Tulelake Irrigation District

Groundwater Management Plan

April 2013

TULELAKE IRRIGATION DISTRICT

GROUNDWATER MANAGEMENT PLAN

2013

Prepared by

MBK ENGINEERS

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Acronyms and Abbreviations

AMSL	Above mean sea level
CASGEM	California Statewide Groundwater Elevation Monitoring
DWR	California Department of Water Resources
District	Tulelake Irrigation District
Ft	Feet
GWMP	Groundwater Management Plan
KBRA	Klamath Basin Restoration Agreement
KWAPA	Klamath Water and Power Agency
OPP	On-Project Plan
OPPA	On-Project Plan Area
Reclamation	U.S. Bureau of Reclamation
SWN	State Well Number
USGS	U.S. Geological Survey
WDL	Water Data Library

Section 1 - Introduction

Tulelake Irrigation District (District) is preparing a Groundwater Management Plan (GWMP) as authorized by sections 10753-10753.11 of the California Water Code. The preparation of the GWMP will include the development of appropriate groundwater "Management Objectives" within the GWMP area (District boundary) and the corresponding monitoring to assure that the Management Objectives are being met. California Water Code Section 10750 et seq. (SB 1938) authorizes local agencies which provide water to a service area overlaying a groundwater basin to adopt and implement a GWMP for that basin. The District held a hearing on August 29, 2011 to discuss the development and adoption of a GWMP with interested parties. On September 12, 2011, the District adopted a resolution of intention to draft a GWMP (Resolution 2011-02) and published the Resolution in the Herald and News (see Appendix A). The District is now in a position to consider all of the components set forth in Water Code Section 10753.7 and select those components which are appropriate for inclusion in the District's GWMP. The primary goal in developing the GWMP is to work cooperatively with landowners within the District to most efficiently monitor the groundwater resources and to continue with an efficient and effective conjunctive use program during years where surface water supplies are limited or not available.

The District has been working with interested parties including local, county, state and federal representatives to develop the "Management Objectives" of the GWMP and define the "Elements" of the GWMP that will facilitate achievement of the Management Objectives. In October of 2012 the District transmitted a fact sheet and statement to interested parties informing them of the opportunity for involvement in the development of the GWMP (see Appendix A). The first of a series of public meetings was held on November 15, 2012. A second public meeting was held on February 27, 2013 to provide a Draft GWMP to interested parties for review and comment prior to finalizing the GWMP. Comments to the Draft GWMP were received from the Klamath Basin Area Office (KBAO), US Bureau of Reclamation (Reclamation). No additional comments were received. The comments provided by KBAO were reviewed and incorporated into this GWMP. A second hearing to consider the adoption of the GWMP is scheduled for April 25, 2013. A copy of the letter to interested parties informing them of the second public hearing is also included in Appendix A.

Section 2 - Tulelake Irrigation District

The following section provides information on the background and development of the District and briefly described the water rights/contracts, infrastructure, and available water supplies (surface water and groundwater) and the proposed GWMP area.

In 1902, Congress enacted the Reclamation Act (Act of June 17, 1902, ch. 1093, 32 Stat. 388). Construction of the Klamath Reclamation Project began in 1906. Prior to the construction of the Klamath Reclamation Project most of the lands within the current boundary of the District were submerged. The submergence of this land created a body of water known as Tule Lake. To reclaim this area and drain Tule Lake, two outlets were constructed at the southern end of the lake that would direct the flow into lava beds. The flow to drain Tule Lake began in October 1909 and continued until 1912 when the lake level dropped below the elevation of the drains.

Construction of the Klamath Reclamation 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. By 1916, approximately 5,900 acres within the previously submerged region of Tule Lake had been exposed and work began on the Tule Lake portion of the Klamath Reclamation Project (Tule Lake Unit) with the construction of a distribution and drainage systems for exposed lands along the northern portion of the lake. In 1917, the first Tule Lake lands opened to homestead entry. By 1921, the exposed lakebed had increased to about 20,000 acres.

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 continued on the distribution, levee and drainage systems within the Tule Lake Unit. By 1923, the continued diversion of Lost River water to the Klamath River and diversions for irrigation resulted in approximately 85,000 of the 90,000 previously submerged acres within the Tule Lake Unit being 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 Tule Lake were leased for farming. The Copic Bay region of Tule Lake was opened to homesteading in 1947 and 1948. By the 1950s, about 44,000 acres had been homesteaded.

In 1952 the District was formed. On September 10, 1956, the District entered into a contract with U.S. Bureau of Reclamation (Reclamation) for repayment of the construction charges and the transfer of the District operation and maintenance of the facilities used to deliver water to the District lands. Figure 1 identifies the development timeline for the District.

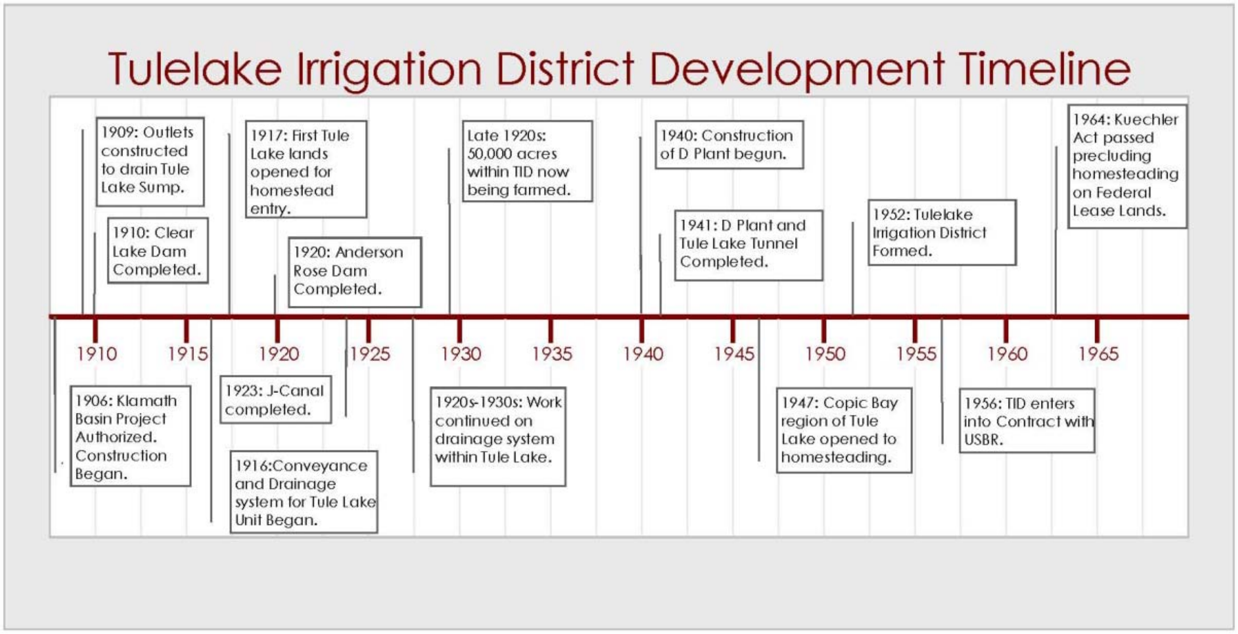


Figure 1 Tulelake Irrigation District development timeline

The District currently encompasses 96,000 acres, of which Tule Lake and the Tule Lake National Wildlife Refuge are included. The irrigable acreage of the District is approximately 64,000 acres, of which approximately 18,000 acres are Federal Lease Lands owned by the United States. In addition to the Federal Lease Lands, the Public Lands include areas utilized by the U.S. Fish and Wildlife Service for farming and other uses.

Typical crop types produced within District include alfalfa, cereal grains, mint, onion, pasture, and potatoes. The general mix of crops within the District is identified in Table 1.

Table 1. Representative cropping pattern (2005)

Crop Type	Acres	Percentage of Total Acres Irrigated
Alfalfa	16,928	26.7%
Cereal Grains [1/]	22,578	35.6%
Mint	2,226	3.5%
Onions	2,668	4.2%
Potatoes	7,536	11.9%
Pasture	1,641	2.6%
Other [2/]	9,777	15.4%
Total	63,354	100%

[1/] Cereal grains consist of acreage planted to barley, wheat, oats, and rye.
[2/] Other crops include peas, horseradish and hay (mostly grasses)

Water Rights and Contracts

Prior to the formation of the District, water was delivered by Reclamation to homesteaders and other landowners. Following the formation of the District, and the execution of Contract No. 14-06-200-5954 with United States, the District began providing water service to lands within the District. The Klamath River water rights for the Klamath Reclamation Project are currently being adjudicated by the State of Oregon. Contractually, Reclamation recognizes certain lands within the District as having a higher contractual priority to Klamath Reclamation Project supplies than other lands. The District is an active participant in the on-going Klamath River Adjudication.

Lands within the District also have rights to use water from Lost River. Although some Lost River water rights were adjudicated in 1918, a recent court decision ruled that the 1918 process had not adjudicated water rights in the Klamath Reclamation Project. There is some uncertainty on this issue. Some lands within the District may possess California riparian rights to Lost River or Tule Lake.

Infrastructure

The majority of the 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. Klamath River water is diverted at locations on the Lost River Diversion Channel known as Station 48 and the No. 1 Drain during the irrigation season. These diversions provide Klamath River flows to the District and other water users. The District 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 to the District.

The District operates and maintains a diversion dam on the channel of the Lost River, 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 District's J-Canal, which distributes water to more than one-half of the District'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 District. Water not diverted by the District at Anderson-Rose Dam flows through the Lost River and into the Tule Lake Sumps. Water regulated and stored within the Tule Lake Sumps may be diverted or re-diverted for irrigation within the District or discharged by the District's D-Pumping Plant to the P-Canal, which serves the Lower Klamath National Wildlife Refuge (LKNWR) and the water users on the P-Canal system of the Project.

The operational spills and tailwater resulting from irrigation within the District are conveyed through the District's extensive drainage system, which utilizes gravity and pumped discharge into portions of the canal system or into the Tule Lake Sumps.

Figure 2 identifies the major facilities within the District, including the conveyance and drainage system.

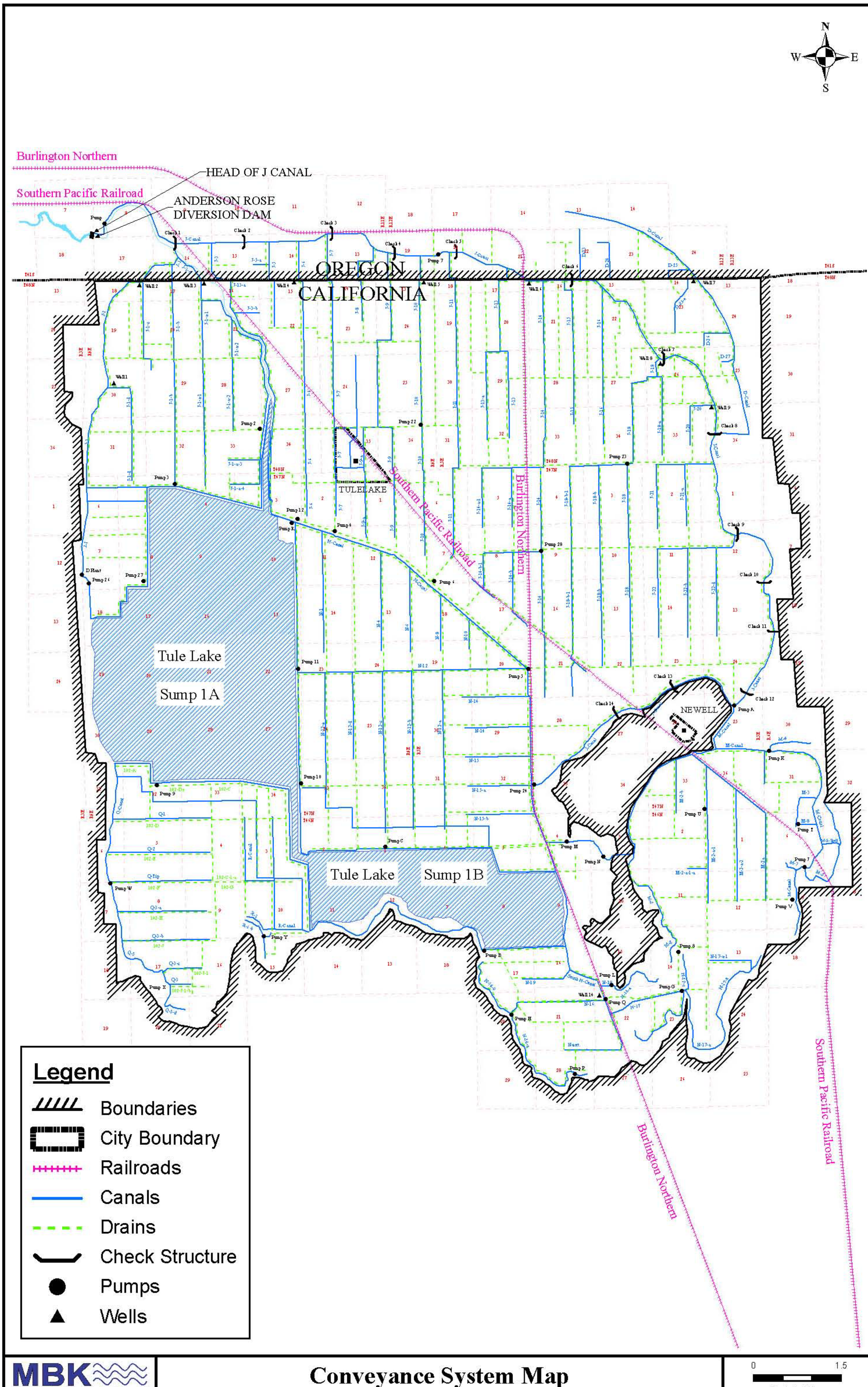


Figure 2. Tulelake Irrigation District conveyance system map

Available Water Supplies

The surface water supplies available to the District 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 under some conditions. In addition, in 2001, the District constructed 10 groundwater wells to provide supplemental water supplies during dry years. Groundwater is only utilized within the District during dry years and represents a small portion of the total water supplies available in any given year. Table 2 provides a summary of information for the 10 wells owned and operated by the District.

Table 2. District owned and operated groundwater wells

State Well Number (SWN)	District Groundwater Well No.	Well Capacity (cfs)	Well Horse Power	Well Depth	Well Casing (inches)
48N04E30F002M	1	22.3	300	734	24
48N04E18J001M	2	24.5	600	1,541	16 & 14
48N04E16M001M	3	17.8	600	1,681	12
48N04E15K001M	4	24.5	600	1,433	14
48N04E13K001M	5	20.1	600	1,565	14
48N05E16P001M	6	11.6	400	2,380	12
48N05E14R001M	7	9.6	500	2,020	14
48N05E26D001M	8	8.9	400	1,807	14
48N05E36D001M	9	15.6	600	2,043	12
46N05E22D001M	14	27.9	500	567	24

It is important to note that individuals within the District own and operate groundwater wells for domestic, municipal, and irrigation purposes to supplement surface water supplies. Limited data exists in regards to the number and location of the privately owned wells within the District, except those wells that have been monitored by the California Department of Water Resources (DWR) for groundwater elevation or quality. The location, and number of groundwater wells within the District area is further discussed in the *Existing Groundwater Conditions* Section of this GWMP.

Area Covered by GWMP

As further described in *Existing Groundwater Conditions* Section of this GWMP, the District is located within the southeastern region of the Upper Klamath Basin, within the Tule Lake Subbasin. The Tule Lake Subbasin, as defined by DWR Bulletin 118, has a northern boundary contiguous to the California-Oregon border. In general, the District boundary is equivalent to the Tule Lake Subbasin boundary (as defined by Bulletin 118) and for the purposes of this GWMP, the District boundary represents the GWMP area. The GWMP area includes lands in Modoc and Siskiyou Counties. Figure 3 identifies the location of the GWMP area, including pertinent entity boundaries and borders.

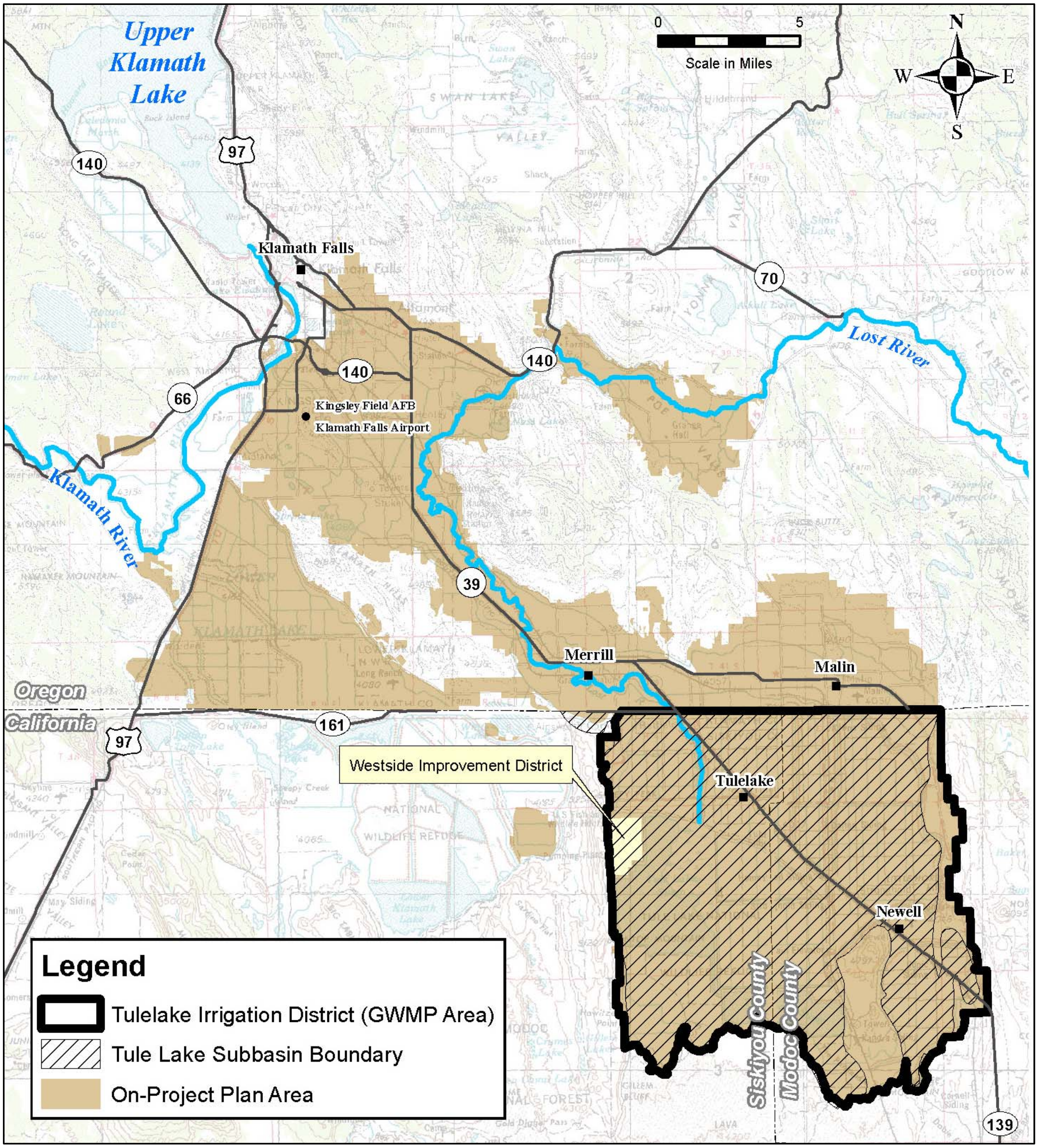


Figure 3. Location of the GWMP area and pertinent entity boundaries

Section 3 - Water Code Provisions Related to Groundwater Management, County Ordinances, Legislation and Agreements

In 1992, the California State Legislature adopted Assembly Bill 3030 (AB 3030) and in 2002 Senate Bill 1938 (SB 1938) was enacted. These two pieces of legislation have been incorporated into the California Water Code (Water Code), Section 10750 et seq., to encourage local public agencies/water purveyors to voluntarily adopt formal plans to manage groundwater resources within their jurisdictions. In 2011 a subsequent piece of legislation, Assemble Bill 359 (AB 359) was adopted amending Sections 10752, 10753, 10753.2, 10753.4, 10753.5, and 10753.7 of the Water Code, relating to groundwater. AB 359 also added Section 10753.11 to, the Water Code. The District has prepared a GWMP to be compliant with AB 3030 and revisions to the Water Code pursuant to SB 1938 and AB 359.

As identified in Section 10753.7 (a)(1-6) of the Water Code a GWMP is required to include the following components:

- Identification of basin Management Objectives for the groundwater basin that is subject to the GWMP,
- Components relating to the monitoring and management of groundwater levels within the groundwater basin, groundwater quality degradation, inelastic land surface subsidence, changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the groundwater basin, and a description of how recharge areas identified in the GWMP substantially contribute to the replenishment of the groundwater basin.
    - A map detailing the area of the groundwater basin, as defined in DWR Bulletin 118, and the area of the local agency, that will be subject to the GWMP, as well as boundaries of other local agencies that overlie the basin in which the agency is developing a GWMP, and
    - A map identifying the recharge areas for the groundwater basin,

In accordance with Section 10753.7 (a) (5) the local agency (District) shall adopt monitoring protocols that are designed to detect changes in the groundwater levels, water quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin. These monitoring protocols shall be designed to generate information that promotes efficient and effective groundwater management.

As provided in Water Code Section 10753.8, a GWMP may include the following components:

- control of saline water intrusion
- identification and management of wellhead protection areas and recharge areas
- regulation of the migration of contaminated groundwater
- administration of a well abandonment and well destruction program
- mitigation of conditions of overdraft

- replacement of groundwater extracted by water producers
- monitoring of groundwater levels and storage
- facilitating conjunctive use operations
- identification of well construction policies
- construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects
- development of relationships with state and federal regulatory agencies
- review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.

Of the groundwater management components listed in the Water Code, those already being investigated and actively implemented by the District include monitoring of groundwater elevations, facilitating conjunctive use during years when surface water is limited or not available, and development of relationships with local county, state, and federal agencies. The historical focus of groundwater management within the District has been on maintaining the groundwater water supply, in respect to both quantity and quality, and to avoid conditions of overdraft, primarily by developing a supplemental groundwater pumping program specifically during dry years. The District's objective is to continue to deliver surface water supplies to individuals within the GWMP area and to limit the use of groundwater to times when surface water supplies are insufficient to meet demand.

Groundwater management components identified in Water Code Section 10753.8 (recommended components) that have not been implemented or included in the GWMP are applicable to groundwater quality and contamination issues that are not relevant to the GWMP area, e.g. control of saline water intrusion, and control or cleanup of groundwater contamination.

In summary, the District has prepared this GWMP to be compliant with the AB 3030, SB 1938, and AB 359 requirements embedded in the Water Code and its interest in developing and sustaining reliable water supplies. This GWMP identifies three (3) Basin Management Objectives (Management Objectives). In order to meet these objectives, applicable components of AB 3030, SB 1938, and AB 359 have been included within the GWMP in the form of "Elements" which will provide the framework to meet the Management Objectives. These Elements may be a single component as identified in the guidelines for preparation of a GWMP, or they may capture multiple components, as further described in the *Groundwater Management Plan Elements* section of this GWMP.

County Ordinances

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 the District and the GWMP 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 historical practices of a district. These provisions are consistent with current District operations.

California Statewide Groundwater Elevation 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. The purpose of the program is to identify seasonal and long-term trends in groundwater levels within California's groundwater basins by regularly and systematically monitoring groundwater elevations in California's alluvial basins and subbasins. CASGEM was approved for implementation on November 9, 2009, and the program began on January 1, 2012. The statute requires, under the guidance of DWR, that local monitoring entities collect and report monitoring data as available using an existing network of monitoring wells, as well as existing established monitoring programs, if relevant. DWR may require that additional monitoring wells be constructed only if funds are specifically provided.

DWR's main role in administering the CASGEM program is to provide public outreach, create and maintain data submittal, and support the local entities through the process of becoming a monitoring entity and preparing their monitoring plans. One of the primary goals of CASGEM is to provide to the public a readily available database for use in water supply planning and management.

The District enrolled in the CASGEM program on behalf of its landowners in 2010. In addition, the District prepared and submitted a Groundwater Monitoring Plan to DWR which defines a groundwater well monitoring network and the frequency and procedure relative to collection of groundwater data (see Appendix B).

Klamath Basin Restoration Agreement

The District is a party to the Klamath Basin Restoration Agreement (KBRA), a broad agreement among many interests covering many subjects. One element of the KBRA is the requirement that Klamath Water and Power Agency (KWAPA), a joint exercise of powers agency of which the District is a member, prepare the so-called "On-Project Plan" (OPP). The OPP generally will cover the major irrigated lands of the Klamath Project that use Klamath River water, which includes lands within the District. The purpose of the OPP is to align water supply and demand within the On-Project Plan Area (OPPA). Implementation of the OPP would be based on federal funding. There are negotiated constraints on the extent to which KWAPA will use, or bring about the use of, groundwater. The development of a GWMP by the District is not part of the OPP process or required by or intended to assist in implementation of the KBRA. However, this GWMP is not expected to be incompatible with the OPP when adopted.

Section 4 - Management Objectives for the GWMP Area

Over the past decade there has been increased development and use of groundwater supplies within the GWMP area. As part of the District's long-term water supply management, the District installed 10 groundwater production wells and began conjunctive use operations in 2001. Since that time the District has integrated groundwater with the available surface water supplies to meet demand during years when surface water availability has been limited.

Following the installation of the District's wells, groundwater elevation, quality and related data have been collected to progressively define and understand basin conditions, and to continue to provide an understanding of potential effects of groundwater pumping within the GWMP area. Information derived from the monitoring and management efforts to date has allowed the District and various individual pumpers in the GWMP area to continue to rely on groundwater to augment the surface water supply to meet local demand during dry periods.

This GWMP provides a management framework for maintaining a high quality, reliable, and sustainable supply of groundwater to the GWMP area. The District has identified the following Management Objectives, for the GWMP area:

Management Objective 1: Development of conjunctive use of groundwater, to support years when surface water is limited or not available to meet demand.

Management Objective 2: Avoidance of overdraft and associated undesirable effects such as declining groundwater elevations, and land subsidence; in effect continue the successful integrated use of groundwater as a supplemental water supply.

Management Objective 3: Preservation of groundwater quality for beneficial use in the GWMP area.

The District's primary purpose is to provide a sufficient water supply to meet all demands within the District boundary and GWMP area. It is the District's intent to continue delivering surface water to landowners as the primary water supply source. During periods where there is limited or no surface water availability, the District and landowners within the GWMP area have and will continue to rely on groundwater pumping to meet demand.

Quantitatively, the preceding goals translate into general provisions for monitoring groundwater levels and quality, including fluctuations in seasonal demands and varying local hydrologic conditions (wet and dry periods). Specific issues to be considered include the evaluation of available groundwater storage capacity, determination of sustainable groundwater yield, and avoidance of land subsidence.

Section 5 - Existing Groundwater Conditions

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 GMPW area (Tule Lake Subbasin). In addition, this section summarizes available data relative to groundwater elevations, groundwater quality, and surface level subsidence within the GWMP area. As further described below, limited water quality and groundwater elevation data exists for the GWMP area, in terms of both the spatial and temporal distribution of data collection. Where possible, observations were provided to qualify the short term trends (from 2001 to 2011) in order to provide additional explanation and background. These observations were then used during the development of the GWMP Elements.

Upper Klamath Basin Regional Geologic Setting

The Upper Klamath 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 4 identifies the location of the Upper Klamath Basin. As further described in this section, the Tule Lake Subbasin is located in the southeastern portion of the Upper Klamath Basin. The following section briefly describes the geologic settings of the Upper Klamath Basin, including hydrologic units, direction of groundwater flow, and locations where recharge to the Upper Klamath Basin is occurring.

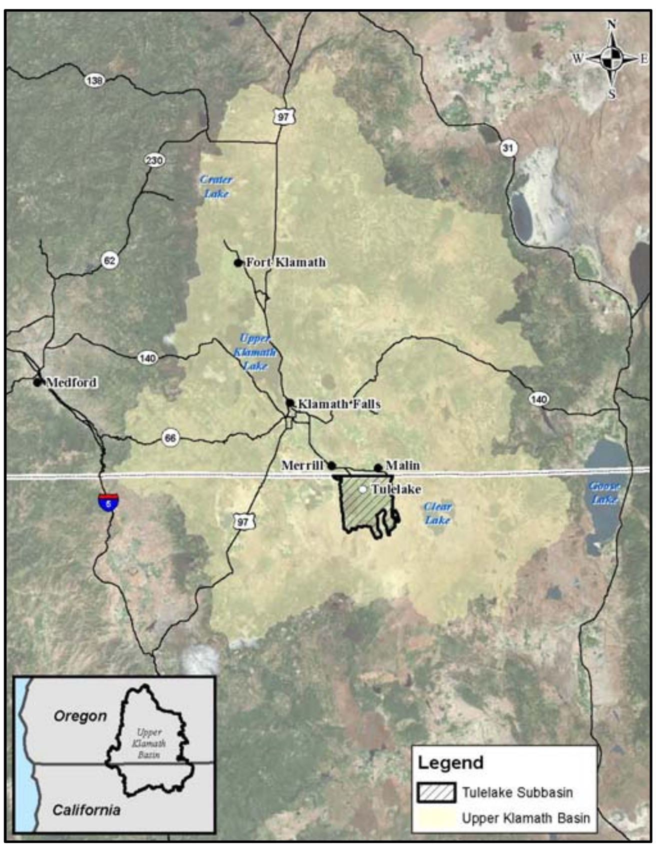


Figure 4. Upper Klamath Basin boundary and Tule Lake Subbasin boundary

Volcanic and tectonic activity formed most of the Upper Klamath Basin. The main geologic provinces are the Cascades Range to the west of the Upper Klamath Basin, consisting of relatively low-permeability rocks, and the Basin and Range fault-block mountains and sediment-filled basins farther to the east. The rock formations that comprise the groundwater basin include brecciated lava flows, volcanic vent deposits, and coarse-grained facies of volcaniclastic sedimentary deposits (MBK Engineers et al, 2012a).

A key feature of the rock formations of the groundwater basin are the deformations caused by multiple generations of Basin and Range faulting, which further complicate the stratigraphy. The faulting causes vertical displacement of the strata, thereby enhancing the interconnectedness of the permeable layers within the groundwater basin. The region consists of extensive block faulting that forms north-to-northwest trending graben valleys separated by large horst mountain blocks (Jenks and Beaulieu, 2001). In general, the rock formations of the groundwater basin are a series of interconnected productive aquifers intermixed with less permeable basalt and layers of low-permeability volcaniclastic sediment.

Hydrologic units in the area mainly consist of Tertiary volcanic flows and Quaternary alluvial sediments that fill the lake basins and fluvial valleys (Gates, 2001). Figure 5 identifies the hydrologic units of the Upper Klamath Basin, Oregon and California.

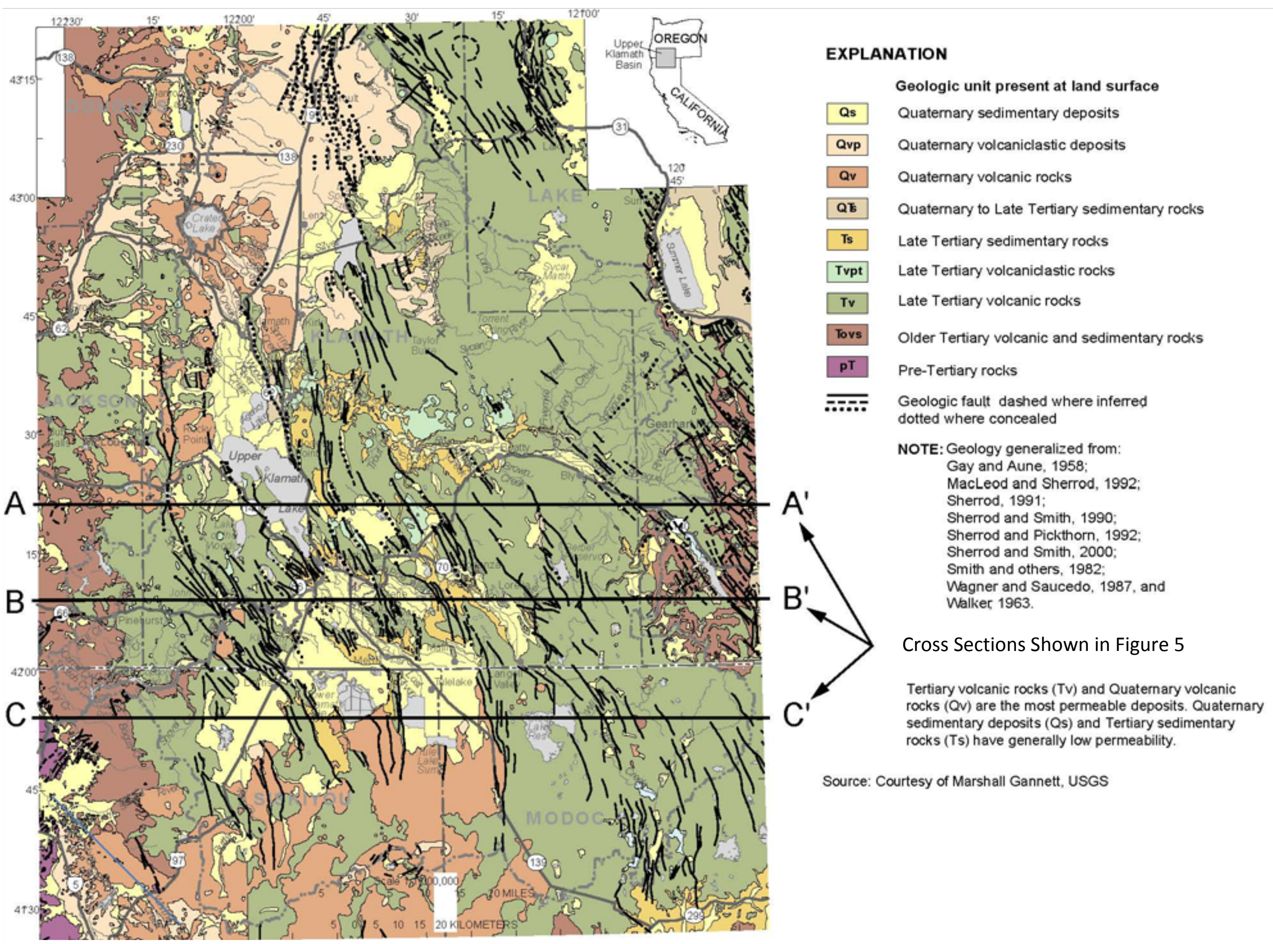
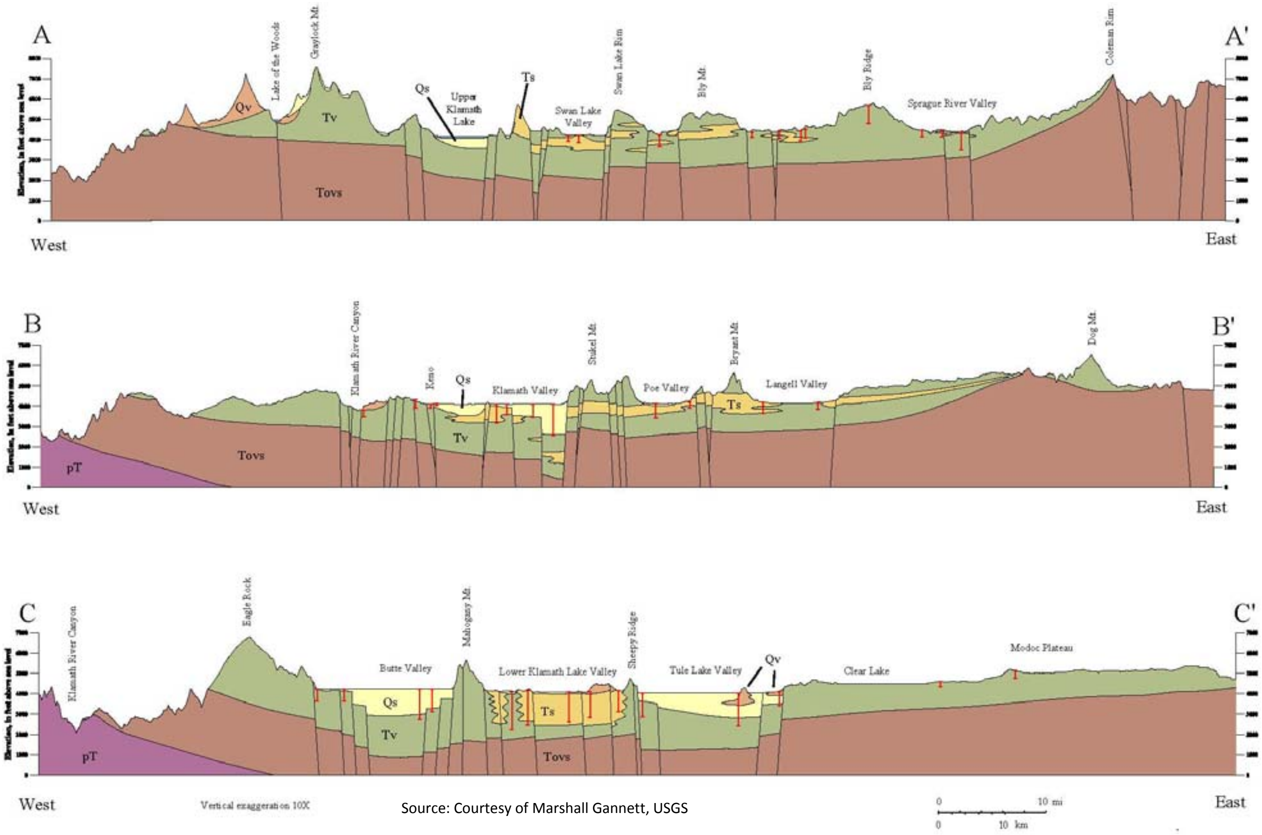


Figure 5. Hydrologic Units of the Upper Klamath Basin, Oregon and California

Figure 6 shows a series of west-to-east geologic cross sections through the central part of the Upper Klamath Basin. These cross sections show the late tertiary volcanic rock units as well as older tertiary volcanic rock units of the groundwater basin and the quaternary and tertiary sedimentary aquifers.



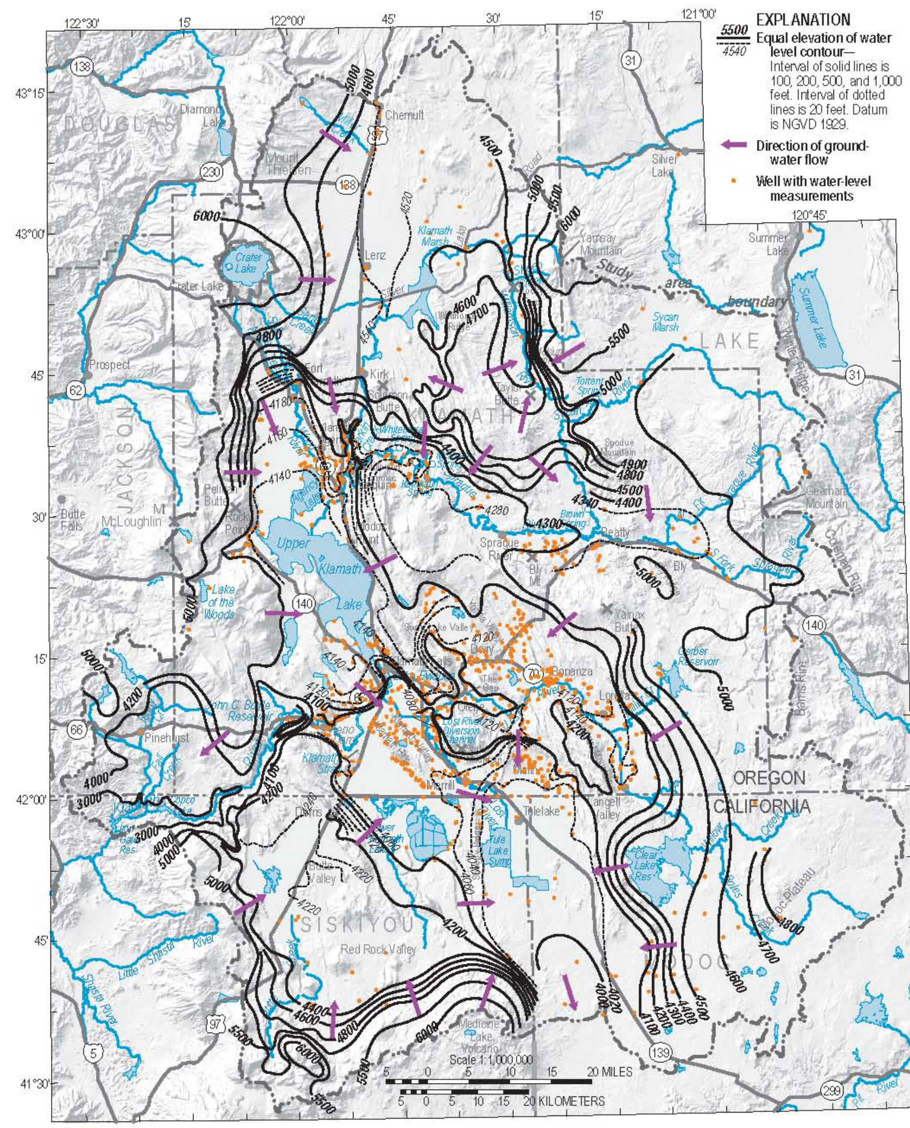
Source: Courtesy of Marshall Gannett, USGS

Figure 6. Generalized Geographic Sections through the Central Part of the Upper Klamath Basin

Geothermal resources are present within the Upper Klamath Basin as indicated by hot springs and hundreds of geothermal wells in and near Klamath Falls, near and south of Olene Gap, and areas near the Klamath Hills. Other geothermal areas include Swan Lake Valley; Langell Valley southwest of Lorella, Oregon; and several other areas within the Upper Klamath Basin. There are no known regions of geothermal resources underlying the GWMP area.

The location and quantity of groundwater movement, including migration and recharge within any groundwater basin is difficult to quantify, as 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 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, titled *Ground-water*

*Hydrology of the Upper Klamath Basin, Oregon and California (*Gannett et al, 2007) describes 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 and 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 7; Gannett et al., 2007).

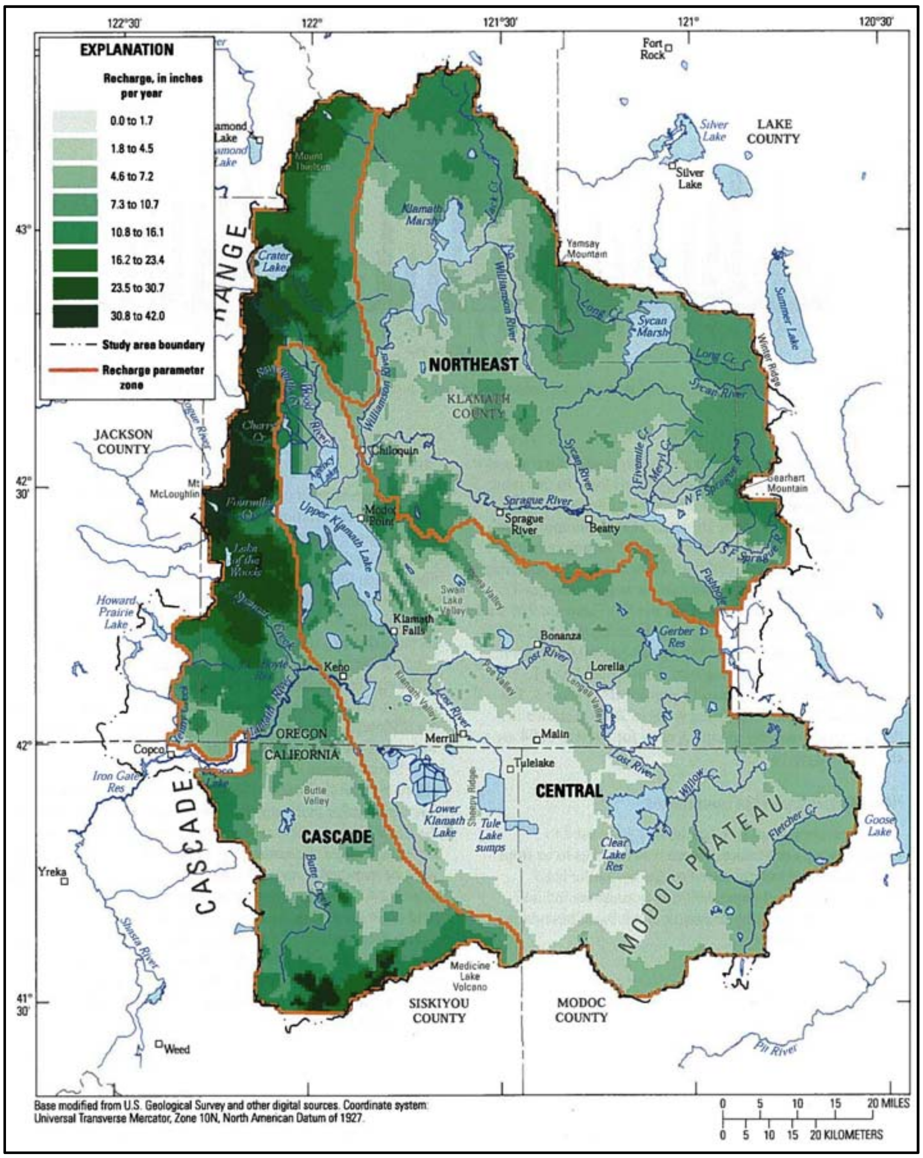


Gannett, Marshall W., Kenneth E. Lite, Jr., Jonathan L. LaMarche, Bruce F. Fisher, and Danial J. Polette. 2007. *Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California.* USGS Scientific Investigations Report 2007-5050, Version 1.1.

Figure 7. Generalized Water-Level Contours and Approximate Directions of Regional Groundwater Flow within the Upper Klamath Basin, Oregon and California

Groundwater Recharge within the Upper Klamath Basin

Groundwater recharge is generally greatest in upland areas where the largest amount of precipitation occurs. The principle recharge areas in the Upper Klamath Basin are the Cascade Range and uplands within and on the eastern margin of the Upper Klamath Basin. 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 8 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 8. Estimated mean annual groundwater recharge from precipitation in the Upper Klamath Basin, Oregon and California, 1970-2004, in inches, and recharge parameter zones

Irrigation activities also can result in groundwater recharge. Irrigation canals typically lose some water to the shallow parts of the groundwater system. No data are available to determine the amount of ground-water recharge from canal leakage and deep percolation of irrigation water in the Upper Klamath Basin (Gannett et al, 2007). However, groundwater recharge from irrigation activities is indicated because the water table in the shallow aquifers in the Klamath Reclamation Project area rises during the irrigation season, and 2001 measurements showed the shallow water table decline when irrigation was severely curtailed during that irrigation season (Gannett et al, 2007).

Tule Lake Subbasin

The Tule Lake Subbasin as defined by DWR Bulletin 118 (Basin No. 1-2.01, Bulletin 118-2003) covers 76,000 acres within the southeastern portion of the Upper Klamath Basin, bounded to the west by Sheepy Ridge, to the south by low lying volcanic fields of the north slope of the Medicine Lake Highlands, to the east by the Bryant Mountain Highlands, and to the north by the California and Oregon state line. It is acknowledged by DWR that the northern portion of the Tule Lake Subbasin physically extends into Oregon, and is bounded by Stukel Mountain and Buck Butte Highlands areas. However, for the purposes of the development of this GWMP, only the portion of the subbasin as identified by Bulletin 118 is included in the GWMP area. The location of the Tule Lake Subbasin boundary as compared to the Upper Klamath Basin boundary is identified in Figure 4.

The geology in the Tule Lake Subbasin is consistent with the regional geologic setting described in the *Upper Klamath Basin Regional Geologic Setting* sub-section of the GWMP. The Tule Lake Subbasin is formed mainly by faults within the area, the exception being the southern boundary which is the low-lying volcanic fields of the Medicine Lake Highlands. This area is a large shield volcano where Medicine Lake occupies the crater at the peak. The Gillems Bluff Fault is the Tule Lake Subbasin's western boundary. This fault is a major feature of the Medicine Lake volcanic highlands and forms the escarpment of Sheepy Ridge which creates the separation of the Tule Lake and Lower Klamath Subbasins. The eastern boundary of the Tule Lake Subbasin is the Big Crack fault which forms the mountains between Tule Lake and Clear Lake Reservoir. The physical northern boundary of the Tule Lake Subbasin is made up of northwest trending faults. However as previously described, and for the purposes of this GWMP, the California and Oregon border represents the northern extent of the Tule Lake Subbasin.

Water Bearing Formations

DWR Bulletin 118 includes descriptions of the subsurface water bearing materials in the Tule Lake Subbasin. The principal formations include Tertiary to Quaternary lake deposits and volcanics.

Pleistocene Upper Basalt – These basalt flows border the subbasin on the south (to the west of the Peninsula) following the north flank of the Medicine Lake Highlands and outcrop as a boundary to the southeast of Coptic Bay. The unit is unweathered, vesicular, and olivine which is highly permeable. The flows are above the saturated zone, but due to fracturing, some areas readily yield water to wells and also allow for recharge.

Pleistocene Intermediate Basalt – These rocks border the subbasin to the south and east. The unit is thin-bedded flows of diabasic olivine basalt and generally highly permeable due to jointing and bedding planes. However, in some areas extensive cross faulting has created low yields; however, in area of sufficient fractures, interconnections, and saturated depths, wells can yield moderate to large quantities of water. High yields are found in the Panhandle region where the unit is greater than 400 feet thick with well yields up to 9,500 gallons per minute (gpm). Moderate yields are found in the area of Prisoners Rock and the Peninsula. In this vicinity, the unit reaches up to 400 feet thick with well yields ranging from 500 to 3,100 gpm.

Pliocene to Holocene Lake Deposits – The lake deposits are found away from the boundaries of the subbasin and consist of sand, silt, clay, ash, lenses of diatomaceous earth, and semi-consolidated shale. These deposits have a low permeability and may act as a confining layer. Wells in the deposits would yield approximately 30 gpm and be less than 150 feet deep.

Pliocene to Miocene Lower Basalt – This older unit of basalt forms the northeastern barrier of the subbasin and is exposed to the surface to the east and west. Where the unit is exposed it exhibits fracturing and is an important source of recharge for the basin. The material ranges from ophitic olivine basalt to porphyritic basalt which exhibits weak columnar jointing. The aquifer is highly permeable and mainly confined within the subbasin where it underlies lake sediments. The basalt is ranges in depth from 810 on the east side of the basin to 1,190 feet mid-basin and 190 feet on the far west side of the subbasin. Well yields on the east side range from 4,000 to 7,000 gpm; well yields from the mid-basin west range from 9,000 to 12,000 gpm.

Groundwater Pumping

Groundwater pumping within California is not regulated by the State. Instead it is limited by rules of correlative rights and reasonable use that ordinarily are applied in litigation settings. Due to the lack of available data, there is uncertainty as to the precise quantity of groundwater that is pumped within the GWMP area. DWR has estimated annual extractions from the groundwater basin within the GWMP area of approximately 8,500 acre-feet (i.e., non-dry year pumping) (DWR, 2011). This groundwater pumping is primarily for domestic, stockwatering, and municipal supplies (e.g., City of Tule Lake).

Larger scale pumping in the GWMP area has been due to participation in water bank programs during years where 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 GWMP area (DWR, 2011). This pumping estimate includes the 8,500 acre-feet of estimated pumping for domestic, stockwatering, and municipal supplies.

A significant reduction in available surface water supplies in 2010 to the Klamath Reclamation Project (including deliveries to the District) resulted in the greatest quantity of groundwater pumped for participation in the 2010 Water User Mitigation Program (WUMP) as compared to previous water bank programs. Therefore, groundwater pumping during the 2010 irrigation season for participation in the 2010 WUMP was reviewed.

Approximately 101,200 acre-feet of groundwater was pumped for participation in the 2010 WUMP within the Klamath Reclamation Project, of which approximately 54,400 acre-feet was pumped within the District (GWMP area). The remaining 47,800 acre-feet of groundwater was pumped within the Oregon portion of the Klamath Reclamation Project.

Groundwater extractions in 2010 represent the largest exercise of the groundwater basin underlying the Klamath Reclamation Project (and GWMP area), and as such the potential effects, including the drawdown and recovery, are significant to understanding the groundwater basin response to pumping. A report titled Groundwater Efficiency Use Analysis Task 2 and 3 prepared for Klamath Water and Power Agency in 2011. This report identified the location and quantity of groundwater pumping and defined regions for analysis. Only those areas where wells participated in the 2010 WUMP were divided into regions. Therefore, the large area in the middle and southwest corner of the District were not included in a region, as no wells within these areas participated in the 2010 WUMP. Figure 9 identifies the various regions within the GWMP area and the wells within those regions.

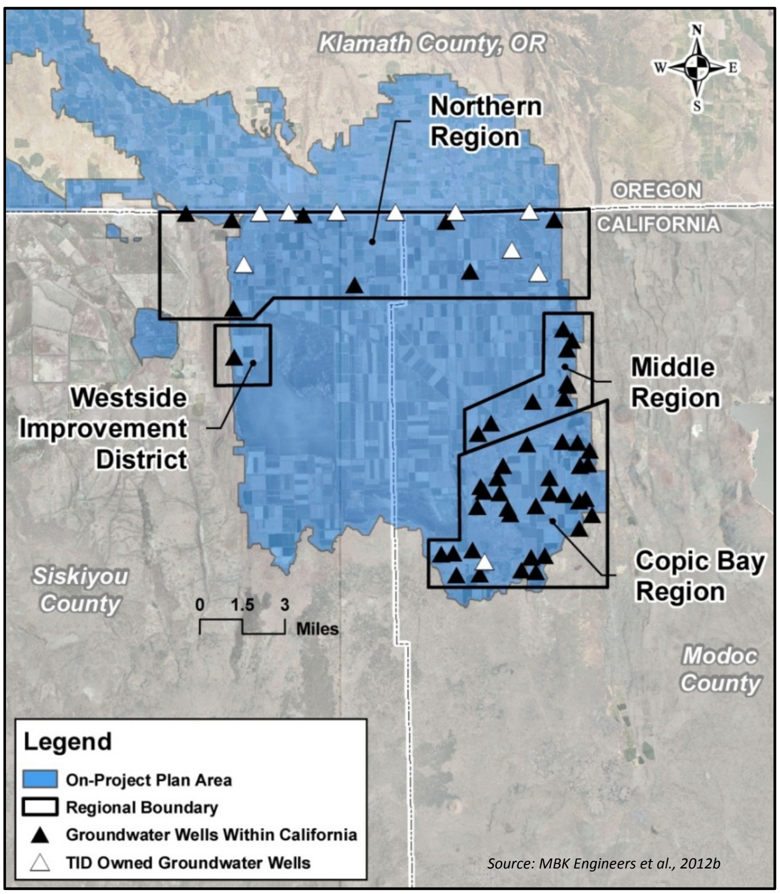


Figure 9. Subregions within Tulelake Irrigation District

The volume of groundwater pumping within each region during 2010 is identified in Table 3.

Table 3. Groundwater Pumping within GWMP area during 2010

Region	Quantity Pumped (acre-feet)	Percentage of Pumping within each Region
Northern	23,960	44%
Middle	2,943	5%
Copic Bay	27,361	50%
Westside Improvement District	99	>1%
Total	54,363	100%

As identified in Table 3 the majority of the pumping within the GWMP area in 2010 occurred within the Northern and Copic Bay region. This distribution identifies approximately half of the groundwater pumping within the GWMP area occurred in the southeastern portion of the District during 2010. This pumping distribution may be representative of potential future pumping if surface water is not available to meet the demand within the GWMP area.

Groundwater Elevations

Groundwater elevation data has been collected by DWR and the USGS beginning in the 1980's within the GWMP 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 2000's the monitoring well network had expanded to an average of seventy (70) wells monitored on a monthly basis within the Tule Lake Subbasins and an adjacent subbasin (the Lower Klamath Subbasin).

The groundwater elevation data collected by DWR and other entities, including the District is uploaded to the DWR Water Data Library (WDL): http://www.water.ca.gov/waterdatalibrary/index.cfm. Table 4 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 Tule Lake Subbasin on a monthly basis.

Table 4. Wells monitored for groundwater elevations within and near the GWMP 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	Present
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	Present
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	2/25/2010
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
48N04E30E001M	619060	4647474	185	19	185	Domestic	9/30/1998	Present
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

State Well Number	Well Location		Well Depth (ft)	Perforations (ft)		Well Use	Period of Record	
	UTM East	UTM North		Top	Bottom		Begin	End
48N03E14M001M	615964	4650542	454			Irrigation	9/11/1998	3/29/2010
48N02E14J001M	607580	4650361	203	21	200	Domestic	8/17/1998	4/21/2010
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
46N06E08E001M	639424	4633481	213			Irrigation	9/8/1998	Present
46N06E07K002M	638839	4633192	100			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	Present
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	300			Domestic	11/8/2001	Present
41S12E16J001W	631556	4652891	380			Municipal	11/8/2001	Present
41S12E15M002W	631946	4652420	84			Municipal	11/8/2001	Present
41S11E16R002W	622342	4650776	70			Industrial	8/28/2002	Present
41S11E16R001W	622046	4650694	27			Domestic	11/8/2001	Present

Note: Additional groundwater elevation measurements are available for District owned wells beginning in January, 2001. These data have not been uploaded to the WDL.

Figure 10 identifies the distribution of groundwater wells actively monitored for groundwater elevations within and near the GWMP 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 GWMP, 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 elevations within the GWMP area. Some wells with unknown depths are also shown on Figure 10.

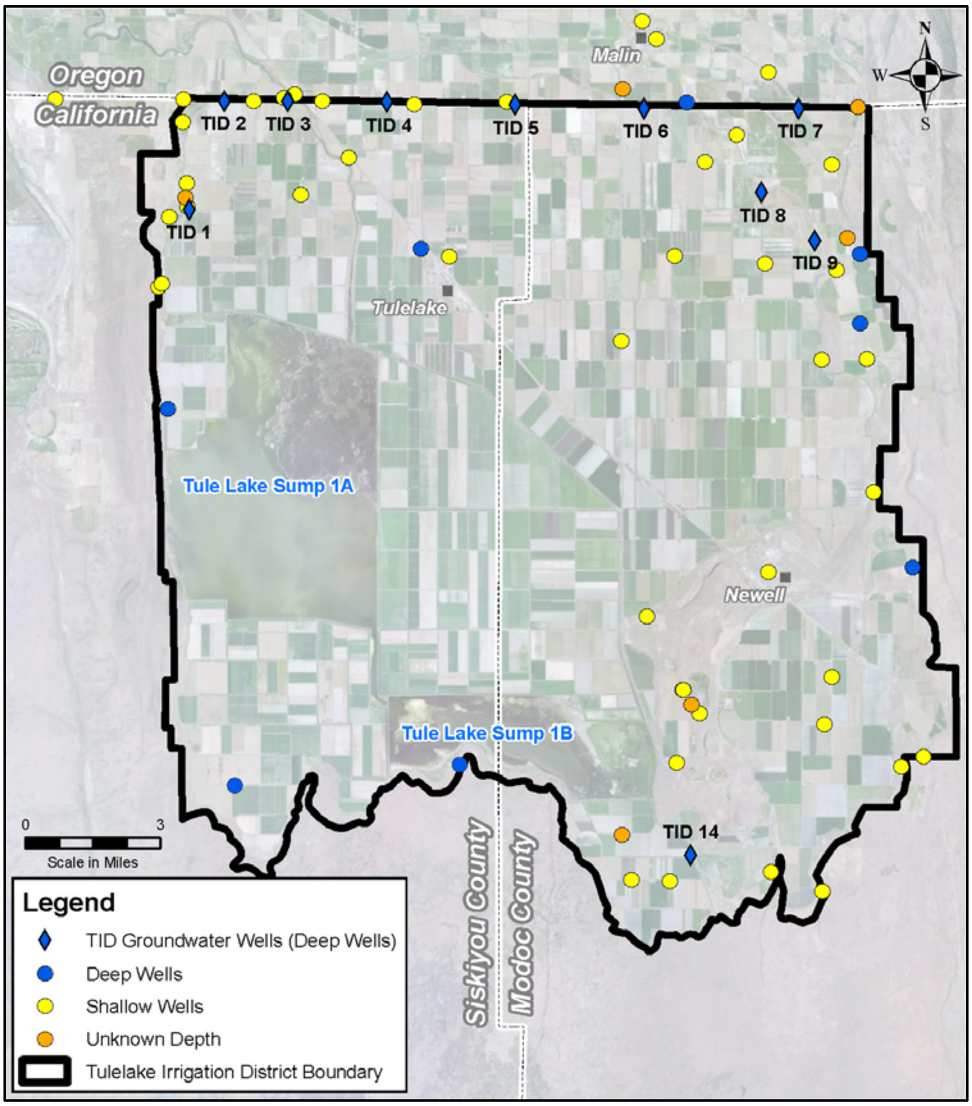


Figure 10. Wells monitored for groundwater elevations within and near the GWMP area

The reduction in available surface water supplies beginning in 2001 has resulted in an increase in groundwater extraction within the Klamath Reclamation Project and the GWMP 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 11 identifies the location of the wells where groundwater elevation data was reviewed and represented in hydrographs include (Figures 12 through 20) as further described below.

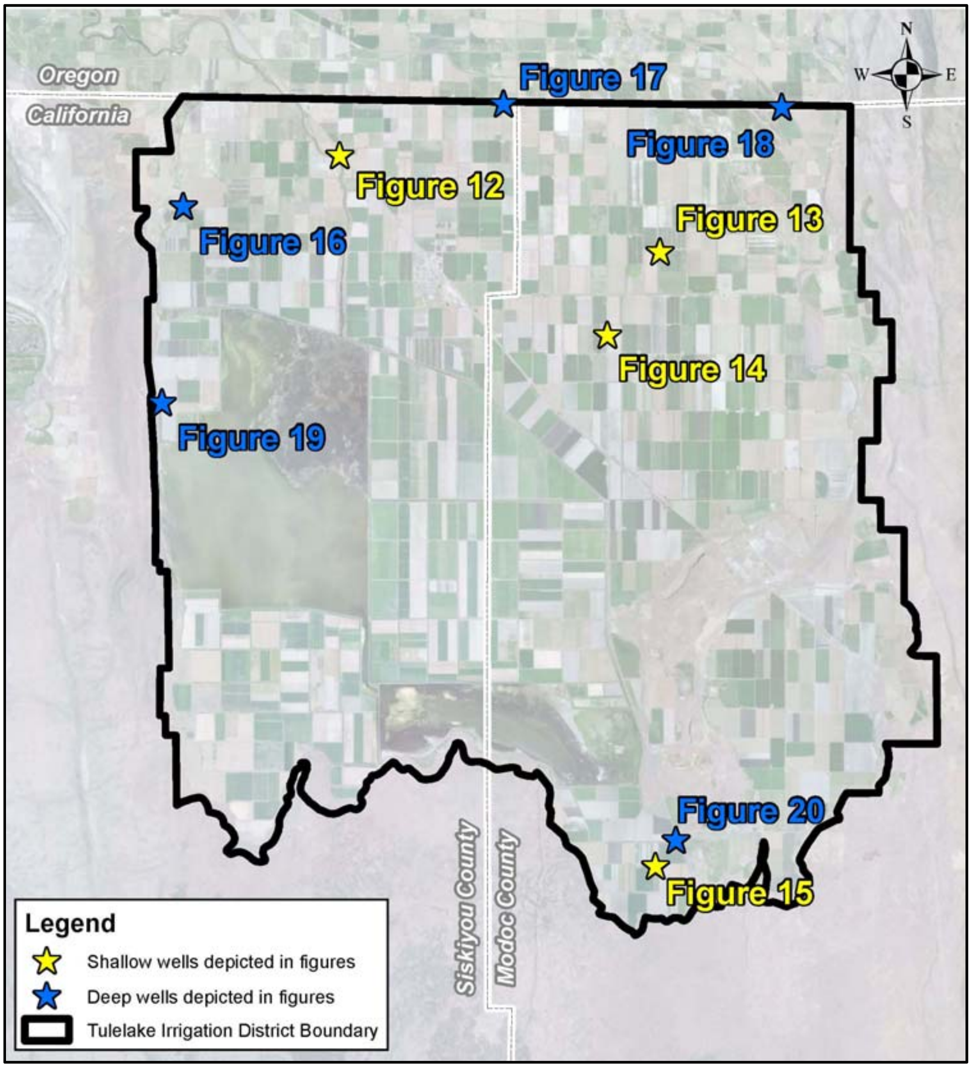


Figure 11. Wells monitored for groundwater elevations within and near the GWMP area represented in Figure 12 though Figure 20

Figures 12 through 15 include wells described previously as relatively shallow groundwater wells, those with drilling depths of less than 500 feet. Figures 16 through 20 include wells described as deep groundwater wells, i.e., those with well depths greater than 500 feet.

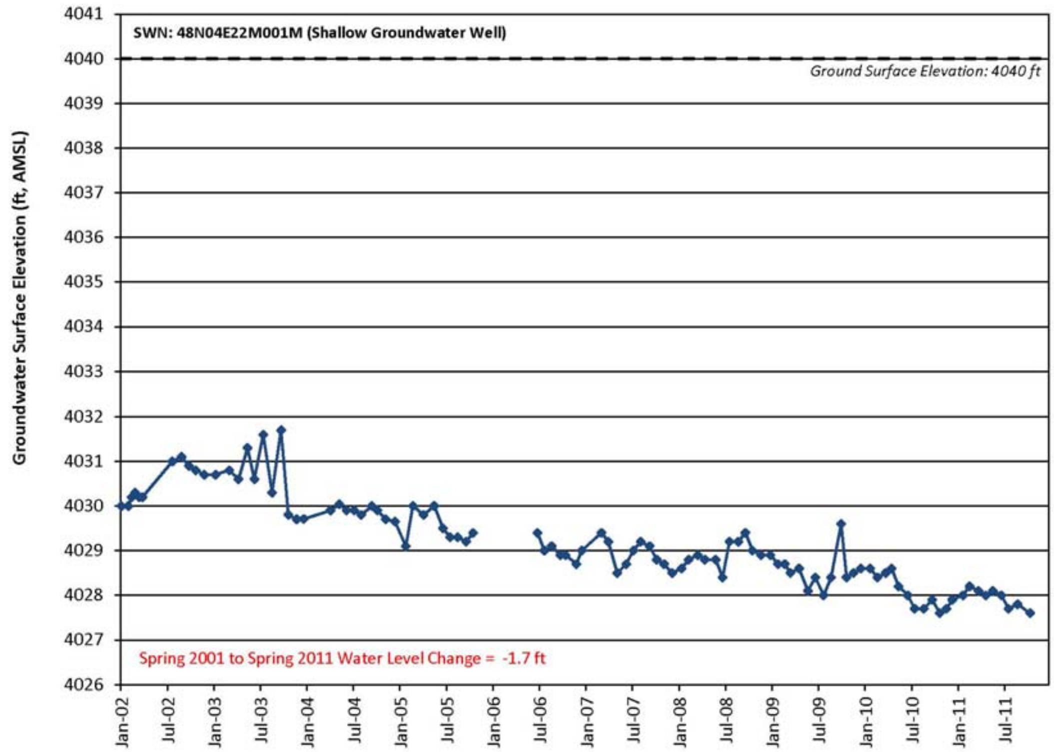


Figure 12. Groundwater hydrograph for SWN: 48N04E22M001M

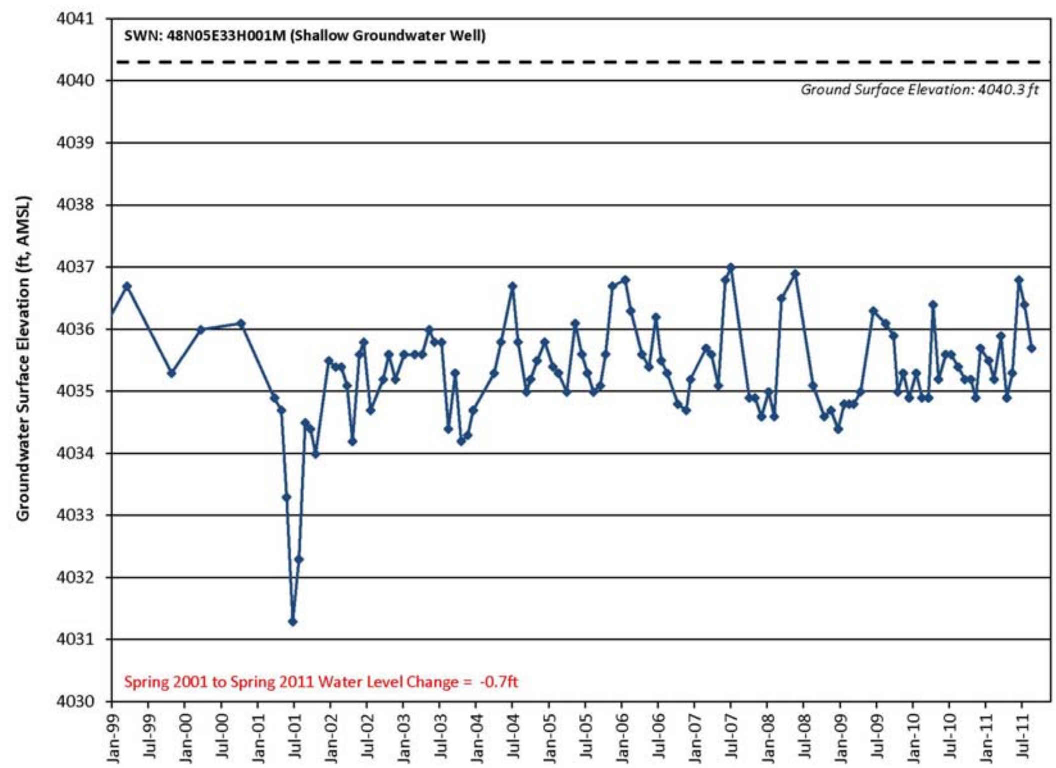


Figure 13. Groundwater hydrograph for SWN: 48N05E33H001M

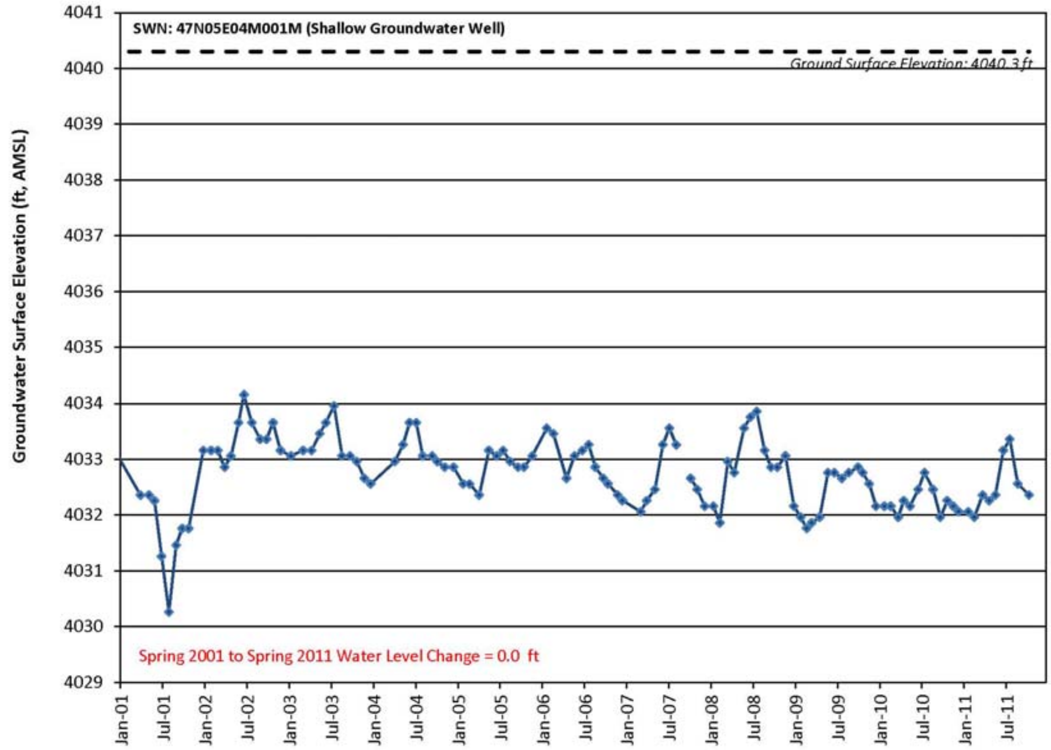


Figure 14. Groundwater hydrograph for SWN: 47N05E04M001M

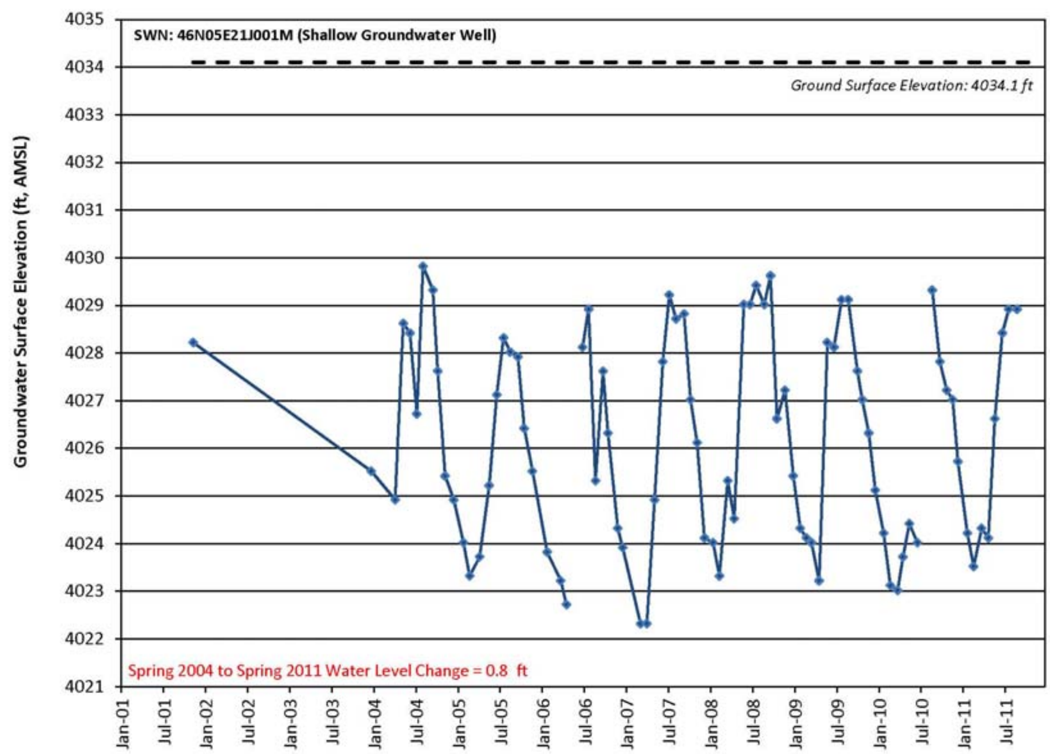


Figure 15. Groundwater hydrograph for SWN: 46N05E21J001M

As indicted in Figures 12 through 15 relatively shallow groundwater wells within the GMWP area show minimal changes (less than 2 feet) in groundwater elevations when comparing spring 2001 to spring 2011 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 GWMP area identify a similar (minimal) change in groundwater elevations during this time period.

In order to identify potential changes in groundwater elevations within the volcanic aquifer underlying the GMWP area, hydrographs of deeper groundwater wells (drilled deeper than 500 feet) are identified in Figures 16 through 20.

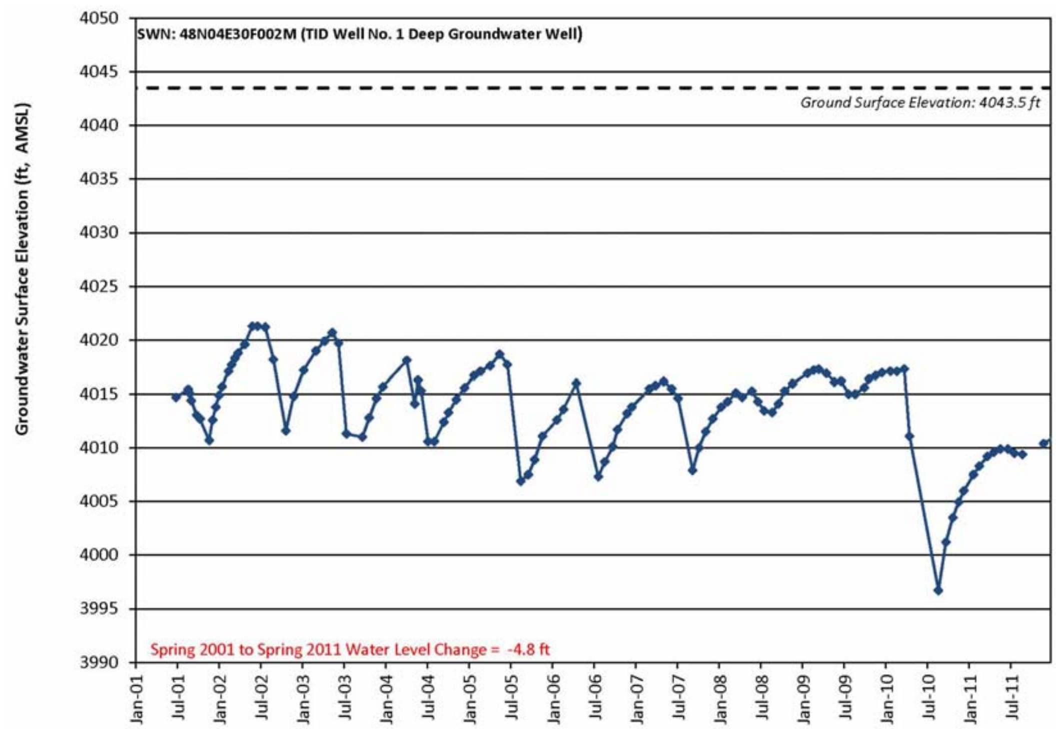


Figure 16. Groundwater hydrograph for SWN: 48N04E30F002M (TID Well No. 1)

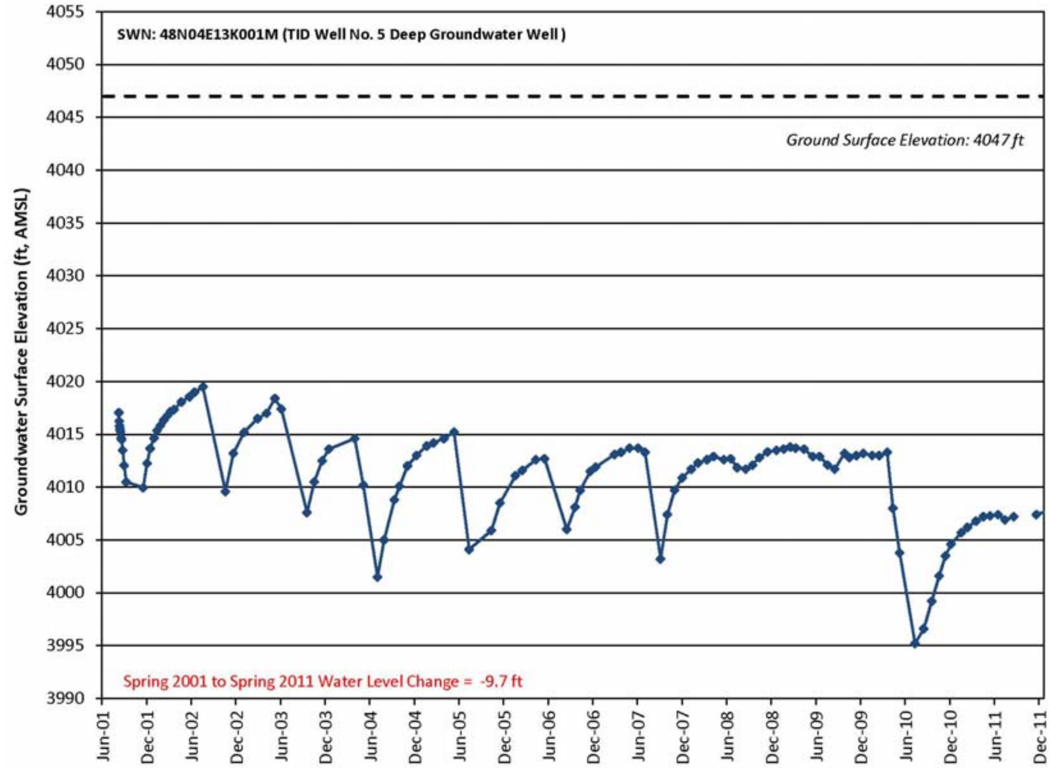


Figure 17. Groundwater hydrograph for SWN: 48N04E13K001M (TID Well No. 5)

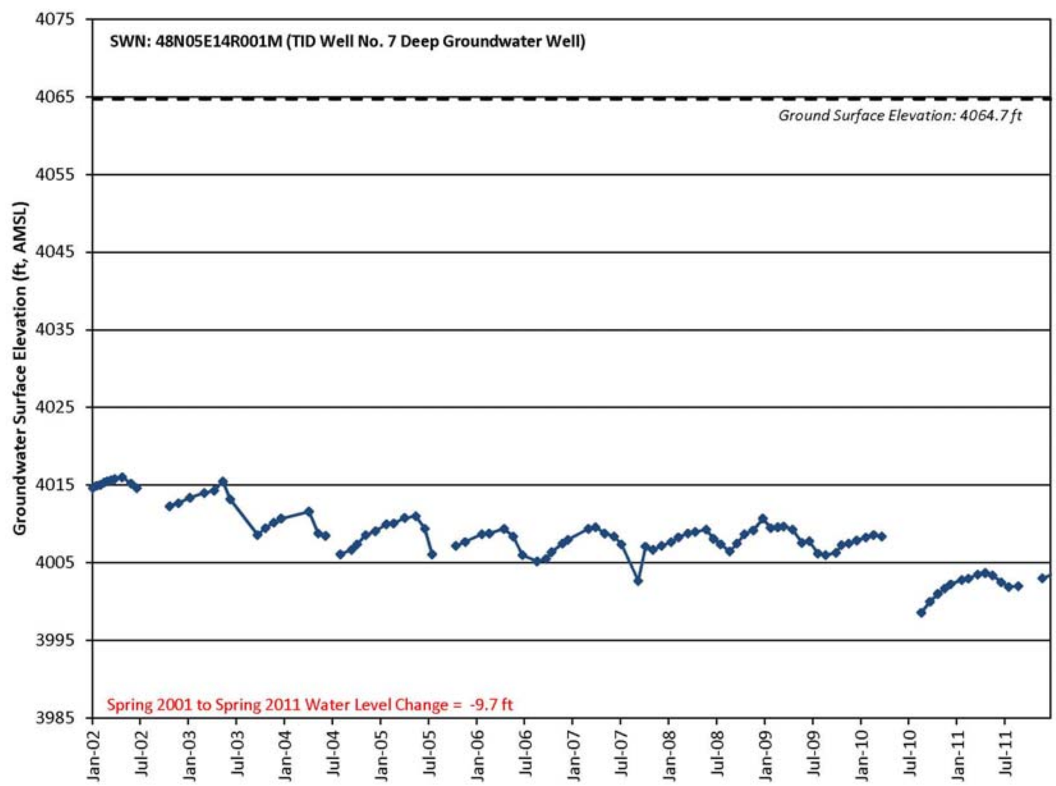


Figure 18. Groundwater hydrograph for SWN: 48N05E14R001M (TID Well No. 7)

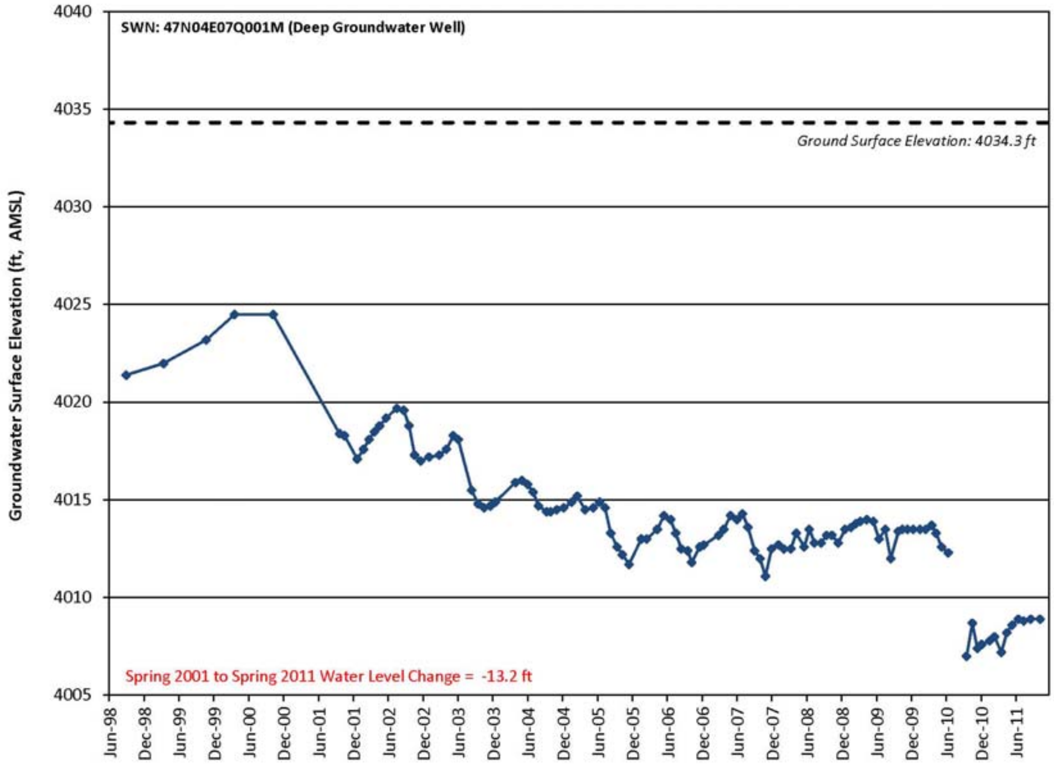


Figure 19. Groundwater hydrograph for SWN: 47N04E07Q001M

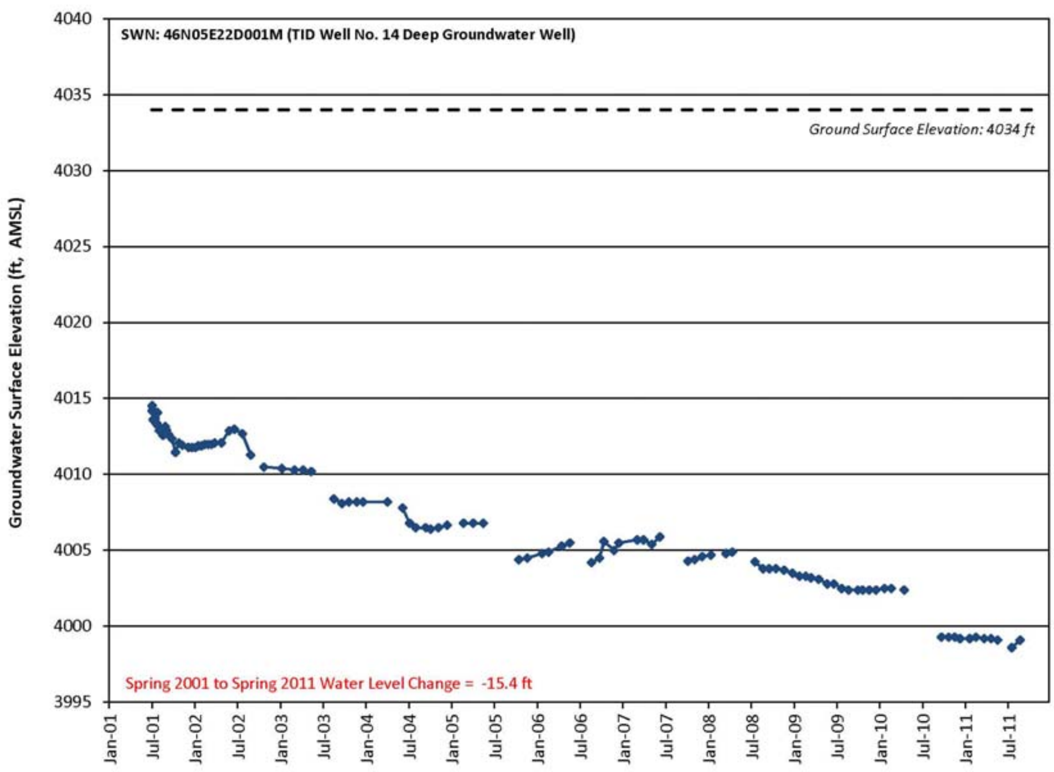


Figure 20. Groundwater hydrograph for SWN: 46N05E22D001M (TID Well No. 14)

The hydrographs for deeper groundwater wells show a greater change in the groundwater elevations from spring 2001 to spring 2011 as compared to the hydrographs for the shallow groundwater wells. This deeper volcanic aquifer appears to be primarily recharged through precipitation and the groundwater movement of flows from north to south within the Upper Klamath Basin. The change in spring 2001 to spring 2011 elevation at these groundwater wells ranges from approximately -5 feet to approximately -15 feet.

It is important to note, that the deeper aquifer is likely recharged from precipitation; and therefore, groundwater elevation trends may be more directly impacted through the quantity of groundwater extracted and climatic conditions. Since the increased level of monitoring and groundwater extraction that has occurred in 2001, there has not been a period of more than one consecutive year of above average precipitation in the Upper Klamath Basin. Unfortunately, limited data exists in regards to groundwater elevation data prior to 2001, during wet and dry hydrologic periods in order to better qualify historic fluctuations in groundwater elevations within the deeper volcanic aquifer.

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 volcanic aquifer.

Figure 21 identifies groundwater elevations and contours within the GWMP area for spring 2001, prior to the groundwater pumping during the subsequent irrigation season (ft, AMSL). For the purposes of developing the contours, spring 2001 and 2010 elevations observed during the months of March and April were utilized. However, for the development of the spring 2001 contour, data from January for the District's wells was the only elevation data available; and therefore, these January data were also utilized to develop the figures.

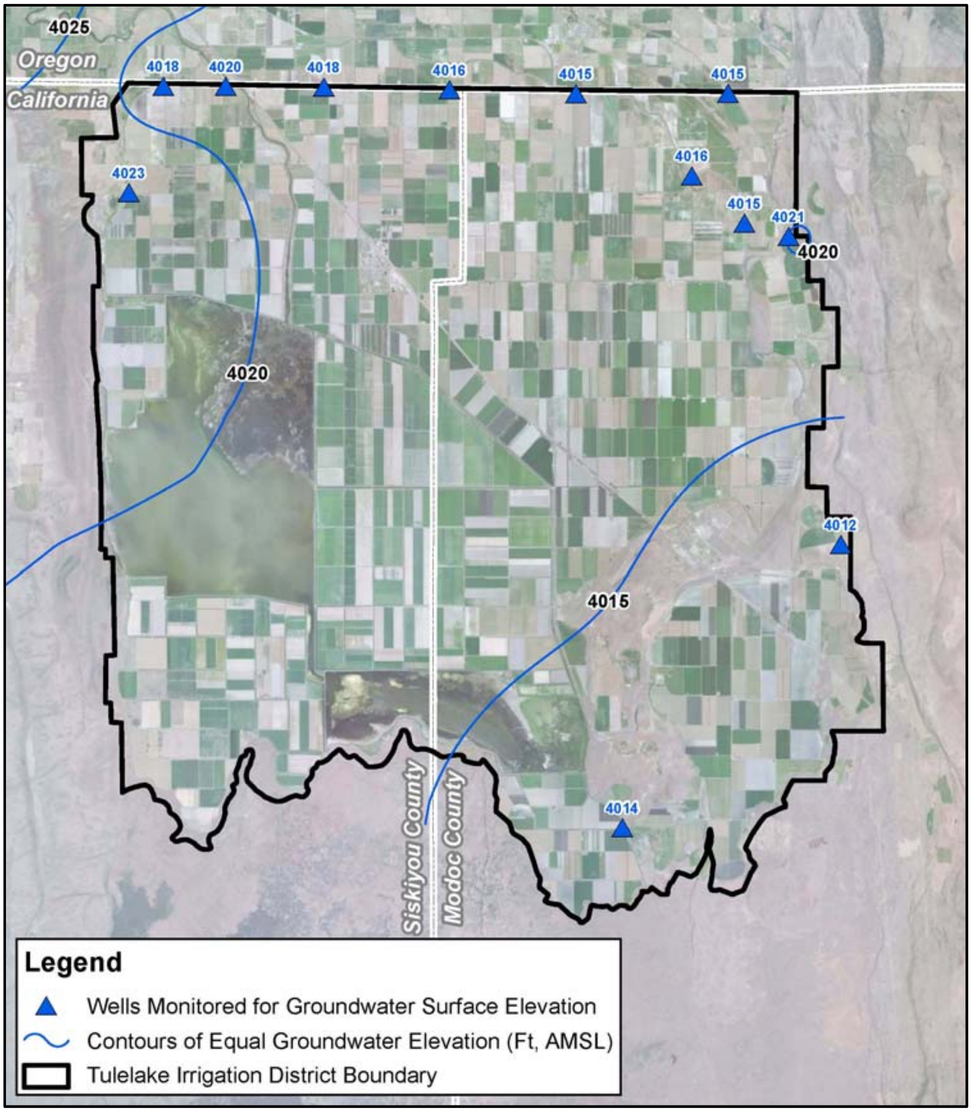


Figure 21. Spring 2001 groundwater surface elevations.

As previously stated, 2001 surface water deliveries were limited. This resulted in an increase in groundwater pumping during the 2001 irrigation season. Additional reductions in available surface water supplies following 2001, specifically during the years 2002-2007, and 2010 resulted in increased groundwater pumping within the GWMP area in those years.

Figure 22 shows spring 2010 groundwater elevations and contours within the GWMP area.

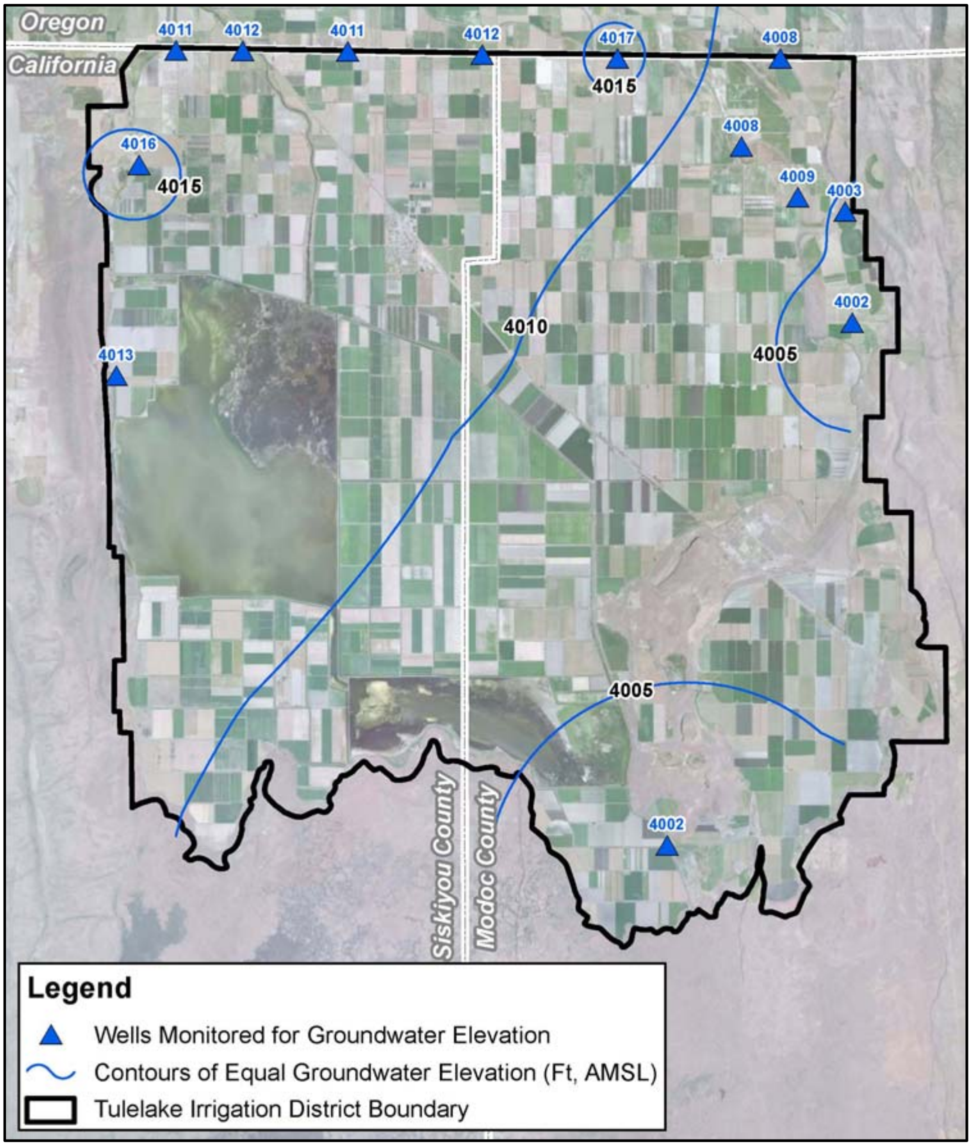


Figure 22. Spring 2010 groundwater surface elevations.

Significant surface water curtailments during the 2010 irrigation season resulted in an additional increase in groundwater pumping within the GWMP area, as compared to recent pumping (post 2001). Figure 23 shows fall 2010 groundwater elevations and contours within the GWMP area.

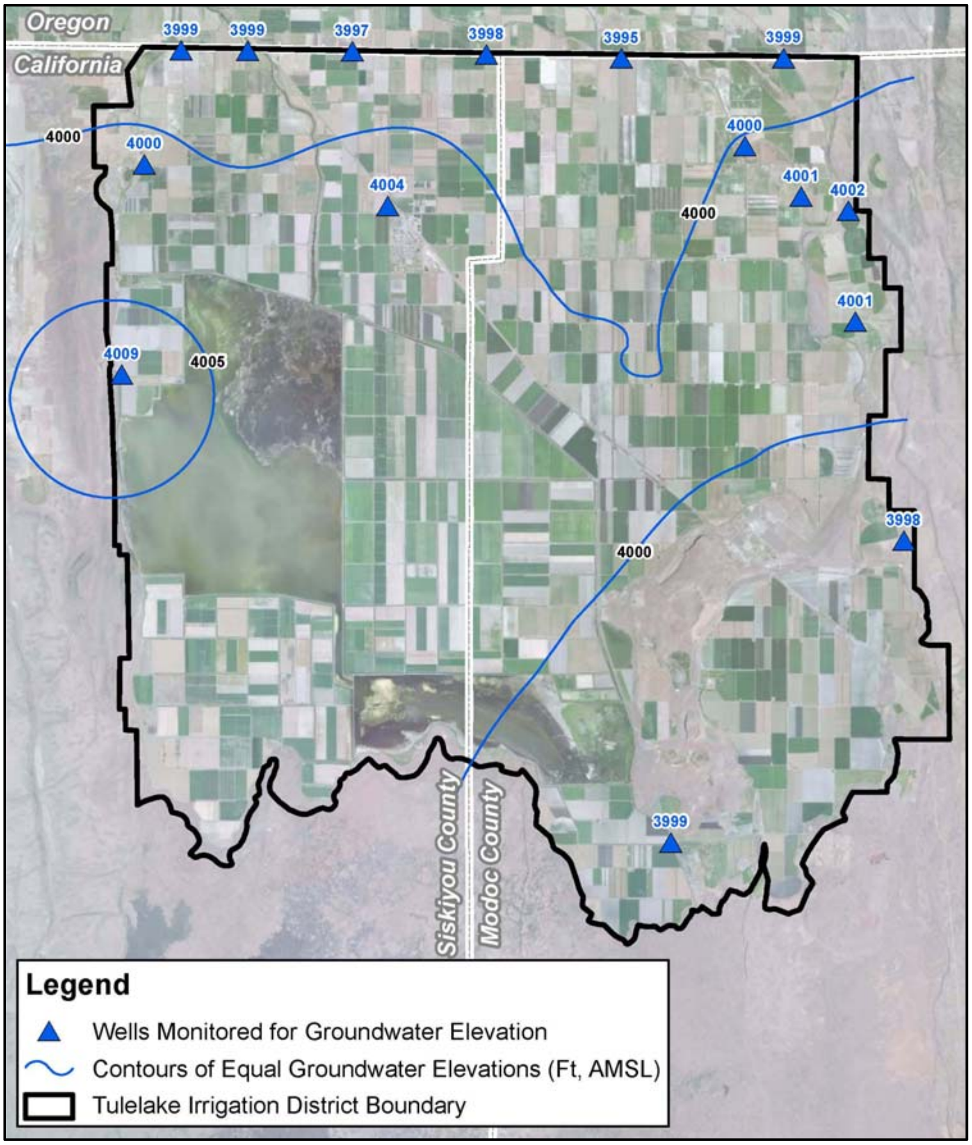


Figure 23. Fall 2010 groundwater surface elevations.

Figure 24 shows the relative change in groundwater elevations between the spring of 2010 and fall of 2010.

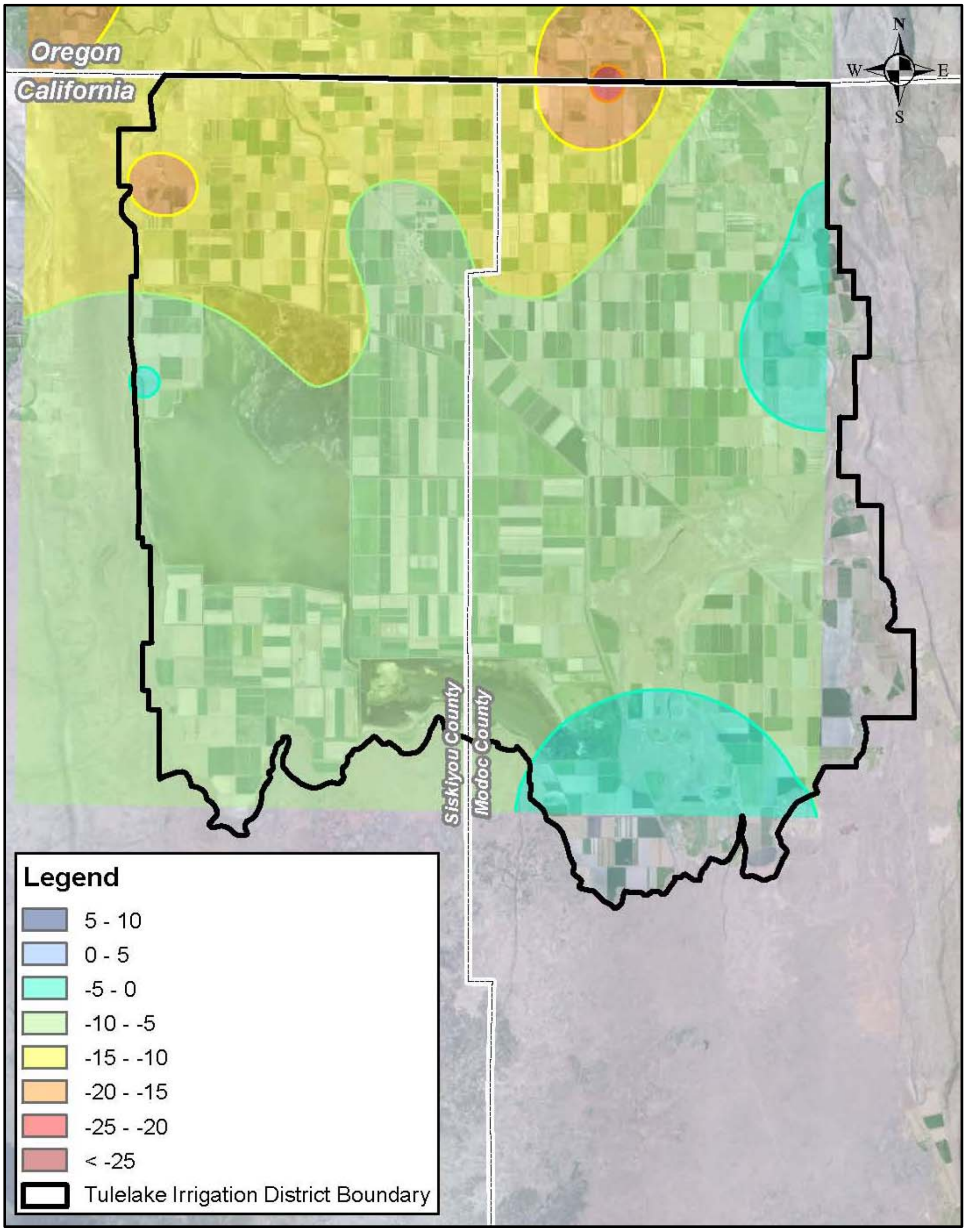


Figure 24. Change in groundwater surface elevations from spring 2010 to fall 2010.

Localized cones of depression appear to be the result of pumping within the northern region of the GWMP area. As depicted in Figure 24, cones of depression identify declines in groundwater elevations of approximately 0 to -20 feet.

Figure 25 identifies the spring 2011 groundwater elevations and contours within the GWMP area.

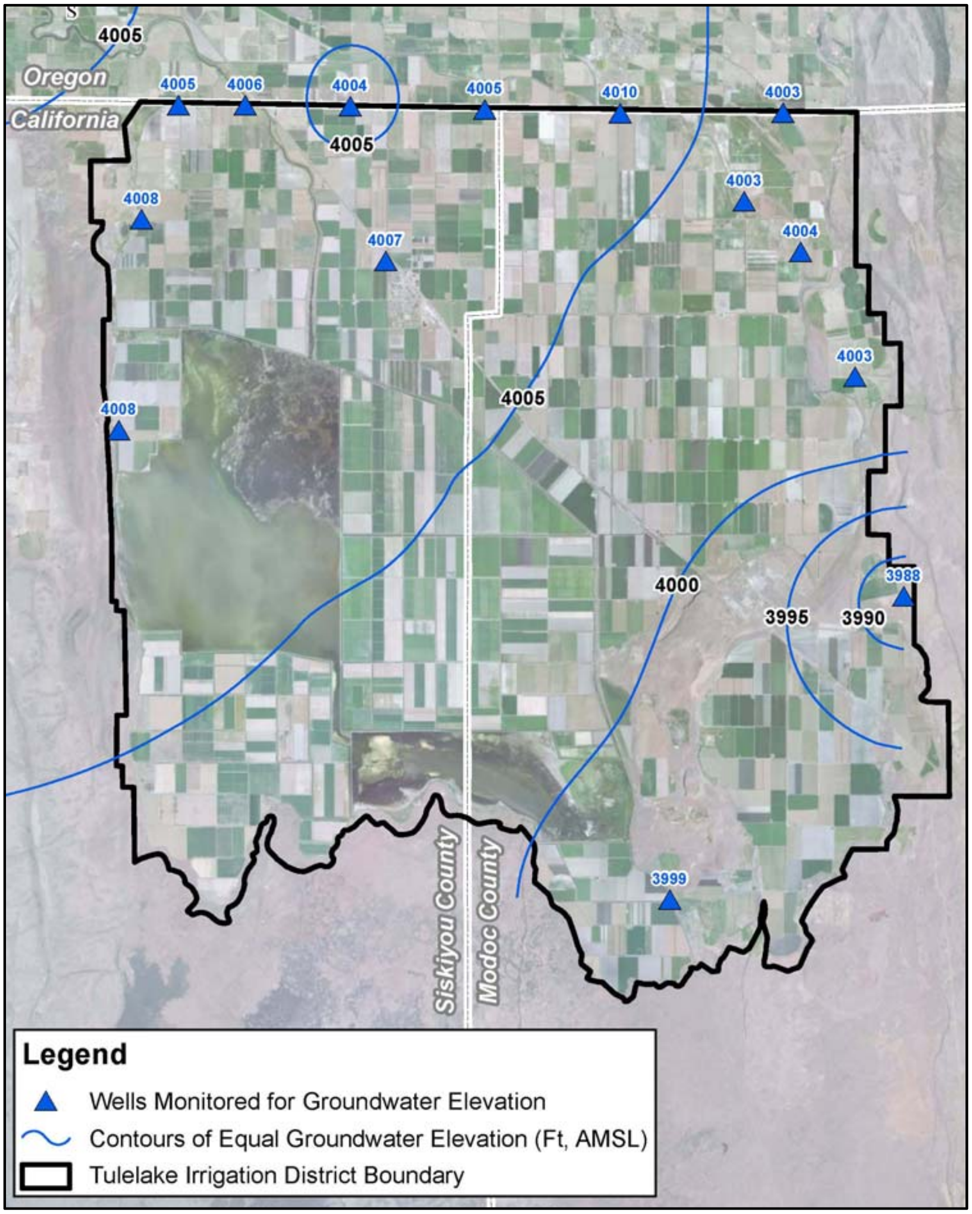


Figure 25. Spring 2011 groundwater surface elevations.

As depicted in Figure 25, groundwater elevations underlying the northern portion of the GWMP area increased slightly (by an average of approximately +5) from the fall of 2010 to the spring of 2011. The wells in the south eastern portion of the GWMP area do not indicate similar recovery occurred during this period.

Land Subsidence

Land subsidence is the lowering of the ground surface though 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 occur during periods when the aquifer is not fully recharged and groundwater levels reach historic lows.

Monitoring of land subsidence within the Upper Klamath Basin, and 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 monuments and preformed a GPS survey of the ground surface elevation. In 2011, DWR re-surveyed the monuments to identify any potential land subsidence. Although the final report summarizing the results of the survey has not been published, preliminary reports and conversations with DWR Northern District staff have identified that there is no evidence of land subsidence within the Tule Lake Subbasin (personal communication: Lawrence, 2011).

Groundwater Quality

Limited groundwater monitoring data are available within Tule Lake Subbasin for the parameters typically used to assess quality for irrigation purposes. In addition, 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.

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).

For the purposes of this GWMP general water quality thresholds identified for each of the groundwater quality parameters below are based on the *Water Quality for Agriculture, FAO Irrigation and Drainage Paper 29 Rev 1.* Although it is recognized that the guidelines for interpretations of water quality for irrigation identified in the *Water Quality for Agriculture* (FAO, 1985) are general guidelines for the understanding of potential affects (decreased yields) for sensitive crops, these values have been referenced as a conservative assumption.

It is important to note that groundwater is utilized as a supplemental water supply within the GWMP area, and when available, irrigators rely on surface water supplies or a combination (blending) of surface and groundwater supplies to irrigate crops.

Total Dissolved Solids (TDS)

Within the Tule Lake Subbasin, levels of TDS are higher in areas closer to the lake deposits and are proportional to the thickness of the deposit layer. Water from the wells in volcanic rocks several miles from the lake deposits or from deep wells developed beneath the confining lake deposits typically contain low to moderate TDS (DWR 2004). TDS concentrations above 450 mg/L may be undesirable for sensitive crops (FAO, 1985). The maximum TDS concentrations observed in wells with TDS data during the period 1999 through 2011 in the vicinity of the GWMP area are illustrated in Figure 26.

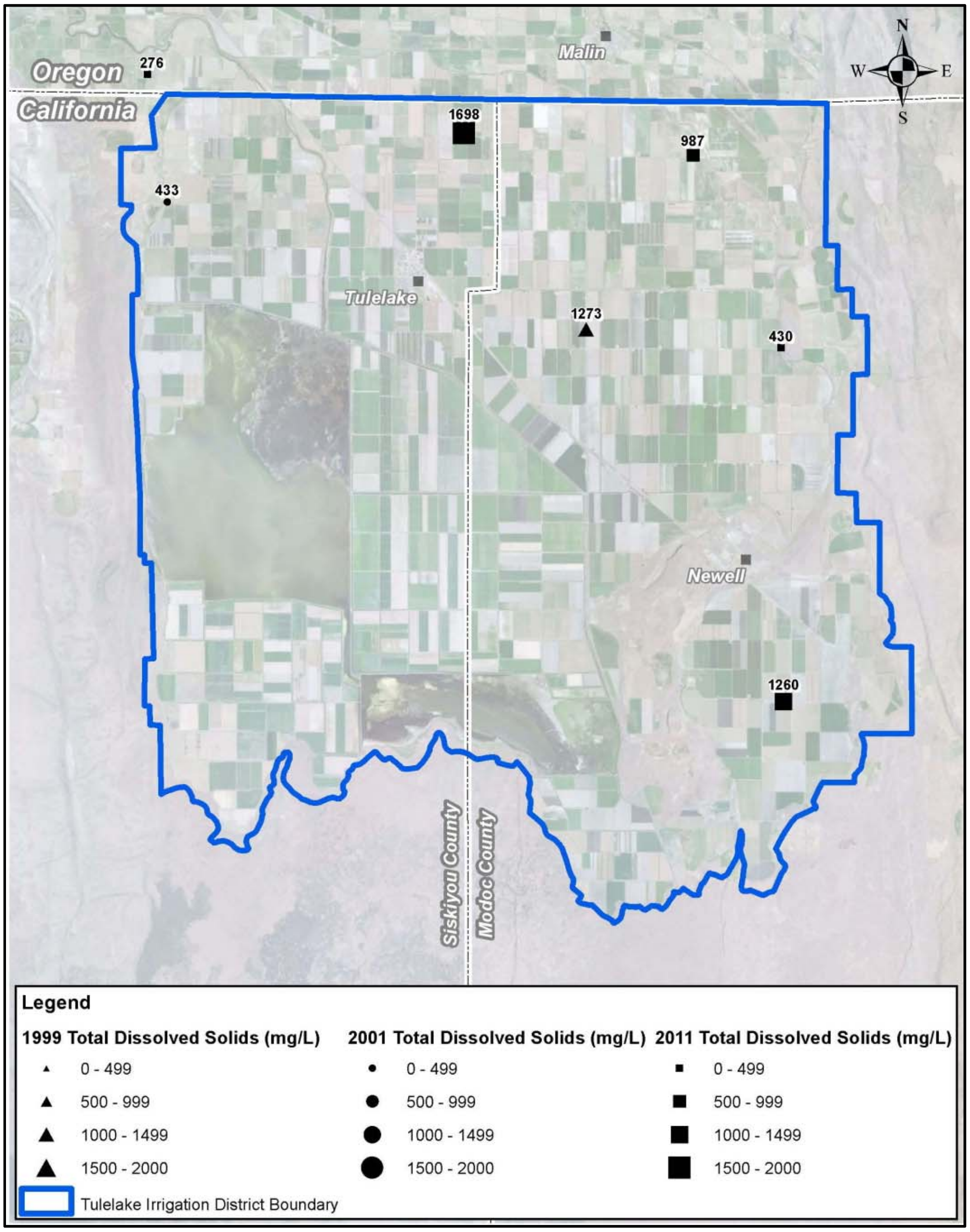


Figure 26. Total Dissolved Solids (TDS) concentration within and near GWMP area (mg/L)

As shown on Figure 26, limited water quality data exists in the GWMP area for all parameters, including TDS.

Chloride

Chloride concentrations above 142 mg/L for surface irrigation applications and 106 mg/l for sprinkler applications have been identified as potentially affecting sensitive crops (FAO, 1985). The maximum concentration of chloride in wells with water quality data between 1999 and

2011 in and around the GWMP area indicate, with the exception of one anomalous well where chloride was reported to be 193 mg/L, historical concentrations of less than 106 mg/L with most below 42 mg/L.

Sodium

Sodium is a naturally occurring mineral in groundwater because most rocks and soils contain sodium compounds from which sodium is easily dissolved. The FAO identified sensitive crops may be affected by sodium concentrations greater than 69 mg/L (FAO, 1985). The maximum concentrations of sodium reported between 1999 and 2010 indicate that the majority of the wells are below the 69 mg/L concentration; however, sodium concentrations as high as 292 mg/L were reported at some well locations.

Boron

The FAO identified sensitive crops may be affected by boron concentration greater than 0.7 mg/L (FAO, 1985). Although boron concentrations at two groundwater wells have been reported at slightly elevated (1.2 and 1.9 mg/L) concentrations within and near the GWMP area have historically been less than 0.7 mg/L. Boron concentrations reported for the majority of the wells have been below what is referred to as the “reporting limit” (i.e., below the concentration detectable by the water quality measurement device).

Observations

Based on the relatively short period of record and limited data for the Tule Lake Subbasin it is difficult to identify trends relative to changes in elevation or water quality. This section provides general observations which describe changes in elevations observed within the GWMP area. Due to the limited availability of water quality data (samples at most wells were only collected once), groundwater quality trends are not addressed. However, examination of the limited available data indicates that the groundwater quality is suitable for agricultural purposes. There have been no indications from growers within the District of water quality concerns or adverse impacts to crop yields.

As previously described the most influential source of groundwater recharge for the Upper Klamath Basin is precipitation. Since the increased level of monitoring and groundwater extraction that has occurred since 2001, there has not been a period of more than one consecutive year of having above average precipitation in the Upper Klamath Basin. Subsurface flows of groundwater within the Upper Klamath Basin generally flow from north to south toward the Tule Lake Subbasin. The increase in groundwater pumping due to dry hydrologic conditions throughout the Upper Klamath Basin have influenced (decreased) the subsurface flow of groundwater to the Tule Lake Subbasin and therefore limited the recharge potential within the southern extent of the Tule Lake Subbasin.

Many of the hydrographs indicate that as of spring of 2011 groundwater elevations at wells within the GWMP area are generally within a few feet of the pre-2001 groundwater elevations observed within the GWMP area. These wells are predominantly shallow groundwater wells (with drilling depths of less than 500 feet) that experience relatively small fluctuations of seasonal drawdown. Deeper wells (including the District’s wells) indicate groundwater elevation changes of up to a maximum of -15 feet (spring 2001 to spring 2011). Wetter hydrologic conditions resulted in minimal groundwater pumping in 2011. Preliminary groundwater elevation data collected by the District for spring of 2012 shows additional recovery of approximately 1 to 5 feet above the 2011 levels.

The limited data and relatively recent increase in groundwater pumping does not provide for sufficient information to identify long term trends within the GWMP area. It is understood that continued monitoring of the groundwater basin is necessary to make informed decisions and to manage and protect the groundwater resource. The following GWMP Elements provide the framework to monitor and manage the groundwater resource to meet the GWMP Management Objectives.

Section 6 - Groundwater Management Plan Elements

As previously identified, this GWMP provides a management framework for maintaining a high quality, reliable, and sustainable supply of groundwater within the GWMP area. In order to understand and provide guidance for operation of its groundwater wells and for other relevant purposes, the District has identified the following Management Objectives:

Management Objective 1: Development of conjunctive use of groundwater, to support years where surface water is limited or not available to meet demand

Management Objective 2: Avoidance of overdraft and associated undesirable effects such as declining groundwater elevations, migration of poor groundwater quality, and land subsidence; in effect continue the successful integrated use of groundwater as a supplemental water supply.

Management Objective 3: Preservation of groundwater quality for beneficial use in the GWMP area.

To accomplish those goals, this GWMP incorporates a number of components recommended in the AB 3030 and SB 1938 GWMP guidelines. For simplicity and consistency with the District's Management Objectives, these recommended components have been organized and defined in the following ten (10) GWMP "Elements". As previously identified components not included in the Elements are not applicable to the District or GWMP area (e.g., saline intrusion).

The Elements formally recognize the effectiveness of a number of ongoing water resource management activities, and they recognize the need for additional activity, to meet the Management Objectives of this GWMP. The Elements also reflect a wider focus on local groundwater management, such as continuing cooperation between land owners and the District, as well as with other water resource management entities in the region to address regional resource opportunities and/or challenges. In summary, this GWMP is intended to enable the District, individual landowners, and their regional neighbors to continue use of local groundwater as a supplemental water supply during years of surface water shortages, and to work with other agencies via implementation of the following Elements.

Element 1: Monitoring of Groundwater Elevation, Storage, Quality, Pumping and Land Subsidence

Element 2: Monitoring and Management of Surface Water Flows and Quality

Element 3: Determination of Sustainable Yield and Avoidance of Overdraft

Element 4: Continuation of Conjunctive Use to Supplement Surface Water Supplies during Years of Surface Water Shortages

Element 5: Agency Coordination, Stakeholder Involvement, and Public Outreach

Element 6: Public Education and Water Conservation Programs

Element 7: Well Construction, Abandonment and Destruction Policies

Element 8: Management and Protection of Recharge Areas and Wellhead Protection Areas

Element 9: Provisions to Update the Groundwater Management Plan

Element 10: Implementation Procedures

Each of the Elements is discussed below.

Element 1 - Monitoring of Groundwater Elevations, Quality, Pumping, and Land Subsidence

Prior to 2001 and the installation of groundwater wells by the District, landowners within the District relied on surface water deliveries from the Klamath Reclamation Project and locally owned private groundwater wells. Since 2001, the supplemental groundwater supply has become an important component of overall water supply in the District, particularly during periods of surface water shortages. The development and use of groundwater within the area has resulted in the collection of some amount of groundwater level data, beginning in the 1980's. However, the collection of groundwater elevation data within the GWMP area has in most cases been inconsistent in both location and frequency of sampling. As a result of the installation of the District's groundwater wells in 2001 and individual landowner participation in water bank programs and activities, a more comprehensive data set has been collected. The following data are currently being collected.

Groundwater Elevations

The District has established a groundwater monitoring network consisting of the District owned wells, USFW dedicated monitoring wells, and private landowner wells. These 15 wells within the District's boundary are identified on Figure 27. The District may also request voluntary reporting by landowners who wish to do so. The District monitors the well network on a monthly basis during the year and on a weekly basis when the pumps are operating. The District has enrolled in the CASGEM program and prepared and submitted a groundwater monitoring plan to DWR (See Appendix B).

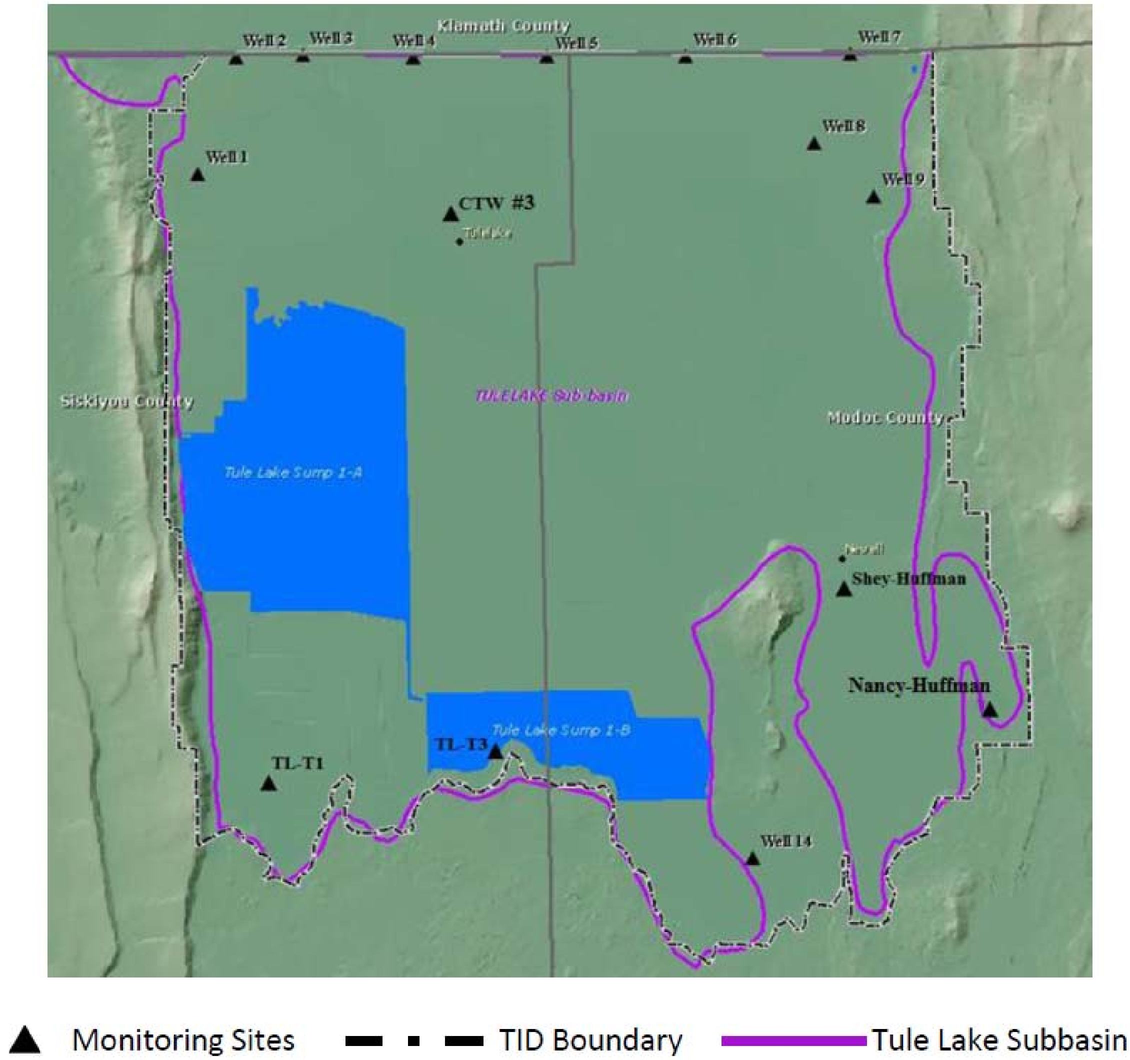


Figure 27. Tulelake Irrigation District groundwater monitoring network.

<u>Groundwater Quality</u>

Water quality data has historically (from 2001-present) been collected by DWR, Reclamation and the USGS within the GWMP area. Some groundwater quality data is maintained by DWR and the USGS, but there is no regular groundwater quality monitoring program that covers the GWMP area.

The District has participated in water bank programs beginning in 2001, which has resulted in monitoring efforts by Reclamation, including measurements of groundwater quality parameters in approximately thirty (30) wells during 2001. Groundwater quality field parameters have not been continuously collected in more recent years at all of these locations. As one of the Management Objectives, the publicly available groundwater quality data will be compiled and complemented by future efforts to monitor groundwater quality. Indicator parameters (e.g. TDS, pH, EC, Boron, etc.) will be collected in order to monitor groundwater quality in selected wells, consistent with the District's Management Objectives on a location and frequency to be determined by the District.

Groundwater Pumping

Part of this GWMP is to incorporate the efforts of others including the USGS and DWR to estimate District-wide groundwater pumping, to track over time, and to incorporate the data into an analysis described in other Elements of this GWMP. It is unclear at this time the precise amount of groundwater pumped by individual landowners within the GWMP area in a given year. Estimates of the relative magnitude of groundwater pumping within the GWMP area may be derived from the quantities of water pumped for participation in water bank program activities. Although this may not provide the exact quantity of groundwater pumped within the District, it may provide a general magnitude of groundwater pumping which may be beneficial for future planning efforts and to meet the Management Objectives of this GWMP. The District may also request voluntary reporting of quantities pumped by landowners who wish to do so.

Land Subsidence

Subsidence has not been an issue within the GWMP area, and the preliminary results of a recent study by DWR, have identified that no subsidence has occurred during the study period of 2001 through 2011.

Continuation and potential expansion of groundwater level and groundwater quality data collection, continuation of land subsidence data collection, and initiation of an effort to estimate the groundwater pumping during dry periods are key to accomplishing the Management Objectives in this GWMP. Monitored groundwater levels and quality, and estimated pumping, along with subsidence data, will be organized into a computerized database (Microsoft Excel spreadsheet or similar tool) for the entire District. This information will be the basis for defining groundwater basin conditions and developing operational protocols that allow conjunctive use to support the ongoing supplemental groundwater supply while avoiding undesirable conditions such as chronically depressed groundwater levels, degraded groundwater quality, and inelastic subsidence.

The first Element of this GWMP is to continue to implement the CASGEM groundwater monitoring program that is comprised of a network of wells, such as those illustrated in Figure 27, for groundwater level monitoring. That data will be complemented by ongoing water quality and subsidence monitoring by DWR, Reclamation and the USGS and by annual estimates of groundwater pumping based on participation in water bank program activities. The frequencies and types of groundwater data collection will vary as a function of specific Management Objectives as they may be identified in various parts of the groundwater basin.

Element 2: Monitoring and Management of Surface Water Flows and Quality

Groundwater is readily recharged by a combination of precipitation, natural surface water flow, and return flow from applied agricultural irrigation, as well as subsurface inflow from other areas. The District operates the Tule Lake Sumps 1A and 1B as a recirculation reservoir which also provides opportunity for groundwater recharge in the groundwater basin (Tule Lake Subbasin).

Surface water flows to the GWMP area are measured at the Anderson Rose Dam as both spill to the Tule Lake Sumps via the Lost River and diversions to the J-Canal for delivery within the District. Additional surface water inflow from an upstream irrigation district (Klamath Irrigation District) was measured historically; however, in recent years (post 2007) measurement at these locations are no longer available. The District is currently working with Reclamation to redeploy measurement devices at these locations to measure inflow to the District.

Ongoing monitoring of surface water storage and flows within the Upper Klamath Basin, and GWMP area are an important component in understanding recharge to the groundwater basin. The flows in concert with surface water and groundwater quality data will be essential to incorporating surface water considerations into management of the underlying aquifer system. Therefore, monitoring of surface water quality will also be part of this GMWP, and the resultant data will be incorporated into the database for analysis and understanding of groundwater effects on surface water. The District will continue to work with Reclamation to install measurement devices at the drainage inflow locations to the GWMP area and continue to measure inflow at Anderson Rose Dam and deliveries to the J-Canal. Additional critical measurement locations are outside of the District; and therefore, the District will continue to coordinate with other entities to obtain and understand surface water storage and flows within the Upper Klamath Basin.

The frequencies and collection of surface water quality data will vary as a function of specific Management Objectives for the GWMP area.

Element 3 – Determination of Sustainable Yield and Avoidance of Overdraft

Historic long-term data regarding groundwater conditions in the GWMP area are limited. During the recent period of groundwater pumping (2001-2010) there were, and continue to be, short-term fluctuations in groundwater levels have been observed that are basically related to variations in local hydrological conditions and associated fluctuations in recharge and pumping. Such fluctuations are typical of groundwater basin conditions in any conjunctive use setting; groundwater is utilized from storage during dry years, or dry periods, and that storage is replenished during subsequent wet years, or periods.

While historical operating experience, complemented by observed groundwater conditions, will remain an appropriate basis for general planning for available sustainable groundwater supplies, it is possible to more precisely analyze basin conditions to determine values or ranges of yield under varying hydrologic conditions, and to assess the impacts of various management actions that might be implemented in the basin. The ultimate intent of this GWMP Element is to develop an understanding of the sustainable yield of the basin, under varying hydrologic conditions and developing local cultural practices, so that groundwater development and use can be managed in such a way to meet an appropriate fraction of total water demand during periods of surface water shortages while avoiding levels of groundwater use that would result in overdraft conditions.

A major consideration in achieving the goals of this GWMP will be to develop a working understanding of the groundwater basin and the continued conjunctive use of supplemental surface water supplies while avoiding groundwater overdraft. Toward that goal, the monitoring described in Elements 1 and 2 will be interpreted in Element 3 to analyze projected results, i.e. groundwater levels, and storage in order to design the optimal distribution of pumping or to refine the range of dry period pumping volumes. The result will facilitate planning for supplemental groundwater water supplies, and proactive recharge activities to augment basin yield to meet water supply demand. This Element will be coordinated through the USGS modeling efforts, and other entities that are continuing to analyze the groundwater basin.

Element 4 – Continuation of Conjunctive Use to Supplement Surface Water Supplies during Years of Surface Water Shortages

Conjunctive use consists of meeting water demands primarily through surface water supplies and during dry years pumping groundwater to supplement water shortages. Conjunctive use of local groundwater and surface water will continue to be a key Element in meeting all of the goals for the GWMP area, most notably utilizing groundwater as a supplemental water supply without over-drafting the Tule Lake Subbasin. Recent experience with groundwater pumping and aquifer response to varying hydrologic conditions has shown that the groundwater basin can support variations in pumping during dry periods.

As part of conjunctively using surface water and groundwater, it is recognized that there will continue to be year to year variations in the need for supplemental groundwater. Similarly, there are expected to be variations in local groundwater conditions as a function of local hydrologic conditions which affect, among other things, the magnitude of the natural recharge to the groundwater basin from year to year. Thus, conjunctive use management is necessary to ensure that the groundwater basin is maintained as a component of water supply during dry periods. Conjunctive use management is similarly important to ensure that local groundwater system can be replenished, via reduced pumping and/or as a result of wetter local hydrologic conditions, during periods of wet/normal surface water availability.

A major consideration in this GWMP will be accomplishing this Element in concert with Element 3, i.e. determination of sustainable yield and avoidance of overdraft. Toward that goal, the monitoring described in Elements 1 and 2 will be interpreted in Element 3 to understand basin response to variations in the amounts and distribution of pumping throughout the District.

The results of the monitoring and interpretation of Elements 1 through 3 will facilitate ongoing distribution of surface water, as well as planning for continuation of the supplemental groundwater supplies, and evaluating the potential for proactive recharge activities to augment basin yield to meet the Management Objectives. Thus, implementation of this Element, within the confines of Element 3, will be essential to accomplishment of the first Management Objective for the groundwater basin.

Element 5 - Agency Coordination, Stakeholder Involvement, and Public Outreach

The District has a working relationship with DWR for coordinated groundwater monitoring in the GWMP area. In addition, the District coordinates with the Oregon Water Resources Department (OWRD), the USGS, county, and local government (e.g., irrigation districts) entities for coordinated groundwater monitoring efforts. This GWMP envisions continued cooperation with these entities and other interested parties to continue and improve groundwater monitoring in the GWMP area.

This GWMP element is primarily included to formalize the historical local and state agency working relationships as part of comprehensively managing local groundwater, in concert with currently developed surface water, to accomplish all the Management Objectives for the GWMP area.

The District will work with other County, State and Federal regulatory agencies when appropriate to protect the groundwater basin and achieve broader local and regional benefits. The District will review land use plans as they are available and coordinate with land use planning agencies to assess activities which create a reasonable risk of impacts to the groundwater basin within the GWMP area.

Element 6 - Public Education and Water Conservation Programs

As part of its water delivery operations, the District solicits land use and cropping plans from landowners who receive surface water from the District each year. The resultant data are utilized to estimate water requirements and to identify the need for additional supplemental groundwater pumping to meet District demand. Part of that allocation effort includes public education about the extent and availability of surface water. GWMP Element 6 is included to reflect a direction toward expanded public education regarding groundwater and surface water conditions, all relative to irrigation water requirements and the Management Objectives to avoid overdraft and any related undesirable effects.

Element 7 - Well Construction, Abandonment, and Destruction Policies

Well construction permitting within the Tule Lake Subbasin is administered by the Modoc and Siskiyou County Health Departments, which effectively implement the State 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. One Management Objective of this GWMP is the protection and preservation of groundwater quality for domestic, municipal and agricultural purposes. This Management Objective requires that all wells be properly constructed and maintained during their operational lives. Additional wells must be properly destroyed after their useful lives, so that they do not adversely affect groundwater quality by, for example, serving as conduits for movement of contaminants from the ground surface and/or from a poor quality aquifer to one of good quality. Toward that end, GWMP Element 7 is included in the GWMP to support well construction and destruction policies, and to participate in their implementation throughout the GWMP area, particularly with regard to surface and inter-aquifer well sealing and proper well destruction, which are critical in the management of an aquifer system.

Element 8 - Management and Protection of Recharge Areas and Wellhead Protection Areas

Aquifers beneath the GWMP area are recharged by precipitation, streamflow, applied irrigation water, and subsurface inflow from other areas. Land use within the area has historically been primarily agricultural.

GWMP Element 8 includes groundwater management activities such as continued monitoring of land uses and associated impacts on groundwater recharge, potentially leading to participation in land use planning to protect critical recharge areas. Similarly, wellhead protection areas within which pumping of individual wells directly affects groundwater flow towards those wells, will be analyzed and mapped as appropriate with the intent to protect them if necessary. This is not expected to be of major importance in light of prevailing good groundwater quality and as local groundwater use continues to be primarily for irrigation supply.

Element 9 - Provisions to Update the Groundwater Management Plan

The elements of this GWMP reflect the current understanding of the occurrence of groundwater in the overall GWMP area. The Management Objectives are designed to achieve certain goals to protect and preserve groundwater quantity and quality for overlying beneficial use into the foreseeable future. At the same time, the Management Objectives of this GWMP are intended to continue the opportunity for conjunctive use during years of surface water shortage.

Ultimately, it is recognized that, while the GWMP provides a framework for present and future actions, new data will be developed as a result of implementation of the GWMP. That new data could identify conditions which will require modifications to currently definable management actions. As a result, this GWMP is intended to be a flexible document which can be updated to modify existing Elements and/or incorporate new Elements as appropriate in order to recognize and respond to future groundwater conditions and to address changing Management Objectives as they evolve in the GWMP area.

Element 10 - Implementation Procedures

Once the GWMP is adopted by the District’s Board of Directors, its implementation will begin. The District will continue collecting groundwater elevation data at the defined monitoring well network and continue to coordinate with local, county, and federal entities to monitor conditions and identify potential changes in the groundwater basin.

Section 7 - References

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Appendix A

TULELAKE IRRIGATION DISTRICT

BOARD OF DIRECTORS RESOLUTION NO. 2011-2

INTENTION TO DRAFT AN AB 3030 GROUNDWATER MANAGEMENT PLAN

BE IT RESOLVED by the Board of Directors of the TULELAKE IRRIGATION DISTRICT that, in accordance with Section 10750-10756 of the California Water Code, it Intends to Draft a Groundwater Management Plan (GMP) for the purpose of further developing the Counties' water resources. This Water Code Section was created by the 1992 Assembly Bill 3030 (AB 3030). GMPs developed in accordance with AB 3030 are known as AB 3030 Groundwater Management Plans.

WHEREAS, the plan area of Tulelake Irrigation District's AB 3030 GMP is the Tule Lake Subbasin (1-2.01) located in the Upper Klamath River Groundwater Basin (1-2 – California Department of Water Resources Bulletin 118 for the North Coastal Hydrologic Study Area) of Siskiyou and Modoc Counties, and

WHEREAS, technical information and reports have been compiled for a comprehensive plan for the development of an AB 3030 GMP for the Tule Lake Subbasin,

NOW, THEREFORE, BE IT FURTHER RESOLVED that the General Manager of TULELAKE IRRIGATION DISTRICT is hereby authorized and directed to file its Intention to Draft an AB 3030 Groundwater Management Plan with the California Department of Water Resources.

PASSED AND ADOPTED by the Board of Directors of the TULELAKE IRRIGATION DISTRICT, State of California, on this 12th day of September, 2011, by the following vote:

AYES: Directors Crawford, Havlina, Staunton and Wright
NOES:
ABSENT: Director Heiney
ABSTAIN:

ATTEST:

Earl C. Danosky

Earl C. Danosky, Secretary/General Manager

AFFIDAVIT OF PUBLICATION
STATE OF OREGON,
COUNTY OF KLAMATH

I, Jeanine P. Day, Finance Director, being duly sworn, depose and say that I am the principle clerk of the publisher of the Herald and News, a newspaper in general circulation, as defined by Chapter 193 ORS, printed and published at Klamath Falss in the aforesaid county and state; that I know from my personal knowledge that the
Legal#13752 RESOLUTION 2011-2
TULELAKE IRRIGATION DISTR
a printed copy of which is hereto annexed, was published in the entire issue of said newspaper for: 2

Insertion(s) in the following issues:
09/20/2011 09/27/2011

Total Cost: $248.06

Jeanine P Day

Subscribed and sworn by Jeanine P Day before me on:
27th day of Septemberin the year of 2011

Notary Public of Oregon
My commision expires on May 15, 2012

OFFICIAL SEAL
DEBRA A. GRIBBLE
NOTARY PUBLIC - OREGON
COMMISSION NO. 429083
MY COMMISSION EXPIRES MAY 15, 2012

TULELAKE IRRIGATION DISTRICT
BOARD OF DIRECTORS RESOLUTION NO. 2011-2
INTENTION TO DRAFT AN AB 3030
GROUNDWATER MANAGEMENT PLAN

BE IT RESOLVED by the Board of Directors of the TULELAKE IRRIGATION DISTRICT that, in accordance with Section 10750-10756 of the California Water Code, it Intends to Draft a Groundwater Management Plan (GMP) for the purpose of further developing the Counties' water resources. This Water Code Section was created by the 1992 Assembly Bill 3030 (AB 3030). GMPs developed in accordance with AB 3030 are known as AB 3030 Groundwater Management Plans.

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WHEREAS, technical information and reports have been compiled for a comprehensive plan for the development of an AB 3030 GMP for the Tule Lake Subbasin,

NOW, THEREFORE, BE IT FURTHER RESOLVED that the General Manager of TULELAKE IRRIGATION DISTRICT is hereby authorized and directed to file its Intention to Draft an AB 3030 Groundwater Management Plan with the California Department of Water Resources.

PASSED AND ADOPTED by the Board of Directors of the TULELAKE IRRIGATION DISTRICT, State of California, on this 12th day of September, 2011, by the following vote:
AYES: Directors Crawford, Havlina, Staunton and Wright
NOES:
ABSENT: Director Heiney
ABSTAIN:
ATTEST:
/s/ Earl C. Danosky, Secretary/General Manager
#13752 September 20, 27, 2011.

Tulelake Irrigation District

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

Subject: Preparation of Tulelake Irrigation District's Groundwater Management Plan

Tulelake Irrigation District (TID) is preparing a Groundwater Management Plan (Plan) as authorized by sections 10753-10753.11 of the California Water Code. The preparation of the Plan will include the development of appropriate groundwater management objectives within the Plan area (Tule Lake Subbasin) and the corresponding monitoring to assure that the management objectives are being met.

TID's Board of Directors adopted a resolution of intention to adopt a groundwater management plan on September 12, 2011 (Resolution 2011-02). Objectives for the Plan include to comply with existing legislation, educate water users relative to groundwater resources, develop and meet management objectives and to provide a monitoring program to inform water users of the groundwater conditions in the Plan area.

TID encourages public participation in development of the Plan. The following describes how interested parties may participate in developing the Plan:

1. TID will establish and maintain a list of persons interested in receiving notices regarding Plan preparation, meeting announcements, and availability of draft Plans, maps, and other relevant documents. If you wish to be placed on this list of interested persons, please submit a request in writing, to the address below.
2. TID welcomes your submittal of technical or other information that may be useful for the development of the Plan. Please submit any such information to the address below.
3. TID's staff is available to discuss the development of the Plan with interested persons. Please call the office at the number below to make an appointment, or visit during office hours and staff will accommodate you if possible at that time.
4. Attend the public meetings described in the attached fact sheet, and provide your input.

The First Public Meeting will be held on November 15th, 2012 at 10 A.M. at the Tulelake Fire Hall.
(1 Ray Oehlerich Way, Tulelake, CA 96134)

The attached brief fact sheet provides more information and other references. To be placed on the list of interested persons or for other information, please contact Brad Kirby at the following:

Phone: (530) 667-2249	e-mail: tid@cot.net	Mailing Address:	Physical Address:
		P.O. Box 699	2717 Havlina Rd
		Tulelake, CA 96134	Tulelake, CA 96134

Sincerely,

Brad C. Kirby
Assistant to the Manager
Tulelake Irrigation District

Tulelake Irrigation District
Groundwater Management Plan
Fact Sheet

Contact:

Brad Kirby
Assistant to the Manager
Tulelake Irrigation District

(530) 667-2249

tid@cot.net

Mailing Address:
P.O. Box 699
Tulelake, CA 96134

Physical Address:
2717 Havlina Rd
Tulelake, CA 96134

Current Schedule:

Nov 2012 – Public Meeting

November 15th, 2012

10 A.M.

Tulelake Fire Hall

1 Ray Oehlerich Way

Tulelake, CA 96134

Feb 2013– Public Meeting

TBD

Mar 2013 – Public Hearing

TBD

May 2013 – Consider Approval

TBD

Interested Party Participation

Tulelake Irrigation (TID) is preparing a Groundwater Management Plan as authorized under the California Water Code (sections 10753-10753.11) .The preparation of the Plan will include the development of appropriate groundwater management objectives within the Plan area (Tule Lake Subbasin) and corresponding monitoring to assure that the management objectives are being met. The management objectives will be developed through coordination and discussions with interested parties including but not limited to landowners/growers, public agencies, and Ca. Department of Water Resources. TID will facilitate participation of interested parties in the development of the Plan. In addition, TID will hold public meetings to inform interested parties of the development of the Plan and provide opportunity for public participation and comment.

The Plan is not a requirement of, and is not being developed for, the Klamath Basin Restoration Agreement (KBRA) or the "On-Project Plan" of the KBRA. The Plan should, however, be compatible with these separate activities.

The Purpose of a Groundwater Management Plan

The purpose of the Groundwater Management Plan is to meet management objectives within the groundwater basin. The general purpose, scope and benefits of developing a groundwater management plan are as follows:

- Meet management objectives of long-term, sustainable, reliable and good quality groundwater supply
- Facilitate conjunctive use of groundwater as a supplemental water supply
- Establish monitoring protocols and define a monitoring well network to track changes in the groundwater basin conditions
- Eligibility for application of funding through the Ca. Department of Water Resources for groundwater projects including but not limited to groundwater level and quality monitoring, new well construction, reconstruction of existing wells, and well deconstruction

This Groundwater Management Plan will not regulate groundwater within the Plan area, nor is it TID's intent to impose assessments on groundwater users under the Plan.

Additional Resources:

The Ca. Department of Water Resources provides useful information on the development of groundwater management plans, which are often referred to as "AB 3030 Plans" and groundwater monitoring within California. Available information and resources are identified below:

http://www.water.ca.gov/groundwater/gwmanagement/sb_1938.cfm

http://www.water.ca.gov/groundwater/gwmanagement/ab_3030.cfm

http://www.water.ca.gov/groundwater/bulletin118/update2003.cfm

http://www.water.ca.gov/groundwater/casgem/

Tulelake Irrigation District

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

Subject: Tulelake Irrigation District's Groundwater Management Plan

On April 25, 2013, at 10:00 a.m., at the Tulelake Firehouse (1 Ray Oehlerich Way, Tulelake, CA 96134), Tulelake Irrigation District (TID) will hold a public hearing to consider whether to adopt a groundwater management plan (Plan) for TID's service area, including the area within the boundaries of TID in Siskiyou and Modoc Counties, California. The Plan under consideration has been developed under the authority of California Water Code section 10750 et seq. for the Plan Area of the state's Tule Lake Subbasin (1-2.01) of the Upper Klamath River Groundwater Basin. Copies of the Plan and any maps prepared under Part 2.75 of Division 6 of the California Water Code may be obtained for the cost of reproduction at TID's office (2717 Havlina Road, Tulelake, CA 96134), or via e-mail upon request (tid@cot.net).

In summary, the Plan includes the following: (a) descriptions of TID, its water rights and contracts, relevant infrastructure, available water supplies, and area covered by the Plan; (b) description of various provisions of the California Water Code applicable to groundwater management plans, as well as descriptions of local ordinances (such as county ordinances) related to groundwater, and legislation and agreements; (c) management objectives for the Plan area; (d) description of existing groundwater conditions, including geologic conditions, groundwater quantity and quality; and, (e) Plan elements including element 1 related to monitoring of groundwater elevations, quality, pumping, and land subsidence; element 2 related to monitoring and management of surface water flows and quality; element 3 related to determination of sustainable yield and avoidance of overdraft; element 4 related to continuation of conjunctive use to supplement surface supplies during years of surface water shortage; element 5 related to agency coordination, stakeholder involvement, and public outreach; element 6 related to public education and water conservation programs; element 7 related to well construction, abandonment, and destruction policies; element 8 related to management and protection of recharge areas; element 9 related to provisions to update the Plan; and element 10 pertaining to implementation procedures. The Plan under consideration does not propose that TID levy fees or become a regulator of groundwater extraction.

At any time prior to the conclusion of the April 25 hearing, any landowner within TID may file a protest to the adoption of the Plan in accordance with California Water Code sections 10753.5 and 10753.6. Such protests should be filed with TID at 2717 Havlina Road, Tulelake, CA 96134. If a majority protest is not filed by the conclusion of the hearing, TID may, within 35 days of the conclusion of the hearing, adopt the proposed Plan.

Interested parties should plan to attend the public hearing, April 25, 2013, at 10:00 a.m. For further information call the Tulelake Irrigation District at (530) 667-2249.

Sincerely,

Brad C. Kirby
Assistant to the Manager
Tulelake Irrigation District

Appendix B

Tulelake Irrigation District

Groundwater Monitoring Plan

TID

TABLE OF CONTENTS

INTRODUCTION

The purpose of this groundwater monitoring plan is to provide a reference and procedural basis for groundwater monitoring in the Tule Lake Subbasin (1-2.01). Using the policies and procedures set forth in this plan the Tulelake Irrigation District, hereafter referred to as TID, will regularly and systematically monitor groundwater elevations at designated monitoring sites. With the data collected under this plan, along with the existing data that TID has compiled since 2001, TID will be able to demonstrate seasonal and long-term trends of groundwater elevations in the Tule Lake Subbasin. The information gathered will be reported to the California Department of Water Resources (DWR) under the California Statewide Groundwater Elevation Monitoring (CASGEM) program.

MONITORING PLAN RATIONALE

TULE LAKE SUBBASIN (1-2.01)

TID lies within the Tule Lake Subbasin of the Upper Klamath River Groundwater Basin. TID's boundary encompasses most of, if not the entire, California portion of the Tule Lake Subbasin. The Tule Lake Subbasin is located within the California portion of the Klamath Basin, approximately 30 miles southeast of the City of Klamath Falls, OR, and is split by the boundary of Siskiyou County and Modoc County. The subbasin is bounded to the west by the Gillems Bluff Fault that forms the steep eastern slope of Sheepy Ridge, which separates the Tule Lake and Lower Klamath subbasins. The subbasin is bounded to the east by the Big Crack Fault that forms the western edge of the block faulted mountains between Tule Lake and Clear Lake Reservoir. The subbasin is bounded to the south by the low-lying volcanic fields on the north slope of the Medicine Lake Highlands. As stated in Bulletin 118, the subbasin is bounded to the north by the state boundary of Oregon and California.

The principal water-bearing formations in the Tule Lake Subbasin include Tertiary to Quaternary lake deposits and volcanics.

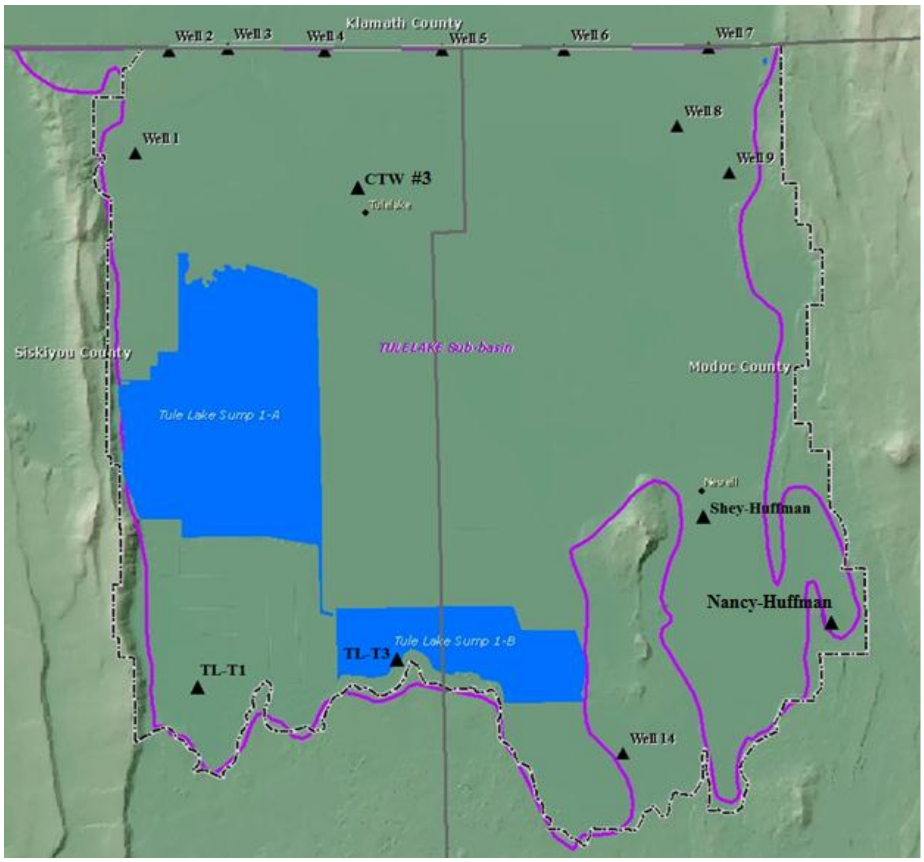
There are two principal sources of recharge in the subbasin: underflow from the rapidly replenished and permeable unconfined system of adjacent volcanic rocks, and infiltration of surface water through marginally permeable sedimentary deposits. The area surrounding the subbasin consists of mainly Holocene and Miocene volcanic rocks that capture most of the incipient precipitation and intermittent stream flow by infiltration through fractures. This source of recharge is believed to be the most significant for the subbasin due to the very slow infiltration rates in the sedimentary deposits.

HISTORY OF GROUNDWATER MONITORING IN THE TULE LAKE SUBBASIN (1-2.01)

TID has been monitoring groundwater levels within the Tule Lake Subbasin since 2001. The 2001 to present data has been collected from the ten wells that TID owns within the district, and more recently, TID has collected data from five additional privately owned sites. DWR also measures about fifty wells in the Tule Lake Subbasin including the ten TID wells. The DWR monitored wells throughout the subbasin are a mixture of domestic, irrigation, industrial, monitoring, municipal, and stock wells of varying depths. All of the wells are measured by DWR during spring, summer, and fall of every year. A map of the DWR monitoring sites can be found in Appendix A.

WELL NETWORK

The well network that TID monitors consists of 15 wells which are spread throughout the Tule Lake Subbasin within the District's boundary. The sites that were selected by TID were done so in order to provide the best overall coverage available of the Tule Lake Subbasin. A map of the well network is shown in Figure 1 below.



▲ Monitoring Sites — ▪ — TID Boundary ——— Tule Lake Subbasin

Figure 1. TID Groundwater Monitoring Network

Of the 15 monitoring sites, 10 of them are owned and operated by TID. They are most commonly known as TID 1 through 9 and TID 14. Most of these wells are positioned in the northern most part of the California portion of the Tule Lake Subbasin, with the exception of TID 14 which is located in the southern section in an area known as the Panhandle. The additional five wells that TID monitors under the CASGEM program are privately owned sites. The site shown on the map as CTW #3 is the newest well drilled by the City of Tulelake located at the northern tip of the city limits. The sites depicted as TL-T1 and TL-T3 are well test sites drilled by the U.S. Fish and Wildlife Service within the confines of the Tule Lake National Wildlife Refuge. The remaining two wells are situated in the southeast portion of the Tule Lake Subbasin in an area known as Copic Bay, and both are owned by a local farming entity identified as the Huffman Brothers. All 10 of TID's wells, as well as the two wells owned by the U.S. Fish and Wildlife Service, are designated as CASGEM wells. The wells known as CTW #3, Shey-Huffman, and

Nancy-Huffman are designated as Voluntary due to a confidentiality agreement between TID and the owners. All pertinent well information for each of the TID monitoring sites can be found in Appendix B.

MONITORING SCHEDULE

TID's monitoring of the groundwater elevation of each of the monitoring sites is done on a monthly basis. Collection and documentation of groundwater elevation data of all monitoring sites is conducted within a single day within the first full week of each month of the year. This gives a sufficient month by month picture of the groundwater fluctuation. In the case of temporary inaccessibility to any of the sites due to weather conditions, or any other conditions, collection of the data for those sites is done as soon as possible when the conditions improve.

FIELD METHODS

REFERENCE POINT

All reference point (RP) information for each of TID's monitoring sites can be found in the table in Appendix B. A photograph and written description of the reference point for each monitoring site can be found in Appendix C.

RECORDING DEPTH TO WATER MEASUREMENTS

TID's method for recording depth to water measurements is the Electric Sounding Tape Method. All measurements for a single recording period are recorded on a single TID Groundwater Field Data Sheet, of which an example can be found in Appendix D.

DEPTH TO WATER MEASUREMENT INSTRUCTIONS

BEFORE MAKING A MEASUREMENT:

- Inspect the electric sounding tape and electrode probe before using it in the field. Check the tape for wear, kinks, frayed electrical connections and possible stretch; the cable jacket tends to be subject to wear and tear. Test that the battery and replacement batteries are fully charged.

- Check the distance from the electrode probe's sensor to the nearest foot marker on the tape, to ensure that this distance puts the sensor at the zero foot point for the tape. If it does not, a correction must be applied to all depth-to-water measurements. Record this correction on the TID Groundwater Field Data Sheet.

- Check the circuitry of the electric sounding tape before lowering the electrode probe into the well. To determine proper functioning of the tape mechanism, dip the electrode probe into tap water and observe whether the indicator light and beeper indicate a closed circuit.

- Wipe down the electrode probe and 5 to 10 feet of the tape with a disinfectant wipe, rinse with de-ionized or tap water, and dry.

MAKING A MEASUREMENT:

- Identify the appropriate site on the TID Groundwater Field Data Sheet and record whether or not the well is running, the pumping rate, and the accumulated acre-feet meter reading in the designated columns for the site.

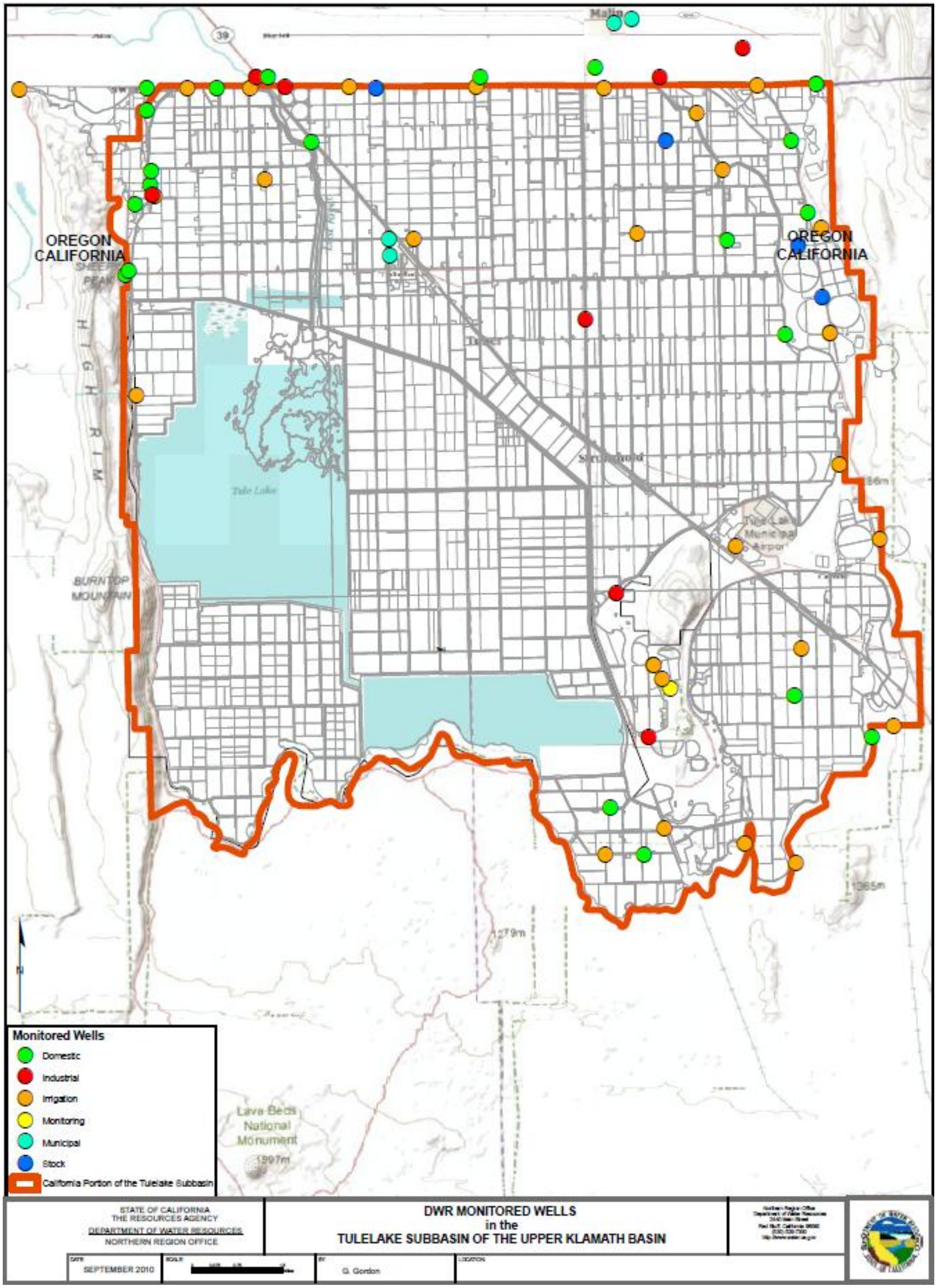
- Lower the electrode probe slowly into the well until the indicator shows that the circuit is closed and contact with the water surface is made. Avoid letting the tape rub across the top of the well casing. Place the tip or nail of the index finger on the insulated wire at the RP and read the depth to water to the nearest 0.1 foot. Record this value in the “DEPTH to WATER” column of the TID Groundwater Field Data Sheet for the appropriate site.

- Record any notable comments, problems, or inaccuracies in the “COMMENT” section for the appropriate site.

AFTER MAKING A MEASUREMENT:

- Wipe down the electrode probe and the section of the tape that was submerged in the well water, using a disinfectant wipe and rinse thoroughly with de-ionized or tap water. Dry the tape and probe and rewind the tape onto the tape reel. Do not rewind or otherwise store a dirty or wet tape.

APPENDIX A: DWR TULE LAKE SUBBASIN MONITORING MAP



APPENDIX B: TID MONITORING WELL INFORMATION

Local Well ID	TID #1	TID #2	TID #3	TID #4
State Well Number	48N04E30F002M	48N04E18J001M	48N04E16M001M	48N04E15K001M
Reference Point ELEV	4047.75	4057.99	4056.23	4051.35
Ground Surface ELEV	4047.05	4056.02	4055.73	4049.60
Well Use	Irrigation	Irrigation	Irrigation	Irrigation
Well Status	Active	Active	Active	Active
Well Coordinates	E 121.5567 N 41.9721	E 121.5455 N 41.9980	E 121.5251 N 41.9979	E 121.4931 N 41.9978
Well Completion Type	Single	Single	Single	Single
Total Well Depth / Drilled Depth	740 / 740	1545 / 1550	1680.57 / 1710	1432.8 / 1440
Screen Interval #1	260-700	1260-1540	1153.1-1292.32	1211.65-1432.8
Screen Interval #2	--	--	1334.44-1354.46	--
Screen Interval #3	--	--	1375.49-1455.58	--
Screen Interval #4	--	--	1476.62-1536.82	--
Screen Interval #5	--	--	1599.89-1680.57	--
Screen Interval #6	--	--	--	--
Well Completion Report Number	751108	751109	751110	751111
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

Local Well ID	TID #5	TID #6	TID #7	TID #8
State Well Number	48N04E13K001M	48N05E16P001M	48N05E14R001M	48N05E26D001M
Reference Point ELEV	4051.44	4054.28	4068.45	4050.29
Ground Surface ELEV	4050.50	4052.38	4068.29	4049.10
Well Use	Irrigation	Irrigation	Irrigation	Irrigation
Well Status	Active	Active	Active	Active
Well Coordinates	E 121.4519 N 41.9971	E 121.4106 N 41.9962	E 121.3609 N 41.9963	E 121.3727 N 41.9762
Well Completion Type	Single	Single	Single	Single
Total Well Depth / Drilled Depth	1566.83 / 1570	2380 / 2600	2020 / 2030	1807.35 / 1810
Screen Interval #1	935.18-955.18	822.61-1084.77	814.26-1155.03	1247.45-1647.47
Screen Interval #2	1015.44-1035.51	1375.28-1719.34	1255.65-1336.09	1662.23-1802.35
Screen Interval #3	1075.71-1095.63	1805.29-2108.14	1396.6-1436.85	--
Screen Interval #4	1135.79-1556.81	2257.02-2358.1	1497.24-1537.37	--
Screen Interval #5	--	--	1577.66-1617.78	--
Screen Interval #6	--	--	1678.47-2020	--
Well Completion Report Number	751112	751113	751114	751115
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

Local Well ID	TID #9	TID #14	TL-T1 Q3B	TL-T3 GP
State Well Number	48N05E36D001M	46N05E22D001M	--	--
Reference Point ELEV	4049.25	4037.78	4034.1	4047.1
Ground Surface ELEV	4047.91	4037.47	4032.7	4045.6
Well Use	Irrigation	Irrigation	Observation	Observation
Well Status	Active	Active	Inactive	Inactive
Well Coordinates	E 121.3555 N 41.9647	E 121.3955 N 41.8174	E 121.5420 N 41.8341	E 121.4697 N 41.8391
Well Completion Type	Single	Single	--	--
Total Well Depth / Drilled Depth	2043.04 / 2060	567 / 571	500/500	500/500
Screen Interval #1	1060.46-1941.59	114.11-234.16	Open Hole 20-500	Open Hole 20-500
Screen Interval #2	1982.49-2022.54	254.14-314.16	--	--
Screen Interval #3	--	334.14-554.25	--	--
Screen Interval #4	--	--	--	--
Screen Interval #5	--	--	--	--
Screen Interval #6	--	--	--	--
Well Completion Report Number	751116	751117	--	--
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

Local Well ID	Shey-Huffman	Nancy-Huffman	CTW #3
State Well Number	--	--	--
Reference Point ELEV	4045.2	4048.8	4038.2
Ground Surface ELEV	4044.9	4047.7	4037.6
Well Use	Irrigation	Irrigation	Municipal
Well Status	Active	Active	Active
Well Coordinates	E 121.3650 N 41.8774	E 121.3255 N 41.8492	E 121.4815 N 41.9605
Well Completion Type	Single	Single	Single
Total Well Depth / Drilled Depth	520/520	212/212	2761 / 2790
Screen Interval #1	80-245	Open Hole 20-212	2560.5-2761
Screen Interval #2	Open Hole 245-520	--	--
Screen Interval #3	--	--	--
Screen Interval #4	--	--	--
Screen Interval #5	--	--	--
Screen Interval #6	--	--	--
Well Completion Report Number	962868	782127	797943
Groundwater Basin of Well	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01	Tule Lake Subbasin 1-2.01

APPENDIX C: TID MONITORING WELL REFERENCE POINT INFORMATION

Reference points for all monitoring sites are marked with fluorescent orange paint.

TID #1: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #2: The reference point is the lip of the sounding tube located on the south side of the well casing

TID #3: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #4: The reference point is the lip of the sounding tube located on the south side of the well casing

TID #5: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #6: The reference point is the lip of the sounding tube located on the north side of the well casing

TID #7: The reference point is the lip of the sounding tube located on the south side of the well casing

TID #8: The reference point is the lip of the sounding tube located on the west side of the well casing

TID #9: The reference point is the lip of a hole in the casing located on the north side of the well casing

TID #14: The reference point is the lip of the sounding tube located on the west side of the well casing

Shey-Huffman: The reference point is the lip of the sounding tube located on the west side of the well casing

Nancy-Huffman: The reference point is the lip of a hole in the casing located on the south side of the well casing

TL-T1: The reference point is the lip of a hole in the top of the well casing

TL-T3: The reference point is the lip of a hole in the top of the well casing

CTW #3: The reference point is the lip of a hole in the casing located on the north side of the well casing

APPENDIX D: TID GROUNDWATER FIELD DATA SHEET

DATE: ________ **TID GROUNDWATER FIELD DATA SHEET** **YEAR:** ________

WELL SITE	CA STATE WELL #	TIME	R/NR	GPM	ACRE FEET	DEPTH to WATER	COMMENTS
TID #1	48N04E30F002M						
TID #2	48N04E18J001M						
TID #3	48N04E16M001M						
TID #4	48N04E15K001M						
TID #5	48N04E13K001M						
TID #6	48N05E16P001M						
TID #7	48N05E14R001M						
TID #8	48N05E26D001M						
TID #9	48N05E36D001M						
TID #14	46N05E22D001M						
Q-3-B							
Gazebo Point							
Shey-Huffman							
Nancy-Huffman							
City of Tulelake							