California's Groundwater Update 2013

A Compilation of Enhanced Content for California Water Plan Update 2013

April 2015

State of California
Natural Resources Agency
Department of Water Resources

NORTH LAHONTAN HYDROLOGIC REGION

Contents

Tables

Figures

Acronyms and Abbreviations Used in this Chapter

AB	Assembly Bill
ACWA	Association of California Water Agencies
AWMP	agricultural water management plan
bgs	below ground surface
BMO	basin management objective
CASGEM	California Statewide Groundwater Elevation Monitoring
CDPH	California Department of Public Health
CWP	California Water Plan
CWS	community water system
DAU	detailed analysis unit
DWR	California Department of Water Resources
GAMA	Groundwater Ambient Monitoring and Assessment
gpm	gallons per minute
GWMP	groundwater management plan
HAL	health advisory level
IRWM	integrated regional water management
LLNL	Lawrence Livermore National Laboratory
MCL	maximum contaminant level
msl	mean sea level
MTBE	methyl tertiary butyl ether
NL	notification level
North Lahontan region	North Lahontan Hydrologic Region
PA	Planning Area
RWMG	regional water management group
RWQCB	regional water quality control board
SB	Senate Bill
SB X7-6	California 2009 Comprehensive Water Package
SB X7-7	Water Conservation Bill of 2009
SMCL	secondary maximum contaminant level
SNMP	salt and nutrient management plan
SWN	State Well Number

SWRCB	State Water Resources Control Board
taf	thousand acre-feet
TDS	total dissolved solids
USGS	U.S. Geological Survey
UWMP	urban water management plan

Chapter 10. North Lahontan Hydrologic Region Groundwater Update

Introduction

The primary goal of the North Lahontan Hydrologic Region (North Lahontan region) groundwater update is to expand information about region-specific groundwater conditions for *California Water Plan Update 2013*, and to guide more informed groundwater management actions and policies. A second goal is to steadily improve the quality of groundwater information in future California Water Plan (CWP) updates to a level that will enable regional water management groups (RWMGs) to accurately evaluate their groundwater resources and implement management strategies that can meet local and regional water resource objectives within the context of broader statewide objectives. The final goal is to identify data gaps and groundwater management challenges that will guide prioritizing of future data collection and funding opportunities relevant to the region.

This regional groundwater update is not intended to provide a comprehensive and detailed examination of local groundwater conditions, or be a substitute for local studies and analysis. Nonetheless, where information is readily available, this update does report some aspects of the regional groundwater conditions in greater detail.

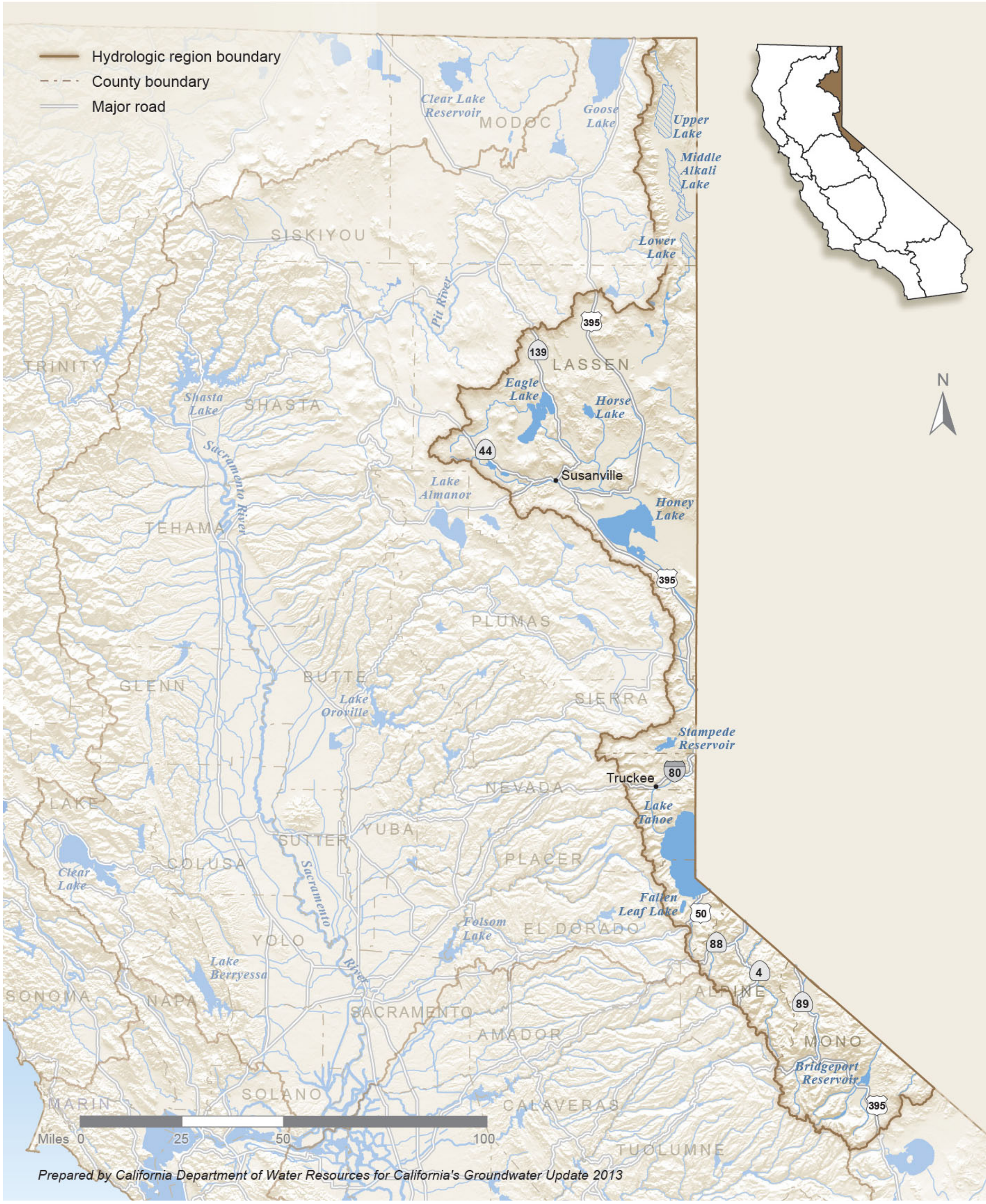
The North Lahontan region shown in Figure 10-1 is a diverse region covering more than 6,100 square miles. It includes all, or portions, of eight predominantly rural Northern California counties — Modoc, Lassen, Sierra, Nevada, Placer, El Dorado, Alpine, and Mono. The region is bordered by Oregon to the north, Nevada to the east, and the eastern slopes of the Warner Mountains and the Sierra Nevada to the west. The southern extent of the North Lahontan region is the area between the Mono Lake and East Walker River watersheds, which is the boundary between the North and South Lahontan hydrologic regions. The North Lahontan region includes the Eagle Lake, Susan River/Honey Lake, Truckee River, Carson River, and Walker River watersheds. Significant geographic features in the region include the Sierra Nevada, Lake Tahoe, and the volcanic terrain of the Modoc Plateau, as well as the topographic depressions of the Madeline Plains, Surprise Valley, and Honey Lake Valley. The topography, geology, hydrology, and land use practices are highly variable, as are the various associated approaches to water resource management.

The climate in the region is arid to high desert. Average annual precipitation can be as low as 4 inches to 5 inches in the northern portion of the region that encompass the valleys of eastern Modoc and Lassen counties. In the southern part of the region, annual precipitation is about 30 inches in the Walker Mountains and more than 60 inches in the upper reaches of the Truckee, Carson, and Walker river basins of the Sierra Nevada. Most of the winter precipitation is snow, which generally accumulates in mountain areas above 5,000 feet. In the valleys, winter precipitation is a mixture of rain and some snow, which usually melts between storms. Snowpack from the eastern slopes of the Sierra Nevada melts in the late spring and summer to become the primary source of surface-water supplies for northern Nevada and for much of California in the region east of the Sierra Nevada. In wet years, surface water can meet much of the region's water demand, but in dry years, most of the North Lahontan region relies heavily on groundwater to meet demand.

Information from the 2010 census indicates that the population of the North Lahontan region is approximately 96,000 residents, with slightly fewer than 75,000 residents living within the boundaries of the region's 27 groundwater basins. Three groundwater basins, Tahoe South, Honey Lake Valley, and Martis Valley contain 86 percent of the region's population. Most of the remaining region is sparsely populated with 10 groundwater basins having no population within their boundaries.

The groundwater update for the North Lahontan region provides an overview and assessment of the region's groundwater supply and development, groundwater use, monitoring efforts, aquifer conditions, and various groundwater management activities. It also identifies challenges and opportunities associated with sustainable groundwater management. The regional update starts with a summary of findings, examines groundwater data gaps, and makes recommendations to further improve the overall sustainability of groundwater resources. This is followed by a comprehensive overview of the relevant groundwater topics.

Figure 10-1 North Lahontan Hydrologic Region



Findings, Data Gaps, and Recommendation

The following information is specific to the North Lahontan region and summarizes the findings, data gaps, and recommendations.

Findings

The bulleted items presented in this section are adopted from more comprehensive information presented in this chapter and generally reflect information that was readily available through August 2012. Much of the groundwater information, including well infrastructure discussions, water supply analysis, and groundwater management plan (GWMP) reviews, are new to this update of the CWP. The groundwater data presented in this chapter will be used as the foundation for the next update of California Department of Water Resources (DWR) Bulletin 118 and the CWP, with the goal of generating information that can be used to make informed decisions to sustainably manage California's groundwater resources. The following information highlights the groundwater findings for the North Lahontan region.

Groundwater Supply and Development

- The North Lahontan region contains 27 DWR Bulletin-118-2003–recognized alluvial groundwater basins and subbasins underlying approximately 1,600 square miles, or 26 percent of the hydrologic region (Figure 10-2 and Table 10-1).
- Based on DWR well-log records, the total number of wells completed in the North Lahontan region between 1977 and 2010 is approximately 4,069 and ranges from a high of 3,858 wells for Lassen County to a low of approximately 211 wells for Alpine County (Figure 10-3 and Table 10-2).
- Based on the California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization completed in December 2013, two groundwater basins or subbasins in the North Lahontan region are identified as medium priority, two basins are listed as low priority, and 23 basins or subbasins are listed as very low priority. The two medium-priority basins include approximately 9 percent of the annual groundwater use and nearly 55 percent of the 2010 population living within the region's groundwater basin boundaries (Figure 10-6 and Table 10-3).

Groundwater Use and Aquifer Conditions

- The 2005-2010 average annual total water supply for the North Lahontan region, based on planning area boundaries, is estimated at 513 thousand acre-feet (taf). Water demands in the region are met through a combination of local surface-water supplies, groundwater, and reused/recycled water supplies (Figure 10-7).
- Groundwater contributes about 32 percent (166 taf) of the 2005-2010 average annual total water supply for the North Lahontan region. Groundwater extraction in the North Lahontan region accounts for about 1 percent of California's 2005-2010 average annual groundwater use, but it accounts for nearly 100 percent of the supply for some local communities in the region (Figure 10-7 and Table 10-4).
- Groundwater supplies, based on average annual estimates for 2005-2010, contributes 27 percent of the supply to meet the total agricultural water uses, 84 percent of the supply to meet total urban uses, and 48 percent of the supply to meet the total managed wetlands use in the North Lahontan region (Table 10-4).

- Between 2002 and 2010, total annual groundwater extraction in the North Lahontan region ranged between 142 taf in 2005 and 180 taf in 2007 and contributed between 32 percent and 34 percent toward the annual water supply (see Figure 10-8).
- Of the groundwater pumped on an annual basis between 2002 and 2010, between 69 percent and 76 percent of the groundwater was used for agricultural purposes (Figure 10-9).

Groundwater Monitoring Efforts

- A total of 221 wells are actively monitored for groundwater-level information in the North Lahontan region (Figure 10-10 and Table 10-7).
- There are an estimated 56 community water systems (CWSs) in the North Lahontan region with an estimated 139 active CWS wells; 25 of the CWS wells (18 percent) are identified as being affected by one or more chemical contaminants that exceed a maximum contaminant level (MCL). The affected wells are used by 10 CWSs in the region, with 7 of the 10 affected CWSs serving small communities. The most prevalent groundwater contaminants affecting community drinking water wells in the region include arsenic and gross alpha particle activity. In addition, five regional wells are affected by multiple contaminants (Tables 10-10, 10-11, and 10-12).
- There are no land subsidence monitoring programs operating in the North Lahontan region.

Groundwater Management and Conjunctive Management

- There are four GWMPs within the North Lahontan region that collectively cover about 50 percent of the Bulletin 118-2003 alluvial basin area within the region and about 21 percent of the overall region.
- DWR's assessment of GWMPs in the North Lahontan region determined that three of the four GWMPs have been developed or updated to include the legislative requirements of Senate Bill (SB) 1938 and are considered "active" for the purposes of the GWMP assessment.
- Only one GWMP in the region addressed all of the required components identified in California Water Code Section10753.7 (Figure 10-12).
- Of the 89 agencies or programs identified as operating a conjunctive management or groundwater recharge program in California, none is located in the North Lahontan region.

Data Gaps

Gaps in groundwater information are separated into three categories: data collection and analysis, basin assessments, and sustainable management. Where possible, the discussion of data gaps is specific to the North Lahontan region, although many of the identified gaps are applicable to several or all hydrologic regions in California. Addressing these data gaps at both the local level and State agency level will help ensure that groundwater resources throughout California are better characterized and sustainably managed.

Data Collection and Analysis

Although the general characterization of the major alluvial aquifer systems in the North Lahontan region is satisfactory, there is a need to further improve the characterization of many of the region's aquifers. More complete hydrogeological data is necessary to better understand basin-wide and region-wide groundwater levels, groundwater quality, groundwater use, and the interaction between surface water and groundwater.

Information related to groundwater extraction, groundwater use, managed and natural recharge, and groundwater basin budgets in the North Lahontan region is extremely limited and has been estimated. Much of the related information has been estimated primarily through water supply balance and land use information derived from DWR's land use surveys. Little or no information is known about the fractured-bedrock aquifers located throughout the North Lahontan region, or how they interact with the region's alluvial aquifer systems.

Some local water agencies in the North Lahontan region are collecting appropriate groundwater data, conducting necessary analysis, and are sustainably managing their basins by using their existing authorities. Locally collected and analyzed data, which could be used by RWMGs and State agencies to better characterize the groundwater basins in the North Lahontan region, are generally not readily available.

Basin Assessments

Region-wide depth-to-groundwater information and annual estimates of change in groundwater in storage are not well understood for many of the groundwater basins in the North Lahontan region.

Groundwater quality in the North Lahontan region ranges from excellent to poor. There is the potential for future groundwater pollution because of the use of septic systems in both hard-rock areas and in alluvial aquifers. Water quality in domestic wells has not been studied extensively in the region.

Although the GWMPs in the North Lahontan region address the topic of land subsidence, there are no known land-subsidence monitoring programs in the region.

There are no groundwater recharge or conjunctive use projects in the North Lahontan region that were identified as part of the statewide conjunctive management survey, but some projects may be in the planning or feasibility stage. The survey conducted as part of *California Water Plan Update 2013* was unable to collect comprehensive information about many statewide programs. As a result, a general understanding of the effectiveness of the State's groundwater recharge and conjunctive management programs could not be determined. In addition, it is unknown whether local agencies have complied with the groundwater recharge mapping requirements of Assembly Bill (AB) 359, which went into effect on January 1, 2013.

Sustainable Management

The four active GWMPs in the North Lahontan region that meet some or all of the SB 1938 groundwater management requirements cover 50 percent of the alluvial groundwater basin area. A key gap to implementing sustainable groundwater management practices at the local level is the limited authority of some agencies to assess management fees, restrict groundwater extraction, and regulate land use in groundwater-short areas.

Recommendations

While much information is known about some of the groundwater basins in the North Lahontan region, comprehensive information that could provide a realistic water budget to determine groundwater sustainability in the region is largely unknown. To better characterize and sustainably manage the region's groundwater resources, the following recommendations are made for the North Lahontan region:

- Increase collection and analysis of groundwater level, quality, use, and extraction data, as well as information regarding the surface-water–groundwater interaction in alluvial aquifers, to a level that allows for development of groundwater budgets, groundwater supply forecasting, and assessment of sustainable groundwater management practices.
- Increase data collection in fractured-bedrock aquifers to determine the degree of interaction that the upland areas and mountain counties have with the region's alluvial aquifers.
- Establish land-subsidence monitoring in areas of high groundwater use to quantify the potential permanent loss of groundwater storage throughout the region that has been caused by excessive local groundwater pumping.
- Continue to monitor groundwater quality throughout the region to better determine sources of natural and anthropogenic contamination, and comply with all groundwater quality protection strategies recommended by the Lahontan Regional Water Quality Control Board.
- Update all existing GWMPs to meet the standards in California Water Code Section10750 et seq. and ensure that GWMPs are prepared for all high- and medium-priority groundwater basins identified by the CASGEM Basin Prioritization process.
- Determine the extent and effectiveness of any new or proposed groundwater recharge or conjunctive management programs in the North Lahontan region by having DWR work with local water managers to complete the conjunctive management survey information and ensure that the groundwater recharge mapping requirements of AB 359 are met.
- Ensure local agency goals, actions, and plans for sustainable groundwater management are compatible with, and roll-up to, a minimum set of goals and actions established by the overlying integrated regional water management (IRWM) plan.
- Provide local and regional agencies the authority to assess fees, limit groundwater extraction, and restrict land use in groundwater-short areas as needed, to better establish a path toward sustainable groundwater management.
- Develop annual groundwater management reports that summarize groundwater management goals, objectives, and performances measures, current and projected trends for groundwater extraction, groundwater levels, groundwater quality, land subsidence, and surface-water–groundwater interaction. Annual reports should evaluate how existing groundwater management practices contribute toward sustainable groundwater management. They should also identify proposed actions for improvements.

Groundwater Supply and Development

This section provides an overview of the key aquifer systems that contribute groundwater to the regional supply, the well infrastructure used to develop these supplies, and an introduction to groundwater basin prioritization for the region.

Groundwater resources in the North Lahontan region are primarily supplied by alluvial and fractured-rock aquifers. Alluvial aquifers are comprised of sand and gravel or finer-grained sediments; with groundwater stored within the voids, or pore space, between the alluvial sediments. Fractured-rock aquifers consist of impermeable granitic, metamorphic, volcanic, or hard sedimentary rocks, with groundwater being stored within cracks, fractures, or other void spaces. The distribution and extent of alluvial and fractured-rock aquifers and water wells vary within the North Lahontan region. A brief description of the alluvial aquifers for the region is in the following paragraphs. Additional information regarding alluvial and fractured-rock aquifers is available online at http://water.ca.gov/groundwater/bulletin118/index.cfm.

Alluvial Aquifers

The North Lahontan region contains 27 DWR Bulletin 118-2003 alluvial groundwater basins and subbasins underlying approximately 1,600 square miles, or 26 percent, of the 6,100 square-mile hydrologic region. The majority of the easily accessible groundwater in the North Lahontan region is stored in alluvial aquifers. A detailed description of aquifers within this hydrologic region is beyond the scope of this report. This section includes a brief summary of the major groundwater basins and aquifers within the North Lahontan region. Additional information regarding groundwater basins in this hydrologic region may be obtained online from DWR Bulletin 118-2003 (http://www.water.ca.gov/groundwater/bulletin118/update_2003.cfm) or DWR Bulletin 118 Groundwater Basin Maps and Descriptions (http://www.water.ca.gov/groundwater/bulletin118/gwbasins.cfm). Figure 10-2 shows the location of the alluvial groundwater basins and subbasins in the region. Table 10-1 lists the name and number associated with the alluvial groundwater basins and subbasins.

Groundwater extracted by wells located outside of the alluvial basins is supplied largely from fractured-rock aquifers. In some cases, groundwater stored within a thin overlying layer of alluvial deposits, or a thick soil horizon, may also contribute to a well's groundwater supply. The most heavily used groundwater basins in the region include Honey Lake Valley and Surprise Valley groundwater basins.

Figure 10-2 Alluvial Groundwater Basins and Subbasins in the North Lahontan Hydrologic Region

Table 10-1 Alluvial Groundwater Basins and Subbasins in the North Lahontan Hydrologic Region

Basin/Subbasin	Basin Name	Basin/Subbasin	Basin Name
6-1	Surprise Valley	6-93	Harvey Valley
6-2	Madeline Plains		Grasshopper Valley
6-3	Willow Creek Valley	6-95	Dry Valley
6-4	Honey Lake Valley	6-96	Eagle Lake Area
6-5	Tahoe Valley	6-97	Horse Lake Valley
6-5.01	Tahoe Valley South	6-98	Tuledad Canyon Valley
6-5.02	Tahoe Valley West	6-99	Painters Flat
6-5.03	Tahoe Valley North	6-100	Secret Valley
6-6	Carson Valley	6-101	Bull Flat
6-7	Antelope Valley	6-104	Long Valley
6-8	Bridgeport Valley	6-105	Slinkard Valley
6-67	Martis (Truckee) Valley	6-106	Little Antelope Valley
6-91	Cow Head Lake Valley	6-107	Sweetwater Flat
6-92	Pine Creek Valley	6-108	Olympic Valley

Honey Lake Valley Groundwater Basin

The largest groundwater basin in the North Lahontan region is the Honey Lake Valley Groundwater Basin (6-4) in Lassen County. The basin is bound on the north and northeast by the basalt of Antelope Mountain, Shaffer Mountain, the Amadee and Skedaddle mountains, and the Modoc Plateau, and on the southwest by the granitic rocks of the Diamond Mountains. The basin covers approximately 311,741 acres. Well-yield data from well-completion reports indicate that groundwater production in the Honey Lake Valley Groundwater Basin varies between 20 gallons per minute (gpm) and 2,500 gpm, with an average yield of 780 gpm.

The primary alluvial groundwater-bearing geologic formations are the Pleistocene lake and near-shore deposits, and the Holocene alluvial-fan deposits. The Pleistocene lake and near-shore deposits consist of clay, silt, sand, and gravel; the composition varies greatly by location. Data indicates there are a number of highly permeable layers in the area northwest of Honey Lake. But east and north of Honey Lake, the deposits are much finer and groundwater production is much less. The near-shore deposits form a continuous band around the edge of the valley. These deposits are more consistently coarse-grained and yield significant amounts of groundwater. The Holocene alluvial-fan deposits consist of poorly sorted material ranging from boulders to clay and may be as thick as 300 feet in some locations. Well yields are high in locations where deposits are coarse-grained and of sufficient thickness.

Surprise Valley Groundwater Basin

The second largest groundwater basin in the North Lahontan region is the Surprise Valley Groundwater Basin (6-1) in Modoc and Lassen counties, covering approximately 228,460 acres. The groundwater basin is located in the northeast corner of California and is shared with Nevada. It is bound on all sides by faults, including the Surprise Valley fault and the Hays Canyon fault. It is considered to be a *closed groundwater basin*, meaning that it has no drainage outlet. Well-yield data from well completion reports indicate that groundwater production in the Surprise Valley Groundwater Basin varies between 350 gpm and 2,500 gpm, with an average yield of 1,400 gpm.

The primary groundwater-bearing formations in the Surprise Valley Groundwater Basin are the Pleistocene near-shore deposits and the Holocene alluvial-fan deposits. The Pleistocene near-shore deposits consist of gravel, sand, and silt deposited around the edge of an ancient lake that once covered the valley. They range in thickness of as much as 5,000 feet. The near-shore deposits have moderate-to-high permeability and can yield significant amounts of groundwater to wells. The Holocene alluvial-fan deposits consist of gravel, sand, silt, and clay. The alluvial fans slope from surrounding mountain sides into the valley, forming not only the primary aquifer, but also transmitting recharge water from the hillsides to the valley groundwater basin. The alluvial-fan deposits are as much as 1,000 feet thick and are capable of yielding large quantities of groundwater to wells.

Martis Valley Groundwater Basin

The Martis Valley Groundwater Basin (6-67) is located in Placer and Nevada counties covering approximately 36,381 acres. The groundwater basin is a fault-bounded basin located east of the Sierra Nevada crest. The elevation of Martis Valley is between 5,000 feet and 6,000 feet above mean sea level (msl). The mountains surrounding the Martis Valley are 1,000 feet above msl to more than 3,000 feet above msl. Average precipitation in the valley is 23 inches in the lower elevations of the eastern portion and nearly 40 inches in the western areas. Well-yield data from well completion reports indicate that groundwater production in the Martis Valley Groundwater Basin can be as much as 1,500 gpm, with an average yield of 150 gpm.

The primary groundwater-bearing formations in the Martis Valley Groundwater Basin are the Miocene to Pliocene basin fill deposits interbedded with sediments of stream and lake deposits. There is also extensive Pleistocene glacial material and recent alluvial material that have embedded impermeable clay and silt layers.

Madeline Plains Groundwater Basin

Another significant groundwater basin in the North Lahontan region is the Madeline Plains Groundwater Basin (6-2) located in Lassen County. The groundwater basin is bounded primarily by mountainous terrain consisting mostly of late Pliocene and early Pleistocene basalt. It covers approximately 156,152 acres. There is limited well-yield data from well-completion reports, but available data indicate that groundwater production in the alluvial portion of the Madeline Plains Groundwater Basin is generally limited to domestic or stock wells.

The primary groundwater-bearing geologic formations in the alluvial Madeline Plains Groundwater Basin are the Holocene and Pleistocene sedimentary and lake-related deposits, which consist of clay, silt, sand, and gravel, varying greatly by location. The deposits can be found as shallow alluvial fan deposits around the margins of the basin, and as near-shore and lake deposits.

Fractured-Rock Aquifers

Fractured-rock aquifers are generally found in the mountainous areas of a hydrologic region, extending from the edges of the alluvial groundwater basins and foothill areas, up into the surrounding mountains. Because of the highly variable nature of void spaces within fractured-rock aquifers, wells drawing from fractured-rock aquifers tend to have less capacity and less reliability than wells drawing from alluvial aquifers. Generally, wells drawing from fractured-rock aquifers yield 10 gpm or less. Although the volume and rate of groundwater supplied by fractured-rock aquifers is small in comparison to groundwater resources supplied by alluvial aquifers in the region, fractured-rock aquifers tend to be a critically important water supply source for many individual domestic wells and small public water systems within the North Lahontan region. The following paragraphs provide a brief description of the two fractured-rock aquifers in the North Lahontan region.

Honey Lake Valley Fractured-Rock

Significant fractured-rock groundwater-bearing formations in the Honey Lake Valley Groundwater Basin are the late Pliocene and early Pleistocene volcanic rocks considered part of the Modoc Plateau. The rocks generally have scoriaceous tops and bottoms with very dense interiors. These rocks can be highly permeable where fractured or jointed and can act as a recharge conduit and yield significant amounts of groundwater, depending on location.

Madeline Plains Fractured-Rock

Another significant source of groundwater in the Madeline Plains Groundwater Basin is the Pliocene-Pleistocene and Pleistocene basalt that comprises approximately 80 percent of the land surface surrounding the basin. It is also found inter-fingered with and below the lake deposits. The rock consists of multiple units of jointed and fractured basalt. Because it is highly permeable and exists extensively in both the surface and subsurface of the area, the basalt acts as the primary aquifer and primary recharge conduit for the basin. The basalt groundwater yields are generally less than 500 gpm, but can be more than 3,000 gpm.

Well Infrastructure

A key aspect to understanding the region's groundwater supply and development is identifying the age, distribution, and type of wells that have been drilled in a region. A valuable source of well information is the well completion reports, or well logs, submitted by licensed well drillers to the landowner, the local county department of environmental health, and DWR. Among other things, well logs commonly identify well location, construction details, borehole geology data, installation date, and type of well use.

Well drillers have been required by law to submit well logs to the State since 1949. California Water Code Section13751 requires drillers that construct, alter, abandon, or destroy a well to submit a well log to DWR within 60 days of the completed work.

Well logs submitted to DWR for wells completed from 1977 through 2010 were used to evaluate the distribution and the uses of groundwater wells in the region. DWR does not have well logs for all the wells drilled in the region, and for some well logs, information regarding well location or use is inaccurate, incomplete, ambiguous, or missing. Consequently, some well logs could not be used in the evaluation. But for a regional scale evaluation of well installation and distribution, the quality of the data is considered adequate and informative. Additional information regarding assumptions and methods of reporting well-log information to DWR is provided in Appendix A.

The number and distribution of wells in the North Lahontan region are grouped according to their location by county, and according to six most common well-use types: domestic, irrigation, public supply, industrial, monitoring, and other. Public supply wells include all wells identified on the well completion report as municipal or public. Wells identified as “other” include a combination of the less-common well types, such as stock wells, test wells, or unidentified wells with no information listed on the well log.

Two counties were included in the analysis of well infrastructure for the North Lahontan region; both counties are partially within one or more adjacent hydrologic regions. Well-log data for counties that fall within multiple hydrologic regions were assigned to the hydrologic region containing a majority of alluvial groundwater basins within the county. As a result, well logs for Alpine and Lassen counties only are recorded in Table 10-2, which lists the number of well logs for the North Lahontan region between 1977 and 2010, by county and by well use.
Figures 10-3 and 10-4 provide an illustration of this data by county and for the region as a whole.

Table 10-2 Number of Well Logs, by Well Use and by County, for the North Lahontan Hydrologic Region (1977-2010)

	Total Number of Well Logs by Well Use						
County	Domestic	Irrigation	Public Supply	Industrial	Monitoring	Other	Total Well Records
Lassen	2,932	315	43	38	319	211	3,858
Alpine	132	4	25	2	47	1	211
Total Well Records	**3,064**	**319**	**68**	**40**	**366**	**212**	**4,069**

The total number of wells installed in the North Lahontan region between 1977 and 2010 is approximately 4,069. Of that number, 3,858 are in Lassen County and 211 are in Alpine County. In most counties, domestic-use wells account for the majority of well logs on file at DWR. In Lassen County and Alpine County, domestic wells account for 76 percent and 63 percent, respectively, of the wells located in the county.

Figure 10-4 displays the percentage of wells by use for the North Lahontan region between 1977 and 2010. Overall, domestic wells in the North Lahontan region account for 75 percent of the total number of wells, while the number of irrigation wells account for about 8 percent. Monitoring wells make up about 9 percent of the wells, public supply wells account for about 2 percent, and less than 1 percent of the region’s wells are categorized as industrial wells.

In addition to analyzing the number of wells by location and use, well logs were analyzed by well installation date (Figure 10-5). Evaluating the number and types of wells drilled during a period of time can help offer a perspective on the average age of the existing infrastructure and the general pattern of wells installed during various water years and economic cycles. Well-log records for the 2007-2010 period are known to be less complete because of constraints associated with processing and incorporating the data.

Figure 10-3 Number of Well Logs by County and Use for the North Lahontan Hydrologic Region (1977-2010)

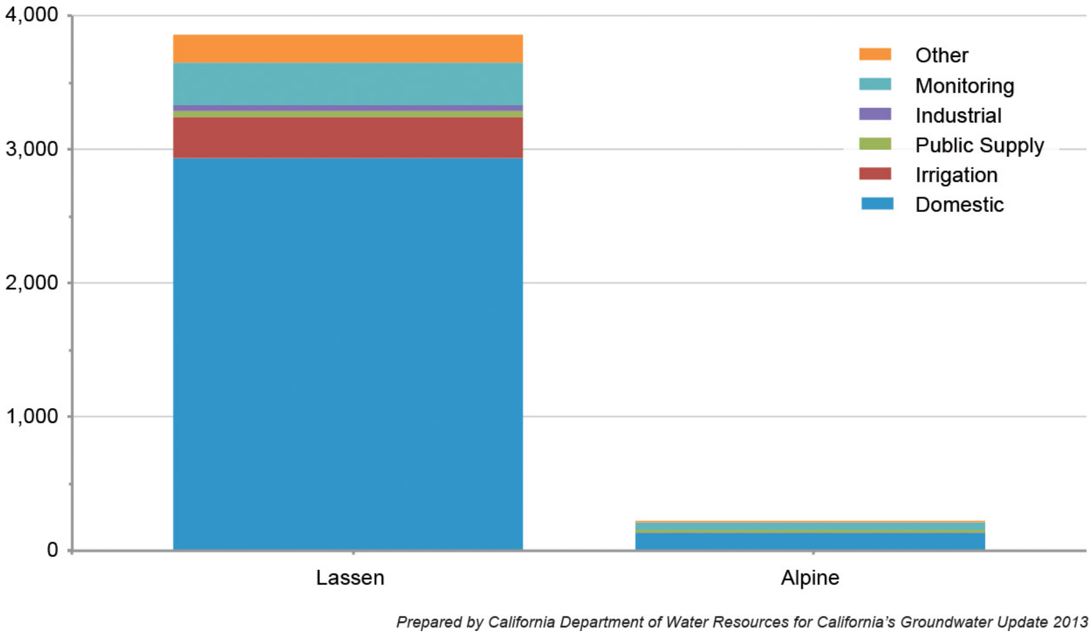
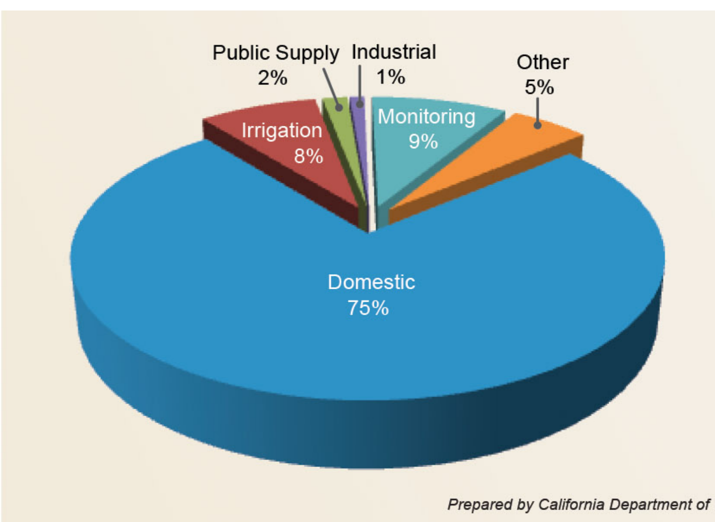


Figure 10-4 Percentage of Well Logs by Type of Use for the North Lahontan Hydrologic Region (1977-2010)



North Lahontan Well Logs Summary by Well Type

Well Type	Number of Well Logs
Domestic	3,064
Irrigation	319
Public Supply	68
Industrial	40
Monitoring	366
Other	212
Total	**4,069**

Figure 10-5 shows a cyclic pattern of well installation for the North Lahontan region, with new well construction ranging from about 45 to 200 wells per year, with an average of about 125 wells per year. Multiple factors are known to affect the annual number and type of wells drilled. Some of these factors include annual variations in weather, economy, agricultural cropping trends, or alternative water supply availability.

Figure 10-5 Number of Well Logs per Year, by Well Use, for the North Lahontan Hydrologic Region (1977-2010)

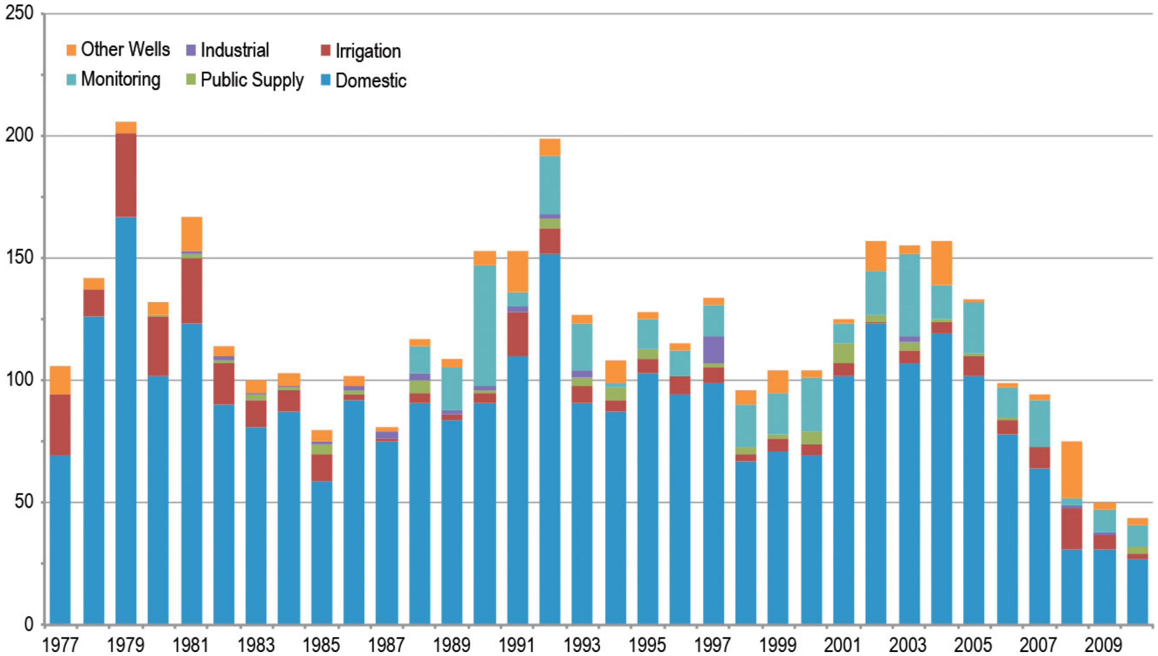


Figure 10-5 shows that the installation of irrigation wells in the North Lahontan region peaked at about 25 wells per year following the 1976-1977 drought. Irrigation well installation dropped to less than three wells per year during the wet years of the mid-1980s, before increasing to about nine wells per year during the 1991-1996 drought, and about eight wells per year during the 2005-2009 drought. Much of the irrigation well infrastructure installed during the late 1970s and early 1980s is still being used today.

While the rate of irrigation well construction can be related to changes in weather conditions, domestic well drilling activity can sometimes be attributed to the health of the economy and fluctuations in residential housing construction. Throughout many regions of California, an increase in domestic well drilling was observed between 2002 and 2006. In the North Lahontan region, the increase in domestic well construction between 2001 and 2005 is likely the result of an increase in housing construction. Similarly, the 2006 to 2010 decline in domestic well drilling is likely the result of declining economic conditions and the related drop in housing construction. A portion of the lower number of well logs recorded for 2010 could also be to the result of delays in receiving and processing of well completion reports.

Monitoring wells in the North Lahontan region were first recorded in significant numbers in 1988, with about 10 wells being installed. Starting in 1984, the California Underground Storage Tank program took effect and led to an increase in the installation of wells to monitor groundwater quality. In the North Lahontan region, an average of 20 monitoring wells were installed annually from 1988 through 1993, with a peak of about 50 wells in 1990. Another period of increased monitoring-well installation occurred from 1995 through 2007, averaging about 15 wells per year, which may have been the result of numerous shallow monitoring wells that were installed to monitor methyl tertiary butyl ether (MTBE) contamination in groundwater. The

DWR well-log database does not distinguish between monitoring wells installed as part of a groundwater cleanup project, and those installed primarily to collect changes in groundwater levels. It is estimated that the majority of monitoring well installations during this time was in response to groundwater-quality monitoring by local groundwater-quality assessment and remediation projects. Since 2007, monitoring well installations in the North Lahontan region have averaged approximately five wells per year.

CASGEM Basin Prioritization

As part of the California 2009 Comprehensive Water Package legislation (SB X7-6), DWR implemented the CASGEM program. The SB X7-6 groundwater monitoring legislation added Part 2.11 to Division 6 of the California Water Code Section10920 et seq., which established provisions and requirements for local agencies to develop and conduct groundwater-level monitoring programs. The legislation requires DWR to identify the current extent of groundwater elevation monitoring within each of the alluvial groundwater basins defined under Bulletin 118-2003 and to prioritize those basins, so as to help identify, evaluate, and determine the need for additional groundwater-level monitoring. The basin prioritization process (California Water Code Section 10933[b]) directs DWR to consider, to the extent data are available, the following eight components:

1. The population overlying the basin.
2. The rate of current and projected growth of the population overlying the basin.
3. The number of public supply wells that draw from the basin.
4. The total number of wells that draw from the basin.
5. The irrigated acreage overlying the basin.
6. The degree to which persons overlying the basin rely on groundwater as their primary source of water.
7. Any documented impacts on the groundwater within the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation.
8. Any other information determined to be relevant by the department.

Using groundwater reliance as the leading indicator of basin priority, DWR evaluated California’s 515 groundwater basins and categorized them into four prioritization groups: high, medium, low, and very low.

Table 10-3 lists the medium-, low-, and very-low-priority CASGEM groundwater basins for the North Lahontan region. The final full listing of the CASGEM groundwater basin prioritization is provided in Appendix B. Figure 10-6 shows the groundwater basin prioritization for the region. Of the 27 groundwater basins and subbasins within the North Lahontan region, two groundwater basins are identified as medium priority (Tahoe South Groundwater Subbasin and Martis Valley Groundwater Basin), two basins are identified as low priority, and 23 groundwater basins are listed as very low priority.

The two medium-priority basins account for about 55 percent of the population that overlies the alluvial basins and about 9 percent of the groundwater use within the region’s 27 basins. Also, the two medium-priority basins account for more than 50 percent of the public supply wells and have no acreage that requires irrigation. Although the primary intent of the basin prioritization effort is to assist DWR in implementing the CASGEM program, based on the comprehensive set of data included in the analysis, the basin prioritization effort is also a valuable statewide tool to help evaluate, focus, and align limited resources toward the implementation of effective groundwater management practices, as well as improving the statewide reliability and sustainability of groundwater resources.

Table 10-3 CASGEM Prioritization for Groundwater Basins in the North Lahontan Hydrologic Region

Basin Prioritization	Count	Basin/Subbasin Number	Basin Name	Subbasin Name	2010 Census Population
High	0	None			
Medium	1	6-5.01	Tahoe Valley	Tahoe South	25,967
Medium	2	6-67	Martis Valley		14,743
Low	1	6-4	Honey Lake Valley		23,566
Low	2	6-1	Surprise Valley		1,127
Very Low	23	See Appendix B			
Total	**27**	**Population of North Lahontan Groundwater Basin Area:**			**74,609**[a]

Notes:

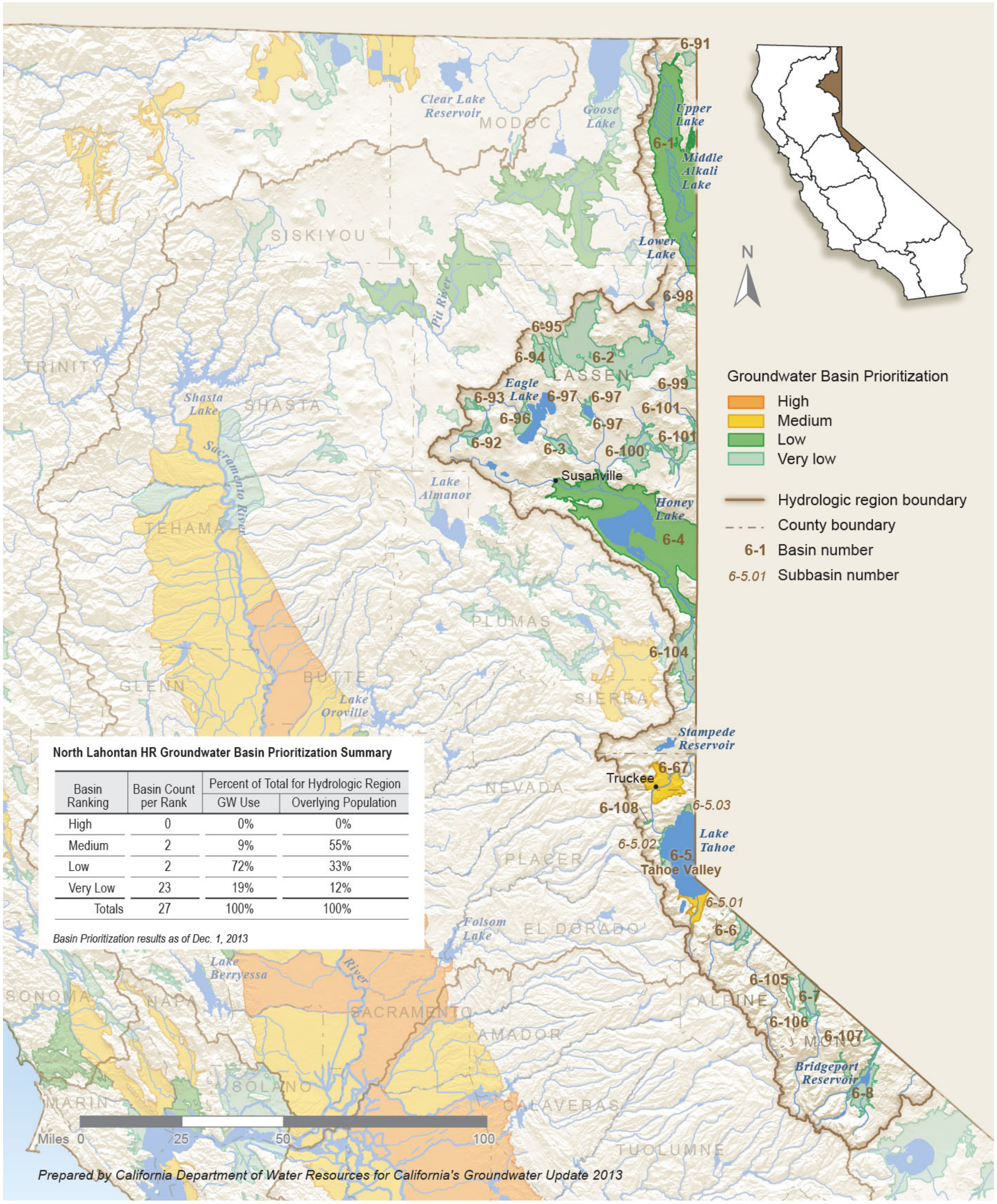
[a]Population of the groundwater basin area includes the population of all basins within the North Lahontan Hydrologic Region.

Ranking as of December 2013.

Senate Bill X7-6 (SB X7-6; Part 2.11 to Division 6 of the California Water Code Section 10920 et seq.) requires, as part of the California Statewide Groundwater Elevation Monitoring Program, the California Department of Water Resources to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater-level monitoring by considering available data that include the population overlying the basin, the rate of current and projected growth of the population overlying the basin, the number of public supply wells that draw from the basin, the total number of wells that draw from the basin, the irrigated acreage overlying the basin, the degree to which persons overlying the basin rely on groundwater as their primary source of water, any documented impacts on the groundwater within the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation, and any other information determined to be relevant by the California Department of Water Resources.

Using groundwater reliance as the leading indicator of basin priority, the California Department of Water Resources evaluated California's 515 alluvial groundwater basins and categorized them into four groups — high, medium, low, and very low.

Figure 10-6 CASGEM Groundwater Basin Prioritization for the North Lahontan Hydrologic Region



North Lahontan HR Groundwater Basin Prioritization Summary

Basin Ranking	Basin Count per Rank	Percent of Total for Hydrologic Region	
		GW Use	Overlying Population
High	0	0%	0%
Medium	2	9%	55%
Low	2	72%	33%
Very Low	23	19%	12%
Totals	27	100%	100%

Basin Prioritization results as of Dec. 1, 2013

Groundwater Use

The amount and timing of groundwater extraction, along with the location and type of groundwater use, are fundamental components for building a groundwater basin budget and identifying effective options for groundwater management. While some types of groundwater uses are reported for some California basins, the majority of groundwater users are not required to monitor, meter, or publically record their annual groundwater extraction amount. Groundwater use estimates for this report are based on water supply and balance information derived from DWR land use surveys, and from groundwater-use information voluntarily provided to DWR by water purveyors or other State agencies.

Groundwater extraction estimates derived from land and water-use methods typically assume that local surface-water supplies are the first to be used to meet local water demands. Once surface-water supplies have been fully allocated, if crop demand and water balance information indicates that additional water supplies are needed, groundwater supplies are then applied until the full water use is met and the overall supply and use for the area is balanced. For agricultural areas employing conjunctive management practices, which may involve frequent exchanges between surface-water and groundwater supplies, making accurate estimates of annual groundwater extraction by using the land and water-use method can be challenging.

DWR water supply and balance data are collected and analyzed by hydrologic regions, which largely correspond to watershed boundaries. The land and water-use data are first compiled and analyzed by detailed analysis units (DAUs). Water supply and balance data for DAUs are then compiled into larger planning areas, and then into hydrologic regions, and finally into a statewide water supply and balance estimate. To assist local resource planning, DWR also generates water supply and balance information by county. Although some local groundwater management groups independently develop groundwater extraction estimates for their local groundwater basins, DWR does not currently generate groundwater-use information by groundwater-basin area.

Water use is reported by water year (October 1 through September 30), and categorized according to urban, agriculture, and managed wetland uses. Reference to *total water supply* for a region represents the sum of surface-water supplies, groundwater supplies, and reused/recycled water supplies. Reused/recycled water supplies include desalinated water supplies. Groundwater-use information is presented by planning area, county, and type of use. Additional information regarding water-use analysis is provided in Appendix A and Appendix C.

2005–2010 Average Annual Groundwater Supply

Water demands in the North Lahontan region are met through a combination of local surface water and local groundwater extraction. The groundwater-use information presented below first discusses total water supply assumptions by using planning area boundaries. In the North Lahontan region there are two planning areas, the Lassen Planning Area (PA) and the Alpine PA. The groundwater use for the region is also presented using county boundaries; in this case, there are two counties represented in the North Lahontan region — Lassen County and Alpine County. Because the two boundary assumptions encompass different land areas, the total water supply estimates and the amount of groundwater used in those areas can vary. Groundwater extraction in the North Lahontan region accounts for about 1 percent of California's 2005-2010 average annual groundwater use; but, it accounts for nearly 100 percent of the supply for some local communities in the region.

Groundwater Use by Planning Area Boundaries

The 2005-2010 average annual total water supply for the region, assuming planning area boundaries, is estimated at 513 taf, with 68 percent (347 taf) of the total supply met by North Lahontan region surface-water sources. Approximately 166 taf (32 percent) of the total water supply for the region is met by groundwater, while 12 taf of reused/recycled water is used throughout the region.

Table 10-4 lists the 2005-2010 average annual total water supply met by groundwater, according to planning area and by type of use, and by the percentage that groundwater contributes to the total water supply for the type of use and the region. Table 10-5 identifies the percentages of the North Lahontan region's 2005-2010 average annual groundwater supply that is used by planning area and by the type of use. Figure 10-7 shows the planning area locations for the region and illustrates the groundwater-use information presented in Table 10-4 and Table 10-5.

The 2005-2010 average annual total water supply for the North Lahontan region is 513 taf, with groundwater contributing about 32 percent (166 taf) of the total supply. Although 32 percent of the region's total water supply is met by groundwater, groundwater supplies meet 84 percent (37 taf) of the region's total urban water use and 27 percent (118 taf) of the region's total agricultural water use. Of the 513 taf of average total water supply in the North Lahontan region, 44 taf are used for urban supplies, while 446 taf are used for agricultural purposes. In the North Lahontan region, water required for managed wetlands account for 23 taf of the region's total water supply. Groundwater resources supply almost 11 taf (48 percent) of the water required for those managed wetland applications.

Table 10-4 Average Annual Groundwater Supply and Percentage of Total Water Supply, According to Planning Area and Type of Use, for the North Lahontan Hydrologic Region (2005-2010)

North Lahontan Hydrologic Region		Agriculture Use Met by Groundwater		Urban Use Met by Groundwater		Managed Wetlands Use Met by Groundwater		Total Water Use[a] Met by Groundwater	
PA Number	**PA Name**	**taf**	**%[b]**	**taf**	**%[b]**	**taf**	**%[b]**	**taf**	**%[b]**
801	Lassen	117.8	39%	18.9	85%	10.7	48%	147.5	43%
802	Alpine	0.6	0%	18.2	83%	0.0	0%	18.8	11%
2005-2010 Annual Average HR Total		**118.4**	**27%**	**37.1**	**84%**	**10.7**	**48%**	**166.2**	**32%**

Notes:

HR = hydrologic region, PA = planning area, taf = thousand acre-feet

[a]Total water use = groundwater + surface water + reuse

[b]Percentage use is the percentage of the total water supply that is met by groundwater, by type of use.

2005-2010 precipitation equals 94 percent of the 30-year average for the North Lahontan Hydrologic Region.

Table 10-5 Percentage of Average Annual Groundwater Supply, According to Planning Area and Type of Use, for the North Lahontan Hydrologic Region (2005-2010)

North Lahontan Hydrologic Region		Agriculture Use of Groundwater	Urban Use of Groundwater	Managed Wetlands Use of Groundwater	Groundwater Use by PA
PA Number	PA Name	%[a]	%[a]	%[a]	%[b]
801	Lassen	80%	13%	7%	89%
802	Alpine	3%	97%	0%	11%
2005-2010 Annual Average HR Total		**71%**	**22%**	**6%**	**100%**

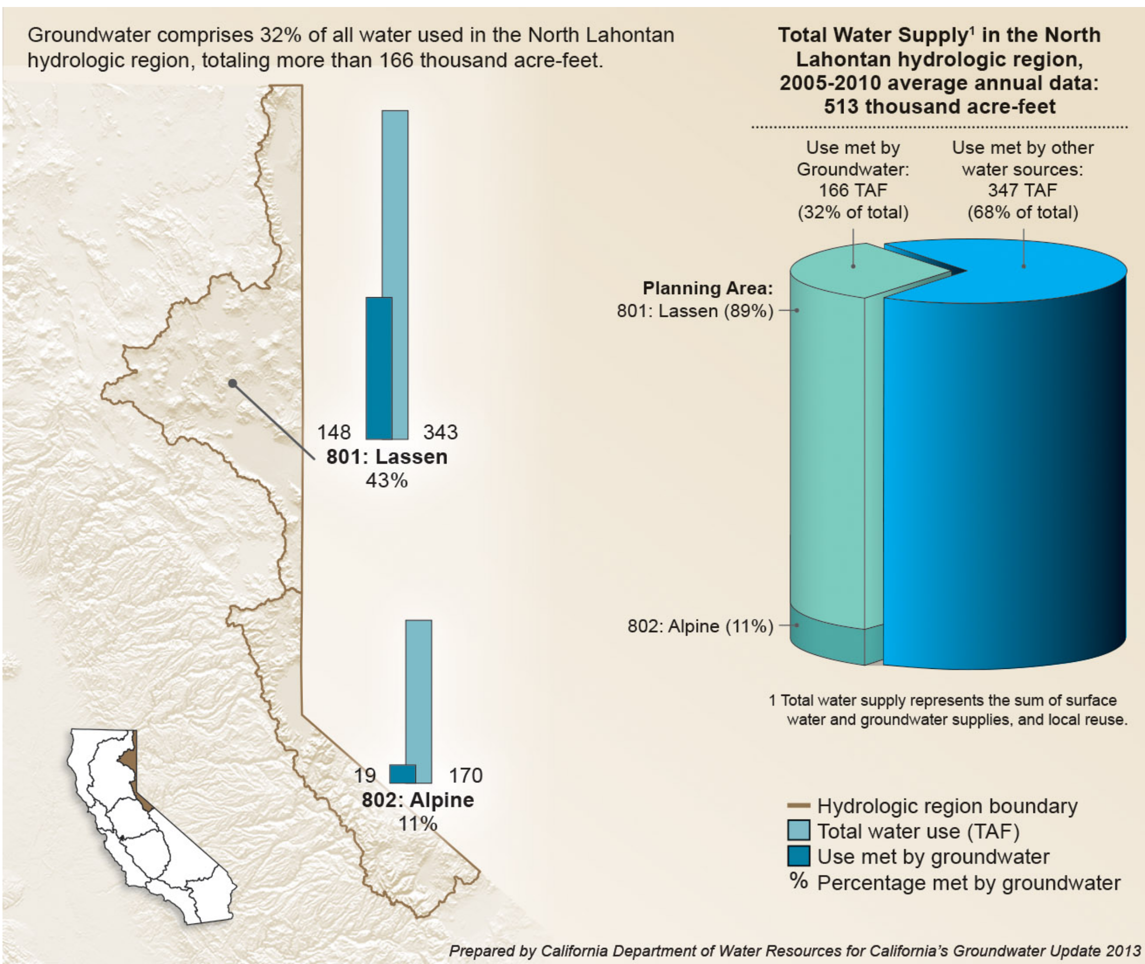
Notes:

HR = hydrologic region, PA = planning area

[a]Percentage use is average annual groundwater use by planning area and type of use, compared with the total groundwater use for the hydrologic region.

[b]Percentage of hydrologic region total groundwater use.

Figure 10-7 Groundwater Use and Total Water Supply Met by Groundwater, by Planning Area, in the North Lahontan Hydrologic Region (2005-2010)



Groundwater Use by County Boundaries

Total water supply and average groundwater use for agricultural, urban, and managed wetland purposes was also calculated using county boundaries. Because county boundaries do not align with planning area or hydrologic region boundaries, regional totals for groundwater, based on county area, will vary from the estimates shown in Table 10-4. Table 10-6 lists the 2005-2010 average annual groundwater use according to county, by type of use, and by the percentage groundwater contributes to the total water supply of the region's counties. Tables showing groundwater use for all 58 California counties are provided in Appendix C.

The 2005-2010 average annual total water supply for Lassen County and Alpine County is approximately 369 taf, which is less than the 513 taf estimate calculated using planning area boundaries. Most of the difference in total water supply estimates comes from agricultural supply. Total water supply for agricultural purposes assuming planning area boundaries is 447 taf, while the same estimate using county boundaries is 320 taf.

Table 10-6 shows that the total groundwater use in the two counties is 129 taf, with almost all of that use attributed to Lassen County. In Lassen County, groundwater contributes 36 percent of the total water supply. Groundwater supplies within the two-county area are used primarily to meet agricultural demand, with 99 taf (77 percent) of the 129 taf total groundwater use going to meet that demand. Overall, groundwater contributes 35 percent of the total water supply for the two-county region.

Table 10-6 Average Annual Total Water Supply Met by Groundwater, According to County and Type of Use, for the North Lahontan Hydrologic Region (2005-2010)

North Lahontan Hydrologic Region	Agriculture Use Met by Groundwater		Urban Use Met by Groundwater		Managed Wetlands Use Met by Groundwater		Total Water Use Met by Groundwater	
County	**taf**	**%[a]**	**taf**	**%[a]**	**taf**	**%[a]**	**taf**	**%[a]**
Alpine	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Lassen	99.2	33%	18.7	80%	10.7	42%	128.6	36%
2005-2010 Annual Average HR Total	99.2	31%	18.7	79%	10.7	42%	128.6	35%

Notes:
HR = hydrologic region, taf = thousand acre-feet
[a]Percentage use is the percentage of the total water supply that is met by groundwater, by type of use.
2005-2010 precipitation equals 94 percent of the 30-year average for the North Lahontan Hydrologic Region.

Change in Annual Groundwater Use

Changes in annual amount and type of groundwater use may be related to a number of factors, such as changes in surface-water availability, urban and agricultural growth, economic fluctuations, and water use efficiency practices.

Figure 10-8 illustrates the 2002-2010 water supply trend for the North Lahontan region. The right side of Figure 10-9 illustrates the total water supply volume by supply type (groundwater, surface water, and reused/recycled water), while the left side shows the percentage of the overall water supply that is met by those sources of water. The center column in both figures identifies the water year along with the corresponding amount of precipitation, as a percentage of the previous 30-year average for the hydrologic region.

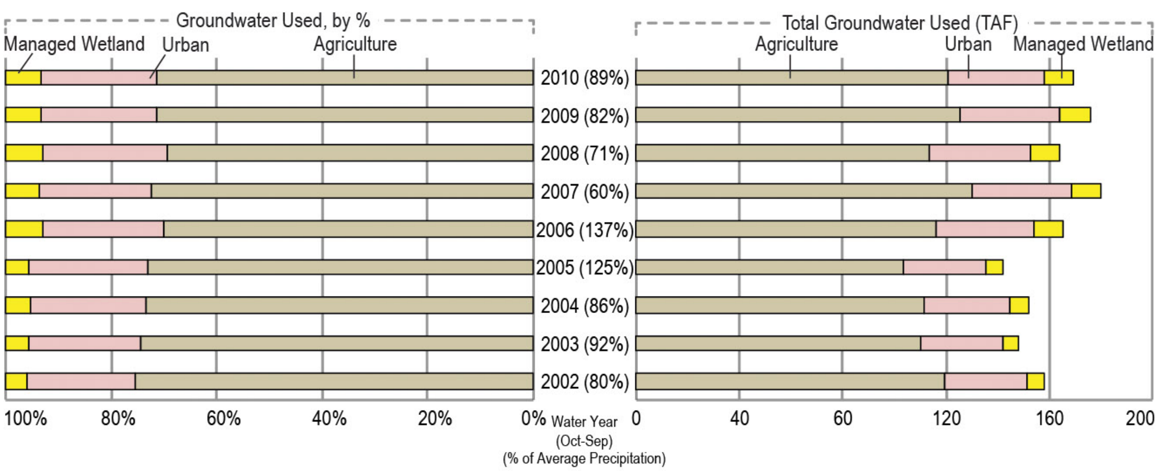
Figure 10-8 shows the annual water supply for the North Lahontan region fluctuated between a low of 439 taf in 2005 and a high of 548 taf in 2007. During each of the water years shown in Figure 10-8, annual groundwater supply met between 32 percent and 34 percent of the region's total supply each year.

Figure 10-9 shows the 2002-2010 groundwater supply trend by urban, agricultural, and managed wetland uses in the North Lahontan region. The right side of Figure 10-9 illustrates the annual volume of groundwater extraction by type of use, while the left side shows the percentage of

Figure 10-8 Annual Surface Water and Groundwater Supply Trend for the North Lahontan Hydrologic Region (2002-2010)

Prepared by California Department of Water Resources for California's Groundwater Update 2013

Figure 10-9 Annual Groundwater Supply Trend by Type of Use for the North Lahontan Hydrologic Region (2002-2010)



Prepared by California Department of Water Resources for California's Groundwater Update 2013 groundwater extraction by type of use. Groundwater use to meet urban demand in the region ranged from 20 percent to 24 percent of the average annual groundwater extraction for the region. Agricultural demand ranged between 69 percent and 76 percent. The remaining groundwater extraction (4 percent to 7 percent) was used to meet managed wetland demands.

Groundwater Monitoring Efforts

Groundwater resource monitoring and evaluation is a key aspect to understanding groundwater conditions, identifying effective resource management strategies, and implementing sustainable resource management practices. California Water Code Section10753.7 requires local agencies seeking State funds administered by DWR to prepare and implement GWMPs that include monitoring of groundwater levels, groundwater quality degradation, inelastic land subsidence, and changes in surface-water flow and quality that directly affect groundwater levels or quality. The protocols associated with groundwater monitoring can vary greatly depending on the local conditions; but overall, monitoring protocols should be designed to generate information that promotes efficient and effective groundwater management.

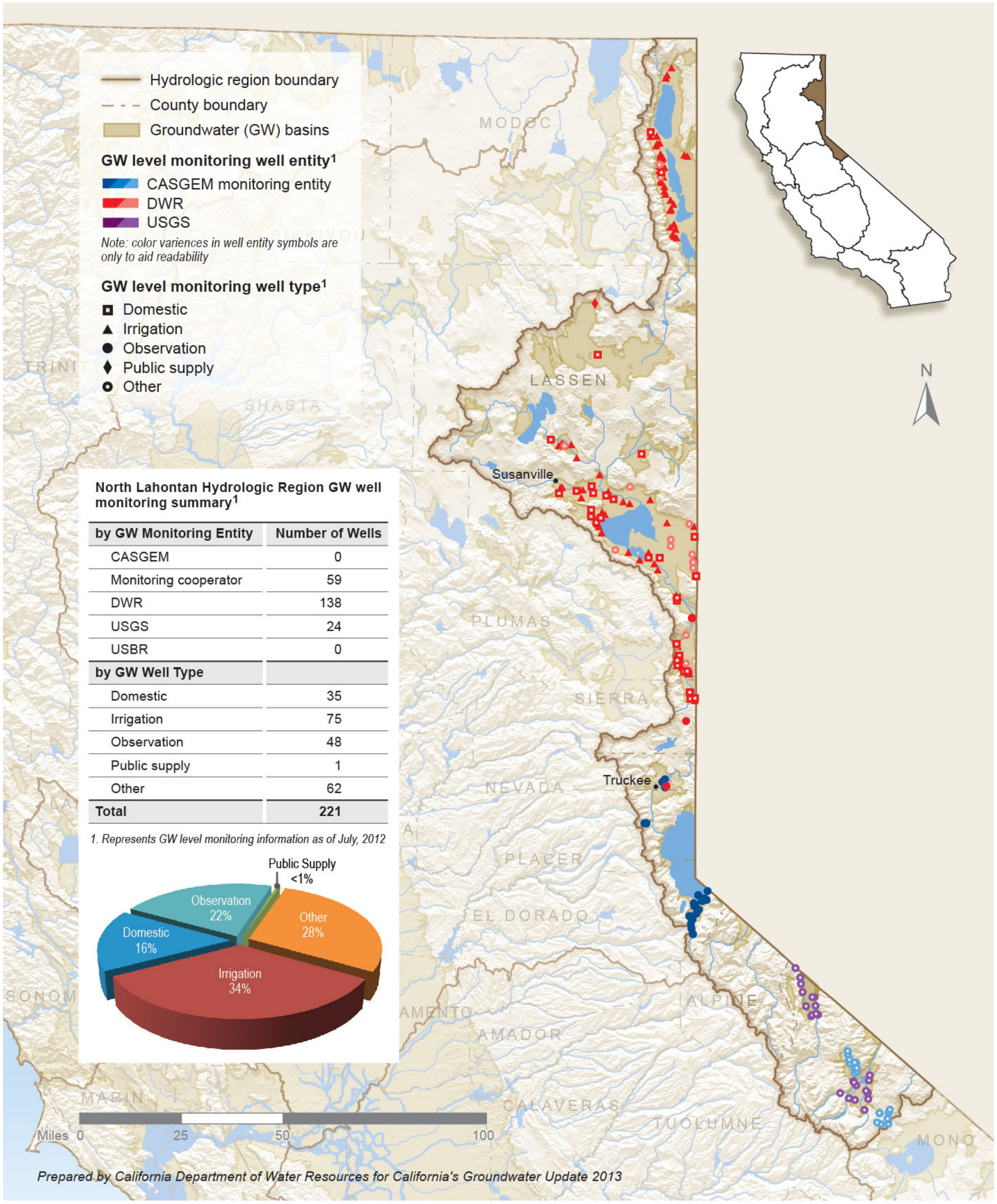
This section summarizes some of the groundwater level, groundwater quality, and land subsidence monitoring activities in the North Lahontan region. The summary includes publically available groundwater data compiled by DWR, State Water Resources Control Board (SWRCB), California Department of Public Health (CDPH), and the U.S. Geological Survey (USGS). Information regarding the groundwater monitoring methods, assumptions, and data availability is provided in Appendix A.

Groundwater-Level Monitoring

State and federal agencies with groundwater-level monitoring programs in the region include DWR and USGS. Groundwater-level monitoring is also performed by CASGEM-designated monitoring entities, as well as local cooperators that measure, or contract others to measure, groundwater levels. Groundwater-level information presented in this section represents data that is publically available through DWR or USGS online information systems. Privately collected and locally maintained groundwater-level information is not discussed in this section. The groundwater-level information in this section only includes active monitoring wells or those wells that have been measured since January 1, 2010, and monitoring groups that have entered data into the CASGEM or USGS online databases as of July 2012. Because monitoring programs are frequently adjusted to meet changing demands and management actions, groundwater-level information presented for the North Lahontan region may not represent the most current information available. Updated groundwater-level information may be obtained online from the DWR CASGEM Program Web site (http://www.water.ca.gov/groundwater/casgem/), and through the USGS National Water Information System (http://waterdata.usgs.gov/nwis).

A list of the number of monitoring wells in the North Lahontan region by monitoring agencies, cooperators, and CASGEM-designated monitoring entities is provided in Table 10-7. The locations of the monitoring wells, by monitoring entity and monitoring well type, are shown in Figure 10-10.

Figure 10-10 Monitoring Well Location by Agency, Monitoring Cooperator, and CASGEM Monitoring Entity for the North Lahontan Hydrologic Region



by GW Monitoring Entity	Number of Wells
CASGEM	0
Monitoring cooperator	59
DWR	138
USGS	24
USBR	0
by GW Well Type	
Domestic	35
Irrigation	75
Observation	48
Public supply	1
Other	62
Total	**221**

Table 10-7 Groundwater-Level Monitoring Wells, by Monitoring Entity, for the North Lahontan Hydrologic Region

State and Federal Agencies	Number of Wells
California Department of Water Resources	138
U.S. Geological Survey	24
U.S. Bureau of Reclamation	0
Total State and Federal Wells	**162**
Monitoring Cooperators	**Number of Wells**
Mono County	19
Placer County Water Agency	3
South Tahoe Public Utility District	30
Squaw Valley Public Service District	7
Total Cooperator Wells	**59**
CASGEM Monitoring Entities	**Number of Wells**
None	0
Total CASGEM Entity Wells	**0**
Total Hydrologic Region Monitoring Wells	**221**

Notes:
CASGEM = California Statewide Groundwater Elevation Monitoring Program
Table represents monitoring information as of July 2012.
Table includes groundwater-level monitoring wells having publically available online data.

Table 10-7 shows that 221 wells in the North Lahontan region are actively monitored for groundwater-level information. DWR's Northern Region and North Central Region offices collect groundwater-level data from 138 monitoring wells in 12 of the region's 27 basins. The USGS monitoring network consists of 24 wells in three basins and subbasins. A total of four cooperators monitor 59 wells in the North Lahontan region. As of July 2012, there were no CASGEM wells being monitored because no local monitoring groups had been designated as monitoring entities by DWR.

Most of the groundwater-level monitoring networks include a variety of well use types. The groundwater-level monitoring wells are categorized by the type of well use and include irrigation, domestic, observation, public supply, and other. Groundwater-level monitoring wells identified as "other" include a combination of the less-common well types, such as stock wells, test wells, industrial wells, or unidentified wells (no information listed on the well log). Wells listed as "observation" also include those wells described by drillers in the well logs as "monitoring" wells. Some of the domestic and irrigation wells used for groundwater-level monitoring include actively operated wells and older inactive or unused wells.

Domestic wells are typically relatively shallow and screened in the upper portion of the aquifer system, while irrigation wells tend to be constructed deeper within the aquifer system. Consequently, groundwater-level data collected from domestic wells typically represent shallow aquifer conditions, while groundwater-level data from irrigation wells represent middle-to-deep aquifer conditions. Some observation wells are constructed as a nested or clustered set of dedicated monitoring wells, designed to characterize groundwater conditions at very specific and discrete production intervals throughout the aquifer system.

Figure 10-10 indicates agencies that collect the groundwater elevation data, and graphically displays groundwater-level monitoring wells by use. A percentage breakdown of the groundwater-level monitoring wells by use, illustrated by the pie chart, indicates that wells identified for irrigation or observation uses make up the majority of the region's monitoring wells, comprising 34 percent and 22 percent of the total, respectively. Wells listed as domestic or other account for 16 percent and 28 percent of the total, respectively, while public supply wells comprise less than 1 percent of the region's total.

Groundwater-Quality Monitoring

Groundwater-quality monitoring is an important aspect to effective groundwater basin management and is one of the required groundwater management planning components under California Water Code Section 10753.7. Groundwater-quality monitoring and assessment evaluates current conditions, can be used to establish groundwater-quality thresholds, and can help guide management decisions. Without sufficient groundwater-quality monitoring, it is almost impossible to determine if groundwater problems exist, or to forecast the potential for future problems that may warrant management actions. Many local, regional, and State agencies have statutory responsibility or authority to collect water quality and water use/level data and information. But monitoring is inconsistent throughout the state, with significant regional variation in parameters monitored, monitoring frequency, and data availability. In spite of these inconsistencies, there are excellent examples of groundwater monitoring programs being implemented at the local, regional, and State levels.

Regional and statewide groundwater-quality monitoring information and data are available to the public on DWR's Water Data Library (http://www.water.ca.gov/waterdatalibrary/), the SWRCB's Groundwater Ambient Monitoring and Assessment (GAMA) Web site (http://www.waterboards.ca.gov/gama/geotracker_gama.shtml), and the GeoTracker GAMA Web site (http://geotracker.waterboards.ca.gov/). The GAMA Program was created in 2000 by the SWRCB to better understand California's groundwater quality issues. The GAMA Program was later expanded, as part of the Groundwater Quality Monitoring Act of 2001, resulting in a publicly accepted plan to monitor and assess groundwater quality in basins that account for more than 95 percent of the state's groundwater use. The GAMA Web site includes a description of the GAMA program and also provides links to published GAMA documents and related reports.

GeoTracker GAMA is an online groundwater information system that provides the public with access to groundwater-quality data. The data is geographically displayed and includes analytical tools and reporting features to assess groundwater-quality conditions. GeoTracker GAMA allows users to search for more than 60 million standardized analytical test results from more than 200,000 wells. It contains more than 125 million data records. These data records were obtained from different sources such as the SWRCB, regional water quality control boards (RWQCBs), CDPH, California Department of Pesticide Regulation, USGS, and Lawrence Livermore National Laboratory (LLNL). In addition to groundwater quality data, GeoTracker GAMA contains more than 2.5 million depth-to-groundwater measurements from DWR and the RWQCBs. GeoTracker

GAMA also contains hydraulically fractured oil and gas well information from the California Division of Oil, Gas, and Geothermal Resources. Groundwater-quality data in DWR's Water Data Library primarily includes baseline minerals, metals, and nutrient data associated with regional monitoring.

Table 10-8 provides agency-specific groundwater-quality information. Additional information regarding assessment and reporting of groundwater-quality information is listed under the "Aquifer Conditions" section of this chapter.

Table 10-8 Sources of Groundwater Quality Information for the North Lahontan Hydrologic Region

Agency	Links to Information
State Water Resources Control Board http://www.waterboards.ca.gov/	**Groundwater** http://www.waterboards.ca.gov/water_issues/programs/#groundwater • Communities that Rely on a Contaminated Groundwater Source for Drinking Water http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/index.shtml • Hydrogeologically Vulnerable Areas http://www.waterboards.ca.gov/gama/docs/hva_map_table.pdf • Aquifer Storage and Recovery http://www.waterboards.ca.gov/water_issues/programs/asr/index.shtml **Groundwater Ambient Monitoring and Assessment (GAMA) Program** http://www.waterboards.ca.gov/gama/index.shtml • GeoTracker GAMA (Monitoring Data) http://www.waterboards.ca.gov/gama/geotracker_gama.shtml • Domestic Well Project http://www.waterboards.ca.gov/gama/domestic_well.shtml • Priority Basin Project http://www.waterboards.ca.gov/water_issues/programs/gama/sw_basin_assesmt.shtml • Special Studies Project http://www.waterboards.ca.gov/water_issues/programs/gama/special_studies.shtml • California Aquifer Susceptibility Project http://www.waterboards.ca.gov/water_issues/programs/gama/cas.shtml **Contaminant Sites** • Land Disposal Program http://www.waterboards.ca.gov/water_issues/programs/land_disposal/ • Department of Defense Program http://www.waterboards.ca.gov/water_issues/programs/dept_of_defense/ • Underground Storage Tank Program http://www.waterboards.ca.gov/ust/index.shtml • Brownfields http://www.waterboards.ca.gov/water_issues/programs/brownfields/
California Department of Public Health http://www.cdph.ca.gov/Pages/DEFAULT.aspx	**Division of Drinking Water and Environmental Management** http://www.cdph.ca.gov/programs/Pages/DDWEM.aspx • Drinking Water Source Assessment and Protection (DWSAP) Program http://www.cdph.ca.gov/certlic/drinkingwater/Pages/DWSAP.aspx • Chemicals and Contaminants in Drinking Water http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chemicalcontaminants.aspx • Chromium-VI http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chromium6.aspx • Groundwater Replenishment with Recycled Water http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/Waterrecycling.aspx

Agency	Links to Information
California Department of Water Resources http://www.water.ca.gov/	Groundwater Information Center http://www.water.ca.gov/groundwater/index.cfm • Bulletin 118 Groundwater Basins http://www.water.ca.gov/groundwater/bulletin118/gwbasins.cfm • California Statewide Groundwater Elevation Monitoring (CASGEM) http://www.water.ca.gov/groundwater/casgem/ • Groundwater Level Monitoring http://www.water.ca.gov/groundwater/data_and_monitoring/gw_level_monitoring.cfm • Well Construction Standards http://www.water.ca.gov/groundwater/wells/standards.cfm • Well Completion Reports http://www.water.ca.gov/groundwater/wells/well_completion_reports.cfm
California Department of Toxic Substance Control http://www.dtsc.ca.gov/	EnviroStor http://www.envirostor.dtsc.ca.gov/public/
California Department of Pesticide Regulation http://www.cdpr.ca.gov/	Groundwater Protection Program http://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm • Well Sampling Database http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp_sampling.htm • Groundwater Protection Area Maps http://www.cdpr.ca.gov/docs/emon/grndwtr/gwpa_maps.htm
U.S. Environmental Protection Agency http://www.epa.gov/safewater/	U.S. Environmental Protection Agency STORET Environmental Data System http://www.epa.gov/storet/
U.S. Geological Survey http://ca.water.usgs.gov/	U.S. Geological Survey Water Data for the Nation http://waterdata.usgs.gov/nwis

Land Subsidence Monitoring

Land subsidence has been shown to occur in areas having a significant decline in groundwater levels. When groundwater is extracted from aquifers in sufficient quantity, the groundwater level is lowered and the water pressure, which supports the skeletal structure of the sediment grains, decreases. A decrease in water pressure causes more weight from the overlying sediments to be supported by the sediment grains in the aquifer. In unconsolidated deposits, the increased weight from overlying sediments may compact the fine-grained sediments and permanently decrease both the porosity of the aquifer and the ability of the aquifer to store water. The partial collapse of the aquifer's skeletal structure results in the subsidence of the land surface overlying the aquifer. *Elastic land subsidence* is the reversible and temporary fluctuation of the earth's surface in response to seasonal periods of groundwater extraction and recharge. *Inelastic land subsidence* is the irreversible and permanent decline in the earth's surface resulting from the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system (U.S. Geological Survey 1999).

There are no land subsidence monitoring programs in the North Lahontan region.

Aquifer Conditions

Aquifer conditions and groundwater levels change in response to varying supply, demand, and weather conditions. During years of normal or above normal precipitation, or during periods of low groundwater use, aquifer systems tend to recharge and respond with rising groundwater levels. As a result, if groundwater levels rise sufficiently, water table aquifers can reconnect to surface-water systems, contributing to the overall base flow or directly discharging onto the ground surface via wetlands, seeps, and springs.

During dry years or periods of increased groundwater use, seasonal groundwater levels tend to fluctuate more widely and, depending on annual recharge conditions, may respond with a long-term decline in groundwater levels, both locally and regionally. Depending on the amount, timing, and duration of groundwater-level decline, affected well owners may need to deepen wells or lower pumps to regain access to groundwater.

Lowering of groundwater levels can also affect the surface-water–groundwater interaction by inducing additional infiltration and recharge from nearby surface-water systems, by reducing the groundwater contribution to the water base flow of surface-water systems, and by reducing groundwater discharge to wetlands areas. Extensive lowering of groundwater levels can also result in land subsidence caused by the dewatering, compaction, and loss of storage within finer-grained aquifer systems.

Groundwater Occurrence and Movement

Groundwater comes from infiltration of precipitation and of water from streams, canals and other surface-water systems, and moves from higher to lower elevations. Under predevelopment conditions, the occurrence and movement of groundwater was largely controlled by the surface and the subsurface geology, the size and distribution of the natural surface-water systems, the average annual hydrology, and the regional topography. But many decades of high-volume groundwater extraction can considerably affect the natural occurrence and movement of groundwater. Areas of high groundwater extraction tend to redirect and capture groundwater underflow that may otherwise have contributed to nearby surface-water systems, leading to varying degrees of surface-water depletion. High-capacity wells screened over multiple aquifer zones also lend themselves to vertical aquifer mixing, which can additionally alter natural groundwater flow conditions. Moreover, infiltration along unlined water conveyance canals, percolation of applied irrigation water, and direct recharge programs create significant groundwater recharge areas where none previously existed.

Depth to Groundwater

Understanding the local depth to groundwater provides a better awareness of these factors:

- Potential interaction between groundwater and surface-water systems.
- Relationship between land use and groundwater levels.
- Potential for land subsidence.
- Groundwater contributions to the local ecosystems.
- Costs associated with well installation and groundwater extraction.

Under predevelopment aquifer conditions, changes in the depth to groundwater will generally correlate with ground surface elevation. For example, with increasing ground surface elevation, there is a corresponding increase in the depth to groundwater. In high-use basins or in conjunctively managed basins, the correlation between depth to water and ground surface elevation will eventually start to break down and show significant variability. This can even occur in areas where there is little change in ground surface elevation.

Depth-to-groundwater data for some of the groundwater basins in the North Lahontan region are available online via the DWR Water Data Library (http://www.water.ca.gov/waterdatalibrary/), the DWR CASGEM system (http://www.water.ca.gov/groundwater/casgem/), and the USGS National Water Information System (http://waterdata.usgs.gov/nwis).

No detailed depth-to-groundwater information was generated for the North Lahontan region as part of *California Water Plan Update 2013*.

Groundwater Elevations

Depth-to-groundwater measurements can be converted to groundwater elevations if the elevation of the ground surface is known. Groundwater elevation contours provide a good regional estimate of the occurrence and movement of groundwater. Similar to topographic contours, the pattern and spacing of groundwater elevation contours can be used to help estimate the direction of groundwater movement and the gradient, or rate, of groundwater flow. DWR monitors the depth to groundwater in some groundwater basins within the North Lahontan region. But groundwater elevation contours were not developed.

Groundwater Level Trends

Depth-to-water measurements collected from a particular well over time can be plotted to create a hydrograph. Hydrographs assist in the presentation and analysis of seasonal and long-term groundwater-level variability and trends over a time. Because the highly variable nature of the aquifer systems within each groundwater basin, and because of the variable nature of annual groundwater extraction, recharge, and surrounding land use practices, the hydrographs selected for discussion do not attempt to illustrate or depict average aquifer conditions over a broader region. Rather, the hydrographs were selected to help tell a story of how the local aquifer systems respond to changing groundwater extractions and implementation of resource management practices.

The hydrographs are identified according to the State Well Number (SWN) system. The SWN identifies a well by its location using the U.S. Public Lands Survey System of township, range, and section. More information on the SWN system is provided in DWR's information brochure *water facts* No. 7 (http://www.water.ca.gov/pubs/conservation/waterfacts/numbering_water_wells_in_california__water_facts_7_/water_facts_7.pdf).

Figure 10-11 shows hydrograph examples for five selected groundwater elevation monitoring wells in the North Lahontan region and provides a brief explanation of the hydrograph story. More detailed information about the hydrograph can be found in the following paragraphs.

Hydrograph 41N16E35D003M

Figure 10-11a is a hydrograph for well 41N16E35D003M located in the Surprise Valley Groundwater Basin (6-1). The well is an irrigation well with an unknown depth that has groundwater-level measurements dating back to the late 1960s. Groundwater levels in this well were monitored each spring and fall, or semi-annually, from 1969 to 2011. The hydrograph shows seasonal fluctuations in groundwater levels of about 5 feet to 10 feet during years of normal precipitation and approximately 10 feet to 20 feet during drought periods (1976-1977, 1988-1991, 2001-2002, and 2007-2009).

A long-term comparison of spring-to-spring groundwater levels shows a decline and recovery from the late 1960s through the 1990s, and shows a gradual recovery from the early 2000s to present. Overall, spring-to-spring groundwater levels in this aquifer during years of normal precipitation show a trend of declining groundwater levels since the early 1970s. There is also an overall trend of an increase in seasonal groundwater-level fluctuations since the mid-1990s, with a great fluctuation during drought years because of an increase in groundwater use. The Surprise Valley Groundwater Basin is designated as a CASGEM low-priority groundwater basin.

Hydrograph 29N12E16M002M

Figure 10-11b is a hydrograph for well 29N12E16M002M located in the Honey Lake Valley Groundwater Basin (6-4). The well is a domestic well that is constructed in the semi-confined portion of the upper aquifer system, for which groundwater-level measurements date back to the mid-1970s. Groundwater levels in this well were monitored monthly during 1973, and semi-annually in the spring and fall, from 1973 to 2011.

The hydrograph shows seasonal fluctuations in groundwater levels of about 5 feet to 10 feet during years of normal precipitation, 3 feet to 5 feet during wet years, and approximately 15 feet to 30 feet during drought periods. A long-term comparison of spring-to-spring groundwater levels in well 29N12E16M002M shows a gradual decline and recovery of groundwater levels associated with the 1976-1977 and the 1988-1994 drought periods. Aquifer response to the recent 2008-2009 drought resulted in all-time lows for groundwater levels in this area, with levels about 25 feet below the 1976-1977 drought levels, and 15 feet below the 1986-1994 drought levels. Recovery from the 2007-2010 drought period began with an above-average water year during 2010-2011. Since the mid-1980s, spring-to-spring groundwater levels in this portion of the aquifer system show a trend of slightly declining groundwater levels during years of normal precipitation. This well also shows an overall trend of an increase in groundwater-level fluctuations since the mid-1970s because of an increase in groundwater use. Honey Lake Valley Groundwater Basin is designated as a CASGEM low-priority groundwater basin.

Hydrograph 17N17E29B001M

Figure 10-11c is a hydrograph for well 17N17E29B001M located in the Martis Valley Groundwater Basin (6-67), which is located southeast of the town of Truckee, between Truckee and Lake Tahoe. The well is an active observation well drilled 100 feet below ground surface (bgs). It generally reflects water table fluctuations in the alluvial aquifer that overlies a fractured-bedrock system in the Sierra Nevada. Groundwater elevations in this well have been monitored semi-annually since 1990, generally in the fall before the snow falls and in the spring when the snow melts.

The hydrograph shows almost no seasonal groundwater elevation fluctuations between 1990 and 2007. After 2007, the groundwater table dropped approximately 8 feet and subsequently fluctuated an additional 10 feet between spring and fall measurements. Other shallow groundwater monitoring wells in the Martis Valley exhibited similar trends, as shown in the April 2013 Martis Valley GWMP. The lowering of the groundwater table in the area after 2007 is likely because of new groundwater use associated with adjacent residential and recreational land development in the Martis Valley. The groundwater table in this area, prior to 2007, was present less than 3 feet below the ground surface. The well is located within 300 feet of Middle Martis Creek, which was indicated in a 2003 surface-water–groundwater interaction study discussed in the 2013 Martis Valley GWMP to be neither a gaining stream nor a losing stream because of the stable water table. Because the groundwater table has been lowered 10 feet or more, Middle Martis Creek is now potentially a losing stream, which would recharge the groundwater aquifer with surface water.

The average annual groundwater extraction from aquifers within Placer County, between 2005 and 2010, was 38.5 taf per year, which accounted for 13 percent of Placer County's average annual total water supply. The Martis Valley Groundwater Basin is designated as a CASGEM medium-priority groundwater basin.

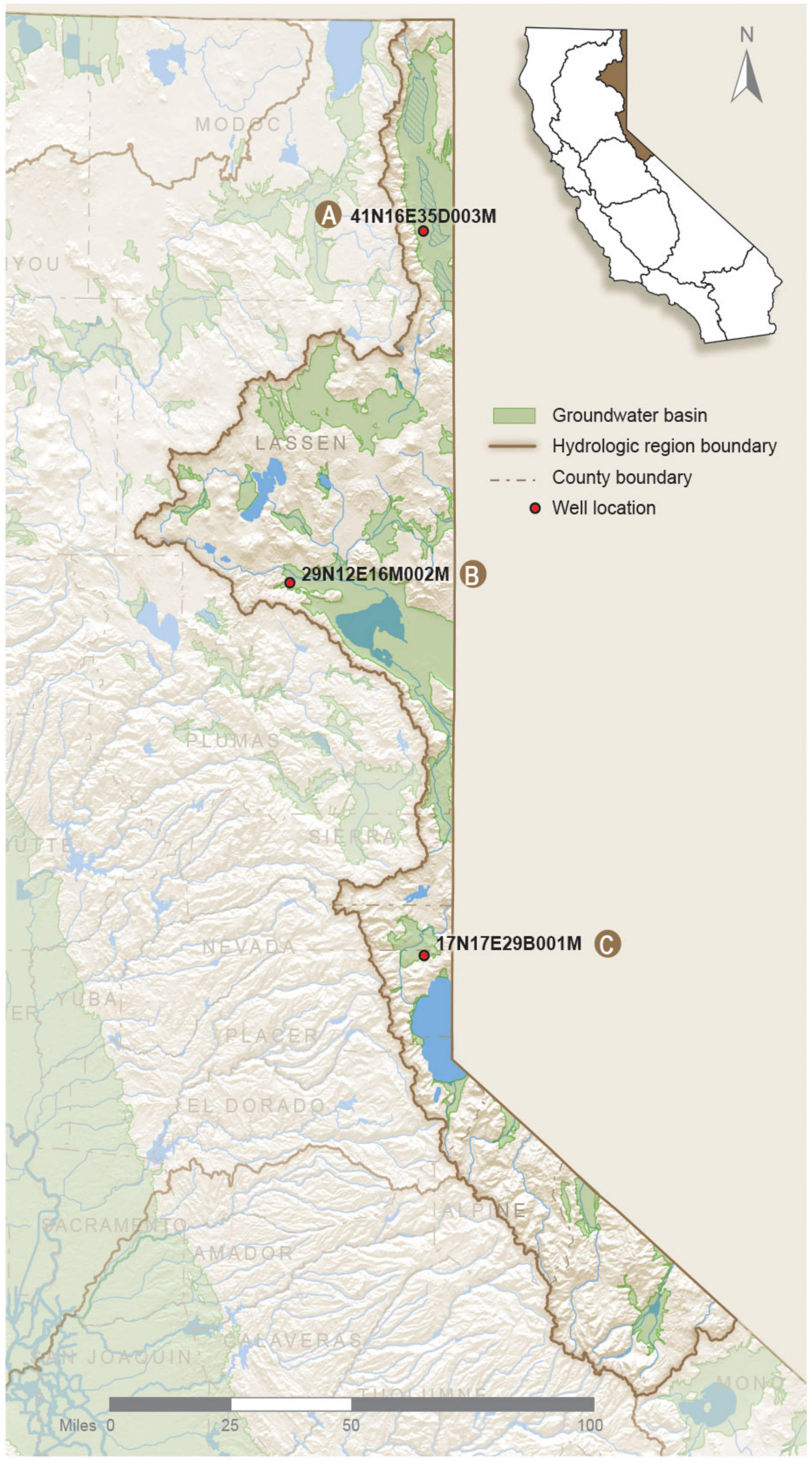
Figure 10-11 Groundwater Hydrographs for the North Lahontan Hydrologic Region, Page 1

Aquifer response to changing demand and management practices

Hydrographs were selected to help tell a story of how local aquifer systems respond to changing groundwater demand and resource management practices. Additional detail is provided within the main text of the report.

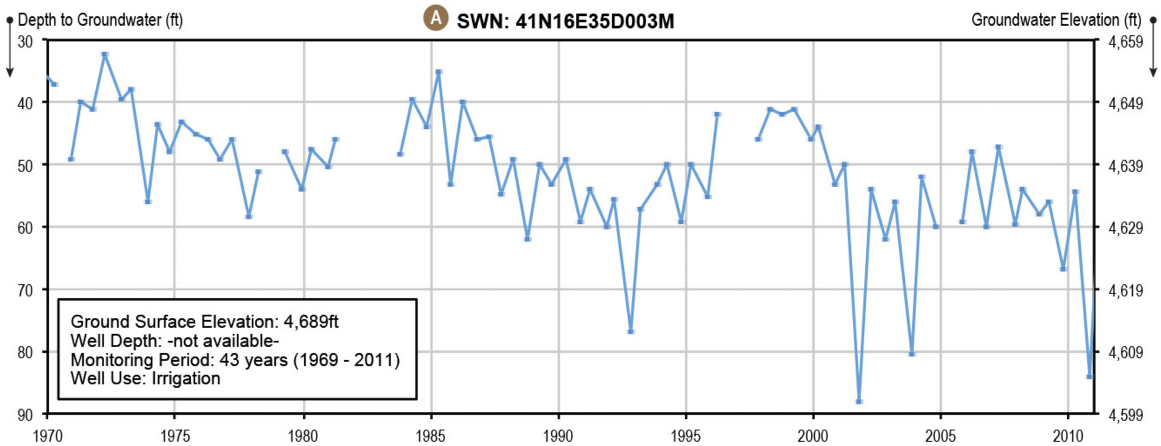
Hydrographs (A) 41N16E35D003M, (B) 29N12E16M002M and (C) 17N17E29B001M: shows the aquifer response to the long-term hydrologic cycles and season variations associated with local precipitation conditions. The large seasonal fluctuations in the recent years indicate intensification of pumping activity.

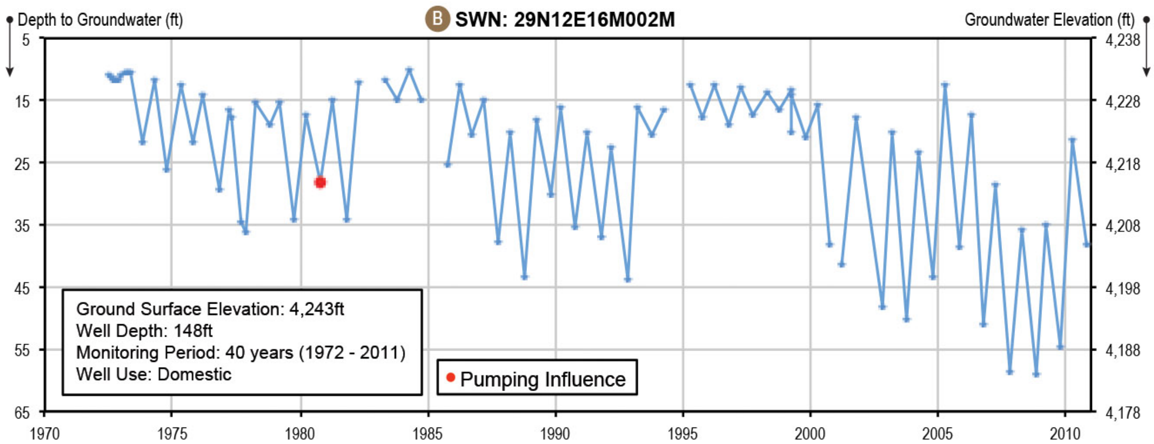
Regional locator map

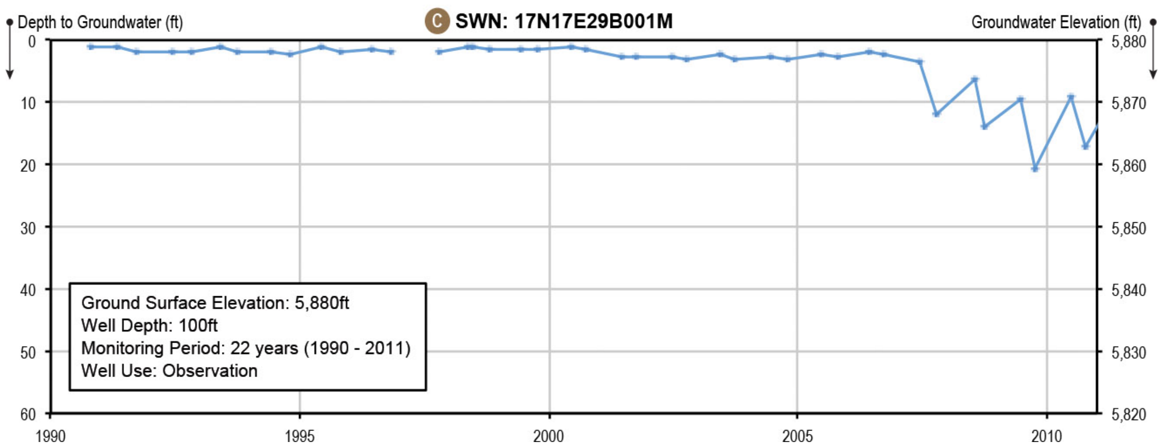


Prepared by California Department of Water Resources for California's Groundwater Update 2013

Figure 10-11 Groundwater Hydrographs for the North Lahontan Hydrologic Region, Page 2







Change in Groundwater in Storage

Change in groundwater in storage is the difference in groundwater volume between two different time periods. Change in groundwater in storage is calculated by multiplying the difference in groundwater elevation between two monitoring periods, by the overlying groundwater basin area, and by the estimated specific yield or volume of pore space from which water may be extracted.

Examining the annual change in groundwater in storage over a series of years helps identify aquifer response to changes in hydrology, land use, and groundwater management. If the volumetric change in storage is negligible over a period represented by average hydrologic and land use conditions, the basin is considered to be in equilibrium. Declining groundwater levels and reduction of groundwater in storage during years of average hydrology and land use does not always indicate basin overdraft or unsustainable management; typically, some additional investigation is required. Use of groundwater in storage during years of diminishing surface-water supply, followed by active recharge of the aquifer when surface water or other alternative supplies become available, is a recognized and acceptable approach to conjunctively managing a groundwater basin. Additional information regarding risks and benefits of conjunctive management in California can be found in *California Water Plan Update 2013,* Volume 3, Chapter 9, "Conjunctive Management and Groundwater Storage."

Changes in groundwater in storage estimates for basins within the North Lahontan region were not developed for the *California Water Plan Update 2013*.

Groundwater Quality

In basins in the northern portion of the North Lahontan region, groundwater quality ranges widely from poor to excellent. Wells that obtain their water supply from lake deposits can have high concentrations of boron, arsenic, fluoride, nitrate, and total dissolved solids (TDS). TDS content generally increases toward the central portions of these basins where concentrations have accumulated over time. The groundwater along the margins of most of these basins tends to be of much better quality. There is a potential for future groundwater pollution occurring in urban/suburban areas where single-family septic systems have been installed, especially in hard-rock areas. Groundwater quality in the alpine basins is good to excellent; but, as in any area where single-family septic systems have been installed, there is potential for degradation of groundwater quality.

Several State and federal GAMA-related groundwater quality reports that help assess and outline the groundwater quality conditions for the North Lahontan region are listed in Table 10-9.

Groundwater Quality at Community Drinking Water Wells

The SWRCB recently completed a report to the legislature titled, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water*. The report focused on chemical contaminants found in active groundwater wells used by CWSs. A CWS is defined under the California Health and Safety Code (Section 116275) as a "public water system that serves at least 15 service connections used by yearlong residents, or regularly serves at least 25 yearlong residents of the area served by the system." A CWS serves the same group of people, year round,

Table 10-9 GAMA Groundwater Quality Reports for the North Lahontan Hydrologic Region

Data Summary Reports

- Cascade Range and Modoc Plateau
  http://pubs.usgs.gov/ds/688/pdf/ds688.pdf
- Tahoe – Martis
  http://www.waterboards.ca.gov/gama/docs/tahoemartis_dsr.pdf
- Sierra Nevada
  http://www.waterboards.ca.gov/gama/docs/dsr_sierra_regional.pdf

Assessment Reports

- Status and Understanding of Groundwater Quality in the Tahoe-Martis, Central Sierra, and Southern Sierra Study Units
  http://pubs.usgs.gov/sir/2011/5216/

Fact Sheets

- Groundwater Quality in the Tahoe and Martis Basins
  http://pubs.usgs.gov/fs/2011/3143/

Domestic Well Project

- Domestic well were sampled in El Dorado County, but no wells were located in the North Lahontan Hydrologic Region.

Other Relevant Reports

- Communities that Rely on a Contaminated Groundwater Source for Drinking Water
  http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/index.shtml

Note:
GAMA = Groundwater Ambient Monitoring and Assessment Program

from the same group of water sources. The findings of this report reflect raw untreated groundwater quality and do not necessarily reflect the final quality of groundwater delivered to these communities.

While most large CWSs are able to construct, operate, and maintain a water treatment system to remove or reduce groundwater contaminants, small CWSs often cannot afford the cost to operate and maintain a treatment system. As a result, some are unable to provide drinking water that meets primary drinking water standards. In the North Lahontan region there are an estimated 56 CWSs and 139 active wells used by CWSs. Twenty-five wells, or 18 percent, are affected by one or more chemical contaminants that exceed an MCL and require treatment (Table 10-10). These affected wells are used by 10 CWSs in the region with 7 of the 10 affected CWSs serving small communities that often need financial assistance to construct a water treatment plant or alternative solution to meet drinking water standards (Table 10-11). The most prevalent groundwater contaminants in the region affecting CWSs wells are arsenic and gross alpha particle activity (Table 10-12). In addition, 5 of the 139 wells in the region are affected by multiple chemical contaminants.

Table 10-10 Community Drinking Water Wells that Exceed a Primary Maximum Contaminant Level Prior to Treatment in the North Lahontan Hydrologic Region

Well Information	Community Water System[a] Wells
Number of Affected Wells[b]	25
Total Wells in the Region	139
Percentage of Affected Wells[b]	18%

Source: State Water Resources Control Board's report to the Legislature, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water* (2013).
Notes:
[a]Community water system means a public water system that serves at least 15 service connections used by year-long residents or regularly serves at least 25 year-long residents of the areas served by the system (Health and Safety Code Section 116275).
[b]Affected wells exceeded a primary maximum contaminant level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.

Table 10-11 Community Drinking Water Systems that Rely on Contaminated Groundwater Wells in the North Lahontan Hydrologic Region

System Information	Community Water Systems[a]		
	Number of Affected Water Systems[b]	Total Water Systems in the Region	Percentage of Affected Water Systems[b]
Small Systems Population ≤ 3,300	7	50	14%
Medium Systems Population 3,301 – 10,000	0	3	0%
Large Systems Population > 10,000	3	3	100%
Total	**10**	**56**	**18%**

Source: State Water Resources Control Board's report to the Legislature, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water* (2013).
Notes:
[a]Community water system means a public water system that serves at least 15 service connections used by year-long residents or regularly serves at least 25 year-long residents of the areas served by the system (Health and Safety Code Section 116275).
[b]Affected water systems are those with one or more wells that exceed a primary maximum contaminant level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.
State small water systems are not included in the totals. These systems serve five to 14 service connections and do not regularly serve water to more than 25 people. In general, state small water systems are regulated by local county environmental health departments.

Table 10-12 Contaminants Affecting Community Drinking Water Systems in the North Lahontan Hydrologic Region

Principal Contaminant	Number of Affected Water Systems[b] (PC exceeds the Primary MCL)	Number of Affected Wells[c,d] (PC exceeds the Primary MCL)
Arsenic	8	19
Gross Alpha Particle Activity	3	7
1,2-Dichloroethane (1,2-DCA)	1	1
Fluoride	1	1
Tetrachloroethylene (PCE)	1	1
Uranium	1	1

Source: State Water Resources Control Board's report to the Legislature, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water* (2013).
Notes:
MCL = maximum contaminant level (State and/or federal), PC = principal contaminant
[a]Community water system means a public water system that serves at least 15 service connections used by year-long residents or regularly serves at least 25 year-long residents of the areas served by the system (Health and Safety Code Section 116275).
[b]Affected water systems are those with one or more wells that exceed a primary maximum contaminant level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.
[c]Affected wells exceeded a primary maximum contaminant level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.
[d]Five wells are affected by two contaminants.

Groundwater Quality — GAMA Priority Basin Project

The GAMA Priority Basin Project was initiated to provide a comprehensive baseline of groundwater quality in the state, and assess deeper groundwater basins that account for more than 95 percent of all groundwater used for the public drinking water supply. The GAMA Priority Basin Project is grouped into 35 groundwater basin groups statewide called "study units," and is being implemented by the SWRCB, the USGS, and the LLNL.

The GAMA Priority Basin Project tests for constituents that are a concern in public supply wells. The list of constituents includes:

- Field parameters.
- Organic constituents.
- Pesticides.
- Constituents of special interest.
- Inorganic constituents.
- Radioactive constituents.
- Microbial constituents.

For the North Lahontan region, the USGS has completed data summary reports for the following study units that may partially or entirely reside within the region:

- Cascade Range and Modoc Plateau.
- Tahoe-Martis.
- Sierra Nevada.

One of the three study units, the Tahoe-Martis Study Unit, resides entirely within the North Lahontan region. The other two study units cover multiple regions. The Cascade Range and

Modoc Plateau Study Unit includes wells in the North Lahontan, Sacramento River, and North Coast hydrologic regions. The Sierra Nevada Study Unit includes wells in the Sacramento River, San Joaquin River, Tulare Lake, and North Lahontan hydrologic regions.

For comparison purposes only, groundwater quality results from these data summary reports were compared against public drinking water standards established by CDPH and/or the U.S. Environmental Protection Agency. These standards included primary MCLs, secondary maximum contaminant levels (SMCLs), notification levels (NLs), and lifetime health advisory levels (HALs). The summary of untreated groundwater quality results for these study units is shown on Table 10-13. In addition to these data summary reports, USGS has completed assessment reports and fact sheets for groundwater basins in the North Lahontan region (Table 10-9).

Groundwater Quality Analysis of Domestic Wells

Private domestic wells are typically used by either single family homeowners or other groundwater-reliant systems which are not regulated by the State. Domestic wells generally tap shallower groundwater, making them more susceptible to contamination. Many domestic well owners are unaware of the quality of the well water because the State does not require well owners to test their water quality. Although private domestic well water quality is not regulated by the State, it is a concern to local health and planning agencies and to State agencies in charge of maintaining water quality.

In an effort to assess domestic well water quality, the SWRCB's GAMA Domestic Well Project samples domestic wells for commonly detected chemicals at no cost to well owners who voluntarily participate in the program. Results are shared with the well owners and used by the GAMA Program to evaluate the quality of groundwater used by private well owners. As of 2011, the GAMA Domestic Well Project had sampled 1,146 wells in six county focus areas (Monterey, San Diego, Tulare, Tehama, El Dorado, and Yuba counties).

The GAMA Domestic Well Project tests for chemicals that are most commonly a concern in domestic well water. These constituents include:

- Bacteria (total and fecal coliform).
- General minerals (sodium, bicarbonate, calcium, others).
- General chemistry parameters (pH, TDS, others).
- Inorganics (lead, arsenic and other metals) and nutrients (nitrate, others).
- Organics (benzene, toluene, PCE, MTBE, and others).

In addition to those constituents, the GAMA Domestic Well Project may analyze for locally known chemicals of concern. Some of these chemicals include radionuclides, perchlorate, pesticides, and chromium VI.

Portions of eight counties make up the North Lahontan region, and the GAMA Domestic Well Project has not sampled private domestic wells in this region. Private domestic wells were sampled in El Dorado County, but they were all located in either the Sacramento or San Joaquin hydrologic region.

Table 10-13 Groundwater Quality Results from GAMA Data Summary Reports for the North Lahontan Hydrologic Region

Constituent	Health Based Threshold	Number of Detections Greater Than Health Based Threshold				
		Cascade Range and Modoc Plateau[a]			Tahoe-Martis	Sierra Nevada Study Unit[b]
		Honey Lake Valley	Quaternary and Tertiary Volcanic Areas	Modoc-Cascade Low Use Basin		
Number of Wells		15	2	1	52	8
Inorganic Constituents						
Arsenic	MCL	2	-	-	9	2
Boron	NL	-	-	-	2	-
Fluoride	MCL	-	-	-	-	-
Molybdenum	HAL	1	-	-	3	-
Nitrate	MCL	1	-	-	-	-
Selenium	MCL	-	-	-	-	-
Strontium	MCL	-	-	-	1	-
Uranium	MCL	2	-	-	2	-
Vanadium	NL	1	-	-	-	-
Organic Constituents						
VOCs	MCL	-	-	-	1	-
Pesticides	MCL	-	-	-	-	-
Constituents of Special Interest						
Perchlorate	MCL	-	-	-	-	-
NDMA	NL	-	-	-	-	-
Radioactive Constituents						
Gross Alpha	MCL	2	0	0	3	4
Secondary Standards						
Chloride	SMCL	-	-	-	1	-
Iron	SMCL	1	-	-	3	-
Manganese	SMCL	4	-	-	5	1
Sulfate[c]	SMCL	-	-	-	1	-
Total Dissolved Solids[c]	SMCL	6	-	-	3	-

Sources:

U.S. Geological Survey report, *Ground-Water Quality Data in the Cascade Range and Modoc Plateau Study Unit, 2010*; U.S. Geological Survey report, *Ground-Water Quality Data for the Tahoe-Martis Study Unit, 2007*; U.S. Geological Survey report, *Ground-Water Quality Data for the Sierra Nevada Study Unit, 2008.*

Notes:

GAMA = Groundwater Ambient Monitoring and Assessment Program, HAL = lifetime health advisory level (U.S. Environmental Protection Agency), MCL = maximum contaminant level (State and/or federal), NL = notification level (State), SMCL = secondary maximum contaminant level (State), TDS = total dissolved solids, VOC = volatile organic compound

[a]The Cascade Range and Modoc Plateau Study Unit includes 90 wells in the North Coast, Sacramento River, and North Lahontan hydrologic regions. Eighteen wells are in the North Lahontan Hydrologic Region (shown on U.S. Geological Survey report Figures 4C and 4F. Well ID numbers LU-04, HL-01 thru 15, QV-06, TV-08).

[b]The Sierra Nevada Study Unit includes 83 wells in the Sacramento River, San Joaquin River, Tulare Lake, and North Lahontan hydrologic regions. Eight wells are in the North Lahontan Hydrologic Region.

[c]Wells that exceed secondary maximum contaminant levels for sulfate and total dissolved solids are greater than recommended levels.

Groundwater Quality Protection

In the North Lahontan region a number of efforts are underway to protect groundwater quality. The Lahontan RWQCB is taking different regulatory approaches to address specific groundwater impacts and is working with local stakeholders to develop comprehensive salt and nitrate management plans using collaborative basin planning efforts to address problems with salinity and nitrates in groundwater. These efforts are discussed in the next section.

The Lahontan RWQCB is taking the following regulatory approaches to address groundwater quality impacts in the North Lahontan region:

- Protect and monitor groundwater quality by issuing individual and general waste discharge requirement orders such as:
    - Federal Subtitle D standards for landfills, including final covers at closed landfills and liners at expanded landfills.
    - California Title 27 standards for waste management units, including double-lined surface impoundments.
    - Time schedules to line certain waste treatment or discharge units at wastewater treatment plants, and reduce effluent nitrogen levels along with groundwater monitoring where wastes are directly discharged to groundwater.
- Require responsible parties to cleanup polluted groundwater at sites including:
    - Department of Defense installations that have large chlorinated solvent and petroleum hydrocarbon releases.
    - Leaking underground petroleum storage tanks, especially in areas not served by public water supplies.
    - Wastewater plants that contributed to groundwater nitrate pollution.
    - Mines where historical releases caused groundwater pollution.
    - Industrial sites such as rail facilities with chlorinated solvent pollution, and bulk oil distribution facilities with petroleum hydrocarbon pollution.
    - Commercial sites such as former dry cleaner operations with chlorinated solvent pollution.
- Collaboration with local agencies and other stakeholders in areas such as:
    - Alternative onsite septic treatment systems.
    - Developing local agency management plans for the SWRCB's Onsite Wastewater Treatment System policy.
    - Evaluation of, and input to, separate federal, State, regional, and county public agency plans with groundwater protection elements.
    - Developing comprehensive salt and nutrient management plans (SNMPs).
- Evaluate required groundwater quality monitoring program data.
- Broaden public participation in all programs.
- Coordinate with local agencies to implement well design and destruction program.
- Reduce site cleanup backlog.

Salt and Nutrient Management Plans

The SWRCB's Recycled Water Policy (Resolution No. 2009-0011) was adopted in 2009 with a goal of managing salt and nutrients from all sources in a basin-wide or watershed-wide basis. This policy requires the development of regional or sub-regional SNMPs for every groundwater basin or subbasin in California. Each plan must include monitoring, source identification, and implementation measures.

Throughout the North Lahontan region, participating in the development of the SNMPs is of paramount importance to improve water quality in the region and provide for a sustainable economic and environmental future. The Lahontan RWQCB is working with partners and stakeholders to develop SNMPs for seven groundwater basins. The Lahontan RWQCB will be collaborating with IRWM groups, and affected stakeholders, to develop SNMPs for Martis Valley (6-67), Carson Valley (6-6), Olympic Valley (6-108), and Honey Lake Valley (6-4) groundwater basins, and the three Tahoe Valley (6-5) groundwater subbasins.

Land Subsidence

Basin management objectives (BMOs) and monitoring protocols that relate to inelastic land subsidence and groundwater management are addressed in California Water Code Section10753.7. In the North Lahontan region, all active GWMPs adequately address the topic of land subsidence, but there are no known land subsidence monitoring programs in the region. Additional information regarding land subsidence in California is provided in Appendix F.

Groundwater Management

In 1992, the California Legislature provided an opportunity for formal groundwater management with the passage of AB 3030, the Groundwater Management Act (California Water Code Section 10750 et seq.). *Groundwater management*, as defined in DWR's Bulletin 118-2003, is “the planned and coordinated monitoring, operation, and administration of a groundwater basin, or portion of a basin, with the goal of long-term groundwater resource sustainability.” Groundwater management needs are generally identified and addressed at the local level in the form of GWMPs. If disputes over how groundwater should be managed cannot be resolved at the local level, additional actions, such as enactment of ordinances by local entities with jurisdiction over groundwater, passage of laws by the Legislature, or decisions made by the courts (basin adjudications) may be necessary to resolve the conflict. Under current practice, DWR’s role in groundwater management is to provide technical and financial assistance to support local agencies in their groundwater management efforts.

In addition to AB 3030, enacted legislation includes SB 1938, AB 359, and provisions of SB X7-6 and AB 1152. These significant pieces of legislation establish specific procedures on how GWMPs are to be developed and adopted by local agencies. They define the required and voluntary technical components that must be part of a GWMP and CASGEM groundwater-elevation monitoring plan. AB 359, introduced in 2011, made changes to the California Water Code that require local agencies to provide a copy of their GWMP to DWR and requires DWR to provide public access to those plans. Prior to the passage of AB 359, which went into effect on January 1, 2013, local groundwater management planning agencies were not required to submit their GWMPs to DWR. As a result, the groundwater management information included in this report is based on documents that were readily available or submitted to DWR as of August 2012 and may not be all-inclusive, especially for those plans that were in the process of being finalized and adopted in 2012.

Groundwater management in California also occurs through other resource planning efforts. Urban water management plans (UWMPs) incorporate long-term resource planning to meet existing and future water demands. Agricultural water management plans (AWMPs) advance irrigation efficiency that benefits both farms and the environment. IRWM planning is a collaborative effort to regionally identify and align all aspects of water resource management and planning. Given California's reliance on groundwater to meet municipal, agricultural, and environmental needs, developing a thorough understanding of the planning, implementation, and effectiveness of existing groundwater management in California is an important first step toward sustainable management of this valuable resource.

DWR's Groundwater Web site (http://water.ca.gov/groundwater/) has the latest information on California's groundwater management planning efforts. It includes a summary of the Sustainable Groundwater Management Act, enacted in September 2014. The Sustainable Groundwater Management Act, a three-bill legislative package, includes the provisions of SB 1168 (Pavley), AB 1739 (Dickinson), and SB 1319 (Pavley). The act mandates the formation of locally controlled groundwater sustainability agencies in high- and medium-priority groundwater basins with the goal of sustainably managing local groundwater resources.

The following sections provide an inventory and review of GWMPs, groundwater basin adjudications, county ordinances, and other groundwater planning activities in the North Lahontan region.

Groundwater Management Plan Inventory

Groundwater management information included in this chapter is based on GWMP documents that were readily available or submitted to DWR as of August 2012. The inventory of GWMPs identifies adopting and signatory agencies, the date of plan adoption, the location of plans by county, and the groundwater basins the plans cover. The inventory also provides the number of GWMPs developed based on AB 3030 (1992) legislation and the number developed or updated to meet the additional groundwater management requirements associated with SB 1938 (2002).

Figure 10-12 shows the location and distribution of the GWMPs within the North Lahontan region and indicates pre- and post-SB 1938 GWMPs. Table 10-14 lists the known North Lahontan region GWMPs (as of August 2012).

Four GWMPs exist within the North Lahontan region, which has a total land area of approximately 6,100 square miles and approximately 1,600 square miles of alluvial groundwater basins, as identified in Bulletin 118-2003. The four GWMPs cover approximately 1,300 square miles of the total land area and about 800 square miles of the alluvial basins, which represents approximately 21 percent of the land area and 50 percent of the alluvial basin area within the North Lahontan region.

The inventory and review of GWMPs in the North Lahontan region determined that three of the four GWMPs have been developed or updated to include the requirements of SB 1938 and are considered "active" for the purposes of GWMP review. One GWMP covers one of the two basins identified as medium priority under the CASGEM Basin Prioritization Project. The two medium-priority basins account for about 55 percent of the population that overlies the groundwater basins and about 9 percent of the groundwater use for the region.

Figure 10-12 Groundwater Management Plans in the North Lahontan Hydrologic Region

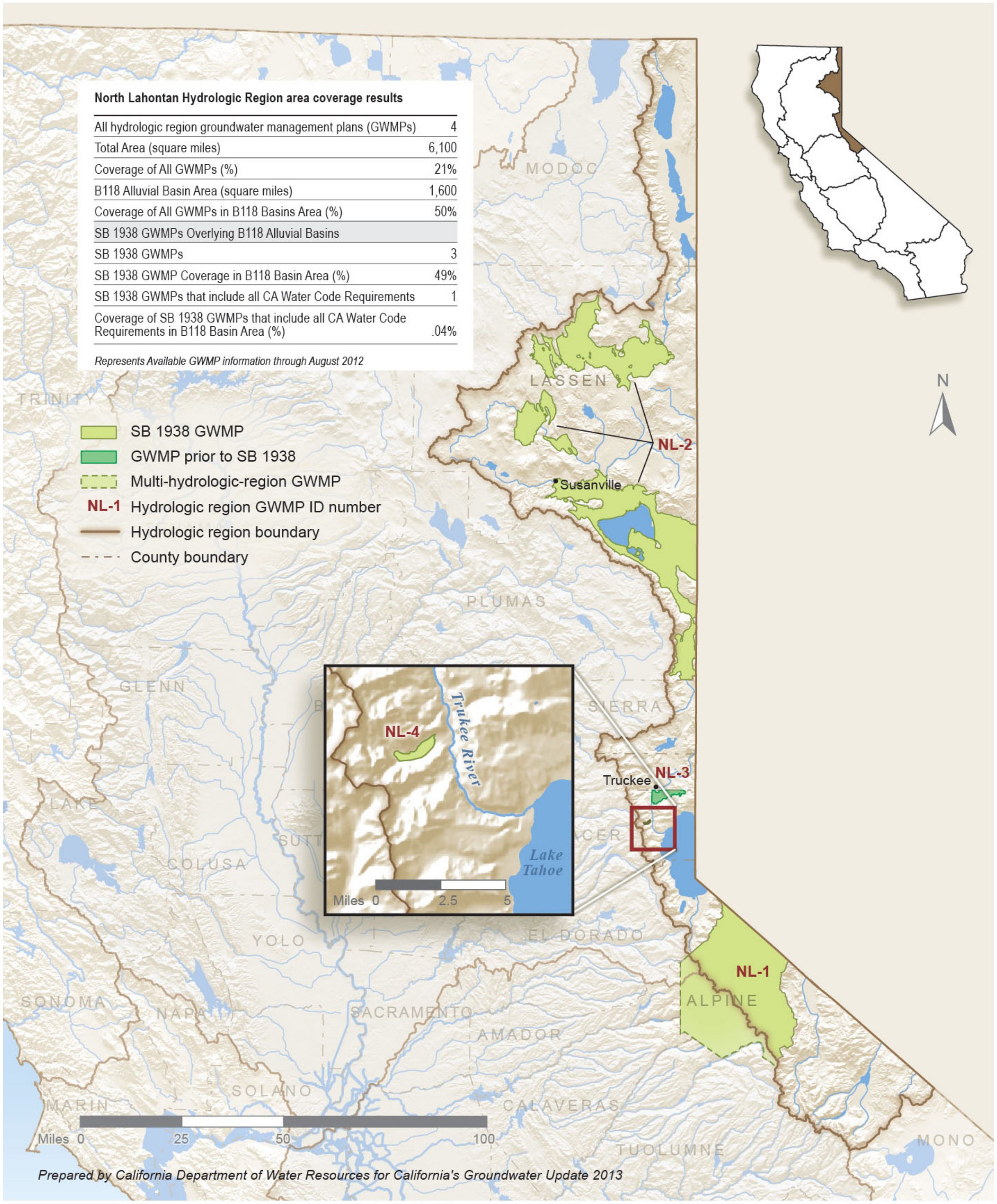


Table 10-14 Groundwater Management Plans in the North Lahontan Hydrologic Region

Map Label	Agency Name	Date	County	Basin Number	Basin Name
NL-1	**Alpine County**	2007	Alpine	6-6	Carson Valley Basin
	No signatories on file				Non-B118 Basin
NL-2	**Lassen County**	2007	Lassen	6-104	Long Valley Basin
	No signatories on file			6-2	Madeline Plains Basin
				6-3	Willow Creek Valley Basin
				6-4	Honey Lake Valley Basin
				6-94	Grasshopper Valley Basin
				6-95	Dry Valley Basin
				6-96	Eagle Lake Area Basin
				5-4	Big Valley Basin
NL-3	**Placer County Water Agency**	1998	Placer	6-67	Martis (Truckee) Valley Basin
	No signatories on file				Non-B118 Basin
NL-4	**Squaw Valley Public Service District**	2007	Placer	-	Non-B118 Basin
	No signatories on file				

Notes:
B118 = California's Groundwater: Bulletin 118-2003
Table reflects the plans that were received by August 2012.

Groundwater Management Plan Assessment

In 2011 and 2012, DWR partnered with the Association of California Water Agencies (ACWA) to survey local water agencies about their groundwater management, conjunctive management, and water banking practices. The survey also intended to build a better understanding of existing groundwater management efforts in California. In addition to the information gleaned from the DWR/ACWA groundwater management survey, DWR independently reviewed the GWMPs to determine the following information:

- How many of the post-SB 1938 GWMPs meet the six required components included in SB 1938 and incorporated into California Water Code Section10753.7.
- How many of the post-SB 1938 GWMPs include the 12 voluntary components included in California Water Code Section10753.8.
- How many of the implementing or signatory GWMP agencies are actively implementing the seven recommended components listed in DWR Bulletin 118-2003.

Groundwater management planning information collected through the DWR/ACWA survey and through DWR's assessment is not intended to be punitive in nature. It is widely understood that the application of effective groundwater management in California is rife with jurisdictional, institutional, technological, and fiscal challenges. DWR is committed to assisting local agencies develop and implement effective, locally planned, and locally controlled groundwater management programs. DWR is also committed to helping promote State and federal partnerships, and to coordinate with local agencies to expand groundwater data collection, management, and planning activities that promote effective local groundwater management. The overall intent of the GWMP assessment and reporting is to help identify groundwater management challenges and successes, and provide recommendations for local and statewide improvement.

Information associated with the GWMP assessment is based on data that were readily available or received through August 2012. Requirements associated with the 2011 AB 359 (Huffman) legislation, related to groundwater recharge mapping and reporting, did not take effect until January 2013 and are not included in the GWMP assessment effort conducted as part of *California Water Plan Update 2013*. The following information will only address the active plans that were determined by DWR to meet some or all of the SB 1938 requirements.

Required GWMP Components

California Water Code Section 10753.7 requires that six components be included in a GWMP for an agency to be eligible for State funding administered by DWR for groundwater projects, including projects that are part of an IRWM program or plan. The required components of a GWMP are:

1. **Basin Management Objectives**: Basin management objectives (BMOs) include components relating to the monitoring and managing of groundwater levels within the groundwater basin, groundwater quality degradation, inelastic land surface subsidence, changes in surface flow and surface-water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin. BMOs also include a description of how recharge areas identified in the plan substantially contribute to the replenishment of the groundwater basin.
2. **Agency Cooperation**: The plan will involve other agencies that enable the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin.
3. **Mapping**: The plan will include a map that details the area of the groundwater basin, as defined in DWR’s Bulletin 118, and the area of the local agency that is subject to the plan, as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan.
4. **Recharge Areas**: Commencing January 1, 2013, the GWMP shall include a map identifying the recharge areas for the groundwater basin, and provide the map to the appropriate local planning agencies and all interested persons, after adoption of the GWMP.
5. **Monitoring Protocols**: The local agency shall adopt monitoring protocols designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence (in basins for which subsidence has been identified as a potential problem), and flow and quality of surface water that directly affect groundwater levels, or quality, or are caused by groundwater pumping in the basin.
6. **GWMPs Located Outside Bulletin 118 Groundwater Basins**: Plans located outside the DWR Bulletin 118 alluvial groundwater basins will incorporate the

above components and shall use geologic and hydrologic principles appropriate to those areas.

Three of the six components include subcomponents that were also evaluated. The requirement to develop a map of recharge areas was not required until January 1, 2013; consequently, the requirement was not evaluated. In addition, the requirement for local agencies located outside a Bulletin 118-2003–recognized groundwater basin was not applicable for any of the GWMPs in the North Lahontan region.

DWR determined that one out of three active GWMPs incorporated all of the required components. Table 10-15 identifies the percentage of active plans that meet the required components and subcomponents of California Water Code Section 10753.7. The two plans that did not meet all of the required components did not address one or more of the required BMO subcomponents, provide complete maps, or lacked one or more of the required monitoring protocols. A detailed description of the individual component assessment is provided in the following paragraphs.

Basin Management Objectives

The BMO assessment consisted of each of the four required BMO subcomponents evaluated as part of the GWMP review. The subcomponents include the monitoring and management of (1) groundwater levels, (2) groundwater quality, (3) inelastic land subsidence, and (4) surface-water–groundwater interaction.

The initial assessment results for the North Lahontan region indicated that one of three GWMPs met the overall BMO requirement by providing the necessary measurable objectives, along with the actions which will occur when preset conditions or triggers are met, for each of the BMO subcomponents. Two of the active GWMPS did not meet the overall BMO component but did have the necessary plans for one or more of the required BMO subcomponents; as a result, the GWMP was indicated to be in partial compliance.

The only BMO subcomponent that was missing, or not adequately addressed within the active GWMPs, was the planning requirements for the monitoring and management of surface-water–groundwater interaction. This requirement was not properly addressed in two of the three plans assessed.

Agency Cooperation

The three active GWMPs in the North Lahontan region provided sufficient details on how the agency was going to coordinate and share groundwater management activities with neighboring agencies and local governments.

Mapping

The mapping requirement of SB 1938 has three subcomponents. The GWMPs are required to provide: (1) one or more maps which depict the GWMP area, (2) the associated Bulletin 118-2003 groundwater basin(s), and (3) all neighboring agencies located within the basin(s). The GWMP review determined that two of the three active GWMPs met all of the required mapping components, while one GWMP did not provide one or more of the required components.

Table 10-15 Assessment for GWMP Requirement Components in the North Lahontan Hydrologic Region

Senate Bill 1938 Required Components	Percentage of Plans that Meet Requirement
Basin Management Objectives	33%
BMO: Monitoring/Management Groundwater Levels	100%
BMO: Monitoring Groundwater Quality	100%
BMO: Inelastic Subsidence	100%
BMO: SW/GW Interaction and Affects to Groundwater Levels and Quality	33%
Agency Cooperation	100%
Map	67%
Map: Groundwater Basin Area	67%
Map: Area of Local Agency	67%
Map: Boundaries of other Local Agencies	67%
Recharge Areas (January 1, 2013)	Not Assessed
Monitoring Protocols	33%
MP: Changes in Groundwater Levels	100%
MP: Changes in Groundwater Quality	100%
MP: Subsidence	100%
MP: SW/GW Interaction and Affects to Groundwater Levels and Quality	33%
Met all Required Components and Subcomponents	**33%**

Notes:
GW = groundwater, GWMP = groundwater management plan, SW = surface water
Table reflects assessment results of Senate Bill 1938 plans that were received by August 2012.

Monitoring Protocols

The monitoring protocol component consists of four subcomponents. In accordance with SB 1938, GWMPs are required to establish monitoring protocols for assessing groundwater levels, groundwater quality, inelastic land subsidence, and surface-water–groundwater interaction.

The assessment for the monitoring protocols component was similar to the review of the BMO component. An overall assessment determined that one of the three active GWMPs met each of the required monitoring protocol subcomponents. The other two active GWMPs were missing details for one or more of the subcomponents. All of the active plans met the monitoring protocol requirements for measuring groundwater levels, groundwater quality, and inelastic subsidence. The only monitoring protocol subcomponent that was missing, or not adequately addressed within the active GWMPs, was the requirement for the monitoring and management of surface-water–groundwater interaction. This requirement was not properly addressed in two of the three plans assessed.

Voluntary GWMP Components

In addition to the six required components, California Water Code Section10753.8 provides a list of 12 components that may be included in a GWMP. The voluntary components include the following:

1. The control of saline water intrusion.
2. Identification and management of wellhead protection areas and recharge areas.
3. Regulation of the migration of contaminated groundwater.
4. The administration of a well abandonment and well destruction program.
5. Mitigation of conditions of overdraft.
6. Replenishment of groundwater extracted by water producers.
7. Monitoring of groundwater levels and storage.
8. Facilitating conjunctive use operations.
9. Identification of well construction policies.
10. The construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.
11. The development of relationships with State and federal regulatory agencies.
12. The review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.

The percentage of GWMPs in the North Lahontan region that included the voluntary components is shown in Table 10-16. The assessment of some voluntary components was expanded to include subcomponents, which aided in determining a level of inclusion, but reporting was not done on a subcomponent level. In many cases during this analysis, if the plan included one of more of the subcomponents, the plan was considered to fully meet the voluntary component.

The voluntary components that were fully addressed by each of the three active GWMPs in the North Lahontan Region include groundwater contamination, well abandonment and destruction, groundwater monitoring, well construction, and regulatory agency involvement. The least-addressed of the voluntary components were topics related to groundwater extraction and replenishment, conjunctive use, and land use. It is not clear from the plan reviews if the low percentage was the result of timing (occurred after plan adoption), the agencies feeling they were not needed, or both.

In summary, one of the three GWMPs in the North Lahontan region incorporated all 12 voluntary components, one plan incorporated nine voluntary components, and one plan incorporated seven voluntary components.

Table 10-16 Assessment of GWMP Voluntary Components in the North Lahontan Hydrologic Region

Voluntary Components	Percentage of Plans that Include Component
Saline Intrusion	67%
Wellhead Protection and Recharge	67%
Groundwater Contamination	100%
Well Abandonment and Destruction	100%
Overdraft	67%
Groundwater Extraction and Replenishment	33%
Monitoring Groundwater Levels and Storage	100%
Conjunctive Use Operations	33%
Well Construction Policies	100%
Construction and Operation	67%
Regulatory Agencies	100%
Land Use	33%

Notes:
GWMP = groundwater management plan
Table reflects assessment results of Senate Bill 1938 plans that were received by August 2012.

GWMP Components Recommended by Bulletin 118-2003

Bulletin 118-2003, Appendix C provides a list of seven recommended components related to management development, implementation, and evaluation of a GWMP that should be considered to help ensure effective and sustainable groundwater management. The Bulletin 118-2003 recommended components include:

1. **Guidance:** Establish an advisory committee to assist in GWMP development and implementation.
2. **Management Area:** Describe the physical setting, aquifer characteristics, and background data.
3. **BMOs, Goals, and Actions:** Describe how the current or planned actions help to meet the overall management objectives and goals.
4. **Monitoring Plan Description:** Describe groundwater monitoring type, location, frequency, and aquifer interval.
5. **IRWM Planning:** Describe efforts to coordinate with other land use or water management planning.
6. **Implementation:** Develop status reports with management actions, monitoring activities, basin conditions, and achievements.
7. **Evaluation:** Periodic Assessment of conditions versus management objectives.

Table 10-17 identifies the percentage of the three active GWMPs in the North Lahontan region that included each of the seven recommended components outlined in Bulletin 118-2003. The assessment determined that two of the three active GWMPs in the region incorporated all seven

Table 10-17 Assessment of DWR Bulletin 118-2003 Recommended Components in the North Lahontan Hydrologic Region

Recommended Components	Percentage of Plans that Include Component
GWMP Evaluation	100%
GWMP Implementation	100%
Management Area	100%
BMOs, Goals, and Actions	67%
GWMP Guidance	67%
IRWM Planning	100%
Monitoring Plan Description	100%

Notes:
BMO = basin management objective, GWMP = groundwater management plan, IRWM = integrated regional water management
Table reflects assessment results of Senate Bill 1938 plans that were received by August 2012.

components recommended in Bulletin 118-2003, and the third GWMP incorporated five of the seven recommended components, lacking details for BMOs and guidance.

DWR/ACWA Survey — Key Factors for Successful GWMP Implementation

The survey respondents were asked to provide feedback on which components helped make their GWMP implementation successful. The participants were asked to provide additional insights and list additional components, but not to rank their responses in terms of importance. One agency from the North Lahontan region participated in the survey and identified broad stakeholder participation, collection and sharing of data, adequate surface-water supplies, adequate regional and local surface storage and conveyance systems, and adequate funding as key factors for a successful GWMP implementation. Table 10-18 is a summary of the individual response.

DWR/ACWA Survey — Key Factors Limiting GWMP Success

Survey participants were also asked to identify key factors they felt impeded implementation of their local GWMP. Table 10-19 summarizes the results from the two agencies that responded to the survey in the North Lahontan region. Both respondents indicated that limited participation across a broad distribution of interests, and collecting and sharing of information and data, were impediments to GWMP implementation. One of the respondents also indicated that limited funding for planning and programs, limited access to planning tools, limited outreach and education, and unregulated groundwater pumping have been challenging factors.

DWR/ACWA Survey — Opinions of Groundwater Sustainability

Finally, the survey asked if the respondents were confident in the long-term sustainability of their current groundwater supply. Two participants responded to this question and both felt long-term sustainability of their groundwater supply was possible. There were no opposing views regarding long-term sustainability of groundwater sources in the North Lahontan region.

Table 10-18 Survey Results for Key Components Contributing to Successful GWMP Implementation, North Lahontan Hydrologic Region

Key Components that Contributed to Success	Respondents
Sharing of Ideas and Information with other Water Resource Managers	1
Data Collection and Sharing	1
Adequate Surface-Water Supplies	1
Adequate Regional and Local Surface Storage and Conveyance Systems	1
Outreach and Education	-
Developing an Understanding of Common Interest	-
Broad Stakeholder Participation	1
Water Budget	-
Funding	1
Time	-

Notes:
GWMP = groundwater management plan
Results from an online survey sponsored by the California Department of Water Resources and conducted by the Association of California Water Agencies — 2011 and 2012.

Table 10-19 Survey Results for Factors that Limited the Successful GWMP Implementation in the North Lahontan Hydrologic Region

Limiting Factors	Respondents
Participation Across a Broad Distribution of Interests	2
Data Collection and Sharing	2
Funding for Groundwater Management Planning	1
Funding for Groundwater Management Projects	1
Funding to Assist in Stakeholder Participation	-
Understanding of the Local Issues	-
Outreach and Education	1
Groundwater Supply	-
Surface Storage and Conveyance Capacity	-
Access to Planning Tools	1
Unregulated Pumping	1
Lack of Governance	-

Notes:
GWMP = groundwater management plan
Results from an online survey sponsored by the California Department of Water Resources and conducted by the Association of California Water Agencies — 2011 and 2012.

Groundwater Ordinances

Groundwater ordinances are laws adopted by local authorities, such as cities or counties, to manage groundwater. In 1995, the California Supreme Court declined to review a lower court decision (*Baldwin v. Tehama County*) that says state law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage and regulate groundwater. Since 1995, the decision has remained untested. As a result, the precise nature and extent of the authority of cities and counties to regulate groundwater is still uncertain.

The most common groundwater ordinances in the region are associated with policies governing well abandonment and destruction, and well construction. Five of the counties in the region have groundwater ordinances requiring a permit for transferring groundwater out of a basin. Some of the least common groundwater ordinances in the North Lahontan region are related to basin management objectives and establishing guidance committees. None of the ordinances in the North Lahontan region address groundwater recharge. Table 10-20 lists the ordinances adopted in the North Lahontan region.

Table 10-20 Groundwater Ordinances for the North Lahontan Hydrologic Region

County	Groundwater Management	Guidance Committees	Export Permits	Recharge	Well Abandonment and Destruction	Well Construction Policies
Alpine	-	-	Yes	-	Yes	Yes
El Dorado	-	-	-	-	Yes	Yes
Lassen	Yes[a]	Yes	Yes	-	Yes	-
Modoc	-	-	Yes	-	-	Yes
Mono	-	-	Yes	-	Yes	Yes
Nevada	-	-	-	-	Yes	Yes
Placer	-	-	-	-	Yes	Yes
Sierra	-	-	Yes	-	-	-

Notes:
[a]Establishes basin management objectives.
Table represents information as of August 2012.

Special Act Districts

Greater authority to manage groundwater has been granted to a few local agencies created through a special act of the Legislature. The specific authority of each agency varies, but the agencies can be grouped into two general categories: (1) agencies having authority to limit export and extraction (upon evidence of overdraft or threat of overdraft), or (2) agencies lacking authority to limit extraction, but having authority to require reporting of extraction and levy replenishment fees. There are no special act districts with enhanced groundwater management authorities in the North Lahontan region.

Court Adjudication of Groundwater Rights

Another form of groundwater management in California is through the courts. When the groundwater resources do not meet water demands in an area, landowners may turn to the courts to determine how much groundwater can be rightfully extracted by each overlying landowner or appropriator. The court typically appoints a watermaster to administer the judgment and to periodically report to the court.

There are currently 24 groundwater adjudications in California. The North Lahontan region does not have any groundwater adjudications.

Other Groundwater Management Planning Efforts

Groundwater management is also occurring through other avenues. IRWM incorporates the physical, environmental, societal, economic, legal, and jurisdictional aspects of water management into regional solutions through open and collaborative stakeholder process to promote sustainable water use. UWMPs incorporate long-term resource planning to meet existing and future water demands. AWMPs advance irrigation efficiency that benefits both farms and the environment.

Integrated Regional Water Management Plans

IRWM improves water management and supports economic stability, environmental stewardship, and public safety. IRWM plans involve multiple agencies, stakeholders, individuals, and groups, and cross jurisdictional, watershed, and political boundaries. The methods used in IRWM planning include developing water management strategies that relate to water supply, water quality, water-use efficiency, operational flexibility, stewardship of land and natural resources, and groundwater resources.

Statewide, the majority of IRWM plans address groundwater management in the form of goals, objectives, and strategies. They defer implementation of groundwater management and planning to local agencies through local GWMPs. There are a few IRWM plans that actively manage groundwater. Efforts by these IRWM RWMGs include creating groundwater contour maps for basin operations criteria, monitoring groundwater elevations, and monitoring groundwater quality.

There are three IRWM plans covering the majority of the North Lahontan region. One is in the process of being developed, and two are being implemented. One of the active IRWM planning regions resides solely within the North Lahontan region, and the other active IRWM plan extends from the southern part of the North Lahontan region into the Mono County area of the South Lahontan Hydrologic Region. One of the active IRWM plans relies on local GWMPs for managing groundwater resources. This region has noted that conflicts over groundwater supply have occurred when use exceeds natural recharge. Another source of conflict is groundwater supply planning that is related to large seasonal population fluctuations. To address future groundwater conflict, the partnership relies on the development and adoption of local GWMPs which contain conflict resolution procedures that can be utilized by the IRWM partnership. Other groundwater management objectives for this region include creating a reliable groundwater supply, protecting groundwater quality, and managing groundwater for multiple uses.

The other IRWM planning region relies on counties that have not adopted GWMPs, but instead have groundwater ordinances in place which employ land use planning and the authority of locally elected county boards to manage groundwater resources. The ordinances establish guidelines to manage the transport, transfer, acquisition, and sale of surface water and groundwater to protect the overall economy and environment of the counties. They also establish policy regarding transfers or transport of groundwater to areas outside the county and the watershed.

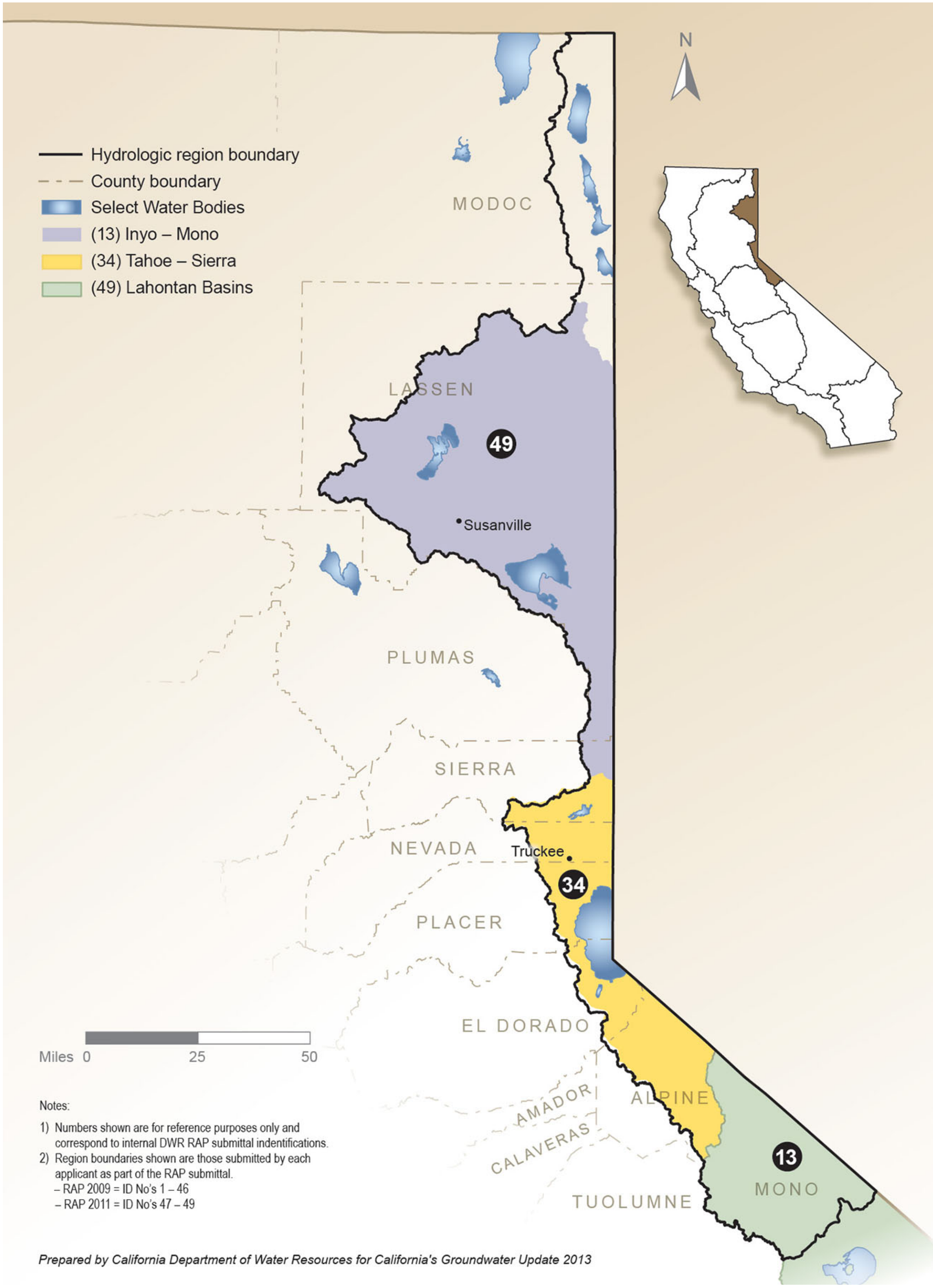
Figure 10-13 shows the areas of the North Lahontan region covered by IRWM plans as of September 2011. Table 10-21 lists the status of the IRWM planning areas by hydrologic region. More information about IRWM planning can be found at http://www.water.ca.gov/irwm/index.cfm.

Table 10-21 Status of Integrated Regional Water Management Plans in the North Lahontan Hydrologic Region

Hydrologic Region	IRWM Plan Name	Date	IRWM Plan Status	IRWM Map Number
North Lahontan	Tahoe-Sierra	2007	Active	34
North Lahontan	Lahontan Basins		In Progress	49
North Lahontan/South Lahontan	Inyo-Mono	2011	Active	13
			IRWM Planning Regions	3
			Active IRWM Plans	2
			IRWM Plans In Development	1
			IRWM Plans that Cross Hydrologic Boundaries	1

Notes:
IRWM = integrated regional water management
Table represents information as of August 2012.

Figure 10-13 Integrated Regional Water Management Plans in the North Lahontan Hydrologic Region



Urban Water Management Plans

UWMPs are prepared by California's urban water suppliers to support their long-term resource planning and to ensure adequate water supplies are available to meet existing and future water demands. UWMPs include system descriptions, demands, and supplies, as well as water shortage reliability and water shortage contingency planning. In addition, the Water Conservation Bill of 2009 (SB X7-7) requires that urban water suppliers:

- Develop a single standardized water use reporting form for urban water suppliers.
- Develop method(s) by July 2011 to identify per capita targets to meet the 20 percent reduction by 2020.
- Develop technical methodologies and criteria for calculating all urban water use.
- Convene a task force to develop alternative best management practices for commercial, industrial, and institutional water use.

Urban use of groundwater is one of the few uses that meter and report annual groundwater extraction volumes. The groundwater extraction data is currently submitted with the UWMP and then manually translated by DWR staff into a database. Online methods for urban water managers to directly enter their water use along with their UWMP updates is currently be evaluated. Updated UWMPs are currently under review by DWR. Additional information regarding urban water management and UWMPs can be found at http://www.water.ca.gov/urbanwatermanagement/.

Agricultural Water Management Plans

AWMPs are developed by water and irrigation districts to advance the efficiency of farm water management while benefitting the environment. The AWMPs provide another avenue for local groundwater management. Some of the efficient water management practices currently being implemented include controlling drainage problems through alternative use of lands, using recycled water that otherwise would not be used beneficially, improvement of farm irrigation systems, and lining or piping ditches and canals. In addition, SB X7-7 requires that agricultural water suppliers:

- Report the status of AWMPs and efficient water management plans, and evaluate their effectiveness.
- Adopt regulations to measure the volume of water delivered, and adopt a pricing structure based on quantity delivered.
- Develop a method for quantifying efficiency of agriculture water use, and a plan for implementation.
- Propose new statewide targets for regional water management practices for recycled water, brackish groundwater, and stormwater runoff.
- Promote implementation of regional water management practices through increased incentives and removal of barriers.

New and updated AWMPs addressing the SB X7-7 requirements were required to be submitted to DWR by December 31, 2012, for review and approval. More information about AWMPs can be found at http://www.water.ca.gov/wateruseefficiency/agricultural/agmgmt.cfm.

Conjunctive Management Inventory

Conjunctive management, or *conjunctive use*, refers to the coordinated and planned use and management of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. Managing both resources together, rather than in isolation, allows water managers to use the advantages of both resources for maximum benefit.

As part of the *California Water Plan Update 2013*, an inventory and assessment of conjunctive management projects was conducted. The overall intent of this effort was to (1) provide a statewide summary of conjunctive water management program locations, operational methods, and capacities, and (2) identify their challenges, successes, and opportunities for growth. The results of the inventory would be shared with policymakers and other stakeholders to enable an informed decision making process regarding groundwater and its management. Additional information regarding conjunctive management in California, as well as discussion on associated benefits, costs, and issues, can be found in *California Water Plan Update 2013*, Volume 3, Chapter 9, "Conjunctive Management and Groundwater Storage."

The statewide conjunctive management inventory and assessment consisted of literature research, an online survey, personal communication with local agencies, and a documented summary of the conjunctive management projects in California. Information from these efforts was compiled into a comprehensive spreadsheet of projects and historic operational information, which was updated and enhanced from a DWR/ACWA survey.

The online survey administered by ACWA requested the following conjunctive management program information from its member agencies:

- Location of conjunctive use project.
- Year project was developed.
- Capital cost to develop the project.
- Annual operating cost of the project.
- Administrator/operator of the project.
- Capacity of the project in units of acre-feet.

Although initial response to the DWR/ACWA survey was encouraging, the number of survey participants and the completeness of those responses were limited. In an attempt to build on the survey and develop a greater understanding of the size and diversity of conjunctive management projects in California, staff from each of DWR's four region offices in the Division of Integrated Regional Water Management contacted, either by telephone or through e-mail, each of the entities identified as having a conjunctive management program. DWR's follow-up information gathering requested additional details regarding:

- Source of water received.
- Put and take capacity of the groundwater bank or conjunctive use project.
- Type of groundwater bank or conjunctive use project.
- Program goals and objectives.
- Constraints on development of conjunctive management or groundwater banking (recharge) program.

Statewide, 89 conjunctive management and groundwater recharge programs were identified. Because of confidentiality concerns expressed by some local agencies, information for some existing conjunctive use programs was not reported. Conjunctive management and groundwater recharge programs in the planning and feasibility stage were not included in the inventory.

A statewide map and series of tables listing the conjunctive management projects identified by DWR and grouped by hydrologic region, with information specific to the 11 questions noted in this section, is provided in Appendix D. The project locations shown on the map represent the implementing agency's office address and do not represent the project location sites.

Conjunctive Management Inventory Results

Of the 89 agencies or programs identified as operating a conjunctive management or groundwater recharge program in California, no programs are located in the North Lahontan region.

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