CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MEETING OF JUNE 9, 2010
KINGS BEACH

ITEM: 1

SUBJECT: **INFORMATIONAL WORKSHOP ON DRAFT TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SEDIMENT AND NUTRIENTS AT LAKE TAHOE**

ISSUES:

1. What pollutants are causing Lake Tahoe's transparency loss and what pollutant reductions are necessary to achieve the transparency standard?

2. What are the options for reducing pollutant loads and what strategy should be implemented?

3. What are the significant issues raised by interested parties?

DISCUSSION: Water Board staff will present summary information regarding:

- Lake Tahoe TMDL source and load reduction opportunity analysis
- Planned pollutant load allocations
- Proposed implementation plan
- Issues raised by involved stakeholders.

Four enclosures have been included to provide context for the workshop:

1. Final Lake Tahoe Total Maximum Daily Load Report – Executive Summary. A brief overview of the draft staff report for the Lake Tahoe TMDL.

2. Lake Tahoe TMDL Pollutant Reduction Opportunity Report – Executive Summary. This document describes the TMDL development process and the research and monitoring conducted to quantify fine sediment particle, nitrogen, and phosphorus load reduction options.

3. Integrated Water Quality Management Strategy Project Report – Chapter 2. This selected chapter explains how the results of

the Pollutant Reduction Opportunity work were integrated into a single implementation strategy.

4. Lake Clarity Crediting Program Handbook – Executive Summary. The Lake Clarity Crediting Program provides the structure to track and account for actions to reduce urban stormwater pollutant loads.

Water Board staff expect to release the draft Lake Tahoe TMDL staff report and proposed Basin Plan amendments for public comment in early June 2010. The following schedule is tentatively planned for the draft Lake Tahoe TMDL at the Board's regularly scheduled meetings:

June 9, 2010: Informational workshop
September 7-8, 2010: Formal public hearing
November 9-10, 2010: Potential adoption of TMDL

RECOMMENDA-TION: No Action. This is an informational item only.

Enclosures:

1. Final Lake Tahoe Total Maximum Daily Load Report – Executive Summary.
2. Lake Tahoe TMDL Pollutant Reduction Opportunity Report – Executive Summary.
3. Integrated Water Quality Management Strategy Project Report – Chapter 2.
4. Lake Clarity Crediting Program Handbook – Executive Summary.

ENCLOSURE 1

Final

Lake Tahoe Total Maximum Daily Load Report

Draft: June 2010

California Regional Water Quality Control Board, Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150

Contact Person:
Douglas F. Smith, P.G.
Senior Engineering Geologist
Telephone: (530) 542-5453
DFSmith@waterboards.ca.gov

Nevada Division of Environmental Protection
901 South Stewart Street, Suite 4001
Carson City, Nevada, 89701-5249

Contact Person:
Jason Kuchnicki
Environmental Scientist IV
Telephone: (775) 687-9450
jkuchnic@ndep.nv.gov

01-0004

Executive Summary

This document is the Staff Report that summarizes the Numeric Target, Pollutant Source Analysis, Load Allocations, Implementation Plan, Adaptive Management Process, and the required Regulatory Analysis for the Lake Tahoe Total Maximum Daily Load (Lake Tahoe TMDL).

Lake Tahoe is an oligotrophic alpine lake situated on the California-Nevada border at approximately 6224 feet elevation. The lake surface area is 194 mi^2 with a contributing drainage area of 314 mi^2. Lake Tahoe is fed by 63 tributary streams and 52 intervening zones that drain directly to the lake. The largest tributary is the Upper Truckee River, which contributes approximately 25 percent of the lake's annual flow. The Truckee River, Lake Tahoe's one outlet, flows to its terminus in Nevada's Pyramid Lake. The natural rim of Lake Tahoe is at 6223 feet above sea level. A dam regulates water flow from the natural rim to the maximum lake level of 6229.1 feet.

Section 303(d) of the Clean Water Act requires states to compile a list of impaired water bodies that do not meet water quality standards. The Clean Water Act also requires states to establish total maximum daily loads (TMDLs) for such waters. The deep water transparency standard for Lake Tahoe is the average annual Secchi depth measured between 1967 and 1971, an annual average Secchi depth of 29.7 meters (97.4 feet). The deep water transparency standard for Lake Tahoe has not been met since its adoption. In 2008 the annual average Secchi depth was approximately 21.2 meters (70 feet), or 8.5 meters (27.9 feet) from the standard.

The ongoing decline in Lake Tahoe's deep water transparency is a result of light scatter from fine sediment particles (primarily particles less than 16 micrometers in diameter) and light absorption by phytoplankton. The addition of nitrogen and phosphorus to Lake Tahoe contributes to phytoplankton growth. Fine sediment particles are the most dominant pollutant contributing to the impairment of the lake's deep water transparency, accounting for roughly two thirds of the lake's impairment.

Because these three pollutants are responsible for Lake Tahoe's deep water transparency loss, Lake Tahoe is listed under Section 303(d) as impaired by input of nitrogen, phosphorus, and sediment. The goal of the Lake Tahoe TMDL is to set forth a plan to restore Lake Tahoe's historic deep water transparency to 29.7 meters annual average Secchi depth.

A pollutant source analysis conducted by the Water Board and NDEP identified urban uplands runoff, atmospheric deposition, forested upland runoff, and stream channel erosion as the primary sources of fine sediment particle, nitrogen, and phosphorus loads discharging to Lake Tahoe. The largest source of fine sediment particles to Lake Tahoe is urban stormwater runoff, comprising 72 percent of the total fine sediment particle load. The urban uplands also provide the largest opportunity to reduce fine sediment particle and phosphorus contributions to the lake.

To achieve the transparency standard, estimated fine sediment particle, phosphorus, and nitrogen loads must be reduced by 65 percent, 35 percent, and 10 percent, respectively. Achieving these load reductions is expected to take 65 years.

A 20-year interim transparency goal, known as the Clarity Challenge requires basin-wide pollutant load reductions be achieved within 15 years, followed by five years of monitoring to confirm that 24 meters of Secchi depth transparency has been reached. Implementation efforts must reduce basin-wide fine sediment particle, phosphorus, and nitrogen loads by 32 percent, 14 percent reduction in phosphorus, and 4 percent, respectively.

The Lake Tahoe TMDL's Pollutant Reduction Opportunity Report identified options for reducing pollutant inputs to Lake Tahoe from the four largest pollutant sources: urban upland runoff, atmospheric deposition, forested upland runoff, and stream channel erosion. The Integrated Water Quality Management Strategy Report effort combined selected pollutant controls to develop several integrated implementation strategies. Stakeholder input helped guide the development of a single Recommended Strategy to meet the Clarity Challenge goal.

The Recommended Strategy focuses on reducing basin-wide fine sediment particle loading to Lake Tahoe and provides the basis for the Lake Tahoe TMDL pollutant load allocation distribution and for the TMDL implementation plan to achieve the Clarity Challenge. The Recommended Strategy demonstrates that load reductions needed to achieve the Clarity Challenge are possible and are estimated to cost $1.5 billion over a 15 year implementation period.

Implementation actions are required to achieve needed load reductions from each of the four major pollutant source categories. The Lake Tahoe TMDL implementation plan emphasizes ongoing implementation of known technologies while encouraging more advanced and innovative operations, maintenance, and capital improvement efforts to address urban stormwater pollution. Ongoing land management practices and policies are expected to achieve necessary fine sediment particle, nitrogen, and phosphorus load reductions from forested areas. Stream restoration projects will address stream channel bank and bed erosion sources. Measures to reduce dust from paved and unpaved roadways, parking areas, construction sites, and other disturbed lands will reduce fine sediment particle and phosphorus loading from the atmosphere.

The Water Board and NDEP have developed detailed performance and compliance measures, along with assessment and reporting protocols for the urban pollutant source category. These measures include a Lake Clarity Crediting Program to link actions to expected pollutant load reductions and an Accounting and Tracking Tool to track load reduction progress.

Adaptive management, or periodic evaluation and reassessment, is necessary for the long term success of the Lake Tahoe TMDL. The Lake Tahoe TMDL Management System provides a framework for adaptively managing the implementation of the Lake Tahoe TMDL. This framework guides a continual improvement cycle to track and evaluate project implementation and load reductions, and informs the milestone assessments the Regional Water Board will conduct during the 20 year implementation timeframe of the Lake Tahoe TMDL. Adaptive management will address ongoing changes from climate change, catastrophic wildfires, and other significant events. At 5 years from the TMDL effective date, resource managers will evaluate load allocations and the TMDL implementation approach and update as needed.

ENCLOSURE 2

Lake Tahoe TMDL Pollutant Reduction Opportunity Report

March 2008

v2.0

CALIFORNIA Water Boards STATE WATER RESOURCES CONTROL BOARD REGIONAL WATER QUALITY CONTROL BOARDS

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01-0009

Executive Summary

The Lake Tahoe Basin is in a montane-subalpine setting above an altitude of approximately 1,900 meters (6,234 ft) in the Sierra Nevada Range of California and Nevada. Lake Tahoe is losing its famed clarity because of excess loading of fine sediments and nutrients. As a result, the California Regional Water Quality Control Board, Lahontan Region (Lahontan Water Board) and the Nevada Division of Environmental Protection (NDEP) initiated the Lake Tahoe Total Maximum Daily Load (Lake Tahoe TMDL). The Lake Tahoe TMDL program includes a comprehensive research component and a restoration planning effort. The Lake Tahoe TMDL is answering a set of core questions summarized in Table ES-1.

This report represents a significant step forward in the development of the Lake Tahoe TMDL. It provides a first estimate of the potential Basin-wide pollutant load reductions at several levels of effort. Targeted research will refine these initial estimates over the coming years through a continual improvement and adaptive management process.

Table ES-1. Lake Tahoe TMDL synopsis with this work highlighted

TMDL phase	Questions	Products
Phase One— Pollutant Capacity and Existing Inputs	**What pollutants are causing Lake Tahoe's clarity loss?**	Research and analysis of fine sediment, nutrients and meteorology
	How much of each pollutant is reaching Lake Tahoe?	Existing pollutant load to Lake Tahoe from major sources
	How much of each pollutant can Lake Tahoe accept and still achieve the clarity goal?	Linkage analysis and determination of needed pollutant load reduction
		Document: TMDL Technical Report
Phase Two— Pollutant Reduction Analysis and Planning	**What are the options for reducing pollutant inputs to Lake Tahoe?**	Estimates of potential pollutant load reduction opportunities **Document:** Lake Tahoe TMDL Pollutant Reduction Opportunity Report
	What strategy should we implement to reduce pollutant inputs to Lake Tahoe?	Integrated Strategies to control pollutants from all sources
		Load reduction allocations and implementation milestones
		Implementation and Monitoring Plans
		Document: Final TMDL
Phase Three— Implementation and Operation	**Are the expected reductions of each pollutant to Lake Tahoe being achieved?**	Implemented projects & tracked load reductions
	Is the clarity of Lake Tahoe improving in response to actions to reduce pollutants?	Project effectiveness and environmental status monitoring
	Can innovation and new information improve our strategy to reduce pollutants?	Lake Tahoe TMDL continual improvement and adaptive management system, targeted research
		Document: Periodic Milestone Reports

Phase One

Phase One of the Lake Tahoe TMDL answered three important questions:

1. **What pollutants are causing Lake Tahoe's clarity loss?**
2. **How much of each pollutant is reaching Lake Tahoe?**
3. **How much of each pollutant can Lake Tahoe accept and still achieve the clarity goal?**

Extensive scientific research conducted for the Lake Tahoe TMDL has identified five major sources of pollutants and estimated the annual load of pollutants that are delivered from each source. The numeric results are summarized in the pollutant budget Table ES-2. It is useful context for the results presented in this report. The Lake Clarity Model was also developed to help evaluate the load reduction necessary to meet the Lake Tahoe TMDL water clarity target of 29.7 m (97.4 ft.) annual average Secchi depth. This information is presented in detail in the Lake Tahoe TMDL Technical Report (Technical Report), which can be found on the Lahontan Water Board web site
(http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Tahoe_Index.htm).

Table ES-2. Pollutant loading budget for Lake Tahoe from Phase One Technical Report

Source category		Total nitrogen (metric tons/year)	Total phosphorus (metric tons/year)	Number of fine sediment particles ($x10^{18}$/ year)
Upland	Urban	63	18	348
	Non-Urban	62	12	41
Atmospheric Deposition	Wet + Dry	218	7	75
Stream Channel Erosion		2	< 1	17
Groundwater		50	7	NA*
Shoreline Erosion		2	2	1
TOTAL		**397**	**46**	**481**

*NA = Not applicable because it was assumed that groundwater does not transport fine sediment particles.

Phase Two

Phase Two began in 2005 and is the focus of current efforts to answer two additional questions:

1. **What are the options for reducing pollutant inputs to Lake Tahoe?**
2. **What strategy should we implement to reduce pollutant inputs to Lake Tahoe?**

This report answers the first question by providing initial estimates of the potential Basin-wide pollutant load reductions at several levels of effort. This information will form the basis for the development and selection of an Integrated Water Quality Management Strategy (Integrated Strategy). During the fall of 2007 the public and stakeholders will be engaged to inform the development of potential Integrated Strategies. Load allocations, a TMDL element required by the federal Clean Water Act, will be informed by the preferred Integrated Strategy. Load allocations ultimately assign responsibility for achieving the required load reductions and may be made to watersheds, management/regulatory programs, jurisdictions, or a combination of these. In addition, water quality crediting and trading will be analyzed as a programmatic means to assist implementation of projects designed to achieve load reduction requirements. These elements will compose the Final TMDL report that is planned for completion in the winter of 2008/2009.

Phase Three

Phase Three is the implementation phase of the Lake Tahoe TMDL restoration plan and addresses three additional questions:

1. **Are the expected reductions of each pollutant to Lake Tahoe being achieved?**
2. **Is the clarity of Lake Tahoe improving in response to actions to reduce pollutants?**
3. **Can innovation and new information improve our strategy to reduce pollutants?**

The Lake Tahoe TMDL will be implemented through projects, programs and regulations included in the Tahoe Regional Planning Agency (TRPA) Regional Plan, the USDA Forest Service (USFS) Land and Resource Management Plan, state funding agency programs, and permits issued through the Lahontan Water Board and NDEP. Load reductions related to projects and programs will be tracked and project effectiveness will be monitored. Ongoing research and monitoring will improve the scientific basis for adjusting the Lake Tahoe TMDL and Integrated Strategy over time. A formal, continual improvement and adaptive management process will be used to focus implementation on the most effective and appropriate pollutant controls.

General Approach

This analysis estimated potential pollutant load reductions and associated costs at a Basin-wide scale. This is the first comprehensive estimate of possible load reductions based on differing levels of effort applied to the to major pollutant sources. The Lahontan Water Board and NDEP intend to use this information as a basis for discussion with stakeholders on developing a broad Basin-wide strategy to protect water quality.

The analysis was performed in three steps including an evaluation of potential pollutant controls, a site-scale analysis, and an extrapolation to the Basin-wide scale (See Figure ES-1). The steps were pursued independently by each of four groups of experts known as Source Category Groups (SCGs). The groups were overseen by a committee responsible for providing direction and maintaining consistency of results called the Source Category Integration Committee (SCIC). The approach and results were further reviewed by experts not previously involved with the Lake Tahoe TMDL program. The results of each SCG were processed by the project team and combined into two related sets of tables that are summarized in the results section of this Executive Summary.

In many cases the SCGs took necessarily individualized approaches to their analyses. The unique details of each SCG's approach are explained in their specific chapters.

Key Participants

SCGs
The Lahontan Water Board and NDEP identified and assembled respected experts into Source Category Groups (SCGs) to investigate pollutant control options for each major source of pollutants entering Lake Tahoe. Each SCG included a group lead that coordinated the technical investigations and overall staffing of the group.

SCIC
Review and cross-SCG coordination has been provided by a Source Category Integration Committee (SCIC). The SCIC included staff from the Lahontan Water Board, NDEP and TRPA, a Pathway Coordination Team representative, and a Science Advisor involved with long-term TMDL development experience.

Step 1: Pollutant Control Option Evaluation

These analyses began with evaluations of pollutant control options (PCO) that could be applied. Each SCG compiled a list of potential PCOs on the basis of professional experience, local knowledge, and input from the SCIC, Pathway Technical Working Groups, the Pathway Forum, and other sources. The SCGs then screened the list of PCOs and focused investigations on PCOs that were expected to produce large Basin-wide pollutant load reductions and could be quantified well enough at this time to be used in calculations.

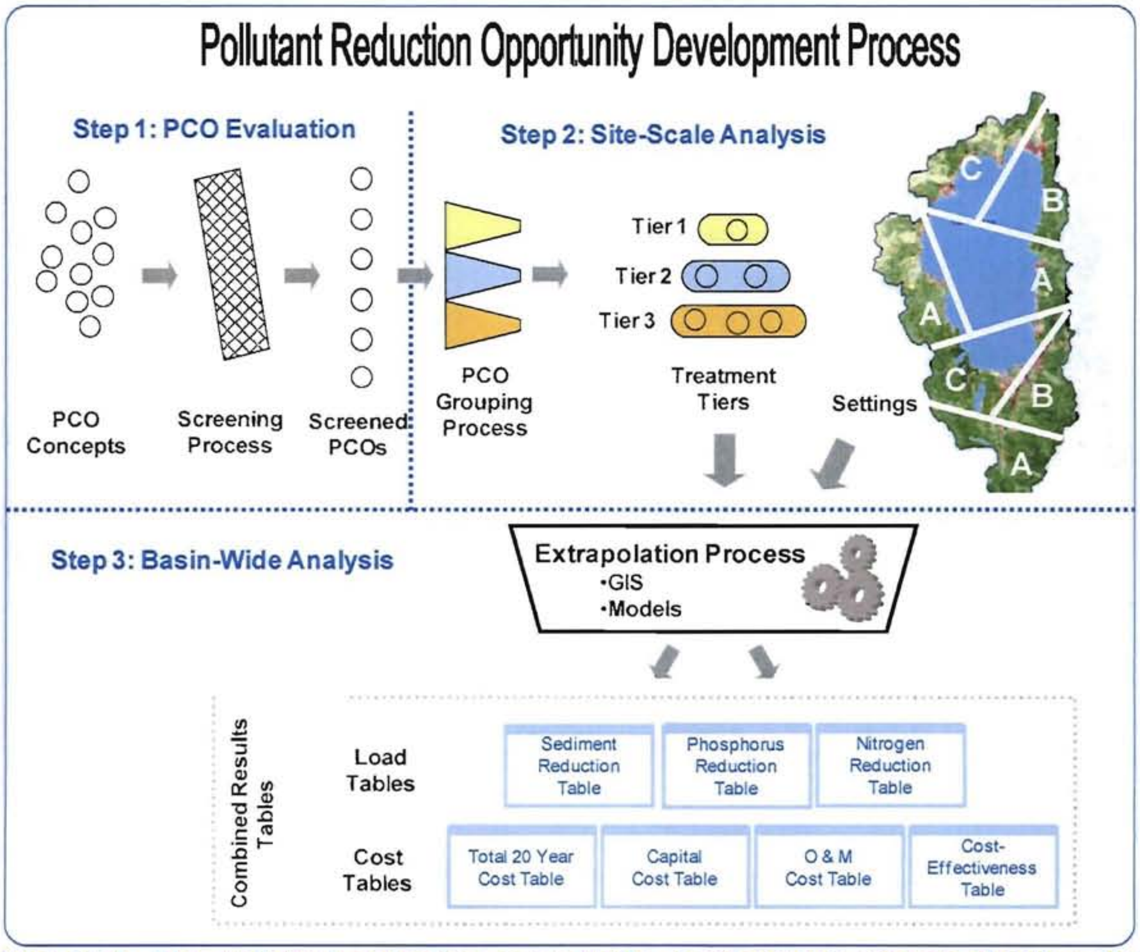

Figure ES-1. The pollutant reduction opportunity development process showing three analysis steps. Step 1: consider wide-ranging Pollutant Control Options and select PCOs most likely to produce large load reductions and quantifiable results. Step 2: group PCOs into several Treatment Tier that could be applied to Settings representative of the landscape characteristics. Step 3: extrapolate site-scale results Basin-wide using tools such as GIS and predictive models. Combined results were captured in a set of spreadsheet tables.

Step 2: Site-scale Analysis

Each SCG analyzed pollutant load reductions and implementation costs of applying PCOs on a representative site scale. During this step, the SCGs defined the representative site areas, called *Settings* and packages of PCOs, called *Treatment Tiers* (Tiers) that could be applied.

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Settings

Each SCG categorized the physical area of the Lake Tahoe Basin into a number of representative Settings on the basis of several criteria. Settings were largely determined by the physical characteristics of the land such as average slope or soil type. Settings were in part determined by the applicability of PCOs. For example, water quality projects use different PCOs depending on how much impervious coverage is present. In other cases, Settings were determined by the way that they deliver pollutants to Lake Tahoe. For instance, atmospheric loads are highly affected by the distance of the source from the Lake, so the atmospheric SCG defined Settings according to distance from the Lake. Settings were selected to ensure that all treatable areas of the Lake Tahoe Basin were included while maintaining a manageable number of Setting-PCO combinations. Summary definitions of each SCG's Settings are provided in Table ES-3.

Table ES-3. Summary definition of Settings for each source category

Setting name	Definition
Atmospheric Settings	
Setting 1	The entire band of land less than 0.2 kilometer from the Lake. Pollutant emissions from this Setting will reach the Lake most readily.
Setting 2	The entire band of land less than 1 kilometer from the Lake (includes Setting 1).
Setting 3	The entire band of land less than 3 kilometers from the Lake (includes Settings 1 & 2)
Setting 4	The entire Lake Tahoe Basin (includes Settings 1, 2, & 3)
Urban and Groundwater Settings	
Concentrated – Steep	Areas where impervious coverage is relatively concentrated and there is minimal space for PCOs to be constructed. Average slope of the area is *greater than* 10%.
Concentrated – Moderate	Areas where impervious coverage is relatively concentrated and there is minimal space for PCOs to be constructed. Average slope of the area is *less than* 10%.
Dispersed – Steep	Areas where impervious coverage is relatively dispersed and there is adequate area for PCOs to be constructed among the impervious coverage or downhill from it. Average slope of the area is *greater than* 10%
Dispersed – Moderate	Areas where impervious coverage is relatively dispersed, and there is adequate area for PCOs to be constructed among the impervious coverage or downhill from it. Average slope of the area is *less than* 10%.
Forested Uplands Settings	
Setting A	Highly disturbed areas with significant compaction such as unpaved roads.
Setting B	Areas subject to major soil disturbance such as ski runs, campgrounds, and steep bare slopes. These areas are characterized by moderate vegetative cover, little mulch or duff, and low-infiltration capacity.
Setting C	Typical Tahoe forested areas that are managed for forest health and defensible space. These areas are characterized by well-established plant communities, thick duff layers and high soil-hydrologic function. The large majority of the Basin land area falls into Setting C.
Stream Channel Settings	
Upper Truckee River	The entire restorable channel of the Upper Truckee River.
Blackwood Creek	The entire restorable channel of Blackwood Creek.
Ward Creek	The entire restorable channel of Ward Creek.

Treatment Tiers

The SCGs combined screened PCOs into Treatment Tiers designed to provide a spectrum of potential load reduction and effort level within each Setting. Each SCG specifically defined its own Treatment Tiers however the following descriptions provide a general understanding of the definitions that guided the SCG's work.

- Tier 1—A basic set of PCOs that represented a step forward in practices generally used for existing projects in the Lake Tahoe Basin. Constraints to implementation and cost-effectiveness of particular PCOs selection for this Tier. This Tier was often the least expensive to implement of the three Tiers and represented the lowest level of effort relative to the other Tiers.
- Tier 2—A mix of the PCOs used in Tiers 1 and 3. The Tier 2 analysis generally provided a greater load reduction and cost than Tier 1.
- Tier 3—The maximum load reduction potential evaluated by the SCG. Land ownership, cost-effectiveness and other constraints were considered less important in formulating this Tier. This Tier was generally the most expensive to implement of the three Tiers.

Treatment Tier definitions for each SCG are summarized in Table ES-4.

Table ES-4. Summary definitions of Treatment Tiers for each source category

Treatment Tier name	Summary definition
Atmospheric	
Tier 1	A baseline of existing loading from which to compare. This source category was different than others because this *Tier* does not result in load reductions.
Tier 2*	A set of PCOs that is deemed effective and particularly cost effective. Numeric estimates are based on average literature values.
Tier 3	A set of PCOs deemed more effective and difficult to implement. Estimates based on literature values that were the most favorable for load reduction.
Urban & Groundwater	
Tier 1*	An upper-end use of existing practices and technologies. Spatial application within the treatment area considers typical site and funding constraints. Assumes 50% completion of residential best management practices (BMPs).
Tier 2	A significantly higher-use, advanced, gravity-driven treatment technologies applied more aggressively within the treatment area. Traditional limitations on property acquisition and maintenance rates are relaxed in this Tier. Assumes 100% completion of residential BMPs.
Tier 3	A composite of pumping and centralized treatment systems for concentrated settings (both moderate and steep) and Tier 2 treatments for dispersed settings (both moderate and steep).
Forested Uplands	
Tier 1*	Includes *standard* treatments used or required by management agencies in current practice.
Tier 2	A middle level of treatment that includes *state-of-the-art* practices designed to achieve *functional* rehabilitation of hydrologic properties.
Tier 3	Treatments designed to develop site conditions that will mimic undisturbed, *natural* conditions after a period of time. This Tier represents the maximum load reduction possible in the Setting.

(table continues next page)

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Stream Channel	
Tier 1	Restoration. A set of treatments that modifies planform, increases length and sinuosity, connects floodplain and decreases slope such that a *restored* condition is eventually reached. This Tier is designed to achieve load reductions as well as other ecosystem objectives such as riparian habitat, flood control, and recreation value.
Tier 2*	Rehabilitation. A combination of channel restoration (Tier 1) and simple bank protection (Tier 3) that focuses on cost-effective treatments, and property ownership is considered a factor.
Tier 3	Bank protection. A basic set of channel armoring and minor bank slope reductions that increase hydraulic resistance and reduce bank failure. This Tier does not achieve multiple ecosystem objectives.

* These Tiers include pollutant controls that are most closely related to those used in the most effective EIP projects however; they do not represent a baseline or status quo condition that applies to existing projects.

Step 3: Basin-wide Extrapolation

The SCGs used models and spatial analysis to estimate the pollutant load reduction potential and associated cost of applying each Treatment Tier to each applicable Setting within their source category. The tools and procedures used to complete the extrapolation step are described more completely within each SCG's chapter. The result of the extrapolation step is a Basin-wide estimate of potential pollutant load reductions and associated costs.

Results

Summary results from all SCGs are combined in Figure ES-2 and Table ES-5 to describe potential load reductions and estimated costs. Additional data including results for each Setting is available in Chapter 6 (*Combined Results: Load and Cost Tables*) of this document. Review of the more detailed analysis results will be necessary to understand the subtleties of the information and select an Integrated Strategy.

Load reductions are critical to determine whether the Lake Tahoe TMDL clarity goals can be achieved while costs are a consideration for implementation of pollutant controls. Figure ES-2 summarizes the potential load reduction estimates from each SCG in relation to the Technical Report's total pollutant budget. It also includes the total 20-year cost of the Treatment Tier that could achieve the relative reductions. This cost includes all capital investment and operations & maintenance (O&M) costs necessary to ensure ongoing load reductions. No attempt has been made to separate the cost to control a particular pollutant because most controls contribute to reductions of more than one pollutant. Table ES-5 contains the data displayed in Figure ES-2 and makes it possible to compare results between different source categories or Tiers (columns) but not between the differing pollutants (rows).

These results must be viewed within the context with which they were estimated. The values assume that all pollutant controls are applied to the maximum applicable area on which they could be used. The SCGs did not consider how long it would take to achieve full implementation in their analyses. The values presented signify the total load reduction possible once the PCOs are fully installed, Basin-wide.

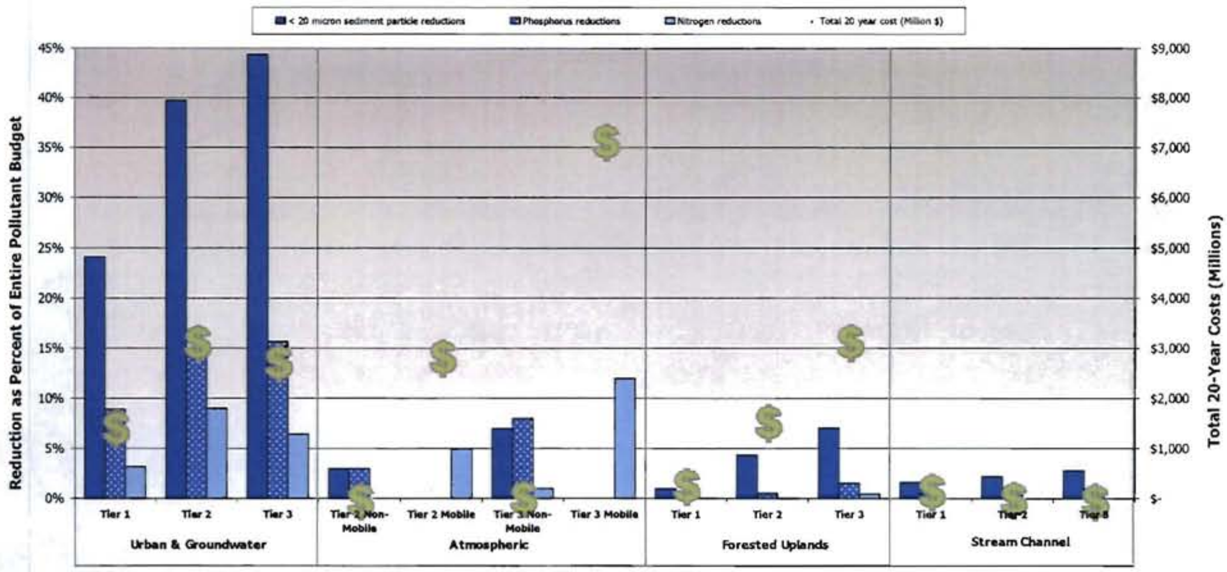

Figure ES-2. This chart presents two separate data sets for comparison. Estimated load reductions as a percent of the entire Lake Tahoe TMDL pollutant budget are shown by vertical bars that can be read on the left axis. Total 20-year costs for each Tier are represented as dollar signs that can be read on the right axis. Each cost is associated with all three pollutant load reductions represented by the vertical bars.

Table ES-5. Summary table of estimated potential load reductions as a percent of the total pollutant budget and total 20-year costs

Source Category and Tier	< 20 micron sediment particle reductions	Phosphorus reductions	Nitrogen reductions	Total 20 year cost (Million $)	20 year capital cost (Million $)	Annual O&M cost (Million $)
Atmospheric[4]						
Tier 2 Non-Mobile	3%	3%	0%	$35	$28	$0
Tier 2 Mobile	0%	0%	5%	$2,900	$280	$130
Tier 2 Sub-total	3%	3%	5%	$2,900	$300	$130
Tier 3 Non-Mobile	7%	8%	1%	$88	$74	$1
Tier 3 Mobile	0%	0%	12%	$7,200	$690	$330
Tier 3 Sub-total	8%	8%	13%	$7,300	$760	$330
Urban & Groundwater						
Tier 1	24%	9%	3%	$1,500	$1,400	$3
Tier 2	40%	15%	9%	$3,200	$2,800	$21
Tier 3	44%	16%	6%	$2,800	$2,500	$15
Forested Uplands						
Tier 1	1%	0%	0%	$320	$193	$6
Tier 2	4%	1%	0%	$1,600	$1,400	$7
Tier 3	7%	2%	0%	$3,200	$3,100	$0
Stream Channel						
Tier 1	2%	1%	N/A	$210	$210	$0
Tier 2	2%	1%	N/A	$50	$51	$0
Tier 3	3%	1%	N/A	$15	$15	$0

Notes:
1. These results are based on the assumption that controls are applied to the maximum applicable area.
2. Columns are not summed because Tiers are not additive. Only one Tier can be selected for each source category.
3. Rows are not summed because each represents a different quantity.
4. Atmospheric pollutant reduction opportunities have been split between 1) non-mobile sources, which consist of transportation infrastructure and stationary source reductions and 2) mobile sources, which consist of reductions from reduced vehicle emissions resulting from reducing vehicle miles traveled.

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Figure ES-2 and Table ES-5 show the following results for loads and costs.

Load Results

1. Urban and groundwater sources show the largest opportunity to reduce pollutants of concern.
    a. In general, these controls show several times more load reduction potential than fine sediment particles from the three other source categories combined. Fine sediment particle load reductions come from urban runoff pollutant controls, not groundwater treatment.
    b. Nutrient loads from this source are also controllable, but to a lesser extent.
2. Atmospheric controls provide the largest opportunity (13 percent) to reduce nitrogen loads and can reduce significant amounts of the fine sediment (8 percent) and phosphorus (8 percent) loads.
3. Forest and Stream Channel sources show moderate potential for load reductions in fine sediment and limited potential for reduction of nutrients.
4. Achieving clarity goals will require implementation of controls in all source categories.

Cost Results

1. Urban and groundwater pollutant controls show 20 year costs ranging from \$1.5-3.2 billion. These costs are similar to forest upland costs and higher than costs for other source categories but higher load reduction potentials make urban and groundwater pollutant control relatively cost effective.
2. Forested uplands costs show a broad range (\$320 million to \$3.1 billion) that corresponds positively with increasing load reductions. The estimates show somewhat lower cost effectiveness than urban and groundwater sources and emphasize the need to focus restoration on high priority, disturbed areas to make these controls cost effective.
3. Atmospheric cost results do not include the potential revenue that could be generated through VMT reduction incentives. Atmospheric non-mobile costs (\$35-\$88 million) are orders of magnitude less than mobile costs (\$2.9 to \$7.2 billion). Non-mobile fine sediment controls are highly cost effective.
4. Stream channel costs are lower for higher numbered Treatment Tiers, unlike other source categories. This is because Tier 3 controls involve basic bank hardening that is inexpensive and effective for reducing stream channel erosion. However, this analysis did not include the potential treatment of upland loads being transported by the stream. Tier 1 restorations are considered likely to provide water quality benefits by allowing sedimentation in flood plains, as well as other benefits such as flood control and enhanced riparian habitat. Thus, these results could be adjusted upward in the future as tools for estimating all benefits are fully developed.

Source Category Considerations

This section presents key considerations and additional findings related to each source category that provide important context for understanding load reduction and cost results.

Atmospheric Sources

1. Atmospheric cost results do not include the potential revenue that could be generated through VMT reduction incentives.
2. There is a significant cost difference between mobile source PCOs that target nitrogen and non-mobile controls that typically target fine sediment and phosphorus. In general, Basin-wide total costs to control nitrogen from mobile sources are two orders of magnitude higher than comparable costs to control fine sediment and phosphorus. It is possible to focus effort on stationary sources or mobile sources separately.
3. The atmospheric estimates presented in the results tables do not attempt to include entrained dust deposition to Lake Tahoe from mobile sources. After this report was complete, the SCG completed a preliminary estimate of this load and found that VMT reductions up to 25 percent resulted in fine sediment particle load reductions less than half of one percent. This result supported the initial assumption that VMT reductions do not provide a significant opportunity for significant fine sediment particle load reductions. However it is important to note that current scientific understanding of the linkage between VMT and fine sediment loading to Lake Tahoe is not well characterized and this research need has been identified for inclusion within the Tahoe Science Consortium's Draft Science Plan.
4. In some instances, atmospheric PCOs overlap with Urban and Forest PCOs. As a result, Integrated Strategies that employ both atmospheric and urban or forest controls will include some double counting of costs. Integrated Strategies that do not employ both atmospheric controls, but do employ urban or forest controls will not account for the associated atmospheric pollutant reductions. Examples of such overlap include:
    - Paved roads where the atmospheric group estimated the total costs of street sweeping and the urban and groundwater group estimated the cost of PSC-1 which includes street sweeping/vacuuming.
    - Unpaved roads where atmospheric dust control strategies could potentially overlap forested uplands particulate runoff controls.

Urban and Groundwater Sources

1. Tier 3 has the greatest estimated pollutant load reduction capabillity and is more cost effective than Tier 2. Tier 3 has the potential to reduce sediment particle loads of approximately 4% more than Tier 2 controls and it costs approximately 13% less for Basin-wide application. Additionally, as the concentration of urban development increases Tier 3 appears to become more cost effective. Source controls with both pollutant concentration and hydrologic volume effects (e.g. private property BMPs) are an important component of this tier.
2. The investment in a Tier 2 level of O&M activities is a significant cost that is at least an order of magnitude greater than the current resources devoted to water quality O&M. While, O&M cost estimates are preliminary and must be verified and compared to existing storm water utility programs, an increase in O&M activity will be needed to increase pollutant reductions.
3. The estimates of potential load reduction for the centralized pumping and treatment controls that make up part of Tier 3 have the lowest confidence among all urban Treatment Tiers because of the numerous assumptions that were made about the design of centralized treatment systems. Additional work has already begun to better characterize the feasibility of these kinds of pollutant controls.

Forested Uplands Sources

1. Unpaved roads represent a small fraction of forested upland land-uses in the Basin, however, annual per acre fine sediment loading rates from unpaved roads are roughly double that from ski trails and 20–40 times greater than loading rates from undeveloped forested areas.
2. Obliteration of *legacy areas*—such as old logging roads, trails, abandoned landings, and other erosion *hot spots*—has the greatest potential to efficiently reduce loading from forested areas, especially if conducted in combination with planned thinning and fuels reduction treatments.
3. This analysis does not consider wildfire or controlled-burn effects on subwatershed hydrologic dynamics and subsequent stream loading. The effect of fire on runoff, sediment, and nutrient yield in the Basin is a topic that requires additional research and focused analyses beyond those considered here. The analysis framework developed here could be applied to future fire analysis and continued investigation into the water quality effects of fire should be considered a top priority.
4. Results show little nitrogen removal by forested upland controls because regression equations used in the model applied could not be adjusted to match existing datasets. Additional work has shown that estimates for nitrogen removal by the SCG were particularly conservative. Future results are expected to show larger load reductions of nitrogen for this source category.
5. There is a general need to define terms and establish clear, quantitative success criteria for different treatments and PCOs within the Basin. One important reason that costs are so difficult to generalize is that some treatments are poorly defined or defined very differently from agency to agency, and contractor to contractor.

Stream Channel Sources

1. The total load reductions available from reducing stream channel erosion are relatively small, however, they are quite cost effective. In addition, current load reduction estimates do not account for treatment of upland loads during flood events, which would further improve the cost effectiveness of stream channel restoration. Future research is targeted to quantify the potential load reductions achievable by increasing floodplain connectivity and over-bank flows.
2. The uncertainty about PCO effectiveness for bank protection (Tier 3) is more likely to overestimate load reductions and underestimate costs than visa versa.

Next Steps

The results of the SCG efforts will form the basis for the development and selection of Integrated Strategies. Initial Integrated Strategies will be used to stimulate discussion during the Lake Tahoe TMDL 2007 Public Participation Series. This set of workshops and discussions will solicit valuable input from the engaged public, local governments, and the Pathway Forum. Lake Tahoe TMDL decision makers including Lahontan Water Board, NDEP and TRPA will use the input gathered to select the most acceptable package of pollutant controls.

Load Allocations

Results from the Lake Tahoe TMDL 2007 Public Participation Series and Integrated Strategy development will guide selection of the most acceptable load allocations. Load allocations are assignments of allowable loads and load reduction requirements allocated to appropriate agencies, programs, business sectors, or other legal entities. While the sum of all Tahoe Basin allocations must eventually result in attainment of the 29.7 meter clarity standard, initial milestones will be set to reach a series of achievable targets. Load allocations will be based on at least one of several methods and are expected to satisfy principles of cost-effectiveness, equitability, public acceptance, and accountability.

Final TMDL

Under the Clean Water Act and California law, final TMDLs must contain all the elements addressed during Phase One and Two of the Lake Tahoe TMDL. A complete description of the Lake Tahoe TMDL elements is presented in the Technical Report.

The Lake Tahoe TMDL implementation plan will present a detailed process for achieving load reductions over a specified time frame. Preparation for the implementation plan is ongoing, but several expectations have emerged among Lake Tahoe TMDL collaborating agencies. The Lake Tahoe TMDL will integrate with the Pathway efforts to update resource management plans by providing load reduction targets that can be incorporated into the TRPA Regional Plan, the Environmental Improvement Program, and Lake Tahoe Basin Management Unit Forest Plan. The Lahontan Water Board and NDEP will incorporate the Lake Tahoe TMDL implementation needs into the Lahontan Basin Plan and NDEP Continuous Planning Process documents.

The Lake Tahoe TMDL monitoring plan will describe procedures for tracking load reductions and documenting progress toward achieving milestones. It will also describe how project effectiveness measurements and ongoing research will refine the understanding of factors driving loading to the Lake. The monitoring plan will become the scientific basis for the formal cycles of continual improvement and adaptive management that will be initiated during Phase Three of the Lake Tahoe TMDL.

All elements from Phases One and Two will be packaged in a Final TMDL document that will complete Phase Two. The Gantt chart in Figure ES-3 provides an overview of the time frames expected to develop each element and complete each phase. Note that the implementation and operation phase of the Lake Tahoe TMDL is expected to continue for a period of decades beyond 2009. Current discussions of likely time frames for achievement of the Lake Tahoe TMDL load reductions range from 30 to 100 years.

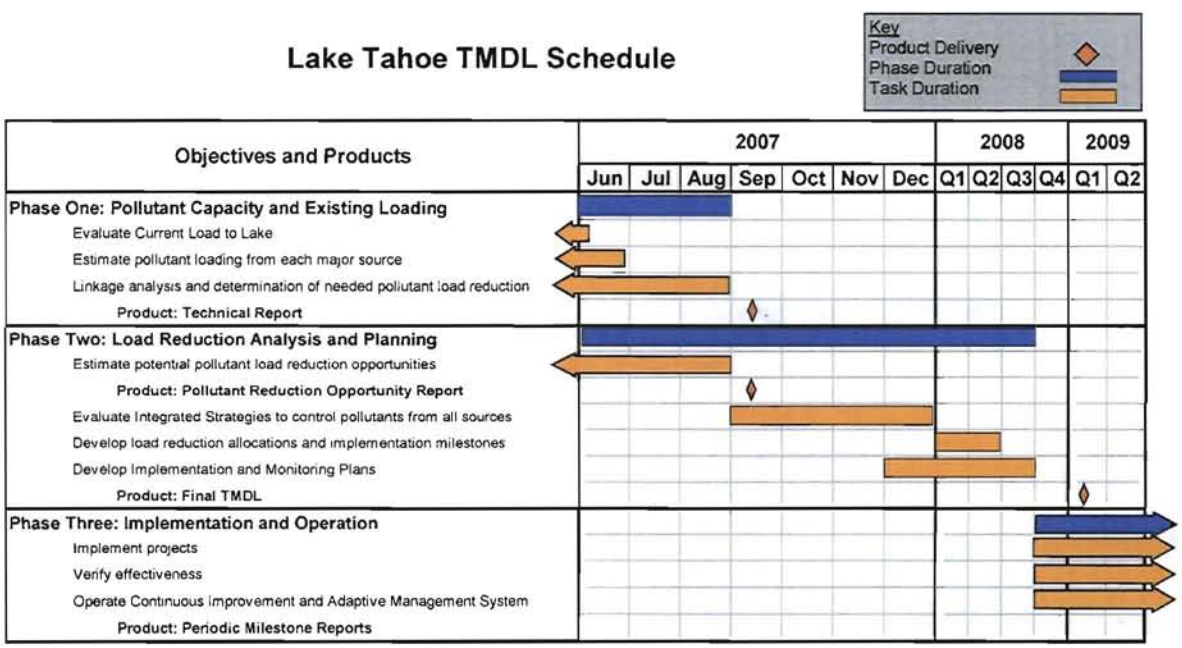

Figure ES-3. A Gantt chart showing the three phases of the Lake Tahoe TMDL.

01-0021

ENCLOSURE 3

01-0022

Integrated Water Quality Management Strategy Project Report

March 2008
v1.0

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

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NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

01-0023

2. Recommended Water Quality Management Strategy

The Recommended Strategy incorporates the best available science and extensive stakeholder input to describe a Basin-wide, non-prescriptive strategy to inform agencies as they create TMDL load allocations and develop an implementation plan. The Recommended Strategy also serves to estimate a practical distribution of potential reductions from each source category. The Recommended Strategy combines pollutant controls from all four major categories of pollutant sources while focusing on reducing fine sediment particles delivered by urban runoff. Implementing the Recommended Strategy is estimated to involve a $1.5 billion capital investment and will achieve the Clarity Challenge, which calls for approximately 32 percent reduction in the Basin-wide fine sediment particle load.

This chapter presents the Recommended Strategy by describing suggested actions for each of the major pollutant source categories and then describes the estimated results of implementing the Recommended Strategy. Chapter three explains the process of technical analysis and stakeholder input used to formulate the Recommended Strategy.

Non-Prescriptive Strategy

The Recommended Strategy is intended to guide implementing agencies in their efforts to achieve required load reductions. The Recommended Strategy does not directly translate to recommendations for project-scale application, and implementing agencies are not required to implement the specific pollutant controls contained within the Recommended Strategy. It is intended that more-detailed, geographically specific analyses be pursued for site-scale implementation and budget planning.

2.1. Source Category Recommendations

The Recommended Strategy incorporates recommendations tailored to each source category because they deposit pollutants into Lake Tahoe via differing mechanisms and at different rates. For each source category, three key elements define the actions within the Recommended Strategy. *Treatment tiers* are groups of pollutant controls that were screened by technical experts to be broadly applicable to the Tahoe Basin. Each source category's treatment tiers can be applied to a portion of the potential opportunities available within the Tahoe Basin. Thus, *Application level* is expressed as a percent of total possible application. For instance, a 75 percent application level of a particular urban treatment tier would mean that three- quarters of the Tahoe Basin's urban areas would be treated with that group of pollutant controls and one- quarter would remain untreated. The treatment tiers can be applied at various application levels to several different *Settings* that are based on Basin-wide physical characteristics and applicable pollutant controls. The Recommended Strategy is based on several assumptions that are described at the end of the section.

Comments and observations about the relative confidence related to each source category's analysis are discussed at the end of each source category section. These comments are based on the TMDL team's interpretation of technical confidence ratings provided by source category experts combined with confidence ratings of the TMDL pollutant budget (Lahontan and NDEP 2007a, p. 5-164).

Urban Runoff Focus

The majority of pollutant loading, and also estimated potential pollution control, come from urban runoff. Thus, this is the area of focus for the Recommended Strategy (Lahontan and NDEP 2007a and 2007b). The Recommended Strategy focuses on advanced practices and innovative technology to control fine sediment particles from the urban runoff source category.

Pollutant Controls Included

Urban pollutant controls are categorized into three treatment tiers that are targeted to four settings. The names of the treatment tiers and example controls include the following:

- **Best Current Practices (Tier 1)** – Detention and retention basins, stormwater vaults, road shoulder stabilization, vacuum sweeping on heavily sanded roads, limited impervious coverage removal and 50 percent completion of private property best management practices (BMPs)
- **Advanced, Intensive Practices (Tier 2)** – Wetland and passive filtration basins, media filters in stormwater vaults, deicing compounds or advanced abrasive (sand) recovery, intensive maintenance of stormwater infrastructure, 100 percent completion of private property BMPs
- **Innovative Technology (Tier 3)** – Active pumping and filtration systems for stormwater applied to urban areas with concentrated impervious coverage (such as *downtown* areas) and Tier 2 treatment applied to urban areas with dispersed impervious coverage (such as many residential areas)

The Recommended Strategy includes these pollutant controls at different application levels in four settings based on configuration of impervious coverage and slope. The areas with concentrated impervious coverage, such as commercial land uses with extensive streets and rooftops, involve a greater application level of the higher treatment tiers. The land uses with more dispersed impervious coverage, such as residential land uses with less pavement and more open space, require less advanced treatments at a lower application level. For each of these settings, Table 2-1 provides the application level included in the Recommended Strategy. Additional information about the mix of pollutant controls included in each treatment tier and the process for deriving these numbers is in Appendix C.

Table 2-1. Application Level for Urban Pollutant Controls Used in the Recommended Strategy

Pollutant controls	Concentrated impervious coverage areas on steep slopes	Concentrated impervious coverage areas on moderate slopes	Dispersed impervious coverage areas on steep slopes	Dispersed impervious coverage areas on moderate slopes
Best Current Practices (Tier 1)	20%	20%	30%	40%
Advanced, Intensive Practices (Tier 2)	–	–	–	40%
Innovative Technology (Tier 3)	50%	50%	–	–
% of Total Area Treated	**70%**	**70%**	**30%**	**80%**

Note: percentages represent the amount of urban area treated with pollutant controls. Hyphens indicate that these controls are not included in the Recommended Strategy for this source category. These percentages are not project-level recommendations; they represent percentages of the entire urban area within the Lake Tahoe Basin.

Table 2-1shows that Basin-wide, 20 percent of the urban area with concentrated impervious coverage on steep slopes would be treated with best current practices (Tier 1). 50 percent of these areas would be treated with innovative technology (Tier 3) pollutant controls. The remaining 30 percent of these areas would remain untreated. Taken together, the treatment tiers and their application levels to each urban setting compose the Recommended Strategy for the urban source category.

Relative Confidence

The analyses of urban runoff controls are considered of high enough confidence to use for management decisions at the Basin-wide scale. However, an analysis of confidence revealed that the centralized pumping and stormwater treatment systems included in the innovative technology (Tier 3) pollutant controls will benefit from additional analysis future efforts. In particular, many of the design assumptions made in determining the cost and effectiveness of innovative technology treatments such as pumping and filtering stormwater are subject to adjustment as new information becomes available from testing of different designs. In some cases, Tier 3 results are sensitive enough to the assumptions made that sediment removal rates or costs could be adjusted up or down significantly.

Atmospheric Deposition Focus on Stationary Sources

Lower, but significant, pollutant loads and cost-effective treatments are available by controlling stationary atmospheric dust sources. The cost-effective fine sediment load reduction available through enhanced maintenance and operation of nonmobile dust sources leads to recommendations that focus on controls for both paved and unpaved roadways, as well as parking lots and construction sites. Pollutant controls include street sweeping with advanced vacuum sweeping equipment, graveling dirt roads, other dust control efforts for construction and reducing residential wood burning.

The Recommended Strategy focuses on nonmobile sources of dust particles within the atmospheric source category because these sources provide the bulk of fine particles within this source category and because mobile sources predominantly produce nitrogen, not fine particles. Nonmobile sources of fugitive dust, such as both paved and unpaved roads are responsible for more than 88 percent of atmospheric fine particle emissions in the Lake Tahoe Basin (Lahontan and NDEP 2007b, p. 52). Mobile sources, such as vehicles, produce a relatively large amount of Lake Tahoe's nitrogen load but only 1.3 percent of fine particles (Lahontan and NDEP 2007b, p. 52). Nitrogen is one nutrient that can enhance algae growth. But the TMDL Technical Report showed that light absorption by algae is responsible for approximately one-third of lake clarity loss as demonstrated by the Lake Tahoe Clarity Model (Clarity Model) (Lahontan and NDEP 2007a, pp. 3-13 through 3-14). Finally, stationary source controls for fine particles and their associated phosphorus are three orders of magnitude less expensive per ton than mobile sources according to expert analysis provided in the PRO Report v2.0.

Pollutant Controls Included

The Recommended Strategy for atmospheric deposition sources includes controls for paved and unpaved roads, as well as parking lots, construction areas and residential wood burning. They are classified into two treatment tiers by treatment intensity. The *Increased Intensity* treatment tier is generally applied more intensively or extensively than current efforts. This group of pollutant controls was referred to as *Tier 2* in the PRO Report v2.0 and includes the following:

- Every other week street sweeping with vacuum equipment that captures 10 micron particles
- Pave dirt roads at access points
- Speed limits on unpaved roads
- Gravel 50 percent of unpaved roads, including forest roads
- Require adequate soil moisture during earth-moving operations
- Use dust suppressants on exposed soil at road-building projects
- 20 percent reduction in residential wood burning emissions

The second group of controls, called *High Intensity*, is applied more intensively and pollutant load reduction effectiveness is higher. In the PRO Report v2.0, this group of pollutant controls was referred to as *Tier 3*, and it includes the following:

- Weekly street sweeping with vacuum equipment that captures 10 micron particles
- Pave all unpaved roads
- Limit speeds on unpaved roads
- Require adequate soil moisture during earth-moving operations
- Use dust suppressants on roadway and construction projects
- 50 percent reduction in residential wood burning emissions

Table 2-2. Application Level of Pollutant Controls for Atmospheric Sources of Fine Particles Used in the Recommended Strategy

Pollutant control	Basin-wide application level
Increased Intensity (Tier 2)	30%
High Intensity (Tier 3)	50%
Total % Application	**80%**

Note: values represent the percent of total, Basin-wide road length or bare area treated with pollutant controls.

Relative Confidence

The atmospheric science behind these recommendations is an area of lower confidence than other source categories because it has not been studied as long or thoroughly. Water quality studies of the urban and forested uplands in the Lake Tahoe Basin have a long history and excellent body of research that supports the estimates of potential load reduction and costs associated with fine particle controls. The body of research is less well developed in the atmospheric sciences. For instance, the Tahoe Basin's first study relating vehicles and the entrained fine particles they generate was completed in 2005. The results of this work have influenced the Lake Tahoe TMDL, but additional study is necessary to numerically link Vehicle Miles Traveled (VMT) to the fine sediment particle load to Lake Tahoe. An improved understanding of this linkage would allow greater confidence in the Recommended Strategy's recommendation to focus efforts on nonmobile sources such as paved and unpaved roads.

Stream Channel Erosion and Stream Restoration

Multi-objective stream channel restoration programs are well established, and methods do not offer wide latitude in treatment options. Thus, the recommendations for this source category are based on current plans and approaches. The analysis focuses only on fine sediment particles released from stream banks and beds, and does not consider the other potential benefits available from stream or wetland restoration. The analysis is based on the top three fine sediment particle producing streams in the Basin, which are responsible for 96 percent of the fine sediment particle load in this source category (Lahontan and NDEP 2007b, p. 212). These streams, in order of load production, are as follows:

- Upper Truckee River
- Blackwood Creek
- Ward Creek

The Recommended Strategy includes stream restoration because it is very cost-effective and follows the lead of stream management agencies because they are pursuing a broad scope of ecosystem benefits. The TMDL program focuses exclusively on the clarity of Lake Tahoe and should not disturb the multi-objective scope of existing stream restoration programs. The relative contribution to the Basin-wide fine sediment particle load for this source category is relatively small at 4 percent (Lahontan and NDEP

2007a, p. 4-164). The estimated maximum load reduction of the potential pollutant controls fall into a range of 1.7 to 2.7 percent of Basin-wide load (Lahontan and NDEP 2007b, p. 261). However, stream channel restoration provides very cost-effective fine sediment particle reductions (Lahontan and NDEP 2007b, p. 267). The Recommended Strategy includes pollutant controls that match current approaches and objectives.

Pollutant Controls Included

The evaluation of potential load reductions and costs involved with stream channel sources defined two kinds of restoration or treatment approaches. *Unconstrained restoration* of the stream includes a set of treatments that modify planform, increases length and sinuosity, connect floodplain and decrease slope such that a restored condition is eventually reached. These treatments are designed to achieve load reductions as well as other ecosystem objectives such as riparian habitat enhancement, flood control and recreation value. Estimates for these treatments assumed ideal construction access and project sequencing. Typical limitations on property acquisition are not considered in the analysis of unconstrained restoration. The second kind of restoration, *Bank protection,* is a basic set of channel armoring and minor bank slope reductions that increases hydraulic resistance and reduce bank failure. This kind of project does not achieve multiple ecosystem objectives but is very cost-effective in reducing fine sediment particles.

The current and planned future projects under consideration in the Tahoe Basin generally involve a *mixed approach* of unconstrained restoration where possible and simple bank protection on constrained stream reaches. The Recommended Strategy would implement the mixed approach in projects to include 80 percent of the potentially treatable stream channels for the three streams (i.e. an 80 percent application level). The mixed approach and 80 percent application limit recognize that certain project areas could be overly costly or difficult to address.

For the purposes of this analysis, pollutant controls were assumed to include the following distribution *within a project*:

- 45 percent bank protection
- 35 percent unconstrained restoration
- 10 percent bank strengthening
- 5 percent toe stabilization
- 5 percent bank lowering or angle reduction

Relative Confidence

The analysis of stream channel pollutant controls is considered to be of high enough confidence to support Basin-wide management decisions. However, improvements are suggested based on the model applied in the analysis. Load reductions are estimated using the Bank Stability and Toe Erosion Model (BSTEM) by the National Sedimentation Lab. This model is deemed reliable in determining the loading effects for bank protection, but it is less able to accurately estimate the effects of unconstrained restoration. Future, scheduled efforts will use an improved model, Conservational Channel Evolution and Pollutant Transport System (CONCEPTS), to estimate the effects of unconstrained restoration.[1] In addition, the load reductions do not consider the potential for streams and associated wetlands to provide treatment for urban and forest fine sediment particle loads from overbank flows. Tahoe's science organizations have already begun to study the potential water quality benefits of reconnecting floodplains.

[1] For additional discussion of stream channel modeling approaches, see Lahontan and NDEP 2007b, pp. 228 & 248.

Forested Uplands Planned Activities

Federal, state, and some of the larger local management agencies have well-defined, multi-objective restoration programs with established funding and established restoration plans. The TMDL program is focused on the clarity of Lake Tahoe and should not adversely affect the multi-objective scope of existing forest restoration programs. The Recommended Strategy incorporates load reductions from planned or expected activities of multi-objective forest restoration programs. However, these considerations do not include some of the expedited fuels reduction approaches being discussed following the June 2007 Angora Fire, which may have lasting impacts on fuels reduction plans.

Estimates of the potential load reductions available from forested uplands showed a maximum of 7 percent reduction of the overall Basin-wide fine sediment budget (Lahontan and NDEP 2007b, p. 257). The majority of this reduction comes from applying controls at a very large scale on low sediment-yielding forests. Treatment of an area this extensive increases capital costs of forest treatments alone to approximately $3 billion (Lahontan and NDEP 2007b, p. 257). However, there are small, disturbed areas (e.g., unpaved roads, campgrounds and ski runs) where relatively high sediment particle yields and easy access make pollutant controls cost-effective. Therefore, the Recommended Strategy focuses its efforts on disturbed areas and planned activities including restoration and mitigation of impacts.

Pollutant Controls Included

The Recommended Strategy for forested uplands focuses the most effort on easy-access, high pollutant yielding disturbed areas and some additional effort on implementing advanced water quality improvements on small portions of the less-disturbed parts of the forest. The forested uplands were divided into two categories on the basis of a gradient of disturbance. *Moderate to highly disturbed* areas have significantly compacted soils, little to no duff layer and moderate vegetative cover. Examples of these areas can include unpaved roads and trails, ski runs, campgrounds, cut and fill slopes or steep, exposed areas. *Typical Tahoe forested* areas have good soil hydrologic function, well-established plant communities and thick mulch or duff layers. These areas include most places that appear undisturbed, such as areas managed for forest health and second or third growth areas, but that could have legacy impacts from past activity.

Pollutant controls can be specialized to particular land uses (e.g., unpaved roads, campgrounds or ski runs) but can generally be divided into two categories of their own. *Standard BMP treatments* are planned by federal and state land management agencies for their roads, trails and fuels reduction projects. These treatments are referred to as *Tier 1* treatments in the PRO Report v2.0. Examples of these treatments include the following:

- Full, unpaved roadway BMPs (waterbars, armored ditches, rut stabilization) and annual maintenance
- Hydro-seeding and tackifier for ski runs
- Forest treatments implemented with ground-based equipment and required BMPs

Advanced treatments designed to achieve a range of effects from better hydrologic function to complete restoration that will mimic natural conditions as time progresses. These treatments are referred to as *Tier 2* or *Tier 3* treatments in the PRO Report v2.0. Examples of these treatments can include those found under standard BMP treatments, plus the following:

- Mulching and revegetating with seeding or transplanted seedlings on ski runs
- Road re-contouring, tilling, organic soil amendments, mulch, and revegetation with seedlings and seeding
- Urban sediment capture BMP for paved roadways (e.g., stormwater vaults, settling basins)

- Full restoration of legacy roads and trails

The Recommended Strategy applies the pollution controls at different application levels for each of the settings described above. Table 2-3 displays the application level for each treatment tier to each category of forested land. Efforts focus on moderate to highly disturbed areas, and the majority of treatments follow existing requirements. A small fraction of the typical forested area is recommended for treatment. This area is based on rough estimates of the area planned for fuels reduction treatment within the current planning horizon of approximately 20 years.

Table 2-3.Application Level of Pollutant Controls for Forested Upland Sources of Fine Particles Used in the Recommended Strategy

Pollutant control	Moderate to highly disturbed	Typical Tahoe forested
Standard BMP Treatments (Tier 1)	60%	-
Advanced Treatments (Tiers 2 & 3)	20%	5%
% of Total Area Treated	**80%**	**5%**

Note: values represent the percent of total Basin-wide area treated with pollutant controls. A hyphen indicates that this treatment is not included in the Recommended Strategy.

Relative Confidence

The analysis of forest upland pollutant controls is considered to be of high enough confidence to warrant management decisions at a Basin-wide scale. However, some finer points of the modeling analysis and understanding of fire effects have been identified for additional research. The technical experts who provided these analyses have recommended additional research regarding watershed modeling that would include soil properties at a finer spatial scale, additional quantitative analysis of advanced water quality pollutant controls, and exploration of the long-term costs of standard BMPs versus full restoration. This analysis specifically did not attempt to quantify the effects or costs of wildfire or controlled burns. Current efforts both inside and outside the Lake Tahoe TMDL are focused on gaining a better understanding of the pollutant loading effects of fire.

Assumptions

Several assumptions are necessary to develop the Recommended Strategy. The assumptions described below are the most immediate and defining assumptions of this analysis, but the Recommended Strategy also relies on additional assumptions that are captured in the PRO Report v2.0 and in Chapter 3:Development of the Recommended Strategy. Some of the assumptions apply universally, while others are applicable to a specific source category and are marked as such. The assumptions are numbered for reference purposes only and are not ranked in order of importance.

1. The maximum application level for pollutant controls to any given area is 80 percent. This reflects the understanding that project-scale implementation issues occur that cannot be determined at a Basin-wide planning scale. In particular, some areas might not be accessible or are unable to achieve the estimated load reductions. Site-specific challenges such as high groundwater, utility line interference, or bedrock intrusions could also make projects excessively costly in some areas.
2. **Urban:** The minimum application level for the urban Tier 1 pollutant controls is 20 percent. This assumption is necessary because implementers have already completed or are planning projects that will achieve this level within the next few years. While Tier 1 pollutant controls might be retrofitted in the future, they are assumed to be more cost-effective for addressing untreated runoff during this planning horizon.

3. **Forest sources:** As currently planned, approximately15 percent of the Basin's federal- and state-owned forest lands will be treated to reduce forest fuel loads during the next 20 years. Roughly two-thirds of the treated areas will receive standard BMPs for water quality, while the other one-third (5 percent of Basin-wide area) will receive advanced pollutant controls.
4. Street sweeping costs will be distributed between urban and atmospheric source categories. Roadway fine sediment controls are included in both urban and atmospheric source categories because they control fine sediment particle delivery to the Lake via entrained dust deposition and urban runoff. The costs of these pollutant controls are redundantly included in both source categories for this analysis. During implementation these costs will only be necessary once and the overall cost of the Recommended Strategy will be reduced.

2.2. Results

Implementation of the Recommended Strategy is estimated to result in the necessary pollutant load reductions to achieve the Clarity Challenge. The overall pollutant reductions, costs and clarity effects are described in this section. The results account for the combined effect of all controls described in Section 2.1.

Reductions in Fine Sediment Particles

The Recommended Strategy focuses on pollutant controls for fine sediment particles because these particles are responsible for roughly two-thirds of the clarity loss Lake Tahoe has exhibited. Figure 2-1 shows that the Recommended Strategy is estimated to reduce fine sediment particle (smaller than 20 micron) loads to Lake Tahoe by a total of 32 percent relative to the Lake Tahoe pollutant budget presented in the Technical Report (Lahontan and NDEP, p. 4-164).

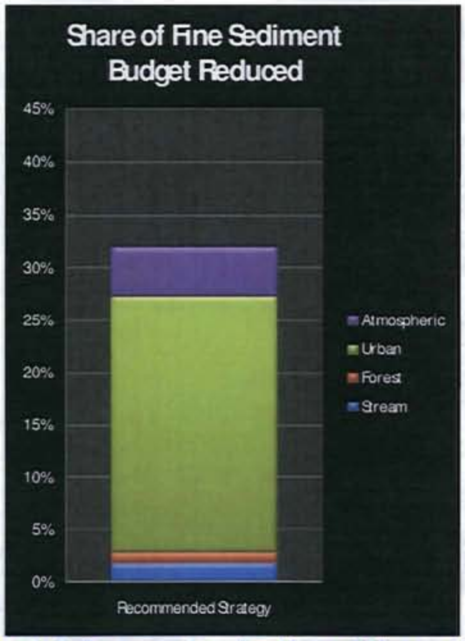

Figure 2-1. Analytic results for total percent reduction of the entire Lake Tahoe fine sediment budget for the Recommended Strategy.

Implementation of the Recommended Strategy controls is projected to achieve fine sediment particle load reductions from all the source categories; however, only a small minority of fine particles is from the forest or stream categories. Urban stormwater pollutant controls account for the large majority of these reductions, providing approximately 25 percent of the Basin-wide total fine sediment particle budget. Atmospheric controls focused on nonmobile sources are estimated to account for 5 percent of the Basin-wide total fine sediment particle budget. Forested upland and stream channel source controls are estimated to produce 1 percent and 2 percent of the Basin-wide load reduction, respectively.

These results are not intended to discount the importance of forested upland treatments or stream channel restoration as approaches for improving the environment of Lake Tahoe. The PRO Report v2.0 shows that the load reduction available from stream channel erosion is the second most cost-effective way to control fine sediment (Lahontan and NDEP 2007b, p. 272). In addition, stream channel reductions do not include the potential of streams and associated wetlands to capture and control sediment from urban or other upland sources. The 1 percent forested runoff estimate reflects that a relatively low fine sediment particle yield (per acre) and forested lands are generally difficult to access for cost-effective treatments. The fine sediment particle producing land uses within forested areas, such as unpaved roads, ski runs and burn areas provide important opportunities to achieve cost-effective load reductions. For these reasons, the Recommended Strategy includes continued treatment of forest and stream channel sources according to the plans laid out by management and funding agencies such as the Lake Tahoe Basin Management Unit (LTBMU), the California Tahoe Conservancy (CTC) and Nevada Division of State Lands (NDSL).

Lake Clarity Effects

The pollutant load reductions resulting from implementation of the Recommended Strategy are predicted to bring Secchi depth measurements of lake clarity to approximately 78 feet, achieving the Clarity Challenge laid out in chapter one. Figure 2-2 illustrates results obtained using a liner-regression of the Clarity Model results assuming fine sediment particle reductions only. These results demonstrate arrested clarity loss and a 13-foot improvement over the 2006 average Secchi depth of 67.7 feet (TERC 2007, p. 10.2). Achievement of this milestone would be a significant waypoint on the path to eventual attainment of the long-term clarity goal of 97.4 feet (Lahontan and NDEP 2007a, p. 2-8).

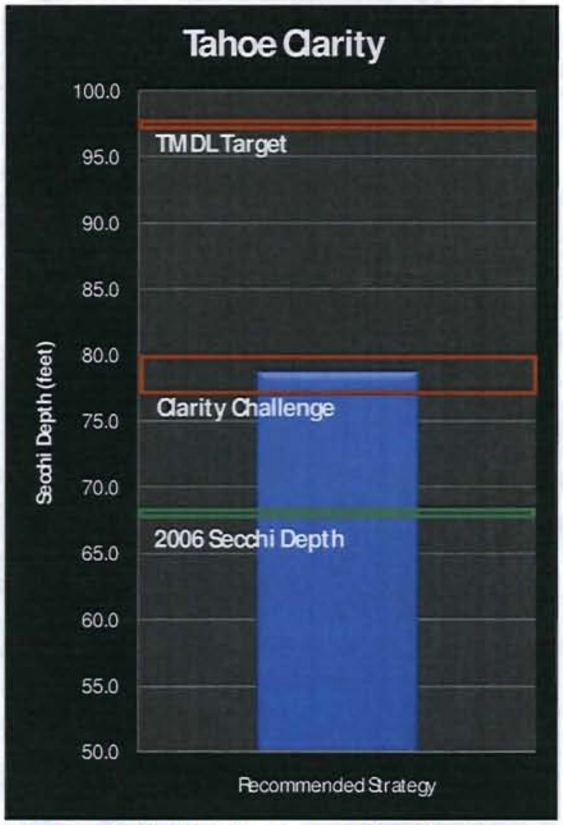

Figure 2-2. The Clarity Model predicts that implementing the Recommended Strategy will achieve the Clarity Challenge of 77-80 feet of Secchi depth as Lake Tahoe's clarity measurement moves from the 2006 value toward the overarching TMDL Target.

This result is calculated using a linear regression of outputs from the Clarity Model as reported in the TMDL Technical Report. The resulting Secchi depths are considered to be a conservative estimate because they do not include the benefits of reducing nutrients that would be associated with any pollutant controls that reduce fine sediment particles. Key sources of uncertainty in this estimate result from assumptions necessary for the Clarity Model and potential non-linearity in lake response to fine sediment inputs.

Costs

The 20-year capital and annual operations and maintenance (O&M) costs of implementing the Recommended Strategy are estimated by groups of experts on a control-by-control basis and then aggregated into totals for each major source category. Capital costs include all implementation costs such as planning, design, acquisition and replacement costs when the useful life of the controls is shorter than 20 years. More detailed analysis is necessary for budgeting and project level planning; these estimates are provided only as rough approximations.

Implementing the entire Recommended Strategy as analyzed would involve an estimated capital investment of approximately $1.5 billion. Figure 2-3 shows a breakdown of the costs associated with each of the major source categories in addition to the total amount. All values are in 2007/2008 equivalent dollars. The majority of costs, $1.3 billion, are for urban runoff pollutant controls. Pollutant controls for other sources estimated are $120 million, $48 million and $40 million for forest runoff, atmospheric and stream channel pollutant controls, respectively. The relatively high investment in urban runoff controls is reflective of the importance of this source category in reducing fine sediment particle loads. Both types of costs are important because state and federal funding has historically been available for capital investments, while local jurisdictions have been responsible for O&M costs.

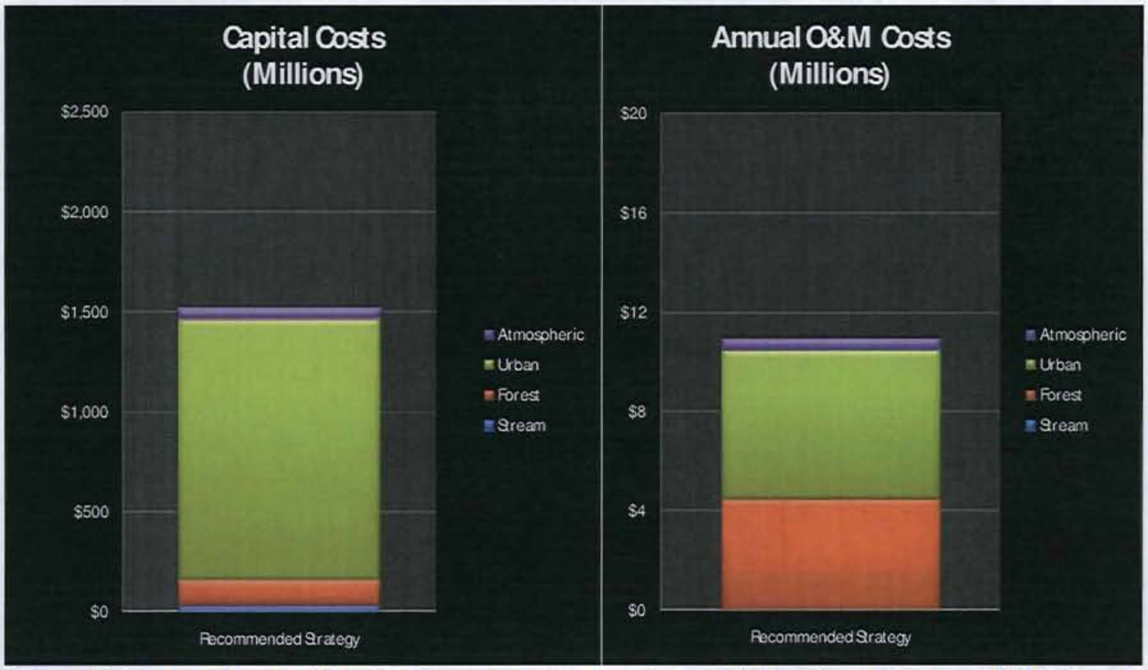

Figure 2-3. An estimated $1.5 billion in capital costs and $11 million in annual O&M costs would be needed to initiate and maintain effectiveness of the Recommended Strategy.

Figure 2-3 above, shows estimates of funding needed annually to operate and maintain recommended pollutant controls including a breakdown of the cost by major source category. These costs are reasonably evenly divided between urban runoff controls and forested runoff controls at $6.0 million and $4.5 million, respectively. Atmospheric controls are estimated to cost approximately half a million dollars annually, while stream channel controls are estimated to be self-sustaining for the life of the project. The average annual O&M costs include all requirements to maintain effectiveness of the pollutant controls at the efficiency used in load-reduction estimates for the expected life of the project.

2.3. Milestone Analysis

The Lake Tahoe TMDL must establish *milestones* along the path toward achieving the Clarity Challenge and, eventually, the Lake Tahoe TMDL's overarching numeric target for Secchi depth. The Recommended Strategy's pollutant controls and application levels define one of the milestones. The current best available science finds that achievement of the load reductions associated with the Recommended Strategy are possible by the third milestone and will accomplish the Clarity Challenge. *Implementation periods* (periods) are the intervals between milestones in which a level of effort (represented by $500 million dollars) is focused on effectively implementing the recommended pollutant controls. Specific application levels of pollutant controls and resulting costs and benefits are calculated using the Packaging and Analysis Tool[2]. The milestones may be used to guide allocations and permitting decisions as the Lake Tahoe TMDL moves forward.

Pollutant Controls Included

The pollutant controls included in the milestone analysis are based on the Recommended Strategy and include the same selection of pollutant controls. At each milestone, application levels for the treatment tiers are adjusted. Thus, the pollutant control table for this analysis includes values for each source category's settings and treatment tiers at each milestone. The table is included for reference as Table C-2 in Appendix C.

General trends within the table show increasing pollutant control application levels until the third milestone. During the fourth period, many of the current best practices (Tier 1 controls) are projected to be retrofitted or replaced with advanced practices or innovative technologies (Tier 2 and 3 controls). The advanced and innovative technologies are not widely applied during the first two periods because they are assumed to be under development. However, they are assumed to be widely applied during the third and fourth periods, when they are expected to be available for broad application.

Overview Milestone Results

The milestones incorporate load reductions and costs from each of the source categories, but an overview should provide the clearest picture of the important trends that result from the milestone analysis before looking at source category specifics. Figure 2-4 depicts the capital costs and percent of the entire Basin-wide pollutant budget for fine sediment at each of the milestone periods. The center of each bubble is at the potential percent reduction of the overall Basin-wide fine sediment budget at each milestone. The size of the bubble represents the estimated capital cost (in millions) of implementing controls and is rounded to two significant figures. These costs are estimates of the cumulative total needed to reach each milestone.

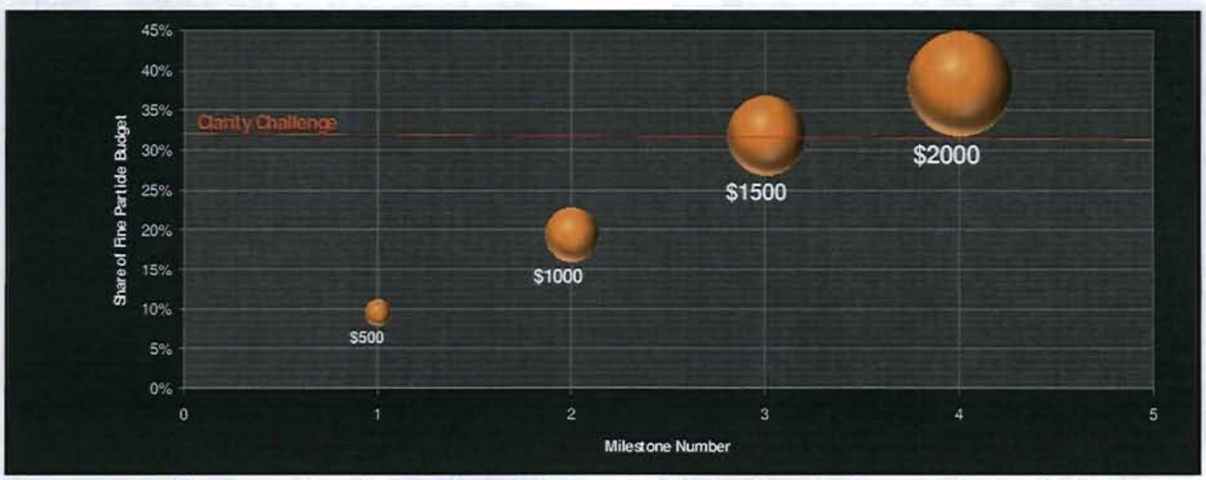

Figure 2-4. Milestones showing estimated fine particle load reductions and cumulative costs (millions) surrounding the Recommended Strategy. Milestone number three is the Recommended Strategy.

One of several important features of the milestone analysis is the ability to achieve the estimated load reductions needed for Clarity Challenge by the end of the third period. This analysis also shows potential

[2] For an additional description of the PAT and its use during creation of the Recommended Strategy, see Section 3-2 and Appendix A.

to move beyond the Clarity Challenge by achieving a 38 percent reduction of fine sediment particle loads by the fourth milestone. The results also show different load reduction rates during each period.

First Period – Initial load reductions are 10 percent because the implementers are focused on employing current best practices as the only available pollutant controls.

Second Period – Marginal[3] load reductions of 9 percent reflect growing implementation capacity with development of new and advanced technologies for fine sediment particle treatment.

Third Period – Marginal load reductions of 13 percent reflect acceleration from applying advanced fine sediment control technologies and increased implementation capacity.

Fourth Period – Marginal load reduction of 6 percent because of a slowing rate of reduction as load reduction opportunities become limited and retrofitting Tier 1 projects is necessary.

The overview results show that the Clarity Challenge can be met and exceeded, but additional planning and strategy adjustments will be necessary before the overarching TMDL target of 97.4 feet can be reached. This planning should be performed before the fourth milestone is reached so that implementers can fill their project pipelines with well-targeted projects before the current planning horizon ends.

Source Category Results

At each milestone, expenditures and load reductions are contributed by each source category. Table 2-4 provides load reduction and costs for each of the source categories. The information provided is the cumulative total at each milestone.

This analysis assumes that all reductions for atmospheric, forest and stream channel sources are complete by the third milestone. Additional work on urban sources would continue through the fourth period, but the area available for applying pollutant controls becomes so constrained during this period that load reduction decelerates. In addition, O&M of most pollutant controls would have to be carried beyond this planning horizon to maintain the load reductions.

[3] Marginal change is defined as the incremental change from the previous milestone.

Table 2-4. Estimated Pollutant Reduction and Costs by Source Category for Four Milestones[4,5]

Source category	Milestone #1			Milestone #2			Milestone #3[6]			Milestone #4		
	% Fine particle reduction[7]	Capital costs (millions)	O&M costs (millions)	% Fine particle reduction	Capital costs (millions)	O&M costs (millions)	% Fine particle reduction	Capital costs (millions)	O&M costs (millions)	% Fine particle reduction	Capital costs (millions)	O&M costs (millions)
Atmospheric	1%	$12	$0.12	2%	$23	$0.24	5%	$46	$0.48	5%	$50	$0.49
Forest Upland	0%	$42	$2.6	1%	$77	$3.9	1%	$120	$4.5	1%	$120	$4.6
Stream Chan.	0%	$10	$0.0	1%	$20	$0.00	2%	$40	$0.00	2%	$40	$0.00
Urban Upland	7%	$440	$1.7	15%	$910	$3.7	25%	$1,300	$6.0	31%	$1,700	$11
Total	10%	$500	$4.5	19%	$1,000	$7.8	32%	$1,500	$11	38%	$2,000	$16

4 **Rounding:** Displayed values have been rounded to two significant figures. Totals were calculated using all available decimal places, then rounded. This causes the apparent errors in column totals.

5 **Milestone Totals:** The numeric results presented in this table are cumulative totals for each milestone.

6 **Milestone #3:** The third milestone corresponds to the Recommended Strategy. Load reductions associated with the Recommended Strategy (and thus the third milestone) are expected to achieve the Clarity Challenge.

7 **Percent of Total Load:** Fine sediment particle reductions are shown as a percent of the entire Basin-wide pollutant budget

Assumptions

The results of the milestone analysis depend on challenging assumptions about funding availability, pollutant control implementation rates and availability of new technologies. The primary assumptions are captured below.

1. The minimum application level for current best practices (Tier 1) controls on urban areas in the third period is 20 percent. This assumption is necessary because implementers have already completed or are planning projects that will achieve this level before innovative practices (Tier 2) or new technologies (Tier 3) are available.
2. The maximum application level for pollutant controls to any given area is 80 percent. This reflects the understanding that implementation issues occur that cannot be determined at a Basin-wide planning scale. In particular, some areas might not be accessible, or pollutant reductions might not be achievable at certain sites. Site-specific challenges such as high groundwater, utility line interference, or bedrock intrusions could also make projects excessively costly in some areas.
3. For the purposes of quantitative analysis, the periods were assumed to be 5 years. This assumption allows the load reductions necessary to reach the Clarity Challenge to be achieved in 15 years. However, the Recommended Strategy and the milestones do not need to be tied to any particular number of years.
4. Funding in the amount of $500 million is available and expendable in each 5-year period. This assumption is considered challenging but reasonable because committed funding was reported as $1.123 billion during the first 8 years of the Lake Tahoe Environmental Improvement Program (EIP) (TRPA 2006, p. 2). Approximately 50 percent of this funding was expended on projects and research for water quality purposes (TRPA 2006, p. 7). Although the EIP's 8-year period is longer than the 5 years assumed for this analysis, the assumption is plausible given the implementation capacity that the Basin has gained during the first round of the EIP. This is the extent of the feasibility analysis that was considered for this assumption. The Recommended Strategy's cost estimates are above and beyond the previous funding of the EIP.
5. Advancements in atmospheric pollutant control technology can be implemented more quickly than advancements in urban pollutant controls. Urban control advancements necessitate new technology that must be researched, demonstrated and pilot tested. Higher technology controls for atmospheric sources, such as fine sediment-effective sweepers used in concrete manufacturing plants, are currently available.
6. The lag between the achievement of necessary load reductions and lake clarity response is assumed to be 10 years. The TMDL Technical Report includes an analysis using the Clarity Model that shows lake clarity achieving the clarity target within 15 years if all urban pollutant loads are reduced at a rate of 4.5 percent per year (Lahontan and NDEP 2007a, p. 5-56). At the outer limit, this implies that lake clarity lag could not be longer than 15 years. Another study of precipitation rates and their effect on Secchi depth measurements showed that the majority of clarity effects were noted within 2 years of precipitation extremes. Thus, it is reasonable to assume that the lake's clarity lag will be between 2 and 15 years.
7. Technology limitations determine early ability to produce advanced practices and new technology (Tiers 2 and 3, respectively) projects in the urban source category. This understanding results in three assumptions for the milestone analysis.
    - **First Period:** Research into new technology and general applicability of advanced practices

- **Second Period:** Limited application of advanced practices and pilot implementation of new technologies
- **Third Period:** Widespread availability of advanced practices and innovative technology

These assumptions are reflected in the milestone analysis constraints that allow only 10 percent of urban areas to be treated with new technology by the third milestone. Cost and opportunity constraints determine the ability to implement projects in later time periods.

ENCLOSURE 4

LAKE CLARITY CREDITING PROGRAM HANDBOOK

FOR LAKE TAHOE TMDL IMPLEMENTATION

September **2009**

Motivating Effective Action To Improve Lake Tahoe Clarity

A program of the Lahontan Regional Water Quality Control Board and Nevada Division of Environmental Protection, in cooperation with the Tahoe Regional Planning Agency and U.S. Environmental Protection Agency.

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Updates posted at

http://www.waterboards.ca.gov/lahontan/water_issues/programs/tmdl/lake_tahoe/index.shtml or

http://ndep.nv.gov/BWQP/tahoe.htm

THE LAKE CLARITY CREDITING PROGRAM

The Lake Clarity Crediting Program (Crediting Program) establishes the framework that connects on-the-ground actions to the goal of restoring Lake Tahoe clarity. It defines a comprehensive and consistent accounting system administered by the Lahontan Regional Water Quality Control Board (Water Board) and the Nevada Division of Environmental Protection (NDEP) to track pollutant load reductions from urban stormwater using Lake Clarity Credits. The Crediting Program aligns policies with ongoing implementation in order to drive accountability and motivate effective action to improve Lake Tahoe clarity.

The Lake Tahoe clarity standard is 29.7 meters.[1] In 2004 lake clarity was 22.4 meters.[2] The primary culprit in clarity loss is fine sediment particles less than 16 micrometers (µm) in diameter. Urban stormwater contributes more than 70 percent of fine sediment particles and a significant portion of the nitrogen and phosphorus loads to the lake.[3] The Clarity Challenge defines an interim clarity milestone of 24 meters. Meeting this milestone requires a 34 percent basin-wide reduction of fine sediment particles from urban stormwater.

■ A COMPREHENSIVE AND CONSISTENT ACCOUNTING SYSTEM

Tracking Lake Clarity Credits (credits) creates a consistent means to quantitatively assess progress toward the Clarity Challenge milestone.

CREDIT DEFINITION

The Lake Clarity Credit is defined on the basis of a relationship among pollutant load reductions (load reductions) of fine sediment particles, total nitrogen and total phosphorus[4]. The current credit definition focuses on load reductions of the primary pollutant of concern: fine sediment particles.

1 Lake Clarity Credit = 1.0×10^{16} fine sediment particles with a diameter smaller than 16 µm

Pollutant load reduction is defined as the difference between the estimated average annual amount of pollutants entering Lake Tahoe under standard baseline conditions[5] and the estimated average annual amount of pollutants entering the lake under expected conditions. All pollutant loading reaching a surface waterbody that flows to Lake Tahoe is assumed to enter the lake.

CREDIT POTENTIAL AND CREDIT AWARDS

The Crediting Program emphasized effective ongoing implementation of pollutant controls that result in pollutant load reductions to Lake Tahoe. It recognizes that initiating actions through designing and constructing a water quality improvement project, purchasing an effective sweeper, or adopting a municipal

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[1] The Lake Tahoe clarity standard is measured by Secchi Disk and defined in the Water Quality Control Plan for the Lahontan Region (Basin Plan), the Nevada Administrative Code Chapter 445A – Water Controls, and the Tahoe Regional Planning Agency Regional Plan – Threshold Standards defined in Amendment 82-11.

[2] Lake Tahoe clarity is defined as the depth below the lake surface at which a Secchi disk can no longer be seen as it is lowered.

[3] The Crediting Program tracks load reductions of all three pollutants of concern identified in the Lake Tahoe TMDL from urban stormwater: fine sediment particles, total phosphorus and total nitrogen. In the future the Crediting Program could be expanded to define load reduction estimation and condition assessment methods, and credits related to load reductions from atmospheric deposition to the lake surface, forest uplands, and stream bank erosion. Currently, Lake Clarity Credits pertain only to urban sources; however, the TMDL Tracking and Accounting Tool enables tracking and reporting of load reductions from nonurban sources.

[4] See Section 0.2 for a complete Lake Clarity Credit definition.

[5] The baseline conditions correspond to typical 2004 conditions. See Chapter 0 and the Catchment Credit Schedule Technical Guidance and Instructions for details.

ordinance creates the potential to reduce pollutant loading to the lake. However, to realize that load reduction potential, treatment best management practices (BMPs) must be effectively maintained, equipment must be operated at appropriate times, and municipal programs must engage citizens to change their practices.

Credits are awarded annually for effective, ongoing implementation of pollutant controls in urban catchments.[6] Effective implementation of pollutant controls results in actual conditions of urban lands and treatment BMPs that are near-to or better-than the expected conditions used as the basis for load reduction estimates. Actual conditions in a given year are compared to the expected conditions to determine the appropriate amount of credit to award in that year.

Condition assessment methods are used to determine actual conditions. When actual conditions in a given year are near-to or better-than expected conditions the actual loading from the catchment is likely the same or less than the expected loading. This is grounds for awarding the full credit potential amount for that year. If the actual conditions are worse than expected conditions the actual loading is likely to be higher than the expected loading. This is cause to award less than the full credit potential amount.

■ ALIGNING POLICIES WITH ACTIONS

The Crediting Program drives accountability and motivates effective action by aligning policies with on-the-ground actions. The Crediting Program tracks load reductions and credits. Figure A shows that load reductions and credits align (1) policies, (2) regulatory requirements and program goals, (3) implementation plans, (4) design and implementation of pollutant controls in specific catchments, and (5) maintenance activities and inspection results reported in annual stormwater reports. In particular, credits are used to determine compliance in National Pollutant Discharge Elimination System (NPDES) permits and Memoranda of Agreement (MOA).

Figure A: Credits align policies and on-the-ground actions –Credits and load reductions are used to align policies with actions and ongoing implementation.

Policies – TMDL Milestones, TRPA Thresholds & EIP Performance Measures

Load reductions are used by the Water Board, NDEP, the Tahoe Regional Planning Agency (TRPA) and the Environmental Improvement Program (EIP) partners to report progress toward meeting total maximum daily load (TMDL) load reduction milestones, TRPA threshold standards, and EIP goals.

Regulatory Requirements – NPDES Permits, MOA & TRPA Code

Credit requirements are the amount of credit an urban jurisdiction is required to achieve in a year, as defined in its urban stormwater NPDES permit or MOA. TRPA also uses load reductions as performance metrics during performance reviews to determine the release of development commodities, such as residential building allocation and commercial floor area.

Implementation Plans – Stormwater Management Plans & EIP Project Selection

Individual urban jurisdiction stormwater management plans (SWMP) define actions to meet load reduction requirements and achieve credit requirements. EIP project selection considers load reduction potential as one factor in determining funding priorities.

Pollutant Controls – Water Quality Improvement Projects, Maintenance Plans, Programs and Ordinances

Pollutant controls include water quality improvement projects, maintenance plans, and municipal programs and ordinances. Pollutant controls implemented in specific catchments establish the load reduction and credit potential.

[6] An urban catchment is a contiguous area containing urban land uses with runoff draining to a surface waterbody. This definition allows urban jurisdictions some flexibility to define urban catchments that work for their modeling and planning purposes. Any single square foot of land is included in only one urban catchment.

<u>Operations & Maintenance Activities</u> – <u>Sweeping Roadways, Maintaining BMPs & Implementing Programs</u>

Pollutant load reduction potential is realized when pollutant controls are effectively operated, maintained and implemented. Inspection results inform the prioritization of operations and maintenance activities.

<u>Stormwater Reports</u> – <u>Annual NPDES, MOA & Maintenance Efficiency Plan Reporting</u>

Inspection results and credit declarations are included in annual stormwater reports. Credit awards are determined by comparing actual conditions to expected conditions of pollutant controls. The sum of credit awards for an urban jurisdiction determines whether the jurisdiction is meeting the credit requirements defined in its NPDES permit or MOA.

Figure B illustrates how the sum of credits awarded for specific catchments is related to credit requirements included in NPDES permits and MOA. The example urban jurisdiction has several catchments that generate load reductions and credits. The credits awarded for each catchment are based on the actual conditions in the catchment each year. The urban jurisdiction is in compliance with credit requirements each year that it meets or exceeds the annual credit requirement.

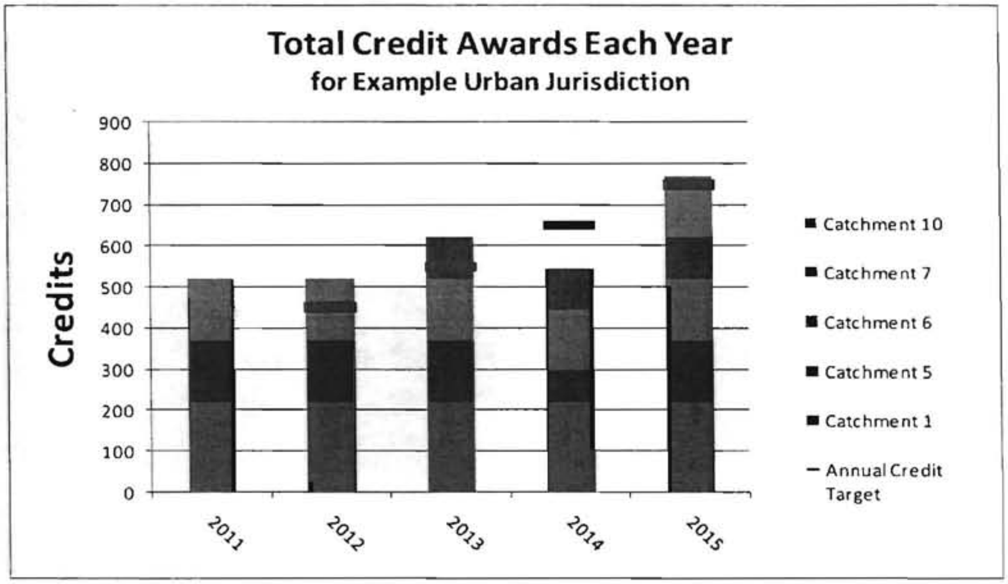

Figure B: Credit awards related to credit targets – A sample illustration of urban jurisdiction credit targets and credit awards. The red lines indicate the credit targets for an urban jurisdiction. The stacked bars show the total credits awarded each year. Each colored segment in the bars represents the credits awarded for a specific catchment.

■ PRIMARY PROCESSES AND SUPPORTING TOOLS

PROCESSES

The Crediting Program defines methods for, and roles in, the three Crediting Program primary processes: (1) establishing consistent load reduction estimates and catchment credit schedules for pollutant controls implemented in specific catchments, (2) awarding credits for ongoing implementation, and (3) managing and adjusting the Crediting Program to ensure that it continues to motivate effective action to improve Lake Tahoe clarity over time.

TOOLS

The Crediting Program encourages the use of a standard set of tools and methods. The Pollutant Load Reduction Model (PLRM) is the standard load reduction estimation tool that integrates load reductions achieved through combinations of pollutant controls, including source control practices and treatment BMPs in catchments. The BMP Maintenance Rapid Assessment Methodology (BMP RAM) and Road RAM are the standard condition assessment methodologies used to inspect and report actual conditions. The TMDL Accounting and Tracking Tool stores all credit information, and generates reports showing the number of credits awarded each year for specific catchments and urban jurisdictions. The TMDL Accounting and Tracking Tool also tracks and reports load reductions achieved, at all scales, from specific catchments to the entire Tahoe Basin.

Figure C shows the relationship between typical pollutant controls and these standard tools. It also indicates that effectiveness data generated through the Regional Stormwater Monitoring Program (RSWMP) are used to test load reduction estimations and condition assessment methods. RSWMP provides the scientific information necessary to improve standard tools and methods over time.

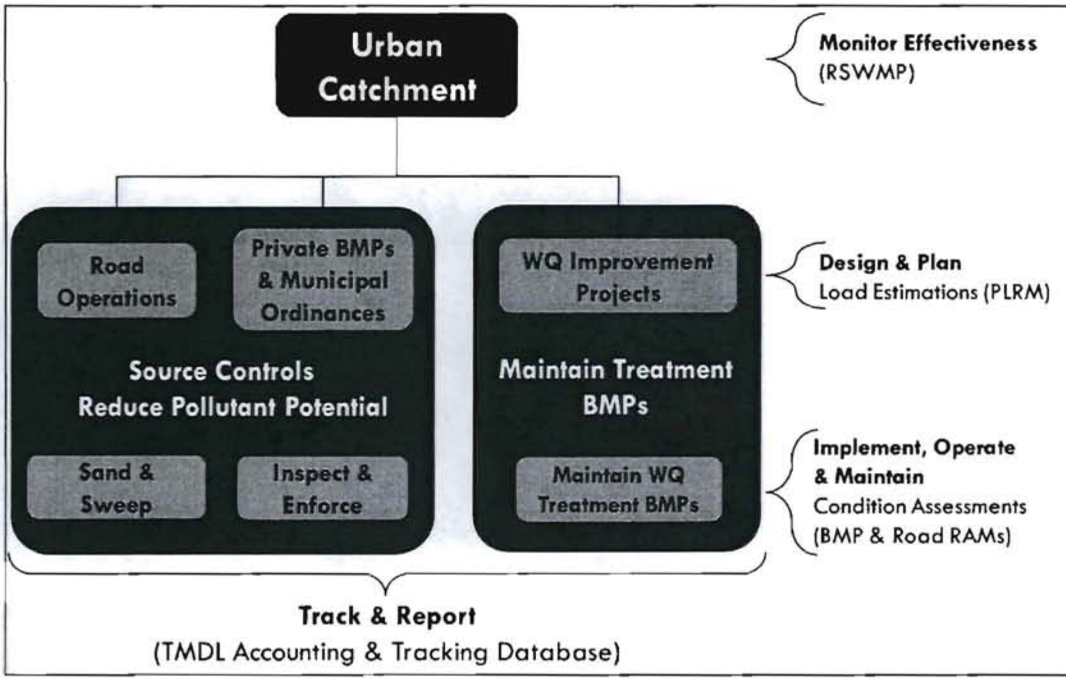

Figure C: Typical pollutant controls relationship to standard methods & monitoring – Pollutant controls are implemented in urban catchments. Condition assessment methods (BMP RAM & Road RAM) are used to inspect treatment BMPs and roads to determine how actual conditions compare to expected conditions used in load reduction estimates, using PLRM. Effectiveness monitoring conducted by RSWMP determines the observed load reductions from a catchment and compares them to the estimated load reductions. The TMDL Accounting and Tracking Tool calculates credit awards for ongoing implementation of pollutant controls and generates credit and load reduction reports.

■MOTIVATING EFFECTIVE ACTION

The Crediting Program motivates effective action to improve Lake Tahoe clarity by rewarding prioritization, encouraging cooperation, and enabling innovation and adaptive management. By quantifying load reductions based on local land use and meteorological conditions, the Crediting Program rewards actions that target areas with the greatest potential to achieve load reductions. Further, by focusing on the actual conditions present during each year, instead of rote adherence to static maintenance plans, the Crediting Program enables stormwater managers and maintenance personnel to determine when and how to maintain the condition of treatment BMPs and roads in the most cost-effective manner possible. This respects the professional judgment of stormwater managers while ensuring that the most important pollutant controls are effectively maintained.

The Crediting Program encourages cooperation among urban jurisdictions by enabling credits to be distributed. Credits generated in a catchment in one urban jurisdiction can be distributed to any urban jurisdiction in the Lake Tahoe Basin as determined appropriate by the urban jurisdictions. This enables urban jurisdictions to share equipment and expertise to reach the common goals of regulatory compliance and improved lake clarity.

The Crediting Program provides a structure to ensure that improvements to load reduction estimation methods and the credit definition minimize near-term compliance issues and thus are less politically charged and more likely to occur. Catchment credit schedules, developed for specific catchments, enable regulators and urban jurisdictions to commit to the credit potential for implementing actions for a defined number of years. This predictability enables urban jurisdictions to innovate and invest resources confidently—knowing that changes to load reduction estimation methods will not lead to near-term regulatory compliance issues. Further, by limiting the duration of catchment credit schedules, and requiring the use of the best-available science with

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new and updated load reduction estimates, the Crediting Program ensures that over time the number of credits awarded will match the best estimate of actual load reductions.

The regulatory, funding and implementation agencies within the Lake Tahoe Basin are committed to using scientific findings to inform policy and to direct action. The Crediting Program enhances the agencies' ability to meet this commitment by defining a transparent and practical approach that improves policies and targets cost-effective, on-the-ground actions to improve Lake Tahoe clarity.

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The Lake Clarity Crediting Program Handbook (Handbook) describes processes, identifies tools for completing related analyses, and provides examples to illustrate how to guide Crediting Program participants to efficiently implement the Crediting Program.

■ HANDBOOK ORGANIZATION

Urban jurisdiction stormwater managers are the primary audience of the Handbook. The Handbook defines the roles and responsibilities of the regulators, urban jurisdiction stormwater managers, scientists, and EIP partners and interested stakeholders. The Handbook includes hyperlinks and shortcuts to assist experienced users in quickly navigating to the point in the document necessary to complete specific steps. New users seeking an initial understanding of the Crediting Program should consider first reading through the relevant chapters of the document, then scanning the forms and associated technical guidance documents, and finally reading the appendices.

PROGRAM DESCRIPTIONS & PROCESS OVERVIEW CHAPTERS

Figure D shows the Handbook overall organization. Chapter 0 describes the Crediting Program in the context of related policies, establishes the official credit definition, defines the how credits may be used, and outlines roles in Crediting Program implementation. Chapters 1 through 3 define the specific steps to complete each of the primary Crediting Program processes: (1) estimating load reductions and establishing catchment credit schedules, (2) reporting conditions and awarding credits, and (3) reporting results and improving the Crediting Program.

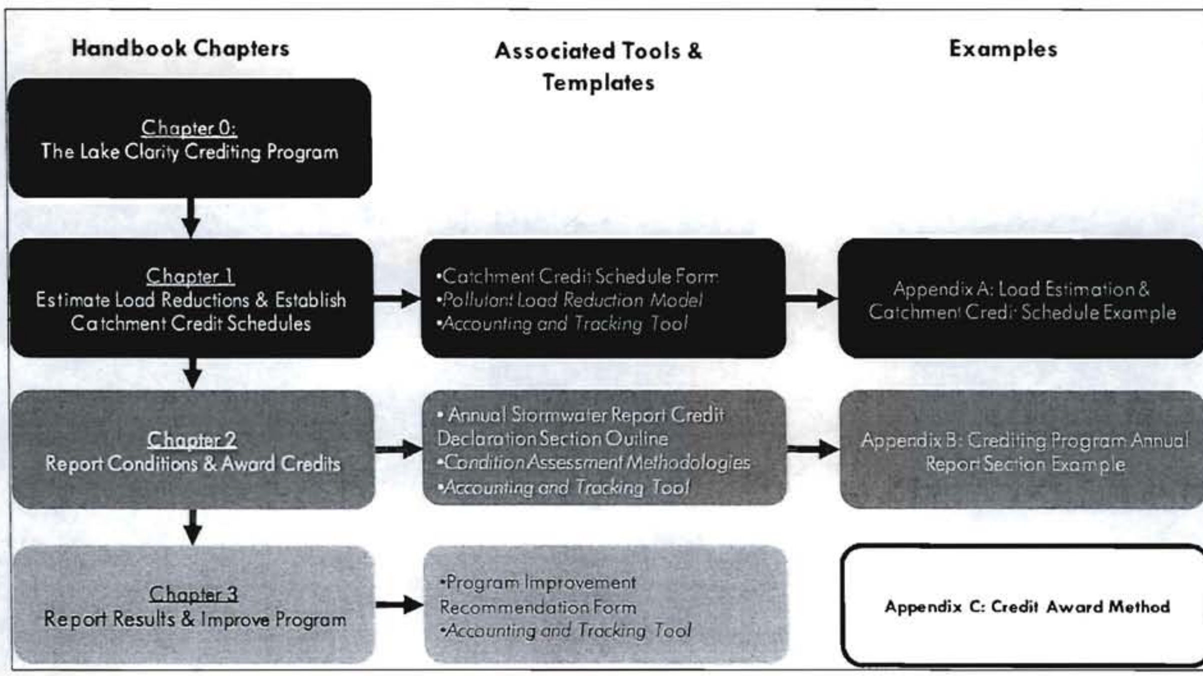

Figure D: Lake Clarity Crediting Program Handbook organization – Chapter 0 provides context and defines Lake Clarity Credits, Chapters 1 through 3 describe the primary processes: (1) estimating load reductions and establishing catchment credit schedules, (2) reporting conditions and awarding credits, and (3) reporting results and improving the Crediting Program. Tools and templates facilitate consistent and efficient completion of the processes. Italicized tools and templates are external to the Handbook. The appendices provide examples that illustrate how a typical stormwater manager and regulator implement the processes.

TOOLS & TEMPLATES

Following chapters 1 through 3 are a set of tools and templates that are to be used and completed at specified steps. These tools and templates include specific instructions to ensure consistent and efficient information transfer between urban jurisdictions, regulators and other involved parties. The tool and template instructions include detailed technical guidance defining how to complete related analyses.

APPENDICES EXEMPLIFYING PROCESSES & DETAILING TECHNICAL FRAMEWORK

Appendix A complements chapter 1. It contains a step-by-step example for developing a load reduction estimate and catchment credit schedules. Appendix B complements chapter 2, providing a step-by-step example for developing the Credit Declaration Section of an annual stormwater report and awarding credits. Appendix C presents the technical framework for relating load reduction estimates to condition assessment inspections results and defines the Crediting Program credit award method. Appendix C is useful for those developing load reduction estimates and implementation plans, but it is not required for understanding the mechanics of how to complete the primary processes to receive credit for implementing pollutant controls.

REFERENCES AND SHORTCUTS

References and a glossary of terms follow the appendices.

Certain text in the Handbook is bolded, italicized, underlined or otherwise formatted to facilitate the user's understanding of the Handbook. The text formatting tags are as follows:

- An underline indicates either a hyperlink to another section or step in the document, a tool or template included in the Tools and Templates section of the document, or a reference to additional information.
- The first instance of words defined in the glossary is italicized.
- The first instance of the primary role(s) in each step is bolded to indicate primary responsibility and required involvement for completing that step.
- Additional explanations, important definitions and equations are presented in text boxes.

COMPANION PROJECT REPORT

The Lake Clarity Crediting Program Project Report is a companion document that presents the rationale for many of the decisions related to Crediting Program design. It also describes options considered during the development of the Crediting Program and additional functions that could add to the scope and usability of the Crediting Program in the future.

■ USER SHORTCUT TABLES

The following set of tables enables urban jurisdiction stormwater program managers and regulators familiar with Lake Clarity Crediting Program operations to go directly to the specific steps, tools and templates necessary to complete specific steps defined in the Handbook. These tables include hyperlinks to items within the Lake Clarity Crediting Program Handbook.

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Urban Jurisdictions

Urban jurisdictions are involved in (1) developing load reduction estimates and draft catchment credit schedules, (2) reporting inspection results and declaring credits in annual reports, and (3) contributing suggestions to improve the Crediting Program through the annual program improvement process. Urban jurisdictions are directly involved in the steps of, and will use the tools and forms shown in, the Urban Jurisdiction shortcut table (Table A).

Process	Step #	Tools & Templates	Crediting Program Products
Estimate Load Reductions & Draft Catchment Credit Schedule	1.1	Catchment Credit Schedule	Draft Catchment Credit Schedule
Verify Load Reduction Estimate & Catchment Credit Schedule	1.2	Issue Resolution Punchlist	Final Catchment Credit Schedule
Register Catchment	1.3	Accounting & Tracking Tool	Registered Catchment
Inspect	2.1	BMP RAM	Inspection Results
Maintain, Operate & Administer Pollutant Controls	2.2		Inspection Results
Report & Declare Credits	2.4	Annual Stormwater Report – Credit Declaration Section Outline; Accounting & Tracking Tool	Annual Stormwater Report – Credit Declaration Section
Synthesize Findings	3.6	Program Improvement Recommendation Form	Synthesis of Findings Report; Program Improvement Recommendation

Table A: Urban jurisdiction shortcut table - Showing the steps with urban jurisdictions playing a necessary and active role, as well as the methods, tools and templates used and the resulting products.

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REGULATORS

Regulators, and specifically Water Board and NDEP staff, are involved in (1) reviewing load reduction estimates and approving catchment credit schedules, (2) conducting independent validation inspections, reviewing information submitted in annual reports, and awarding credits, and (3) leading the development of the Crediting Program Progress Report, the Synthesis of Findings Report, and program improvement recommendations. The Water Board and NDEP staffs are directly involved in the steps and will use the tools and forms shown in the Regulator shortcut table (Table B).

Process Step	Step #	Tools & Templates	Crediting Program Products
Verify Load Reduction Estimate & Catchment Credit Schedule	1.2	Issue Resolution Punchlist	Final Catchment Credit Schedule
Approve Final Credit Schedule	1.4	Accounting & Tracking Tool	Accepted Catchment Credit Schedule & Approved Catchment Registration
Validate Conditions	2.3	Accounting & Tracking Tool	Inspection Results
Award Credits	2.5	Issue Resolution Punchlist; Accounting & Tracking Tool	Credit Awards
Translate TMDL Allocations to Credit Requirements	3.1	Accounting & Tracking Tool	
Refine Protocols & Accepted Methods	3.2	Lake Clarity Crediting Program Handbook	Updated Handbook; Updated Identified Operational Improvements List
Prioritize Research & Monitoring Needs	3.3		Updated & Prioritized List of Areas for Investigation
Guide Monitoring & Research	3.4		
Report Program Performance	3.5		Lake Clarity Crediting Program Performance Report
Synthesize Findings	3.6	Program Improvement Recommendation Form	Synthesis of Findings Report; Program Improvement Recommendation
Engage Stakeholders	3.7		
Develop Program Improvement Recommendations	3.8	Program Improvement Recommendation Form	Program Improvement Recommendations
Decide Upon Program Improvement	3.9		Record of Decisions

Table B: Regulator shortcut table – Showing the steps with regulators playing a necessary and active role, as well as the methods, tools and templates used and the resulting products.

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