**South Tahoe Public Utility District**

# Tahoe Valley South Subbasin (6-5.01) Annual Report

## 2017 Water Year

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## CERTIFICATION

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**LIST OF ABBREVIATIONS**

**2017 WOS:** 2017 Well Owners Survey

**ABC Alternative:** An Analysis of Basin Conditions that demonstrates that the basin has operated within its sustainable yield for at least a 10-year period

**AF:** Acre-feet

**AFY:** Acre-feet per year

**BMOs:** Basin Management Objectives specified in the GWMP

**County Water Agency:** El Dorado County Water Agency

**District:** South Tahoe Public Utility District

**DRI:** Desert Research Institute

**DWR:** California Department of Water Resources

**Feasibility Study:** Engineering feasibility study of remedial alternatives to mitigate PCE groundwater contamination in the South "Y" Area

**GWMP:** Groundwater Management Plan

**GWMP Alternative:** A GWMP developed pursuant to Part 2.75 of the Water Code

**GSA:** Groundwater Sustainability Agency

**GSP:** Groundwater Sustainability Plan

**GSP Alternative:** Alternative to a GSP

**LBWC:** Lukins Brothers Water Company

**LRWQCB:** Lahontan Regional Water Quality Control Board

**MCLs:** maximum contaminant levels

**MDD:** Maximum daily demand

**MGD:** Million gallons per day

**MOU:** Memorandum of Understanding

**MT3DMS:** Modular three-dimensional transport model

**OW:** Observation well

**PCE:** Tetrachloroethylene

**PWS:** Public water system

**SAG:** Stakeholders Advisory Group

**SCWS:** Small community water systems

**SGMA:** Sustainable Groundwater Management Act

**SNOTEL:** Snow telemetry

**SWRCB:** California State Water Resources Control Board

**SWRCB-DOFA:** SWRCB Division of Financial Assistance

**TKPOA:** Tahoe Keys Property Owners Association

**TKWC:** Tahoe Keys Water Company

**TRPA:** Tahoe Regional Planning Agency

**TVS Basin:** Tahoe Valley South Subbasin of the Tahoe Valley Groundwater Basin, Groundwater Basin 6-5.01

**USGS:** U.S. Geological Survey

**UWMP:** South Tahoe Public Utility District 2015 Urban Water Management Plan

**WBZs:** Water-bearing zones

**WY:** Water Year

# 0 Executive Summary

The Tahoe Valley South Subbasin of the Tahoe Valley Groundwater Basin, designated by the California Department of Water Resources (DWR) as Groundwater Basin 6-5.01 (TVS Basin) is a discrete, highly productive sedimentary geologic basin located in the City of South Lake Tahoe and portions of El Dorado County, California. The 2017 Annual Report presents a management level summary of groundwater conditions within the TVS Basin using data collected from the Basin Monitoring Program and results from numerical hydrologic models as well as the South Tahoe Public Utility District's (District) progress on its Basin Management Objectives (BMOs).

**Groundwater Conditions**

The 2017 Annual Report provides monitoring data for the for the 2017 Water Year (WY), which is the 12-month period starting October 1, 2016 through September 30, 2017.

**Water Year Classification.** In terms of precipitation, 2017 WY was a very wet water year, which followed a normal water year and a three year below normal period (2012 WY -2015 WY drought).

**Groundwater Recharge.** During the 2017 WY, TVS model recharge is calculated at 108,322 acre-feet (AF).

**Groundwater Levels.** Measured groundwater elevations were above normal, compared to the 10-year base period for groundwater levels (2001 WY -2010 WY), and increased, on average about 4.7 feet compared to 2016 WY groundwater levels.

**Groundwater Quality.** Tetrachloroethylene (PCE) groundwater contamination continued to have an impact on groundwater local supplies in the South "Y" Area. The South "Y" Plume covers an area of approximately 400 acres, impairing three public water system (PWS) wells and threatening three other PWS wells within the South Lake Tahoe sub-area. The total source capacity of active PWS wells in the TVS Basin presently exceeds the maximum day demand (MDD) minimum threshold for water quality by 5.3 million gallons per day (MGD). Although source capacity has declined due to wells impaired by degraded water quality, these impairments have not resulted in an undesirable result. During the 2017 WY, the District, in partnership with the Lukins Brothers Water Company (LBWC) and Tahoe Keys Property Owners Association (TKPOA), submitted a Full Proposal (FAAST # 36772) requesting funding through the Proposition 1 Groundwater Sustainability Program to conduct an engineering feasibility study of remedial alternatives to mitigate PCE groundwater contamination in the South "Y" Area (Feasibility Study). In March 2017, the District received notice of preliminary grant award conditioned on the successful negotiation of an agreement with the State Water Resources Control Board - Division of Financial Assistance (SWRCB-DOFA).

**Groundwater Production.** Metered groundwater production from PWS wells, which accounts for more than 90% of groundwater extractions in the TVS Basin, totaled 6,654 AF; this is approximately 14% below the median value (7,767 AF) over the groundwater production period of record (2005 WY – 2017 WY).

**Groundwater Storage.** For the 2017 WY, the annual change in groundwater storage is + 61,840 AF. This is the highest annual change in storage, calculated by the TVS model for the TVS Basin. Since 2005 WY, the cumulative change in groundwater storage is + 57,819 AF.

**Basin Management Objectives**

Groundwater management activities performed during the 2017 WY included items required for ongoing compliance with the Sustainable Groundwater Management Act (SGMA) and varying efforts to address actions under the 2014 Groundwater Management Plan (Kennedy-Jenks, 2014) (2014 GWMP) Implementation Plan. Significant achievements during the 2017 WY included:

- Submittal of two alternatives to a Groundwater Sustainability Plan (GSP Alternative) to DWR for public comment and DWR review and evaluation: (1) the District's 2014 GWMP pursuant to Water Code section 10733.6(b)(1) and (2) an Analysis of Basin Conditions pursuant to Water Code section 10733.6(b)(2).

- Execution of a Memorandum of Understanding (MOU) with the El Dorado County Water Agency (County Water Agency) to cooperatively manage groundwater resources and to coordinate implementation of the SGMA throughout the TVS Basin.

- Preliminary Award of Proposition 1 Groundwater Grant Program funding to complete a feasibility study of remedial alternatives for the removal of PCE contamination from groundwater in the South "Y" Area.

- Completion of Phase II hydrologic models and numerical analysis to inform BMOs specified in the GWMP.

- Expanded outreach including performance of a well owner's survey of small community water systems (SCWS) and domestic well owners within the TVS Basin.

# 1 Introduction

The District has prepared the following report for the TVS Basin. The 2017 Annual Report presents a management level summary to assess groundwater conditions and supplies within the TVS Basin, using data collected from the District's Basin Monitoring Program. Progress on implementation of BMOs defined in the 2014 GWMP is also reported.

This report was prepared in compliance with both the annual reporting requirements of the 2014 GWMP (Kennedy-Jenks, 2014) and the requirement to submit an annual report by April 1 of each year following the adoption of a GSP or GSP Alternative pursuant to section 356.2 of the GSP Regulations. On December 28, 2016, the District concurrently submitted (1) its 2014 GWMP as a GSP Alternative pursuant to Water Code section 10733.6(b)(1) and (2) an ABC Alternative as a GSP Alternative pursuant to Water Code section 10733.6(b)(2) to DWR for public comment and DWR review and evaluation.[1]

The 2017 Annual Report is the third annual report issued since adoption of the 2014 GWMP. Table 1-1 lists the components required for inclusion in annual reports submitted by a Groundwater Sustainability Agency (GSA) to DWR following adoption of a GSP or GSP Alternative. Also listed are the corresponding section(s) where this information is found in this report.

| § 356.2 | ANNUAL REPORT COMPONENT | SECTION(s) |
|---|---|---|
| (a) | General information, including an executive summary and a location map depicting the basin covered by the report | Executive Summary; Section 1.1; Fig. 1-1; Fig. 1-2 |
| (b) | A detailed description and graphical representation of the following conditions of the basin managed in the Plan: | |
| (1) | Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows: | |
| (A) | Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions. | Section 2.4.2; Fig. 2-6 |
| (B) | Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year. | Section 2.4; Fig. 2-4; Appendix A |

[1] As part of its submittals, the District indicated its preference to DWR that the review be sequenced in such a manner that its GWMP Alternative be reviewed first, and should DWR agree that the GWMP Alternative is functionally equivalent to a GSP, review of the ABC Alternative would not be necessary.

| | | |
|---|---|---|
| (2) | Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions. | Section 2.6; Table 2-2; Fig. 2-8, Fig. 2-9. All reported water use in Section 2.6 is municipal for residential, commercial and landscaping uses. |
| (3) | Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year. | Not Applicable; surface water for recharge or in-lieu use is not used as a source of supply. Surface water is used as a primary source of supply by the Lakeside Park Association. The annual volume of surface water used by this system is not provided in this report. |
| (4) | Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year. | Section 2.6.1; Table 2-3; Table 2-4. The water use data provided in Section 2.6 is presented in calendar years, as provided in the District's 2015 Urban Water Management Plan. |
| (5) | Change in groundwater in storage shall include the following: | |
| (A) | Change in groundwater in storage maps for each principal aquifer in the basin. | Section 2.7- The annual change in groundwater storage is presented as a single value for the entire basin which is derived from the water budget calculated by the groundwater model for the TVS Basin. As the model calculates groundwater storage for all layers within the principal aquifer (e.g. Basin-fill Aquifer), a storage map is not provided in this report. A graph depicting annual and cumulative change in groundwater storage is provided as Figure 2-10. |

| | | |
|---|---|---|
| (B) | A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year. | Section 2.7; Fig. 2-10. All water use, in terms of groundwater production, shown in Figure 2-10 is municipal for residential, commercial and landscaping uses |
| (c ) | A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report. | Section 3.0[2] |

**Table 1-1**. Component requirements of Annual Reports submitted to DWR by GSAs (§356.2).

## 1.1 TVS Basin

The TVS Basin is part of the larger Tahoe Valley Groundwater Basin, which is located within the Lake Tahoe Hydrologic Basin and incorporates the sediment-filled basins bordering Lake Tahoe. The Tahoe Valley Groundwater Basin is subdivided into three sub-basins: the TVS Basin, the Tahoe Valley West sub-basin, and the Tahoe Valley North sub-basin (Figure 1-1). Of these three sub-basins, the TVS Basin is the largest and most productive.

Elevations within the TVS Basin range from 6,225 feet at lake level, rising to above 6,500 feet within the groundwater basin. Elevations extend above 10,000 feet within the surrounding watersheds along the Carson Range and Sierra Nevada. Portions of seven watersheds overlie the TVS Basin, the largest of these is the Upper Truckee River watershed. The Upper Truckee River flows north across the entire length of the TVS Basin and drains into Lake Tahoe through the Upper Truckee Marsh. The Upper Truckee River is joined by Grass Lake and Big Meadow Creeks along the southern extent of its course, Angora Creek centrally, and Trout Creek near Lake Tahoe.

[2] The discussion in Section 3.0 of this Annual Report only applies to the 2014 GWMP and the GWMP Alternative; it is not applicable to the ABC Alternative. The ABC Alternative is a "report" rather than a "plan" and, as such, does not require implementation or set forth any milestones, projects, or management actions.

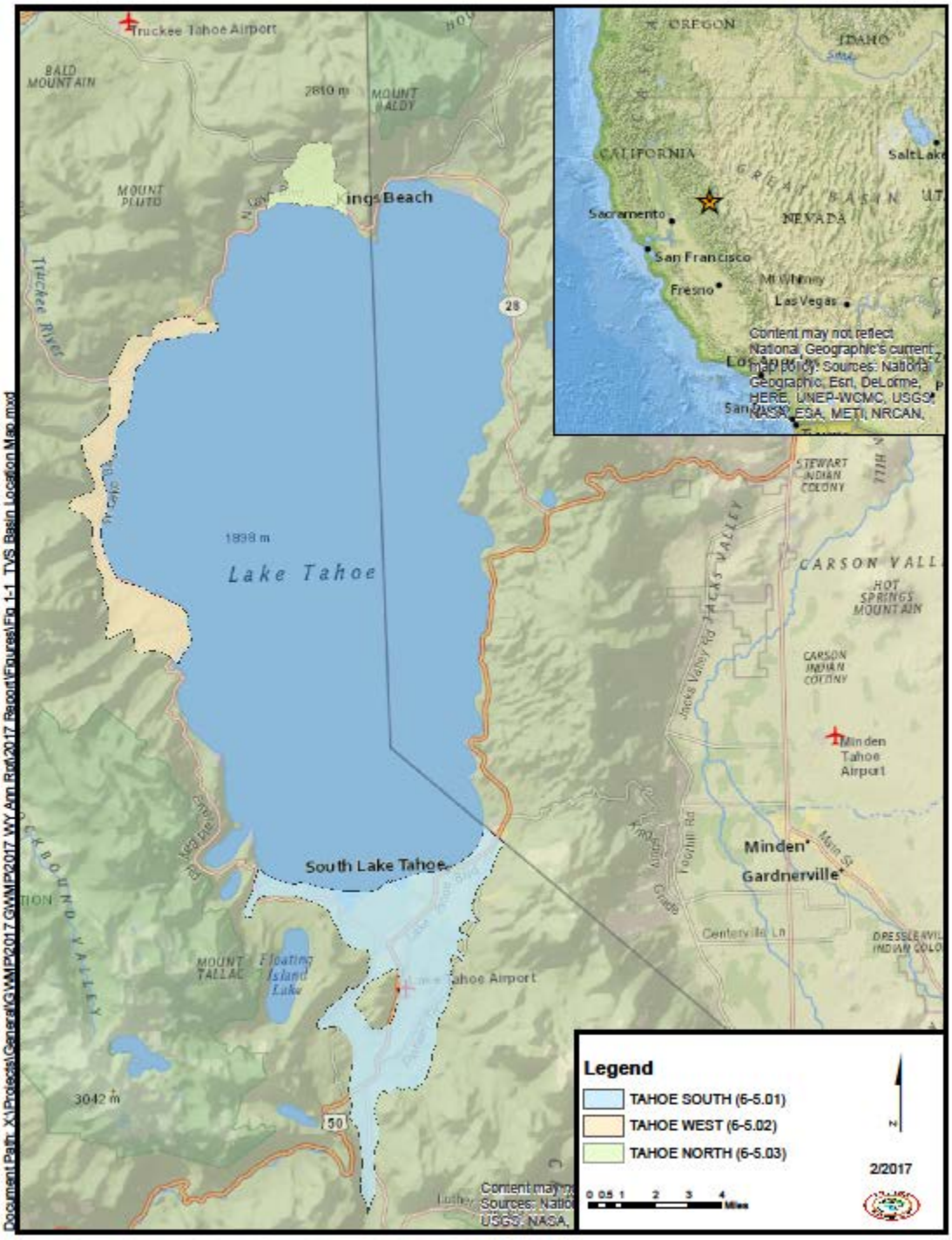


**Figure 1-1.** Lake Tahoe area regional map with DWR-designated groundwater basins.

The TVS Basin has an area of approximately 23 square miles (14,814 acres) in El Dorado County, California (Figure 1-2). The TVS Basin is roughly triangular-shaped, bounded on the southwest by the Sierra Nevada, on the southeast by the Carson Range, and on the north by the southern shore of Lake Tahoe. The Basin generally conforms to the valleys of the Upper Truckee River and Trout Creek. The TVS Basin does not share a boundary with any other DWR basin or sub-basin. The City of South Lake Tahoe overlies the northern portion of the TVS Basin. The southern boundary extends about 3 miles south of the town of Meyers. The northeast boundary of the TVS Basin is defined by the California-Nevada state line. For ease of description, the TVS Basin is subdivided into six geographically based sub-areas, referred to as the Tahoe Keys, South Lake Tahoe, Bijou, Angora, Meyers and Christmas Valley sub-areas. The location and extent of these sub-areas are shown on Figure 1-2.

The TVS Basin underlies several different jurisdictions which include the City of South Lake Tahoe and portions of eastern El Dorado County, which encompasses the unincorporated communities of Meyers, Angora Highlands and Christmas Valley. Within the greater South Lake Tahoe area, the majority of the land use is classified as Conservation area, followed by Residential, Recreation, Commercial and Public Service, and Tourist areas. The majority of the Conservation areas are federal lands managed by the United States Forest Service - Lake Tahoe Basin Management Unit. Most of the federally managed land is located outside of the TVS Basin, but does include large areas around the Camp Richardson/Fallen Leaf Lake area within the northwest portion of the TVS Basin; and along the basin margin on the east side of the TVS Basin.

Groundwater is the primary source of drinking water for the communities overlying the TVS Basin. Surface water for recharge or in-lieu use is not presently used, but is projected to be used as a potential future source of supply. Most water wells drilled in the TVS Basin are completed in basin-fill deposits that generally consist of unconsolidated glacial, lake and stream sediments. These sedimentary deposits fill the lower reaches of the canyons that drain toward Lake Tahoe and underlie the relatively flat lying valley floors. These deposits can be over 1,000 feet thick in the deeper portions of the TVS Basin, but thin toward the basin margins where they cover shallow bedrock areas. Numerous water-bearing zones (WBZs) have been identified using lithologic and geophysical logs, and interpreted correlations to divide the basin-fill into multiple layers, representing regionally correlated units of high and low permeability. Units of relatively high permeability typically correspond to coarse-grained glacial outwash, fluvial and deltaic deposits forming the basin-fill aquifer. The laterally continuous fine-grained lacustrine (lake-bed) deposits form local confining layers or aquitards that affect groundwater flow between these higher permeability deposits.

Figure 1-3 is a conceptual hydrogeological cross section across the northern portion of the TVS Basin used to illustrate the WBZs. The different WBZ designations are informal and are based on the local geographic area and the stratigraphic order in which the unit occurs. This is indicated as a subscript from deep to shallow depth (1 = lowermost zone; 5 = uppermost zone). The deepest zone (WBZ1) occurs in the deepest portions of the basin, generally at depths below 600 feet, and may act as a confined aquifer and show artesian conditions in some areas. The middle two zones (WBZ2 and WBZ3) represent the

interval at depths between 200 to 600 feet and the shallowest two zones (WBZ4 and WBZ5) represent depths to 200 feet (Bergsohn, 2011).

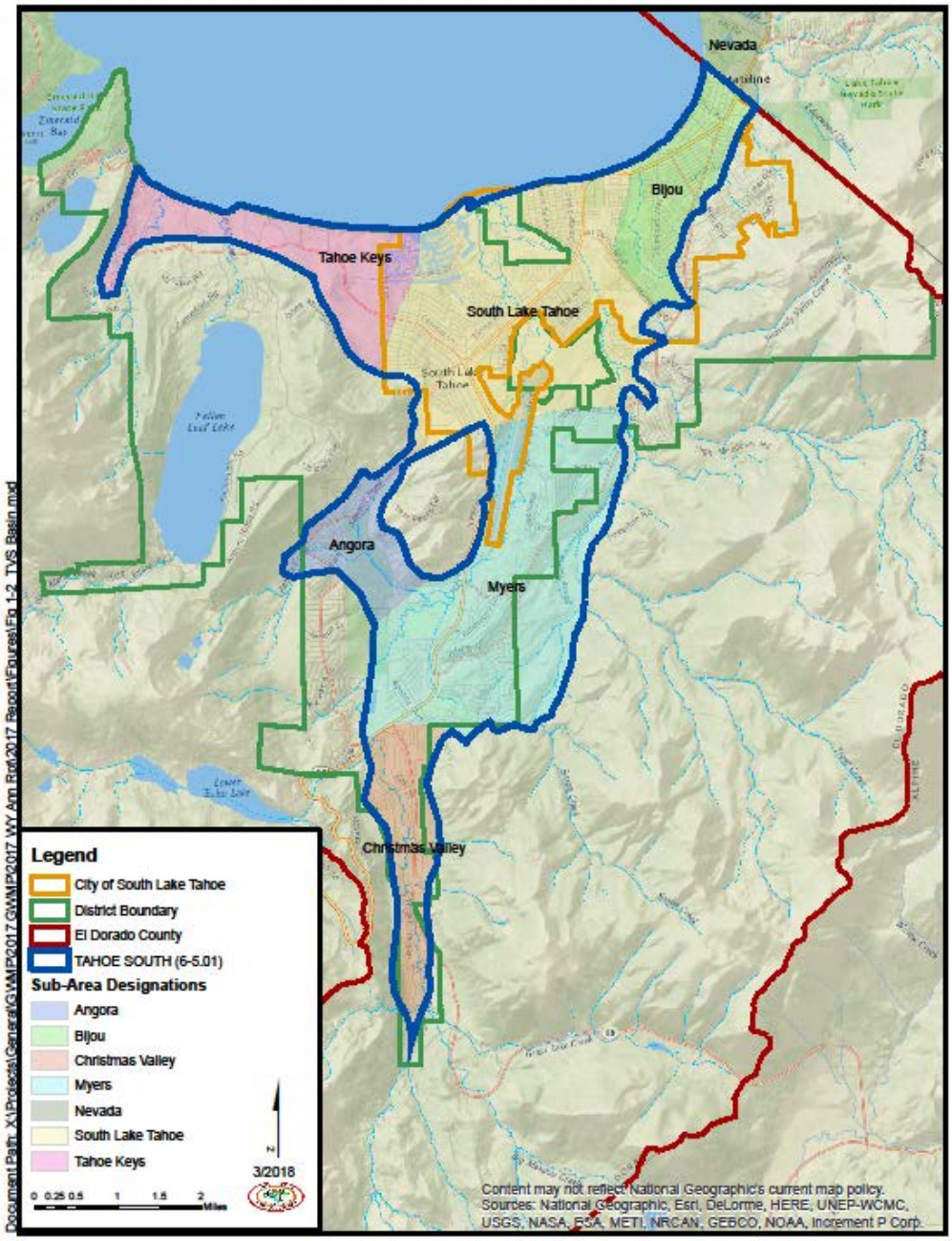


**Figure 1-2.** TVS Basin showing jurisdictional boundaries and geographically-based sub-area designations used in this report.

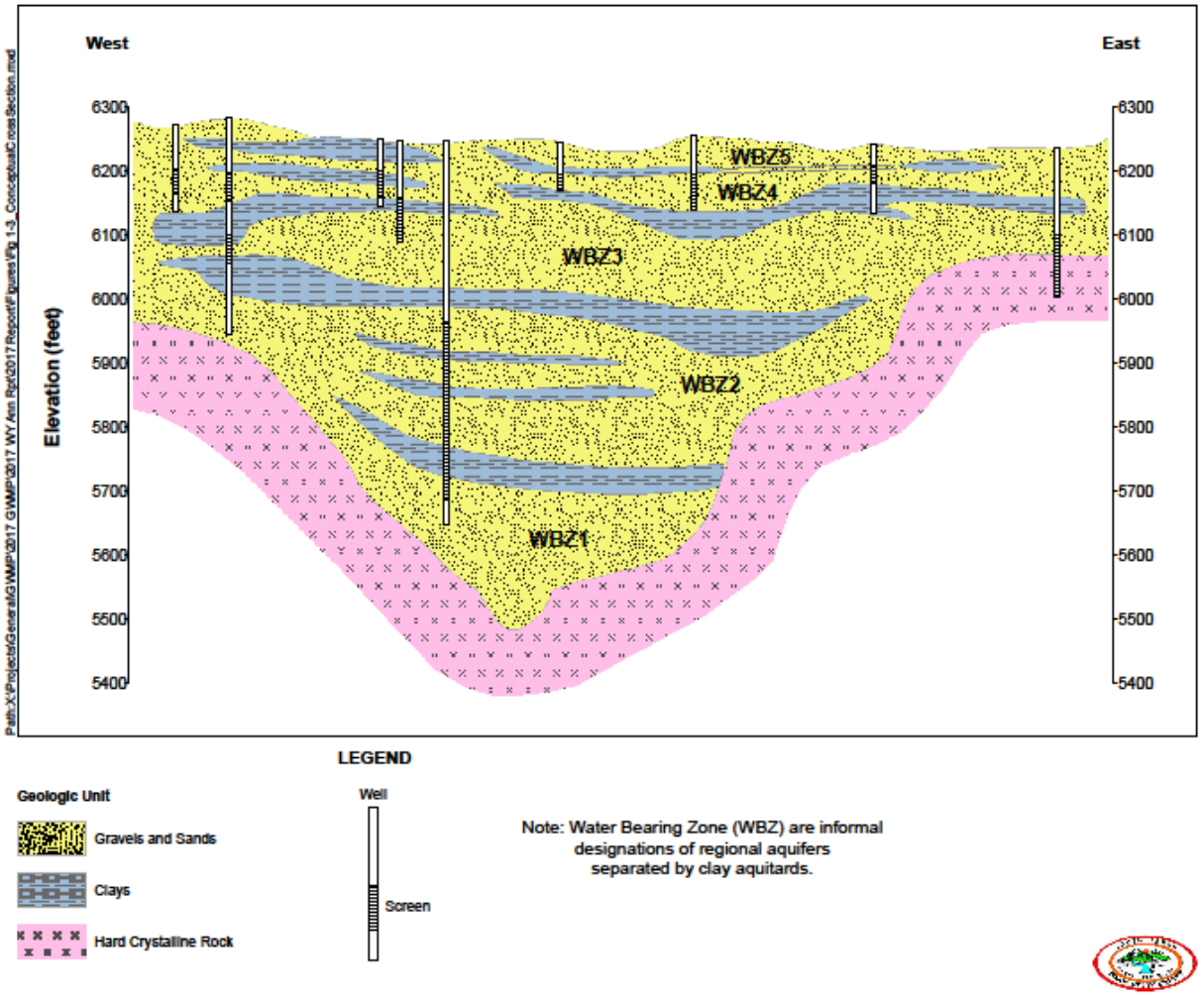


**Figure 1-3**. Conceptual geologic cross-section oriented east-west showing typical WBZs within the TVS Basin (Adapted from Kennedy-Jenks (2014)).

## 1.2 Water Year Classification

In terms of precipitation, 2017 WY was a very wet water year using the water year classification developed for the TVS Basin. Under the GSP Regulations, annual precipitation in a basin is required to be described in terms of water year type. DWR generally assigns water year type based on river flow indices or precipitation amounts and has developed water year classification systems for several hydrologic basins in California. For example, for the Sacramento Valley hydrologic basin, SWRCB developed five categories based on runoff forecasts and previous water year's index: 1) wet, 2) above normal, 3) below normal, 4) dry, and 5) critical (SWRCB, 1978).

DWR has not developed a water year classification for the Lake Tahoe hydrologic basin. As such, the District requested that the Desert Research Institute (DRI) develop a water year classification for the TVS Basin. The water year classification was created following development of the TVS Basin water budget by DRI. During development of the water budget, a strong linear correlation was identified between simulated precipitation from the regional Groundwater Surface Water Flow Model for the Truckee River Basin and groundwater recharge to the TVS Basin. Linear correlation was also found between groundwater recharge to model calculated change in groundwater storage. Using these relationships from the modeling analysis, total accumulated precipitation measured at the four National Resource Conservation Service snow telemetry (SNOTEL) stations within the model area were further evaluated to find the SNOTEL station with the best correlation to the simulated precipitation from the Groundwater Surface Water Flow Model. SNOTEL 508: Hagan's Meadow, CA was found to have the best correlation with model simulated groundwater recharge and change in groundwater storage. Therefore, National Resource Conservation Service precipitation records for this station were used to classify water year type for the TVS Basin (Carroll et al., 2016b). The regression equation between annual total precipitations at SNOTEL 508: Hagan's Meadow, CA to groundwater recharge within the TVS Basin and surrounding watersheds is shown below in Figure 1-4. The regression equation has an R-squared ($R^2$) of 0.92, which is a statistical measure of how close the data are to the fitted regression line.

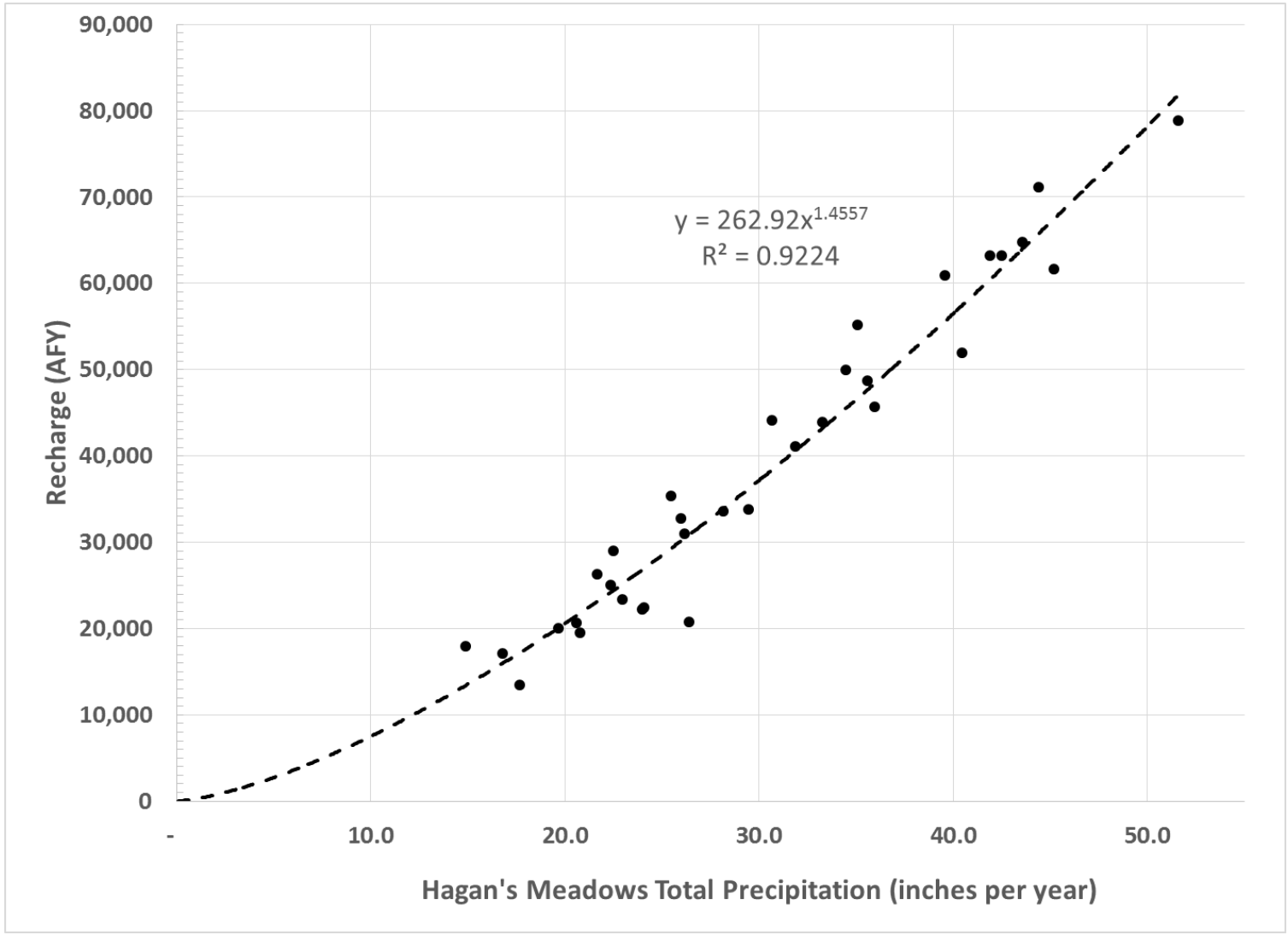


**Figure 1-4**. SNOTEL 508: Hagan's Meadow, CA annual precipitation versus modeled groundwater recharge within the TVS Basin (G. Pohll et al., 2016)

For the TVS Basin, water years 1979 – 2017 were categorically defined by assuming a normal distribution in precipitation and establishing ranges based on the z-statistics in Table 1-2. To allow more flexibility in water year type, seven categories were established: 1) very wet, 2) wet, 3) above normal, 4), normal, 5) below normal, 6) dry, and 7) critical. The very wet periods are indicated by a z-statistic > 1.5 and occur in 1982 WY, 2011 WY and 2017 WY. The critical water year is indicated by a z-statistic – 1.5 and occurs when total accumulated precipitation is less than 14 inches. During the 2017 WY, total accumulated precipitation was the highest total measured (67.50 inches) at SNOTEL 508: Hagan's Meadow, CA. To account for this maximum value, the total precipitation range for each category was recalculated using the corresponding z-statistic for each category. Table 1-2 shows the z-statistics, the recalculated precipitation range for each water year type, and the number of each water year type (Count) occurring over the period of record (1979 – 2017) for SNOTEL 508: Hagan's Meadow, CA. Figure 1-5 shows a graphical representation of this record.

| WY Type | z (upper) | Precipitation (in) | | Count |
|---|---|---|---|---|
| | | > | ≤ | |
| Very Wet | > 1.5 | 49 | - | 3 |
| Wet | 1.5 | 43 | 49 | 4 |
| Above Normal | 1 | 37 | 43 | 4 |
| Normal | 0.5 | 26 | 37 | 12 |
| Below Normal | -0.5 | 20 | 26 | 12 |
| Dry | -1.0 | 14 | 20 | 4 |
| Critical | -1.5 | 0 | 14 | 0 |

**Table 1-2**. Classification system for Water Year (WY) Type based on observed WY accumulated precipitation at SNOTEL 508: Hagan's Meadows, CA. Upper bound of z-statistic and ranges in precipitation (inches) (Adapted from Carroll *et al.,* 2016b).

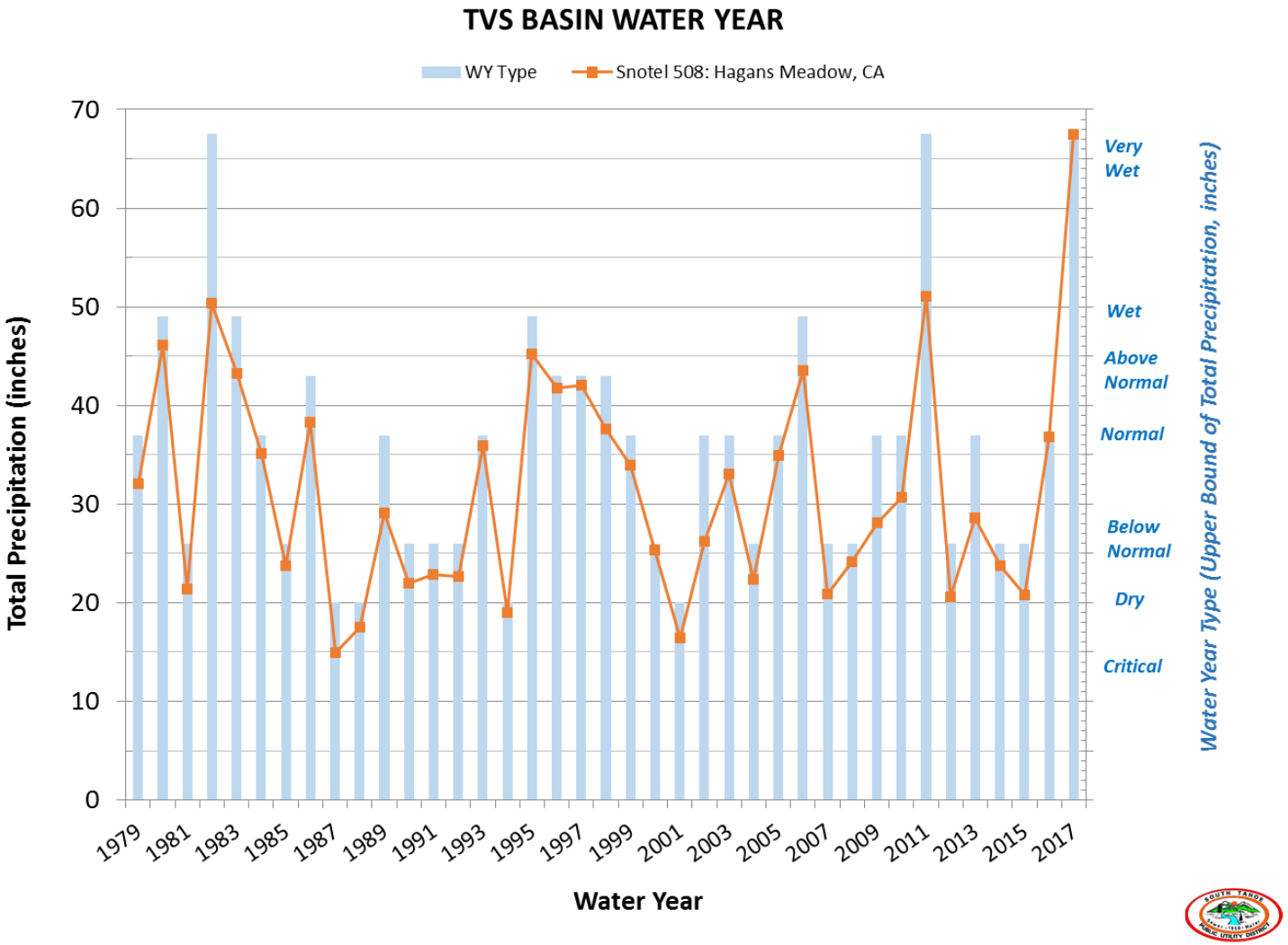


**Figure 1-5**. The annual accumulated precipitation measured at SNOTEL 508: Hagan's Meadow, CA and water year type indicated on the vertical axis along the right-side of the graph. Precipitation ranges for each water year type are listed in Table 1-2.

# 2 Groundwater Conditions

The following section presents data collected by the District and derived from numeric groundwater models to show the current state of the TVS Basin. Hydrographs showing groundwater elevation trends across the TVS Basin are provided in Appendix A.

## 2.1 Groundwater Model

The groundwater model for the TVS Basin was developed by DRI for the TVS Basin and its surrounding watersheds to prepare a water budget, perform complex hydrologic analyses and inform BMOs specified in the GWMP (Carroll, *et al.*, 2016a). The groundwater model for the TVS Basin quantifies basin conditions using the U.S. Geological Survey (USGS) MODFLOW-NWT (Niswonger *et al.,* 2011) software. MODFLOW-NWT is the latest installment of the USGS modular program and relies on the Newton solution method and an unstructured, asymmetric matrix solver to calculate groundwater head. MODFLOW-NWT is specifically designed to work with the upstream weighted package to solve complex, unconfined groundwater flow simulations to maintain numerical stability during the wetting and drying of model cells.

The model grid is oriented north-south and contains 342 rows and 251 columns. Horizontal cell size is 100 meters (328 feet) and is based on the need to capture steep topography, narrow canyons and potentially steep hydrologic gradients, which are present in the TVS Basin (Figure 2-1). The model is subdivided into four subsurface layers to maintain reasonable computation time. Layers are determined based on production well screen intervals. Land surface elevations are based on 30 meter (98 feet) Digital Elevation Model aggregated to a 100 meter (328 feet) resolution. Layer thicknesses are 40 meters (131 ft) for layer 1 and layer 2, and 100 meters (328 feet) for layer 3. The layer 4 bottom elevation is set to a constant 1,600 meters (5,248 feet) to produce variable thickness ranging from approximately 114 meters (274 feet) along the northern boundary with Lake Tahoe to 1,300 meters (4,264 feet) at watershed divides.

The groundwater model simulates two distinct time periods. The first represents steady-state conditions prior to any significant groundwater production in the basin. Hydraulic conductivity was calibrated using the steady-state model configuration. The transient model simulates the period 1983-2017 to calculate changes in groundwater levels and flux due to variations in climate and groundwater extractions.

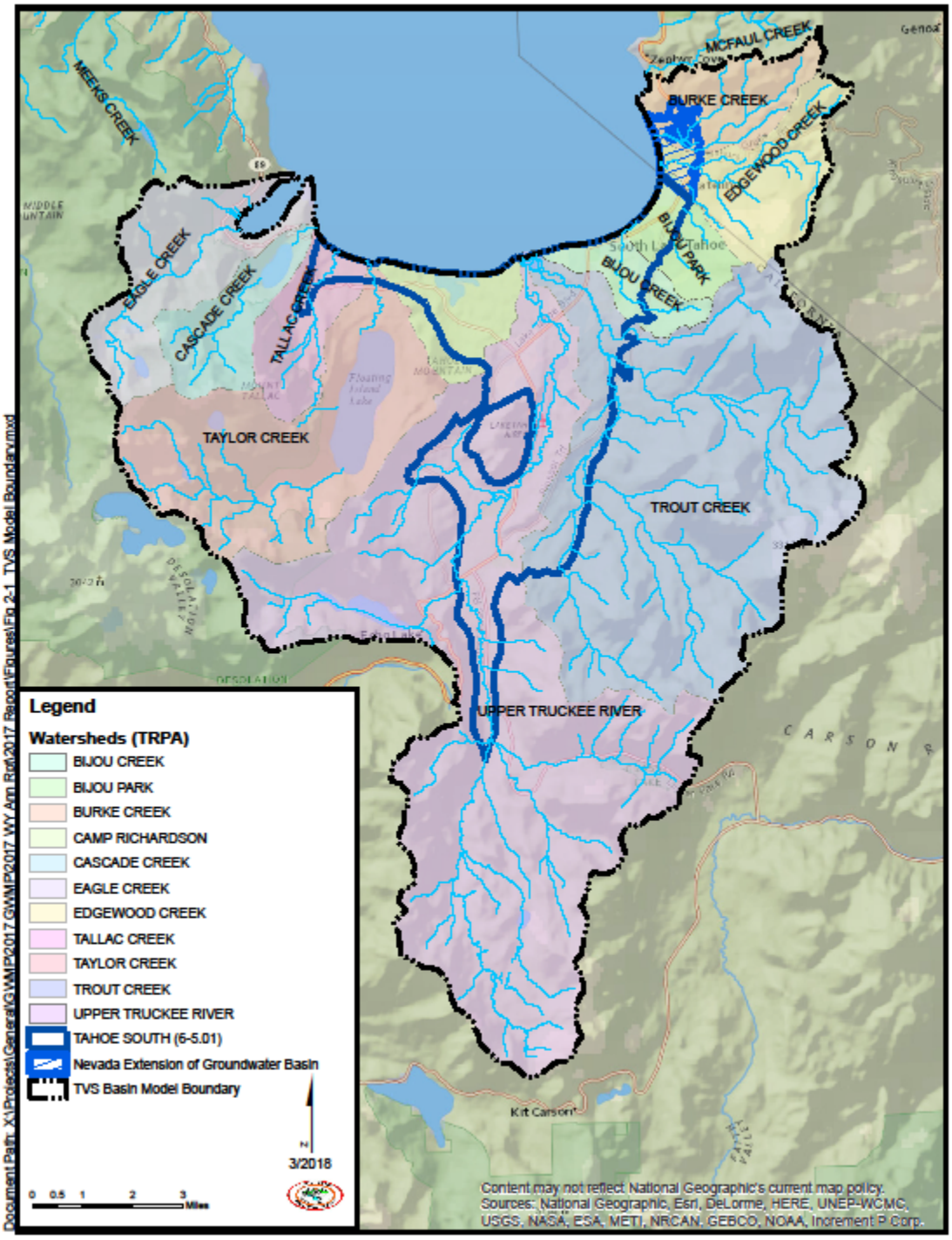


**Figure 2-1.** The groundwater model for the TVS Basin encompasses the entire TVS Basin as well as the surrounding watersheds contributing recharge to the TVS Basin.

## 2.2 Groundwater Recharge

Recharge for the TVS Basin was extracted from the transient model developed by DRI for the TVS Basin. Figure 2-2 shows annual groundwater recharge over the simulation period of the transient model (1983 WY- 2017 WY). During the 2017 WY, the model recharge is 108,322 AF. This is more than double the average groundwater recharge to the TVS Basin over the simulation period.

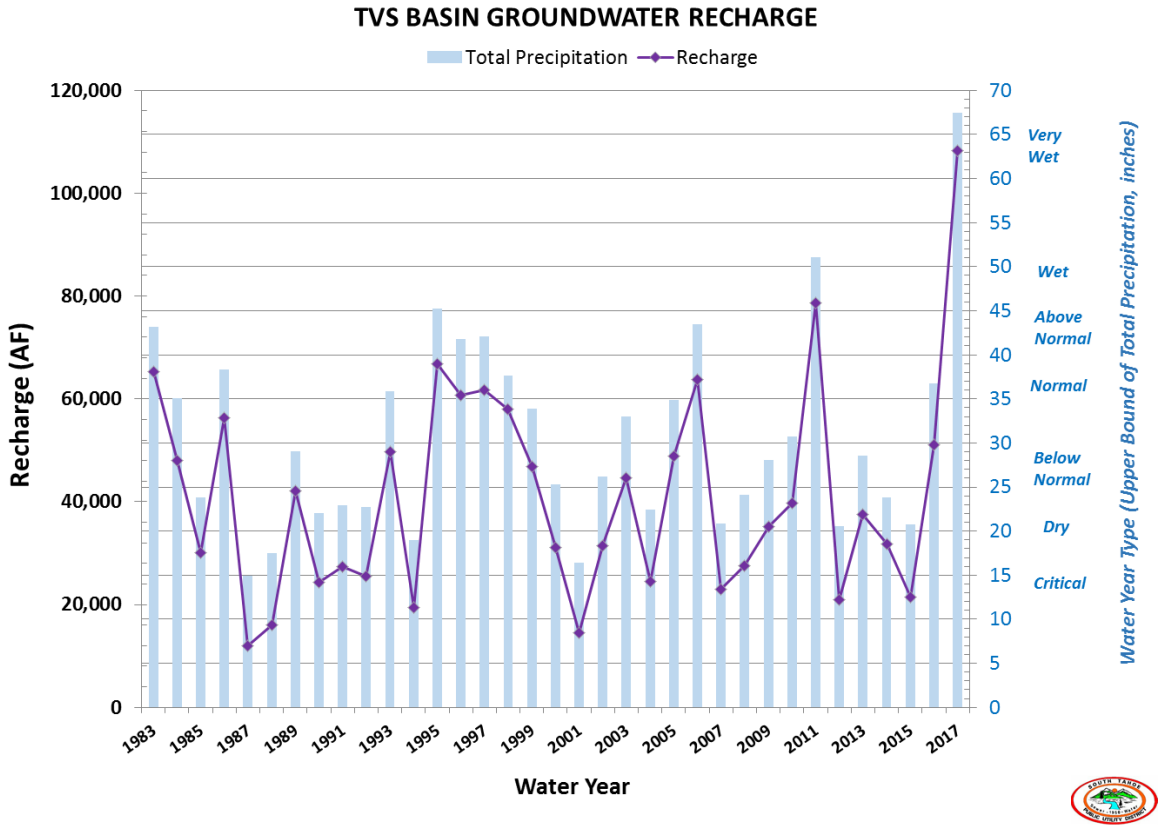


**Figure 2-2.** TVS Basin model recharge (AFY) from 1983 WY – 2017 WY. Water year type using the TVS Basin classification from total precipitation measured at SNOTEL 508 Hagan's Meadow, CA is indicated on the secondary vertical axis on the far right-side of the graph.

## 2.3 Groundwater Level Monitoring

The District regularly measures groundwater levels in its forty-seven (47) wells located throughout the TVS Basin. The District well network includes thirty (30) observation wells and seventeen (17) PWS wells (Figure 2-3). All of the PWS wells are actively used for drinking water supply. Two of these wells are on stand-by status, used only for emergency purposes. The observation wells include monitoring wells,

sentinel wells and test wells, as well as former drinking water supply wells that have been removed from service and are no longer connected to the District's water distribution system. Only the observation wells are used in the California State Groundwater Elevation Monitoring program.

Construction details for selected wells in which hydrographs are provided (Appendix A) are set forth in Table 2-1. The sub-areas, shown in Table 2-1, are informal designations using the geographically-based designations (Christmas Valley, Meyers, Angora, South Lake Tahoe, Tahoe Keys and Bijou) shown in Figure 1-2. The Christmas Valley sub-area is in the southernmost portion of the TVS Basin, south of Lake Valley and Highway 50. The Meyers sub-area is located in the southern portion of Lake Valley from Highway 50 north to Twin Peaks. The Angora sub-area is located in the northern portion of Lake Valley west of Twin Peaks. The South Lake Tahoe sub-area is located north of Lake Valley. The Tahoe Keys sub-area is located at the north end of the TVS Basin, west of the South Lake Tahoe sub-area; while the Bijou sub-area is located east of the South Lake Tahoe sub-area.

The Basin Monitoring Program is described in Section 9.0 of the 2014 GWMP and generally involves the collection, compilation and evaluation of groundwater level, groundwater quality, groundwater production and climate data from numerous sources for the TVS Basin. As part of the groundwater level monitoring effort, the District uses both hand and continuous readings to monitor groundwater elevation trends across the TVS Basin. Hand readings are collected from each of the TVS Basin groundwater elevation monitoring wells in the fall and spring of each water year. Hand readings from active PWS wells are collected a minimum of 12 hours after well pumps are turned-off for static water level measurements. A smaller number of observation wells (13) are fitted with dedicated water-level monitoring equipment. The data loggers are programmed to collect pressure head and temperature readings at 6:00 AM and 6:00 PM on a daily basis to provide a continuous record of groundwater levels in the TVS Basin.

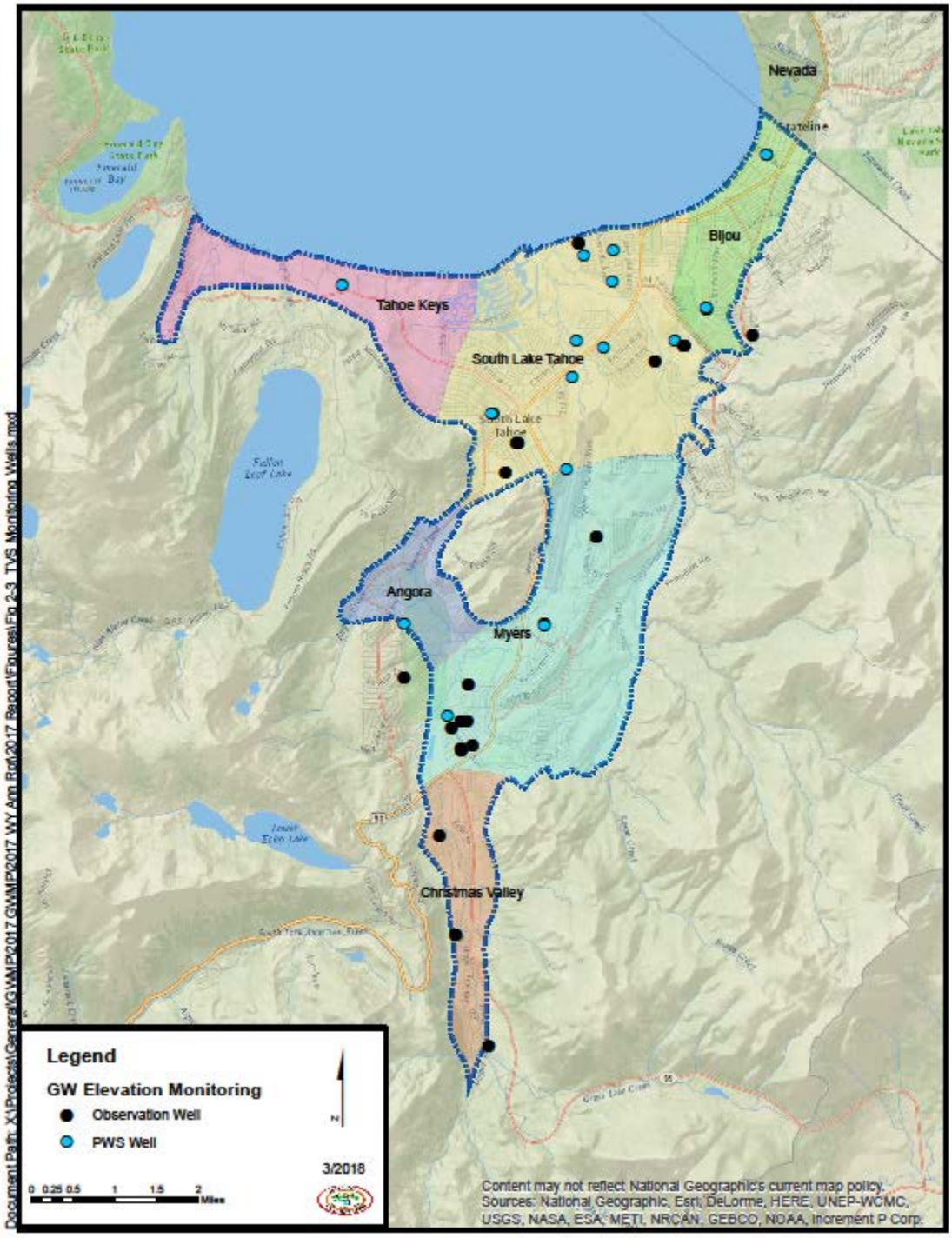


**Figure 2-3**. Locations of wells used for monitoring changes in groundwater elevation within the TVS Basin.

| Well | Sub-Area | Reference Point Elevation (ft msl) | Top of Screen Depth (ft bgs) | Bottom of Screen Depth (ft bgs) |
|---|---|---|---|---|
| Mountain View | Angora | 6313.14 | 95 | 164 |
| Blackrock Well #1 | Bijou | 6242.72 | 168 | 180 |
| Glenwood Well #3 | Bijou | 6261.68 | 112 | 192 |
| Henderson OW | Christmas Valley | 6369.78 | 79 | 100 |
| | | | 142 | 205 |
| Bakersfield | Meyers | 6310.50 | 130 | 170 |
| | | | 180 | 240 |
| Elks Club Well #1 | Meyers | 6284.63 | 110 | 142 |
| Washoan OW | Meyers | 6307.84 | 102 | 144 |
| | | | 165 | 186 |
| | | | 207 | 228 |
| | | | 249 | 270 |
| CL-1 | South Lake Tahoe | 6278.37 | 104 | 114 |
| CL-3 | South Lake Tahoe | 6278.49 | 39 | 49 |
| Paloma | South Lake Tahoe | 6267.10 | 188 | 248 |
| | | | 268 | 408 |
| Sunset | South Lake Tahoe | 6249.00 | 275 | 430 |
| Martin OW | South Lake Tahoe | 6262.42 | 95 | 115 |
| | | | 125 | 145 |
| | | | 160 | 180 |
| | | | 200 | 240 |
| USGS TCF-1-1 | South Lake Tahoe | 6296.48 | 325 | 340 |
| USGS TCF-1-2 | South Lake Tahoe | 6296.47 | 245 | 260 |
| USGS TCF-1-3 | South Lake Tahoe | 6296.65 | 158 | 163 |
| USGS TCF-1-4 | South Lake Tahoe | 6296.63 | 130 | 140 |
| USGS TCF-1-5 | South Lake Tahoe | 6296.63 | 88 | 98 |
| Lily OW | South Lake Tahoe | 6236.08 | 35 | 37.5 |
| Valhalla | Tahoe Keys | 6256.50 | 110 | 170 |

**NOTES:**
feet msl: Elevation in feet above mean sea level (NAVD88).
ft bgs: Depth in feet below ground surface.

**Table 2-1**. Well screen intervals for selected groundwater elevation wells within the Tahoe Valley South Basin. Hydrographs for selected wells to show groundwater level trends within each sub-area are provided in Appendix A.

## 2.4 Groundwater Levels

Hydrographs of continuous groundwater elevation readings collected from four observation wells across the TVS Basin are provided below in Figure 2-4. The Henderson Observation Well (OW) is located near the south end of the TVS Basin at the north end of the Christmas Valley sub-area. The Washoan OW is located near the center of the TVS Basin, within the north half of the Meyers sub-area. The Martin OW and Lily OW are both located at the north end of the TVS Basin, within the South Lake Tahoe sub-area. The Martin OW is located near the east margin of the basin within the south half of the sub-area; and the Lily OW is located near the south shore of Lake Tahoe within the north half of the sub-area.

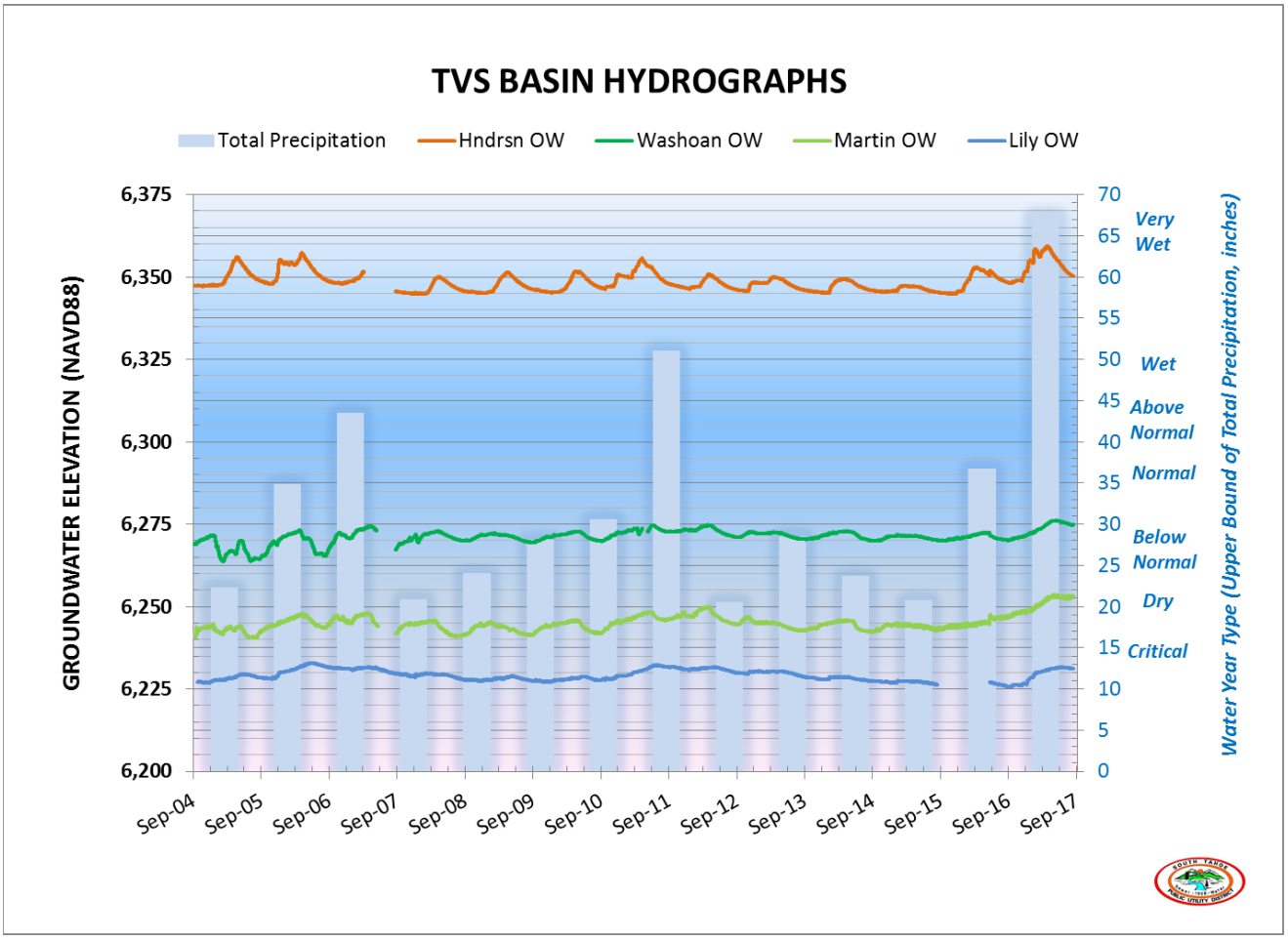


**Figure 2-4**. Continuous groundwater level readings collected from selected wells distributed across the TVS Basin.

Over the period of record (2005 WY – 2017 WY), the continuous readings show that groundwater elevations have been relatively stable. During this period, there were five below normal water years; five normal water years; one wet water year; and two very wet water years (*see* Figure 1-5). Regular

fluctuations representing seasonal changes in groundwater elevations are most pronounced in the Henderson OW. Groundwater elevations tend to rise during the winter storm season when precipitation exceeds evaporation, plant transpiration (evapotranspiration) is at its lowest and groundwater production is at or near seasonal low water demands. As a result, seasonal high groundwater levels typically occur between early-April through mid-June. Groundwater levels then tend to decline during the summer and into the fall, when evapotranspiration exceeds precipitation and groundwater production is at or near seasonal high water demands. Seasonal low groundwater elevations typically occur at the end of this seasonal cycle from between mid-July through mid-November.

Groundwater elevations within the TVS Basin marginally declined after the 2011 WY (very wet) through the 2012 – 2015 Drought and then recovered during the 2016 WY (normal). The magnitude of these changes is ascertained by comparing interannual changes in seasonal high groundwater levels (May readings) measured from all of the groundwater elevation monitoring wells.

### 2.4.1 Basin Condition (Groundwater Levels)

Hand readings collected from the groundwater elevation monitoring wells in May of each water year are compared to hand readings collected during a 10-year period (2001 WY- 2010 WY) prior to the 2012-2015 Drought. The purpose of this analysis is to gage the current condition of groundwater levels compared to a base period for groundwater levels selected for the TVS Basin. This period was selected for the base period as groundwater level data for the groundwater elevation monitoring wells are relatively complete. During this period accumulated precipitation measured at SNOTEL 508: Hagan's Meadow, CA averaged 29.3 inches, which is within the normal range of precipitation for the TVS Basin. During the base period for groundwater levels there were: one dry water year; three below normal water years; five normal water years; and one wet water year (see Figure 1-5).

Hand readings collected during the May 2017 water year were used to define current basin conditions as being either normal, above normal, or below normal with respect to the record of groundwater levels collected during the base period (2001 WY – 2010 WY). The percentile rank of the groundwater elevation measured during the May 2017 monitoring event at each well was determined for more than thirty (30) of the groundwater elevation monitoring wells using the record of hand readings collected for that well during the base period. The percentile rank of the May 2017 groundwater elevation for each well was then plotted on a cumulative frequency diagram to show the current state of the TVS Basin in terms of groundwater levels (Figure 2-5).

Figure 2-5 shows the distribution of groundwater elevations measured during the May 2015, May 2016 and May 2017 monitoring events using their respective percentile ranks within the record of groundwater levels measured for the same wells during the base period. The 2015 WY was a below normal water year at the end of the 2012-2015 Drought. During 2015 WY, the median for the May 2015 groundwater elevations was in the middle of the normal range (52%) of the base period elevations and seven wells had below normal groundwater elevations. During 2016 WY, the median for the May 2016 groundwater elevations was at the lower end of the above normal range (86%) of the base period

elevations and only one well had below normal groundwater elevations. This well (Seneca Observation Well) is located outside the west boundary of the TVS Basin. During 2017 WY, the median for the May 2017 groundwater elevations was at the higher end of the above normal range (97%) of the base period elevations and all wells were in the above normal range, with the exception of the Sunset Well which was within the normal range. Between May 2011 and May 2015, the difference in groundwater elevations decreased an average of 3.98 feet. Between May 2015 and May 2016, the difference in groundwater elevations increased an average of 2.21 feet; and between May 2016 and May 2017, the difference in groundwater elevations increased 4.70 feet. Using these averages, groundwater levels across the TVS Basin appear to have fully recovered from the total decline in groundwater levels that occurred during the 2012-2015 Drought.

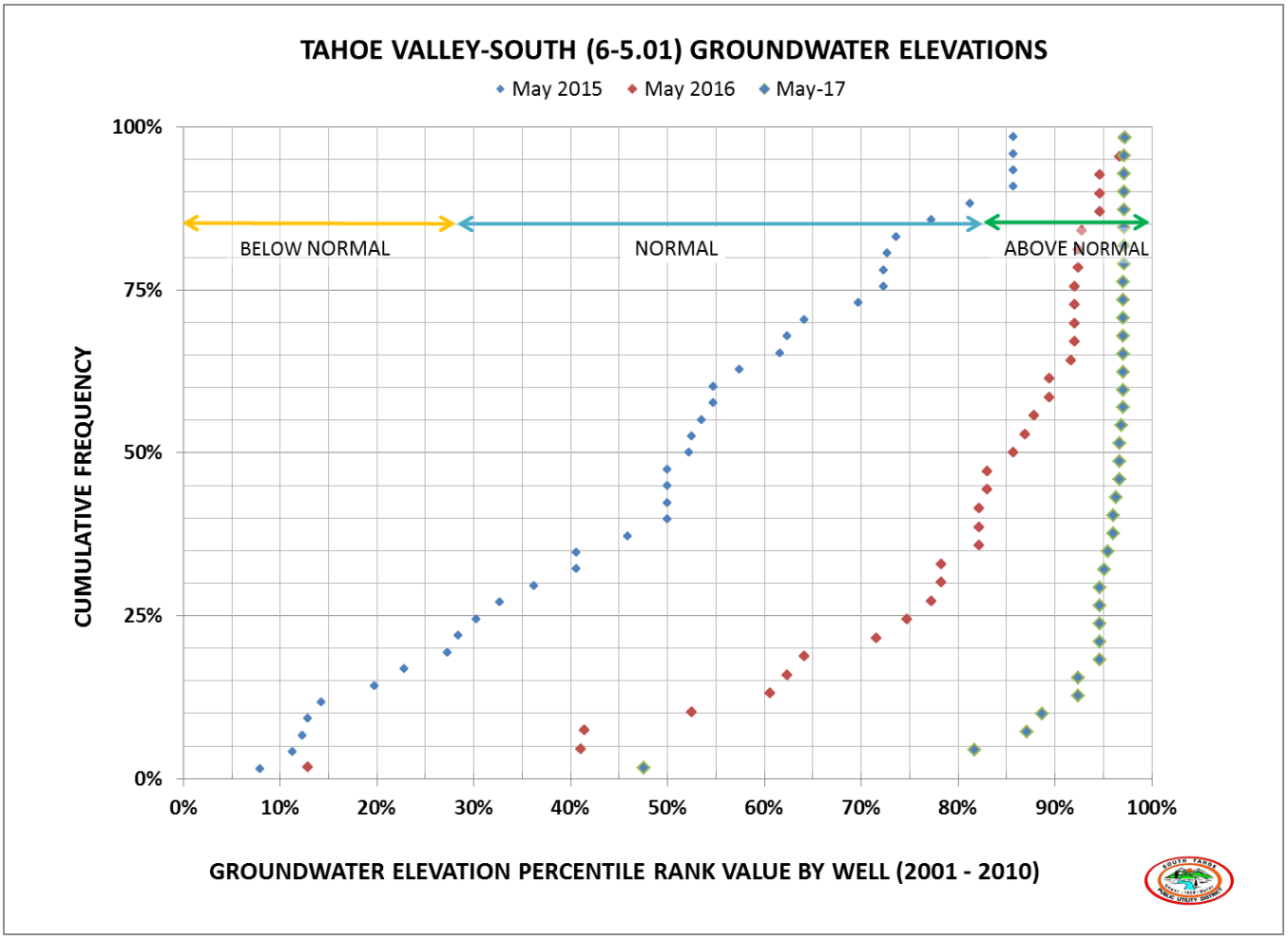


**Figure 2-5.** Hand readings collected during the May groundwater elevation monitoring event for the 2015 WY through 2017 WY compared to the record of hand readings for the same wells collected during the 2001 WY -– 2010 WY base period for groundwater levels.

### 2.4.2 Groundwater Elevation Contours

Groundwater elevation contour maps for October 2016 and May 2017 are presented in Figure 2-6 and represent seasonal low and seasonal high groundwater elevation conditions. The typical pattern is for seasonal low groundwater conditions to occur in the late summer and early fall due to low recharge following the relatively dry summer months and increased groundwater pumping to meet high water demands. Seasonal high groundwater conditions typically occur in the spring following the spring snowmelt and runoff and lower groundwater pumping needed to meet low water demands.

The groundwater model for the TVS Basin simulates the period 1983-2017 to calculate changes in groundwater levels and flux due to variations in climate and groundwater extractions. Model simulated groundwater levels were used to generate the groundwater contours presented in Figure 2-6. These contours are considered appropriate to illustrate the general pattern of groundwater flow in the TVS Basin.

Comparison of contours shows that the generalized pattern of groundwater flow remains similar between October 2016 and May 2017. This is consistent with the hydrograph data (Appendix A) that shows the typical variation in groundwater levels is on the order of only a few feet. In most of the TVS Basin, the May 2017 water level contours progress northward indicating a general rise of groundwater levels compared to October 2016 groundwater levels. Inspection of Figure 2-6 shows that rising groundwater levels reduced the extent of a local groundwater depression defined by the 6227 contour along the north margin of the TVS Basin, within the South Lake Tahoe sub-area. Within this contour, the general direction of groundwater flow is locally reversed, with a portion of groundwater flow moving south from Lake Tahoe into the depression. Outside the 6227 contour, groundwater flow through the South Lake Tahoe sub-area is generally directed northward from the TVS Basin to Lake Tahoe.

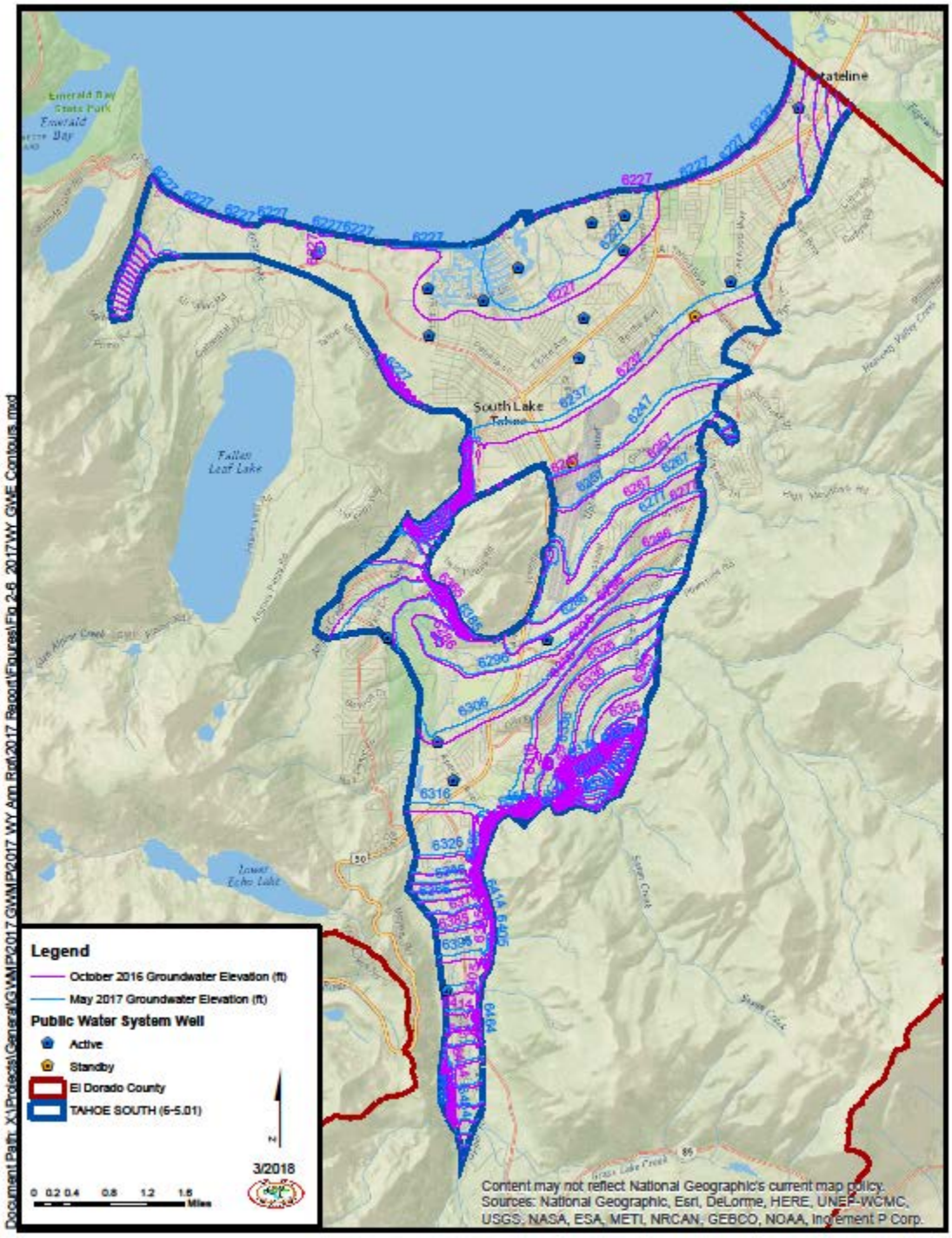


**Figure 2-6.** TVS Basin model simulated groundwater levels (upper 300 ft) for seasonal low (October 2016) and seasonal high (May 2017) groundwater elevations. Contour interval is 10 ft.

## 2.5 Groundwater Quality

Groundwater in the TVS Basin is typically of excellent quality; however, there is historical isolated groundwater contamination from regulated industrial and commercial chemicals which is impairing a few water supplies. Over the past ten years, arsenic, iron, and radionuclides (uranium) have been found in both PWS wells and private wells at concentrations exceeding primary or secondary maximum contaminant levels (MCLs) (Pohll *et al.,* 2016). Well head treatment is presently used to remove arsenic from groundwater produced at one active PWS well (Arrowhead Well No. 3). Two other PWS wells are currently on stand-by status due to arsenic (Airport Well) and uranium (College Well) concentrations above MCLs in these wells.

Man-made contaminants which have occurred in the TVS Basin include petroleum hydrocarbon and chlorinated hydrocarbon compounds. Of these, the two most prominent constituents of concern are Methyl-tertiary Butyl Ether and PCE. Well head treatment is presently used to remove PCE from groundwater produced at one active PWS well ((TKWC) Well No. 2) within the South Lake Tahoe sub-area. A second wellhead treatment system used for the removal of PCE from groundwater is also located within this sub-area at the Clement Well, which is presently inactive. Chlorinated hydrocarbons have been detected in private and municipal supply wells within this area since 1989, when these compounds were required to be first tested in regulated drinking water sources.

During the 2017 WY, trace levels of Methyl-tertiary Butyl Ether (0.4 ppb) were detected in a one of four quarterly samples collected from a single PWS well (Glenwood Well No. 5) at concentrations below primary or secondary MCLs. The Glenwood Well is located near the south end of the Bijou sub-area. The actual presence and potential source of the contamination is presently unknown.

During the 2017 WY, trace levels of PCE were detected in the Clement Well and in the TKWC #1 Well at concentrations below primary MCLs. Both wells are located within or neighboring the South “Y” Plume situated within the north central portion of the TVS Basin (Figure 2-7). The boundaries of this contaminant plume have been generally defined using maximum PCE concentrations detected in groundwater samples collected from between 2011 through early 2016. From these data, the contaminant plume is estimated to cover an area of approximately 465 acres (GEI Consultants, 2016).

The South “Y” Plume has impaired three PWS wells (LBWC #2, LBWC #5 and TKWC #2) with a combined source capacity of 3.25 MGD. Trace levels of PCE below MCLs are presently detected in one PWS well (TKWC #1). This well is located about ½-mile south of the south shore of Lake Tahoe, near the leading edge of the contaminant plume. Since June 2016, PCE concentrations in raw water samples collected from this well have generally ranged from 1.5 to 4 µg/L. Potential impairment of TKWC #1 would further reduce the total production capacity of area drinking water sources by an additional 1.44 MGD. Groundwater management actions taken to mitigate this groundwater concern are described in Sections 3.7 and 3.8.

Two other PWS wells (LBWC #1 and TKWC #3) west of the South “Y” plume are presently non-detect for PCE. The District has mutual aid and assistance agreements for the emergency provision of drinking

water using inter-tie connections from its water distribution system to both the LBWC and TKPOA water systems. During the 2017 WY, the District provided 11.83 million gallons through its inter-tie connection to LBWC, which is about 16% of its total water production for the 2017 WY.

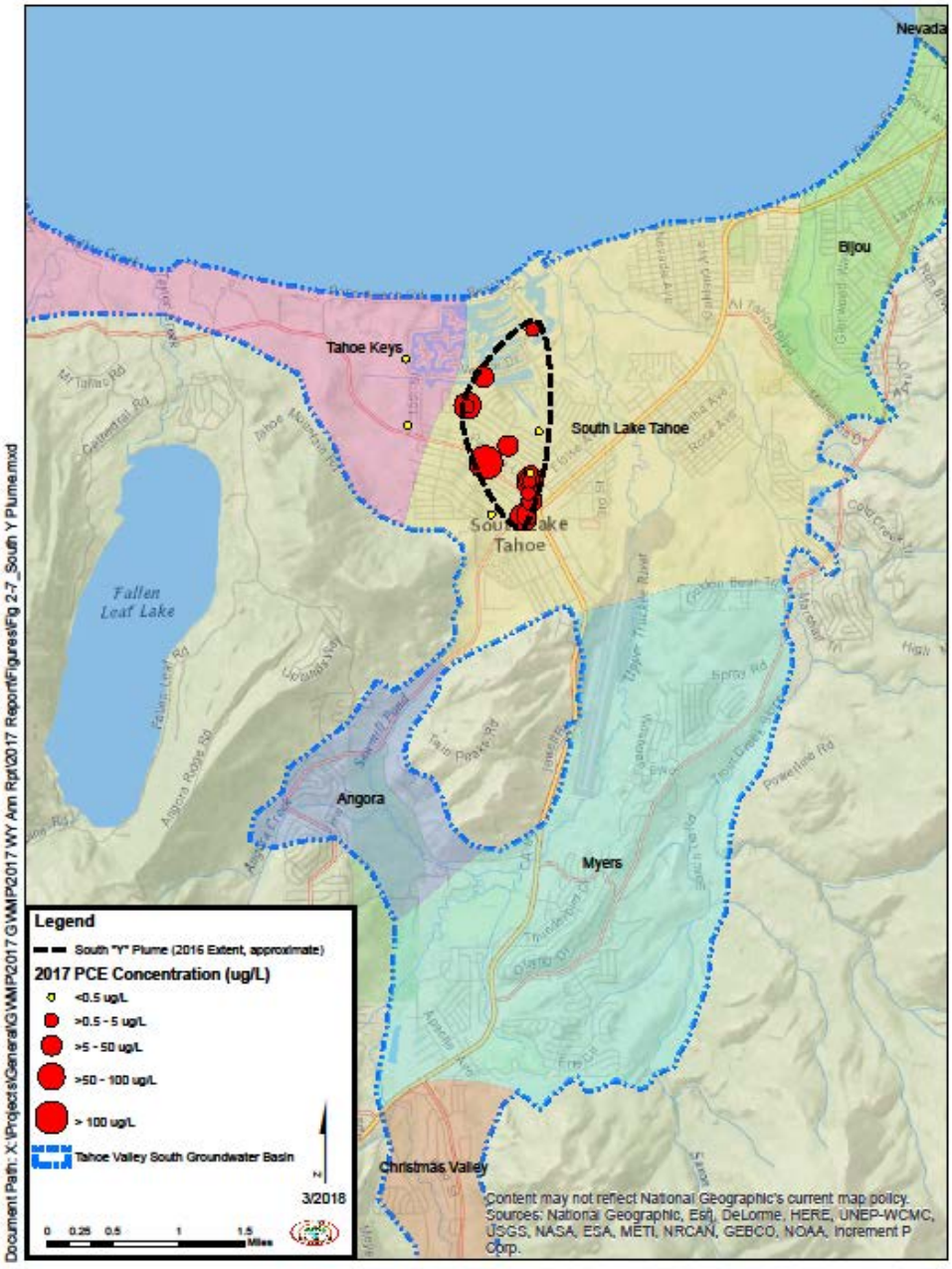


**Figure 2-7**. Location of the South "Y" Plume within the TVS Basin, as defined by wells with PCE concentrations above 5 micrograms per liter during 2011 - 2017 (Adapted from GEI Consultants, 2016a).

The District's high reliance on groundwater requires that PWS wells must have sufficient source capacity to meet water system demands within the TVS Basin. Because of this reliance on groundwater and susceptibility of groundwater sources to contamination, the total source capacity of active PWS wells is used as an indicator to describe current basin conditions with respect to groundwater quality (Pohll *et al.,* 2016). During the 2017 WY, the total source capacity of PWS wells operating within the TVS Basin is estimated at 28.12 MGD. The minimum threshold for groundwater quality within the TVS Basin is the total MDD requirement for all beneficial users of groundwater within the TVS Basin, estimated at 22.775 MGD (Pohll *et al.,* 2016). As the total source capacity of PWS wells exceeds the MDD requirement for all beneficial users, the impact of the South "Y" Plume has not reached the level of an undesirable result. However, the total source capacity of PWS wells has declined by more than 10% compared to 2011 levels (32.4 MGD). The majority of this decline is attributed to degraded water quality impacts from the South Y Plume (see Figure 3-1). At present, the total source capacity of PWS wells exceeds the MDD requirement by 5.3 MGD or about 25% of the MDD.

In 2016, the District in partnership with LBWC and the TKPOA undertook renewed investigations to describe the extent of PCE contamination and identify remedial measures that could be used to remove this contamination from groundwater to protect existing groundwater sources used for drinking water supply. This included completion of an engineering assessment of an inactive water supply well (LBWC #4) for use as a potential extraction well (GEI, 2016a); compilation of historical data to show the spatial and temporal distribution of PCE contamination in the South "Y" Area (GEI, 2016b); and initial development of a modular three-dimensional transport model (MT3DMS) that could be used to evaluate various remedial alternatives designed to mitigate contamination from the South "Y" Plume.

During the 2017 WY, the water purveyors (District, LBWC and TKPOA) continued water quality monitoring to better understand the current extent of PCE contamination in PWS wells; the preliminary MT3DMS model was completed, and negotiations were initiated with the SWRCB to perform a Pre-Design Investigation and Feasibility Study under a Proposition 1 Groundwater Planning Grant to address this contaminant problem. Detailed discussions of these activities are provided in Sections 3.7.2 and 3.8.1 of this report.

In May 2017, the Lahontan Regional Water Quality Control Board (LRWQCB) issued a Clean Up and Abatement Order requiring remediation and additional investigation of PCE groundwater contamination resulting from historic PCE release from the Lake Tahoe Laundry Works site at 1024 Lake Tahoe Boulevard, South Lake Tahoe, CA (CAO No. R6T-2017-0022). In response to CAO No. R6T-2017-0022, Seven Springs Limited Partnership and Fox Capital Management Corporation submitted an initial Work Plan to the LRWQCB in July 2017. The initial Work Plan was deemed to be incomplete. A revised Work Plan was submitted to the LRWQCB on March 19, 2018.

## 2.6 Groundwater Production

Groundwater is the primary source of drinking water throughout the TVS Basin and is supplied for residential and commercial water use. More than 90 percent of groundwater extractions from within the TVS Basin are from PWS wells operated by the District, TKWC and LBWC. Groundwater extractions from these wells are metered using propeller or turbine type flowmeters with a register for total flow and a flow rate indicator. Totalizer readings are recorded on a daily basis by the District and on a monthly basis by TKWC and LBWC. Accuracy of measurement for these flow meters is typically on the order of +/- 2%.

Table 2-2 shows the monthly and total pumping volumes of groundwater extracted by PWS wells during the 2017 WY. During the 2017 WY, a total of seventeen (17) PWS wells were active, of which two were on stand-by status (restricted for emergency use only).

| PUBLIC WATER SYSTEM | UNITS | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JLY | AUG | SEPT | 2017 WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Tahoe Public Utility District (District) | AF | 371 | 295 | 400 | 347 | 292 | 319 | 288 | 449 | 707 | 873 | 763 | 549 | 5,652 |
| Tahoe Keys Water Company (TKWC) | AF | 56 | 17 | 16 | 24 | 23 | 20 | 21 | 85 | 139 | 128 | 147 | 122 | 797 |
| Lukins Brothers Water Company (LBWC) | AF | 16 | 9 | 10 | 14 | 12 | 12 | 10 | 22 | 29 | 18 | 24 | 28 | 206 |
| **TVS BASIN PWS TOTALS** | | 443 | 321 | 426 | 385 | 327 | 351 | 319 | 556 | 875 | 1,019 | 934 | 699 | 6,654 |

**Table 2-2.** Monthly pumping volumes for PWS wells in the TVS Basin during the 2017 water year, reported in AF.

Annual groundwater production from each of the TVS Basin PWS wells included in Table 2-2 above is shown below in Figure 2-8. Since the 2005 WY, the annual groundwater extractions from the pumping of these PWS wells has ranged from a low of approximately 6,298 AF in 2015 WY to a high of approximately 9,652 AF in 2007 WY, with a median value of 7,767 AF. During the 2017 WY, the total groundwater production from these wells (6,654 AF) was about 14% below the median value. Figure 2-9 shows the locations of the active PWS wells and accompanying pumping volumes for the 2017 WY.

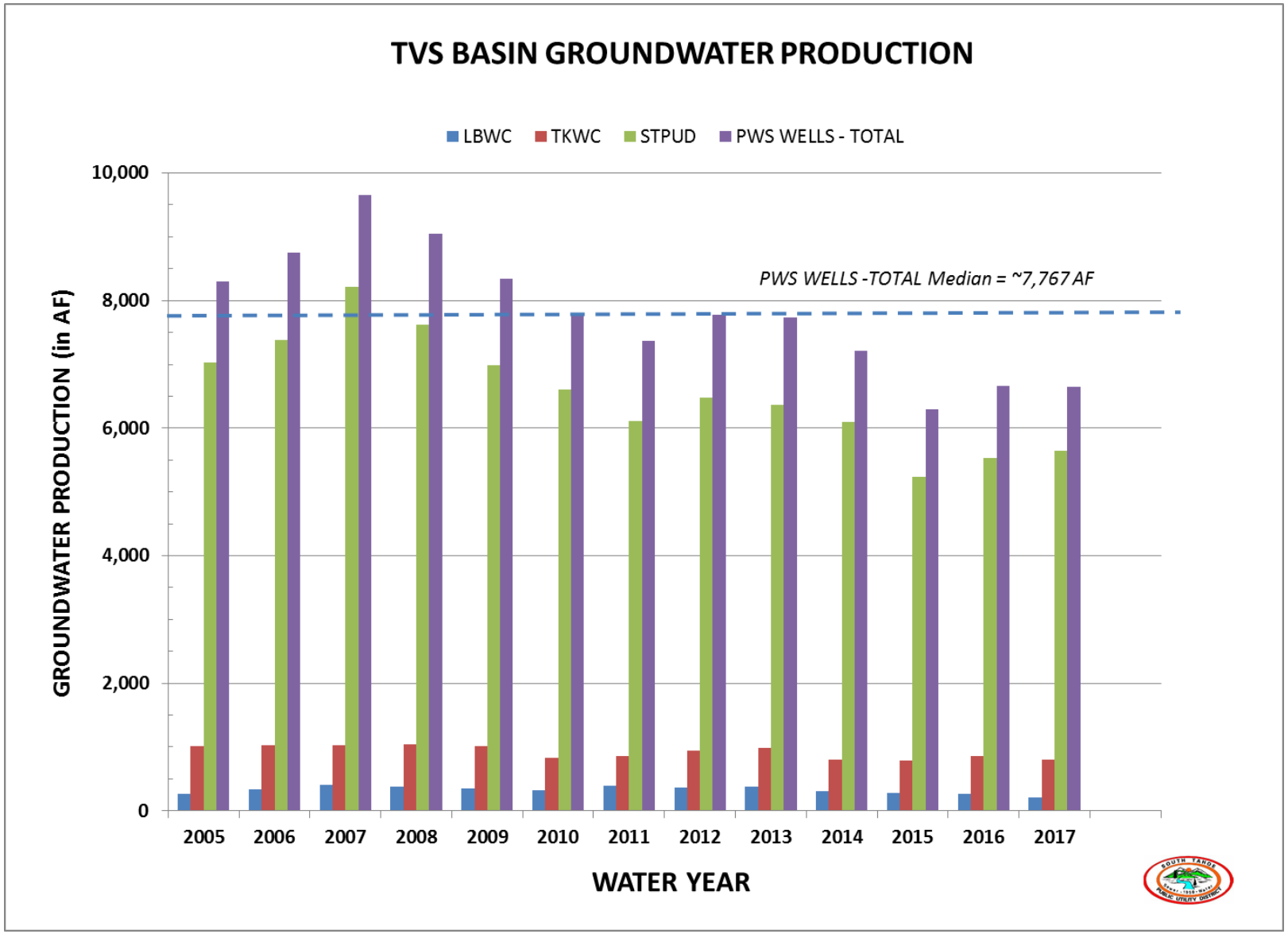


**Figure 2-8.** Groundwater production trends for public water system wells in the TVS Basin since the 2005 WY, in AF.

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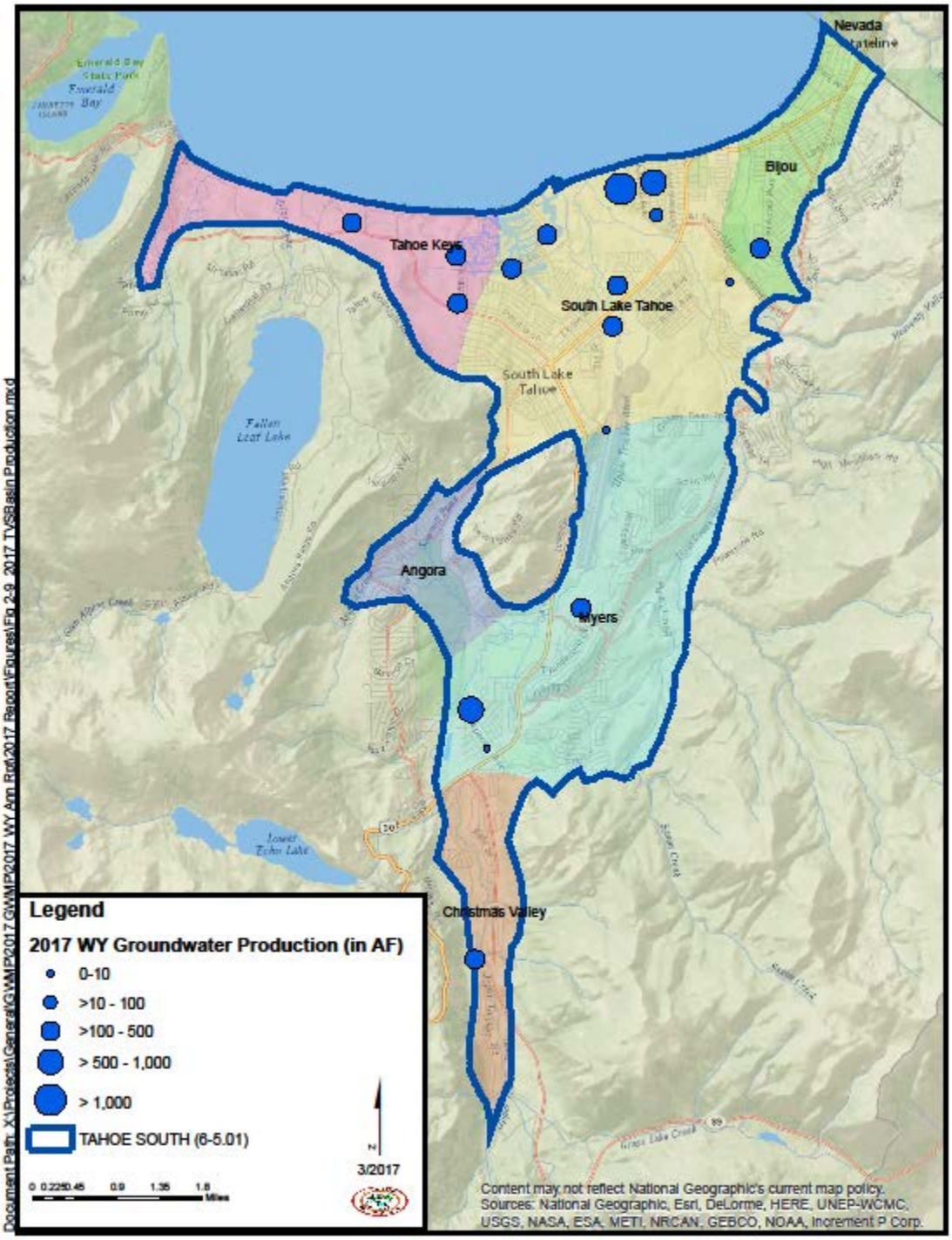


**Figure 2-9.** Groundwater extraction from PWS wells during the 2017 WY, in AF. These wells account for more than 90% of the groundwater pumped from the TVS Basin.

### 2.6.1 Water Use

Total water use information provided in this section is from the District's 2015 Urban Water Management Plan (UWMP) (J. Crowley Group, 2016). The water use data provided in the UWMP is presented in calendar years and is provided as such in this report. As indicated in Table 2-2 above, the District produces the majority of drinking water used within the TVS Basin (5,652 AF or 85% of TVS Basin PWS totals). Although not complete, information from the UWMP is believed to be representative of water demand trends within the TVS Basin, calculated on a calendar year basis.

Actual water demands for the 2017 WY have not been categorized; therefore, 2015 water demands from the UWMP are presented in Table 2-3. All non-residential customers are metered; however, 41 percent residential customers are still unmetered. The District is in the process of installing meters on all connections and is projected to be fully metered by 2025. The majority of the District's customers are residential. The District's commercial category includes office and retail, as well as the resorts including hotels, restaurants, and snowmaking. "Losses" account for non-metered water use such as firefighting, flushing, leaks, water theft, or meter inaccuracies.

| Use Type *(Add additional rows as needed)* | 2015 Actual | | |
|---|---|---|---|
| | Additional Description *(as needed)* | Level of Treatment When Delivered | Volume, AFY |
| Single Family | | Drinking Water | 1,853 |
| Multi-Family | | Drinking Water | 915 |
| Commercial | includes institutional | Drinking Water | 1,950 |
| Landscape | | Drinking Water | 6 |
| Losses | non-revenue water | Drinking Water | 517 |
| | | **TOTAL** | **5,241** |

**Table 2-3.** District 2015 water system demands for potable water (J. Crowley Group, 2016).

Because use of recycled water within the Lake Tahoe basin is generally prohibited by the Porter-Cologne Act there are no recycled water demands. Water losses during 2015 are calculated per the DWR/AWWA water audit methodology. 2015 water losses as a percent of total water use are used to project future water losses through 2035 (J. Crowley Group, 2016).

## 2.7 Groundwater Storage

The annual change in groundwater storage is the difference in the volume of water in an aquifer from one year to the next. Figure 2-10 shows the annual trends of groundwater extractions from PWS wells and the changes in groundwater storage, as derived from the annual water budget calculated by the groundwater model for the TVS Basin from 2005 WY through 2017 WY. The main components of the water budget include groundwater recharge; groundwater discharge to streams (baseflow); groundwater flux to Lake Tahoe; and groundwater pumping. Changes in groundwater storage are calculated from the differences in total inflow (recharge) and total outflows (baseflow, flux to Lake Tahoe and groundwater pumping) to the modeled region over a specified period (Carroll, *et al.*, 2016a).

Groundwater storage changes in response to climate variability and changes in groundwater extraction rates. Figure 2-10 shows that the change in groundwater storage ranged from -19,407 AF during the 2012 WY (below normal) to + 61,840 AF during the 2017 WY (very wet). During water years when the annual change in groundwater storage is negative, groundwater levels decrease slightly. During water years when the annual change in groundwater storage is positive, groundwater levels increase slightly. As annual groundwater production trends are slightly declining, the variation in groundwater storage shows the magnitude of the annual change that may occur in response to climate variability.

Long-term reductions in groundwater storage within the TVS Basin are not occurring. This is evidenced by stable groundwater levels (*see* Section 2.4) and the cumulative change in groundwater storage. Since 2005 WY, the cumulative change in groundwater storage is + 57,819 AF.

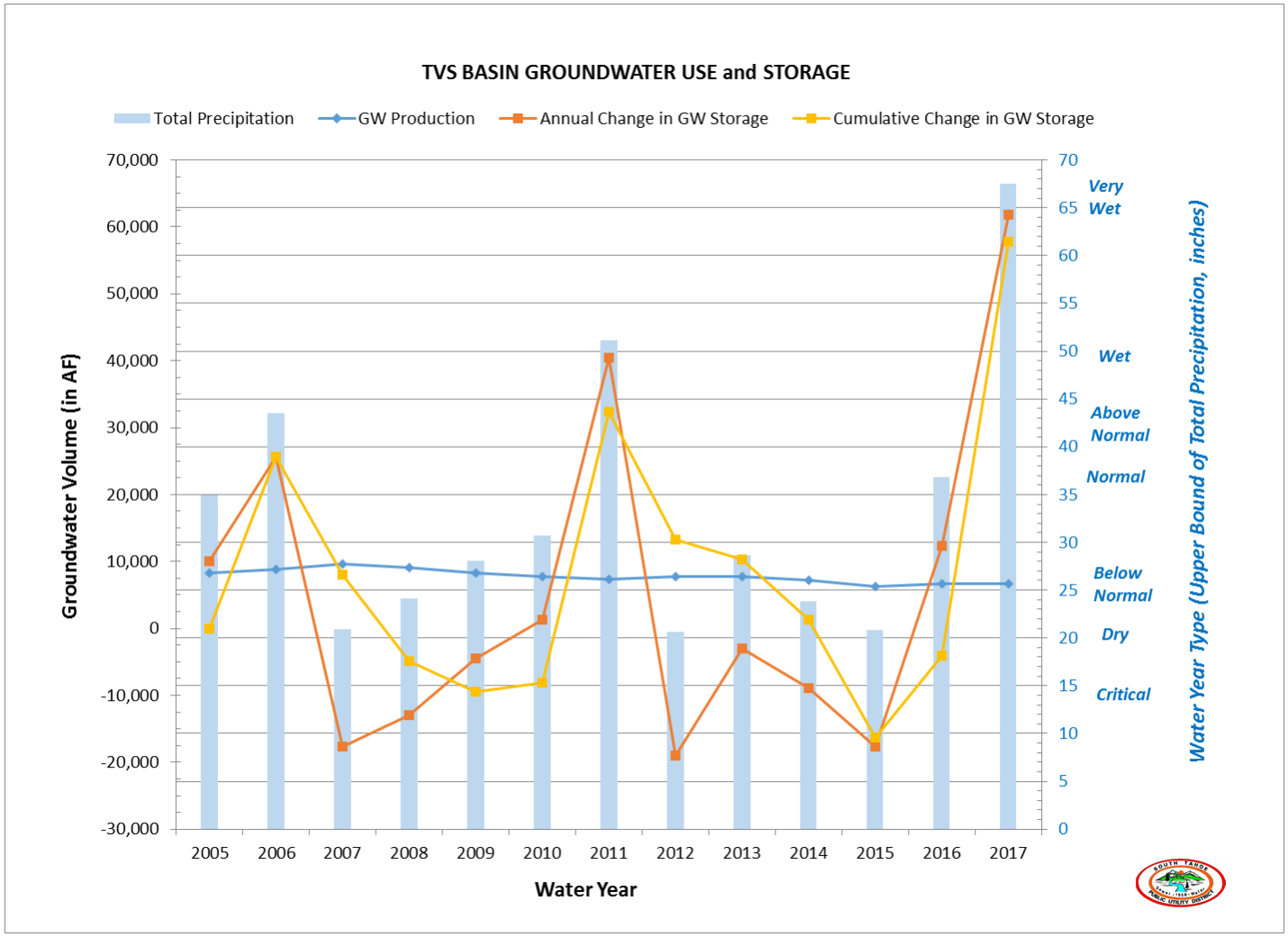


**Figure 2-10**. Annual groundwater production from public water supply wells and modeled annual and cumulative change in groundwater storage, in AFY, for the TVS Basin from 2005 WY through 2017 WY. Water year type using the TVS Basin classification is indicated on the vertical axis along the right-side of the graph. Positive annual changes in groundwater storage indicate periods of rising groundwater level.

# 3 Basin Management Objectives

BMOs are flexible guidelines for the management of groundwater resources that describe specific actions to be taken by the District to meet locally developed objectives at the basin or sub-area scale. Under the 2014 GWMP, eight BMOs have been defined for groundwater management of the TVS Basin.

- BMO #1 – Maintain a sustainable long-term groundwater supply
- BMO #2 – Maintain and protect groundwater quality
- BMO #3 – Strengthen collaborative relationships with local water purveyors, governmental agencies, businesses, private property owners and the public
- BMO #4 – Integrate groundwater quality protection into local land use planning activities
- BMO #5 – Assess the interaction of water supply activities with environmental conditions
- BMO #6 – Convene an ongoing Stakeholder's Advisory Group (SAG) as a forum for future groundwater issues
- BMO #7 – Conduct technical studies to assess future groundwater needs and issues
- BMO #8 - Identify and obtain funding for groundwater projects.

The following section describes the implementation of projects and management actions taken during the 2017 WY.

## 3.1 BMO #1- Maintain a Sustainable Supply

The purpose of BMO #1 is to implement measures to manage the groundwater levels for long term sustainability and reliability of the water supply for all users within the TVS Basin. The measurable goal for tracking groundwater levels is to sustain groundwater levels within the normal range of groundwater levels during the base period (2001 WY – 2010 WY) for groundwater levels (Section 2.2.1). If long-term groundwater levels show a consistent declining trend that falls below the normal range, then an assessment of the cause for the decline would be conducted. If excessive groundwater pumping is found to be the cause, then measures would need to be taken to either redistribute the pumping to other portions of the basin, or reduce pumping at the implicated well(s). No action would be required if the condition described above is not observed.

During the 2017 WY, the median for the May 2017 groundwater elevations was at the upper end of the Above Normal range (97%) of the base period. Groundwater levels will continue to be monitored in accordance with the Basin Monitoring Program.

## 3.2 BMO #2 – Maintain and Protect Groundwater Quality

Groundwater in the TVS Basin is typically of excellent quality; however, there is historical isolated groundwater contamination from regulated industrial and commercial chemicals, which is impairing a few water supplies. The nature of the aquifer makes it highly vulnerable to groundwater contamination as evidenced by these past contaminant releases.

The purpose of BMO #2 is to implement measures to maintain and protect groundwater quality in order to sustain the beneficial use of groundwater resources. These measures would address contamination from manmade contaminants and not natural constituents intrinsic to the aquifer. This would include setting measurable goals and continuing proactive measures to protect groundwater quality. The groundwater quality measurable goals are consistent with existing regulations and policies. These would include:

- All groundwater supply wells will meet drinking water standards as defined by the SWRCB Division of Drinking Water.
- Groundwater quality in the TVS Basin will not be impaired so as to affect its beneficial use of current or potential future use of groundwater for public water supply as defined by the LRWQCB Basin Plan.
- Detection of contaminants from regulated industrial and commercial chemicals in any well within the TVS Basin will be evaluated as to its potential as an emerging groundwater quality threat to the water supply.
- Information on areas of degraded water quality will be collected and maintained in order to consider its effect on available water supply and the development of future groundwater supplies.

The objective of setting quantitative goals for BMO #2 is to provide a means for assessing the relative threat of contamination. The goals are tied to the regulatory requirements, but also make the detection of any manmade contaminant require review and analysis. In this manner, the goals establish a mechanism to be proactive in addressing contamination issues before they reach levels that threaten the beneficial use of groundwater sources within the TVS Basin.

### 3.2.1 Source Capacity

The measurable goal for BMO #2 is that degraded water quality concerns within the TVS Basin should not rise to a level that threatens the ability of groundwater sources (PWS wells) to meet water system demands. Demand requirements for public water systems are calculated in accordance with methods described under Section 64554 of the California Waterworks Standards. Under these standards, a PWS's sources shall have the capacity to meet the system's MDD calculated using water system's daily, monthly or annual water use data, as available. These standards also include a water system's requirements for peak hourly demand; however, these requirements are directed toward the adequacy

of the water system's distribution system to provide sufficient flows. As the goal for BMO #2 is to prevent degraded water quality from impairing groundwater sources to a point where water demands can no longer be met and that the PWS wells account for more than 90% of the groundwater use, only the MDD for the PWS wells are used to establish a minimum threshold for degraded water quality in the TVS Basin.

More than 90% of the total water demand is satisfied by the PWS wells operated by the District, TKWC and LBWC. To account for the beneficial users of groundwater not connected to these water systems, a 10 percent safety factor is added to the MDD derived for these water systems to determine the minimum threshold for the TVS Basin. Results of these calculations provide a minimum threshold of 22.775 MGD needed to meet of the MDD for all beneficial users in the TVS Basin.

The current state of the TVS Basin with regard to groundwater quality is indicated below in Figure 3-1. The total production capacity for all active PWS wells operating within the TVS Basin is 28.12 MGD, which exceeds the MDD minimum threshold for water quality by 5.3 MGD. However, total source capacities have declined since 2011 and continue to be of concern if capacity is not replaced. Groundwater management actions taken to mitigate this groundwater concern are described below in Sections 3.7 and 3.8.

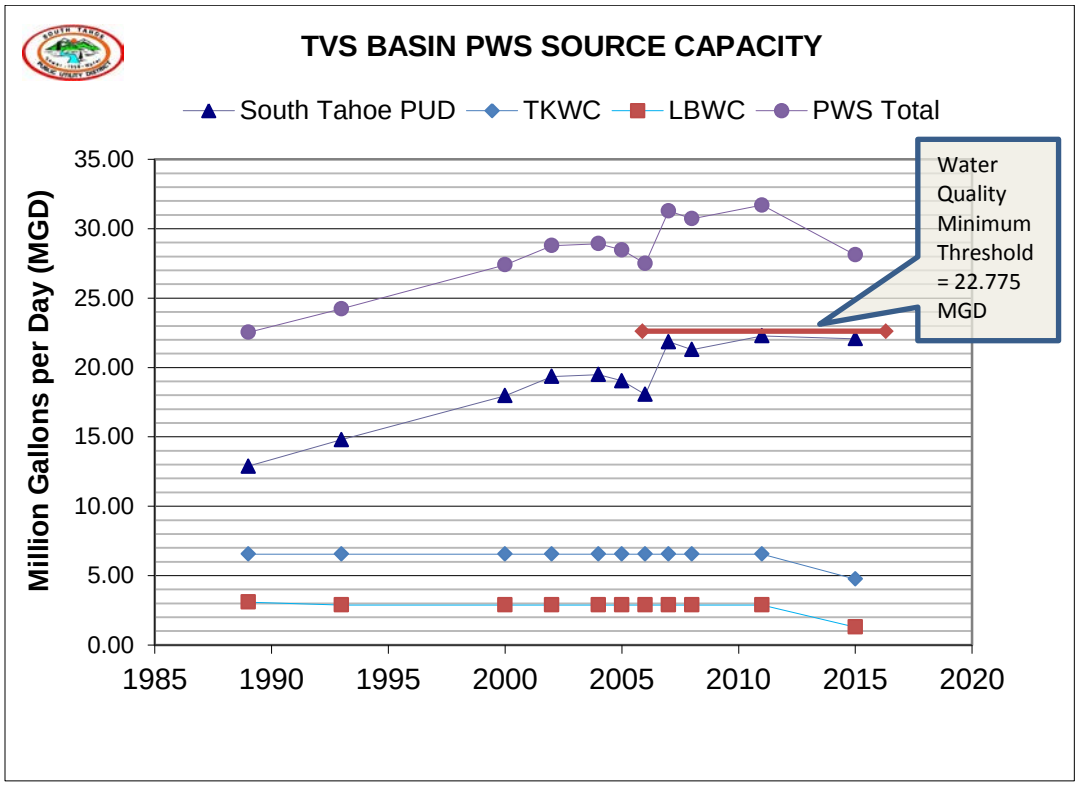


**Figure 3-1.** Source capacity, in million gallons per day, for active public water system wells operating within the TVS Basin from 1989 through 2015 (adapted from Pohll *et al*., 2016).

## 3.3 BMO #3 – Building Collaborative Relationships

The TVS Basin includes a wide range of stakeholders in addition to the District, including smaller water companies and domestic well owners. Government agencies, local business interests, environmental groups and private citizens also have interests in local groundwater management. Collaboration and coordination with other local agencies and stakeholders for implementation of the 2014 GWMP is achieved through the SAG. SAG members during the 2017 WY are listed in Table 3-1.

| Member | Title | Affiliation |
|---|---|---|
| Jason Burke | Storm Water Coordinator | City of South Lake Tahoe |
| Ken Payne, PE | General Manager | El Dorado County Water Agency |
| Robert Lauritzen, PG | Geologist | El Dorado County Environmental Management Division |
| Brian Grey, PG | Engineering Geologist | Lahontan Regional Water Quality Control Board |
| Joey Keely | Ecosystem Staff Officer | USFS-Lake Tahoe Basin Management Unit |
| Jennifer Lukins | Water Purveyor | Lukins Brothers Water Company |
| Rick Robillard, PE | Water Purveyor | Tahoe Keys Water Company |
| Bob Loding | Water Purveyor | Lakeside Mutual Water Company |
| Scott Carroll | Environmental Planner | California Tahoe Conservancy/Real Property Owner |
| Rebecca Cremeen | Associate Planner | Tahoe Regional Planning Agency |
| Harold Singer | Retired | Non-Business Community Rate Payer |

**Table 3-1.** 2017 WY Stakeholder Advisory Group members.

### 3.3.1 GSA Formation

The TVS Basin lies entirely within El Dorado County, and largely within the jurisdiction of the District. Since November 17, 2015, the District has been recognized as the exclusive GSA for the portion of the TVS Basin within its jurisdiction (South Tahoe Public Utility District -1 GSA). During the summer of 2016, the County Water Agency and the District began discussing options to form a GSA in the portion of the TVS Basin outside of the District's jurisdiction. Pursuant to these discussions—as well as additional conversations with DWR—the County Water Agency and the District determined that it would be appropriate for the District to become the GSA for the portion of the TVS Basin outside of its jurisdiction (i.e., within the County Water Agency's jurisdiction). Concurrent with this decision, the County Water Agency and the District drafted an MOU setting forth the County Water Agency's and the District's agreement to cooperatively manage and coordinate implementation and enforcement of the SGMA in this portion of the Basin. The County Water Agency and the District subsequently entered into this MOU and the District submitted a groundwater sustainability agency formation notice (GSA Formation Notice) to DWR on September 16, 2016 for the portion of the TVS Basin outside of its jurisdiction (2016 GSA Formation Notice).

On December 28, 2016, the District was recognized as the exclusive GSA for the portion of the TVS Basin located outside of its service area jurisdiction (South Tahoe Public Utility District -2 GSA). In March 2017, discussions with the SWRCB raised concerns about an agency forming a GSA outside of its jurisdiction. These concerns raised a risk that the South Tahoe Public Utility District -2 GSA may be considered invalid and that the TVS Basin could potentially be designated as "probationary" by the SWRCB and be put under state management. To ensure that the County Water Agency and the District are able to retain local control of the TVS Basin's groundwater resources, the District agreed to rescind its 2016 GSA Formation Notice and the County Water Agency agreed to elect to act as the GSA for the portion of the TVS Basin covered by the District's 2016 GSA Formation Notice.

On May 4, 2017, the District adopted a resolution rescinding its 2016 GSA Formation Notice. The withdrawal notice had no effect on the South Tahoe Public Utility District -1 GSA formation notice or its status as the exclusive GSA for the portion of the TVS Basin within its service area. On June 14, 2017, the County Water Agency held a public hearing and elected to become the GSA for the portion of the TVS Basin outside of the District's service area boundaries; and the District submitted to DWR its notice of intent to withdraw the South Tahoe Public Utility District-2 GSA for the portion of the TVS Basin outside of its service area. On June 15, 2017, the County Water Agency GSA formation notice for the El Dorado County Water Agency GSA was posted on the DWR website through the SGMA Portal.

Concurrent with the County Water Agency GSA formation notice for the El Dorado County Water Agency GSA and the District's notice of intent to withdraw the South Tahoe Public Utility District-2 GSA, the District and County Water Agency entered into an Amended and Restated MOU to work collaboratively to sustainably manage groundwater resources and implement SGMA throughout the entire TVS Basin. With execution of the MOU (on June 14, 2017), the TVS Basin is in full compliance with GSA formation requirements.

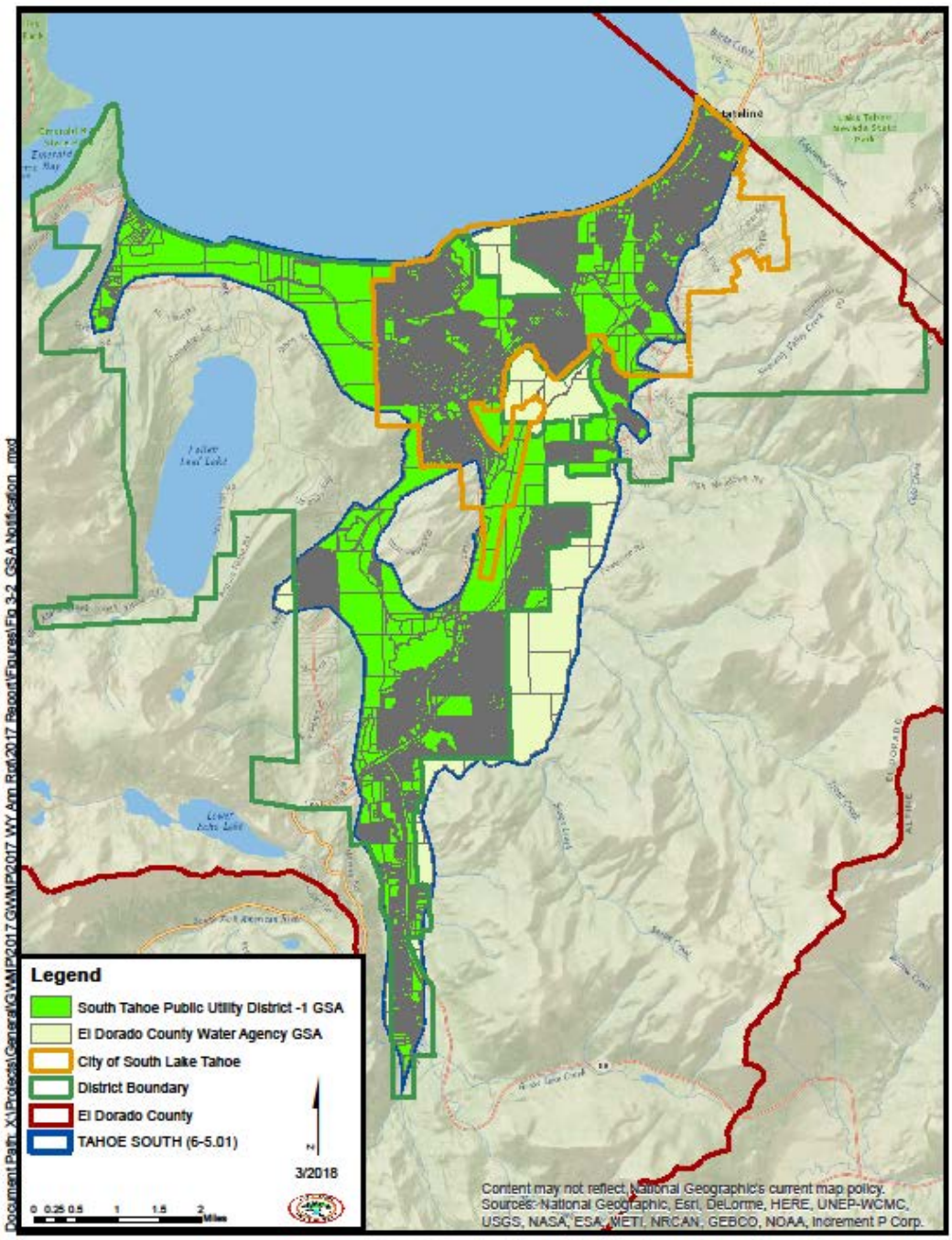


**Figure 3-2.** GSA boundaries for the TVS Basin. The District is regarded as the exclusive GSA for portions of the basin within its service area. The County Water Agency is regarded as the exclusive GSA for portions of the basin outside the District' service area. Through an MOU, the District and County Water Agency GSAs implement the SGMA across the full extent of the TVS Basin.

In addition to completing GSA formation requirements for the TVS Basin, the District and County Water Agency are required to adopt either a GSP or GSP Alternative by January 31, 2022. GSP Alternatives under SGMA include:

- A GWMP developed pursuant to Part 2.75 of the Water Code (GWMP Alternative);
- Management plan pursuant to an adjudication action; or
- An Analysis of Basin Conditions that demonstrates that the basin has operated within its sustainable yield for at least a 10-year period (ABC Alternative) (Water Code, § 10733.6(b).)

To be eligible to submit any of the above GSP Alternatives, a local agency must be able to demonstrate that (1) the GSP Alternative applies to the entire basin (23 Cal. Code Regs., § 358.2(a)), and (2) the basin is in compliance with Part 2.11 of the Water Code. The local agency must also demonstrate that its GSP Alternative is "functionally equivalent to the elements of a [GSP] required by Articles 5 and 7... [and is] sufficient to demonstrate the ability of the [GSP] Alternative to achieve the objectives of [ACT]." (23 Cal. Code Regs, § 358.2(d)).

Groundwater management within the TVS Basin has been practiced by the District since 2000, starting with enactment of its original 2000 GWMP as Ordinance No. 477-00 (Groundwater Ordinance). During 2014, this ordinance was updated and replaced by the 2014 GWMP, prepared in accordance with AB3030, also known as the Groundwater Management Act (Water Code, § 10750 et. seq.). For the past several years, the District has been implementing the 2014 GWMP, which has been successful in sustainably managing the TVS Basin's groundwater resources for the region's various beneficial users.

During the 2016 WY, the District conferred with the SAG about submitting a GSP Alternative; compared the 2014 GWMP to the requirements of both SGMA and the GSP Regulations to demonstrate that the 2014 GWMP is functionally equivalent to a GSP; completed an ABC Alternative to demonstrate that the TVS Basin has operated within its sustainable yield for at least a 10-year period; and completed DWR's Alternative Elements Guide to demonstrate that the ABC Alternative is functionally equivalent to a GSP.

In December 2016, the District concurrently submitted both the 2014 GWMP as a GWMP Alternative and an ABC Alternative Plan for public comment and DWR review and evaluation. As part of its submittals, the District indicated its preference to DWR that the review be sequenced in such a manner that its GWMP Alternative be reviewed first and should DWR agree that the GWMP Alternative is functionally equivalent to a GSP, review of the ABC Alternative is not necessary. Acceptance of the GWMP Alternative would allow the District to continue groundwater management activities under the 2014 GWMP and amend this plan as needed, to be fully compliant with new requirements under SGMA. DWR is required to complete its review and assessment of the District's submitted GSP Alternatives within two years of submission (Section 107344.4 (d)). Under the GSP Regulations, DWR assessment of the GSP Alternatives is required to include determination that the GSP Alternative as submitted is approved, incomplete or inadequate (§ 355.6 (d)). Status updates on these assessments are anticipated from DWR in mid-2018.

### 3.3.2 GWMP Outreach

Over the past year, the District convened the following presentations, public hearings and/or workshops to inform the interested public and agencies of groundwater management activities being performed in the TVS Basin.

1. December 15, 2016: District Board Meeting; Submittal of GSP Alternatives for the TVS Basin
2. March 7, 2017: TKPOA Water Quality Committee Meeting; TVS Basin Groundwater Management and South "Y" PCE Plume
3. March 16, 2017: District Board Meeting; Groundwater Management Plan 2016 Water Year Annual Report
4. April 26, 2017: SAG Workshop No. 1
5. May 4, 2017: District Board Meeting; GSA Formation Withdrawal; Amended and Restated MOU
6. July 6, 2017: District Board Meeting; 2017 Well Owners Survey
7. August 8, 2017: County Water Agency Board of Directors: TVS Basin Groundwater Management (2016/2017) Cost Share Projects
8. December 15, 2017: SAG Workshop No. 2.

In addition to these public meetings, the District has made improvements to its website which includes the addition of a Groundwater Page used to post information about current groundwater management issues within the TVS Basin and activities being performed by the GSAs (https://stpud.us/groundwater/). 2014 GWMP documents, workshop agendas, meeting materials and meeting notes are linked to this web page, which are available for download at http://stpud.us/news/groundwater-management-plan/.

#### *3.3.2.1 2017 Well Owners Survey*

As part of its outreach efforts, the District conducted a survey of SCWS and domestic well owners and users of wells not connected to municipal water services within the TVS Basin. The purposes of the 2017 WOS were to;

1. Inform well owners of groundwater management planning and implementation efforts within the TVS Basin;
2. Encourage participation of well owners in the SAG; and
3. Confirm the inferred location and use of SCWS and domestic wells within the TVS Basin.

The 2017 WOS spanned a two-month period from August through October 2017. Planning for the survey involved the development of the survey questionnaire, survey team recruitment, preparation of outreach materials and compilation of available well owner lists from the District and SAG members, including El Dorado County and the United States Forest Service –Lake Tahoe Basin Management Unit.

From these lists a total of 578 domestic and 56 SCWS potential wells were inferred to be located on parcels located within or surrounding the TVS Basin (Figure 3-3).

Prior to the survey, the 2017 WOS was advertised using local media, public service announcements , direct mail notification letters, door hangers and the District's website. Participation in the 2017 WOS was made available through a URL for direct access to the survey online, through paper copy on request from the District, and through direct door-to-door survey performed by a dedicated 3-member survey team. The 2017 WOS was successful in collecting surveys from a total of 370 respondents. Of these respondents, 247 confirmed the presence of a well on their parcel; 77 indicated that there was no well on the parcel; and 2 were uncertain if a well was located on their parcel. Figure 3-3 shows the locations of the inferred wells and the confirmed locations from the 2017 WOS. The 2017 WOS results are provided in Appendix B.

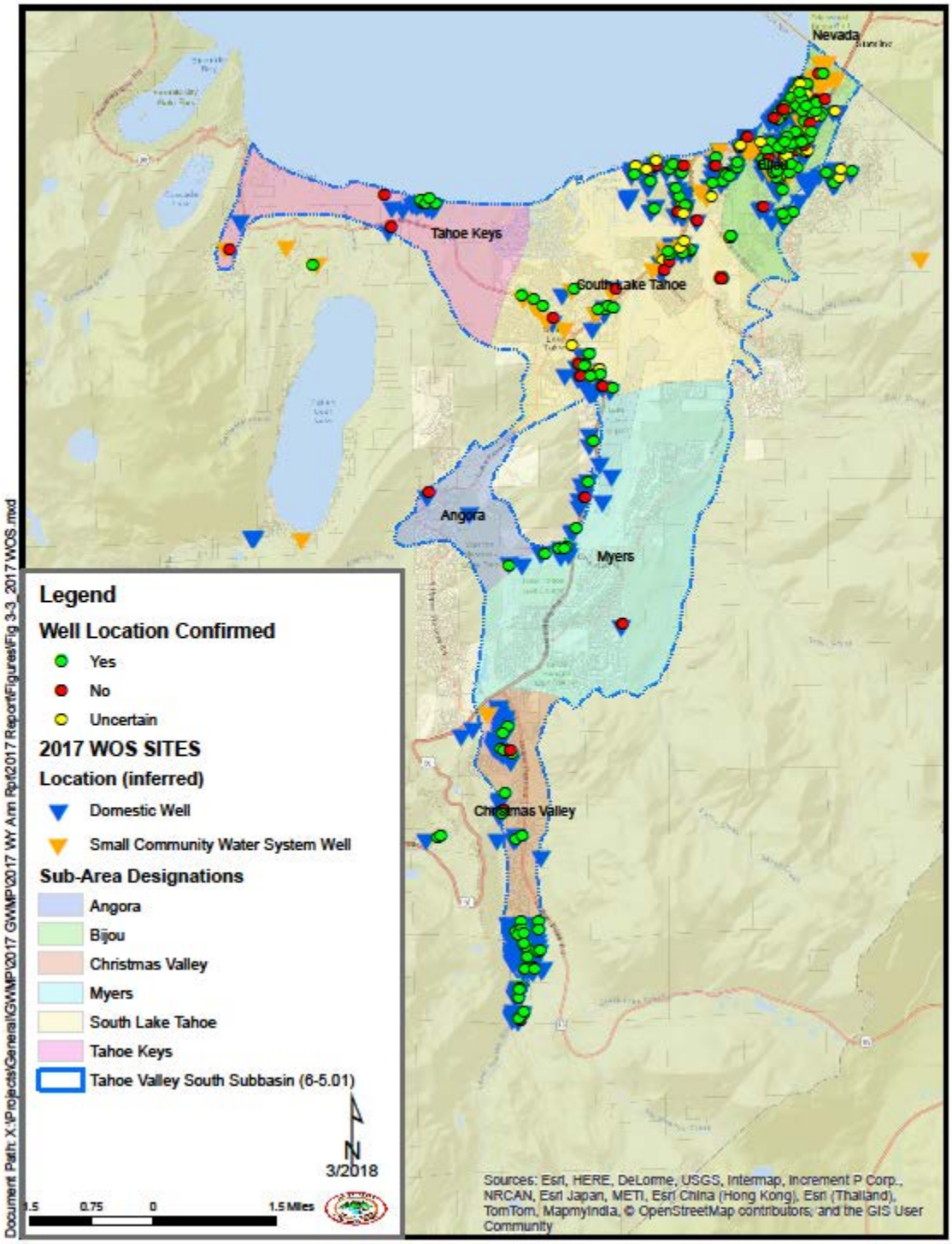


**Figure 3-3.** Inferred and confirmed locations of SCWS and Domestic wells identified by the 2017 Well Owners Survey. A copy of the survey results are provided in Appendix B.

## 3.4 BMO #4 – Integrating Groundwater Quality Protection and Land Use Planning

A key element of the 2014 GWMP is an ongoing program of monitoring groundwater conditions and the potential threat of groundwater contamination within the TVS Basin. In order to better understand this potential threat, the locations of potential contaminating activity sites operating within the TVS Basin are regularly updated and compared to source water production zones surrounding active PWS wells, defined using the modified calculated fixed radius method (CDHS- DDW, 1999). Descriptions of these zones are as follows:

- **Zone A: Microbial/Direct Chemical Contamination Zone.** Protects the drinking water supply from viral, microbial and direct chemical contamination and is defined by the surface area overlying the portion of the aquifer that contributes water to the well within a two-year time-of-travel.
- **Zone B5: Chemical Contamination Zone.** Prevents chemical contamination of the water supply, and to protect the drinking water source for the long term; encompassing the area between the two- and five-year time-of-travel. This zone provides for more response time for chemical spills.
- **Zone B10: Chemical Contamination Zone.** Prevents chemical contamination of the water supply, and to protect the drinking water source for the long term; encompassing the area between the five- and ten-year time-of-travel. This zone allows for some attenuation or remediation of contaminant sites, or if necessary, time to develop alternate sources of water supply.

The number and types of potential contaminating activities found within each source water protection zone are summarized in Table 3-2. The updated Drinking Water Source Assessment and Protection map for the TVS Basin is presented as Figure 3-4.

| Potential Contaminating Activity Sites | | |
|---|---|---|
| **Number of sites (count)** | **Type(s)** | **Potential Contaminants (CDPH, 1999)** |
| **Zone A** | | |
| 2 | Sewer Pump Station | Sewage, treatment chemicals |
| 1 | Wastewater Treatment Plant | Municipal wastewater; sludge; treatment chemical; nitrates; heavy metals; coliform and noncoliform bacteria; nonhazardous wastes |
| 1 | Wells( such as water supply, monitoring well) | Treatment chemicals |
| **Zone B5** | | |

| | | |
|---|---|---|
| 4 | Gas Stations | Gasoline, Diesel fuel, Oils; solvents; miscellaneous wastes |
| 2 | Cleaners | Soaps; detergents, waxes; miscellaneous chemicals, hydrocarbons |
| 2 | Automotive Repair | Waste oils; solvents; acids; paints; automotive wastes; miscellaneous cutting oils. |
| 1 | Sewer Pump Station | Sewage, treatment chemicals |
| **Zone B10** | | |
| 3 | Sewer Pump Station | Sewage, treatment chemicals |
| 2 | Automotive Repair | Waste oils; solvents; acids; paints; automotive wastes; miscellaneous cutting oils. |
| 2 | Gas Stations | Gasoline, Diesel fuel, Oils; solvents; miscellaneous wastes |
| 1 | Auto Body | Waste oils; solvents; acids; paints; automotive wastes; miscellaneous cutting oils |
| 1 | Boat Building and Repair | Diesel fuels; oil; sewage from boat waste disposal area; wood preservative and treatment chemicals; paints; waxes; varnishes; automotive wastes |
| 1 | Car Wash | Soaps; detergents, waxes; miscellaneous chemicals, hydrocarbons |
| 1 | Dry Cleaners | Solvents (perchloroethylene, petroleum solvents, Freon); spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate) |
| 1 | Hardware/lumber/parts stores | Hazardous chemical products in inventories; heating oil and fork lift fuel from storage tanks; wood-staining and treating products such as creosote; paints; thinners; lacquers; varnishes |
| 1 | Medical/dental offices and clinics | Various chemical substances. |

**Table 3-2.** The numbers and types of potential contaminating activity sites found within source water protection zones delineated within the TVS Basin.

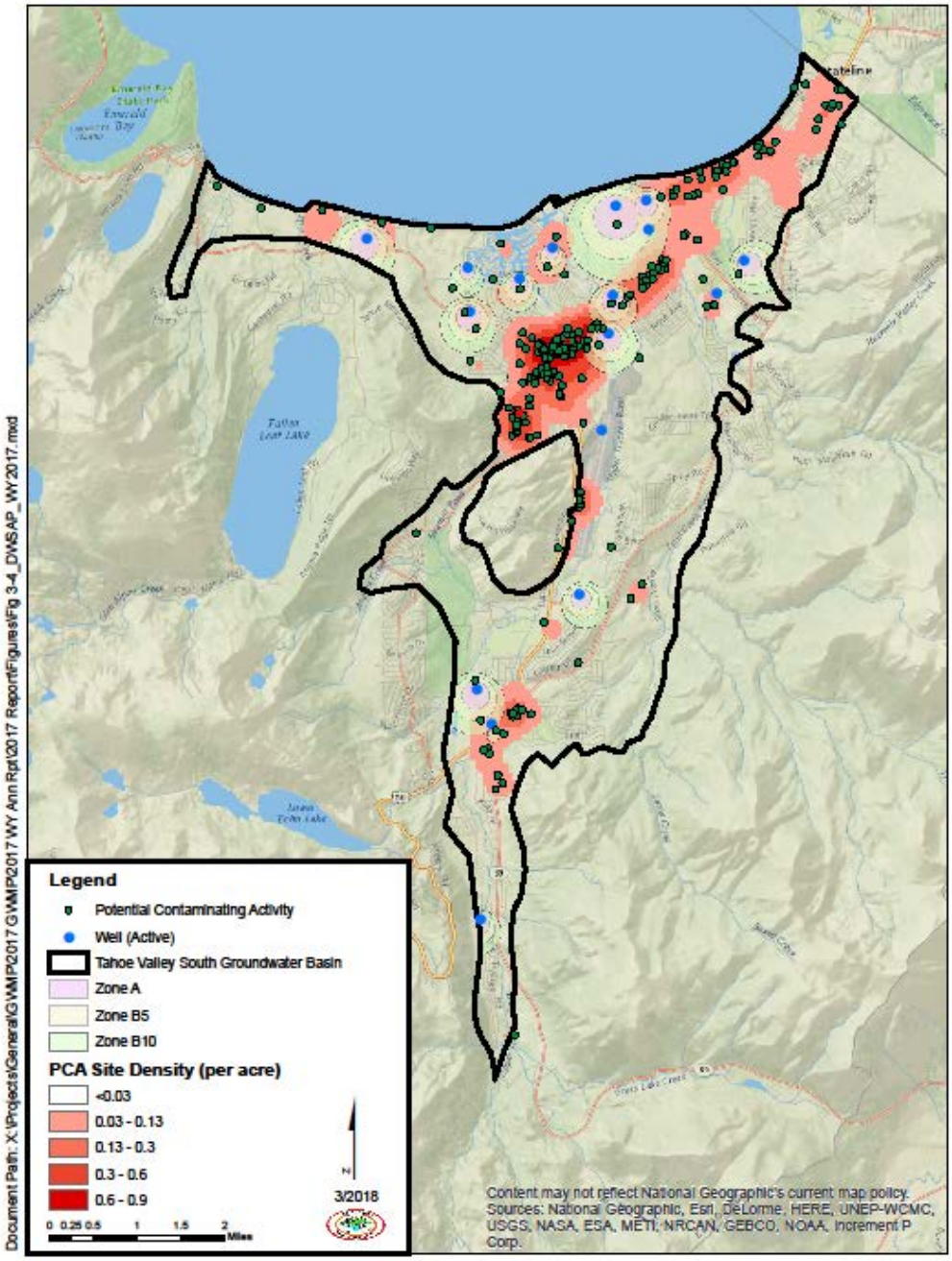


**Figure 3-4.** Drinking water protection areas for public water supply wells in the TVS Basin. Drinking water protection areas surrounding these wells are generated using the modified calculated fixed radius method (CDHS- DDW, 1999) and the average groundwater production rate for each active well (2008 WY -2017 WY).

## 3.5 BMO #5 – Interaction of Water Supply Extractions on Environmental Conditions

The TVS Basin is located in a unique environmental setting. Water supply operations using groundwater may affect environmental conditions or be affected by changes in the environment. Groundwater – surface water interactions with Lake Tahoe and the rivers and streams serve as both groundwater discharge and recharge locations depending on their location and the time of year. Understanding the interactions is a necessary part of providing sound groundwater management for the TVS Basin.

During the 2017 WY, additional analyses of the hydrologic system were completed using recently developed hydrologic modeling tools developed by DRI (Pohll, *et al.,* 2018). Two types of calculations were performed to address pumping effects on surface water (BMO #5, Action 1). The first approach involved evaluating model simulated groundwater levels with and without pumping at individual wells to determine the reduction in groundwater flows to surface water over time. The second approach used the model to produce maps of surface water depletion within the TVS Basin. These maps are referred to as "capture maps" which are useful for illustrating the effects of pumping locations on surface water depletion over a large set of possible pumping locations within an aquifer (Leake *et al,* 2010).

Figure 3-5 presents the results of evaluation from the first approach used to assess the impacts of pumping effects on surface waters. The analysis shows that as pumping rates increased during the 1980s, depletion rates for streams steadily increased from a few hundred AFY in 1983 to an average of 2,500 AFY from 2000 – 2015. Following 2000, the baseflow reduction from streams represents about 2 percent of the average annual runoff (124,000 AFY). This is well below the minimum threshold defined as baseflow depletions in excess of 10 percent of average annual runoff (Pohll *et al.,* 2016).

Capture maps from Lake Tahoe and local streams revealed two areas where the sources of water withdrawal are different. North of the Lake Tahoe Airport, most of water withdrawal is from Lake Tahoe. South of the Lake Tahoe Airport, most of water withdrawal is from streams. To ensure that depletion rates to surface waters at the south end of the TVS Basin do not cause harm to stream ecology, DRI is recommending that pumping rates do not exceed 12,400 AFY south of the Lake Tahoe Airport (Pohll, *et al,* 2018). During the 2017 WY, four active wells were operating south of the Lake Tahoe Airport having a combined total pumping rate of about 1,150 AFY, which is less than 10% of the recommended maximum pumping rate.

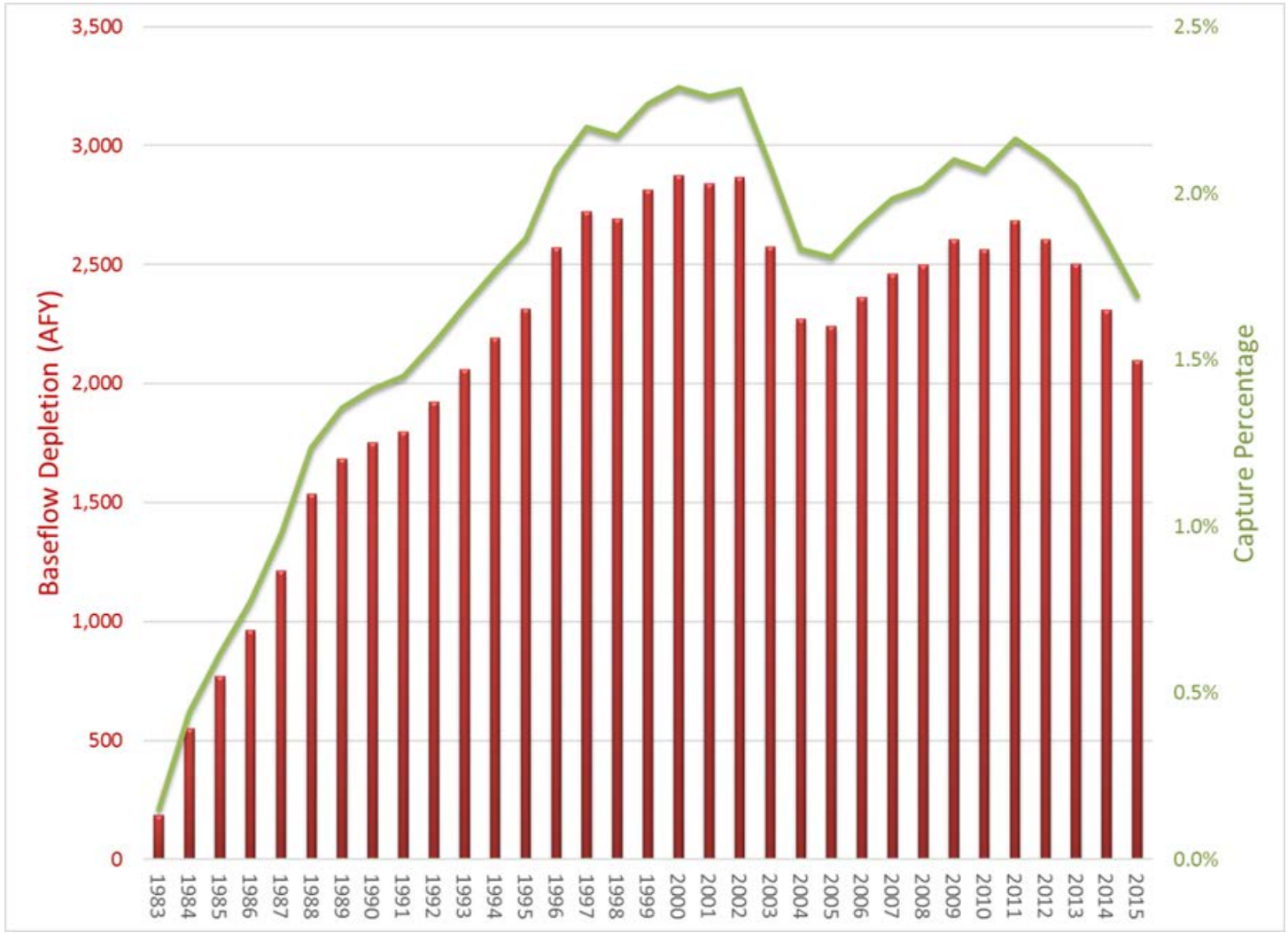


**Figure 3-5**. The effect of groundwater pumping on baseflow depletion for the TVS Basin as calculated using modeled differences in groundwater levels with and without pumping. The capture percentage is calculated as the ratio of baseflow depletion and average annual runoff (124,000 AFY) (Adapted from Pohll, *et al*. 2018).

## 3.6 BMO #6 – Stakeholders Advisory Group (SAG)

The purpose of BMO #6 is to provide guidance regarding the role of the SAG in plan implementation. This includes hosting regular SAG workshops in order to provide a forum for discussion of groundwater management issues in the TVS Basin and receive a regional perspective from different members of the community (*see* Table 3-1). Other important functions of the SAG include:

1. Facilitation for interagency collaboration;
2. Assessing groundwater supply issues;
3. Assessing groundwater protection issues;
4. Data sharing; and
5. Developing regional support for groundwater projects.

During the 2017 WY, SAG workshops were convened in April and December. Major topics discussed during these workshops are listed in Table 3-3 Minutes from these workshops are provided in Appendix C.

| **WORKSHOP 1 (April 26, 2017)** | **TOPICS** |
|---|---|
| | Groundwater Dependent Ecosystems |
| | GWMP Items |
| | South "Y" Activity Updates |
| | South "Y" Remedial Alternatives FS |
| | 2017 Well Owners Survey |
| | GSA Formation/MOU |
| **WORKSHOP 2 (Dec. 15, 2017)** | **TOPICS** |
| | South "Y" Remedial Alternatives FS |
| | South "Y" Activity Updates |
| | 2017 Well Owners Survey Results |
| | USFS Groundwater Resources Management |
| | GWMP Items |

**Table 3-3.** Major discussion topics for SAG Workshops convened during the 2017 WY.

## 3.7 BMO #7 – Technical Studies

Understanding the factors that control groundwater conditions in the TVS Basin is important for long-term management. Several studies have been conducted over the years, but additional work is needed to help address emerging issues. The District and/or other local water purveyors and well owners will need to conduct various studies to support groundwater management decision makers. The projects reported under BMO #7 outline some of the studies being conducted by the District to further the understanding of the groundwater basin to help support groundwater management.

### 3.7.1 TVS Basin Groundwater Model

During the 2016 WY, DRI completed the initial phase (Phase 1) of development of groundwater models and hydrologic modeling tools for implementation of the GWMP. Phase 1 generally involved: acquiring the data to update the District's existing groundwater flow model and DRI's existing integrated GSFLOW hydrologic model for the South Tahoe watersheds; constructing and calibrating a steady-state groundwater flow model for the TVS Basin; constructing and calibrating a transient integrated hydrologic model for the South Tahoe watersheds; and calculating a water budget for the TVS groundwater system (Carroll *et al*., 2016a).

DRI completed work on Phase 1 in February 2016 and has been working on Phase 2 since that time. Phase 2 work completed by DRI extended all boundary stresses through 2015 WY for Phase 2 modeling analysis and provided detailed analysis concerning the spatial and temporal distribution of recharge across the TVS model domain. During initial work on Phase 2, DRI also defined a threshold between recharge and groundwater storage at approximately 43,200 AFY (Carroll *et al*., 2016b). Recharge below this threshold results in negative changes in groundwater storage and falling groundwater levels, while recharge above this threshold results in positive changes in groundwater storage and rising groundwater levels.

During the 2017 WY, DRI completed the following Phase 2 modeling work:

1. Updating the MODFLOW and GSFLOW models through the 2015 WY;
2. Constructing calibrated transient GSFLOW predictive models (2015 – 2100) to evaluate hydrologic effects resulting from climate change;
3. Constructing calibrated transient MODFLOW predictive models (2015 – 2065) for groundwater sustainability planning;
4. Completing hydrologic modeling tools to address specific BMO Actions identified under the 2014 GWMP;
5. Training District staff to maintain and use the calibrated models; and
6. Completing regular project management status reports and a final technical report documenting model development and model simulation results.

Results of the Phase 2 modeling work are documented in the South Lake Tahoe Groundwater Model Update (Carroll *et al.,* 2016b) and in the report Addressing Basin Management Objectives for the Tahoe Valley South (6-5.01) Groundwater Basin, California, Desert Research Institute (BMO Report) (Pohll et al., 2018). The BMO Report details the modeling analyses and major conclusions on the following five BMOs from the 2014 GWMP:

**BMO #7, Action 3: Update the existing TVS Basin groundwater model**

> **Conclusion:** Sophisticated numerical modeling tools have been developed to assess the hydrologic conditions within the TVS Basin. The modeling framework improves water balance estimates of precipitation, streamflow, evapotranspiration, mountain-front recharge,

infiltration, and groundwater flow. The models provide a quantitative tool for evaluating future conditions as well as furthering the overall hydrogeological understanding of groundwater conditions in the TVS Basin.

**BMO #4, Action #2: Delineate recharge areas**

**Conclusion:** Most of the recharge occurs in the Crystal Range of the Sierra Nevada and the Carson Range. Annual recharge ranges from 9 inches in the valley to upwards of 34 inches in the higher elevations. Groundwater recharge is largely dependent on annual precipitation. A regression equation was developed between annual precipitations at Hagan's Meadows climate station to groundwater recharge. Average annual recharge over the entire simulation period (1983– 2015) was 39,000 AFY which is relatively close to the recharge depletion threshold.

**BMO #5, Action 1: Determine pumping effects on surface water**

**Conclusion:** A baseflow depletion analysis was performed for local streams and Lake Tahoe separately over the simulation period 1983 – 2015. As groundwater pumping increased in the 1980s, baseflow depletion rates for Lake Tahoe steadily increased from just under a 1,000 AFY in 1983 to an average of 5,900 AFY from 2000 – 2015. The depletion rates for streams steadily increased from a few hundred AFY in 1983 to an average of 2,500 AFY from 2000 – 2015. Following 2000, the baseflow reduction from streams represents 2 percent of the average annual runoff (124,000 AFY). Capture maps from Lake Tahoe and streams were created. Results revealed two areas where the sources of groundwater withdrawal are different. North of the Lake Tahoe Airport, most of the groundwater withdrawal is from Lake Tahoe. South of the South Lake Tahoe Airport, most of groundwater withdrawal is from streams. To ensure that this threshold is not exceeded, we are recommending that groundwater pumping rates do not exceed 12,400 AFY south of the airport to ensure that stream ecology is not harmed.

**BMO #5, Action 3: Determine the impacts of climate change**

**Conclusion:** Six climate scenarios were developed to assess the impact of a changing climate on the TVS Basin. They include drier with less warming (Q1), drier with more warming (Q2), wetter with more warming (Q3), wetter with less warming (Q4), warming only with no change in future precipitation (Q5), and a 12 year drought scenario (Q6). The two wetter scenarios resulted in groundwater recharge rates 24 and 34 percent larger than baseline conditions for the wet/hot (Q3) and wet/warm (Q4) scenarios, respectively. The dryer scenarios led to less recharge of 24 and 32 percent less than baseline, for the dry/hot (Q2) and dry/warm (Q1) scenarios, respectively. Increasing temperatures without changing precipitation (Q5) led to 5 percent less recharge as compared to baseline conditions. The drought scenario (Q6) resulted in 32 percent less recharge. The dry/hot scenario resulted in the largest water level declines with most regions experiencing declines of 0 – 10 feet on only small areas in the south and declines in the southeast of just over 10 feet. The TVS Basin will remain in a sustainable condition under each of the climate scenarios investigated; therefore, no additional management activities are required

at this time beyond ongoing monitoring. Additional research on the impacts of climate change on the groundwater resources in the TVS Basin is not needed until CO2 emissions far exceed those being predicted in RCP 8.5 (worst case).

**BMO #7, Action 4: Develop a monitoring network**

**Conclusion:** Two areas were identified as needing additional groundwater monitoring:

1. The area just north of the South "Y" to monitor localized drawdown effects from wells not controlled by the District and to more thoroughly monitor the PCE contaminant plume in this region. The PCE monitoring plan should be developed in conjunction with the ongoing feasibility study of remedial alternatives to mitigate the regional South "Y" Plume; and

2. Though less critical, additional monitoring in the southeast, near Saxon Creek, would help identify potential groundwater level changes due to climate change.

### 3.7.2 South Y Investigations

As part of the work for the Feasibility Study, the District collected additional groundwater samples from inactive drinking water source wells in the vicinity of the South "Y" including the LBWC #2 Well (Offline, impaired), the LBWC #4 Well (Offline, abandoned), the LBWC #5 Well (Offline, impaired), the Rockwater Apartment Well (Offline, abandoned) and the Tahoe Valley Elementary School Well (Offline, abandoned). Groundwater samples were also collected from CL-1, a deep monitoring well located at the District's Clement Well Site. Groundwater samples were collected from these wells during four sampling events from between December 2016 through October 2017 to provide up to date information on the extent of PCE concentrations for use during the Feasibility Study. TKWC provided water quality monitoring results through June 2017 for each of their three wells to supplement this data set.

In October 2016, the District entered into an agreement with DRI to add a fate and transport model to the existing groundwater model framework developed for the TVS Basin. It was recognized that a fate and transport groundwater model would be needed to simulate PCE migration of the South "Y" Plume and evaluate the effectiveness of varying remedial alternatives, in terms of their capacity to remove PCE contaminant mass and inhibit the further movement of the contaminant plume. Results from this alternatives analysis would then be used to refine the Feasibility Study by identifying the likely best alternative(s) for mass removal and cleanup time, thereby reducing the number of remedial alternatives requiring further engineering evaluation for the Feasibility Study.

During the 2017 WY, hydrologic information was compiled and DRI developed the fate and transport model grid by extracting a section of the original model grid covering the area of the South "Y" Plume and extending northward to Lake Tahoe. The fate and transport model grid was further refined in the area of the existing plume and along the expected plume migration path. Model boundary conditions

were established for local areal recharge, streams (Upper Truckee River and Trout Creek), Lake Tahoe, and groundwater pumping from area wells.

Review of the groundwater production data from South "Y" Area wells showed that substantial changes in the location and magnitude of groundwater pumping across the South "Y" Area occurred since at least 2008. A transient model was subsequently developed to adequately simulate the response of the groundwater system to changing pumping conditions. Flow simulations were run using MODFLOW-NWT. Fate and transport simulations were run using MT3DMS. MT3DMS is a modular three-dimensional transport model for the simulation of advection, dispersion, and chemical reactions of dissolved constituents in groundwater systems (Zheng and Wang, 1999).

In April 2017, the preliminary model was presented to stakeholders, along with a matrix of remedial alternatives proposed for fate and transport modeling evaluation. During the meeting it was determined that simulations of remedial alternatives should be postponed until after additional groundwater sampling planned during the 2017 WY is completed.

## 3.8 BMO #8 – Funding

Groundwater projects require funding. In addition to funding from local sources, there are state and federal grants and other funding programs available. These types of opportunities require effort to prepare grant funding applications.

### 3.8.1 Proposition 1 GSP

During the 2016 WY, the District in collaboration with the SAG identified potential projects for funding to address the PCE groundwater contamination in the South "Y" Area. Using the findings of the South "Y" Investigations (Section 3.7.2), the District in partnership with the LBWC and TKPOA, prepared pre-applications and a full proposal (FAAST # 36772) requesting funding through the Proposition 1 Groundwater Sustainability Program to conduct an engineering feasibility study of remedial alternatives to mitigate PCE groundwater contamination in the South "Y" Area. The total project budget for this request is $588,540.00 with a 50% funding match of $294,270.00 and a grant request of $294,720.00. Expenditures for supporting studies (e.g., South "Y" Investigations) and technical planning used to develop the feasibility study are used for the funding match.

On March 30, 2017, the District received notice of preliminary grant award of up to $294,270.00, conditioned on the successful negotiation of an agreement with SWRCB-DOFA. On May 18, 2017, the District Board adopted Resolution No. 3059-17 to accept the grant award. Following adoption of the Resolution, the District entered into negotiations with SWRCB-DOFA staff considering changes to the scope of work and budget presented in the proposal. During these negotiations, current groundwater quality data for the South "Y" Plume was available and a Pre-Design Investigation was developed which was subsequently added to the scope of work. The Pre-Design Investigation involves installing a test well that can be used for data collection to identify the vertical extent of PCE contamination and which could be used as a pumping well during added field tests to define aquifer properties for engineering design. Inclusion of the Pre-Design Investigation increased total project budget to $1,008,590.00 with a 50% funding match of $504,295.00 and a grant request of $504,295.00. Expenditures for supporting studies (e.g., South "Y" Investigations) and technical planning used to develop the Pre-Design Investigation and Feasibility Study will be used for the funding match. This will also include County Water Agency funds through the County Water Agency Cost Share Grant Program.

### 3.8.2 GWMP Costs

Costs for implementation of the 2014 GWMP are accounted from the District's Water Enterprise Fund. Development and implementation costs for groundwater management activities have been supported by the County Water Agency under its Cost Share Grant program. Under this program, the County Water Agency assists projects eligible under Section 96-11 of the El Dorado County Water Agency Act and

Board Expenditure Priority Policy (No. B-1003). Grants used for these projects are typically at a 50% matching fund level.

Figure 3-6 shows the 2014 GWMP expenditures during the fiscal year ending June 30, 2017. Costs for groundwater management projects and groundwater management activities totaled $591,450.64. Over the first 3-years of implementation, the total cost is $1,046,050.67.

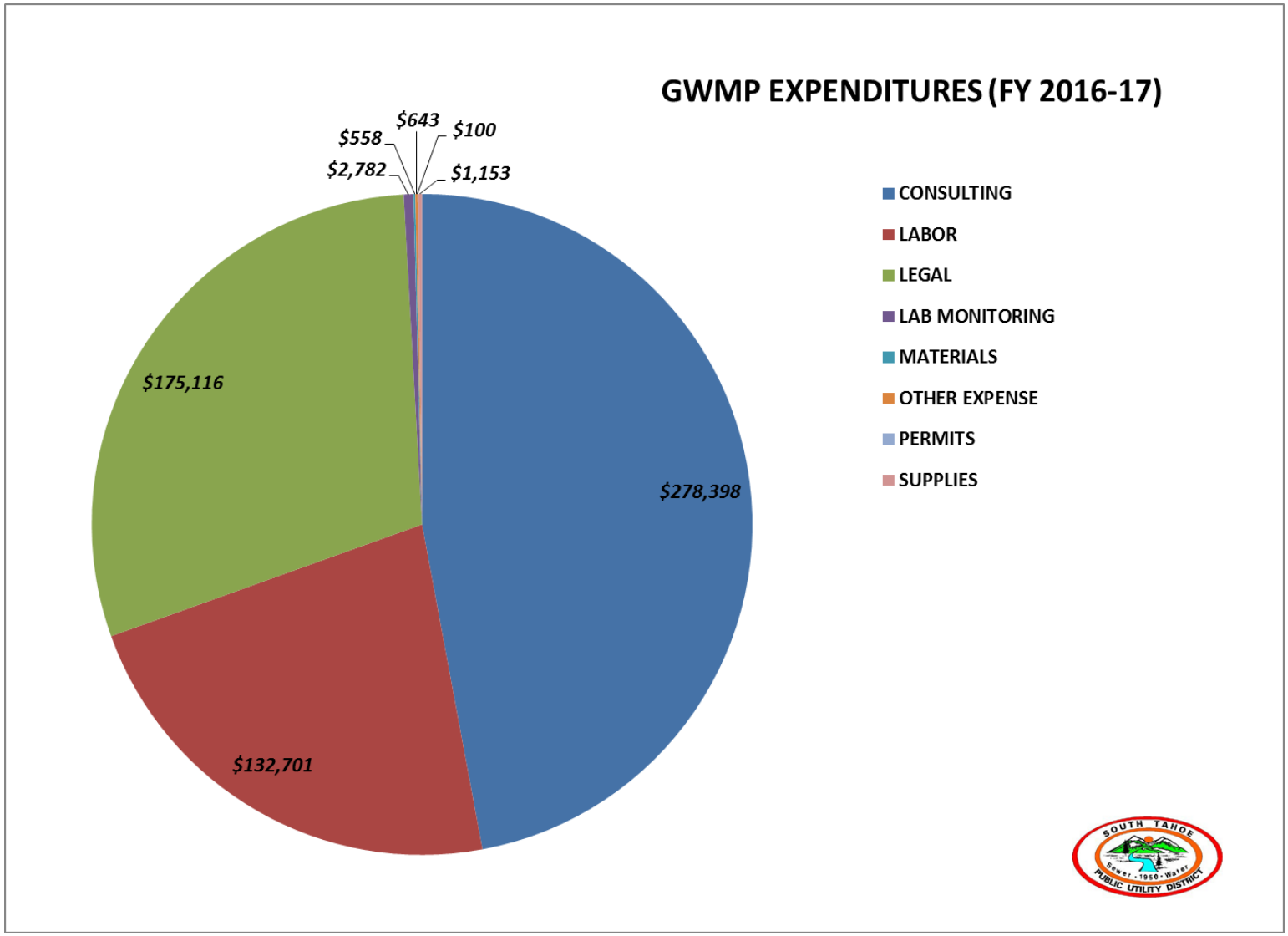


**Figure 3-6.** GWMP implementation costs for FY 2016-17.

# 4 Proposed Actions (2018 WY)

Groundwater management activities for the 2018 WY will generally involve continuing the progress of on-going work started during the 2017 WY and the proposed actions listed below;

1. Continue to monitor new regulations and Basin Monitoring Program guidance issued by the DWR and SWRCB for implementation of SGMA;
2. Complete a final agreement with the SWRCB-DOFA and proceed with the Feasibility Study (Section 3.7.2);
3. Continue to engage with DWR and respond to any questions that may arise during GSP Alternative review (Section 4.1);
4. Consider the findings and conclusions of the BMO report for potential changes to the Basin Monitoring Program and 2014 GWMP (Section 3.7.1);
5. Consider results of the 2017 WOS (Appendix B) and actively pursue participation of SCWS and domestic well owners through the SAG;
6. Continue to monitor basin conditions and groundwater supplies;
7. Continue to update the SAG on the progress of 2014 GWMP-related activities, seeking active participation of its members;
8. Continue to inform the public of groundwater management activities through public hearings, SAG workshops, notifications through its interested parties list, and the District's web page; and,
9. Adoption of a GSP Alternative once approved by DWR.

# 5 2014 GWMP Changes

The 2014 GWMP was last updated in late 2014 to be fully compliant with DWR requirements (AB3030 Plan; Water Code § 10750 et seq.) and to better reflect the groundwater concerns of the greater South Lake Tahoe community. As indicated previously in Section 3.0, activities during the 2017 WY focused on items needed to satisfy compliance with new SGMA requirements and conduct projects to address actions identified in the 2014 GWMP.

There were no plan component changes, including addition or modification of BMOs, during the period covered by this report.

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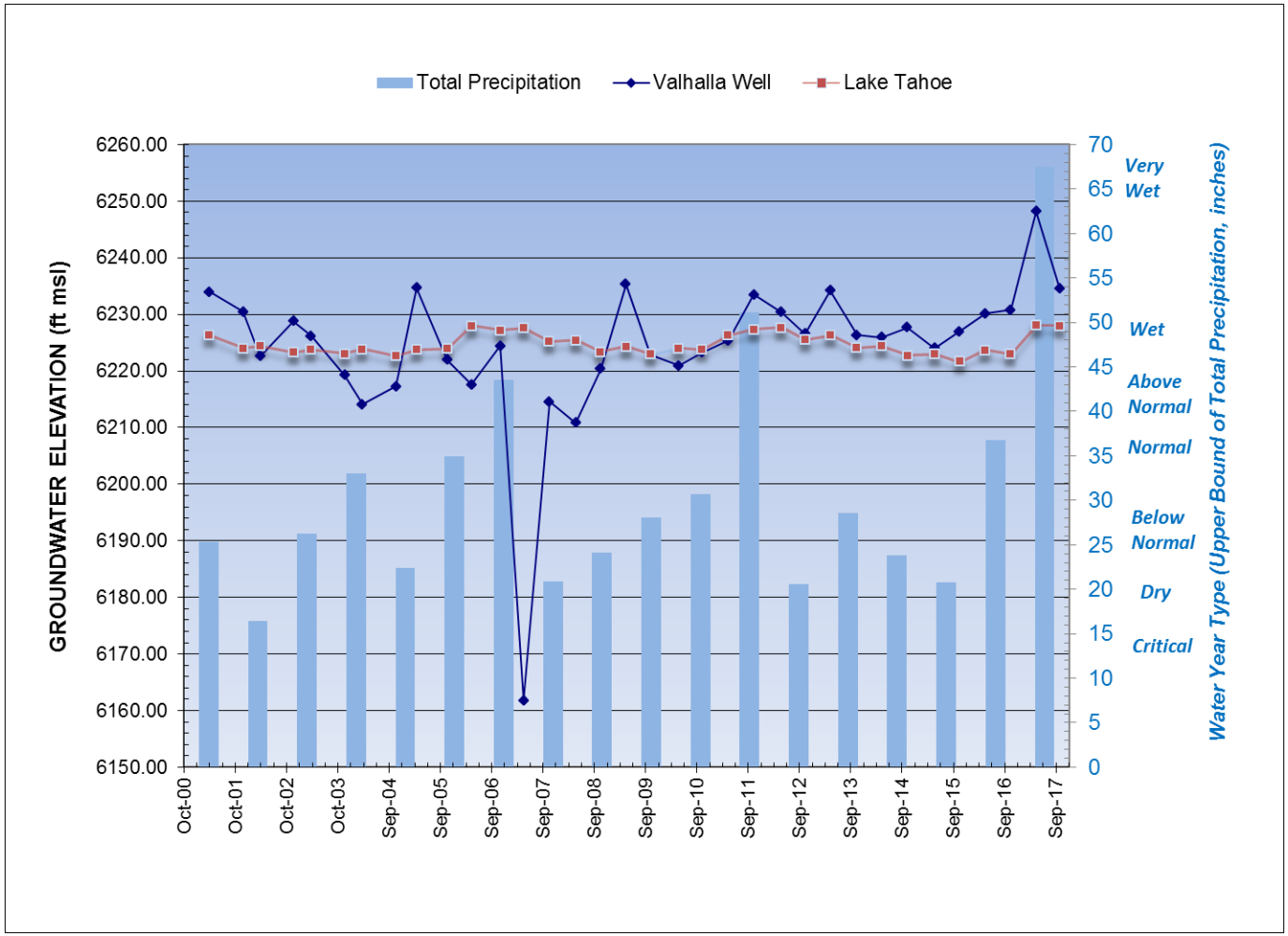
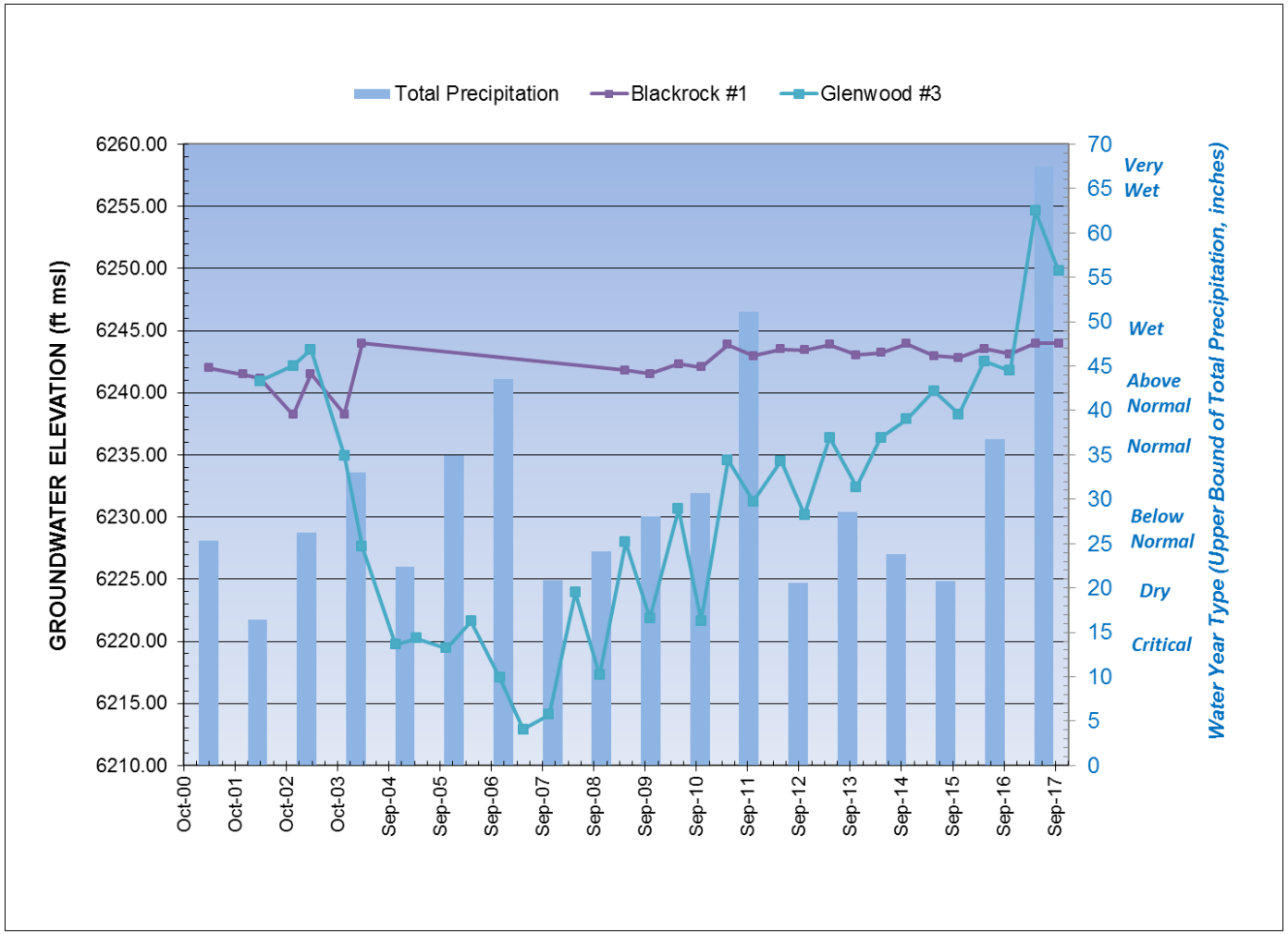
# APPENDIX A

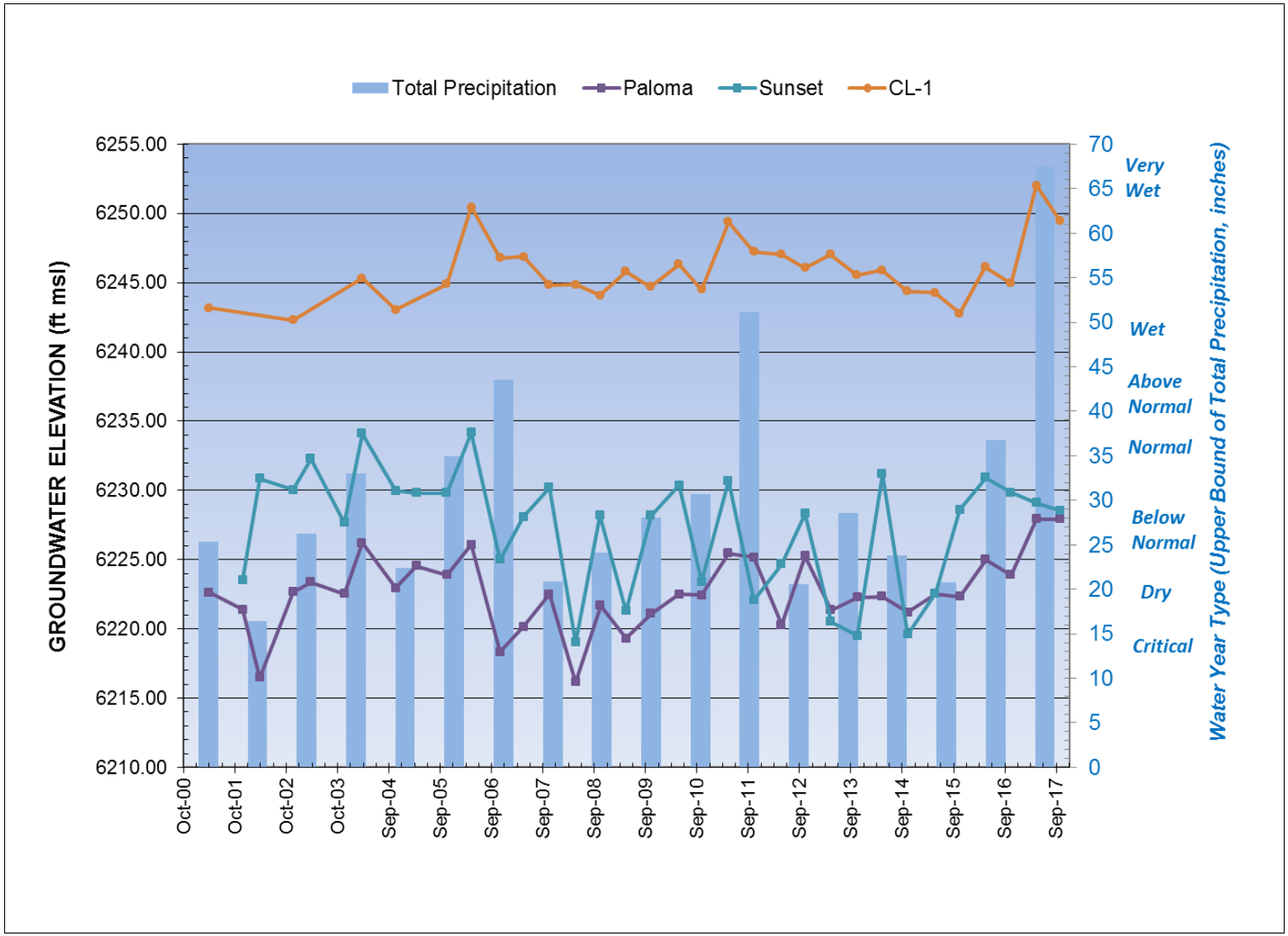
# TVS Basin Hydrographs



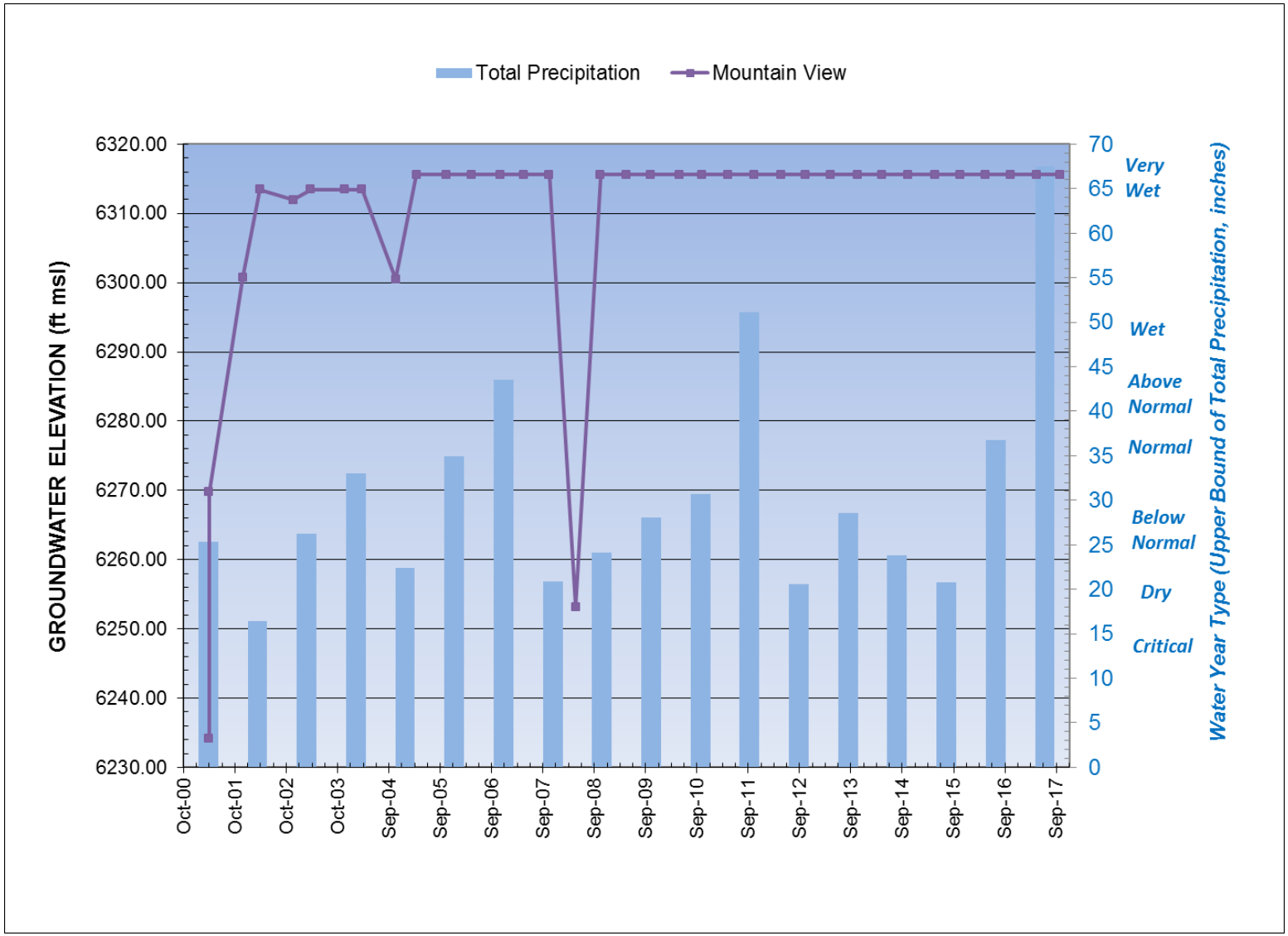

**Appendix A – 1.** Groundwater hydrograph for the Valhalla Well (6,257 feet msl) within the Tahoe Keys sub-area. Also shown is the water level (stage) of Lake Tahoe measured at USGS 10337000. All readings are static water levels collected following a minimum 12-hour recovery time, with the exception of the May 2007 reading, which is a pumping water level measured at a well pumping rate of 700 gallons per minute(gpm). Water year type using the TVS Basin Water Classification is indicated using the bar chart and upper bound of total precipitation displayed on the secondary-y axis.



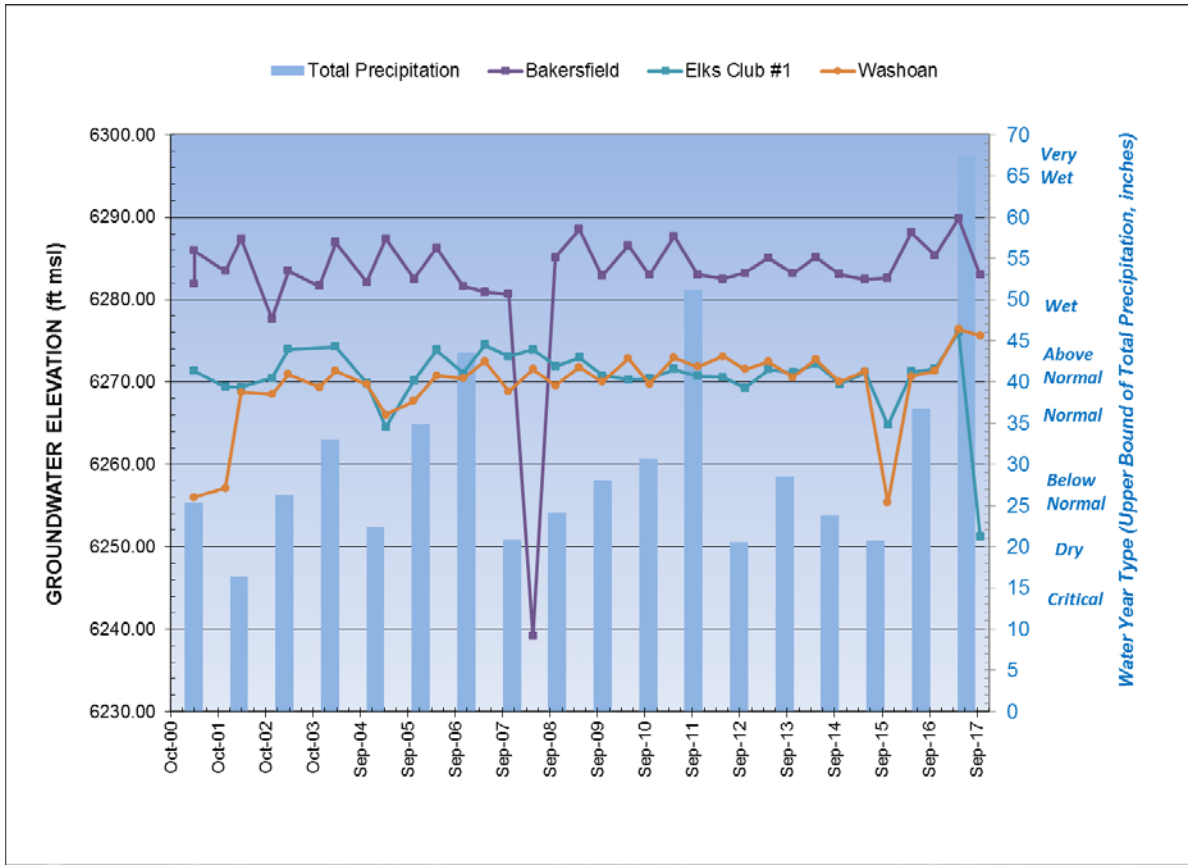

**Appendix A – 2.** Groundwater hydrograph for the Blackrock #1 (6,241 feet msl) and Glenwood #3 (6,260 feet msl) wells within the Bijou sub-area. Static water levels in the Blackrock #1 well are stable and slightly rise above ground surface ((6,240 feet msl). The Glenwood #3 well is used to monitor water levels near an active PWS well (Glenwood #5). In 2007, the District restricted water production from Glenwood #5 in order to sustain groundwater production from this sub-area. The water level response in Glenwood #3 shows that this change in operation has been successful in allowing groundwater levels to recover to sustainable levels.



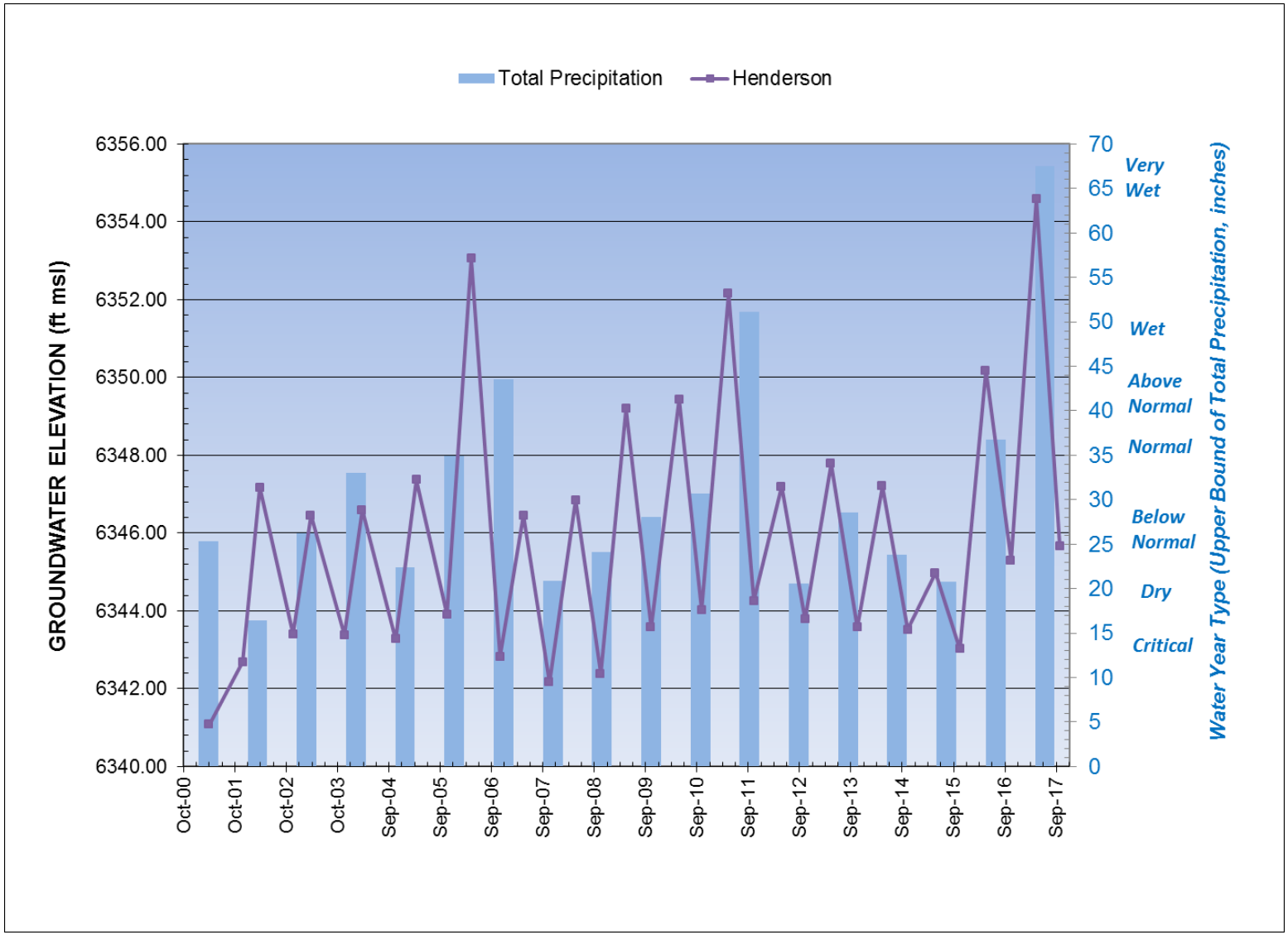

**Appendix A – 3**. Groundwater hydrograph for the Paloma (6,267 feet msl); Sunset (6,249 feet msl) and CL-1 (6,279 feet msl) wells in the South Lake Tahoe sub-area. Groundwater levels in these wells are stable and do not exhibit a long-term downward trend.



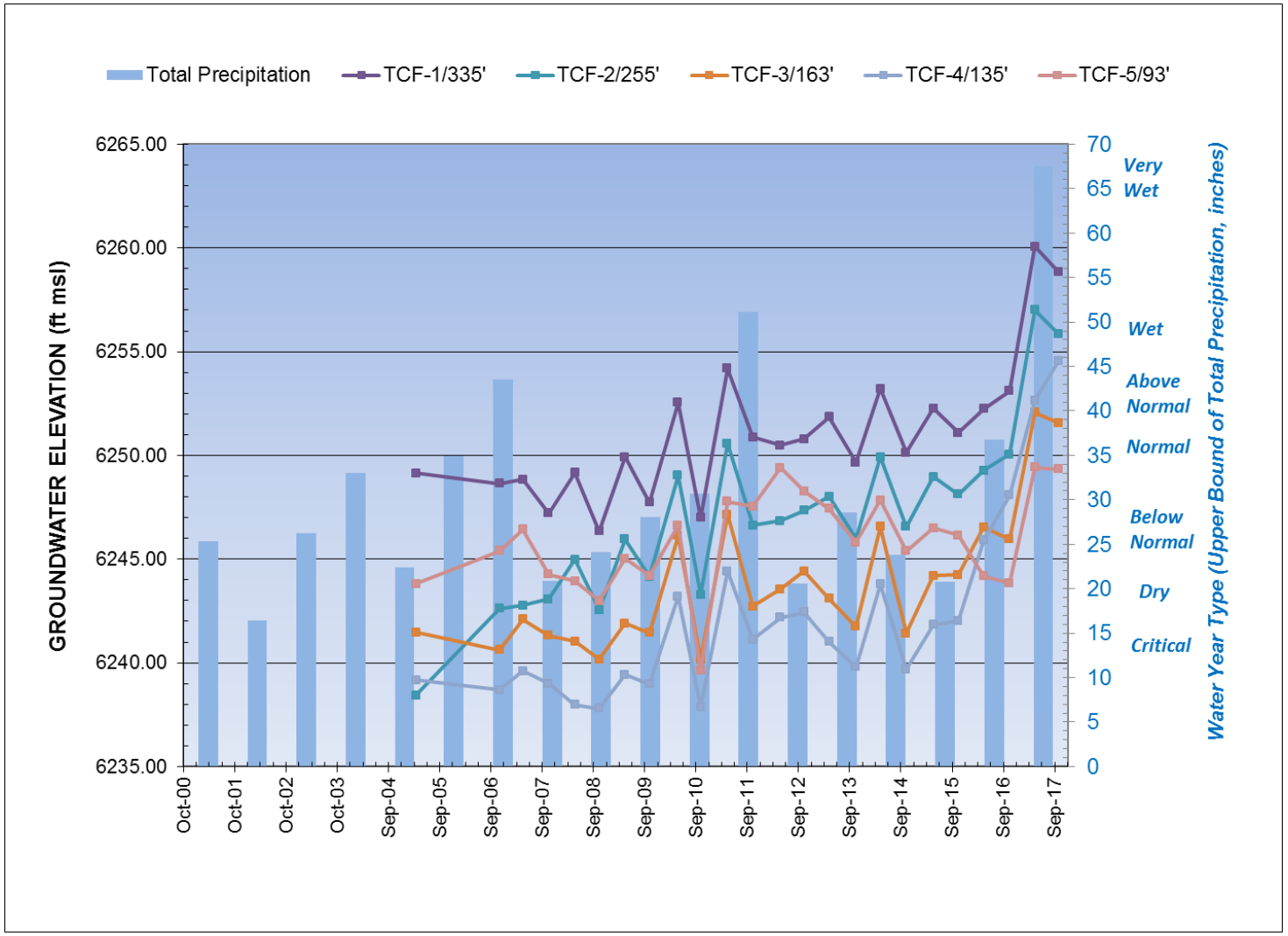

**Appendix A – 4**. Groundwater hydrograph for the Mountain View (6,313 feet msl) well (artesian flowing well) in the Angora sub-area.



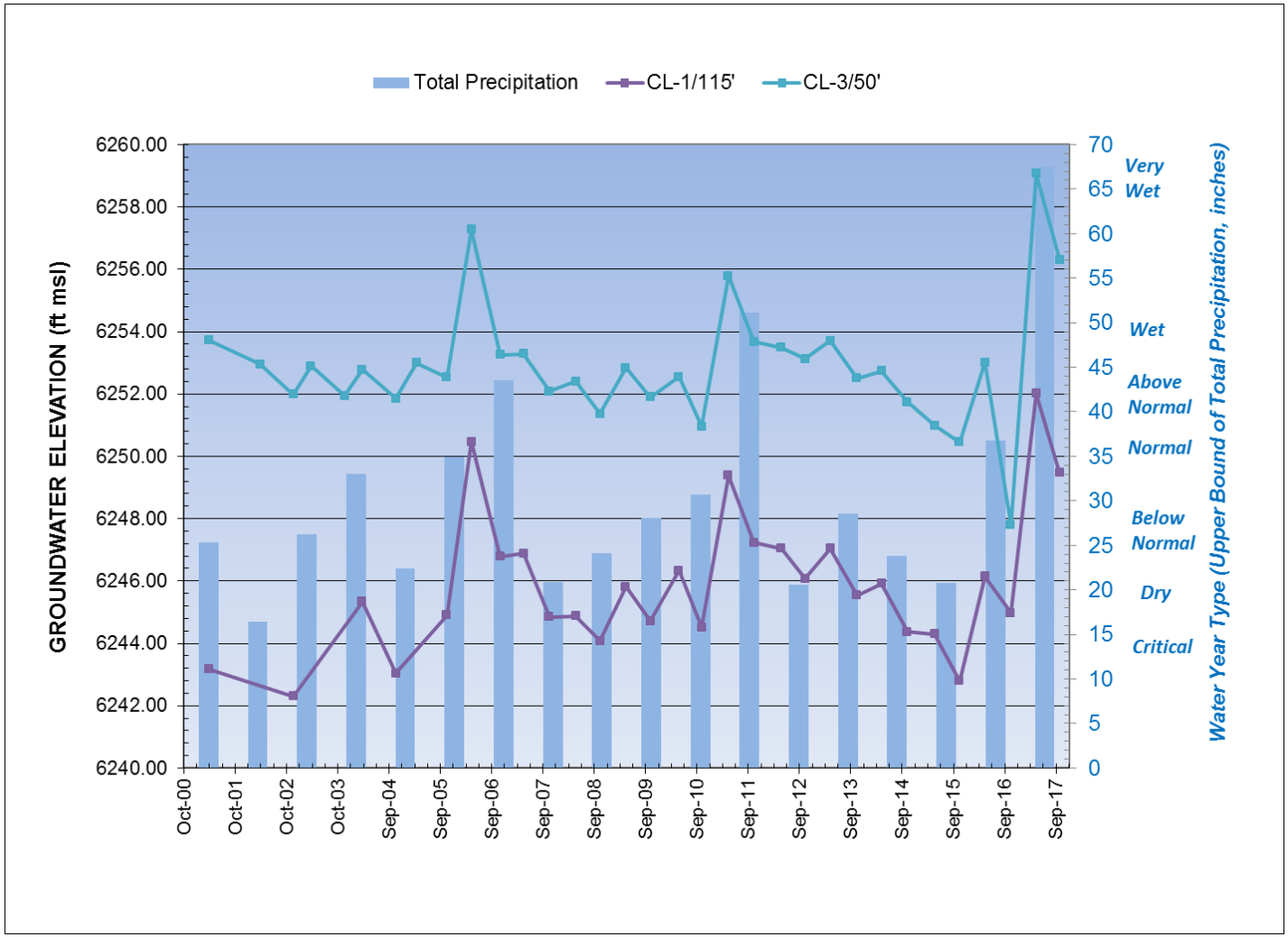

**Appendix A - 5.** Groundwater hydrograph for the Bakersfield (6,311 feet msl); Elks Club #1 (6,283 feet msl) and Washoan (6,308 feet msl) wells in the Meyers sub-area. Groundwater levels in the Meyers sub-area are relatively stable with short periods of declining water levels in response to increased pumping rates. Static water levels collected from the Bakersfield Well are following a minimum 12-hour recovery time, with the exception of the May 2008 reading which is a pumping water level measured at a well pumping rate of 1,500 gallons per minute(gpm). The Elks Club #1 Well is situated in close proximity to an active pumping well (Elks Club Well #2). Static water levels collected from the Elks Club #1 are typically collected when the Elks Club Well #2 is off. The October 2017 reading is a water level measured when the Elks Club #2 Well was pumping at a rate of 310 gallons per minute (gpm).




**Appendix-6.** Groundwater hydrograph for the Henderson Well (6,366 feet msl) within the Christmas Valley sub-area. Groundwater levels in this well are stable and do not exhibit a long-term downward trend.




**Appendix – 7.** Groundwater hydrograph for the USGS TCF nested well (6,296 feet msl) within the South Lake Tahoe sub-area. Total well depths for the observation wells completed within the common borehole are as indicated. The complex vertical flow directions indicated by differences in groundwater levels in this well are believed to result from lowered head in BZ 4 induced by pumping of the Glenwood #5 well.




**Appendix - 8.** Groundwater hydrograph for the Clement Well cluster (6,279 feet msl) within the South Lake Tahoe sub-area. Total well depths for the observation wells comprising the well cluster are as indicated. Both CL-1 and CL-3 monitor groundwater levels from the uppermost water-bearing zone (TKZ5). Vertical flow is directed downward indicative of recharge adjacent to Tahoe Mountain.

# APPENDIX B

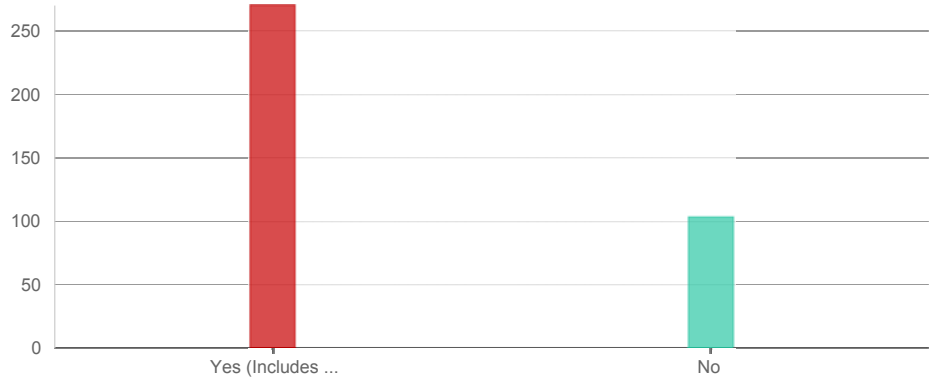
# 2017 Well Owner Survey Results

# (12/10/2017)

# Well Owner Survey Results Final

**Are you the property owner at this address?**

Column Bar Pie Map




Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes (Includes Property Managers) | 270 | 72.00% |
| No | 104 | 27.73% |

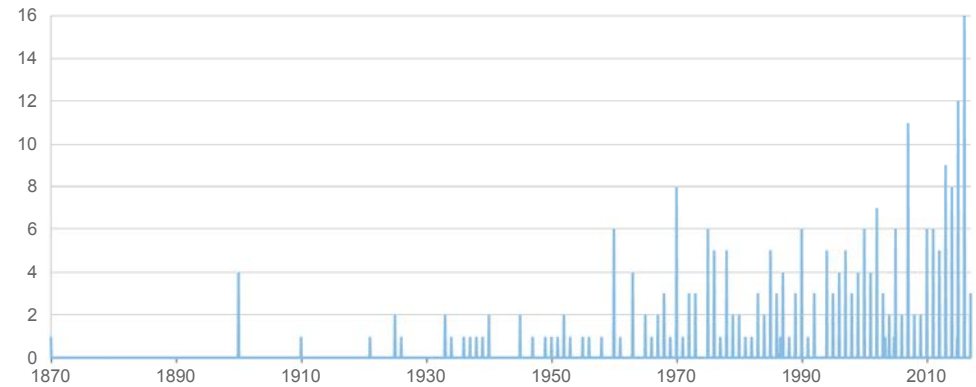
Answered: 374 Skipped: 1

**Since when have you owned this property?**

Histogram

Tip: drag on the chart to zoom in the data.

Reset




Hide Table

| Date | Count |
|---|---|
| Dec 31, 1869 - Jan 31, 1870 | 1 |
| Dec 28, 1899 - Jan 28, 1900 | 4 |
| Dec 28, 1909 - Jan 28, 1910 | 1 |
| Dec 28, 1920 - Jan 28, 1921 | 1 |
| Dec 28, 1924 - Jan 28, 1925 | 2 |

| Date | Count |
|---|---|
| Dec 28, 1925 - Jan 28, 1926 | 1 |
| Dec 28, 1932 - Jan 28, 1933 | 2 |
| Dec 28, 1933 - Jan 28, 1934 | 1 |
| Dec 28, 1935 - Jan 28, 1936 | 1 |
| Dec 28, 1936 - Jan 28, 1937 | 1 |
| Dec 28, 1937 - Jan 28, 1938 | 1 |
| Dec 28, 1938 - Jan 28, 1939 | 1 |
| Dec 28, 1939 - Jan 28, 1940 | 2 |
| Dec 28, 1944 - Jan 28, 1945 | 2 |
| Dec 28, 1946 - Jan 28, 1947 | 1 |
| Dec 28, 1948 - Jan 28, 1949 | 1 |
| Dec 28, 1949 - Jan 28, 1950 | 1 |
| Dec 28, 1950 - Jan 28, 1951 | 1 |
| Dec 28, 1951 - Jan 28, 1952 | 2 |
| Dec 28, 1952 - Jan 28, 1953 | 1 |
| Dec 28, 1954 - Jan 28, 1955 | 1 |
| Dec 28, 1955 - Jan 28, 1956 | 1 |
| Dec 28, 1957 - Jan 28, 1958 | 1 |
| Dec 28, 1959 - Jan 28, 1960 | 6 |
| Dec 28, 1960 - Jan 28, 1961 | 1 |
| Dec 28, 1962 - Jan 28, 1963 | 4 |
| Dec 28, 1964 - Jan 28, 1965 | 2 |
| Dec 28, 1965 - Jan 28, 1966 | 1 |
| Dec 28, 1966 - Jan 28, 1967 | 2 |
| Dec 28, 1967 - Jan 28, 1968 | 3 |
| Dec 28, 1968 - Jan 28, 1969 | 1 |
| Dec 28, 1969 - Jan 28, 1970 | 8 |
| Dec 28, 1970 - Jan 28, 1971 | 1 |
| Dec 28, 1971 - Jan 28, 1972 | 3 |
| Dec 28, 1972 - Jan 28, 1973 | 3 |
| Dec 28, 1974 - Jan 28, 1975 | 6 |
| Dec 28, 1975 - Jan 28, 1976 | 5 |
| Dec 28, 1976 - Jan 28, 1977 | 1 |
| Dec 28, 1977 - Jan 28, 1978 | 5 |

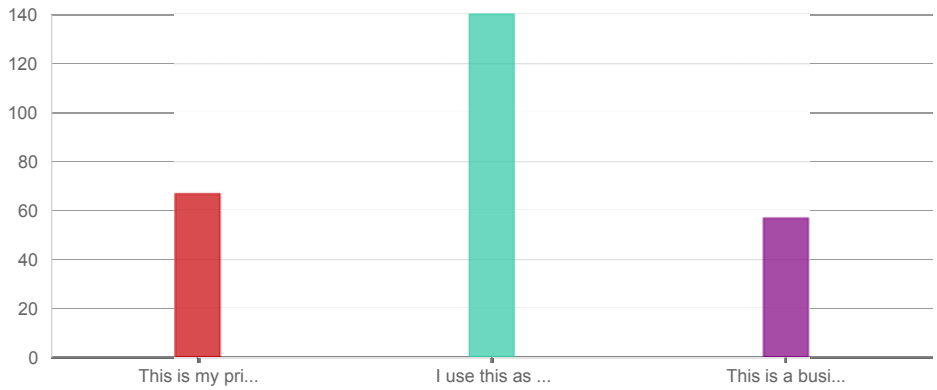
| Date | Count |
|---|---|
| Dec 28, 1978 - Jan 28, 1979 | 2 |
| Dec 28, 1979 - Jan 28, 1980 | 2 |
| Dec 28, 1980 - Jan 28, 1981 | 1 |
| Dec 28, 1981 - Jan 28, 1982 | 1 |
| Dec 28, 1982 - Jan 28, 1983 | 3 |
| Dec 28, 1983 - Jan 28, 1984 | 2 |
| Dec 28, 1984 - Jan 28, 1985 | 5 |
| Dec 28, 1985 - Jan 28, 1986 | 3 |
| Jul 28, 1986 - Aug 28, 1986 | 1 |
| Dec 28, 1986 - Jan 28, 1987 | 4 |
| Dec 28, 1987 - Jan 28, 1988 | 1 |
| Dec 28, 1988 - Jan 28, 1989 | 3 |
| Dec 28, 1989 - Jan 28, 1990 | 6 |
| Dec 28, 1990 - Jan 28, 1991 | 1 |
| Dec 28, 1991 - Jan 28, 1992 | 3 |
| Dec 28, 1993 - Jan 28, 1994 | 5 |
| Dec 28, 1994 - Jan 28, 1995 | 3 |
| Dec 28, 1995 - Jan 28, 1996 | 4 |
| Dec 28, 1996 - Jan 28, 1997 | 5 |
| Dec 28, 1997 - Jan 28, 1998 | 3 |
| Dec 28, 1998 - Jan 28, 1999 | 4 |
| Dec 28, 1999 - Jan 28, 2000 | 6 |
| Dec 28, 2000 - Jan 28, 2001 | 4 |
| Dec 28, 2001 - Jan 28, 2002 | 7 |
| Dec 28, 2002 - Jan 28, 2003 | 3 |
| Apr 28, 2003 - May 28, 2003 | 1 |
| Dec 28, 2003 - Jan 28, 2004 | 2 |
| Sep 28, 2004 - Oct 28, 2004 | 1 |
| Dec 28, 2004 - Jan 28, 2005 | 6 |
| Dec 28, 2005 - Jan 28, 2006 | 2 |
| Dec 28, 2006 - Jan 28, 2007 | 11 |
| Dec 28, 2007 - Jan 28, 2008 | 2 |
| Dec 28, 2008 - Jan 28, 2009 | 2 |
| Dec 28, 2009 - Jan 28, 2010 | 6 |

| Date | Count |
|---|---|
| Dec 28, 2010 - Jan 28, 2011 | 6 |
| Dec 28, 2011 - Jan 28, 2012 | 5 |
| Dec 28, 2012 - Jan 28, 2013 | 9 |
| Dec 28, 2013 - Jan 28, 2014 | 8 |
| Oct 28, 2014 - Nov 28, 2014 | 1 |
| Dec 28, 2014 - Jan 28, 2015 | 12 |
| Dec 28, 2015 - Jan 28, 2016 | 16 |
| Dec 28, 2016 - Jan 2, 2017 | 3 |

Answered: 258 Skipped: 117

**As owner, which best describes your relationship to this property?**

Column Bar Pie Map




Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| This is my primary residence. | 67 | 17.87% |
| I use this as a second home / vacation residence. | 140 | 37.33% |
| This is a business property. | 57 | 15.20% |

Answered: 264 Skipped: 111

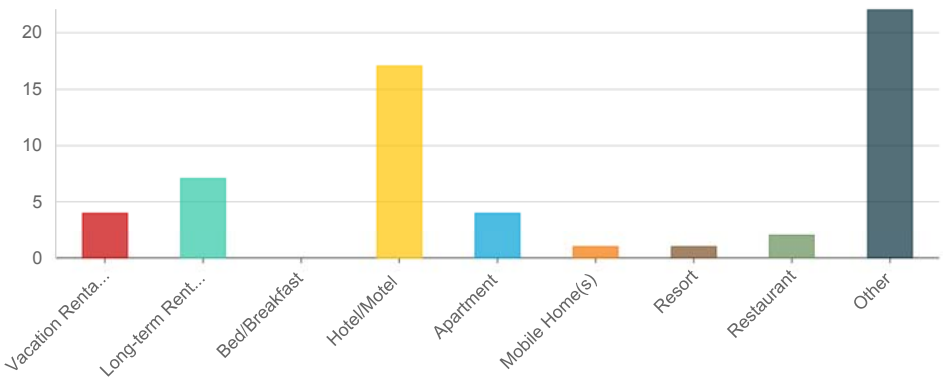
**As a second home I use this property primarily:** Word Cloud


Hide Table

| Response | Count |
|---|---|
| july_sept | 73 |
| throughyear | 41 |
| atrandom | 26 |
| april_june | 13 |
| oct_dec | 6 |
| jan_mar | 4 |

Answered: 138 Skipped: 237

**Please select the best description of the business(es) use of this address.** Column Bar Pie Map




Hide Table Empty Categories Sort

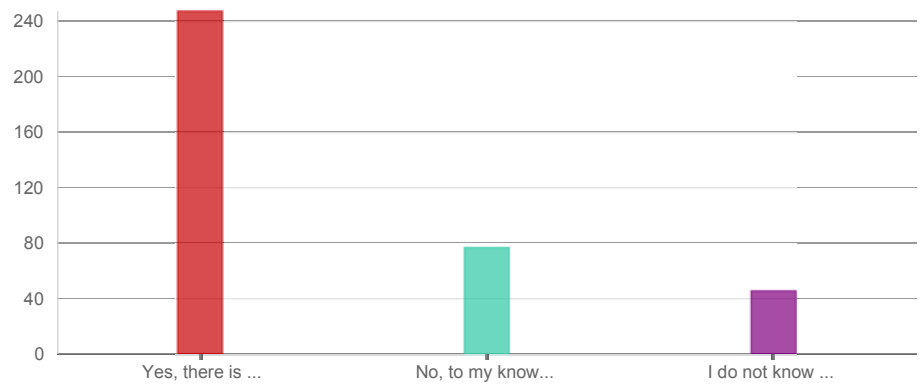
| Answers | Count | Percentage |
|---|---|---|
| Vacation Rental | 4 | 1.07% |
| Long-term Rental | 7 | 1.87% |
| Bed/Breakfast | 0 | 0.00% |
| Hotel/Motel | 17 | 4.53% |

| Answers | Count | Percentage |
|---|---|---|
| Apartment | 4 | 1.07% |
| Mobile Home(s) | 1 | 0.27% |
| Resort | 1 | 0.27% |
| Restaurant | 2 | 0.53% |
| Other | 22 | 5.87% |

Answered: 58 Skipped: 317

**Is there a well at this property?**

Column Bar Pie Map



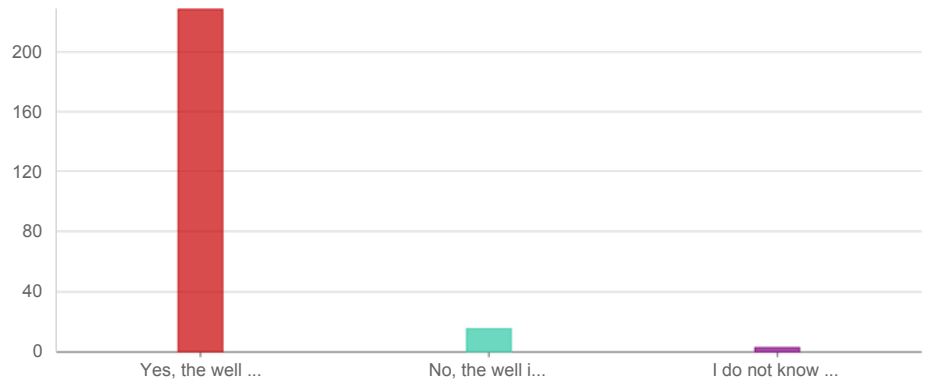

Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes, there is a well. | 247 | 65.87% |
| No, to my knowledge there is not a well. | 77 | 20.53% |
| I do not know if there is a well on this property. | 46 | 12.27% |

Answered: 370 Skipped: 5

**Is the well in use?**

Column Bar Pie Map



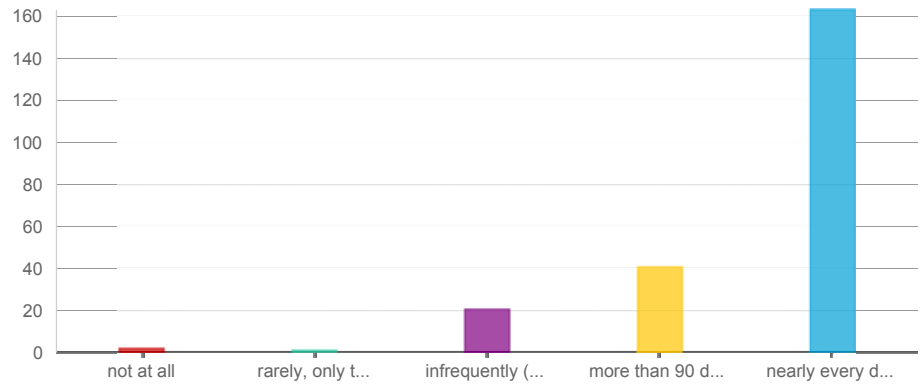

Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes, the well is used. | 229 | 61.07% |
| No, the well is not used. | 15 | 4.00% |
| I do not know whether the well is used. | 3 | 0.80% |

Answered: 247 Skipped: 128

**How often do you use the well?**

Column Bar Pie Map



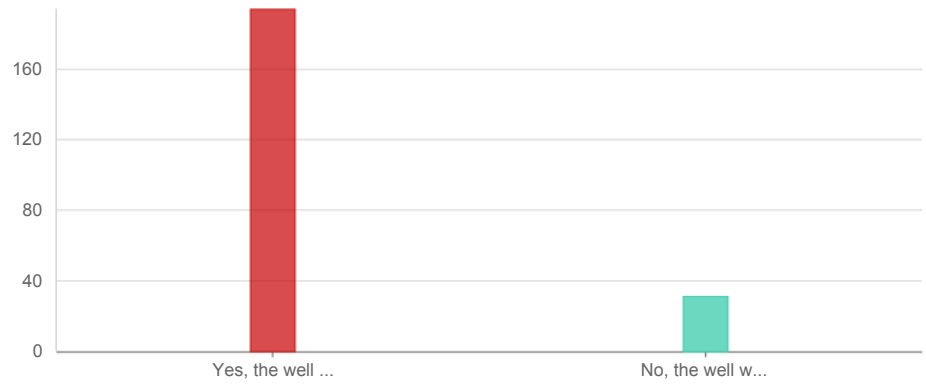

Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| not at all | 2 | 0.53% |
| rarely, only to check or maintain it (less than 15 days a year) | 1 | 0.27% |
| infrequently (approx. 15 to 90 days a year) | 21 | 5.60% |
| more than 90 days a year (but not every day) | 41 | 10.93% |
| nearly every day | 163 | 43.47% |

Answered: 228 Skipped: 147

**Is the well the primary source of household or business water?**

Column Bar Pie Map




Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes, the well is the primary source of water. | 194 | 51.73% |
| No, the well water is not used for household or business purposes but is used solely for irrigation. | 31 | 8.27% |

Answered: 225 Skipped: 150

**Is there a secondary, or backup, source of household water?**

Column Bar Pie Map

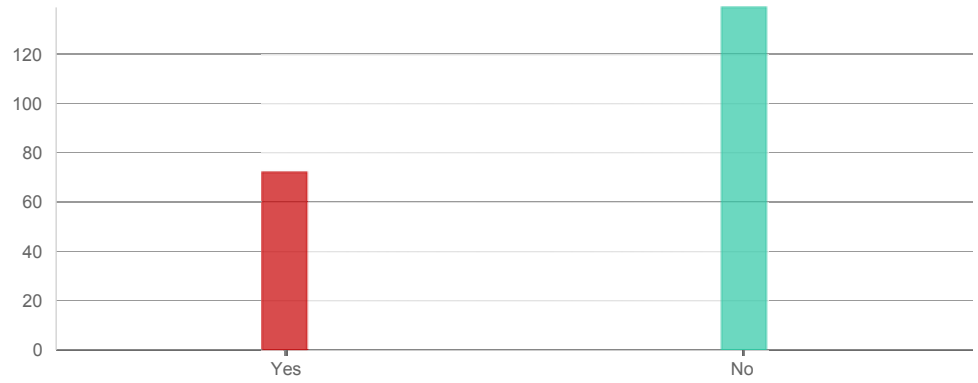

Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes | 10 | 2.67% |
| No | 180 | 48.00% |

Answered: 190 Skipped: 185

**May [I/We] view the well?**

Column Bar Pie Map




Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes | 72 | 19.20% |
| No | 139 | 37.07% |

Answered: 211 Skipped: 164

**What qualities of the well water do you most like?** Word Cloud


Hide Table

| Response | Count |
|---|---|
| purity | 152 |
| taste_color_odor | 152 |
| none | 42 |
| other | 38 |

Answered: 241 Skipped: 134

**What qualities of the well water do you most dislike?** Word Cloud

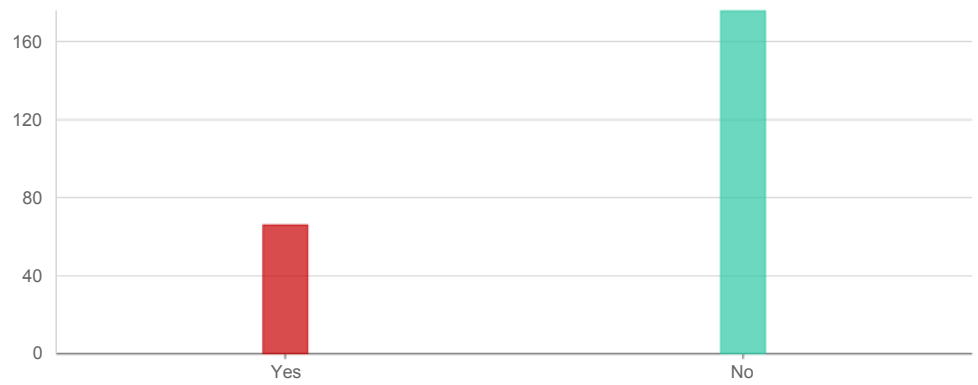

Hide Table

| Response | Count |
|---|---|
| none | 153 |
| mineraldeposits | 57 |
| other | 24 |
| taste_color_odor | 22 |

Answered: 241 Skipped: 134

**Do you now or have you ever had any concern about the well water?**

Column Bar Pie Map




Hide Table

Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes | 66 | 17.60% |
| No | 176 | 46.93% |

Answered: 242 Skipped: 133

**The well water concern is/was in regard to:**

Word Cloud

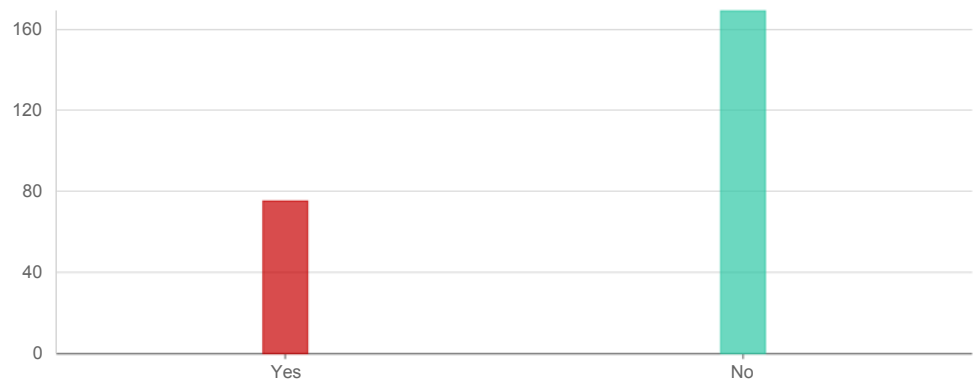

Hide Table

| Response | Count |
|---|---|
| contaminants | 34 |
| other | 23 |
| color | 18 |
| taste | 9 |
| odor | 8 |

Answered: 65 Skipped: 310

**Do you now or have you ever had any concern about the well system?**

Column Bar Pie Map




Hide Table

Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes | 75 | 20.00% |
| No | 169 | 45.07% |

Answered: 244 Skipped: 131

**Well concerns:**

Word Cloud


Hide Table

| Response | Count |
|---|---|
| pump | 35 |
| other | 32 |
| wellhead | 12 |
| waterquality | 12 |
| waterproduction | 11 |
| wellconnection | 6 |

Answered: 75 Skipped: 300

**Has the concern about the system been resolved?**

Column Bar Pie Map

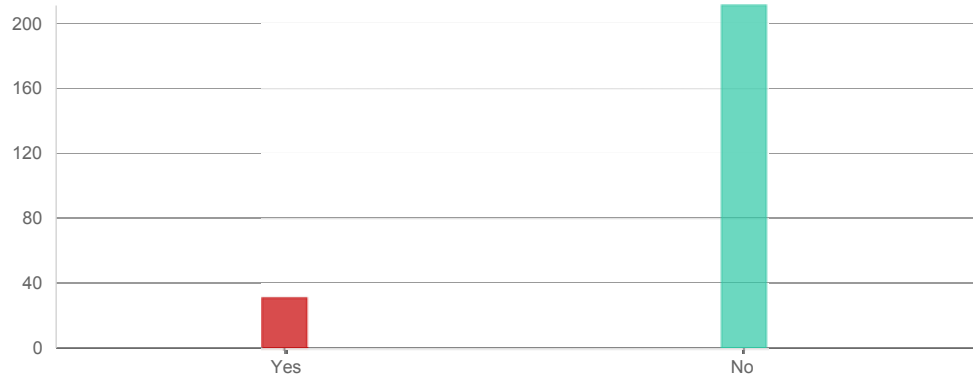

Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes | 50 | 13.33% |
| No | 26 | 6.93% |

Answered: 76 Skipped: 299

**Are you interested in receiving information about County guidelines and requirements for well abandonments?**

Column Bar Pie Map



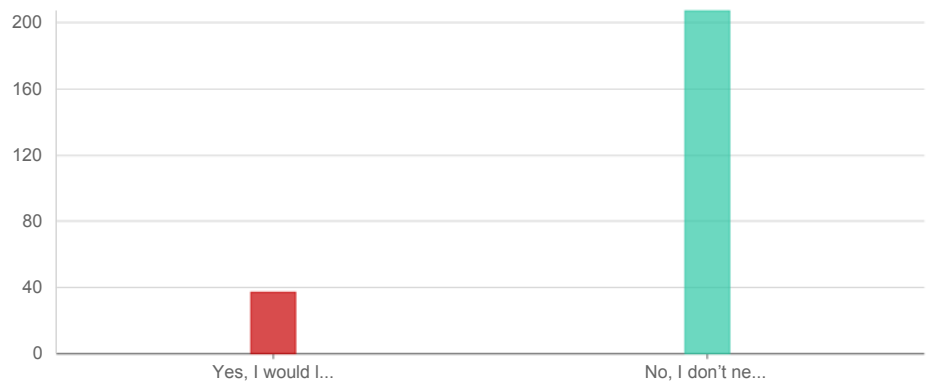

Hide Table Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes | 31 | 8.27% |
| No | 211 | 56.27% |

Answered: 242 Skipped: 133

**Would you like information about connecting to a public water system?**

Column Bar Pie Map




Hide Table

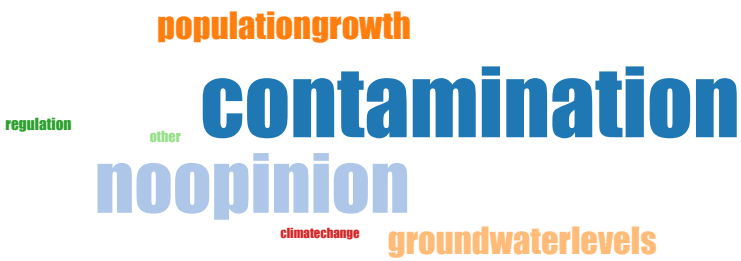
Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes, I would like to know more about connecting to the public water system. | 37 | 9.87% |
| No, I don't need any information about connecting to the public water system. | 207 | 55.20% |

Answered: 244 Skipped: 131

**What do you consider the top three groundwater concerns in our South Tahoe community?**

Word Cloud



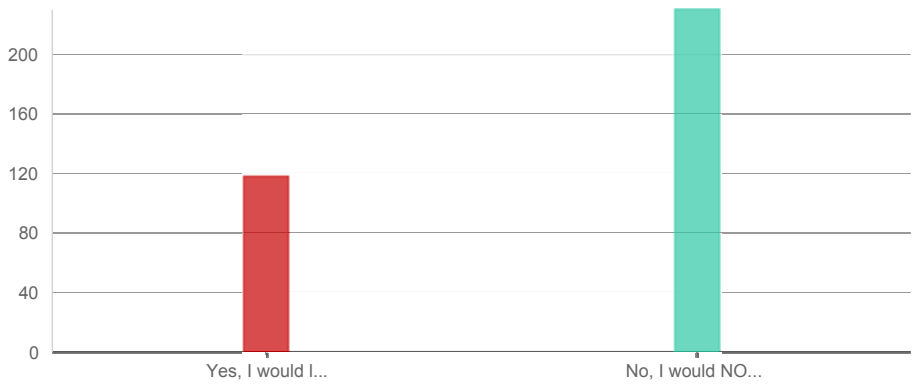

Hide Table

| Response | Count |
|---|---|
| contamination | 147 |
| noopinion | 129 |
| populationgrowth | 74 |
| groundwaterlevels | 74 |
| regulation | 50 |
| other | 48 |
| climatechange | 45 |

Answered: 350 Skipped: 25

**Would you like to receive occasional District email updates about local groundwater management and wells?**

Column Bar Pie Map




Hide Table

Empty Categories Sort

| Answers | Count | Percentage |
|---|---|---|
| Yes, I would like to be on the District's groundwater email list | 118 | 31.47% |
| No, I would NOT like to be on the District's groundwater email list | 230 | 61.33% |

Answered: 348 Skipped: 27

# APPENDIX C

## SAG Workshop Minutes

## Workshop 1 (April 26, 2017)

## Workshop 2 (December 15, 2017)

# AGENDA

| | |
|---|---|
| DATE | Wednesday, April 26th, 1:30 PM – 4:30 PM |
| LOCATION | South Tahoe Public Utility District Board Room, 1275 Meadow Crest Drive, South Lake Tahoe, CA |
| STAKEHOLDER ADVISORY GROUP LIST | Ken Payne, P.E., (El Dorado County Water Agency); Robert Lauritzen, P.G. (El Dorado County -EMD); Jason Burke (City of South Lake Tahoe); Scott Carroll (CA Tahoe Conservancy); Greg Daum (Meyers Chevron); Thomas Gavigan, P.G. and Brian Grey (Lahontan Regional Water Quality Control Board); Rebecca Cremeen (TRPA); Joey Keely (USFS – LTBMU); Bob Loding (Lakeside Park Water Co. ); Jennifer Lukins (Lukins Brothers Water Co); John Larson (Tahoe Keys Water Co.); Harold Singer (Community Rate Payer); Doug Dame (Barton Health); John Thiel and Ivo Bergsohn (South Tahoe PUD) |
| MEETING HOST | Ivo Bergsohn (South Tahoe PUD) |
| FACILITATOR | |

## BASIN MANAGEMENT OBJECTIVES (BMO)

1. Maintain a sustainable long-term groundwater supply.
2. Maintain and protect groundwater quality.
3. Strengthen collaborative relationships with local water purveyors, governmental agencies, businesses, private property owners and the public.
4. Integrate groundwater quality protection into local land use planning activities.
5. Assess the interaction of water supply activities with environmental conditions.
6. Convene an on-going Stakeholders Advisory Group (SAG) as a forum for future groundwater issues.
7. Conduct technical studies to assess future groundwater needs and issues.
8. Identify and obtain funding for groundwater projects.

## WORKSHOP OBJECTIVES

OBJECTIVES

1. Learn about Groundwater Dependent Ecosystems (GDEs) in relation to SGMA requirements.
2. Receive an update on recent activities for on-going groundwater management under SGMA.
3. Share information on the progress of on-going activities in response to the South Y Plume.
4. Learn about the planned feasibility study of remedial alternatives for the South Y Plume.
5. Consider the Well Owners Survey being planned for 2017.

SEE REVERSE FOR AGENDA

# AGENDA

| Time | Description | |
|---|---|---|
| 1:30 | **Welcome and Self-Introductions** | **Round Robin** |
| 1:40 | **TVS Basin (6-5.01) - Open Forum**<br>**Opportunity for members to briefly raise topics within the subject matter of the SAG and not listed on the Agenda.** | **Round Robin** |
| 1:50 | **Groundwater Dependent Ecosystems (GDE's)** | **G. Werner, TNC** |
| 2:30 | **GWMP - Related Item Updates**<br>• **Alternative Submittals**<br>• **Annual Report, 2016 WY** | **Bergsohn** |
| 2:50 | **South Y Activity Updates**<br>• **TKPOA Phase 1 Facilities Plan**<br>• **LBWC Wellhead Treatment**<br>• **So. Y Fate & Transport Model**<br>• **LRWQCB Source Investigation – Phase II** | **SAG** |
| 3:20 | **Break** | |
| 3:30 | **So. Y Remedial Alternatives FS** | **Bergsohn** |
| 3:50 | **2017 Well Owners Survey** | **Bergsohn** |
| 4:10 | **GSA Formation/Coordination Agreement** | **(tbd)** |
| 4:30 | **Adjourn** | |

**NOTES from TAHOE VALLEY SOUTH BASIN**
**GROUNDWATER MANAGEMENT PLAN SAG WORKSHOP 1**
**Wednesday, April 26th, 2017**
**1:30 PM – 4:30 PM**
**South Tahoe Public Utility District Board Room,**
**1275 Meadow Crest Drive,**
**South Lake Tahoe, CA**

**MEETING HOST & FACILITATOR:** Ivo Bergsohn (South Tahoe PUD)

**ATTENDEES:** Ivo Bergsohn, South Tahoe PUD (District); Gregg Werner, The Nature Conservancy; Jennifer Lukins, Lukins Bros. Water Co. (LBWC); Jason Burk, City of South Lake Tahoe (CSLT); Scott Carroll, Calif. Tahoe Conservancy (CTC); Richard Solbrig, District; Brian Grey, Lahontan Water Board (Lahontan); Lisa Dernbach, Lahontan; Dan Segan, Tahoe Regional Planning Agency (TRPA); Bob Loding, Lakeside Park Association (LPA)

**BASIN MANAGEMENT OBJECTIVES (BMO)**

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5. Consider the Well Owners Survey being planned for 2017.

**Open Forum**

Scott Carroll made the observation that the groundwater is high.

**Groundwater Dependent Ecosystems (GDEs)** Gregg Werner provided a presentation.

Ivo explained that the Groundwater Resources Association provided a Webcast regarding GDEs and The Nature Conservancy's (TNC) framework to assess GDEs for Groundwater Sustainability Plans (GSPs). Ivo got a call from Greg notifying the District about comments submitted by TNC to DWR on the District's Alternative Submittals to DWR to satisfy GSP requirements under SGMA. Ivo asked Gregg if someone from TNC would be interested in presenting the webcast info to our group.

Greg provided a powerpoint, explaining that they are in the rollout process at TNC--developing information and tools for mapping and managing GDEs. TNC is in the early stages of getting information out to help Groundwater Sustainability Agencies (GSAs) deal with GDEs in their GSPs.

**NOTES from TAHOE VALLEY SOUTH BASIN**
**GROUNDWATER MANAGEMENT PLAN SAG WORKSHOP 1**
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TNC is a 501c3 nonprofit; science-based organization; dealing in the best available scientific data; using a non-confrontational approach, i.e., non-litigious. Their focus is people *and* nature, because if solutions won't work for people they are not likely to going to be effective. TNCs interest in groundwater arises due to California's Mediterranean climate; seasonal dependence of ecosystems on groundwater; and detrimental impact to GDEs should groundwater levels fall below the root zone.

Gregg explained the importance of including TNC's GDE in Groundwater Sustainability Agencies' Sustainability Plans and how and why they should be included in these plans. GDEs are defined in GSP Regulations and their beneficial uses must be considered under SGMA.TNC has completed mapping that can be used by GSAs to identify GDEs within their groundwater basins.

Santa Clara River, Ventura County example- groundwater levels declined in response to over pumping during recent drought; had a significant impact on riparian forest on TNC property bordering the Santa Clara River. Managing GDEs was critical; however little information describing GDEs was available; TNC felt developing this information was critical to help GSAs protect GDEs through SGMA. TNC wants to insure that protection of GDEs is actually implemented by GSAs through their GSPs.

GDE 101- series of animations that depict four GDE Types; wetlands; streams and rivers; seeps and springs; and terrestrial vegetation.

PGDE Mapping- Partnership with CDFW and DWR to state-wide mapping of potential GDEs; using vegcamp database; national wetland resources inventory; Calfire vegetation layer; plus a couple of other spatial data sets. Mapping will provide basic information on plant community types and probability of whether area is a GDE, based on vegetation rooting depth and inferred groundwater level. PGDEs are based on current extents to help establish 2015 baseline conditions.

Guidance Framework- How-to-guide on considering GDEs under SGMA (Fox Canyon Example); case study will be used as a guidance document to illustrate TNC process under framework. TNC is informing consultants; GSA board members and staff; and local stakeholders. Information will be available through Groundwater Resources Hub (website devoted to GDE information).

Tahoe Basin - Comparison of GDEs to SEZs; definitions appear similar; unclear whether SEZs include terrestrial vegetation that may be supported by near surface groundwater. PGDE mapping is pretty close to SEZ mapping; not exact. SEZs probably include the majority of GDEs within the Tahoe Basin.

SGMA Wheel- Step by Step Technical Guidance (adapted from Australia, New Zealand, South Africa, other countries with Mediterranean Climate). Step 1: Map and Characterize GDEs, Ground-truth mapping, GDE Characterization (Hydrologic Regime, Ecological Assets); Step 2: Determine Potential Effects on GDEs: Lowering of GW Levels, Degraded WQ; and Surface Water Depletion- What is likelihood that these potential effects impact GDEs; Biological Indicators –TNC is developing a detailed database of plant rooting depths to support groundwater management and maintain groundwater levels within root zone depths; Satellite Imagery Review; NDVI – Normalized Difference Vegetation Index; shows change in vegetative growth, can use to establish baseline; Step 3 -5: Establish Sustainability Criteria: Measurable Objectives and Interim Milestones; Step 6-7: Monitor & Manage; GW Use, levels, water quality, GDE health; Manage: to increase supply, to reduce demand, to restore.

Q&A

TNC Review - Gregg stated that he has read and provided comments on quite a few GSPs proposed by numerous agencies. He feels our GWMP was definitely one of the better ones. With respect to our 2014 Plan, he said it looked to him like we got caught in the cycle where SGMA was still being debated. Compared to many, District plan was actually a management plan.

Gregg suggestion to us for our Plan- Ideas to Consider: 1) Use SGMA Terminology to clearly define SGMA equivalents; make it evident that our proposed plan is a SGMA Plan for legitimacy; 2) Compare and review PGDE and SEZ mapping to get a better feeling for overlap, whether complete or partial (and to what extent); 3) Analyze and document health of GDE's as part of knowing how to improve; documenting 2015 GDE extent is important.

Greg suggested we could use the rooting depth tool/analysis recognizing rooting depths in Tahoe are different than in Bakersfield, as well as NDVI and Satellite Imagery. He touched on the concept of updating Alternative Plan or developing a new GSP, consolidating information from satellite photos, incorporating GDE regular monitoring via site analyses, as well as the interconnected surface waters. For example, how much water goes from the basin into Lake Tahoe?

SEZ layers are based on historical data; this would be a challenge for establishing 2015 baseline under SGMA. Has TNC established metrics for assessing GDE health? TNC is working on it.

Has TNC looked at SFEI website as a good source of example and suggested we look at the EcoAtlas link there for wetlands mapping?

Gregg Werner/TNC will provide a copy of the slide presentation to Ivo.

TNC is not as far along as they would like in their ability to upload updated survey information into their maps; the technology is moving so fast that even their 5 year old databases are having trouble communicating with the newer versions/information. TNC has been discussing the need to figure out a good integrative system. TNC does not provide transpiration information for GDEs; this is something that has been discussed. But due to limited resources they are forced to target what will get the biggest bang for their buck.

**GWMP - Related Item Updates**

- **Alternative Submittals:** since October 2016 Workshop. Ivo did not do formally approve minutes. Has posted them and provided as Attachment 1 to this meeting's materials. Ivo asked if the group would be okay with removing formal approvals of workshop minutes prior to posting them to the website. He would appreciate feedback on this topic.

- **Work on alternative plan submittals** – corresponds to Section 10.3 of SGMA. Also the 2016 Water Year Annual Report. Ivo posted a link to the District's website for plan documents page.

Alternative Submittals: SGMA allows, under the Groundwater Management Act for alternatives in lieu of Groundwater Sustainability Plan. Ivo identified the requirements. Reasons the District felt alternative submittal option was appropriate: due to working successfully under the existing GWMP for the past couple of years. A number of undesirable results were identified, but most do not occur within our groundwater basin; no history of declining water levels, no declines of groundwater storage; GSPs are not cheap; resources could be better used to address groundwater concerns identified in our existing GWMP to correct and/or mitigate. We/SAG discussed three types of alternatives--existing plan; adjudication

action; analysis of basin conditions. District submitted two alternatives: our existing plan, and analysis of basin conditions. Ivo provided and reviewed the schedule from 12/15/2015 Board Item 8d Submission of Alt Plans (Resolution 3044-16) through 4/1/2018 (First Annual Report Submittal Deadline). We received one set of comments from The Nature Conservancy. Starting May 2016 we worked with DRI to complete the analysis of basin conditions and submitted Alternatives Element Guide and the environmental documents needed for the analysis. These documents are on the District's website, or obtained from the Department of Water Resources website. http://sgma.water.ca.gov/portal/alternative/all.

There were 24 submittals from 16 different water agencies. Of that amount six agencies have more than one submittal. Depth of the comments ranged from Eel River Basin received 35 comments, to our submittal which received a single comment (from TNC). Comments on the existing plan were included in the materials package for this SAG meeting. Staff is developing responses to TNC comments to return to TNC and DWR. If any SAG members would like to review the responses, please let Ivo know. As part of our submittal we requested DWR prioritize review of our submittals, review our existing plan, if found to be substantially complete there would be no need to take the time to review the basin analysis. Their review deadline is within 2 years of submission (12/29/2018), but they will be working to complete it earlier.

- **Annual Report, 2016 WY**: We did complete the 2016 Water Year Annual Report. Ivo extended a thank-you to all those who contributed data to that report. He presented contents at a Public Hearing on March 16. The Report was finalized on March 30 and submitted to DWR on April 3, 2017 for input with respect to meeting their expectations. It has also been posted on the District's webpage.

The 2016 report almost doubled in size because of the new reporting requirements. New reporting requirements included, water year type classification, groundwater elevation contours, groundwater extractions bubble plot; description of water use type; groundwater sustainability action plan; groundwater management plan implementation costs (which was not a specific requirement but was asked for by DWR).

We identified on-going activities: South Y Pre-Evaluation Sampling, in support of the groundwater modeling effort and feasibility study regarding current distribution of PCE groundwater contamination. Two rounds of samples 4th Qtr. of 2016, and second set completed for 1st Qtr. of 2017. 2nd round completed early to mid-May. Then Fate Transport Model evaluation – for use in evaluation and optimize removal of the PCE from groundwater in our South Y Area. Modeling 15 remedial scenarios and then will narrow down to 7 to be used for feasibility study.

Results from Fourth Quarter 2016 sampling (map). Also included monitoring information from Tahoe Keys collected during that quarter. High concentrations of PCE found in Tahoe Keys Well and Lukins Brothers Well (from static samples). Lisa Dernbach suggested that Ivo to include the sampling results that have been collected from the former Lake Tahoe Laundry Works site (LTLW)—this information should be available in July. Ivo indicated that July might be too late. Ivo will keep this in mind.

For the annual report in the coming year: Ivo asked the group to please let him know if anyone had any ideas or thoughts about the direction we are headed. Things we have on our list, and are doing: 1) staying informed with new BMPs; 2) SWRCB Prop 1—we have submitted the grant application; 3) be responsive to any questions from DWR during the Alternatives Evaluation process; 4) complete South Y On-going

activities; 5) complete groundwater model work; and 6) Use groundwater models to identify potential future sites for groundwater monitoring wells for the monitoring program.

We received funding from Prop 1 and will use it for developing an RFP for engineering consulting services to conduct this analysis; expanding our outreach effort-–we will be conducting a survey of small community and domestic well owners to get word out about the Groundwater Sustainability Act; continue monitoring groundwater basin conditions; continue to work with SAG; encourage participating from the public via workshops and notices of different activities.

Ivo provided slide of pie chart of expenditures for FY 2015-16. Most of the funds were spent on consultant costs pertaining to LBWC #4 Extraction Well study costs.

Ivo crunched some numbers to calculate a Cost of Non-Compliance chart showing that costs to beneficial users would be substantial. Private well owners would be $100/year for non-compliance; and larger agencies such as South Tahoe PUD would be approximately $300,000/year for non-compliance.

**South Y Activity Updates**

**TKPOA Phase 1 Facilities Plan:** TKPOA selected Kennedy/Jenks (via proposals submitted in response to an RFP back in February) to develop a facilities plan for their water system to help manage the PCE contamination issue in their wells. Selection was approved by their Board on April 18. The Phase 1 facilities plan schedule is to be completed in August. They are concerned about what will happen this summer with the PCE contaminations continuing to rise in their Number 1 well. Last round of testing was at 1.8 (down from last summer). Their No. 2 well is their current lead well.

**LBWC Wellhead Treatment:** Jen Lukins reported they would appreciate any news on potential funding sources. She has been advised that their application for SRF is in legal review right now, but has no idea how long it could be there. She is working on finishing up annual financials and getting those into the bank for interim funding. She is hoping to get their application moved into someone's box for review. Their water company will maintain last summer's conservation regulations--2x/week for 2 hours. They saw 15% savings with this.

**So. Y Fate & Transport Model:** DRI continues to work diligently on this (Attachment 3). There is a Power Point Presentation from DRI from early April. The Model is ready to run remedial scenarios. Trying to get feedback from PRP's. There have been some discussions regarding source models. The District and DRI are considering whether to wait-on starting to run alternatives until the results of the off-site investigation are received from the LTLW PRPs. These findings may affect the contaminant distribution as currently simulated in the F&T Model, but would not likely impact the flow field as simulated in the model.

**LRWQCB Source Investigation – Phase II Update:** Lisa Dernbach reported that the investigation for PCE source continues. State Water Board submitted an application for $163,000 to continue their PCE Source investigation on the west side of the City. We have not heard back from the State Water Board (Lisa expects funding might become available after fiscal year – July). If they receive the requested funds, she expects they would be looking at a Fall investigation. Lisa reported that the additional investigative work proposed by LTLW is not being required by the State Water Board; they are pursuing other possible PCE sources on their own. SWB will still consider the LTLW be the principal PCE contributor. SWB will

also not review their plan, as it is being viewed as a stall tactic that has been used by others before. They will still be the majority contributor.

**So. Y Remedial Alternatives Feasibility Study:** District received a notice at end of March and will be putting together a technical proposal (RFP) that will include the scope of work. The grant is 50% match. We used already-completed and paid-for efforts--Lukins Bros well investigation for PCE; and the work we are doing on the Fate and Transport model—as match. Three main components include Stakeholder outreach (3 workshops); DAC Outreach (meeting geared to Lukins Bros customers; presentation to City Council to apprise them of the problem and effort; inform District Board). Ivo asked for input on type of information the SAG thinks we should include in these workshops. The permitting requirements will be minimal since this is a planning level grant. Work involved will entail: 1) review of regulatory orders pertinent to groundwater cleanup, 2) LBWC compliance order; 3) monitoring well installation (Optional). If we moved forward with the monitoring well aspect then we would need to obtain the appropriate encroachment, etc. permits. Other work tasks will involve 4) administration tasks; and 5) Planning/design /engineering/environmental work being done to precede facility study.

Feasibility Study: data review/kick-off (may be able to include this during a SAG); screen modeled alternatives (narrow down number of alternatives from 15 to 7 potential alternatives); define infrastructure needs (3 alternatives); Develop Life-Cycle Costs (3 alternatives); Complete CEQA IS Checklist (3 alternatives); select recommended alternative (1 alternative.). Once the recommended alternative is identified, preparation of the Implementation Plan would occur. Then the selected consultant would prepare and submit the engineering Feasibility Study Report.

Jenn Lukins suggested targeting local agencies specifically for the feasibility study workshops. Maybe include the Chamber, Lodging Association, Real Estate Agents. Richard said he thought the Chamber might be willing to host a meeting.

**2017 Well Owners Survey:** As part of the effort toward building collaborative relationships with users in the basin, we plan to conduct a well survey. Based on our records and information obtained from the County, there are between approximately 52 small community and non-community water system wells and about 600 domestic wells located within our groundwater basin. Highest incidence of these wells is located near the Stateline area and at the south end of Christmas Valley and more toward the center of the basin. We would like to survey and inform well owners of the Groundwater Sustainability Act and what it does (District's roll as GSA and the types of activities we are pursuing). We hope to accomplish a number of things through the survey—1) identify well-owners' groundwater concerns within our basin; 2) confirm for certain these wells (identified in numerous surveys) actually exist; and 3) determine if the well is actively being used. If it is discovered that the well exists but is inactive, we can hopefully abandon it. We would like to get these well owners participating in some of the groundwater management work that we are undertaking here in the basin. Approach/Outreach: public service announcements, introductory mailings, door hangers, questionnaires. Conduct Survey: will use various approaches, i.e., via electronic (Survey Monkey), face-to-face/door-to-door; online; District web site portal. Once the data is compiled, it will be used to guide future actions regarding types of approach for well management. Ivo provided a schedule for survey, which is on hold until after July 1 due to budgetary issues. We anticipate being able to conduct the survey Aug/Sept.; and report data by October 2017. Lisa Dernbach expressed that the outcome should be interesting and useful, especially for the

County. El Dorado County will be very interested in what we find out and how it compares to the information they have on file. Ivo said he would like any and all input and comments.

**GSA Formation/Coordination Agreement:** File non-exclusive groundwater MOU with the county for managing the areas of the Tahoe Valley-South Basin located outside the service area of the District because the County is not interested in being a GSA. We were under the impression that the DWR approved of this. However during later discussions with SWRCB it was mentioned that was not the case and the thought was that this act would likely find the District non-compliant with the requirements of a Groundwater Sustainability Agency and thereby subject to significant fines (~$300,000). Even worse than that, it would allow SWRCB to step in and manage the basin water. Back to the drawing board. We talked to the County and asked if they would be the GSA for the fringe area to avoid State Board coming in. County Water Agency agreed to take on the roll in those areas. District will adopt a Resolution and Amended MOU with the County, and then it will go to the County Water Agency Board for a public hearing, and make a submittal to the State Water Board. When the County is deemed to be the GSA, the District will notice a withdrawal of their acceptance so there will be no gap in coverage. District will continue to be GSA for portions within its service area; El Dorado County Water Agency will serve as GSA for areas outside District's service area.

There will be a single Groundwater Sustainability Plan for both District and County to adopt. This issue came about due to differing points of views. But we cannot afford to risk the State Water Board finding outside area being invalid and not covered by a GSA. Richard announced that the County would probably adopt their part of this at their May 17 meeting. Ivo reminded everyone that there are NO groundwater withdrawals in the areas outside our service area. These areas consist mostly of BLM areas, areas set aside for conservation, or state lands. Richard thought there might be a couple private parcels, but if they do develop the District would need to expand our service area and incorporate them into it. This is basically only an administrative fix.

The workshop was adjourned at 4:30 PM

# SIGN-IN SHEET

## South Tahoe Public Utility District

### TAHOE VALLEY SOUTH BASIN (6-5.01)
### GROUNDWATER MANAGEMENT PLAN

***STAKEHOLDERS ADVISORY GROUP***
***WORKSHOP No.1***

**Wednesday, April 26, 2017**
**(1:30 PM – 4:30 PM)**

| NAME | AFFILIATION | PHONE | EMAIL |
|---|---|---|---|
| Ivo Bergsohn | S. Tahoe PUD | (530) 543-6204 | IBERGSOHN@STPUD.DST.CA.US |
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| Scott Carroll | CTC | 530-543-6067 | scarroll@tahoe.ca.gov |
| Richard Solbrig | STPUD | 530-543-6201 | rsolbrig@stpud.us |
| Brian Grey | Lahontan Water Board | 530 542-5421 | brian.grey@waterboards.ca.gov |
| Lisa Dernbach | " " | 530 542-5424 | lisa.dernbach@ " " |
| DAN SEGAN | TRPA | 617-943-9046 | dsegan@TRPA.org |
| Bob Ludwig | LPA | 775.772-3699 | Doctertz@AOL.com |
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# AGENDA

| | |
|---|---|
| DATE | Friday, December 15, 2017; 9:00 AM -12:00 PM |
| LOCATION | South Tahoe Public Utility District Board Room, 1275 Meadow Crest Drive, South Lake Tahoe, CA |
| STAKEHOLDER ADVISORY GROUP LIST | Ken Payne, P.E., (El Dorado County Water Agency); Robert Lauritzen, P.G. (El Dorado County -EMD); Jason Burke (City of South Lake Tahoe); Scott Carroll (CA Tahoe Conservancy); Greg Daum (Meyers Chevron); Brian Grey (Lahontan Regional Water Quality Control Board); Rebecca Cremeen (TRPA); Joey Keely (USFS – LTBMU); Bob Loding (Lakeside Park Water Co. ); Jennifer Lukins (Lukins Brothers Water Co); John Larson, Rick Robillard, P.E. (Tahoe Keys Water Co.); Vacant (LT Unified School District); Harold Singer (Community Rate Payer); Doug Dame (Barton Health); Ivo Bergsohn (South Tahoe PUD) |
| MEETING HOST | Ivo Bergsohn (South Tahoe PUD) |
| FACILITATOR | |

## BASIN MANAGEMENT OBJECTIVES (BMO)

1. Maintain a sustainable long-term groundwater supply.
2. Maintain and protect groundwater quality.
3. Strengthen collaborative relationships with local water purveyors, governmental agencies, businesses, private property owners and the public.
4. Integrate groundwater quality protection into local land use planning activities.
5. Assess the interaction of water supply activities with environmental conditions.
6. Convene an on-going Stakeholders Advisory Group (SAG) as a forum for future groundwater issues.
7. Conduct technical studies to assess future groundwater needs and issues.
8. Identify and obtain funding for groundwater projects.

## WORKSHOP OBJECTIVES

OBJECTIVES

1. Discuss the 2018 South Y Feasibility Study scope and schedule.
2. Review results from the 2017 Well Owners Survey.
3. Learn about Groundwater Resources Management under the USFS-LTBMU.

SEE REVERSE FOR AGENDA

# AGENDA

| Time | Description | |
|---|---|---|
| 9:00 | **Welcome and Self-Introductions** | **Round Robin** |
| 9:10 | **TVS Basin (6-5.01) - Open Forum**<br>**Opportunity for members to briefly raise topics within the subject matter of the SAG and not listed on the Agenda.** | **Round Robin** |
| 9:20 | **So. Y Remedial Alternatives FS** | **S. Itagaki, KJC** |
| 10:00 | **South Y Activity Updates**<br>• **TKPOA Phase 1 Facilities Plan (R. Robillard)**<br>• **LBWC Wellhead Treatment (J. Lukins)**<br>• **LRWQCB Report (B. Grey)**<br>• **So. Y Pre-Evaluation Sampling (I. Bergsohn)** | **SAG** |
| 10:30 | **Break** | |
| 10:45 | **2017 Well Owners Survey** | **Bergsohn** |
| 11:15 | **Groundwater Resources Management** | **Bringolf/Keely, USFS-LTBMU** |
| 11:45 | **GWMP Updates**<br>• **Alternative Submittals**<br>• **Phase II Modeling Report**<br>• **Annual Report, 2017 WY** | **Bergsohn** |
| 12:00 | **Adjourn** | |

***Meeting Minutes***

*Tahoe Valley South Subbasin Groundwater Management Plan*

***Stakeholders Advisory Group Workshop 2***

*Meeting Date: Friday, December 15, 2017 (9 a.m. – 12 Noon)*

**Attendees**: See attached Sign-In Sheet

## Open Forum

- No discussion

## So. Y Remedial Alternatives FS

- Sachi Itagaki with Kennedy/Jenks Consultants (KJC) ran though items having to do with 2018 remedial alternatives investigation. Roles and levels of interest from SAG members regarding the feasibility study.
- Sachi referred to her handout as she provided a rundown of the summary.
- The feasibility study will have a separate Stakeholders Advisory Group (SAG) that will probably include at least some of the same members as the GWMP SAG members.
- Scope of work is large and identifies obligations of the State Water Board and South Tahoe PUD (grantor and grantee). Lots of administrative tasks, GPS coordinates and surveyed elevations to establish common datum between wells used to study groundwater flow, etc. There is a Quality Assurance plan related to how samples are collected; uploading project data to GeoTracker permitting and site access agreements related to the field work. She explained that the Technical Advisory Committee for the So. Y Remedial Alternatives would be independent of the full GWMP SAG.
- She discussed the MOU between the State and STPUD that we currently in the process of being worked out. STPUD's attorney has reviewed it and we are not starting discussions with SWB staff.
- Purpose of the Feasibility Study is to identify remediation methods that do not preclude interference with alternatives being considered by LBWC and TKPOA for their drinking water wells.
- Identifying alternatives (number and location of additional remediation wells), costs (both capital and O&M) of alternatives, looking at long term ramifications, develop Remedial Action Plan, etc.
- STPUD has done ongoing monitoring.
- Outreach is part of the Feasibility study. There will be outreach to this SAG and to disadvantaged communities. Included in the scope of this study is a total of six meetings to be used for outreach (meetings, workshops, webcasts).
- Technical Advisory Committee – part of scope between the State and STPUD. Grant is being administered from the State--Regional Water Board Tricia Carter). Responsibilities: they will provide input on monitoring & reporting program, Pre-Design Investigative (PDI) work plan, Feasibility Study work plan, and interim Remedial Action Plan.
- Stakeholders Advisory Group – will be separate from this SAG (will be referred to as the FS SAG). My include Forest Service, PDI site property owner (e.g. Stanford Alumni Assoc. or CSLT), interested parties (LT Laundry Works (LTLW) parties), and others interested in the very localized area that we will be concerned with. Need to

generate a list. (Scoped to conduct up to six meetings.) Those interested in participating in this SAG will be asked to provide feedback and comment on Feasibility Study. Initial interest show of hands: Jen Lukins, Rick Robillard, Ivo Bergsohn (IB). Will reach out to the Alumni Association, LTLW.

- Schedule-wise: hope to able to do actual field work in the spring. Alumni Association – folks who volunteered their site to be used in this work, asked that we be done by April. In order to meet this request we will need to conduct field work in the winter. Work Plan draft should be pretty quick, feasibility study itself will be about 6-7 months after the work plan.
- Goal for schedule is to complete the FS in a reasonable time frame where the District would be well positioned to request funding for implementation dollars.
- Scott Ferguson asked what is the interaction between the TAC and the FS SAG; may consider combining FS SAG with TAC meetings to advantage direct interaction between these two groups; Why are there two separate groups?; this was a condition of the grant Agreement. if there was a particular reason that the GWMP SAG and So. Y Remediation SAG could not be the same group. Sachi didn't know of any specific reason and thought there could be efficiency in working them together.
- Ivo asked the group for ideas about how to go about when, where, how to pursue the public outreach aspect, i.e. where would be a good first engagement with public to roll out the project. Lisa Dernbach (LD) suggested Tahoe Valley Elementary School – high tide meeting so parents can attend. Especially since the work will be taking place in this neighborhood. Sachi asked if there was awareness already. Jen feels there is a general awareness; they know something is wrong but don't understand the who, what, how, when, where, and whys of it. Scott (CTC) would like to see more press on this (use of media—papers, radio, etc.). Since we are in the study phase it's a good time to get out ahead of this. John Thiel (JT) suggested bringing the media in for a discussion to get them involved to understand. Jen cautioned that this type of discussion with media MUST USE A CAREFULLY CRAFTED MESSAGE with a FACT sheet and map (LD), so they can very specifically see and understand what is going on, and so that there is no misinterpretation by the media. Challenge is to communicate message succinctly (JB)

**South Y Activity Updates**

TKPOA Phase 1 – (Rick Robillard (RR), TKWC Manager).

- Deals with groundwater and the PCE plume affecting 2 wells. Tahoe Keys Water Company (TKWC) contracted with KJ to develop a Facilities Plan to address the contamination. KJ put together Title 22 Requirements Standards and a plan for how to meet them, including alternatives if TKWC should lose their ability to meet water demands (serve water to its customers) due to PCE contamination. Currently one well is affected but has a filtration system on it, but its source capacity is being limited, but is potable. The Title 22 identifies how TKWC PCE contamination issues affect other stakeholders. KJ put together feasibility alternatives for moving forward.

Future projects, alternatives, etc. to deal with contaminants. Currently in the draft final stage of planning document.. Weighted matrix (short term/long term). Expect to be moving draft facilities plan into the final stage shortly. Once this is achieved they will hold a "town forum" to roll out the plan to the TKPOA who will be paying for it. RR expects this to be completed within about a month.

- Once plan and alternatives are decided, will move to engineering docs, etc.
- RR - all 3 wells are operational. In summer rely on all three wells to meet system demand. Have had PCE detections but not at levels that exceed limits.
- RR - Challenge for TKWC is going to be dealing with very significant costs-$2.5mil to $12mil in costs depending on the selected alternative.
- RR- TKWC has had detections in some wells that have not exceeded MCLs.

JEN –

- Approaching 90% on plans and specs for the work (Wellhead Treatment System at LBWC #5; abandonment at LBWC #2) at their 12th Street Well Site LBWC #2 and #5). Public notice will be going out today for the construction loan application for this treatment plant, subject to a three-month review. This will be a surcharge passed on to customers. We are hopeful that construction will take place this summer. In light of recent test results, staff engineers from the State will meet with SWRCB-DOFA to determine permitting issues at Well 5. Well No. 2 will be destroyed and we will apply to replace it, however we have not located a new site yet. The Feasibility Study will help determine the new site and how we will go about that process, i.e., placement and solution. Feasibility Study will consider all the replacement and relocation issues including location of new well, depth, migration pattern of plum and potential draw of contaminated plume by new well, etc. Jen reported that the State indicated to move forward and continue down the path they have taken, cautioning that a more extensive feasibility study may be needed so as not to draw the plume in a new direction and make matters worse. Harold Singer (HS) raised question about the implementation grant and whether it could be used to fund TKWC and LBWC efforts. Issue is timing of funding and need of water companies to have something in-place sooner rather than later. Use of implementation grant for these efforts could result in delay. FS will consider alternatives being considered by LBWC and TKWC; focus of FS is to select a remedial alternative that compliments LBWC and TKWC efforts (IB). Insurance is currently paying for clean-up at LTLW site (LD) Does LBWC have enough confidence in available data that would allow LBWC to identify a new well location? (JK). That will need to be considered during the FS (JL). J. Keely (JK) offered assistance should LBWC consider a site on USFS lands.

LRWQCB Report – (Brian Grey (BG)).

- Explained that there have been some organizational changes, one being that Laurie Kemper (Assistant EO) is retiring, and Doug Smith is new AEO; Jeff Brooks is now the Supervisor to whom Brian reports. Lisa Dernbach handling 445 project. Brian provided a brief chronology of recent work: CAO issued May 2012; Work Plan submitted July 26. It was considered an incomplete submittal and went into the public comment period. After the comment period closed they received additional

comments from Tahoe Keys (historical storm drain system). Responsible Party (RP) and Seven Springs petitioned, Fox's petition was thrown out, Fox filed separate suit against Regional Board. Phase1 activities were conditionally accepted and went out 10/23/2017 and were completed as one continuous core boring and groundwater sampling. They remobilized on November 15, 2017 to do additional CPT/MIP screening. Only able to do one boring 42' at GW 1 location, November 7 advanced to 82' but experienced mechanical issues and demobilized. Rescheduled drilling for 12/26/2018. Due to holiday congestion the City nixed the 26th date for drilling; schedule has been pushed until after Holidays (January 7, 2018) Gregg Drilling is Drilling Contractor. Work Plan review -LRWQCB staff comment letter in draft and comments on revised groundwater are being reviewed. SB4.5 being investigated by Lisa Dernbach, known as the Westside PCE Investigation – when instigated 280ppb PCE was detected in Rockwater Well/Apartments on Emerald Bay Road and 10th Street. It is believed, because of the limited pumping (Sonny's BBQ), that the estimated PCE source was within a block. Submitted a scope of work to the State for funding to look for a source near the Rockwater. State encouraged us to expand the scope of work, which we did. The expanded SOW includes 10 monitoring wells, a soil vaper survey, possibly a tracer test and CPT/MIP survey near Rockwater Apartments area. Would also like to conduct an indoor air survey to determine risks to inhabitants. LD would like to conduct the Westside Investigation sometime during the spring 2018, to avoid summer season traffic. Challenge of pumping contaminated wells – Sampling costs are very expensive due to added costs for handling, treatment and disposal of contaminated water (JL).

So. Y Pre-Eval – (Ivo)

- IB Presentation - brief summary of results from Pre-Evaluation Sampling. 2016 District started conducting sampling and well assessment L4. In parallel, Tahoe Keys funded a study looking at occurrence of PCE in the South Y Area and compiled all historical data (GEI Study). Found numerous data gaps in sampling data and it was determined that the need to collect new groundwater water quality data was in order. Tried to collect new data from: LRWQCB data from existing monitoring wells, TKPOA Wells #1, #2, #3, LBWC Wells #1,2,4,5; Tahoe Valley School, Rockwater Apts, and from Clement Well site (CL-1); 7 Springs/Fox Capital Off Site Invest. Data compilation was provided to DRI to see if any changes were needed in the Fate and Transport Model. Collected data would provide a check against the contaminant distribution predicted by the model. Ivo ran through a series of slides summarizing and explaining sampling events. Questions asked about sampling methods and conditions of operations before and during sampling. Ivo explained that there were various conditions of operations or lack thereof surrounding samplings. There was discussion regarding geological and vertical gradient information relative to the sampling, as well as if these factors would be part of the FS. Sachi explained how and when these items would be factored in and how they would be used. Ivo said that to the extent that we can, he would like this information incorporated into the data. Another question was posed regarding whether this data has been brought into the model? Ivo explained the Model work is "on hold".

- IB presented slide showing GW flow direction from District Well data from the South Y Area; GW Flow directed to NNE; low gradient of about 0.008 ft/ft.
- Highest levels of PCE contamination found along east side of plume near intersection Eloise Avenue and 5th Street.
- Hi levels of groundwater contamination found in Rockwater Well (PCE > 100 ppb); LBWC#4 (PCE in 20 -50 ppb); and LBWC (PCE > 50 ppb)- extremely impaired source; TKWC #2 ( 20 ppb/influent treated); TKWC #1 (PCE about 2 ppb).
- PCE was not detected in LBWC # 1 and TKWC #3 wells.
- Vertical Distribution Plots – PCE Concentration versus Sample Depth- bottom screened interval in feet below ground surface. – Highest PCE concentrations in shallow wells found at LTLW site (25' depth); MW4b (50' depth); Rockwater Well (100' depth); lowest concentrations at greatest depths in TKWC #1.
- JK – all all results from pumped wells ?- Results are from three sampling events which included both grab samples using passive samples and grab samples from pumped wells, purging volume = 5 well volumes (IB).
- Offsite Inv. Results (EKI for 7 Springs/Fox Capital)- District requested sampling near Rockwater Well (west side portion of investigation) Vertical distribution plot: James Street samples show vertical extent of contamination on east side of plume (depths > 60 feet)- very high levels (PCE – 100 – 1000 ppb); on west side of plume high concentrations at deeper levels (PCE -100 ppb at 100' depths).
- Upper grouping – South Y eastside; Lower grouping – west side; could be interpreted as multiple plumes; however only a single source has been identified. More groundwater data is needed to better define groundwater flow patterns within contaminant plume; this is one of the objectives of the PDI. HS inquired about impact of geology and vertical hydraulic gradients on PCE distribution. Available data shows the vertical gradients are directed downward; geology will definitely be considered during the PDI, look at potential contaminant pathways from above 100 feet to PCE contamination found at LBWC #5 (IB).
- Jen – believes that a lot of the work will be valuable to LBWC during their engineering study; thanked Ivo for all his dedication and hard work and for all the information being pulled together and collected. Value from production wells without corroboration wells could be very misleading.
- JK – during PDI- consider the pumping time and screen length when comparing PCE concentrations between wells.
- LD- Recent sampling at LTLW site showed higher PCE concentrations; may be more realistic for actual PCE concentrations than samples collected from wells that are pumped continuously which may provide a diluted sample result.

**2017l Owners Survey was conducted in order to**

- IB Presentation - brief summary of results from 2017 Well Owners Survey (2017 WOS). Purposes 2017 WOS; 1) Inform well owners of Groundwater Management Plan activities occurring within our groundwater basin; 2) Introduce the District as the GSA update well owners on the work being doing with

groundwater management within the basin; 3) Help identify well owner concerns for inclusion in the TVS Basin Groundwater Management Plan; 4)Encourage well owner participation in our SAG (Identify interested domestic and community well owners); and 5) Confirm small community water system and domestic well locations.The survey occurred over a 6-week period from mid-August through September. Last couple weeks of this 6-week period consisted of assessing and organizing the information.

- The 2017 Well Owner Survey included parcels for a potential of 562 domestic well sites; and 58 other small community water system sites (shows number of sites surveyed/visited). He reported that we had 374 respondent sites (61% of inferred locations). Of these, 331 were domestic well sites; 43 were community and non-community well sites. Received responses to well on property from 247 respondents. Most of the respondents were property owners; largest majority were second home owners. Majority of second home owners occupied property between July and September. Likes – aesthetics. Majority concern from respondents is groundwater contamination followed by population growth and groundwater levels.
- The Survey was offered in person, via phone, and on-line.
- Ivo ran through the data collected and compiled from the survey.
- 93% of responders indicated that their private well was being used.
- Gathered quite a bit of information. We have a better and deeper insight in to owners and operators of these wells. This information will allow us to have a more focused outreach.
- There will be a write-up summarizing this survey information/data. We are having some difficulty pulling the information out of the ESRI software we used, but we are working on it.
- A question was asked regarding whether the survey included questions that would assist us in assessing potential demand. Ivo indicated that there was some information collected as to when and how much these wells are used which will feed into the demand information.
- Sachi indicated she would contact Jen so they could discuss possible outreach to any of the survey populous who might be in the South Y area.
- Ivo has additional ideas about possibly conducting a Phase 2 survey/outreach and trying to contact the sites we were not able to reach in the initial survey.
- JL- may want to consider offering water quality testing to well owners as part of expanded outreach.

**Groundwater Resources Management**

- Joey Keely (JK), Ecosystem Staff Officer & Research Coordinator at USFS, spoke. Provided some personal background and qualifications and introduced Nicole Bringolf, Hydrologist with USFS. They are working on inventorying water rights and uses side of things. Nicole has access to recent developments regarding usable documents, etc. Groundwater and Eco Systems Level 2, and Level 1 goes into

varying levels of assessments. Joe brought and presented a slide presentation that a colleague (Jaime Gough, WRU User Group) in Boise put together.

- Presented a slide show for how to use and access reports via USFS Water Rights & Uses (WRU) Geospatial Interface (GI). More Info – USFS Natural Resource Manager (NRM) at nrm@fs.fed.us
- Joey talked about other ways the system and resources could be used including populating database with well logs and water quality information.
- Also spoke to the idea of using USFS land for wells, or other water facilities needed, and the steps that have to be taken and considerations/checklists gone through prior to permission to use USFS lands.
- USFS has programmatic needs to assess impacts to natural resources from groundwater use; watch not only the USFS water resources, but those within a mile of the forest boundary because of the draw and cone of affect that is caused by any wells or groundwater uses on the peripheral. Impacts on seeps, bogs, fens, ponds, springs, etc. – groundwater bearing zones.
- When considering permits for new wells USFS considers alternative sources of supply outside USFS lands; current demands on natural resources; and changes to baseflow; declines in spring flows. USFS cannot direct applicant to conduct studies, but will provide comments where USFS has concerns where significant and should at a minimum be initially evaluated (e.g. vegetation, stream flows/fish).
- JK discussed current USFS efforts; SNPLA funding (reallocated 2012 returned funds through Tahoe Regional Exec. Committee to secondary projects); USFS-LTBMU submitted request for funding to; 1) second cycle of Angora Burn Area Monitoring; and 2) Water Uses and Protection. Water Uses and Protection would focus on completing inventory and analysis of water uses on lands within USFS-LTBMU; identification and assessment of Groundwater Dependent Ecosystems (GDEs); identification of water needs for watershed health and ecosystem sustainability, identification of surface water source zones and source water protection zones for groundwater and facilitation of conjunctive management of surface/ground water resources. Anticipate having funding available to start this work in 2018. Will also look beyond groundwater-dependent systems to balance of groundwater and surface water, and likely places USFS has allowed water access. They will be reviewing past points of diversion around the lake. They have a lot more work ahead to complete. To this point they have done mostly surface water investigations, and still have a lot of groundwater information to gather.
- USFS concern – development along stream courses has resulted in change from using riparian rights to groundwater (echo creek example). Focus is on impact of shallow wells (< 50 foot depth) on surface waters. Only community water systems are required to be metered. USFS stipulates water use conditions within permit; such as period of use; number of people per cabin and allotted water use.
- JK suggested that Sheryl Schumacher (USFS – Engineering) would be the contact suggested to Ivo to find out what information USFS can share. Ivo would like to have access to information pertaining to the Rainbow Tract which is in our groundwater

basin. NB noted that at Rainbow Tract, residents want to go to move away from using surface water and got to groundwater due to water quality concerns. For new special use permit, a meter may be required. Ivo will contact Nicole to get more information.

- JK- USFS-LTBMU inventory on surface water sources and springs is pretty complete; next focus will be on wells. Meyers Landfill – need to work on off-site investigation for feasibility study to address groundwater impacts from off-site plume. Strong restoration in stream meadows, including removal of conifers to restore groundwater levels.
- Question was asked by Ivo if the USFS is contemplating developing Groundwater Management Program of their own for USFS lands. And if so, how would they anticipate working with the local Groundwater Sustainability Agency? Joe indicated that the USFS has had a Groundwater Management Program since 1998. Have a public based website at national level that describes this program; https://www.fs.fed.us/science-technology/geology/groundwater. The USFS is not a regulator.

## GWMP Report Updates

Alternative Submittals

- To close workshop today…
- District 12/2016 submitted Groundwater Management Plan and analysis of basin conditions to Department of Water Resources. Ivo heard that with respect to the SGMA they have two years from the submittal date to complete their evaluation. Last year they wanted to get it done within the first year, now it will not be until mid-2018. We are looking forward to receiving some feedback on our submittals.
- Our submittals will be deemed either “Approved”; “Incomplete” (to be corrected in timely manner (180 days)); or inadequate and thus “Disapproved”.
- Ivo has heard that if we receive an evaluation of “incomplete”, we would consider that a victory. We will work very hard to address the deficiencies.

Phase II Modeling Report

- DRI has been updating the models for our groundwater basin.
- We received a draft groundwater management report. Important sections are: Section 3 which addresses delineating recharge areas and how they change over time and space on a seasonal basis; capture zones within the groundwater basin; Section 4 that looks at pumping surface water – see changes in groundwater flux; Section 5 which focuses on climate change effects (simulations); and Section 6 which uses the model to look at potential changes and recommendations to augment the Basin Monitoring Program.
- Looks forward to sharing when complete.

Annual Report, 2017 WY

- This will be the first annual report that we are officially required to submit to DWR.
- Ivo wanted to thank Jen (LBWC) and Rick (TKWC) for providing their 2017 WY production data.
- We would like to get Lakeside Park Water's production data for 2017. Bob Loding agreed to provide this.
- Ivo reported that the 2017 Water Year was very wet…off the charts. Total precipitation greater than 60" which translates to 120,000 acre feet of groundwater recharge (estimated based on relationship between precipitations at Hagan's Meadow to groundwater recharge).
- Groundwater levels in the basin are up comparing to May 2016 groundwater levels a bit over 4.5' across basin on average.
- We will not do rest of data analysis. Due to DWR by April 1, 2018. Presentation to District Board presenting Annual Report anticipated during first quarter of 2018. Annual Report will be made available on District's website.

Meeting is adjourned.

# SIGN-IN SHEET

## South Tahoe Public Utility District

### TAHOE VALLEY SOUTH BASIN (6-5.01)
### GROUNDWATER MANAGEMENT PLAN

***STAKEHOLDERS ADVISORY GROUP***
***WORKSHOP No.2***
**Friday, December 15, 2017**
**(9:00 AM – 12:00 PM)**

| NAME | AFFILIATION | PHONE | EMAIL |
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| Rick Robillard | TKWC | 530-542-6415 | rrobillard@tahoekeyspoa.org |
| Jennifer Lukins | LBWC | 541-2606 | jennifer@lukinswater.com |

# SIGN-IN SHEET

## South Tahoe Public Utility District

### TAHOE VALLEY SOUTH BASIN (6-5.01)
### GROUNDWATER MANAGEMENT PLAN

***STAKEHOLDERS ADVISORY GROUP***
***WORKSHOP No.2***
**Friday, December 15, 2017**
**(9:00 AM – 12:00 PM)**

| NAME | AFFILIATION | PHONE | EMAIL |
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| Heidi Brough | STPUD | 543-6205 | |
| Bob Loding (via telephone) | Lakeside ~~Mutual~~ Park Water | 542-2314 | docwtr@aol.com |
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