

Section 5: Resource Management Strategies

The strategies presented in this section include those considered within this Integrated Regional Water Management Plan (IRWM Plan) to help achieve the objectives presented in Section 4 (Objectives).

5.1 Resource Management Strategy (RMS) Summary

The RMS considered for this IRWM Plan includes those listed in the California Water Plan (CWP) Update 2009 and the CWP Update 2013 Public Review Draft. The CWP Update 2009 lists 33 strategies grouped into six management objectives, including six strategies that may generally fit into the management objectives but are limited in their feasibility due to long-term planning needs. The CWP Update 2013 Draft adds three strategies for a total of 36, grouped into seven management objectives. The following table summarizes the CWP Management Objectives and RMS organized for consistency with the CWP Update 2013. RMS that are italicized and bracketed are considered not applicable to the Tahoe-Sierra Region (Region) at this time.

CWP Management Objective	Resource Management Strategies
Reduce Water Demand	Agricultural Water Use Efficiency Urban Water Use Efficiency
Improve Flood Management	Flood Management
Improve Operational Efficiency and Transfers	<i>[Conveyance – Delta]</i> Conveyance – Regional/Local System Reoperation Water Transfers
Increase Water Supply	Conjunctive Management & Groundwater <i>[Desalination (Brackish and Sea Water)]</i> Precipitation Enhancement Municipal Recycled Water <i>[Surface Storage – CALFED/State]</i> Surface Storage – Regional/Local
Improve Water Quality	Drinking Water Treatment and Distribution Groundwater Remediation/Aquifer Remediation Matching Water Quality to Use Pollution Prevention Salt and Salinity Management Urban Stormwater Runoff Management
Practice Resource Stewardship	Agricultural Land Stewardship Ecosystem Restoration Forest Management Land Use Planning and Management Recharge Area Protection Sediment Management (CWP Update 2013 Draft) Watershed Management
People and Water (CWP Update 2013 Draft)	Economic Incentives Outreach and Engagement (CWP Update 2013 Draft) Water and Culture (CWP Update 2013 Draft) Water-Dependent Recreation

CWP Management Objective	Resource Management Strategies
Other Strategies	Crop Idling for Water Transfers <i>[Dewvaporation or Atmospheric Pressure Desalination]</i> <i>[Fog Collection]</i> Irrigated Land Retirement Rainfed Agriculture <i>[Waterbag Transport/Storage Technology]</i>

[] RMS not applicable to Tahoe-Sierra IRWM Plan

A brief explanation of the reasoning that select RMS are not applicable to the Region follows:

- Conveyance – Delta. The Region does not supply or obtain water to or from the Sacramento-San Joaquin Delta because the watersheds drain to the east to Nevada.
- Desalination. There is no ready source of saline or brackish water for desalination in the Region.
- Surface Storage – CALFED/State. The Region is unlikely to be involved in the five CALFED storage projects because there are no conveyances from CALFED storage to the Region.
- Waterbag Transport/Storage Technology. The Region is not located along the coast to take advantage of this strategy.
- Dewvaporation or Atmospheric Pressure Desalination. The specific process for humidification-dehumidification desalination using brackish water is unlikely to be applicable in the Region.
- Fog Collection. Fog is not prevalent on the Region; therefore, this strategy is of limited feasibility.

5.2 RMS Applicable to the Region

RMS applicable to the Region and those that contribute to achieving the IRWM Plan objectives presented in Section 4 are described in the following subsections.

5.2.1 Reduce Water Use

5.2.1.1 Agricultural Water Use Efficiency

The agricultural water use efficiency strategy involves measures that reduce the amount of water used for agricultural irrigation while maintaining agricultural productivity. This strategy includes improvements in irrigation technology and water management practices that result in direct improvements in water use efficiency as well as education and training efforts that lead to improved water management.

This strategy has limited applicability to the Region due to small size of the agricultural sector in the Region as described in Section 2 (Region Description). However, in the Carson River valley where most of the Region's agriculture is centered, and where water storage to mitigate the potential effects of changes in runoff volume and timing due to climate change is limited largely to groundwater, this strategy aligns with the Water Supply and Groundwater Management IRWM Plan Objectives, particularly WS3 and GWM3.

5.2.1.2 Urban Water Use Efficiency

The urban water use efficiency strategy addresses indoor and outdoor residential, commercial, industrial and institutional water uses. This strategy is a key component of the Water Conservation Act of 2009 (Senate Bill x7-7 [SBx7-7]) which requires all urban water suppliers (more than 3,000 connections or supply more than 3,000 acre-feet per year) to increase water use efficiency in an effort to meet the statewide goal of achieving a 20% reduction in per capita water use by 2020. This strategy includes improvements in technology or water management that lower water use or increase beneficial uses from existing water quantities. This strategy also includes educational programs and other measures that result in the adoption of technological improvements or behavioral changes that reduce water demand.

This strategy is applicable to the larger water suppliers that must comply with SBx7-7 as well as the many smaller water suppliers across the Region even though they do not face a regulatory requirement for efficiency. Due to the climate change vulnerabilities in the Region, this strategy can help all water suppliers to adapt to the potential effects of climate change, especially increased water supply variability. This strategy aligns with the Water Supply and Groundwater Management IRWM Plan Objectives, especially WS3 and GWM3.

5.2.2 Improve Flood Management

5.2.2.1 Flood Management

The flood risk management strategy involves both structural and non-structural measures to reduce overall flood risk, manage flood flows and programs that improve flood preparedness, response and recovery. Structural approaches to flood management include dams and reservoirs, levees, channel modifications and diversions. Non-structural measures focus on land use management such as floodplain restoration and development policies.

While flooding is not a major concern within the Region, natural systems and flood management infrastructure in the Region are vital for downstream communities' flood risk management. Changes to precipitation patterns and runoff due to climate change may exacerbate existing flood risks in the Region and downstream. This strategy aligns with the Integrated Water Management IRWM Plan Objective IRWM4.

5.2.3 Improve Operational Efficiency and Transfers

5.2.3.1 Conveyance – Regional/Local

Regional/local conveyance refers to the use of both natural waterways and built infrastructure to move water to areas where it is needed or to move water away from areas to protect existing resources. The regional/local conveyance strategy covers the distribution and conveyance of local sources of water and imported water for the purposes of improving water supply, water quality, recreation, habitat, and flood management.

This strategy is applicable within the Region for both the extensive network of natural creeks that collect



Trout Creek Restoration Project
(Photo courtesy of the Town of Truckee)

stormwater and snowmelt, and the water distribution infrastructure constructed and maintained by small and large water suppliers in the Region. A resilient local conveyance strategy may be important in adapting to changes in precipitation patterns and runoff due to climate change. Within the Region there are several projects underway considering energy recapture such as the hydro-generation unit on the recycled water pipeline in Alpine County, feasibility studies for other hydroelectric generation opportunities and a community wide evaluation of green energy generation with the Tahoe Basin and Alpine County. This strategy aligns with the Water Quality, Water Supply, Ecosystem Restoration, and Integrated Water Management IRWM Plan Objectives, especially WQ4, WQ5, WS2, ER1, IWM4, IWM5, and IWM6.

5.2.3.2 System Reoperation

System reoperation involves changes to the existing operation of water systems to address existing problems, to increase water supply reliability or to adapt to future changes. The system reoperation strategy includes reoperation of surface water storage facilities, groundwater sourced water systems and associated conveyance infrastructure. These resources may be related to the Conjunctive Management and Groundwater Storage RMS depending upon location.

In the Region, reoperation has limited applicability as the surface water flows have been adjudicated and the operation of most dams is based on the needs of downstream water users in Nevada. However, reoperation of surface water infrastructure related to California users' water rights and infrastructure for groundwater extraction may provide benefits to water suppliers and water users in the Region. This strategy may support adaptation to the effects of climate change by providing additional flood protection and water storage behind the Martis Creek Dam, which is currently operating with open spillways due to poor dam condition. This strategy aligns with the Water Supply, Ecosystem Restoration, and Integrated Water Management IRWM Plan Objectives, especially WS2, GWM3, and IWM6.

5.2.3.3 Water Transfers

Water transfers are voluntary exchanges of water or water rights among water users. A water transfer can be a change in point of diversion, place of use or type of use. Water transfers typically occur using one of the following: transfer of water from reservoirs that would otherwise have been carried over to the following year, use of groundwater instead of surface water deliveries and transfer of the surface water rights, transfer of previously banked groundwater, reduction of existing consumptive use and transfer of the resulting water savings, and reduction of water losses and transfer of the recovered water.

Water transfers have not frequently been pursued internally within the Region; however, there may be current or future situations in which this strategy may benefit water users in the Region.

5.2.4 Increase Water Supply

5.2.4.1 Conjunctive Management and Groundwater

Conjunctive management is the coordinated planning and use of surface water and groundwater to maximize the water available to a region. The conjunctive management and groundwater storage strategy involves intentional recharge of groundwater basins to provide water storage when excess surface water is available. Groundwater management, project

construction, and capacity building are the three fundamental elements of conjunctive management.

There are several defined groundwater basins within the Region, and most water users rely primarily on groundwater for their water supply. Conjunctive management may improve the reliability of source water for water suppliers that rely on groundwater or surface water, especially with future uncertainties due to climate change and the heavily adjudicated surface water rights with much of the surface water in the Region allocated to downstream users. This strategy aligns with Water Supply, Groundwater Management, and Integrated Water Management IRWM Plan Objectives, especially WS1, WS2, GWM1, GWM3, IWM1, IWM2, IWM4, IWM5, and IWM6.

5.2.4.2 Precipitation Enhancement

Precipitation enhancement, commonly called “cloud seeding,” artificially stimulates clouds to produce more rainfall or snowfall than they would naturally. Cloud seeding injects special substances into the clouds that enable snowflakes and raindrops to form more easily. Precipitation enhancement is the one form of weather modification done in California.

Nevada’s Desert Research Institute has a Cloud Seeding Project ongoing in the Lake Tahoe Basin, and Truckee and Carson River valleys. Cloud seeding in the Sierra and the Tahoe area has been conducted since the 1960s largely to benefit water users in Nevada and California’s Central Valley, which are outside the Region. Local ski areas also may benefit from cloud seeding activities.

5.2.4.3 Municipal Recycled Water

Water recycling is the treatment and reuse of wastewater. The recycled municipal water strategy applies specifically to the application of municipal wastewater with the intention of putting the water to a beneficial use that would not occur through discharge of the wastewater.

As described in Section 2, recycled water from South Tahoe PUD is currently used in Alpine County, primarily for irrigation of ranchlands. There may be other opportunities for production and use of recycled water in the Region in the future, although use of recycled water within the Lake Tahoe Basin is prohibited with few exceptions by the Porter-Cologne Act, and water supplies are generally adequate and the need for recycled water is limited. This strategy aligns with Water Supply IRWM Plan Objectives, especially WS1.

5.2.4.4 Surface Storage – Regional/Local

Surface storage consists of the collection and storage of water within on-stream or off-stream reservoirs for later release. This strategy includes the use surface storage for water supply as well as flood management.

There are currently several reservoirs in the Region. Operation of the dam on the outlet of Lake Tahoe as well as operation of three of the largest reservoirs: Boca, Stampede, and Prosser Creek, are governed by interstate agreements and are generally operated for the fisheries and agricultural users in Nevada. Reservoirs that are operated for the benefit of water users in the Region include Martis Creek Lake in the Truckee River HU that is designated for recreational use and water supply, as well as the Indian Creek and Harvey Place Reservoirs in the West Fork Carson River HU that are storage reservoirs for the recycled wastewater from South Tahoe PUD used for agriculture in Alpine County. This strategy aligns with the Water

Quality, Water Supply, and Integrated Water Management IRWM Plan Objectives, especially WQ5, WS1, WS2, IWM4, IWM5, and IWM6.

5.2.5 Improve Water Quality

5.2.5.1 Drinking Water Treatment and Distribution

The drinking water treatment and distribution strategy is focused on ensuring that water provided for human consumption is safe for drinking. Drinking water treatment includes processes that treat, blend or condition water to meet potable standards, and drinking water distribution includes the storage, pumping and delivery of potable water to customers. This strategy includes measures both within the treatment processes and distribution system that are necessary to produce and maintain safe drinking quality.

Ensuring that drinking water in the Region meets water quality standards is a high priority in the Region. Delivery of drinking water may involve improvements to the distribution systems or to the water treatment systems. Managing sources of pollution is also seen as an important means for facilitating compliance with water quality regulations and increasing the reliability and safety for drinking water users in the Region. This strategy aligns with the Water Quality, Water Supply, and Groundwater Management IRWM Plan Objectives, especially WQ4, WS2, and GWM2.

5.2.5.2 Groundwater Remediation/Aquifer Remediation

Groundwater and aquifer remediation is the improvement of groundwater quality to meet intended beneficial uses. Groundwater impairment may be the result of naturally occurring constituents or anthropogenic contamination. The groundwater and aquifer remediation strategy includes both passive techniques which allow for in-situ degradation or dispersion of contaminants and active treatment which remove the contaminants through chemical, biological or physical processes.

Within the Region concerns with regard to groundwater quality include naturally occurring substances like arsenic in the Martis Valley groundwater basin and anthropogenic contamination largely from fueling stations and dry cleaners throughout the Region but especially in the Tahoe Valley – South groundwater basin. Drinking water quality is managed through treatment and/or blending prior to delivery to customers. This strategy aligns with the Water Quality, Water Supply, and Groundwater Management IRWM Plan Objectives, especially WQ4, GWM1, and GWM2.

5.2.5.3 Matching Water Quality to Use

The strategy of matching water quality to use aims to optimize water resources by directing higher quality sources of water to end uses that require that higher quality, such as drinking water or certain industrial processes, and using sources of water with lower quality in applications where the lower quality is adequate. This strategy reduces the treatment costs associated with water supply.

This strategy has limited applicability in the Region due to restrictions on the use of recycled water in the Lake Tahoe Basin. In some cases, raw water is currently used where higher quality water is not needed, such as golf course irrigation and snow-making.

5.2.5.4 Pollution Prevention

The pollution prevention strategy addresses both point sources, such as wastewater treatment plants, and nonpoint sources, such as most stormwater discharges from urbanized areas, road erosion especially unpaved roads in steep forest areas, agricultural runoff and unauthorized land uses. This strategy includes efforts to identify sources of pollutant load, reduce pollution causing activities and capture pollutants before they enter waterways.

Generally, the quality of surface water and groundwater in the Region meets drinking water standards, however, there are concerns with both point source and nonpoint source discharges. Point source discharges include leaking underground storage tanks and chemical spills impacting groundwater, treated wastewater, and historical mine locations in the Carson River HUs. Nonpoint source discharges include stormwater runoff especially from urban areas, post-wildfire areas, and other disturbed land. This strategy is a priority to the IRWM Plan participants and aligns with the Water Quality, Groundwater Management, and Ecosystem Restoration IRWM Plan Objectives, especially WQ1, WQ2, WQ5, WQ6, GWM2, ER1, ER3, and ER4.

5.2.5.5 Salt and Salinity Management

Salt and salinity management requires an understanding of how salts enter a region, often from irrigated agriculture and large scale wastewater discharge, and how they are diluted and



Storm Drain Outlet
(Photo courtesy of Tahoe Resource Conservation District)

displaced within the region. As such, this strategy necessitates studies to improve the understanding of regional salt loading and the extent and magnitude of a region's salt problems. It also includes steps that reduce salt inputs and sequester or dispose of salts.

This strategy has limited applicability to the Region as there is little irrigated agriculture or industrial discharges, and few municipal or domestic wastewater discharges. Salt management from application of recycled water in Alpine County is regulated by the Regional Water Quality Control Board.

5.2.5.6 Urban Stormwater Runoff Management

The urban stormwater runoff management strategy involves the capture, conveyance and treatment of stormwater and dry weather runoff for purposes of improving flood management, water quality or water supply.

Management of urban runoff is a priority in the Region, especially in the Lake Tahoe Basin where sediments and nutrients in runoff affect the clarity of Lake Tahoe.

Changes to precipitation patterns and runoff due to climate change may stress existing runoff management systems. This strategy is a priority to the IRWM Plan participants and aligns with the Water Quality and Ecosystem Restoration IRWM Plan Objectives, especially WQ1, WQ2, and ER4.

5.2.6 Practice Resource Stewardship

5.2.6.1 Agricultural Land Stewardship

The agricultural lands stewardship strategy includes measures that promote the continued use of agricultural lands and the protection of natural resources through the maintenance of agricultural lands. Erosion control measures are an example of agricultural land stewardship practices that support the viability of croplands while offering water resource and water quality benefits. Other agricultural land stewardship practices such as wetlands restoration and the use of agricultural lands for nonstructural flood management preserve the open space characteristics of agricultural lands that can offer water resources and environmental benefits.

This strategy has limited applicability to the Region due to small size of the agricultural sector. In the Carson River valley where most of the Region's agriculture is centered, this strategy aligns with the Integrated Water Management IRWM Plan Objectives, especially IRWM4.

5.2.6.2 Ecosystem Restoration

Ecosystem restoration addresses natural landscapes and biological communities that have been modified by past activities. The ecosystem restoration strategy aims to increase the diversity of native species and biological communities and the abundance and connectivity of habitats, particularly in aquatic, riparian and floodplain ecosystems. This strategy includes protection and recovery of at-risk species, wetlands restoration and construction, floodplain reconnection and invasive species removal.

This strategy is a priority in the Region, especially wetland and meadow restoration, invasive species management, wildfire risk management, and other restoration activities that improve habitat and ecosystem functions such as infiltration and nutrient removal. Resilient habitats are important for adapting to potential changes in precipitation patterns and runoff due to climate change. This strategy aligns with the Water Quality and Ecosystem Restoration IRWM Plan Objectives, especially WQ5, and ER1 through ER4.

5.2.6.3 Forest Management

The forest management strategy focuses on forest management activities that are designed to improve the availability and quality of water for downstream users, on both publicly and privately owned forest lands as part of a broader effort to maintain a sustainable, resilient forest ecosystem.

Due to the large percentage of land area in the Region that is forest land and the vulnerability of forest land to increased wildfire and other potential effects of climate change (i.e. impaired forest health and increase of invasive species), this strategy is very applicable in the Region. Forest management in the Region focuses on fuel reduction; post wildfire restoration; management of aquatic, riparian, and meadow ecosystems; and management of invasive species. This strategy aligns with the Water Quality and Ecosystem Restoration IRWM Plan Objectives, especially WQ5, and ER1 through ER3.

5.2.6.4 Land Use Planning and Management

The land use planning and management strategy incorporates the availability of water supplies, water quality requirements and flooding and drainage considerations into land use decisions.

Improved coordination of land use and water planning has been identified as a need in the State.

Coordination of land use and water planning is applicable in the Region because it encompasses multiple local and regional jurisdictions. Water quality is one of the main water-related topics to land use and management. This strategy aligns with the Integrated Water Management IRWM Plan Objective IRWM2.

5.2.6.5 Recharge Area Protection

The recharge areas protection strategy includes the protection and enhancement of groundwater recharge areas. The strategy includes methods such as low impact development and land conservation to ensure areas suitable for recharge remain accessible. It also includes measures to protect groundwater recharge areas from contamination.

This strategy is applicable in the Region as groundwater is the source for most water users and all groundwater in the Region originates from infiltration. In addition, low impact development measures have been used for decades as a means of achieving surface water quality improvement with commensurate recharge benefits. This strategy aligns with the Water Quality IRWM Plan Objectives, especially WQ5.

5.2.6.6 Sediment Management

The sediment management strategy acknowledges both the benefits and impacts of sediments. Sediments are beneficial when of appropriate size and in the correct location such as for spawning gravels as well as floodplain and beach replenishment. The negative attributes of sediment occur when it accumulates in reservoirs and flood channels and/or causes clouding in water with associated impacts to fish and invertebrate life.

Sediment impacts are a priority in many waterbodies in the Region, including Lake Tahoe, which has a TMDL for sediment and nutrients, which are often associated with sediments. Management of sediments in the Region includes restoration of riparian areas and meadows, management of wildfire risk, and post-wildfire restoration and erosion prevention. Changes to precipitation patterns and runoff due to climate change may exacerbate existing sediment impacts. This strategy aligns with the Water Quality and Ecosystem Restoration IRWM Plan Objectives, especially WQ1, WQ2, WQ5, ER1, and ER3.

5.2.6.7 Watershed Management

The watershed management strategy uses watershed boundaries as the basis for managing natural resources. Watershed management is the process of creating and implementing plans, programs, projects, and activities to restore, sustain, and enhance functions on a watershed level.

Management using watershed boundaries has long been a practice in the Region, especially given the mountainous topography and the need to transcend political jurisdiction boundaries around Lake Tahoe. This strategy aligns with nearly all of the IRWM Plan Objectives, especially the Water Quality and Ecosystem Restoration Objectives.

5.2.7 People and Water

5.2.7.1 Economic Incentives

Economic incentives is the use of financial tools such as grants, loans, rebates and water pricing to influence water management. Financial assistance incentives in the form of grants, loans and rebates can be used to promote implementation of projects that improve water management and protect water resources. Water rate incentives can be used to promote more efficient use of water.

Economic incentives for water users such as implementation of water metering and rebate programs have already been shown to promote water use efficiency and reductions. Further application of similar incentives will be important to achieve the objectives of this IRWM Plan. In addition, the small population of the Region makes it essential to identify and pursue external funding sources in order to provide the resources to implement the IRWM Plan.

5.2.7.2 Outreach and Engagement

The outreach and engagement strategy describes the shifts in early water management decision-making from strictly technically-based decisions that, over time, have resulted in unintended consequences such as degraded ecosystems and/or social injustices. The strategy acknowledges the need for improved outreach and engagement so that citizens can be more knowledgeable and participate more effectively in debates regarding water which can, in turn, gain valuable support for a range of water management programs.

Public outreach activities conducted as part of the development of this IRWM Plan are discussed in Section 1. Continued engagement and education of the public will be important for the implementation of this IRWM Plan. This strategy aligns with the Integrated Water Management IRWM Plan Objective IRWM3.

5.2.7.3 Water and Culture

The water and culture strategy recognizes the inherent role and value of water in many cultures whether they are Native American, agriculture and ranching, fishing or environmental cultures. The cultural considerations in water management can include subsistence activities such as traditional hunting, fishing and plant collecting; recreation activities such as swimming, boating, wildlife viewing or hiking; spiritual activities that acknowledge the cleansing and renewing properties of water; and historic preservation of artifacts, buildings, flumes, mills, and other significant sites.

Water and other aquatic resources are a vital component of the cultural life within the Region. The Region is partly defined by the cultural connection to water through aquatic recreation activities, fishing, aesthetic values, and other water-dependent activities such as skiing.



Boater on Lake Tahoe
(Photo courtesy of Sgt. Brian Williams, SLT Police)

5.2.7.4 Water-Dependent Recreation

The water-dependent recreation strategy includes recreational activities that are dependent on water, including skiing, fishing, swimming, waterfowl hunting and birding, boating, canoeing, and kayaking, as well as activities that do not require water but are enhanced by water, including wildlife viewing, picnicking, camping, and hiking, biking, and riding on trails.

This strategy is very applicable to the Region as the economy of the Region is largely reliant on water-dependent recreation.

5.2.8 Other Strategies

Three of the Other Strategies included in CWP 2013 are not applicable to the Region as noted in Section 5.2, and the remaining three are of marginal consideration or not being considered as described below.

5.2.8.1 Crop Idling for Water Transfers

The crop idling for water transfers strategy is a specific water transfer strategy in which irrigated lands are removed from production or dry farmed in order to make water available for transfer.

This strategy is not being considered in the Region as there is very little irrigated agricultural land in the Region, and no formal programs in place for crop idling.

5.2.8.2 Irrigated Land Retirement

The irrigated land retirement strategy permanently removes farmland from irrigated agriculture.

This strategy is not being considered in the Region as there is very little irrigated agricultural land in the Region, and most irrigated farmland is located in the Carson River HU where some of the water demand is met by recycled water and where there is little other demand for recycled water.

5.2.8.3 Rainfed Agriculture

Rainfed agriculture relies solely on rainfall to provide all crop consumptive water use. In California where little precipitation occurs during the spring and summer growing seasons, the use of the rainfed agriculture strategy is very limited. Implementation of rainfed agriculture would require matching cropping patterns to precipitation patterns likely resulting in single cropping, most likely of low value products like hay.

Although agriculture is not a large sector in the Region, this strategy is potentially applicable within the Region. The main form of agriculture in the Region has currently and historically been dry farming of pasture grass used for cattle grazing. Some lands in the Carson River HU are irrigated with recycled water.

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