Community Watershed Partnership

Developing Community-Based Watershed Strategies –Final Report - December 2015

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ACRONYM LIST

BMP	Best Management Practice
CAP	Credit Accounting Platform
CASQA	California Stormwater Quality Association
CICU	Commercial-Industrial-Communications-Utilities
CHP	Constant Head Permeameter
CTC	California Tahoe Conservancy
CWP	Community Watershed Partnership
DCIA	Directly Connected Impervious Area
ECP	Erosion Control Project
EPA	Environmental Protection Agency
FSP	Fine Sediment Particles
ILA	Interlocal Agreement
IMP	Implementers' Monitoring Program
LCCP	Lake Clarity Crediting Program
LID	Low Impact Development
MFR	Multi-Family Residential
NDEP	Nevada Division of Environmental Protection
NHC	Northwest Hydraulic Consultants
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTCD	Nevada Tahoe Conservation District
PAC	Project Advisory Committee
PLRM	Pollutant Load Reduction Model
PLRP	Pollutant Load Reduction Plan
RAM	Rapid Assessment Method
ROW	Right-of-Way
RSWMP	Regional Stormwater Monitoring Program
SEZ	Stream Environment Zone
SFR	Single-Family Residential
SNPLMA	Southern Nevada Public Land Management Act
TAC	Technical Advisory Committee
Tahoe RCD	Tahoe Resource Conservation District
TMDL	Total Maximum Daily Load
TRPA	Tahoe Regional Planning Agency
UPC	Urban Planning Catchment
USFS	U.S.D.A. Forest Service
Water Board	Lahontan Regional Water Quality Control Board (Water Board)

INTRODUCTION

Lake Tahoe is among the largest, deepest, and clearest lakes in the world. Its cobalt blue appearance, spectacular alpine setting, and remarkable water clarity is recognized worldwide. Recreational opportunities and scenic vistas have made Lake Tahoe a top national and international tourist destination. While visibility into the lake's depths is currently at 70 feet, it is listed as impaired because over thirty feet of clarity has been lost since the late 1960s. To address the impairment, the Lake Tahoe Total Maximum Daily Load (TMDL) program, a 65-year plan to restore lake clarity to the 1967-1971 level, was adopted in 2011; it brought with it new regulatory requirements for state and local stormwater jurisdictions to reduce urban pollutant loads to Lake Tahoe.

Approved by the Environmental Protection Agency (EPA) and the states of California and Nevada, the TMDL sets targets for a significant reduction of fine sediments, nitrogen, and phosphorus flowing to Lake Tahoe. On the California side of the basin, the Lahontan Regional Water Quality Control Board (Water Board) issues a Municipal National Pollutant Discharge Elimination System (NPDES) permit to co-permittees and in Nevada the Nevada Division of Environmental Protection (NDEP) developed an Interlocal Agreement (ILA), to implement the Lake Tahoe TMDL. As part of the NPDES/ILA, local stormwater jurisdictions are required to implement urban best management practices (BMPs) to decrease pollutant loading from urban runoff, estimate the resulting pollutant load reductions, monitor and evaluate select urban catchment outfalls and BMPs for flow volumes and sediment and nutrient loads, and identify potential funding mechanisms. Area-wide stormwater treatment, rather than individual parcel-level BMPs, has become a preferred BMP strategy for effective TMDL implementation. Expected benefits of area-wide stormwater treatment include costs savings related to the economy of scale, and effective maintenance and tracking of pollutant loads.

The main objectives of the Community-Based Watershed Strategies Grant were to:

- Support partner agencies in better integrating watershed planning efforts for both the private parcel BMP retrofit and the Lake Tahoe TMDL programs while improving public support and perception of Area Plan projects,
- Identify community interest and ability to contribute to long-term stormwater maintenance and monitoring needs,
- Build local Conservation District capacity to assist local jurisdictions with the stormwater catchment registration process,
- Continue to offer technical services and education/outreach to the public regarding the measures property owners can take to reduce environmental impacts to Lake Tahoe,
- Increase the data resolution of NPDES permit stormwater compliance monitoring by sampling additional storms.

This was accomplished through a program called the Community Watershed Partnership, which is intended to provide useful conservation and TMDL implementation information to Basin managers, regulators, stormwater jurisdictions, and the community. Three case studies are provided for area-wide planning in the Meyers and Tahoma communities in El Dorado County and the Tahoe Valley area in the City of South Lake Tahoe. In addition, a summary of a California-Tahoe initiative to analyze stormwater program costs and evaluate alternative funding strategies is presented. Finally, as a result of this grant, Tahoe RCD staff is now fully trained in Lake Tahoe TMDL pollutant load estimation and monitoring methods; assistance with TMDL permit planning and compliance was provided as part of this project for both El Dorado County and the City of South Lake Tahoe. Under these funds Tahoe RCD also continued

promote environmental conservation by providing services to the public such as education, outreach, and direct technical assistance.

PROJECT BACKGROUND

Road systems and urban development have increased the total impervious area in the Tahoe Basin, resulting in increased stormwater runoff volumes due to decreased natural infiltration. Stormwater runoff transports sediment, as well as nitrogen and phosphorus, resulting in more pollutant loading from impervious urban catchments located within each jurisdiction. Areas with greater hydrologic connectivity to Lake Tahoe are believed to have the highest potential to contribute pollutant loads directly to the lake. To date, jurisdictions around the lake have spent tens of millions of dollars implementing environmental improvement projects with the primary purpose to reduce stormwater impacts to Lake Tahoe. These projects often include numerous stormwater treatment strategies spread throughout urban catchments, and may include stormwater infrastructure in the form of BMPs such as curb and gutter, sediment traps, a variety of treatment vaults and infiltration mechanisms, street sweepers, constructed wetlands, and source control measures like slope stabilization.

Lake Tahoe TMDL

The Lake Tahoe TMDL is a comprehensive, long-term plan to reverse the decline in deep-water transparency of Lake Tahoe and restore mid-lake clarity to the 1967-1971 level of 29.7 meters (97.4 feet). TMDL science suggests that up to two-thirds of the decrease in clarity is attributable to fine sediment particles (FSP, <16 µm in diameter), and that the urbanized areas, roadways in particular, account for approximately 72% of FSP that eventually enter the lake (Lake Tahoe TMDL Technical Report, 2010).

Following the adoption of the TMDL in August 2011, the Lahontan Regional Water Quality Control Board (Water Board) issued a Municipal National Pollutant Discharge Elimination System (NPDES) permit for urban stormwater discharges from El Dorado County, Placer County and the City of South Lake Tahoe. Nevada Division of Environmental Protection (NDEP) soon followed suit with Washoe and Douglas Counties, and developed an Interlocal Agreement (ILA) with Nevada jurisdictions. The NPDES permit and ILA require stormwater jurisdictions in the Lake Tahoe Basin to take measures to decrease pollutant loading from stormwater runoff in urbanized areas. To comply with the NPDES and ILA, local jurisdictions must implement pollutant controls to decrease FSP and nutrient inputs, must estimate pollutant load reductions as a result of implemented pollutant controls, and must monitor and evaluate select urban catchments and Best Management Practices (BMPs) for sediment and nutrient loads.

The Lake Clarity Crediting Program (LCCP) was developed by Lahontan, NDEP, Tahoe Regional Planning Agency (TRPA), and the EPA as an accounting system to track pollutant load reductions for the Lake Tahoe TMDL. The Pollutant Load Reduction Model (PLRM) is the standard basin-wide pollutant load reduction estimation tool for the LCCP. Estimated pollutant load reductions in selected catchments are translated into credit; the catchments are then registered on the Credit Accounting Platform (CAP), the online TMDL interface for local urban jurisdictions and regulators. The LCCP developed two rapid assessment methods (RAM) that serve as checks to evaluate the condition of implemented pollutant controls – BMP RAM for BMPs installed by the local jurisdictions, and Road RAM for improvement to road conditions. PLRM, CAP, Road RAM, and BMP RAM are known collectively as the Lake Tahoe TMDL Tools. Over the course of this project, these tools were being developed and/or improved. As a result, several different versions of the PLRM (v1.1, v2.0.2, and v2.1) were used to provide model results in this

document. Although improvements to the model were done in such a way as to minimize differences between model versions, each model will provide similar, but slightly different results.

In California, jurisdictional Pollutant Load Reduction Plans (PLRPs) required by the Lake Tahoe TMDL define specific load reduction actions stormwater jurisdictions plan to achieve throughout the watershed. Local California jurisdictions are now in the process of registering catchments in order to demonstrate load reduction achievements, receive credits, and comply with the TMDL.

To assist the local stormwater jurisdictions with NDPES/ILA compliance, in October 2013 the Tahoe RCD began TMDL stormwater compliance monitoring for the Lake Tahoe basin under the Southern Nevada Public Land Management Act (SNPLMA) funded Implementers' Monitoring Program (IMP), a component of the Lake Tahoe Regional Stormwater Monitoring Program (RSWMP).

In addition to compliance monitoring, the California jurisdictions are required to develop a financial plan to ensure a sustainable funding source to implement a multi-decadal TMDL program. Funds necessary to comply with the future monitoring requirements, pollutant load reduction modeling, catchment registration, and implementation of pollutant control measures will be challenging to secure. In order for the TMDL to function as designed however, it is important that a long term funding strategy be both identified and supported by the community.

Community Watershed Partnership

The Community Watershed Partnership (CWP) was developed through funding provided by SNPLMA, and sponsored by both the Natural Resources Conservation Service (NRCS) and the EPA. The funding for this program is intended to identify and address natural resource concerns or needs at a watershed level, and is designed to engage a variety of stakeholders to help facilitate communication between landowners, the general public, and Basin managers while furthering TMDL implementation and the restoration of Lake Tahoe.

The CWP approach complements the many environmental improvement projects implemented around the Lake Tahoe Basin by the California Tahoe Conservancy (CTC), U.S.D.A. Forest Service (USFS), and the local stormwater jurisdictions. Improvements gained in water quality have largely resulted from urban stormwater capital improvement projects, as well as restoration work in stream environment zones. In addition to implementing large scale projects, there are opportunities for each private property owner to contribute to watershed restoration efforts by either implementing individual water quality BMPs on their parcel, or by partnering with stormwater jurisdictions on area-wide treatment. Until very recently, the opportunity for private property owners to participate in an area-wide treatment facility was non-existent. Ultimately, successful implementation of BMPs on both the public and private scale will move Lake Tahoe closer to attaining its clarity goals. How each neighborhood or urban center executes this process will be a focus for Basin managers for the next several decades.

The TRPA Code of Ordinances requires BMPs on all private parcels in the Tahoe basin. In 2002, the Tahoe RCD, the Nevada Tahoe Conservation District, NRCS, and the TRPA adopted a Memorandum of Understanding to establish a partnership that would provide technical support to homeowners, contractors, and property managers in implementing water quality BMPs on private property. Through grant funded incentive programs, the Tahoe RCD and its partners provided cost-free property evaluations and BMP implementation plans for over fifteen years. However, only about three out of every ten private properties on the California side of the Tahoe Basin have installed BMPs, leaving the majority of private property owners in California out of compliance with the TRPA Code. Responding to these numbers, Lake Tahoe stormwater managers are evaluating creative solutions to reduce erosion in our watersheds and capture stormwater runoff draining to Lake Tahoe.

Over the past decade the Conservation District role has been to assist single family homeowners, whereas TRPA's role has been to assist the multi-family and commercial properties in complying with the BMP Retrofit Program. However, following this decade long effort to assist with compliance and evaluating the cost benefit of this effort, partnering agencies have recognized a need to modify the BMP Retrofit Program to consider possible proficiencies that can be gained through the development of area-wide treatment systems; both in the residential and commercial corridor. Fundamentally, a programmatic change has been identified to integrate the BMP Retrofit Program into a larger Stormwater Program, especially given the future direction of stormwater monitoring and TMDL attainment. This community planning work started as part of a CWP effort with previous funding from the NRCS. Utilizing the Conservation Districts to continue the facilitation of this approach will help to better assimilate the BMP program with TMDL Management Programs around the Tahoe Basin.

More recently, the TRPA adopted the 2012 Regional Plan update which encourages both regional stormwater treatment options and community input into the planning process. The TRPA has been working with community leaders, local jurisdictions, and residents to develop a series of "Area-wide Community Plans" around the Lake Tahoe Basin. These Plans will help establish designated land uses within the boundaries of the Community Plan area - complimenting the community engagement and planning work performed with these proposed CWP funds.

The EPA's Community Based Watershed Strategy grant enabled the Tahoe RCD to explore approaches that integrate strategies for public and private solutions using education, information sharing, partnership development and project implementation in the watershed. Through a community-based approach Tahoe RCD provided an increase in general knowledge of restoration objectives, opportunities for improving environmental stewardship, and enhancements to the Lake Tahoe Basin's BMP and TMDL programs.

PROJECT SCOPE

The overarching purpose of the Community-Based Watershed Strategies Grant was to assist local jurisdictions, private property owners, land managers, environmental agencies, and commercial businesses with TMDL implementation and promote environmental conservation through a community-based watershed approach. The intent was to focus the community-based effort on implementation and maintenance of individual and jointly-treated BMPs for protection and restoration of water quality. Through an integrated strategy for public and private partnership using education, information sharing and implementation, the project intended to increase general knowledge of restoration objectives, opportunities for improving environmental stewardship, and enhancement of the BMP retrofit program. In addition, this project intended to connect the private and public works EIP projects while being adaptable to local community priorities. The specific objectives of this project were the following:

1) Support partner agencies in better integrating watershed planning efforts for both the private parcel BMP retrofit and the Lake Tahoe TMDL programs while improving public support and perception of Area Plan projects,

2) Identify community interest and ability to contribute to long-term stormwater maintenance and monitoring needs,

3) Build local Conservation District capacity to assist local jurisdictions with the stormwater catchment registration process,

4) Continue to offer technical services and education/outreach to the public regarding the measures property owners can take to reduce environmental impacts to Lake Tahoe,

5) Increase the data resolution of NPDES permit stormwater compliance monitoring by sampling additional storms.

The Meyers and Tahoma communities in El Dorado County and the Tahoe Valley area in the City of South Lake Tahoe were selected for CWP engagement due to several factors: the development of the Meyers Area Plan by El Dorado County and TRPA, the development of the Tahoe Valley Area Plan by the City of South Lake Tahoe, low private property BMP implementation rates, and the potential for stormwater pollutant generation (Figure 1 & Figure 2). Additionally, the Tahoe RCD performed a technical analysis of the Tahoma watershed to help support TMDL adaptive management actions (Figure 3). Also in effort to assist local jurisdictions with TMDL compliance, the Tahoe RCD initiated a Stormwater Funding Partnership, which evaluated current and anticipated future program costs as well as alternative funding strategies. To improve internal Tahoe capacity to assist local jurisdictions with TMDL permit/agreement compliance, one catchment each was chosen to work through the registration process (PLRM modeling, BMP RAM, and CAP registration) for the City of South Lake Tahoe and El Dorado County (Figure 4 & Figure 5). Additionally, Tahoe RCD staff were trained Road RAM and assisted with Road RAM measurements in both El Dorado County and the City of South Lake Tahoe. Tahoe RCD staff was also very involved in the Lake Tahoe TMDL Stormwater Tools Improvement process, and provided valuable feedback and improvement to the Stormwater Tools. Tahoe RCD also promoted environmental conservation through education, outreach, and direct technical assistance to the public. An explanation of task-by-task grant accomplishments is included as Appendix A; the format of the task-by-task grant accomplishments follows the format of the Community Watershed Strategies grant quarterly reports.

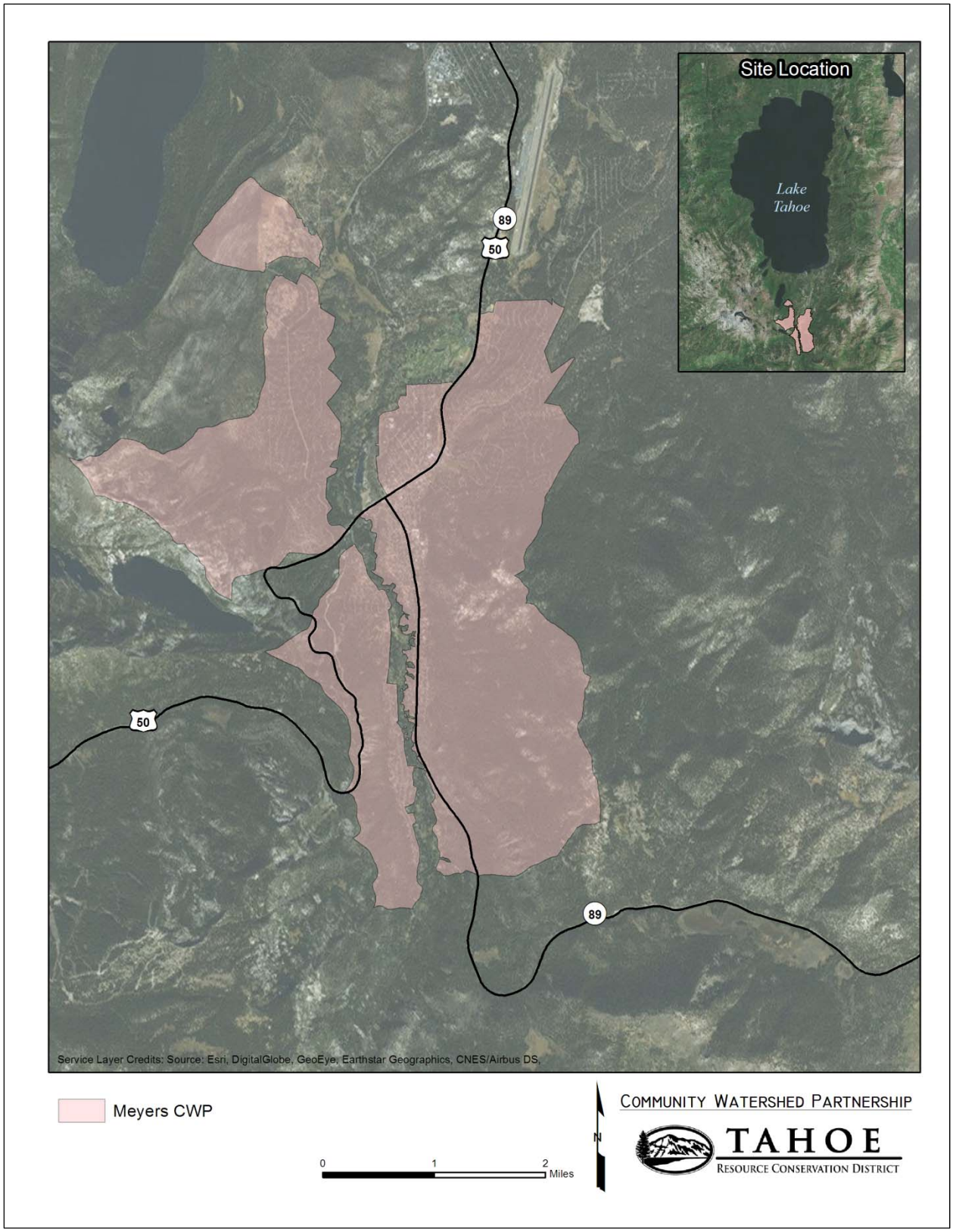


Figure 1 Community Watershed Partnership Modeling Project Area, Meyers California.

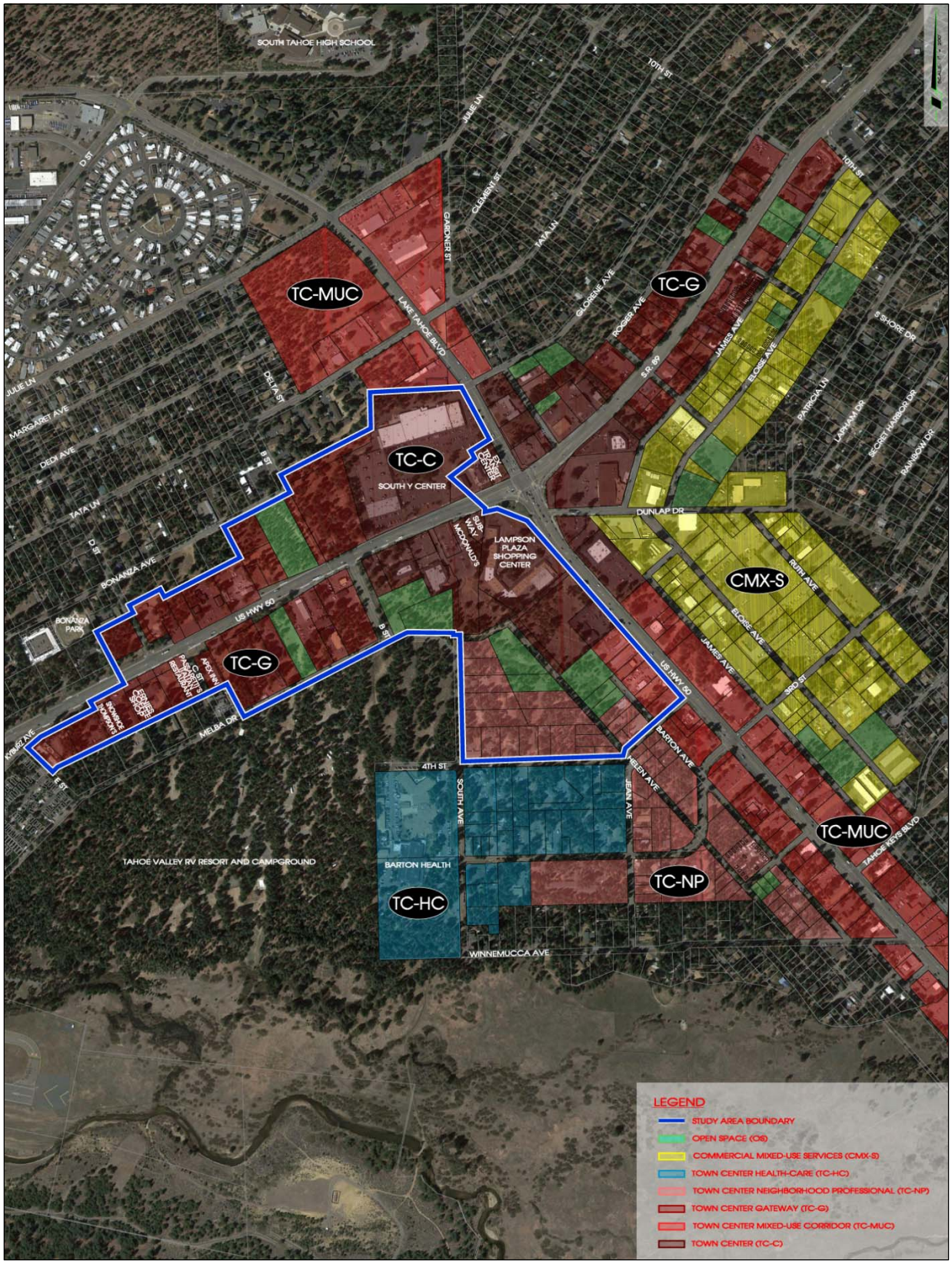


Figure 2 Community Watershed Partnership Initial Study Area, Tahoe Valley Greenbelt, City of South Lake Tahoe, California (solid blue line denotes boundary of study area).

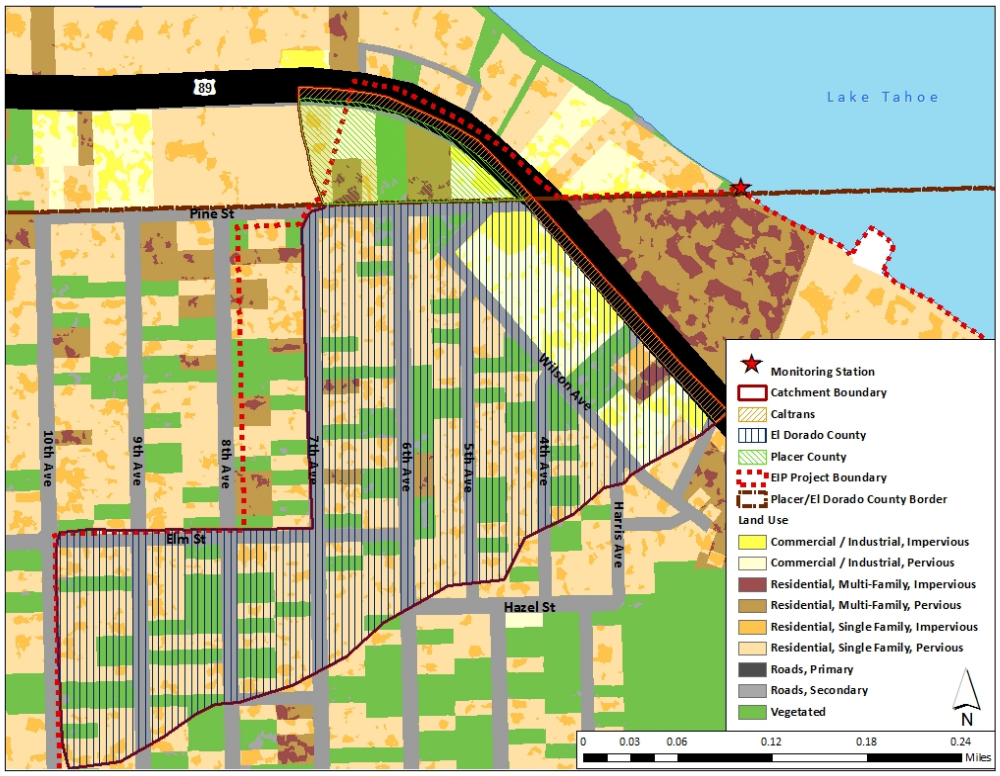


Figure 3 Tahoma monitoring station, including catchment boundary, EIP project boundary, and land use.

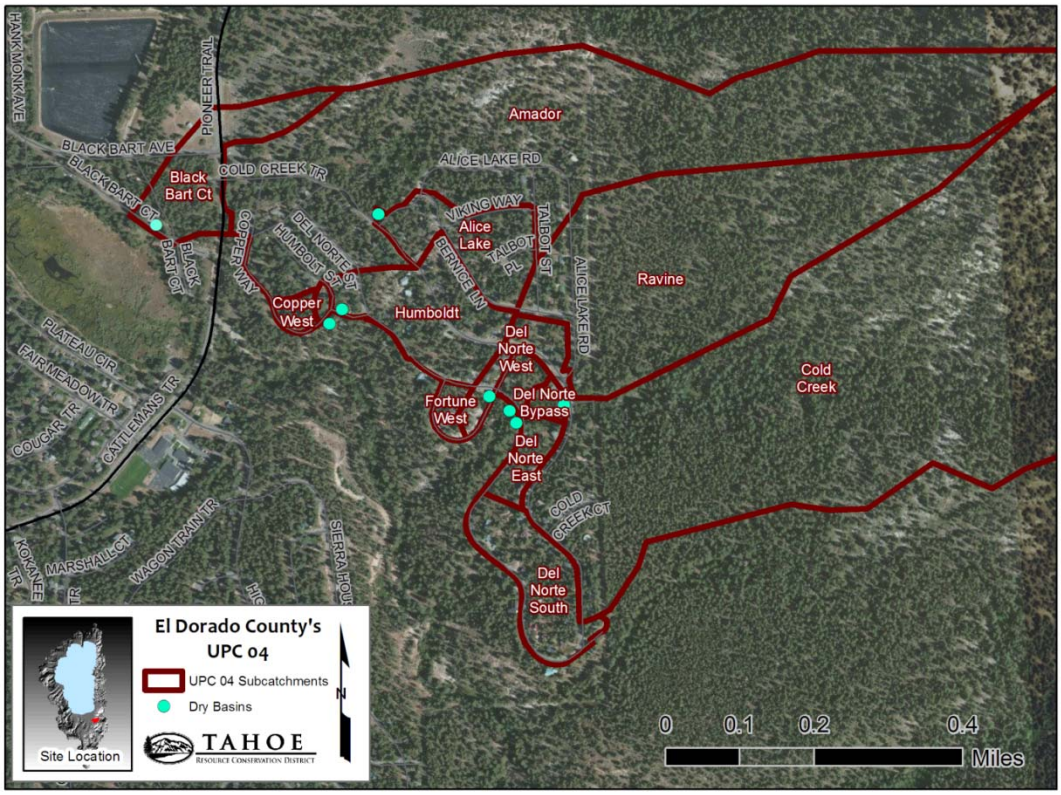


Figure 4 PLRM v2.1 subcatchment delineation for El Dorado County's UPC 04.

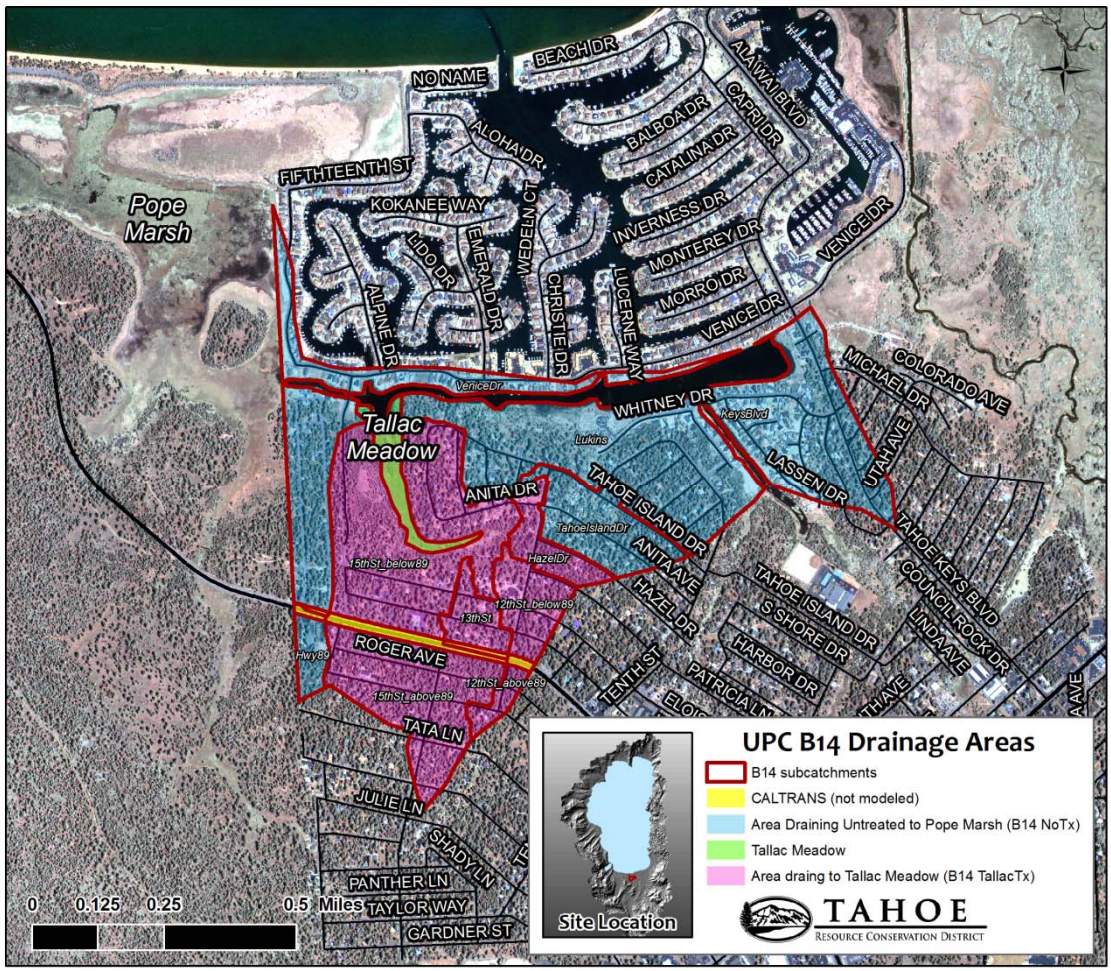


Figure 5 PLRM v2.0.2 subcatchment delineation for the City of South Lake Tahoe's 12th Street ECP (UPC B14). Area draining to Tallac Meadow is highlighted in pink, area draining untreated to Pope Marsh is highlighted in blue, and Caltrans area is highlighted in yellow (Caltrans not modeled).

AREA-WIDE PLANNING

The CWP strategy for Tahoma, Meyers, and Tahoe Valley was intended to provide useful TMDL implementation information to Basin managers, regulators, and stormwater jurisdictions. This section fulfills objective # 1 of the Community Based Watershed Strategy Grant: "Support partner agencies in better integrating watershed planning efforts for both the private parcel BMP retrofit and the Lake Tahoe TMDL programs while improving public support and perception of Area Plan projects". The Tahoma, Meyers, and Tahoe Valley communities were identified as priority watersheds for development of community-based watershed strategies through a CWP ranking process that evaluated proximity to the lake, slope, soils, precipitation, and modeled pollutant load contributions. The development of the CWP Strategy was guided by three Technical Advisory Committees (TACs) led by the Tahoe RCD, and in partnership with EPA, the CTC, the USFS, El Dorado County, the City of South Lake Tahoe, the Water Board, and sub-consultant RO Anderson to ensure the projects were well coordinated and relevant to other projects implemented in the watershed. The TACs also helped identify project goals, and provided input on project execution.

The Tahoe RCD reached out to the Tahoma and Meyers communities in El Dorado County, as well as the City of South Lake Tahoe through a program called the Community Watershed Partnership to provide landscape conservation planning and technical services related to BMP implementation and area-wide stormwater planning. As part of this community engagement effort the Tahoe RCD also surveyed Meyers' homeowners and business owners on their willingness to support the management and treatment of stormwater on an area-wide scale in lieu of implementing individual parcel-level infiltration BMPs. Individual commercial property owners within the City's Tahoe Valley Area Plan were also interviewed. The purpose of the interviews was to determine the level of interest commercial property owners might have for supporting the management and treatment of stormwater through a Greenbelt design project that might include bike and pedestrian connections, and recreation amenities that could serve both locals and visitors.

As a result of these efforts, two separate conceptual drawings for an area-wide stormwater system with integrated community amenities in both Meyers and Tahoe Valley are provided (four total). Additionally, PLRM estimates are included for Tahoma, Meyers, and Tahoe Valley to investigate the pollutant load reduction potential for private parcel BMPs versus area-wide treatment systems. Although there are many advantages of area-wide stormwater treatment over individual parcel BMPs, community perception of area-wide treatment was not always positive. Engaging the community early in the planning stages is critical to gain community support and trust for ultimate project success.

Case Study: Tahoma

The Tahoma catchment is considered a rural community on the west shore of Lake Tahoe. The 49.5 acre catchment straddles the Placer County/El Dorado County border and comingles waters from both jurisdictions (Figure 3), plus waters from the Caltrans maintained Highway 89. The land-uses in this catchment are primarily moderate density residential and secondary roads in the Tahoe Cedars subdivision, but also include some commercial/industrial/communications/utilities (CICU) and primary roads. Twenty-eight percent of the catchment area is impervious. The runoff from this catchment has strong hydrologic connectivity to Lake Tahoe and discharges pollutant loads directly to the lake. As of 2014 Tahoma has low BMP implementation rates of 14% for single-family residential (SFR) BMP, and 0% for both MFR and CICU. Evaluating community interest in an area-wide plan or a benefit assessment district was not conducted under this project. Refer to Appendix B for the *Tahoma, CA - Final Watershed Strategy Report.*

PLRM Modeling: Tahoma

Modeling for the Tahoma catchment was conducted using PLRMv2.0.2. Approximately half of the Tahoma catchment drains to a large (16,617ft^3) detention basin located on the corner of 6th Avenue and Elm Street (referred to as "6th Avenue detention basin"). The Tahoma catchment is divided into three separate sub-catchments for PLRM modeling: the area above 6th Avenue detention basin (the upper watershed), the area below 6th Avenue detention basin (the lower watershed), and the area within Caltrans' jurisdiction (Figure 6 & Figure 7). According to PLRM v2.0.2, the 6th Avenue detention basin treats 90% of the runoff from the catchment that drains into it under baseline conditions.

Due to the high treatment capacity of the 6th Avenue detention basin, the Tahoe RCD investigated what type of work could be performed below the 6th Avenue basin to help El Dorado County in achieving cost effective management strategies for TMDL implementation.

In the Tahoma sub-catchment below the 6th avenue detention basin, the pervious area in El Dorado County's right-of-way (ROW) located outside of a sensitive stream environment zone (SEZ) totals 96,600 ft^2. If less than 20 percent of this area were converted to LID infrastructure such as rain gardens, microbasins, or bio-swales, it could provide in 16,430ft^3 of stormwater treatment volume capacity (assuming a 1 ft depth capacity), similar to the treatment capacity of the 6th Avenue detention basin. PLRMv2.0.2 model results for FSP reduction using LID infrastructure are shown in Table 1; the results indicate if 25% of the roads in the lower watershed drained to LID infrastructure, FSP would be reduced by approximately 2,100 lbs/year or 10.5 credits. If 100% of the roads in the lower watershed drained to LID infrastructure, PLRM estimates a reduction of approximately 7,000 lbs/year of FSP (or 35 credits).

Figure 7 shows BMP compliance rates for SFR private parcels in the Tahoma catchment. There are currently 16 parcels that have BMP compliance certificates in the Tahoma catchment, while 115 SFR parcels have not yet implemented BMPs. The range of TMDL pollutant load reduction credits achieved through implementing area-wide treatment in the county's ROW could provide a large potential for attaining TMDL credits. Alternatively, working with 115 individual homeowners to implement SFR BMPs is likely a more staff intensive and costly approach to attaining TMDL credits. Specifically, if the County were to achieve 100 percent SFR compliance in the Tahoma watershed they would attain only 0.8 credits (Table 2) as compared to the estimated 10 to 30 credits by implementing dispersed LID treatment in the ROW (Table 1).

At this time, it is not likely that the County would pursue regulatory action on SFR parcels to achieve this level of TMDL credit; a more palatable approach however, might involve the development of a benefit assessment that would guarantee long term maintenance of infrastructure, while homeowners could

receive a BMP certificate of completion from TRPA once source control measures alone are implemented. On average with a typical lot, installing SFR BMPs can cost between $1,000-$10,000. A common constraint for implementing BPMs is that many residents don't have the available funding to either install or pay someone to install their BMPs. A benefit assessment could allow for a spreading out of the SFR cost over a 25 to 40 year period and the County would then have funding for maintenance and TMDL load reduction accounting; this approach offers regulatory compliance for homeowners and the County. Through similar CWP efforts in the Tahoe Basin, the Tahoe RCD and TRPA have seen that this type of private-public partnership encourages homeowners to do their part, especially when they see leadership from local government that brings cost effective solutions.

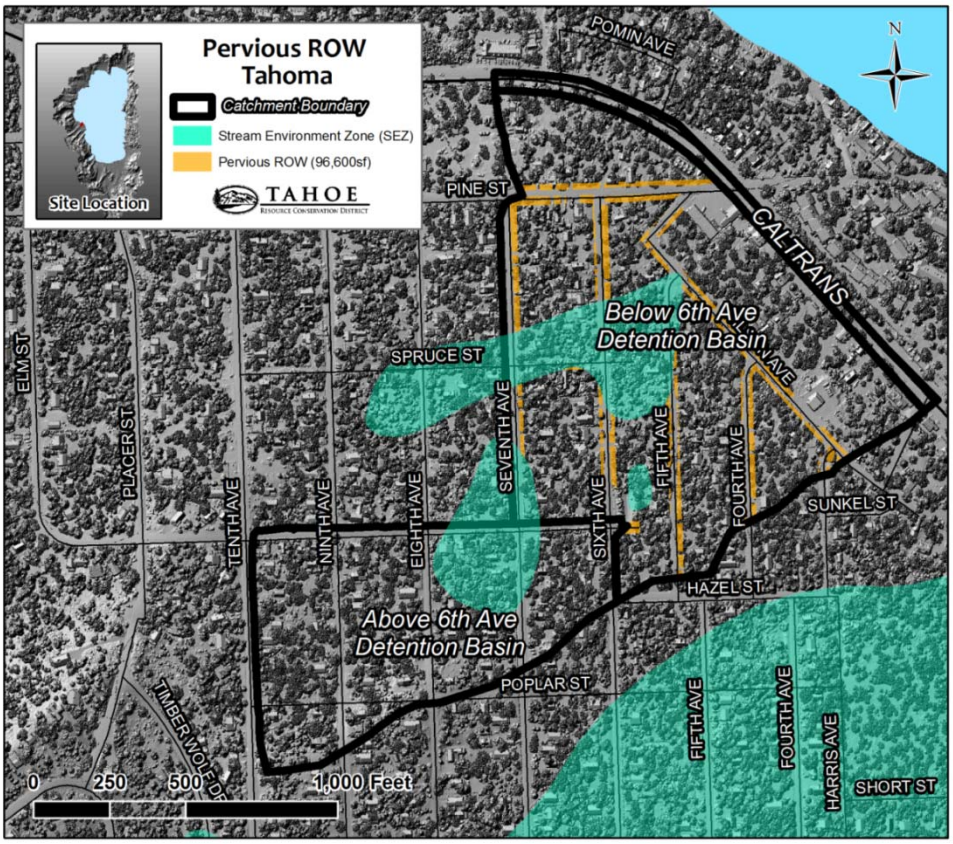


Figure 6 El Dorado county pervious right-of-way outside of the stream environment zone (SEZ) in the catchment below 6th Avenue detention basin in Tahoma.

Table 1 Tahoma catchment FSP reduction for LID infrastructure.

Tahoma Catchment - Below 6th Ave Detention Basin Pervious channel with 16,430 cf volume capacity			
% Roadway draining to LID	FSP % reduction	FSP lbs/year reduction	# Credits
25	24.9	2,102	10.5
50	49.6	4,186	20.9
75	73.9	6,234	31.1
100	83.1	7,008	35.0

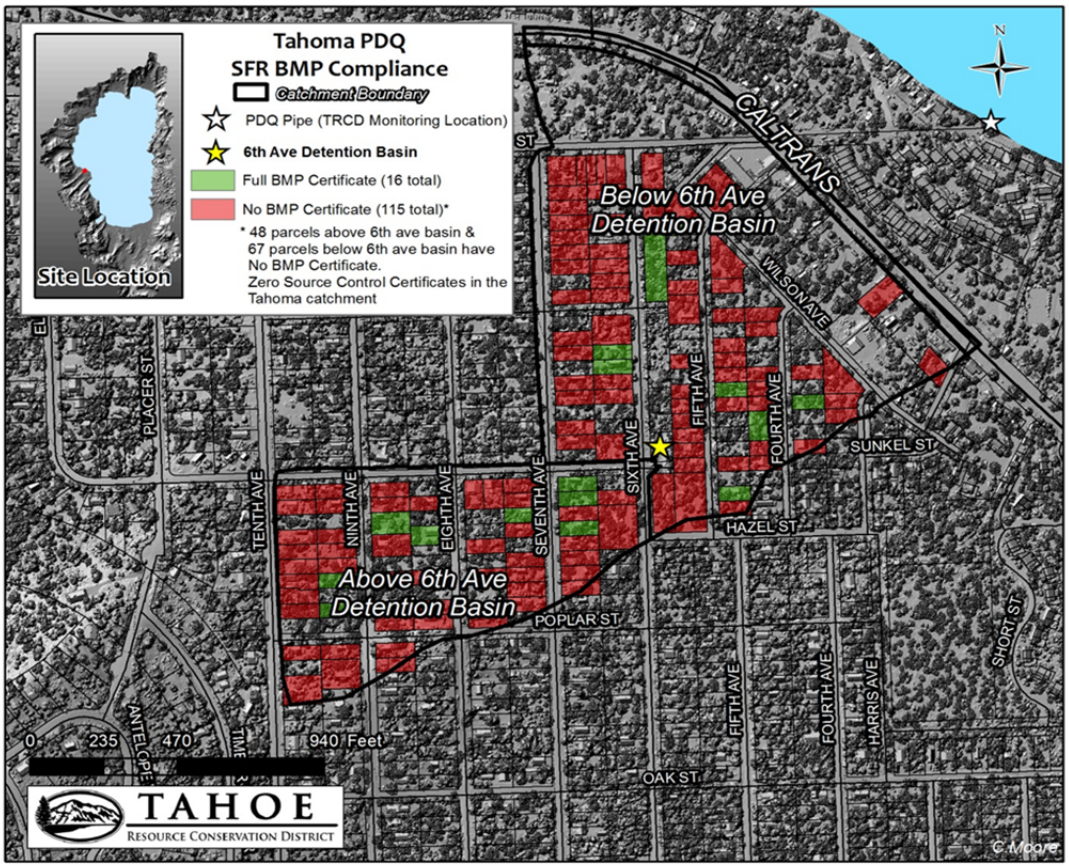


Figure 7 Tahoma Catchment and Single Family Residential BMP Compliance (overall SFR BMP compliance is 14%).

Table 2 Number of potential Lake Clarity Credits that could be obtained through 100% SFR BMP compliance in the Tahoma catchment.

Pollutant Load Reduction Potential Tahoma	
BMPs	**# Credits**
100% SFR BMP Implementation	0.8

Case Study: Meyers

(Top Row left to right). Meyers Commercial-Core along US Highway 50 and Meyers Creek with Adjacent Meadow (Source: Coleen Shade)

Meyers functions as one of 6 "gateways" into the Lake Tahoe Basin. However, more visitors enter the Tahoe Basin through Meyers than through any other entry point. Meyers serves as the residential, commercial, and public service hub for the El Dorado County portion of the Lake Tahoe Basin. In 1993, the Meyers Community Plan was adopted by both the TRPA and El Dorado County to guide planning and development in the Meyers commercial core and to be responsive to the unique circumstances found within the built environment and the natural landscape. The area has a relatively low rate of BMP implementation (~17%).

With the adoption of the TRPA's Regional Plan Update in 2012, an effort is underway to update existing Community Plans, which are now being called Area Plans, throughout the Basin. The Meyers Area Plan (Area Plan) was in the draft stages during the efforts of this study. The current draft of the Area Plan builds upon the 1993 plan. The Area Plan also includes lands not previously contained within the 1993 plan and includes additional implementation measures to achieve both economic and environmental objectives.

The first stages of this project were focused on convening a TAC including agency representatives from the Tahoe RCD, EPA, El Dorado County, and the consultant team from RO Anderson. Based on the TAC discussions, the consultant team was directed to develop two BMP concept strategies for the Meyers commercial core (Figure 8 & Figure 9). In addition to concept designs, the consultant team was asked to interview existing property and business owners within the Meyers commercial core that represented properties that had either complied with BMP requirements or had not yet installed BMPs. The purpose for the interviews was to gauge the interest in supporting (both in concept and financially) the implementation of an area-wide BMP/stormwater system that would provide conveyance and treatment throughout the identified study area for both public and private properties. Refer to Appendix B, the *Tahoe Valley & Meyers, CA - Final Watershed Strategy Report*, for the full report.

Concurrent to the Tahoe RCD's CWP effort in Meyers, the Area Plan led by El Dorado County and TRPA was nearing completion of a public draft. Both the content and the process of the Area Plan was questioned by the community, and during the summer of 2014 newspaper articles and public opinion seemed to suggest that the community was not interested in new development in Meyers. The controversy and skepticism of the Area Plan became a real constraint for implementing tasks planned

for the CWP project. In fact, the Tahoe RCD was asked by the County and TRPA to hold off from bringing the developed area-wide strategies to the Advisory Council and the community (Figure 8 & Figure 9). At the final TAC meeting, it was decided that due to low support from business and property owners, coupled with topographic constraints for developing an area-wide system, pushing forward with the CWP project could affect future opportunities for area-wide stormwater treatment.

Meyers Study Area 2014 – Flooding Across from Lira's Market (Source: John Dayberry)

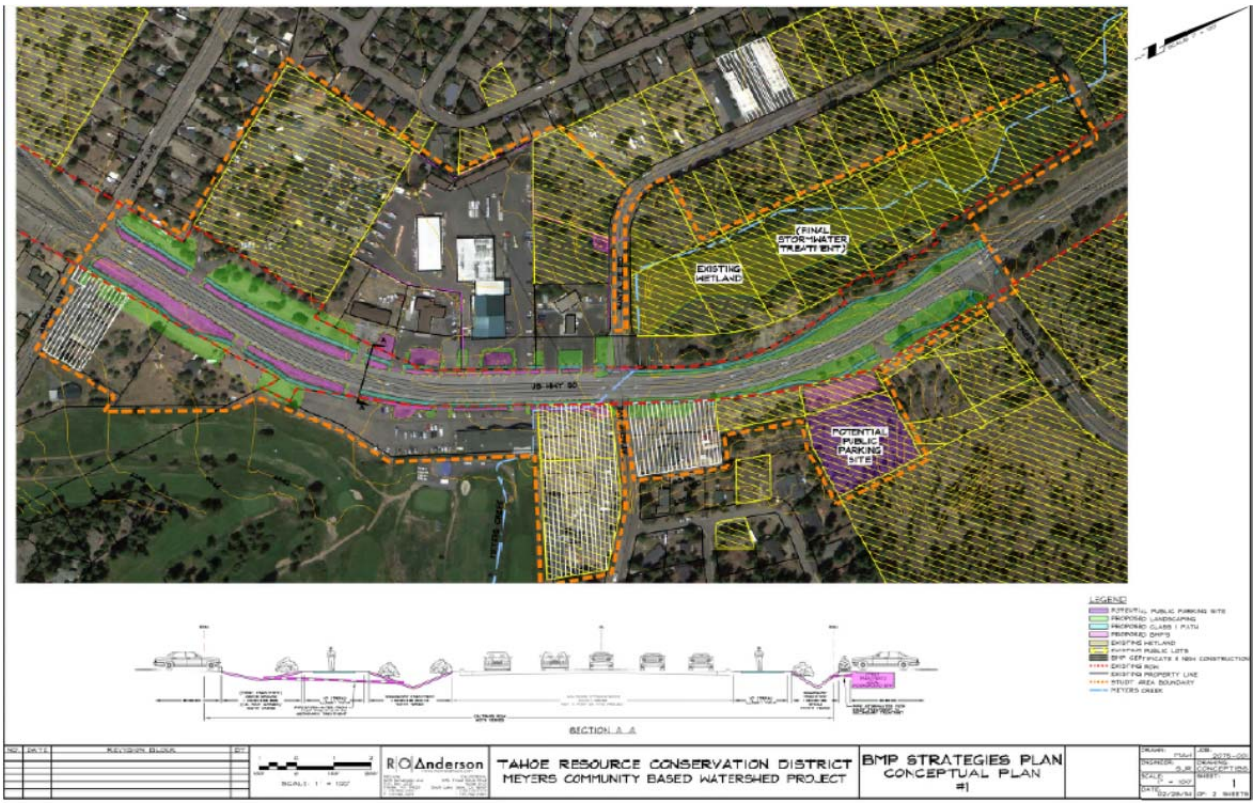


Figure 8 Meyers Study Area – Conceptual Plan #1

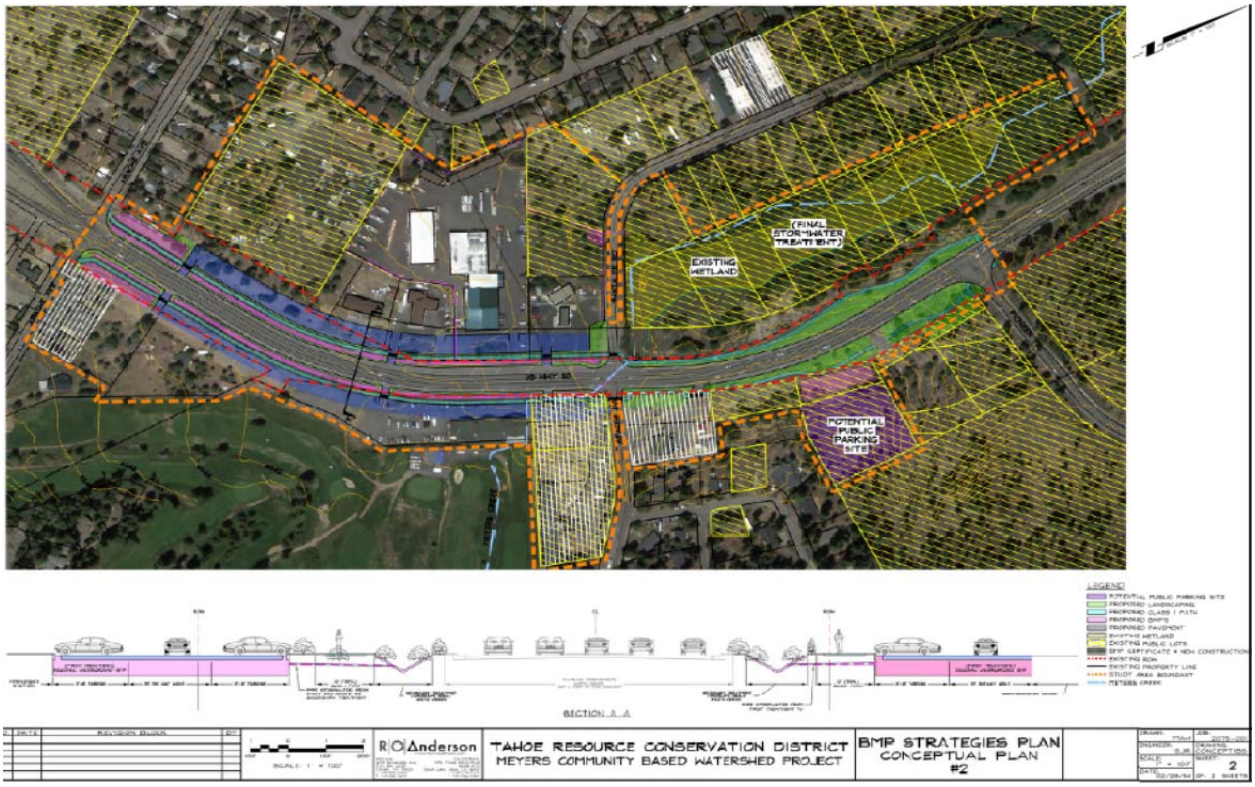


Figure 9 Meyers Study Area – Conceptual Plan #2

Meyers PLRM Modeling

The Meyers PLRMv1.1 modeling exercise demonstrated the advantages of a strategy that achieves BMP implementation in commercial corridors over individual SFR BMPs; refer to the *Tahoe Valley & Meyers, CA - Final Watershed Strategy Report* included in Appendix B for full model results and discussion. The total number of Lake Clarity Credits that could be obtained through 100% SFR BMP implementation was approximately 4.5 credits (~900 lbs/year FSP reduction), while approximately 20 credits (~4,000 lbd/year FSP reduction) were estimated for area-wide treatment in the Meyers Commercial Core (Table 3); four times the amount of credits for 100 percent SFR BMP compliance. These numbers are not surprising in that the PLRM model assumes that pollutant loading from SFR parcels is relatively low when compared to commercial properties, and therefore much more credit can be gained through BMP implementation that treats runoff from commercial properties.

The Meyers PLRM modeling also illustrated the level of effort necessary to receive Lake Clarity Credits. Treating the commercial core is a much more efficient way to attain TMDL credits. Of course it would be necessary to get most of the CICU property owners on board with the plan, which would no doubt require a certain level of information sharing, coordination and commitment. In contrast, to obtain 100 percent SFR BMP compliance would require *approximately 750 in total*. Single family residential property owners have been slow to comply with the TRPA ordinance, and it would be no small task to achieve this goal.

Table 3 Number of potential Lake Clarity Credits that could be obtained through 100% SFR BMP compliance and area wide treatment in the Meyers catchment.

Pollutant Load Reduction Potential Meyers		
	# Credits	**FSP Reduced (lbs/year)**
100% SFR BMP Implementation	4.5	900
Meyers Area-Wide Treatment	20	4,000

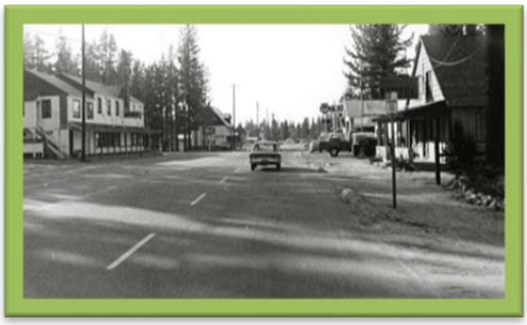
Case Study: Tahoe Valley

The Tahoe Valley Area Plan is bounded on the north, west, and south primarily by residential subdivisions dating back to the 1960s. The plan area is bordered by the Upper Truckee Marsh and the South Lake Tahoe Airport on the southeast. Today, the Tahoe Valley area is dominated by commercial development abutting U.S. Highway 50 and State Route 89. The Highway right-of-way lines meander inconsistently as do existing development setbacks. Parcel sizes vary and development is fragmented. New development, consistent with design, materials, and landscaping standards contrast with the many older motor lodges built in the 1960s. In addition to discontinuous landscape improvements, the lack of uniform connectivity of pedestrian and bicycle paths is a problem for both mobility and aesthetics.

Our study area land uses include residential, commercial, tourist accommodation and industrial (Figure 2). Refer to Appendix B, the *Tahoe Valley & Meyers, CA - Final Watershed Strategy Report*, for the full report. Tahoe Valley is the gateway neighborhood for South Lake Tahoe. Its commercial uses serve both the South Shore residents and visitors stocking up on their Tahoe-stay provisions. The commercial uses include clothing stores, factory outlets, drug stores, restaurants, and a supermarket. These uses occupy structures ranging in age and physical condition from the 1890's to present day construction.

Over the last century, the Tahoe Valley area has been heavily disturbed and its natural resources have been manipulated and reduced to a few vegetated and undeveloped parcels found behind the Highway 50 commercial "strip". An ephemeral stream (Tahoe Valley Creek) runs through the Greenbelt study area.

The plan area includes three drainage basins including the Tahoe Valley system that runs south of the "Y" intersection, which is directly connected to the Upper Truckee River. The other two drainage basins drain into the Tahoe Keys Lagoons before being released into Pope Marsh. Many properties contain excess coverage over the Bailey land capability limitations and approximately 50% of the commercial parcels have BMPs installed.



(Left) Tahoe Valley Commercial-Core; Heading east on US Highway 50 early 1960s (Source: Don Lane)
(Right) Tahoe Valley Commercial-Core; At B Street and US Highway 50 (Source: Bill Kingman)

The first stages of this project were focused on convening a TAC including agency representatives from the Tahoe RCD, EPA, City of South Lake Tahoe, and the consultant team from RO Anderson. Based on the TAC discussions, the consultant team was directed to prepare a site plan of the Greenbelt project area and Greenbelt amenity sample boards. In preparation for the first Advisory Group work session, property owner interviews were conducted to inform the work session process and to find out the property owners' level of interest in an area-wide stormwater treatment system. The interview results found that there were a high percentage of property owners interested in exploring the possibility of creating a public/private partnership for the purpose of implementing an integrated Greenbelt stormwater treatment system.

Greenbelt Integrated Area-Wide Stormwater Concept Plan

Advisory Group work sessions focused on soliciting ideas and preferences for the types of community amenities to integrate into the area-wide Greenbelt stormwater treatment system. Advisory Group participants were provided with two concept scenarios; one focused on amenities to support passive activities and the other on amenities to support active ventures. The group selected a combination of both active and passive activities to integrate. There was a consensus on the amenities which included a public plaza, a small community amphitheater, naturally designed playgrounds, community garden, multi-use paths, and recreational activities that flowed through Greenbelt (par course or Frisbee golf). Safety features were also integrated into all of the preferred concepts. These features included lighting and highway pedestrian and bicyclist crossings. Gateway features, art and wayfinding were also identified as important features that should be used to unify and brand the Greenbelt. The geographical locations obtained about an 80% agreement. Without knowing the exact configuration of the stormwater features, preferred locations were a bit imprecise. Figure 10 and Figure 11 illustrate the Advisory Group's preferred concept.

Prior to the close of the last work session the participants were asked to indicate, by a show of hands, if they were interested in continuing to explore a public/private partnership with the City of South Lake Tahoe to financially support the implementation of the Greenbelt integrated area-wide stormwater project. All indicated they were interested in continuing the exploration. A few individuals wanted to make it clear that until the numbers were available (total cost and property owners' fair share) they could not commit to anything else at this point.

Tahoe Valley Greenbelt Property Owners Meeting.

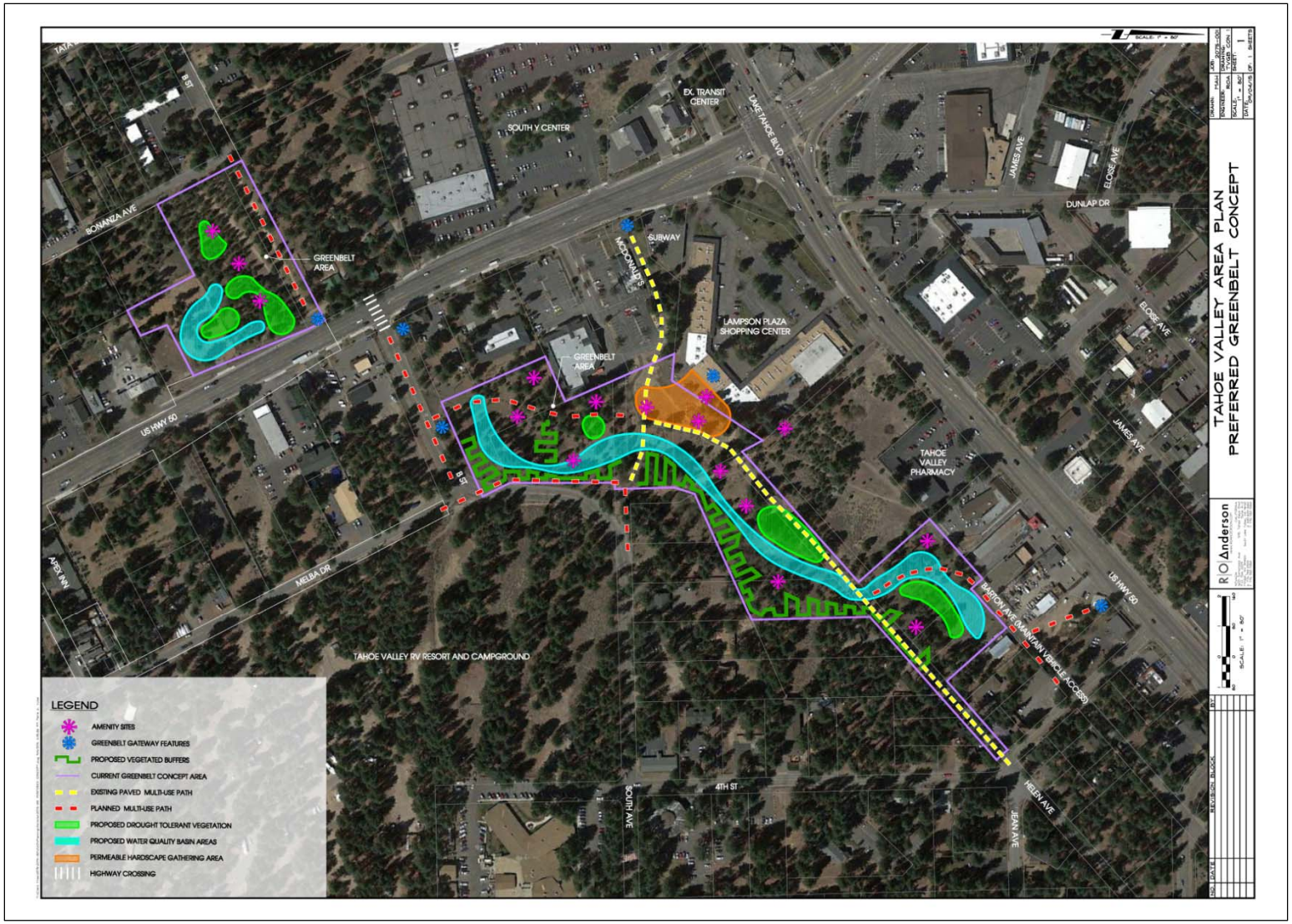


Figure 10 Advisory Group's Preferred Concept Plan.

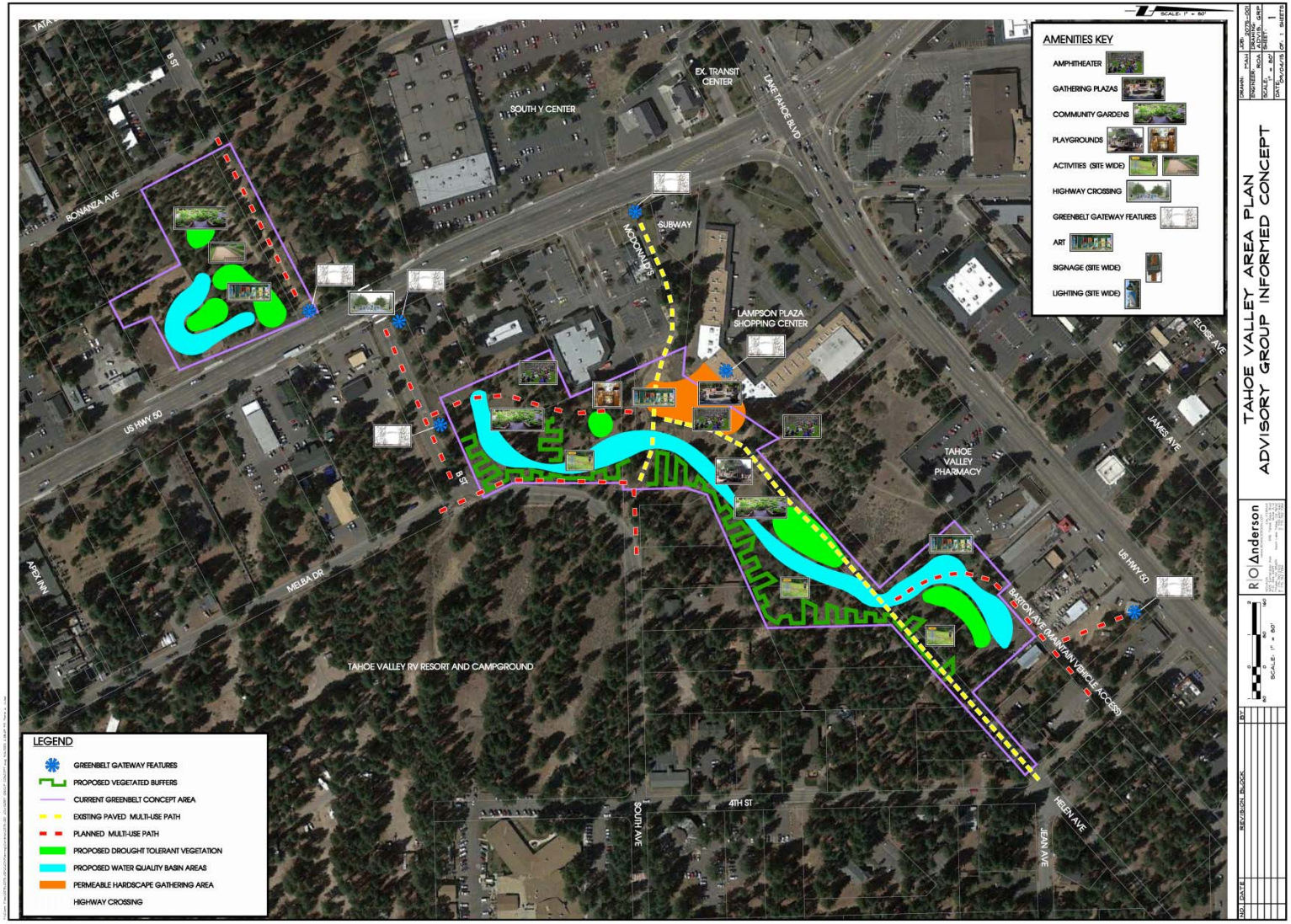


Figure 11 Advisory Group's Preferred Concept Plan with Amenities.

PLRM Modeling: Tahoe Valley

The Tahoe Valley PLRMv2.1 modeling exercise demonstrated the advantages of private parcel BMP implementation in commercial corridors over individual SFR/MFR BMPs; refer to the *Tahoe Valley & Meyers, CA - Final Watershed Strategy Report*, included in Appendix B for full model results and discussion. The total number of Lake Clarity Credits that could be obtained through 100% private parcel BMP implementation is 5 credits (~1,000 lbs/year FSP reduction) for SFR, 8 credits (~1,600 lbs/year FSP reduction) for MFR, and 83 credits for CICU (~16,600 lbs/year FSP reduction) (Table 4). Meanwhile, Lake Clarity Credits for area-wide treatment in the Tahoe Valley Commercial Core is estimated to be 168 credits (~33,600 lbs/year FSP reduction); approximately 34 times the amount of credits for 100% SFR private parcel BMPs, 23 times the amount of credits for 100% private parcel MFR BMPs, and 2 times the amount of credit for 100% CICU BMPs. For MFR/SFR parcels, these numbers are not surprising in that the PLRMv2.1 model assumes that pollutant loading from SFR/MFR parcels is relatively low when compared to commercial properties; therefore much more credit can be gained through BMP implementation on commercial properties. As mandated by the LCCP, the BMP'ed area treated, and in this case, the number of credits, decreases by half for CICU private parcel BMPs greater than 5 years old (LCCP 2015); to obtain full credit would require continual BMP recertification of these properties, which would likely require a large effort. In contrast, maintaining an area-wide treatment system would likely be a simpler process than requiring maintenance/recertification for each individual CICU private parcel owner on a 5-year basis.

This modeling exercise also illustrated level of effort and the potential cost necessary to receive Lake Clarity Credits. To obtain 100% BMP implementation on CICU parcels would require 66 BMP certificates. In contrast, to obtain 100% BMP implementation would require 346 SFR BMPs and 197 MFR BMPs (Table 5). Single-family residential and multi-family residential property owners have been slow to comply with the TRPA ordinance, and it would be no small task to achieve this goal. Cost estimates for BMP implementation are included in Table 5, and the cost benefit of BMP installation for private parcel CICU is clear, with CICU private parcels costing $53,226 per credit, compared to $89,545 per credit for MFR, and $432,500 per credit for SFR. An area-wide treatment system for the Tahoe Valley Commercial Core would likely be even more cost efficient than individual parcel-level BMPs since an area-wide treatment systems may be simpler to construct and maintain than installing BMPs on each individual parcel. Treating the commercial core is a much more efficient way to attain TMDL credits; of course it would be necessary to get most of the CICU property owners on board with the plan, which would no doubt require a certain level of information sharing, coordination and commitment.

Table 4 Number of potential Lake Clarity Credits that could be obtained through 100% SFR, MFR, and CICU BMP compliance and area wide treatment in the Tahoe Valley catchment.

Pollutant Load Reduction Potential Tahoe Valley		
	# Credits	**FSP Reduced (lbs/year)**
100% SFR BMP Implementation	5	1,000
100% MFR BMP Implementation	8	1,600
100% CICU BMP Implementation	83	16,600
Tahoe Valley Area-Wide Treatment	168	33,600

Table 5 Cost of installation and number of certificates needed to achieve 100% private parcel BMP'ed area in the Tahoe Valley catchment.

Cost of Install for 100% Private Parcel BMPs in Tahoe Valley			
Certificates Needed (#)	**Clarity Credits (#)**	**Install Cost TOTAL**	**Install Cost PER CREDIT**
Single Family Residential (SFR) BMPs **(BMP age doesn't influence credit potential)**			
346	5	$1,730,000	$432,500
MFR BMPs **(>5 years old)**			
197	8	$985,000	$89,545
CICU BMPs **(>5 years old)**			
66	83	$3,300,000	$53,226

Adaptive Management Recommendations

In the commercial core areas around the Lake Tahoe Basin there is a need to provide a concentrated education effort focused on alternative, area-wide strategies for improving water quality. The efforts have to make it very clear what the potential benefits and values will be to a private property owner when they become a financial participant in an area-wide stormwater project. Participation in area-wide solutions has the potential to save commercial property owners tens of thousands of dollars per property compared to installation of parcel-level BMPs.

From the planning and regulatory side it is important to demonstrate the value a comprehensive storm water system can bring to a commercial district and the value it can add to individual property owners. For example, a large piece of commercial property may individually cost a half million dollars to adequately BMP, but as a partner in an area-wide system the property owner's contribution assessment could be less than half that cost. In addition, where usable space is a premium, a commercial property owner may find value in not needing to remove parking spaces to install individual detention basins on site. In particular, when we are talking about commercial properties, systems that consider the integration of aesthetic enhancements, recreation benefits, parking and circulation improvements have a better chance of gaining investment (financially and politically) by commercial property owners.

On the other hand, for single family residences it is relatively less expensive to install BMPs. To ask the owner of a single family residence to pay more than a couple of thousand dollars into an assessment district in exchange for eliminating the requirement to install and maintain BMPs on the parcel will likely be challenging. An additional option for the Tahoe RCD and its stormwater partners to explore is an annual stormwater fee that would be relative to the average cost homeowners would pay to install BMPs, but spread out over a 40-50 year time frame. If implemented jurisdiction wide, stormwater managers would have a consistent annual budget to commit to infrastructure maintenance and BMP replacement; providing a long-term and reliable community-based restoration approach.

In both cases however, either a neighborhood benefit assessment or a jurisdiction-wide assessment, approximately 30 percent of individual private property owners on the California side of the Lake Tahoe Basin have already complied with TRPA's ordinance and installed BMPs. Although maintenance is an ongoing burden, these property owners would likely opt to maintain their BMPs onsite as it would be less expensive than to be financial partners in area-wide storm water projects.

The Meyers and Tahoe Valley Greenbelt CWP projects had two very different outcomes. Both community locations were working through the process of adopting an Area Plan within their separate jurisdictions (El Dorado County and the City of South Lake Tahoe). Both CWP Study Areas concentrated on the commercial core properties and both projects anticipated area-wide stormwater solutions to benefit both public and privately owned parcels. U.S. Highway 50 runs down the middle of both study areas creating safety and connectivity constraints. Approximately 50% of the developed commercial properties have installed BMPs.

Though the similarities are numerous, the two CWP projects can be differentiated by just a couple of dissimilarities which can be attributed to politics/leadership and education. The Meyers Area Plan update process was in its second year when Tahoe RCD embarked on the CWP for the Meyers core area. The Area Plan process had created mistrust in the community for both the process and the agencies involved. The process did not include opportunities to inform the Area Plan participants with visual examples of development scenarios the plan was contemplating. This approach left room for individual interpretation for what the implementation of the plan might look like; not all accurate or factual.

Neither the County's Planning Director nor someone with experience in the preparation of Community Plans representing TRPA was engaged in the process. Planning staff assigned worked diligently to draft language that would be acceptable only to have it misrepresented by opposing views. Several meetings were facilitated by the County Supervisor for the Meyers area (District 5), which made the process more political than it needed to be. And, 2014 was an election year for the District 5 Supervisor seat.

In contrast, the City of South Lake Tahoe initiated its Tahoe Valley Area Plan process with a recap of where the process had been (the City had started the planning process in 2005) and asked participants to identify visual preferences based on examples of different types of development. In addition to planning staff, the City was represented at these meetings by the City Manager, Community Development Director and the Planning Director. At each subsequent meeting City staff made it clear both in the plan's language and visual examples what changes had been made because of the feedback that was received. Participants gained investment in the plan and were excited about plan elements such as the Greenbelt. The City's process nurtured trust and did not become political. Participants were educated along the way.

When individual interviews were conducted with the Meyers commercial property owners to explore their interest in an area-wide stormwater system, a common response heard was the mistrust for the County to do "right" by the property owners. When individual interviews were conducted with the Tahoe Valley Greenbelt property owners they were already excited about the Greenbelt element because of the City's Area Plan process. It should be added that at the time when the first Tahoe Valley Greenbelt interviews were being conducted (late summer 2014) the City was building the Harrison Avenue commercial district project, and area-wide plan located close to the project area.

Through these PLRM modeling efforts, area-wide stormwater systems for the Lake Tahoe Basin's CICU development areas have been shown to provide the biggest bang for the buck. For the least amount of dollars per credit with the most pollutant load reduction, it seems clear this is a tool local jurisdictions can use to achieve TMDL targets. However, there is significant work that needs to be accomplished up-front in order to establish the public/private partnerships that can be sustained through design development, the financial negotiations of an assessment district and implementation of the area-wide project.

The implementation of the Lake Tahoe TMDL is still in its early stages and jurisdictions are focused on the most cost-effective way to attain credits required by TMDL permits. In the future, however, as credits become harder to obtain, jurisdictions may take a second look at how SFR/MFR BMPs can help them achieve their pollutant reduction goals.

Recommendations for Future Area Plan Collaboration

- Participants in the planning and design stages should be identified and engaged as early as possible in the process. Participants need to include: decision makers, property owners, and agencies with jurisdiction. Others to consider early in the process are utility providers, Caltrans, and potential funding agencies.
- If a financial partnership between public and private entities is a goal, the establishment of what the decision space will be (consensus, vote, public entity makes decision, etc.) is critical.
- Include an expert on assessment districts on the team who will clearly articulate financial requirements and opportunities under the law.

STORMWATER FUNDING STRATEGIES

The Stormwater Funding Strategies component of the grant addresses Objective #2: Identify community interest and ability to contribute to long-term stormwater maintenance and monitoring needs.

The City of South Lake Tahoe, El Dorado County, and Placer County (local jurisdictions) are responsible for managing stormwater programs in California Tahoe. Until recently, grant funding has been the primary means of implementing stormwater capital improvements, monitoring effectiveness, and reporting outcomes. Available local financial resources, which are often very limited, have been used primarily for inspections, operations and maintenance along with coordinating the program to meet NPDES permit requirements. This grant funding, which the local jurisdictions have been very successful in securing in the past, is no longer available at the levels previously experienced. At the same time TMDL science and modeling results show the next required load reductions are best achieved through targeted maintenance of stormwater infrastructure putting further pressure on available local financial resources.

These local jurisdictions are regulated by an NPDES permit issued every five years by the Lahontan Regional Water Quality Control Board. As part of their permit, the Water Board has asked co-permittees to evaluate dedicated funding strategies to assist with achieving long-term TMDL goals.

To help local jurisdictions comply with this permit condition, Tahoe RCD contracted with a consulting team to lead them through a financial analysis of their programs and an evaluation of the various funding strategies available for them to pursue. In addition, a Stormwater Funding Partnership was formed, which included members from El Dorado County, City of South Lake Tahoe, Placer County, the Water Board, TRPA, and EPA.

The Stormwater Funding Partnership addressed two key questions:

- What is the financial outlook for California's stormwater programs for the next five years? (And what is the variability associated with existing funding?
- What alternative funding strategies could support stormwater programs over the long-term? (And, should they be pursued?)

The Partnership explored these questions over the course of three "Core" meetings and one broader "Leadership Stakeholder" meeting attended by agency, business, and community stakeholders.

In terms of the financial outlook of stormwater programs, there are indications to suggest the next permit term will contribute additional obligations to local sources of funding. For instance, local jurisdictions anticipate that since much of the "low hanging fruit" (projects and activities that cost-effectively reduce pollutant load) has already been accomplished, meeting the next set of load reduction goals will be harder and more expensive to meet. Additionally, TMDL science shows that the maintenance of existing stormwater quality improvement projects as well as treatments such as street sweeping and vactoring offer the largest opportunity to reduce pollutant loads. However, as these activities are ineligible for grant funding, the increase in these activities would place additional pressure on local funding sources. Grant sources for stormwater monitoring, an important NPDES compliance activity, are also concluding in 2016. This funding obligation will transfer to local funding sources. Finally, as local sources of funding are largely discretionary (that is, subject to variability based on competing civic priorities), there is no guarantee that stormwater funds will continue to be allocated at a level sufficient to meet permit conditions.

The Stormwater Funding Partnership explored alternative funding strategies that could be dedicated to stormwater programs. These included creative, non-traditional funding approaches such as miles driven tax, basin-entry fees, and recreation fees. The Partnership also evaluated traditional funding mechanisms such as a Transient Occupancy Tax, Balloted Property-Related Fee, General Special Tax and Special Special Tax. As many of these options would fund stormwater programs partially, the Partnership determined that a "Portfolio Approach" – that is the selection of two or more alternatives either implemented at once or over a few years – could be a feasible alternative to consider further. Also, through one-on-one consultations with regional government and community stakeholders, the Partnership learned of other initiatives sponsored by groups representing issues such as transportation/transit, recreation, and snow removal. The Partnership was encouraged to evaluate whether partnership with these other initiatives would strengthen their public case for funding and chance of success.

As a result, the Partnership presented these findings to the Leadership Stakeholder. The general consensus was that there was justification to pursue a dedicated source of program funding, and to take the next steps, such as public opinion polling, to hone in on which funding strategies would be publicly acceptable to pursue. The initiative brought to light creative ways to stretch existing funding sources to implement robust stormwater programs, comply with the Permit, achieve TMDL load reduction targets and address local priorities.

CAPACITY BUILDING FOR THE LAKE TAHOE TMDL

The third objective of the Community-Based Watershed Strategies Grant was to "build local Conservation District capacity to assist local jurisdictions with the stormwater catchment registration process." Through trainings with NHC and Nevada Tahoe Conservation District (NTCD), along with the conducting data collection and modeling for the jurisdictions, the Tahoe RCD has built capacity to assist the local jurisdictions with the stormwater catchment registration process. Tahoe RCD staff is fully trained and capable of providing assistance through conducting BMP/Road RAM measurements, building and running PLRM V2.1 models, and organizing all files needed for catchment registration in CAP. Through beta-testing and catchment registration to the jurisdictions, several products resulted from these efforts, including a cost estimate for catchment registration, a comparison of infiltration observations for dry basins, a comparison of pollutant load reduction for various pollutant controls in the City of South Lake Tahoe's 12th Street Erosion Control Project (ECP) in Urban Planning Catchment (UPC) B14, and catchment registration assistance for El Dorado County's Montgomery Estates UPC 04.

Catchment Registration Cost Estimate

To better assist the jurisdictions, the Tahoe RCD determined a general cost estimates for catchment registration. The amount of time needed to build a PLRMv2.1 model is largely a wild card; it will vary greatly from catchment to catchment and depends on the number of BMPs in place and the complexity of the existing stormwater infrastructure in the catchment, among other factors. The time required to build and run a PLRM v2.1 model for a less complex catchment could take 18 hours, and for a more complex catchment could take upwards of 48 hours (Northwest Hydraulic Consultants (NHC), personal communication 2015). BMP RAM is estimated to take approximately 2 hours per BMP (NHC, personal communication 2015), in the most simple catchment there might be 1 BMP, which would only take 2 hours total, and in a very complicated catchment there could be 10 or more BMPs, which could take up to 20 hours to BMP RAM. Tahoe RCD would budget 32 hours for registration and reporting, bringing the total to 100 hours for registration of a more complicated catchment, *if everything went smoothly,* which is similar to the amount of time El Dorado County estimated for catchment registration in their pollutant load reduction plan (PLRP 2013). However, one of the lessons learned from this project is that things do not often go smoothly, especially when dealing with new releases of tools. With the amount of bugs and technical difficulties encountered over the course of this project, one could feasibly estimate that catchment registration could take 2 or 3 times more hours; however, for simplicity sake, we will assume that 100 hours is a reasonable estimate. Taking Tahoe RCD staff at the fully burdened rate plus a 15% admin cost is approximately equal to $40/hour. Therefore, the Tahoe RCD could conceivably provide BMP catchment registration for the jurisdictions for $4,000/catchment (Table 6). For each registered road class, the minimum number of segment locations is 4, and the maximum number is 20. It is estimated to take about 2 hours of field work and data entry for 4 segments and Road RAM observations must be conducted 4 times a year. So the Road RAM time commitment is estimate to conduct observation sis 16 to 40 hours per year. Five hours could be considered a rough estimate of the additional PLRM modeling time needed with Road RAM. So adding Road RAM would add $840 to $1,800 per year.

Tahoe RCD TMDL Catchment Registration Estimate of Total Cost	
BMPs	**Cost**
Catchment with 10 BMPs	$4,000
Catchment with 10 BMPs + Min Road RAM (1 registered road class)	$4,840
Catchment with 10 BMPs + Max Road RAM (1 registered road class)	$5,800

Table 6 Estimated cost of TMDL catchment registration offered by Tahoe RCD.

Comparison of Infiltration Observations for Dry Basins in Lake Tahoe

Infiltration is a key observation for determining dry basin function with BMP RAM. However, results can vary depending on the type of measurement used, the location of the measurement within a dry basin, the time of day/year the measurement is conducted, and many other extraneous variables. During the fall of 2014, Tahoe RCD staff investigated 3 different methods for obtaining infiltration observations in dry basins (Figure 12): constant head permeameter (CHP), infiltrometer, and the California Stormwater Quality Association (CASQA) 48-hour drawdown method (CASQA method). A full report of findings is included in Appendix B in the report titled *A comparison of infiltration observations for dry basins in Lake Tahoe* and the results are summarized below. This report was distributed to the jurisdictions to assist in choosing an infiltration observation method for dry basins.

Figure 12 Tahoe RCD staff conducts CHP and infiltrometer measurements for a dry basin in the City of South Lake Tahoe.

The CHP method consists of maintaining a constant "head" (constant water level) below the soil surface and measuring infiltration over time. One main criticism of the CHP is that since the measurement occurs below the soil surface (the area prone to sedimentation and subsequent clogging), it may not adequately represent infiltration in a dry basin. CHP measurements are subject to spatial heterogeneity and can vary dramatically throughout a single dry basin. The CHP method is relatively time-intensive, taking approximately 1 hour to complete per dry basin. On the plus side, measurements can be consistently scheduled (they do not require a large precipitation event prior to completing measurements).

The infiltrometer method refers to a single-ring infiltrometer filled with 4 inches of water; the amount of water infiltrated over time provides an infiltration rate. In contrast to the CHP, the infiltrometer measures infiltration at the soil surface. Similar to CHP, infiltrometer measurements show a large degree of spatial heterogeneity and can vary tremendously within a dry basin. The infiltrometer is also relatively time-intensive, taking approximately 1 hour to complete per dry basin. Finally, measurements can be consistently scheduled as they do not require a large precipitation event prior to completing measurements.

The CASQA method involves visiting a dry basin 48 to 72 hours after a precipitation event to determine whether or not water has infiltrated. One of the main criticisms of the CASQA method is that it does not provide a quantitative assessment of infiltration rate; it is a binary system in that the dry basin either did or did not infiltrate the water. However, with the spatial heterogeneity observed with the CHP and infiltrometer methods within a single dry basin, it raises questions on whether or not these methods can be trusted to quantitatively determine basin function. Compared to the CHP and infiltrometer methods, the CASQA method is not very time intensive, taking approximately 5 minutes per dry basin to complete. Finally, the main disadvantage of the CASQA method is it is weather dependent, making scheduling more difficult than the CHP and infiltrometer.

After comparing CHP, infiltrometer, and the CASQA method, the Tahoe RCD recommends the use of the CASQA method as the best choice for evaluating the infiltration status of dry basins with BMP RAM. First and foremost, CASQA provides BMP standards that are nationally recognized. Further, since the CASQA method directly observes whether or not a basin has infiltrated water within the required time frame, and the spatial heterogeneity of both CHP and infiltrometer could give a false sense of basin performance (by providing both over- and under-performing infiltration rates), in this regard CASQA serves as a better indicator for basin performance. The CASQA method is also much more time-efficient as compared to the other methods, taking less than 10% of the time as CHP/infiltrometer. The method is, however, precipitation-dependent, which makes scheduling observations difficult. Due to the substantial decrease in required staff time, the appropriateness of this measurement for the task at hand, and CASQA's reputation for setting the industry standard for stormwater BMPs, the Tahoe RCD recommends that the CASQA method with BMP RAM for evaluating infiltration function of dry basins.

12th Street catchment ECP (UPC B14) PLRM modeling

The City of South Lake Tahoe requested Tahoe RCD assistance with potential registration of the 12th Street ECP (UPC B14) catchment (Figure 5). The City had hoped to obtain credit for pollutant load reduction by maintaining older infrastructure in this catchment. However, the catchment is not well connected to Lake Tahoe (<20% connectivity). Due to the low connectivity to Lake Tahoe, PLRM v2.0.2 modeling revealed relatively low credit potential for improving existing infrastructure *in this area*. The City therefore decided against registering this catchment within the current permit term. Instead of building a PLRM model for catchment registration, Tahoe RCD staff used PLRM to model different water quality improvement scenarios and completed sensitivity analyses on basin sizing to compare the credit potential of different improvement actions. PLRM v2.0.2 modeling revealed a diminishing return on increased basin sizing, in other words, at a certain basin size increasing the size the basin size further provides little improvement in pollutant load reduction (Figure 13). The greatest credit potential came from disconnecting directly-connected impervious area (DCIA) (16 credits or ~3,200 lbs/year FSP reduction), followed by improvements to roads to the best possible Road RAM score of 5 (5.6 credits or ~1,120 lbs/year FSP reduction). There was minimal Credit Potential from BMP implementation on SFR, MFR, and CICU land uses. One-hundred percent SFR BMP compliance would result in < 1 credit (~80 lbs/year FSP reduction) and would require 446 full BMP certificates, costing homeowners an estimated $446,000 to $3,568,000. Similarly, 100% MFR BMP compliance would provide < 1 credit (~100 lbs/year FSP reduction), and 1.2 (~200 lbs/year FSP reduction) credits could be obtained with 100% CICU BMP implementation (due to limited CICU land use in this area). If these private parcels were treated area-wide, it would result in a total of 2.1 (~420 lbs/year FSP reduction). The City of South Lake Tahoe found these comparisons of water quality improvement actions very informative and useful, and the full report is included in Appendix B as *TMDL Catchment Registration and Testing TMDL Tools: PLRM Modeling in the City of South Lake Tahoe's Urban Planning Catchment B14*.

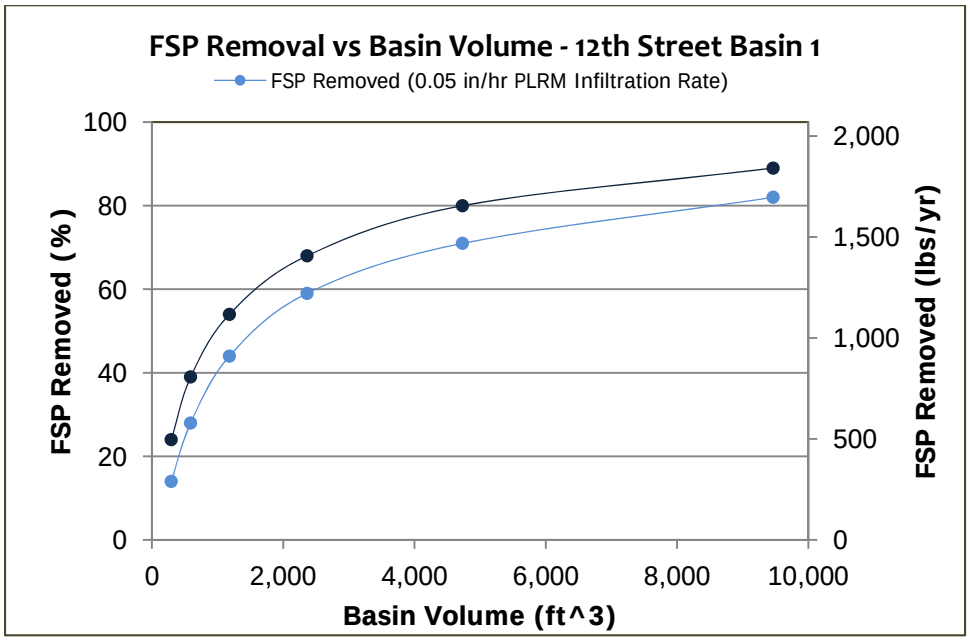


Figure 13 FSP removal in percent and pounds per year with increasing basin volume for the slowest (0.05in/hr) and fastest (0.50in/hr) PLRMv2.0.2 infiltration rates for a dry basin in the 12th Street ECP (UPC B14) catchment. Dots represent model runs. Basin volumes are doubled with each successive model run. Increasing basin volume provides diminishing returns on water quality benefit.

Montgomery Estates (UPC04) Catchment Registration Assistance

El Dorado County requested Tahoe RCD assistance with catchment registration for Montgomery Estates UPC 04 (Figure 4), which is slated for registration this permit term according to El Dorado County's original pollutant load reduction plan (PLRP 2013). Tahoe RCD staff conducted BMP RAM measurements in this catchment (no Road RAM was required because the County isn't planning on registering roads this permit term). Through GIS analysis and field verification, the catchment was modeled with PLRM v2.1 (Figure 4). Modeled results provided similar pollutant load reduction estimates as compared to PLRM v1.1. Through PLRMv2.1 estimates, all BMPs within Montgomery Estate's UPC04 were classified as either "key", "essential", or "supporting". All data required for catchment registration in CAP was collected and organized into appropriate file structures. After the official TMDL tools release, Tahoe RCD staff spent time with El Dorado County explaining the interworking of the built model and entering data into the RAM/CAP databases. El Dorado County was satisfied with the data collection and modeling work conducted by Tahoe RCD, and was ready to register the catchment. However, Tahoe RCD and El Dorado County ran into technical difficulties with the CAP database which prevented final catchment registration. Once these technical difficulties are addressed El Dorado County has all of the information needed for full catchment registration. Catchment registration for Montgomery Estates UPC04 will likely take place during water year 2016 and reported on by March 2017. See the *PLRM Results - Letter to El Dorado County* describing model results, included in Appendix B.

Stormwater Tools Improvement

The Lake Tahoe TMDL Tools were improved under these funds through Tahoe RCD involvement with the development and beta testing for these tools. Tahoe RCD staff was part of the Lake Tahoe TMDL Stormwater Tool Improvement Project Advisory Committee (PAC) and provided insight, ideas, and feedback during the improvement period of the existing TMDL tools. Concurrent with, and after the conclusion of these meetings, Tahoe RCD staff provided invaluable beta testing and debugging of PLRMv2.0.2 and the RAM/CAP databases through training and data collection/input exercises involved in modeling the City of South Lake Tahoe's 12th Street ECP (UPC B14) catchment and El Dorado County's Montgomery Estates UPC04. Any bugs encountered were documented and described to the appropriate agency, and many kinks in the TMDL stormwater tools were discovered and addressed through this process. Thus the Lake Tahoe TMDL tools are more stable and robust as a result of this funding effort.

EDUCATION AND OUTREACH

Throughout the life of the Community-Based Watershed Strategies Grant, many education and outreach efforts took place to meet objective #4: "Continue to offer technical services and education/outreach to the public regarding the measures property owners can take to reduce environmental impacts to Lake Tahoe".

Through Tahoe RCD's stormwater outreach campaign, Tahoe RCD staff raised greater awareness within the community through education and thoughtful discussions about the negative impacts stormwater pollution on Lake Tahoe's clarity. Tahoe RCD staff used local media resources, including radio and print public service announcements, to raise awareness of stormwater pollution as a pertinent environmental issue within the Basin. Community events gave staff the ability to have meaningful connections with community members that assisted them in understanding the issue of stormwater pollution as a whole

while building off knowledge community members previously had in regards to this pressing environmental concern.

An advertisement from Tahoe RCD's Stormwater Outreach Campaign.

Tahoe RCD staff assisted property owners and collaborated with local agencies on issues related to erosion control, irrigation and fertilizer management, native and invasive species, and fire-wise landscaping. Direct outreach was provided to greater than 50 residents/homeowners over the life of the project. This task was accomplished through administering community surveys, engagement through the Stormwater Symposium on December 10th, 2014, and direct homeowner technical assistance.

Tahoe RCD staff coordinated with Tahoe Basin partners to provide technical assistance and conservation education. Activities included participation and/or direct sponsorship of the following:

- UCCE Master Gardener Meetings,
- The annual BMP Contractors Workshops on April 17-18, 2014,
- Water Wise Landscaping Workshop on June 11, 2014,
- Community service learning demonstration volunteer days on May 31 and June 21, 2014,
- The Wildfire Safety Expo on June 2, 2014,
- Community service learning demonstration volunteer day with the California Conservation Corps on August 16, 2104,
- The Conservation Landscape Tour on August 21, 2014
- Fire Fest on September 27, 2014.

7th Annual Landscape Conservation Tour, August 21, 2014.

Fire Fest, September 27, 2014.

The Tahoe RCD also coordinated with the South Tahoe PUD to provide technical assistance to Turf Buy Back Program participants. Tahoe RCD trained STPUD conservation specialists on water wise landscaping and revegetation techniques. Additionally, monthly meetings with the Tahoe Fire and Fuels Public Information Team resumed during this reporting period where Tahoe RCD staff has been in participation.

Staff collaborated with the League to Save Lake Tahoe and provided technical expertise to the Pipe Keepers program as well as Eyes on the Lake and Snapshot Day monitoring efforts. Tahoe RCD also assisted in coordinating the 2013 Tahoe Basin Watershed Education Summit (TBWES). Additionally, at Tahoe Farm Day Tahoe RCD staff demonstrated source control and BMP techniques to over 500 fourth and fifth graders at Camp Richardson held on September 16th, 2014.




South Lake Tahoe Farm Day, September 16th, 2014.

TAHOMA WATER QUALITY EVALUATION FOR RSWMP

Tahoe RCD conducted a water quality evaluation for RSWMP in Tahoma in support of the grant's objective #5: Increase the data resolution of NPDES permit stormwater compliance monitoring by sampling additional storms.

In order to assist with implementing TMDL objectives, in 2013 the Tahoe RCD developed a monitoring plan with three primary goals: (1) comply with the monitoring requirements contained in the stormwater permits and agreements, (2) collect meaningful data this is useful for informing jurisdictions' efforts to effectively and efficiently manage their stormwater programs, and (3) support TMDL implementation progress assessment and program improvement. Approved by both California and Nevada TMDL regulators in 2013, the Implementers' Monitoring Plan established a lake-wide partnership between the Tahoe RCD, El Dorado County, Placer County, the City of South Lake Tahoe, Caltrans, Douglas County, Washoe County, NTCD, and the Nevada Department of Transportation known as the Implementers' Monitoring Program (IMP).

Tahoma was one of the many sites selected by the IMP as a catchment outfall monitoring site for NPDES permit compliance. Under the current IMP monitoring plan, only four precipitation events per year are monitored. The additional level of data collection helped assess data resolution needs for attaining reasonable annual pollutant loads within the Tahoma catchment. With these funds the Tahoe RCD monitored an additional seven storms beyond what is stated in the IMP Monitoring Plan for the Tahoma Watershed, meeting objective #5 of the Community Based Watershed Strategy Grant: "Increase the data resolution of NPDES permit stormwater compliance monitoring by sampling additional storms."

Furthermore, data collected under the NPDES permit and the EPA funds are complementary to long-term regional stormwater monitoring efforts proposed under the Tahoe Basin's Regional Storm Water Monitoring Program (RSWMP). All data was collected in a manner consistent with RSWMP monitoring protocols so it can easily be analyzed to align with the goals and objectives presented in the multi-agency driven RSWMP Data Quality Objective Plan (DRI et al 2011a), Quality Assurance Project Plan (DRI et al 2011b), and Sample Analysis Plan (DRI et al 2011c). The following is a brief summary of the data collected during water year 2014; the full report can be found in Appendix B in the *Tahoma, CA - Final Watershed Strategy Report*.

The Tahoma catchment is considered a rural community on the west shore of Lake Tahoe. The 49.5 acre catchment straddles the Placer County/El Dorado County border and comingles waters from both jurisdictions (Figure 3), plus waters from the Caltrans maintained Highway 89. The land-uses in this catchment are primarily moderate density residential and secondary roads in the Tahoe Cedars subdivision, but also include some commercial/industrial/communications/utilities (CICU) and primary roads. Twenty-eight percent of the catchment area is impervious. The runoff from this catchment has strong hydrologic connectivity to Lake Tahoe and discharges pollutant loads directly to the lake.

El Dorado County implemented phase I of a water quality improvement project the Tahoma catchment in 2014, listed within the Lake Tahoe Environmental Improvement Program (EIP); phase II of this project is slated for 2016. The EIP project focused on reducing sediment delivery to the lake through source control, hydrologic design, and stormwater treatment. The monitoring station is located near the mouth of the drainage, and data from this site characterizes runoff from the catchment outfall. Since monitoring at the Tahoma catchment began before the implementation of El Dorado County's EIP, this site provides the unique opportunity to collect data related to pre- and post- water quality improvements. The lessons learned in this catchment can be valuable to other moderate density residential neighborhoods with direct hydrologic connectivity to Lake Tahoe.

According to the Association of California Water Agencies, water year 2014 was one of the driest in the State's recorded history, with less than 60% of average precipitation. Figure 14 shows the continuous hydrology and cumulative precipitation for water year 2014. The total precipitation for water year 2014 at the Tahoma meteorological station was 20.56 inches. The majority of the precipitation fell in the fall/winter season (14.95 inches).

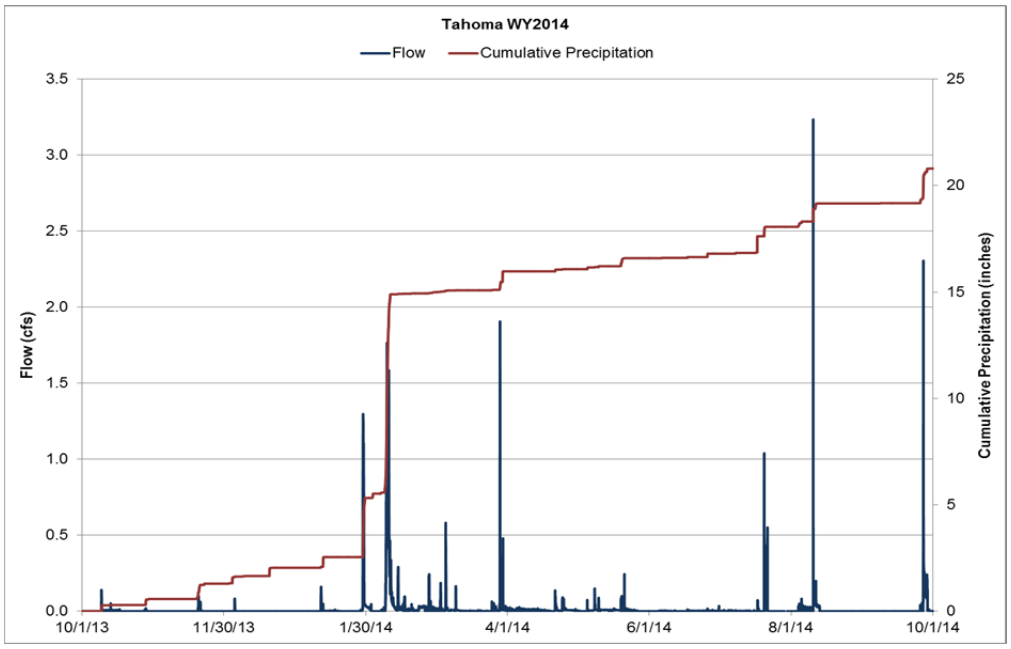


Figure 14 Continuous hydrology and cumulative precipitation at the Tahoma catchment outfall during water year 2014.

Flow weighted water quality samples were taken across the hydrograph for all eleven runoff events. Continuous hydrology, continuous turbidity and events sampled during water year 2014 are presented in Figure 15. The highest turbidities were seen during the largest storm of the year (February 7-10, 2014). The greatest flows were seen during the thunderstorm that occurred on August 10, 2014 as the peak precipitation reached 0.28 inches in ten minutes.

The NPDES permit requires that seasonal and annual precipitation and runoff volumes, as well as average seasonal and annual loads for FSP, TN, and TP are reported. These statistics are presented in Table 7. It is not surprising that fall/winter accounts for the highest loading as the total runoff volume is approximately three times higher than the other two seasons.

Equations to convert turbidity to FSP have been developed specifically for the Lake Tahoe Basin (2NDNATURE 2014). Using these equations, continuous turbidity measurements at the Tahoma catchment outfall were converted to FSP load estimates and compared to estimates made from event sampling (Table 8). Continuous turbidity appears to underestimate loads during spring and summer runoff and over-estimate during the fall and winter season as compared to the autosampler; annual load estimates however, are reasonably close.

The PLRMv1.1 estimates 5,263 pounds of FSP from the Tahoma catchment as an 18-year average. Considering that precipitation during water year 2014 was about 60 percent of average, modeled FSP loads this year would be predicted to be about 3,158 pounds, which is not unreasonable compared to the measured 2,503 lbs.

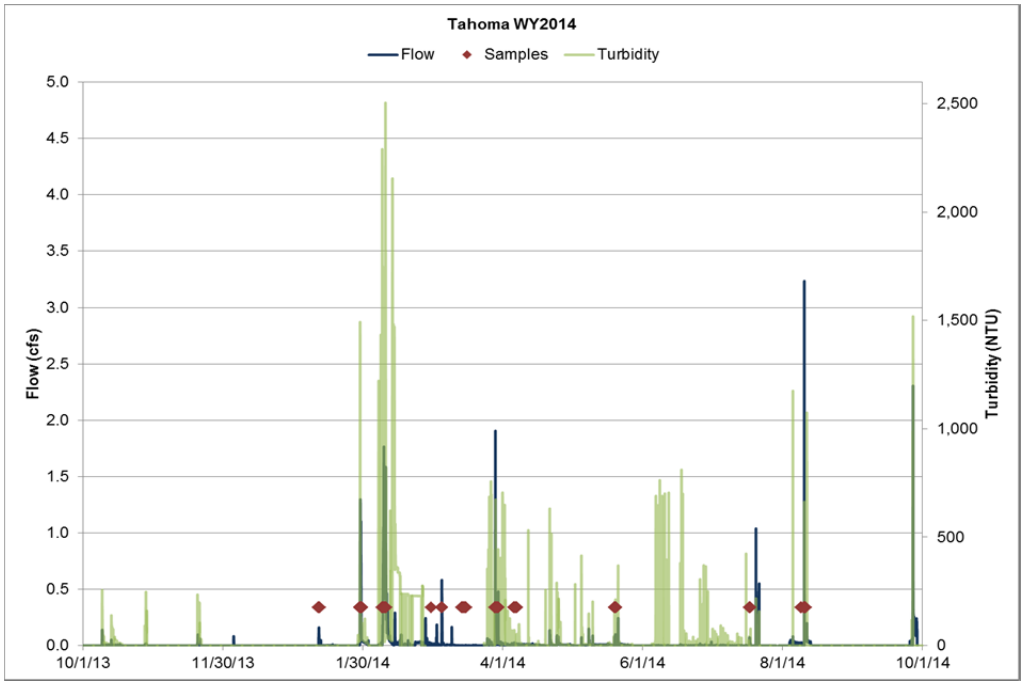


Figure 15 Continuous hydrology, continuous turbidity, and sampled events at the Tahoma catchment outfall during water year 2014.

Table 7 Seasonal and annual precipitation and runoff volumes, plus average seasonal and annual load estimations for FSP, TN, and TP for water year 2014 at the Tahoma catchment outfall.

TAHOMA CATCHMENT	Precipitation (in)	Runoff Volume (cf)	FSP load (lbs)	TN load (lbs)	TP load (lbs)
Fall/Winter (Oct1-Feb28)	14.95	207,798	910	7	4
Spring (Mar1-May31)	1.60	65,114	673	5	3
Summer (Jun1-Sep30)	4.01	59,000	921	9	6
Annual Totals	20.56	331,911	2,503	21	14

TAHOMA CATCHMENT	Runoff Volume (cf)	FSP load (lbs) from continuous turbidity	FSP load (lbs) from event sampling
Fall/Winter (Oct1-Feb28)	207,798	1,446	910
Spring (Mar1-May31)	65,114	204	673
Summer (Jun1-Sep30)	59,000	258	921
Annual Totals	331,911	1,908	2,503

Table 8 Comparison of FSP load estimates in the Tahoma catchment calculated using continuous turbidity and autosampler methods during water year 2014.

SUMMARY

Through the Community-Based Watershed Strategies Grant and the Community Watershed Partnership (CWP), the Tahoe RCD was able to provide useful conservation and TMDL implementation information to Basin managers, regulators, stormwater jurisdictions, and the community. Under these funds the Tahoe RCD presented three case studies for area-wide planning, developed stormwater program funding strategies, built internal Tahoe Resource Conservation District (Tahoe RCD) capacity to assist the local jurisdictions with TMDL permit/agreement compliance, provided landscape conservation planning and technical services related to BMP implementation, conducted public education and outreach related to watershed health and stormwater, and provided additional stormwater monitoring for the TMDL .

Under the CWP, Tahoe RCD provided area-wide planning for the Tahoma, Meyers, and Tahoe Valley area. For all three areas, PLRM models results show that there is a considerably greater pollutant load reduction potential for area-wide treatment compared to individual private parcel BMPs. The Meyers and Tahoe Valley communities were investigated to assess interest in supporting (both in concept and financially) a public/private partnership for an area-wide system that would provide stormwater treatment and public amenities (e.g. parking, lighting, art). Both communities expressed very different opinions of the area-wide plans. In Tahoe Valley, the community had been engaged by the local jurisdiction (the City of South Lake Tahoe) for a many years in talks of a public/private area-wide comprehensive stormwater system and was therefore already enthusiastic about such a partnership. Therefore, the concepts plans developed by RO Anderson (Tahoe RCD's subcontractor) were well received and community engagement was positive. In Meyers, however, the larger community was probably engaged in area-plan discussions a little too late in the planning process. The community felt a lack of trust with the local jurisdiction (El Dorado County), and so area-wide planning discussions were postponed and it was requested that the concept plans developed by RO Anderson to not be presented to the community. The main difference between the two case studies was the level of trust with local government. For this reason it is important to engage the community early and often in the planning stages, so that they feel their voices heard and they are able to develop the level of trust necessary to move forward from the planning to implementation stages of project.

The development of a Stormwater Funding Partnership supported and guided by a subconsulting team was instrumental in determining the financial outlook of stormwater programs over the next permit term as well as evaluating potential options for securing a dedicated, alternative source of funding. The Partnership determined that the additional financial obligations that would be felt by local jurisdictions over the next permit term were sufficient to warrant further investigation into alternative funding options. Also, the Partnership's pro-active engagement of key stakeholders at the agency executive, elected official, and community and business leader level was effective in engendering support for their pursuit of dedicated funding. In terms of next steps, the Partnership has been encouraged by leadership stakeholders to continue, formalize their organizational structure and council of external "champions", explore partnerships with other resource areas also pursuing funding initiatives, and understand the public appetite for alternative funding initiatives through public opinion polling.

Internal Tahoe RCD capacity to assist with TMDL compliance with CAP, PLRM, BMP RAM and Road RAM was developed through these funds. Several work products were provided as a result of these efforts. A cost-estimate for catchment registration with the TMDL Credit Accounting Platform is included in this report. A comparative study of infiltration observation methods for assessing the function of dry basins is presented in Appendix B, titled *A comparison of infiltration observations for dry basins in Lake Tahoe*. During the initial PLRM modeling stages for the City of South Lake Tahoe, it was found that very little pollutant load reduction potential (credits) existed for improving existing stormwater infrastructure in

the 12th Street ECP (UPC B14). The City therefore decided to delay registering this catchment. Instead, Tahoe RCD provided the credit potential for alternative pollutant controls; the final report *TMDL Catchment Registration and Testing TMDL Tools: PLRM Modeling in the City of South Lake Tahoe's Urban Planning Catchment B14* describes the findings and is included in Appendix B. For El Dorado County's Montgomery Estates (UPC 04) catchment, Tahoe RCD staff developed a full PLRM model, conducted BMP RAM measurements, and assisted with data entry into the BMP RAM and CAP databases. However, prior to registration of this catchment, database bugs were encountered with CAP, so registration was not completed. See *PLRM Results - Letter to El Dorado County* included in Appendix B for a description of PLRM and BMP RAM results. Tahoe RCD staff attended Road RAM trainings and assisted NTCD and the City of South Lake Tahoe with Road RAM measurements and is therefore fully trained and ready to perform Road RAM for the jurisdictions. Throughout the course of this project Tahoe RCD staff was part of the Stormwater Tools Improvement PAC and provided both valuable input for tools development as well as beta testing/debugging of the developed tools, thus making them more robust.

Education, outreach, and direct technical assistance continue to be important for promoting environmental awareness and conservation. Under these funds, the Tahoe RCD provided landscape conservation and BMP plans to the public; promoted a stormwater outreach campaign to inform the public about issues and solutions for stormwater pollution; organized the 7th Annual Landscape Conservation tour; coordinated volunteer events with local agencies, and presented at many public outreach events. The Tahoe RCD also coordinated with the South Tahoe PUD to provide technical assistance to Turf Buy Back Program participants.

Finally, stormwater monitoring was conducted under these funds. The additional monitoring helped increase the data resolution of TMDL stormwater compliance monitoring and thus leverage the Tahoe RCD's Regional Stormwater Monitoring Program (RSWMP).

This report describes the bulk of work and achievements completed under the Community-Based Watershed Strategies Grant, which was made possible through the support of the EPA. For a complete list and explanation of task-by task deliverables completed under these funds, see Appendix A; the format of the task-by-task grant accomplishments follows the format of the Community Watershed Strategies grant quarterly reports.

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APPENDICES