North Lahontan Hydrologic Region — Table of Contents

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Acronyms and Abbreviations Used in This Report

[under development]

ACWA	Association of California Water Agencies
CASGEM	California Statewide Groundwater Elevation Monitoring
CDPH	California Department of Public Health
DPR	Department of Pesticide Regulation
GAMA	Groundwater Ambient Monitoring and Assessment
GWMP	Groundwater Management Plan
IRWM	integrated regional water management
LLNL	Lawrence Livermore National Laboratory
PA	Planning Area
RWQCBs	Regional Water Quality Control Boards
USGS	U.S. Geological Survey

North Lahontan Hydrologic Region

North Lahontan Hydrologic Region Summary

The North Lahontan Hydrologic Region (North Lahontan region) includes part of the western edge of the Great Basin, a large landlocked area that covers most of Nevada and northern Utah. The eastern drainages of the Cascade Range and the eastern Sierra Nevada, north of the Mono Lake drainage, make up the region. All surface water drains eastward toward Nevada. This hydrologic region extends about 270 miles from the Oregon border to the southern boundary of the Walker River drainage in Mono County (Figure NL-1). The region covers 6,122 square miles, about 4 percent of California's total area, but is inhabited by only about 0.3 percent of the state's population. The region includes portions of Modoc, Lassen, Sierra, Nevada, Placer, El Dorado, Alpine, and Mono counties.

PLACEHOLDER Figure NL-1 Map of the North Lahontan Hydrologic Region

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The region abounds with large, natural landscapes. The northern part is primarily arid high desert with relatively flat valleys at elevations of 4,000 to 5,000 feet. The eastern slopes of the Sierra Nevada comprise the central and southern portions of this region, which includes the California portion of the Lake Tahoe Basin. The major rivers of the region—Truckee, Carson, and Walker—carry the mountain snowmelt through California into Nevada. Mountain peaks up to 12,279 feet from the western boundary of the region.

Current State of the Region

Setting

Watersheds

The North Lahontan region contains all of the Susan River; the upper parts of the Truckee, Carson, and Walker River basins; and Surprise Valley watersheds. These streams have no outlets to the sea and terminate in lakes or playas. Most rivers have elevated base flows due to snowmelt from the Sierra Nevada and Cascade mountains, and from reservoir releases that maintain instream flows.

In the north, the Susan River flows southeasterly and empties into Honey Lake. Other minor streams in the north begin in the Warner Mountains and drain into Lower, Middle, or Upper Alkali lakes in Surprise Valley. The major portion of the Truckee River system originates in California and flows into Lake Tahoe and out toward Reno, Nevada, and then into Pyramid Lake. Trout Creek and the Upper Truckee River flow from the western slopes of the Carson Range and the eastern slopes of the Sierra into Lake Tahoe at the city of South Lake Tahoe. The Little Truckee River contributes near the head of Truckee Canyon just west of the river's exit into Nevada. The east and west forks of the Carson River are separate in California; they drain Alpine County and flow into Nevada. These forks of the Carson River meet near Minden, Nevada, and terminate near Fallon, Nevada, in either Carson Lake and Pasture or the Carson Sink. The East and West Walker rivers, entirely separate in California, originate in Mono County, flow into Nevada, join near Yerington, and then flow to Walker Lake.

The North Lahontan region watersheds are listed in Table NL-1 and can be seen in Figure NL-2. Numerous watershed groups have been organized in the Carson River, Lake Tahoe, Truckee River, Susan River, and Honey Lake basins. See listings and discussion later in this report under Watershed Management.

PLACEHOLDER Table NL-1 North Lahontan Hydrologic Region Watersheds Proceeding from North to South

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PLACEHOLDER Figure NL -2 North Lahontan Region Watersheds

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A predominant factor in the shaping of the landscapes and habitat in the North Lahontan Region are forest fires. Forest fires can increase flooding, surface erosion, mass wasting (landslides), and consequent degradation of water clarity through increased sediment loads. Forest fire effects that worsen runoff are the reduced surface vegetation and the "cooking" out of soil organics, which can form a nearly impervious (hydrophobic) layer of tars below the soil surface. As a result of the June 2007 Angora fire (see Photo NL-1), 15 percent of highly erosive area tributary to the Upper Truckee River developed a high degree of hydrophobicity. Fortunately this degree of hydrophobicity and precipitation conditions did not result in mass erosion. In the aftermath of the fire rebuilding of the area commenced. After clean up 63 percent of homeowners had filed building plans by June 2008, and as of June 2012, 84 of 499 affected parcels have changed ownership displaying the resiliency of the residents in the region (Lake Tahoe News, June 2012).

PLACEHOLDER Photo NL-1 Angora Fire

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In response to the effects of the Angora fire, California Governor Arnold Schwarzenegger and Nevada Governor Jim Gibbons signed a memo of understanding establishing the California-Nevada Tahoe Basin Fire Commission. The commission performed a comprehensive review of the laws, policies, and practices that affect the vulnerability of the Tahoe Basin to wildfires. Its findings and recommendations were submitted May 27, 2008. One conclusion was that there should be a reduction of forest floor fuel. In lieu of the report a $200+ million joint effort over the next 10 years will reduce forest floor fuel. The cooperating agencies in the 10 year Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction Plan are as follows:

- Lake Tahoe Basin Management Unit
- Tahoe Regional Planning Agency
- Nevada Tahoe Resource Team
- Nevada Division of Forestry
- Nevada Division of State Lands
- Nevada Fire Safe Council
- CAL FIRE – California Tahoe Conservancy

- California State Parks
- North Tahoe Fire Protection District
- Tahoe-Douglas Fire Protection District
- Lake Valley Fire Protection District
- South Lake Tahoe Fire Department
- Fallen Leaf Fire Department
- Meeks Bay Fire Protection District

Starting in 2007, under the 10 year plan approximately 65,000 acres of fuel reduction is targeted for fuel reduction treatments, which has progressed at a rate of 5,000 to 7,000 acres per year. As of September 2013, approximately 54,000 acres have been treated for fuel reduction since 2007. The plan target is will be accomplished through the cooperative efforts of the aforementioned parties. While the fuel reduction effort will help reduce the amount and voracity of wildfires in the area there are some concerns of the reduction leading to increased runoff and water quality issues.

For example, the Lahontan Regional Water Quality Control Board considered water quality issues concerning a 10,000-acre, decade-long, fuel reduction project called the South Shore Fuel Reduction and Healthy Forest Restoration Project. In the Board's consideration and the EIS submitted by the Lake Tahoe Basin Management Unit of the USFS, erosion control protocols that apply to forest operations were applied until vegetative cover became established. The conclusion of the study was that erosion potential of some areas, mainly the skid trails and landings used in conjunction with whole tree removal, would temporarily increase. However, the BMP's used would reduce or eliminate these impacts; in the event they did not, the methods could be adaptively managed to cause no impacts. As to the majority of the vegetation removal, there would be no negative effect on erosion characteristics because increased sunlight exposure would promote the growth of ground cover. Furthermore the removal of trees would tend to raise the water table leading to longer contributions from ephemeral or perennial springs and seeps.

The South Shore Fuel Reduction Project and the thinning and removal of burned trees resulting from the Angora fire of June 2007, will result in the generation of biomass. To the extent possible and where it would not disturb high erosion potential soils, the biomass is to be removed and either sawn into lumber, chipped and used in particleboard, or used as fuel in energy producing biomass-burning facilities.

Some of the concerns about the project were based on habitat values, which were also dealt with in the EIS. First, the EIS stated that the majority of destruction of habitat would be in the so-called wildlife urban interface; which would be close to urbanized areas either not used extensively by wildlife or not of high habitat potential as a result of urbanization. Further, the report concluded that thinning would lead to increased growth of remaining vegetation, increased stand resistance to drought, insects and disease, and, of course, reduce the largest threat, devastation by an extreme fire event. Reduction in the risk of the latter was generally concluded to outweigh any reduction in habitat so that the project as a whole was rated as having a low risk for creating a significant negative effect.

Groundwater Aquifers

Groundwater resources in the North Lahontan Hydrologic Region are supplied by both alluvial and fractured-rock aquifers. Alluvial aquifers are composed 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 region. 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 the well's groundwater supply. A brief description of the aquifers for the region is provided below.

Aquifer Description

Alluvial Aquifers

The North Lahontan Hydrologic Region contains 27 DWR Bulletin 118-2003 recognized alluvial groundwater basins and subbasins underlying approximately 1,600 square miles, or about 26 percent of the 6,100 square mile hydrologic region. Figure NL-3 shows the location of the alluvial groundwater basins and subbasins and Table NL-2 lists the associated names and numbers. The most heavily used groundwater basins in the region are - Honey Lake Valley and Surprise Valley Groundwater Basins. The two basins account for more than 70 percent of the average 166 taf of groundwater pumped annually during the 2005-2010 period. Two other basins are also considered important for the region – Martis Valley and Madeline Plains Groundwater Basins.

PLACEHOLDER Figure NL-3 Alluvial Groundwater Basins and Subbasins within the North Lahontan Hydrologic Region

PLACEHOLDER Table NL-2 Alluvial Groundwater Basins and Subbasins within the North Lahontan Hydrologic Region

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The largest groundwater basin in the region is the Honey Lake Valley Groundwater Basin in Lassen County. The basin covers approximately 312,000 acres. Well yield data indicate that groundwater production in the basin ranges from 20 to 2,500 gpm, with an average of 780 gpm. The primary alluvial groundwater-bearing 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. 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 alluvial fan deposits consist of materials ranging from boulders to clay. The deposits 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.

The second largest groundwater basin in the region is the Surprise Valley Groundwater Basin in Modoc and Lassen counties, covering approximately 228,000 acres. The groundwater basin is located in the northeast corner of California and is shared with Nevada, and it is bound on all sides by faults, including the Surprise Valley fault and the Hays Canyon fault. The groundwater basin is considered 'closed', meaning that it is without an outlet. Well yield data indicate that groundwater production in the basin ranges from 350 to 2,500 gpm, with an average of 1,400 gpm. The primary groundwater-bearing formations 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 up to 5,000 feet. These deposits have moderate to high permeability and can yield significant amounts of groundwater. The Holocene alluvial fan deposits consist of gravel, sand, silt, and clay. They range in thickness up to 1,000 feet in some locations. These deposits are capable of yielding large quantities of groundwater.

The Martis Valley Groundwater Basin is located in Placer and Nevada counties covering approximately 36,000 acres. Well yield data indicate that groundwater production in the basin can be up to 1,500 gpm, with an average yield of 150 gpm. The primary groundwater-bearing formations are the Miocene to Pliocene basin fill deposits that are interbedded with sediments of stream and lake deposits.

The Madeline Plains Groundwater Basin is located in Lassen County covering approximately 156,000 acres. Available, limited data indicate that groundwater production in the alluvial portion of the basin is generally limited to domestic or stock wells. The primary groundwater-bearing geologic formations are the Holocene and Pleistocene sedimentary and lake-related deposits, which consist of clay, silt, sand, and gravel, varying greatly by location.

Fractured-Rock Aquifers

Fractured rock aquifers are generally found in the mountainous areas of a region, extending from the edges of the alluvial groundwater basins and foothill areas, up into the surrounding mountains. Due to the highly variable nature of the 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. On average, wells drawing from fractured-rock aquifers yield 10 gpm or less. Although fractured-rock aquifers are less productive compared to alluvial aquifers, they tend to be a critically important water supply source for many individual domestic wells and small public water systems in the region.

A significant fractured-rock groundwater-bearing geologic formation in the Honey Lake Valley Groundwater Basin is the late Pliocene and early Pleistocene volcanic rocks. The rock generally has dark, glassy, igneous tops and bottoms with very dense interiors. These rocks can be highly permeable where fractured or jointed and act as a recharge conduit and can yield significant amounts of groundwater.

Another significant source of groundwater in the Madeline Plains Groundwater Basin is the Pliocene-Pleistocene and Pleistocene basalt that comprises approximately 80% of the land surface surrounding basin. The basalt consists of multiple units of jointed and fractured basalt. It is highly permeable and exists extensively in both the surface and subsurface of the area, it acts as the primary aquifer and primary recharge conduit for the basin. The groundwater yields are generally less than 500 gpm, but can be as high as 3000 gpm or more.

More detailed information regarding the aquifers in the North Lahontan Hydrologic Region is available online from California Water Plan Update 2013 (Update 2013) Volume 4, Reference Guide, the article "California's Groundwater Update 2013" and DWR Bulletin 118-2003.

Well Infrastructure and Distribution

Well logs submitted to DWR for water supply wells completed during 1977 through 2010 were used to evaluate the distribution of water wells and the uses of groundwater in the North Lahontan Hydrologic

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. Hence, some well logs could not be used in the current assessment. However, for a regional scale evaluation of well installation and distribution, the quality of the data is considered adequate and informative. The number and distribution of wells in the 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 in 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 (no information listed on the well log).

Two counties were included in the analysis of well infrastructure for the North Lahontan Hydrologic Region; both Lassen and Alpine Counties are partially contained within the region. 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. Well log information listed in Table NL-3 and illustrated in Figure NL-4 show that the distribution and number of wells vary widely by county and by use. The total number of wells installed in the region between 1977 and 2010 is approximately 4,100, of which about 3,900 is in Lassen County and only about 200 in Alpine County. In both counties, domestic wells make up the majority of well logs — about 2,900 in Lassen County and 100 in Alpine County. The count for domestic wells is followed by the count for monitoring wells – about 300 in Lassen County and 50 in Alpine County. Communities with a high percentage of monitoring wells compared to other well types may indicate the presence of groundwater quality monitoring to help characterize groundwater quality issues.

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

PLACEHOLDER Figure NL-4 Number of Well Logs by County and Use for the North Lahontan Hydrologic Region (1977-2010)

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Figure NL-5 shows that the number of domestic wells make up the majority of well logs (75 percent) in the region while irrigations wells account for only about eight percent of well logs. Monitoring wells make up nine percent of the wells; public supply and industrial wells account for about two and one percent, respectively.

PLACEHOLDER Figure NL-5 Percentage of Well Logs by Use for the North Lahontan Hydrologic Region (1977-2010)

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Figure NL-6 shows a cyclic pattern of well installation for the region, with new well construction ranging from about 50 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 the annual variations in climate, economy, agricultural cropping trends, or alternative water supply availability.

PLACEHOLDER Figure NL-6 Number of Well Logs Filed per Year by Use for the North Lahontan Hydrologic Region (1977-2010)

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The increase in domestic well construction between 2001 and 2005 is likely due to increases in housing construction. Similarly, the 2006 to 2010 decline in domestic well drilling is likely due to declining economic conditions and the related drop in housing construction. A portion of the lower number of well logs recorded for 2009 and 2010 could also be due to delays in receiving and processing of well completion reports.

Irrigation well installation is more closely related to climate conditions, cropping trends and surface water availability. Installation of irrigation wells increase following dry water year conditions, for example, the 1976-77 and 1991-1996 droughts. Much of the irrigation well infrastructure installed during the late 1970s and early 1980s in the region is still being used today.

The onset of monitoring well installation in the mid- to late-1980s is likely associated with federal underground storage tank programs signed into law in the mid-1980s. The installation of monitoring wells in the region peaked in 1990 at about 50 wells, with an average of about 20 monitoring wells installed per year from 1988 through 1993. Between 1995 and 2007, monitoring well installation in the region has averaged approximately 15 wells per year. The majority of monitoring well installation during this period is likely in response to groundwater quality monitoring needs resulting from local groundwater quality assessment and remediation projects. Since 2007, monitoring well installation in the region has dropped to an average of approximately five wells per year.

More detailed information regarding assumptions and methods of reporting well log information is available online from Update 2013 Volume 4, Reference Guide, the article "California's Groundwater Update 2013."

California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization

The Legislature in 2009, as part of a larger package of water-related bills, passed Senate Bill 7x 6 (SBx7 6; Part 2.11 to Division 6 of the California Water Code § 10920 et seq.), requiring that groundwater elevation data be collected in a systematic manner on a statewide basis and be made readily and widely available to the public. DWR was charged with administering the program, which was later named the "California Statewide Groundwater Elevation Monitoring" or "CASGEM" Program. The new legislation requires DWR to identify the current extent of groundwater elevation monitoring within each of the alluvial groundwater basins defined under Bulletin 118-2003. The legislation also requires DWR to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater level monitoring by considering available data. Box NL-1 provides a summary of these data considerations and resulting possible prioritization category of basins. *More detailed information on groundwater basin prioritization is available online from Update 2013 Volume 4, Reference Guide, the article "California's Groundwater Update 2013."*

PLACEHOLDER Box NL-1 California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization Data Considerations

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Figure NL-7 shows the groundwater basin prioritization for the region. Of the 33 basins within the region, two basins were identified as medium priority, two as low priority, and 23 basins as very low priority; no basin was identified as high or very high priority. Table NL-4 lists the medium and low CASGEM priority groundwater basins for the region. The two medium priority basins account for about 55 percent of the population and about XX percent of groundwater supply for the region. The basin prioritization could be a valuable tool to help evaluate, focus, and align limited resources for effective groundwater management, and reliability and sustainability of groundwater resources.

PLACEHOLDER Figure NL-7 CASGEM Groundwater Basin Prioritization for the North Lahontan Hydrologic Region

PLACEHOLDER Table NL-4 CASGEM Groundwater Basin Prioritization for the North Lahontan Hydrologic Region

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North Lahontan Hydrologic Region 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 (§10753.7) requires local agencies seeking State funds administered by DWR to prepare and implement groundwater management plans 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. This section summarizes some of the groundwater level, groundwater quality, and land subsidence monitoring efforts within the North Lahontan Hydrologic Region. Groundwater level monitoring well information includes only active monitoring wells — those wells that have been measured since January 1, 2010. *Additional information regarding the methods, assumptions, and data availability associated with the groundwater monitoring is available online from Update 2013 Volume 4, Reference Guide, the article “California’s Groundwater Update 2013.”*

Groundwater Level Monitoring

A list of the number of monitoring wells in the region, by monitoring agencies, cooperators, and CASGEM monitoring entities, is provided in Table NL-5. The locations of these monitoring wells by monitoring entity and monitoring well type are shown in Figure NL-8. Table NL-5 shows that a total of 221 wells in the region have been actively monitored for groundwater levels since 2010. DWR monitors 138 wells in 12 basins; the U.S. Geological Survey (USGS) monitors 24 wells in three basins; four cooperators monitor the remaining 59 wells. At present, there are no CASGEM wells being monitored as no monitoring entities have been designated by DWR.

PLACEHOLDER Table NL-5 Groundwater Level Monitoring Wells by Monitoring Entity in the North Lahontan Hydrologic Region

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PLACEHOLDER Figure NL-8 Monitoring Well Location by Agency, Monitoring Cooperator, and CASGEM Monitoring Entity in the North Lahontan Hydrologic Region

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The groundwater level monitoring wells are categorized by the type of well use and include domestic, irrigation, 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. Domestic wells are typically relatively shallow and are in the upper portion of the aquifer system, while irrigation wells tend to be deeper and are in the middle-to-deeper portion of the aquifer system. Some observation wells are constructed as a nested or clustered set of dedicated monitoring wells, designed to characterize groundwater conditions at specific and discrete production intervals throughout the aquifer system. Figure NL-9 shows that wells identified as irrigation account for the majority - 34 percent of the monitoring wells in the region; followed by other (28 percent), observation (22 percent), and domestic (16 percent).

PLACEHOLDER Figure NL-9 Percentage of Monitoring Wells by Use in the North Lahontan Hydrologic Region

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Groundwater Quality Monitoring

Groundwater quality monitoring is an important aspect to effective groundwater basin management and is one of the components that are required to be included in groundwater management planning in order for local agencies to be eligible for State funds. Numerous State, federal, and local agencies participate in groundwater quality monitoring efforts throughout California. A number of the existing groundwater quality monitoring efforts were initiated as part of the Groundwater Quality Monitoring Act of 2001, which implemented goals to improve and increase the statewide availability of groundwater quality data. A summary of the larger groundwater quality monitoring efforts and references for additional information are provided below.

Regional and statewide groundwater quality monitoring information and data are available on the SWRCB Groundwater Ambient Monitoring and Assessment (GAMA) Web site and the GeoTracker GAMA groundwater information system developed as part of the Groundwater Quality Monitoring Act of 2001. The GAMA Web site describes GAMA program and provides links to all published GAMA and related reports. The GeoTracker GAMA groundwater information system geographically displays information and includes analytical tools and reporting features to assess groundwater quality. This system currently includes groundwater data from the SWRCB, Regional Water Quality Control Boards (RWQCBs), California Department of Public Health (CDPH), Department of Pesticide Regulation

(DPR), DWR, USGS, and Lawrence Livermore National Laboratory (LLNL). In addition to groundwater quality data, GeoTracker GAMA has more than 2.5-million depth to groundwater measurements from the Water Boards and DWR, and also has oil and gas hydraulically fractured well information from the California Division of Oil, Gas, and Geothermal Resources. Table NL-6 provides agency-specific groundwater quality information. Additional information regarding assessment and reporting of groundwater quality information is furnished later in this report.

PLACEHOLDER Table NL-6 Sources of Groundwater Quality Information

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Land Subsidence Monitoring

Land subsidence has been shown to occur in areas experiencing a significant decline in groundwater levels. However, no information has been collected for subsidence monitoring as part of Update 2013.

Ecosystems

Table NL-7 lists threatened, endangered and species of special concern found in the counties of North Lahontan Hydrologic region.

PLACEHOLDER Table NL-7 Threatened, Endangered, and Special Concern Species of the North Lahontan Hydrologic Region

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The ecosystems in the North Lahontan Hydrologic Region are diverse and vary from alpine conditions to near desert. The ecosystems by county in the North Lahontan Hydrologic Region are as follows:

Modoc County is a sage steppe into which western and Utah juniper are encroaching. Within that county, Surprise Valley is a high altitude (4,000 feet) desert valley with forested mountains on the west and a series of alkaline lakes in the valley and as part of the Great Basin because water drains to these lakes and evaporates. Western and Utah juniper are native to the region, and, therefore, not an invasive species, they have been found to be a species encroaching beyond their original territory due to anthropogenic change in the form of past cattle grazing practices and fire suppression. Mechanistically, cattle remove the fine fuel loads at the base of the junipers, which decreases the fire return frequency while increasing juniper seedling development. Synergistically fire suppression aids the juniper gains from their reduced burn off rate. A juniper overstory can predominate to a degree that suppresses all understory fine fuels (grasses and forbs which are wild flowers) in as little as 45 years and grazing has been practiced in the region for 140 years. Juniper predominance is a non-virtuous cycle in that each juniper can consume forty gallons of water on a hot summer day. The presence of juniper has been found to both increase the volume of run-off for a given storm intensity and duration with a concomitant increase in the amount of soil erosion in pounds per acre. The mechanism by which this takes place is that the juniper precludes other ground cover and hence exposes the soil to direct raindrop impact. This effect is more prevalent where soil moisture conditions are marginal in which the juniper transpires the available moisture and the groundcover is left with nothing to subsist on. Thus on whatever slope facing approaching storms groundcover may be able to co-exist and there is no increase in erosion whereas on the more xeric opposite slope there is not enough moisture to support both and the groundcover disappears. The US Forest Service and Bureau of Land Management have instituted juniper removal projects with the Sierra Nevada Conservancy, contributing funding to the latter in the 382,349 acre Buffalo-Skeddadel [greater sage grouse] Population Management Unit. The connection of the greater sage grouse to junipers is that the junipers reduce upland early brood rearing habitat in the understory of grasses and forbs. Sage brush obligate species such as the sage grouse and the pygmy rabbit have declined as a result of the ecosystem change brought about by juniper encroachment. The removed junipers are either burned, chipped and left in place to decompose, used as firewood or in some cases where not limited by haulage costs, burned at the thirty mega-watt, hybrid geothermal Honey Lake Power Facility in Wendell, California.

Lassen County contains a Sage-Grouse and sagebrush ecosystem, portions of which are being preserved in the Buffalo-Skedaddle Population Management Unit northeast of Susanville. It also has Eagle and Honey lakes in its low-lying portion. The Honey Lake and Willow Creek Wildlife Areas preserve existing wetlands in the area. Approximately 50,000 cattle graze in Lassen County on the grasses in the sagebrush areas and on irrigated pasture. The establishment of exotic species of grasses such as cheatgrass, an annual that lacks deeper root systems, has changed the ecosystem to one that is more erosive than that which existed when native grasses predominated.

In the more alpine Sierra, El Dorado, Nevada, Placer, and Alpine counties exist riparian and lacustrine (natural lakes, ponds and human-made reservoirs) ecosystems. The riparian ecosystems are labeled according to their inhabitants, thus area streams are referred to as conifer forest snowmelt streams, trout headwater streams, trout/sculpin streams, sucker/dace/redside streams, and whitefish cutthroat/sucker streams. Of the latter, the Lahontan cutthroat trout riverine variant (the other variant being lacustrine) persists currently in only 8.8 miles (2.4 percent) of the historical 360 miles of stream habitat. The goal of current watershed management initiatives is to increase that percentage. The small lakes (less than one-tenth acre in size) in this region are in glaciated, mountainous areas and were formed either as glacially scoured basins or deposited ridges of glacial debris that dammed streams. Snowmelt pools are clear, low in basic nutrients for plants (oligotrophic), and may contain only seasonal organisms. Farther downslope, smaller natural lakes have been augmented by the placement of low, human-made dams to provide water for agriculture or (originally) hydropower and now increasingly urban uses.

The most notable feature of the region is Lake Tahoe, one of the low dammed, oligotrophic lakes. Now low in basic nutrients for plants, the Lake’s state could change if current efforts to keep it pristine are not effective. Concerns arise from the presence of invasive flora, Eurasian milfoil (Myriophyllum spicatum) and curly pond weed (Potamogeton crispus), and fauna such as the Asian clam. The latter was first observed in 2002, but now is abundant along the lake’s southeast shore at depths of 3 to 30 feet. This is particularly unfortunate because it may indicate that Tahoe’s waters contain enough calcium to support zebra and quagga mussels (if introduced) and because their very presence presents a substrate for such an invasion. Worse still is the perceived association of filamentous algae blooms that are thought to spring from the nitrogen-laden excretions of the Asian clam.

Various species have invaded the area including the Asian clam and the white top plant (lepidium draba, and latifolium) and cause, in the case of the Asian clam, filamentous algal blooms and in the case of whitetop exclude more desirable, native plant species. The assemblage of fish present in the waters of the area contains numerous introduced species that exclude desirable native species such as the Lahontan Cutthroat Trout (LCT).

The whitetop plant (*Lepidium draba and Lepidium laitfolium*), is very aggressive and eliminates desirable vegetation. The plant tends to grow in floodplains and near watercourses over the entire region and can be spread over longer distances by water conveyance of seeds or root fragments. Unfortunately although the plant's root system is extensive it does not hold soil during flood events resulting in bank caving along water courses as is shown in Photo NL-2 below. Most of the watercourses in the region have a whitetop infestation that may aggregate tens of thousands of acres, presenting a major problem. Control methods include mechanical removal, grazing by sheep and goats during the pre-flowerings phase and multiple applications of herbicides the latter being the proposed method at this time.

PLACEHOLDER Photo NL-2 Whitetop (perennial pepperweed) Roots Do Not Form Interlocking Mesh that Holds Soil

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

In the lower elevations of the region, human-made, multipurpose reservoirs were constructed originally for agriculture, flood control, and urban and recreational uses. But increasingly, often through legal intervention and water rights purchases, they have been turned to environmental restoration and urban uses. The ecosystems of human-made reservoirs differ from those of natural lakes in that the reservoir levels rise and fall, are generally steeper sided and thus vegetative littoral (shore side) zones are not established, and, generally, habitat structural diversity is lessened altering fish populations.

In Mono County the ecosystem reverts to the sage desert of the northern portions again with irrigated pasture and alfalfa fields with some produce in the eastern valleys bordered by forested mountains to the west. Notably the West Walker River that meanders through this section of the region has been designated a California Wild and Scenic River and therefore is protected from further human-made modifications.

Lastly, as an update to the 2009 spotting of a lone wolverine that entered the region, as of February 2012, the same specimen still resided in the Tahoe National Forest. Early in 2012, a gray wolf tagged with a radio collar in Idaho and called "OR-7" visited the region. This male wolf was near Litchfield in Lassen County not far from Susanville, but has since left the state and the region. OR-7 as he appeared in southern Oregon is shown below in Photo NL-3.

PLACEHOLDER Photo NL-3 Wolf OR-7 Southwest Modoc County May 7, 2012.

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Flood

The North Lahontan Hydrologic Region includes part of the western edge of the Great Basin, the eastern drainages of the Cascades, and the eastern Sierra Nevada north of the Mono Lake drainage, including the California portion of the Lake Tahoe Basin. The hydrologic region extends from the Oregon border to the southern boundary of the Walker River drainage in Mono County. The North Lahontan Hydrologic Region contains all of the Susan River, the upper parts of the Truckee, Carson, and Walker River basins, and the Surprise Valley watershed. These streams have no outlets to the sea and terminate in lakes and playas.

At least 4,000 people are exposed to the 500-year flood event in the North Lahontan Hydrologic Region, as well as nearly $1 billion in the value of structures and $10 million in the value of crops. Flooding primarily occurs in the Truckee River region, including Lake Tahoe, Honey Lake, Walker River Basin, and Susan River. Martis Creek Reservoir is identified as being at high risk for catastrophic failure, which could result in severe flooding downstream therefore the reservoir only operates as a check and is not filled. Floods in the hydrologic region originate principally from the melting of the Sierra snowpack and from rainfall in December and January.

Major floods occur less regularly in the North Lahontan Hydrologic Region compared with the rest of the state. Major historic floods in the hydrologic region include floods in February 1968, February 1986, and January 1997. In February 1968, continuous rain for nearly a week caused extensive flooding in the Honey Lake watershed. The Susan River and storm drains overflowed, inundating roads and stranding travelers in Susanville. Flooding in Honey Lake Valley isolated many ranchers from emergency services. In January 1997, an intense rainstorm falling on a large snowpack caused catastrophic flooding throughout the hydrologic region. The West Fork Walker River damaged approximately 6 miles of Highway 395 and 100 homes in Walker and Walker Valley. The swollen Truckee River destroyed sewer and power lines leading to ski resorts, inundated residences and stores in Truckee, and damaged 20 bridges, several stream gauges and destroyed a power plant diversion. In Alpine County, floodwaters washed out road shoulders, destroyed bridges, and damaged Highways 4, 88, and 89; damages for the county were estimated at $8.4 million. The flood control of the region, other than in the Lake Tahoe region, is not well developed and, therefore, some agricultural and urban areas are subject to flooding by flood events of one percent probability or less. In addition in the Tahoe region the Corps of Engineers' Martis Creek Dam is subject to seepage and potential collapse if the pool is raised, therefore it is operated with spillways open at all times until the problem is addressed. Other dams in the Tahoe area have been proposed to being raised slightly to allow them to contain a recently revised maximum credible flood event.

Climate

Dry summers with occasional scattered thundershowers characterize the region's climate. Most precipitation falls in late fall and winter. Precipitation is less than five inches in the valleys of Eastern Modoc and Lassen counties. Precipitation is about 30 inches in the Walker Mountains and more than 60 inches in the Sierra Nevada in the upper reaches of the Truckee, Carson, and Walker River basins. 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.

Demographics

Population

The North Lahontan region had the smallest population of the state's 10 hydrologic regions about 0.3 percent of the state's total population lives in this region, and 56 percent of the region's population lives in incorporated cities. Between 2000 and 2010, the region shrank by 2,125 people, a decline of 2.15 percent over the 10-year period. For areas not near the population center in and around Lake Tahoe, the trend is for slow growth and maintenance of an agriculture-based life style with some increase in timbering for the sole purpose of reducing the severity of wildfire.

In the Tahoe-Truckee region, the populace of the Truckee region grew by 14% while that in the Lake Tahoe basin within California declined by 9%. Overall the population of the two areas combined, declined 3.5% because the majority of the population was in the Tahoe Basin. The increase in population in Truckee is related to recreation and part-time vacation home visits, and the services that relate thereto. There is also a trend toward developments that may increase the amount of recreational usage, but at the same time reduce the environmental impacts of replaced facilities that were not as environmentally well-designed.

Tribal Communities

Tribes in the North Lahontan Region are given in Table NL-8 below. Each tribal community that is listed as having land also has water rights for that land. In addition to land holdings within the North Lahontan region, there are fourteen allotments within the region that tribal communities have the right to use including the collection of vegetation.

PLACEHOLDER Table NL-8 California Native American Tribes in the North Lahontan Hydrologic Region

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Currently, Tribal landholdings located in this region include: Antelope Valley (Coleville), Bridgeport, Cedarville, Fort Bidwell, Meeks Bay, Susanville (Susanville, Honey Lake, Maidu Nation, and Wadatkuta) and Woodfords reservations, rancherias, and communities. The Pyramid Lake and Walker River Paiute Tribes have their land bases in Nevada. Approximately fourteen individual allotments are also located within this region.

Tribal Collaborative Efforts

The Walker River Tribe actively participates in the Walker River Recovery Implementation Team, and the Management Oversight Group, as well as monitoring water conditions on the Walker River.

The Washoe Tribe has a series of MOUs with the US Forest Service for land use management in the Lake Tahoe Basin. In 2008, a pilot program was initiated to use traditional stewardship practices to regenerate meadow vegetation.

The Pyramid Lake Tribe is working with the US Fish and Wildlife Service on Lahontan Cutthroat Trout restoration and recovery; the tribe is part of the management oversight team.

Concerns and Priorities:

- Protection of surface waters from contamination
- Maintaining sufficient flow to sustain a healthy environment
- Dam removal performed in a manner that avoids or mitigates negative environmental effects
- Water rights
- Water quality, water may be accessible, but quality is not acceptable for use
- Watershed restoration using natural, indigenous plants

Challenges tribes are facing regarding water or water related conditions:

- Pressure from urban, agriculture and industrial interests to divert increasing quantities of water from instream flows
- Falling water tables that dry up historical springs
- Local agencies lacking cultural sensitivity needed to work with tribes
- Lack of long term water quality monitoring data and need to establish same

Disadvantaged Communities

The State of California defines a disadvantaged community as a community with an annual Median Household Income (MHI) that is less than 80% of the statewide MHI. The U.S. EPA maintains a mapping system associated with its Environmental Justice Program called EJView available at http://epamap14.epa.gov/ejmap/entry.html that provides demographic data at a gross scale. According to EJView none of the communities in the North Lahontan Region meet this criterion; pockets of disadvantaged populations might be apparent if more refined demographic data were readily available. Significant populations of Spanish-speaking people throughout the region, and Native Americans in smaller more isolated communities may meet the criterion for disadvantaged communities. One aspect of underserved communities is that they may not have a water supply that meets current drinking water standards.

Land Use Patterns

The North Lahontan Hydrologic Region consists of mainly national forests, lands under the jurisdiction of the US Bureau of Land Management, and ski and vacation resorts. Cattle ranching is the principal agricultural activity, and pasture and alfalfa are the dominant irrigated crops. Commercial crop production is limited because of the short growing season, although garlic has been grown in Antelope Valley near Coleville on the West Walker River in the region's southern portion and also in Surprise Valley in eastern Modoc County.

In the Truckee-Tahoe area and surrounding mountains tourism and recreation are the principal economic activities. The lower meandering streams of the Walker, Carson, and Truckee rivers are famous for trout fly-fishing and also offer water sports, hiking, and camping with the eastern Sierras as a backdrop. On a typical summer day in the high country, visitors in the Tahoe basin will outnumber full-time residents. During the winter, the population swells again as ski resorts attract visitors from all over the world as well as California's urban areas due to the regions number of world-class resorts. Due to the beauty and recreational opportunities in these areas a rapid increase in the number of new vacation homes in the 1990s and the early 21st century brought about controls on their effects to environmental issues such as storm water and Total Daily Maximum Loads (TMDLs) along with the ascendancy of watershed protection groups. Urban growth in the Lake Tahoe Basin is controlled by the Tahoe Regional Planning Agency (TRPA), which is responsible for protecting the basin's sensitive environment and water quality.

The state wildlife areas around Honey Lake divert water to provide important habitat for waterfowl and several threatened or endangered species, including the bald eagle, sand hill crane, bank swallow, and peregrine falcon.

The majority of the counties in the North Lahontan Region are wild lands or open space owned by the government. Some of the counties, notably those at the extreme north and south ends of the region have significant numbers of acres dedicated to agriculture. The portions of Nevada, Placer, and El Dorado Counties within the North Lahontan Region have zero acres of active agriculture. The Modoc and Lassen Counties have 45,751 and 79,134 acres of active agriculture, respectively.

As an example, the portion of northern Mono County that is within the North Lahontan Region comprises approximately 695,000 acres of which, approximately 30,000 acres are used for agriculture. The remainder is small town sites, rangeland used for grazing, sage steppe, or mountains. The two areas of agricultural use are the Antelope Valley and the Bridgeport Valley. Previously the Slickard Valley, 4,460 acres, and the Little Antelope valley, 2,560 acres, had supported agriculture, but have since been converted to wildlife areas. The primary agriculture use is irrigated pasture, alfalfa production, and grazing. One peculiar land use is for the U. S. Marine Corps Mountain Warfare Training Center in Pickel Meadow, which occupies 54,000 acres.

Regional Resource Management Conditions

Water in the Environment

The region's rivers, in order of flow, are the Truckee, Walker, Carson, and Susan. An ongoing concern is the clarity of Lake Tahoe, which has been the subject of a $1.2 billion program and a Memorandum of Understanding between the United States and the states of California and Nevada. The east and west forks of the Carson River and Leavitt Creek, a tributary to the West Carson, are Wild and Scenic rivers. The east fork of the Carson River, Heenan Lake on Heenan Creek, a tributary to the east fork, the East Walker River, the Little Truckee River and Martis Creek Lake are trophy trout waters. Lahontan cutthroat trout, Paiute cutthroat trout found in Silver King Creek, and Eagle Lake Rainbow trout are heritage trout, or trout that existed in California before the intervention of European societies.

Another initiative in the region in the area of water governance is Truckee River Operating Agreement (http://www.usbr.gov/mp/troa/final_oa/index.html). TROA, if implemented, would resolve basin wide issues for a number of water rights decrees, court orders, and purchased water rights that affect the Truckee and Carson rivers. TROA contains operating procedures designed to make more efficient use of existing Truckee River reservoirs and to provide multiple benefits, such as enhanced conditions for endangered cui-ui (pronounced *kwee-wee*) and threatened Lahontan cutthroat trout; reduced streamflow variability; improved streamflows and water quality in all seasons; and maintenance of reservoir storage to better serve recreational uses (see Photo NL-4).

PLACEHOLDER Photo NL-4 Juvenile Lahontan Cutthroat Trout from By Day Creek Ecological Reserve

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The principal environmental uses of water in the North Lahontan region are those of State wildlife areas around Honey Lake. The Honey Lake Wildlife Area (HLWA) in southern Lassen County consists of the 4,271 acre Dakin Unit and the 3,569-acre Fleming Unit. The two units provide important habitat for several threatened or endangered species, including the bald eagle, sandhill crane, and bank swallow. This wildlife area has winter-storage rights from the Susan River from November 1 until the last day of

February. The HLWA also operates eight wells, each producing between 1,260 and 2,100 gallons per minute. In an average year, the HLWA floods 3,000 acres by March 1 for waterfowl brood habitat.

In 1989, the California Department of Fish and Wildlife (DFW) purchased the 2,714-acre Willow Creek Wildlife Area in Lassen County to preserve existing wetlands and to increase the potential for waterfowl production and migration habitat. About 2,000 acres are wetlands and riparian habitats. The endangered bald eagle and sandhill crane also inhabit this area. The DFG operates the Doyle Wildlife Area, also in the Honey Lake Basin. This wildlife area is protected as dry land winter range for deer and requires less water than the Honey Lake or Willow Creek areas.

In the southern portion of the region, the DFW has established the Slinkard/Little Antelope Valley Wildlife Area. This area of previously established agricultural land to the west of Topaz and Walker California uses water from legacy irrigation works to create deer and wildlife habitat. Further south the West Walker River Wildlife Area uses water from streams, rivers and springs for the same purpose.

Water Supplies

To see an overview of the region's water inflows and outflows see Figure NL-10.

PLACEHOLDER Figure NL-10 North Lahontan Regional Inflows and Outflows

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Surface Water

Unimpaired runoff of the streams and rivers of the North Lahontan region averages 1.5 million acre-feet per year, of which only about one-fifth occurs in the drier, northern portion. The largest rivers in the region and their average regulated runoff at the Nevada state line are the Truckee River with 540,000 acre-feet; the Carson River, 469,000 acre feet; and the Walker River, 428,000 acre-feet. The Susan River is the only major river in the northern half of the region, and its annual discharge at Susanville averages 60,000 acre-feet.

Runoff in Modoc County flows into terminus lakes, specifically the upper, middle and lower lakes in Surprise Valley. A smaller portion of the runoff from the north and east portions of the region flow into basins that feed groundwater in Oregon and Nevada. The Susan River flows in a southerly direction into Honey Lake in Lassen County, and Long Valley Creek flows in a northerly direction to the same lake. There is an interbasin transfer into the North Lahontan region from the South Pit River system, which is in the Sacramento River Hydrologic Region from Moon Lake (formerly Tule Lake Reservoir) and to the Madeline Plain basin.

Most of the runoff in the Truckee River Basin originates in the Sierra Nevada in California. A portion of that runoff is stored in federal reservoirs—Lake Tahoe in California and Nevada and Prosser Creek, Stampede, Boca, and Martis Creek reservoirs—and non-federal reservoirs—Donner and Independence lakes in California. Operation of these reservoirs regulates much of the flow in the Truckee River Basin in most years. Together these reservoirs can store about a million acre-feet of water. A number of court decrees, agreements, and regulations govern day-to-day operations, administered by the Federal Water Master for the Orr Ditch court. The reservoirs are operated to capture runoff as available when flow in the river is greater than that needed to serve downstream water rights in Nevada and to maintain prescribed streamflows in the Truckee River, known as Floriston Rates and measured at the Farad gage near the California-Nevada state line. Floriston Rates provide water for hydropower, urban use in Truckee Meadows, instream flow, and agricultural water rights. In general, each reservoir has authorization to serve specific uses. Releases are made from the reservoirs as necessary to meet dam safety or flood control requirements and to serve water rights when unregulated flow cannot be diverted to serve those rights. Minimum reservoir release rates are maintained as specified in applicable agreements and the reservoir licenses.

Water is exported from this region through an interbasin diversion of from 6,000 to 10,000 acre-feet per year from the Little Truckee River in the vicinity of Henness Pass to Sierra Valley in the Sacramento River Hydrologic Region for agricultural use. This diversion began in the late 19th century. Of similar vintage is a diversion of a lesser amount, approximately 1,000 acre-feet per year, from Echo Lake south of Lake Tahoe into the Sacramento River Hydrologic Region for hydroelectric power generation.

In the southern half of the region, the east fork of the Carson River originates south of Ebbetts Pass in the Carlson-Iceberg wilderness at an elevation of 11,460 feet. The west fork of the Carson River originates near Lost Lakes at an elevation of 9,000 feet. The two forks cross the California-Nevada border and rejoin a mile southeast of Genoa, Nevada, to form the main stem. The only regulation on the Carson River in California is the relatively small (3,100 acre-feet) Heenan Lake Dam and Indian Creek Reservoir (3,100 acre-feet) on tributaries to the east fork of the Carson River.

Farther south on the Walker River, both Bridgeport Reservoir and Topaz Lake are large reservoirs operated by the Walker River Irrigation District to capture the spring snowmelt from the Sierra Nevada and provide summer irrigation water to Nevada farmers in that watershed. Because of the continuing lowering of the level of Walker Lake (the terminus lake for the Walker River) and resultant increase in total dissolved solids (TDS), water rights on the Walker River are currently being litigated.

Table NL-9 lists the major lakes and reservoirs in the North Lahontan region other than the US Army Corps of Engineer's Martis Creek Lake, which is listed in Appendix A, Table NLA-3 Flood control reservoirs, because it pertains only to flooding. The total storage capacity of these lakes is 1.181 million acre-feet excluding Eagle and Honey lakes, which vary depending on the wetness of the water year.

PLACEHOLDER Table NL-9 Major Lakes and Reservoirs in the North Lahontan Hydrologic Region

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Groundwater

The amount and timing of groundwater extraction, along with the location and type of its use, are fundamental components for building a groundwater basin budget and identifying effective options for groundwater management. Although some types of groundwater extractions are reported for some California basins, the majority of groundwater pumpers are not required to monitor, meter, or publicly record their annual groundwater extraction amounts.

Groundwater supply estimates furnished herein are based on water supply and balance information derived from DWR land use surveys, and from groundwater supply information voluntarily provided to DWR by water purveyors or other State agencies.

Groundwater supply is reported by water year (October 1 through September 30) and categorized according to agriculture, urban, and managed wetland uses. The associated information is presented by planning area (PA), county, and by the type of use. Reference to total water supply represents the sum of surface water and groundwater supplies in the region, and local reuse.

2005-2010 Average Annual Groundwater Supply and Trend

Water uses in the region are met through a combination of local surface water and groundwater supplies. Table NL-10 provides the 2005-2010 average annual groundwater supply by PA and by type of use, while Figure NL-11 depicts the PA locations and the associated 2005-2010 groundwater supply in the region. The estimated average annual 2005-2010 total water supply for the region is about 513 taf. Out of the 513 taf total supply, groundwater supply is 166 taf and represents about 33 percent of the region's total water supply; 84 percent (37 taf) of the overall urban water use and 27 percent (118 taf) of the overall agricultural water use being met by groundwater. Forty eight percent (11 taf) of managed wetland uses in the region are met by groundwater. Although statewide, groundwater extraction in the region accounts for only about one percent of California's 2005 - 2010 average annual groundwater supply, it accounts for nearly 100 percent of the supply for some local communities in the region.

PLACEHOLDER Table NL-10 North Lahontan Hydrologic Region Average Annual Groundwater Supply by Planning Area and by Type of Use (2005-2010)

PLACEHOLDER Figure NL-11 Contribution of Groundwater to the North Lahontan Hydrologic Region Water Supply by Planning Area (2005-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Regional totals for groundwater based on county area will vary from the PA estimates shown in Table NL-10 because county boundaries do not necessarily align with PA or hydrologic region boundaries. For the North Lahontan Hydrologic Region, county groundwater supply is reported for Lassen and Alpine Counties. Table NL-11 shows that the total groundwater supply in the two counties is about 129 TAF, with almost all of that pumping occurring in Lassen County. Groundwater supplies in Lassen County are used to meet about 33 percent of the agricultural water use, 81 percent of the urban water use, and 42 percent of the managed wetland use.

PLACEHOLDER Table NL-11 North Lahontan Hydrologic Region Average Annual Groundwater Supply by County and by Type of Use (2005-2010)

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More detailed information regarding groundwater water supply and use analysis is available online from Update 2013 Volume 4, Reference Guide, the article "California's Groundwater Update 2013."

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

Figures NL-12 and 13 summarize the 2002 through 2010 groundwater supply trends for the region. The right side of Figure NL-12 illustrates the annual amount of groundwater versus other water supply, while the left side identifies the percent of the overall water supply provided by groundwater relative to other water supply. The center column in the figure identifies the water year along with the corresponding amount of precipitation, as a percentage of the 30-year running average for the region. Figure NL-13 shows the annual amount and percentage of groundwater supply trends for meeting urban, agricultural, and managed wetland uses.

PLACEHOLDER Figure NL-12 North Lahontan Hydrologic Region Annual Groundwater Water Supply Trend (2002-2010)

PLACEHOLDER Figure NL-13 North Lahontan Hydrologic Region Annual Groundwater Supply Trend by Type of Use (2002-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Figure NL-12 indicates that the annual water supply for the region has fluctuated between 439 TAF in 2005 and 548 TAF in 2007. During the same period, groundwater supply has fluctuated between 142 TAF in 2005 and 180 TAF in 2007, and provided between 32 and 35 percent of the total water supply for the region. Figure NL-13 indicates that groundwater supply meeting agricultural use ranged from 69 to 76 percent of the annual groundwater extraction, while groundwater extraction meeting urban use ranged from 21 to 24 percent. The remaining groundwater extraction (four to seven percent) was used for meeting managed wetland use.

Geothermal

The City of Susanville pumps geothermally heated groundwater and uses it for heating its central district. This results in a diversion of approximately XX acre-feet of water per year, which is discharged to surface drainage and also re-injected. In addition in Cedarville the Surprise Valley High School, Elementary School and the Medical Clinic are heated by 130 °F water from geothermal wells 1860 and 1135 feet deep. The system discharges these waters at a rate of approximately 50 acre-feet per year to an irrigation ditch and an old mill pond. Also at the upper end of Surprise Valley as was noted in the 2009 Update, the Fort Bidwell Indian the reservation had drilled several geothermal wells that had been used for heating and an experimental aquaculture operation. In October 2007 another geothermal exploratory well was drilled at Fort Bidwell resulting in.

Reclaimed Water

Approximately 5,000 acre-feet of reclaimed municipal wastewater is exported annually out of the Lake Tahoe Basin by the South Tahoe Public Utility District for recharge and agricultural use in the Carson River watershed. A slightly smaller amount of sewage effluent, in aggregate, is also exported from the basin by two sanitary districts on the Nevada side of Lake Tahoe. In the 1970s, the state partnered with the Tahoe-Truckee Sanitation Agency to build a state-of-the-art, tertiary wastewater treatment plant north of the Lake Tahoe Basin to reclaim the wastewater and return about 5,600 acre-feet to the Martis Valley groundwater basin each year. Farther to the north, the Susanville Sanitary District reclaims more than 3,000 acre-feet of wastewater each year for use on nearby irrigated pasturelands.

Water Uses

The major agricultural use of water in the North Lahontan region is irrigated pasture or alfalfa, although garlic had been grown near Coleville in the south. Pasture and alfalfa can require three to four feet of water per acre each growing season. Grain crops require less only needing to be irrigated early in the season with one to one and one-half feet of water. Typically, surface water is used during the spring runoff from snowmelt fed streams and then groundwater is used to supplement that flow through the end of the irrigation season at the end of August. Urban water use is less than that for agriculture, but is of growing importance. The major increases in population are in the region's neighboring state, Nevada. Most California urban uses are supplied by groundwater; urban use is growing in the population centers of Truckee and the Lake Tahoe area and the city of Susanville. A major portion of the water resources in the Truckee River Basin are used for environmental enhancement, mostly in Nevada, except that instream flows in California are additionally met as the water flows from California to Nevada.

Drinking Water

The region has approximately 56 community drinking water systems. The majority (over 85%) of these community drinking water systems are considered small (serving less than 3,300 people), with most small water systems serving less than 500 people, see Table NL-12. Small water systems face unique financial and operational challenges in providing safe drinking water. Given their small customer base, many small water systems cannot develop or access the technical, managerial, and financial resources needed to comply with new and existing regulations. These water systems may be geographically isolated, and their staff often lacks the time or expertise to make needed infrastructure repairs; install or operate treatment; or develop comprehensive source water protection plans, financial plans, or asset management plans (US EPA 2012).

PLACEHOLDER Table NL-12 Summary of Large, Medium, Small, and Very Small Community Drinking Water Systems in the North Lahontan Hydrologic Region

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In contrast, medium and large water systems account for less than 15% of region's drinking water systems; however, these systems deliver drinking water to over 70% of the region's population. These water systems generally have financial resources to hire staff to oversee daily operations and maintenance needs and to plan for future infrastructure replacement and capital improvements. This helps to ensure that existing and future drinking water standards can be met.

Snowmaking

One use of water peculiar to the Lake Tahoe and Truckee basins is water used for snowmaking at ski areas. TROA contains special provisions for snowmaking water. Snowmaking water is mostly recovered through melting; therefore, a major fraction of snowmaking water under TROA would not be counted in calculating the allocation of water between California and Nevada. California is allowed 825 acre-feet per year, and Nevada is allowed 350 acre-feet per year. These must be reported, but they are not counted against either's allocation under TROA.

Water Conservation Act of 2009 (SB X7-7) Implementation Status and Issues

Four North Lahontan urban water suppliers have submitted 2010 urban water management plans to DWR. The Water Conservation Law of 2009 (SB X7-7) required urban water suppliers to calculate baseline water use and set 2015 and 2020 water use targets. The urban water management plans indicate the North Lahontan Hydrologic Region had a population-weighted baseline average water use of 265 gallons per capita per day with an average population-weighted 2020 target of 213 gallons per capita per day. The Baseline and Target Data for the North Lahontan urban water suppliers is available on the Department of Water Resources (DWR) Urban Water Use Efficiency website.

The Water Conservation Law of 2009 (SB X7-7) required agricultural water suppliers to prepare and adopt agricultural water management plans by December 31, 2012, and update those plans by December 31, 2015, and every 5 years thereafter. No plans were submitted from the North Lahontan Region. The region has no agricultural suppliers over the 25,000 threshold.

Water Balance Summary

Figure NL-14 summarizes the total developed water supplies and distribution of the dedicated water uses within this hydrologic region for the ten years from 2000 through 2010. As indicated by the variation in the horizontal bars for wet (1998) and dry (2001) years, the distribution of the dedicated supply to various uses can change significantly based on the wetness or dryness of the water year. The more detailed numerical information about the developed water supplies and uses is presented in Volume 5 Technical Guide, which provides a breakdown of the components of developed supplies used for agricultural, urban, and environmental purposes and Water Portfolio data.

PLACEHOLDER Figure NL-14 North Lahontan Hydrologic Region Water Balance by Water Year, 2001-2010

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

In the North Lahontan region, agricultural water use is the largest component of the developed water supply, as is environmental water for instream fish flows. Urban water uses in this region are a much smaller portion of the total. The water supply portion of Figure NL-4 also indicates that the largest supply source is from surface water flows followed by groundwater use and water reuse from agricultural runoff.

Presented in Table NL-13 is the total water supply available to this region for the ten years from 2001 through 2010, and the estimated distribution of these water supplies to all uses. The annual change in the region's surface and groundwater storage is also estimated, as part of the balance between supplies and uses. In wetter water years, water will usually be added to storage; but during drier water years, storage volumes may be reduced. Of the total water supply to the region, more than half is either used by native vegetation; evaporates to the atmosphere; provides some of the water for agricultural crops and managed wetlands (effective precipitation); or flows to Nevada and terminus lakes. The remaining portion, identified as consumptive use of applied water, is distributed among urban and agricultural uses and for diversions to managed wetlands. For some of the data values presented in Table NL-13, the numerical values were developed by estimation techniques, because actual measured data are not available for all categories of water supply and use.

PLACEHOLDER Table NL-13 North Lahontan Hydrologic Region Water Balance Summary, 2001-2010 (thousand acre-feet)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Project Operations

Truckee River Reservoir Operations

System operations are governed primarily by the managing entities of seven lakes and reservoirs, Lake Tahoe, Donner Lake, Prosser Creek Reservoir, Martis Creek Reservoir, Independence Lake, Stampede Reservoir, and Boca Reservoir. A total of 1.09 million acre-feet of useable storage is available for managing water supplies. Of this total useable storage, a maximum of 65,000 acre-feet of joint-use space is used for flood control on a seasonal basis. As much as possible, the flood-control operations of Martis and Prosser Creeks and Stampede and Boca Reservoirs are coordinated to limit Truckee River flows at Reno to 6,000 cubic feet per second (cfs). The useable storage in these reservoirs is the key element to operations within the basin.

Estimates of the downstream demands, water content of the snowpack, and capacity of these facilities to store and control releases downstream govern operations in any particular year. The operations of these facilities are described below.

Central to the current operations of the Truckee River are the Floriston flow rates (Floriston rates also abbreviated FR); these rates account for the flow of water that passes the gage at Farad, California, which is very near the California-Nevada border. These flow rates are a legacy of a paper mill that no longer exists, at Floriston, and run of the river hydroelectric plants some of which still exist and are fed by flumes that are routed along the sides of Truckee Canyon of the river's path toward Reno. The Truckee River is currently operated in accordance with a number of agreements, the most recent being the Truckee River Agreement (TRA) signed in 1935. In part, the agreement confirmed the Floriston rates. The parties agreed to operate Lake Tahoe and Boca Reservoir to meet Floriston rates, which were modified to supply water for irrigation and municipal purposes, and hydroelectric generation. Floriston rates currently vary between 300 and 500 cfs depending on Lake Tahoe elevation and season as shown in Table NL-14.

PLACEHOLDER Table NL-14 Basic Floriston Rates, Truckee River Flow at Farad (cfs)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

The Floriston rates required that there be a mean flow of water in the Truckee River near Floriston of 500 cfs during the period from March 1 to September 30, and 400 cfs between October 1 and the last day of February. The TRA required that if there was insufficient flow from the remaining portion of the Truckee River system to meet the Floriston rates, water would be released, if possible, from Lake Tahoe to maintain those specific rates of flow. These basic Floriston rates were modified by the TRA in the event of insufficient flows even as augmented by Lake Tahoe. The modified flows set forth therein are referred to as reduced Floriston rates. The reduced Floriston rates are dependent upon the level of Lake Tahoe and are as indicated in Table NL-15 below.

PLACEHOLDER Table NL-15 Reduced Floriston Rates, Truckee River Flow at Farad (cfs)

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If the Floriston rate flows set forth in the TRA is not being met by natural flow, water must be released from Lake Tahoe and/or Boca Reservoir to maintain the required rate of flow.

Lake Tahoe

When water from Lake Tahoe is available, it is released to maintain Floriston rates as follows:

- Release from Lake Tahoe if Lake Tahoe elevation is more than 6,225.5 feet above mean sea level (msl).
- Release from Boca Reservoir if Lake Tahoe elevation is less than or equal to 6,225.5 feet above msl.

When the Floriston rate is met without Lake Tahoe releases, sufficient water is released to maintain but not exceed minimum flows of 50 cfs from October 1 to March 31 and 70 cfs from April 1 to September 30 below Lake Tahoe Dam.

Donner Lake

Donner Lake has a capacity of 9,500 af. The dam at Donner Lake is operated to prevent the water surface elevation from exceeding 5,935.8 feet above mean sea level. If the lake elevation is less than 5,932.0 feet, no water can be released during June, July, and August. The elevation of Donner Lake must be lowered to 5,926.9 feet by November 15 to meet dam safety requirements. During normal operations, all inflow is released between November 15 and April 15. Donner Lake stores privately owned water, so releases are not used to meet Floriston rates.

Martis Creek Reservoir

Currently Martis Creek reservoir is operated in a spillway gates open mode only until seepage issues with the dam can be addressed. As such Martis Creek Reservoir is operated only as a flow through reservoir unless its inflow rate exceeds the capacity of the spillway gates at which point it would simply retard flow by storing it until reservoir levels lower until the reservoir again returns to the flow through condition.

Prosser Creek Reservoir

Prosser Creek Reservoir has a storage capacity of 29,800 af. It has to be drawn down to provide 20,000 af of storage space for flood control by November 1 of each year. Other than the flood control space requirement, up to 30,000 af of water can be stored in Prosser Reservoir from April 10 to August 10 if the Floriston rate and Truckee Canal demands are met and if Boca, Independence, and Stampede Reservoirs are full or at their flood control limits.

Independence Lake

The useable storage capacity of Independence Lake is 17,500 af. Truckee Meadows Water Authority (TMWA) has a pre-1914 right to store the first 3,000 acre-feet of water before the Floriston rate requirements are implemented. TMWA can store more water in Independence Lake only if Boca Reservoir is full and the Floriston rate is met. TMWA does not release water stored in Independence to meet Floriston Rates.

Stampede Reservoir

Stampede Reservoir has a storage capacity of 226,500 acre-feet. For flood control, Stampede Reservoir must be drawn down to have 22,000 acre-feet of storage space by November 1 of each year. A credit storage system has been established to use water supplies more efficiently to meet municipal and industrial demands as well as enhance the in-stream fishery; this system is currently in use and would likely be modified under should TROA go into effect. Under this system, water stored can be credited for various purposes if all other water right demands are met. The credit-storage operation cannot adversely affect other water rights. Other than the flood control space requirement, water can be stored in Stampede Reservoir if Boca Reservoir and Independence Lake are filled and if the Floriston rate is met. Because it has junior water rights and because it does not have a water right permit for the full capacity of the reservoir, Stampede Reservoir seldom fills.

Boca Reservoir

Boca reservoir has a storage capacity of 41,100 af. For flood control, Boca Reservoir must have 8,000 af of storage space by November 1 of each year. If the Floriston rates are met, the reservoir can store up to 25,000 acre-feet before meeting TCID demand downstream. Boca Reservoir can store up to 40,000 af if the Floriston rates and Washoe County Conservation District demands are met. Releases are made from the reservoir or Lake Tahoe to maintain the Floriston rates.

Heenan Lake Reservoir

The only significant reservoir in the Carson River watershed in the state of California is Heenan Lake Reservoir on Heenan Creek with a capacity of 3,100 af. It is owned by the California Department of Fish and Game and is used for the purpose of rearing trout. Its operations scheme is not known, but it is likely used just to provide pondage for the trout rather than actively for other purposes such as irrigation and certainly not for flood operations.

Bridgeport Reservoir

The second largest reservoir on the Walker River system is Bridgeport Reservoir located on the East Walker River. Completed in 1924, it is a 63-foot high dam that impounds approximately 44,000 acre-feet of water. Bridgeport Reservoir, along with Topaz Reservoir, constitutes Walker River Irrigation District's main facilities for water storage for agriculture in Nevada.

Topaz Reservoir

The largest reservoir on the Walker River system is the Topaz Reservoir located on the West Walker River. Completed in 1937, the reservoir has a capacity of 60,000 acre-feet and diverts water from the West Walker River via a 1,200-foot tunnel on the California side of the Lake to supply it. There is a canal on the Nevada side to return water back to the River.

Presented below in Table NL-16 are most of the other reservoirs in the region except some that are so small that they are not with the jurisdiction of the Division of Safety of Dams of the Department of Water Resources.

PLACEHOLDER Table NL-16 Operations of Other Reservoirs in North Lahontan Region by County from North to South

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Water Quality

The region's water is generally of high quality given its alpine origins, but can be affected by nitrate in some areas and historical chemical contaminants such as MTBE. Another distinct quality parameter is the presence of fine inorganic sediment in Lake Tahoe that restricts the clarity of the Lake. Other rivers and streams within the region are impaired by various other pollutants from metals in mining districts to pathogens in areas where grazing takes place.

Surface Water Quality

Priority Subregional Water Quality Issues/Status

Truckee River

Stressors within the Truckee River watershed are primarily related to nonpoint sources including the legacy effects from grazing, railroad construction, channel crossing and straightening, gravel mining and an extensive road network. In 2012, the Truckee River Watershed Council began restoration of the lower alluvial fan of Cold Creek channel to create 0.8 acres of floodplain; remove 4,995 tons of fine sediment from eroding streambanks; re-grade stream banks to sustainable slopes along 1,035 feet of stream channel; increase existing riparian habitat by 0.8 acres; and improve hydrologic function to restore natural process and reduce risk of future downstream erosion (Truckee River Watershed Council, 2013).

The middle Truckee River TMDL was approved by the Lahontan Regional Water Quality Control Board in May 2008 and by the U.S. Environmental Protection Agency in September 2009, as a plan to attain sediment-related water quality objectives to protect in-stream aquatic life beneficial uses (SWRCB, 2008). Flow events from thunderstorms, snow melt, and dam releases were producing turbidity spikes that exceeded the water quality objective and a TMDL for sediment was necessary. Population growth and urbanization within the surrounding region have also impacted the in-stream aquatic beneficial uses. The TMDL target is to reach the annual 90th percentile value of less than or equal to 26 milligrams per liter (mg/L) suspended sediment as measured at the Farad monitoring station (SWRCB, 2011). The TMDL indicators and implementation measures can be found on the State Water Boards website.

Lake Tahoe

The clarity and water quality in Lake Tahoe is of high importance and concern. A Regional Plan written by the Tahoe Regional Planning Authority seeks to reduce loads of sediment and algal nutrients to Lake Tahoe and restore 80 percent of disturbed lands that have not been developed to support the water quality objective of maintaining Lake Tahoe as an ultra-oligotrophic lake with unique clarity. Measures to achieve this water quality objective are as follows:

- Limit fertilizer use
- Restore 80% of disturbed lands
- Increase BMP disclosures in purchase documents for real estate and accelerate implementation of BMP's
- Focus on inspection and enforcement
- Limit sediment and dust mobilization at construction sites
- Prevent contamination from disposal of snow
- Amend the TRPA Code of Ordinances (code) to require traction sand to be resistant to pulverization in use and to be of low phosphorus content
- Adopt storm water plans for urban and undeveloped lands
- Incorporate BMP's in OHV trails or close them
- Adopt urban upland TMDL load allocations schedules and TRPA permits based on the same,

- Prohibit discharge of fertilizers on large turf areas
- Amend the Code to specify limits on fertilizer use
- Within Stream Environment Zones (SEZ's) prohibit the use of fertilizers and restore 25% of SEZ's disturbed by transportation facilities
- Establish water quality standards for SEZ's and prohibit new land coverage or permanent disturbance in SEZ's and encourage public acquisition of SEZ's
- Curb the current exemptions for the discharge of municipal or industrial waste in the region
- Restore natural flood plains and create incentives to relocate structures out of 100 year flood plains in high priority areas

In addition to specific measures recounted above, the U. S. Army Corps of Engineers, Sacramento District, funded the development of a (sediment) Load Reduction Planning Tool — a computer program that incorporates detailed land uses and surface characteristics to predict the sediment yield for a particular project. Three case studies were considered leading to a prediction of the reduction in sediment yield that could be expected for each development. The result was a projection of load reductions, which were very significant, on the order of 80 percent. Because it had been found that the major source of sediment was urban areas, over time as re-development occurred significant reduce in the sediment load and its effect on the clarity of Lake Tahoe would result. Although this is encouraging, another study of the rate of re-development and attendant water quality improvement measures concluded that the rate was not rapid enough to attain currently established goals (USACE, 2010).

<u>Carson, Susan, and Walker River</u>

Activities such as livestock grazing, camping, fishing, and mining, and the occurrence of droughts, floods, and wastewater effluent disposal have affected the water quality within the Carson and Walker River watersheds. The Lahontan Regional Water Quality Control Board has set sodium standards for the Carson and Walker river watersheds in Resolution R6T-2006-0047, amending the Basin Plan (SWRCB, 2007).

The Susan River watershed currently has three impaired segments at the Honey Lake Wildfowl Management Ponds and the Susan River. The Honey Lake Wildfowl Management Ponds contain approximately 665 acres that are impaired with metals, salinity, TDS, and chlorides from agriculture and geothermal development activities, and the Susan River contains approximately 58 miles that are impaired with mercury from an unknown source. The proposed TMDL completion date is 2019 (USDA, 2011).

Numeric water quality objectives for the Susan River watershed are defined in the Basin Plan for total dissolved solids, chloride, sulfate, boron, nitrogen, and phosphorus. Historical toxicity and pesticide detections in Susan River water samples violated the narrative water quality objectives for toxicity and pesticides contained in the Lahontan Basin Plan. Since the magnitude of toxicity in Susan River was found to be in the low to moderate level range and the source of toxicity was unknown a TMDL was not recommended (LRWQCB, 2005).

Groundwater Quality

Recently, the Water Boards completed a statewide assessment of community water systems that rely on contaminated groundwater. Contamination of local groundwater resources results in higher costs for ratepayers and consumers due to the need for additional water treatment. This report identified 10 community drinking water systems in the region that rely on at least one contaminated groundwater well as a source of supply (see Table NL-17). A total of 25 community drinking water wells are affected by groundwater contamination, and the most prevalent contaminants are arsenic and gross alpha particle activity, both naturally occurring contaminants (see Table NL-18). The majority of the affected systems are small water systems, which often need financial assistance to construct a water treatment plant or to obtain an alternate solution to meet drinking water standards.

PLACEHOLDER Table NL-17 Summary of Small, Medium, and Large Community Drinking Water Systems in the North Lahontan Hydrologic Region that Rely on One or More Contaminated Groundwater Well(s)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table NL-18 Summary of Contaminants Affecting Community Drinking Water Systems in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Groundwater Conditions and Issues

Groundwater Occurrence and Movement

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

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

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 groundwater levels rise, they reconnect to surface water systems, contributing to surface water base flow or wetlands, seeps, and springs.

The movement of groundwater is from areas of higher hydraulic potential to areas of lower hydraulic potential, typically from higher elevations to lower elevations. The direction of groundwater movement can also be influenced by groundwater extractions. Where groundwater extractions are significant, groundwater may flow towards the extraction point. Rocks with low permeability can restrict groundwater flow through a basin. For example, a fault may contain low permeability materials and restrict groundwater flow.

Depth to Groundwater

The depth to groundwater has a direct bearing on the costs associated with well installation and groundwater extraction operations. Understanding the local depth to groundwater can also provide a better understanding of the local interaction between the groundwater table and the surface water systems, and the contribution of groundwater aquifers to the local ecosystem.

Because of resource and time constraints, depth-to-groundwater contours for the region could not be developed as part of the groundwater content enhancement for Update 2013. However, depth-to-groundwater data for some of the groundwater basins in the region are available online via DWR's Water Data Library and the USGS National Water Information System.

Groundwater Elevations

Groundwater elevation contours can help estimate the direction of groundwater movement and the gradient, or rate, of groundwater flow. Although DWR monitors the depth to groundwater in some groundwater basins within the region, because of resource and time constraints groundwater elevation contours for the region could not be developed as part of the groundwater content enhancement for Update 2013.

Groundwater Level Trends

Plots of depth-to-water measurements in wells over time (groundwater level hydrographs) allow analysis of seasonal and long-term groundwater level variability and trend over time. Because of the highly variable nature of the physical aquifer systems within each groundwater basin, and because of the variable nature of annual groundwater availability, recharge, and surrounding land use practices, the hydrographs presented herein do not attempt to illustrate or depict average aquifer conditions over a broader region. Rather, the selected hydrographs are intended to help tell a story about how the local aquifer systems respond to changing groundwater pumping quantity and to the implementation of resource management practices. The hydrographs are designated according to the State Well Number System (SWN), which identifies each well by its location using the public lands survey system of township, range, section, and tract.

Hydrograph 41N16E35D003M

Hydrograph 41N16E35D003M (Figure NL-15A) is from an irrigation well in the Surprise Valley Groundwater Basin, with an unknown depth. The hydrograph shows a decline and recovery from the early 1970s through the 1990s and show a gradual recovery from the early 2000s to 2010. Overall, the hydrograph shows a declining groundwater levels trend since the early 1970s. There is also an overall increase in seasonal groundwater level fluctuations since the middle 1990s, with greater fluctuations during drought years due to increased groundwater pumping. For example, the seasonal fluctuations in groundwater levels during years of average hydrology vary from five to 10 feet, while the seasonal fluctuations in groundwater levels during drought periods (1976-77, 1988-91, 2001-2002, and 2007-09) vary from 10 to 20 feet. The Surprise Valley basin is designated as a CASGEM low priority basin.

Hydrograph 29N12E16M002M

Hydrograph 29N12E16M002M (Figure NL-15B) is from a domestic well located in the Honey Lake Valley Groundwater Basin that is constructed in the semi-confined portion of the upper aquifer system. The hydrograph shows a gradual decline and recovery of groundwater levels associated with the 1976-77 and the 1988-94 drought periods. Aquifer response to the recent 2008-2009 drought resulted in all-time lows for groundwater levels in the region, with levels about 25 feet below the 1976-77 drought and 15 feet below the 1986-1994 drought levels. Recovery from the 2007-2010 drought period has just begun with an above average water year in 2011. There is an overall trend of an increase in groundwater level fluctuations since the middle 1970s, with greater fluctuations during drought years due to increased groundwater pumping. For example, the hydrograph shows seasonal fluctuations in groundwater levels of about three to five feet during wet years, five to 10 feet during years of average hydrology, and 15 to 30 feet during drought periods. Honey Lake Valley basin is designated as a CASGEM low priority basin.

Hydrograph 17N17E29B001M
[To be written]

PLACEHOLDER Figure NL-15 Groundwater Level Trends in Selected Wells in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Change in Groundwater Storage

Change in groundwater storage is the difference in stored groundwater volume between two time periods. Examining the annual change in groundwater storage over a series of years helps identify the aquifer response to changes in climate, land use, or groundwater management over time. If the change in storage is negligible over a period represented by average hydrologic and land use conditions, the basin is considered to be in equilibrium under the existing water use scenario and current management practices. However, declining storage over a period characterized by average hydrologic and land use conditions does not necessarily mean that the basin is being managed unsustainably or subject to conditions of overdraft. Utilization 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 conjunctive water management. *Additional information regarding the risks and benefits of conjunctive management can be found online from Update 2013 Volume 3, Chapter 9, the article "Conjunctive Management and Groundwater Storage Resource Management Strategy*."

Because of resource and time constraints, changes in groundwater storage estimates for basins within the region were not developed as part of the groundwater content enhancement for the CWP Update 2013.

Flood Management

Traditionally, the approach to flood management was to develop narrowly focused flood infrastructure projects. This infrastructure often altered or confined natural watercourses, which reduced the chance of flooding thereby minimizing damage to lives and property. This traditional approach looked at floodwaters primarily as a potential risk to be mitigated, instead of as a natural resource that could provide multiple societal benefits.

Today, water resources and flood planning involves additional demands and challenges, such as multiple regulatory processes and permits, coordination with multiple agencies and stakeholders, and increased environmental awareness. For example, in Alpine County, the Markleeville Creek Floodplain Restoration Project is designed to re-establish the natural form and function of Markleeville Creek as it flows through the former site of a U.S. Forest Service Guard Station. In Nevada County, the Trout Creek Restoration Project (Reaches 4 and 5) would require infrastructure improvements to create the ideal stream restoration alignment. Infrastructure improvements include adjusting the Glenshire Drive alignment and constructing two new bridges across Trout Creek to support the relocated balloon track.

Flood management challenges in the North Lahontan Hydrologic Region include:

- Inadequate flood information, including maps and data
- Inconsistent control of upstream water sources
- Aging and undersized flood infrastructure
- Inadequate flood risk awareness

The identified issues were based upon interviews with ten agencies with varying levels of flood management responsibilities in each county of the hydrologic region. For a list of agencies with flood management responsibility in the North Lahontan Hydrologic Region that participated in these meetings, refer California's Flood Future Report Attachment E: Information Gathering Technical Memorandum.

Damage Reduction Measures

Flood exposure in the North Lahontan Hydrologic Region occurs along the Walker River Basin in Mono County; Trout Creek in El Dorado County; Truckee, Carson, Walker, and Susan Rivers in Placer County; Truckee River and Martis Creek in Nevada County; and Susan River in Lassen County. Floods within the region originate principally from melting of the Sierra snowpack and from rainfall. Most flood events occur in December and January as a result of multiple storms and saturated soil conditions, but floods can occur in October and November or during the late winter or early spring months.

In the North Lahontan Hydrologic Region more than 4,000 people and over $823 million in assets are exposed to the 500-year flood event. Figure NL-16 and NL-17 provide a snapshot of people, structures, crop value, and infrastructure, exposed to flooding in the region for the 100-year and 500-year floodplain. Over 110 state and federal threatened, endangered, listed, or rare plant and animal species exposed to flood hazards are distributed throughout the North Lahontan Hydrologic Region.

PLACEHOLDER Figure NL-16 Flood Hazard Exposure to the 100-Year Floodplain in the North Lahontan Region

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PLACEHOLDER Figure NL-17 Flood Hazard Exposure to the 500-Year Floodplain in the North Lahontan Region

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Levee Performance and Risk Studies

Flood Hazard mitigation planning is an important part of emergency management planning for floods and other disasters. Hazard Mitigation is defined as any sustained action taken to reduce or eliminate long-term risk to human life and property from hazards.

In the North Lahontan Hydrologic Region 14 local flood management projects or planned improvements were identified. Four of these projects have identified costs totaling approximately $17 million while the remaining projects do not have costs associated with them at this time. Five local planned projects use an integrated water management approach to flood management, including the Markleeville Creek Restoration Project and the Susan River Parkway Project. These identified projects and improvements are summarized in the California's Flood Future Report Attachment E: Information Gathering Technical Memorandum.

Water Governance

Agencies with Responsibilities

Of the 140 separate entities that manage water in this hydrologic region, a few are listed below in Table NL-19; it includes those Nevada interests that control most of the water in the region.

PLACEHOLDER Table NL-19 Water Management Entities

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Flood Governance

California's water resource development has resulted in a complex, fragmented and intertwined physical and governmental infrastructure. Although primary responsibility might be assigned to a specific local entity, aggregate responsibilities for flood management are spread among more than 26 agencies in the North Lahontan Hydrologic Region with many different governance structures

The North Lahontan Hydrologic Region contains four small floodwater storage facilities and channel improvements that have been built by the U.S. Army Corps of Engineers (USACE) or the U.S. Bureau of Reclamation (Reclamation). For a list of major infrastructure, refer California's Flood Future Report Attachment E: Information Gathering Technical Memorandum. The North Lahontan Hydrologic Region contains floodwater storage facilities and channel improvements funded and/or built by the State and federal agencies. Flood management agencies are responsible for operating and maintaining approximately 25 miles of levees, more than 60 dams and reservoirs, and other facilities within the North Lahontan Hydrologic Region. Reservoirs with flood control capability have been built by USACE, Reclamation, and DWR on Prosser Creek, the Little Truckee River, and Martis Creek.

Truckee River Operating Agreement

As of September 2013, TROA is yet to be implemented and may not be implemented for years. While TROA is pending, a number of decrees and agreements govern the operation of the Truckee River system and take into consideration the urban uses, agricultural uses, and environmental needs including the level of Pyramid Lake and the well-being of its cui-ui population. The primary agreements and decrees are General Electric Decree (1913, US District Court, Eastern District of CA); Truckee River Agreement (1935); Decree C-125 (1940, US District Court, Reno NV) pertaining to the Walker River; Orr Ditch Decree (1944, US District Court, Reno NV); and the Alpine Decree (1980, US District Court, Reno NV), which apportions the waters of the Carson River. Other decrees, agreements, and administrative regulations also affect the operation of the Truckee River. The California-Nevada Interstate Compact (1971) was ratified by both states, but not by Congress, which must ratify all such compacts before they take effect. However, California and Nevada both have policies to abide by the compact, and its terms informed the provisions of TROA. The above pre-TROA documents impose an operating regime on the

Truckee River system that is inflexible in terms of storage and water releases but that TROA would improve upon. Public Law 101-618 (1990), the Truckee-Carson-Pyramid Lake Water Rights Settlement Act, (Settlement Act) will go into effect once TROA is implemented. The Settlement Act will settle numerous lawsuits over Truckee River water rights, formally allocate the waters between the states of California and Nevada, adopt the Alpine Decree, and usher in river operations pursuant to the more flexible terms of TROA.

TROA identifies instream flow requirements for the Truckee River system at various points (Table NL-20). TROA establishes “bypass flows” or flows that are not to be diverted into hydropower stations on the Truckee Canyon reach of the main stem of the Truckee River. Instream flows have not been established for the Carson River in California because there are no regulation facilities on that river except Heenan reservoir. As a result of drought effects on fish, the California State Water Resources Control Board (State Water Board) issued a decision that a minimum instream flow of 20 cubic feet per second should be maintained below Bridgeport Dam on the East Walker River.

PLACEHOLDER Table NL-20 Flow Requirements for Truckee River System

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Groundwater Governance

California does not have a statewide management program or statutory permitting system for groundwater. However, one of the primary vehicles for implementing local groundwater management in California is a Groundwater Management Plan (GWMP). Some agencies utilize their local police powers to manage groundwater through adoption of groundwater ordinances. Groundwater management also occurs through other avenues such as basin adjudication, integrated regional water management plans, urban water management plans, and agriculture water management plans.

Groundwater Management Assessment

Figure NL-18 shows the location and distribution of the GWMPs within the region based on a GWMP inventory developed through a joint DWR/Association of California Water Agencies (ACWA) online survey and follow-up communication by DWR in 2011-2012. Table NL-21 furnishes a list of the same. GWMPs prepared in accordance with the 1992 AB 3030 legislation, as well as those prepared with the additional required components listed in the 2002 SB 1938 legislation are shown. Information associated with the GWMP assessment is based on data that was 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 current GWMP assessment.

PLACEHOLDER Figure NL-18 Location of Groundwater Management Plans in the North Lahontan Hydrologic Region (figure is being updated)

PLACEHOLDER Table NL-21 Groundwater Management Plans in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

The GWMP inventory indicates that four groundwater management plans exist within the region although none of the four GWMPs are fully contained within the region. All of the four GWMPs cover areas overlying Bulletin 118-2003 alluvial groundwater basins. However, three plans also include areas that are not identified in Bulletin 118-03 as alluvial basins. Collectively, the four GWMPs cover 1,300 square miles. This includes about 800 square miles (50 percent) of the Bulletin 118-2003 alluvial groundwater basin area in the region. Three of the four GWMPs have been developed or updated to include the SB 1938 requirements and are considered active for the purposes of Update 2013 GWMP assessment. As of August 2012, one of the two the basins identified as medium priority under the CASGEM Basin Prioritization (see Table NL-GW-3) was not covered by an active GWMP, but by a pre-SB1938 GWMP; the other medium priority basin was not covered by any GWMP. The two medium priority basins account for about 55 percent of the population and about XX percent of groundwater supply for the region.

Based on the information compiled through inventory of the GWMPs, an assessment was made to understand and help identify groundwater management challenges and successes in the region, and provide recommendations for improvement. Information associated with the GWMP assessment is based on data that were readily available or received through August 2012 by DWR. The assessment process is briefly summarized below.

The California Water Code §10753.7 requires that six components be included in a groundwater management plan for an agency to be eligible for state funding administered by DWR for groundwater projects, including projects that are part of an integrated regional water management program or plan (see Table NL-22). Three of the components also contain required subcomponents. The requirement associated with the 2011 AB 359 (Huffman) legislation, applicable to groundwater recharge mapping and reporting, did not take effect until January 2013 and was not included in the current GWMP assessment. In addition, the requirement for local agencies outside of recognized groundwater basins was not applicable for any of the GWMPs in the region.

In addition to the six required components, Water Code §10753.8 provides a list of twelve components that may be included in a groundwater management plan (Table NL-22). 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 plan (NL-22).

As a result, the GWMP assessment was conducted using the following criteria:

- How many of the post SB 1938 GWMPs meet the six required components included in SB 1938 and incorporated into California Water Code §10753.7?
- How many of the post SB 1938 GWMPs include the twelve voluntary components included in California Water Code §10753.8?
- How many of the implementing or signatory GWMP agencies are actively implementing the seven recommended components listed in DWR Bulletin 118 - 2003?

PLACEHOLDER Table NL-22 Assessment for SB 1938 GWMP Required Components, SB 1938 GWMP Voluntary Components, and Bulletin 118-03 Recommended Components

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

In summary, assessment of the groundwater management plans in the North Lahontan Hydrologic Region indicates the following:

- One of the three active GWMPs adequately address all of the required components identified in WC §10753.7; the two plans that fail to meet all the required components, do not address the Basin Management Objective (BMO) and Monitoring Protocol subcomponents for surface water-groundwater interaction or provide required maps. Analysis of the GWMPs for other regions also reveals that when a plan lacks BMO details for surface water and groundwater interaction, it generally lacks details for Monitoring Protocols as well.
- One of the three active GWMPs incorporate the 12 voluntary components listed in Water Code §10753.8, one plan incorporates nine and the other plan incorporates seven of the 12 voluntary components.
- Two of the three active GWMPs include all seven components, and the remaining plan includes five of the seven components recommended in Bulletin 118-03.

The DWR/ACWA survey asked respondents to identify key factors that contributed to the successful implementation of the agency's GWMP. Only one agency from the region participated in the survey. The responding agency identified sharing of data and ideas, broad stakeholder participation, adequate surface water supplies and surface storage and conveyance systems, and adequate funding as key factors to successful GWMP implementation.

Survey participants were also asked to identify factors that impeded implementation of the GWMP. Two survey respondents pointed to limited participation and data collection and sharing of information as impediments to GWMP implementation. Funding, unregulated pumping, access to planning tools, and outreach and education were also identified as factors that impeded successful implementation of GWMPs. Funding is a challenging factor for many agencies because the implementation and the operation of groundwater management projects typically are expensive and because the sources of funding for projects typically are limited to either locally raised monies or to grants from State and federal agencies.

Finally, the survey asked if the respondents were confident in the long-term sustainability of their current groundwater supply. The two respondents felt long-term sustainability of their groundwater supply was possible.

The responses to the survey are furnished in Tables NL-23 and NL-24. *More detailed information on the DWR/ACWA survey and assessment of the GWMPs are available online from Update 2013 Volume 4, Reference Guide, the article "California's Groundwater Update 2013."*

PLACEHOLDER Table NL-23 Factors Contributing to Successful Groundwater Management Plan Implementation in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

PLACEHOLDER Table NL-24 Factors Limiting Successful Groundwater Management Plan Implementation in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

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 that State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage groundwater under their police powers. Since 1995, the *Baldwin v. Tehama County* decision has remained untested; thus the precise nature and extent of the police power of cities and counties to regulate groundwater is still uncertain.

There are a number of groundwater ordinances that have been adopted by counties in the region (Table NL-25). The most common ordinances are associated with groundwater wells. These ordinances regulate well construction, abandonment, and destruction. Five of the counties in the region have groundwater ordinances requiring a permit for transferring groundwater out of the basin. Only a few of groundwater ordinances in the region stipulate establishing Basin Management Objectives (BMOs) and guidance committees. None of the ordinances in the region address groundwater recharge.

PLACEHOLDER Table NL-25 Groundwater Ordinances that Apply to Counties in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Special Act Districts

Greater authority to manage groundwater has been granted to a few local agencies or districts 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 to levy replenishment fees. There are no Special Act Districts in the North Lahontan Hydrologic Region.

Court Adjudication of Groundwater Rights

Another form of groundwater management in California is through the courts. There are currently 24 groundwater adjudications in California. The North Lahontan Hydrologic Region does not have any adjudicated groundwater basins.

Other Groundwater Management Planning Efforts

Groundwater management also occurs through other avenues such as integrated regional water management (IRWM) plans, urban water management plans, and agriculture water management plans. Box NL-2 summarizes these other planning efforts.

PLACEHOLDER Box NL-2 Other Groundwater Management Planning Efforts in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Current Relationships with Other Regions and States

Because the river channels of the Truckee, Carson, and Walker rivers naturally flow into Nevada, a large amount of the surface water from these watersheds has historically been reserved for use by Nevada interests under various interstate water rights settlements and agreements.

There are three small historical exports of surface water out of the North Lahontan region. At Echo Lakes in the upper Lake Tahoe Basin, an average of about 703 acre feet per year is exported through the Echo Lake Conduit into the south fork of the American River in the Sacramento River region in conjunction with a hydroelectric power development (Project 184) that began in 1876. Another water export of from 6,000 to 10,000 acre-feet per year is taken from the upper reaches of the Little Truckee River for irrigation use in Sierra Valley (a part of the Feather River Basin within the Sacramento River Hydrologic Region). At the southern end of the North Lahontan region, a third small water diversion from Virginia Creek provides approximately 1,000 acre-feet per year of surface water to the Mono Lake Basin in the South Lahontan Hydrologic Region for summer irrigation purposes.

The only water import into the North Lahontan region occurs in northern Lassen County, where an average of about 3,000 acre-feet is imported from Moon Lake in the South Fork of the Pit River (Sacramento River Hydrologic Region) for irrigation in the Madeline Plains area.

The rivers of the region all flow eastward from mountain valleys which provide sites for dams therefore all the flood control on the Truckee River system is exercised in California at the aforementioned Boca, Prosser and Stampede dams whose flood functions are controlled by the U.S. Army Corps of Engineers notwithstanding the fact that the dams are owned by the U.S. Bureau of Reclamation. This flood control may have some effect in California, but basically are in place to keep the Truckee River flows in Reno, Nevada below 6,000 cubic feet per second. These dams are currently being raised by small increments to be able to contain newly imposed maximum credible events. In addition, the Reno area is working to put into place greater capacity channels because the 1997 flood overwhelmed the current channels.

On the Carson River there is no real means of regulating flow and floods such as those in 1997 flooded populated areas of the Carson Valley. Likewise there is effectively no regulation on either of the Walker Rivers in California, notwithstanding the existence of Bridgeport and Topaz lakes which simply pass flood flows, but the downstream areas are not as populated as the neighboring state areas in the Carson River Valley so much of the damage from the 1997 flood occurred to California infrastructure.

The inter-regional water operations affect recreation in Nevada in the terms of the level of Pyramid Lake, which in prior days was the home to very large Lahontan Cutthroat Trout (LCT). With the passage of time after water began to be diverted away from flow into Pyramid Lake recreational values in terms of the size and numbers of fish declined because of disrupted migratory pathways to spawning beds. TROA, has, as one of its objectives, the restoration of LCT populations through more flexible control of flows, which would have a beneficial effect on recreation within Nevada. On a smaller scale TROA contains provisions concerning the amount of water that may cross the border in the form of artificially made snow. In water year 2011 rafting in the Truckee Canyon in Nevada was initiated because of the ample flows provided by that wet year. This is not the ordinary case however as much of the rafting industry activity is located in the Truckee River in a short reach just below Tahoe Dam. Regulation of flows under the existing agreement that regulates the interstate flow of water in the Truckee River has had the effect of delaying the date on which California rafting can begin. Water skiing in California lakes can be limited by lake levels therefore if lakes are drawn down perhaps by fish procreation needs in Nevada during the water skiing season that constitutes another inter –regional recreational effect of water operations.

The lower meandering streams of the Carson, Truckee and Walker rivers are famous for trout fly-fishing and offer water sports, hiking, and camping with the eastern sierra as a backdrop. On a typical day in the high country, visitors may well out number full-time residents. The flow needed to insure recreational opportunities such as the ones listed above, are inherently subject to the agreed upon flows between the two states.

Interregional and Interstate Planning Activities

The TROA process extended over two decades in an attempt to coordinate the releases from the storage in the Sierras and has accomplished a degree of interstate planning in as much as the TROA EIS looks out into the future to 2030 in its impact analyses.

Under the SECURE Water Act the U.S. Department of Interior, Bureau of Reclamation (USBR) established the WaterSMART (Sustain and Manage America's Resources for Tomorrow) in February 2010 under which it is conducting a Truckee Basin Study the purpose of which is to project the water supplies for the next fifty years including the effects of climate change. The USBR also conducted an updated flood analysis, which resulted in a more extreme maximum credible [flood] event and caused them to raise the height of local flood control dams by a few feet. The USACE study of what to do about the collapse hazard at Martis Dam might also be considered and interstate planning activity because Martis Dam's purpose is to protect the Truckee Meadows area including Reno from floods.

Practicing Resource Stewardship

The level of stewardship in the immediate vicinity of Lake Tahoe is high in that it is classified as an Outstanding National Water Resource that has received top tier recognition both nationally and internationally through such organizations as the Tahoe-Baikal Institute linking it with Lake Baikal southern Siberia. In addition there are numerous governmental and non-governmental organizations concerned with environmental stewardship such as Caltrout, Trout Unlimited, The Truckee River Watershed Council, the Sierra Conservancy, the Sierra Club numerous resource conservation districts and many more organizations that are constantly proposing improvements in environmental stewardship. Outside the shadow of notoriety cast by Lake Tahoe and its environs there are trail councils, river councils and numerous other organizations intent on improving the relationship of society with the environment.

Regional Water Planning and Management

IRWM regions have been formed in the Truckee and Carson River basins (Tahoe-Sierra IRWM region), the East and West Walker River basin (Inyo-Mono IRWM region) and the Madeline Plains, Honey-Eagle Lake, and Smoke Creek basins (Lahontan Basins IRWM region). The Tahoe-Sierra IRWM region is currently in the process of updating their integrated regional water management plan, which is tentatively scheduled to be completed by June 2015. The Inyo-Mono IRWM region adopted an updated integrated regional water management plan in November 2012, which is intended to serve as a primary reference for water resources management in the Inyo-Mono region. The Lahontan Basins IRWM region was approved by DWR in the region acceptance process in September 2011 and is at a more formative stage in the planning process, compared to Tahoe-Sierra and Inyo-Mono.

Between 2000 and 2010, the population of both the Lahontan Basins and Inyo-Mono IRWM regions did not change rapidly; while the population of the Truckee area in the Tahoe-Sierra IRWM region increased 14 percent and the Tahoe portion of that region decreased 9 percent.

Since the Tahoe-Sierra region encompasses the Truckee and Carson Rivers, the region is subject to decrees and agreements of many decades duration and could at least prospectively be covered by the more encompassing Truckee River Operating Agreement if it should go into effect after the resolution of pending litigation. The Walker Rivers, subject to the C-125 decree, are also in litigation and in the process of being re-operated in a way to provide more water to continuingly declining and more saline Walker Lake.

The Lake Tahoe Basin, part of the Tahoe-Sierra IRWM region, is within the area covered by the California Tahoe Conservancy (CTC), a state agency within the Department of Natural Resources. The CTC is the owner of over 4,800 parcels of undeveloped land, including urban lots, in the basin totaling over 6,000 acres acquired for the protection of natural resources and open space. The CTC has undertaken many projects that have preserved the environment and enhanced recreational opportunities. The Sierra Nevada Conservancy region boundary surrounds the CTC and includes the Truckee River Basin along with the counties of Modoc, Lassen, Alpine, and the northern portion of Mono. The Sierra Nevada Conservancy is also a state agency that was created in 2004 and supports working forests, watershed health, and recreational projects in its area. The Sierra Nevada Conservancy has acquired land or conservation easements on land, has supported projects in the hydrologic region at Independence Lake, Lacey Meadows, and Webber Lake on the Little Truckee River, and in Cold Stream Canyon feeding Donner Creek.

IRWM Planning and Projects

IRWM promotes the coordinated development and management of water, land, and related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Flood management is a key component of an integrated water management strategy. In the future, IRWM planning efforts will need to be coordinated with flood management planning efforts. Historically, this has been a challenging task because the agencies involved with IRWM and flood management tend to have different regional boundaries with sometimes-conflicting goals and objectives. Where the regional boundaries overlap, a great effort of coordination and prioritization will need to occur to put forward multi-benefit projects that will improve public safety, foster environmental stewardship, and support economic stability within the region. More reliable funding and improved agency alignment are required at all levels. Updated technical and risk management approaches will be needed to protect the public from flooding by assessing risk, as well as by improving flood readiness, making prudent land use decisions, and promoting flood awareness. Project implementation methods could benefit from integrated water management-based approaches to leverage the limited funding and other flood management resources. In short, future solutions should be aligned with broader watershed-wide goals and objectives and must be crafted in the context of integrated water management.

The Tahoe-Sierra IRWM

The Tahoe-Sierra IRWM was formed to represent the diverse interests of the Eastern Sierra watersheds from Alpine County through the Lake Tahoe Basin and Truckee areas. The Tahoe-Sierra IRWM regional water management group members are signatories to a Memorandum of Understanding (MOU) that facilitates the implementation of the Tahoe-Sierra IRWM Plan. The Tahoe-Sierra IRWM Plan integrates a set of coordinated strategies for the management of water resources and for the implementation of projects that protect Tahoe-Sierra communities from drought, protect and improve water quality, and improve local water security. The Tahoe-Sierra IRWM Plan goals are to.

1. Protect and improve water quality;
2. Protect the community water supply;
3. Manage the groundwater for sustainable yield;
4. Contribute to ecosystem restoration; and
5. Implement integrated watershed management through the Tahoe-Sierra region.

The Tahoe-Sierra IRWM has obtained a round 1 and round 2 planning grant, along with a $1.4 million round 1 implementation grant. The planned projects in the implementation grant are scheduled for completion in 2016 and consist of the following:

- Community Watershed Planning: Community Conservation Planning and Implementation Effort on a Sub-Watershed Level
- Town of Truckee – Water Quality Monitoring Program
- Little Truckee River Restoration and Bridge Replacement Project
- Negro Canyon Restoration:. Sediment Removal in Negro Canyon
- Regional Water Conservation Program
- Montgomery Estates Erosion Control Project: Install best management practices in South Lake Tahoe's Montgomery Estates Subdivision
- Griff Creek Water Quality Improvements: Stream Environment Zone improvements for sediment transport and fish passage

The Inyo-Mono IRWM

The Inyo-Mono IRWM regional water management group's mission is to research, identify, prioritize, and act on regional water issues, and related social and economic issues, to protect and enhance the region's environment and economy. The Inyo-Mono IRWM regional water management group members are signatories to an MOU that facilitates the implementation of the Inyo-Mono IRWM Plan.

As stated above, the Inyo-Mono IRWM Plan was recently adopted and the Inyo-Mono IRWM was recently awarded a round 2 planning grant for fulfilling plan standards through focused planning studies and programmatic operations. The focused tasks are to (1) sustain and build upon Inyo-Mono IRWM Program Operations; (2) conduct planning studies; (3) enhance integration of climate change information into the Inyo-Mono IRWM Planning process; (4) incorporate data management information and GIS data on the Inyo-Mono IRWM Plan website; (5) identify and establish stable sources of funding for the Inyo-Mono IRWM Plan; and (6) integrate and update the Inyo-Mono IRWM Plan to meet DWR's 2012 IRWM Plan Standards. The Inyo-Mono IRWM received a $1.08 million round 1 implementation grant to fund seven projects in the region:

- Safe Drinking Water and Fire Water Supply Feasibility Study for Tecopa
- Coleville High School Water Project
- Round Valley Joint Elementary School Water Supply Reliability Enhancement

- New Hilltop Well
- Well Rehabilitation (Phase I)
- Laws, Independence, and Lone Pine Pump Operation Redundancy and SCADA Improvements
- CSA-2 Sewer System Upgrade

Lahontan Basins IRWM

The purpose of the Lahontan Basins IRWM efforts is to expand and enhance the collaborative network of water management agencies to effectively manage all aspects of water use and conservation within the region, and across regions. The Lahontan Basins IRWM region occupies an enclosed watershed in the northern portion of the North Lahontan Hydrologic Region. The region includes the Madeline Plains, Honey-Eagle Lake, and the Smoke Creek sub-basins. Lassen County, Honey Lake Valley Resource Conservation District, Lassen Irrigation Company, and the City of Susanville are the four signatories that have signed an MOU.

The Lahontan Basins IRWM has not received any planning or implementation grant funds and as of September 2013, has not created an IRWM Plan. Much of the water management history has been involved in assuring reliable water supplies (including quantity and quality) to support agriculture in the region and in maintaining good water quality in support of local fish populations, some of which are endemic to the basin. Other water management issues include impairments for salinity and metals of the Susan River and Honey Lake; maintaining levels of and nutrient impairments in Eagle Lake; and invasive species and groundwater management in the Long Valley Creek drainage.

Regional Studies

Currently Perazzo Meadows, restored in 2011, is being monitored to determine the effects of restoration. There is no controversy about the fact that such restorations generally raise the water table in the area restored and change the vegetation back to what it had been and eliminates sage brush, but there currently isn’t any accepted proof that base flows are increased in dry months. There is the argument that what water is stored in the meadow is not given back during such periods and goes to deep percolation and increased transpiration. Judging from more extended experience just over the crest of the Sierras from Honey Lake to the west in Plumas County, a definitive answer to the question of augmentation of base flow may not be known for more than a decade after project completion and thus is beyond the scope of this report.

The UC Davis Tahoe Environmental Research Center continues to study the factors affecting the clarity of Lake Tahoe and, in addition, other water quality and environmental factors that weigh on the restoration and sustainable use of the Lake Tahoe basin. Among these factors is the trophic state of the Lake. The trophic index of the Lake was found to have not changed significantly over the past 30 years while at the same time trend of the primary production of algae has been increasing over that time period and longer. Another study of the Asian clam, an invasive species, infestation was studied by covering two one half acre sections of the lake bottom with rubber mats to determine if that would eradicated them which to a large degree it did. Another invasive species concern, which is being proactively responded to, is whether quagga mussels can reproduce in Lake Tahoe. The pro-active response has been to inspect all boats entering the lake for quagga infestations with the result that of the 20,446 inspections conducted quaggas were found on only 10 boats. In parallel, the ability of the quagga to reproduce in Lake Tahoe’s relatively cool, relatively calcium, poor water is being studied. DWR studied the occurrence of quaggas in lakes throughout the state and characterized the properties of the lakes in which they can thrive and found that Lake Tahoe is not a good environment for them. University of Nevada Reno researcher Sudeep Chandra had found that adult quaggas could survive in Lake Tahoe water, but at the time of this report is not 100 percent certain that they could reproduce in the lake and therefore establish themselves in that lake even if accidently introduced.

Challenges

Drought and Flood Planning

TROA contains a detailed scheme for re-operating the reservoirs on the Truckee River that will result in water releases that are better timed to meet needs and, therefore, prevent the wasteful use of water. Additionally TROA contains specific rules that are effective during drought conditions. In order to achieve the rescheduled releases that are at the heart of TROA water must be accumulated in the Truckee reservoirs for later release. Each reservoir has accounts for the water being stored in it that will make up the re-scheduled releases. One of the complications is that certain of the water accounts include evaporative losses and some do not pursuant to the terms of TROA. The U.S. Watermaster's office in Reno is developing a computer program written in a computer programming environment known as "RiverWare" which is an object oriented program language that is a product of collaboration between the USBR and the Center for Advanced Decision Support for Water and the Environment (CADSWES) an adjunct of the University of Colorado at Boulder

RiverWare is a definite improvement over current spreadsheet programs, which were used to keep track of the water in the Truckee River. RiverWare allows a diagram of the interconnected river system to be placed on the computer screen from which the program generates water balance equations for the "objects", such as a reservoir placed on the system diagram. Extensive rule sets are input to the model that then calculates the amounts of water in the various reservoirs and the flows in the channels that connect to the reservoirs and lakes. With the system thus specified one can project what the state of storage will be in the future, up to fifteen months for the operations model version of the TROA RiverWare model. Even more importantly the TROA RiverWare model will be able to account for all the various forms of water credits that are accumulated given TROA's rules that provide for holding back releases and then releasing them at the most opportune moment. Given the complexities of TROA it is probable that current methods would not be up to the task of keeping track of all the water in the system. Thus the application of modern technology and computer tools is leading to the more efficient management of water.

Drought Contingency Plans

Drought periods in the North Lahontan Region are inconsistent in their timing and persistence. The area goes through periods of heavy rain/snowfall and extreme drought. The fickleness of the weather and randomness of rainfall illustrates the need for drought plans that manage drought for short- and long-term drought periods. A drought plan is in place for major portions of the region held by the US Bureau of Land Management. TROA contains drought provisions also, but those pertain mostly to operations that affect Nevada entities because the Sierra Nevada in California is their major source of surface water.

The North Lake Tahoe Public Utility District, Placer County Water Agency, South Lake Tahoe Public Utility District, Tahoe City Public Utility District and the Truckee Donner Public Utility District have drought contingency plans in their Urban Water Management Plans. In addition the Squaw Valley Public Service District has conducted an analysis that indicates in an extended drought that its groundwater sources would be inadequate and is exploring the possibility of receiving imported water. The Tahoe City Public Utility District adopted an ordinance on June 23, 2009, which included a drought preparedness response plan.

PLACEHOLDER Photo NL-5 Dec. 2011(left) - April 2012 (right) Snow Levels Illustrating Randomness of Precipitation

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Water Supply Reliability

As has been mentioned agriculture in the region is practiced only to the extent water is available thus operating in what could be considered a perpetual drought in that the amount of production is strictly limited by the amount of water available in any given year. For instance the number of cuttings of alfalfa, the predominate crop, is limited by the amount of water available. In the context of agronomy as it is practiced in the agricultural portions of the North Lahontan Region, reliability of water supply is taken to mean the variation from year to year of the quantity of water available and is set given the amount of precipitation. As has also already been discussed water is spread on fields early in the season from surface water sources and then the length of the growing season is determined by the availability of supplemental groundwater. The groundwater in the volcanic groundwater aquifers is often exhausted each year during drier years so the season is cut short. To increase reliability is really then to increase the quantity of water to extend the date to which additional growing can occur. In this sense water reliability to obtain a full growing season would rely on the ability to develop new sources of groundwater that could be accessed economically, assuming, of course, that the available water is being used reasonably efficiently.

Water Transfers

Given that surface water sources are likely fully appropriated in neighboring regions from which water might potentially be imported, it is unlikely that any increase in the importation of water would occur at least for agricultural purposes. This statement applies to the northern and southern portions of the region where the principle use for water is agriculture. The possibility exists for the curtailment of exports, but at a cost since the export water rights have been well established for a century and more. Curtailing exports is additionally unlikely because the major exports are in the Truckee River and Lake Tahoe Basins where there is no agricultural use and water availability is adequate for the near term future. At the southern border of the North Lahontan Region the possibility does exist that the exportation from Virginia Creek could be re-purposed to supplement supplies in the East Walker River watershed, however the amounts of export is only one thousand acre-feet per year and that would not significantly increase supplies.

Looking to the Future

Future Conditions

Future Scenarios

For Update 2013, the Water Plan evaluates different ways of managing water in California depending on alternative future conditions and different regions of the state. The ultimate goal is to evaluate how different regional response packages, or combinations of resource management strategies from Volume 3, perform under alternative possible future conditions. The alternative future conditions are described as future scenarios. Together the response packages and future scenarios show what management options could provide for sustainability of resources and ways to manage uncertainty and risk at a regional level. The future scenarios are comprised of factors related to future population growth and factors related to future climate change. Growth factors for the North Lahontan are described below. Climate change factors are described in general terms in Chapter 5, Volume 1.

Water Conservation

The Water Plan scenario narratives include two types of water use conservation. The first is conservation that occurs without policy intervention (called background conservation). This includes upgrades in plumbing codes and end user actions such as purchases of new appliances and shifts to more water efficient landscape absent a specific government incentive. The second type of conservation expressed in the scenarios is through efficiency measures under continued implementation of existing best management practices in the Memorandum of Understanding (CUWCC 2004). These are specific measures that have been agreed upon by urban water users and are being implemented over time. Any other water conservation measures that require additional action on the part of water management agencies are not included in the scenarios, and would be represented as a water management response.

North Lahontan Growth Scenarios

Future water demand in North Lahontan hydrologic region is affected by a number of growth and land use factors, such as population growth, planting decisions by farmers, and size and type of urban landscapes. See Table NL-26 for a conceptual description of the growth scenarios used in the CWP. The CWP quantifies several factors that together provide a description of future growth and how growth could affect water demand for the urban, agricultural, and environmental sectors in North Lahontan region. Growth factors are varied between the scenarios to describe some of the uncertainty faced by water managers. For example, it is impossible to predict future population growth accurately, so the CWP uses three different but plausible population growth estimates when determining future urban water demands. In addition, the CWP considers up to three different alternative views of future development density. Population growth and development density will reflect how large the urban landscape will become in 2050 and are used by the CWP to quantify encroachment into agricultural lands by 2050 in the North Lahontan region.

PLACEHOLDER Table NL-26 Conceptual Growth Scenarios

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For Update 2013, DWR worked with researchers at the University of California, Davis, to quantify how much growth might occur in North Lahontan region through 2050. The UPlan model was used to estimate a year 2050 urban footprint under the scenarios of alternative population growth and development density. (see http://ice.ucdavis.edu/project/uplan for information on the UPlan model). UPlan is a simple rule-based urban growth model intended for regional or county-level modeling. The needed space for each land use type is calculated from simple demographics and is assigned based on the net attractiveness of locations to that land use (based on user input), locations unsuitable for any development, and a general plan that determines where specific types of development are permitted. Table NL-27 describes the amount of land devoted to urban use for 2006 and 2050, and the change in the urban footprint under each scenario. As shown in the table, the urban footprint grew by about 3 thousand acre under low population growth scenario (LOP) by 2050 relative to 2006 base-year footprint of about 40 thousand acres. Urban footprint under high population scenario (HIP), however, grew by about 13 thousand acres. The effect of varying housing density on the urban footprint is also shown.

PLACEHOLDER Table NL-27 Growth Scenarios (Urban) – North Lahontan

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Table NL-28 describes how future urban growth could affect the land devoted to agriculture in 2050. Irrigated land area is the total agricultural footprint. Irrigated crop area is the cumulative area of agriculture, including multi-crop area, where more than one crop is planted and harvested each year. Each of the growth scenarios shows a decline in irrigated acreage over existing conditions, but to varying degrees. As shown in the table, irrigated crop acreage declines on average by about 1700 acres by year 2050 as a result of low population growth and urbanization in North Lahontan region, while the decline under high population growth was higher by about 600 acres.

PLACEHOLDER Table NL-28 Growth Scenarios (Agriculture) – North Lahontan

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

North Lahontan 2050 Water Demands

In this section a description is provided for how future water demands might change under scenarios organized around themes of growth and climate change described earlier in this chapter. The change in water demand from 2006 to 2050 is estimated for the North Lahontan region for the agriculture and urban sectors under nine growth scenarios and 13 scenarios of future climate change. The climate change scenarios included the 12 CAT scenarios described in Chapter 5, Volume 1 and a 13th scenario representing a repeat of the historical climate (1962-2006) to evaluate a “without climate change” condition.

Figure NL-19 shows the change in water demands for the urban and agricultural sectors fewer than nine growth scenarios, with variation shown across 13 climate scenarios. The nine growth scenarios include three alternative population growth projections and three alternative urban land development densities, as shown in Table NL-26. The change in water demand is the difference between the historical average for 1998 to 2005 and future average for 2043 to 2050. Urban demand is the sum of indoor and outdoor water demand where indoor demand is assumed not to be affected by climate. Outdoor demand, however, depends on such climate factors as the amount of precipitation falling and the average air temperature. The solid blue dot in Figure NL-19 represents the change in water demand under a repeat of historical climate, while the open circles represent change in water demand under 12 scenarios of future climate change.

Urban demand increased only under high population growth scenarios while it decreased under low and current trend population scenarios. On average, it increased by only about 4 thousand acre-feet when compared with historical average of 40 thousand acre-feet. Under the three low and current population scenarios, the decrease was about 6 thousand acre-feet and 0.5 thousand acre-feet, respectively, when compared with historical average. The decreases in future demands under some scenarios are attributed to a low population growth combined with improvements in water use efficiency. The results show change in future urban water demands are less sensitive to housing density assumptions or climate change than to assumptions about future population growth.

Agricultural water demand decreases under all future scenarios due to reduction in irrigated lands as a result of urbanization and background water conservation when compared with historical average water demand of about 430 thousand acre-feet. Under the three low population scenarios, the average reduction in water demand was about 3 thousand acre-feet while it was about 5 thousand acre-feet for the three high population scenarios. For the three current trend population scenarios, this change was about 2 thousand acre-feet. The results show that low-density housing would result in more reduction in agricultural demand since more lands are lost under low-density housing than high-density housing.

PLACEHOLDER Figure NL-19 Change in North Lahontan Agricultural and Urban Water Demands for 117 Scenarios from 2006-2050 (TAF per year)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Water Management Plan Summaries

Inclusion of the information contained in IRWMP's into the CWP Regional Reports has been a common suggestion by regional stakeholders at the Regional outreach meetings since the inception of the IRWM program. To this end the California Water Plan has taken on the task of summarizing readily available integrated water management plans in a consistent format for each of the regional reports. This collection of information will not be used to determine IRWM grant eligibility. This effort is ongoing and will be included in the final CWP updates and will include up to 4 pages for each IRWMP in the regional reports.

In addition to these summaries being used in the regional reports we intend to provide all of the summary sheets in one IRWMP Summary "Atlas" as an article included in Volume 4. This atlas will, under one cover, provide an "at-a-glance" understanding of each IRWM region and highlight each region's key water management accomplishments and challenges. The atlas will showcase how the dedicated efforts of individual regional water management groups (RWMGs) have individually and cumulatively transformed water management in California.

All IRWMP's are different in how are organized and therefore finding and summarizing the content in a consistent way proved difficult. It became clear through these efforts that a process is needed to allow those with the most knowledge of the IRWMP's, those that were involved in the preparation, to have input on the summary. It is the intention that this process be initiated following release of Update 2013 and will continue to be part of the process of the update process for Update 2018. This process will also allow for continuous updating of the content of the atlas as new IRWMP's are released or existing IRWMP's are updated.

As can be seen in Figure NL-20 there is are two IRWM planning efforts that are ongoing in the North Lahontan Hydrologic Region.

PLACEHOLDER Figure NL-20 Integrated Water Management Planning in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Placeholder Text:. At the time of the Public Review Draft the collection of information out of the IRWMP's in the region has not been completed. Below are the basic types of information this effort will summarize and present in the final regional report for each IRWMP available. An opportunity will be provided to those with responsibility over the IRWMP to review these summaries before the reports are final.

Region Description:. This section will provide a basic description of the IRWM region. This would include location, major watersheds within the region, status of planning activity, and the governance of the IRWM. In addition, an IRWM grant funding summary will be provided.

Key Challenges: The top five challenges identified by the IRWM would be listed in this section.

Principal Goals/Objective: The top five goals and objectives identified in the IRWMP will be listed in this section.

Major IRWM Milestones and Achievements: Major milestones (Top 5) and achievements identified in the IRWMP would be listed in this section.

Water Supply and Demand: A description (one paragraph) of the mix of water supply relied upon in the region along with the current and future water demands contained in the IRWMP will be provided in this section.

Flood Management: A short (one paragraph) description of the challenges faced by the region and any actions identified by the IRWMP will be provided in this section.

Water Quality:. A general characterization of the water quality challenges (one paragraph) will be provided in this section. Any identified actions in the IRWMP will also be listed.

Groundwater Management:. The extent and management of groundwater (one paragraph) as described in the IRWMP will be contained in this section.

Environmental Stewardship:. Environmental stewardship efforts identified in the IRWMP will be summarized (one paragraph) in this section.

Climate Change: Vulnerabilities to climate change identified in the IRWMP will be summarized (one paragraph) in this section.

Tribal Communities:. Involvement with tribal communities in the IRWM will be described (one paragraph) in this section of each IRWMP summary.

Disadvantaged Communities:. A summary (one paragraph) of the discussions on disadvantaged communities contained in the IRWMP will be included in this section of each IRWMP summary.

Governance: This section will include a description (less than one paragraph) of the type of governance the IRWM is organized under.

Resource Management Strategies

Volume 3 contains detailed information on the various strategies that can be used by water managers to meet their goals and objectives. A review of the resource management strategies addressed in the available IRWMP's is summarized in Table NL-29.

PLACEHOLDER Table NL-29 Resource Management Strategies addressed in IRWMP's in the North Lahontan Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Conjunctive Management and Groundwater Storage

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.

A survey undertaken in 2011-2012 jointly by DWR and ACWA to inventory and assess conjunctive management projects in California is summarized in Box NL-3. *More detailed information about the survey results and a statewide map of the conjunctive management projects and operational information, as of July 2012, is available online from Update 2013 Volume 4, Reference Guide, the article "California's Groundwater Update 2013."*

PLACEHOLDER Box NL-3 Statewide Conjunctive Management Inventory Effort in California

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the chapter.]

Conjunctive Management Inventory Results

Although 89 conjunctive management programs were identified in California as part of the DWR/ACWA survey, no programs are located in the region.

Additional information regarding conjunctive management in California as well as discussion on associated benefits, costs, and issues can be found online from Update 2013 Vol. 3 Ch. 9 Conjunctive Management and Groundwater Storage Resource Management Strategy.

Regional Resource Management Strategies

Regional response packages are defined as being derived from mixing and matching resource management strategies to provide water and resources benefits, diversification of the region's water portfolio and supporting regional self-sufficiency. The strategies thought to be applicable to the North Lahontan Region, already discussed in the section entitled Resource Management Strategies. This section provides examples of strategies applied by several regional entities in the North Lahontan Hydrologic Region.

Sierra Nevada Conservancy

The conservancy has granted funds to support the purchase of forestlands, which are placed under conservation easements and allow for selective timber harvesting to preserve the health of the forest. Placing forestlands under conservation easements is an example of forest and watershed management and recharge area protection strategies. In addition the conservancy has funded habitat preservation projects that produce benefits under these same strategies. Finally the conservancy has also undertake fuel reduction projects which in the long term support the pollution protection strategy by preventing extreme wildfire events that have devastating impacts to water quality.

California Tahoe Conservancy WQ & Watersheds projects

In conjunction with the USFS this organization initiated a project known as the Al Tahoe Erosion Control Project in 2011 that included the placement of roadside infiltration pads that allowed parking along urban street in this South Lake Tahoe neighborhood in the dry season and infiltration basins during the wet season that trapped sediment that otherwise would have entered Lake Tahoe. In addition for the Brockway Erosion Control Project they installed features that settle the sediment coming from Highway 28 and neighboring streets from entering Lake Tahoe. Finally as a part of efforts extending over the last decade and a half the CTC restored portions of Angora Creek’s connection to its banks by removing fill material and replacing culverts that were restricting the creek flow and thereby causing erosion of the creek’s banks.

The Tahoe Resources Conservation District contracted with Alpine County to replace leaking water lines, complete another well and install meters and hydrants in Markleeville at a cost of $674,250. This project increased the reliability of water supplies and accounting for it use within the region.

Climate Change

For over two decades, the State and federal governments have been preparing for climate change effects on natural and built systems with a strong emphasis on water supply. Climate change is already impacting many resource sectors in California, including water, transportation and energy infrastructure, public health, biodiversity, and agriculture (USGCRP, 2009; CNRA, 2009). Climate model simulations based on the Intergovernmental Panel on Climate Change's 21st century scenarios project increasing temperatures in California, with greater increases in the summer. Projected changes in annual precipitation patterns in California will result in changes to surface runoff timing, volume, and type (Cayan, 2008). Recently developed computer downscaling techniques indicate that California flood risks from warm-wet, atmospheric river type storms may increase beyond those that we have known historically, mostly in the form of occasional more-extreme-than-historical storm seasons (Dettinger, 2011).

Currently, enough data exists to warrant the importance of contingency plans, mitigation (reduction) of greenhouse gas (GHG) emissions, incorporating adaptation strategies, and methodology and infrastructure improvements that benefit the region at present and into the future. While the State is taking aggressive action to mitigate climate change through GHG reduction and other measures (CARB, 2008), global impacts from carbon dioxide and other GHGs that are already in the atmosphere will continue to impact climate through the rest of the century (IPCC, 2007).

Resilience to an uncertain future can be achieved by implementing adaptation measures sooner rather than later. Because of the economic, geographical, and biological diversity of California, vulnerabilities and risks from current and future anticipated changes are best assessed on a regional basis. Many resources are available to assist water managers and others in evaluating their region-specific vulnerabilities and identifying appropriate adaptive actions. (EPA/DWR, 2011; Cal-EMA/CNRA, 2012).

Observations

The region's climate regime is unique compared to the rest of the state; due to its location on the eastern slope of the Sierra Nevada, precipitation is subject to a rain shadow effect resulting in drier conditions. However, mean annual precipitation in Northern California has increased slightly in the past century, and precipitation has considerable annual variation (DWR, 2006). Over the past century, air temperatures measured throughout the region indicate a general warming trend. Region-specific air temperature data was retrieved through the Western Regional Climate Center (WRCC). The WRCC has temperature and precipitation data for the past century. Through an analysis of National Weather Service Cooperative Station and PRISM Climate Group gridded data, scientists from the WRCC have identified 11 distinct regions across the state for which stations located within a region vary with one another in a similar fashion. These 11 climate regions are used when describing climate trends within the state (Abatzoglou, et al. 2009). DWR's hydrologic regions, however, do not correspond directly to WRCC's climate regions. A particular hydrologic region may overlap more than one climate region and, hence, have different climate trends in different areas. For the purpose of this regional report, climate trends of the major overlapping climate regions are considered to be relevant trends for respective portions of the overlapping hydrologic region.

The Bay Region overlaps the WRCC Central Coast and Sacramento-Delta Regions, and also small portions of the WRCC North Coast and North Central Regions. Mean temperatures in the Central Coast Region have increased about 1.1-2.0°F (0.6-1.1°C), with minimum values increasing more than maximums [1.6-2.6 °F (0.9-1.4 °C) and 0.4-1.5°F (0.2-0.8°C), respectively]. Inland, temperatures in the Sacramento-Delta Region show a similar warming trend. A mean increase of 1.5-2.4°F (0.8-1.3°C) was recorded, with minimum temperatures increasing 2.1-3.1°F (1.2-1.7°C) and maximum temperatures increasing 0.7-1.9°F (0.4-1.1°C). Mean annual precipitation in Northern California has increased slightly in the 20th century, and precipitation patterns in the region have considerable geographic and annual variation (DWR 2006).

Locally in the North Lahontan region within the WRCC Northeast climate region, mean temperatures have increased by about 0.8 to 2.0 °F (0.5 to 1.1 °C) in the past century, with minimum and maximum temperatures increasing by about 0.9 to 2.2 °F (0.5 to 1.2 °C) and by 0.4 to 2.1 °F (0.2 to 1.2 °C), respectively (WRCC, 2012).

Since 1980, the Truckee River Basin has responded to climate trends with a decline in spring snowpack, less precipitation falling as snow, and earlier snowmelt (Lea, 2010). Water Year runoff trends from the past century are varied throughout the region. For example, the East Carson and West Walker River Systems runoff has trended upward by 2 taf/yr from 1922-2005 and the Truckee River system has seen no significant runoff trend in the past century (DWR 2006).

Projections and Impacts

While historic data is a measured indicator of how the climate is changing, it can't project what future conditions may be like under different GHG emissions scenarios. Current climate science uses modeling methods to simulate and develop future climate projections. A recent study by Scripps Institution of Oceanography uses the most sophisticated methodology to date, and indicates by mid-century (2060-2069) temperatures will be 3.4 to 4.9 °F (1.9 to 2.7 °C) higher across the state than they were from 1985 to1994 (Pierce et al, 2012). Annual mean temperatures by 2060-69 are projected to increase 4.7 °F (2.6 °C) for the WRCC Northeast climate region, with increases of 3.4 °F (1.9 °C) during the winter months and 6.5 °F (3.6 °C) during summer. Climate projections for this region, from Cal-Adapt indicate that temperatures between 1990 and 2100 will increase by 4.5 °F (2.5 °C) in the winter and 9 °F (5 °C) in the summer (Cal-EMA and CNRA, 2012).

Changes in annual precipitation across California, either in timing or total amount, will result in changes in type of precipitation (rain or snow) in a given area, and in surface runoff timing and volume. Most climate model precipitation projections for the state anticipate drier conditions in southern California, with heavier and warmer winter precipitation in northern California. More intense wet and dry periods are anticipated, which could lead to flooding in some years and drought in others. In addition, extreme precipitation events are projected to increase with climate change (Pierce et al, 2012). Since there is less scientific detail on localized precipitation changes, there exists a need to adapt to this uncertainty at the regional level (Qian, Y., et al, 2010).

Recent computer downscaling techniques indicate that California flood risks from warm-wet, atmospheric river type storms may increase beyond those that we have known historically, mostly in the form of occasional more-extreme-than-historical storm seasons (Dettinger, 2011). A higher proportion of precipitation falling as rain instead of snow and increased storm frequency will impact the system's ability to provide effective flood protection. As previously mentioned the North Lahontan region does not have a well-developed flood control system; with climate change, the region may experience a 1 percent event more frequently. Warmer temperatures will result in more precipitation falling as rain instead of snow, decreased snowpack, and increased wildfire risk (Cal-EMA and CNRA, 2012).

The Sierra Nevada is projected to experience a 48 to 65 percent reduction of its historic average snowpack by the end of this century (van Vuuren et al., 2011). Snowmelt dominated watersheds in the region will each have a unique snowmelt response depending on elevation and the amount of warming that occurs. Climate projections indicate that temperatures will continue to rise by the end of the century diminishing April 1st snowpack (Table 30). DWR projects that with a 1°C (1.8°F) rise, the Tahoe basin April 1st snow covered area drops to 55 percent, whereas the Carson and Walker basins are less impacted due higher mean elevations (2006). A projected temperature rise of 5°C (9°F) would leave Truckee and Tahoe basins with 8 percent snow coverage, West Carson, East Carson, and East Walker basins with approximately 25 percent snow coverage, and West Walker basin with 41 percent snow coverage.

PLACEHOLDER Table NL-30 North Lahontan Snow Covered Area Changes with Temperature

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Adaptation

Climate change has the potential to impact the region, whose economy relies on environmental benefits. Local ecosystems provide for the timber industry, agriculture and grazing, tourism, and water supply. Projected climate change will increase the vulnerability of natural and built systems in the region. Impacts to natural systems will challenge aquatic and terrestrial species with changing habitats, diminished water quantity and quality, and invasive species. With increased atmospheric carbon dioxide concentrations and warmer temperatures, forests will respond with higher productivity. Although short-term gains are expected, reduced water availability, drier conditions, invasive species, more severe pest outbreaks, and wildfire may surmount any gain in productivity. Large increases in wildfire risk are projected for all parts of the region (Westerling et al., 2009; CRNA, 2012). Built systems will be impacted by changing hydrology and runoff timing, loss of natural snowpack storage, making the region more dependent on surface storage in reservoirs and groundwater sources. Increased future water demand for both natural and built systems may be particularly challenging with less natural storage and less overall supply.

Water managers and local agencies must work together determine the appropriate planning approach for their operations and communities. While climate change adds another layer of uncertainty to water planning, it does not fundamentally alter the way water managers already address uncertainty (EPA/DWR, 2011). However, stationarity (the idea that natural systems fluctuate within an unchanging envelope of variability) can no longer be assumed, so new approaches will likely be required (Milly et al., 2008).

Local agencies, as well as federal and state agencies, face the challenge of interpreting new climate change data and information and determining which adaptation methods and approaches are appropriate for their planning needs. The Climate Change Handbook for Regional Water Planning (EPA/DWR, 2011) provides an analytical framework for incorporating climate change impacts into the regional and watershed planning process and considers adaptation to climate change. This handbook provides guidance for assessing the vulnerabilities of California's watersheds and hydrologic regions to climate change impacts, and prioritizing these vulnerabilities.

Integrated regional water management (IRWM) planning is a framework that allows water managers to address climate change on a smaller, more regional scale. Climate change is now a required component of all IRWM plans (DWR 2010). IRWM regions must identify and prioritize their specific vulnerabilities, and identify adaptation strategies that are most appropriate for their sub-regions. Planning strategies to address vulnerabilities and adaptation to climate change should be both proactive and adaptive, starting with strategies that benefit the region in the present-day while adding future flexibility and resilience under uncertainty.

The region already experiences chronic water shortages; with a continued decrease in snowpack the region is particularly vulnerable to water supply as less surface water is available during the summer from snowpack fed streams and rivers. Agricultural Water Use Efficiency is a Resource Management Strategy outlined in the Water Plan to adapt to water scarcity. The strategy helps the grower to use water in a way that is most effective to the crop, while minimizing yield losses.

With a projected increase in storm events, infrastructure in the region becomes more vulnerable as many residences, commercial facilities, highways, roads, and agricultural land are in the 1 percent event flood zone. A Resource Management Strategy to adapt to increased flooding risk is Integrated Flood

Management. This strategy employs several approaches including; structural improvement and maintenance of constructed facilities, coordinated flood operations, land use management, and disaster preparedness.

Additional resource management strategies found in the Water Plan Volume 3 not only assist in meeting water management objectives, but also provide benefits for adapting to climate change in the region include:

- Conveyance – Regional/local
- Conjunctive Management and Groundwater storage
- Precipitation Enhancement
- Surface Storage – Regional/Local
- Pollution Prevention
- Ag Land Stewardship
- Ecosystem Restoration
- Forest Management
- Land Use Planning and Management
- Recharge Area Protection
- Watershed Management

The myriad of resources and choices available to managers can seem overwhelming, and the need to take action given uncertain future conditions is daunting. However, there are many actions that water managers can take to prepare for climate change, regardless of the magnitude of future warming. These actions often provide economic and public health co-benefits. Water and energy conservation are examples of strategies that make sense with or without the additional pressures of climate change. Conjunctive management projects that manage surface and groundwater in a coordinated fashion could provide a buffer against variable annual water supplies. Forecast-coordinated operations would provide flexibility for water managers to respond to weather conditions as they unfold.

Water managers will need to consider both the natural and built environments as they plan for the future. Stewardship of natural areas and protection of biodiversity are critical for maintaining ecosystem services important for human society such as carbon sequestration, pollution remediation, and habitat for pollinators. Increased cross-sector collaboration between water managers, land use planners and ecosystem managers provides opportunities for identifying common goals and actions needed to achieve resilience to climate change and other stressors.

Mitigation

California's water sector has a large energy footprint, consuming 7.7% of statewide electricity (CPUC, 2010). Energy is used in the water sector to extract, convey, treat, distribute, use, condition, and dispose of water. Figure 3-26, Water-Energy Connection in Volume 1, CA Water Today shows all of the connections between water and energy in the water sector; both water use for energy generation and energy use for water supply activities. The regional reports in Update 2013 are the first to provide detailed information on the water-energy connection, including energy intensity (EI) information at the regional level. This EI information is designed to help inform the public and water utility managers about the relative energy requirements of the major water supplies used to meet demand. Since energy usage is related to Greenhouse Gas (GHG) emissions, this information can support measures to reduce GHG's, as mandated by the State.

Figure NL-21 shows the amount of energy associated with the extraction and conveyance of 1 acre-foot of water for each of the major sources in this region. The quantity used is also included, as a percent. For reference, Figure 3-26, Water-Energy Connection in CA Water Today, Volume 1 highlights which water-energy connections are illustrated in Figure NL-21– only extraction and conveyance of raw water. Energy required for water treatment, distribution, and end uses of the water are not included. Not all water types are available in this region. Some water types flow by gravity to the delivery location and therefore do not require any energy to extract or convey (represented by a white light bulb).

Recycled water and water from desalination used within the region are not show in Figure NL-21 because their energy intensity differs in important ways from those water sources. The energy intensity of both recycled and desalinated water depends not on regional factors but rather on much more localized, site, and application specific factors. Additionally, the water produced from recycling and desalination is typically of much higher quality than the raw (untreated) water supplies evaluated in Figure NL-21. For these reasons, discussion of energy intensity of desalinated water and recycled water are included in Volume 3, Resource Management Strategies.

Energy intensity, sometimes also known as embedded energy, is the amount of energy needed to extract and convey (Extraction refers to the process of moving water from its source to the ground surface. Many water sources are already at ground surface and require no energy for extraction, while others like groundwater or seawater for desalination require energy to move the water to the surface. Conveyance refers to the process of moving water from a location at the ground surface to a different location, typically but not always a water treatment facility. Conveyance can include pumping of water up hills and mountains or can occur by gravity) an acre-foot of water from its source (e.g. groundwater or a river) to a delivery location, such as a water treatment plant or a State Water Project (SWP) delivery turnout. Energy intensity should not be confused with total energy—that is, the amount of energy (e.g. kWh) required to deliver all of the water from a water source to customers within the region. Energy intensity focuses not on the total amount of energy used to deliver water, but rather the energy required to deliver a single unit of water (in kWh/acre-foot). In this way, energy intensity gives a normalized metric, which can be used to compare alternative water sources.

In most cases, this information will not be of sufficient detail for actual project level analysis. However, these generalized, region-specific metrics provide a range in which energy requirements fall. The information can also be used in more detailed evaluations using tools such as WeSim (http://www.pacinst.org/publication/wesim/), which allows modeling of water systems to simulate outcomes for energy, emissions, and other aspects of water supply selection. It's important to note that water supply planning must take into consideration a myriad of different factors in addition to energy impacts; costs, water quality, opportunity costs, environmental impacts, reliability and other many other factors.

Energy intensity is closely related to Greenhouse Gas (GHG) emissions, but not identical, depending on the type of energy used (see CA Water Today, Water-Energy, Volume 1). In California, generation of 1 megawatt-hour (MWh) of electricity results in the emission of about 1/3 of a metric ton of GHG, typically referred to as carbon dioxide equivalent or CO2e (eGrid, 2012). This estimate takes into account the use of GHG-free hydroelectricity, wind, and solar and fossil fuel sources like natural gas and coal. The GHG emissions from a specific electricity source may be higher or lower than this estimate.

Reducing GHG emissions is a State mandate. Water managers can support this effort by considering energy intensity factors, such as those presented here, in their decision making process. Water use efficiency and related best management practices can also reduce GHGs (See Volume 2, Resource Management Strategies).

Accounting for Hydroelectric Energy

Generation of hydroelectricity is an integral part of many of the state's large water projects. In 2007, hydroelectric generation accounted for nearly 15% of all electricity generation in California. The State Water Project, Central Valley Project, Los Angeles Aqueduct, Mokelumne Aqueduct, and Hetch Hetchy Aqueducts all generate large amounts of hydroelectricity at large multi-purpose reservoirs at the heads of each system. In addition to hydroelectricity generation at head reservoirs, several of these systems also generate hydroelectric energy by capturing the power of water falling through pipelines at in-conduit generating facilities (In-conduit generating facilities refer to hydroelectric turbines that are placed along pipelines to capture energy as water runs downhill in a pipeline (conduit). Hydroelectricity is also generated at hundreds of smaller reservoirs and run-of-the-river turbine facilities.

Hydroelectric generating facilities at reservoirs provide unique benefits. Reservoirs like the State Water Project's Oroville Reservoir are operated to build up water storage at night when demand for electricity is low, and release the water during the day time hours when demand for electricity is high. This operation, common to many of the state's hydropower reservoirs, helps improve energy grid stabilization and reliability and reduces GHG emissions by displacing the least efficient electricity generating facilities. Hydroelectric facilities are also extremely effective for providing back-up power supplies for intermittent renewable resources like solar and wind power. Because the sun can unexpectedly go behind a cloud or the wind can die down, intermittent renewables need back up power sources that can quickly ramp up or ramp down depending on grid demands and generation at renewable power installations.

Despite these unique benefits and the fact that hydroelectric generation was a key component in the formulation and approval of many of California's water systems, accounting for hydroelectric generation in energy intensity calculations is complex. In some systems like the SWP and CVP, water generates electricity and then flows back into the natural river channel after passing through the turbines. In other systems like the Mokelumne aqueduct water can leave the reservoir by two distinct out flows, one that generates electricity and flows back into the natural river channel and one that does not generate electricity and flows into a pipeline flowing into the East Bay Municipal Utility District service area. In both these situations, experts have argued that hydroelectricity should be excluded from energy intensity calculations because the energy generation system and the water delivery system are in essence separate (Wilkinson, 2000).

DWR has adopted this convention for the energy intensity for hydropower in the regional reports. All hydroelectric generation at head reservoirs has been excluded from Figure NL-21. Consistent with Wilkinson (2000) and others, DWR has included in-conduit and other hydroelectric generation that occurs as a consequence of water deliveries, such as the Los Angeles Aqueduct's hydroelectric generation at San Francisquito, San Fernando, Foothill and other power plants on the system (downstream of the Owen's River Diversion Gates). DWR has made one modification to this methodology to simplify the display of results: energy intensity has been calculated at each main delivery point in the systems; if the hydroelectric generation in the conveyance system exceeds the energy needed for extraction and conveyance, the energy intensity is reported as zero (0). I.e., no water system is reported as a net producer of electricity, even though several systems do produce more electricity in the conveyance system than is used (e.g., Los Angeles Aqueduct, Hetch Hetchy Aqueduct). (For detailed descriptions of the methodology used for the water types presented, see Technical Guide, Volume 5).

PLACEHOLDER Figure NL-21 Energy Intensity of Raw Water Extraction and Conveyance in the North Lahontan Hydrologic Region

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Table NL-1 North Lahontan Hydrologic Region Watersheds Proceeding from North to South

Watershed	Area (miles²)	Location	Planning activity	Comments
Cow Head	--	Modoc County mostly in OR, NV		
Surprise Valley	756	Modoc County partly in NV		
Madeline Plains	793	Lassen & Modoc Counties mostly in CA		Receives water from Sacramento Hydrologic Region, Pit River
Smoke Creek Desert	--	Lassen County almost entirely in NV		
Honey-Eagle Lakes	1939	Lassen & Sierra counties partly in NV	Subject to Lassen County Groundwater Ordinance	Groundwater extracted for wetlands and, in NV, from Fish Springs Ranch
Truckee River	932	Sierra, Nevada & Placer counties	TROA, Tahoe-Sierra IRWM	Subject to numerous court orders & decrees, subject of major planning efforts
Lake Tahoe	506	Placer & El Dorado counties, partly in NV	TROA, Tahoe-Sierra IRWM, Tahoe Reg. Planning Agency	Subject to numerous court orders & decrees, subject of major planning efforts
Upper Carson	341	El Dorado, Alpine & Mono counties in CA	TROA, Carson Water Subconservancy District, Alpine Watershed Group	Subject to the *Alpine* decree within TROA
West Walker	250	Alpine & Mono counties		Currently in litigation
East Walker	380	Mono county		Currently in litigation, Virginia Creek diversion in Walker Basin to Mono Lake basin which lies in South Lahontan Hydrologic Region

Table NL-2 Alluvial Groundwater Basins and Subbasins within 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	6-94	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

Table NL-3 Number of Well Logs by County and Use 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

Table NL-4 CASGEM Groundwater Basin Prioritization for the North Lahontan Hydrologic Region

Basin Prioritization	Count	Basin/Subbasin Number	Basin Name	Subbasin Name	2010 Census Population
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 *Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013*			
Totals:	**27**			**Population of GW Basin Area:**	**74,609**

Table NL-5 Groundwater Level Monitoring Wells by Monitoring Entity in the North Lahontan Hydrologic Region

State and Federal Agencies	Number of Wells
DWR	138
USGS	24
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**
N/A	0
Total CASGEM Monitoring Entities:	**0**
Grand Total	**221**

Table represents monitoring information as of July, 2012.

Table NL-6 Sources of Groundwater Quality Information

Agency	Links to Information
State Water Resources Control Board	Groundwater • Communities that Rely on a Contaminated Groundwater Source for Drinking Water • Nitrate in Groundwater: Pilot Projects in Tulare Lake Basin/Salinas Valley • Hydrogeologically Vulnerable Areas • Aquifer Storage and Recovery • Central Valley Salinity Alternatives for Long-Term Sustainability (CV-Salts) GAMA • GeoTracker GAMA (Monitoring Data) • Domestic Well Project • Priority Basin Project • Special Studies Project • California Aquifer Susceptibility Project Contaminant Sites • Land Disposal Program • Department of Defense Program • Underground Storage Tank Program • Brownfields
California Department of Public Health	Division of Drinking Water and Environmental Management • Drinking Water Source Assessment and Protection (DWSAP) Program • Chemicals and Contaminants in Drinking Water • Chromium-6 • Groundwater Replenishment with Recycled Water
Department of Water Resources	Groundwater Information Center • Bulletin 118 Groundwater Basins • California Statewide Groundwater Elevation Monitoring (CASGEM) • Groundwater Level Monitoring • Groundwater Quality Monitoring • Well Construction Standards • Well Completion Reports
Department of Toxic Substances Control	• EnviroStor
Department of Pesticide Regulation	Groundwater Protection Program • Well Sampling Database • Groundwater Protection Area Maps
U.S. Environmental Protection Agency	US EPA STORET Environmental Data System
United States Geological Survey	USGS Water Data for the Nation

Table NL-7 Threatened, Endangered and Special Concern Species of the North Lahontan Hydrologic Region

Scientific name	Common name	Federal status	California status	CA Dept. Fish and Wildlife	CA Native Plant Society List
Taxidea taxus	American badger	None	None	SSC	
Martes Americana	American marten	Candidate			
Haliaeetus leucocephalus	bald eagle	Delisted	Endangered		
Riparia riparia	bank swallow	None	Threatened		
Gratiola heterosepala	Boggs lake hedge-hyssop	None	Endangered		1B.2
Cypseloides niger	black swift	None	None	SSC	
Athene cunicularia	burrowing owl	None	None	SSC	
Strix occidentalis occidentalis	California spotted owl	None	None	SSC	
Pseudocopaeodes eunus obscurus	Carson wandering skipper	Endangered	None		
Gulo gulo	California wolverine	Candidate	Endangered		
Canis lupus	gray wolf	Endangered	None		
Strix nebulosa	great gray owl	None	Endangered		
Centrocercus urophasianus	greater sage-grouse	Candidate	None	SSC	USF&WS to determine status by 2015
Grus canadennsis	greater sandhill crane	None	Threatened		
Siphateles bicolor ssp. 2	High Rock Spring tui chub	None	None	SSC	
Oncorhynchus clarki henshawi	Lahontan Cutthroat Trout	Threatened	None		
Asio otus	long eared owl	None	None	SSC	
Catostomus microps	Modoc sucker	Endangered	Endangered		
Catostomus platyrhynchus	mountain sucker	None	None	SSC	
Accipiter gentilis	northern goshawk	None	None	SSC	
Lithobates pipiens	northern leopard frog	None	None	SSC	
Rana pretiosa	Oregon spotted frog	Candidate	None	SSC	
Martes pennant pacifica	Pacific fisher	Candidate	Candidate	SSC	
Antrozous pallidus	pallid bat	None	None	SSC	
Ovis Canadensis sierrae	Sierra Nevada big horn sheep	Endangered	Endangered		
Aplodontia rufa californica	Sierra Nevada mountain q	None	None	SSC	
Vulpes vulpes necator	Sierra Nevada red fox	None	Threatened		
Lepus Americanus tahoensis	Sierra Nevada snowshoe hare	None	None	SSC	
Rana sierrae	Sierra Nevada yellow-legged frog	Candidate	Candidate Threatened	SSC	
Orcutia tenuis Hitchc.	slender Orcutt grass	Threatened	Endangered		
Buteo swainsoni	Swainson's hawk	None	Threatened		
Rorippa subumbellata	Tahoe yellow cress	Candidate	Endangered		1B.1
Agelaius tricolor	tricolored blackbird	None	None	SSC	
Charadrius alexsandrinus niv	western snowy plover	Threatened	None	SSC	
Ivesia webberi	Webber Ivesia	Candidate			
Lepus townsendii townsendii	western white tailed jackrabbit	None	None	SSC	
Empidonax traillii exitimus	Willow Flycatcher	None	Endangered		

Scientific name	Common name	Federal status	California status	CA Dept. Fish and Wildlife	CA Native Plant Society List
Xanthocephalus xanthocephalus	Yellow headed blackbird	None	None	SSC	
Dendroica petechia brewsteri	Yellow warbler	None	None	SSC	

Source: California Natural Diversity Database (CNDDB) Quick Viewer

SSC = Species of Special Concern

Table NL-8 California Native American Tribes in the North Lahontan Hydrologic Region

California Native American tribe	Cultural affiliation
Andrew Jackson, Susanville ,CA	Aporiage (Pit River Tribe) and Maidu
Antelope Valley Paiute Tribe, Coleville, CA	Maidu
Honey Lake Maidu	Maidu

Source: California Native American Heritage Commission

Table NL-9 Major Lakes and Reservoirs in the North Lahontan Hydrologic Region

	Active storage (acre-feet)	Date	Description	Major tributary
Northern				
Eagle Lake	550,000 [a]	Geologic	Terminal Lake	Pine Creek
Honey Lake	Variable	Geologic	Terminal Lake	Susan River
Middle				
Boca Res.	41,100	1937	U.S. Bureau of Reclamation	Little Truckee River
Donner Lake	9,500	1930s	Truckee Meadows Water Auth, Truckee-Carson ID	Snowmelt
Independence Lake	17,500	1939	Truckee Meadows Water Auth.	Snowmelt
Lake Tahoe	744,600 [b]	1913	U.S. Bureau of Reclamation	Upper Truckee River
Prosser Creek Res.	29,800	1962	U.S. Bureau of Reclamation	Prosser Creek
Stampede Res.	226,500	1970	U.S. Bureau of Reclamation	Little Truckee River
Southern				
Bridgeport Lake	44,000	1924	Walker R. Irrigation Dist.	E. Walker River
Heenan Lake	3,100	1923	DFW fish rearing lake	E. Heenan Lake Creek
Topaz Lake	65,000	1937	Walker R. Irrigation Dist.	W. Walker River

[a] No controlled outflow

[b] This represents the acre-feet that is in top 6.1 feet above the rim and therefore controllable

Table NL-10 North Lahontan Hydrologic Region Average Annual Groundwater Supply by Planning Area (PA) and by Type of Use (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	
PA Number	**PA Name**	**TAF**	**%**	**TAF**	**%**	**TAF**	**%**	**TAF**	**%**
801	Lassen	117.8	39%	18.9	85%	10.7	48%	147.5	43%
802	Alpine	0.6	0%	18.2	82%	0.0	0%	18.8	11%
2005-10 Annual Average HR Total:		118.4	27%	37.1	84%	10.7	48%	166.2	32%

Note:1) TAF = thousand acre-feet

2) Percent use is the percent of the total water supply that is met by groundwater, by type of use.

3) 2005-10 Precipitation equals 94% of the 30-yr average for the North Lahontan Region

Table NL-11 North Lahontan Hydrologic Region Average Annual Groundwater Supply by County and by Type of Use (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**	**%**	**TAF**	**%**	**TAF**	**%**	**TAF**	**%**
Lassen	99.2	33%	18.7	81%	10.7	42%	128.6	36%
Alpine	0.0	0%	0.0	0%	0.0	0%	0.0	0%
2005-10 Annual Ave. Total:	99.2	31%	18.7	79%	10.7	42%	128.6	35%

Note:1) TAF = thousand acre-feet

2) Percent use is the percent of the total water supply that is met by groundwater, by type of use

3) 2005-10 Precipitation equals 94% of the 30-yr average for the North Lahontan Hydrologic Region

Table NL-12 Summary of Large, Medium, Small, and Very Small Community Drinking Water Systems in the North Lahontan Hydrologic Region

	Community Water Systems		Population Served	
Water System Size	**(Systems)**	**(%)**	**(Population)**	**(%)**
Large (> 10,000 Pop)	3	5%	56,730	57%
Medium (3,301 – 10,000 Pop)	3	5%	18,134	18%
Small (500 – 3,300 Pop	18	32%	19,087	19%
Very Small (<500 Pop)	32	57%	5,224	5%
CWS that Primarily Provide Wholesale Water	0	0%	---	---
TOTAL	56		99,175	

Table NL-13 North Lahontan Hydrologic Region Water Balance Summary, 2001-2010 (thousand acre-feet)

Table NL-X North Lahontan Hydrologic Region water balance for 2001-2010 (in TAF)

North Lahontan (TAF)	Water Year (Percent of Normal Precipitation)									
	2001 (49%)	2002 (80%)	2003 (92%)	2004 (86%)	2005 (125%)	2006 (137%)	2007 (60%)	2008 (71%)	2009 (82%)	2010 (89%)
Water Entering the Region										
Precipitation	3,756	5,752	6,560	6,132	8,992	9,714	4,244	5,042	5,851	6,347
Inflow from Oregon/Mexico	0	0	0	0	0	0	0	0	0	0
Inflow from Colorado River	0	0	0	0	0	0	0	0	0	0
Imports from Other Regions	3	3	3	3	3	3	3	4	3	3
Total	**3,759**	**5,755**	**6,563**	**6,135**	**8,995**	**9,717**	**4,247**	**5,046**	**5,854**	**6,350**
Water Leaving the Region										
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	307	321	300	323	294	334	367	344	362	349
Outflow to Oregon/Nevada/Mexico	552	730	921	738	1350	2002	742	773	911	1025
Exports to Other Regions	9	10	8	11	7	8	11	9	1	9
Statutory Required Outflow to Salt Sink	113	103	129	122	160	202	119	126	136	140
Additional Outflow to Salt Sink	92	7	7	10	8	10	9	9	9	10
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	3,223	4,828	5,223	5,182	6,949	6,823	3,446	4,132	4,606	4,610
Total	**4,296**	**5,998**	**6,589**	**6,386**	**8,767**	**9,379**	**4,694**	**5,393**	**6,025**	**6,142**
Change in Supply										
[+] Water added to storage [-] Water removed from storage										
Surface Reservoirs	-430	-151	59	-170	307	434	-342	-254	-70	305
Groundwater **	-107	-92	-85	-81	-79	-96	-105	-93	-101	-97
Total	**-537**	**-243**	**-26**	**-251**	**228**	**338**	**-447**	**-347**	**-171**	**208**
Applied Water * (Ag, Urban, Wetlands) (compare with Consumptive Use)	490	513	483	517	475	547	596	561	589	570

* Definition: Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

** Definition: Change in Supply: Groundwater – The difference between water extracted from and water recharged into groundwater basins in a region. All regions and years were calculated using the following equation:

change in supply: groundwater = intentional recharge + deep percolation of applied water + conveyance deep percolation and seepage - withdrawals

This equation does not include unknown factors such as natural recharge and subsurface inflow and outflow. For further details, refer to Volume 4, Reference Guide – *California's Groundwater Update 2013* and Volume 5 Technical Guide.

n/a = not applicable

Table NL-14 Basic Floriston Rates, Truckee River Flow at Farad (cfs)

March – September	October – February
500	400

Table NL-15 Reduced Floriston Rates, Truckee River Flow at Farad (cfs)

Lake Tahoe Elevation	October	November 1 – February 28-9	March	April – September
Under 6225.25 ft	400	300	300	500
6225.25 – 6226 ft	400	350	350	500
Above 6226 ft	400	400	500	500

Table NL-16 Operations of Other Reservoirs in North Lahontan Region by County from North to South

County/Reservoir	Owner	Lat/Lon	Source	Storage, af	Operations
Modoc					
Lake Annie	Schandler Ranch, Inc	41.9082 - 120.109	Eight Mile Creek	200	Early season release assumed
Fee Reservoir	Fee Ranch, Inc. & P. H. Peterson	41.8187 -120 03	Rock Creek	7,120	" " " " " " "
Lassen					
Antelope (Ducasse) Reservoir	Robert Harvey	40.8356 -120.48	Madeline Plains	1,500	Early season release assumed
Buckhorn Reservoir	Edgar S. Roberts	40.852 -120.09	Buckhorn Creek	2,000	" " " " " " "
Branham Flat Reservoir	Mapes Ranch, Inc.	40.7289 -120.51	Branham Creek	1,200	" " " " " " "
Dodge Reservoir	Edgar S. Roberts	40.9678 -120.14	Red Rock Creek	10,000	" " " " " " "
Eagle Lake	Not a reservoir	40.6027 -120.7012	Pine Creek is major tributary	500,000	Not actually operated; water leaks through Bly Tunnel into Willow Creek
Hog Flat Reservoir	Lassen Irrigation Company	40.4363 -120.91	Tributary to Susan River	8,000	Spring release ending no later than July1
Horse Lake Reservoir	Snow Storm Ranch	40.6806 -120.39	Snowstorm Creek	75	Early season release assumed
Leavitt Lake	Lassen Irrigation Company	40.3756 -120.50	Tributary to Susan River	7,482	" " " " " " "
McCoy Flat Reservoir	Lassen Irrigation Company	40.4537 -120.94	Susan River	17,290	Spring release ending no later than July1
Pete's Valley Reservoir	Pete's Valley Partners	40.5441 -120.45	Pete's Creek	240	Early season release assumed
Round Corral Reservoir	BLM	40.9 -120.017	Buckhorn Canyon	720	Seasonal watering
Round Valley	Jack and Thomas Swickard	40.5154 -120.66	Round Valley Creek	5,500	" " " " " " "
Smoke Creek Reservoir	Jackrabbit Properties, LLC	40.6281 -120.00	Smoke Creek	960	" " " " " " "
Snowstorm Reservoir	BLM	40.66 -120.45	Snowstorm Creek	160	Seasonal watering
Spaulding Lake	R.C. Roberts Ranches, Licensee	40.9243 -120.28	Tributary to Madeline Plains	147	" " " " " " "
Sworinger Reservoir	John & Lani Estill	401.1798 -120.1	Tributary to Silver Creek	4,050	Early season release assumed
Upper/Lower Biscar Reservoirs	BLM	40.545 -120.31	Snowstorm Creek	174	Operated for aquatic habitat

County/Reservoir	Owner	Lat/Lon	Source	Storage, af	Operations
Sierra	See major reservoirs above				
Nevada	" " " " "				
Placer					
Fallen Leaf Lake	USFS	38.922 -120.06	Taylor Creek	6,800	Operated to maintain instream flows
Lake Tahoe	USBR	39.167 -120.15	Upper Truckee River	732,000	See operations discussion above
Quail Lake	USFS	39.0710 -120.16	Tributary to Lake Tahoe	70	Operated to maintain instream flows
El Dorado					
Upper & Lower Echo Lakes	El Dorado Irrigation District	38.8350 -120.04	Tributary to Upper Truckee River	1,900	Inter-basin transfer to American River averaging 703 af mostly after Labor Day. Level maintained July-Labor Day for navigation between upper & lower lakes
Fallen Leaf Lake	U.S.A.	38.5513 -120.0620	Tributary to Lake Tahoe	Ask USFS Hydrologist	??? ask LTBMU hydrologist
Lake Tahoe	USBR	39.167 -120.15	Upper Truckee River	732,000	See operations discussion above
Alpine					
Harvey Place Reservoir	South Lake Tahoe Public Utility District	38.7647 -119.78	Treated effluent from So. Lake Tahoe waste water plant	3,700	Releases of 4,000 + af of treated effluent during growing season, but expansion of land applied to is under way
Indian Creek Reservoir	South Lake Tahoe Public Utility District	38.7518 -19.78	Indian Creek	3,160	Level maintained for recreational purposes
Kinney Reservoir	Alpine Land & Reservoir Company	38.5572 -119.81	Tributary to Silver Creek	900	Early season release assumed
Upper & Lower Kinney Lakes	" " " " "	38.5583 -119.83	Tributary to Silver Creek	1,248	" " " " " " "
East & West Lost Lakes	Carson water Subconservancy Dist.	38.6461 -119.95	Lost Creek	340	Operated to maintain instream flows
Upper & Lower Sunset Lakes	Alpine Land & Reservoir Company	38.6136 -119.88	Pleasant Valley Creek	860	Early season release assumed
Red Lake Reservoir	CA Dept. of Fish & Wildlife	38.6987 -119.97	Red Lake Creek	1,410	Operated to maintain instream flows [Emailed Ed James]
Tamarac Lake	Alpine Land & Reservoir Company	38.6082 -119.90	Tributary to Pleasant Valley Creek	400	Early season release assumed

County/Reservoir	Owner	Lat/Lon	Source	Storage, af	Operations
Wet Meadows Lake	" " " " "	38.6079 -119.87	" " " " "	450	" " " " " " "
Mono					
Black/Junction Reservoir	Bently Family LP	38.3374 -119.48	Black Creek	185	Early season release assumed
Bridgeport Reservoir	Walker River Irrigation District	38.3226 -119.21	East Walker River	44,100	Captures snowmelt for later release
Lobdell Lake	Unknown	38.441 -119.365	Deep Creek	Unknown	Apparently not jurisdictional lake
Poore Lake Reservoir	Park Livestock Co.	38.3159 -119.52	Poore Creek	1,200	Early season release assumed
Topaz Lake	Walker River Irrigation District	38.6499 -119.50	West Walker River	15,000	Captures snowmelt for later release
Upper/Lower Twin Lakes	Centennial Livestock	38.1679 -119.33	Robinson Creek	6,081	Early season release assumed

Table NL-17 Summary of Small, Medium, and Large Community Drinking Water Systems in the North Lahontan Hydrologic Region that Rely on One or More Contaminated Groundwater Well(s)

	Small Systems ≤ 3,300	Medium Systems 3,301 – 10,000	Large Systems > 10,000	Total
No. of Affected Community Drinking Water Systems	7	0	3	10
No. of Affected Community Drinking Water Wells	12	0	13	25

Source: Water Boards 2012 Draft Report on “Communities that Rely on Contaminated Groundwater”

Note: 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 NL-18 Summary of Contaminants Affecting Community Drinking Water Systems in the North Lahontan Hydrologic Region

Principal contaminant (PC)	Community drinking water systems where PC exceeds the Primary MCL	Community drinking water wells where PC exceeds the Primary MCL
Arsenic	8	19
Gross alpha particle activity	3	7

Source: Water Boards 2012 Draft Report on "Communities that Rely on Contaminated Groundwater"

Notes:

1. Only the 2 most prevalent contaminants are shown.

2. 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 NL-19 Water Management Entities

ENTITY	SECTOR
South Tahoe Public Utility District (STPUD)	water/wastewater
Bridgeport Public Utility District	water/wastewater
Lakeside Park Water Company	water
Leavitt Lake Community Service District	water/wastewater
Lukins Brothers Water Company, Incorporated	water
Pyramid Lake Paiute Tribe	water for endangered species
City of Susanville	water
Susanville Park River Water Company	water
Tahoe Keys Water Company	water
Tahoe Cedars Water Company	water/wastewater
Tahoe-Truckee Sanitation Agency (T-TSA)	wastewater
Truckee Carson Irrigation District	agricultural water
Truckee-Donner Public Utility District	water
Truckee Meadows Water Authority	urban water for Reno/Sparks
Twin Lakes Enterprises	water
Walker River Irrigation District	agricultural water
Washoe County Water Conservation District	agricultural water
Washoe Paiute Tribe	water
Carson Water Sub-conservancy District	bi-state watershed organization

Table NL-20 Flow Requirements for the Truckee River System

Location	Existing min. instream flow (cfs)	Enhanced min. TROA flow (cfs)
Below Lake Tahoe Dam	50-70	75
Below Donner Lake	2-3	5-8
Below Prosser Creek Dam	0-5	12-25
Below Independence Lake	2	2-8
Below Stampede Res.	22.5	45
Bypass flows, Truckee River	0-50	50-150

Note: cfs = cubic feet per second

Table NL-21 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	1998	Placer	6-67	Martis (Truckee) Valley
	No signatories on file				Non-B118 Basin
NL-4	Squaw Valley Public Service District	2007	Placer	-	Non-B118 Basin
	No signatories on file				

Table NL-22 Assessment for SB 1938 GWMP Required Components, SB 1938 GWMP Voluntary Components, and Bulletin 118-03 Recommended Components

SB 1938 GWMP Required Components	Percent 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 & Affects to Groundwater Levels & 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 (1/1/2013)	Not Assessed
Monitoring Protocols	33%
MP: Changes in groundwater levels	100%
MP: Changes in groundwater quality	100%
MP: Subsidence	100%
MP: SW/GW Interaction & Affects to Groundwater Levels & Quality	33%
SB 1938 GWMP Voluntary Components	**Percent of plans that include component**
Saline Intrusion	67%
Wellhead Protection & Recharge	67%
Groundwater Contamination	100%
Well Abandonment & Destruction	100%
Overdraft	67%
Groundwater Extraction & Replenishment	33%
Monitoring	100%
Conjunctive Use Operations	33%
Well Construction Policies	100%
Construction and Operation	67%
Regulatory Agencies	100%
Land Use	33%

Bulletin 118-03 Recommended Components	Percent of plans that include component
GWMP Guidance	67%
Management Area	100%
BMOs, Goals, & Actions	67%
Monitoring Plan Description	100%
IRWM Planning	100%
GWMP Implementation	100%
GWMP Evaluation	100%

Table NL-23 Factors Contributing to Successful Groundwater Management Plan Implementation in the North Lahontan Hydrologic Region

Key components	Respondents
Data collection and sharing	1
Outreach and education	-
Developing an understanding of common interest	-
Sharing of ideas and information with other water resource managers	1
Broad stakeholder participation	1
Adequate surface water supplies	1
Adequate regional and local surface storage and conveyance systems	1
Water budget	-
Funding	1
Time	-

Table NL-24 Factors Limiting Successful Groundwater Management Plan Implementation in the North Lahontan Hydrologic Region

Limiting Factors	Respondents
Funding for groundwater management projects	1
Funding for groundwater management planning	1
Unregulated Pumping	1
Groundwater Supply	-
Participation across a broad distribution of interests	2
Lack of Governance	-
Surface storage and conveyance capacity	-
Understanding of the local issues	-
Access to planning tools	1
Outreach and education	1
Data collection and sharing	2
Funding to assist in stakeholder participation	-

Table NL-25 Groundwater Ordinances that Apply to Counties in the North Lahontan Hydrologic Region

County	Groundwater Management	Guidance Committees	Export Permits	Recharge	Well Abandon-ment & Destruction	Well Construction Policies
Alpine	-	-	Y	-	Y	Y
El Dorado	-	-	-	-	Y	Y
Lassen	Y *	Y	Y	-	Y	-
Modoc	-	-	Y	-	-	Y
Mono	-	-	Y	-	Y	Y
Nevada	-	-	-	-	Y	Y
Placer	-	-	-	-	Y	Y
Sierra	-	-	Y	-	-	-

* An asterisk indicates that the ordinance establishes Basin Management Objectives.

Table NL-26 Conceptual Growth Scenarios

Scenario	Population Growth	Development Density
LOP-HID	Lower than Current Trends	Higher than Current Trends
LOP-CTD	Lower than Current Trend	Current Trends
LOP-LOD	Lower than Current Trends)	Lower than Current Trends
CTP-HID	Current Trends	Higher than Current Trends
CTP-CTD	Current Trends	Current Trends
CTP-LOD	Current Trends	Lower than Current Trends
HIP-HID	Higher than Current Trends	Higher than Current Trends
HIP-CTD	Higher than Current Trends	Current Trends
HIP-LOD	Higher than Current Trends	Lower than Current Trends

Source: California Department of Water Resources 2012.

Table NL-27 Growth Scenarios (Urban) — North Lahontan

Scenario [a]	2050 Population (thousand)	Population Change (thousand) 2006 [b] to 2050	Development Density	2050 Urban Footprint (thousand acres)	Urban Footprint Increase (thousand acres) 2006 [c] to 2050
LOP-HID	113.1 [d]	15.2	High	46.2	2.7
LOP-CTD	113.1	15.2	Current Trends	46.4	2.9
LOP-LOD	113.1	15.2	Low	46.6	3.1
CTP-HID	119.9 [e]	22.0	High	48.0	4.5
CTP-CTD	119.9	22.0	Current Trends	48.4	4.9
CTP-LOD	119.9	22.0	Low	48.6	5.1
HIP-HID	159.8 [f]	61.9	High	54.8	11.3
HIP-CTD	159.8	61.9	Current Trends	56.5	13.0
HIP-LOD	159.8	61.9	Low	58.5	15.0

Source: California Department of Water Resources 2012.

Notes:

[a] See Table NL-26 for scenario definitions.

[b] 2006 population was 97.9 thousand.

[C] 2006 urban footprint was 43.5 thousand acres.

[d] Values modified by the California Department of Water Resources (DWR) from the Public Policy Institute of California.

[e] Values provided by the California Department of Finance.

[f] Values modified by DWR from the Public Policy Institute of California.

Table NL-28 Growth Scenarios (Agriculture) — North Lahontan

Scenario [a]	2050 Irrigated Land Area [b] (thousand acres)	2050 Irrigated Crop Area [c] (thousand acres)	2050 Multiple Crop Area [d] (thousand acres)	Chang in Irrigated Crop Area (thousand acres) 2006 to 2050
LOP-HID	128.2	128.2	0.0	+1.8
LOP-CTD	128.1	128.1	0.0	+1.7
LOP-LOD	128.1	128.1	0.0	+1.7
CTP-HID	128.0	128.0	0.0	+1.6
CTP-CTD	128.1	128.1	0.0	+1.7
CTP-LOD	128.0	128.0	0.0	+1.6
HIP-HID	127.3	127.3	0.0	+0.9
HIP-CTD	127.0	127.0	0.0	+0.6
HIP-LOD	126.7	126.7	0.0	+0.3

Source: California Department of Water Resources 2012.

Notes:

[a] See Table NL-26 for scenario definitions.

[b] 2006 Irrigated land area was estimated by the California Department of Water Resources (DWR) to be 126.4 thousand acres.

[c] 2006 Irrigated crop area was estimated by DWR to be 126.4 thousand acres.

[d] 2006 multiple crop area was estimated by DWR to be 0.0 thousand acres.

Table NL-29 Resource Management Strategies Addressed in IRWMP's in the North Lahontan Hydrologic Region

Resource Management Strategy	IRWMP 1	IRWMP 2
Agricultural Water Use Efficiency		
Urban Water Use Efficiency		
Conveyance – Delta		
Conveyance – Regional/Local		
System Reoperation		
Water Transfers		
Conjunctive Management & Groundwater		
Desalination		
Precipitation Enhancement		
Recycled Municipal Water		
Surface Storage – CALFED		
Surface Storage – Regional/Local		
Drinking Water Treatment and Distribution		
Groundwater and Aquifer Remediation		
Match Water Quality to Use		
Pollution Prevention		
Salt and Salinity Management		
Agricultural Lands Stewardship		
Economic Incentives		
Ecosystem Restoration		
Forest Management		
Land Use Planning and Management		
Recharge Areas Protection		
Water-Dependent Recreation		
Watershed Management		
Flood Risk Management		
Flood Management		
Desalination (Brackish and Sea Water)		
Salt and Salinity Management		

Table NL-30 North Lahontan Snow Covered Area Changes with Temperature

Basin	Mean elevation [ft]	Average Apr. 1 snow line [ft]	Total area [mi2]	Snow Covered Area [percent of basin]	1°C (1.8°F) Rise [% of basin]	2°C (3.6°F) Rise [% of basin]	3°C (5.4°F) Rise [% of basin]	4°C (7.2°F) Rise [% of basin]	5°C (9°F) Rise [% of basin]
Truckee	6,790	5,500	430	100%	84%	58%	35%	17%	8%
Tahoe	7,030	6,000	510	100%	55%	41%	29%	18%	8%
W. Carson	8,050	6,000	70	100%	100%	100%	71%	51%	25%
E. Carson	7,530	6,000	350	86%	77%	66%	54%	47%	22%
W. Walker	8,650	6,500	180	100%	94%	83%	67%	53%	41%
E. Walker	8,250	6,500	360	97%	83%	69%	50%	36%	26%

Figure NL-1 North Lahontan Hydrologic Region

Figure NL-2 North Lahontan Hydrologic Region Watersheds

PLACEHOLDER Photo NL-1 Angora Fire

[photo to come]

Figure NL-3 Alluvial Groundwater Basins and Subbasins within the North Lahontan Hydrologic Region

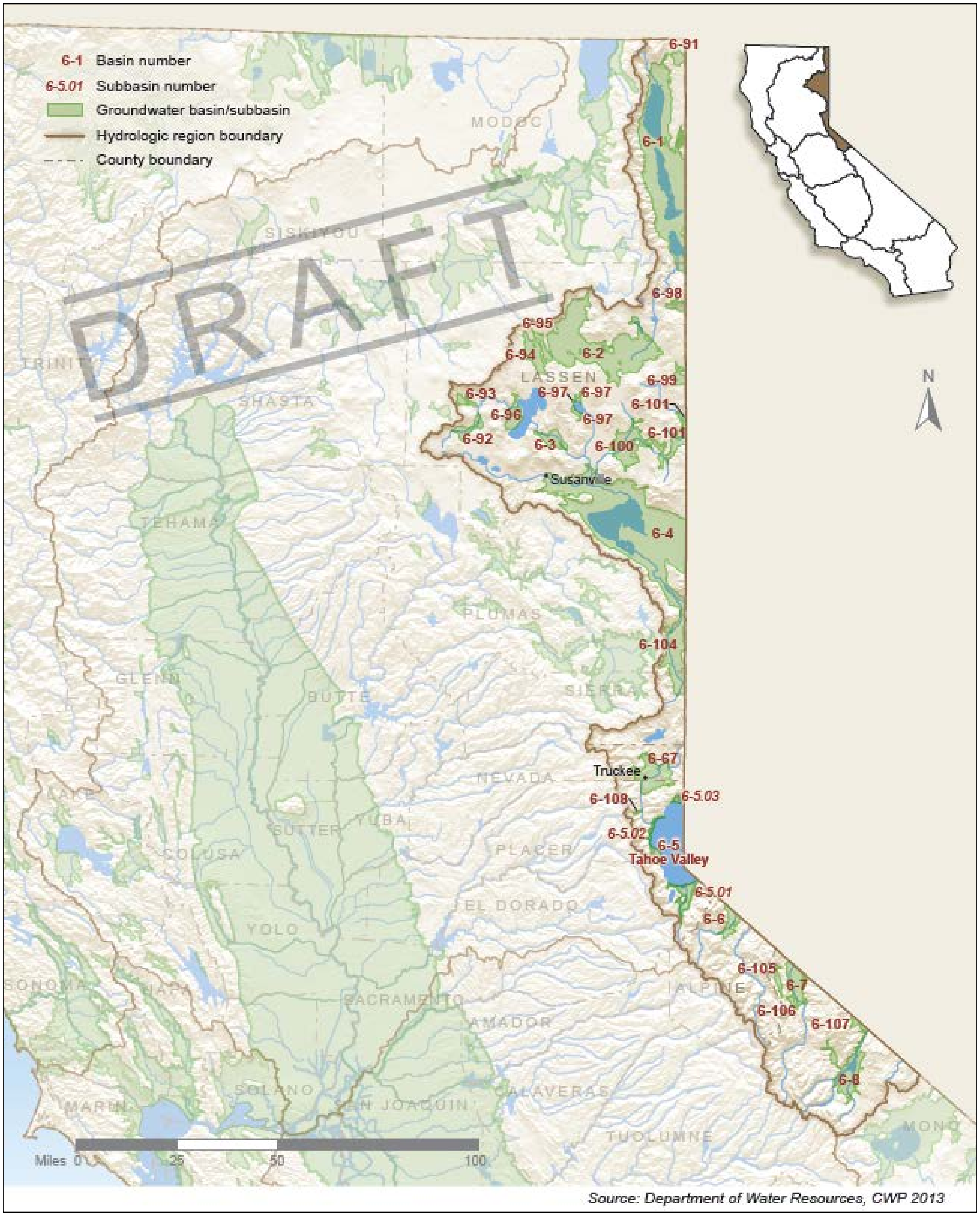


Figure NL-4 **Number of Well Logs by County and Use for the North Lahontan Hydrologic Region (1977–2010)**

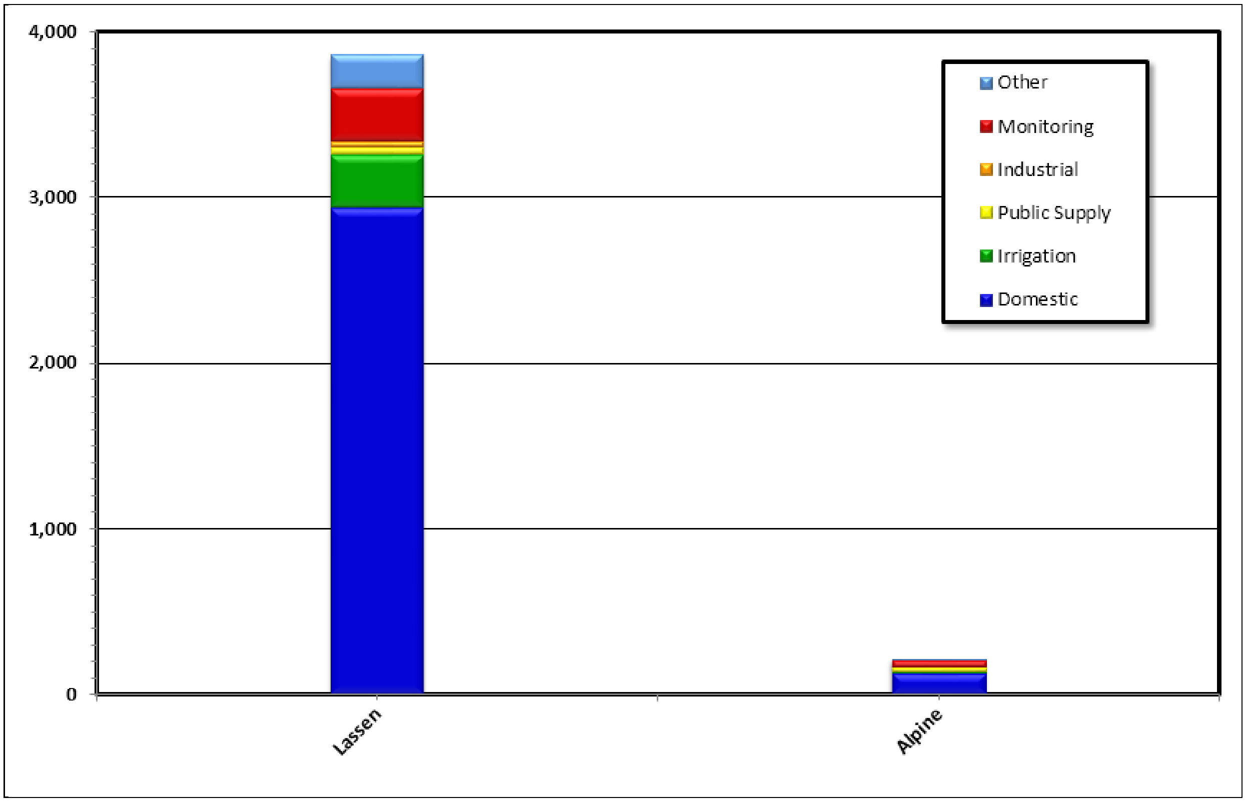


Figure NL-5 Percentage of Well Logs by Use for the North Lahontan Hydrologic Region (1977–2010)

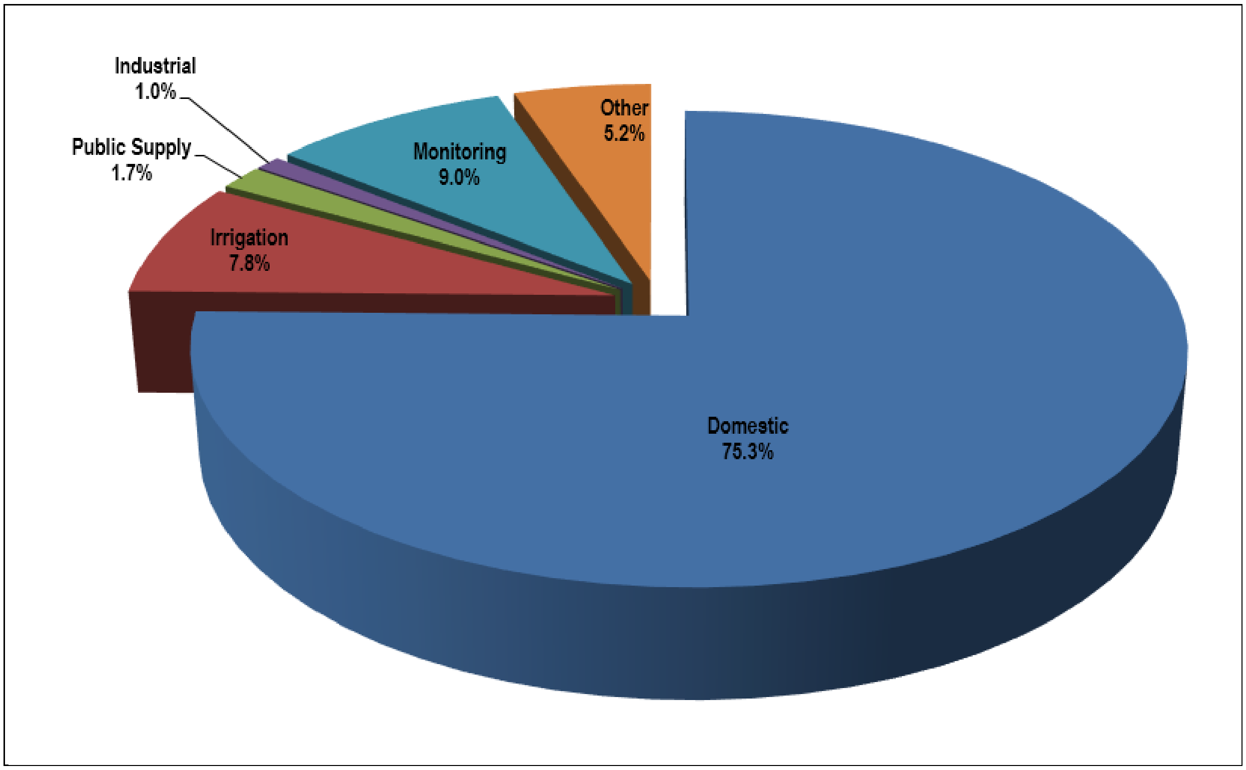


Figure NL-6 Number of Well Logs Filed per Year by Use for the North Lahontan Hydrologic Region (1977–2010)

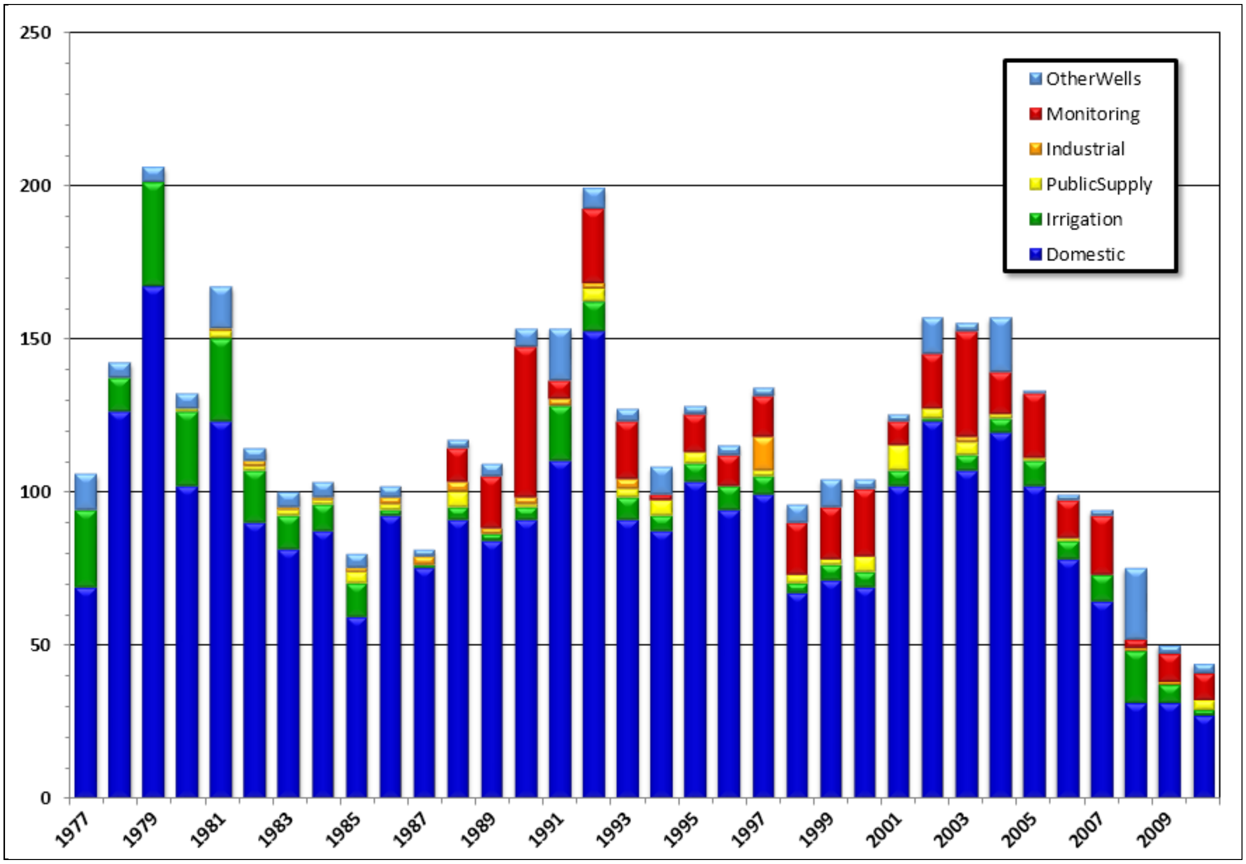


Figure NL-7 **CASGEM Groundwater Basin Prioritization for the North Lahontan Hydrologic Region**

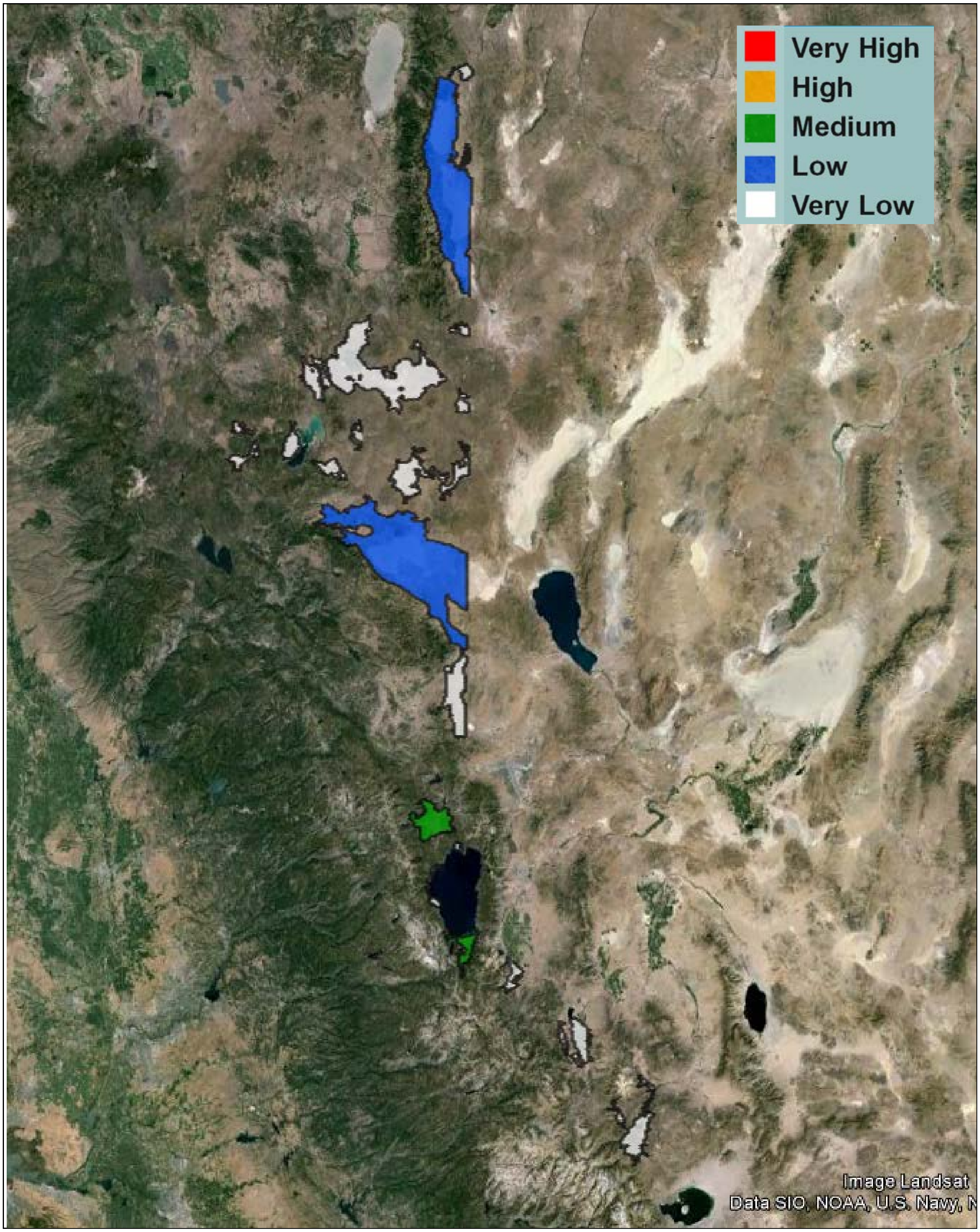
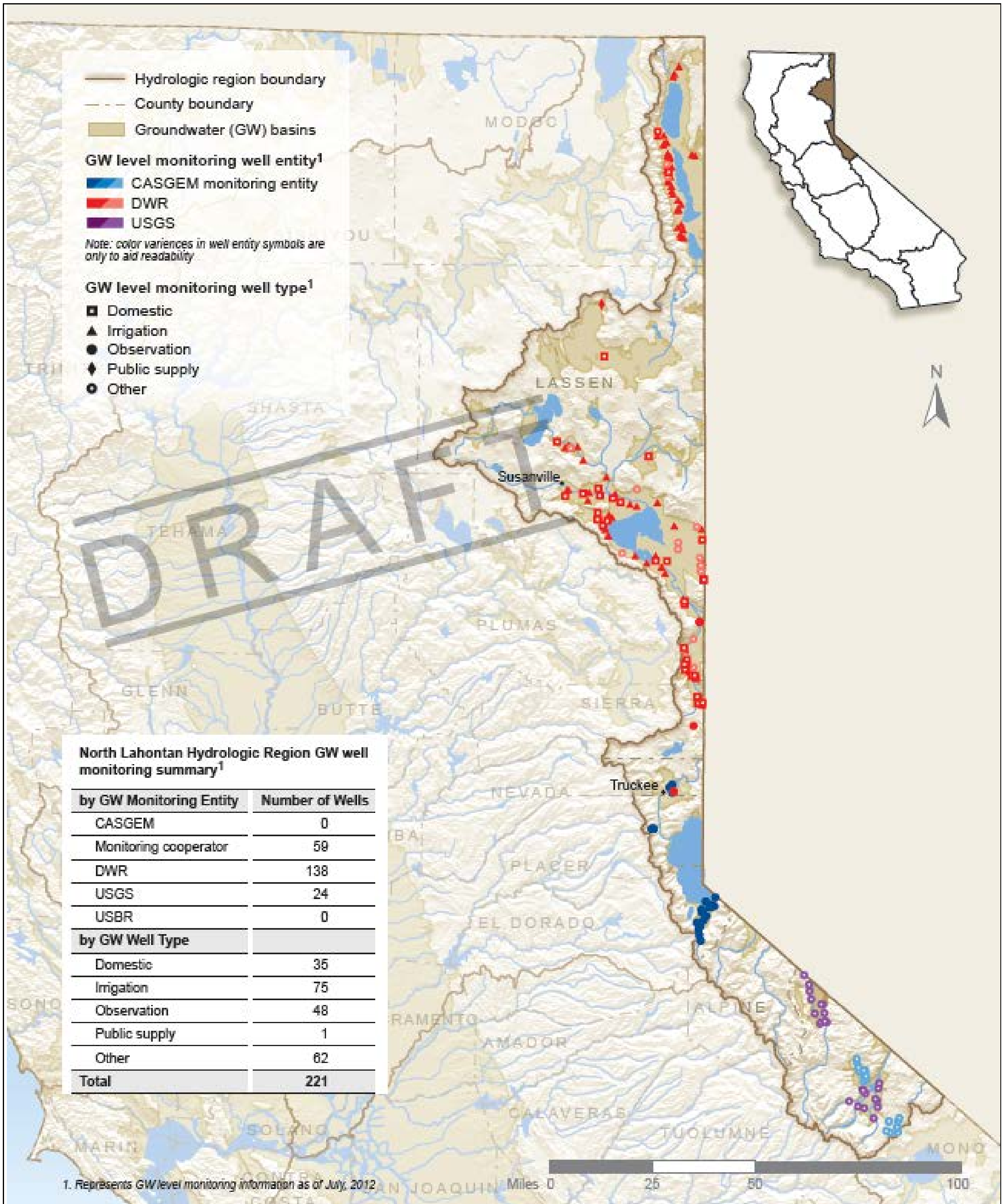


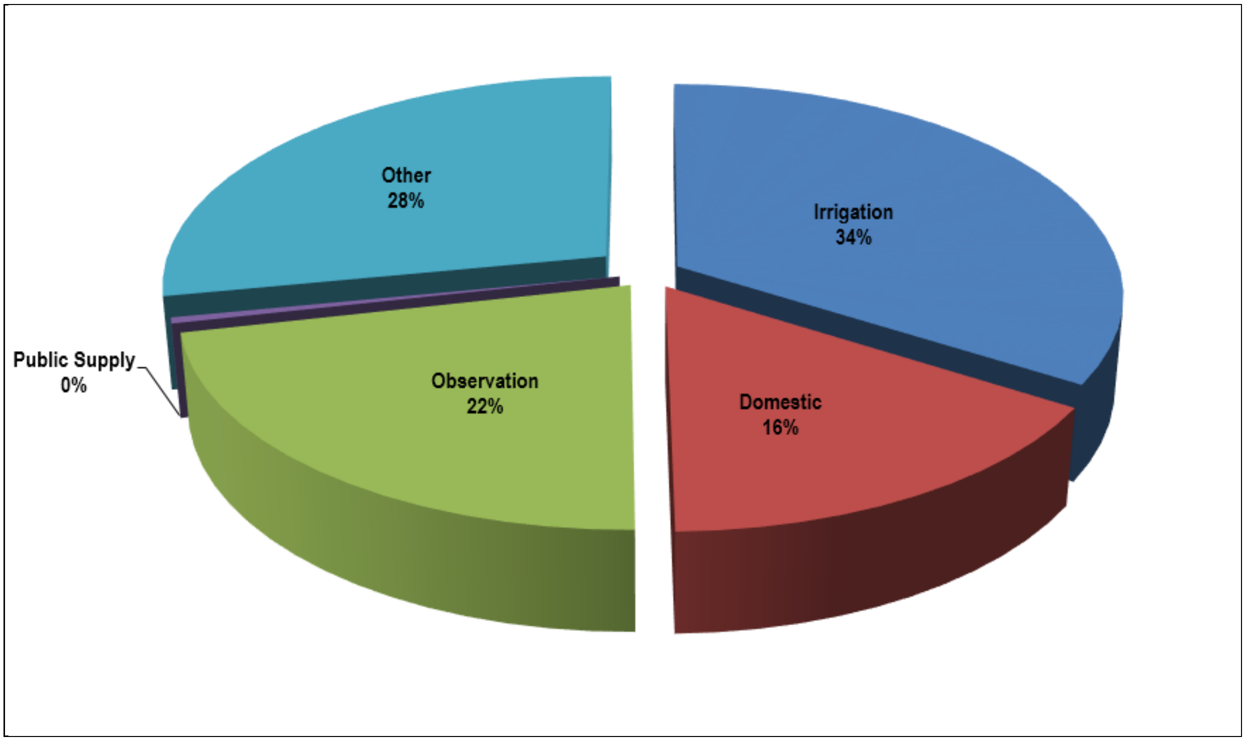
Figure NL-8 Monitoring Well Location by Agency, Monitoring Cooperator, and CASGEM Monitoring Entity in the North Lahontan Hydrologic Region



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**

Source: Department of Water Resources, CWP 2013

Figure NL-9 Percentage of Monitoring Wells by Use in the North Lahontan Hydrologic Region



PLACEHOLDER Photo NL-2 Whitetop (perennial pepperweed) Roots Do Not Form Interlocking Mesh that Holds Soil

[photo to come]

PLACEHOLDER Photo NL-3 Wolf OR-7 Southwest Modoc County May 7, 2012

[photo to come]

PLACEHOLDER Photo NL-4 Juvenile Lahontan Cutthroat Trout from By Day Creek Ecological Reserve

[photo to come]

Figure NL-10 North Lahontan Regional Inflows and Outflows in 2010

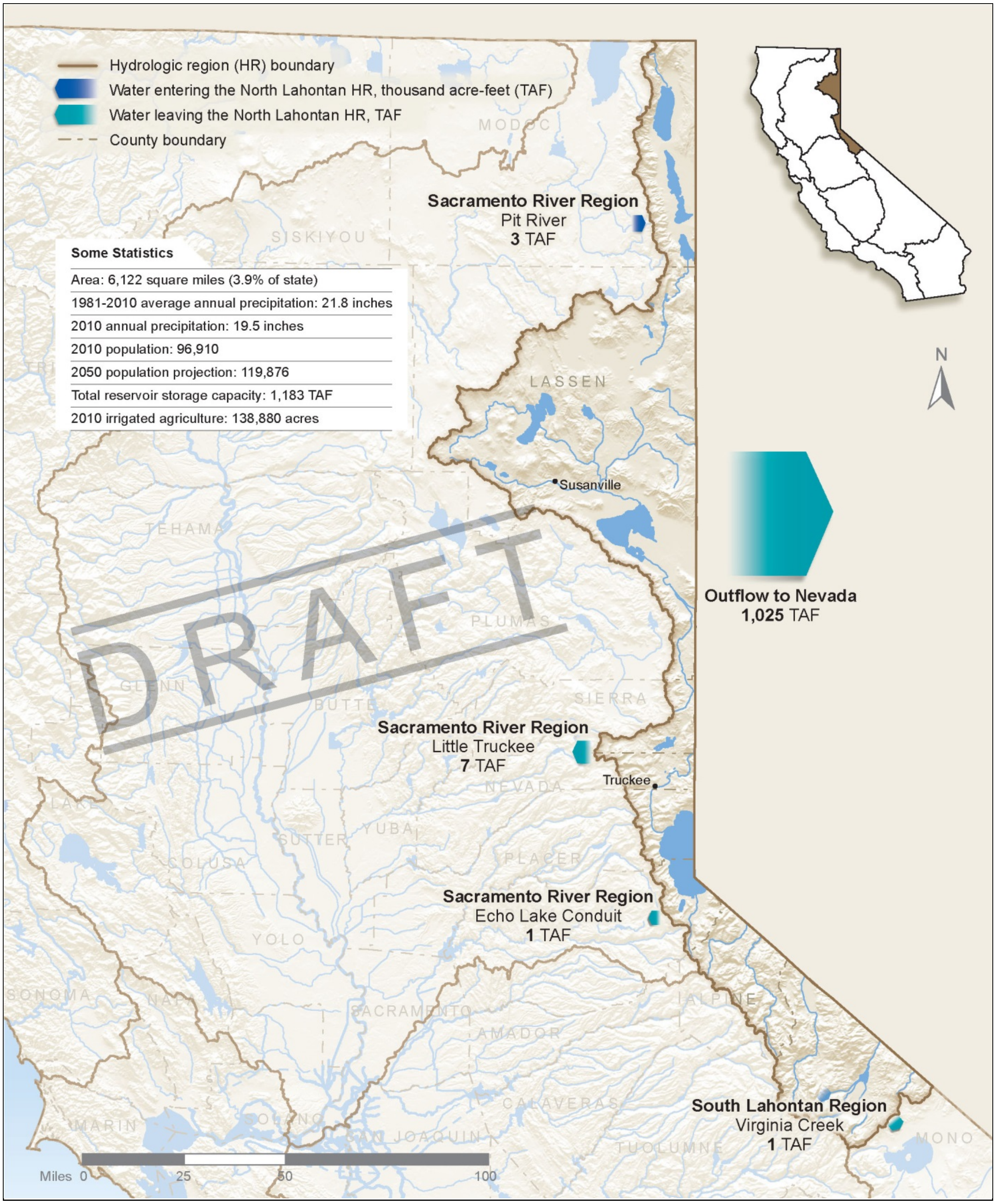


Figure NL-11 Contribution of Groundwater to the North Lahontan Hydrologic Region Water Supply by Planning Area (2005-2010)

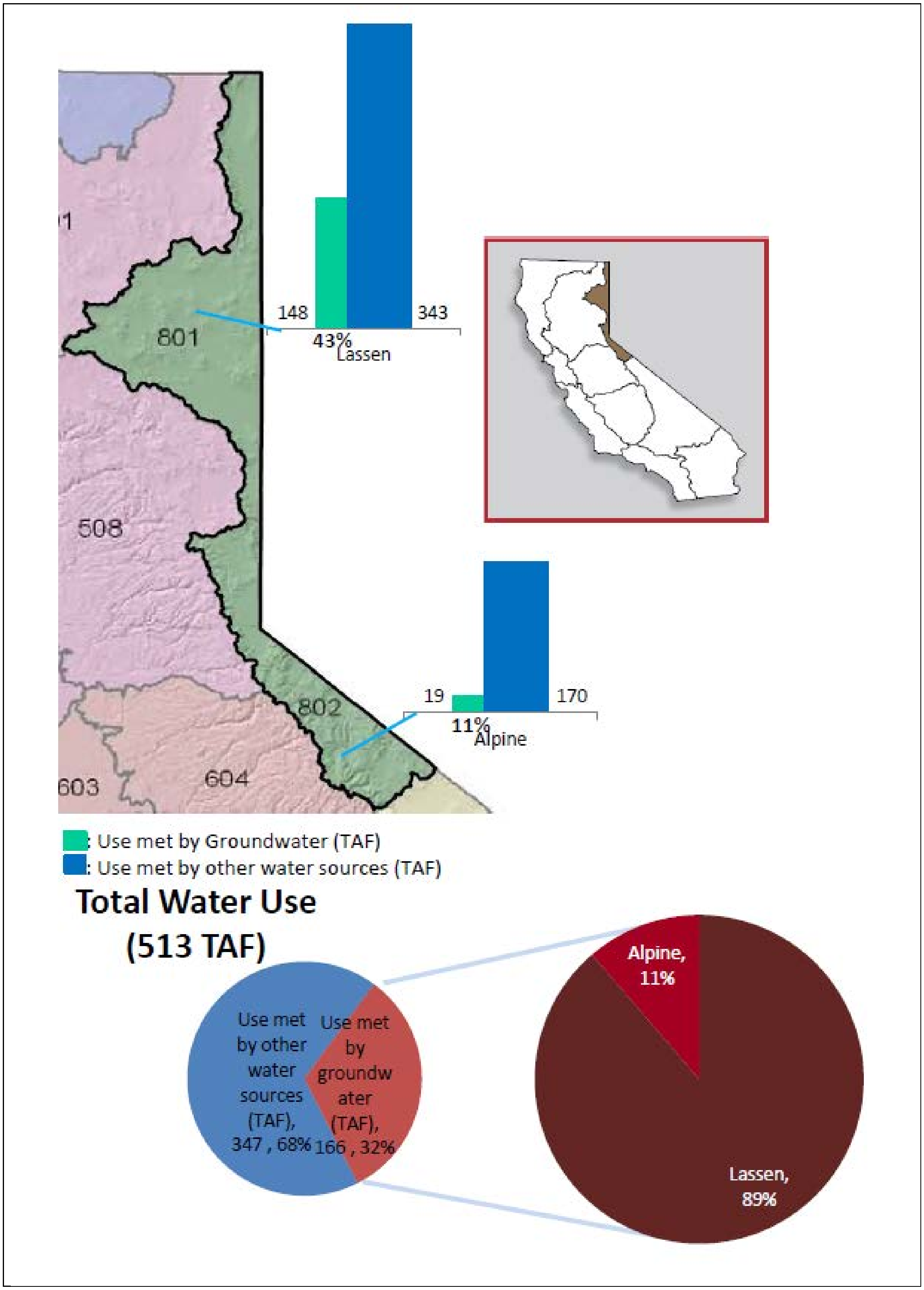


Figure NL-12 North Lahontan Hydrologic Region Annual Groundwater Water Supply Trend (2002-2010)

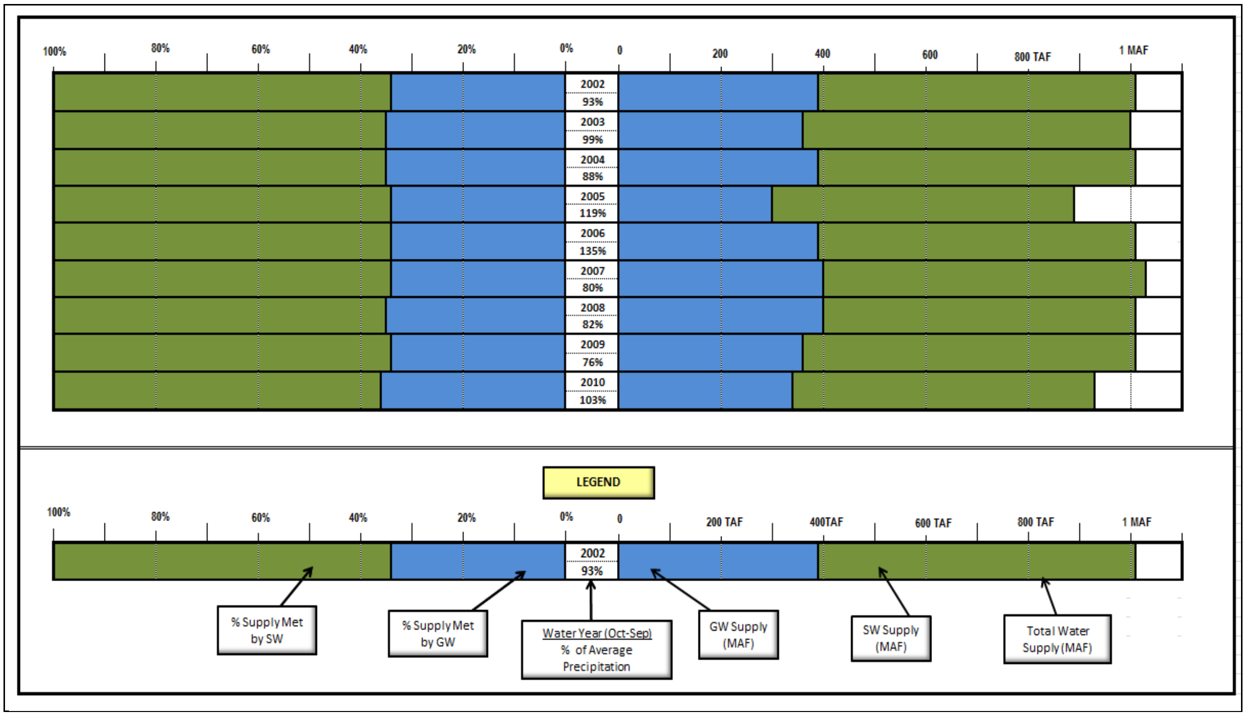


Figure NL-13 North Lahontan Hydrologic Region Annual Groundwater Supply Trend by Type of Use (2002-2010)

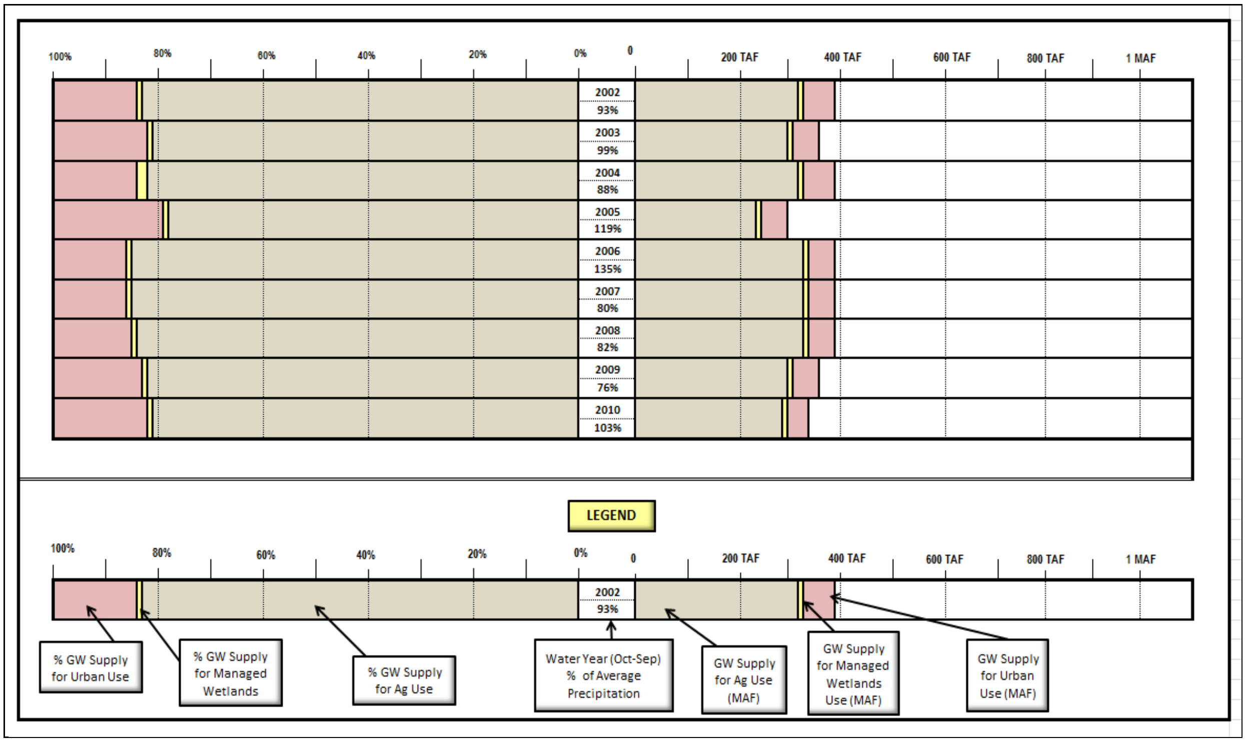
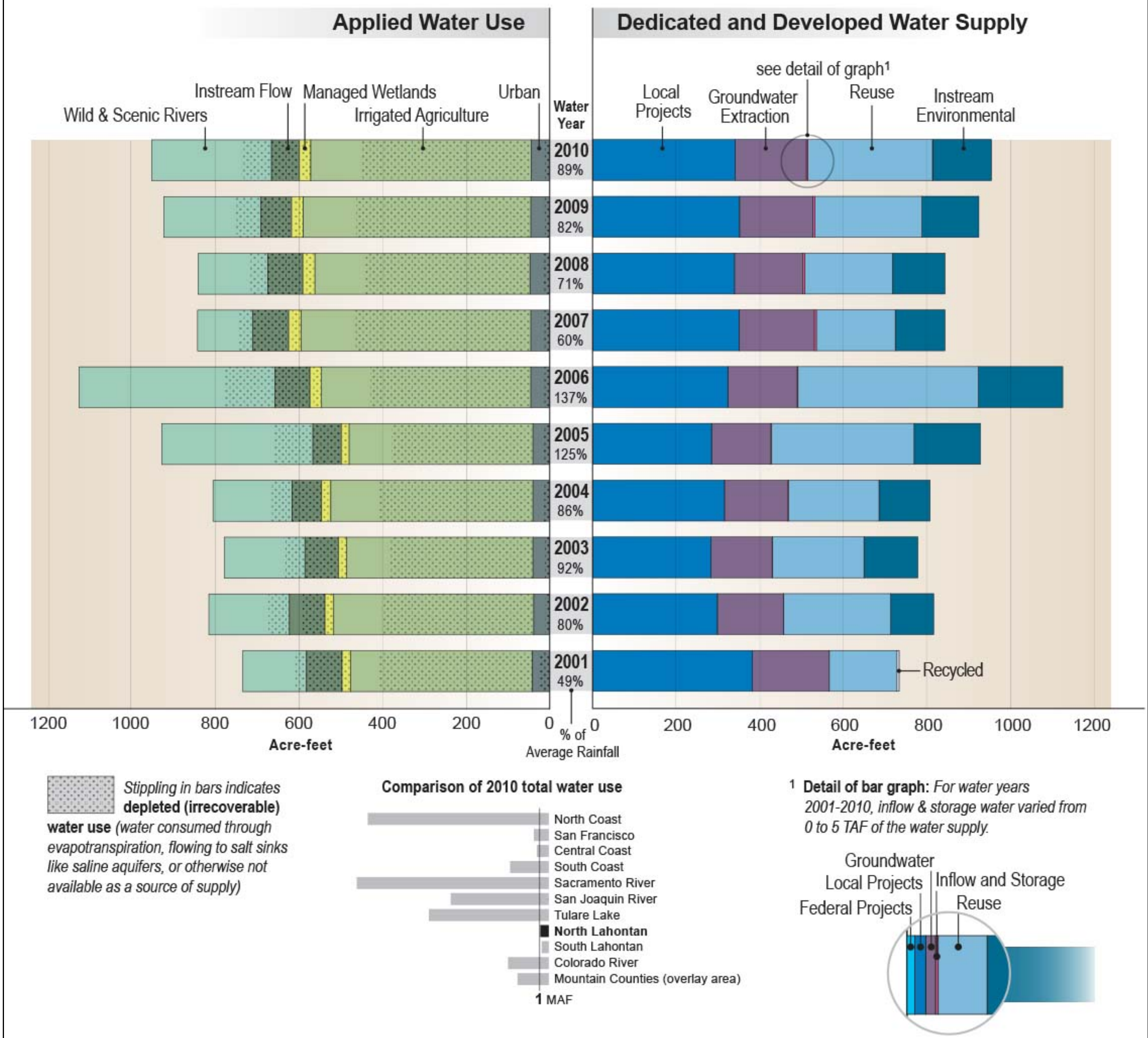


Figure NL-14 North Lahontan Hydrologic Region Water Balance by Water Year, 2001-2010

California's water resources vary significantly from year to year. Ten recent years show this variability for water use and water supply. Applied Water Use shows how water is applied to urban and agricultural sectors and dedicated to the environment and the Dedicated and Developed Water Supply shows where the water came from each year to meet those uses. Dedicated and Developed Water Supply does not include the approximately 125 million acre-feet (MAF) of statewide precipitation and inflow in an average year that either evaporates, are used by native vegetation, provides rainfall for agriculture and managed wetlands, or flow out of the state or to salt sinks like saline aquifers. Groundwater extraction includes annually about 2 MAF more groundwater used statewide than what naturally recharges – called groundwater overdraft. Overdraft is characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years.



Key Water Supply and Water Use Definitions

Applied water. The total amount of water that is diverted from any source to meet the demands of water users without adjusting for water that is depleted, returned to the developed supply or considered irrecoverable (see water balance figure).

Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

Instream environmental. Instream flows used only for environmental purposes.

Instream flow. The use of water within its natural watercourse as specified in an agreement, water rights permit, court order, FERC license, etc.

Groundwater Extraction. An annual estimate of water withdrawn from banked, adjudicated, and unadjudicated groundwater basins.

Recycled water. Municipal water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.

Reused water. The application of previously used water to meet a beneficial use, whether treated or not prior to the subsequent use.

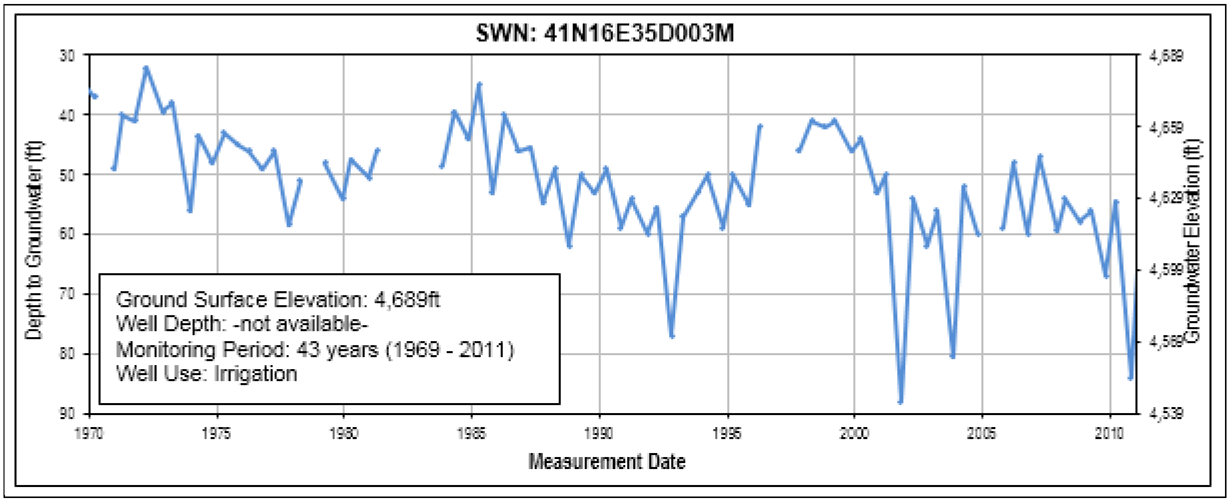
Urban water use. The use of water for urban purposes, including residential, commercial, industrial, recreation, energy production, military, and institutional classes. The term is applied in the sense that it is a kind of use rather than a place of use.

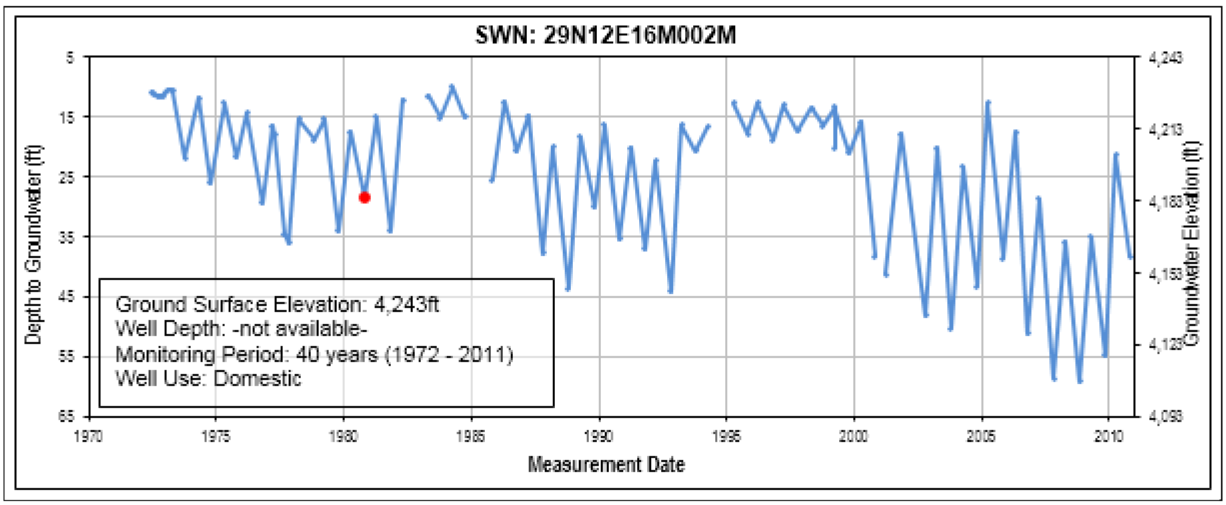
Water balance. An analysis of the total developed/dedicated supplies, uses, and operational characteristics for a region. It shows what water was applied to actual uses so that use equals supply.

North Lahontan Water Balance by Water Year Data Table (MAF)

	2001 (49%)	2002 (80%)	2003 (92%)	2004 (86%)	2005 (125%)	2006 (137%)	2007 (60%)	2008 (71%)	2009 (82%)	2010 (89%)
Applied Water Use										
Urban	41	38	40	40	40	45	45	47	45	44
Irrigated Agriculture	435	479	446	484	440	502	550	515	545	528
Managed Wetlands	21	21	20	22	19	27	30	29	28	27
Req Delta Outflow	0	0	0	0	0	0	0	0	0	0
Instream Flow	85	85	80	71	68	84	86	84	74	67
Wild & Scenic R.	153	193	193	189	362	469	132	167	232	287
Total Uses	**733**	**816**	**778**	**806**	**929**	**1125**	**843**	**843**	**924**	**953**
Depleted Water Use (stippling)										
Urban	26	10	12	14	14	13	13	15	12	12
Irrigated Agriculture	369	365	342	369	337	384	421	395	418	405
Managed Wetlands	17	18	16	17	15	21	22	22	22	21
Req Delta Outflow	0	0	0	0	0	0	0	0	0	0
Instream Flow	85	53	80	71	68	84	86	84	74	67
Wild & Scenic R.	29	50	50	50	92	119	33	42	62	72
Total Uses	**526**	**496**	**499**	**522**	**525**	**620**	**575**	**558**	**588**	**578**
Dedicated and Developed Water Supply										
Instream	0	103	129	122	159	202	119	126	136	140
Local Projects	382	298	283	315	284	323	350	339	351	341
Local Imported Deliveries	0	0	0	0	0	0	0	0	0	0
Colorado Project	0	0	0	0	0	0	0	0	0	0
Federal Projects	0	0	0	0	0	0	0	0	0	0
State Project	0	0	0	0	0	0	0	0	0	0
Groundwater Extraction	184	158	146	152	142	166	180	164	176	170
Inflow & Storage	0	1	1	1	1	2	5	4	4	4
Reuse & Seepage	162	256	219	217	342	432	189	210	257	298
Recycled Water	5	0	0	0	0	0	0	0	0	1
Total Supplies	**733**	**816**	**778**	**806**	**929**	**1,125**	**843**	**843**	**924**	**953**

Figure NL-15 Groundwater Level Trends in Selected Wells in the North Lahontan Hydrologic Region





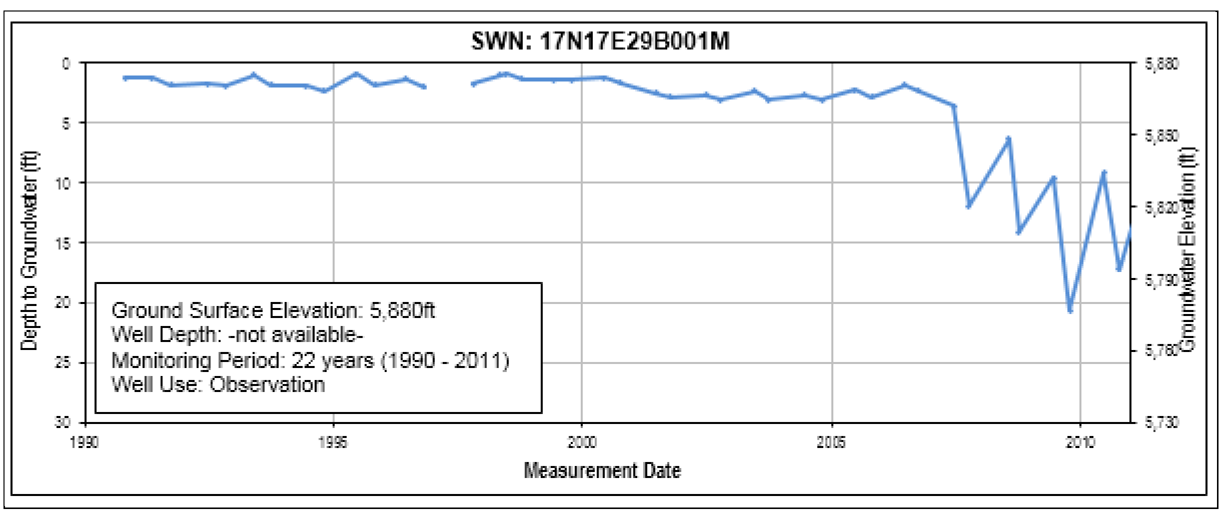
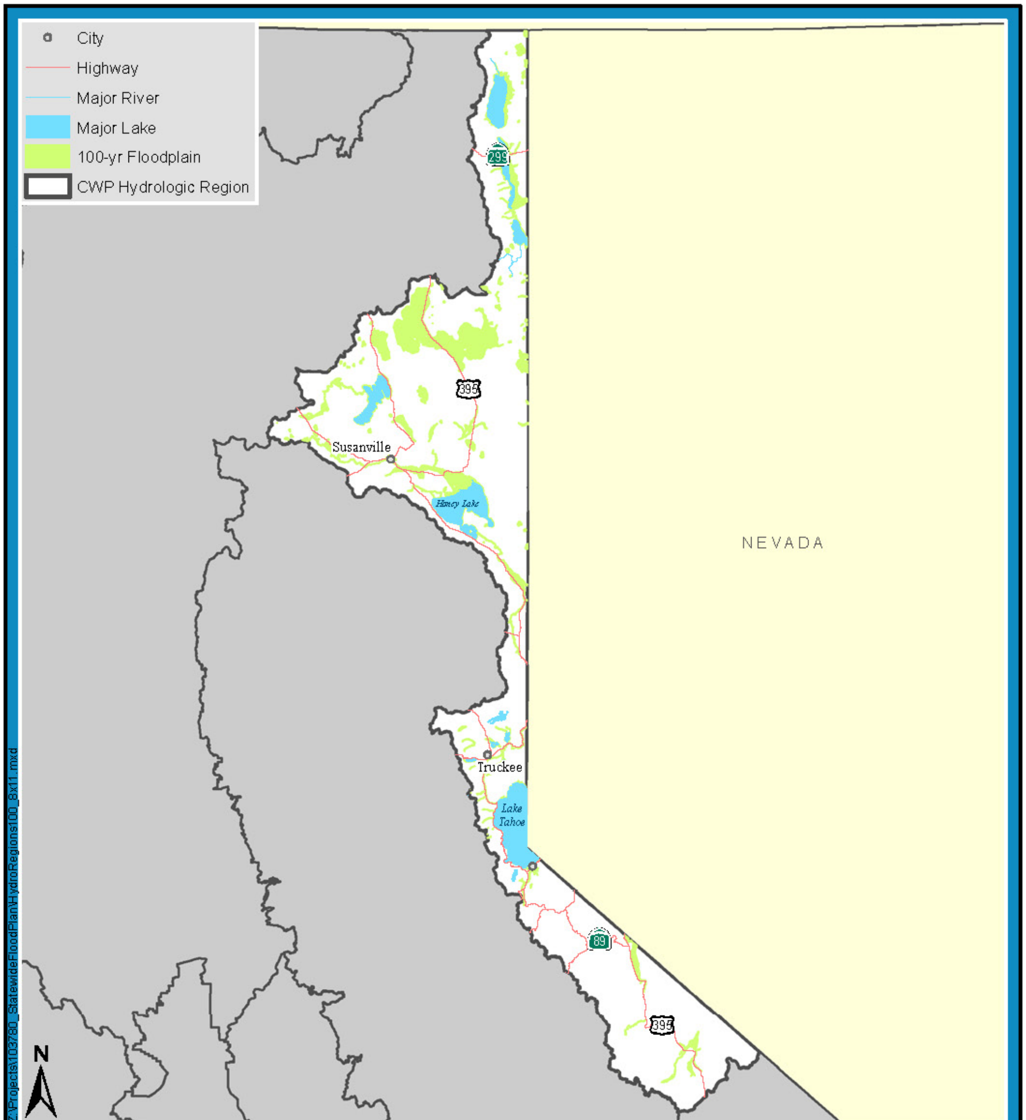


Figure NL-16 Flood Hazard Exposure to the 100-Year Floodplain in the North Lahontan Region



North Lahontan Key Results

Total Population:	97,800	Transportation Facilities:	70
Population Exposed:	3,600	Transportation Segments (miles):	94
Percent of Population Exposed:	4	Essential Facilities:	3
Exposed Structures:	3,200	Lifeline Utilities:	2
Value of Exposed Structure and Contents:	$714.2 Million	Dept. of Defense Facilities:	1
Total Area (acres)	3.9 Million	Dept. of Defense Facilities (acres):	56,674
Exposed Area (acres)	487,400	High Potential Loss Facilities:	9
Percent of Area Exposed:	12	Native American Tribes:	1
Exposed Ag.Crops (acres):	42,900	Native American Tribal Lands (acres):	9
Percent of Ag. Crops Exposed:	27	Sensitive Animal Species Exposed:	46
Value of Exposed Ag. Crops:	$9.9 Million	Sensitive Plant Species Exposed:	68

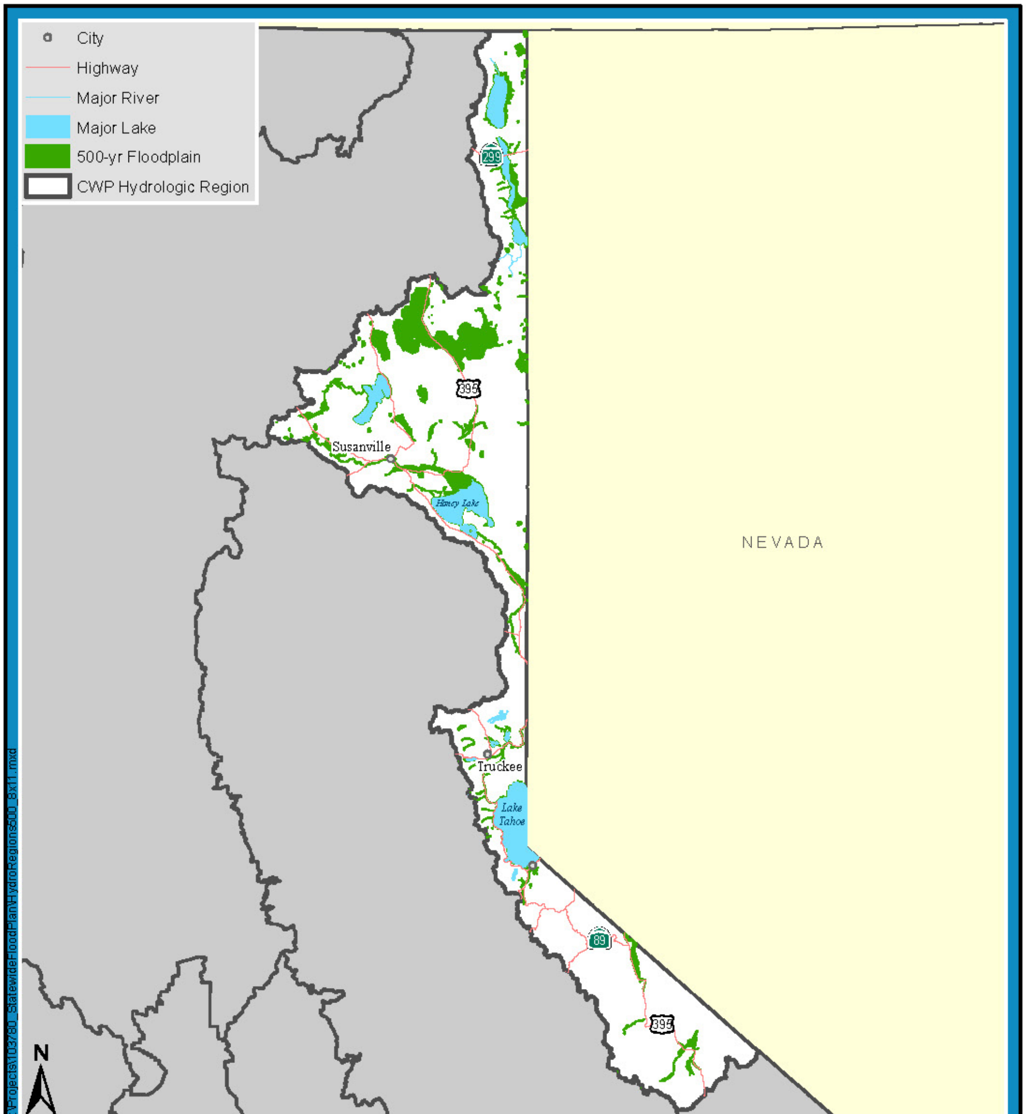
Statewide Flood Hazard Exposure Summary for the North Lahontan Hydrologic Region 100-year Floodplain

STATEWIDE FLOOD MANAGEMENT PLANNING PROGRAM

FloodSAFE CALIFORNIA

Jan 28, 2013

Figure NL-17 Flood Hazard Exposure to the 500-Year Floodplain in the North Lahontan Region



North Lahontan Key Results

Total Population:	97,800	Transportation Facilities:	75
Population Exposed:	4,000	Transportation Segments (miles):	96
Percent of Population Exposed:	4	Essential Facilities:	3
Exposed Structures:	3,500	Lifeline Utilities:	2
Value of Exposed Structure and Contents:	$823.0 Million	Dept. of Defense Facilities:	1
Total Area (acres)	3.9 Million	Dept. of Defense Facilities (acres):	56,674
Exposed Area (acres)	488,400	High Potential Loss Facilities:	9
Percent of Area Exposed:	12	Native American Tribes:	2
Exposed Ag.Crops (acres):	43,200	Native American Tribal Lands (acres):	14
Percent of Ag. Crops Exposed:	27	Sensitive Animal Species Exposed:	46
Value of Exposed Ag. Crops:	$10.0 Million	Sensitive Plant Species Exposed:	68

Statewide Flood Hazard Exposure Summary for the North Lahontan Hydrologic Region 500-year Floodplain

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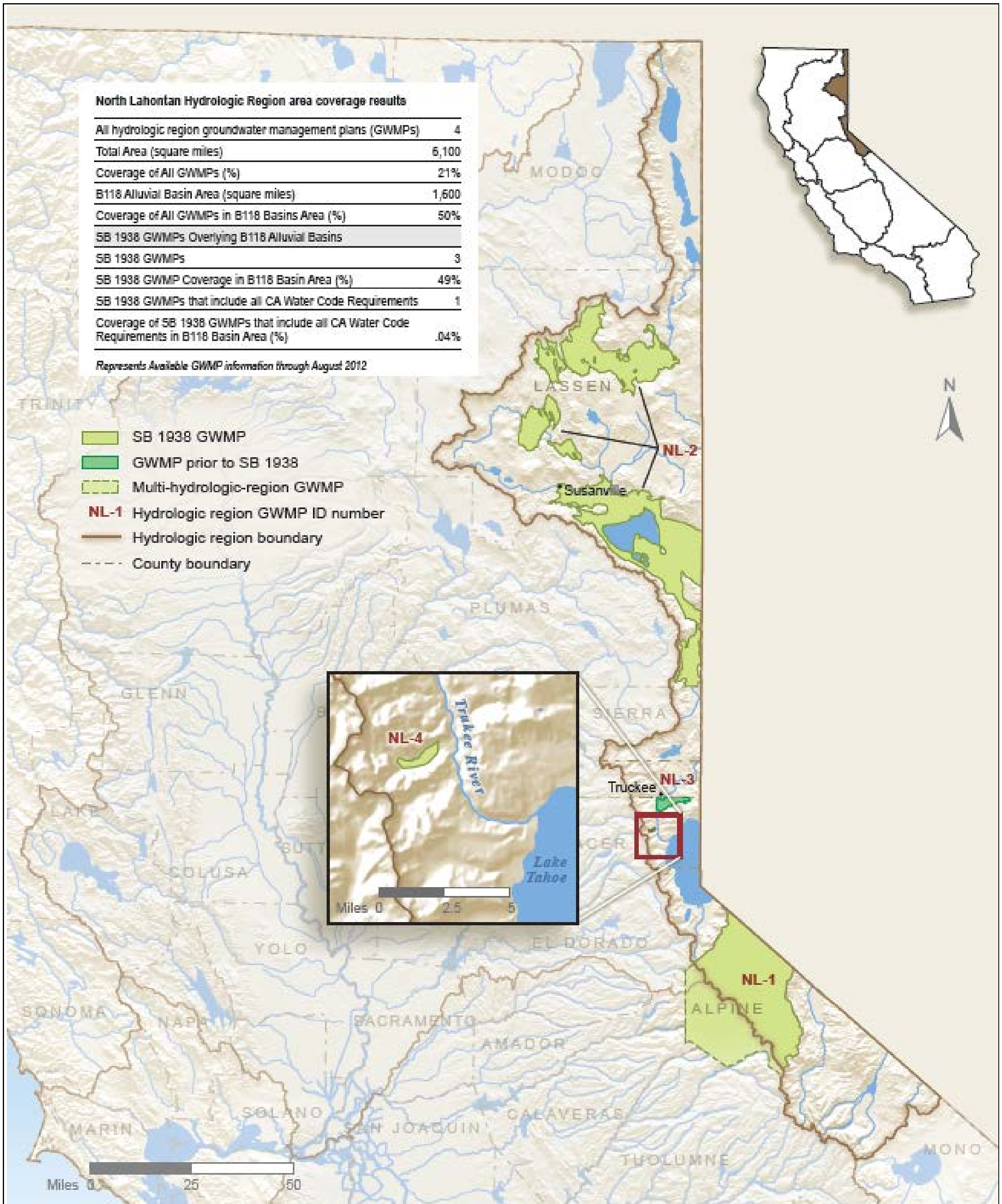
Figure NL-18 Location of Groundwater Management Plans in the North Lahontan Hydrologic Region



North Lahontan Hydrologic Region area coverage results

All hydrologic region groundwater management plans (GWMPs)	4
Total Area (square miles)	5,100
Coverage of All GWMPs (%)	21%
B118 Alluvial Basin Area (square miles)	1,600
Coverage of All GWMPs in B118 Basins Area (%)	50%
SB 1938 GWMPs Overlying B118 Alluvial Basins	
SB 1938 GWMPs	3
SB 1938 GWMP Coverage in B118 Basin Area (%)	49%
SB 1938 GWMPs that include all CA Water Code Requirements	1
Coverage of SB 1938 GWMPs that include all CA Water Code Requirements in B118 Basin Area (%)	.04%

Represents Available GWMP information through August 2012

Source: Department of Water Resources, CWP 2013

PLACEHOLDER Photo NL-5 Dec. 2011(left) - April 2012 (right) Snow Levels Illustrating Randomness of Precipitation

[photo to come]

Figure NL-19 Change in North Lahontan Agricultural and Urban Water Demands for 117 Scenarios from 2006-2050 (thousand acre-feet per year)

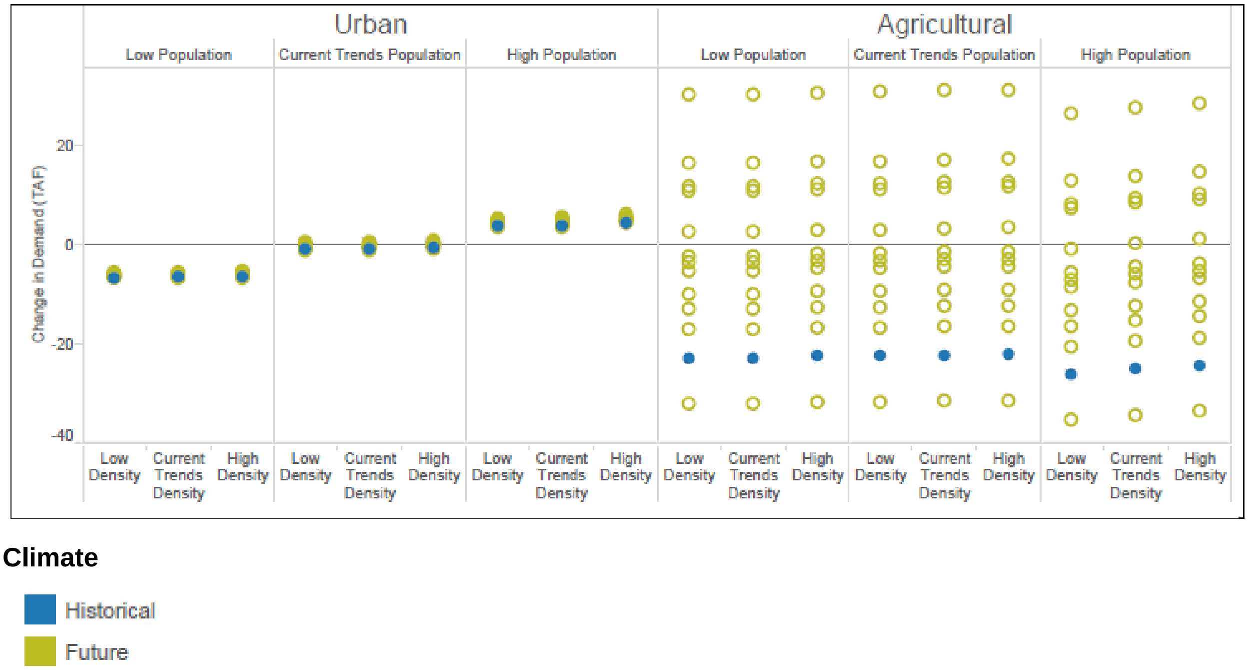


Figure NL-20 Integrated Water Management Planning in the North Lahontan Region

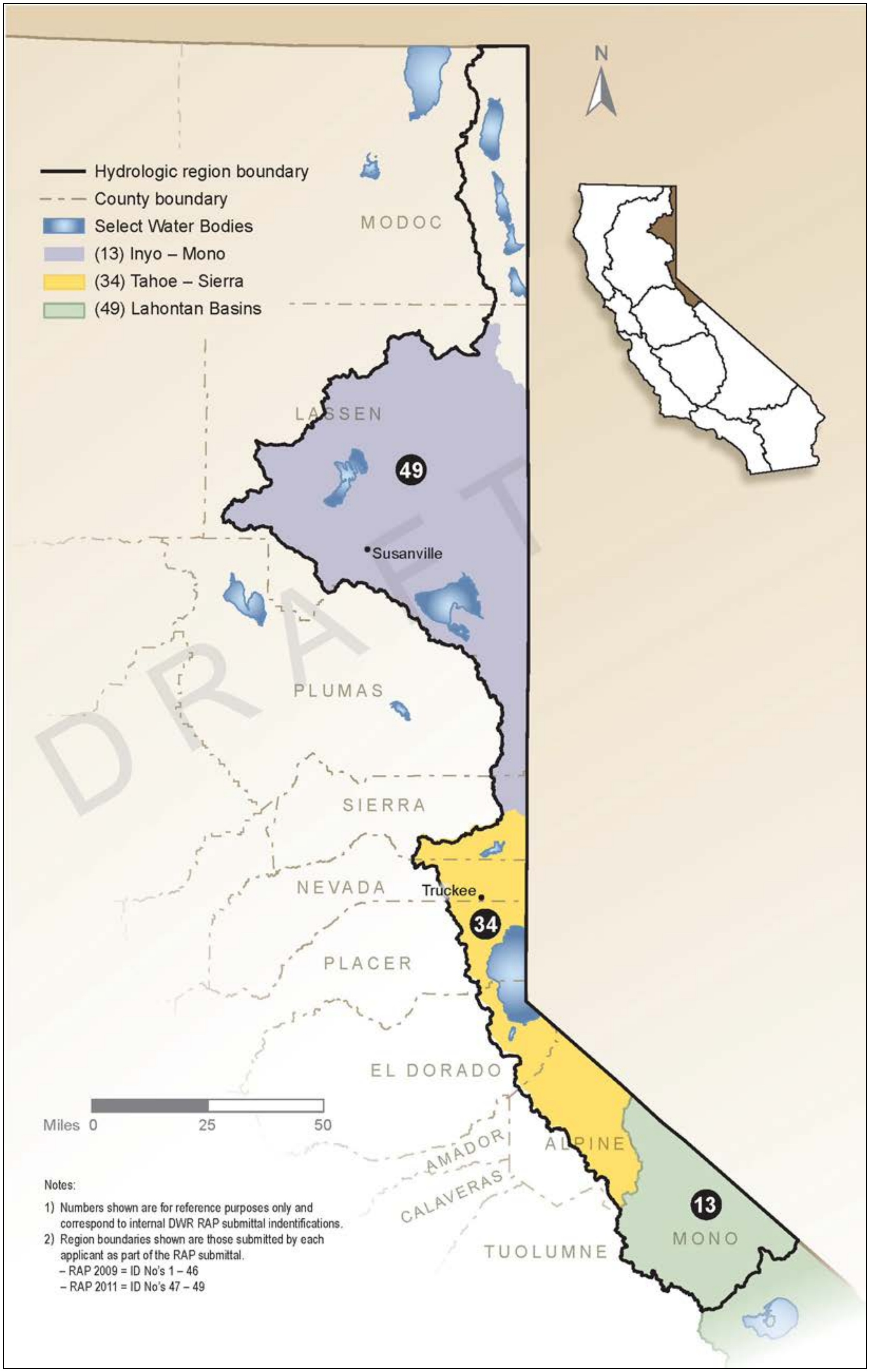


Figure NL-21 Energy Intensity of Raw Water Extraction and Conveyance in the North Lahontan Region

Type of Water	Energy Intensity (yellow bulb = 1-500 kWh/AF)	% of regional water supply
Colorado (Project)	*This type of water not available*	0%
Federal (Project)	*This type of water not available*	0%
State (Project)	*This type of water not available*	0%
Local (Project)	<250 kWh/AF	44%
Local Imports	*This type of water not available*	0%
Groundwater	<250 kWh/AF	22%

Energy intensity per acre foot of water

Energy intensity (EI) in this figure is the total amount of energy required for the extraction and conveyance of one acre-foot of water and does not include treatment, distribution to point of use, or end use energy (e.g., water heating). These figures should be seen as ranges within which the EI of different sources of each water type would likely fall i.e., a water type with four bulbs should be interpreted to mean that most sources of that water type in the region would have an EI of between 1,501-2,000 kWh/ acre-ft of water. Smaller light bulbs represent an EI of greater than zero, and less than250 kWh/acre-ft. EI of desalinated and recycled water is not shown, but is covered in Resource Management Strategies #XX and #YY respectively, Volume 3. (For detailed description of the methodology used to calculate EI in this figure, see Technical Guide, Volume 5 or References Guide, Volume 4 (TBD)).

Box NL-1 California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization Data Considerations

Senate Bill 7x 6 (SBx7 6; Part 2.11 to Division 6 of the California Water Code § 10920 et seq.) requires, as part of the CASGEM program, DWR to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater level monitoring by considering available data listed below:.

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, and

8. Any other information determined to be relevant by the DWR.

Using groundwater reliance as the leading indicator of basin priority, DWR evaluated California's 515 alluvial groundwater basins and categorized them into five groups:

- Very High
- High
- Medium
- Low
- Very Low

Box NL-2 Other Groundwater Management Planning Efforts in the North Lahontan Hydrologic Region

The Integrated Regional Water Management plans, Urban Water Management plans, and Agriculture Water Management plans in the North Lahontan Hydrologic Region that also include components related to groundwater management are briefly discussed below.

Integrated Regional Water Management Plans

There are three IRWM plans covering the majority of the North Lahontan Hydrologic Region. Two IRWM plans are currently being implemented, and one IRWM plan is being developed. One of the adopted IRWM regions resides completely within the North Lahontan Hydrologic Region, and the other adopted IRWM region extends from the southern part of the North Lahontan Hydrologic Region into the Mono County of the South Lahontan Hydrologic Region.

One of the adopted IRWM plans relies on local groundwater management plans for managing groundwater resources. This plan states that conflicts over groundwater supply have occurred when pumping has exceeded natural recharge, as well as due to large seasonal fluctuations in population. In order to address future groundwater supply conflicts, the IRWM plan relies on the development and adoption of local groundwater management plans which contain conflict resolution procedures. Other groundwater management objectives for this IRWM region include creating a reliable groundwater supply, protecting groundwater quality, and managing groundwater for multiple uses.

The other adopted IRWM plan relies on counties within the region that do not have adopted groundwater management plans but have groundwater ordinances in place which utilize land-use planning and police powers of locally elected county boards to manage groundwater resources. The ordinances establish policies to manage the transport, transfer, acquisition, and sale of surface water and groundwater to protect the overall economy and environment of the counties. The ordinances also include policies regarding transfers or transport of groundwater to areas outside the county and the watershed.

Urban Water Management Plans

Urban Water Management plans 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 uses. 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 Urban Water Management plan 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 plan updates is currently under evaluation and review by DWR. Because of the time-line, the plans could not be reviewed for assessment for Water Plan Update 2013.

Agricultural Water Management Plans

Agricultural Water Management plans are developed by water and irrigation districts to advance the efficiency of farm water management while benefitting the environment. New and updated Agricultural Water Management plans addressing several new requirements were submitted to DWR by December 31, 2012 for review and approval. These new or updated plans provide another avenue for local groundwater management, but because of the time-line, the plans could not be reviewed for assessment for Water Plan Update 2013.

Box NL-3 Statewide Conjunctive Management Inventory Effort in California

The effort to inventory and assess conjunctive management projects in California was conducted through literature research, personal communication, and documented summary of the conjunctive management projects. The information obtained was validated through a joint DWR-ACWA survey. The survey requested the following conjunctive use program information:

1. Location of conjunctive use project;

2. Year project was developed;

3. Capital cost to develop the project;

4. Annual operating cost of the project;

5. Administrator/operator of the project; and

6. Capacity of the project in units of acre-feet.

To build on the DWR/ACWA survey, DWR staff contacted by telephone and email the entities identified to gather the following additional information:

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

Statewide, a total of 89 conjunctive management and groundwater recharge programs were identified. Conjunctive management and groundwater recharge programs that are in the planning and feasibility stage are not included in the inventory