

# TULELAKE SUBBASIN GROUNDWATER CORE TEAM

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## **AGENDA FOR WEDNESDAY, DECEMBER 8, 2021 1:00 PM**

**Alternate Meeting Locations:  
204 South Court Street, Alturas, CA 96101**

Pursuant to California Governor Gavin Newsom's Executive Order N-25-20 & N-29-20 issued on March 12, 2020 and March 17, 2020, relating to the convening of public meetings in response to the COVID-19 pandemic, the Tulelake Sub Basin Core Team will be enacting social distancing procedures for the Tulelake Sub Basin Core Team Meetings to members of the public and staff. Additionally, members of the Tulelake Sub Basin Core Team are allowed to attend the meeting via teleconference and to participate in the meeting to the same extent as if they were present.

**To protect the public, staff, and members of the Tulelake Sub Basin Core Team, members of the public are encouraged to participate in the Core Team meetings in the following ways:**

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Public comments can also be emailed to [clerkoftheboard@co.modoc.ca.us](mailto:clerkoftheboard@co.modoc.ca.us) by 5:00 p.m. on December 7, 2021 to be entered into the record.

## AGENDA FOR TUESDAY, DECEMBER 8, 2021

The Sustainable Groundwater Management Act (SGMA) established a new structure for managing California's groundwater resources at a local level by local agencies. SGMA requires, by June 30, 2017, the formation of locally controlled groundwater sustainability agencies (GSAs) in the State's high- and medium-priority groundwater basins and subbasins (basins). A GSA is responsible for developing and implementing a groundwater sustainability plan (GSP) to meet the sustainability goal of the basin to ensure that it is operated within its sustainable yield, without causing undesirable results.

### 1:00 PM Call to Order

#### Pledge of Allegiance

**Public Comment** - *This is the time set aside for citizens to address the Core Team on matters on the consent agenda and matters not otherwise on the agenda. Comments should be limited to matters within the jurisdiction of the Core Team. If your comment concerns an item shown on the agenda please address the Core Team after that item is open for public comment. By law, the Core Team cannot take action on matters that are not on the agenda. The chair reserves the right to limit the duration of each speaker to three minutes. Speaker may not cede their time.*

*Agenda items with times listed will be considered at that time all other items will be considered as listed on the agenda or as deemed necessary by the Chair.*

#### Approval or Additions/Deletions to Agenda

#### Correspondence

##### Consideration / Action

1. CONSIDERATION/ACTION: Overview public comments received regarding the Public Draft Groundwater Sustainability Plan (GSP).
2. ACTION: Approve Final Draft Groundwater Sustainability Plan.
3. DISCUSSION: GSP Adoption and Timeline.

#### Core Team Members Reports

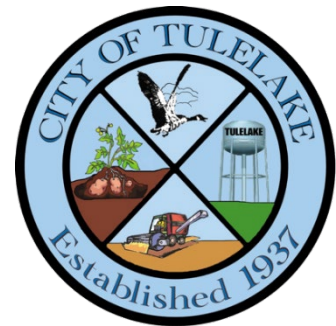
1. Siskiyou County
2. City of Tulelake
3. Modoc County

#### ADJOURNMENT

Parties with a disability as provided by the American Disabilities Act who require special accommodations or aides in order to participate in the public meeting should make the request to the Clerk at [clerkoftheboard@co.modoc.ca.us](mailto:clerkoftheboard@co.modoc.ca.us) at least 48 hours prior to the meeting. POSTED AT CITY HALL, TULELAKE IRRIGATION DISTRICT, ONLINE, AND AT TULELAKE POST OFFICE ON DECEMBER 3, 2021.

# Tule Lake Subbasin

## Groundwater Sustainability Plan



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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.



## 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 2003a).

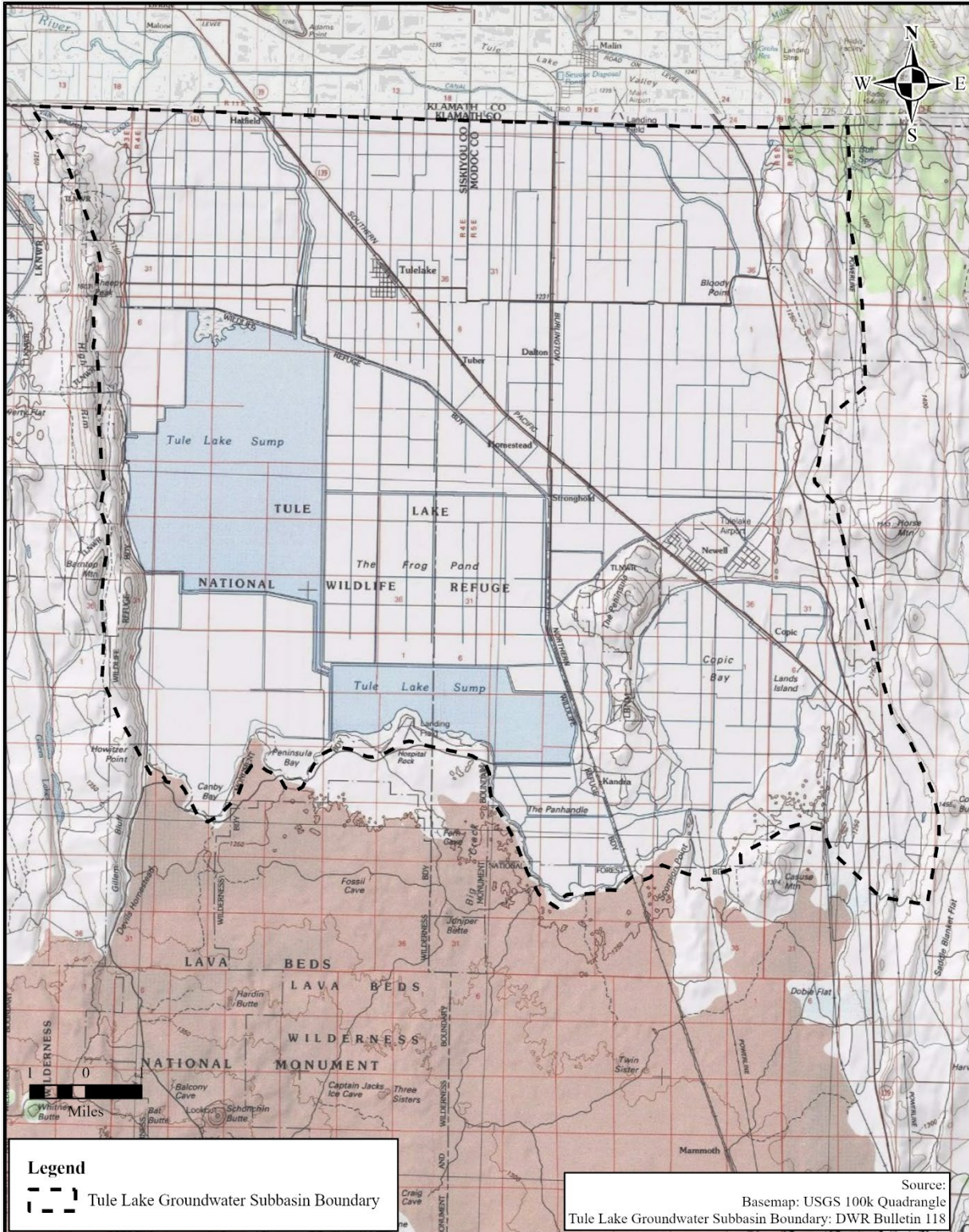


Figure ES-2. Tule Lake Subbasin Boundary

## **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
<b>Total Inflow</b>	<b>236</b>	<b>268</b>	<b>238</b>	<b>242</b>
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
<b>Total Outflow</b>	<b>240</b>	<b>251</b>	<b>238</b>	<b>242</b>
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.

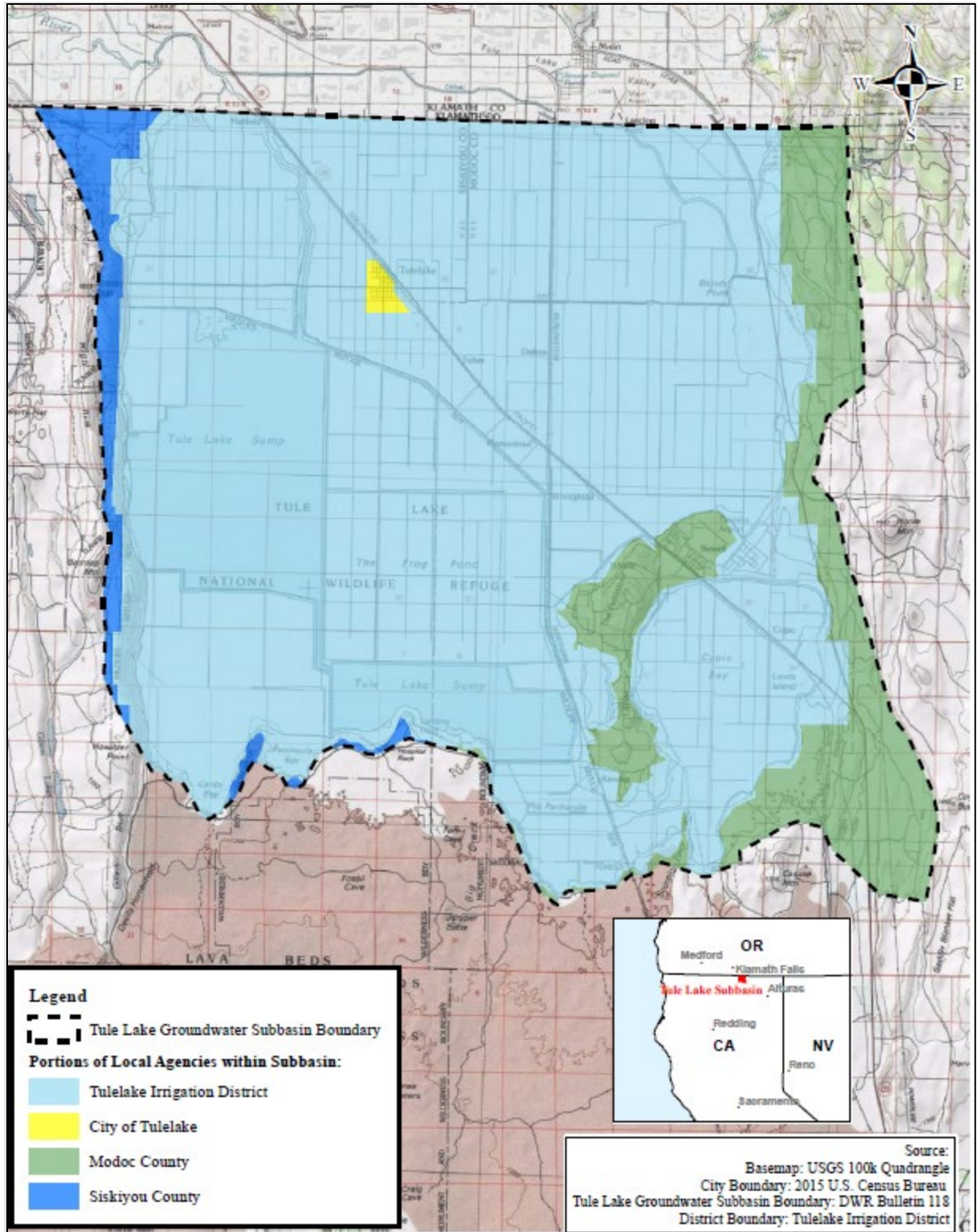


Figure 1-1. Location of the Groundwater Sustainability Agencies within the Tule Lake Subbasin

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 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.tid@cot.net](mailto:bkirby.tid@cot.net)

### **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.

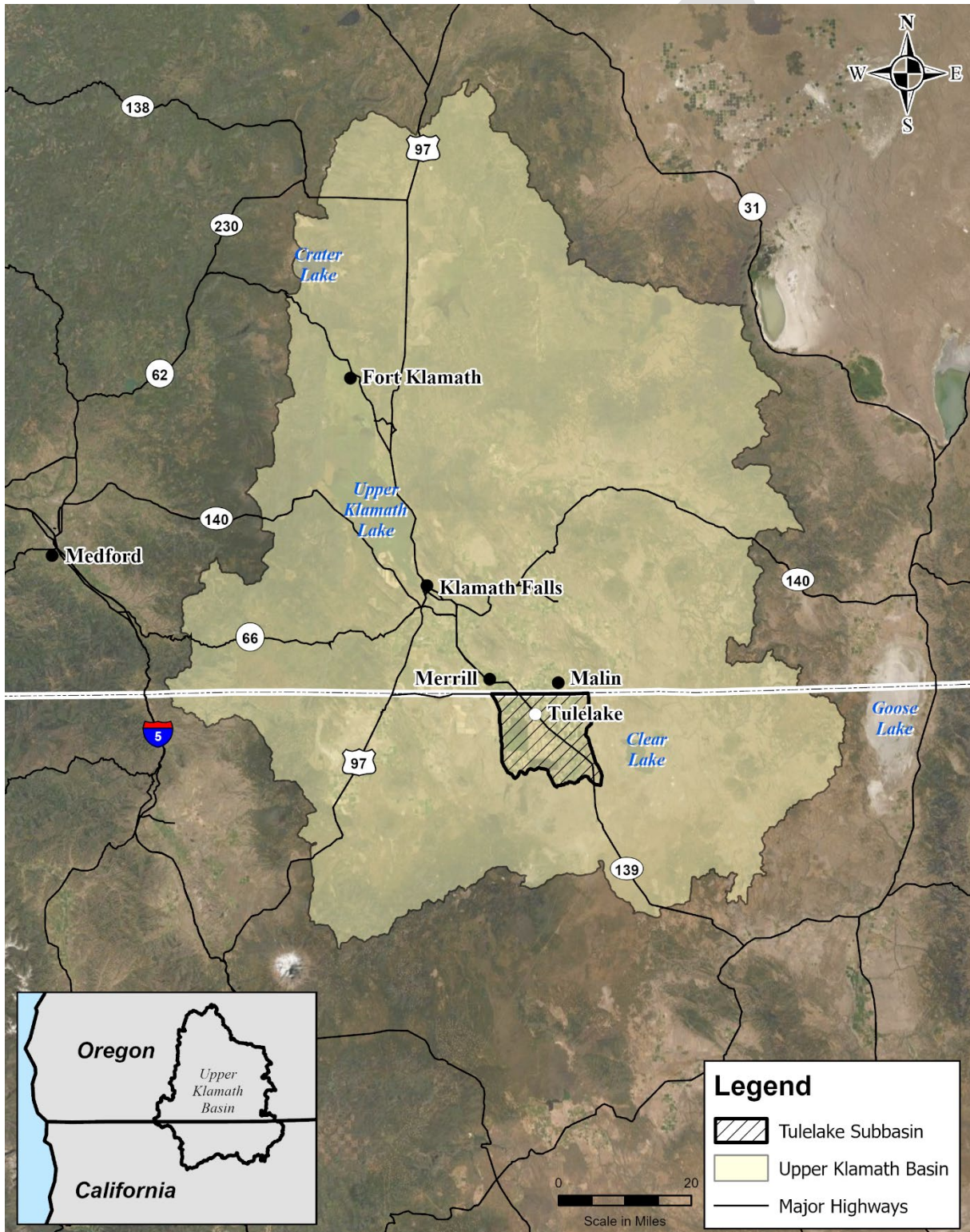


Figure 2-1. Upper Klamath Basin Boundary and Tule Lake Subbasin Boundary

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.

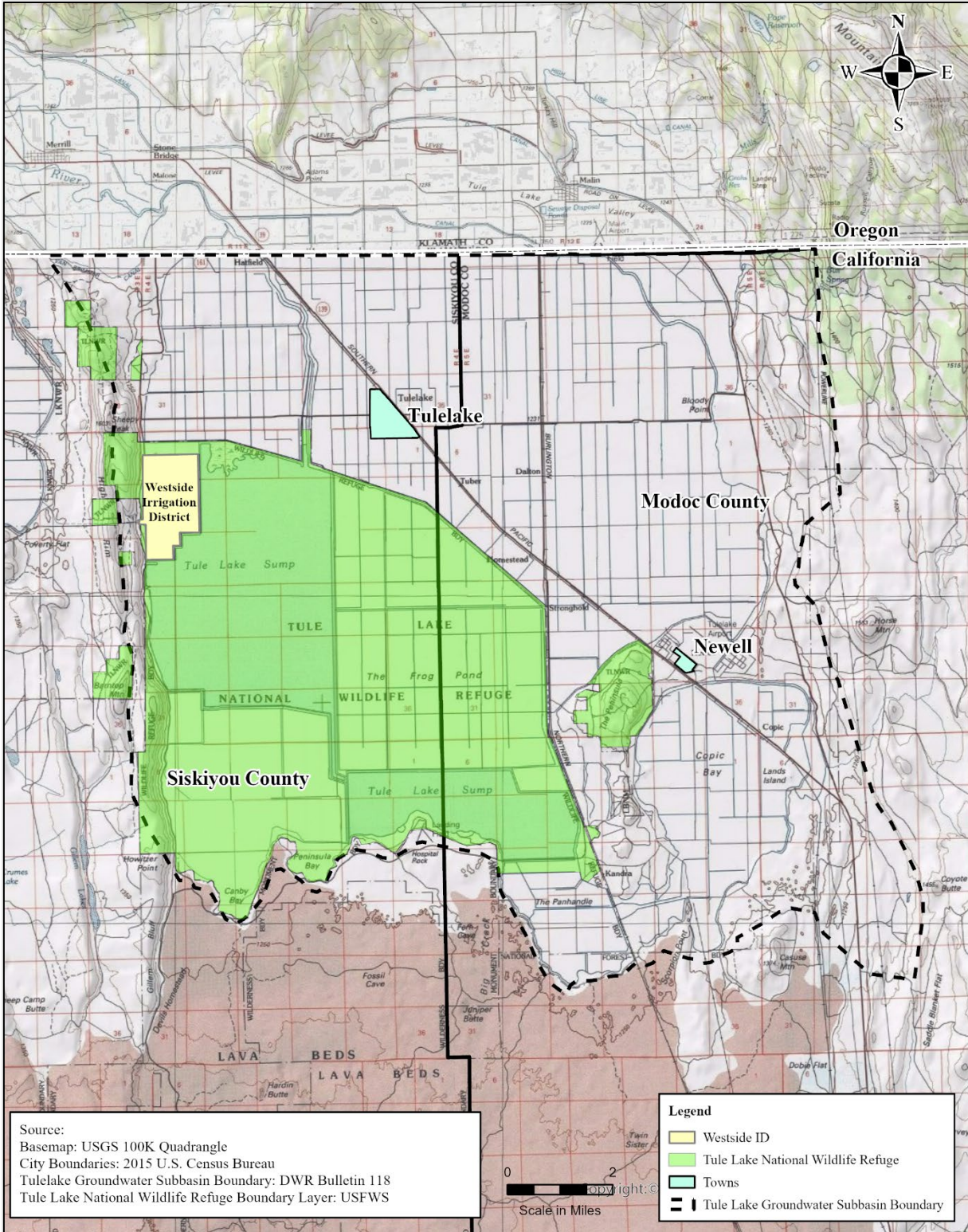


Figure 2-2. Jurisdictional boundaries within the Tule Lake Subbasin

**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**

<b>Land Use</b>	<b>Acres</b>
<b>Urban</b>	<b>627</b>
Urban	627
<b>Managed Wetland</b>	<b>13,607</b>
Managed Wetland	13,607
<b>Agriculture</b>	<b>64,287</b>
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
<b>Unclassified Areas</b>	<b>32,000</b>
<b>Sub-basin Acres</b>	<b>110,521</b>

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.

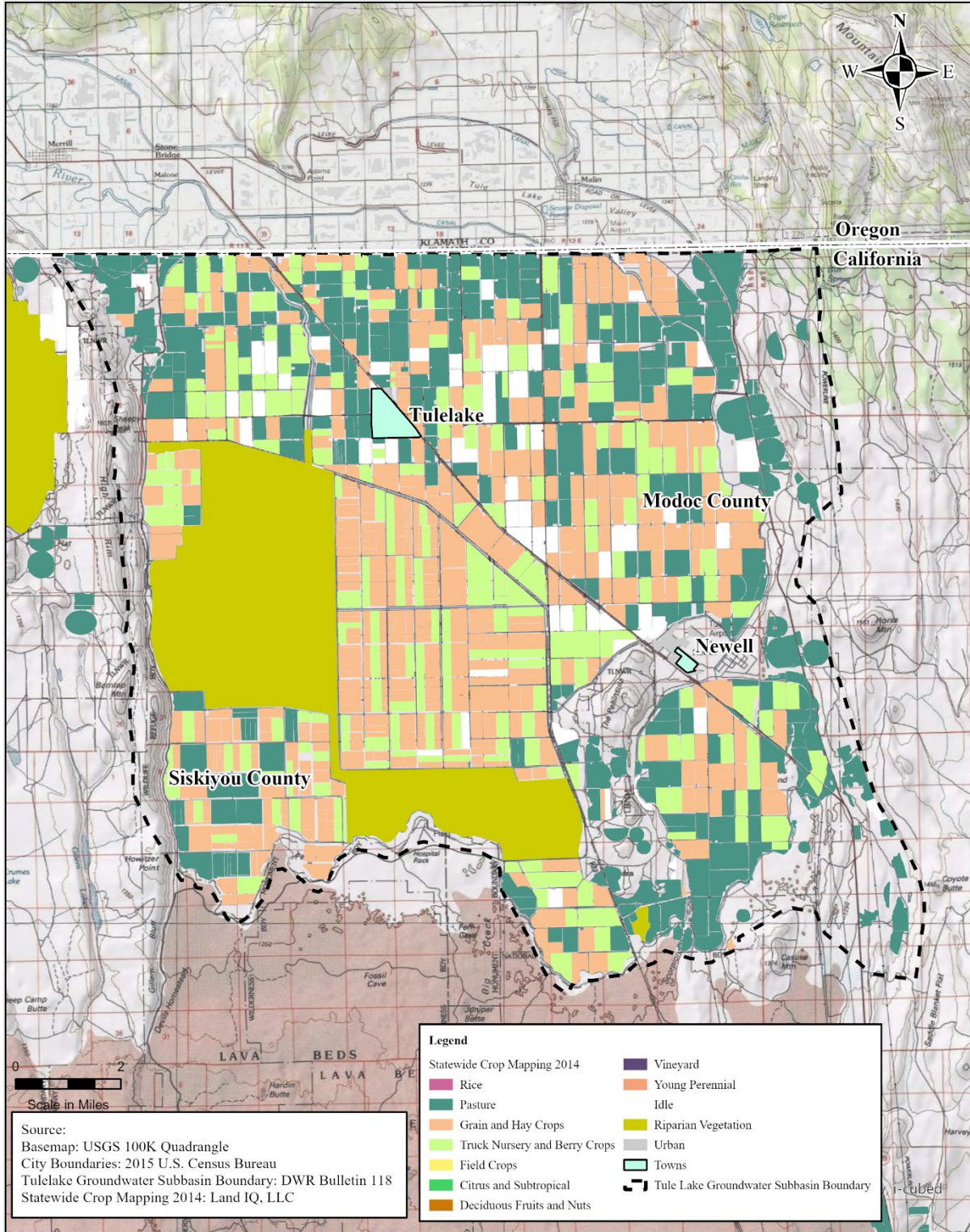


Figure 2-3. Tule Lake Subbasin 2014 Crop Map

#### ***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.

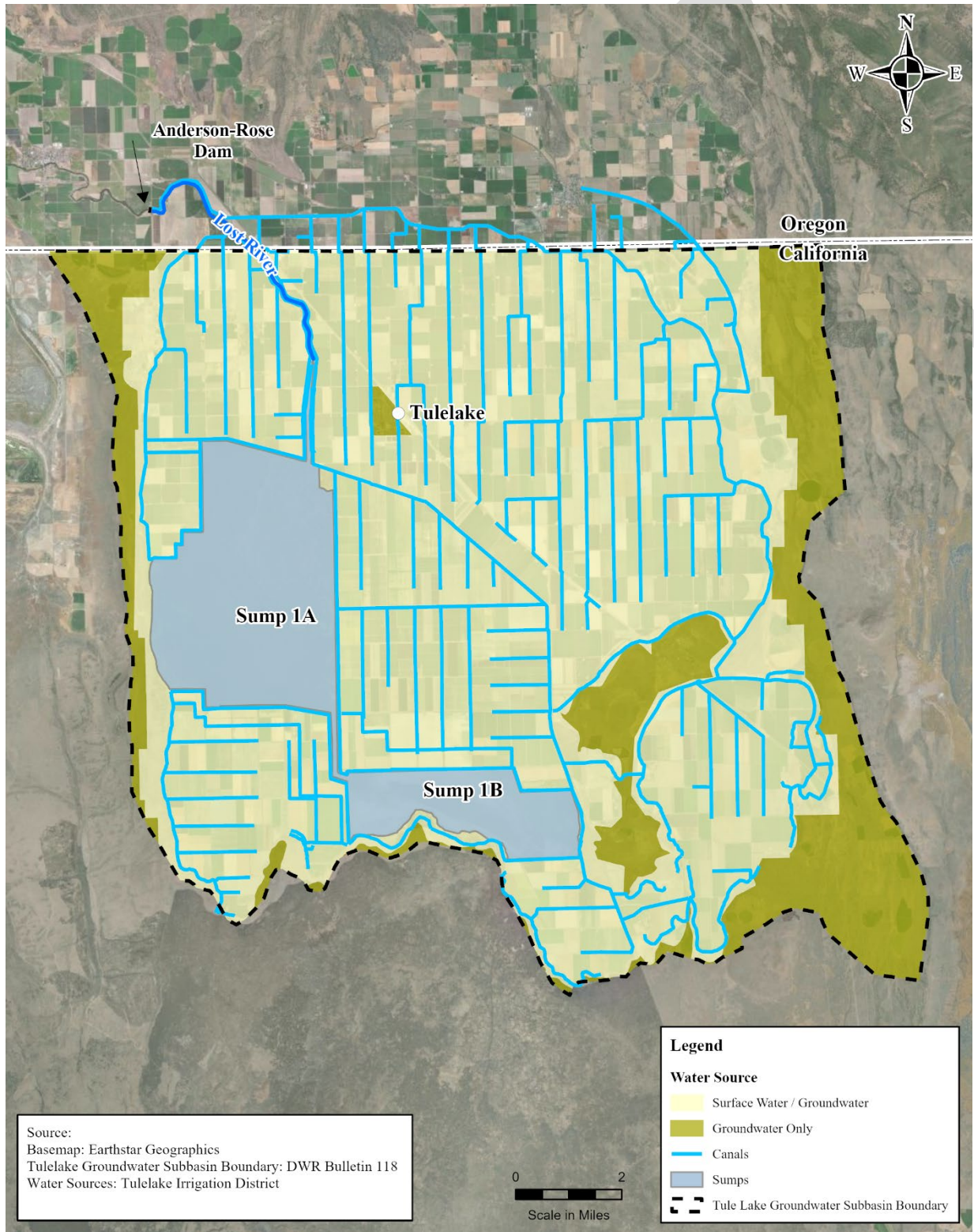


Figure 2-4. Water Source Types

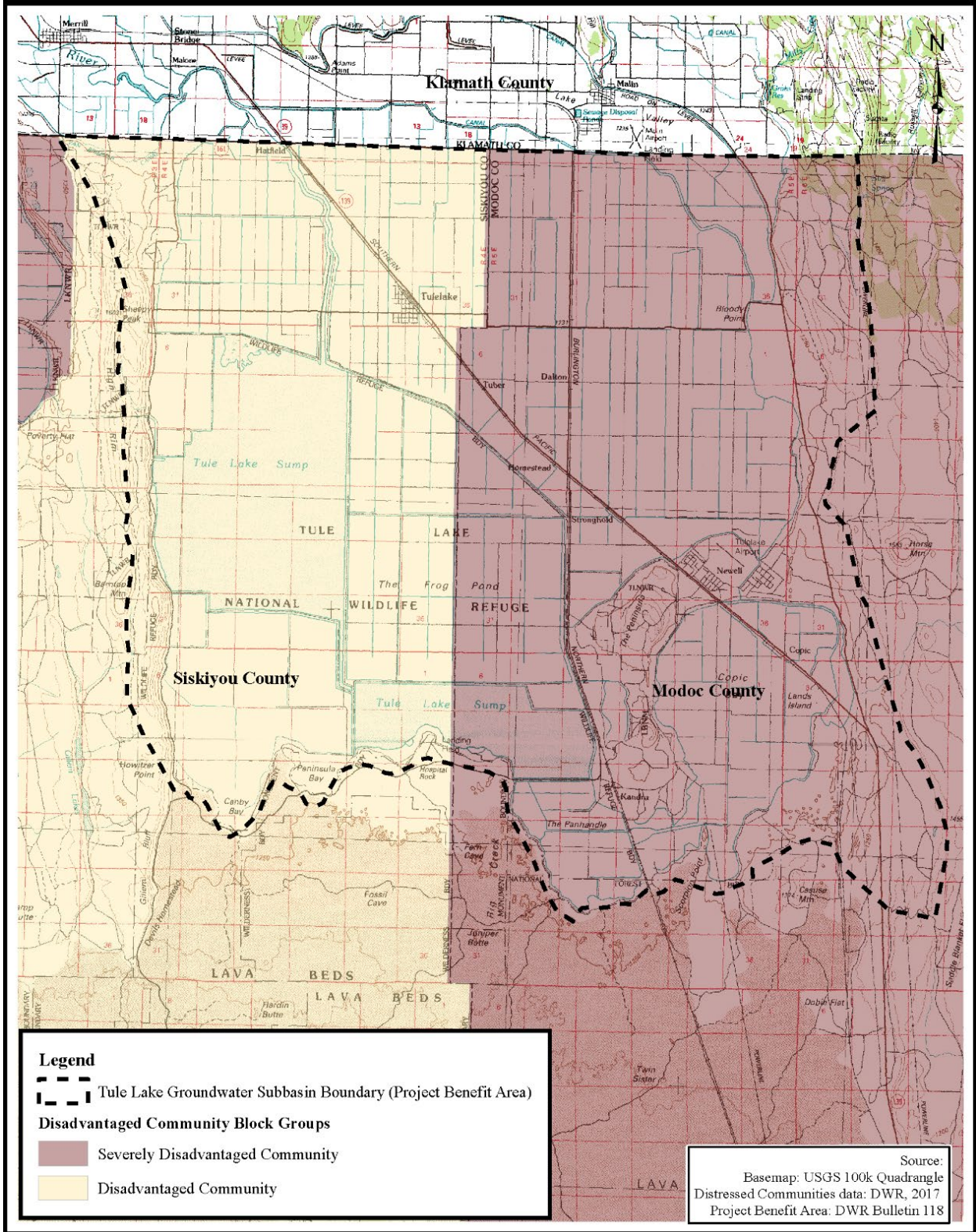


Figure 2-5. Disadvantaged Communities within Tule Lake Subbasin

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.

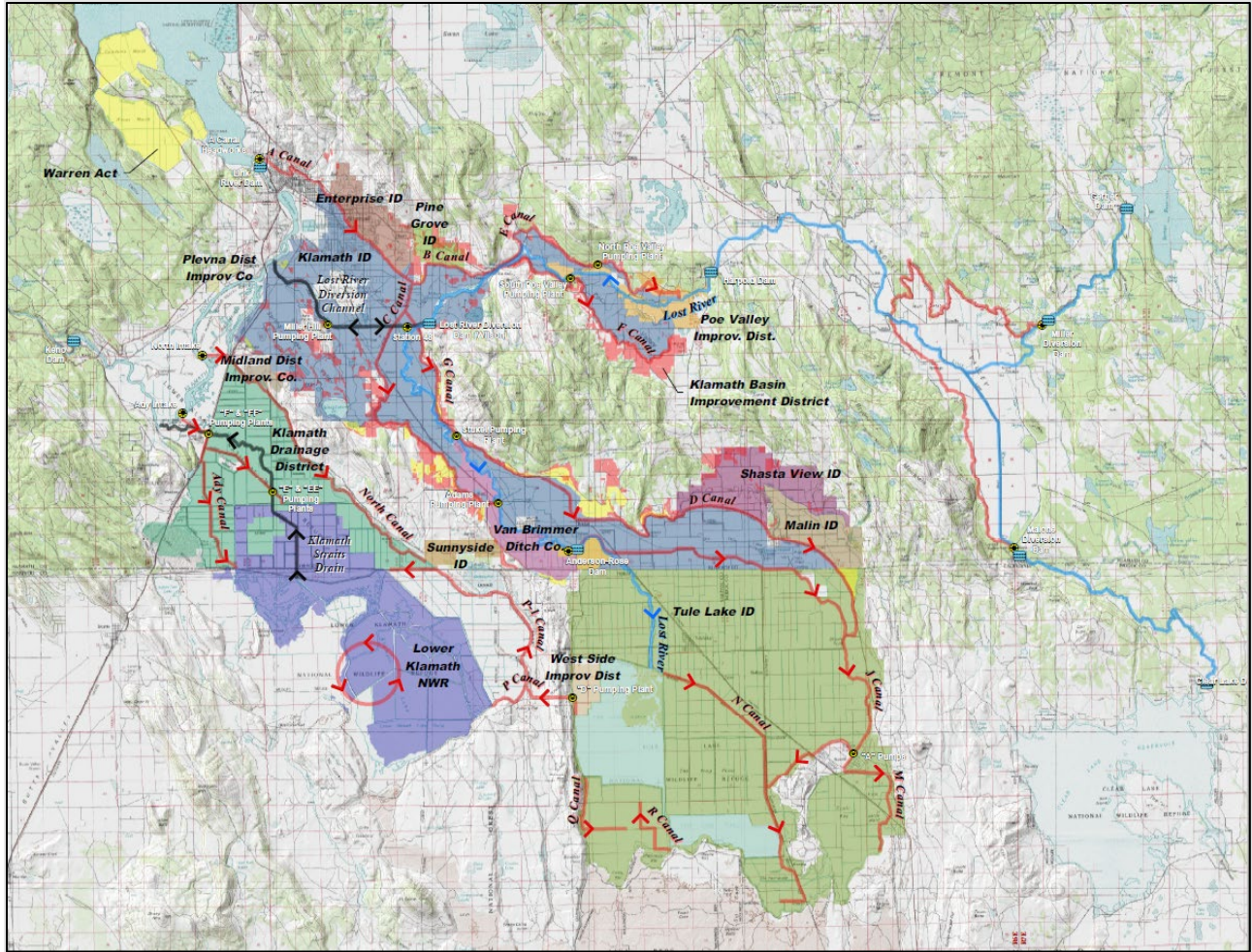


Figure 2-6. Klamath Project Conveyance Facilities

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

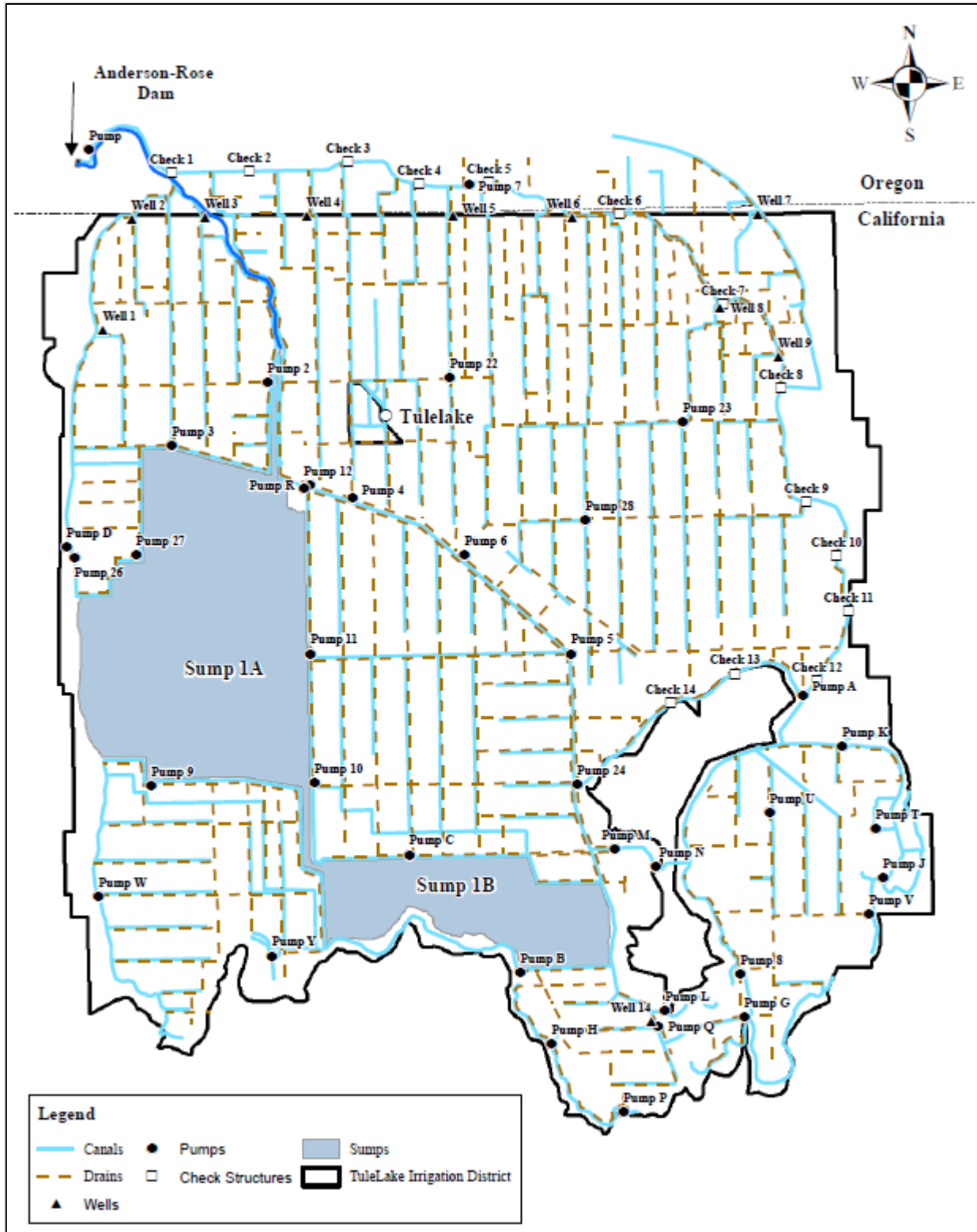


Figure 2-7. District Conveyance and Drainage Facilities

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 <sup>1</sup>	11	36
Domestic & Public Supply	108	41
Total	227	155

Source: DWR Well Completion Report Database, downloaded January 2021

<sup>1</sup> 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.

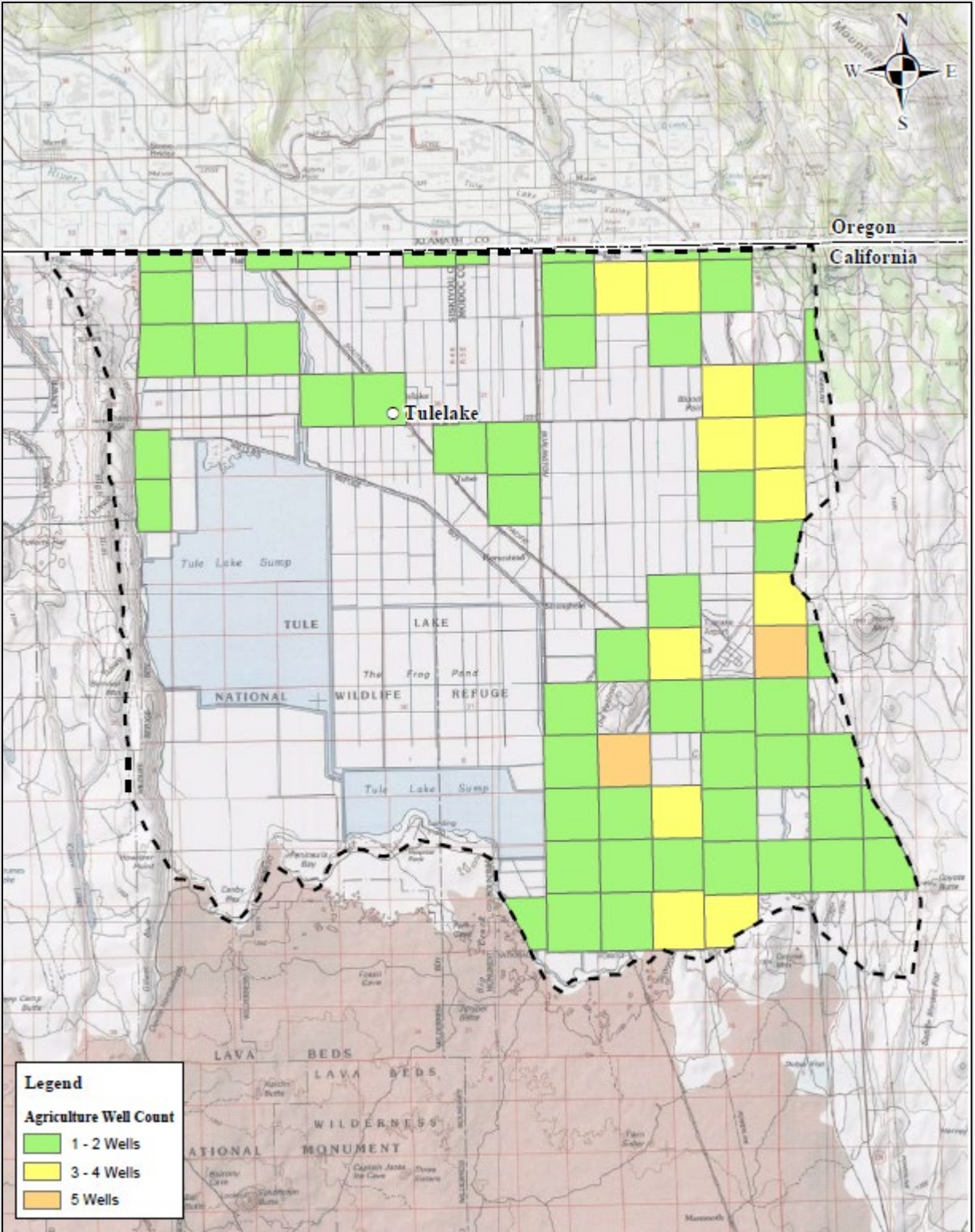


Figure 2-8. Density of Agricultural Wells per Square Mile

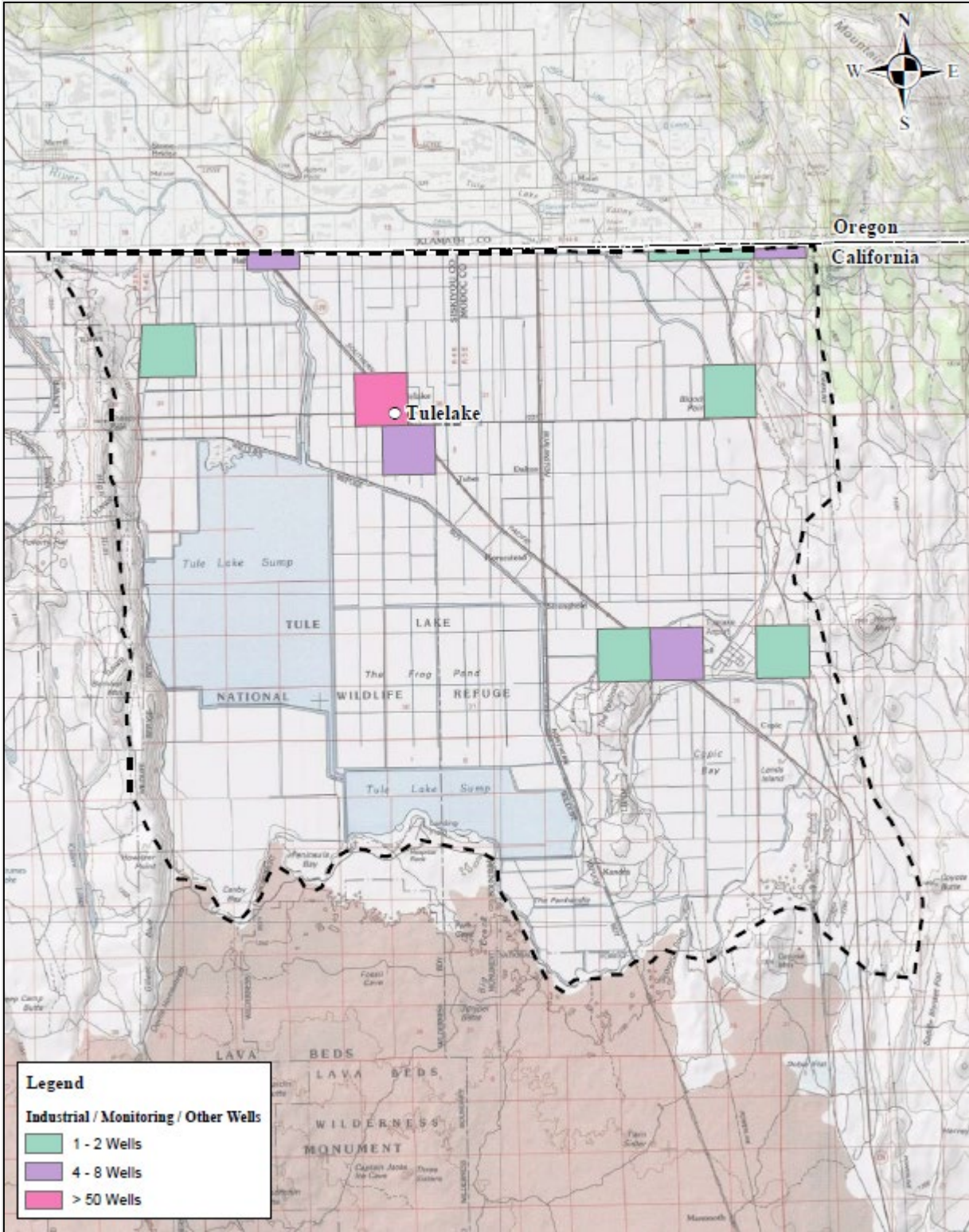


Figure 2-9. Density of Industrial/Monitoring/Miscellaneous Wells per Square Mile

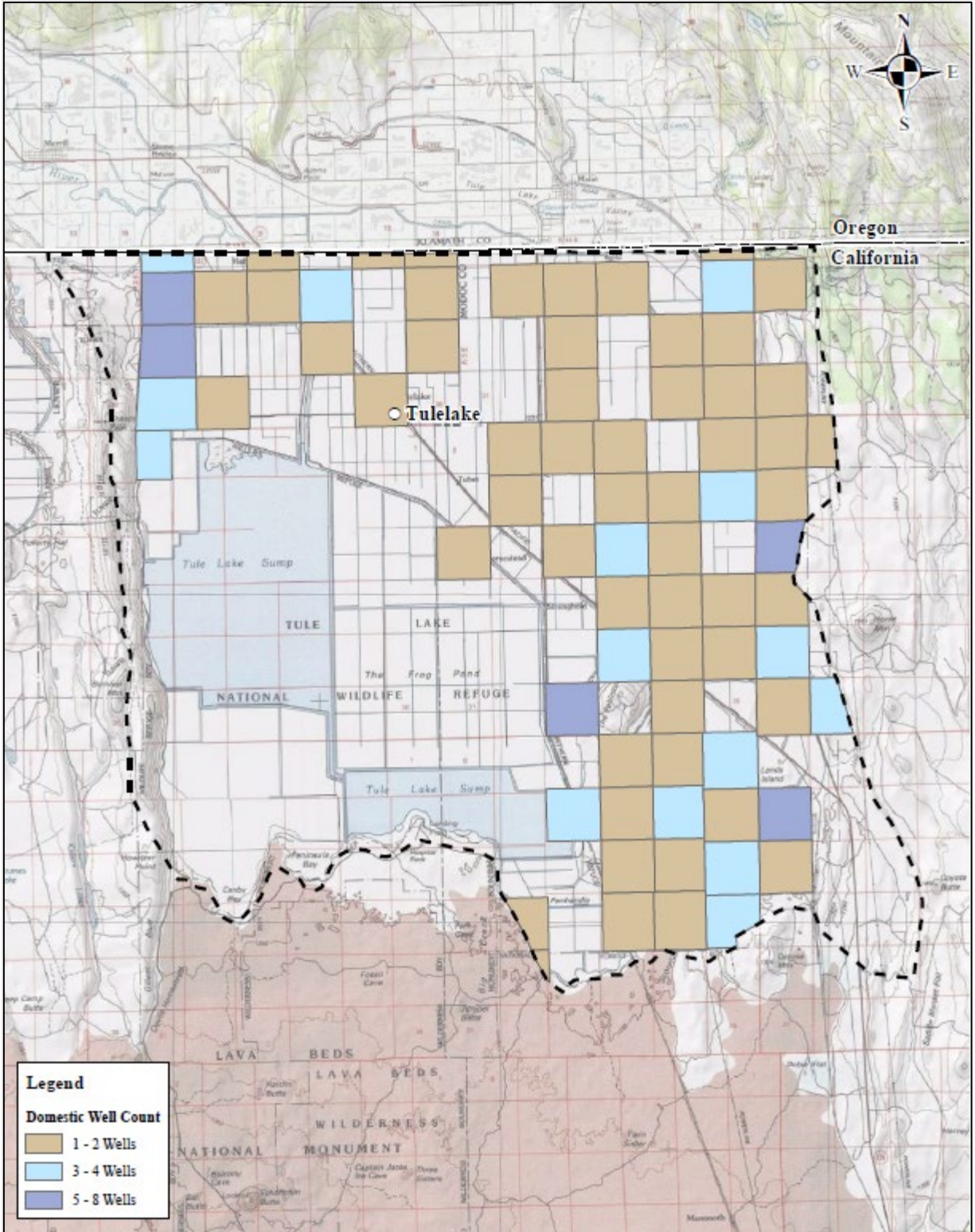


Figure 2-10. Density of Domestic and Public Supply Wells per Square Mile

## **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  $\pm 6\%$
- 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. 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.

**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

### 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, 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 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.

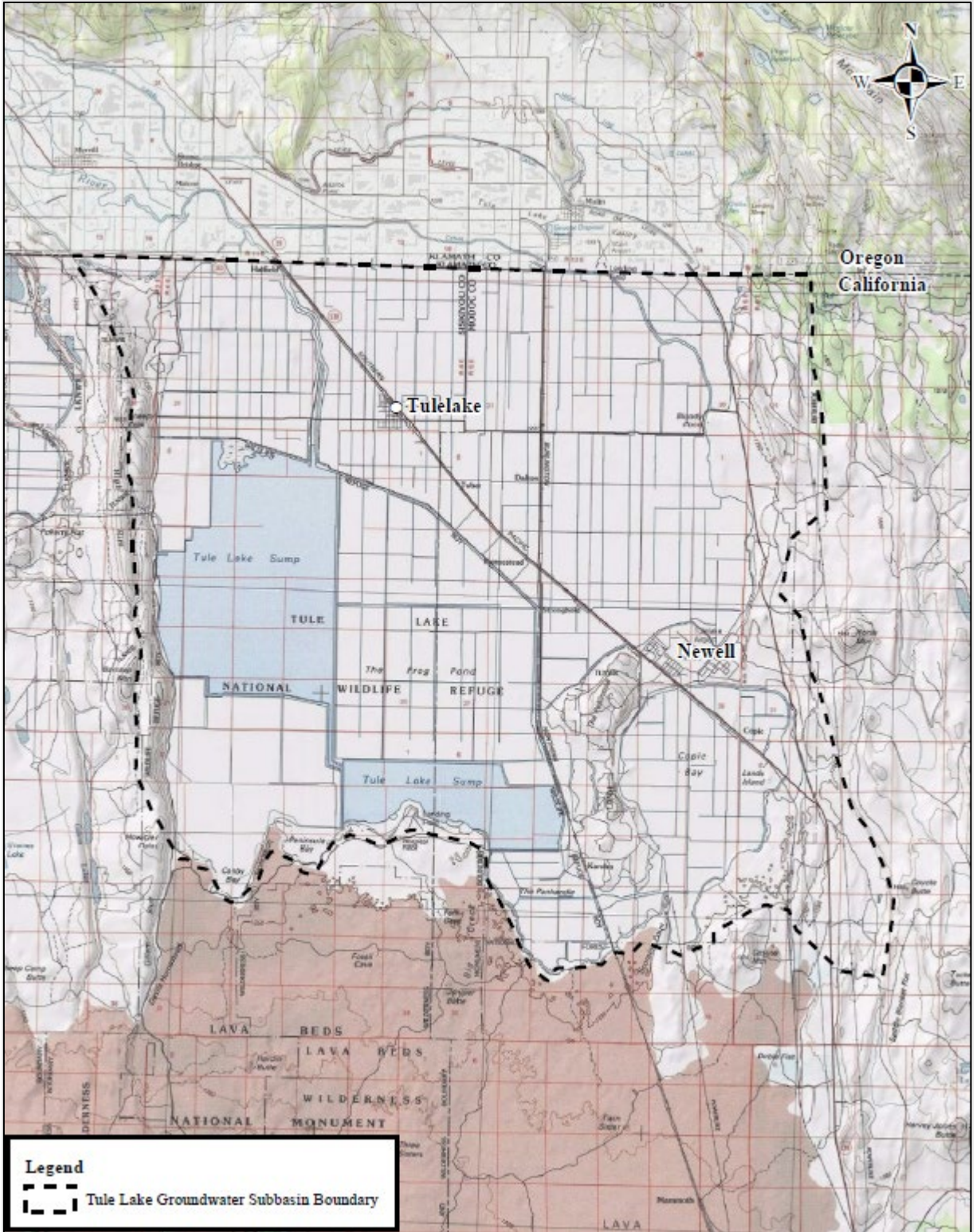


Figure 2-11. Tule Lake Subbasin Boundary

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.

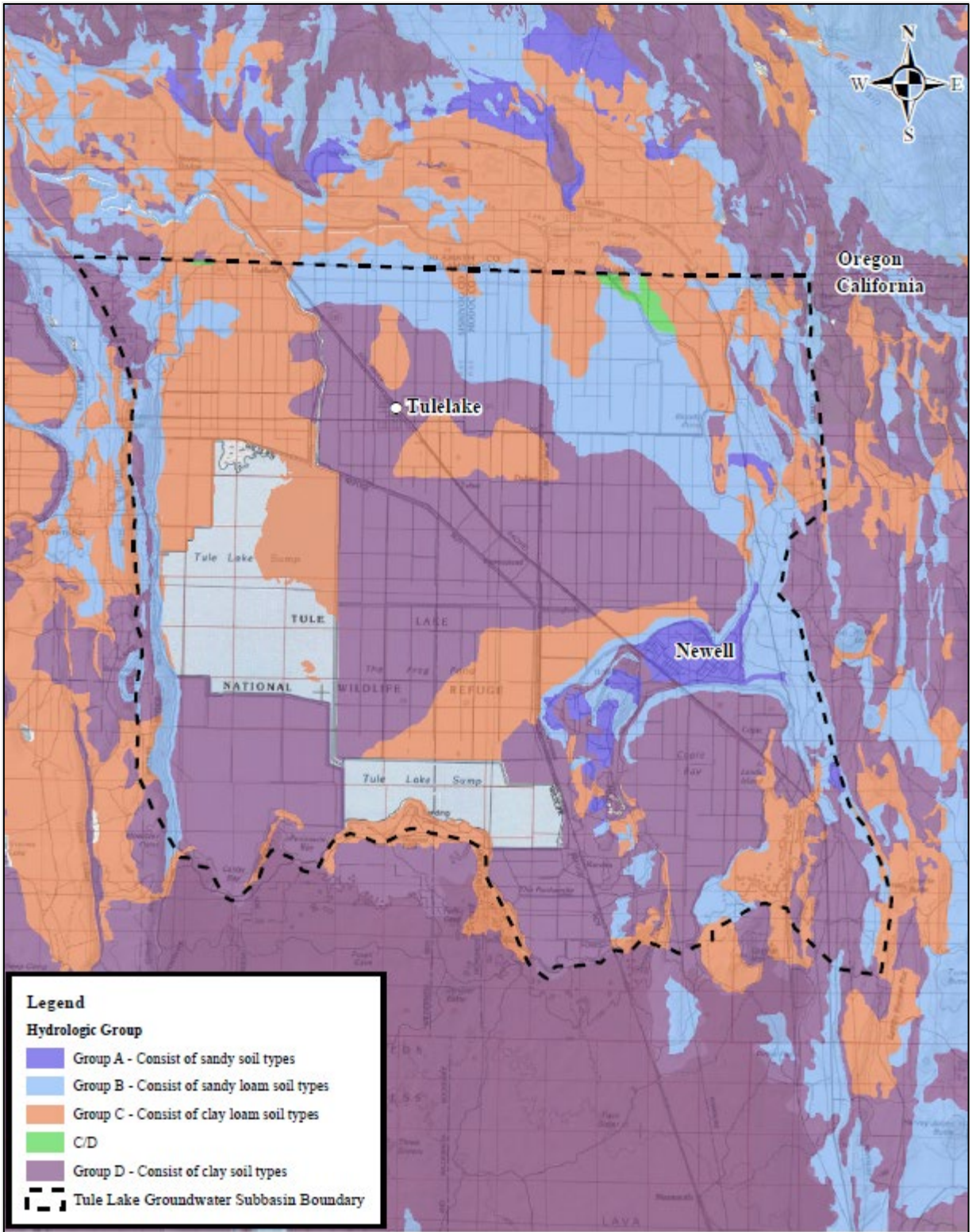


Figure 2-12. Tule Lake Subbasin Soil Characteristics

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

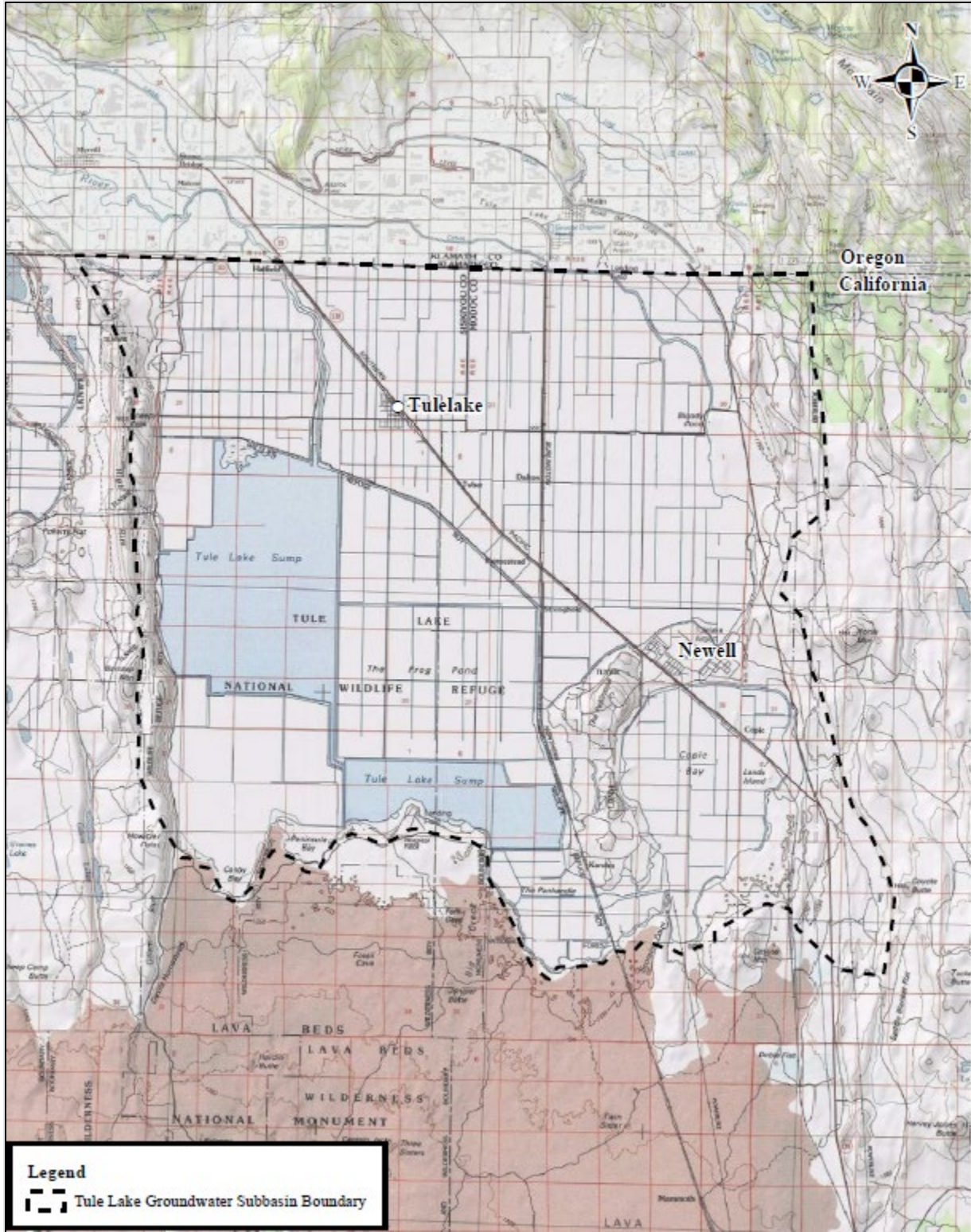


Figure 2-13. Tule Lake Subbasin Topography

### **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 scoriaceous 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, 2003a).

**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, 2003b). At the edges of the basin at the north, east, and west, the Lower Basalt acts more unconfined or semi-confined (DWR, 2003a). 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, 2003a). 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, 2003a). 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, 2003b).

**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, 2003a). 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, 2003b).

**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, 2003b).

**Pliocene to Holocene Lake Deposits.** The surficial deposits, consisting mostly of fluvial and lacustrine sediments are unconsolidated to semi-consolidated (DWR, 2003a). 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 interfingering 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, 2003a).

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 2003a). 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.

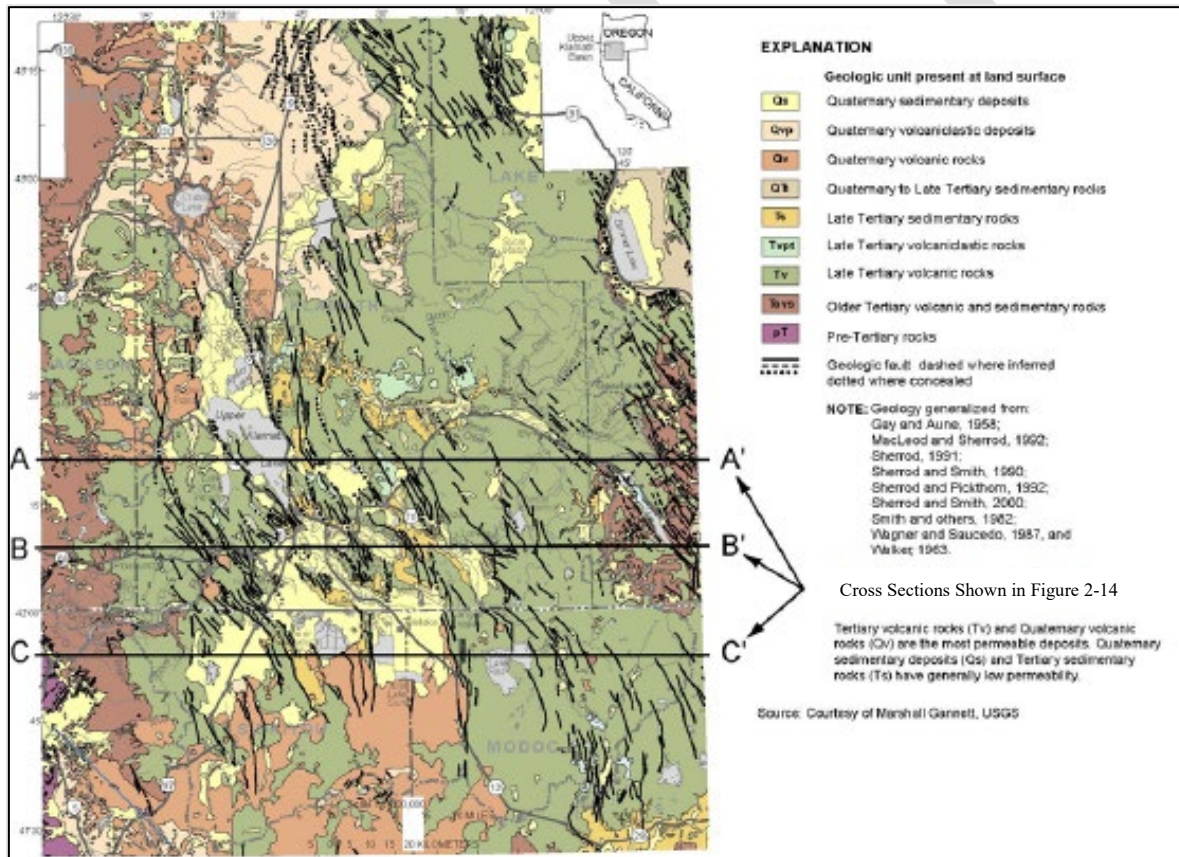
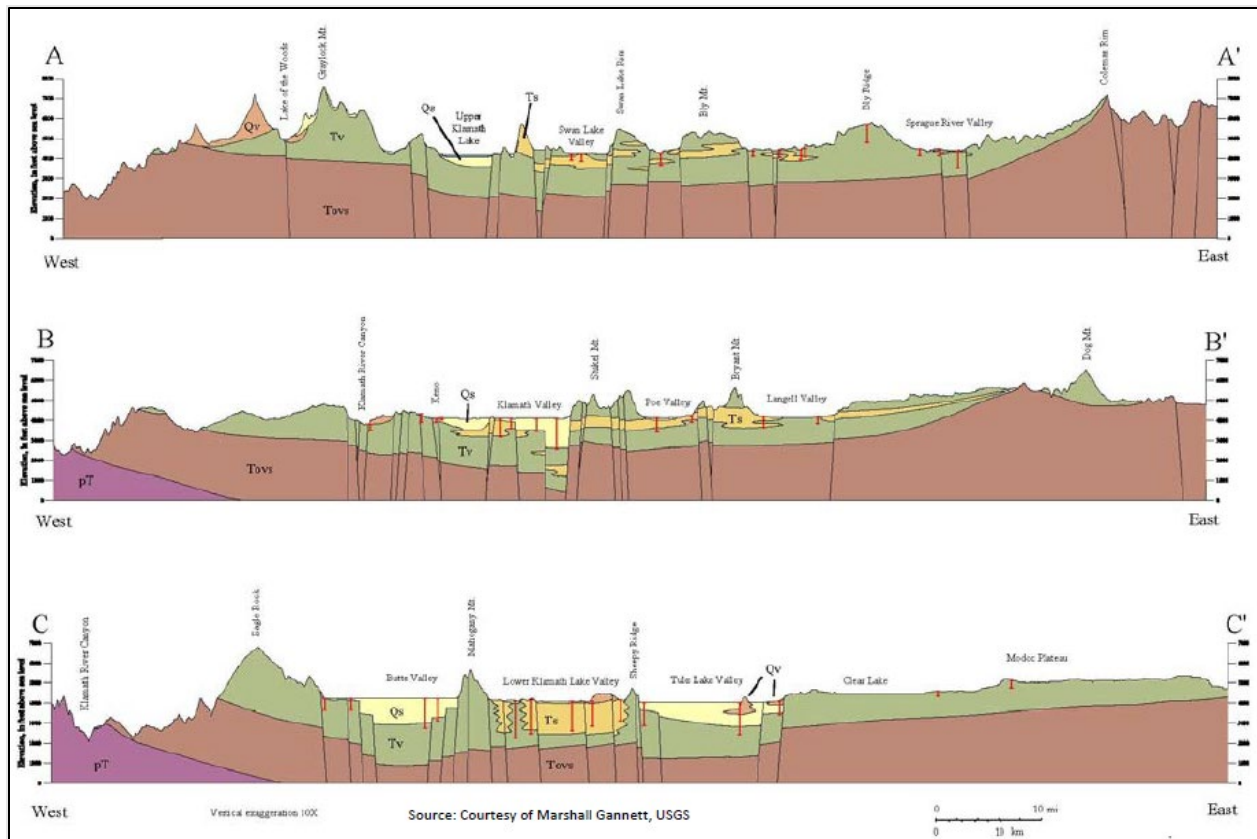


Figure 2-14. Hydrologic Units of the Upper Klamath Basin, Oregon, and California

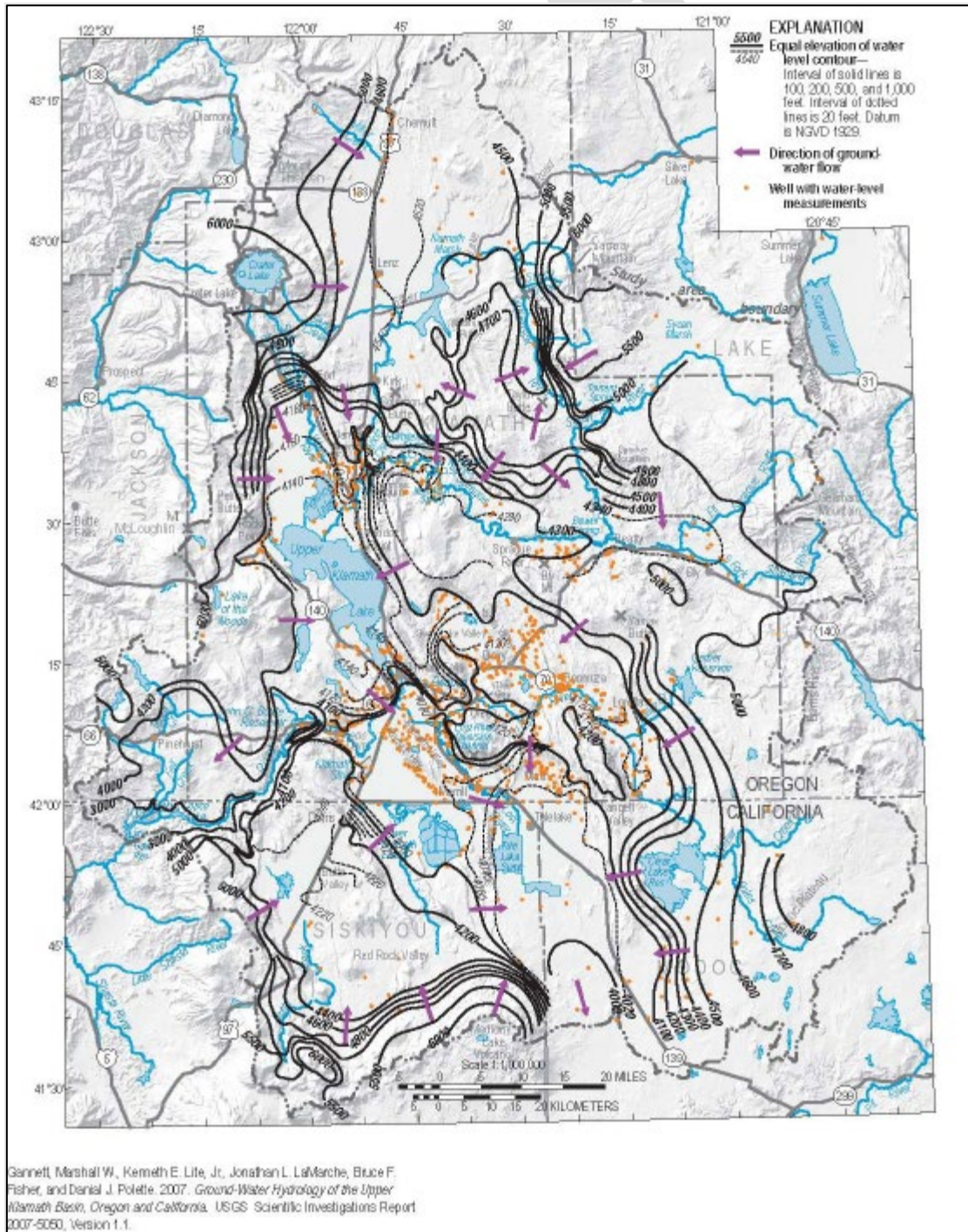


**Figure 2-15. Series of West-to-East Geologic Cross Sections through the Central Part of the Upper Klamath Basin**

The findings by the USGS correlate to cross sections developed by DWR, which identify interbedded volcanics, and fill deposits occurring at varying depths (DWR, 2003a). 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., 2007), 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., 2007).



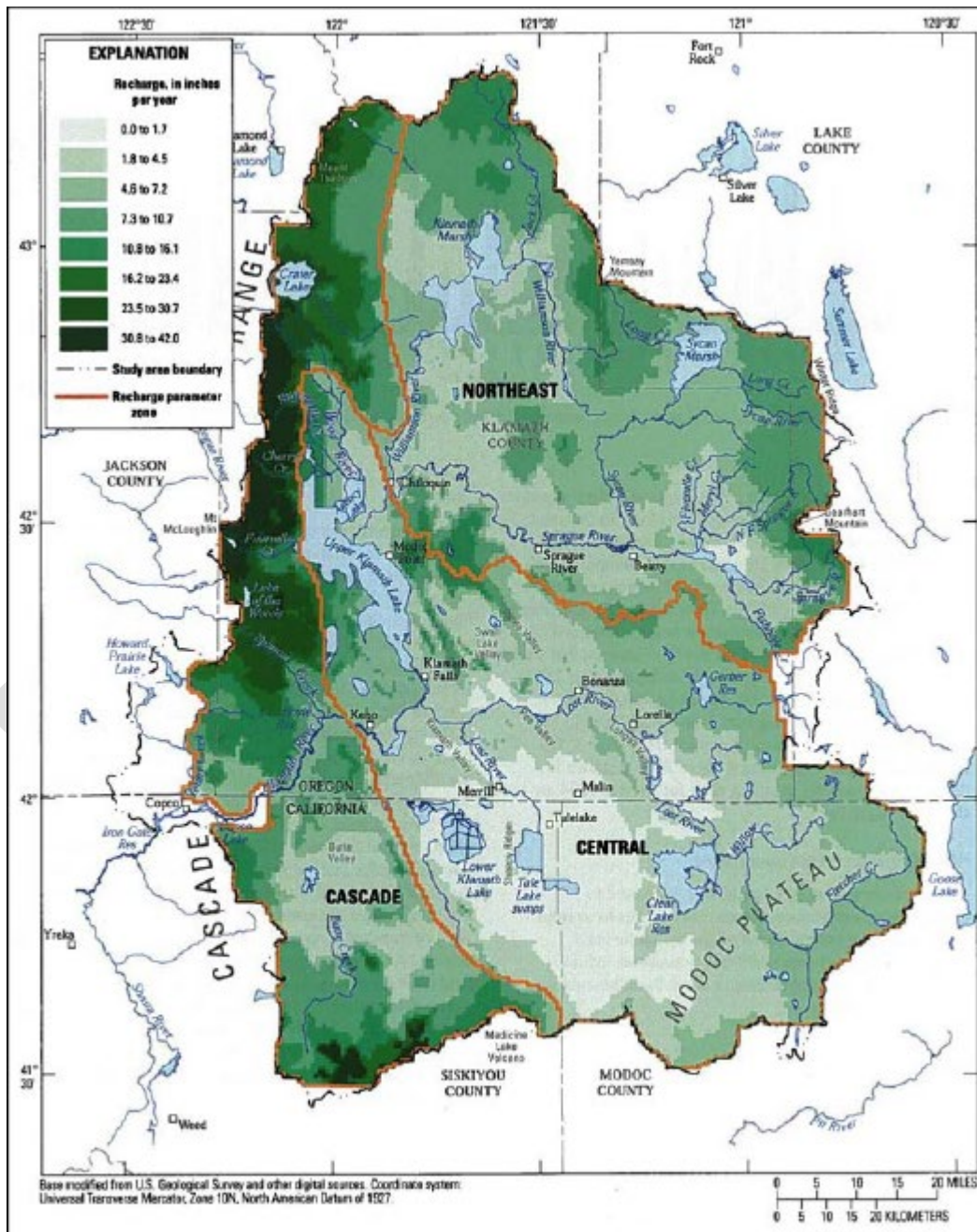
**Figure 2-16. Generalized Water-Level Contours and Approximate Directions of Regional Groundwater Flow within the Upper Klamath Basin, Oregon, and California**

### ***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, 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.

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, 2003b). 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, 2003a). 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, 2003b). 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, 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, 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., 2007).

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., 2007).

#### **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**

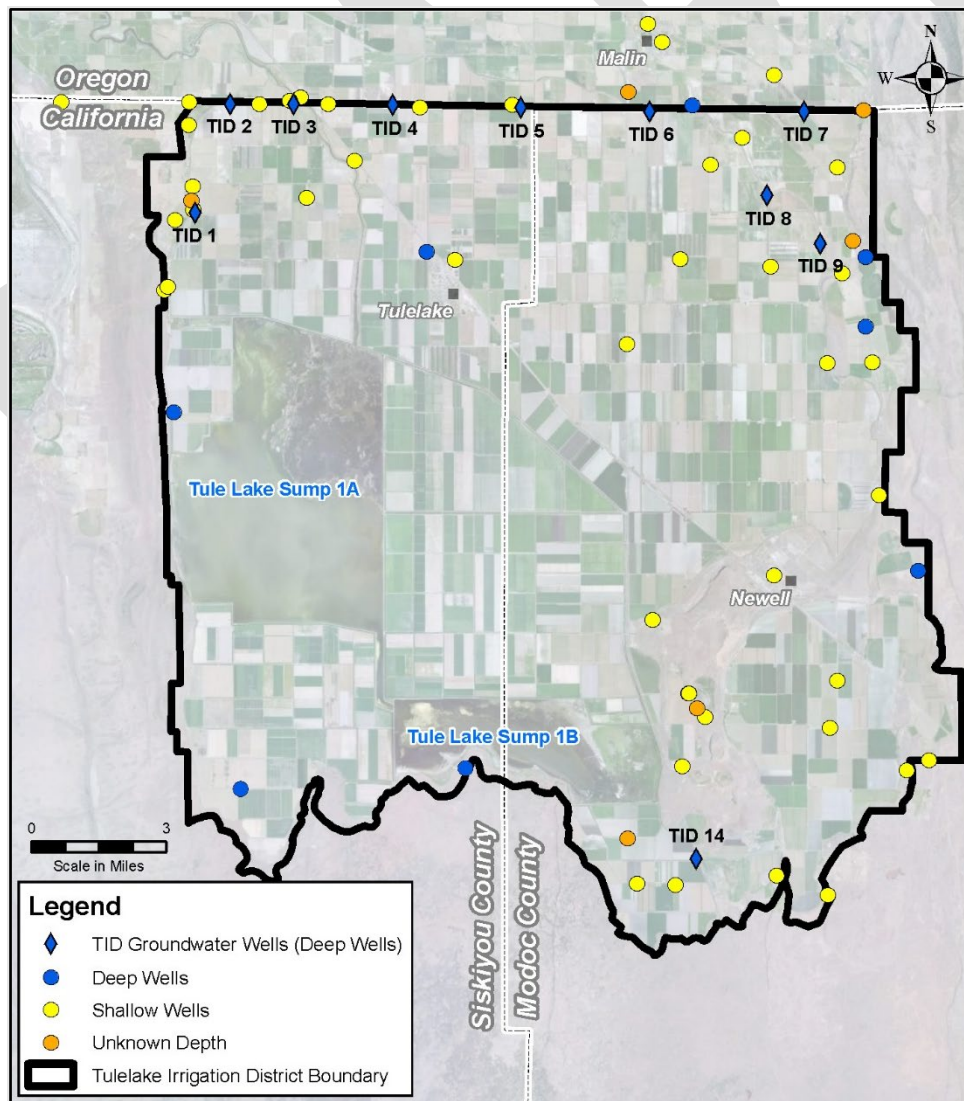
State Well Number	Well Location		Well Depth (ft)	Perforations (ft)		Well Use	Period of Record	
	UTM East	UTM North		Top	Bottom		Begin	End
48N05E36K001M	636857	4646373	66	21	66	Stock	11/9/2001	Present
48N05E36A002M	637472	4646826	528	-	-	Irrigation	9/16/1998	Present
48N05E35F001M	634950	4646522	32	25	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.

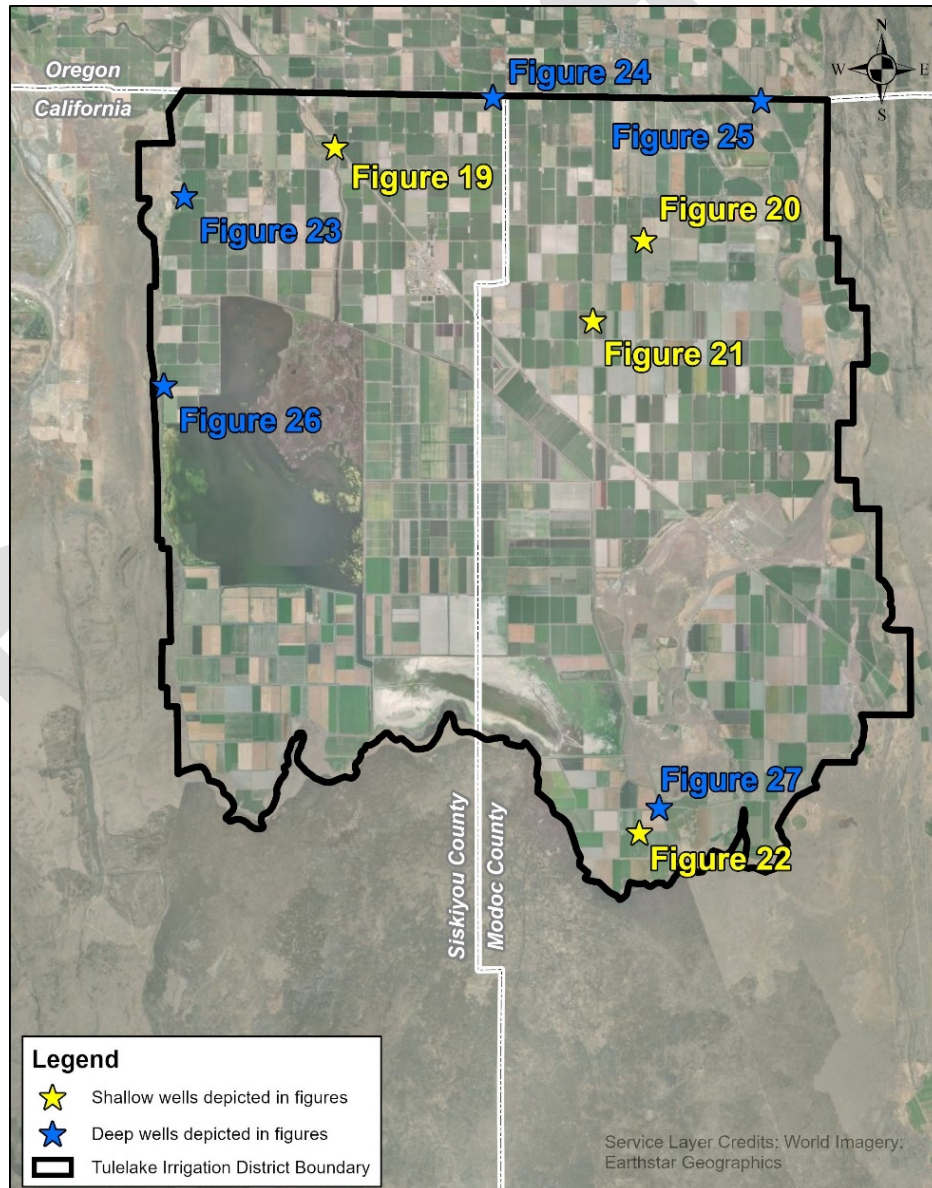
Figure 2-18 identifies the distribution of groundwater wells actively monitored for groundwater elevations within and near the GSP area. The wells shown on this figure include groundwater wells drilled to depths such that extraction may occur from the alluvial aquifer or from the deeper, more productive 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.

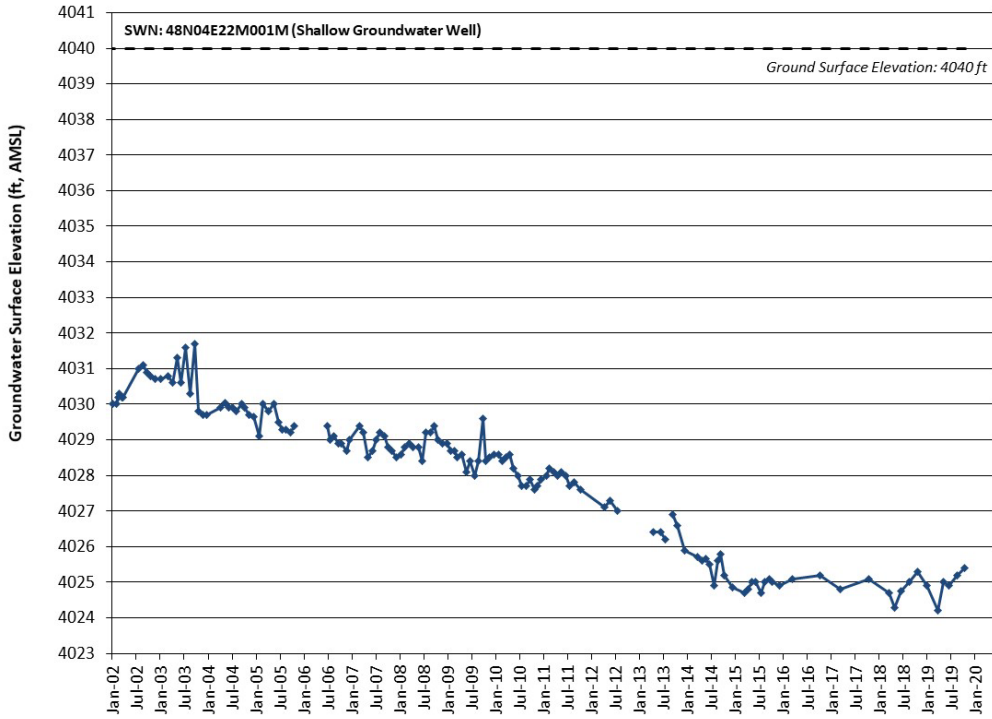


Figure 2-20. Groundwater Hydrograph for SWN: 48N04E22M001M

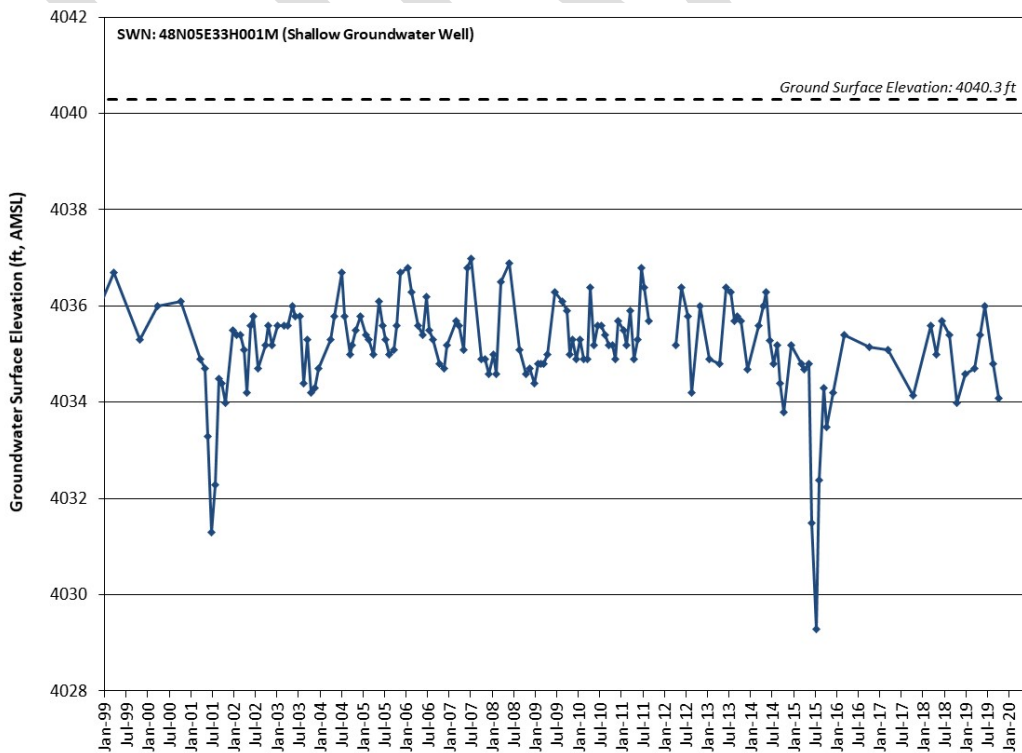


Figure 2-21. Groundwater Hydrograph for SWN: 48N05E33H001M

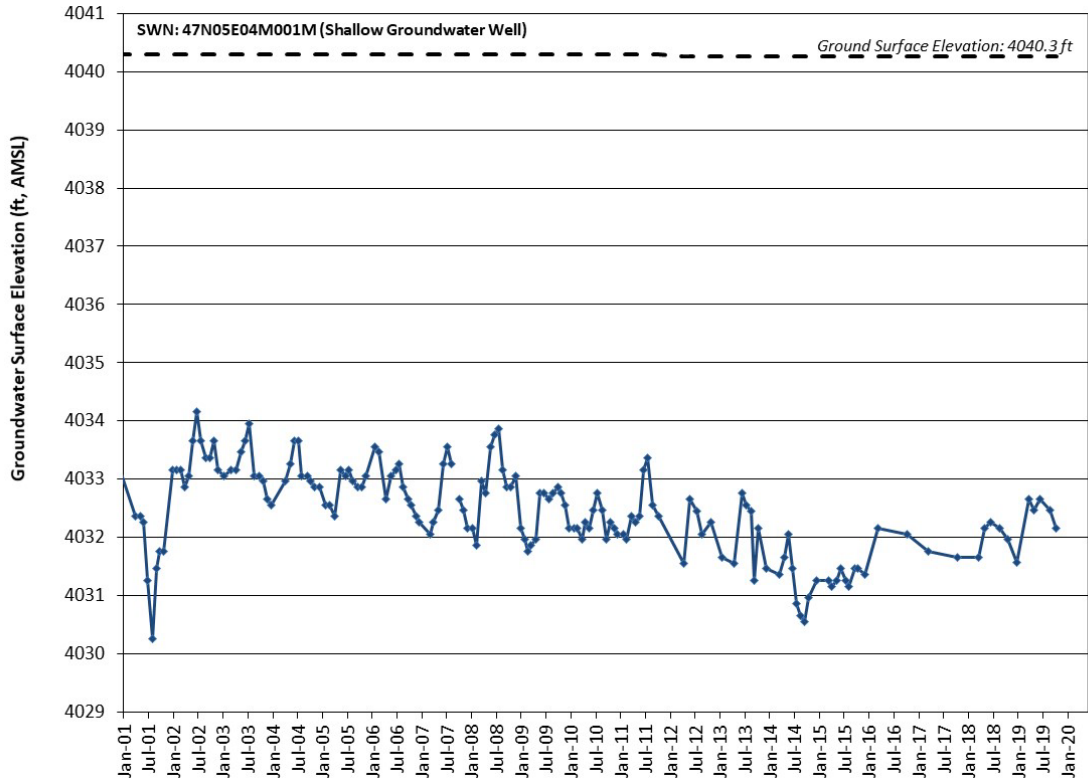


Figure 2-22. Groundwater Hydrograph for SWN: 47N05E04M001M

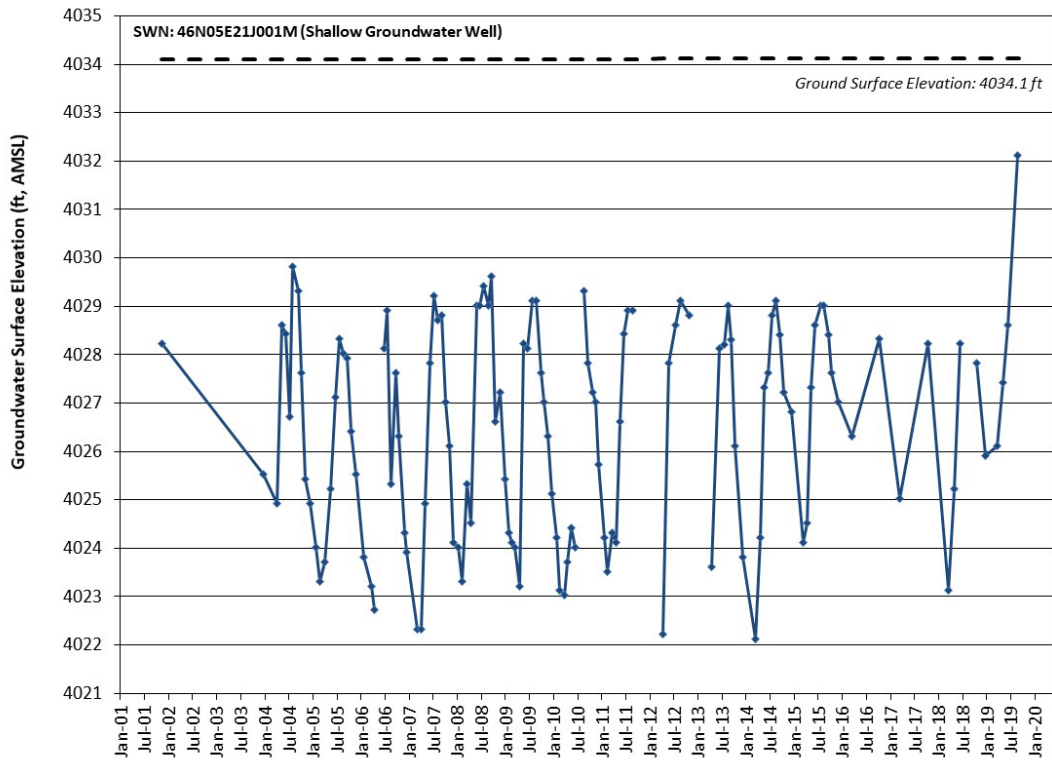


Figure 2-23. Groundwater Hydrograph for SWN: 46N05E21J001M

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).

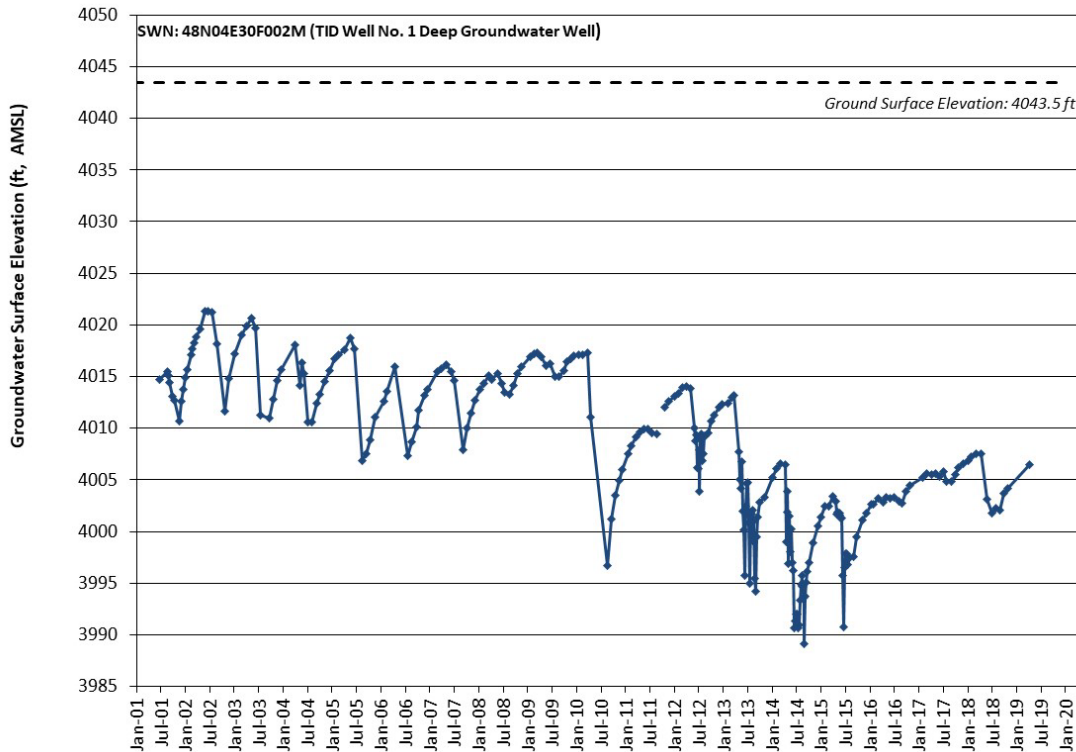


Figure 2-24. Groundwater Hydrograph for SWN: 48N04E30F002M (TID Well No. 1)

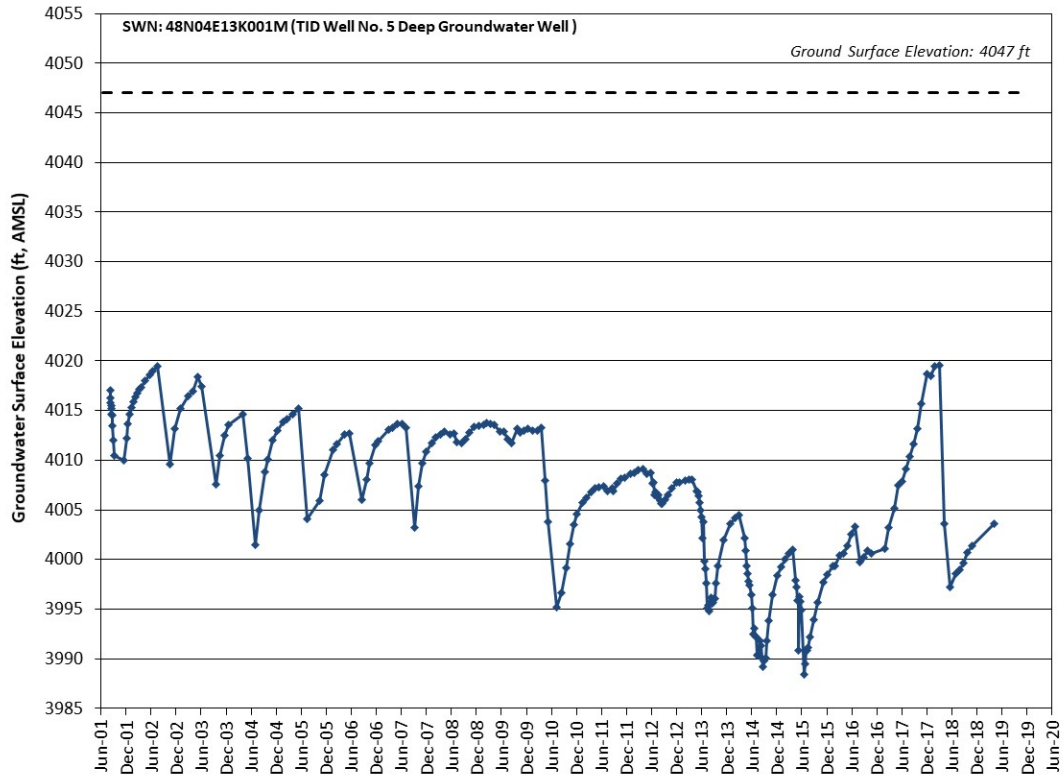


Figure 2-25. Groundwater Hydrograph for SWN: 48N04E13K001M (TID Well No. 5)

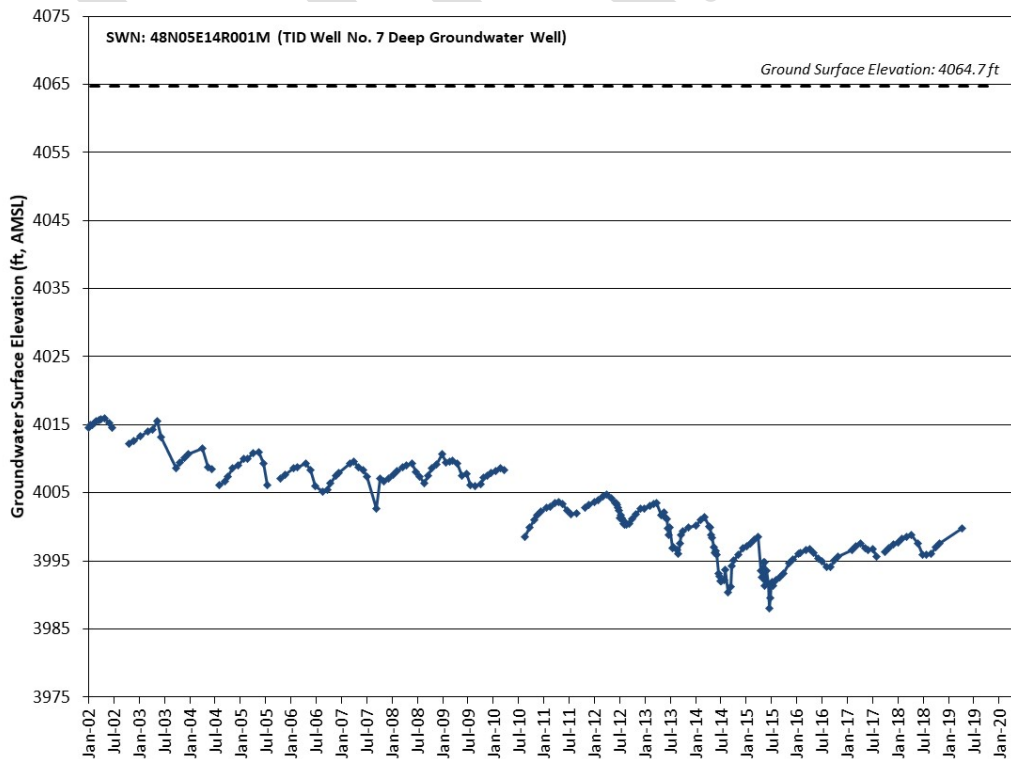


Figure 2-26. Groundwater Hydrograph for SWN: 48N05E14R001M (TID Well No. 7)

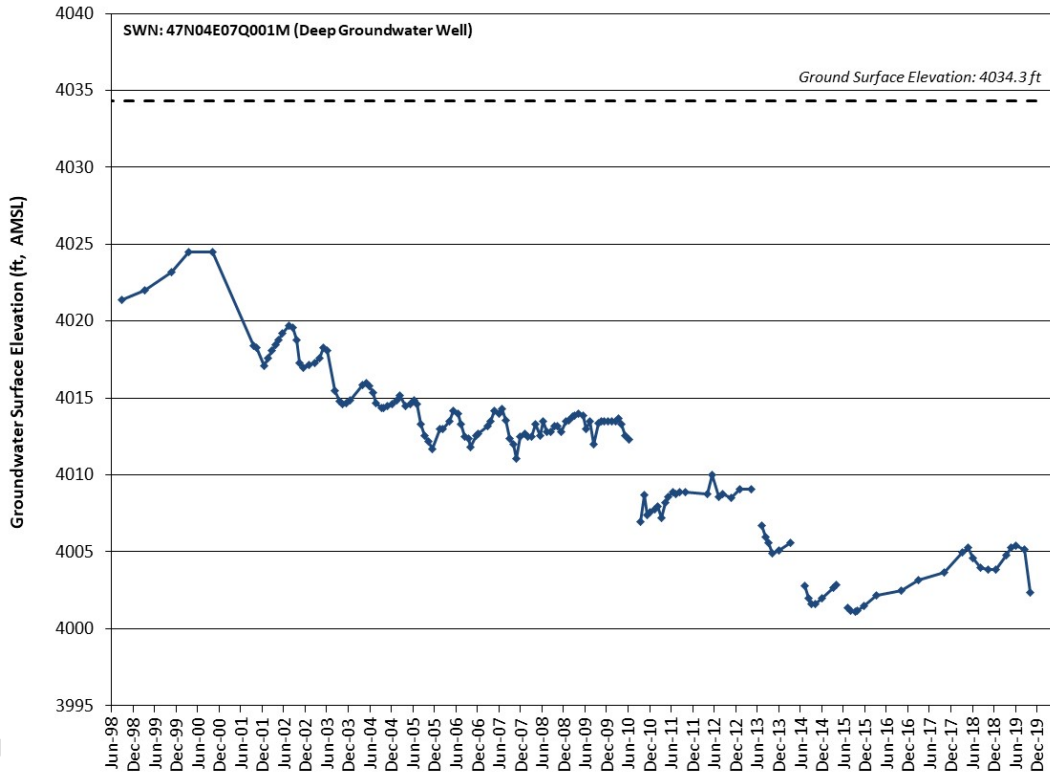


Figure 2-27. Groundwater Hydrograph for SWN: 47N04E07Q001M

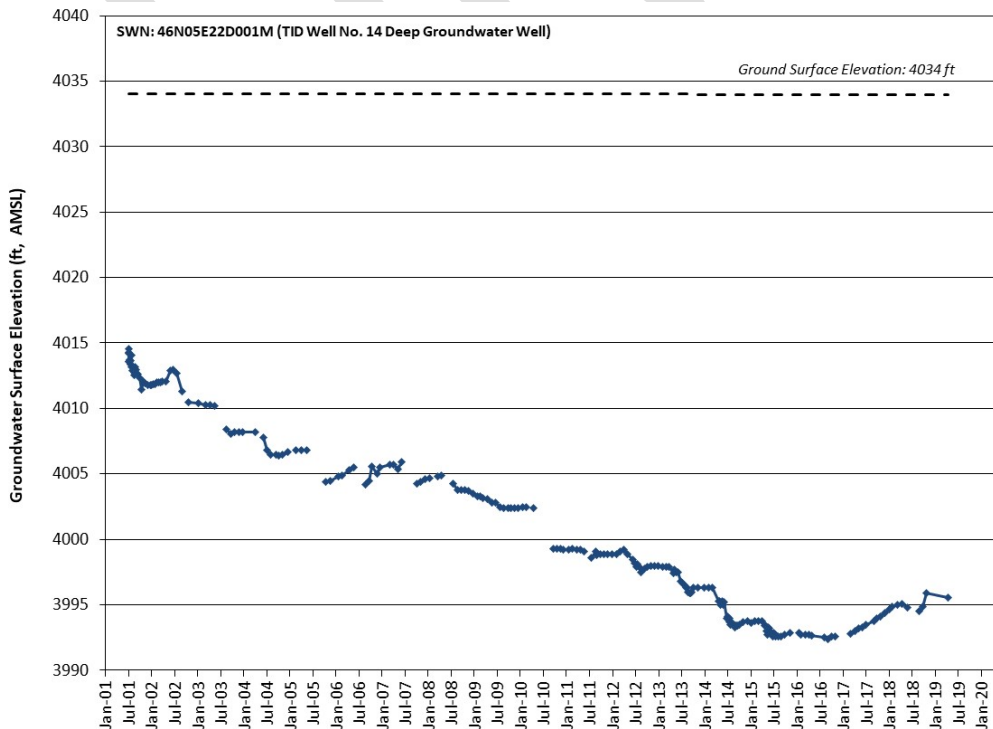


Figure 2-28. Groundwater Hydrograph for SWN: 46N05E22D001M (TID Well No. 14)

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<sup>1</sup> for spring 2015 and spring 2019, respectively, prior to the groundwater pumping during the subsequent irrigation season (ft, AMSL).

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<sup>1</sup> 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.

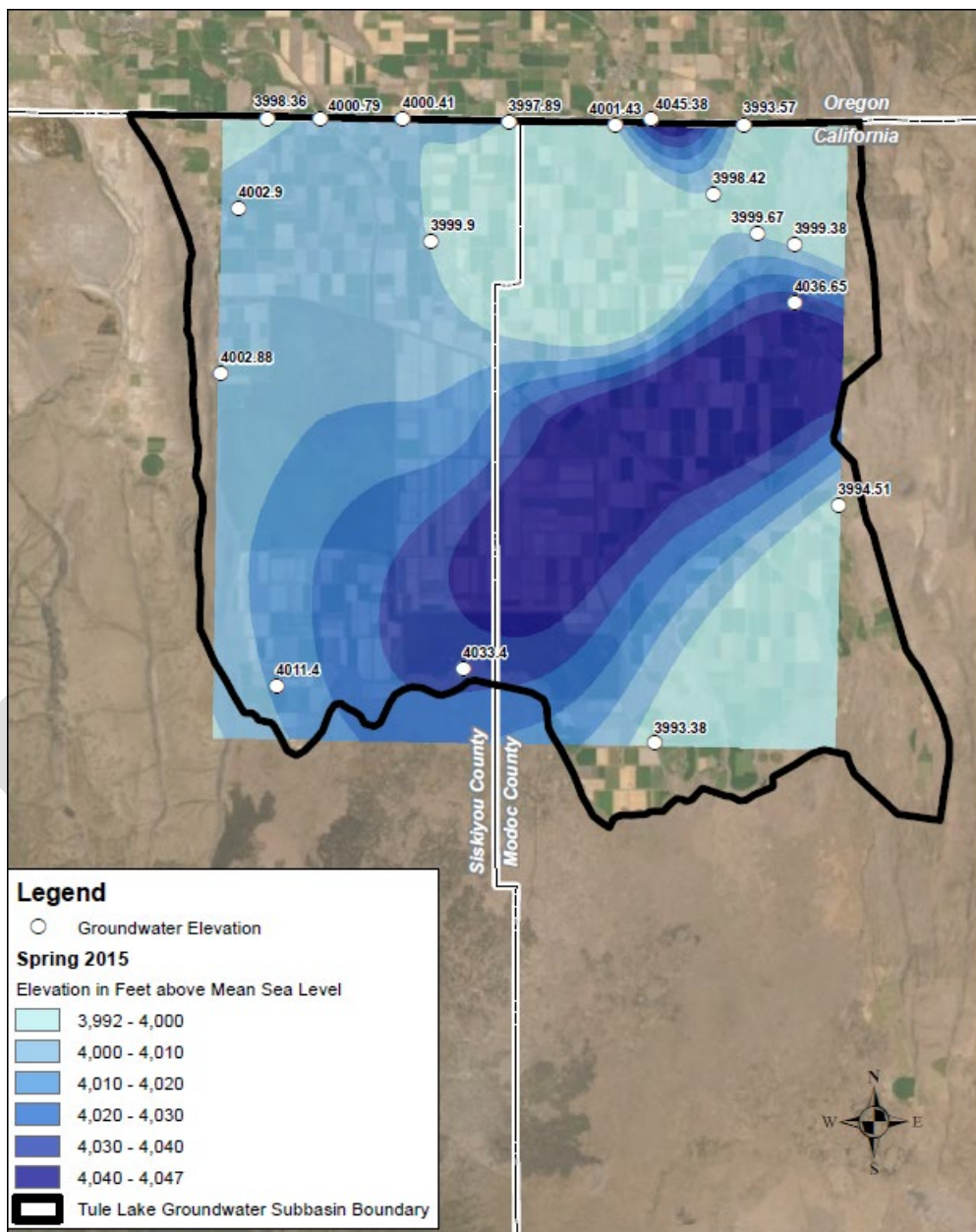


Figure 2-29. Spring 2015 Groundwater Surface Elevations

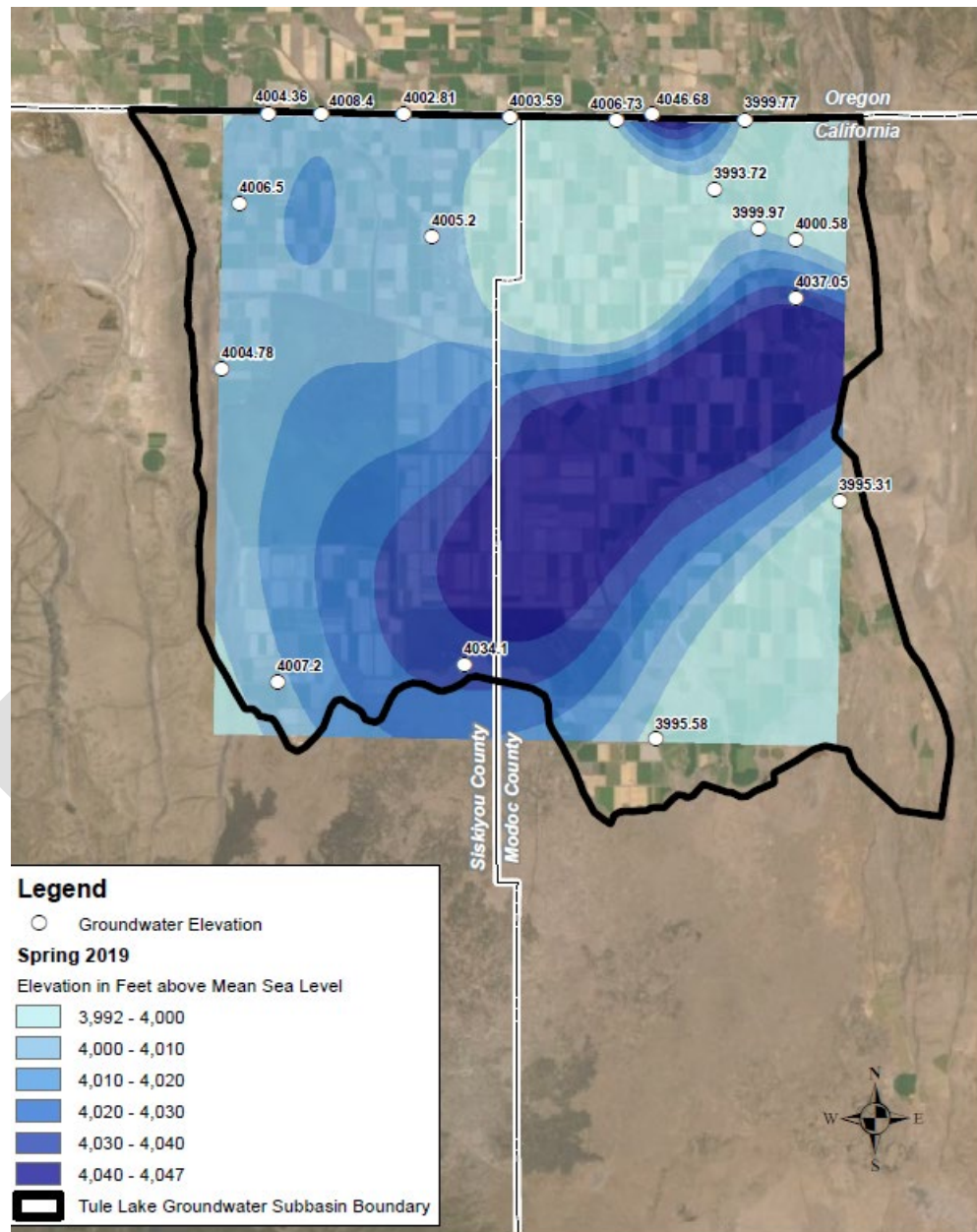


Figure 2-30. Spring 2019 Groundwater Surface Elevations

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).

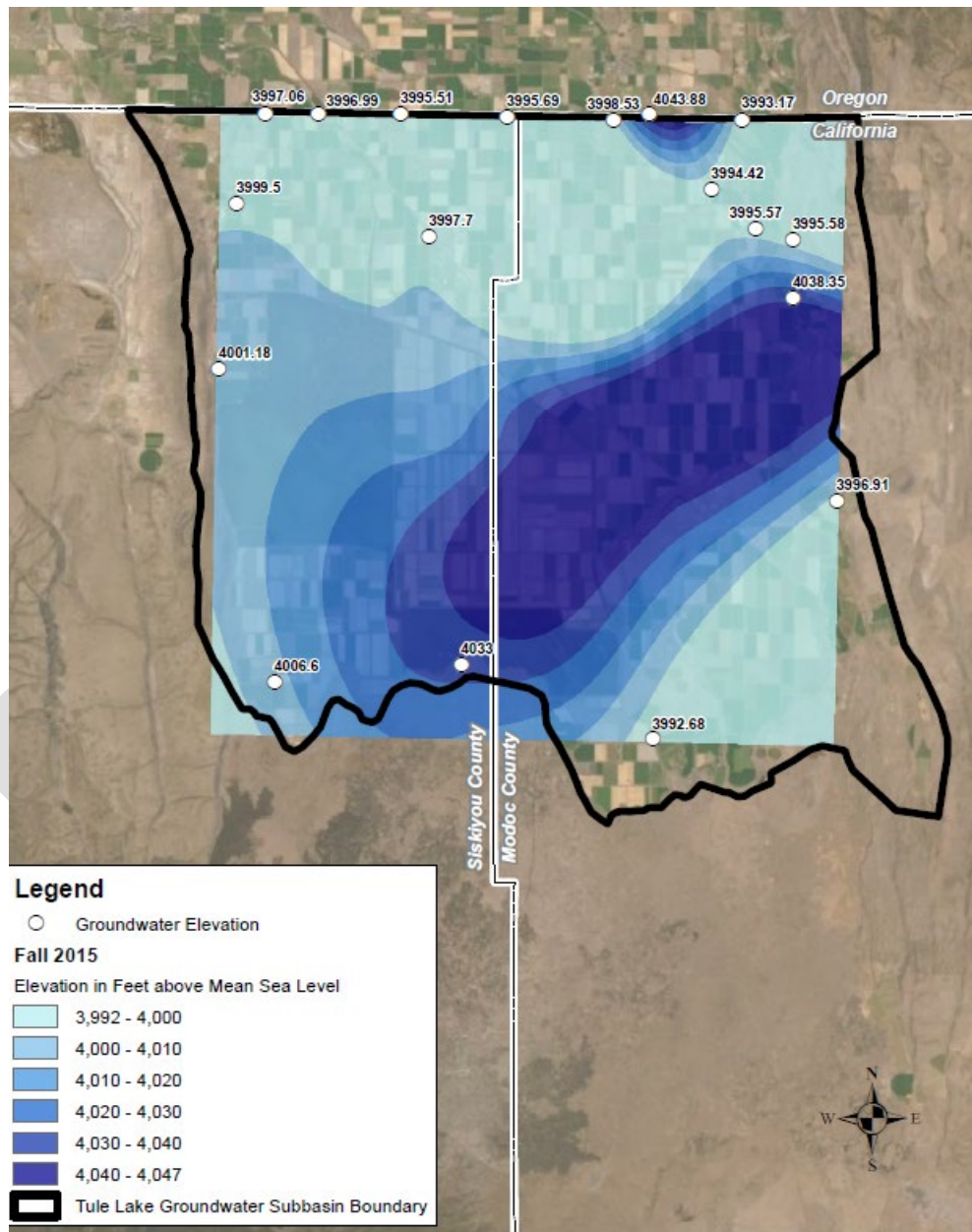


Figure 2-31. Fall 2015 Groundwater Surface Elevations

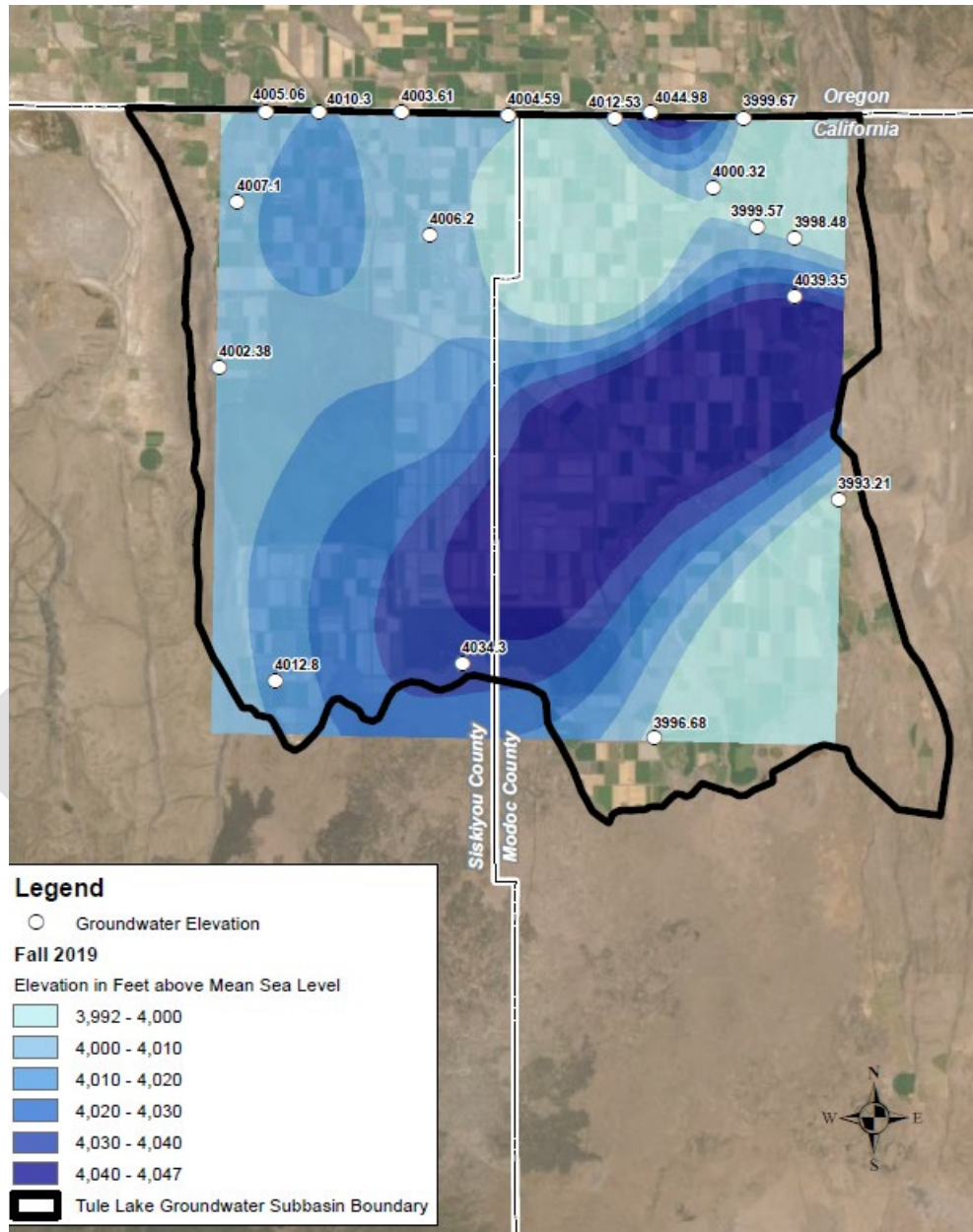


Figure 2-32. Fall 2019 Groundwater Surface Elevations

### 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<sup>2</sup>. 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.

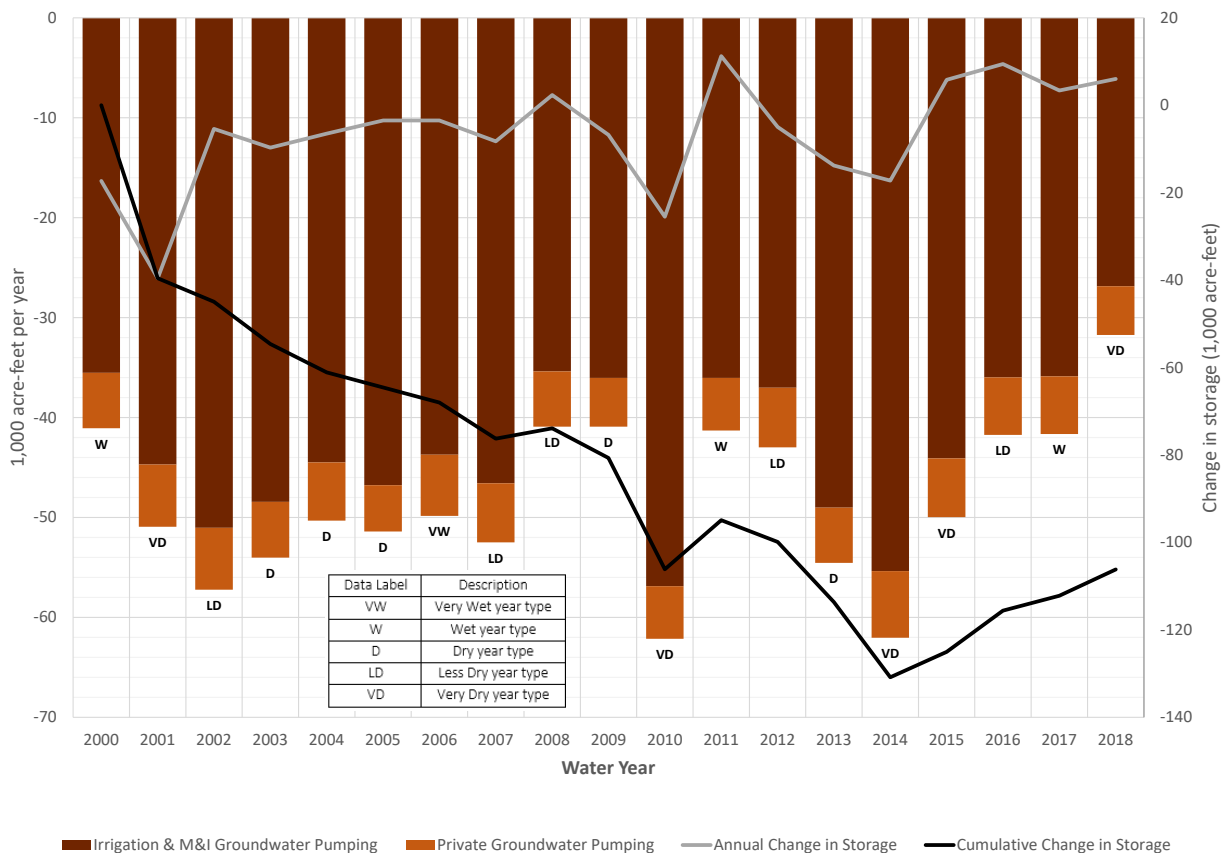


Figure 2-33. Estimated Groundwater Pumping and Change in Storage

### 2.2.2.5 Seawater Intrusion

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

<sup>2</sup> 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.

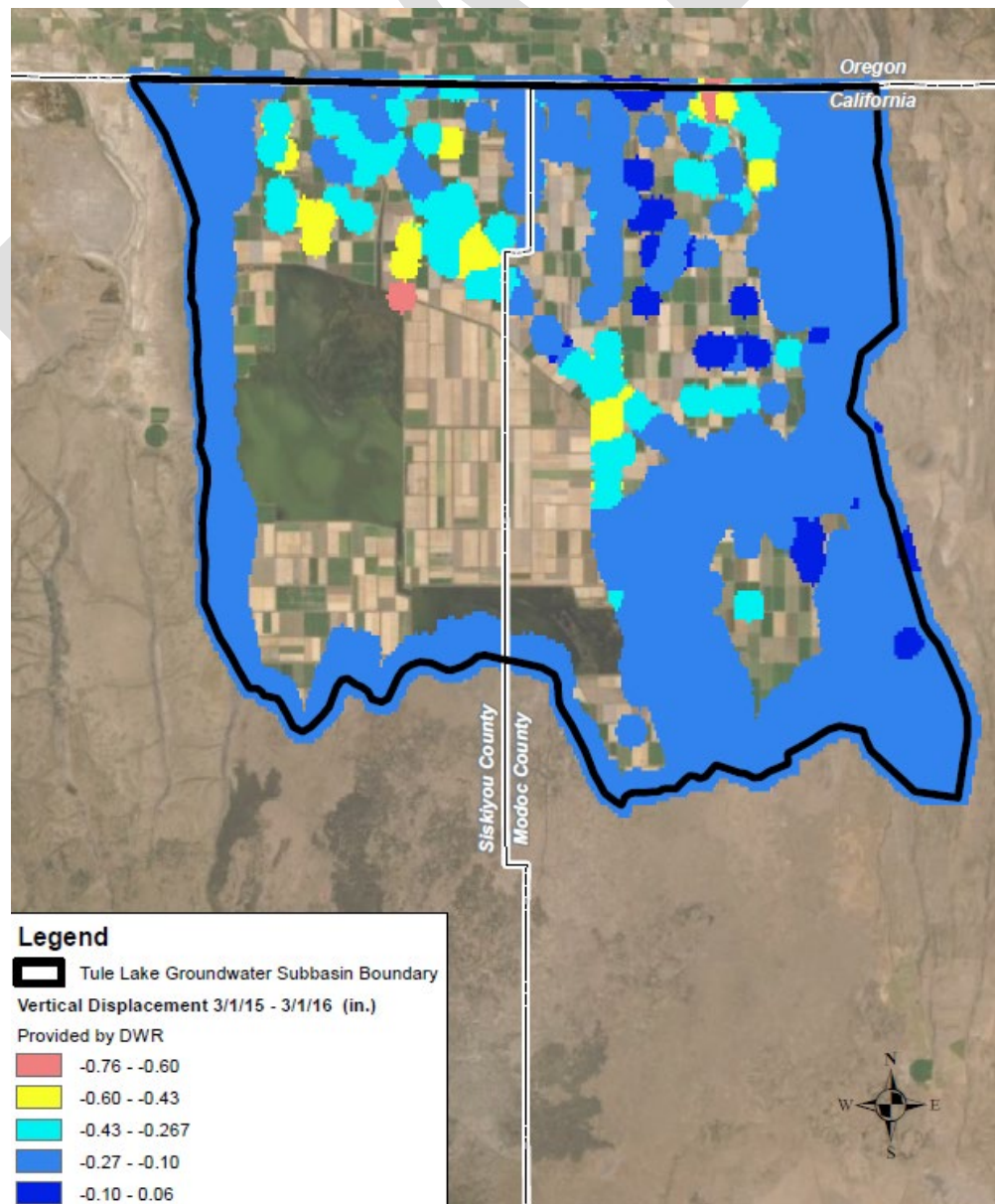


Figure 2-34. Tule Lake Subbasin 2015-2016 Land Surface Displacement

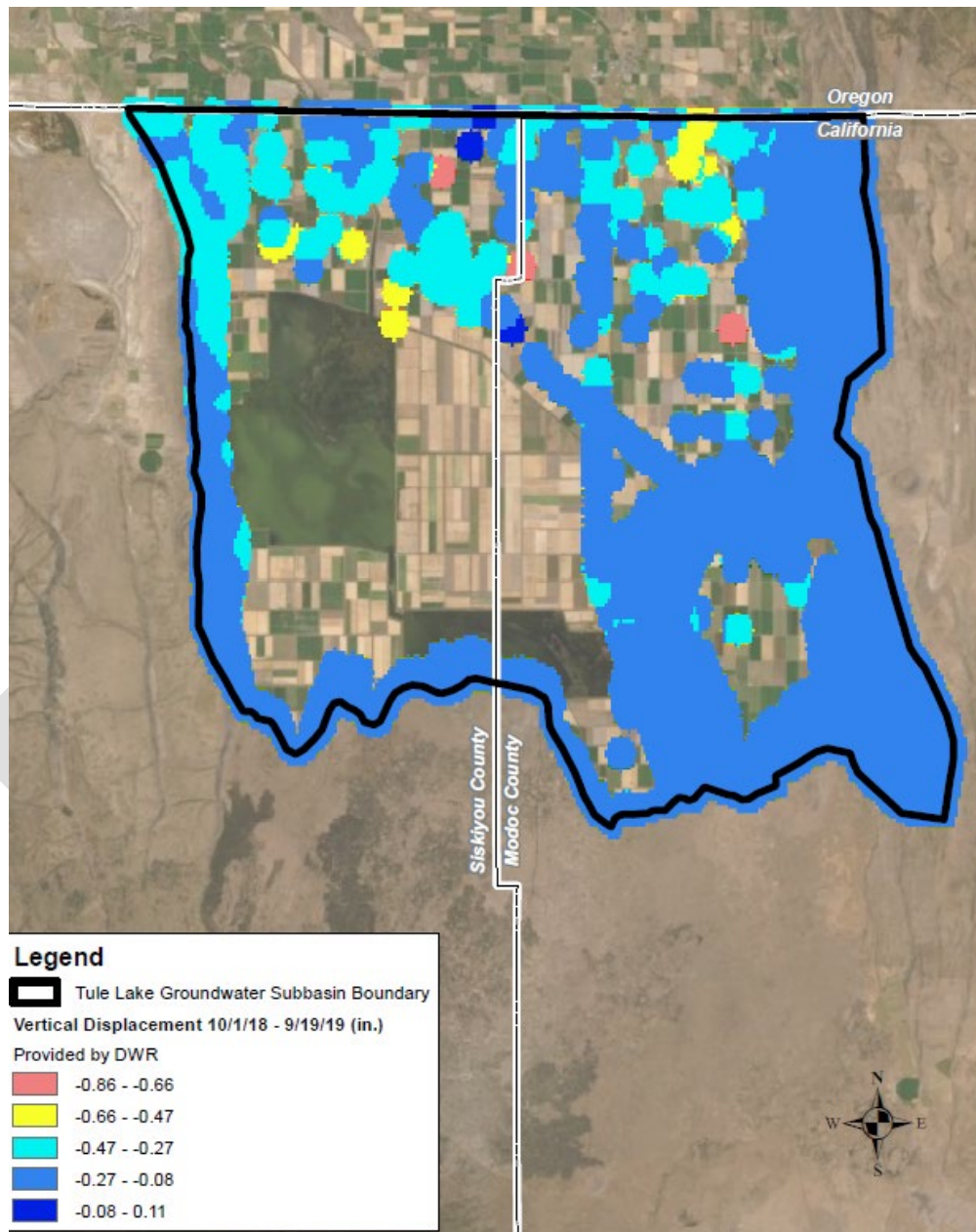
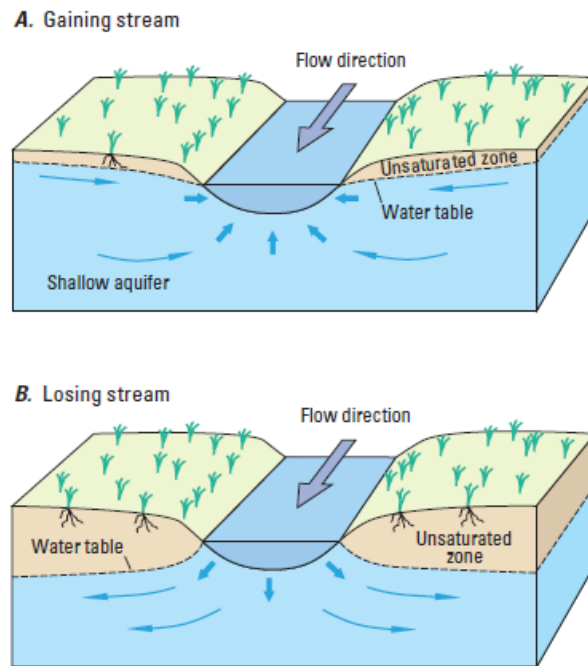


Figure 2-35. Tule Lake Subbasin 2018-2019 Land Surface Displacement

### 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.

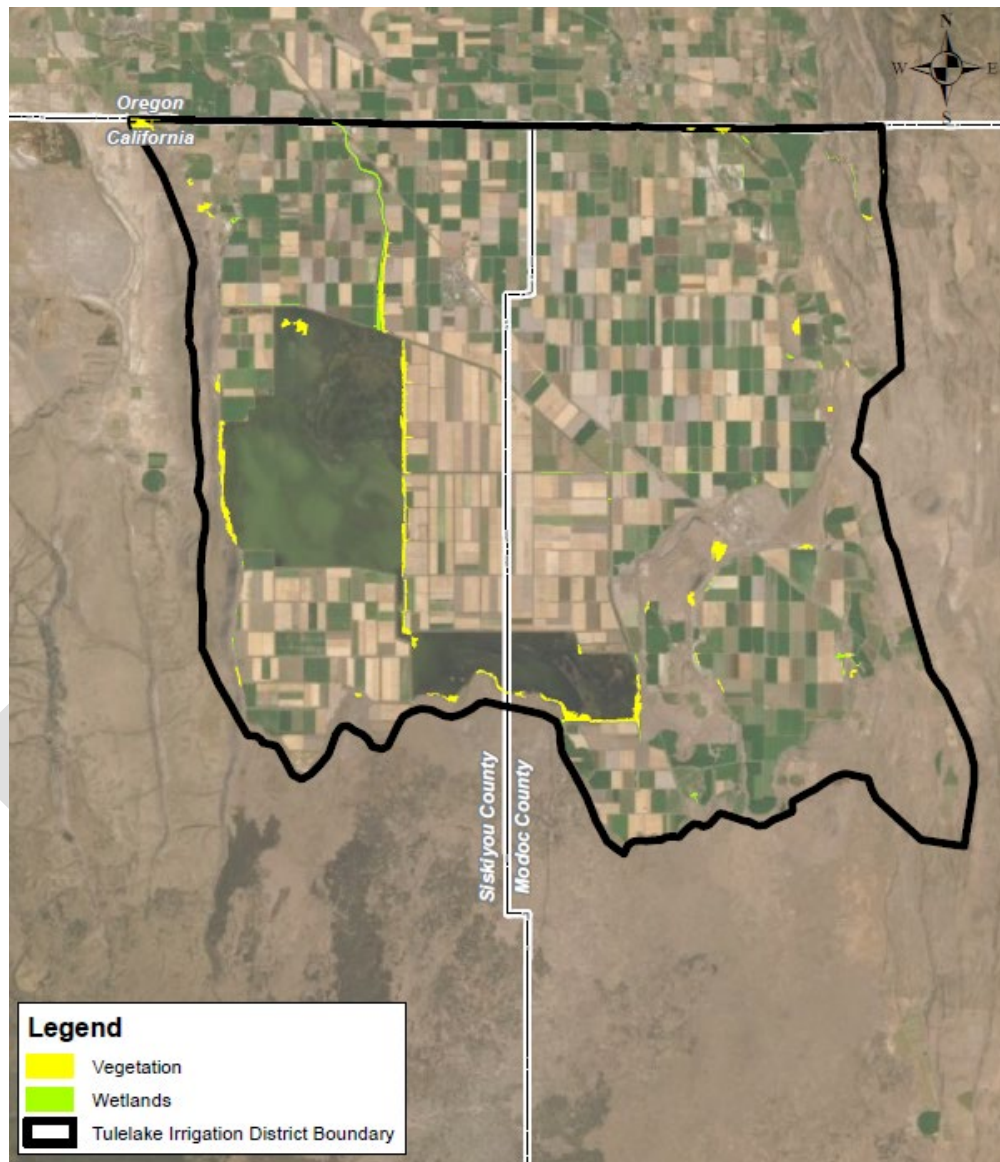
The Tule Lake National Wildlife Refuge is located within the Subbasin and primarily consists of four “Sumps,” two of which act as regulating reservoir within TID (Sumps 1A and 1B). The other two Sumps (Sumps 2 and 3) have been reclaimed and are farmed as lease and co-op lands. The operational spills 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.

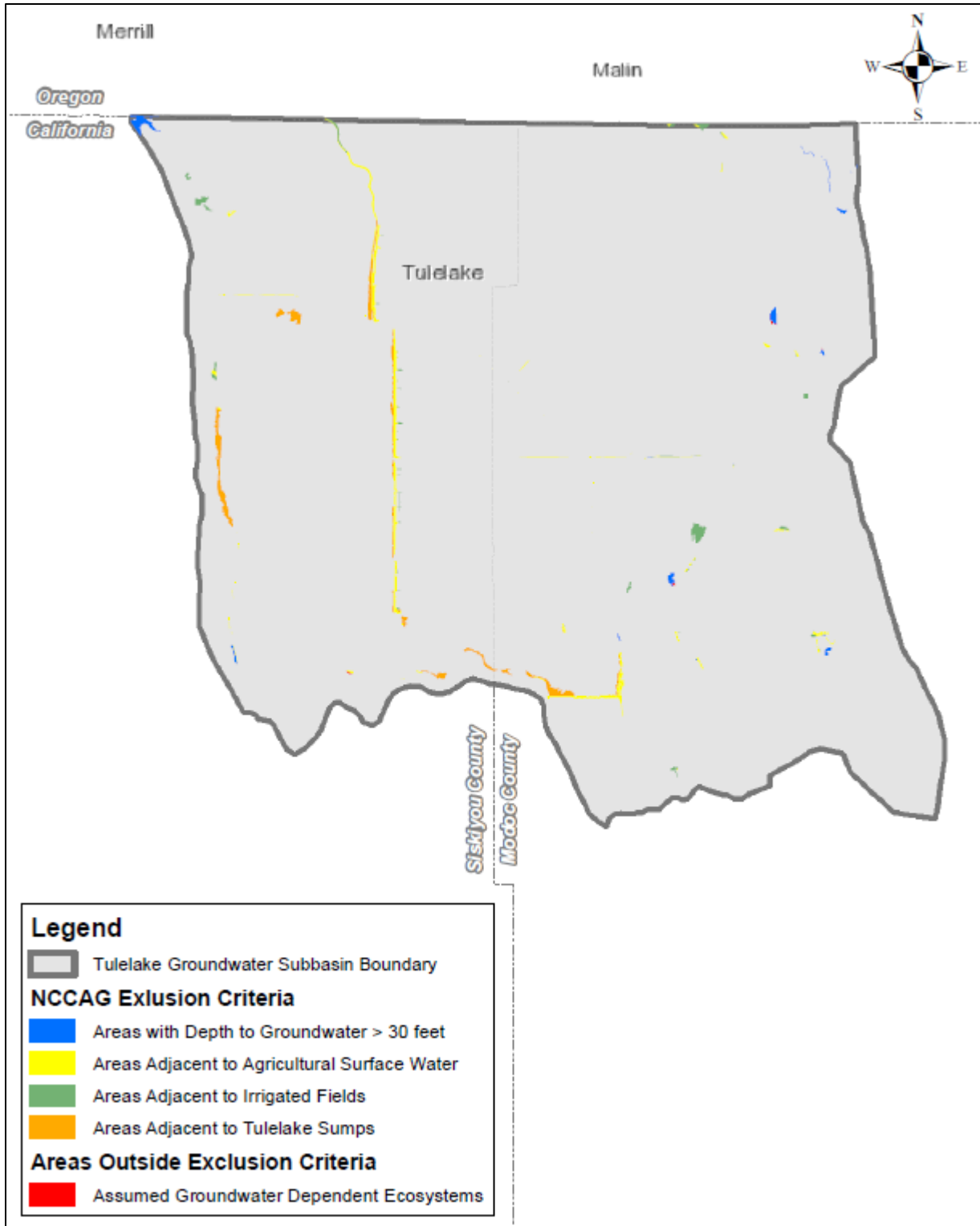


Figure 2-38. Assumed Groundwater Dependent Ecosystems

## 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

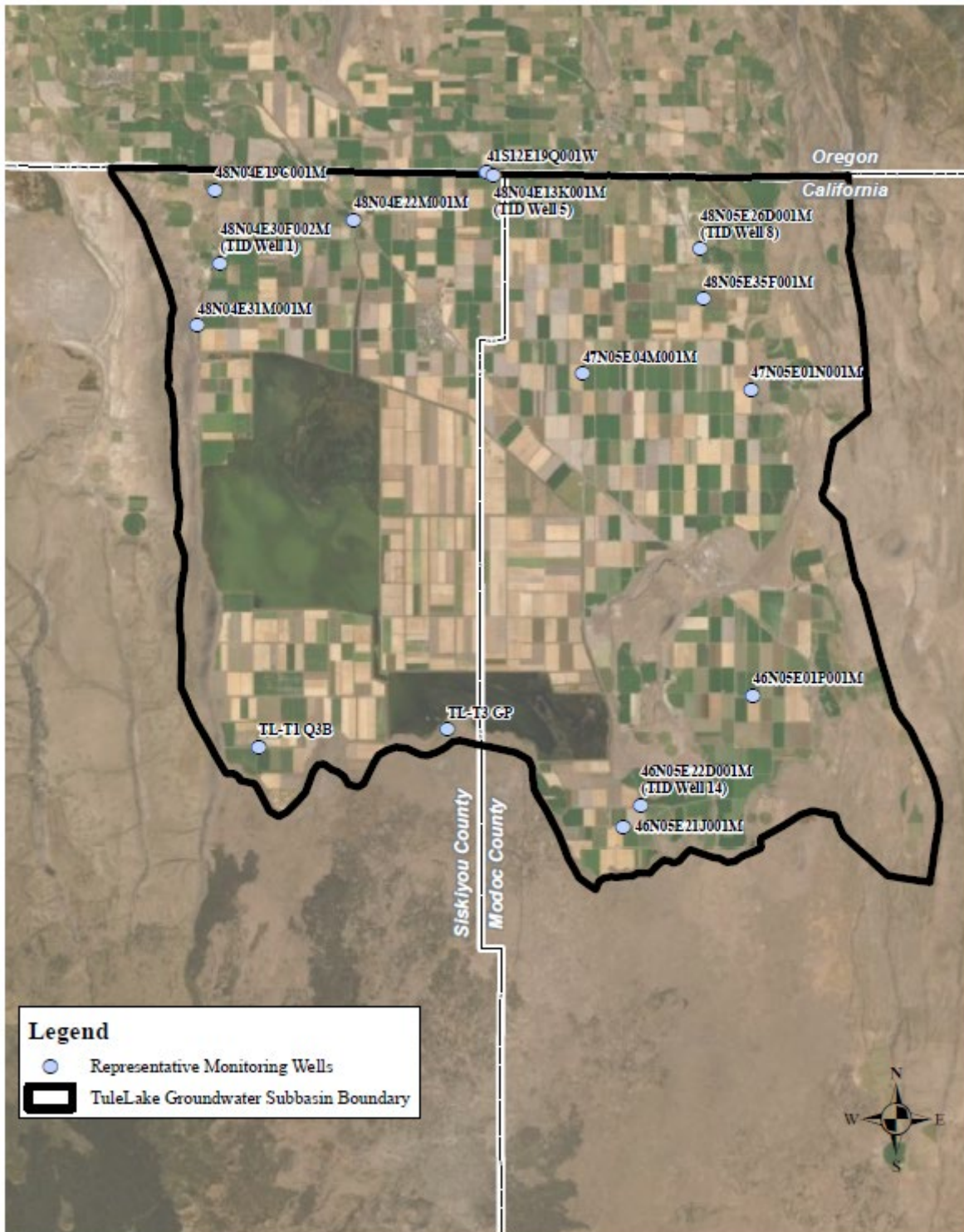


Figure 3-1. Representative Groundwater Level Monitoring Network

### 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 <sup>2</sup> )
Heath (1976)	0.2-10
Sophocleous (1983)	6.3
Hopkins (1984)	
Basins pumping more than 10,000 AFY per 100 miles <sup>2</sup>	4.0
Basins pumping between 1,000 and 10,000 AFY per 100 miles <sup>2</sup>	2.0
Basins pumping between 250 and 1,000 AFY per 100 miles <sup>2</sup>	1.0
Basins pumping between 100 and 250 AFY per 100 miles <sup>2</sup>	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.

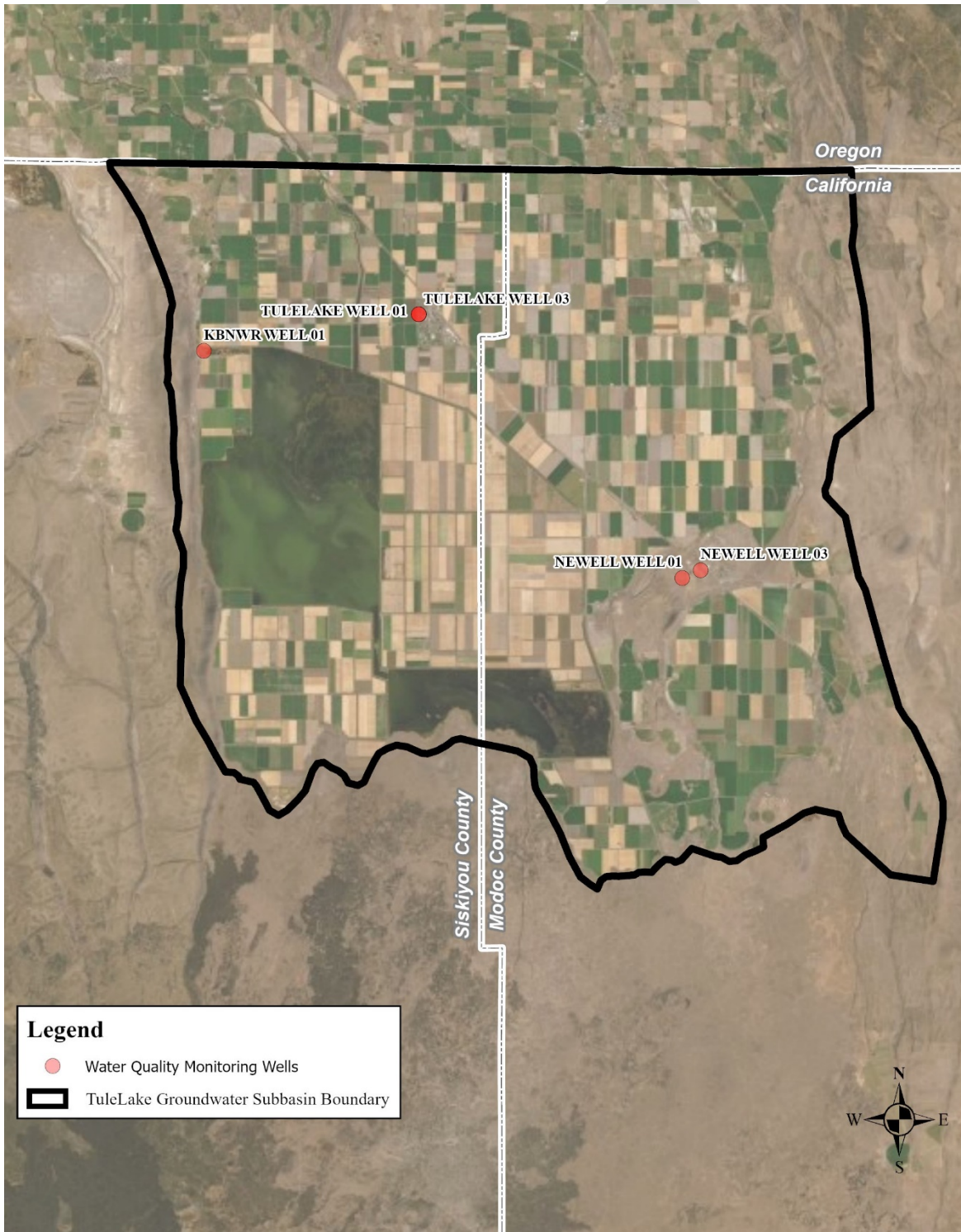


Figure 3-2. Groundwater Quality Monitoring Network

### 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<sup>3</sup>.

### 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.

<sup>3</sup> <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

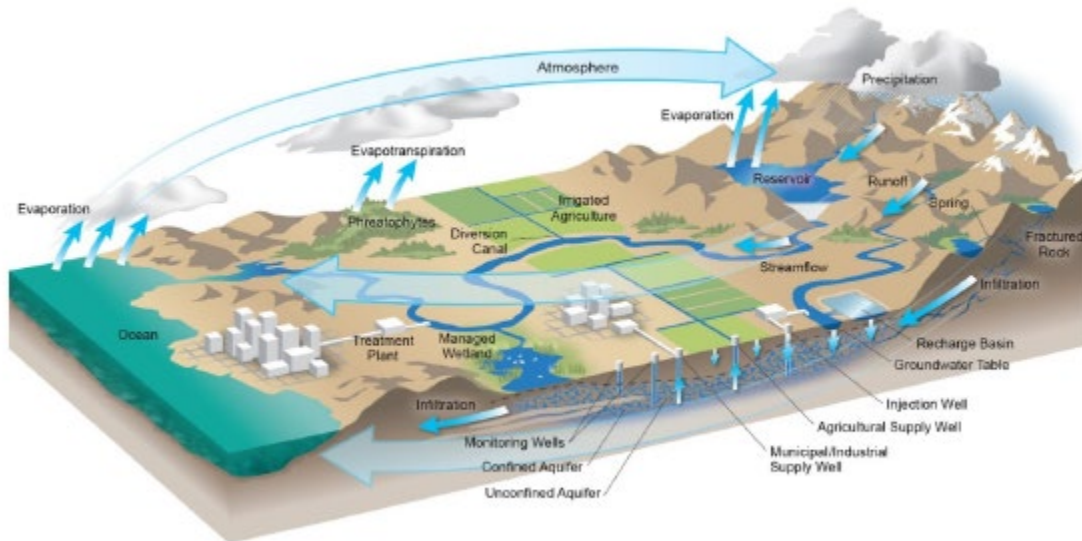
Table 3.4 summarizes the representative monitoring networks' individual contributions to monitoring each Sustainability Indicator. Seawater Intrusion is not applicable to the Tule Lake Subbasin, and therefore is not included.

**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.

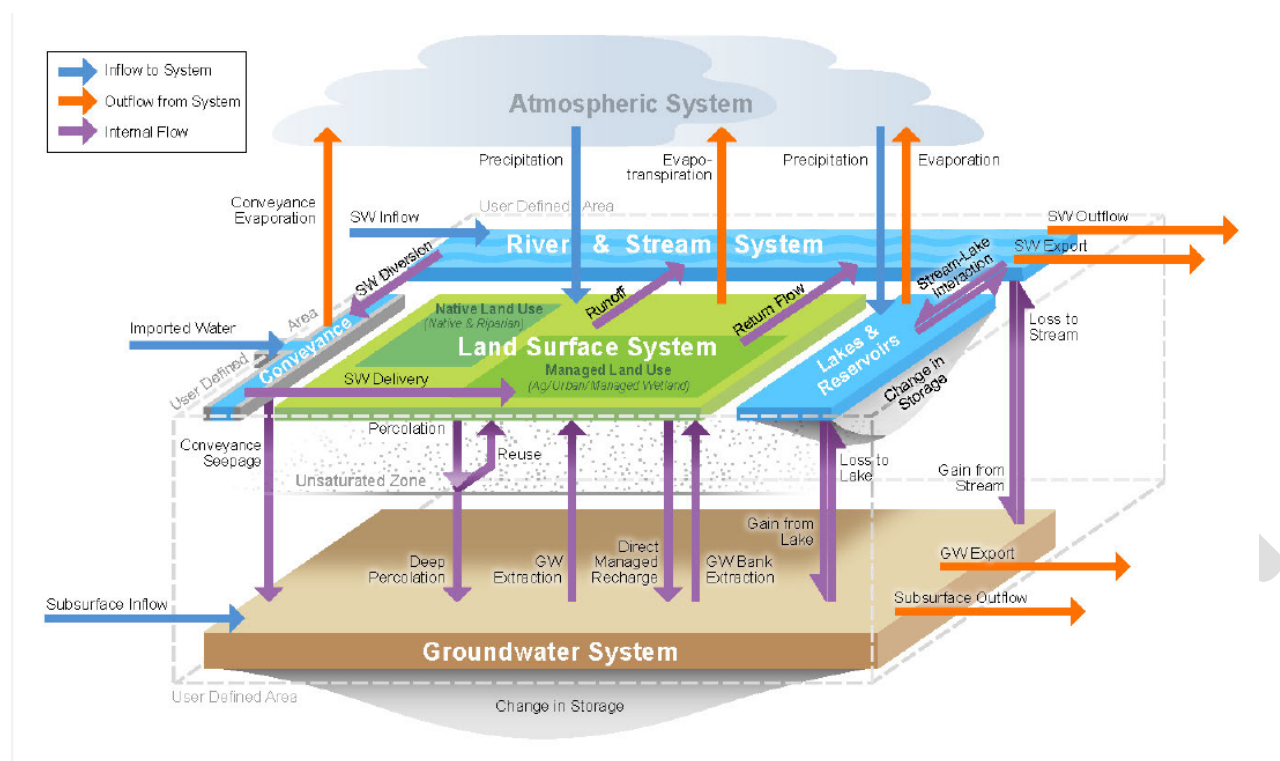


Figure 4-2. Water Budget Schematic (Source DWR 2016)

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<sup>4</sup>. 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<sup>5</sup> 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
<b>Total Inflow</b>	<b>200</b>	<b>248</b>	<b>242</b>	<b>246</b>	<b>284</b>	<b>249</b>
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

<sup>4</sup> Additional details regarding the water budgets, including Water Budget Terms presented in this Section, are provided in Appendix K.

<sup>5</sup> <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
<b>Total Outflow</b>	<b>211</b>	<b>251</b>	<b>243</b>	<b>244</b>	<b>285</b>	<b>253</b>
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
<b>Total Inflow</b>	<b>186</b>	<b>200</b>	<b>196</b>	<b>209</b>	<b>245</b>	<b>211</b>
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
<b>Total Outflow</b>	<b>186</b>	<b>200</b>	<b>196</b>	<b>210</b>	<b>245</b>	<b>211</b>

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
<b>Total Inflow</b>	<b>268</b>
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
<b>Total Outflow</b>	<b>251</b>
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
<b>Total Inflow</b>	<b>214</b>
Evapotranspiration of Precipitation	59
Evapotranspiration of Applied Water	80
Runoff From Farm	10
Groundwater Recharge from Precipitation & Applied Water	61
Shallow Groundwater Evapotranspiration	4
<b>Total Outflow</b>	<b>214</b>

#### 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

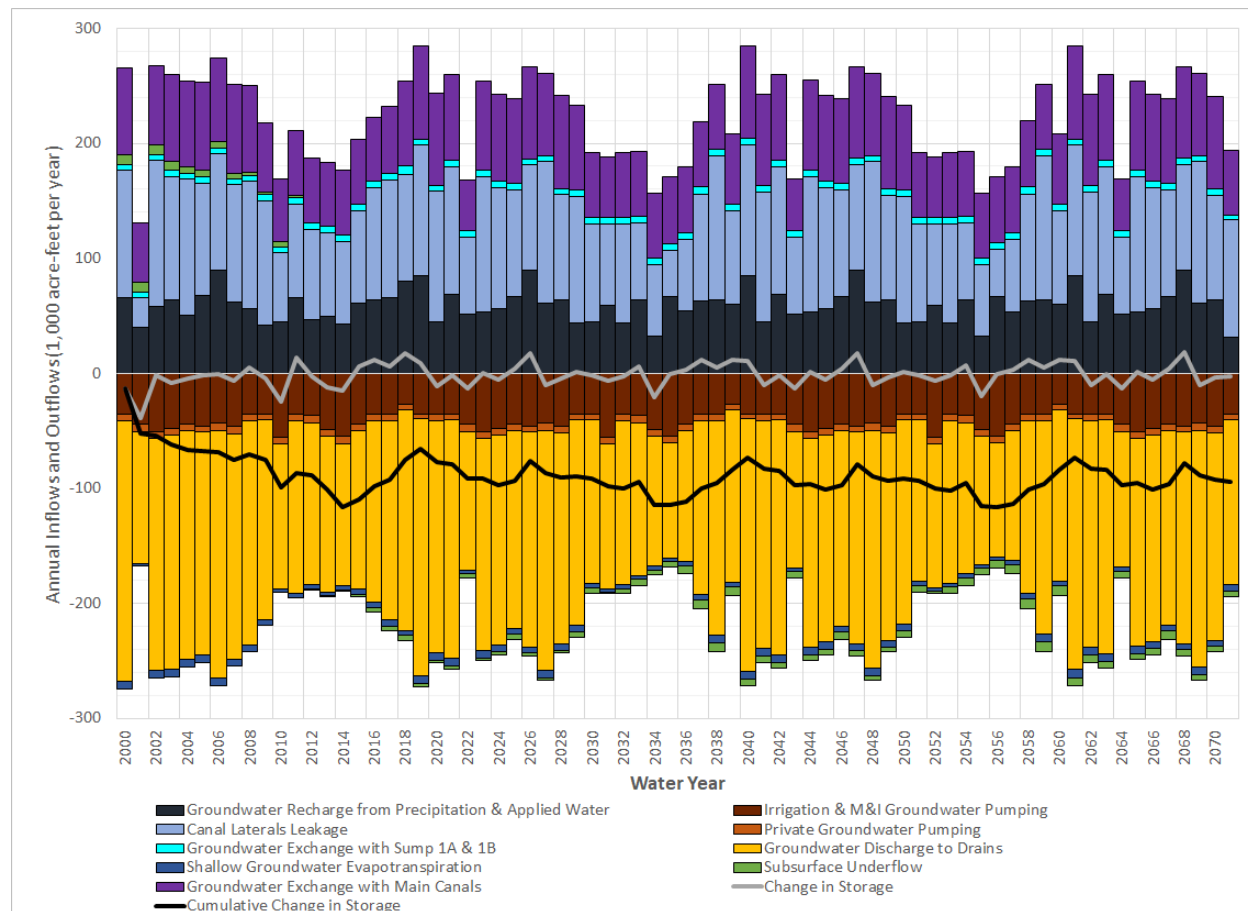
climate data from that period was repeated 2.5 times to achieve a 50-year period for projections. These data were used to develop the projected water budget baseline (i.e., without climate change). See Appendix K for further discussion on this topic.

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
<b>Total Inflow</b>	<b>238</b>
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
<b>Total Outflow</b>	<b>238</b>
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**

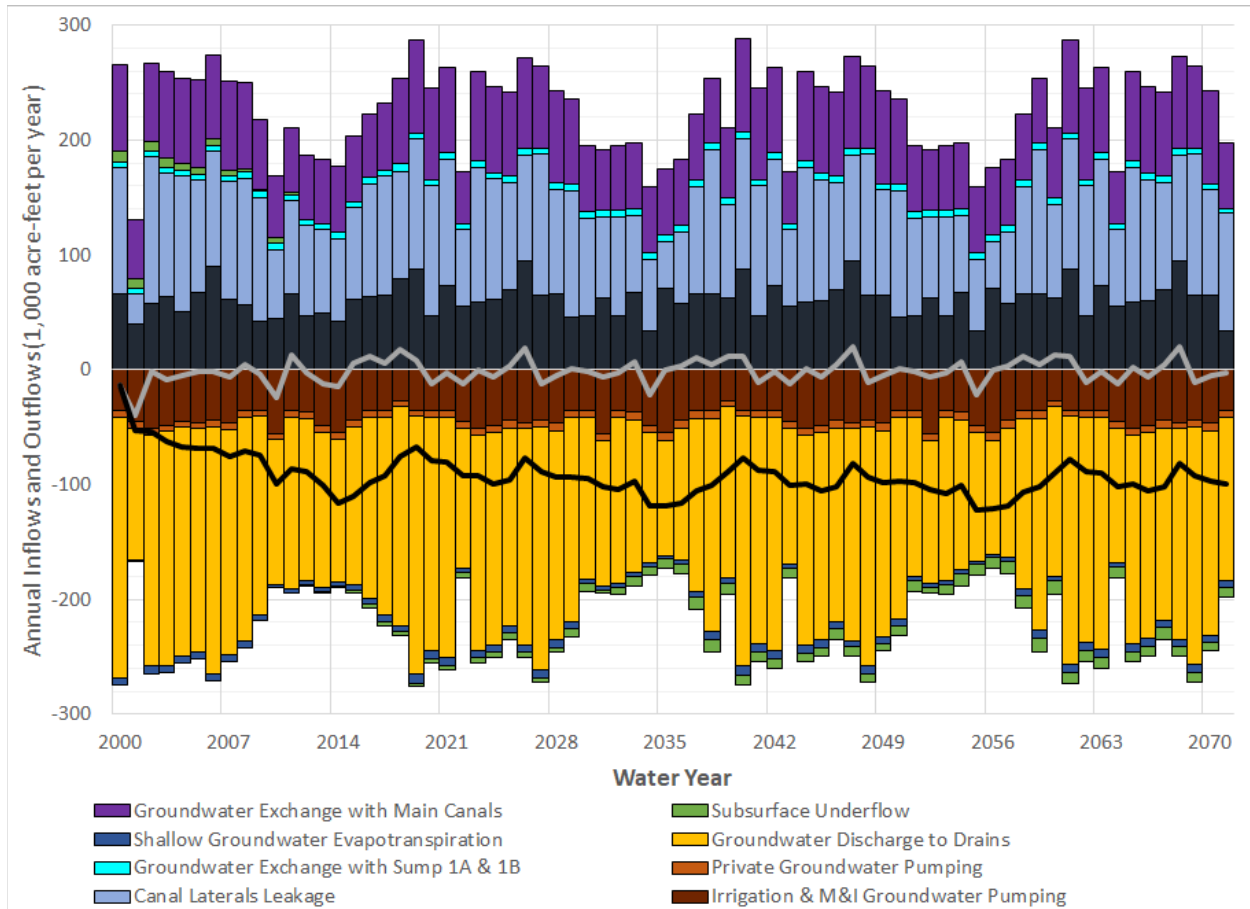
For the projected water budget with climate change, DWR provided alternatives for use by GSAs, which included climate change factors. Reclamation, in coordination with DWR and the Oregon Water Resources Department, released the Klamath River Basin Study in 2019 (Study) (USBR, 2016). The Study evaluated 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
<b>Total Inflow</b>	<b>242</b>
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
<b>Total Outflow</b>	<b>242</b>
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.

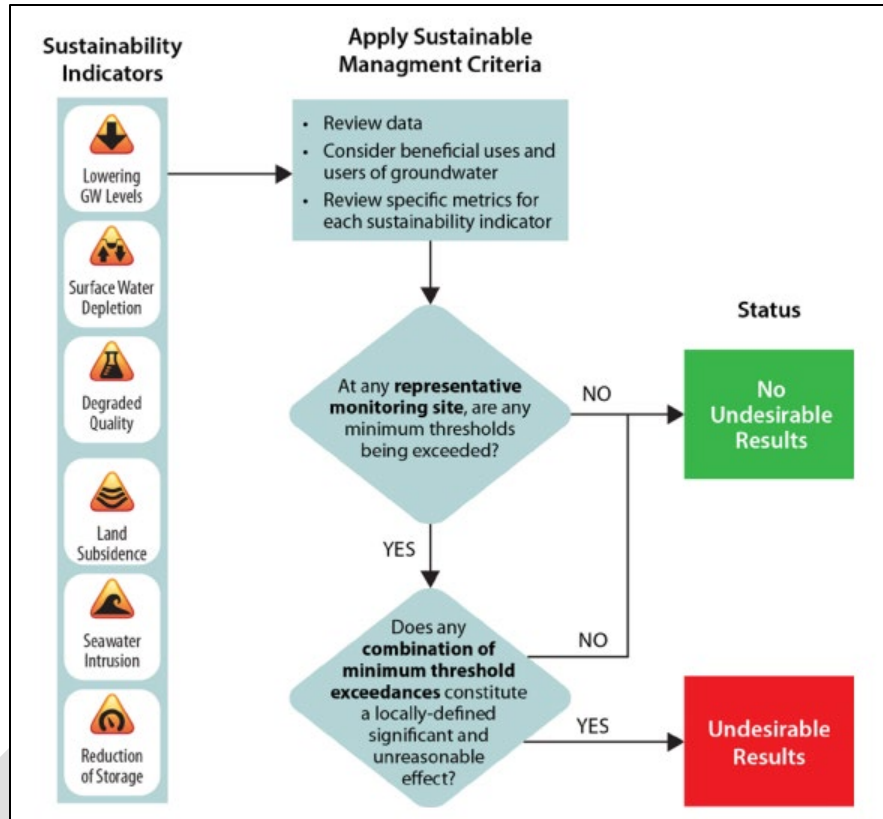


Figure 5-1. Relationship of Sustainability Indicators, SMCs, MTs, and Undesirable Results (DWR)

## 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. In extreme cases, groundwater levels may decrease to an extent where it becomes necessary to lower pump bowls and/or deepen the production well.

#### ***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. 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 effects a large number of domestic wells.

### ***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.

1. If the monitoring well depth is less than 500 feet and within three miles of a domestic well or wells, then the MT is defined as the minimum domestic well depth. Appendix M provides additional information on this process.
2. If the monitoring well depth is greater than or equal to 500 feet, then the MT is defined as the historical low groundwater measurement plus a 10 percent buffer, rounded up to the nearest whole number.

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	32	32	8
48N04E22M001M	29	50	50	15
48N04E31M001M	31	48	48	23
48N04E19C001M	15	29	29	11
47N05E04M001M	10	15	15	9
47N05E01N001M	22	49	49	15
46N05E21J001M	12	32	32	10
46N05E01P001M	13	24	24	11
41S12E19Q001W	14	50	50	6
48N04E30F002M (TID Well 1)	72	-	80	38
48N04E13K001M (TID Well 5)	192	-	212	42

State Well Number	Historic Low (ft bgs)	Min. Domestic Well Depth (ft bgs)	Minimum Threshold (ft bgs)	Measurable Objective (ft bgs)
48N05E26D001M (TID Well 8)	276	-	304	48
46N05E22D001M (TID Well 14)	90	-	99	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. 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 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.

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## 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 Wells <sup>1</sup>	X	X	
Water Quality Monitoring Network	X		
Groundwater Dependent Ecosystems	X		
Groundwater Recharge Project(s)	X	X	X
Domestic Well Assistance <sup>1</sup>	X	X	X
Adaptive Management Strategy <sup>1</sup>	X	X	X

<sup>1</sup> 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.

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appendices placeholder