Report Details — Administrative Draft

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Region	North Lahontan Hydrologic Region
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Box information

Please list corresponding boxes and their status (as well as the status of any graphics that go in them) here. Note that the publications staff will compile an acronym/abbreviation list as part of the table of contents, so box numbering for other types of content may begin with 1.

Alternative energy box information:

This box is associated with: Looking to the Future/Future Conditions/Interregional Planning Activities/Increase Water Supply

Box NL-1 Energy- Water Connection

by John Headlee, DWR

Any increase in water supplies in the North Lahontan Region it is almost certainly going to be from groundwater. To increase groundwater there must be sources of water and a source of energy to bring it to the surface economically. As stated in the 2009 Update finding new groundwater sources depends on further characterization of the geology. That task must be accomplished first and may be partially completed because of the amount of information being accumulated through geothermal investigations. For purposes of this comparison the Surprise Valley will be used as an example although other alternative energy sites exist in other portions of the region.

Hydro-electric power

Hydro-electric power generated in the northwest is available from Surprise Valley Electrification Corporation at the rate of $0.06 per kWH.

Geothermal in Lake City Geothermal Area

Almost the entire North Lahontan Region falls in what the BLM terms a Geothermal Potential Area. There are geothermal prospects in Modoc, Lassen and Mono counties within the region. Geothermal energy from the geothermal prospect at Lake City in Modoc county could be developed at about 3 cents per kWH

Wind Energy

The Surprise Valley is rated as having good-excellent wind power resource potential. Costs for wind power are 4 cents per kWH which is competitive with imported hydro-electrically generated power.

Solar Energy

The cost of photo voltaic power is not competitive with other sources.

Regardless of the current accuracy of the above projected power rates, northwest hydroelectric power will approach its limit in 2014-2015 meaning that local utilities will have to pay market rates for some of their power or build energy sources which means energy costs will increase. In addition in California twenty percent of energy will have to be generated by renewable sources by 2017 which will necessitate a departure from historic sources. An additional advantage of locally produced energy is that long distance transmission with its attendant losses and costs is not necessary since the energy would be used locally.

Given that the power is available at costs less than hydro-electric power and that power sources must change in the near future, there remains the task of further characterizing the groundwater basins to determine if the region possess the necessary combination of a groundwater source and energy that could lead to an increase in water supplies that is economic.

Box NL-2 California Native American Tribal Information, North Lahontan Hydrologic Region[Same as 2009, won't display?]

Demographics: Tribes with historic or cultural ties to the North Lahontan region are primarily the Pit River (Achomawi), Maidu, Northern Paiute, Paiute, and Washoe.

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), Woodfords, and XL Ranch 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.

Table information	*Please list corresponding tables and their status here.*
Glossary entries	*Type any terms/definitions here that you would like to see included in the glossary. Please ensure they are defined in the text of this report, too.*
Captions	*Type any captions for known photos here. Include the image's file name or description of photo.*
Recommended pull quotes	*Suggest pull quotes for this report here. (Copy and paste sentences from the text that may pull readers in.)*
Column notes	*If additional information needs to appear in the margins (e.g., directional notes to readers, perhaps telling them where to find related content in other sections of Update 2013), type that information here and indicate what portion of the report it should accompany.*

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North Lahontan Hydrologic Region

North Lahontan Hydrologic Region Summary and Recommendations

Summary [summarization is being hld until report complete]

This subsection contains a discussion of the following topics.

- Highlights from regional report leading up to resource management strategies and policies.

Resource Management Strategies and Policies [See the IRWM groups. Opportunity to say what you want from your IRWM plan, source Mary Randall, Eben Swain direct]

This subsection contains a discussion of the following topics. (Primary authors may be Regional Office staff, coordinating with design teams and regional forum participants with an emphasis on local integrated regional water management [IRWM] managers.)

- Implementation recommendations (and priorities where possible).

Sources for this information may be IRWM plans, the Senate Bill x7-7 process, urban water management plans, agricultural water management plans, groundwater management plans, water elements of general plans, floodplain management plans, stormwater plans, Regional Water Quality Control Board basin plans and water quality reports, watershed management plans, habitat conservation plans, multi-species conservation plans, etc.

Considerations for this subsection:

- This section will directly support funding recommendations in the Update 2013 finance plan (within Volume 1).
- Priorities will be regionally driven and can vary from specific regionally preferred projects to entire IRWM or other plans.
- Priorities can be expressed by IRWM, county, or another geopolitical subdivision.

Finance

This subsection contains a discussion of the following topics.

Prop 84 made fifty-four million dollars available to the Sierra Nevada Conservancy and thirty-six million to the California Tahoe Conservancy. SNC has undertaken one hundred and seventy-five restoration and environmental enhance projects and has disbursed forty million dollars.][source SNC web site accessed 3/30/12]

- An estimate of total funding proposals within the region.

[New One point Pierre Stephens brought up is that it is assumed for almost all other regions that

improvements in one region will produce indirect benefits in other downstream regions, however, because the NL region drains to Nevada those indirect benefits will not accrue to citizens of California. Some discussion of this proposition might be appropriate although it would tend to de-prioritize this border region.]

- Cost-sharing criteria.[See http://www.cdph.ca.gov/certlic/drinkingwater/Pages/DWPfunding.aspx]

[Given the importance of this section development of content for this section is deferred until information is developed within the report to support this "summary." Suggested sources are the IRWM plans which admittedly for the North Lahontan Region are in their infancy the first implementation grant having been granted to Sierra-Tahoe region, but the project has not been executed at this time. Time will be required to allow projects to be developed if this is to be a summary of just IRWM projects that were implemented between the 2009 update and the 2013 update. It is pointed out how2ever, that there have been Proposition 50 and then Proposition 84 projects that have been completed. Wait until May-June 2012 progress report issues that will detail projects completed.]

Notwithstanding the above considerations here is some content for the Finance section]

[New, finance

A total of more than 10 million dollars in implementation funds is estimated to be needed for conservation measures that would result in savings fifteen percent of the water applied to the 20,000 acre irrigated area on the lower Susan River. Assuming that the measures installed have a useful life of twenty years that amounts to a cost of conserved water of from $48 to $95 per acre foot which is within economic reason.[Ask Ceci Dale Cesmat, email to CeCI.DaleCesmat@ca.usda.gov 2/15/12] source Susan river rapid Watershed Assessment, p. 46

Water Planning and Governance

In September of 2011 the new Lahontan Basins Integrated Regional Water Management Region was approved. It joins the Tahoe-Sierra IRWM and the Inyo-Mono IRWM that is in formation in seeking watershed wide solutions to water concerns in the region. At this point there is no IRWM region in the extreme north of the region in Modoc County.

Current State of the Region

[Note: Align with region description in IRWM standards.]

Setting

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.

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 form the western boundary of the region.

[background factors in the region and unique subregions.]

affecting water availability-[copied] In Modoc and Lassen counties, groundwater is limited. Groundwater pumping capacity is known to diminish very rapidly during the first year of droughts.

uses The primary use of water is agricultural, but with increasing amounts of urban use and a use peculiar to the central portion of the region around Lake Tahoe which is snow making at ski areas..

quality The region's water is generally of high quality given its alpine origins, but can be affected by nitrates 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.

flood management 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 1 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 are being raised slightly to allow them to contain a recently upwardly revised maximum credible flood event.

ecosystems Various species have invaded the area including the asian clam and the white top plant (lepidium draba) 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 contain numerous introduced species that exclude desirable native species such as the Lahontan Cutthroat Trout (LCT).

IRWM plans, basin plans, population data, conservancy reports, regional studies:

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Integrated Regional Water Management Program (IRWMP) regions have been formed in the Truckee and Carson River basins (Tahoe-Sierra IRWM) and East and West Walker River basin (Inyo-Mono IRWM) and in the Madeline Plains, Honey-Eagle Lake & Smoke Creek basins the Lahontan Basins IRWM region and have been accepted. The first two are, respectively, assembling project plans and identifying and prioritizing regional water issues while the third is at a more formative stage. The currently most mature of the regional water resources administration processes is in the Tahoe-Sierra region where the Truckee and Carson Rivers are 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 are 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 population of both the northern and southern most IRWM regions is not changing rapidly [check with Salma Kibrya] while the population of the Truckee area in the Tahoe-Sierra IRWM region grew 14% between the 2000 and 2010 censuses while that of the Tahoe portion of that region has decreased by 9% over that same time period.

The Lake Tahoe Basin, part of the Tahoe-Sierra IRWM region, is within the area covered by the California Tahoe Conservancy, a state agency within the Department of Natural Resources, which has undertaken many projects that have preserved the environment and enhanced recreational opportunities. In addition the conservancy is the owner of over 4800 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 larger in area Sierra Nevada Conservancy surrounds the California Tahoe Conservancy and includes areas within the hydrologic region in the Truckee River Basin and the northern and southern counties of Modoc, Lassen, Alpine and northern Mono counties. The Sierra Conservancy is also a state agency and was created in 2004 which supports working forests, watershed health and recreational projects in its area. It, likes it Tahoe sister agency, has acquired land or conservation easements on land, has supported projects in the hydrologic region at Lacey Meadows near Webber Lake on the Little Truckee River, in Hope Valley on the West fork of the Carson River, and a recreational project with the Lassen Lands and Trails Trust in acquiring the “Modoc Line” railroad right of way for trail use.

Regional Studies- Currently Perazzo Meadows, restored in 2011, is being monitored to determine the affects of that 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 U. C. 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 are 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.

[Existence of other regional studies GAP? Email to Mary Randall 1/21/12].

Tribal Communities: Tribes in the North Lahontan Region are: Antelope Valley Paiute and Washoe Paiute of Antelope Valley, Bridgeport Indian Colony (40 acres), Cedarville Northern Paiute (25.4 ac.), Ft. Bidwell Indian Community (3603 ac.), Honey Lake Maidu, Susanville Indian Rancheria (1341 ac.), Waddatkhuta Band Northern Paiute (unknown area near Woodfords) and the Susanville Rancheria (302 ac.), Honey Lake Washoe Tribe of CA & NV. Each tribal community that is listed as having land also has water rights for that land. In addition to land there are fourteen allotments within the region that tribal communities have the right to use including the collection of vegetative materials.

Climate and Trends: Most precipitation falls as snow in the mountains. In the valleys the snow may not remain between storms. Most of surface water other than from occasional summertime thunder storms is from spring runoff from the mountains. The trend is for warmer night time temperatures which result in less snow pack storage of water and as a consequence earlier spring runoff.

Population and Land Use trends: 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 area around lake Tahoe the population in the lake Tahoe Basin itself decreased 9% in the decade between the 2000 and 2010 censuses whereas the population in and around the Town of Truckee increased by 14%. The increase in Truckee is for recreation and part time homes 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. The latter is manifested by improved drainage and best management practices for stormwater and energy conscious building designs using more insulation and features that take advantage of solar energy.

Watersheds

[same as 2009 update except for redline and strike out] 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. 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.

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

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 Figure NL-2), 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.

Following 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. To view the full report, go to http://resources.ca.gov/TahoeFireCommission/. One of the basic conclusions was that there should be more reduction of forest floor fuel. A $200+ million effort over the next 10 years will reduce forest floor fuel. In the period covered by this report fuel reduction treatment is expected to proceed at the rate of approximately 5000 additional acres per year. Concerns about the effects of fuel reduction treatment on water quality were considered by the Lahontan Regional Water Quality Control Board (April 11 &12th, 2012) concerning a 10,000 acre, decade long fuel reduction project called the South Shore Fuel Reduction & Healthy Forest Restoration project and were passed in time for commencement of the project within the May 1 through October15, 2012 period during which soil disturbing projects can be undertaken. [check with Duncan Leao, EIS lead, LTBMU (530) 543-2660 after the summer of 2012 to see if this is true]

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 that checked for erosion until vegetative cover again 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, which is only a minor portion of the project, would temporarily increase. However the BMP's used would reduce or eliminate these impacts and 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 greater 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 Project and the thinning and removal of burned trees resulting from the Angora fire of June 2007 will result in the generation of bio-mass. To the extent possible and where it would not disturb high erosion potential soils, the bio-mass is to be removed and either sawn into lumber, chipped and used in particle board or used as fuel in biomass burning energy facilities. [source, Duncan Leao, LTBMU EIS Lead, personal communication January 27, 2012 ph number above]

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, i.e. close to urbanized areas which were either not used extensively by wildlife or not possessed 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 a whole was rated as having a low risk for creating a significant negative effect.

Describe the major or significant watersheds of the region. This should also include a description of existing interregional or interstate ties that the watersheds may have. [Done]

Groundwater Aquifers

[Taken from water supplies so remove this portion from that section or simply refer to this] Most urban water uses in the North Lahontan region are supplied by groundwater wells. Twenty-four groundwater basins and two subbasins are recognized in the region. Thirteen of these basins are shared with Nevada, and one is shared with Oregon. These basins cover about 1.033 million acres (1,610 square miles) or about 26 percent of the entire region. Information about groundwater storage capacities is available for only 6 of the 26 basins; the combined storage for these underground basins is estimated at approximately 24 million acre-feet. Although the groundwater basins were delineated based on mapped alluvial fill, much of the groundwater produced actually comes from underlying fractured rock aquifers.

Describe major or significant groundwater basins found in this region. Description could include major agricultural and municipal areas served and trends in the use of groundwater, such as more reliance. [done, but without any comments on usage trends or locales which can be done later]

Ecosystems

Table NL-2 lists threatened, endangered and species of special concern found in counties in the of North Lahontan Hydrologic region.

Modoc County is described as sage steppe into which western and Utah juniper are encroaching. Within that county, Surprise Valley has been described as 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.

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 Wildlife Area and Willow Creek Wildlife Area 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 by 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/or 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.

Another invasive species that is terrestrial and therefore not related to Lake Tahoe is whitetop (*Lepidium draba and Lepidium laitfolium*), which is very aggressive and eliminates desirable vegetation. The plant tends to grow in floodplains and near water courses 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 hshown in figure NL-??? below. Most of the water courses 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.

Figure NL-??? Whitetop (perennial pepperweed) roots do not form interlocking mesh that holds soil

Source: Susan Donaldson, Univ. Nevada Cooperative Extension, 2010

Although western and Utah juniper are native to the region, and, therefore, not an invasive species, they are 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 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 rain drop 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

[sources for juniper erosion effects: Susan River Area Rapid Watershed Assessment, Natural Resources Conservation Service, USDA, 2011; Miller, R. E. et al., Biology, Ecology, and Management of Western Juniper, Technical Bulletin 152, June 2005, Oregon State University Agricultural Experiment Station, Corvallis Oregon, pp. 35-37; Wilcox. B.P. & Davenport, D.W., Juniper Encroachment: Potential Impacts to Soil and Morphology, Interior Columbia Basin Ecosystem Management Project, 1995 accessed on 2/15/12 at sagebrushsea.org. for further info: Derick Wilson, Susanville Office; BLM & Casey Pasero USFS ,]

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.

Finally, at the southern end of the North Lahontan region in the northern portion of 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.

Table NL-2, Threatened, Endangered & Special Concern Species of the North Lahontan Hydrologic Region

Scientific name	Common name	Federal status	California status	CA Dept. Fish and Game	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	See NFWS_9_12 for preliminary determination
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	

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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 americaSSCnus tahoensis	Sierra Nevada snow shoe 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		
Xanthocephalus xanthocephalus	Yellow headed blackbird	None	None	SSC	
Dendroica petechia brewsteri	Yellow warbler	None	None	SSC	
SSC = Species of Special Concern. Source: California Natural Diversity Database (CNDDB) Quick Viewer.					

In the 2009 Update it was stated that a lone wolverine entered the region and as of this writing in February 2012 the same specimen still resides 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 Figure NL-??

Figure NL-?? Gray wolf OR-7 as he appeared near Medford Oregon before entering the region

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Figure NL-??? Wolf OR-7 southwest Modoc County May 7, 2012, Richard Shinn, CDF&G

Climate

Dry summers with occasional scattered thundershowers characterize the region's climate. Most precipitation falls in late fall and winter. Precipitation is less than 5 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.

Growing seasons vary considerably each year. In the mountain valleys, where most crops are grown, an average 120 days are frost free from late May to mid-September.

Cloud seeding projects had been proposed about 80 miles to the west of the North Lahontan region. Questions have been raised regarding their effect on temporal and spatial precipitation patterns within the

North Lahontan Hydrologic Region, but according to the latest study results there is no sensible change in downstream precipitation levels or if there is precipitation is enhanced if the upwind result was also an enhancement in precipitation levels.[1]

Describe the typical climate for the region — snowpack, seasonality of rainfall, evaporation rates, etc.

Demographics

[update with Salma Kibrya] 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 grew by ????? people, a growth of ????? percent over the 10-year period. [For historical population data, 1960–2005, see Volume 5, Technical Guide.????] An interesting note is that 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% and overall the population of the two areas combined declined 3.5% because the preponderance of the population was in the Tahoe Basin.

[update with Salma Kibrya] In Water Plan Update 2013 we project population growth based on the assumptions of future scenarios. Discussion of the three scenarios used in this Water Plan and how the region's population may change through 2050 can be found later in this report under[?????] Looking to the Future.

California Government Code §65352.3 requires cities and counties to consult with Native American Indian Tribes during the adoption or amendment of local general plans or specific plans. A contact list of appropriate Tribes and representatives within a region is maintained by the Native American Heritage Commission. (See Box NL-2 for information about regional Tribal concerns.) A Tribal Consultation Guideline, prepared by the Governor's Office of Planning and Research, is available online at http://www.opr.ca.gov/programs/docs/09_14_05%20Updated%20Guidelines%20(922).pdf. [link broken]

[require updating?] Box NL-2 California Native American Tribal Information, North Lahontan Hydrologic Region

Demographics: Tribes with historic or cultural ties to the North Lahontan region are primarily the Pit River (Achomawi), Maidu, Northern Paiute, Paiute, and Washoe.

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), Woodfords, and XL Ranch reservations[parts of XL Ranch, but not XL ranch *per se*], rancherias, and communities. The Pyramid Lake and Walker River Paiute Tribes have their land bases in

[1] Summarization of results present at the Weather Modification Association annual meeting in Las Vegas April 25-27, 2012 provided in personal communication from Moory Roos, DWR,

Nevada. Approximately fourteen individual allotments are also located within this region.

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:

Restoration of native fisheries, especially the cui-ui and Lahontan Cutthroat Trout.

Accomplishments:

In 1998, the Washoe Tribe was awarded a Special Use Permit by the US Forest Service to operate the Meeks Bay Resort and Marina. The Tribe also holds a permit for plant material gathering.

Fort Bidwell is evaluating options for geothermal wells.

NOTE: Above information was gathered from Tribal input at the California Water Plan Update regional workshops and the Tribal water plenary sessions that are supporting the California Tribal Water Summit.

[need input from Salma Kibrya as to where communities located in NL region]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 EJVview 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, however, it is suspected that pockets of disadvantaged populations would be apparent if more refined demographic data were readily available. It is known that there are significant populations of Spanish speaking people in the cities of Kings Beach and South Lake Tahoe and throughout the region and native Americans at smaller more isolated communities. One aspect of underserved communities is that they may not have a water supply that meets current drinking water standards. Arsenic levels in drnking wter is a concern that continues at Bridgeport California as of the date of this writing. [Ck this]. It is expected that more concerns would be evident if there were more information available. [find out from DPH sources]

Two wells that supplied the Coleville High School had an unsafe level of uranium. This concern has persisted for more than a decade and is currently being addressed by using point of use reverse osmosis systems, but these do not completely address the concern at all locations. Efforts are underway to provide a water treatment system and to separate irrigation systems from drinking water sources. [sources Inyo-Mono IRWMP]

Other than arsenic here are other drinking water exceedances there are other safe drinking water concerns. The only persistent, observed deficiencies were the coliform count at Floriston. [but there may be more if I could find the California DPH list of troubled systems mentioned at the DAC/EJ kickoff meeting on 2/212. See notebook of even date].

Land Use Patterns

Much of the region is either national forest or lands under the jurisdiction of the US Bureau of Land Management. Cattle ranching is the principal agricultural activity, and pasture and alfalfa are the dominant irrigated crops. Commercial crop production is very 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 strawberries are grown in the Honey Lake Valley near Susanville .

[Ck strawberries with David Lile UCCE, emailed 2/16/12, no respsonse call Ag Commissioner?]

Tourism and recreation are the principal economic activities in the Truckee-Tahoe area and surrounding mountains. The lower meandering streams of the Walker, Carson, and Truckee rivers are famous for trout fly-fishing, but also offer water sports, hiking, and camping with the eastern Sierra 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. The region has a number of world-class resorts.

A rapid increase in the number of new vacation homes in the 1990s and the early 21st century brought about controls on their effects such as storm water and Total Daily Maximum Loads (TMDLs) and also 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. To the north, the town of Truckee and the adjacent Martis Valley region are undergoing urban development.

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.

Tribal Communities

A Native American Tribe may be federally recognized, and the federal government may set aside lands for Tribes as reservations. In California these reservations are often named "Rancherias." One

interpretation of the Spanish term Rancheria is small Indian settlement. Granted Tribal lands in the North Lahontan region are listed in Table NL-3

Table NL-3 Tribal communities in the North Lahontan Hydrologic region

Tribe, Location	Number of members	Physical presence	Allotments	Recognition status	Water governance
Antelope Valley Paiute, Coleville, CA	Unknown	Community Coleville, CA	Unknown	Currently petition BIA for Recognition	Unknown
Washoe Paiute of Antelope Valley, Coleville, CA	Unknown	Community Coleville, CA	Unknown	Currently Petition BIA for recognition	Unknown
Bridgeport Indian Colony	100, 43 on reservation	40 acres in Bridgeport, CA	Unknown	Recognized, Title I, PL 93-638 (25 USC 450[c][d])	Unknown
Cedarville Rancheria Northern Paiute	30	19 acre Rancheria Cedarville, CA	Unknown	Unknown	Unknown
Coleville Washoe & Paiute, Coleville, CA	Unknown	Unknown	Unknown	Unknown	Unknown
Fort Bidwell Indian Community, Modoc County	Approx. 126	3335 acre community Ft. Bidwell, CA 12 Mi. South & East of OR & NV borders	Unknown	Federally recognized 1936 as Gidutikad band of Northern Paiute	Geothermal well proposed for community central heat. Water quality monitoring at logging sites.
Honey Lake Maidu & Maidu Nation	Unknown	Community, Susanville, CA	Unknown	Unknown	Unknown
Pyramid Lake Paiute Tribe	2253	475,000 acre Reservation Washoe County, NV	Unknown	Federally Recognized	May 2008 control most water in Stampede & Prosser Cr. reservoirs to for preserve cui-ui. Effect: Recreational & habitat values in CA reservoirs tied to reservoir levels. Granted Treatment as State (TAS) status *viz-a-viz* Water Quality 1/07
Susanville Indian Rancheria, Maidu (recognition in progress) Washoe Tribe of NV & CA, Pit River Nation	577 (March 2008)	1341 acres Susanville, Sierra Army Depot, Cradle Vly. Ranch Nr. Antelope Lk. Doyle, Termo Janesville, Johnstonville, Standish, CA	Unknown	Susanville Indian Rancheria (SIR) Federally Recognized	Upper Rancheria supplied from Susanville water system source for which is Cady and Bagwell springs and 3 wells. Water is tested by the Environmental Protection Department of the SIR to Federal drinking water standards
Wadatkhuta Band of Northern Paiutes of Honey Lake Valley Community	Unknown	Community in vicinity of Susanville, CA	Unknown	Currently petition BIA for Recognition	Unknown
Washoe Tribe of CA & NV	1500 (mostly in NV)	Meeks bay on Lk. Tahoe & Woodfords Community near Marklee-	Tribal Trust lands in Alpine, Placer & Sierra counties including Pine nut	Federally recognized under Indian Reorg. Act of June 18, 1934. Applied for TAS	Stakeholders in the leviathan mine clean up because Leviathan Cr. is tributary to Bryant Cr. which is tributary to E.

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Tribe, Location	Number of members	Physical presence	Allotments	Recognition status	Water governance
		ville, CA	allotments	status *viz-a-viz* CWA §§303 & 401. 2007.	Fork of Carson River

[Need to access general plans, content not this detailed in 2009 update] Describe the amount of land dedicated to urban, agricultural, and environmental uses and trends. Include a description of the density or intensity of urban and agricultural use of the lands, such as triple cropping, or the number of dwelling units per acre planned for the region. Sources for this information could be general plans.

[Looked through the Mono County General Plan, but found no tabulations about what current land use was.]

[2/08/12 got with Jason Harbaugh who supplied the number of acres of active Ag lands in all NL counties]

The vast majority of the surface area of all 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 as is shown in table NL-??? below:

Table NL-???Number of Active Agriculture Acres in the counties comprising the NL Region

County	Ag Acres
Modoc	45,751
Lassen	79,134
Nevada	9
Placer	0
El Dorado	0
Alpine	4204
Northern Mono	30,072

Source north Central Region DWR latest surveys, some dated 1994

As an example the portion of northern Mono County that is within the North Lahontan Region comprises approximately 695,000 acres of which, from above, approximately 30,000 acres are used for agriculture.

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The remainder is small town sites, range land 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, 4460 acres, and the Little Antelope valley, 2560 acres, had supported agriculture, but have since been converted to wildlife areas as is shown below in Table NL-??? [wildlife areas in NL Region]. The primary agriculture use is irrigated pasture, alfalfa production and grazing. One particular 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. Of major 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, that is, only trout over 18 inches may be caught there. Lahontan cutthroat trout, Paiute cutthroat trout found in Silver King Creek, and Eagle Lake Rainbow trout are heritage trout, that is, trout that existed in California before the intervention of European societies.

In addition to the Lake Tahoe clarity improvement program, 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 and when it is implemented, would resolve basinwide issues for a multitude 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 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 Box NL-3).

At the time of this writing in 2012, 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

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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-5). 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.

Table NL-5 TROA Minimum instream flows in the Truckee Basin

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
cfs = cubic feet per second		

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 Game (DFG) 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.

[Added]

In the southern portion of the region, the DFG 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.

Table NL-?? Wildlife Areas in North Lahontan Region Environmental Water Uses.

Wildlife Area	County	Area, acres	Species	Water Use
Bass Hill	Lassen	5,553	deer	marsh
Biscar	Lassen	540	pronghorn watering	upper & lower Res.Bass Hill on Snow-storm Creek
Doyle	Lassen	10.740	deer	Long Valley Creek
By Day Cr. Eco Reserve	Mono	unknown	LCT* critical aquatic refuge	By Day Creek instream flow
E. Walker River	Mono	1,367	many fauna	riparian habitat
Hallelujah Junction	Lassen/Sierra	13,314	deer	Long Valley Creek
Green Creek	Mono	720	deer, bear	Green Creek
Heenan Lake	Alpine	1,653	Trout	Heenan Cr.
Honey Lake Dakin/Fleming	Lassen	7,667	migratory birds	see text
Hope Valley	Alpine	2,869	many fauna	wet meadows W. fork Carson River
Pickel Mdw.	Mono	990	mule deer, water fowl	Millie & Mud Lakes

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Red Lake	Alpine	860	many fauna	Forestdale & Red Lake Cr.
Slinkard/Little Antelope Vly.	Mono	11,684	deer	see text
Truckee River	Nevada	700	fishing access	riparian habitat
W. Walker River	Mono	770	deer	riparian habitat
Willow Creek	Lassen	2722	grouse ante-lope prong-horn quail	Tules, streams channels wet-lands meadow

*Lahontan Cutthroat Trout, source Bridgeport Ranger Dist. Humboldt-Toiyobe NF
Table source: Calif. DFG Lands Viewer mapping system

NL-? Juvenile Lahontan cutthroat trout from By Day Creek Ecological Reserve [California DFG, Bridgeport ranger dist., Hudson, Kling, Becker, 10/2004, from www.monocounty.ca.gov/cdd_20site/Planning/Projects/documents/ByDayCreek2*]

Water Balance Summary [unrevised from 2009, needs revision]

Figure NL-3 summarizes the total developed water supplies and distribution of the dedicated water uses within this hydrologic region for the eight years from 1998 through 2005. 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 [still volume 5?], which provides a breakdown of the components of developed supplies used for agricultural, urban, and environmental purposes and Water Portfolio data.

[Place marker for ½ page Figure NL-3]

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For the North Lahontan region, agricultural water use is the largest component of the developed water supply, while dedicated environmental water for instream fishery flows is also a significant component of developed water use. Urban water uses in this region are a much smaller portion of the total. The water supply portion of Figure NL-3 also indicates that the largest supply source is from surface water flows, with some groundwater also in use. Water reuse from agricultural runoff is also a significant component of the supply to downstream water users within the region.

Table NL-6 [still table?] presents information about the total water supply available to this region for the eight years from 1998 through 2005, 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 other states, the Pacific Ocean, 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 6, the numerical values were developed by estimation techniques, because actual measured data are not available for all categories of water supply and use.

[Place marker for one page table NL-6]

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Water Governance

Describe the existing water governance that exists for the region. This could be a description of the major water wholesalers, major municipal and agricultural water agencies, flood institutions, and any other governance structure that has influence on how water is managed in the region.

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

•	South Tahoe PUD (STPUD)	water/wastewater
•	Bridgeport PUD	water/wastewater
	Lakeside Park Water Company	water
	Leavitt Lake Community Svc. Dist.	water/wastewater
	Lukins Brothers Water Co, Inc.	water
•	Pyramid Lake Paiute Tribe	water for endangered species
	City of Susanville	water
•	Susanville Park River Water Co.	water
•	Tahoe Keys Water Co.	water
	Tahoe Cedars Water Company	water/wastewater
•	Tahoe-Truckee Sanitation Agency. (T-TSA)	wastewater
•	Truckee Carson Irrigation District	ag water
•	Truckee-Donner Public Utility District	water
	Truckee Meadows Water Authority	urban water for Reno/Sparks
	Twin Lakes Enterprises	water
•	Walker River Irrigation District	ag water
•	Washoe County Water Conservation District.	ag water

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- Washoe Paiute Tribe water
- Carson Water Subconservancy District bi-state watershed organization

Water Supplies

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 through Cedar Creek to Moon Lake (formerly Tule Lake Reservoir) and eventually to Madeline Plain. [Topos at DFG lands viewer does not demonstrate this ask Northern Regional Office]

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

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a mile southeast of Genoa, Nevada, to form the main stem. The only regulation on the Carson River in California are 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.

[Already used at p.7] Most urban water uses in the North Lahontan region are supplied by groundwater wells. Twenty-six groundwater basins and three subbasins are recognized in the region. Thirteen of these basins are shared with Nevada, and one is shared with Oregon. These basins cover about 1.033 million acres (1,610 square miles) or about 26 percent of the entire region. Information about groundwater storage capacities is available for only 6 of the 26 basins; the combined storage for these underground basins is estimated at approximately 24 million acre-feet. Although the groundwater basins were delineated based on mapped alluvial fill, much of the groundwater produced actually comes from underlying fractured rock aquifers.

Ground water in the region is produced from the groundwater basins described in summary form in the preceding Groundwater Aquifers section. -In the volcanic areas of Modoc and Lassen counties volcanic flows are interstratified with lake sediments and alluvium. Wells ~~constructed~~ screened in the volcanic portions of this stratigraphy commonly produce large amounts of groundwater, whereas wells constructed in fine-grained lake deposits produce less. Because the thickness and lateral extent of the fractured hard rocks outside of the defined basins are generally not known, actual groundwater in storage in these areas is also unknown.

About 5,000 acre-feet of reclaimed municipal wastewater are 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.

Table NL-4 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.

Table NL-4 Major lakes and reservoirs in the North Lahontan Hydrologic Region

	Active storage	Date	Description	Major tributary

	(acre-feet)			
Northern				
Eagle Lake	550,000 [1]	Geologic	Terminal Lake	Pine Creek
Honey Lake	Variable	Geologic	Terminal Lake	Susan River
Middle				
Boca Res.	41,100	1937	US 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 [2]	1913	US Bureau of Reclamation	Upper Truckee River
Prosser Creek Res.	29,800	1962	US Bureau of Reclamation	Prosser Creek
Stampede Res.	226,500	1970	US Bureau of Reclamation	Little Truckee River
Southern				
Bridgeport Lake	44,000	1924	Walker R. Irrigation Dist.	E. Walker River
Heenan Lake	3,100	1923	DFG fish rearing lake	E. Heenan Lake Creek
Topaz Lake	65,000	1937	Walker R. Irrigation Dist.	W. Walker River
1- No controlled outflow				
2- This represents the acre-feet that is in top 6.1 feet above the rim and therefore controllable.				

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 requires less only needing to be irrigated early in the season with one to one and one-half feet o 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.

One use of water peculiar to the Lake Tahoe and Truckee basins is for snow-making at ski areas. TROA contains special provisions for snow-making water. Snow-making water is mostly recovered through melting. Therefore, a major fraction of snow-making water under TROA would not be counted in

calculating the allocation of water between California and Nevada. Also, 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.

TROA identifies instream flow requirements for the Truckee River system at various points (Table NL-5). 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.

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, bank swallow, and peregrine falcon. 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 Game (DFG) 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 Modoc and Lassen counties, groundwater is limited. Groundwater pumping capacity is known to diminish very rapidly during the first year of droughts. This could make management of these wildlife areas difficult in the future.

Rivers designated as wild and scenic constitute a large part of the environmental water use in the North Lahontan region although this use is flow-through in nature, i.e., the water is used simply by flowing through the river. The California portions of the interstate east fork of the Carson River and West Walker River and its Leavitt Creek tributary are State-designated wild and scenic.

[The quantities of water uses would be provided in the water portfolios; however, a narrative to bring forward the story this data provides would be included here.]

Project Operations

[There was no description of operations in the 2009 update. Therefore it would have to be added. A source of this type of information might be the general description of current river

operations contained in the document "A summary of Truckee River Operations (probably done by the USBR in preparation for an earlier model]

For instance: from www.waterrights.ca.gov/EIRD/appendices/AppendixB.pdf (which is the DEIS for the replacement of Farad diversion dam

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 1,089,570 af of useable storage is available for managing water supplies. Of this total useable storage, a maximum of 65,000 af 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 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 so called Floriston flow rates (Floriston rates also abbreviated FR) , i.e. the flow of water passed the gage at Farad, CA which is very near the Nevada border. These flow rates are a legacy of a paper mill that no longer exists, at Floriston, and run of the river hydroelectricplants 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 hydroeletrric generation. Floriston rates currently vary between 300 cubic feet per second (cfs) and 500 cfs depending on Lake Tahoe elevation and season as shown in Tables NL-???

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

Mar.—Sept.	Oct. – Feb.
500	400

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 r*educed Floriston rates*. The reduced Floriston rates are dependent upon the level of Lake Tahoe and are as indicated in Table NL-??? below:

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

Lake Tahoe Elevation	October	Nov. 1 -- Feb. 28-9	March	Apr. – September
Under 6225.25 ft	400	300	300	500
6225.25 – 6226 ft	400	350	350	500
Above 6226 ft	400	400	500	500

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

Operations of specific Truckee River reservoirs

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 1,089,570 af of useable storage is available for managing water supplies. Of this total useable storage, a maximum of 65,000 af 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 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 describedbelow.

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.

These minimum instream flow requirements are conditioned on a series of constraints. These constraints center primarily around a requirement that a similar amount of Prosser Creek water must be available for storage in Prosser Creek Reservoir or that uncommitted water in Prosser Creek Reservoir must be available. Water stored in Prosser Creek Reservoir specifically as a result of Lake Tahoe instream flow releases is known as *Tahoe Exchange Water*. The amount of water released from Lake Tahoe for these minimum instream flow requirements is credited in Prosser Creek and is released when needed to maintain Floriston rates.

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 msl. 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

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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 af 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 af. For flood control, Stampede Reservoir must be drawn down to have 22,000 af of storage space by November 1 of each year. A credit storage system has been established to more efficiently use water supplies 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. Under the credit system, excess water in wet years may be stored and credited for future municipal and industrial uses or for future fishery demands. Storage of water for future credit for municipal and industrial uses is provided for TMWA if the Floriston rate is met and if the power company is releasing water from Independence Lake. TMWA can store water to which it has a right but is not using at this time because full demand has not been reached. TMWA can use its water rights to store the first 12,000 af as firm water and the next 24,000 af as non-firm water. Any non-firm water remaining by April 1 in a non-drought year will become fish-credit water. In drought years, the non-firm water is stored for use by TMWA. Court decisions dictate that Stampede Reservoir water be used for regulating flows for the endangered cui-ui (pronounced *kwee-wee*) fish. Releases for endangered species are coordinated between USBR, the U.S. Fish and Wildlife Service and the Pyramid Lake Paiute Tribe. These releases are not carried out every year, but are reserved for years when a large successful spawn is likely. Under the credit system, the PLPT can store water for future fishery needs when there is water flowing into Pyramid Lake in excess of the fishery needs.

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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 af 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.

Other reservoirs

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 3100 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 an certainly not for flood operations [email Ed James XO of Carson Water Subconservancy District. He had something in mind about re-operating in conjunction with Red Lake etc.]

Presented below in table NL-??? are most of the other reservoirs in the region excepting 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.

Table NL-??? 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	Robrt 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	“ “ “ “ “ “ “ “

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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
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 Sub-conservancy 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 & Game	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	Tributarry to Plea-sant Valley Creek	400	Early season release assumed
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	Park Livestock Co.	38.3159	Poore Creek	1,200	Early season release assumed

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Reservoir		-119.52			
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

[Major water supply project operations could be described here, along with challenges faced in the operations. Include a description of how reservoirs and facilities are operated to meet the varied and changing demands.]

Surface Water Quality

[Wait for input from Jose' Alarcon + IRWM group input]

Groundwater Quality

To the east and north of Honey Lake water quality may be impaired for agricultural uses due to salt content. [Cites DWR ground water bulletin B-118 which see]

Aquifer Conditions and Issues

As stated above in the Settings section the aquifers in Lassen and Modoc counties can become depleted rapidly during the first year of drought leaving no reserves for droughts extending over multiple years. Since growing alfalfa predominates in the region more generally and is harvested multiple times during a growing season, the depletion of groundwater toward the end of the growing season simply restricts the number of times the crop is harvested and therefore the productivity per acre. Thus productivity is elastic, changing with the wet or dry nature of the water year. Contaminant plumes do not affect the agricultural lands of the region with the understanding that naturally occurring salt is not in this context being considered a contaminant. Recharge with recycled water in the Tahoe and Truckee basins is restricted by the Porter Cologne Water Quality Act which specified that no sewage effluent would be disposed of in the Tahoe Basin and by water supply considerations in the Truckee Basin which mandates that effluent be allowed to make its way into the Truckee River after being disposed of to a subsurface disposal system in the vicinity of the Tahoe Truckee Sanitation Authority's waste water treatment plant in Truckee.

Flood Management **[Rely on input from flood management, but find out who is responsible for this]**

Risk Characterization

This would be a summary of the risk characterization for the region. Sources for this information would be out of the efforts from Statewide Flood Management section of DWR's Strategic Planning Branch.

Historic Floods

Major floods occurred in the North Lahontan region in 1950-51, 1962-63, 1964-65, 1986, and 1997. Table NL-????? below gives statistics for the major rivers in the region and is followed by a description of flood events.

Table NL-?????? Record floods for selected streams, North Lahontan Hydrologic Region

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
East Walker R.	near Bridgeport	106	6.7	1,910
West Walker R.	near Coleville	204	10.2	12,500
East Fork Carson R.	below Markleeville Creek, near Markleeville	260	11.8	18,900
West Fork Carson R. [1]	at Woodfords	80	15.4	8,100
Truckee R.	at Tahoe City	165	9.6	2,690
Truckee R.	near Truckee	234	10.0	11,900
Little Truckee R.	below Boca Dam, near Truckee	129[3]	6.1	2,720
Trout Cr. [1]	near Tahoe Valley	26	11.1[2]	615
taf = thousand acre-feet; ft = feet; cfs = cubic feet per second				
1 Regionally significant site with less than 100 sq mi tributary watershed area				
2 Different date than peak discharge				
3 Most recent but less than period of record				

Flood Descriptions

Early Floods. During 1950-51, intense winter rainstorms produced flooding on the Truckee, Carson, and Walker Rivers. The floods of 1962-63 caused extensive damage in the Carson River Basin. Severe floods occurred from December 1964 to January 1965, causing heavy damage in the Truckee River Basin.

February 1968. Continuous rain for nearly a week in February 1986 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.[appears to be dupe of below with years transposed.]

February 1986. 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.

January 1997. In early January 1997, an intense rainstorm falling on a large snowpack caused catastrophic flooding throughout the region. It was estimated that 200-year flood stages were reached on the West Fork Walker River, which damaged approximately six miles of Highway 395 and 100 homes in Walker

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Valley. A swollen Truckee River destroyed sewer and power lines leading to ski resorts, inundated residences and stores in Truckee and damaged 20 bridges and several stream gages. 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.

Describe the historic flood events that had occurred in this region.

Damage Reduction Measures

Flood Risk Management

Flood risk management includes a wide variety of projects and programs, which may be grouped as Structural Approaches (constructed facilities, coordination and reservoir operations, maintenance), Land Use Management (regulation, flood insurance), and Disaster Preparedness, Response, and Recovery (information and education, event management).

Structural Approaches

Constructed Facilities. The North Lahontan region contains four small floodwater storage facilities and channel improvements. Reservoirs with flood control reservations have been built by US Army Corps of Engineers (USACE) on Martis Creek and by US Bureau of Reclamation (USBR) on Prosser Creek and at Stampede and Boca reservoirs on the Little Truckee River. The integrity of Martis Creek Reservoir is under investigation, and it is not now being used for flood control. All four reservoirs are designed to protect Reno, Nevada, and incidentally reduce flood damage in their respective stream channels and on the Truckee River. USACE enlarged the Truckee River's channel downstream of Lake Tahoe Dam at Tahoe City in 1988. Local sponsors and descriptions for reservoirs and non-storage flood control facilities in the region are listed in ~~Appendix A~~ in Table NL~~A 3~~ Flood control facilities below.

Table NL~~A 3~~ ????? Flood control facilities, North Lahontan Hydrologic Region

Facility	Stream	Owner (sponsor)	Description	Protects
Reservoirs and lakes				
Martis Creek L.	Martis Cr.	USACE	See Note 1	Martis Creek, Truckee River, and Reno
Prosser Creek Res.	Prosser Cr.	USBR	20 taf flood control	Prosser Creek, Truckee River, and Reno
Stampede Res.	Little Truckee River	USBR	22 taf flood control	Little Truckee River, Truckee River, and Reno
Boca Res.	Little Truckee River	USBR	8 taf flood control	Little Truckee River, Truckee River and Reno

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Coordination and Reservoir Operations. There are no forecast-based operations agreements for operation of flood protection facilities in the region. However, during high water periods, reservoir operators coordinate with the California Department of Water Resources (DWR) and USACE during daily operations conferences at the State-Federal Flood Operations Center in Sacramento. These conferences often lead to voluntary modifications of individual schedules to improve overall system operation.

System operations are accomplished mainly by managing storage in the region's seven lakes and reservoirs—Lake Tahoe, Donner Lake, Prosser Creek Reservoir, Martis Creek Lake, Independence Lake, Stampede Reservoir, and Boca Reservoir. Out of a total of 1,089,570 acre-feet useable storage, 50,000 acre-feet is available for flood control. Flood control operations of Prosser Creek and Stampede and Boca reservoirs and any residual retarding effect from Martis Valley Lake are coordinated to limit Truckee River flows at Reno to 6,000 cubic feet per second when possible. 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.

During normal operations, Martis Creek Lake is maintained at a minimum pool and all inflow is released. At the present time, the integrity of Martis Creek Dam is being investigated, and the lake is not being used for flood control. Prosser Creek Reservoir has to be drawn down to provide 20,000 acre-feet of storage space for flood control by November 1 of each year. For flood control, Stampede Reservoir must be drawn down to have 22,000 acre-feet of storage space by November 1 of each year. Boca Reservoir must have 8,000 acre-feet of flood reservation space by November 1 of each year.

Maintenance. Maintenance of flood control works is a critical activity which preserves the integrity of the facilities, ensuring continued protection for the public. This effort is made more difficult by two factors: (1) Lack of adequate financing for many installations is the result of tax-management efforts of the late 20th century which have placed controls on former sources of revenue, and (2) heightened public awareness of the environment has resulted in new regulations making the permitting process lengthy and expensive. Compounding the problem, deferred maintenance can cause establishment of new habitat which then must be protected.

Maintenance of flood control facilities is usually the responsibility of the local maintaining agency, which is usually the local sponsor, or if there is none, the constructing agency. In this region, USACE projects are maintained directly by USACE. USBR projects are Prosser Creek Reservoir, Stampede Reservoir, and Boca reservoirs, which are maintained by USBR.

Land Use Management

Regulation. Nonstructural flood management measures are sparsely implemented in the North Lahontan region. Counties are the main agencies responsible for designating and regulating floodways. Placer County adopted an ordinance banning building in the Truckee River channel between Tahoe City and Squaw Creek, which USACE describes as subject to inundation. TRPA has a land use ordinance

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including subdivision and grading restrictions that prohibit construction requiring filling or grading of wetlands, stream environmental zones, or floodplains. All local land use jurisdictions must adopt a floodplain management ordinance identifying 1 percent floodplains and floodways, in order to qualify for Federal Emergency Management Administration (FEMA) flood insurance.

Flood Insurance. The National Flood Insurance Program (NFIP) is administered by FEMA. It enables property owners in participating communities to purchase insurance as protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. About 97 percent of California communities participate in the NFIP. Of those, approximately 12 percent participate in the Community Rating System (CRS) Program, which encourages communities to go beyond minimum NFIP requirements in return for reduced insurance rates. Quality floodplain mapping is critical to administering an effective flood insurance program, developing hydrologic and hydraulic information for determining floodplain boundaries, and allocating flood protection project funds.

FEMA has provided Digital Flood Insurance Rate Maps (DFIRMs) for all areas within the region. As of the time of this writing, February 2012, DFIRMs in five of the region's eight counties had been updated at times ranging from February 2010 to February 2012, one more update will have been completed by the time of issuance of this report, another county is in discussions about updating and the remaining county was updated in 2001 [and has no plans for an update at this time. Ray Lee?]

CRS rates communities from 1 to 10 on the effectiveness of flood protection activities. The lower ratings bring larger discounts on flood insurance. Of the eight counties and three cities in the region, one county participates in CRS. As of February 2012, Placer County is in CRS Class 5. See http://www.fema.gov/business/nfip/crs.shtm for more information on the CRS system.

Disaster Preparedness, Response, and Recovery

Information and Education. The California Data Exchange Center (CDEC) provides real-time and historical hydrometeorological data for hundreds of stations statewide, as well as real-time data on releases, spill rates, and elevations of many reservoirs. For this region, CDEC provides gage data from the Natural Resources Conservation Service (38 gages), US Geological Survey (USGS) (23 gages), and several other federal, State, and local agencies, for a total of 132 gages, and real-time flow and stage data for the Susan, Truckee, Carson, and Walker rivers. For access to CDEC data, see http://cdec.water.ca.gov/

The USGS maintains and publishes statistics for stream gages nationwide. For access to USGS gage data, see http://waterdata.usgs.gov/nwis.

DWR's Awareness Floodplain Mapping program provides an easy-to-use computer interface for viewing areas vulnerable to flooding by the flood event having a 1 percent probability of occurrence. The program applies to areas not already covered by FEMA Flood Insurance Rate Map. For this region, maps have been drawn for six of the eight counties in the region of which three offer complete coverage. By 2015, all areas expected to develop over the next 25 years will have mapped floodplains. See http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/awareness_floodplain_maps/ for Flood Aware maps. It will be noticed that Nevada and El Dorado counties seem to be missing but this is not entirely correct since Placer and Sierra counties overlap to provide coverage of Nevada County and El Dorado County is covered by the aforementioned DFIRM maps.

Accurate hydrologic and hydraulic models inform emergency actions before, during, and after floods. The National Weather Service's (NWS) Advanced Hydrologic Prediction Service uses historical hydrologic data, current river and watershed conditions, and near-term meteorological outlooks to forecast river flows. The service is publicly available for certain streams of the North Lahontan region whose locations are given in Table NL~~A-5~~ ??? below.

Table NL~~A-5~~ ???? Advanced Hydrologic Prediction Service stream forecast points, North Lahontan Hydrologic Region

River Basin	Stream	Location
Susan River	Susan River	Susanville
Truckee River	Tahoe Basin	Lake Tahoe Inflow
Truckee River	Prosser Creek	Prosser Creek Reservoir
Truckee River	Little Truckee River	Stampede Reservoir
Truckee River	Little Truckee River	Boca Reservoir
Truckee River	Truckee River	Farad
Carson River	West Fork Carson River	Woodfords
Carson River	East Fork Carson River	Markleeville
Walker River	West Walker River	Coleville
Walker River	East Walker River	Bridgeport Reservoir

Event Management. Under the Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS), initial flood emergency response is made by the responsible party at the site. When its resources are exhausted, the county emergency management organization (operational area) provides support. If necessary, additional support is coordinated by Inland Region of the California Emergency Management Agency (Cal EMA). Through the Cal EMA region and Cal EMA headquarters, help can be obtained from any State agency. Cal EMA coordinates with federal agencies and private organizations as well. The State-Federal Flood Operations Center (a joint facility of DWR and the Sacramento Weather Office and California-Nevada River Forecast Center, both units of NWS) is normally called early in the event to provide weather and river forecasts, facilitate information flow, provide field situation analysis, and give flood fight expertise. Severe situations that require Cal EMA involvement may also require emergency response by USACE, which is obtained by request of DWR. Table NL~~A-4~~ , ????? below shows a list of specific response organizations.

Recovery after a flood event may involve the funding and construction services of USACE if the facilities are parts of federal projects. Availability of resources to repair local and private facilities; remove floodwater; and restore housing, businesses, and infrastructure often depends on the severity of the event and the allocation of event-specific federal or State funds. Flood preparedness and mitigation efforts are promoted and funded by many organizations, including city and county governments, Cal EMA, DWR,

NWS, and USACE.

Table NL~~A-4~~ ???? Flood emergency responders, North Lahontan Hydrologic Region

Responder	Level	Comment
Person(s) or organization(s) on the site	0	Any emergency
Emergency services units of the three cities in the region	1	Any emergency
Emergency services units of the eight counties in the region	1 or 2	Any emergency, and by request from Level 1 responders
Department of Water Resources	2	Flood Operations Center, flood fight and Corps liaison
California Emergency Management Agency, Inland Region	3	Any emergency, Alpine, El Dorado, Lassen, Modoc, Nevada, Placer, and Sierra Counties, by request of county (operational area)
California Emergency Management Agency, Southern Region	3	Any emergency, Mono County, by request of county (operational area)
US Army Corps of Engineers	3	Specified water-related emergencies, by request of DWR
California Conservation Corps	3	Personnel and equipment for flood fight
Department of Forestry and Fire Protection	3	Personnel and equipment for flood fight
California Emergency Management Agency Headquarters	4	All emergencies, entire hydrologic region, by request of Cal EMA Region

Describe the existing damage reduction measures in place. These include structural and non-structural measures (flood control dams and reservoir operations, levees, bypass structures, local flood mitigation measures, etc.).

Current Relationships with Other Regions and States

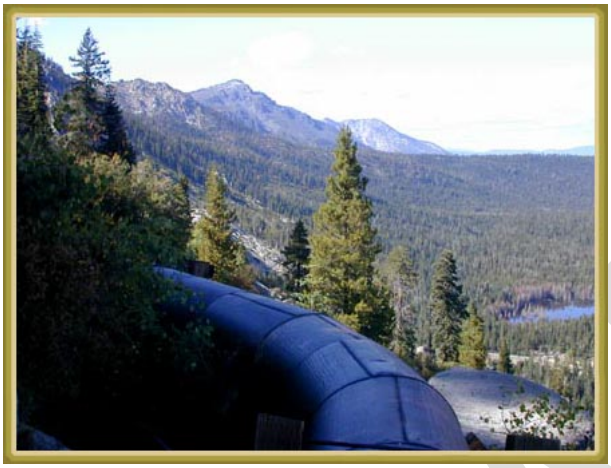
Because the river channels of the Truckee, Carson, and Walker rivers naturally flow into Nevada, a large amount of the surface water from these watersheds has historically been reserved for use by Nevada interests under various interstate water rights settlements and agreements.

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.

Figure NL-??? Echo Lake Conduit © 2012 Bayard Geis, Bayardo Design &Sierra valley diversion



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 a tributary of 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 in to place greater capacity channels because the current channels were overwhelmed by the 1997 flood.

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, not withstanding 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 basically 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 path ways to spawning beds. TROA, should it go into effect, 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 even 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.[new material between highlighted lines]

Implementation Activities (2009-2013)

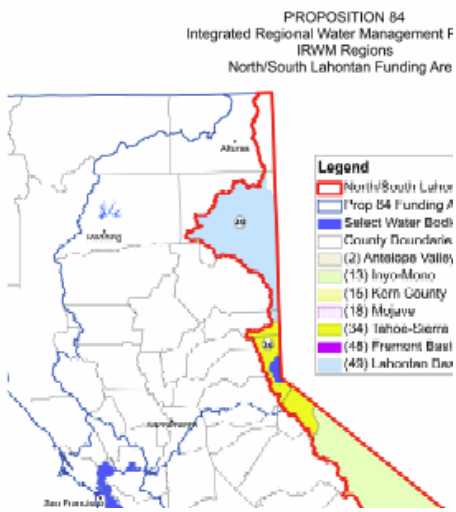
Although as disclosed in the 2009 Update TROA has been signed it has not yet been implemented due to pending litigation. Notwithstanding this bar to implementation numerous pre-implementation activities have been undertaken such as development of the computer program that will account for water released under TROA, preparation of a template for the report that will report was use in California and the identification of non-residential groundwater wells that will come under the provisions of TROA.

Other projects proposed by IRWM groups are

Sierra-Tahoe IRWM: [Ebin Swain, Director, eben.swain@ca.nacdnet.net & Lynn Nolan STPUD, grants Coordinator, see http:www.stpud.us/plan_documents.html (dated 2007. But see information on financing)]

The Tahoe Sierra IRWM had obtained recognition as the planning body for the Tahoe Sierra area shown in Figure (2009 update it was NL-4) ??? below. It has obtained a round one planning grant and has applied for a round 2 planning grant. It also has obtained $1.4 million in implementation grants with which it intends to conduct water quality improvement projects including meadow restoration, BMP placement and culvert replacements and groundwater/instream flow interaction studies.

Figure NL -???? IRWM Regions in North Lahontan Hydrologic Region



Inyo-Mono IRWM: Rob Mark Drew, PhD, mdrew@caltrout.org Sent email

The initial IRWM plan was submitted and revised pursuant to Proposition 84 requirements and a phase 2 plan was submitted in March of 2012. A Proposition 84 Planning Grant was awarded in early 2011. In January, 2011, a proposed first round implementation grant was submitted to DWR. Fifteen projects were included in the proposal although funding, at least as of this writing was not approved. Among the projects proposed were drinking water treatment improvements in the town of Coleville and improvement/restoration and nutrient research and development along the East and West Walker Rivers. Further project proposal rankings are due to be conducted in mid August of 2012.

Lahontan Basins: Gaylord Norwood, gnorwood@co.lassen.ca.us Sent email to Mary Randall 3/26/12 re anything projects that they have planned. She responded that I had summarized it correctly as far as is currently known below.]

The Lahontan Basins IRWM obtained approval as a region by DWR in September of 2011. Although the region is in its formative stage it is presumed that it will propose projects that will enhance water supply and reliability along with such environmental improvement projects as may arise.

[New topic, a non-IRWM program]

The increased pace of forest fuel reduction mentioned in the 2009 Update has taken place with the rate of project completion increasing to a relatively high rate compared to previous rate and that rate is being continued as has been discussed above in the Watershed section under the State of the Region heading.

This subsection contains a discussion of the actions that have been taken since the last California Water Plan update to meet the water challenges in the region.

Considerations for this subsection:

- The efforts we will be doing for the progress report [this is presumably the report on completed projects that will issue May-June 2012. Per Gary Lippner discussion 4/3/12 await this report for project accomplishment details] format should provide some content for this section. We should not, however, be limited to the progress report if significant activities have occurred in the region since the last update.

Drought Contingency Plans

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.

While the 2009 Water Plan was in preparation Gov. Schwarzenegger declared a drought emergency, the first that had been declared since 1991 and before that in 1977. The fact that rainfall in the interim completely alleviated the drought is a demonstration of the on again- off again nature of drought conditions and although at the time of this writing the state is not in a drought condition that fact illustrates the point that drought planning has to be done in advance because occurrences are random in nature. California Water Code §10632 (part of the Urban Water Management Act of 1983) requires that each utility serving 3,000 or more customers or which provides more than 3,000 acre-feet of water per year prepare a water management plan. These plans are required to contain a water shortage contingency section that demonstrates water availability for a three year dry period after the three driest years in succession of record and to describe the actions, e.g. rationing, that would be taken in the case of drought. Accordingly 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 such 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. In addition to water plans in order to qualify for federal assistqance in the event of a disaster, the U.s. congress in 2000 passed PL 106-390 which requires each governmental entity must determine its vulnerabilities to disasters which takes the form of a Multi-Jurisdictional Hazard Mitigation Plan. This plan considers drought in descriptive terms, ranks its probability and suggests planning efforts be undertaken. [Modoc County EOP, date?, Lassen County MJHP, 2010; Ray Lee of DWR Federal flood Insurance Program thinks all counties have them except for Alpine]

“

[Suggested sources. Gov. Schwarzenegger’s XO S-06-08, June 4, 2008. Discuss fact that drought is a sporadic off/on thing. Then search the web by county with the search term ????? county drought plan. Figure NL-??? Variability: Bailey’s Beach lift near High Camp at 8200 feet December 2012 (Need permission of RGJ, Tim Dunn or get something from the photo lab showing low snow levels and Red Dog also at Squaw Valley 4/13/12[need permission Squaw web cam?]

Resource Management Strategies

Strategies: The following strategies were taken from Table NL-7 from 2009 update. Only strategies applicable to the NL region have been addressed.

Ecosystem Restoration: [Wait for the compilation of completed projects due in May- June 2012 for all of these. Note: May have to expand categories of projects if improvements have occurred in categories other than those below]

Meadows restoration has proceeded in the Perazzo Meadows on the Little Truckee River during 2011.

[Ask Dr. Roy Mark Drew, mdrew@caltrout if there has been a continuation of the activities outlined below from the earlier drafts of the 2009 update:

[Both of the following; wait for May-June 2012 compilation of completed projects]

Environmental and Habitat Protection and Improvement:

Same as immediately above under Ecosystem Restoration.

Flood Management:

As already mentioned Prosser and Stampede dams are being raised (Boca also? Doubt because downstream from Stampede. Get construction dates from USBR. Continuing study of Martis Creek Dam with no resolution yet. Ask USACE PM.

Groundwater Management:

The Vidler Water Company's extraction of water from Fish Springs Ranch just over the border in Nevada, but within the Honey Lake groundwater basin shared with California, largely did not occur because there was no market for additional water because of a slow down in the new home market. This is a temporary situation and it is expected that groundwater extractions are likely to become a concern again in the future when that market recovers.

[Check for any new groundwater plans with the various counties. ≈7/24/12 told by Dave Willoughby of plans underway for Bordertown area in NV]

The City of Susanville pumps geothermally heated groundwater and uses it for heating its central district. [geothermal department (530) 257-1041 on 4/13/12, Russ Brown responded 4/19/12, will email quantities drained and re-injected]. This results in a diversion of approximately ??? acre-feet of water per

year which is discharged to surface drainage and ??? 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[2]. The system discharges these waters at a rate of approximately 50 acre-feet per year to an irrigation ditch and an old mill pond. [Ck still correct?]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???.[contact Jack Truxel of Department of Oil Gas & Geothermal and/or Joe LaFleur who made presentation in Oct. 2010] In addition as mentioned in the adjoining NL-Box NL-1, a geothermal prospect has been identified in Modoc County at the Lake City Geothermal area.

[Check, geothermal, for instance the Geothermal Department of Susanville Utilities remains and the extracted water is wasted to a drain? Is there any kind of a geothermal plan for Modoc County?]

Recreation and Public Access:

Portions to Truckee Canyon had been bought and the public now has access to the reach of the river from Hirschdale RD. (down to opposite side to 14001 Iceland RD? who bought, funding from???)

Imported Water:

[Check to see if the amount of water imported to the Madeline Plain remains constant.]

Stormwater Capture and Management:

[(none for re-use just to control suspended solids) BMP's continue to be added. Have there been any developments from the studies being carried out at the Polar Creek fish hatchery?]

As is stated below in the section on Water Governance, Best Management Practices (BMP's) remain a concern in the Lake Tahoe Basin and are likely to receive added attention in terms of BMP requirement disclosure at the time of sale of real estate, inspection and enforcement.

Water Conservation:

STPUD already has a water conservation program and TROA, should it go into effect, will require a water conservation program in order to qualify for measuring water use at the point of use instead of at the source once 100% water meter installation is achieved likely only be by 2025. However more than two thousand water meters have been installed and since the beginning of 2011 those meters now have to

[2] Information gathered from public sources. No DWR well data was relied on in making these statements.

be read and water billed on a volumetric basis. Studies have shown generally that metering water use has resulted in twenty percent less water use which may be a challenge in the North Lahontan region since outdoor landscaping is not as prevalent as it would be in general and that is the primary urban water use.

Water Quality Protection and Improvement:

In the North Lahontan region water quality improvements in the Lake Tahoe Basin are focused on factors that impact the clarity of Lake Tahoe which are largely small inorganic particulate matter. Thus BMP's are being installed on drainages and even in the yards of residences. Further reduction of particulate matter generated from driving on paved surfaces are similarly treated with roadside BMP's. [As above find out results of UC's BMP experiments at Polar Creek fish hatchery grounds.]

Water Recycling:

Sewage effluent recycling in the Lake Tahoe Basin is prohibited by law and in the Truckee River Basin by agreement. By law in that the Porter-Cologne Act prevents any sewage effluent from being discharged in the Lake Tahoe Basin. By agreement because under TROA, if it goes into effect, recycling of water is prohibited because it would decrease flows in the Truckee River. However outside Truckee-Tahoe beyond the reach of the proposed TROA, re-use is practiced. At the High Desert State Prison and the collocated California Correctional Center, Susanville, 1.4 million gallons per day (1568 acre-feet annually) of treated sewage effluent is applied to 320 acres of alfalfa that is used for non-dairy cattle feed. The effluent is stored in ponds during the winter and applied throughout the growing season. The rate of application is limited to that at which the nitrogen in the effluent is absorbed by the alfalfa crop. This re-use is currently being expanded to 1.8 million gallons per day that will be applied to 570 acres. [source: pers. communication with George Nichol, PhD. 3/20/12]

In the remainder of the region population densities are not such that water recycling would have a significant effect.

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[3] 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 [Is this true, or does the growing season

[3] This phrase may be a matter of semantics, As the California Drought Contingency Plan states at p. 58 "…"If the amount water that is available to [Californians] is less than [what they want] they perceive shortage. …As climate change decreases the amount of run-off available to the state, … this shortage could increase. Although some people refer to this as a "permanent drought," a new-long term average precipitation cannot be a drought, which is the state of getting less precipitation than average. The Drought Contingency Plan addresses the incremental impacts from increased dryness in drought years, not ongoing shortage, which is the domain of the California Water Plan."

run out?, Ask David Lile UCCES, Susanville, emailed 4/11/12]. 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 [check to see that the short growing season is not the limiting factor, see Lile email above]. 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. [Resolution of quandary: The author does not possess knowledge that there have been no steps taken to increase water supplies = water reliability. It is almost certain that some private party drilled another well or that a well was deepened. Source of this information is : well logs? (confidential)

Water Transfers

[First check to see that the imports from the south fork of the Pit River are being fully exploited noting that it is highly likely that this is the case. The only reason that would not be the case would be lack of demand for the cattle/alfalfa that is being raised.]

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.

Watershed Planning

TROA represents a planning effort that would, if it were to come into effect, instill more flexibility into the operation of the Truckee River and result in more water needs being met at appropriate times. [Research other planning efforts: IRWM plans will for meadow restoration might, although not yet demonstrated, result in a more gradual release of water from source areas that would act like retarding reservoirs and thus smooth the supply of water.] To the extent that IRWMP's result in the installation of new piping that does not leak as much, water would be saved, but not in an overall sense because the leaked water would enter the groundwater of the area whereas water more efficiently retained in pipes would end up in the sewage stream that would, in the case of the Lake Tahoe Basin, be exported out of basin. In short some IRWMP projects would likely result in better water quality than supply availability. [check to see what water shed planning efforts there are in the Honey Lake area from 2009: the only thing is mention in Table NL-1 column 4. Also see others such as TROA and various litigations. See also the

Placer County GW plan of 2007 attached to their 2010 Urban water management plan]

Wetland Enhancement and Creation

See above efforts at meadow restoration e.g. Perazzo Meadows and Merrill Davies meadows in Sierra County. [Dave Willoughby will ask Lisa Wallace, Lynn Nolan and Marcia Beals about any other projects There is also the Dakin Unit in the Honey Lake area and the other wetlands and mentioned above.]

Water Governance

On the Truckee River, there have been no changes in water governance, but there is pending litigation that might lead to changes in water governance in the form of the institution of TROA's more flexible operating criteria and the dispute resolution process setforth therein. In the Walker River watershed the Walker Basin Project, see http://www.walkerbasin.org, operating wholly within Nevada at the time of this writing in March 2012 is proceeding to acquire water rights that will be held by the National Fish and Wildlife Foundation (NFWF) for use to enhance water flows to Walker Lake. Discussions are being had about the future extent of this project. Perhaps the most distinct change is water governance is the institution of an Integrated Regional Watershed Management (IRWM) program by DWR. It has resulted in the establishment of committees of stakeholders in the IRWM regions shown in figure NL-??? (p. NL-45) that will guide the ensuing discourse about the way water planning is done. Because of the benefits entailed it may be anticipated that the furthest northeast region of the state, Modoc County, may at some point also become part of this process in which case the entire region would be included in the IRWM process. [Check the individual counties to see if they have posted any notices of new Boards or commissions]

As mentioned below in the section on Regional water Planning and management, Integrated Regional Watershed Management (IRWM) groups have been formed that cover all but the extreme north east corner of the state and the hydrologic region.

State Funding Received [Obtain the "progress report" of May-June 2012 for a hopefully detailed account of funding both state and local.]

Describe the State funding received to implement water-related infrastructure, coordination, or planning in the region. [seek information that Pierre Stephens offered, contact Keith Wallace, Gary Lippner & Tim Nelson?]

Local Investment

Describe the local investment made to implement water-related infrastructure, coordination, or planning in the region. [seek information from the respective counties' web sites.]

Water Conservation Act of 2009 (SB x7-7) Implementation Status and Issues

The California Legislature passed the Water Conservation Act of 2009 (SBX7) that requires more reporting of water use, to include use by riparian water rights holders that is new to water governance. These electronically filed reports are in addition to triennial reports already being filed by users who are asserting appropriative rights through Statements of Diversion and Use with the State Board. These data when more fully developed will provide the first picture of riparian uses in the region including those

claimed by the United States since it claims riparian rights for instream flows for virtually every stream within the boundaries of the land over which they have jurisdiction. Groundwater is indirectly affected by this legislation in that DWR will carry out the California Statewide Groundwater Elevation Monitoring (CASGEM) program which measures the levels of groundwater at a greater number of locations than had previously been the case and which will result in a more refined estimate of the amount of groundwater use.

As indicated above one of the issues SBX7 will address is the amount of water diverted by riparian water right holders. This is a concern for instance in the Walker Basin where there is continuing litigation concerning water rights and knowledge of the amount of riparian diversions will potentially facilitate a compromise settlement of this litigation. The amount of water use could also become an issue if TROA is implemented since it requires an annual accounting of water uses in the Lake Tahoe and Truckee River Basins to determine if the respective states of California and Nevada have stayed within the water use allocations contained within TROA.

Interregional and Interstate Activities

TRPA Regional Plan Update –[Expect "end of 2012"]

The Tahoe Regional Planning Authority (TRPA), a bi-state agency that controls development in the Lake Tahoe Basin, has [prospectively, by the end of 2012?] revised its Regional Plan. This is revision is the first since 1986. Because the region is largely built out through actual development and buying up of parcels by the California Tahoe Conservancy and other conservation entities, the plan now seeks to improve environmental conditions by controlling re-development in a way that leads to improvement in legacy developments. The planning strategies that affect water by which this will be achieved are: [From the EIS draft (or more exactly from a descriptive table)]

Housing Alternatives: In conjunction with local governments and other organizations, develop a regional housing needs assessment by 12/31/13. Affordable housing will be provided [for] in suitable locations for the residents of the region. Special incentives to include bonus development rights will be given to promote affordable or government-assisted housing for households with 80% of the county's median income and for very low income households making 50% of the "respective" county's median incomes as determined by the U.S. Department of Housing and Urban Development. This additional development is expected to both increase the population and hence the water use in the region and to improve run off water quality from legacy developments constructed before standards for run off had been tightened.

The revised plan 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 goal are to limit fertilizer use, restore 80% of disturbed lands, increase BMP disclosures in purchase documents for real estate and accelerate implementation of BMP's and by focusing 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.[consider a bullet list of text box for this enumerations of proposed water quality measures]

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 which is a computer program into which the areas of detailed land uses and surface characteristic are input which leads to a prediction of 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. [sources: USACE an Economic analysis Private Source Stormwater BMP Expenditures on Redevelopment Projects, 3/10/2010.]

Litigation filed by Nevada interests has halted the implementation of TROA. It will remain unimplemented until the litigations is resolved. There are both substantive and procedural issues being litigated. A substantive issue is whether TROA injures any valid water rights. This matter is currently before both the U.S. District Court for Nevada in Reno and before the State Board. No time of resolution can be projected. Procedural issues arising under the Administrative Procedures Act (APA) have also been raised before that District Court. The APA is the law under which the adequacy of the analysis of the impacts of TROA under the National Environmental Protection Act (NEPA) have been addressed in the TROA Environmental Impact Statement. No time of resolution can be projected for the resolution of this litigation either.

As mentioned above discussions are being held to determine if litigation concerning the Walker River can be resolved short of proceeding with the litigation which has been filed and has been ongoing for years in that matter. These discussions are being held between parties in California and Nevada. No time of resolution can be projected for these processes either.

On March 13, 2012 the Tahoe Transportation District approved a water shuttled program with service between Kings Beach and Tahoe City which should reduce the number of car trips and improve water quality because of a reduction in road abrasion particulate pollution making its way into Lake Tahoe. [Sac Bee, March 18, 2012]

Looking to the Future

Pursuant to the current trend IRWM processes are expected to grow in importance in the formation of water resources management policies in the IRWM regions of the North Lahontan Region. The overall

objective of the IRWM process is to reach consensus decisions on interrelated water resources issues on a watershed wide scale rather than focusing on activities on a project by project basis. [see IRWM web site for further explication if required.]

Future Conditions

Future Scenarios

Relationship of scenarios to regionally derived plans:

The three demographic scenarios considered are staying with current trends, slow and strategic growth and expansive growth. It is expected that of the three scenarios that which will be followed is slow and strategic growth. Current urban growth will be muted by both economic conditions because for the next three year update period the return of the 1 million jobs lost during the great Recession of 2008-2009 is being projected only by 2018 with strong job growth and by 2023 with moderate job growth with current wages at the same level as 1998. [source UCB policy briefing by the Institute for Research on labor and Employment, Center on Wage and Employment Dynamics: "A Depressive State: Assessing California's Labor Market Four Years after the Onset of the Great Recession, http://www.irle.berkeley.edu/research/A_Depressive_State.pdf April 2012) Also the region is either approaching build out in the Lake Tahoe Basin or is not expected or desired to grow except for the Truckee area where growth might be more evident than in any other area and there is no particular driver for a change in water use. Accordingly regional plans are directed mainly at the improvement of water quality in the Lake Tahoe Basin and habitat restoration in other areas and increased reliability of water supply which in this region is a reduction of year-to-year variation in the date when the water runs out. The state objectives as given in the 2009 Update Highlights volume include objective one, expand IRWM's so that regional self-sufficiency is increased and four and five, protect surface water and groundwater quality and expand environmental stewardship all of which are consistent with this region's IRWM plans. The remaining two scenarios are unlikely to occur and therefore, will not be considered here [maybe the analytical and work tools work team is required to consider the other scenarios?]

Climate Change

[I heard from Peter Coombe, NRO 2/28/12. That content follows below.]

Climate change models suggest that the North Lahontan region will generally receive less annual precipitation, with more of that precipitation falling as rain. Climate change scenarios indicate a higher reliance on groundwater to maintain current levels of agricultural development. Similar climate change scenarios for the Lake Tahoe area indicate increased use of groundwater to accommodate population growth.

[There is of course also the material from the WEAP analysis which I would assume are going to be provided, perhaps in an enhanced version for this update.]

[This draft received from Peter 6/01/12]

Climate Change

Climate change is already impacting many resource sectors in California, including public health, biodiversity, agriculture, and vital State infrastructure such as water, transportation, and energy (CNRA, 2009). Model simulations using the Intergovernmental Panel on Climate Change's 21st century climate scenarios project increasing temperatures in California, with greater increases in the summer (Cayan, 2008). Changes in annual precipitation patterns across California will result in changes to volume, type, and surface runoff timing. Due to the economic, geographical, and biological diversity of the state, vulnerabilities and risks due to current and future anticipated changes are best assessed on a regional basis. While the State of California is taking aggressive action to mitigate climate change through greenhouse gas (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. Many resources are available to assist water managers and others in evaluating their region-specific vulnerabilities and identifying appropriate adaptive actions (EPA, 2011; CNRA, 2012).

Over the past century, observed data in California indicate increasing maximum, mean and minimum temperatures, shifts in precipitation patterns, and shifts in annual runoff timing. The region's mean annual temperatures have risen about 2°F (BOR, 2011); however, temperatures some climate zones in the region have remained stable or even decreased. Mean annual precipitation in Northern California has increased slightly from 1890 to 2002 and precipitation patterns in the region have considerable geographic and annual variation (DWR, 2006). 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).

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. Anticipated impacts from climate change in the region under a high GHG emissions scenario include a continued warming trend with air temperature increases from 4°F to 5°F in the winter and 6°F to 10°F in the summer by 2100. Warmer temperatures will result in more precipitation falling as rain instead of snow, decreased snowpack, and increased wildfire risk (CRNA, 2012).

Changes in annual precipitation across California, either in timing or total amount, will result in changes to type of precipitation (rain or snow) in a given area, and to surface runoff timing and volume. Climate model precipitation projections for the State are not all in agreement, but most anticipate drier conditions in the southern part of California, with heavier and warmer winter precipitation in the North (cite). Since there is less scientific detail on localized precipitation changes, there exists a need to adapt to this uncertainty at the regional level (Leung, 2012). While future precipitation and runoff is somewhat uncertain, greater flood magnitudes are anticipated as more frequent atmospheric river storm events encounter the region (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.

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 1). DWR (2006) projects that with a 1° C 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. A projected temperature rise of 5° C would leave two basins with 8 percent snow coverage, three basins with approximately 25 percent snow coverage, and West Walker basin with 41 percent snow coverage.

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

Basin	**Mean elevation**	**Average Apr. 1 snow line**	**Total area**	**Snow Covered Area**	**1° C Rise**	**2° C Rise**	**3° C Rise**	**4° C Rise**	**5° C Rise**
	[ft]	[ft]	[mi2]	[percent of basin]	[% of basin]	[% of basin]	[% of basin]	[% of basin]	[% 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%

Historical and projected climate changes have 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. 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.

Climate change will potentially impact the forests and timber industry. 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).

Adaptation

As the science of climate change quickly develops and evolves, local agencies face the challenge of interpreting new information and determining which methods and approaches are appropriate for their planning needs. The Climate Change Handbook for Regional Water Planning (2011) provides an analytical framework for incorporating climate change impacts into a regional and watershed planning process and considers adaptation to climate change. This handbook provides guidance for assessing the vulnerabilities of California's watersheds and regions to climate change impacts, and prioritizing these vulnerabilities. The California Emergency Management Agency (Cal-EMA) and the California Natural

Resources Agency (CNRA) have developed a guide to assist local agencies in adapting to climate change (Cal-EMA and CNRA, 2012). Additional tools to supplement these resources include the on-line Cal-Adapt (http://cal-adapt.org/), which has been designed to provide access to data and information produced by the State's scientific and research community.

Specific responses to climate change will need to address increasing temperatures and changing hydrologic patterns to assure an adequate future water supply. Responses should involve no-regrets strategies such as additional surface water storage, improved conveyance, conjunctive management/groundwater storage, improved flood control, agriculture stewardship, forest management, restoration to enhance and sustain ecosystems, and conservation.

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 (Ch. 2) 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 (Ch. 28). The 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 (Ch. 5); Conjunctive Management and Groundwater storage (Ch. 8); Precipitation Enhancement (Ch. 10); Surface Storage – Regional/Local (Ch. 13); Pollution Prevention (Ch. 17); Ag Land Stewardship (Ch. 20); Ecosystem Restoration (Ch. 22); Forest Management (Ch. 23); Land Use Planning and Management (Ch. 24); Recharge Area Protection (Ch. 25) and; Watershed Management (Ch. 27).

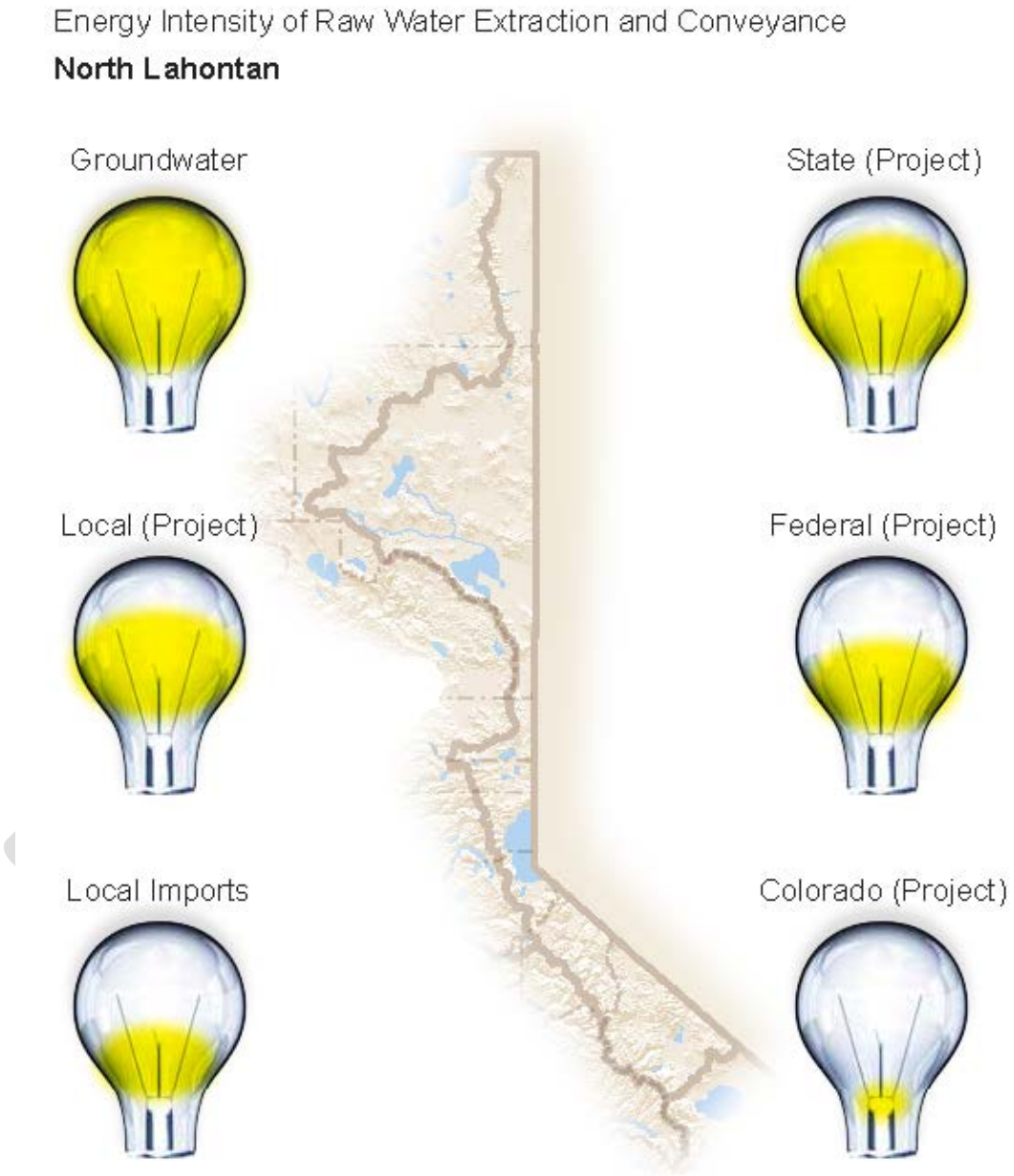
The region contains a diverse landscape with different climate zones, making it difficult to find one-size-fits-all adaptation strategies. Water managers and local agencies must work together determine the appropriate planning approach for their operations and communities. While climate change adds another layer of uncertainty to water planning, it does not fundamentally alter the way water managers already address uncertainty (USEPA and DWR, 2011). However, stationarity can no longer be assumed, so new approaches will likely be required (Milly et al., 2008).

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 no-regrets strategies that benefit the region in the present-day while adding future flexibility and resilience under uncertainty.

Mitigation

This is the first Water Plan to include specific energy intensity information within the regional reports. A conceptual graphic and footnotes will indicate relative energy intensity of raw water extraction and con-

veyance for the primary water supply sources for this region. The draft concept sketch appears below, with the shading of the light bulbs (or other approach) still to be developed. The climate change team will work to gather as much information as possible on comparative energy intensity, to provide water managers a rough idea of which sources of water require greater energy use. *(DRAFT sketch does not have proper indicators at this time).*



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 which 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.

Considerations:

Reducing Water Demand:

A condition in TROA is that the water purveyor in the Truckee meadows area would undertake a toilet replacement program in exchange for a reduction in the amount of consumptive use attributed to their system Additionally that water purveyor was to achieve 90% metering of residences. Both of these objectives have been met notwithstanding the fact that TROA is not in effect.

Improve operational Efficiency and Transfers:

TROA requires a considerable amount of data concerning the quantity of releases therefore remotely controlled gates and telemetered flow gauges have been installed by the U. S. Watermaster's Office in Reno. Along with this information a database to record and analyze the flow quantities was developed and a computer program is being developed to account for the water. In addition that office has sponsored studies and is placing instrumentation that will allow the amount of evaporation from lakes to be determined in order to correctly charge the water accounts for evaporation according to the terms of TROA.

Increase Water Supply

As above this is probably a matter of finding more groundwater since surface water supplies are spoken for. One aspect that may not have been explored already in this report is that if a watershed is adjudicated it could and almost certainly would be adjudicated for both ground and surface water as opposed to the current California system in which groundwater is much more loosely regulated. An adjudication could result in a grant of right to extract more groundwater, but that is only arguably the case and not likely because downstream interests would undoubtedly assert that surface water was fully appropriated (probably easily shown given the number of unproven claims of diversion and use) and a diminution of surface water flow could be related to groundwater extraction leading to a decision by a federal judge, given that this would undoubtedly be an inter-state claim, that no further groundwater extraction should be allowed.

To access additional groundwater additional geological studies would have to be conducted and sources of energy at a reasonable price would have to be developed. The latter might be in the form of locally sourced wind, geothermal or solar sources. These energy sources would only be economic if they can compete with imported hydro-electric energy sources from the northwestern United States.

Improve Water Quality

Already discussed in the context of providing BMP's to remove suspended solid from water. There, however, also concerns within the region of nitrate and salt concentrations and organic contaminants such as MTBE, a legacy fuel additive and PCB's in the donner lake area. The solution for MTBE was to ban MTBE as an additive and two stroke engines on Lake Tahoe. Sine tha t time MTBE concentrations have begun to decline. [expand discussion to include BTESX frm gas stations? Go into detail as to the source of the PCB's in Donner lake?]

Practicing Resource Stewardship

The level of stewardship in the immediate vicinity of lake Tahoe is quite high in that it I 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. [see the list in 2009 update.]

Improved Flood Management

Defer to IFP for content in this section however it is believed that they will recognize that due to the physiography of the region in the more mountainous regions and the preponderance of low density agricultural development in the valleys, that flood works are generally at a low level of development and that results in certain losses to infrastructure and agricultural lands when flooding does occur, but does not result in wide spread high value damage or loss of life issue that isn't avoidable.

Flood Risk Characterization [rely on IFP for this material}

Future Vision

Regional Future Vision

The rural communities in the region tend to want to stay that way without undue levels of development. One instance of this is a ranching family that moved from a coastal, metropolitan area where their operation had been for over a century to the North Lahontan region in order to continue raising cattle. In the more developed areas in the vicinity of Lake Tahoe development of second house communities is underway along with a strong recreational industry and a push now for attendant recreational worker housing and an attempt to fill in the summer season with occupations that would support year round occupancy and the related support for schools and community facilities.

The view of the regional stakeholders is to make the most that they can with the unevenly distributed water resources, in some places water is quite abundant and in others not, but basically the path forward is to continue as things are now with gradual development in the Lake Tahoe area. One thing TROA would

provide, should it ever become effective, would be an interstate allocation of water without the threat of winner take all litigation that would cause water supply dislocations. This would relieve the uncertainty that currently surrounds development and free the State Board to address water rights applications in the region that have been held in abeyance since 1972.

[Further information from IRWM statements of purpose?]

Tribal Objectives/Vision [rely on Tribal Council input]

Objectives and vision of the tribal interests in the region would be described here.

Relevant Statewide Interests and Objectives

One statewide interest is that California maintains sovereignty over the water that is within its borders. This means that notwithstanding the fact that the water in the North Lahontan region is largely controlled by Nevada interests, that it would still be governed by California State law while it is within the borders of the state. Every time there is an adjudication of an interstate water resource a federal court will necessarily become involved and they are not limited by state law in fashioning an allocation [Ck with OC]. That could lead to the governance of California groundwater by principles that do not follow California law. It is for this reason that discussions are underway to try to settle interstate water allocation concerns without court action.

Another concern that will hopefully not rise to statewide status arises from TROA in that it requires a modification to the California Well Standards at least for the three counties in the Truckee River Basin so that wells that are within a certain distance of any tributary to the Truckee River must completed at a level that will not exert any short term influence on the flow of water in the river. If properly limited this should be regional and not lead to a statewide concern.

Describe statewide interests and objectives and how they might influence or affect the region. State government initiatives would be discussed in relation to the region.

Regional Water Planning and Management

(1) Status of IRWM or other regional plans

The Sierra-Tahoe region has obtained a phase 1 planning grant and has applied for a phase 2 planning grant and has developed projects to accomplish with the $1.4 million dollar implementation grant they received. There planned projects are:

Study of the interaction between pumping and flows in Squaw Creek in Olympic (Squaw) Valley
Replace the stormwater system that drains Bijou Meadow and construct infiltration basins
Sedimentation removal from Little Truckee River and installation of a flow gauge
With Truckee River Watershed council remove sediment creating features in Negro Canyon

Install BMP's in South Lake Tahoe's Montgomery Estates subdivision
Tahoe Resource Conservation District residential BMP retrofit planning
Town of Truckee Water Quality monitoring to determine sources of sediment in stormwater
Replace a narrow bridge over the Little Truckee River to reduce scour erosion
Water conservation program for regional water purveyors
Griff Creek Stream Environment Zone improvements for sediment transport and fish passage

The Inyo-Mono IRWM

As stated above the Inyo-Mono IRWM projects proposed that fell within the region were drinking water treatment improvements at Coleville High School and improvement/restoration and nutrient research and development along the East and West Walker Rivers.

Lahontan Basins IRWM

This organization was accepted as an IRWM region during September 2011 and it is assumed that their projects are going to address water supply and reliability and water quality concerns. The former is presumed from the fact that approximately sixty percent of its land mass has an annual precipitation of less than eighteen inches. The latter is indicated by section 303(d) listings which list waterways in the region impacted by salinity, mercury and toxicity to test species of unknown origin.

The challenges encountered have been typical of any startup effort. First there was the challenge of region formation which is still ongoing in that there is no region that includes the extreme northeastern corner of the state. Once regions were accepted there were teething problems with the initial project proposals which have only now been partly overcome. Acceptance of any particular project, of course, was also affected by the availability of funds

Water scarcity is an every year occurrence in the northern and southern portions of the region with agricultural activities adjusted to fit that amount of water available. Only the BLM has prepared drought emergency plans for non-urban areas. [check?]

Integrated Regional Water Management Coordination and Planning

As already stated there is no IRWM region in the northeastern portion of the region and that is an improvement needed for the IRWM process.

Accomplishments

The Perazzo Meadows project is just into it first year of monitoring. As above the projects have not yet been implemented? (I keep thinking about the $12.5 million that was supposedly spent; By whom? Where? See Pierre's list of implementation grants and see if any of them are in the region. It is known that there were, for instance, water quality improvement projects, but did they precede the IRWM process? Yes, they were Prop 50 grants and then prop 84 grants. See for instance the EIP (Environmental Improvement Program) at TRPA web site]

[Was told to obtain the Perazzo Meadows PowerPoint presentation fromTRandy Westmoreland, email to same requesting PoerPoint, 6/25/12.]

Challenges

See above under paragraph beginning with "The 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.

Resource Management Strategies

[Note: (1) Align with resource management strategy impacts and benefits of IRWM standards. (2) Information for this section will be regionally derived. The "statewide" strategies (i.e., the updated text from Volume 2 of Update 2009) will be published in a separate volume, not in these regional reports.]

Strategy Availability

Only those strategies that were available in the North Lahontan Region were setforth as considerations in the section above entitled Interregional and Interstate Planning Activities as possibilities for this region. The benefits that might be achieved by implementing these strategies are taken in order of their presentation above. Water demand reduction is typically the outcome of the installation of water meters. Improvements on the order of twenty percent reduction are typical when meters are installed however this

applies only to the Municipal and Industrial (M&I) portion of water use which in the case of the North Lahontan region is a minor fraction of the water use in the north and south agricultural portions of the region. In the Tahoe-Truckee area extensive landscaping is rare and due to the fact that most ordinary water use, approximately seventy-five percent of annual use, is for outdoor watering, placing meters may not have the usual impact on reduction in water use. There is however, the California "20% by 2020" water use reduction program so it is expected that a reduction of twenty percent will eventually be recognized from the installation of water meters. One advantage of complete meter installation, perhaps not occurring until required in 2025 is that under TROA any one hundred percent metered districts can measure their water use at the point of use instead of at the point of diversion, which is at the water company. This makes a probable difference of percent or more since that is the amount of water that a water distribution system usually looses. The lost water, at least that which is lost due to leaks, of course returns to groundwater so the system is made partially whole for any reduction in use indicated for metered districts.

Water demand reduction for agricultural uses in the north and south areas of the region may also not be as readily attained as it is in other agricultural regions because the main crop is alfalfa or irrigated pasture which is not as susceptible to reduction in water use by such measures as drip irrigation as would a crop that consists of individual plants.

As has been indicated above the Rapid Watershed Assessment of the Susan River indicates that watershed improvements might reduce water use by fifteen percent. In addition California's 20[%] by 2020 law favors that percentage at least for urban uses.

The strategies in the 2009 update that apply to this region have been reviewed above in the section entitled Interregional and Interstate Planning Activities. One may consider that these measures could reduce water use by 15-20%

Regional 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 Regional Resources Strategies, has addressed this subject. [Can't really say much more?]

The number of IRWM planning grants accepted in the region is two and the number of IRWM implementation grants is one. [Say something about anything done under the implementation grant to Sierra-Tahoe ask Eben Swain, Lynn Nolan and get information from Dave Willoughby per Lisa Wallace and Marcia Beals.] It does occur to me *ala* the 2009 update that there are many more implementation grants that have been completed outside of the IRWM process than within it at this (March 2012) point in time.

On this point confirmed with Pierre that projects executed under "other programs" were to be included.

Sierra Nevada Conservancy: [from their web site. Searchable project database. Ck below with Keri Timmer and/or Angela Avery]

Found that they were allocated $54 million under Prop 84, were founded in 2004 and have purchased conservation easements on farm and ranches, but in the period since 2009 they have not placed any improvements in the ground, having just performed "pre-project due diligence" such as doing EIS' and monitoring for baseline conditions and that they disbursed nearly $40 million doing so.]

The Sierra Nevada Conservancy puts forward the value of "working landscapes" to downstream users. One effort that its stresses is the quantification of the value of ecosystem services provided by healthy watersheds. They realize that water is the most important benefit to other regions and seek recognition of this fact and support for investment in watersheds that will sustain their function. Threats to watersheds that they want to allay include extreme wild fire occurrence, poorly planned development and unauthorized recreational use whereas the things they support are sustainable use of working landscapes as they term the natural environment in their region.

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 during the wet season that trapped sediment that otherwise would have entered Lake Tahoe. [Uncertain if there has been any construction check with Eben Swain?] 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 port 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. [see two summry write ups of material from web sites.

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. [source minutes of Alpine County BD of Supes 4-1-2008 + *Register Courier* headline of Sat. 8/27//2011 indicating work would proceed in September 2011.]

References

This section contains the list of end references supporting the narrative. Use the subheadings below and see the guidance on in-text citations and end references within *California Water Plan Update 2013 Publications Process and Style Guide*. Also available is a tool called "Click-and-Type References."

Considerations:

- Document sources of chapter text.
- Link to documentation of data sources for portfolios.
- Link to other water management plans and elements.

References Cited

List references here.

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Additional References

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Personal Communications

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Publications staff: Acronyms and abbreviations will be presented for each chapter individually. References for citations will appear within each chapter, as well. Use the lists below to create acronym tables for each chapter, generate tables of contents, and crosscheck information within the text.

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