Lake Tahoe TMDL Program

2014 Synthesis of Findings & Program Adjustment Recommendation Memo

October 2014

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LAKE TAHOE TMDL PROGRAM

The *Synthesis of Findings & Program Adjustment Recommendation Memo* is an annual product of the Lake Tahoe TMDL Program. Lake Tahoe TMDL Program Managers at Lahontan Regional Water Quality Control Board and at Nevada Division of Environmental Protection are responsible for its content.

For more information about this document or the TMDL Program, contact:

Robert Larsen
Senior Environmental Scientist
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150

Phone: (530) 542-5439
Email: rlarsen@waterboards.ca.gov

Jason Kuchnicki
Lake Tahoe Watershed Program Manager
Nevada Division of Environmental Protection
901 S. Stewart St., Suite 4001
Carson City, NV 89701

Phone: (775) 687-9450
Email: jkuch@ndep.nv.gov

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INTRODUCTION

Each year Lake Tahoe TMDL Program Managers and stakeholders consider and evaluate TMDL Program operations, achievements and challenges and highlight new relevant scientific findings. This process of synthesizing findings enables TMDL Program Managers to identify implementation and policy issues, opportunities for program adjustment, and emerging information needs. TMDL Program Managers compile and synthesize these findings. The synthesized findings are paired with a memo detailing program adjustment recommendations. The combined document, the annual *Synthesis of Findings & Program Adjustment Recommendation Memo*, allows Lahontan Water Board and NDEP executives to have an informed discussion about the need for proposed program adjustments.

The *2014 TMDL Synthesis of Findings & Program Adjustment Recommendation Memo* includes new findings and addresses comments provided by stakeholders in review of the *2010-2013 Synthesis of Findings & Program Adjustment Recommendation Memo.* The organization of this document is as follows:

Stakeholder Feedback

Stakeholder feedback received on the *2010-2013 Synthesis of Findings & Program Adjustment Recommendation Memo* is also captured in the *2014 Stakeholder Feedback Capture Sheet*, an appendix to this document. The sheet is a tool for TMDL Program Managers to track and respond to stakeholder feedback – including suggested program adjustments or information needs – in an organized and transparent manner. TMDL Program Managers update and sort the sheet each year for public release in conjunction with this memo. A primary feedback mechanism that assists with population of the sheet is the Stakeholder Feedback Form, available on the TMDL Online Interface.

Part I: Findings

Findings are grouped into one of three subject areas: A) Urban Stormwater Management; B) Non-Urban Source Category Management and C) Overall TMDL. A box at the beginning of each subject area contains summary findings drawn from themes within that subject area. These summary findings represent the broadest level of synthesis completed by TMDL Program Managers and reflect findings deemed most important to Lake Tahoe TMDL management and implementation. The box at the beginning of each subject area also highlights notable updates to the subject area since release of the 2010-2013 document.

Part II: Recommendations

This section is a distillation of actionable recommendations proposed by TMDL Program Managers to adjust the TMDL Program, including both management strategies and policies. TMDL Program Managers create the recommendations based on their review of new science, stakeholder feedback, and direct learning over the past year. Generally, adjustment recommendations proposed in Part II reflect findings from Part I. Findings not linked to recommendations either support existing policy, require actions outside TMDL Program Manager's purview, or are not currently actionable due to incomplete information or lack of implementation resources. Proposed recommendations guide and inform discussions at the TMDL *Program Review Meeting*, an annual meeting between TMDL Program Managers and Lahontan Water Board and NDEP executives . Like findings, recommendations are grouped into one of three subject areas: A) Urban Stormwater Management; B) Non-Urban Source Category Management; and C) Overall TMDL.

References

References cited are placed in categories that disclose to readers the amount and type of peer review associated with each reference.

Appendix

The Appendix includes the *2014 Stakeholder Feedback Capture Sheet*, a list of the input provided by TMDL stakeholders regarding information needs and recommendations for program adjustments as well as Program Manager's responses to these comments.

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PART I: FINDINGS

Introduction

Findings are grouped into three subject areas and further categorized according to themes. Individual findings within each subject area and theme are statements synthesized from existing documents or drawn from observations or stakeholder comments or feedback.

Findings are organized as follows.

A. Urban Stormwater Management
    1. Urban Roads
    2. Pollutant Source Control BMPs
    3. Stormwater Treatment BMPs
B. Non-Urban Source Category Management
    4. Forest Management and Erosion Control
    5. Stream Restoration
C. Overall TMDL
    6. Monitoring
    7. Tools and Models
    8. Climate Change
    9. Nearshore Water Quality

2014 Summary Findings

Urban Stormwater Management

- Wintertime traction abrasive application to roadways is the primary specific source of both fine sediment particles (< 16μm) in stormwater runoff and PM10 in the urban upland and atmospheric deposition source categories, respectively.
- Pollutant source control best management practices (PSC BMPs) are more cost effective than stormwater treatment (SWT) BMPS in reducing fine sediment particles from urban roads.
- Improving PSC BMPs has the direct benefit of improving the effectiveness and reducing maintenance cycles of SWT BMPs.
- There has been a consistent and ubiquitous lack of appropriate maintenance conducted on SWT BMPs throughout the Tahoe basin. Regular inspection and maintenance of SWT BMPs is needed to sustain intended fine sediment particle load reductions.
- Targeted implementation of SWT and PSC BMPs on developed parcels is a cost-effective strategy for reducing pollutant loads.

Non-Urban Source Category Management

- Active unpaved roads are estimated to produce sediment yields (both FSP and other suspended solids) that are 1-3 orders of magnitude greater than inactive unpaved roads.
- The Angora Fire did not result in massive sediment or nutrient inputs to Lake Tahoe tributaries due to the geography in which the fire burned, weather conditions following the fire, and expenditure of resources to mitigate potential effects. A large fire that burned in different conditions could have a significant detrimental effect on water quality.
- Forest management with appropriate mitigation techniques can reduce sediment generation from forested lands and developed properties.
- Restoring floodplain connectivity and geomorphic function in riverine systems can provide substantial FSP load reductions.

Overall TMDL

- Monitoring urban catchment stormwater, tributary streams, and the lake itself are all critical to evaluate the effects of stormwater management practices, track pollutant loading trends, and assess the Lake's response to TMDL implementation efforts. However, there is a lack of long-term stable funding to support these monitoring efforts.
- Overall, average annual lake clarity levels have shown a decade-long trend of stabilization.
- Laser diffraction instruments are appropriate instruments for particle size distribution analysis in urban stormwater. Sonication is critical to restore particle size distribution profiles in stormwater samples with holding times greater than one day.
- Various Lake Tahoe basin research efforts have found strong correlations between field turbidity measurements and FSP (both mass and number of particles) in stormwater, streams, and land use data. The slope of the relationship can vary depending on the FSP source.
- Updates to lake clarity model calculations have shown very good agreement between measured and modeled transparency, and validated the current implementation strategy of the TMDL.
- Improvements to the suite of TMDL stormwater tools is in progress and is expected to provide more effective implementation, adaptive management, and progress tracking of pollutant load reduction from Urban Uplands.
- A 2013 PLRM model calibration exercise indicated the PLRM performs reasonably well on seasonal and annual time scales, as intended based on model develoment objectives.
- The level of potential water quality impacts attributable to climate change is mixed: sediment loads are not projected to increase substantially, but nutrient availability from within the lake could increase substantially.
- If Lake Tahoe ceases to mix by the middle of the 21st Century, the resulting substantial nutrient availability from within the lake could result in a dramatic decline in lake clarity such that the possibility of achieving the clarity standard of nearly 100 feet would need to be reevaluated.
- Nearshore conditions are expected to improve in response to Lake Tahoe TMDL implementation, particularly in the vicinity of effective load reduction efforts.

A. URBAN STORMWATER MANAGEMENT

2014 Findings and Notable Updates

Summary Findings

1. Wintertime traction abrasive application to roadways is the primary specific source of both fine sediment particles (< 16µm) in stormwater runoff and PM10 in the urban upland and atmospheric deposition source categories, respectively.
2. Pollutant source control best management practices (PSC BMPs) are more cost effective than stormwater treatment (SWT) BMPS in reducing fine sediment particles from urban roads.
3. Improving PSC BMPs has the direct benefit of improving the effectiveness and reducing maintenance cycles of SWT BMPs.
4. There has been a consistent and ubiquitous lack of appropriate maintenance conducted on SWT BMPs throughout the Tahoe basin. Regular inspection and maintenance of SWT BMPs is needed to sustain intended fine sediment particle load reductions.
5. Targeted implementation of SWT and PSC BMPs on developed parcels is a cost-effective strategy for reducing pollutant loads.

Notable Updates

This subject area contains the following refinements and additions to the 2010-2013 findings:

- Clarifing information was added regarding the results of several studies related to roadway generated FSP. In particular, the findings below more specifically synthesize information regarding the source of roadway generated particulate matter.

1. Urban Roads

FINDINGS

A. On average, 12,000 metric tons of traction abrasives have been applied to Tahoe basin roads annually to improve road safety. A strong seasonal pattern was exhibited during urban road condition experiments where the maximum stormwater runoff concentrations and variability across sites significantly decreases from the winter months through the spring and summer (2NDNATURE et al. 2010). Furthermore, compared with the summer season, road dust emissions increased, on average, by a factor of 5 in winter and about a factor of 10 when traction control material was applied to the roads after snow events (Zhu et al. 2009). These findings support the hypotheses that chronic winter road abrasive applications and subsequent pulverization by vehicles generate the vast majority of airborne PM10 in the Lake Tahoe Basin.

B. On average, nearly 300 metric tons of particulate matter <10µm (PM10) are contributed annually to the atmosphere by vehicles traveling on paved roads in Tahoe Basin (Kuhns et al. 2010; Zhu et al. 2009). As such, re-suspended paved road dust remains a significant source of fine sediment within the atmospheric deposition pollutant source category (Engelbrecht et al., 2009; Cahill et al. 2011).

C. Other potential sources of airborne PM10 and surface runoff FSP from roadways include road shoulder and road cut-slope erosion, abrasion of the roadway itself and car tire degradation (2NDNATURE et al. 2010). A study using chemical fingerprinting techniques to determine FSP source contributions in stormwater runoff from highway sources including road surface abrasion, winter traction material, road shoulder and ditch erosion, and soil erosion produced inclusive results as the source samples were found to be quite similar in

relative element composition. This fact, in conjunction with a broader range of element concentrations naturally represented in the highway runoff samples, meant there is too much overlap inherent to the test samples in their source sample attributions. The overall composition of runoff samples was about 25 percent organic, with very minimal evidence of any biological material in the SEM images. Thus road and tire wear may have contributed up to one-quarter of the total FSP mass in runoff samples (Heyvaert et al. 2012).

2. Pollutant Source Control BMPs

FINDINGS

A. A contemporary cost benefit analysis of potential strategies to meet TMDL load reduction targets indicates pollutant source control best management practices (PSC BMPs[1]) are up to an order of magnitude more cost effective than increased implementation of stormwater treatment (SWT) BMPS[2] (2NDNATURE and NHC 2011a).

B. Roadway sweeping effectiveness studies found a statistically significant reduction in the FSP mass accumulated on the road surface with the use of a high efficiency vacuum assisted sweeper. The study results also support the hypothesis that more frequent sweeping with appropriate equipment reduces the amount of pulverized FSP that accumulates on the roadway (2NDNATURE 2012, NTCD et al. 2011).

C. Frequent wintertime street sweeping and/or the use of anti-icing pretreatment is estimated to be three orders of magnitude more cost effective than other options evaluated to reduce the annual mass of PM10 generated from urban roads in the Tahoe basin. Estimates of more than 60 percent reduction in regional PM10 emissions are expected when annual road abrasive applications are reduced, and all urban roads are frequently and effectively swept during winter months to recover as much of the applied material as possible (Kuhns et al. 2010).

D. Substantial stormwater and atmospheric FSP load reductions are expected when jurisdictions minimize abrasive application and increase the frequency and improve the effectiveness of street sweeping. This is especially true in the winter and spring when the most abrasives are applied to roads. Further investigation of real-world applications of such controls will help determine which practices provide the greatest cost-benefit. Viable and cost-effective strategies to control road-FSP derived loads include:

   i. Employing advanced control technology abrasive spreading equipment to target and minimize the mass of abrasives applied and reduce cast-off through pre-wetting of materials (2NDNATURE et al. 2010; TRPA 2012).

   ii. Using either high efficiency street sweepers that include regenerative air and/or vacuum assist or street cleaners featuring captive hydrology technologies (NHC et al 2009; Sutherland and Jelen 1996; Center for Watershed Protection 2008; Blosser et al. 2003; Schilling 2005).

   iii. Reducing the residence time of abrasives and the mass available for pulverization by vehicle traffic. Abrasive residence time can be reduced by sweeping roadways shortly after abrasive application events, and targeting sweeping practices to those locations where the most abrasives were applied. Pulverized material may be effectively dispersed throughout the road network by vehicle traffic. (2NDNATURE et al. 2010, 2012a; 2NDNATURE, 2012; NTCD et al. 2011; Kuhns et al. 2010).

[1] Pollutant source control BMPs reduce the source of pollutants prior to being entrained in stormwater.

[2] Stormwater treatment BMPs remove pollutants entrained in runoff through infiltration, particle capture, media filtration and/or nutrient cycling.

iv. Selecting abrasives that are more resistant to pulverization, and therefore potentially remain as coarse material on the road surface for longer durations (Caltrans 2012).

v. Pre-washing abrasives to remove FSP prior to application on Tahoe roads, and/or selecting abrasives to minimize the initial proportion of FSP (Caltrans 2012).

vi. Increasing durability of road surfaces by better maintaining their integrity and/or using more durable paving materials such that road surfaces remain free of cracks and crevices for longer periods of time. Cracks and crevices in pavement can accumulate FSP that most sweepers cannot remove, but that is effectively mobilized and transported by stormwater runoff events (2NDNATURE et al. 2010, NTCD et al. 2011).

vii. Using traction abrasive alternatives such as biodegradable polymers and/or applying anti-icing treatments to roadways. The environmental impacts associated with such alternatives may need to be taken into account before use.

viii. Employing traffic safety measures, such as increasing public transit ridership or reducing and enforcing speed limits during storms, that minimize abrasive application reductions or result in incremental reductions in FSP generation via vehicular pulverization.

3. Stormwater Treatment BMPs

FINDINGS

A. There is a consistent and ubiquitous lack of appropriate maintenance conducted on stormwater treatment (SWT) BMPs in the Tahoe basin. The lack of maintenance has been observed for private (residential, commercial) and public (roadways, facilities) SWT BMPs. All types of SWT BMPs suffer from insufficient maintenance: vegetated swales, sediment traps, dry basins, wet basins, cartridge filters, and treatment vaults (2NDNATURE 2006, 2NDNATURE et al. 2012a).

B. Qualitative observations suggest problems associated with existing SWT BMPs are primarily due to a lack of proper conveyance and/or accumulation of excessive sediment, debris or vegetation, which may be a result of flawed design, poor construction, or lack of regular maintenance (2NDNATURE et al. 2012a, 2013).

C. The performance of infiltration BMPs rapidly declines due to clogging (2NDNATURE and NHC 2011b).

i. FSP loading rates estimated for driveway and parking lot runoff substantially affected infiltration capacity within a few years, resulting in a failure to meet the Tahoe Regional Planning Agency's 20-year storm (1 inch of rain/ hour) infiltration design standard (2NDNATURE 2006, 2010; 2NDNATURE et al. 2012a, 2013).

ii. Infiltration BMP configurations with more lateral (side) infiltration surface area experienced a somewhat slower decline in measured infiltration capacity because less FSP accumulated at the sides of the BMP relative to the bottom (2NDNATURE et al. 2013).

D. SWT BMPs that rely upon particle settling (Treatment Vaults, Sediment Traps and Drop Inlets) are not effective at removing FSP entrained in stormwater (2NDNATURE et al 2009, 2NDNATURE et al. 2012a; Dennett and Ridenoure, 2007).

E. An FSP load reduction analysis determined that significant stormwater load reductions may be achieved through implementation of SWT and PSC BMPs on developed parcels (2NDNATURE and NHC 2011a). Related findings from the study include:

i. The most efficient FSP load reductions may be achieved by targeting Commerical/Institutional/Communications/Utilities (CICU) land uses due to the much larger pollutant potential of this land use type.

ii. Significant stormwater load reductions may be achieved through implementation of SWT and PSC BMPs on Multi-Family Residential (MFR) and Single-Family Residential (SFR) land uses that have high degrees of directly connected impervious area.

iii. Improper construction and unreliable maintenance are potential issues for parcel-scale SWT BMP performance. Long-term maintenance is needed to achieve estimated load reductions.

iv. Planning-level cost estimates found parcel-level BMP implementation to be an order of magnitude less cost-effective strategy than advanced roadway operations and maintenance practices but two to four times more cost-effective than implementation of large-scale water quality improvement projects.

B. NON-URBAN SOURCE CATEGORY MANAGEMENT

2014 Findings and Notable Updates

Summary Findings

1. Active unpaved roads are estimated to produce sediment yields (both FSP and other suspended solids) that are 1-3 orders of magnitude greater than inactive unpaved roads.
2. The Angora Fire did not result in massive sediment or nutrient inputs to Lake Tahoe tributaries due to the geography in which the fire burned, weather conditions following the fire, and expenditure of resources to mitigate potential effects. A large fire that burned in different conditions could have a significant detrimental effect on water quality.
3. Forest management with appropriate mitigation techniques can reduce sediment generation from forested lands and developed properties.
4. Restoring floodplain connectivity and geomorphic function in riverine systems can provide substantial FSP load reductions.

Notable Updates

This subject area contains the following refinements and additions to the 2010-2013 findings:

- A study regarding the sediment and nutrient inputs to Angora Creek and the Upper Truckee River following the Angora Fire was added.
- Additional detail regarding water quality affects of pile burning and control burning was added.
- A synthesis of studies detailing the effectiveness of the Blackwood Creek Restoration Project and the Cookhouse Meadow Restoration Project were added.

4. Forest Management and Erosion Control

FINDINGS

A. Active unpaved roads are estimated to produce sediment yields (both FSP and other suspended solids) that are 20-2000 times (1-3 orders of magnitude) greater than inactive unpaved roads, and provide higher contributions of FSP (42-52 percent of sediment mass in runoff from active unpaved roads compared to 12-43 percent sediment mass from inactive unpaved roads) (Drake et al. 2012). Grading active unpaved roads was shown to increase sediment yield by 3,300 percent (33 times) compared to ungraded conditions. Various BMP strategies have been shown to reduce sediment yields from unpaved roads as well from ski runs (Drake et al. 2012). Specifically:

   i. Mulch (2-3 inch depth of wood chips or pine needles) applied to inactive dirt roads reduced sediment yields by 72 to 86 percent (measured with rainfall simulation). Similar sediment reductions of 60-90 percent were achieved with the same mulch applications on ski runs.

   ii. For large disturbed slopes, such as ski runs, mulch filter berms have been shown to reduce sediment yields in surface runoff by 45 percent.

   iii. Applying gravel to armor active unpaved roads (graded and ungraded) was shown to reduce sediment by up to two orders of magnitude and reduce ongoing maintenance costs including grading.

B. Short-term vegetation establishment on eroding slopes has been shown to be an insufficient (and sometimes misleading) predictor of long-term restoration success (Herrick et al. 2006) and erosion resistance (Grismer et al. 2009).

C. The Angora Fire that burned 3,100 acres of forest in the summer of 2007 was the largest and most severe wildfire in recent history in the Tahoe Basin. However, there was no evidence of massive sediment or nutrient inputs into Angora Creek or further downstream to the Upper Truckee River or to Lake Tahoe (Reuter et al. 2010, Oliver et al. 2011) following the fire. A number of factors contributed to the reduced affect seen after the Angora Fire, including: 1) low precipitation and lack of severe storms during the next storm season; 2) re-growth of new vegetation; 3) the Washoe Meadows with its grassland vegetation and minimal slope acted as a buffer that polished runoff reaching the Upper Truckee River; and 4) the U.S. Forest Service Lake Tahoe Basin Management Unit (USFS-LTBMU) and California Tahoe Conservancy (CTC) embarked on a watershed restoration program to help stabilize the steep slopes within the burn area.

   Data was collected by USFS-LTBMU on Angora Creek in 2011 near the downstream boundary of USFS-LTBMU lands within Angora Fire burn area. That data was compared with results from previous data collection and analysis efforts at this site, dating back to 1991. The analysis indicated: 1) initially elevated sediment and total phosphorus concentrations had essentially returned to pre-fire levels; and 2) nitrogen concentrations were higher than pre-fire levels, but well below California tributary water quality standards (Norman et al. 2012a).

   Despite the fact that pollutant loading from the Angora Fire was not as substantial as it could have been, this should not be taken as an indication that wildfires will not affect erosion and nutrient/sediment loading following future wildfires. The Gondola Fire at Lake Tahoe in 2002 was followed by a large precipitation event, resulting in erosion that was estimated to remove 1.4 cm of soil from the burned area (Murphy et al. 2006). The Gondola Fire was neither as severe nor as large as the Angora Fire, but resulted in much greater watershed response as a consequence of the timing and magnitude of post-fire precipitation. Consequently, on-going efforts by USFS-LTBMU and other agencies to control forest fuels and fire potential are important mitigation measures to protect water quality.

D. Pile burning can alter soil properties, including reducing porosity and infiltration rates, increasing soil nitrate, and result in increased erosion rates for several years post burn (Hubbert et al. 2013). Impacts of pile burning can be greatly reduced by being cognizant of the content of each pile and treating the burn site following burning (Busse et al. 2013). Piles of large-sized wood (logs) burn much hotter and longer than piles containing small sized material. Soil damage can be greatly mitigated by "mopping up" (i.e., quenching the fire with water after the bulk of the biomass is consumed, and thereby avoiding lengthy lingering beds of hot coals).

E. Hubbert et al. (2013) found no consistent evidence of increased nutrient movement downslope from burned piles. Overland flow of nitrate, phosphate, and sulfate generally declined with distance away from the pile edge, and there was only a modest, inconsistent change in subsurface nutrient concentrations downslope from piles.

F. Erosion rates were found to be twice as high when mastication of fuels results in bare soil compared to leaving patches of masticated material that cover 25-50 percent of the soil surface (Stubblefield et al. 2012).

G. "Light on the land" equipment and treatment techniques used for mechanical vegetation treatments did not result in substantially adverse ecological effects on Tahoe Basin soils evaluated (Norman et al. 2012b). On the other hand, modeled estimates of different mechanical treatment techniques such as whole tree skidding as compared with cut-to-length

harvest indicate differences in forest runoff event mean concentrations (EMCs) by factors of 5-50 times, depending on land use and soil type. Volcanic soils with high erosion potential are especially prone to experience high EMCs in forest runoff (Tetra Tech 2012).

H. Eight landscape treatments were tested for reducing erosion risk and maintaining low fire risk using rainfall simulation and burn tests (IERS 2012). Results showed:

   i. Soil loosening, incorporation of woody material and surface mulching can reduce sediment yield and improve erosion resistance compared to compacted, partially vegetated areas with no mulch cover.

   ii. Mulch cover is highly effective at preventing erosion, but some mulch (pine needles, landscape bark) pose high fire risk.

   iii. Roto-tilled woodchips and duff mulch have the lowest erosion risk/fire risk combination.

5. Stream Restoration

FINDINGS

A. The Stream Load Reduction Tool (SLRT) is a recently developed model that provides load reduction estimates that can potentially be used to support the tracking of pollutant load reductions in conjunction with the implementation of the Lake Tahoe TMDL (2NDNATURE 2013). SLRT was developed to provide a consistent and relatively simple estimation approach to quantify the average annual pollutant load at the downstream boundary of a stream reach by modeling the critical processes influencing water quality over decadal time scales. Downstream water quality improvements associated with a stream restoration project are a function of: 1) Increased pollutant retention on the floodplain that would have otherwise been transported downstream (floodplain retention) and 2) Reduced pollutant generation via stream bank stability that would have otherwise eroded (stream channel erosion). SLRT estimates the average annual FSP load exported from the downstream boundary of the subject reach for both pre- and post-restoration conditions, the difference being the average annual FSP load reduction as a result of restoration actions (2NDNATURE 2014).

B. A recent study (2NDNATURE 2014) estimated the average annual FSP load reduction (MT/yr) for seven stream restoration projects in the Upper Truckee River Watershed using SLRT. Cumulatively, a potential 109 MT/yr of FSP may be reduced from the Upper Truckee River (≈ 20% reduction in the total FSP load) if all of these restoration projects are implemented and respond as modeled.

C. Targeted floodplain sampling during eight independent overbank events on two floodplains consistently measured FSP load reductions as a result of floodplain interactions (2NDNATURE 2011, 2013). Reach scale water quality monitoring efforts during water year 2010 and water year 2011 overbank events on the restored reach of Trout Creek measured FSP load reductions. Mass balance estimates of the event scale FSP retention on the floodplain exceeded FSP contributions from channel erosion in systems where the channel capacity and morphology approximates natural conditions (2NDNATURE 2013).

D. Laboratory simulations demonstrated FSP accumulation and microfilm creation on vertical structures perpendicular to flows, suggesting FSP retention on floodplain vegetation could be substantial (Andrews et al. 2011, Fauria 2013). Modeling of suspended sediment on the Trout Creek restored floodplain indicated that flocculation (i.e., the aggregation of smaller particles) is the most important physical mechanism influencing FSP removal on floodplains, followed by sediment stranding due to infiltration and gravitational settling (Andrews et al. 2011).

E. In simulations using a calibrated BreZo model (a hydrodynamic flood simulation algorithm), inducing overbank flow via weir installation had a greater effect on the total FSP load reduction due to overbank flow than increasing floodplain vegetation or backwater depressions (Andrews et al. 2011).

F. Multiple studies have been conducted over the last few years to improve the technical understanding of physical streambank processes. These studies have led to direct improvements to the BSTEM Dynamic and CONCEPTS models and their ability to assess the potential impacts of various mitigation measures and restoration actions. Improvements include modeling floodplain soil heterogeneity, incorporating the effects of riparian vegetation (RipRoot), and quantifying meander migration rates (Bankhead et al. 2013; Garcia et al. 2010; Langendoen 2011, 2013; Motta et al. 2010, 2011, 2012; Simon et al. 2011).

G. While toe erosion is responsible for only a small proportion of the total erosion within a stream, hydraulic erosion of the bank toe is the precursor to geotechnical failure of the stream bank as a result of bank oversteepening (Simon et al. 2011; Bankhead et al. 2013).

H. Observations immediately following in-channel restoration of Blackwood Creek Reach 6 showed an increase in the extent of flooding, particularly in the small magnitude, high recurrence flows. A decrease in average shear stress for all floods was modeled, showing a 39 percent decrease for the 1.5-year recurrence flow and a 48 percent decrease for a 20-year recurrence flow (Immeker 2012). A decrease in shear stress is expected to reduce erosion of the streambank,thereby reducing the overall sediment load due to channel erosion.

I. On the reach of Blackwood Creek restored in the USFS-LTBMU Phase IIIA project (Reach 6) USFS-LTBMU estimated that average annual bank erosion from 1965 to 2007 in the Phase IIIA project area accounted for nearly 50 percent of the total annual fine sediment load generated from bank erosion along the entire length of the main stem channel and about 5 percent of the total annual yield from the entire Blackwood Creek watershed. Since completion of the Phase IIIA project in 2009, the project has achieved or shown positive trends, including the following (Norman et al. 2013):

   i. Measurements of sediment retained on the floodplain the first year after restoration indicates retention of 142 tons of silt and clay sized particles. Visual observations and photos in the following year indicate sediment deposition continues to occur on constructed floodplain surfaces. Fine sediment retention is expected to continue as vegetation on active floodplain surfaces becomes better established.

   ii. Overall bank stability increasing from approximately 30 percent to 95% within the project reach. The reach has changed from one dominated by channel erosion to one dominated by floodplain deposition.

J. The Cookhouse Meadow Restoration 5-year report (Oehrli et al. 2013) documents that overbank flows continue to flood the meadow at the desired recurrence interval of 1.5-years. Sediment sampling in 2012 provided a rough quantitative estimate of the degree to which meadow surfaces are being replenished with sediments deposited by overbank floods; approximately 40 tons total, of which a little more than half consist of silt/clay sized particles. The results provide a conservative estimate of total sediment storage and the report concluded that all deposits outside the main channel will remain sequestered and therefore removed.

C. OVERALL TMDL

2014 Findings and Notable Updates

Summary Findings

1. Monitoring urban catchment stormwater, tributary streams, and the lake itself are all critical to evaluate the effects of stormwater management practices, track pollutant loading trends, and assess the Lake's response to TMDL implementation efforts. However, there is a lack of long-term stable funding to support these monitoring efforts.
2. Overall, average annual lake clarity levels have shown a decade-long trend of stabilization.
3. Laser diffraction instruments are appropriate instruments for particle size distribution analysis in urban stormwater. Sonication is critical to restore particle size distribution profiles in stormwater samples with holding times greater than one day.
4. Various Lake Tahoe basin research efforts have found strong correlations between field turbidity measurements and FSP (both mass and number of particles) in stormwater, streams, and land use data. The slope of the relationship can vary depending on the FSP source.
5. Updates to lake clarity model calculations have shown very good agreement between measured and modeled transparency, and validated the current implementation strategy of the TMDL.
6. Improvements to the suite of TMDL stormwater tools is in progress and is expected to provide more effective implementation, adaptive management, and progress tracking of pollutant load reduction from Urban Uplands.
7. A 2013 PLRM model calibration exercise indicated the PLRM performs reasonably well on seasonal and annual time scales, as intended based on model develoment objectives.
8. The level of potential water quality impacts attributable to climate change is mixed: sediment loads are not projected to increase substantially, but nutrient availability from within the lake could increase substantially.
9. If Lake Tahoe ceases to mix by the middle of the 21st Century, the resulting substantial nutrient availability from within the lake could result in a dramatic decline in lake clarity such that the possibility of achieving the clarity standard of nearly 100 feet would need to be reevaluated.
10. Nearshore conditions are expected to improve in response to Lake Tahoe TMDL implementation, particularly in the vicinity of effective load reduction efforts.

Notable Updates

This subject area contains the following refinements and additions to the 2010-2013 findings:

- Additional details were added regarding the findings of a study (Hayvaert et al. 2011a) that assessed protocols for FSP measurement.
- A finding synthesizing research comparing measured vs. modeled lake clarity was added.
- Findings from a 2013 study comparing representative PLRM models to measured water quality datasets were added.
- Additional findings regarding the potential affects of climate change to Lake Tahoe were added.
- Additional findings regarding Lake Tahoe's nearshore quality were added.

6. Monitoring

FINDINGS

A. Data collected as part of the long-term tributary monitoring effort known as the Lake Tahoe Interagency Monitoring Program (LTIMP) was instrumental in supporting Lake Tahoe TMDL development. Funding for LTIMP continues to decline, threatening data continuity and the ability to detect changes in pollutant loading at the watershed scale over time.

B. A partnership of stakeholders provides funding to support in-lake clarity monitoring. Results of this monitoring show that overall, average annual clarity levels have shown a decade-long trend of stabilization (UC Davis 2014).

C. Urban stormwater monitoring at the catchment scale is critical to assess status and trends over time. A quality assurance project plan, sampling and analysis plan and data quality objectives were developed as part of initial basin-wide effort to implement and coordinate a regional stormwater monitoring program or RSWMP (Heyvaert et al. 2011b,c,d).

   As part of RSWMP, the Implementers Monitoring Plan (IMP) was established to perform permit compliance monitoring. The IMP will monitor outfall runoff from five urban catchment sites and four SWT BMP effectiveness projects covering two different treatment approaches. Runoff monitoring conducted under the IMP will facilitate a better understanding of how storm water management practices are affecting runoff water quality. The IMP is an important step in implementing a more comprehensive basin-wide catchment scale monitoring network (TRCD 2013a, 2013b).

   California Proposition 84 funding has been secured through 2017 to establish a centralized structure responsible for organizing and administering the Lake Tahoe RSWMP. In addition to programmatic development tasks, the project will build on the IMP and establish additional stormwater monitoring sites to assess urban stormwater runoff pollutant load status and trends at a catchment scale (TRCD, 2013b).

D. A variety of methods are currently in use at Tahoe for conducting laboratory analyses of suspended fine sediment particles (FSP). With funding from the SNPLMA Science Program, Heyvaert et al (2011a) assessed protocols for FSP measurement and assembled particle size distribution data into a comprehensive data set. Results included:

   i. Patterns in lake sample FSP concentrations suggested a strong correlation between annual precipitation and lake particle concentrations. Lake concentrations of FSP tended to be highest in the upper water column above the Secchi depth. Spring and early summer FSP concentrations were greater than winter concentrations, coinciding with snowmelt.

   ii. FSP concentrations in stormwater samples were generally several orders of magnitude greater than FSP concentrations in lake and steam samples.

   iii. Holding times longer than one day can affect the particle size distribution results for stormwater samples, with a tendency towards increases in larger particles with increased holding time. Sonication was shown to restore the samples to the original particle size distribution profiles, while dispersants did not.

   iv. The LiQuilaz (laser optical) particle counting instrument is more appropriate for low concentrations typical of streams and Lake Tahoe, while laser diffraction instruments (e.g., Beckman Coulter LS-13320 and Micrometrics Saturn DigiSizer) are more appropriate for the higher concentrations found in urban stormwater.

E. Continued instrument quality assessment and quality control are critical to ensure data integrity for automated equipment. The freeze and thaw weather cycles in Tahoe can wreak havoc on continuous flow and water quality monitoring equipment. Manual measurements

to calibrate the instrument readings are imperative to ensure high confidence in the observed data (2NDNATURE 2006; 2NDNATURE et al. 2010, 2012a, 2012b).

F. Various Lake Tahoe basin research efforts have found strong correlations between field turbidity measurements and FSP (both mass and number of particles) in stormwater, streams, and land use data. The slope of the relationship can vary depending on the FSP source. (2NDNATURE 2011, 2013; 2NDNATURE et al. 2010, 2012a, 2012b; Heyvaert et al. 2011a).

G. Analyzing the 2003-2004 stormwater monitoring dataset collected as part of the TMDL, Zelin (2011) found that mass loading of FSP was on average the highest for the rain-on-snow events, although thunderstorms and rain also introduced large loads.

7. Tools and Models

A. The Lake Tahoe TMDL pollutant source analysis was conducted using The Lake Tahoe Watershed Model (LSPC). LSPC watershed loading estimates are linked as inputs to the Lake Clarity Model. The Lake Clarity Model is used to predict lake clarity response as a function of various pollutant levels to the lake over long-time scales (i.e. years to decades). Researchers have recently updated LSPC loading estimates based on data collected subsequent to the Lake Tahoe TMDL analysis (Sahoo et al. 2013). The updated load estimates based on the additional years of data were very similar to the TMDL estimates. Though some interannual differences exist, through 2008 there was very good agreement between measured and modeled transparency (Secchi depth). These findings validate the conclusions and the current implementation strategy of the TMDL.

B. TMDL Implementers and TMDL Program Managers have been working to improve and refine the suite of stormwater tools that support quantifying urban pollutant load reduction efforts through the Lake Clarity Crediting Program (Crediting Program; Lahontan Water Board and NDEP 2009). The current suite of tools includes the Pollutant Load Reduction Model (PLRM) and two condition assessment tools: Road Rapid Assessment Methodology and Best Management Practices Rapid Assessment Methodology (ROAD RAM and BMP RAM, respectively). The Tahoe Integrated Stormwater Tool (TIST) is the online TMDL registration and accounting platform that provides for the management of relevant data and sharing of information between the Urban Jurisdictions and TMDL Program Managers. The Stormwater Tools Improvement Project has been initiated to refine and improve the current suite of stormwater tools by addressing priority operational improvement needs identified by researchers, tool users and tool developers. The *Lake Clarity Crediting Program Handbook*, the protocol that guides use of the stormwater tools is also in the process of being updated to align with the updated tools.

C. PLRM is the water quality planning tool designed to predict average annual runoff volumes and pollutant loads that is currently used by TMDL implementers to estimate potential pollutant load reductions associated with collective water quality improvements in urban catchments. There is a strong desire by the stormwater community to better understand the performance, limitations and opportunities to inform the PLRM. A series of recent research conducted by the developers of PLRM have identified and implemented a series of data collection and model development efforts to address these desires by the stormwater community. Most recently, 2NDNature and Northwest Hydrologic Consultants (2NDNATURE and NHC 2014) used a series of data and information to: 1) document the runoff volumes and FSP pollutant loading from three urban catchments; 2) evaluate the influence of changing road conditions on these pollutant loads; and 3) build representative PLRM models to compare to the measured water quality datasets. The results of the model calibration exercise and comparison to measured pollutant loads suggest that PLRM models can perform reasonably well on the seasonal and annual time scales, as intended based on the

objectives of the model design. However, the model's predicted runoff volumes and pollutant loads can have notable discrepancies with the measured data at the event time scale. The discrepancies are particularly evident during periods of snow hydrology when the model is dependent on accurate inputs of temperature data to predict snow accumulation and melt, or when complex drainage conditions are present in the monitored catchment such as a baseflow component. The authors note the generation of comparable and representative PLRM estimates to measured data is a time consuming and complex undertaking, and recommended that data collection related to PLRM should focus on informing PLRM algorithms that are directly testable and improvable: PLRM characteristic runoff concentrations from land surfaces (CRCs) and PLRM characteristic effluent concentrations from stormwater treatment BMPs (CECs), in particular.

8. Climate Change

FINDINGS

A. The 21st Century global climate is expected to experience long-term changes in response to anthropogenic greenhouse gas emissions. Investigations on the potential impacts of climate change on water resources in the Lake Tahoe basin to date have focused on identifying existing impacts and trends in the historical data (e.g. Coats et al. 2006). The potential effects of changing meteorologic conditions on a variety of topics such as expected future air temperature, amount and type of precipitation, stream discharge, sediment and nutrient loading characteristics, BMP performance, lake mixing and water quality response, were investigated using existing water resource models already developed for the Lake Tahoe TMDL (Coats et al. 2010, 2013). A sophisticated statistical downscaling methodology was applied to produce simulated data records at a 12 km grid scale in the Tahoe Basin for the 21st Century (2000-2099) (Dettinger 2012). The results of this modeling were published in a special issue of the journal Climatic Change in 2012 (e.g. Costa-Cabral et al. 2012). Specific findings included:

   i. By the middle of the 21st Century (after about 2050) Lake Tahoe could cease to mix to the bottom. This would result in complete oxygen depletion in the deep waters and an increase in sediment release of nitrogen and phosphorus. Annual loading of soluble reactive phosphorus under sustained conditions of lake stratification (no deep mixing) and anoxic sediments could be twice the current load from all other sources. Loading of ammonium under these conditions could increase the amount of biological available nitrogen that enters the lake by 25 percent. This effect on the Lake Tahoe's nutrient budgets could have a dramatic and long-lasting impact on on annual Secchi depth which could be in the range of 15-20 m as compared to measured values of 21-22 m since 2000 (Sahoo et al. 2012).

   ii. Changes in climatic conditions including upward trends in minimum and maximum air temperature. There are no strong trends in annual precipitation amounts, though there is the possibility of a decline in precipitation toward the end of the century (Coats et al. 2012).

   iii. Projected increases in drought severity, especially toward the end of the century, combined with legacy vegetation, forest fuel accumulation and warmer temperatures can significantly increase the risk of wildfire (Westerling et al. 2006; Coats 2010; Coats et al. 2012). Mackey et al. (2013) found that nutrient loading directly to the lake surface via atmospheric deposition of aerosols, especially during wildfire affected the growth of very small phytoplankton and could influence primary productivity.

iv. Consistent with increasing air temperatures, there is a continuing shift from snowfall to rain, and a movement toward earlier snowmelt and runoff during the water year, with dramatic increases in flood magnitude in the middle third of the century, is expected. In addition, there a possible downward shift in the hydrologic flow-duration curve scenario in the last third of the century (Coats et al. 2012).

v. Increases in flood magnitude due to more precipitation falling as rain are expected to result in a modest decline in BMP performance due to a flashier precipitation regime. However, a simulation (the modeled Improved Condition with full BMP implementation) showed that BMPs continued to provide more than 80 percent FSP reduction potential relative to the Baseline Condition throughout the entire simulation period. These results suggest that while climate change will have some effect on the performance of these water quality improvements, any diminished performance will be relatively small and load reductions as a result of BMP implementation would still be substantial (Coats et al. 2010).

vi. Sediment and nutrient loading to Lake Tahoe from terrestrial sources should not increase, to any meaningful level, as a result of climate change and may actually decrease due to the estimated decline in water yield (Riverson et al. 2012).

9. Nearshore Quality

FINDINGS

A. Changes in nearshore conditions at Lake Tahoe have become evident to visitors, residents and resource managers. Of particular concern are the changes in nearshore clarity, increasing periphyton growth, spread of invasive species, and a decline of native species in the nearshore biological communities. Recently, Lahontan Water Board and NDEP along with the Tahoe Regional Planning Agency and U.S. Environmental Protection Agency collaborated with Desert Research Institute, UC Davis and University Nevada Reno to develop the Nearshore Evaluation and Monitoring Framework Report (Heyvaert et al. 2013). This effort provided a comprehensive review and analysis of historical and current data reports related to Lake Tahoe's nearshore, evaluated the relevancy of water quality indicators to the nearshore environment, and developed a monitoring plan framework to track changes and assess nearshore condition. Findings relevant to the Lake Tahoe TMDL Program include:

i. Indicators identified as most relevant to the nearshore environment were clarity, trophic status, community structure, and those related to protection of human health. For the purpose of establishing a monitoring program, 10 metrics were selected to provide a comprehensive and integrated assessment of nearshore condition: turbidity, light transmission, chlorophyll, phytoplankton, periphyton, macrophytes, benthic macroinvertebrates, fish and crayfish, toxicity and harmful microorganisms.

ii. Nutrient and fine sediment loading reductions resulting from Lake Tahoe TMDL implementation will provide not only improve mid-lake clarity, but also will benefit nearshore clarity and related characteristics. Nearshore water quality is strongly influenced by localized pollutant input, so a load reduction action that may improve the open-water may or may not have a directly comparable effect on all nearshore areas.

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PART II: RECOMMENDATIONS

Introduction

Adopting well-supported TMDL Program adjustment recommendations based on new information is key to the TMDL Program's adaptive management process. Such adjustments ensure procedures and tools are practical and encourage effective actions to meet TMDL Policy objectives.

This section is a distillation of actionable recommendations proposed by TMDL Program Managers to adjust the TMDL Program, including management strategies and guiding policies. TMDL Program Managers present these recommendations to Lahontan Water Board and NDEP executives for discussion and approval. Recommendations that TMDL Program Managers do not currently plan to implement, or that require action from other entities (e.g. TMDL Implementers or Coordinating Partners) are captured in the *2014 Stakeholder Feedback Capture Sheet,* an appendix to this document available, also available on the TMDL Online Interface.

Proposed adjustment recommendations reflect the summary findings from Part I. Findings not linked to recommendations either support existing policy, require actions beyond TMDL Program Manager's purview, or are not currently actionable due to incomplete information or lack of implementation resources. Recommendations are grouped into one of three subject areas: A) Urban Stormwater Management; B) Non-Urban Source Category Management and C) Overall TMDL. Each recommendation within each subject area includes:

- Recommendation
- Description
- Response category: I, II, or III
- Alignment with findings
- Status
- Resources required

RESPONSE CATEGORIES

To establish a relative level of effort associated with each suggested recommendation, adjustment recommendations are placed into one of the following three response categories:

- **Response Category I** – Minor TMDL Program Adjustments. Generally, Category I adjustments may be executed by TMDL Program Managers at any time with consultation only from TMDL Executives. Little or no additional funding is required to implement Category I recommendations.
- **Response Category II**– Adjustments to TMDL Program technical tools, process, protocols or policy. Category II adjustments may require formal approval from Lahontan and NDEP TMDL Executives orformal approval from the Lahontan Regional Water Board and NDEP Administrator. Additional funding is usually required to implement Category II recommendations.
- **Response Category III –** Adjustments that would require amending the EPA-Approved Lake Tahoe TMDL Report. Category III recommendations may be warranted in the case of new scientific findings or substantial changes to environmental or economic conditions. Category III recommendations are first reviewed and approved or rejected by Lahontan and NDEP TMDL Executives. Following an approval process mandated by State or Federal laws and regulation, they are implemented through the appropriate policy change process for each agency. Additional funding would be required to implement Category III recommendations.

Summary of Recommendations

	RECOMMENDATION	RESPONSE CATEGORY	RESOURCES REQUIRED
SW.1.	Advocate for Urban Jurisdictions to secure funding for road operations and maintenance	I	TMDL Program Managers' time to assist Urban Jursidictions who are pursuing funding for operations and maintenance efforts.
SW.2.	Update the Lake Clarity Crediting Program Handbook.	II	Significant TMDL Program Managers' time to work with and oversee consultants hired to revise the *Crediting Program Handbook*; to draft new BMP inspection and maintenance guidance; and to coordiante with appropriate staff at TRPA.
NU.1.	Establish a new TMDL Performance Measure (TMDL PM) to track and report floodplain restoration activities in a manner consistent with TRPA EIP Program reporting efforts.	I	TMDL Program Managers' time to: craft a new TMDL PM information sheet; coordinate the collection of new data with TRPA and with the EIP Reporting Tool; highlight the importance of carefully tracking "Acres of SEZ Enhanced or Restored" to TMDL Implementers.
O.1.	Advocate for ongoing nearshore status and trend monitoring and broadcast the relationship of nearshore quality to TMDL implementation in TMDL Management System products.	I	TMDL Program Managers' time to work with appropriate agency staff people and scientists specializing in nearshore quality to craft effective and accurate messages.

A. URBAN STORMWATER MANAGEMENT

SW.1 Advocate for Urban Jurisdictions to secure funding for road operations and maintenance

Description: As stated by findings in "Urban Roads" and "Pollutant Source Control BMPs" road FSP derived loads are controllable, and significant load reductions can be expected when Urban Jurisdictions minimize traction abrasive application and increase the frequency and improve the effectiveness of recovery efforts – especially in the winter and spring.

While Urban Jurisdictions are taking action to increase the efficacy of street sweeping and other abrasive recovery practices and are exploring opportunities to reduce traction abrasive application rates, traditional funding sources (including federal and state grant programs) consider operations and maintenance practices ineligible for grant funding. As a result Urban Jurisdictions struggle to find funding for staff and equipment needed to perform and verify cost-effective operations and maintenance work.

The TMDL Program does not have access to funding sources to support Urban Jurisdictions' road operations and maintenance work. However, there are actions the TMDL Program may take to advocate for BMP road operations and maintenance funding:

1) Use TMDL Management System materials to highlight the importance and need for road operations and maintenance funding.
2) Advocate for road operations and maintenance funding and support efforts to revise grant program policies that prohibit or put limitiations on the funding of these activities.
3) Provide consultation assistance and advice to Urban Jurisdictions applying for road operations and maintenance funding, and draft letters of support for any proposals that seek such funding. If needed, officially partner with Urban Jurisdictions seeking funding through grant proposals or other measures.

Response Category I: This recommendation is consistent with the current focus of the TMDL implementation plan and the Lake Clarity Crediting Program and is not anticipated to require additional resources to implement.

Alignment with Findings: This recommendation is supported by findings in "Urban Roads and "Pollutant Source Control BMPs"

Status: TMDL Program Managers actively seek and take advantage of every opportunity to support the need for road operations and maintenance funding.

Resources Required: Significant additional resources are not anticipated being required to build road operations and maintenance messaging into 2015 and 2016 TMDL Management System products or to advocate for road operations and maintenance funding when presented with the opportunity. Some additional time may be required by TMDL Program Managers to assist Urban Jursidictions who are pursuing funding for road operations and maintenance efforts, but the additional effort required is expected to be minimal.

SW.2 Update the Lake Clarity Crediting Program Handbook.

Description: The Lake Clarity Crediting Program (Crediting Program) defines a comprehensive and consistent accounting system for Lahontan Water Board and NDEP to track pollutant load reductions from urban stormwater using Lake Clarity Credits. The *Lake Clarity Crediting Program Handbook (Crediting Program Handbook)* describes the processes and tools for Crediting Program participants – including TMDL Implementers and TMDL Program Managers – to effectively implement the Crediting Program. It is critical that the *Crediting Program Handbook* provide clear and consistent guidance to Crediting Program participants for the TMDL Program to be effective. Lessons learned since adoption of the *Crediting Program Handbook* in 2011 call for an update. Key drivers for this update include:

1) Updated stormwater tools: Adjustments are currently being made to the suite of tools used to implement the Lake Clarity Crediting Program through the Tahoe Urban Stormwater Tools Improvement Project. Improvements are being made to user functionality, stability, and integration and alignment of each tool. It is critical that the *Crediting Program Handbook* reflect new processes and procedures associated with these improvements to Crediting Program stormwater tools.
2) Lessons learned during pilot testing: Pilot testing of the existing stormwater tools and development of the TMDL Management System has highlighted the need for revisions and refinements to some Crediting Program processes, refinements of some Crediting Program terms, and clarification of the *Crediting Program Handbook* audience.
3) Need for parcel BMP inspection and maintenance verification protocols: As described by findings in "Stormwater Treatment BMPs", there is a consistent and ubiquitous lack of appropriate maintenance conducted on stormwater treatment (SWT) BMPs in the Tahoe basin. There is a need to create clear technical guidance to objectively define inspection and maintenance protocols and intervals for parcel BMPs. Incorporating annual condition verification requirements of parcel BMPs into the Lake Clarity Crediting Program would help ensure credit awarded for parcel BMP implementation is appropriate. The Lake Clarity Crediting Program currently does not consider the actual function or condition of parcel BMPs. Requirements could be improved to ensure regular parcel BMP condition assessments and verification of acceptable conditions.

Response Category II: Implementing this recommendation would require that TMDL Program Managers commit substantial time to draft, test, and refine new Crediting Program protocols and to oversee consultants assisting with this effort.

Alignment with Findings: This recommendation is supported by findings in "Stormwater Treatment BMPs" and in "Tools and Models."

Status: Consultants to the TMDL Management System are currently scoped and funded to revise the *Crediting Program Handbook*.

Resources Required: TMDL Program Managers will work with consultants to oversee and review revisions to the *Crediting Program Handbook*. TMDL Program Managers are working with stakeholders in an attempt to ensure that parcel BMP inspection and maintenance verification protocol is workable. In addition, TMDL Program Managers will continue to work with appropriate staff at TRPA, Resource Conservation Districts, and other entities as appropriate, to draft, test, refine and incorporate the new protocol into the Lake Clarity Crediting Program.

B. NON-URBAN SOURCE CATEGORY MANAGEMENT

NU.1 Establish a new TMDL Performance Measure (TMDL PM) to track and report floodplain restoration activities in a manner consistent with TRPA EIP Program reporting efforts.

Description: As described by findings in "Stream Restoration", restoring floodplain connectivity and geomorphic function in riverine systems can provide substantial FSP load reductions. Furthermore, effective stream and floodplain restoration projects that increase the frequency, duration and extent of floodplain flows can result in substantial and sustained FSP load reduction opportunities.

TMDL Program Managers suggest elevating the importance of restoring and enhancing streams and associated floodplain areas by adding it as a TMDL Performance Measure (TMDL PM) using the existing EIP PM "Acres of SEZ Enhanced or Restored". Because "Acres of SEZ Enhanced or Restored" is already tracked through the EIP, there will be no need to coordinate with TRPA to add a new performance measure to the EIP Reporting Tool.

To effectively use "Acres of SEZ Enhanced or Restored" to track floodplain restoration activities, it is necessary to distinguish these actions from those associated with "Linear Feet of Stream Channel Enhanced or Restored." This issue is pertinent from a TMDL Implementer standpoint as they are the

agents who will be responsible for reporting both "Linear Feet of Stream Channel Restored or Enhanced" and "Acres of SEZ Enhanced or Restored" each year during the EIP Reporting Process. Clear guidelines distinguishing the activites that differentiate these results will help prevent TMDL Implementers double counting.

Category I: Implementing this recommendation would not alter TMDL Management System processes or tools.

Alignment with Findings and Stakeholder Input: This recommendation is supported by findings in theme 5,"Stream Restoration."

Status: TMDL Program Managers are not currently tracking"Acres of SEZ Enhanced or Restored".

Resources required: Significant additional resources are not anticipated to be required to implement this proposed recommendation. To initate tracking of this PM, TMDL Program Managers would need to create a specific "information sheet" for "Acres of SEZ Enhanced or Restored", and ensure the data needed for TMDL purposes is added to the EIP Reporting Tool. Tracking and reporting of "Acres of SEZ Enhanced or Restored" could occur as early as 2015 depending on: 1) the speed at which resolution is achieved that enables TMDL Implementers to easily distinguish stream channel enhancement/restoration from floodplain enhancement/restoration; and 2) whether any adjustments need to be made to the EIP Reporting Tool, and how easy those adjustments are. Overall, TMDL Program Managers expect the time required to implement these changes will be minimal .

C. OVERALL TMDL

O.1 Advocate for ongoing nearshore status and trend monitoring and broadcast the relationship of nearshore quality to TMDL implementation in TMDL Management System products.

Description: Lake Tahoe's nearshore condition is an issue of primary public and resource management agency concern. As described in "Nearshore Quality" findings, many of the pollutant sources affecting nearshore conditions are the same as those identified by the Lake Tahoe TMDL. Control measures to reduce nutrient and fine sediment loading are expected to improve adjacent nearshore clarity and trophic status conditions. Establishing and conducting regular monitoring through a Nearshore Monitoring Program would facilitate assessing, tracking and reporting whether nearshore condition is improving in response to TMDL implementation as expected.

To date, TMDL Program policy, publicity pieces and products have focused on deep water clarity and have included only limited discussion regarding the relationship between TMDL implementation and nearshore water quality. Implementation of this recommendation will require TMDL Program Managers to actively seek opportunities to highlight nearshore status and trend monitoring efforts and to communicate the relationship between TMDL implementation and nearshore conditions.

TMDL Program Managers will continue to consult with colleagues and partner agencies to discuss how better integration between the nearshore and deep-water lake issues can occur and consider whether and how to incentivize and prioritize the implementation of TMDL load reduction efforts in locations where the greatest benefits to nearshore condition will occur .

Category I: Lahontan Water Board and NDEP are currently engaged with and support pilot implementation of the nearshore quality monitoring program. This recommendation will not require additional resources to implement.

Alignment with Findings and Stakeholder Input: This recommendation is supported by findings in theme 9, "Nearshore Quality."

Status: Funding for pilot implementation of all indicators and metrics as recommended in the Nearshore Evaluation and Montiring Framework Report has been secured through a variety of funding sources. In addition, monitoring efforts have been initiated. However, some of the funding for the pilot effort is one-

time funding. Long-term funding necessary for operation of a Nearshore Quality Monitoring Program remains outstanding.

Resources Required: Significant additional staff resources are not anticipated to be required to implement this proposed recommendation. The major resources required to build nearshore quality messaging into 2015 and 2016 TMDL Program products would be Program Managers' time to work with appropriate agencies' and research insititutions' staffs to craft effective and accurate messages.

REFERENCES

Categorizing References in the Synthesis of Findings

Credibility of the findings in this memo is based in large part on the source information supporting the finding, particularly the level of independent peer review. References cited in this memo are placed in categories that disclose the amount and type of peer review associated with each reference. The intention is to prevent the dissemination of irrelevant findings, unwarranted claims, or inaccurate interpretations and opinions. Generally, both the type (independent vs. colleague or internal review) and amount (number of thorough reviews) can affect the credibility of a document, and the findings distilled from that document. The following categories define three different reference levels based on the 'strength' of the peer review. The categories are organized in order of strongest peer review (scholarly independent peer review) to weakest peer review (draft document and stakeholder comments).

1. Scholarly independent peer review
   Publications in academic journals that adhere to scholarly review processes (e.g., single blind and double blind peer review) resulting in a minimum of three independent peer reviews. Further, the authors must explicitly show how they have addressed the review comments.

2. Formal stakeholder or internal colleague review (grey literature)
   Publications that have been authored or primarily funded by an officially recognized bipartisan organization[3], public agency[4] or research institution[5]; that are distributed and available for public consumption; and that have received multiple reviews from colleagues familiar with the subject area of the publication. Publications within this category are not controlled by commercial publishers. This category includes publications for which the primary author or authors have relied on a technical review committee, advisory committee, or other body of engaged stakeholders for input and review during creation. This category also includes publications for which the primary author or authors have informally requested input and review from colleagues in their field during the creation of the publication. Generally there is an applied assumption that the authors have revised the document to address review comments, but there is rarely an explicit requirement to show how the comments were addressed.

3. Draft documents and stakeholder comments
   Draft documents are documents that have been authored by an officially recognized bipartisan organization, public agency or research institution, but that have not yet been distributed for public consumption. Draft documents may or may not have received formal or internal colleague review. Draft documents include white papers, memos and reports distributed for specific stakeholders, but not for public review.

   Draft documents include documents distributed and available for public consumption that are not authored or funded by an officially recognized bipartisan organization, public agency or research institution. Stakeholder comments also include thoughts, ideas, concerns or questions expressed to TMDL Program Managers via phone, through in-person comments or by email. Findings developed as a result of stakeholder comments should cite, as a reference, the individuals (name and affiliation) who provided the feedback, and the date it was received. Reviewers of the *Synthesis of Findings Report* should clearly be able to tell whether findings were developed from an individual stakeholder comment, or from a collection of similar comments received from a variety of agencies, organizations and individuals.

[3] Such as a 401-C3 organization, consulting firm or other private company
[4] Such as the U.S. Forest Service
[5] Such as an accredited University

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APPENDIX A – 2014 STAKEHOLDER FEEDBACK CAPTURE SHEET

The *Stakeholder Feedback Capture Sheet* is a tool for TMDL Program Managers to track and respond to stakeholder feedback – including suggested program adjustments or information needs – in an organized and transparent manner. The *Stakeholder Feedback Capture Sheet* is populated by TMDL Program Managers who add stakeholder feedback to the list throughout the year. TMDL Program Managers reference the list when drafting the *Synthesis of Findings & Program Adjustment Recommendation Memo.* A primary feedback mechanism that assists with population of the sheet is the Stakeholder Feedback Form, available on the TMDL Online Interface (https://www.enviroaccounting.com/TahoeTMDL/Program/Home).

2014 Stakeholder Feedback Capture Sheet

Note: Consistent with the structure of the *Synthesis of Findings & Program Adjustment Recommendation Memo* , stakeholder feedback is organized within three subject areas: 1) Urban Stormwater Management 2) Non-Urban Source Cateogry Management 3) Overall TMDL. Feedback is organized chronologically by the submittal date within each category.

#	Short Title	Summary of comment (1-3 sentences)	Submittal Date	Stakeholder Information	TMDL Program Manager Response
	Create a short title that can be used to identify the theme of the comment	Provide a 1-3 sentence summary describing the proposed information need, adjustment or other comment. Recommendations for program adjustments should focus on specific actions needed to implement adjustments.	Enter Month/Year Submitted	Provide name and organization and contact information	Describe action taken and/or status on the suggestion.
Urban Stormwater Management					
1	**Effectiveness of roadway O&M practices**	Need better research and information on effect of advanced road maintenance practices – including sweeping and abrasive application. Relatively few sweeper and abrasive options are available in PLRM. More choices need to be available to best reflect the practices being implemented.	May-13	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2046	**Interest being addressed.** The Road Operations Effectiveness Testing project has been initiated to help jurisdictions select cost-effective practices and better understand the expected annual roadways condition as a result of implementing such practices. Through the current Stormwater Tools Improvement Project**,** PLRM has been updated to allow implementing entities to enter road conditions on a 1-5 scale rather than selecting practices. This will allow entities to implement whatever practices they determine to be most cost-effective and feasible for their respective jurisdictions to achieve desired road conditions.
2	**Effectiveness of settling basins**	Effectiveness of settling basins in removing very fine sediment in storm events.	May-13	Cyndie Walck, Eng. Geologist, California Parks, Cyndie.walck@parks.ca.gov, 530-581-0925	**Interest addressed.** Some recent BMP effectiveness studies included the evaluation of dry and wet basins: 2NDNATURE and NHC (2014) and 2NDNATURE and NHC (2012 a,b).
3	**Road RAM improvement**	Need less subjective and less labor intensive method to replace Road RAM. Due to the significant amount of fine sediment particles attributed to paved areas, road conditions need to be assessed consistently throughout the Tahoe Basin and across jurisdictions for successful implementation.	May-13	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2046	**Information need being addressed.** The regulatory agencies have met with implementation agency representatives to address this need through the Stormwater Tools Improvement project. Although alternative methodologies will not be delivered through the project, a path to developing approvable alternatives has been established. It is the jurisdictions' responsibility to develop alternatives and demonstrate equivalancy to established methods if they so choose. Furthermore, the issue of staff resources associated with roadway inspections is being addressed through the Tools Improvement project to streamline protocols as well as training through the Road Operations Testing to increase user precision.
4	**Add sand traps and sumps as a SWT BMP to PLRM**	Reconsider sand traps, sumps, etc. for credit awards; It is evidenced in the vactor material collected annually. The material could be characterized for FSP and the percentage multiplied by the mass each jurisdiction recovers and/or hauls out of the Tahoe Basin.	Jun-13	Leslie Waters, Assoc. Environmental Planner, Caltrans, leslie_waters@dot.ca.gov, 530-741-4191	**Interest addressed.** See 2014 Synthesis of Findings theme 3, "Stormwater Treament BMPs"
5	**Effectiveness of roadway O&M practices**	Provisions in the PLRM, or alternative methods, are needed to account for load reductions achieved by using alternative abrasives. The model seems geared more for capital improvements than modified O&M practices.	Jun-13	Leslie Waters, Assoc. Environmental Planner, Caltrans, leslie_waters@dot.ca.gov, 530-741-4191	**Interest addressed.** Through the current Stormwater Tools Improvement Project**,** PLRM is being modified to allow implementing entities to enter road conditions on a 1-5 scale rather than selecting practices. This will allow entities to implement whatever practices they determine to be most cost-effective and feasible for their respective jurisdictions to achieve desired road conditions.
6	**Effectiveness of roadway O&M practices**	Sweeping operational protocols should be developed to maximize water quality improvement and accurately document locations and quantities for appropriate TMDL crediting. The Pollutant Load Reduction Model (PLRM) includes assumptions, such as pre- and post-sweeping runoff event mean concentrations (EMCs), for the calculation of TMDL load reductions and there is also need to evaluate and confirm these assumptions through field testing and monitoring.	Jun-13	Leslie Waters, Assoc. Environmental Planner, Caltrans, leslie_waters@dot.ca.gov, 530-741-4191	**Interest being addressed.** The Road Operations Effectiveness Testing project has been initiated to help jurisdictions select cost-effective practices and better understand the expected roadway condition as a result of implementing such practices. Roadway conditions are determined using Road RAM, a visual proxy that predicts fine sediment particle concentrations based on the a robust dataset of controlled road washoff experiments.
7	**O&M funding**	Seek funding for operations and maintenance of BMPs on behalf of Urban Jurisdictions - including to reduce traction abrasives on roadways and to maintain stormwater treatment BMPs. Use the Lake Tahoe Federal Advisory Committee and other viable funding groups to change, or get exemptions, for hurdles to funding operations and maintenance.	May-14	John E. Reuter, Ph.D., Research Ecologist Emeritus, Tahoe Environmental Research Center, University of California, Davis, jereuter@ucdavis.edu, 530.304.1473	**Variation of this recommendation included** in 2014 SOF-PARM (SW.1).
8	**Relationship between shade and abrasive application**	Do trees adjacent to roads provide shade that increases icing potential? Would removing trees at select locations along the roadway decrease the amount of abrasives applied on Tahoe roads?	May-14	Tyler J. Thew, P.E. Senior Hydraulic Engineer, NDOT, tthew@dot.state.nv.us, (775) 888-7574,	**Interest noted.** TMDL Program managers consider this a low priority for investigation.
9	**Incentivize innovative roadway operations and maintenance**	Award Urban Jurisdictions who try innovative pollutant source control to reduce FSP on urban roads Lake Clarity Credits. Such innovative PSC BMPs may include… reducing the frequency when abrasives are applied, employing BACT equipment during abrasive application, pre-washing abrasives, applying alternative biodegradable polymers and other options (see 2010-2013 SOF-PARM Finding 2.D.)	May-14	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2046	**Adjustment not recommended**. Credits are only awarded through the Lake Clarity Crediting Program for implemented actions that are verified to be effective. A novel or innovative approach may not necessarily equate to an improved condition or decrease in the pollutant potential associated with roadways. The Roadway Operations Testing project currently in progress is seeking to assess the effectiviess of a variety of roadway operations and maintenance practices. In the future, grant funding may be available for demonstration projects that seek to test the effectiveness of novel, innovative and/or advanced roadway O&M practices.
10	**Source of roadway generated FSP**	More information is needed regarding origin and source attribution of FSP. Until that information need is fulfilled the claim that the majority of roadway FSP is generated from abrasive application is unsubstantiated.	May-14	Tyler J. Thew, P.E. Senior Hydraulic Engineer, NDOT, tthew@dot.state.nv.us, (775) 888-7574	**Interest addressed.** See 2014 Synthesis of Findings theme 1, "Urban Roads".
11	**Environmental effects of road de-icers**	If alternative de-icers are explored it is important to analyze the associated environmental impacts, including the potential relationship between de-icer and aquatic invasive species to ensure that chemicals such as calcium magnesium acetate are not a source of calcium and magnesium for Asian clams. De-icer impacts to soil function should also be considered.	May-14	Melissa Thaw, League to Save Lake Tahoe Contact: Darcie Goodman Collins: darciecollins@keeptahoeblue.org	**Interest noted.** Lahontan Water Board and NDEP agree the ecological effects of any alternatives to abrasives are important to consider.
12	**Effectiveness of roadway O&M practices**	More information is needed to identify what FSP reductions can be expected from implementing various O&M practices. Effectiveness studies are needed using various equipment and various methodologies. This information is needed so TMDL Program Managers, stakeholders, and funders can evaluate and budget for the most cost effective modifications to road operations practices and justify expenditures.	May-14	Tyler J. Thew, P.E. Senior Hydraulic Engineer, NDOT, tthew@dot.state.nv.us, (775) 888-7574	**Interest being addressed.** The Road Operations Effectiveness Testing project has been initiated to help jurisdictions select cost-effective practices and better understand the expected roadways condition as a result of implementing such practices.
13	**Sweeper effectiveness monitoring plan**	Additional infomration iis needed regarding sweepers to improve certainty regarding sweeper effectiveness. Develop an integrated sweeper effectiveness monitoring plan. Design the monitoring plan so that data from numerous locations can be statistically combined.	Jul-14	John E. Reuter, Ph.D., Research Ecologist Emeritus, Tahoe Environmental Research Center, University of California, Davis, jereuter@ucdavis.edu, 530.304.1473	**Interest addressed.** Recently compiled sweeper effectivness information is included in 2014 Synthesis of Findings, section 2. The Road RAM provides a cost effective method to assess the effectiveness of road operations and maintenance activities (including sweeping). Finally, the Road Operations Effectiveness Testing project has been initiated to help jurisdictions select cost-effective practices and better understand the expected roadways condition as a result of implementing such practices.

2014 Stakeholder Feedback Capture Sheet

Note: Consistent with the structure of the *Synthesis of Findings & Program Adjustment Recommendation Memo* , stakeholder feedback is organized within three subject areas: 1) Urban Stormwater Management 2) Non-Urban Source Cateogry Management 3) Overall TMDL. Feedback is organized chronologically by the submittal date within each category.

#	Short Title	Summary of comment (1-3 sentences)	Submittal Date	Stakeholder Information	TMDL Program Manager Response
Non-Urban Source Category Management					
14	**Need for temporary BMPS during stream and meadow restoration**	Information is needed regarding a pollution trading system that can be appliedto projects which have short-term environmental impacts for massively greater long-term benefits. Currently, significant expenses go towards trapping small amounts of sediment that would be disturbed for a few hours or a few days during meadow or stream restorations, even though the restorations will quickly trap a thousand-fold amount of sediment every year. The small amounts of sediments that could be released during construction (if not addressed) should be allowed unless it is clear that their load and duration would be sufficient to kill fish, in the interest of getting the most cost effective solutions and in recognition of the fact that the large annual contributions of sediment from the unrestored stream stress the fish repeatedly. Discussions at the recent UTR Workshop noted the need to consider trade-offs of this kind; these may be included in the Panel Report from the Workshop.	May-13	Susan Norman, Physical Sciences Group Leader, USFS, LTBMU, snorman@fs.fed.us, 530-543-2662	**Interest noted.** Obtaining permits for temporary/potential discharges is a requirement under the Clean Water Act, the regulatory agencies have exercised existing flexibitiy to allow temporary discharges for restoration projects on a project-by-project basis.
15	**Effectiveness of riparian buffers and vegetation filters**	Effectiveness of riparian buffers or vegetation filters in removing very fine sediment –not just from stream overbank flows but from upland sources before they reach the stream	May-13	Cyndie Walck, Eng. Geologist, California Parks, Cyndie.walck@parks.ca.gov, 530-581-0925	**Interest addressed.** See Synthesis of Findings theme 5, "Stream Restoration".
16	**Effects of reconnecting floodplains to stream channels**	Better quantify effects of reconnecting floodplains to stream channels, in reducing fine sediment loads from watersheds.	May-13	Susan Norman, Physical Sciences Group Leader, USFS, LTBMU, snorman@fs.fed.us, 530-543-2662	**Interet addressed.** The Stream Load Reduction Tool has been developed to address this need. No further action will be taken to address this need in the near term.
17	**Do floodplains lose retention capacity over time?**	SEZs are beginning to be looked at to treat urban FSP loads. It is unclear if treatment SEZs would require frequent and intensive maintenance to achieve sustained FSP load reductions as required for urban stormwater treatment BMPs that rely upon retention and infiltration.	Feb-14	Jason Kuchnicki, TMDL Program Manager, NDEP, jkuch@ndep.nv.gov, 775.687.9450	**Interest noted.** Future grant funding may be secured to address this information need.
18	**SLRT and the Lake Clarity Crediting Program**	EPA considers the load reduction estimation methods for both channel restoration and floodplain deposition sufficiently well-developed (an example is the Trout Creek restoration project) that Urban Jurisdictions should discuss opportunities with regulators to determine if channel and floodplain restoration projects may be eligible to generate credits. In order to improve certainty (or minimize equivalency and uncertainty ratios as described on p. TT-32 of the LCCP H), it may be preferable to award credits retroactively based on estimations of actual load reductions achieved rather than to estimate potential load reductions based on application and verification of predictive models.	Feb-14	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Adjustment not currently recommended.** TMDL Program Managers have reservations about awarding credits to TMDL Implementers for stream restoration projects based on SLRT FSP load estimates for the following reasons: 1) A process for linking fine sediment and nutrient load reduction estimate associated with stream restoration project implementation to TMDL baseline load estimates has not been developed. 2) Accounting for urban load reduction implementation activities is the current focus of the Lake Clarity Crediting Program - and has not yet been achieved. Once the Lake Clarity Crediting Program has been successfully demonstrated, TMDL Program Managers will consider awarding credits for other types of crediting activities.
19	**Track Temporary Roads and Road Grading in the Forested Uplands**	Adjust the" Miles of Roads Treated", "Miles of Roads Inspected and Maintained" and the "Miles of Roads Created" TMDL PMs to include tracking and reporting of temporary forest roads that remain on the landscape beyond one construction season. Temporary roads mainly include roads that are built for vegetation management activities. In addition, roads which are graded should be tracked, along with presence/absence of BMPs such as gravel application. An alternative approach would be to track temporary and graded roads under the "Acres of Disturbed Area" PM.	Mar-14	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Adjustment not recommended.** The initial intent of the TMDL Program was to track temporary roads. TMDL Program Managers and consultants asked each non-urban source category TMDL Implementer their method for tracking temporary roads and the availability of data on temporary roads. Due to an overall lack of data it was concluded that temporary roads are not feasible to track at this time. However, a work-around solution is track any roads that remain on the landscape beyond the terms of a project permit as permanent roads (temporary roads that are initially constructed for a fixed term project that are stored for future use by the project implementer).
20	**Track Vegetation Management Activities on Sensitive Lands in the Forested Uplands**	Create a new TMDL PM that tracks the extent (in acres) of vegetation management actions in sensitive areas (e.g. steep slopes and/or sensitive soils) that employ treatment methods with potentially significant load-generating impacts (e.g. whole tree removal).	Mar-14	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Adjustment not recommended.** TMDL Program managers previously considered this recommended action during the initial development of TMDL PMs. Tracking vegetation management was not deemed highly relevant for the following reasons: 1) permits for vegetation management activities result in adequate mitigation of associated impacts; therefore loading from these activities is minimal; and 2) monitoring (environmental and visual) verifies that impacts from of vegetation management activities is minor.
21	**Use hard/numeric targets for TMDL PMs**	EPA recommends that numeric targets, rather than soft targets, should be established where available for TMDL PMs. Numeric targets for some of the selected TMDL PMs are available based on the PRO and IWQMS reports. These numeric targets provide a means of assessing overall progress toward achieving expected implementation activities.	Mar-14	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Adjustment not recommended.** TMDL Program managers are not confident the potential targets derived from the recommendations in the PRO and IWQMS reports would hold-up under scientific scrutiny. Therefore TMDL Program Managers do not recommend setting hard targets for TMDL non-urban PMs at this time. The TMDL Program is working on developing a set of criteria to define and highlight scenarios in which a different approach may be used.

2014 Stakeholder Feedback Capture Sheet

Note: Consistent with the structure of the *Synthesis of Findings & Program Adjustment Recommendation Memo* , stakeholder feedback is organized within three subject areas: 1) Urban Stormwater Management 2) Non-Urban Source Cateogry Management 3) Overall TMDL. Feedback is organized chronologically by the submittal date within each category.

#	Short Title	Summary of comment (1-3 sentences)	Submittal Date	Stakeholder Information	TMDL Program Manager Response
Overall TMDL					
22	**TMDL Report Clearinghouse**	Need a clearinghouse of all TMDL related reports and studies that is kept current with links to access the reports. This is needed to minimize money being spent on similar studies and better utilize the studies and data that exist for the Tahoe TMDL.	May-13	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2046	**Adjustment being considered.** TMDL Program Managers are evaluating the resources required to gather and upload TMDL-related reports and studies to the TMDL Online Interface.
23	**Parcel BMP verficiation**	Developing and formalizing a condition assessment protocol for parcel level BMPs may be warranted due to the large load reduction benefit for the widespread implementation of them as indicated by PLRM results. Components of formalization are: development of protocol to be applied; guidance (i.e., rules) for application of the condition assessment; tracking and reporting database that links with TIST; reduction in credit values for specific proportions of BMPs that are non-functional.	Jul-13	Jason Kuchnicki, TMDL Program Manager, NDEP, jkuch@ndep.nv.gov, 775.687.9450	**Adjustment recommendation retained** in 2014 SOF-PARM. This improvement will is slated to be completed in conjuntion with the Crediting Program Handbook update.
24	**The relationship of FSP mass and particle numbers and field turbidity**	Tahoe Basin researchers have found strong correlations between field turbidity measurements and FSP (both mass and number of particles) in stormwater, streams, and land use data (see 2010-2013 SOF-PARM Finding and Implication #5). However the slope of the relationship can vary depending on the FSP source. The relationship may also be variable over time as sources change. How much does the slope of the relationship vary across sources? Is the variability statistically significant? Information is needed regarding the cost associated with using site specific correlations versus basin-wide relationships already developed and what is the incremental gain in confidence.	Feb-14	Jason Kuchnicki, TMDL Program Manager, NDEP, jkuch@ndep.nv.gov, 775.687.9450 and David Shaw, Balance Hydrologics	**Interest being addressed.** SNPLMA funded research underway to address this need. Future SOF/PARM will report findings and implications from the relevant study.
25	**TMDL implementation costs and financing strategies**	There is a need to refine TMDL implementation costs and financing strategies. The EPA approved TMDL report estimated it would cost $1.3 billion to meet the Urban Upland "Clarity Challenge," however, this is a gross estimate and more information is needed to represent the true cost of implementation. New sources of information include: Urban Jurisdictions Pollutant Load Reduction Plans (PLRPs) and Stormwater Load Reduction Plans (SLRPs), TMDL Strategy Reports, and fiscal analyses related to TMDL implementation costs developed by the CA MS4 permittees.	Apr-14	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Interest addressed.** As noted in the comment, load reduction plans developed by each urban jurisdiction contain updated estimates needed to achieve TMDL milestones.
26	**Climate change impacts to BMP design and function**	Determine whether the size and capacity of SWT BMPs should be adjusted to accommodate potentially larger floods that may be caused by climate change. In addition, research the ability of existing and planned stormwater treatment facilities for treating runoff during an ARkStorm.	May-14	Melissa Thaw, League to Save Lake Tahoe Contact: Darcie Goodman Collins: darciecollins@keeptahoeblue.org	**Interest substantially addressed.** See Synthesis of Finding theme 8, "Climate Change". Futhermore, TMDL management agencies do not regulate the sizing and capacity of SWT BMPs. If climate change is demonstrated as a significant barrier to achieving TMDL goals, TMDL agencies will consider and recommend steps to adjust policy accordingly. Stakeholders will be provided the opportunity to participate in any such decisions through the TMDL Management System process. Finally, the TMDL Program Manager's understanding that an ARKstorm assessment project is nearly complete. The final report from that effort will be reviewed upon release and relevant findings incoprorated into a future SOF-PARM document.
27	**Actual vs. estimated load reductions**	Determine the extent of discrepancy, if any, between estimated load reductions and actual load reductions and improve alignment.	May-14	Melissa Thaw, League to Save Lake Tahoe Contact: Darcie Goodman Collins: darciecollins@keeptahoeblue.org	**Interest addressed.** See the 2014 SOF-PARM "Tools and Models". More information can be found by consulting the individual studies referenced in that section.
28	**The relationship of FSP mass and particle numbers and field turbidity**	Additional relationships should be investigated between streamflow and FSP transport. These relationships, or 'sediment rating curves' are perhaps the best tool for establishing sediment baselines prior to floodplain restoration or BMP implementation, and for assessing the change in fine sediment supply as BMPs and restoration activities are implemented. As sediment supply within a watershed diminishes, suspended sediment concentration at a given streamflow will also diminish.	May-14	David Shaw, Balance Hydrologic and Shay Navarro, TRPA, dshaw@balancehydro.com	**Interest being addressed.** SNPLMA funded research underway to address this need. Future SOF/PARM will report findings and implications from the relevant study.
29	**Monitor Lake Tahoe tributaries**	With the discontinuation of several USGS streamflow gaging stations in the Lake Tahoe Basin, a key parameter in loading calculations will be lost. We recommend that continuation of high-quality and accurate streamflow gaging stations be made a priority for the TMDL program.	May-14	David Shaw, Balance Hydrologics and Shay Navarro, TRPA, dshaw@balancehydro.com	**Interest being addressed.** TMDL Program Managers agree that monitoring is critical to evaluate progress toward meeting TMDL goals. Realizing that there is a lack of long-term stable funding to support monitoring efforts, TMDL Program Managers will continue to advocate for targeted monitoring to assess water quality at multiple scales, including but not limited to storm water, tributary, nearshore, and deep-water lake monitoring needs.
30	**Roadway generated FSP and subsequent transport to Lake Tahoe**	Roads have been identified as the largest source of FSP to the air, but the connection between roadway generated FSP to the air and subsequent FSP transport to the lake is not clear. Studies that clarify the quantity of roadway generated FSP that makes it way to the lake via atmospheric deposition as opposed to other means (e.g. through lateral runoff) are needed.	May-14	John E. Reuter, Ph.D., Research Ecologist Emeritus, Tahoe Environmental Research Center, University of California, Davis, jereuter@ucdavis.edu, 530.304.1473	**Interest noted.** TMDL Program managers consider this information need a lower priority relative to the needs related to understanding how roadway operations and maintenance practices can reduce sediment and nutrient from roadways, regardless of the transport mechanism