				There are no management areas defined in the GSP
(c)			If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.	N/A				There are no management areas defined in the GSP

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10733.2 and 10733.4, Water Code.					
SubArticle 3.			**Sustainable Management Criteria**					
§ 354.22.			**Introduction to Sustainable Management Criteria**					
			This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.24.			**Sustainability Goal**					
			Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.	103	5.1			The Tulelake Subbasin is currently being sustainably managed, and as such, no goal is identified
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10727, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.26.			**Undesirable Results**					
(a)			Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.	103:108	5.2			
(b)			The description of undesirable results shall include the following:					
	(1)		The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.	104	5.2.1.2			
	(2)		The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.	104	5.2.1.3			
	(3)		Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.	104	5.2.1.2			

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(c)			The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.	108:110	5.3.1			
(d)			An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.	102, 75	5, 2.2.2.5			Saltwater Intrusion is not applicable to Tulelake Subbasin
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.28.			**Minimum Thresholds**					
(a)			Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.	108:111	5.3		5.1	Additional information to address corrective actions 1A and 1B provided in in sections 5.2.1.2, 5.2.1.3, 5.2.2.2, 5.3.1.2, table 5.1, and Appendix M of amended GSP
(b)			The description of minimum thresholds shall include the following:					
	(1)		The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.	104, 108, 110	5.2.1.1:5.2.6 5.3.1:5.3.2			
	(2)		The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.	108	5.3			
	(3)		How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.	N/A				There are no adjacent basins
	(4)		How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.	104:107	5.2.1.2, 5.2.2.2, 5.2.3.2, 5.2.4.2, 5.2.5.2			
	(5)		How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.	110	5.3.2			
	(6)		How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.	108, 110	5.3.1, 5.3.2			
(c)			Minimum thresholds for each sustainability indicator shall be defined as follows:					

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:					
		(A)	The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.	94	4.1.1			
		(B)	Potential effects on other sustainability indicators.	108	5.3.1			
	(2)		Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.	108	5.3.1			
	(3)		Seawater Intrusion. The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results. Minimum thresholds for seawater intrusion shall be supported by the following:					
		(A)	Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.	N/A				Seawater Intrusion is not applicable to Tulelake Subbasin
		(B)	A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.	N/A				Saltwater Intrusion is not applicable to Tulelake Subbasin
	(4)		Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.	110	5.3.2			
	(5)		Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:					
		(A)	Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency’s rationale for establishing minimum thresholds in light of those effects.	106	5.2.3.2			
		(B)	Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.	76	2.2.2.7			

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(6)		Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:					
		(A)	The location, quantity, and timing of depletions of interconnected surface water.	78:80	2.2.2.8			
		(B)	A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.	106:107	5.2.4.2, 5.2.4.3			
(d)			An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.	108:110	5.3.1			
(e)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.	105,107:108	5.2.3.1, 5.2.5.2, 5.2.6			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10733, 10733.2, and 10733.8, Water Code.					
§ 354.30.			**Measurable Objectives**					
(a)			Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.	108:111	5.3			
(b)			Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.	108:111	5.3			
(c)			Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.	108:111	5.3			
(d)			An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.	108:111	5.3			

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(e)			Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.	108:111	5.3			
(f)			Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.	N/A				Not Present (Optional)
(g)			An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.	N/A				Not Present (Optional)
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					
SubArticle 4.			**Monitoring Networks**					
§ 354.32.			**Introduction to Monitoring Networks**					
			This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.34.			**Monitoring Network**					
(a)			Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.	59, 84, 112:113	2.2.2.1, 3.3.1, 6.1.2:6.1.3			Additional information to address corrective actions 1A and 1B provided in in sections 5.2.1.2, 5.2.1.3, 5.2.2.2, 5.3.1.2, table 5.1, and Appendix M of amended GSP
(b)			Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:					
	(1)		Demonstrate progress toward achieving measurable objectives described in the Plan.	87, 108:111	3.3.1.3, 5.3			
	(2)		Monitor impacts to the beneficial uses or users of groundwater.	109	5.3.1.2			

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	(3)		Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.	40,109:110	2.1.2.4:2.1.2.5, 5.3.1.2			
	(4)		Quantify annual changes in water budget components.	75, 109:110	2.2.2.4, 5.3.1			
(c)			Each monitoring network shall be designed to accomplish the following for each sustainability indicator:					
	(1)		Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:					
		(A)	A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.	86:87	3.3.1.2			
		(B)	Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.	87	3.3.1.3			
	(2)		Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.	84, 96	3.3, 4.1.2			
	(3)		Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.	N/A				Seawater Intrusion is not applicable to Tulelake Subbasin
	(4)		Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.	76,88:90, 113	2.2.2.6, 3.3.2, 6.1.3			
	(5)		Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.	76:78, 87:88	2.2.2.7, 3.3.1.4			
	(6)		Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:					
		(A)	Flow conditions including surface water discharge, surface water head, and baseflow contribution.	78, 88	2.2.2.8, 3.3.1.5			
		(B)	Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.	78, 88	2.2.2.8, 3.3.1.5			
		(C)	Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.	78, 88	2.2.2.8, 3.3.1.5			
		(D)	Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.	78, 88	2.2.2.8, 3.3.1.5			

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(d)			The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.	91	3.3.3			
(e)			A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.	84, 88, 59	3.3, 3.3.1, 3.3.2, 2.2.2.1			
(f)			The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:					
	(1)		Amount of current and projected groundwater use.	87, 96, 97	3.3.1.4, 4.1.2, 4.1.3			
	(2)		Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.	52, 70, 78	2.2.1.2, 2.2.2.2, 2.2.2.8			
	(3)		Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.	104, 105	5.2.2.2, 5.2.1.2			
	(4)		Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.	94	4.1.1			
(g)			Each Plan shall describe the following information about the monitoring network:					
	(1)		Scientific rationale for the monitoring site selection process.	84:85	3.3.1.1			
	(2)		Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.	84:85	3.3.1.1			
	(3)		For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.	108:111	5.3		5.1, 5.2	
(h)			The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.	84:91, 114	3.2,3.3,6.1.7	3-1, 3-2	3.1	
(i)			The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.	87	3.3.1.3			Additional information is available in Appendix J

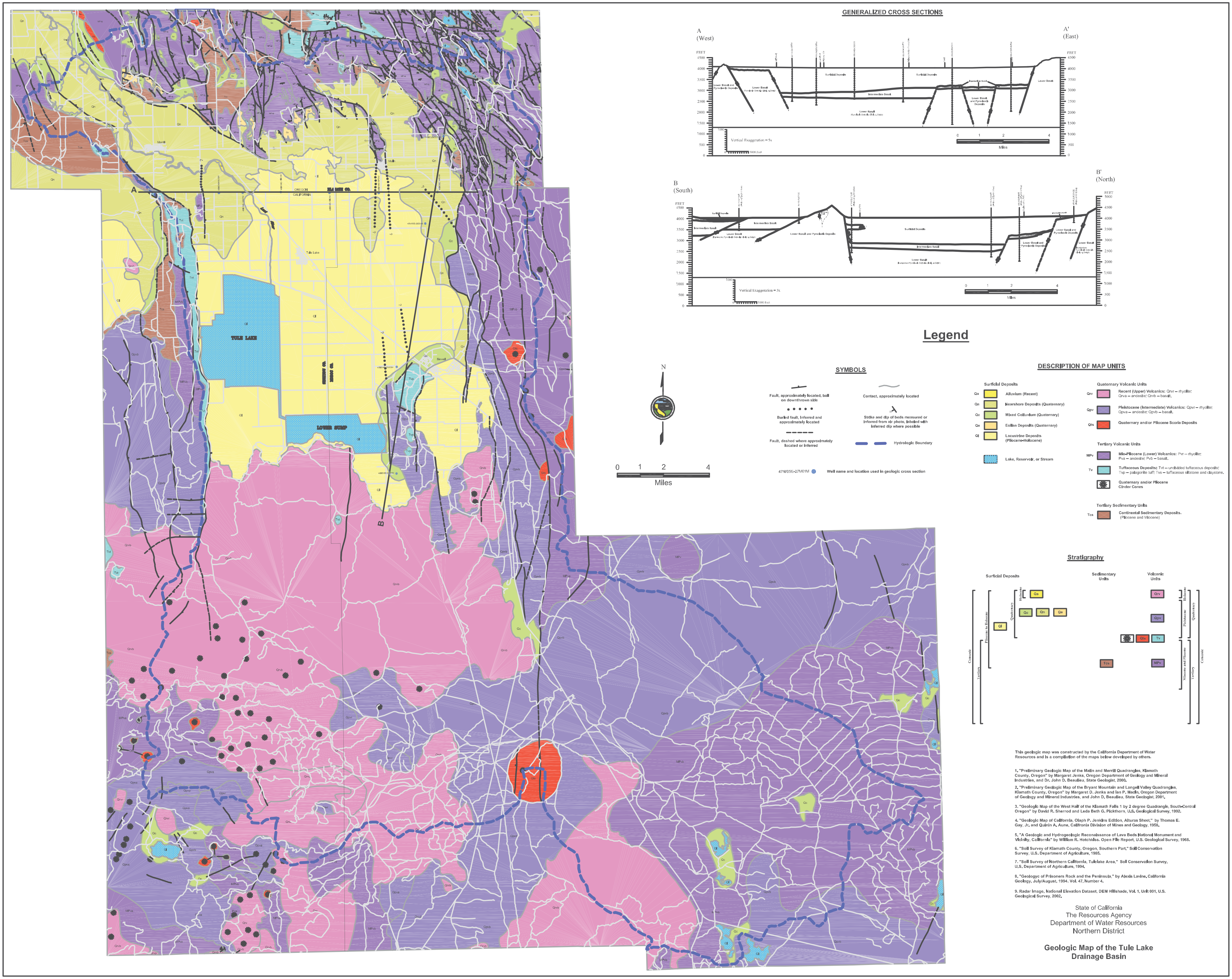
Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(j)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.	108	5.2.6			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, 10728, 10733, 10733.2, and 10733.8, Water Code					
§ 354.36.			**Representative Monitoring**					
			Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:					
(a)			Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.	84, 90	3.3.1.1, 3.3.2.1			Additional information to address corrective actions 1A and 1B provided in in sections 5.2.1.2, 5.2.1.3, 5.2.2.2, 5.3.1.2, table 5.1, and Appendix M of amended GSP
(b)			(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:					
	(1)		Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.	87, 91, 105:108	3.3.1.3, 3.3.3, 5.2.2.3, 5.2.3.3, 5.2.4.3, 5.2.5.3			
	(2)		Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.	108, 114	5.3.1, 6.1.7			
(c)			The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.	84:85	3.3.1.1			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2 and 10733.2, Water Code					
§ 354.38.			**Assessment and Improvement of Monitoring Network**					
(a)			Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.	112:113	6.1.1:6.1.4			
(b)			Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.	88, 90, 112	3.3.1.6, 3.3.2.4, 6.1.2			
(c)			If the monitoring network contains data gaps, the Plan shall include a description of the following:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		The location and reason for data gaps in the monitoring network.	88, 90	3.3.1.6, 3.3.2.4			
	(2)		Local issues and circumstances that limit or prevent monitoring.	88	3.3.1.6			
(d)			Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.	112, 113	6.1.2, 6.1.3			
(e)			Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:					
	(1)		Minimum threshold exceedances.	108, 110	5.3.1, 5.3.2			
	(2)		Highly variable spatial or temporal conditions.	112, 114	6,6.1.7			
	(3)		Adverse impacts to beneficial uses and users of groundwater.	114	6.1.7			
	(4)		The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.	N/A				There are no adjacent basins
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10728.2, 10733, 10733.2, and 10733.8, Water Code					
§ 354.40.			**Reporting Monitoring Data to the Department**					
			Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10728, 10728.2, 10733.2, and 10733.8, Water Code.					
SubArticle 5.			**Projects and Management Actions**					
§ 354.42.			**Introduction to Projects and Management Actions**					
			This Subarticle describes the criteria for projects and management actions to be included in a Plan to meet the sustainability goal for the basin in a manner that can be maintained over the planning and implementation horizon.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.44.			**Projects and Management Actions**					
(a)			Each Plan shall include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.	112, 114	6.1:6.1.7			Additional information related to domestic well assistance provided in sections 2.1.2.10, 6.1.6, and table 2.4 of amended GSP
(b)			Each Plan shall include a description of the projects and management actions that include the following:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:					
		(A)	A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.	112, 114	6.1.1:6.1.7			
		(B)	The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.	114	6.2			
	(2)		If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.	94	4.1.1			No overdraft conditions were identified
	(3)		A summary of the permitting and regulatory process required for each project and management action.	115	6.3			
	(4)		The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.	114	6.1.8		6.1	
	(5)		An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.	115	6.4			
	(6)		An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.	115	6.3			
	(7)		A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.	115	6.3			
	(8)		A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.	112, 116	6.1, 7.1			
	(9)		A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.	113	6.1.5			
(c)			Projects and management actions shall be supported by best available information and best available science.	117:118	7.3.1			
(d)			An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.	112	6			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					

Appendix E.
Tule Lake Subbasin Geologic Map and Cross-Sections

PLATE 1



GENERALIZED CROSS SECTIONS

Legend

SYMBOLS

Fault, approximately located, ball on downthrown side

Contact, approximately located

Buried fault, inferred and approximately located

Strike and dip of beds measured or inferred from air photo, labeled with inferred dip where possible

Fault, dashed where approximately located or inferred

Hydrologic Boundary

47N/05E-27M01M ● Well name and location used in geologic cross section

DESCRIPTION OF MAP UNITS

Surficial Deposits

Qa 🟨 Alluvium (Recent)

Qn 🟨 Nearshore Deposits (Quaternary)

Qc 🟩 Mixed Colluvium (Quaternary)

Qe 🟧 Eolian Deposits (Quaternary)

Ql 🟨 Lacustrine Deposits (Pliocene-Holocene)

🟦 Lake, Reservoir, or Stream

Quaternary Volcanic Units

Qrv 🟪 **Recent (Upper) Volcanics:** Qrvr -- rhyolite; Qrva -- andesite; Qrvb -- basalt.

Qpv 🟪 **Pleistocene (Intermediate) Volcanics:** Qpvr -- rhyolite; Qpva -- andesite; Qpvb -- basalt.

Qts 🟥 **Quaternary and/or Pliocene Scoria Deposits**

Tertiary Volcanic Units

MPv 🟪 **Mio-Pliocene (Lower) Volcanics:** Pvr -- rhyolite; Pva -- andesite; Pvb -- basalt.

Tv 🟦 **Tuffaceous Deposits:** Tvt -- undivided tuffaceous deposits; Tvp -- palagonite tuff; Tvs -- tuffaceous siltstone and claystone.

✱ **Quaternary and/or Pliocene Cinder Cones**

Tertiary Sedimentary Units

Tcs 🟫 **Continental Sedimentary Deposits.** (Pliocene and Miocene)

Stratigraphy

This geologic map was constructed by the California Department of Water Resources and is a compilation of the maps below developed by others.

1. "Preliminary Geologic Map of the Malin and Merrill Quadrangles, Klamath County, Oregon" by Margaret Jenks, Oregon Department of Geology and Mineral Industries, and Dr. John D. Beaulieu, State Geologist, 2000.
2. "Preliminary Geologic Map of the Bryant Mountain and Langell Valley Quadrangles, Klamath County, Oregon" by Margaret D. Jenks and Ian P. Madin, Oregon Department of Geology and Mineral Industries, and John D. Beaulieu, State Geologist, 2001.
3. "Geologic Map of the West Half of the Klamath Falls 1 by 2 degree Quadrangle, South-Central Oregon" by David R. Sherrod and Leda Beth G. Pickthorn, U.S. Geological Survey, 1992.
4. "Geologic Map of California, Olaph P. Jenkins Edition, Alturas Sheet," by Thomas E. Gay, Jr. and Quinin A. Aune, Califronia Division of Mines and Geology, 1958.
5. "A Geologic and Hydrogeologic Reconaissance of Lava Beds National Monument and Vicinity, California" by William R. Hotchkiss. Open File Report, U.S. Geological Survey, 1968.
6. "Soil Survey of Klamath County, Oregon, Southern Part," Soil Conservation Survey, U.S. Department of Agriculture, 1985.
7. "Soil Survey of Northern California, Tulelake Area," Soil Conservation Survey, U.S. Department of Agriculture, 1994.
8. "Geologyc of Prisoners Rock and the Peninsula," by Alexis Lavine. California Geology, July/August, 1994. Vol. 47, Number 4.
9. Radar Image, National Elevation Dataset, DEM Hillshade, Vol. 1, Unit 001, U.S. Geological Survey, 2002.

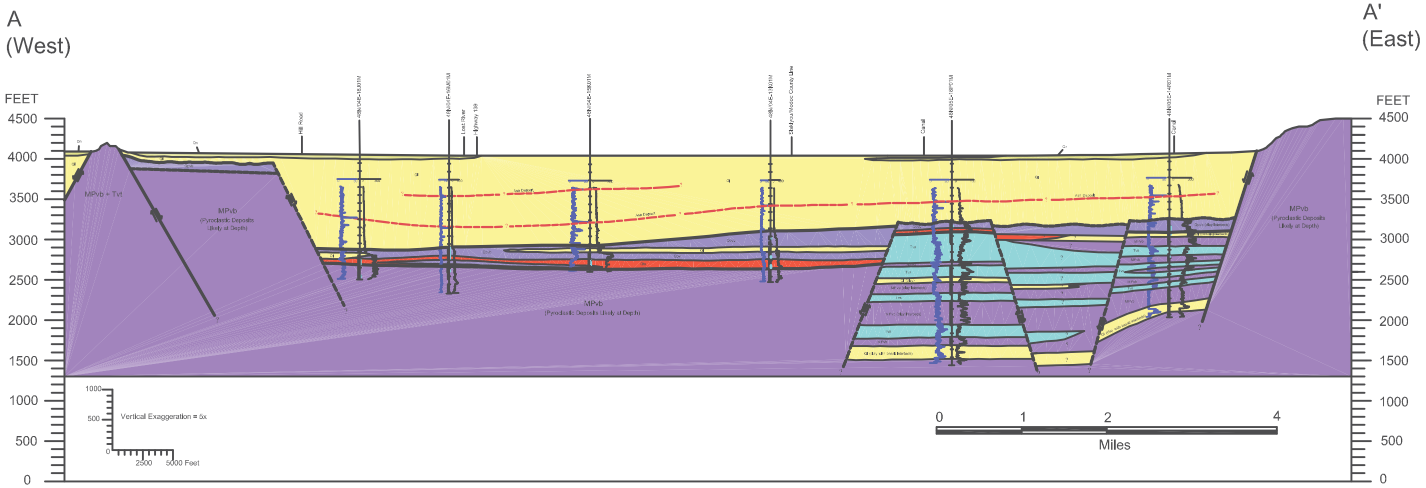
State of California
The Resources Agency
Department of Water Resources
Northern District

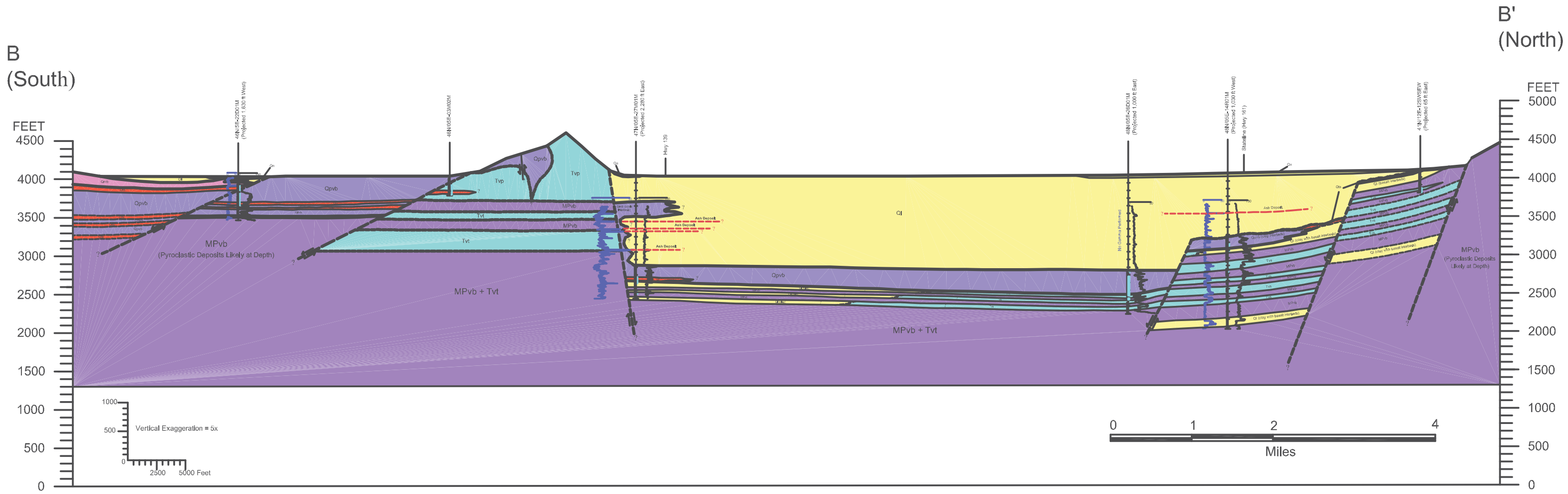
Geologic Map of the Tule Lake Drainage Basin

PLATE 2

State of California
The Resources Agency
Department of Water Resources
Northern District

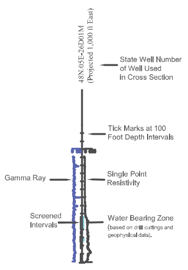
Tule Lake Subbasin
Geologic Cross Sections
A-A' and B-B'



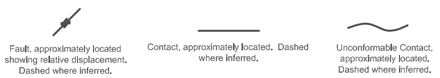


Legend

Well Diagram



Symbols



Note: For illustration purposes, dip angles of faults are approximate.

Description of Map Units

Surficial Deposits

Qn	▨	**Nearshore Deposits (Quaternary)**
Ql	▨	**Lake Deposits (Pliocene-Holocene)**

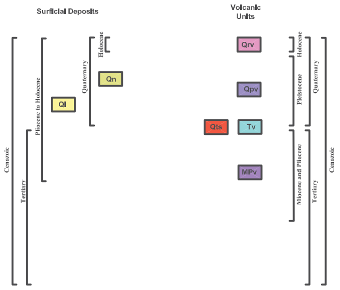
Quaternary Volcanic Units

Qrv	▨	**Recent (Upper) Volcanics:** Qrvr -- rhyolite; Qrva -- andesite; Qrvb -- basalt.
Qpv	▨	**Pleistocene (Intermediate) Volcanics:** Qpvr -- rhyolite; Qpva -- andesite; Qpvb -- basalt.
Qts	▨	**Quarternary and/or Pliocene Scoria Deposits**

Tertiary Volcanic Units

MPv	▨	**Mio-Pliocene (Lower) Volcanics:** Pvr -- rhyolite; Pva -- andesite; Pvb -- basalt.
Tv	▨	**Tertiary Volcanic Deposits:** Tvt -- undivided tuffaceous deposits; Tvp -- palagonite tuff. Tvs -- tuffaceous siltstone and claystone

Stratigraphy



Appendix F.
Technical Memorandum – Water Year Type Development for Tule Lake Subbasin

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE: December 11, 2020

PREPARED BY: Kyle Knutson, P.E.

REVIEWED BY: Lee Bergfeld, P.E.

SUBJECT: Water Year Type Development for Tule Lake Subbasin

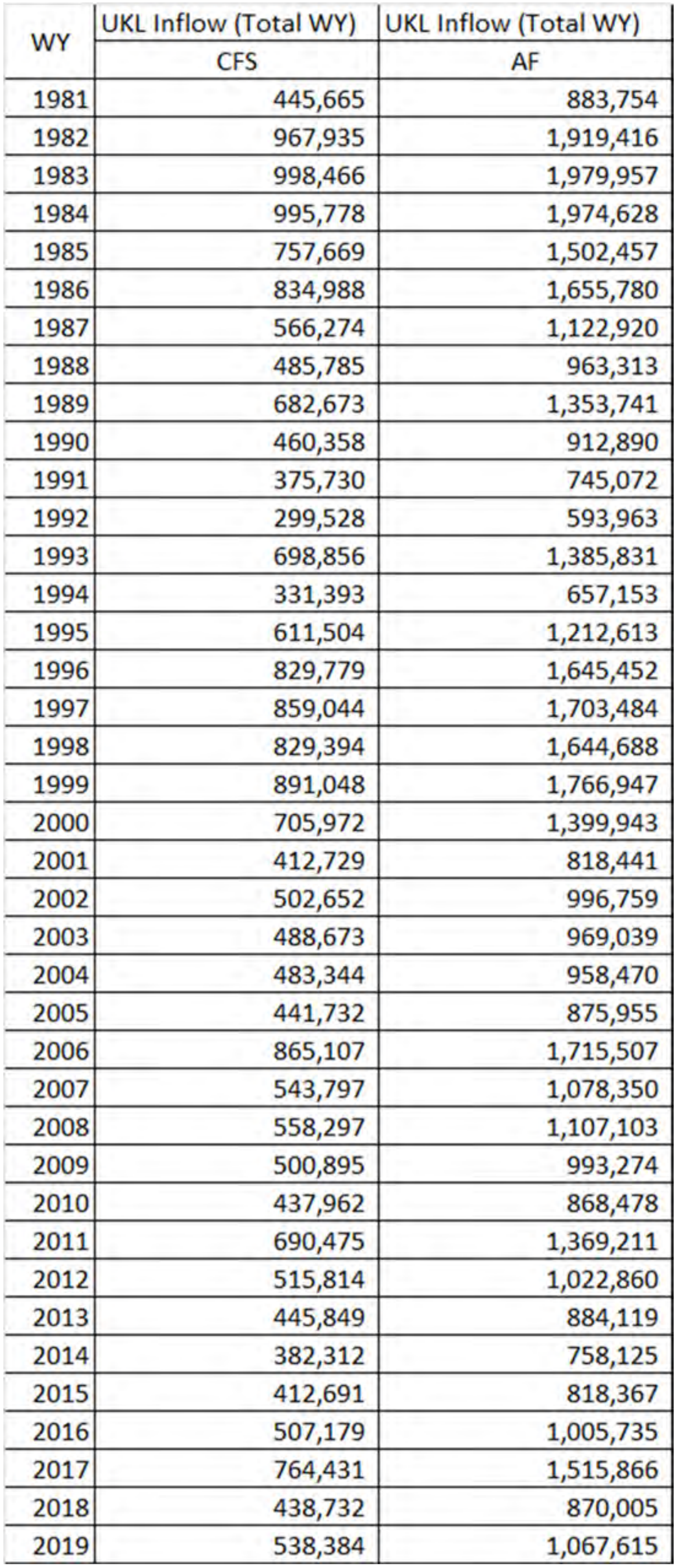
1. PURPOSE

The Groundwater Sustainability Agency (GSA) representatives in the Tule Lake Subbasin are currently developing a Groundwater Sustainability Plan (GSP). Water year type related analyses are required as part of the GSP development process. A water year type classification system is not currently developed for the Tule Lake Subbasin. The purpose of this memorandum is to describe the methodology and results for a water year type classification system for the Tule Lake Subbasin based on inflow to Upper Klamath Lake (UKL).

2. METHODOLOGY

The water supplier districts within the Tulelake Subbasin receive surface water supplies from UKL. Therefore, a water year type classification system was developed based on inflow to UKL. Records of UKL inflow during the period of water year 1981 through water year 2019 were obtained from the Interim Operations Model used by the United States Bureau of Reclamation for operations of the Klamath Project. These records are summarized in Table 1 below.

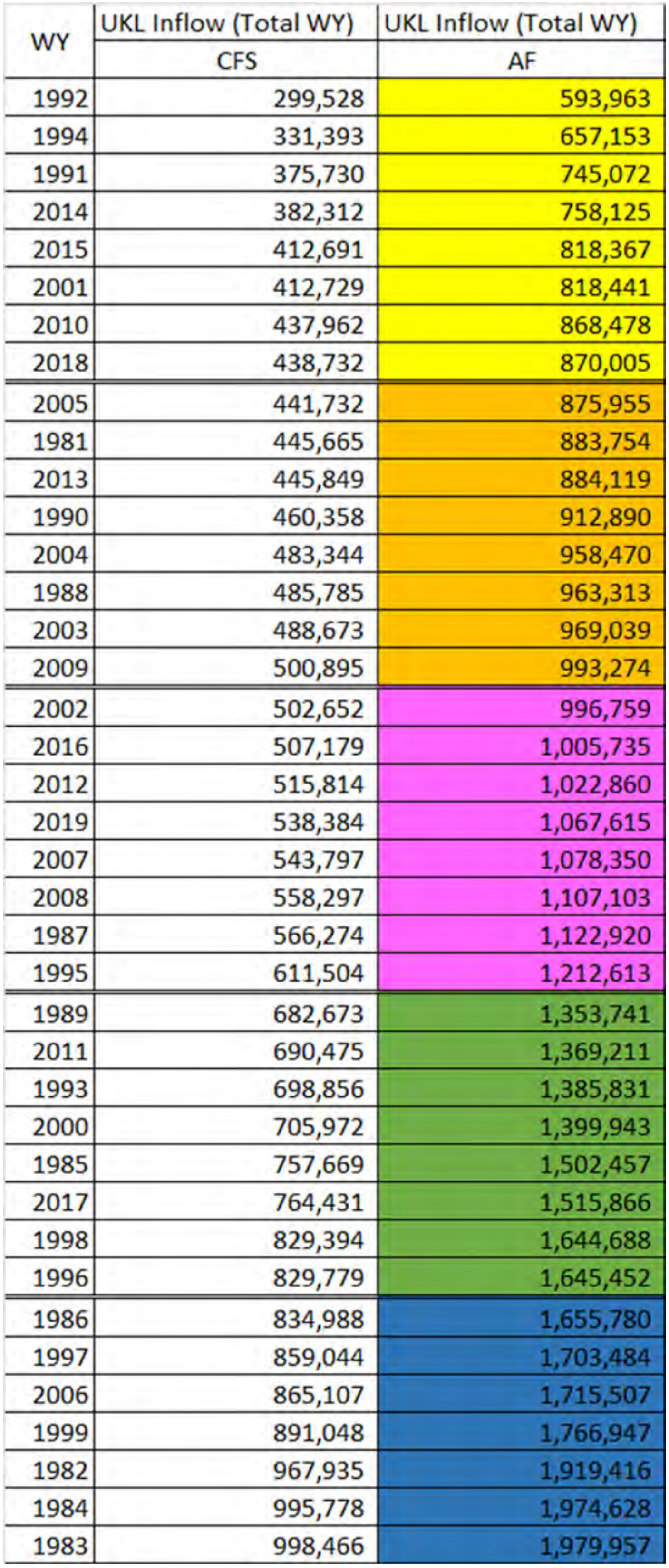
Table 1: Summary of UKL Inflow sorted chronologically.



WY	UKL Inflow (Total WY)	UKL Inflow (Total WY)
	CFS	AF
1981	445,665	883,754
1982	967,935	1,919,416
1983	998,466	1,979,957
1984	995,778	1,974,628
1985	757,669	1,502,457
1986	834,988	1,655,780
1987	566,274	1,122,920
1988	485,785	963,313
1989	682,673	1,353,741
1990	460,358	912,890
1991	375,730	745,072
1992	299,528	593,963
1993	698,856	1,385,831
1994	331,393	657,153
1995	611,504	1,212,613
1996	829,779	1,645,452
1997	859,044	1,703,484
1998	829,394	1,644,688
1999	891,048	1,766,947
2000	705,972	1,399,943
2001	412,729	818,441
2002	502,652	996,759
2003	488,673	969,039
2004	483,344	958,470
2005	441,732	875,955
2006	865,107	1,715,507
2007	543,797	1,078,350
2008	558,297	1,107,103
2009	500,895	993,274
2010	437,962	868,478
2011	690,475	1,369,211
2012	515,814	1,022,860
2013	445,849	884,119
2014	382,312	758,125
2015	412,691	818,367
2016	507,179	1,005,735
2017	764,431	1,515,866
2018	438,732	870,005
2019	538,384	1,067,615

The total annual UKL inflow records were then sorted from lowest to highest inflow per water year. Next, these years were grouped into five ranges with seven to eight water years in each range. See Table 2 below for a summary of the ranges.

Table 2: Summary of UKL Inflow sorted from lowest to highest inflow per water year.



WY	UKL Inflow (Total WY)	UKL Inflow (Total WY)
	CFS	AF
1992	299,528	593,963
1994	331,393	657,153
1991	375,730	745,072
2014	382,312	758,125
2015	412,691	818,367
2001	412,729	818,441
2010	437,962	868,478
2018	438,732	870,005
2005	441,732	875,955
1981	445,665	883,754
2013	445,849	884,119
1990	460,358	912,890
2004	483,344	958,470
1988	485,785	963,313
2003	488,673	969,039
2009	500,895	993,274
2002	502,652	996,759
2016	507,179	1,005,735
2012	515,814	1,022,860
2019	538,384	1,067,615
2007	543,797	1,078,350
2008	558,297	1,107,103
1987	566,274	1,122,920
1995	611,504	1,212,613
1989	682,673	1,353,741
2011	690,475	1,369,211
1993	698,856	1,385,831
2000	705,972	1,399,943
1985	757,669	1,502,457
2017	764,431	1,515,866
1998	829,394	1,644,688
1996	829,779	1,645,452
1986	834,988	1,655,780
1997	859,044	1,703,484
2006	865,107	1,715,507
1999	891,048	1,766,947
1982	967,935	1,919,416
1984	995,778	1,974,628
1983	998,466	1,979,957

Based on the rankings in Table 2, water year type classifications were identified for each range, which are summarized in Table 3 below.

Table 3: Summary of Water Year Types for Tulelake Subbasin based on UKL Inflow.

Water Year Type	Range
Very Dry (VD)	UKL Inflow ≤ 875,000 AF
Less Dry (LD)	875,000 AF < UKL Inflow ≤ 1,000,000 AF
Dry (D)	1,000,000 AF < UKL Inflow ≤ 1,360,000 AF
Wet (W)	1,360,000 AF < UKL Inflow ≤ 1,700,000 AF
Very Wet (VW)	1,700,000 AF < UKL Inflow

3. References

(HDR, 2017). Technical Memorandum Dry Creek (Bear River) Un-Gaged Streamflow Estimate.

Appendix G.
GAMA Water Quality Overview

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE: December 2, 2021

PREPARED BY: Angela Bezzone, P.E.

REVIEWED BY: Kyle Knutson, P.E.

SUBJECT: Review of Available Water Quality Data

1. PURPOSE

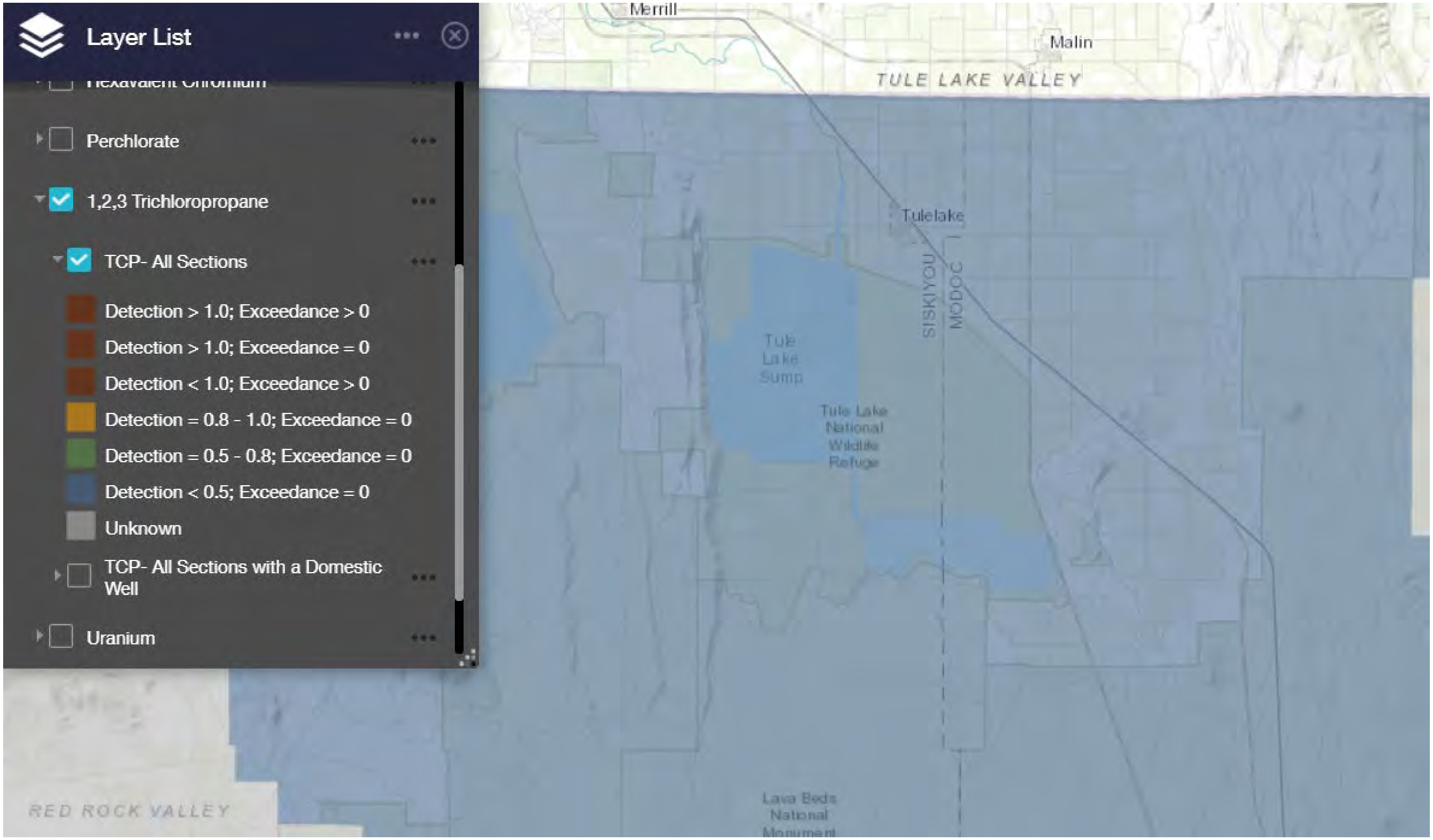
The Groundwater Sustainability Agency (GSA) representatives in the Tule Lake Subbasin are currently developing a Groundwater Sustainability Plan (GSP). The purpose of this section is to provide a summary of water quality data sources which were reviewed. The Groundwater Ambient Monitoring and Assessment (GAMA) Program was created by the State Water Resources Control Board (SWRCB) which makes groundwater quality and contamination data available to the public.

2. DATA

GAMA Online Tools were utilized to review water quality conditions within the Tule Lake Subbasin. These resources can be accessed at: https://www.waterboards.ca.gov/water_issues/programs/gama/online_tools.html

The following is a list of attached data which were relied upon for the GSP.

- Screenshots of the maps generated by the Domestic Well Water Quality Tool
- A description of the Needs Assessment performed for arsenic
- Pie charts of key constituents in all wells monitored in the subbasin



Layer List

☐ Hexavalent Chromium

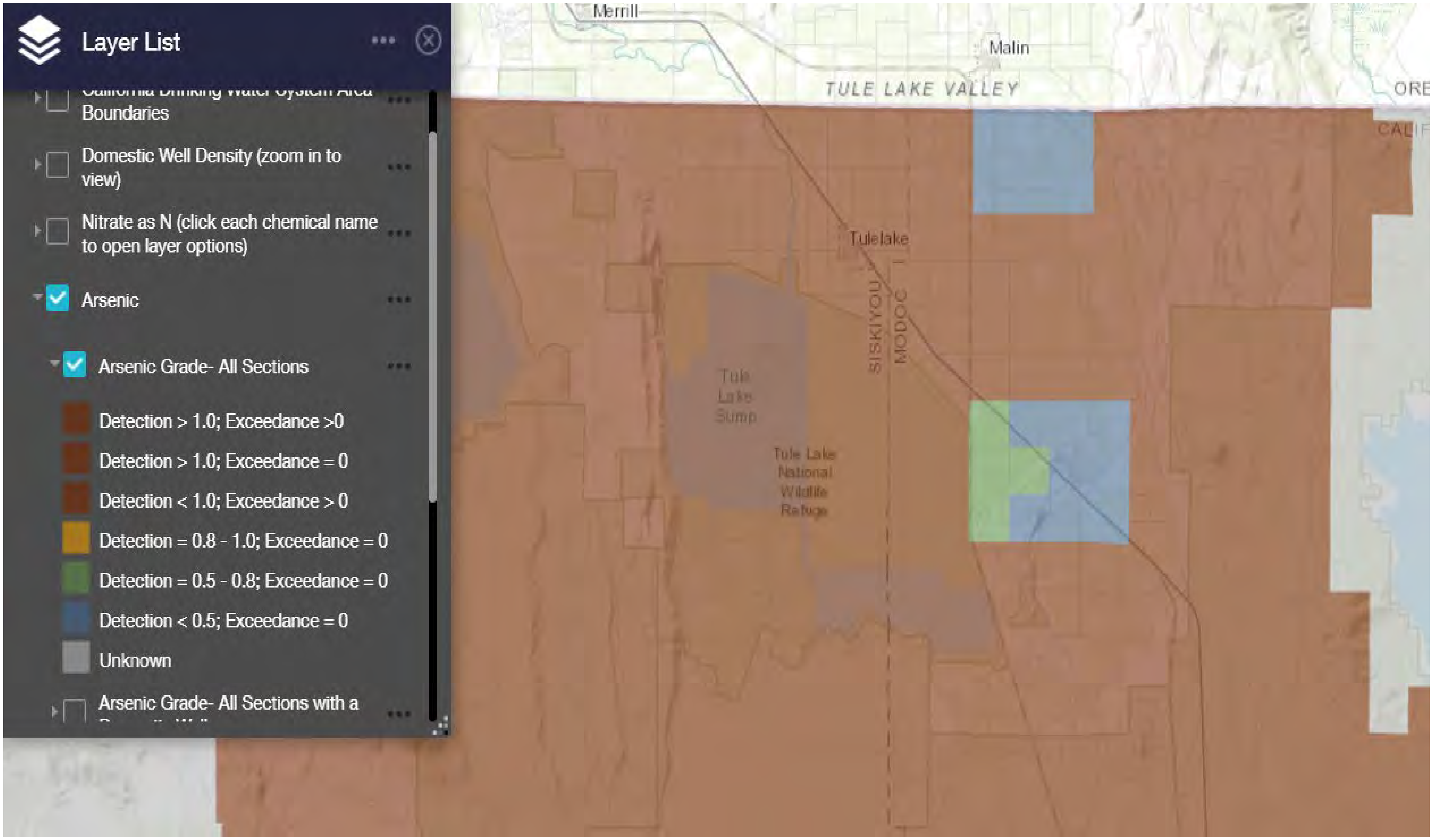
☐ Perchlorate

☑ 1,2,3 Trichloropropane

- ☑ TCP- All Sections
  - 🟫 Detection > 1.0; Exceedance > 0
  - 🟫 Detection > 1.0; Exceedance = 0
  - 🟫 Detection < 1.0; Exceedance > 0
  - 🟧 Detection = 0.8 - 1.0; Exceedance = 0
  - 🟩 Detection = 0.5 - 0.8; Exceedance = 0
  - 🟦 Detection < 0.5; Exceedance = 0
  - ▨ Unknown
- ☐ TCP- All Sections with a Domestic Well

☐ Uranium

Figure G-1. 1,2,3 Trichloropropane Exceedance Map



Layer List

☐ California Drinking Water System Area Boundaries

☐ Domestic Well Density (zoom in to view)

☐ Nitrate as N (click each chemical name to open layer options)

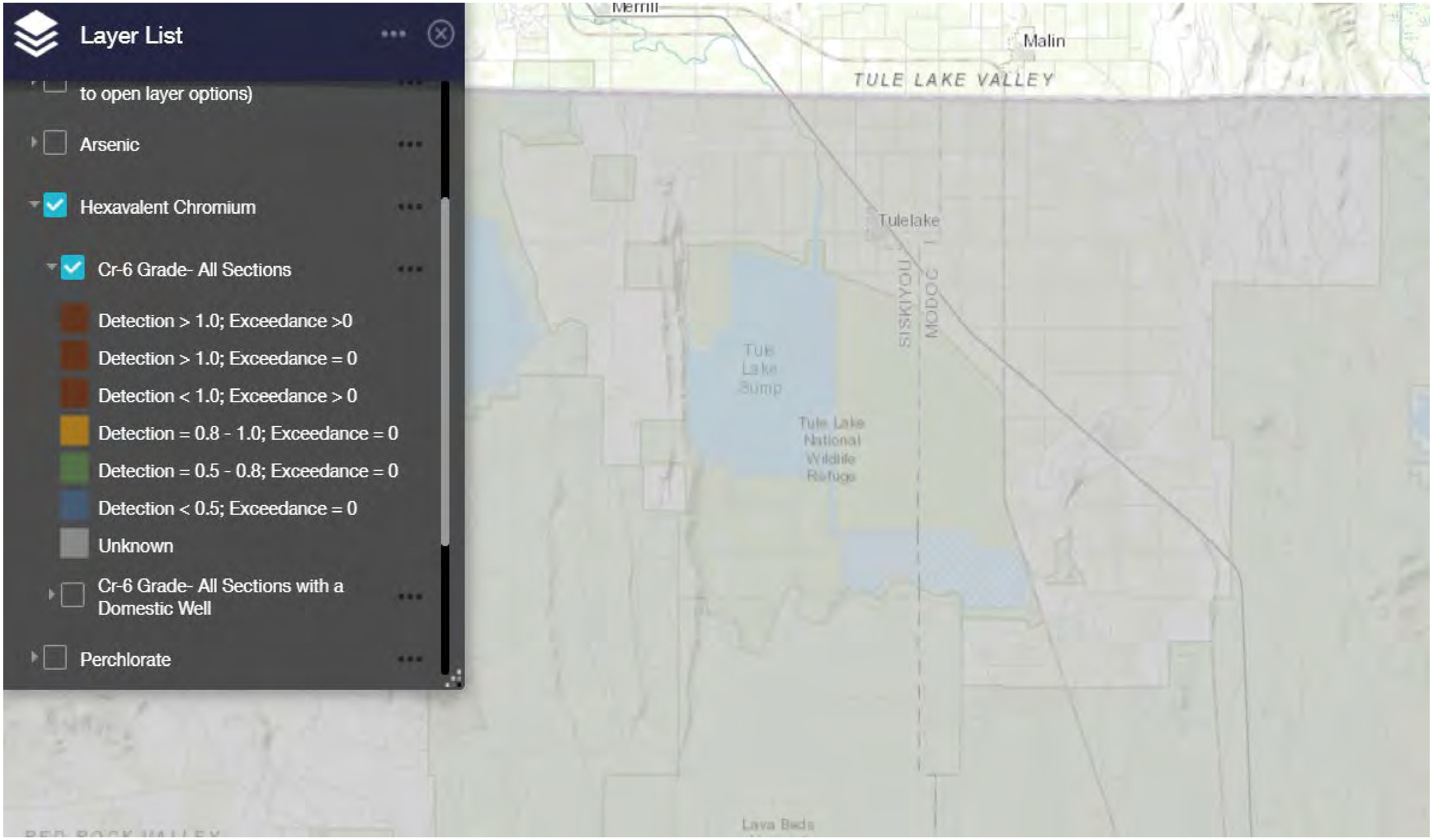
☑ Arsenic

☑ Arsenic Grade- All Sections

- 🟫 Detection > 1.0; Exceedance >0
- 🟫 Detection > 1.0; Exceedance = 0
- 🟫 Detection < 1.0; Exceedance > 0
- 🟧 Detection = 0.8 - 1.0; Exceedance = 0
- 🟩 Detection = 0.5 - 0.8; Exceedance = 0
- 🟦 Detection < 0.5; Exceedance = 0
- ⬜ Unknown

☐ Arsenic Grade- All Sections with a

Figure G-2. Arsenic Exceedance Map



Layer List

to open layer options)

☐ Arsenic

☑ Hexavalent Chromium

- ☑ Cr-6 Grade- All Sections
  - 🟫 Detection > 1.0; Exceedance >0
  - 🟫 Detection > 1.0; Exceedance = 0
  - 🟫 Detection < 1.0; Exceedance > 0
  - 🟧 Detection = 0.8 - 1.0; Exceedance = 0
  - 🟩 Detection = 0.5 - 0.8; Exceedance = 0
  - 🟦 Detection < 0.5; Exceedance = 0
  - ⬜ Unknown
- ☐ Cr-6 Grade- All Sections with a Domestic Well

☐ Perchlorate

Figure G-3. Hexavalent Chromium Exceedance Map

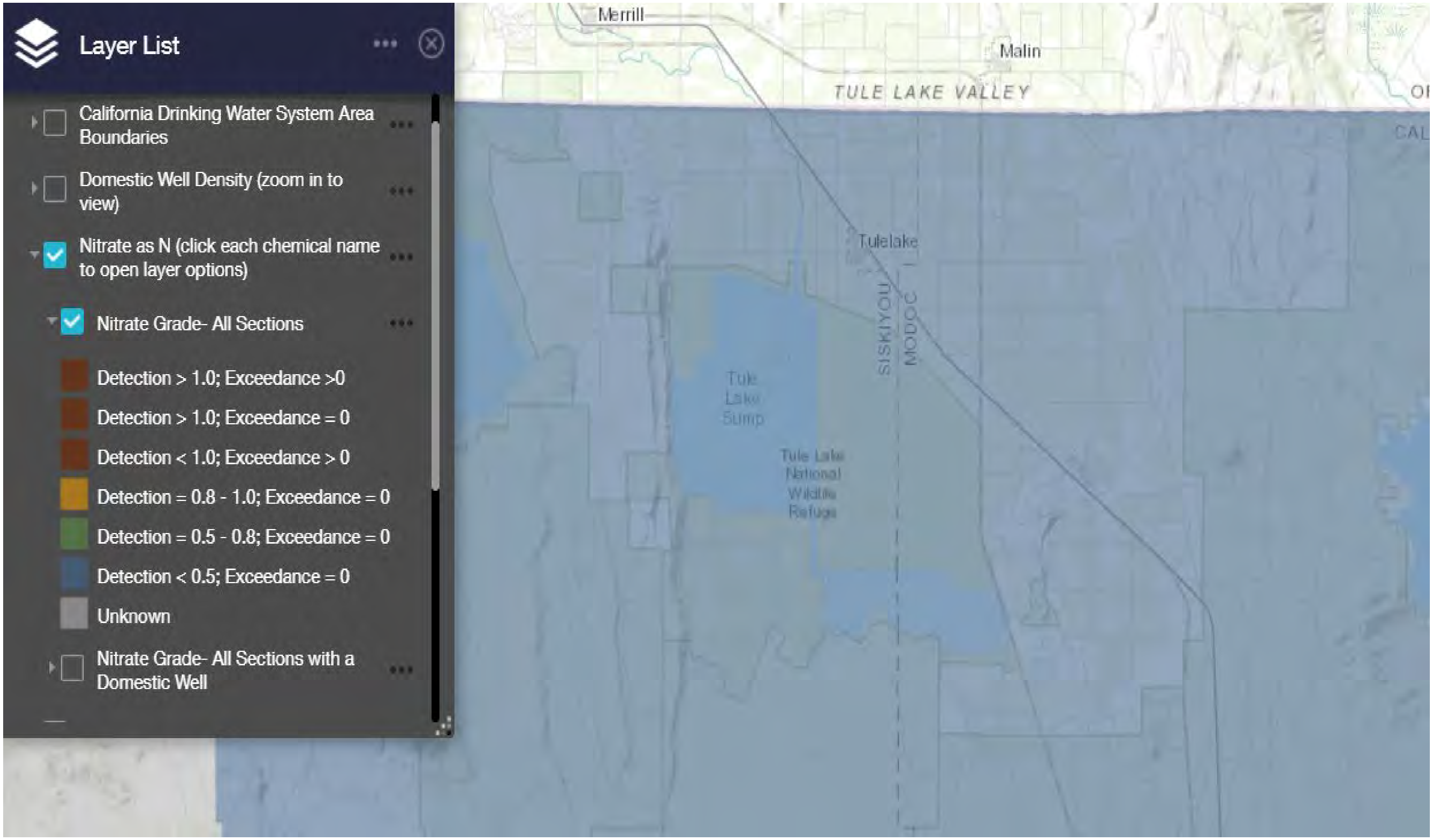


Figure G-4. Nitrate Exceedance Map

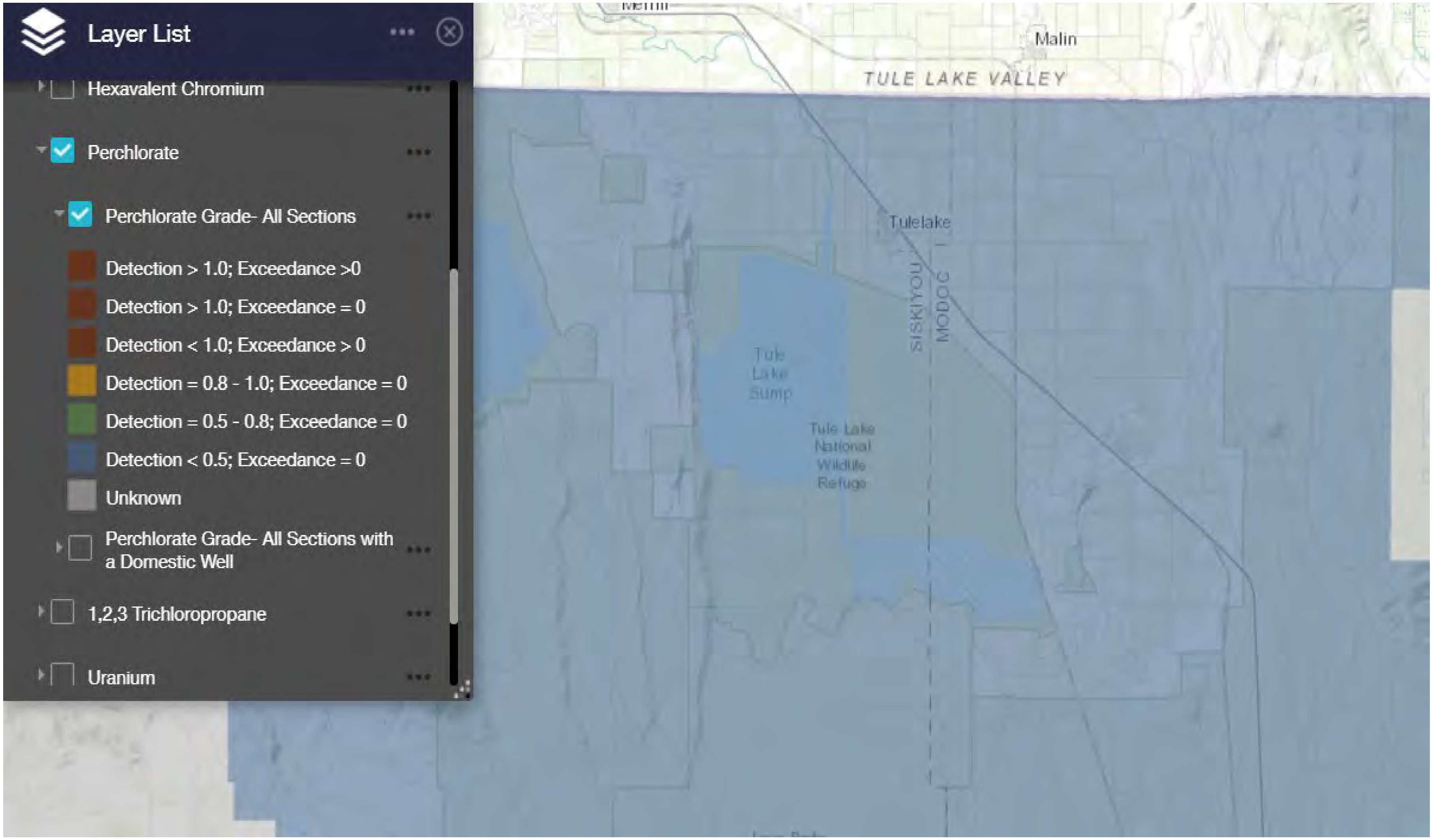


Figure G-5. Perchlorate Exceedance Map

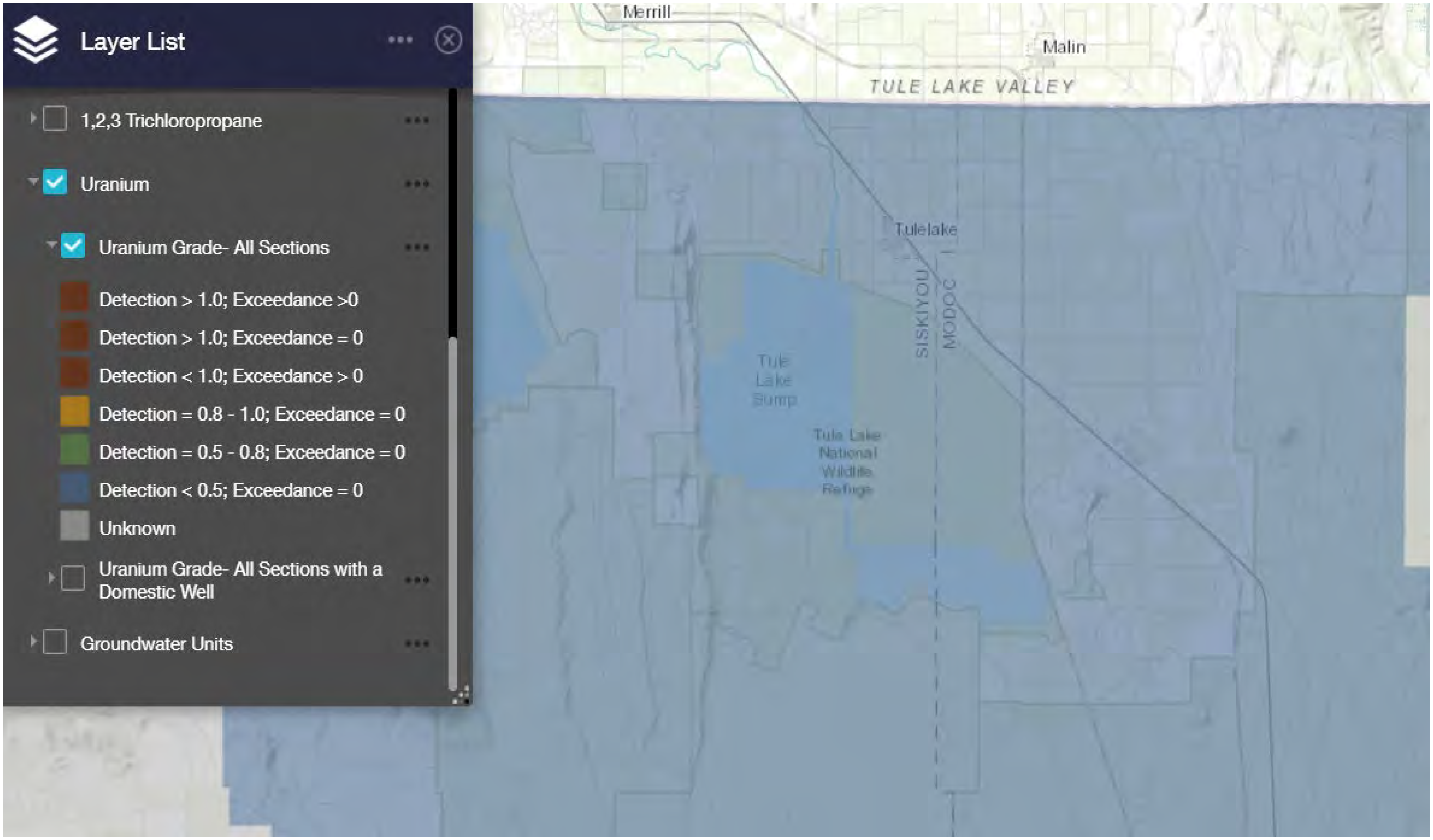


Figure G-6. Uranium Exceedance Map

Needs_Assessment_Arsenic

Overview

By section, the water quality grade for arsenic, as determined by the methodology published in the Needs Analysis White Paper.

Map Image Layer by DBellan@EPA

Created: Jan 9, 2020
Updated: Jan 9, 2020
View Count: 5,123

Description

By section, the water qulaity grade for arsenic, as determined by the methodology published in the Needs Analysis White Paper.

Feature layer available.

The State Water Resources Control Board (State Water Board) was tasked to conduct a Needs Assessment of the state of drinking water in California (SB 862, 2018). The State Water Board Division of Drinking Water (DDW) identified three elements for this analysis: (1) identification of public water systems at risk, (2) identification of domestic wells and state small systems at risk, and (3) an analysis of the cost to implement Human Right to Water. The information provided in this application supports the second element, identifying the location and number of domestic wells potentially accessing groundwater affected by constituents at concentrations above regulatory levels.

Since the water supply accessed by domestic wells is not regulated by the state, accurate locations and groundwater quality data is generally not available. The values presented in this application represent estimates of domestic well location density and groundwater quality. The information provided in this application should not be interpreted to represent measured data. Rather, this analysis is intended to help prioritize future sampling and

Open in Map Viewer

Open in Scene Viewer

Open in ArcGIS Desktop

Metadata

Details

Source: Map Service
Size: 1 KB
★★★★★

Share

Owner

BD DBellan@EPA

Tags

groundwater, State Water Resources Control Board, GAMA, water quality, ArcGIS, Service Definition, .sd

characterization efforts and to support the cost analysis associated with the Needs Assessment.
Domestic depth groundwater quality estimates for six constituents are shown on the map: nitrate, arsenic, hexavalent chromium*, uranium, 1,2,3 trichloropropane (123 TCP), and perchlorate. For each constituent, groundwater quality estimates can be displayed for all Public Land Survey System (PLSS) sections statewide, or for only the PLSS sections that include at least one domestic well (domestic well counts and locations were obtained from the Department of Water Resources Online System of Well Completion Reports). Data fields for each section include the estimated average constituent concentration, the methodology used to calculate that average, the number of recent MCL/SMCL exceedances, and an overall water quality grade. The grade is a rated representation of the combined section detection and number of recent MCL/SMCL exceedances (see below). Section detections are represented by an MCL index, which is the constituent concentration divided by its regulatory threshold (MCL, SMCL, etc.). An MCL index of 1 reflects a value of the MCL/SMCL, while a 0.8 index represents a value of 80% the MCL/SMCL. The method indicates which of the three sources of data were used to estimate the section concentration: data from within the section, data from neighboring sections, or data from the groundwater unit. Other fields include area, the domestic well count, and the MTRS (the PLSS section number listed as meridian, township, range, and section).

Water Quality Grades:
6: Recent MCL exceedances > 0, average section detection > MCL
5: Recent MCL exceedances = 0, average section detection > MCL
4: Recent MCL exceedances > 0, average section detection < MCL
3: Recent MCL exceedances = 0, average section detection 80 – 100% of MCL
2: Recent MCL exceedances = 0, average section detection between 50 – 80% of MCL
1: Recent MCL exceedances = 0, average section detection < 50% of MCL
0: unknown water quality (no data available)

Ambient groundwater quality data from water supply well sources in the GAMA Groundwater Information System were processed through time and depth filters developed for this analysis in order to capture the depths accessed by domestic wells (by groundwater unit). This process allowed the analysis to include an increased amount of water quality data, and from sources typically

Credits (Attribution)

For any questions or comments, please email Dori Bellan and/or Emily Houlihan, GAMA Program geologists.
dorian.bellan@waterbpo
emily.houlihan@waterbo

URL

View

https://gispubl

not utilized for analyzing the domestic well water resource, creating a more robust analysis. Censored data (non-detect, below reporting, and zero-values) underwent a substitution process.

*For hexavalent chromium, a comparison value of 20 µg/L was used in place of an MCL.

Layers

Needs_Assessment_Arsenic

Terms of Use

All data in this map can be downloaded or connected to a GIS through the State Water Board REST endpoint, also accessed through the item details of each layer in this application.

Contact Us

GAMA Home

Download GAMA Data

SWRCB Home

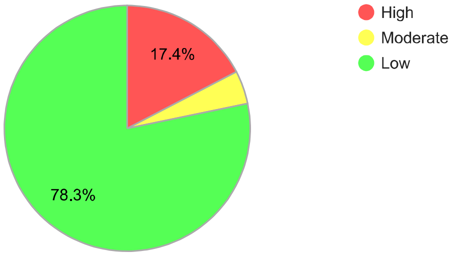
CUSTOM GIS WELL PIE CHART REPORT

GIS LAYER	GIS NAME	TIMEFRAME	VIEW COUNTS BY
Groundwater Basins	KLAMATH RIVER VALLEY - TULELAKE (1-002.01)	All Years	Distinct Wells

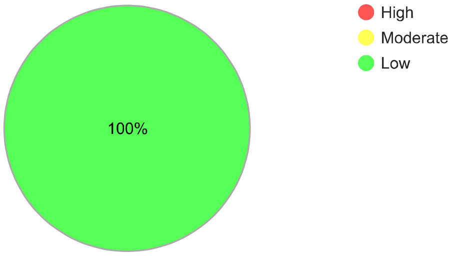
WELL CATEGORY	DATASETS
Domestic, Irrigation / Industrial, Monitoring, Municipal, Water Supply, Other	All Datasets

☐ **High -** Wells whose Maximum Sampling was Above the Comparison Concentration
☐ **Moderate -** Wells whose Maximum Sampling was Between 1/2 the Comparison Concentration and the Comparison Concentration
☐ **Low -** Wells whose Maximum Sampling was Below 1/2 the Comparison Concentration

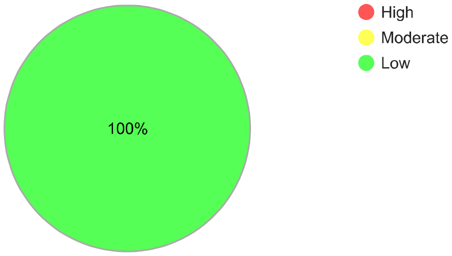
Major Ions



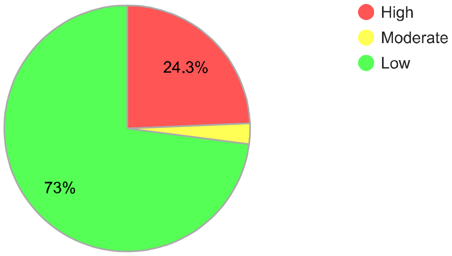
Radionuclides



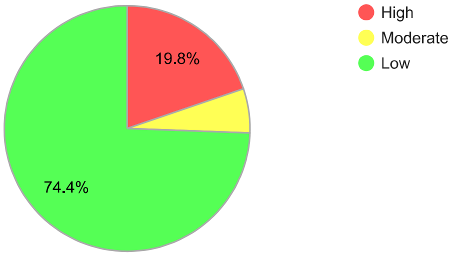
Pesticides



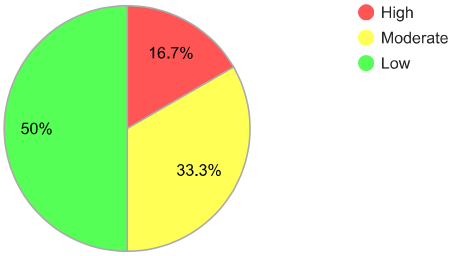
Volatile Organic Compounds



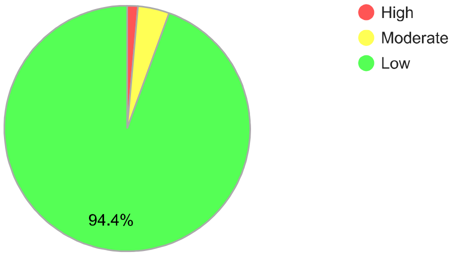
Trace Elements



Total Dissolved Solids



Nutrients



Appendix H.
Technical Memorandum – GDE Identification Data Processing Approach

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE: September 10, 2021
TO: Tulelake GSAs
PREPARED BY: Jason Bone, MBK Engineers
SUBJECT: GDE Identification Data Processing Approach

1. BACKGROUND

Groundwater Dependent Ecosystems (GDE) are defined in the Sustainable Groundwater Management Act (SGMA) Regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (23 CCR § 351[m]). The Natural Communities Commonly Associated with Groundwater (NCCAG) database was used to identify plants commonly associated with groundwater use. The NCCAG was developed by a working group comprised of the California Department of Water Resources (DWR), the California Department of Fish and Wildlife (CDFW), and The Nature Conservancy (TNC). Two habitat classes are included in the NCCAG dataset: 1) wetland features commonly associated with the surface expression of groundwater under natural and unmodified conditions; and 2) vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes).

An analysis was performed to evaluate each NCCAG against criteria to determine if it is a GDE. The criteria listed below identify characteristics which would make a NCCAG not a GDE.

1. Areas with a depth to groundwater greater than 30 feet.
2. Areas adjacent to agricultural surface water (i.e., canals and drains).
3. Areas adjacent to irrigated fields.
4. Areas adjacent to the Tule Lake Sumps.

2. NCCAG GIS DATA USED

The NCCAG database was available in 2 GIS shapefiles – i02_NCCAG_Vegetation_1_002_01.shp and i02_NCCAG_Wetlands_1_002_01.shp, which was downloaded in July 2020 from https://gis.water.ca.gov/app/NCDatasetViewer/.

Summary of Vegetation and Wetlands NCCAG GIS Data

Tulelake Irrigation District contains the following NCCAGs Vegetation and Wetland Types:

Vegetation Name	Count	Summary of Acres
Tule - Cattail	1	56.82
Greasewood	2	10.01
Wet Meadows	39	715.62
Wetland Name	**Count**	**Summary of Acres**
Palustrine, Emergent, Persistent, Semi-permanently Flooded	1	0.72
Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	1	74.03
Seep or Spring	1	0.18
Palustrine, Emergent, Persistent, Seasonally Flooded	25	44.29
Riverine, Unknown Perennial, Unconsolidated Bottom, Semi-permanently Flooded	55	12.92
Total Acres		**914.59**

3. DATA USED AND ACTIONS TAKEN TO EVALUATE EACH OF THE FOUR CRITERIA

Criteria 1 – Areas with a Depth to Groundwater Greater than 30 Feet

To determine areas where the depth to groundwater was greater than 30 feet, recent groundwater depth elevation data and ground elevation data were collected. Groundwater depths (Elevation in Feet above Mean Sea Level) were obtained from DWR's Water Data Library, and the land surface elevation data used was LiDAR IM Bare Earth DEM (Digital Elevation Model) data from https://gdg.sc.egov.usda.gov/. Groundwater depth elevation data from Spring 2019 were selected for this analysis, and ArcGIS Desktop software was used to find the difference between the ground surface elevation and Spring 2019 groundwater elevation depths. The analysis identified areas within the Tule Lake Subbasin where the depth to groundwater was greater than 30 feet, and ArcGIS Desktop software was used to intersect those areas with the NCCAGs GIS data. TNC has developed guidance documents to help GSAs identify GDEs. These guidance documents suggest that depth to groundwater greater than 30 feet would not support a GDE. NCCAGs in areas with depth to groundwater greater than 30 feet are assumed to not access groundwater and are represented as "Areas with a depth of groundwater greater than 30 feet" in Figure 2-37.

This analysis resulted in selecting parts of 31 NCCAGs polygons for a total of 99.76 acres of which 11 are Vegetation NCCAGs for 95.36 acres and the other 20 are Wetland NCCAGs for 4.4 acres.

Criteria 2 – Areas Adjacent to Agricultural Surface Water

The majority of the Subbasin is agricultural land and intersected by a system of irrigation canals, ditches, and drains. The irrigation system brings in surface water which is available to the NCCAGs. To determine those areas adjacent to agricultural surface water, we analyzed the proximity of NCCAGs to those irrigation system features. Using GIS layers representing the irrigation system and ArcGIS Desktop software, we defined an area or buffer of 150 feet surrounding the irrigation system linear features. The irrigation system GIS layers were provided by Tulelake Irrigation District. NCCAGs within 150 feet of the irrigation conveyance facilities area are assumed to access the available surface water and are represented as "Area adjacent to agricultural surface water" in Figure 2-37.

This analysis resulted in selecting parts of 160 NCCAGs polygons for a total of 325.89 acres of which 60 are Vegetation NCCAGs for 262.06 acres and the other 100 are Wetland NCCAGs for 63.83 acres.

Criteria 3 – Areas Adjacent to Irrigated Fields

Similar to areas adjacent to irrigation water conveyance facilities, areas near irrigated fields benefit from the irrigation water used to support crops. To determine those areas adjacent to irrigated fields, we analyzed the proximity of NCCAGs to the irrigated fields. Using a GIS layer representing the irrigated fields (provided by Tulelake Irrigation District) and ArcGIS Desktop software, we defined an area or buffer of 50 feet surrounding all the irrigated fields. ArcGIS Desktop software was used to identify which NCCAGs intersected with the irrigated fields and the 50-foot buffer. NCCAGs within 50 feet of the irrigated fields are assumed to access available surface water and are considered adjacent to irrigated fields, which are represented as "Areas adjacent to irrigated fields" in Figure 2-37.

This analysis resulted in selecting parts of 39 NCCAGs polygons for a total of 117.55 acres of which 22 are Vegetation NCCAGs for 104.29 acres and the other 17 are Wetland NCCAGs for 13.26 acres.

Criteria 4 - Areas Adjacent to the Tule Lake Sumps

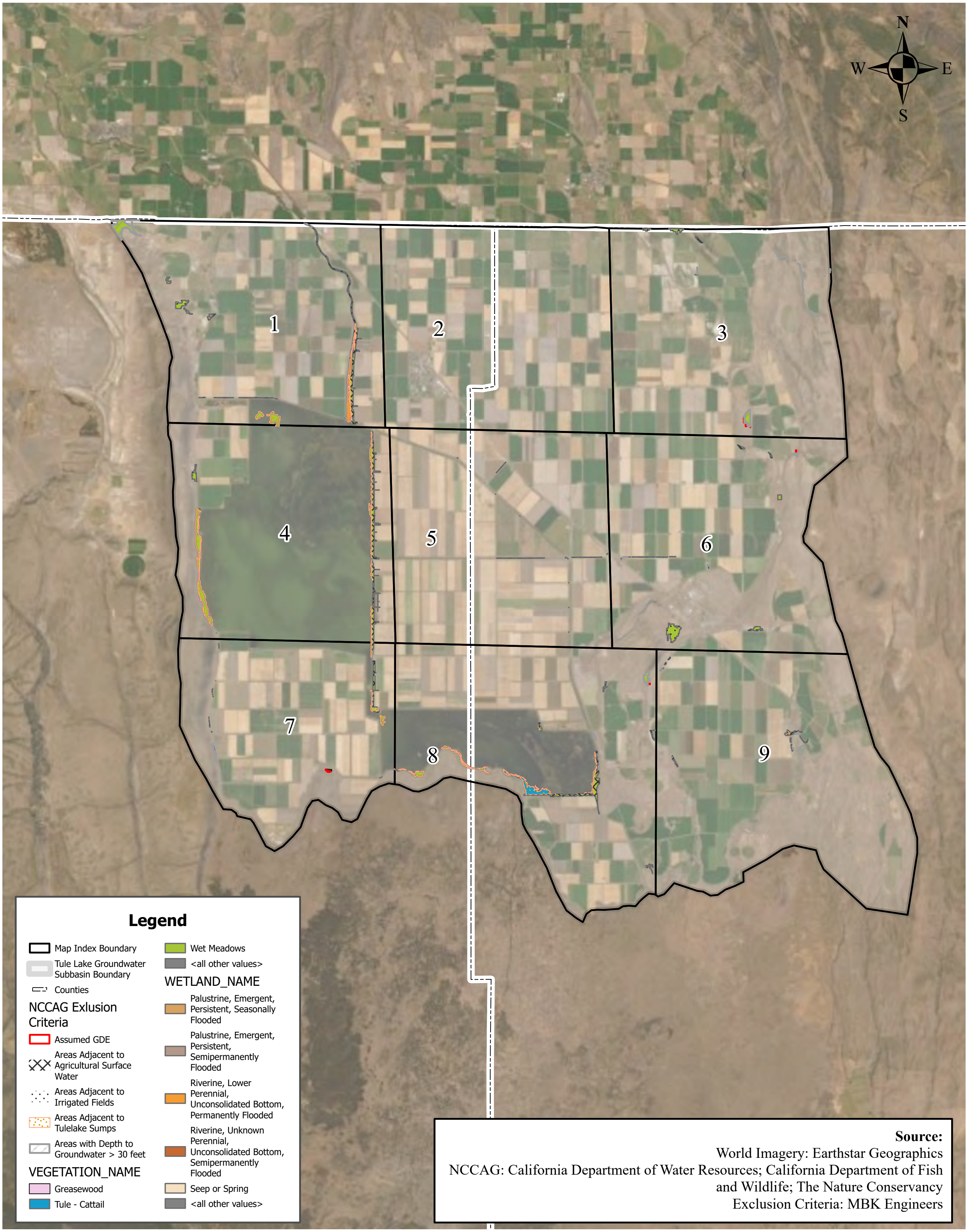
The Tule Lake Sumps provide water for adjacent ecosystems. To determine which NCCAGs are adjacent to the Tule Lake Sumps, we analyzed the proximity of NCCAGs to the Tule Lake Sumps, which typically have water year-round. Using a GIS layer representing the Tule Lake Sumps (provided by Tulelake Irrigation District) and ArcGIS Desktop software, we defined an area or buffer 150 feet surrounding all the Tule Lake Sumps. ArcGIS Desktop software was used to identify which NCCAGs intersected with the Tule Lake Sumps and the 150-foot buffer. NCCAGs within 150 feet of the Tule Lake Sumps are assumed to access available surface water and are considered adjacent to the Tule Lake Sumps, which are represented as “Areas adjacent to the sumps” in Figure 2-37.

This analysis resulted in selecting parts of 35 NCCAGs polygons for a total of 366.24 acres of which 33 are Vegetation NCCAGs for 359.49 acres and the other 2 are Wetland NCCAGs for 6.75 acres.

Jason Bone

Jason Bone, MBK Engineers

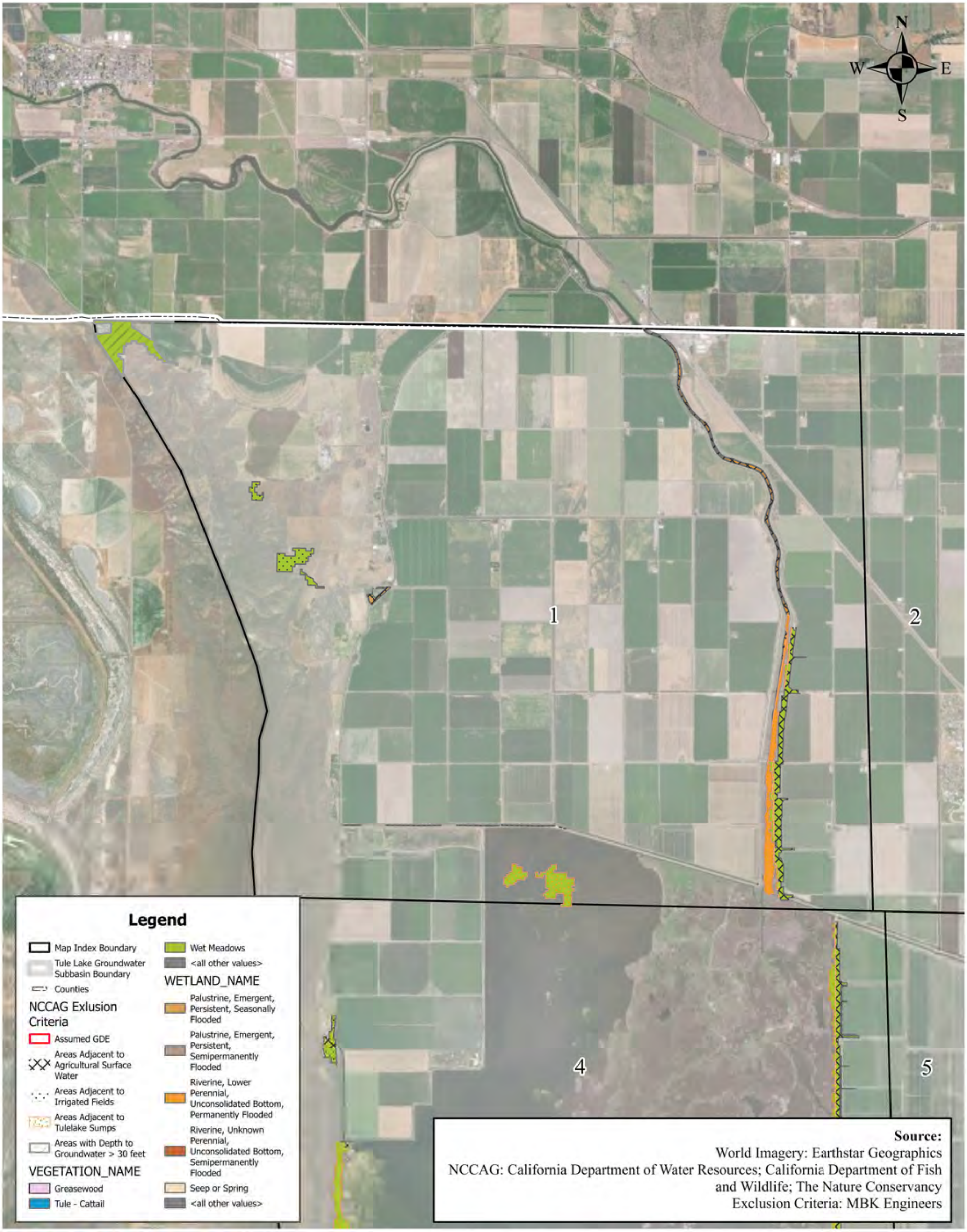
JB/ab/oh
8888.10\GDE Identification Technical Memorandum 9-10-2021



Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

Natural Communities Commonly Associated Inside and Outside GDE Criteria

0 1 2 3 Miles



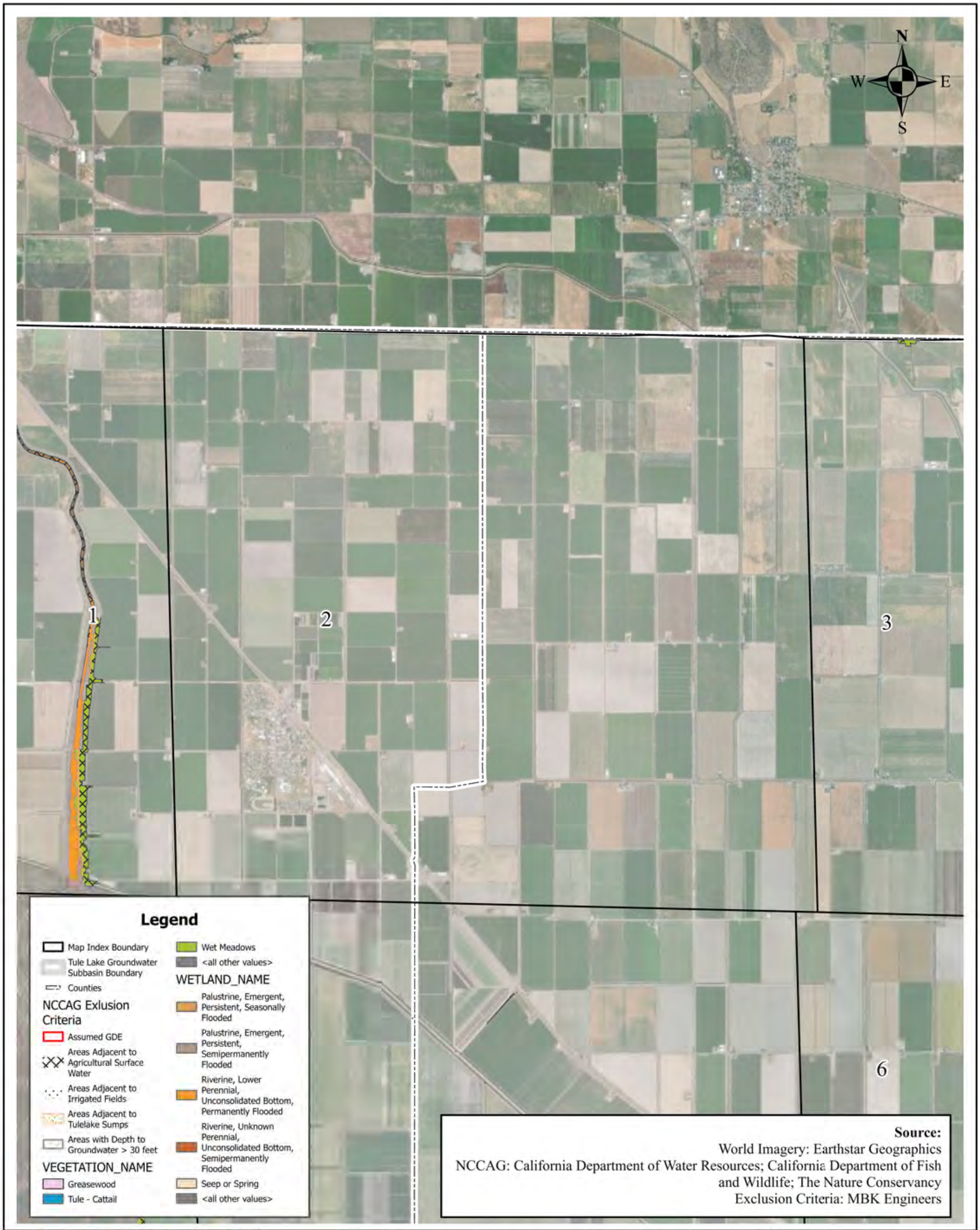
Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

MBK ENGINEERS

Natural Communities Commonly Associated

Inside and Outside GDE Criteria

0 1 Miles



Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

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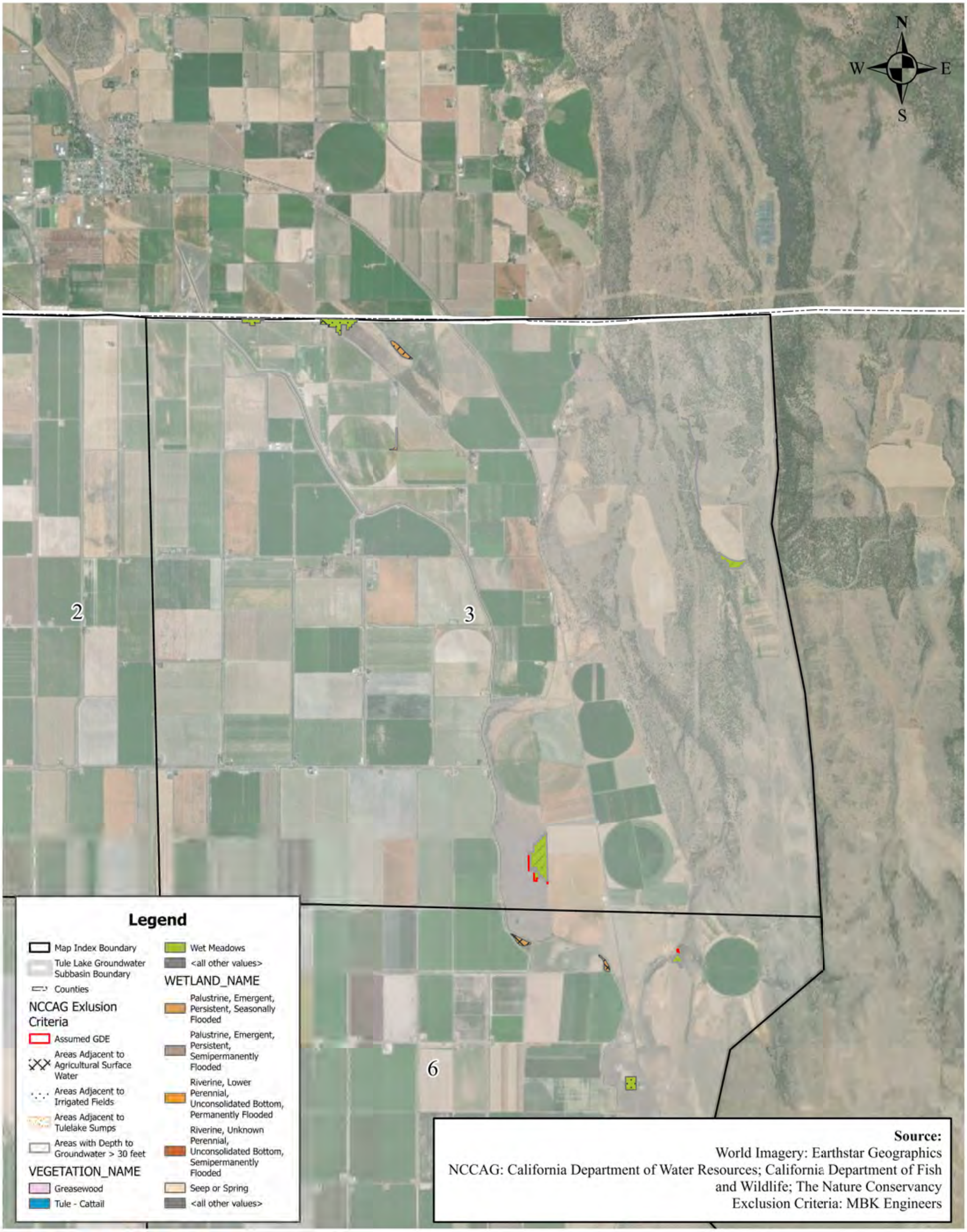
Natural Communities Commonly Associated

Inside and Outside GDE Criteria



Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

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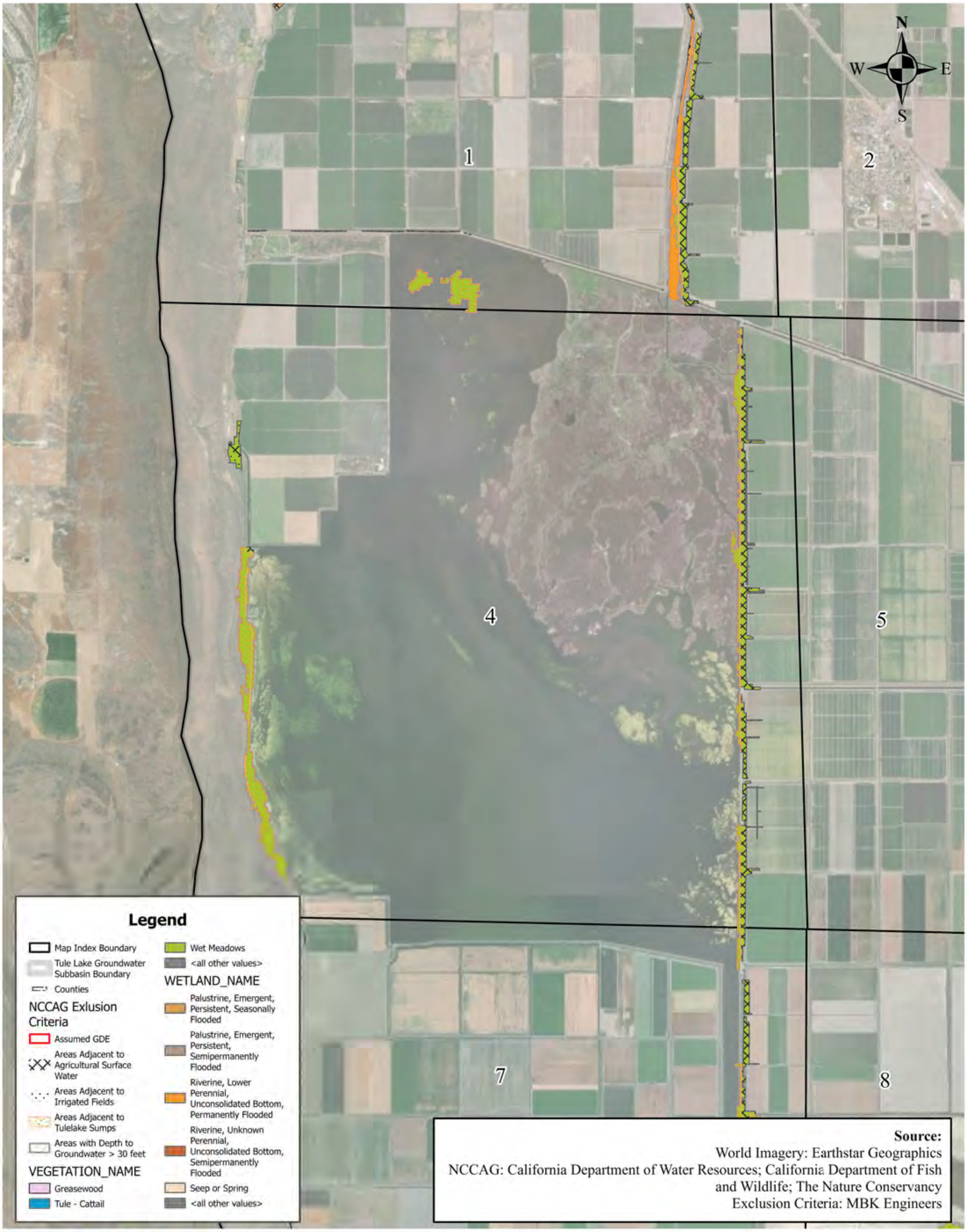
Natural Communities Commonly Associated
Inside and Outside GDE Criteria

0 1 Miles



Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

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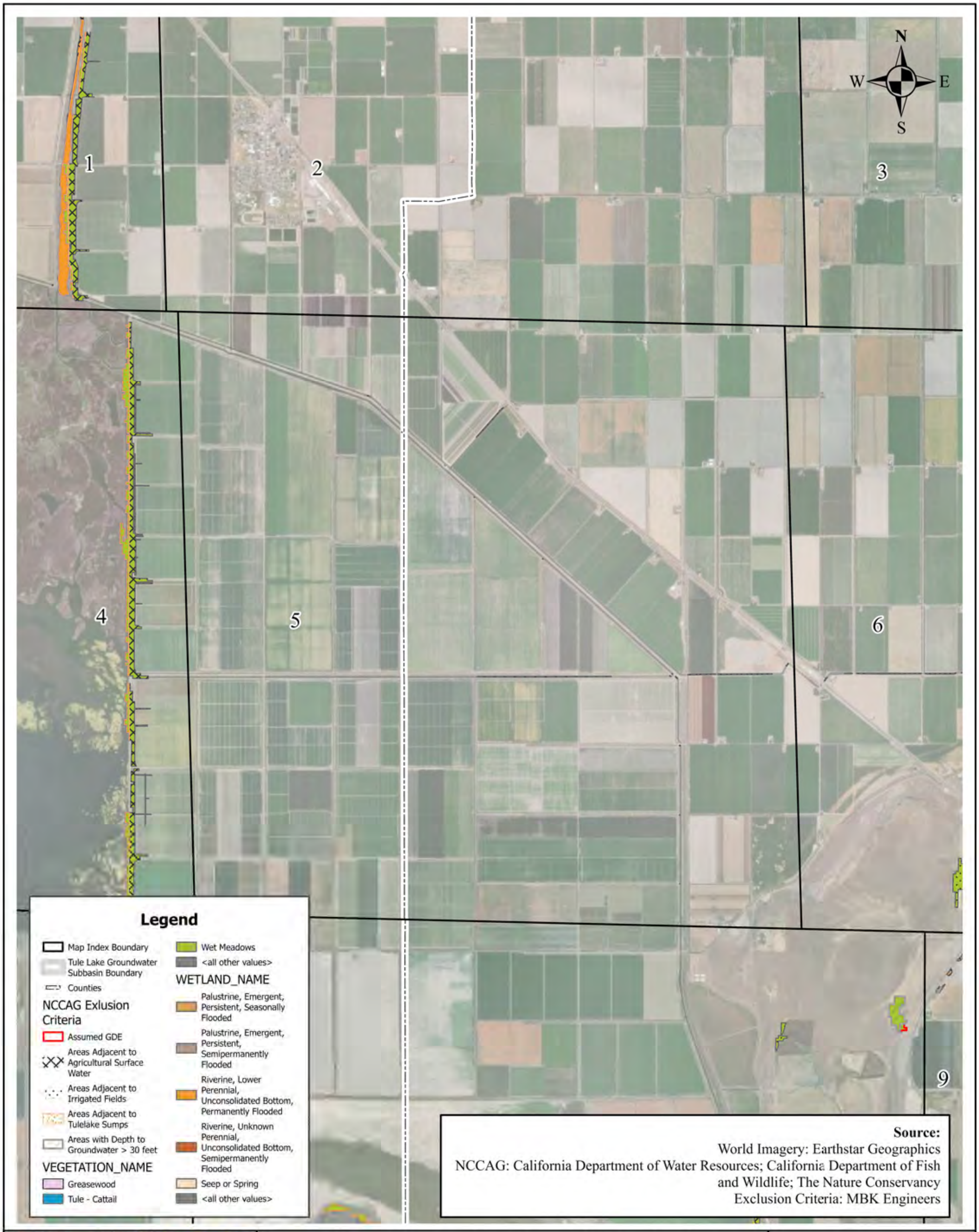
Natural Communities Commonly Associated

Inside and Outside GDE Criteria

0 1 Miles



Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

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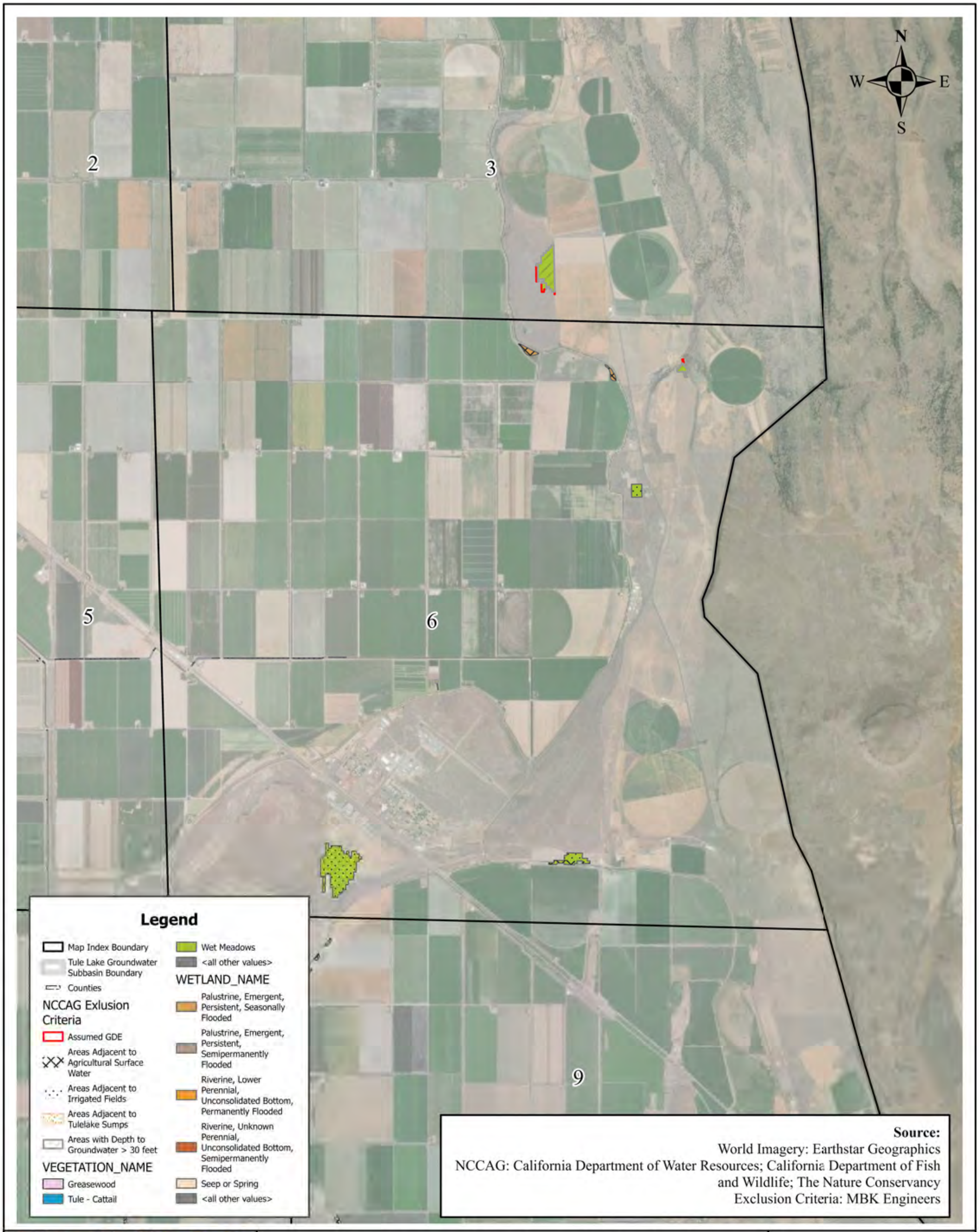
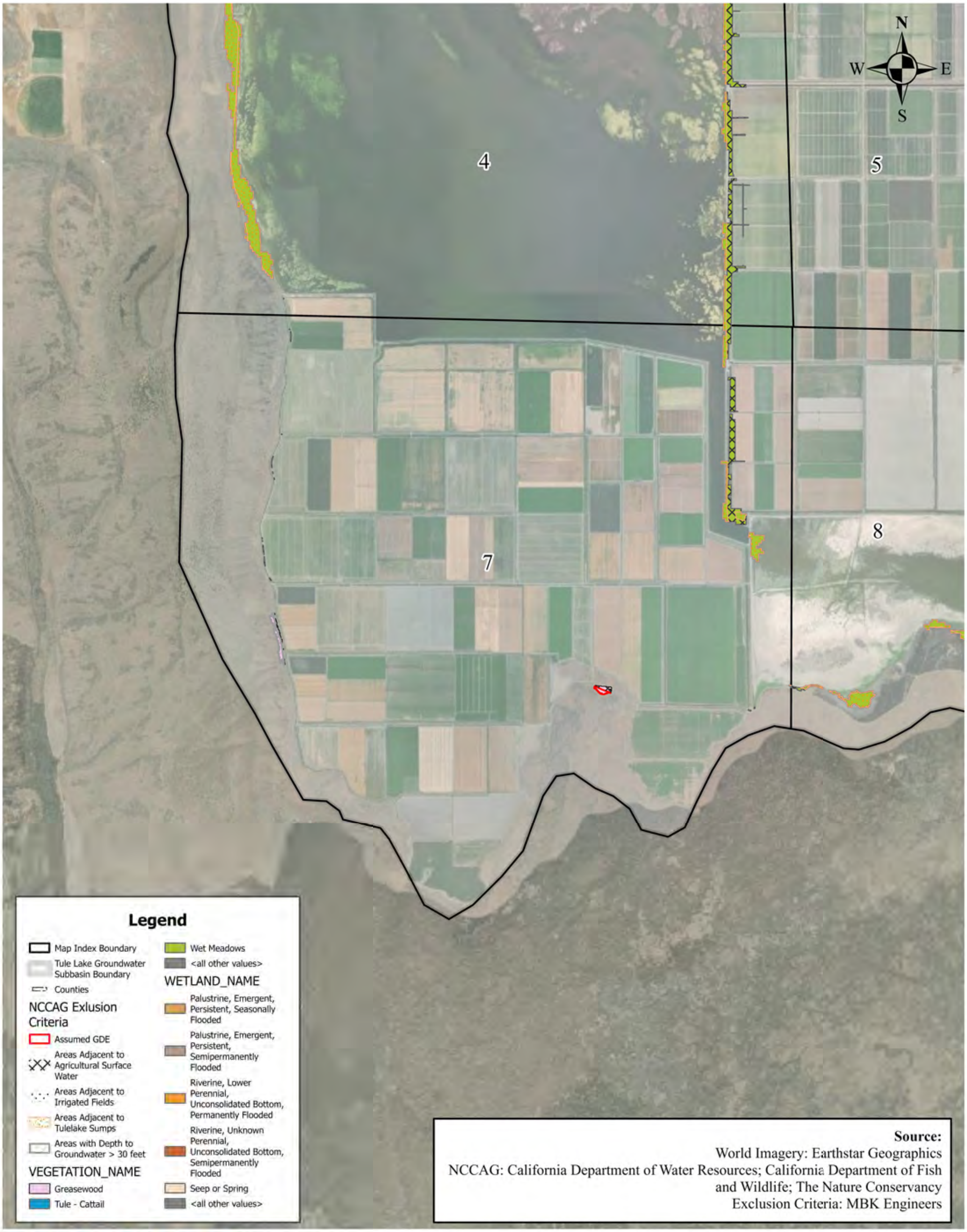
Natural Communities Commonly Associated
Inside and Outside GDE Criteria



Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

MBK ENGINEERS

Natural Communities Commonly Associated
Inside and Outside GDE Criteria



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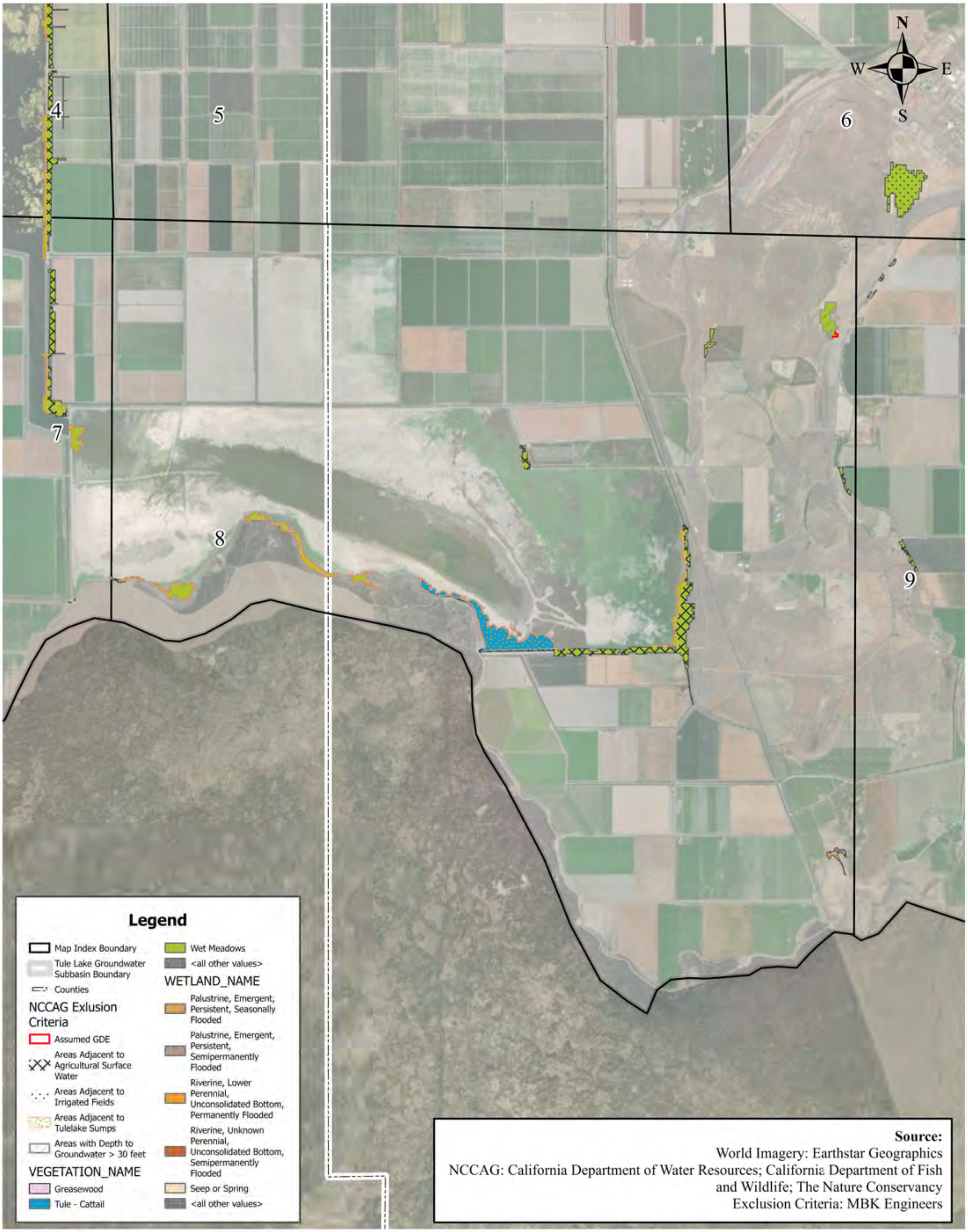
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

MBK ENGINEERS

Natural Communities Commonly Associated
Inside and Outside GDE Criteria

0 1 Miles



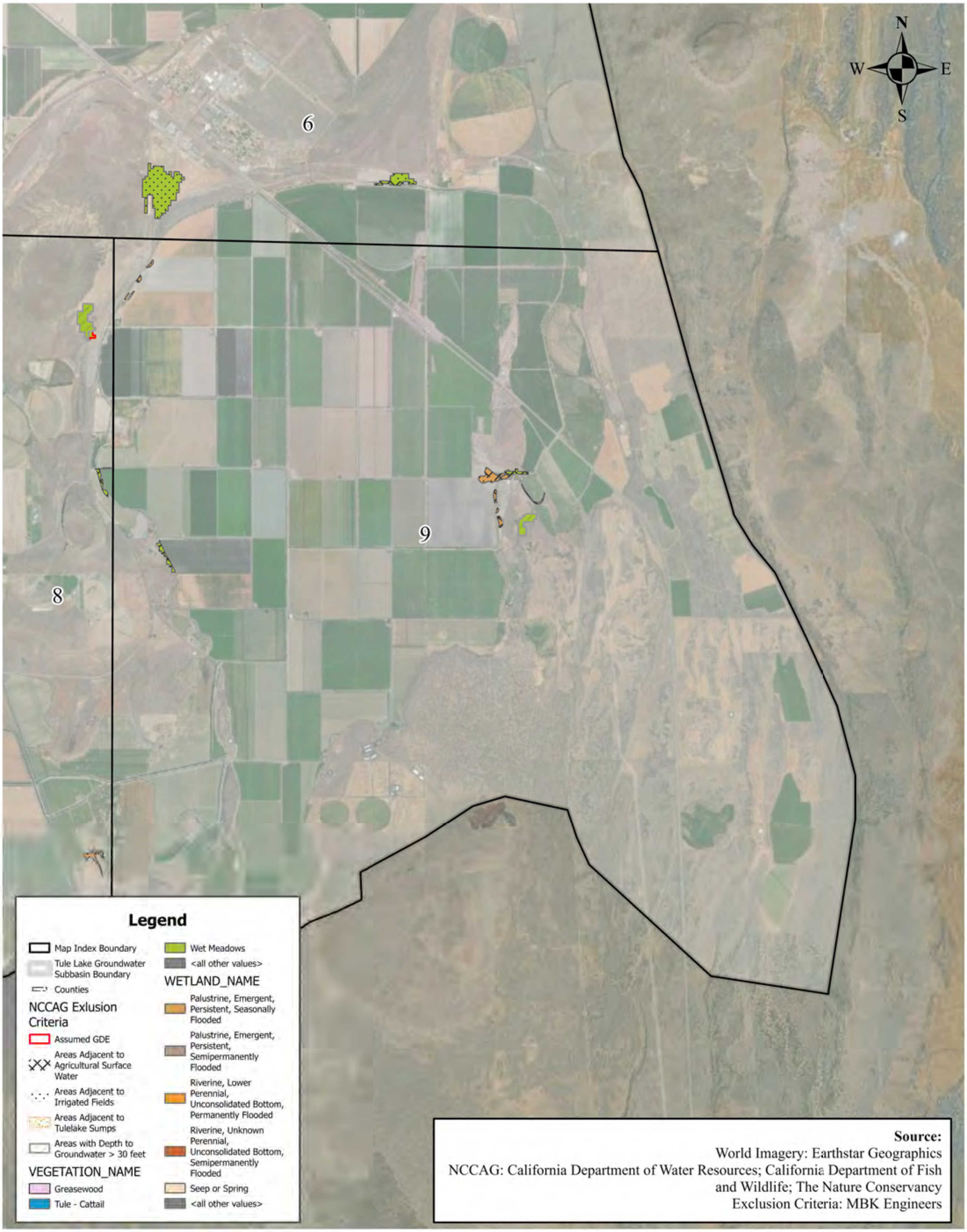
Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

MBK ENGINEERS

Natural Communities Commonly Associated

Inside and Outside GDE Criteria

0 1 Miles



Source:
World Imagery: Earthstar Geographics
NCCAG: California Department of Water Resources; California Department of Fish and Wildlife; The Nature Conservancy
Exclusion Criteria: MBK Engineers

MBK ENGINEERS

Natural Communities Commonly Associated
Inside and Outside GDE Criteria

0 1 Miles

Appendix I.
Representative Monitoring Well – Well Completion Reports

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 751030

Page ____ **of** ____

Owner's Well No. ____

Date Work Began 12/9/01, Ended 12/14/01

Local Permit Agency Siskiyou County Health

Permit No. 3697 Permit Date 6/27/01

DWR USE ONLY — DO NOT FILL IN

48N 4E-13

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) x VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ____ FLUID ____

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	1	Gravel fill
1	12	Brn clay & sand
12	40	Yellow chalk
40	50	Gray clay
50	55	Brn & white pumice
55	65	Gray clay

TOTAL DEPTH OF BORING 65 (Feet)

TOTAL DEPTH OF COMPLETED WELL 65 (Feet)

WELL OWNER

WELL LOCATION

Address 23234 Stateline Rd.

City Tulelake

County Siskiyou

APN Book 001 Page 140 Parcel 080

Township 48N Range 4E Section 13

Latitude ___ NORTH (DEG. MIN. SEC.) Longitude ___ WEST (DEG. MIN. SEC.)

LOCATION SKETCH

NORTH

WEST

EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

x NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ___ Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) x
livestock

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 7 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 7'6" (Ft.) & DATE MEASURED 12/14/01

ESTIMATED YIELD * 20 (GPM) & TEST TYPE bailer

TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN 1 (Ft.)

** May not be representative of a well's long-term yield.*

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	CASING (S) TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	23	10								
+1	23		x				A53B	6	.250	
23	65	6								

DEPTH FROM SURFACE Ft.	to Ft.	ANNULAR MATERIAL TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	23	x			

JAN 23 2002

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- ___ Other ____

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Larry G. DeSpain Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

3114 Boardman Ave., Klamath Falls, OR 97603
ADDRESS CITY STATE ZIP

Signed Larry G DeSpain 12/15/01 643450
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

46N-05E-01M

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 090610

State Well No.
Other Well No.

[illegible] Intent No.
Loca[illegible] it No. or Date

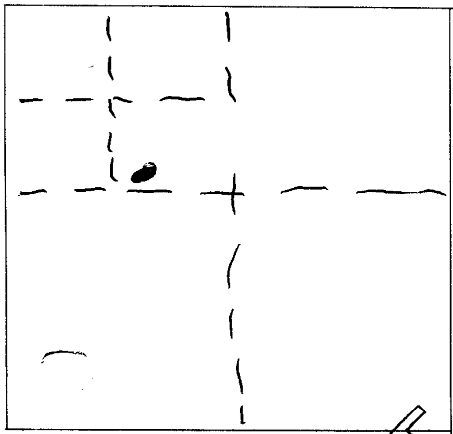
(2) LOCATION OF WELL (See instructions):

County Modoc Owner's Well Number

Well address if different from above

Township /1/ 46N Range 5E Section 1

Distance from cities, roads, railroads, fences, etc.
S.E. ¼ of the S.W. ¼



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other ☐

(5) EQUIPMENT:

Rotary ☐ Reverse ☐
Cable ☒ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☐ No ☒ Size
Diameter of bore
Packed from to ft.

(7) CASING INSTALLED:

Steel ☒ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
0	78½	6	.188

(8) PERFORATIONS: none

Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 76 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 6 to 8 ft.
Method of sealing cement

(10) WATER LEVELS:

Depth of first water, if known 87 ft.
Standing level after well completion 20 ft.

(11) WELL TESTS:

Was well test made? Yes ☒ No ☐ If yes, by whom? self
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test 20 ft. At end of test 22 ft
Discharge 35 gal/min after 1 hours Water temperature 56
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 101 ft. Depth of completed well 101 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	1	fill
1	5	black soil
5	12	gray clay
12	16	brown clay
16	45	gray clay
45	50	pumic & clay layers
50	57	gray lava
57	72	sandstone & clay layers
72	73	pumic stone
73	87	gray clay
87	101	pumic & black sand

Work started 8/16 19 82 Completed 8/19 19 82

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED John A Van Meter 534
(Well Driller)

NAME John A. Van Meter
(Person, firm, or corporation) (Typed or printed)

Address P.O. Box 204

City Malin, Ore Zip 97632

License No. 194473 Date of this report 8/ 19/82

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 1 of 2

AUG 02 2001

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 751117

Owner's Well No. TID #14
Date Work Began 6/19/01, Ended 6/29/01
Local Permit Agency Modoc County
Permit No. 2001-14 Permit Date

DWR USE ONLY — DO NOT FILL IN
46N/05E-22
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD REVERSE FLUID Air & Mud

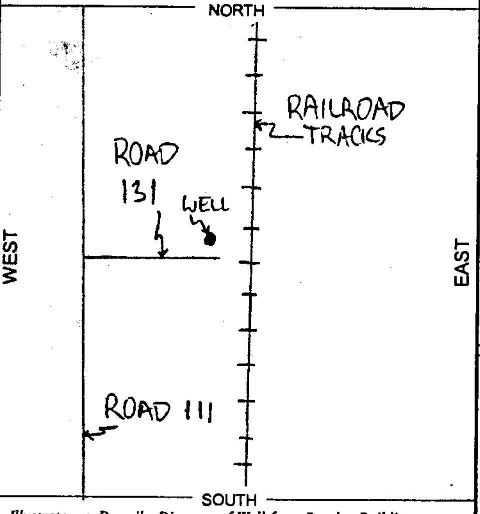
DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	5	Topsoil
5	15	Gray sandy clay
15	45	Hard basalt
45	65	Clay
65	80	Sandy clay
80	105	Gray and black basalt
105	215	Cinders
215	340	Hard basalt
340	380	Cinders
380	440	Gray-black basalt
440	480	Fractured basalt
480	500	Hard basalt
500	571	Gray-black medium hard basalt

TOTAL DEPTH OF BORING 571 (Feet)
TOTAL DEPTH OF COMPLETED WELL 567 (Feet)

WELL LOCATION

Address County Road 131
City Southwest of Newell CA 96134
County Modoc
APN Book 008 Page 080 Parcel 05
Township 46 N Range 5 E Section ~~16~~ 22
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
✓ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 18 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 18.5 (Ft.) & DATE MEASURED
ESTIMATED YIELD ~~10,000~~ ~~500~~ 9500 (GPM) & TEST TYPE Airlift
TEST LENGTH 0.5 (Hrs.) TOTAL DRAWDOWN ~~0.2~~ 2~~3~~0 (Ft.)
May not be representative of a well's long-term yield.

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	CASING (S) TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	20	38			✓		A53B	33.25	0.375	
+2	114	31	✓				A53B	23.25	0.375	
114	234	31		✓			A53B	23.25	0.375	0.125
234	254	31	✓				A53B	23.25	0.375	
254	314	31		✓			A53B	23.25	0.375	0.125
314	334	31	✓				A53B	23.25	0.375	

DEPTH FROM SURFACE Ft.	to Ft.	ANNULAR MATERIAL TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	98	✓			
98	234				1/2 x 3/4 SRI
234	244		✓		
244	314				1/2 x 3/4 SRI
314	324		✓		
324	558				1/2 x3/4 SRI

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME Lang Exploratory Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
P.O. Box 5279 Elko NV 89801-5279
ADDRESS CITY STATE ZIP
Signed ___ WELL DRILLER/AUTHORIZED REPRESENTATIVE 07/11/01 DATE SIGNED 694686 C-57 LICENSE NUMBER

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

DEC 10 2001

ORIGINAL
File with DWR

Page 2 of 2

Owner's Well No. TID #14

Date Work Began 6/19/01, Ended 6/29/01

Local Permit Agency Modoc County

Permit No. 2001-14 Permit Date

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 751117

DWR USE ONLY – DO NOT FILL IN

46N05E-22

STATE WELL NO./ STATION NO.

LATITUDE

LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD REVERSE FLUID Air & Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	5	Topsoil
5	15	Gray sandy clay
15	45	Hard basalt
45	65	Clay
65	80	Sandy clay
80	105	Gray and black basalt
105	215	Cinders
215	340	Hard basalt
340	380	Cinders
380	440	Gray-black basalt
440	480	Fractured basalt
480	500	Hard basalt
500	571	Gray-black medium hard basalt

TOTAL DEPTH OF BORING 571 (Feet)

TOTAL DEPTH OF COMPLETED WELL 567 (Feet)

WELL LOCATION

Address County Road 131

City Southwest of Newell CA 96134

County Modoc

APN Book 008 Page 080 Parcel 05

Township 46 N Range 5 E Section ~~15~~ 22

Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH

WEST

EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ✓ Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 18 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 18.5 (Ft.) & DATE MEASURED

ESTIMATED YIELD • 500 (GPM) & TEST TYPE Airlift

TEST LENGTH 0.5 (Hrs.) TOTAL DRAWDOWN 0.2 (Ft.)

May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
334	554	31		✓			A53B	23.25	0.375	0.125
554	567	31	✓				A53B	23.25	0.375	
0	420	31	✓				A53B	2.067	0.1574	Sounder

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
558	571	✓			

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analysis
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Lang Exploratory Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

P.O. Box 5279 Elko NV 89801-5279
ADDRESS CITY STATE ZIP

DEC 10 2001

Signed ___ WELL DRILLER/AUTHORIZED REPRESENTATIVE 07/11/01 DATE SIGNED 694686 C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

47N05E01M

ORIGINAL
File with DWR

Notice of Intent No.
Local Permit No. or Date

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in
No. 098953
State Well No.
Other Well No.

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

(2) LOCATION OF WELL (See instructions):

County Modoc Owner's Well Number
Well address if different from above
Township 47N Range 5E Section 1
Distance from cities, roads, railroads, fences, etc.
E. END OF COUNTY RD 102

X

WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other ☐

(5) EQUIPMENT:

Rotary ☒ Reverse ☐
Cable ☐ Air ☒
Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☐ No ☒ Size
Diameter of bore 6"
Packed from to ft.

(7) CASING INSTALLED:

Steel ☒ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
+1½	48½	6	.250

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 20 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.
Method of sealing

(10) WATER LEVELS:

Depth of first water, if known 23 ft.
Standing level after well completion 11 ft.

(11) WELL TESTS:

Was well test made? Yes ☒ No ☐ If yes, by whom? EES
Type of test Pump ☐ Bailer ☐ Air lift ☒
Depth to water at start of test 11 ft. At end of test 11 ft
Discharge 100+ gal/min after 1 hours Water temperature 54°
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG:

Total depth 65 ft. Depth of completed well 65 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	1	BROWN SANd
1	3	BROWN CLAY
3	17	LIGHT YELLOW CLAY
17	19	DARK/BROWN SANd
19	23	GRAY ShALE
23	46	BLACK SANd & SMALL GRAVEL
46	61	DARK GRAY SANdSTONE
61	63	GRAY LAVA ROCK
63	65	DARK GRAY SANdSTONE

JAN 7 1983

CONFIDENTIAL WELL LOG
Water Code Section 13752.
These data are restricted to
governmental agencies for use
in making studies.

Work started 9/13/82 19 Completed 9/15/82 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED E E Storey 00525
(Well Driller)

NAME E E STOREY WELL DRILLING
(Person, firm, or corporation) (Typed or printed)

Address 3847 Hope
City KLAMATH FALLS ORE Zip 97601
License No. 192492 Date of this report 12/1/82

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

47N/5E-~~8~~ 4

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do Not Fill In

№ 62637

State Well No.

Other Well No.

CONFIDENTIAL LOG
Water Code Sec. 13752

(2) LOCATION OF WELL:

County Modoc Owner's number, if any

Township, Range, and Section T 47N R5E Sec.5

Distance from cities, roads, railroads, etc. S.E. corner of the S.W.¼ of the S.E.¼ M.D.M.

(3) TYPE OF WORK (*check*):

New Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (*check*):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Other ☐

(6) CASING INSTALLED:

STEEL: SINGLE ☒ DOUBLE ☐ OTHER:

From ft.	To ft.	Diam.	Gage or Wall	If gravel packed: Diameter of Bore	From ft.	To ft.
0	56	6"	¼			

Size of shoe or well ring: none Size of gravel:

Describe joint welded

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen none

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☒ No ☐ To what depth 56 ft.

Were any strata sealed against pollution? Yes ☒ No ☐ If yes, note depth of strata

From 10 ft. to 12 ft.

From ft. to ft.

Method of sealing cased

(9) WATER LEVELS:

Depth at which water was first found, if known 10 ft.

Standing level before perforating, if known ft.

Standing level after perforating and developing 8 ft.

(10) WELL TESTS: bailer test

Was pump test made? Yes ☐ No ☒ If yes, by whom? self

Yield: 35 gal./min. with none ft. drawdown after 1 hrs.

Temperature of water 54 Was a chemical analysis made? Yes ☐ No ☒

Was electric log made of well? Yes ☐ No ☒ If yes, attach copy

(11) WELL LOG:

Total depth 75 ft. Depth of completed well 71 ft.

Formation: *Describe by color, character, size of material, and structure*

ft. to ft.

0----4----top soil
4---23---yelllow clay
23---68---gray clay
68---72--- pumice gravel and sand
72--75--gray clay

Work started 2/12 19 73 Completed 2/13 19 73

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME John A. Van Meter
(Person, firm, or corporation) (*Typed or printed*)

Address P.O. Box 204 Malin, Oregon 97632

[SIGNED] John A. Van Meter
(*Well Driller*)

License No. 194473 Dated 2/13, 19 ~~7~~ 73

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-68)

25179-950 9-68 50M TRIP △D OSP

ORIGINAL
File with DWR

Page 1 of 2

STATE OF CALIFORNIA
WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 751112

DWR USE ONLY — DO NOT FILL IN
48N/04E-13
STATE WELL NO./ STATION NO.
LATITUDE
LONGITUDE
APN/TRS/OTHER

Owner's Well No. TID #5
Date Work Began 7/14/01, Ended 7/26/01
Local Permit Agency Siskiyou County
Permit No. 3713 Permit Date

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD REVERSE FLUID Air & Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	917	Dark olive gray lake sediments
917		Dark olive gray to black, weak to moderately
	940	vesicular basalt
970	970	Gray flow breccia
970		Gray, fragemented, locally vesicular basalt
	1020	with some clay
1020		Gray, finely vesicular basalt, vesicles range from
	1130	open to mineral filled
1130	1150	Dark gray to gray green sand with clay
1150	1160	Olive green clay
1170		Interbedded blue gray to olive green clay and
	1200	gray to dark gray basalt
1200	1220	Dark gray to gray vesicular basalt
1220		Dark gray to gray vesicular basalt with fracture
	1230	fill material
1230	1240	Varicolored clay
1240		Gray to gray green, locally vesicular basalt,
	1270	locally fractured
1270		Gray to red brown, vesicular to scoriaceous
	1380	basalt
1380	1388	Gray, massive, weakly vesicular basalt
1388	1398	Gray, massive strongly vesicular basalt
1398		Dark gray to black basalt, interbedded soft
	1560	vesicular and massive
1560	1570	Basalt, becomes more massive

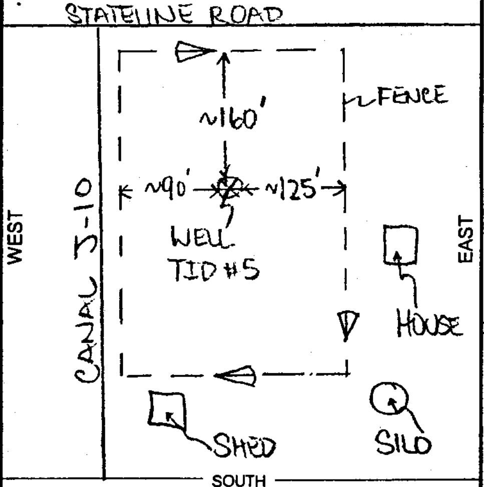
TOTAL DEPTH OF BORING 1570 (Feet)
TOTAL DEPTH OF COMPLETED WELL 1567 (Feet)

WELL OWNER

WELL LOCATION

Address Stateline Road at J-10 Canal
City Tulelake CA 96134
County Siskiyou
APN Book 001 Page 014 Parcel 07
Township 48 N Range 4 E Section 13
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)
✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)
WATER SUPPLY
___ Domestic ___ Public
✓ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 29.12 (Ft.) & DATE MEASURED 8/14/01
ESTIMATED YIELD * 10,500 (GPM) & TEST TYPE Pump
TEST LENGTH 73.98 (Hrs.) TOTAL DRAWDOWN 96.39 (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	17	38			✓		A53B	33.25	0.375	
+1	402	31	✓				A53B	23.25	0.375	
378.8	935.2	19	✓				A53B	13.376	0.312	
935.2	955.2	19		✓			A53B	13.376	0.312	0.125
955.2	1015	19	✓				A53B	13.376	0.312	
1015	1036	19		✓			A53B	13.376	0.312	0.125

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	462.0	✓			
462.0	487.6			✓	Sand
487.6	871.0			✓	Crushed gravel
871.0	883.0	✓			
883.0	910.0				Sand
910	1565				1/2 x 3/4 SRI

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

DEC 10 2001

NAME Lang Exploratory Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
P.O. Box 5279 Elko NV 89801-5279
ADDRESS CITY STATE ZIP
Signed ___ 08/28/01 694686
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 2 of 2

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 751112

DWR USE ONLY — DO NOT FILL IN
48N/04E-13
STATE WELL NO./ STATION NO.
LATITUDE
LONGITUDE
APN/TRS/OTHER

Owner's Well No. TID #5
Date Work Began 7/14/01, Ended 7/26/01
Local Permit Agency Siskiyou County
Permit No. 3713 Permit Date

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD REVERSE FLUID Air & Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	917	Dark olive gray lake sediments
917		Dark olive gray to black, weak to moderately
	940	vesicular basalt
970	970	Gray flow breccia
970		Gray, fragemented, locally vesicular basalt
	1020	with some clay
1020		Gray, finely vesicular basalt, vesicles range from
	1130	open to mineral filled
1130	1150	Dark gray to gray green sand with clay
1150	1160	Olive green clay
1170		Interbedded blue gray to olive green clay and
	1200	gray to dark gray basalt
1200	1220	Dark gray to gray vesicular basalt
1220		Dark gray to gray vesicular basalt with fracture
	1230	fill material
1230	1240	Varicolored clay
1240		Gray to gray green, locally vesicular basalt,
	1270	locally fractured
1270		Gray to red brown, vesicular to scoriaceous
	1380	basalt
1380	1388	Gray, massive, weakly vesicular basalt
1388	1398	Gray, massive strongly vesicular basalt
1398		Dark gray to black basalt, interbedded soft
	1560	vesicular and massive
1560	1570	Basalt, becomes more massive

TOTAL DEPTH OF BORING 1570 (Feet)
TOTAL DEPTH OF COMPLETED WELL 1567 (Feet)

WELL LOCATION

Address Stateline Road at J-10 Canal
City Tulelake CA 96134
County Siskiyou
APN Book 001 Page 014 Parcel 07
Township 48 N Range 4 E Section 13
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST
EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
✓ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 29.12 (Ft.) & DATE MEASURED 8/14/01
ESTIMATED YIELD • 10,500 (GPM) & TEST TYPE Pump
TEST LENGTH 73.98 (Hrs.) TOTAL DRAWDOWN 96.39 (Ft.)
May not be representative of a well's long-term yield.

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	CASING (S) TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
1036	1076	19	✓				A53B	13.376	0.312	
1076	1096	19		✓			A53B	13.376	0.312	0.125
1096	1136	19	✓				A53B	13.376	0.312	
1136	1557	19		✓			A53B	13.376	0.312	0.125
1557	1567	19	✓				A53B	13.376	0.312	
+1	370	31	✓				A53B	2.067	0.154	Sounder

DEPTH FROM SURFACE Ft.	to Ft.	ANNULAR MATERIAL TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	462.0	✓			
462.0	487.6			✓	Sand
487.6	871.0			✓	Crushed gravel
871.0	883.0	✓			
883.0	910.0				Sand
910	1565				1/2 x 3/4 SRI

DEC 10 2001

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME Lang Exploratory Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
P.O. Box 5279 Elko NV 89801-5279
ADDRESS CITY STATE ZIP
Signed ___ 08/28/01 694686
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

48N/04E-18M

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 078748

N ntent No.

Local Permit No. or Date AP# 001-110-100

State Well No.

Other Well No.

(1

Ad

Cit

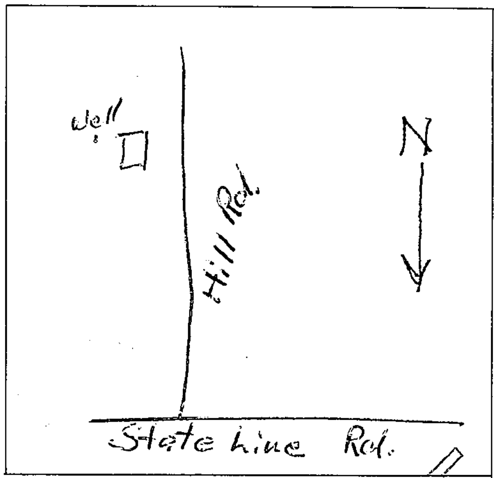
(2) **LOCATION OF WELL** (See instructions):

County Siskiyou Owner's Well Number

Well address if different from above

Township 48N Range 4E Section 18

Distance from cities, roads, railroads, fences, etc.



WELL LOCATION SKETCH

(3) **TYPE OF WORK:**

New Well ☒ Deepening ☐

Reconstruction ☐

Reconditioning ☐

Horizontal Well ☐

Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) **PROPOSED USE:**

Domestic ☒

Irrigation ☒

Industrial ☐

Test Well ☐

Stock ☐

Municipal ☐

Other ☐

(5) **EQUIPMENT:**

Rotary ☒ Reverse ☐

Cable ☐ Air ☐

Other ☐ Bucket ☐

(6) **GRAVEL PACK:**

Yes ☒ No ☐ Size 3/8

Diameter of bore

Packed from 20 to 38 ft.

(7) **CASING INSTALLED:**

Steel ☒ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
+2	-38	6"	.250

(8) **PERFORATIONS:**

Type of perforation or size of screen

From ft.	To ft.	Slot size
-22	-38	1/4 X 5

(9) **WELL SEAL:**

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 20 ft.

Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.

Method of sealing Casing & Cement.

(10) **WATER LEVELS:**

Depth of first water, if known 10 ft.

Standing level after well completion 6 ft.

(11) **WELL TESTS:**

Was well test made? Yes ☒ No ☐ If yes, by whom? Mike Wright

Type of test Pump ☐ Bailer ☐ Air lift ☒

Depth to water at start of test 6 ft. At end of test 20 ft

D 20 gal/min after 1 hours Water temperature 66

Che nalysis made? Yes ☐ No ☒ If yes, by whom?

Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) **WELL LOG:** Total depth 38 ft. Depth of completed well 33 ft.

from ft.	to	ft.	Formation (Describe by color, character, size or material)
0	-	10	Brown Sand
10	-	20	(SWL 6') Brown Sand
20	-	38	" Gravel & Black Sand

DEC 31 1991

Work started 11/8 19 91 Completed 11/12 19 91

WELL DRILLER'S STATEMENT: 1379

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED
(Well Driller)

NAME Roger Chancellor Drilling
(Person, firm, or corporation) (Typed or printed)

Address 12150 Hill Rd.

City Klamath Falls, OR. Zip 97603

License No. Date of this report

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

48N/12E-16 *Do not fill in*

4E No. 11064

Notice of Intent No.

Local Permit No. or Date

State Well No.

Other Well No.

\
A
C

(2) LOCATION OF WELL (See instructions):

County Siskiyou Owner's Well Number

Well address if different from above

Township 48 N Range K-12 E 4 Section 16

Distance from cities, roads, railroads, fences, etc. S.W. ¼ of the S.W. ¼

WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐

Reconstruction ☐

Reconditioning ☐

Horizontal Well ☐

Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☒

Irrigation ☐

Industrial ☐

Test Well ☐

Stock ☐

Municipal ☐

Other ☐

(5) EQUIPMENT:

Rotary ☐ Reverse ☐

Cable ☒ Air ☐

Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☐ No ☒ Size

Diameter of bore

Packed from to ft.

(7) CASING INSTALLED:

Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	31	.6	.188			

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 30 ft.

Were strata sealed against pollution? Yes ☒ No ☐ Interval 30 ft.

Method of sealing ~~XXXXX~~ cement

(10) WATER LEVELS:

Depth of first water, if known 7 ft.

Standing level after well completion 7 ft.

(11) WELL TESTS:

Was well test made? Yes ☒ No ☐ If yes, by whom? self

Type of test Pump ☐ Bailer ☒ Air lift ☐

Depth to water at start of test 7 ft. At end of test 8 ft

Discharge 30 gal/min after 1 hours Water temperature 55

Chemical analysis made? Yes ☐ No ☒ If yes, by whom?

Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG:

Total depth 135 ft. Depth of completed well 135 ft.

from ft. to ft.	Formation (Describe by color, character, size or material)
0--5 -	top soil
5--27 -	gray clay and sand
27--120 -	gray clay
120--130	sand and pumice gravel
130--135	gray clay

Work started 9/20 1977 Completed 9/22 1977

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED John A. Van Meter
(Well Driller)

NAME John A. Van Meter 534
(Person, firm, or corporation) (Typed or printed)

Address ~~P. O. BOX 204~~
City Malin, Oregon Zip 97632
License No. 194473 Date of this report 9/30/77

CONFIDENTIAL

NOT FOR PUBLIC USE
WATER CODE SEC. 13752

188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 43816-950 7-76 50M QUAD ⓘT OSP

ORIGINAL
File with DWR
Page 1 of 1

AUG 02 2001

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 751108

DWR USE ONLY — DO NOT FILL IN
48N/04E-30
STATE WELL NO./ STATION NO.
LATITUDE
LONGITUDE
APN/TRS/OTHER

Owner's Well No. TID #1
Date Work Began 5/26/01, Ended 6/8/01
Local Permit Agency Siskiyou County Health Dept.
Permit No. 3666 Permit Date

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD REVERSE FLUID Air & Mud

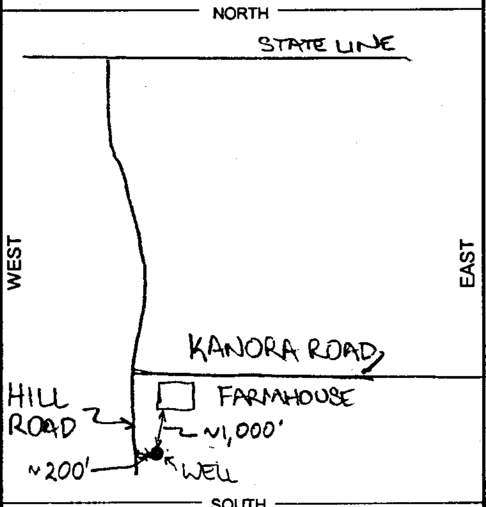
DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	160	Sand, gravel and clay
160	200	Dark brown basalt
200	210	Hard basalt
210	220	Fractured basalt
220	350	Hard basalt
350	710	Fractured basalt
710	730	Basalt with light gray clay
730	740	Light brown basalt with minor black basalt

TOTAL DEPTH OF BORING 740 (Feet)
TOTAL DEPTH OF COMPLETED WELL 734 (Feet)

WELL LOCATION

Address Hill Road
City Tulelake CA 93614
County Siskiyou
APN Book 001 Page 017 Parcel 10
Township 48 N Range 4 E Section 30
Latitude ___ DEG. MIN. SEC. ___ DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)
✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)
WATER SUPPLY
___ Domestic ___ Public
✓ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 200 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 22.6 (Ft.) & DATE MEASURED 6/8/01
ESTIMATED YIELD * 600 (GPM) & TEST TYPE Airlift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN 0.2 (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	20	38			✓		A53B	33.25	0.375	
+2	260	31	✓				A53B	23.25	0.375	
260	700	31		✓			A53B	23.25	0.375	0.125
700	734	31	✓				A53B	23.25	0.375	
+1	380	31	✓				A53B	2.067	0.1574	Sounder

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	220	✓			
220	230				8 X 12 Sand
230	290				1/8 X 3/8 SRI
290	734				1/2 X 3/4 SRI
734	740	✓			

ATTACHMENTS (✓)
___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME Lang Exploratory Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
P.O. Box 5279 Elko NV 89801-5279
ADDRESS CITY STATE ZIP
DEC 10 2001
Signed
WELL DRILLER/AUTHORIZED REPRESENTATIVE
07/11/01
DATE SIGNED
694686
C-57 LICENSE NUMBER

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

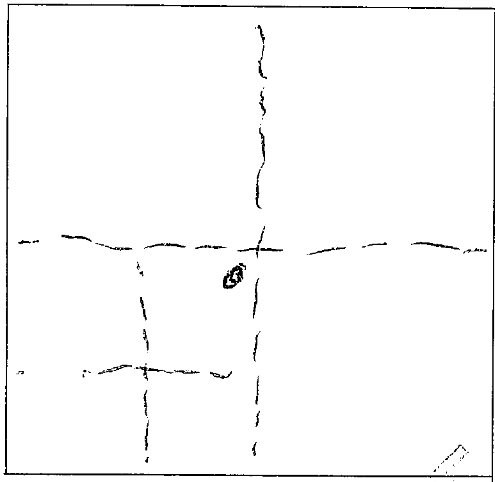
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do not fill in
No. 099000
State Well No. 48N/4E-31 ✓
Other Well No.

Notice of Intent No.
Local Permit No. or Date

(
A
C Zip

(2) LOCATION OF WELL (See instructions):
County Siskiyou Owner's Well Number
Well address if different from above
Township 48N Range 4E Section 31
Distance from cities, roads, railroads, fences, etc.
N.E. $\frac{1}{4}$ of the S.W. $\frac{1}{4}$



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other ☐

(5) EQUIPMENT:
Rotary ☐ Reverse ☐
Cable ☐ Air ☒
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☒ Size
Diameter of bore
Packed from to ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS: none
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	20	6	.250			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 19 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.
Method of sealing cement & casing

(10) WATER LEVELS:
Depth of first water, if known 28 ft.
Standing level after well completion 7 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom?
Type of test Pump ☐ Bailer ☐ Air lift ☒
Depth to water at start of test ft. At end of test ft
Discharge 20 gal/min after 1 hours Water temperature 56
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 40 ft. Depth of completed well 29 ft.

from ft.	to	ft.	Formation (Describe by color, character, size or material)
0	-	6	top soil
6	-	25	blue clay
25	-	29	sand & gravel
29	-	40	gravel

Work started 9/16 1981 Completed 9/16 1981

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
SIGNED John A. Van Meter
(Well Driller)
NAME John A. Van Meter 534
(Person, firm, or corporation) (Typed or printed)
Address P.O. Box 204
City Malin, Ore. Zip 97632
License No. 194473 Date of this report 10/ 2/81

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

Page 1 of 2

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 751115

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./ STATION NO. 48N/05E-26

LATITUDE

LONGITUDE

APN/TRS/OTHER

Owner's Well No. TID #8

Date Work Began 8/16/01, Ended 9/7/01

Local Permit Agency Modoc County

Permit No. 2001-8 Permit Date

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD REVERSE FLUID Air & Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	1240	Gray clay, lake bottom sediments
1240	1305	Basalt, vesicular to amygdaloidal, fractured
1305	1320	Sandstone and siltstone
1320	1336	Massive basalt
1336	1474	Basalt, vesicular to amygdaloidal, fractured
1474	1530	Basalt, massive, vesicular, and amygdaloidal
1530	1578	Basalt, vesicular to amygdaloidal
1578	1610	Ash rich clay and silt
1610	1640	Basalt, massive, vesicular and amygdaloidal
1640	1670	Claystone to siltstone
1670	1720	Basalt, massive
1720	1745	Claystone to siltstone
1745	1750	Medium to coarse grained volcanic sand
1750	1770	Claystone to siltstone
1770	1810	Basalt, massive, locally fractured

TOTAL DEPTH OF BORING 1810 (Feet)

TOTAL DEPTH OF COMPLETED WELL 1807 (Feet)

WELL LOCATION

Address J Canal & Canal J-18

City South of Malin, Or. in CA

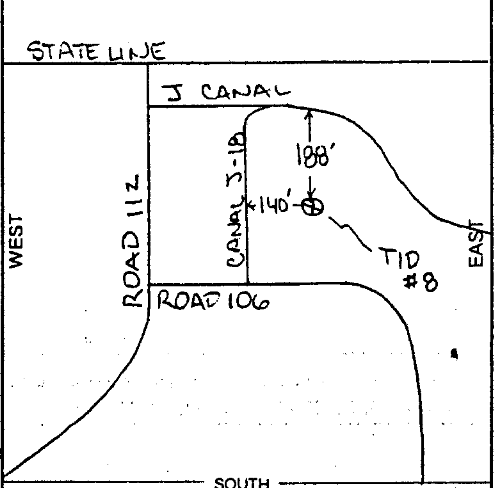
County Modoc

APN Book 005 Page 040 Parcel 14

Township 48 N Range 5 E Section 26

Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ✓ Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 33 (Ft.) & DATE MEASURED 9/3/01

ESTIMATED YIELD • 3935 (GPM) & TEST TYPE Pump

TEST LENGTH 27.25 (Hrs.) TOTAL DRAWDOWN 267 (Ft.)

May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	15	38			✓		A53B	33.25	0.375	
+1	400	31	✓				A53B	23.25	0.375	
379.9	1250	19	✓				A53B	13.25	0.375	
1250	1635	19		✓			A53B	13.25	0.375	0.125
1635	1650	19	✓				A53B	13.25	0.375	
1650	1802	19		✓			A53B	13.25	0.375	0.125

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	456	✓			
456	466				1/8 X 3/8 SRI
466	1175			✓	Crushed Gravel
1175	1200	✓			
1200	1210				1/8 x 3/8 SRI
1210	1787				1/2 x 3/4 SRI

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analysis
- ___ Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Lang Exploratory Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

P.O. Box 5279 Elko NV 89801-5279
ADDRESS CITY STATE ZIP

DEC 10 2001

Signed
WELL DRILLER/AUTHORIZED REPRESENTATIVE

09/18/01 DATE SIGNED

694686 C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 2 of 2

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 751115

DWR USE ONLY — DO NOT FILL IN
48N/05E-26
STATE WELL NO./ STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. TID #8
Date Work Began 8/16/01, Ended 9/7/01
Local Permit Agency Modoc County
Permit No. 2001-8 Permit Date

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD REVERSE FLUID Air & Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	1240	Gray clay, lake bottom sediments
1240	1305	Basalt, vesicular to amygdaloidal, fractured
1305	1320	Sandstone and siltstone
1320	1336	Massive basalt
1336	1474	Basalt, vesicular to amygdaloidal, fractured
1474	1530	Basalt, massive, vesicular, and amygdaloidal
1530	1578	Basalt, vesicular to amygdaloidal
1578	1610	Ash rich clay and silt
1610	1640	Basalt, massive, vesicular and amygdaloidal
1640	1670	Claystone to siltstone
1670	1720	Basalt, massive
1720	1745	Claystone to siltstone
1745	1750	Medium to coarse grained volcanic sand
1750	1770	Claystone to siltstone
1770	1810	Basalt, massive, locally fractured

TOTAL DEPTH OF BORING 1810 (Feet)
TOTAL DEPTH OF COMPLETED WELL 1807 (Feet)

WELL LOCATION

Address J Canal & Canal J-18
City South of Malin, Or. in CA
County Modoc
APN Book 005 Page 040 Parcel 14
Township 48 N Range 5 E Section 26
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST
EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
✓ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 33 (Ft.) & DATE MEASURED 9/3/01
ESTIMATED YIELD 3935 (GPM) & TEST TYPE Pump
TEST LENGTH 27.25 (Hrs.) TOTAL DRAWDOWN 267 (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
1802	1807	19	✓				A53B	13.25	0.375	Cement
										Bullnose
+1	370	31	✓				A53B	2.067	0.154	Sounder

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
1787	1810	✓			

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME Lang Exploratory Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
P.O. Box 5279 Elko NV 89801-5279
ADDRESS CITY STATE ZIP
Signed ___ WELL DRILLER/AUTHORIZED REPRESENTATIVE 09/18/01 DATE SIGNED 694686 C-57 LICENSE NUMBER

DEC 10 2001

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

48N 5E-35F1 48N/5E-35

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do Not Fill In

Nº 128124

State Well No.
Other Well No.
CONFIDENTIAL LOG
Water Code Sec. 13752

(1) OWNER:

(2) LOCATION OF WELL:

County Modoc Owner's number, if any
Township, Range, and Section T 48N R 5E Sec. 35
Distance from cities, roads, railroads, etc. S.E.¼ of the N.W.¼
M.D.M.

(3) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Other ☐

(6) CASING INSTALLED:

STEEL: OTHER:
SINGLE ☒ DOUBLE ☐

If gravel packed

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
0	20	6"	.280			

Size of shoe or well ring: none
Size of gravel:
Describe joint XXXXX weld

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen none

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☒ No ☐ To what depth 20 ft.
Were any strata sealed against pollution? Yes ☒ No ☐ If yes, note depth of strata
From 8 ft. to 12 ft.
From ft. to ft.
Method of sealing cased

(9) WATER LEVELS:

Depth at which water was first found, if known 25 ft.
Standing level before perforating, if known 6 ft.
Standing level after perforating and developing 6 ft.

(10) WELL TESTS: bailer

Was pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: 40 gal./min. with ½ ft. drawdown after 1 hrs.
Temperature of water 55 Was a chemical analysis made? Yes ☐ No ☒
Was electric log made of well? Yes ☐ No ☒ If yes, attach copy

(11) WELL LOG:

Total depth 33 ft. Depth of completed well 32 ft.
Formation: *Describe by color, character, size of material, and structure*
ft. to ft.

0---1--top soil
1---3---brown sand
3---12---brown clay and sand
12--14---brown clay
14---22--layers of brown and blue clay
22--25---gray clay
25---30--pumice gravel and black sand
30--33---pumice gravel and brown sand

CONFIDENTIAL LOG
Water Code Sec. 13752

Work started 6/17 19 75, Completed 6/18 19 75

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME John A. Van Meter
(Person, firm, or corporation) (*Typed or printed*)

Address P.O. Box 204 Malin, Oregon 97632

[SIGNED] John A. Van Meter
(Well Driller)

License No. 194473 Dated 6/19, 1975

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-68)

67189-780 8-72 30M TRIP OSP

Appendix J.
Groundwater Monitoring Plan

TULELAKE IRRIGATION DISTRICT

GROUNDWATER MONITORING PLAN

TABLE OF CONTENTS

INTRODUCTION

The purpose of this groundwater monitoring plan is to provide a reference and procedural basis for groundwater monitoring in the Tule Lake Subbasin (1-2.01). Using the policies and procedures set forth in this plan the Tulelake Irrigation District, hereafter referred to as TID, will regularly and systematically monitor groundwater elevations at designated monitoring sites. With the data collected under this plan, along with the existing data that TID has compiled since 2001, TID will be able to demonstrate seasonal and long-term trends of groundwater elevations in the Tule Lake Subbasin. The information gathered will be reported to the California Department of Water Resources (DWR) under the California Statewide Groundwater Elevation Monitoring (CASGEM) program.

MONITORING PLAN RATIONALE

TULE LAKE SUBBASIN (1-2.01)

TID lies within the Tule Lake Subbasin of the Upper Klamath River Groundwater Basin. TID's boundary encompasses most of, if not the entire, California portion of the Tule Lake Subbasin. The Tule Lake Subbasin is located within the California portion of the Klamath Basin, approximately 30 miles southeast of the City of Klamath Falls, OR, and is split by the boundary of Siskiyou County and Modoc County. The subbasin is bounded to the west by the Gillems Bluff Fault that forms the steep eastern slope of Sheepy Ridge, which separates the Tule Lake and Lower Klamath subbasins. The subbasin is bounded to the east by the Big Crack Fault that forms the western edge of the block faulted mountains between Tule Lake and Clear Lake Reservoir. The subbasin is bounded to the south by the low-lying volcanic fields on the north slope of the Medicine Lake Highlands. As stated in Bulletin 118, the subbasin is bounded to the north by the state boundary of Oregon and California.

The principal water-bearing formations in the Tule Lake Subbasin include Tertiary to Quaternary lake deposits and volcanics.

There are two principal sources of recharge in the subbasin: underflow from the rapidly replenished and permeable unconfined system of adjacent volcanic rocks, and infiltration of surface water through marginally permeable sedimentary deposits. The area surrounding the subbasin consists of mainly Holocene and Miocene volcanic rocks that capture most of the incipient precipitation and intermittent stream flow by infiltration through fractures. This source of recharge is believed to be the most significant for the subbasin due to the very slow infiltration rates in the sedimentary deposits.

HISTORY OF GROUNDWATER MONITORING IN THE TULE LAKE SUBBASIN (1-2.01)

TID has been monitoring groundwater levels within the Tule Lake Subbasin since 2001. The 2001 to present data has been collected from the ten wells that TID owns within the district, and more recently, TID has collected data from five additional privately owned sites. DWR also measures about fifty wells in the Tule Lake Subbasin including the ten TID wells. The DWR monitored wells throughout the subbasin are a mixture of domestic, irrigation, industrial, monitoring, municipal, and stock wells of varying depths. All of the wells are measured by DWR during spring, summer, and fall of every year. A map of the DWR monitoring sites can be found in Appendix A.

WELL NETWORK

The well network that TID monitors consists of 15 wells which are spread throughout the Tule Lake Subbasin within the District's boundary. The sites that were selected by TID were done so in order to provide the best overall coverage available of the Tule Lake Subbasin. A map of the well network is shown in Figure 1 below.

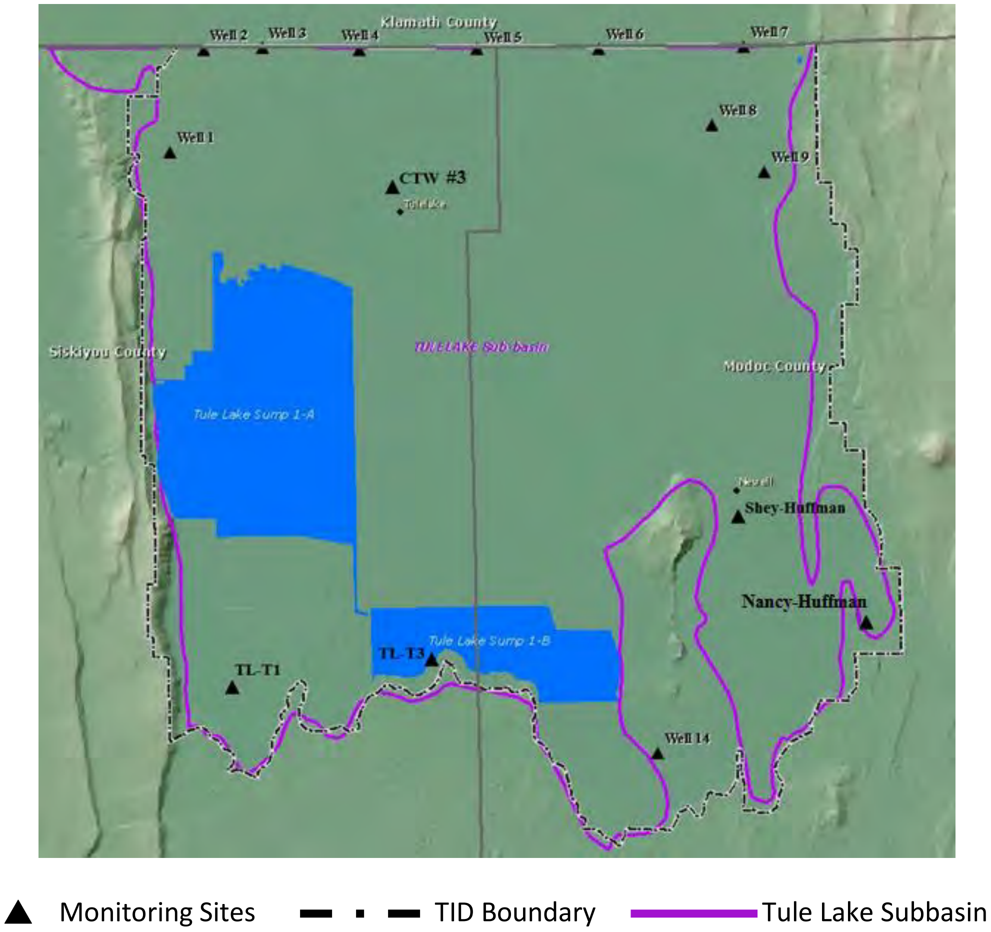


Figure 1. TID Groundwater Monitoring Network

Of the 15 monitoring sites, 10 of them are owned and operated by TID. They are most commonly known as TID 1 through 9 and TID 14. Most of these wells are positioned in the northern most part of the California portion of the Tule Lake Subbasin, with the exception of TID 14 which is located in the southern section in an area known as the Panhandle. The additional five wells that TID monitors under the CASGEM program are privately owned sites. The site shown on the map as CTW #3 is the newest well drilled by the City of Tulelake located at the northern tip of the city limits. The sites depicted as TL-T1 and TL-T3 are well test sites drilled by the U.S. Fish and Wildlife Service within the confines of the Tule Lake National Wildlife Refuge. The remaining two wells are situated in the southeast portion of the Tule Lake Subbasin in an area known as Copic Bay, and both are owned by a local farming entity identified as the Huffman Brothers. All 10 of TID's wells, as well as the two wells owned by the U.S. Fish and Wildlife Service, are designated as CASGEM wells. The wells known as CTW #3, Shey-Huffman, and

Nancy-Huffman are designated as Voluntary due to a confidentiality agreement between TID and the owners. All pertinent well information for each of the TID monitoring sites can be found in Appendix B.

MONITORING SCHEDULE

TID's monitoring of the groundwater elevation of each of the monitoring sites is done on a monthly basis. Collection and documentation of groundwater elevation data of all monitoring sites is conducted within a single day within the first full week of each month of the year. This gives a sufficient month by month picture of the groundwater fluctuation. In the case of temporary inaccessibility to any of the sites due to weather conditions, or any other conditions, collection of the data for those sites is done as soon as possible when the conditions improve.

FIELD METHODS

REFERENCE POINT

All reference point (RP) information for each of TID's monitoring sites can be found in the table in Appendix B. A photograph and written description of the reference point for each monitoring site can be found in Appendix C.

RECORDING DEPTH TO WATER MEASUREMENTS

TID's method for recording depth to water measurements is the Electric Sounding Tape Method. All measurements for a single recording period are recorded on a single TID Groundwater Field Data Sheet, of which an example can be found in Appendix D.

DEPTH TO WATER MEASUREMENT INSTRUCTIONS

BEFORE MAKING A MEASUREMENT:

- Inspect the electric sounding tape and electrode probe before using it in the field. Check the tape for wear, kinks, frayed electrical connections and possible stretch; the cable jacket tends to be subject to wear and tear. Test that the battery and replacement batteries are fully charged.

- Check the distance from the electrode probe's sensor to the nearest foot marker on the tape, to ensure that this distance puts the sensor at the zero foot point for the tape. If it does not, a correction must be applied to all depth-to-water measurements. Record this correction on the TID Groundwater Field Data Sheet.

- Check the circuitry of the electric sounding tape before lowering the electrode probe into the well. To determine proper functioning of the tape mechanism, dip the electrode probe into tap water and observe whether the indicator light and beeper indicate a closed circuit.

- Wipe down the electrode probe and 5 to 10 feet of the tape with a disinfectant wipe, rinse with de-ionized or tap water, and dry.

MAKING A MEASUREMENT:

- Identify the appropriate site on the TID Groundwater Field Data Sheet and record whether or not the well is running, the pumping rate, and the accumulated acre-feet meter reading in the designated columns for the site.

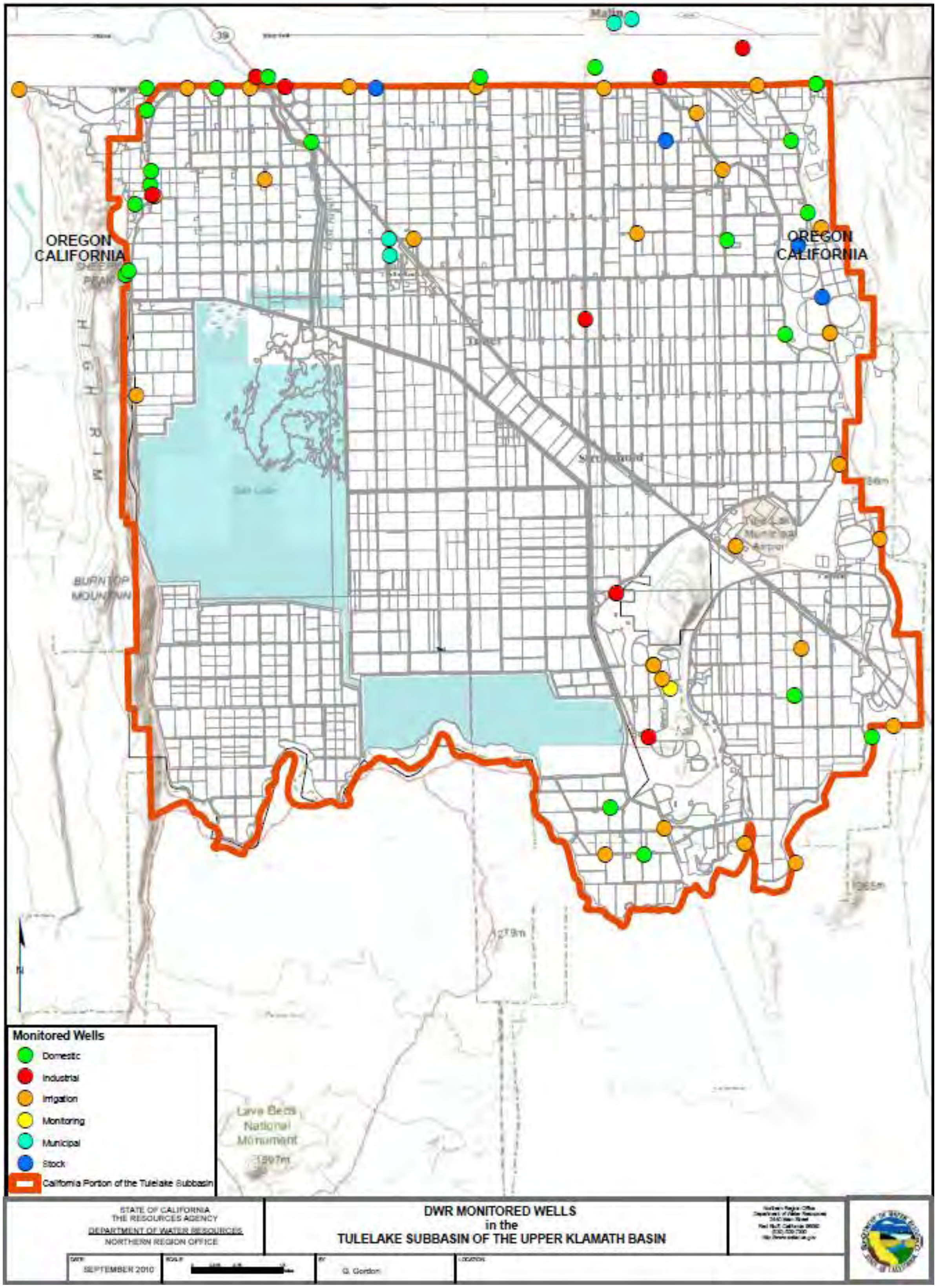
- Lower the electrode probe slowly into the well until the indicator shows that the circuit is closed and contact with the water surface is made. Avoid letting the tape rub across the top of the well casing. Place the tip or nail of the index finger on the insulated wire at the RP and read the depth to water to the nearest 0.1 foot. Record this value in the “DEPTH to WATER” column of the TID Groundwater Field Data Sheet for the appropriate site.

- Record any notable comments, problems, or inaccuracies in the “COMMENT” section for the appropriate site.

AFTER MAKING A MEASUREMENT:

- Wipe down the electrode probe and the section of the tape that was submerged in the well water, using a disinfectant wipe and rinse thoroughly with de-ionized or tap water. Dry the tape and probe and rewind the tape onto the tape reel. Do not rewind or otherwise store a dirty or wet tape.

APPENDIX A: DWR TULE LAKE SUBBASIN MONITORING MAP



APPENDIX B: TID MONITORING WELL INFORMATION

Local Well ID	TID #1	TID #2	TID #3	TID #4
State Well Number	48N04E30F002M	48N04E18J001M	48N04E16M001M	48N04E15K001M
Reference Point ELEV	4047.75	4057.99	4056.23	4051.35
Ground Surface ELEV	4047.05	4056.02	4055.73	4049.60
Well Use	Irrigation	Irrigation	Irrigation	Irrigation
Well Status	Active	Active	Active	Active
Well Coordinates	E 121.5567 N 41.9721	E 121.5455 N 41.9980	E 121.5251 N 41.9979	E 121.4931 N 41.9978
Well Completion Type	Single	Single	Single	Single
Total Well Depth / Drilled Depth	740 / 740	1545 / 1550	1680.57 / 1710	1432.8 / 1440
Screen Interval #1	260-700	1260-1540	1153.1-1292.32	1211.65-1432.8
Screen Interval #2	--	--	1334.44-1354.46	--
Screen Interval #3	--	--	1375.49-1455.58	--
Screen Interval #4	--	--	1476.62-1536.82	--
Screen Interval #5	--	--	1599.89-1680.57	--
Screen Interval #6	--	--	--	--
Well Completion Report Number	751108	751109	751110	751111
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

Local Well ID	TID #5	TID #6	TID #7	TID #8
State Well Number	48N04E13K001M	48N05E16P001M	48N05E14R001M	48N05E26D001M
Reference Point ELEV	4051.44	4054.28	4068.45	4050.29
Ground Surface ELEV	4050.50	4052.38	4068.29	4049.10
Well Use	Irrigation	Irrigation	Irrigation	Irrigation
Well Status	Active	Active	Active	Active
Well Coordinates	E 121.4519 N 41.9971	E 121.4106 N 41.9962	E 121.3609 N 41.9963	E 121.3727 N 41.9762
Well Completion Type	Single	Single	Single	Single
Total Well Depth / Drilled Depth	1566.83 / 1570	2380 / 2600	2020 / 2030	1807.35 / 1810
Screen Interval #1	935.18-955.18	822.61-1084.77	814.26-1155.03	1247.45-1647.47
Screen Interval #2	1015.44-1035.51	1375.28-1719.34	1255.65-1336.09	1662.23-1802.35
Screen Interval #3	1075.71-1095.63	1805.29-2108.14	1396.6-1436.85	--
Screen Interval #4	1135.79-1556.81	2257.02-2358.1	1497.24-1537.37	--
Screen Interval #5	--	--	1577.66-1617.78	--
Screen Interval #6	--	--	1678.47-2020	--
Well Completion Report Number	751112	751113	751114	751115
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

Local Well ID	TID #9	TID #14	TL-T1 Q3B	TL-T3 GP
State Well Number	48N05E36D001M	46N05E22D001M	--	--
Reference Point ELEV	4049.25	4037.78	4034.1	4047.1
Ground Surface ELEV	4047.91	4037.47	4032.7	4045.6
Well Use	Irrigation	Irrigation	Observation	Observation
Well Status	Active	Active	Inactive	Inactive
Well Coordinates	E 121.3555 N 41.9647	E 121.3955 N 41.8174	E 121.5420 N 41.8341	E 121.4697 N 41.8391
Well Completion Type	Single	Single	--	--
Total Well Depth / Drilled Depth	2043.04 / 2060	567 / 571	500/500	500/500
Screen Interval #1	1060.46-1941.59	114.11-234.16	Open Hole 20-500	Open Hole 20-500
Screen Interval #2	1982.49-2022.54	254.14-314.16	--	--
Screen Interval #3	--	334.14-554.25	--	--
Screen Interval #4	--	--	--	--
Screen Interval #5	--	--	--	--
Screen Interval #6	--	--	--	--
Well Completion Report Number	751116	751117	--	--
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

Local Well ID	Shey-Huffman	Nancy-Huffman	CTW #3
State Well Number	--	--	--
Reference Point ELEV	4045.2	4048.8	4038.2
Ground Surface ELEV	4044.9	4047.7	4037.6
Well Use	Irrigation	Irrigation	Municipal
Well Status	Active	Active	Active
Well Coordinates	E 121.3650 N 41.8774	E 121.3255 N 41.8492	E 121.4815 N 41.9605
Well Completion Type	Single	Single	Single
Total Well Depth / Drilled Depth	520/520	212/212	2761 / 2790
Screen Interval #1	80-245	Open Hole 20-212	2560.5-2761
Screen Interval #2	Open Hole 245-520	--	--
Screen Interval #3	--	--	--
Screen Interval #4	--	--	--
Screen Interval #5	--	--	--
Screen Interval #6	--	--	--
Well Completion Report Number	962868	782127	797943
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

APPENDIX C: TID MONITORING WELL REFERENCE POINT INFORMATION

Reference points for all monitoring sites are marked with fluorescent orange paint.

TID #1: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #2: The reference point is the lip of the sounding tube located on the south side of the well casing

TID #3: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #4: The reference point is the lip of the sounding tube located on the south side of the well casing

TID #5: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #6: The reference point is the lip of the sounding tube located on the north side of the well casing

TID #7: The reference point is the lip of the sounding tube located on the south side of the well casing

TID #8: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #9: The reference point is the lip of a hole in the casing located on the north side of the well casing

TID #14: The reference point is the lip of the sounding tube located on the west side of the well casing

Shey-Huffman: The reference point is the lip of the sounding tube located on the west side of the well casing

Nancy-Huffman: The reference point is the lip of a hole in the casing located on the south side of the well casing

TL-T1: The reference point is the lip of a hole in the top of the well casing

TL-T3: The reference point is the lip of a hole in the top of the well casing

CTW #3: The reference point is the lip of a hole in the casing located on the north side of the well casing

APPENDIX D: TID GROUNDWATER FIELD DATA SHEET

DATE: ________ **TID GROUNDWATER FIELD DATA SHEET** **YEAR:** ________

WELL SITE	CA STATE WELL #	TIME	R/NR	GPM	ACRE FEET	DEPTH to WATER	COMMENTS
TID #1	48N04E30F002M						
TID #2	48N04E18J001M						
TID #3	48N04E16M001M						
TID #4	48N04E15K001M						
TID #5	48N04E13K001M						
TID #6	48N05E16P001M						
TID #7	48N05E14R001M						
TID #8	48N05E26D001M						
TID #9	48N05E36D001M						
TID #14	46N05E22D001M						
Q-3-B							
Gazebo Point							
Shey-Huffman							
Nancy-Huffman							
City of Tulelake							

Appendix K.
Numerical Flow Model Documentation

Jacobs

Numerical Flow Model Documentation

Appendix K

September 2021

Tulelake Subbasin Groundwater Sustainability Agencies

Contents

1. Introduction

On behalf of the Tulelake Subbasin Groundwater Sustainability Agencies (GSAs), CH2M HILL Engineers, Inc. (CH2M and now Jacobs Engineering Group, Inc. [Jacobs]) has developed an integrated groundwater/surface-water flow model of an area encompassing the Tulelake groundwater Subbasin (Subbasin) in portions of Siskiyou and Modoc Counties, California and extends to the north of the Subbasin within Klamath County, Oregon. This report, prepared by Jacobs, documents the development, calibration, and application of this numerical model to support the four GSAs in preparation of a Groundwater Sustainability Plan (GSP). This model is hereafter referred to as the GSA Model to differentiate it from other numerical models developed in recent years for this area and to emphasize its intended use to support the GSAs in the development of the GSP.

The GSA Model integrates the three-dimensional (3D) groundwater and surface-water systems, land surface processes, and water management operations. Development of this model included the assimilation of information on land use, water infrastructure, hydrogeologic conditions, and agricultural water demands and supplies. The GSA Model was built upon two existing numerical groundwater flow models for the region developed by the United States Geological Survey (USGS) (Gannett et al., 2012, and Pischel et al., 2015). The GSA Model is based upon the best available data and information as of January 2020. It is expected that this model will be updated as additional monitoring data are collected and analyzed and as knowledge of the hydrogeologic conceptual model evolves during implementation of the GSP.

The center of the Subbasin is located at latitude 41.94°N and longitude 121.42°W, approximately 300 miles north of downtown Sacramento. **Figure 1-1** (figures are located at the end of their respective sections) shows the location of the Subbasin. The study area boundary (shown in yellow in **Figure 1-1**) was selected to coincide with natural hydrologic features, such as catchment and Subbasin (1-002.01) boundaries, to help establish a hydrologic framework for the GSA Model.

1.1 Background

In 2014, in response to the continued overdraft of many of California's groundwater basins, the State of California enacted the Sustainable Groundwater Management Act (SGMA) to provide local and regional agencies the authority to sustainably manage groundwater. The Tulelake Subbasin is subject to SGMA because it is one of 127 basins and subbasins identified in 2014 by the California Department of Water Resources (DWR) as being medium- or high-priority, based on population, groundwater use, and other factors. Under SGMA, high- and medium-priority basins not identified as critically overdrafted must be managed according to a GSP by January 31, 2022. DWR has identified the Tulelake Subbasin (1-002.01) as a medium-priority subbasin. SGMA requires medium-priority groundwater subbasins being managed by a groundwater sustainability agency to reach or maintain sustainability within 20 years of implementing its GSP. Within the framework of the SGMA, sustainable groundwater management is defined as the management and use of groundwater in a manner that can be maintained during the planning and implementation period without causing undesirable results. The GSA Model has been developed to help prepare water budgets and guide planning efforts associated with the GSP.

1.2 Modeling Objectives

The modeling objectives include the following:

- Support development of land, surface water, and groundwater budgets for historical, current, and future conditions within the Tulelake Subbasin to support preparation of the GSP.
- Help guide the development of sustainable management criteria (SMC) as part of the GSP process.
- Support refinement of monitoring networks during implementation of the GSP, if needed.

- Provide insights into how implementation of projects and management actions, if needed, could potentially affect groundwater conditions during implementation of the GSP.

The GSA Model is only one line of analysis being used to help the GSAs develop and implement its GSP. This model will not ultimately "decide" whether the Subbasin is being managed sustainably. Collection, reporting, and analysis of field data during GSP implementation will be used in conjunction with SMC to demonstrate to DWR whether the Subbasin is being managed sustainably. One of the main purposes of the model is to provide plausible water budgets associated with potential future conditions, so the GSAs can develop a plan for the continued responsible management of the Subbasin.

1.3 Model Function

To achieve the modeling objectives, the GSA Model was developed and calibrated using available data and professional judgment. This 3D model was constructed and calibrated to simulate monthly groundwater and surface-water flow conditions within a 610 square mile (mi^2) area encompassing the Subbasin. The USGS codes MODFLOW-OWHM: One Water Hydrologic Flow Model version 2 (Boyce et al., 2020) and the Basin Characterization Model version 8 (Flint et al., 2013; Flint and Flint, 2014) were used in conjunction with the graphical-user-interface Groundwater Vistas version 8 (Environmental Simulations Inc., [ESI], 2020) and other custom utilities to develop and use the GSA Model to achieve the modeling objectives. Subsequent sections of this report provide additional details regarding the development and application of the GSA Model.

1.4 Model Assumptions and Limitations

The development of the GSA Model included the following assumptions and limitations:

- Subsurface geologic materials, including granular unconsolidated material (e.g., gravel, sand, silt, and clay), and volcanic material (weathered and competent) are all modeled as equivalent porous media.
- Groundwater and surface water are modeled as a single-density fluid.
- Monthly stress periods have been incorporated into the simulations. As such, variations in flow processes that occur within a given month are not explicitly simulated; instead, monthly average flow rates are implemented.
- In the absence of detailed well logs, assumptions had to be made regarding well construction and locations for some of the pumping wells represented in the model.
- Mathematical models like the GSA Model described herein can only approximate surface and subsurface flow processes, despite their high degree of precision. A major cause of uncertainty in these types of models is the discrepancy between the coverage of measurements needed to understand site conditions and the coverage of measurements generally made under the constraints of limited time and budget (Rojstaczer, 1994).
- Because the GSA Model is a flow model, it cannot perform solute transport calculations. Therefore, it cannot directly provide estimates or forecasts of constituent concentrations in the modeled environment. Therefore, other approaches are being implemented to support the GSA in addressing water quality aspects of its GSPs.

Given these assumptions and limitations, numerical flow models like the GSA Model should be considered tools to provide insight and qualitative projections of future conditions. Therefore, important planning decisions that use output from the GSA Model must be made with an understanding of the uncertainty in and sensitivity to model input parameters. These planning decisions should also consider other site data, local and regional drivers, professional judgment, and the inclusion of safety factors.

2. Conceptual Model Overview

The Subbasin is a portion of Upper Klamath River Groundwater Basin located in California and Oregon. The subbasin is bounded to the west by the Gillems Bluff Fault which extends beneath and is a major structural feature of the Medicine Lake volcanic highlands (Lavine 1994). The fault forms the steep eastern escarpment of Sheepy Ridge, which separates the Tule Lake and Lower Klamath subbasins (DWR 2003b). The basin boundary extends to the fault-controlled drainage divide between the Tule Lake and Lower Klamath Lake subbasins (the crest of Sheepy Ridge). Volcanic deposits extend eastward from the crest beneath the Quaternary sediment and are penetrated by wells, which are producing from the volcanic deposits on the west margin of the basin (Gannett 2016). The subbasin is bounded to the east by the Saddle Blanket Fault Zone, a north-trending normal fault which forms the western edge of the block faulted mountains between Tule Lake and Clear Lake Reservoir. The subbasin extends to a portion of the Quaternary volcanic deposits which includes irrigation wells (Gannett et al. 2007). Clear Lake Reservoir is the headwaters of Lost River. Lost River flows north into Oregon, and meanders through the Poe and Langell valleys before it flows south into California and ends at the Tule Lake sump (DWR 2003b). The subbasin is bounded to the south by the low-lying volcanic fields on the north slope of the Medicine Lake Highlands. Medicine Lake occupies the crater at the peak of this large, relatively young shield volcano. The subbasin includes the Peninsula and extends to the east to the Saddle Blanket Fault Zone. Wells in these areas where the volcanics are exposed, mostly produce from the surficial volcanic deposits, but some wells penetrate through the surficial deposits and underlying basin-filling sediments to the underlying volcanic strata (Gannett 2016). To the north, the basin extends into Oregon and is bounded by northwest trending normal faults on the south side of the mountain block dividing Poe Valley from the Tule Lake Subbasin. Approximately two thirds of the subbasin are in California. For the purposes of this Groundwater Sustainability Plan and SGMA, the subbasin is bounded to the north by the state boundary of Oregon and California.

Local precipitation and infiltration of surface water from the channels, lakes and sumps of the Lower Klamath and Tule Lake subbasins provide recharge for the alluvial aquifer system. Water levels in the alluvial aquifer fluctuate seasonally in response to canal and irrigation operations (DWR 2003a). Surface water supplies available to the Tulelake Irrigation District provide an unknown amount of groundwater recharge. These surface water supplies include natural flow from the Klamath River, stored water from Upper Klamath lake and Lake Ewauna, return flows from upstream irrigation, and flow from the Lost River.

Aquifer discharge occurs when groundwater is extracted by wells, discharges to streams, is evapotranspired by phreatophytes, or flows out of the groundwater basin in the subsurface (DWR 2003a). Most groundwater production in the Tule Lake Subbasin is from the underlying volcanic strata, volcanic deposits on the periphery of the basin, and volcanic deposits that partly overlie basin-filling sediment in the Peninsula area. However, wells in any of these areas may produce from surficial volcanic deposits, basinfilling sediments, or underlying volcanic strata (Pischel and Gannett 2015). In general, interbasin groundwater flow from the Tule Lake Subbasin is southward (Gannett, et al. 2007).

3. Numerical Model Construction

3.1 Code Selection

The USGS code MODFLOW-OWHM: One Water Hydrologic Flow Model (OneWater) version 2 (Boyce et al., 2020) was selected for this modeling effort, in conjunction with the graphical-user-interface Groundwater Vistas version 8 (ESI, 2020) and other custom utilities to develop the GSA Model. OneWater is an updated formulation, built upon the MODFLOW-2005 (Harbaugh, 2005) framework. OneWater accommodates the development of a 3D, physically based, spatially distributed, integrated groundwater/surface-water flow model. The OneWater code was selected for the following reasons:

- OneWater is based on MODFLOW-2005, which has been used extensively in groundwater evaluations worldwide for many years and is well-documented. OneWater contains an improved solution scheme that can handle a variety of complex, variably saturated flow conditions, which are relevant to groundwater conditions in the Subbasin.
- OneWater has been benchmarked and verified, so the numerical solutions generated by the code have been compared with analytical solutions, subjected to scientific review, and used on other modeling projects. Verification of the code confirms that OneWater can accurately solve the governing equations that constitute the mathematical model.
- OneWater accommodates a comprehensive suite of groundwater and surface-water boundary conditions.

3.1.1 Numerical Assumptions

OneWater is conceptualized mathematically into two hydrologic flow regimes: surface flow and subsurface flow. The surface-flow regime, as configured for the GSA Model described herein, includes runoff, and channel flow interaction with the subsurface. The subsurface-flow regime underlies the surface-flow regime and includes variably saturated zones representing porous media through which groundwater flows and can interact with the surface-flow regime.

3.1.2 Scientific Basis

The theory and numerical techniques that are incorporated into OneWater have been scientifically tested. The governing equations of variably saturated subsurface flow have been solved by several modeling codes over the past few decades, on a wide range of field problems. Therefore, the scientific basis of the theory and the numerical techniques for solving these equations have been well-established. The OneWater user's manual (Boyce et al., 2020) detail the governing equations and other information on the codes.

3.1.3 Data Formats

Several American Standard Code for Information Interchange (ASCII) data files were used to parameterize the GSA Model. **Table 3-1** shows the grouping of various data items in the GSA Model input files.

Table 3-1. OneWater Input File Description

File Extension	Version	Purpose [a]	Parameters [a,b]
BAS	6	• Basic Package establishes active and inactive cells and initial heads	• IBOUND array by layer (active domain) • Initial heads by layer
DIS	NA	• Discretization Package establishes information on how time and space are subdivided • Establishes whether the numerical solution is steady state or transient	• Grid cell dimensions • Layer interface elevations • Stress period durations • Number of time steps per stress period • Time step multiplier • Stress period type (steady state or transient)
UPW	1	• Upstream Weighting Package contains aquifer hydraulic parameters, which constrain flow between model cells	• Horizontal and vertical hydraulic conductivity • Groundwater storage parameters
FMP	4	• Farm Process contains soil, vegetation, water source, and water use information • Controls supply and demand to facilitate computation of runoff, groundwater recharge from precipitation and applied water, and agricultural pumping	• Consumptive use terms • Soil type • Rooting depths • Irrigation efficiency • Groundwater root flag and root pressures • Capillary fringe • Vadose zone options • ET factors • Water source and delivery information • Irrigation fractions
GHB	OWHM	• General-Head Boundary Package controls groundwater inflow and outflow from the Tulelake Sumps and through lateral subsurface boundaries	• Boundary head and conductance by stress period • Model layer designations
RIV	OWHM	• River package controls surface water and groundwater exchanges associated with the Lost River and primary conveyance canals within the Subbasin	• Boundary head and conductance by stress period • Model layer designations
DRT	7	• Drain Return Package directs rejected recharge to streams	• Drain head and conductance • Recipient SFR nodes for drained groundwater
MNW	2	• Multi-Node Well Package simulates agricultural groundwater pumping	• Well dimension and construction information • Groundwater pumping rate by stress period • Model layer(s) designations
NWT	1.2.0	• Newton Solver solves the governing flow equations	• Solver iteration and closure terms • Backtracking and other solver options
NAM	NA	• Name File specifies names of input and output files	• No parameters are included
OC	NA	• Output Control File specifies the type of runtime information to write to output files	• User-defined print and save statements

[a] As implemented in the GSA Model. Alternative uses of the package are also possible.

[b] Not intended to be an exhaustive list of input parameters. Please see the model code documentation and online resources for additional information.

NA = not applicable, because it is built into the main OneWater code

Output from the GSA Model also follows the USGS MODFLOW output file formats and includes ASCII as well as binary files. Although a variety of optional output files can be generated with the OneWater code, **Table 3-2** summarizes the main output files used for this modeling effort.

Table 3-2. Selected OneWater Output File Description

File Name or Extension	Content
LST	- ASCII listing file containing runtime information included in the simulation
FB-Details	- ASCII file containing Farm Process inflows and outflows by water balance subregions for all output times
FDS	- ASCII file containing supply and demand information for all output times
HDS	- Binary file containing cell-by-cell modeled groundwater elevations for all output times
CBB	- Binary file containing cell-by-cell subsurface flows for all output times

3.2 Model Domain

A numerical model must use discrete space to represent the hydrologic system. The simplest way to discretize space is to subdivide the study area into many subregions (i.e., grid blocks) of the same size. This grid-building strategy was implemented for this modeling effort and is described in the following subsections. The model domain of the GSA Model was developed to fully encompass the Tulelake Subbasin as defined by the final Basin Boundary Modifications distributed in 2018 by the California Department of Water Resources (DWR). In general, the model boundary was extended beyond the Tulelake Subbasin to the watershed margins to fully capture the extent of the greater basin from which water may contribute to the Tulelake Subbasin. In some instances, there are boundaries for which the contributing area intersects lower elevations within valleys from which the GSP Model extent was delineated. At these locations, groundwater elevations will be prescribed based on available groundwater elevation data to account for potential flow across these boundaries as discussed in Section 3.7.2.1.

3.2.1 Areal Characteristics of Model Grid

The GSA Model grid mathematically represents a 610-square-mile area that includes the Subbasin and a portion of the surrounding contributing area. The model grid is aligned north-south and east-west and georeferenced to the 1983 North American Datum (NAD83) of the Universal Transverse Mercator (UTM) Zone 10 North coordinate system, in units of U.S. feet. The GSA Model boundary follows hydrologic boundaries surrounding the Subbasin to encompass areas that are potentially hydraulically connected to the Subbasin. **Figure 3-1** shows the GSA Model domain, which is partitioned into grid blocks (i.e., cells) horizontally spaced on 250-foot centers, which results in 272,064 active cells per model layer. The 250-foot cell spacing allows for sufficient spatial resolution to support development of water budgets for the GSP.

3.2.2 Vertical Characteristics of Model Grid

The GSA Model was subdivided into six vertically stacked layers to provide a 3D representation of the principal aquifers. **Table 3-3** lists the model layer designations and thicknesses. These layers were developed to provide sufficient vertical resolution to facilitate the following:

- Evaluation of the effects of groundwater pumping on shallow and regional water resources
- Assignment of pumping stresses to appropriate depths within the aquifer that reflect the major producing zones within the aquifer system

Table 3-3. Summary of Model Layers

Model Layer	Description	Model Layer Thickness (feet)	Depth of Layer Bottom (feet bgs)
1	• Comprised primarily of quaternary sedimentary deposits within Subbasin surrounded by quaternary volcanic rocks, and tertiary volcanic rocks	0.4 to 3,743	0.4 to 3.743
2	• Comprised primarily of tertiary sedimentary rocks within the Subbasin surrounded by tertiary volcanic rocks	183 to 900	202 to 3,943
3	• Comprised primarily of tertiary sedimentary rocks within the Subbasin surrounded by tertiary volcanic rocks	183 to 900	402 to 4,143
4	• Comprised primarily of tertiary mixed sedimentary and volcanic deposits within the Subbasin surrounded by tertiary volcanic rocks	300 to 800	935 to 4,818
5	• Comprised primarily of tertiary mixed sedimentary and volcanic deposits within the Subbasin surrounded by tertiary volcanic rocks	300 to 800	1420 to 5,493
6	• Comprised primarily of tertiary mixed sedimentary and volcanic deposits within the Subbasin surrounded by tertiary volcanic rocks	200 to 1,100	1,931 to 6,593

bgs = below ground surface

Model Layers 1 and 2 are set as unconfined, convertible layers to allow transmissivity to vary temporally and spatially according to the layer's saturated thickness and horizontal hydraulic conductivity. Model Layers 3, 4, 5, and 6 are set as confined, so transmissivity only varies spatially according to the cell thickness and horizontal hydraulic conductivity therein.

Model Layers 1 and 2 are set as unconfined, convertible layers to allow transmissivity to vary temporally and spatially according to the layer's saturated thickness and horizontal hydraulic conductivity. Model Layers 3, 4, 5, and 6 are set as confined, so transmissivity only varies spatially according to the cell thickness and horizontal hydraulic conductivity therein.

Layer thicknesses were devised based on the USGS regional model and DWR derived top of volcanic contours and cross-sections developed as part of the Upper Klamath Basin Hydrogeologic Investigation (DWR, 2003). Model Layer 1 thicknesses of the GSP Model were established to be the same thickness of the USGS regional model. Total thickness of Model Layers 2 and 3 of the GSP Model were initially established based on the Layer 2 thicknesses of the USGS model. Model Layer 3, however, was modified to better reflect the bottom of basin fill sediments based on DWR top of volcanic structure contours and cross-sections. Model Layers 4 and 5 were split into an even thickness to capture screening intervals from pumping wells that extend through these depths. Finally, Model Layer 6 was extended beyond the deepest pumping wells in the region to provide an adequate buffer between the deepest pumping wells and the bottom most layer of the GSP Model.

3.3 Surface Parameters

The surface parameters required by the GSA Model are the land surface elevations, surface water feature characteristics, soils distribution, land use, and water balance subarea distribution.

3.3.1 Topography

A 10-meter digital elevation model (DEM) raster dataset along with 1-meter LiDAR data forms the basis for land surface elevations covering the modeling domain. These land surface elevations were assigned to the top of Model Layer 1. Elevation data were processed using ArcGIS Version 10 software. **Figure 3-2** illustrates the land surface elevations incorporated into the top of the model grid.

3.3.2 Soils Data

Soils data were obtained from the Natural Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) for the extent of the GSA Model. SSURGO data were processed to obtain a distribution of texture classification across the model domain. Texture classification was then translated into a simulated soil category to serve as input to FMP (**Table 3-4**). Dominant soil type was then assigned to each model grid cell based on the spatial distribution of each simulated soil category (**Figure 3-3**). Default soil categories

Table 3-1 - Translation of NRCS Texture Class to Simulated Soil Category

Simulated Soil Category	Texture Classification
Sand	Sand
	Cinders
	Fragmental Material
Sandy Loam	Clay Loam
	Silty Clay Loam
	Silty Clay
	Clay
Silty Clay	Loamy Sand
	Sandy Loam
	Loam
	Slightly Decomposed Plant Material
	Silt Loam
	Cobbly Loam
	Stony Loam
	Gravelly Loam
	Gravelly Sand
	Unweathered bedrock

3.3.3 Surface Water Features

Within the Subbasin a complex series of conveyance systems exist that are used to convey water throughout the Tulelake Irrigation District (TID). The following sections provide a description of these surface water conveyance features and their characterization for implementation in the GSA Model.

3.3.3.1 Lost River and Tulelake Irrigation District Conveyance System

TID is comprised of a system of main canals and canal laterals that receive water from the Lost River and other conveyance systems in the Oregon extent of the GSA Model. **Figure 3-4** presents the extent of TID's main canals, canal laterals, and Lost River as simulated in the GSA Model. Flow through the Lost River is diverted into TID's conveyance system from which water is distributed throughout the Subbasin to provide water for irrigation use.

Assumptions associated with the simulation of these surface water features is discussed further under Section 3.7.2.2.

Adjacent to TID's main canals and laterals are a series of open-ditch drains that are used to drain agricultural fields and convey water throughout the irrigation district. **Figure 3-5** presents the extent of TID's drain system through the Subbasin as simulated in the GSA Model. Assumptions associated with the simulation of TID's drain system is discussed further under Section 3.7.2.3.

3.3.3.2 Tulelake Sumps

Within the Subbasin exist two surface water features, referred to as the Tulelake Sumps, that serve as important habitat for wildlife refuge, collection and containment of drainage water and flood flows, and to supply irrigation water throughout the Subbasin (WMP, 2017). **Figure 3-6** presents the extent of the Tulelake Sumps as simulated in the GSA Model. The Tulelake Sumps are operated in accordance with the United States Fish and Wildlife Service Biological Opinion dated July 13th, 1998 and the 1999 Regulation for Tule Lake Sump Modified Rules. The Biological Opinion prescribes water level requirements throughout the year in order to maintain appropriate conditions to prevent flooding and to provide suitable habitat for wildlife. To control water-levels in the Tulelake Sumps, TID recirculates water from the sumps into the irrigation system and utilizes the D-Plant pumping station to remove water from the Tulelake Sumps. The location of the D-Plant pumping station is shown in **Figure 3-6**. Water removed through D-Plant is pumped through Sheepy Ridge to the west providing water to refuges and conveyance systems to the west of the Subbasin. Assumptions associated with the simulation of the Tulelake Sumps is discussed further under Section 3.7.2.4.

3.3.4 Land Use

3.3.4.1 Tulelake Subbasin

Available land use datasets were compiled from Modoc and Siskiyou Counties and TID to establish a set of land use conditions throughout the Tulelake Subbasin. Within the Tulelake Subbasin, land use is primarily comprised of agricultural crop categories along with some riparian and native vegetation and urban areas. Riparian and native vegetation areas were assumed to persist throughout the analysis period of the GSA Model as established through the county datasets. However, two sets of agricultural conditions were identified, as discussed in the following paragraphs, to establish two sets of land use conditions within TID representing 2008 (**Figure 3-7**) and 2010 (**Figure 3-8**) conditions.

TID annual crop acreage data for years 2000 through 2018 were analyzed to develop crop categories and land use conditions that could be simulated in the GSA Model. Crop categories provided in the TID reports were lumped into six different crop categories for inclusion in the GSA Model based on similar annual crop consumptive use requirements of each crop type. Crops with similar demands were combined to create a single category for simulation in the GSA Model (**Table 3-1**). In general, the predominant crop types within TID are alfalfa, grains, mint, potatoes, and pasture. Mint, potatoes and a number of other crops were combined based on similar consumptive use requirements into an 'All Other Crops' category.

Table 3-1 presents crop acreage for the 2008 and 2010 periods based on the GSA Model crop category and the associated TID crop report category. Generally, the crops grown within TID have been relatively stable over the analysis period, however, there are years where significant idling of fields can occur due to availability of water and various water management programs instituted to support farmers in fallowing fields within a given year. Most notably are the years 2001 and 2010 when significant idling occurred throughout TID. Based on the crop acreage trends, two years were selected to represent two separate land use conditions throughout TID. First, the year 2008 was selected to represent average conditions within TID, where the acreages reflected the crop distribution in a normal or average year (**Figure 3-7**). The year 2010 was selected to represent years in which significant idling occurred as the idle acreage in this year was deemed to represent average idle conditions in TID

(**Figure 3-8**). The 2010 land use acreage was used to represent land use in the GSA Model for the years of 2001, 2010, and 2014 -2015 when crop idling occurred. All other years during the simulation period have been assigned 2008 land use conditions.

Table 3-2 Simulated Crop Category and Average TID Crop Acreage for Historical Period

Model Category	TID Crop Report Category	2008 Acreage	2010 Acreage
Alfalfa	Alfalfa	19,921	16,120
	Other Hay	2,541	3,564
All Other Crops	Onions	2,449	1,874
	Mint	2,584	3,035
	Beets	0	0
	Peas	153	0
	Horseradish	436	358
	Strawberries	0	81
	Potatoes/Spuds	8,033	5,770
Grains	Barley	3,582	8,030
	Wheat	17,471	9,850
	Oats	114	360
	Rye	40	55
Idle	Idle	1,863	11,695
	House/Farmstead	658	671
Pasture	Pasture	1,283	1,314
Urban	Res. Comm. Ind.	289	338

3.3.4.2 Oregon Klamath Project Water Users and Private Groundwater Pumping

While the primary focus of the GSA Model is to simulate groundwater conditions in the Tulelake Subbasin, significant irrigation occurs just beyond the California-Oregon border, to the north of the Subbasin. Similar to Tulelake Irrigation District, most of the area within the Oregon portion of the GSA Model domain are comprised of water users that receive surface water supply from the Bureau of Reclamation's Klamath Project. Limited spatially distributed land use data for these water users was available during the development of the GSA Model. Thus, estimates of irrigable acreage and crop consumptive use for the year 2008 were used from the On-Project Plan (OPP) to help inform potential consumptive use quantities of water for areas within the Oregon portion of the GSA Model domain. **Table 3-3** presents estimates of irrigable acreage, consumptive use, water requirements, and on-farm efficiencies for districts within the Oregon portion of the GSA Model domain

Based on the estimated on-field water requirement for these irrigation districts, the regions within GSA Model for each irrigation district was assigned a crop coefficient based on the Alfalfa crop which has an approximate water requirement of 33 acre-inch per acre which aligns closely to the on-field water requirements presented in **Table 3-3**.

Table 3-3 Estimates of Crop Consumptive Use for Oregon Based Irrigation Districts

District Name	Total District Irrigable Acreage[1]	Consumptive Use (AFY)	On-Field Water Requirement (AFY)	On-Field Water Requirement (Acre-Inch/acre)	On-Farm Efficiency Estimate
Klamath Irrigation District	49,980	116,570	140,060	33.6	0.83
Malin Irrigation District	3,480	8,080	9,700	33.4	0.83
Shasta View Irrigation District)	4,900	11,140	13,360	32.7	0.83
Van Brimmer Ditch Company	4,790	11,560	14,220	35.6	0.81
[1]Total District acreages presented represent the total acres within the Klamath Project and does not necessarily reflect District acreages contained in the GSA Model.					

3.3.4.3 Private Lands

Most of the irrigated agricultural lands within the GSA Model are within the Klamath Project and receive a surface water supply. However, there are some areas where agriculture is dependent solely on groundwater pumping. Limited information is known regarding irrigation demands, on-farm efficiency, and well locations for these areas. Areas were identified through discussions with local stakeholders and through consultation of aerial imagery to identify areas outside of known water purveyor service areas that appear to contain irrigated agriculture. Consumptive use estimates for these areas were assumed to be consistent with an alfalfa crop.

3.3.5 Water Balance Subarea Delineation

As part of FMP development, water balance subareas (WBS) are designated to help control supply and demand specifications and input and output data. WBS specification for the GSA Model were delineated based primarily on TID distribution systems, Klamath Project water users within the GSA Model domain, and areas that are deemed irrigated but do not receive water as part of an irrigation district. **Figure 3-9** presents the distribution of WBS throughout the GSA Model domain.

3.4 Subsurface Flow Parameters

The subsurface hydraulic parameters required by the GSA Model are the horizontal hydraulic conductivity (Kh), vertical hydraulic conductivity (Kv), specific yield (Sy), and specific storage (Ss).

3.4.1 Hydraulic Conductivity

Initial hydraulic conductivity distributions and parameterizations were adopted from Upper Klamath Basin groundwater flow model developed by the USGS (Gannett et al., 2012). **Figure 3-10** presents hydraulic property zonation for layers 1 through 3 from the upper Klamath Basin model as presented in Gannett et al., 2012. In layer 1, the Tulelake region is comprised of primarily quaternary sediments throughout the Subbasin with quaternary volcanic deposits to the south of the Tule Lake Sumps. In layer 2, the majority of the Subbasin is comprised of tertiary sediments of younger basins and tertiary volcanic rocks to the south. Finally, in Layer 3, the Subbasin is comprised of primarily tertiary mixed sedimentary and volcanic deposits with tertiary volcanic rocks to the south. **Table 3-4** presents the hydraulic conductivity and vertical anisotropy ratio for each the primary units in layers 1 through 3 from the Upper Klamath Basin Model (Gannett et al., 2012). Parameterization and zonation of subsurface hydraulic properties were adapted from the Upper Klamath Basin model for the GSA

Model. Additional layer and parameter refinements were made during the calibration process of the GSA model as discussed in Section 4.

Table 3-4 – Upper Klamath Basin Model Hydraulic Conductivity

Layer	Lithology	Hydraulic Conductivity (feet/day)	Vertical Anisotropy [Kh:Kv]
1	Quaternary sediment	501	18
	Quaternary volcanic deposits	1	100
2	Tertiary sediments – Younger basins	25	250
	Tertiary volcanic rocks	10	1000
3	Tertiary mixed sedimentary volcanic deposits	1	10
	Tertiary volcanic rocks	50	22
Vertical anisotropy represents the ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity.			

3.4.2 Groundwater Storage

Groundwater storage (i.e., storativity) is handled through the assignment of two parameters, including the Specific Yield (Sy) and Specific Storage (Ss). Model Layers 1 and 2 are set as unconfined, convertible layers to allow transmissivity to vary temporally and spatially according to the layer's saturated thickness and Kh. These model layers require the user to input both Sy and Ss values, which can vary on a cell-by-cell basis. If a model cell during a given stress period in Model layers 1 or 2 is fully saturated, then the model computes a storativity as the product of the Ss and cell thickness. If a model cell during a given stress period in Model layers 1 or 2 is partially saturated, then the model uses the Sy. Model layers 3, 4, 5, and 6 are set as confined, so the model computes for each stress period a storativity value as the product of the Ss and cell thickness for these model layers. Thus, groundwater storage properties do not vary temporally in Model layers 3, 4, 5, and 6. The GSA Model was initially assigned uniform Sy and Ss values of 10 percent and 1×10-6 per foot (ft^{-1}), respectively, based on literature values and professional judgement. Section 4 describes the modification of these values during the calibration process.

3.5 Time Discretization

The calibration version of the GSA Model simulates historical hydrologic conditions from October 1997 through September 2018, whereas the projection version of the GSA Model simulates future hydrologic conditions from October 2018 through September 2071. All versions of the GSA Model include monthly stress periods to adequately simulate seasonal hydrologic processes.

3.6 Initial Flow Conditions

The establishment of a transient GSA Model necessitates establishment of initial flow conditions in the hydrologic system. Initial conditions refer to the initial distribution of heads (i.e., groundwater elevations) throughout the model domain. Initial conditions for the calibration simulations were established in a "spin-up" manner. This step involved assigning initial heads intended to approximate September 1997 conditions and then allowing the monthly stress periods to "work through" the monthly conditions through September 1999 (i.e., the end of the spin-up period). Additionally, most data used in development of GSA Model boundary conditions started in the year 2000. Therefore, model output data from the spin-up period are not included in the assessment of calibration or water budgets. Thus, presentation of calibration results and water budgets described in Sections 4 and 5 are representative of October 1, 1999 through September 30, 2018 (i.e., WYs2000 through 2018).

3.7 Boundary Conditions

3.7.1 Specified-flux Boundaries

The following section describes boundary conditions in the GSA Model where either a volumetric or linear flux is used to simulate various flow processes.

3.7.1.1 Precipitation and Reference Evapotranspiration

FMP requires input of precipitation and reference evapotranspiration to establish climatic conditions in the land surface system water budget. Precipitation and reference evapotranspiration were processed from the US. Geological Survey (USGS) Basin Characterization Model (BCM) (Flint et al., 2013). BCM utilized a down-scaling approach to process PRISM based climate data from 800-meter down to 270-meter resolution to provide more spatial variability. Precipitation and reference evapotranspiration data were then sample to each model grid cell of the GSP Model to provide monthly precipitation and reference evapotranspiration rates throughout the model domain for the entire model simulation period.

Figure 3-11 presents annual precipitation totals based on the gridded BCM data mapped across the extent of GSA Model. On average, the region experiences approximately 13.6 inches per year with a low of 7.9 inches per year in water year 2001 and a maximum of 21.6 inches per year in water year 1998.

An analysis was conducted to compare the BCM based gridded reference evapotranspiration to an average of two local AgriMET stations in the Klamath Region (Klamath Falls and Worden stations). **Figure 3-12** presents annual estimates of reference evapotranspiration based on an average of all grid cells in the model domain versus the average of the two AgriMET stations. In general, the AgriMET stations measured a larger amount of annual reference evapotranspiration as compared to the gridded BCM data. In part, this is due to the reference crop from the AgriMET stations being based on alfalfa rather than a short or long grass reference crop. Based on this comparison, and the difference in reference crops, a correction factor was applied to the BCM gridded data to better reflect local measurements of reference evapotranspiration and the alfalfa reference crop.

Figure 3-13 presents monthly average BCM potential evapotranspiration before and after adjusting to local AgriMET station data. In general, the applied correction factor increases reference evapotranspiration from May through September during the irrigation season of the region.

3.7.1.2 Consumptive Use

To estimate crop consumptive use, FMP utilizes reference evapotranspiration and crop coefficients to determine a crop specific consumptive use estimate. Monthly crop coefficients were developed based on AgriMET station data for crop specific actual evapotranspiration in conjunction with the reference evapotranspiration. **Figure 3-14** presents monthly crop coefficients (Kc) for each of the GSA Model crop categories. Consumptive use is related to the Kc and ET_0 based on **Equation 3-1**, as follows:

$$\text{Consumptive Use} = Kc \times ET_0 \qquad (3\text{-}1)$$

Kc values were associated with crop category and land use polygon throughout the model domain (**Figures 3-7 and 3-8**). These data, along with areal fractions of land use per cell, serve as input to the GSA Model to define the consumptive use of water for each WBS.

3.7.1.3 Tulelake Irrigation District Water Deliveries

Within FMP, shallow groundwater and precipitation serve as the first sources of water utilized to meet consumptive use demands within a WBS. In areas of irrigated agriculture within TID, an additional source of water is provided through Non-Routed Deliveries (NRDs) specified as part of FMP. NRDs represent the delivery of combined surface water and groundwater from TID as specified monthly volumes of water available for consumptive use demands. Water delivery estimates were provided by TID based on the deliveries of water from each canal system. Delivery estimates were then distributed to each WBS representative of TID. **Figure 3-15** presents the annual TID water deliveries for each of the TID WBS as presented in **Figure 3-9**. The majority of TID's water deliveries occur within the California portion of the J System at approximately 48 TAFY on average during the historical simulation period. The remaining water deliveries average approximately 39 TAFY for a total of approximately 86 TAFY for the historical simulation period.

3.7.1.4 Tulelake Irrigation District and Known Private Groundwater Pumping

Throughout the Subbasin groundwater is pumped from TID wells and private users augment surface water supplies for irrigation. **Figure 3-16** presents the locations of simulated pumping wells in the GSA Model. TID maintains ten pumping wells throughout the Subbasin that are used to augment supplies in the TID conveyance system. Annual production rates for the TID pumping wells were available throughout the historical simulation period of the GSA Model. Annual rates were distributed into monthly pumping rates for incorporation in the MNW package of the GSA Model.

Figure 3-17 presents the annual pumping distribution for all simulated wells within the Subbasin. Due to limited private pumping records throughout the historical simulation period, WY 2014 was assumed to represent typical groundwater pumping volumes for the private groundwater pumping wells in the Subbasin. WY 2014 monthly pumping rates were specified for each of the private pumping wells for each year of the simulation assuming that the demand on these wells is constant from year-to-year. Pumping values for WY 2014 at the private pumping wells ranged from a high of approximately 5 TAFY to a minimum of 0 TAFY with an average pumping rate of approximately 1.2 TAFY per well.

3.7.1.5 Calculated Private Groundwater Pumping

Private groundwater pumping in the GSA Model that are outside of the TID service area are estimated and simulated through the FMP. Model cells associated with irrigated land uses can pump groundwater from a 'virtual well' to supplement sources of water. In the case where a water source is not provided, the irrigated area is assumed to utilize local groundwater as the sole supply. Irrigation requirements, and ultimately private groundwater pumping, are based on the consumptive use of the model cell's land use minus the availability of precipitation and shallow groundwater to satisfy consumptive use demands. The remaining consumptive use demand is pumping from layer 4 of the GSA Model.

3.7.1.6 Canal Lateral Leakage

Leakage to groundwater associated with the TID canal laterals were specified directly in the GSA Model as a linear flux. Monthly estimates of canal leakage were obtained from TID's H20Sys water budget accounting dataset. Canal system specific rates were distributed evenly across model grid cells that intersect with the canal laterals (**Figure 3-4**). **Figure 3-18** presents the estimated annual canal lateral leakage by canal system. The J System makes up the bulk of the conveyance system, and therefore, canal lateral leakage ranging from a low of approximately 12 TAFY in WY 2001 to a maximum of 83 TAFY in WY 2002. The amount of canal lateral leakage is dependent on the surface water availability from the Klamath Project for that year, where 2001 was a low surface water supply year resulting in minimal leakage from canals. The North N, Q and R, and M and South N Systems all portray a similar low in canal lateral leakage in 2001. Total canal lateral leakage for the entire TID conveyance system is approximately 96 TAFY on average.

3.7.2 Head-dependent Flux Boundaries

The following section describes boundary conditions in the GSA Model where the flux used to simulate various hydrologic processes are dependent on groundwater elevations (i.e., heads) in the aquifer.

3.7.2.1 Subsurface Lateral Flow

Head-dependent subsurface lateral flow boundary conditions were implemented in three separate locations to account for potential subsurface inflow and outflow along the GSA Model boundaries. **Figure 3-19** presents the locations of the Northern, Northwestern, and Southern subsurface lateral boundary conditions. Head and conductance values were specified for each stress period of the GSA Model to represent head conditions along each of these boundary locations to allow for subsurface flow across the model boundary. Measured water-levels at wells near to the boundary were utilized to assign head values through time (**Figure 3-19**). **Figure 3-20** and **3-21** present measured water level data and the resulting simulated groundwater elevation simulated in the GSA Model for the Northern and Southern lateral subsurface flow boundaries. Limited measured data was available in proximity to the Northwestern subsurface lateral boundary, thus, a static average value of 4047.7 feet above NAVD88 was specified for this boundary.

3.7.2.2 Lost River and Tulelake Irrigation District Main Canals

Minimum elevations were extracted from the topographic surface used to define the top elevation of layer 1 of the GSA Model at each of the model grid cells that comprise the Lost River and TID main canals (**Figure 3-4**). A scheme was developed to represent the timing of flows through the Lost River and TID's main canals where the elevation assigned to respective cells of the RIV package are either assigned a stage elevation (system is flowing) or a channel bottom elevation (system is not flowing) depending on the timing of flows through the system. The stage elevation was assumed to be 5 feet greater than the channel bottom elevation to reflect conditions of the channel feature passing flow through the system. Leakage from the Lost River and TID Main Canals is computed through the RIV package based on assigned conductance values for each grid cell. Conductance values and timing of flows will be adjusted during the calibration process as described under Section 4.

3.7.2.3 Tulelake Irrigation District Drains

Groundwater discharge to drains is simulated through the DRT package. Minimum elevations were extracted and assigned for each grid cell intersected by TID drains (**Figure 3-5**). To reduce any potential numerical feedback conductance values of DRT cells that overlap with the RIV package was set to zero, effectively turning off the DRT package in this cell. Flow to drains is then calculated based on the gradient between the underlying water table and the elevation assigned at the drain cell, scaled by the conductance term of the drain cell.

3.7.2.4 Tulelake Sumps

Surface water and groundwater exchange from the Tulelake Sumps is simulated through the GHB package. GSA Model grid cells covering the extent of the Tulelake Sumps serve as the spatial extent of the GHB (**Figure 3-6**). Conductance values and head elevation values are specified for each cell of the GHB package. **Figure 3-22** presents monthly average measured Tulelake Sump water surface elevations specified for each cell of the Tulelake Sump GHB as provided by TID. An average value of 4,034.74 was assigned for the first two years of the historical simulation period due to limited availability of measured data during this time.

3.7.2.5 Groundwater Recharge from Precipitation

Groundwater recharge from precipitation is computed by the FMP package, whereby the water that is not consumed through consumptive use is available for either recharge or overland runoff.

3.7.2.6 Groundwater Recharge from Applied Water

Groundwater recharge from applied water is derived through the FMP package, based on the on-farm efficiency term. The inefficient losses, like precipitation, can either recharge the aquifer or become overland runoff. This boundary condition only applies to irrigated crops.

3.7.2.7 Shallow Groundwater Evapotranspiration

Shallow groundwater uptake is simulated through the FMP package, whereby crops can utilize shallow groundwater as a source of supply to meet consumptive use water demands. Access to shallow groundwater is determined based on the crop rooting depths, capillary fringe height, and the elevation of the water table during a given month in the simulation. This boundary condition is applied areally across the top of the entire model domain.

3.7.3 No-Flow Boundaries

The lateral model boundary cells depicted in **Figure 3-1** that are not assigned other boundary conditions and the bottom of the deepest model layer (i.e., Model layer 6) are assigned the no-flow boundary condition. Inherent with the assignment of no-flow boundaries is the assumption that these boundaries coincide with locations of groundwater divides.

4. Model Calibration

Model calibration is a process of tuning numerical model parameters to adequately replicate measured field conditions of interest. The numerical models described herein were calibrated in accordance with the Standard Guide for Calibrating a Ground-Water Flow Model Application (American Society for Testing and Materials, 1996) and the Modeling BMP (DWR, 2016a). As described in Section 3.5, WYs 1998 through 2018 were selected as the historical simulation period, however, the historical calibration period has been selected as WY 2000 through WY 2018 due to the availability of data associated with surface water conditions, land use, groundwater pumping, and Tulelake Sump water surface elevation. This section discusses the calibration targets, process, and results, including the historical and current water budgets.

4.1 Calibration Targets

Quantitative and qualitative calibration targets were selected to evaluate progress during calibration of the GSA Model. Time-varying heads at well locations throughout the Subbasin served as quantitative calibration targets. Calibration involved adjusting Kh, Kv, storativity, RIV and DRT package conductance, and other boundary condition parameters within reasonable ranges until there was adequate consistency between modeled and calibration target values. Calibration summary statistics were computed for head targets to provide a quantitative measure of the GSA Model's ability to replicate head target values. Head calibration was evaluated using the following summary statistics:

- Residual, computed as the modeled head value minus the target (i.e., measured) head value
- Mean residual (MR), computed as the sum of all residuals divided by the number of observations
- Root mean squared residual (RMSR), computed as the square root of the mean of all squared residuals
- RMSR divided by the range of target head values (RMSR/Range)
- Coefficient of determination (R^2), computed as the square of the correlation coefficient

During the quantitative calibration effort, Jacobs executed work with the following general goals:

- Minimize global bias in heads (e.g., all heads being too high or too low as compared with the target heads)
- Minimize the spatial bias of residuals in key subareas of the model domain
- Minimize residuals, MR, RMSR, and RMSR/Range values
- Strive for R^2 values as close to 1.00 as possible

In addition to calibrating to transient heads, qualitative targets were also used to aid in the calibration process. Calibration summary statistics were not computed for qualitative calibration targets. The qualitative targets used for the modeling effort are as follows:

- General groundwater flow patterns throughout the model domain
- Estimates of leakage from TID's Main Canals
- Tulelake Sump water balance closure calculated based on estimated and simulated Tulelake Sump inflows and outflows

Targets classified as "qualitative" should not be interpreted as being unimportant. The main distinction is that summary statistics are not computed for qualitative targets, because doing so is not a requirement or is even typical for groundwater flow model documentation. **Figure 4-1** shows the head calibration target locations.

4.2 Calibration Process

The calibration process focused on defining FMP parameter values, surface and subsurface parameter distributions, and boundary-condition values until there was a reasonably close match to both quantitative and qualitative targets. The main parameters adjusted during the calibration process were the Kh and Kv values within and outside of the Basin, TID Main Canals conductance, and FMP parameter values. Parameter values were adjusted throughout the calibration process to provide goodness of fit for the calibration targets as previously discussed.

The product resulting from this calibration process was an integrated groundwater/surface-water flow model that incorporates important aspects of the hydrogeologic conceptual model and the professional judgment of engineers and scientists familiar with the study area. The following section describes the results of the calibration effort.

4.3 Calibration Results

The following subsections describe the calibration results for time-varying groundwater levels, general groundwater flow patterns, TID Main Canals Leakage, and the Tulelake Sump Water Balance. Calibrated values for key parameters and boundary conditions are also presented.

4.3.1 Groundwater Levels

Figure 4-2 presents the modeled versus target (i.e., measured) groundwater levels to evaluate potential global biases and the overall ability of the GSA Model's to replicate historical groundwater elevations. In general, points trend along the one-to-one correlation line with some points falling above and below the line. This highlights that the GSP Model does not contain a global bias where all modeled groundwater levels are either always above or always below this line. Global calibration statistics for the data presented in **Figure 4-2** are listed in **Table 4-1** and are within industry standards for adequate model calibration (e.g., small MR with an RMSR/Range < 10 percent with an R^2 close to 1).

Table 4-1 – Calibration Summary Statistics for Groundwater Elevations

Global Calibration Statistics	Value	Unit
Mean Residual (MR)	-0.3	feet
Root Mean Squared Residual (RMSR)	17.5	feet
Range of Measured Values (Range)	177	feet
RMSR/Range	9.88	percent
Coefficient of Determination (R^2)	0.23	unitless
Number of Values	7,281	unitless
Residual is computed by subtracting the target (i.e. measured) groundwater level from the modeled groundwater level.		

Although there is no indication of global bias in modeled groundwater elevations, there is an indication of some degree of spatial bias. For example, there is also a cluster of points in the x-axis range of 4,100 to 4,150 feet above the North American Vertical Datum of 1988 (NAVD88) in **Figure 4-2** where the model tends to underestimate groundwater levels. **Figure 4-3** is provided to further evaluate spatial biases in modeled groundwater elevations by displaying a spatial distribution of MR values for each calibration target well. According to this figure, there is some spatial bias in the eastern portion of the Subbasin and in Oregon to the Northeast where modeled heads tend to underestimate the target heads. In this portion of the model domain there is a series of canals and drains that enter the Subbasin connecting with TID conveyance systems. No information was readily available at the time of developing the GSA Model to quantify the potential for groundwater recharge from canal and drain flows in this region. Thus, the GSA Model tends to underestimate groundwater recharge and resulting groundwater elevations. Additionally, there are wells in the northeast where the model is able to simulate water levels in good agreement with measured data. As you move south, along the eastern end of the Subbasin, there is a mixture of over and underestimates when comparing simulated to measured groundwater levels.

Figure 4-4 includes hydrograph comparisons of transient modeled and target groundwater levels. The horizontal and vertical axes on the hydrographs presented in **Figure 4-4** have been standardized to facilitate making comparisons among the hydrographs. In general, simulated groundwater levels follow similar trends to the target groundwater-level data. However, in some instances, the GSA Model either overestimates or underestimates groundwater levels. Additionally, depending on the layer from which the target well was screened in the GSA Model, the groundwater hydrograph may portray larger or smaller groundwater level fluctuations as compared to groundwater-level target data.

Figure 4-5 illustrates the modeled water table during May 2016, which contained above average annual precipitation (**Figure 3-11**). It is provided to illustrate general patterns of groundwater flow. Groundwater generally moves from North to South through the Subbasin flattening out in the central portion of the Subbasin where agricultural groundwater pumping and the TID drains and sumps tend to flatten out the groundwater elevation gradients. Beyond the Subbasin to the South, flow generally continues towards the Southern lateral subsurface boundary. The overall groundwater flow pattern being illustrated in **Figure 4-5** is reasonable based on the understanding of groundwater use in the Basin and local hydrogeologic characteristics.

4.3.2 Main Canals Leakage

Main canal conductance served as one of the primary calibration parameters for fine-tuning of the GSA Model by comparing simulated leakage from main canals with estimated values. **Figure 4-6** presents a comparison of estimated and simulated total annual main canal seepage. Estimated canal seepage is based on H20Sys water budget estimates provided by TID. On average, total main canal leakage is estimated to be approximately 59 TAFY as compared to the 54 TAFY simulated by the GSA Model. The modeled main canal leakage generally follows similar trends as the estimated main canal leakage with higher leakage in the earlier period of the historical simulation period (WY 2002 through WY 2008) and a reduction in leakage from WY 2009 through WY 2018. Due to the simplistic implementation of canal wetting and drying in the GSA Model, the model is not quite able to capture the year-to-year variability that is likely driven by the amount of flow through the system in any given year. The GSA Model likely overestimates the main canal stage in some years and underestimates stage in others causing the resulting leakage estimates to over or underestimate as compared to the estimated main canal leakage. Due to the nature of the canal leakage being estimates, the performance of the GSA Model in simulating canal leakage is deemed adequate. Further study of TID conveyance systems could better characterize the amount of leakage that occurs from these canals to improve estimates of main canal leakage throughout the Subbasin.

4.3.3 Sump Water Balance

Considering the complexities of the TID conveyance system operations including the operations of the Tulelake Sumps to meet regulatory requirements and for use as storage for recirculation of irrigation water, an external Tulelake Sump water balance was developed as a means to calibrate the volume of water discharging to drains in the GSA Model. **Figure 4-7** presents the components of the Tulelake Sump water balance considered as part of this effort. Ultimately, water leaving the subsurface through drains is either recirculated directly from the drains for irrigation or flows into the Tulelake Sumps. Depending on water surface elevation conditions, water is pulled from the Tulelake Sump from a series of pumps (D-Plant, R, 11, and 12) or flows by gravity into the Q and R canal systems to the South (**Figure 4-7**). Pumps R, 11, and 12 recirculate water from the Tulelake Sumps back into canals for irrigation purposes. However, water removed through D-Plant pumping facility to pump water through Sheepy Ridge to the west of the Subbasin to supplement refuge and irrigation supplies in areas to the west. Estimates of water recirculated through Pumps R, 11, and 12 were incorporated in the Tulelake Sump water balance based on H20Sys Water Balance estimates provided by TID. Pumping through D-Plant was continually monitored throughout the historical past providing monthly estimates of the volume of water removed from the system to support the Tulelake Sump water balance. The records for D-Plant pumping provide a key piece of observed data for the surface water budget that helps provide confidence in the GSA Model's representation of the system. D-Plant pumping represents the summation of flows out of the basin that is typically only estimated in most basin water budgets.

Considering the Tulelake Sumps are open water bodies, precipitation and evaporation from these water bodies were also considered as part of the Tulelake Sump water balance. An open water evaporation estimate for the Klamath Region was used based on study by Risley and Gannett, 2006 to provide a monthly estimate of evaporation from the Tulelake Sumps. Based on these estimates, the open water evaporation was estimated to be approximately 49 inches per year. Given that the Tulelake sumps cover approximately 13,000 acres, this evaporation rate equates to a total annual evaporation of approximately 53 TAFY. This annual estimate of open water evaporation serves as an outflow from the Tulelake Sumps water balance. For precipitation, annual GSA model average precipitation was used in conjunction with the Tulelake Sump area to provide an estimate of annual precipitation falling directly on the Tulelake Sumps equal to approximately 10 TAFY on average.

Figure 4-8 presents the time-series annual sump water balance. The data driving this water balance is a combination of GSA Model simulated values, external calculations, and water balance estimates from the H20Sys Spreadsheets provided by TID. The primary driver of inflows to the Tulelake Sumps is the drain inflow. To maintain water levels in the Sumps, the drain inflow is balanced through recirculation of water through pumps and canal headworks, and loss to groundwater. The largest outflow from the Tulelake Sumps was D-Plant pumping between WY 2000 through WY 2009 which average approximately 57 TAFY during this period. From WY 2010 through WY 2018, D-Plant pumping was utilized to a lesser extent, averaging approximately 18 TAFY of water removed through D-Plant pumping. Based on this configuration of the Sump Water Balance, there is some imbalance to the water budget, however the overall error is a relatively small percentage of the total exchange of water through this system. Such an imbalance may result from TID operations not adequately captured at the monthly scale of the estimates and GSA Model simulated values as shown. The primary goal was to reduce the imbalance as much as possible while maintaining adequate calibration results and metrics as previously discussed.

4.3.4 Surface Parameters

The primary surface parameters modified during the calibration process was the conductance values associated with the TID Main Canals as simulated through the RIV package. Calibrated conductance values in the RIV package ranged from 500 to 10,000 square feet per day. Conductance values were modified across the district to better match estimates of TID Main Canal leakage.

4.3.5 Subsurface Parameters

Initial distributions of hydraulic conductivity were adapted from the Upper Klamath Basin model as discussed under Section 3.4.1. Through the calibration process of the GSA Model, hydraulic conductivity distribution and parameter values were modified to meet the previously discussed calibration targets. **Figures 4-9** through **4-14** presents the hydraulic conductivity distribution for each of the six layers incorporated in the GSA Model.**Table 4-2** presents the calibrated subsurface parameter values for each model layer and corresponding lithologic unit within the layer.

Table 4-2 – Calibrated Subsurface Parameters

Model Layer	Unit	Hydraulic Conductivity (ft/day)	Vertical Anisotropy [Kh:Kv]	Specific Storage
1	Qs	100	100	2.40E-03
	Qv	5	100	2.40E-03
	Tve	1	1,000	2.40E-03
	Tvw	1	1,000	2.40E-03
	Tsy	25	10	2.40E-03
	Tso	25	10	2.40E-03
2	Tso	25	10	4.36E-05
	Tsv	25	10	4.36E-05
	Tsy	25	10	4.36E-05
	Tve	1	100	4.36E-05
	Tvw	1	100	4.36E-05
3	Tso	25	10	4.36E-05
	Tsv	25	10	4.36E-05
	Tsy	25	10	4.36E-05
	Tve	1	1,000	4.36E-05
	Tvw	1	1,000	4.36E-05
4	Tsv	3	10	1.68E-05
	Tve	1	1,000	1.68E-05
	Tvw	1	1,000	1.68E-05
5	Tsv	3	10	1.68E-05
	Tve	1	1,000	1.68E-05
	Tvw	1	1,000	1.68E-05
6	Tsv	3	10	1.05E-05
	Tve	1	1,000	1.05E-05
	Tvw	1	1,000	1.05E-05

Notes:
Qs = Quaternary sedimentary deposits
Qv = Quaternary volcanic rocks
Tve = Tertiary volcanic rocks (east)
Tvw = Tertiary volcanic rocks (west)
Tsy = Tertiary sedimentary rocks (younger basins)
Tso = Tertiary sedimentary rocks (older basins)
Tsv = Tertiary mixed sedimentary and volcanic deposits
Vertical anisotropy represents the ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity.
Specific yield is specified as 10% for Layers 1 and 2; Layers 3 through 4 do not have a specific yield as these layers are simulated as confined.

4.3.6 Numerical Mass Balance

It is important to review the numerical mass balance of model simulations to ensure that good mathematical closure is achieved. The percent discrepancy in the mass balance for each stress period ranged from -0.001 to 0.0002 percent in the calibration simulation. The cumulative percent discrepancy in the numerical mass balance was -0.06 percent in the calibration simulation. Thus, the transient historical model achieved excellent numerical mass balances associated with the water budgets described in the following sections.

4.4 Historical and Current Water Budgets

GSP Regulations Section 354.18 requires the GSA to develop historical, current, and projected water budgets for the Subbasin. The historical water budget evaluates the availability and reliability of past surface water supplies and agricultural demands. The 20-year hydrologic period of WYs 1999 through 2018 was selected for developing the historical water budget to include a period of representative hydrology, while capturing recent Subbasin operations. The current water budget evaluates the availability and reliability of more recent surface water supplies and agricultural demands. WY 2018 was selected for developing the current water budget representing recent hydrology and Subbasin operations.

The water budgets described herein have been developed in accordance with the general guidelines provided in DWR's Water Budget BMP (DWR, 2016b) to help quantify the volumetric rate of water entering and leaving the Basin. Water enters and leaves the Basin naturally, such as through precipitation and streamflow, and through human activities, such as pumping and groundwater recharge from irrigation. Separate historical, current, and projected water budgets have been developed for two different "systems", including the land system and groundwater system. **Table 4-3** lists the water budget components for each of these systems.

Table 4-3 – Land and Groundwater Systems Water Budget Components

Land System Inflow Components	Land System Outflow Components
Precipitation	Evapotranspiration of Precipitation
Water into the Rootzone	Evapotranspiration of Applied Water
Surface Water Deliveries	Runoff from Farm
Groundwater Deliveries	Groundwater Recharge from Precipitation and Applied Water
	Shallow Groundwater Evapotranspiration
Groundwater System Inflow Components	**Groundwater System Outflow Components**
Groundwater Recharge from Precipitation and Applied Water	Irrigation and M&I Groundwater Pumping
Canal Laterals Leakage	Private Groundwater Pumping
Tulelake Sumps Leakage	Groundwater Discharge to Drains
Main Canals and Lost River Leakage	Shallow Groundwater Evapotranspiration
Subsurface Flow into Subbasin	Groundwater Discharge to Tulelake Sumps
	Groundwater Discharge to Main Canals and Lost River
	Subsurface Flow Out of Subbasin

4.4.1 Land System

Table 4-4 presents averages of the individual Subbasin components of the historical and current land system water budgets. **Figure 4-15** presents the annual time series of each Subbasin component of the historical and current land system water budgets. Tabulated water budget values presented herein are reported to the nearest whole number, in TAF, from the GSA Model. This has been done out of convenience. It is not the intention of the authors to imply that the values are accurate to the nearest TAF.

Table 4-4 – Historical and Current Average Annual Land System Budget

Groundwater Budget Term	Historical Average Annual Flow (TAFY) WYs 2000-2018	Current Annual Flow (TAFY) WY 2018
Inflows		
Precipitation	89	116
Water into the Rootzone	5	4
Surface Water Deliveries	100	89
Groundwater Deliveries	6	5
Total Inflow	200	214
Outflows		
Evapotranspiration of Precipitation	36	59
Evapotranspiration of Applied Water	90	80
Runoff from Farm	11	10
Groundwater Recharge from Precipitation & Applied Water	58	61
Shallow Groundwater Evapotranspiration	5	4
Total Outflow	200	214

According to the GSA Model, the Subbasin experienced an average of approximately 200 TAFY of land inflows and outflows during the 20-year historical period. Primary inflows to the Subbasin land system water budget are surface water deliveries for irrigation and precipitation, whereas, the primary outflows from the Subbasin land system water budget are evapotranspiration of applied water and groundwater recharge from precipitation and applied water. The hierarchy of inflow and outflows under current conditions is the same as that under the historical period, however, the total inflows and outflows under current conditions are approximately three TAFY greater than historical condition average.

4.4.2 Groundwater System

Table 4-5 presents averages of the individual Subbasin components of the historical and current groundwater system water budgets. **Figure 4-16** presents the annual time series of each Subbasin component of the historical and current groundwater system water budgets.

According to the GSA Model, the Subbasin experienced an average of approximately 236 TAFY of groundwater inflows during the 20-year historical period. Primary inflows to the Subbasin groundwater system water budget are canal laterals leakage, main canal and lost river leakage, and groundwater recharge from precipitation and applied water. Groundwater outflows from the Subbasin averaged approximately 240 TAFY with the largest outflow components being groundwater discharge to drains and irrigation and M&I groundwater pumping. The hierarchy of inflow and outflows under current conditions is the same as that under the historical period.

Over the 20-year historical period, the change in groundwater storage declined by approximately 4 TAFY which is approximately 1.7% of the average total inflows and outflows. Under current conditions, the change in stored groundwater was less 1 TAFY with the groundwater system being very close to in balance for WY 2018. The small decline in groundwater stored under the historical period is likely within the uncertainty of the estimates of the water budget. Thus, the estimated change in groundwater storage is within the potential error of groundwater budget estimates, meaning small changes to individual water budget estimates could potentially result in no change in groundwater storage over time.

Table 4-5 – Historical and Current Average Annual Groundwater System Budget

Groundwater Budget Term	Historical Average Annual Flow (TAFY) WYs 2000-2018	Current Annual Flow (TAFY) WY 2018
Inflows		
Groundwater Recharge from Precipitation & Applied Water	59	80
Canal Laterals Leakage	92	93
Tulelake Sumps Leakage	5	7
Main Canals and Lost River Leakage	63	72
Subsurface Flow into Subbasin	17	17
Total Inflow	236	269
Outflows		
Irrigation & M&I Groundwater Pumping	42	27
Private Groundwater Pumping	6	5
Total Subbasin Groundwater Pumping	48	32
Groundwater Discharge to Drains	171	192
Shallow Groundwater Evapotranspiration	5	5
Groundwater Discharge to Tulelake Sumps	0	0
Groundwater Discharge to Main Canals and Lost Rivers	2	2
Subsurface Flow Out of Subbasin	14	21
Total Outflow	240	251
Change in Stored Groundwater	-4	17

5. Model Projections

5.1 Assumed Future Conditions

GSP Regulations Section 354.18 requires the GSA to develop historical, current, and projected water budgets for the Basin. Section 4.4 discusses the historical and current water budgets. To develop the projected water budget, certain boundary conditions needed to be modified from the calibration version of the model, which was used to evaluate historical conditions, to convert it into a projection tool configured to simulate assumed future climatic conditions.

As part of the GSP development effort, two projected simulation runs were developed using the GSA Model representing future baseline conditions and future baseline conditions with assumptions of projected climate change. The following sections describe the process of converting the historical model into a projection model for the future baseline and future baseline with climate change conditions.

5.1.1 Climate Change

One requirement of the projected water budget is to account for climate change. Projected climate conditions were adapted from the DWR provided data and tools representing future climate change scenarios. As described in the *Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development* (DWR, 2018), a time-period analysis was incorporated in the GSA Model to translate historical variability to conditions representative of the climate change trends established in the 2070 climate change scenario.

From the DWR climate change scenario, historical reference evapotranspiration and precipitation values were adjusted to reflect projected changes in temperature and precipitation under the DWR 2070 climate change scenario. **Figure 5-1** presents annual precipitation under historical and 2070 climate change adjusted conditions. Under projected conditions, historical annual precipitation is projected to increase from an average of 13.6 inches to an average of 14.4 inches. **Figure 5-2** presents annual ET_0 under historical and 2070 climate change adjusted conditions. Under 2070 climate conditions, reference evapotranspiration is projected to increase as compared to historical conditions by approximately 3.2 inches per year. To develop the 52-year future period covering WY 2019 through WY 2071, historical precipitation and ET_0 adjusted for 2070 climate conditions were repeated to cover the project simulation period.

5.1.2 Surface Water Availability

As discussed in previous sections, surface water for irrigation plays a large role in the operations of the TID system. Historical Klamath Project operations were used to develop a set of surface water conditions that reflect historical hydrologic conditions which were then compared to predictions of surface water supply based on the Klamath Project Interim Operations model. The Klamath Project Interim Operations model was developed by the U.S. Bureau of Reclamation and is the accepted model for preforming planning-level analyses of the Klamath Project.

Based on the Klamath Project Interim Operations model, projected annual surface water availability at Anderson-Rose Dam was estimated representing the total surface water availability for conveyance into the TID system. Total surface water availability was combined with TID groundwater pumping volumes to represent total supply for TID. **Figure 5-3** presents historical versus projected total supply for TID for the historical simulation period. In general, supplies are projected to be close to historical conditions with some increases and decreases in certain years as compared to historical conditions. For the historical simulation period, historical supply averaged approximately 122 TAFY as compared to 121 TAFY under projected conditions.

Total TID supply was then split into estimates of surface water deliveries by TID canal system and canal lateral leakage as scaled by the change in projected supply as compared to historical conditions. Monthly fractions of the total surface water deliveries that served as deliveries or canal lateral leakage were developed based on historical estimates. Assuming current operations of the TID system will continue, these monthly fractions were applied to the projected total surface water availability. **Figure 5-4** presents the historical versus projected annual TID water deliveries. Projected water deliveries are generally within the range of historical values with an average volume of water delivered of approximately 100 to 110 TAFY under projected conditions as compared to the 100 TAFY historical average. Estimated surface water deliveries were incorporated for the projected simulation period as NRDs as described under Section 3.7.12. **Figure 5-5** presents the historical and projected total canal lateral leakage. Projected canal lateral leakage is generally within the range of historical values with an average canal lateral leakage of approximately 98 TAFY under projected conditions as compared to the 96 TAFY historical average. Projected canal lateral leakage was distributed evenly across each canal system and prescribed as a volumetric flux for the projected period as described under Section 3.7.16.

Additional sources of supply into TID canals and drains come from operational spills from upgradient irrigation districts and through recirculation of Tulelake Sump and drain water within TID. Limited information is available regarding the quantity of water entering TID's canals and drains. For the purposes of the projected simulations, spills into TID were assumed to be fixed under historical conditions. As such, any changes in surface water conditions are based solely on the projected volume of water available as part of TID's Klamath Project supply.

5.1.3 Groundwater Pumping

Considering the availability of surface water in the Subbasin is projected to be similar to historical conditions, historical groundwater pumping rates per well were repeated based on repetition of pumping rates from WY 1998 through WY 2018 to cover the full projected period. Groundwater pumping well locations and construction information are assumed to be consistent with historical conditions.

5.1.4 Sump Water Levels

Operations of the Tulelake Sumps are assumed to be consistent with historical conditions. Thus, monthly historical Tulelake Sump water surface elevations were repeated to cover the future simulation period.

5.1.5 Lateral Subsurface Boundaries

Lateral subsurface boundaries in the GSA Model represent transient groundwater elevation conditions requiring a full time-series of conditions under future conditions. Considering the uncertainty in groundwater elevations into the future, the historical timeseries associated with the boundary condition locations presented in **Figure 3-18** are repeated to cover the entire projected simulation period.

5.2 Model Setup for Projection Scenarios

For the future baseline simulation, the GSA Model was configured to run the historical and projected simulation periods as one continuous simulation. Simulating the historic and projected periods as a continuous simulation ensures that there are no discontinuities in Subbasin conditions between the end of the historical period and the start of the projection period. **Table 5-1** presents a comparison of the assumptions associated with the historical and projection simulations.

Table 5-1: Overview of Assumptions for the Historical and Projection Periods

Simulation Item	Assumption/Basis for Historical Simulation Periods	Assumption/Basis for Projection Simulation Periods
Hydrologic Period	• Historical: WYs 1999 through 2018 • Monthly time intervals	• WYs 2019 through 2071 as represented by a repeating pattern of historical conditions (WY 1997 through 2018) • Monthly time intervals
Precipitation	• Downscaled PRISM (PRISM Climate Group, 2020) precipitation dataset, as processed using the BCM (Flint et al., 2013)	• Repeating pattern of historical precipitation for projection baseline • Climate change adjustment factors applied to projection baseline based on the DWR 2070 climate scenario (DWR,)
Reference Evapotranspiration	• ET_0 is computed using the BCM (Flint et al., 2013) based on air temperature projections • Klamath Region AgriMET Stations: Klamath Falls and Worden used to correct of BCM ET_0	• Repeating pattern of historical ET_0 for future baseline conditions • Repeating pattern of historical ET_0 adjusted to reflect DWR 2070 climate change scenario
Crop Coefficients	• Monthly crop coefficients developed based on AgriMET station data	• Same as historical
Land Use/Cropping	• 2008 and 2010 TID reported crop acreages with 2008 representative of average conditions and 2010 representative of years when crop idling occurred	• Repeating pattern of 2008 and 2010 land use conditions based on historical designation
Surface Water Availability	• Based on water balance estimates from TID's H20Sys for WY 2000 through WY 2018; WY 1998 and WY 1999 filled in with average conditions	• Historical conditions with modified conditions representing future conditions • Repeating pattern of projected historical conditions
Well Infrastructure	• Input from TID, WUMP program, and OWRD	• Same as historical
Sump Water Elevation	• Historical measured daily water surface elevation averaged on a monthly interval	• Repeating pattern of historical monthly average water surface elevation
Subsurface Lateral Flow	• Based on historical measured water levels in the vicinity of each subsurface lateral boundary location	• Repeating pattern of historical monthly groundwater elevations

5.3 Projected Groundwater Levels

Figure 5-6 includes hydrograph comparisons of transient modeled and target groundwater levels for the future baseline and future baseline with 2070 climate scenario conditions. Simulated groundwater levels are presented from the start of the historical simulation period (WY 1998) through the end of the projected period (WY 2071). The horizontal and vertical axes on the hydrographs presented in **Figure 5-6** have been standardized to facilitate making comparisons among the hydrographs. In general, simulated groundwater levels tend to decline through the historical simulation period and level-off through the end of the project simulation period. Overall, there are minor changes in the future baseline as compared to the future baseline with climate change scenario except for a number of wells that portray lower groundwater levels under the future baseline with 2070 climate as compared to future baseline conditions.

5.4 Projected Water Budgets

The following sections provide comparisons of the projected water budgets to the historical water budget for the land and groundwater system water budgets. Water budget estimates are subject to change in future GSP updates as the understanding of Subbasin conditions evolves during implementation of the GSP.

5.4.1 Land System

Table 5-2 presents averages of the individual Subbasin components of the historical, future baseline, and future baseline with 2070 climate conditions land system water budgets. **Figure 5-7** presents the annual time series of each Subbasin component of the historical and future baseline land system water budgets. In general, the hierarchy of inflows and outflows from the land system are consistent under historical and future conditions. This is expected due to the projected boundary conditions reflecting a repeating pattern of historical conditions. However, minor changes are observed under the future baseline with climate change scenario for precipitation and evapotranspiration of precipitation and applied water. These changes are result of the projected changes in climate as defined by the 2070 climate change scenario. Overall, the changes in climate tend to drive more throughput from the system with more total inflow and outflow as compared to historical and future baseline conditions.

Table 5-2 – Average Annual Historical and Projected Land System Water Budgets

Groundwater Budget Term	Historical Average Annual Flow (TAFY) WYs 2000-2018	Future Baseline Average Annual Flow (TAFY) WYs 2019-2071	Future Baseline with 2070 Climate Conditions Average Annual Flow (TAFY) WYs 2019-2071
Inflows			
Precipitation	89	93	96
Water into the Rootzone	5	5	5
Surface Water Deliveries	100	100	110
Groundwater Deliveries	6	6	6
Total Inflow	200	203	218
Outflows			
Evapotranspiration of Precipitation	36	36	38
Evapotranspiration of Applied Water	90	90	99
Runoff from Farm	11	12	12
Groundwater Recharge from Precipitation & Applied Water	58	60	63
Shallow Groundwater Evapotranspiration	5	5	5
Total Outflow	200	203	218

5.4.2 Groundwater System

Table 5-3 presents averages of the individual Subbasin components of the historical, future baseline, and future baseline with 2070 climate conditions groundwater system water budgets. **Figure 5-8** presents the annual time series of each Subbasin component of the historical and future baseline groundwater system water budgets. In general, the hierarchy of inflows and outflows from the land system are consistent under historical and future conditions. This is expected due to the projected boundary conditions reflecting a repeating pattern of historical conditions. However, minor changes are observed under the future baseline with climate change scenario for groundwater recharge from precipitation and applied water and Main Canals and Lost River leakage. These changes are a result of the projected changes in climate as defined by the 2070 climate change scenario. Overall, the changes in climate tend to drive more throughput from the system with more total inflow and outflow as compared to historical and future baseline conditions.

Similar to current conditions, the two future projections result in no change in stored groundwater averaged over the projected simulation period. According to the change in stored groundwater and trends observedin the simulated projected groundwater-level hydrographs indicate that the Subbasin is generally stablereflecting sustainable conditions.

Table 5-3 – Average AnnualHistorical and Projected Groundwater Water Budgets

Groundwater Budget Term	Historical Average Annual Flow (TAFY) WYs 2000-2018	Future Baseline Average Annual Flow (TAFY) WYs 2019-2071	Future Baseline with 2070 Climate Conditions Average Annual Flow (TAFY) WYs 2019-2071
Inflows			
Groundwater Recharge from Precipitation & Applied Water	59	59	63
Canal Laterals Leakage	92	93	93
Tulelake Sumps Leakage	5	6	6
Main Canals and Lost River Leakage	63	66	66
Subsurface Flow into Subbasin	17	15	15
Total Inflow	236	238	242
Outflows			
Irrigation & M&I Groundwater Pumping	42	42	42
Private Groundwater Pumping	6	6	6
Total Subbasin Groundwater Pumping	48	47	48
Groundwater Discharge to Drains	171	165	165
Shallow Groundwater Evapotranspiration	5	5	5
Groundwater Discharge to Tulelake Sumps	0	0	0
Groundwater Discharge to Main Canals and Lost Rivers	2	1	1
Subsurface Flow Out of Subbasin	14	20	22
Total Outflow	240	239	242
Change in Stored Groundwater	-4	0	0

6. Conclusions and Recommendations

Jacobs has developed an integrated groundwater/surface-water flow model called the GSA Model of an area encompassing the Tulelake Subbasin in Modoc and Siskiyou Counties, California. This report was prepared by Jacobs to support the GSAs in the preparation of the GSP. This model integrates the 3D groundwater and surface-water systems, land surface processes, and operations. The model was constructed and calibrated to simulate groundwater and surface-water flow conditions within a 610 mi^2 area encompassing the Basin using the USGS OneWater code (Boyce et al., 2020) and the USGS BCM (Flint et al., 2013; Flint and Flint, 2014). The calibration version of the GSA Model simulates historical hydrologic conditions from October 1997 through September 2018, whereas the projection version of the GSA Model simulates future hydrologic conditions from October 2018 through September 2071. The climate change projections are based on DWR's 2070 climate change scenario (DWR, 2018). All versions of the model include monthly stress periods to adequately simulate seasonal hydrologic processes.

The historical and projected groundwater systems all indicate that the Subbasin is relatively in balance where the annual average change in storage ranges from a decrease of 4 TAFY under historical conditions to zero TAFY of change under projected conditions. Projected hydrographs indicate that the Subbasin is likely converging on a new equilibrium where water levels are generally stable over the SGMA implementation period.

Now that the GSA Model has been developed to support the GSAs in the preparation of the GSP, it could also be used during the implementation of the GSP to aid in the following:

- Help prioritize and refine the monitoring well network used to demonstrate whether the Subbasin is being managed sustainably
- Forecast potential outcomes to potential conditions or actions not evaluated herein
- Test hypotheses about interrelationships among different hydrologic processes of interest
- Support the GSA with decisions related to managing their water supply portfolios resulting in capital investments for projects and management actions, if necessary
- Provide technical graphics to support public outreach efforts
- Aid in the development of annual SGMA-related reports to DWR, as needed
- Support constructive dispute resolution on the basis of objective scientific analyses, if necessary

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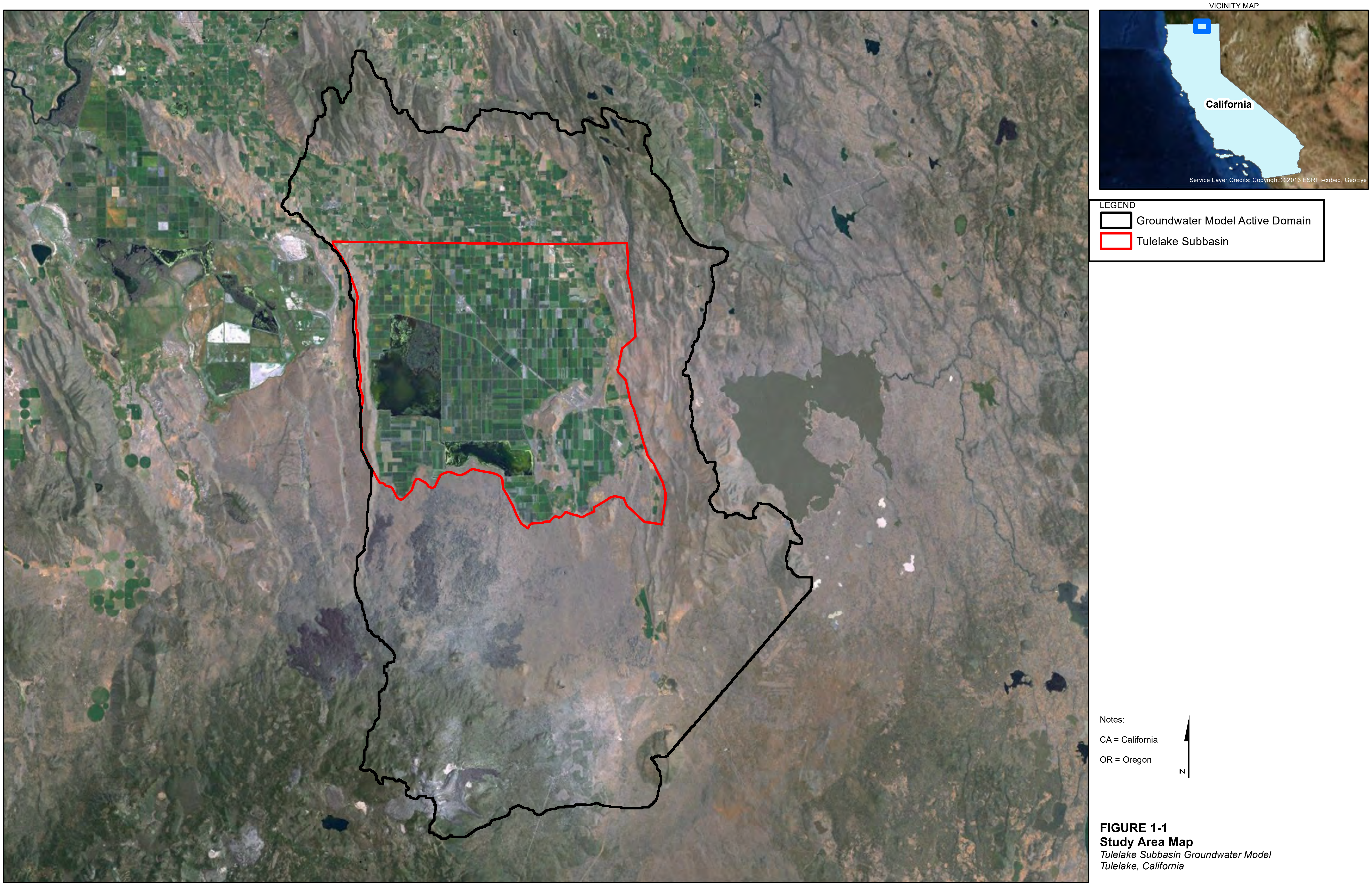
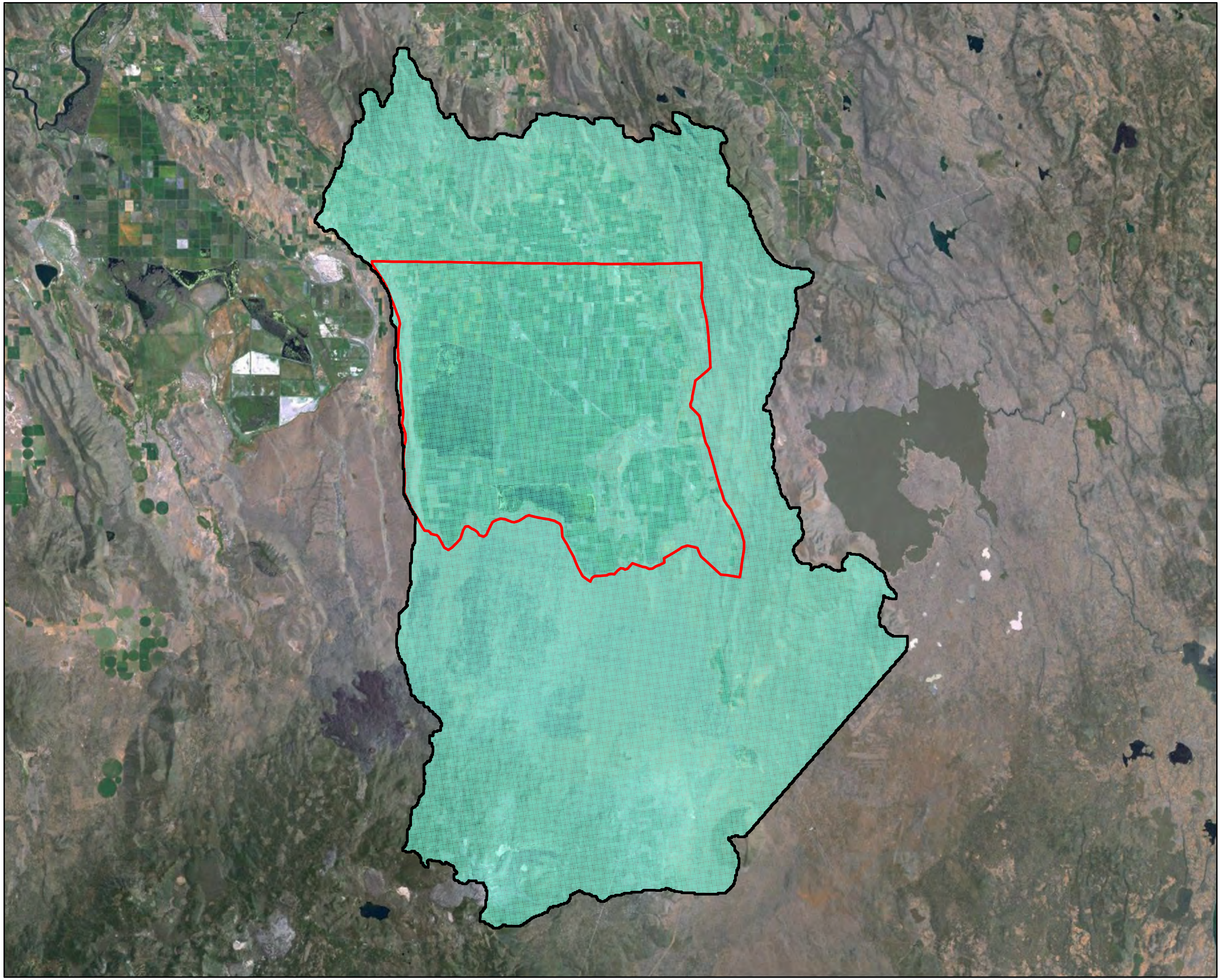


FIGURE 1-1
Study Area Map
Tulelake Subbasin Groundwater Model
Tulelake, California



VICINITY MAP

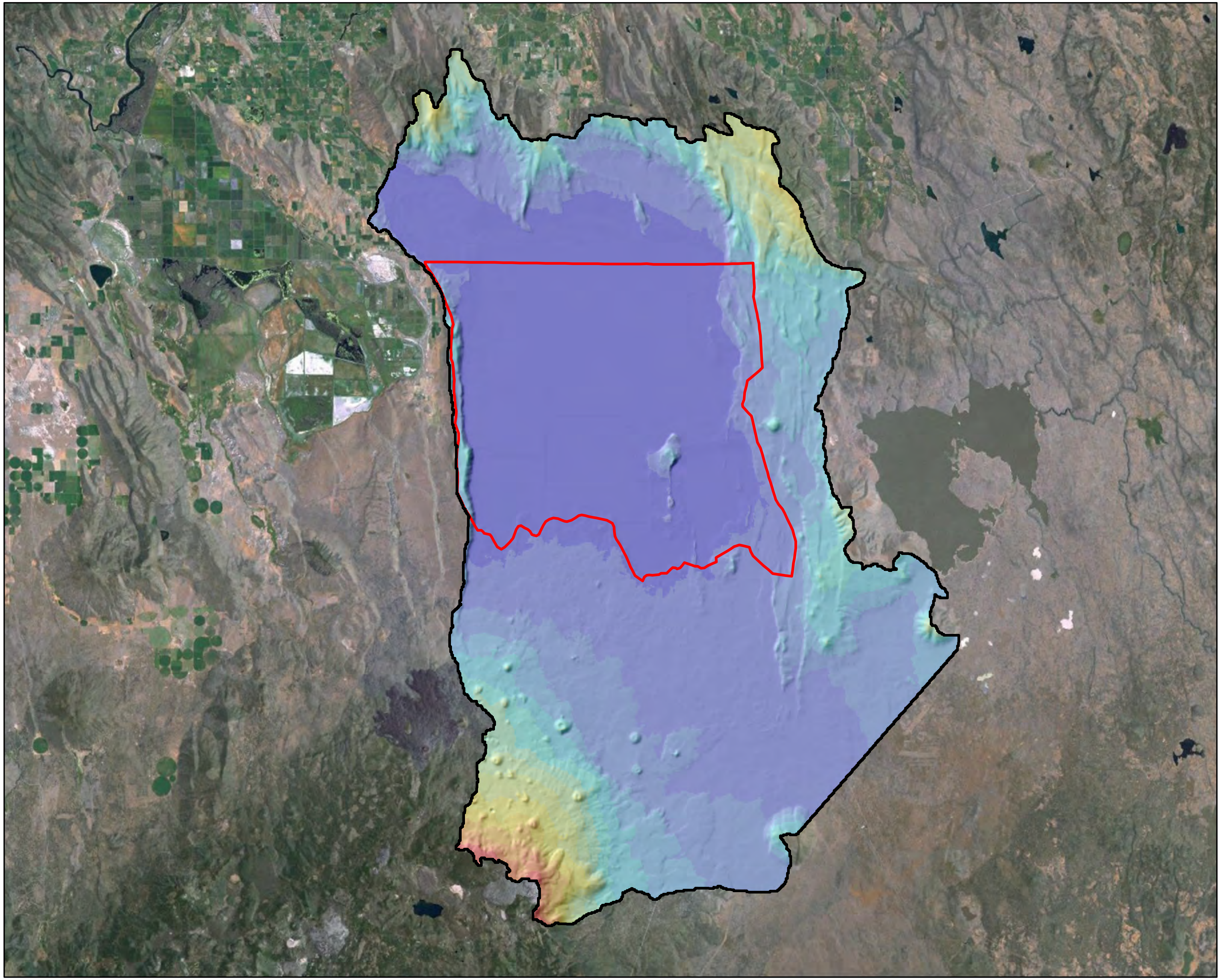
LEGEND

- ☐ Model Domain Boundary
- 🟥 Tulelake Groundwater Subbasin
- ☐ Active Model Cell Boundary

Notes:

N

FIGURE 3-1
Model Domain: Plan View
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



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LEGEND

- ⬛ Model Domain Boundary
- 🟥 Tulelake Groundwater Subbasin

Modeled Land Surface Elevation (feet NAVD88)

- 🟥 7,302 - 7,893
- 🟧 6,999 - 7,301
- 🟧 6,726 - 6,998
- 🟨 6,438 - 6,725
- 🟨 6,164 - 6,437
- 🟨 5,907 - 6,163
- 🟩 5,649 - 5,906
- 🟩 5,376 - 5,648
- 🟩 5,118 - 5,375
- 🟦 4,890 - 5,117
- 🟦 4,678 - 4,889
- 🟦 4,465 - 4,677
- 🟦 4,268 - 4,464
- 🟪 4,101 - 4,267
- 🟪 4,024 - 4,100

Notes:

CA = California
OR = Oregon
NAVD88 = North American Vertical Datum of 1988

N

FIGURE 3-2
Modeled Land Surface Elevations
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

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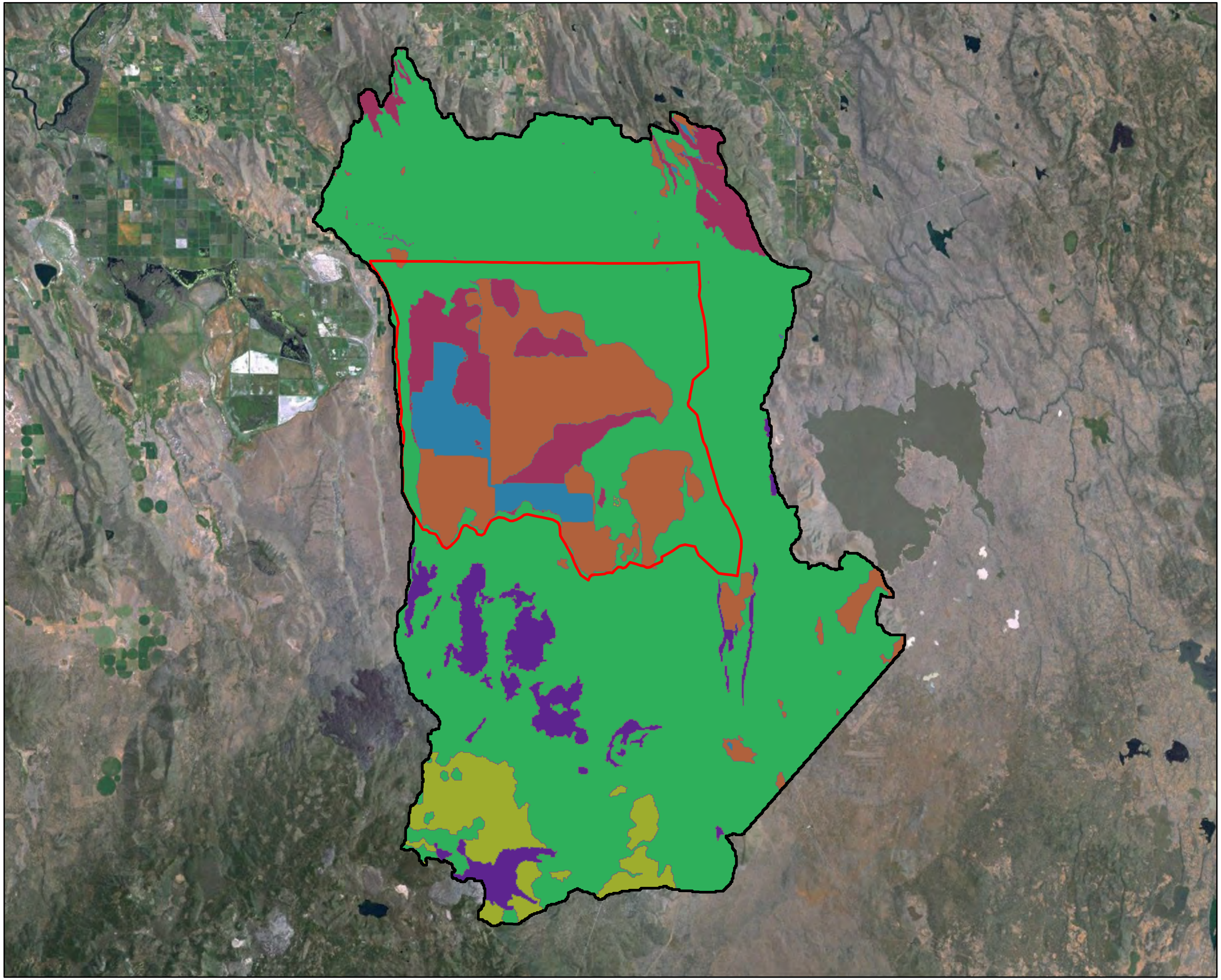

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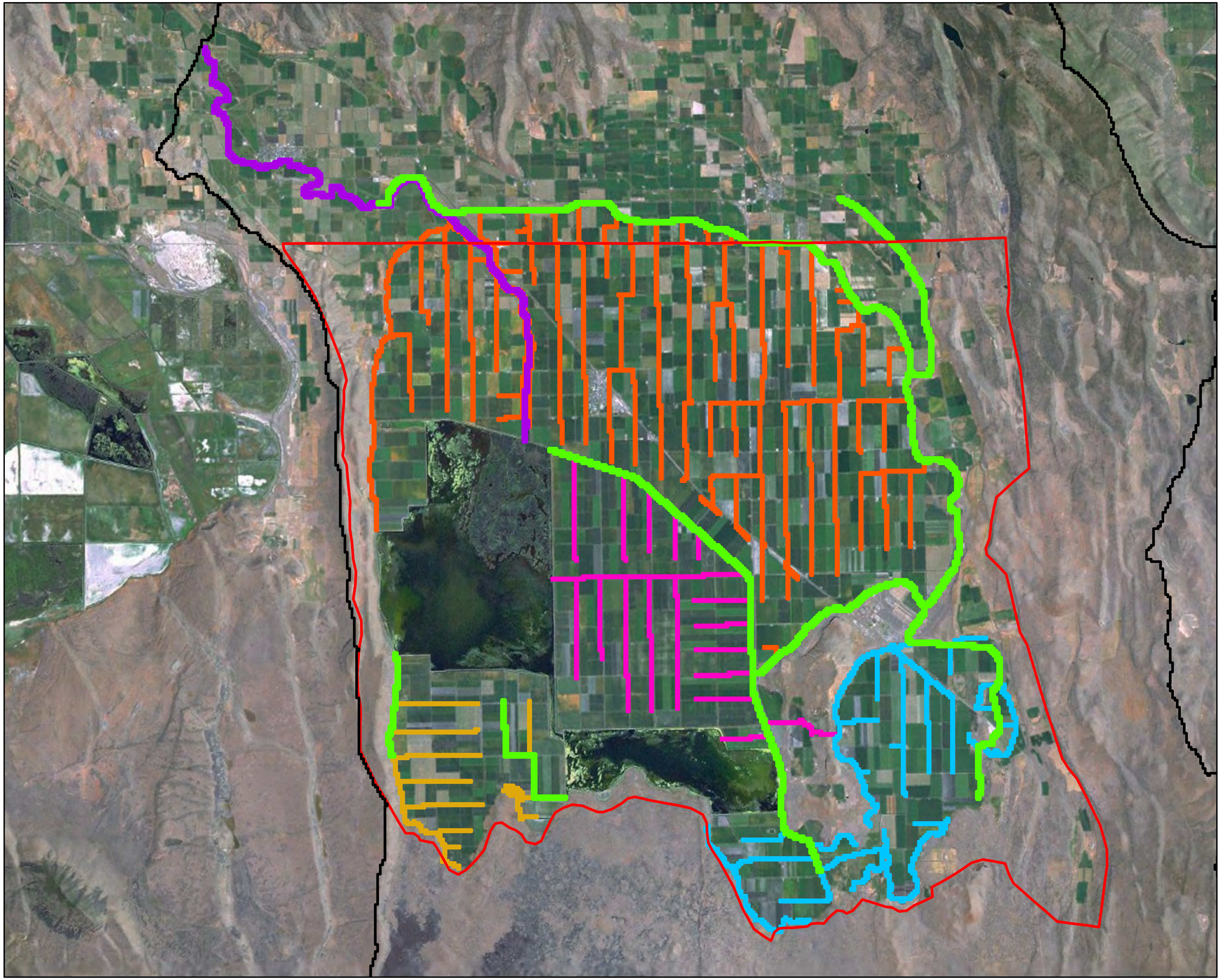
Notes:

FIGURE 3-3
Modeled Distribution of Soil Types

Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



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LEGEND

- ☐ Model Domain Boundary
- ☐ Tulelake Groundwater Subbasin
- ☐ TID Main Canals
- ☐ Lost River

Canal Laterals

- ☐ J System
- ☐ M & South N Systems
- ☐ North N System
- ☐ Q & R Systems

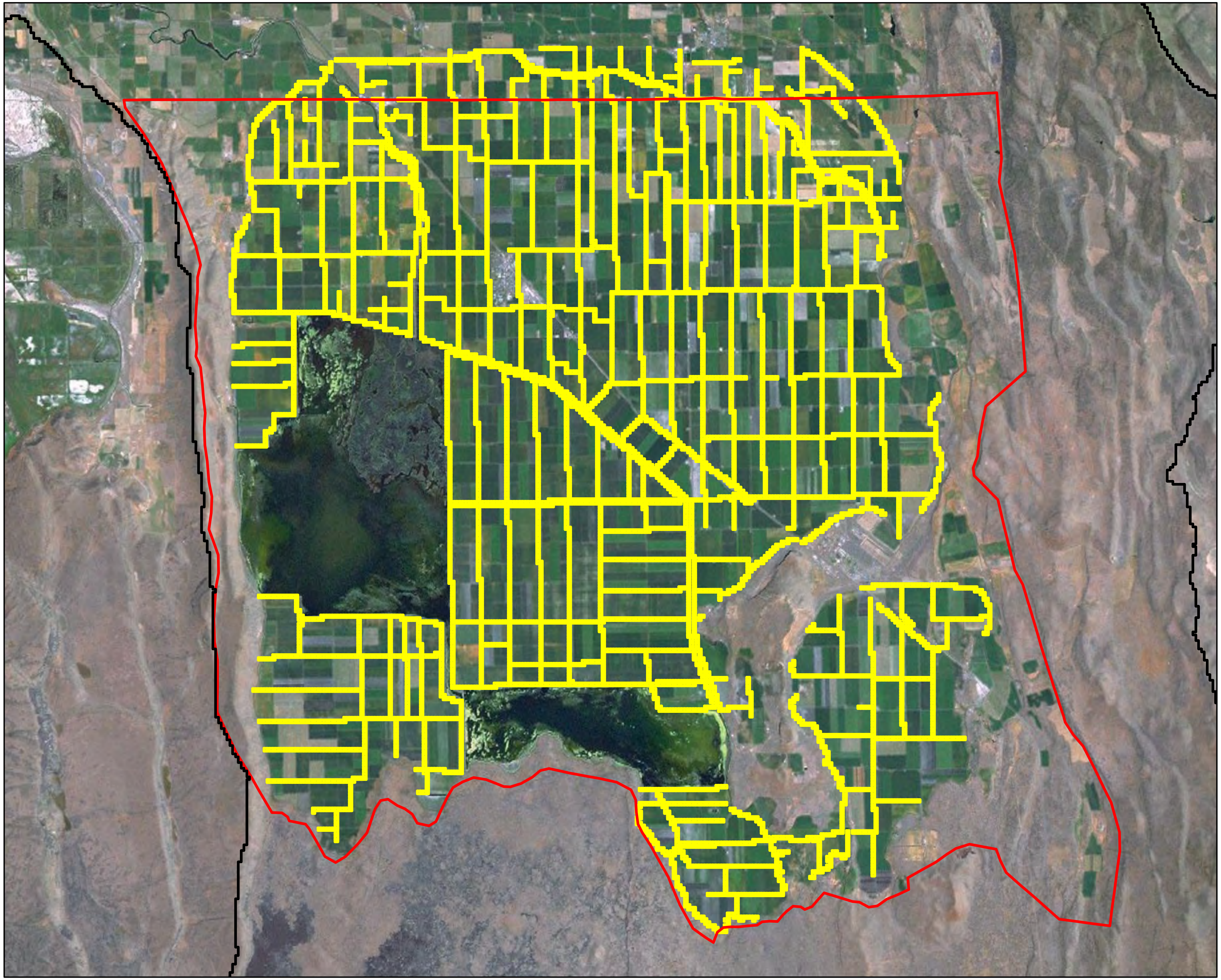
Notes:

TID = Tulelake Irrigation District

N

FIGURE 3-4
Simulated Lost River and Tulelake Irrigation District Conveyance Systems

Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



VICINITY MAP

LEGEND

⬛ Model Domain Boundary
🟥 Tulelake Groundwater Subbasin
🟨 Simulated TID Drains

Notes:

TID = Tulelake Irrigation District

N

FIGURE 3-5
Simulated Tulelake Irrigation District Drains
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

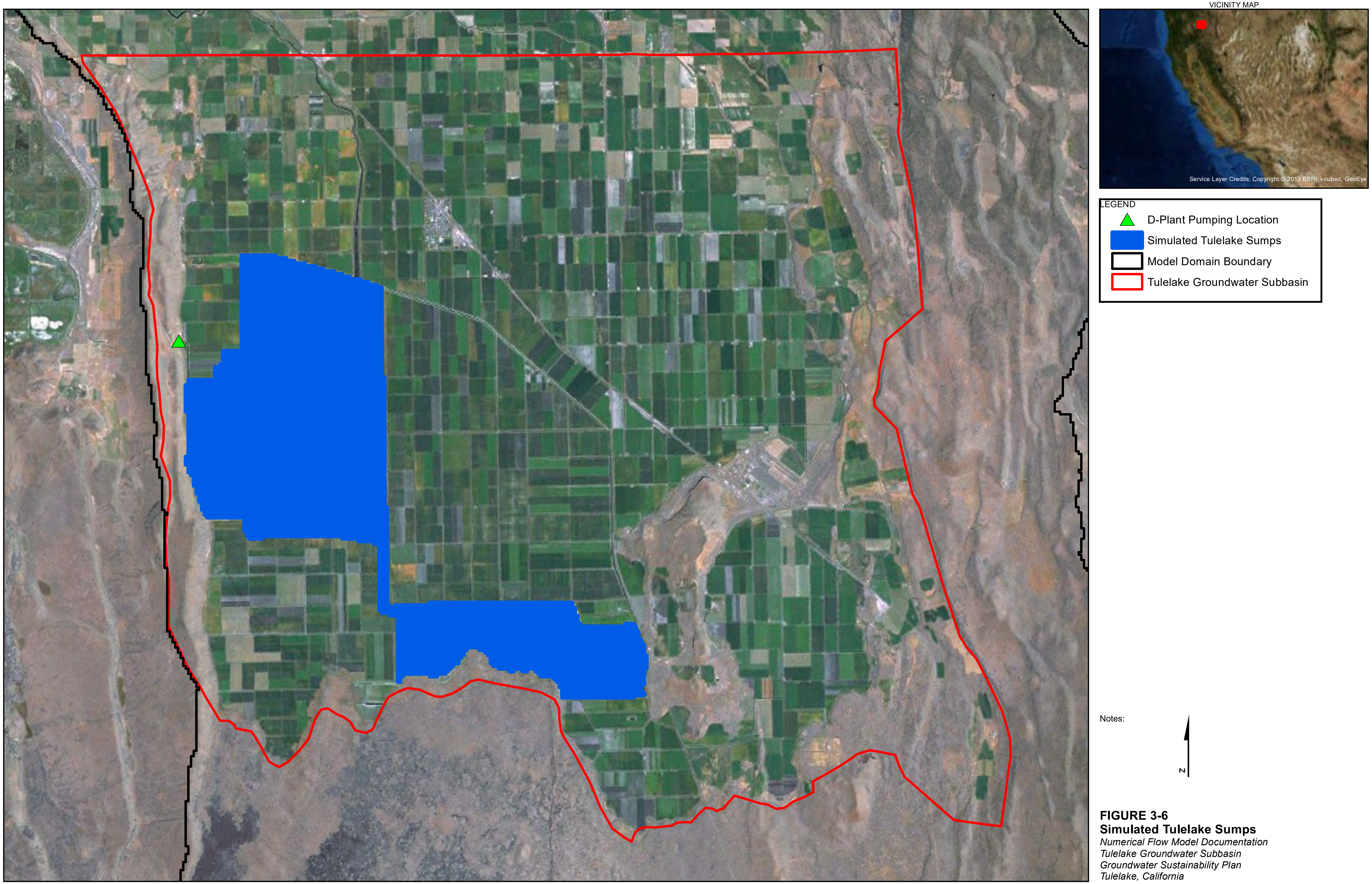
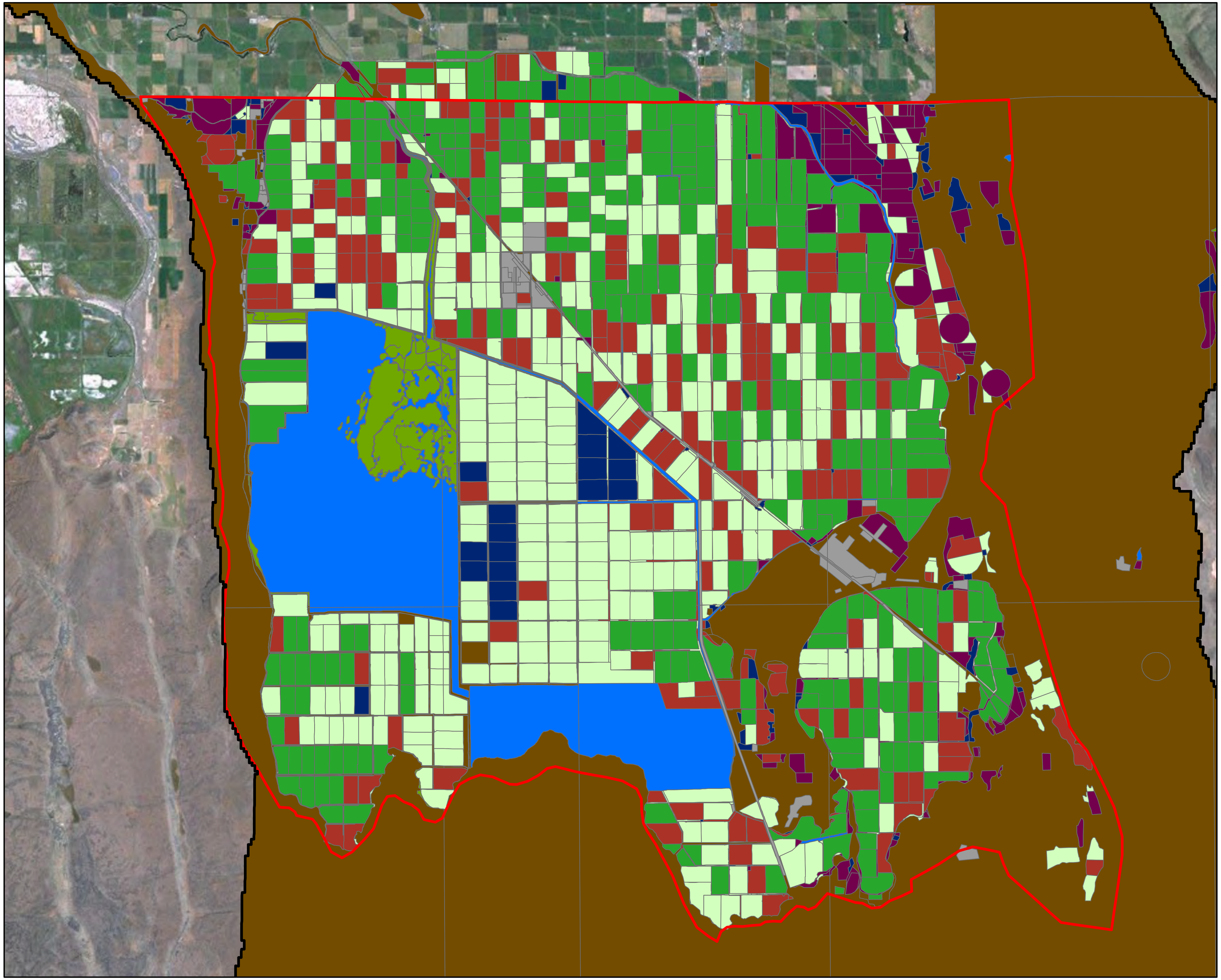


FIGURE 3-6
Simulated Tulelake Sumps
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



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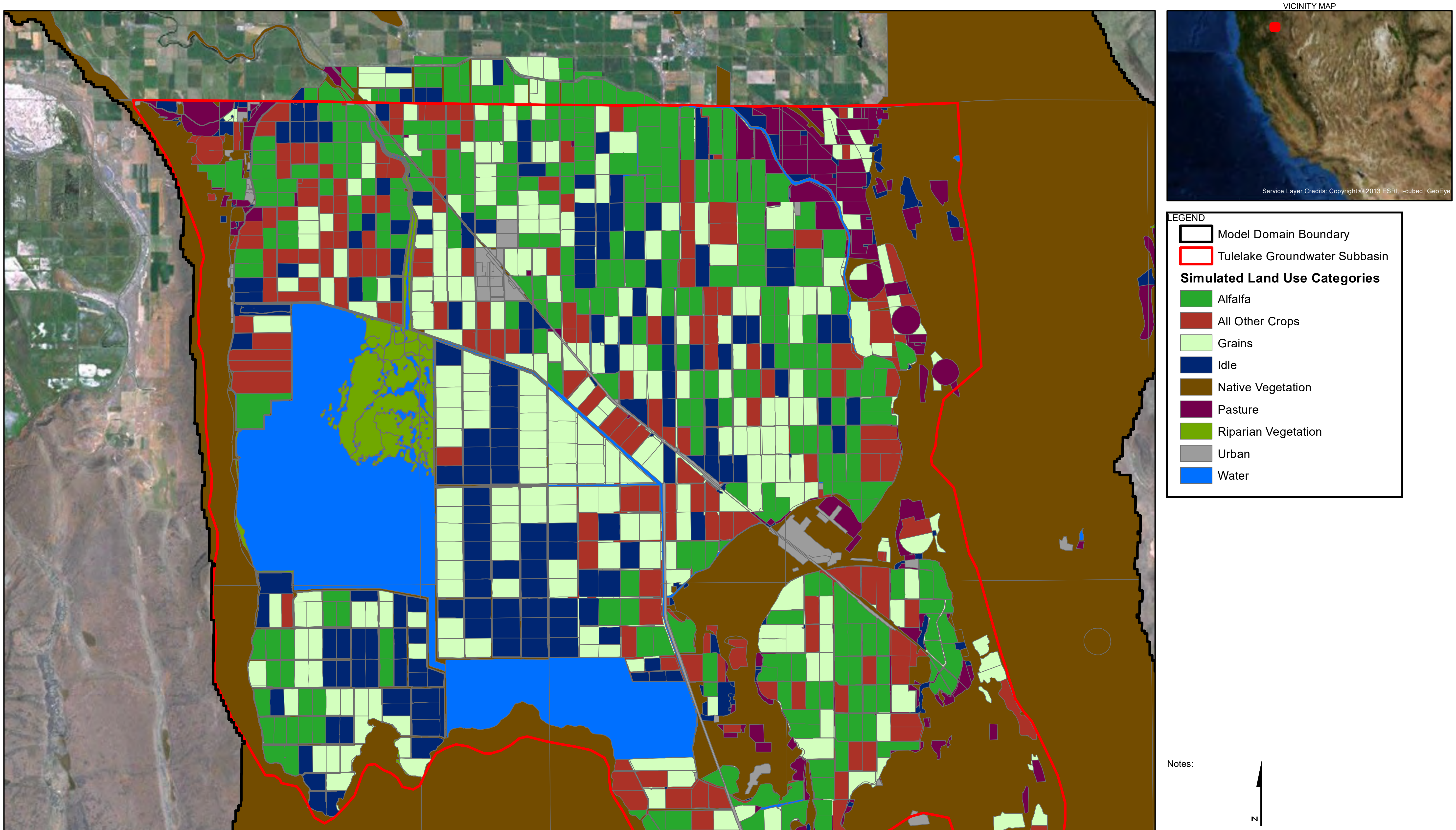
Notes:

FIGURE 3-7
2008 Simulated Land Use
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



Notes:

FIGURE 3-8
2010 Simulated Land Use
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

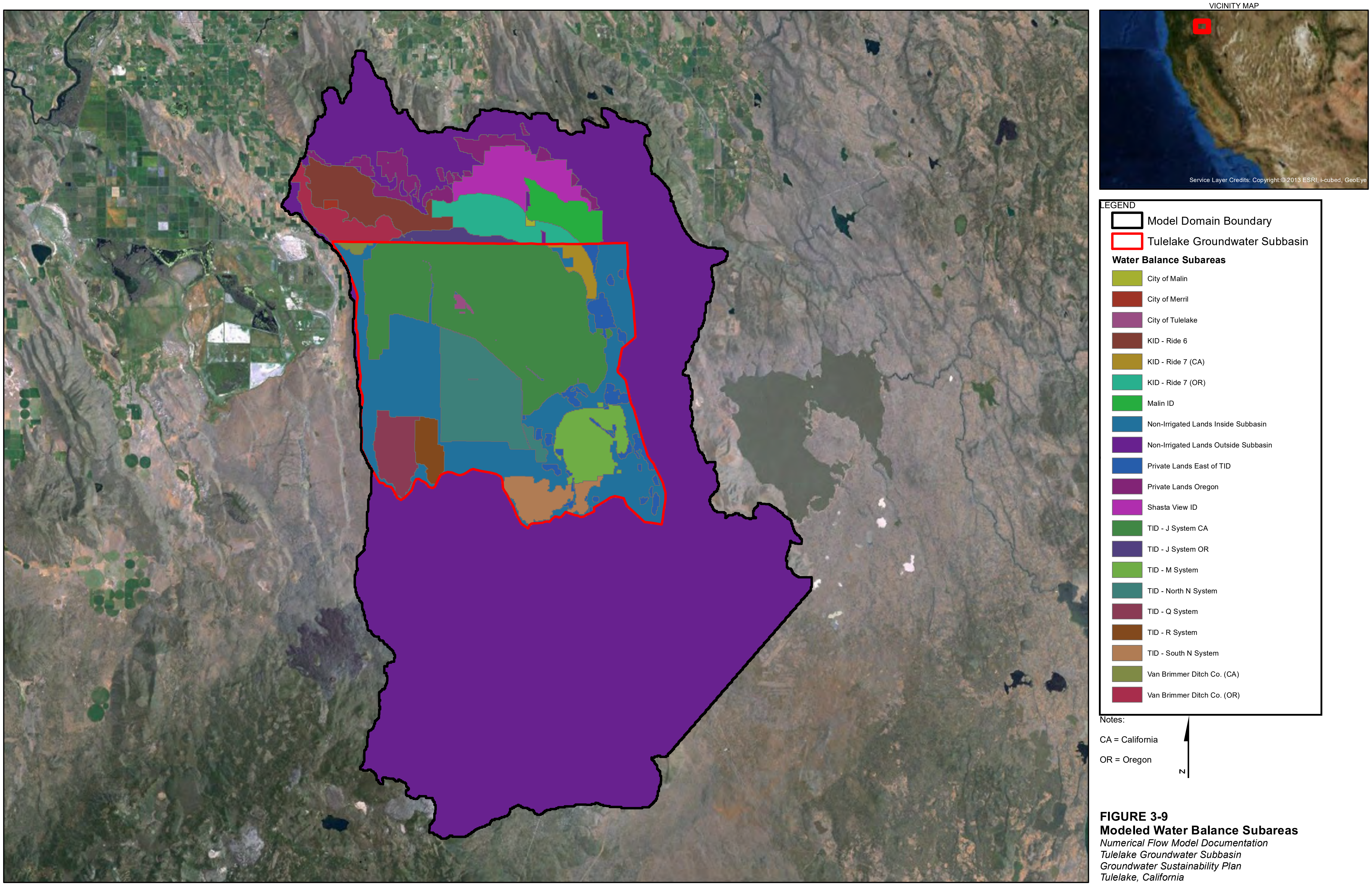
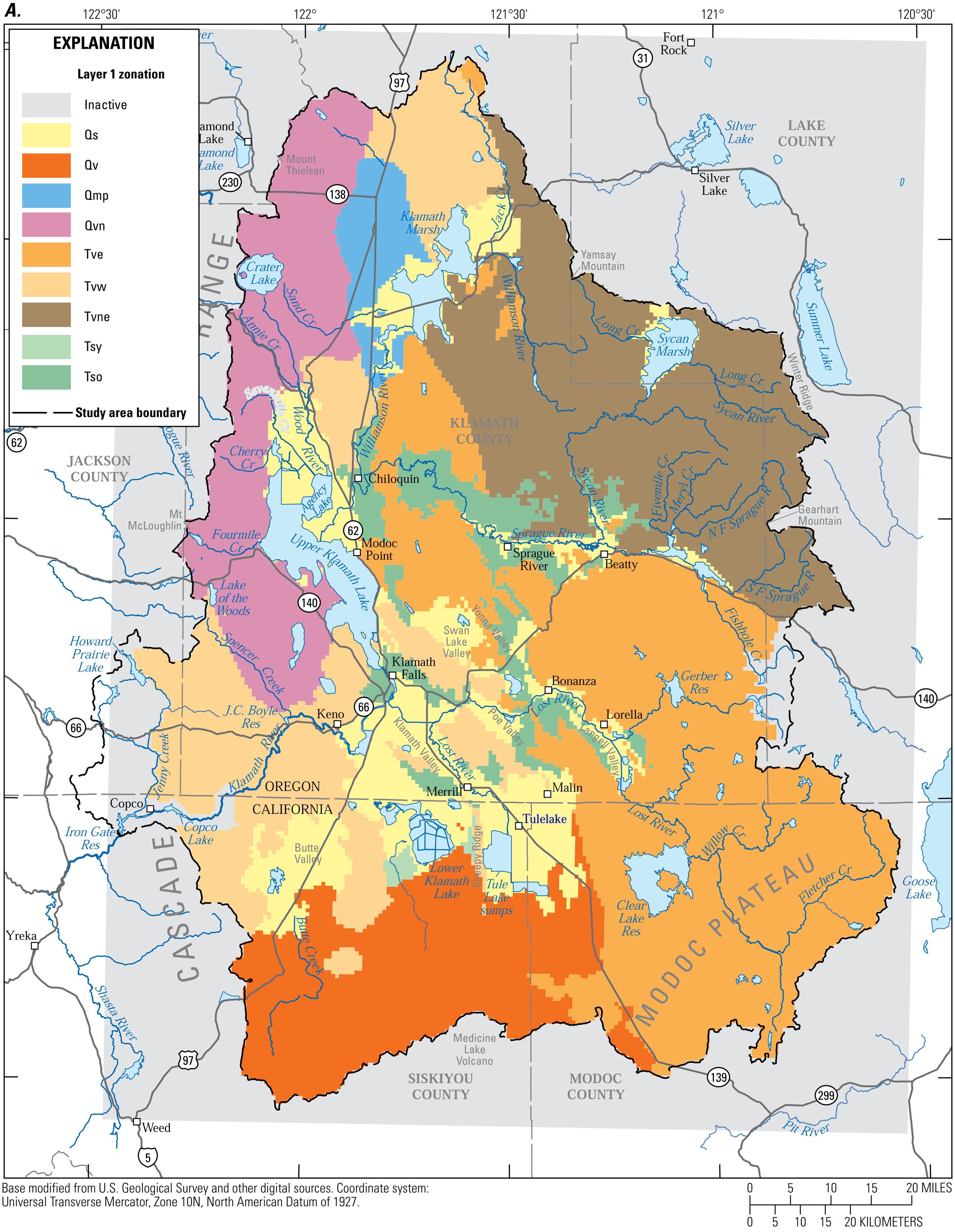
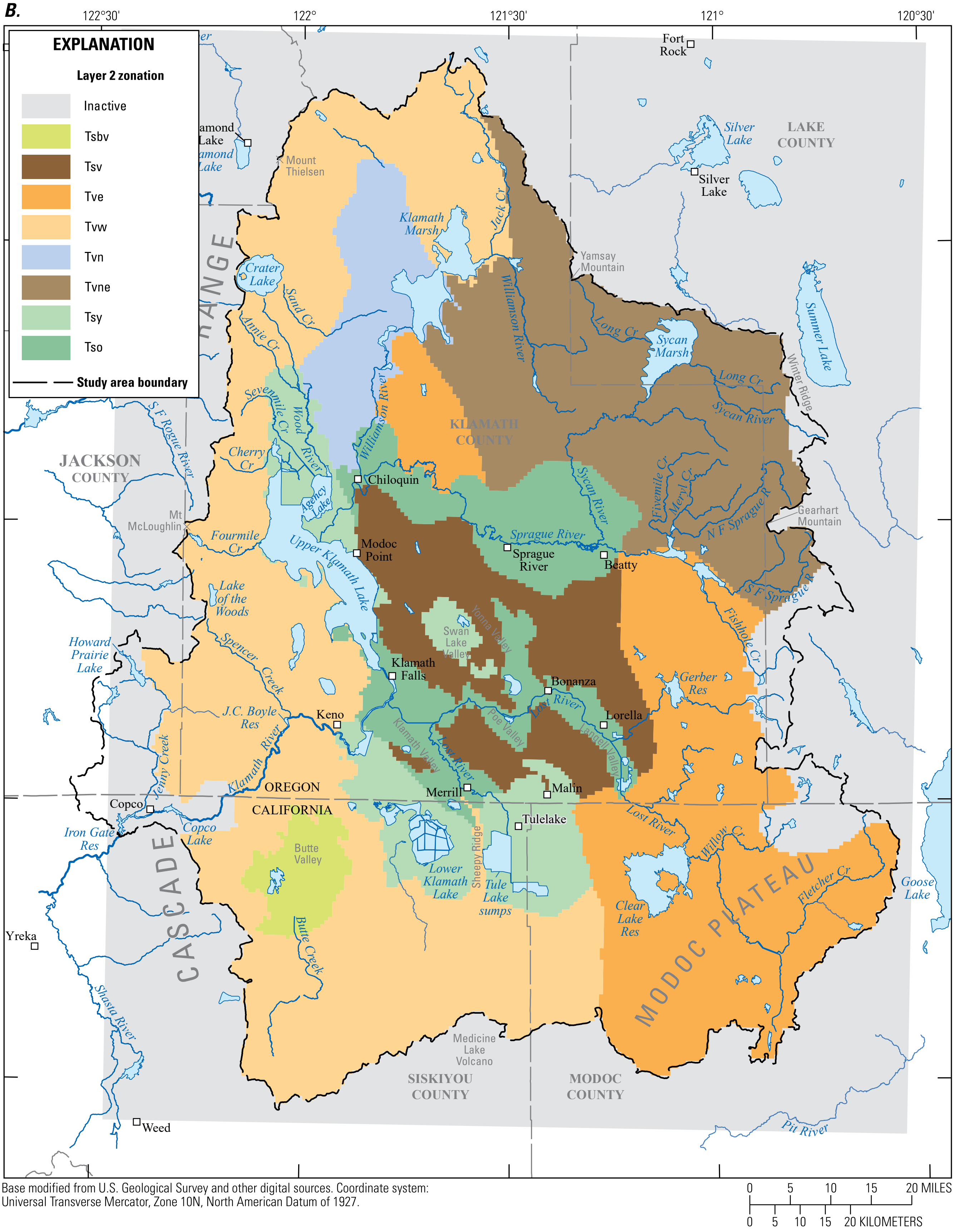


FIGURE 3-9
Modeled Water Balance Subareas
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



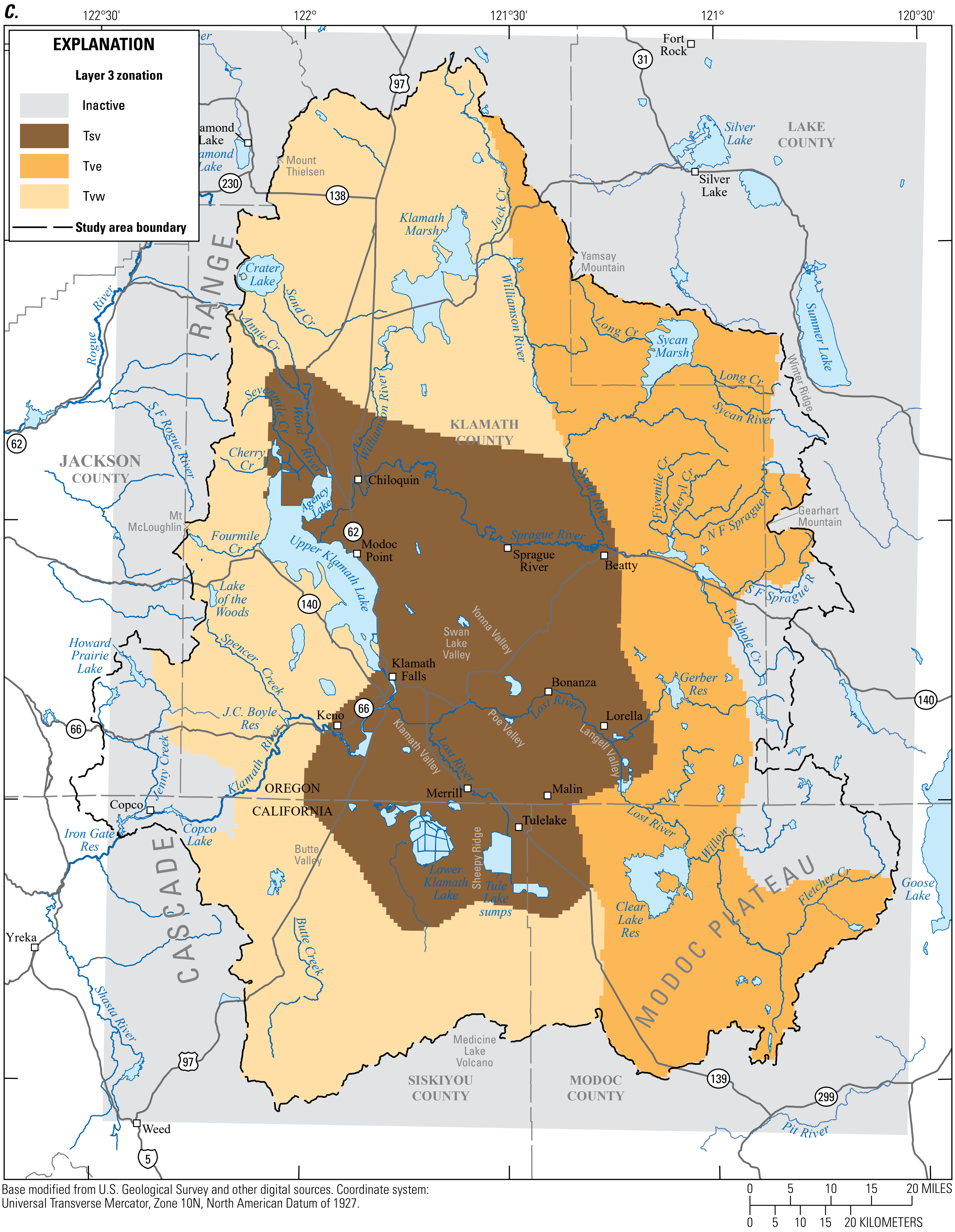
Base modified from U.S. Geological Survey and other digital sources. Coordinate system: Universal Transverse Mercator, Zone 10N, North American Datum of 1927.

Figure 6. Upper Klamath Basin, Oregon and California, regional groundwater flow model hydraulic-conductivity zonation. (*A*) Layer 1 zonation; (*B*) Layer 2 zonation; and (*C*) Layer 3 zonation. Hydrogeologic unit definitions: Qs, Quaternary sediment; Qv, Quaternary volcanic deposits; Qvn, Quaternary volcanic deposits north; Qmp, Quaternary Mazama pumice; Tvn, Tertiary volcanic deposits north; Tsbv, Tertiary sediments, Butte Valley; Tsy, Tertiary sediments younger basins; Tso, Tertiary sediments older basins; Tsv, Tertiary mixed sedimentary and volcanic deposits; Tvw, Tertiary volcanic rocks west; Tve, Tertiary volcanic rocks east; Tvne, Tertiary volcanic rocks northeast.



Base modified from U.S. Geological Survey and other digital sources. Coordinate system: Universal Transverse Mercator, Zone 10N, North American Datum of 1927.

Figure 6.—Continued



Base modified from U.S. Geological Survey and other digital sources. Coordinate system: Universal Transverse Mercator, Zone 10N, North American Datum of 1927.

Figure 6.—Continued

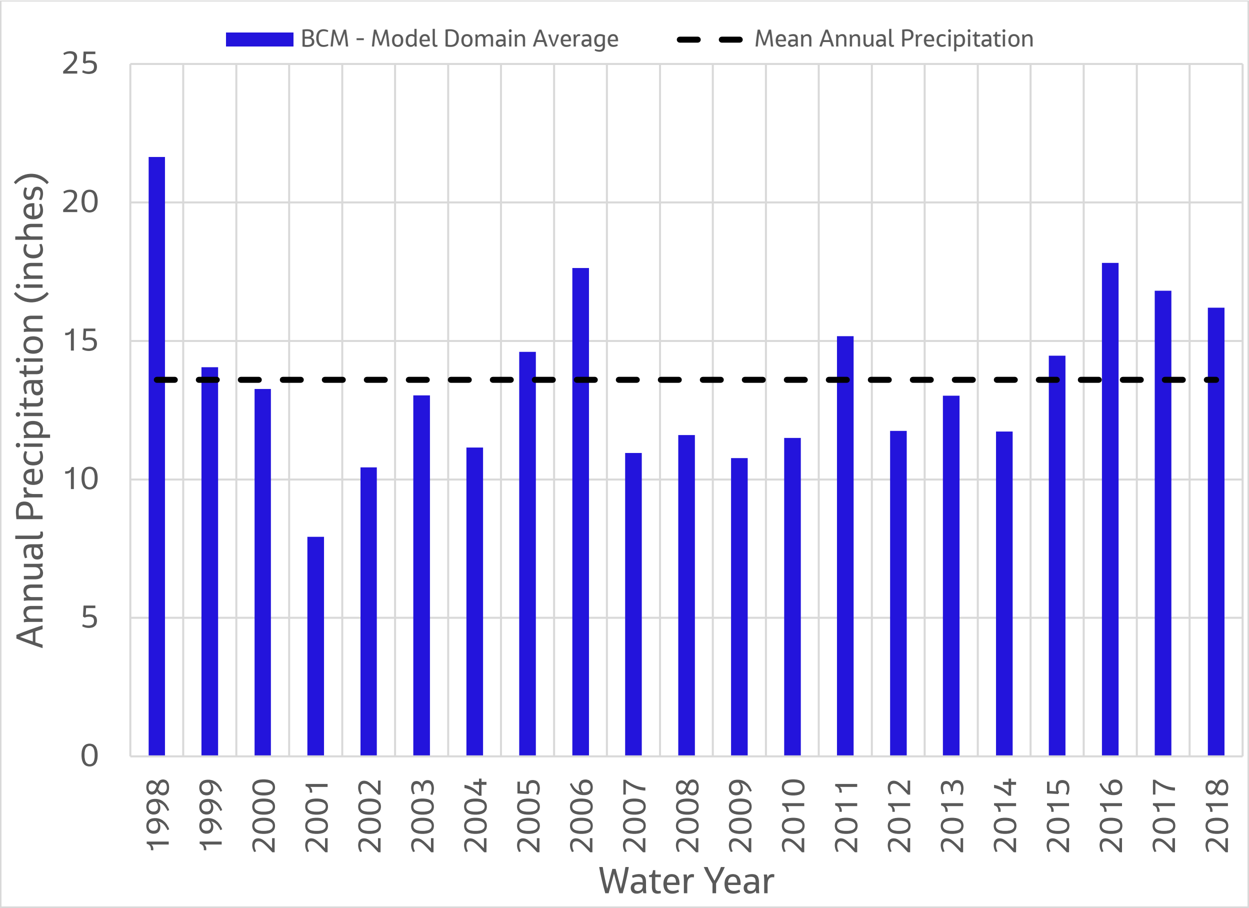


Figure 3-11 – Modeled Annual Precipitation

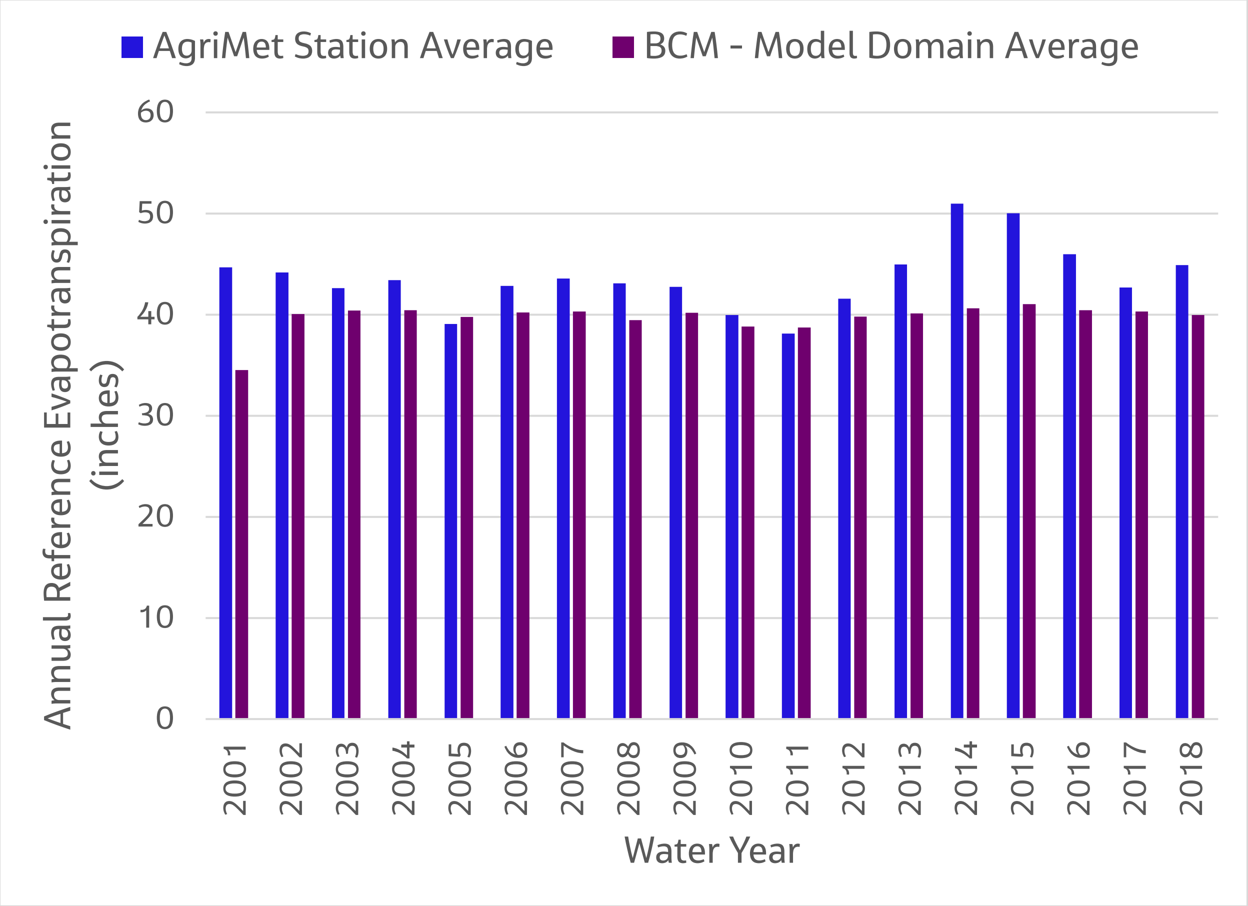


Figure 3-12 – Annual Reference Evapotranspiration

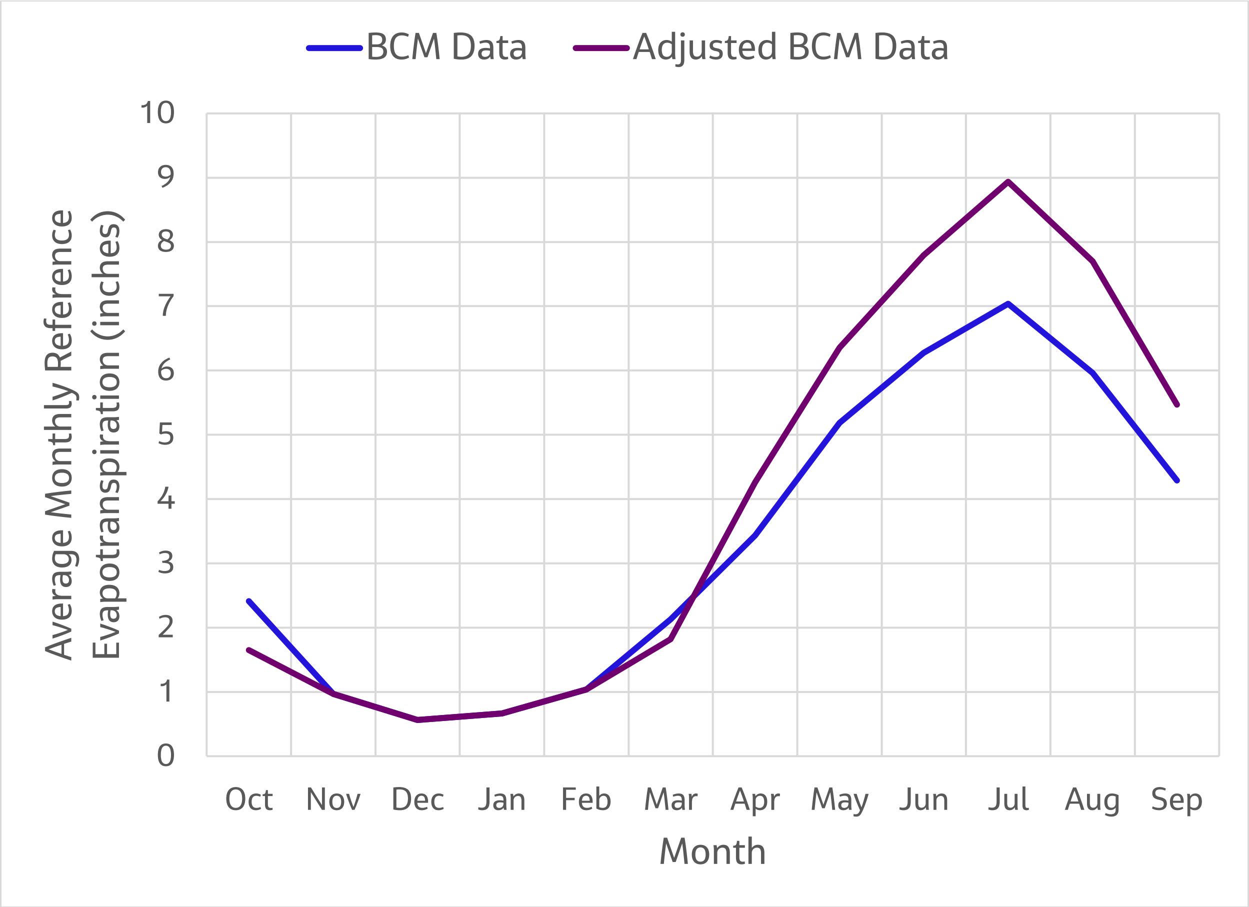


Figure 3-13 – Monthly Average Reference Evapotranspiration

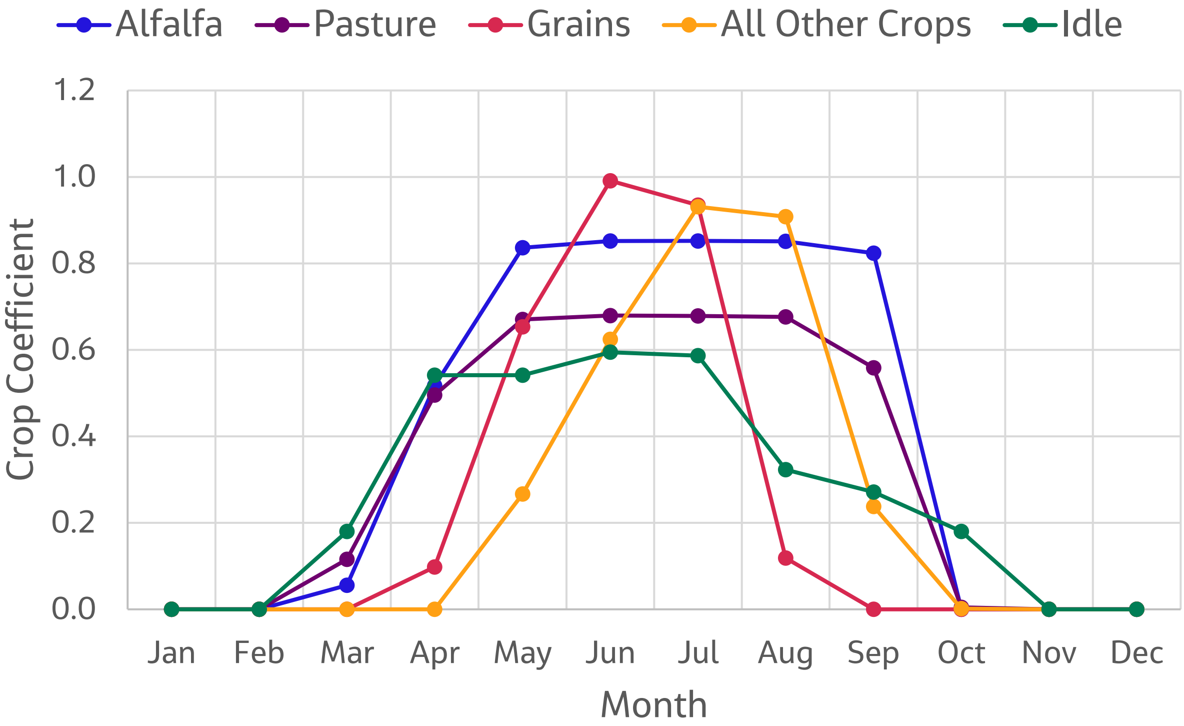


Figure 3-14 - Monthly Crop Coefficients

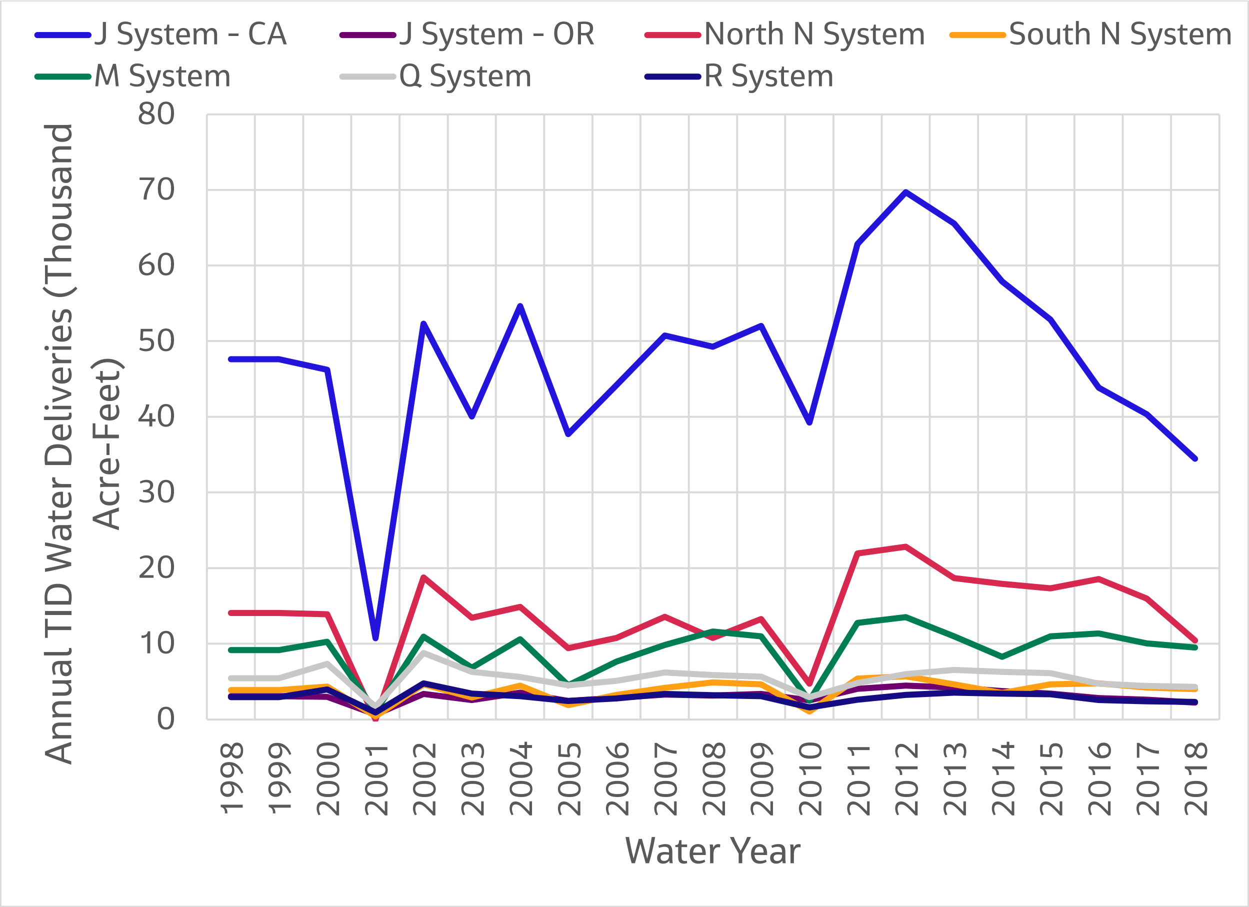
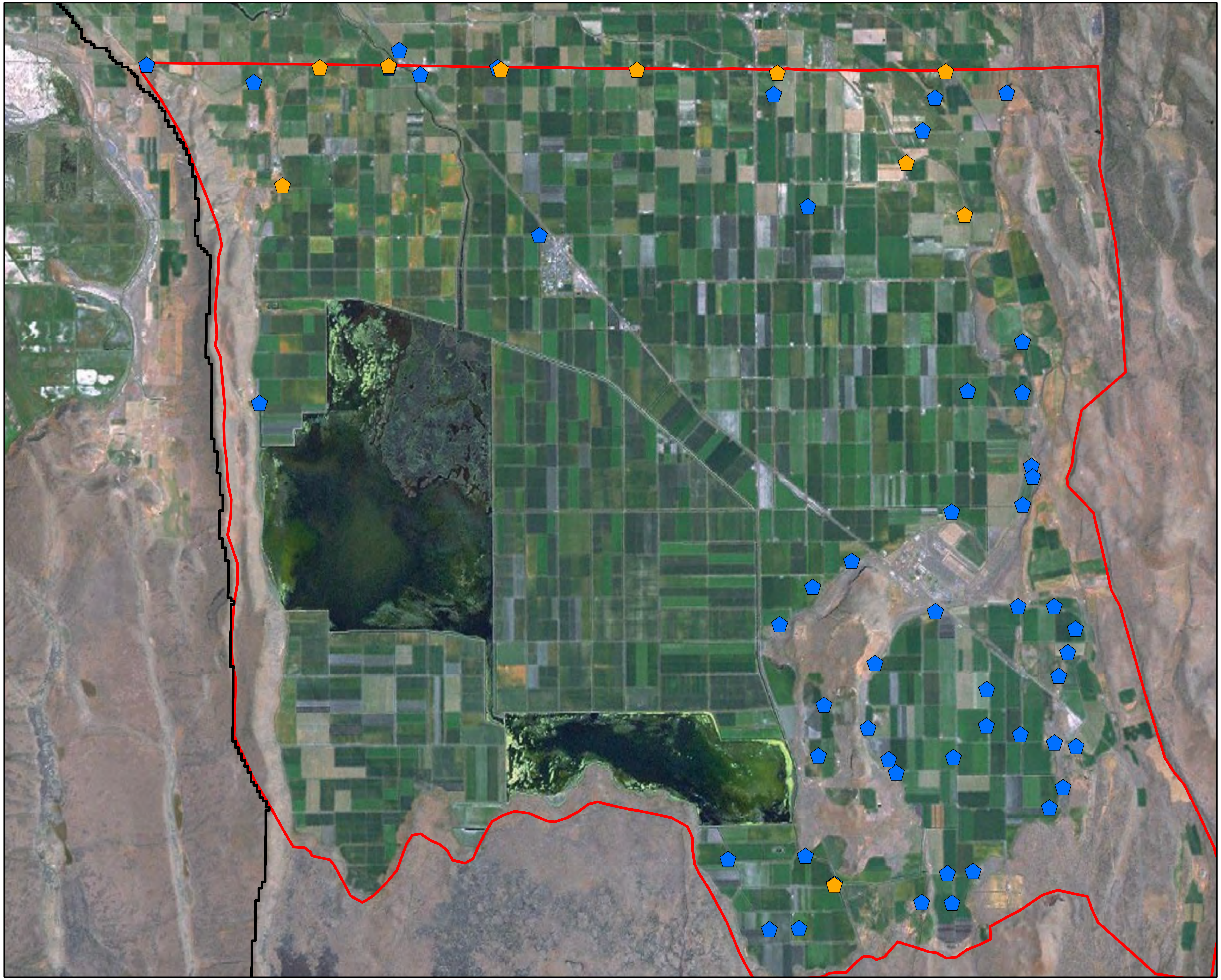


Figure 3-15 – Annual TID Water Deliveries



VICINITY MAP

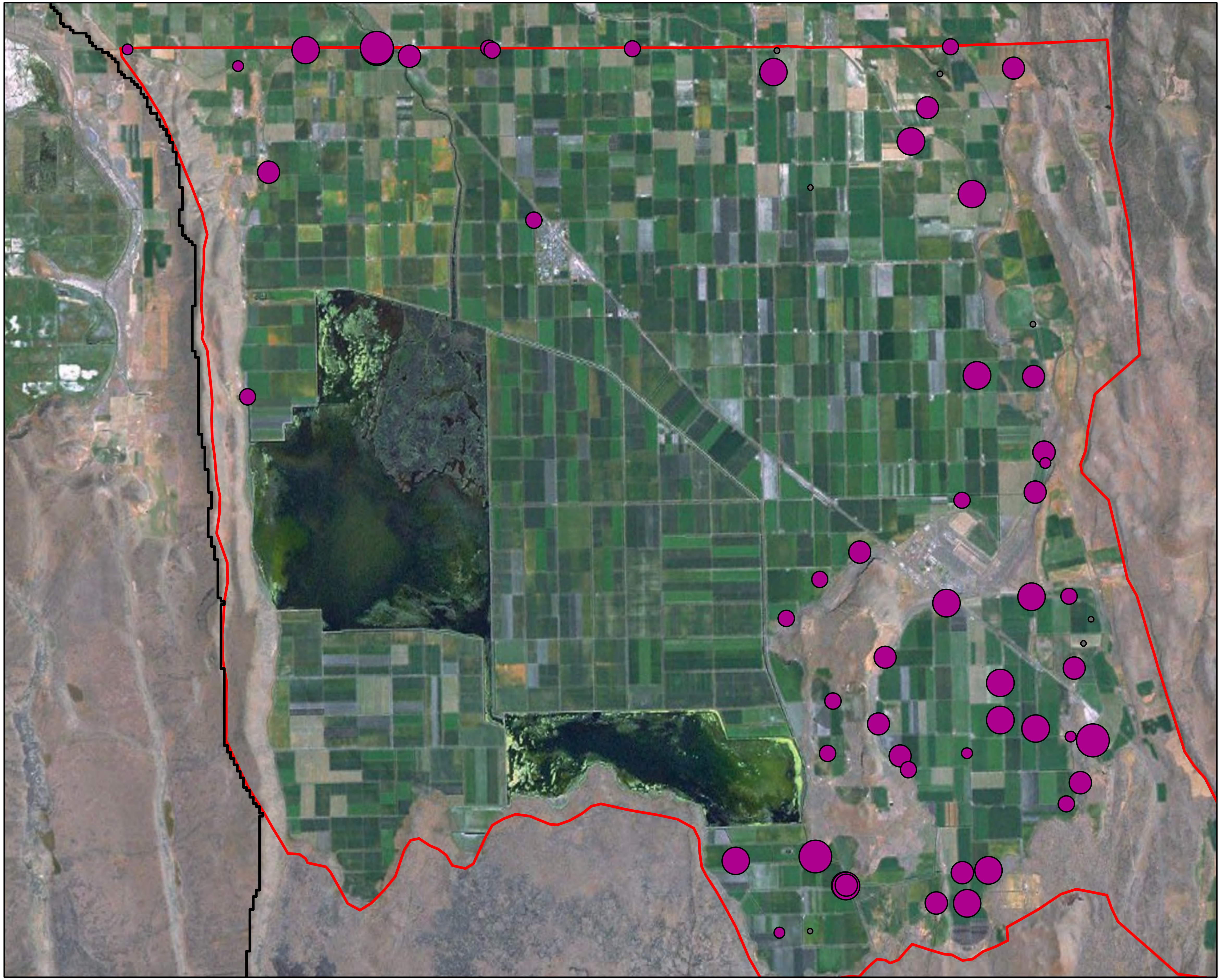
LEGEND

Simulated Pumping Well

- ⬟ Private Well
- ⬟ TID Well
- ☐ Model Domain Boundary
- 🟥 Tulelake Groundwater Subbasin

Notes:

FIGURE 3-16
Simulated Pumping Well Locations
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



VICINITY MAP

LEGEND

WY 2014 Annual Pumping (Acre-Feet)

- ● 0
- ● 1 - 250
- ● 251 - 750
- ● 751 - 1,500
- ● 1,500 - 3,000
- ● 3,000+
- ☐ Model Domain Boundary
- 🟥 Tulelake Groundwater Subbasin

Notes:

WY = Water Year

N

FIGURE 3-17
WY 2014 Annual Pumping Volume
at Simulated Pumping Wells
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

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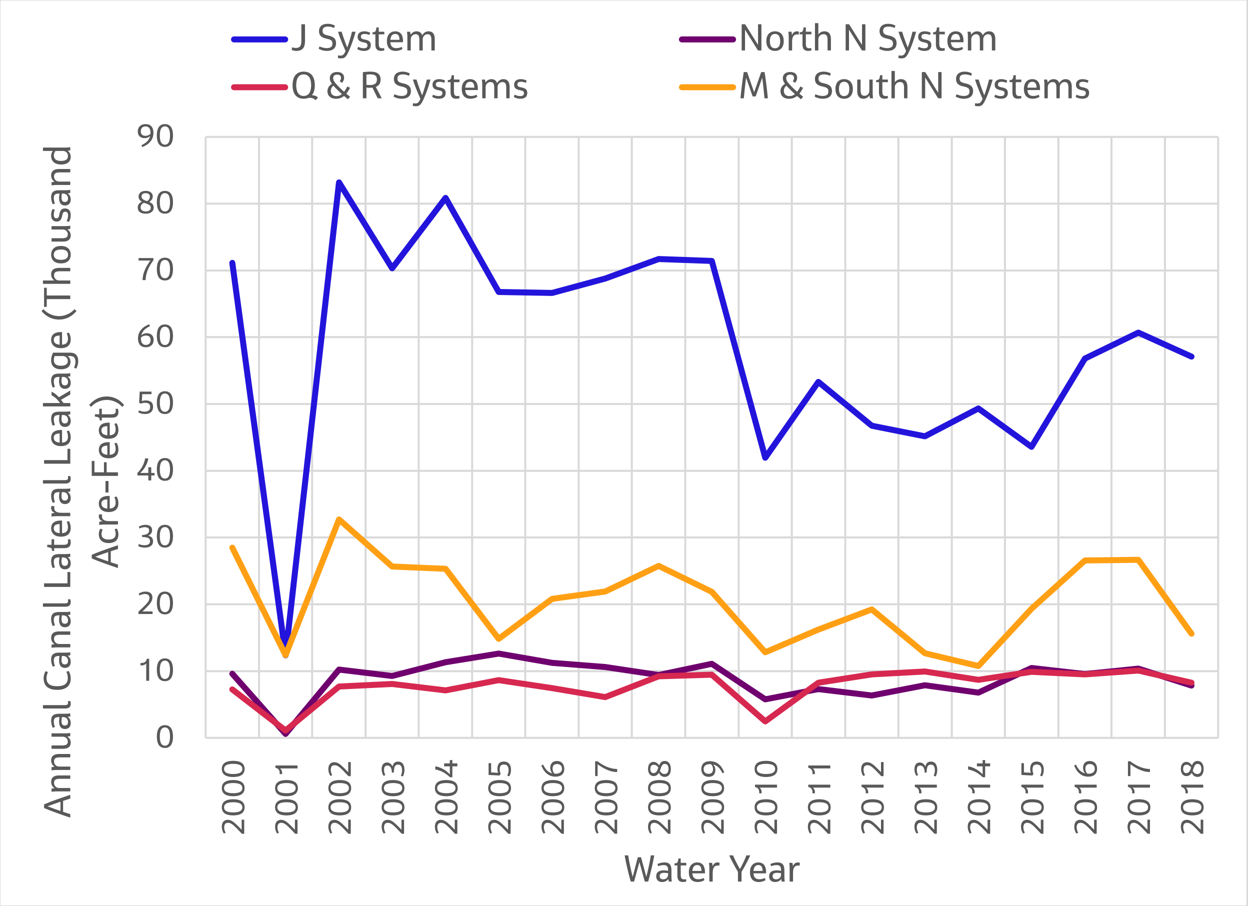
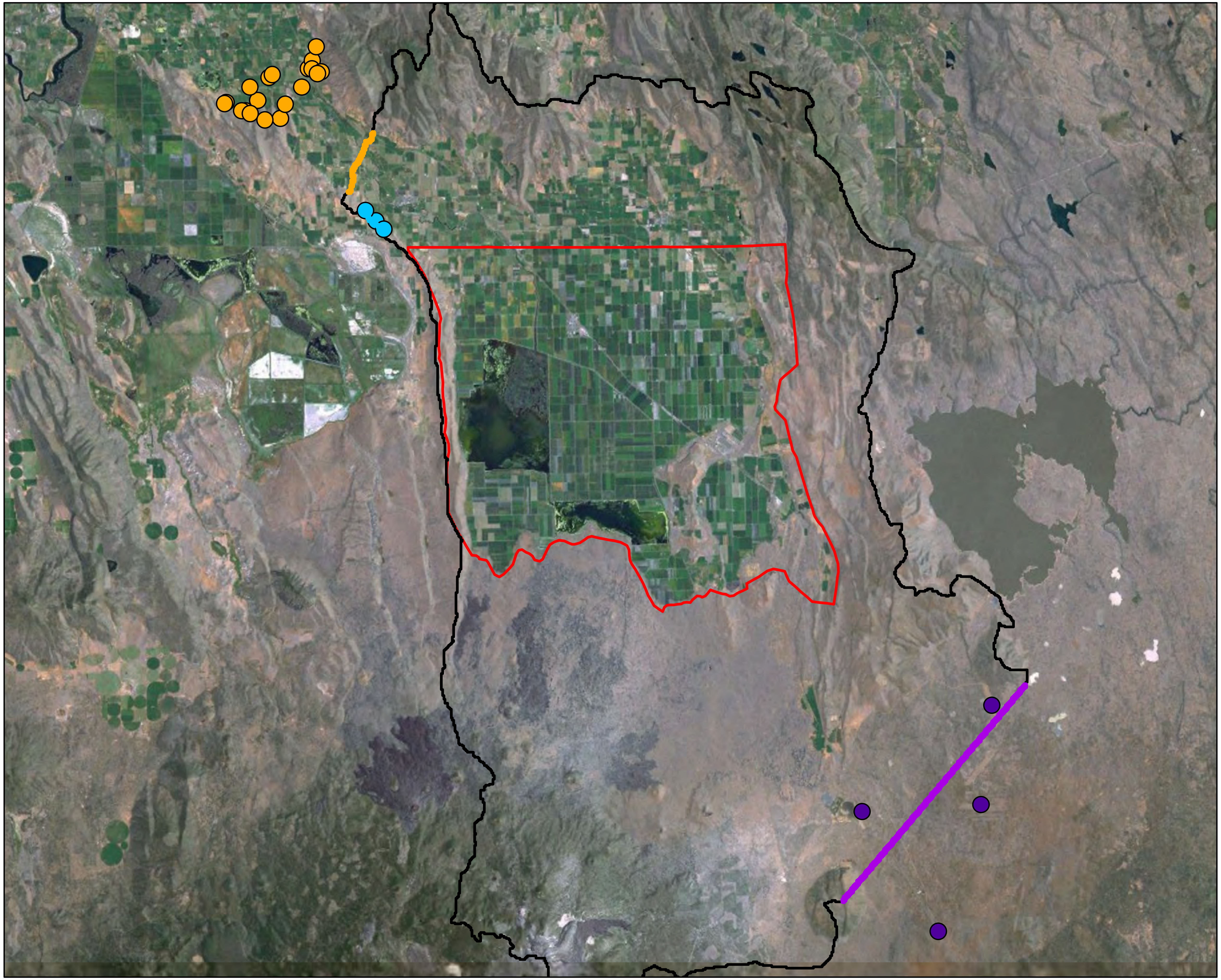


Figure 3-18 – Annual Estimated Canal Lateral Leakage



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LEGEND

🟧	Northern General Head Boundary
🟦	Northwestern General Head Boundary
🟪	Southern General Head Boundary
🟠	Northern Boundary Wells
🔵	North Western Boundary Wells
🟣	Southern Boundary Wells
☐	Groundwater Model Active Domain
🟥	Tulelake Subbasin

Notes:

N

FIGURE 3-19

Lateral Subsurface Boundary Locations

Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

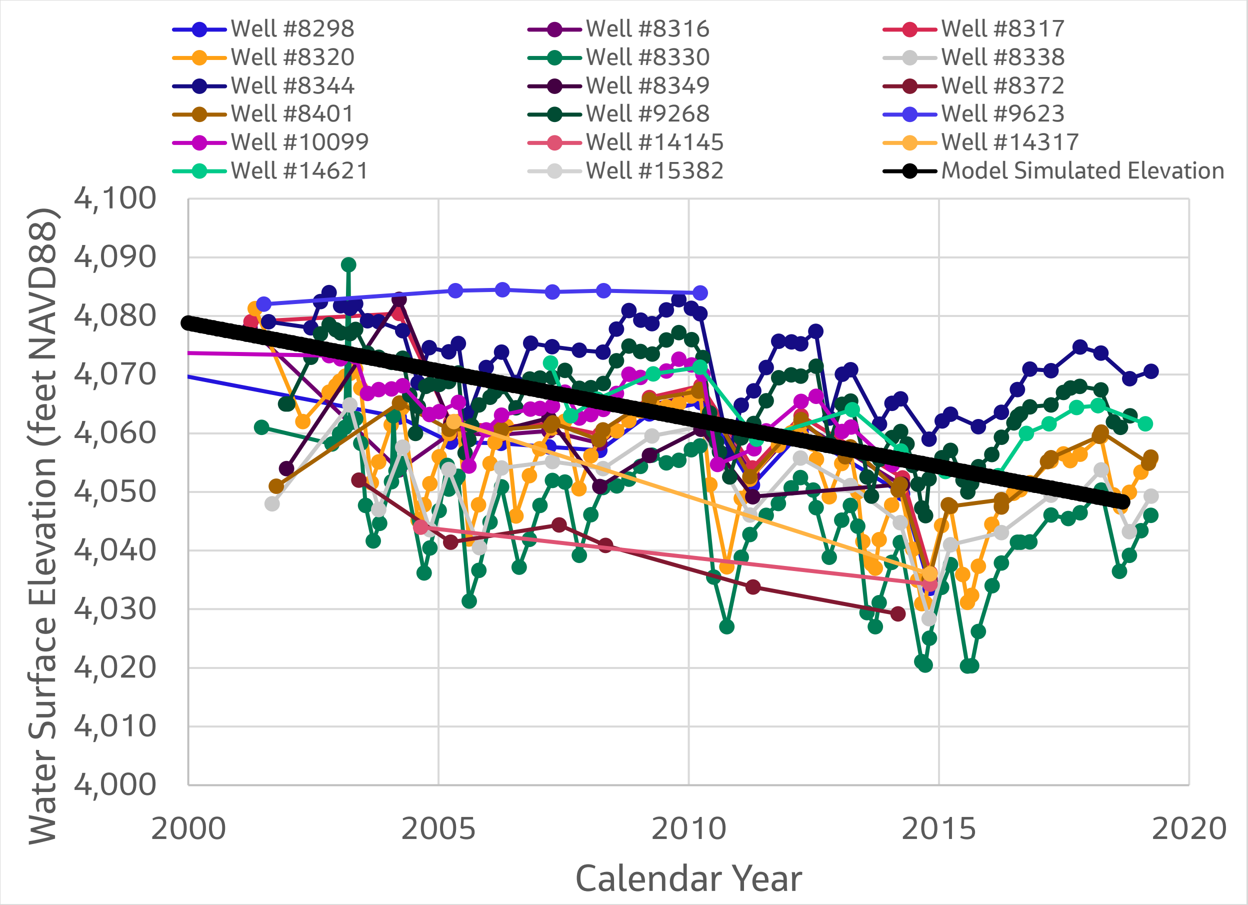


Figure 3-20 – Northern General Head Boundary Water Level Data

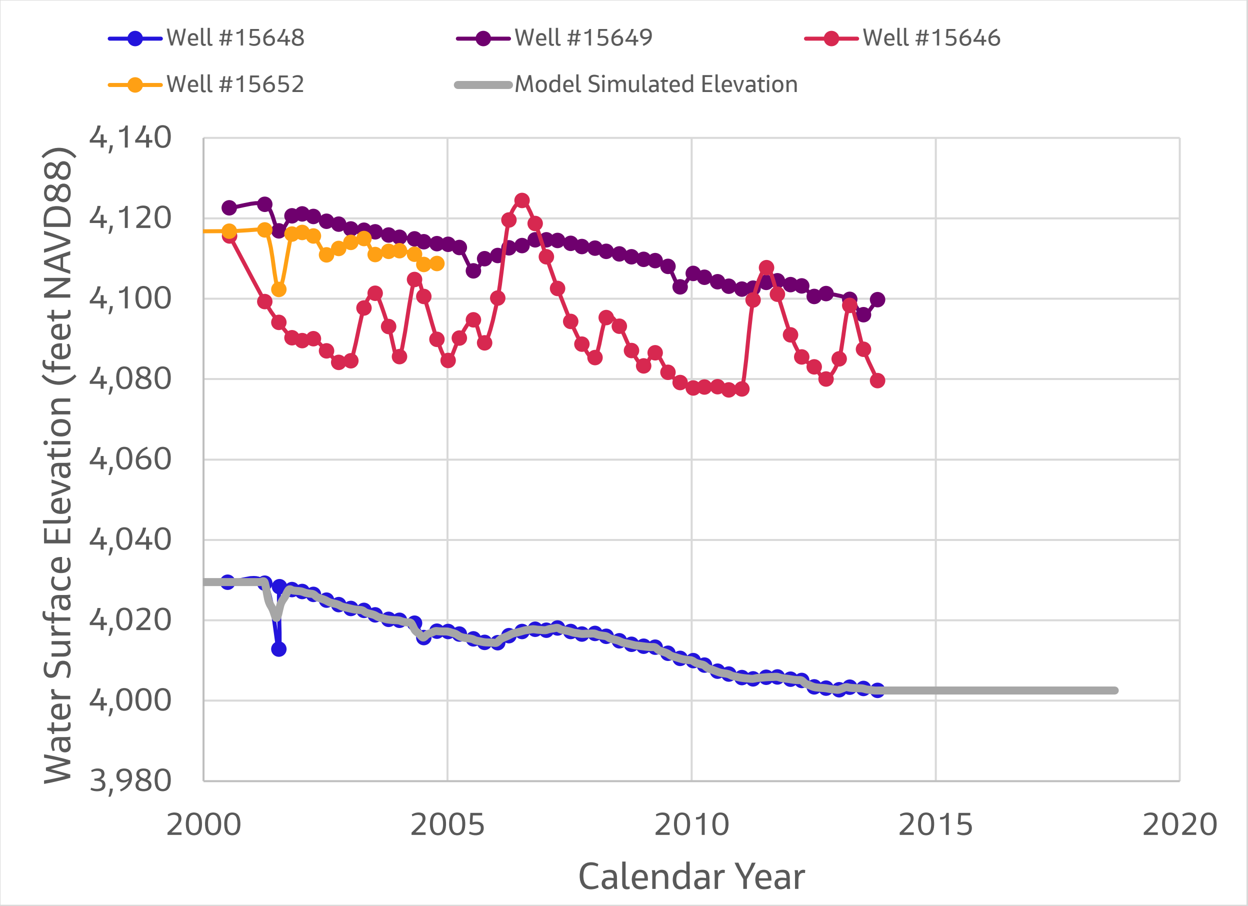


Figure 3-21 – Southern Boundary Water Level Data

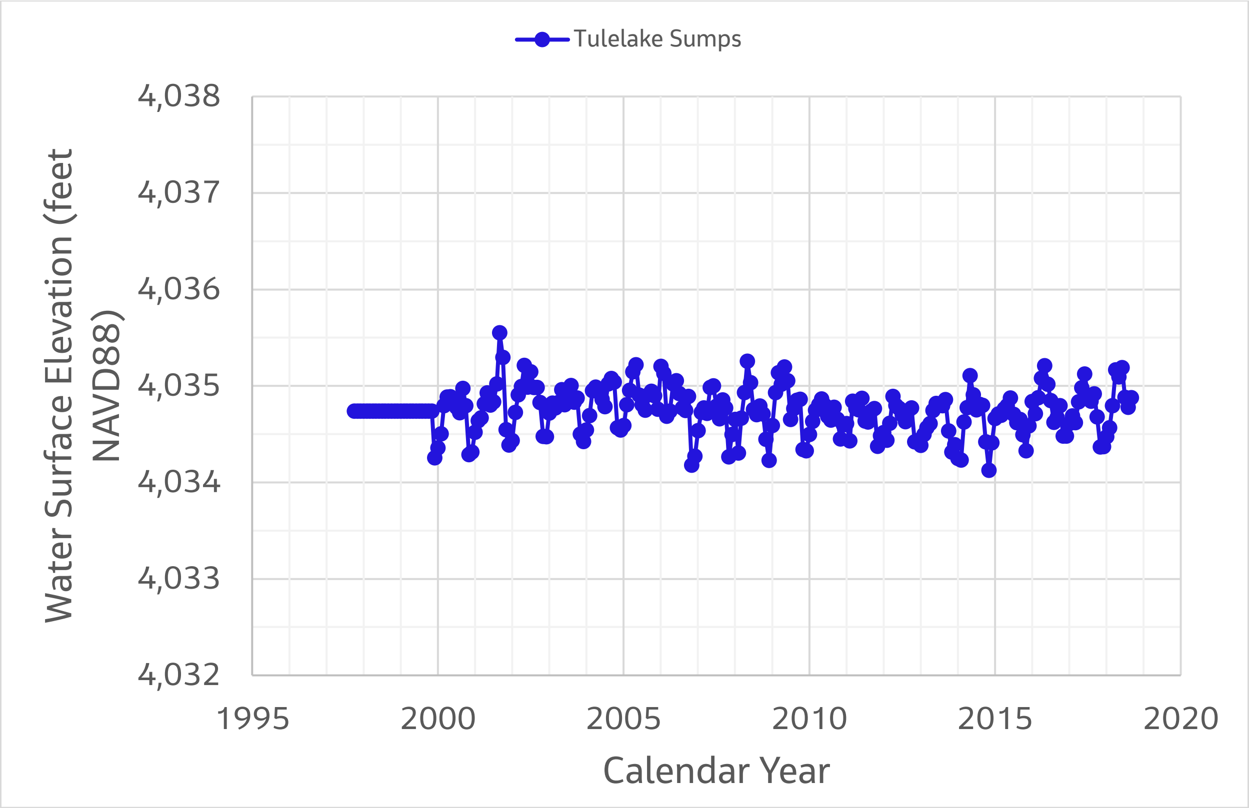
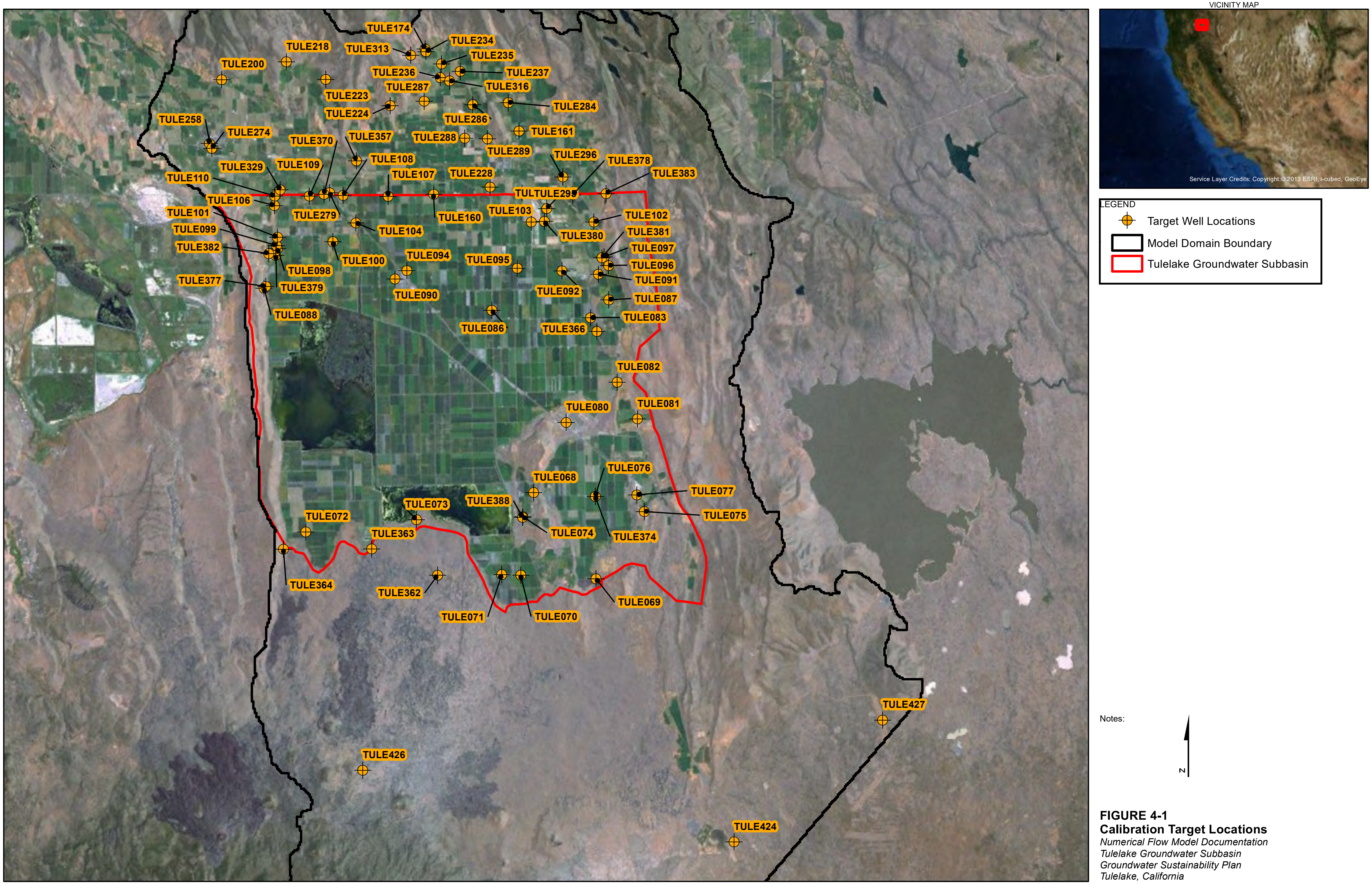


Figure 3-22 – Tulelake Sumps Historical Water Surface Elevation



Notes:

N

FIGURE 4-1
Calibration Target Locations

Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

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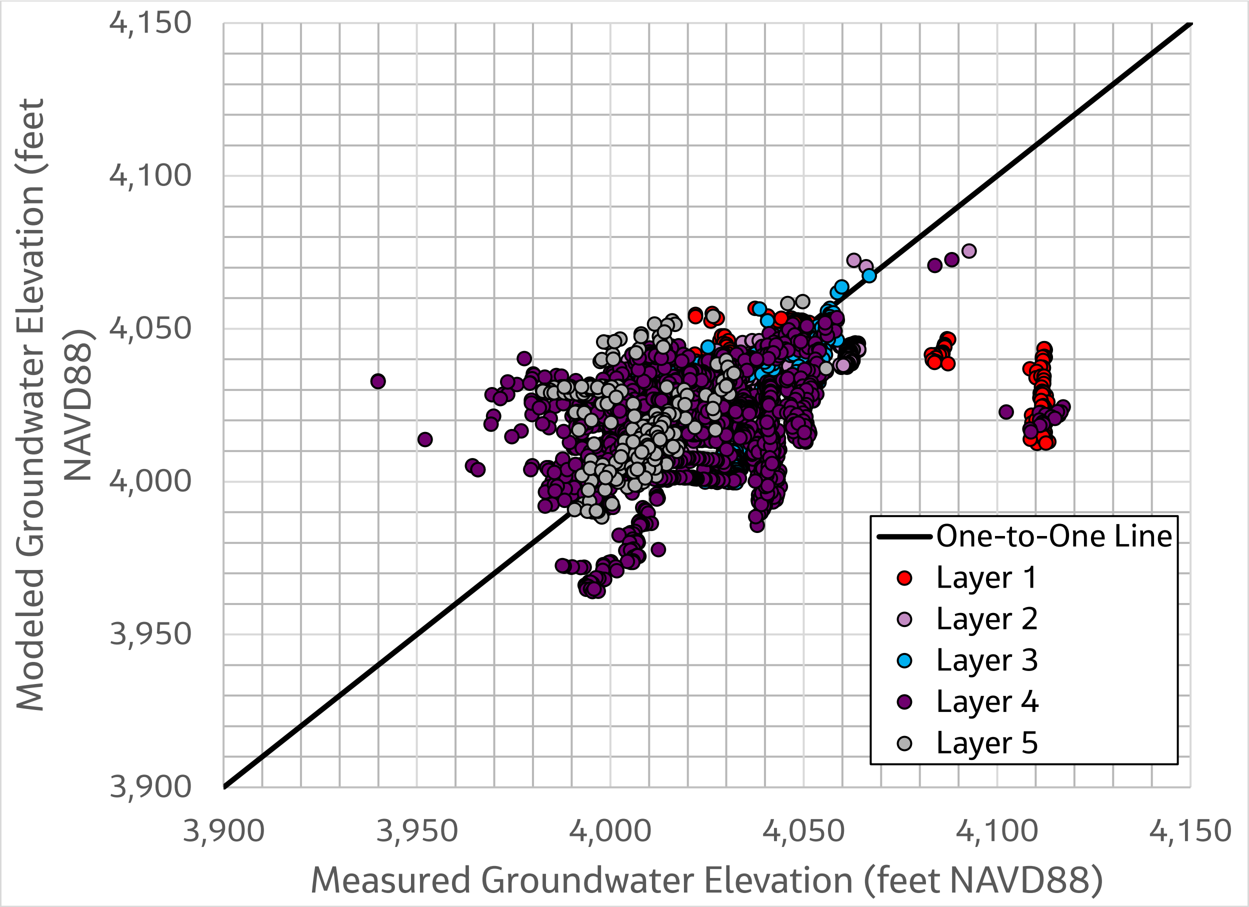
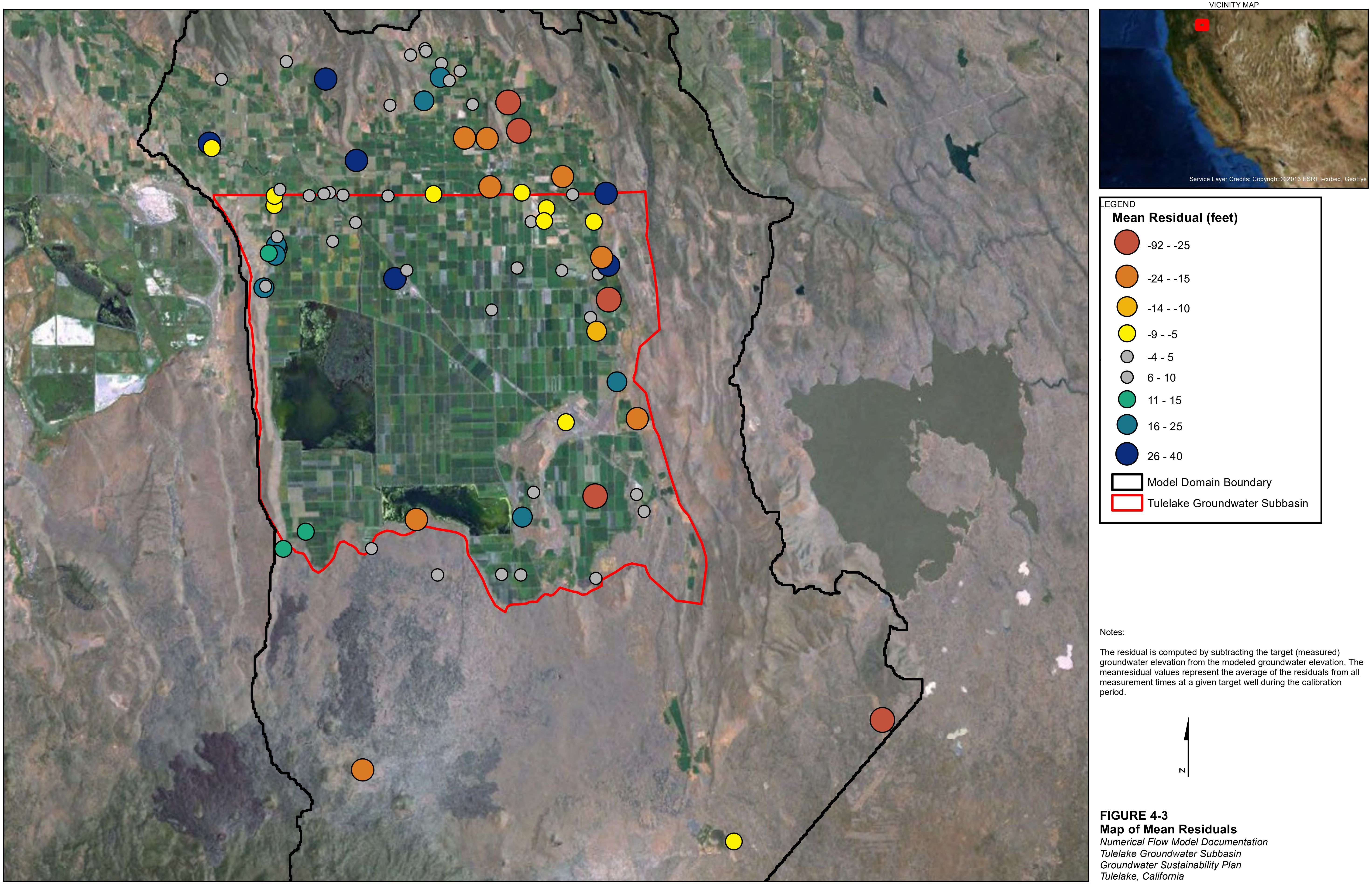


Figure 4-2 – Modeled Versus Target Groundwater Elevations



Notes:

The residual is computed by subtracting the target (measured) groundwater elevation from the modeled groundwater elevation. The meanresidual values represent the average of the residuals from all measurement times at a given target well during the calibration period.

FIGURE 4-3
Map of Mean Residuals
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

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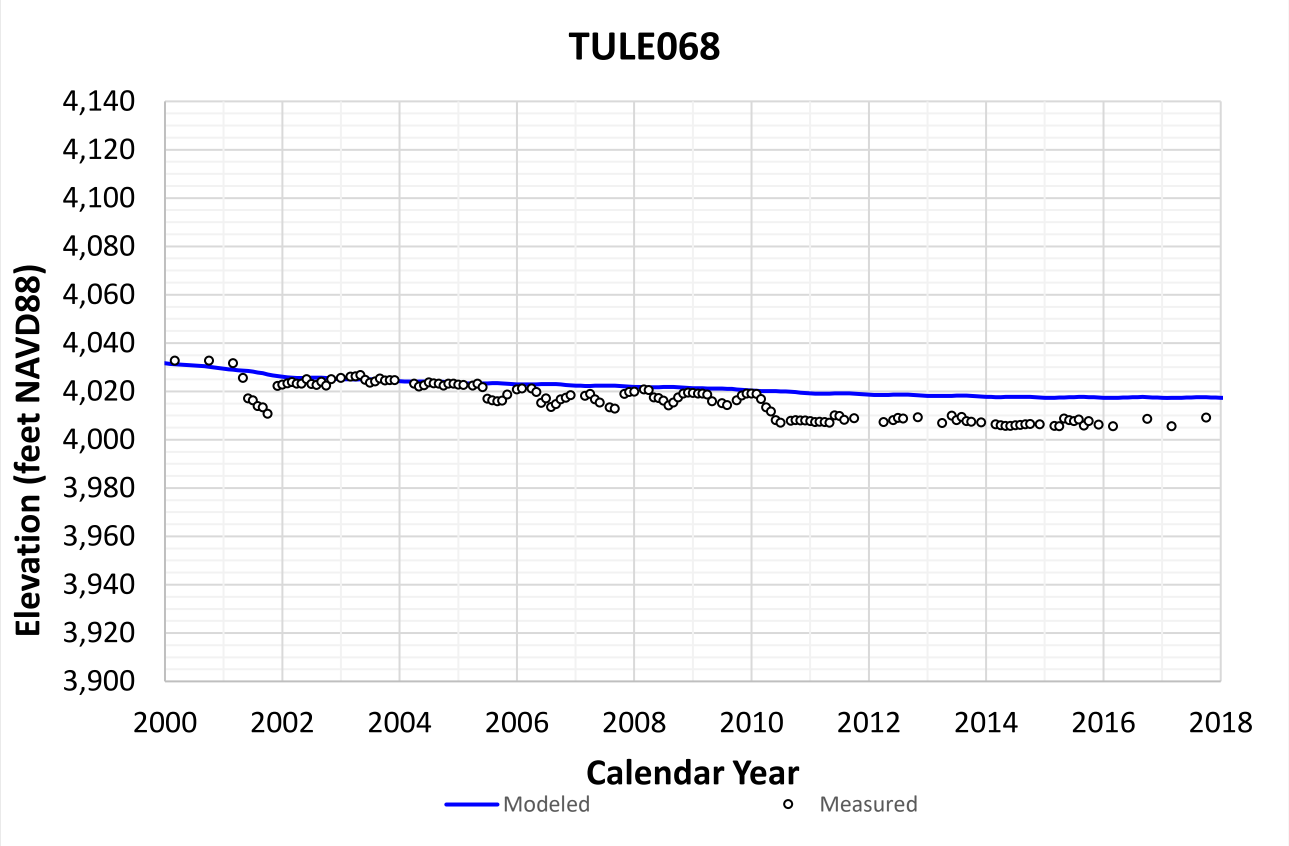


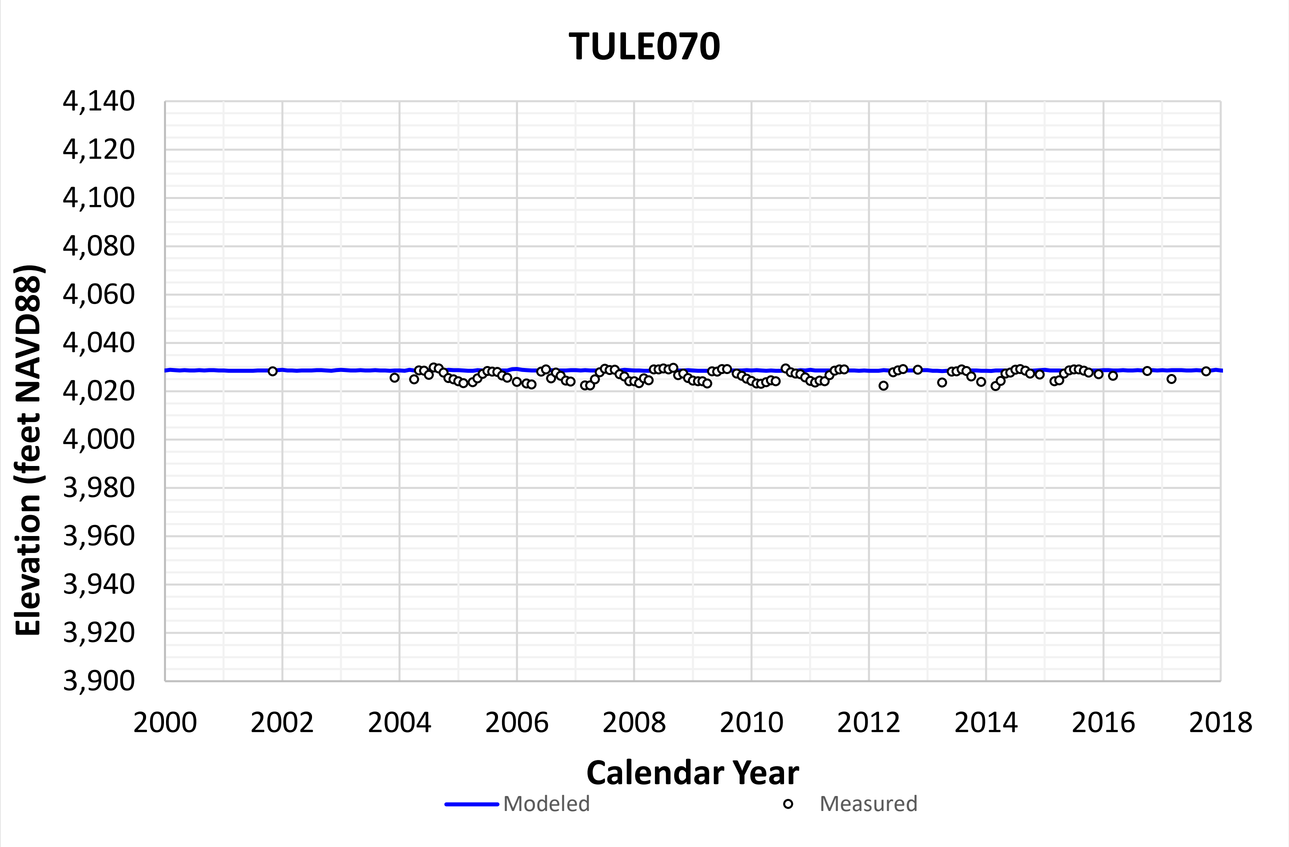
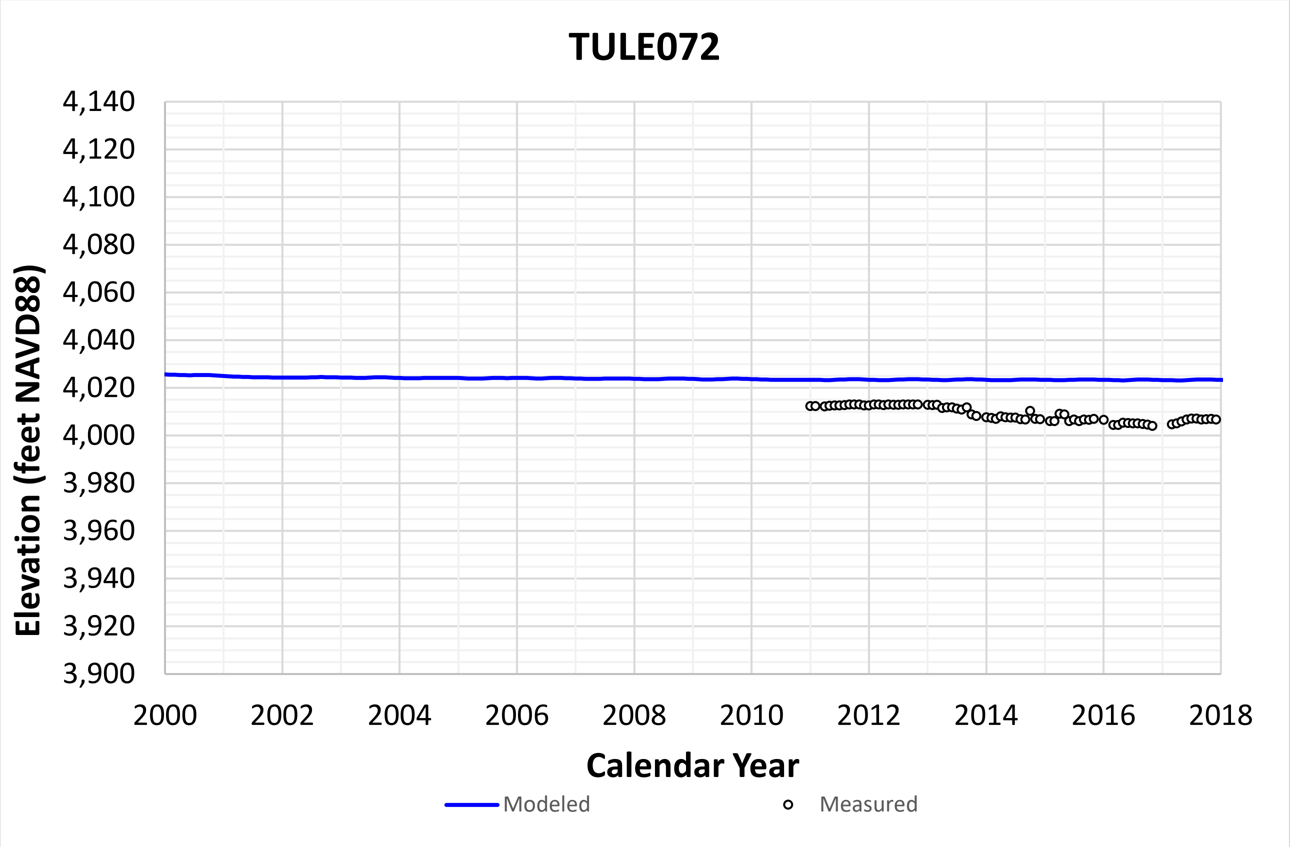


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



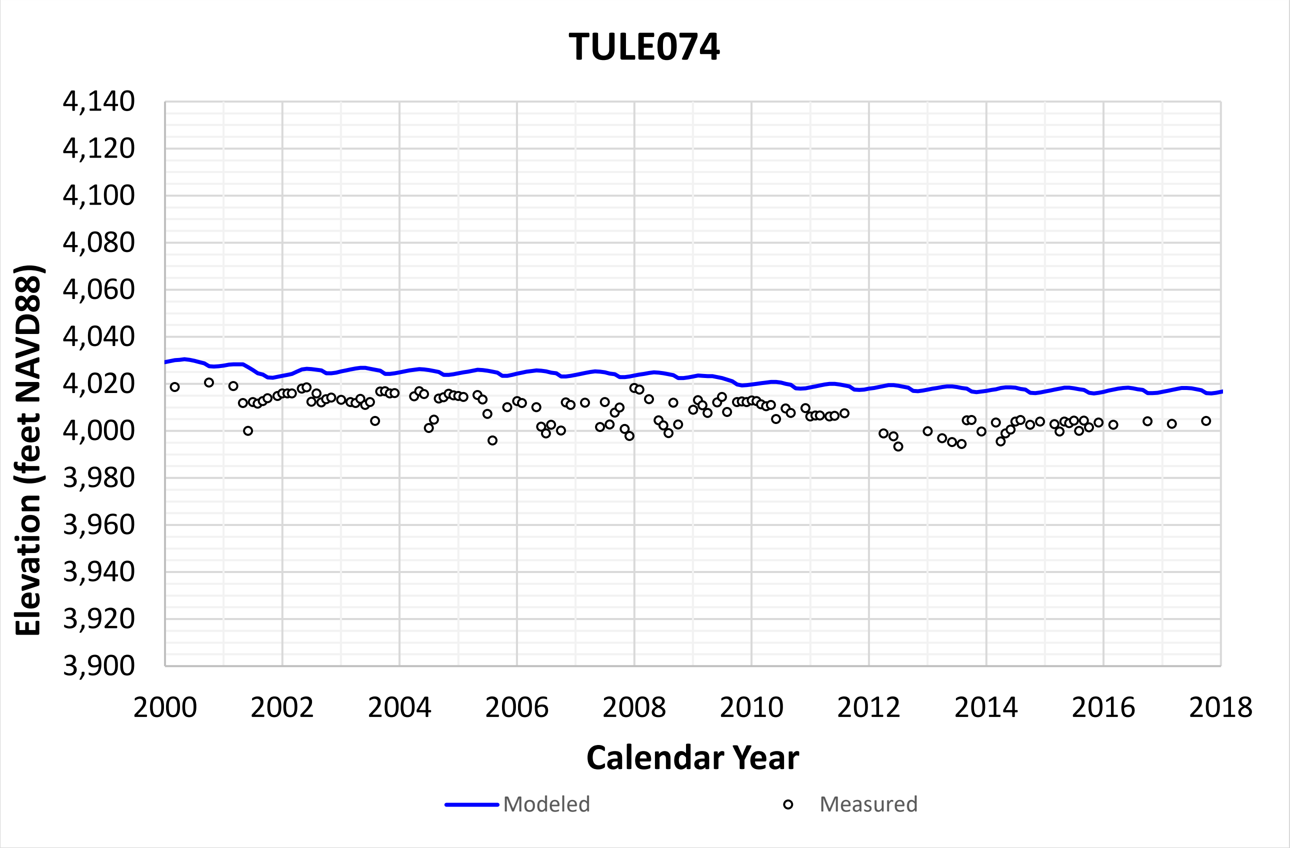
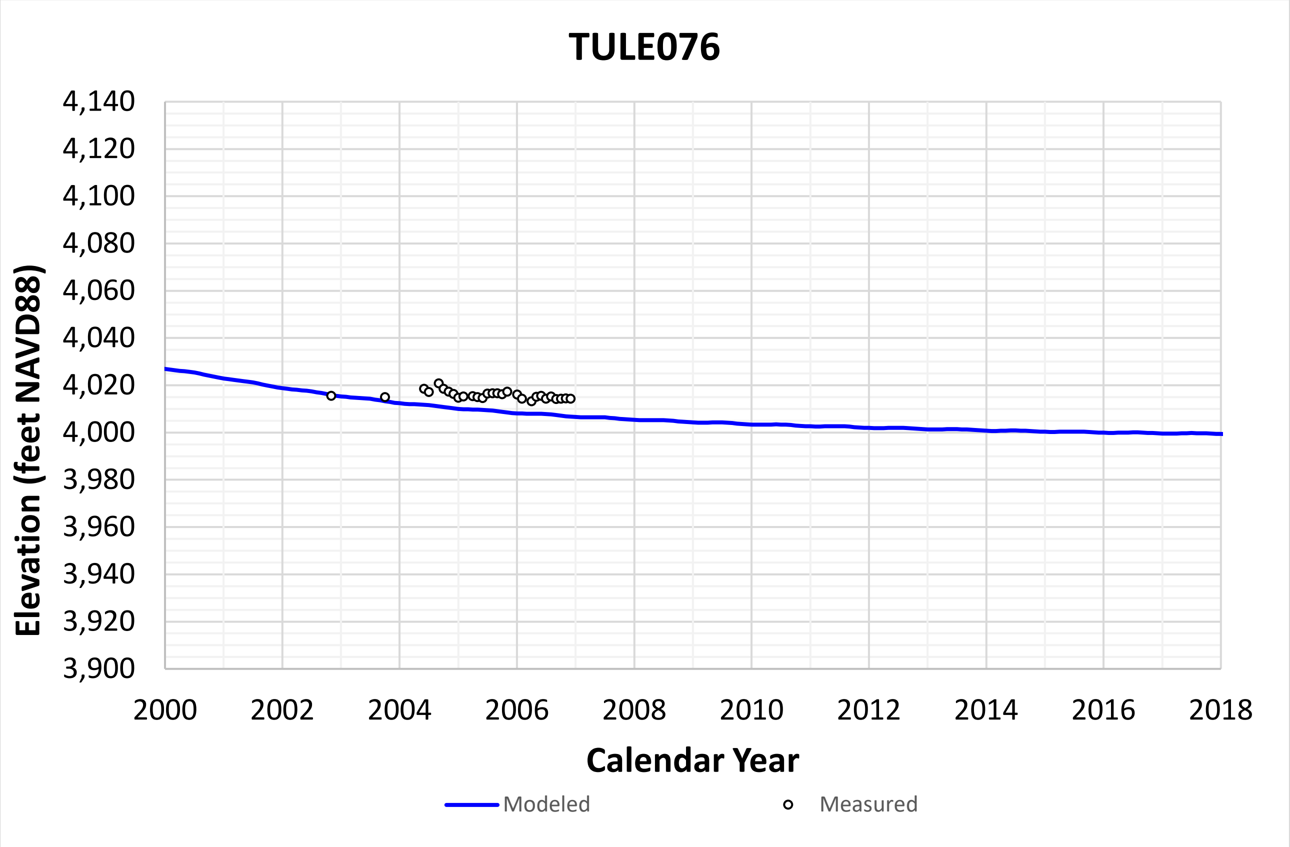


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



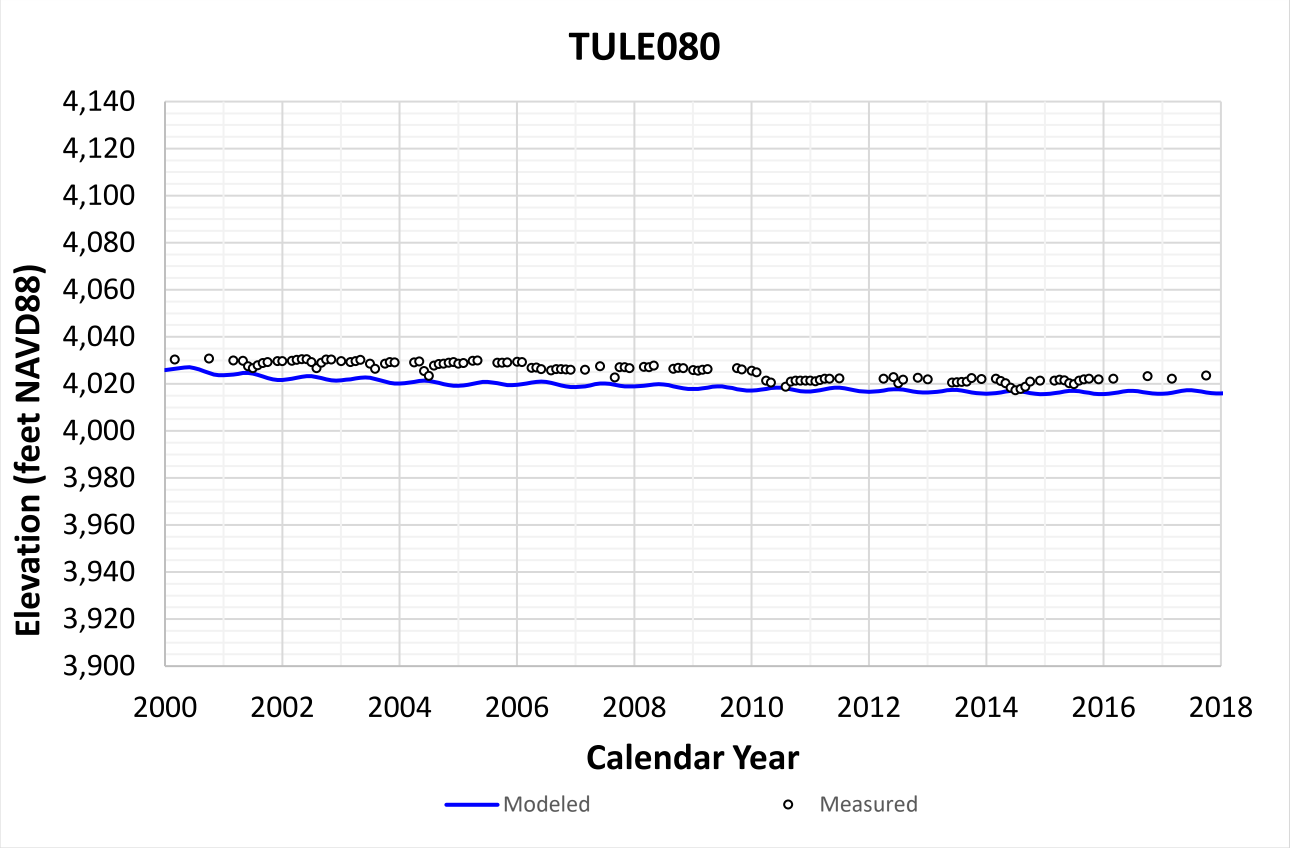
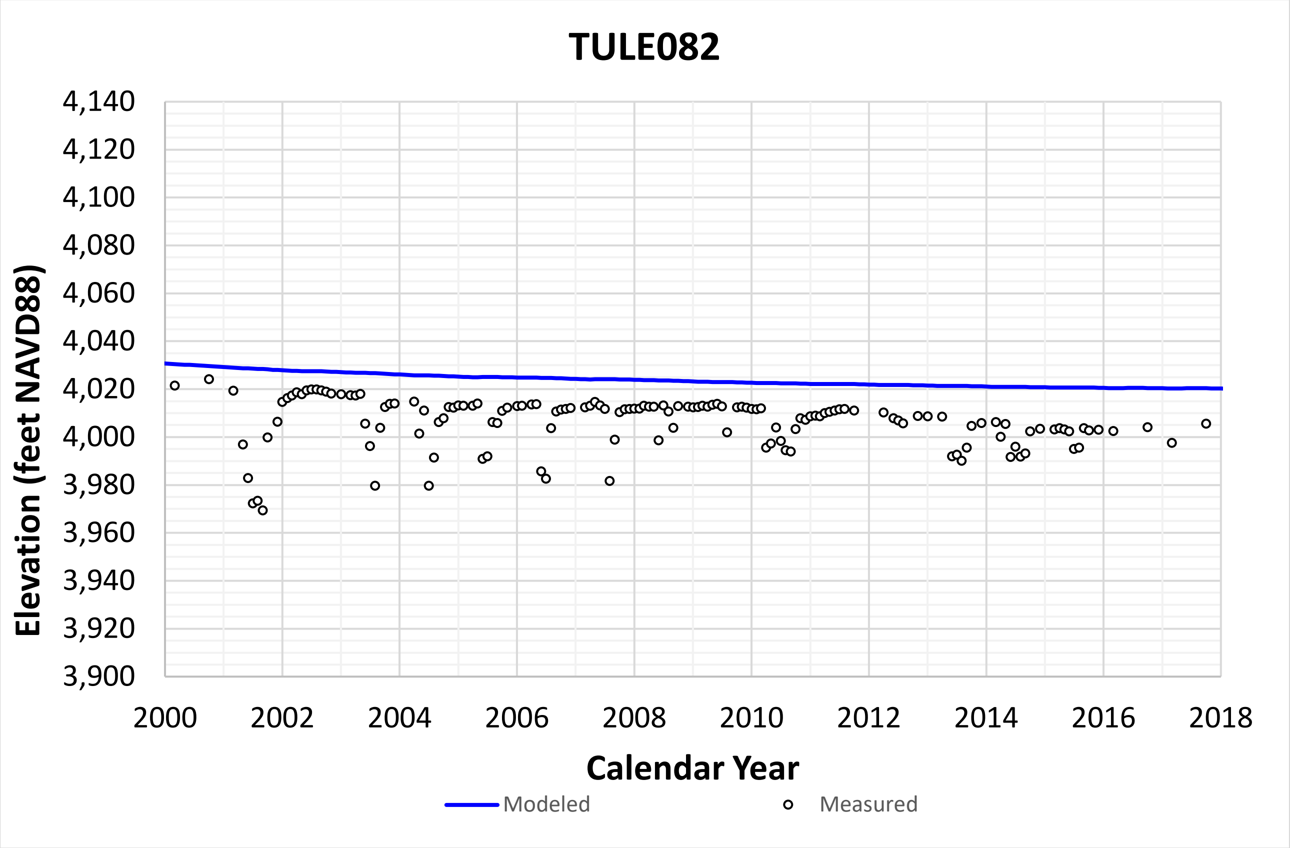


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



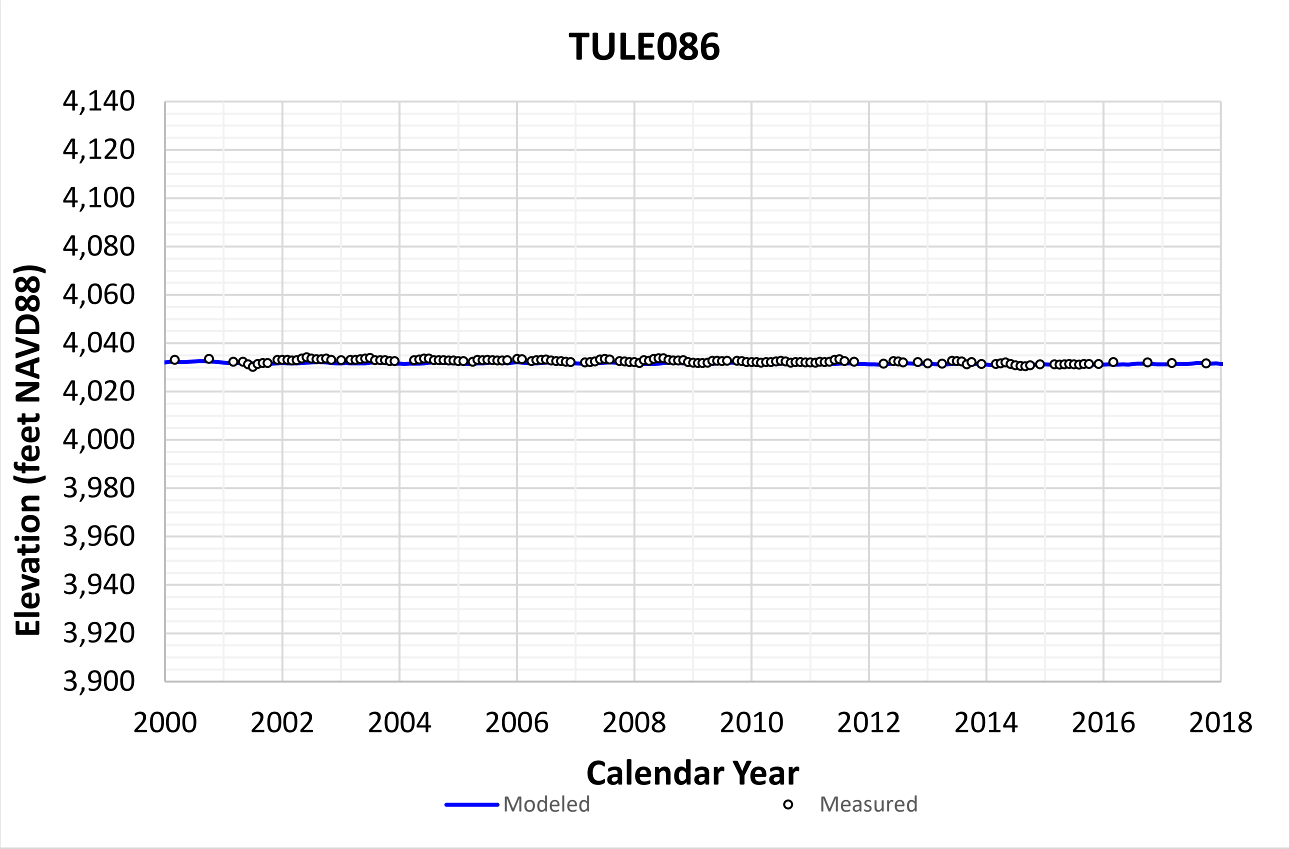
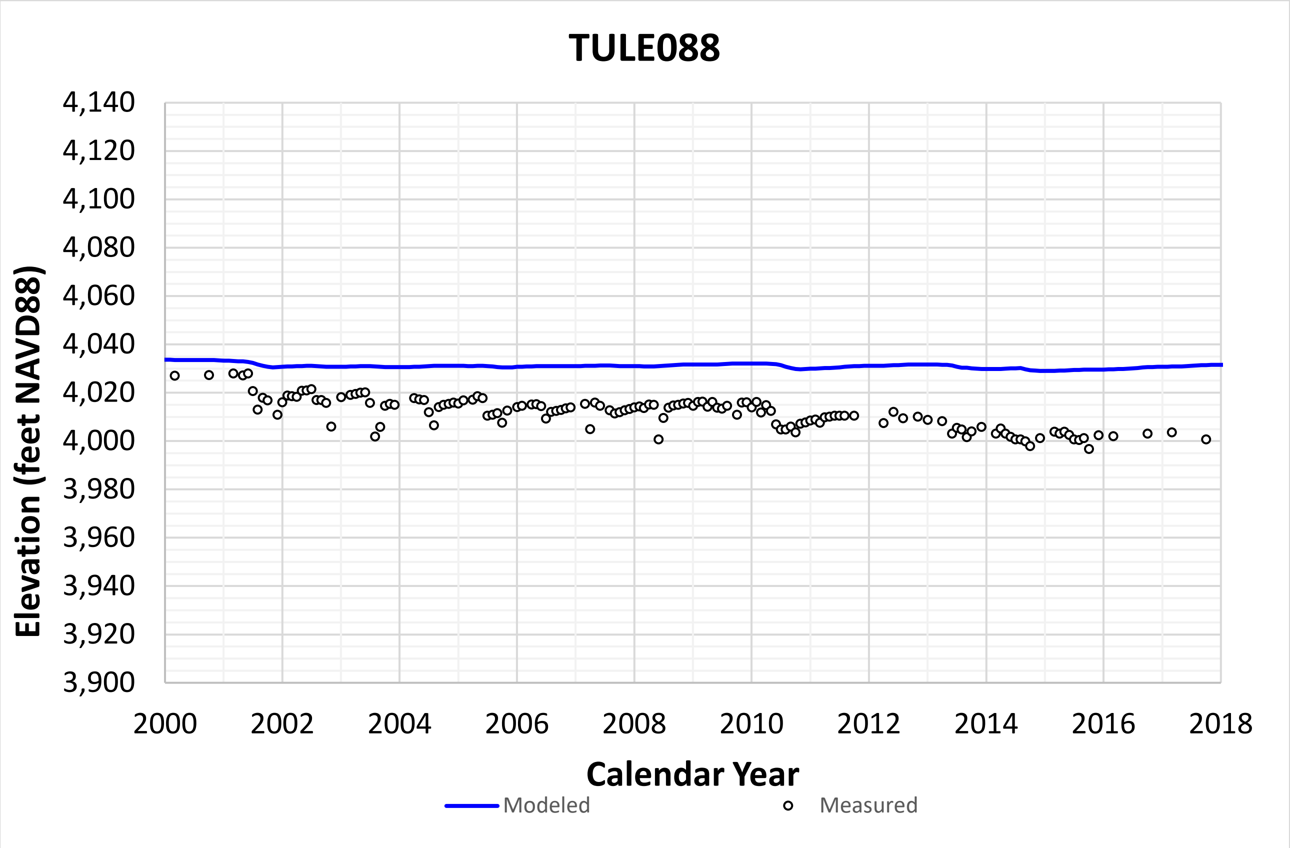


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



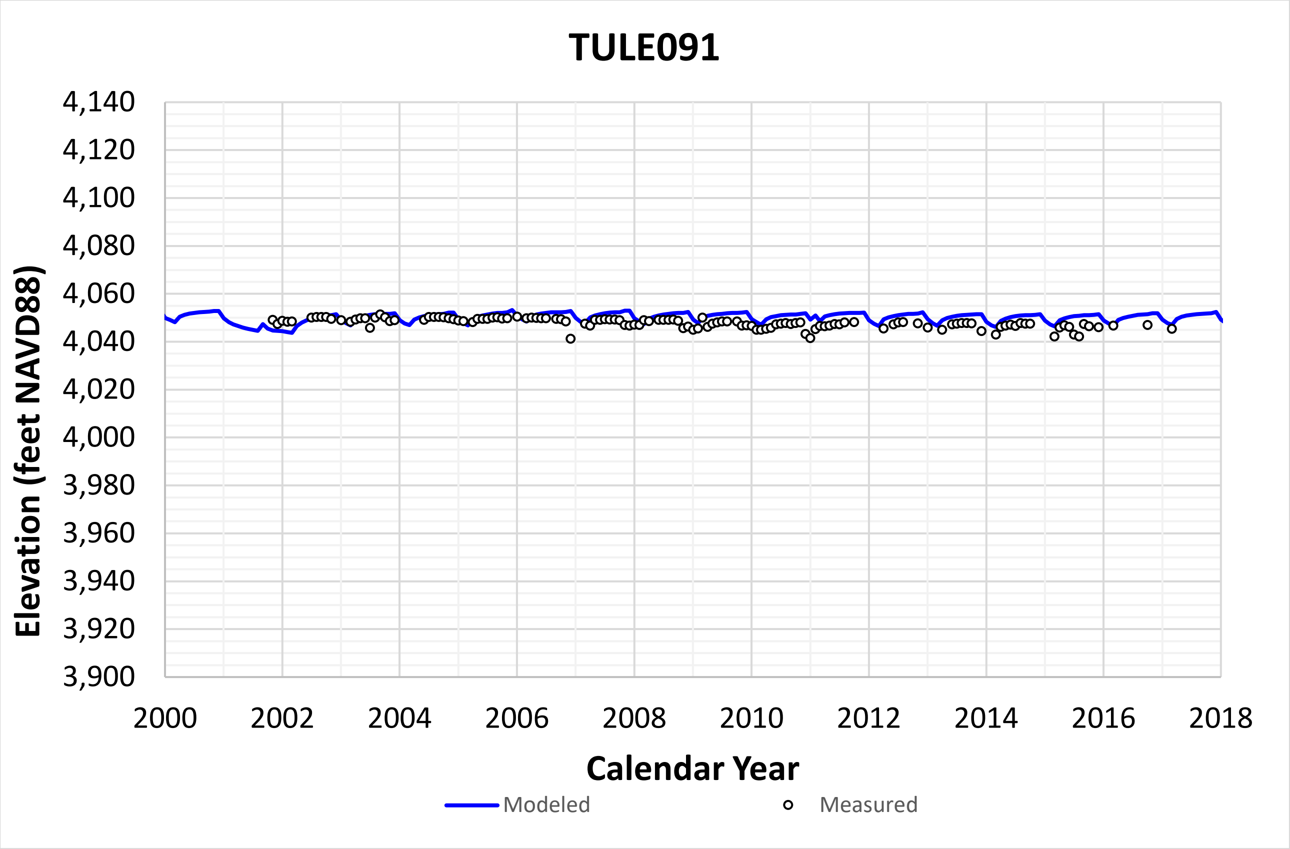
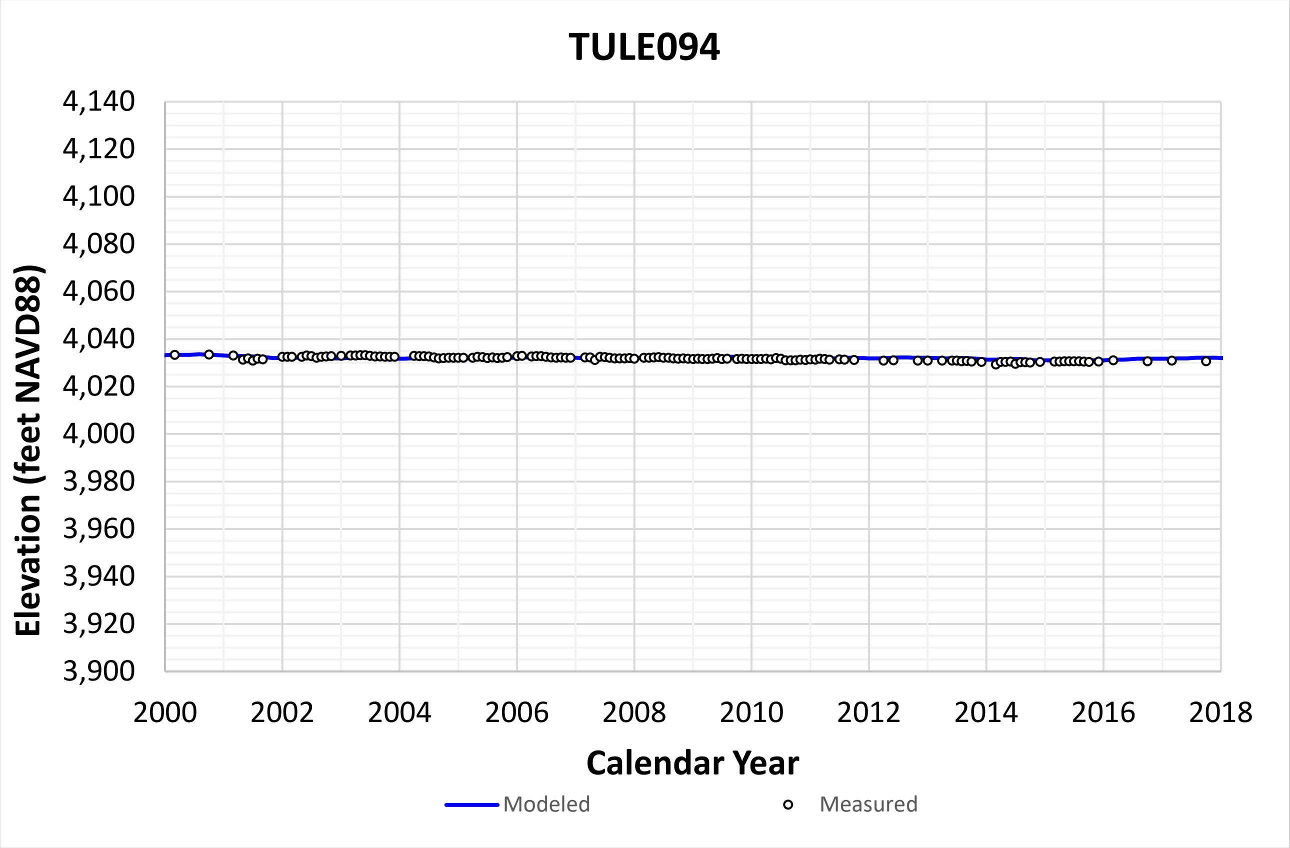


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



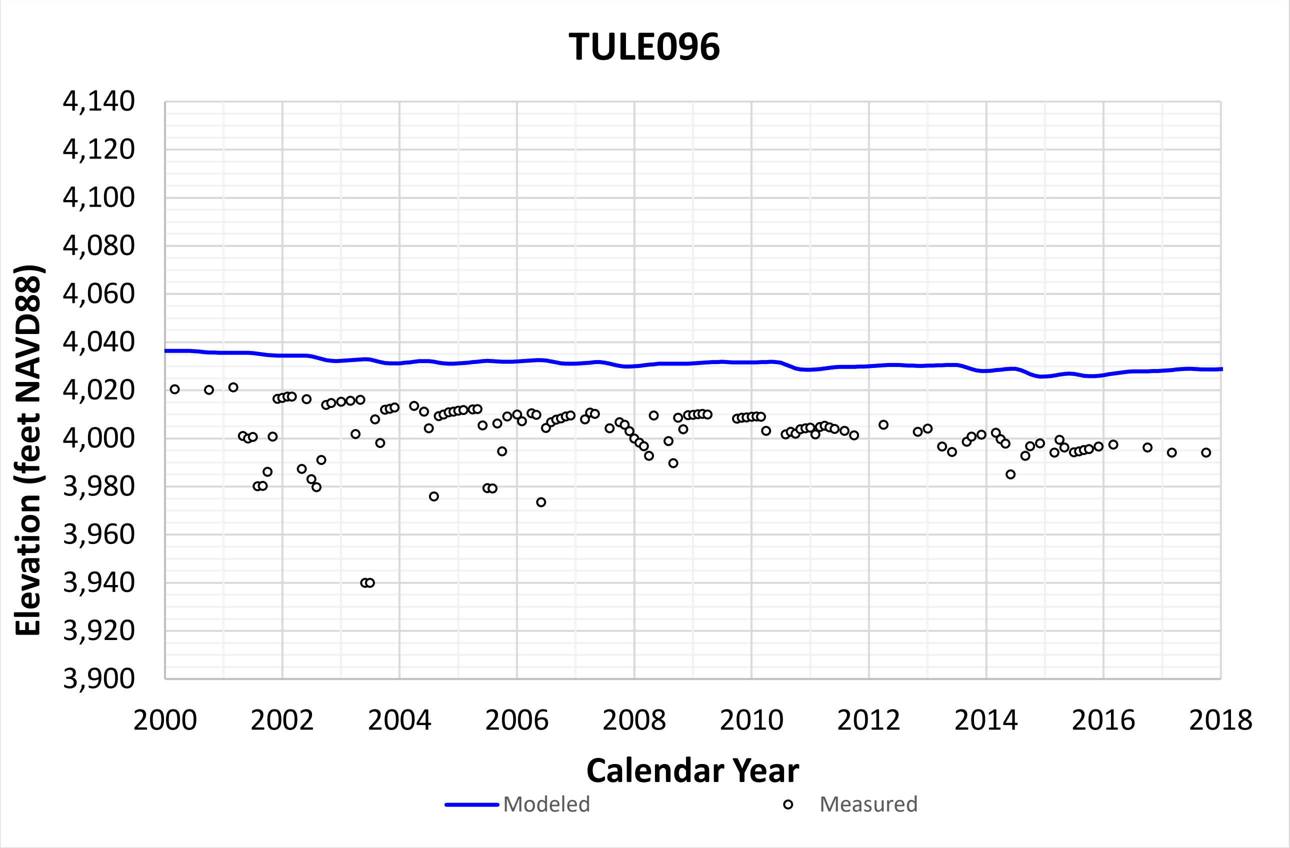
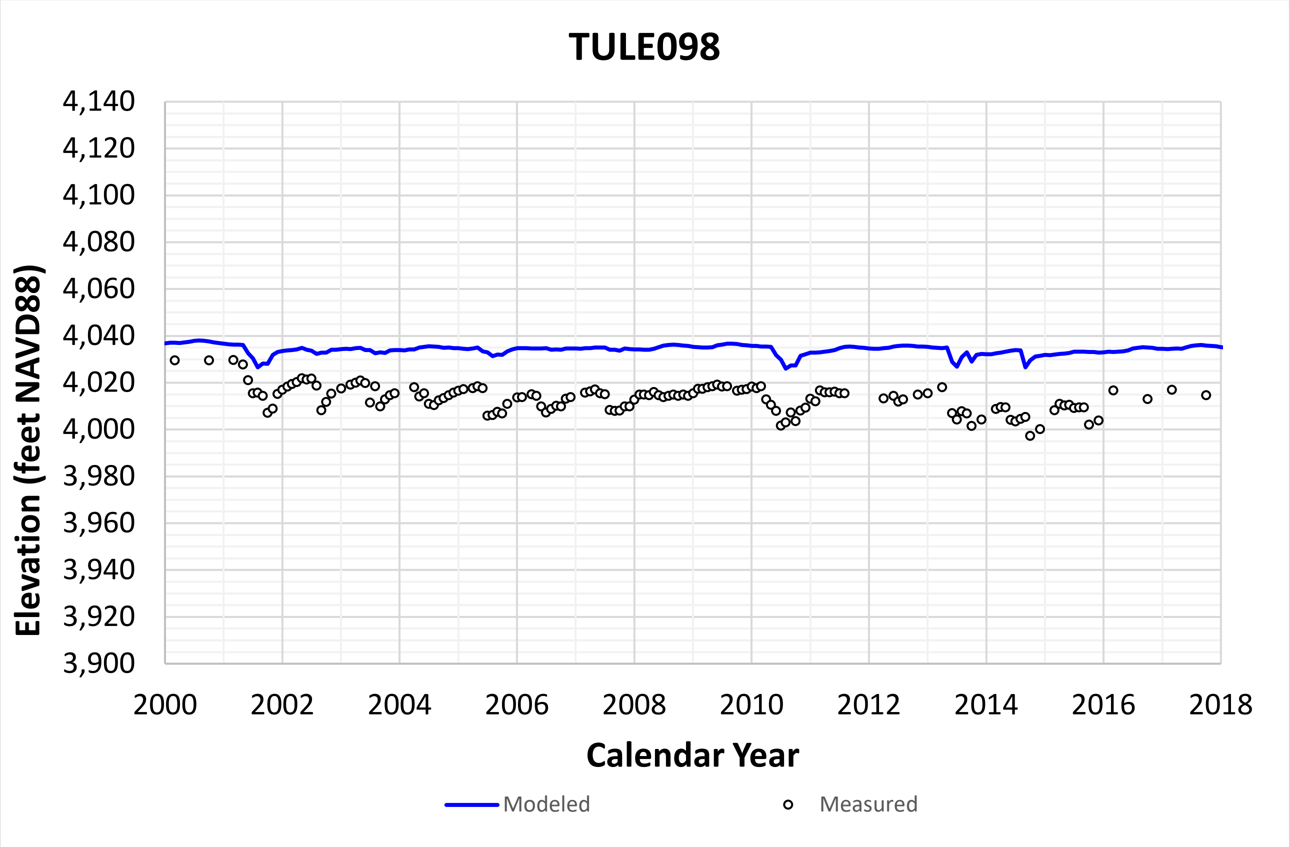


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



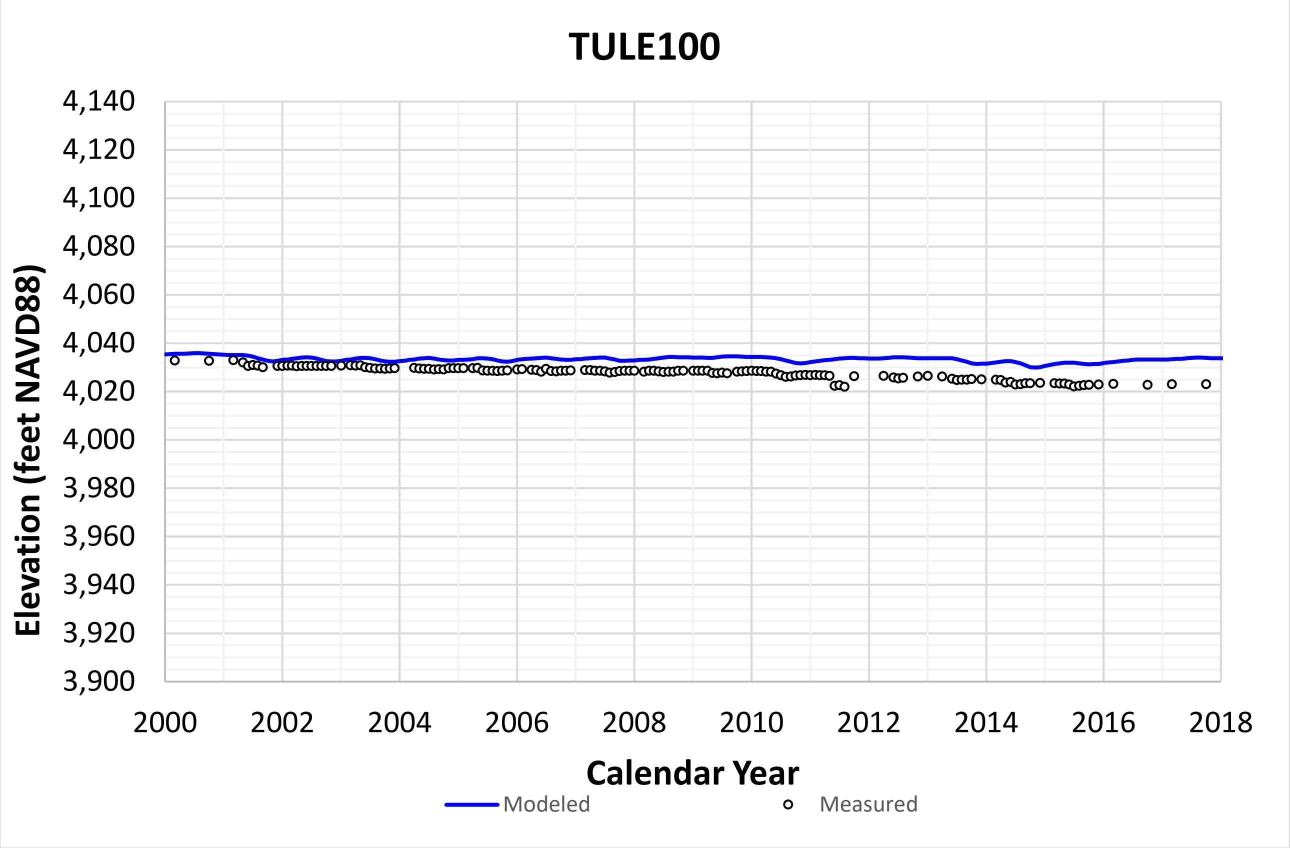
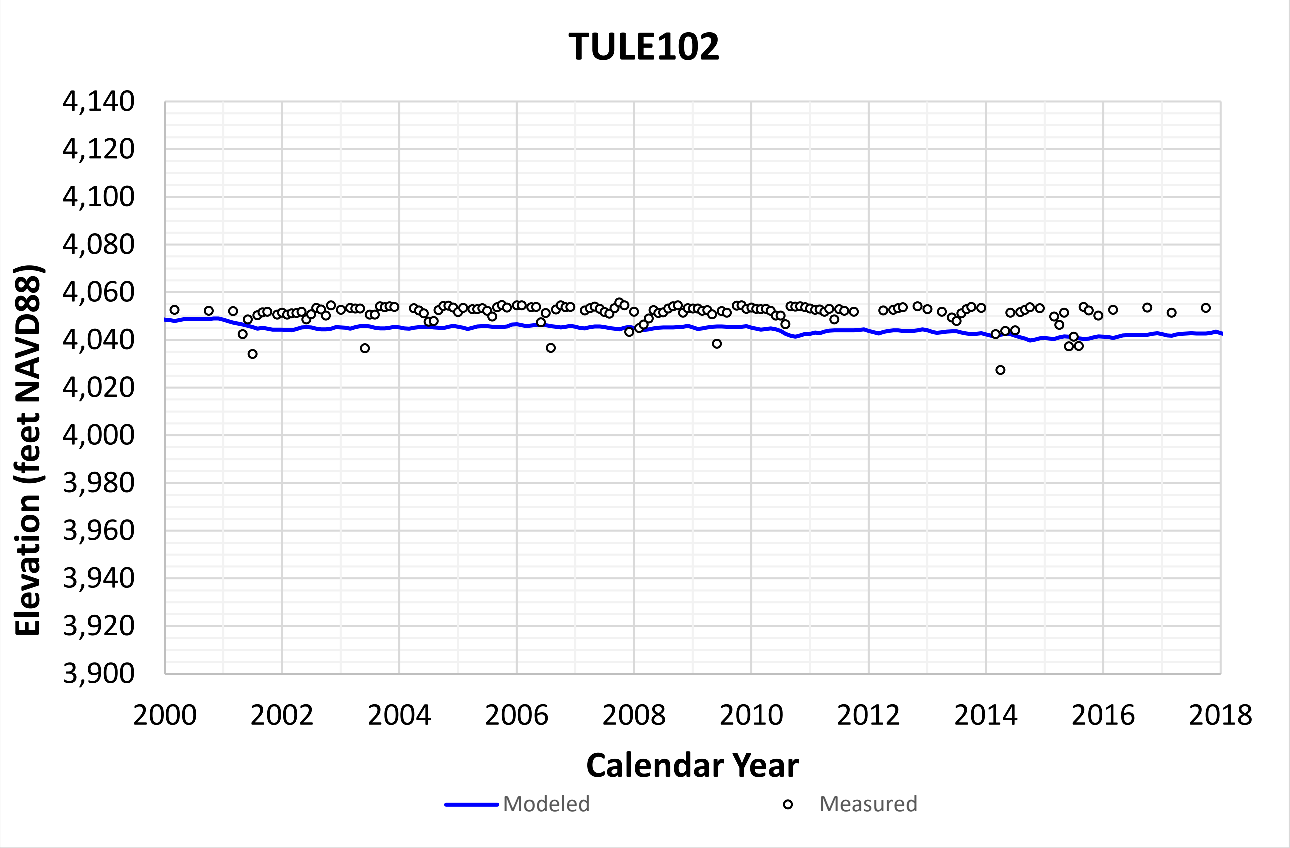


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



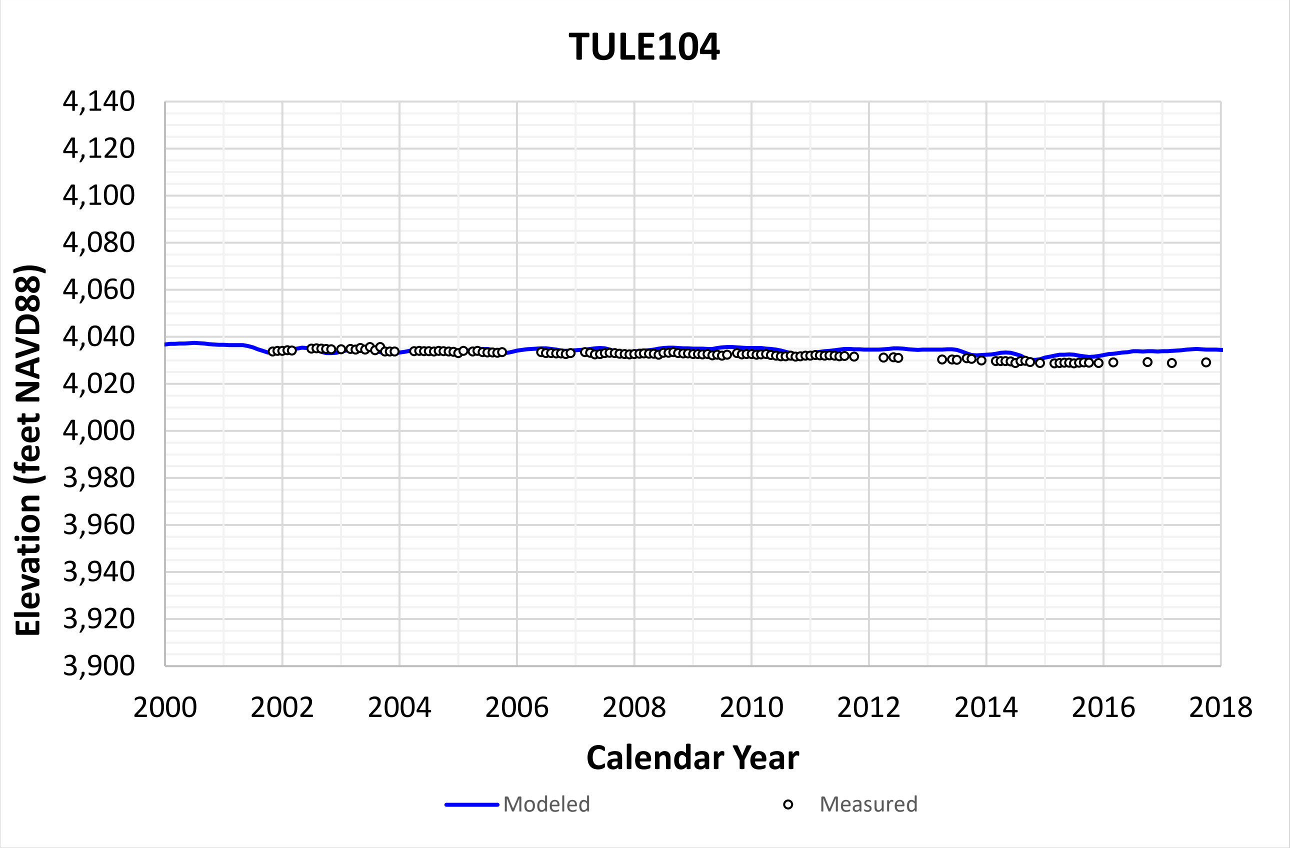
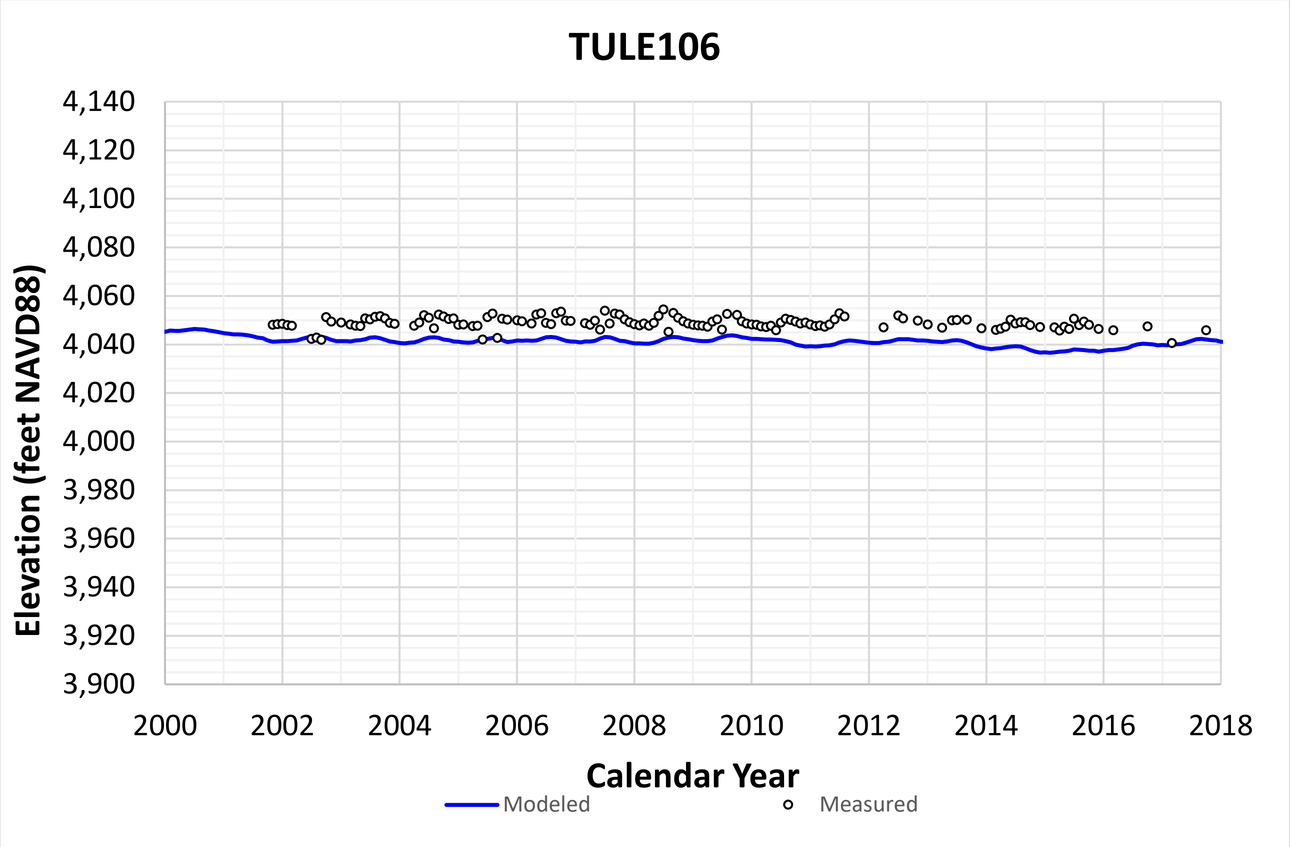


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



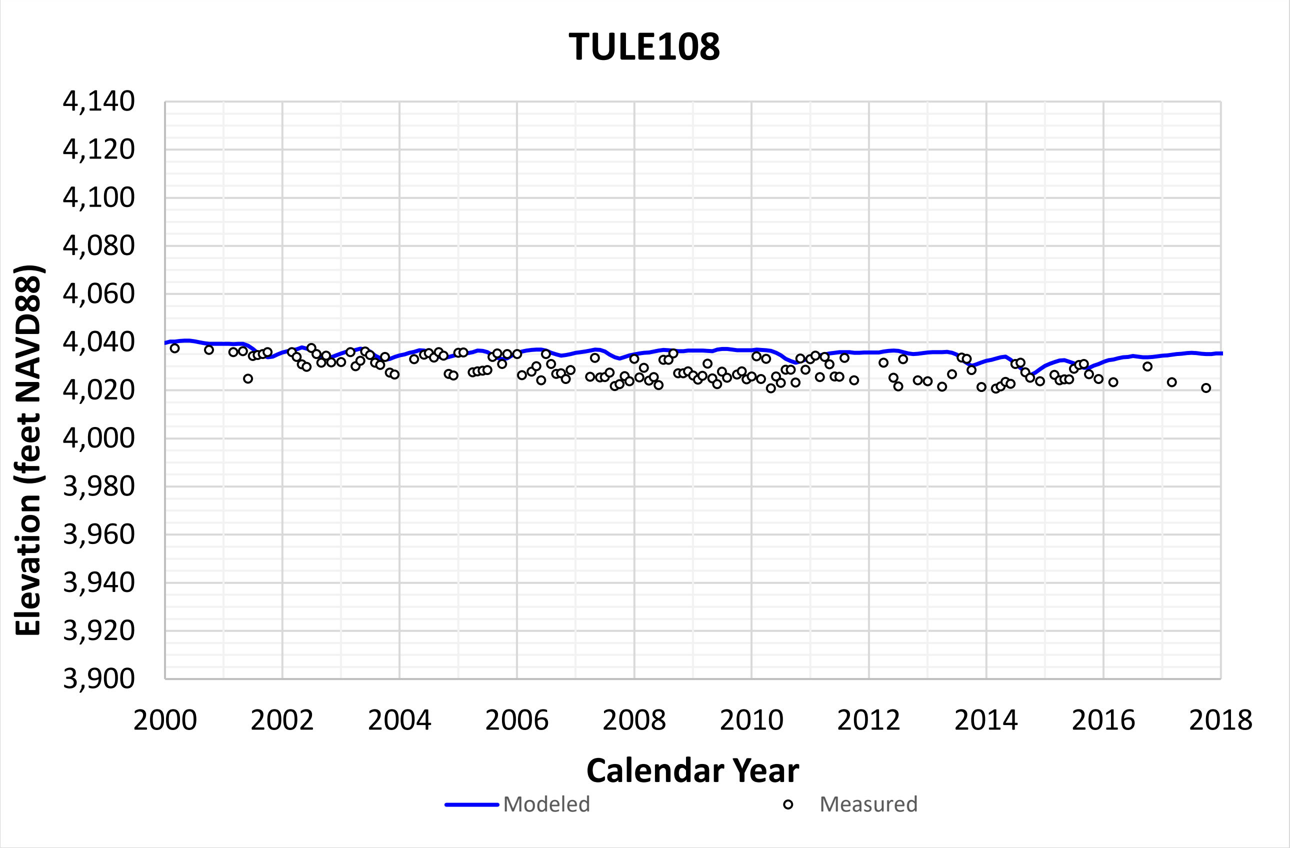
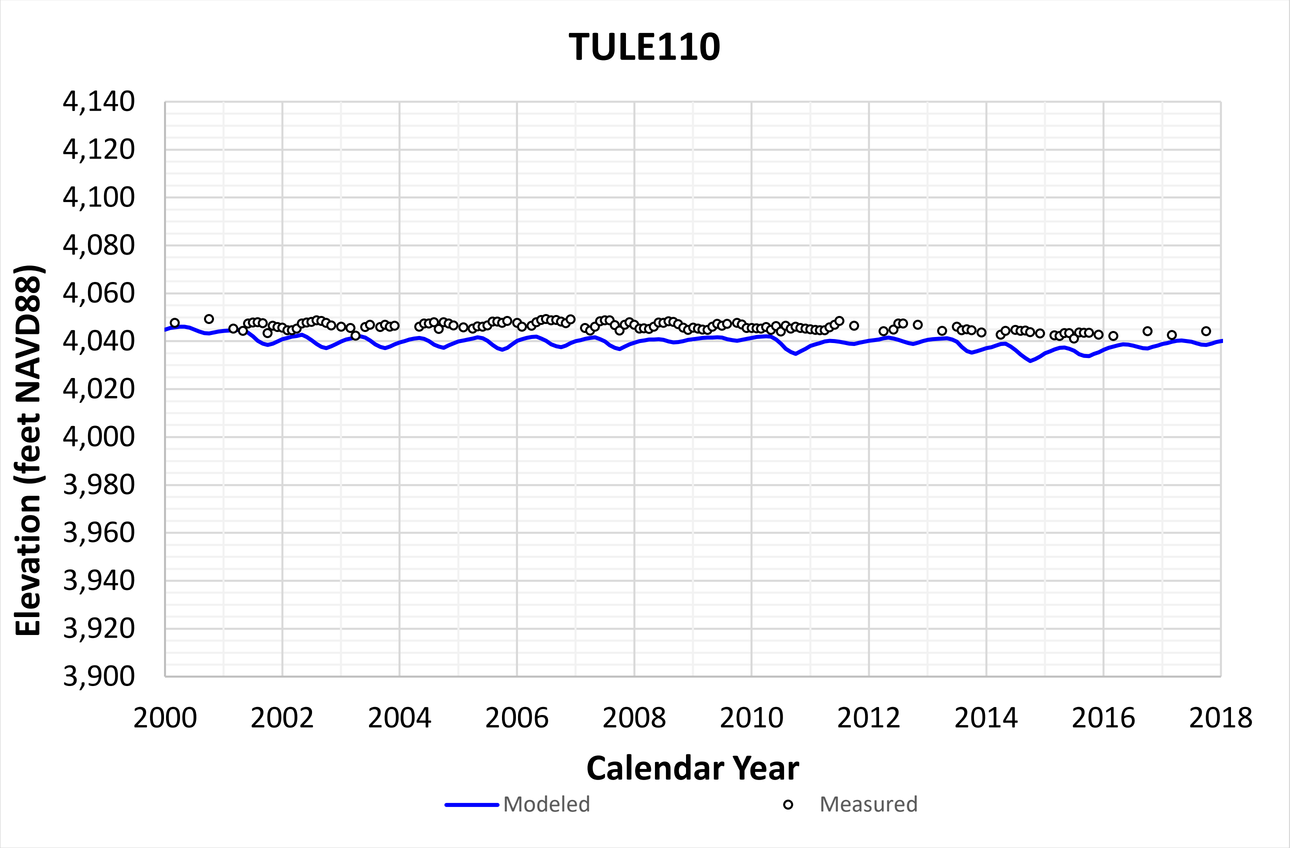


Figure 4-4

Modeled versus Measured Groundwater Elevation Hydrographs



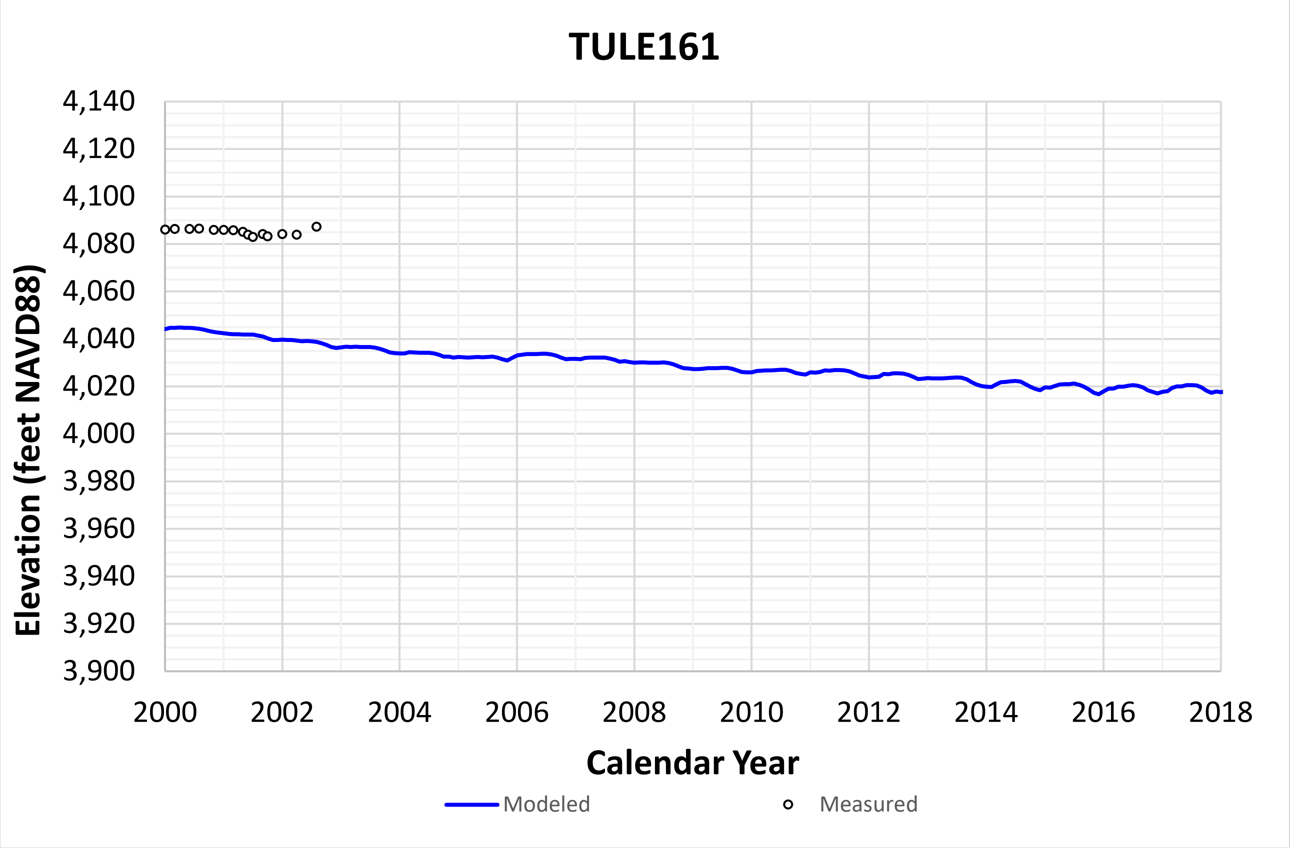
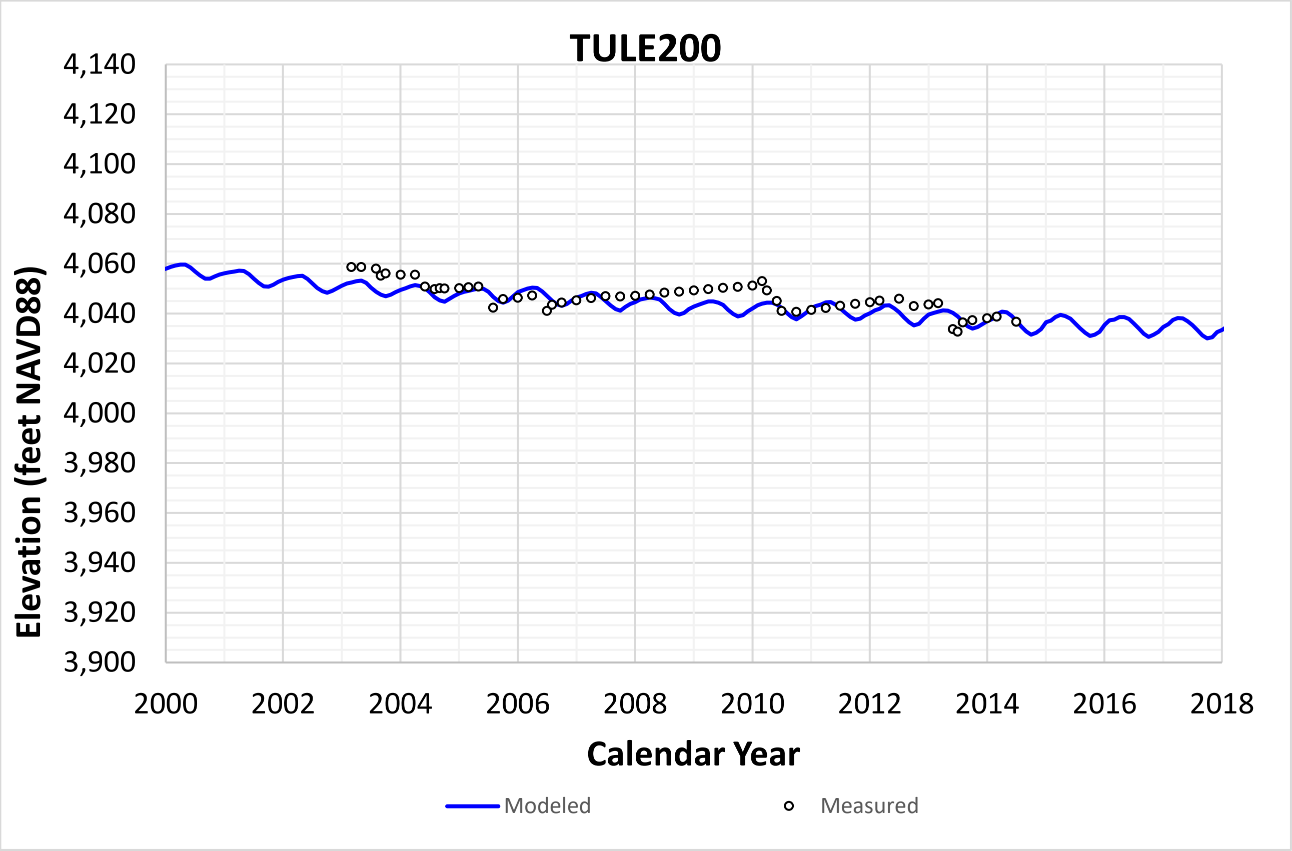


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



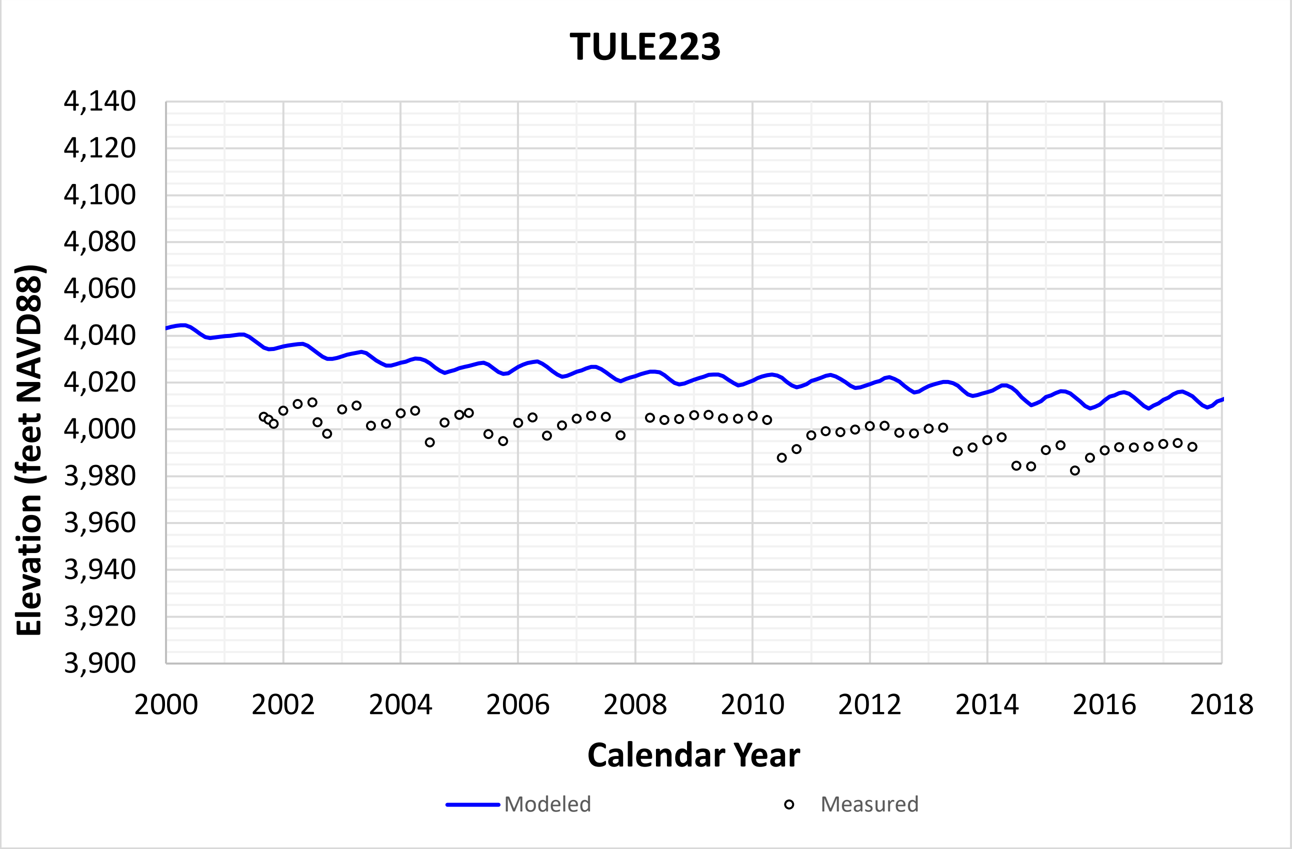
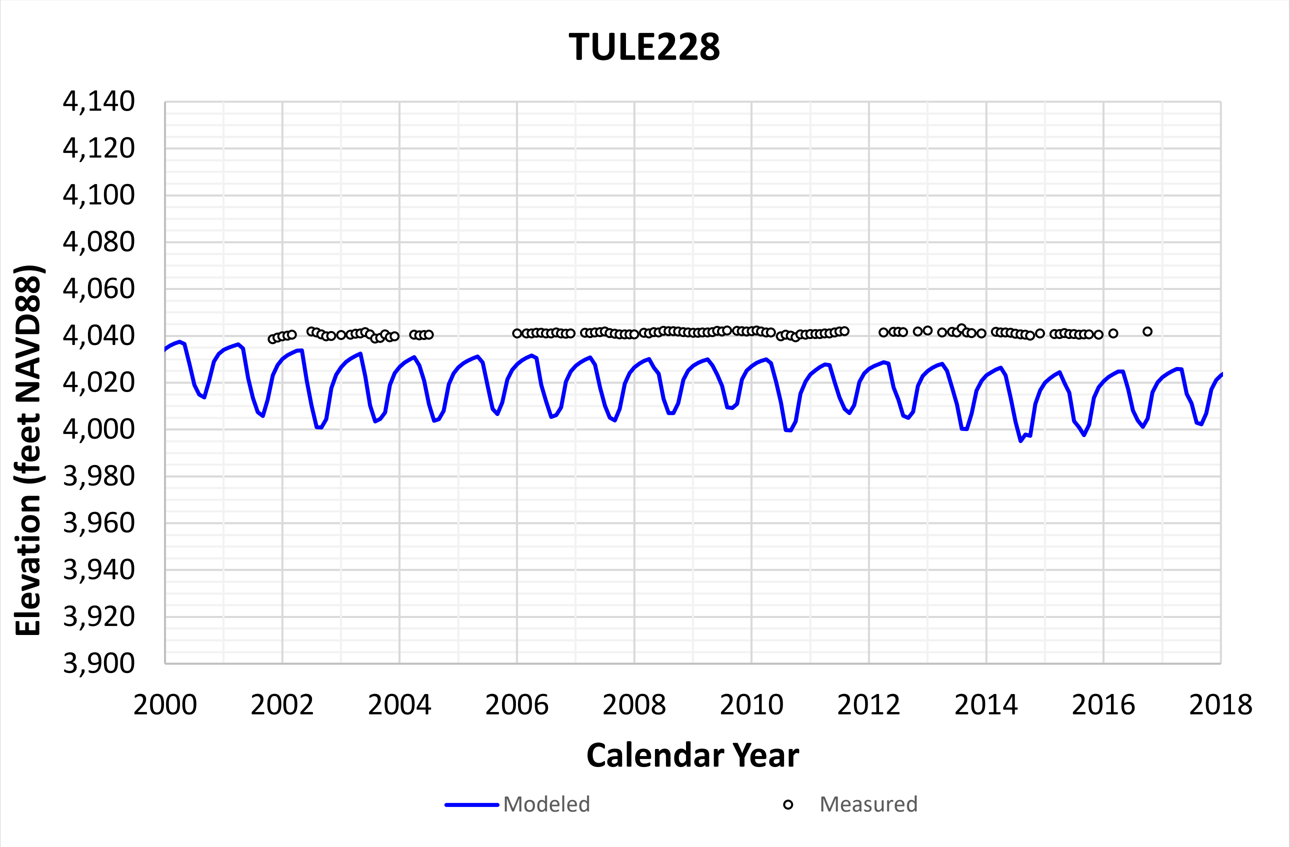


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



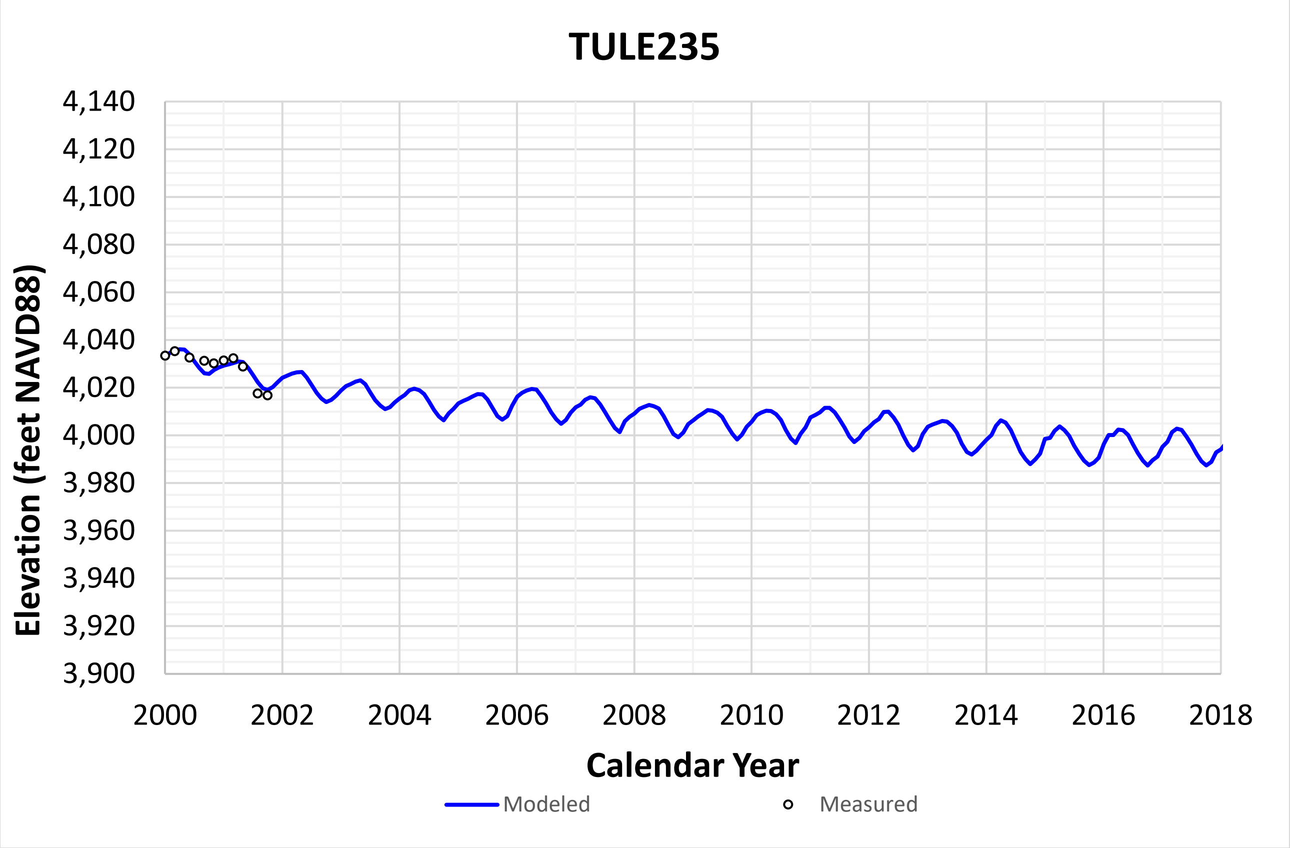
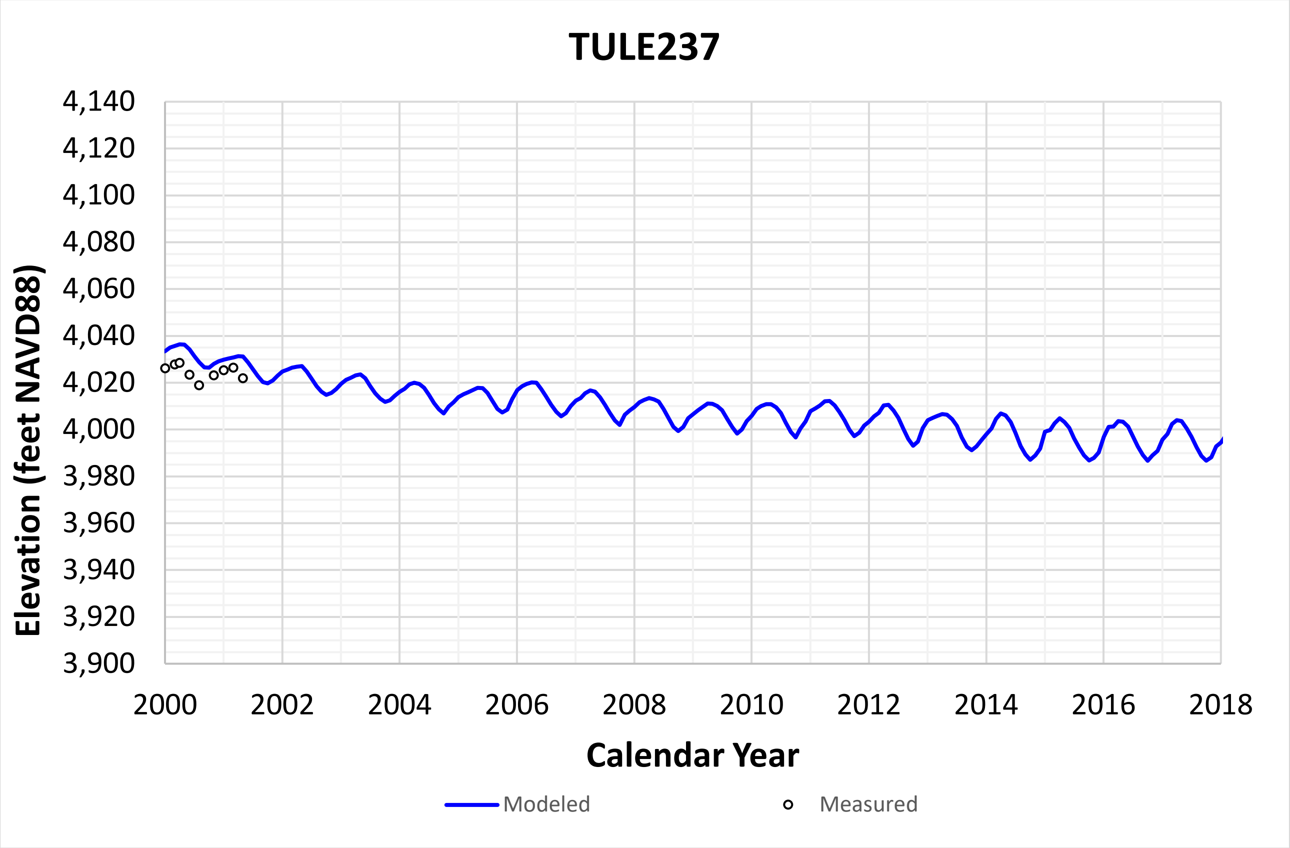


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



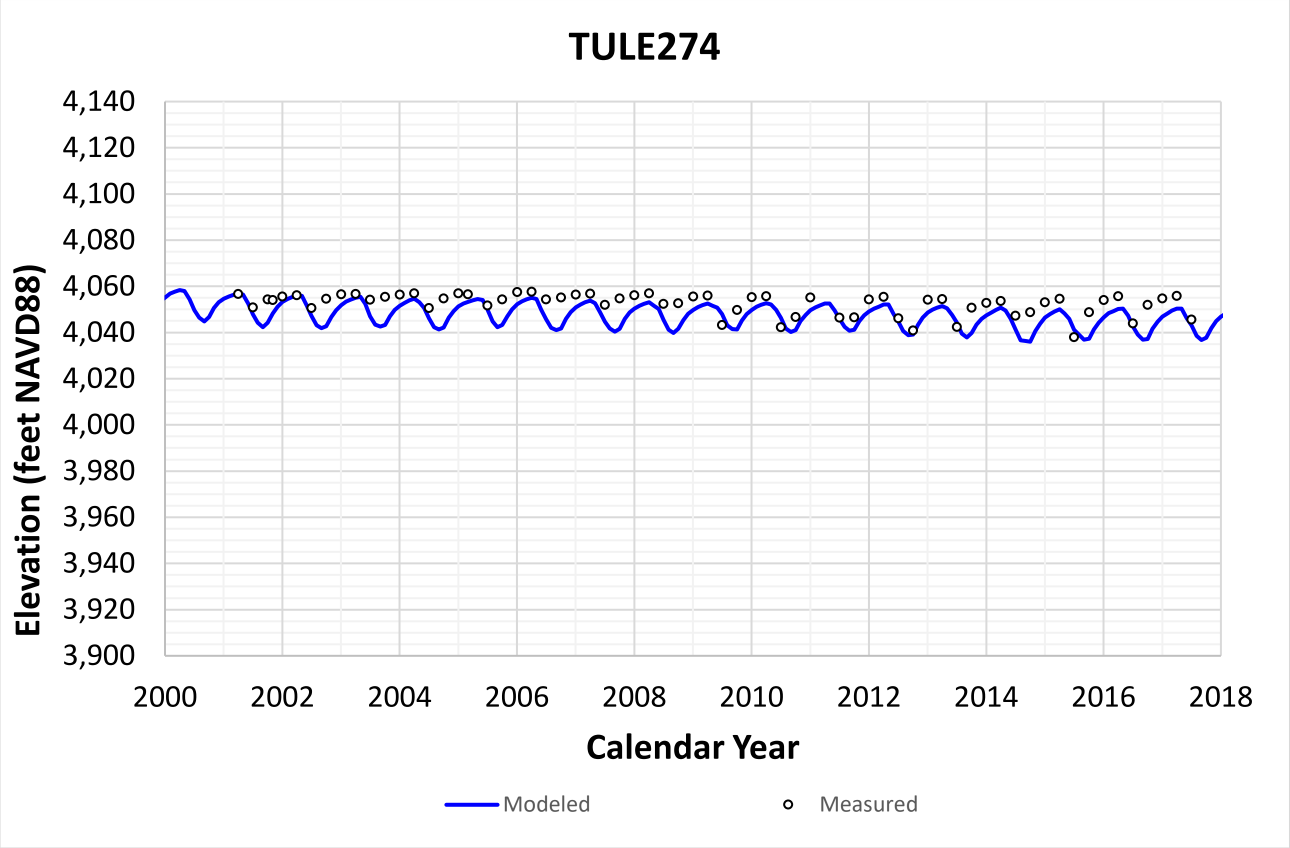
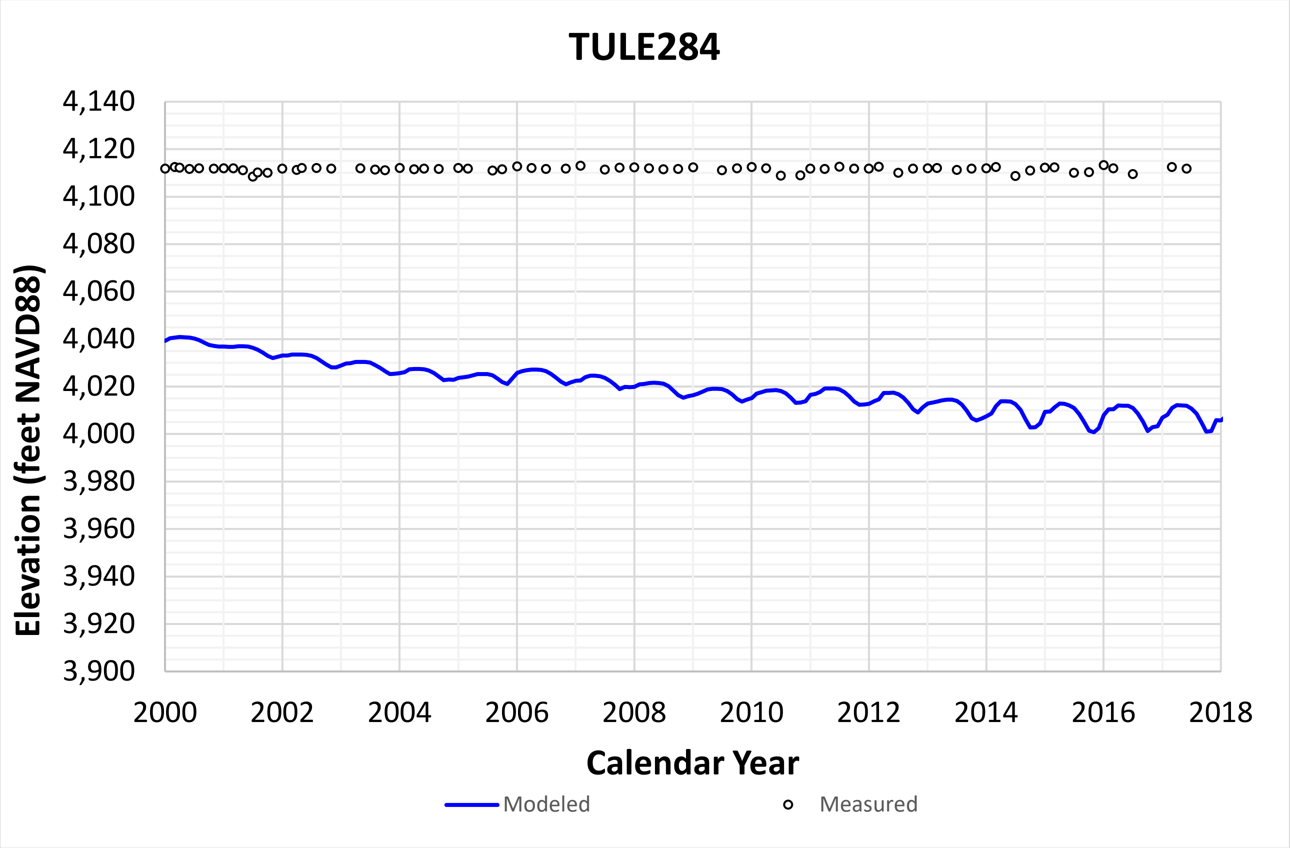


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



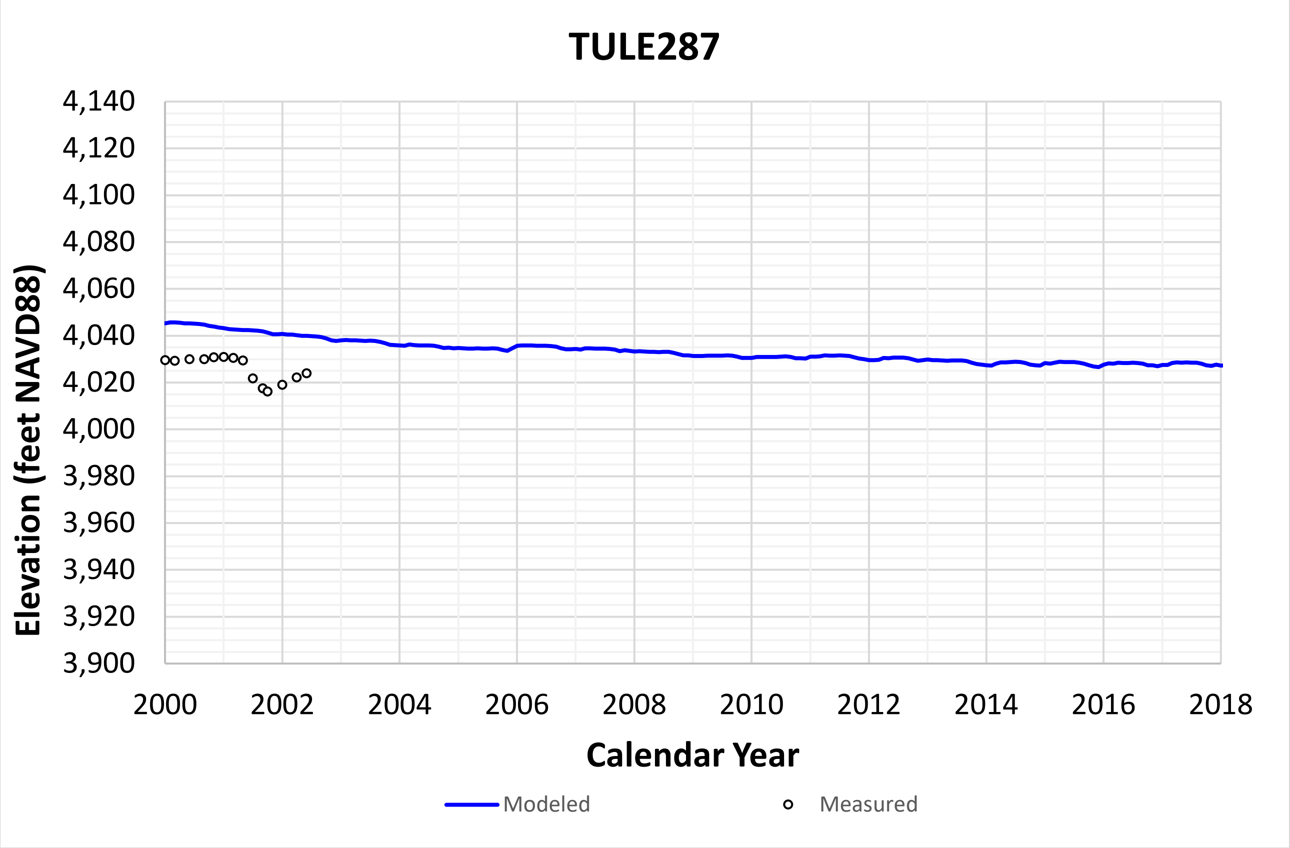
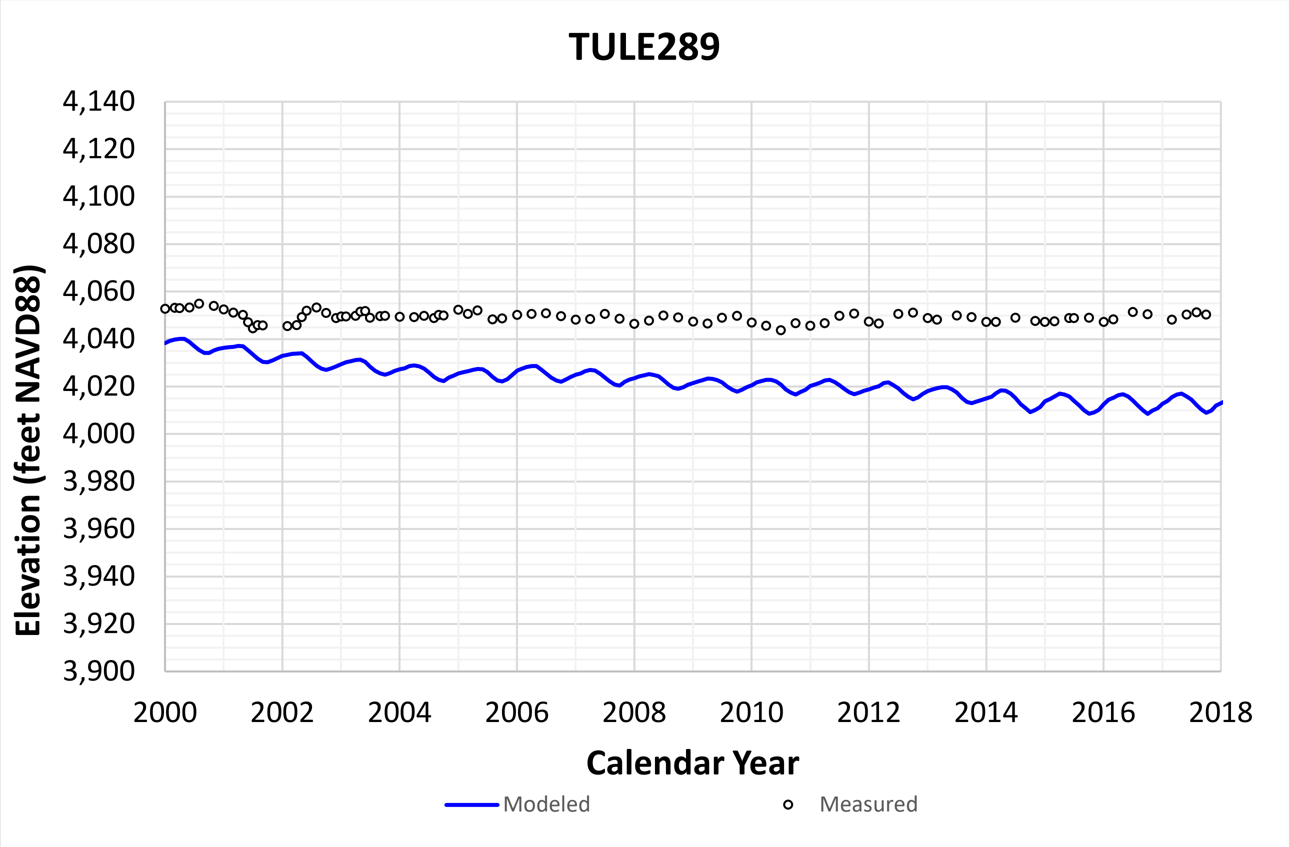


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



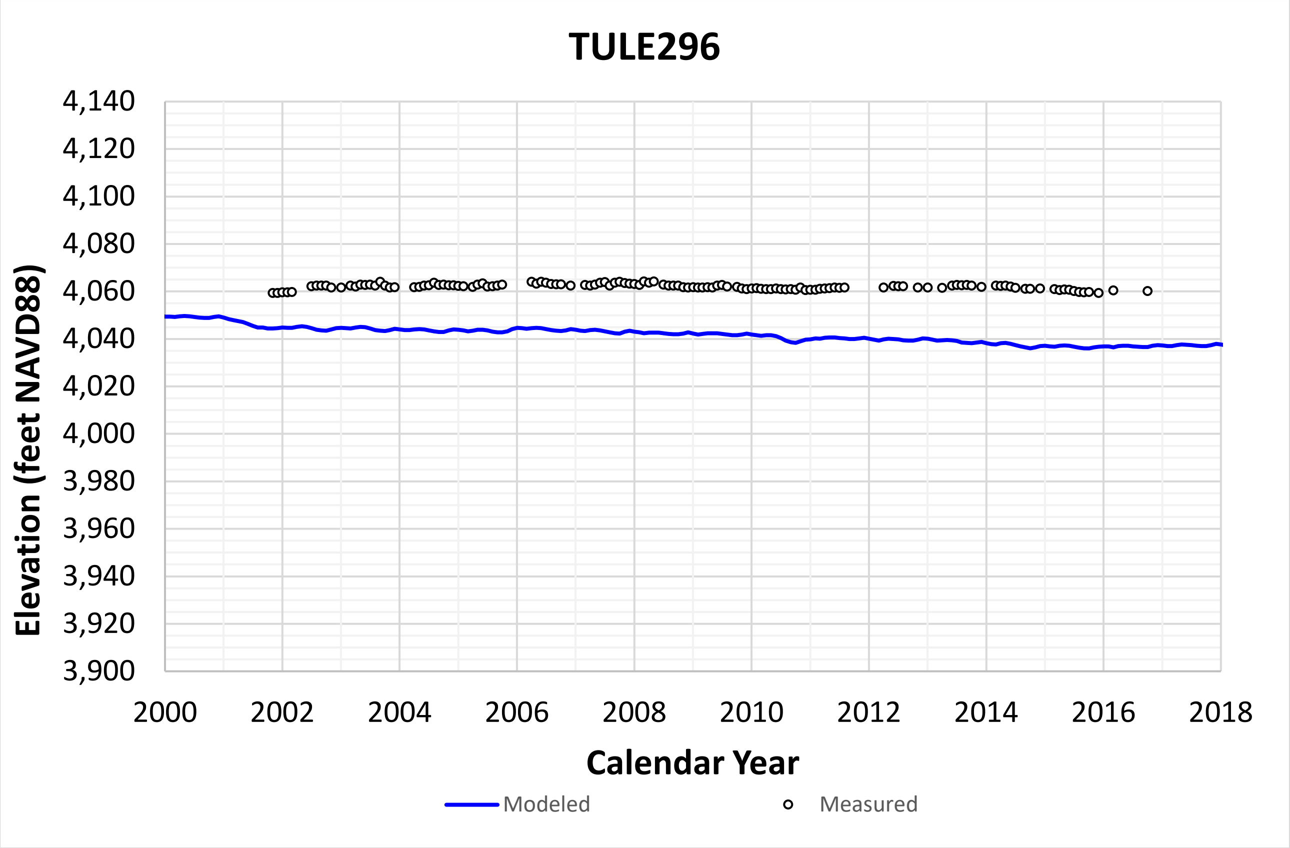
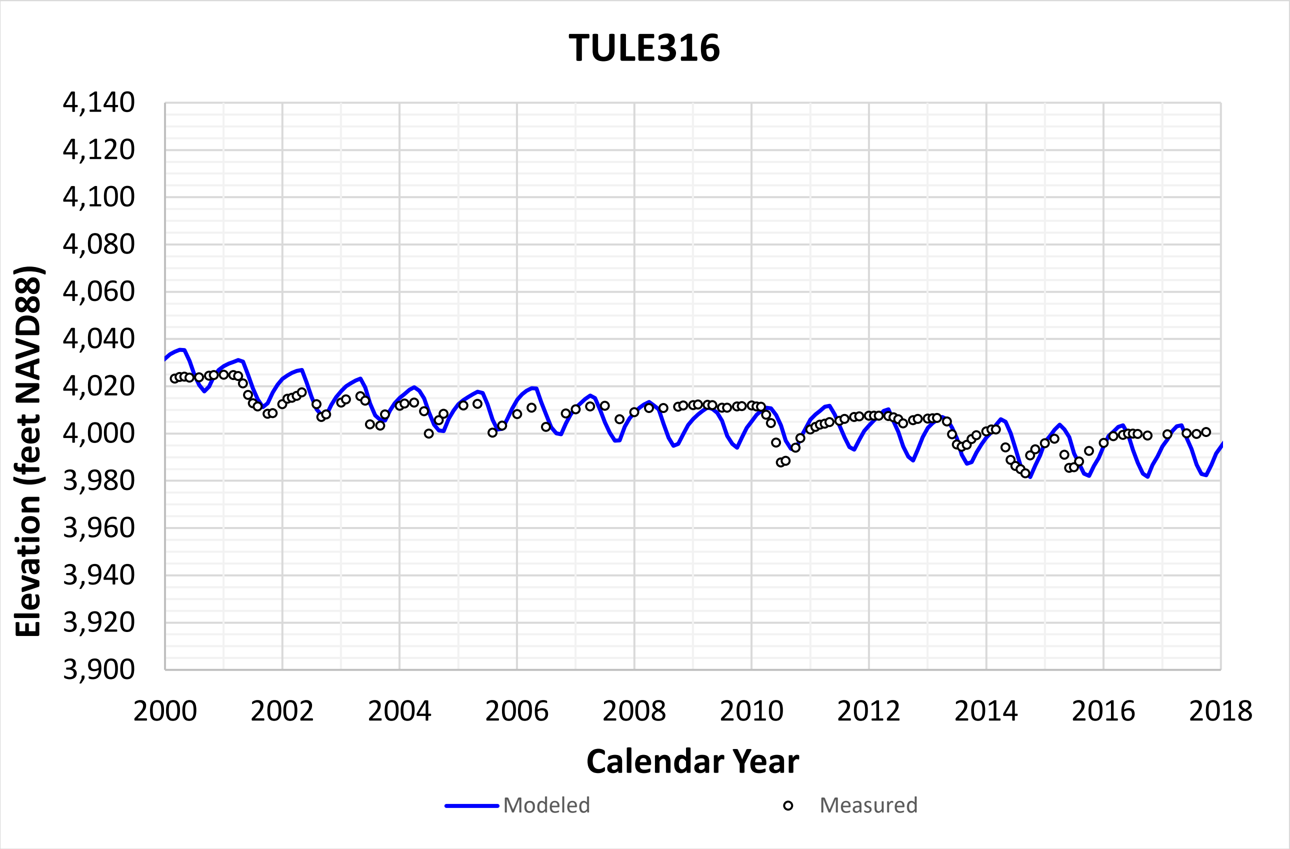


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



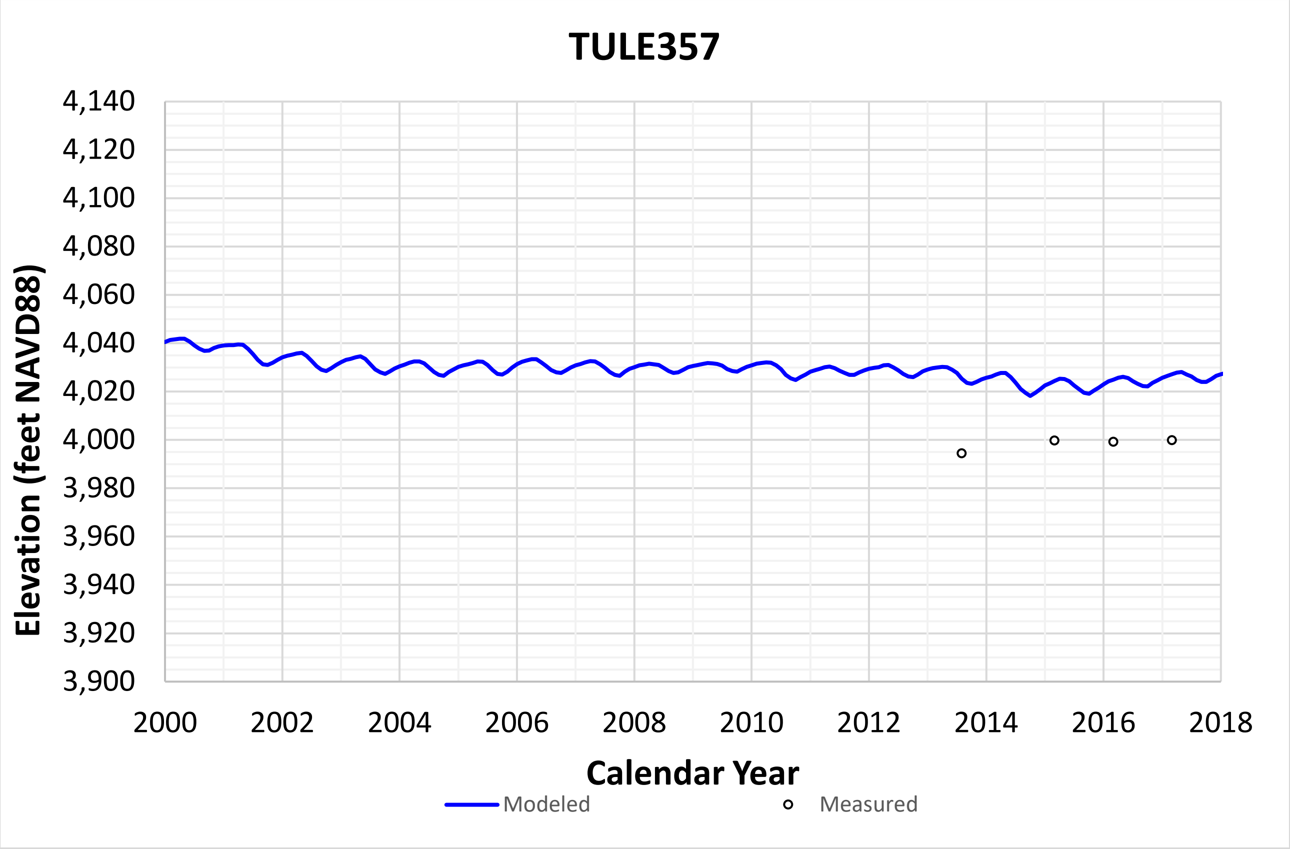
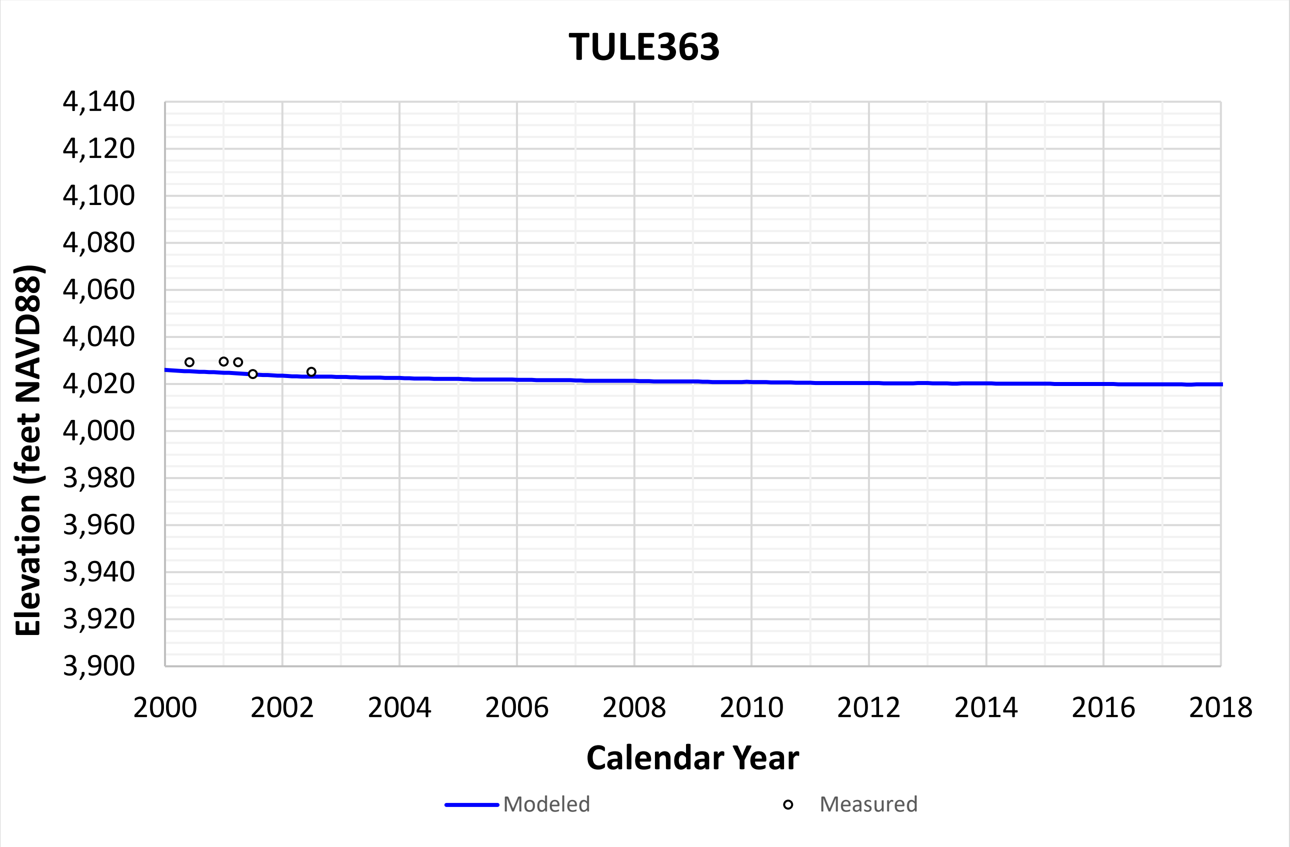


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



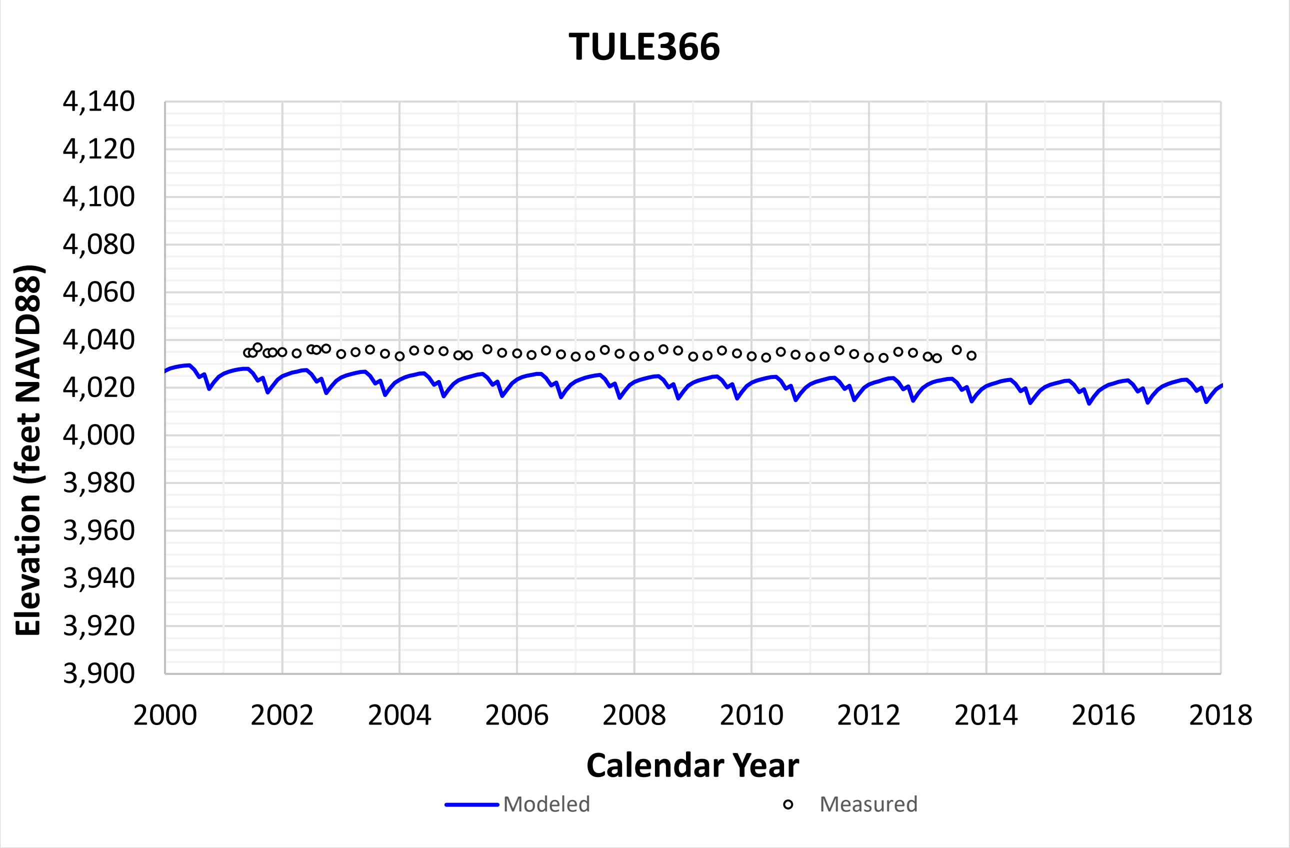
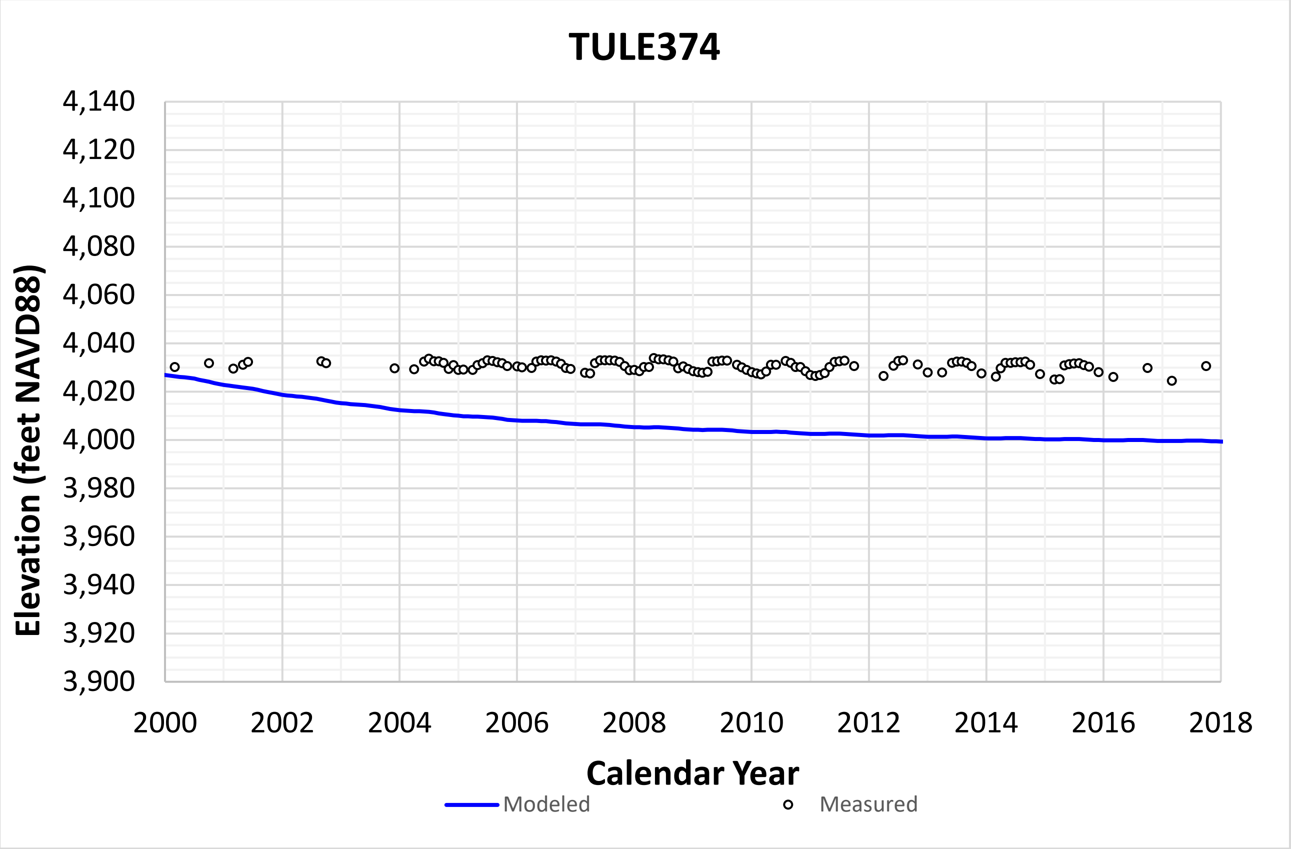


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



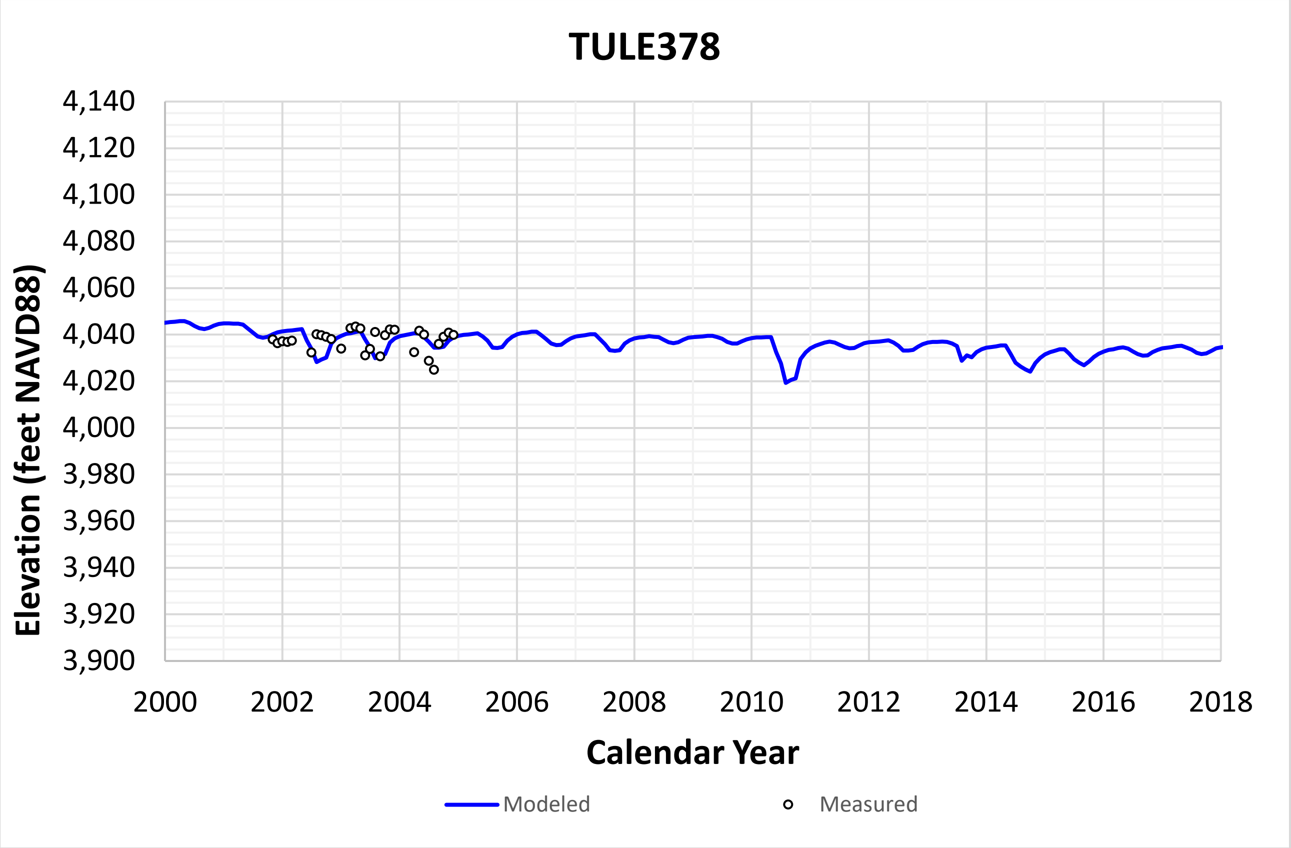
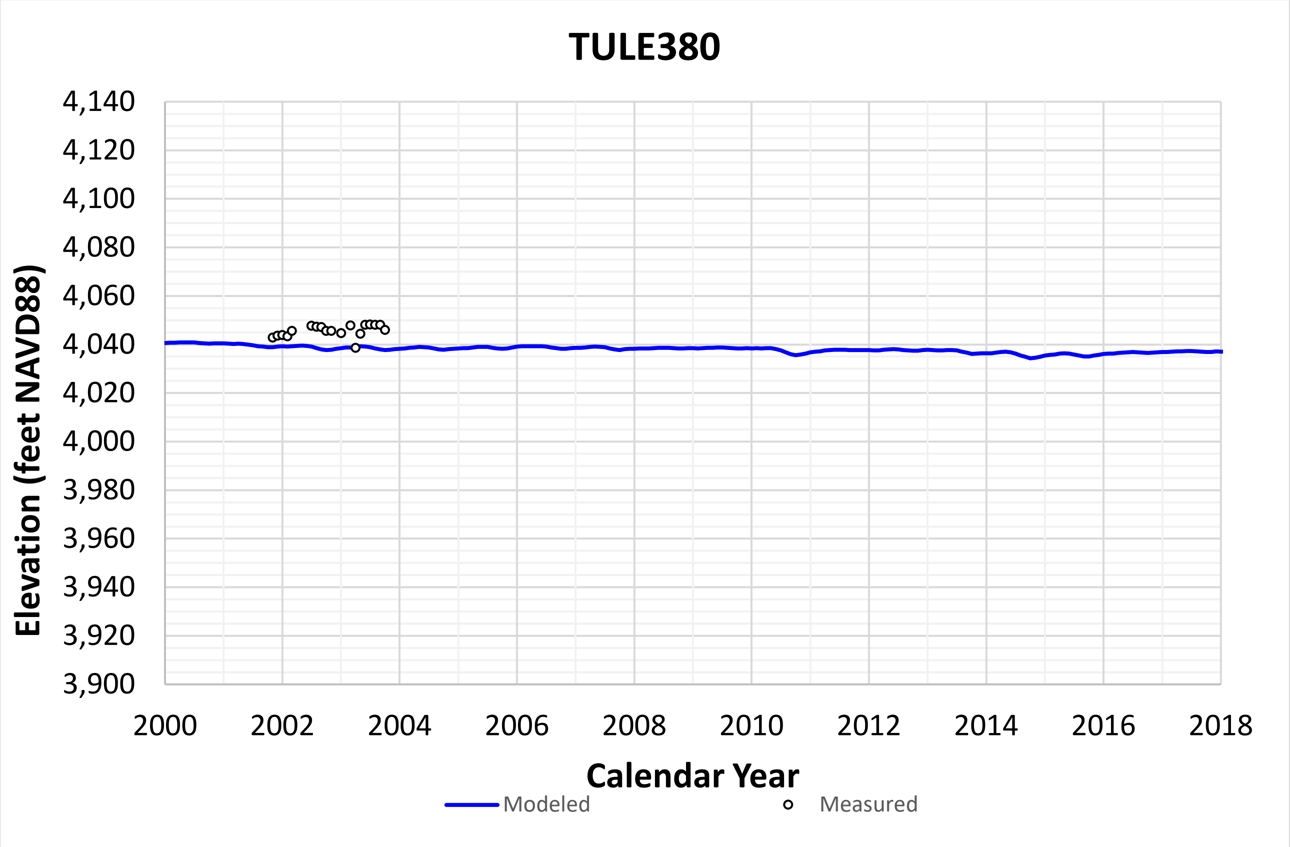


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



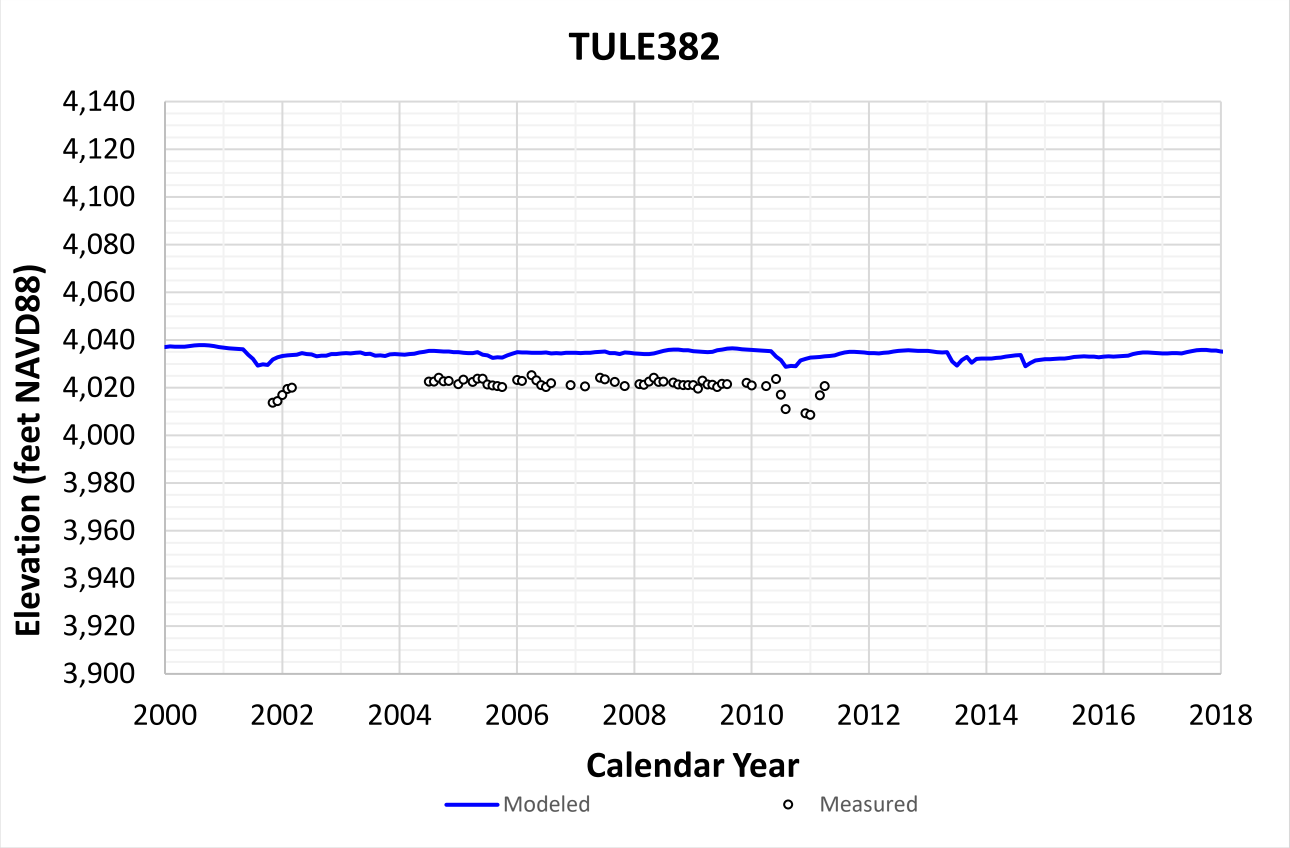
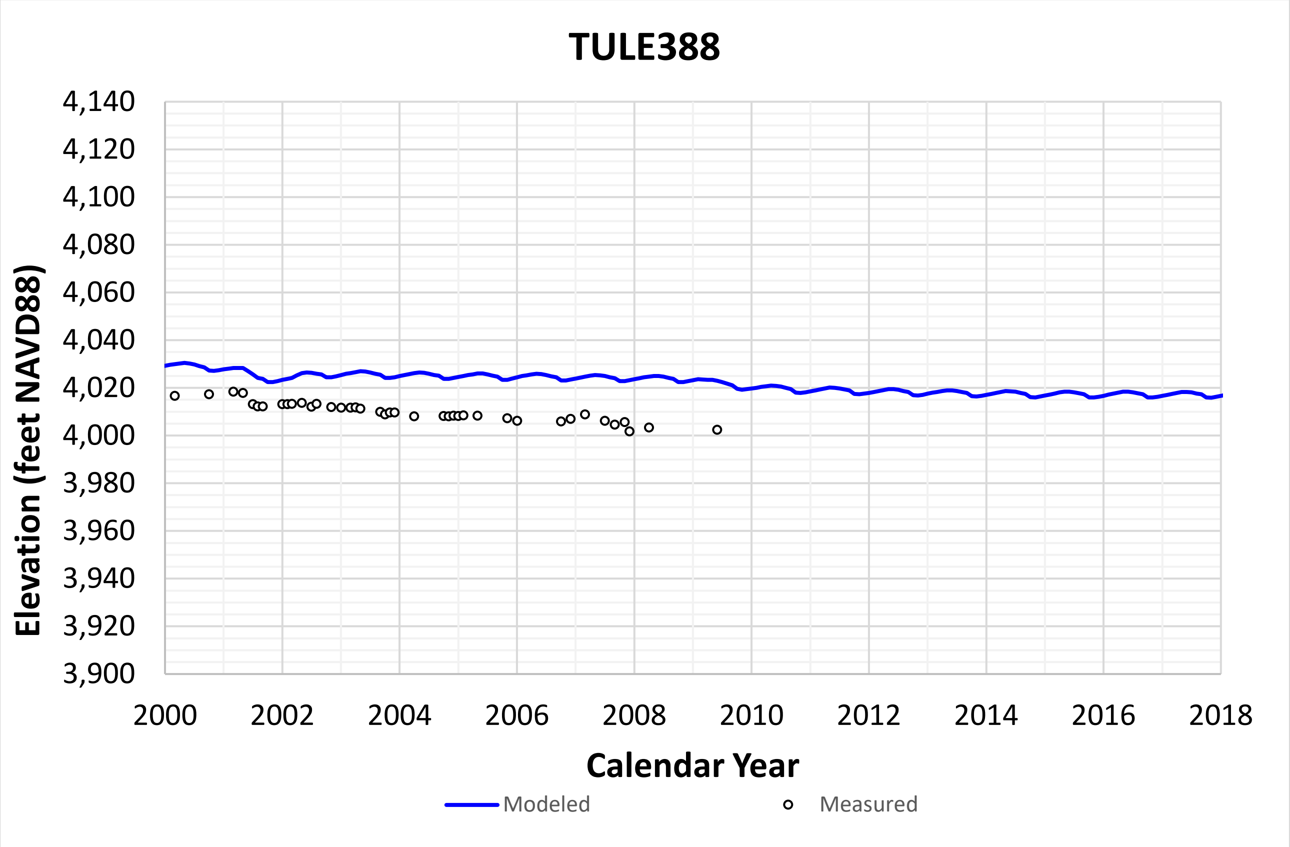


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



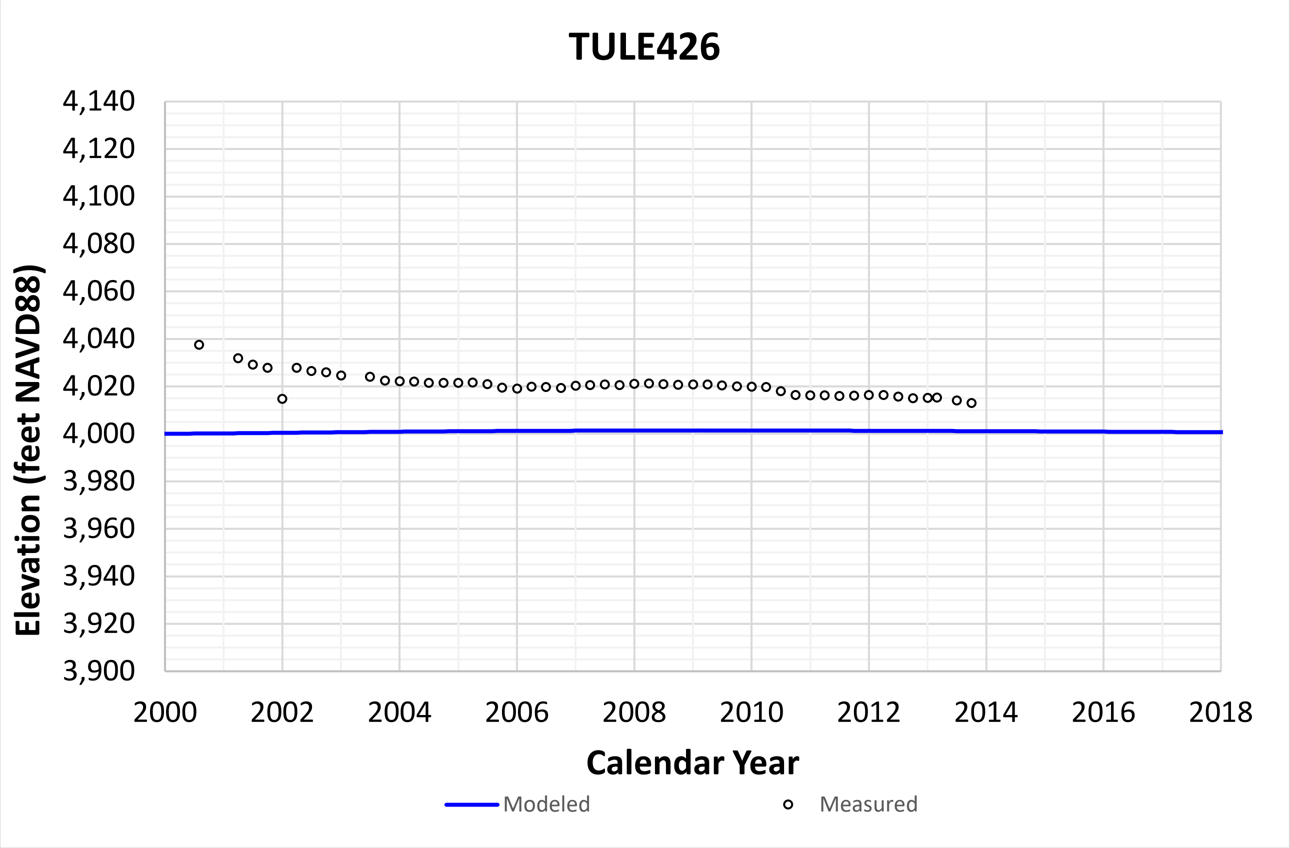
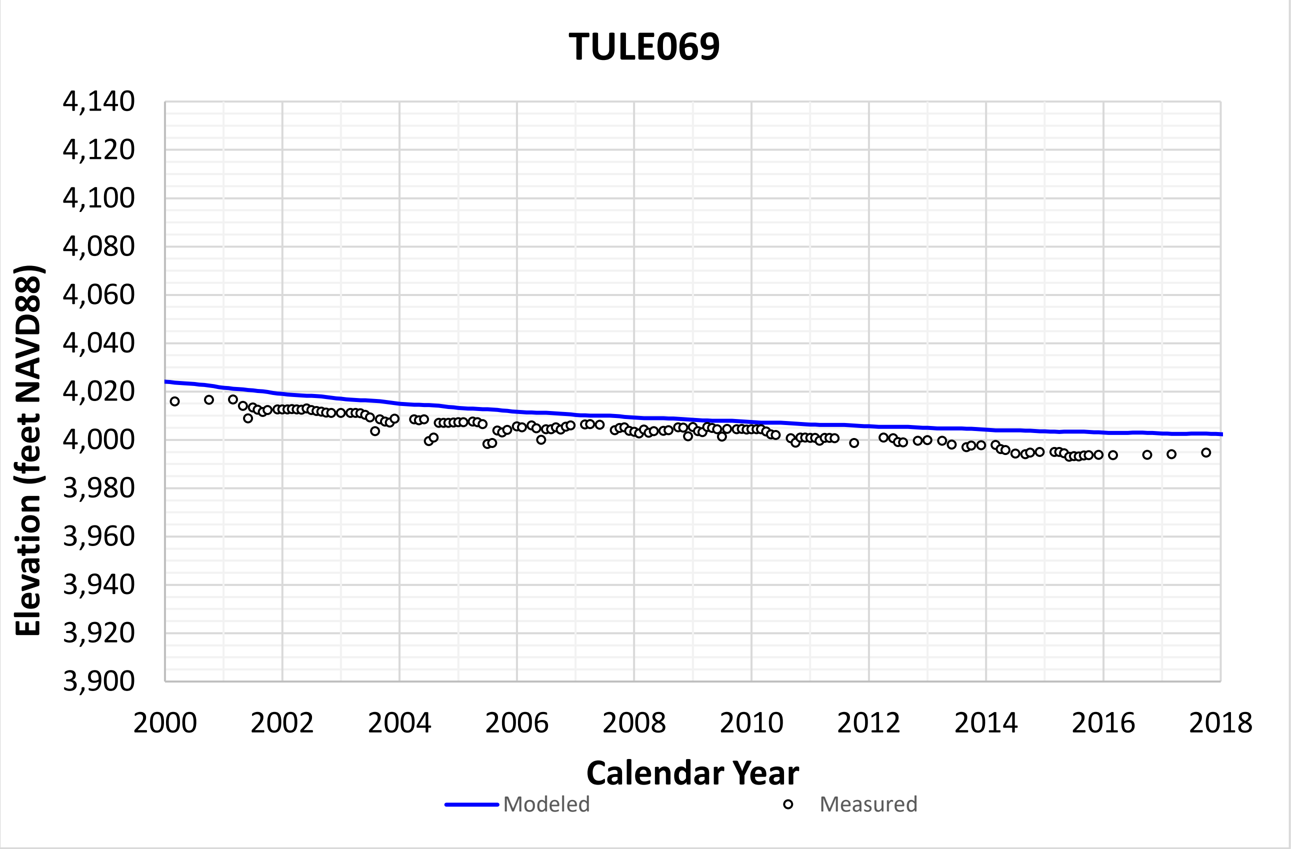


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs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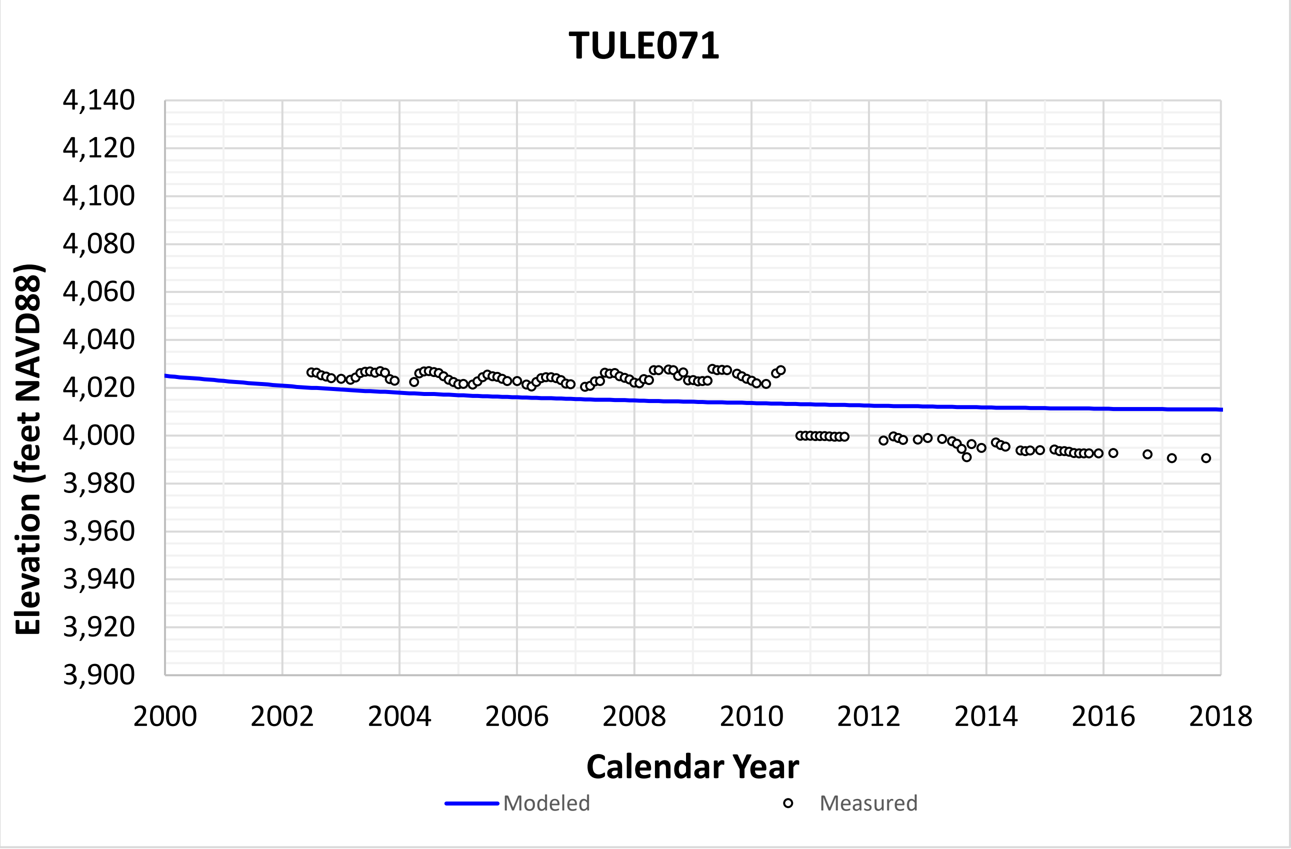
4,120
4,100
4,080
4,060
4,040
4,020
4,000
3,980
3,960
3,940
3,920
3,900
Elevation (feet NAVD88)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Calendar Year
Modeled
Measured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4,020
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Elevation (feet NAVD88)
2000
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Calendar Year
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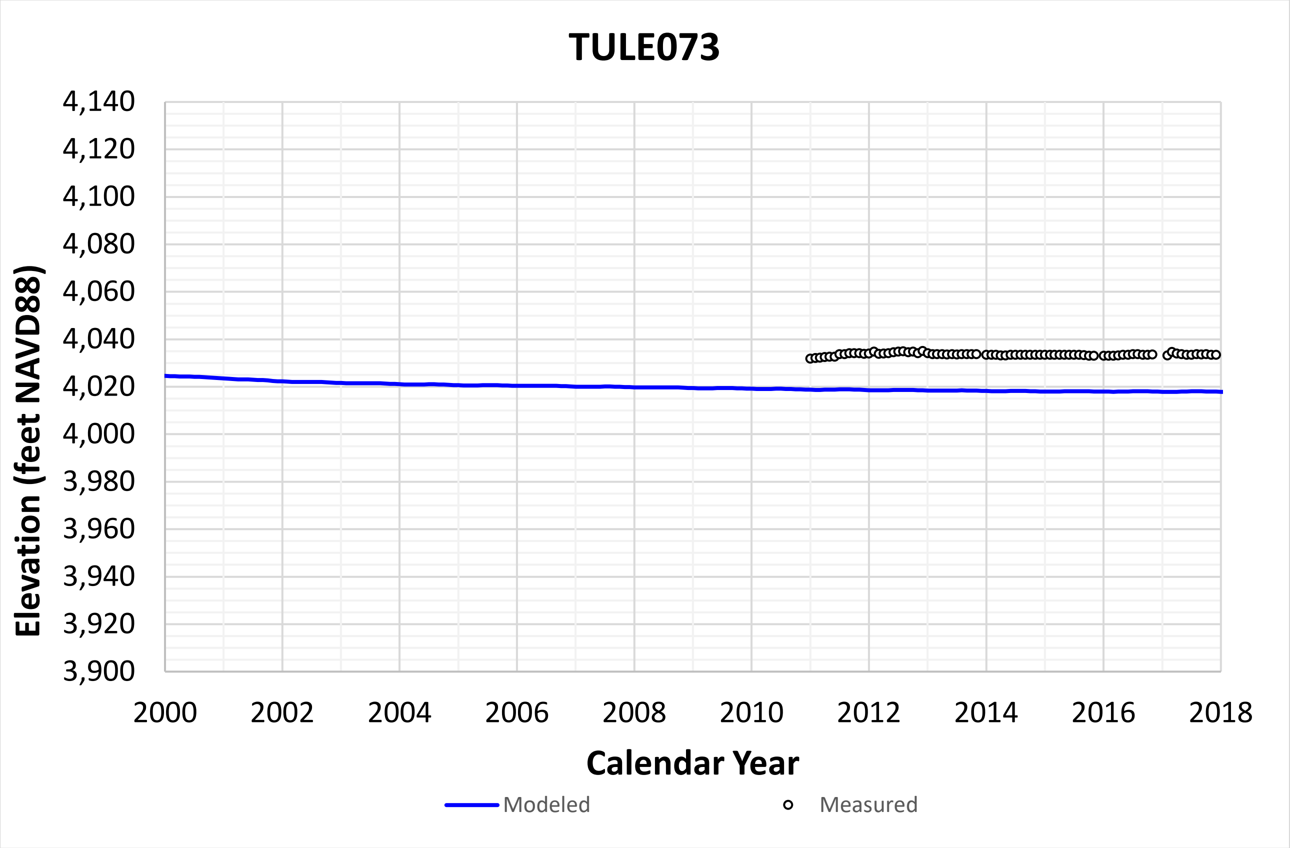


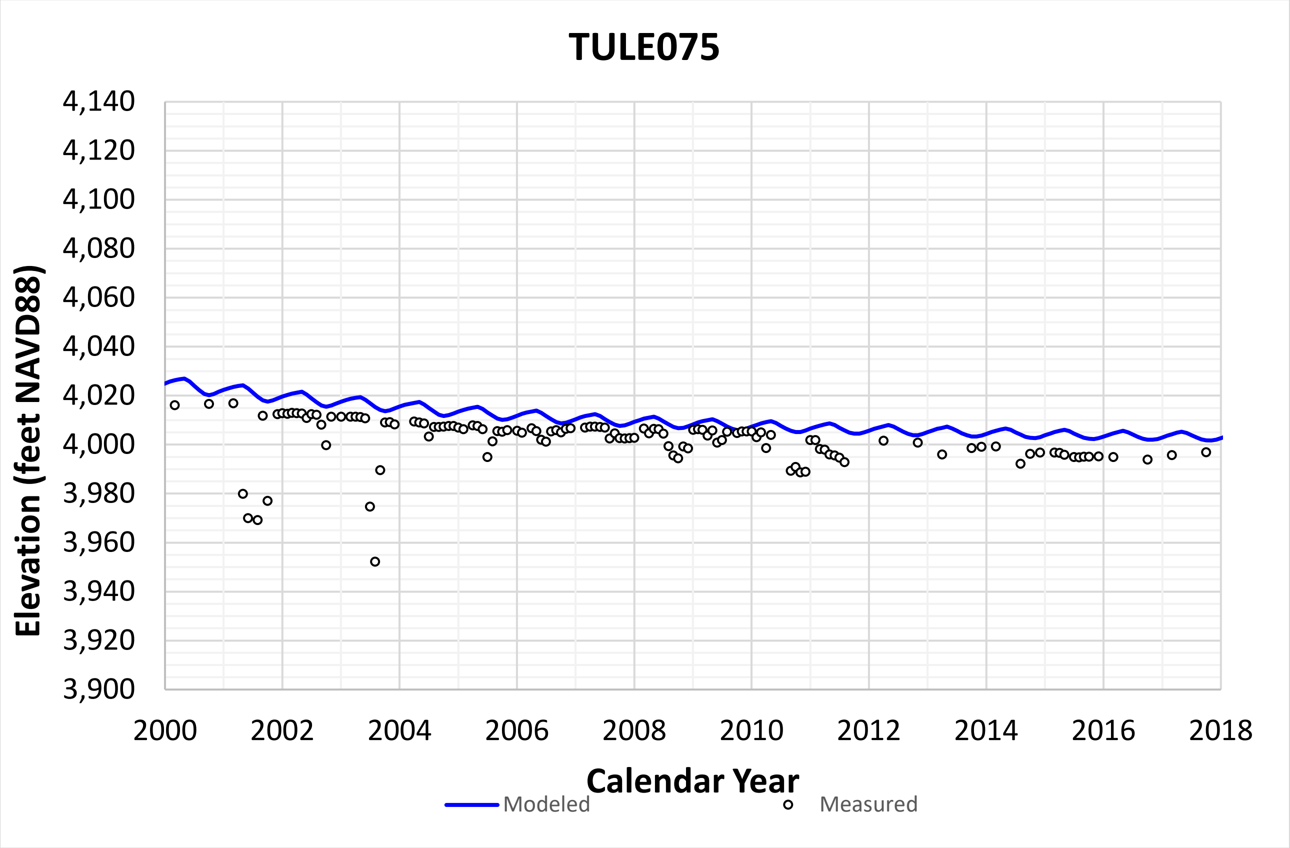
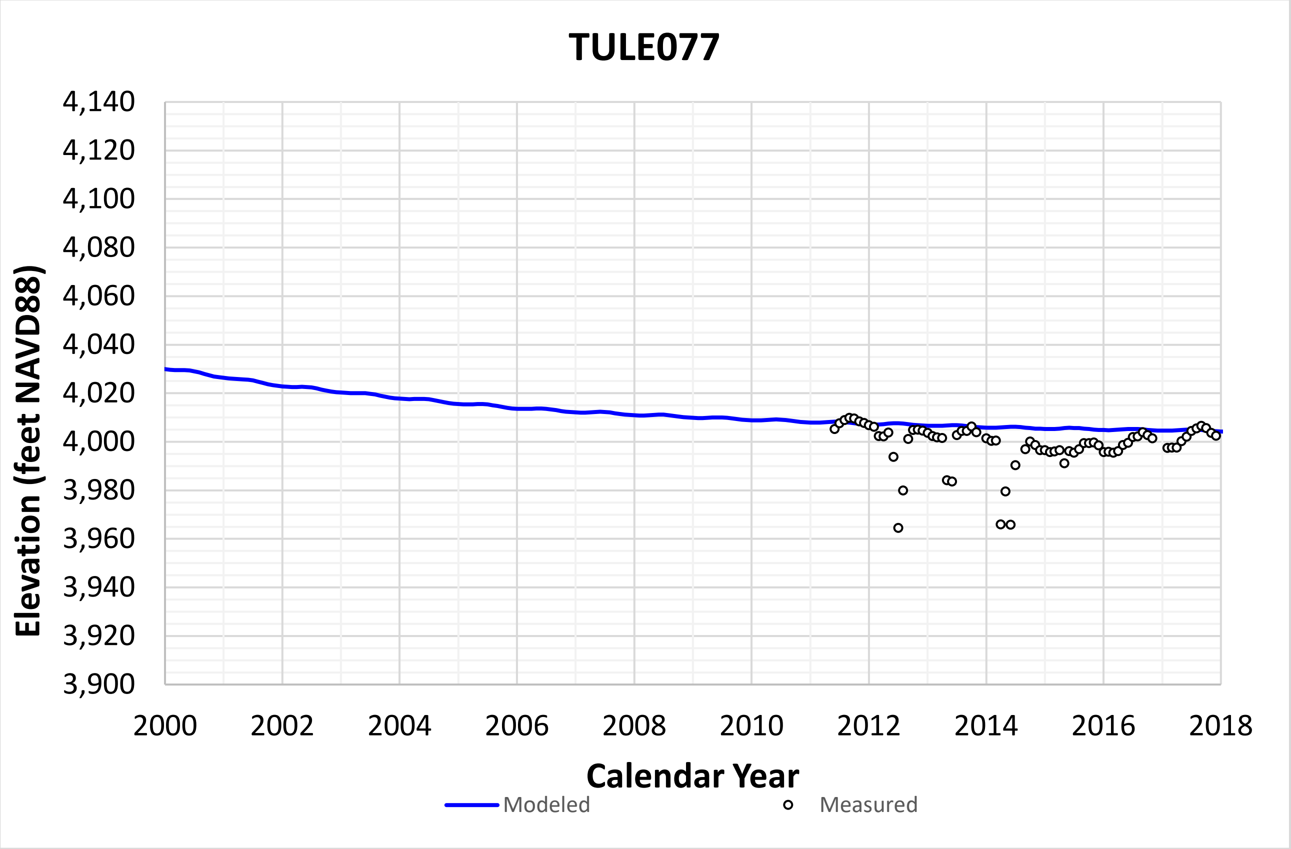


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



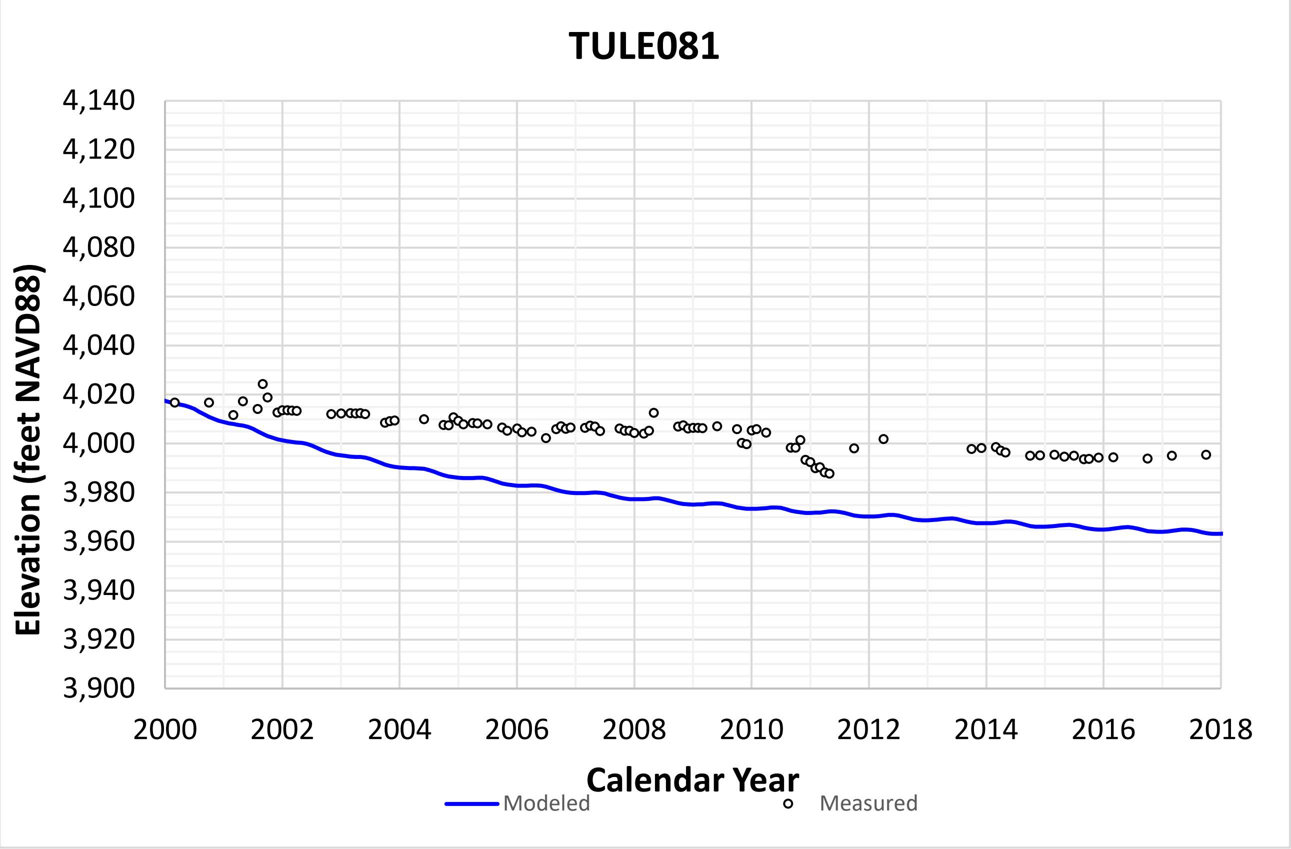
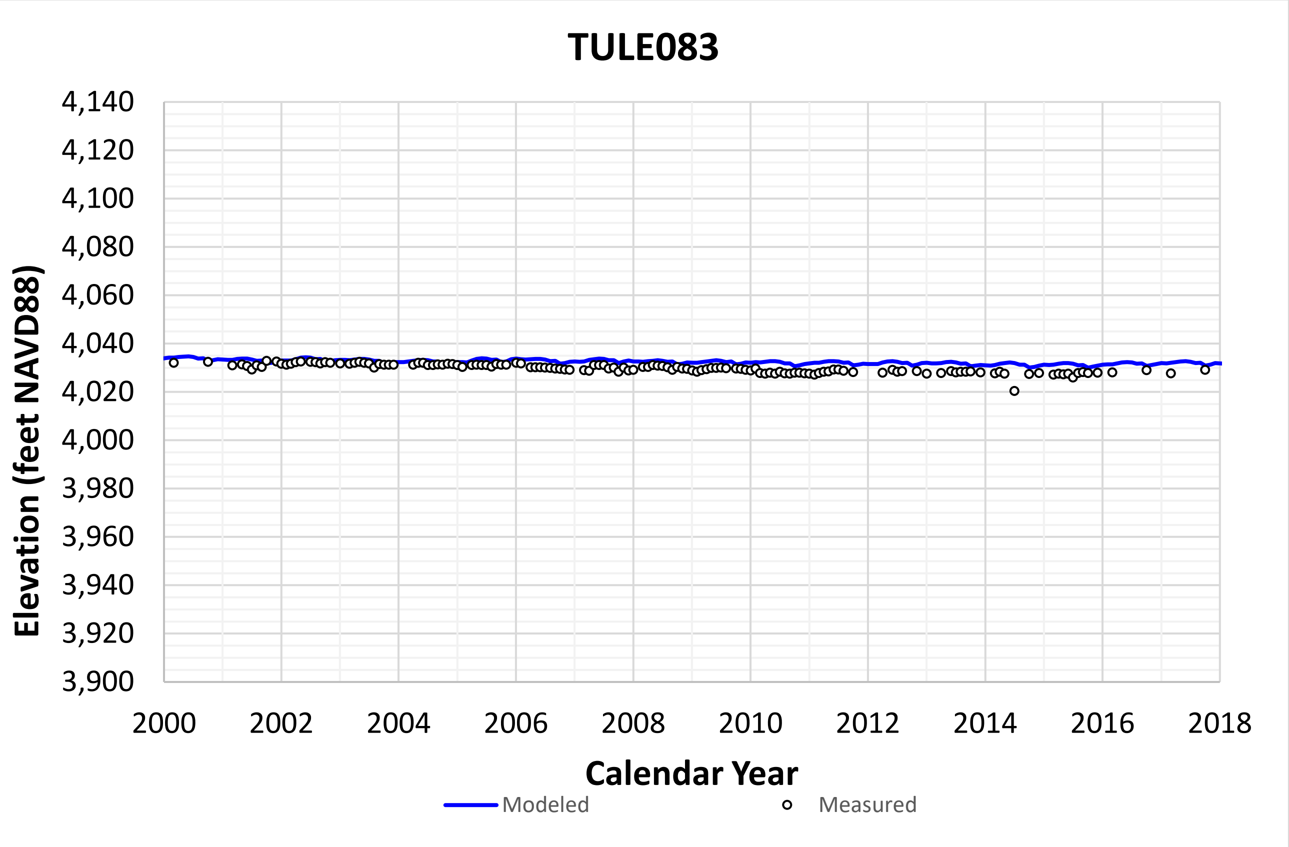


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs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4,020
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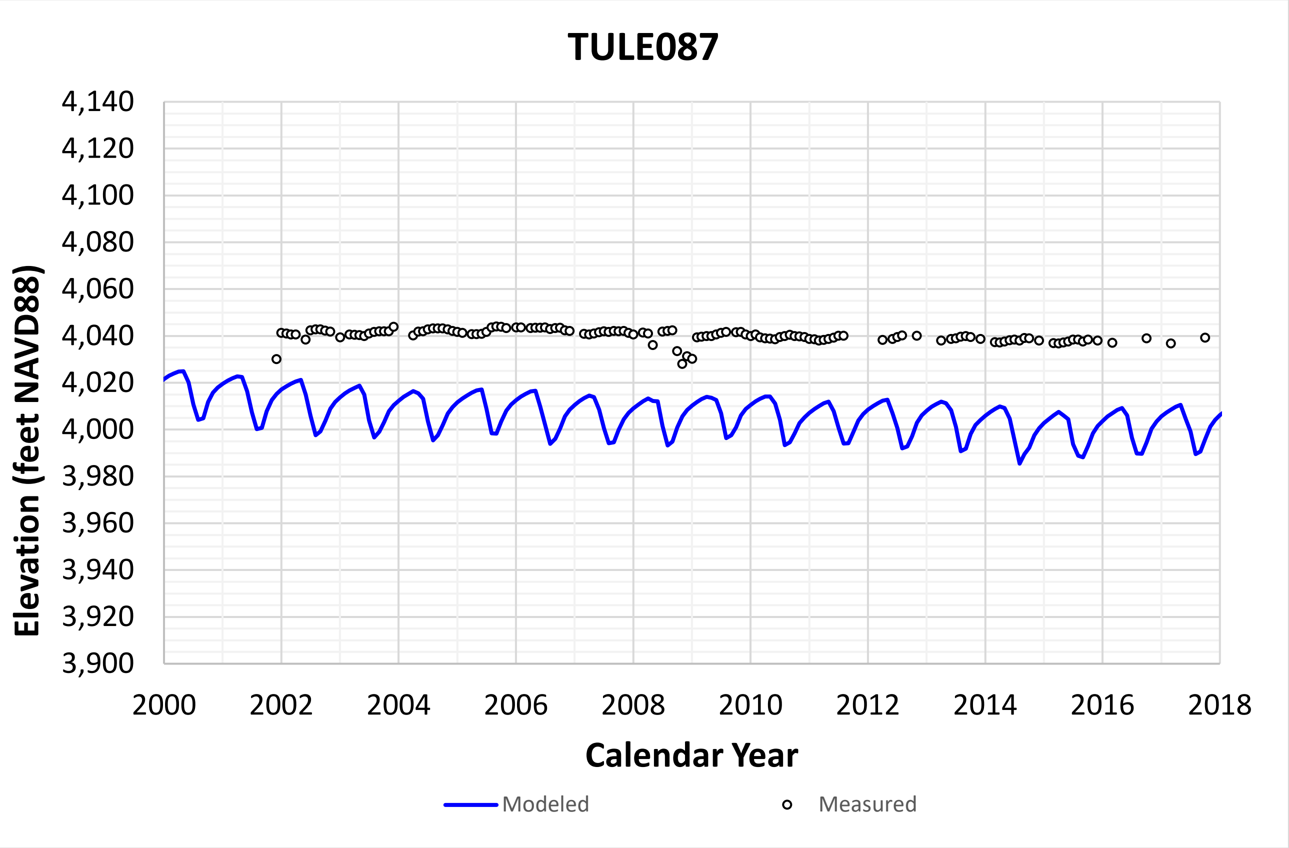
3,960
3,940
3,920
3,900
Elevation (feet NAVD88)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Calendar Year
Modeled
Measured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Elevation (feet NAVD88)
2000
2002
2004
2006
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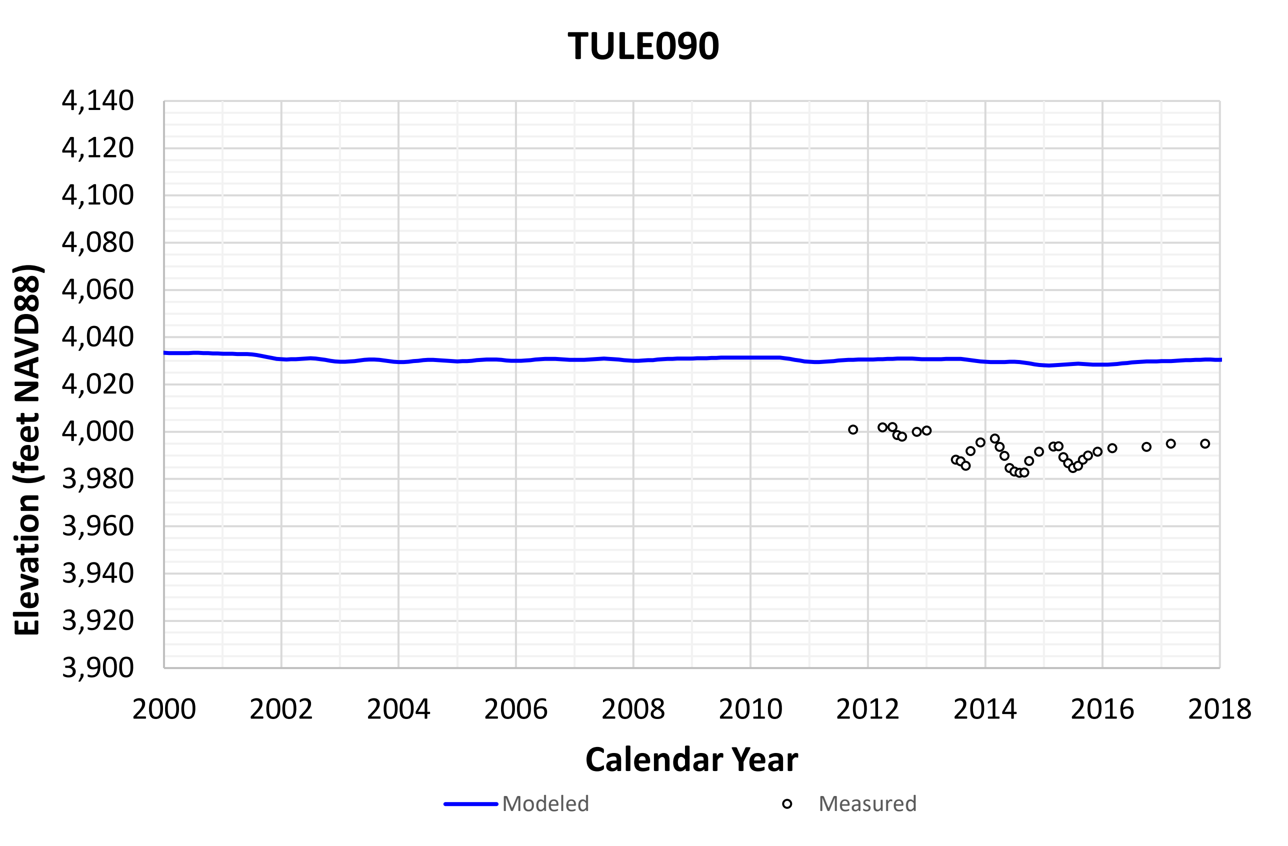
Calendar Year
Modeled
Measured



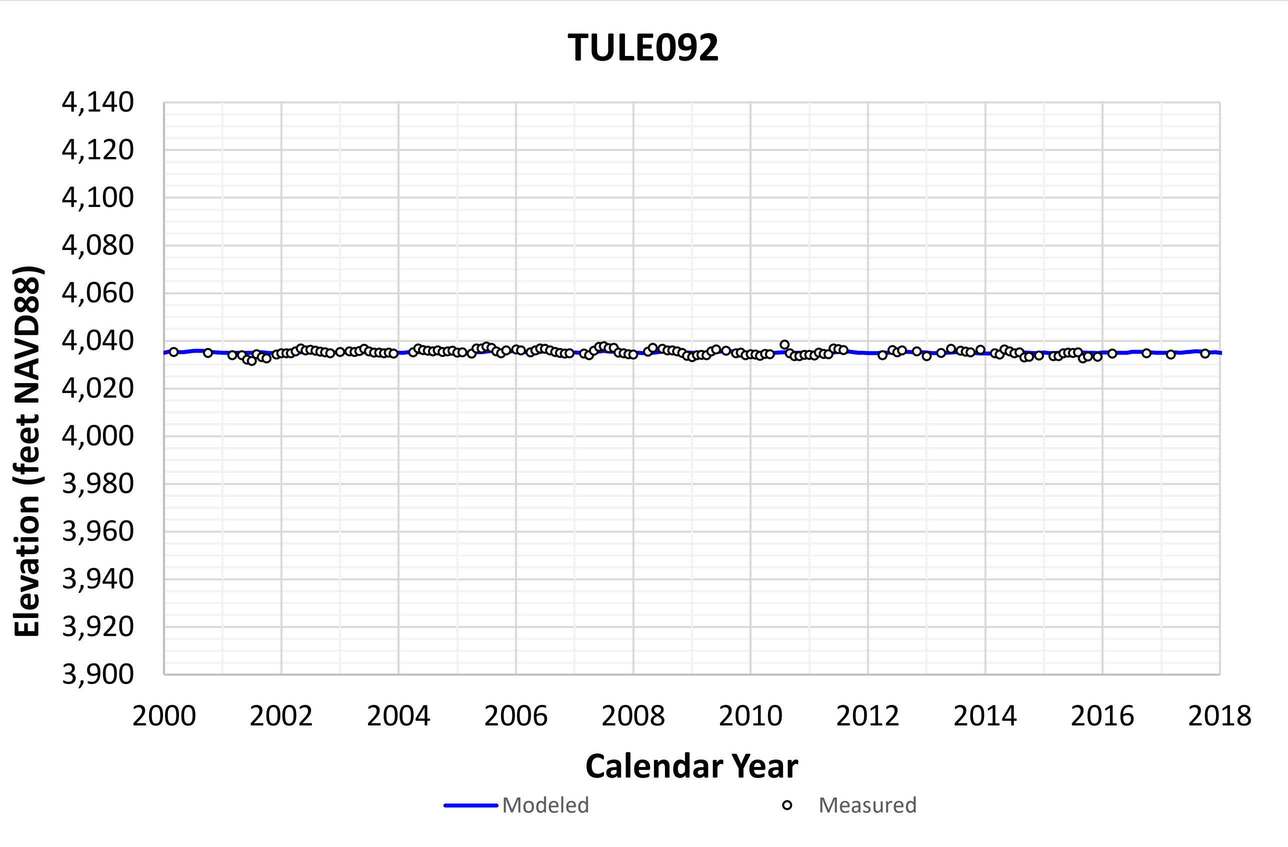
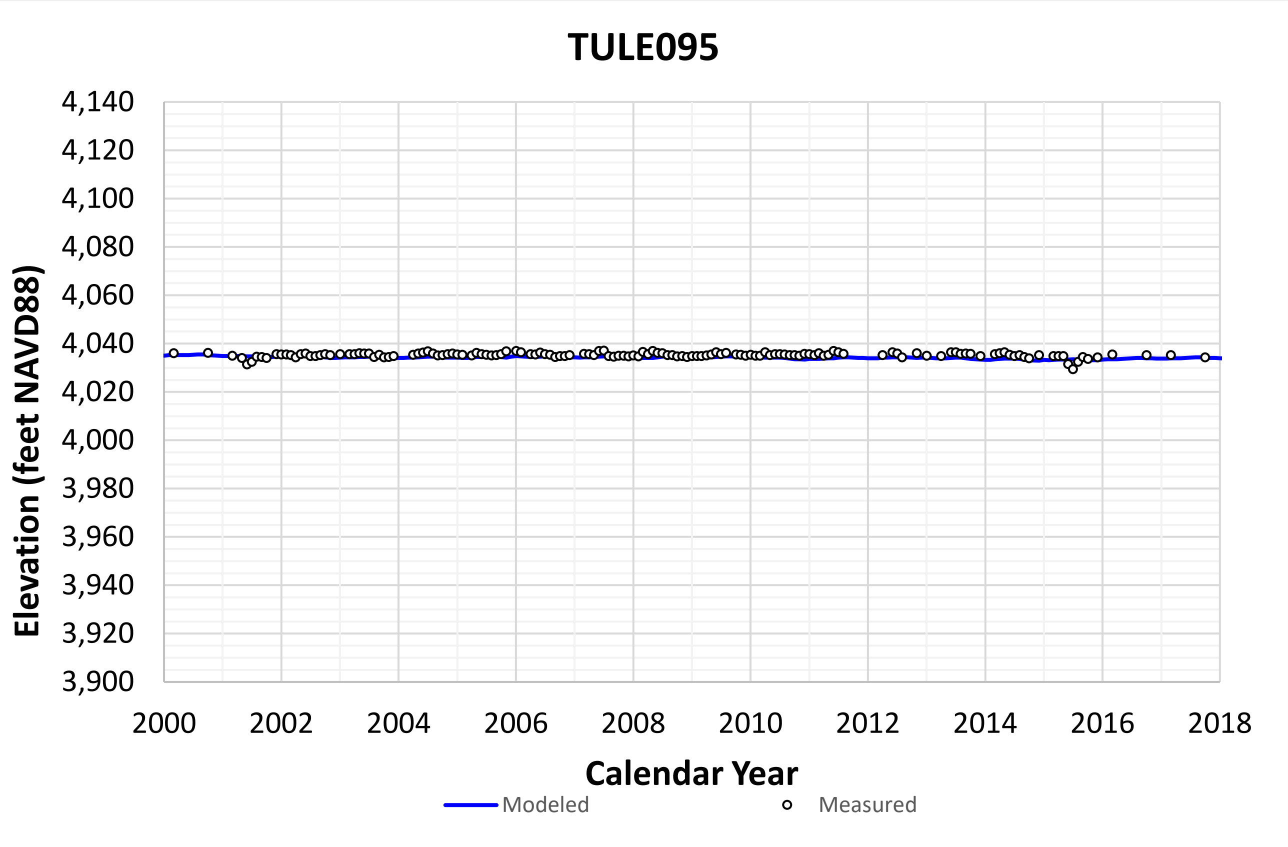


Figure 4-4

Modeled versus Measured Groundwater Elevation Hydrographs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4,000
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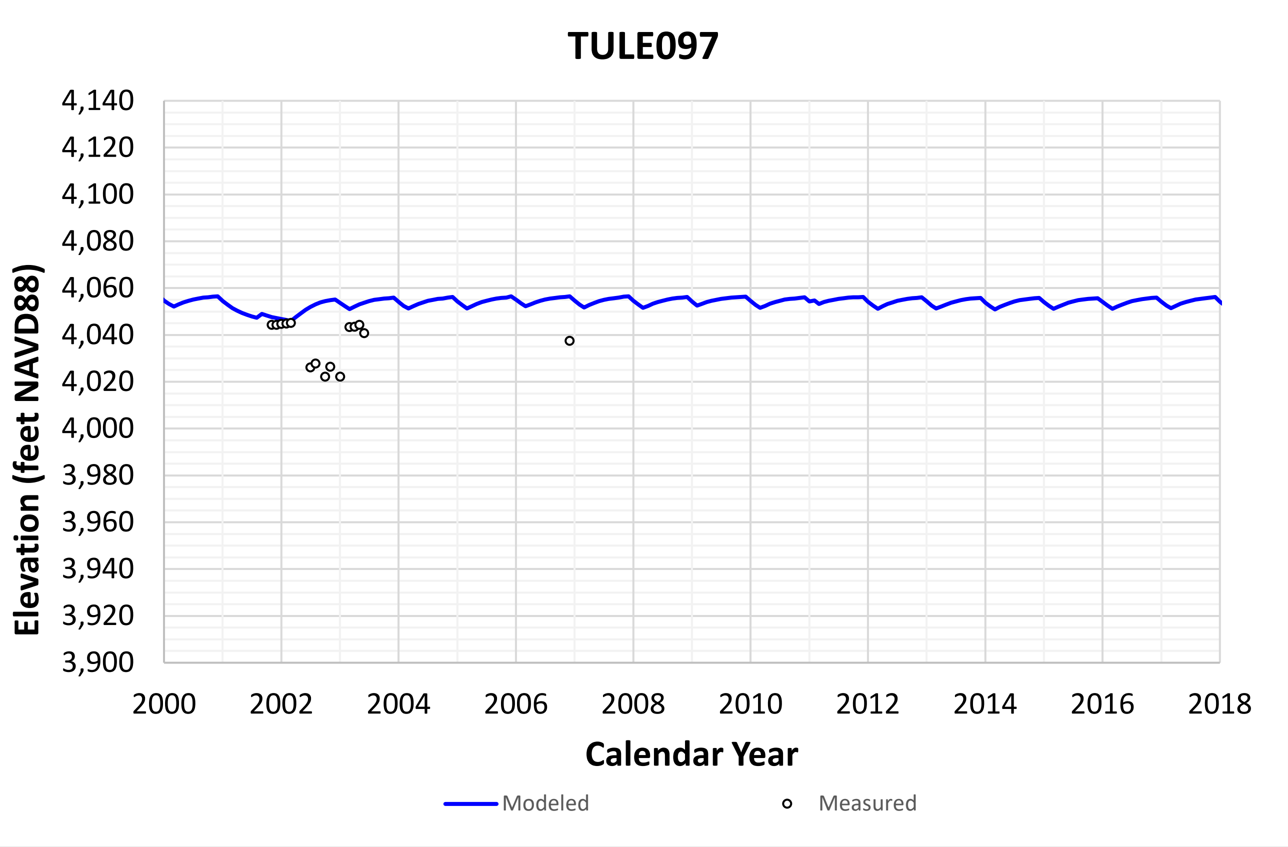
3,960
3,940
3,920
3,900
Elevation (feet NAVD88)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Calendar Year
Modeled
Measured


TULE097
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4,100
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Elevation (feet NAVD88)
2000
2002
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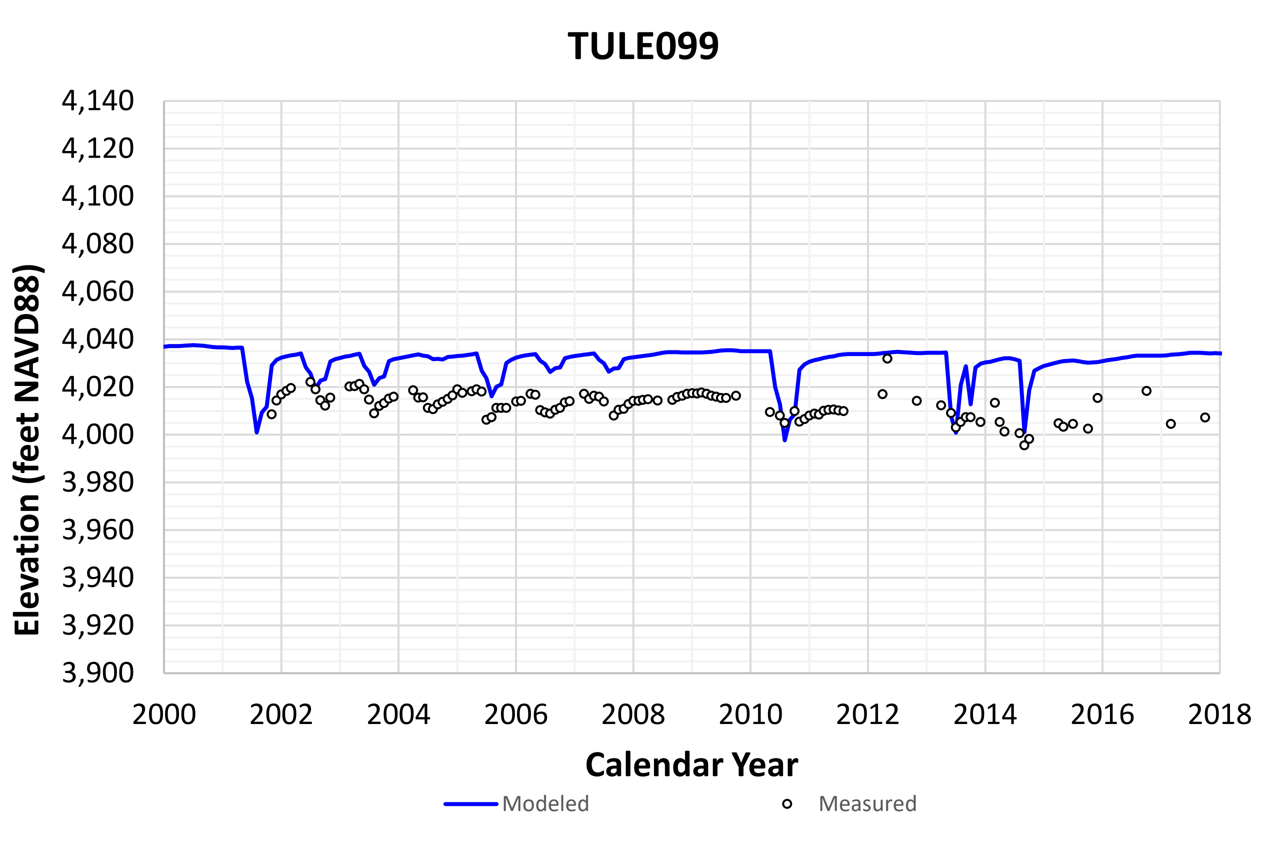
Calendar Year
Modeled
Measured



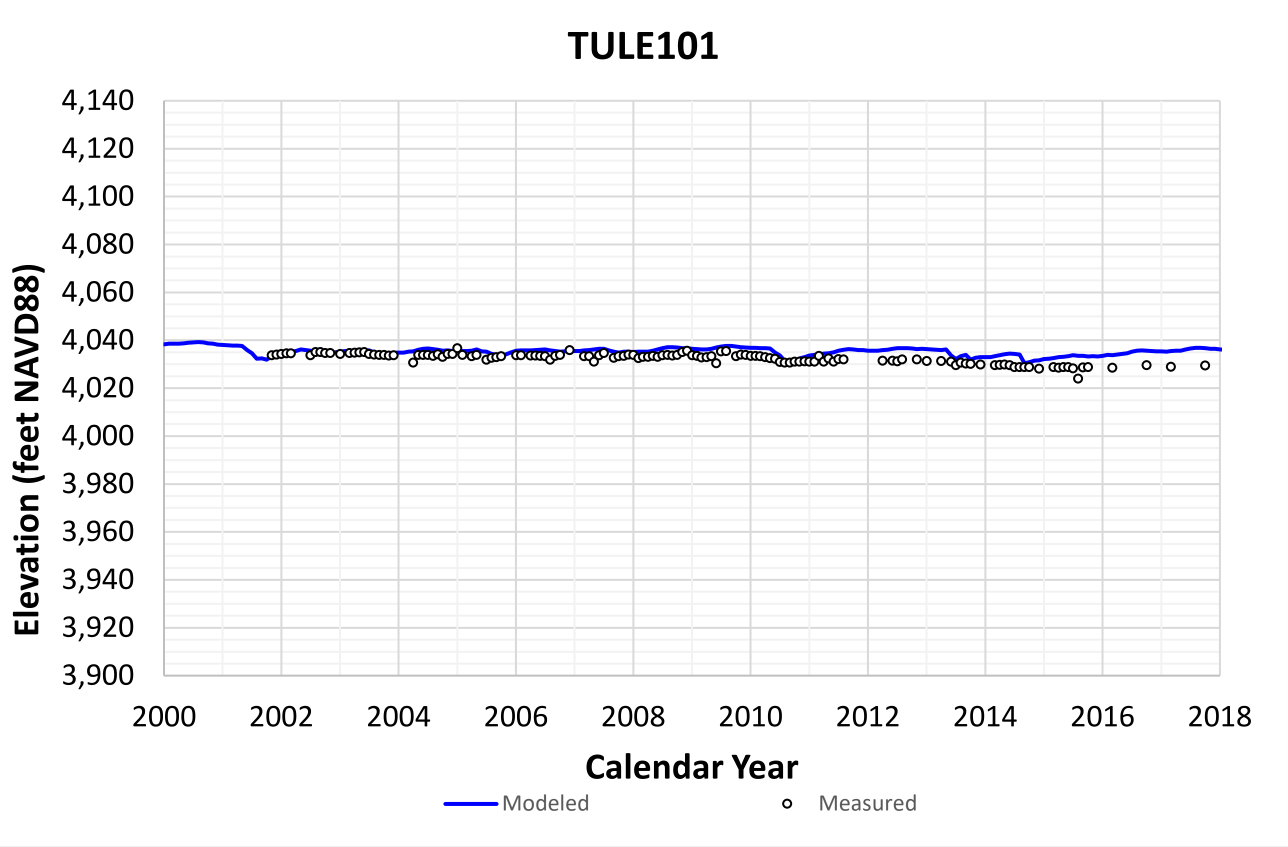
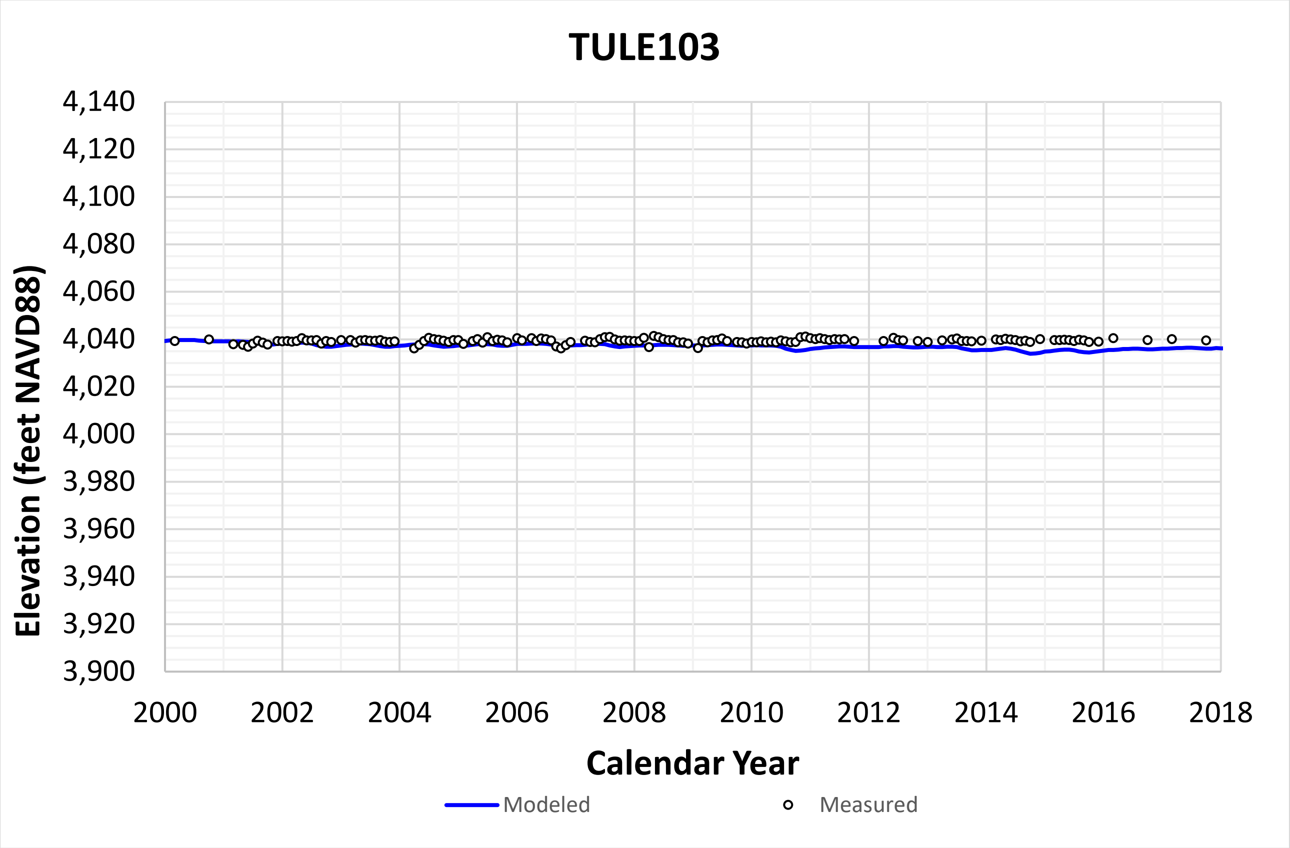


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



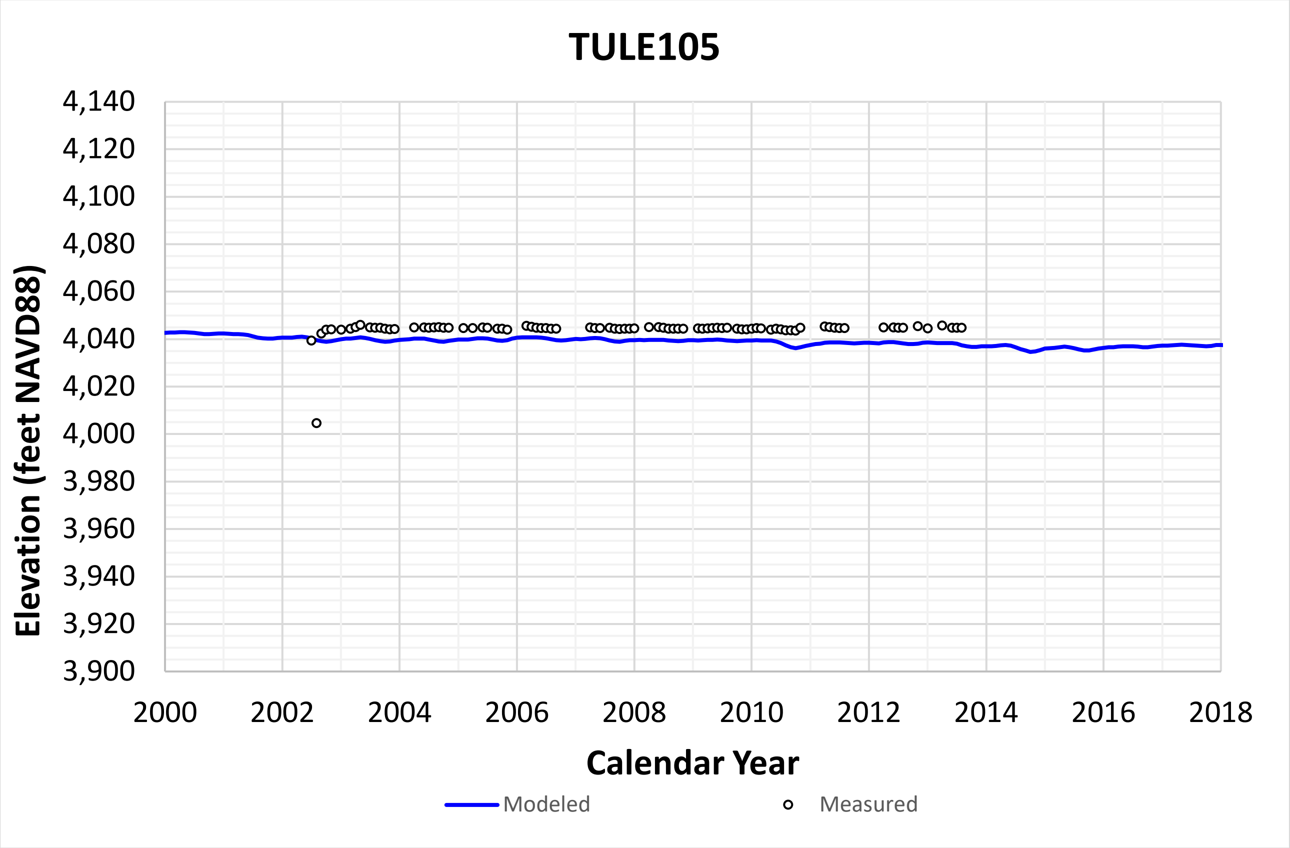
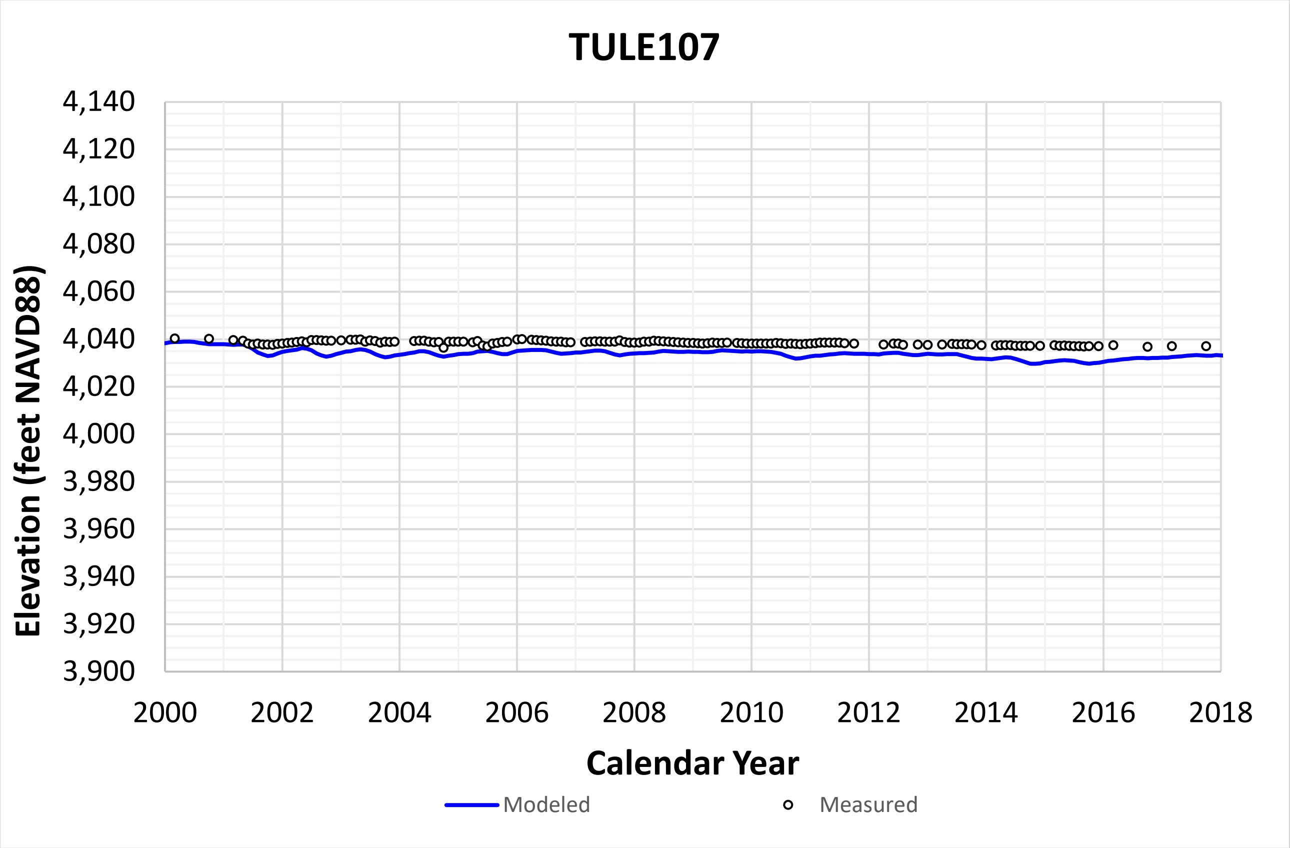


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



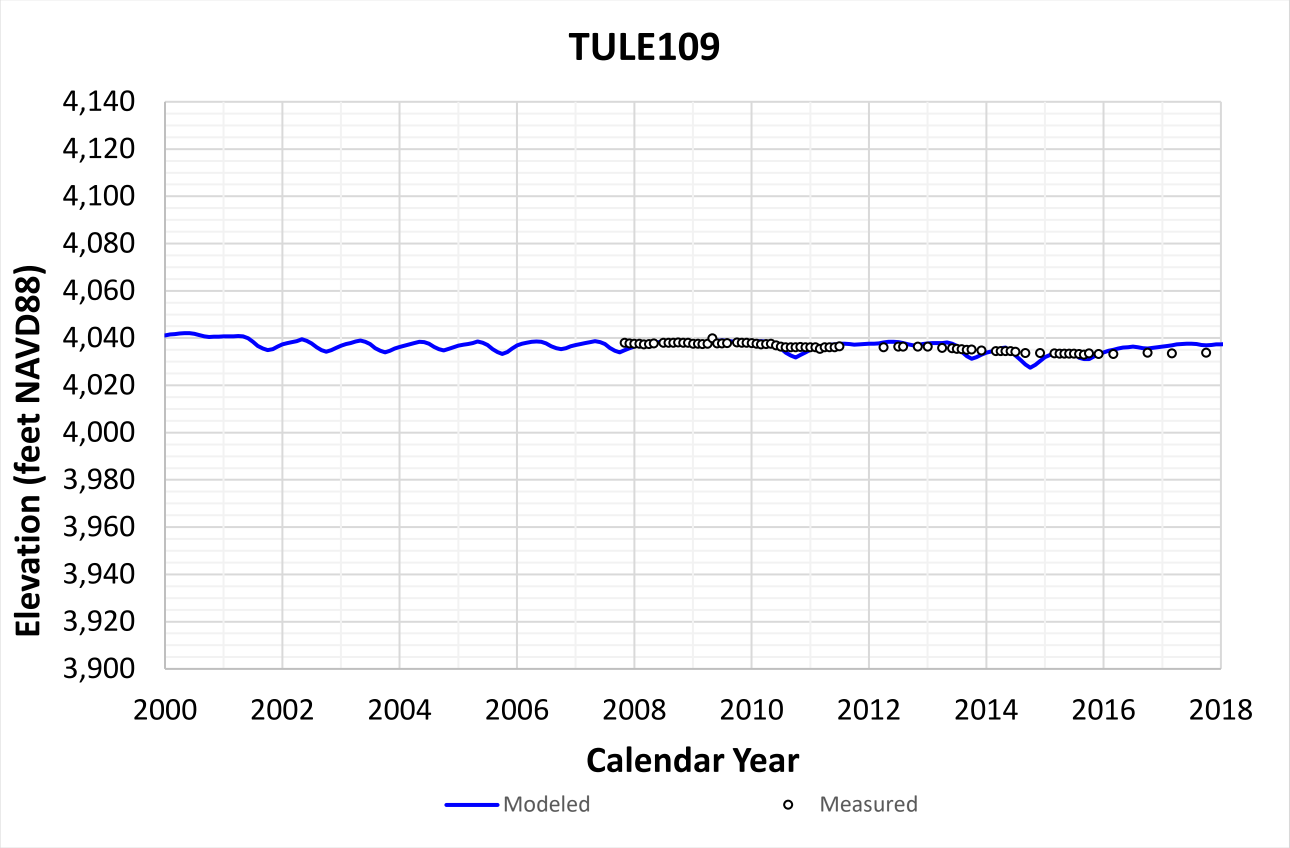
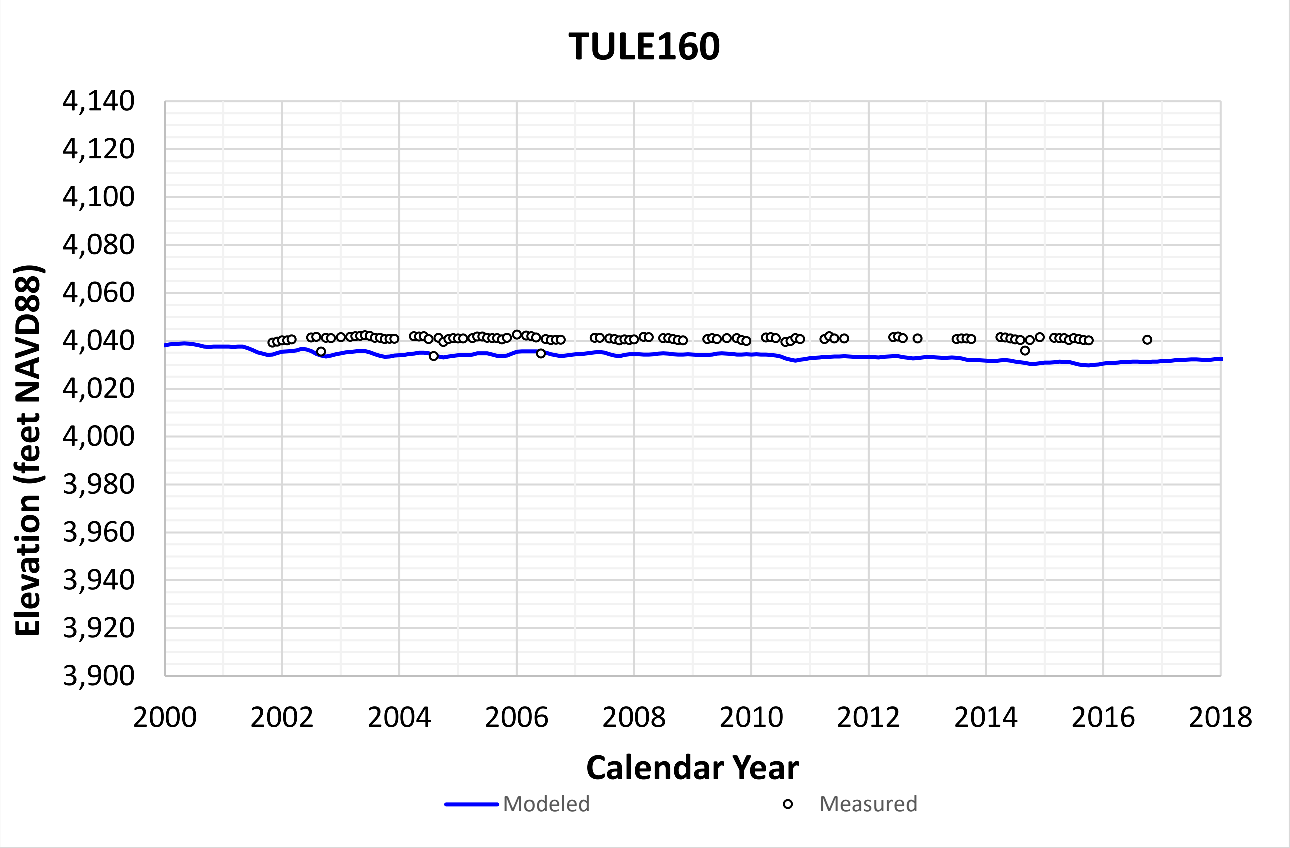


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



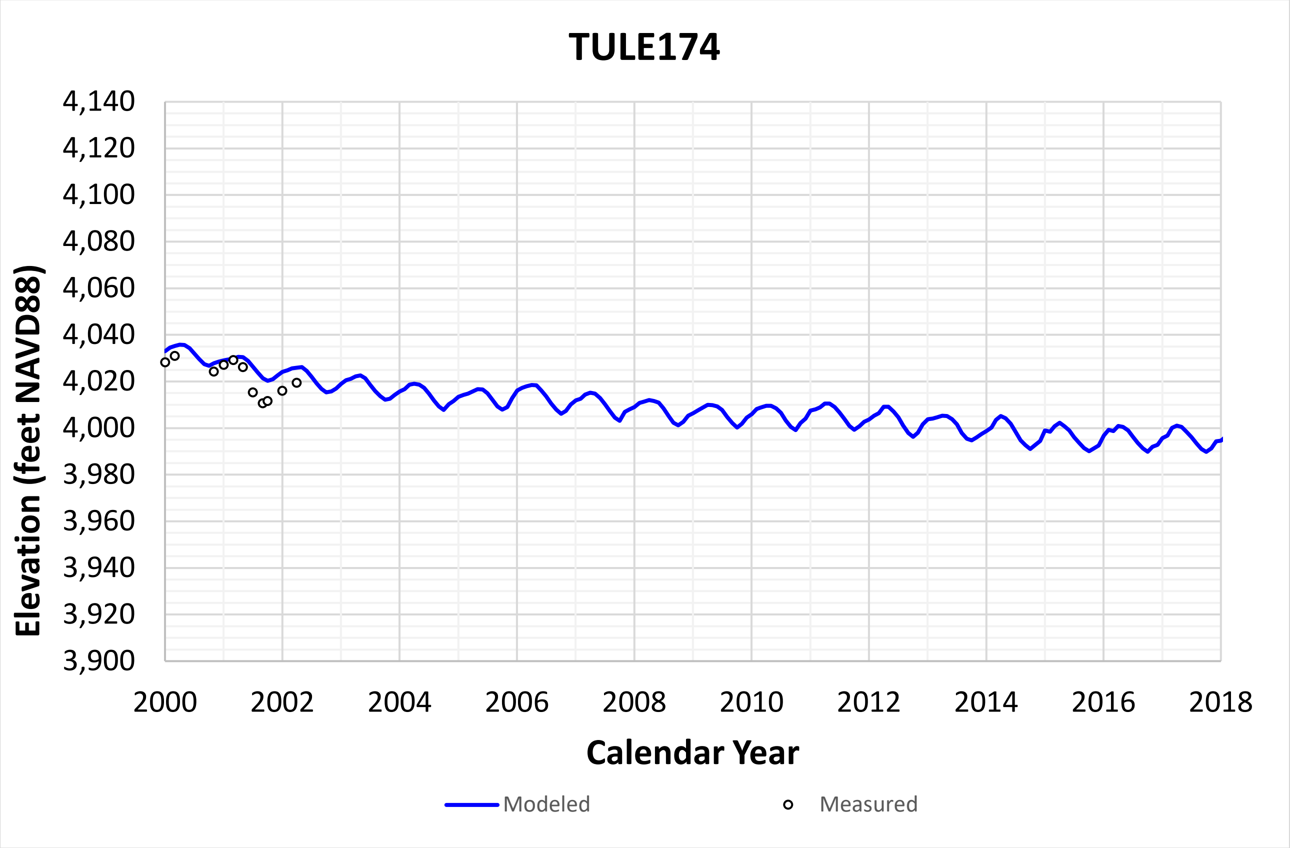
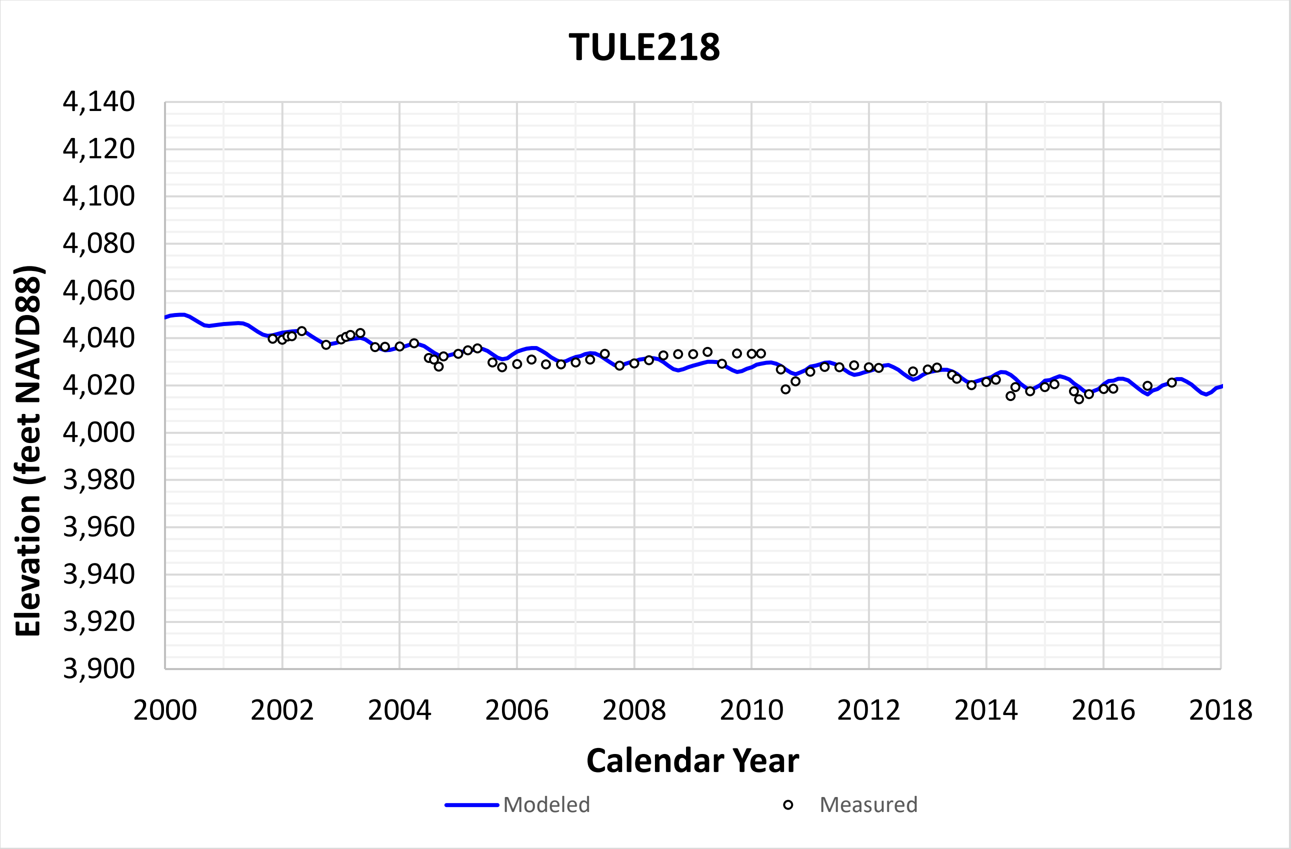


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs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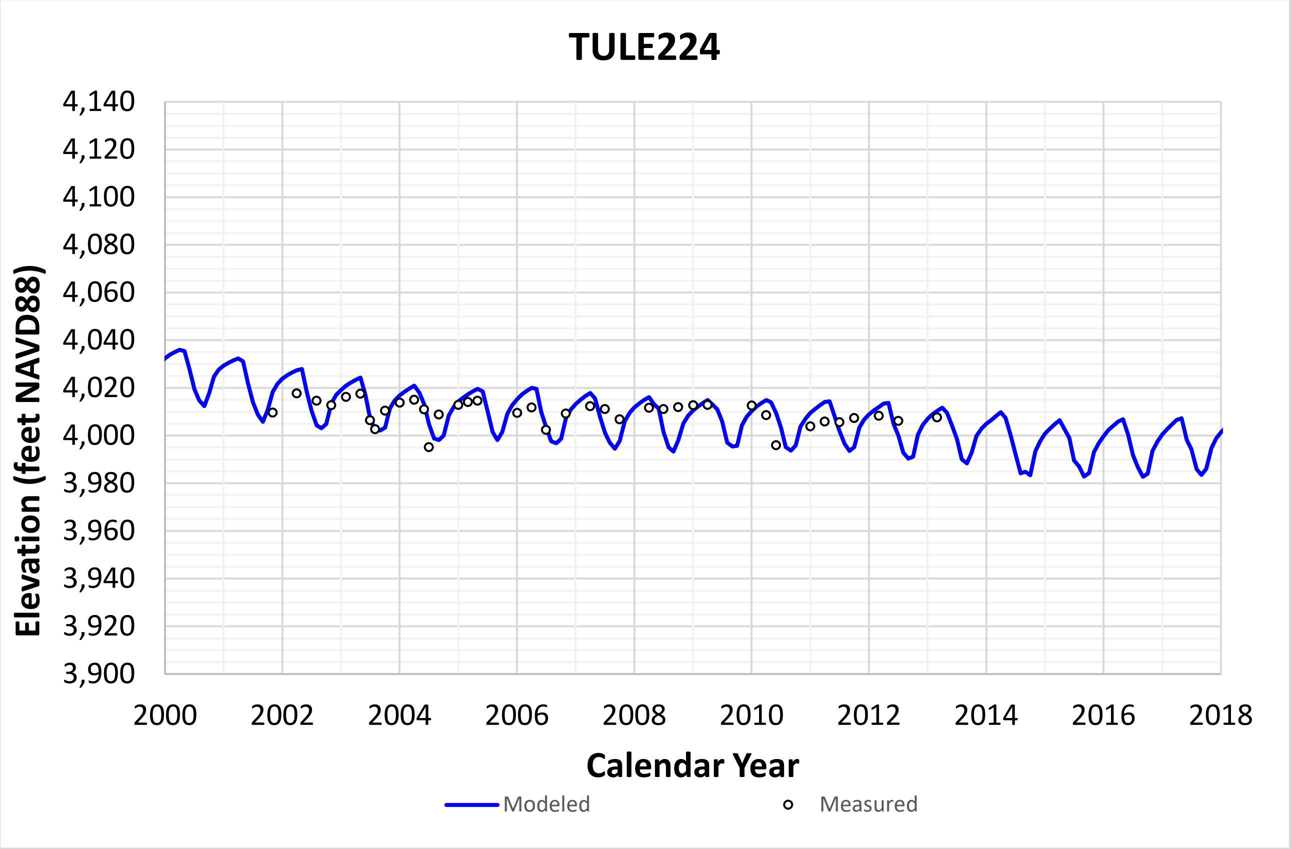
4,100
4,080
4,060
4,040
4,020
4,000
3,980
3,960
3,940
3,920
3,900
Elevation (feet NAVD88)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Calendar Year
Modeled
Measured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Elevation (feet NAVD88)
2000
2002
2004
2006
2008
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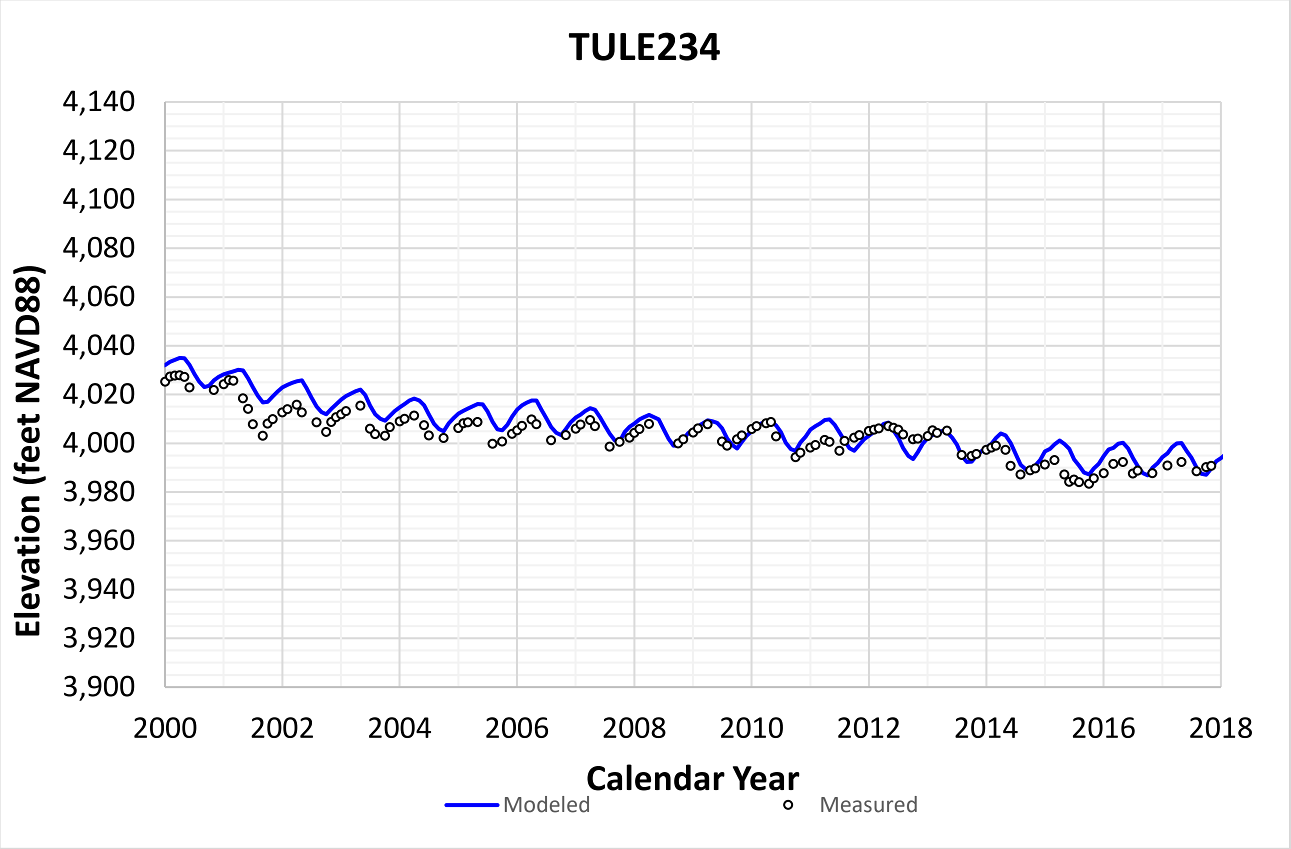
2012
2014
2016
2018
Calendar Year
Modeled
Measured



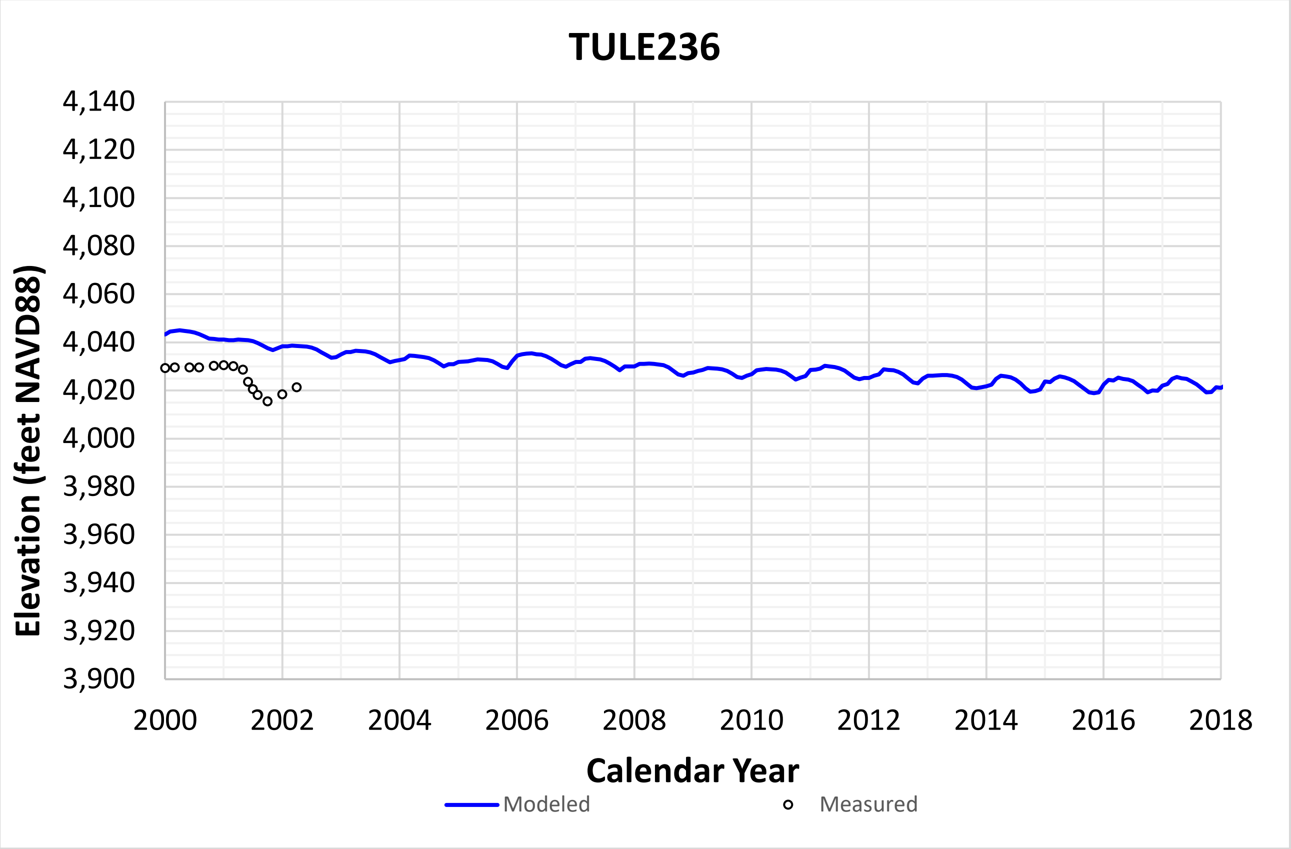
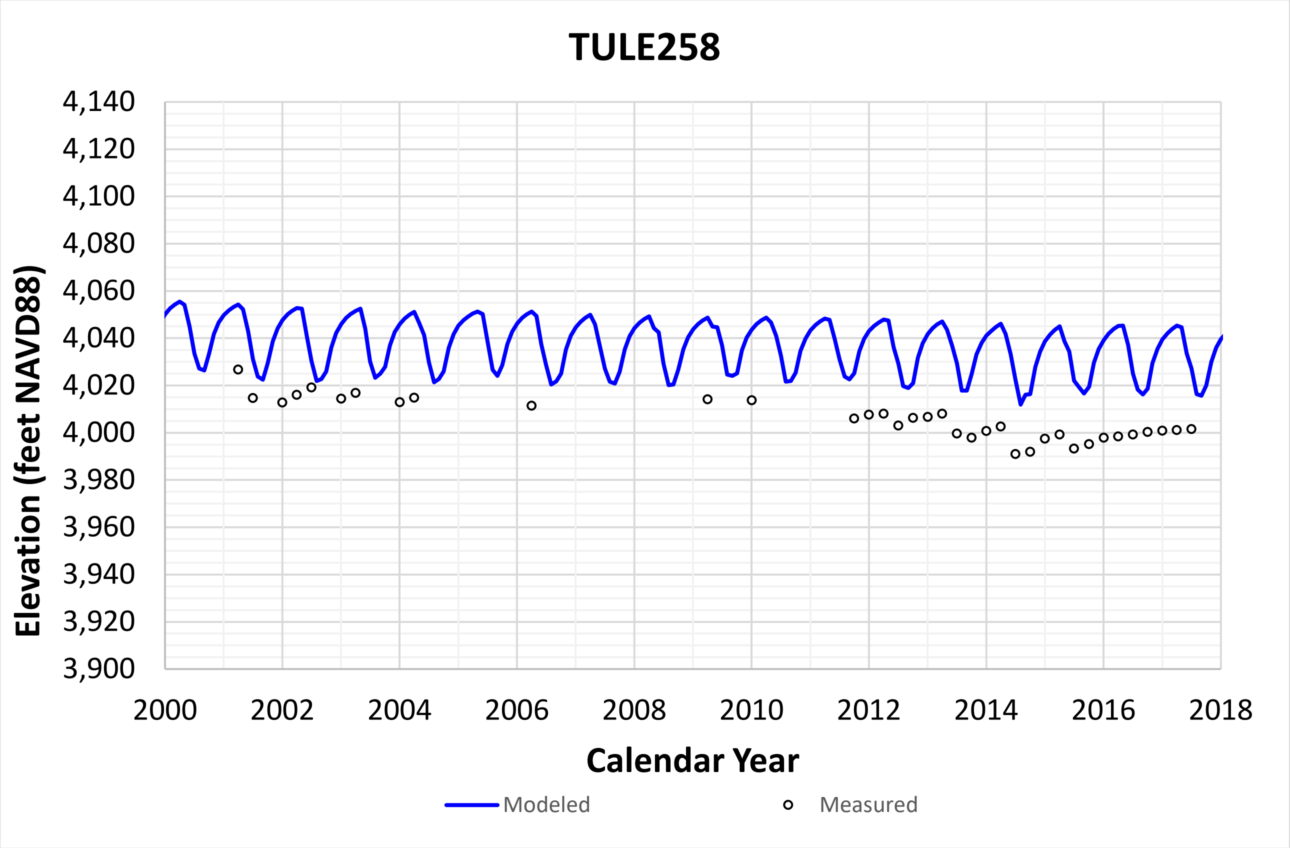


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



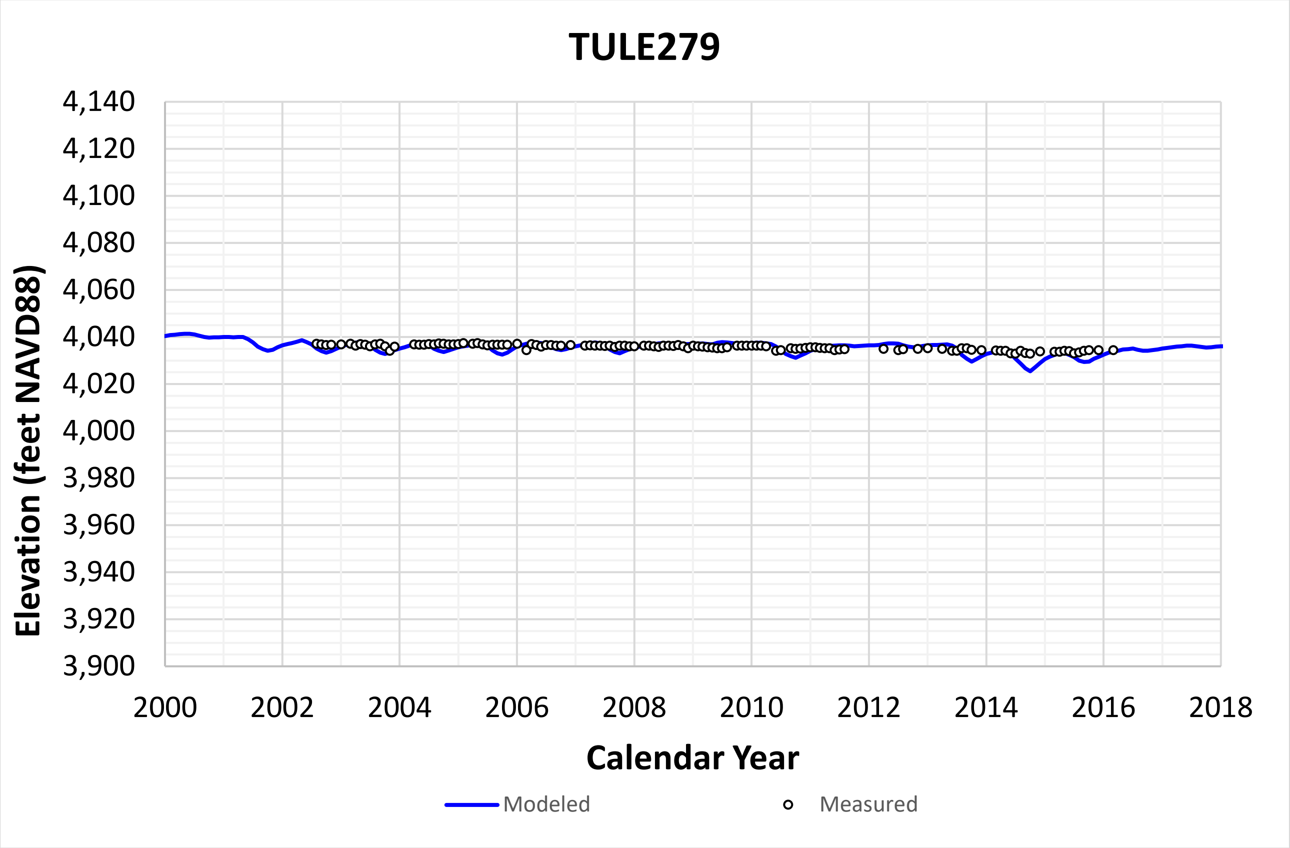
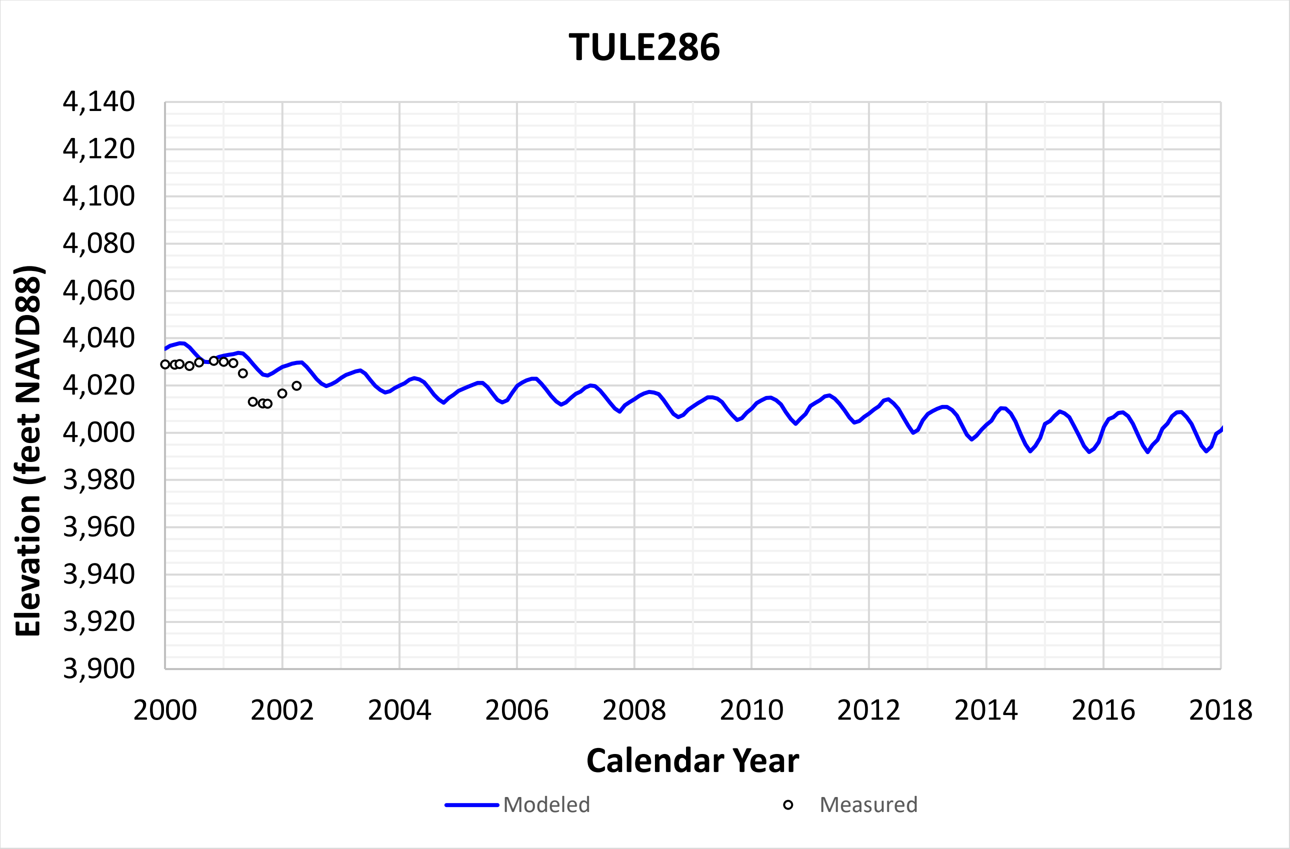


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs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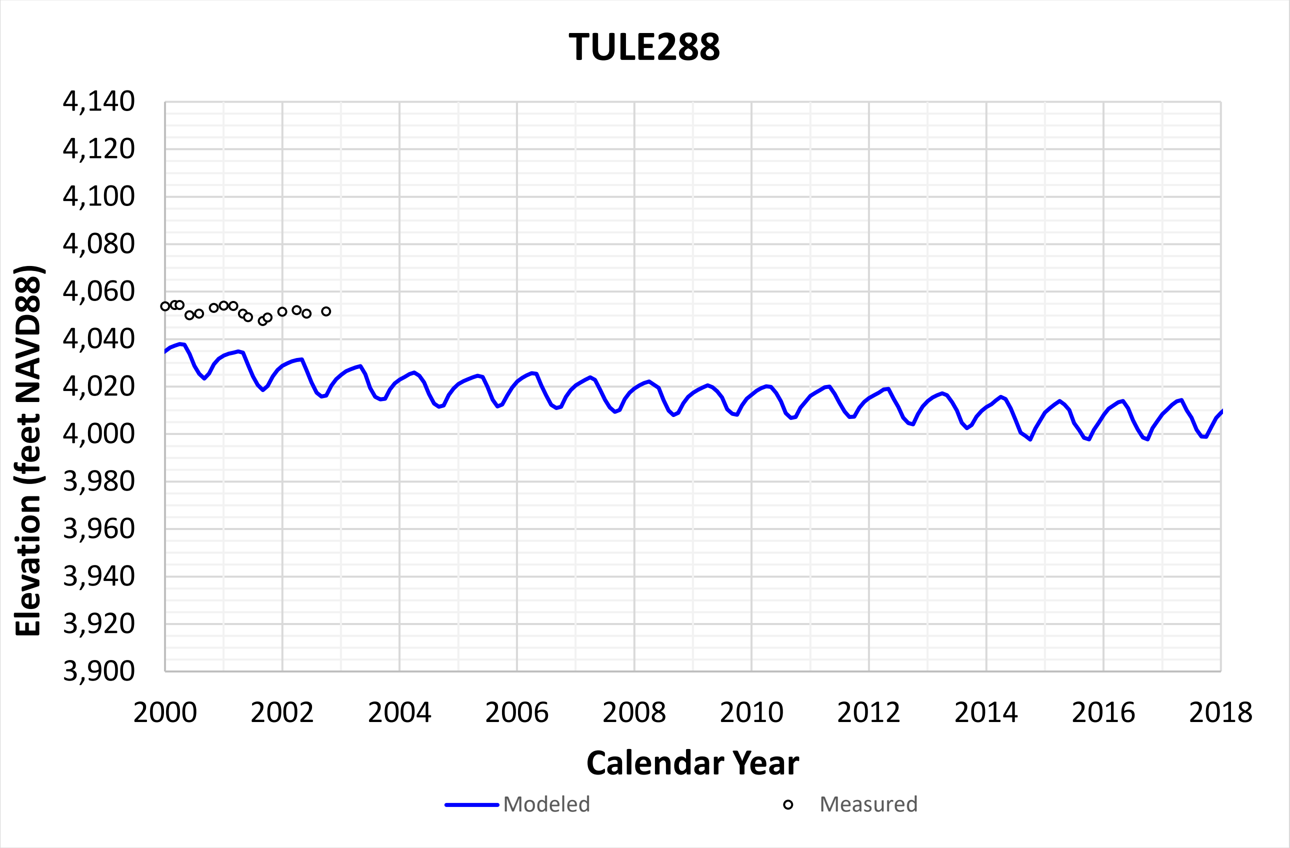
Elevation (feet NAVD88)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Calendar Year
Modeled
Measured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Elevation (feet NAVD88)
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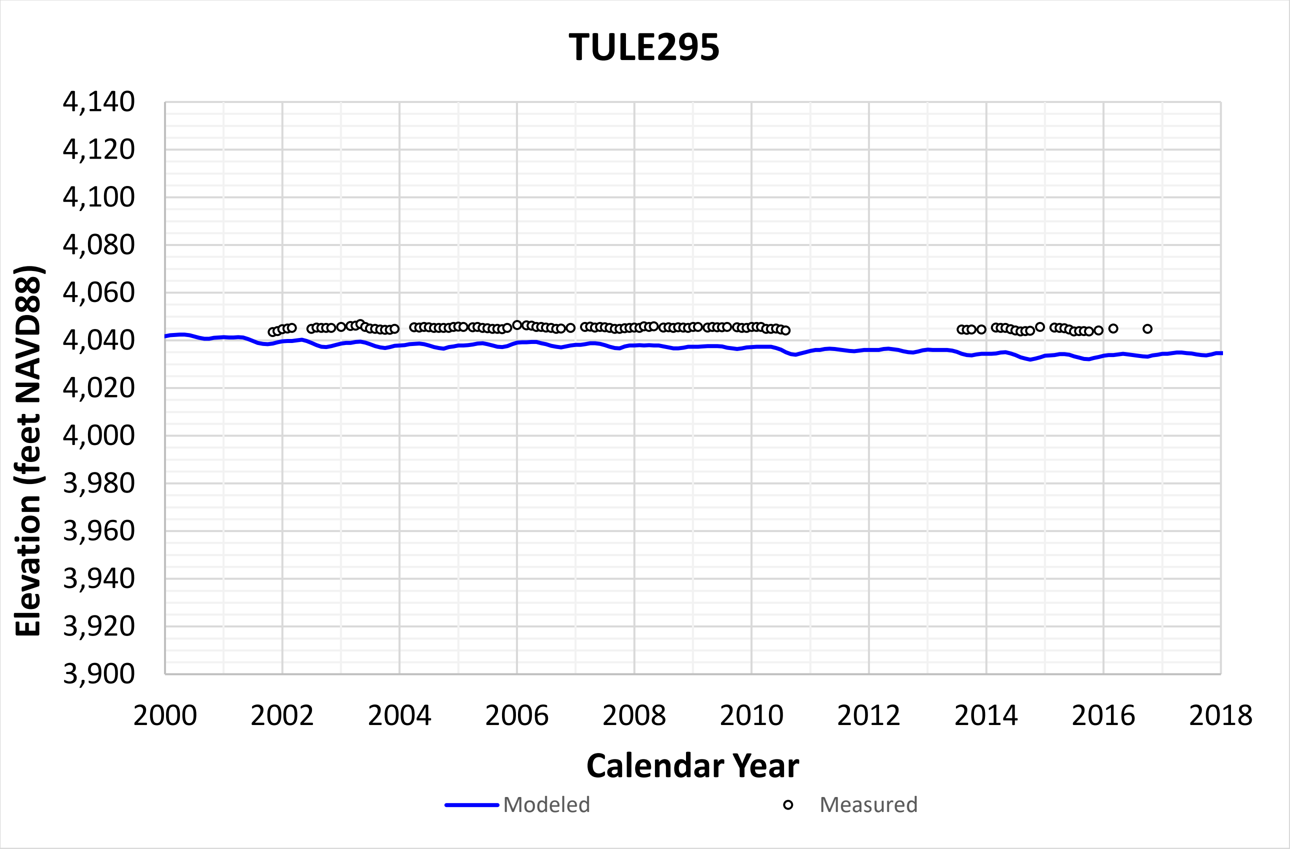
Calendar Year
Modeled
Measured



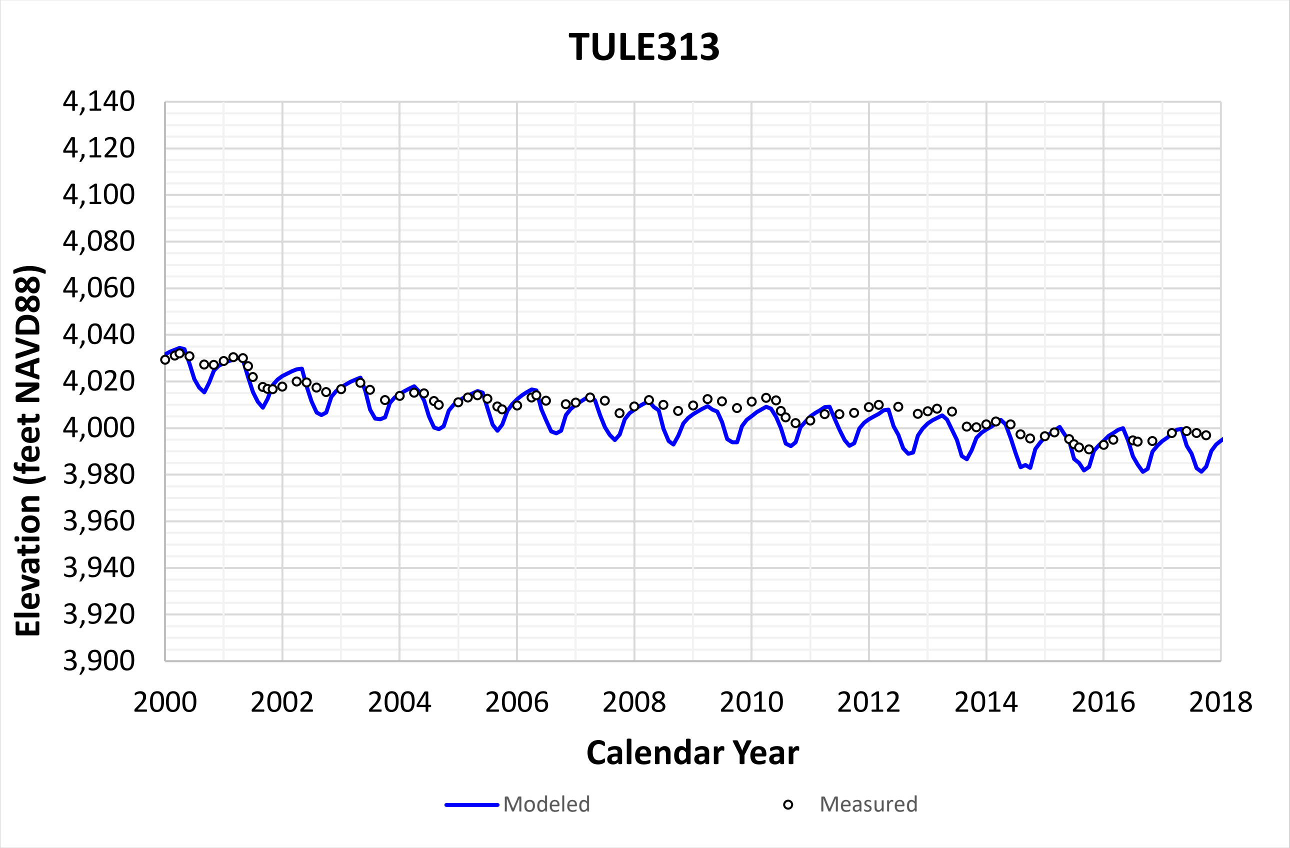
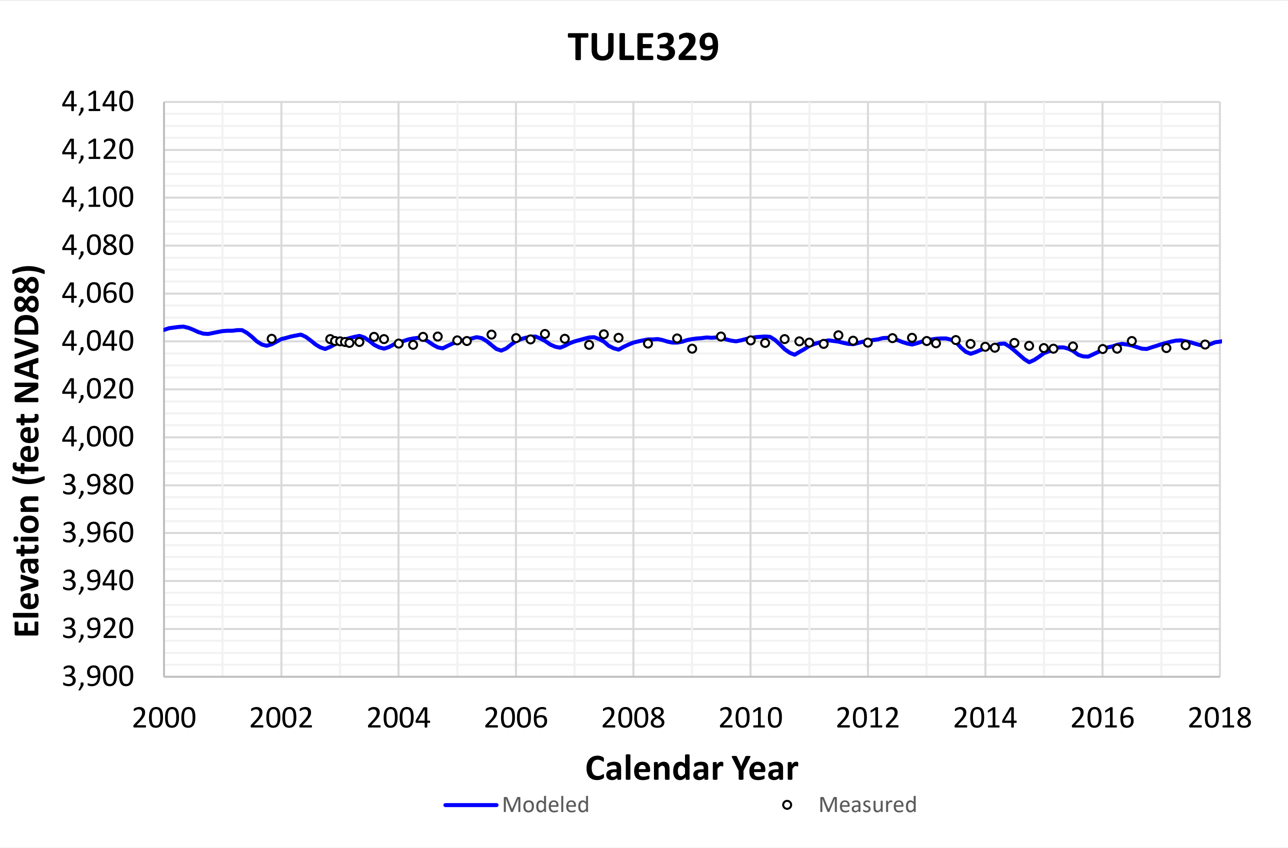


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs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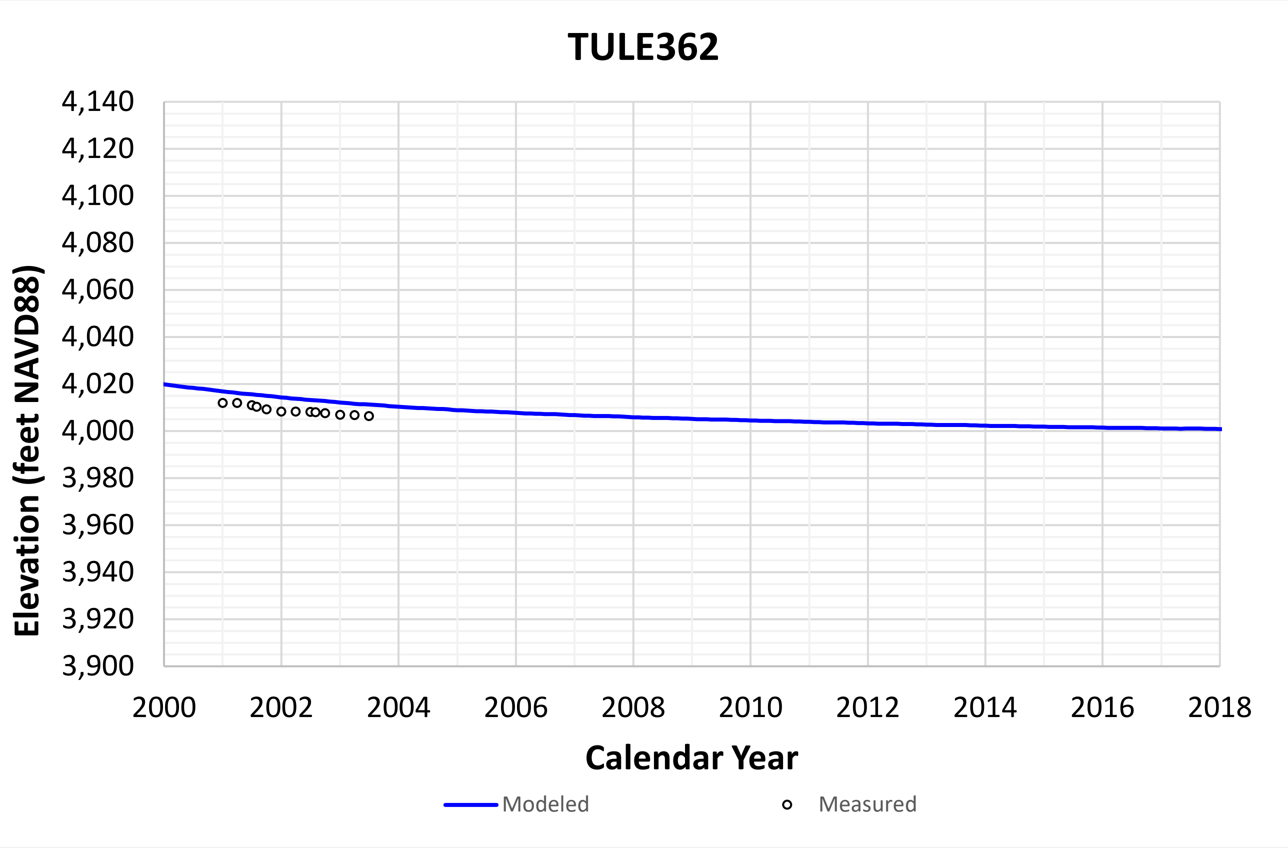
Elevation (feet NAVD88)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Calendar Year
Modeled
Measured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Elevation (feet NAVD88)
2000
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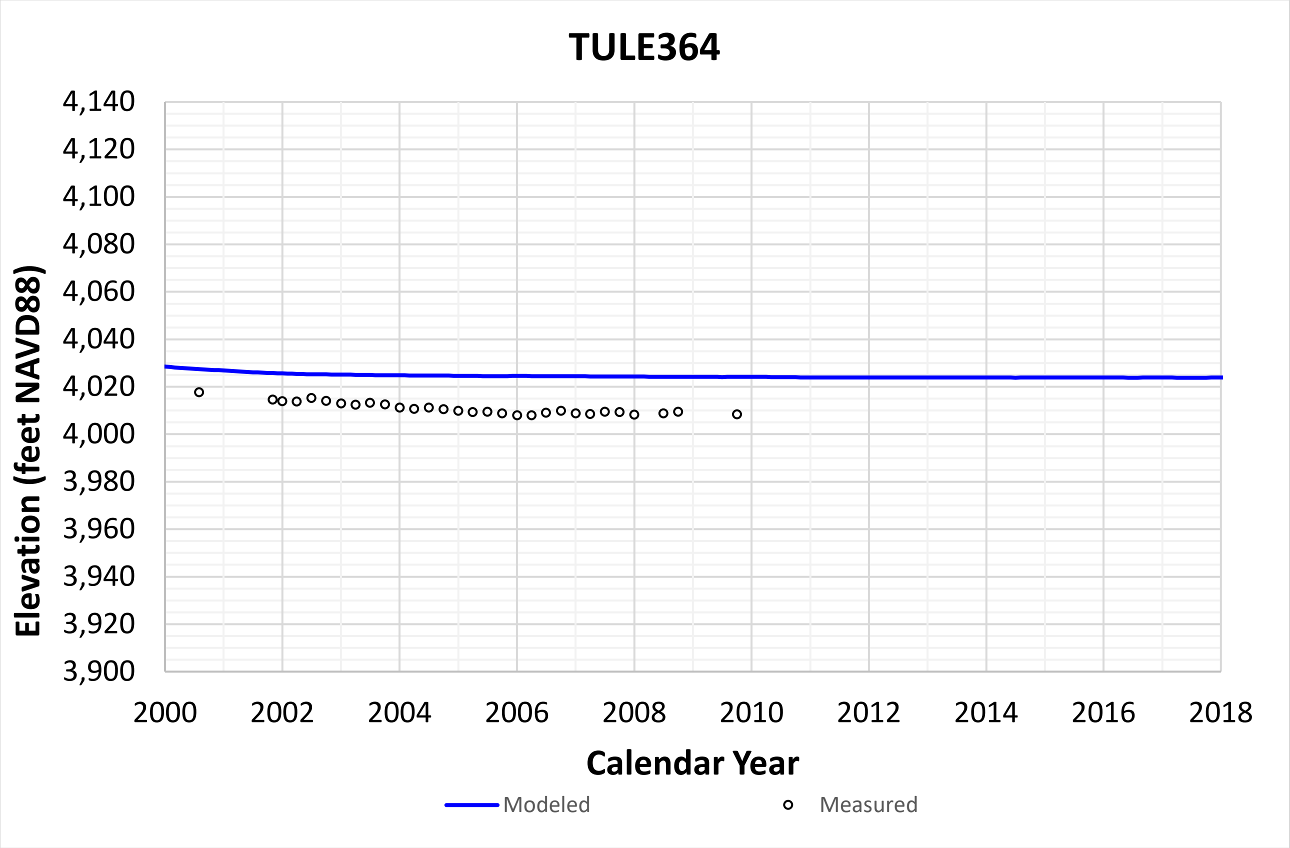
2018
Calendar Year
Modeled
Measured



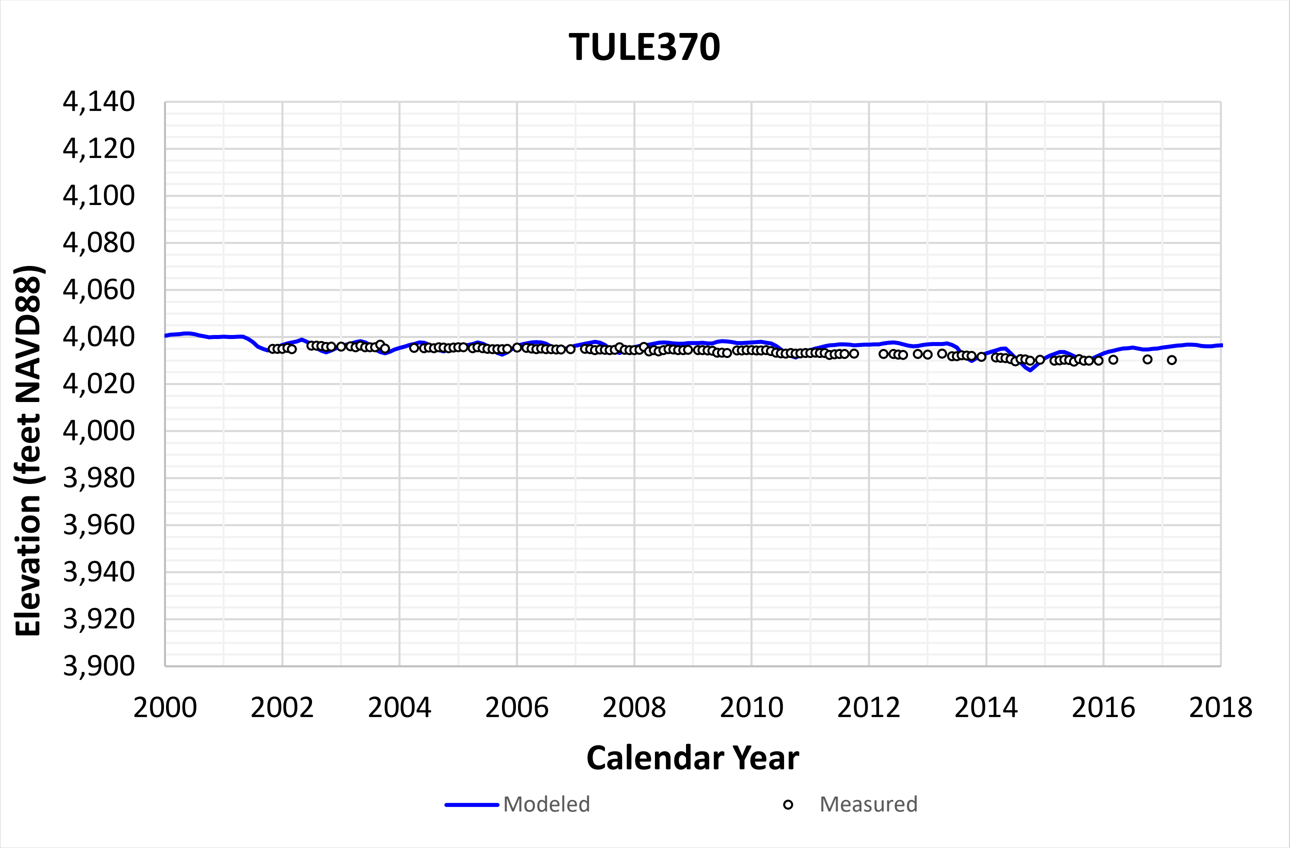
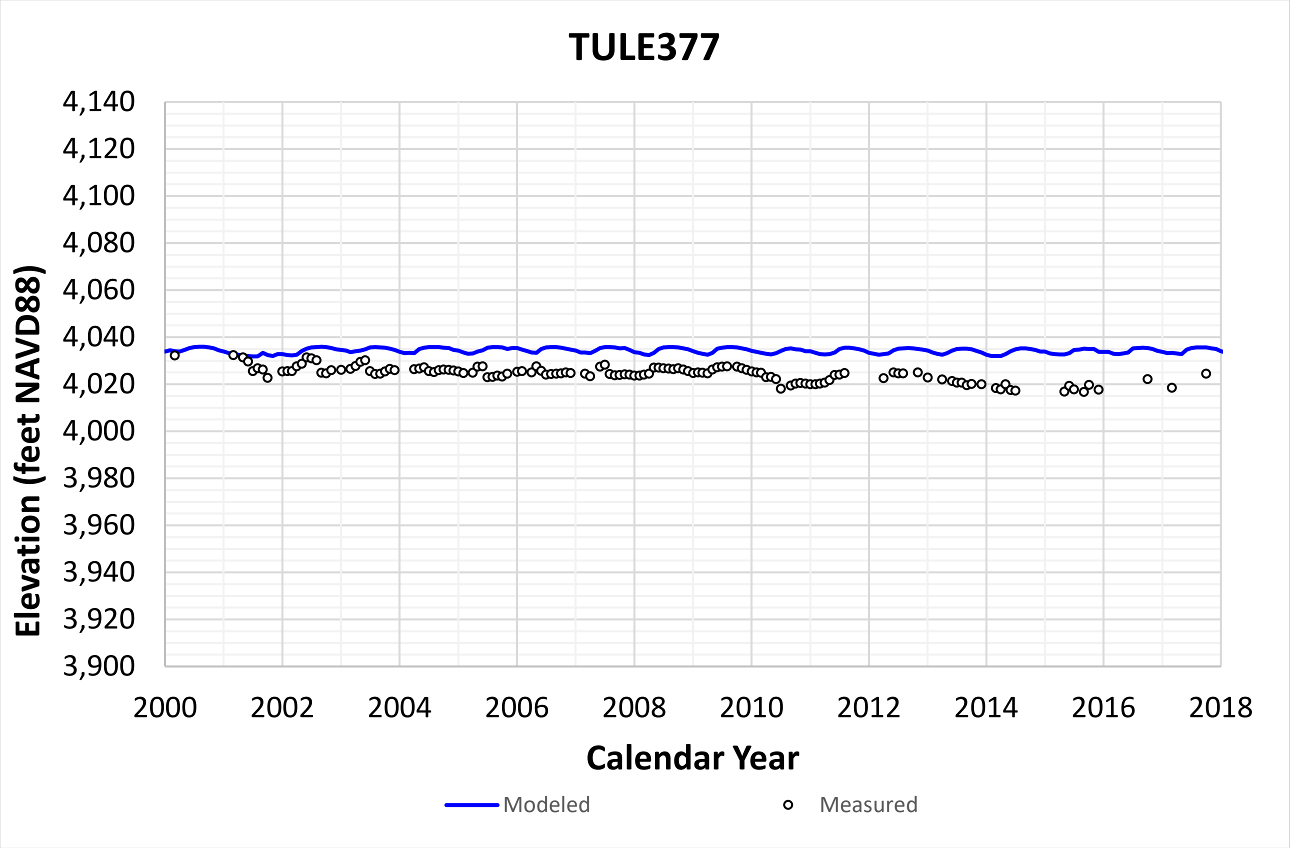


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



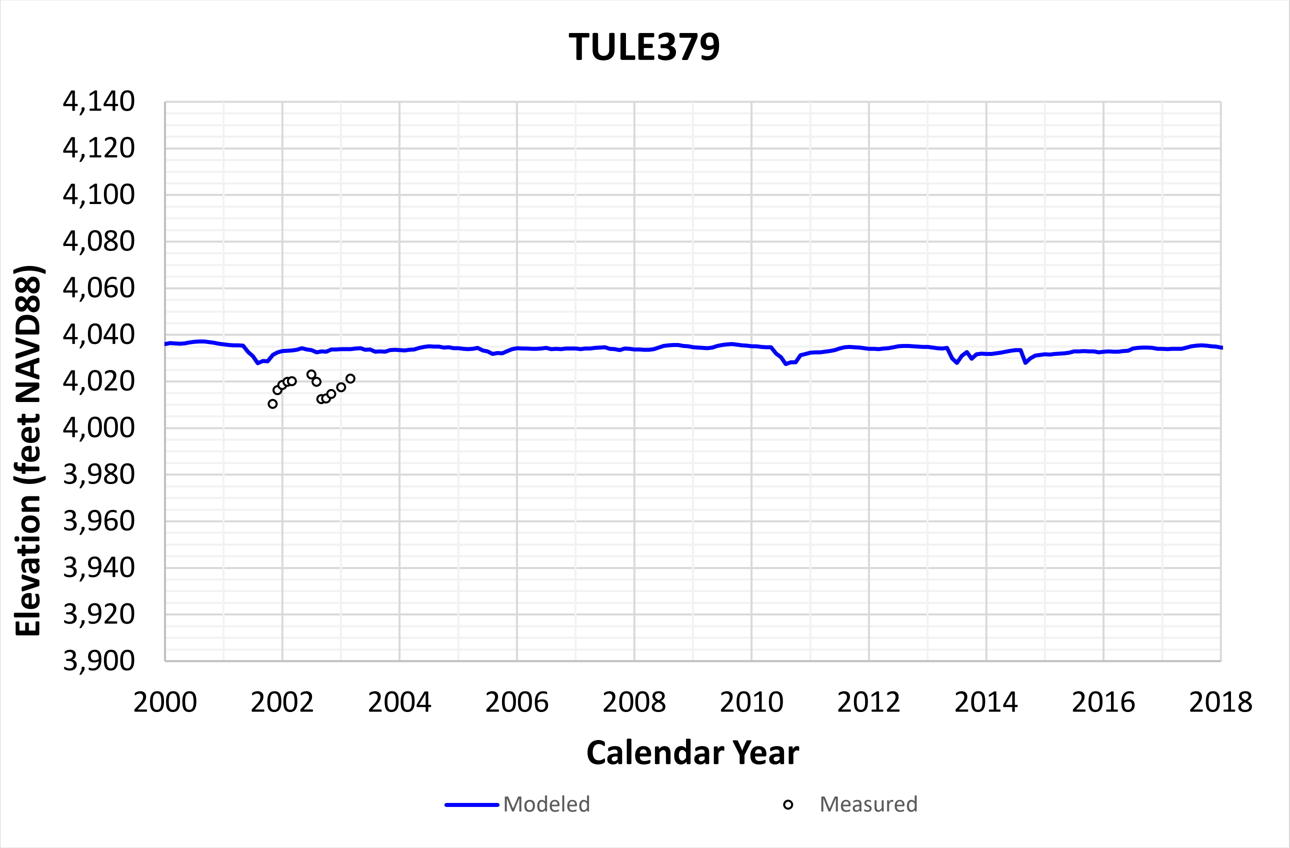
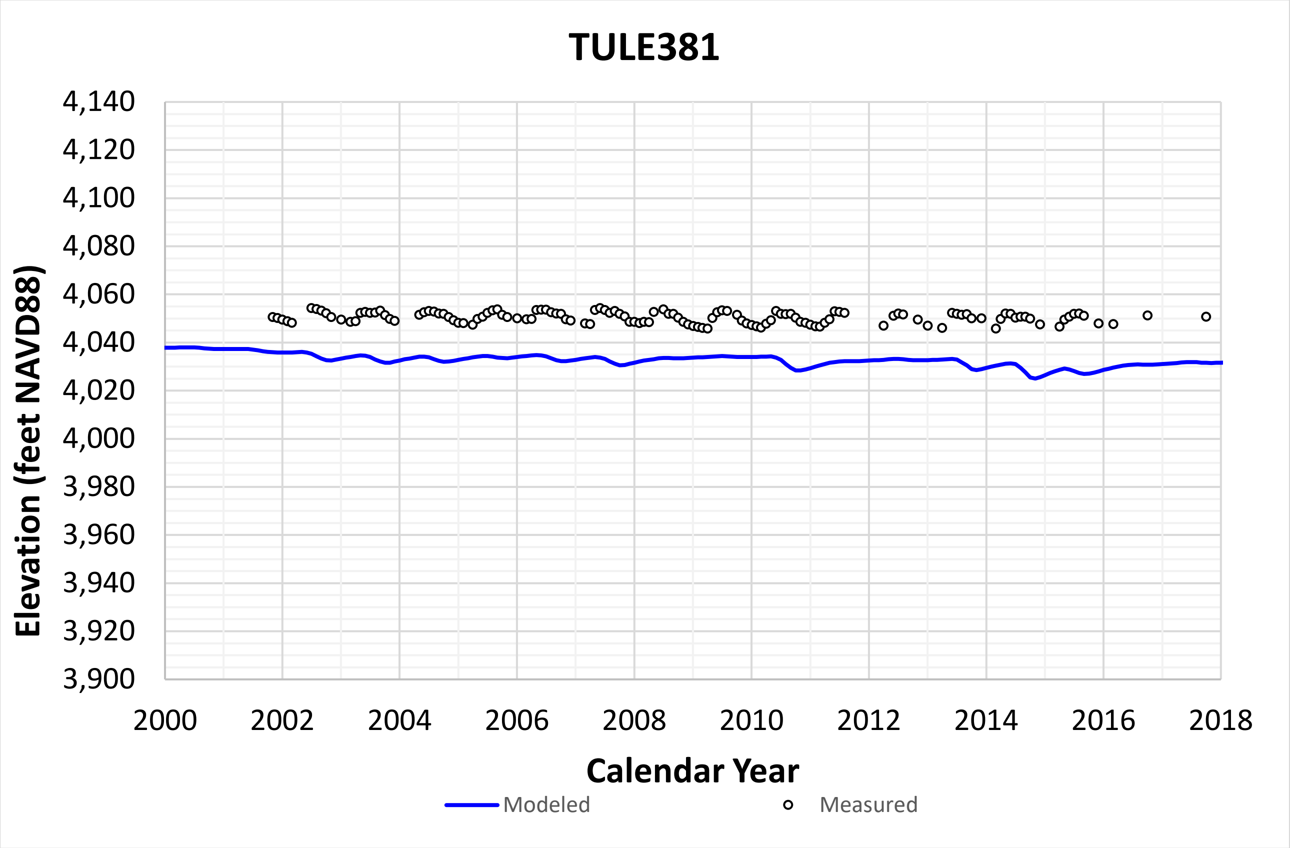


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



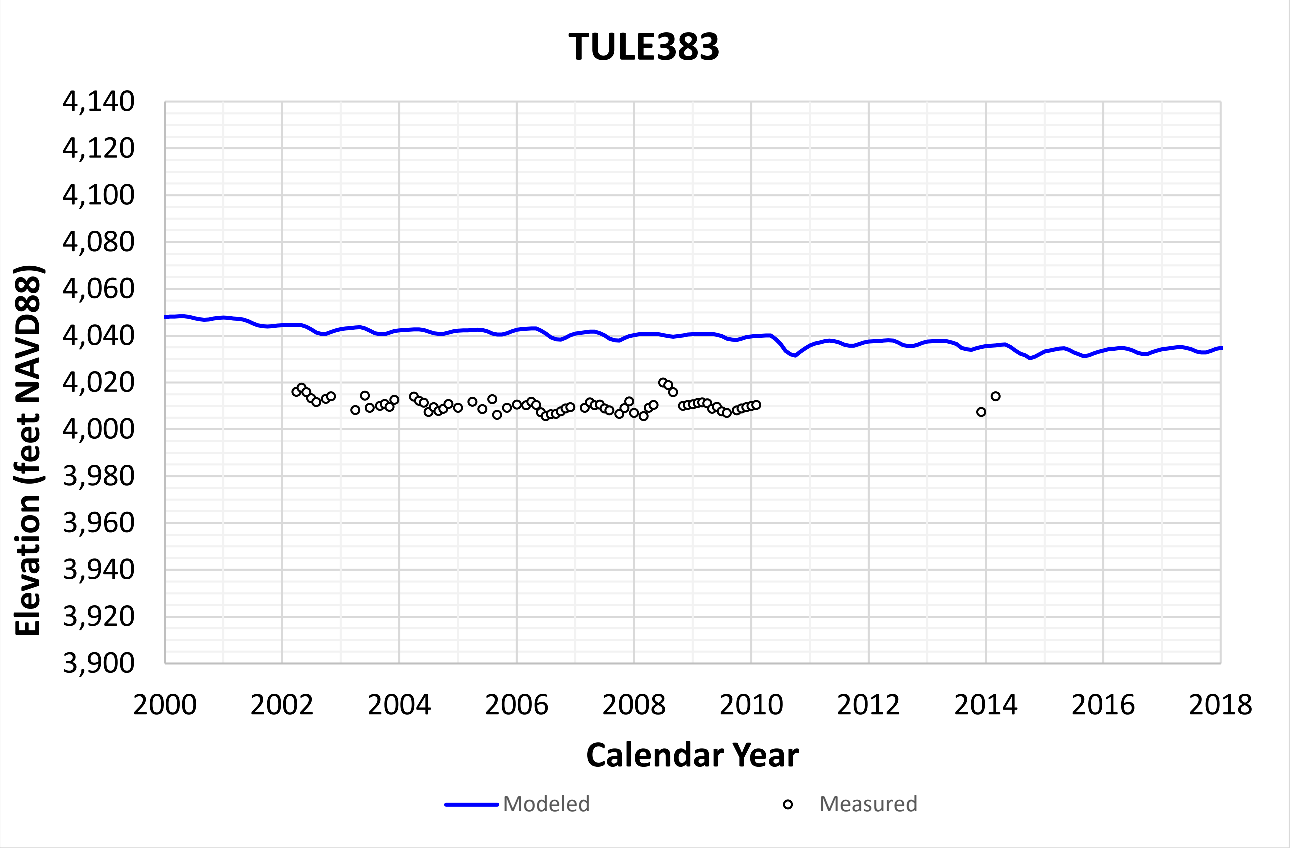
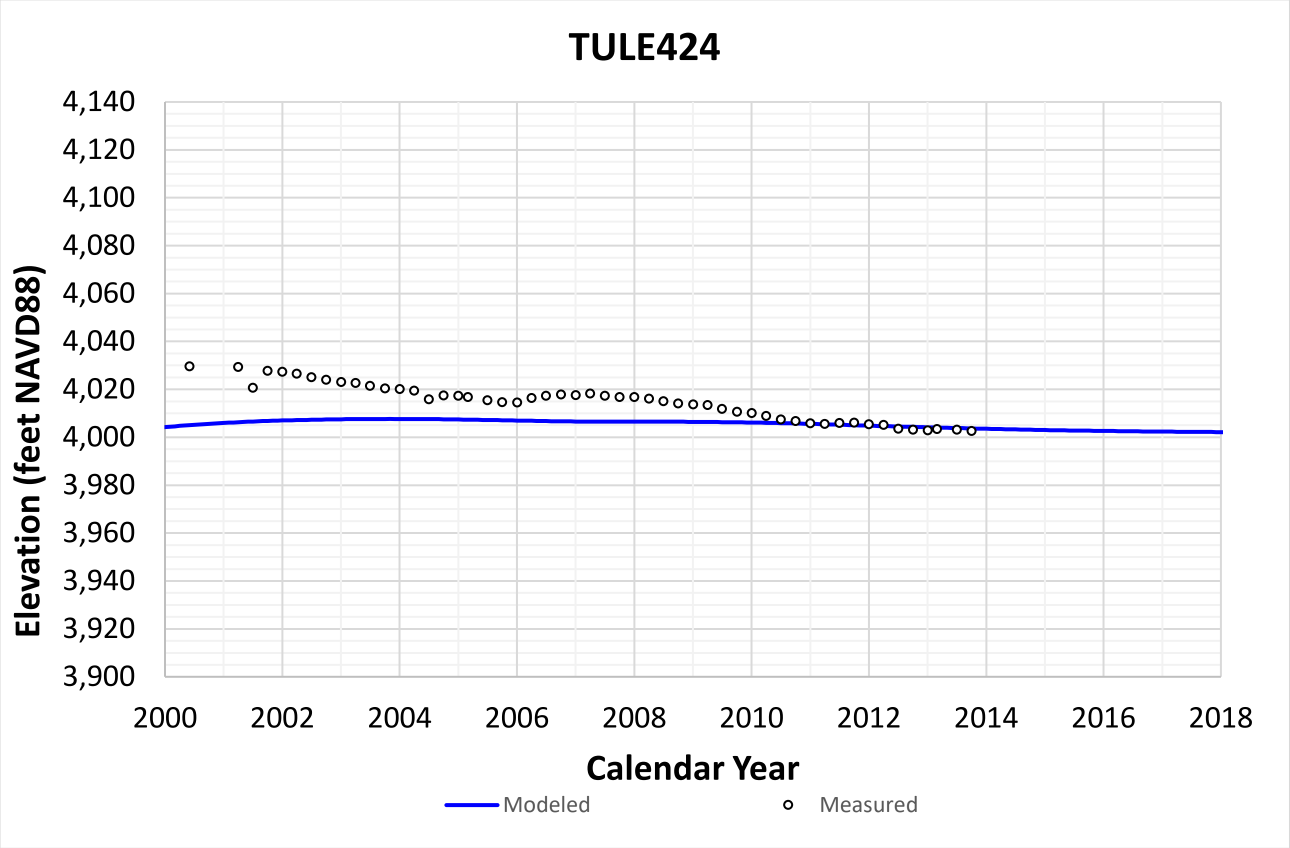


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



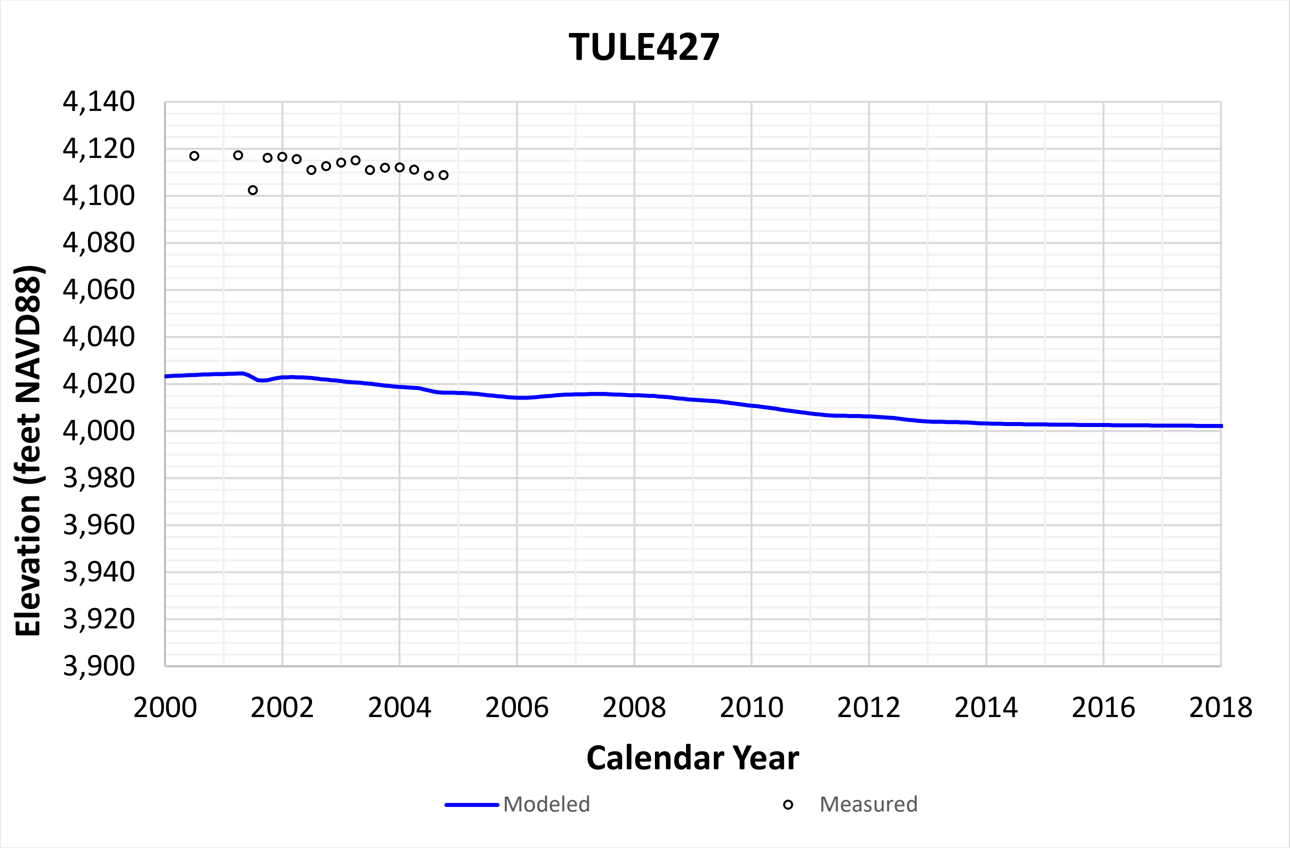
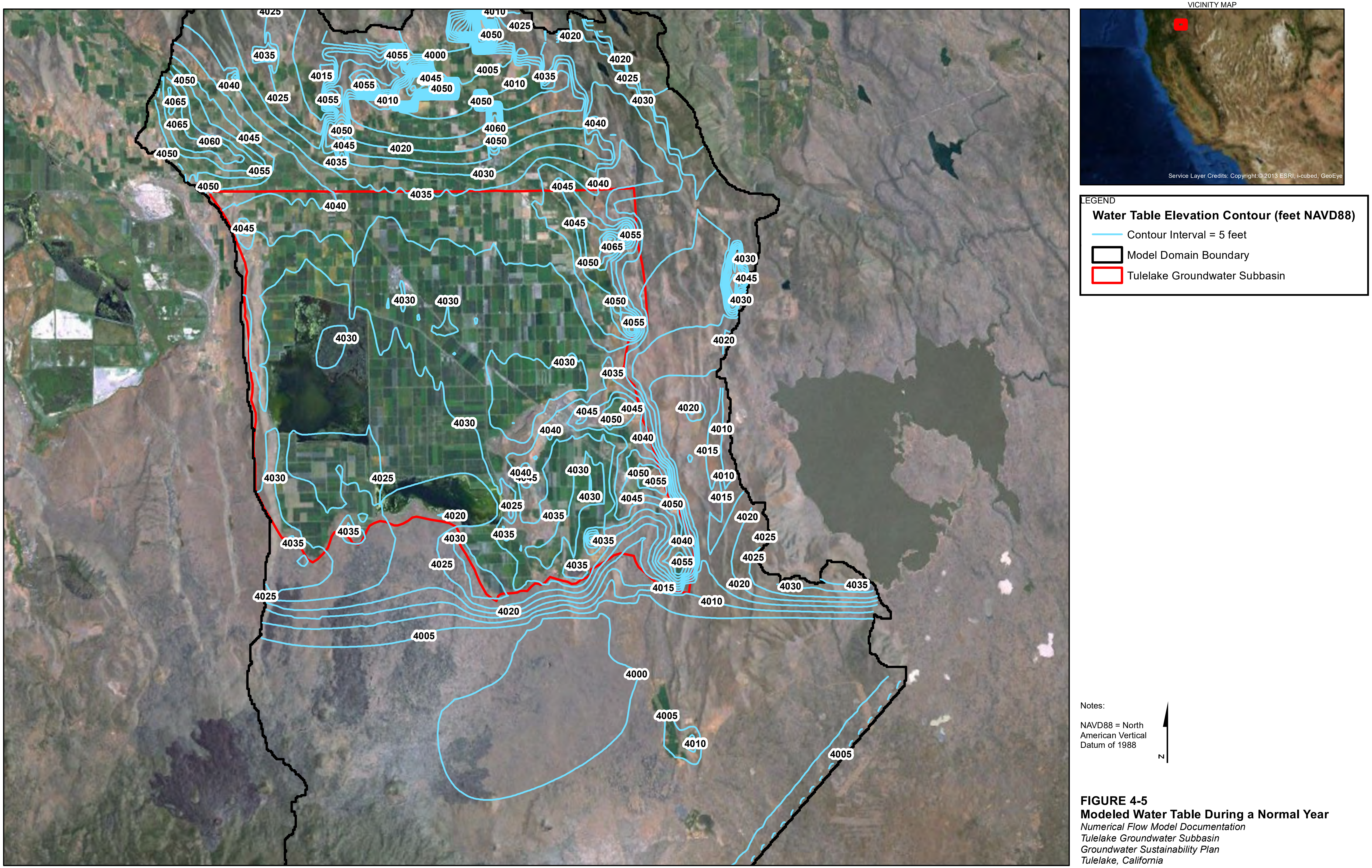


Figure 4-4
Modeled versus Measured Groundwater Elevation Hydrographs



Notes:

NAVD88 = North American Vertical Datum of 1988

FIGURE 4-5
Modeled Water Table During a Normal Year
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

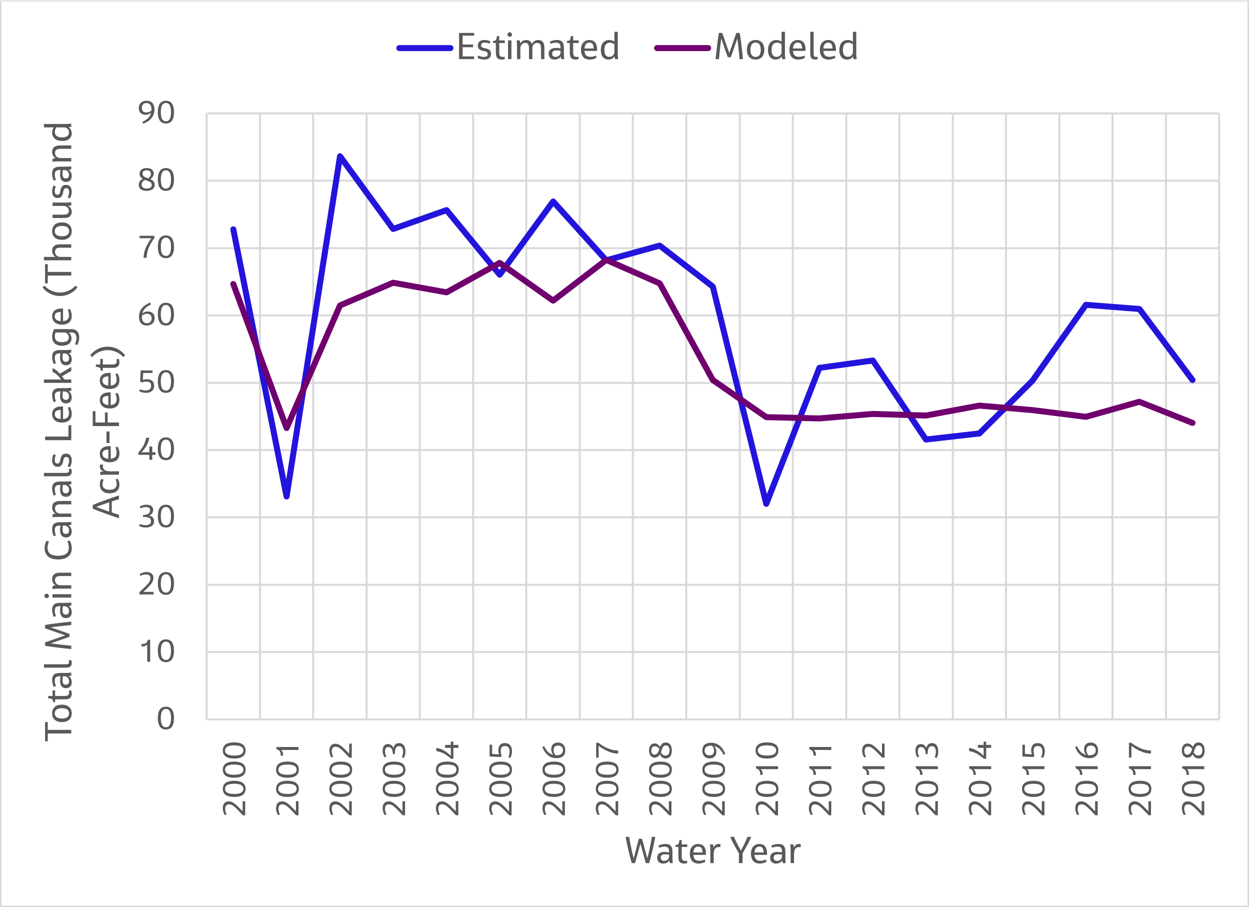
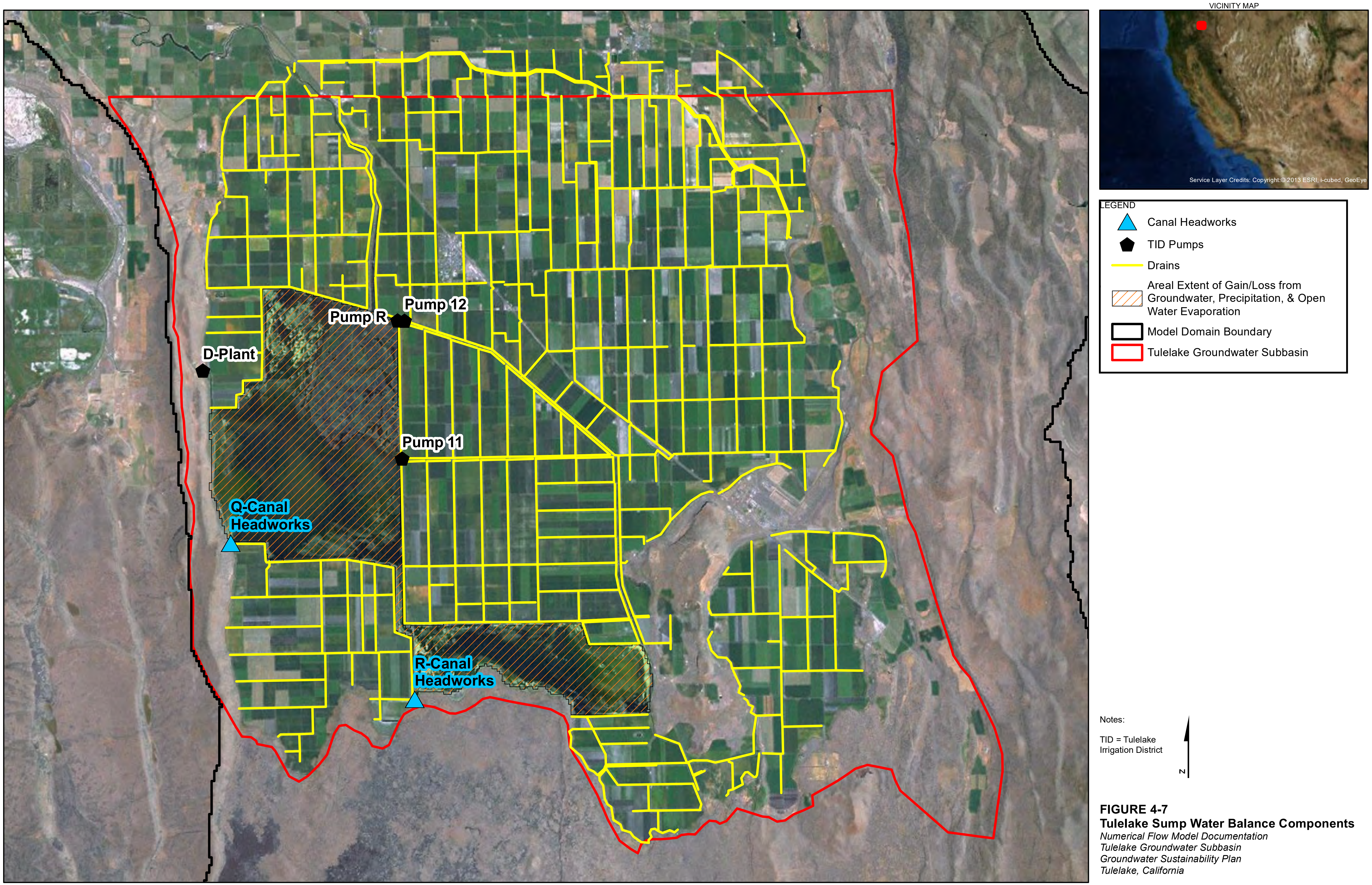


Figure 4-6 – Simulated Versus Estimated Main Canal Leakage



Notes:

TID = Tulelake Irrigation District

FIGURE 4-7
Tulelake Sump Water Balance Components
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

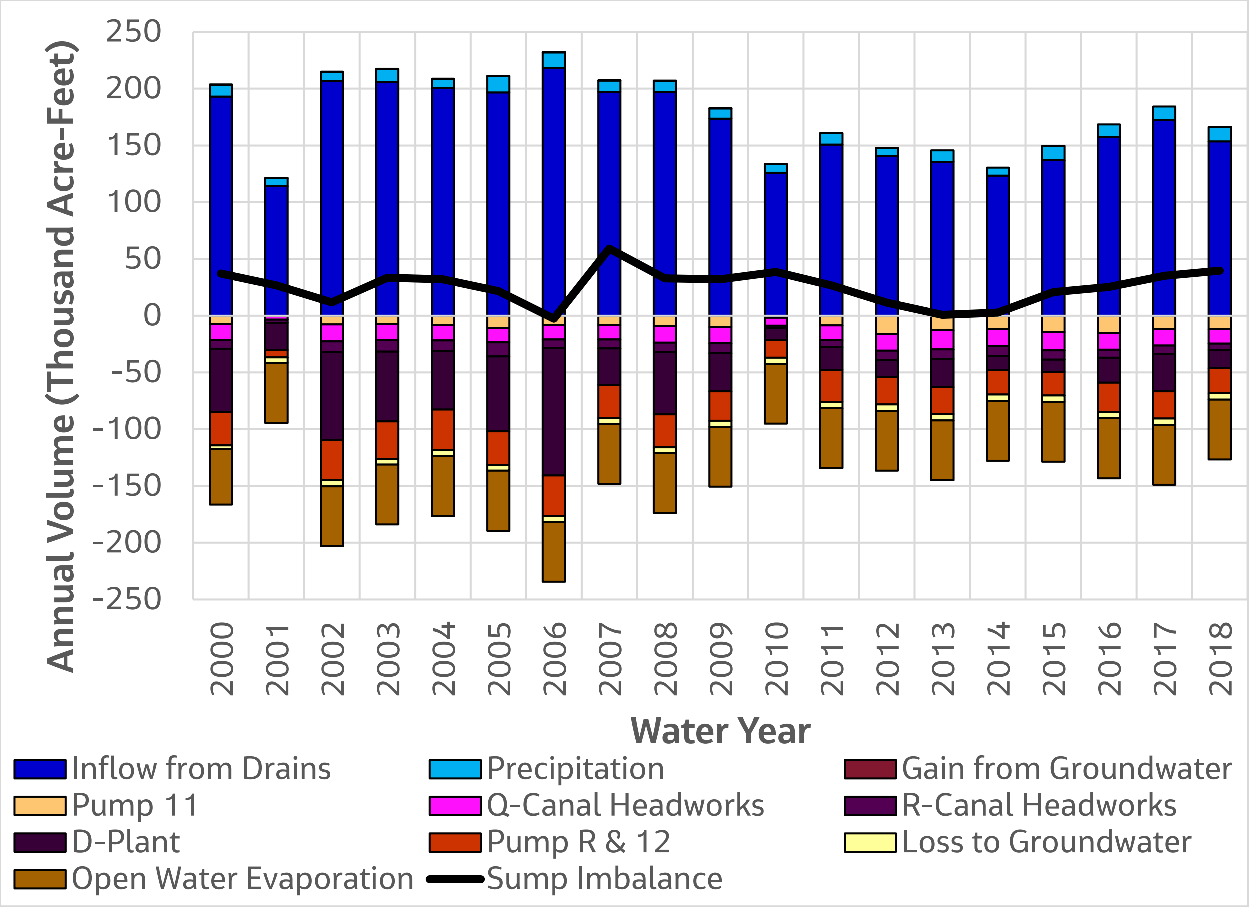
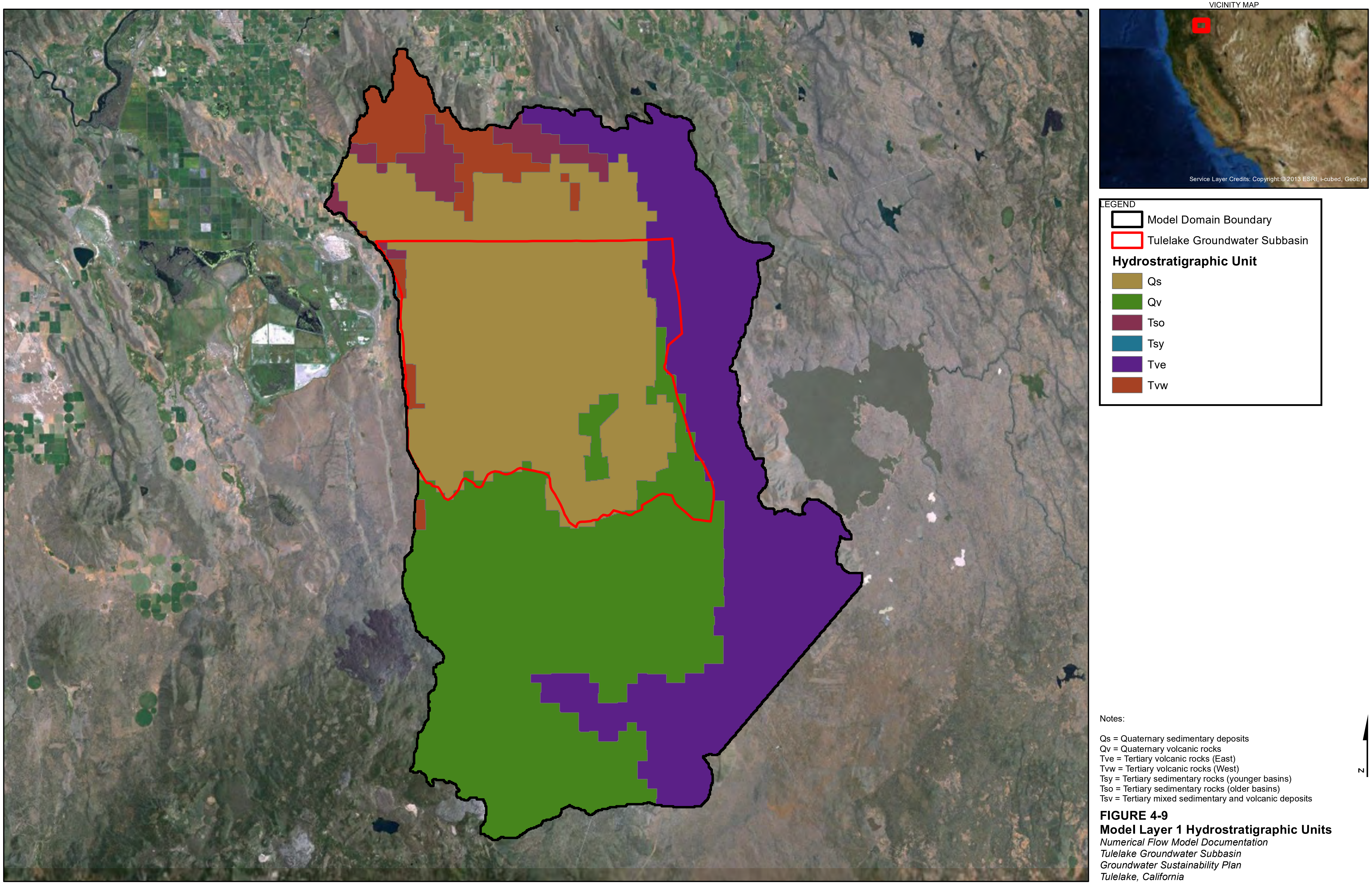


Figure 4-8 – Annual Sump Water Balance

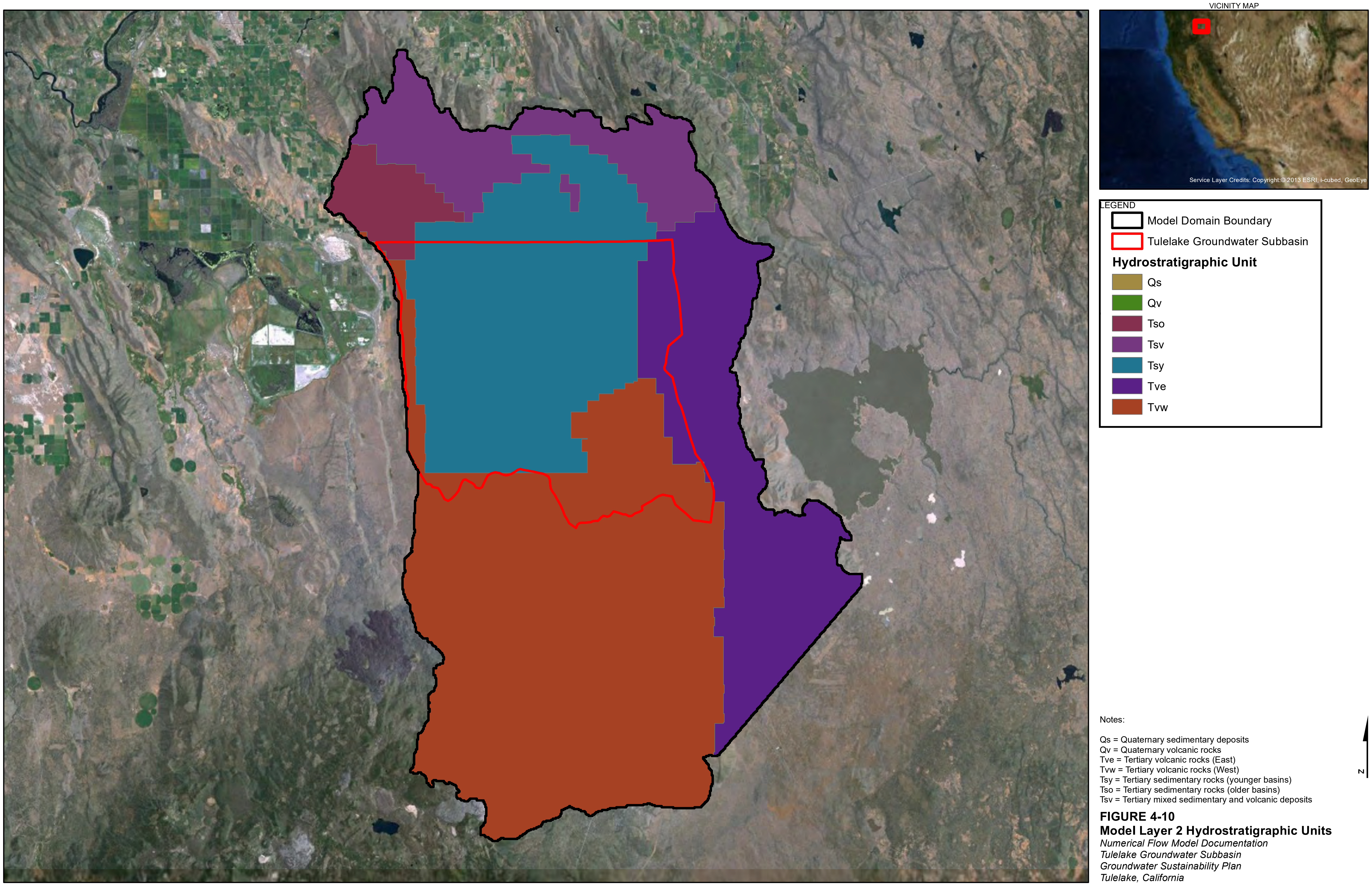


Notes:

Qs = Quaternary sedimentary deposits
Qv = Quaternary volcanic rocks
Tve = Tertiary volcanic rocks (East)
Tvw = Tertiary volcanic rocks (West)
Tsy = Tertiary sedimentary rocks (younger basins)
Tso = Tertiary sedimentary rocks (older basins)
Tsv = Tertiary mixed sedimentary and volcanic deposits

FIGURE 4-9
Model Layer 1 Hydrostratigraphic Units
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

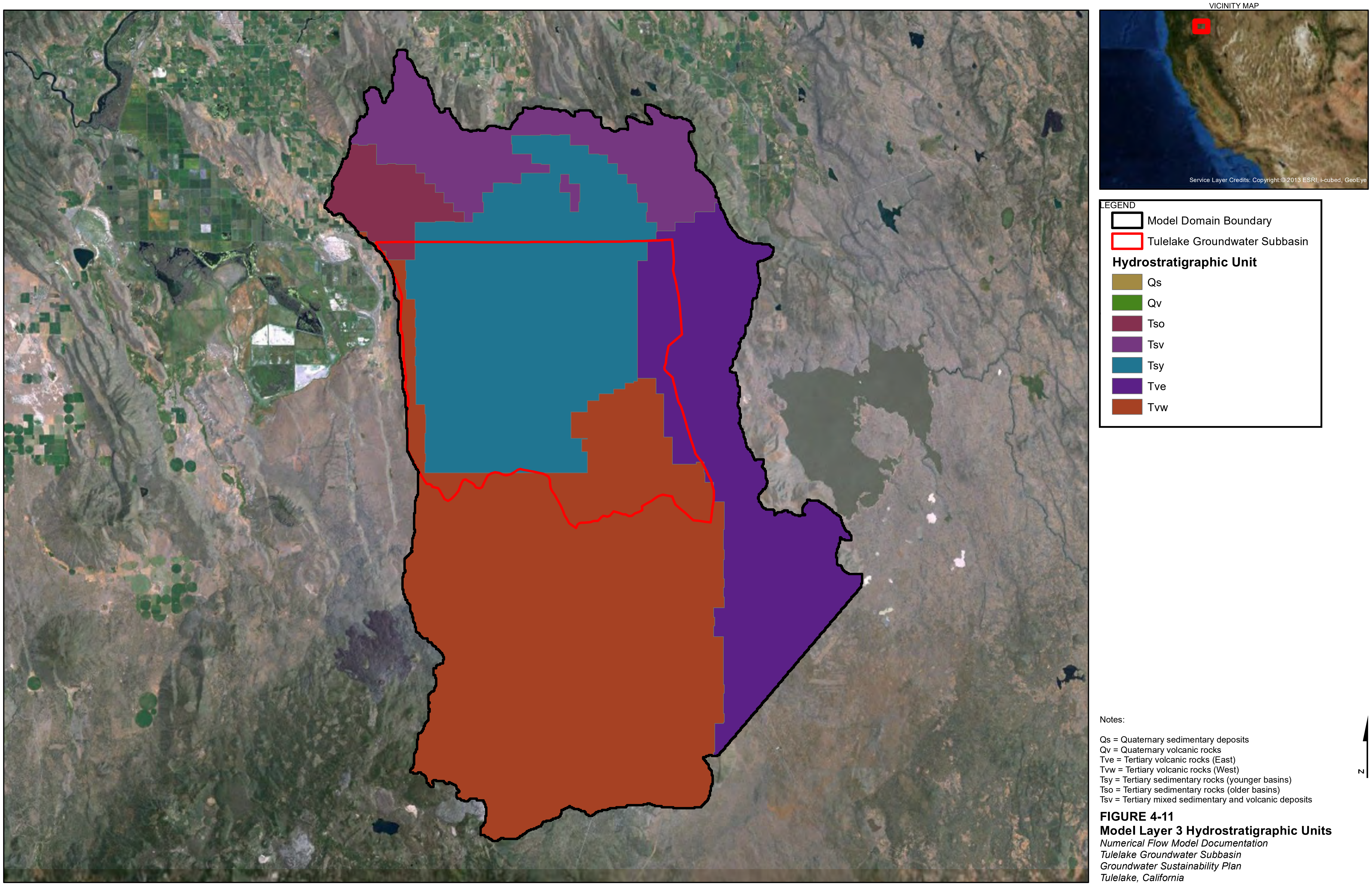
JACOBS



Notes:

Qs = Quaternary sedimentary deposits
Qv = Quaternary volcanic rocks
Tve = Tertiary volcanic rocks (East)
Tvw = Tertiary volcanic rocks (West)
Tsy = Tertiary sedimentary rocks (younger basins)
Tso = Tertiary sedimentary rocks (older basins)
Tsv = Tertiary mixed sedimentary and volcanic deposits

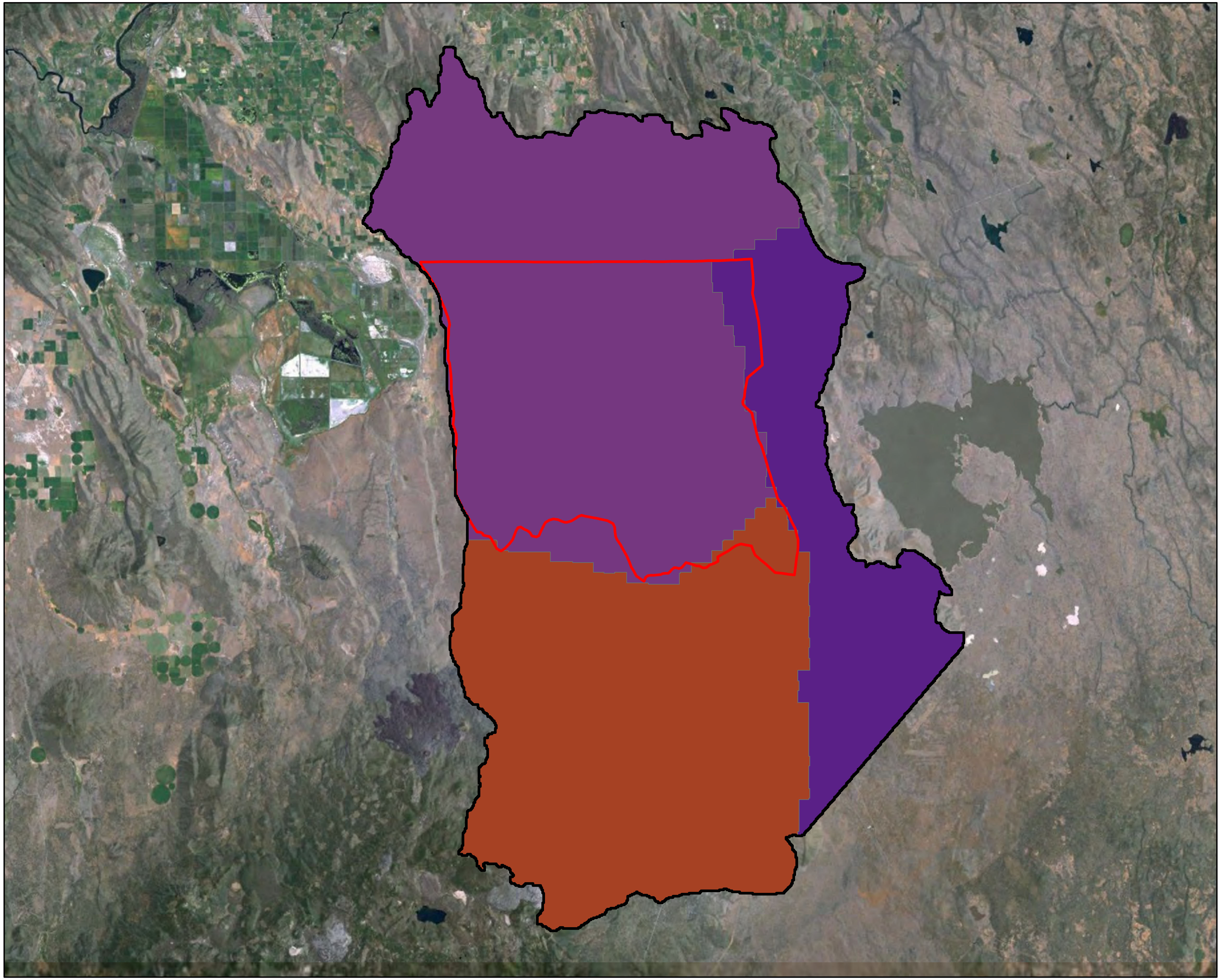
FIGURE 4-10
Model Layer 2 Hydrostratigraphic Units
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



Notes:

Qs = Quaternary sedimentary deposits
Qv = Quaternary volcanic rocks
Tve = Tertiary volcanic rocks (East)
Tvw = Tertiary volcanic rocks (West)
Tsy = Tertiary sedimentary rocks (younger basins)
Tso = Tertiary sedimentary rocks (older basins)
Tsv = Tertiary mixed sedimentary and volcanic deposits

FIGURE 4-11
Model Layer 3 Hydrostratigraphic Units
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



VICINITY MAP

LEGEND

- ☐ Model Domain Boundary
- 🟥 Tulelake Groundwater Subbasin

Hydrostratigraphic Unit

- ■ Tsv
- ■ Tve
- ■ Tvw

Notes:

Qs = Quaternary sedimentary deposits
Qv = Quaternary volcanic rocks
Tve = Tertiary volcanic rocks (East)
Tvw = Tertiary volcanic rocks (West)
Tsy = Tertiary sedimentary rocks (younger basins)
Tso = Tertiary sedimentary rocks (older basins)
Tsv = Tertiary mixed sedimentary and volcanic deposits

N

FIGURE 4-12
Model Layer 4 Hydrostratigraphic Units
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

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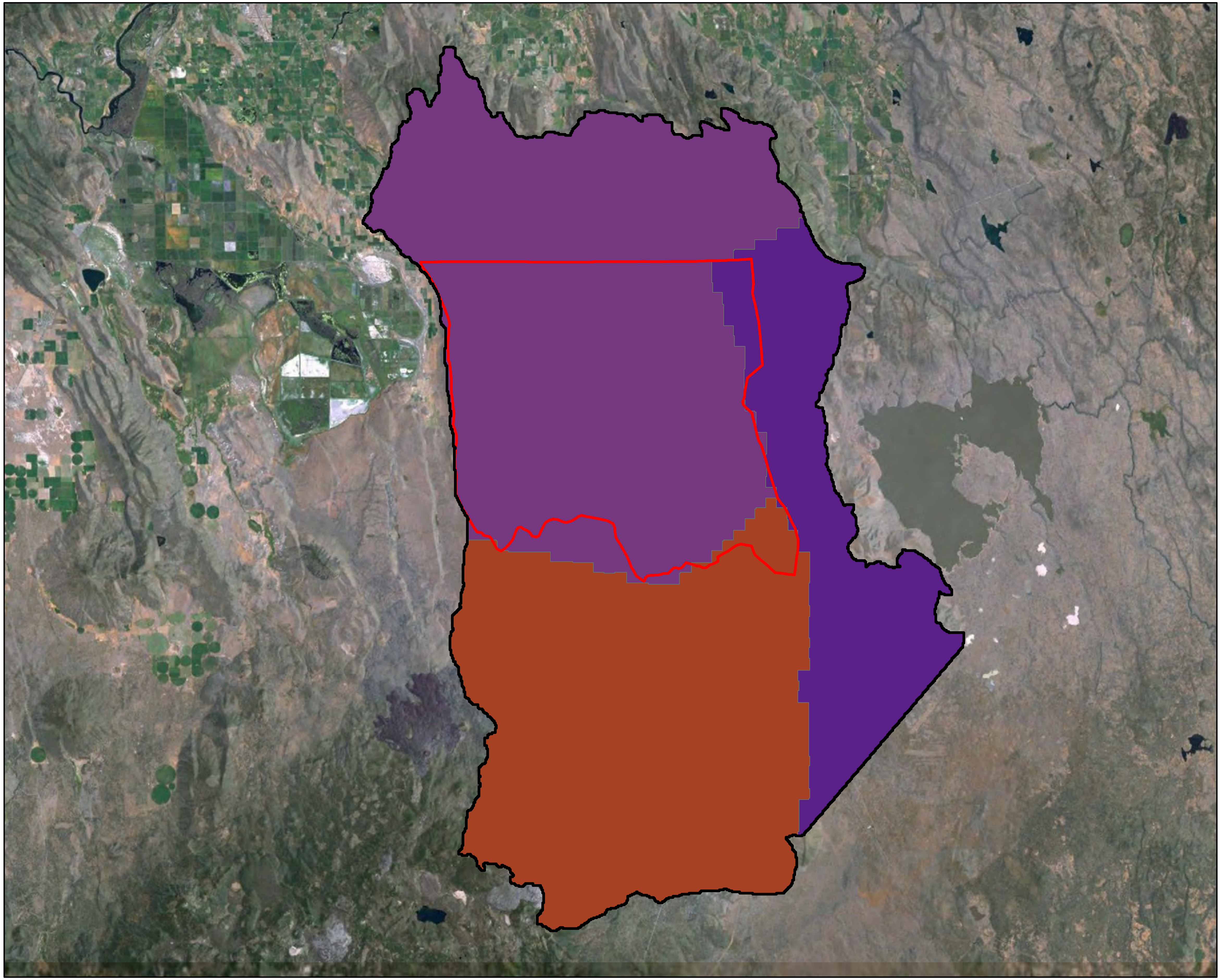

VICINITY MAP

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LEGEND

☐ Model Domain Boundary

🟥 Tulelake Groundwater Subbasin

Hydrostratigraphic Unit

🟪 Tsv

🟪 Tve

🟫 Tvw

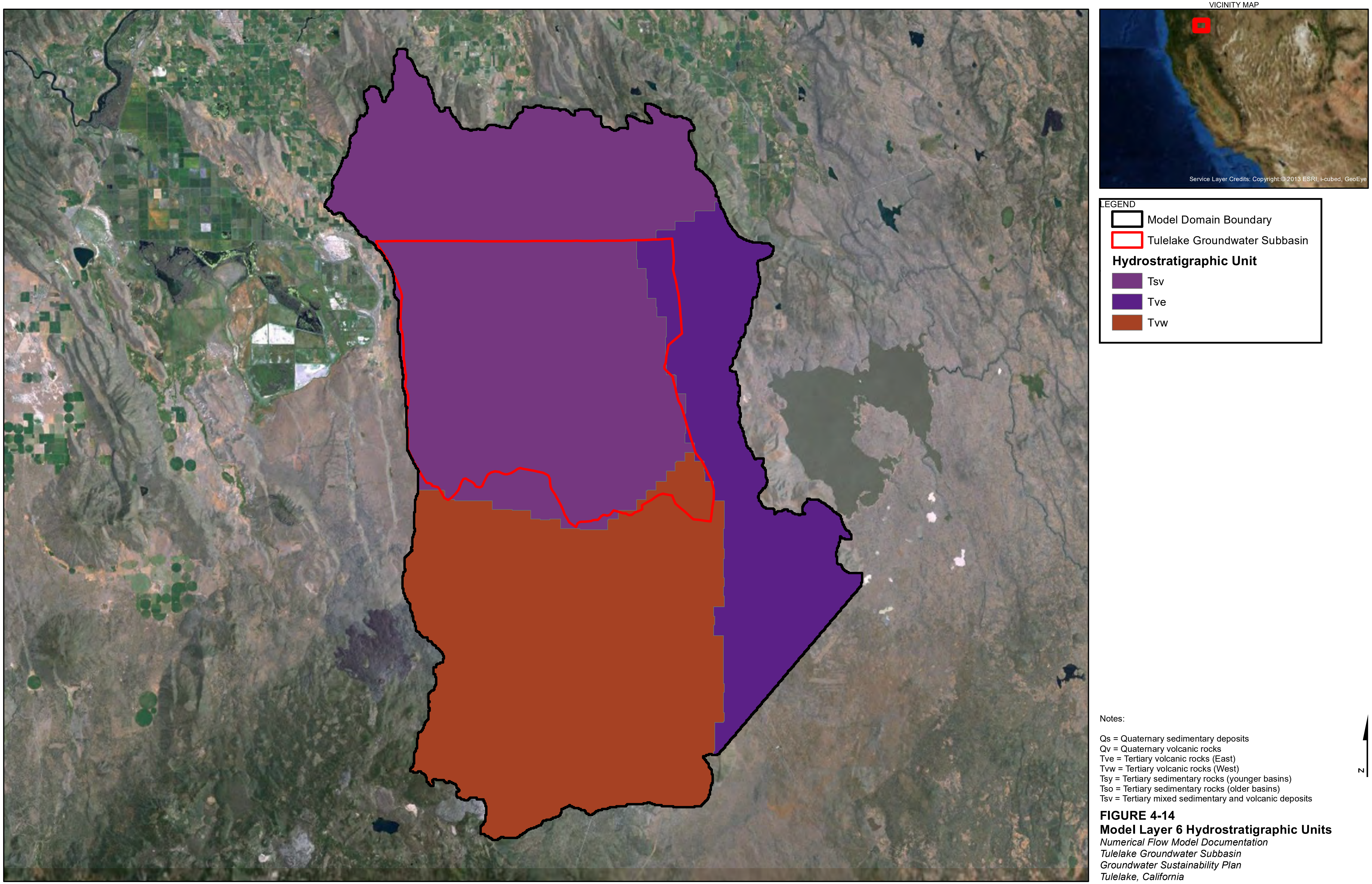
Notes:

Qs = Quaternary sedimentary deposits
Qv = Quaternary volcanic rocks
Tve = Tertiary volcanic rocks (East)
Tvw = Tertiary volcanic rocks (West)
Tsy = Tertiary sedimentary rocks (younger basins)
Tso = Tertiary sedimentary rocks (older basins)
Tsv = Tertiary mixed sedimentary and volcanic deposits

N

FIGURE 4-13
Model Layer 5 Hydrostratigraphic Units

Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California



Notes:

Qs = Quaternary sedimentary deposits
Qv = Quaternary volcanic rocks
Tve = Tertiary volcanic rocks (East)
Tvw = Tertiary volcanic rocks (West)
Tsy = Tertiary sedimentary rocks (younger basins)
Tso = Tertiary sedimentary rocks (older basins)
Tsv = Tertiary mixed sedimentary and volcanic deposits

FIGURE 4-14
Model Layer 6 Hydrostratigraphic Units
Numerical Flow Model Documentation
Tulelake Groundwater Subbasin
Groundwater Sustainability Plan
Tulelake, California

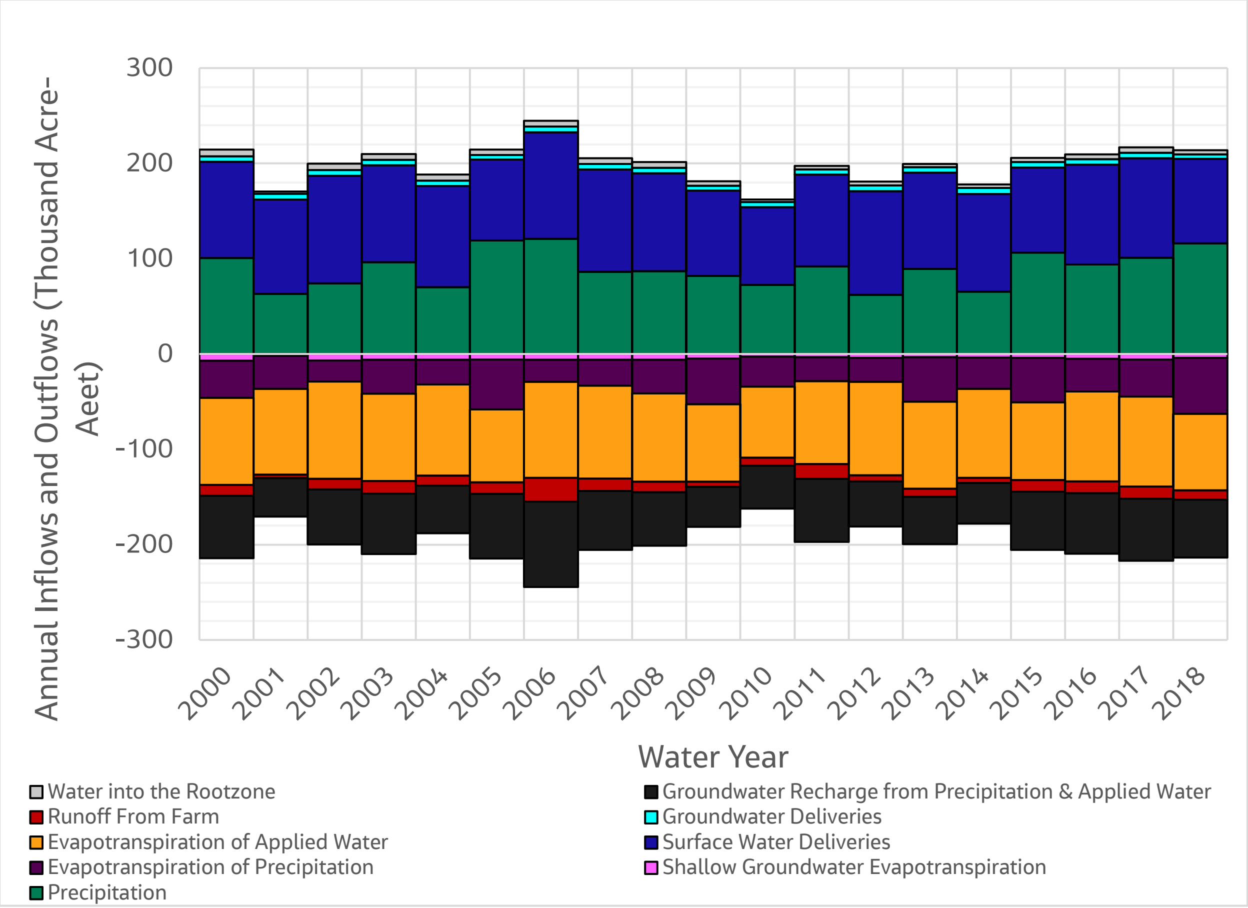


Figure 4-15 – Historical Annual Land Surface Budget

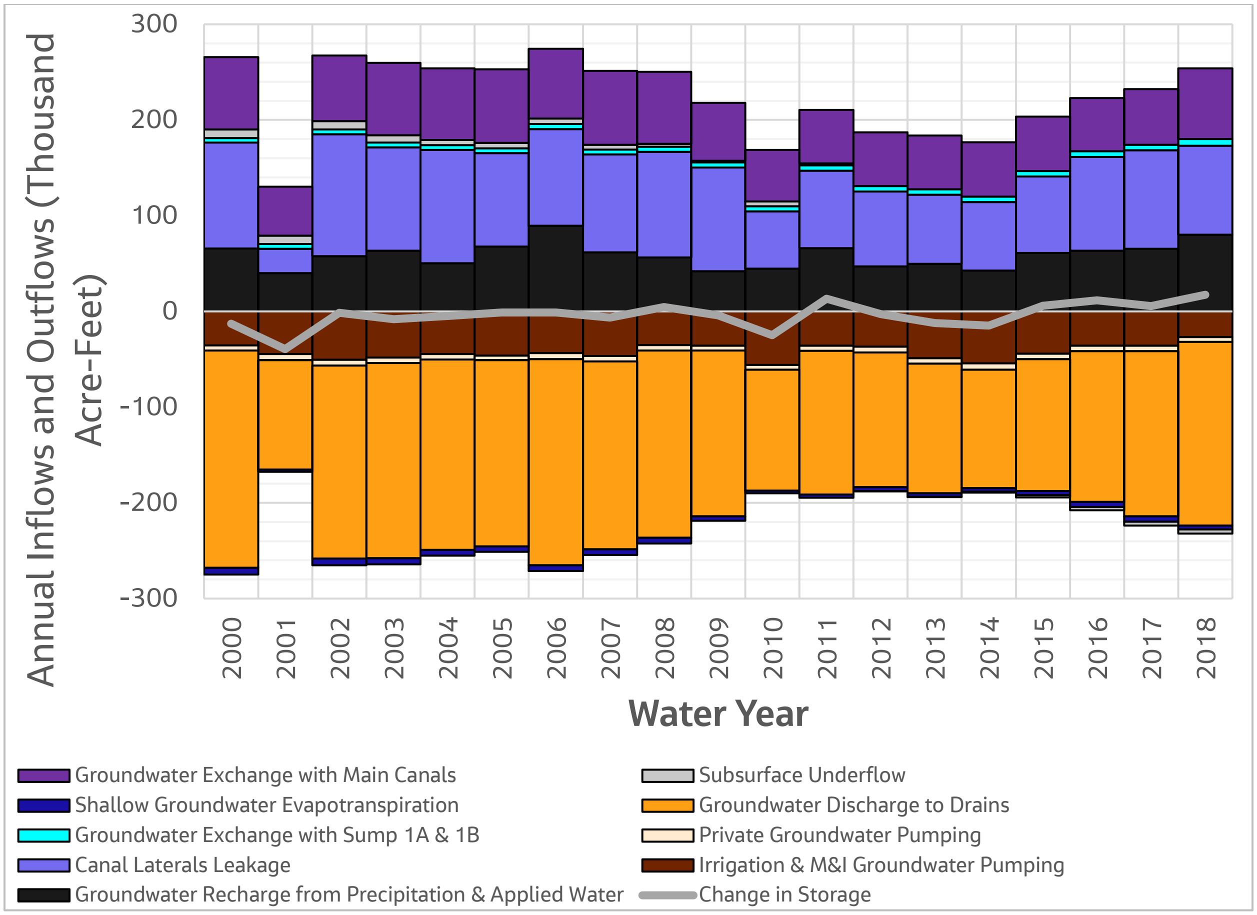


Figure 4-16 – Historical Annual Groundwater System Water Balance

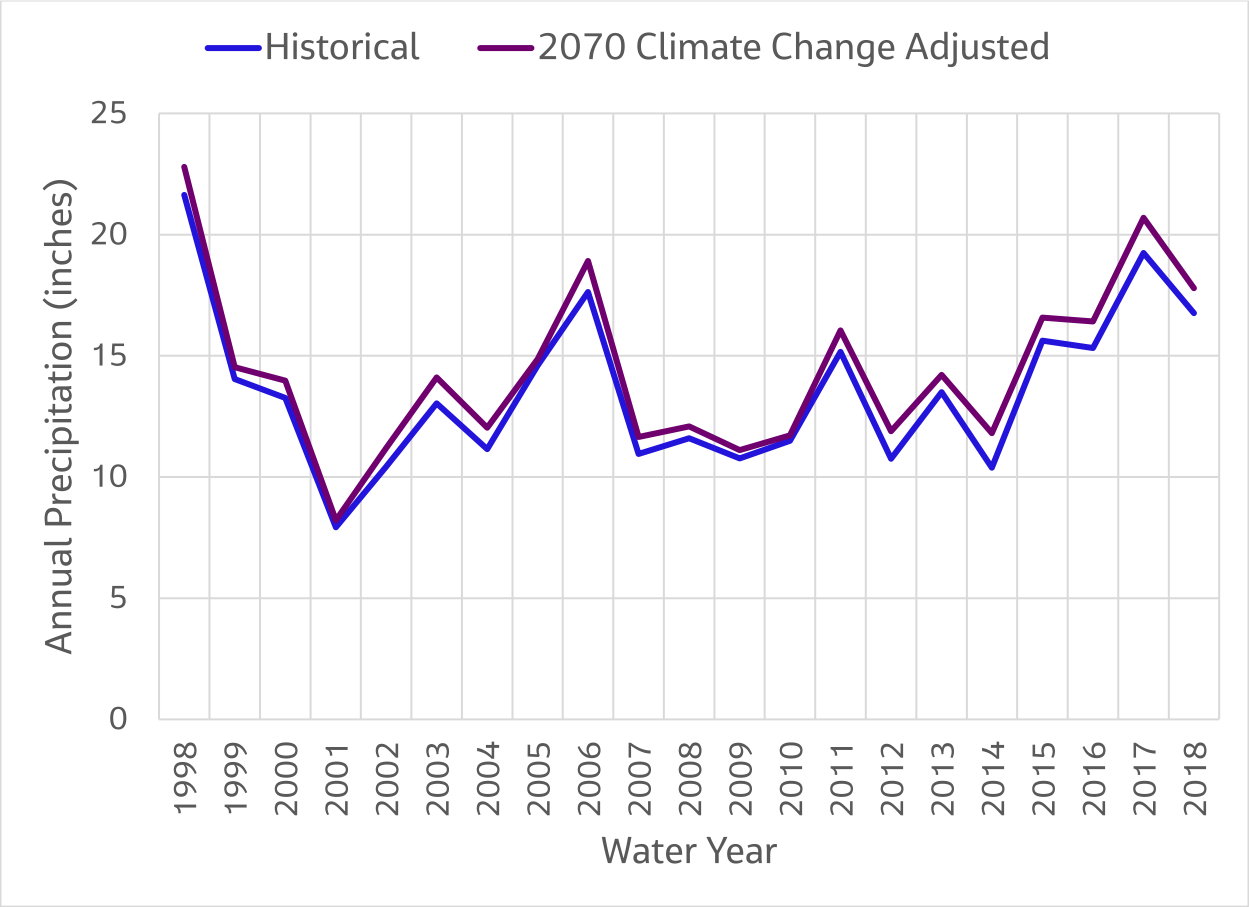


Figure 5-1 – Historical Versus 2070 Climate Change Adjusted Precipitation

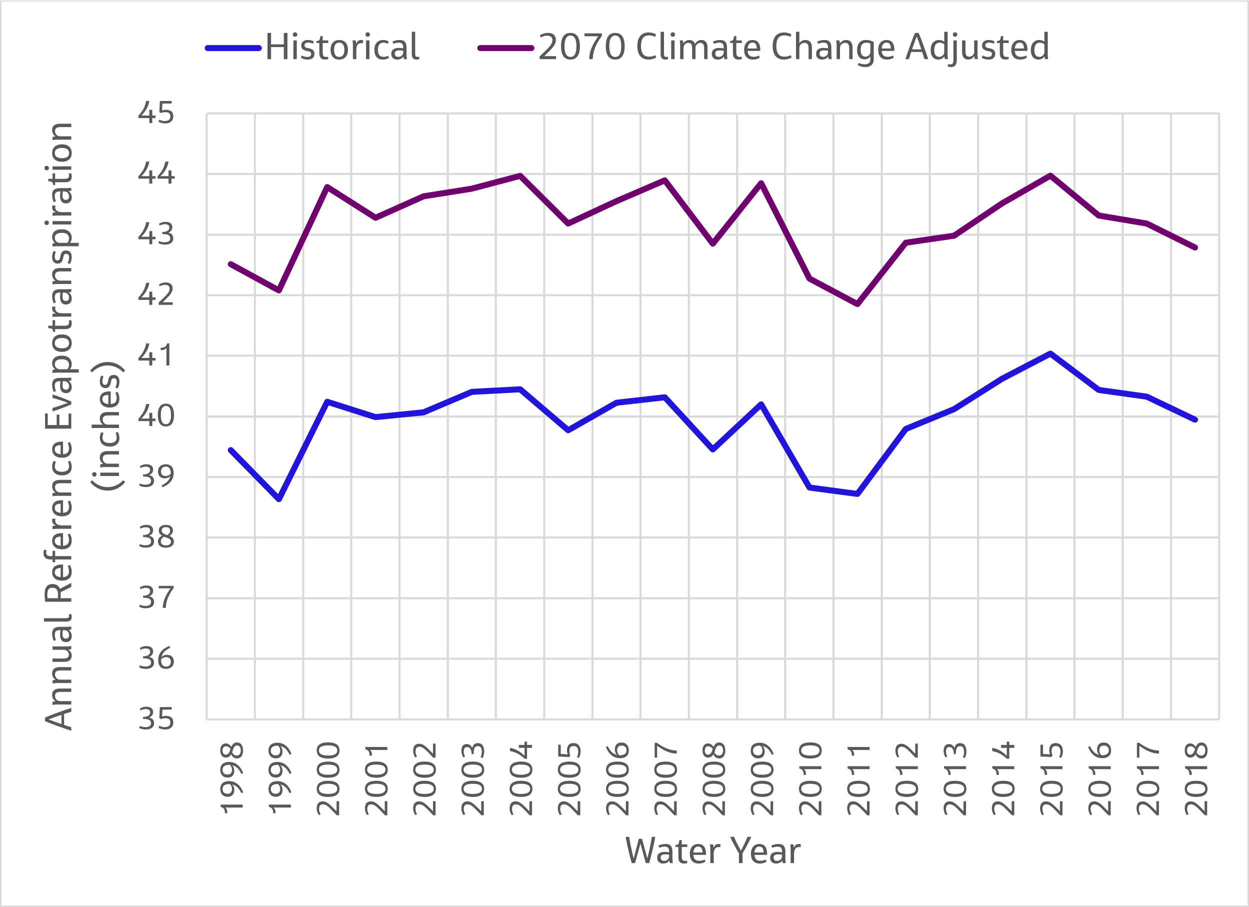


Figure 5-2 – Historical Versus 2070 Climate Change Adjusted Reference Evapotranspiration

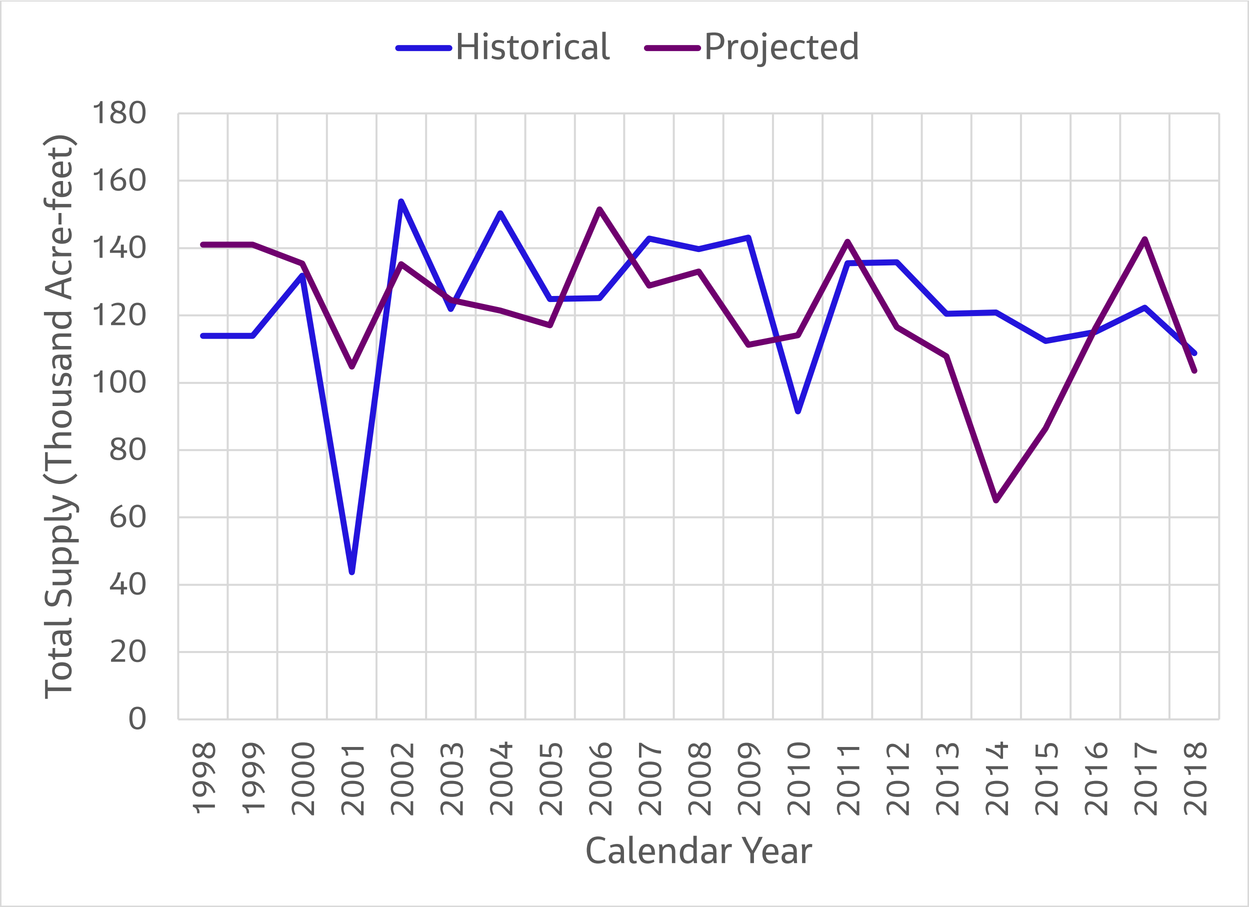


Figure 5-3 – Historical Versus Projected TID Total Supply

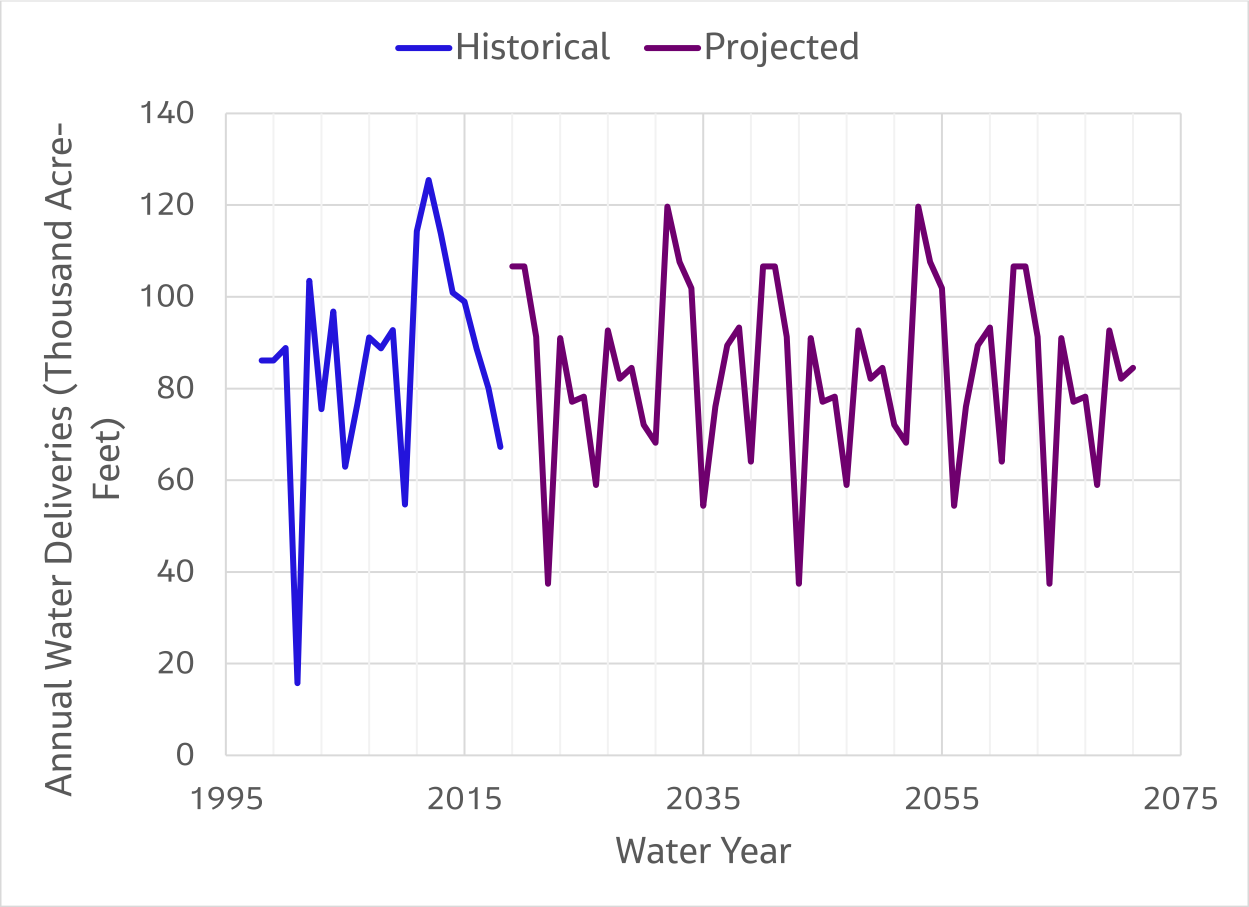


Figure 5-4 – Historical and Projected TID Water Deliveries

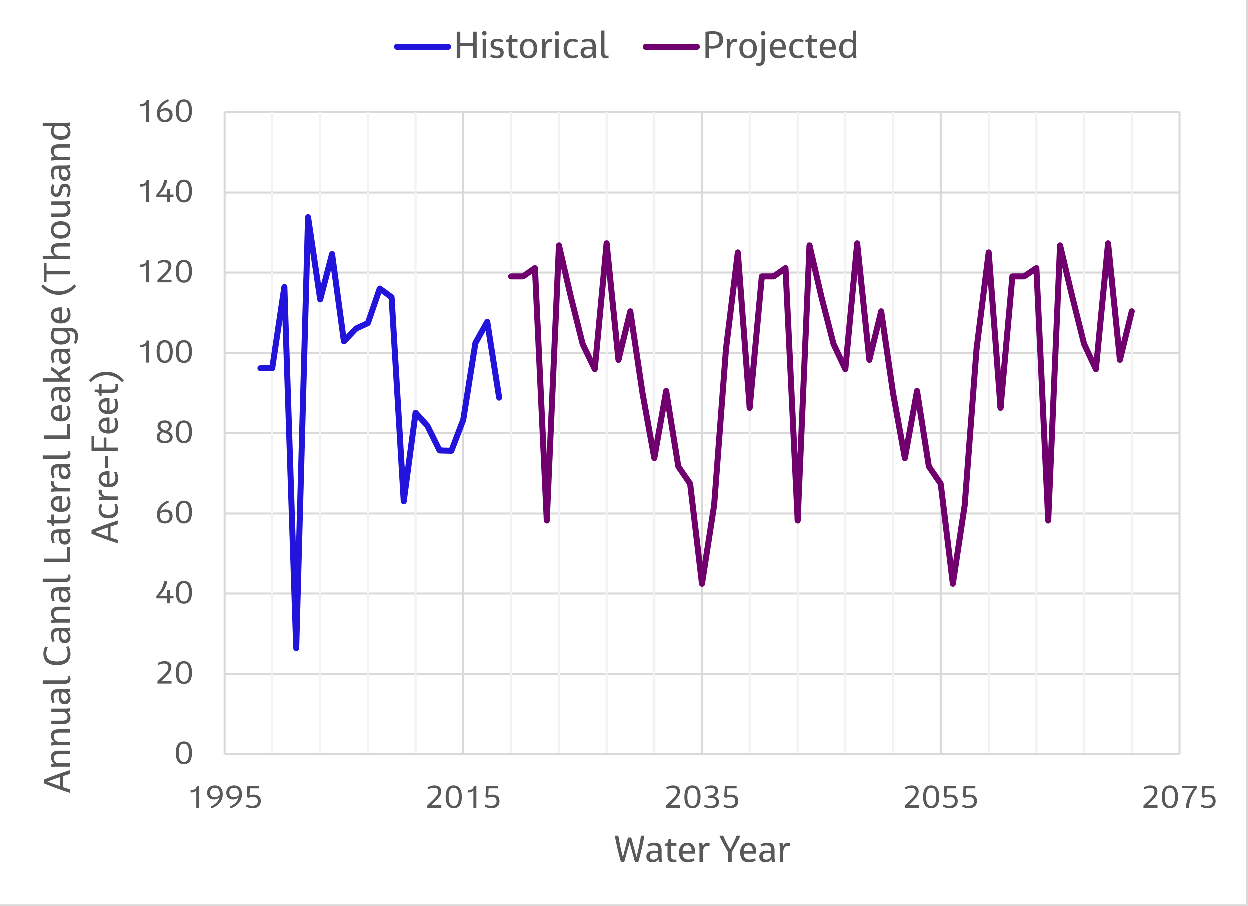
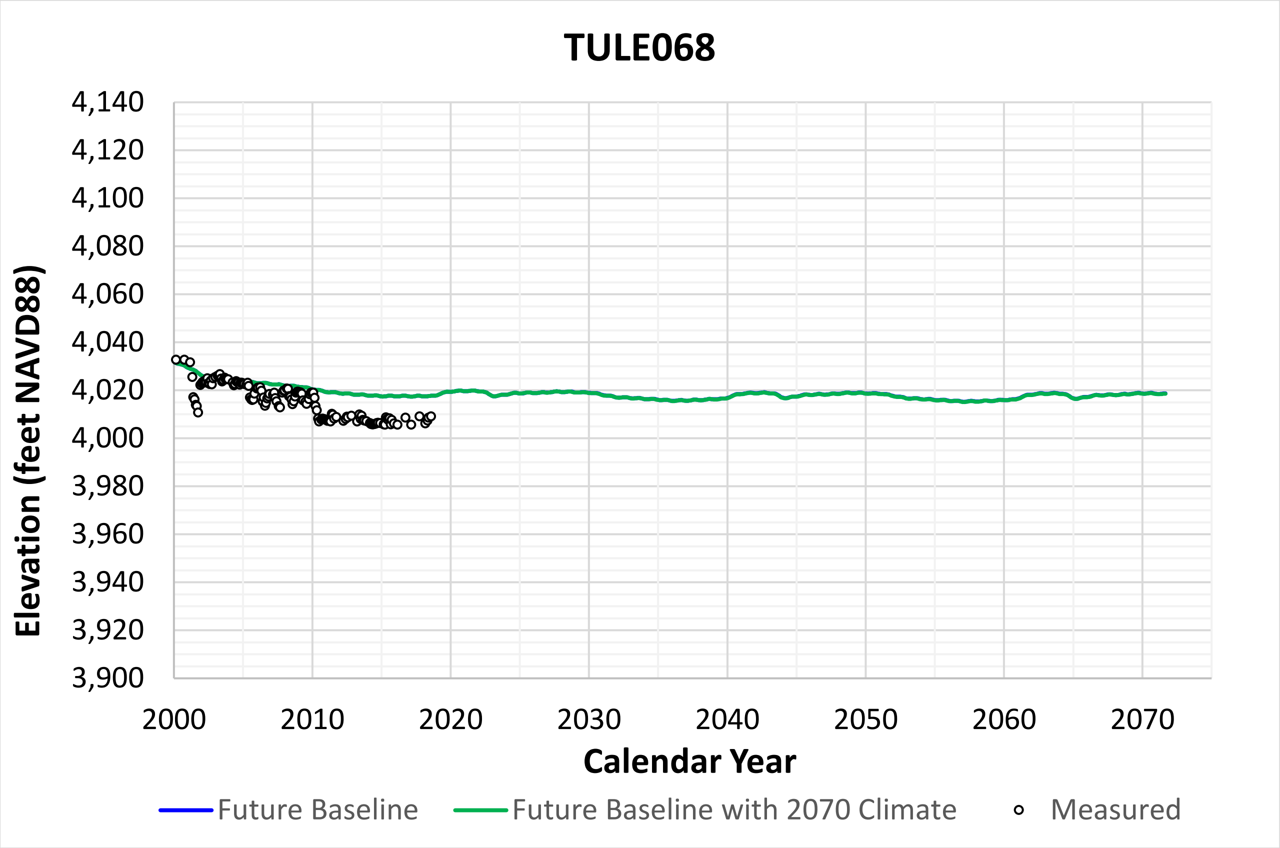


Figure 5-5 – Historical and Projected Canal Lateral Leakage



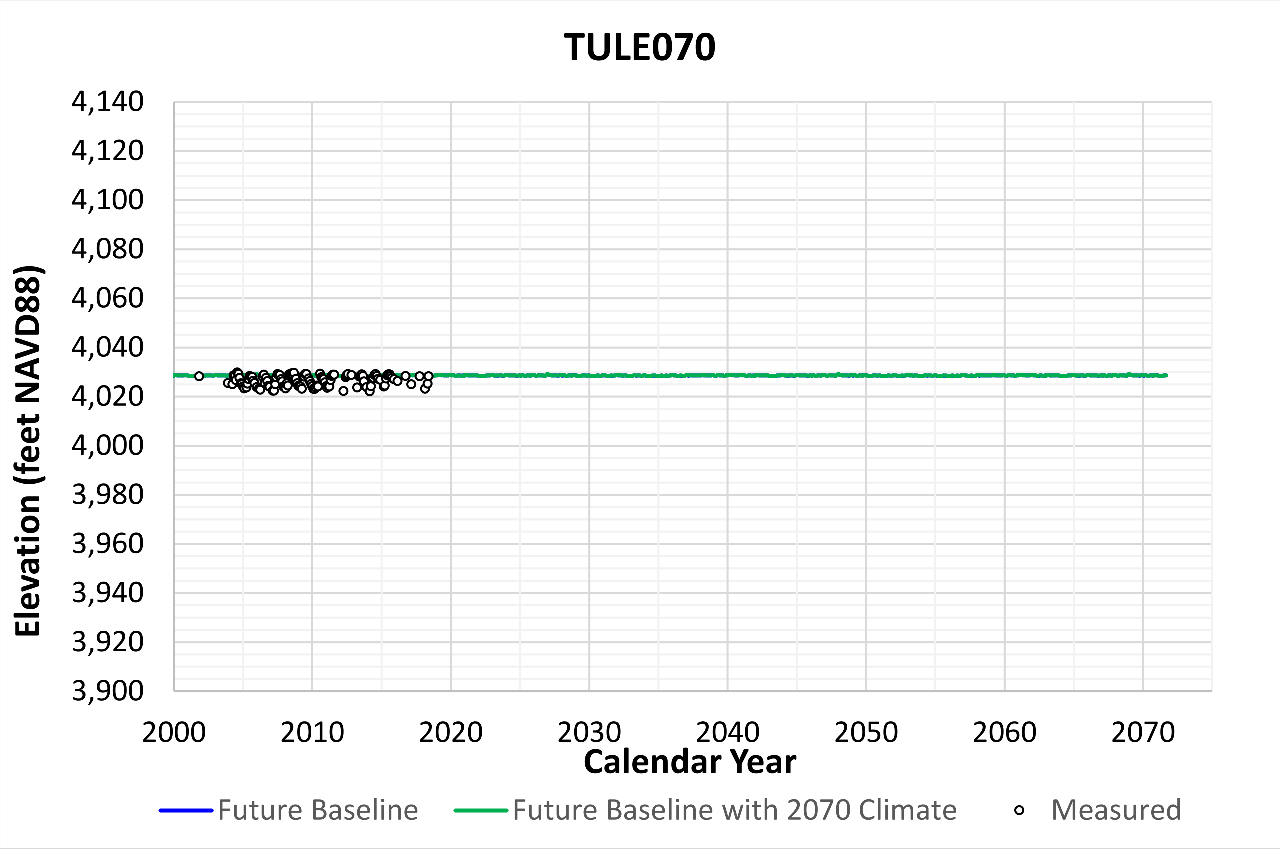
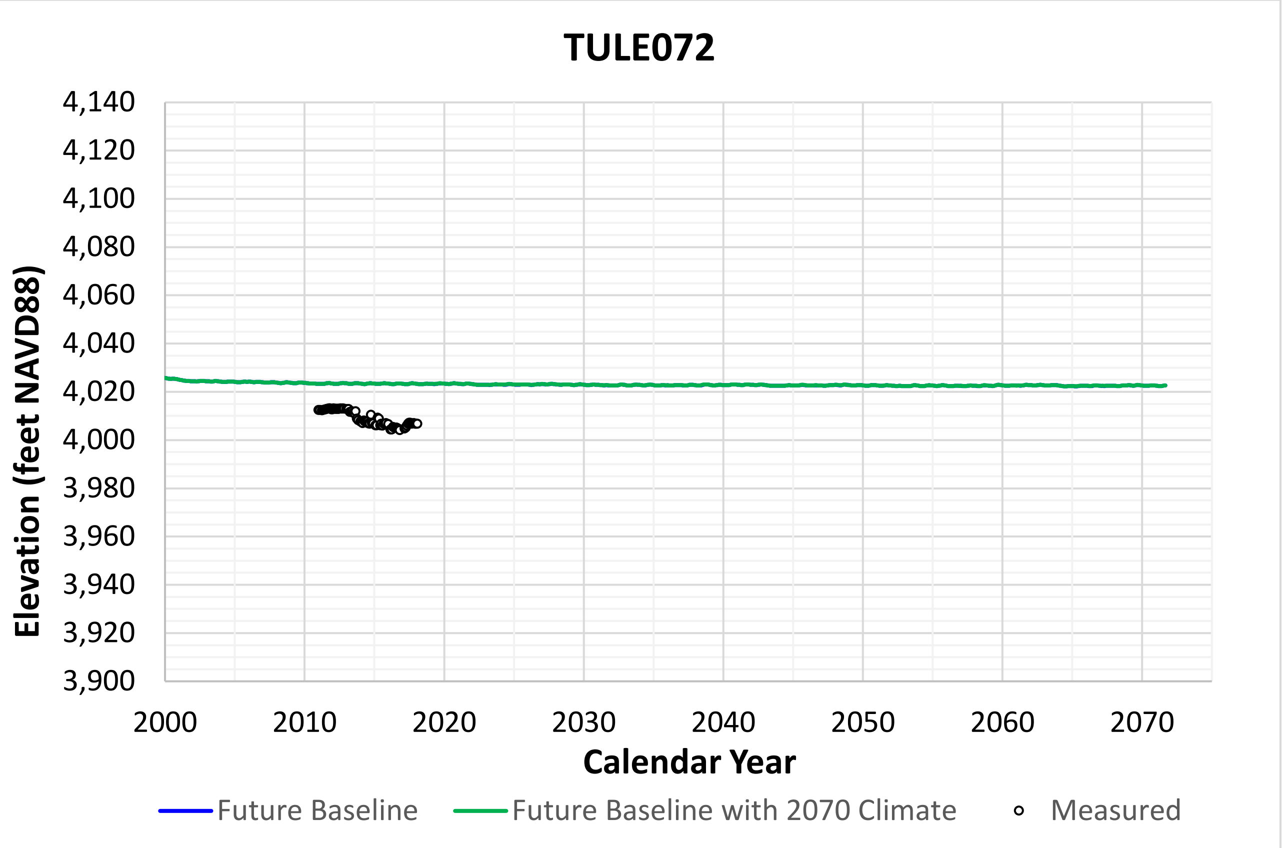


Figure 5-6
Comparison of Projected Groundwater Levels



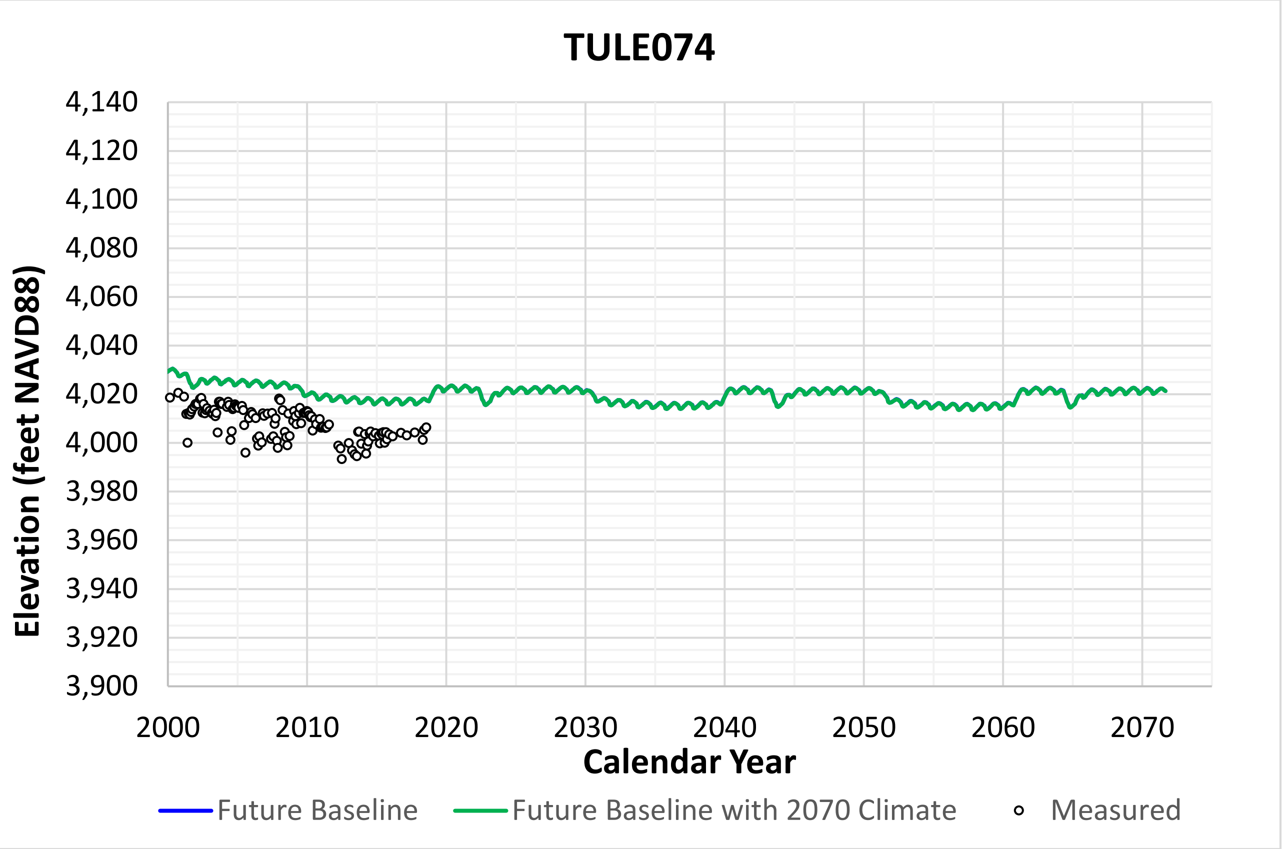
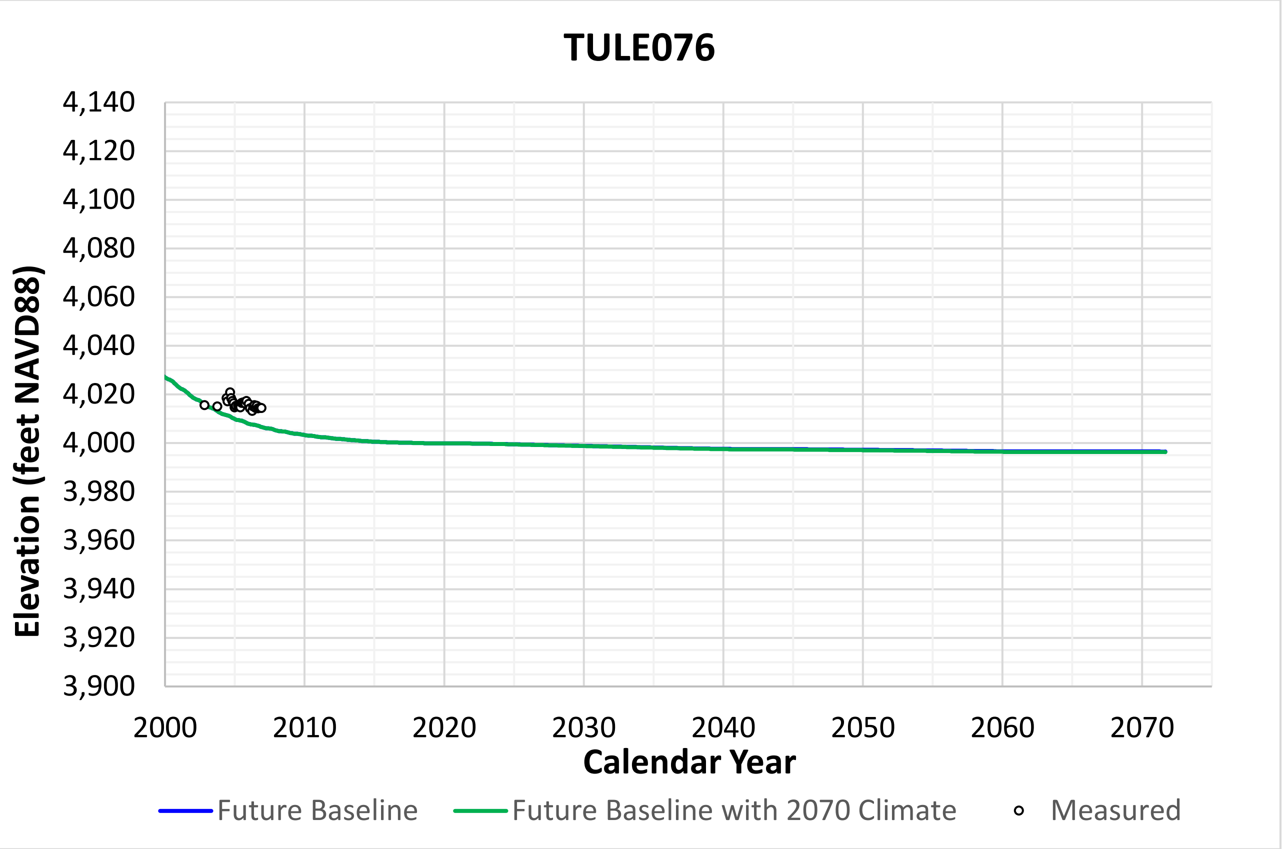


Figure 5-6
Comparison of Projected Groundwater Levels



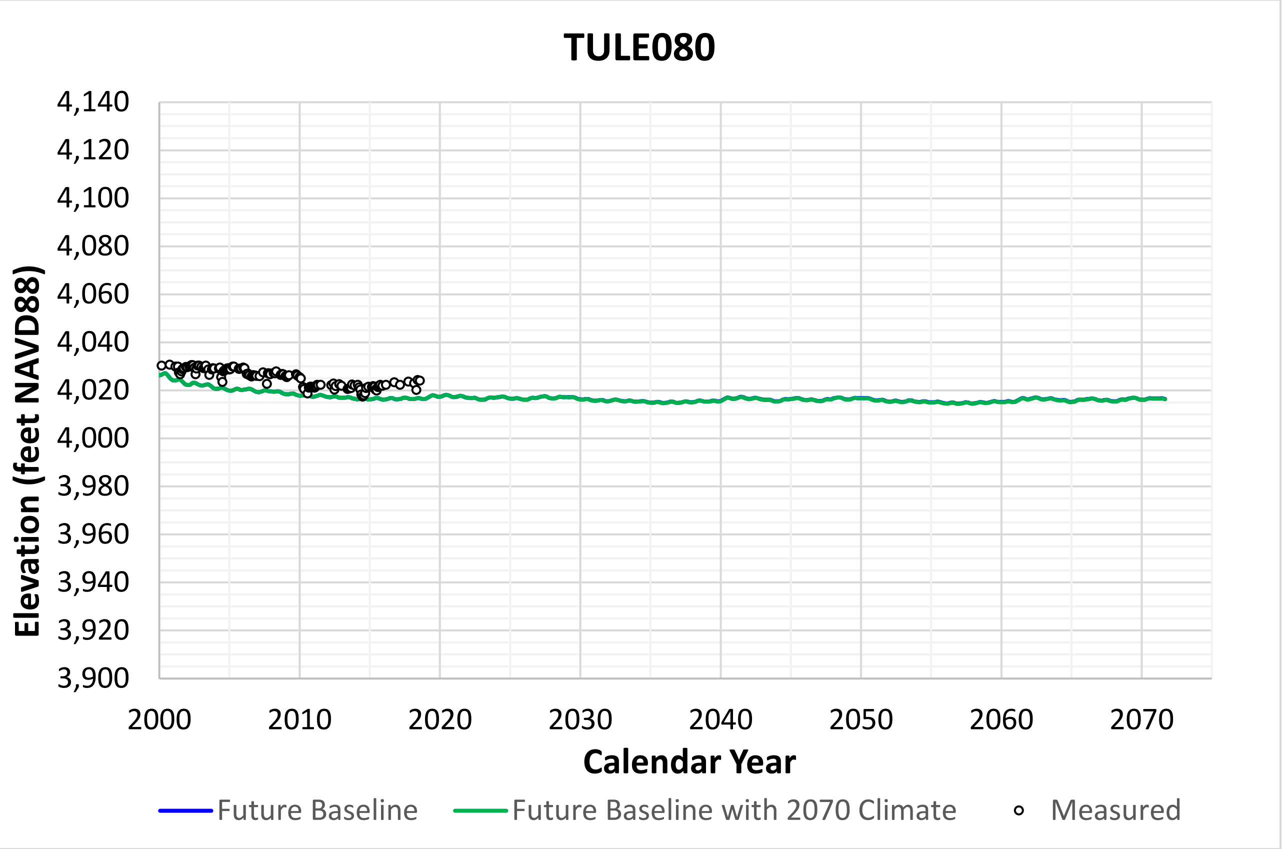
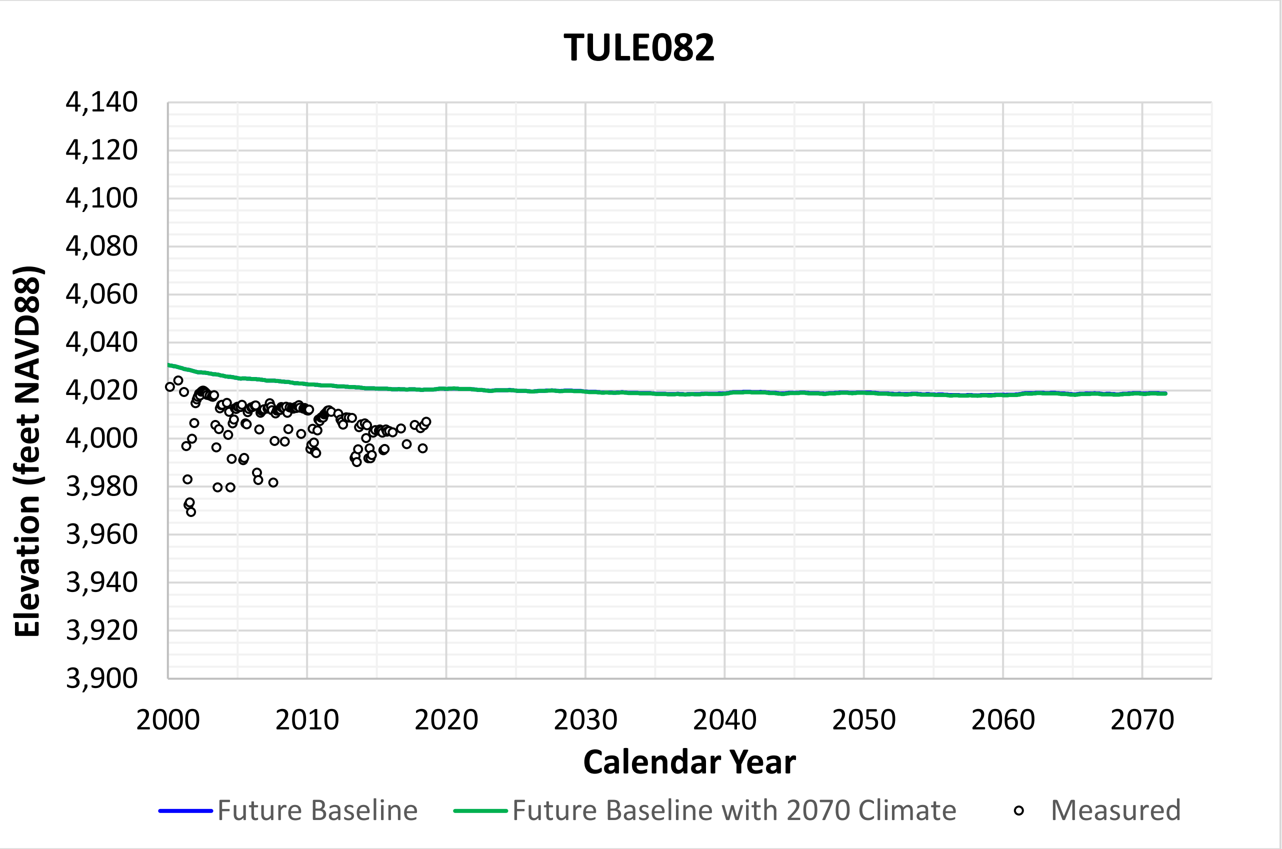


Figure 5-6
Comparison of Projected Groundwater Levels



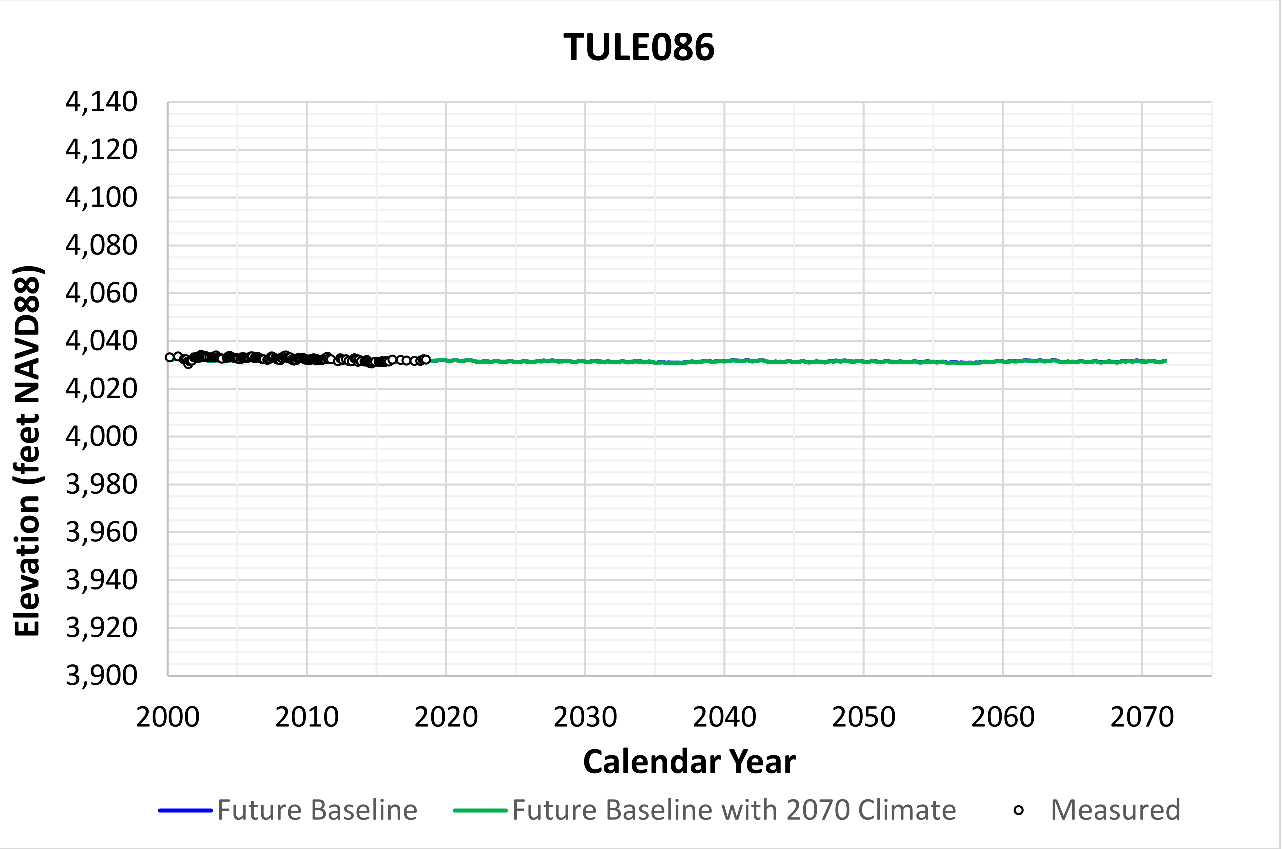
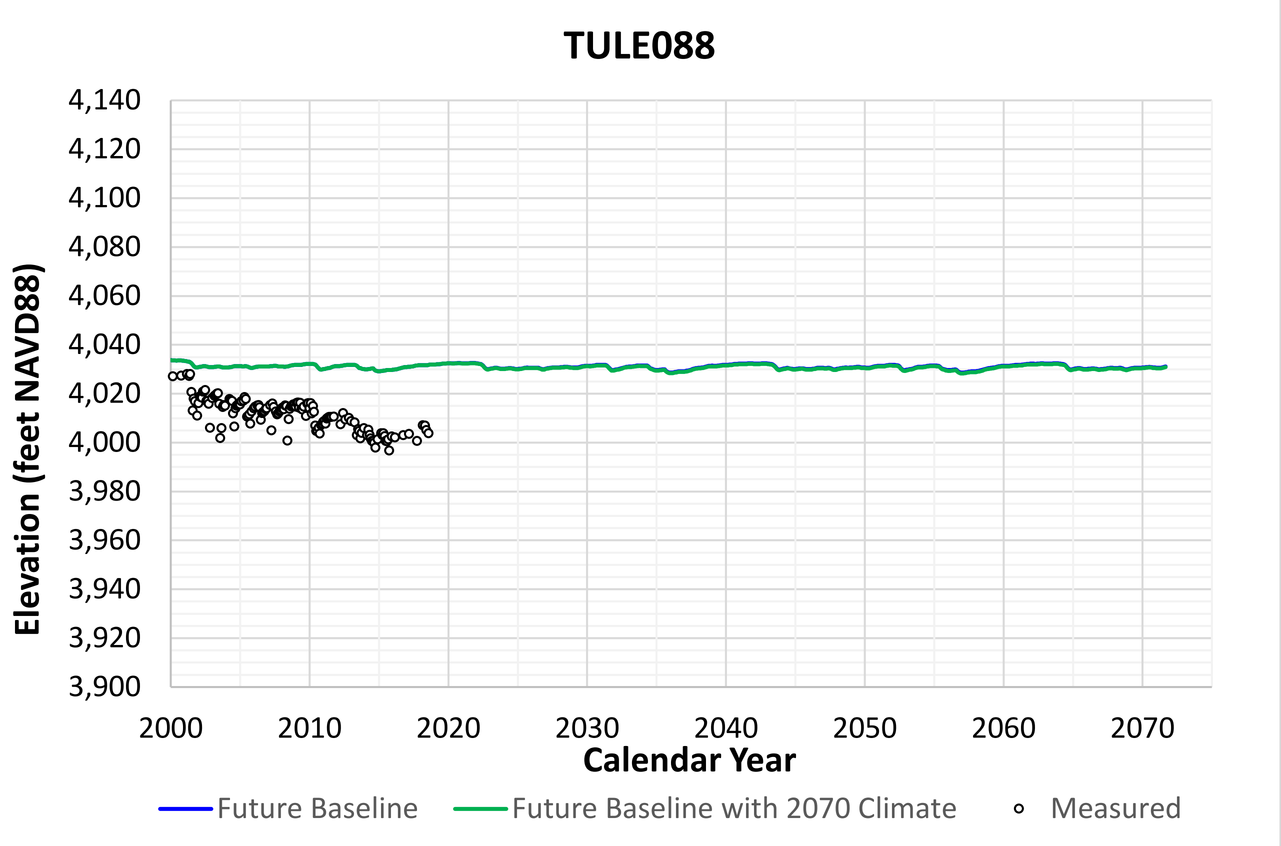


Figure 5-6
Comparison of Projected Groundwater Levels



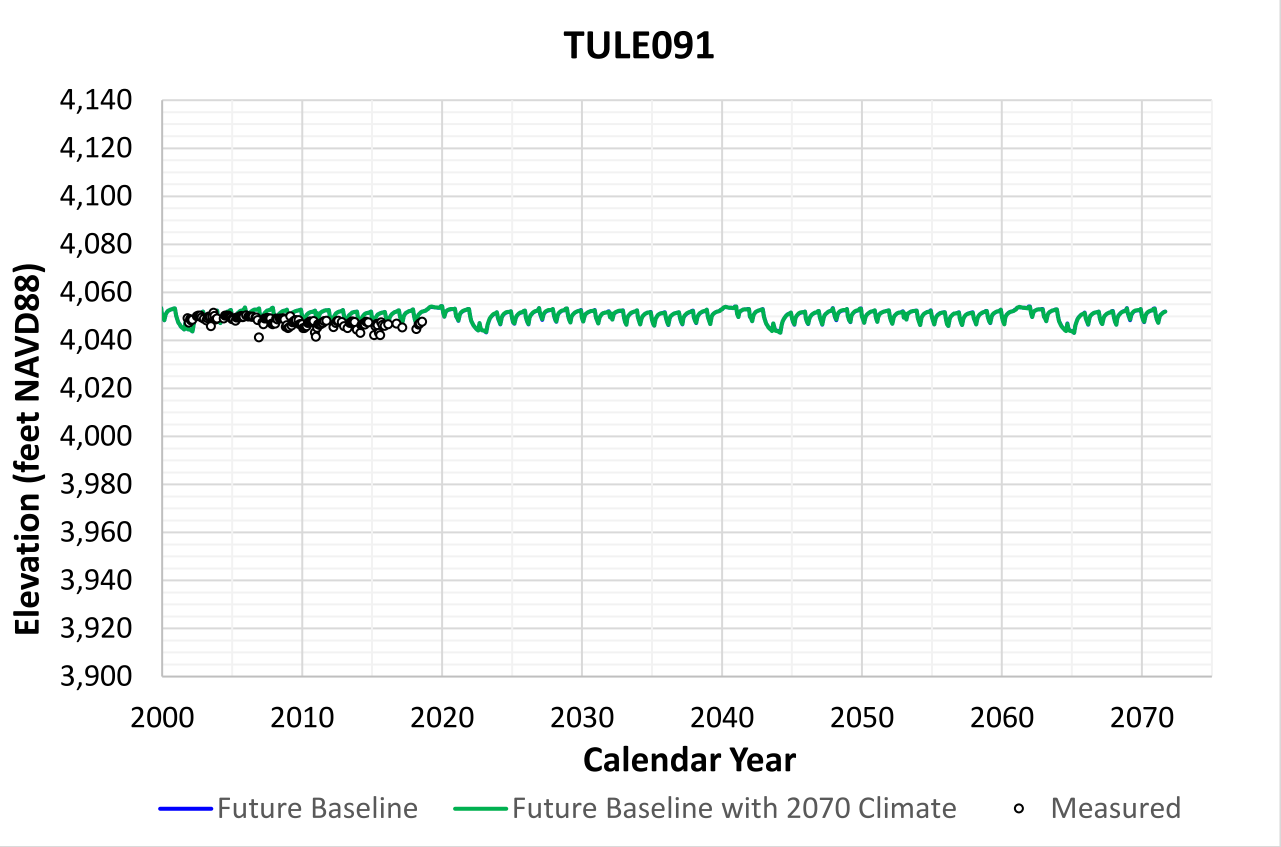
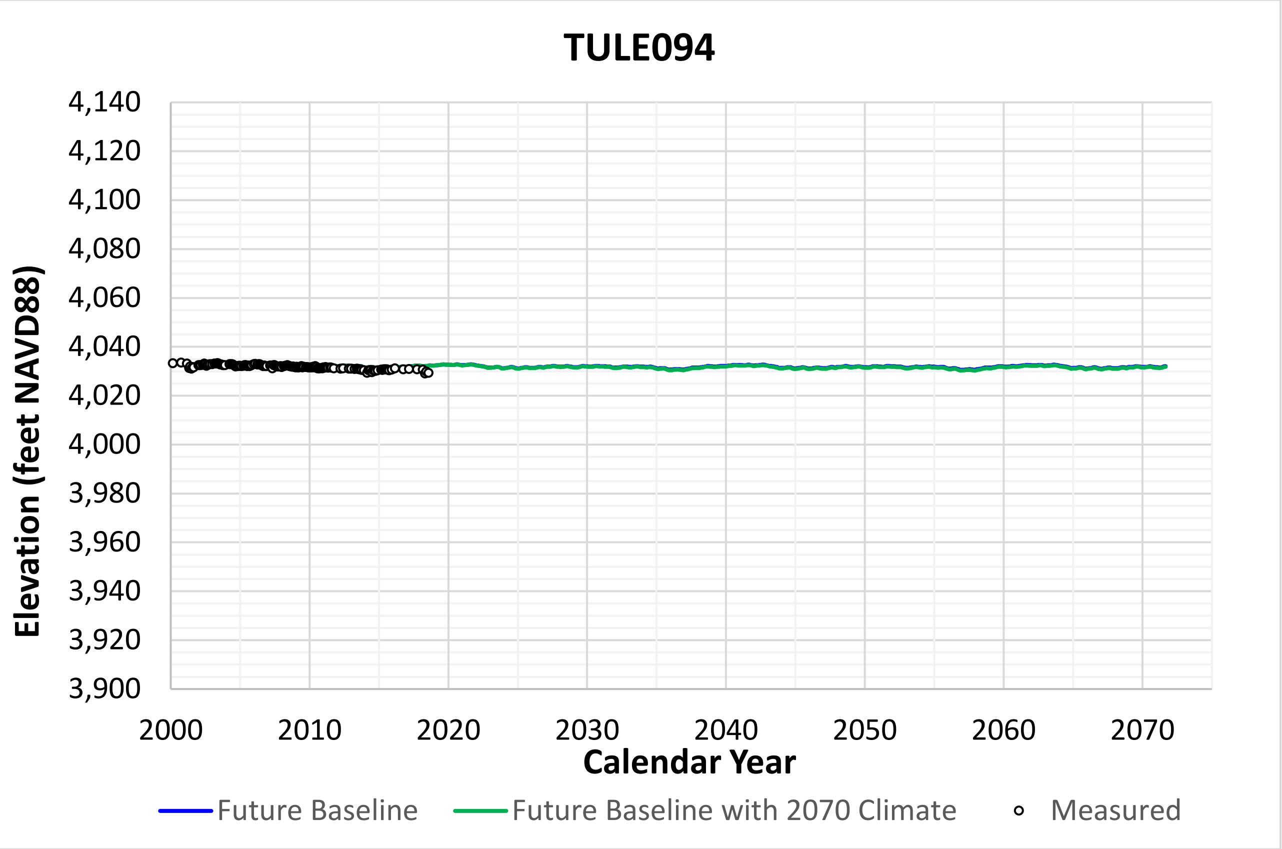


Figure 5-6
Comparison of Projected Groundwater Levels



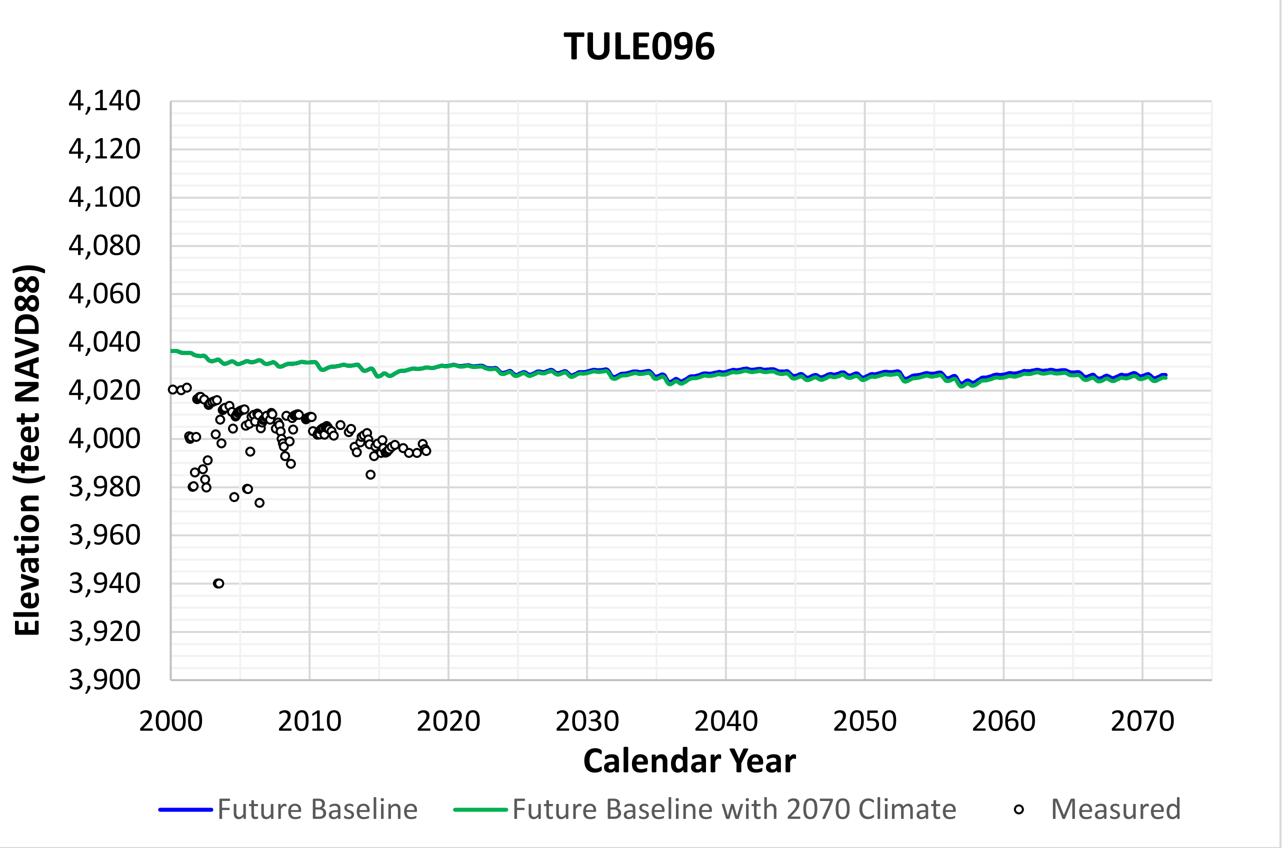
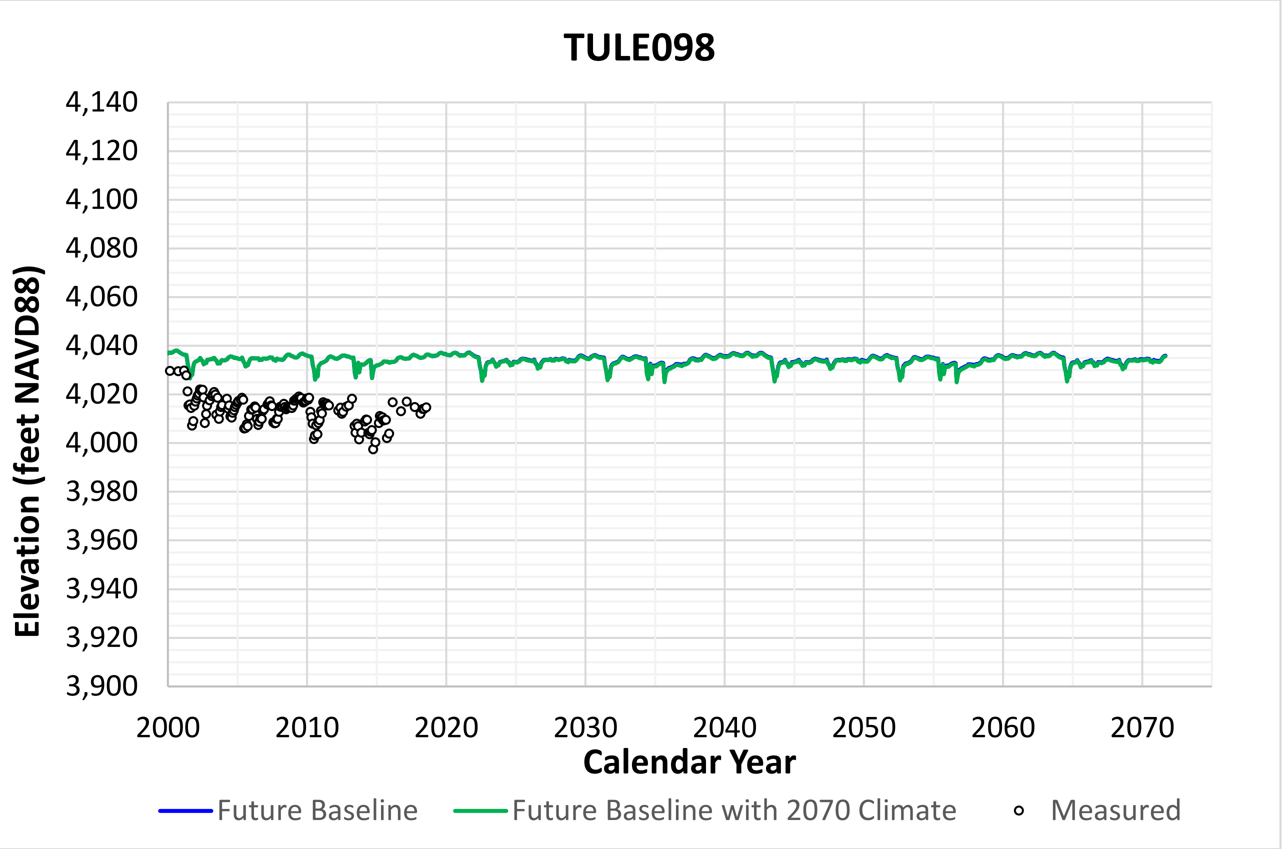


Figure 5-6
Comparison of Projected Groundwater Levels



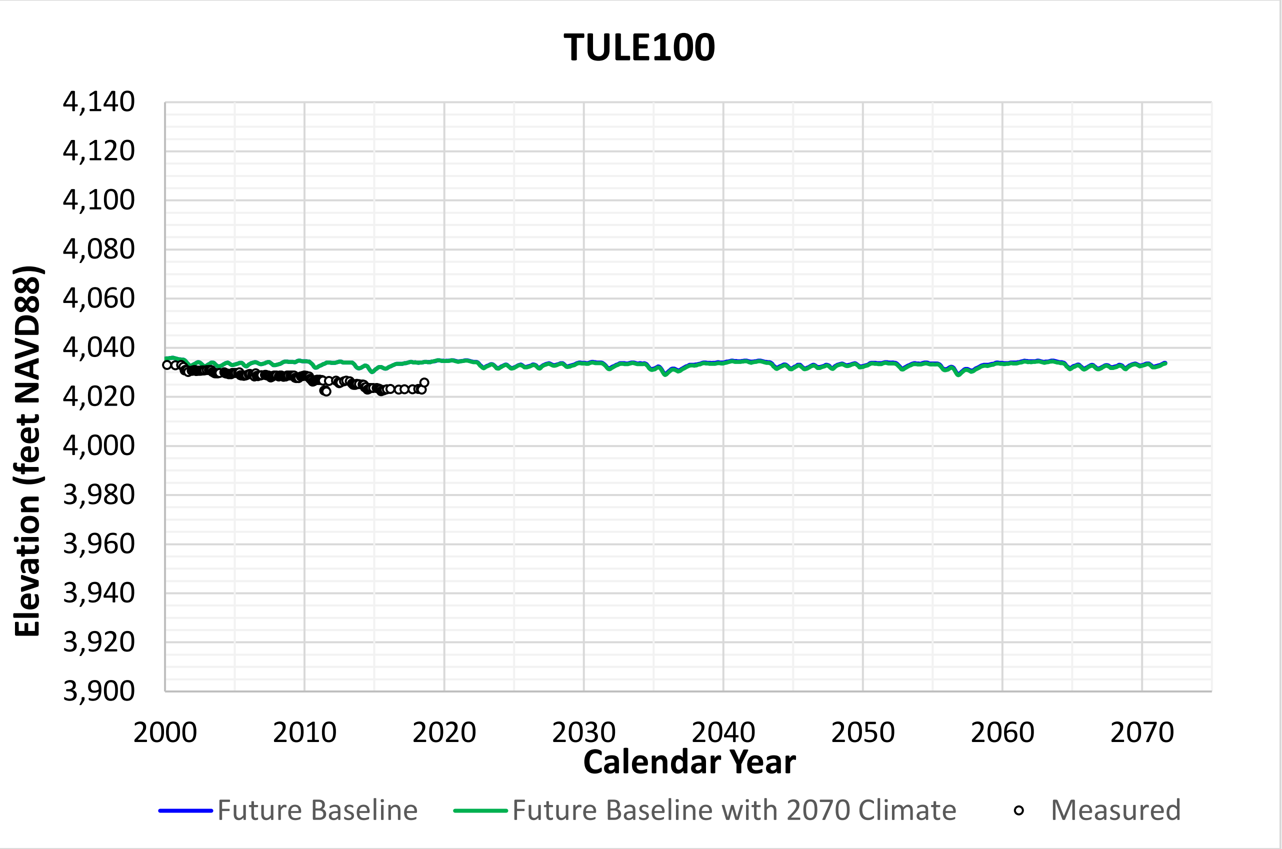
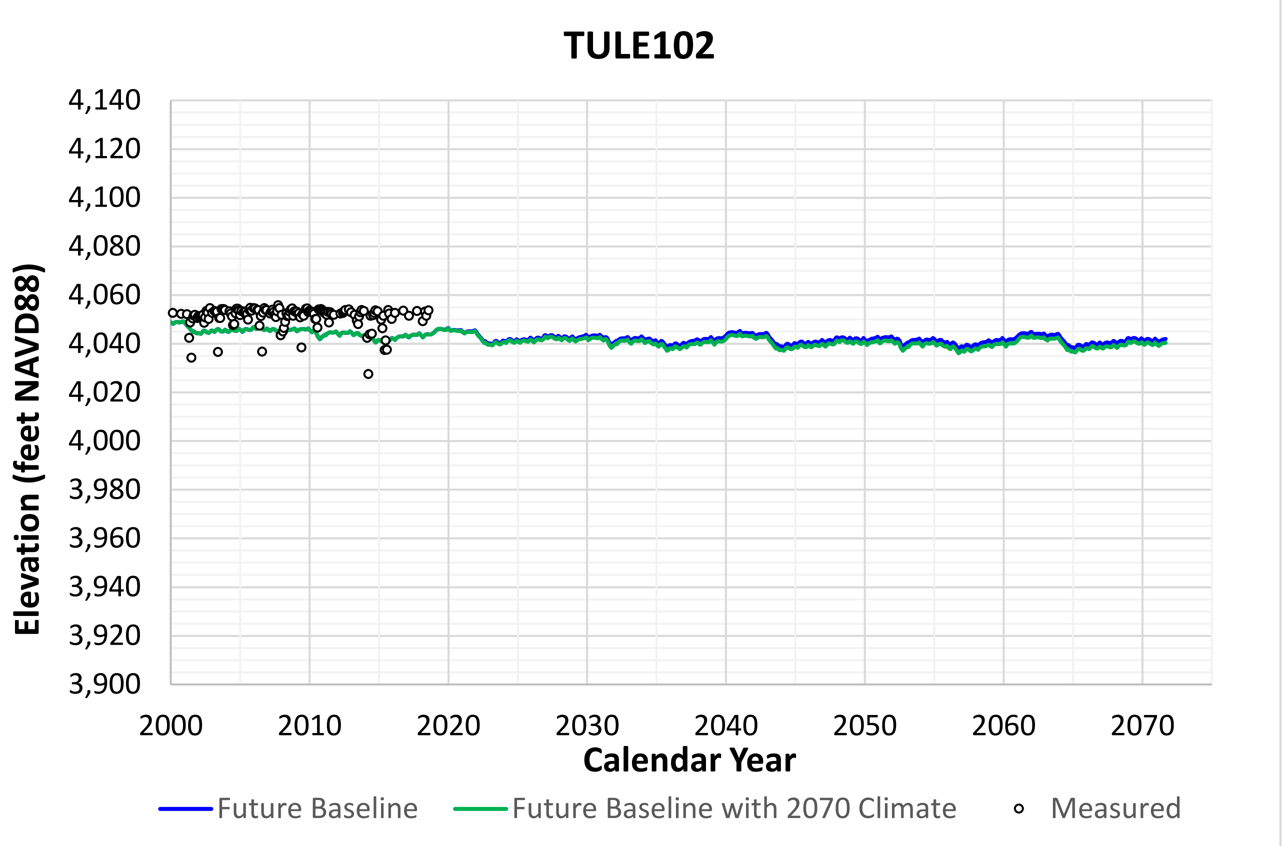


Figure 5-6
Comparison of Projected Groundwater Levels



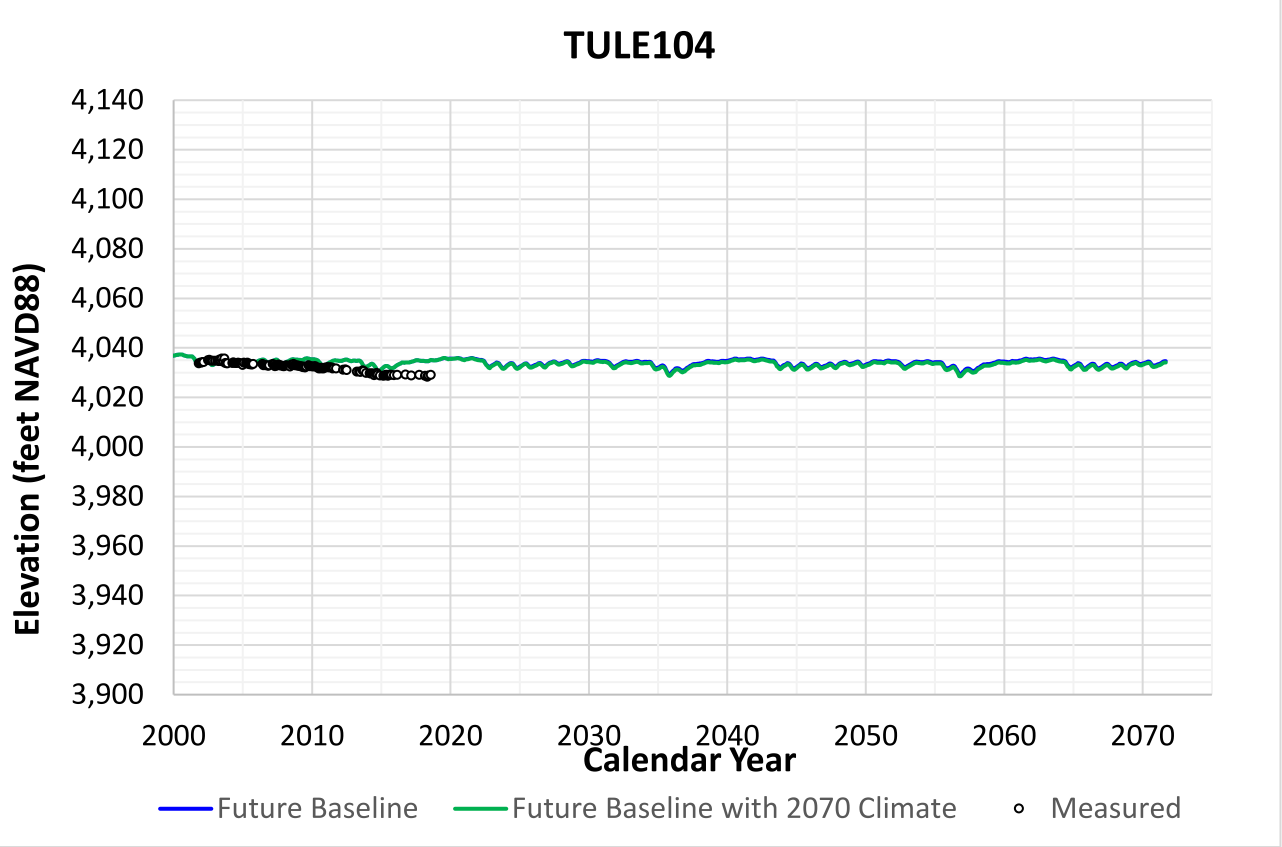


Figure 5-6
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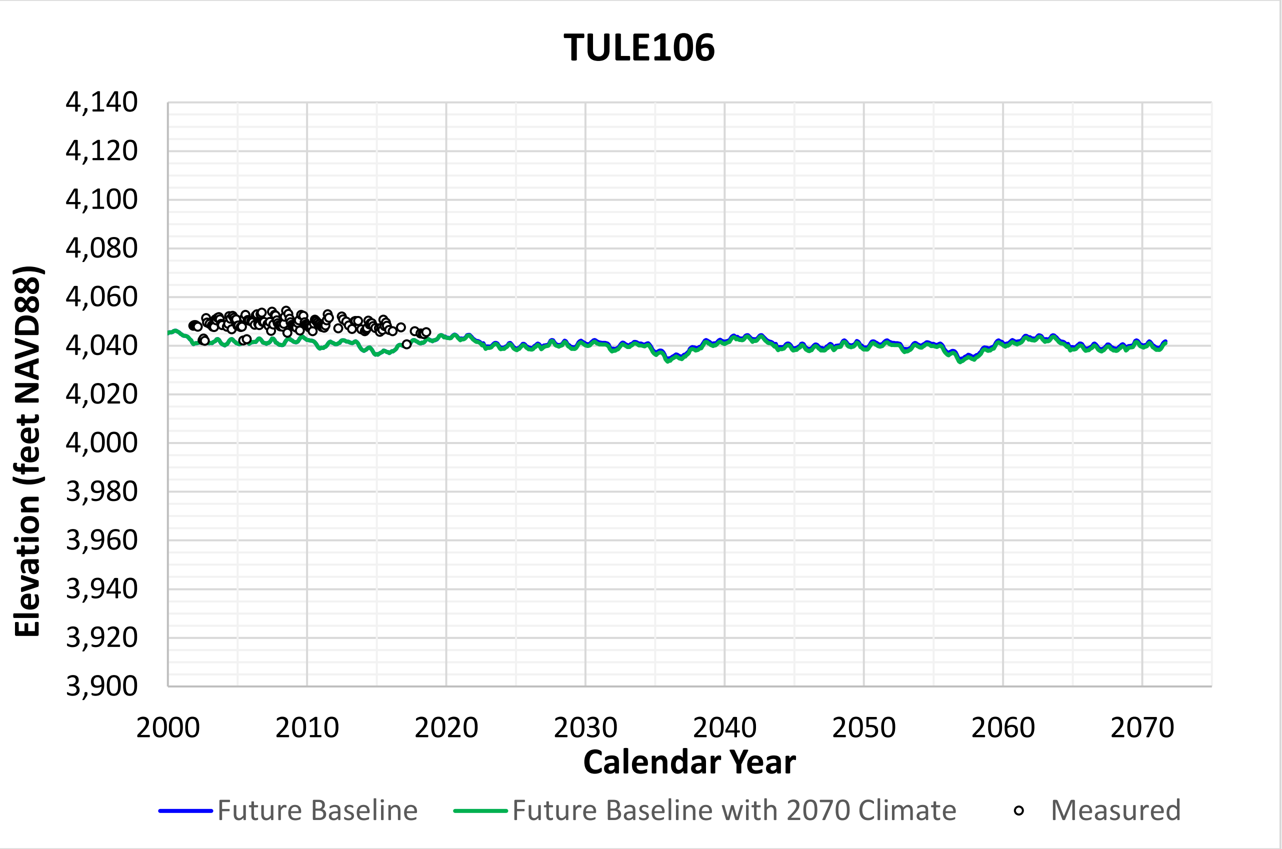

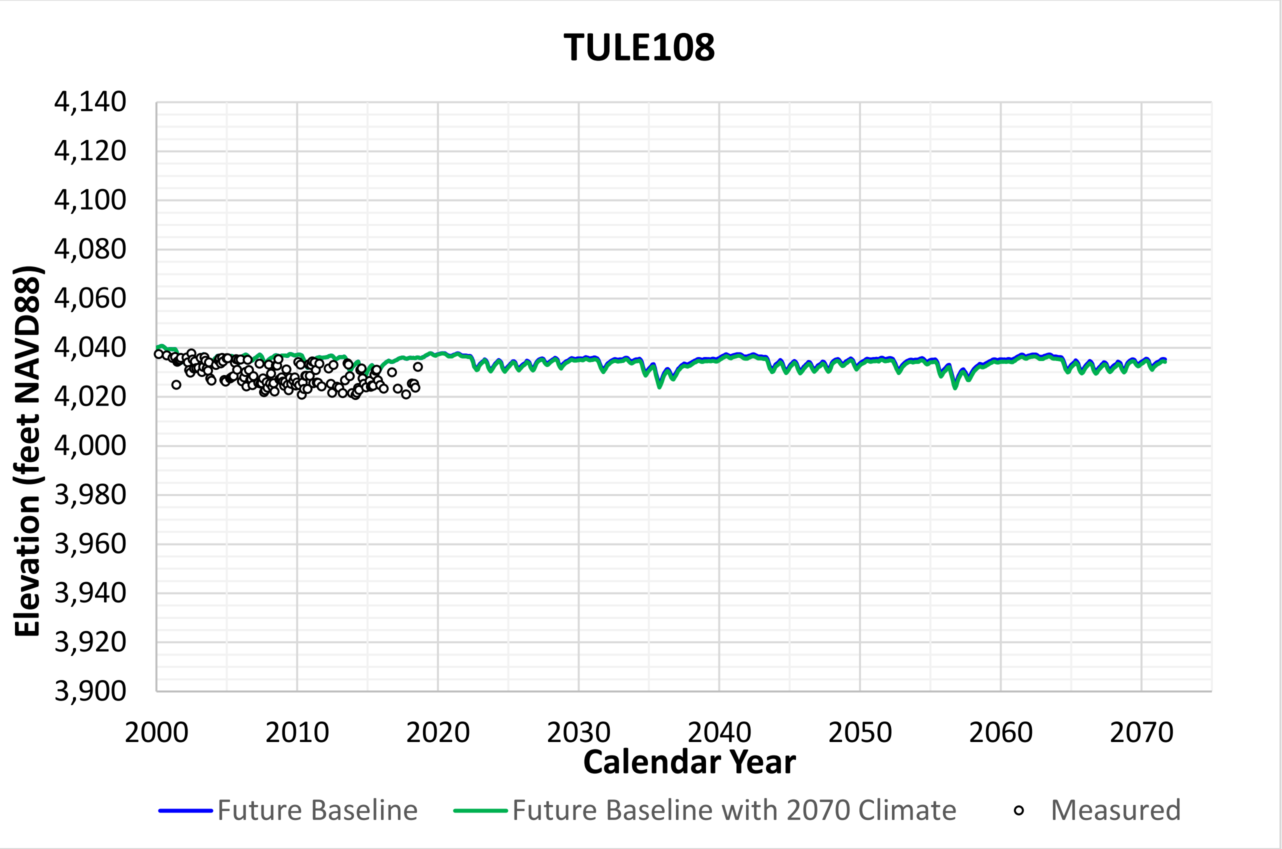

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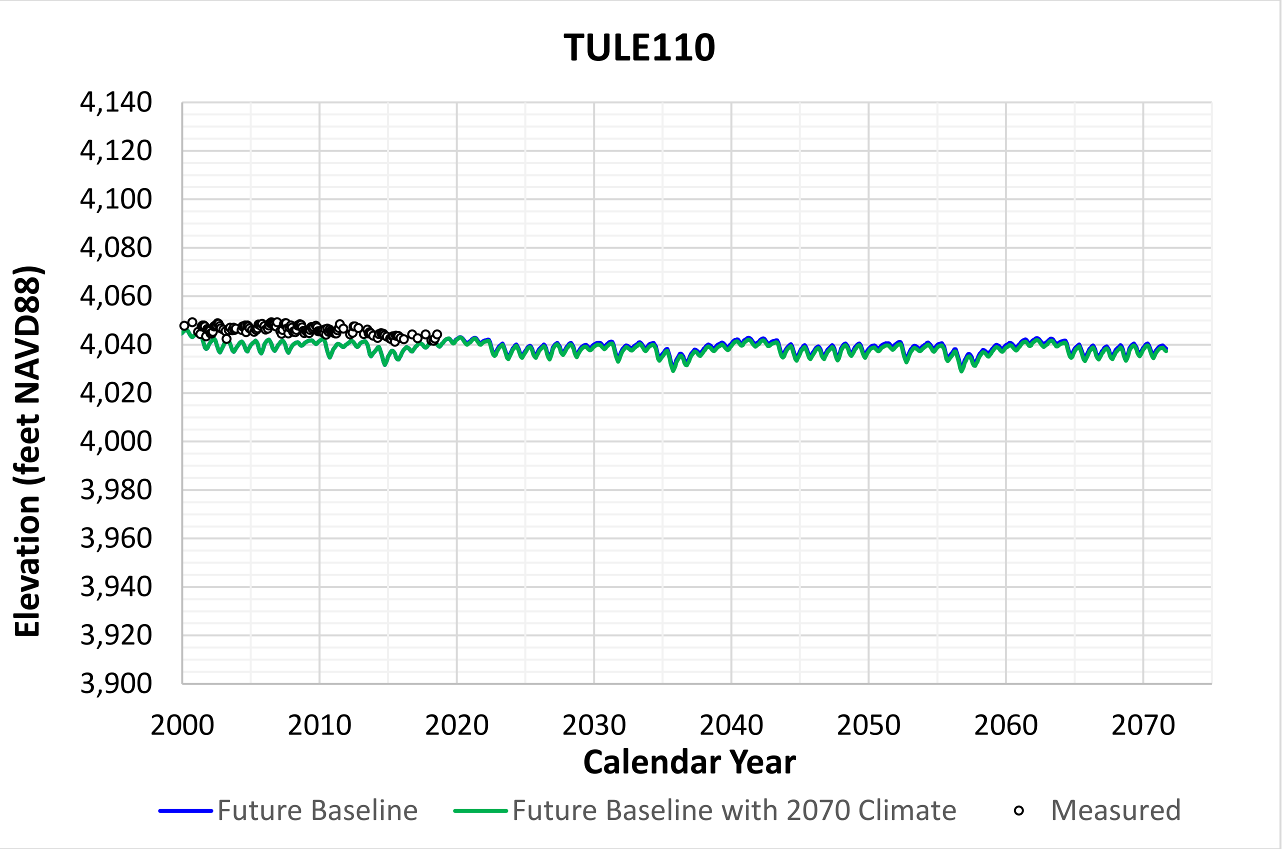

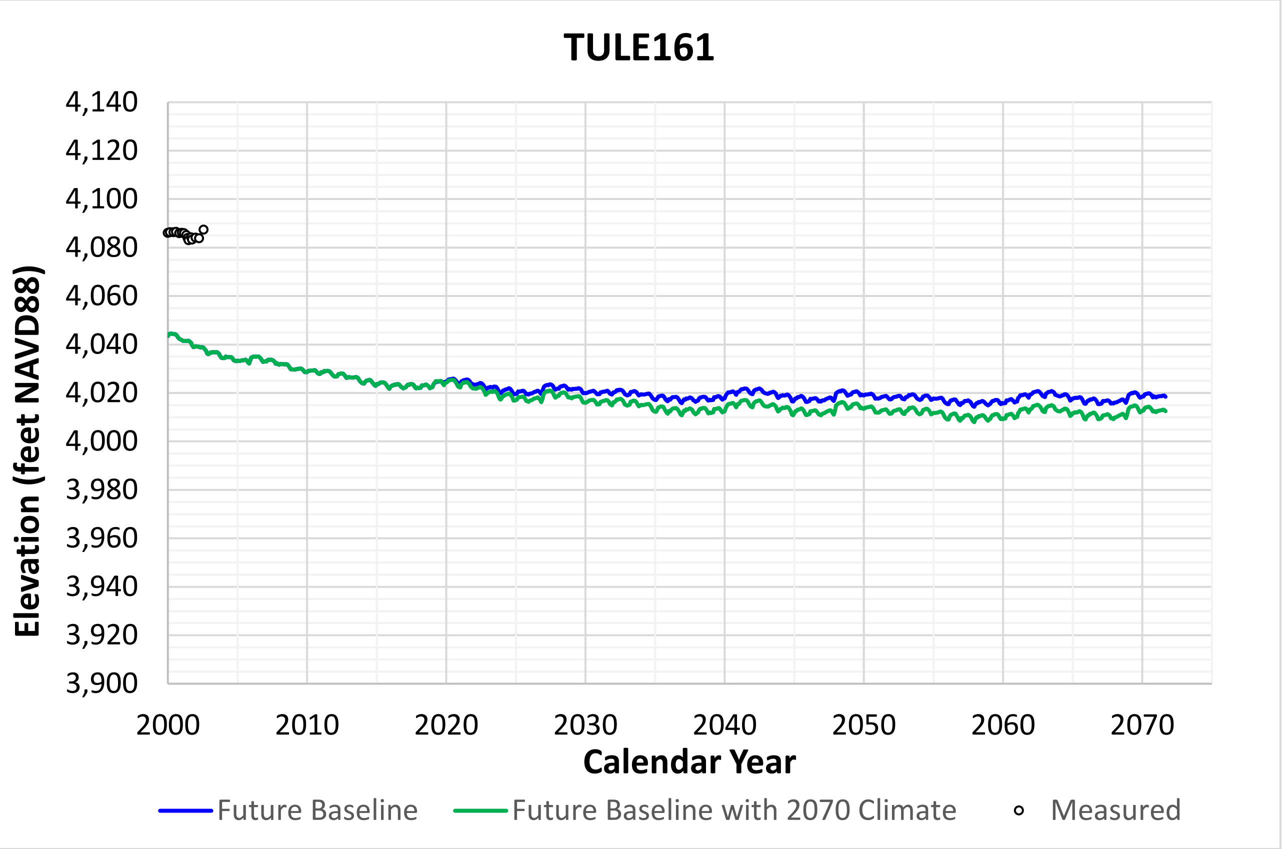

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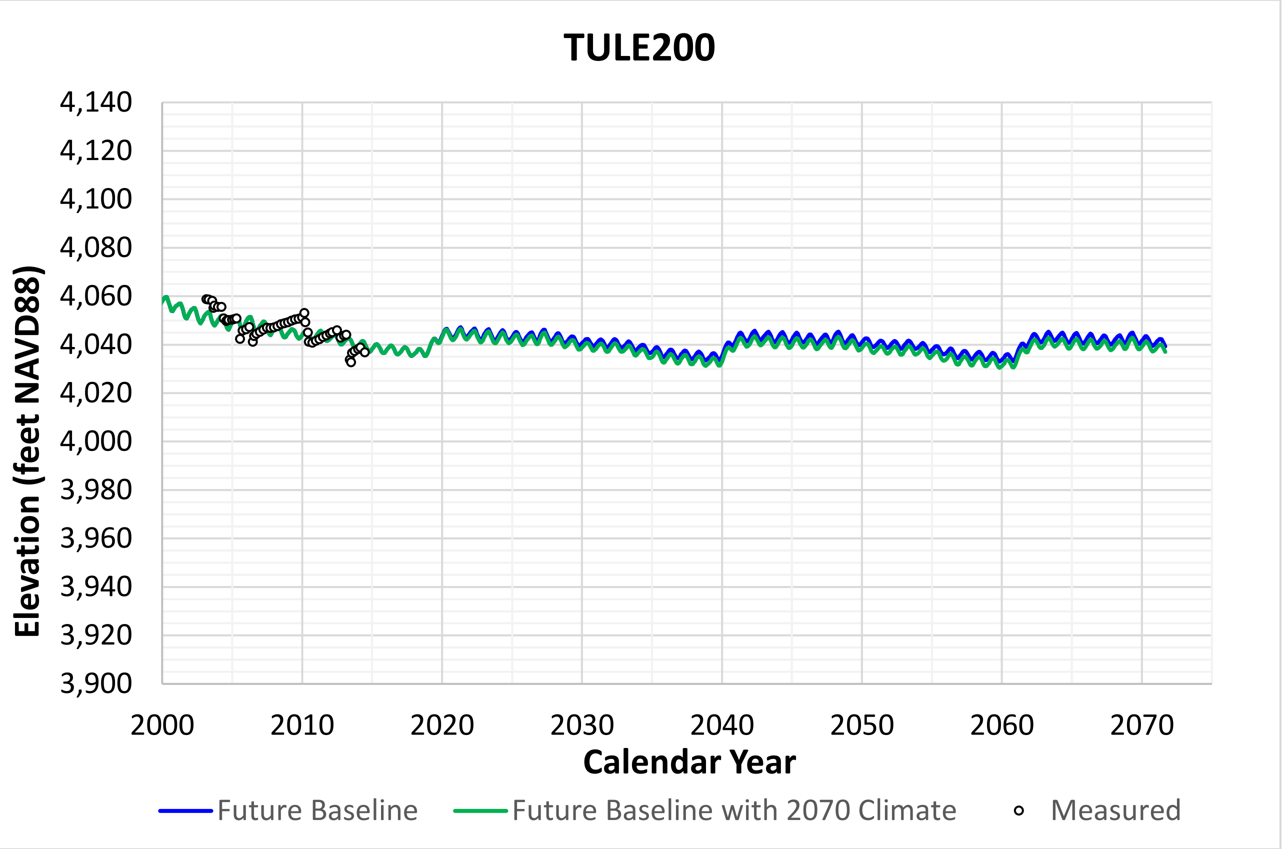

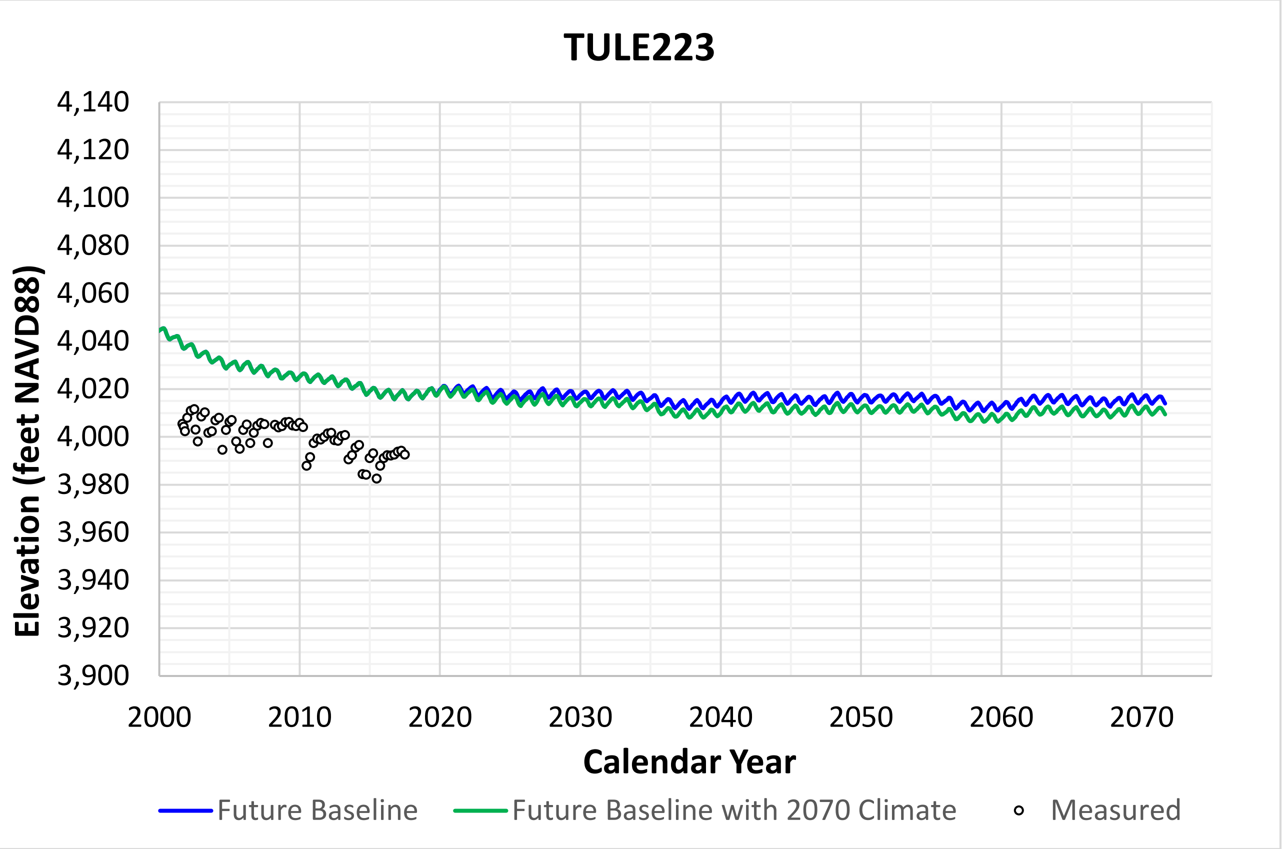

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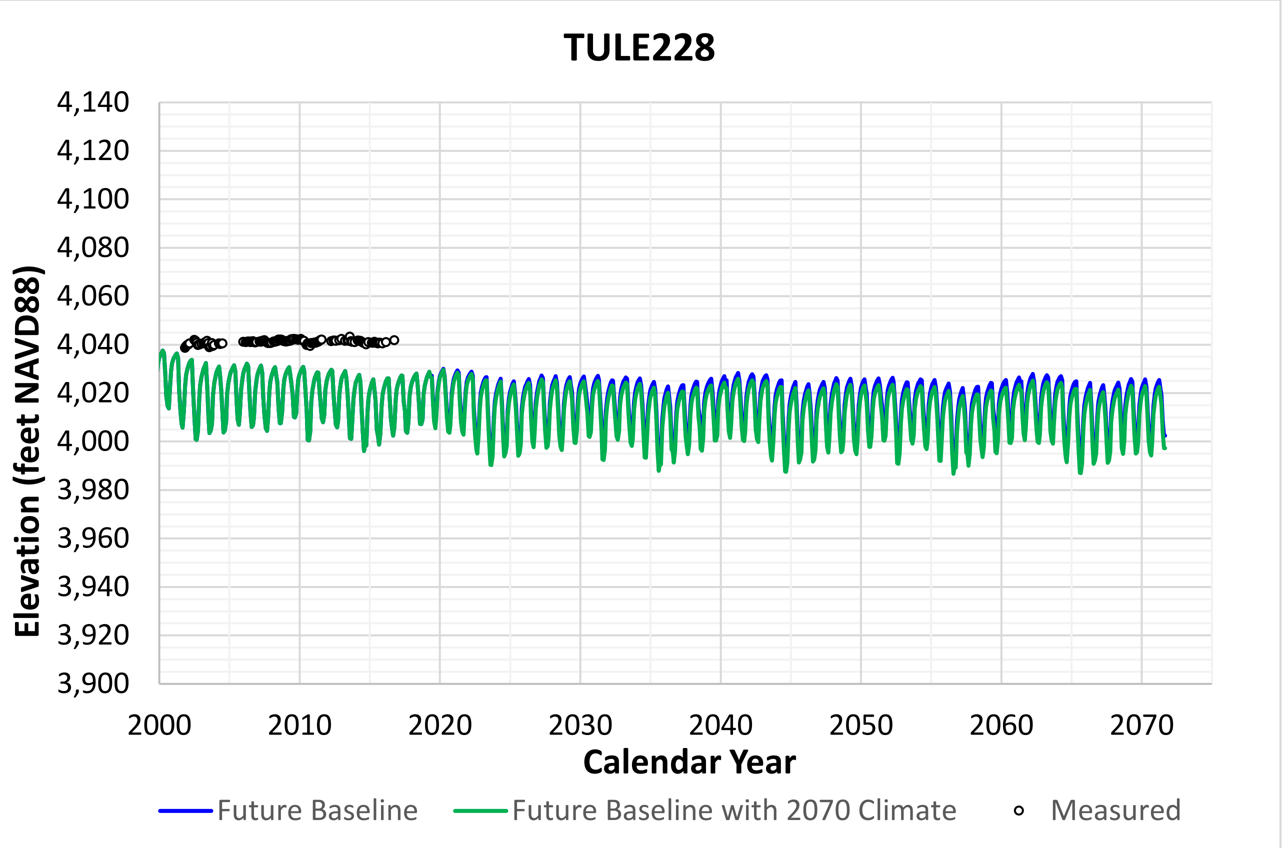

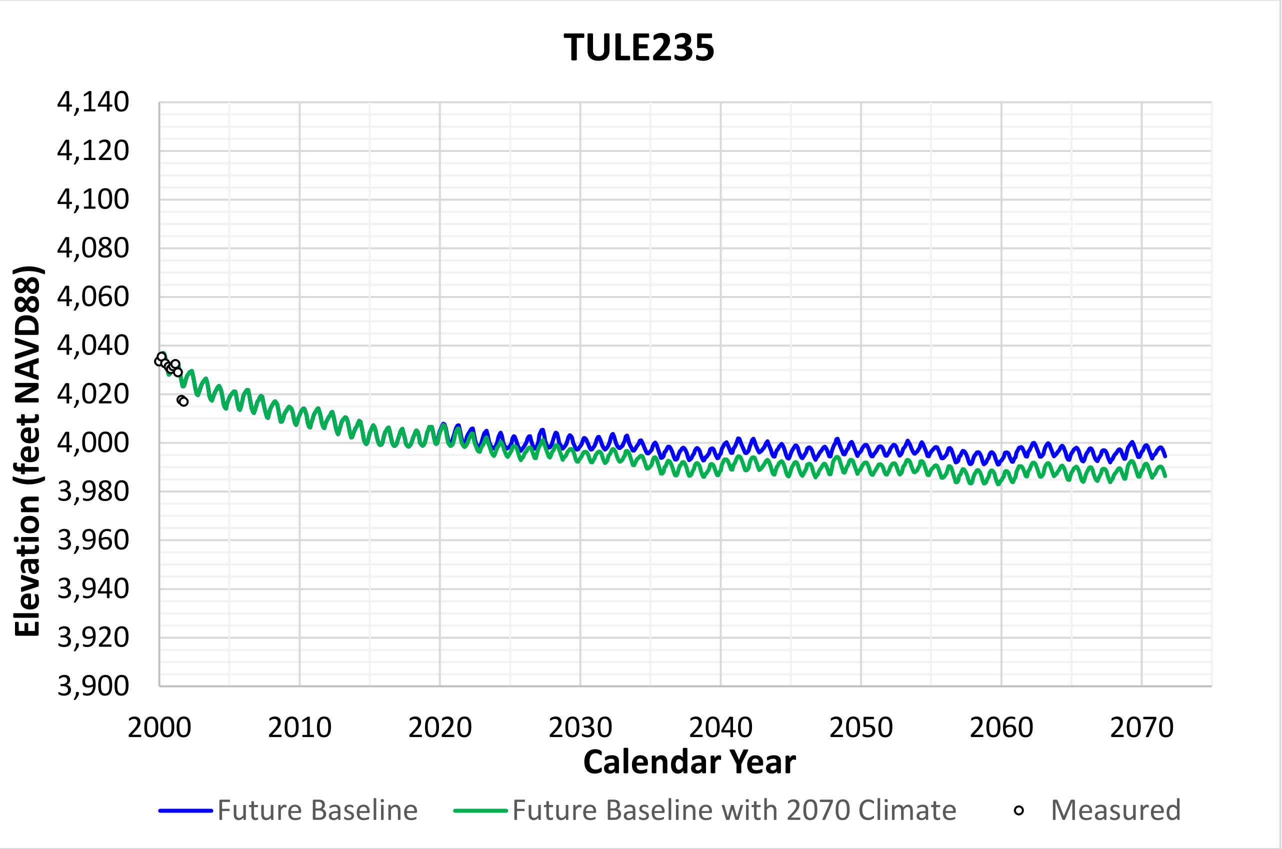

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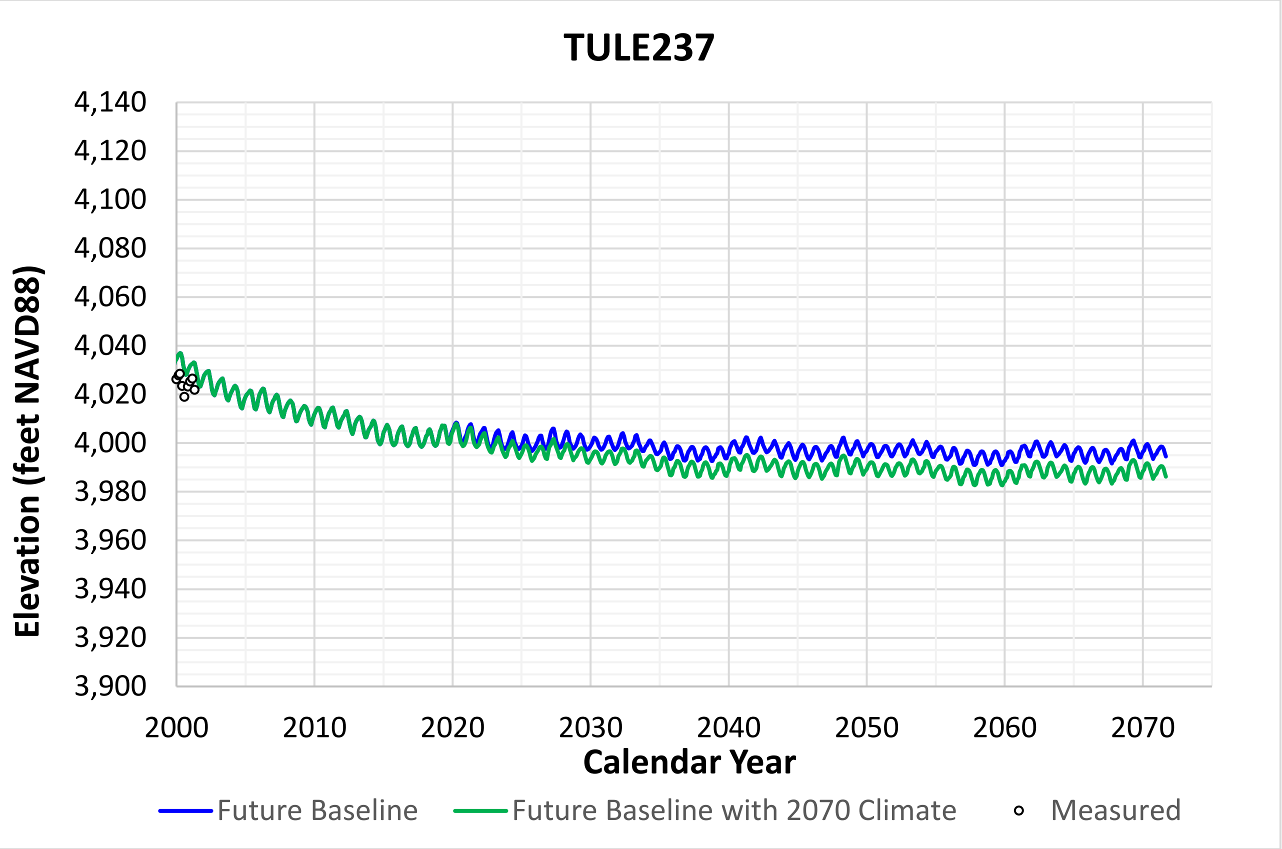

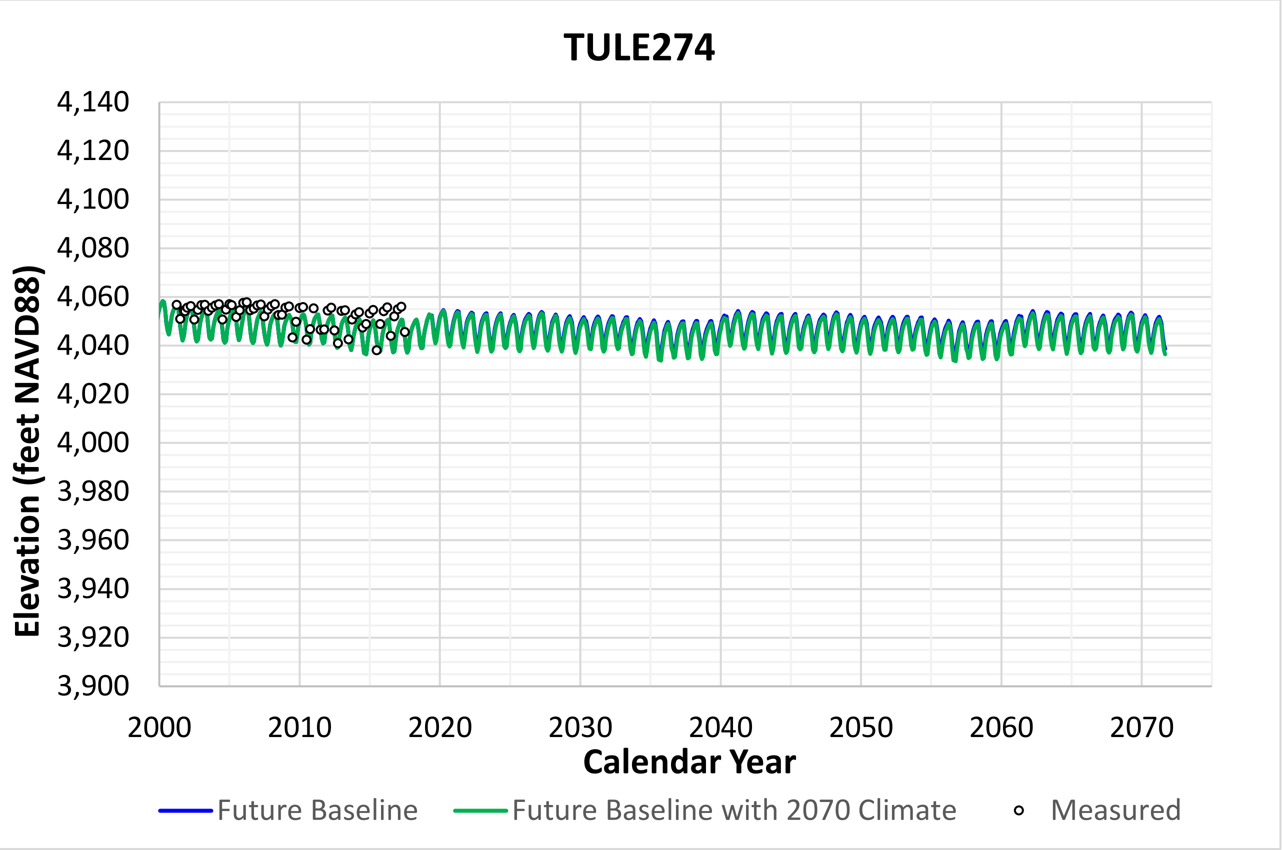

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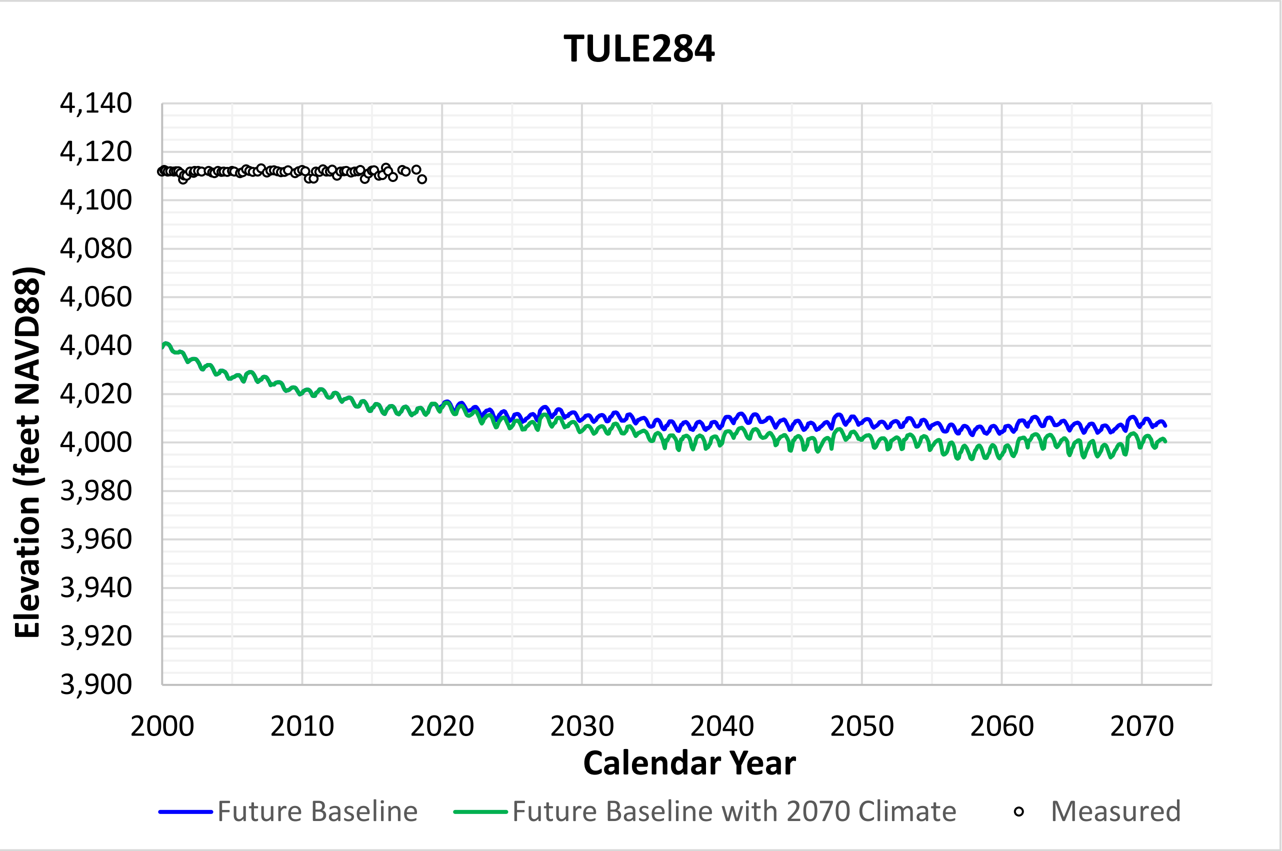

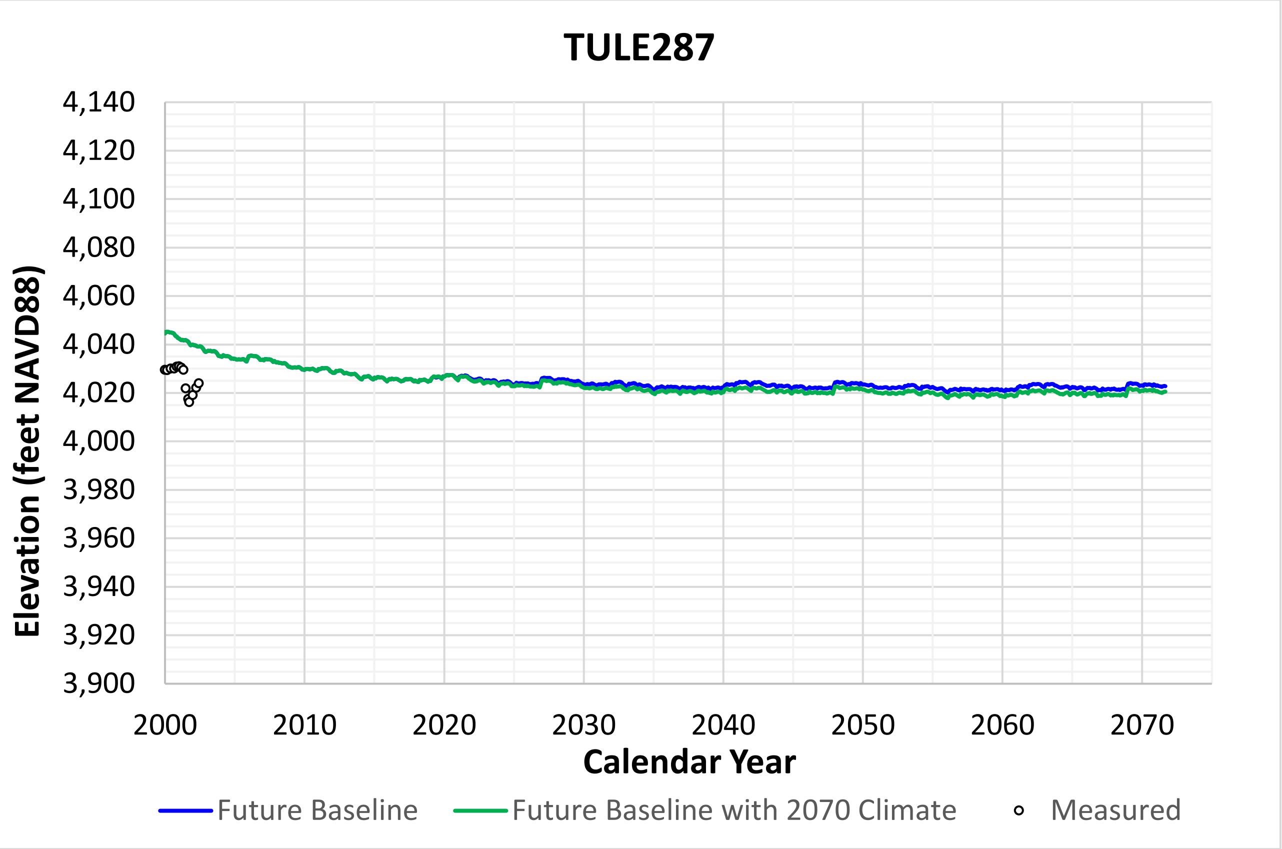

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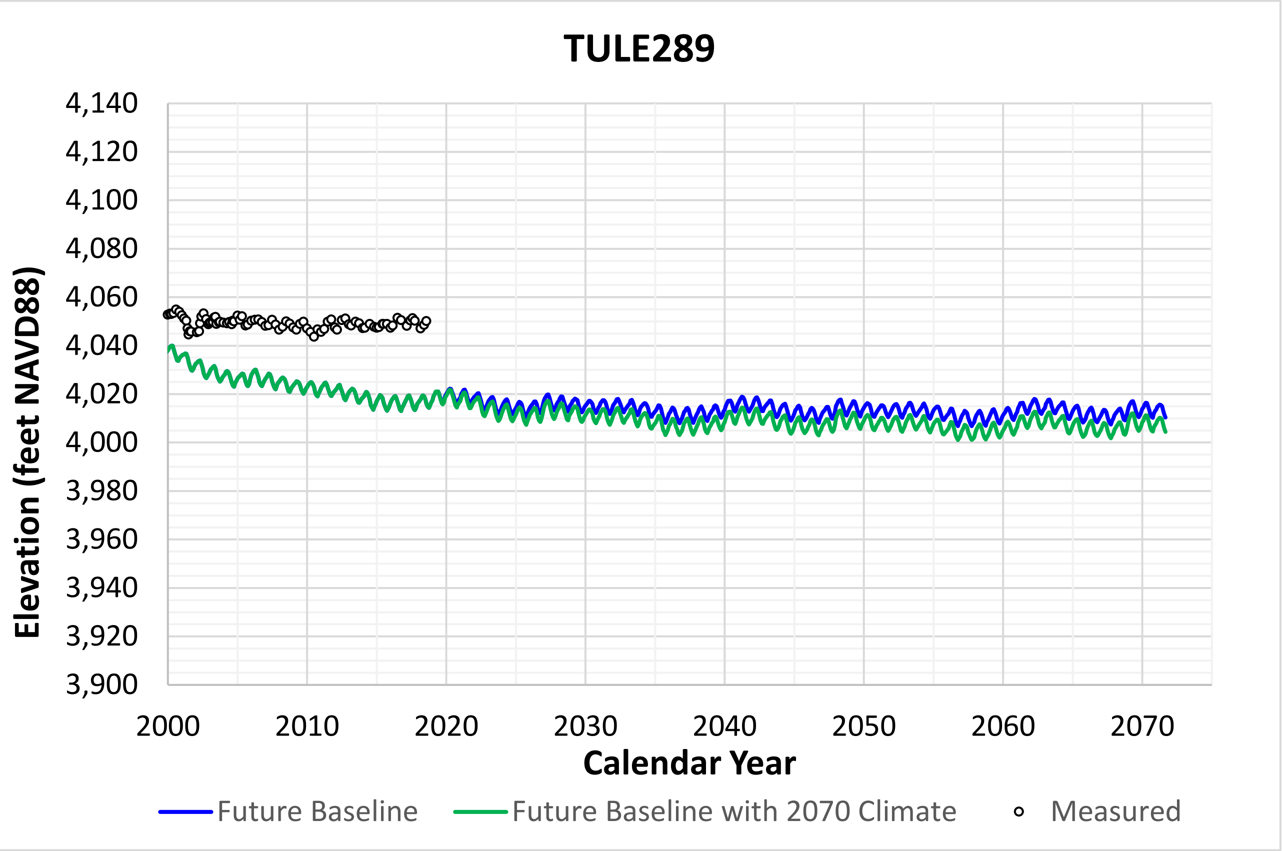

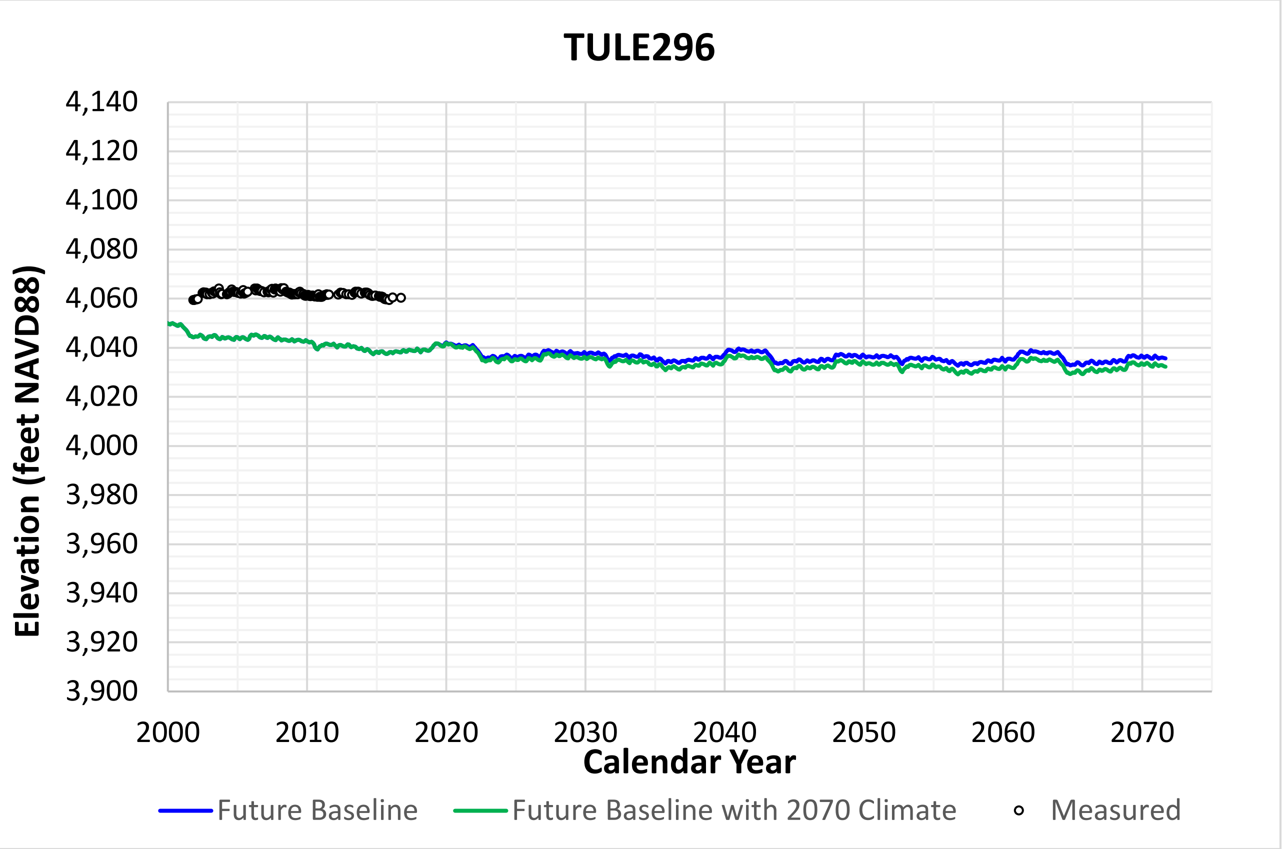

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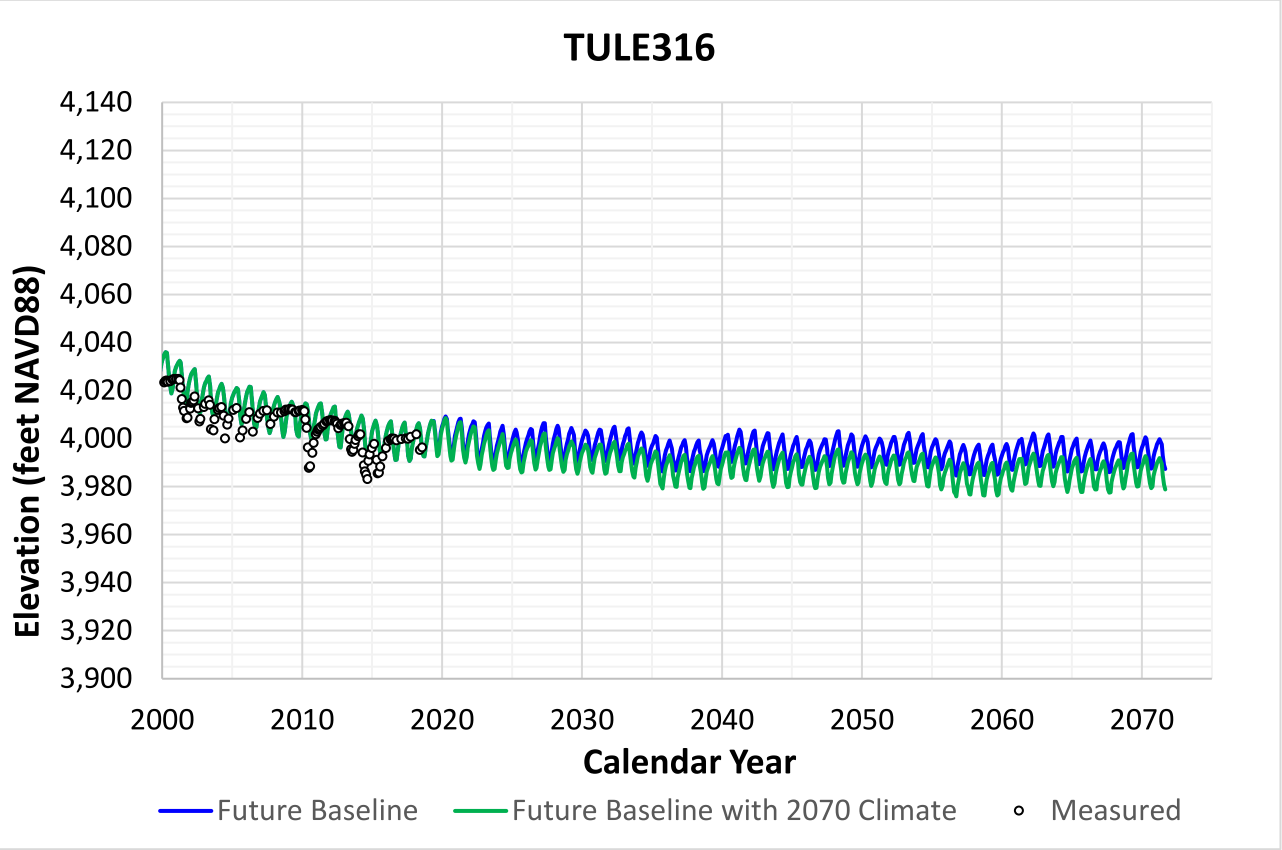

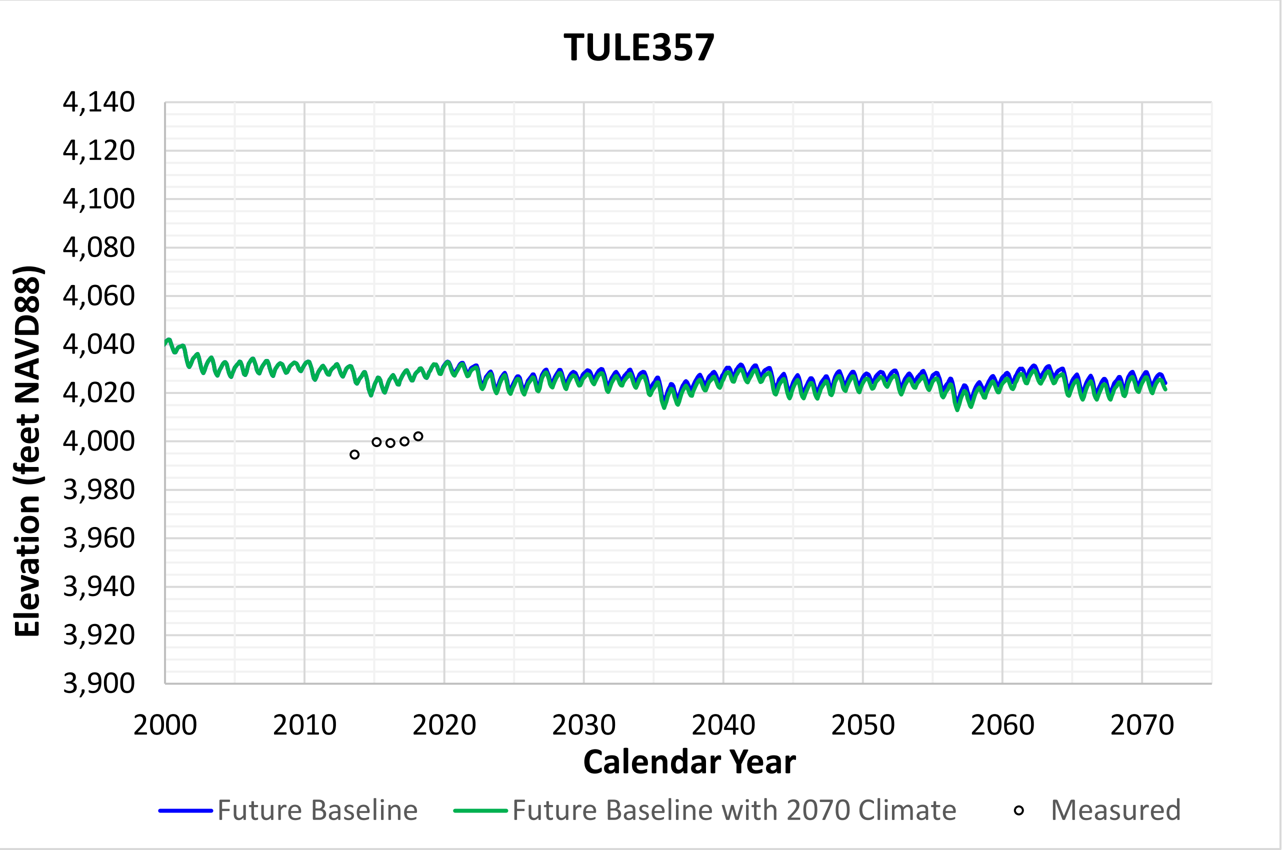

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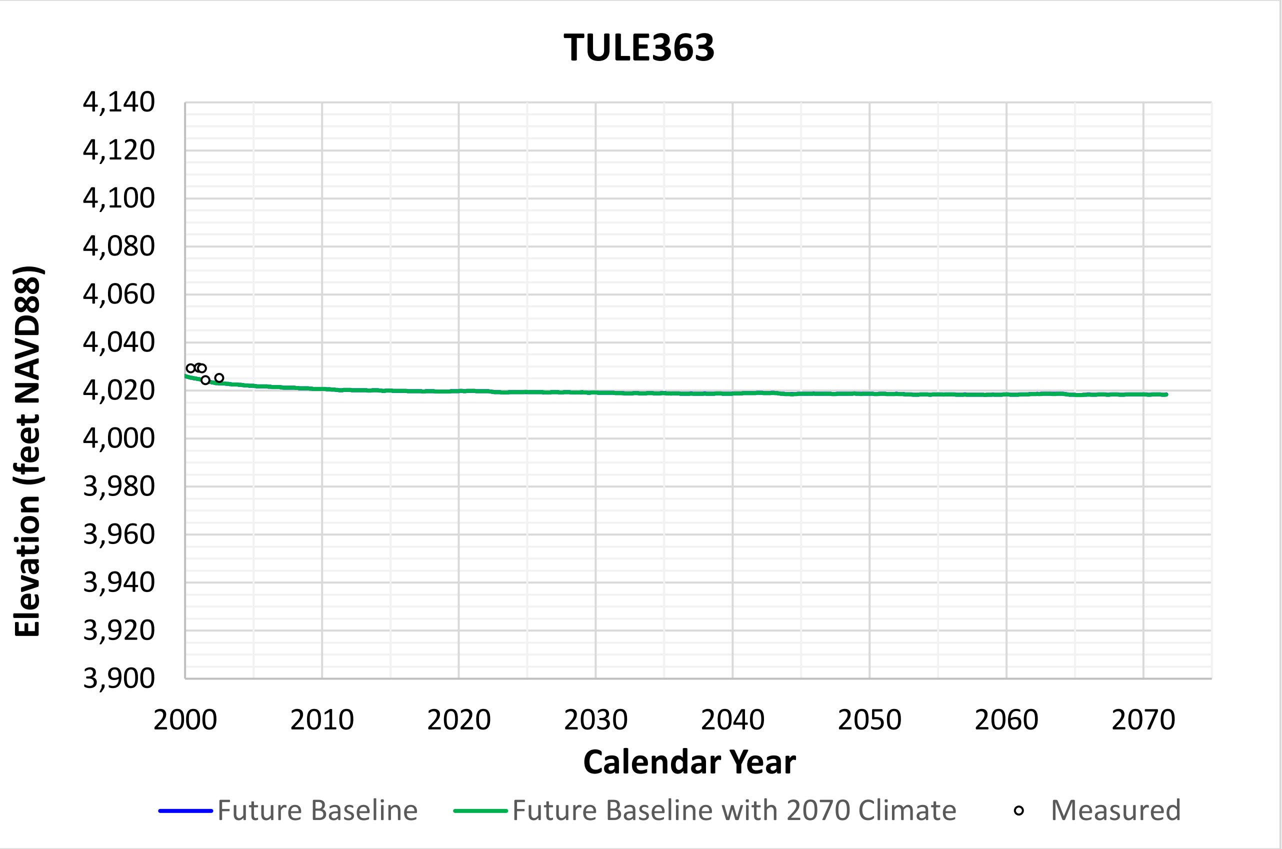

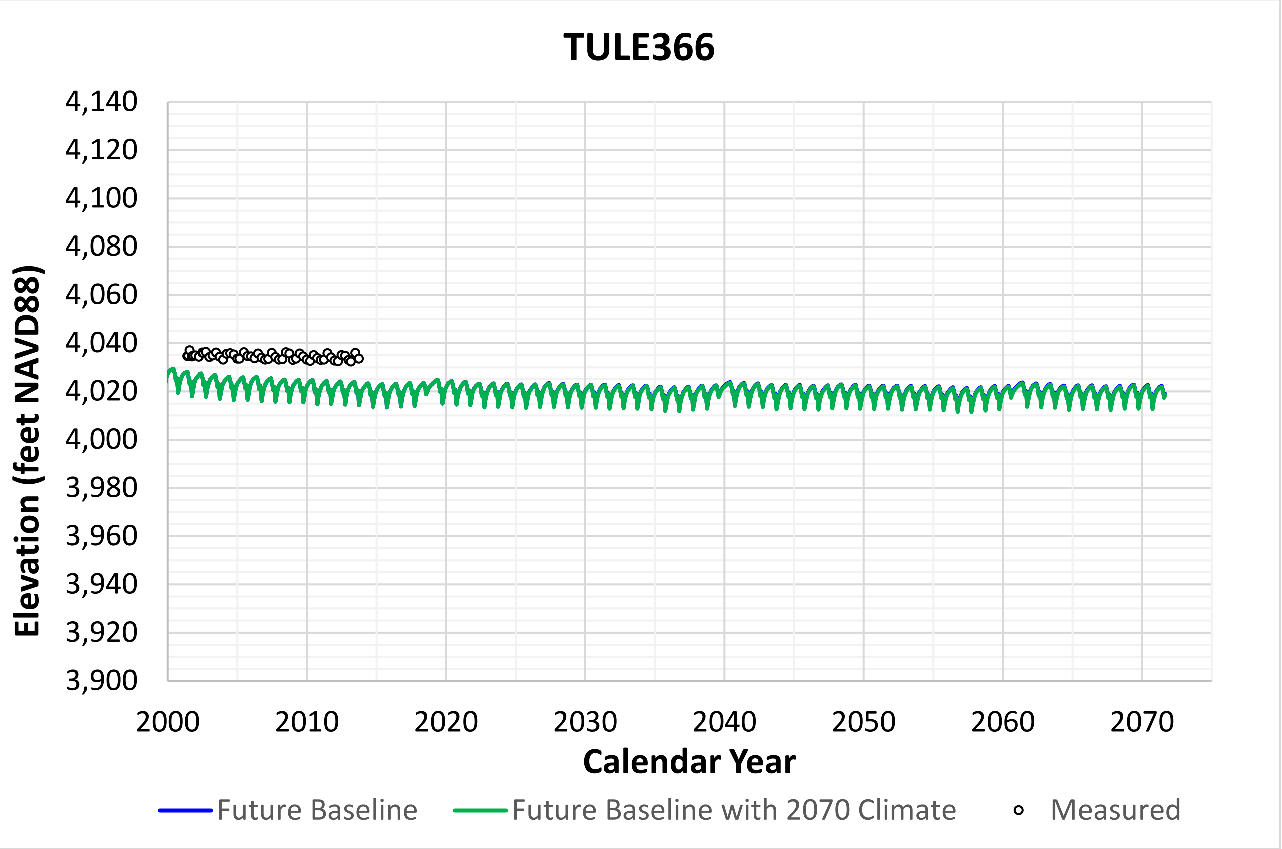

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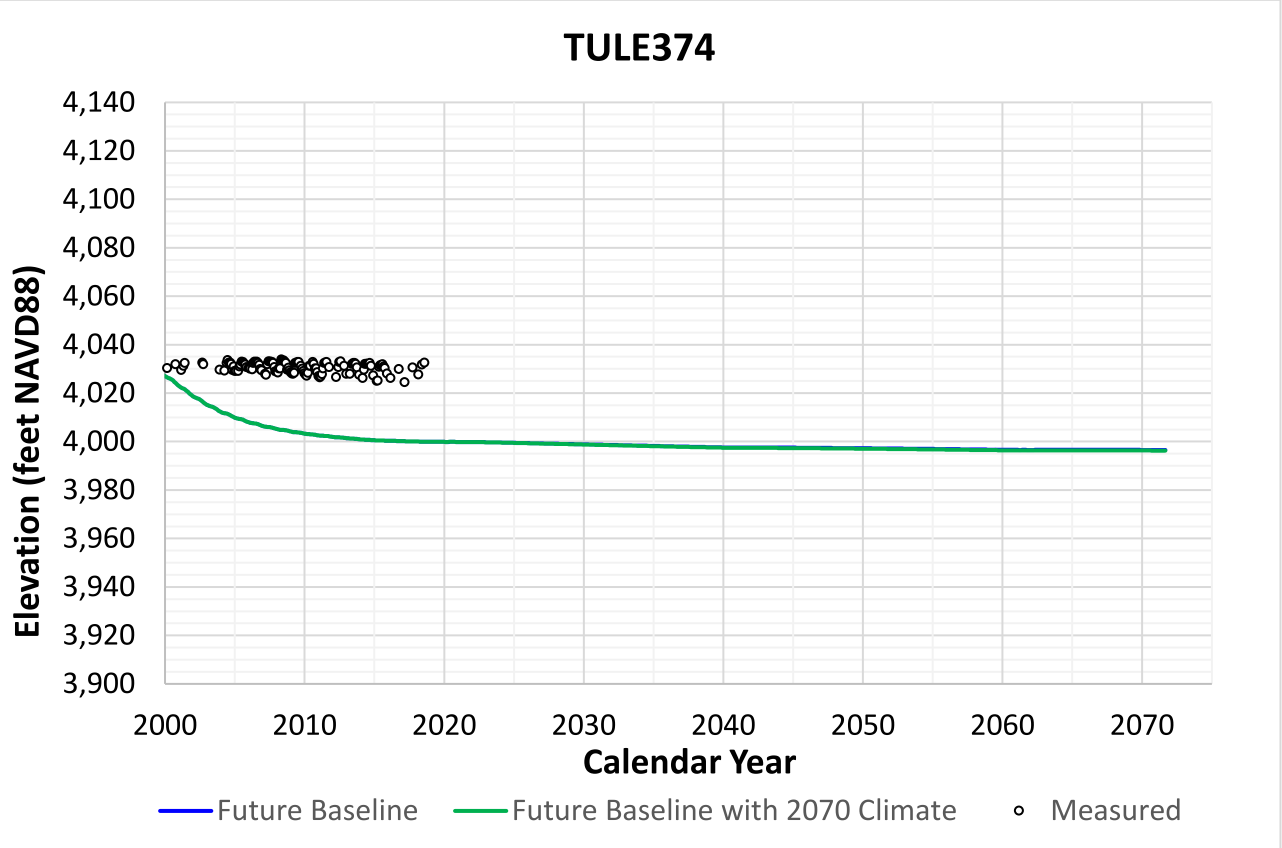

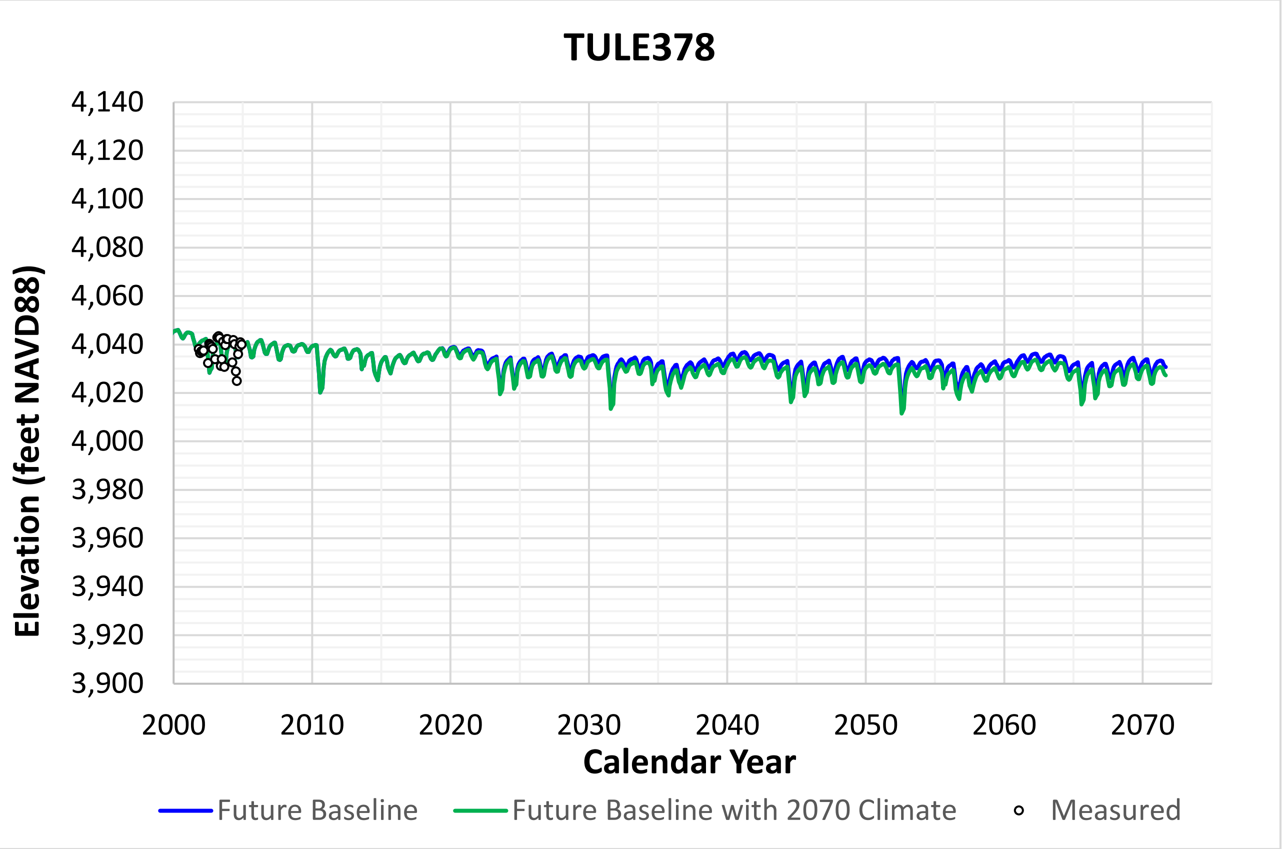

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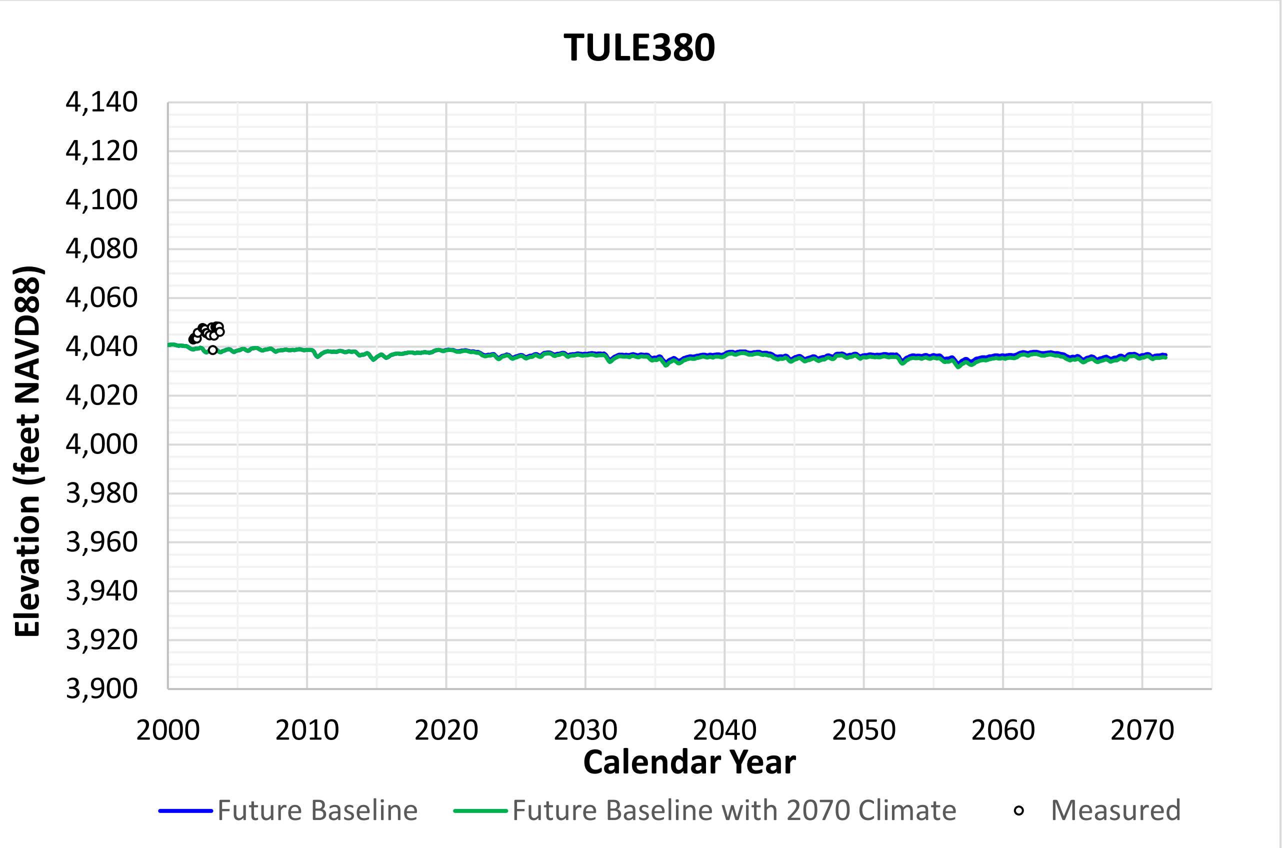

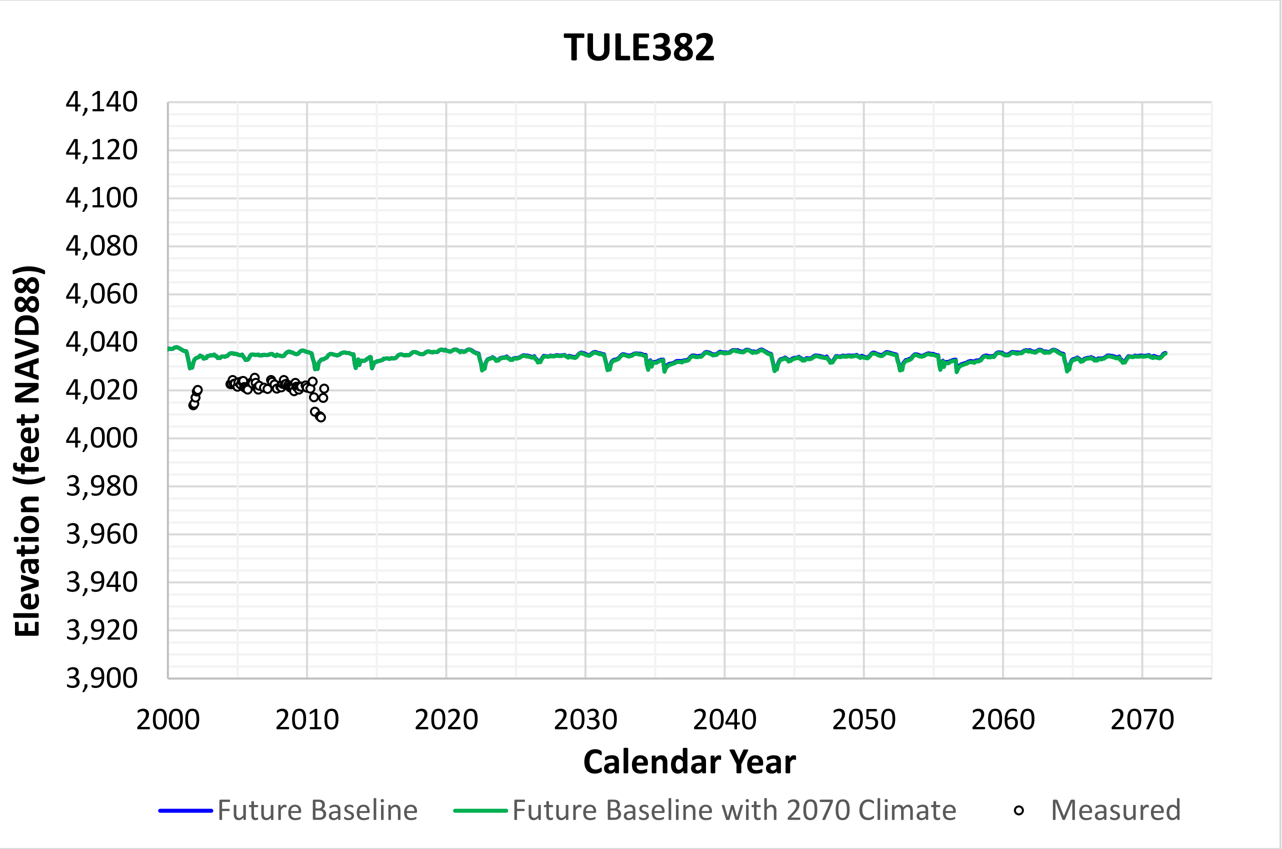

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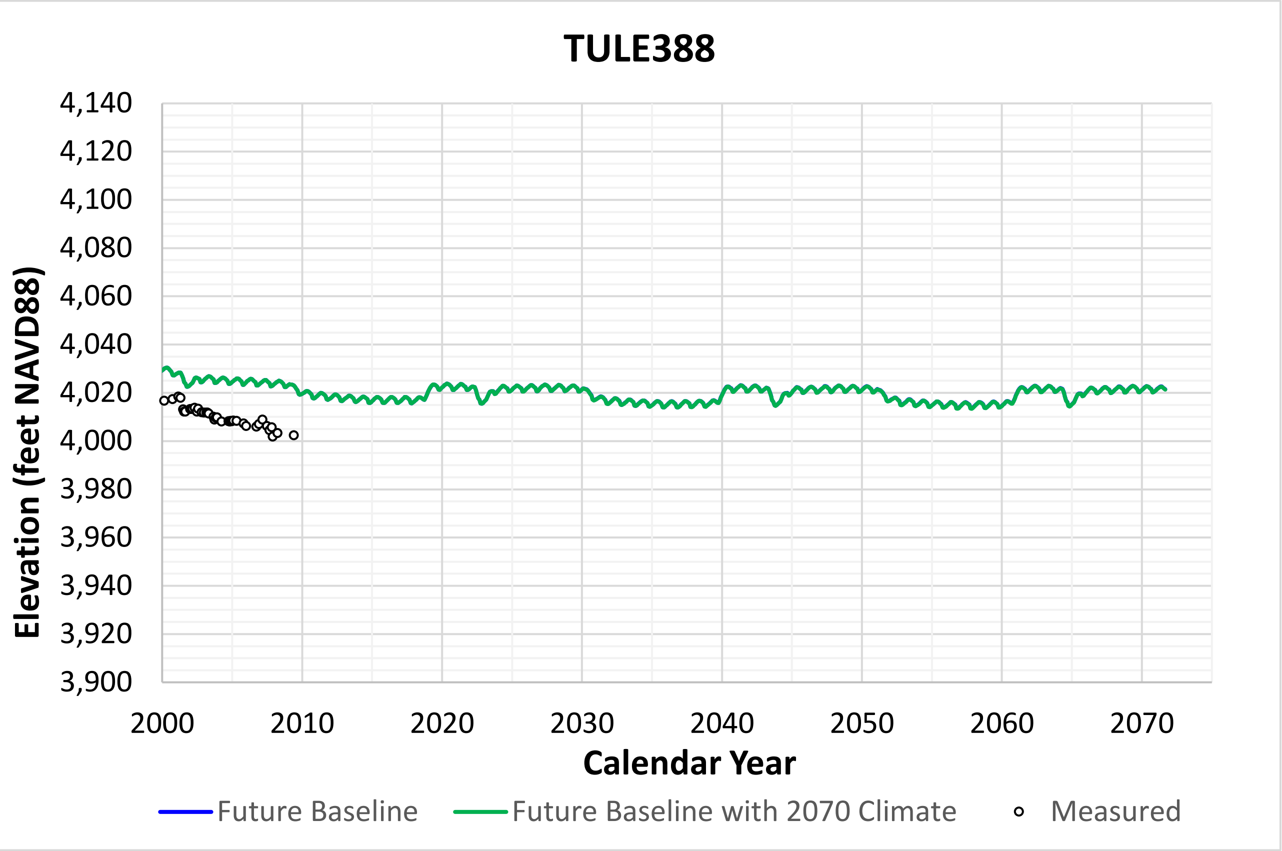

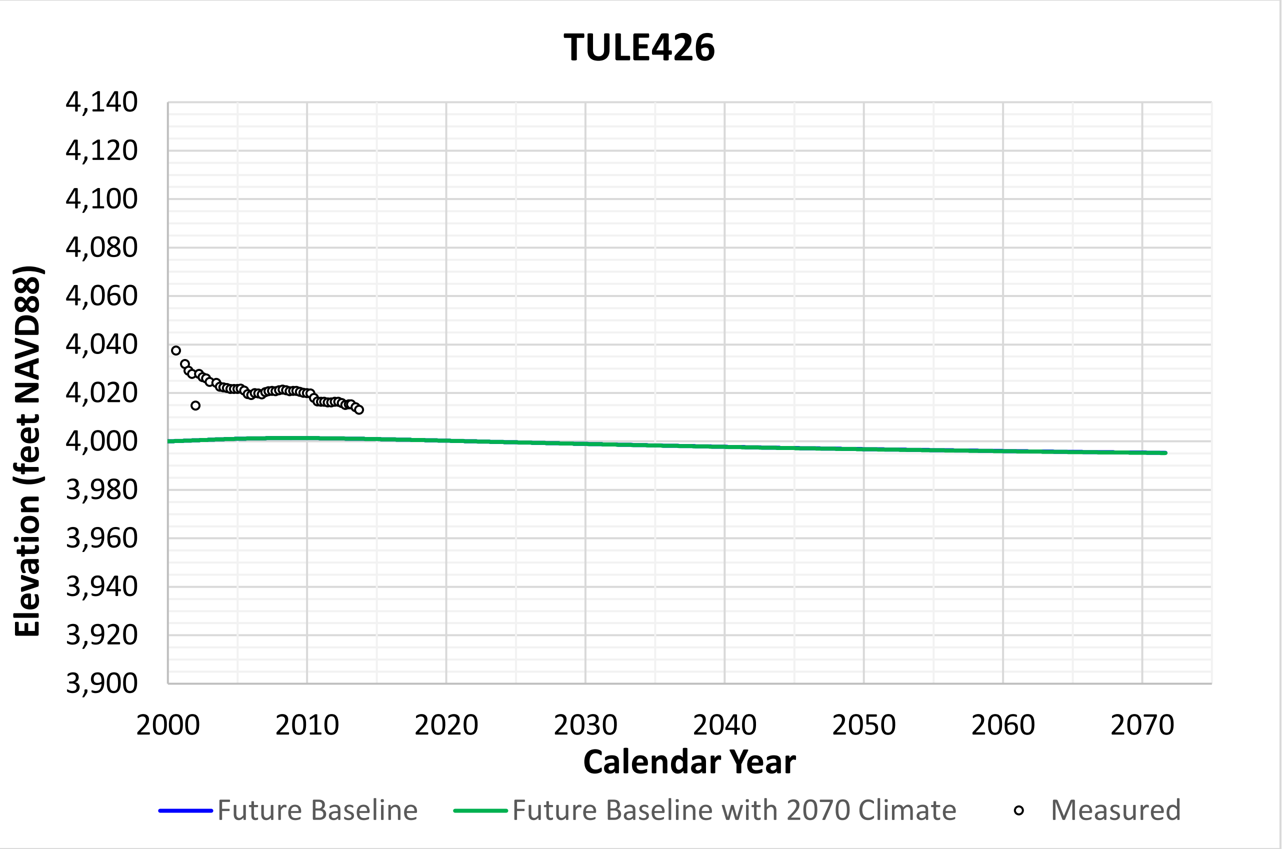

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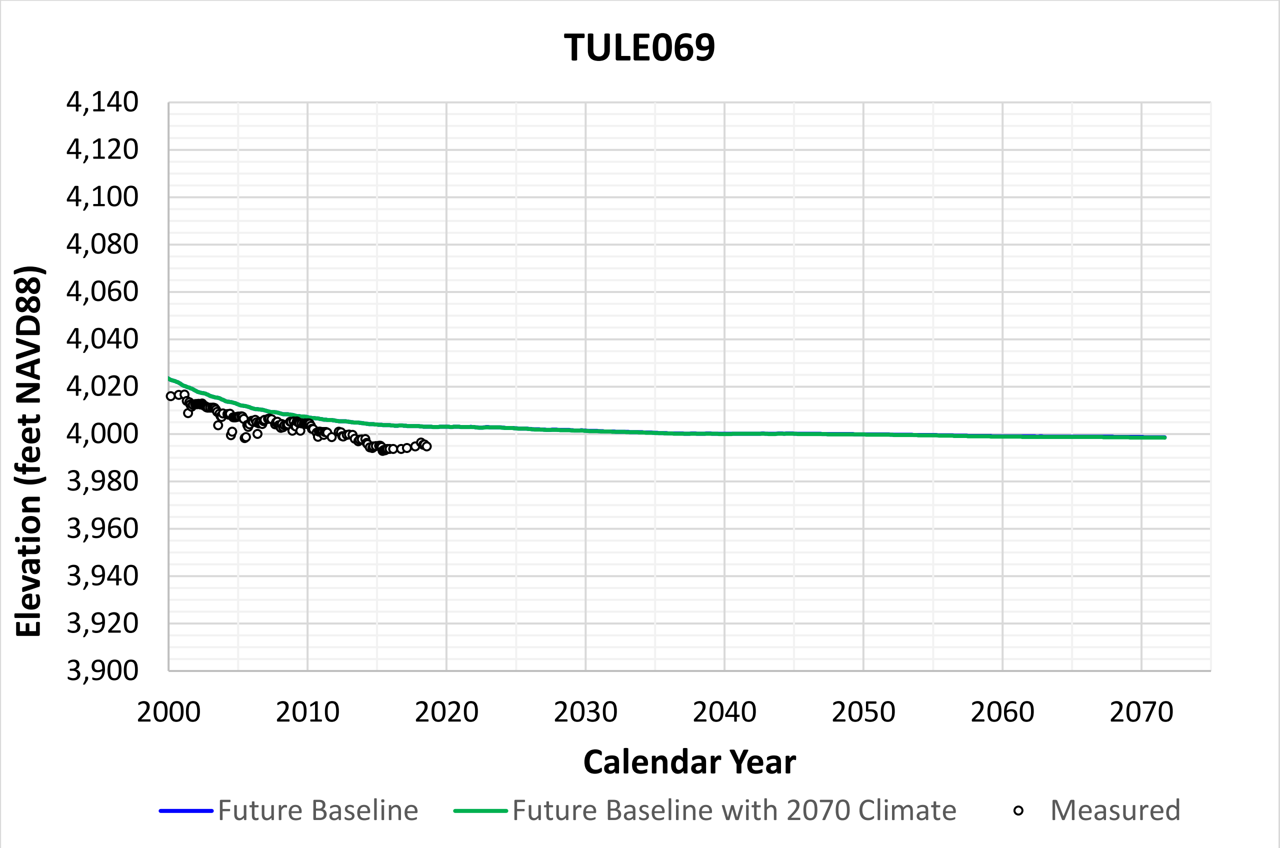

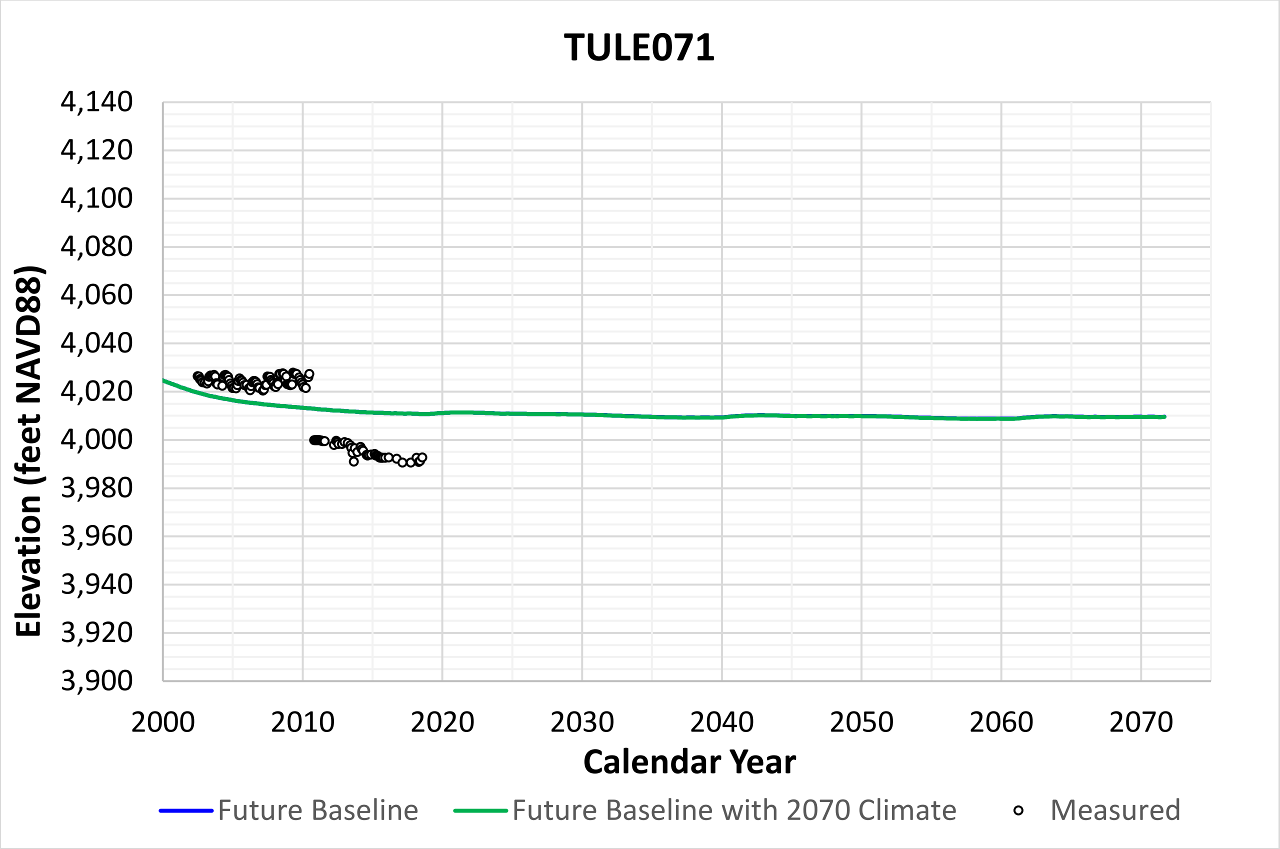

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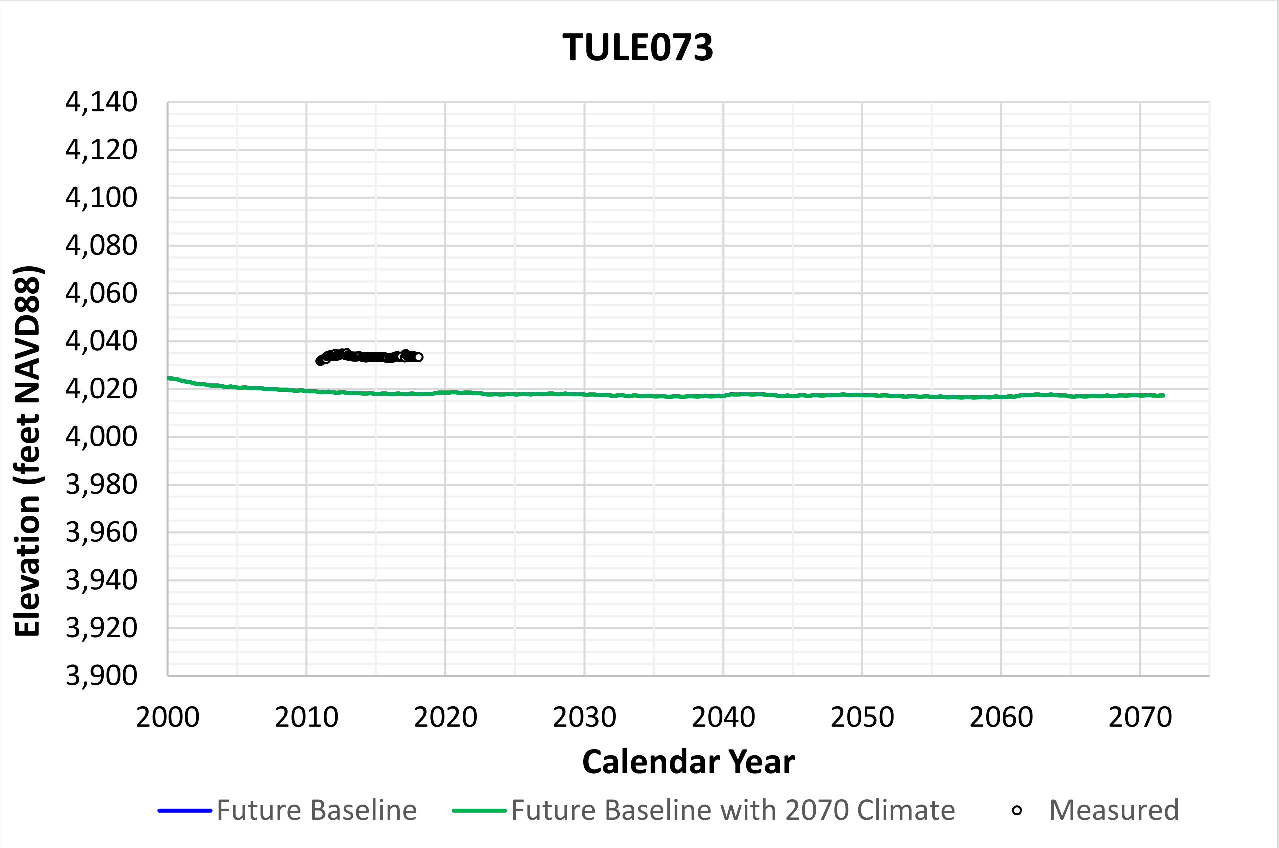

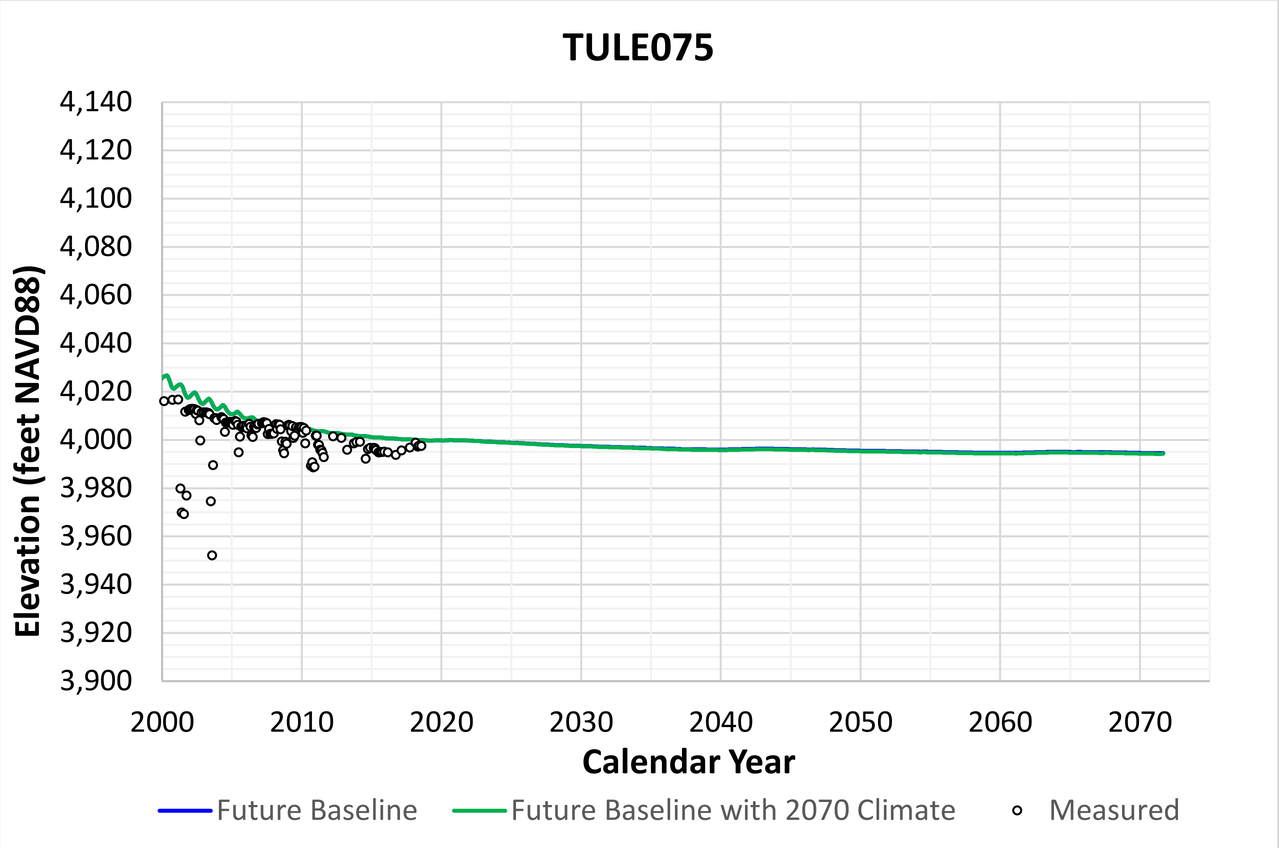

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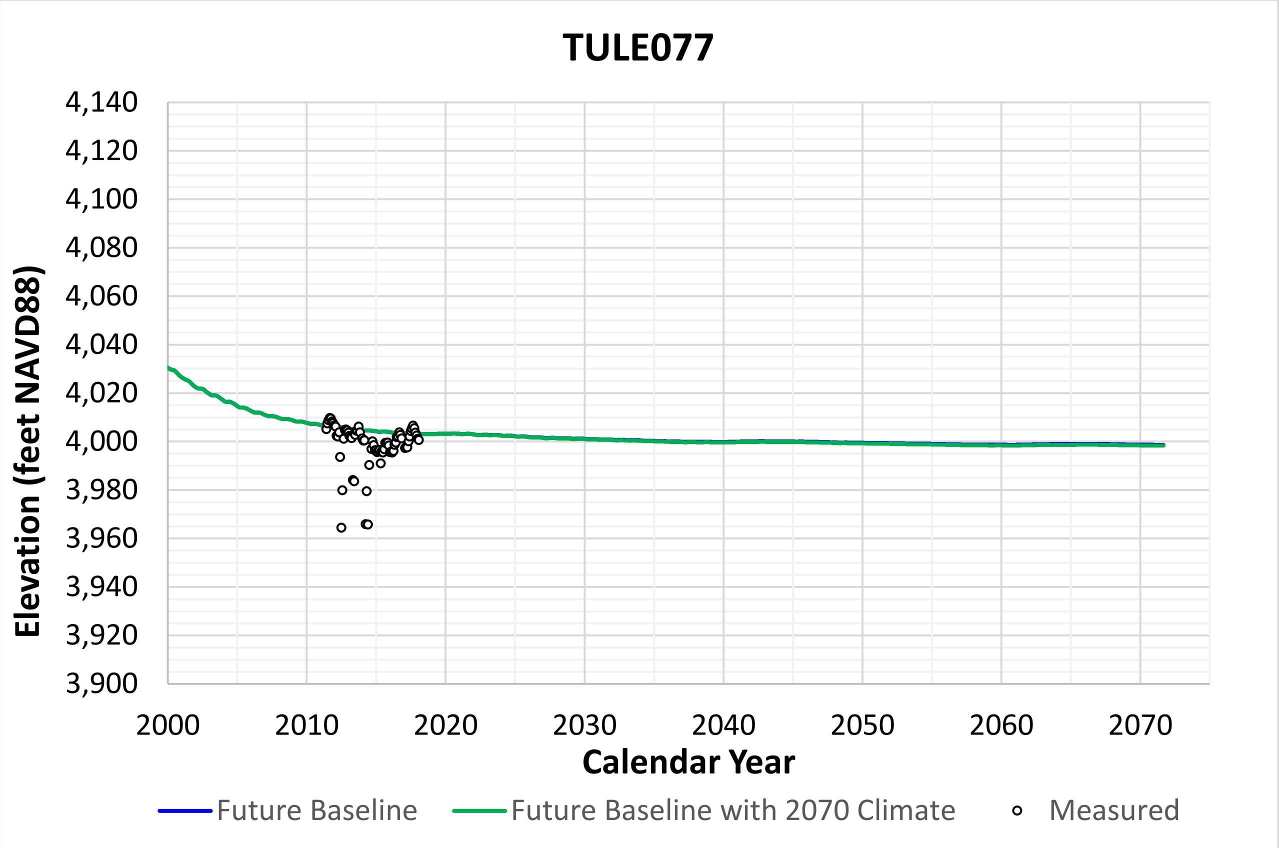

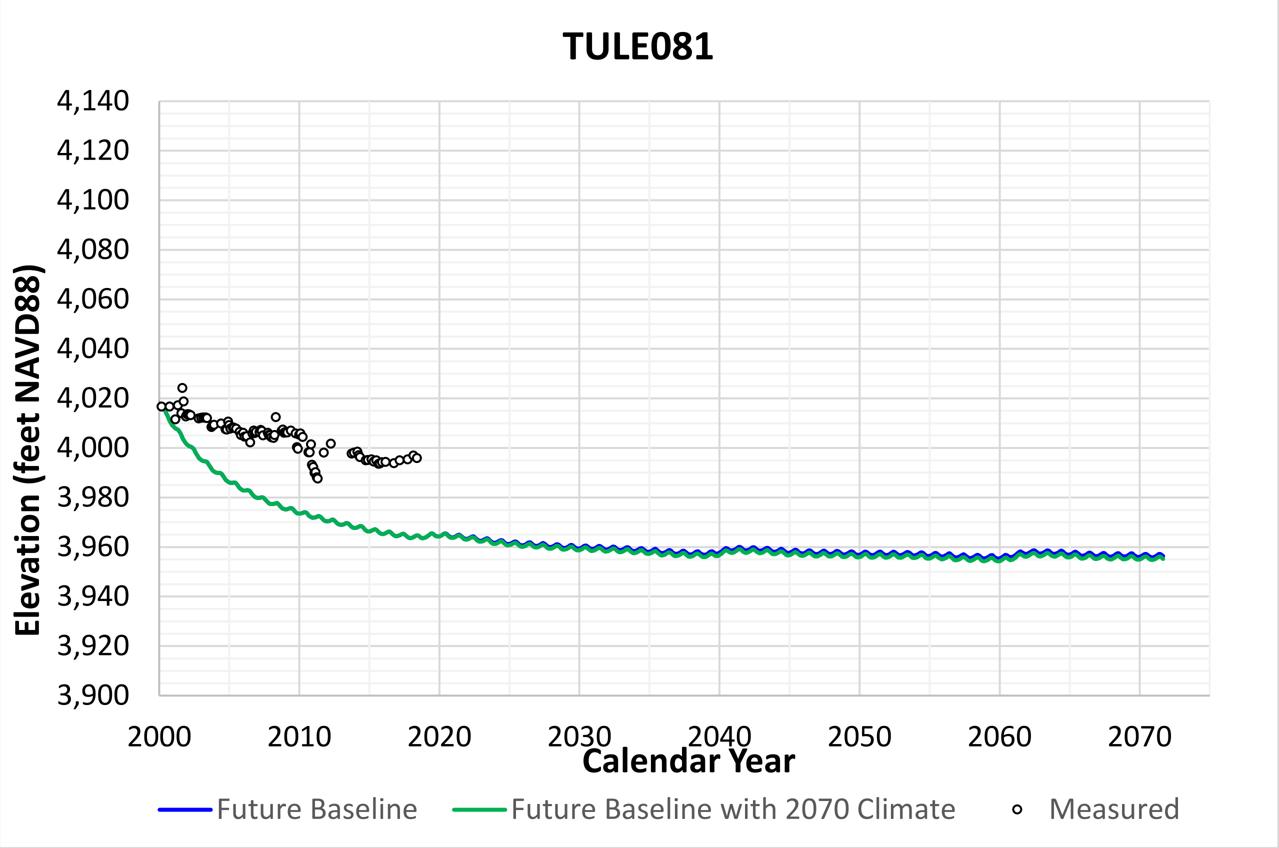

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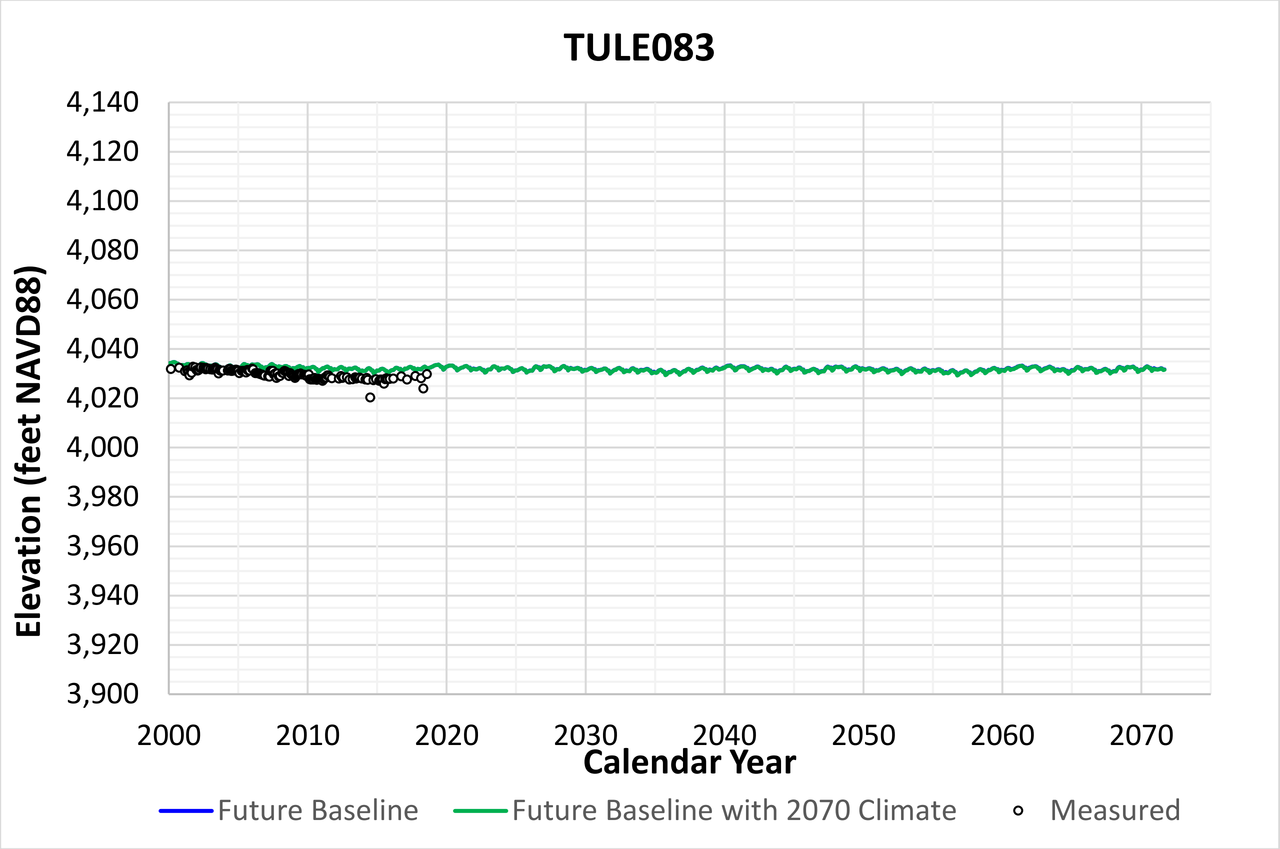

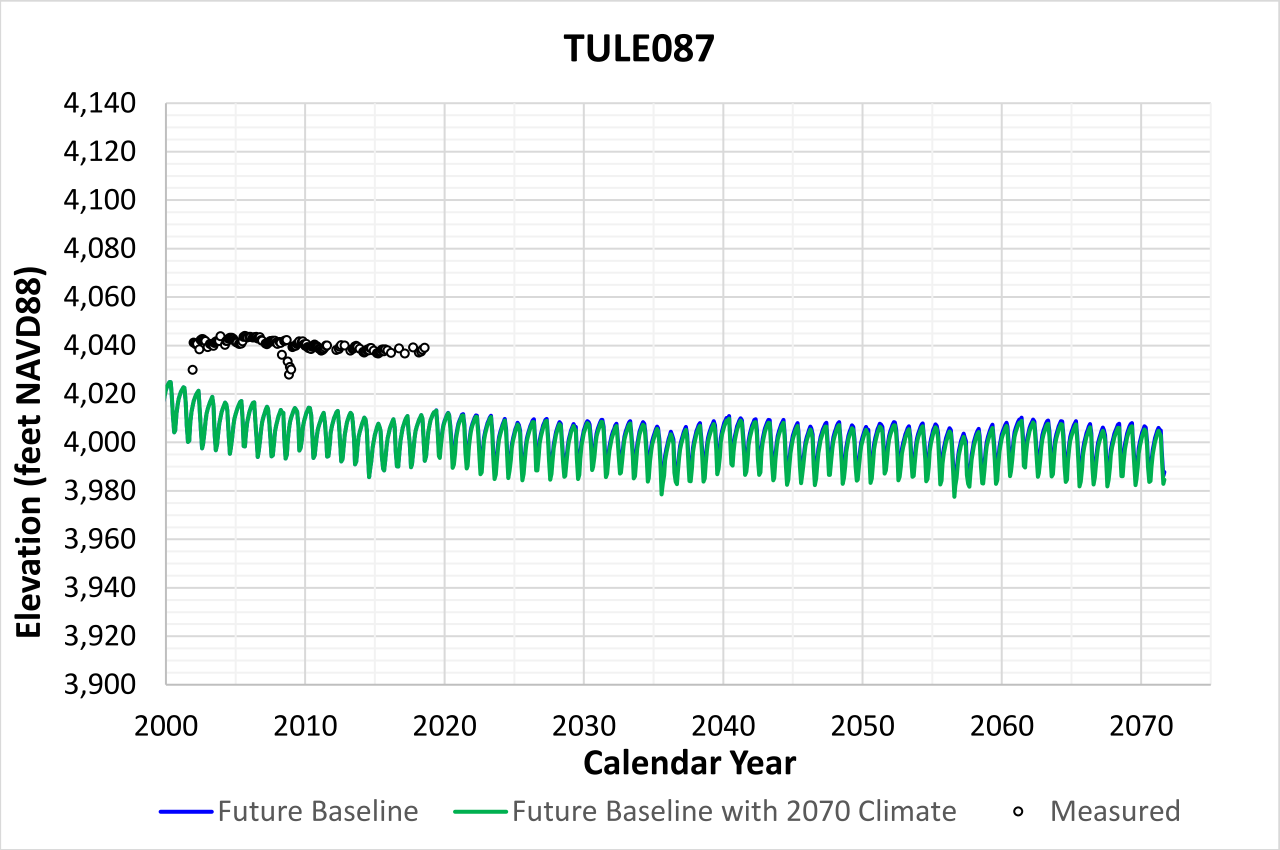

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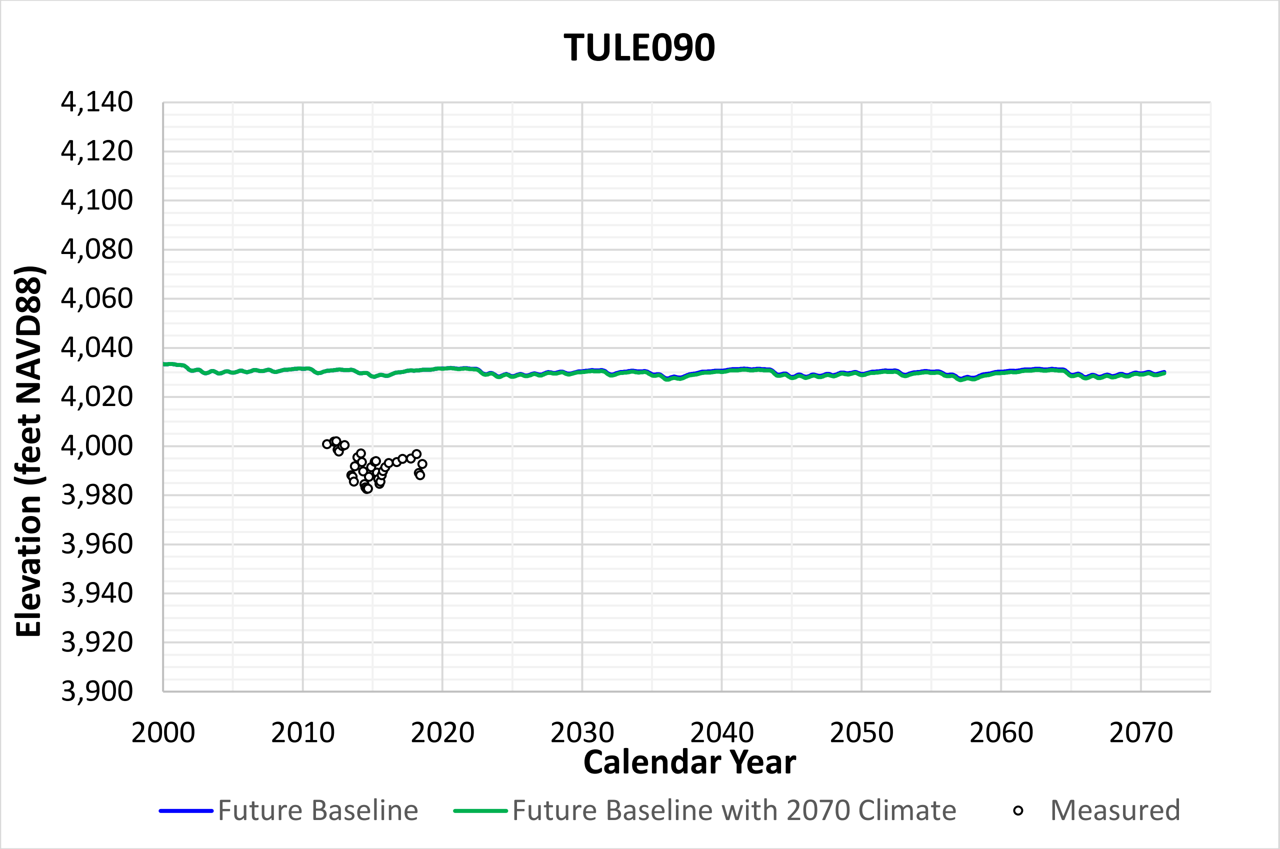

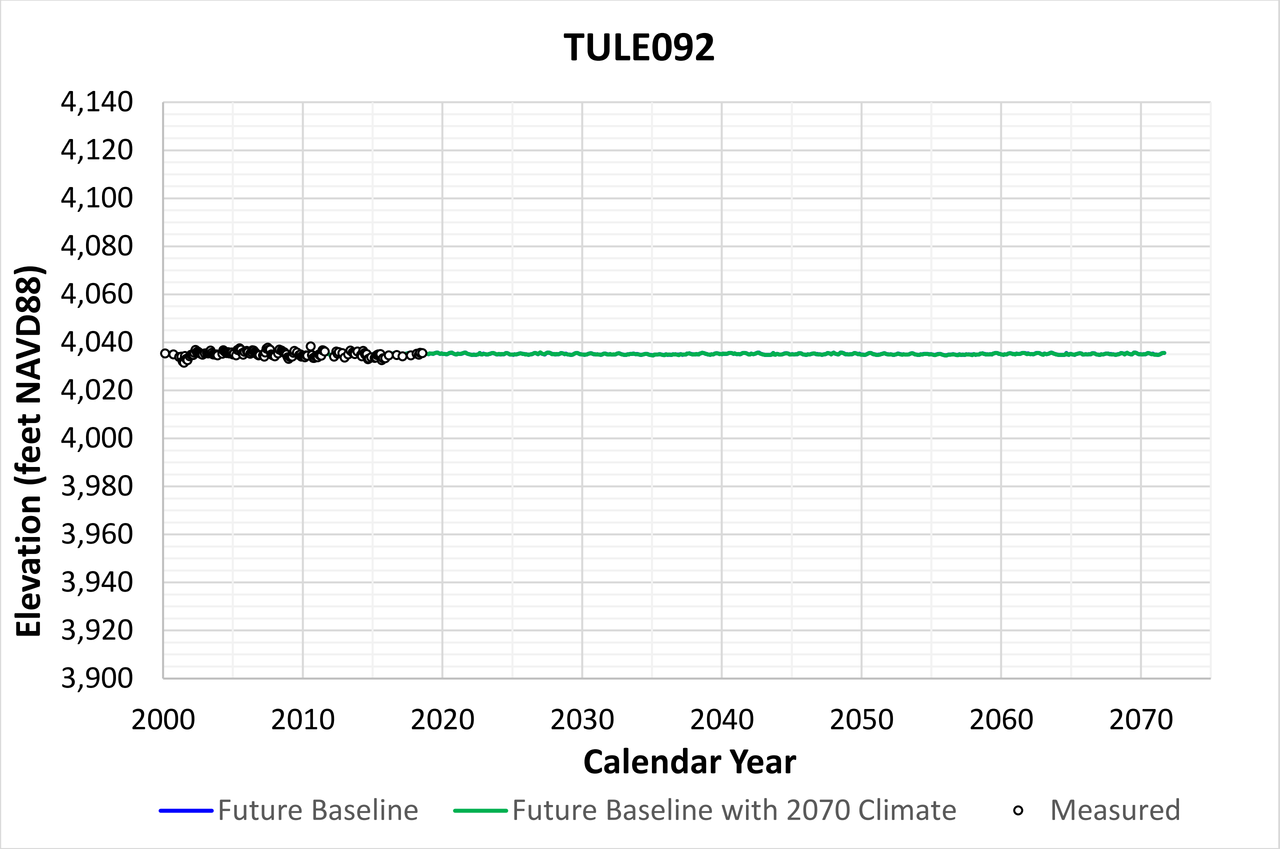

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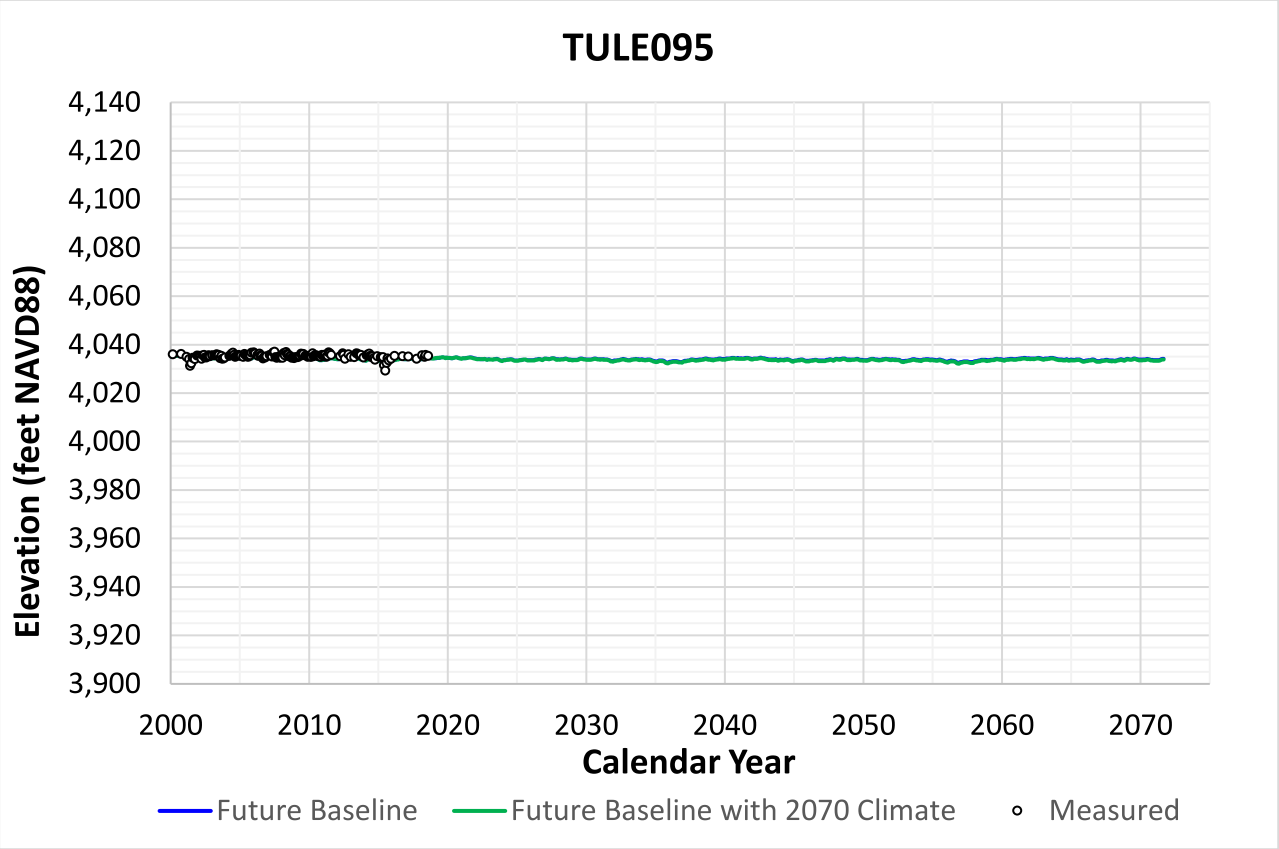

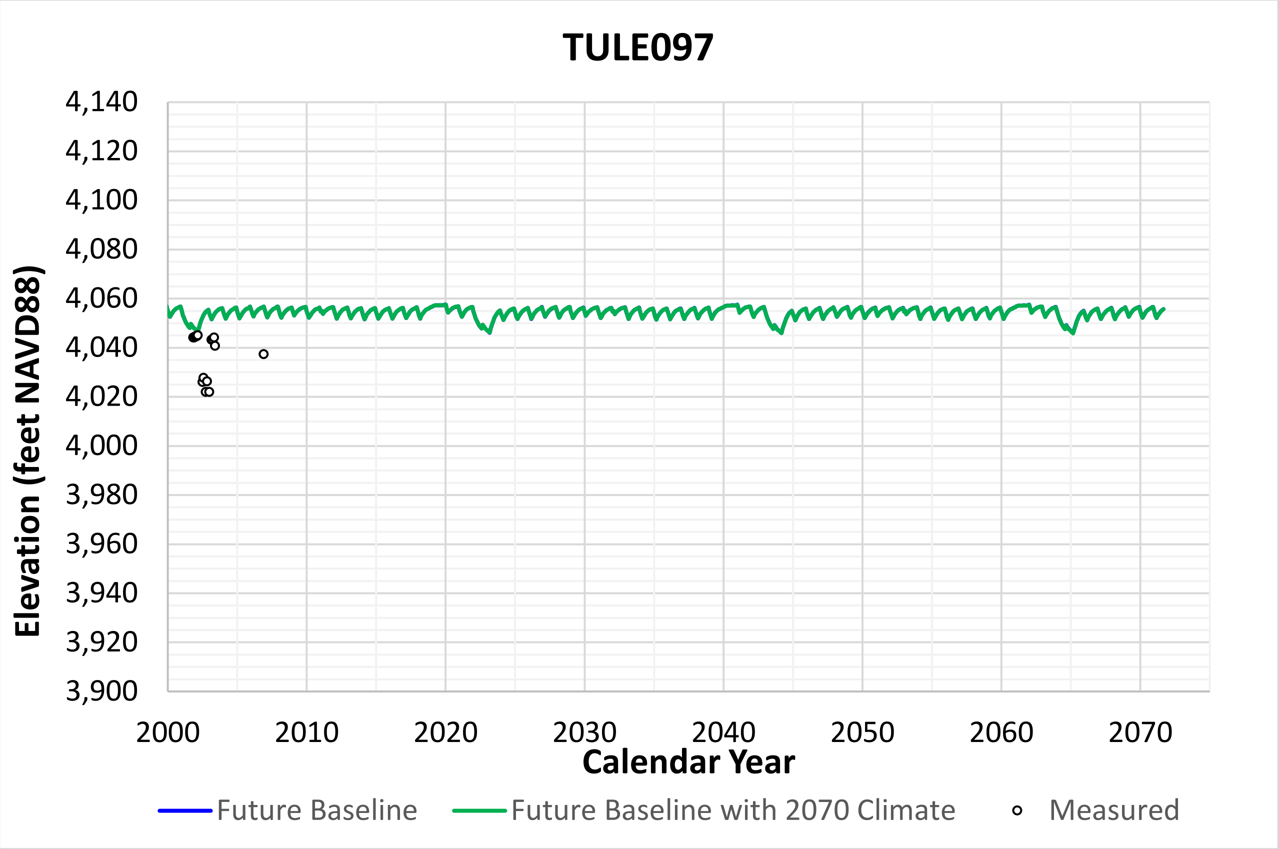

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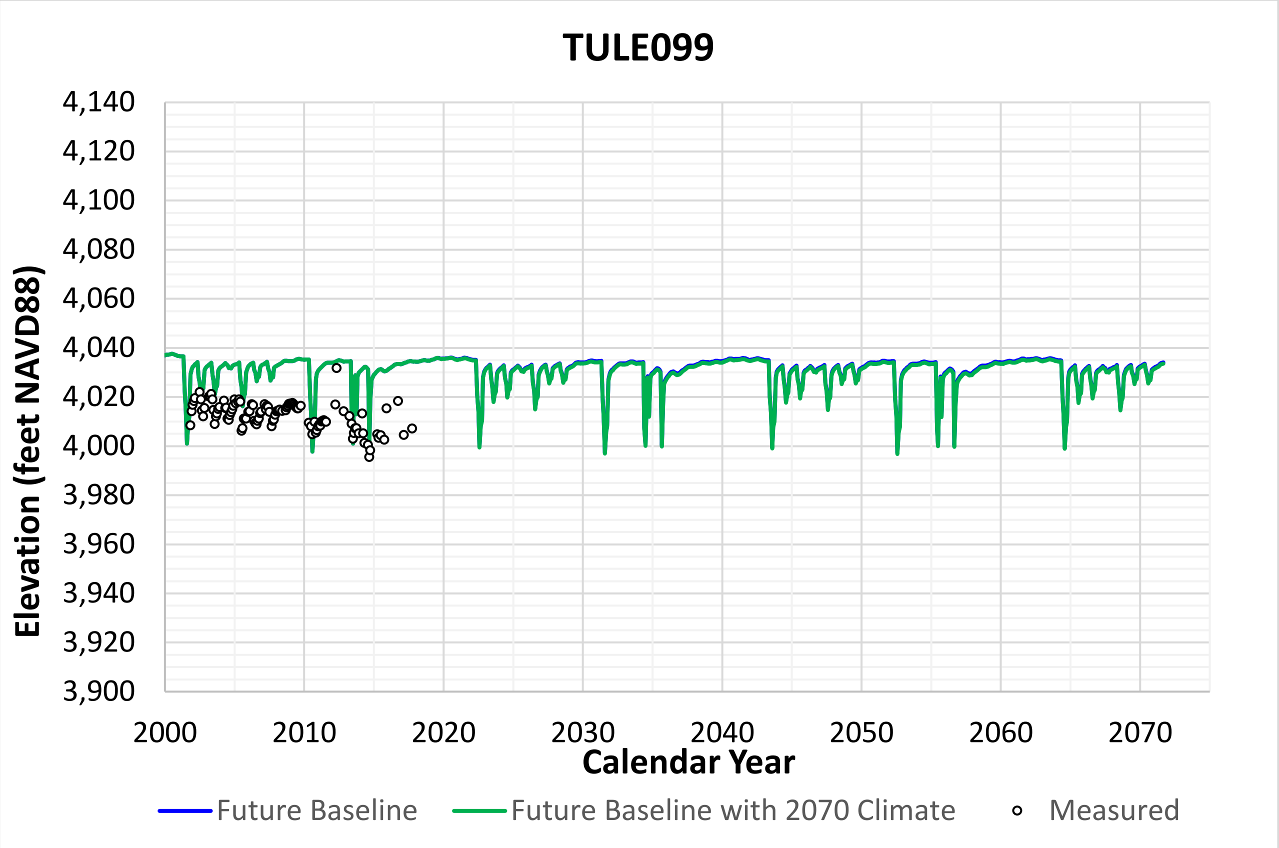

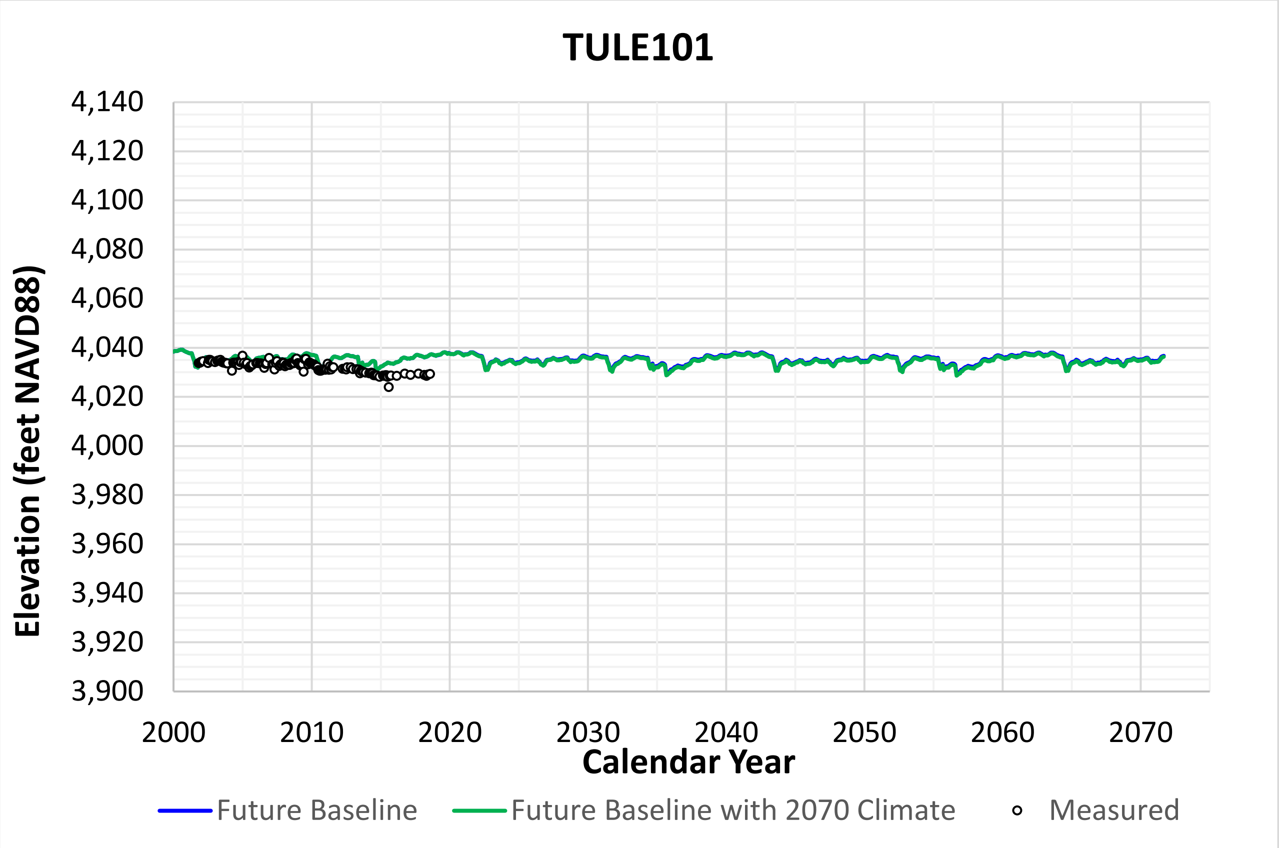

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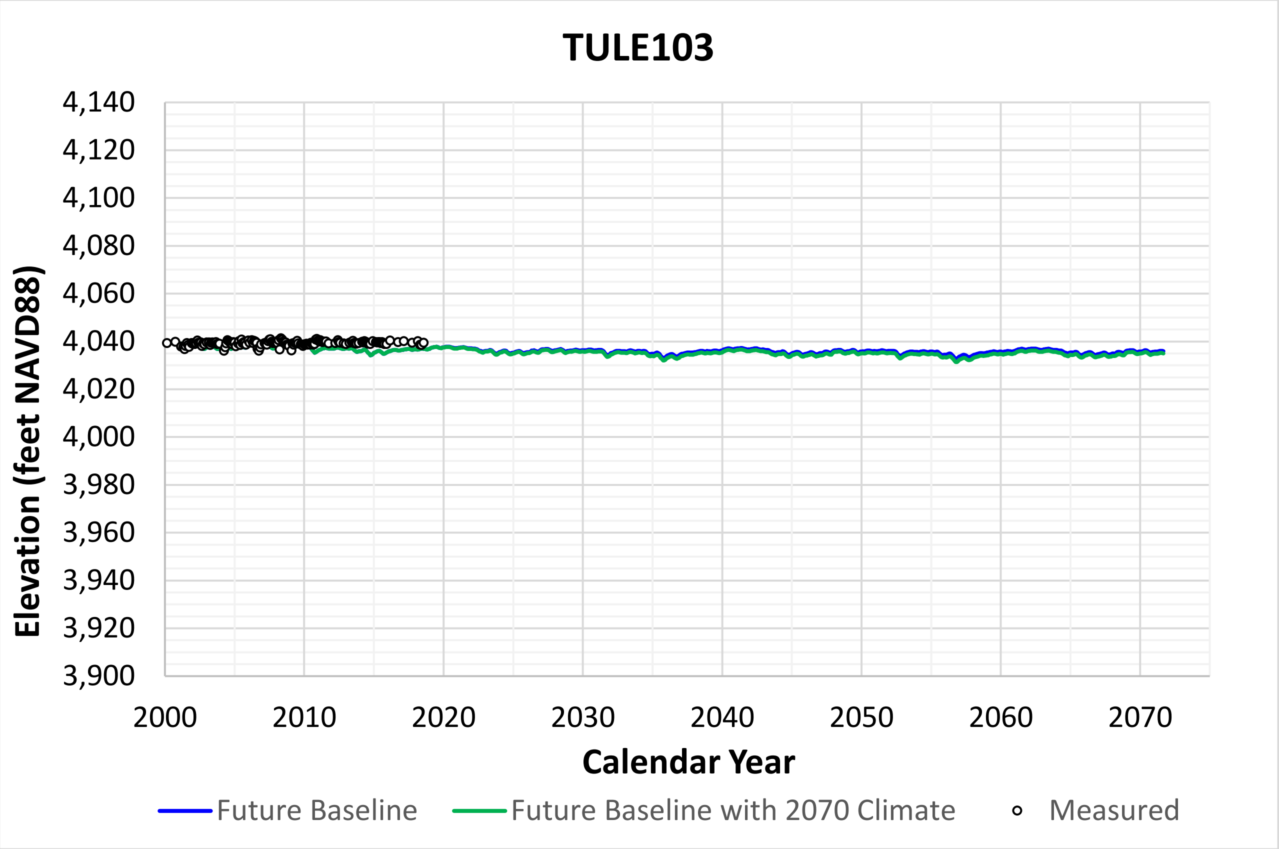

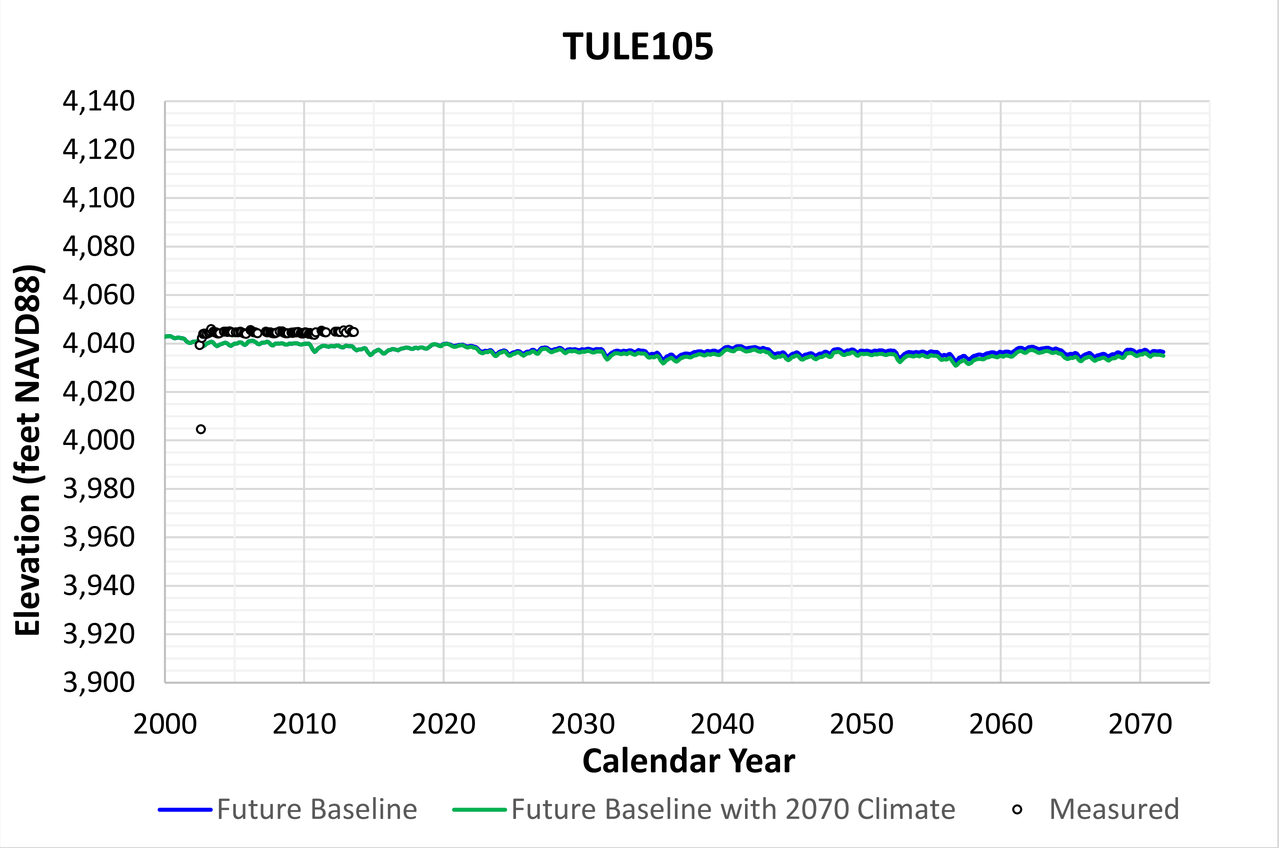

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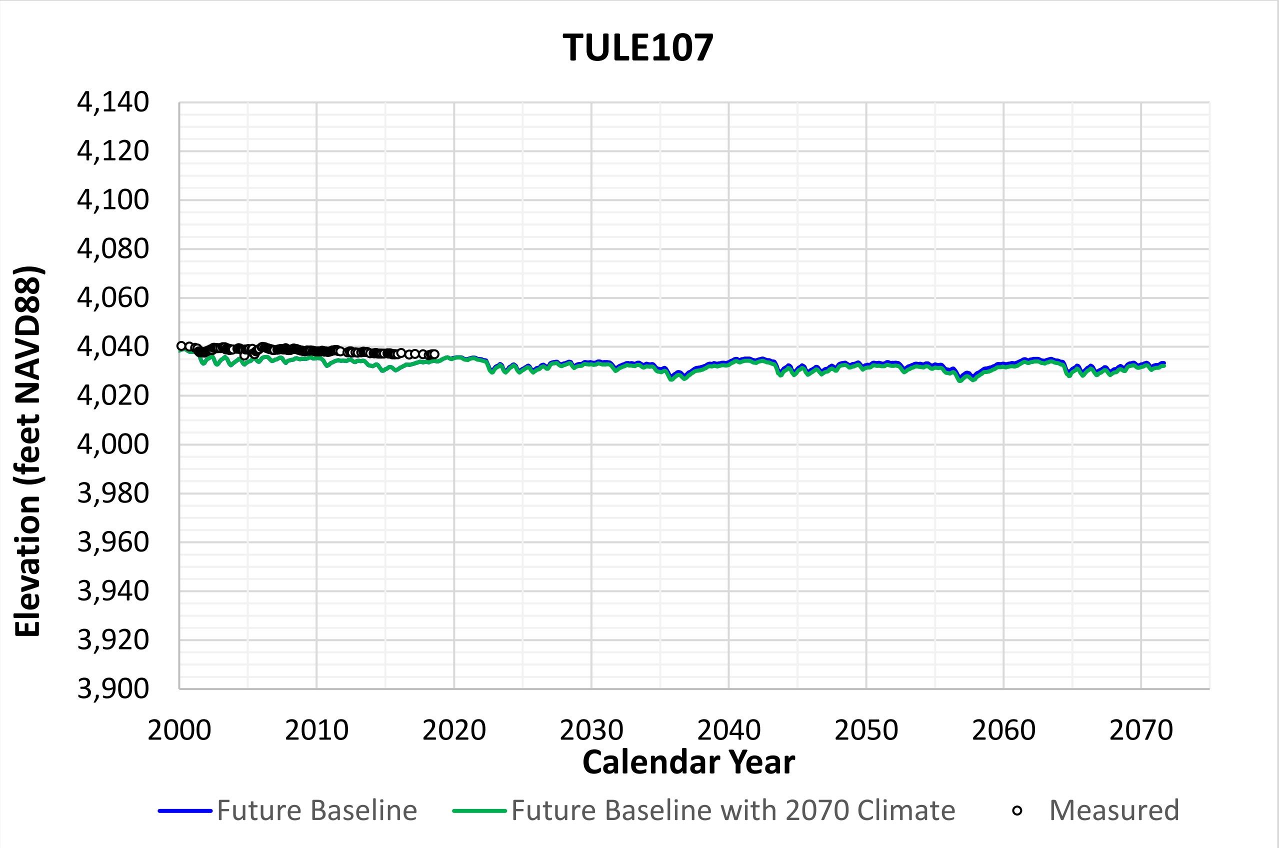

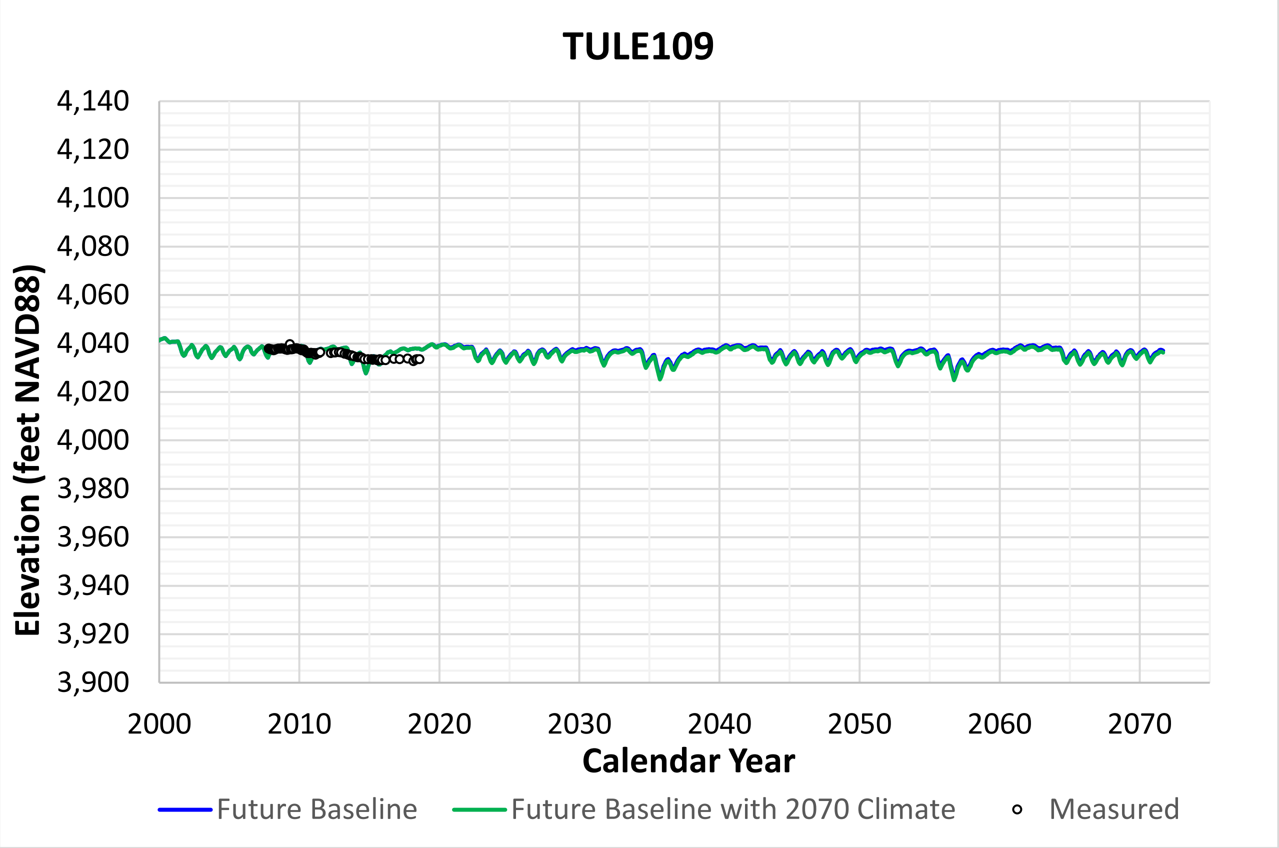

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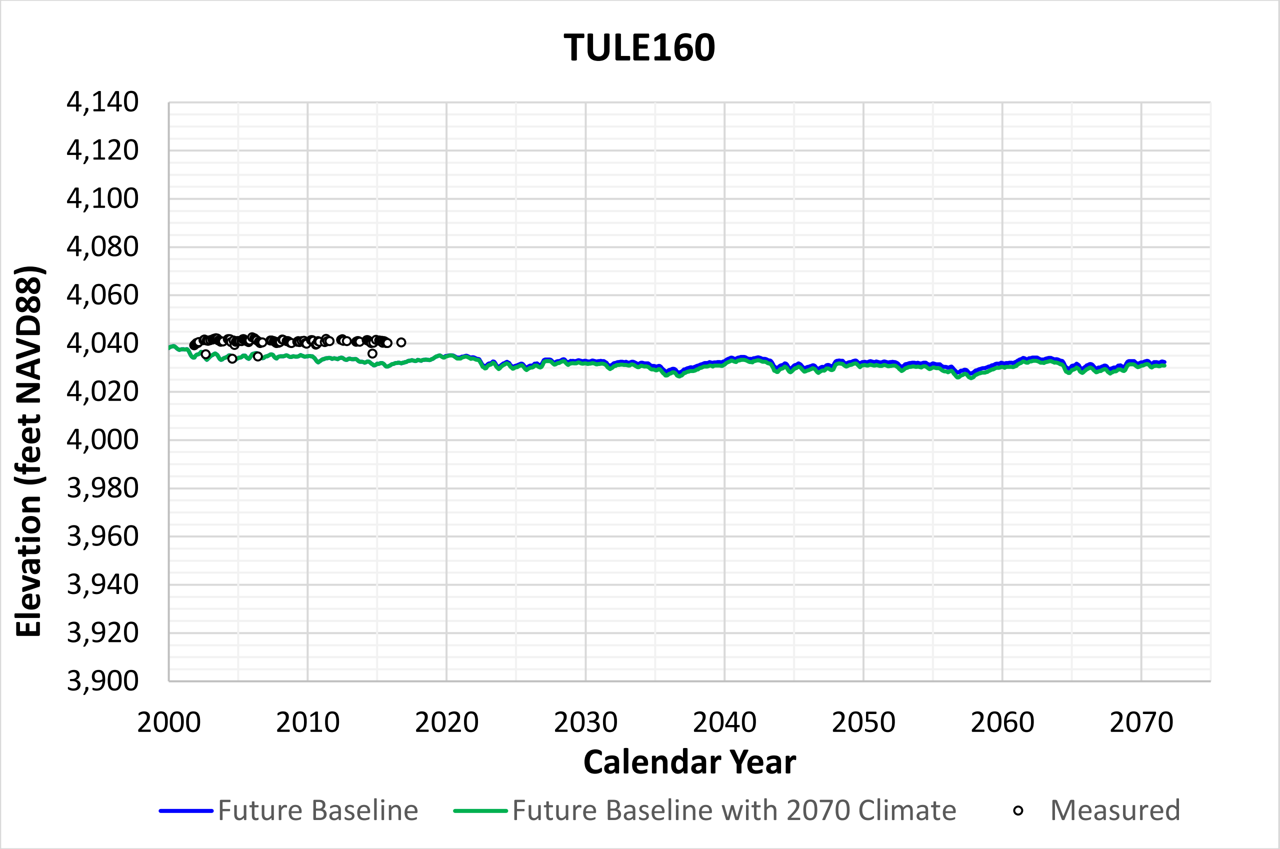

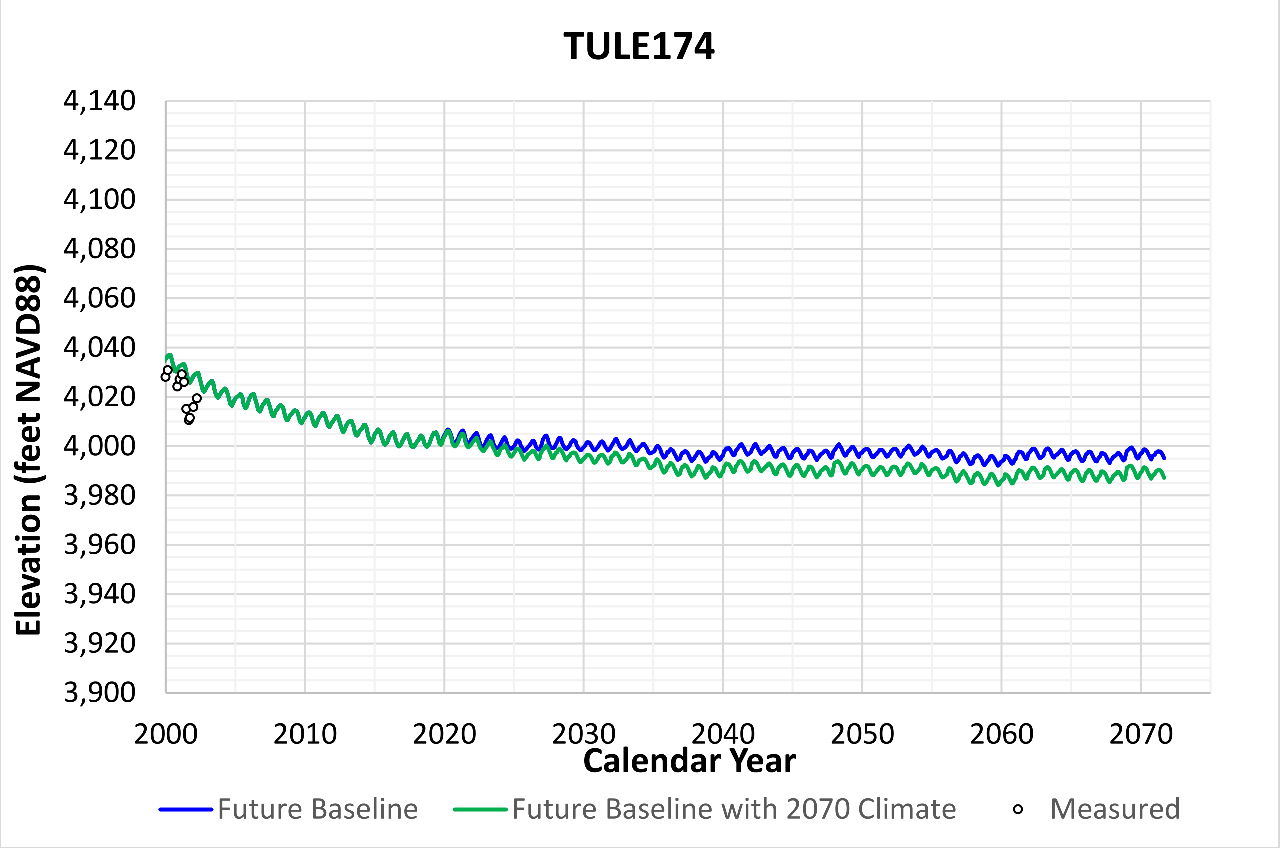

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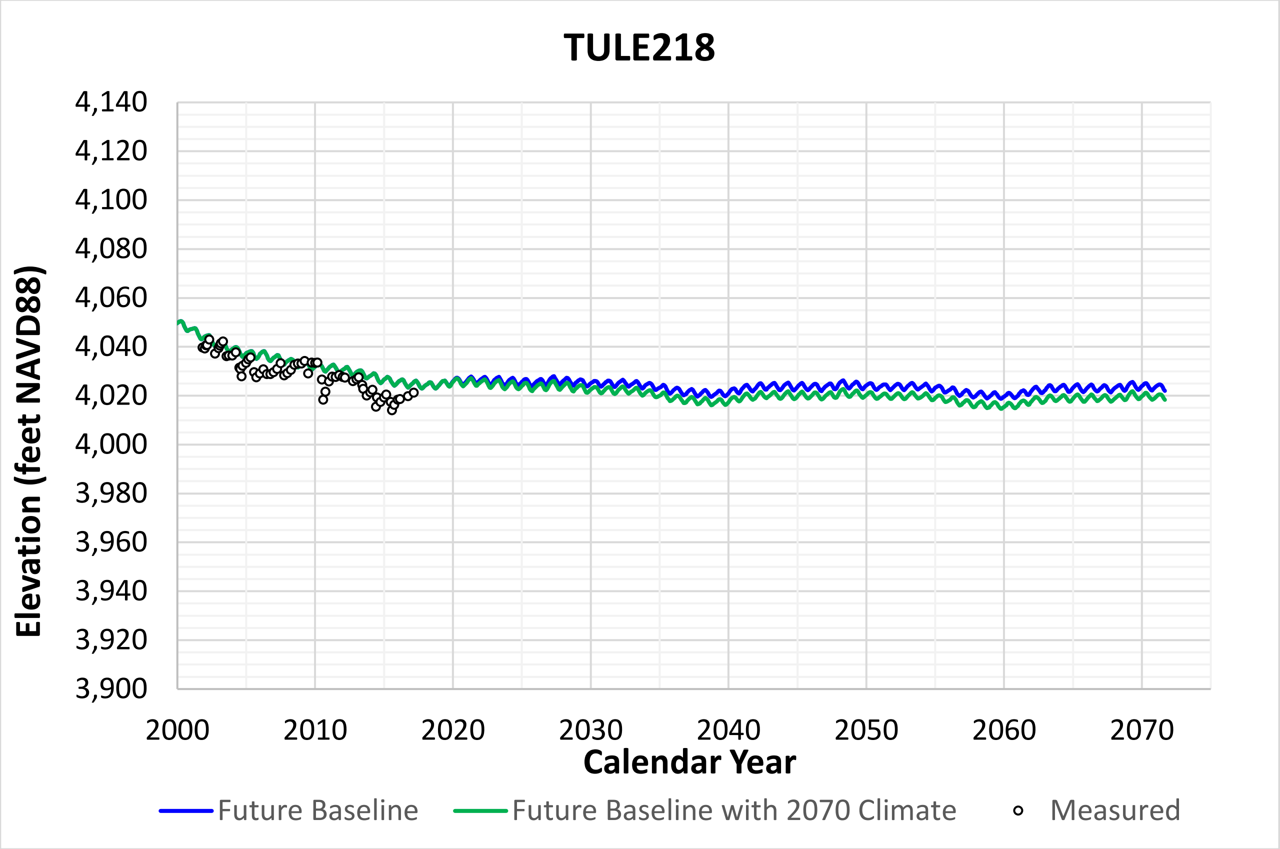

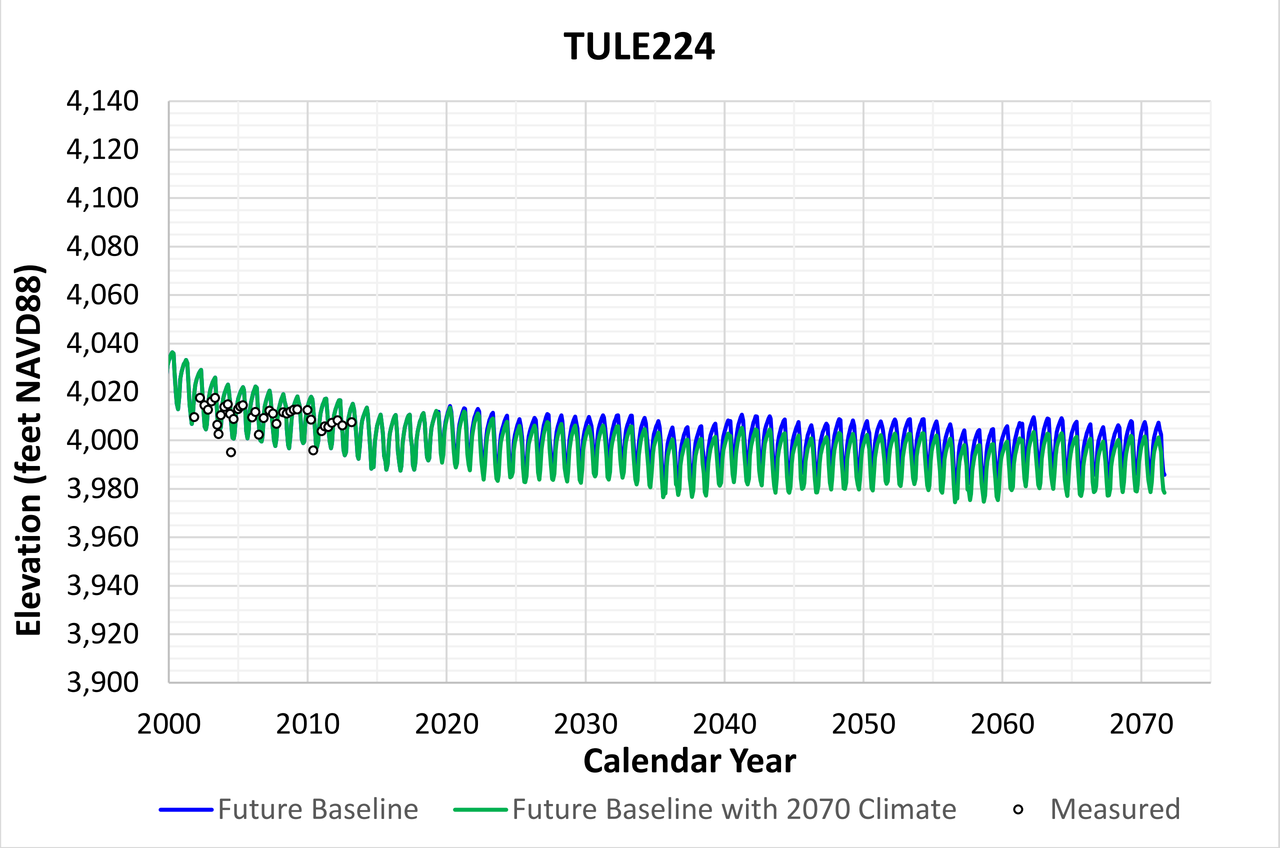

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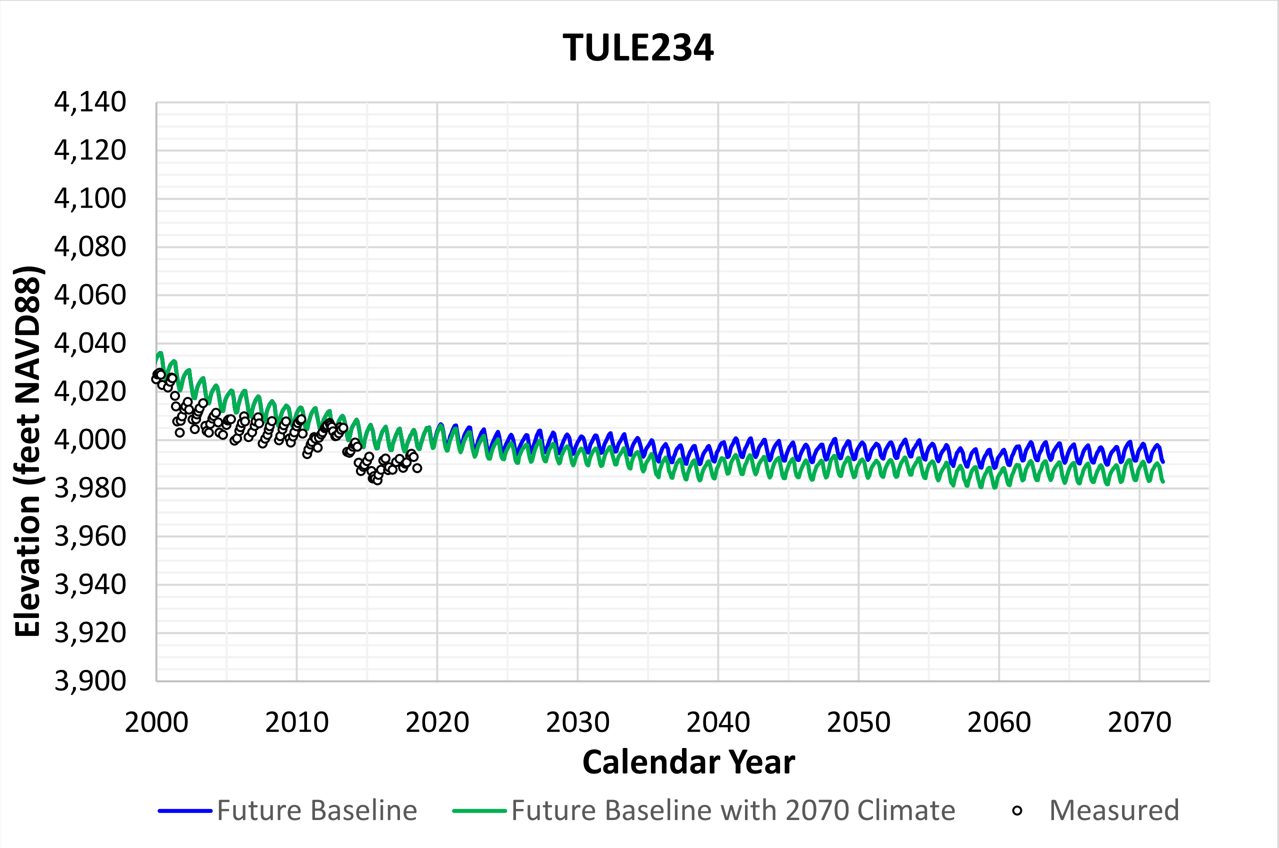

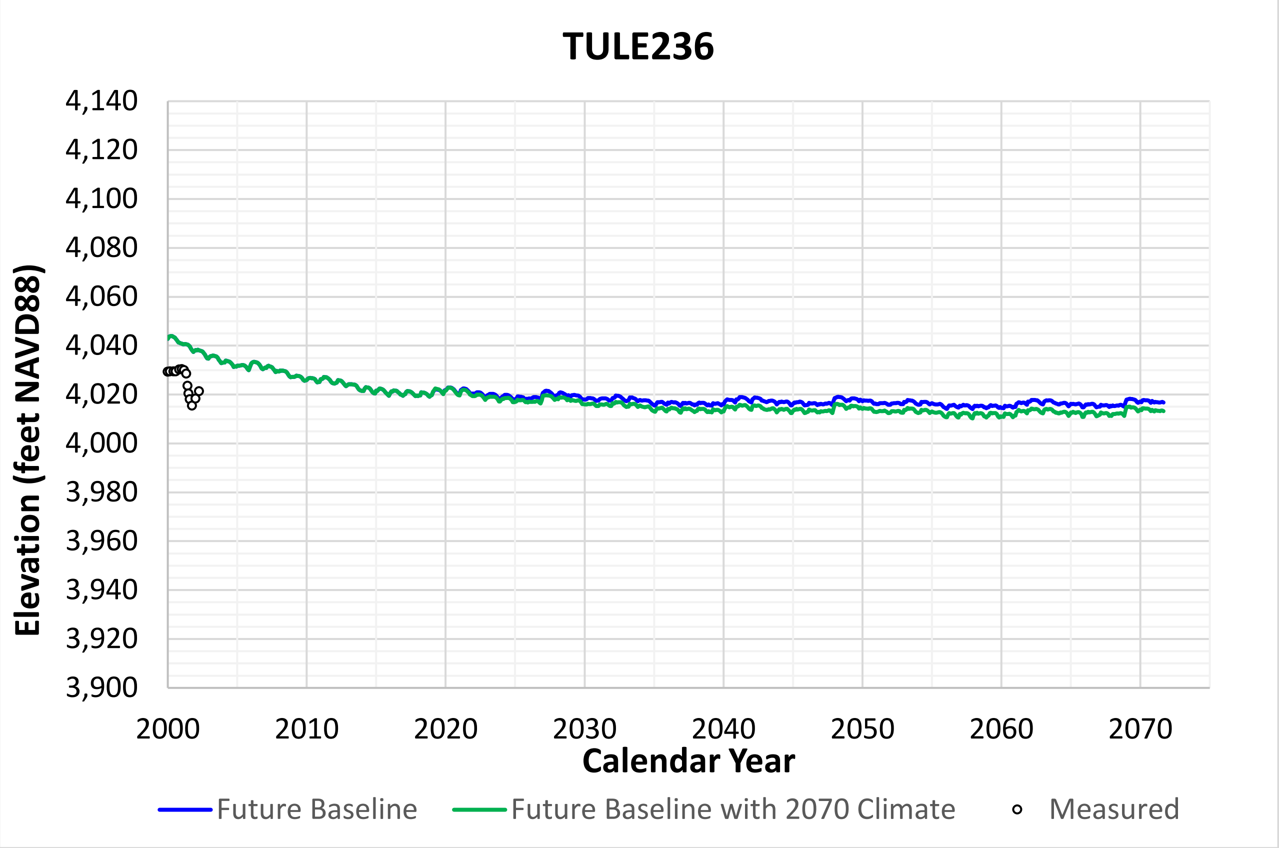

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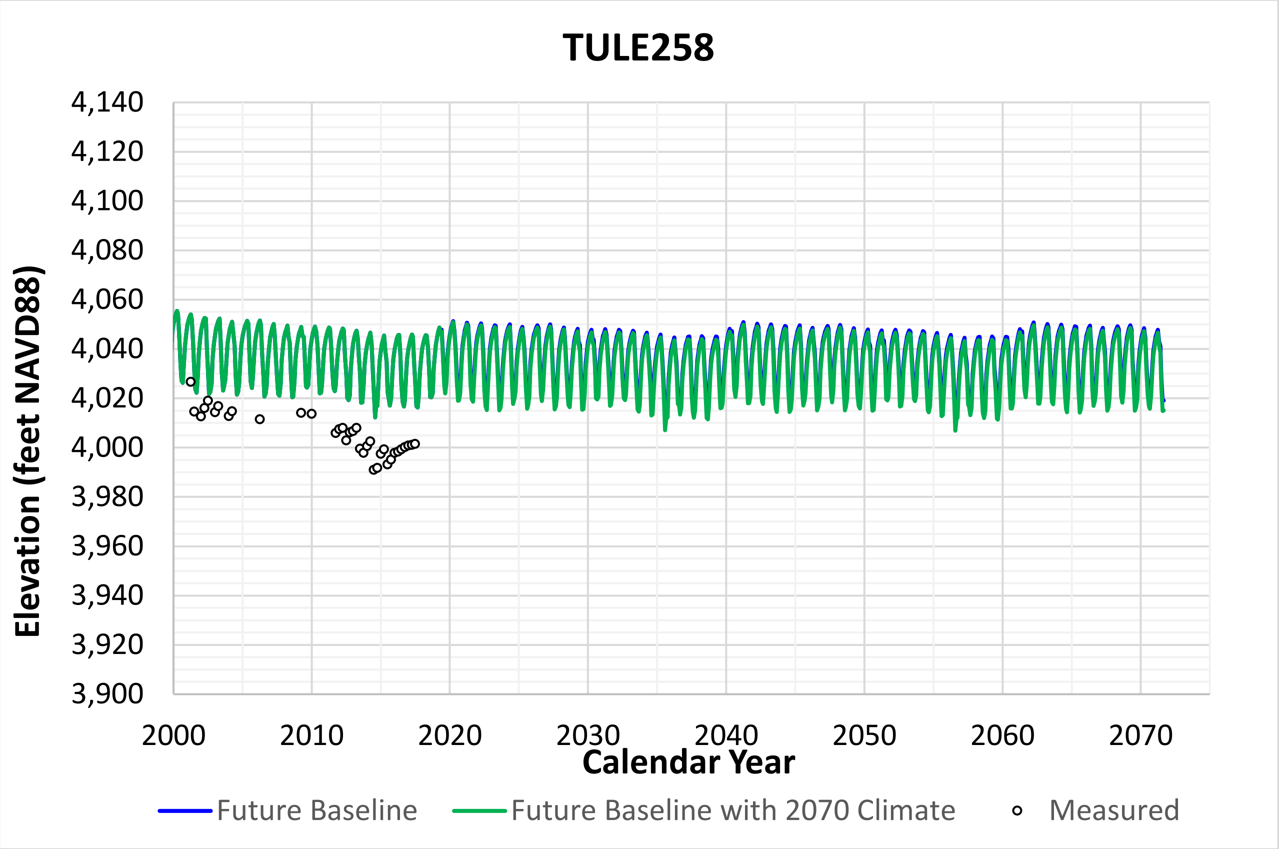

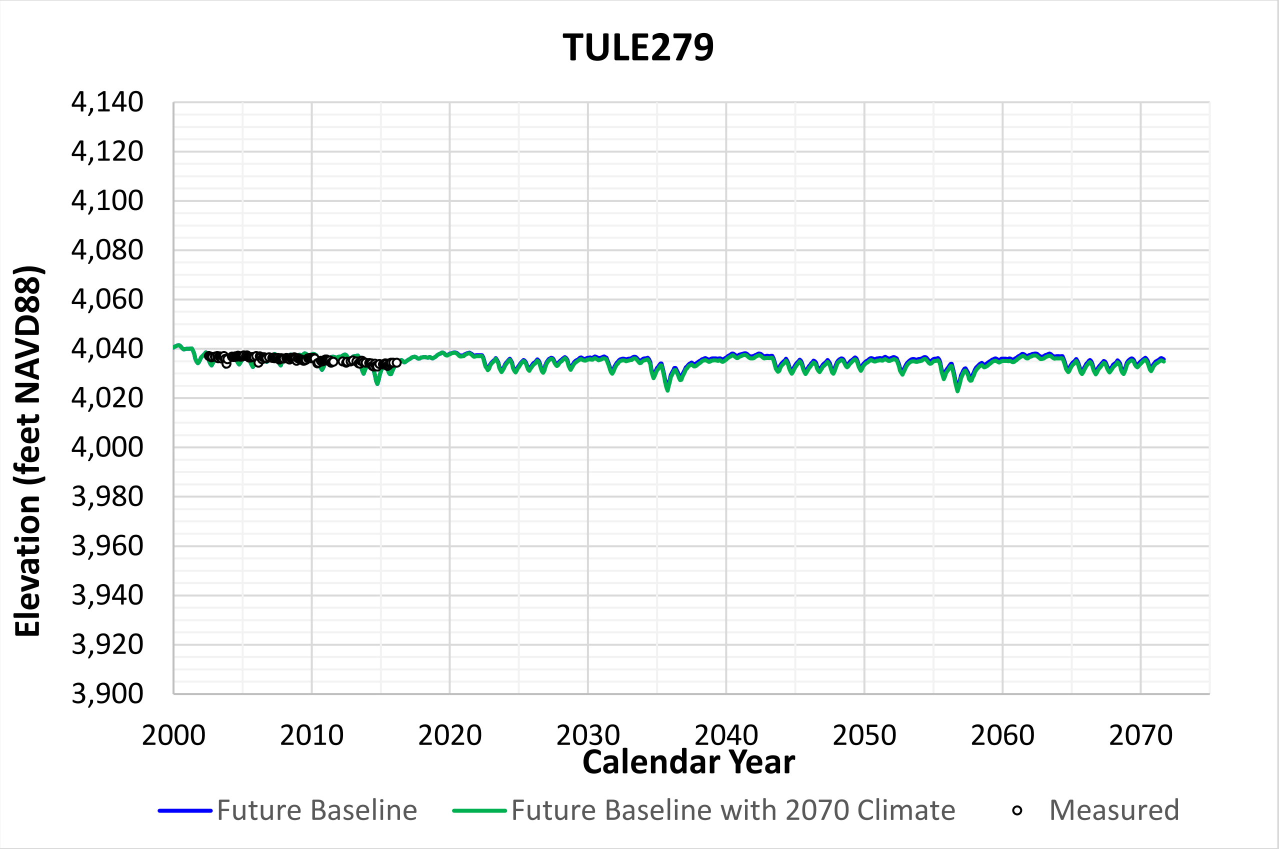

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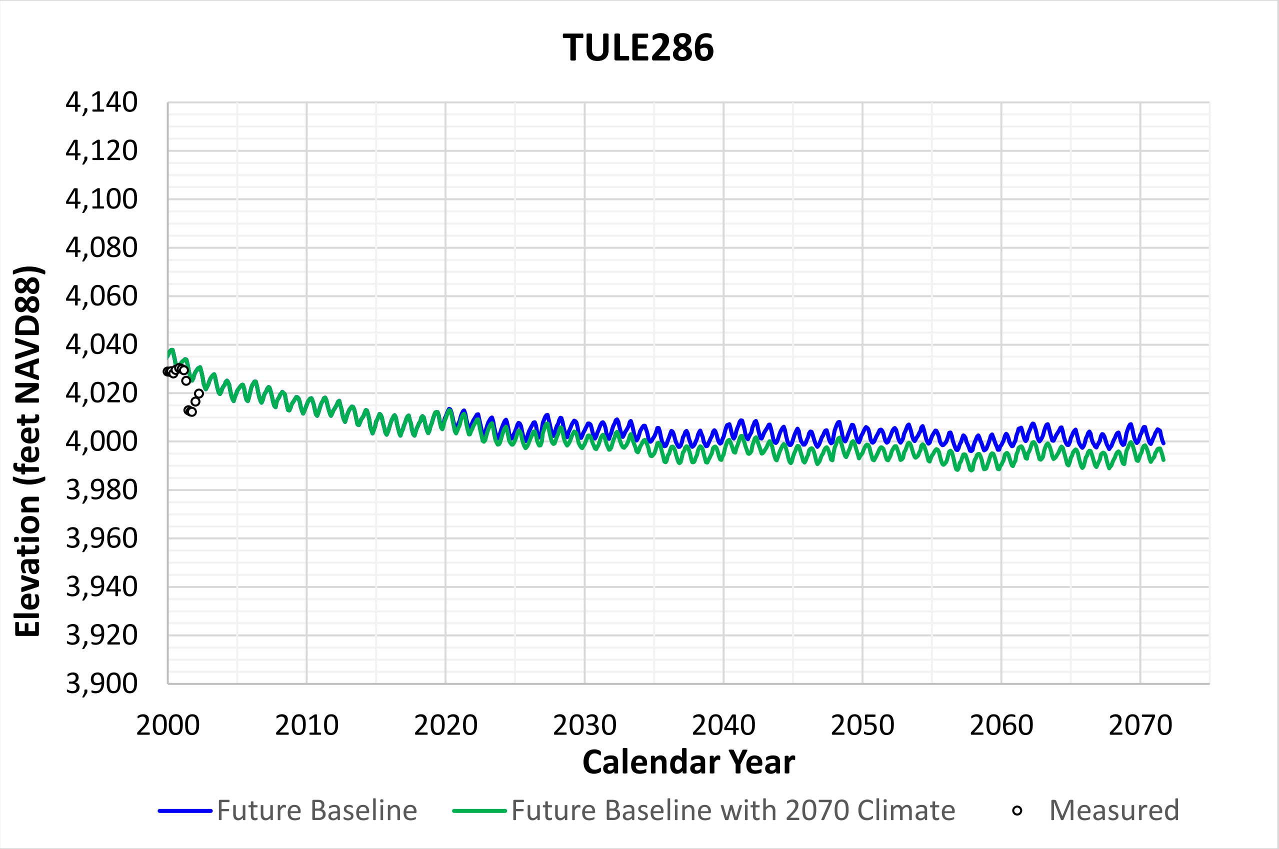

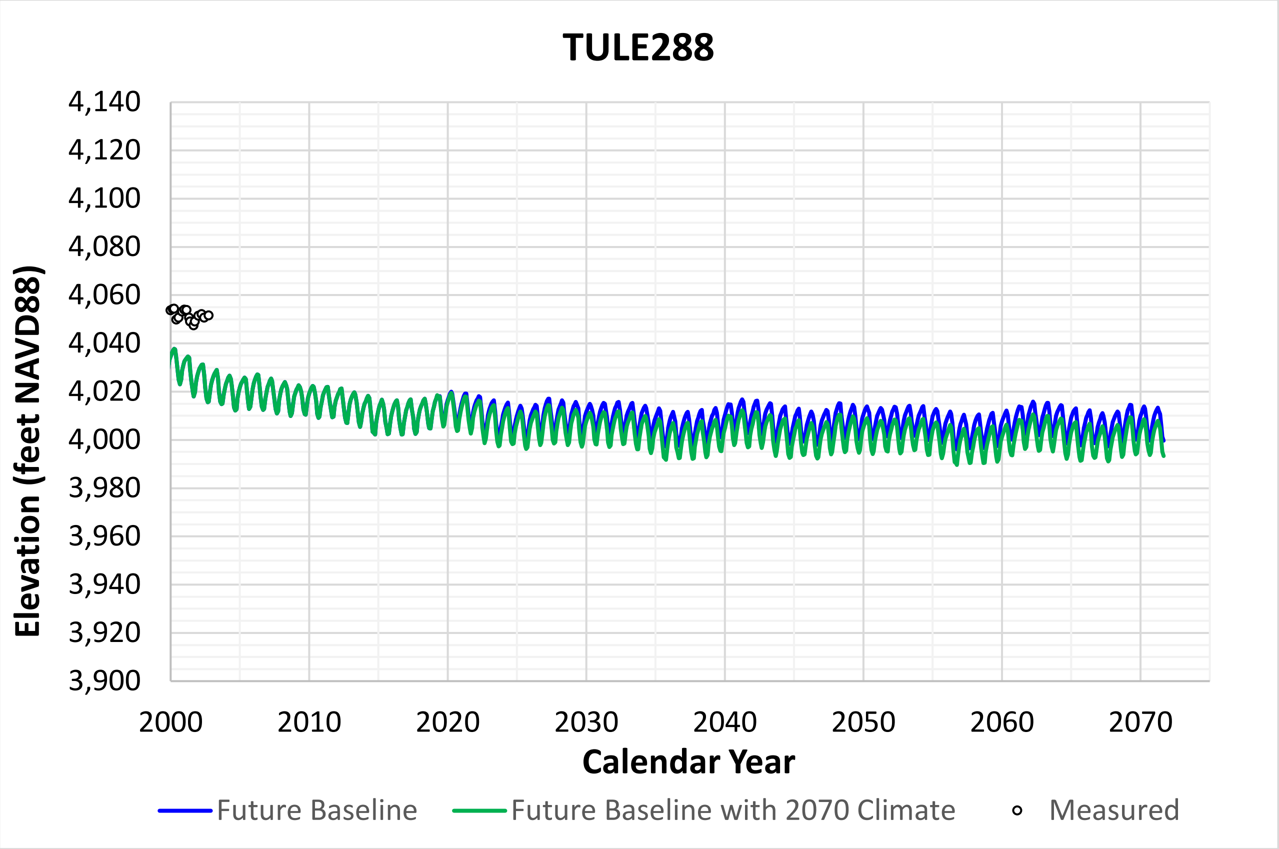

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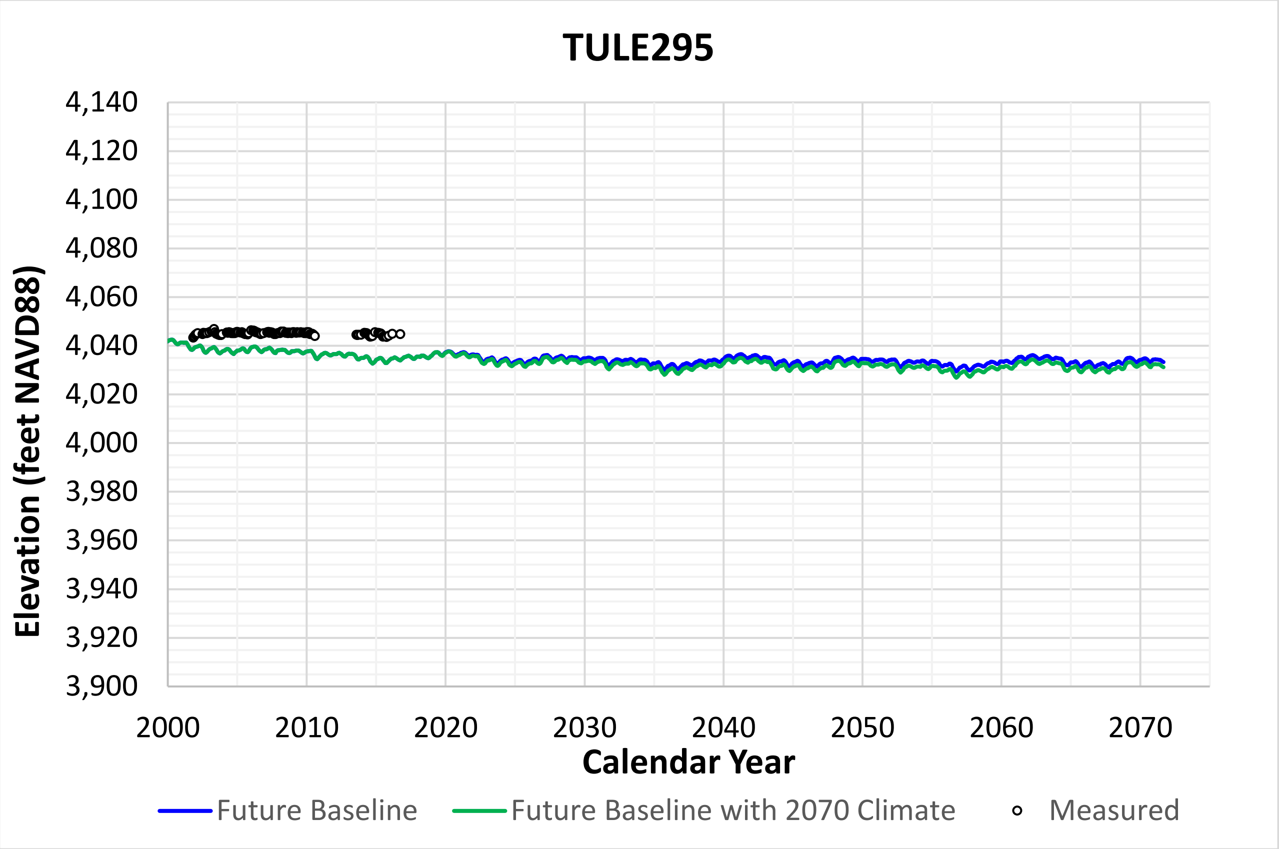

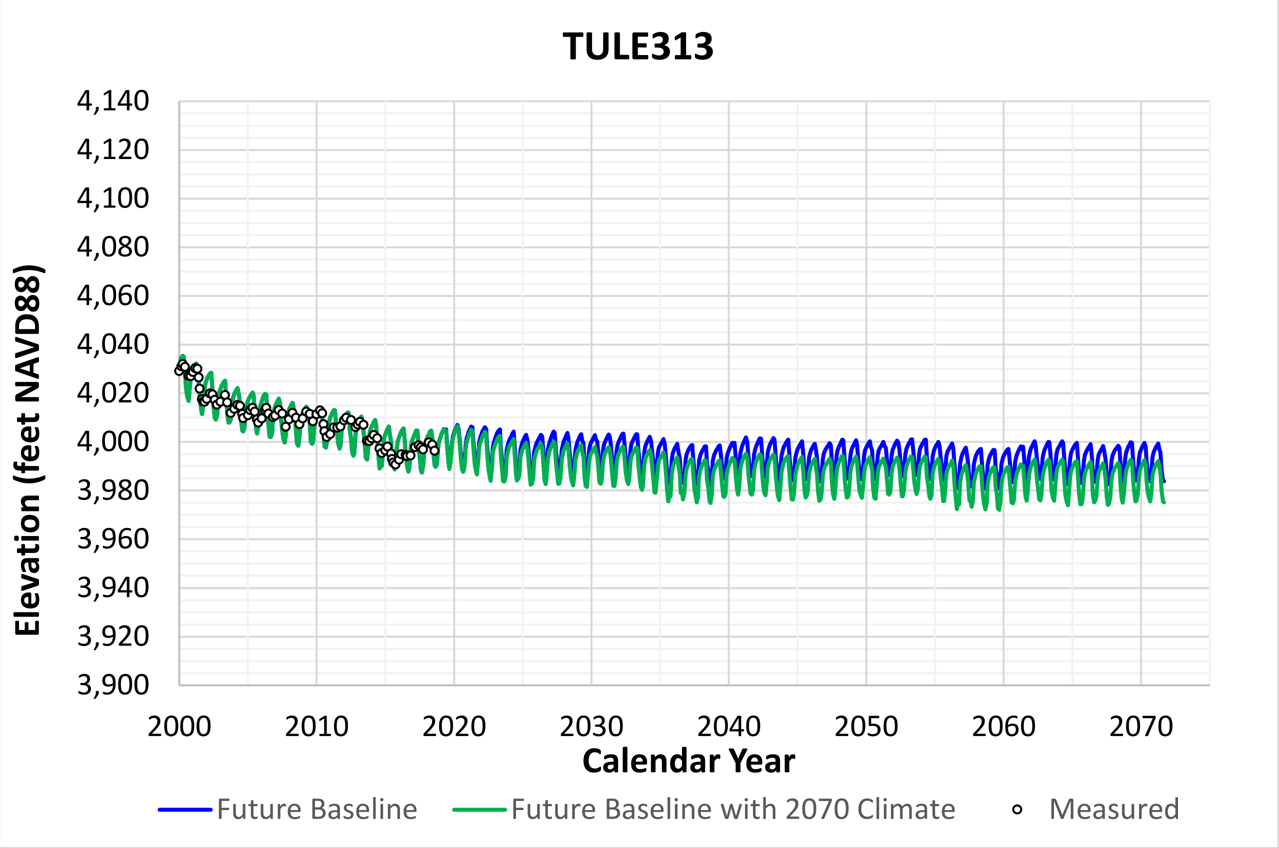

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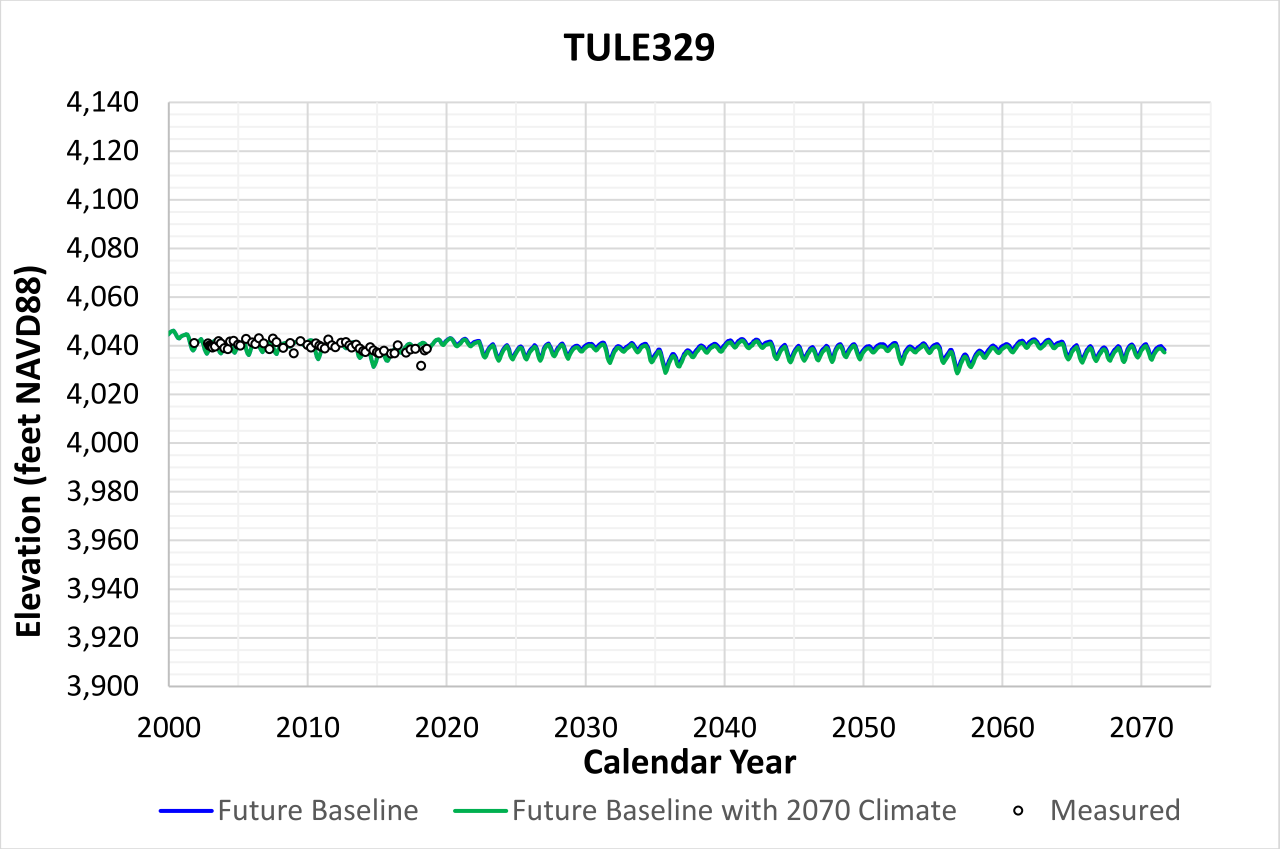

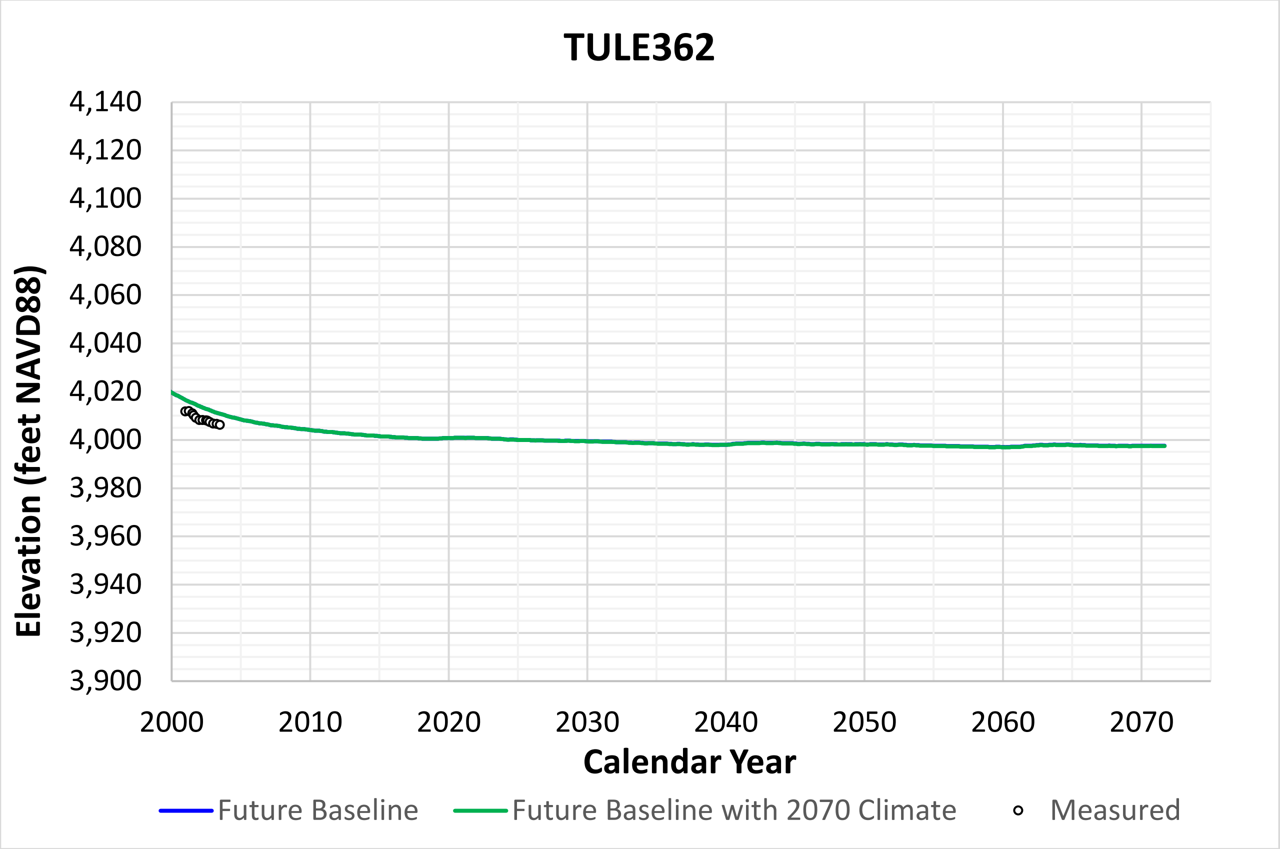

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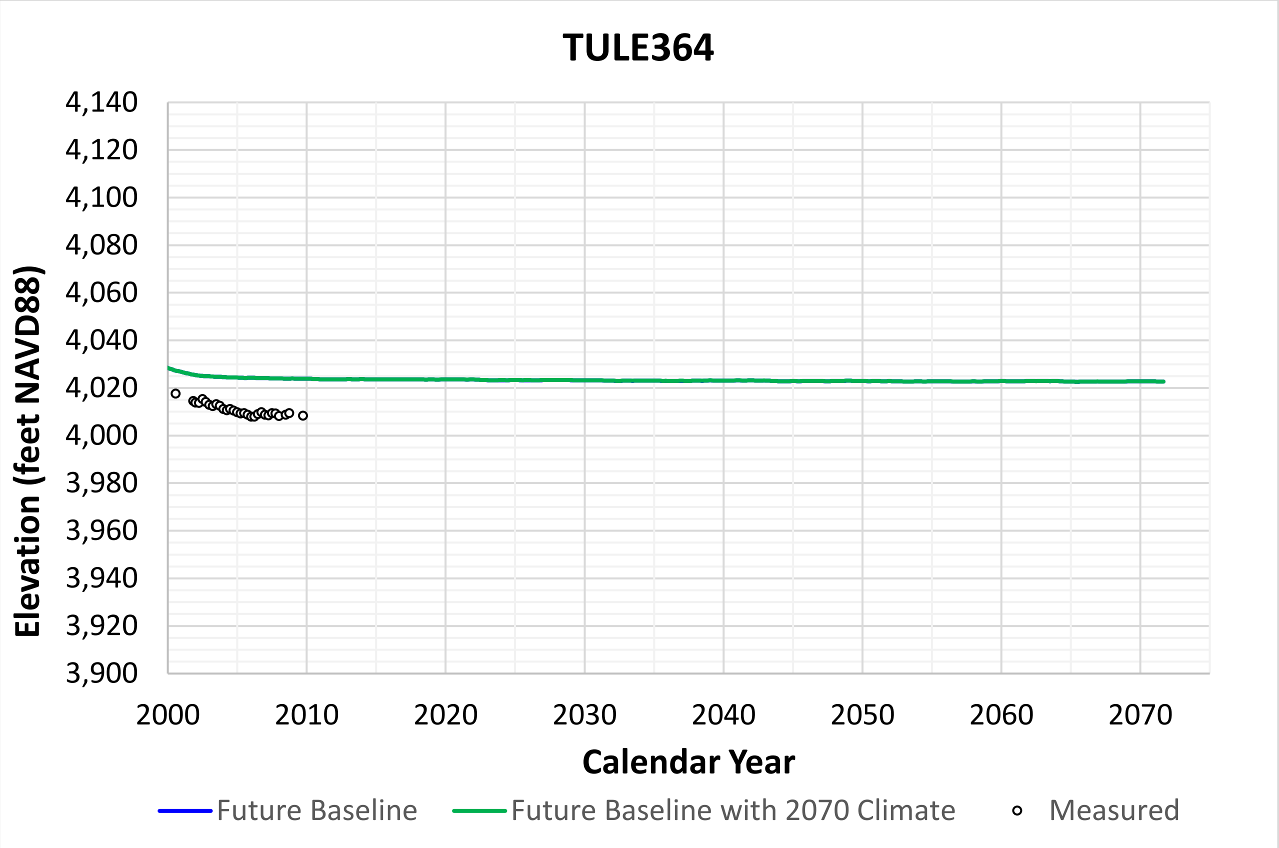

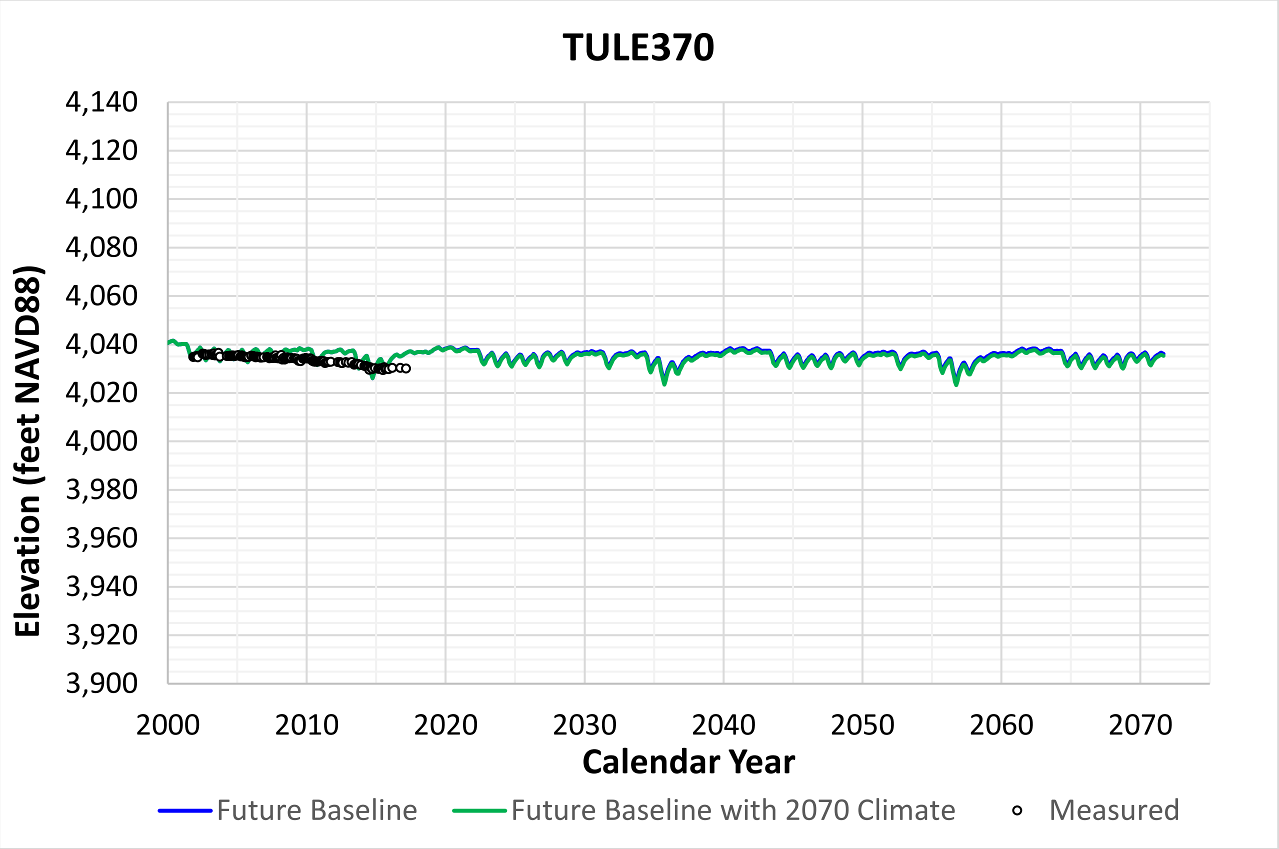

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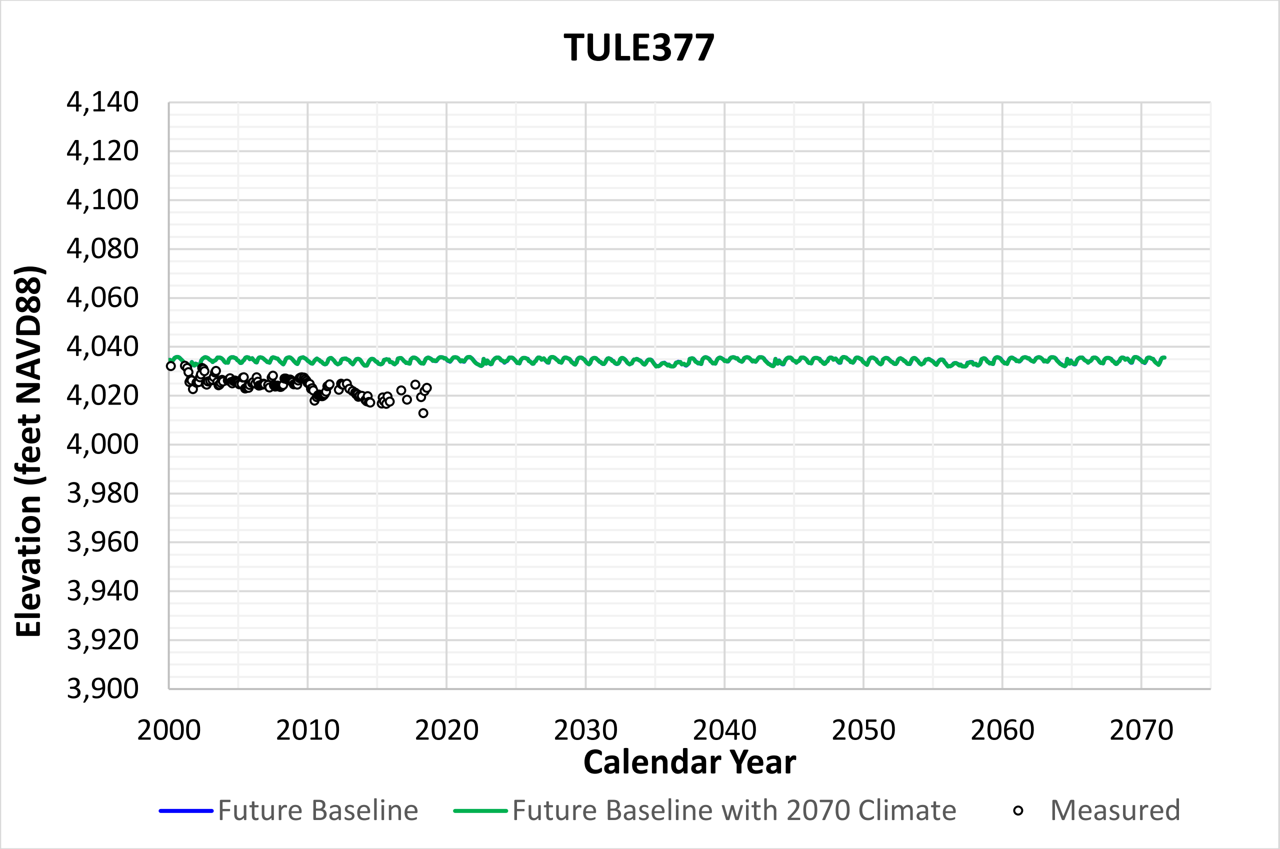

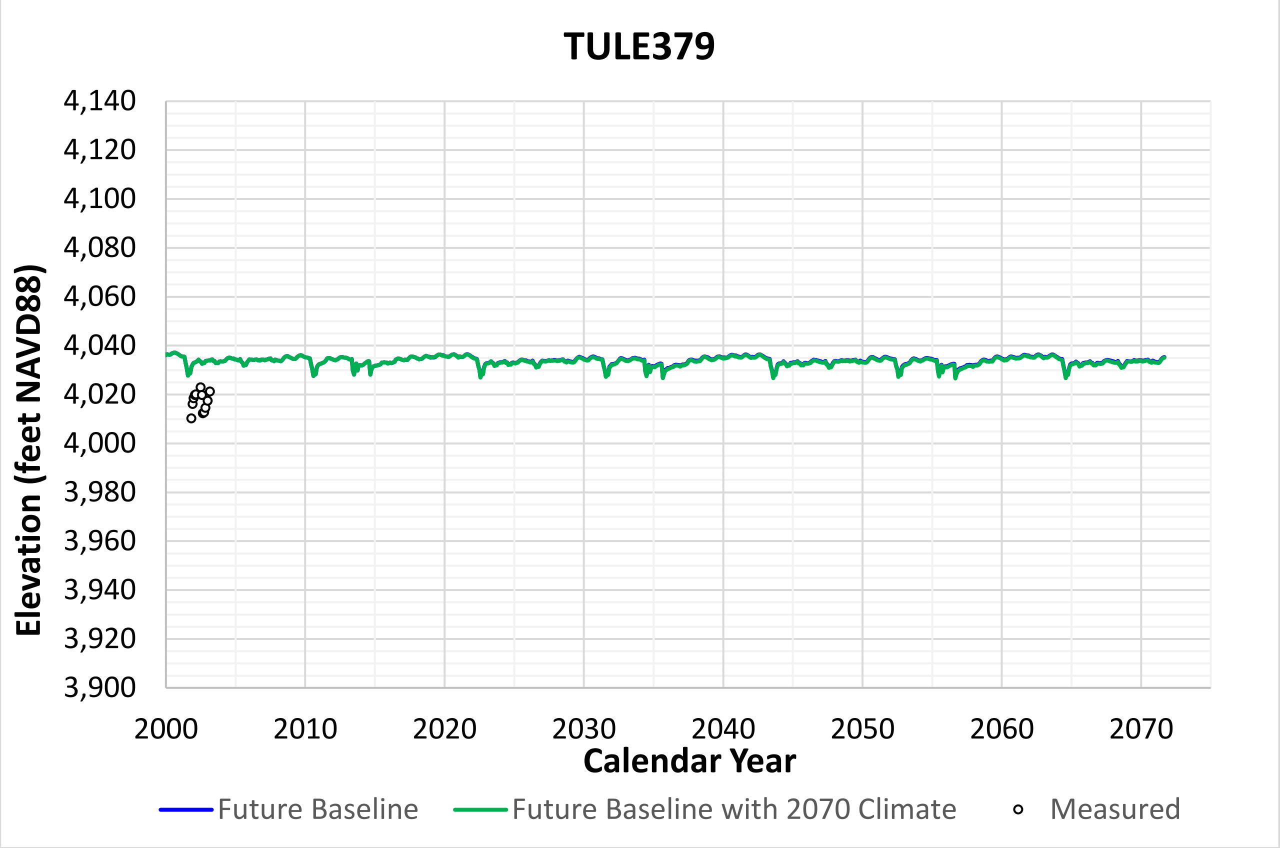

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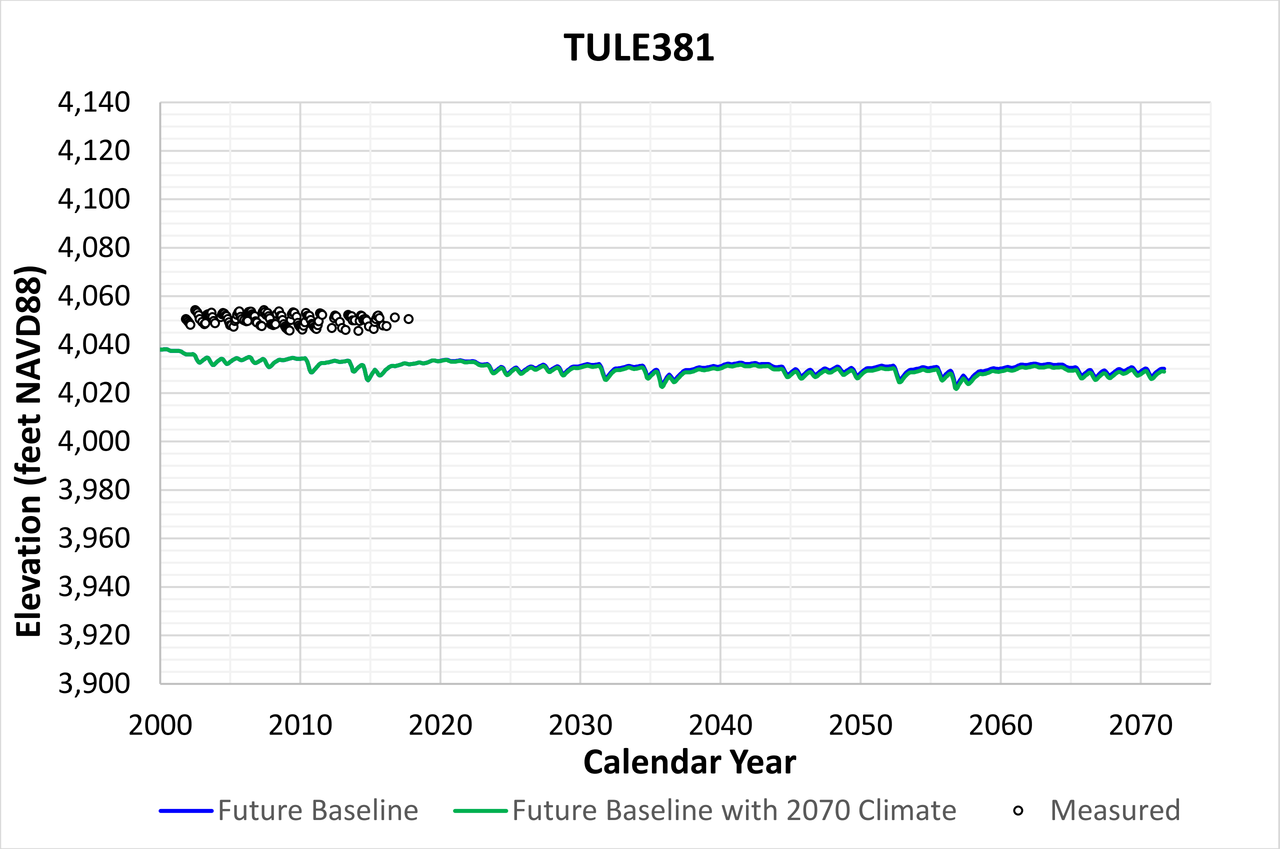

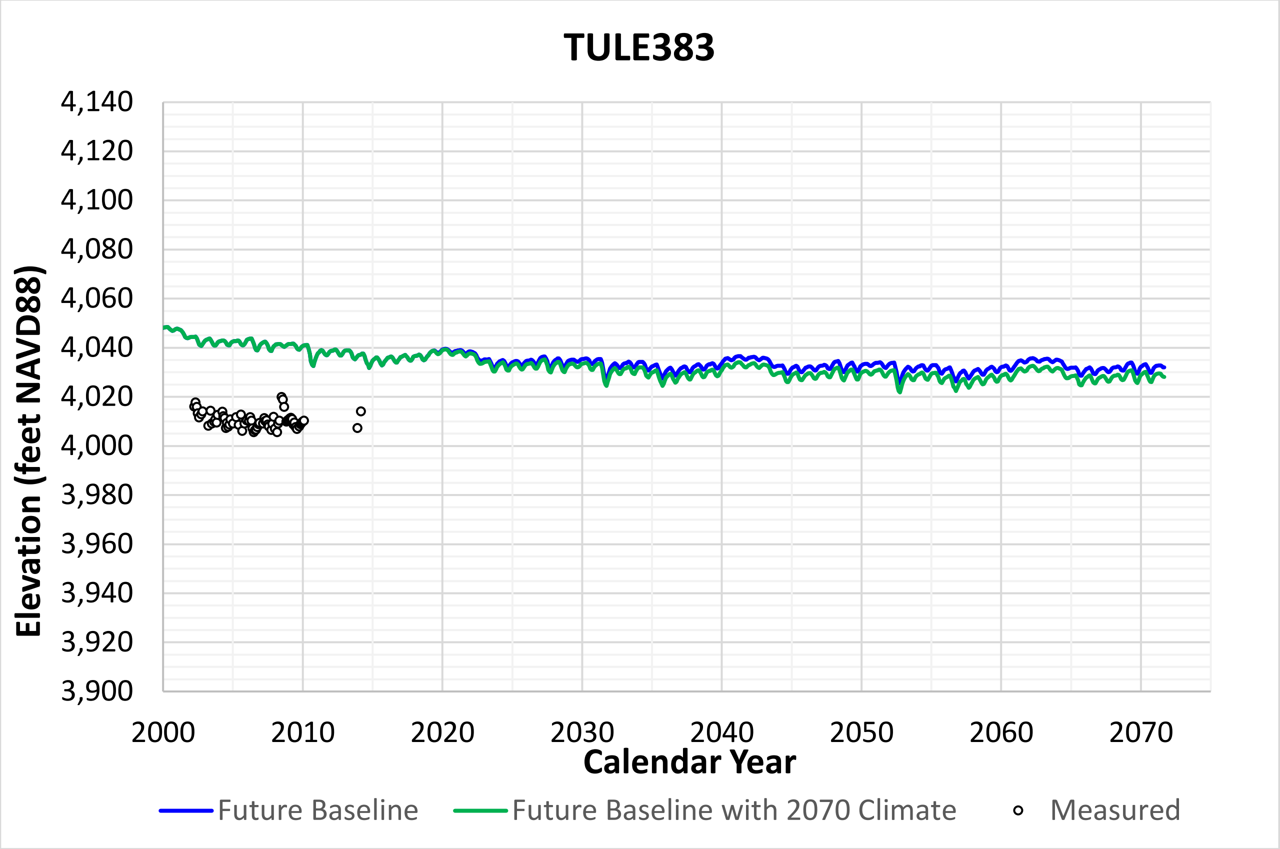

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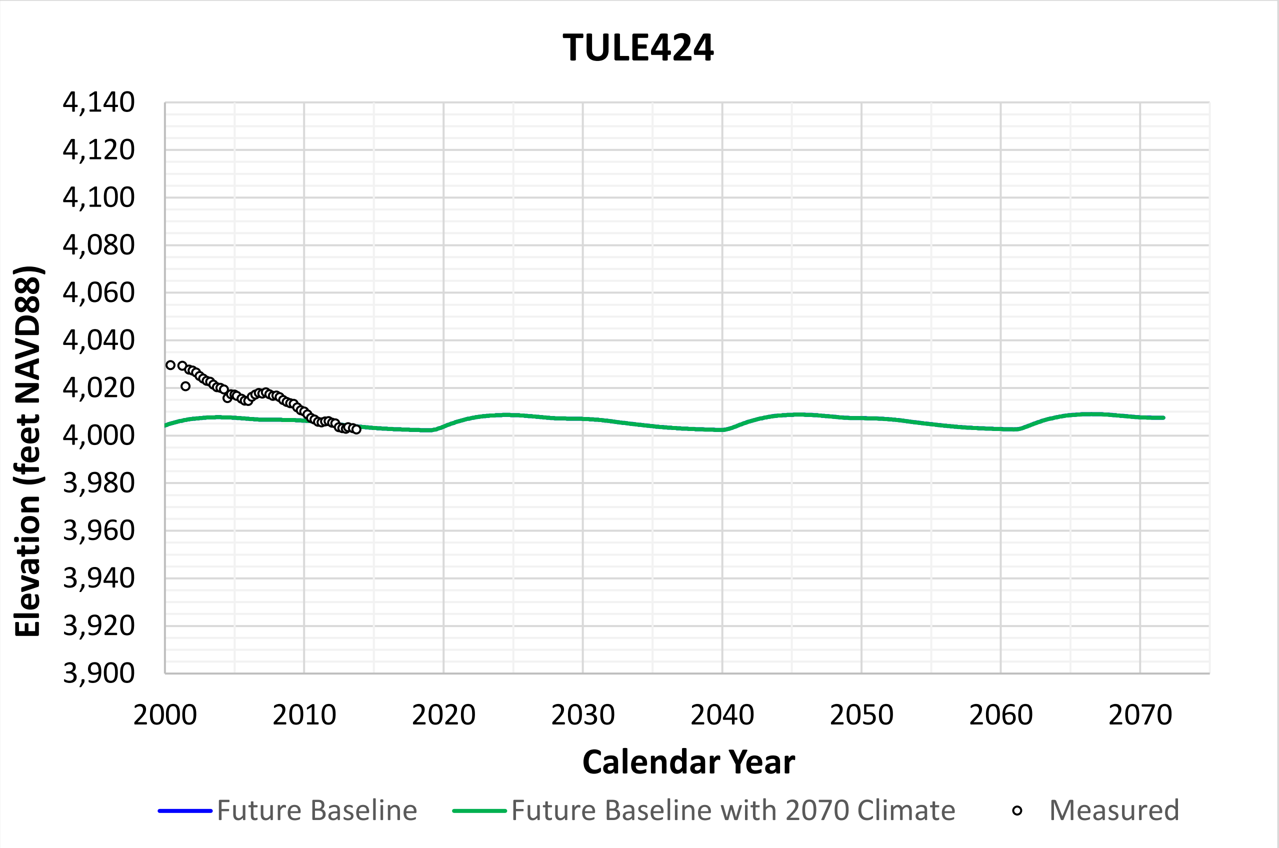

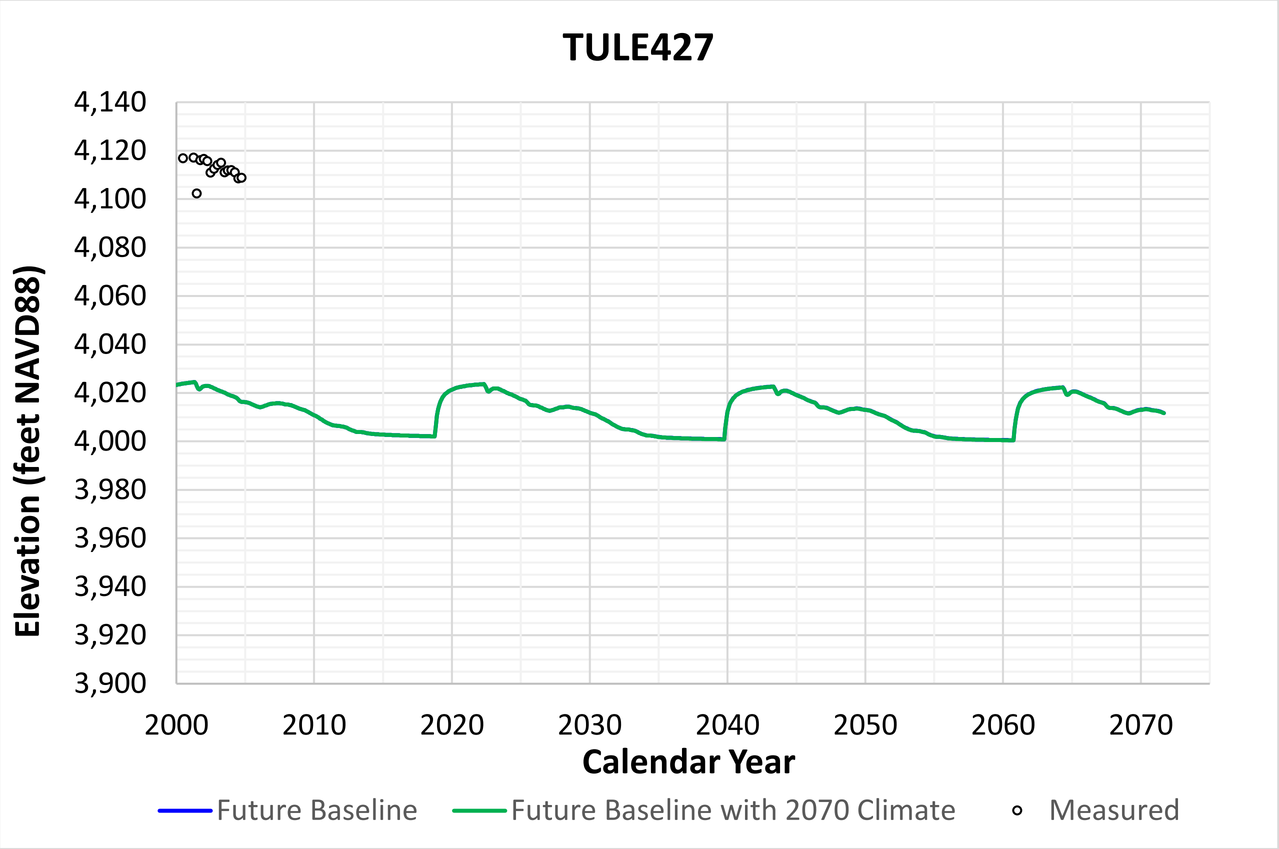

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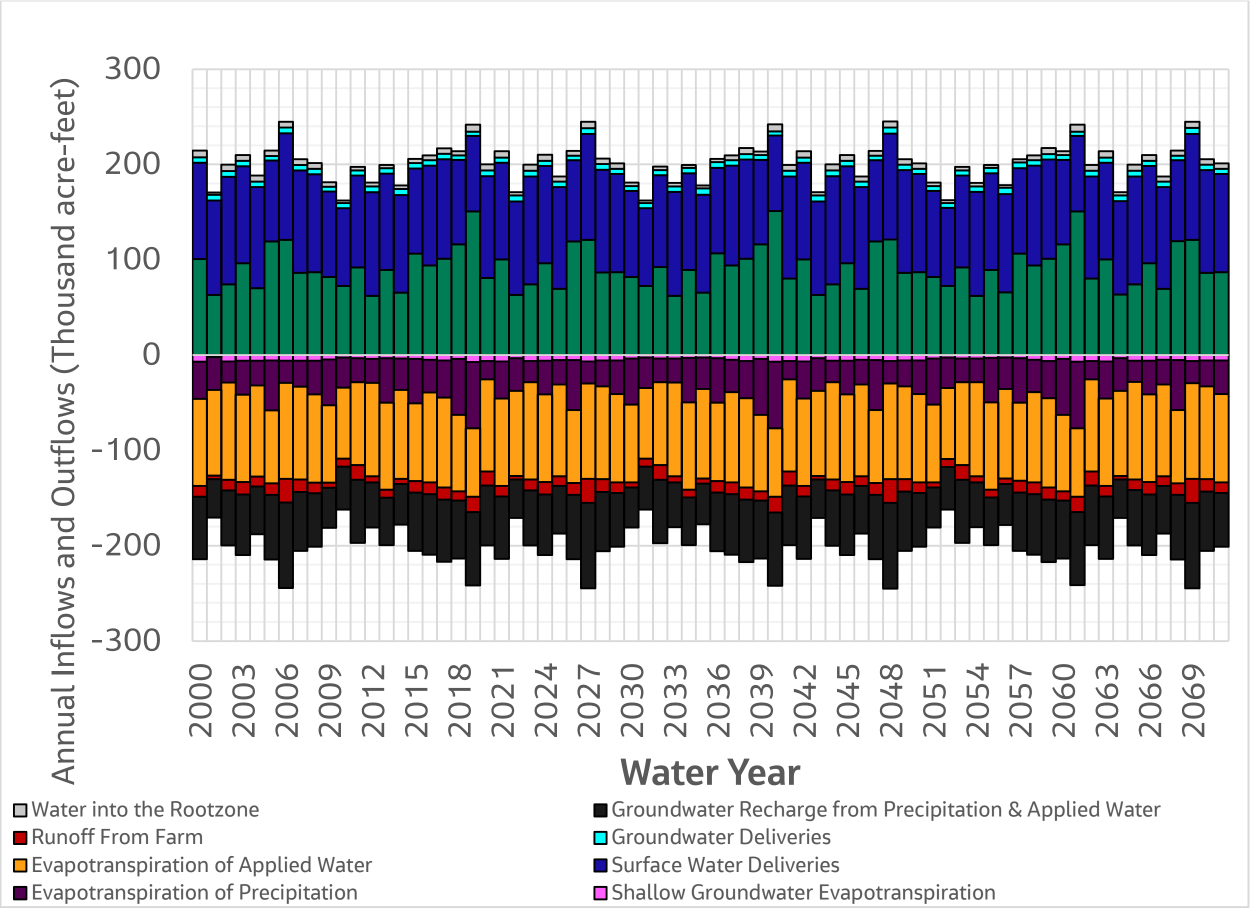

Figure 5-7 – Historical and Projected Annual Land System Water Balance

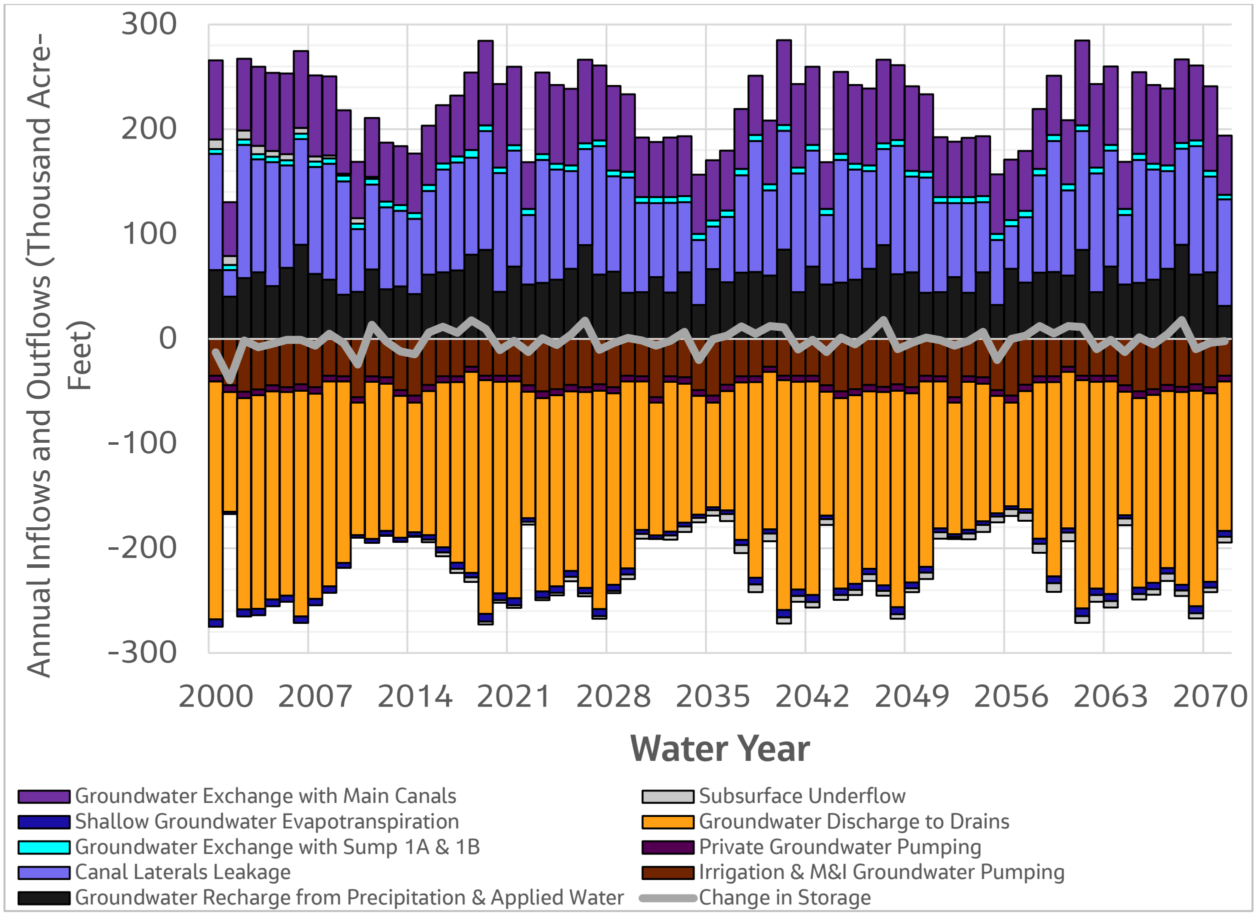

Figure 5-8 - Historical and Projected Annual Groundwater System Water Balance

Appendix L.
Ad Hoc Committee Meeting Summary, June 1, 2021

MBK ENGINEERS

Water Resources ◆ Flood Control ◆ Water Rights

MEETING SUMMARY

DATE: June 4, 2021

TO: File: Tulelake Subbasin GSP

FROM: Kyle Knutson

SUBJECT: June 1, 2021 Ad Hoc Committee Meeting Summary

On June 1, 2021, Angela Bezzone and Kyle Knutson participated in a Tule Lake Core Team Ad Hoc Committee meeting to discuss undesirable result definitions and minimum thresholds (MT) for the Tulelake Subbasin Groundwater Sustainability Plan (GSP). Also in attendance were Gary Wright and Kraig Beasly of the Tulelake Irrigation District (TID) Groundwater Sustainability Agency (GSA), and Matt Huffman, David King, Ken Masten, and Mike Byrne of the Tulelake Subbasin Advisory Committee. Below is a summary of the group's recommendation for undesirable result definitions and agreed upon approach for MTs.

Table 1. Undesirable Results Definitions

Undesirable Result	Proposed GSP Definition
Chronic Lowering of Groundwater Levels	Groundwater elevations dropping below the Minimum Threshold criteria at four representative monitoring locations over three consecutive spring measurements.
Change-In-Storage	Monitoring of groundwater levels will be used as a proxy for this undesirable result.
Land Subsidence	Monitoring of groundwater levels will be used as a proxy for this undesirable result.
Depletion of Interconnected Surface Water	As stated above, the only surface water within the Subbasin is a small portion of the Lost River which terminates in the Tule Lake Sumps. This system is highly regulated as part of the US Bureau of Reclamation's Klamath Project. Due to the nature of the Lost River and Sumps, a separate monitoring network for groundwater-surface water interaction has not been developed. However, DWR Monitoring Well No. 48N04E22M001M is located adjacent to the Lost River and is included in the Groundwater Level Monitoring Network. Groundwater elevations dropping below the Minimum Threshold criteria at this representative monitoring locations over three consecutive spring measurements.
Degraded Water Quality	Changes in groundwater quality due to SGMA-related groundwater management activities (such as groundwater extraction and groundwater recharge) and groundwater quality that causes significant and unreasonable reductions in long-term viability of domestic, agricultural, municipal, and environmental uses over the planning and implementation horizon of this GSP as indicated by water quality data measured in at least 50% of representative monitoring wells exceeding the minimum thresholds for a groundwater quality constituent for two consecutive measurements at each location during non-drought years.
Seawater Intrusion	Not applicable for Tulelake Subbasin

In regard to minimum thresholds for the Tulelake Subbasin GSP representative monitoring wells, the group agreed to use a combination of domestic wells depths within a 3-mile radius of representative monitoring wells or the historical low groundwater level measurement at the representative monitoring well plus a 10% buffer. For representative monitoring wells relying upon the historical low groundwater level as the MT, the Committee recommends an evaluation of groundwater levels at the end of the current irrigation season to consider the impact of the current drought conditions on groundwater levels.

Kyle Knutson

Kyle Knutson

KK/ab

Appendix M.
Representative Groundwater Monitoring Well Hydrographs

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE:	June 14, 2024
PREPARED BY:	Chris Connor
REVIEWED BY:	Angela Bezzone, P.E. and Kyle Knutson, P.E.
SUBJECT:	Updated Methodology for Determination of Minimum Thresholds

Purpose

As documented in Appendix L of the Tule Lake Subbasin Groundwater Sustainability Plan (GSP), the Groundwater Sustainability Agencies (GSAs) provided direction on the methodology used to establish minimum thresholds (MTs) for groundwater levels at each representative monitoring well. On January 18, 2024, the Department of Water Resources (DWR) transmitted a letter to the GSAs (Attachment A). The letter stated that the GSP was found to be "incomplete" and identified two corrective actions relative to the MTs, which are generally described below. Based upon the comments received in the DWR letter, the purpose of this technical memorandum is to provide an overview of the updated methodology to establish MTs for the GSP and describe how the corrective actions have been addressed.

Well Completion Report Review

During development of the GSP, well completion reports (WCR) for the Tule Lake Subbasin were downloaded from DWR's Well Completion Report Map Application (Application)[1] and reviewed using ESRI's ArcGIS mapping software. Due to the length of time between development of the GSP and this effort to revise the GSP, the WCRs were downloaded again to ensure that any new WCRs and any changes to WCRs were included. On March 28, 2024, 428 WCRs[2] were downloaded and stored in a file geodatabase. Unless a WCR has coordinates, the Application assigns the WCR to the centroid of the associated Public Land Survey System section. There were eight instances where the centroid of a section was adjacent to, but outside of the Tule Lake Subbasin boundary. Due to the proximity of the centroid in these instances, it was assumed that the accompanying WCRs were likely related to wells within the Tule Lake Subbasin and therefore included in the analysis. The wells were organized into the following six categories.

1. Domestic (156 of 428)
2. Irrigation (135 of 428)
3. Public Supply (4 of 428)

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[1] https://gis.water.ca.gov/app/wcr/

[2] Records within the database did not always contain well completion reports. These records were not removed from the overall analysis, nor were they removed from the counts that follow in this memorandum.

4. Industrial, Other, or Unknown (43 of 428)
5. Monitoring (62 of 428)
6. Destroyed (28 of 428)

Next, 98 wells were removed from the analysis (eight wells identified as Other that were additionally categorized as Test Well or Vapor Extraction, 62 wells identified as Monitoring, and 28 wells identified as Destroyed), leaving a total of 330 WCRs to be evaluated to establish MTs.

Upon further review of the remaining 330 WCRs, 23 additional wells were removed from the analysis for the reasons below.

- Well was drilled for sparging (14 wells identified as Industrial, Other or Unknown)
- Issues arose during drilling, which resulted in not completing construction of the well (1 well identified as Irrigation and 1 well identified as Other)
- Note on WCR confirmed well has been destroyed (1 well identified as Irrigation, 1 well identified as Domestic, and 3 wells identified as Unknown)
- Well is a duplicate (1 Irrigation well)
- Well is no longer in use, and household associated with well is abandoned (1 well identified as Other, see Attachment E which includes the WCR with an additional note about well status)

In addition, during review of the remaining 330 WCRs, 2 wells were reassigned to a different category for the reason below.

- Well has since been deepened (2 Other reassigned to Domestic)

In total, 307 (428 less 98 less 23) wells were used to update the MTs for the representative monitoring wells.

The 307 wells were organized into the following six categories.

1. Domestic (155 of 307)
2. Irrigation (132 of 307)
3. Public Supply (4 of 307)
4. Industrial, Other, or Unknown (17 of 307)
5. Monitoring (0 of 307)
6. Destroyed (0 of 307)

Corrective Action A: Minimum Threshold Determination

As described in the GSP, the primary water supply for agricultural operations within the Tule Lake Subbasin is surface water from the Klamath Project. If the surface water supply is not sufficient to meet demand within the Tulelake Irrigation District (District) then the District will operate its groundwater wells to provide additional water supply. Lastly, private irrigation well owners within the District will operate their wells if the surface water supply and District well supply is not sufficient to meet their demand. Based on these operations, there were two methodologies established to determine the MT at each representative monitoring well, which are described below.

- Representative monitoring wells that are used for irrigation have MTs set to the well's lowest static groundwater level measurement recorded plus a 10 percent buffer.
- The "Near" function in ArcGIS Pro software was used to associate each of the 307 WCRs with the closest representative monitoring well. All representative monitoring wells that are not an irrigation well have MTs set to either the shallowest or second shallowest well within its Near grouping. However, if there are not any wells within a representative monitoring well's Near grouping, then the MT is equal to the well's lowest static groundwater level measurement recorded plus a 10 percent buffer.

Table 1 below shows the lowest static groundwater level measurement recorded at each of the representative monitoring wells identified as irrigation wells and the corresponding MT.

Table 1 MTs for Representative Monitoring Wells Identified as Irrigation Wells

Representative Monitoring Well	Lowest Static Well Measurement (ft bgs)	Date	Updated Minimum Threshold (ft bgs)
48N04E30F002M (TID Well 1)	71.70 ft	10/1/2022	79
48N04E13K001M (TID Well 5)	81.66 ft	10/1/2022	90
46N05E22D001M (TID Well 14)	48.39 ft	12/1/2022	54
48N05E26D001M (TID Well 8)	66.81 ft	8/1/2022	74

Table 2 below shows the updated minimum thresholds for each representative monitoring well that is not identified as an irrigation well.

Table 2 MTs for Non-Irrigation Representative Monitoring Wells

Representative Monitoring Well	Original MT (ft bgs)	Updated MT (ft bgs)	Notes
46N05E01P001M	24	24	The two shallowest wells in WCR database have since been deepened. MT is set to shallowest remaining well, which is a domestic well with a depth of 24'.
48N04E22M001M	50	120	The shallowest well was an irrigation well with a depth of 31'; however, since private irrigation wells are not a main source of supply* the MT was based on the shallowest non-irrigation well, which is a domestic well with a depth of 120’.
48N04E19C001M	29	33	The shallowest well was an irrigation well with a depth of 28'; however, since private irrigation wells are not a main source of supply* the MT was based on the shallowest non-irrigation well, which is a domestic well with a depth of 33’.
47N05E04M001M	15	33	MT is set to the shallowest domestic well (33’). WCR database has a double entry for a 31’ deep irrigation well; however, since private irrigation wells are not a main source of supply* the MT was based on the shallowest non-irrigation well.
47N05E01N001M	49	42	There is a 15’ domestic well drilled in 1996; however, based upon a review of a historical hydrograph for 47N05E01N001M this well likely went dry in 2011, which is prior to SGMA. Therefore, the MT is set to the next shallowest well which is a domestic well with a depth of 42’.
48N04E31M001M	48	29	MT is set to shallowest well which is a domestic well with a depth of 29’.
41S12E19Q001W	50	39	The shallowest well is a 14’ deep domestic well; however, based on a conversation with the well owner the well is no longer in use, and the household associated with well is abandoned (see Attachment E). MT is set to the next deepest domestic well which has a depth of 39’. There is a 33' deep irrigation well; however, since private irrigation wells are not a main source of supply* the MT was based on the shallowest non-irrigation well.
46N05E21J001M	32	32	MT is set to 32’, which is the depth of 46N05E21J001M as it is the shallowest well in its group.
48N05E35F001M	32	29	MT is set to 29' to cover a domestic well that was initially grouped with TID Well 8; however, it was moved to the 48N05E35F001M group to ensure it was covered.
TL-T1 Q3B	35	35	There are no wells near TL-T1 Q3B, as noted above the MT is set to lowest measurement recorded plus a 10% buffer.
TL-T3 GP	16	16	There are no wells near TL-T3 GP, as noted above the MT is set to lowest measurement recorded plus a 10% buffer.

*As identified above, the primary water supply for agricultural operations within the Tule Lake Subbasin is surface water from the Klamath Project. If the surface water supply is not sufficient to meet demand within the Tulelake Irrigation District (District) then the District will operate its groundwater wells to provide additional water supply. Lastly, private irrigation well owners within the District will operate their wells if the surface water supply and District well supply is not sufficient to meet their demand.

Table 3 below summarizes the original MTs identified in the GSP and the updated MTs based on the analysis described above. Hydrographs for each representative monitoring well, including the updated MTs, are provided in Attachment B.

Table 3 Original and Updated MTs for all Representative Monitoring Wells

Representative Monitoring Well	Original MT (ft bgs)	Change (ft)	Updated MT (ft bgs)
46N05E01P001M	24	+0	24
48N04E22M001M	50	-70	120
48N04E19C001M	29	+1	28
48N04E30F002M (TID Well 1)	80	+1	79
47N05E04M001M	15	-18	33
47N05E01N001M	49	+7	42
48N04E31M001M	48	+19	29
41S12E19Q001W	50	+0	50
48N04E13K001M (TID Well 5)	212	+122	90
46N05E21J001M	32	+0	32
46N05E22D001M (TID Well 14)	99	+45	54
48N05E35F001M	32	+3	29
48N05E26D001M (TID Well 8)	304	+230	74
TL-T1 Q3B	35	+0	35
TL-T3 GP	16	+0	16

Corrective Action B: Potential Dewatered Wells

Corrective Action B within DWR's letter requested the GSAs to determine the number of wells potentially dewatered if an undesirable result were to occur. For this analysis, it was assumed that the water levels dropped uniformly across all wells within its Near grouping. Four thresholds were examined for each representative monitoring well.

1. Total number of potential dewatered wells if MT is reached
2. Total number of potential dewatered wells if MT is exceeded by up to one (1) foot
3. Total number of potential dewatered wells if MT is exceeded by up to five (5) feet
4. Total number of potential dewatered wells if MT is exceeded by up to ten (10) feet

Table 4 provides the results of the exercise described above. Maps showing each representative monitoring well and the associated potentially dewatered wells are provided in Attachment C.

Table 4 Number of Potential Dewatered Wells if an MT is Reached or Exceeded

Representative Monitoring Well	MT (ft bgs)	MT is Reached	Exceed by 1'	Exceed by 5'	Exceed by 10'
46N05E01P001M	24	1	1	1	1
48N04E22M001M	120	3*	3	6	6
48N04E19C001M	28	1	1	2	2
48N04E30F002M (TID Well 1)	79	0	0	0	0
47N05E04M001M	33	2*	2	3	5
47N05E01N001M	42	2*	2	4	7
48N04E31M001M	29	1	1	1	1
41S12E19Q001W	39	3*	3	3	3
48N04E13K001M (TID Well 5)	90	0	0	0	0
46N05E21J001M	32	1	1	1	1
46N05E22D001M (TID Well 14)	54	0	0	0	0
48N05E35F001M	29	1	1	2	2
48N05E26D001M (TID Well 8)	74	0	0	0	0
TL-T1 Q3B	35	0	0	0	0
TL-T3 GP	16	0	0	0	0

**Refer to notes in Table 2 regarding wells used to determine MTs*

If undesirable results were to occur, they would likely be experienced by domestic wells users first as they tend to be shallower than irrigation wells, public water supply wells, industrial wells, and other/unknown wells. If groundwater levels were to decline below MTs then these domestic wells would potentially be dewatered, resulting in the need for deepening or replacement. As shown in the analysis above, the MTs are protective of domestic and water supply groundwater wells within the Tule Lake Subbasin. As described in Table 2, there are 4 irrigation wells and 2 domestic wells that are not protected by the MTs, as reflected in Table 4. However, the wells are no longer in use, not a primary water supply source, and/or may have gone dry during drought periods prior to SGMA, which led to those wells being excluded from the analysis.

In many cases if an MT is reached at any given representative monitoring well, then a single well could potentially be dewatered. As identified in Section 5.2.1.3 of the GSP the GSAs developed an undesirable result definition that includes both a number of measurements and a period of time. In regard to the number of measurements, as an exceedance at a single representative monitoring well could be a localized issue, the GSAs developed an undesirable result definition that MTs at four representative monitoring wells (i.e., 4 out of 15 or approximately 26%) to exceed their MTs. As noted in Section 5.2.1.3 and Section 6.1.7 of the GSP, the GSAs plan to conduct additional monitoring at these wells, and in the event of an MT exceedance at a single representative monitoring well, the GSAs will meet to discuss if additional monitoring or action is necessary to hopefully prevent an issue from spreading. In an effort to prevent undesirable results from occurring, the GSAs developed the combination of the undesirable result definition and the plan for additional monitoring. In regard to the period of time to be considered, the undesirable result definition states that MTs need to be exceeded for three consecutive spring measurements to account for one to two year extreme hydrologic conditions that could result in outlier measurements.

Corrective Action B: Level of Impacts to Potential GDEs

Corrective Action B of DWR's letter also requested the GSAs to identify the level of impacts to potential Groundwater Dependent Ecosystems (GDEs) if undesirable results were to occur. As identified in Appendix H of the GSP, a total of 5.1 acres of potential GDEs have been identified within the Tule Lake Subbasin which covers a total area of 110,521 acres. This 5.1 acres is generally in five locations described below and shown on the maps in Attachment C.

1. Two potential areas of Greasewood totaling 1.5 acres located in the southwestern area of the Subbasin.
2. Two potential areas of Wet Meadows totaling 2.4 acres located in the eastern area of the Subbasin.
3. One potential area of Wet Meadows totaling 1.2 acres located in the southeastern area of the Subbasin.

As noted in Section 6.1.4 of the GSP, the GSAs have identified the potential GDEs as a data gap and plan to conduct a field inspection of these areas to better understand the vegetation present and confirm potential rooting depths. In addition, as noted in Section 6.1.3 of the GSP, the GSAs have identified the lack of monitoring wells as a data gap as additional monitoring could provide the GSAs a better understanding of water levels near the potential GDEs and confirm if the vegetation is able to access groundwater. Therefore, the GSAs through GSP implementation will attempt to gain a better understanding of these areas via field inspections and additional monitoring.

As noted in the GSP, the Tule Lake Subbasin is currently being sustainably managed. Projects and management actions like those noted above will promote better understanding of the Subbasin and allow for continued sustainability. If undesirable results were to occur, then up to 5.1 acres of potential GDEs may be impacted.

Attachments

Attachment A: January 18, 2024 letter from Department of Water Resources

Attachment B: Representation monitoring well hydrographs

Attachment C: Maps showing potentially dewatered wells

Attachment D: Maps showing potential GDE locations

Attachment E: Updated Well Completion Report

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER
MANAGEMENT OFFICE
715 P Street, 8th Floor | Sacramento, CA 95814 | P.O. Box 942836 | Sacramento, CA 94236-0001

January 18, 2024

Brad Kirby
Tulelake Irrigation District GSA
P.O. Box 699
Tulelake, CA 96134
tid@cot.net

RE: Klamath River Valley – Tulelake Subbasin - 2022 Groundwater Sustainability Plan

Dear Brad Kirby,

The Department of Water Resources (Department) has evaluated the groundwater sustainability plan (GSP or Plan) submitted for the Klamath River Valley – Tulelake Subbasin. The Department has determined that the Plan is "incomplete" pursuant to Section 355.2(e)(2) of the GSP Regulations.

The Department based its incomplete determination on recommendations from the Staff Report, included as an enclosure to the attached Statement of Findings, which describes that the Subbasin's Plan does not satisfy the objectives of the Sustainable Groundwater Management Act (SGMA) nor substantially comply with the GSP Regulations. The Staff Report also provides corrective actions which the Department recommends the Subbasin's groundwater sustainability agencies (GSAs) review while determining how to address the deficiencies.

The Subbasin's GSAs have 180 days, the maximum allowed by the GSP Regulations, to address the identified deficiencies. Where addressing the deficiencies requires modification of the Plan, the GSAs must adopt those modifications into the GSP and all applicable coordination agreement materials, or otherwise demonstrate that those modifications are part of the Plan before resubmitting it to the Department for evaluation no later than July 16, 2024. The Department understands that much work has occurred to advance sustainable groundwater management since the GSAs submitted the GSP in January 2022. To the extent to which those efforts are related or responsive to the Department's identified deficiencies, we encourage you to document that as part of your Plan resubmittal. The Department prepared a Frequently Asked Questions document to provide general information and guidance on the process of addressing deficiencies in an "incomplete" determination.

Department staff will work expeditiously to review the revised components of your Plan resubmittal. If the revisions sufficiently address the identified deficiencies, the Department will determine that the Plan is "approved". In that scenario, Department staff will identify additional recommended corrective actions that the GSAs should address early in implementing the GSP (i.e., no later than the first required periodic evaluation). Among other items, those corrective actions will recommend the GSAs provide more detail on their plans and schedules to address data gaps. Those recommendations will call for significantly expanded documentation of the plans and schedules to implement specific projects and management actions. Regardless of those recommended corrective actions, the Department expects the first periodic evaluations, required no later than January 2027 – one-quarter of the way through the 20-year implementation period – to document significant progress toward achieving sustainable groundwater management.

If the Subbasin's GSAs cannot address the deficiencies identified in this letter by July 16, 2024, then the Department, after consultation with the State Water Resources Control Board, will determine the GSP to be "inadequate". In that scenario, the State Water Resources Control Board may identify additional deficiencies that the GSAs would need to address in the state intervention processes outlined in SGMA.

Please contact Sustainable Groundwater Management staff by emailing sgmps@water.ca.gov if you have any questions related to the Department's assessment or implementation of your GSP.

Thank You,

Paul Gosselin

Paul Gosselin
Deputy Director
Sustainable Groundwater Management

Attachment:

1. Statement of Findings Regarding the Determination of Incomplete Status of the Klamath River Valley – Tulelake Subbasin Groundwater Sustainability Plan

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

STATEMENT OF FINDINGS REGARDING THE DETERMINATION OF INCOMPLETE STATUS OF THE KLAMATH RIVER VALLEY – TULELAKE SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

The Department of Water Resources (Department) is required to evaluate whether a submitted groundwater sustainability plan (GSP or Plan) conforms to specific requirements of the Sustainable Groundwater Management Act (SGMA or Act), is likely to achieve the sustainability goal for the Tulelake Subbasin, and whether the GSP adversely affects the ability of an adjacent basin or subbasin to implement its GSP or impedes achievement of sustainability goals in an adjacent basin or subbasin. (Water Code § 10733.) The Department is directed to issue an assessment of the GSP within two years of its submission. (Water Code § 10733.4.) This Statement of Findings explains the Department's decision regarding the submitted Plan by the Tulelake Irrigation District Groundwater Sustainability Agency, Modoc County Groundwater Sustainability Agency, Siskiyou County Groundwater Sustainability Agency, and City of Tulelake Groundwater Sustainability Agency (collectively, the GSAs or Agencies) for the Klamath River Valley – Tulelake Subbasin (Basin No. 1-002.01).

Department management has reviewed the enclosed Staff Report, which recommends that the identified deficiencies should preclude approval of the GSP at this time. Based on its review of the Staff Report, Department management is satisfied that staff have conducted a thorough evaluation and assessment of the Plan and concurs with, and hereby adopts, staff's recommendation and all the corrective actions provided. The Department thus determines the Plan Incomplete based on the staff assessment and recommendations. In particular, the Department finds:

The GSAs must provide a more detailed explanation and justification regarding the development of the sustainable management criteria for groundwater levels, particularly the undesirable results and minimum thresholds, and quantitatively describe the effects of those criteria on the interests of beneficial uses and users of groundwater. Department staff recommend the GSAs consider and address the following:

a. The GSAs must re-evaluate minimum thresholds for wells that previously were established based on pumping (dynamic) depths, and set minimum thresholds based on a depletion of supply at static depths (i.e., Tulelake Irrigation District wells #5, #8, and #14 or any other deep groundwater wells, or those with well depths greater than 500 feet, the GSAs decide to set SGMA criteria for).

b. The GSAs should analyze the number of wells that may be dewatered and the level of impacts to groundwater dependent ecosystems that may occur without rising to significant and unreasonable levels constituting undesirable results. Identify the number and location of wells that may be negatively affected when minimum thresholds are reached. The GSAs should explain how well mitigation will be considered by the GSAs during their management of the Subbasin in a project or management action as part of the GSP. Department staff also encourage the GSAs to review the Department's April 2023 guidance document titled *Considerations for Identifying and Addressing Drinking Water Well Impacts*.[1]

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[1] https://water.ca.gov/Programs/Groundwater-Management/Drinking-Water-Well.

Based on the above, the GSP submitted by the Agencies for the Klamath River Valley – Tulelake Subbasin is determined to be incomplete because the GSP does not satisfy the requirements of SGMA, nor does it substantially comply with the GSP Regulations. The corrective actions provided in the Staff Report are intended to address the deficiencies that, at this time, preclude approval. The Agencies have up to 180 days to address the deficiencies outlined above and detailed in the Staff Report. Once the Agencies resubmit their Plan, the Department will review the revised GSP to evaluate whether the deficiencies were adequately addressed. Should the Agencies fail to take sufficient actions to correct the deficiencies identified by the Department in this assessment, the Department shall disapprove the Plan if, after consultation with the State Water Resources Control Board, the Department determines the Plan inadequate pursuant to 23 CCR § 355.2(e)(3)(C).

Signed:

Karla Nemeth

Karla Nemeth, Director
Date: January 18, 2024

Enclosure: Groundwater Sustainability Plan Assessment Staff Report – Klamath River Valley – Tulelake Subbasin

State of California
Department of Water Resources
Sustainable Groundwater Management Program
Groundwater Sustainability Plan Assessment
Staff Report

Groundwater Basin Name:	Klamath River Valley – Tulelake Subbasin (No. 1-002.01)
Submitting Agency:	Tulelake Irrigation District Groundwater Sustainability Agency, Modoc County Groundwater Sustainability Agency, Siskiyou County Groundwater Sustainability Agency, and City of Tulelake Groundwater Sustainability Agency
Submittal Type:	Initial GSP Submission
Submittal Date:	January 31, 2022
Recommendation:	Incomplete
Date:	January 18, 2024

The Sustainable Groundwater Management Act (SGMA)[1] allows for any of the three following planning scenarios: a single groundwater sustainability plan (GSP) developed and implemented by a single groundwater sustainability agency (GSA); a single GSP developed and implemented by multiple GSAs; and multiple GSPs implemented by multiple GSAs and coordinated pursuant to a single coordination agreement.[2] Here, as presented in this staff report, a single GSP covering the entire basin was adopted and submitted to the Department of Water Resources (Department, DWR) for review.[3]

The Tulelake Irrigation District, Modoc County, Siskiyou County, and City of Tulelake GSAs (collectively, the GSAs) jointly submitted the Tule Lake Groundwater Sustainability Plan (GSP or Plan) to the Department for evaluation and assessment as required by SGMA and the GSP Regulations.[4] The GSP covers the entire Klamath River Valley – Tulelake Subbasin (Subbasin) for the implementation of SGMA.

Evaluation and assessment by the Department is based on whether an adopted and submitted GSP, either individually or in coordination with other adopted and submitted GSPs, complies with SGMA and substantially complies with the GSP Regulations. Department staff base their assessment on information submitted as part of an adopted GSP, public comments submitted to the Department, and other materials, data, and reports that are relevant to conducting a thorough assessment. Department staff have

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[1] Water Code § 10720 *et seq*.
[2] Water Code § 10727.
[3] Water Code §§ 10727(b)(1), 10733.4; 23 CCR § 355.2.
[4] 23 CCR § 350 *et seq*.

evaluated the GSP and have identified deficiencies that staff recommend should preclude its approval.[5] In addition, consistent with the GSP Regulations, Department staff have provided corrective actions[6] that the GSAs should review while determining how and whether to address the deficiencies. The deficiencies and corrective actions are explained in greater detail in Section 3 of this staff report and are generally related to the need to define sustainable management criteria in the manner required by SGMA and the GSP Regulations.

This assessment includes four sections:

- **Section 1 – Evaluation Criteria:** Describes the legislative requirements and the Department's evaluation criteria.
- **Section 2 – Required Conditions:** Describes the submission requirements, GSP completeness, and basin coverage required for a GSP to be evaluated by the Department.
- **Section 3 – Plan Evaluation:** Provides a detailed assessment of identified deficiencies in the GSP. Consistent with the GSP Regulations, Department staff have provided corrective actions for the GSAs to address the deficiencies.
- **Section 4 – Staff Recommendation:** Provides staff's recommendation regarding the Department's determination.

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[5] 23 CCR §355.2(e)(2).

[6] 23 CCR §355.2(e)(2)(B).

1 EVALUATION CRITERIA

The Department evaluates whether a Plan conforms to the statutory requirements of SGMA[7] and is likely to achieve the basin's sustainability goal.[8] To achieve the sustainability goal, the Plan must demonstrate that implementation will lead to sustainable groundwater management, which means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.[9] Undesirable results are required to be defined quantitatively by the GSAs overlying a basin and occur when significant and unreasonable effects for any of the applicable sustainability indicators are caused by groundwater conditions occurring throughout the basin.[10] The Department is also required to evaluate whether the Plan will adversely affect the ability of an adjacent basin to implement its groundwater sustainability program or achieve its sustainability goal.[11]

For a Plan to be evaluated by the Department, it must first be determined that it was submitted by the statutory deadline[12] and that it is complete and covers the entire basin.[13] Additionally, for those GSAs choosing to develop multiple GSPs, the Plan submission must include a coordination agreement.[14] The coordination agreement must explain how the multiple GSPs in the basin have been developed and implemented utilizing the same data and methodologies and that the elements of the multiple GSPs are based upon consistent interpretations of the basin's setting. If these required conditions are satisfied, the Department evaluates the Plan to determine whether it complies with SGMA and substantially complies with the GSP Regulations.[15] As stated in the GSP Regulations, "[s]ubstantial compliance means that the supporting information is sufficiently detailed and the analyses sufficiently thorough and reasonable, in the judgment of the Department, to evaluate the Plan, and the Department determines that any discrepancy would not materially affect the ability of the Agency to achieve the sustainability goal for the basin, or the ability of the Department to evaluate the likelihood of the Plan to attain that goal."[16]

When evaluating whether the Plan is likely to achieve the sustainability goal for the basin, Department staff review the information provided for sufficiency, credibility, and consistency with scientific and engineering professional standards of practice.[17] The Department's review considers whether there is a reasonable relationship between the

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[7] Water Code §§ 10727.2, 10727.4, 10727.6.
[8] Water Code § 10733(a).
[9] Water Code § 10721(v).
[10] 23 CCR § 354.26.
[11] Water Code § 10733(c).
[12] 23 CCR § 355.4(a)(1).
[13] 23 CCR §§ 355.4(a)(2), 355.4(a)(3).
[14] 23 CCR § 357.4.
[15] 23 CCR § 350 *et seq*.
[16] 23 CCR § 355.4(b).
[17] 23 CCR § 351(h).

information provided by the GSAs and the assumptions and conclusions presented in the Plan, including: whether the interests of the beneficial uses and users of groundwater in the basin have been considered; whether sustainable management criteria and projects and management actions described in the Plan are commensurate with the level of understanding of the basin setting; and whether those projects and management actions are feasible and likely to prevent undesirable results.[18] The Department also considers whether the GSAs have the legal authority and financial resources necessary to implement the Plan.[19]

To the extent overdraft is present in a basin, the Department evaluates whether the Plan provides a reasonable assessment of the overdraft and includes reasonable means to mitigate overdraft if present.[20] When applicable, the Department will assess whether coordination agreements have been adopted by all relevant parties and satisfy the requirements of SGMA and the GSP Regulations.[21] The Department also considers whether the Plan provides reasonable measures and schedules to eliminate identified data gaps.[22] Lastly, the Department's review considers the comments submitted on the Plan and evaluates whether the GSAs have adequately responded to the comments that raise credible technical or policy issues with the Plan.[23]

The Department is required to evaluate the Plan within two years of its submittal date and issue a written assessment.[24] The assessment is required to include a determination of the Plan's status.[25] The GSP Regulations provide three options for determining the status of a Plan: approved,[26] incomplete,[27] or inadequate.[28]

Even when the Department determines a Plan is approved, indicating that it satisfies the requirements of SGMA and is in substantial compliance with the GSP Regulations, the Department may still recommend corrective actions.[29] Recommended corrective actions are intended to facilitate progress in achieving the sustainability goal within the basin and the Department's future evaluations, and to allow the Department to better evaluate whether implementation of the Plan adversely affects adjacent basins. While the issues addressed by the recommended corrective actions in an approved Plan do not, at the time the determination was made, preclude its approval, the Department recommends that the issues be addressed to ensure the Plan's implementation continues to be consistent with SGMA and the Department is able to assess progress in achieving the

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[18] 23 CCR §§ 355.4(b)(1), (3), (4) and (5).
[19] 23 CCR § 355.4(b)(9).
[20] 23 CCR § 355.4(b)(6).
[21] 23 CCR § 355.4(b)(8).
[22] 23 CCR § 355.4(b)(2).
[23] 23 CCR § 355.4(b)(10).
[24] Water Code § 10733.4(d); 23 CCR § 355.2(e).
[25] Water Code § 10733.4(d); 23 CCR § 355.2(e).
[26] 23 CCR § 355.2(e)(1).
[27] 23 CCR § 355.2(e)(2).
[28] 23 CCR § 355.2(e)(3).
[29] Water Code § 10733.4(d).

basin's sustainability goal.[30] Unless otherwise noted, the Department proposes that recommended corrective actions be addressed by the submission date for the first periodic assessment.[31]

After review of the Plan, Department staff may conclude that the information provided is not sufficiently detailed, or the analyses not sufficiently thorough and reasonable, to evaluate whether it is likely to achieve the sustainability goal for the basin. If the Department determines the deficiencies precluding approval may be capable of being corrected by the GSAs in a timely manner,[32] the Department will determine the status of the Plan to be incomplete. A Plan deemed incomplete may be revised and resubmitted to the Department for reevaluation of whether all deficiencies have been addressed and incorporated into the Plan within 180 days after the Department makes its incomplete determination. The Department will review the revised Plan to evaluate whether the identified deficiencies were sufficiently addressed. Depending on the outcome of that evaluation, the Department may determine the resubmitted Plan is approved. Alternatively, the Department may find a formerly deemed incomplete GSP is inadequate if, after consultation with the State Water Resources Control Board, it determines that the GSAs have not taken sufficient actions to correct any identified deficiencies.[33]

The staff assessment of the Plan involves the review of information presented by the GSAs, including models and assumptions, and an evaluation of that information based on scientific reasonableness. In conducting its assessment, the Department does not recalculate or reevaluate technical information provided in the Plan or perform its own geologic or engineering analysis of that information. The recommendation to approve a Plan does not signify that Department staff, were they to exercise the professional judgment required to develop a Plan for the basin, would make the same assumptions and interpretations as those contained in the Plan, but simply that Department staff have determined that the assumptions and interpretations relied upon by the submitting GSAs are supported by adequate, credible evidence, and are scientifically reasonable.

Lastly, the Department's review and assessment of an approved Plan is a continual process. Both SGMA and the GSP Regulations provide the Department with the ongoing authority and duty to review the implementation of the Plan.[34] Also, GSAs have an ongoing duty to reassess their GSPs, provide annual reports to the Department, and, when necessary, update or amend their GSPs.[35] The passage of time or new information may make what is reasonable and feasible at the time of this review to not be so in the future. The emphasis of the Department's periodic reviews will be to assess the GSA's progress toward achieving the basin's sustainability goal and whether implementation of

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[30] Water Code § 10733.8.
[31] 23 CCR § 356.4.
[32] 23 CCR § 355.2(e)(2)(B)(i).
[33] 23 CCR § 355.2(e)(3)(C).
[34] Water Code § 10733.8; 23 CCR § 355.6.
[35] Water Code §§ 10728, 10728.2.

the Plan adversely affects the ability of GSAs in adjacent basins to achieve their sustainability goals.

2 REQUIRED CONDITIONS

A GSP, to be evaluated by the Department, must be submitted within the applicable statutory deadline.[36] The GSP must also be complete and must, either on its own or in coordination with other GSPs, cover the entire basin. If a GSP is determined to be incomplete, Department staff may recommend corrective actions that address minor or potentially significant deficiencies identified in the GSP. The GSAs in a basin, whether developing a single GSP covering the basin or multiple GSPs, must sufficiently address those required corrective actions within the time provided, not to exceed 180 days, for the GSP to be reevaluated by the Department and potentially approved.

2.1 SUBMISSION DEADLINE

SGMA required basins categorized as high- or medium-priority as of January 1, 2017 and to submit a GSP no later than January 31, 2022.[37]

The GSAs submitted the Tule Lake Groundwater Sustainability Plan GSP to the Department on January 31, 2022, in compliance with the statutory deadline.

2.2 COMPLETENESS

GSP Regulations specify that the Department shall evaluate a GSP if that GSP is complete and includes the information required by SGMA and the GSP Regulations.[38]

The GSAs submitted an adopted GSP for the entire Subbasin. Department staff determined that the Tule Lake Groundwater Sustainability Plan GSP was complete and include the required information, sufficient to warrant an evaluation by the Department. Therefore, the Department posted the GSP to its website on February 14, 2022.

2.3 BASIN COVERAGE

A GSP, either on its own or in coordination with other GSPs, must cover the entire basin.[39] A GSP that intends to cover the entire basin may be presumed to do so if the basin is fully contained within the jurisdictional boundaries of the submitting GSAs.

The GSP intends to manage the entire Tulelake Subbasin and the jurisdictional boundaries of the submitting GSAs appear to cover the entire Subbasin.

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[36] Water Code § 10720.7.
[37] Water Code § 10720.7(a)(2).
[38] 23 CCR § 355.4(a)(2).
[39] Water Code § 10727(b); 23 CCR § 355.4(a)(3).

3 PLAN EVALUATION

As stated in Section 355.4 of the GSP Regulations, a basin "shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act." The Department's assessment is based on a number of related factors including whether the elements of a GSP were developed in the manner required by the GSP Regulations, whether the GSP was developed using appropriate data and methodologies and whether its conclusions are scientifically reasonable, and whether the GSP, through the implementation of clearly defined and technically feasible projects and management actions, is likely to achieve a tenable sustainability goal for the basin.

Department staff have identified deficiencies in the GSP, the most serious of which preclude staff from recommending approval of the GSP at this time. Department staff believe the GSAs may be able to correct the identified deficiencies within 180 days. Consistent with the GSP Regulations, Department staff are providing corrective actions related to the deficiencies, detailed below, including the general regulatory background, the specific deficiency identified in the GSP, and the specific actions to address the deficiency.

Additionally, Department staff note some of the information presented in the water budget, including the assumption that surface water supplies will be delivered at historical levels and the projection of no future overdraft, is not supported by, but rather is at variance with information contained in the Plan. The Plan acknowledges that surface water availability has been limited in the Subbasin beginning in 2001[40] and that groundwater use has generally increased. The GSAs concludes that "if surface water supply were to decrease, groundwater extractions would likely increase potentially leading to the chronic lowering of groundwater levels."[41] The Plan acknowledges a reduction in surface water deliveries since 2001, but also predicts that water deliveries will remain at current levels or higher for the foreseeable future;[42] however, the Plan includes a study by the U.S. Bureau of Reclamation that predicts that future surface water deliveries may be limited.[43] In light of this information, Department staff believe it is prudent for the GSA's to evaluate scenarios in which surface water deliveries are reduced, and develop projects and management actions that could be implemented, as needed, to respond in the event such reductions occur.

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[40] Tulelake GSP, Section 2.2.2.1, pp. 63-64.
[41] Tulelake GSP, Section 5.2.1.2, p. 104.
[42] Tulelake GSP, Appendix K, Table 5-2, p. 375.
[43] U.S. Bureau of Reclamation, *Final Report. Klamath River Basin Study. Technical Memorandum 86-68210-2016-06*, p. 272. March 1, 2016.

3.1 DEFICIENCY 1. THE GSP DOES NOT DEVELOP SUSTAINABLE MANAGEMENT CRITERIA FOR THE CHRONIC LOWERING OF GROUNDWATER LEVELS IN A MANNER SUBSTANTIALLY COMPLIANT WITH THE GSP REGULATIONS.

3.1.1 Background

It is up to the GSA to define undesirable results and GSAs must describe the effect of undesirable results on the beneficial uses and users of groundwater.[44] From this definition, the GSA establishes minimum thresholds, which are quantitative values that represent groundwater conditions at representative monitoring sites that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause the basin to experience undesirable results.[45] Put another way, the minimum thresholds represent conditions that, if not exceeded, should prevent the basin from experiencing the undesirable results identified by the GSA. Minimum thresholds for chronic lowering of groundwater levels are the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results.[46] Quantitative values for minimum thresholds should be supported by information and criteria relied upon to establish and justify the minimum threshold,[47] and a quantitative description of how conditions at minimum thresholds may affect the interests of beneficial uses and users of groundwater.[48]

3.1.2 Deficiency

Department staff conclude that the GSAs did not define undesirable results and minimum thresholds for the chronic lowering of groundwater levels in the manner required by SGMA and the GSP Regulations. As explained below, the GSP does not identify minimum thresholds with sufficient supporting information to allow Department staff to evaluate whether the criteria are reasonable or whether operating the Subbasin to avoid those thresholds is consistent with avoiding undesirable results. Furthermore, some of the proposed thresholds appear to have been developed improperly by relying on groundwater levels determined while active pumping is occurring, which may measure depletion of supply for an individual well but does not provide the static groundwater measurements necessary to assess the depletion of supply for the Subbasin.

It is the responsibility of the Department to evaluate whether a GSA has considered the interests of beneficial uses and users of groundwater, including groundwater dependent ecosystems and any domestic users who may be impacted by lowering groundwater levels, as part of the planned management of the basin.[49] The GSAs have set thresholds based on the shallowest domestic well, however based on public information described

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[44] 23 CCR § 354.26 (b)(3), § 354.28 (b)(4).

[45] 23 CCR § 354.28, DWR Best Management Practices for the Sustainable Management of Groundwater: Sustainable Management Criteria (DRAFT), November 2017.

[46] 23 CCR § 354.28 (c)(1).

[47] 23 CCR § 354.28 (b)(1).

[48] 23 CCR § 354.28 (b)(4).

[49] 23 CCR § 355.4 (b)(4).

below, impacts to beneficial users may be occurring in the Subbasin that are not anticipated or included in the Plan. Department staff conclude additional information is needed about how the GSAs performed their analysis and evaluated the interests of beneficial uses and users when establishing sustainable management criteria for groundwater levels.

3.1.3 Deficiency Details

GSP Regulations require that GSAs describe the processes and criteria relied upon to define undesirable results caused by the chronic lowering of groundwater levels. Undesirable results occur when significant and unreasonable effects due to chronic lowering of groundwater levels are caused by conditions occurring throughout the basin.[50]

The GSAs developed sustainable management criteria for the chronic lowering of groundwater levels with the assumption that the Subbasin is currently being sustainably managed. The GSP states that an undesirable result is "a result that would cause significant and unreasonable impacts to beneficial uses and users of groundwater over the implementation period of this GSP" and would occur when groundwater elevations drop below the minimum threshold criteria at four of the 15 representative monitoring locations over three consecutive spring measurements.[51] The conditions that the GSAs state as potential causes of undesirable results include that the "[l]owering of groundwater levels would result in increased power costs to extract groundwater"[52] and "[i]n extreme cases, groundwater levels may decrease to an extent where the cost to pump water exceeds the value of the agriculture or effects a large number of domestic wells."[53] As discussed below, the description of undesirable results and establishment of minimum thresholds are not consistent with requirements of the GSP Regulations.

The GSP Regulations require GSAs to set minimum thresholds for chronic lowering of groundwater levels at "the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results."[54] The GSP explains that minimum thresholds were determined by considering historical Subbasin conditions and are based on considerations for beneficial users and uses of groundwater.[55] The GSP establishes two different sets of groundwater level minimum thresholds for the representative monitoring wells, as follows:

1. If the monitoring well depth is less than 500 feet and within three miles of a domestic well(s), the minimum threshold is defined as the minimum domestic well depth at that monitoring well.

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[50] 23 CCR § 354.26 (a).
[51] Tule Lake Subbasin GSP, Section 5.2.1.3, p. 104.
[52] Tule Lake Subbasin GSP, Section 5.2.1.3, p. 104.
[53] Tule Lake Subbasin GSP, Section 5.2.2.2, p. 105.
[54] 23 CCR § 354.28 (c)(1).
[55] Tule Lake Subbasin GSP, Section 5.3.1.2, p. 109.

2. If the monitoring well depth is greater than or equal to 500 feet, the minimum threshold is defined as the historical low groundwater measurement plus a 10 percent buffer, rounded up to the nearest whole number.

Department staff have identified two key problems with how the GSAs have set minimum thresholds. First, the GSP does not appear to use static groundwater level measurements as the basis for the sustainable management criteria for one or more of the representative monitoring site wells. The GSP Regulations require “static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.”[56] There are discrepancies between the historical lows reported in Table 5.1 for two representative monitoring wells and the historical lows shown on hydrographs provided in the GSP; further, one representative monitoring well does not have a hydrograph (TID Well No. 8) in the GSP.[57] These discrepancies indicate that historical low groundwater levels may not be accurately depicted in these wells, which likely effect the sustainable management criteria set at these locations. The GSP states that representative monitoring wells are represented in hydrographs where static groundwater elevation data was measured,[58] but comparing well data in the GSP with hydrographs in the Department’s SGMA Portal monitoring site, the minimum thresholds seem to be based on pumping or dynamic depths rather than static depths to groundwater. This is problematic because, as stated above, the GSP Regulations require that static measurements be made to represent basin conditions wholistically rather than individual well conditions. Department staff’s evaluation is supported by a public comment from the State of Oregon Water Resources Department, stating, “these threshold values use the maximum pumping depth measurements as opposed to non-pumping levels. In some cases, this sets the minimum threshold hundreds of feet below the current water table elevations.”[59]

Table 1, below, presents values reported in the GSP as historical low depths for three representative monitoring wells, and compares these values with the approximate “static” historical low estimated by Department staff (based on hydrographs presented in the GSP) and “dynamic” historical low values reported in the Department’s SGMA Portal. All values are reported in feet below ground surface (ft bgs).

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[56] 23 CCR §354.34(c)(1)(B).

[57] Tule Lake Subbasin GSP, Figure 2-24, p. 67, Figure 2-25, p. 68, and Figure 2-28, p. 69.

[58] Tule Lake Subbasin GSP, Section 2.2.2.1, p. 64.

[59] GSP Submittal Comments 1-002.01 TULELAKE, Department of Water Resources SGMA Portal, CDWR-Tule Lake Response Letter_20220812signedTB.pdf.

Table 1. Comparison of Static Water Levels and Assumed Dynamic Water Levels.

Well No.	GSP Reported Historical Low (ft bgs) from Table 5.1	Approximate "Static" Historical Low (ft bgs) from GSP Hydrograph	"Dynamic" Historical Low (ft bgs) from SGMA Portal
48N04E13K001M (TID Well 5)	192	58[60]	192.3[61]
48N05E26D001M (TID Well 8)	276	No Data Reported	276.7[62]
46N05E22D001M (TID Well 14)	90	42[63]	90.3[64]

The data reported in the first column of Table 1, which is reported in the GSP as static low values, is far closer to "dynamic" pumping measurements from the same wells, shown in column 3, than "static" values extrapolated from the hydrograph provided in Appendix M of the GSP[65] (column 2 in Table 1). Staff conclude that the Plan misidentified the nature of well measurements reported in column 1 (and in Table 5.1 in the GSP) as static when they are apparently dynamic water level measurements. The difference is significant because the GSP defines minimum thresholds for chronic lowering of groundwater levels as a function of historical trends and the rate of groundwater elevation decline based on projected water use in the Subbasin, and dynamic measurements present significantly lower groundwater elevations than static measurements.[66] Furthermore, dynamic groundwater level measurements represent the efficiency of an individual well and do not represent static Subbasin conditions and therefore, do not represent the rate of groundwater elevation decline, meaning a reduction in pumping rates could still allow for large declines of non-pumping groundwater level before minimum thresholds are reached. As such, dynamic groundwater levels should not be used to establish sustainable management criteria. Best management practice and industry standard indicate that wells selected for inclusion in the GSAs' monitoring network, and by extension those with established sustainable management criteria, should be evaluated to ensure that groundwater level data obtained meet data quality objectives for that well.[67] "For example, some wells may be directly influenced by nearby pumping, or injection and observation of the aquifer response may be the purpose of the well. Otherwise, the network should contain an adequate number of wells to observe the overall static conditions and the specific project effects." The data quality objective process, which follows the U.S. EPA Guidance on Systematic Planning Using the Data Quality Objectives

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[60] Data from June 2015.

[61] Department of Water Resources, SGMA Portal, Well Elevation Chart, 419971N1214519W001 (TID #5) [website], https://sgma.water.ca.gov/SgmaWell/well/wellelevationchart/24209#elevation, (Data from June 24, 2010, accessed 25 July 2023).

[62] Department of Water Resources, SGMA Portal, Well Elevation Chart, 419762N1213727W001 (TID #8) [website], https://sgma.water.ca.gov/SgmaWell/well/wellelevationchart/24257#elevation, (Data from September 26, 2002, accessed 25 July 2023).

[63] Data from July 2016.

[64] Department of Water Resources, SGMA Portal, Well Elevation Chart, 418174N1213955W001 (TID #14) [website], https://sgma.water.ca.gov/SgmaWell/well/wellelevationchart/24257#elevation, (Data from August 10, 2018, accessed 25 July 2023).

[65] Tule Lake Subbasin GSP, Appendix M, pp. 510-527.

[66] 23 CCR 354.28 (c)(1).

[67] 23 CCR §354.34(c)(1)(B), *DWR Best Management Practices for the Sustainable Management of Groundwater: Monitoring Networks and Identification of Data Gaps*, December 2016.

Process, presents a method that can be applied directly to the sustainability criteria quantitative requirements.[68] The GSAs should revise the minimum threshold for all wells to be based on a static groundwater level that represents a depletion of supply that would lead to undesirable results (see Corrective Action 1a).

The second problem Department staff identified with how the GSAs have set minimum thresholds is that the GSP does not demonstrate how the interests of beneficial uses and users were considered. The GSP Regulations require GSAs to consider how conditions at minimum thresholds may affect the interests of beneficial uses and users of groundwater.[69] Although the GSP refers to agricultural and domestic users, it does not provide a reasonably comprehensive description of the potential undesirable results that might be experienced by all beneficial uses and users during plan implementation. The GSP discusses the potential effects of the chronic lowering of groundwater levels related to agricultural use and the costs to pump groundwater, but does not mention potential effects on domestic users or other uses,[70] or define what the GSAs consider effects to "a large number of domestic wells"[71] to be, although the GSP acknowledges that in the Subbasin, at least "2,400 people are dependent on groundwater for domestic purposes."[72]

Declining groundwater levels have affected beneficial users in the Subbasin during implementation of the GSP, including impairments to drinking water access. In June 2023, the City of Tulelake was awarded grant funding to rehabilitate two wells including lowering a pump, provide bottled water, and install an emergency potable water filling station due to declines in regional groundwater levels.[73] Department staff are concerned that impacts to domestic and municipal water sources within the Subbasin may result from proposed groundwater management activities and that the GSP does not adequately identify those potential impacts nor plan to address them through projects and management actions. Information from the Department's California's Groundwater Live: Groundwater Levels 'Current Groundwater Level Conditions' dashboard[74] showed 7 monitoring wells at their 'All-Time Low', 23 monitoring wells 'Much Below Normal', 7 monitoring wells 'Below Normal', and 9 monitoring wells at 'Normal' or 'Above Normal' in the mid-summer of 2023. The GSA's Annual Report also reported a loss in storage of over 14,000 acre-feet during Water Year 2021-2022[75] and the hydrograph for representative monitoring well TL-T3 (located in the southern portion of the Subbasin near the Sump 1B area) shows

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[68] DWR Best Management Practices for the Sustainable Management of Groundwater: Groundwater Monitoring Protocols, Standards, and Sites, December 2016.

[69] 23 CCR 354.28 (b)(4).

[70] Tule Lake Subbasin GSP, Section 5.2.1.2, p. 104.

[71] Tule Lake Subbasin GSP, Section 5.2.2.2, p. 105.

[72] Tule Lake Subbasin GSP, Executive Summary, p. 10.

[73] Department of Water Resources Small Community Drought Relief Program, City of Tulelake application: *Attachment I, Part III – Summary of Project Costs; Scope of Work and Project Description*, p. 6.

[74] Department of Water Resources, *California's Groundwater Live: Groundwater Levels 'Current Groundwater Level Conditions'* [website], https://storymaps.arcgis.com/stories/b3886b33b49c4fa8adf2ae8bdd8f16c3, (accessed 25 July 2023).

[75] Tule Lake Subbasin GSP Annual Report Water Year 2022, Table 2-3, p. 15.

groundwater levels within 1 foot of reaching the minimum threshold for that well[76]. If, after considering the deficiency described above, the GSAs retain minimum thresholds that allow for continued lowering of groundwater levels and those below historical lows, then it is reasonable to assume that additional wells may be impacted during implementation of the Plan. While SGMA does not require all impacts to groundwater uses and users to be mitigated, the GSAs should consider including a formal mitigation strategy, describing how drinking water impacts that may occur due to continued overdraft during the period between the start of Plan implementation and achievement of the Subbasin's sustainability goal will be addressed. If mitigation strategies are not included, the GSP should contain a thorough discussion, with supporting facts and rationale, explaining how and why the GSAs determined not to include specific actions or programs to monitor and mitigate drinking water impacts from continued groundwater lowering below 2015 levels.

Information is available to the GSAs to support their explanation and justification for the criteria established in their Plan. For example, the Department's well completion report dataset,[77] or other similar data, can be used to estimate the number and kinds of wells expected to be impacted at the proposed minimum thresholds. Additionally, public water system well locations and water quality data can currently be obtained using the State Water Board's Geotracker website.[78] Administrative contact information for public water systems, and well locations and contacts for state small water systems and domestic wells, can be obtained by contacting the State Water Board's Needs Analysis staff. The State Water Board is currently developing a database to allow for more streamlined access to this data in the future.

Department staff have determined that the GSAs have not considered possible worsening conditions, such as a reduction in expected surface water supplies, and therefore, the GSAs should evaluate and describe the potential effects on domestic wells and other beneficial users and uses of groundwater, such as environmental users. Although the GSP states that "[d]uring 2021 and some prior years, domestic wells within the Subbasin have experienced issues where the supply has gone dry",[79] Department staff do not believe that the GSAs have provided sufficient information to define if, and what, significant and unreasonable impacts could not occur in domestic wells or to other beneficial users (e.g., municipal drinking water sources, environmental, wetlands) before groundwater levels reach the minimum thresholds in monitoring wells less than 500 feet deep (defined as the minimum domestic well depth). Lastly, the use of what are suspected to be pumping groundwater level depths, reported as static groundwater level depths in the GSP as historical lows for these three representative wells, is also of concern to Department staff. Department staff have proposed recommended corrective actions,

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[76] Tule Lake Subbasin GSP Annual Report Water Year 2022, Appendix B, p. 37.
[77] Department of Water Resources, *Well Completion Reports* [website], https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports, (accessed 3 April 2023).
[78] State Water Resources Control Board, *GeoTracker* [website], https://geotracker.waterboards.ca.gov/, (accessed 3 April 2023).
[79] Tule Lake Subbasin GSP, Section 6.1.6, p. 113.

described below, requiring the GSAs to identify undesirable results that it wishes to avoid and to establish minimum thresholds that will avoid undesirable results for groundwater users and uses in the Subbasin.

The GSAs do not disclose whether the proposed minimum thresholds may impact environmental uses and users such as the Subbasin's two main wetlands (including seasonal wetlands, permanent vegetation, and open water areas).[80] The GSP also does not account specifically for these uses and users in future groundwater system[81] or land system water budgets.[82] Several public comments made to the GSAs on the draft GSP and to the Department on the final GSP voice concerns that environmental users of groundwater were not considered in the water budget and sustainable management criteria. The GSAs responded to one such concern with the following statement: "the Tule Lake Sumps are operated pursuant to the Biological Opinion and impacted by Reclamation's operation of the Klamath Project. Therefore, operation of the Sumps and protection of beneficial users of the Sumps is outside the jurisdiction of this GSP."[83] Department staff do not agree with the GSAs that "protection of beneficial users of the Sumps is outside the jurisdiction of this GSP" because the Tule Lake Sumps water budget is a factor in Subbasin water budgets, management of the Subbasin's surface and groundwater could affect beneficial uses and users in the Sumps area, and because these groundwater uses and users are identified in the Plan.

While the GSP acknowledges the proposed thresholds could lead to impacts that include to beneficial uses and users if groundwater levels are depleted, the Plan does not provide a clear description of the circumstances under which such impacts would become significant and unreasonable to particular beneficial uses and users. Department staff are unable to determine whether the interests of beneficial uses and users or groundwater, as well as the land uses and property interests potentially affected by the use of groundwater in the Subbasin, have been considered.[84] The GSAs must identify the number, location, and percentage of wells that may be impacted at the proposed minimum thresholds, as well as those wells that may not be addressed through the proposed Domestic Well Assistance investigation[85] and explain how the interests of beneficial uses and users were considered. The GSA must also evaluate how the proposed management may impact environmental users such as groundwater dependent ecosystems (see Corrective Action 1b).

Additionally, the Tulelake Subbasin is one of only three medium-priority groundwater basins in California that are truncated by the state border but whose basin fill is in direct connection with basin-fill sediments in an adjacent state.[86] While the SGMA basin

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[80] Tule Lake Subbasin GSP, Section 2.1.1.3, p. 25.
[81] Tule Lake Subbasin GSP, Appendix K, Table 5-3, p. 376.
[82] Tule Lake Subbasin GSP, Appendix K, Table 5-2, p. 375.
[83] Tule Lake Subbasin GSP, Appendix C, "Responses to Public Comments" Table, Comment # 8.1, p. 236.
[84] 23 CCR § 355.4 (b)(4).
[85] Tule Lake Subbasin GSP, Section 6.1.6, pp. 113-114.
[86] Tule Lake Subbasin GSP, Section 2.2.1.1, pp. 46-47.

boundary ends at the state line, the U.S. Geological Survey identifies the area defined by the Department as the Klamath River Valley Basin as part of the Upper Klamath Groundwater Basin[87] located within both California and Oregon.[88] Though the GSP makes little mention of the hydrogeologic properties of the U.S. Geological Survey-designated northern portion of the basin, the GSP explains that an integrated groundwater and surface water flow model that included the north of the Subbasin within Klamath County, Oregon, was developed to prepare water budgets for the Subbasin.[89] However, The GSP explains that "[f]or the purposes of SGMA, the Subbasin is bounded to the north by the state boundary of Oregon and California."[90] Department staff agree that per SGMA,[91] the GSAs should consider whether their GSP impedes achievement of sustainability goals in adjacent subbasins within California. However, the law is silent about how GSAs should consider effects on adjacent subbasins outside of the state of California.

A public comment received from the Oregon Department of Water Resources (ODWR) states there have been historical impacts to beneficial uses and users in the Oregon portion of the overall hydrologic basin, which the comment claims have been caused by groundwater use in the California portion of the Klamath River Valley Basin (i.e., the Tulelake Subbasin). The letter details how the ODWR has implemented its own regulation of groundwater in the Klamath River Valley Basin as a result of historical impacts. The letter further states there are concerns about how the implementation of the Tulelake GSP may affect users in Oregon and impact the effectiveness of the regulations governing the Oregon portion of the Klamath River Valley Basin, including that the "plan does not address past groundwater budget imbalances dating back to at least 2001, significant groundwater level declines observed in 2020 and 2021, and large increases in domestic wells in Oregon going dry in 2021 and 2022".[92] While SGMA does not require a GSA to consider the interests of beneficial uses and users outside of California, under this unique circumstance, it may be prudent for the GSA to coordinate with the ODWR outside of the framework of SGMA.

3.1.4 Corrective Action 1

The GSAs must provide more detailed explanations and justifications regarding the sustainable management criteria for chronic lowering of groundwater levels, particularly the undesirable results and minimum thresholds and the effects of those criteria on the

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[87] U.S. Geological Survey, *Upper Klamath Basin Groundwater Studies*, [website], https://www.usgs.gov/centers/oregon-water-science-center/science/upper-klamath-basin-groundwater-studies#overview, (accessed 22 September 2023).
[88] Tule Lake Subbasin GSP, Appendix K, p. 350.
[89] Tule Lake Subbasin GSP, Section 4, p. 93.
[90] Tule Lake Subbasin GSP, Section 2.2.1.1, p. 47.
[91] Water Code § 10733(c).
[92] GSP Submittal Comments 1-002.01 TULELAKE, Department of Water Resources SGMA Portal, CDWR-Tule Lake Response Letter_20220812signedTB.pdf.

interests of beneficial uses and users of groundwater. Specifically, the Plan must be amended as follows:

a. The GSAs must re-evaluate minimum thresholds for wells that previously were established based on pumping (dynamic) depths, and set minimum thresholds based on a depletion of supply at static depths (i.e., TID wells #5, #8, and #14 or any other deep groundwater wells, or those with well depths greater than 500 feet, the GSAs decide to set SGMA criteria for).

b. The GSAs should analyze the number of wells that may be dewatered and the level of impacts to groundwater dependent ecosystems that may occur without rising to significant and unreasonable levels constituting undesirable results. Identify the number and location of wells that may be negatively affected when minimum thresholds are reached. Compare well infrastructure for all well types in the Subbasin with minimum thresholds at nearby suitably representative monitoring sites. Document all assumptions and steps clearly so that it will be understood by readers of the GSP. Include maps of potentially affected well locations, identify the number of potentially affected wells by well type, and provide a supporting discussion of the effects. The GSAs should explain how well mitigation will be considered by the GSAs during their management of the Subbasin in a project or management action as part of the GSP. Department staff also encourage the GSAs to review the Department's April 2023 guidance document titled *Considerations for Identifying and Addressing Drinking Water Well Impacts*.[93]

4 STAFF RECOMMENDATION

Department staff believe that the deficiencies identified in this assessment should preclude approval of the GSP for the Klamath River Valley – Tulelake Subbasin. Department staff recommend that the GSP be determined incomplete.

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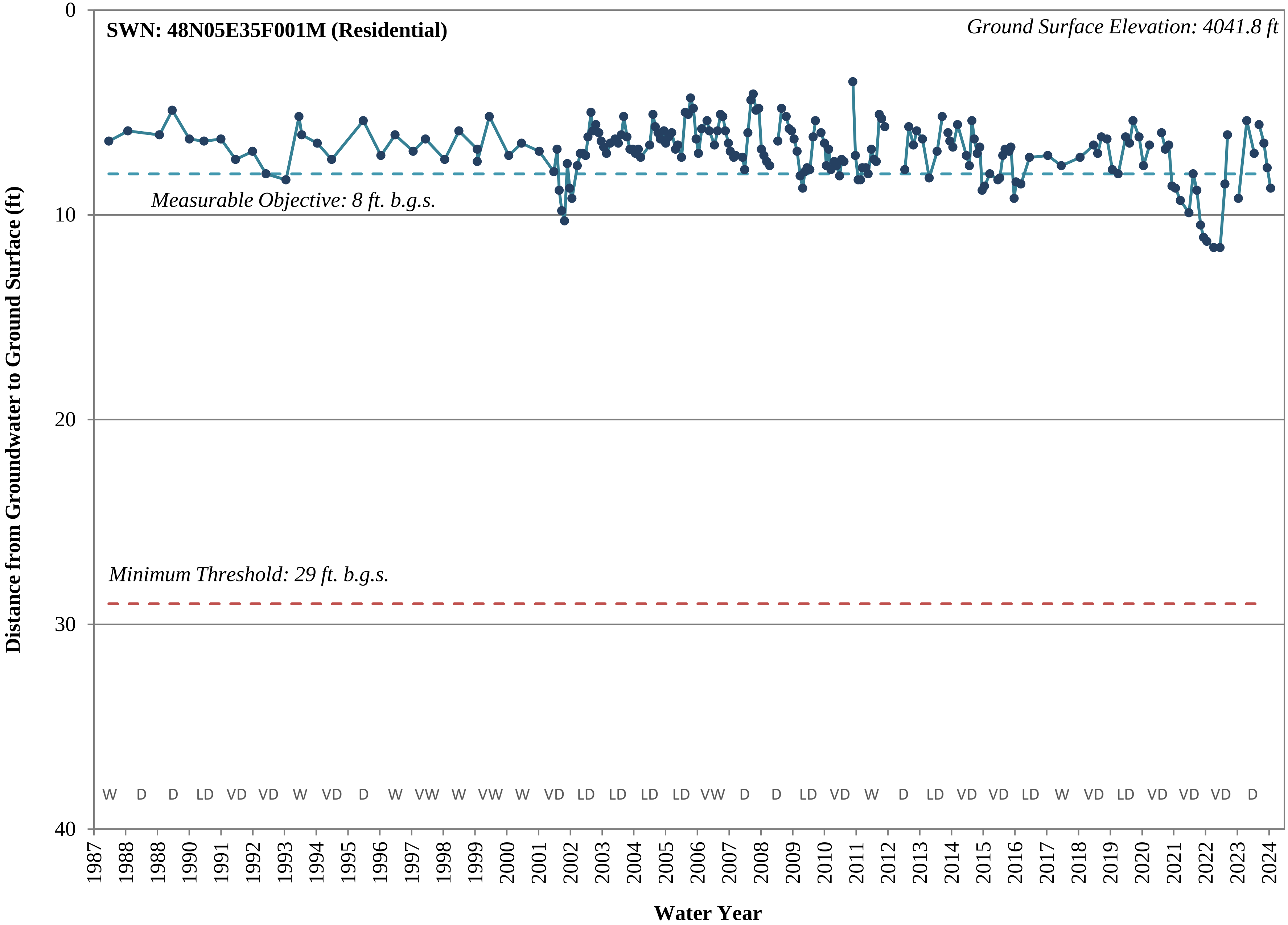
[93] https://water.ca.gov/Programs/Groundwater-Management/Drinking-Water-Well.


SWN: 48N05E35F001M (Residential)
Ground Surface Elevation: 4041.8 ft
Measurable Objective: 8 ft. b.g.s.
Minimum Threshold: 29 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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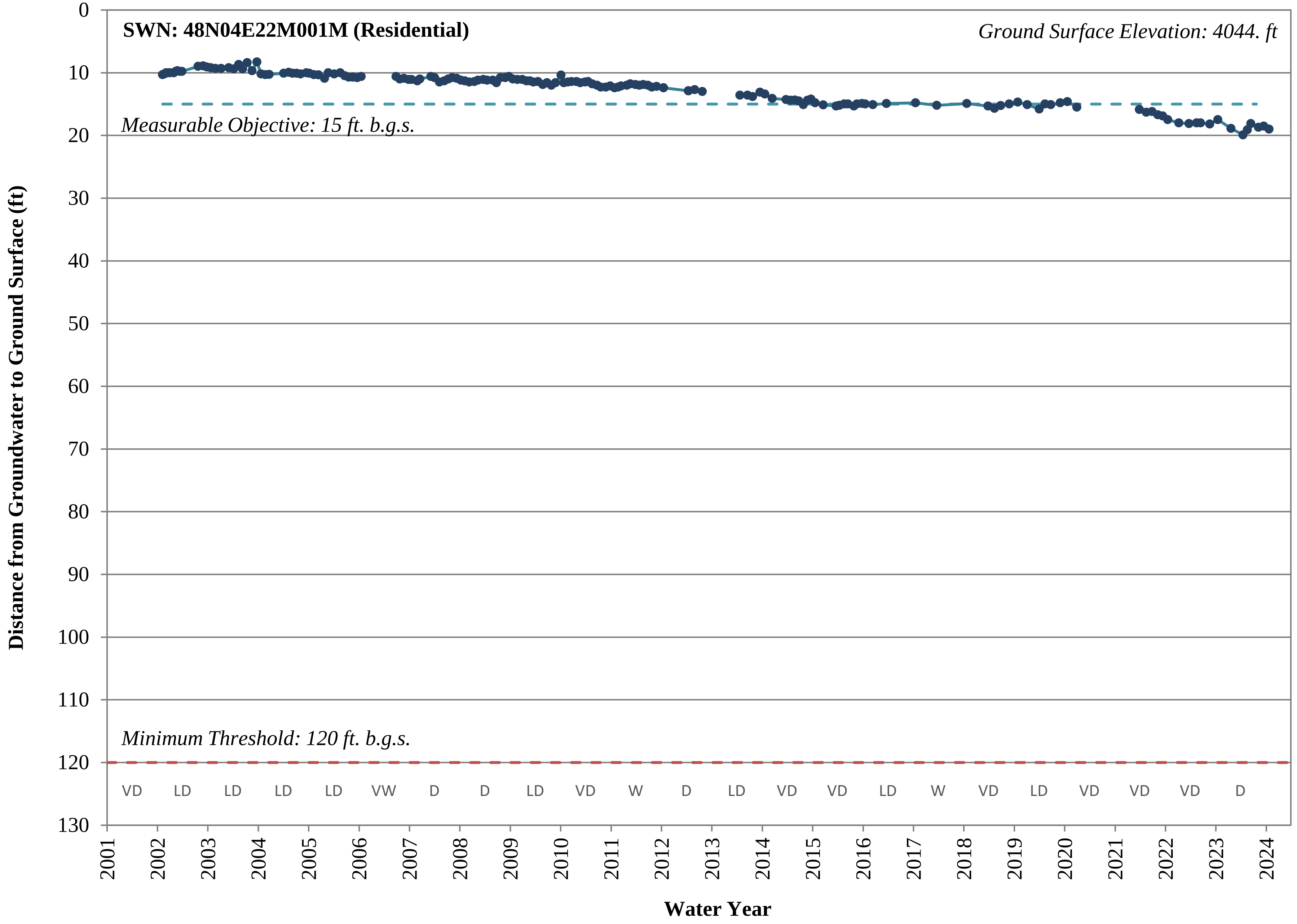
Water Year


SWN: 48N04E22M001M (Residential)
Ground Surface Elevation: 4044. ft
Measurable Objective: 15 ft. b.g.s.
Minimum Threshold: 120 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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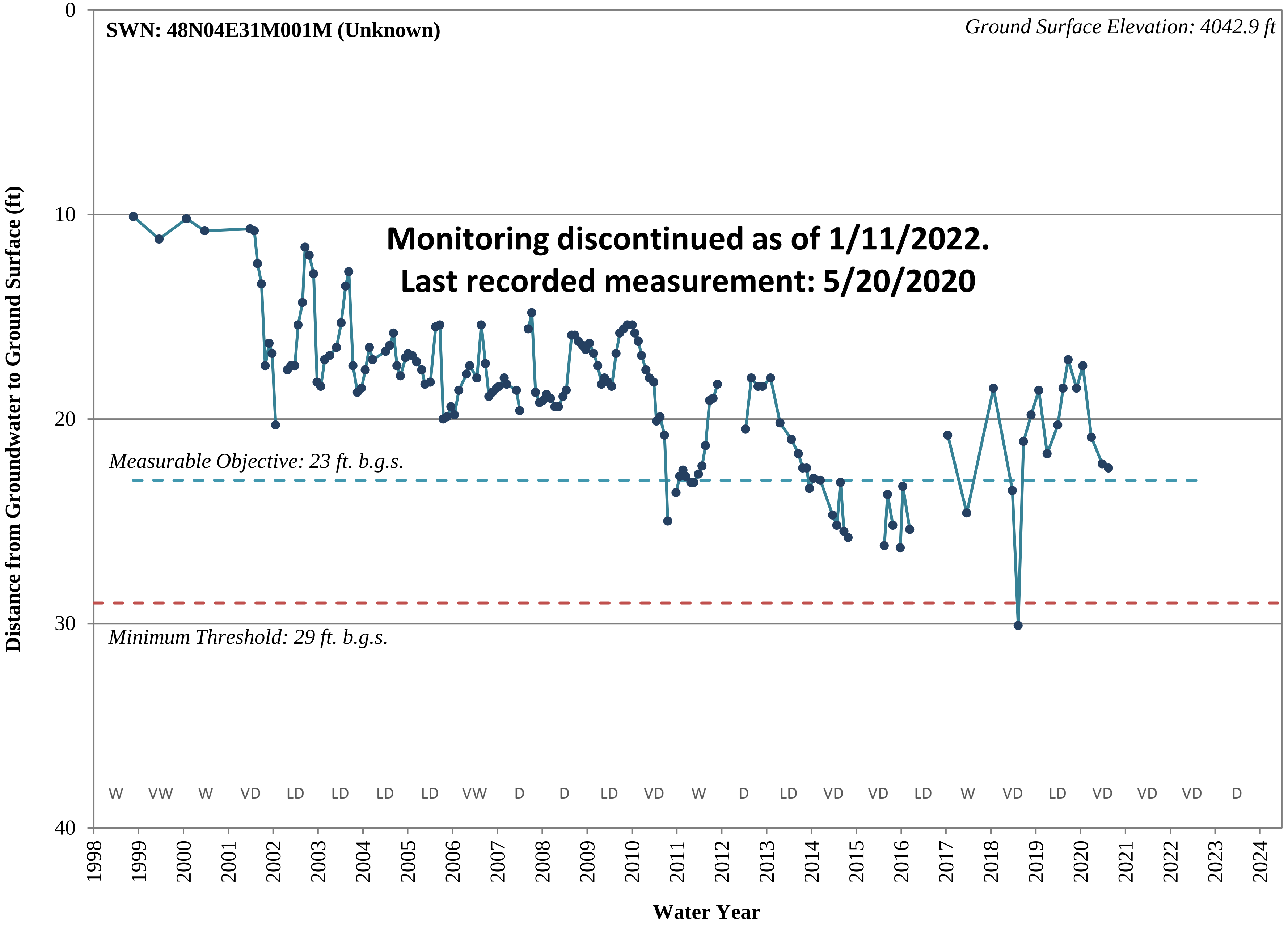
SWN: 48N04E31M001M (Unknown)
Ground Surface Elevation: 4042.9 ft
Monitoring discontinued as of 1/11/2022.
Last recorded measurement: 5/20/2020
Measurable Objective: 23 ft. b.g.s.
Minimum Threshold: 29 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
0
10
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30
40
W VW W VD LD LD LD LD VW D D LD VD W D LD VD VD LD W VD LD VD VD VD D
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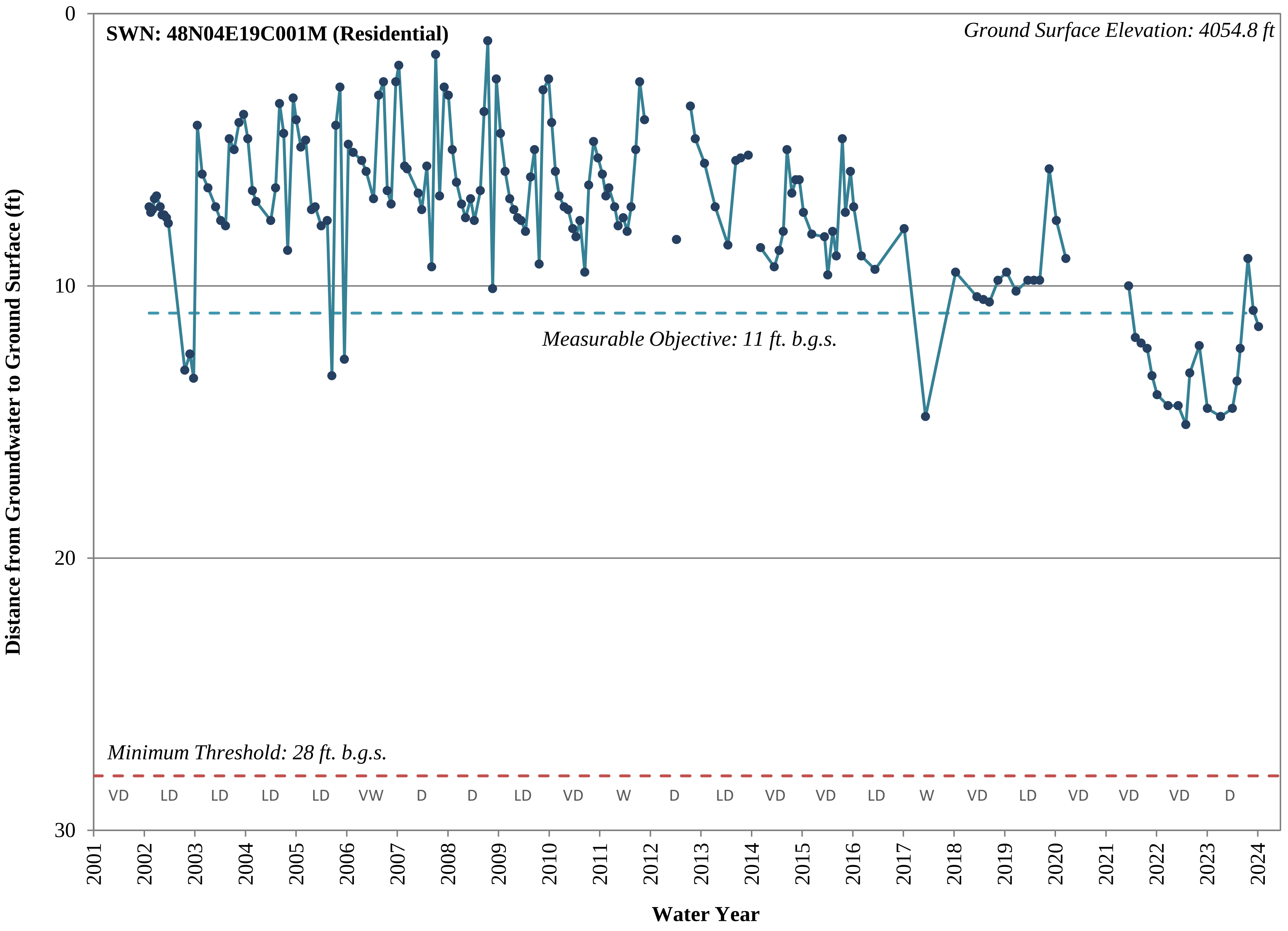
SWN: 48N04E19C001M (Residential)
Ground Surface Elevation: 4054.8 ft
Measurable Objective: 11 ft. b.g.s.
Minimum Threshold: 28 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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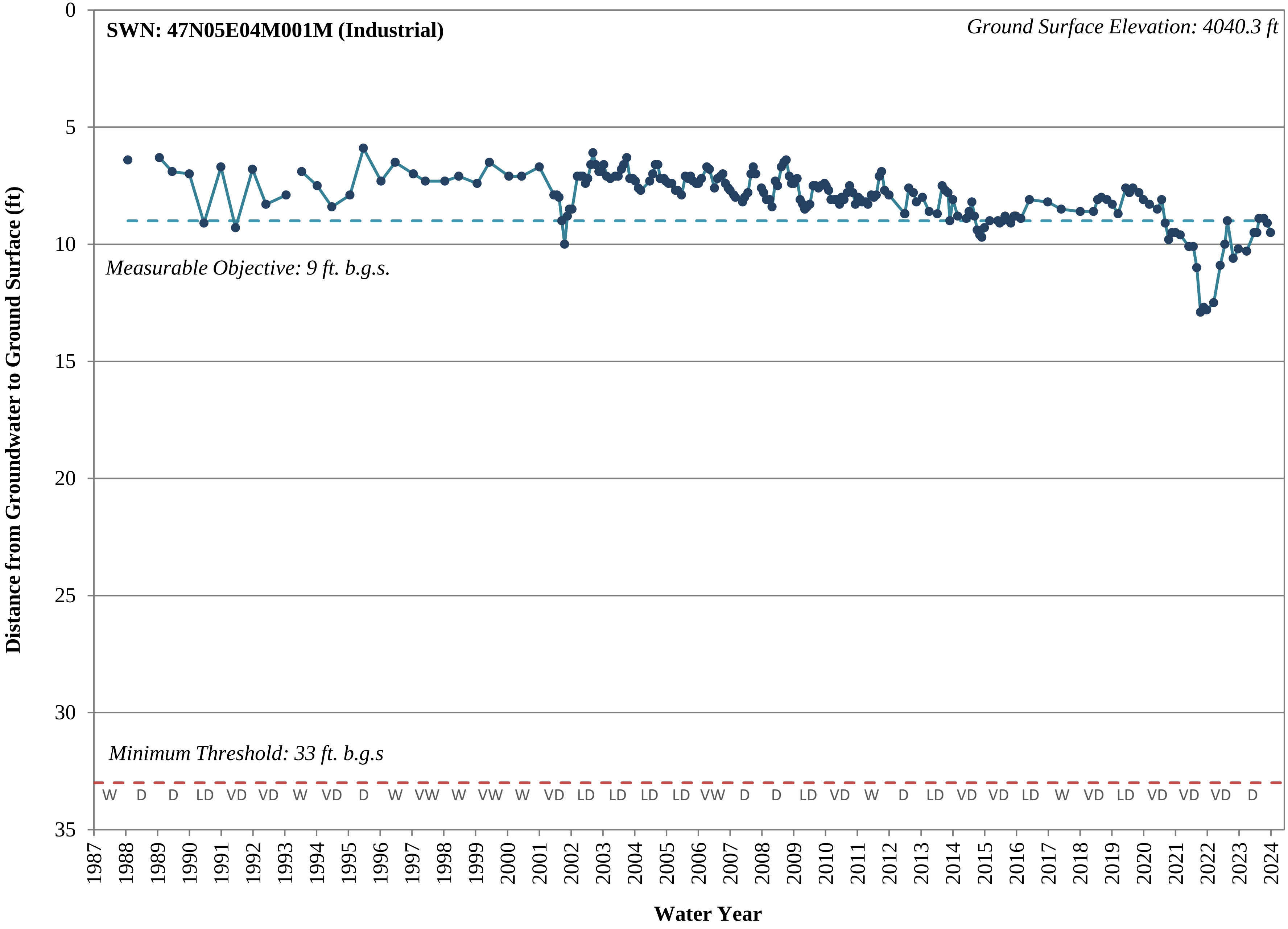
SWN: 47N05E04M001M (Industrial)
Ground Surface Elevation: 4040.3 ft
Measurable Objective: 9 ft. b.g.s.
Minimum Threshold: 33 ft. b.g.s
Distance from Groundwater to Ground Surface (ft)
0
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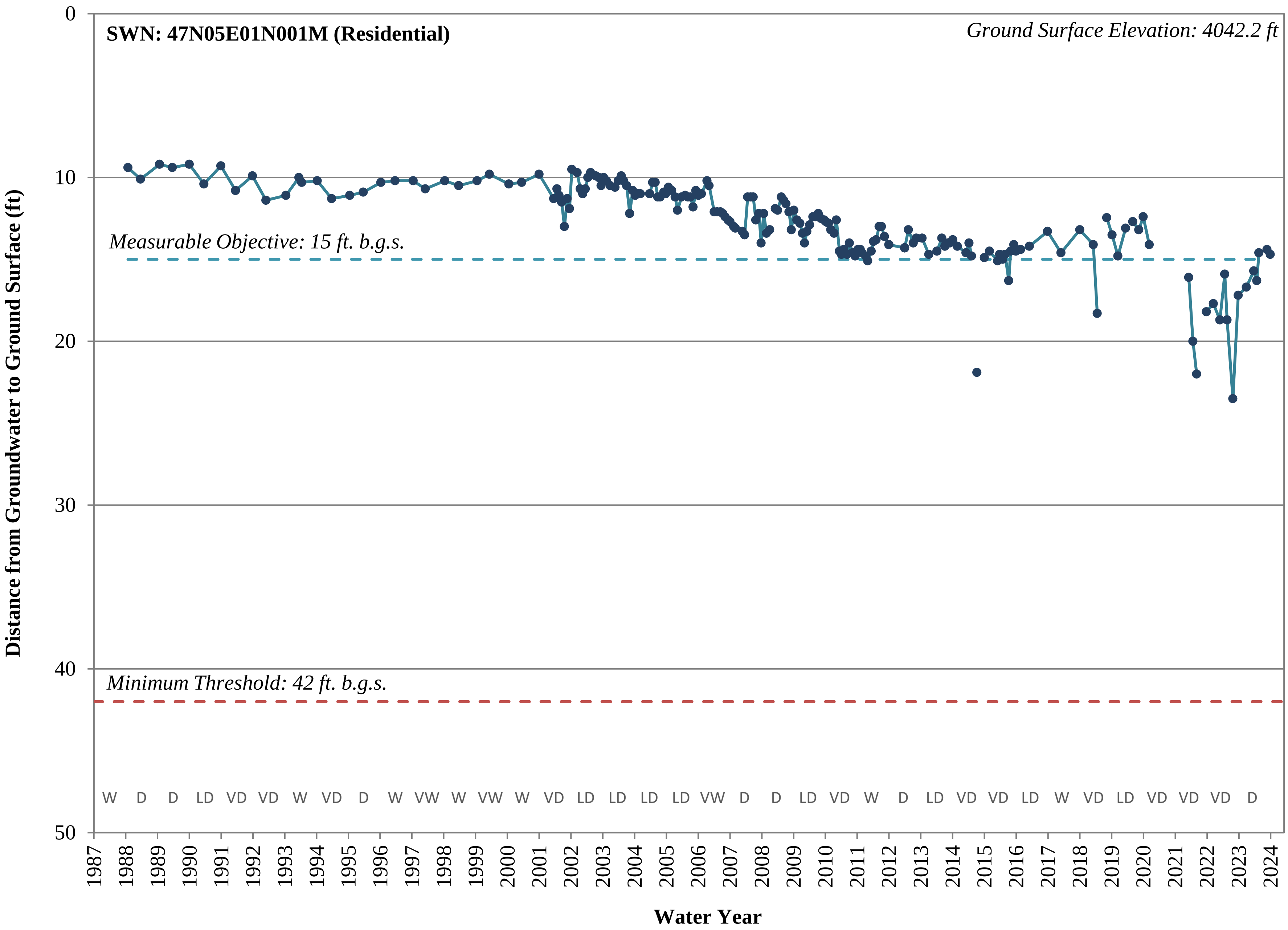
SWN: 47N05E01N001M (Residential)
Ground Surface Elevation: 4042.2 ft
Measurable Objective: 15 ft. b.g.s.
Minimum Threshold: 42 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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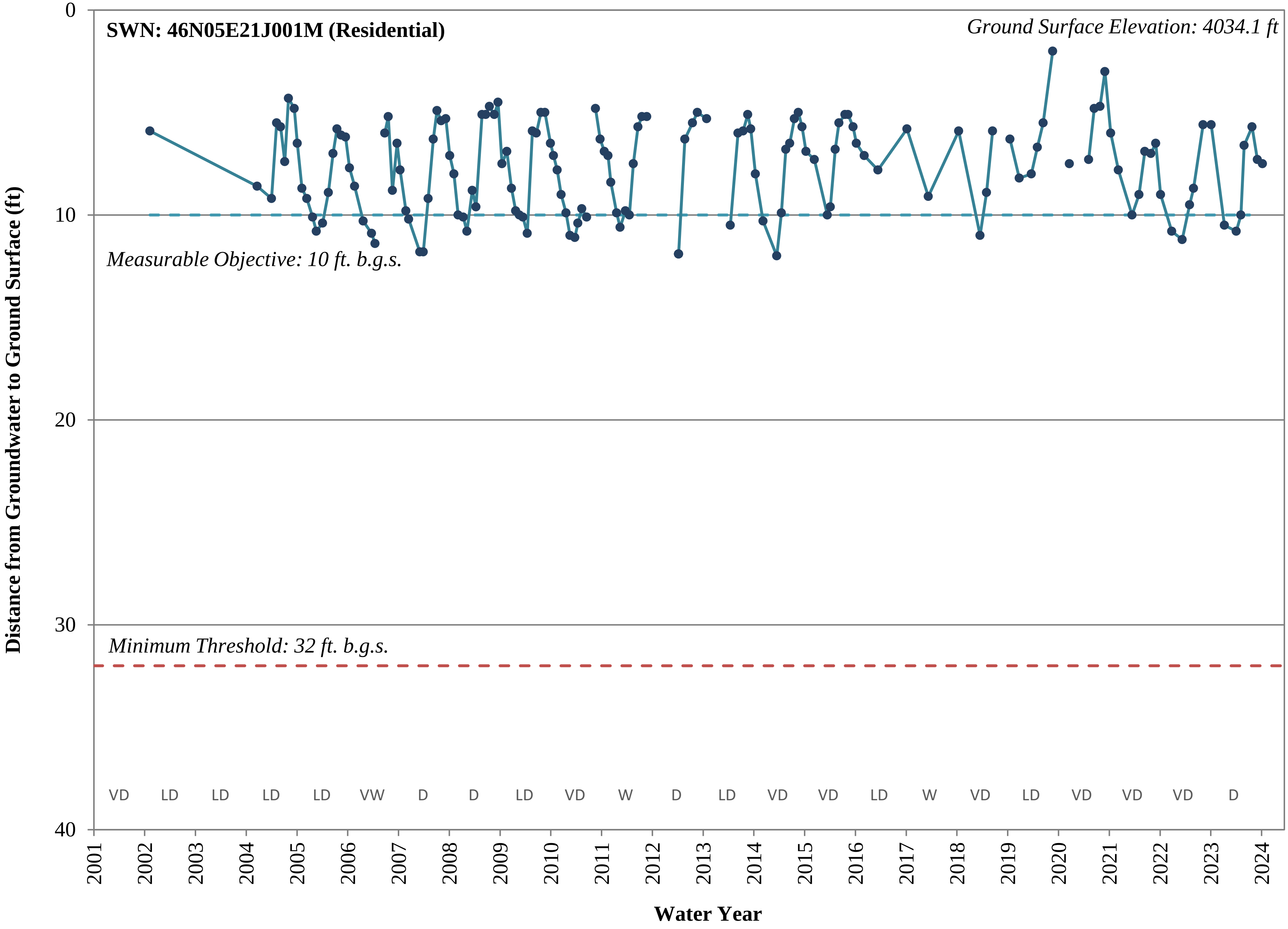
SWN: 46N05E21J001M (Residential)
Ground Surface Elevation: 4034.1 ft
Measurable Objective: 10 ft. b.g.s.
Minimum Threshold: 32 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
0
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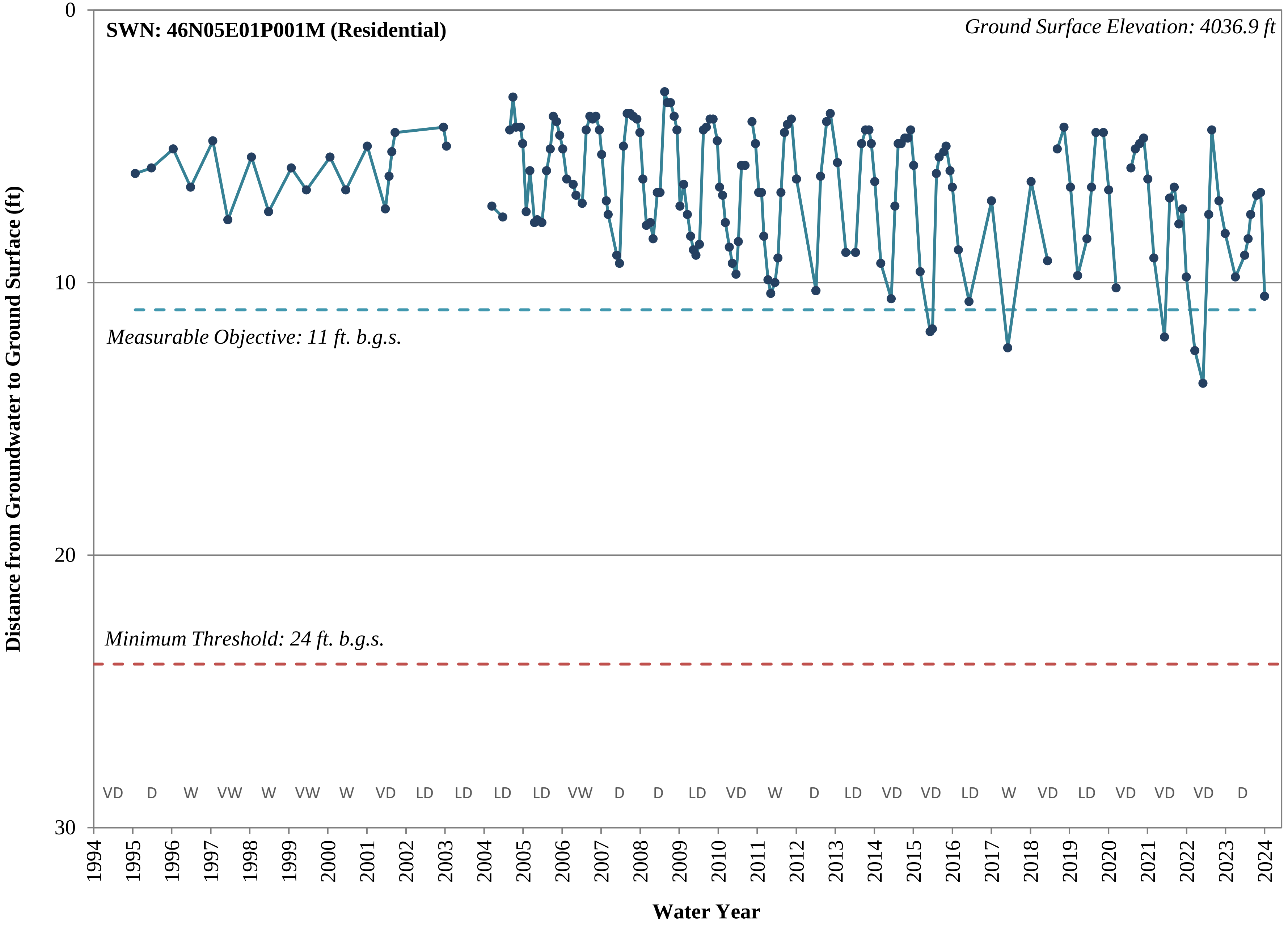
Water Year


SWN: 46N05E01P001M (Residential)
Ground Surface Elevation: 4036.9 ft
Distance from Groundwater to Ground Surface (ft)
0
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Measurable Objective: 11 ft. b.g.s.
Minimum Threshold: 24 ft. b.g.s.
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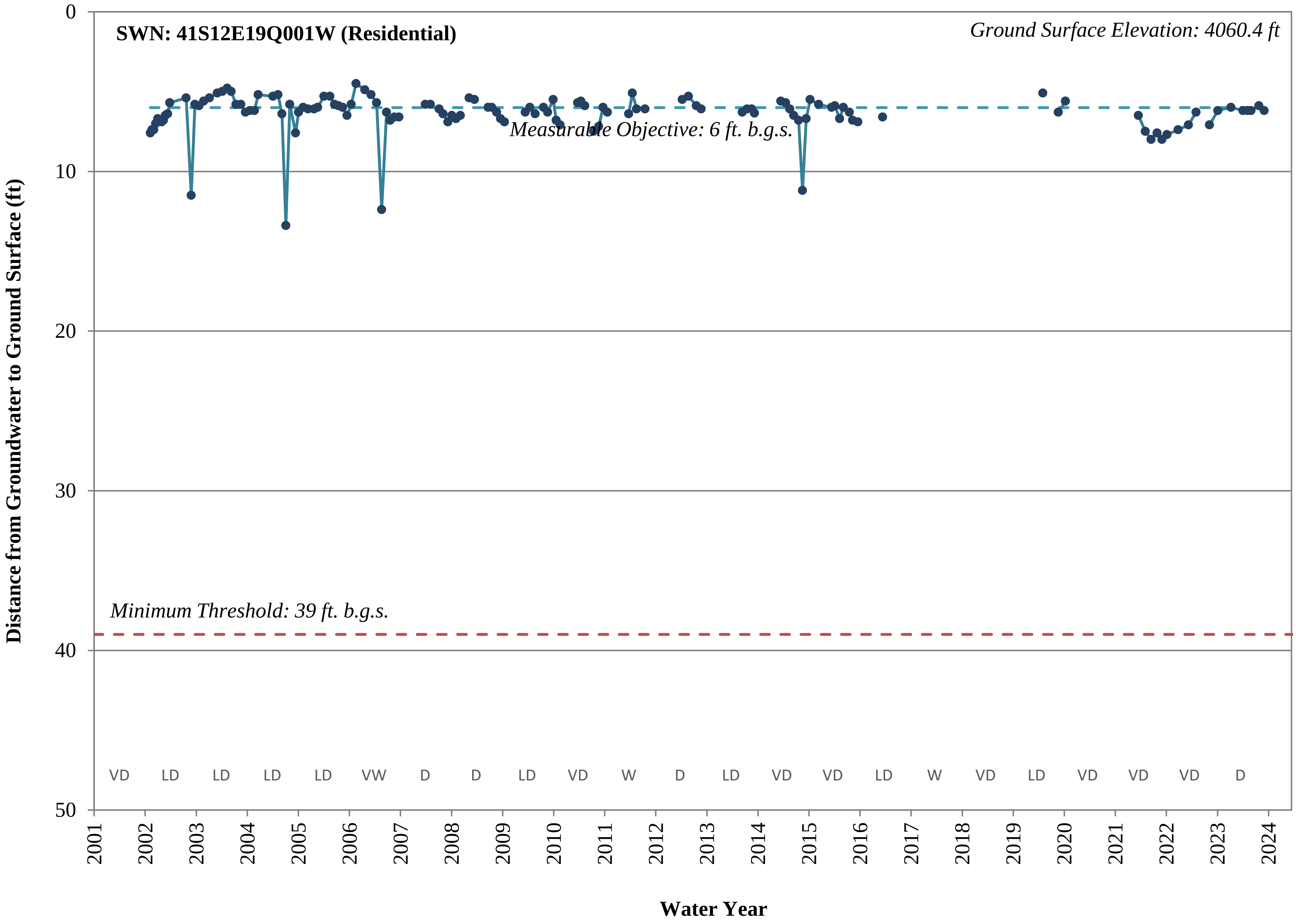
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024
Water Year


SWN: 41S12E19Q001W (Residential)
Ground Surface Elevation: 4060.4 ft
Measurable Objective: 6 ft. b.g.s.
Minimum Threshold: 39 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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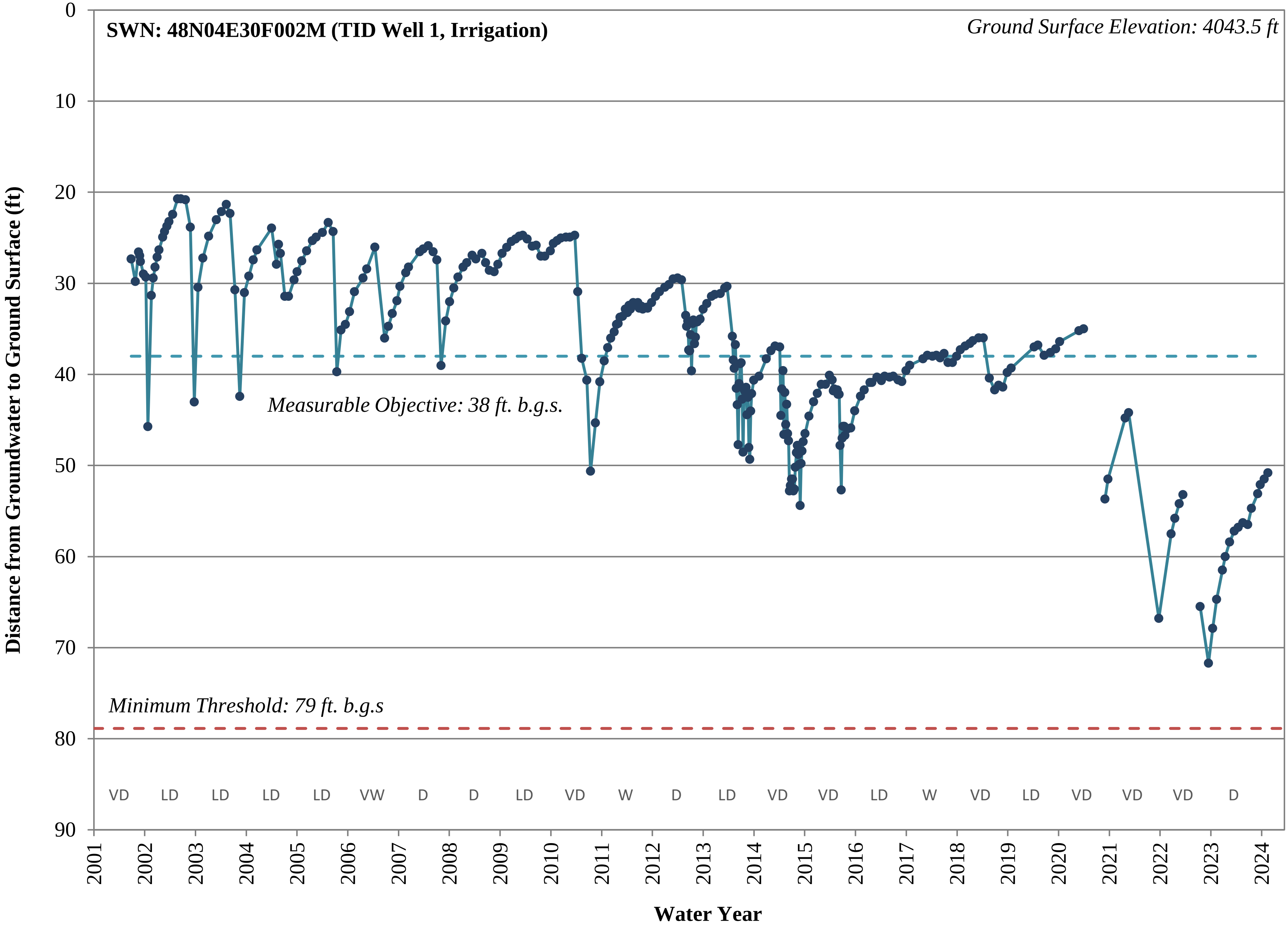
Water Year


SWN: 48N04E30F002M (TID Well 1, Irrigation)
Ground Surface Elevation: 4043.5 ft
Measurable Objective: 38 ft. b.g.s.
Minimum Threshold: 79 ft. b.g.s
Distance from Groundwater to Ground Surface (ft)
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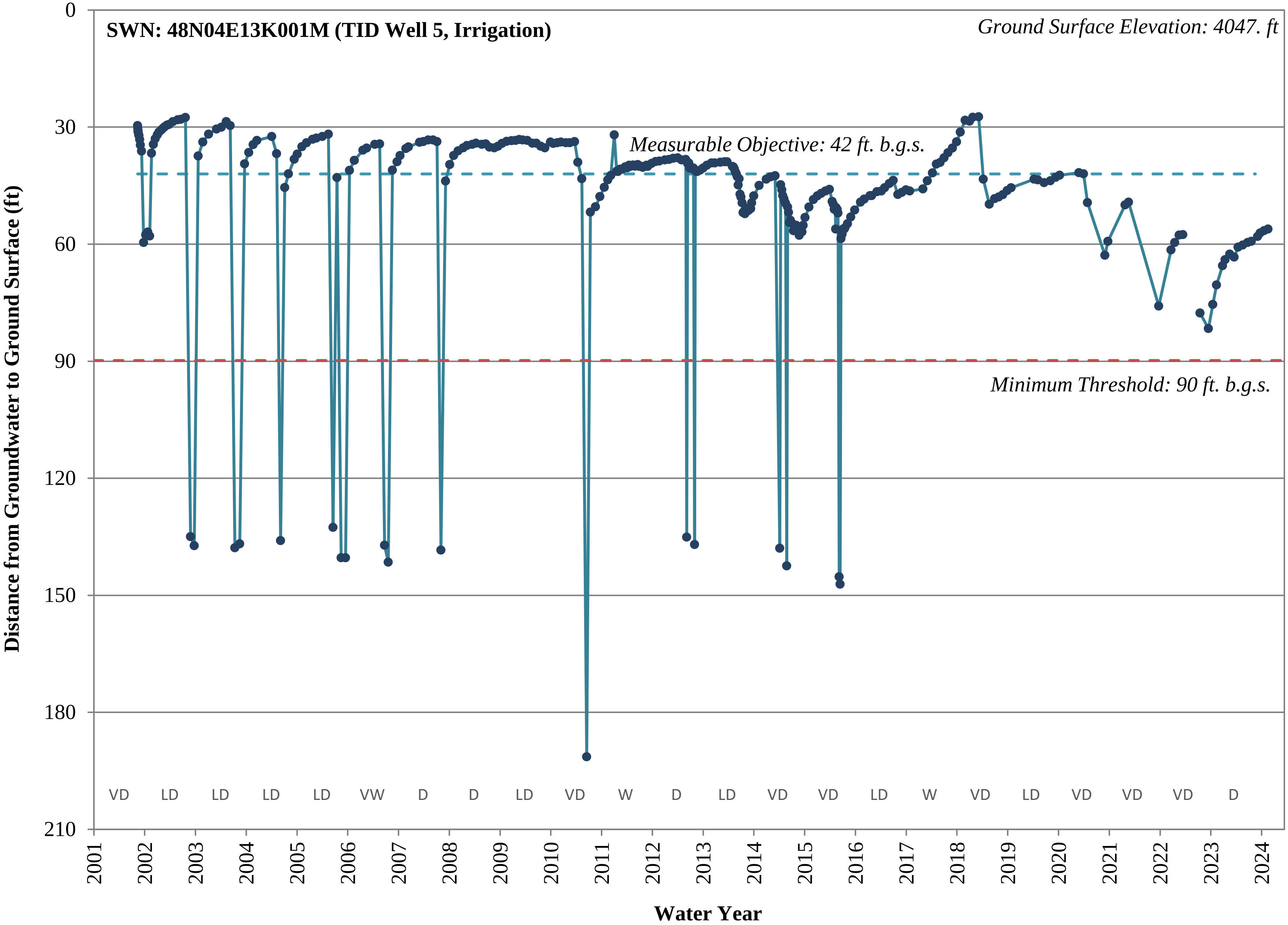
SWN: 48N04E13K001M (TID Well 5, Irrigation)
Ground Surface Elevation: 4047. ft
Measurable Objective: 42 ft. b.g.s.
Minimum Threshold: 90 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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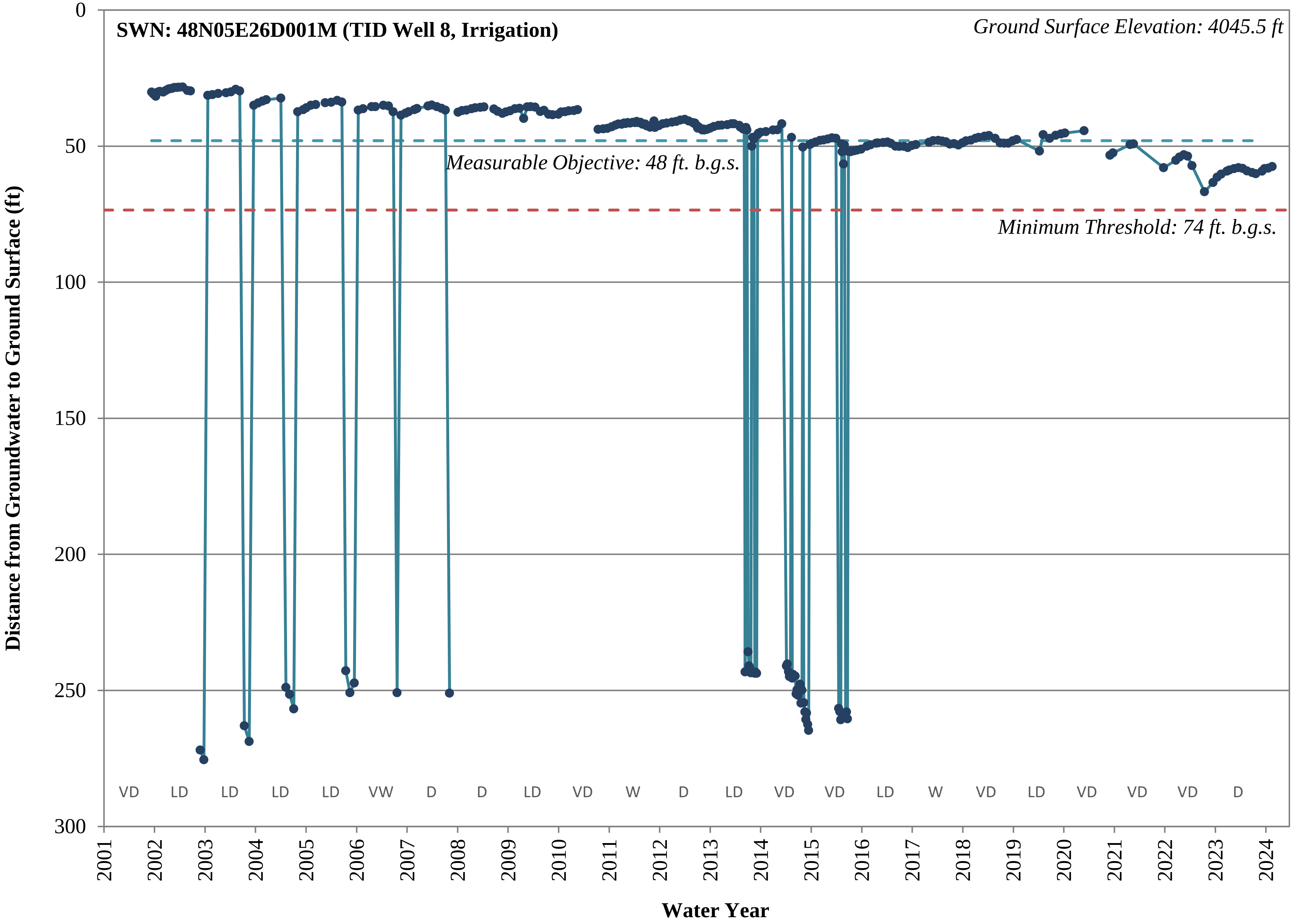
SWN: 48N05E26D001M (TID Well 8, Irrigation)
Ground Surface Elevation: 4045.5 ft
Measurable Objective: 48 ft. b.g.s.
Minimum Threshold: 74 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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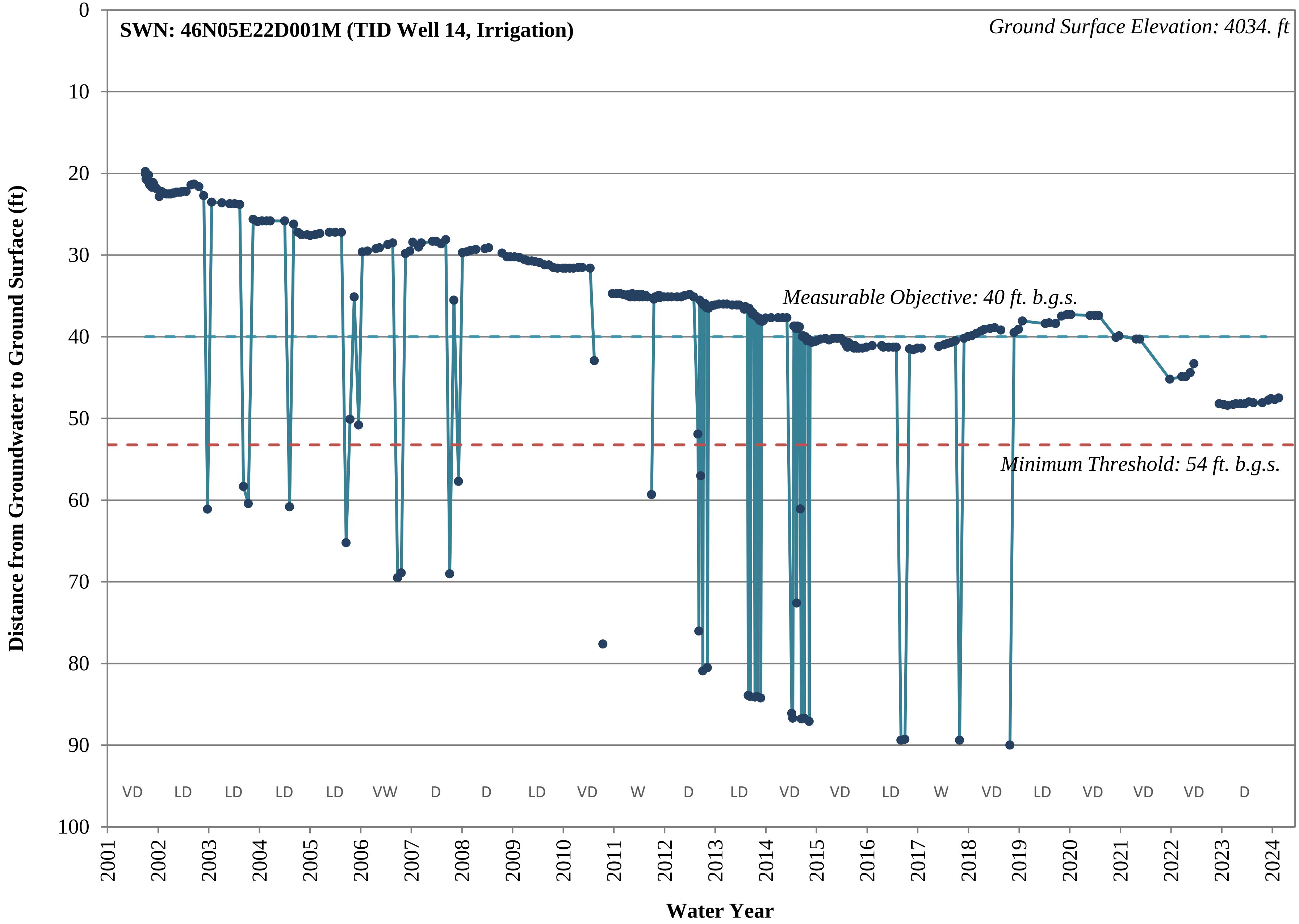
Water Year



SWN: 46N05E22D001M (TID Well 14, Irrigation)
Ground Surface Elevation: 4034. ft
Measurable Objective: 40 ft. b.g.s.
Minimum Threshold: 54 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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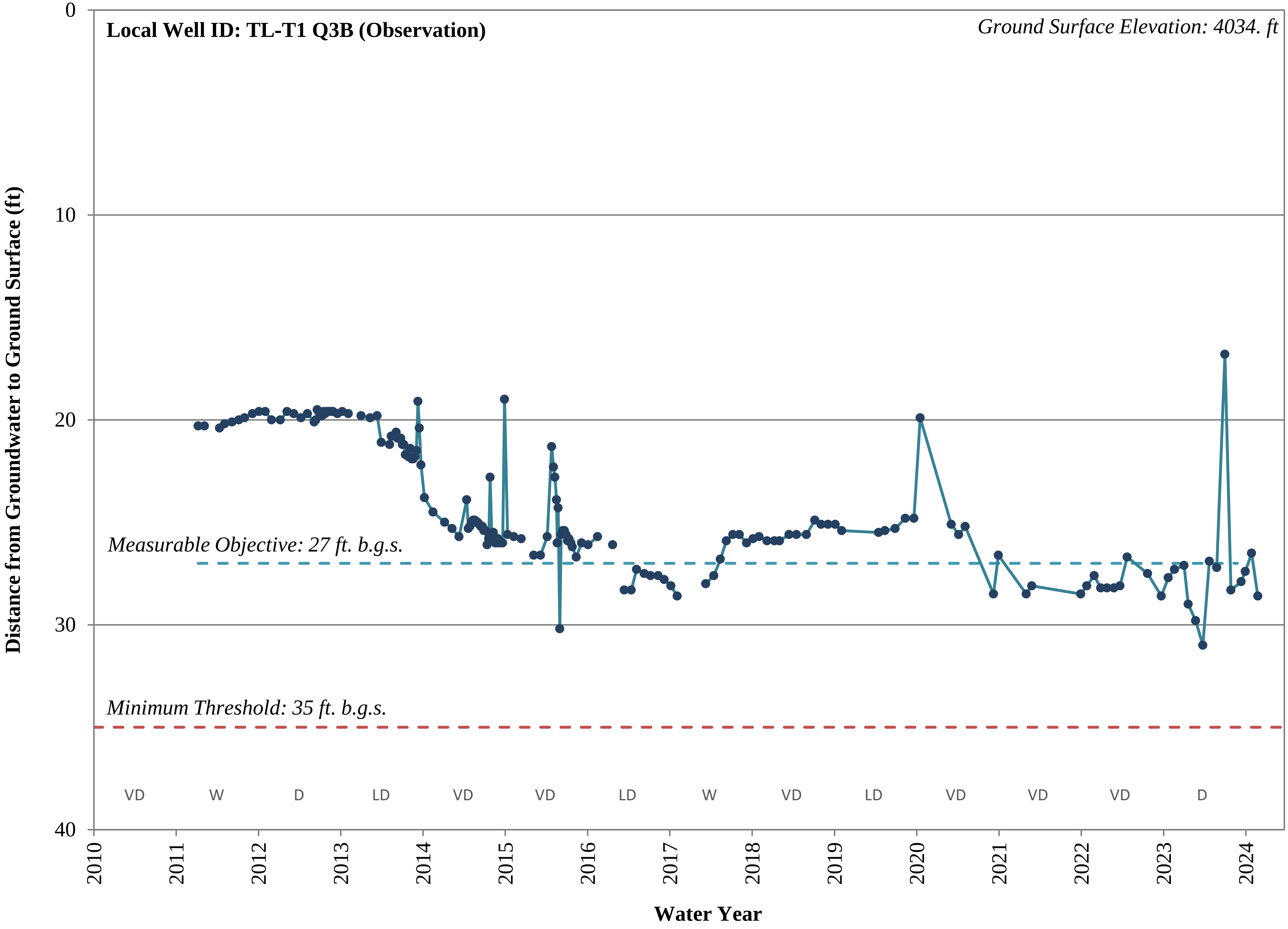
Local Well ID: TL-T1 Q3B (Observation)
Ground Surface Elevation: 4034. ft
Measurable Objective: 27 ft. b.g.s.
Minimum Threshold: 35 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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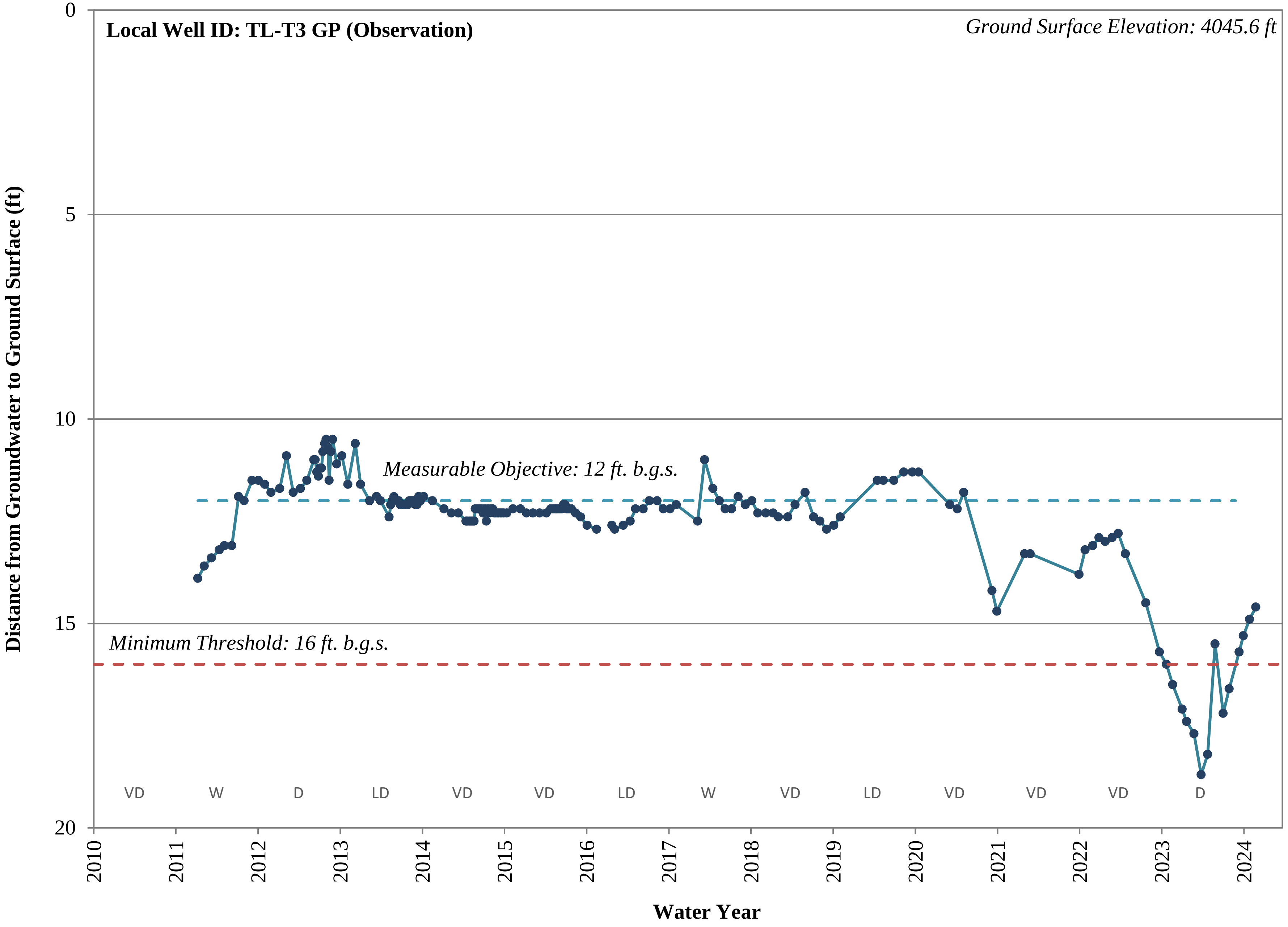
Local Well ID: TL-T3 GP (Observation)
Ground Surface Elevation: 4045.6 ft
Measurable Objective: 12 ft. b.g.s.
Minimum Threshold: 16 ft. b.g.s.
Distance from Groundwater to Ground Surface (ft)
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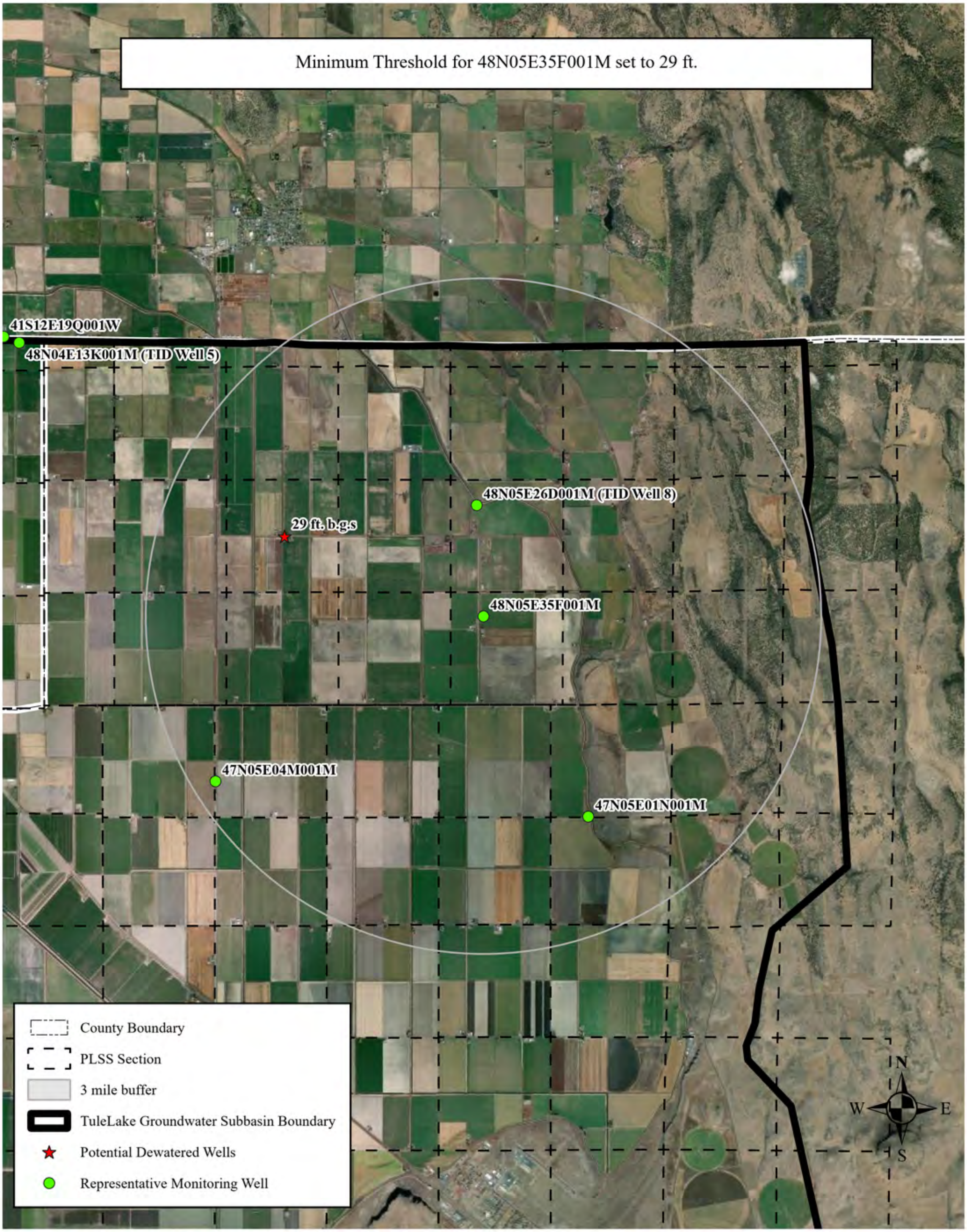
Water Year

Minimum Threshold for 48N05E35F001M set to 29 ft.

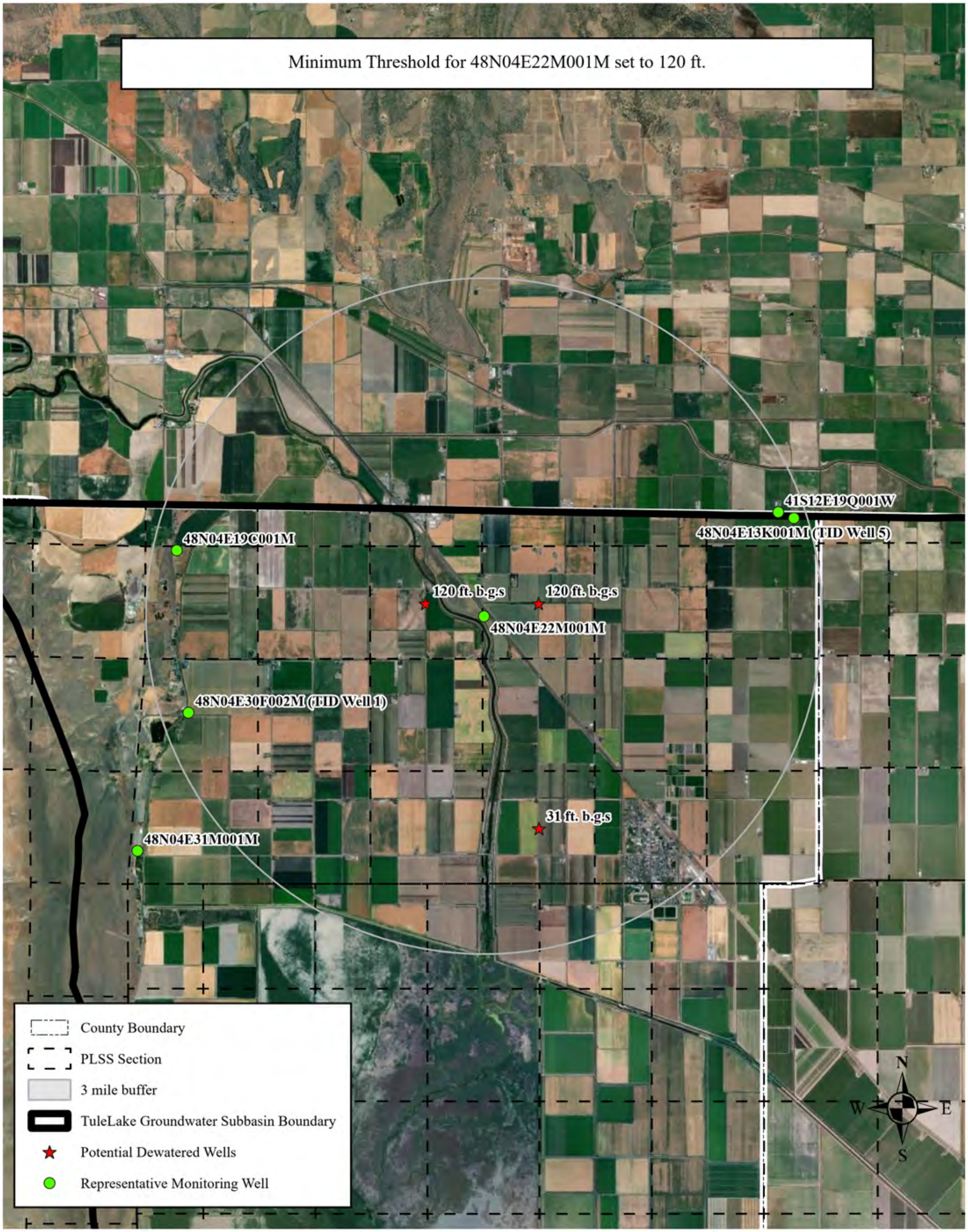


MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well 48N05E35F001M

0 ½ 1 Mi

1 of 15


Minimum Threshold for 48N04E22M001M set to 120 ft.

MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well

48N04E22M001M

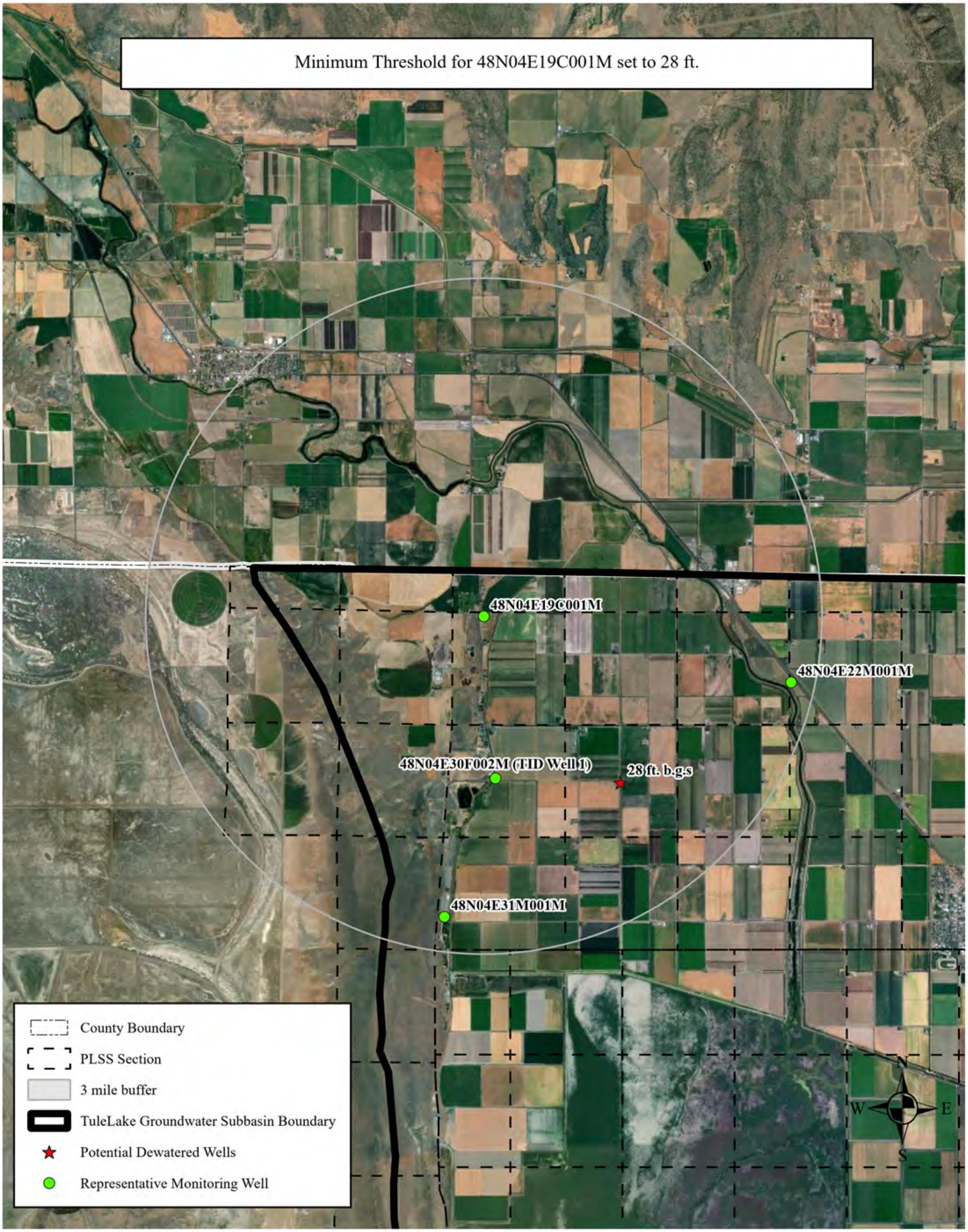
0 ½ 1 Mi


Minimum Threshold for 48N04E31M001M set to 29 ft.

MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well 48N04E31M001M

0 ½ 1 Mi



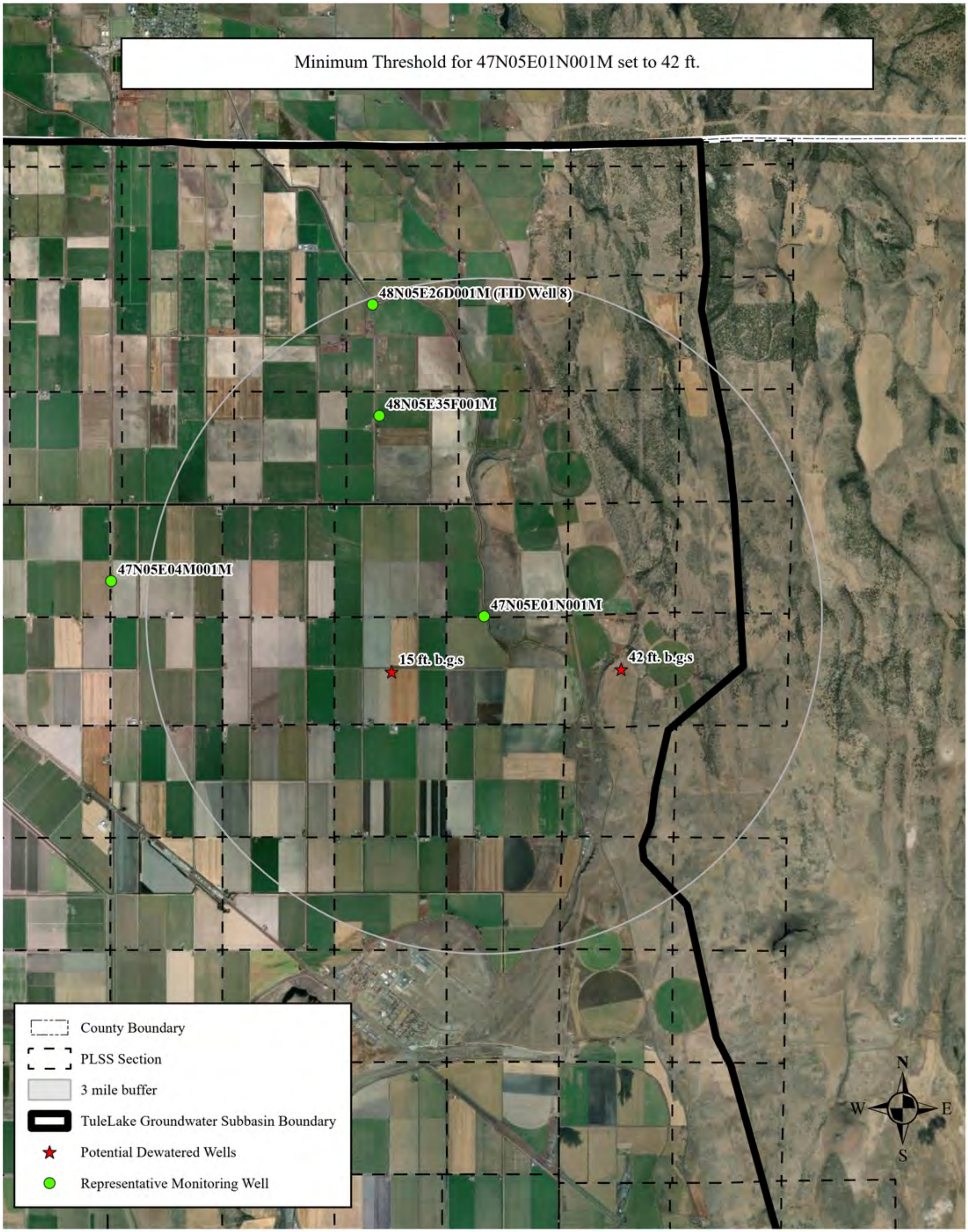
MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well
48N04E19C001M

0 ½ 1 Mi

Location of potential dewatered wells near representative monitoring well 47N05E04M001M

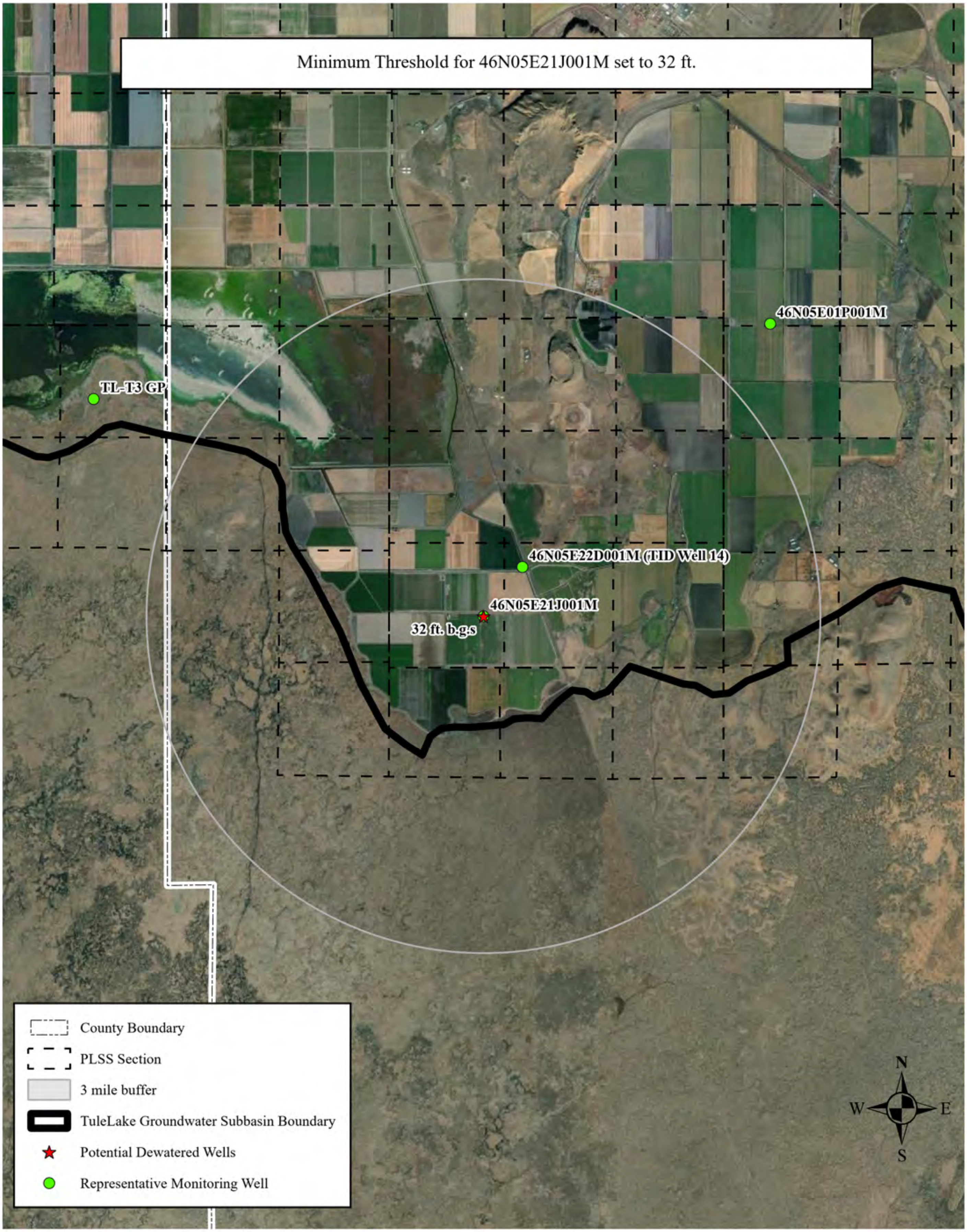
0 ½ 1 Mi



Minimum Threshold for 47N05E01N001M set to 42 ft.

Location of potential dewatered wells near representative monitoring well 47N05E01N001M

0 ½ 1 Mi



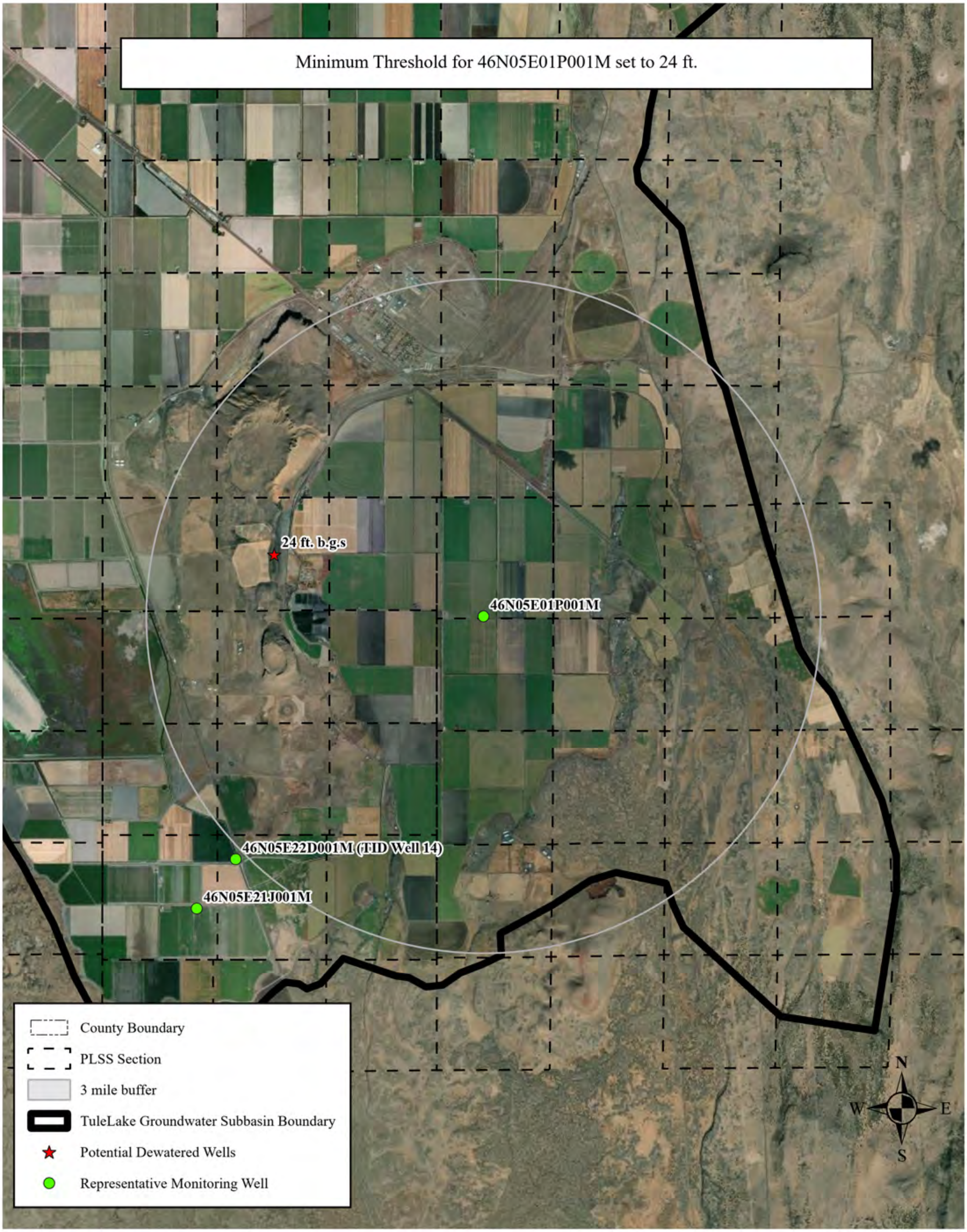
Minimum Threshold for 46N05E21J001M set to 32 ft.

MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well 46N05E21J001M

0 ½ 1 Mi

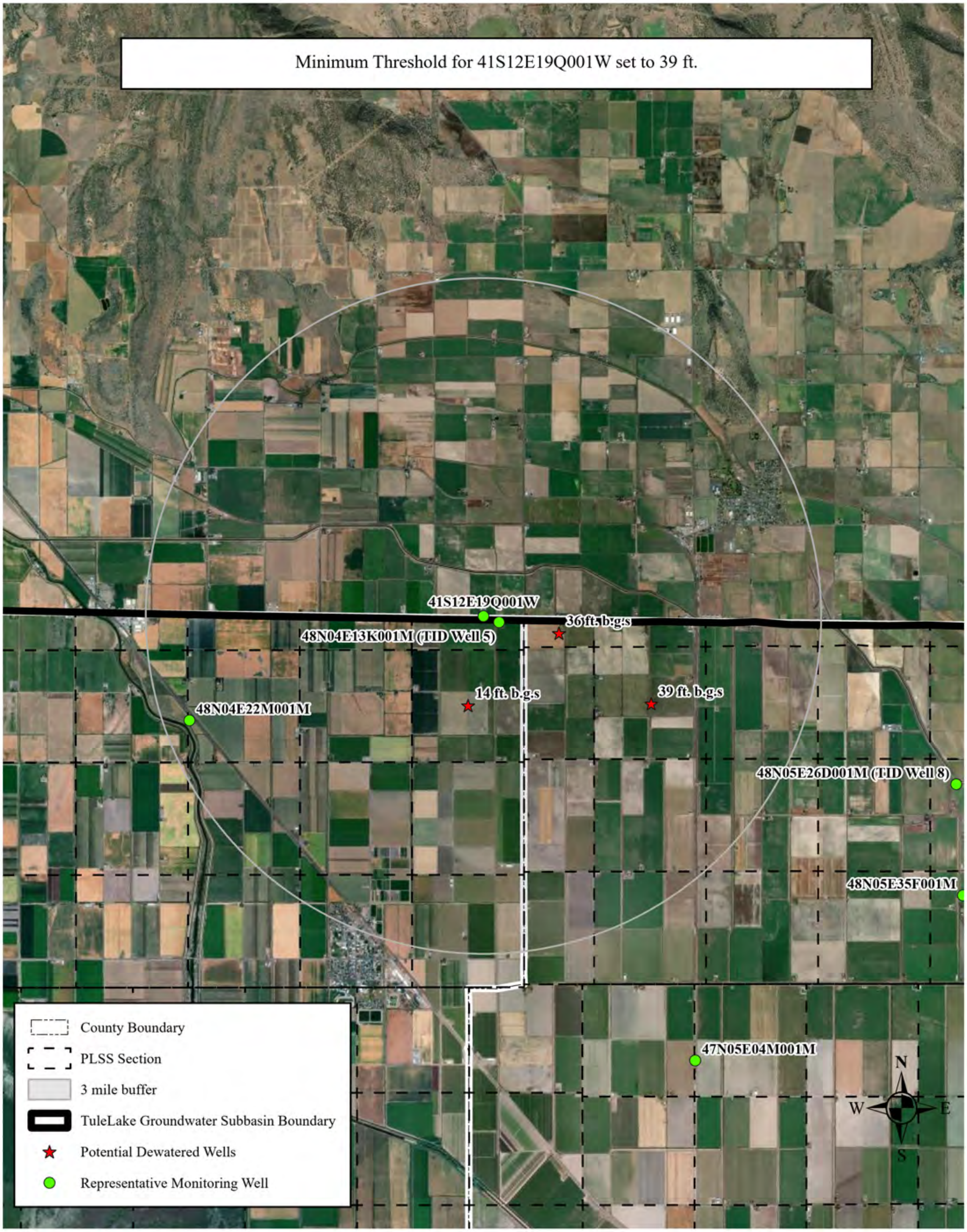
Minimum Threshold for 46N05E01P001M set to 24 ft.



MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well 46N05E01P001M

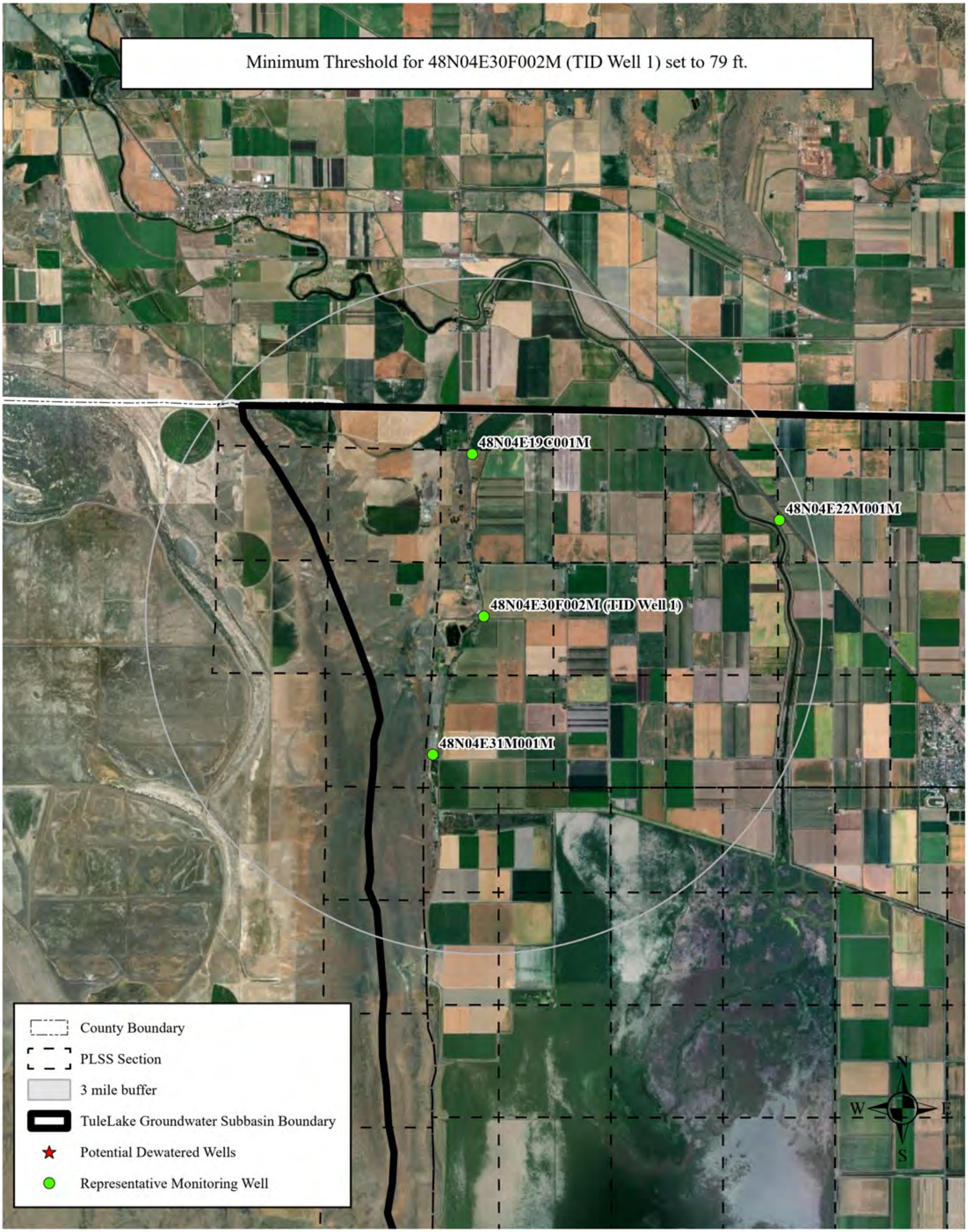
0 ½ 1 Mi



MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well 41S12E19Q001W

0 ½ 1 Mi

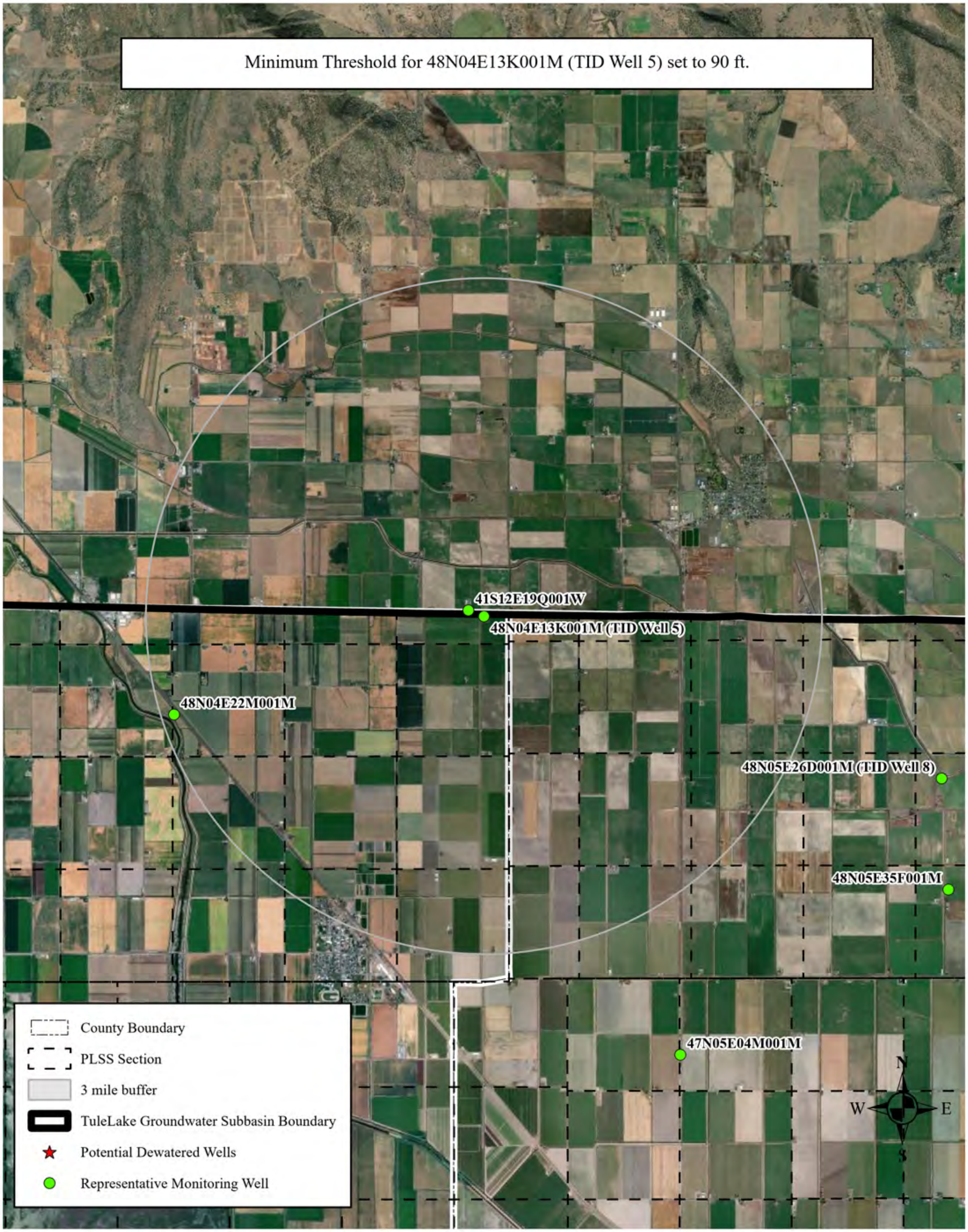


Minimum Threshold for 48N04E30F002M (TID Well 1) set to 79 ft.

MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well 48N04E30F002M (TID Well 1)

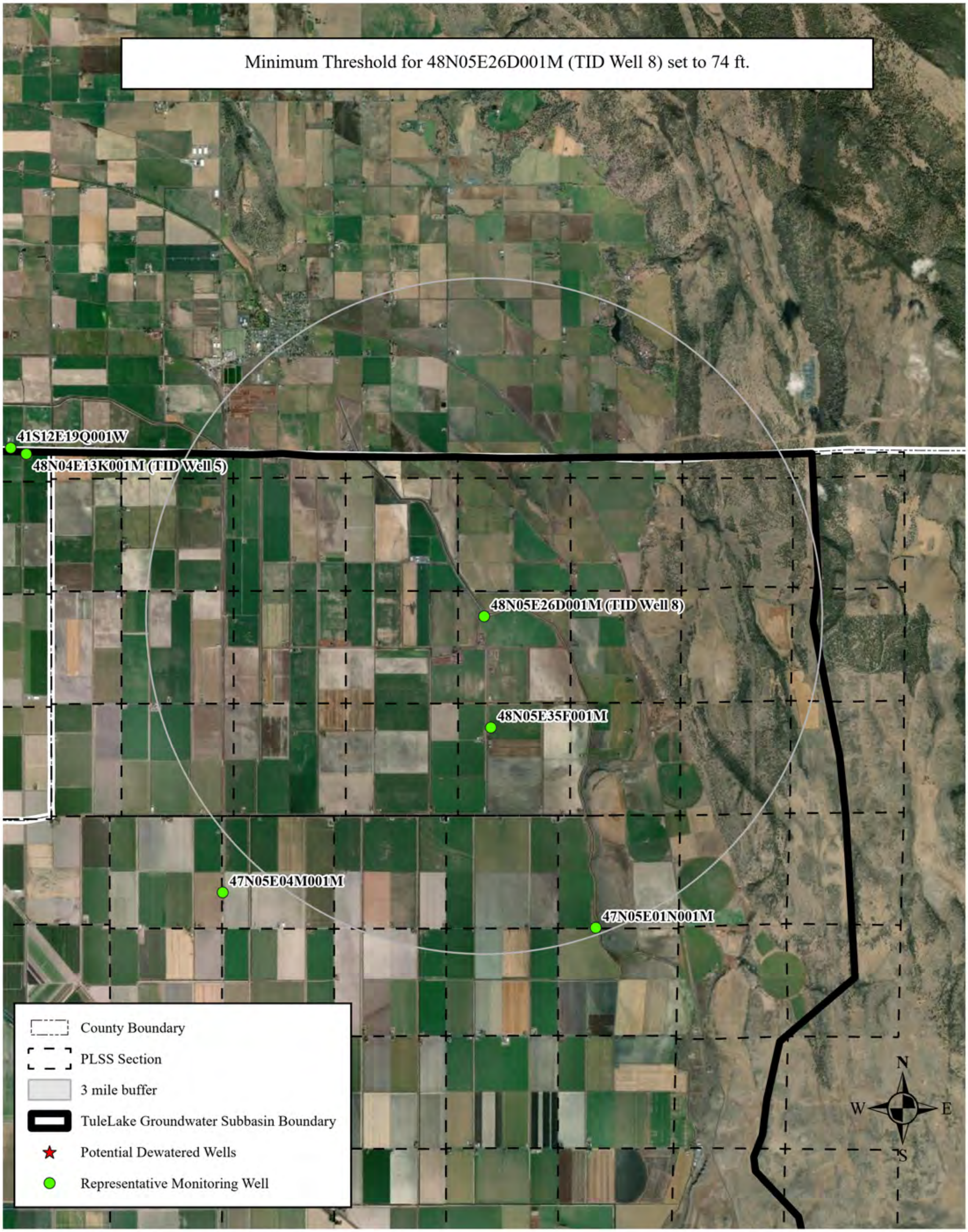
0 ½ 1 Mi



MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well 48N04E13K001M (TID Well 5)

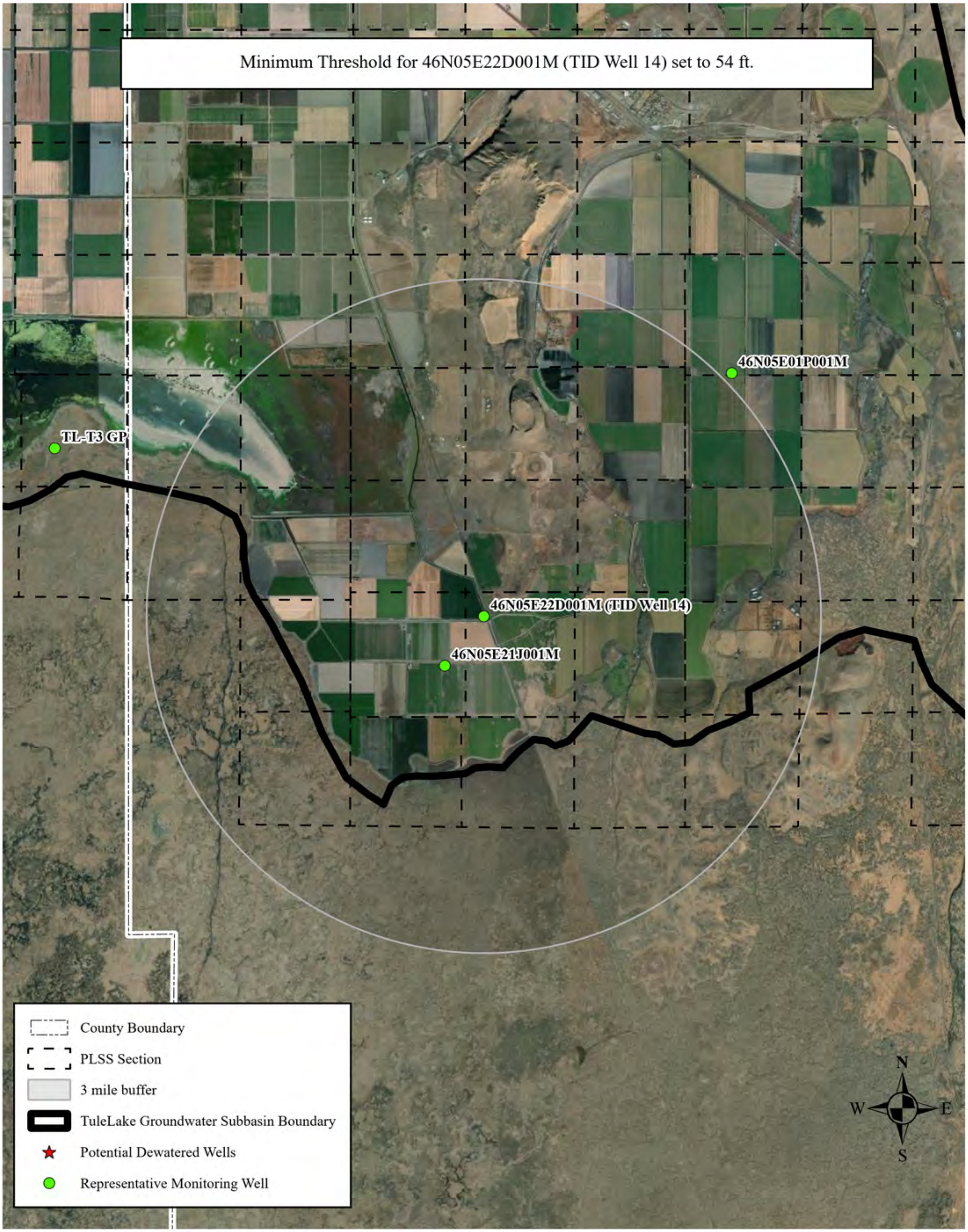
0 ½ 1 Mi


Minimum Threshold for 48N05E26D001M (TID Well 8) set to 74 ft.

MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well
48N05E26D001M (TID Well 8)

0 ½ 1 Mi

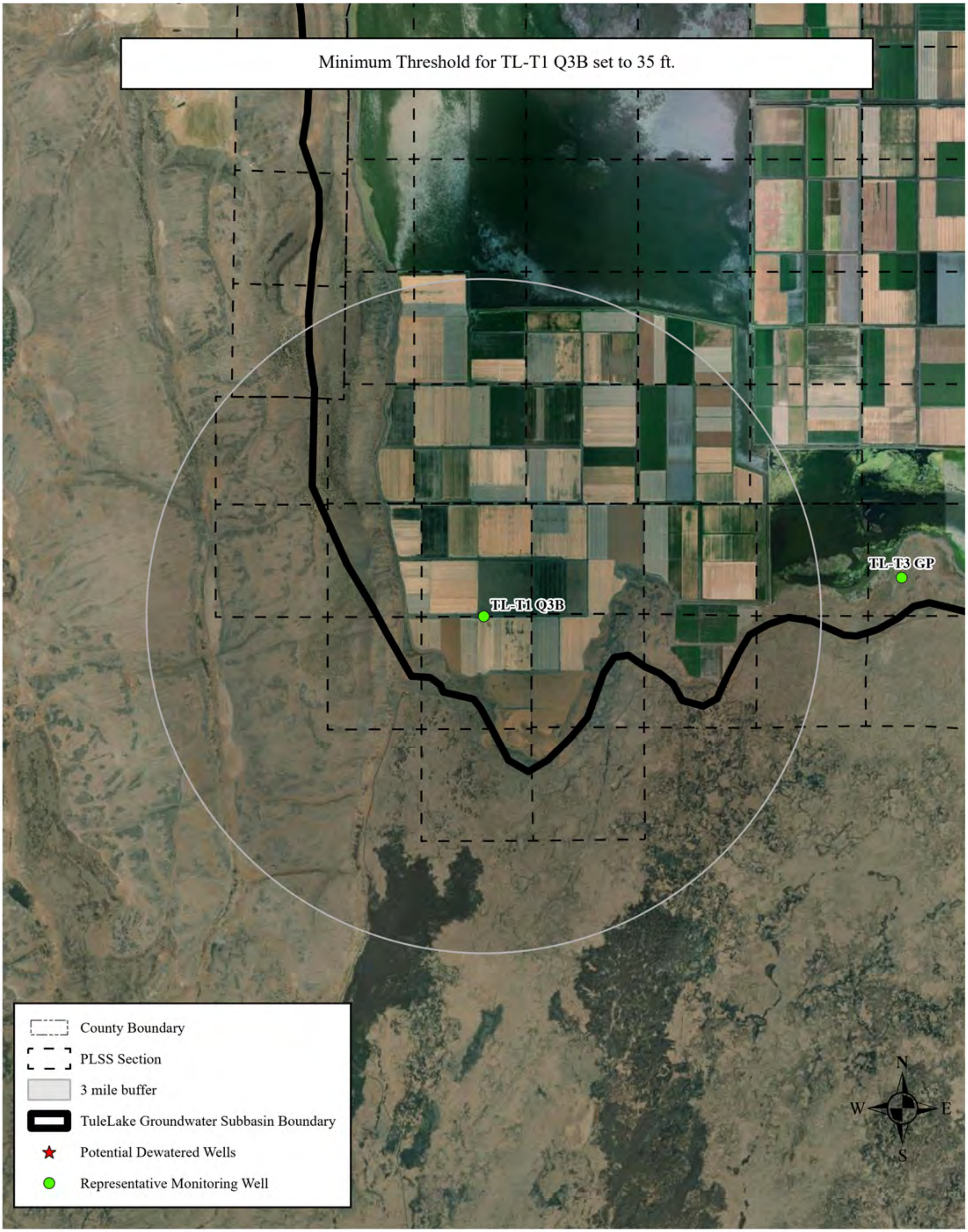


MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well

46N05E22D001M (TID Well 14)

0 ½ 1 Mi

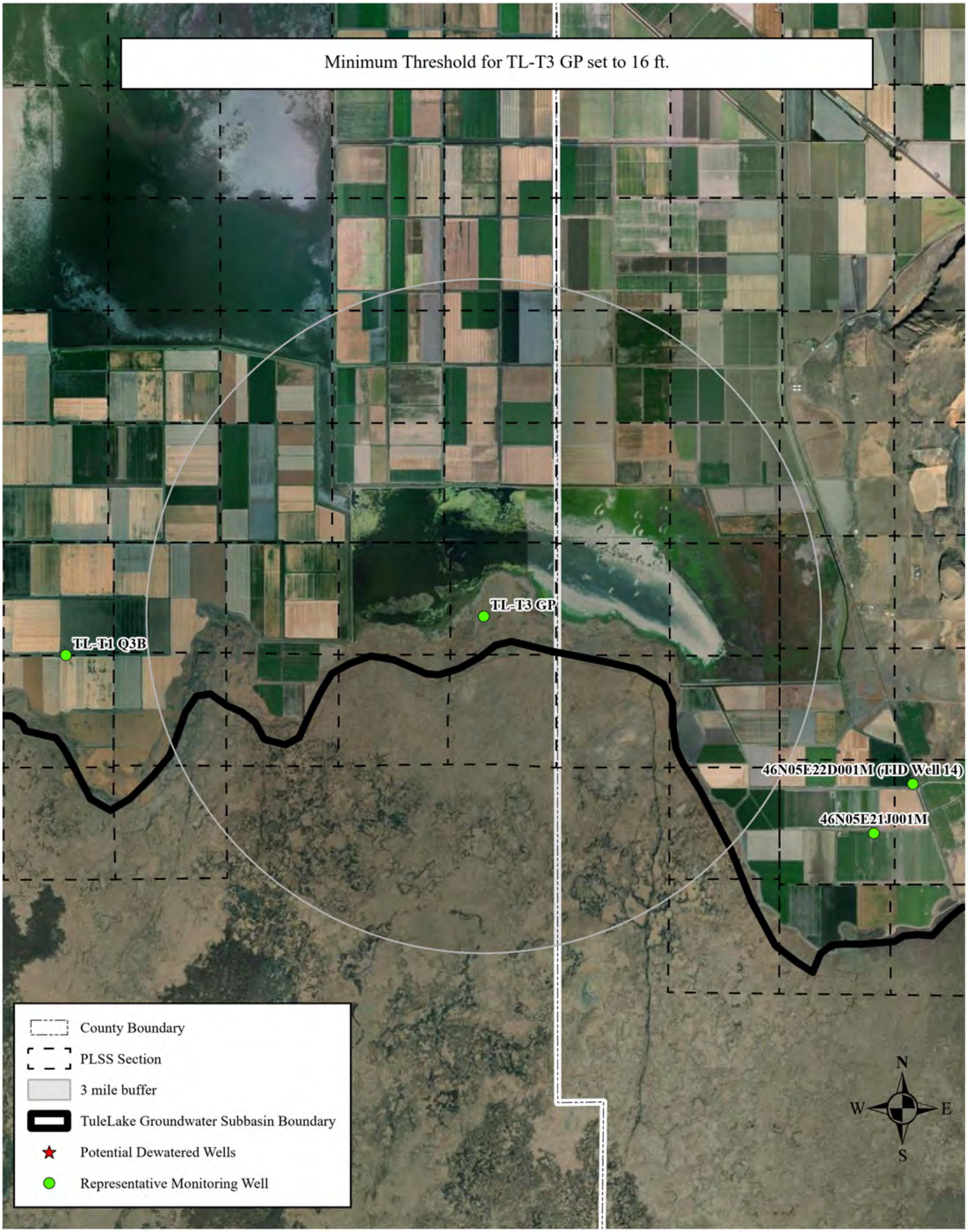


Minimum Threshold for TL-T1 Q3B set to 35 ft.

MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well TL-T1 Q3B

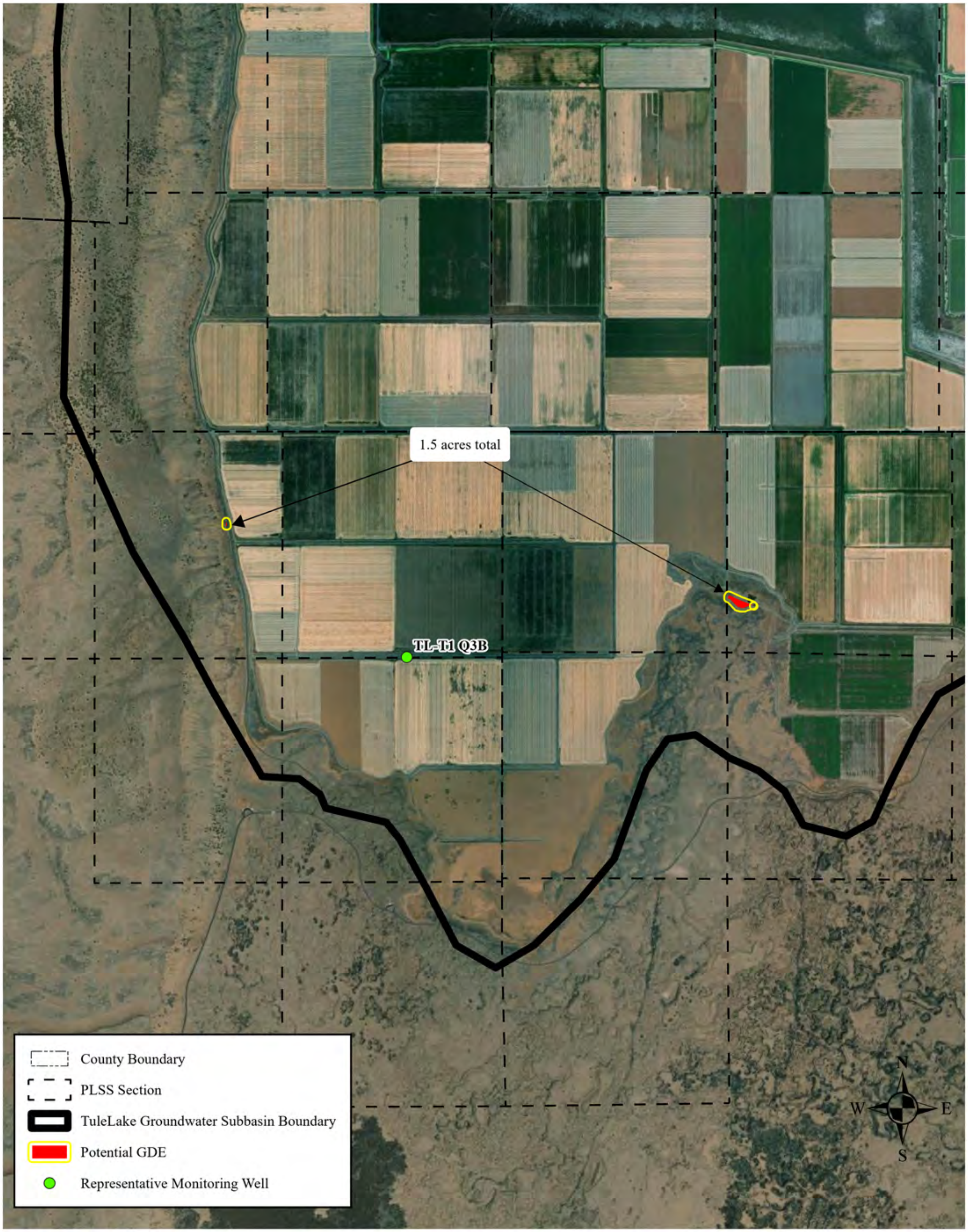
0 ½ 1 Mi



MBK ENGINEERS

Location of potential dewatered wells near representative monitoring well TL-T3 GP

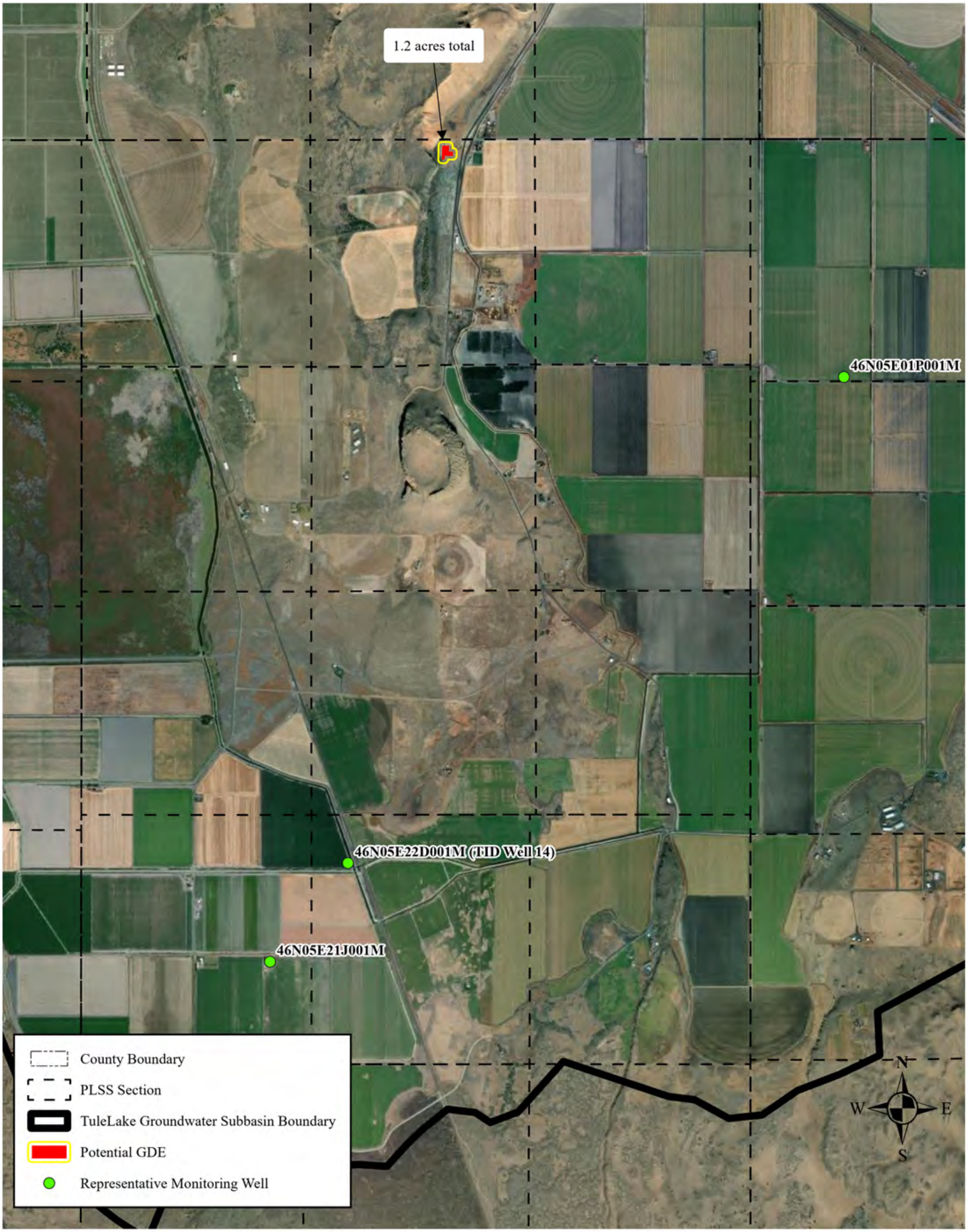
0 ½ 1 Mi



MBK ENGINEERS

Location of potential groundwater dependent ecosystems

0 ¼ ½ Mi



Location of potential groundwater dependent ecosystems

0 ¼ ½ Mi

2 of 3

MBK ENGINEERS

Location of potential groundwater dependent ecosystems

0 ¼ ½ Mi

#1000170A

48N/4E-24

Tulelake

Log # 260

6/3/2024

KYLE KNUTSON OF MBK SPOKE WITH ROD BAILEY WHO IS THE CURRENT WELL OWNER HE SAID THAT HE PURCHASED THE PROPERTY IN 2009 AND HAS NEVER USED THE WELL. THE BUILDING ASSOCIATED WITH THE WELL IS CURRENTLY VACANT.

X

Paul Tschirky   Tule Lake Calif.
June 8, 1944

0-----5	Soil
5----32	Clay--- Water bearing seep at 32'
32----52	Clay
52----	Pumice water bearing gravel

24' of 8¼" O D Casing No shoe Driven to seat

Water level----
Large flow of water fairly good for that area

NOTE: ON AUG. 20, 1998 I TALKED TO MR & MRS PAUL TSCHIRKY. SHE SHOWED US WHERE THE WELL IS. IT IS COVERED & CAPPED. SHE SAID THE WATER WAS BAD.
HE HAND BORED ANOTER WELL ABOUT 20' EAST. THIS IS THEIR DOMESTIC WATER SOURCE. I PLUMBED IT & FOUND IT TO BE 14' DEEP.
THE WATER LEVEL WAS 6.1' BELOW TOP OF CASING.
Earl Hanson

DRILLED BY STOREY