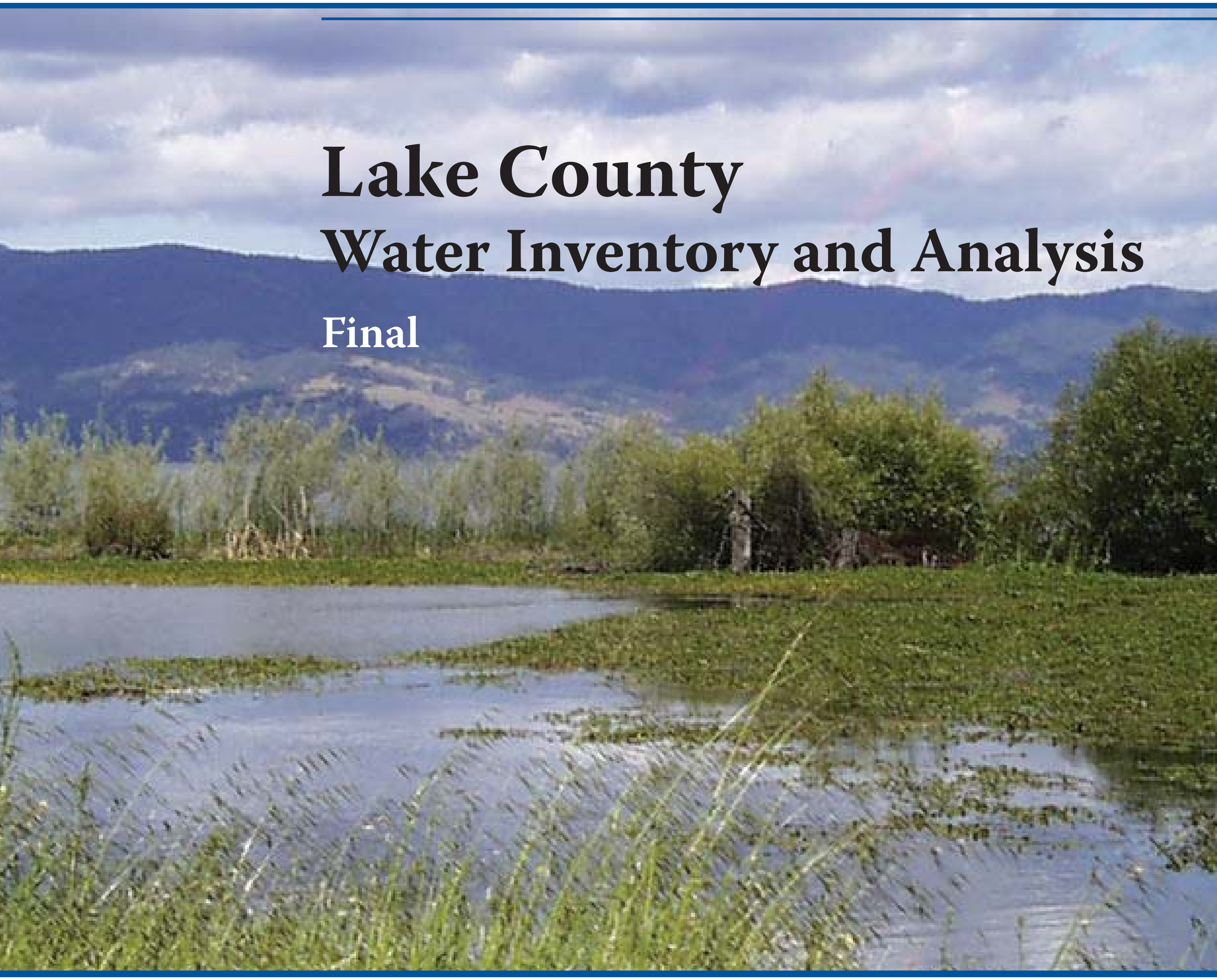
CDM In Cooperation with the
California Department of Water Resources, Northern District

Lake County
Water Inventory and Analysis

Final



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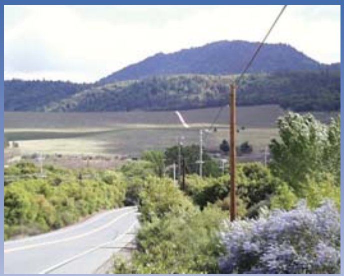

Lake County Watershed Protection District

Lake County Water Inventory and Analysis

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Section 1 Introduction

Like much of California, Lake County is facing water supply challenges. County residents use water for multiple purposes including urban, agricultural, environmental, and recreational needs. These water demands are growing, which places increasing pressure on the County's surface and groundwater supplies.

Lake County has been experiencing an influx of new residents, businesses, and agricultural uses which require additional water supplies. From 2000 to 2004, the County's population increased over 8 percent, about 5,000 residents, to 63,110. The majority of Lake County's crops are perennial. The County is a popular wine grape growing area, which is a high-value crop. The vineyards require a consistent annual irrigation supply. Groundwater is the preferred source for irrigation because it is generally more reliable than surface water.

County surface water supplies also provide recreation opportunities and meet environmental needs. Surface water flows support important fish habitat and riparian vegetation along the waterways. The primary water feature in the County is Clear Lake, which is the largest freshwater lake wholly in California. It provides multiple environmental and recreational benefits, but relies on adequate water levels and water quality to achieve these benefits. Kayakers and rafters come to Lake County for premiere Class II to Class V whitewater runs on Cache Creek, Putah Creek, and the Eel River. Adequate instream flows are needed to support these recreational needs.

Clear Lake

The Lake County Watershed Protection District (District) supports management of these water needs with limited surface and groundwater supplies. The Water Inventory and Analysis will help the Watershed Protection District, water purveyors, and landowners to better understand and proactively manage the resource in a sustainable manner.

1.1 Lake County Watershed Protection District

The Lake County Watershed Protection District works to protect and maintain water resources within Lake County. The District is administered by the County Department of Public Works. District responsibilities include:

- Water Resources Planning: plan for groundwater and watershed management;

- Flood Control: administer the National Flood Insurance Program for Lake County, plan and implement flood control projects, and maintain levees and creeks; and
- Operations and Maintenance: operate and maintain the Kelsey Creek Detention Structure, Adobe Creek Reservoir, Highland Springs Reservoir, Highland Springs Park, and the Middle Creek Flood Control Project.

1.2 Inventory and Analysis Purpose

In 2004, to further its objective to help with water resource planning in the County, the District applied for an AB303 grant from the California Department of Water Resources (DWR). DWR awarded funding to the District to complete this Inventory and Analysis Report and a Countywide Groundwater Management Plan that is also underway. In addition to providing funding, DWR Northern District helped complete the Inventory and Analysis. DWR Northern District provided groundwater data for Sections 2 and 3, and completed the water demand and use calculations in Section 4.

In addition to the Inventory and Analysis Report and the Countywide Groundwater Management Plan, the District also completed a Water Demand Forecast Technical Memorandum (TM). This Inventory and Analysis provides a snapshot of current water supplies and demands to use as a baseline for water planning. The Water Demand Forecast TM provides an estimate of future municipal, agricultural, environmental, and recreational demands in the County. This TM is available separately from the District, but Section 5 also summarizes the methods and results of the future water demand study to complement the information within the Inventory and Analysis.

The purpose of the Water Inventory and Analysis project is to provide: 1) a supplementary tool for water management in Lake County; 2) a reference and educational tool for water managers and stakeholders in Lake County; and 3) a stepping-stone toward integrated water resources planning in the County. In a time when water resource reliability is uncertain in many areas of California, the District is working with local stakeholders toward a common goal of ensuring a reliable future supply by documenting the current status of water use and supply, identifying areas of need, and developing recommendations that will ensure a supply of high quality water into the future.

1.3 Inventory Unit Development

The District identified regions, or Inventory Units, for use in completing the Inventory and Analysis. The District divided the County into ten Inventory Units to help derive results for water supply and use on a local level as well as on a countywide level. Inventory Units are areas that have similar geologic, topographic, and political characteristics. Each Inventory Unit generally represents the boundaries of an entire watershed, although the Inventory Unit boundaries also incorporate political boundaries such as city or county lines.

Figure 1-1 at the end of this section displays the land use within Lake County. Agricultural and municipal land use generally occurs in valleys that have topography, soils, and water sources conducive to agricultural or municipal development. The District used land use information, coupled with watersheds and groundwater basins, to create the Inventory Units.

Table 1-1 presents the Inventory Units, the characteristics of each Inventory Unit, and the communities included in each Unit. Figure 1-2 at the end of this section presents the ten Inventory Units and the included communities.

Table 1-1
Lake County Inventory Units

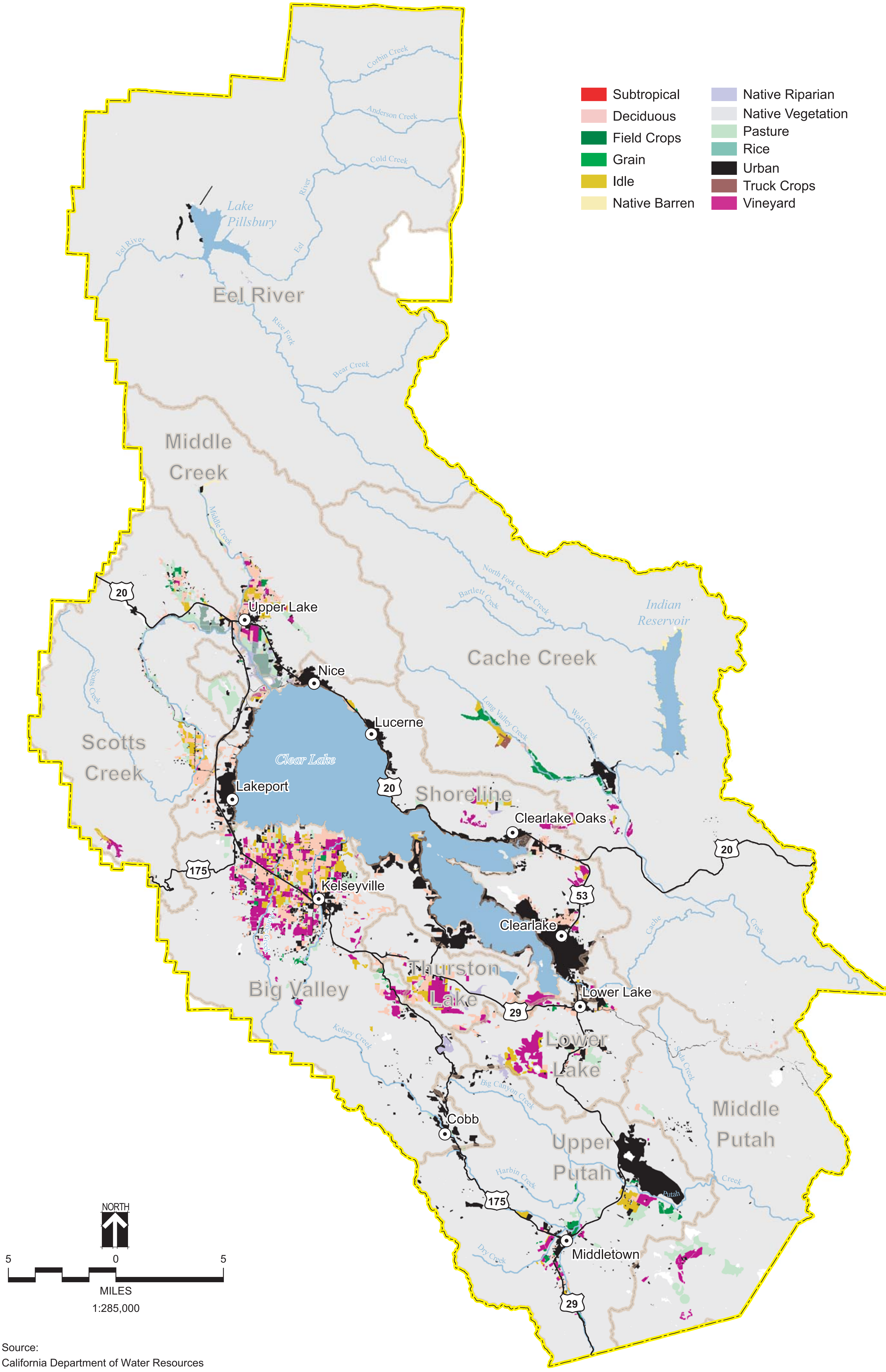
Inventory Unit	*Inventory Unit Characteristics*	*Major Communities within Inventory Unit*
Upper Putah	Upper Putah watershed	Middletown Coyote Valley
Middle Putah	Middle Putah watershed	
Shoreline	Includes development along the perimeter of Clear Lake	Nice Clearlake Clearlake Oaks Lucerne Lakeport
Thurston Lake	Thurston Lake watershed	
Middle Creek	Middle Creek watershed	Upper Lake
Scotts Creek	Scotts Valley groundwater basin	
Big Valley	Big Valley groundwater basin	Cobb Kelseyville Finley
Lower Lake	Lower Lake watershed	Lower Lake
Cache Creek	Cache Creek watershed	
Eel River	Eel River watershed	

Water use and supply data has been developed for each Inventory Unit. The sum of the ten Inventory Units establishes a countywide water budget and provides comprehensive water use and supply data.

1.4 Document Contents

The following is a list of sections included in the Water Inventory and Analysis report and a brief statement regarding each section's contents.

- Section 2 describes the existing physical setting, including topography, climate, hydrology, and hydrogeology;
- Section 3 discusses the water use and management activities within the 10 Inventory Units;
- Section 4 describes water use and supply during average and dry years and water use trends;
- Section 5 summarizes the methods and results of the Water Demand Forecast TM (discussed in Section 1.2);
- Section 6 presents conclusions and recommendations; and
- Section 7 includes references from the report.



Source:
California Department of Water Resources
California Spatial Information Library

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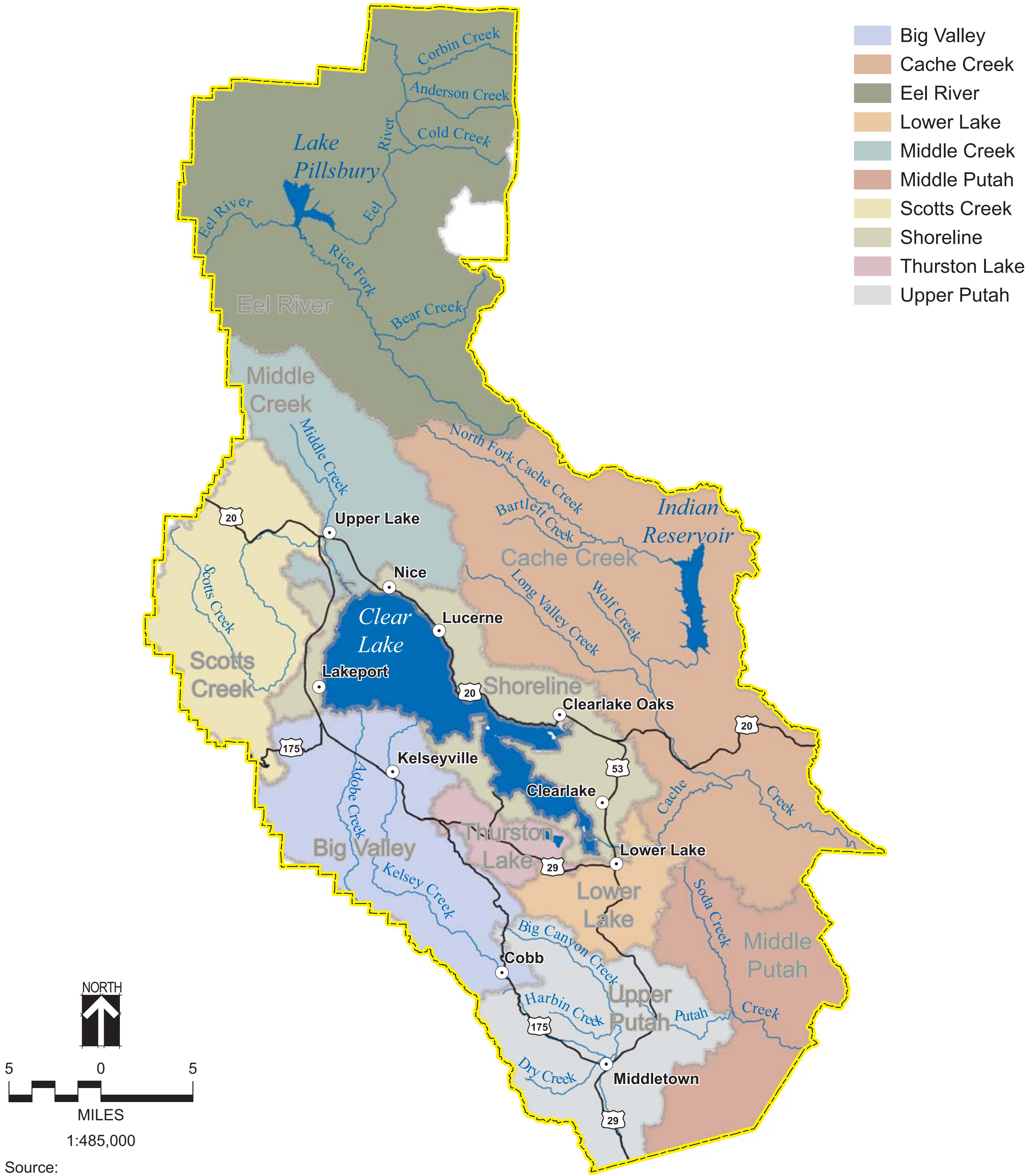
Figure 1-1
Land Use



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The Lake County Watershed Protection District
California Spatial Information Library

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Figure 1-2
Inventory Units

Section 2
Physical Setting

Lake County is a topographically diverse area in the Coast Ranges of California. Hills, mountains, and valleys are the predominant landforms. The County contains the headwaters of the Eel River, Cache Creek, and Putah Creek, which are three major drainages in the County. The northern portion of the County drains into the Eel River, which flows west into Mendocino County. The central portion of the County drains into Clear Lake and then into Cache Creek, which flows east into Yolo County. The southern portion of the County drains into Putah Creek, which flows south into Napa County.

2.1 Topography

Lake County encompasses roughly 1,261 square miles (807,000 acres) of varied topography in the Coastal Range (USDA 1989). Clear Lake is the largest water body in the County, and has an approximate elevation of 1,320 feet above mean sea level (msl). The highest point in Lake County is Snow Mountain with an elevation of 7,038 feet, and the lowest elevation is 500 feet above msl in the southeastern portion of the County in the Cache Creek drainage. Figure 2-1 at the end of this section illustrates Lake County topography.

Figure 2-2 identifies the area and elevation characteristics of Lake County. The figure shows the percent of land that is below each elevation. For example, the figure shows that 50 percent of the County is below 2,000 feet and ninety percent is below 3,500 feet.

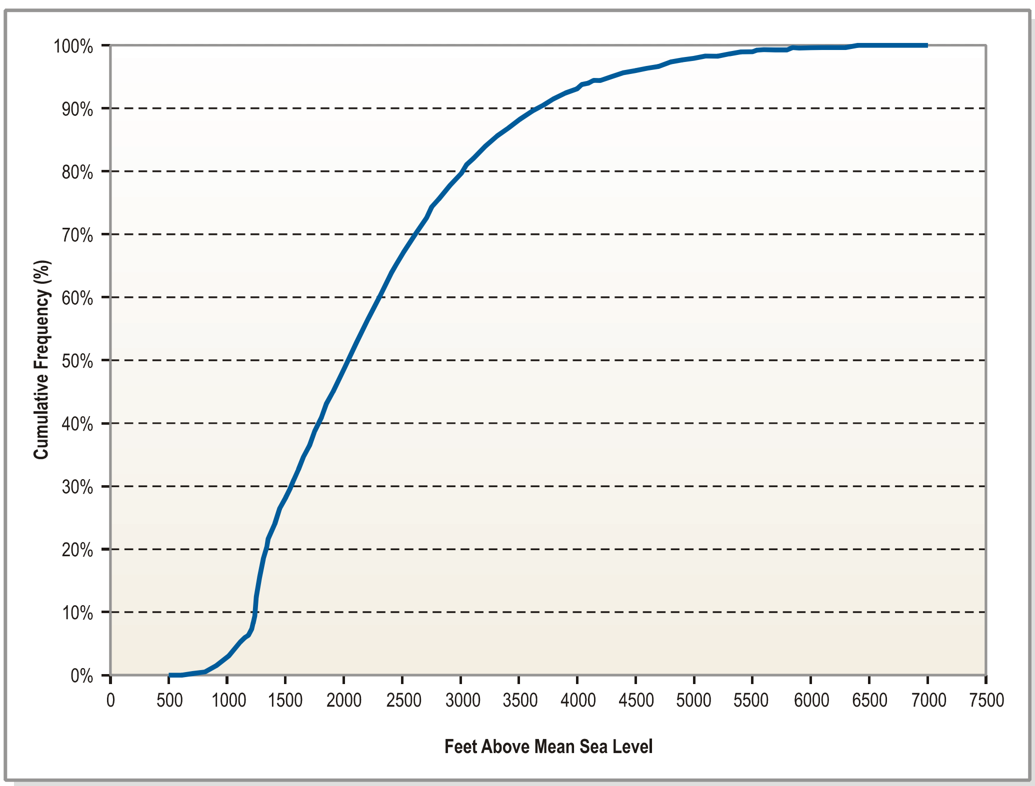

Figure 2-2
Cumulative Frequency Elevation

2.2 Climate

The Pacific Ocean and the mountains are the primary influences on Lake County's Mediterranean climate. Generally, Lake County experiences warm, dry summers, and cool, moist winters. In the summer, a continual tropical air mass typically creates high daytime temperatures and cool evening temperatures. In winter, a marine air mass typically keeps temperatures above 20 degrees Fahrenheit (F) (USDA 1989). The last freeze in spring generally occurs from the end of April to the middle of May, and the first freeze of fall occurs around the middle of October to the middle of November (USDA 1989). Valley regions around Clear Lake have a growing season that ranges from 150 to 210 days (USDA 1989). The average temperatures in winter and summer in Lake County are 43 and 73 degrees F, respectively (USDA 1989).

Lake County's temperature and precipitation are similar on both the eastern and western sides of Clear Lake. Two selected weather stations, shown in Figure 2-3, provide information on temperature, rainfall, and snowfall for both sides of the lake:

Clear Lake: on the east side of Clear Lake, elevation 1,349 feet above msl, in the Shoreline Inventory Unit, records extending 51 years through 2005.

Lakeport: on the west side of Clear Lake, elevation 1,340 feet above msl, in the Shoreline Inventory Unit, records extending 61 years through 2005.

The stations were chosen because they were the only stations in Lake County to have long periods of record. The stations also represent the general climate around Clear Lake, and are near representative of the elevation where most water resources activity takes place. The following sections use data from these stations to describe Lake County conditions.

2.2.1 Temperature

Table 2-1 includes the average, maximum, and minimum monthly mean air temperatures at the two stations. Daily temperature measurements show similar results for the same month at both stations. The temperatures in Table 2-1 indicate a wide seasonal variability at both stations. Average monthly temperatures range from about 43°F during December through January to about 73°F during July through August.

Table 2-1 Monthly Air Temperatures at Two Stations (Degrees F)						
Month	**Lakeport**			**Clear Lake**		
	Avg	**Max**	**Min**	**Avg**	**Max**	**Min**
January	42.9	59.0	24.7	42.8	60.8	23.6
February	46.4	65.7	28.9	45.2	66.6	26.6
March	48.7	68.5	28.6	48.7	71.0	30.8
April	53.6	76.3	31.7	52.9	75.9	32.2
May	60.4	85.3	39.9	60.0	84.0	38.3
June	67.6	92.6	43.6	68.0	92.2	46.7
July	74.1	100.1	44.4	73.6	97.7	45.5
August	73.1	100.6	43.3	72.5	100.5	47.2
September	68.5	93.6	43.8	67.3	94.1	39.8
October	59.5	83.2	37.9	58.6	82.3	33.8
November	49.0	68.6	30.6	48.6	70.8	30.0
December	43.3	59.9	25.5	43.0	62.7	21.7

Source: National Climatic Data Center, Ashville, NC

Minimum recorded temperatures are below freezing in November, December, January, February, March, and April (Lakeport only). Maximum temperatures are near 100 degrees in July and August.

2.2.2 Precipitation

Precipitation is influenced by the mountains within Lake County; increased precipitation typically occurs at higher elevations due to orographic cooling. Air temperatures cool as an air mass rises over the mountains, resulting in condensation that falls as precipitation. Orographic effects cause an increase in precipitation in the north and southwestern portions of Lake County, as shown on Figure 2-3 at the end of this section. Table 2-2 presents average, maximum, and minimum annual rainfall and snowfall for the two stations, illustrating the significant year-to-year variability in precipitation in Lake County.

Table 2-2 Total Annual Rainfall and Snowfall at Two Stations (Inches)		
	Lakeport	**Clear Lake**
Rainfall		
Average	30.52	27.28
Maximum	53.49	61.88
Minimum	10.05	8.26
Snowfall		
Average	0.28	1.85
Maximum	4.00	24.50
Minimum	0	0

Source: National Climatic Data Center, Ashville, NC

Table 2-3 depicts the monthly precipitation variability over the period of record for the two stations. Precipitation is strongly seasonal, occurring generally in October through April. In summer months, areas of high pressure are commonly established over northern California, effectively blocking the inland movement of moist marine air. Thus, most precipitation falls in late fall and winter. Figure 2-4 illustrates the average precipitation during both winter (October - March) and summer (April – September) at both stations, and demonstrates that almost 90 percent of precipitation occurs in the winter. On average, very little rain occurs in the months of May through September.

Table 2-3
Monthly Precipitation at Two Stations (Inches)

Month	Lakeport			Clear Lake		
	Avg	Max	Min	Avg	Max	Min
January	7.22	22.74	0.24	6.08	25.96	0.29
February	5.04	16.52	0.24	4.87	22.34	0.03
March	3.66	13.18	0.39	3.38	16.00	0.08
April	2.03	6.43	0.08	1.53	5.60	0.00
May	0.55	2.20	0.00	0.70	3.56	0.00
June	0.37	2.04	0.00	0.21	1.39	0.00
July	0.16	0.83	0.00	0.15	1.27	0.00
August	0.22	1.70	0.00	0.21	2.70	0.00
September	0.54	2.84	0.00	0.56	3.49	0.00
October	2.12	7.74	0.00	1.53	7.40	0.00
November	3.90	12.42	0.25	3.54	10.99	0.00
December	4.72	14.33	0.00	4.54	15.90	0.00

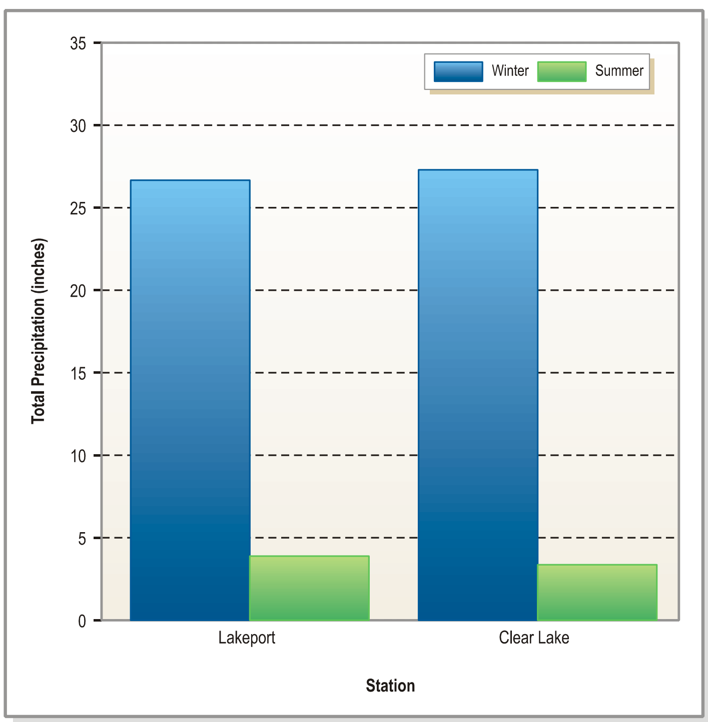

Figure 2-4
Average Seasonal Precipitation at Two Stations

2.3 Surface Water Hydrology

The hydrologic and hydraulic response characteristics of Lake County's rivers and streams vary depending on the watershed headwater origins, area-elevation relationships, soil types, and precipitation accumulation patterns.

Figure 2-5 at the end of this section shows the major surface water bodies and stream gauge locations within Lake County. The Eel River flows through the northern portion of the County, draining through Lake Pillsbury into Mendocino County. Putah Creek flows in the southwestern portion of the County, draining into Lake Berryessa in Napa County. Clear Lake is the largest freshwater lake wholly within the state of California. The lake has an average depth of about 26 feet, and is composed of three arms: a roughly circular Upper Arm, the east-trending Oaks Arm, and the southeast-trending Highlands Arm, as shown in Figure 2-6 (Sims 1988a). Many important tributary streams drain into Clear Lake, including Kelsey, Adobe, Scotts, and Middle Creeks. These streams contribute to groundwater recharge in Lake County. The streams flow over permeable geologic formations and percolate into the subsurface as groundwater recharge. Cache Creek drains Clear Lake and flows to the east into Yolo County and into the Sacramento River.

Figure 2-6
Clear Lake Arms

2.3.1 Surface Water Flows and Variability

This section describes the surface water flow, variability, and infrastructure that influence hydrologic stream response. Lake County has three major drainages: the Eel River drainage, the Putah Creek drainage, and the Cache Creek drainage, as discussed below.

Figures 2-7 through 2-11 show data from stream gauges on major streams in Lake County. The average monthly low (minimum) flows, the average high (maximum) flows, and the average of average monthly flows are indicated by the bars in figures 2-7 through 2-11. Average minimum flows were calculated by averaging the lowest recorded flow in each month and averaging that flow with the lowest recorded flow in the same month in all other years of the gauges period of record. The same calculation was performed to acquire monthly maximum flows. Average flows were calculated by averaging the daily flow of each month to get a monthly average flow, which was then averaged with the monthly average flow for the same months in all other years of the gauges period of record

Eel River Drainage

The Eel River's drainage includes Corbin Creek, Anderson Creek, Cold Creek, and Bear Creek. The drainage includes the highest point in Lake County, Snow Mountain. Pacific Gas and Electric created Lake Pillsbury on the Eel River as part of its Potter Valley Project. This project diverts water downstream on the Eel River to generate power, and releases the water into the Russian River. Diverted flows supplement Russian River water supplies in Mendocino and Sonoma Counties. Lake Pillsbury captures approximately one percent of the Eel River flow (Lake Pillsbury/Upper Eel CRMP 2005).

Figure 2-7 shows minimum, average, and maximum flows on the Eel River downstream of Lake Pillsbury. While Lake Pillsbury captures some winter flows for release during periods of lower flow, the small size of diversions to the reservoir compared to overall river flows results in an annual flow pattern that generally maintains a natural seasonal hydrograph with high flows in the winter and very low flows in the summer. The general hydrologic characteristics of the Eel River's drainage consist of direct rainfall runoff with very small snowmelt and base flow components. A comparison of flows on the Eel River (Figure 2-7) and precipitation at Lakeport (Figure 2-5) shows a strong correlation between rainfall and flows in the Eel River. The flows demonstrate the runoff's connection to precipitation (mostly rain) falling on the watershed.

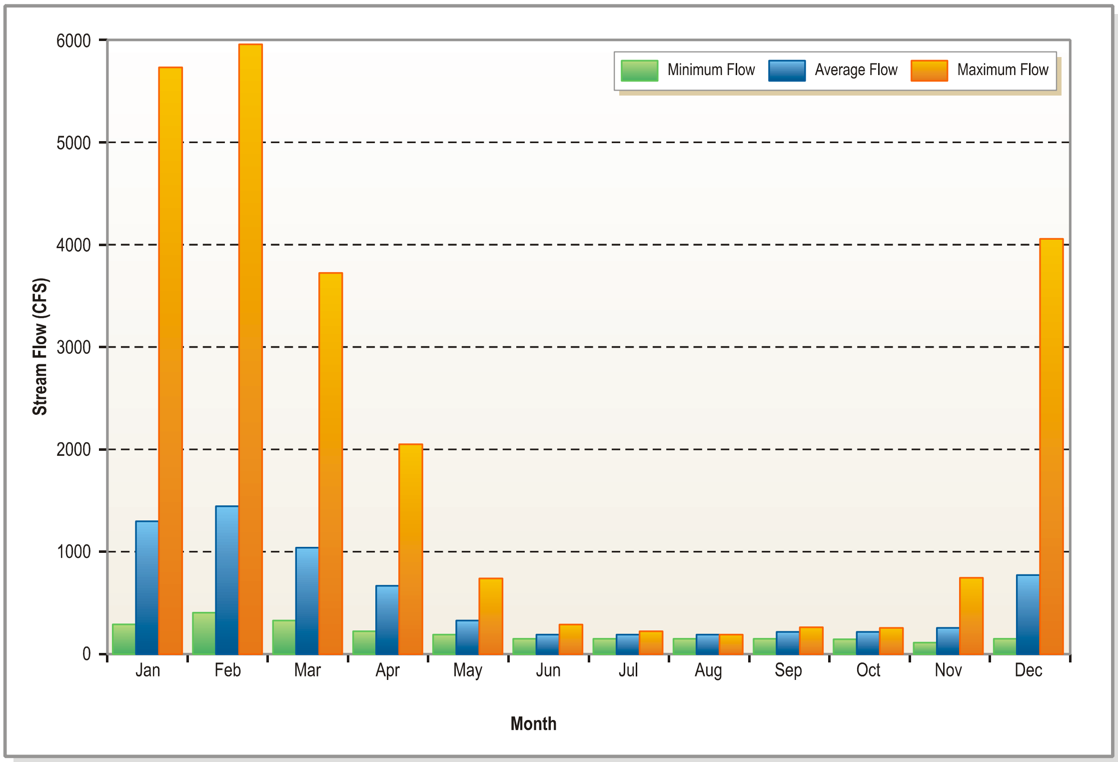

Figure 2-7
Monthly Flows on the Eel River Below Scott Dam
Near Potter Valley
USGS Stream Gauge 11470500

Putah Creek Drainage

Putah Creek's drainage includes Harbin Creek, Big Canyon Creek, St. Helena Creek, and Soda Creek. The drainage also includes Collayomi Valley, Long Valley, and the Coyote Valley. The general hydrologic characteristics of the Putah Creek drainage consist of direct rainfall runoff with a very small snowmelt and base flow components. The portions of Putah Creek within Lake County do not have any reservoirs to provide surface storage to regulate flows. A comparison of flows on Putah Creek (Figure 2-8) and precipitation at Lakeport (Figure 2-5) shows a strong correlation between rainfall and flows on Putah Creek.

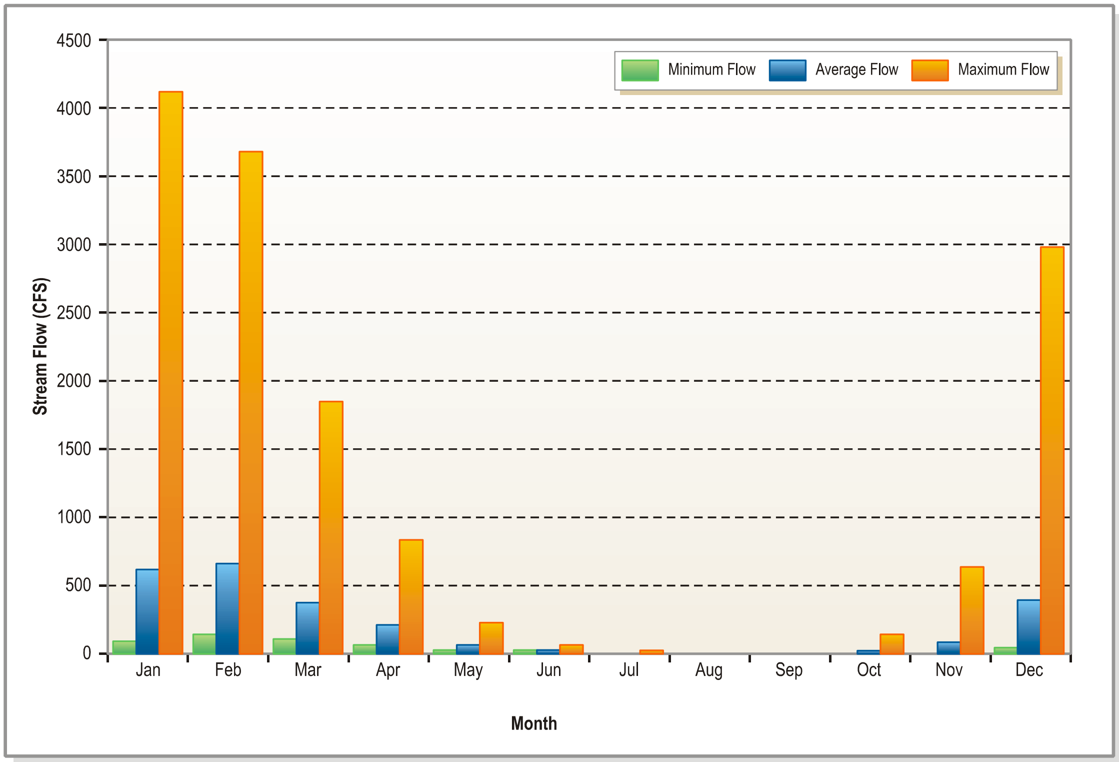

Figure 2-8
Monthly Flows on Putah Creek Near Guenoc
USGS Stream Gauge 11453500

Cache Creek Drainage

Cache Creek has two major reaches in Lake County: the North Fork and the main branch. The North Fork of Cache Creek drains an area north of the Clear Lake watershed through Indian Valley Reservoir, and includes Long Valley Creek, Wolf Creek, and Bartlett Creek. Cache Creek's main branch drains Clear Lake and flows eastward into Yolo County. Kelsey Creek, Adobe Creek, Scott's Creek, and Middle Creek drain through Clear Lake to the main stem of Cache Creek.

Clear Lake and the Indian Valley Reservoir heavily influence the flow characteristics of Cache Creek. Unmanaged flows above the Indian Valley Reservoir on Cache Creek show a strong response to rainfall and low base flows. In contrast, managed flows on Cache Creek below the Indian Valley Reservoir and Clear Lake show a reduced influence of precipitation and increased base flows.

Historic unmanaged flows on the North Fork of Cache Creek (gauge #11451500) are direct rainfall runoff, with a small average flow component (Figure 2-9[1]). Historic unmanaged flows on the North Fork compared with precipitation at Lakeport (Figure 2-3) show a strong correlation between rainfall and flow levels.

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[1] Gauge 11451500 is a discontinued stream gauge that provides data before construction of Indian Valley Reservoir, which monitored flows from 1931-1981. Gauge 11451300 is a current gauge downstream of Indian Valley Reservoir that began in monitoring in 1984 and has replaced 11451500.

Managed flows on the North Fork of Cache Creek (gauge #11451300) and the main branch of Cache Creek (gauge #11451000) show the influence of the upstream surface water storage, which captures heavy winter runoff and releases flow during periods of decreased precipitation (Figures 2-10 and 2-11). The seasonal hydrographs show increased flow during the summer months (June through September) compared to the unregulated flow pattern in the North Fork (Figure 2-9). Flows on the managed branches of Cache Creek also have reduced maximum flows during the winter months (December through February). During the winter wet season, maximum flows on the managed portion of the North Fork of Cache Creek are less than half of the maximum flows on the unmanaged reach of the North Fork of Cache Creek.

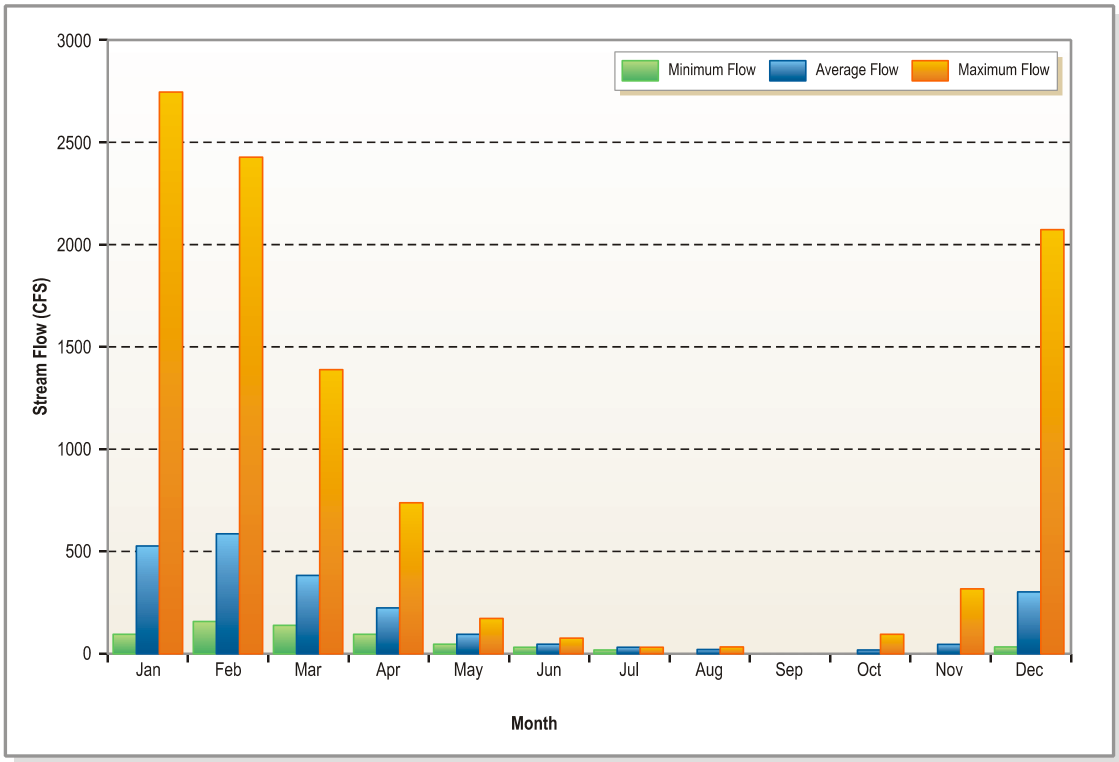


Figure 2-9
Monthly Flows on the North Fork of Cache Creek Near Lower Lake
USGS Stream Gauge 11451500

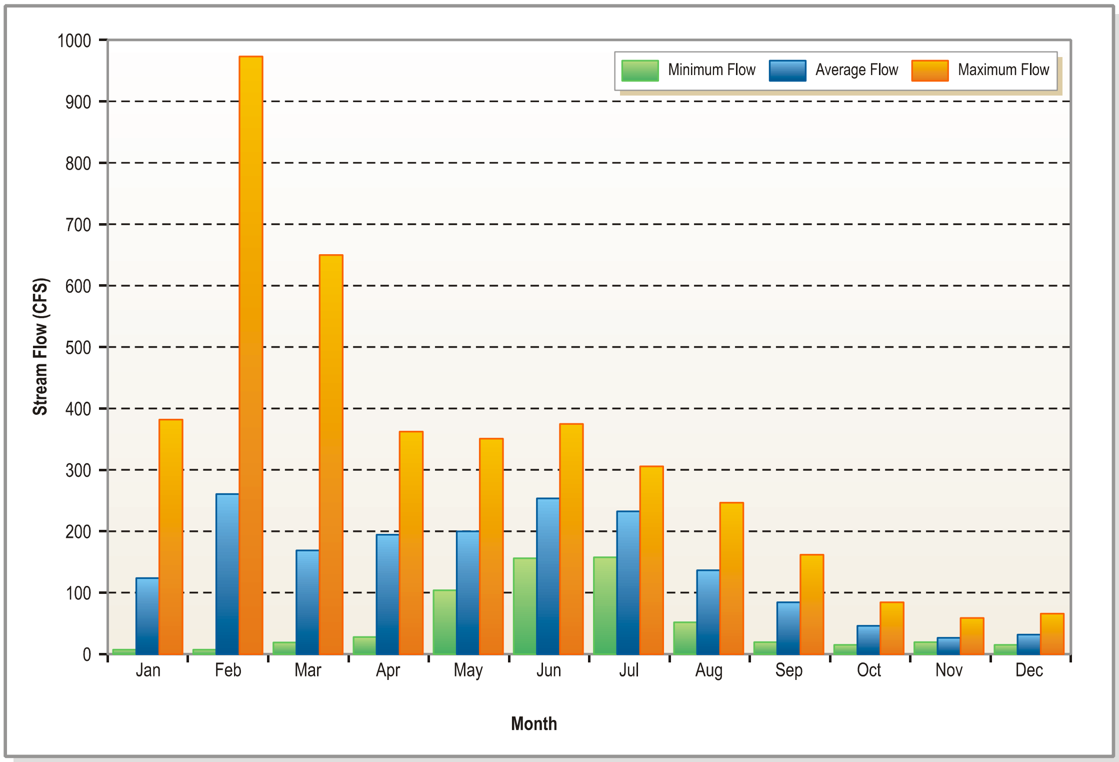


Figure 2-10
Monthly Flows on the North Fork of Cache Creek Near Clearlake Oaks
USGS Stream Gauge 11451300

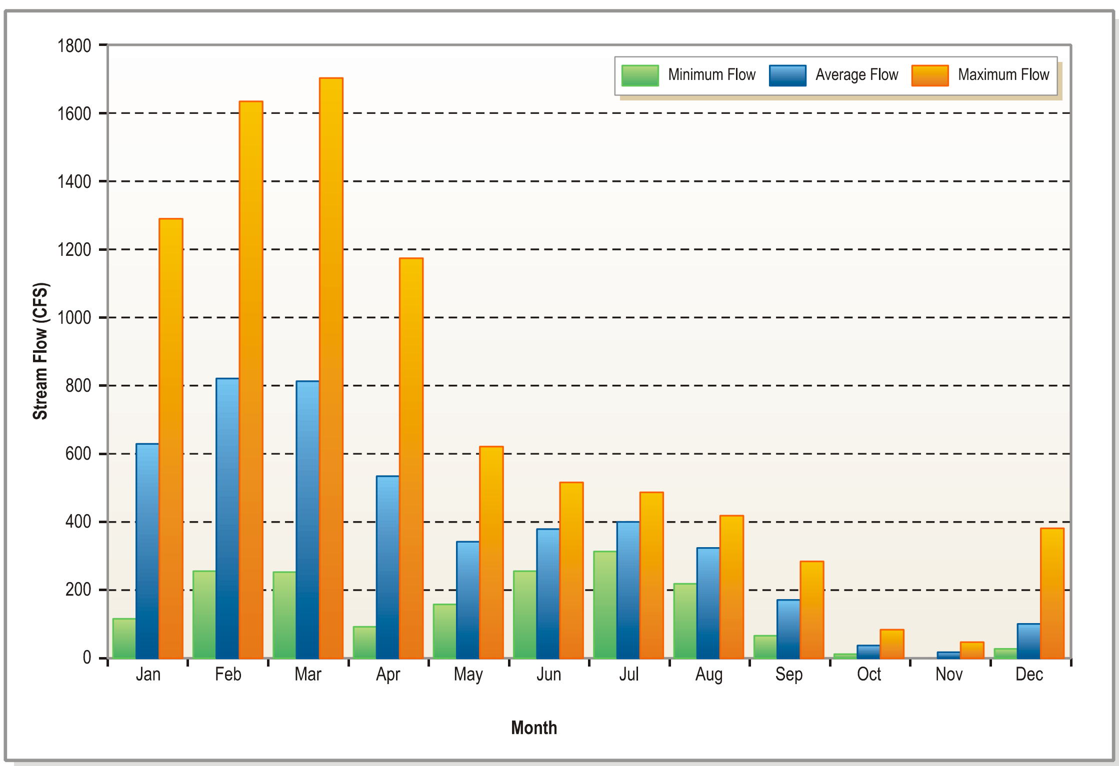


Figure 2-11
Monthly Flows on Cache Creek Near Lower Lake
USGS Stream Gauge 11451000

2.4 Soils

Lake County has over 80 different soil types. The soils vary widely in depth, texture, drainage, and other characteristics. Figure 2-12 at the end of this section shows general soils characteristics in Lake County.

The types of soils generally vary based on topography, and fall into five major groups:

- **Nearly Level to Strongly Sloping Soils in Valleys and Basins -** These soils are generally very deep and occur in valleys and along creeks in Lake County.
- **Gently Sloping to Moderately Steep Soils on Dissected Alluvial Terraces** – These soils are very deep and occur in lowlands surrounding Clear Lake.
- **Moderately Sloping to Very Steep Soils on Uplifted, Dissected Hills –** These soils are very deep and occur over the Cache Formation geologic unit, and in the uplands of Big Valley.
- **Moderately Sloping to Very Steep Soils on Hills and Mountains -** These soils are shallow to moderately deep, and generally occur in the mountainous regions in Lake County.
- **Gently Sloping to Very Steep Soils on Volcanic Hills and Mountains –** These soils are generally moderately deep to very deep, and occur over the Clear Lake Pleistocene Volcanics geologic formation, generally south of Clear Lake.

2.5 Geology

This section presents an overview of the geologic features of Lake County. One of the primary influences on the geology of the County is its location in the Coast Range province of California. Geology in the Coast Ranges consists of a metamorphic rock that forms many ridges and mountains; volcanic rocks that form volcanoes, hills, geysers, and hot springs; and sedimentary rocks that form groundwater basins in valleys. The current extents of geologic formations are shown in a geologic map of Lake County (Figure 2-13 at the end of this section). Table 2-4 lists major geologic formations.

The geologic evolution of the Coast Ranges includes underwater deposition, mountain building episodes, volcanism, and regional faulting. The Franciscan Formation was originally deposited 125 million years ago at the edge of the Pacific Ocean, and the fluctuating sea levels caused alternating deposition of shale and sandstone. After the formation was deposited, it was uplifted and squeezed by movement of tectonic plates, forming the majority of the Coast Ranges as we see it today. The Franciscan Formation forms the bedrock in the mountains and under other valley formations.

Table 2-4 **Major Geologic Formations in Lake County**			
Formation Name	***Rock Type***	***General Location***	***Age***
Franciscan Formation	Metamorphic	Throughout Lake County	150-165 million years old
Cache Formation	Sedimentary	East of Clear Lake	1.6-1.8 million years old
Clear Lake Volcanics	Volcanic	South of Clear Lake	2.5 million years old to recently
Serpentinized Ultramafic Rocks	Metamorphic	Multiple small areas in Lake County	unknown
Quaternary Alluvium	Sedimentary	Groundwater basins	recent

Faulting occurred in Lake County, lowering an area in the Coast Ranges. This area became filled with gravels and sands from creeks in the mountains and became the Cache Formation. Toward the end of the Cache Formation's deposition, faulting created a depression that combined with lava flows created the basin that contains Clear Lake. Volcanic activity occurred intermittently through the Pleistocene with the extrusion of a number of separate lava flows, beginning the deposition of the Clear Lake Pleistocene Volcanics, including Mount Konocti and the surrounding area. Other depressions and valleys in the Coast Ranges began to be filled with sands, silts and gravels carried by streams, resulting in the deposition of alluvial basins (Brice 1953).

Clear Lake has been present in some form for over 500,000 years (Sims 1988b). The Lake has been shallow throughout its history and is bounded by faults that are part of the San Andreas fault system. These faults strongly influence the position, depth, and long history of this natural lake (Sims 1988b).

2.6 Groundwater Hydrology

Groundwater basins are composed primarily of shallow alluvial deposits, and deposits of the Clear Lake Volcanics over the fractured basement rock of the Franciscan Formation. Significant information is available for sedimentary deposits in major groundwater basins; however, very little information is available for the smaller alluvial basins and the water in the Clear Lake Volcanics (a "source area"). Groundwater in many basins is close to the surface in the spring, and decreases in level over the summer. Lake County has 12 groundwater basins and one groundwater source area, as shown in Figure 2-14 at the end of this section.

The following sections generally contain information about water-bearing formations, groundwater hydrogeology, groundwater quality, and subsidence within each basin. Some basins, however, have little or no available information to characterize local conditions. The sections include available published information and anecdotal information, where available. Basins with little information include only a brief summary of basin conditions.

There are a number of terms used to discuss groundwater and the productivity of groundwater aquifers. These terms may be used in the discussion of individual groundwater basins described below if information was available. Terms used in this section include:

- **Specific Capacity -** The specific capacity of a well depends on hydraulic characteristics of the aquifer and on the construction of the well. Specific capacity is determined by dividing the wells production by the drawdown that occurs during pumping. Higher specific capacities in wells tend to be indicative of higher aquifer production.

- **Specific Yield –** The specific yield is the percent of space in the ground that will drain by gravity when the water table drops. Specific yield is reported as a percent. Higher specific yields tend to be indicative of higher aquifer production. An example of a good specific yield is 7%, the average specific yield of aquifers in the Sacramento Valley.

- **Transmissivity –** Transmissivity is related to the speed that water moves through an aquifer. Higher transmissivity values tend to be indicative of higher aquifer production. An example of a good transmissivity is 100,000 gpd/ft, which is the average transmissivity of a productive aquifer in the Sacramento Valley.

- **Well Production -** Well production is the amount of water that is produced from a well, measured in gallons per minute.

2.6.1 Gravelly Valley Groundwater Basin

The Gravelly Valley Groundwater Basin is in the northern portion of Lake County (Figure 2-14) in the Eel River Inventory Unit. Lake Pillsbury borders the basin to the south, and the Franciscan Formation borders the basin to the west, north, and east. This basin has very little available hydrogeologic information.

2.6.2 Upper Lake Basin

The Upper Lake Basin is northwest of the northern end of Clear Lake (Figure 2-14). The Upper Lake Basin is composed of three valleys: Middle Creek Valley, Clover Valley, and Bachelor Valley. Middle Creek and Clover Valleys are in the Middle Creek Inventory Unit, and are bordered to the east and north by the Franciscan Formation and to the west by Lower Cretaceous Marine rocks. Bachelor Valley is in the Scott’s Creek Inventory Unit and is bounded primarily by the Franciscan Formation and by Middle Creek Valley to the east.

Water-Bearing Formations

Quaternary Alluvium

Quaternary Alluvium includes channel deposits, fan deposits, and gravel, sand and fine materials (ESA 1978). The channel alluvium occurs along Middle, Alley, and Clover Creeks. The mouths of several ravines and small canyons that enter into the valley contain fan and older alluvial deposits that consist of gravel, sand, and fine materials. These deposits reach a thickness of 40 to 50 feet and decrease downstream to only a few feet (ESA 1978). Quaternary alluvium is generally a good water producing unit.

Pleistocene Terrace Deposits
The Pleistocene terrace deposits, consisting of poorly consolidated clay, silt, and sand with some gravel lenses, border the west and northwest of Middle Creek Valley. Because of the deposits' high clay content, they have a low permeability and are less significant as a groundwater source (ESA 1978).

Pleistocene Lake and Floodplain Deposits
Underlying the valley floors of Middle, Clover, and Alley creeks are fine-grained lacustrine sediments and coarser grained floodplain deposits. These deposits overlie bedrock and older unconsolidated sediments and generally range from 60 to 110 feet in thickness. Sediments in the Middle Creek Valley area form a confining layer for an underlying artesian aquifer system (ESA 1978). The floodplain deposits contain sand and gravel lenses from former stream channels. The fine-grained lake deposits have low permeability with specific yields from about 3 to 5 percent while wells screened in the sand and gravel lenses produce an average of 230 gpm (DWR 1957).

Groundwater Hydrogeology

Groundwater recharges the Upper Lake Basin at the mouths of canyons and around the periphery of the basin. Recharge also occurs along Middle Creek, Clover Creek, and Alley Creek (ESA 1978). Groundwater recharge occurs from the stream channels during the early part of the wet season, and the basin fully recharges and contributes to stream flow during most wet seasons. Lesser amounts of recharge occur to the groundwater basin through percolation of smaller streams and direct rainfall.

Groundwater levels in the Upper Lake Basin are shallow and have remained constant over the last 40 years. Figure 2-15 at the end of this section shows hydrographs in the Upper Lake Basin that indicate groundwater levels and trends. Water levels in the basin are generally within 10 feet of the ground surface in the spring. Groundwater levels have stayed constant spring to spring. The general direction of groundwater flow in Upper Lake Basin is southward toward Clear Lake. In Clover Valley, groundwater moves to the northwest, towards Middle Creek.

Groundwater in the Upper Lake Basin fluctuates between 5 and 15 feet from spring to fall. Total storage in the Upper Lake Basin is approximately 9,000 acre-feet (ESA 1978). DWR estimated total storage to be 10,900 acre-feet and usable storage to be 5,000 acre-feet. Specific yield for the depth interval of 0 to 100 feet is approximately 8 percent (DWR 1957). Average-year agricultural groundwater demand in the Upper Lake basin is approximately 4,000 acre-feet per year.

Groundwater Quality/ Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

2.6.3 Scotts Valley Basin

The Scotts Valley Basin is the source of water supply for Lakeport and adjacent agricultural areas. It is west of Clear Lake in the Scotts Valley Inventory Unit (Figure 2-14). The basin includes Scotts Valley, the foothills between Scotts Valley and Clear Lake, and the foothills immediately to the south of Lakeport. Clear Lake borders the basin to the east and the Franciscan Formation borders the basin to the north, west and south. Scotts Creek flows through Scotts Valley and drains to the northwest around White Rock Mountain into the Upper Lake Basin.

Over time, Scotts Creek has changed drainage directions and affected the development of the basin. Originally, Scotts Creek drained into Clear Lake during the deposition of the Quaternary Terrace Deposits. Clear Lake drained to the west, towards the Pacific Ocean at that time. Cache Creek then eroded back into the Cache Formation far enough to reach Clear Lake, and the lake started draining into Cache Creek to the east. Scotts Creek began to flow through Clear Lake's old drainage to the west, towards the Pacific Ocean. During this time, Scotts Creek eroded into the Quaternary Terrace Deposits, creating the depression that is now Scotts Valley. Scotts Creek deposited a layer of gravels in the bottom of Scotts Valley. A large landslide occurred in the Scotts Creek drainage, blocking its drainage to the west and creating a lake in Scotts Valley. The lake deposited the clay that makes up the floor of Scotts Valley today. Eventually Scotts Creek eroded a new channel, carving its present course to Clear Lake around White Rock Mountain into the Upper Lake Basin to Clear Lake. The old drainage of Scotts Creek that was blocked by the landslide has filled up with water to form the Blue Lakes.

Water-Bearing Formations

Quaternary Alluvium

The channel deposits of Scotts Creek and the valley deposits in the southern portion of Scotts Valley are composed of Quaternary Alluvium. Older stream channels deposited by Scotts Creek also underlie Quaternary Lake and Floodplain Deposits in the northern portion of Scotts Valley. In the southern portion of the valley, the alluvium is exposed at the surface. It is 40 to 70 feet thick (Ott Water Engineers 1987) and is the recharge area for the valley. In the northern portion of the valley, where the alluvium is buried by lake deposits, the alluvium is 85-105 feet deep, is 5-10 feet thick, and is a confined groundwater aquifer (Wahler 1970). Wells completed in the confined portion of Quaternary Alluvium produce up to 600 gallons per minute, and specific yield is estimated to vary between 20 and 25 percent (Wahler 1970).

Quaternary Lake and Floodplain Deposits

The northern portion of Scotts Valley is underlain by lake deposits of clay ranging in thickness from 60 to 90 feet (DWR 1957). This clay layer acts as a confining layer for the northern portion of Scotts Valley, where it overlies Quaternary Alluvium. Permeability in lake deposits is low, and specific yield of the clays is about 3 percent (Wahler 1970).

Quaternary Terrace Deposits

Quaternary Terrace deposits lie directly on bedrock and consist of poorly consolidated clay, silt, and sand, with some gravel. Quaternary Terrace deposits form the ridge that separates Scotts Valley from Clear Lake, and are exposed in foothills in the western and southern portions of the Scotts Valley Basin. The Quaternary Terrace Deposits also underlie the alluvium and lake deposits in Scotts Valley. The specific yield of terrace deposits is estimated to be between 5 and 10 percent, and wells in the formations sustain small yields of up to 60 gallons per minute (Wahler 1970).

Groundwater Hydrogeology

The south end of Scotts Valley serves as the principal recharge area for the entire valley (Wahler 1970). Surface water flow in Scotts Creek percolates into the aquifer in the southern portion of Scotts Valley at a rate of approximately 1,000 acre-feet per month (Wahler 1970). When Scotts Creek is not flowing, this recharge does not take place

Hydrographs in Figure 2-16 at the end of this section show groundwater levels in the Scotts Valley Basin are shallow in the spring and experience wide fluctuations over the irrigation season. Water levels in the basin are on average 10 feet below the ground surface in the spring, and spring groundwater levels have remained generally constant over the last 40 years.

Spring to summer drawdown of the water table varies by position in the Scotts Valley Basin, with Scotts Valley experiencing larger drawdown than the rest of the basin. Spring to summer drawdown in the Scotts Valley ranges from 30 to 60 feet, and drawdown near Burger Lake and south of Lakeport is roughly 10 feet. Anecdotal information from groundwater users in Scotts Valley indicates that the summer drawdown is far enough to de-water some pumps. The general direction of groundwater flow in the Scotts Valley Basin is northward along Scotts Creek in the Scotts Valley portion of the basin, and eastward towards Clear Lake in the eastern and southern portions of the basin (Wahler 1970). Groundwater levels in the basin seem to completely recover each wet season, and overall there does not appear to be any increasing or decreasing trend in long term groundwater levels.

Total groundwater in storage in Scotts Valley is approximately 5,900 acre-feet (Wahler 1970). DWR estimated usable storage to be 4,500 acre-feet (DWR 1957). Specific yield for the depth interval of 0 to 100 feet is approximately 8 percent (DWR 1957). Average-year agricultural groundwater demand in the Scott's Valley basin is approximately 2,370 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current published information regarding groundwater quality and inelastic land surface subsidence is unavailable. Anecdotal evidence in the form of elevated well casings (two to four feet above ground) indicates that the valley may have subsided by as much as four and one half feet. There have been no reports of groundwater quality issues associated with increased drawdown.

2.6.4 Big Valley Groundwater Basin

The Big Valley Basin is the source of water supply for Kelseyville and is the largest agricultural area in Lake County. It lies south of Clear Lake in the Big Valley Inventory Unit (Figure 2-14). The basin includes the lowlands portion of Big Valley near Clear Lake, and the southern uplands portion near Adobe and Kelsey Creeks. The Big Valley Groundwater Basin is bordered by Clear Lake to the north, the Clear Lake Volcanics to the east and the Franciscan Formation borders the basin to the west and south. Adobe and Kelsey Creeks flow through Big Valley and drain to the north into Clear Lake.

Big Valley is roughly triangular shaped, and is at most six miles wide and approximately eight miles long. The ground surface in the northern portion of the basin gently slopes to the north towards Clear Lake. There are uplands on the west side of the valley, and separate uplands in the south central portion of the valley that have been uplifted approximately 400 feet by a fault (Christensen 2003).

Water-Bearing Formations

Hydrogeology in Big Valley is comprised of two distinct areas: the younger alluvial and basin deposits in the north, and raised uplands comprised of the Kelseyville Formation in the south. The two areas are separated by the Big Valley Fault, which uplifted the Kelseyville Formation and created the uplands in the south.

Christenson Associates, Inc. identified 4 major aquifers in the Big Valley area in the *Big Valley Ground Water Recharge Investigation Update* (2003). The younger alluvial system in the northern portion of the basin contains two main aquifers, designated "A1" and "A2". A clay-rich lake deposits layer designated "C2" separates the aquifers from each other (Christensen 2003). The Kelseyville Formation also includes two aquifers, designated "A3", and "volcanic ash". The "A3" aquifer and "volcanic ash" aquifers are separated by a clay layer designated "C3". Figure 2-17 is a cross section of Big Valley's aquifers and shows the spatial relationships between the aquifers and clay layers.

"A1" Aquifer

Much of the northern portion of Big Valley is directly underlain by alluvial deposits ranging from 10 feet to 126 feet thick (Christensen 2003). The deposits are likely to be stream deposits, consisting of gravel, sand, and silt. The "A1" aquifer is generally unconfined except near and under Clear Lake, where it is confined by an overlying clay layer.

"A2" Aquifer

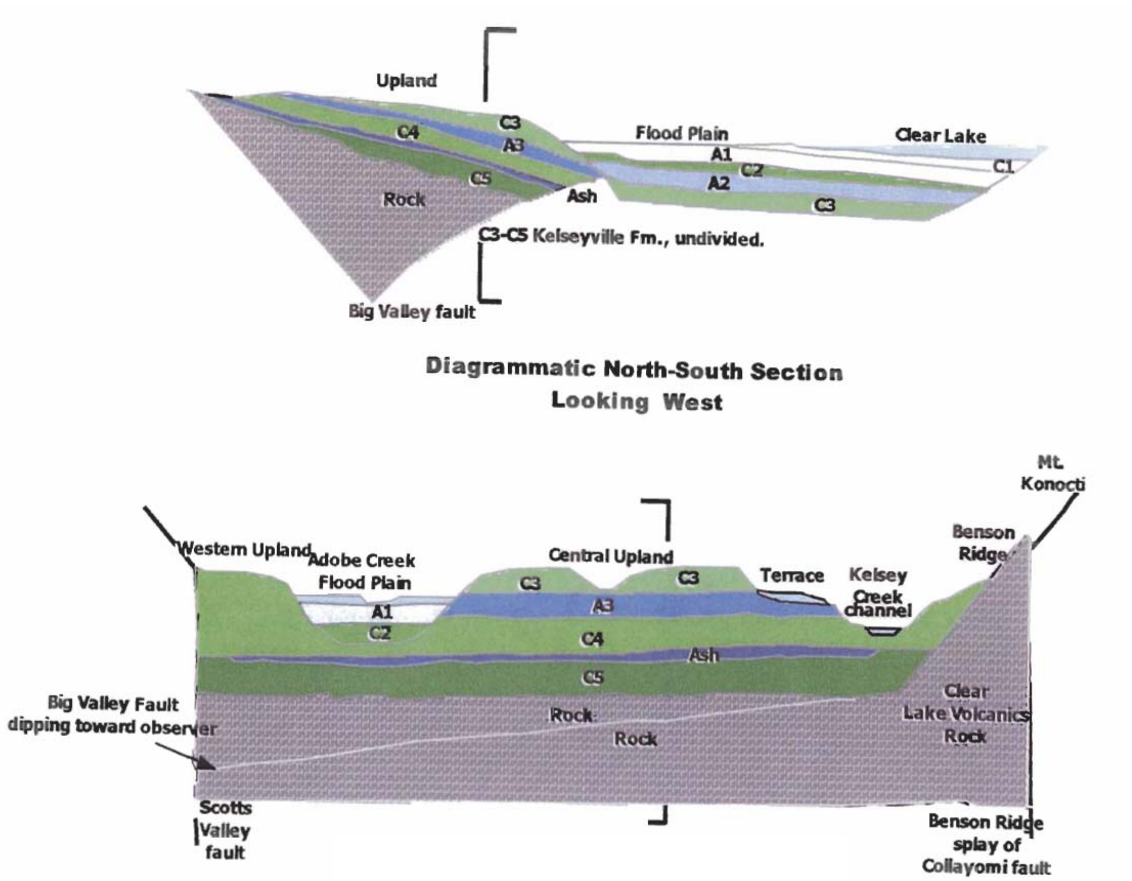
The "A2" aquifer is below the "A1" aquifer and a confining clay layer, designated "C2" (Christensen 2003). The "A2" aquifer ranges from 14 to 140 feet in thickness, and is likely to be composed of stream deposits of gravel, sand, and silt clay. The "A2" aquifer is generally confined or semi-confined.

"A3" Aquifer

Much of the uplands in the southern portion of Big Valley are underlain by the "A3" aquifer, ranging from 5 to 160 feet in thickness. The deposits in the "A3" aquifer are similar to the deposits in the "A1" and "A2" aquifers, likely being comprised of stream deposits, gravel, sand, and silt. The "A3" aquifer is generally unconfined (Christensen 2003)

"Volcanic Ash" Aquifer

The "Volcanic Ash" aquifer is below the "A3" aquifer and a confining clay layer, designated "C3" (Christensen 2003). The "Volcanic ash" aquifer is generally 2 to 5 feet thick, with thicknesses as high as 50 feet reported in two wells. The aquifer consists of volcanic tuff, and water throughout the aquifer is confined (Christensen 2003).



Source: Christensen Associates Inc.

Figure 2-17
Diagrammatic Cross Sections of Big Valley Water-bearing Formations

Groundwater Hydrogeology

The majority of recharge to groundwater in the "A1" and "A2" aquifers is from infiltration of surface flow from Kelsey and Adobe Creeks into the aquifer system. Additional recharge to the "A1" and "A2" aquifers occurs from percolation of rainfall, and underflow from the "A3" aquifer. The "A1" aquifer may also receive recharge from Clear Lake during the summer, when pumping has lowered the groundwater level below the level of Clear Lake (Christensen 2003).

The "A3" aquifer is recharged by percolation of rainfall and by infiltration of water from Kelsey Creek. Recharge of groundwater in the "Volcanic ash" aquifer is poorly understood. It is probably recharged by underflow from uplands, and infiltration of streamflow at surface exposures of the volcanic ash (Christensen 2003).

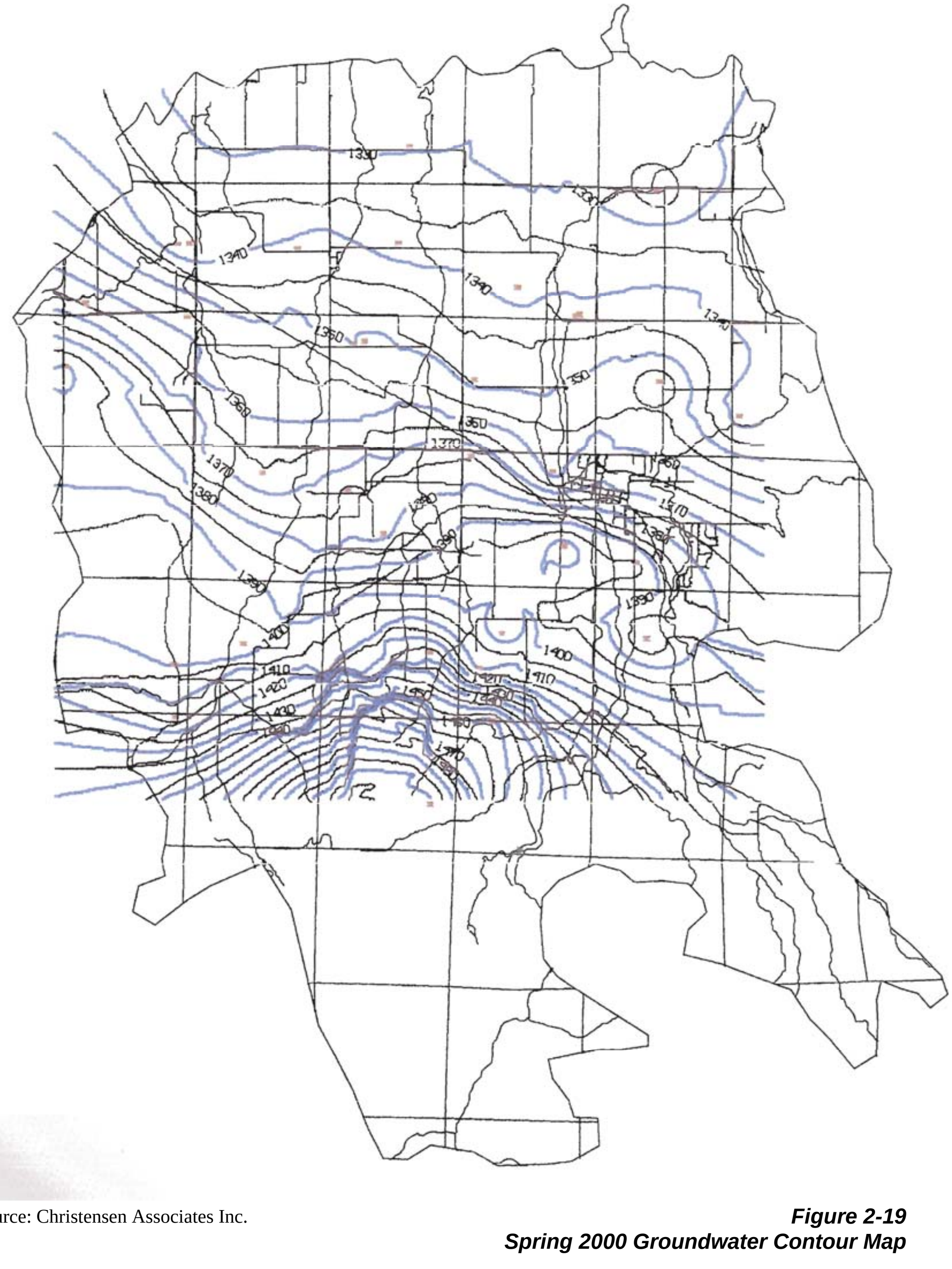
Hydrographs in Figure 2-18 at the end of this section show groundwater levels in the Big Valley Groundwater Basin behave differently in the northern portion than in the southern portion of the basin. Hydrographs in the northern portion, the alluvial system portion of Big Valley, are typically shallow in the spring and experience wide fluctuations over the irrigation season. Water levels in the northern portion are typically five feet below the ground surface in the spring, and decrease from 10 to 50 feet in the summer. Hydrographs in the southern portion, marked in Figure 2-18 by yellow, in the uplands in Big Valley, show that water levels in this area are significantly farther below ground surface than in the northern portion. Spring groundwater levels range from 70 to 90 feet below ground surface, while summer groundwater levels are typically 30 to 40 feet below spring levels. Spring groundwater levels have remained generally constant over the last 40 years except in drought periods. Drought periods can be seen in the hydrographs between 1975 and 1977, and between 1987 and 1992.

Figure 2-19 presents a groundwater contour map of groundwater levels observed in the spring of 2000. The general direction of groundwater flow in Big Valley is generally northward towards Clear Lake. The gradient of groundwater levels in the southern portion of the valley is approximately 70 feet per mile. The gradient in the northern portion of the valley is approximately 20 feet per mile.

Figure 2-20 presents a contour map showing the change in groundwater levels between the spring of 2000 and the summer of 2000. Figure 2-20 shows a number of areas in Big Valley where groundwater was significantly lower over the summer. There was a 50-foot decline in water levels around the town of Finley, a 50-foot decline southeast of Kelseyville, and two 20-foot declines near Kelseyville.

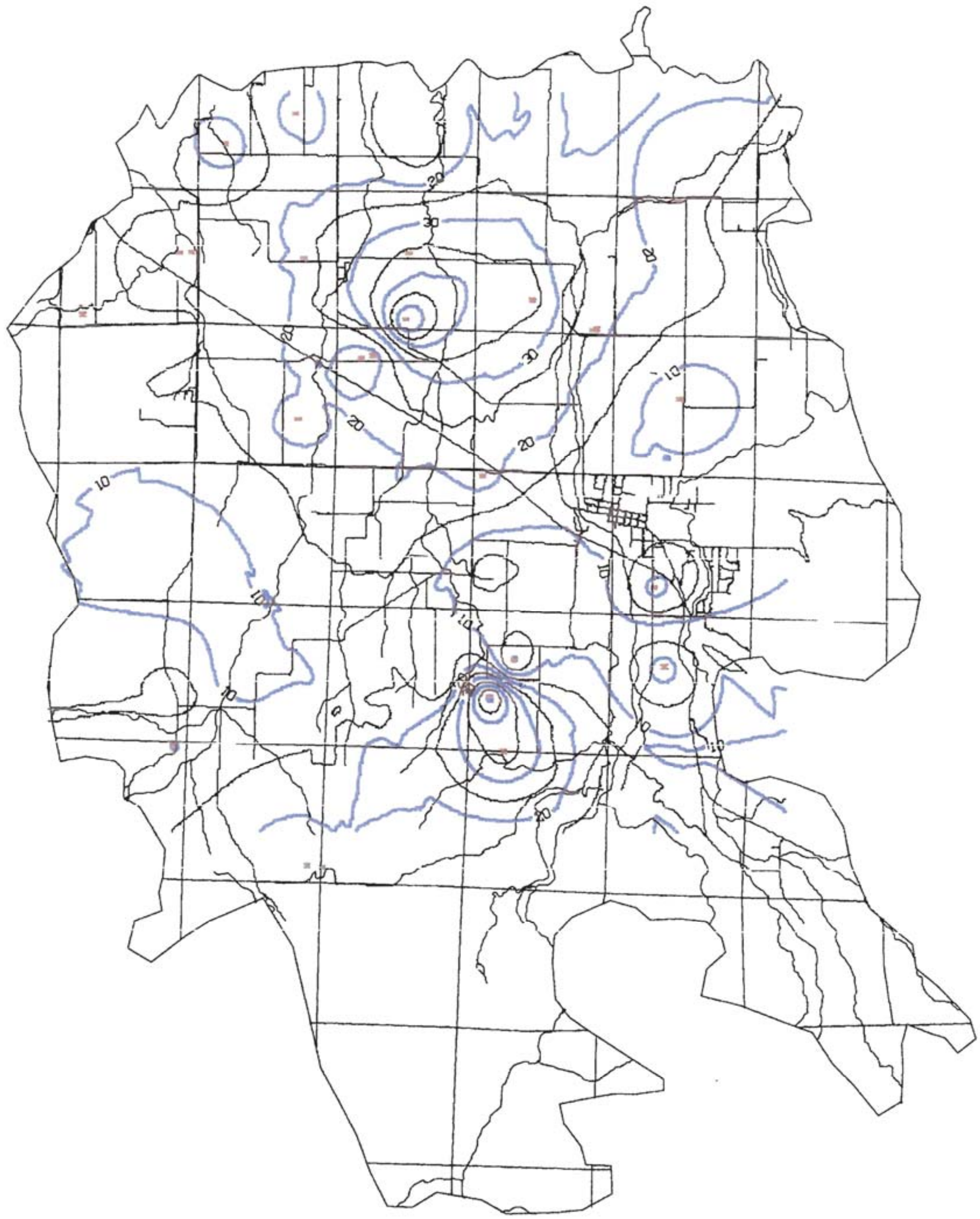
Groundwater in storage in Big Valley has been estimated several times. DWR estimated groundwater in storage to be 105,000 acre-feet for a saturated depth interval of 10 to 100 feet in 1960. In 2004, DWR estimated usable storage to be 60,000 acre-feet. DWR estimated specific yield in 1957 to be 8 percent. Well yields from PG&E reports in 1957 average 374 gpm for unconfined wells and 495 gpm for 'confined' wells;

specific capacities were estimated to be 31 gallons per minute per foot for unconfined wells and 77 for 'confined' wells (DWR 1957). Average-year agricultural groundwater demand in the Big Valley basin is approximately 11,360 acre-feet per year.



Source: Christensen Associates Inc.

Figure 2-19
Spring 2000 Groundwater Contour Map



Source: Christensen Associates Inc.

Figure 2-20
Change in Groundwater Elevation, Spring to Summer 2000

Groundwater in the Big Valley Groundwater Basin may be overdrafted during periods of drought, when there is inadequate recharge during winter months to replace water extracted during the summer months. Potential impacts of overdraft during these periods might include: water shortages for irrigation, water shortages for municipal use, deterioration of groundwater quality, dry wells, and ground subsidence.

2.6.5 High Valley Basin

The High Valley Basin includes High Valley, a small valley north of Clearlake Oaks (Figure 2-14) in the Shoreline Inventory Unit. The valley is three miles long and one mile wide. The Franciscan Formation borders High Valley on the north, west, and south, and an area of volcanic rocks near Round Mountain borders High Valley to the east. Drainage occurs through the narrow gorge of Schindler Creek to the southeast.

Water-Bearing Formations

Quaternary Alluvium

Quaternary Alluvium in High Valley consists of up to 100 feet of fine grained lake deposits. The perimeter of the deposit consists of alluvial fan deposits that may contain coarser sediments. Alluvium is generally a good water producing unit.

Holocene Volcanics

Holocene volcanics likely originated from the vicinity of Round Mountain. The volcanics underlie the fine grained alluvium in the valley and form a confined aquifer. The volcanics were initially a productive aquifer; however, well yield has reduced over time. Recharge is likely reduced by the fine grained alluvium preventing infiltration to the volcanics (DWR 2003).

Groundwater Hydrogeology

The alluvial aquifer portion of High Valley is recharged through direct precipitation. Recharge to the deeper volcanic aquifer is likely through the perimeter of the valley through alluvial fans (DWR 2003).

Hydrographs in Figure 2-21 at the end of this section show groundwater levels in High Valley have slow recovery after droughts. Water levels in the basin range from 10 to 30 feet below the ground surface in the spring. Spring groundwater levels have fluctuated considerably over the last 40 years. After the drought of 1976, spring groundwater levels had declined 45 feet, and it took 5 years for water levels to recover to pre-1976 levels. This trend of slow recovery is indicative of low recharge rates to the basin.

Spring to summer drawdown of the water table is 5 to 10 feet during an average year in High Valley. The general direction of groundwater flow in High Valley is unknown. DWR estimated storage capacity of High Valley to be 9,000 acre-feet of storage between depths 10 to 100 feet. Usable storage capacity is approximately 900 acre-feet (DWR 1960). Average-year agricultural groundwater demand in the High Valley basin is approximately 40 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

2.6.6 Burns Valley Basin

Burns Valley Basin is in the Shoreline Inventory Unit (Figure 2-14). The Franciscan Formation borders the Burns Valley Basin on the north, Clear Lake borders the basin on the west, and the Clear Lake Cache Formation borders the basin on the south and east.

Water-Bearing Formations

Quaternary Alluvium

The valley lowlands contain stream channel gravel and adjacent floodplain deposits. These lowland deposits are Quaternary Alluvium and are composed of silt, sand, and gravel. The southern end of the valley has a maximum thickness of approximately 50 feet (DWR 2003). Groundwater in this formation is unconfined and typically provides water for domestic use.

Quaternary Terrace Deposits

Quaternary Terrace Deposits have been deposited on the sides of the alluvial plain in the Burns Valley Basin. The terrace deposits are approximately 15 feet above the valley floor and slope up the valley to a similar elevation as the foothill exposures of the Cache Formation. Groundwater in this formation is not well understood.

Lower Lake Formation

The Lower Lake Formation, consisting of lake deposits, underlies the alluvial and terrace deposits in the Burns Valley Basin. The formation consists of fine sands, silts, and think interbeds of marl and limestone (Rymer 1981), and has a maximum thickness of 200 feet (DWR 2003). The formation has low permeability and provides water to wells at up to a few hundred gallons per minute (DWR 2003).

Groundwater Hydrogeology

DWR monitors one well in the Burns Valley Basin. The monitoring well indicates that groundwater levels fluctuate from 2 feet below ground surface in the spring to 10 feet below ground surface in the fall. The well also indicates that water levels rose in the Burns Valley Basin in 1981-1983. No information on groundwater movement is available. DWR estimates the useable storage capacity to be 1,400 acre-feet (DWR 1960). Average-year agricultural groundwater demand in the Burns Valley basin is approximately 14 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

2.6.7 Coyote Valley Basin

Coyote Valley Basin is in the southeastern portion of the County along Putah Creek (Figure 2-14) and is part of the Upper Putah Inventory Unit. Coyote Valley Basin is 5 miles long and 2.5 miles wide. Clear Lake Volcanics border Coyote Valley Basin to the east, Serpentinized ultramafic rocks border the basin to the south and west, and the Franciscan Formation borders the basin to the north. Low hills of basalt are found in the south and southeastern part of the valley.

Water-Bearing Formations

Holocene Alluvium

Holocene alluvium is the primary water-bearing unit in the basin and overlies the Cache Formation. The alluvium consists of floodplain and channel deposits of Putah Creek and alluvial fan deposits in the southwestern portion of the valley and at the valley boundaries. The deposits are primarily composed of poorly stratified sand and gravel, with limited fine grained material. The formation is predominantly interbedded coarse sand and gravel, and ranges from about 100 to 300 feet thick (DWR 1976). Groundwater within the upper 100 feet of the formation is largely unconfined (Peterson 1996). Wells drilled in the alluvium produce on average 1,000 gallons per minute (Aust 2006).

Plio-Pleistocene Volcanics and Cache Formation

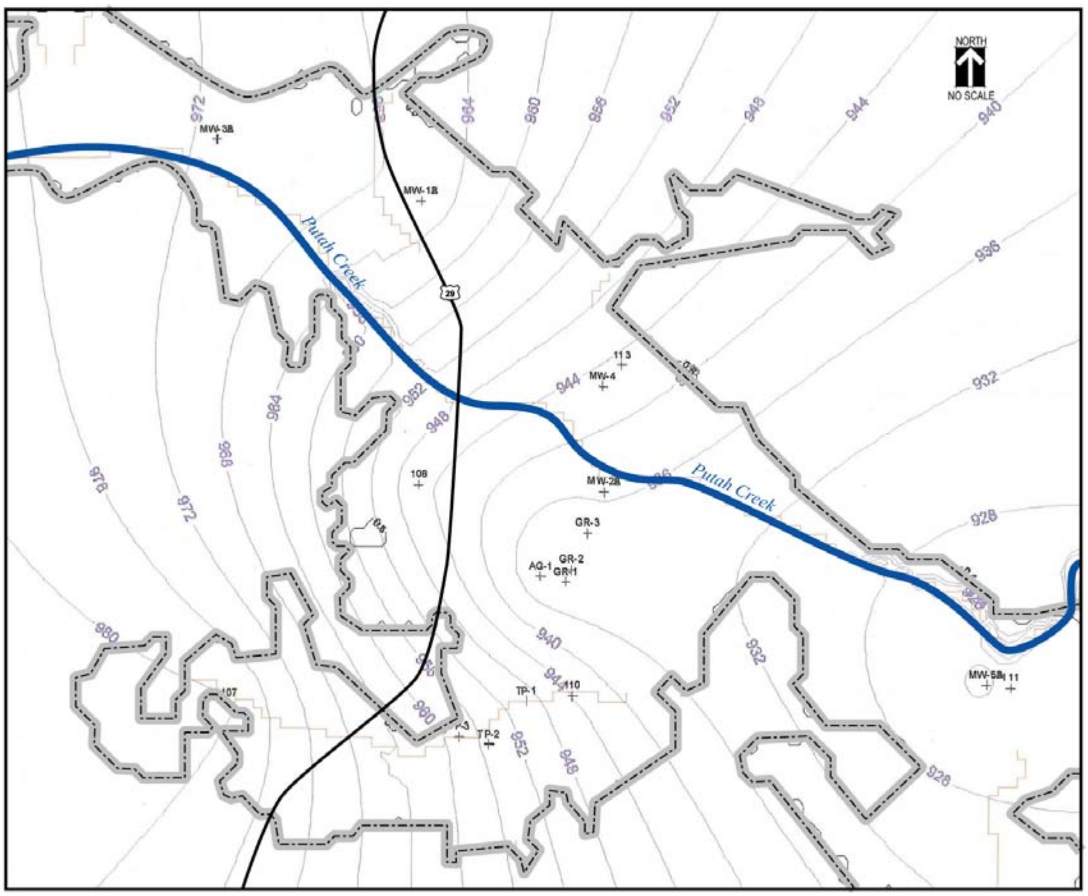
Underlying the valley alluvium is a poorly understood mixture of volcanic rocks and sediments that may be related to the Cache Formation. The southeastern part of the valley contains volcanic rocks and Cache Formation tuffaceous deposits that may be waterbearing. The poorly consolidated tuffaceous deposits are found fairly deep beneath the hills to the northeast where they are overlain and potentially interbedded with basaltic flows. The northeast edge of the valley contains Cache Formation outcrops that likely underlie much of the alluvium. The Cache Formation is made of gravel, silt, sand and the upper layers contain water-laid tuffs and tuffaceous sands become dominant (DOM 1953). The Cache Formation has low permeability because most of the strata are too high in clay or silt to allow for great water movement.

Groundwater Hydrogeology

Putah Creek is the main groundwater recharge source for Coyote Valley Basin. Some recharge occurs from precipitation on the alluvial plain and from side-stream runoff.

Hydrographs in Figure 2-22 at the end of this section show groundwater levels in the Coyote Valley Basin are shallow in the spring, decrease over the summer, and recover during the winter. Water levels in the basin are between 10 to 15 feet below ground surface on average in the spring. Spring groundwater levels have been generally stable throughout the valley.

Spring to summer drawdown of the water table varies by position in the Coyote Valley Basin, with areas in the west experiencing larger drawdown than the rest of the basin. Spring to summer drawdown in the western areas ranges from 20 to 25 feet, and drawdown on the eastern side of the valley ranges from 5 to 10 feet. The general direction of groundwater flow in the Coyote Valley is to the southeast, in the direction of Putah Creek flow (Figure 2-23). DWR estimated 29,000 acre feet of storage capacity and 7,000 acre feet of useable storage capacity in 1960. Average-year agricultural groundwater demand in the Coyote Valley basin is roughly 670 acre-feet per year.



Source: Hidden Valley Lake Community Services District

Figure 2-23
Coyote Valley Groundwater Level Contours, April 2001

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

2.6.8 Collayomi Valley Basin

The Collayomi Valley Basin is in the southern portion of Lake County (Figure 2-14) and is the source of water supply for Middletown and adjacent agricultural areas. The basin includes Collayomi and Long Valley, both in the Upper Putah Inventory Unit. The two valleys are considered a single groundwater basin due to their hydrologic continuity. The Franciscan Formation borders the basin to the west, and a mixture of Serpentinized Ultramafic Rocks and Franciscan Formation borders the basin to the north, east, and south. A small area of volcanic rocks borders the central southern portion of the valley. The boundary is typically the edge of the valley floor except where water bearing basalt and landslide debris extend beyond the valley floor.

Water-Bearing Formations

Quaternary Alluvium

Quaternary alluvium in the Collayomi Valley Basin consists of deposits of clay and silt, with localized areas of channelized gravel. Near Putah Creek, shallow deposits of fine sand and cobbles are present. The maximum thickness of alluvium in the basin is approximately 350 feet in Collayomi Valley, and 475 feet in Long Valley (DWR 1976). Alluvium generally is a productive water bearing unit.

Groundwater Hydrogeology

Recharge occurs in the Collayomi basin next to Putah, Dry, and St. Helena Creeks. Some recharge also occurs from infiltration of irrigation water and direct rainfall. Recharge in Long Valley may be impeded by hardpan conditions near the ground surface (DWR 1976).

Hydrographs in Figure 2-24 at the end of this section show groundwater levels in the Collayomi Valley Basin are shallow in the spring and experience fluctuations over the irrigation season. Water levels in the basin range from 3 to 15 feet below the ground surface in the spring, and spring groundwater levels have remained generally constant over the last 40 years.

Spring to summer drawdown of the water is generally between 5 and 20 feet throughout the Collayomi Valley Basin. The direction of groundwater flow in the Collayomi Valley is to the north where it discharges to Putah Creek. Groundwater flow in Long Valley is from the southeast to the northwest where it also discharges to Putah Creek. Groundwater in both valleys generally flows the same direction as surface flow (CMA 1987). Groundwater levels in the basin seem to completely recover each wet season, and overall there does not appear to be any increasing or decreasing trend in groundwater levels.

Total storage in the basin is approximately 37,000 acre-feet (CMA 1987). DWR estimates groundwater storage in the Collayomi Basin to be 29,000 acre-feet with a useable storage capacity of 7,000 acre-feet (DWR 1960). Average-year agricultural groundwater demand in the Collayomi Valley basin is 266 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

2.6.9 Lower Lake Basin

The Lower Lake Basin is southeast of Clear Lake (Figure 2-14) in the Shoreline and Lower Lake Inventory Units. The rocks of the Great Valley sequence border the Lower Lake Basin on the south (Rymer 1981), and. the Cache Formation and volcanic rock border the basin to the north. The Lower Lake Formation and volcanic rocks occur within the basin.

Water-Bearing Formations

Quaternary Alluvium

Alluvial deposits consist of clay, silt, sand and gravel and are approximately 50 to 75 feet thick. Irrigation wells constructed near the alluvial deposits provide about 400 to 600 gpm (Upson 1955). The alluvial plain of Herndon Creek likely contains gravelly clay, and is interbedded with gravel layers. Wells in the area with depths of approximately 75 feet yield up to 250 gpm with 40 feet of drawdown (Upson 1955).

Lower Lake Formation

The Lower Lake Formation includes conglomerate, sandstone, siltstone, limestone, tuff, and diatomite (Rymer 1981). Younger alluvial deposits are found above the Lower Lake Formation and cover an area almost two-thirds of the basin. Permeability is variable but generally low because the strata are high in clay or silt. The formation thickness is unknown. Well yields are about 150 to 240 gpm (Upson 1955).

Groundwater Hydrogeology

Precipitation and seepage from Herndon Creek and Clear Lake are the main sources of recharge for the basin (Upson 1955). Recharge is also likely from Copsey and Seigler Canyon creeks. Infiltration of rain falling on the outcrop areas is the likely source of groundwater recharge in the Cache Formation (Upson 1955).

DWR monitored three groundwater wells in the Lower Lake Basin, but discontinued monitoring by 1995. Monitoring prior to 1995 indicates that groundwater levels fluctuated from an average of 10 feet below ground surface in the spring to an average of 20 feet below ground surface in the fall. There is no information on groundwater movement.

The basin’s storage capacity is approximately 3,000 to 4,000 acre-feet (Upson 1955). Additional storage capacity is available as part of the Lower Lake Formation but thickness and yield are unknown. Average-year agricultural groundwater demand in the Lower Lake Valley basin is approximately 17 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

2.6.10 Long Valley Groundwater Basin

Long Valley Groundwater Basin is in the northeast portion of the County (Figure 2-14) in the Cache Creek Inventory Unit. The Franciscan Formation borders most of the Long Valley Groundwater Basin. Volcanic rocks form a small section of the southern boundary. Very little information exists about this groundwater basin. Average-year agricultural groundwater demand in the Long Valley basin is approximately 250 acre-feet per year.

2.6.11 Clear Lake Cache Formation Groundwater Basin

The Clear Lake Cache Formation Groundwater Basin is east of Clear Lake and is in both the Shoreline and Cache Creek Inventory Units (Figure 2-14). The Clear Lake Cache Formation Groundwater Basin shares a boundary with the Burns Valley Groundwater Basin in the southwest. Lower Cretaceous marine and Mesozoic ultra-basic intrusive rocks bound the south of the basin. Lower Cretaceous marine deposits border the east portion of the basin, and the Franciscan Formation borders the north and west portions of the basin.

Water-Bearing Formations

Cache Formation

The Cache Formation is generally of low porosity, and is the only water-bearing formation in the Clear Lake Cache Formation Groundwater Basin. The Cache Formation ranges in age from 1.6 to 1.8 million years old and is over 13,000 feet thick (Hearn 1988). The Cache Formation is characterized by sandstone, conglomerate, and gray sandstone with light-olive-gray conglomerate lower in the section. It represents fluvial deposition, and was deposited in a fault-controlled, subsiding basin (Rymer 1981). The Cache Formation overlies the Franciscan Formation and Serpentinized Ultramafic Rocks, and is overlain by the Clear Lake Pleistocene Volcanics, and the Lower Lake Formation (Rymer 1981). The Cache Formation dips to the southwest.

Groundwater Hydrogeology

Groundwater levels have not been monitored in the Cache Formation. Other hydrogeologic information for the basin is unavailable. Average-year agricultural groundwater demand in the Clear Lake Cache Formation basin is approximately 90 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

2.6.12 Middle Creek Groundwater Basin

The Middle Creek Groundwater Basin is in the Middle Creek Inventory Unit (Figure 2-14). The Franciscan Formation borders the Middle Creek Groundwater Basin to the north and east. Lower Cretaceous Marine deposits bound the basin to the west. Little information is available about the Middle Creek Groundwater Basin. Anecdotal information indicates that groundwater levels in the Middle Creek Groundwater Basin change approximately 20 feet annually. Average-year agricultural groundwater demand in the Middle Creek basin is approximately 70 acre-feet per year.

2.6.13 Clear Lake Volcanics Groundwater Source Area

The Clear Lake Volcanics groundwater source area is south of Clear Lake and is in the Shoreline, Middle Putah, and Upper Putah Inventory Units. The Clear Lake Volcanics share a boundary with the Big Valley Groundwater Basin to the west (Figure 2-14). The Franciscan Formation bounds the south and east of the area.

Water-Bearing Formations

Clear Lake Volcanics

The Clear Lake Volcanics consist of basalt, andesite, and other volcanic rocks in a complex sequence. The Clear Lake Volcanics are heavily faulted and fractured, and are over 4,000 feet thick near Mount Konocti (Hearn 1988). A well drilled near the intersection of Red Hills Road and Highway 29 revealed that the formation was 1,600 feet thick at that location (Slade 2002). Groundwater in the Clear Lake Volcanics occurs primarily in fractures, joints, and within weathered zones that formed in between volcanic eruptions. The amount of groundwater available to a well in the formation is highly dependent on the size, openness, frequency, and interconnection of fractures and joints encountered in the well.

Groundwater Hydrogeology

Overall, the hydrogeologic properties of the Clear Lake Volcanics vary widely between different locations in the area, and are not well defined. In some areas, pump tests have been performed to determine aquifer properties. Pump tests determine an aquifer's characteristics at a particular well location. Pump tests typically reveal specific capacity and transmissivity. Specific capacity is a calculated number based on the pumping rate in gallons divided by a measurement of the difference of static and pumping levels in the well. Higher specific capacities indicate a productive well, and low specific capacities indicate an unproductive well. Transmissivity is the capacity of an aquifer to transmit water. A higher transmissivity indicates the aquifer is able to transmit more water.

A pumping test performed on a well east of Soda Bay Road in the Clear Lake Volcanics revealed a specific capacity of 43 gpm/ft, and a transmissivity ranging between 20,000 and 86,000 gpd/ft (Hicke 2002). Other pump tests performed near the intersection of Red Hills Road and Highway 29 indicated specific capacities of 1.25, 47.6, and 18.7 gpm/ft, and pumping rates of 555 gpm, 150 gpm, and 670 gpm. Average-year agricultural groundwater demand in the Clear Lake Volcanics basin is approximately 2,270 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

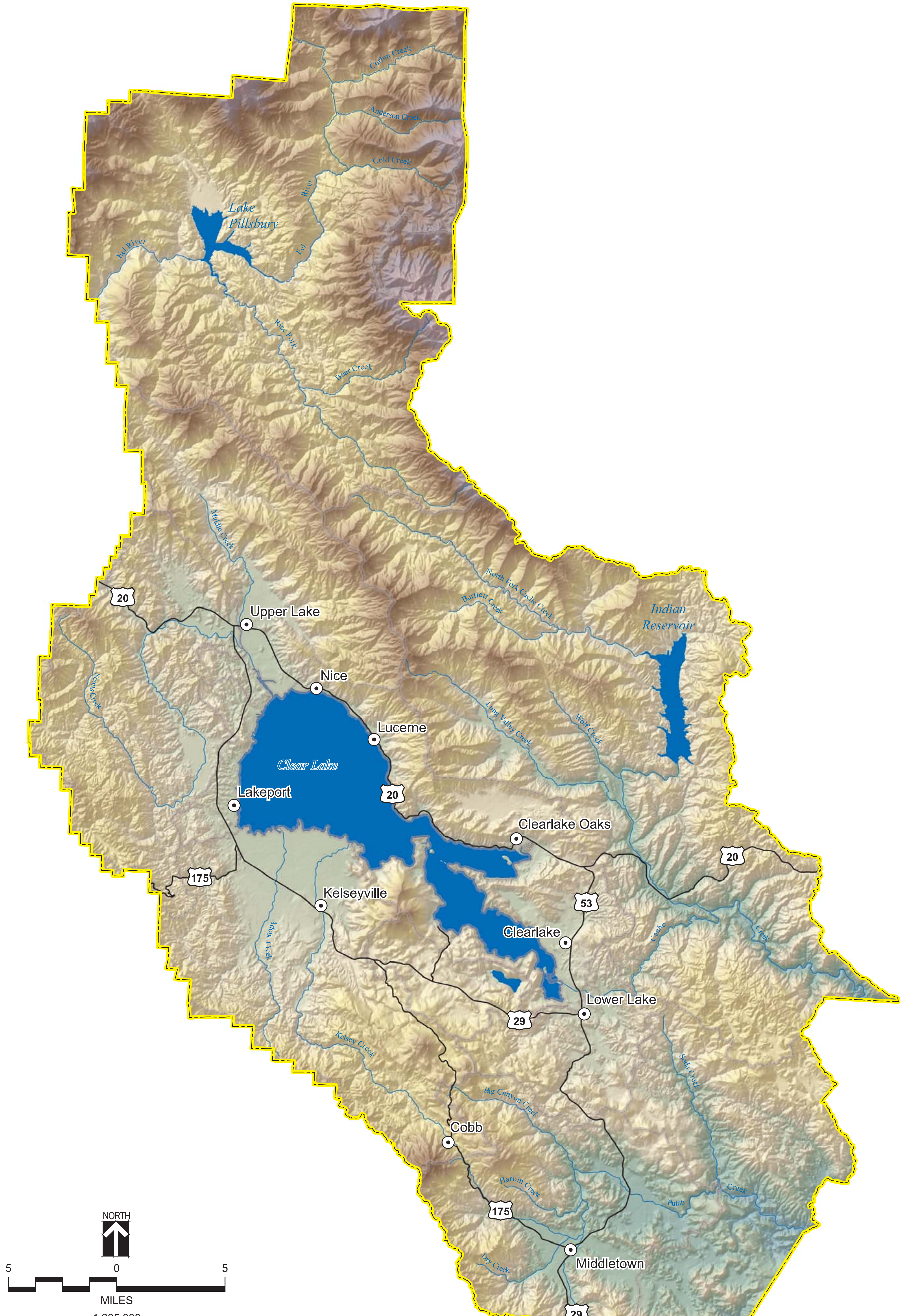
2.7 Agricultural Water Demand by Groundwater Basin

Water demand was calculated to estimate the average year agricultural water use overlying groundwater basins in Lake County. The calculation was performed using 2001 land use data from DWR, and crop irrigation requirements for an average water year from DWR. Acreage of land use of each crop was multiplied by the crop's water demand and a factor representing irrigation efficiency, and then demand for each crop was totaled by groundwater basin. Calculations for each groundwater basin are presented in Appendix A. This data provides a snapshot of approximate water demand near the year 2001; land use changes that occurred after 2001 are not represented by this calculation.

Groundwater Basin	Land Irrigated with Surface Water (acres)	Land Irrigated with Groundwater (acres)	Irrigated Land Total (acres)	Surface Water Demand (acre-ft)	Groundwater Demand (acre-ft)	Total Demand (acre-ft)
Gravelly Valley	0	0	0	0	0	**0**
Upper Lake Valley	1,117	1,509	2,920	4,182	4,075	**8,257**
Scotts Valley	0	856	856	0	2,369	**2,369**
Big Valley	23	6,765	6,788	91	11,363	**11,454**
High Valley	0	64	64	0	36	**36**
Burns Valley	162	5	167	91	14	**105**
Coyote Valley	1,059	348	1,407	3,402	671	**4,073**
Collayomi Valley	33	317	350	146	266	**412**
Lower Lake Valley	0	31	31	0	17	**17**
Long Valley	0	118	118	0	253	**253**
Clear Lake Cache Formation	26	132	158	15	85	**100**
Middle Creek	0	18	18	0	73	**73**
Clear Lake Volcanics	185	2,979	3,164	820	2,271	**3,091**

Table 2-5
Agricultural Demand in Lake County by Groundwater Basin During an Average Year

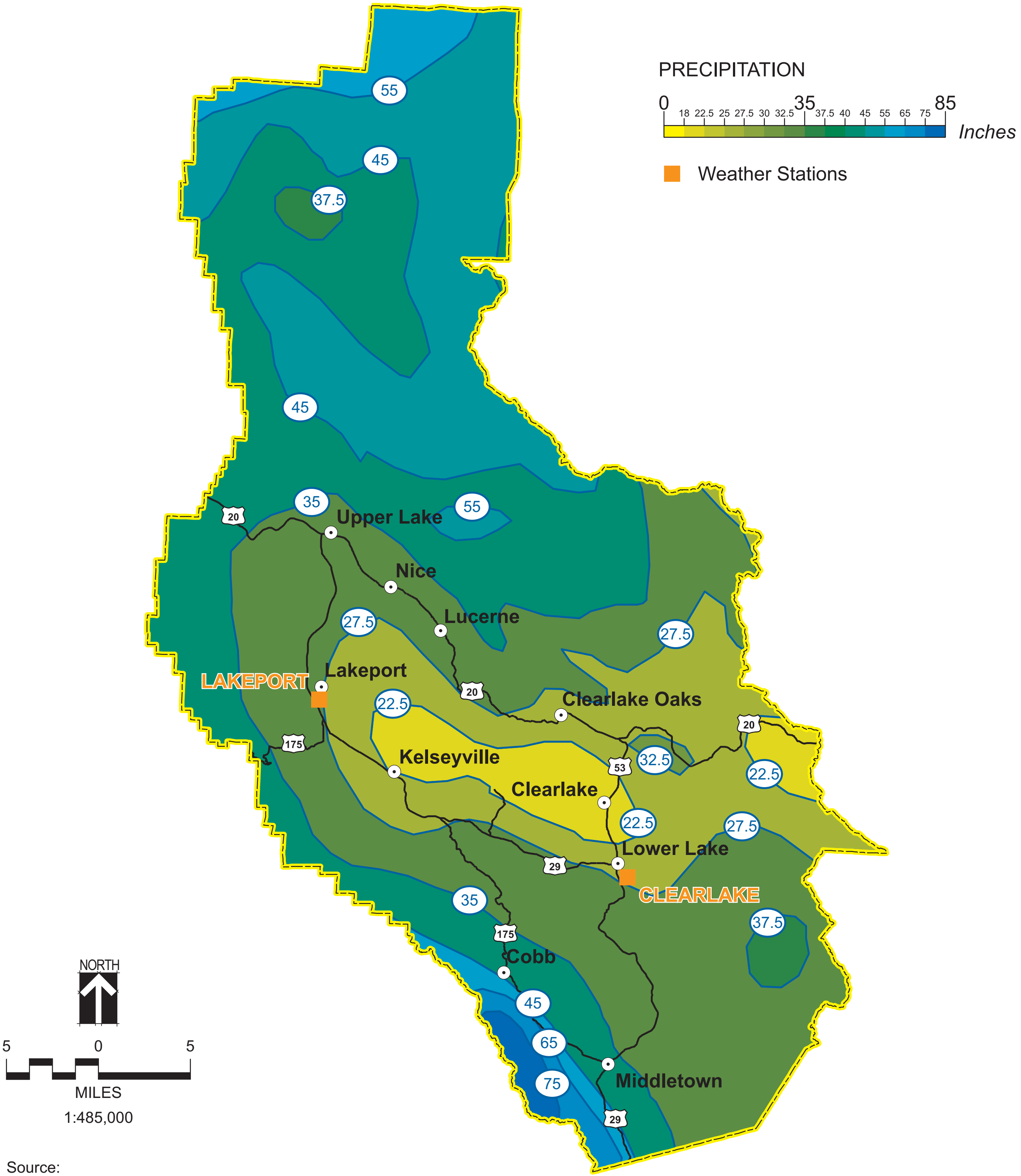
Table 2-5 presents the agricultural water demand for an average year by groundwater basin. Table 2-5 indicates that groundwater is the primary source of water for Lake County groundwater basins. Groundwater basins with a groundwater demand over 1,000 acre-feet per year include: Upper Lake Valley, Scotts Valley, Big Valley, Coyote Valley, and the Clear Lake Volcanics Groundwater Source Area.



Source:
National Geographic TOPO! Software
California Spatial Information Library

CDM

Figure 2-1
Topography



Source:
California Spatial Information Library

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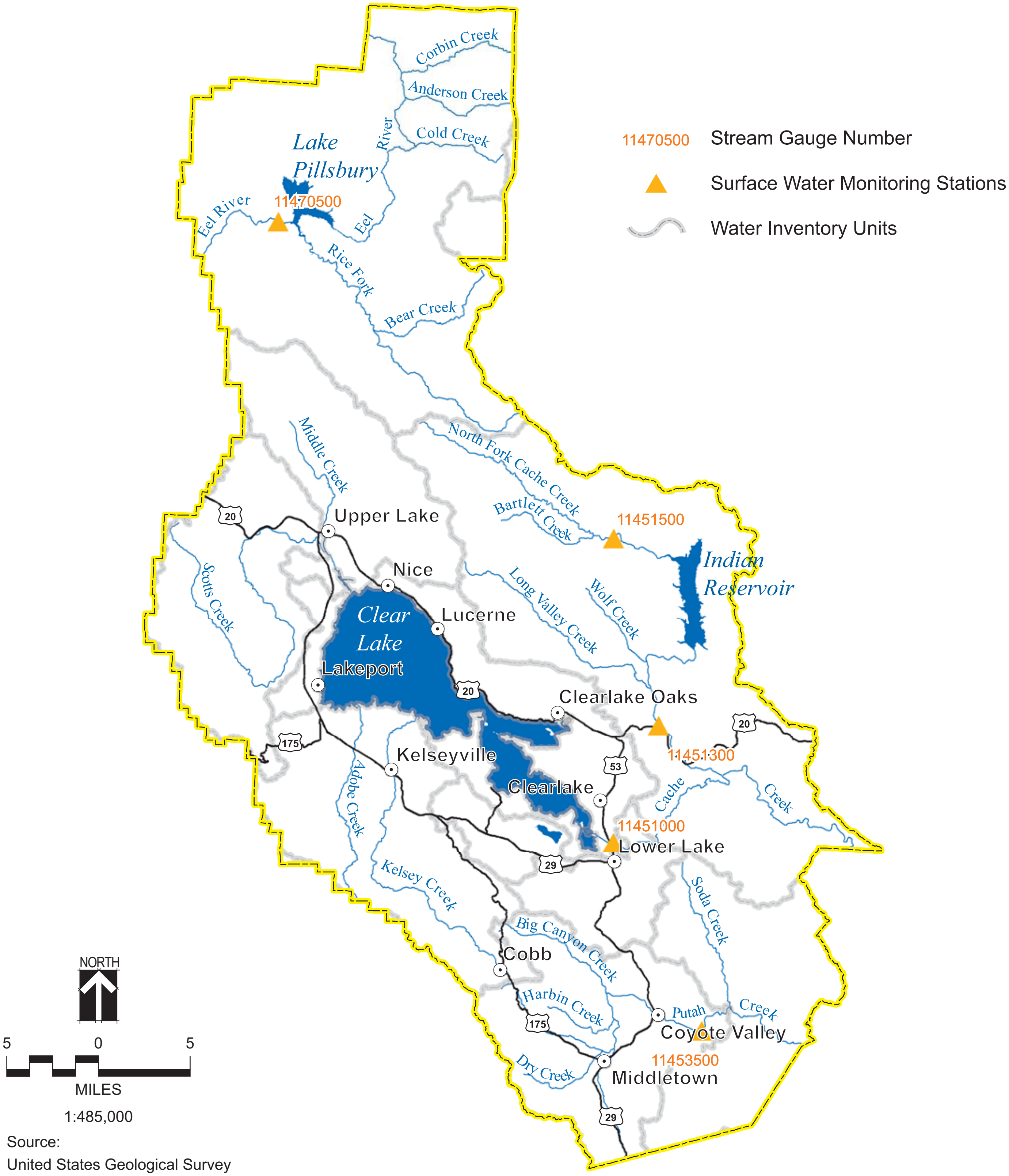
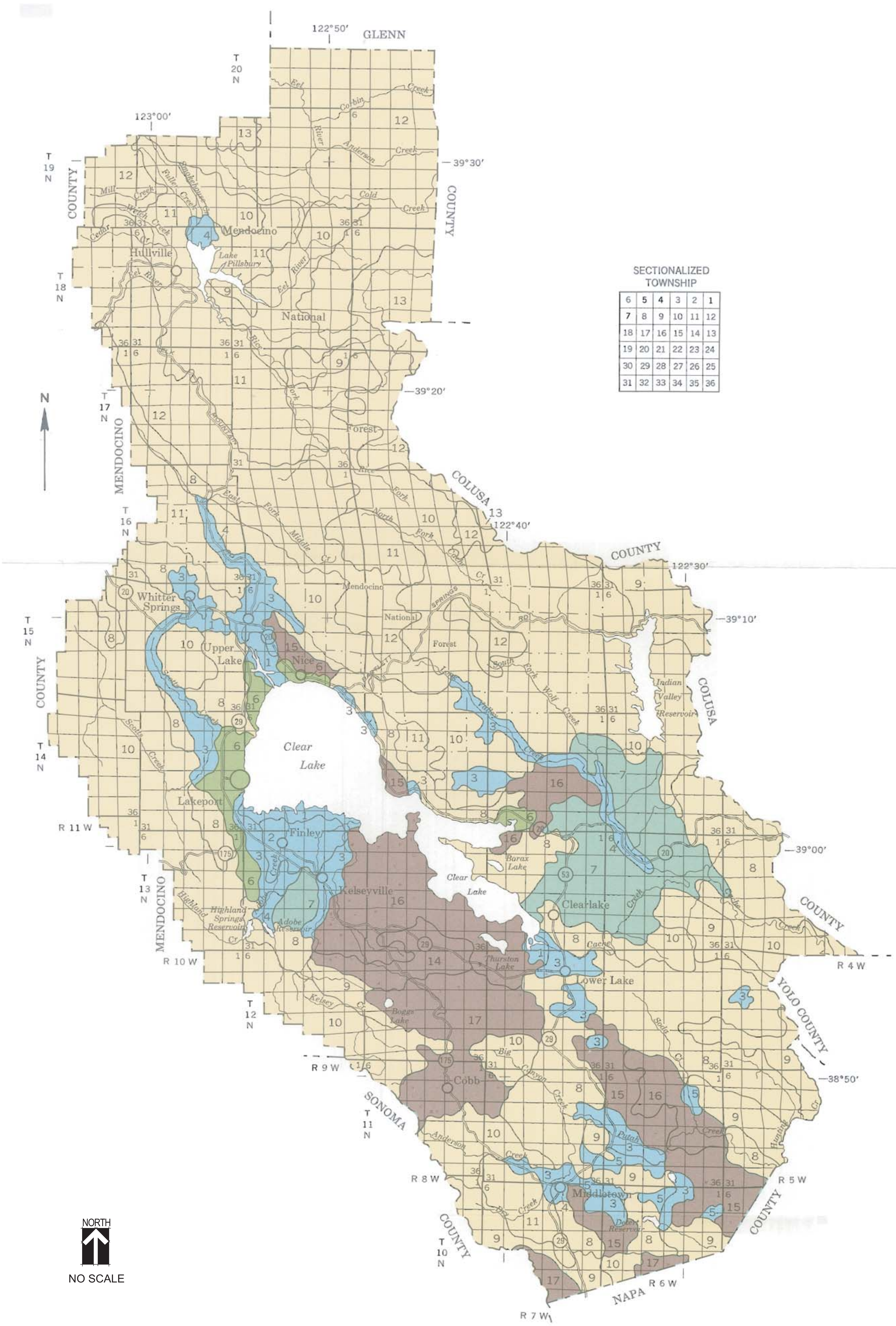
Figure 2-3
Annual Rainfall



Source:
United States Geological Survey
The Lake County Watershed Protection District
California Spatial Information Library

CDM

Figure 2-5
Surface Water Bodies and Stream Gauge Locations



Source:
California Department of Water Resources
California Spatial Information Library

CDM

Figure 2-12
Soils and Legend

LEGEND

NEARLY LEVEL TO STRONGLY SLOPING SOILS IN VALLEYS AND BASINS

1 Tulelake-Fluvaquentic Haplaquolls: Very deep, nearly level, very poorly drained and poorly drained silty clay loam; in lake basins and marshes

2 Cole-Clear Lake Variant-Clear Lake: Very deep, nearly level, poorly drained clay loam and clay; in basins

3 Still-Lupoyoma: Very deep, nearly level, moderately well drained and well drained loam and silt loam; on alluvial plains and flood plains

4 Talmage-Xerofluvents-Riverwash: Very deep, nearly level to moderately sloping, somewhat excessively drained very gravelly sandy loam and very gravelly loamy sand, and Riverwash; on alluvial fans and flood plains

5 Maxwell-Yorkville Variant: Very deep, nearly level to strongly sloping, somewhat poorly drained and well drained clay loam; on valley and basin floors and rims

GENTLY SLOPING TO MODERATELY STEEP SOILS ON DISSECTED ALLUVIAL TERRACES

6 Manzanita-Wappo-Forbesville: Very deep, gently sloping to moderately steep, moderately well drained and well drained loam; on dissected alluvial terraces

MODERATELY SLOPING TO VERY STEEP SOILS ON UPLIFTED, DISSECTED HILLS

7 Phipps-Bally: Very deep, gently sloping to very steep, well drained loam and gravelly sandy clay loam; on uplifted, dissected hills

MODERATELY SLOPING TO VERY STEEP SOILS ON HILLS AND MOUNTAINS

8 Millsholm-Skyhigh-Bressa: Shallow and moderately deep, moderately sloping to steep, well drained loam; on hills

9 Henneke-Okiota-Montara: Shallow, moderately sloping to steep, well drained and somewhat excessively drained very gravelly loam and clay loam; on hills and mountains

10 Maymen-Etsel: Shallow, moderately sloping to very steep, somewhat excessively drained loam and gravelly loam; on hills and mountains

11 Sanhedrin-Speaker-Kekawaka: Moderately deep to very deep, moderately sloping to very steep, well drained loam and gravelly loam; on mountains

12 Neuns-Deadwood-Sheetiron: Shallow and moderately deep, moderately steep to very steep, well drained and somewhat excessively drained gravelly loam and very gravelly sandy loam; on mountains

13 Freezeout-Yollabolly: Shallow and moderately deep, steep and very steep, well drained and excessively drained very gravelly sandy loam; on mountaintops

GENTLY SLOPING TO VERY STEEP SOILS ON VOLCANIC HILLS AND MOUNTAINS

14 Glenview-Bottlerock-Arrowhead: Moderately deep and very deep, gently sloping to steep, well drained very gravelly loam, extremely gravelly loam, and extremely gravelly sandy loam; on obsidian hills

15 Sobrante-Guenoc-Hambright: Shallow and moderately deep, gently sloping to very steep, well drained loam, clay loam, and very gravelly loam; on basalt hills

16 Konocti-Benridge: Moderately deep and very deep, gently sloping to very steep, well drained cobbly loam and loam; on andesite, basalt, and dacite hills and mountains

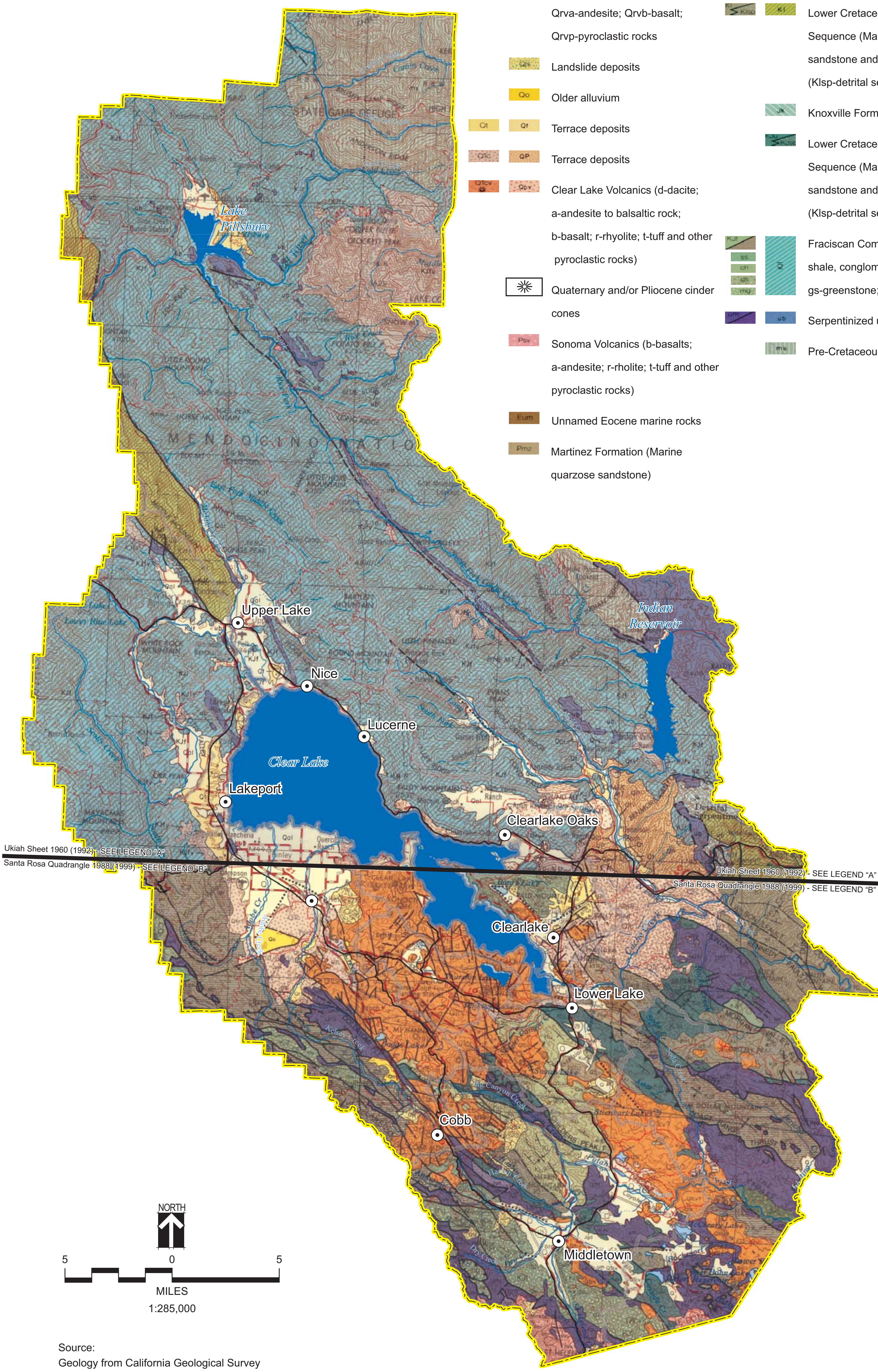
17 Collayomi-Aiken-Whispering: Moderately deep and very deep, moderately sloping to very steep, well drained very gravelly loam and loam; on andesite, basalt, and dacite mountains

Compiled 1985

Source:
California Department of Water Resources
California Spatial Information Library

CDM

Figure 2-12
Soils and Legend

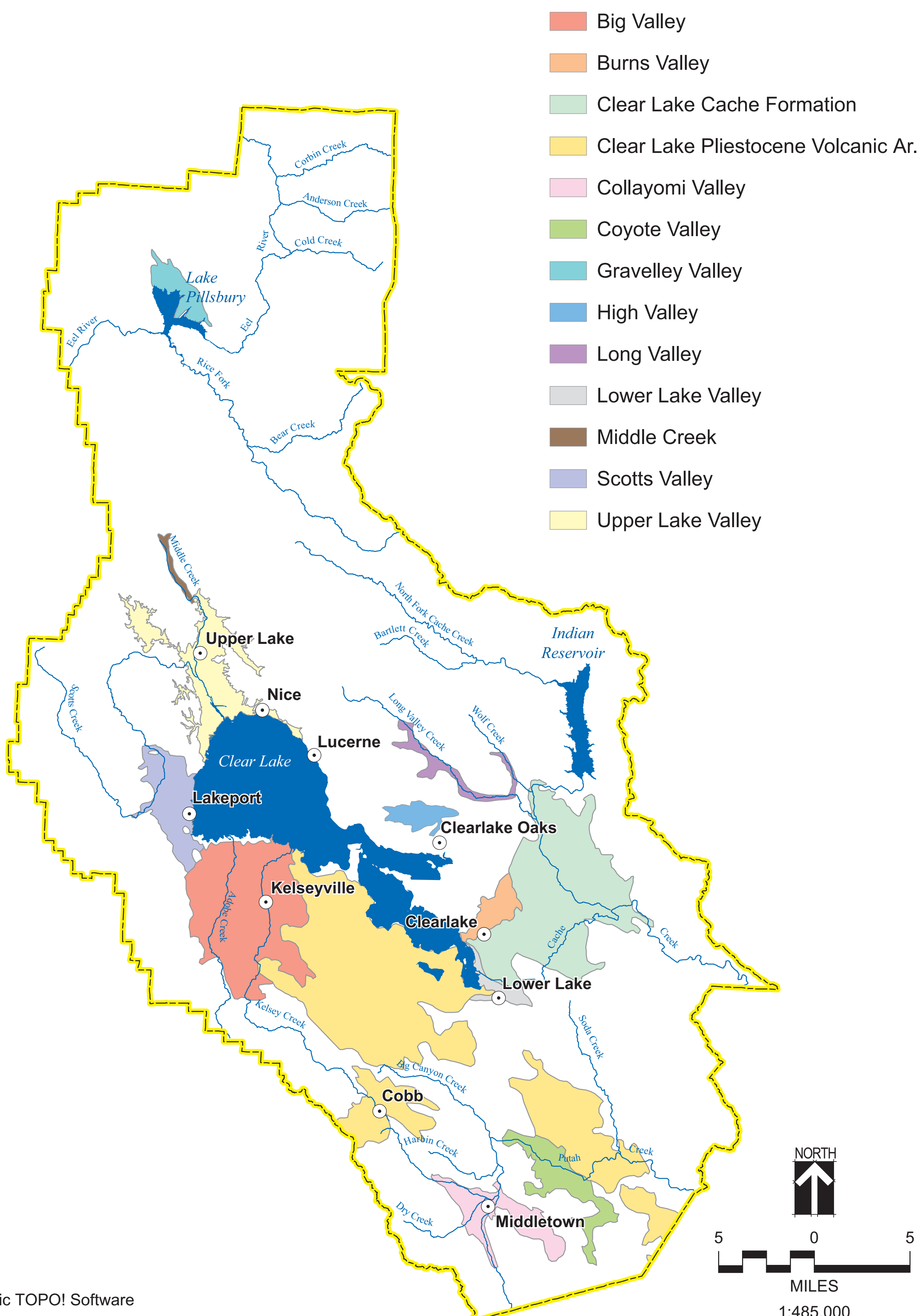


B	A	
Q	Qal	Alluvium
	Qrv	Recent volcanic; Qrvr-rhyolite; Qrva-andesite; Qrvb-basalt; Qrvp-pyroclastic rocks
	Qls	Landslide deposits
	Qo	Older alluvium
Qt	Qt	Terrace deposits
QTc	QP	Terrace deposits
QTcv	Qbv	Clear Lake Volcanics (d-dacite; a-andesite to balsaltic rock; b-basalt; r-rhyolite; t-tuff and other pyroclastic rocks)
		Quaternary and/or Pliocene cinder cones
	Psv	Sonoma Volcanics (b-basalts; a-andesite; r-rholite; t-tuff and other pyroclastic rocks)
	Eum	Unnamed Eocene marine rocks
	Pmz	Martinez Formation (Marine quarzose sandstone)
Ku	Ku	Upper Cretaceous (Undifferentiated marine rocks)
Klsp	Kl	Lower Cretaceous Great Valley Sequence (Marine mudstone, sandstone and conglomerate) (Klsp-detrital serpentine)
	Jk	Knoxville Formation
	KJsp	Lower Cretaceous Upper Jurassic Sequence (Marine mudstone, sandstone and conglomerate) (Klsp-detrital serpentine)
KJf, ss, ch, gs, mg	Jf	Fraciscan Complex* (ss-sandstone, shale, conglomerate; ch-chert; gs-greenstone; mg-metagraywacke)
um	ub	Serpentinized ultramafic rocks*
	ms	Pre-Cretaceous metasedimentary rocks

Source:
Geology from California Geological Survey
California Spatial Information Library

CDM

Figure 2-13
Geology



Source:
National Geographic TOPO! Software
California Spatial Information Library

Figure 2-14
Groundwater Basins

CDM

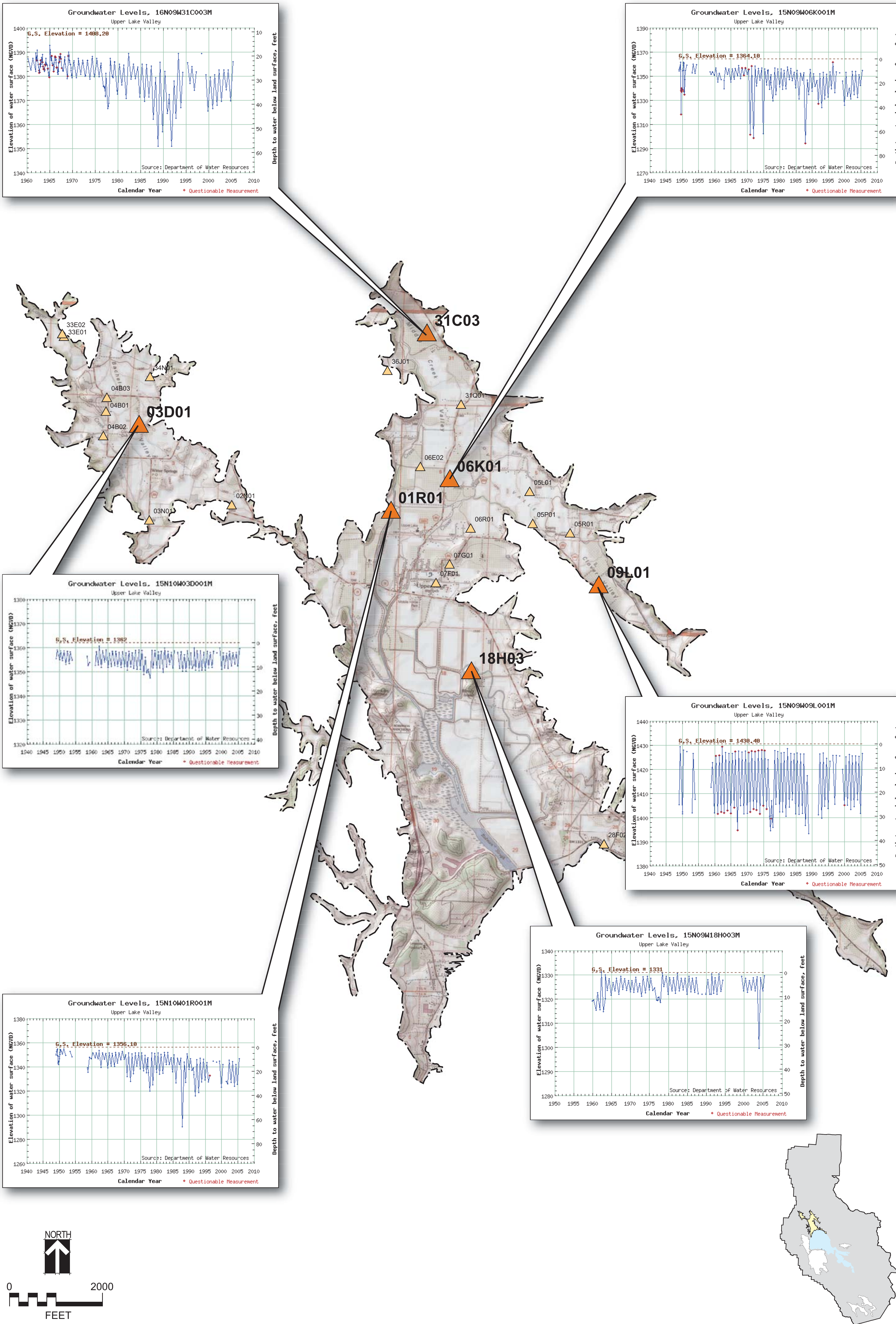


Figure 2-15
Select Hydrographs in the
Upper Lake Valley Groundwater Basin

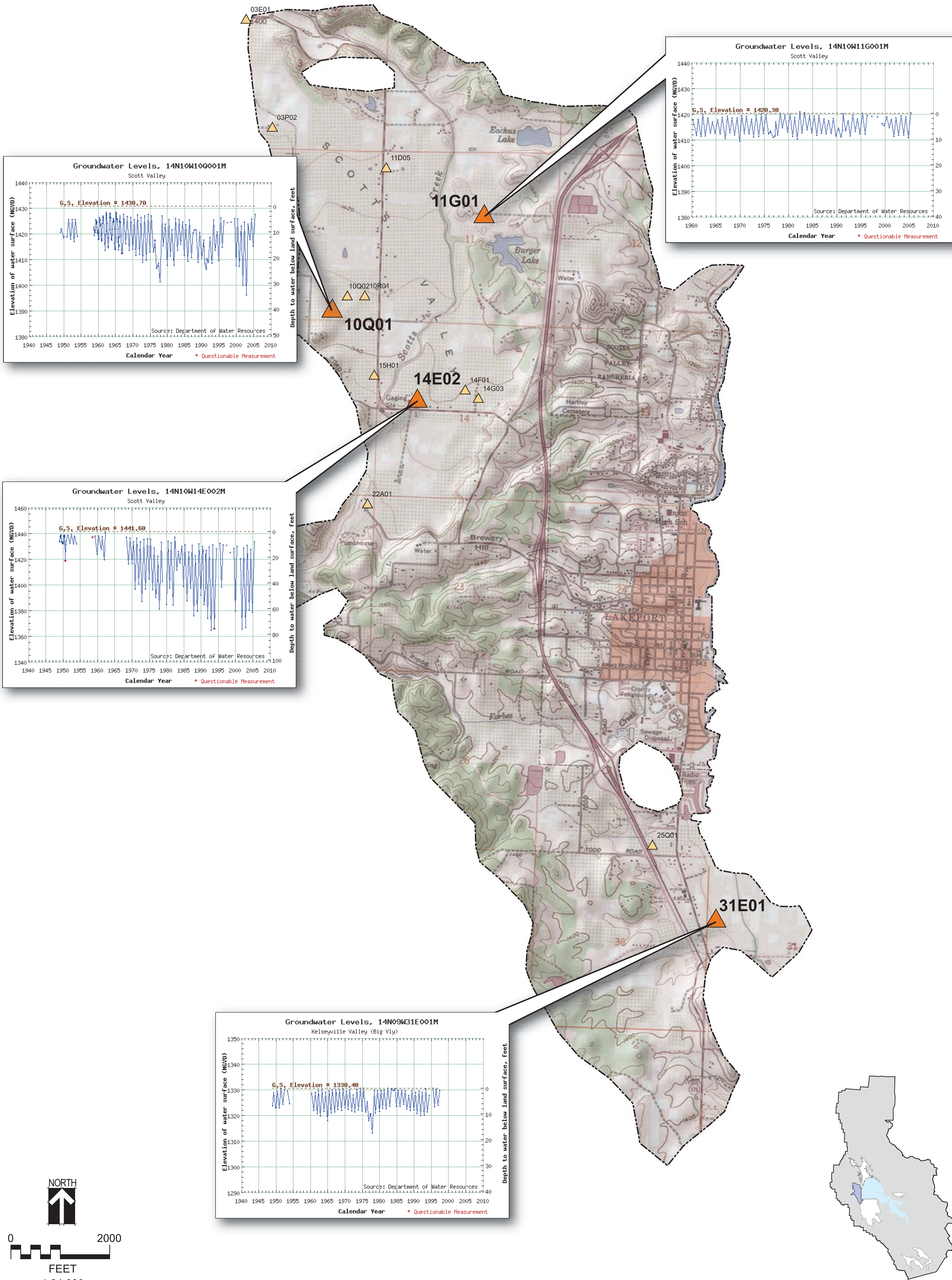


Figure 2-16
Select Hydrographs in the
Scotts Valley Groundwater Basin

CDM

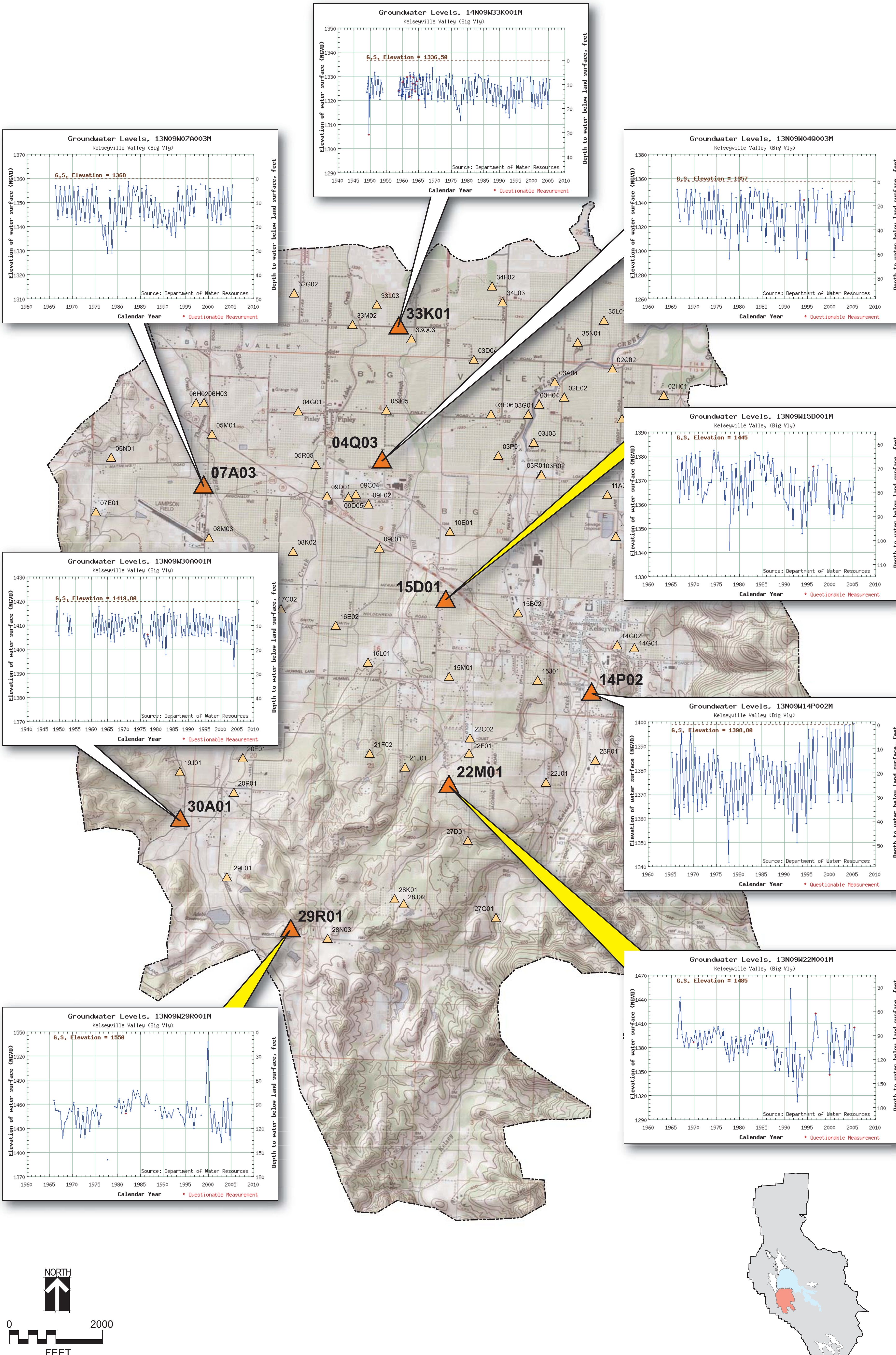
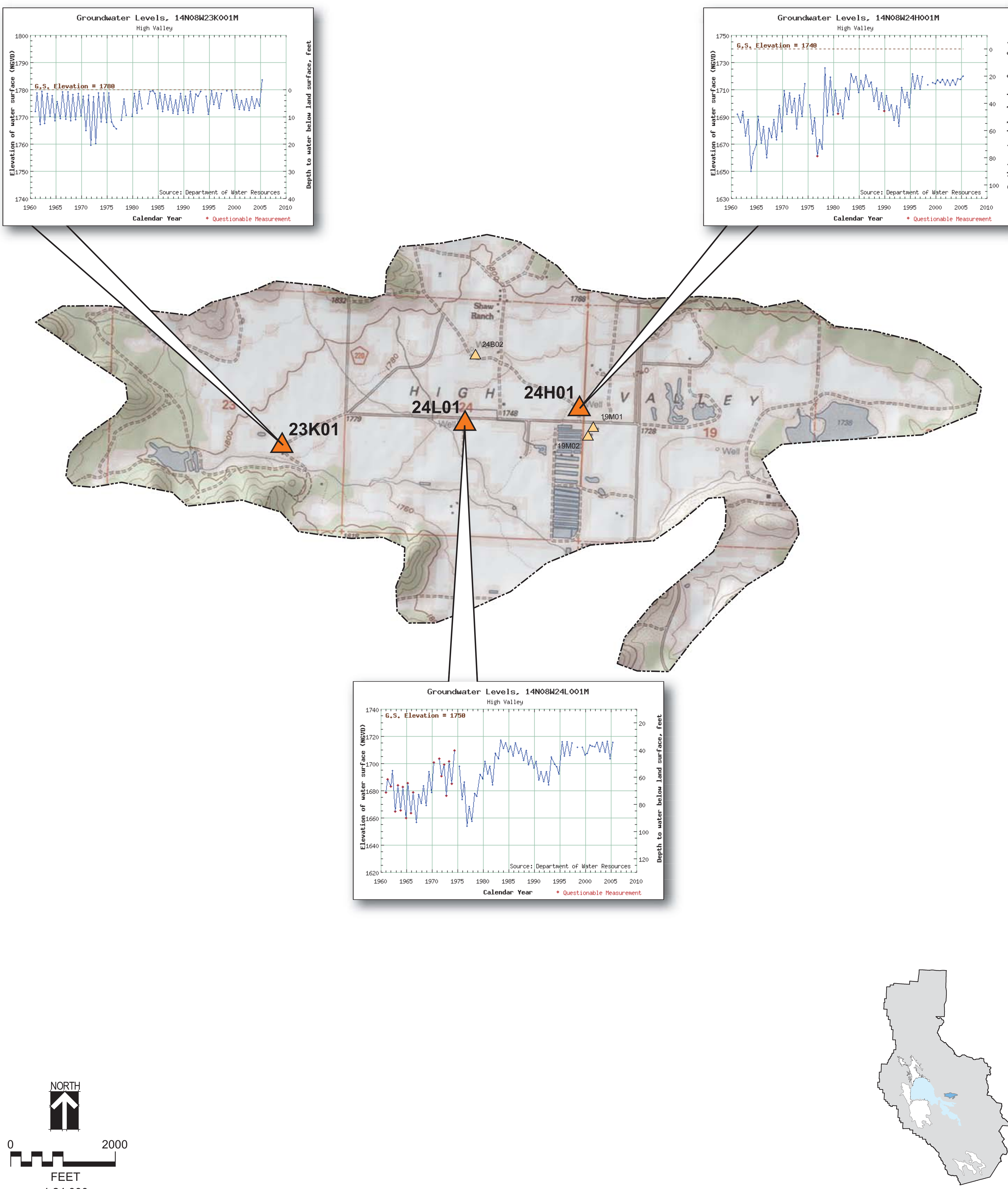


Figure 2-18
Select Hydrographs in the
Big Valley Groundwater Basin

CDM



CDM

Figure 2-21
Select Hydrographs in the
High Valley Groundwater Basin

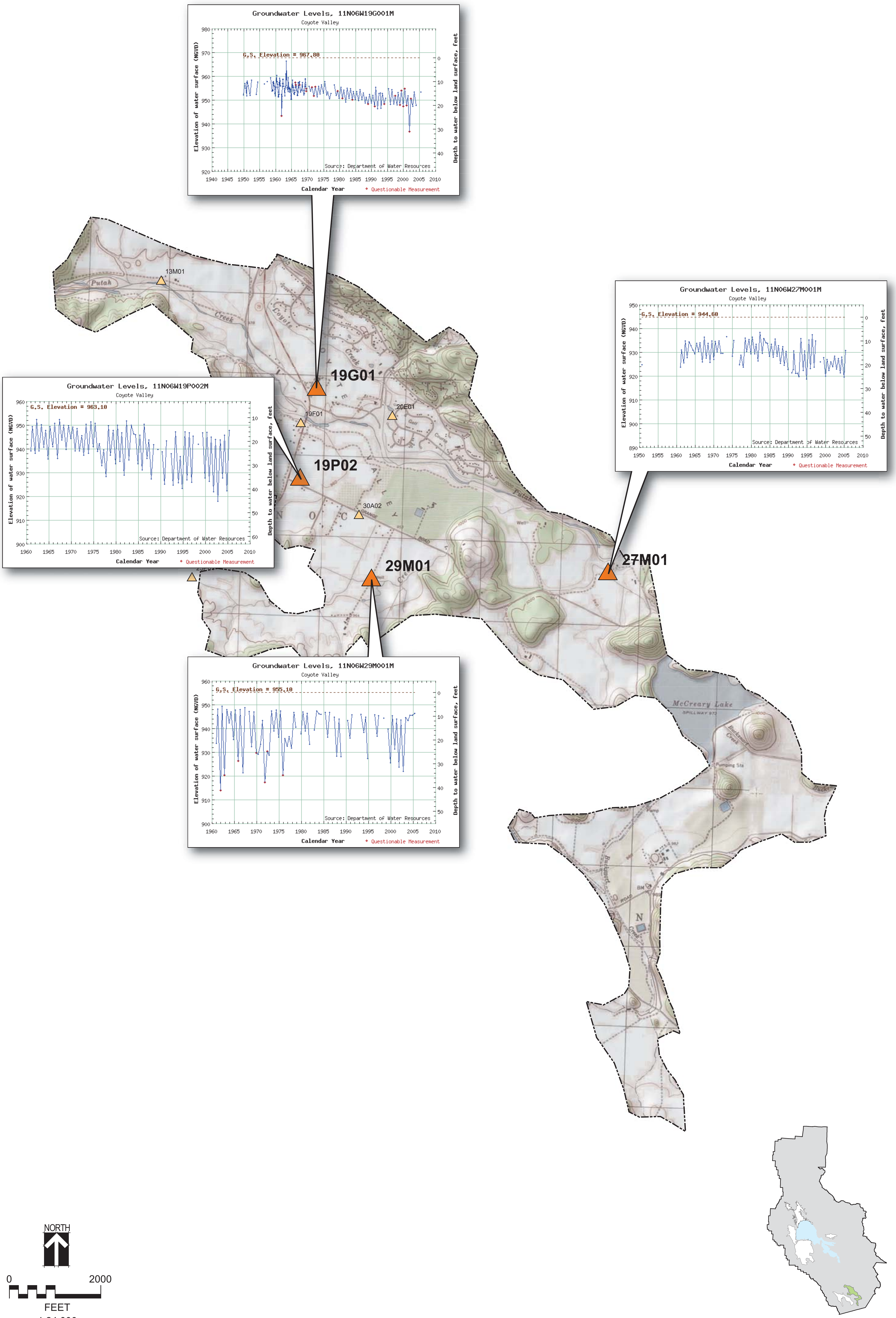


Figure 2-22
Select Hydrographs in the
Coyote Valley Groundwater Basin

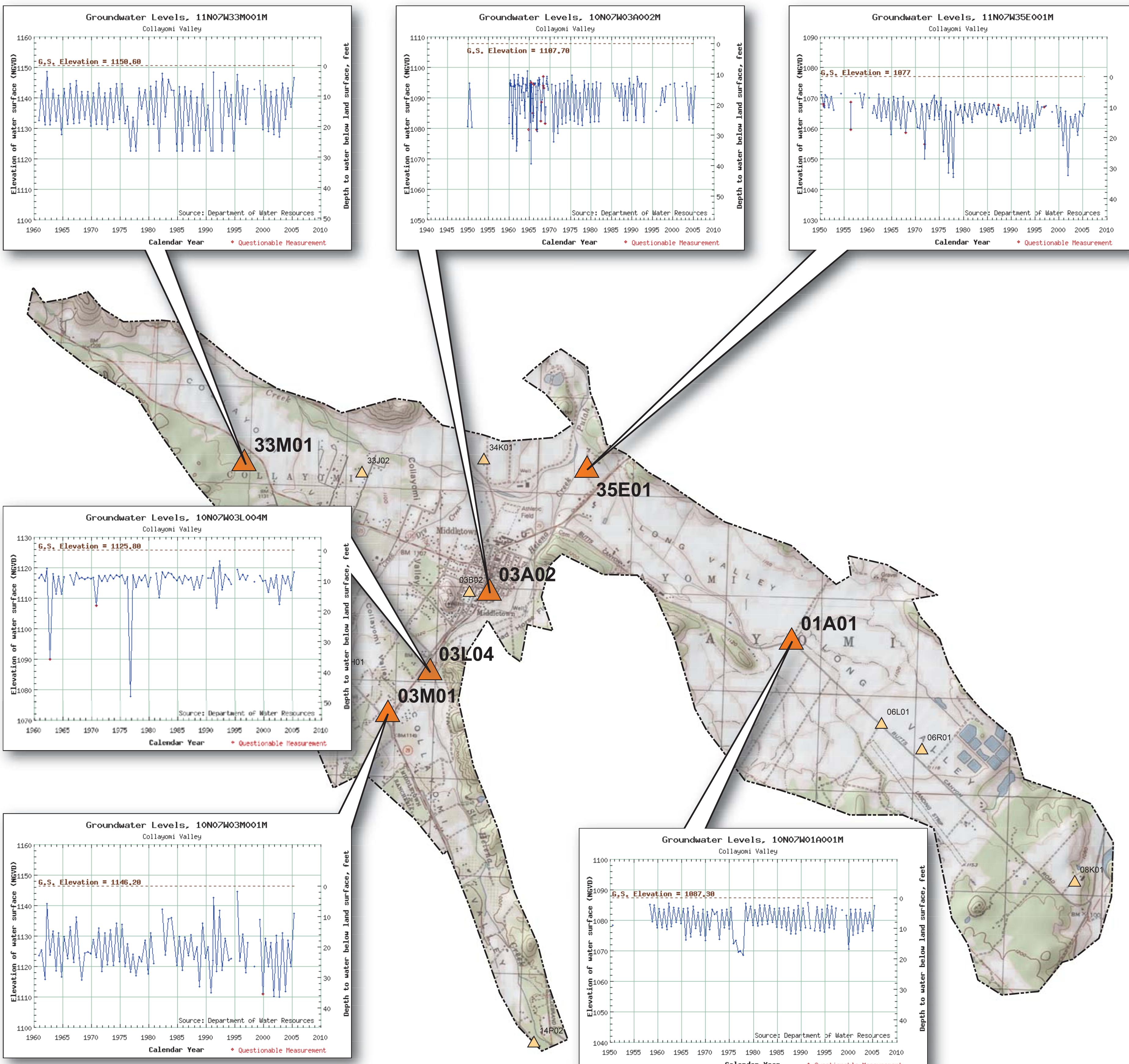


Figure 2-24
Select Hydrographs in the
Collayomi Valley Groundwater Basin

CDM

Section 3
Water Management

3.1 Water Sources and Issues

Surface water and groundwater are the main sources of water for domestic, environmental, and agricultural uses within Lake County. Disputes over surface water rights, deterioration of Clear Lake water quality, and increasing future water demand are major issues facing the County. Groundwater concerns include long-term sustainability of water quality and quantity, and watershed protection.

Sections 3.1.1 and 3.1.2 describe water rights and sources. Section 3.1.2 also describes Lake County groundwater. Section 3.2 describes water management activities and issues within each Inventory Unit.

3.1.1 Surface Water Management

Overview of Surface Water Rights

Water has always been an essential commodity in California and a complex system of water rights has developed. The Gold Rush of 1848 was the first major period in California's history where water resources were used significantly. Since then, competition for water resources has intensified with the growth of residential (domestic), industrial, and agricultural uses.

"Riparian rights" are the highest priority water rights and are attached to land that borders natural waterways. Based on legal precedents, riparian rights water can only be used on the property adjacent to the waterway and users are prohibited from transferring their water. Previously, riparian rights secured unlimited water use. A later court case established that riparian rights water users must be held to a standard of "reasonable use" and are prohibited from waste, unreasonable use, or unreasonable methods of diversion.

"Appropriative rights" are the second type of water rights and can be secured by properties that do not directly border waterways. Miners were the first to initiate this water rights system by posting a notice to divert water and secure the water right. Appropriative water rights were recognized legally in 1855, and are prioritized by a "first in time, first in right" hierarchy. Appropriative water rights must be put to "beneficial use" and can expire if the water is not used for a period of five years.

Surface water rights maintain that water use must be "reasonable and beneficial." Beneficial uses include hydroelectric power, municipal and industrial, domestic, irrigation, stock watering, fire protection, frost protection, recreation, protection and enhancement of fish, wildlife habitat, and aesthetic enjoyment.

Conflicts developed between water users over the distinctions between riparian and appropriative water rights. In order to address these issues, The Water Commission Act of 1913 declared water a property of the state. The Water Commission Act also created a permit process to control water rights and established the State Water Resources Control Board (SWRCB) to govern the permit process. The Water Commission Act became the basis for appropriating water. The Act does not apply to riparian, appropriative, or groundwater rights established prior to 1914 ("Pre-1914" rights).

All riparian and appropriative rights, however, are now subject to the constitutional requirement of reasonable and beneficial use (article X, section 2), as adopted by the people in a 1928 amendment. This duty includes the duty to conserve and make water available for as many uses as possible (including environmental and instream benefits) before it flows to the sea. Subsequent to the 1928 amendment, the area of origin doctrine has developed in California through statute and judicial interpretation, to preserve to watersheds and counties of water origin the water necessary for their reasonable future use and economic growth. Finally, within the past 35 years the public trust doctrine has also been strengthened, requiring the state and its subdivisions to reassess prior water allocations and evaluate new water allocations to preserve fishing, commerce, navigation, and environmental quality whenever feasible.

During years of water shortage, appropriative rights users must cut back their water use. The most recent right-holders are the most junior and are subject to the cutbacks first. Appropriative rights holders continue to be cut back in an inverse priority until the shortage is corrected. If conditions are so severe that a shortage remains even after all appropriative rights holders have stopped using water, then riparian right-holders must share the remaining reduction.

Conflicts regarding the quantity of water available for parties with water rights can be resolved by adjudicating the water body. In this situation, a court judgment allocates the water of a natural waterway between parties within the drainage area. A general adjudication of water rights determines the validity and extent of existing water rights in a given area. Adjudication is a legal process, conducted through the Superior Court in the County in which the water is located. Adjudication does not create new rights, it only confirms existing rights. Lake County has no adjudicated waterbodies.

Surface Water Supplies in Lake County

Surface water is an important source of water in Lake County. Agricultural and domestic users that own properties adjacent to waterways have riparian water rights to local streams. Lake County water users generally have water rights on smaller, often ephemeral waterways. The larger two water bodies that supply surface water to users, Clear Lake and Putah Creek, are discussed below in more detail.

Clear Lake

Clear Lake is a large, freshwater lake roughly in the center of Lake County. Some water users, including the Highlands Water Company and the City of Lakeport, have limited riparian water rights to Clear Lake. Yolo County, to the southeast of Lake

County, holds the majority of the water rights to Clear Lake, its tributaries, and Cache Creek (which drains the lake). Most Lake County purveyors do not have rights to Clear Lake and must enter into contracts with Yolo County to purchase Clear Lake surface water.

Numerous water and ditch companies dating back to the late 1800s acquired appropriative water rights from Cache Creek and its source, Clear Lake. The Yolo Water and Power Company later obtained many of these companies. In 1912, the Yolo Water and Power Company made an application for water from Cache Creek, including Clear Lake and all the streams flowing into the lake. Up to this point, Lake County had never applied for water rights and so the water right was given to the Yolo Water and Power Company. Eventually the Clear Lake Water Company purchased the Yolo County Water and Power Company, which was then purchased by Yolo County Flood Control and Water Conservation District. Today the Yolo County Flood Control and Water Conservation District's appropriative water right allows them to divert up to 150,000 acre-feet of water annually from Clear Lake with certain conditions. The Gopcevic Decree (1920) established Yolo Water and Power's water right for Clear Lake to be between 0 and 7.56 feet Rumsey and required the lake to be operated between 0 and 7.56 feet Rumsey, with certain exceptions during flood conditions. The Solano Decree (1978, revised March 30, 1995) regulates summer lake levels and the maximum amount of water that Yolo County Flood Control and Water Conservation District can divert. Section 4.6.1 discusses the Solano Decree in further detail.

Putah Creek

Putah Creek flows southeast through the southern portion of the County. It passes through the community of Hidden Valley before it enters Napa County. The Bureau of Reclamation and agencies within Solano County constructed the Solano Project on Putah Creek within Napa and Solano Counties. The Solano Project, which began operation in 1959, includes the following facilities:

- Monticello Dam, which captures water from Putah Creek in Lake Berryessa;
- Putah Diversion Dam, which diverts water out of Lower Putah Creek just downstream of Monticello Dam; and
- Putah South Canal, which delivers water to local agencies.

After the creation of the Solano Project, upstream users within Lake and Napa Counties were involved in several disputes related to diversions of water from Putah Creek. The two settlements described below established diversion amounts for the entire creek.

<u>Putah Creek Upstream Watershed Settlement</u>

In 1995, the Condition 12 Settlement Agreement settled longstanding disputes between appropriative water rights holders and Solano Water Agency. This settlement placed a cap on future water development in the Lake Berryessa watershed and allocated a limited amount of future water development rights to projects in Napa and Lake Counties. A court-appointed Watermaster monitors water use and enforces the settlement.

Putah Creek Downstream Settlement
In 1996, the Sacramento Superior Court ruled that additional flows were needed in Putah Creek downstream from the Solano Diversion Dam. Solano parties appealed the judgment. The case was settled in 2000 with the Putah Creek Accord, which resolved all disputes. The settlement provides increased flows to Putah Creek, but reduces flows when Lake Berryessa storage is low. The settlement also includes a process for addressing illegal surface water diversion in Putah Creek. A committee, including Yolo and Solano County representatives, was established to address issues on the creek including habitat enhancement projects. A Streamkeeper was hired to monitor habitat. This settlement does not affect water use as rights in Lake County.

3.1.2 Groundwater

Groundwater Rights

The SWRCB has no jurisdiction over groundwater use. Only adjudicated basins have an established system of rights; in non-adjudicated groundwater basins, users are not required to apply for groundwater rights before use.

Similar to surface water adjudications described above, groundwater basins become adjudicated when local landowners choose to settle groundwater disputes in court. The court must then make the decision on how to distribute the groundwater resources fairly. Typically, a Watermaster is appointed to monitor the basin and to ensure all parties pump only the amount of water they have been allotted. To date, Lake County has no adjudicated groundwater basins.

State law provides for management of groundwater by local agencies (CWC Sec. 10750 et seq.). The Lake County Water Protection District adopted a groundwater management plan on May 18, 1999 for the Big Valley groundwater basin pursuant to this law. The District will be adopting a groundwater management plan for all 12 groundwater basins and one source area within the County in early 2006. Lake County also adopted a groundwater export ordinance (Lake County Code Chapter 28) on February 9, 1999 that requires a permit to export more than one acre-foot per year of groundwater from the County. In order to obtain a permit, the applicant must demonstrate the export will not adversely affect groundwater supplies in Lake County.

Well Distribution

Lake County has approximately 5,300 wells. The wells are classified by purpose as domestic, irrigation, municipal, monitoring, and other. Approximately 3,400 of the 5,300 wells in the County are in a groundwater basin as defined by DWR. Table 3-1 presents the total number of wells by type within Lake County groundwater basins.

Table 3-1
Number of Wells by Use and Groundwater Basin

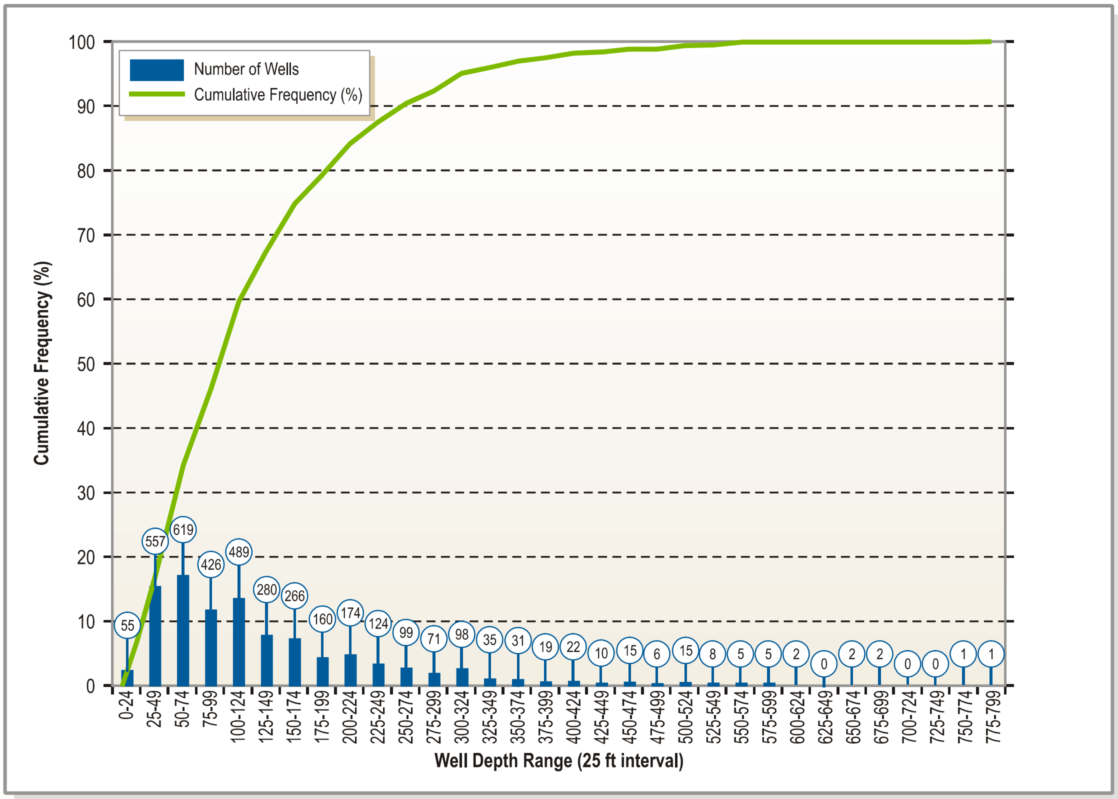
Groundwater Basin	Domestic Wells	Irrigation Wells	Municipal Wells	Monitoring Wells	Other Wells	Totals
Clear Lake Cache Formation	71	9	0	10	7	97
Scotts Valley	235	87	2	0	31	355
Long Valley	30	7	0	0	4	41
High Valley	19	10	0	0	8	37
Burns Valley	86	13	0	3	9	111
Collayomi Valley	141	34	1	16	22	214
Coyote Valley	86	17	5	6	13	127
Lower Lake	243	25	8	9	13	298
Gravelly Valley	13	0	1	0	3	17
Clear Lake Pleistocene Volcanics	537	59	11	8	52	667
Middle Creek	39	3	0	0	4	46
Upper Lake	243	99	6	22	68	438
Big Valley	463	297	9	29	162	960
Total of All GW Basins	2219	664	67	101	399	3450
All Wells not in a GW Basin	1377	149	41	119	197	1883
Total for Lake County	**3596**	**813**	**108**	**220**	**596**	**5333**

Note: “Municipal Wells” include wells listed as municipal or public. “Other Wells” Include wells listed as abandoned, exploratory other, stock, test, unknown, or unused.
Source: Department of Water Resources Well Completion Report

Table 3-1 shows that of the 5,333 wells in Lake County, 3,596 wells are domestic, 813 wells are irrigation, 108 wells are municipal wells, 220 wells are monitoring wells, and 596 wells are listed as “other”. Figure 3-3 provides the number of wells drilled by year in Lake County. The majority of all wells drilled are for domestic use. There has been an increase in the total number of wells drilled from 1999 to 2004.

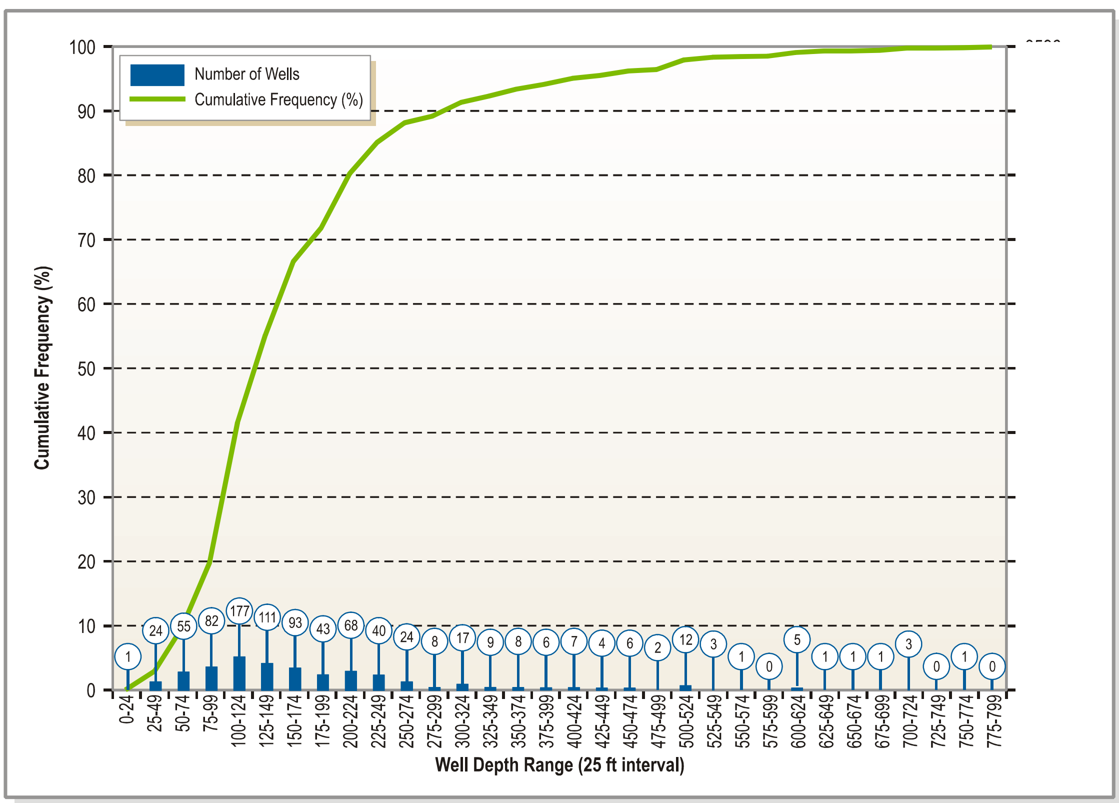
Well Depths

DWR’s Well Completion Report database also provided well depth and well use data. This database identifies well categories (either domestic or irrigation) and well depth. Figures 3-1 and 3-2 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Lake County. The figures are based on a total of 4,409 well records. The cumulative frequency, on the left axis of the figure, shows the percent of all wells that are shallower than the line. For example, approximately 50 percent of all domestic wells are shallower than 100 feet deep, and approximately 50 percent of all irrigation wells are shallower than 125 feet deep.



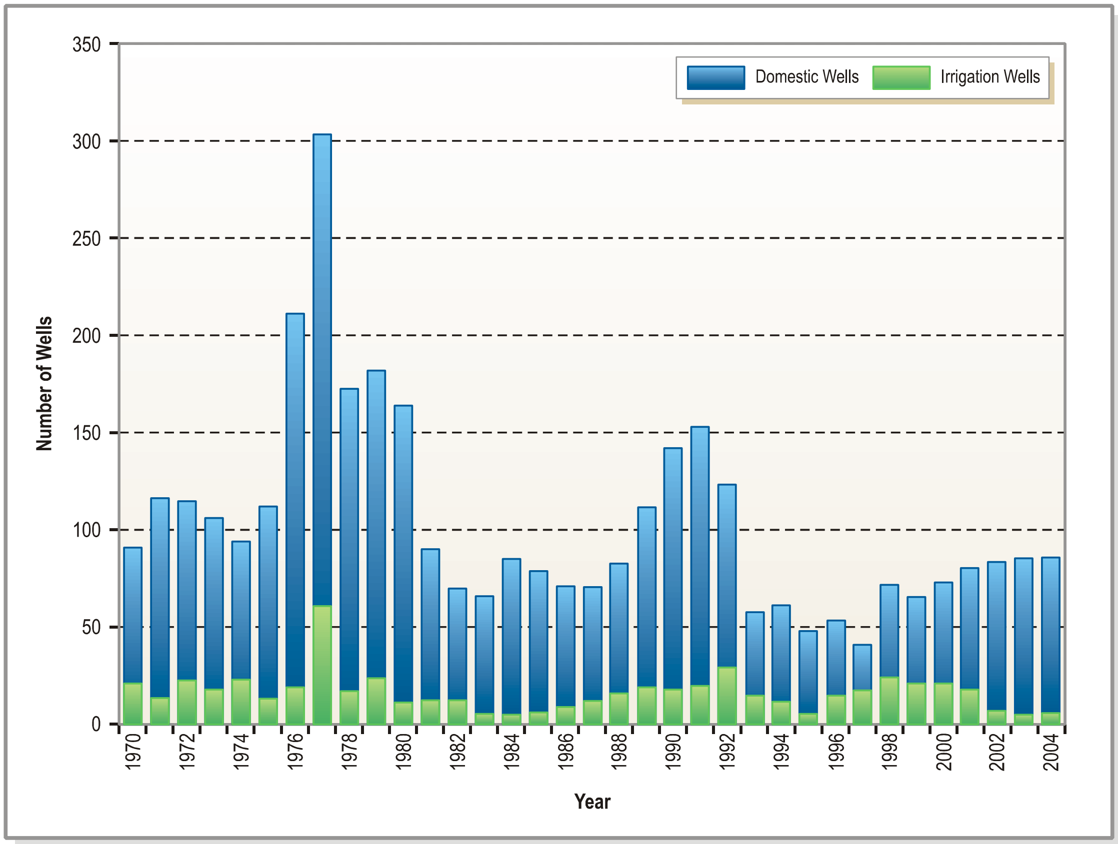
Source: Department of Water Resources

Figure 3-1
Depth Distribution of Domestic Wells in Lake County



Source: Department of Water Resources

Figure 3-2
Depth Distribution of Irrigation Wells in Lake County



Source: Department of Water Resources

Figure 3-3
Wells Drilled by Year in Lake County

Groundwater Response to Extraction

Groundwater levels typically decline during the summer period because of the higher extraction rates required to meet increased demands. In Lake County, groundwater hydrographs show a typical groundwater response to extraction. Long-term hydrographs in Lake County groundwater basins generally indicate that groundwater levels decline in the summer while groundwater is being extracted, and groundwater levels recover during the winter when demands are much lower. Evidence shows that during drought periods the groundwater basins do not fully recover, possibly leading to short-term overdraft. However, long term trends in the hydrographs in Lake County appear to indicate that annual groundwater extractions are not exceeding annual groundwater recharge in groundwater basins.

Groundwater Use

The majority of water use in Lake County is supplied by groundwater. Figure 3-4 (at the end of this section) shows water sources for land within Lake County. Figure 3-4 illustrates that surface water use occurs primarily in the northwestern lake area near Scotts Creek and Middle Creek. Surface water use also occurs in Big Valley near Clear Lake.

3.2 Water Management

This section provides an overview of the institutional issues regarding water supply sources, land uses, management practices, and water-related issues and concerns for water users and agencies throughout the County. This information is used to produce and verify the data in Section 4, which presents a detailed accounting of Lake County's water inventory. For the data to be clearly understood, it is important to understand the sources of water supply and the activities that create the demand.

The following sections provide information about each Inventory Unit and a summary of water resources management information collected during interviews with water agencies. As discussed in Section 1, Lake County is divided into ten Inventory Units to develop a detailed water supply and use analysis. The Inventory Units have similar geologic, topographic, and political characteristics. Table 3-2 shows the major communities associated with each Inventory Unit; this list of communities formed the basis for water agency interviews and research.

Table 3-2
Major Communities in Inventory Units

Inventory Unit	*Major Communities Within Inventory Unit*
Upper Putah	Middletown Coyote Valley
Middle Putah	
Shoreline	Buckingham Clearlake Clearlake Oaks Glenhaven Lucerne Lakeport Nice Soda Bay
Thurston Lake	
Middle Creek	Upper Lake
Scotts Creek	
Big Valley	Adams Springs Cobb Finley Kelseyville Loch Lomond
Lower Lake	Lower Lake
Cache Creek	
Eel River	

Lake County includes multiple agencies that supply municipal water, but almost no agencies that provide agricultural water supplies because growers typically rely on individual wells. Data on the municipal water agencies were collected during an interview process. Selected agencies were interviewed based on size and location to obtain information from agencies that were distributed throughout the County. Data on crop acreage and population counts were obtained from the Department of Water Resources Northern District. The following Inventory Unit descriptions vary based on availability of data. Table 3-3 provides a summary of municipal water agencies who were interviewed.

Table 3-3
Lake County Municipal Water Agency Interview Summary

Agency	Inventory Unit	Interviewee	Surface Water	Groundwater
Callayomi CWD	Upper Putah	Frank Haas General Manager		X
Hidden Valley Lake CSD	Upper Putah	Steve Shaw Utility Superintendent		X
City of Lakeport	Shoreline	Mark Brannigan Utility Superintendent	X	X
Buckingham Park CWD	Shoreline	Robert King Board of Directors Chair	X	
Highlands Water Company	Shoreline	Jeff Davis Plant Supervisor Norm Birdsey Lead Operator	X	
Konocti CWD	Shoreline	Frank Costner General Manager	X	
Upper Lake CWD	Middle Creek	Rochelle Henry General Manager		X
Cobb Area CWD	Big Valley	Robert Stark General Manager		X
Lake County Special Districts	Shoreline Big Valley Upper Putah Cache Creek	Peggie King Resources Manager	X	X

Overall, the interviews demonstrated that municipal and agricultural users often had similar concerns throughout the County. The sections below summarize these countywide concerns. Following sections provide a summary of information for each Inventory Unit; additional information about individual municipal water agencies is in Appendix C.

Environmental groups within the County are also engaged in water resources activities. Appendix C also identifies these environmental groups, and summarizes their goals and activities.

3.2.1 Water Management Issues

3.2.1.1 Typical Agricultural Water User Issues

Agricultural water users within Lake County are concerned about water quality, irrigated lands water quality discharge waivers, water quantity, recycled water for agricultural use, water rights, and groundwater management. Agricultural experts were interviewed to obtain information regarding the agricultural community's concerns (Hajik 2005; March 2005; Seeley 2005; Elkins 2005).

Clear Lake Water Quality

Water quality concerns differ for surface water and groundwater. Agricultural users have concerns that Clear Lake is not meeting mercury or nutrient water quality objectives. Water quality problems result from erosion within the watershed. After wildfires remove the vegetation, drainage from these areas causes erosion problems, resulting in increased sediment, nutrients (e.g. phosphorus), and mercury flowing into Cache Creek. Ongoing Scotts Valley and Middle Creek wetlands restoration projects will help reduce these concerns.

Groundwater Quality

Groundwater quality issues in Lake County include high levels of boron and chloride that can be harmful for perennial crops (such as orchards) that are sensitive to these constituents. Groundwater also has high bicarbonate and acid levels. Some vineyards using groundwater must also manage bacterial water quality problems (Elkins 2005). In some areas, growers indicated a decrease of groundwater quality with depth; however, this issue was not widespread.

Agricultural Waivers Program

Growers are participating in a watershed coalition group, which monitors the water quality of discharge from irrigated lands and provides a Regional Water Quality Control Board waiver for participating growers. The growers must pay fees associated with discharge. There is no documentation of existing pesticide issues in Lake County.

Urban Development

The agricultural community is concerned that increased urban development could compromise agricultural water supplies. Conversely, some areas could benefit by increased urban development by using recycled water as an agricultural water supply.

Lack of Local Water Rights

Local residents and the agricultural community are very concerned about the lack of locally-held water rights. Legal requirements to perfect a riparian or appropriative water right can cost a great deal. Clear Lake water users (which include some growers) are also concerned about payment to Yolo County for use of Clear Lake water.

Future Adjudication of Groundwater

Lake County agricultural experts indicate that the farming community is concerned about future adjudication of groundwater. Farmers would prefer local control over their groundwater resources.

3.2.1.2 Typical Municipal Water User Issues

Municipal water issues within the County include groundwater supply and quality, surface water quality, infrastructure needs, water rights, and other needs. Table 3-3 indicates the municipal agencies that were interviewed to develop this list of concerns.

Groundwater Supplies

Municipal water agencies are concerned about groundwater supply. They believe that a planned study of groundwater resources will be beneficial to manage groundwater basins. Groundwater quality is another concern. Agencies rely on groundwater supply for domestic users, and ongoing water quality protection is important. In valley areas, wastewater flows can compromise the groundwater quality.

Surface Water Quality

Agencies that rely on surface water from Clear Lake are concerned with surface water quality. Algae blooms in Clear Lake are caused by cultural eutrophication. During the summer the algae blooms affect water odor and taste, requiring increased water treatment. Runoff from streams increases turbidity in the water during the winter. Rather than addressing these surface water quality concerns independently, it may be beneficial to form a cohesive group or to have a single entity, such as Lake County, perform regular water quality monitoring and implement projects to improve water quality.

Infrastructure Improvements

Many agencies have a need for infrastructure maintenance and upgrades. Emergency generators could keep wells pumping during power outages. Replacement of corroded or undersized distribution lines, drilling additional wells, upgrading treatment plants for capacity and newer methods of treatment (such as ozone), additional storage, and upgrading SCADA systems would help to decrease supply reliability risks and improve water quality.

Locally-Held Water Rights

Agencies that rely on Clear Lake water for supply are also very concerned about the lack of locally-held water rights. Those agencies with surface water rights have minimal rights and must obtain most of their local, adjacent water through payment to Yolo County. Agencies are concerned with paying YCFCWD for water pumped from Clear Lake.

Miscellaneous

Other municipal issues include a need for personnel resources to prepare grant applications. Agencies do not have the financial resources to redirect a staff member to focus on grant applications, but without receiving grants the agencies cannot go forward with repairs and upgrades. Agencies would also like help with restoration and maintenance of creeks and watersheds to protect supplies and reduce flood risks.

3.2.2 Inventory Unit Water Supply and Use

This section identifies locations of municipal water agencies in the County, organized by Inventory Unit. It also summarizes water uses and water sources within each Inventory Unit. Detailed information about selected municipal agencies is available in Appendix C.

3.2.2.1 Upper Putah Inventory Unit

The Upper Putah Inventory Unit is in the southwestern portion of Lake County, and includes approximately 69,046 acres, as shown in Figure 3-5.

The Upper Putah Inventory Unit includes the communities of Anderson Springs, Middletown, and Hidden Valley Lake. The 2001 population of the Upper Putah Inventory Unit was 6,766. The primary irrigated crop types in this region are grapes, pasture, grain, and other deciduous crops. The total irrigated crop area in 2001 was 945 acres, and total dry-farmed crop area was 820 acres. Non-irrigated crops include grain, pasture, and walnuts.

Urban water users are served by municipal systems or are self-supplied, depending on their location. Agricultural water users are self-supplied. Groundwater is the primary source of supply for both urban and agricultural water users. Municipal water systems in the Upper Putah Inventory Unit include Callayomi County Water District and Hidden Valley Lake Community Service District. Independent groundwater wells supply approximately 1,663 people.

Figure 3-5
Upper Putah Water Agencies

3.2.2.2 Middle Putah Inventory Unit

The Middle Putah Inventory Unit is in the southeastern portion of Lake County. It includes approximately 62,654 acres.

The Inventory Unit is rural. The 2001 population of the Middle Putah Inventory Unit was 229. The primary irrigated crop types in this region are pasture and grapes. The total irrigated crop area in 2001 was 1,522 acres, and total dry-farmed crop area was 67 acres. Walnuts are the non-irrigated crops in this region.

The Middle Putah Inventory Unit does not contain any water agencies that supply domestic or agricultural water; all domestic and agricultural water users are self-supplied. Groundwater is the primary source of supply for all water users.

3.2.2.3 Shoreline Inventory Unit

The Shoreline Inventory Unit is in the center of Lake County. It includes approximately 55,618 acres. Figure 3-6 shows the Inventory Unit. The Inventory Unit follows the shoreline of Clear Lake.

Inventory Unit communities include Nice, Lucerne, Glenhaven, Clearlake Oaks, City of Clearlake, Buckingham, Soda Bay, and the City of Lakeport. The 2001 population of the Shoreline Inventory Unit was 37,047. The primary irrigated crop types in this region are grapes, pasture, walnuts, almonds, other deciduous crops, and strawberries. The total irrigated crop area in 2001 was 1,867 acres, and total dry-farmed crop area was 1,818 acres. Non-irrigated crops include walnuts, pasture, almonds, grain, and eucalyptus.

The Shoreline Inventory Unit has multiple municipal systems that serve urban water users, as shown in Table 3-4. These municipal systems use a combination of groundwater and surface water supplies from Clear Lake and its tributaries. Urban water users can also be self-supplied with groundwater wells. Independent groundwater wells supply a population of approximately 10,000 people in the Inventory Unit.

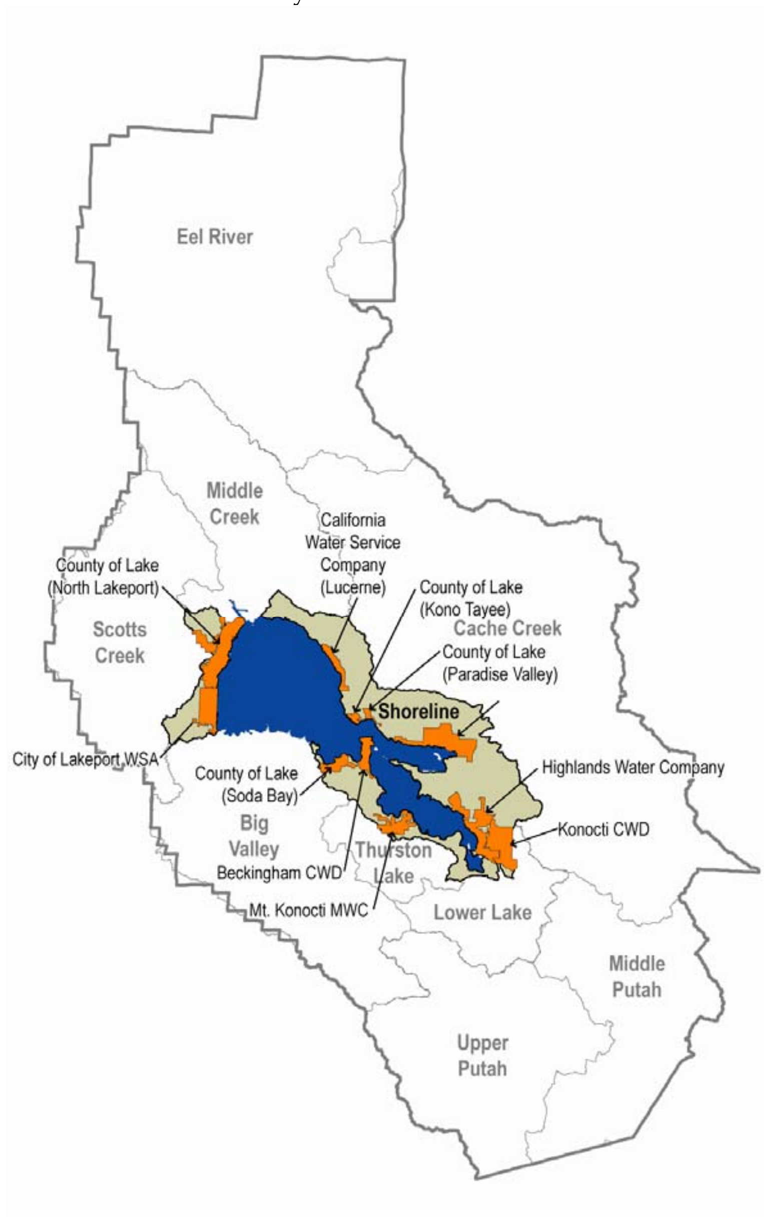


Figure 3-6
Shoreline Water Agencies

Table 3-4
Shoreline Municipal Water Systems

Water System	Community Served	Location on Lake
Nice Mutual Water Company	Nice	North Shore, Upper Arm
California Water Service Company -Lucerne	Lucerne	Northeast Shore, Upper Arm
Clearlake Oaks County Water District	Clearlake Oaks	North Shore, Oaks Arm
California Cities Water Company	City of Clearlake	Northeast Shore, Lower Arm
Highlands Water Company	City of Clearlake	East Shore, Lower Arm
Konocti County Water District	City of Clearlake	East Shore, Lower Arm
Crescent Bay Improvement Company	Crescent Bay	South Shore, Lower Arm
Westwind Mobile Home Park	Westwind Mobile Home Park	South Shore, Lower Arm
Mt. Konocti Mutual Water Company	Mt. Konocti	South Shore, Lower Arm
Richmond Park Resort	Richmond Park Resort	South Shore, Lower Arm
Clearwater Mutual Water Company	Konocti Bay area	Southwest Shore, Lower Arm
Konocti Harbor Resort & Spa	Konocti Harbor Resort & Spa	West Shore, Lower Arm
Riviera West Mutual Water Company	Riviera West	West Shore, Lower Arm
Buckingham Park Water District	Buckingham Park	West Shore, Lower Arm
CSA 20 - Soda Bay	Soda Bay	Southeast Shore, Upper Arm
City of Lakeport	City of Lakeport	West Shore, Upper Arm
CSA 21 - North Lakeport	North Lakeport	West Shore, Upper Arm
CSA 13 – Kono Tayee	Kono Tayee	Northeast Shore, Upper Arm
CSA 16 – Paradise Valley	Paradise Valley	Northeast Shore, Upper Arm

3.2.2.4 Thurston Lake Inventory Unit

The Thurston Lake Inventory Unit is in the central portion of Lake County, south of Clear Lake. The Inventory Unit contains approximately 14,097 acres.

The Thurston Lake Inventory Unit is rural. The 2001 population of the Inventory Unit was 98. Primary irrigated crop types in this region are grapes and pasture. The total irrigated crop area in 2001 was 1,597 acres, and total dry-farmed crop area was 969 acres. Non-irrigated crops include walnuts and grain.

The Thurston Lake Inventory Unit does not contain any water agencies that supply water. Domestic and agricultural water users are self-supplied. Groundwater is the primary source of supply for both domestic and agricultural water users.

3.2.2.5 Middle Creek Inventory Unit

The Middle Creek Inventory Unit is on the western side of Lake County, just northwest of Clear Lake. The Middle Creek Inventory Unit includes approximately 57,371 acres, as shown in Figure 3-7.

The main community in the Inventory Unit is Upper Lake. The 2001 population of Middle Creek Inventory Unit was 1,906. The primary irrigated crop types in this region are rice, pasture, pears, grapes, walnuts, other truck, alfalfa, and strawberries. In 2001, the total irrigated crop area was 2,142 acres, and the total dry-farmed crop area was 920 acres. Non-irrigated crops include walnuts, pasture, grain, and pears.

Upper Lake has a water agency that supplies urban customers; remaining domestic and agricultural users are self-supplied. Groundwater provides the primary water source for urban, domestic, and agricultural users. Some agricultural users also use surface water from Clear Lake and Middle Creek. Independent groundwater wells supply drinking water to approximately 917 people.

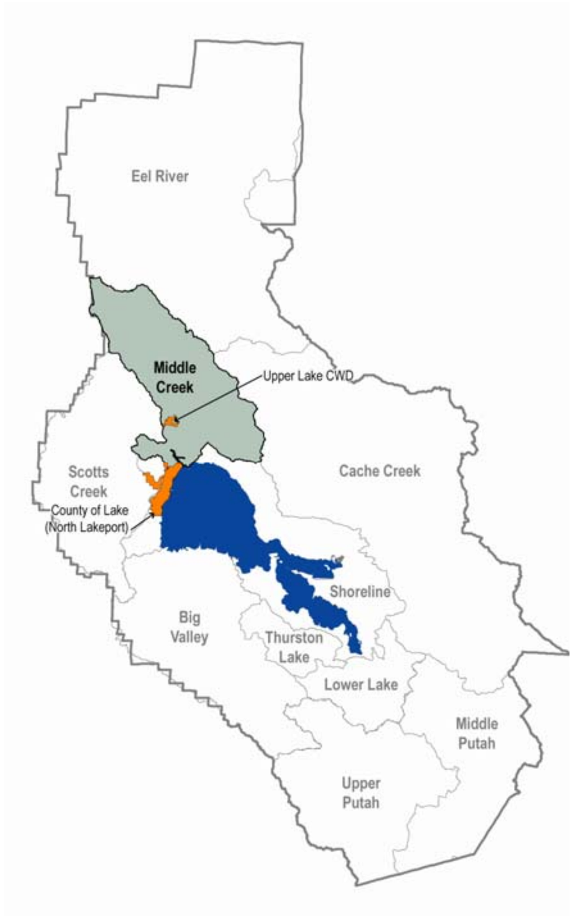


Figure 3-7
Middle Creek Water Agencies

3.2.2.6 Scotts Creek Inventory Unit

The Scotts Creek Inventory Unit is in the western portion of Lake County. It includes approximately 66,870 acres. Figure 3-8 shows the Inventory Unit.

The Inventory Unit is rural. The 2001 population of the Scotts Creek Inventory Unit was 650. The primary irrigated crop types in this region are pears, pasture, rice, grapes, walnuts, alfalfa, other deciduous, grain, pistachios, and other truck crops. The total irrigated crop area in 2001 was 2,205 acres, and total dry-farmed crop area was 1,066 acres. The non-irrigated crops in this region are walnuts, pasture, grain, and eucalyptus.

Two municipal water agencies serve portions of the Inventory Unit. Remaining domestic and agricultural water users are self-supplied. Groundwater is the primary source of supply for both domestic and agricultural water users. Independent groundwater wells supply drinking water to approximately 650 people.

Figure 3-8
Scotts Creek Water Agencies

3.2.2.7 Big Valley Inventory Unit

The Big Valley Inventory Unit is in the southwest area of Lake County. It includes approximately 77,427 acres, as shown in Figure 3-9.

The Inventory Unit includes the communities of Cobb, Adams Springs, and Loch Lomond in the mountainous eastern region, and Kelseyville and Finley in the Big Valley region. The 2001 population of the Big Valley Inventory Unit was 7,764. The primary irrigated crop types in this region are grapes, pears, walnuts, pasture, grain, other truck crops, other deciduous crops, and corn. The total irrigated crop area in

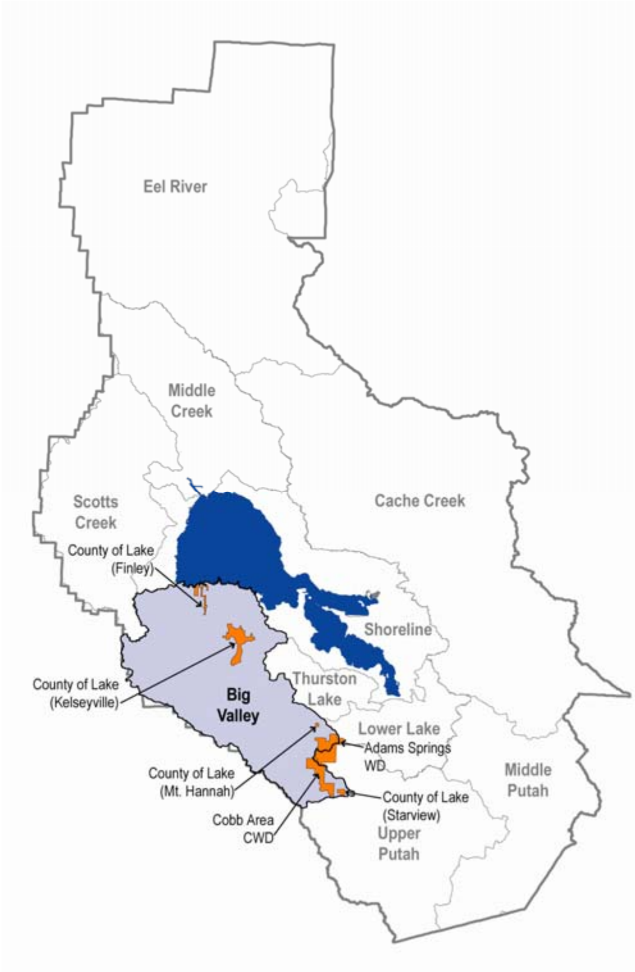


Figure 3-9
Big Valley Water Agencies

2001 was 7,707 acres, and total dry-farmed crop area was 2,327 acres. Non-irrigated crops include walnuts, pasture, grain, almonds, and grapes.

3.2.2.8 Lower Lake Inventory Unit

The Lower Lake Inventory Unit is the center of the County, to the southeast of Clear Lake, and includes approximately 23,195 acres. Figure 3-10 shows the Inventory Unit.

The Inventory Unit includes the community of Lower Lake. The 2001 population of the Lower Lake Inventory Unit was 2,066. The primary irrigated crop types in this region are grapes, walnuts, other truck, and other deciduous. The total irrigated crop area in 2001 was 1,450 acres, and total dry-farmed crop area was 819 acres. Non-irrigated crops include walnuts, pasture, and grain.

A municipal system serves municipal water users. Municipal and domestic water users can also be self-supplied with groundwater. The Lower Lake County Water District serves the community of Lower Lake. Agricultural water users are self-supplied. Groundwater is the primary source of supply for both residential and agricultural water users. Independent groundwater wells supply drinking water to approximately 311 people. A small portion of industrial water use is produced from undefined surface water (DWR 2005).

Figure 3-10
Lower Lake Water Agencies

3.2.2.9 Cache Creek Inventory Unit

The Cache Creek Inventory Unit is in the eastern portion of Lake County, as shown in Figure 3-11. It includes approximately 182,883 acres.

The Inventory Unit includes the community of Spring Valley. The 2001 population of the Cache Creek Inventory Unit was 1,094. The primary irrigated crop types in this region are grapes, other truck, and walnuts. The total irrigated crop area in 2001 was 543 acres, and total dry-farmed crop area was 768 acres. Non-irrigated crops include grain, walnuts, and pasture.

A municipal system, CSA 2 - Spring Valley (administered by Lake County Special Districts, Section 3.2.2.11) serves water users in Spring Valley. Municipal water users can also be self-supplied with groundwater. Agricultural water users are self-supplied. Sources of water are groundwater and surface water from Cache Creek. Independent groundwater wells supply drinking water to approximately 239 people. Industrial water users use both groundwater and surface water (DWR 2005).

Figure 3-11
Cache Creek Water Agencies

3.2.2.10 Eel River Inventory Unit

The Eel River Inventory Unit is in the northern section of Lake County. It includes approximately 189,395 acres.

The unit is in the Mendocino National Forest and is rural. The 2001 population of the Inventory Unit was 26. No crops are grown in the region. Water users are self-supplied, and groundwater is the source of drinking water.

3.2.2.11 Lake County Special Districts

Lake County Special Districts (Special Districts), manages ten municipal water systems and four regional wastewater systems. Facilities that Special Districts manage, treat and deliver drinking water to 33,000 customers in 21 communities throughout Lake County. Special Districts' facilities also collect and treat wastewater, and reuse treated effluent. Figure 3-12 shows the locations of the drinking water systems and wastewater treatment plants.

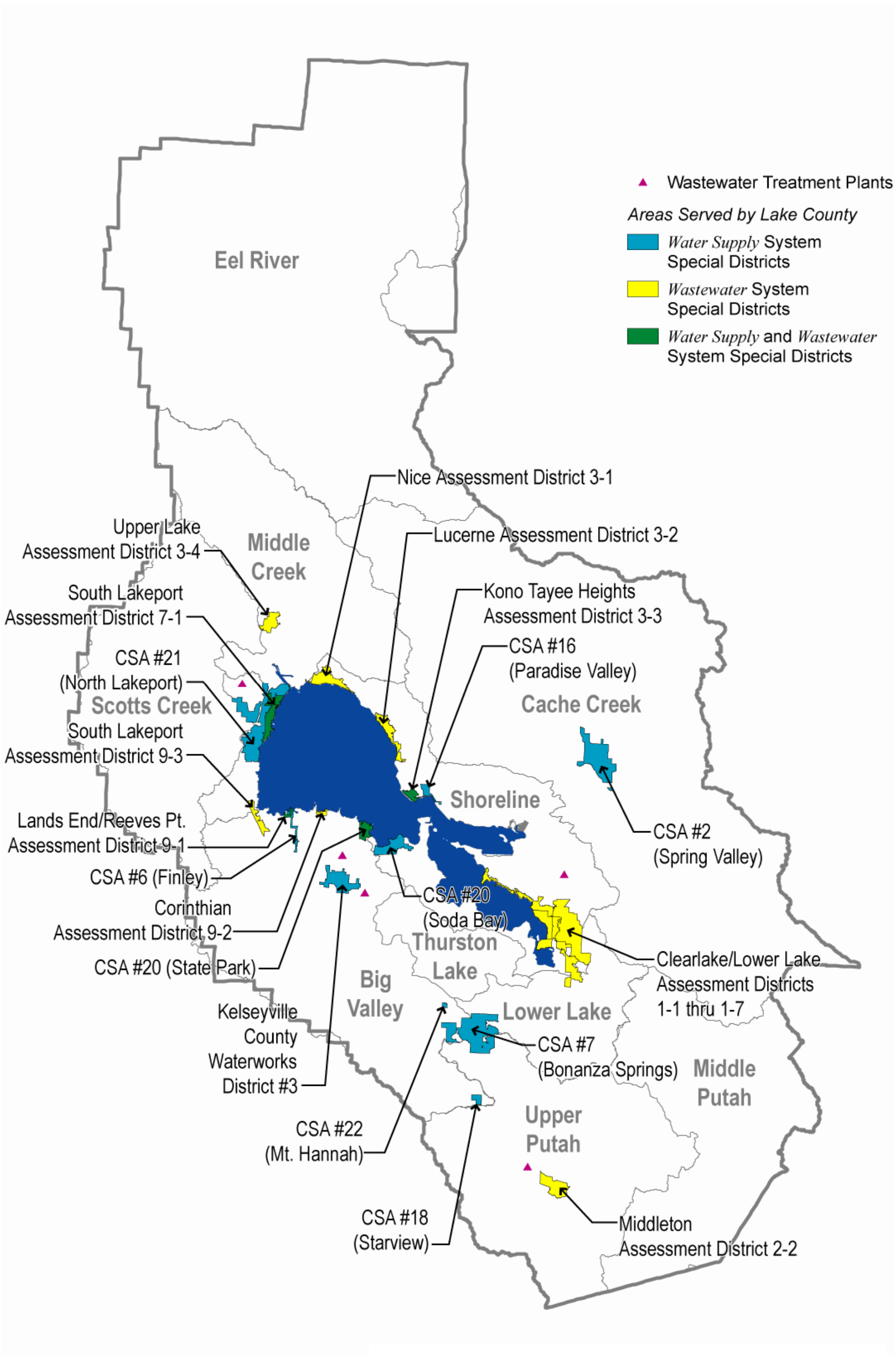
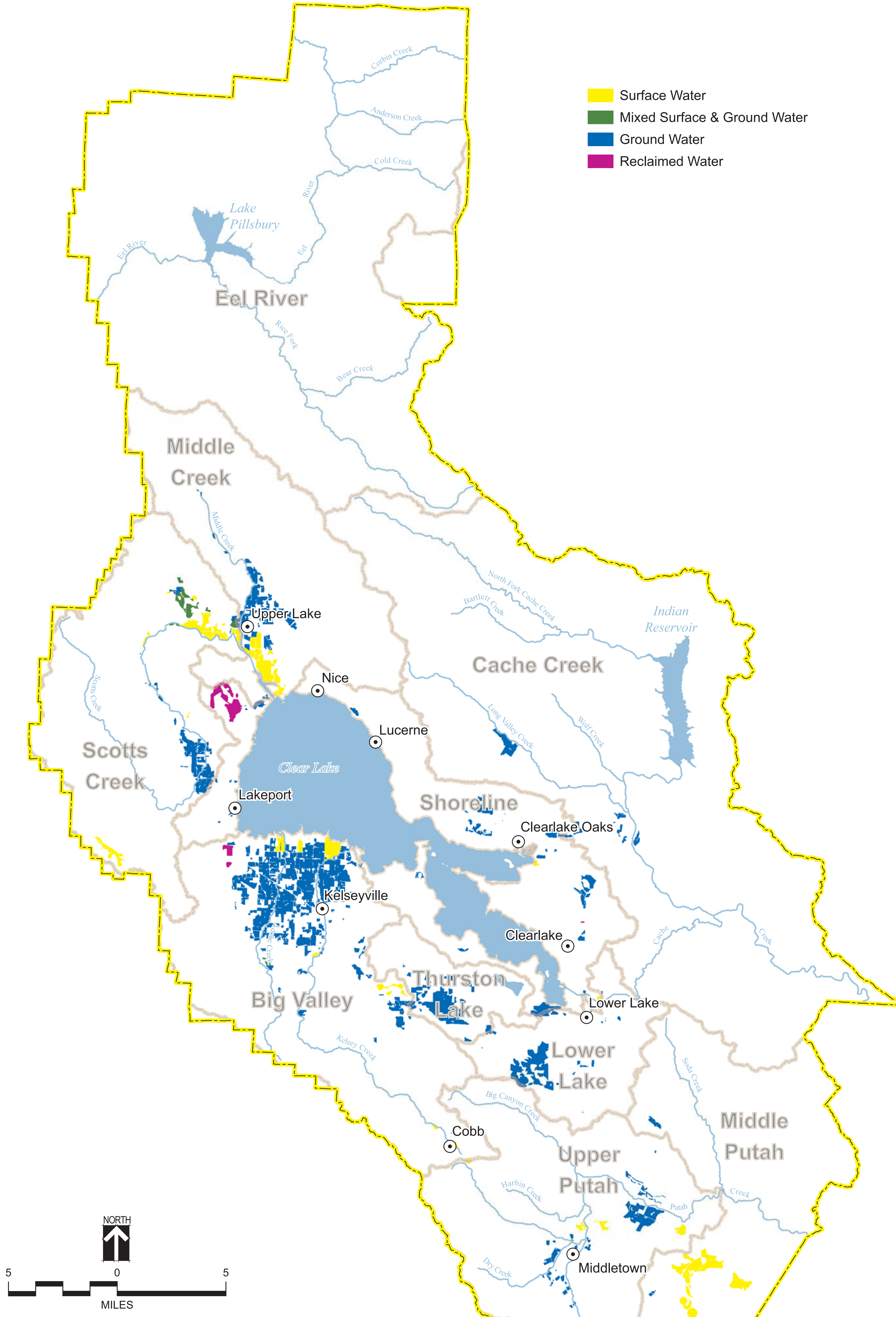


Figure 3-12
Lake County Special Districts



Source:
California Department of Water Resources
California Spatial Information Library

Figure 3-4
Water Sources

Section 4
Methods and Results

4.1 Water Use and Supply Analysis Methodology

Water budgets were determined by using the "applied water" methodology. Applied water is the "total amount of water that is diverted from any source to meet the demands of water users, without adjusting for system losses" (DWR 2005). The applied water methodology only calculates the managed and measured elements of the hydrologic cycle. The applied water budgets, therefore, do not include some water flowing through the County, such as streamflows that are not diverted or managed in any way.

Water use and water supply are factors of the applied water budget. Water use data includes agricultural, urban, and environmental water uses. Water supply data includes surface water, groundwater, and water reuse. The purpose of this analysis is to develop water budgets using data on current water use and supply at the Inventory Unit level, as well as for the entire County.

The applied water methodology is preferred because it provides quantified measurements of managed water within the County. Additionally, DWR uses the applied water methodology in calculations for the Water Plan Update 2005. Water budgets developed for Lake County will be consistent with the methodology used in the Water Plan Update, allowing for an "apples to apples" comparison of information.

The analysis first determined agricultural, urban, and environmental water uses for different water year types (see Section 4.2 for a definition of wet, dry, and average years). This information was combined to calculate the water use for each Inventory Unit using an inflow-outflow analysis (mass balance) that considers supply, depletion, percolation, and outflow. The data created by this analysis was compiled to create a database of the applied water budget for the entire County. The results describe how water use, available supply, and water losses are linked within Lake County's hydrologic system. The following sections detail the process for evaluating water use for agricultural, urban and environmental water use.

4.1.1 Water Use Methodology

This section describes the approach used to quantify applied water use in each Inventory Unit in the County.

Agricultural Water Use

Agricultural water use includes water applied to agricultural crops to enable plant growth, as well as losses that occur during conveyance and as part of the irrigation process. The overall water use is based on "applied water," which indicates the amount of water that a grower applies to each crop. Applied water is derived from plant needs for growth and conveyance and irrigation losses, as described below.

Plant evapotranspiration (ET) is defined as the water that a plant uses for growth during a season and includes evaporation from soils surrounding the plant and water retained by the plant. Plant ET is met through a combination of rainfall and irrigation. The applied water method uses only the managed irrigation component, or the ET of applied water (ETAW). Soil moisture derived from precipitation is considered in the total ET requirement of the crop, but crop water use from precipitation is not reported as applied water use because precipitation is not considered managed water.

The ETAW value for a crop is largely dependent on the type of crop grown, and can range from around 0.5 acre-feet per season for grapes to as high as 3.1 acre-feet per season for pasture. ETAW is also affected by the frequency of irrigation, crop maturity, and climatic factors. The ETAW is divided by the irrigation efficiency to estimate the actual applied water for the crop. The irrigation efficiency is the percentage of applied water that the crop uses. Table 4-1 shows the unit ETAW and unit applied water for common crops within the County.

Table 4-1
2004 Lake County Crops

Crop	*Acreage*	*Unit ETAW (acre-feet/acre)*	*Unit Applied Water (acre-feet/acre)*
Wine Grapes	10,016	0.5	0.56
Pasture	4,050	3.1	4.43
Truck Crops	189	1.5	1.92
Pears	3,419	2.2	2.93
Rice	940	2.7	4.5
Walnuts	1,185	2.3	3.03

To calculate overall water use, the analysis used DWR estimates of ETAW, irrigation efficiency, and crop acreage data for agricultural areas within Lake County. DWR adjusts these values to account for the County's specific climatic conditions. The ETAW per acre was combined with DWR's irrigation efficiency data for each crop to determine the applied water per acre. The applied water per acre was multiplied by the number of acres of each crop type to estimate the amount of water used to irrigate each crop type. The number of acres of the crop was reduced by a factor of 3.5%to account for roads, ditches and other non-irrigated areas to more accurately represent the number of acres of the crop. Water use by crop type was summed by Inventory Unit. Water use by Inventory Unit was summed to represent total agricultural water use for Lake County.

Crop acreage is derived from DWR's Lake County land use survey, which provides land use information for each Inventory Unit. The DWR land use data from 2000 was updated to reflect 2004 conditions based upon stakeholder feedback and the County Agricultural Commissioner reports. Figure 1-2 depicts Lake County's year 2000 land use. Figure 1-2 shows that agricultural land use mainly occurs in the valleys of Lake County, and that pears (shown in pink) and wine grapes (shown in purple) represent a large portion of crops grown in the County.

Urban Water Use

Urban water use includes residential, commercial, industrial, and institutional water uses. Methods to calculate different types of use vary, as described below. Each sector of urban water use was totaled to estimate urban water use by Inventory Unit, and then aggregated for the entire County. These results were reviewed for reasonableness through interviews with urban water purveyors, as described in Section 3.

Residential Use

DWR's public water systems statistics survey provided the main source of information on residential water use. As part of this survey, local water providers annually submit information on their population, water production by source (surface water or groundwater), and metered water deliveries. This survey data is sufficient to quantify urban residential water use for many communities within Lake County; however, some smaller purveyors do not participate in the survey process, and many residential users rely on wells and are not served by a water purveyor. Public water systems statistics are available for the purveyors and communities listed in Table 4-2.

Table 4-2
Water Purveyors with Available Water Use Data

Water Purveyor	Community Served
Buckingham Park Water District	Buckingham Park
California Water Service Company	Lucerne
Callayomi County Water District	Middletown
City of Lakeport	City of Lakeport
Clearlake Oaks County Water District	Clearlake Oaks
Clearlake-Konocti Water Company	Clearlake
Cobb Area County Water District	Cobb
Hidden Valley Lake CSD	Hidden Valley Lake
Kelseyville County Water District #3	Kelseyville
Lake County Special Districts - CSA #2	Spring Valley
Lake County Special Districts – CSA #6	Finley
Lake County Special Districts – North Lakeport	North Lakeport
Lake County Special Districts Starview	Starview
Lower Lake County Water District #1	Lower Lake
Mt. Konocti Water District	Clearlake Riviera
Nice Mutual Water Company	Nice
Southern California Water Company	Clearlake Park
Upper Lake County Water District	Upper Lake

For each purveyor with data available, the "per capita" water use was calculated by dividing total water use by population in the area. These per capita water use rates were applied to estimate water use in areas without data. Water use per person varies among different communities. For example, more rural communities may use less water because they have less landscape irrigation or less commercial and industrial development. In communities without purveyor data, the analysis applied per capita water use rates derived from a similar community. Rural residential areas without purveyor data used per capita water uses from Finley (CSA #6), which has water use rates representative of rural areas.

Population estimates within each community and Inventory Unit were necessary to complete this analysis. The 2000 census provides population for the entire County, but does not distribute that population by area. The population estimates were subdivided into Inventory Units as follows:

- Purveyor information was used, when available, to assign the population within a water district to the appropriate Inventory Unit.

- Aerial photography provided the number of residences within communities and Inventory Units, and the number of residences was multiplied by 2.66, the average number of people per residence, to determine population for areas without purveyor information.

- Remaining people were assigned to the rural residential population of the Shoreline Inventory Unit because it has the largest amount of development and population.

Commercial/Industrial/Institutional and Golf Course Water Use

Defining population within an Inventory Unit and per capita residential water uses allowed calculation of residential water use, but urban water use also includes water for commercial and industrial uses and golf courses. DWR's land use survey also delineates golf courses within each Inventory Unit. The water use for each golf course was estimated using the acreage of the golf course multiplied by the ETAW for turf (see Agricultural Water Use section for more information on ETAW). Commercial and industrial sites were determined by reviewing National Pollutant Discharge Elimination System permits from the Regional Water Quality Control Board, and from an industrial survey that DWR completed in 1994. These sources identify the commercial and industrial users and provide estimates of water use.

Indoor and Outdoor Water Use

The urban water use calculations also separated indoor (e.g., cooking, bathing) and outdoor (e.g., landscape irrigation) use of water. Seasonal variation in water use is generally because of variation in outdoor use. Indoor use remains relatively constant year-round, but outdoor water use is generally higher in the summer because of hot temperatures and lack of precipitation for landscape irrigation. Outdoor water use is generally lower during the winter because precipitation and cooler temperatures reduce the need for outdoor irrigation. The winter month with the lowest water use typically defines indoor use because water is not needed for outdoor irrigation. This indoor water use is roughly constant year-round; therefore, the additional water use each month represents outdoor water use.

Further analysis was conducted to estimate the amount of water that is either returned to the hydrologic system or depleted through consumption. All indoor water use was assumed to return to the system via water treatment or as groundwater percolation through a septic tank. A portion of the outdoor water use during summer months is either depleted by ETAW from landscape irrigation and evaporation from pools or returned to the system by deep percolation from excess irrigation. The indoor and outdoor water use was totaled by Inventory Unit and for the entire County.

Environmental and Recreational Water Use

Environmental water use typically includes applied water used for managed wetlands and instream flow requirements. Recreational water use includes minimum instream flow and water level requirements. The County does not have any managed wetlands that require applied water or instream flow requirements for environmental or recreational needs. The County does have some waterways with recommended flows or water levels for environmental and recreational purposes; however, these flows are not required so they do not factor into the applied water calculations. Section 4.6 discusses environmental and recreational water recommendations within the County.

4.1.2 Water Supply Methodology

The water supply analysis estimates the amounts of water from three main supply sources (surface water, groundwater, and recycled water) based on historical water use. The water supply source was initially determined using DWR land use survey data from the year 2000, which also includes water source data, as shown in Figure 3-4. DWR land use survey data classifies area supplies by source as surface, ground, recycled, or mixed source. The mixed source classification indicates an area that receives its water from both surface and ground sources. Water purveyor interviews helped to update this information to represent 2005 conditions and confirm its reasonableness.

Surface water supplies include local streams or Clear Lake. Surface water supplies are dictated by water rights or water contracts, which limit the amount of supply during different parts of the year and year types. Purveyor interviews determined the supply source, diversion location, diversion amount, and any anecdotal data regarding supply reliability. Surface water supplies were estimated at diversion points based on available diversion records provided by water purveyors. If diversion records were not available, surface water supplies were estimated based on the water use within the area served by a surface water source and limited by the water rights or contracts.

Groundwater supplies are more difficult to estimate because groundwater pumping records are generally not available. Some water purveyors who provide groundwater have historical pumping records available. These records were used to estimate groundwater supply. In areas without available records, or for independent groundwater pumpers, the groundwater supply was estimated based on groundwater use. Methodology may overestimate supplies during dry years, when groundwater basins do not fully recharge.

Lake County has a few areas that rely on both groundwater and surface water supplies. In these areas, the analysis assumed that available surface water was the primary source available, and groundwater comprised the remaining supplies. Lake County does not use recycled water as a primary supply because the Geysers project (outside of the County) receives much of the recycled water.

4.2 Definition of Average-, Dry-, and Wet-Year Scenarios

Historic hydrologic records were reviewed to identify appropriate periods of record that could be used to represent average-, dry- and wet-year water use and supply conditions in Lake County. Calculating water use and supply using each of these hydrologic conditions allows comparisons of use and supply under a variety of hydrologic conditions. The following sections describe the average-, dry-, and wet-year scenarios that are analyzed for each Inventory Unit.

4.2.1 Average-Year Scenario

The purpose of the average-year scenario is to provide an estimate of water use and supply under near average hydrologic conditions. Data from this scenario provides the baseline condition for comparison to dry-year and wet-year conditions. The average year was selected based on a review of historic hydrologic data within the County. Figure 4-1 shows historical annual precipitation totals at Clear Lake, and Figure 4-2 shows historical average flow in Cache Creek. The blue bars in Figure 4-1 and the green bars in Figure 4-2 represent the years chosen to represent average, dry, and wet years. The year 2000 had precipitation and flow near average within Lake County. This selection also corresponds with the average-year type used by DWR in Bulletin 160-05 Update. Therefore, the analysis used 2000 precipitation, runoff, ET, and per capita water use data to represent an average year.

4.2.2 Dry-Year Hydrologic Scenario

The dry-year scenario provides a scenario where maximum water use occurs during periods with reduced supply because of below average hydrologic conditions. A review of hydrologic records shows the year 2001 as a particularly dry year statewide. Figure 4-1 does not show that the year 2001 had the lowest precipitation; however, Figure 4-2 does show that the year 2001 had relatively low flow in Cache Creek. DWR uses the year 2001 in the Bulletin 160-05 Update for the dry-year type. While 2001 is

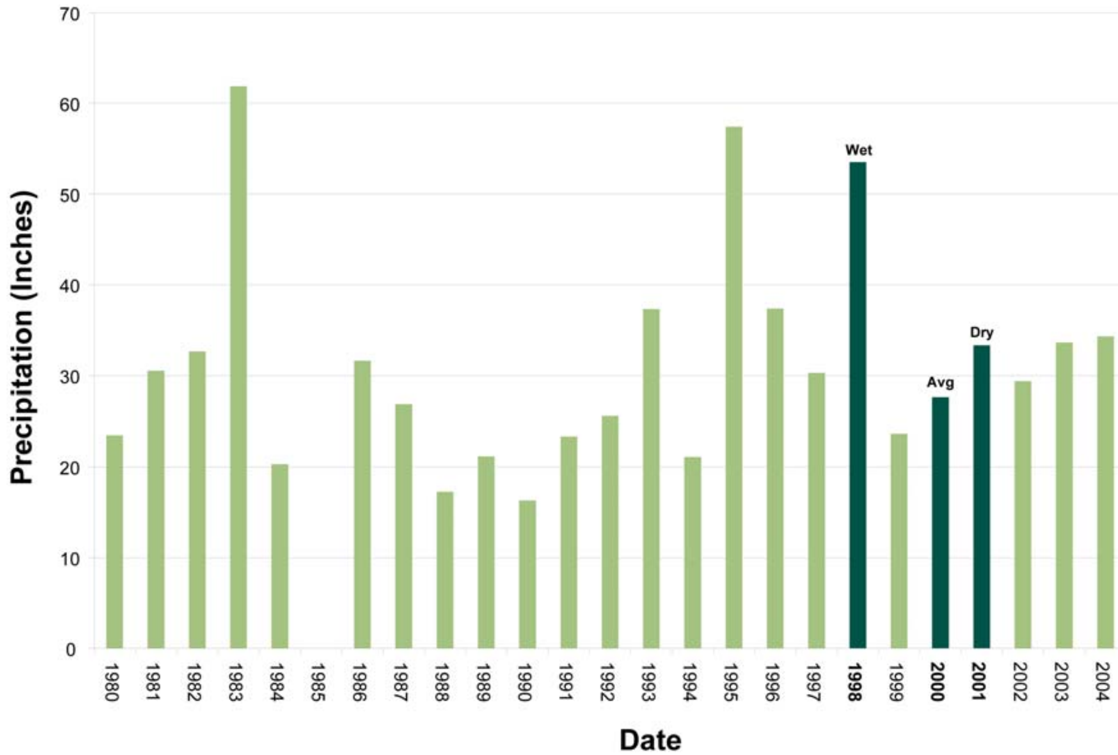


Figure 4-1
Historical Precipitation near Clear Lake

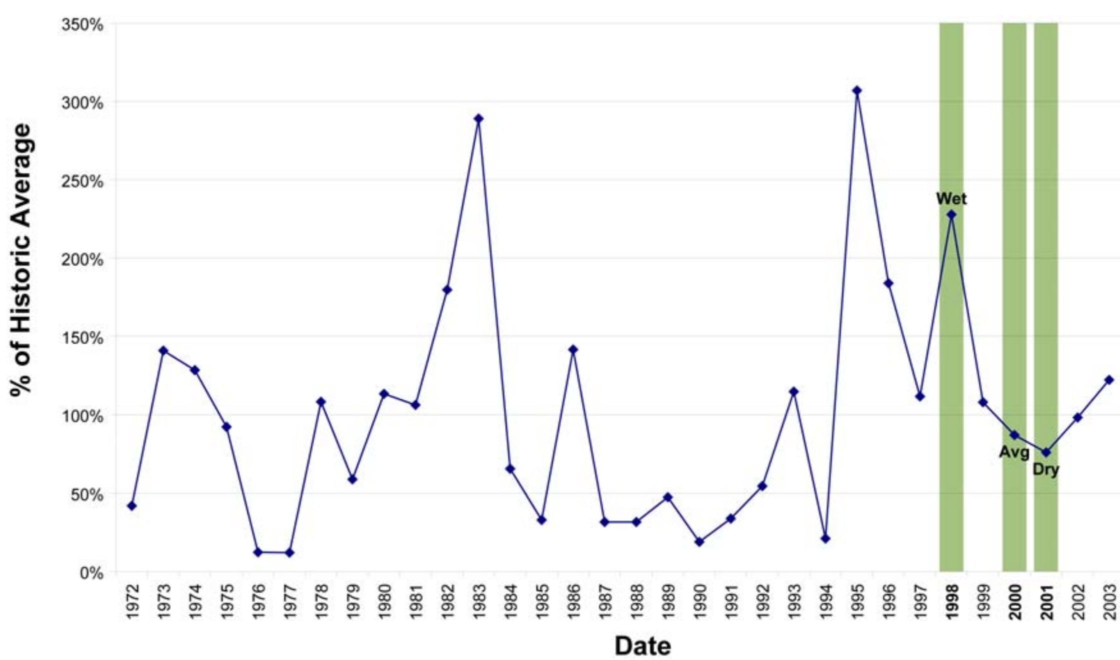


Figure 4-2
Historic Flow as a Percent of Average
Data from USGS Station 11451100, Cache Creek near Clearlake

not the driest recent year, the benefits of generating data comparable to the rest of the state are great. Therefore, the year 2001 was selected to represent the dry-year type scenario for Lake County. The dry-year analysis used 2001 precipitation, runoff, ET, and per capita water use data.

4.2.3 Wet-Year Hydrologic Scenario

The wet-year type scenario illustrates how Lake County's water resources respond to a wet year, when water supply is likely greater than needed to meet water needs. This analysis helps to reveal potential locations and quantities of excess water available during wet years. Figures 4-1 and 4-2 show that 1998 was a wet year in terms of both precipitation and water flow. Additionally, DWR is using 1998 to represent a wet year in the Bulletin 160-05 Update. Therefore, this wet-year analysis used 1998 to represent a wet year, and incorporated 1998 precipitation, runoff, ET, and per capita water use data.

4.3 Summary of Average-Year Inventory

The following section describes the average year water inventory in Lake County, including water uses, supplies, groundwater extractions, and shortages.

4.3.1 Water Use

Table 4-3 presents the Lake County average year water use by Inventory Unit. Average year water use is divided into agricultural, municipal and industrial (M&I), environmental, and conveyance losses. Total Countywide water use in an average year is 51,330 acre-feet. Agriculture has the largest water use at 78 percent, as shown in Figure 4-3.

Table 4-3
Summary of Lake County Water Use in an Average Year
Applied Water (acre-feet)

Inventory Unit	*Agriculture*	*M & I*	*Environmental*	*Conveyance Losses*	*Total Water Use*
Upper Putah	2,082	1,033	0	64	**3,179**
Middle Putah	4,889	37	0	159	**5,085**
Shoreline	3,324	6,646	0	118	**10,088**
Scotts Creek	6,929	120	0	212	**7,261**
Middle Creek	6,637	274	0	204	**7,115**
Big Valley	13,416	1,439	0	416	**15,271**
Lower Lake	923	474	0	31	**1,428**
Cache Creek	479	207	0	15	**701**
Thurston Lake	1,138	18	0	38	**1,194**
Eel River	0	5	0	0	**5**
County Total	**39,817**	**10,256**	**0**	**1,257**	**51,330**

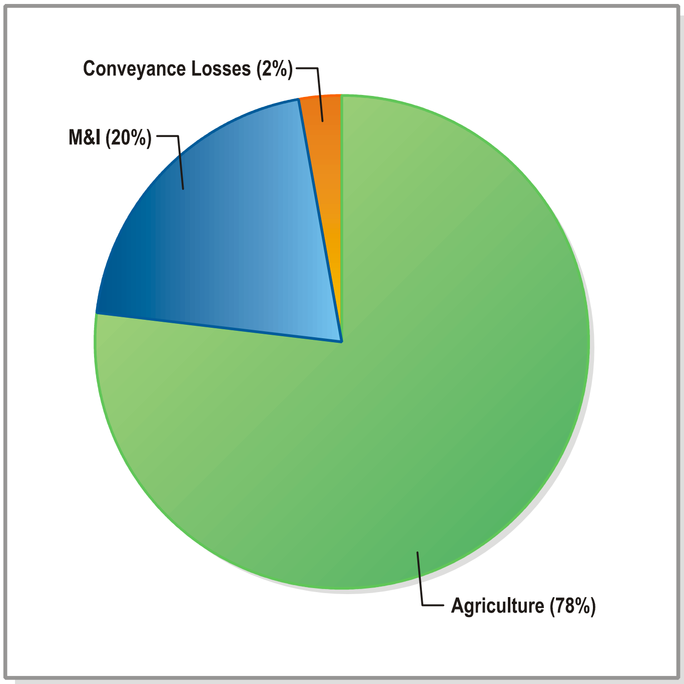


Figure 4-3
Average Year Water Use

Agricultural Water Use

A total of 78 percent of all water used during an average year in Lake County is for agriculture, as presented in Figure 4-3. Agriculture is the largest user of water and is the primary industry in the County. Big Valley Inventory Unit has the highest agricultural water use, representing 35 percent of all the agricultural water in the County. Scott's Creek and Middle Creek Inventory Units are the second highest agricultural water users, each comprising 17 percent of the total agricultural water use. Middle Putah, (96 percent) Scotts Creek (95 percent), and Thurston Lake (95 percent) Inventory Units have the highest agricultural water use as a proportion of their total water use.

M & I Water Use

Lake County's average year total M & I water use is 10,256 acre-feet, which is approximately 20 percent of the total water use (see Figure 4-3). The Shoreline Inventory Unit contains the largest urban area in the County (the City of Clearlake), and is the Inventory Unit with the largest M&I water use at 65 percent. Big Valley and Upper Putah Inventory Units have the second and third largest M&I water use, respectively (14 and 10 percent). Big Valley contains the communities of Kelseyville and Cobb, and the Upper Putah Inventory Unit includes Hidden Valley and Middletown. These communities all have substantial populations, which contribute to their M&I water uses.

Environmental Water Use

Table 4-3 shows that Lake County does not have any applied water use for environmental purposes. This finding does not indicate that Lake County has no environmental water use; rather, as described in Section 4.1.1, Lake County does not have any managed environmental water or instream flow requirements. Section 4.6 qualitatively describes the environmental water use within Lake County.

Conveyance Losses

Average conveyance losses for Lake County account for approximately 2 percent of the total water use, as depicted in Figure 4-3. Conveyance losses result from leaks or seepage from municipal distribution systems, or seepage and other losses from agricultural distribution systems. Many water users within Lake County pump groundwater from independent wells, which limits the extent of distribution systems for both domestic and agricultural purposes. Substantial conveyance losses usually only occur with larger, more complex distribution systems. Overall, conveyance losses are relatively small for all the Inventory Units because most water systems are independent and few large water systems exist.

4.3.2 Supplies

Table 4-4 provides a summary of water supplies in an average year in Lake County. Figure 4-4 shows the total Lake County average year supply by source. Water supply is composed of five sources: local surface water, net groundwater, deep percolation reuse, surface water reuse, and reclaimed wastewater. Comparison of Tables 4-3 and 4-4 indicates water use and supply are equal in an average year.

Table 4-4
Summary of Lake County Water Supplies in an Average Year
Applied Water (acre-feet)

Inventory Unit	*Local Surface*	*Net Groundwater*	*Deep Percolation Reuse*	*Surface Water Reuse*	*Total Water Supply*
Upper Putah	820	1,613	460	287	**3,179**
Middle Putah	3,678	187	234	986	**5,085**
Shoreline	5,655	2,717	1,443	273	**10,088**
Scotts Creek	2,127	3,521	852	761	**7,261**
Middle Creek	2,761	2,632	748	974	**7,115**
Big Valley	1,470	11,161	2,229	412	**15,271**
Lower Lake	10	1,353	65	0	**1,428**
Cache Creek	163	367	171	0	**701**
Thurston Lake	0	1,161	33	0	**1,194**
Eel River	0	2	3	0	**5**
County Total	**16,684**	**24,714**	**6,240**	**3,692**	**51,330**

Local Surface Water

Figure 4-4 shows that local surface water accounts for 33 percent of the total water supply and is the second largest water source in Lake County in an average year. Thurston Lake and Eel River Inventory Units have no surface water supply and rely exclusively on groundwater. Shoreline Inventory Unit uses surface water from Clear Lake and has the largest amount of surface water supply in the County, at 34 percent of all surface water use in the County. Middle Putah uses surface water from smaller local waterways and accounts for 22 percent of the County's surface water supply, which is the second greatest amount after the Shoreline Inventory Unit.

The Middle Putah Inventory Unit also has the largest percentage of its overall supply from surface water, at 72 percent. Shoreline is second with 56 percent. The Inventory Unit with the lowest proportion of surface water (besides Thurston Lake and Eel River), is Lower Lake at 1 percent.

Net Groundwater

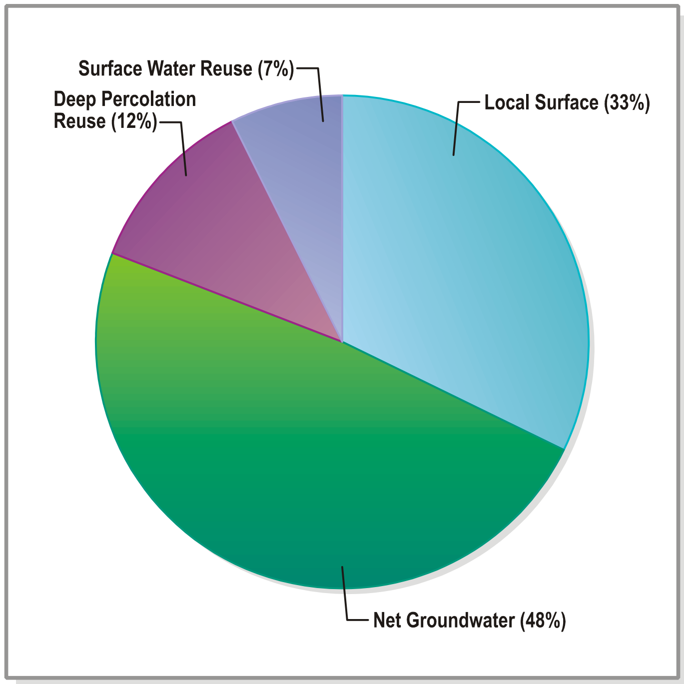


Figure 4-4
Average Year Water Supplies

Net groundwater represents the total groundwater supply minus any percolation that occurs from surface or groundwater supplies. (Total groundwater pumping also equals net groundwater supplies added to deep percolation reuse and surface water reuse, the next two supply categories.) Net groundwater supplies account for approximately 48 percent of Lake County's total water supply. Big Valley Inventory Unit has 45 percent of the net groundwater in the County, which is the largest amount compared to the other inventory units. Scotts Creek uses 14 percent of the County's net groundwater supply, which is the second largest percentage. Thurston Lake and Lower Lake Inventory Units have the highest proportion of net groundwater supply compared to their overall supply, at 97 percent and 95 percent, respectively.

Deep Percolation Reuse

Deep percolation reuse includes water that percolates into the groundwater aquifer after being applied for either municipal or agricultural use, and then is reused. The amount of deep percolation reuse generally corresponds with the amount of net groundwater use and supply. As more groundwater is pumped and used, there is greater potential for some of that water to percolate back into the ground. Deep percolation reuse comprises approximately 12 percent of the water supply in Lake County. Big Valley has the largest amount of the County's total deep percolation reuse at 36 percent, which correlates to having the largest amount of overall groundwater use.

Surface Water Reuse

Surface water reuse represents water that is reused after its initial application; for example, it runs off of one field and is reused on another. Surface water reuse comprises approximately 7 percent of the total water supply in Lake County. Similar to deep percolation reuse, surface water reuse quantities generally correspond to the amount of surface water supplies. Middle Putah and Middle Creek have the largest quantity of surface water reuse in an average year at 986 acre-feet and 974 acre-feet respectively. Lower Lake, Cache Creek, Thurston Lake, and Eel River have no surface water reuse because their primary water supply is groundwater. Shoreline has the largest percentage of surface water supplies, but the surface water reuse represents only 7 percent of total surface water reuse within the County. This difference is because Shoreline uses surface water for municipal uses, and then treats the wastewater and delivers it to the Geysers project.

4.3.3 Net Groundwater Extractions

Table 4-5 summarizes Lake County groundwater extraction in an average year. Net groundwater extraction in the Inventory Unit was calculated from total groundwater supply less any percolation (from either surface water or groundwater supplies) in each Inventory Sub-unit. The resulting net groundwater extraction is the amount of water that is pumped and is not replaced by managed surface or groundwater deep percolation recharge. Higher amounts of net groundwater extraction do not necessarily indicate areas of groundwater overdraft because this analysis does not take natural recharge into account. Natural groundwater percolation through precipitation, runoff, and streams provides much of the groundwater recharge within the County.

Table 4-5
Summary of Groundwater Extractions in an Average Year

Inventory Unit	***Groundwater Extraction (Acre-feet)***			
	Total Ground-water	***Surface Water Deep Percolation***	***Groundwater Deep Percolation***	***Net Groundwater Extractions***
Upper Putah	2,072	61	399	1,613
Middle Putah	421	140	94	187
Shoreline	4,160	229	1,215	2,717
Scotts Creek	4,373	45	807	3,521
Middle Creek	3,380	129	619	2,632
Big Valley	13,390	120	2,109	11,161
Lower Lake	1,504	2	150	1,353
Cache Creek	558	106	85	367
Thurston Lake	1,283	0	122	1,161
Eel River	5	0	3	2
Total	**31,148**	**832**	**5,603**	**24,714**

Big Valley Inventory Unit has the largest amount of net groundwater extraction in the County at 45 percent, followed by Scotts Creek at 14 percent. These two Inventory Units have high extraction rates because they are the predominant agricultural Inventory Units and primarily rely on groundwater supplies for irrigation.

Eel River Inventory Unit has the lowest proportion of net groundwater extraction at 40 percent of the total groundwater extracted, followed by Middle Putah at 44 percent. These two Inventory Units have a high proportion of surface and groundwater deep percolation. More than half of the total groundwater extracted from these two Inventory Units is replaced by surface water deep percolation or groundwater deep percolation.

Thurston Lake and Lower Lake have the highest proportion of net groundwater extraction compared to the total groundwater extraction at 91 percent and 90 percent respectively. They experience little surface water deep percolation and little groundwater deep percolation. Only 9 to 10 percent of the total groundwater extracted in Thurston Lake and Lower Lake is replaced by percolation.

4.3.4 Shortages

During an average year, Lake County is unlikely to experience any water shortages. Table 4-3 and Table 4-4 demonstrate that supply is adequate to meet water use in all Inventory Units.

4.4 Summary of Dry-Year Inventory

The following section presents the dry year inventory in Lake County, which includes water uses, supplies, groundwater extractions, and shortages.

4.4.1 Water Use

Table 4-6 shows the water use in Lake County during a dry year, and Figure 4-5 presents a summary of the water use by sector.

Table 4-6
Summary of Lake County Water Use in a Dry Year
Applied Water (acre-feet)

Inventory Unit	*Agriculture*	*M & I*	*Environmental*	*Conveyance Losses*	*Total Water Use*
Upper Putah	2,428	1,208	0	74	**3,710**
Middle Putah	5,522	38	0	182	**5,742**
Shoreline	3,919	6,680	0	136	**10,735**
Scotts Creek	7,837	122	0	240	**8,199**
Middle Creek	7,467	281	0	228	**7,976**
Big Valley	16,091	1,488	0	497	**18,076**
Lower Lake	1,249	561	0	41	**1,851**
Cache Creek	604	201	0	19	**824**
Thurston Lake	1,510	18	0	49	**1,577**
Eel River	0	5	0	0	**5**
County Total	**46,627**	**10,604**	**0**	**1,466**	**58,697**

The total water use in a dry year is similar to an average year with respect to the breakdown by sector, as shown in Figure 4-5. Agriculture has the largest water use for water in Lake County and comprises approximately 79 percent of the County's total water use.

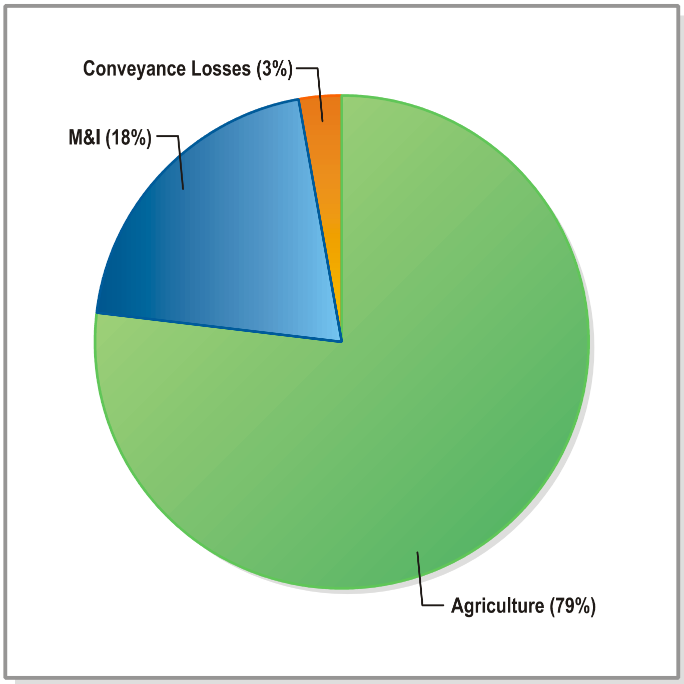


Figure 4-5
Dry Year Water Use

There is an increase in water use during a dry year compared to an average year. Overall, Lake County experiences an approximate 14 percent increase in total water use, an increase of 7,367 acre-feet from the average year water use. Total agricultural water use, total M&I water use, and total conveyance losses all increase during a dry year compared to an average year.

Agricultural water use in a dry year increases approximately 17 percent above average year water use because of increased irrigation needs. In a drier year, less precipitation results in less soil moisture at the beginning of the irrigation season. Agricultural ETAW increases because less of the plant's ET needs are met by precipitation and therefore must be met by agricultural irrigation.

Dry year municipal water use increases by approximately 3 percent. The largest increases in municipal water use occur in the Lower Lake and Upper Putah Inventory Units, which experience increases of 18 percent and 17 percent above average years. Municipal water use increases because landscape irrigation needs similarly increase because of the change in soil moisture.

The increase in municipal and agricultural water use also results in an increase in conveyance losses. Additionally, the drier air and soil conditions can increase evaporation and percolation of water, which increases conveyance losses. Conveyance losses increase by approximately 17 percent.

4.4.2 Supplies

Table 4-7 summarizes dry year water supply in Lake County. Figure 4-6 demonstrates that there is generally little change in the proportion of water supply compared to an average year. Net groundwater is still the largest source of water at approximately 50 percent, followed by local surface water at 30 percent, deep percolation re-use at 13 percent and surface water re-use at 7percent.

Table 4-7
Summary of Lake County Water Supplies in a Dry Year
Water Supplies (acre-feet)

Inventory Unit	Local Surface	Net Groundwater	Deep Percolation Reuse	Surface Water Reuse	Total Water Supply
Upper Putah	926	1,934	518	332	**3,710**
Middle Putah	4,151	210	329	1,052	**5,742**
Shoreline	5,554	3,303	1,526	352	**10,735**
Scotts Creek	2,326	3,942	1,076	856	**8,199**
Middle Creek	3,021	2,973	897	1,085	**7,976**
Big Valley	1,639	13,265	2,637	535	**18,076**
Lower Lake	10	1,732	109	0	**1,851**
Cache Creek	152	487	185	0	**824**
Thurston Lake	0	1,512	65	0	**1,577**
Eel River	0	2	3	0	**5**
County Total	**17,780**	**29,360**	**7,344**	**4,213**	**58,697**

Table 4-7 shows that the total quantity of water supply for the County increases in a dry year for all sources in response to the increase in water uses. The relative contribution of surface water decreases from approximately 33 percent in an average year to 30 percent in a dry year because surface water is less available during dry years. Net groundwater supplies increase from 48 percent in an average year to 50 percent in a dry year. This change indicates that users shift from surface water to groundwater in years with increased water uses but limited surface water supplies.

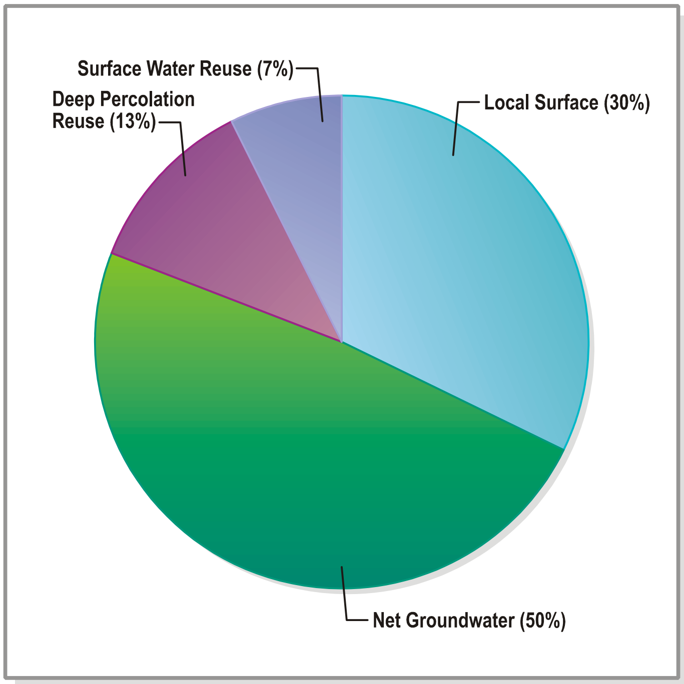


Figure 4-6
Dry Year Water Supplies

Local surface water supply for Lake County increases by 1,096 acre-feet compared to an average year. Shoreline and Cache Creek Inventory Units experience surface water supply decreases in a dry year of 101 and 11 acre-feet, respectively. These decreases are likely because use of Clear Lake and Cache Creek are restricted during a dry year because of lack of availability; therefore, water purveyors are forced to rely more heavily on groundwater supplies.

Total net groundwater supply for the County increases by 4,646 acre-feet in a dry year compared to an average year. All Inventory Units have an increase in the quantity of net groundwater supplies with the exception of Eel River, which has no change from an average year to a dry year.

During a dry year, deep percolation reuse increases by 1,104 acre-feet and surface water reuse increases by 521 acre-feet compared to an average year. These increases are related to the increase in surface water and net groundwater supplies. Users increase surface water diversions and groundwater pumping; therefore, the reuse of these supplies also increases.

4.4.3 Net Groundwater Extractions

Table 4-8 displays Lake County groundwater extractions in a dry year. Total groundwater extracted during a dry year is 36,875 acre-feet. Total net groundwater extraction increases in the County during a dry year by almost 19 percent compared to an average year. This change is attributed to an increase in groundwater pumping as surface water becomes less reliable. Surface water deep percolation and groundwater deep percolation also increase in a dry year because more water is used.

Table 4-8
Summary of Groundwater Extractions in a Dry Year

Inventory Unit	Groundwater Extraction (Acre-feet)			
	Total Ground-water	Surface Water Deep Percolation	Groundwater Deep Percolation	Net Groundwater Extractions
Upper Putah	2,452	69	449	1,934
Middle Putah	539	226	103	210
Shoreline	4,829	173	1,353	3,303
Scotts Creek	5,017	152	924	3,942
Middle Creek	3,870	197	700	2,973
Big Valley	15,902	138	2,499	13,265
Lower Lake	1,917	2	183	1,732
Cache Creek	688	104	97	487
Thurston Lake	1,655	0	143	1,512
Eel River	5	0	3	2
Total	**36,875**	**1,061**	**6,454**	**29,360**

4.4.4 Shortages

As shown in Tables 4-6 and 4-7, water use and water supplies in a dry year are equal; therefore, Lake County does not currently experience any shortages during a dry year. All Inventory Units have adequate supply to meet water use in a dry year. Anecdotal evidence shows that during severe drought events (approximately 10-year recurrence interval) aquifer recharge is frequently insufficient to fully recharge the major aquifers. Without full recharge, groundwater shortages occur, resulting in lower groundwater levels and deteriorating water quality. These conditions have been observed in Big Valley, Scotts Valley, Upper Lake, and Collayomi Valley (Smythe 2006).

4.5 Summary of Wet-Year Inventory

The subsequent sections provide a wet year analysis for Lake County.

4.5.1 Water Use

Table 4-9 shows Lake County water use during a wet year. During a wet year, higher amounts of precipitation increase soil moisture, which decreases the amount of applied water needed to meet plant needs. This change affects both agriculture, which needs less ETAW for each crop, and municipal water use, which experiences a decrease in landscaping needs.

Table 4-9
Summary of Lake County Water Use in a Wet Year
Applied Water (acre-feet)

Inventory Unit	Agriculture	M & I	Environmental	Conveyance Losses	Total Water Use
Upper Putah	1,554	1,011	0	50	**2,615**
Middle Putah	3,912	36	0	130	**4,078**
Shoreline	2,579	5,936	0	92	**8,607**
Scott's Creek	5,410	119	0	168	**5,697**
Middle Creek	5,281	285	0	163	**5,729**
Big Valley	10,191	1,420	0	321	**11,932**
Lower Lake	726	452	0	25	**1,203**
Cache Creek	412	186	0	13	**611**
Thurston Lake	890	18	0	31	**939**
Eel River	0	5	0	0	**5**
County Total	**30,955**	**9,468**	**0**	**993**	**41,416**

Overall water use in the County during a wet year decreases by 9,914 acre-feet compared to an average year. Agriculture is still the largest water user in the County, but agricultural water use decreases approximately 22 percent compared to an average year. Most Inventory Units experience similar decreases in agricultural water use that range from 20 to 25 percent.

M&I water use decreases by approximately 8 percent in a wet year compared to an average year. M&I water uses generally decrease less than agricultural because M&I water uses include uses that remain constant during different water year types, such as commercial water use. Shoreline experiences the largest decrease in M&I water use of 11 percent compared to an average year.

Conveyance losses decrease in a wet year because agricultural and M&I supplies decrease. Conveyance losses in Lake County decrease by approximately 21 percent in a wet year compared to an average year. These losses are relatively consistent over all Inventory Units.

4.5.2 Water Supplies

Table 4-10 shows the composition of Lake County supplies during a wet year. Water supplies decrease in a wet year because water uses decrease, as described above. Figure 4-7 shows the relative contribution of each supply source to the total wet year supply. Overall, the percent contribution of each supply source changes very little from an average year.

Table 4-10
Summary of Lake County Water Supplies in a Wet Year
Water Supplies (acre-feet)

Inventory Unit	Local Surface	Net Groundwater	Surface Water Reuse	Deep Percolation Reuse	Total Water Supply
Upper Putah	678	1,356	168	413	**2,615**
Middle Putah	2,952	188	719	219	**4,078**
Shoreline	4,614	2,532	190	1,271	**8,607**
Scott's Creek	1,750	2,631	591	726	**5,697**
Middle Creek	2,274	2,063	771	621	**5,729**
Big Valley	1,236	8,710	179	1,807	**11,932**
Lower Lake	10	1,155	0	38	**1,203**
Cache Creek	143	313	0	156	**611**
Thurston Lake	0	902	0	37	**939**
Eel River	0	2	0	3	**5**
County Total	**13,656**	**19,852**	**2,618**	**5,290**	**41,416**

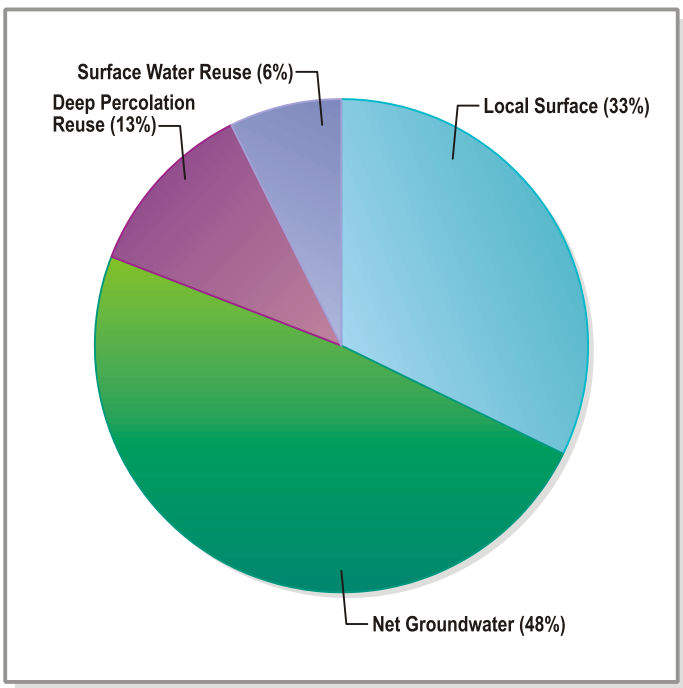


Figure 4-7
Wet Year Water Supplies

The applied water methodology determines the supplies that are needed to meet water uses, but does not estimate overall available supplies within the County. During a wet year, more supplies would likely be available because of the increased surface water flows and groundwater recharge. Although this water is not required to meet immediate water demands, it provides other benefits. It would provide environmental benefits to fisheries and riparian vegetation by providing the pulse flows necessary for some species. Higher flows and more precipitation would also lower crop ETAW, as previously discussed. Additionally, groundwater recharge would provide a base of groundwater storage available for future use.

4.5.3 Net Groundwater Extractions

Table 4-11 shows the net groundwater extraction during a wet year. Net groundwater extractions decrease in a wet year by approximately 20 percent compared to an average year. This decrease is caused by an overall decrease in water use, which reduces demand for groundwater. Additionally, increased surface water availability decreases the need for groundwater pumping.

Table 4-11
Summary of Groundwater Extractions in a Wet Year

Inventory Unit	Groundwater Extraction (acre-feet)			
	Total Ground-water	Surface Water Deep Percolation	Groundwater Deep Percolation	Net Groundwater Extractions
Upper Putah	1,769	49	364	1,356
Middle Putah	407	134	85	188
Shoreline	3,804	161	1,111	2,532
Scott's Creek	3,356	98	628	2,631
Middle Creek	2,684	128	493	2,063
Big Valley	10,517	142	1,665	8,710
Lower Lake	1,285	2	128	1,155
Cache Creek	491	102	76	313
Thurston Lake	1,035	0	133	902
Eel River	5	0	3	2
Total	**25,352**	**816**	**4,684**	**19,852**

4.5.4 Shortages

Tables 4-9 and 4-10 show that supplies are adequate for the water uses within all Inventory Units. During a wet year, available supplies would likely exceed water uses.

4.6 Environmental and Recreational Water Uses

Environmental water use includes applied water used for managed wetlands and instream flows. Recreational water use generally includes instream flow and water level requirements. Other than applied water for managed wetlands, water needs for environmental and recreational uses are generally non-consumptive. Lake County has many areas that provide wetland habitat, but does not have any managed wetlands where water is applied for environmental water use. Therefore, this section discusses lake levels and instream flows, but not managed wetlands.

The environmental and recreational water uses in Lake County do not fit into the applied water methodology; that is, they are not part of the measurable and managed water cycle. This analysis does not quantify these uses because they are not applied water uses; however, providing qualitative information about water uses can assist water managers in understanding the water resources setting in the County.

4.6.1 Recreational and Environmental Needs in Clear Lake

Clear Lake is the largest natural freshwater lake in California, and it is popular for water skiing and bass fishing. Water levels in the lake are a good indicator of its utility for both of these activities.

Captain Rumsey established the natural level of Clear Lake in 1872. He determined that the level of the lake at the Grigsby Riffle (a rock sill) was "zero Rumsey." Lake level measurements are therefore measured relative to this elevation, which is 1,318 feet above mean sea level (Lake County 2004 (a)). In 1914, the Cache Creek Dam was built at the outlet to Cache Creek to regulate the water supply storage in Clear Lake. Yolo County Flood Control and Water Conservation District (FCWCD) owns the dam and uses it to regulate the levels of Clear Lake for flood control and water supply.

Three significant legal decrees influence Clear Lake water levels. Of the three decrees, only one controls releases from Clear Lake for recreational and environmental purposes. The Solano Decree, 1978 (revised March 30, 1995), regulates summer lake levels and the maximum amount of water that Yolo County FCWCD can withdraw each year. The lake level on May 1 of every year determines the amount of water that can be withdrawn that year. Yolo County FCWCD can withdraw its full allotment of 150,000 acre-feet of water if Clear Lake is full on May 1 (7.56 Rumsey). If Clear Lake is below 3.22 Rumsey, no water can be withdrawn. The decree sets monthly maximum limits as well (Lake County 2004 (b), Ott 1987, US Army Corps of Engineers 1992).

4.6.2 Environmental Needs on Cache Creek

The governor signed Assembly Bill 1328 into law on October 6, 2005 to protect a 31-mile stretch of Cache Creek, from the Clear Lake dam to the upper end of the Capay Valley, as a State Wild, Scenic, and Recreational River (Logsdon 2005). This law states that designating Cache Creek as a protected river will not affect the existing water rights of public water agencies within the Lake County portion of the Cache Creek watershed. The legislation further adds that the Act will not affect Yolo County FCWCD's range of operations or quantity of water diverted (i.e., water releases from Clear Lake or Indian Valley Reservoir, or changes in water flow) permitted under existing water rights.

The legislation further adds that it will not affect changes in Yolo County FCWCD's or Lake County's changes in existing water rights or applications for new water rights provided they do not involve construction of a dam, reservoir, or diversion, or other water impoundment facility within the designated segments of Cache Creek.

4.6.3 Cache Creek Watershed Tributaries

The Cache Creek watershed includes the streams that drain into Clear Lake. Riparian vegetation flourishes along these waterways, which promotes habitat for various species. One such stream that drains into Clear Lake is Middle Creek, which flows from the north, between the shoreline communities of North Lakeport and Nice. Table 4-12 shows fish species occurring in Middle Creek. These species are similar to species found in the other creeks and streams that drain into Clear Lake.

Table 4-12 Middle Creek Fish	
Fish Common Name	***Species Status***
Clear Lake Hitch	California Species of Concern
Rainbow Trout	None
Sacramento Sucker	None
California Roach	None
Threadfin Shad	None
Green Sunfish	None
Brown Bullhead Catfish	None

Source: Northwest Biosurvey 2004

The County's mild climate results in little snow, which would provide snowmelt to keep streams flowing longer during the year. Many streams are dry in summer and fall until they are replenished with winter rainfall. Some streams flow year-round because of natural seepage of near-surface groundwater.

Because the streams entering Clear Lake are not controlled by dams or major diversions, actions to benefit fish in these waterways generally cannot include increased water flow requirements.

4.6.4 Instream Flows for Recreation

Portions of the Eel River, Putah Creek, and Cache Creek are popular sites for whitewater rafting or kayaking. All three waterways offer scenic visual resources that include wildlife viewing and riparian vegetation.

Releases from Lake Pillsbury in Lake County affect rafting on the Eel River, and rafters find the run enhanced in October and November when water is released to create space for winter storage. Easiest rafting occurs at 400 cfs, with the preferred level at 800 cfs. Flow over 800 cfs creates bigger rapids and requires a higher experience level from the rafter or kayaker. Rapids range from Class III to above IV, depending on water flows. In addition to recreational opportunities on the Eel River, water levels within Lake Pillsbury can affect recreational opportunities within the lake. The Federal Energy Regulatory Commission is working to relicense the Potter Valley Project.

Putah Creek from Middletown to Berryessa Reservoir has flows ranging from 500 cfs to 2,000 cfs, depending on the season. The creek offers Class II to Class IV+ rapids, with the higher class because of a brushy waterway with overhanging willows.

Cache Creek (from North Fork to Bear Creek) has flows ranging from 350 to 3,000 cfs. Optimal flows upstream are 100 cfs on the North Fork, and 400 cfs at Rumsey Gauge. There are many Class II riffles with one Class III rapid. Commercial rafting companies launch unguided two-seater rafts on the creek.

Table 4-13 shows flows in each river during the years 2000 (an average year) and 2001 (a dry year).

Table 4-13
Average and Wet Year Streamflows

YEAR	Monthly Mean Streamflow (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eel River(1)												
2000	328	2,556	1,189	193	221	175	139	142	154	182	310	118
2001	95	63.4	476	329	218	137	101	103	103	118	242	1,579
Putah Creek(2)												
2000	386	1,224	477	111	55.5	19	4.78	0.83	0.53	3.95	9.65	20.7
2001	133	534	296	54.2	20.3	4.56	0.52	0.39	0.34	0.35	128	808
Cache Creek(3)												
2000	4.16	99.5	827	137	622	702	543	455	282	122	4.18	4.04
2001	4.03	4.27	7.13	11.1	175	180	154	266	8.81	4.89	2.67	2.81

Notes:
(1) USGS Station 11470500: Eel River below Scott Dam near Potter Valley
(2) USGS Station 11453500: Putah Creek near Guenoc
(3) USGS Station 11451000: Cache Creek near Lower Lake

Source: USGS 2005.

In general, 500-800 cfs is an appropriate range for rafting needs (Wilson 2005). Table 4-14 identifies the Eel River, Putah Creek, and Cache Creek rafting classes and recommended flows.

Table 4-14
River Rafting Reaches with Headwaters in Lake County

River Reach Description	Class	Minimum Suggested Flow (cfs)	Maximum Suggested Flow (cfs)
Eel River	III-IV	400	800
Putah Creek	IV-V	500	800
Cache Creek	II-III	250	750

Source: American Whitewater 2005 and Tuthill 2002

Comparing Tables 4-13 and 4-14 shows that the waterways are currently only useable for recreational purposes during a few months of some years. These recreational flows are not required flows; therefore, they are not quantitatively included in the above analysis.

Section 5
Future Water Use

Section 4 presented current water uses and supplies for Lake County; this information helps provide a baseline for water planning within the County. Current uses and supplies, however, only provide the baseline of the information needed for long-term water planning. Understanding potential future changes in water use is also necessary.

This section summarizes methods and results used in the Lake County Water Demand Forecast (October 2005) to forecast future water uses. The Water Demand Forecast TM is a companion document to the Water Inventory and Analysis, and is available from the District.

5.1 Urban Water Use

As discussed in Section 4, urban water use (also referred to as Municipal and Industrial, or M & I) includes water use for residential, commercial, industrial, institutional, and landscape irrigation purposes for city and rural areas. Residential water use is water used in single-family homes, multi-family homes, and mobile homes. Commercial, industrial, and institutional water use includes water used for businesses, industry, government buildings, schools, and hospitals. Landscape water use is water used to irrigate parks, golf courses, cemeteries, and highway medians.

5.1.1 Methods

Two future scenarios were used to forecast urban water use that reflects a range of possible future water use. The demand forecast utilized the results of the inventory for an average year (2000) and a dry year (2001) (see Section 4) to determine likely future water needs for the year 2040 in average and dry years.

Urban water use is forecast by sector. A sector is a group of users with similar water use attributes. Two sectors are used in the demand forecast: residential users and non-residential users. The non-residential sector is further divided into two subsectors: commercial/industrial/institutional (CII) and landscape. Disaggregation of water users into sectors and subsectors with similar water use attributes results in a more accurate forecast. Using inventory data (summarized in Section 4), water use rates are derived for the type of use by sectors and subsectors.

The urban water demand forecast uses indicators of growth to determine future water uses. The forecast assumes that water use will increase relative to growth. Growth indicators used for the forecast include number of people (population) and number of employees (jobs). The forecast uses these demographic data because they are accessible from county and state planning agencies. Per capita water uses are applied to future populations to establish future water uses for the residential sector and non-residential landscape water use. Per employee uses are applied to the future number of jobs in the County to establish future water uses for CII water use.

5.1.2 Results

Forecast results using per capita and per employee growth applied to urban water user sectors indicate that total average and dry year urban water use would increase by 8,835 acre-feet and 9,698 acre-feet, respectively, in 2040. Table 5-1 presents residential and non-residential water use data for 2000 and 2001, and projections of average year water use and dry year water use in 2040.

Table 5-1
2040 Lake County Urban Water Use Summary (acre-feet per year)

Use	*2000 Water Use (Average Year)*[1]	*2001 Water Use (Dry Year)*	*2040 Average Year*	*2040 Dry Year*
CII Use	*1,188*	*1,186*	*2,222*	*2,091*
Landscape Use	*631*	*723*	*1,153*	*1,308*
Total Non-Residential Use	*1,819*	*1,909*	*3,375*	*3,399*
Total Residential Use	9,084	10,109	16,364	18,317
Total Urban Use	**10,903**	**12,018**	**19,738**	**21,716**

Residential water use is forecasted to increase by 7,280 acre-feet in an average year in 2040, an 80 percent increase. Dry year residential use is predicted to increase by 8,208 acre-feet in 2040, an 81 percent increase.

The water use forecast projects that CII water use will increase by 1,034 acre-feet in an average year by 2040, an 87 percent increase. Dry year CII use is projected to increase by 905 acre-feet by 2040, a 76 percent increase.

Landscape water use is forecasted to increase by 522 acre-feet in an average year in 2040, an 83 percent increase. Dry year landscape use is forecast to increase by 585 acre-feet in 2040, an 81 percent increase.

Within Lake County, much of the urban growth is focused in the Upper Putah and Shoreline Inventory Units (Lake County 2005). The Upper Putah Inventory Unit contains the rapidly growing communities of Hidden Valley Lake and Middletown. The Shoreline Inventory Unit contains the lakeside communities of Nice, Lucerne, Clearlake Oaks, Clearlake, Lower Lake, and Lakeport that are also seeing urban growth. The rural unincorporated areas spread throughout the County also showed a high growth rate. Urban water uses are greater in dry years, when there is less precipitation to satisfy applied water needs.

1 Water use in years 2000 and 2001 is similar but not exactly the same as the results presented in Section 4. These calculations of water use are based on population estimates from Lake County's General Plan Update to remain consistent with population estimates used for future projections.

5.2 Agricultural Water Use

Agricultural water is used in the production of commercial crops. Future agricultural water use changes based on changes in land use, economic, and hydrologic conditions.

5.2.1 Methods

The calculation of agricultural water use started with historical average-year and dry-year data to calculate a range of possible future agricultural water use. The future conditions that affect agricultural water use, particularly economic conditions that dictate changes in crops, are very uncertain. To address this uncertainty, three scenarios for each year type are used to describe the amount and type of irrigated crops forecasted for the year 2040. The forecasted irrigated crop acreage and the unit ETAW values per crop determined agricultural water use for each scenario.

The scenarios provide an appropriate range of future agricultural practices and associated water use because future agricultural changes are not explicitly known. The scenarios are not the preferred or probable futures; rather, they provide information to quantify varying assumptions about agricultural water use in the future. Rather than projecting one uncertain future, multiple scenarios represent the potential range of possibilities that are reasonable in 2040, given the data that is available today. The scenarios include changes in crop acreages and types from the existing condition within each Inventory Unit. Forecast scenarios were developed based upon interviews with Lake County agricultural experts. The demand forecast considered current trends and plausible future changes in County agriculture.

Scenario One represents the continuation of current trends witnessed by the County. It assumes that most of the land currently in pears and walnuts will convert to wine grapes and housing (ranchettes on acreage). Some native vegetation will convert to wine grapes.

Scenario Two is similar to Scenario One, but reflects a smaller reduction in pears and walnuts, and a larger increase in wine grapes. A larger amount of native vegetation will convert to wine grapes compared to Scenario One. Ranchette development remains the same as Scenario One.

Scenario Three assumes that growers will retain their land in agriculture, but will expand their marketing efforts with value-added production and diversify their crop choices to alternative crops that have a “specialty” or “gourmet” status. The scenario only considered crops that would grow well in Lake County soils and climatic conditions. Scenario Three assumes pears will convert to pomegranates and figs, walnuts will convert to pecans and chestnuts, and undeveloped land (native vegetation) will convert to heritage and Asian vegetables. Native vegetation will also convert to new wine grape and ranchette acreage.

5.2.2 Results

Table 5-2 shows the results of the agricultural water use forecast for each of the three scenarios for an average and dry year, respectively. Future agricultural water use during an average year decreases by 2 percent (630 acre-feet) under Scenario One, increases by 7 percent (2,688 acre-feet) under Scenario Two, and increases by 22 percent (8,570 acre-feet) under Scenario Three.

During a dry year, agricultural water use increases by 2 percent (1,009 acre-feet) under Scenario One, increases by 11 percent (5,174 acre-feet) under Scenario Two, and increases by 25 percent (11,804 acre-feet) under Scenario Three.

Table 5-2
Projected Agricultural Water Demand

	Historical Data 2000 (Average) 2001 (Dry)		Scenario 1 2040 Forecast		Scenario 2 2040 Forecast		Scenario 3 2040 Forecast	
	Total Irrigated Crop Acreage	Applied Water (acre-feet)	Total Irrigated Crop Acreage	Applied Water (acre-feet)	Total Irrigated Crop Acreage	Applied Water (acre-feet)	Total Irrigated Crop Acreage	Applied Water (acre-feet)
Average Year	19,978	39,817	31,148	39,187	34,096	42,505	33,908	48,387
Dry Year	19,978	46,627	31,148	47,636	34,096	51,801	33,908	58,431

Irrigated acreage in Scenarios One and Two increases substantially (11,000 to 14,000 acres) from current conditions while water use in Scenarios One and Two remains similar to the water use under current conditions. This increase in irrigated acreage without a corresponding change in water use results from the replacement of high water demand crops (pears and walnuts) with low water demand crops (wine grapes). In Scenario Three, irrigated acreage increases as in Scenarios One and Two, but water use increases substantially because pears and walnuts are replaced with other high water demand crops (pomegranates, figs, pecans, and chestnuts).

The Lower Lake Inventory Unit would experience the greatest increase in agricultural water use in an average year of 1,680, 1,932, and 1,680 acre-feet for Scenarios One, Two, and Three, respectively. This substantial increase is a result of the increase of 3,000 to 3,450 acres of land converted to wine grapes. Upper Putah Inventory Unit is also forecasted to have a large increase in agricultural water use.

5.3 Environmental and Recreational Water Use

As discussed in Section 4.6, Lake County does not have any environmental or recreational applied water use. Lake County does, however, have needs for environmental and recreational water, but these needs do not translate into required applied water applications. This section qualitatively discusses how environmental and recreational water use may change into the future.

5.3.1 Methods

Changes in environmental and recreational future water uses are generally related to new legislation or changes in public values. Interviews with environmental and recreational experts within Lake County were used to determine if these types of changes are likely. Additionally, other potential regulatory changes that could affect environmental and recreational uses were researched.

5.3.2 Results

During certain periods, recreational uses (boating, fishing, whitewater rafting, kayaking) would benefit from additional creek flows or lake water levels, however, water facility operators are unlikely to increase releases or water levels because it would restrict water supply, flood protection, or hydropower generation. Many environmental needs in the County are upstream from major dams or diversion facilities, so water facility managers cannot increase water flow in these streams. The state's Wild, Scenic, and Recreational Rivers program has inducted Cache Creek, which will preserve the existing flow regime of Cache Creek into the future.

5.4 Conclusions

Water use in Lake County is likely to increase through 2040. Urban and agricultural water use changes will increase pressure on groundwater and surface water resources. Because surface water rights are not likely to increase, the majority of the future water use will result in additional groundwater pumping. Future agricultural use and urban water use are projected to increase by approximately -630 to 8,570 acre-feet and 8,835 acre-feet respectively in an average year, and 1,009 to 11,804 acre-feet and 9,698 acre-feet respectively in a dry year. Environmental and recreational water use will likely remain similar to the existing condition. Continued planning and management of water resources in the County will be required to help avoid harm to existing users or the environment resulting from increased water uses.

Section 6
Conclusions and Recommendations

The following conclusions and recommendations are based on results of 1) interviews with local water resource stakeholders, 2) water supply and use calculations under average and dry hydrologic conditions, and 3) analysis of groundwater level trends at individual monitoring wells, geologic information, and existing groundwater extraction well infrastructure.

6.1 Conclusions

Completion of the Lake County Water Inventory and Analysis provides a greater understanding of Lake County water resources, which will further future efforts to plan for long-term, sustainable use of water resources.

6.1.1 Physical Condition Conclusions

Lake County is a topographically diverse area in the Coast Ranges of California that includes the headwaters of the Eel River, Cache Creek, and Putah Creek. The County receives approximately 88 percent of its rainfall in the winter (October – March), and approximately 12 percent of its rainfall in the summer (April-September). Stream flows reflect rainfall patterns, with the majority of streamflows occurring November through April.

Lake County is in the Coast Ranges, a complex geologic region where geology strongly influences availability of groundwater resources. The County's mountains and ridges are typically made of hard rock (also known as basement rock), which does not contain abundant groundwater supplies. The County's most plentiful groundwater supplies occur under the surface of valleys, in groundwater basins. Groundwater in basins in non-drought years declines over the summer and fully recovers each winter. Groundwater levels in the groundwater basins decrease during the summer with larger seasonal variations in areas that use groundwater. Areas that use groundwater as the primary supply typically show increased seasonal drawdown over time. These areas include Scotts and Big Valleys, where summer groundwater levels have been decreasing annually. Groundwater levels in other groundwater basins have generally remained constant, and are not in decline.

6.1.2 Water Management Conclusions

Surface water and groundwater are the main sources of water for domestic, environmental, and agricultural uses within Lake County. Disputes over surface water rights, Clear Lake water quality, and groundwater supply are some of the major issues facing the County.

Historically, surface water use in Lake County is a contentious issue. Surface water use from Putah Creek is limited by two legal settlements. Surface water use from Cache Creek, Clear Lake, and its tributaries is limited by Yolo County Flood Control and Water Conservation District's senior appropriative water right, which allows them to divert up to 150,000 acre-feet of water annually.

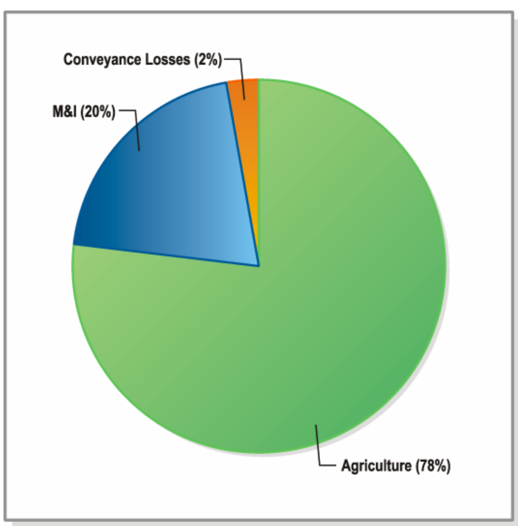
A major issue facing water supply agencies that distribute water from Clear Lake is the water quality of Clear Lake. In the summer, algae blooms clog filtration systems, reduce treatment capacities of treatment plants, increase pH, and affect the taste and odor of the water. During the winter, the lake experiences an increase in silt, which causes high turbidity, increasing treatment costs.

Lake County extensively utilizes groundwater as a water source and has no adjudicated groundwater basins. The County has approximately 3,600 domestic wells, and 800 irrigation wells. Over 50 percent of domestic wells are less than 100 feet deep, and over 50 percent of irrigation wells are less than 125 feet deep. Groundwater extraction for agricultural use occurs primarily in Scotts Valley, Big Valley, and in the volcanic soils south of Mount Konocti.

6.1.3 Water Use and Supply Conclusions

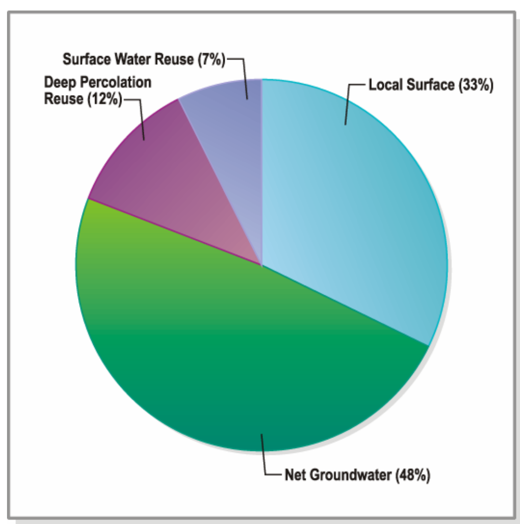
Water use and supply in Lake County was calculated for average, dry, and wet years. Water use includes agricultural, urban, and environmental water uses. Water supply considers surface water, groundwater, and water reuse.

Figures 6-1 and 6-2 illustrate the average year water use and water supply, respectively. Agriculture is the largest user of water in the County, and the largest agricultural demands are in the Big Valley Inventory Unit. During an average year, total countywide water use is 51,330 acre-feet. Groundwater is the largest source of supply in the County during an average water year. In an average year, adequate supplies are available to meet current water use.



Source: DWR 2005

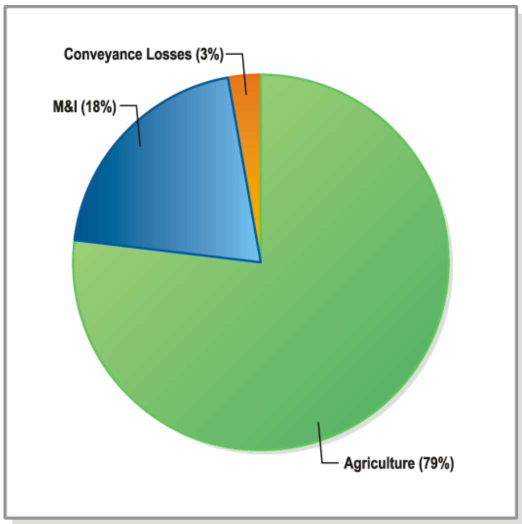
Figure 6-1
Average Year Water Use



Source: DWR 2005

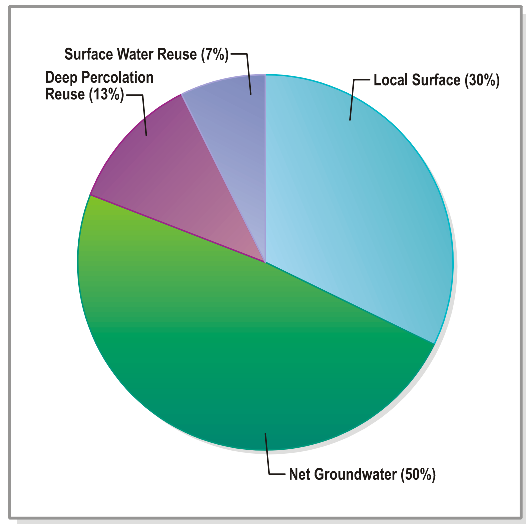
Figure 6-2
Average Year Water Supplies

Figures 6-3 and 6-4 illustrate the dry year water use and supplies, respectively. Relative to an average water year, water use in a dry year from all sectors increases to 58,697 acre-feet, an increase of 7,367 acre-feet (14 percent). Agricultural and M&I water uses increase during a dry year because of higher demand for irrigation of crops and landscape during summer months. There is generally little change in the proportion of water demand and supply compared to an average year. In a dry year, adequate supplies are available to meet demands.



Source: DWR 2005

Figure 6-3
Dry Year Water Use



Source: DWR 2005

Figure 6-4
Dry Year Water Supplies

Agricultural water use in a dry year increases approximately 17 percent above average year water use. In a drier year, less precipitation results in less soil moisture at the beginning of the irrigation season. Agricultural ETAW increases because less of the plant's ET needs are met by precipitation. Dry year municipal water use also increases in a dry year because landscape irrigation needs similarly increase because of the change in soil moisture.

Water use decreases during a wet water year. Wet year water use would be less than in an average year because increased soil moisture at the beginning of the irrigation season would decrease the need for applied water. In a wet year, adequate supplies are available to meet demands. All creeks and streams in the County see increased flows during wet years; this increase indicates that additional supplies may be available in those years. Because these supplies are not diverted, however, does not indicate that they are not being used. Although this water is not required to meet immediate water demands, it provides other benefits. Additional water would percolate to the aquifers, recharging groundwater levels for future use. It would also provide environmental benefits to fisheries and riparian vegetation by providing the pulse flows necessary for some species.

6.1.4 Future Water Use Conclusions

Water use in Lake County is likely to significantly increase through 2040. Increases in both urban and agricultural water use will likely increase pressure on groundwater and surface water resources.

Total Lake County population is forecasted to increase from 58,300 people in 2000 to 105,800 people in 2040. Total urban demand is forecasted to increase from 10,903 acre-feet to 19,738 acre-feet in an average year, an 8,835 acre-feet (81 percent) increase. Dry year urban demand is forecast to increase by 9,698 acre-feet in 2040, an 81 percent increase.

Agricultural demand was calculated under three scenarios. Irrigated acreage in Scenarios One and Two is predicted to increase substantially (11,000 and 14,000 acres) from current conditions while water demand remains similar to the demand under current conditions. This increase in irrigated acreage without a corresponding change in water demand resulted from the replacement of high water demand crops (pears and walnuts) with low water demand crops (wine grapes). In Scenario Three, irrigated acreage is predicted to increase substantially (14,000 acres), but water demand is predicted to increase substantially because pears and walnuts are replaced with other high water demand crops (pomegranates, figs, pecans, and chestnuts).

During an average year, agricultural demand is forecasted to decrease by 2 percent (630 acre-feet) under Scenario One, increase by 7 percent (2,688 acre-feet) under Scenario Two, and increase by 22 percent (8,570 acre-feet) under Scenario Three. During a dry year, agricultural demand is forecasted to increase by 2 percent (1,009 acre-feet) under Scenario One, increase by 11 percent (5,174 acre-feet) under Scenario Two, and increase by 25 percent (11,804 acre-feet) under Scenario Three.

6.2 Recommendations

The following recommendations are based on information contained in the Water Inventory and Analysis Report and information from other ongoing efforts:

- Use data from this report to begin an integrated water resources planning effort within the County.

- Further investigate the availability of future supplies to determine areas where existing water supplies may not be adequate for future water uses.

- Continue to develop the County's AB 3030 Groundwater Management Plan in an effort to promote groundwater management activities that will result in an adequate supply of high quality water into the future.

- Continue to encourage active participation by local stakeholders in both groundwater planning and groundwater monitoring efforts. The District will encourage groundwater monitoring partnerships with local groundwater users.

- Participate in coordinated regional and statewide groundwater monitoring and planning efforts.

- Pursue the installation and monitoring of additional groundwater monitoring wells in areas of data gaps and in areas where increasing groundwater demand is anticipated in the future. Adequate groundwater level information is not available in some groundwater basins, resulting in an incomplete understanding of groundwater levels, movement, and response to extraction. These groundwater basins include: Clear Lake Volcanics Groundwater Source Area, Lower Lake Basin, Burns Valley Basin, Long Valley Groundwater Basin, Clear Lake Cache Formation Groundwater Basin, Middle Creek Groundwater Basin, and Gravelly Valley Groundwater Basin.

- Support additional studies focused on furthering the understanding of individual groundwater source areas and basins.

- Support efforts to study and protect Clear Lake water quality.

- Support efforts to study and protect Lake County surface water quality.

- Work with Yolo County Flood Control and Water Conservation District to cooperatively manage water in the Cache Creek watershed.

Section 7
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Appendix A

Agricultural Water Demand Calculations by Groundwater Basin

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Upper Lake Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00					32.0	32.0	0.0		90.0	90.0	0.0		128.0	128.0
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43			9.0			9.0	3.0		0.0	3.0	4.0		0.0	4.0
GRAPES	0.5	90%	0.56			90%	0.56			139.0		334.0	473.0	70.0		167.0	237.0	78.0		187.0	265.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08			276.0		458.0	734.0	856.0		1,420.0	2,276.0	1,223.0		1,869.0	3,092.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75			154.0		443.0	597.0	339.0		975.0	1,314.0	451.0		1,218.0	1,669.0
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50			539.0			539.0	1,455.0		0.0	1,455.0	2,426.0		0.0	2,426.0
STRAWBERRIES and FLOWERS	1.5	70%	2.14			70%	2.14					32.0	32.0	0.0		48.0	48.0	0.0		68.0	68.0
WALNUTS	2.3	76%	3.03			80%	2.88					283.0	283.0	0.0		651.0	651.0	0.0		815.0	815.0
Total Irrigated Crop Acreage										**1,117.0**		**1,582.0**	**2,699.0**	**2,723.0**		**3,351.0**	**6,074.0**	**4,182.0**		**4,285.0**	**8,467.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Scotts Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56					41.0	41.0	0.0		21.0	21.0	0.0		23.0	23.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75					11.0	11.0	0.0		24.0	24.0	0.0		30.0	30.0
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08					74.0	74.0	0.0		229.0	229.0	0.0		302.0	302.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75					680.0	680.0	0.0		1,496.0	1,496.0	0.0		1,870.0	1,870.0
PISTACHIOS	2.5	90%	2.78			90%	2.78					5.0	5.0	0.0		13.0	13.0	0.0		14.0	14.0
RICE	2.7	60%	4.50			60%	4.50														
STRAWBERRIES	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88					45.0	45.0	0.0		104.0	104.0	0.0		130.0	130.0
Total Irrigated Crop Acreage										**0.0**		**856.0**	**856.0**	**0.0**		**1,887.0**	**1,887.0**	**0.0**		**2,369.0**	**2,369.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Middle Creek Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)				Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70% 4.00		70% 4.00													
ALFALFA - X																	
ALMONDS	2.4	80% 3.00		80% 3.00													
CORN	1.6	73% 2.19		78% 2.05													
EUCALYPTUS																	
GRAIN	0.3	70% 0.43		70% 0.43													
GRAPES	0.5	90% 0.56		90% 0.56													
MEADOW PASTURE																	
MEADOW PASTURE - X																	
OLIVES - CITRUS																	
OTHER DECIDUOUS	2.2	80% 2.75		80% 2.75													
OTHER FIELD																	
OTHER TRUCK	1.5	78% 1.92		78% 1.92													
PASTURE	3.1	70% 4.43		76% 4.08				18.0	18.0	0.0		56.0	56.0	0.0		73.0	73.0
PASTURE - X																	
PEARS	2.2	75% 2.93		80% 2.75													
PISTACHIOS	2.5	90% 2.78		90% 2.78													
RICE	2.7	60% 4.50		60% 4.50													
STRAWBERRIES	1.5	70% 2.14		70% 2.14													
WALNUTS	2.3	76% 3.03		80% 2.88													
Total Irrigated Crop Acreage						**0.0**		**18.0**	**18.0**	**0.0**		**56.0**	**56.0**	**0.0**		**73.0**	**73.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Lower Lake Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)				Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70% 4.00		70% 4.00													
ALFALFA - X																	
ALMONDS	2.4	80% 3.00		80% 3.00													
CORN	1.6	73% 2.19		78% 2.05													
EUCALYPTUS																	
GRAIN	0.3	70% 0.43		70% 0.43													
GRAPES	0.5	90% 0.56		90% 0.56				31.0	31.0	0.0		16.0	16.0	0.0		17.0	17.0
MEADOW PASTURE																	
MEADOW PASTURE - X																	
OLIVES - CITRUS																	
OTHER DECIDUOUS	2.2	80% 2.75		80% 2.75													
OTHER FIELD																	
OTHER TRUCK	1.5	78% 1.92		78% 1.92													
PASTURE	3.1	70% 4.43		76% 4.08													
PASTURE - X																	
PEARS	2.2	75% 2.93		80% 2.75													
PISTACHIOS	2.5	90% 2.78		90% 2.78													
RICE	2.7	60% 4.50		60% 4.50													
STRAWBERRIES	1.5	70% 2.14		70% 2.14													
WALNUTS	2.3	76% 3.03		80% 2.88													
Total Irrigated Crop Acreage						**0.0**		**31.0**	**31.0**	**0.0**		**16.0**	**16.0**	**0.0**		**17.0**	**17.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Long Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)				Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70% 4.00		70% 4.00													
ALFALFA - X																	
ALMONDS	2.4	80% 3.00		80% 3.00													
CORN	1.6	73% 2.19		78% 2.05													
EUCALYPTUS																	
GRAIN	0.3	70% 0.43		70% 0.43													
GRAPES	0.5	90% 0.56		90% 0.56													
MEADOW PASTURE																	
MEADOW PASTURE - X																	
OLIVES - CITRUS																	
OTHER DECIDUOUS	2.2	80% 2.75		80% 2.75													
OTHER FIELD																	
OTHER TRUCK	1.5	78% 1.92		78% 1.92													
PASTURE	3.1	70% 4.43		76% 4.08													
PASTURE - X																	
PEARS	2.2	75% 2.93		80% 2.75													
PISTACHIOS	2.5	90% 2.78		90% 2.78													
RICE	2.7	60% 4.50		60% 4.50													
FLOWERS	1.5	70% 2.14		70% 2.14				117.0	117.0	0.0		176.0	176.0	0.0		250.0	250.0
WALNUTS	2.3	76% 3.03		80% 2.88				1.0	1.0	0.0		2.0	2.0	0.0		3.0	3.0
Total Irrigated Crop Acreage						**0.0**		**118.0**	**118.0**	**0.0**		**178.0**	**178.0**	**0.0**		**253.0**	**253.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Big Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05					8.0	8.0	0.0		13.0	13.0	0.0		16.0	16.0
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43					39.0	39.0	0.0		12.0	12.0	0.0		17.0	17.0
GRAPES	0.5	90%	0.56			90%	0.56			3.0		3,456.0	3,459.0	2.0		1,728.0	1,730.0	2.0		1,935.0	1,937.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75					12.0	12.0	0.0		26.0	26.0	0.0		33.0	33.0
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92					19.0	19.0	0.0		29.0	29.0	0.0		36.0	36.0
PASTURE	3.1	70%	4.43			76%	4.08			20.0		254.0	274.0	62.0		787.0	849.0	89.0		1,036.0	1,125.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75					2,151.0	2,151.0	0.0		4,732.0	4,732.0	0.0		5,915.0	5,915.0
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14					6.0	6.0	0.0		9.0	9.0	0.0		13.0	13.0
WALNUTS	2.3	76%	3.03			80%	2.88					820.0	820.0	0.0		1,886.0	1,886.0	0.0		2,362.0	2,362.0
Total Irrigated Crop Acreage										**23.0**		**6,765.0**	**6,788.0**	**64.0**		**9,222.0**	**9,286.0**	**91.0**		**11,363.0**	**11,454.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
High Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)						Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed	Ground		Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00		70%	4.00													
ALFALFA - X																			
ALMONDS	2.4	80%	3.00		80%	3.00													
CORN	1.6	73%	2.19		78%	2.05													
EUCALYPTUS																			
GRAIN	0.3	70%	0.43		70%	0.43													
GRAPES	0.5	90%	0.56		90%	0.56				64.0	64.0	0.0		32.0	32.0	0.0		36.0	36.0
MEADOW PASTURE																			
MEADOW PASTURE - X																			
OLIVES - CITRUS																			
OTHER DECIDUOUS	2.2	80%	2.75		80%	2.75													
OTHER FIELD																			
OTHER TRUCK	1.5	78%	1.92		78%	1.92													
PASTURE	3.1	70%	4.43		76%	4.08													
PASTURE - X																			
PEARS	2.2	75%	2.93		80%	2.75													
PISTACHIOS	2.5	90%	2.78		90%	2.78													
RICE	2.7	60%	4.50		60%	4.50													
FLOWERS	1.5	70%	2.14		70%	2.14													
WALNUTS	2.3	76%	3.03		80%	2.88													
Total Irrigated Crop Acreage								**0.0**		**64.0**	**64.0**	**0.0**		**32.0**	**32.0**	**0.0**		**36.0**	**36.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Coyote Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43					20.0	20.0	0.0		6.0	6.0	0.0		9.0	9.0
GRAPES	0.5	90%	0.56			90%	0.56			333.0		191.0	524.0	167.0		96.0	263.0	186.0		107.0	293.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75					3.0	3.0	0.0		7.0	7.0	0.0		8.0	8.0
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08			726.0		134.0	860.0	2,251.0		415.0	2,666.0	3,216.0		547.0	3,763.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88														
Total Irrigated Crop Acreage										**1,059.0**		**348.0**	**1,407.0**	**2,418.0**		**524.0**	**2,942.0**	**3,402.0**		**671.0**	**4,073.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Collayomi Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)				Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70% 4.00		70% 4.00													
ALFALFA - X																	
ALMONDS	2.4	80% 3.00		80% 3.00													
CORN	1.6	73% 2.19		78% 2.05													
EUCALYPTUS																	
GRAIN	0.3	70% 0.43		70% 0.43													
GRAPES	0.5	90% 0.56		90% 0.56				292.0	292.0	0.0		146.0	146.0	0.0		164.0	164.0
MEADOW PASTURE																	
MEADOW PASTURE - X																	
OLIVES - CITRUS																	
OTHER DECIDUOUS	2.2	80% 2.75		80% 2.75													
OTHER FIELD																	
OTHER TRUCK	1.5	78% 1.92		78% 1.92													
PASTURE	3.1	70% 4.43		76% 4.08		33.0		25.0	58.0	102.0		78.0	180.0	146.0		102.0	248.0
PASTURE - X																	
PEARS	2.2	75% 2.93		80% 2.75													
PISTACHIOS	2.5	90% 2.78		90% 2.78													
RICE	2.7	60% 4.50		60% 4.50													
FLOWERS	1.5	70% 2.14		70% 2.14													
WALNUTS	2.3	76% 3.03		80% 2.88													
Total Irrigated Crop Acreage						**33.0**		**317.0**	**350.0**	**102.0**		**224.0**	**326.0**	**146.0**		**266.0**	**412.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Clear Lake Volcanics Groundwater Source Area

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56					2,803.0	2,803.0	0.0		1,402.0	1,402.0	0.0		1,570.0	1,570.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08			185.0		162.0	347.0	574.0		502.0	1,076.0	820.0		661.0	1,481.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88					14.0	14.0	0.0		32.0	32.0	0.0		40.0	40.0
Total Irrigated Crop Acreage										**185.0**		**2,979.0**	**3,164.0**	**574.0**		**1,936.0**	**2,510.0**	**820.0**		**2,271.0**	**3,091.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Clear Lake Cache Formation Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56			26.0		127.0	153.0	13.0		64.0	77.0	15.0		71.0	86.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08														
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88					5.0	5.0	0.0		12.0	12.0	0.0		14.0	14.0
Total Irrigated Crop Acreage										**26.0**		**132.0**	**158.0**	**13.0**		**76.0**	**89.0**	**15.0**		**85.0**	**100.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Burns Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)				Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70% 4.00		70% 4.00													
ALFALFA - X																	
ALMONDS	2.4	80% 3.00		80% 3.00													
CORN	1.6	73% 2.19		78% 2.05													
EUCALYPTUS																	
GRAIN	0.3	70% 0.43		70% 0.43													
GRAPES	0.5	90% 0.56		90% 0.56		162.0			162.0	81.0		0.0	81.0	91.0		0.0	91.0
MEADOW PASTURE																	
MEADOW PASTURE - X																	
OLIVES - CITRUS																	
OTHER DECIDUOUS	2.2	80% 2.75		80% 2.75													
OTHER FIELD																	
OTHER TRUCK	1.5	78% 1.92		78% 1.92													
PASTURE	3.1	70% 4.43		76% 4.08													
PASTURE - X																	
PEARS	2.2	75% 2.93		80% 2.75													
PISTACHIOS	2.5	90% 2.78		90% 2.78													
RICE	2.7	60% 4.50		60% 4.50													
FLOWERS	1.5	70% 2.14		70% 2.14													
WALNUTS	2.3	76% 3.03		80% 2.88				5.0	5.0	0.0		12.0	12.0	0.0		14.0	14.0
Total Irrigated Crop Acreage						**162.0**		**5.0**	**167.0**	**81.0**		**12.0**	**93.0**	**91.0**		**14.0**	**105.0**

Appendix B

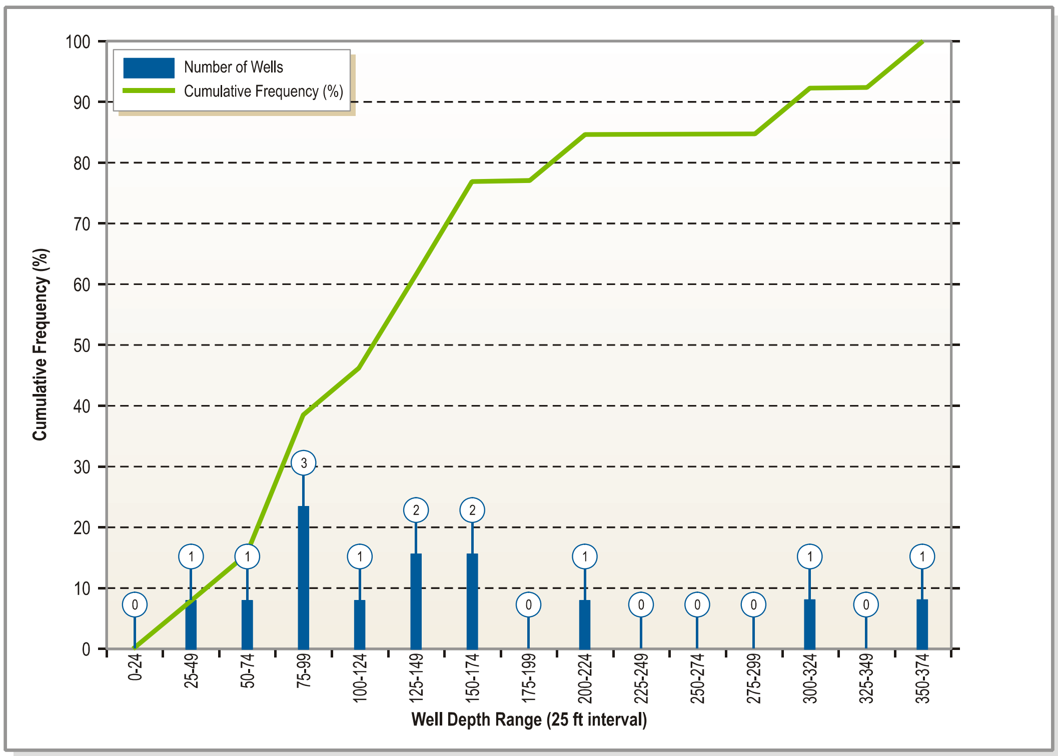
Well Depth Cumulative Frequency Curves

Appendix B
Well Depth Cumulative Frequency Curves

This appendix contains cumulative frequency curves for well depths for domestic and irrigation wells in individual groundwater basins in Lake County. The vertical bars in the figures show the total number of domestic and irrigation wells associated with each 25-foot depth interval in the groundwater basin. The cumulative frequency curves also contain a line showing the cumulative frequency of well depth. The cumulative frequency line corresponds with the "Percentage of Wells" label on the left side of the chart, and the bars relate to the "Number of Wells" on the right side of the chart. For example, The Gravelly Valley cumulative frequency curve shows that the groundwater basin has three domestic wells between 75 and 99 feet deep, and that 40 percent of wells in the groundwater basin are 99 feet deep or shallower.

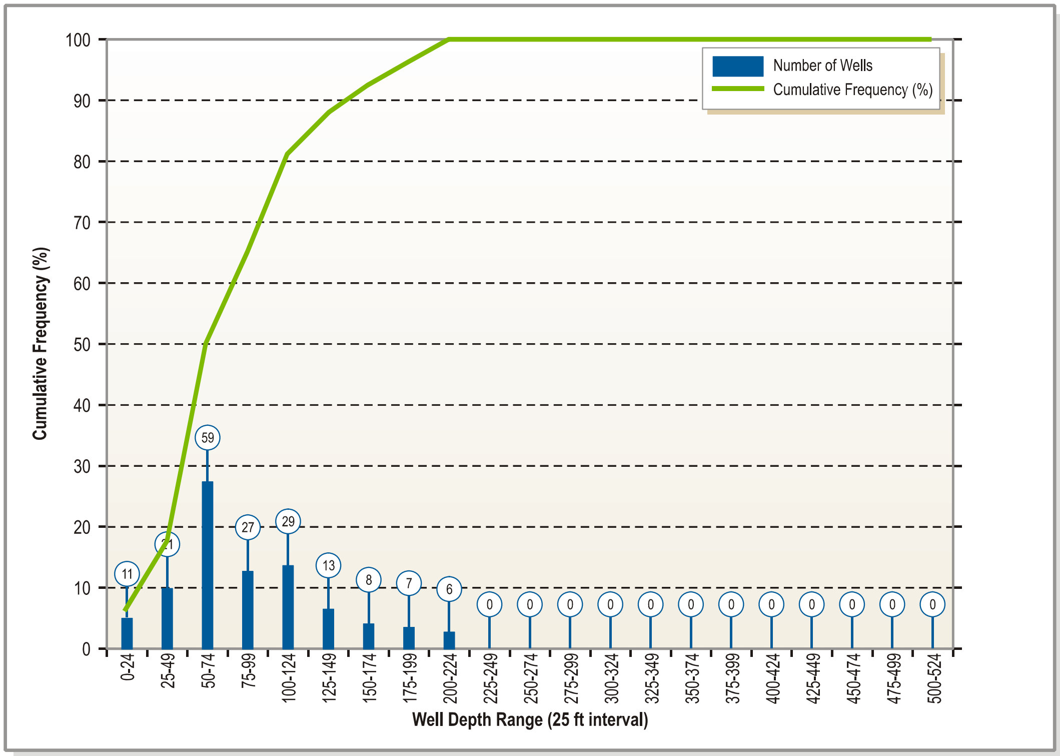
Gravelly Valley Groundwater Basin

There are no irrigation wells in the Gravelly Valley Groundwater Basin.

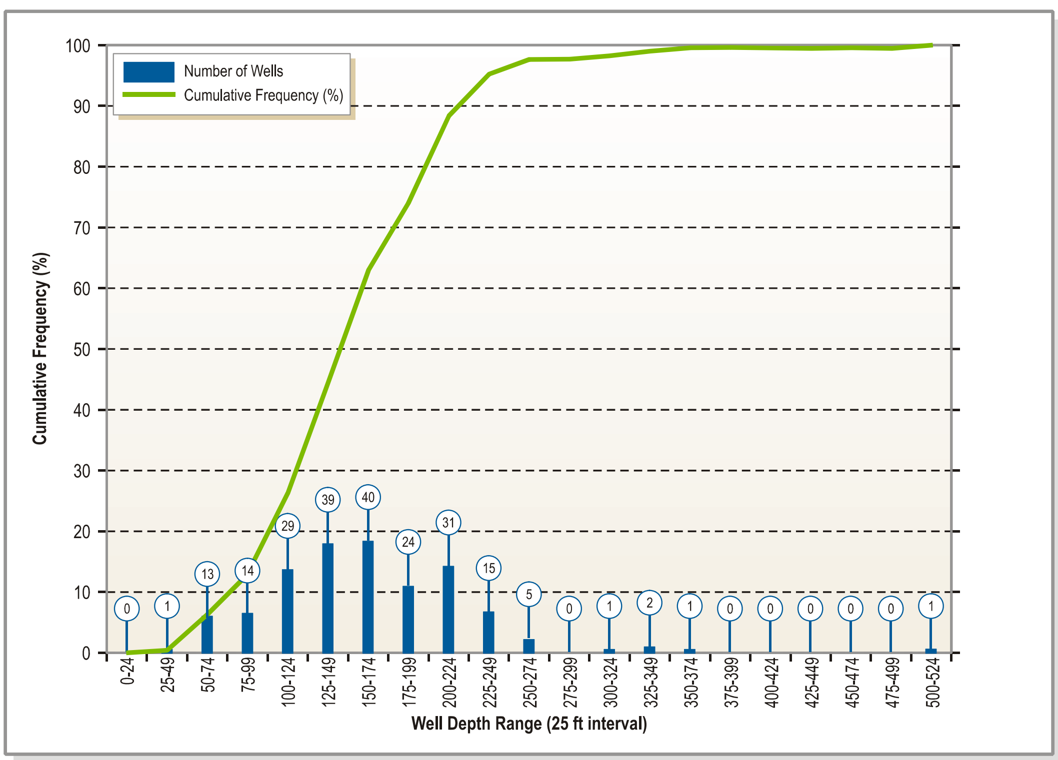


Depth Distribution of Domestic Wells in the Gravelly Valley Groundwater Basin

Northern Portion of the Big Valley Groundwater Basin

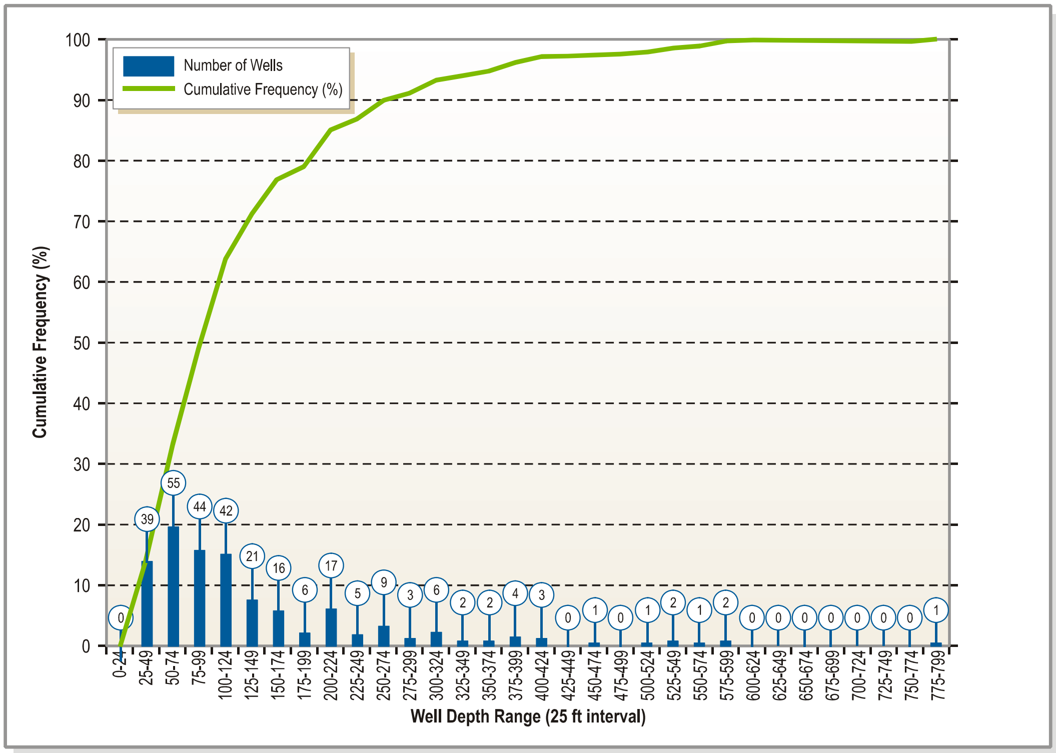


Depth Distribution of Domestic Wells in the Northern Portion of the Big Valley Groundwater Basin

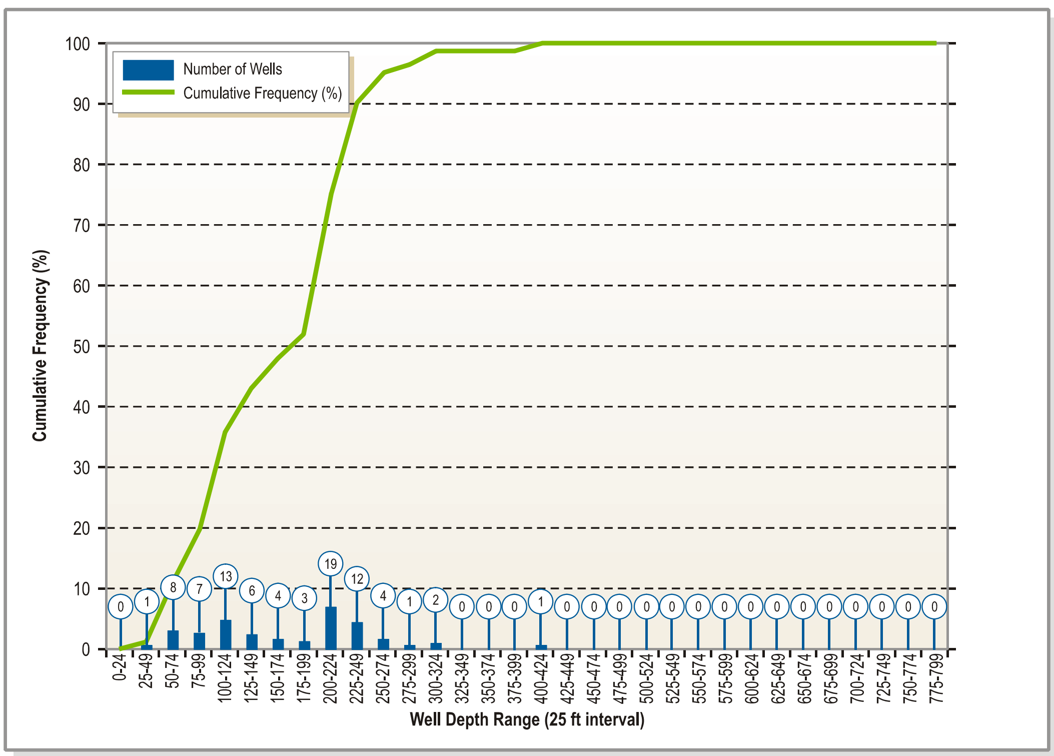


Depth Distribution of Irrigation Wells in the Northern Portion of the Big Valley Groundwater Basin

Southern Portion of the Big Valley Groundwater Basin

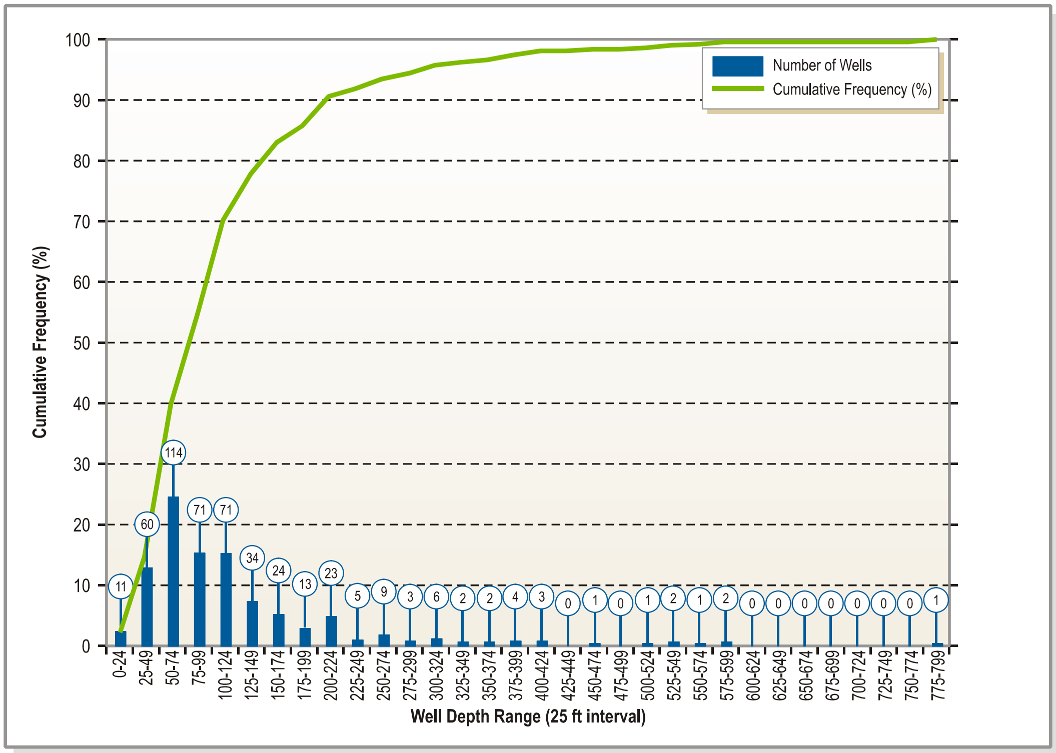


Depth Distribution of Domestic Wells in the Southern Portion of the Big Valley Groundwater Basin

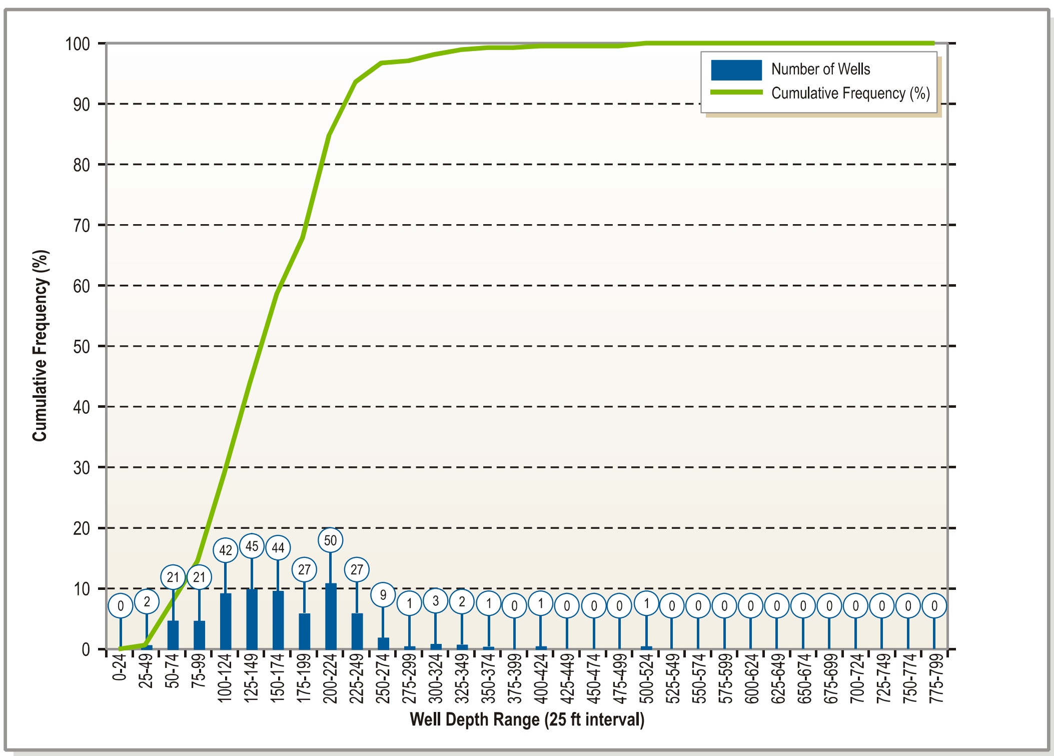


Depth Distribution of Irrigation Wells in the Southern Portion of the Big Valley Groundwater Basin

Both Portions of the Big Valley Groundwater Basin

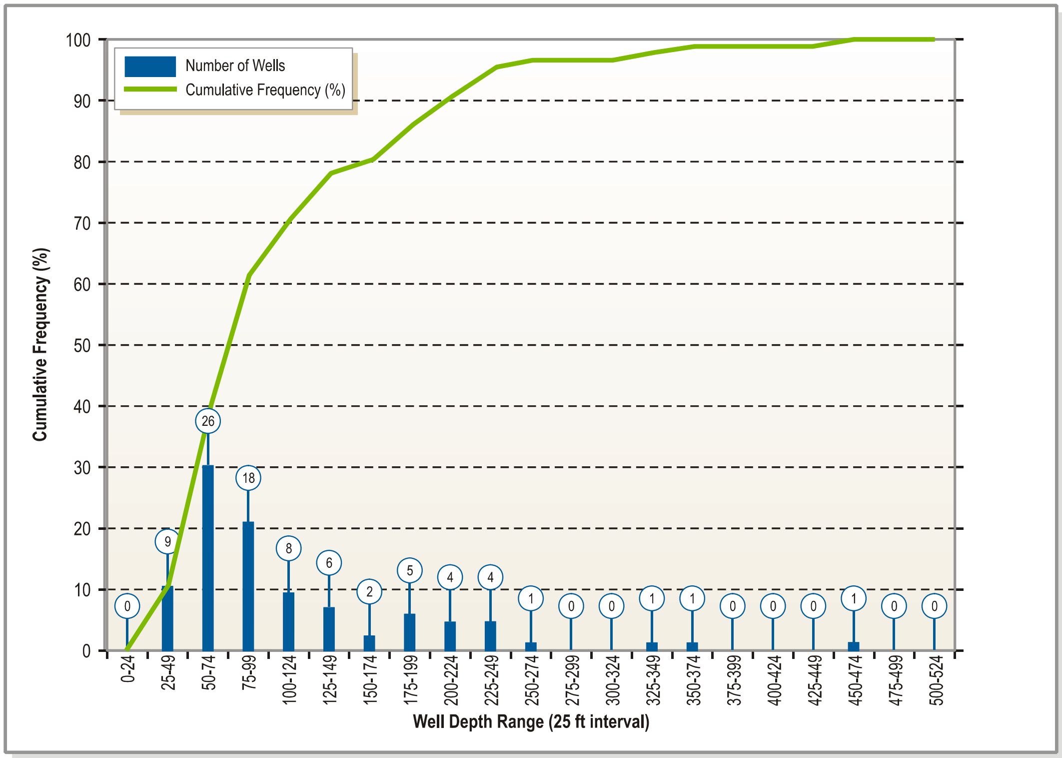


Depth Distribution of Domestic Wells in Both Portions of the Big Valley Groundwater Basin

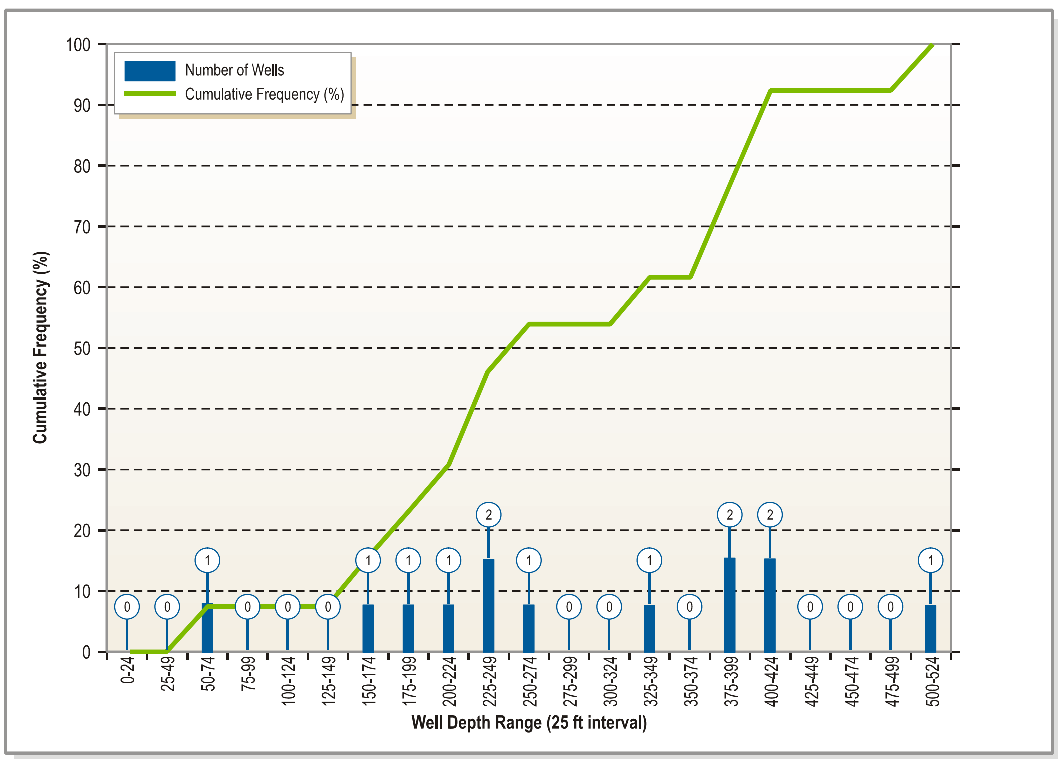


Depth Distribution of Irrigation Wells in Both Portions of the Big Valley Groundwater Basin

Burns Valley Basin

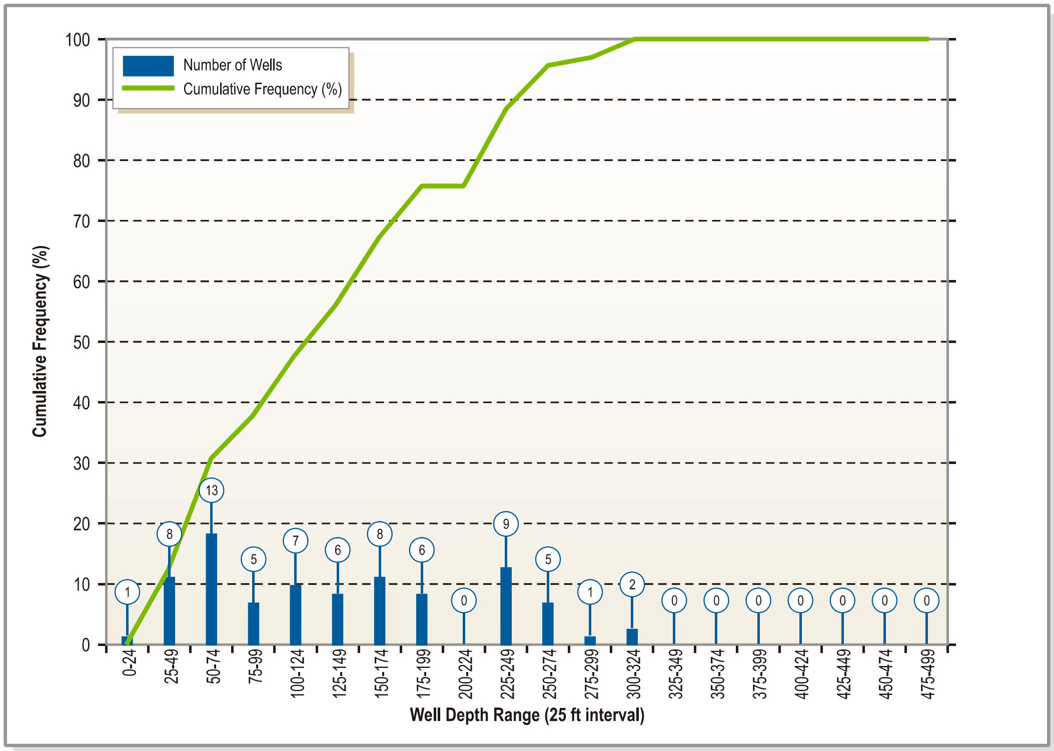


Depth Distribution of Domestic Wells in the Burns Valley Groundwater Basin

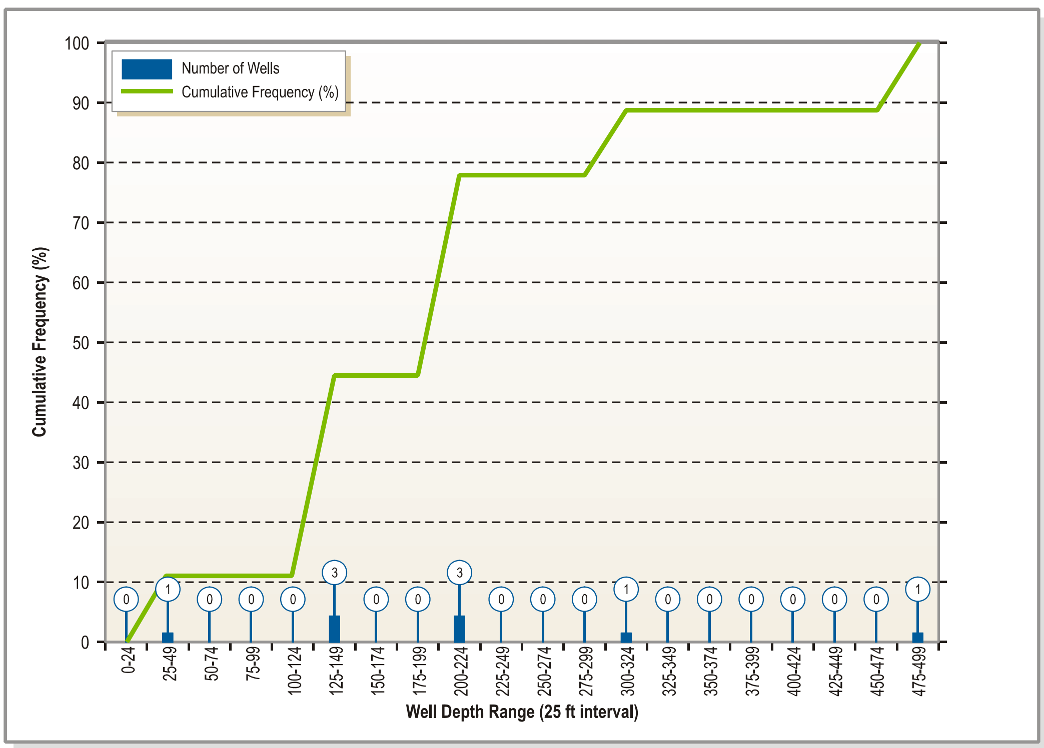


Depth Distribution of Irrigation Wells in the Burns Valley Groundwater Basin

Clear Lake Cache Formation Groundwater Basin

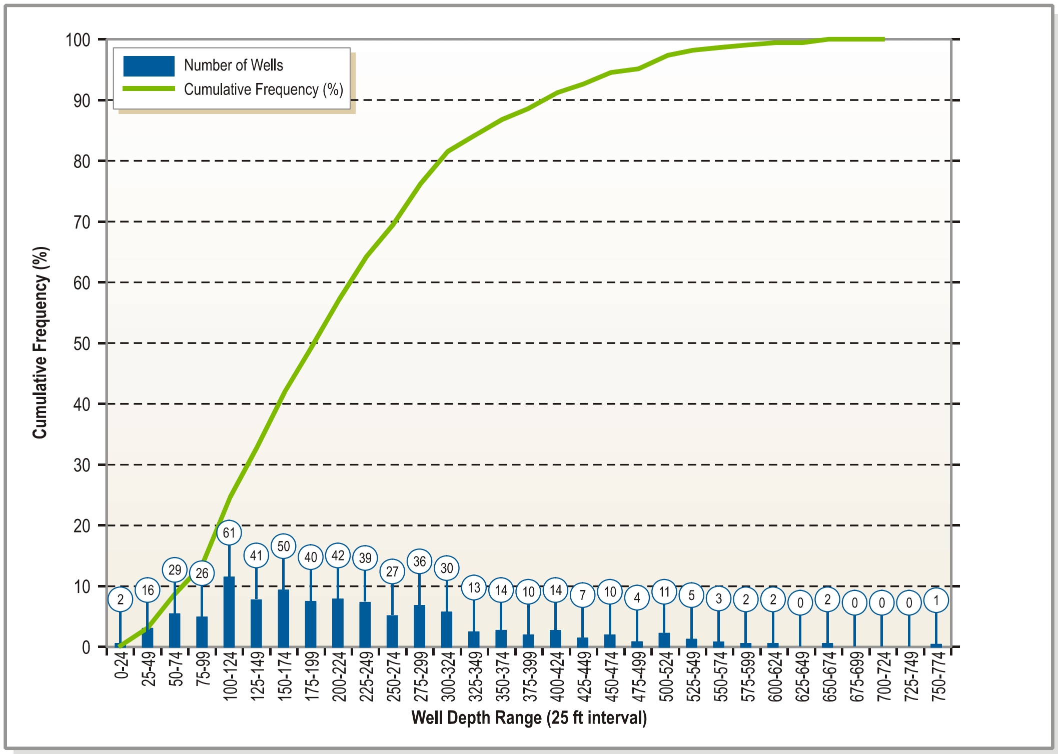


Depth Distribution of Domestic Wells in the Clear Lake Cache Formation Groundwater Basin

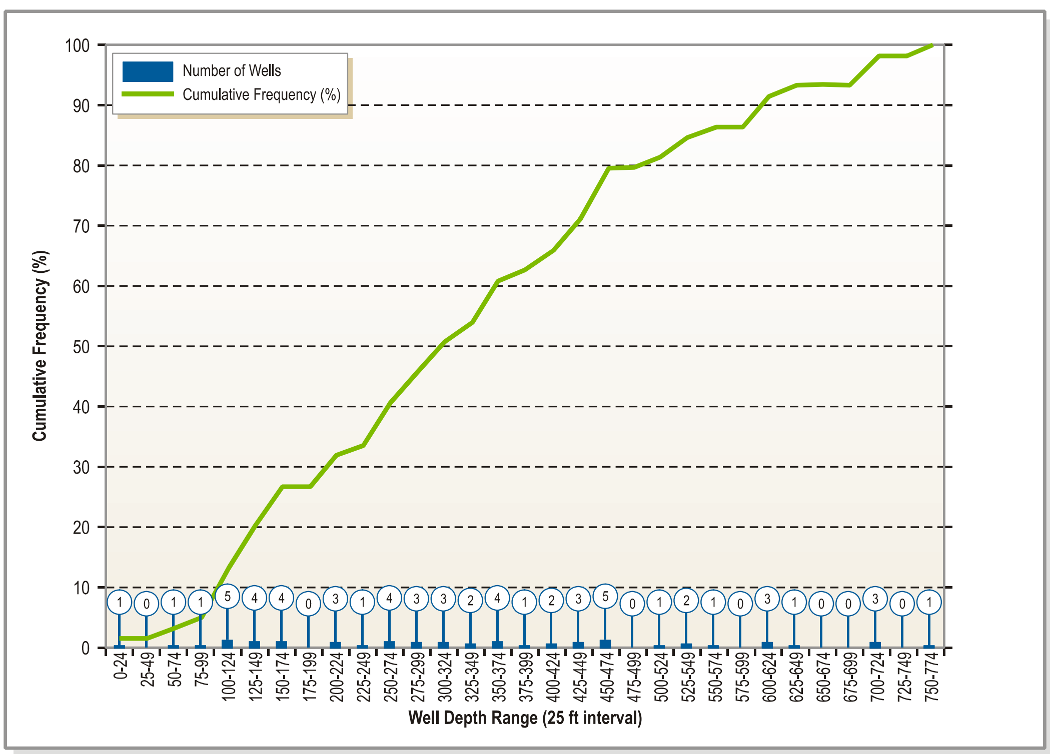


Depth Distribution of Irrigation Wells in the Clear Lake Cache Formation Groundwater Basin

Clear Lake Pleistocene Volcanics Groundwater Source Area

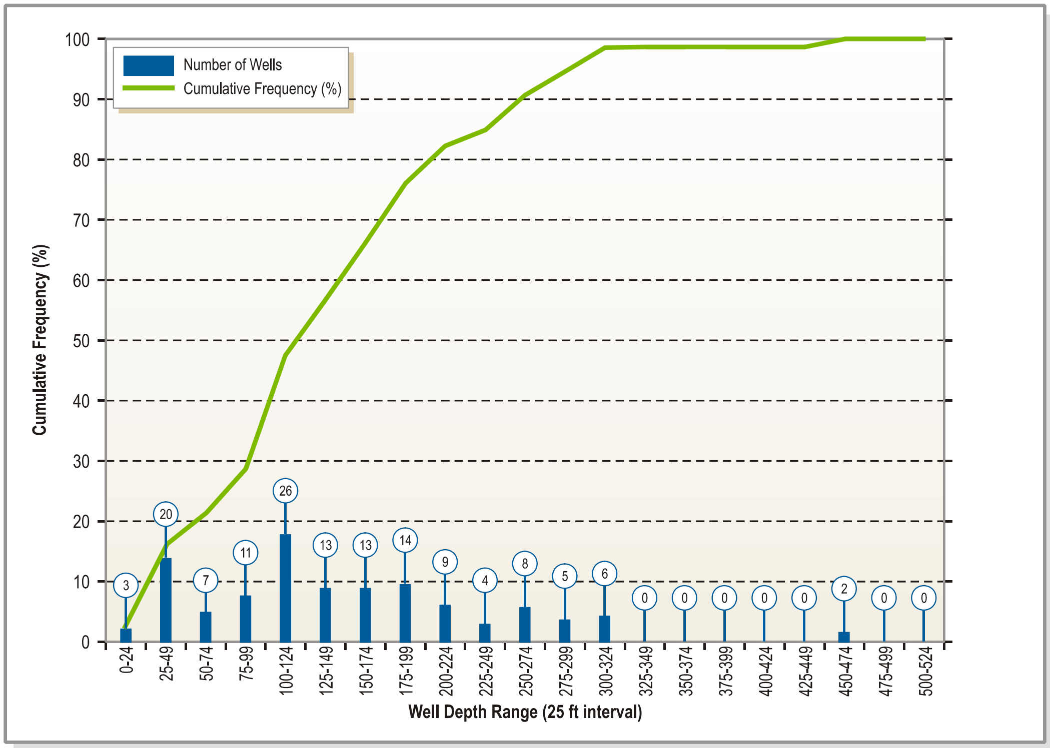


Depth Distribution of Domestic Wells in Clear Lake Pleistocene Volcanics Groundwater Source Area

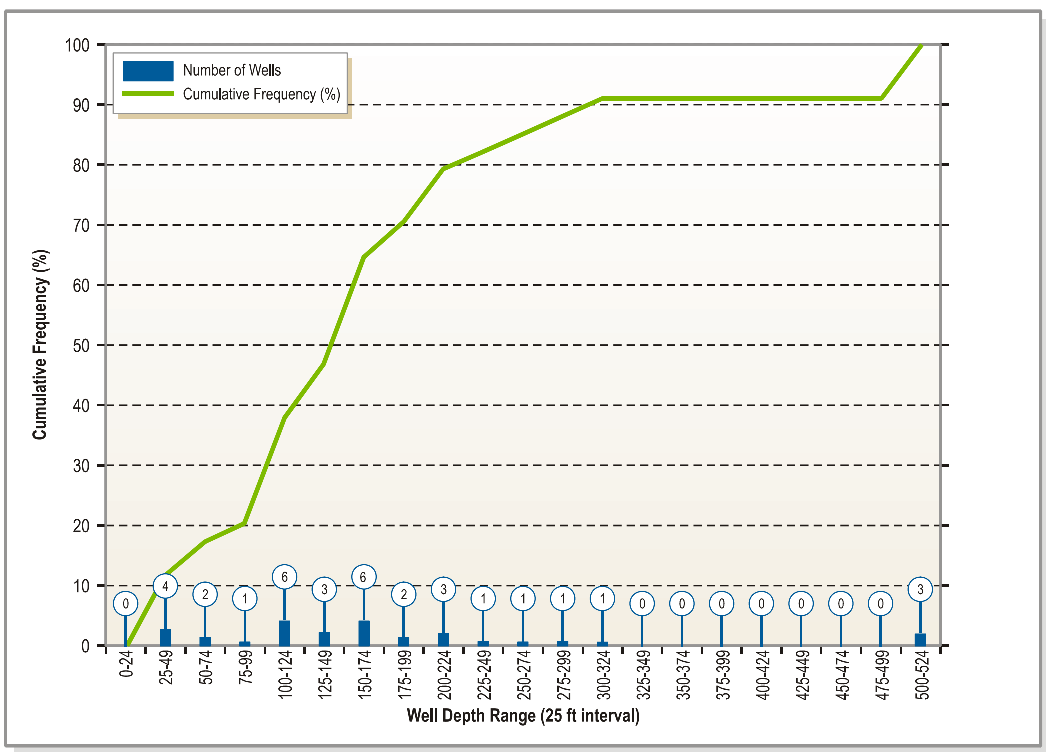


Depth Distribution of Irrigation Wells in Clear Lake Pleistocene Volcanics Groundwater Source Area

Collayomi Valley Basin

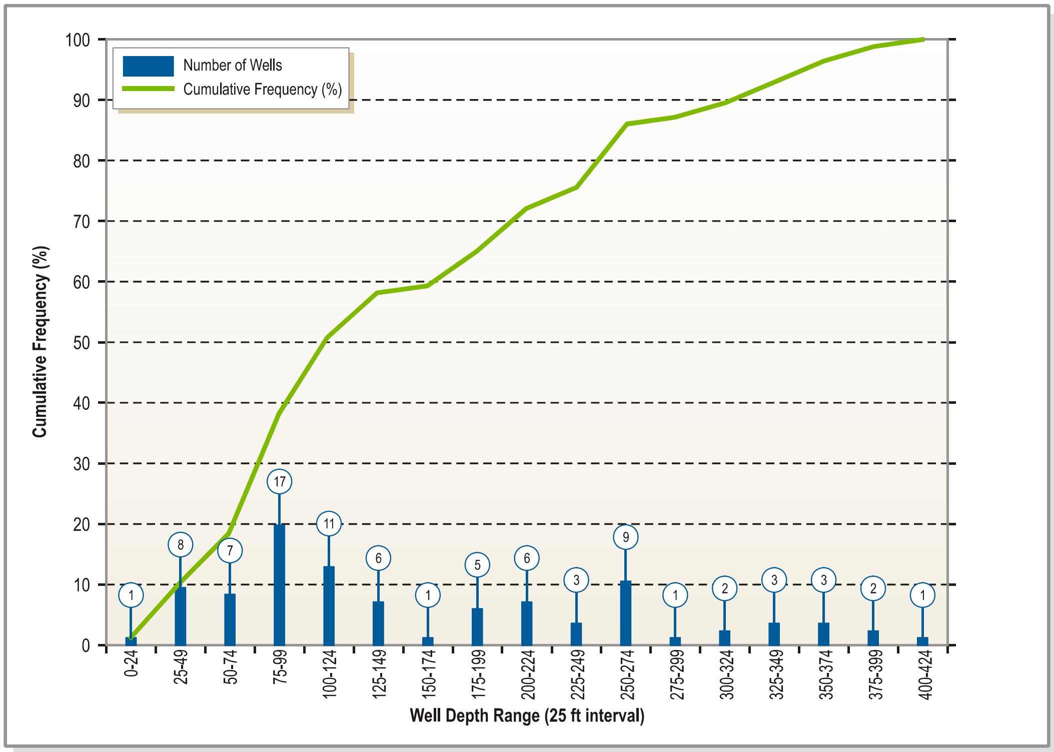


Depth Distribution of Domestic Wells in the Collayomi Valley Groundwater Basin

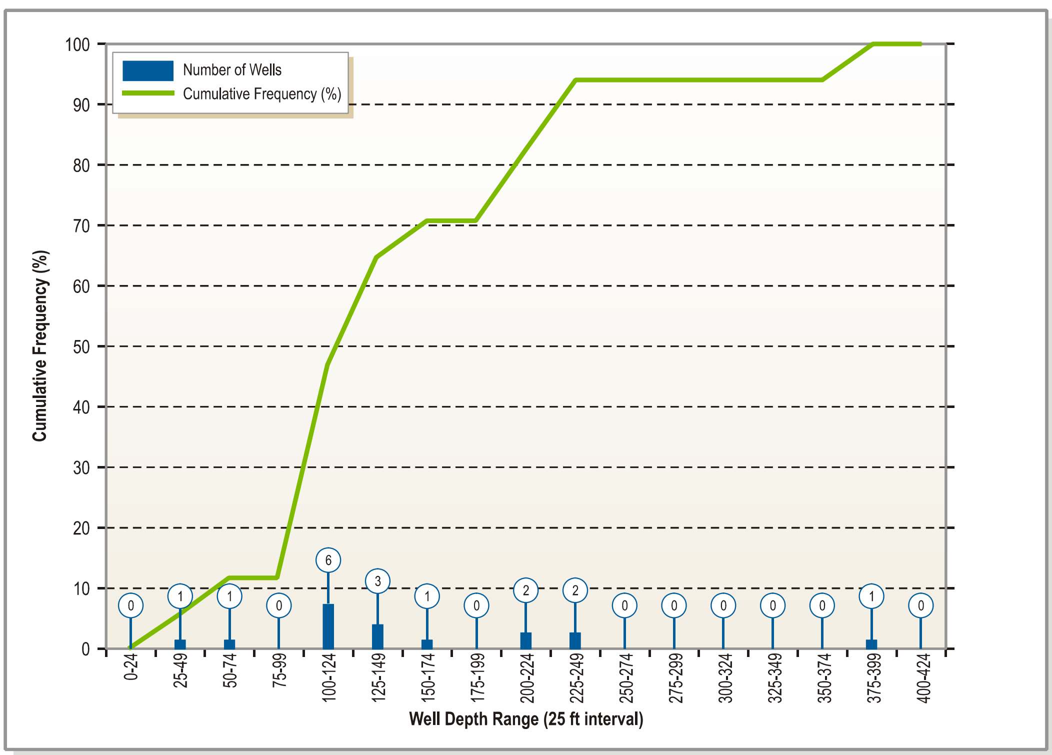


Depth Distribution of Irrigation Wells in the Collayomi Valley Groundwater Basin

Coyote Valley Basin

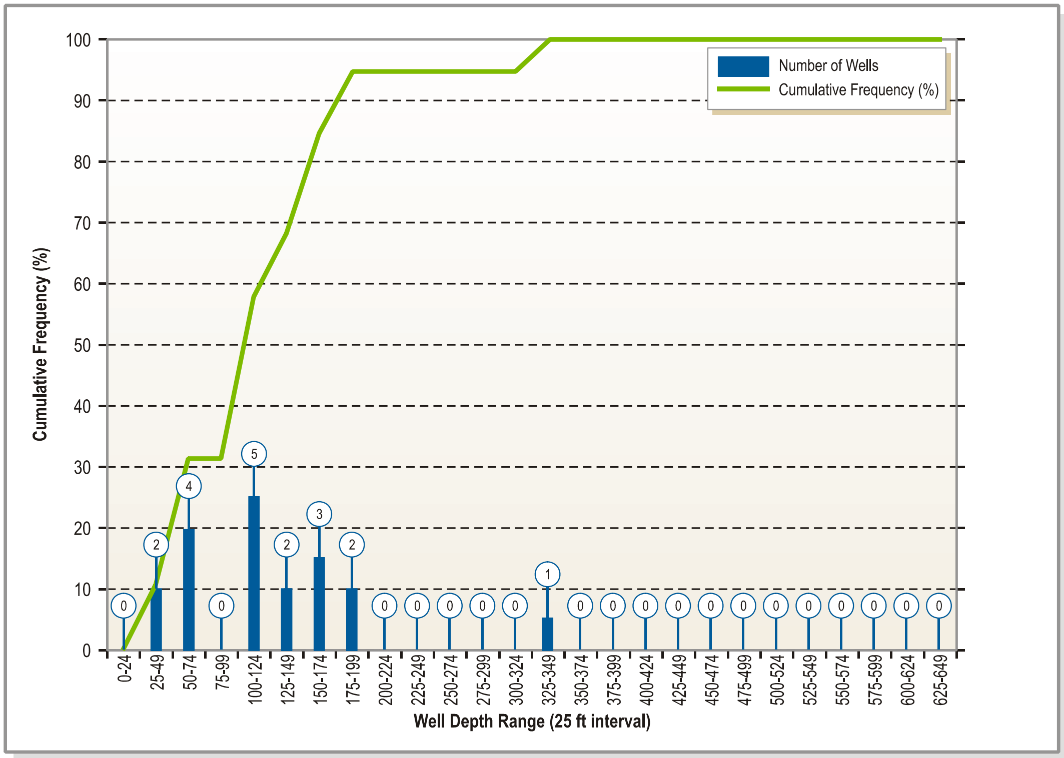


Depth Distribution of Domestic Wells in the Coyote Valley Groundwater Basin

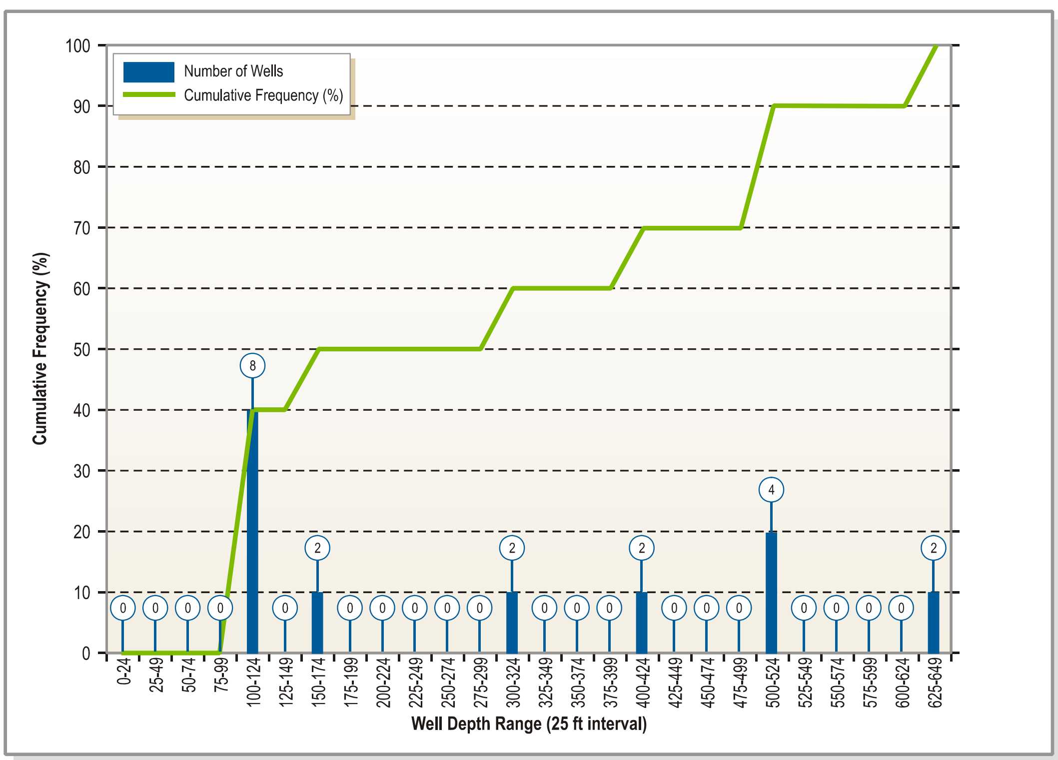


Depth Distribution of Irrigation Wells in the Coyote Valley Groundwater Basin

High Valley Basin

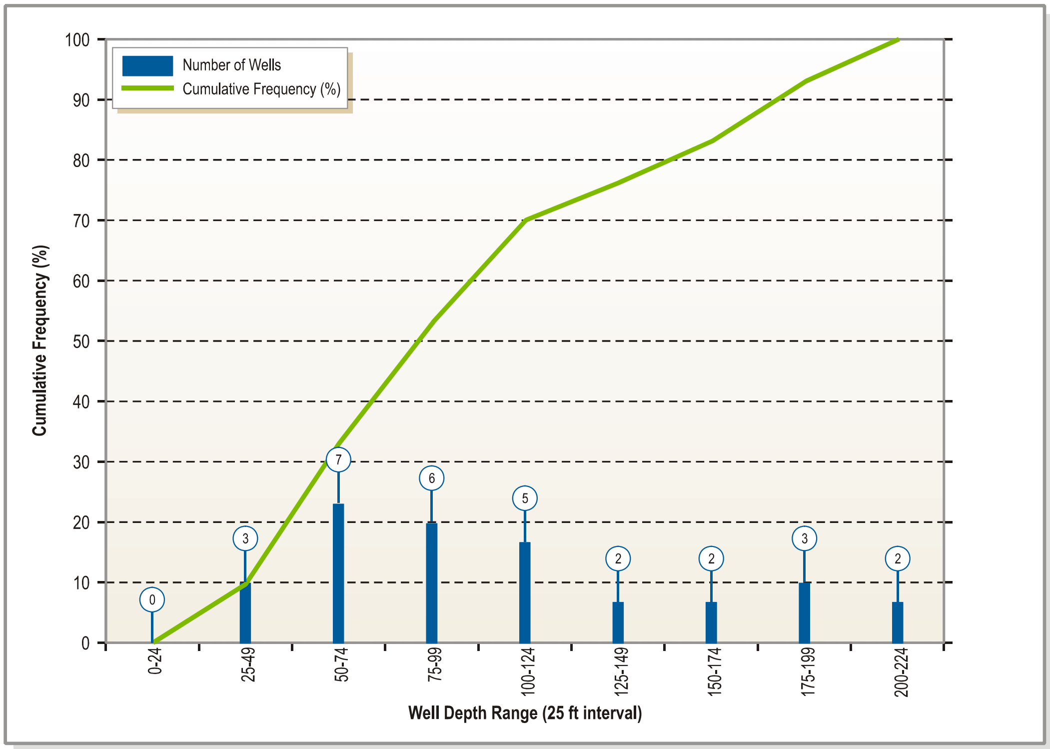


Depth Distribution of Domestic Wells in the High Valley Groundwater Basin

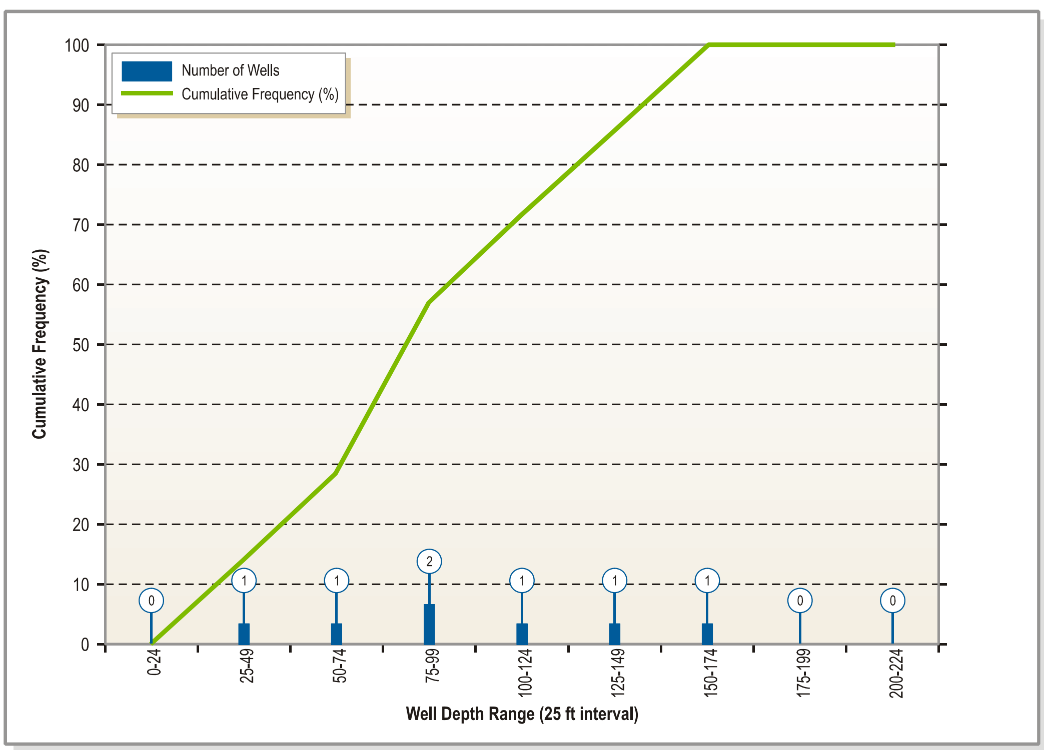


Depth Distribution of Irrigation Wells in the High Valley Groundwater Basin

Long Valley Groundwater Basin

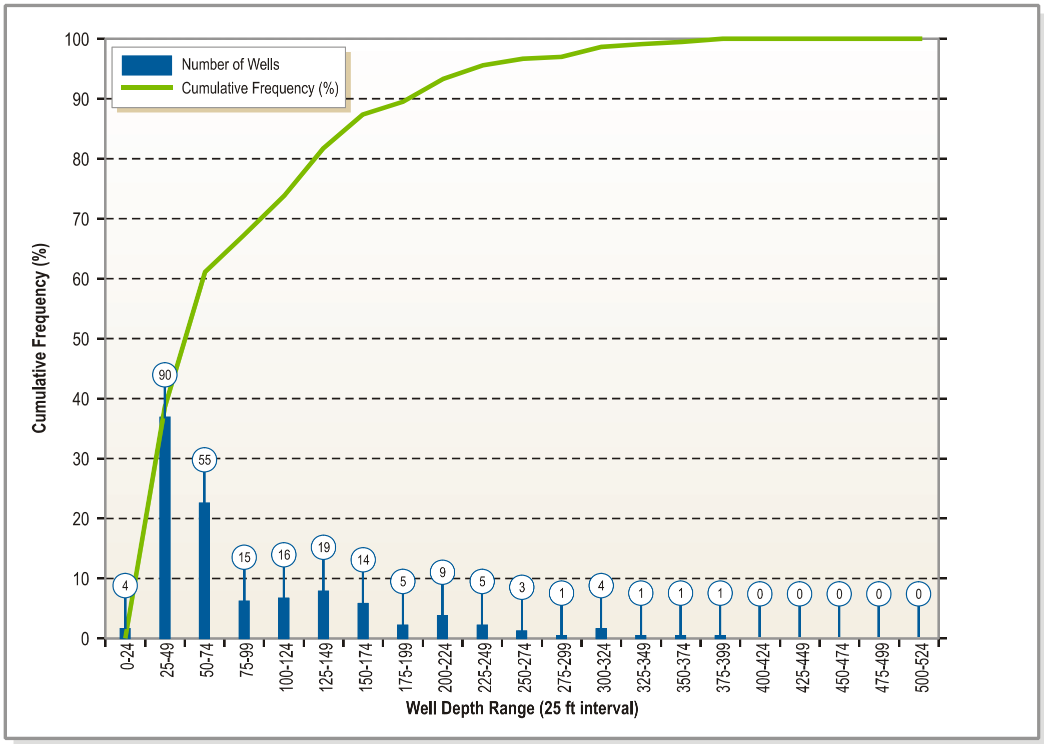


Depth Distribution of Domestic Wells in the Long Valley Groundwater Basin

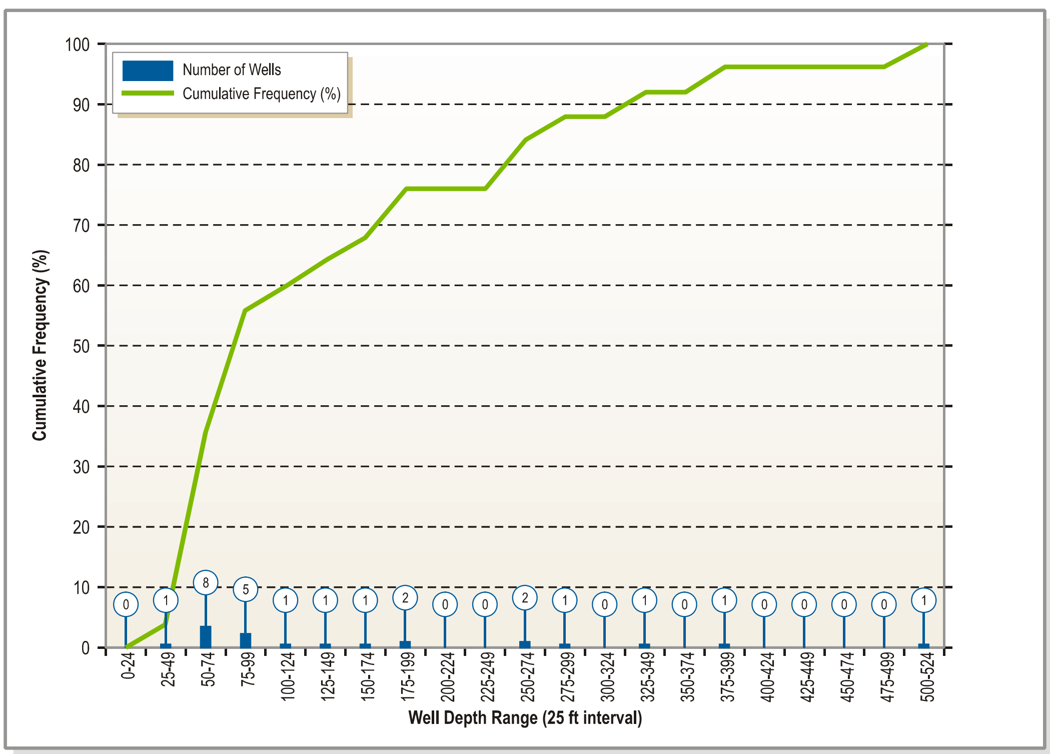


Depth Distribution of Irrigation Wells in the Long Valley Groundwater Basin

Lower Lake Basin

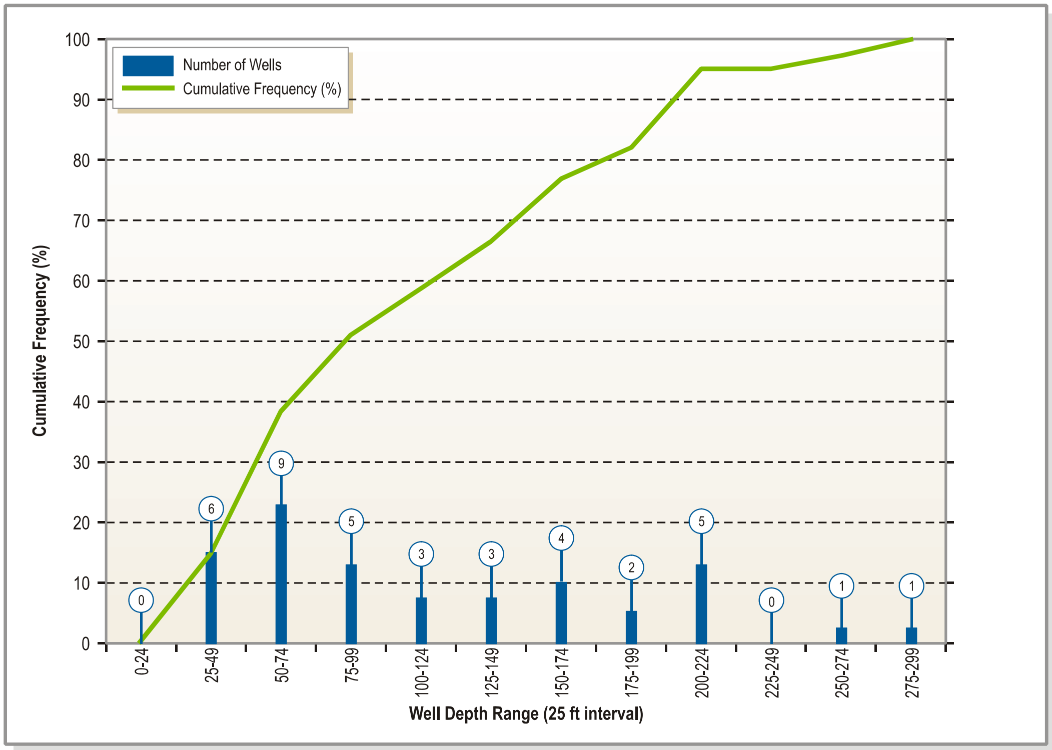


Depth Distribution of Domestic Wells in the Lower Lake Groundwater Basin

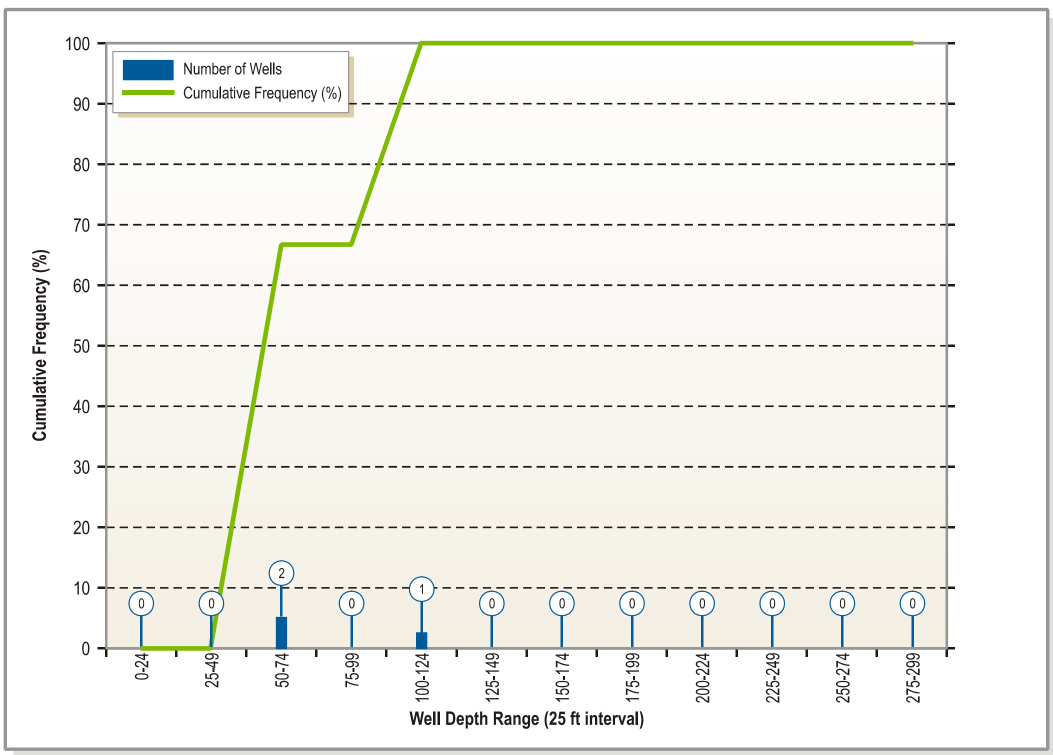


Depth Distribution of Irrigation Wells in the Lower Lake Groundwater Basin

Middle Creek Groundwater Basin

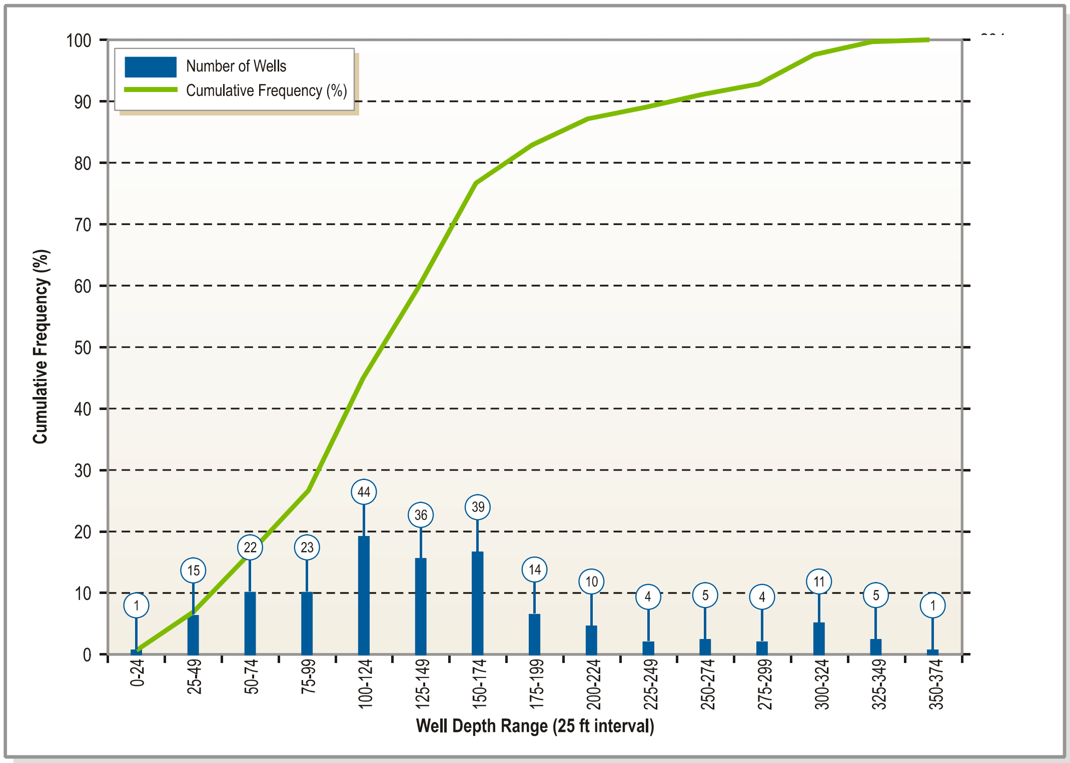


Depth Distribution of Domestic Wells in the Middle Creek Groundwater Basin

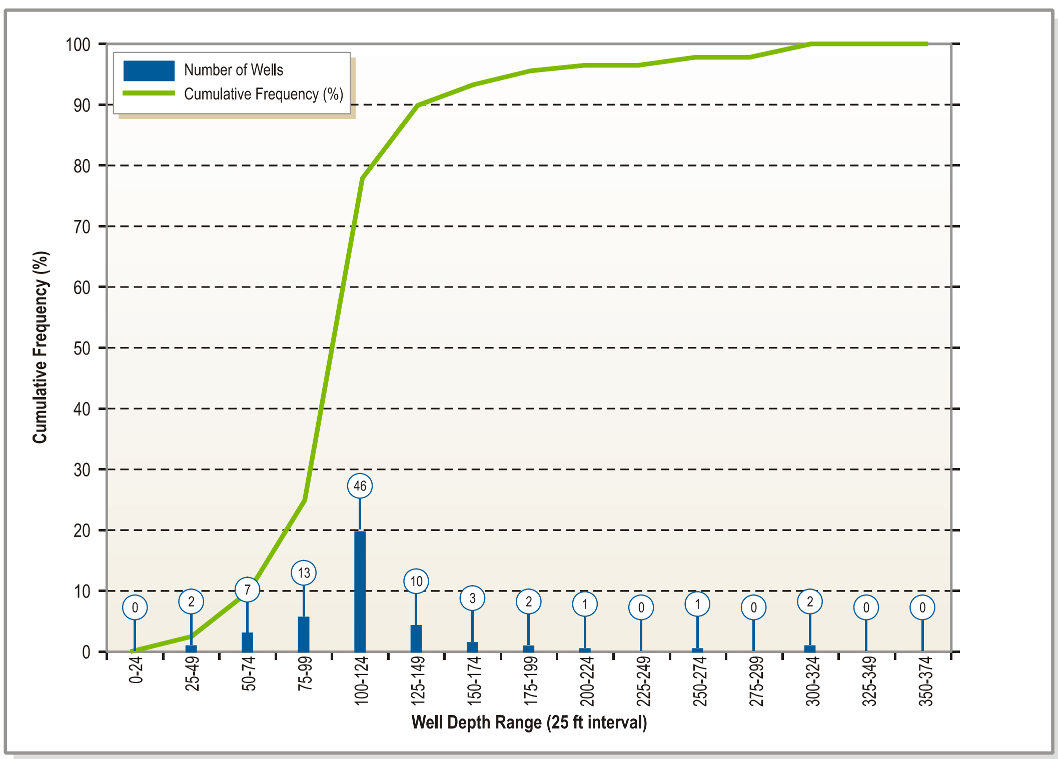


Depth Distribution of Irrigation Wells in the Middle Creek Groundwater Basin

Scotts Valley Basin

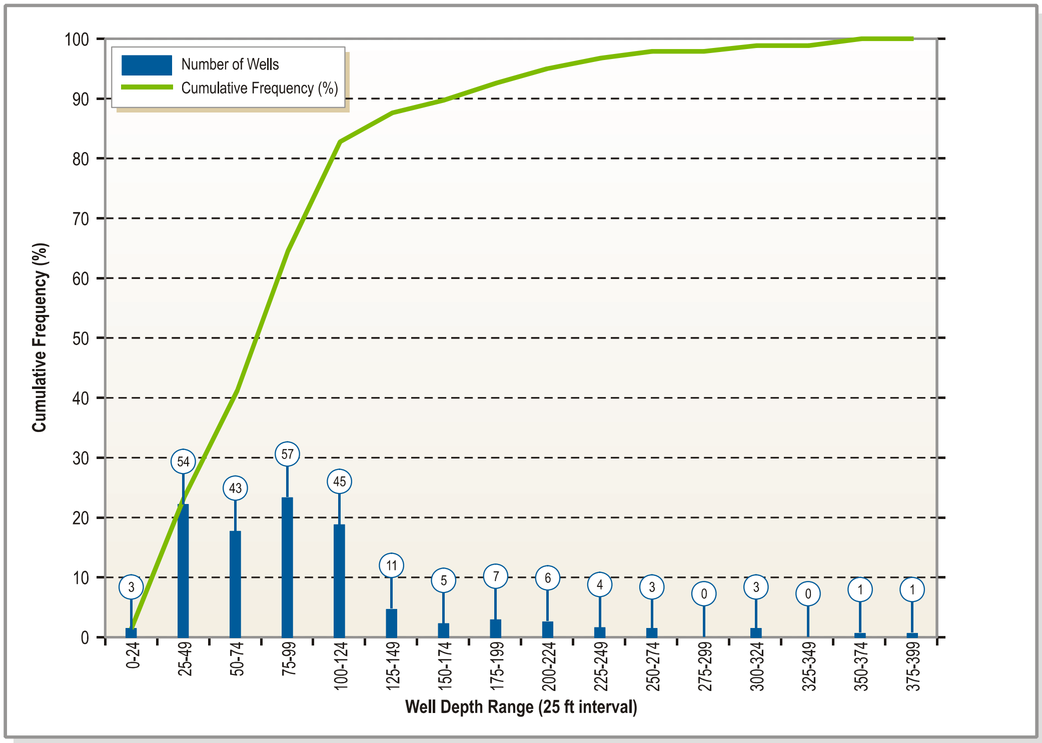


Depth Distribution of Domestic Wells in the Scotts Valley Groundwater Basin

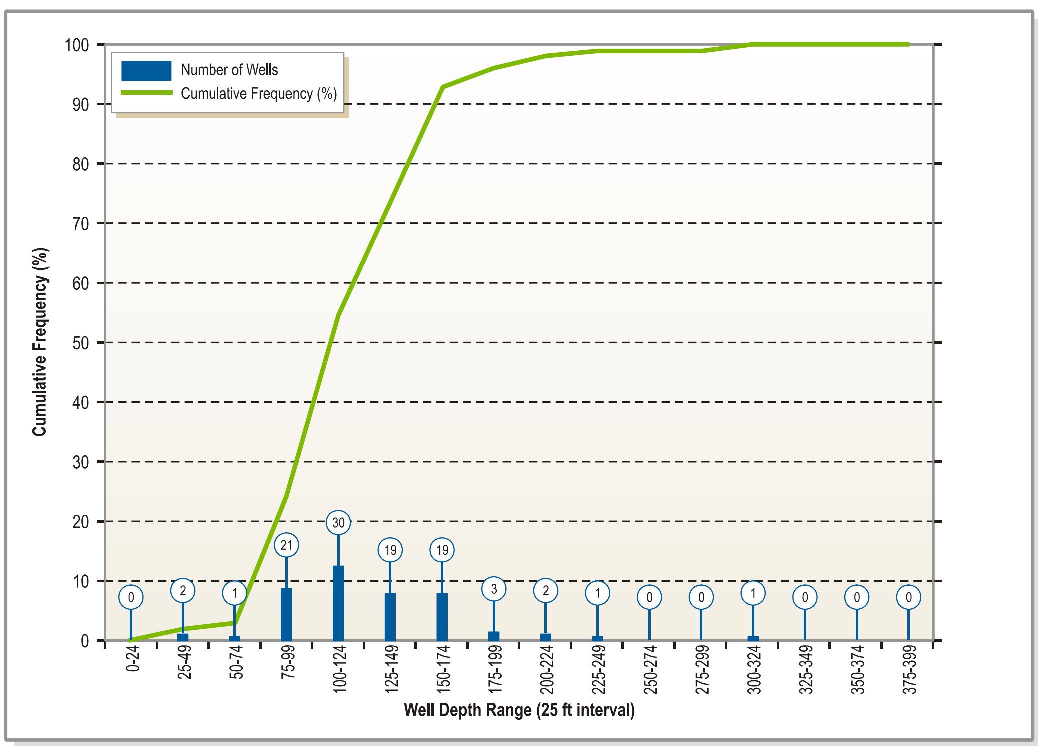


Depth Distribution of Irrigation Wells in the Scotts Valley Groundwater Basin

Upper Lake Basin



Depth Distribution of Domestic Wells in the Upper Lake Groundwater Basin



Depth Distribution of Irrigation Wells in the Upper Lake Groundwater Basin

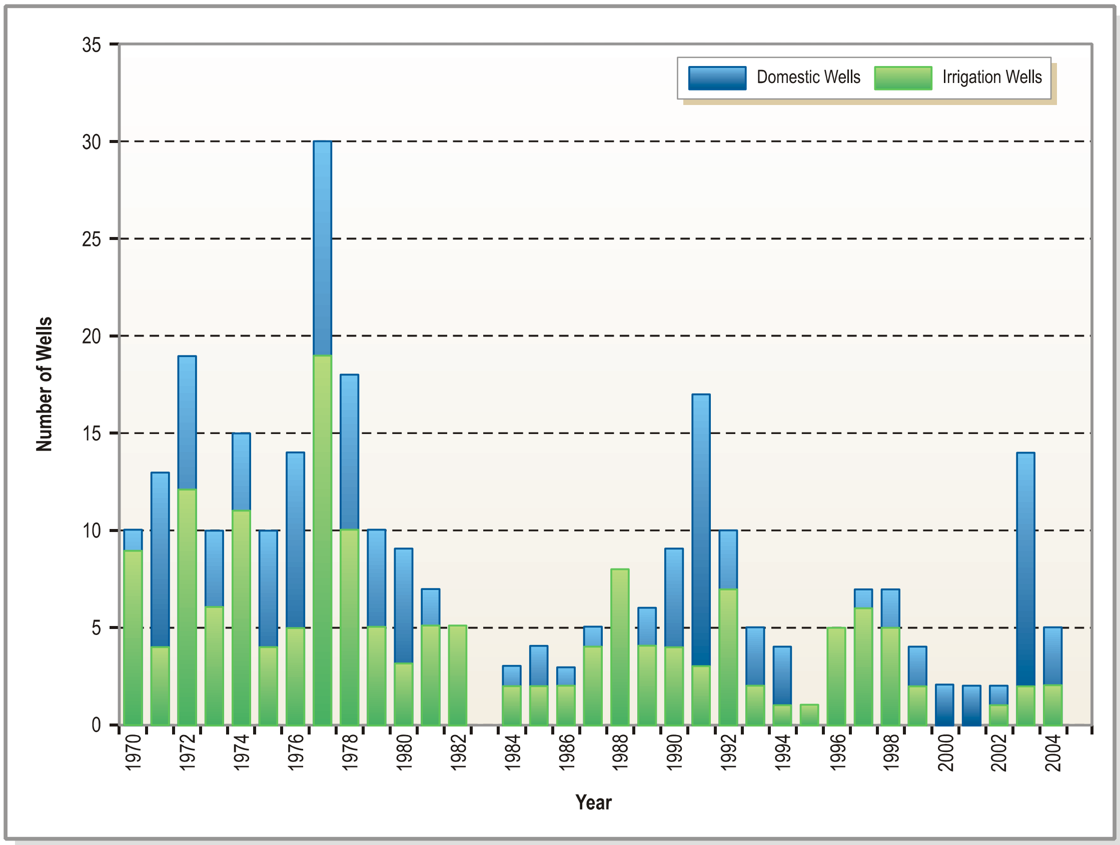
Appendix C

Wells Drilled By Year

Appendix C
Wells Drilled By Year

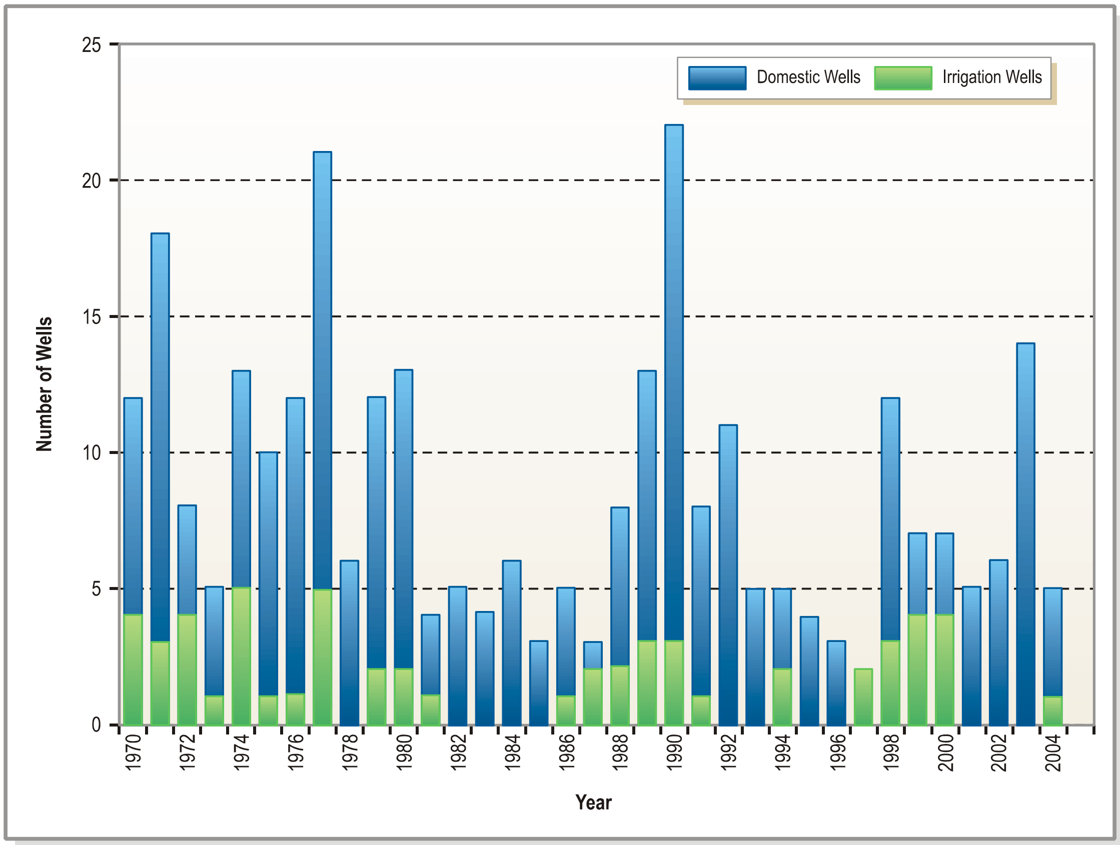
This appendix presents figures showing well completion reports filed by year for individual groundwater basins. These figures present the number of domestic and irrigation wells drilled each year in Lake County.

Northern Portion of the Big Valley Groundwater Basin



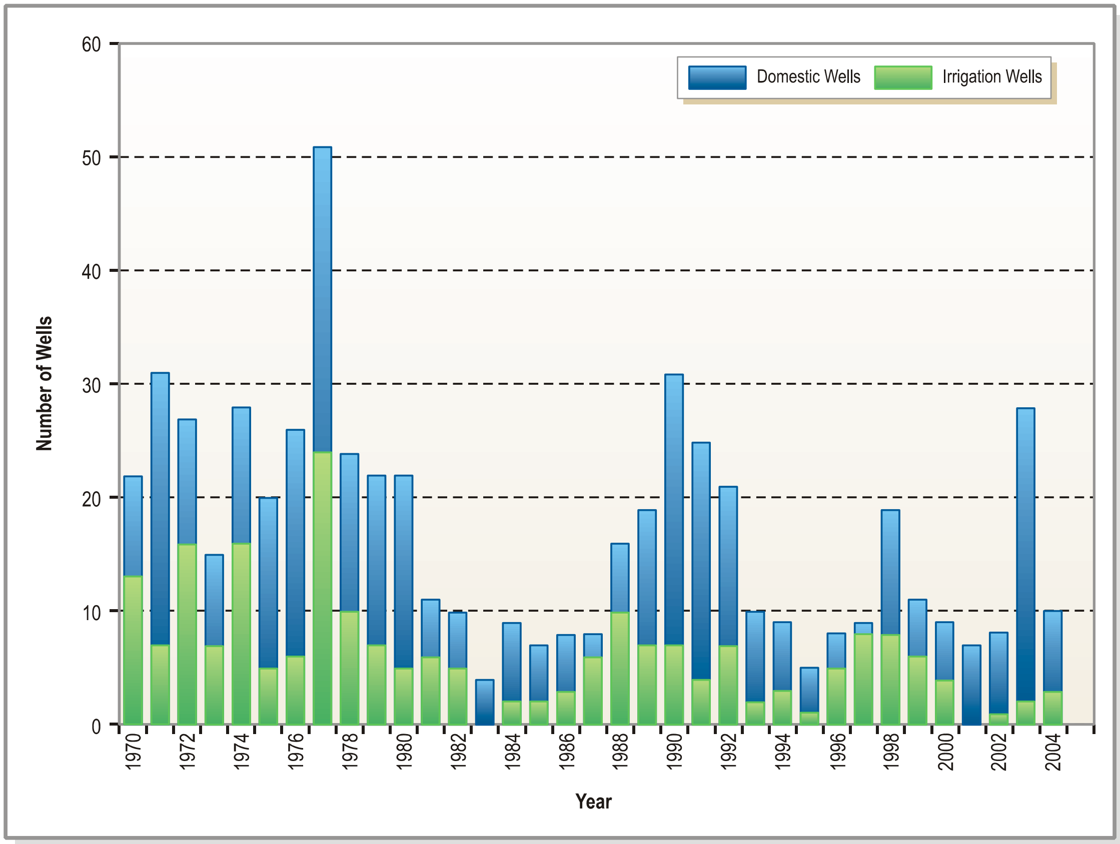
Domestic and Irrigation Well Completion Reports Filed by Year in the Northern Portion of the Big Valley Groundwater Basin After 1970

Southern Portion of the Big Valley Groundwater Basin



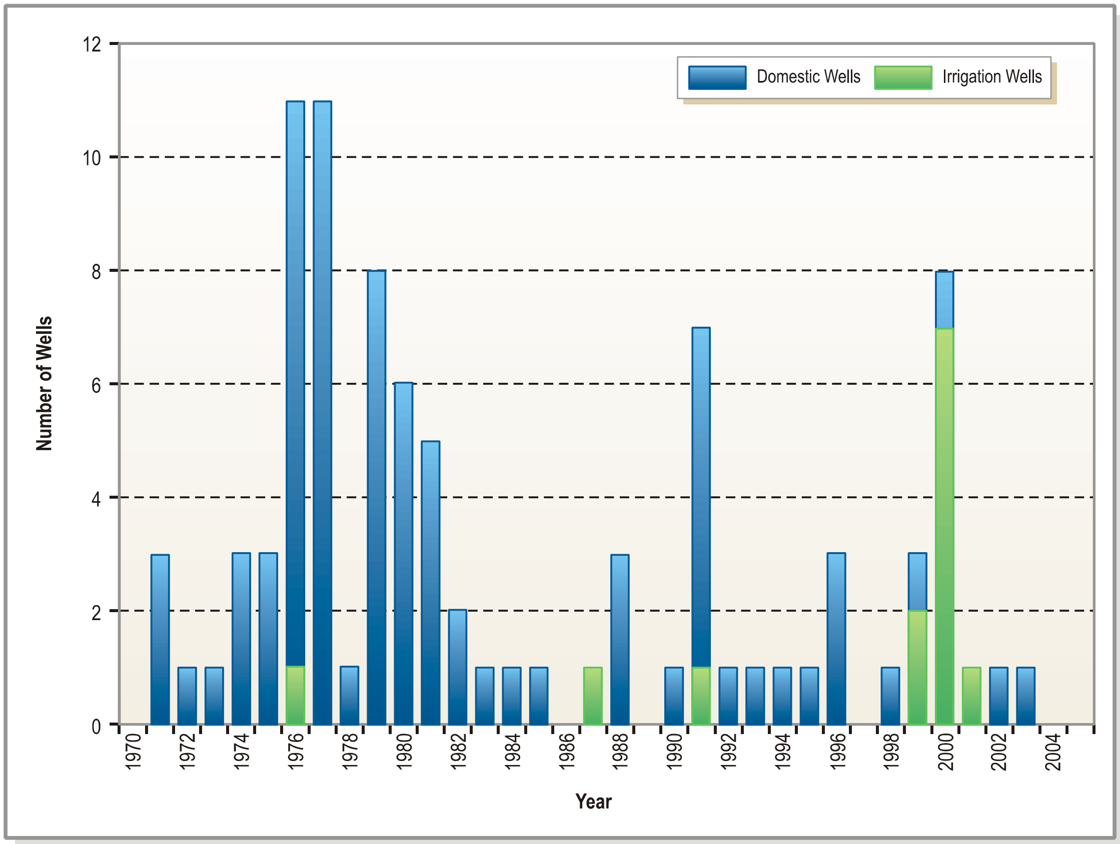
Domestic and Irrigation Well Completion Reports Filed by Year in the Southern Portion of the Big Valley Groundwater Basin After 1970

Both Portions of the Big Valley Groundwater Basin



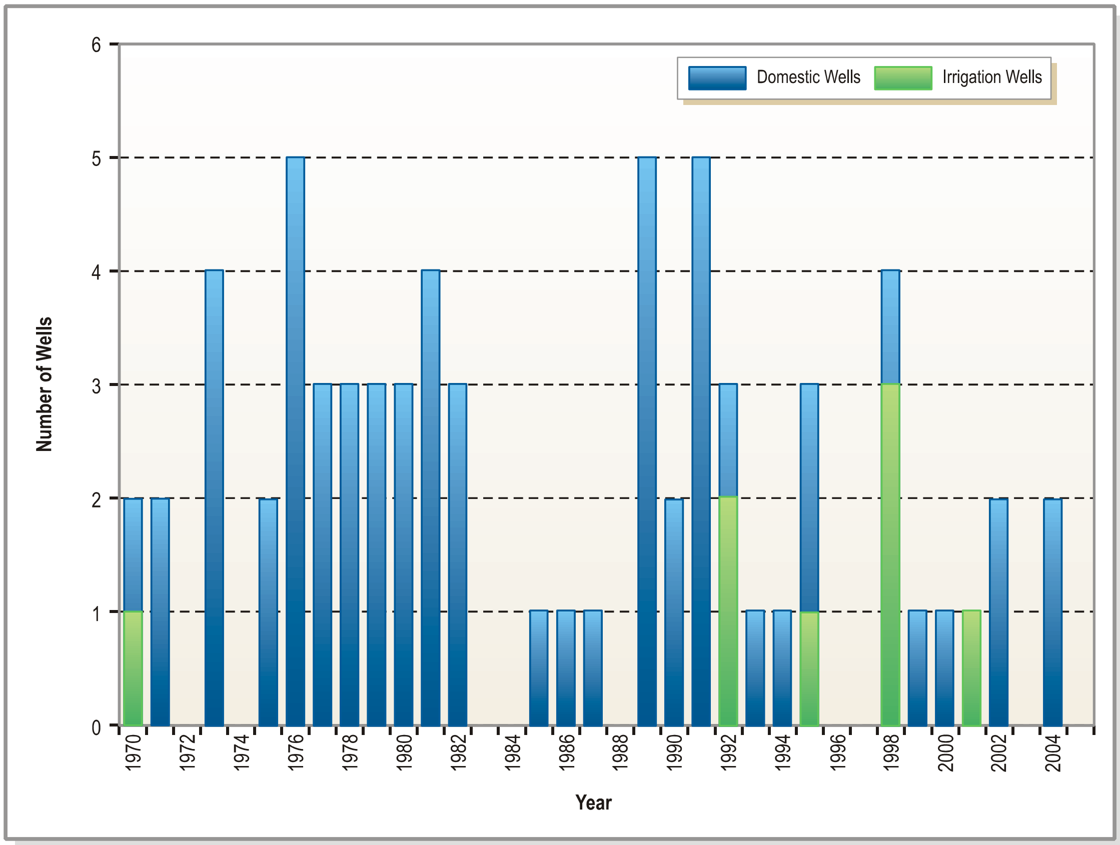
Domestic and Irrigation Well Completion Reports Filed by Year in the Both Portions of the Big Valley Groundwater Basin After 1970

Burns Valley Basin



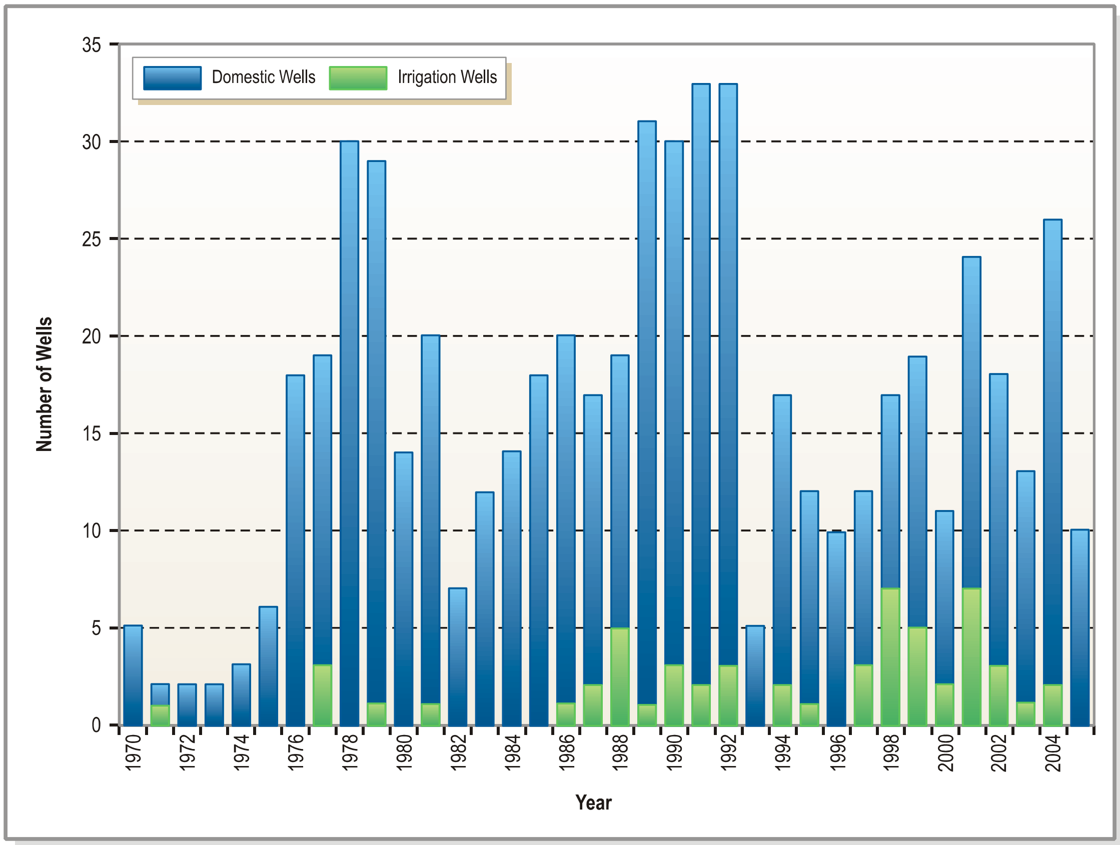
Domestic and Irrigation Well Completion Reports Filed by Year in the Burns Valley Groundwater Basin After 1970

Clear Lake Cache Formation Groundwater Basin



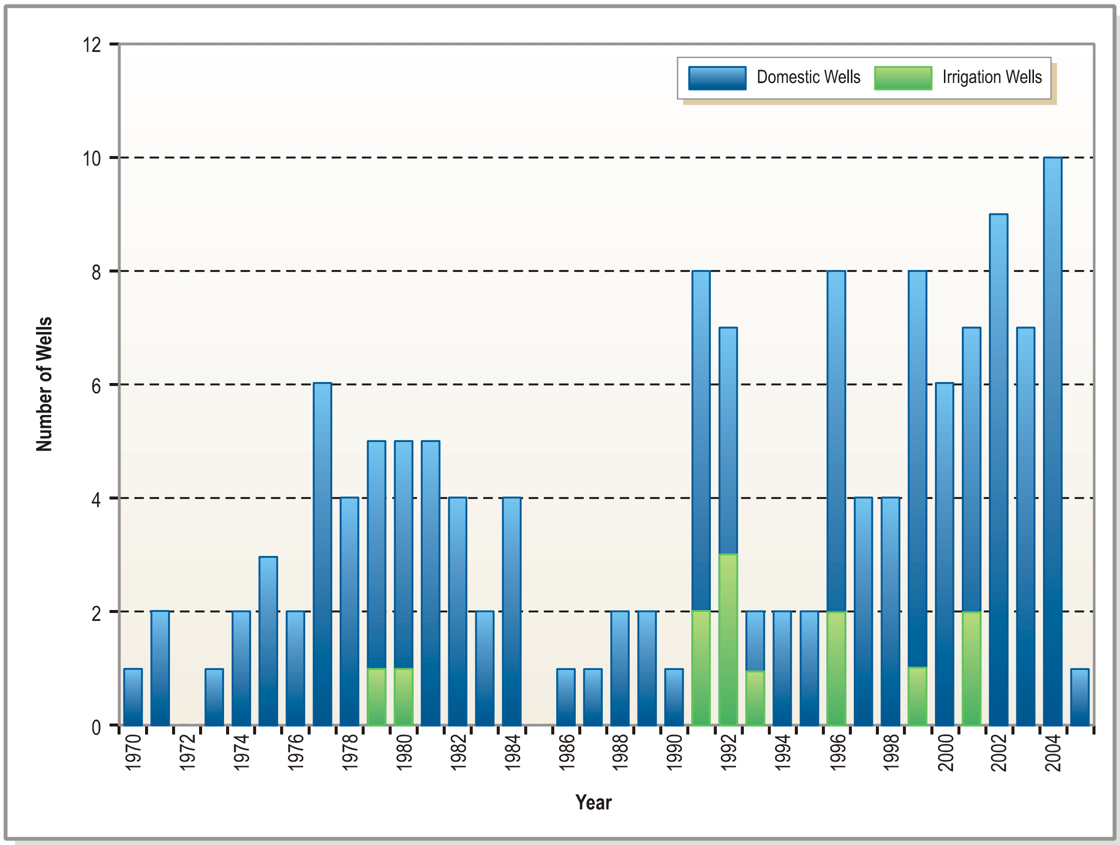
Domestic and Irrigation Well Completion Reports Filed by Year in the Clear Lake Cache Formation Groundwater Basin After 1970

Clear Lake Volcanics Groundwater Source Area



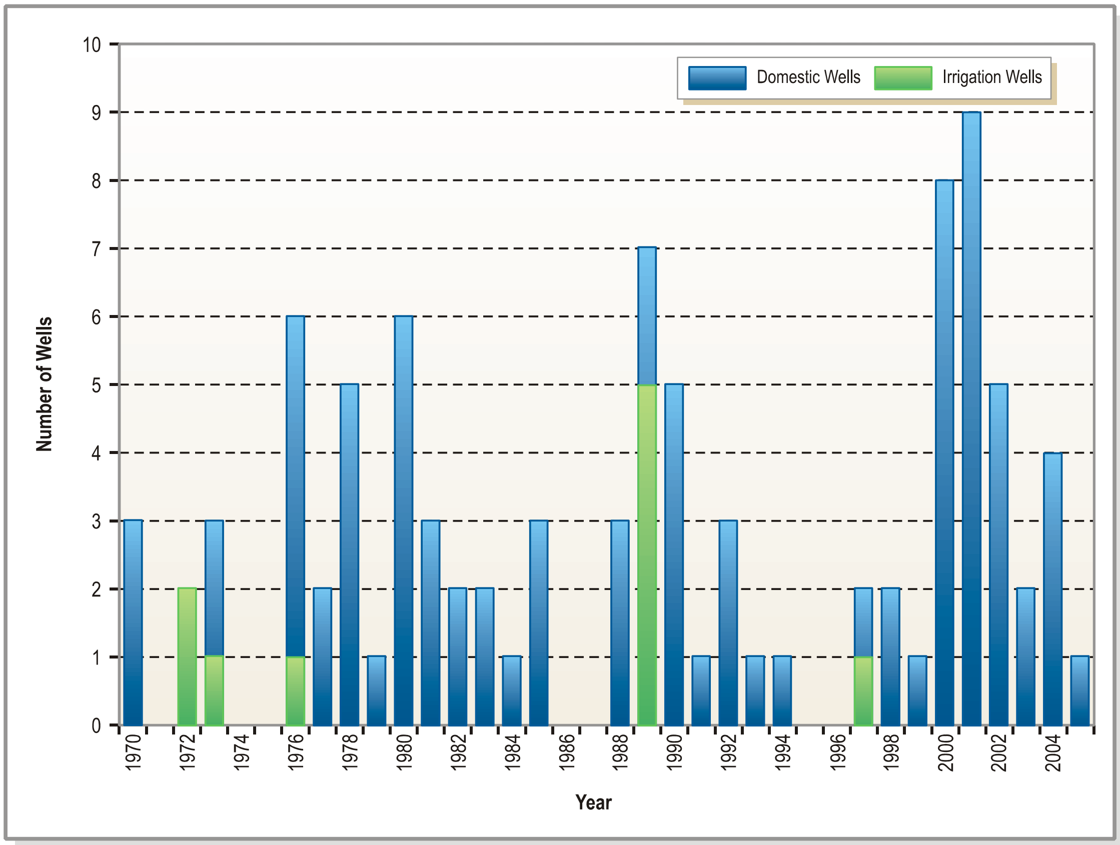
Domestic and Irrigation Well Completion Reports Filed by Year in the Clear Lake Pleistocene Volcanics Groundwater Basin After 1970

Collayomi Valley Basin



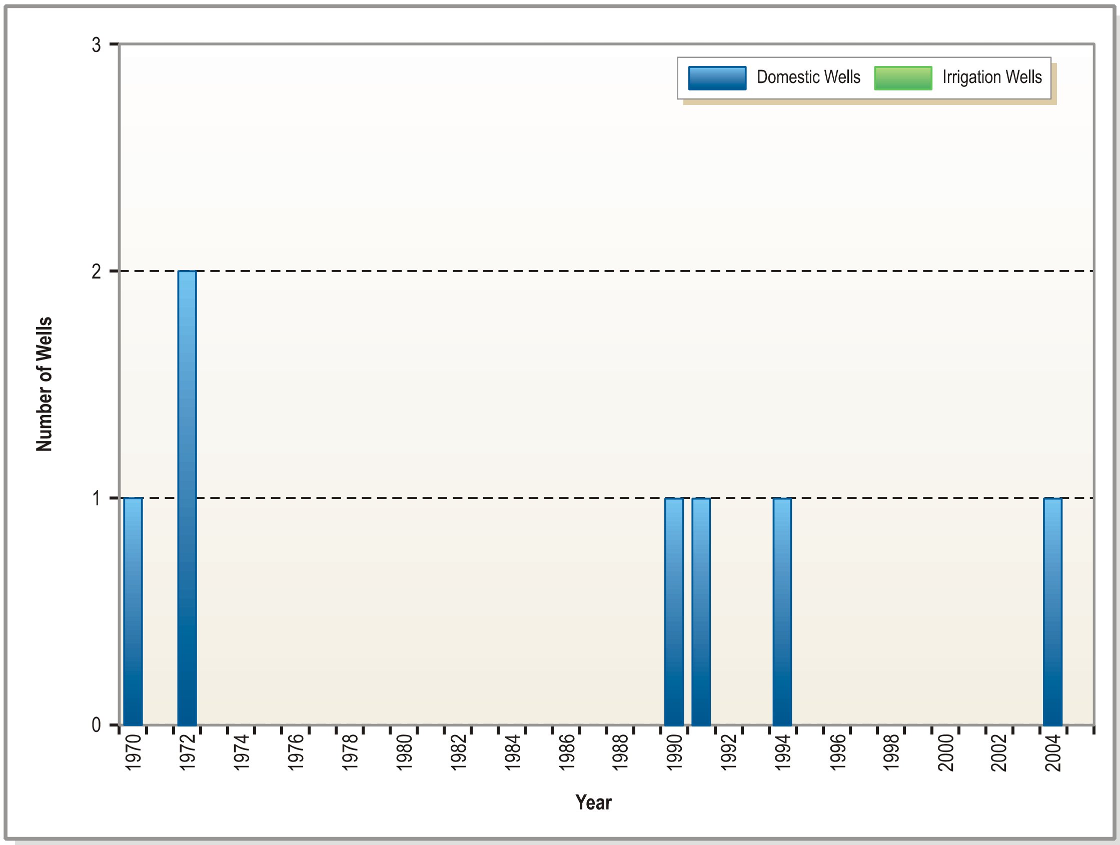
Domestic and Irrigation Well Completion Reports Filed by Year in the Collayomi Valley Groundwater Basin After 1970

Coyote Valley Basin



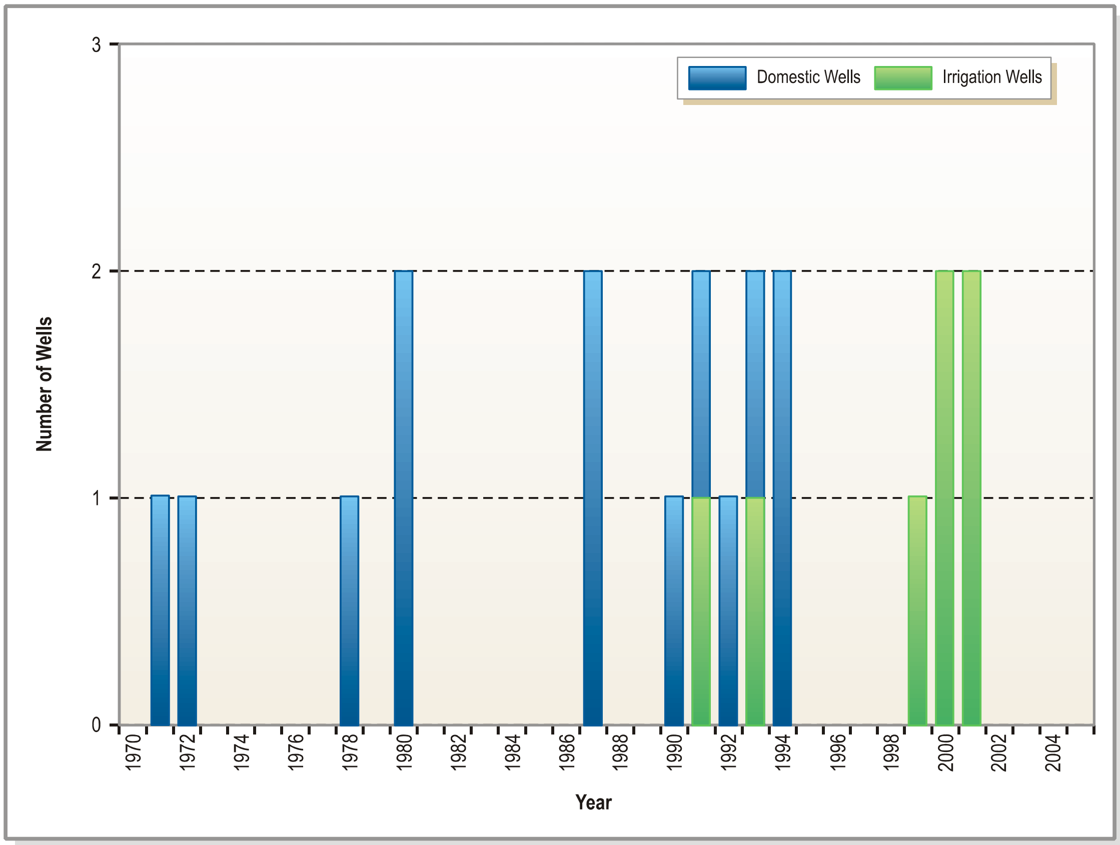
Domestic and Irrigation Well Completion Reports Filed by Year in the Coyote Valley Groundwater Basin After 1970

Gravelly Valley Groundwater Basin



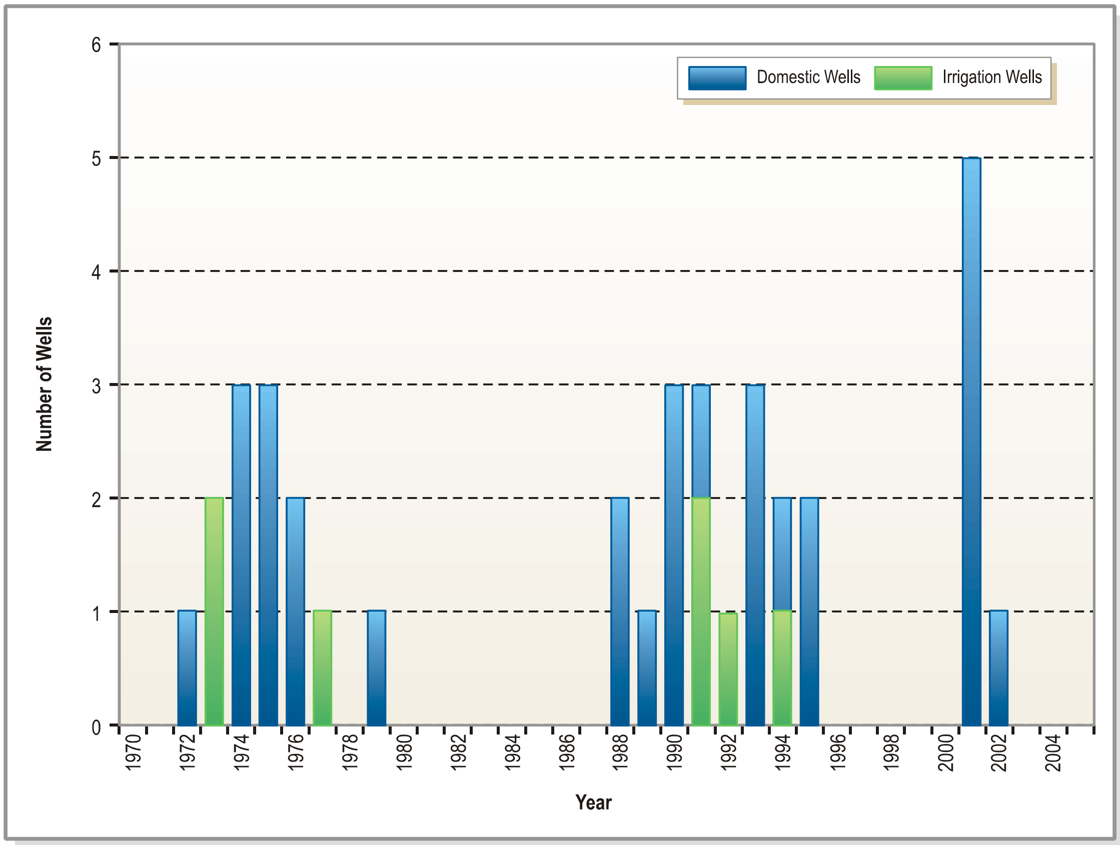
Domestic and Irrigation Well Completion Reports Filed by Year in the Gravelly Valley Groundwater Basin After 1970

High Valley Basin



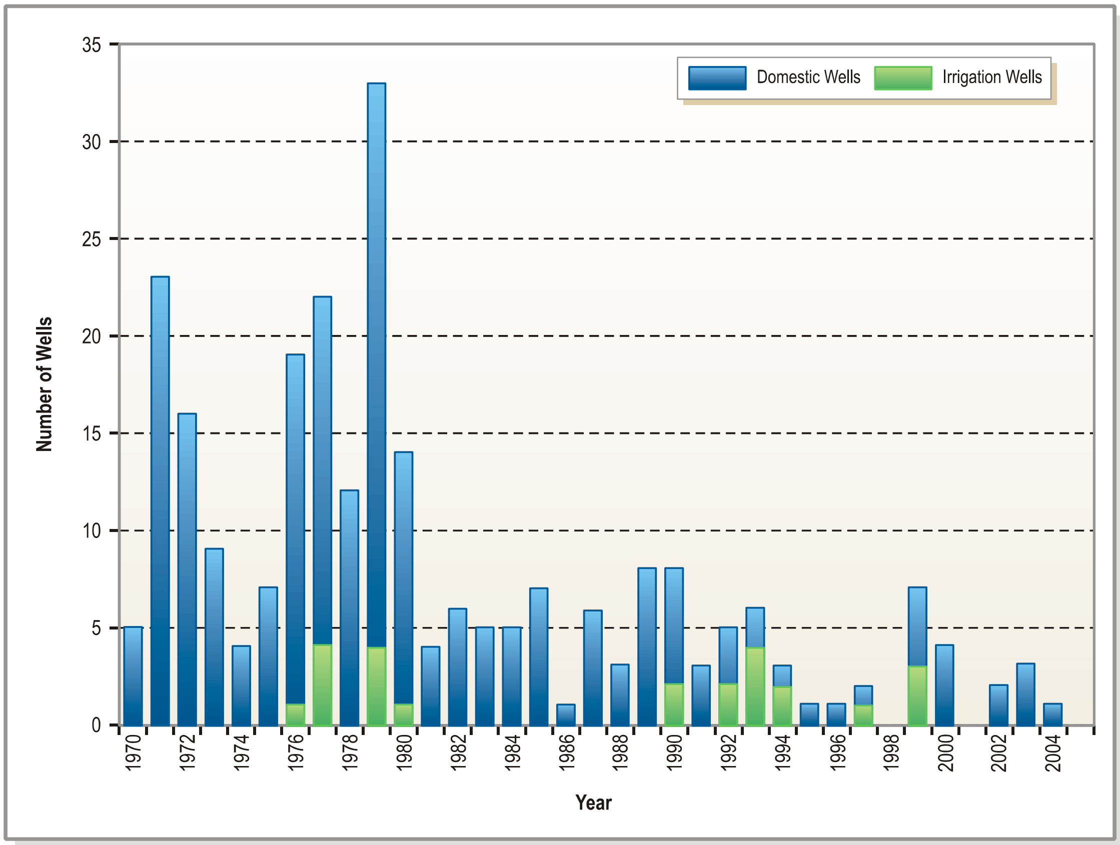
Domestic and Irrigation Well Completion Reports Filed by Year in the High Valley Groundwater Basin After 1970

Long Valley Groundwater Basin



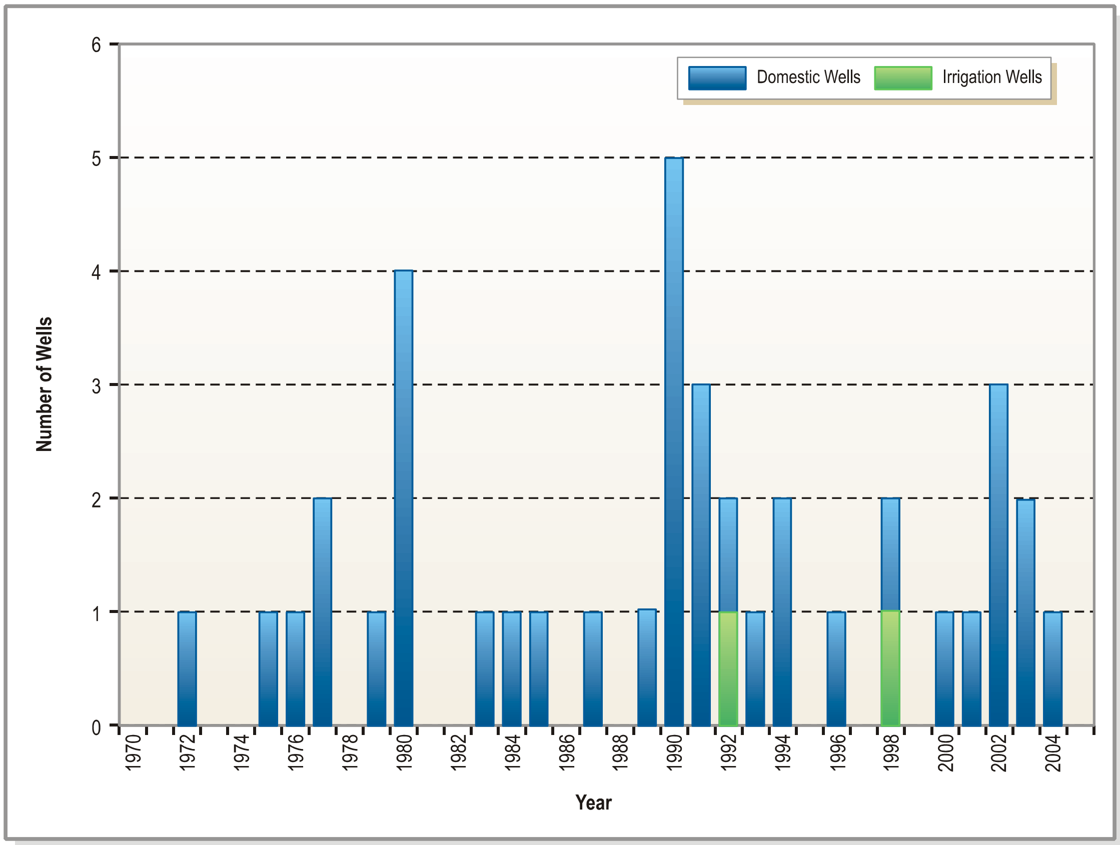
Domestic and Irrigation Well Completion Reports Filed by Year in the Long Valley Groundwater Basin After 1970

Lower Lake Basin



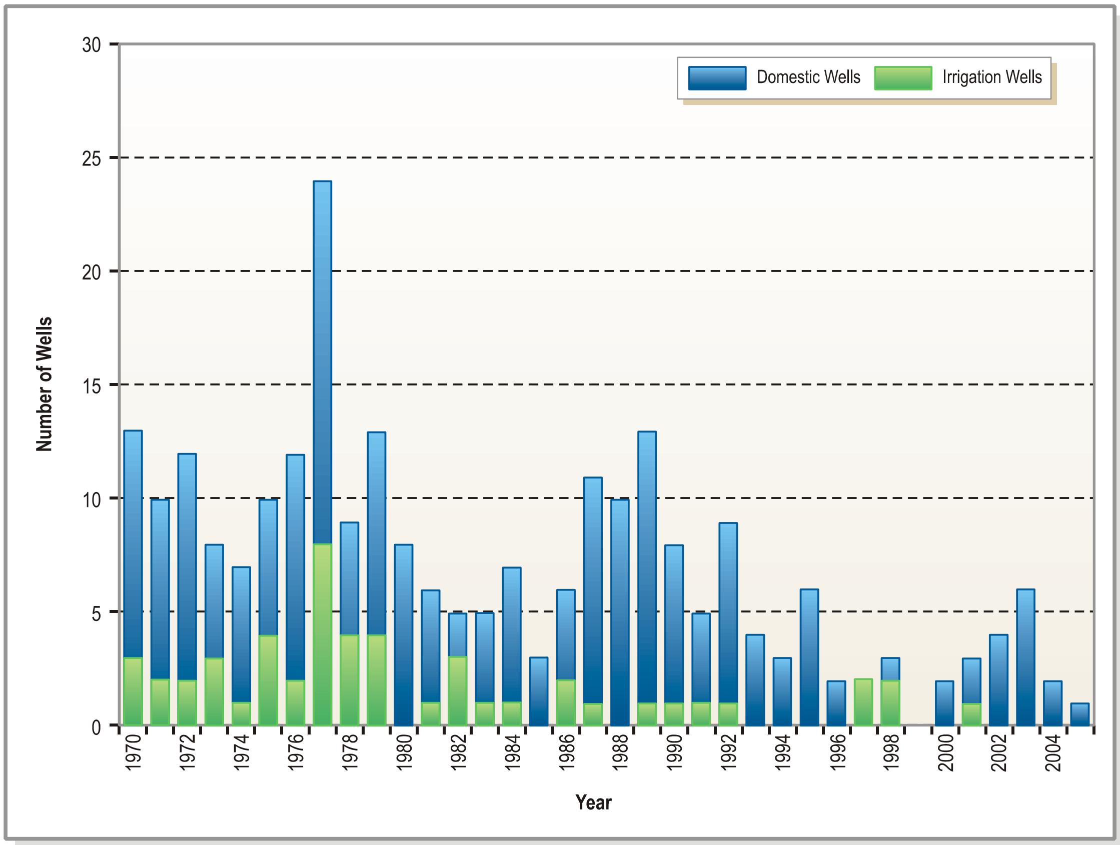
Domestic and Irrigation Well Completion Reports Filed by Year in the Lower Lake Groundwater Basin After 1970

Middle Creek Groundwater Basin



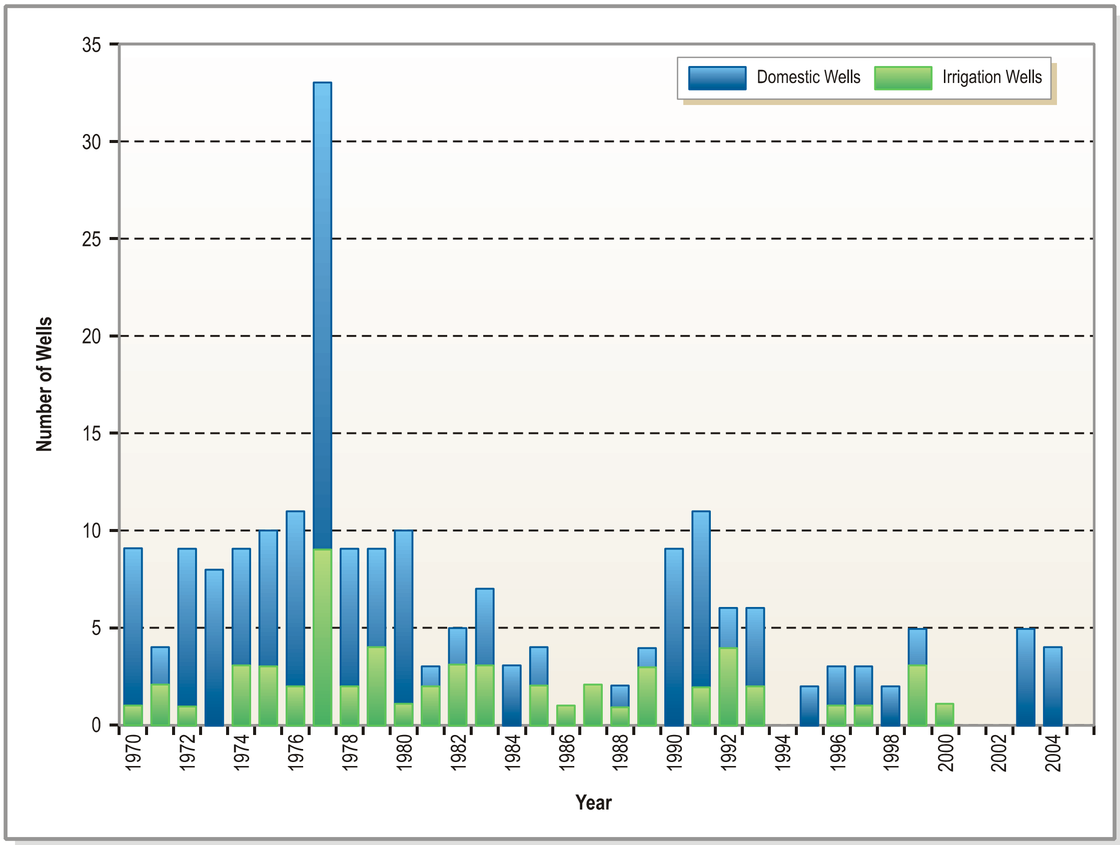
Domestic and Irrigation Well Completion Reports Filed by Year in the Middle Creek Groundwater Basin After 1970

Scotts Valley Basin



Domestic and Irrigation Well Completion Reports Filed by Year in the Scotts Valley Groundwater Basin After 1970

Upper Lake Basin



Domestic and Irrigation Well Completion Reports Filed by Year in the Upper Lake Groundwater Basin After 1970

Appendix D

Water Agencies and Environmental Groups

Appendix D
Water Agencies and Environmental Groups

D.1 Water Agencies

The following section provides detail about water agency information collected during the interview process. The section is organized by Inventory Unit. Lake County Special Districts, which includes ten water systems serving communities throughout Lake County, is discussed in Section D.1.5. Selected agencies were interviewed based on size and location to obtain information throughout the County. Table 3-3 in Section 3 provides a summary of municipal water agencies who were interviewed.

D.1.1 Upper Putah Inventory Unit

D.1.1.1 Callayomi County Water District

The Callayomi County Water District (CWD) assumed operations of the Middletown County Waterworks District #5 in 1978. The Middletown County Waterworks District #5 began operation in 1971. The CWD serves drinking water to Middletown, the Middletown Rancheria (and associated Twin Pines Casino), and nearby areas within its sphere of influence. The CWD's service area is approximately two square miles. The CWD has 332 active connections, including 12 commercial connections. The population within the service area in 2001 was 1,200 people. The CWD expects buildout to include 1,100 new residences. The CWD also expects to annex of a number of existing residences that have an inadequate water supply. The growth is expected to occur at a rate of 8 to 10 new dwellings per year. By 2020, the CWD expects to have 598 connections.

The CWD supplies groundwater from two main domestic water supply wells and one standby well along Putah and Dry Creeks. Annual 2004 water production was approximately 145 acre-feet. The CWD has two storage tanks totaling 625,000 gallons. Conveyance losses are estimated at 10 percent, which includes line flushing and fire department hydrant use. The CWD encourages water conservation by using meters and tiered pricing.

An important issue to the CWD is the continuing protection of the water quality of groundwater. Another concern of the CWD is their lack of emergency generators. During power outages, emergency generators could keep their well pumps operating.

D.1.1.2 Hidden Valley Lake Community Service District

The Hidden Valley Lake Community Service District (CSD) started when it took over operation of the Stonehouse Mutual Water Company in 1992. The CSD provides drinking water and wastewater treatment to residents of the Hidden Valley Lake subdivision, an elementary school, a store, and park facilities. The CSD currently has 2,052 connections. In 2001, the population of the CSD service area was 3,903. The community expects buildout to include an additional 800 to 1,000 homes by 2013.

The CSD supplies groundwater from three domestic water supply wells and one irrigation well along Putah Creek. Annual 2004 water delivery was approximately 260 acre-feet.

The CSD encourages water conservation by offering rebates to customers for low-flow toilets and efficient washing machines. The CSD offers free water conservation kits, and tiered water pricing encourages conservation. The CSD also showcases a drought-tolerant demonstration garden at the district office.

The CSD operates a wastewater treatment plant, which is 30 years old, but upgraded to produce recycled water. The CSD collects wastewater from 1,330 connections. The wastewater is treated to tertiary levels to maximize reuse. The average reclaimed water production for 2004 was 35 acre feet per month. The reclaimed water is used to irrigate the community golf course.

An important issue to the CSD is ongoing water quality protection of groundwater to prevent any future contamination.

D.1.2 Shoreline Inventory Unit

This section will discuss the City of Lakeport, Buckingham Park, Highlands Water Company, and Konocti County Water District municipal water systems. These systems represent a mixture of water sources and issues. Lake County Special Districts, which include North Lakeport, Soda Bay, Kono Tayee, and Paradise Valley water systems in the Shoreline Inventory Unit, are discussed in Section D.1.5.

D.1.2.1 City of Lakeport

The City of Lakeport was incorporated in 1888. The City of Lakeport Utility Department provides drinking water and wastewater services to city residents. The City of Lakeport only serves the city proper, although it does have several out-of-service-area agreements. The County serves water users that are within the Lakeport region but are outside the city limits. The City and County have an interconnection between the systems in case either system requires additional pressure, but it is rarely used. The City of Lakeport has very limited riparian rights to Clear Lake; most water is diverted through contracts with Yolo County.

The City of Lakeport serves approximately 2.3 square miles of the city. It has 2,106 active connections, with most service to residential users. Water connections have been steadily increasing. Large developments are in the planning phases; approximately 340 homes have been proposed to be built over the next few years. In 2001, the population of the City of Lakeport service area was 4,820.

The City of Lakeport uses a combination of surface water and groundwater sources. Four wells supply groundwater. Two of the wells are in seasonal Scotts Creek and pumping does not occur when the creek is flowing. The other two wells are at Green Ranch and are leased from the ranch. These two wells are used year round.

Two pumps divert surface water from Clear Lake. The City of Lakeport has two storage tanks with capacities of 1 million gallons and 1.5 million gallons. The City of Lakeport treats the surface water and then sends it to the two tanks, which are near the wells above Scotts Creek. The City of Lakeport also has two holding tanks, one for chlorine contact, and one for distribution. Surface water treatment includes pre-ozonation, coagulation, clarification and filtration, post-ozonation, activated carbon treatment, chlorination, and pH adjustment when needed. The City has not tracked conveyance losses in several years, but previous losses were less then 10 percent. Total municipal production in 2003 was 949 acre-feet.

Approximately 98 percent of residents in the City of Lakeport service area have wastewater collection. The City of Lakeport does not meter residential wastewater. Commercial accounts are billed for wastewater treatment based on the amount of water they use. The City of Lakeport treats wastewater to the secondary level and uses the treated water for spray irrigation at the treatment plant site.

Wastewater is treated at two wastewater treatment plants. The City of Lakeport serves Finley/Lands End and South Lakeport wastewater needs. Table D-1 shows wastewater treatment information.

Table D-1
City of Lakeport Wastewater Management

Communities Served	Connections	Wastewater Treatment Plant	Treatment Type	Dry Flow (mgd)	Wet Flow (mgd)	Reuse
Finley Lands End	128	LACOSAN SD-9-1	Served by City of Lakeport WWTP	Not Available	Not Available	---
South Lakeport	55	LACOSAN AD-9-3	Served by City of Lakeport WWTP	Not Available	Not Available	---

The major issue facing the City of Lakeport is the seasonal variation of water quality in Clear Lake. In late summer and fall, the water has a high pH level associated with algae blooms and requires additional treatment before distribution. Infrastructure is also a concern and the City of Lakeport would like to replace distribution lines, upgrade the surface water treatment plant, and drill an additional well.

D.1.2.2 Buckingham Park Water District

The Buckingham Park Water District (WD) serves the community of Buckingham, on the south shore of Clear Lake between Soda Bay and Konocti Harbor Resort and Spa. The WD has 445 connections including four commercial connections. Most of the connections are to single-family homes, some of which are vacation homes. The WD system has been increasing at approximately 6 to 12 new connections per year. The

2001 population of the WD service area was 1230. The WD diverts water under riparian rights from Clear Lake.

The WD diverts surface water from Clear Lake, approximately 50 yards from the WD office. Water treatment includes a conventional treatment plant with ozone, liquid chlorine, coagulation, flocculation, clarification, filtration, and chlorine gas. Overall water production is approximately 138 to 233 acre-feet per year. Pumping rates vary from 6 acre-feet per month in the winter, to 31 acre-feet per month in the summer. This summer increase is likely from landscape watering and vacation residence occupancy. Three tanks are in operation: a holding tank with a 25,000-gallon capacity and two storage tanks, one with a 100,000 gallon capacity and one with a 200,000 gallon capacity. WD conveyance losses are estimated at 10 to 15 percent. The WD encourages conservation through tiered pricing and signs. Reclaimed wastewater from system flushes is used for landscaping around the WD office.

The community of Buckingham has a moratorium on growth because of a shortage of water treatment plant capacity and storage. Plans are underway to build a subdivision that could contain up to 100 new homes, but before the development can proceed, the WD must have increased treatment and storage capacity. The WD is planning to increase the treatment capacity by 350 gallons per minute and to build a new storage tank with a capacity of 279,000 gallons.

The major issue for the WD is algae from Clear Lake. The increase in algae reduces treatment capacity during the summer months. Increasing the treatment plant capacity and new storage are also important issues to the WD to allow for more growth.

D.1.2.3 Highlands Water Company

The Highlands Water Company (WC) was formed in 1929 as a mutual water company to serve a nearby subdivision in the City of Clearlake. The WC serves the northwestern portion of Clearlake, an area of approximately 15.2 square miles. It has 2,336 total connections, with 2,260 of those active connections. Major development of this area primarily occurred in the late 1920s, but the population has increased rapidly between 2003 and 2005. The 2003 population was 8,900. The WC is preparing for future growth by modeling its distribution system and expanding the treatment plant to treat backwash water. Highlands Water Company has limited riparian rights to Clear Lake; most water is diverted through contracts with Yolo County.

The WC diverts surface water from Clear Lake. Two pumps in the lake pump all year without restrictions and send water to the treatment plant. Water treatment consists of filtration and sedimentation and a conventional chlorination system. The WC has two tanks at its office site with capacities of 400,000 gallons and 260,000 gallons. The company also owns four other tanks around the area. Total storage capacity of all six tanks is 4.5 million gallons. Overall water production in 2004 was approximately 896 acre-feet. Water use in summer is approximately 4.0 acre-feet per day, while water use in winter is 1.6 acre-feet per day. Seasonal variation in water use is mostly from an increase in summer visitors. Conveyance losses are estimated at 10 to 12 percent.

The WC's main issue is water quality in Clear Lake. During the summer, blue-green algae affect the taste and odor of the water. During the winter, runoff from streams creates an increase in silt loads to the lake and causes high turbidity. The shallow depth of the lake and the nutrients entering it also affect water quality. In addition, the WC believes water districts seem to act as individual entities without a sense of cohesiveness. Regular water quality monitoring by Lake County would be beneficial to all. The WC is also concerned about its infrastructure and would like to replace the distribution system, upgrade the SCADA system, install a new ozone treatment system, and install domes over the clarifiers. These improvements would help to decrease vulnerability and disinfection byproducts.

D.1.2.4 Konocti County Water District

The Konocti County Water District (CWD) serves the areas within southeastern city limits of the City of Clearlake. Highlands Water Company, discussed in section 3.2.5.3, and California Cities Water Company, serves the remainder of the City of Clearlake. The CWD serves an area of 2.9 square miles. The CWD has 1,858 connections, of which 1,599 are active. Most connections are to single-family homes. Four connections serve 80 apartments and are the highest water users in the service area. The City of Clearlake had substantial growth in the late 1980s and early 1990s. After a period of slow growth, the city has started to see another increase. The CWD has installed 40 meters per year over the past two years. The 2004 population of the CWD service area was approximately 4,400. Konocti CWD diverts water through contracts with Yolo County.

The CWD uses surface water from Clear Lake and has a diversion at Mike Thompson Harbor. The CWD uses a conventional water treatment plant with clarification, sedimentation, filtration, and a disinfection system. Water production in 2004 was 408 acre-feet. Conveyance losses are calculated monthly and range from 5 to 25 percent. Demand for water increases during the summer, likely as a result of landscape watering and increased occupancy of vacation homes.

The CWD's major issue is Yolo County's water rights to Clear Lake and high water rates charged by Yolo County for surface water use. Source water quality is also a problem because summer months often have an increase in algae, and winter months can bring an increase in silt. With an increasing population, treatment capacity is a key issue and the CWD is planning to add new filters to increase treatment capacity from 500 gallons per minute to 1,500 gallons per minute.

D.1.3 Middle Creek

D.1.3.1 Upper Lake County Water District

The Upper Lake CWD was established by Lake County in 1964. The County originally managed the CWD, but it has since established its own Board of Directors. The CWD serves the community of Upper Lake and covers an area of approximately two square miles. The CWD has 381 connections, including 29 commercial connections. In 2001, the population of the CWD service area was 989.

Most of the development in this community occurred around 1966. Little new construction occurred from 1967 to 2003. From 2003 to 2005, the County has approved a new 20-unit subdivision and units are under construction. Plans are underway for five other new subdivisions, but these still require County approval. The Master Water Plan estimates 720 homes at buildout.

Two groundwater wells provide water for the CWD. Three chlorine injector tanks treat the water. The CWD has three storage tanks outside of the district on a hill near Upper Lake-Lucerne Road. The CWD water production was 147 acre-feet in 2002. Conveyance system losses are estimated at 13 percent.

The CWD meters water use and applies tiered pricing to water bills. The CWD will also be offering water conservation kits for $8 that include low-flow shower heads, faucet aerators, hose nozzles, and toilet leak tablets. These kits could potentially decrease water use by 40 percent.

The CWD has adequate groundwater to meet the community's future needs, but it lacks adequate infrastructure and pumping capacity. The main issues facing the CWD are a lack of storage, lack of adequate infrastructure, inadequate flows for fire protection, and lack of emergency backup generators. The Department of Health Services informed the CWD that it was operating at 92 percent of its reliable source capacity in 2002 when it had 351 connections. At 424 connections, it will be short 40,000 gallons because of a lack of storage. Supply issues will become critical as Upper Lake moves towards buildout.

D.1.4 Big Valley

The Cobb Area CWD serves the community of Cobb, and operates three other water systems: Loch Lomond Mutual WD, Adam Springs WD, and Pine Grove Water System, all in the mountainous south end area of the inventory unit.

D.1.4.1 Cobb Area County Water District

The Cobb Area CWD serves approximately five square miles of the Cobb community. The CWD has 650 metered connections in Cobb, including about 12 commercial connections. Cobb has no industrial water use. The majority of the connections are to year-round residences. The Cobb system is increasing at a rate of about 10 to 15 connections per year. Cobb has 300 lots remaining of an original 1,000 lots. Approximately 75 lots out of the 300 are probably buildable; steep terrain limits construction on the remainder. In 2001, the population of the CWD service area was 1,453.

Cobb has five sources of groundwater, including two springs and three wells. One spring is leased and produces approximately 30 gallons per minute (gpm). Cobb buys water from a second spring, which produces 250 gpm, which is on property that is for sale. Well #1 produces 250 gpm. Well #2 produces an average of 100 gpm, but production decreases towards the end of the summer. Well #3 produces 125 gpm. The best water quality is from Well #2. Well #3 requires ozonation treatment because of high iron and manganese concentrations. All sources are chlorinated. Overall water production is approximately 154 acre-feet per year.

The Cobb area has a high annual precipitation (65" per year) which minimizes seasonal variation in water use as landscape irrigation water is not needed by plants. Conveyance losses are estimated at 5 to 8 percent. The CWD encourages water conservation by using meters and tiered pricing.

The main issues facing the CWD for all of its systems are water sources, source water quality, and watershed maintenance. A priority project for the CWD is the ownership of all water sources to ensure continued water source accessibility. Storage is also an issue, but is secondary to source water ownership.

The CWD has source water quality issues. The water has a low pH (6.6) with high corrosivity. The CWD uses limestone in filters to correct the pH. In addition, one well also has high iron and manganese concentrations.

The CWD is concerned subsurface water flowing to creek basins could potentially become contaminated by wastewater flows within the watershed. The California Department of Health Services' Drinking Water Source Assessment identified potential wastewater contamination as a source water vulnerability for the CWD. Additionally, the CWD would like increased maintenance and restoration on Kelsey Creek. Fallen trees and brush in the creek alter flow, and silt deposits have widened the creek bed.

D.1.4.2 Loch Lomond Mutual Water District

The Loch Lomond Mutual WD serves three and a half square miles of the Loch Lomond community. The WD has 209 metered connections, including 2 commercial accounts. Loch Lomond is a vacation community, with about 65 percent summer cabins and 35 percent year-round residences. The community has seen an upward trend in conversion of existing summer homes to full-time rentals for local residents over the last five years. Since 2001, the CWD added 11 new connections. Prior to 2001, there were no new connections since 1986. Loch Lomond has limited growth potential, with only 100 lots undeveloped. Soils in the area are not conducive to septic systems, so any lots to be developed would need above-ground engineered septic systems. In 2001, the population of the WD service area was about 530 people.

Loch Lomond has two wells that produce 150 gpm each. One of the wells was hand-dug in the 1940s and serves as a backup well. Two storage tanks provide 186,000 gallons of storage. The WD treats water with granulated limestone in a rapid sand filtration gallery to reduce the corrosivity of the water. All water is chlorinated.

D.1.4.3 Adams Springs Water District

The Adams Springs WD serves two square miles of the Adams Springs community. The WD has 68 unmetered connections that serve primarily year-round residences. Poor soils had stalled growth because of septic system problems. Adams Springs has started to grow with the introduction of above-ground engineered septic systems. The community has growth potential, as there is developable land for another 50 to 100 homes. Water supplies and the conveyance systems are adequate for growth. In 2001, the population of the WD service area was about 174 people.

Adams Springs has a well near Cobb #3 that produces 300 gpm. The WD chlorinates the water.

D.1.4.4 Pine Grove Water System

The Pine Grove Water System (WS) serves one square mile of the Pine Grove community. The Pine Grove community was originally established as a resort in the early 1900s. The WS has 92 unmetered connections that serve primarily residential accounts. The WS also has one connection with the resort including 78 campsites, cabins, or trailers. Pine Grove has strong seasonal residential use, but the seasonal trend is diminishing as more vacation homes convert to year-round use. The WS has added only one new connection in the past 15 years. The WS was historically deteriorating and was unable to meet standards; therefore, the state placed it into receivership with the Cobb Area County Water District. The system was under a Boil Water Advisory until six months ago, which caused a building moratorium in the community. The distribution system is undersized and will not likely accommodate growth.

Pine Grove's supply source is a spring under the influence of surface water. It runs through forest terrain before entering a slow sand infiltration gallery. The WS does not own the land that contains the spring, but rather leases the land that contains the spring drainage. The WS chlorinates the water.

D.1.5 Lake County Special Districts

This section provides further information about the Lake County Special Districts, which are distributed countywide.

The County of Lake operates the Lake County Special Districts (Special Districts), which include ten water systems and four regional wastewater systems. The Special Districts treat and deliver drinking water to 33,000 customers in 21 communities throughout Lake County, collect and treat wastewater, and reuse treated effluent. Figure 3-15 in Section 3 shows the locations of the drinking water systems and wastewater treatment plants.

The Special Districts had 3,653 water connections in 2004. Table D-2 defines the number of connections for each system. Vacation residences are generally located along the lakeshore. Water connection trends vary among communities. North Lakeport is experiencing high growth, while Soda Bay is not growing much because its water system has capacity issues.

Table D-2
System Water Connections

System	*Connections*	*System*	*Connections*
Spring Valley	370	Bonanza Springs	156
Finley	218	Kelseyville	940
Mt. Hannah	35	Soda Bay	556
Star View	134	Kono Tayee	127
North Lakeport	1053	Paradise Valley	64

The Special Districts use a combination of surface water and groundwater for water supply. Surface water is from Clear Lake, except in Spring Valley, which uses surface water from Cache Creek. Spring Valley also uses groundwater sources. Table D-3 shows drinking water sources for the Special Districts' water systems.

Table D-3
Water Sources

System	*Groundwater*	*Surface Water*
Spring Valley	X	X
Finley	X	
Mt. Hannah	X	
Star View	X	
North Lakeport		X
Bonanza Springs	X	
Kelseyville	X	
Soda Bay		X
Kono Tayee	X	
Paradise Valley	X	

The Special Districts managed water systems treat groundwater sources with filters and disinfection methods such as hypo solutions (sodium hypo chlorite). However, systems that use Clear Lake surface water as a source must go through a more involved treatment process that includes granular activated carbon filtration and ozonation. Blue green algae (cyanobacteria) create taste and odor problems in water, and toxins are released when the cells of the algae break down. These treatment processes remove and destroy the toxins.

The Kelseyville Waterworks District #3 has a water conservation ordinance to reduce water use and lessen wastewater treatment system capacity usage (Ordinance 2721). The ordinance requires low-flow toilets and showerheads when reselling homes.

Wastewater is treated at four regional wastewater treatment plants. Table D-4 shows connections, treatment type, flows, and reuse for the treated effluent. Reclaimed wastewater is piped to the Geysers geothermal energy plant for reuse. In addition, the "Full Circle" project is working with farmers to plan reclaimed water use for agricultural irrigation. Wastewater from the Lakeport and Kelseyville treatment plants is treated to tertiary standards, and then diverted for agricultural irrigation.

Table D-4
Lake County Sanitation District Wastewater Management

Communities Served	Connections	Wastewater Treatment Plant	Treatment Type	Dry Flow (mgd)	Wet Flow (mgd)	Reuse
Middletown	434	Middletown Wastewater Treatment Plant	Facultative Pond	0.128	0.24	Geothermal injection
Clearlake Clearlake Park Lower Lake	5592	Southeast Regional Wastewater Treatment	Aerated Lagoons	1.9	6.1	Geothermal injection
Kelseyville Corinthian Bay Clear Lake State Park	830	Kelseyville Wastewater Treatment	Facultative Pond	0.26	0.48	Vineyard irrigation
North Lakeport Upper Lake Nice Lucerne Kono Tayee Paradise Valley	4169	Northwest Regional Wastewater Treatment	Aerated Lagoons	1.6	4.1	Wetlands polishing, Geothermal injection

The main issues for the Special Districts include groundwater supply, maintenance and upgrading of existing facilities, and expansion for growth. The Special Districts are concerned about adequate supply for areas with groundwater and would like a full study of the groundwater resources in the county. Upgrades and maintenance concerns include a water treatment plant for North Lakeport; capacity upgrades for Soda Bay; filtration systems for Mt. Hannah and Bonanza Springs (or a connection with the Loch Lomond system); distribution improvements to the Kelseyville County Waterworks system because the steel is corroding; and resources to prepare grant applications. More information is available at http://co.lake.ca.us/countygovernment/specialdistrictindex.asp .

D.2 Environmental Groups

This section identifies environmental groups, including resource conservation districts, coordinated resource management and planning groups (CRMPs), watershed councils, and concerned citizen groups within Lake County. Information was obtained from various websites and also through contact with members whenever possible. This list is not exhaustive.

D.3 Middle Creek CRMP

The Middle Creek CRMP was formed in April 1999. The area of concern for the Middle Creek CRMP is the Middle Creek watershed that drains an area of approximately 86 square miles. Members include private landowners, public land managers, and conservation groups.

The overall goal of the Middle Creek CRMP is the "protection and restoration of the watershed ecosystem." The CRMP's four main areas of focus include:

- Ecosystem improvement;
- Fuel management;
- Enhancing the viability of human uses in harmony with each other and all animal species that utilize the watershed; and
- Education.

Activities of the Middle Creek CRMP include surveys for soil erosion and invasive weeds, restoration projects on Middle Creek, removal of abandoned vehicles on local roads, and the distribution of pamphlets to ensure off-highway vehicle users stay in designated areas in the Middle Creek Campground. (Middle Creek CRMP 2005)

The Middle Creek CRMP has a website with additional information at: http://watershed.co.lake.ca.us/crmp/middle/middle.html

D.4 Lake Pillsbury/ Upper Eel CRMP

Ken Thompson and Lake County Supervisor Louise Talley formed the Lake Pillsbury/Upper Eel CRMP in 1996. The CRMP focuses on the area around Lake Pillsbury and the Upper Eel River watershed in the northwestern section of Lake County. Members include concerned local residents, citizens, agency representatives, and businesses.

The CRMP's mission statement is:

> "To maintain and enhance the quality of all natural life, animal, plant, fish and human, in the Lake Pillsbury/Upper Eel River watershed through coordination of management of the natural resources that ensures equity among shared interests, respect for diverse uses, and enhancement of the environmental health of the area, while promoting collaborative economic and recreational growth."

The overall goal of the CRMP is the protection and restoration of the watershed ecosystem. The group specifically focuses on ecosystem improvement, Potter Valley Project, erosion control, fuel management, and research and education.

The CRMP is involved in multiple projects and activities within its watershed, including:

- Soda Creek Restoration Project to deepen the river channel and revegetate the area;
- Annual Squawfish Derby to eliminate squawfish which were illegally introduced into the lake years ago;
- Dumpster Days to educate public on impacts of garbage disposal on public lands;
- Development support for the Lake Pillsbury Fire District;
- Light Parade sponsorship to provide a safe alternative to dangerous fireworks on the Fourth of July;
- Studies with the Office of Environmental Health Hazard Assessment and the North Coast Regional Water Quality Control Board to pinpoint the source of mercury in fish after a toxicology study by the California Department of Fish and Game found levels of mercury in some fish were more than 1part per million (ppm), which is the allowable level for fish sold commercially;
- Public education regarding the impacts of traffic on roads, trails, and the environment;
- Maintenance and enhancement of existing trails for the benefit of the resource and recreational users;
- Efforts to bring Federal, State, and local attention and funds to this region for the purposes of preserving, enhancing, and maintaining the environmental and recreational resources of the region; and
- Public education and awareness about the potential relicensing and sale of the Potter Valley Project which includes Scott's Dam (Lake Pillsbury), Cape Horn Dam (Van Arsdale), the Potter Valley tunnel, and a powerhouse in Potter Valley. (Lake Pillsbury/Upper Eel Watershed CRMP 2005)

The Lake Pillsbury/Upper Eel Watershed CRMP has a website available at: http://watershed.co.lake.ca.us/crmp/pillsbury/pillsbury.htm

D.5 Schindler Creek/High Valley Watershed CRMP

The Schindler Creek/High Valley Watershed CRMP group was formed in 1998 to address issues of flooding, erosion and sedimentation in the Schindler Creek/High Valley watershed area near the community of Clearlake Oaks. The watershed includes an area of approximately ten square miles. The group is composed of area property owners, residents, and representatives from various resource agencies at local, state and county levels. The East Lake Resource Conservation District sponsors the CRMP.

The major goal of the CRMP is:

> "Improve and sustain the area's productivity and natural resource base by promoting proper land management through:
>
> – Preservation and protection of aquatic resources and native species;
>
> – Restoration of ecological integrity;
>
> – Working within the watershed and broader landscape context;
>
> – Understanding the natural potential of the watershed; and
>
> – Addressing ongoing causes of degradation."

The CRMP uses a watershed-based approach to address bank erosion, land loss, and sedimentation in the area of Schindler Creek. The CRMP is working to restore banks and channels that were negatively affected by sedimentation and erosion at the mouth of Schindler Creek. The CRMP is also working to:

- Stabilize streambanks;
- Control watershed erosion;
- Revegetate riparian areas;
- Restore fish habitat;
- Restore low flow meander to channel;
- Restore the watershed;
- Remove exotic species; and
- Restore wetlands. (Schindler Creek/High Valley Watershed CRMP 2005, Parker 2005)

Schindler Creek/High Valley Watershed CRMP has a website available at: http://watershed.co.lake.ca.us/crmp/schindler/schindler.html. Additionally, other websites with CRMP information include http://www.ice.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5527, and http://www.ice.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=9753.

D.6 The Upper Putah Creek Stewardship

A group of concerned citizens, aided by the Americorp organization, formed the Stewardship in 1996. The Stewardship's area of concern is approximately 285 square miles of the Upper Putah Creek watershed in Lake and Napa Counties. The Stewardship does not solicit members; however, it interacts with local citizens, students, local landowners, businesses, county government, state government, federal government, colleges and universities, and other groups in the environmental field.

The Stewardship has established the following mission statement and goals:

> "The primary objectives and purposes of this corporation shall be to provide long and short- term watershed management strategies for the Upper Putah Creek Watershed."

The Stewardship is engaged in multiple projects, including:

- Implementation of a State Water Resources Control Board 319(h) grant to conduct macroinvertebrate data, remove invasive weeds, and perform outreach and education functions;
- Restoration work on St Helena Creek in Middletown;
- Hiring a watershed coordinator and securing a grant from the Department of Conservation to pay for the position;
- Water sampling;
- Establishment and operation of a Watershed Center;
- Public education;
- Native plant nursery operation;
- Sacramento River Watershed Program;
- Grant to start a website for the Stewardship;
- "Field Days in the Creek;" and
- Celebrate the Watershed, a fundraiser that will take place in August 2006. (Upper Putah Creek Stewardship 2005, Holford 2005)

Upper Putah Creek Stewardship has a website available from: http://watershed.co.lake.ca.us/crmp/upcs/upcs.html.

D.7 Sierra Club Lake Group

The Lake Group of the Sierra Club Redwood Chapter is part of the larger Redwood Chapter. The Lake Group was formed in 2001 to provide a stronger local Sierra Club presence than that available from the existing Mendocino/Lake Group. The Lake Group is actively involved in projects throughout the entire county. The Lake Group membership includes approximately 350 local environmentalists and is open to everyone. Membership in the national Sierra Club is included.

The Lake Group's mission statement is to "enjoy, explore, and protect the planet." Some current activities include:

- Preserving wilderness and other open spaces;
- Keeping Clear Lake and local watersheds healthy and thriving;
- Controlling rampant growth;
- Leading hikes;
- Conducting informational meetings; and
- Maintaining a strong environmental political voice in the county. (Sierra Club Lake Group 2005, Brandon 2005)

The Lake Group of the Sierra Club maintains a website available from: http://www.redwood.sierraclub.org/lake/

D.8 Clear Lake Environmental Action Network

Clear Lake Environmental Action Network (CLEAN) was formed in July of 2003 to allow participation and to provide understanding of the proposed Environmental Protection Agency (EPA) mitigation efforts at Sulphur Bank Mercury Mine (SBMM) Superfund site in Clearlake Oaks. CLEAN has five members on the Board of Directors and is also supported by local residents, property owners, and concerned individuals and businesses in Lake County.

CLEAN's purpose is to involve the community of Lake County with the SBMM Superfund site. Its mission statement and purpose is to:

- Ensure that the community has a clear understanding of the EPA mitigation efforts at SBMM;
- Provide a forum for concerned individuals to learn about activities at SBMM, discuss their needs and concerns, and have input on the future reclamation/uses at the site;

- Provide ongoing education and information to the public on the remedial efforts, the associated health hazards to the community, and the impact on the local environment, particularly Clear Lake; and
- Streamline interaction with local government, the EPA, and the Lake County community.

CLEAN has been awarded an EPA Technical Assistance Grant, which allows the organization to provide public outreach on issues concerning remediation and subsequent land uses for the SBMM. SBMM is on the federal National Priority List. (CLEAN 2005, Lamb 2005)

CLEAN has a website with more information available from http://www.cleanlake.org/techrfp.html.

D.9 East Lake Resource Conservation District

Middletown and Lower Lake Soil Conservation Districts consolidated in 1961 to create the East Lake Resource Conservation District (RCD). The East Lake RCD is in the southeast portion of Lake County and includes the Upper Putah watershed and a section of the Upper Eel watershed, a total area of approximately 351,000 acres. The East Lake RCD is self-governed by five volunteer members on the Board of Directors who are local citizens and landowners. East Lake RCD is also assisted by many individuals, agencies, groups, and organizations.

Resource Conservation Districts are chartered by the State of California to serve the local community in assistance with natural resource protection. East Lake RCD's main concerns include water quality and quantity enhancement, watershed improvement, and habitat protection. According to its long-range plan, the East Lake RCD's priority for the next ten years is to "give special attention to community resource awareness, land use problems, and solutions for water use and protection. " (RCD Watershed Information Sharing Project 2005)

The East Lake RCD participates in multiple programs and activities, including:

- Water quality monitoring;
- Watershed group support;
- Restoration projects;
- Federal and state agency partnerships;
- Community awareness and education;
- Habitat improvement;

- Supervision of critical issues, grants, public outreach and education, and workshops;
- Preservation of agricultural lands; and
- Technical assistance on soil and water issues. (East Lake RCD 2005, Dills 2005)

East Lake RCD has a website with more information available from: http://watershed.co.lake.ca.us/rcd/east_lake.html.

D.10 West Lake Resource Conservation District

The Scotts Valley RCD, Upper Lake RCD, and the Big Valley RCD combined to form the West Lake RCD in 1960. The West Lake RCD covers an area of approximately 497,960 acres in the northwest section of the county and includes Upper Cache Creek watershed and a section of the Upper Eel watershed. Local citizens and landowners make up the five volunteer members of the Board of Directors for the West Lake RCD. The RCD is supported by many individuals, agencies, groups, and organizations.

West Lake RCD has similar missions and goals to the East Lake RCD because they are both part of the same overall organization. The West Lake RCD's goals include water quantity and quality enhancement, wildlife habitat improvement, watershed education/watershed monitoring, and streambank erosion control and stabilization.

The West Lake RCD has developed the following philosophy to reach their goals:

1) Promote locally-led conservation efforts and address issues between landowners, land users, governmental agencies, other resource specialists or groups, and any other non-government or citizen groups;

2) Preserve, maintain, and enhance the natural resources within the RCD;

3) Provide education and support to landowners when natural resource problems are identified in an effort to further increase awareness of how land use activities affect natural resources; and

4) Improve the quality of life for all who share resources within the RCD. (RCD Watershed Information Sharing Project 2005b)

The West Lake RCD's projects and activities include the same types of projects as those listed above for the East Lake RCD. (West Lake RCD 2005, Dills 2005)

West Lake RCD maintains a website with more information available from: http://watershed.co.lake.ca.us/rcd/west_lake.html.

D.11 Chi Council for the Clear Lake Hitch

The Chi Council is a CRMP that was formed by a Memorandum of Understanding (MOU) in August 2003 with the participation of the County of Lake, local RCDs, local watershed groups, tribal entities, and concerned citizens. The area of concern for the Chi Council is the Clear Lake watershed, particularly the streams and tributaries to the lake. Other than the 10 signators of the MOU, the Chi Council has no formal membership. About 100 individuals are on the contact list, many of whom participate in the Council's voluntary efforts to monitor hitch spawning migrations.

The Chi Council's main goals include the study, protection, and restoration of a viable population of Lavinia exilicauda chi (Clear Lake Hitch), within a healthy watershed ecosystem. Current projects include monitoring the hitch spawning run (which takes place over a period of several weeks every spring), recording observations, and assembling a long-term database. The group also encourages scientific research on hitch and their habitat, enhances public awareness of hitch and their habitat, gathers and preserves information about hitch and their traditional uses by the native peoples of the Clear Lake Basin, and sponsors habitat restoration projects. (Chi Council 2005, Brandon 2005)

The Chi Council maintains a website with more information available from: http://www.lakelive.org/chicouncil.

D.12 Lake County Coordinating Resource Management Committee

The Lake County Coordinating Resource Management Committee was formed in 1990 and includes all of Lake County. The Committee's purpose is to "maintain and enhance the ecosystem and economy of Lake County." Members include watershed groups, state and federal agencies, local CRMPs, local land owners, local tribes, resource conservation districts, local governments, and other various groups.

The Committee objectives include:

1) Improve coordination of research, planning, land management, and resource management by private, local, state, and federal agencies through sharing information, data collection, research, policy development, and other activities.

2) Through a coordinated effort, develop a comprehensive, technically sound recommendation for orderly and quality development, environmental protection, and wise use of the Clear Lake Basin. The recommendations will address identification and solution of problems concerning the Clear Lake Basin, balancing the environmental concerns, private property rights and the customs and culture of the County. These problems include:

- Aquatic vegetation control;

- Economic sustainability and development;
- Education and public involvement;
- Fire control;
- Fisheries management;
- Flooding;
- Insect control;
- Intensity and frequency of nuisance algal blooms;
- Lake level fluctuations;
- Lakeside/riparian/wetland management;
- Land Use;
- Mercury levels in the food chain;
- Sedimentation and delta formation;
- Soil erosion;
- Waste disposal;
- Water quality;
- Water supply;
- Water yield fluctuations; and
- Wildlife management.

The Committee creates a consensus-based partnership approach for the community to manage and restore its natural resources and watersheds. The Committee draws people together from each of Lake County's watersheds, namely Clear Lake, Cache Creek, Putah Creek and Lake Pillsbury-Eel River. They are also interacting with a downstream Cache Creek Stakeholders Group which considers watershed issues in the lower reaches of Cache Creek all the way to the Sacramento River. (Lake County Coordinating Resource Management Committee 2005)

The Lake County Coordinating Resource Management Committee has a website with more information available from: http://watershed.co.lake.ca.us/rmc/index.html