



Lake Tahoe, California and Nevada

Stormwater Runoff Management in the Lake Tahoe Basin

Overview

Lake Tahoe is one of the most iconic water bodies in North America. Its exceptionally clear water and distinctive blue coloring, set in mountainous terrain, make it a unique resource. Bordering both California and Nevada, Lake Tahoe is critical to many functions in the area, including drinking water, recreation and tourism, agriculture, and fisheries and wildlife habitat. California has designated Lake Tahoe as an Outstanding National Resource Water, one of two water bodies in the state to receive that protection. Nevada has designated it as a waterbody of extraordinary ecological or aesthetic value.

Unfortunately, Lake Tahoe faces some of the same water quality challenges as other water bodies. Development in the watershed has increased as tourism has become an important part of the local economy, leading to increased urbanization and more stormwater runoff. Over time, the clarity of the water has declined and algal growth has increased.

Several organizations work to protect this high-value water body. California’s Lahontan Regional Water Quality Control Board (Lahontan Water Board) and the Nevada Division of Environmental Protection (NDEP)

Watershed

Lake Tahoe, California and Nevada

Key Water Quality Concerns

Excessive sediment and nutrients (nitrogen and phosphorus), water clarity

Stakeholder Involvement Techniques

- Stakeholder comment process
- Public comment period on documents
- Annual public meetings
- Stakeholder involvement in implementation
- Transparent website
- Scientific advisory council

Case Study Issues of Interest

Type of Point Sources

-  Municipal Separate Storm Sewer System Discharges
-  Construction Site Stormwater Discharges
-  Industrial Facility Stormwater Discharges

Type of Watershed-Based Permit or Approach

-  Multisource Watershed-Based Permit

Highlighted Approach(es)

-  Implementation of Total Maximum Daily Loads or Other Watershed Pollutant Reduction Goals
-  Coordinated Watershed Monitoring

are the state resource agencies.¹ With the U.S. Congress's consent, the two states formed the Tahoe Regional Planning Agency (TRPA) through a bi-state compact, which developed (and now implements) a comprehensive plan to protect the Lake Tahoe watershed and enforce local ordinances. To address water clarity and algal issues, the states also developed total maximum daily loads (TMDLs) for fine sediment particles, nitrogen, and phosphorus. Local, state, federal, and private partners work to implement the TMDLs to achieve the mid-range and long-range water quality goals established by the TMDLs.

The states and TRPA determined early on that a watershed-based approach was the best way to overcome these challenges. By addressing water quality concerns in both states, coordinating programmatic goals, and leveraging resources, Lake Tahoe is on the path to recovery.

This case study provides an overview of the variety of programs and approaches used to protect and enhance Lake Tahoe, with a focus on the role of watershed-based permits for stormwater runoff.

Background

The watershed-based approach to improving water quality in Lake Tahoe has multiple elements. Two of these elements form the superstructure of the various ongoing efforts and provide direction for other programs and activities.

- **TRPA and the Lake Tahoe Regional Plan.** TRPA was formed in 1969 with the charge of coordinating planning and development, regulatory enforcement, and implementation of environmental (and other) programs for the watershed. As part of this work, TRPA implements the Lake Tahoe Regional Plan, which uses an adaptive management approach and is intended to balance environmental protection and economic development. Last updated in 2022, the [Regional Plan](#) establishes environmental quality thresholds in 10 key areas, including water quality. The water quality thresholds set numeric standards for water transparency and phytoplankton productivity in the main body of the lake, as well as standards for tributaries and surface runoff. The thresholds also include non-numeric management standards for pollutant load reductions, groundwater, and aquatic invasive species. The Regional Plan addresses these thresholds by implementing restoration projects under the [Environmental Improvement Program](#) and enforcing various land use policies in the watershed (e.g., Policy WQ-2.2, which prohibits the discharge of sewage into the lake).
- **Lake Tahoe TMDLs.** California and Nevada co-developed [TMDLs](#) to address impairments in Lake Tahoe for fine sediment, phosphorus, and nitrogen, which were approved by EPA in 2011. The TMDLs established overall pollutant reductions of 65 percent, 35 percent, and 10 percent, respectively. The TMDLs also included an interim goal, known as the Clarity Challenge, of about half of the overall load reduction to improve visibility to a depth of 80 feet. The interim pollutant load reduction goals for the entire watershed would be met over 15 years, followed by a five-year monitoring period.² The TMDLs identified urban stormwater runoff as the primary source of fine sediment and outlined control measures such as land management practices, stormwater runoff source control, and treatment of runoff from roads and parking lots. California and Nevada also developed procedures to track pollutant reduction progress and adaptively manage TMDL implementation.

¹ The Washoe Tribe is also located in the area and has a long history of promoting water quality protection.

² The full implementation of the TMDLs is expected to take about 65 years. Setting an interim goal helps to make measurable progress while long-term improvements are made.

Under these elements are a number of other programs, including the National Pollutant Discharge Elimination System (NPDES) permitting program, with the goal of restoring and maintaining water quality in Lake Tahoe. California manages stormwater pollution in the Lake Tahoe watershed via three watershed-based general permits: one for municipal stormwater from the City of South Lake Tahoe and El Dorado and Placer Counties, a second for construction site runoff, and the third for stormwater from marinas. California has also issued a statewide permit for stormwater discharges from the California Department of Transportation (Caltrans) municipal separate storm sewer system (MS4). Together, these permits address the major sources of urban stormwater pollution in the watershed.

Nevada uses a different approach to address urban runoff. NDEP has developed [Interlocal Agreements \(ILAs\)](#) with the three major implementation partners in the watershed: both counties that border Lake Tahoe, as well as the Nevada Department of Transportation (NDOT). These agreements recognize partners' historic efforts to improve water quality and aim to provide a flexible and collaborative mechanism for implementing the TMDLs. NDEP is also working with California, TRPA, and EPA on specific efforts to improve water quality in the nearshore areas, which are most visible to the public and most frequently used for recreation.

Together, California and Nevada have created the [Lake Clarity Crediting Program](#), which measures the progress of the implementation of the Lake Tahoe TMDL, including tracking water quality improvements, reporting accomplishments, and assessing implementation progress and program effectiveness. A [2022 report](#) that evaluated progress against the 10-year milestones indicated that the partners were successful in achieving the 10-year load reduction goals. These efforts have largely halted the decline in water clarity, as clarity has remained relatively stable for the past 20 years.

Strategies

California and Nevada have taken different approaches to reducing urban stormwater pollution in the watershed. California primarily uses a permit-driven approach, while Nevada's primary approach provides implementation details in State/local agreements. The two states, in combination with TRPA, have also developed programs that focus on restoring water quality and tracking, reporting, and assessing implementation of the TMDLs. The primary elements of each program are described in more detail below.

California: General Permit for Municipal Stormwater

Highlights

The Renewed Waste Discharge Requirements and National Pollutant Discharge Elimination System (NPDES) Permit for Storm Water/Urban Runoff Discharges from El Dorado County, Placer County, and the City of South Lake Tahoe Within the Lake Tahoe Hydrologic Unit (NPDES Permit No. [CAG616001](#)) addresses stormwater from urban areas. Runoff from all urbanized areas within the permittee's jurisdiction (and within the Lake Tahoe watershed) is covered under the permit, including stormwater from MS4s and pollutants from winter roadway operations. The permit implements the Lake Tahoe TMDLs and the [Water Quality Control Plan for the Lahontan Region](#) (Basin Plan) by requiring development of Storm Water Management Plans (SWMPs) and Pollutant Load Reduction Plans (PLRPs), which describe how proposed operations and maintenance efforts will meet the required load reductions.

Components

The TMDLs established a phased implementation approach, with a 15-year timeline for reductions and a five-year monitoring period. The current permit, issued in 2017, represents the second five-year

period of the reduction phase. As a result, the permit also has an interim compliance goal. The required jurisdiction-specific reductions are based on a modeling effort by the permittees. The permittee's SWMP must include components that address construction site runoff; commercial, industrial, municipal, and residential site runoff; stormwater facility inspections; illicit discharge detection and elimination; new development and redevelopment; public education; and municipal personnel training and education. The required reductions and proposed improvement projects are incorporated into a PLRP, which identifies specific subwatersheds and activities that must be completed to achieve the load reduction goals. Compliance and progress tracking are accomplished through a collaborative system (including the [Lake Clarity Crediting Program](#) and the associated [Lake Tahoe Info Stormwater Tools](#)³) that tracks installed projects, baseline credits, and other factors.

California: General Permit for Construction Activities

Highlights

The General Waste Discharge Requirements and National Pollutant Discharge Elimination System Permit for Storm Water Discharges Associated with Construction Activity in the Lake Tahoe Hydrologic Unit, Counties of Alpine, El Dorado, and Placer (NPDES Permit No. [CAG616002](#)) addresses stormwater runoff from construction activities. Specifically, it covers construction activities at sites where land disturbance is 1 acre or greater, or where smaller disturbances are part of a larger development plan. The permit is based on the statewide NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities but is substantially more stringent due to the sensitivity of Lake Tahoe, the elevation, and the need to implement the TMDLs.

Components

This permit includes many of the elements of the statewide general permit and is also consistent with the national effluent limitation guidelines and standards for the construction and development point source category. However, the Lake Tahoe permit is more stringent and prohibits certain discharges, includes additional effluent limits, and requires more frequent inspections.

The permit specifies that stormwater should be allowed to infiltrate at the site to the greatest extent possible. The permit prohibits several types of discharges, including non-stormwater discharges into a floodplain. Water that does discharge from the site is subject to effluent limits for total nitrogen, total phosphorus, total iron, turbidity, grease and oil, and pH that are based on water quality standards for Lake Tahoe. Required BMPs include overall site management, sediment and erosion control measures, and dewatering controls. Inspections are required weekly (as opposed to monthly in the statewide permit). Post-construction requirements include on-site infiltration for runoff from a 20-year, 1-hour storm. Additional monitoring is required for any restoration projects that are installed, including vegetation surveys and an assessment of erosion control structures.

California: General Permit for Marinas

Highlights

The General Waste Discharge Requirements and National Pollutant Discharge Elimination System Permit for Storm Water Runoff Associated with Marina Operations in the Lake Tahoe Hydrologic Unit—El Dorado and Placer Counties (NPDES Permit No. [CAG616003](#)) addresses discharges from marina owners and operators. There are 12 marinas on the California portion of the lake; a general permit was a logical choice to address a group of facilities with similar operations and streamline the permit application process for both the marina owners and the Lahontan Water Board. Any industrial

³ The tools webpage has both a public-facing page and a password-protected interface where the localities can enter data on load reductions.

or minor construction activities (not including dredging, which was removed in the 2016 permit) that disturb less than 1 acre of land area within the watershed would be covered. Construction projects disturbing greater than 1 acre would need coverage under an individual permit or other general permit.

Components

The application requires a Notice of Intent and several other documents—either a Storm Water Pollution Prevention Plan or a BMP Project Plan, plus a Marina Pollution Prevention Plan, a Discharger Monitoring Plan, and a Marina Surface Water Monitoring Plan. These documents describe the BMPs that the permittee will implement to meet the discharge requirements in the permit, as well as how the permittee will comply with monitoring and reporting requirements.

Generally, the permit requires marinas to provide on-site infiltration for runoff from a 20-year, 1-hour storm. If the permittee does not, then it is subject to effluent limitations in the permit. The limits, which implement water quality standards for Lake Tahoe established in the Lahontan Water Board's Basin Plan, include total nitrogen, total phosphorus, total iron, turbidity, grease and oil, and pH. Alternatively, if the permittee discharges stormwater to a municipality or state highway department, the municipality must be able to document that its treatment capability is sufficient to meet its own pollutant load reductions. The permit also includes numeric benchmark levels for other pollutants (including total suspended solids) that ensure BMPs are properly functioning.

The permit also includes extensive monitoring, inspection, and reporting requirements. Marina owners must conduct visual inspections of their facility at least monthly, with a comprehensive inspection once per year. They must also visually inspect the stormwater discharge four times per year and conduct stormwater sampling twice per year. Marina owners are required to conduct additional benchmark monitoring at least quarterly to confirm that BMPs are functioning properly. Lastly, marinas must conduct surface water monitoring of the receiving water.

California: Statewide Stormwater Permit for the Caltrans MS4

Highlights

The Statewide Stormwater Permit and Waste Discharge Requirements for State of California Department of Transportation (NPDES Permit No. [CAS000003](#)) addresses stormwater discharges from the Caltrans MS4. Caltrans owns and operates tens of thousands of miles of roads and other transportation infrastructure across the state, including the associated storm sewers. In addition to requirements that apply statewide, the permit includes requirements for implementing the Lake Tahoe TMDLs.

Components

Runoff from roadways is a significant source of sediment loads to Lake Tahoe, making reductions from this source category critical to improving water quality. The permit includes a schedule for meeting the required fine sediment particle, total phosphorus, and total nitrogen load reductions and requires Caltrans to develop and implement a Pollutant Load Reduction Plan for meeting the required reductions. The permit also requires Caltrans to participate in the [Lake Tahoe Regional Stormwater Monitoring Program](#) or an equivalent program developed by Caltrans.

The permit requires Caltrans to achieve load reductions in California portions of the Lake Tahoe watershed of 71 percent, 50 percent, and 46 percent for fine sediment particles, total nitrogen, and total phosphorus, respectively, by August 16, 2076 (i.e., 65 years after the effective date of the TMDLs). In the interim, the permit requires incremental load reductions to be achieved at each five-year milestone. The 2022 permit represents the third five-year TMDL implementation period and requires

Caltrans to meet load reductions of 34 percent, 21 percent, and 19 percent for fine sediment, total nitrogen, and total phosphorus, respectively, by September 30, 2026 (i.e., the 15-year load reduction milestone).

In its Pollutant Load Reduction Plan, Caltrans must describe how it will meet specified reductions by 2026. The plan must include several elements, including the following:

- A baseline load estimate.
- A list of catchments where pollution reduction activities are expected to take place.
- A list of activities to reduce pollutant loads in those catchments.
- An analysis of a representative catchment demonstrating the expected pollution reductions.
- A schedule for achieving reductions.
- A discussion of how Caltrans will annually assess progress in reducing loads.

Nevada: Interlocal Agreements

Highlights

NDEP has opted to use an agreement-based approach to implement the Lake Tahoe TMDLs. It has established ILAs with Douglas and Washoe Counties and NDOT. These five-year agreements correspond to the implementation schedule of pollutant reduction milestones from the TMDLs. 2021 marks the 10-year implementation milestone, which calls for a 21 percent reduction in fine sediment loading and 14 percent reductions in phosphorus and nitrogen loading in urban stormwater. The 15-year milestone will require a 34 percent fine sediment load reduction. The ILAs also use the Lake Clarity Crediting Program to track and verify the effectiveness of these pollution controls.

Douglas and Washoe Counties are also permittees under Nevada's NPDES General Permit for Discharges from Small MS4s (NPDES Permit No. NVS040000), and NDOT is subject to an individual permit for its MS4 discharges (NPDES Permit No. NV0023329). The general permit establishes general requirements for permittees to document that control measures are consistent with any applicable TMDL WLAs and determine whether the stormwater controls are adequate to meet the WLAs. NDOT's permit specifies that NDOT shall comply with all requirements set forth in its ILA and suggests that a more regulatory approach may be implemented if NDOT breaches the ILA.

Components

The ILAs contain specific obligations and commitments to ensure that implementation remains on track. The counties maintain a Stormwater Load Reduction Plan that identifies specific actions or improvement projects that will be accomplished in the term of the ILA. The ILAs also lay out the inspection, monitoring, and reporting responsibilities. [Annual reports](#) describe the specific pollutant controls implemented and progress toward meeting milestones (typically expressed as "credits" for completing a given project).

Watershed-Wide: Nearshore Water Quality

Highlights

The nearshore environment is often the portion of the lake the public sees the most and where water quality issues are the most apparent. Reductions in water clarity and increased algal growth remain problematic in the nearshore waters, as well as concerns over invasive species and degraded aquatic habitat and communities. Both California and Nevada have developed specialized programs and materials to focus on the nearshore waters.

Components

The [Nearshore Resource Allocation Program \(NRAP\)](#) researches and monitors nearshore conditions and processes to inform management actions. NRAP developed six specific focus areas for study: algae, nearshore clarity, public health, ecological community structure, aquatic invasive species, and trash. NRAP implements several monitoring programs related to these focus areas, including phytoplankton, periphyton, nearshore turbidity, aquatic invasive species, and deep-water plants monitoring.

California, Nevada, TRPA, and EPA collaborated to develop outreach materials to educate the public on the nearshore waters, including a [graphic](#) that shows the many sources of pollution to the lake and the effects they can have on water quality. They also developed a [brochure](#) with information about programs to control invasive species, ongoing monitoring efforts, and a list of ways private citizens can help with the cleanup effort.

The Lahontan Water Board has also established the [Lake Tahoe Nearshore Water Quality Protection Plan](#) (updated in 2018) to analyze monitoring data, assess indicators of threats to human health, and identify research needs.

Watershed-Wide: Lake Clarity Tracker

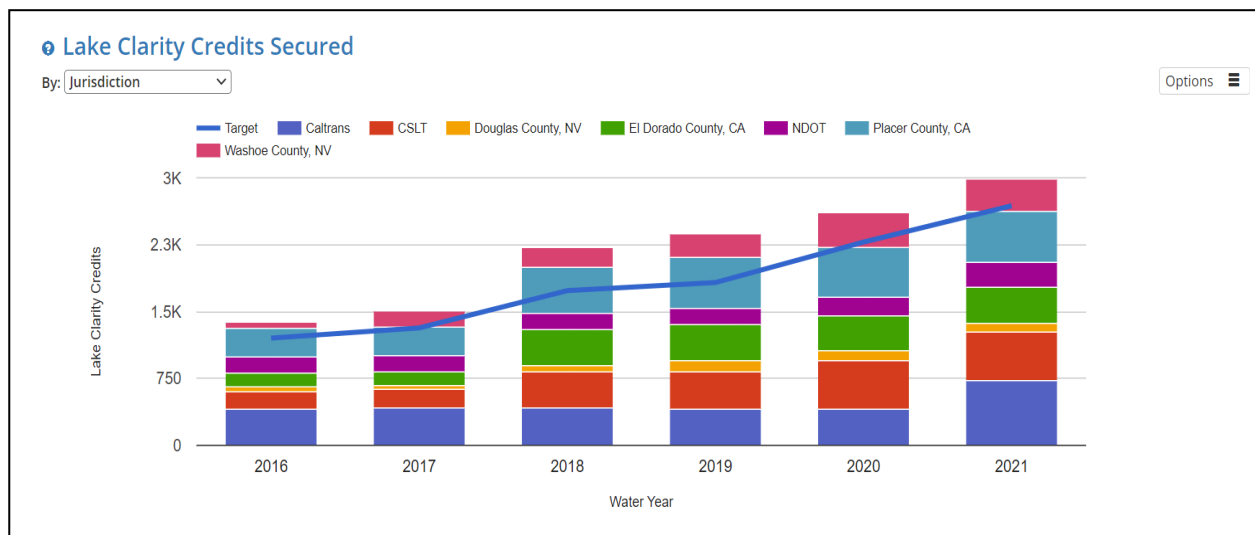
Highlights

As part of the long-term effort to improve water quality, California and Nevada have developed a comprehensive program to track, report, and assess progress in implementing the TMDLs. The [Lake Clarity Tracker](#) is the central hub for information related to the TMDL program, including implementation results and operational procedures that enable performance assessment and continuous improvement over time.

Components

The tracker currently has an inventory of more than 200 individual projects that have been completed, are underway, or are planned for future implementation. Localities upload information to demonstrate progress and plan for future budgetary needs. [Performance results](#) are presented by the source categories from the TMDLs: urban uplands (see Figure 1 below as an example), forest uplands, atmospheric deposition, and stream channel erosion. Progress in the urban sector is tracked by each project earning “credits” (via the [Lake Clarity Crediting Program; see the text box below](#)) toward meeting the implementation goals.

Figure 1. Lake Clarity Credits Awarded by Year (Source: Lake Clarity Tracker)



Public Involvement

In addition to being a drinking water source for many communities, tourism and recreation are a hallmark of the watershed, so the value of clean water is paramount. The public continues to play a huge role in developing and implementing programs for clean water. In addition to comment periods on the TMDLs, draft permits, and triennial review of water quality standards in the Basin Plan, public involvement opportunities include:

- The Lahontan Water Board and Nevada DEP encourage the public to provide input using a feedback form on the Lake Clarity Tracker. Program managers solicit TMDL stakeholders to provide input to improve program operations, including new scientific findings and technical information that support program improvement adjustments, as well as input on annual program priorities, objectives, and actions. Program managers track public comments, discuss them with executives, and respond to them. The Lake Tahoe TMDL Program captures this information in a [Findings & Program Recommendations Memo](#) that it issues each winter. Program managers may also host an annual meeting, if warranted.
- Localities create and enforce on-the-ground policies, ordinances, and other mechanisms to control pollutants. In doing so, the localities work with their residents and businesses to develop and implement these controls. In some cases, these localities may solicit public comment. In others, the locality may be more involved with outreach or education components, which is also an element of public involvement.
- The Lake Clarity Tracker provides a transparent method for the public to monitor progress toward meeting the goals of the TMDLs. The Lake Clarity Tracker also provides details on more than 200 individual improvement projects. These data show that the program has local sponsors, technical partners, and funding sources.
- The TMDL Performance Report is an annual progress report that highlights basin-wide accomplishments toward reducing pollutant loads from urban and non-urban sources. The report is intended to improve program accountability and retain support for continued investment of public dollars for water quality improvements.

In short, the public is involved at every step of water quality improvement efforts, from the programmatic and planning level down to the execution of individual BMPs and specific projects.

Program and Permit Effectiveness

Many of the programs discussed in this case study have been in an implementation stage for a decade or more. As a result, it's possible to look back and see the improvements that have been realized, including improved water quality, increased program efficiency, and more equitable and consistent outcomes. Below are some of the results of these programs:

- The Lake Tahoe TMDL Program has generated effective coordination between state regulators, implementers, and funding entities. The crediting program has offered significant benefits, such as incentivizing jurisdictions to prioritize load reduction efforts on actions and areas where the most environmental benefit can be realized.
- The [TMDL Management System](#) has resulted in numerous improvements that have helped streamline implementation efficiency and overall program effectiveness.
- Localities have greatly improved their inspection and maintenance protocols for pollutant controls, ensuring continued performance over time.
- The development of the Lahontan Water Board's three general permits has streamlined the permitting process, saving resources for agencies and improving the process for permittees.
- Ongoing monitoring and inspection requirements ensure that the control measures in each general permit are properly functioning.
- Annual reports required by each of the Lahontan Water Board's general permits and NDEP's ILAs provide useful information to track progress, identify problem areas, and strategize how to meet future credit targets. These documents, in addition to the program website, provide transparency to the public and allow for greater stakeholder participation.
- As noted above, the partners are meeting their targets for improving Lake Tahoe; the 10-year load reduction milestone was achieved in 2021. Figure 1 above showed the progress in the urban upland sector, where the target number of lake clarity credits for 2021 was 2,686 and the partners implemented a total of 2,987 credits. Every jurisdiction met the targets, showing great teamwork. Urban uplands are also meeting or exceeding goals for nitrogen and phosphorus load reductions.
- Despite having a different approach than the NPDES MS4 general permit on the California side of Lake Tahoe, NDEP's ILAs have achieved the same kinds of planning and implementation actions on the Nevada side, resulting in equivalent levels of progress in implementing the Lake Tahoe TMDLs.
- The TMDL Program is seamlessly integrated into the larger Lake Tahoe Environmental Improvement Program, managed by TRPA. This program works to achieve other important basin-wide goals, including reducing wildlife risk, restoring forest and ecosystem health, and combatting invasive species.

Lessons Learned

After more than a decade of implementation experience, stakeholders can offer some insights into the programs' performance. The primary response was simple: follow the science. The [Tahoe Science Advisory Council](#) (an independent entity comprising academic and government representatives) meets regularly to analyze lake clarity data, discuss new research, and advise program managers on future activities. Before the Lake Tahoe TMDL was developed, program managers believed that algae was the cause of the loss of clarity. However, program managers were quick to adapt to the TMDL's findings and instead focus on fine sediments.

Maintaining flexibility is another key to the programs' success. As shown above, as more data become available, approaches and goals may change. But on a more practical level, providing jurisdictions flexibility when implementing the programs is critical. California and Nevada have chosen two very different approaches, yet both have been able to achieve their goals. On a smaller scale, providing a

locality with a load reduction target and allowing them to choose how they meet that target can provide an effective and efficient approach to achieving the needed reductions.

As noted above, although the localities met their 10-year load reduction goals, the water clarity in Lake Tahoe seems to have plateaued. Adaptive management is vital to making continued progress; this topic is an ongoing discussion among the agencies and the Tahoe Science Advisory Council. Further study and analysis may refine the approach as the complexities of the system are better understood. Similarly, it was mentioned above that the Lake Tahoe Regional Plan established numeric and narrative environmental thresholds to address water quality across 10 different topic areas. Stakeholders are currently working to develop numeric targets for the narrative thresholds, which will improve implementation by providing more specific targets. Over the long term, decision-makers can also consider the role of climate change and how it affects water clarity.

Resources

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Program Information:

https://www.waterboards.ca.gov/lahontan/water_issues/programs/lake_tahoe/
<https://ndep.nv.gov/water/rivers-streams-lakes/lake-tahoe-watershed>
<https://www.trpa.gov/>
<https://clarity.laketahoeinfo.org/>