RELEVANCE TO TRPA TURBIDITY MONITORING PROGRAM AND WATER QUALITY THRESHOLD

The Tahoe Regional Planning Agency (TRPA) has set environmental thresholds for the Tahoe Basin. This project is relevant to one of these thresholds. The only TRPA water quality threshold for near shore waters is the littoral zone turbidity threshold (TRPA threshold WQ-1). The TRPA program for monitoring compliance with this program consists of 9 sample sites in water 25 ft deep (Figure 11) (Whitney, 2002, Personal Communication). These sites range from tens to hundreds of meters offshore. Discrete samples are collected four times a year from depths of 5, 10, 15, 20, 25 ft. The small number of sample sites cannot delineate high turbidity areas like the ones associated with Tahoe Keys and Tahoe City and do not monitor the undeveloped sections of the shore that have the greatest clarity. The infrequent measurements will make it difficult, and maybe impossible, to determine temporal trends.

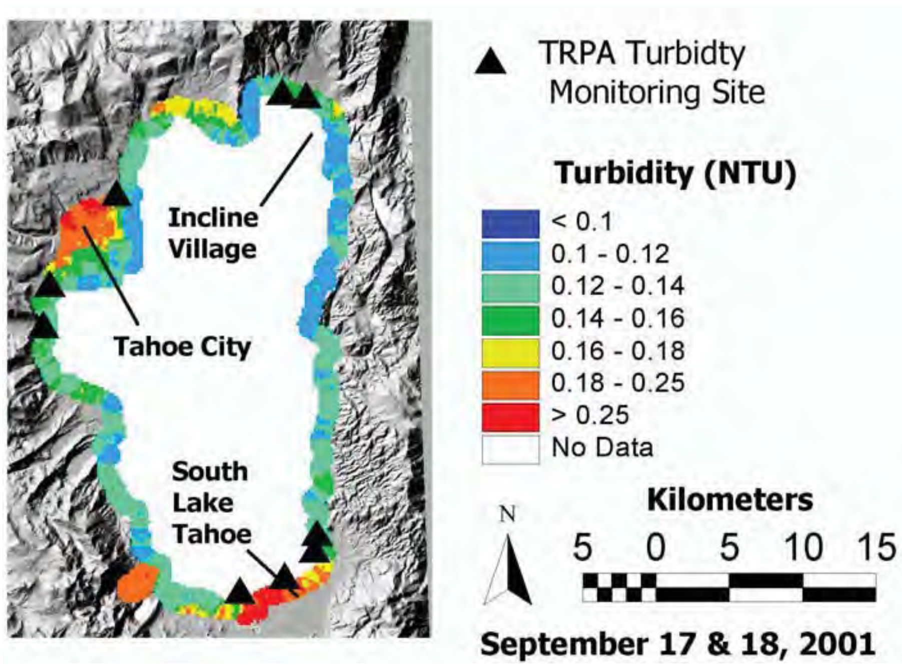

Figure 11. Location of TRPA turbidity monitoring sites and near shore turbidity on September 17 and 18, 2001.

The TRPA turbidity threshold for the littoral zone is 1 NTU in areas not influenced by streams and 3 NTU in areas influenced by streams. This 1 NTU threshold is a factor of 10 times greater than existing conditions off undeveloped areas and a factor of 4 times greater than existing conditions in the most turbid areas of the lake excluding Tahoe Keys. For reference the turbidity of the entire near shore zone would be similar to the turbidity of the Tahoe Keys marina in June before the TRPA threshold was exceeded. The secchi disk depth along the entire shore would be less than ~4 m before the TRPA turbidity threshold was exceeded.

The TRPA littoral turbidity threshold is the only TRPA water quality threshold that is being met. This is because the turbidity threshold is set at a level much greater than ambient conditions and the tight environmental standards of the other thresholds. TRPA staff is aware of the limitations of the current turbidity threshold and monitoring program and is proceeding along a path that may lead to changing the threshold and monitoring program when all the thresholds are reviewed in 2004.

Other indicators of water clarity are also used in Lake Tahoe. One of these is Secchi depth, which is the greatest depth that a black and white disk 20 cm in diameter, can be observed. Another is vertical extension coefficient, which is a measure of the rate that light intensity decreases with depth. Both of these measurements use natural sunlight that passes through the lake surface. The measurements are dependent on the angle of the sun above the horizon, cloud cover and the roughness of the water surface. These methods also require water that is deeper than most of the areas studied in this project. These methods are influenced by conditions over a range of depths as opposed to the turbidity measurement, which is only influenced by conditions at a single depth. It will be possible to develop an approximate empirical relationship between turbidity measured near the surface and the Secchi depth, and this will be done in future projects.

CONCLUSIONS AND HYPOTHESES

This was the first project to conduct detailed studies of the spatial variability of near shore turbidity at Lake Tahoe and hence when the project was developed it was not clear how useful spatial turbidity surveys would be. The project was designed with a broad focus instead of targeting specific issues. This section is divided into conclusions that are well supported by data, and hypotheses that are suggested by the data but not proven.

Conclusions

●There is a large spatial and temporal variability in near shore turbidity. A general pattern is that turbidity is greater during the summer than during the winter. The areas with consistently high turbidity are South Lake Tahoe, Tahoe Keys, and Tahoe City. Kings Beach and Incline Village have high turbidity too, but to a lesser degree. The Tahoe Keys and adjacent lake waters consistently have the highest turbidity and are occasionally greater than the TRPA WQ-1 threshold.

● Emerald Bay consistently has an elevated turbidity. The steep watershed, significant lands disturbance imediately adjacent to the bay due to road construction and avalanche activity, shallow depths and major stream inflow with restricted mixing with deep lake water, make this a unique area.

●Turbidity values are greatest near the shore. If the near shore clarity issue is resolved, the mid-lake clarity issue may also be resolved. However, it maybe possible to have acceptable mid-lake clarity and still have poor clarity near the shore.

●Although atmospheric deposition of nutrients may contribute to a lake wide decline in clarity, it occurs over too large an area to explain the small size of the areas with elevated turbidity. Hence, most of the near shore clarity loss is caused by neighborhood scale local problems.

●The TRPA turbidity monitoring program does not provide an effective means of locating problem areas and does not provide a way to measure changes over long time periods.

●The TRPA littoral zone turbidity threshold (WQ-1) does not provide a level of environmental protection that is consistent with the other TRPA thresholds and may not be consistent with the community's expectations.

Hypotheses

●Groundwater inflow of nutrients may be enhancing algae growth in some areas. The nutrient source may be sewer exfiltration, soil disturbance or fertilizer use.

●Summer thunderstorms and moderate waves may not have a significant short term impact on near shore turbidity.

●Most of the clarity problem may be the result of what is occurring along a small percentage of the shoreline.

RECOMMENDATIONS

●Information on the spatial and temporal variability of turbidity and light attenuation should be collected so that an informed discussion of the TRPA littoral zone turbidity threshold (TRPA water quality threshold WQ-1) can occur before the thresholds are reviewed in 2004.

●An effective near shore clarity monitoring program should be developed that will observe spatial and temporal variations in clarity. The program should monitor the entire lakeshore and portions of the mid-lake, but also have special emphasis on areas known to have low clarity. The program should be constructed so that changes that occur gradually over several decades can be documented.

●Spatial surveys should be conducted to identify sections of the lakeshore that are associated with high turbidity areas. These surveys should be conducted in different seasons because different areas will respond differently during different seasons.

●A program should be developed to identify the relative extent that algae and inorganic particles are responsible for increasing the turbidity. It should be anticipated that high turbidity has different causes in different areas and different seasons. This will require examination of the particles and cannot be done with just the methods presented here.

CONTACT INFORMATION

The data and figures in this report, and the report itself, are available on the web at: http://www.tahoenearshore.dri.edu

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In addition, the draft Imp. Regulations only identify Homewood, Sunnyside, and Tahoma as "Village Centers," while the draft Area Plan includes Tahoe Vista, Carnelian Bay, and Lake Forest/Dollar Hill as Village Centers.[24] Given the inconsistent and additive terms for the various locations since 2012, it is unclear whether the North Lake areas are proposed to be Village Centers, or not. Further confusing this issue is the reference to four subareas: *"The Mixed-Use Subdistricts are classified within one of four Subareas—Greater Tahoe City, North Tahoe East, North Tahoe West, and West Shore."* (Imp. Regulations, p. 9).

We recommend the TBAP and Implementing Ordinances be revised to retain the existing nomenclature for areas outside of Town Centers, while clearly documenting the changes that are being proposed to these areas (where applicable). This will help avoid confusion and help the public to better participate in the TBAP development process. In the future, if significant changes are considered for such areas, new planning terms/labels may be more appropriate. At a minimum, the TBAP package should include a 'crosswalk' which clearly identifies, in text and on maps, the existing Plan Area Statements/Community Plans (and associated Special Areas) in relation to the proposed Subdistricts to provide a clear visual comparison for the public and decision-makers.

2. Nearshore Clarity and Other Nutrient Impacts

a) Nearshore Threshold Standards:

There are five TRPA thresholds related to protection of Tahoe's nearshore areas, and one TRPA threshold focused on aquatic invasive species (a threat that is well-understood to affect nearshore areas).[25]

Nearshore threshold standards:

> Reduce dissolved inorganic nitrogen (N) loading from all sources by 25% of 1973-81 annual average
>
> Reduce the loading of dissolved inorganic nitrogen, dissolved phosphorus, iron, and other algal nutrients from all sources to meet the 1967-71 mean values for phytoplankton primary productivity and periphyton biomass in the littoral zone.
>
> Decrease sediment load as required to attain turbidity values not to exceed three NTU. In addition, turbidity shall not exceed one NTU in shallow waters of the Lake not directly influenced by stream discharges
>
> Reduced dissolved inorganic nitrogen loads from surface runoff by approximately 50 percent, from groundwater approximately 30 percent, and from atmospheric sources approximately 20

[23] "Village Centers include Tahoma, Homewood, Sunnyside, Lake Forest/Dollar Hill, Carnelian Bay and Tahoe Vista." (draft TBAP, p. 71).
[24] "This Area Plan encourages redevelopment in the Village Centers and implements the programs that are allowed under the Regional Plan. Area Plan programs that apply in the Village Centers include mixed use zoning, revised parking regulations, new design standards and secondary dwelling units. Also included are plans to complete trail connections, enhance transit service, and advocate for additional redevelopment incentive programs in the Regional Plan." (TBAP, p. 93); Also identified on Figure 4-5: Area Plan Land Use, p. 95.
[25] http://www.trpa.org/wp-content/uploads/TEVAL2011_Ch4_WaterQuality_Oct2012_Final.pdf

> percent of the 1973-81 annual average. This threshold relies on predicted reductions in pollutant loadings from out-of-basin sources as part of the total pollutant loading reduction necessary to attain environmental standards, even though the Agency has no direct control over out-of-basin sources. The cooperation of the states of California and Nevada will be required to control sources of air pollution which contribute nitrogen loadings to the Lake Tahoe Region.
>
> Support actions to reduce the extent and distribution of excessive periphyton (attached) algae in the nearshore (littoral zone) of Lake Tahoe.

Aquatic Invasive Species standard:

> Aquatic Invasive Species
> MANAGEMENT STANDARD
> Prevent the introduction of new aquatic invasive species into the region's waters and reduce the abundance and distribution of known aquatic invasive species. Abate harmful ecological, economic, social and public health impacts resulting from aquatic invasive species.

As noted by the scientific community, *"Nearshore conditions are inherently localized issues, where different locations around the lake will have different expected levels of nearshore clarity, trophic status, community structure and human health variables."* ("Nearshore Report").[26] However, the RPU's policies (and associated environmental review) were based on implementation of the TMDL requirements,[27] which focus on mid-lake clarity, not the nearshore (or the localized impacts of pollution and how they impact individual nearshore environments).[28]

As noted by the Tahoe Environmental Research Center's (TERC's) State of the Lake Reports (2008-2014),[29] attached algae biomass is generally elevated along the north and west shores of Lake Tahoe.[30] In fact, the biomass in the nearshore adjacent to Tahoe City has been among the highest documented in the State of the Lake Reports each year since 2008 (see maps below).

Although researchers revealed that periphyton concentrations were lower in 2014 (as documented in the 2015 State of the Lake Report[31]), Dr. Geoff Schladow noted that the "result had little to do with what agencies or scientists [have done];" rather, due to drought, measurements of algae concentrations had to be taken in deeper areas of the Lake, where different algae species exist.[32]

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[26] Lake Tahoe Nearshore Evaluation and Monitoring Framework. Final, October 15, 2013; http://www.dri.edu/images/stories/centers/cwes/Nearshore_Evaluation_and_Monitoring_Plan_02.10.14.pdf

[27] "The Draft Regional Plan included targeted amendments that support the findings and water quality improvement strategies of the TMDL." (Final RPU EIS, Volume 1, p. 3-26).

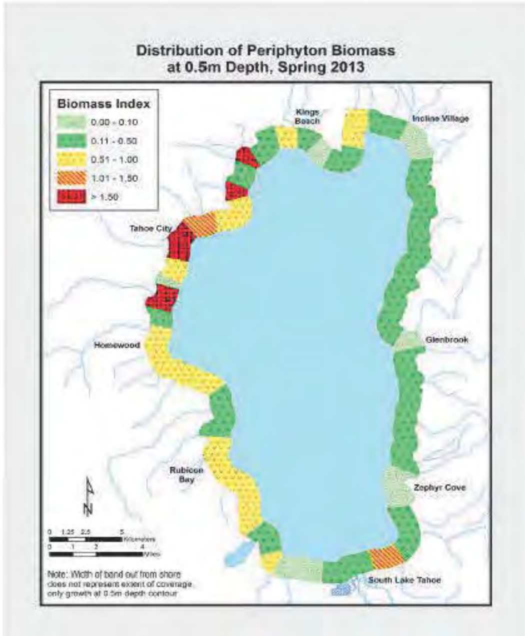
[28] In the Lahontan Regional Water Quality Controls Board's 11/02/2010 response to TMDL comments by the League to Save Lake Tahoe (LTSLT-56), Lahontan stated: "The draft Lake Tahoe TMDL was developed to meet federal requirements under section 303(d) of the federal Clean Water Act, by addressing Lake Tahoe's deep water transparency. Because the Lake is not meeting the deep water transparency standard, it was listed as impaired on the federal 303(d) list. The TMDL was developed to specifically address that impairment. Because Lake Tahoe's nearshore environment is not yet listed as impaired on the State Water Board's 303(d) list, the draft Lake Tahoe TMDL does not specifically address issues in the nearshore." [Emphasis added].

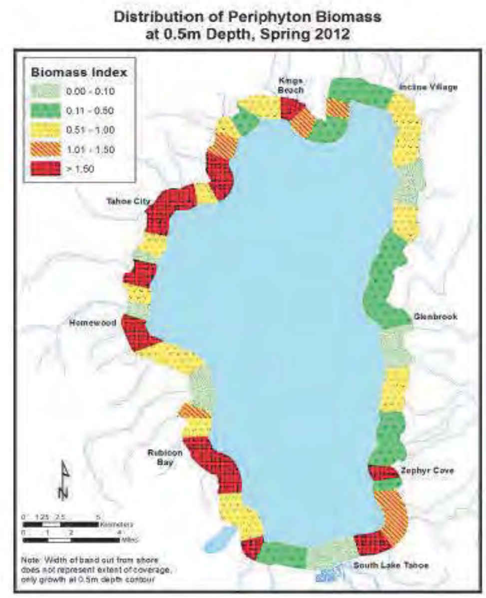
[29] http://terc.ucdavis.edu/stateofthelake/

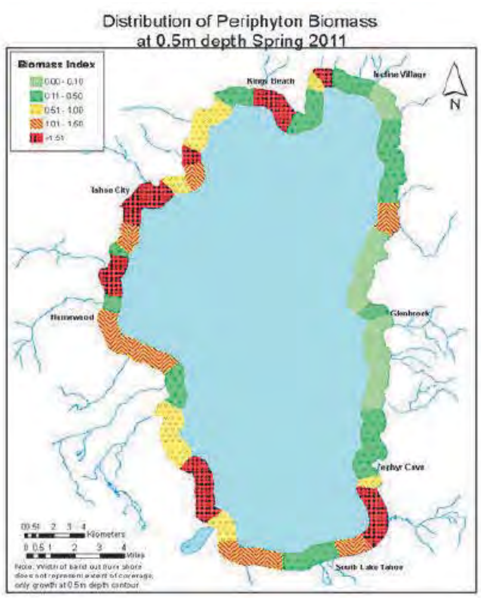
[30] "Zones of elevated PBI are evident, particularly along the north and west shores of Lake Tahoe…" p. 10.9. http://terc.ucdavis.edu/stateofthelake/sotl-reports/2014/10_biology.pdf

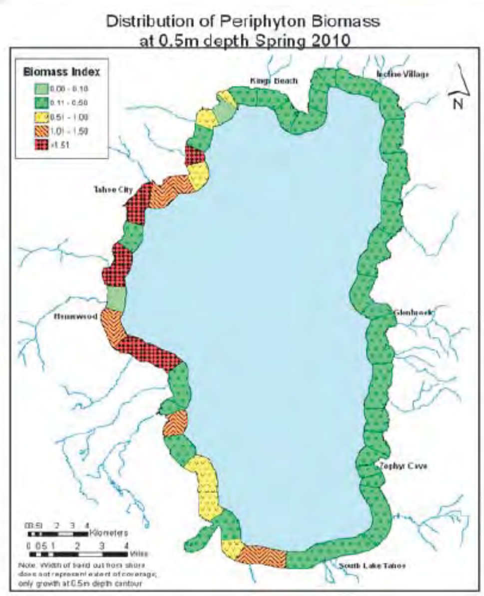
[31] http://terc.ucdavis.edu/stateofthelake/index.html

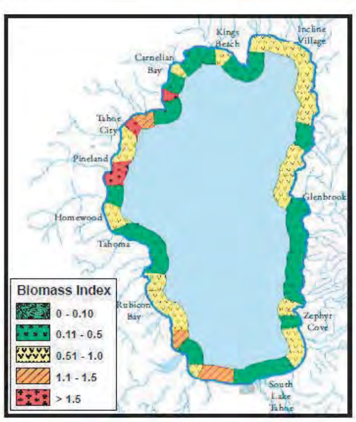
[32] From State of the Lake 2015 Report presentation, 7/23/2015.



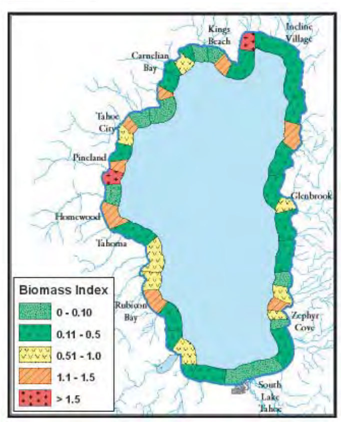




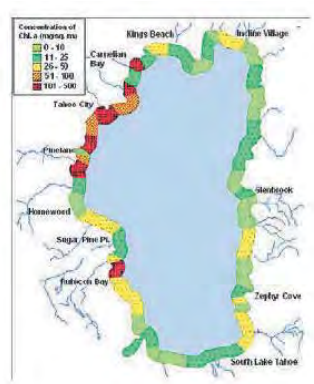




2009



2008



2007

The RPU EIS did not analyze impacts at the localized scale, where effects on the nearshore are more direct. Rather, the RPU EIS's regional analysis treated Lake Tahoe as one large 'bowl,' only examining impacts from the perspective of mid-lake clarity. Where and how much pollution enters the Lake and how it affects the immediate nearshore areas are topics that were not examined in the RPU EIS. In response to public comments requesting examination of the nearshore conditions and increased coverage in Town Centers bordering the Lake,[33] the Final RPU EIS included a PLRM model estimate. However, the model only developed estimates of the *runoff* from properties with BMPs compared to that of properties without BMPs; it contained no examination of the location of the runoff, the existing nearshore conditions, the substrate or lack thereof, water depth, and other local features.[34]

As scientists further note, influences on nearshore conditions include:

> **"5.1 Summary of Influences on Nearshore Condition**
> - Urban stormwater runoff generally contains much higher concentrations of nutrients and fine sediment particles than found in the lake and in runoff from undisturbed areas. These nutrients cause increased localized concentrations of phytoplankton that decrease water clarity. Likewise, higher concentrations of the sediment particles contribute to decrease nearshore clarity.
> - Stream inputs that pass through disturbed watersheds contribute higher concentrations of nutrients and fine particles that decrease nearshore clarity.
> - Upwelling events deliver deep-lake waters to the nearshore. These waters can be enriched in some nutrients relative to local nearshore concentrations.
> - Nutrient inputs from stormwater runoff, stream inputs and ground water may generate increased biomass of phytoplankton and benthic algae (periphyton and metaphyton).
> - Excess fertilizer applications may contribute to groundwater and surface runoff loading of nutrients, which increase the nearshore concentrations of dissolved nutrients that enhance algae concentrations and decrease clarity.
> - Nutrients also affect algae growth rates and species distributions, which can impact community structure." (Nearshore Report, p. 35).

Differences in local areas such as the depth of the nearshore water, which impacts the level of mixing in the nearshore, and the lake bed features in the localized environment (e.g. rocks versus sand), may lead to more or less algae in a given area. For example, the same amount of pollution entering the Lake in the south shore may not have the same impact as an equal amount of pollution entering the Lake near Tahoe City. Additionally, since periphyton is attached algae, it will be more common in areas where there are more items to attach to in the nearshore (e.g. rocks). In addition, the Final RPU EIS notes the PLRM simulation is "a simple aggregate representation of all centers:"

> **Note:** The PLRM simulation described in Appendix C of the Final EIS is a simple aggregate representation of all Centers. The results presented in Table 3-4 are valid as a relative comparison of estimated changes in pollutant loading that could result from policies included in the Final Draft Plan. In practice, the Lake Tahoe TMDL requires local jurisdictions to complete load reduction plans that identify catchments (i.e., sub-watersheds) and their respective pollutant loading to Lake Tahoe. Estimates of existing condition pollutant loading in specific community centers, developed

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[33] For example, 6/27/2012 comments by the CA Attorney General state: "The DEIS explains that attached algae in the nearshore is an important water quality issue, and that addressing it would have a beneficial effect on water quality. Yet the DEIS does not contain any analysis of the impacts to the nearshore of the numerous proposed changes to coverage rules contained in Alternative 3 and other alternatives." (TRPA RPU Final EIS, Volume 2, p. 2-75). [Emphasis added]

[34] Final RPU EIS, Volume 1, p. 3-31 and 3-32.

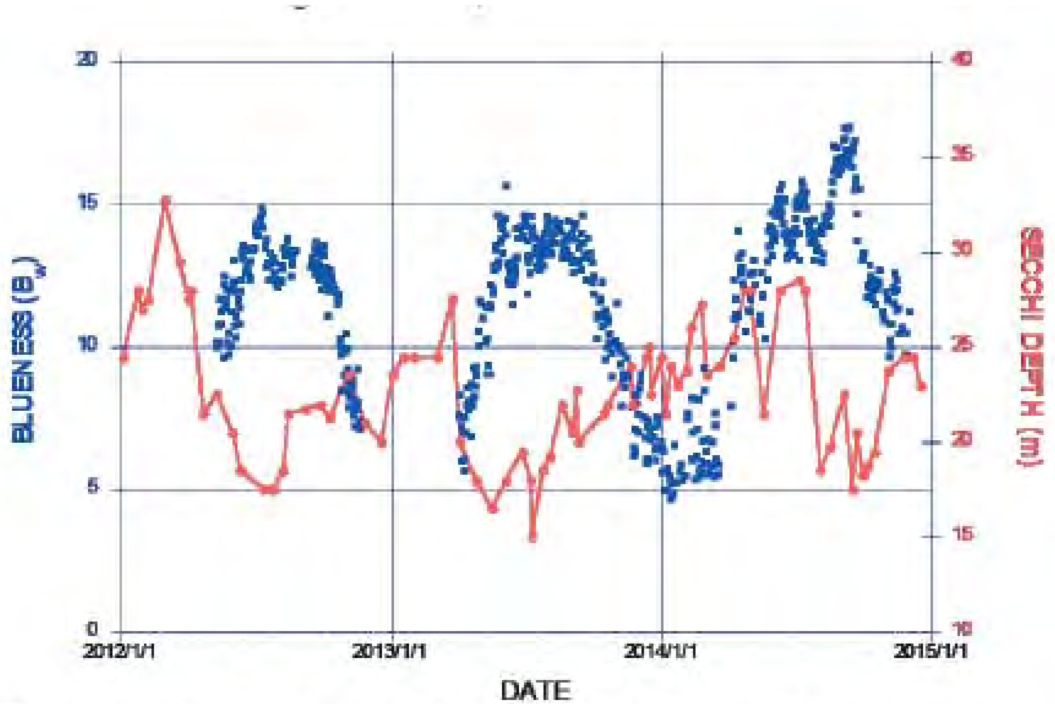
> by local jurisdictions using site-specific analysis and detailed stormwater modeling, will differ from the existing condition estimate presented in Table 3-4. (Final RPU EIS, Volume 1, p. 3-31)

As a result, the TBAP EIR/S must thoroughly examine the specific impacts of each alternative on the nearshore areas affected by land use in the Area Plan. The EIR/S must also clearly identify the existing conditions of Tahoe's nearshore areas that fall within and/or border the Area Plan, and the impacts of the Area Plan's policies and requirements. For example, as more coverage is added in Tahoe City, more stormwater pollution will be apt to enter Lake Tahoe's nearshore in that area. The EIR/S must examine the impacts of the pollution, also considering the depth of the water in the nearshore, potential for mixing/dilution, water flow patterns, and other factors, on water clarity/turbidity in the nearshore (including nutrient and particulate concentrations), habitat, and conditions that may support aquatic invasive species. The EIR/S also needs to identify how Placer County and TRPA will measure the impacts of new and redevelopment on nearshore clarity, and what measures will be taken to mitigate potential impacts, if need be.

b) Nutrient impacts to entire Lake:

On July 23, 2015, Dr. Geoff Schladow from the Tahoe Environmental Research Center (TERC)/UC Davis presented the public with the 2015 State of the Lake Report. In this report, a unique finding was made: the blueness of Lake Tahoe is negatively correlated with clarity. In other words, when clarity improves, there is less blueness, and when clarity declines, there is more blueness. While clarity is affected primarily by the influx of fine inorganic particles into the Lake, the blueness – which is the subject of decades of outreach (e.g. consider the "Keep Tahoe Blue" slogan) – is affected primarily by algae. Thus, as Dr. Schladow noted on 7/23/2015, "if we want to have blue water, we have to work on nutrients." This information is also reported in the document:

> "When the daily average Blueness Index is combined with the measurements of Secchi depth, a surprising result emerges, as evident in the figure below. Blueness and clarity vary opposite to each other. While the clarity is related to the input of very fine particles from the surrounding land, blueness is most strongly related to the algal concentration. The lower the algal concentration, the bluer the lake. The lowest concentration typically occurs in summer when nutrients have been depleted. This is the time of highest particle concentration.
>
> This is good news. We now have an even better understanding of how Lake Tahoe works, and it reinforces the importance of controlling nutrient inputs to the lake, whether from the forest, the surrounding lawns, or even from the air. What is particularly encouraging are the long-term changes. Overall, the blueness has been increasing over the last 3 years and the average annual clarity has stopped declining." (State of the Lake 2015, p. 6.1)



The blueness index plotted against Secchi depth for the last three years. Times of greater blueness occur at times of lower clarity.

Above: Chart of clarity versus 'blueness' from State of the Lake Report.

For years, we have strongly advocated for Plans and Projects to address the need to reduce nutrients – both phosphorous and nitrogen – in order to protect Lake Tahoe's nearshore areas, where algal growth has been increasing (e.g. see periphyton charts above), research has now reiterated the importance of controlling nutrient growth for yet another reason – 'Keeping Tahoe Blue.' The TMDL, upon which the RPU's mid-lake water quality benefits are primarily based, focuses on fine sediments, and does not address nearshore conditions (where nutrients play a larger role).[35] In addition, Dr. Schladow also discussed the variations among Tahoe's different nearshore areas, in fact stating that in order to have a really good understanding of what is going on in the nearshore, monitors should be located every 2-3 miles along the nearshore. This clearly reiterates the importance of localized pollution and physical condition when it comes to nearshore impacts.

This reiterates the need for the TBAP EIR/S to clearly and comprehensively evaluate the amount and location of nutrients that will runoff into Lake Tahoe for each alternative, as well as their impact in stimulating nearshore and mid-lake algal growth.

[35] Information summarized from: Lahontan Water Board, Response to November 11, 2010 TASC Comments on TMDL:

- The TMDL was focused only on mid-lake transparency. (Response to comment TASC-15);
- The Lake Clarity Crediting Program, which is used as a means to track local government compliance with the TMDL, is initially focusing only on fine sediments. (Response to comment TASC-19).

From the *Lake Tahoe Total Maximum Daily Load Technical Report, June 2010:* "This [Tahoe] TMDL does not directly address restoring the nearshore clarity of Lake Tahoe. Rather, the Lake Tahoe TMDL focuses solely on restoring the deep water clarity and transparency." (P. 3-23).

In addition, the two Town Centers in the TBAP are located in very close proximity to Lake Tahoe, allowing more impervious coverage to be placed in areas closest to Lake Tahoe. While the TMDL estimates that a variety of stormwater treatment systems may be used to reduce fine sediments and phosphorous, these systems generally do not remove nitrogen. In fact, the most effective way to remove nitrogen is through vegetative uptake. As noted in the 1982 TRPA EIS for establishing the Environmental Threshold Carrying Capacities,[36] the Basin's soil "is an integral part of the structure and function of the natural ecosystem," "essential for supporting vegetation by providing a medium to anchor roots, store nutrients, and store water for growth." (p. 16). Vegetation, in turn, "is a part of a total system…responsible for removing nutrients, particularly nitrogen, from precipitation…stored in the soil." (Page 18). Impervious coverage "affect[s] the soil's ability to function naturally as a medium for vegetative growth and storage of nutrients and water," and "prevents any infiltration of precipitation and its associated nutrient load, resulting in near total runoff." (Page 17). Increased runoff volume increases its energy, accelerating erosion. (Pages 17-18) [Emphasis added]. Researchers have also recommended ecological "buffers" between roads and the lake to capture runoff: "We should also relocate major roadways, like Highway 50, away from the lake shore," Cahill said. "We need to create ecological buffers [between the roads and the lake], marshes that can capture runoff before it hits the lake."[37]

The TBAP EIR/S needs to analyze the mechanisms that will be necessary to remove nitrogen from the additional coverage allowed by the TBAP. The impacts of coverage that is exempt per TRPA regulations (e.g. bike trails) must be included in this analysis; while it may be exempt from regulatory requirements, the impacts of the coverage must still be analyzed and disclosed. The EIR/S needs to identify the land that will be used to provide the natural functions necessary to remove nitrogen from runoff before it enters Lake Tahoe.

[36] Excerpts attached.
[37] http://articles.latimes.com/2000/feb/16/news/mn-64810

Table 16. Estimated annual cost to remove 1lb of urban derived FSP ($/lb of urban FSP removed/yr).

Project Name	Catchment Area (sq mi)	%Urban	%DCIA	ΔRFP_{fsp} (MT/yr)	Urban derived Δ RFP_{fsp} (MT/yr)	Annualized Unit Cost ($/lb of Urban FSP removed/yr)
UTR Middle Reach	53.7	7.6%	48%	15.8	4.97	$39.00
UTR Sunset Reach 5	51.3	6.3%	44%	26.1	7.07	$44.00
Trout Creek Upper Reach	23.7	2.3%	65%	10.5	2.47	$51.00
UTR Sunset Reach 6	50.3	6.1%	43%	12.4	3.22	$83.00
Angora Sewerline	4.4	6.4%	70%	0.7	0.31	$95.00
UTR Airport	52.3	6.9%	48%	8.2	2.50	$148.00
UTR Golf Course	42.4	3.7%	34%	8.9	1.44	$330.00
Angora SEZ	2.6	3.0%	70%	0.3	0.10	$2,047.00

Table 17. Annualized unit cost estimates for a series of urban water quality improvement strategies developed for Placer County ($/lb of FSP removed/yr). From Table ES.3 in 2NDNATURE and NHC (2011).

	Annualized Unit Cost ($/lb of FSP removed/yr)	
Urban Strategy	Low Estimate	High Estimate
Water quality minded road operation improvements	$ 3.50	$ 4.25
Increased implementation of private parcel BMPs (stormwater volume reductions)	$ 20.00	$ 41.00
Water quality improvement projects (WQIP)	$ 70.00	$ 88.00

Using these methods, three to four of the projects in Table 16 are estimated to be more cost effective than typical urban water quality improvement projects. Urban capital improvement projects are costly and require significant regular maintenance to ensure water quality benefits are sustained over time. Comparisons of the timing of "stormwater treatment" opportunities and the typical volumes of water that can "treated" by urban dry basins verses SEZ meadows vary dramatically and should be considered in more detail to better understand FSP load reduction opportunities of treatment processes. While stream restoration efforts also require significant resources to implement, these annualized cost estimates suggest they can provide relatively cost-effective water quality benefits, with potentially minimal long term maintenance costs. A few stream restoration projects have annualized costs estimated comparable to high density implementation and continued maintenance of private parcel BMPs that are implemented and maintained to retain the 20yr 1hr storm on the parcel. But, as expected, improved road maintenance practices is the most cost effective strategy to reduce FSP loads at the source and continued and sustained focus on FSP source control is assumed critical to achieve long term TMDL goals. We believe this analysis provides substantial evidence that effective stream restoration provides both a desired water quality benefit, in addition to the multitude of ecological and recreational benefits achieved.

Lake Tahoe TMDL Program

2015 Findings & Program Recommendations Memo

December 2015

LAKE TAHOE TMDL PROGRAM

The *Findings & Program 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.

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TABLE OF CONTENTS

INTRODUCTION

Each year Lake Tahoe TMDL Program Managers request stakeholders' assistance in evaluating TMDL Program operations and performance. TMDL Program Managers identify, compile and respond to implementation challenges, policy issues, relevant scientific and technical findings, and emerging information needs. When appropriate, TMLD Program Managers pair the synthesized findings with program adjustment recommendations in an annual *Findings & Program Recommendation Memo* that enables Lahontan Water Board and NDEP executives to have an informed discussion about the need for proposed program adjustments.

The *2015 TMDL Findings & Program Recommendation Memo* (2015 Memo) reiterates important findings from the 2014 document and incorporates new findings from the past calendar year. New and outstanding stakeholder comments are addressed in the *Stakeholder Feedback Capture Sheet*.

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.

Part II: Recommendations
This section distills actionable recommendations to adjust the TMDL Program, including both management strategies and policies. TMDL Program Managers propose recommendations based on 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.

> **Stakeholder Feedback**
>
> Stakeholder feedback is captured in the *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.

Proposed recommendations guide and inform discussions at the TMDL *Program Review Meeting*, an annual meeting between Lahontan Water Board and NDEP executives and TMDL Program Managers. 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.

Appendix
The Appendix includes the *2015 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. Comments remain on the list until addressed and status updates may be provided for those that remain unresolved.

PART I: FINDINGS

Introduction

Findings are grouped into three specific subject areas, outlined below. Individual findings within each subject area are synthesized from existing documents or drawn from observations or stakeholder comments.

A. Urban Stormwater Management
B. Non-Urban Source Category Management
C. Overall TMDL

2015 Summary Findings

There were no new findings related to Urban Stormwater Management or Non-Urban Source Category Management during the past calendar year. Previously listed findings remain relevant and continue to guide Lake Tahoe TMDL program actions. New findings related to the overall TMDL program include recent research regarding stormwater monitoring analysis and reporting techniques, revised pollutant load estimates, and updated information on Lake Tahoe's physical properties and climate condition as reported in the University of California, Davis State of the Lake Report. The revised load estimates and climate and physical information are not significant enough to support any recommended change to the Lake Tahoe TMDL program or associated policy. Through the TMDL Management System process, TMDL Program Managers will continue to assess whether revised loading estimates or new climate information dictates program change.

A. URBAN STORMWATER MANAGEMENT

Key Findings From Previous Assessments

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. Implementing PSC BMPs has the direct benefits of improving the effectiveness and reducing maintenance cycles of SWT BMPs.
4. There is a consistent and ubiquitous lack of appropriate maintenance conducted on SWT BMPs. 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. The most efficient FSP load reductions are likely achievable on Commercial/Institutional/Communications/Utilities (CICU) and Multi-Family Residential (MFR) land uses due to the much larger pollutant potential of these land use types in comparison to the Single Family Residential (SFR) land use.

NEW FINDINGS

There were no new findings related to urban stormwater management practices during the past calendar year. Previously listed findings remain relevant and continue to guide Lake Tahoe TMDL program actions. Please refer to the 2014 Findings and Recommendations Memo for specific details and associated references.

B. NON-URBAN SOURCE CATEGORY MANAGEMENT

Key Findings From Previous Assessments

1. The vast majority of the pollutant loading in forestlands originates from paved and unpaved roads, disturbed areas and public facilities.
2. 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.
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.

NEW FINDINGS

There were no new findings related to non-urban pollutant sources or land management practices during the past calendar year. Previously listed findings remain relevant and continue to guide Lake Tahoe TMDL program actions. Please refer to the 2014 Findings and Recommendations Memo for specific details and associated references.

C. OVERALL TMDL

Key Findings From Previous Assessments

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 continue to show a decade-long trend of stabilization. While measured clarity data are encouraging, they must be considered in the context of consecutive drought years.
3. 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.
4. 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.
5. Nearshore conditions are expected to improve in response to Lake Tahoe TMDL implementation, particularly in the vicinity of effective load reduction efforts.
6. 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.

NEW FINDINGS

1. The 2014 annual average Secchi depth was 77.8 feet (23.7 meters), an increase of 7.6 feet over the previous year. The best clarity in more than a decade is likely a result of a combination of the following factors:
   a. implementation of water quality improvement actions;
   b. continued warm, dry conditions for the third straight year. The 2014 average minimum and maximum air temperatures at Tahoe City were the highest recorded since 1910. Precipitation was only 61% of average, with only 18% of it falling as snow, well below normal. April snowpack in the Tahoe Basin was the lowest recorded in 100 years of record keeping. Reduced precipitation meant fewer contaminants flowed into Lake Tahoe. Due to warmer water and record-high levels of lake stability Lake Tahoe did not mix to its full depth for the third consecutive year.
   c. decreases in the concentration and bloom duration of the algae *Cyclotella gordonesis* (UC Davis 2015).
2. Further review of the updated pollutant load estimates based on additional years of data (Sahoo et al., 2013) indicate a 21% shift in total phosphorous loading between urban and non-urban sources. Non-urban upland source categories loading increased from 26% to 47% while urban source category loading decreased from 39% to 18%.
3. 2NDNATURE (2014) developed technical recommendations to link site-specific urban stormwater monitoring datasets with recommended data analysis and reporting methods to address two priority TMDL management needs: 1) evaluating trends in urban pollutant loading over time as a result of water quality improvement management actions; and 2) informing priority needs of the stormwater tools used by the TMDL program.

a. Standardized data analysis and reporting approaches facilitate stormwater quality trend analyses across sites and provide relative climatic context.
b. To appropriately inform Pollutant Load Reduction Model (PLRM) characteristic effluent concentrations (CECs), treated effluent pollutant samples must be collected across a range of event types, magnitudes and durations from multiple representative BMPs of the same type (e.g., wet basin, dry basin, etc.). The monitored BMPs must be regularly maintained to operate within the acceptable range of performance. Three years of measured effluent concentrations from three specific BMPs of the same type are needed to generate a single recommended CEC (mg/L).
c. Data management, analysis and reporting formats are presented that are relatively simple, repeatable and easily interpreted by managers, funders and other relevant stakeholders.

REFERENCES

2NDNATURE. 2014. Aligning Stormwater Monitoring Datasets with Priority Management Questions. Final Guidance. Prepared for USDA Forest Service Pacific Southwest Research Station. December 2014. http://www.2ndnaturellc.com/reports/

Sahoo, G.B., J.E. Reuter, S.G. Schladow, J. Riverson and B. Wolfe. 2012. Development of a Water Quality Modeling Tool Box to Inform Pollutant Reduction Planning, Implementation Planning and Adaptive Management. University of California-Davis, Tahoe Environmental Research Center. Prepared for USFS-Pacific Southwest Research Station, Berkeley, CA. March 21, 2012.

UC Davis – Tahoe Environmental Research Center. 2015. Tahoe: The State of the Lake Report 2015. Davis, CA. Accessed on August 6, 2015. http://terc.ucdavis.edu/stateofthelake/

PART II: RECOMMENDATIONS

Introduction

This section describes actionable adjustment recommendation proposals developed by the TMDL Program Managers, including management strategies and guiding policies. Recommendations are presented to Lahontan Water Board and NDEP executives for discussion and consideration of approval. Stakeholder recommendations that are either non-actionable, have not been advanced by TMDL Program Managers, or require action from entities other than the TMDL Program agencies (e.g. TMDL Implementers or Coordinating Partners) are captured and responded to in the *2015 Stakeholder Feedback Capture Sheet,* an appendix to this document available, also available on the TMDL Online Interface.

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 or formal 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.

2015 STATUS

There were no new substantive findings during the past calendar year, and TMDL Program Managers are not recommending any program changes. Although updated findings provide valuable status and trend data and stormwater monitoring guidance, the new information does not warrant any change to the Lake Tahoe TMDL program at this time. The pollutant load estimate revisions are reasonably aligned with previous values and do not warrant change to the TMDL implementation approach. While the lake's physical characteristics are partially due to observed climate variables, the noted changes do not reflect a need for policy or program adjustment.

Previously listed recommendations remain relevant, and the following section describes the status of program recommendations made in the *2014 TMDL Findings and Program Recommendations Memo.*

	RECOMMENDATION	RESPONSE CATEGORY	STATUS UPDATE
SW.1.	Support Urban Jurisdictions' efforts to secure funding for road operations and maintenance	I	Ongoing. TMDL Program Managers are actively involved in current work to explore storm water program funding alternatives on the California side of the Lake Tahoe basin.
SW.2.	Update the Lake Clarity Crediting Program Handbook.	II	Complete. The updated Handbook is available here.
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	Ongoing. Other program priorities have prevented progress in implementing this recommendation. TMDL Program Managers will craft an updated PM in partnership with the Tahoe Regional Planning Agency as part of the Environmental Improvmenet Program reporting effort.
O.1.	Support ongoing nearshore status and trend monitoring and broadcast the relationship of nearshore quality to TMDL implementation in TMDL Management System products.	I	Ongoing. TMDL Program Managers are actively engaged in implementing estabslihed nearshore monitoring priorities. Work is also underway to target nearshore monitoring funds on evaluating nearshore processes and causal relationships.

APPENDIX A – 2015 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).

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 Category Management 3) Overall TMDL. Feedback is organized chronologically by the submittal date within each category. Comments remain on the list until addressed and status updates may be provided for those that remain unresolved.

#	Short Title	Summary of comment (1-3 sentences)	Submittal Date	Stakeholder Information	TMDL Program Manager Response
Urban Stormwater Management					
2015-1	**Incentivize the use of more durable traction abrasive material**	TMDL program findings suggest traction abrasives are a significant source of pollutants and using alternative materials could improve water quality. Lake Clarity Credits are awarded for changing observable road conditions, but it's unclear if the road conditions are appreciably altered by alternative abrasive use. Consider different incentives to drive the shift to more durable abrasives to achieve water quality benefit.	May-15	Zach Bradford, League to Save Lake Tahoe, zach@keeptahoeblue.org, 530-541-5388	**Comment addressed.** In using the Road RAM to evaluate roadway condition, the Lake Clarity Crediting Program incentivizes implementation of holistic roadway operations and maintenance strategies that minimize the magnitude and residence time of FSP source material. While specific ideas for incentives to implement effective road operations and maintenance in addition to the Crediting Program are welcome, current research and monitoring indicates the Road RAM sufficiently accounts for roadway condition variables. The California Department of Transportation is planning additional water quailty sampling paired with Road RAM observations and differing traction abrastive strategies to further assess the established water quality and condition assessmetn relationship.
2015-2	**Treatment BMP maintenance**	There is a documented lack of treatment BMP maintenance and the current program doesn't effectively enforce the need for treatment BMP maintenance. The program should reduce Lake Clarity Credit awards when treatment BMPs are't properly maintained.	May-15	Zach Bradford, League to Save Lake Tahoe, zach@keeptahoeblue.org, 530-541-5389	**Comment addressed.** Treament BMP condition assessment and maintenance requirements are primary components of the Lake Clarity Crediting Program; Credit awards are reduced when key and essential treatment BMPs are not maintained in appropriate functioning condition.
2015-3	**Private Parcel BMP Registration**	The maintenance and verification requirements associated with Lake Clarity Credit from private parcel BMP implementation remain uncertain. The proposed 5 year/50% reduction approach shifts emphasis from single family residential BMPs to commercial and multi-family. It is also unclear how the LCCP approach for private property BMPs will be implemented and when it may be revised. Program stability and consistency is needed to allow urban jurisdictions to appropriately plan for meeting load reduction requirements.	May-15	Karin Peternel, Douglas County, kpeternel@co.douglas.nv.us, Jason Burke, City of South Lake Tahoe, jburke@cityofslt.us, 530-542-6038	**Comment addressed.** Parcel BMP maintenance verification policy is now specified in the Lake Clarity Crediting Program Handbook version 2.0. The policy is subject to revision through the Lake Tahoe TMDL Management System process. Execution of any additional or new program or policy adjustment would require TMDL Executive approval.
2015-4	**Lake Clarity Crediting Program Handbook Revision**	Concern regarding stakeholder participation in updating the LCCP Handbook. Specificly, revisions may effect established baseline load and load reduction estimates and associated plans developed using previous assumptions. Should program changes substantively impact load reduction strategies, funding should be identified for jurisdictions to recalculate baseline loadings.	May-15	Karin Peternel, Douglas County, kpeternel@co.douglas.nv.us, Jason Burke, City of South Lake Tahoe, jburke@cityofslt.us, 530-542-6038	**Comment being addressed.** Revisions to the Lake Clarity Crediting Program tools were undertaken with signficant stakeholder support and involvement. Changes to the load estimation tool (PLRM) that ultimately influence previously prepared baseline pollutant loads have been implemented with stakeholder approval. While NDEP and NV Urban Implementers have secured funding, the Lahontan Water Board is working with CA Urban Implementers to identify and secure funding to revise jurisdiction scale baseline pollutant loads.
2014-12	**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	**Comment 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. The final report is due in Fall 2015. The project will also provide Urban Implementers standardized guidance to test and evalute the cost-effectiveness of road operations and maintenance practices in the future.
2014-1	**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	**Comment addressed/being adressed.** The program tracks road condition scores as established by Road RAM protocols. Rather than selecting specific road operations and maintenance practices, the updated Lake Clarity Crediting Program and associated load estimation tools allow entities to implement whatever practices they determine to be most cost-effective and feasible for their respective jurisdictions to achieve desired road conditions. The Road Operations Effectiveness Testing project was initiated to assist and guide jurisdictions in selecting cost-effective road operations and maintenance practices to achieve desired roadwday condition scores. A final project report is due out Fall 2015. Finally, project to test revised Road RAM protocols that eliminate need to access highway drive lanes has been initiated.
2014-3	**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	**Comment addressed.** Road RAM is currently the only road condition assessment approved for the Crediting Program. The Crediting Program allows for approval of alternatives condition assessment methodologies provided they demonstrate equivalency with Road RAM. Equivalency requirements are contained in the Crediting Program Handbook. Furthermore, the Crediting Program has been streamlined to reduce the road condition assessments burden.

#	Short Title	Summary of comment (1-3 sentences)	Submittal Date	Stakeholder Information	TMDL Program Manager Response
Non-Urban Source Category Management					
2014-18	**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.** Awarding credits to TMDL Implementers for stream restoration projects based on SLRT FSP load estimates is not recommended for the following reasons: 1) There is no process to link stream restoration fine sediment and nutrient load reduction estimates to Lake Tahoe TMDL baseline load estimates. 2) The Lake Clarity Crediting Program remains focused on accounting and tracking pollutant loading from urban storm water discharges and SLRT does not evaluate the proportion of pollutant load related to urban storm water. If an Urban Implementer can demonstrate a reduction of urban storm water loads associated with stream channel restoration work, TMDL Program Managers will consider awarding credits for such actions.
Overall TMDL					
2015-5	**LTIMP Data Use**	TMDL program managers should routinely review annual nutrient concentration data collected by LTIMP and consider observed spikes for potential point source problems.	Apr-15	Bob Coats, Tahoe Environmental Research Center, rncoats@ucdavis.edu, 510-295-4049	**Comment Noted.** This a low priority given: (1) competing priorities to manage the TMDL Program; and (2) the LTIMP stream monitoring program has been designed in such a manner that controllable and uncontrollable drivers are integrated. Therefore, it would be extremely difficult if not impossible to determine the cause of observed concentration spikes.
2015-6	**Nearshore Turbidity**	Consider *Effects of Motorized Watercraft on Summer Nearshore Turbidity at Lake Tahoe, California-Nevada* (Alexander and Wigart 2013) to inform the knowledge base of what effects nearshore turbidity.	Jun-15	Dan Kikkert, El Dorado County, dan.kikkert@edcgov.us	**Comment Noted.** This reference was reviewed and considered for inclusion in the 2014 Findings and Recommendations Memo.
2014-28	**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	**Comment being addressed.** SNPLMA funded research underway to address this need. Future SOF/PARM will report findings and implications from the relevant study.
2014-24	**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	**Comment being addressed.** SNPLMA funded research underway to address this need. Future SOF/PARM will report findings and implications from the relevant study.
2014-23	**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 accomplished.** The parcel BMP condition assessment process is described in the Crediting Program Handbook Version 2.0.
2014-22	**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	**Comment addressed.** To keep TMDL Online Interface streamlined to the pertinent information that is easy to find, stormwater and other TMDL-related studies will not be posted to the Online Interface. Rather, links to studies and reports reviewed for relevance and inclusion will be included in future Findings and Recommendations Reports, when and where available.

#	Subject	Summary of comment (1-3 sentences)	Submittal Date	Stakeholder Information	TMDL Program Manager Response
DRAFT Findings and Recommendations Memo & DRAFT Annual Strategy					
2015-7	DRAFT Findings and Recommendations Memo	The draft 2015 F&R memo qualitatively references "non-substantive findings" but lacks quantitative details. Consider including data, trends, or other details to bolster document findings.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2039	**Comment Addressed.** The document was edited to remove the terms substantive and non-substantive as these are subjective terms. Additionally, TMDL Management Agencies try to provide quantitative information to strengthen and support findings and recommendations whenever possible.
2015-8	DRAFT Findings and Recommendations Memo	The draft 2015 F&R memo selectively reports information from the UC Davis State of the Lake Report but ignores other seemingly relevant information. Specifically, the memo lacks information on the relationship between blueness and clarity, doesn't discuss the influence of Cyclotella diatoms on clarity, and fails to discuss deep-lake mixing factors in nutrient loading.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2040	**Comment Addressed.** The document was edited to incorporate information related to the influence of Cyclotella due to the algae's influence on clarity. The current relationship between blueness and clarity as well as the lack of deep-mixing effects on lake nutrient concentrations are both interesting information, but not considered by TMDL Program Managers as relevant for inclusion.
2015-9	DRAFT Findings and Recommendations Memo	It is unclear what draft 2015 F&R memo Section C. Overall TMDL Finding E (regarding urban stormwater monitoring) in is attempting to convey or how it is related to TMDL program activities.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2041	**Comment Addressed.** Finding C.3 (formerly Finding E in the draft document) has been revised in response to this comment.
2015-10	DRAFT Findings and Recommendations Memo	The draft 2015 F&R memo finding that revised loading estimates do not warrant progam change is inadequately supported. Consider adding quantitative specifics.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2042	**Comment Noted.** The 21% shift in phosphorous loading from urban to non-urban sources was determined to not warrant program change on the basis that the current TMDL management approach prioritizes fine sediment particles.
2015-11	DRAFT Findings and Recommendations Memo	It is unclear whether the draft 2015 F&R memo considered the Road Operations Effectiveness Testing Project report.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2043	**Comment Noted.** The referenced project report was not available prior to production of the draft 2015 F&R Memo and thus was not considered. It will be considered for inclusion in the 2016 memo.
2015-12	DRAFT Findings and Recommendations Memo	The draft 2015 F&R memo doesn't adequatly link listed recommendations to specific findings.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2044	**Comment Noted.** No new programmatic recommendations are included in the 2015 memo. Recommendations included in the 2015 F&R Memo are carry-overs from the 2014 memo. Recommendations in the 2014 memo include an "Alignment with Findings" description that links the specific findings with the recommendation.
2015-13	DRAFT Findings and Recommendations Memo	It is unclear whether all stakeholder feedback included in the Appendix A Stakeholder Feedback Table (draft 2015 F&R memo)	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2045	**Comment Noted and Addressed.** All comments submitted were included in the 2015 F&R Memo, except the Dan Kikkert comment submitted on 6/24/15 regarding availability of a 2013 study on watercraft affects on nearshore turbidity. This comment was not orignially included in the Stakeholder Feedback Form becuase the study was reviewed prior to development of the 2014 F&R Memo. However, it has been added to the Stakeholder Feedback Form. In the future, all stakeholder feedback will be included in the Stakeholder Feedback Form for the sake of transparency.
2015-14	DRAFT Findings and Recommendations Memo	The draft 2015 F&R memo lacks specific detail on how the updated PLRM version will influence baseline loads and associated NPDES permits (CA) and Interlocal Agreements (NV)	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2046	**Comment Noted.** It is not the purpose of the F&R Memo to provide this type of information. This information will be fleshed out in conversations with Urban Implementers and specified in updated permits and agreements.
2015-15	DRAFT Findings and Recommendations Memo	It is premature to link nearshore with Crediting Program prior to attainment of first urban five year milestone achieved. Nearshore should not be linked to jurisdictions load reduction planning efforts until 3rd five-year milestone.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2047	**Comment Noted.** At this time, the TMDL Program does not intend on linking nearshore with the Crediting Program. The TMDL Management Agencies belive nearshore improvement is one of many multi-benefit considerations that Urban Implementers should taken into account in the prioritization of load reduction projects and actions.
2015-16	DRAFT Annual Strategy	2016 Annual Strategy "Current Themes" should acknowledge 2016 is the initial year for catchment registration, inspection and award of credits and that implementation tools may need further refinement.	11/13/2015	Kristine R. Klein, Senior Licensed Engineer, Washoe Co., kklein@washoecounty.us, 775-328-2048	**Comment Addressed.** The final 2016 Annual Strategy has incorporated language that addresses this comment.

#	Subject	Summary of comment (1-3 sentences)	Submittal Date	Stakeholder Information	TMDL Program Manager Response
DRAFT Findings and Recommendations Memo & DRAFT Annual Strategy					
2015-17	DRAFT Findings and Recommendations Memo	Consider adding newly available fiscal cost information to the 2015 F&R Memo.	11/13/2015	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Comment Noted.** While new fiscal estimates may drive more cost effective implemenation approaches, the updated cost information does not currently impact the direction of established TMDL program policies. The Water Board and NDEP are committed to addressing cost estimates and compliance implications within the NPDES permit and Interlocal Agreement context.
2015-18	DRAFT Findings and Recommendations Memo	How will the LCCP program schedule provided in the draft 2015 F&R memo impact updates to permits, specifically Reports of Waste Discharge and Pollutant Load Reduction Plans? EPA suggests using the annual F&R memo to describe upcoming program activities.	11/13/2015	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Comment Noted.** The progam implementation schedule remains unchanged. Similarly, Lake Clarity Credit verification and updated permit and interlocal agreement processes are consistent with established timeframes. Please review the existing permit for compliance dates and future submittal requirements.
2015-19	DRAFT Findings and Recommendations Memo	The F&R should identify significant upcoming TMDL related activities and describe how that information will be used to support TMDL implementation.	11/13/2015	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Comment Noted.** TMDL Program Managers agree there is value in broadcasting upcomingTMDL program ativities to ensure stakeholders are informed. While such information is not well aligned with the Findings and Recommendations memo purpose and structure, those details can be found in the Annual Strategy document.
2015-20	DRAFT Findings and Recommendations Memo	The draft 2015 F&R memo should include additiontal nearshore status information as reported inthe UCD SOTL Report. TMDL program should serve as the mechanism to report nearshore program activities.	11/13/2015	Jacques Landy U.S. EPA Lake Tahoe Basin Coordinator (775) 589-5248 landy.jacques@epa.gov	**Comment Noted.** Given the lack of established neashore program stakeholder information distribution processes, TMDL Program Managers agree the TMDL Management System documents can provide an interim solution until such processes are developed. Future documents will consider and, where appropriate, report on nearshore program activities.

EXECUTIVE SUMMARY

(CONTINUED FROM PAGE 2.2)

The input of stream-borne nutrients (nitrogen and phosphorus) to the lake was low again in 2015 due to the low precipitation and subsequent run-off. The last four years have all had nutrient and particle loads a factor of four to five below the long-term mean.

Overall in-lake nitrate concentrations have remained relatively constant over the 33 years of record. In 2015, however, the volume-weighted annual average concentration of nitrate-nitrogen reached an all-time high of 20.6 micrograms per liter, exceeding the previous high of 20.0 micrograms per liter set in 2014. This increase is in part due to the record low mixing this year; nutrients from the bottom of the lake were not brought up to levels where they can be utilized by phytoplankton. The lack of deep-water mixing allows a continued build-up of nitrate in the deep water. Surprisingly, in-lake phosphorus concentrations which had been on a long term decline, displayed an increase in 2015, to the highest level in the last six years.

Biologically, the primary productivity of the lake has increased dramatically since 1959. In 2015, there was a decrease in primary productivity to 206.1 grams of carbon per square meter, the third successive year of reduced productivity. By contrast the biomass (concentration) of algae in the lake has remained relatively steady over time. The annual average concentration for 2015 was 0.63 micrograms per liter, slightly lower than the previous two years. For the period of 1984-2015 the average annual chlorophyll-a concentration in Lake Tahoe was 0.70 micrograms per liter.

This year the annual average Secchi depth, a measure of lake clarity, continued the long-term halt in clarity degradation. The value for 2015 was 73.1 feet (22.3 m), a decrease of 4.8 feet over 2014, but this well above the lowest value recorded in 1997 of 64.1 feet (19.5 m). Year-to-year fluctuations are the norm, and the long-term goal must be seen as attaining a level of clarity which on average meets the basin's standards. Winter (December-March) clarity declined by 7.6 feet to 71.5 feet (21.8 m). The low level of snowfall compared to rain this year caused the water entering the lake to be warmer in 2015, and this introduced fine particles closer to the surface. Summer (June-September) clarity in Lake Tahoe in 2015 was 72.8 feet (22.2 m), a 4.2 foot decline over the value from 2014.

This report is available on the UC Davis Tahoe Environmental Research Center website (http://terc.ucdavis.edu).

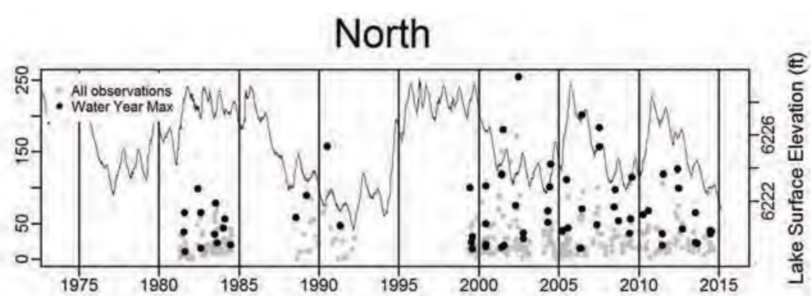
RECENT RESEARCH UPDATES

More or less slime?

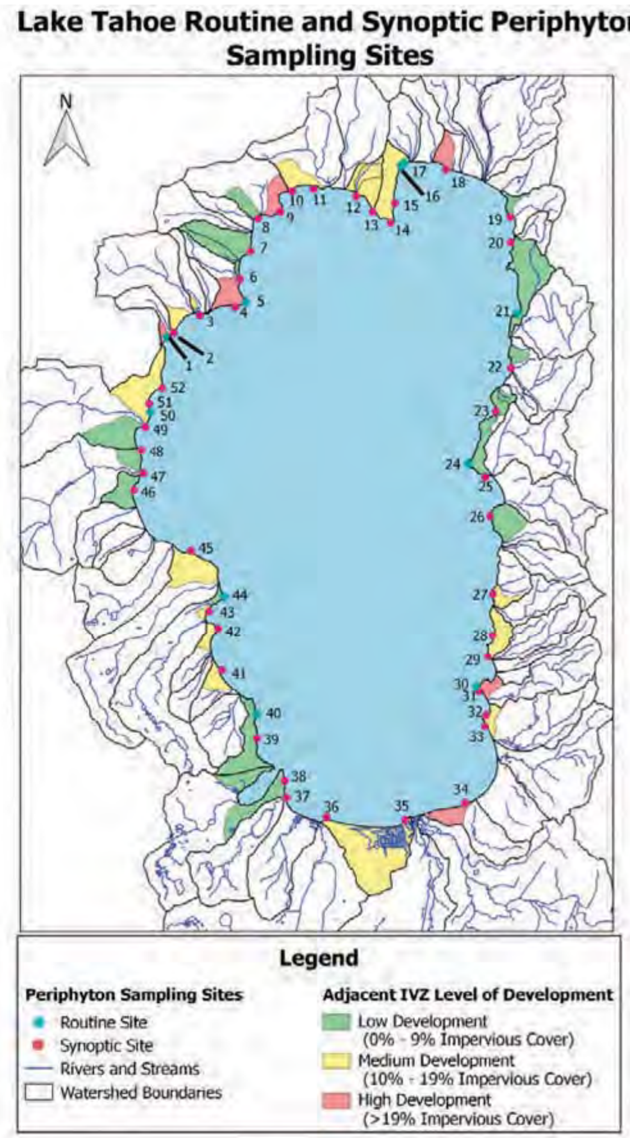
In late 2015, at the request of the TRPA, TERC undertook a review of all the data collected on the status of periphyton, the attached algae on the rocks around the lake that most people refer to as slime. Was there more of it now than there had been in the past? Were some areas naturally worse than others?

TERC has conducted periphyton monitoring in Lake Tahoe since 1982. Monitoring occurred for select periods in the 1980s (1982-85) and 1990s (1989-93). Near-continuous monitoring has occurred since 2000 with a one-year gap in 2004. Periphyton monitoring has primarily focused on measuring levels of algal biomass at six to ten "routine" monitoring sites around the lake. Samples of attached algae for measurement of biomass have been collected from natural rock surfaces at 0.5 m (20 inches) below the water level at the time of sampling. In addition, once each spring an intensive "synoptic" sampling of approximately 40 additional sites is completed. This synoptic sampling is timed to occur when periphyton biomass is believed to be at its spring peak.

With respect to spatial changes, the trends are somewhat definitive, with areas of medium and high development displaying higher levels of periphyton biomass. Whether this is due to the presence of the development itself or whether it is also tied to the fact that development often occurred in areas of flatter land (meadows, wetlands etc.) has yet to be determined.



Chlorophyll-a (in mg/sq. m) for all the North Lake Tahoe sites. The determination of a long term trend is complicated by fluctuating water level and gaps in the data. Even within one year, there are large variations between sites.



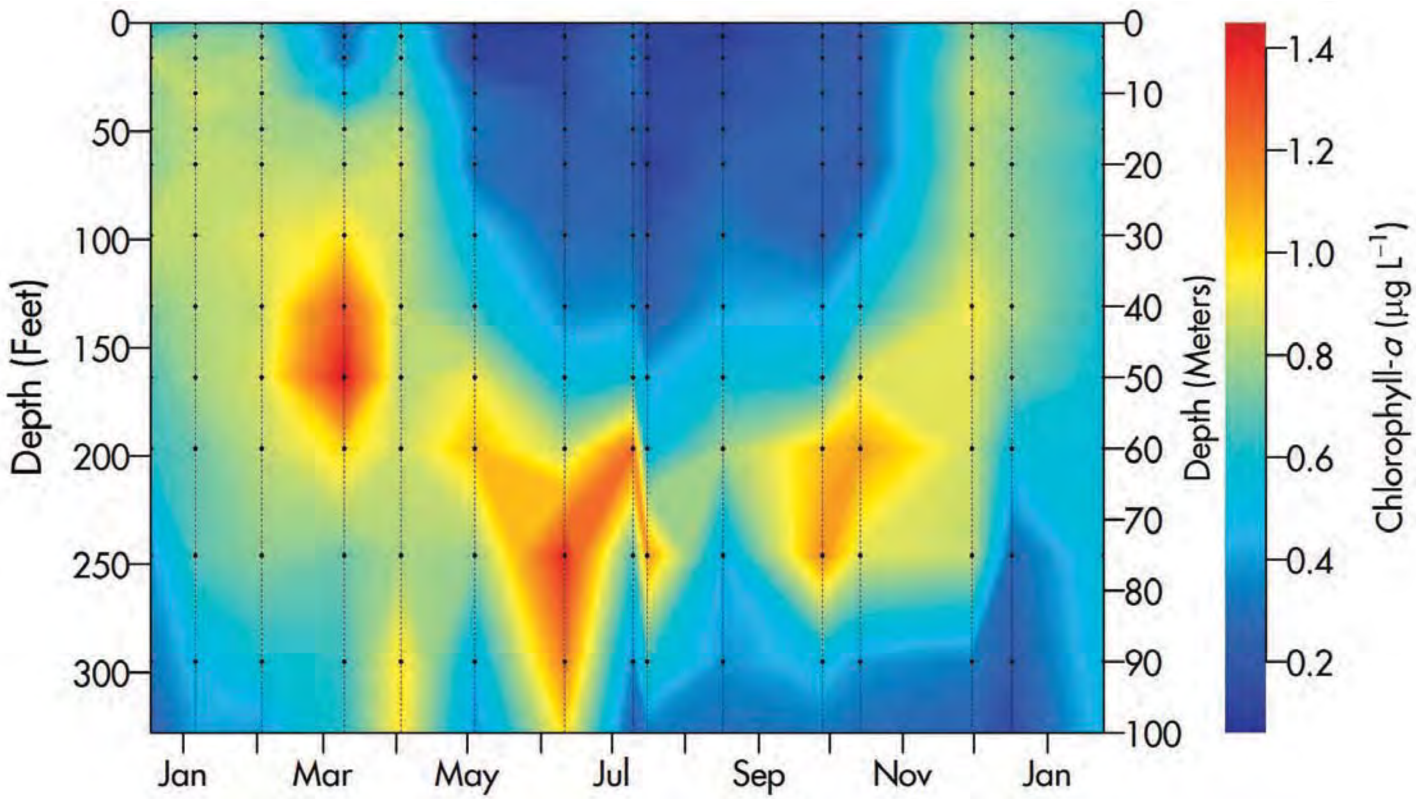
BIOLOGY

Chlorophyll-*a* distribution

In 2015

The distribution of algae (measured as chlorophyll–a) is the result of a combination of light availability, nutrient availability, mixing processes, and to a lesser extent, water temperature. This figure shows color contours of chlorophyll-a concentration down to a depth of 350 feet. Below this depth chlorophyll-a concentrations are near zero due to the absence of light. Lake Tahoe has a "deep chlorophyll maximum" in the summer that occupies the range of 150-300 ft. in the water column. In that depth range the light and nutrient conditions are most favorable for algal growth.

In the early part of the year, the algae were distributed over a greater depth range because of the mixing processes that were occurring. With the onset of thermal stratification in spring, the algae were confined to a discrete band. Throughout the year concentrations decreased as nutrients were depleted. In November and December, the commencement of mixing again redistributed the algae over a broader depth range.



BIOLOGY

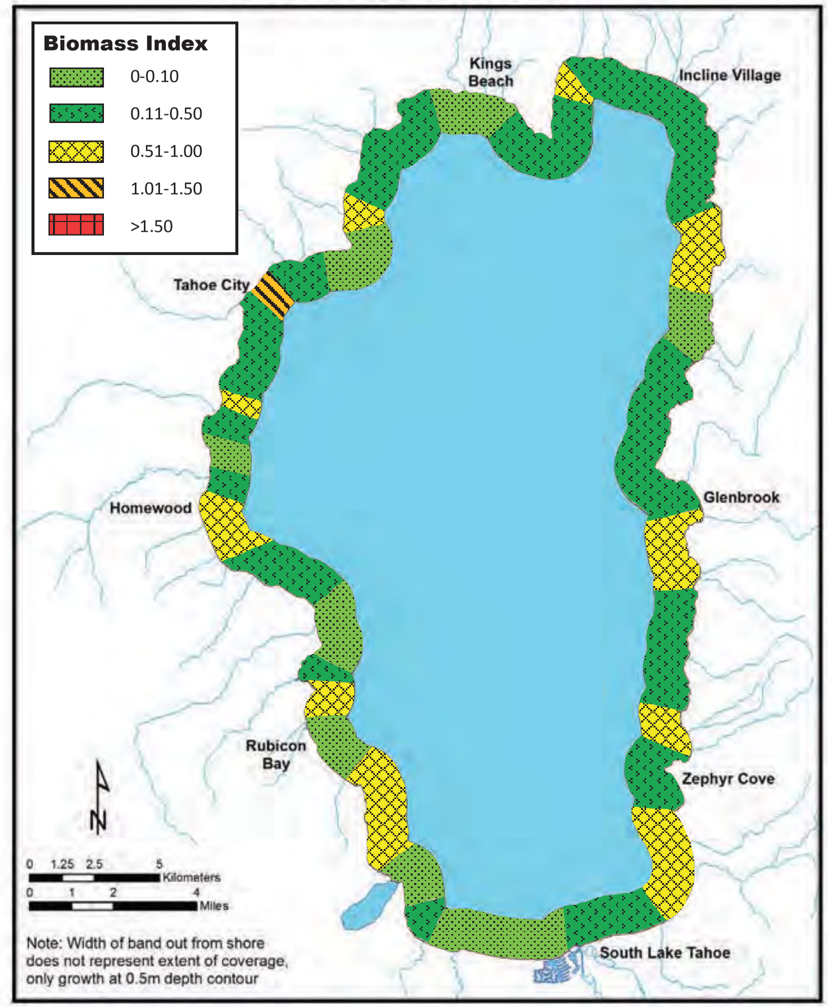
Shoreline algae distribution

In 2015

Periphyton biomass was surveyed around the lake during the spring of 2015, when it was at its annual maximum. Nearly 45 locations were inspected by snorkel survey in 1.5 feet (0.5 m) of water. A Periphyton Biomass Index (PBI) is used as an indicator to reflect what the casual observer would visually detect looking into the lake from the shoreline. The PBI is defined as the fraction of the local bottom area covered by periphyton multiplied by the average length (cm) of the algal filaments. The PBI had fewer very high occurrences (PBI > 1.5) in 2015, possibly due to the low lake levels that prevailed. Instead there was a greater number of moderate areas (PBI = 0.51 -1.0), especially on the east shore. As lake level falls during low lake level years, the 1.5 ft. measurement depth is increasingly dominated by blue-greens at many sites including the east shore sites resulting in moderate biomass index values (in contrast, the east shore often has relatively low growth of algae at higher lake levels).

Note: The width of the colored band does not represent the actual dimension of the onshore-offshore distribution. Similarly, its length does not represent the precise longitudinal extent.

Distribution of Periphyton Biomass at 0.5m Depth, Spring 2015

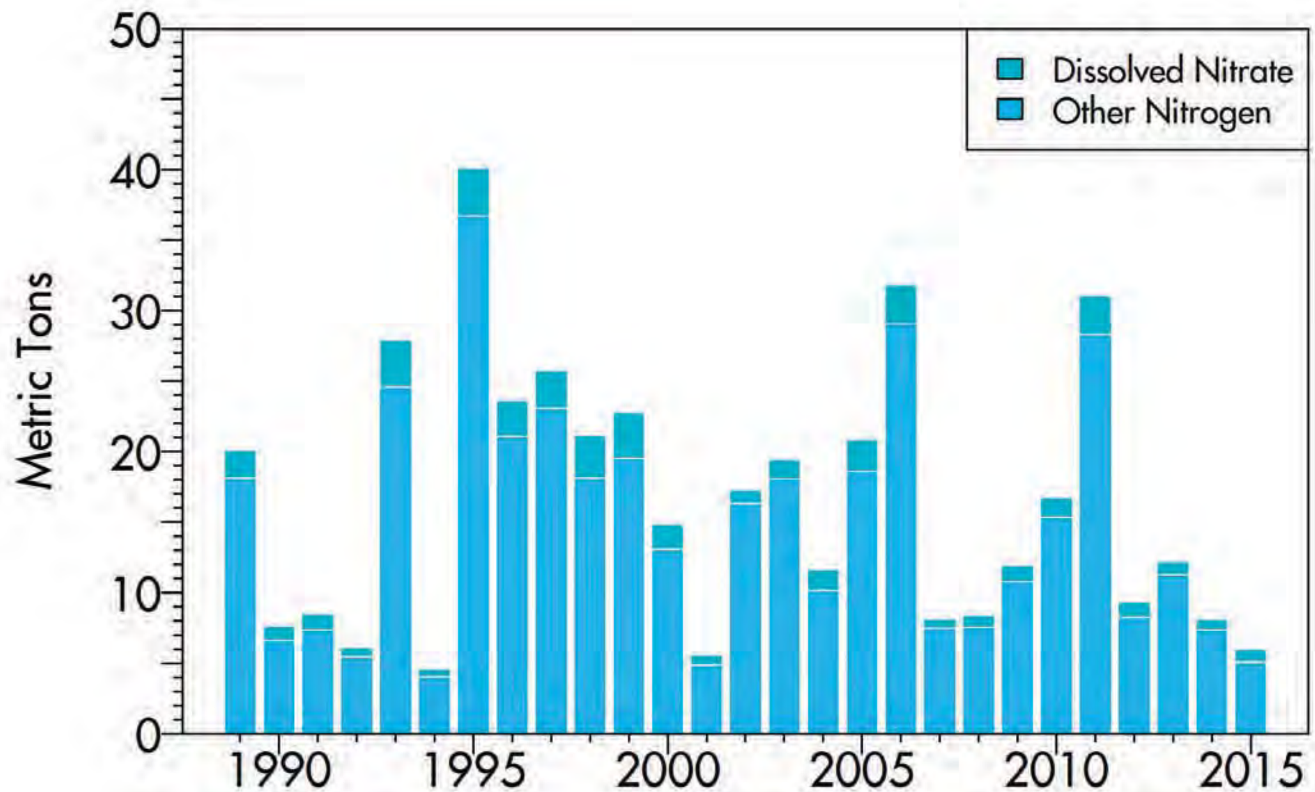


NUTRIENTS AND PARTICLES

Nitrogen contribution by Upper Truckee River

Yearly since 1989

Nitrogen (N) is important because it, along with phosphorus (P), stimulates algal growth. The Upper Truckee River is the largest of the 63 streams that flow into Lake Tahoe, contributing about 25 percent of the inflowing water. The river's contribution of dissolved nitrate and the remainder of the total nitrogen load are shown here. The year-to-year variations primarily reflect changes in precipitation. For example, 1994 had 16.59 inches of precipitation and a low nitrogen load, while 1995 had 60.84 inches of precipitation and a very high nitrogen load. 2015 had 18.1 inches of precipitation, following 2014 with 19.3 inches, 2013 with 25.19 inches and 2012 with 22.48 inches. The average annual precipitation is 31.4 inches. (One metric ton = 2,205 pounds.)



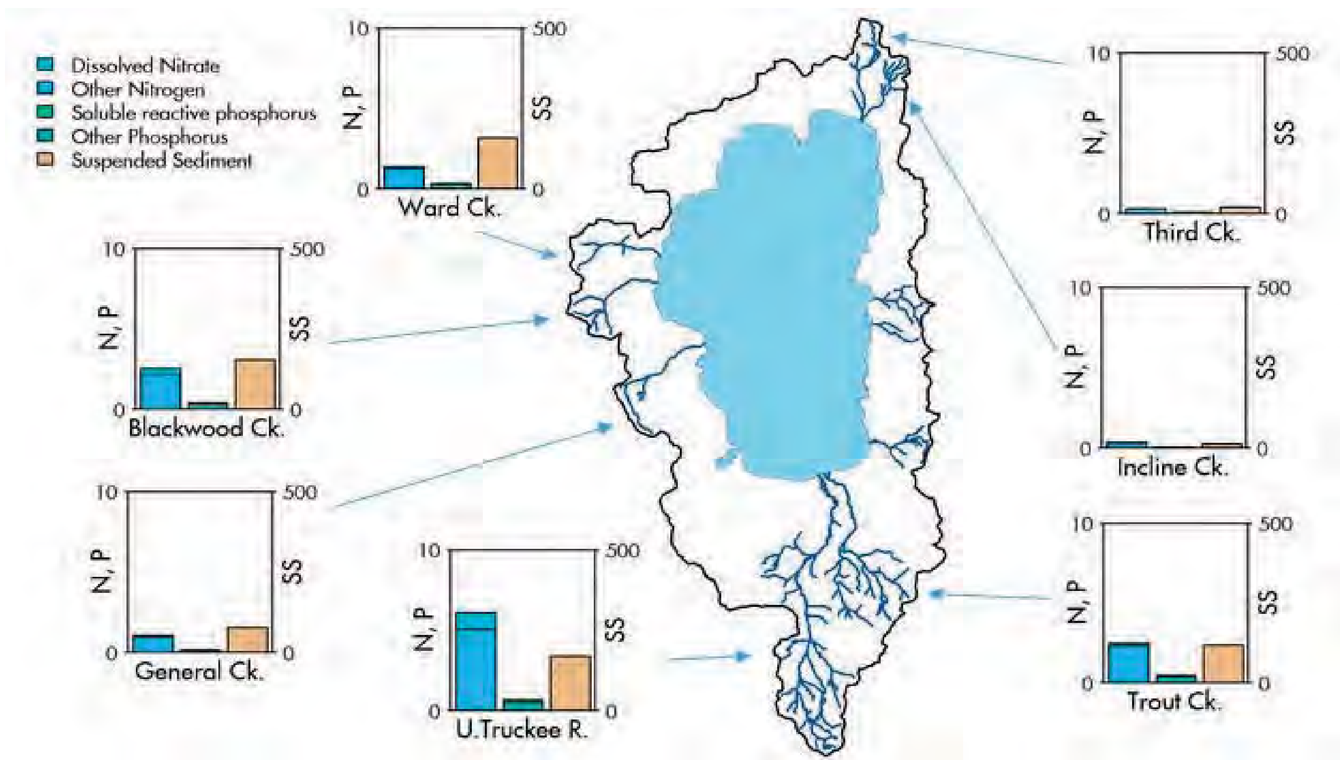
NUTRIENTS AND PARTICLES

Pollutant loads from seven watersheds

In 2015

The Lake Tahoe Interagency Monitoring Program (LTIMP) measures nutrient and sediment input from seven of the 63 watershed streams – a reduction of three streams since 2011. The vast majority of stream phosphorus and nitrogen comes from the Upper Truckee River, Trout Creek, Blackwood Creek and Ward Creek. Pollutant loads from the west-side streams were a factor of four to five lower in each of the last four years, compared with 2011. The suspended sediment was either lower than or similar to last year's values. The notable exception to this was Ward Creek and Blackwood Creek in California. All these reductions were largely due to the effects of the drought.

The LTIMP stream water quality program is supported by the U.S. Geological Survey in Carson City, Nevada, UC Davis TERC and the Tahoe Regional Planning Agency. Additional funding in 2015 was provided by the California Tahoe Conservancy and the Lahontan Regional Water Quality Control Board.

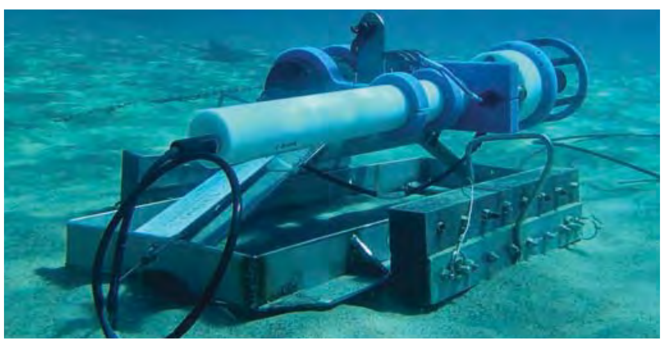


RECENT RESEARCH UPDATES

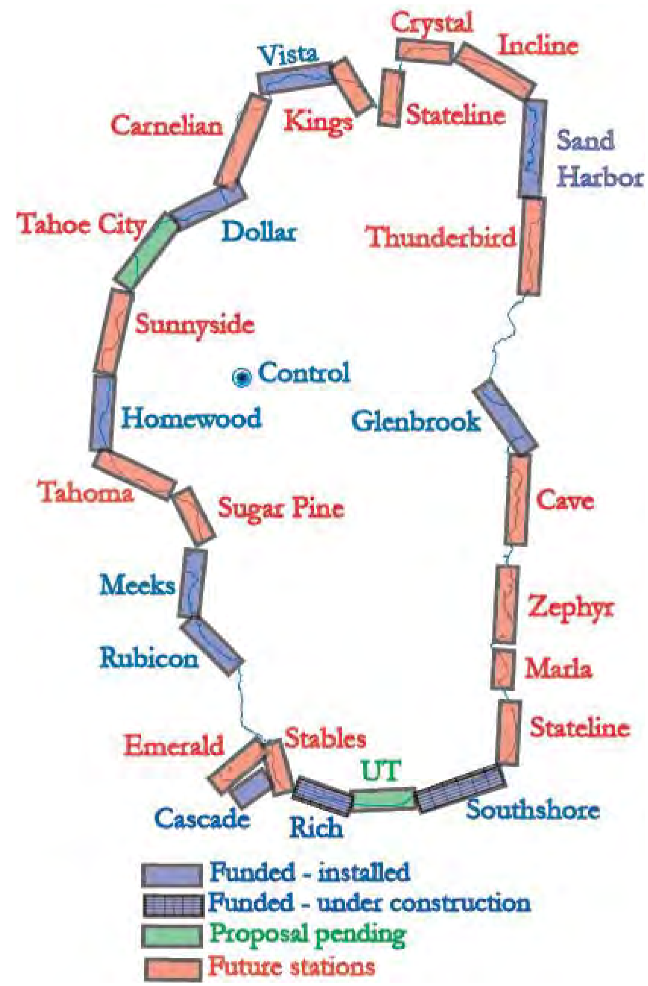
Variability around the shoreline of Lake Tahoe

TERC's Nearshore Network is a system of water quality stations spread around the shallow areas of the lake that continuously measure water quality and physical conditions every 30 seconds, and almost-instantly logs the data to the internet. The current set of stations have been installed with support from private property owners and home-owner associations and are installed at both private docks and public facilities. The map shows the general locations of the existing and under construction stations, as well as potential locations of future stations. Please contact tercinfo@ucdavis.edu if you are interested in funding a future station.

The purpose of the stations is to help understand the variability of conditions in the nearshore around the lake, and to identify the sources of this variability. Until now it has not even been possible to know what "normal" is for most water quality properties. Conditions could be driven by natural lake processes; by pollutant inputs from drains, streams or direct runoff; by accidental releases of contaminants; or by combinations of all of these. Each of these could force a departure from "normal". We now know that "normal" is different, depending on where you are around the lake. Most importantly, the way in which nearshore conditions can be improved depends directly on the underlying causes.



A nearshore station in the shallow water of Lake Tahoe.



Locations of existing and planned nearshore network stations.

different and specific code would need to be added. The staff memo has preliminary draft code in it.

Mr. Marshall said this is a conversion from CFA to TAU or vice versa and it is not about the taking of existing TAUs and converting them to a larger TAU type of unit. That was addressed in the Regional Plan and there are measures that address that, this is about the conversion of those units. The comments regarding taking small units and making them into larger units is a different issue than what we are discussing today.

Committee Comments & Questions

Mr. Lawrence said it is important and if the RPU is going to be successful, we need to figure out a way to look at the existing commodities system and provide proper incentives for getting infrastructure out of these stream zones. He agreed with some of the public comments that SEZ restoration is going to be critical to our success in the future. There also needs to be proper environmental analysis regarding this pilot program, but he is mindful that there are provisions in the Code of Ordinances that are already in place as safeguards for some the concerns that are being raised. It is not necessarily a bad thing if we end up with more land coverage in town centers, but there are things in the Code that limit land coverage. He supported moving forward with a recommendation.

Ms. Aldean said she had a conversation with staff off line about Table B-2 and the need to make it more clear. Anything that is embedded into the Code of Ordinances needs to be clearly understandable. Referring to the comment made earlier about giving applicants more than a one 12 month extension, doesn't the Code provide for some flexibility if in fact a project is being diligently pursued and they are up against a three year deadline.

Mr. Marshall said yes, however, to distinguish between a project that has been permitted and what is happening here which is pre-permit. The project that drives this is not the restoration, but the allocation and then use of those converted units, it is the restoration element.

Ms. Aldean asked if there is still flexibility at the staff level to extend the time that the restoration can be completed if it is being diligently pursued.

Mr. Marshall suggested that we address that issue during the next step which involves taking this proposed language and move it into significant review. There is specific Code of Ordinance language that refers to the time period in which you must show restoration. If we want to add flexibility we need to review what the pros and cons are and how we would do that.

Mr. Shute asked if this would be to come back with Code language in the environmental review.

Mr. Marshall said that is correct and will work with RPIC on the language.

Mr. Yeates said he received an email today of a critique with the comparison of commercial floor areas to tourist bonus unit conversions in the pilot. He asked if we are going to have the ratio peer reviewed to ensure the ratio is appropriate.

Mr. Hester said they received the same email and there are two issues. There was an assumption that it was existing development being converted and it is not. He is not sure how relevant the first part of those comments are. The second part that relates to making the math explicit ate and checking it, staff will do that and have their spreadsheet reviewed again.

Mr. Shute said in addition to being a historic wetland that would be restored to a wetland was the idea that it would be hydrologically connected to the Lake. This is important and it would take a further Code amendment, but he would be more comfortable with that.

Ms. McMahon asked if the committee would like staff to include that in the pilot program language.

Mr. Shute said yes, unless there is an objection from the committee.

Mr. Sevison asked if it could not be connected to the Lake if it is in the Basin.

Mr. Marshall said there are isolated wetlands, so that is a possibility. The way the current Code of Ordinances is drafted for this program is for SEZs. Right now there is no requirement for accessing this bonus pool as a direct connection to the Lake. If the committee would like to impose that, it would be amending and adding a further restriction on the existing categories of SEZs that would be available for this bonus conversion program.

Mr. Bruce suggested that we look at maps before there is any kind of decision on whether or not that is necessary. There can be some significant impacts for the Lake and the Basin that don't necessarily have that direct connection.

Mr. Shute said it would come back in a draft with analysis.
Mr. Cole asked for a clarification in that if it is hydrologically connected via culvert or whatever, he would hope that it would be additional criteria to look at instead of making it more restricted.

Mr. Marshall said when they were talking about a direct hydrologic connection was when we were looking at expanding the properties eligible beyond just currently mapped SEZs. It was a link that if there was a property that was not SEZ but was in the floodplain that it would be close enough to the Lake to make a difference. Because we can apply the current Code to include both restored SEZ and SEZ, we did not need to add that additional language which is why the direct hydrologic language was dropped, not because it was not important, but rather because we did not need to expand the criteria. Staff can provide some examples of what is and what was not.

Mr. Shute suggested leaving it at that because he believes that we can still get the benefit without the connection. He feels that is it something that should come back to RPIC for review when there is further information.

Ms. Aldean said if we wanted to make this part of the criteria, for example, if there are a half of a dozen projects and half of those are hydrologically connected, they may score higher because the assumption is that there is a greater benefit. It would not necessarily be limiting, but it would be part of the criteria that is being used to evaluate the efficacy of a project.

Mr. Marshall said one is the efficacy, a retroactive look at the efficacy of the project versus a ranking of projects. He does not suggest that we do that because currently it is first come first serve.

Ms. Aldean said it would be significantly limiting if the only projects that were eligible were hydrologically connected may stifle the process. If it were just criterion that would be used to evaluate multiple projects, then that would be appropriate.

Mr. Shute asked if these transfers can occur to an area outside a town center; he feels the transfers should be to a town center.
Ms. Cannon said the transfers can only occur to a town center or regional center.

Mr. Shute asked if that is on the books currently.

Ms. Cannon said it is in the Code of Ordinances, Section 51.5.3.

Mr. Hester said staff will work on clarifying the table, check and document the spreadsheet, clarify the reservation period visa via project extensions, analyze the option of direct hydrologic connection to the Lake as a requirement, and ensure that it is only transfers to centers.

projects using ECM funds must result in Soil Conservation and/or Water Quality Threshold gains. The ECM program amendments necessitate adjustments to the MOUs between TRPA and the land banks.

The current ECM fee schedule has not been updated since 2007 due to implementation difficulties. The ECM fee update is an opportunity to improve the feasibility of implementation, program effectiveness, and better fulfill the ECM fee intent to reflect the land bank's cost to acquire and restore coverage. Amendments to Code Section 30.6.1.C.2 are proposed to implement more feasible ECM Fee updates and align ECM fees with consistent regional sales inflations, using an Annual Percentage Growth Rate methodology and index approach.

Coverage Transfers Across HRAs Policy Background and Issue Summary:
Land coverage is the most frequently traded commodity in the Tahoe Region. TRPA regulates the ability to cover land in the Region through a set of coverage rules that differ by land capability, property location, and whether the lot is vacant or previously developed. Land capability is a classification system based on soils, hydrology, geomorphology, and vegetation that determines the amount of development a site can support without experiencing soil or water degradation (The Land-Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide for Planning by Bailey, 1974). Depending on the environmental sensitivity of the site as defined by the Bailey Land Capability Classification or Individual Parcel Evaluation System (IPES), landowners are permitted base allowable coverage between 1 and 30% of their property area. Landowners could transfer additional coverage above the base allowable up to maximum parcel coverages, if the property is eligible pursuant to Code Section 30.4.2. Coverage transferred from sensitive land must be permanently retired as set forth in Code Section 30.4.3.G. and be restored and maintained to a natural state or near natural state (see also Code Section 51.6).

Transfers of coverage are currently allowed only within the same Hydrologically Related Area (HRA). The 1987 Regional Plan partitioned the Region into a series of nine HRAs and the geographic extent of these HRAs is roughly based on the combination of several adjacent watersheds and negotiated adjustments primarily to allow for adequate coverage transfer opportunities in each HRA (see Figure 1). The HRA concept description is provided in the 1984 EIS for the 1987 Regional Plan (p. II-17), which states that "[t]he term "related hydrologic unit" has not yet been specifically defined. However, the Agency will limit transfers of coverage to a reasonable distance from the receiving site, so that the effect on water quality of coverage within the area is no worse than if the development were confined to the respective parcels."

Existing coverage policies limit transfers to within HRAs and therefore, constrain the supply and increase the cost of coverage in some HRAs. The price and availability of coverage varies dramatically throughout the Region from approximately $11/sq. ft. to $87/sq. ft.[1] The limited supply and high cost can serve as impediments to environmental redevelopment of high capability areas in these HRAs. This constraint results in a fragmented market with limited supplies of coverage and higher costs than would be expected if potential sellers of coverage could compete Region-wide. An opportunity exists

[1] See Staff Summary for January 27, 2015 for more detail: http://www.trpa.org/wp-content/uploads/Draft_Coverage_WG_Memo_1_27_2015_FinalVersionFullPacket.pdf.

Integrated

Environmental Restoration Services, Inc.

Homewood Mountain Resort

2006 Restoration Treatment and Monitoring Report

Prepared by Rachel Arst, David Gibbs, and Michael Hogan

INTRODUCTION

Homewood Mountain Resort is a ski area located on the west shore of Lake Tahoe in the town of Homewood, California (Figure 1). This report describes restoration and monitoring activities done at Homewood Mountain Resort in the summer and fall of 2006 by Integrated Environmental Restoration Services (IERS). The project consisted of road removal/restoration treatments on three types of disturbed sites to determine the most appropriate and cost effective techniques for those sites. Following restoration treatment, these sites and representative disturbed and native areas were monitored in order to compare differences pre-and post treatment and to compare those site conditions to comparative native sites. Monitoring data will be used to help determine effectiveness of treatments in controlling sediment movement at its source and to measure plant establishment. This data will help determine appropriate, site specific treatments for future restoration work at Homewood Mountain Resort. This information will be used as the foundation for an area wide road removal and restoration program. Treatment planning and implementation has been coordinated with both the Tahoe Regional Planning Agency (TRPA) and Lahontan Regional Water Quality Control Board staff to maximize agency feedback.

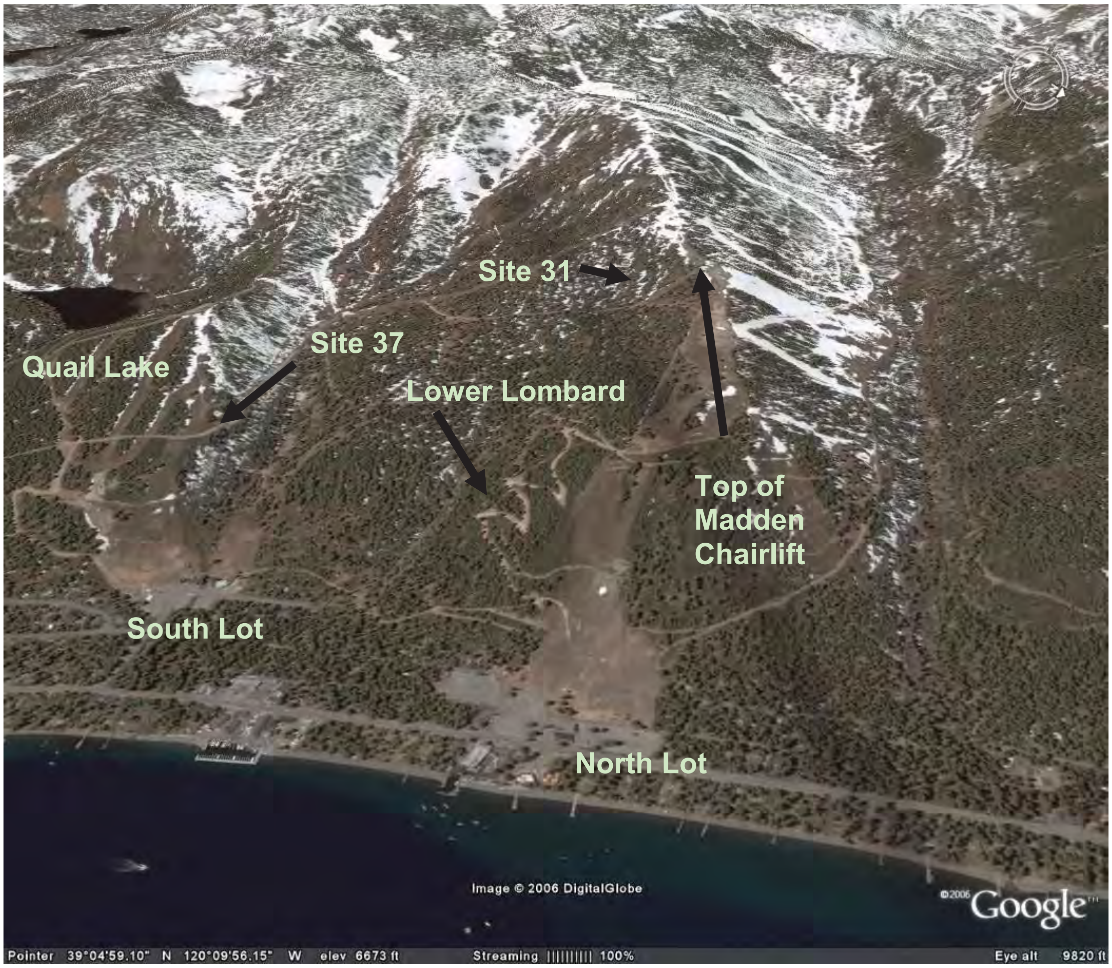


Figure 1. Satellite image of Homewood Mountain Resort on the west shore of Lake Tahoe.

PROJECT GOALS

The goals of the project are: 1) to remove and restore soft coverage (roads and trails) 2) to restore and maximize soil function (hydrologic function and nutrient cycling) 3) to establish mulch and vegetative cover through a variety of treatments and 4) to maximize erosion reduction on treated areas.

Specific treatment goals for this project include:

- Re-establishment of natural slope contours and drainage patterns to stabilize disturbed soil and reconnect disrupted surface and subsurface hydrology.
- Increasing infiltration rates and soil water holding capacity by tilling (soil loosening) and incorporating organic matter and fertilizer into the soil and applying a native pine needle and/or woodchip mulch.

- Initiate a successional process that leads to diverse, mid-seral, self-sustaining, native grass and shrub plant communities.

More specifically, the following treatment questions were posed and are intended to be answered through future monitoring efforts:

- **Site 31:**
    - Is there a difference in hydrologic or soil function when different amounts of woodchips (2, 4 or 6 inches) are tilled into local volcanic soils?
    - Is there a difference in hydrologic or soil function when different types of surface mulch (wood chips, tub grindings or pine needles) are applied at the same rate?
- **Lower Lombard:**
    - Is there an improvement in soil nutrient status and availability and/or in plant establishment and cover in volcanic soil when a compost-type material is used as a soil amendment in addition to organic fertilizer and tub grindings?
- **Site 37:**
    - Is there an improvement in infiltration/hydrologic function and thus runoff and sediment yield potential from an abandoned roadbed when established, mature vegetation is mowed but not removed and the soil mechanically loosened?

SUCCESS CRITERIA

Success criteria are an essential element of project monitoring. Success criteria should be quantitative wherever possible. We have developed these criteria to 1) determine treatment or implementation effects and 2) to determine long term trends relative to erosion, vegetative cover and soil function. We use an adaptive management process to develop, use and interpret success criteria. This adaptive management process (Hogan, 2005) helps assure that success criteria are linked to project goals.

The success criteria directly following treatment (time 0) are:

- Depth to refusal averaging at 12 inches, as measured with a cone penetrometer at 350 psi; and
- Surface mulch cover of at least 98%.

These criteria are used to determine immediate treatment effects. Performance monitoring will be done in subsequent seasons in order to determine how well treatments are functioning relative to the previously stated goals.

SITE DESCRIPTION

General Environment

Homewood Mountain Resort is situated on a steep, heavily forested mountain environment on the west shore of Lake Tahoe, California (Figure 1). The soil is generally derived from andesitic parent material and mixed glacial outwash, with a relatively high amount of fine clay and silt size particles. Elevations range from 6,230-7,880 feet above mean sea level (AMSL). The vegetation at Homewood is typical of similar elevation environments on the west shore of Lake Tahoe. The over-story is predominantly Jeffrey pine (*Pinus jefferyi*) and white fir (*Abies concolor*) with some sugar pine (*Pinus lambertiana*) and incense cedar (*Calocedrus decurrens*). Some red fir (*Abies magnifica*) is present at the higher elevations. The under-story is mainly composed of two types of Ceanothus: tobacco brush (*Ceanothus velutinus)* and whitethorn (*Ceanothus cordultus*), as well as green leaf manzinita (*Arctostaphylos patula*). Scouler's willow (*Salix scouleriana*) predominates in the wetter areas. Few grasses and forbs are present at Homewood in the forested areas.

Pre-Exisiting Conditions

Three different areas were treated and monitored during 2006. The following are descriptions of the pre-treatment conditions.

Site 31

Site 31 is at 7,107 feet elevation and is a road that has recently been used to remove felled trees from the area. Before IERS treatment, the road had a thin layer of surface woodchips (<1 inch) and two water bars. There was very little vegetation. The road has a slope of 8 degrees and faces 53 degrees east (Figures 2 and 3).

Figure 2: Site 31 pre-treatment. Sparse vegetation was present on the road.

Figure 3: Site 31 post-treatment. Soil surface was loosened with tilling and mulch was added.

Lower Lombard

The Lower Lombard site, at an elevation of 6,370 feet, is an old access road which connects the ski trail Lombard Street with 'maintenance building AA' (Figure 4-6). This road area had large rills running the entire length of the slope prior to treatment and was identified as having a high potential for sediment yield. This road has a slope of 13 degrees and faces 102 degrees (south-east) and is surrounded by a tree covered slope with approximately 30% canopy cover.

Figure 4. Lower Lombard site location.

Figure 5. Lower Lombard pre-treatment. Vegetation is not present and the soil is highly compacted.

Figure 6. Lower Lombard post-treatment. Slope was re-contoured to match natural slope angle and woody debris and large rocks were added.

Site 37

Site 37, at an elevation of 6,992 feet, is and old road near the top of Overload ski run. It runs eastward diagonally across the Shortcut and Drainpipe ski runs approximately one hundred vertical feet below the top of Quail Chair. A stand of mature shrub vegetation existed on the site which indicated that the road had not been used for many years. However, the old road bed was still highly compacted, as indicated by pre-treatment penetrometer analysis. Our specific question on this site is whether tilling and additional organic matter incorporation will result in a long term decrease in soil density and an increase in infiltration (Figure 7). This site has a slope of 5 degrees and faces 22 degrees north.

Figure 7. Site 37 after mowing treatment, before other treatments.

TREATMENT SUMMARIES

Site 31

Site 31 is 6,180 square feet and was divided into three plots of approximately 2,060 square feet each (Figure 8). The plots were labeled 1, 2 and 3. Each of the three plots was then divided into three distinct treatment areas of approximately 687 square feet. Different types of mulch were applied to the three plots. Woodchips were used at plot 1, tub grindings were used at plot 2 and pine needle mulch was used at plot 3. Within the plots each treatment area, labeled A, B or C, had different depths of woodchips tilled into the soil. Treatment type A had 2” of woodchips, type B had 4” and type C had 6” (Figure 2).

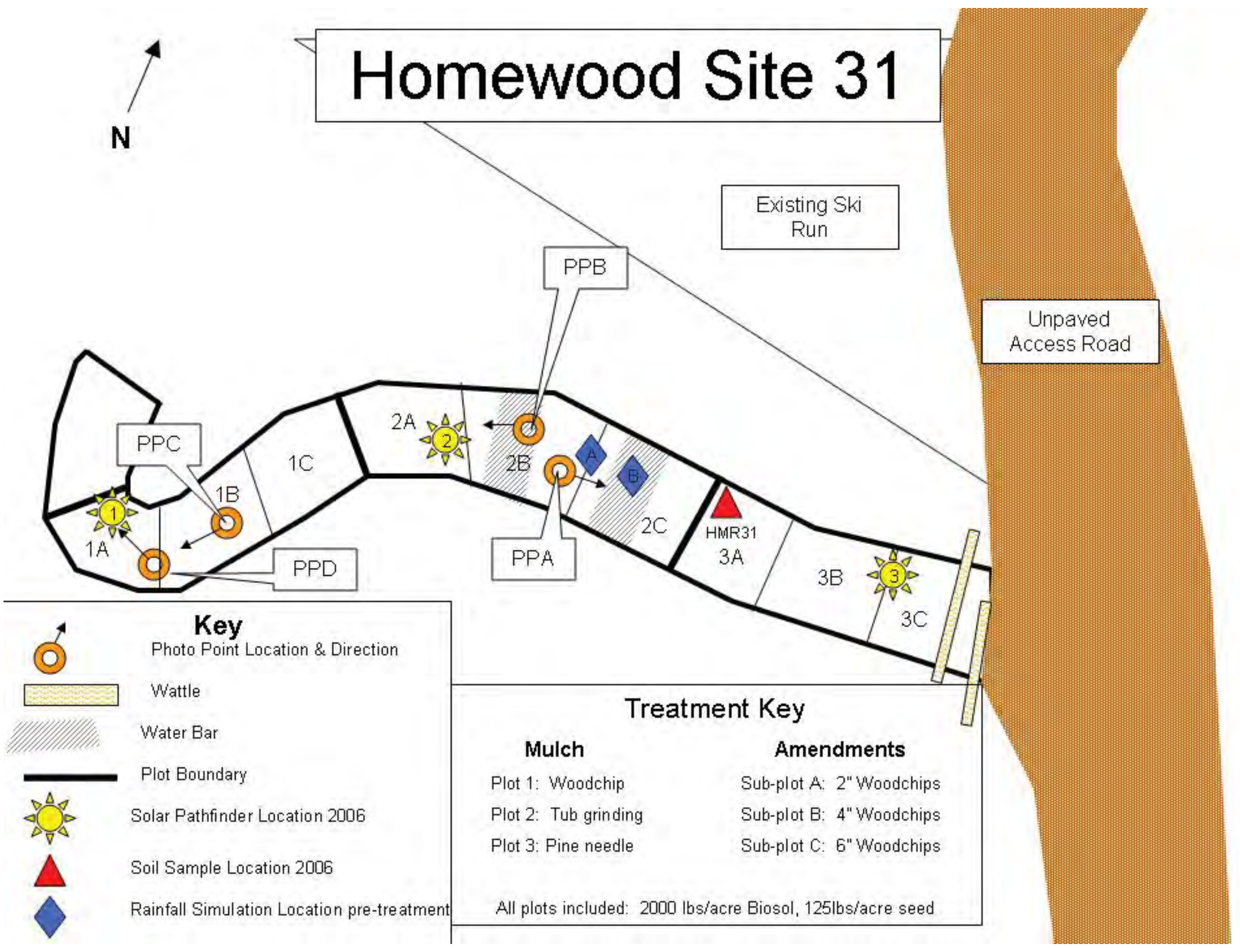


Figure 8. Site 31 Treatment and Monitoring Map. This old road was divided into 3 plots with different mulch types, which were sub-divided into 3 different treatment areas with different amendment rates.

The woodchips were tilled into the soil using the bucket of a full size excavator to a depth of at least 12”. Biosol organic fertilizer was applied at a rate of 2000 lbs/acre. The fertilizer was then hand raked to a depth of approximately 2 inches. The IERS Upland seed was applied at a rate of 125 lbs/acre (Table 1). The seed was lightly raked into the soil with a spring rake. The three different types of mulch were then applied at the appropriate plots to a depth of 2 inches. Mulch was applied so that at least 98% of the area was covered. Cover was occularly estimated. Irrigation was not used.

Table 1: Upland Seed Mix

Common Name	***Scientific Name***	**% Pure Live Seed**
Squirreltail	*Elymus elymoides*	30.5%
Mountain Brome (Bromar)	*Bromus carinatus*	28.8%
Blue Wildrye (Stan 5000)	*Elymus glaucus*	21.8%
Bitterbrush	*Purshia tridentata*	8.7%
Blue Wildrye (Eldorado)	*Elymus glaucus*	6.1%
Greenleaf Manzanita	*Ceanothus velutinus*	1.3%
Sulfur flower buckwheat	*Eriogonum umbellatum*	1.3%
Wax currant	*Ribes cereum*	1.2%
Basin Big Sagebrush	*Artemisia tridentata*	0.2%

Lower Lombard

The Lower Lombard site covers 3,500 square feet and was divided into two plots, plot A and plot B (Figure 9). Plot A is located on the upper third of the site and is approximately one third the size of the entire site at 1,167 square feet. Plot B occupies the lower two thirds of the site and is approximately 2,333 square feet. Tub grindings were spread over both plots to a depth of two inches. A compost-type material[1] (a blend of organic materials prepared at the Truckee Teichert yard) was then spread one inch thick over Plot A. The tub grindings and 'compost' material were tilled into the soil using the bucket of a mini excavator to a depth of at least 12 inches. Biosol was then applied to the surface of the treatment area at a rate of 2000 lbs/acre. The Biosol was hand raked to a depth of approximately 2 inches. The IERS Upland seed mix was applied at a rate of 125lbs/acre (Table 1). The seed was lightly raked into the soil with a spring rake. Pine needle mulch was applied to both plots at an average depth of 2 inches. Mulch was applied so that at least 98% coverage by ocular estimate was achieved. Irrigation was not used.

[1] This material is prepared per a formula developed by Ulf Griegoliet and tested by IERS. While it is not a compost material per se (it did not go through a thermophillic compost process), it does consist of stable organic matter and is low in available, mineral nitrogen.

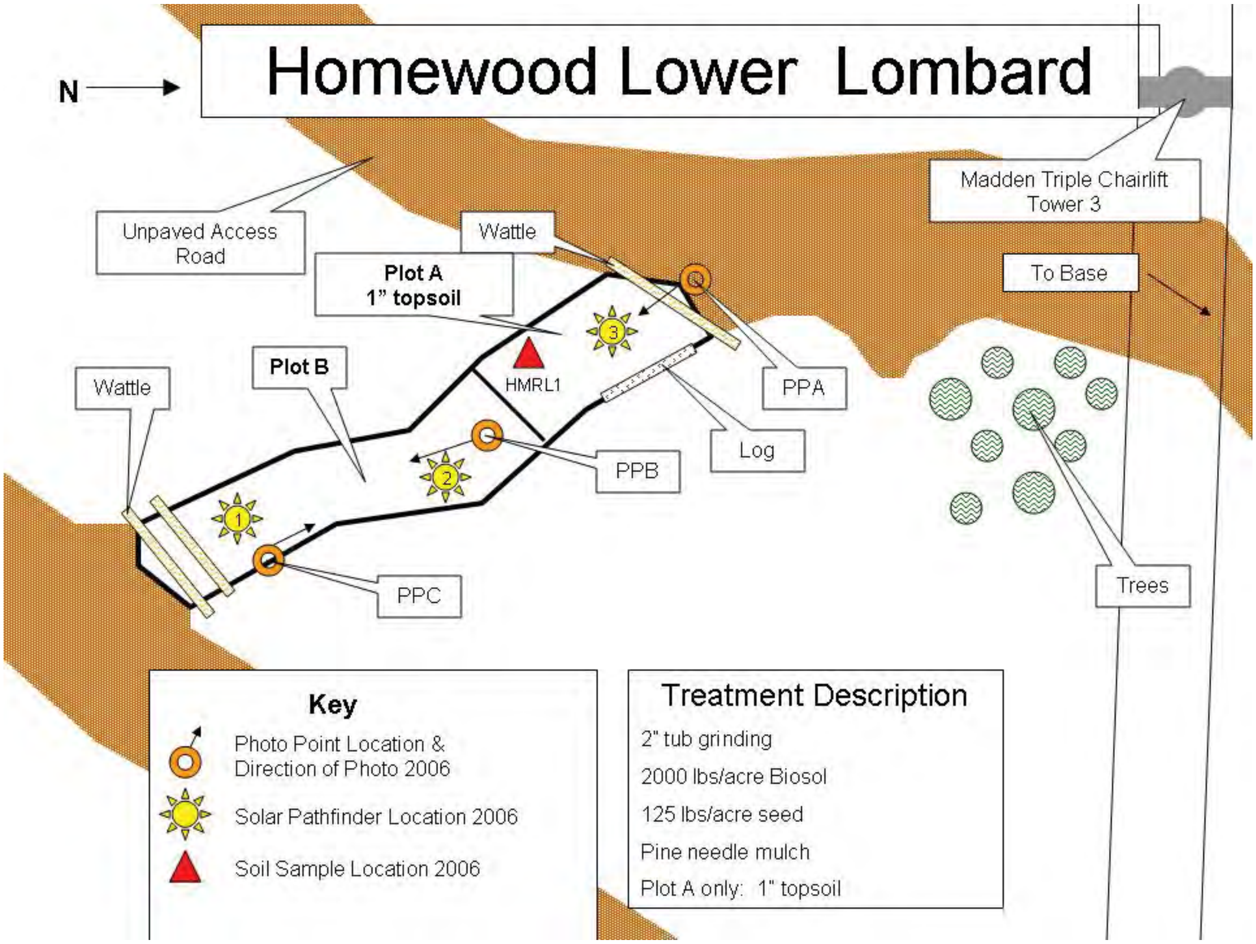


Figure 9. Map of Lower Lombard. Plot A had 1" of topsoil applied in addition to the standard treatment.

Site 37

Site 37 is an abandoned road bed with green leaf manzanita, whitethorn and tobacco brush as the dominant shrubs. While vegetation was well established, the road bed remained highly compacted. Homewood staff mowed the shrub stand to a height of approximately 3 inches and the chips were left on site. IERS staff then applied various applications of wood chips and tilling work was commenced. Snow fell before work was completed. Treatment is slated for completion for the spring of 2007 (Figure 10). The soil in the plots was loosened with tines attached to an excavator bucket to leave the root structure of the established shrubs intact.

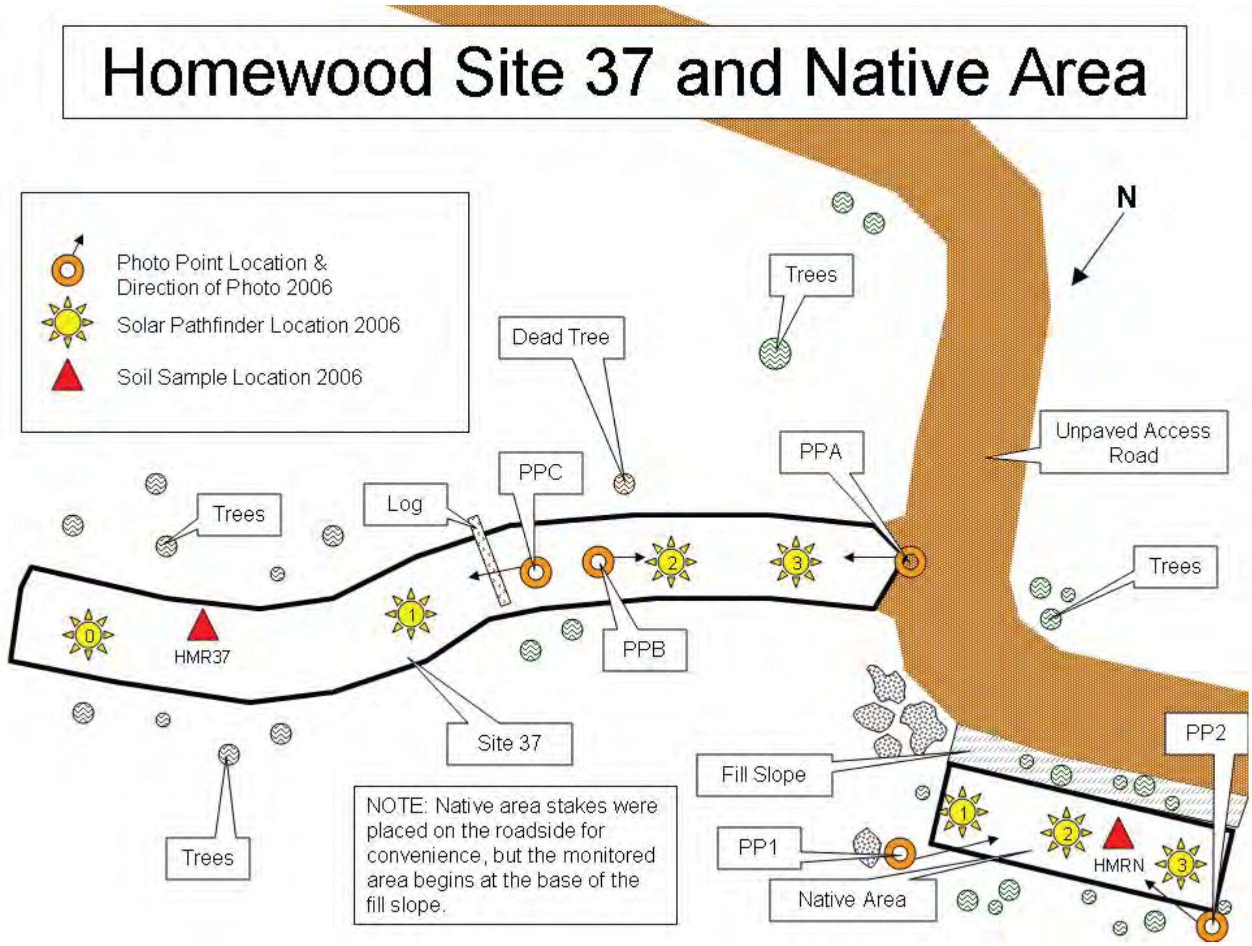


Figure 10. Preliminary Site 37 Treatment Map.

MONITORING

Four sites were monitored in fall 2006: Site 31, Site 37, Lower Lombard (LL), and a native reference site near Site 37 (Figure 10). At each site, soil compaction was measured using an analog cone penetrometer. A penetrometer is a metal rod with a pressure-sensing cone on the tip and a measuring dial on the top. The penetrometer was pushed directly down into the soil until it reached a pressure of 350psi. At this point, the depth it has traveled to, called the depth to refusal (DTR), was recorded. Soil compaction is used as a surrogate measurement for infiltration capacity and erosion potential. Highly compacted soils are associated with low infiltration rates and high sediment yields during storm events.

Soil moisture (percent water content) was measured using a moisture meter which measures volumetric water content at a 4.75 inch depth.

Soil samples were taken at all four monitoring sites to determine pre-treatment nutrient levels. All soil samples were comprised of three composited sub-samples collected from the top 12 inches of the soil horizon. All soil samples were sent to A&L Labs for S3C, a suite of macro and micronutrients as well as organic matter, and total Kjehdahl nitrogen (TKN) nutrient analysis.

Rainfall simulation was conducted at Site 31 pre-treatment and post-treatment. The rainfall simulator “rains” on a three foot square plot from a height of three feet. The rate of rainfall is controlled and the runoff is collected from a trough at the bottom of a frame that captures the runoff. The collected runoff samples are then analyzed for the amount of sediment present.

Figure 11. Rainfall simulator and frame.

Prior to treatment in 2006, soil compaction was measured at each site using a cone penetrometer. All sites, except for the native reference site, were highly compacted, with average DTRs of less than 4”. Following completion of treatment in 2006, penetrometer measurements were taken at Site 31 and Lower Lombard. The mean DTR for Sites 31 and Lower Lombard was measured at 16 inches, suggesting a substantial decrease in soil compaction following tilling (Figure 12).

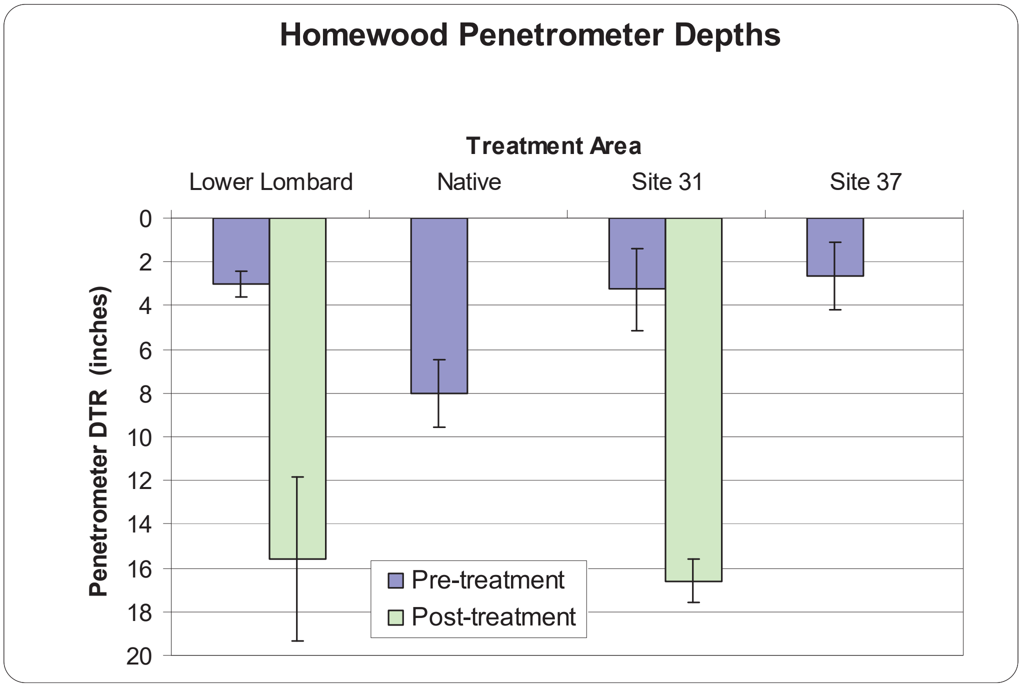


Figure 12. Pre and Post-treatment penetrometer depths. Note that penetrometer depths increased significantly after tilling on both Lower Lombard and Site 31. In both cases, penetrometer depth was greater than the native reference site. Site 37 was not measured in 2006.

Soil moisture was measured pre-treatment at all four sites. The soil moisture levels are within about 4% of each other, with Site 37 having the highest soil moisture of the sites (Figure 13).

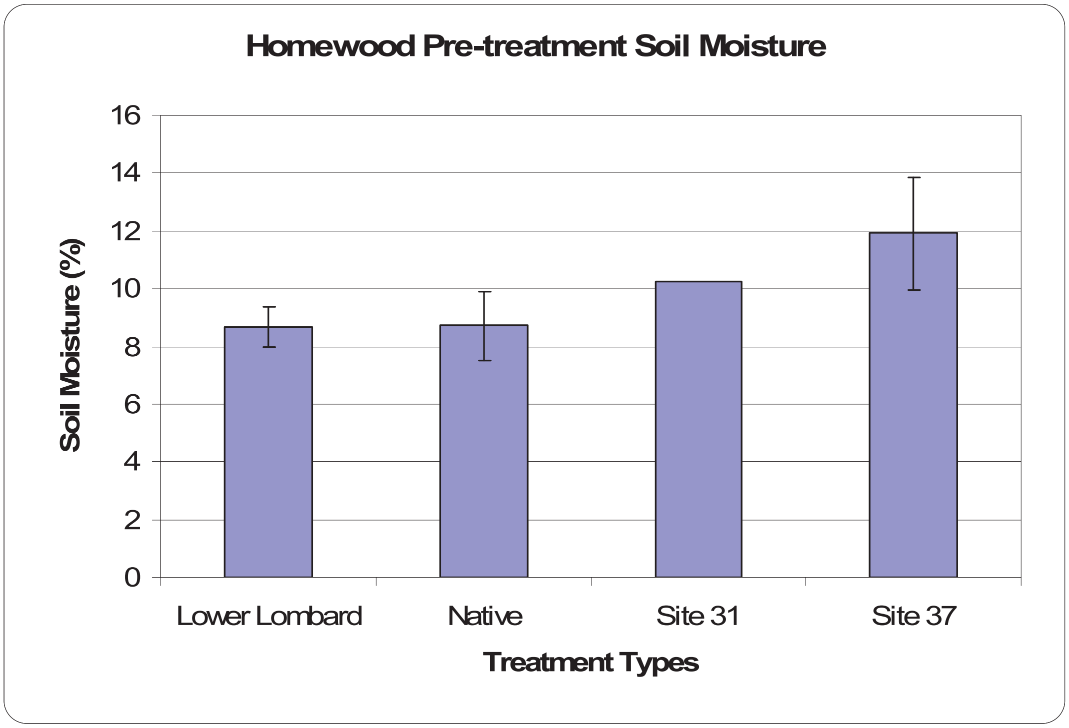


Figure 13. Pre-treatment soil moisture levels. Similar soil moisture levels were found at all the sites.

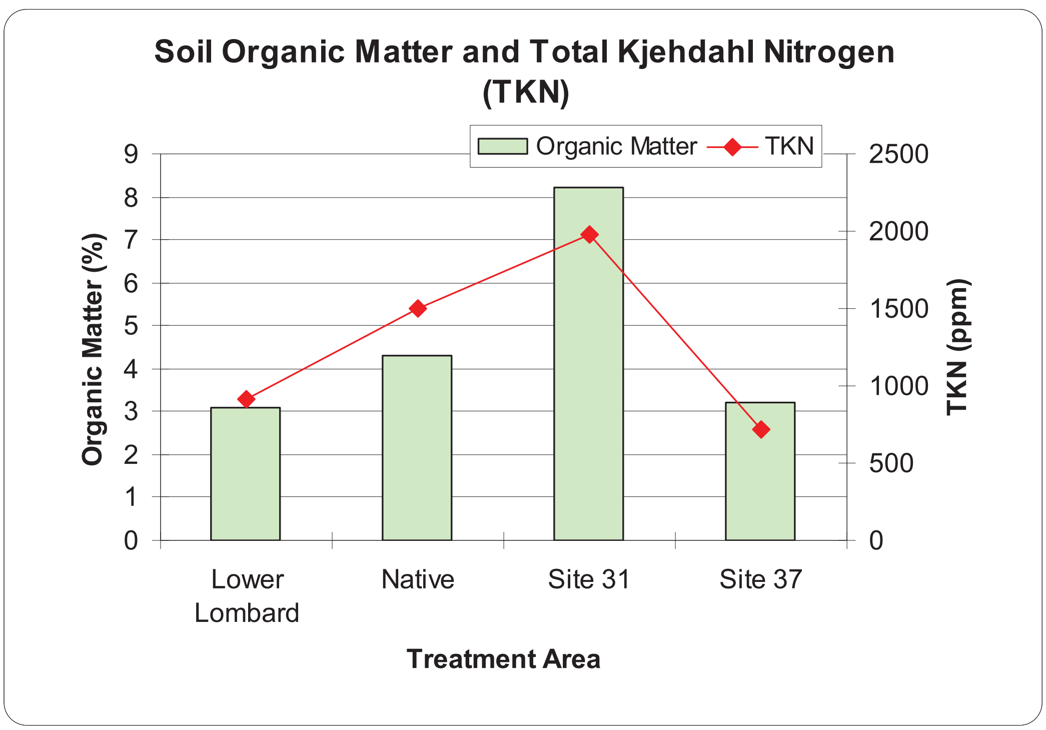


Figure 14. Soil organic matter and TKN. Soil organic matter and TKN were highest at Site 31 and below native reference levels at Lower Lombard and Site 37.

The average organic matter and TKN levels for several native reference sites are presented in Figure 15. Although the organic matter and TKN nutrient levels vary across the different sites in the Tahoe Basin, all of the reference sites have higher nutrient levels than the pre-treatment conditions measured at the three Homewood Mountain treatment sites.

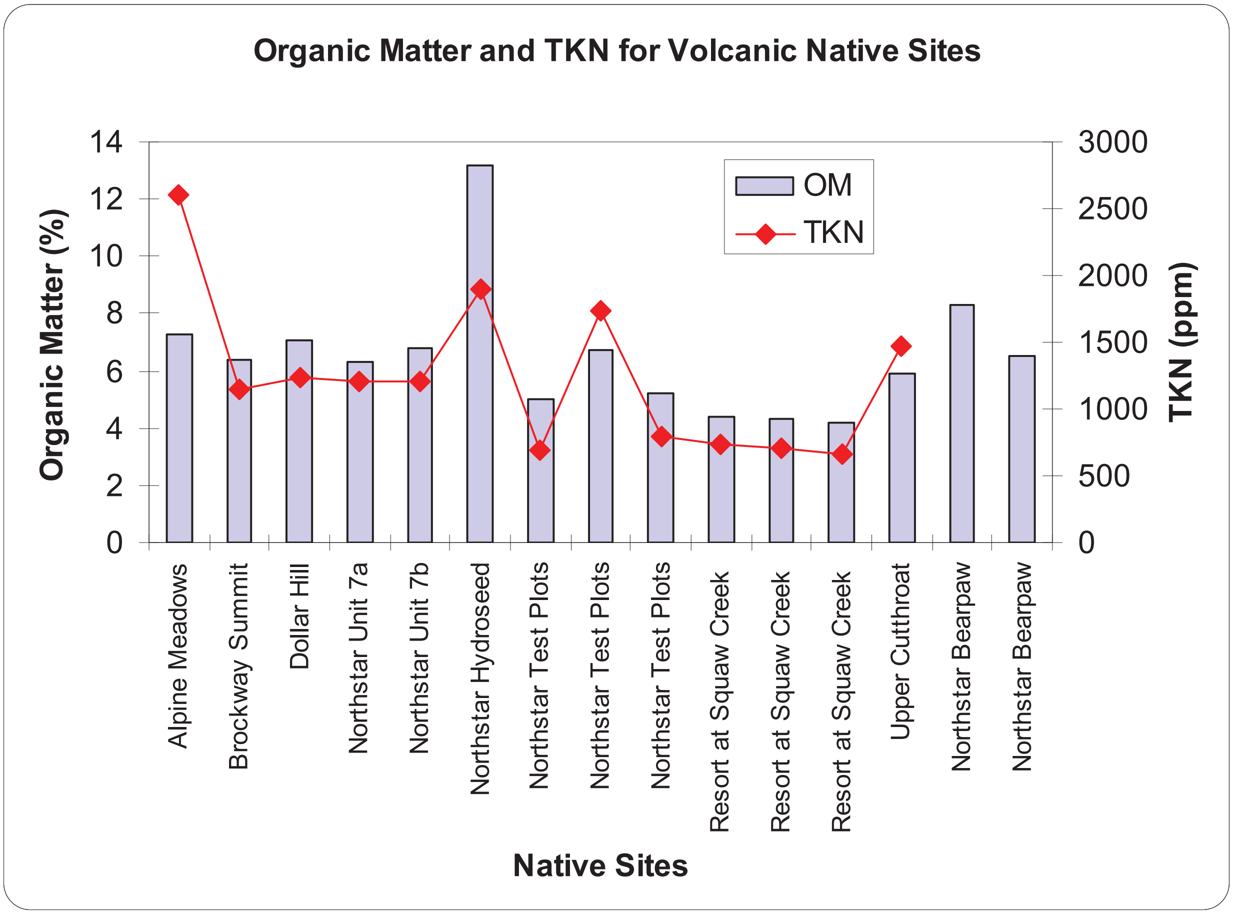


Figure 15. Native reference organic matter and TKN levels. Volcanic soils around the basin showing varying levels of TKN and organic matter.

Soil samples were taken at each treatment site, and a native reference sample was collected for comparison. Soil organic matter and TKN were found to be the highest at Site 31 (Figure 14). Site 31 differed from the other sites in two ways. The lower section of the site had woodchips which had been applied to the surface two seasons ago and were a source of organic matter. Had some wood chips actually been mixed into the soil and had a chance to degrade, a higher level of organic matter would be expected. Site 31 also differed from the other two treatment sites in that the upper section contained a natural seep that fostered more plant growth than observed at the other two treatment sites. The wetter condition and increased plant growth at the upper end of this site would have resulted in increased organic matter and TKN levels due to increased biomass production. The other two treatment areas, Lower Lombard and Site 37, had relatively similar organic matter levels, which, as expected, were lower than the native reference levels.

Rainfall simulations were conducted pre and post-treatment at the shown locations. Two frames were "rained" on during each simulation (Table 1).

Table2. Rainfall simulation time to runoff.

Date	Frame #	Time to Runoff (min:sec)	Avg Depth to Wetting (in)
Pre-treatment 10/24/06	1	2:05	3.5
Pre-treatment 10/24/06	2	13:44	5.5
Post-treatment 11/01/06	1	1:30	0.25
Post-treatment 11/01/06	2	1:50	4.25

Directly following treatments, the runoff times were shorter and the depth to wetting was lower than pre-treatment depths. This can be explained because post-treatment, the wetting front did not reach much below the mulch layer (about a 3" depth). Runoff flowed laterally through the mulch, so it was not possible to measure true infiltration rates post-treatment. Next season, more rainfall simulations will be performed to determine the infiltration rates one year after treatment.

PROJECT GOALS

The following goals were met directly after treatment (Table 3).

Table 3. Project Goals

Goals	Goal achievement
Re-establishment of natural slope contours and drainage patterns to stabilize disturbed soil and reconnect disrupted surface and subsurface hydrology.	• When applicable, treatment areas were re-contoured to match native slope angles.

Goals	Goal achievement
Increasing infiltration rates and soil water holding capacity and decreasing surface erosion by tilling and incorporating organic matter and fertilizer into the soil and applying a native pine needle and/or woodchip mulch.	• Penetrometer depth to refusal measurements, which are an index of infiltration capacity, increased substantially following treatment (see Figure 5). • Ground cover exceeded 98% at all sites by ocular estimate. Increasing infiltration and protecting the soil surface are key steps toward minimizing erosion. • Rainfall simulation will be performed again next season to determine infiltration rates.
Initiate a successional process that leads to diverse, mid-seral, self-sustaining, native grass and shrub plant communities.	• Native seed was incorporated at the sites that lacked vegetation. Next season's monitoring will determine plant cover of the seeded species.

The success criterion was met for average penetrometer depths greater than 12" at 350 psi (Figure 5). The average penetrometer depths range from approximately 15-18 inches.

CONCLUSIONS

Treatment goals were met at all three sites (Table 3). Deep tilling and addition of organic matter decreased soil compaction and added soil organic matter and nutrients. Infiltration is generally increased as soil density decreases. Erosion potential is greatly reduced with ground coverage by mulch of greater than 90%. Baseline monitoring sets the foundation for understanding long term performance trends. This year's data will be compared with data gathered next season to assess the performance of the treatment areas.

RECOMMENDATIONS

- Monitoring, including rainfall simulation should take place during the summer of 2007 after plants have become established so that performance can be assessed.
- Ideally, monitoring will continue for at least 3 years after treatments are completed in order to determine performance trends and cost effectiveness of those treatments.

SUMMARY

A large range of treatments have been installed at HMR during the 2006 season. Those treatments are expected to at least partially define the types of treatments used throughout the mountain for road restoration and removal.

This report links treatment to initial site monitoring. During the 2007 season, additional treatments will be installed and existing treatments will be monitored for function and erosion resistance. The approach is expected to set a new standard of treatment and measurement in the Lake Tahoe Basin.

"Now I know a refuge never grows from a chin in a hand in a thoughtful pose, gotta tend the earth if you want a rose."

Emily Saliers (Indigo Girls)

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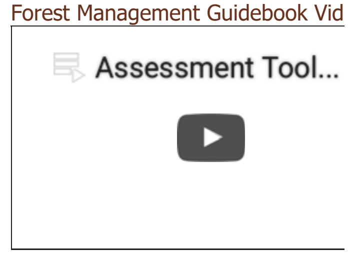
RESEARCH

- Adaptive Management and Effective Implementation of Sediment TMDLs in the Lake Tahoe Basin, USA
- Integrated Monitoring and Assessment of Soil Restoration Treatments in the Lake Tahoe Basin
- Erosion Modeling for Land Management - Scaling from Plots to Small Forest Catchments in the Tahoe Basin
- Evaluation of Revegetation/Mulch Erosion Control Using Simulated Rainfall in the Lake Tahoe Basin:
  - 1. Method Assessment
  - 2. Bare Soil Assessment
  - 3. Treatment Assessment
- Runoff Sediment Particle-Sizes Associated with Soil Erosion in the Lake Tahoe Basin
- Mechanized Mastication Effects on Soil Compaction and Runoff from Forests in the Western Lake Tahoe Basin
- Mechanized Mastication Effects on Soil Compaction and Runoff from Forests in the Western Lake Tahoe Basin
- Soil Nutrients Associated with Revegetation of Disturbed Sites in the Lake Tahoe Basin
- Generation of Water-Stable Soil Aggregates for Improved Erosion Control and Revegetation Success
- Delaying Snowpack Ablation
- A Simultaneous Model for Ultrasonic Aggregate Stability Assessment
- Integrated monitoring and assessment of soil restoration treatments in the Lake Tahoe Basin
- Waddle Ranch Watershed Assessment Phase II

RESOURCES

Forest Management Guidebook

Forest Management Guidebook Vid



- Assessment Tool: Cone Penetrometer
- Assessment Tool: Runoff Simu
- Assessment Tool: Constant He Permeameter
- Assessment Tool: Soil Moisture
- Pile Burning: Part 1
- Pile Burning: Part 2
- Mechanical Treatment

Watershed Management Guidebool

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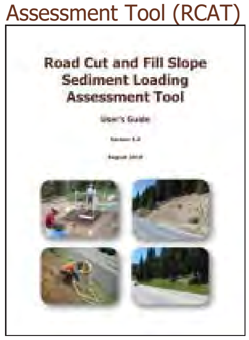
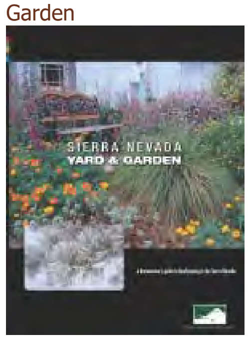
Sediment Source Control Handbook

Road Cut and Fill Slope Sediment Loading Assessment Tool (RCAT)



Sierra Nevada Yard & Garden



Common Ground: Mosaic Landscaping that Prevents Erosion and Minimizes Fire Risk


COMMON GROUND
Learn about easy treatments you can apply around your home to prevent erosion while minimizing fire risk
Create a Mosaic Landscape in your 5 to 30 feet zone

SURFACE WATER QUALITY – QUANTIFICATION OF DESIGN BENEFITS FOR THE BOULDER BAY COMMUNITY ENHANCEMENT PROJECT (CEP) STORMWATER TREATMENT SYSTEM

Overview

Meeting Lake Tahoe water quality improvement targets will require new tools, new approaches and a level of accountability not currently employed. This document describes an existing conditions assessment approach that helps to validate assumptions and sets a robust starting point for what is intended to be a model water quality protection and improvement program for the Lake Tahoe Basin.

Assessments such as this one depend for their accuracy on available data; the types of assumptions made in the calculations and the understanding of the functionality of the treatment elements within the water quality 'treatment train'. We suggest that the process described in this document may be the most robust approach to existing conditions calculations that has been done in the Lake Tahoe-Truckee region. The reason for this claim is that we have used real-time water quality data from the site and we have linked that to actual climate data from wet (including El Nino years) and dry years in order to estimate the variance between types of water years (WYs). We have also used relatively conservative BMP functionality values in order to incorporate some additional confidence in the values stated. This approach, as far as we know, has not been used before and sets a standard that we believe will offer a clear understanding of a starting point for water quality improvement designs.

Perhaps the most important element of our design, besides the robust estimates of performance that this document presents, is the fact that we have designed the system to treat more than the so called 'design storm' or the 20 year-1 hour storm. We recognize that episodic, high flow runoff events typically cause a greater impact than a 1–inch, 1-hour rainstorm, as was experienced in October 2009 where a 2+ inch storm resulted in a great deal of water quality degradation in the Lake Tahoe Basin. We believe, based on a large body of data and observation, that the 20-year /1-hour (20yr/1hr) storm design criteria may be inadequate to meet water quality protection needs and therefore have increased our capacity beyond that.

This document directly addresses the following question:

What is the benefit of the proposed Stormwater Management program (SWMP) for Alternative C vs. implementation of the standard 20yr/1hr design specification? (DEIS Master Comment Response 1)

To provide an answer to this question, the Boulder Bay staff worked with civil engineers at Lumos and Associates and Dr. Mark Grismer PE and Michael Hogan of Integrated Environmental Restoration Services (IERS).

The initial work completed by Lumos and Associates, was the development of a full BMP plan for the Existing Conditions based upon the 20yr/1hr design standard. See Appendix P of the Boulder Bay Community Enhancement Project (CEP) EIS for the stormwater management plan (SWMP) for E20. The E20 SWMP is applicable for Alternatives A, B and E project areas. Additional BMP capacity calculations were completed for the Proposed Project (Alternative C). These calculations are based on a SWMP that includes infiltration galleries, basins and trenches designed to the 20yr/1hr design standard and exclude any accommodation for Washoe County or Nevada Department of Transportation (NDOT) impervious surfaces. The C20 SWMP components are sized to accommodate the on-site infiltration of the 20yr/1hr storm volume. The 20yr/1hr design standard also excludes the use of Low Impact Development (LID) strategies such as pervious pavers, stormwater catchments, biological treatment swales and other dispersed biological treatment facilities and green roofs.

The SWMP proposed for Alternative C (C100) includes components that are sized to accommodate the on-site infiltration of the 50yr/1hr storm volume from the project area and portions of NDOT and Washoe County ROWS, as described on pages 4.3-38 through 4.3-37 of the EIS. Alternative C design proposes LID strategies such as pervious pavers, green roofs, stormwater catchments and biological treatment swales (detailed in Appendix R) that decrease effective coverage, attenuate peak runoff volumes, and increase the SWMP treatment capacity to that of the 100yr/1hr storm volume. Table 4.3-12 presents the supporting calculations for capture and infiltration of the 100yr/1hr storm volume for C100. Table AB-1 in Appendix AB identifies the runoff volume reductions calculated for the proposed LID strategies. For purposes of this supplemental analysis, the 100/yr/1hr storm is modeled for best quantification of the "over and beyond" environmental improvements committed to for TRPA Community Enhancement Program (CEP) participation.

Table 1 presents the comparison of scenarios one, two and three below to C100, represented by scenario four and provides the reader with a clear understanding of the benefits of C100 communicated in terms of volume of untreated runoff that could exit the project area under each of the scenarios:

1. ***Existing Conditions*** – Current project area without 20yr/1hr BMPs installed. This condition was not used for loading comparisons but was included as requested by the League for reference purposes.
2. **E20** - Existing Conditions with 20yr/1hr BMPs installed.
3. **C20** - Alternative C with 20yr/1hr BMPs installed.
4. **C100** - Alternative C with a SWMP design to accommodate project area runoff as well as NDOT and Washoe County ROW runoff, on-site infiltration of the 100 yr/1hr storm volume with the use of LID strategies and the completion of EIP Project #732, Brockway Residential Water Quality Improvement Project.

Boulder Bay does not assume credit for reductions of C100 vs. Existing Conditions. The "over and beyond" of the project is communicated for C100 vs. E20 and C100 vs. C20. Table 1 summarizes the predicted runoff results. For E20, C20 and C100 the SWMP contains all of the project area water in the event of the 20yr/1hr storm. The total runoff including NDOT and Washoe County ROWs for the 20yr/1hr storm is 16,428 cubic feet (CF) for E20, 0 CF for C20 and 0 CF for C100. In the event of the 100-year/1-hour (100yr/1hr) storm event, the total runoff for the including ROWs is 37,920 CF for E20, 21,488 CF for C20 and 0 CF for C100.

Project Area BMP Designs	*Existing Conditions*	E20 Existing Conditions (20 yr Design)***	C20 Alternative C (20 yr Design)	C100 Alternative C (100 yr Design)
BMP Capacity (CF)	500	22,647	39,079	58,152
LID elements (green roofs, pervious pavers, cisterns) (CF)**	none	none	none	12,838
Total Capacity	**500**	**22,647**	**39,079**	**70,990**
20 yr - 1 hr storm Volume (CF)	39,075	39,075	39,075	39,075
Storm Volume Runoff (CF)	38,575	16,428	-4*	-31,915
50 yr - 1 hr storm Volume (CF)	48,844	48,844	48,844	48,844
Storm Volume Runoff (CF)	48,344	26,197	9,765	-22,146
100 yr - 1 hr Storm Volume (CF)	60,566	60,567	60,567	60,567
Storm Volume Runoff (CF)	60,066	37,920	21,488	-10,423

*A negative storm volume runoff represents excess design capacity for the storm event.
**For C100, an estimate of capacity for the LID strategies is included for comparison purposes. The actual capacity varies for the loading calculations depending on antecedent moisture due to previous weather..
***E20 results in runoff for the 20-year storm due to the contribution of NDOT and Washoe County ROW. E20 does not include capacity for theses surfaces.

Table 1. Comparison of total runoff volumes for various designs and storms for project area BMPs/SWMP

Loading Calculations

It is important to note that when stormwater is allowed to run off of the project area, that runoff contains sediment (including fine sediment), nitrogen and phosphorus, the primary elements leading to loss of Lake clarity. It is also critical to understand that the 20yr/1hr storm and the 100yr/1hr storm are design specifications and are not representative of how precipitation and runoff actually occur. In reality, storms often occur in a series, which can result in nearly saturated soils or partially filled storm-water infiltration galleries, tanks or detention basins, thereby reducing conceptual design capacities of storm water management strategies. As a result, we could have a relatively dry year in terms of total moisture, which produces significant runoff because the storms that did occur were abnormally large or occurred in close succession. In order to truly understand the potential for runoff, and as a result the transport of fine sediment, nitrogen and phosphorus, we must model actual data to accommodate the following:

- Multiple storms back-to-back;
- Longer duration storms;
- The timing of storm events (fall, winter, spring); and
- The impact of periodic events such as El Nino years.

In the narrative that follows, we describe how we approached this more robust analysis to both evaluate Alternative C as well as providing an example of how stormwater management options might be better evaluated in the Lake Tahoe Basin.

Methodology

The stormwater management analysis relied on two tracks of information associated in part with some of the Total Maximum Daily Load (TMDL)-related studies of 2007-2008. First, IERS assembled the event sediment concentration measurements by JBR & Assoc. on behalf of Boulder Bay and combined those with the more complete runoff, sediment, nutrients and flow measurements completed by Desert Research Institute (DRI) (Heyveart et al., 2008) (Attachment A) for 2007. The DRI study included the Biltmore sampling site (BM) that includes roughly half of the Boulder Bay project area (8.6 acres). Complete flow and concentrations measurements were captured by DRI for 12 storm events through January 2008. The second track of information was from the LSPC modeling coefficients[1] (sediment loading factors per unit runoff) for the land-use categories identified by DRI for the Crystal Bay area. The complete flow/concentration hydrographs measured by DRI enabled calculation of the total runoff and sediment loads (as well as nutrient loads) from each storm event measured. Comparison of the event and annual sediment loads predicted from LSPC loading factors with that measured by DRI enabled re-calibration of the LSPC-based sediment loading factors; resulting in a net increase of these factors by approximately 3.6 (see Figure 1 below). Also, the JBR event grab sampling data for 2008-09 (Appendix P of the Boulder Bay CEP Project EIS) was found to be consistent with the more complete DRI data. By using the LSPC coefficients approach, IERS was able to develop loading coefficients that were specific to the land use categories included in the Boulder Bay project area as well as consistent with the significant amount of independent loading data available from DRI. The coefficients could then be matched to a routing model specifically developed for the Boulder Bay water quality plan. This model allowed IERS to evaluate individual days and years of actual rain data to determine how the system would perform under dry, wet and El Nino water years as opposed to simply looking at aggregated averages.

The proposed project area (Alternative C) includes the more natural "park" area and slopes associated with the site of the former Tahoe Mariner. IERS has developed the runoff and sediment loading factors associated with soil restoration of such disturbed areas based on several years of rainfall simulation studies. With the revised LSPC sediment loading factors per urban land-use categories combined with the IERS developed factors for the pervious "park" area, IERS developed net sediment loading factors for the entire proposed project area enabling determination of the net sediment and nutrient loads that might be expected for a particular runoff event from the project for each of the four scenarios Existing Conditions, E20, C20 and C100. Because DRI data is not available for fine sediment particles (FSP) as a concentration of storm water runoff, a range of FSP as a percent of total sediment (TSS) was used based on IERS and JBR field-monitoring data. Field monitoring of disturbed soils runoff indicates FSP load is >50% of TSS load for granitic soils and

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[1] LSPC refers to the Load Simulation Program in C++, the modeling program that was used to determine load reduction potential for the Lake Tahoe Total Maximum Daily Load (TMDL) study which the authors of this paper participated in. **http://www.epa.gov/athens/wwqtsc/html/lspc.html**

the JBR data reported levels as high as 90%. For modeling and reporting purposes, FSP <20 microns are reported as 60-90% of total sediment load[2].

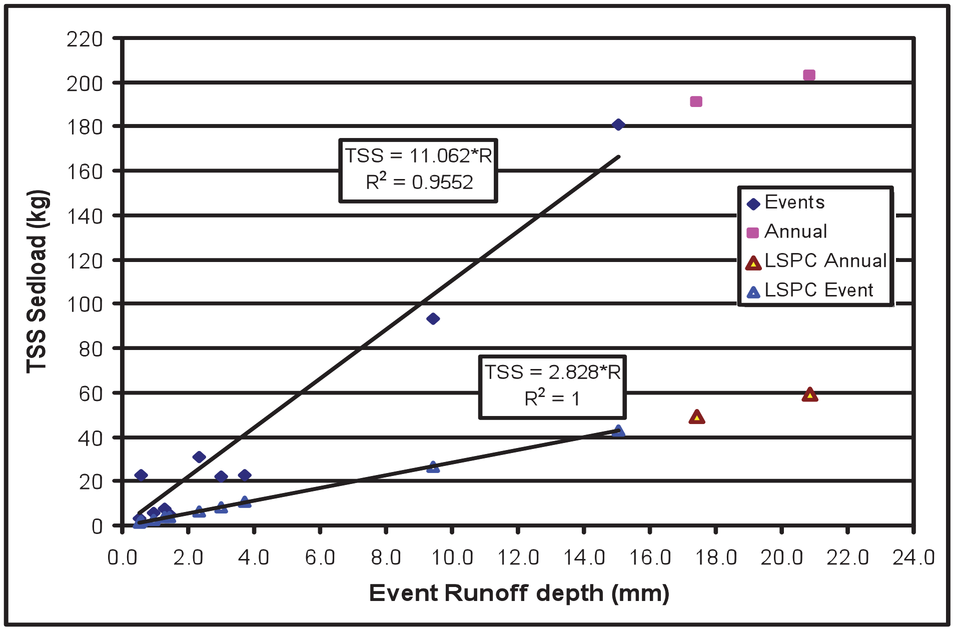

Figure 1. Relationship between event and annual sediment loading and runoff for LSPC based factors and that measured by DRI.

Using the DRI data for the BM site, regressions (see Figure 2 below) between event sediment loads (kg) and nutrient loads (g) enabled computation of nutrient loads per runoff event as well. Although only nine points per regression are apparent in Figure 2, each point represents the cumulative nutrient mass from multiple samples collected during the runoff hydrograph such that a total mass per event could be determined. Such complete data is rarely available in the Lake Tahoe Basin, much less used for loading analyses and is more than adequate to develop a robust correlation. As with any predictive model, the robustness of these coefficients will increase as more users collect rainfall and sediment data from other sites.

The second part of the analysis involved developing a routing/water-balance model of stormwater runoff from the project area using rainfall records from the Tahoe City National Weather Service (NWS) station (TAC) data. We considered runoff from the Existing Conditions, E20, C20 and C100 conditions as described above for comparison purposes.

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[2] TMDL literature has published different estimates for the appropriate threshold for characterization of FSP. Early analysis reported a particle size of 8-10 microns as the particle size responsible for light scattering and thus loss of lake clarity. More recent estimates have increased this particle size estimate to <16 microns and <20 microns in order to increase the relevant population of particles within the TSS defined as FSP; the larger the population, the more restrictive the requirement for treatment. For purposes of this study, IERS used the largest population <20 microns and thus the most conservative requirement.

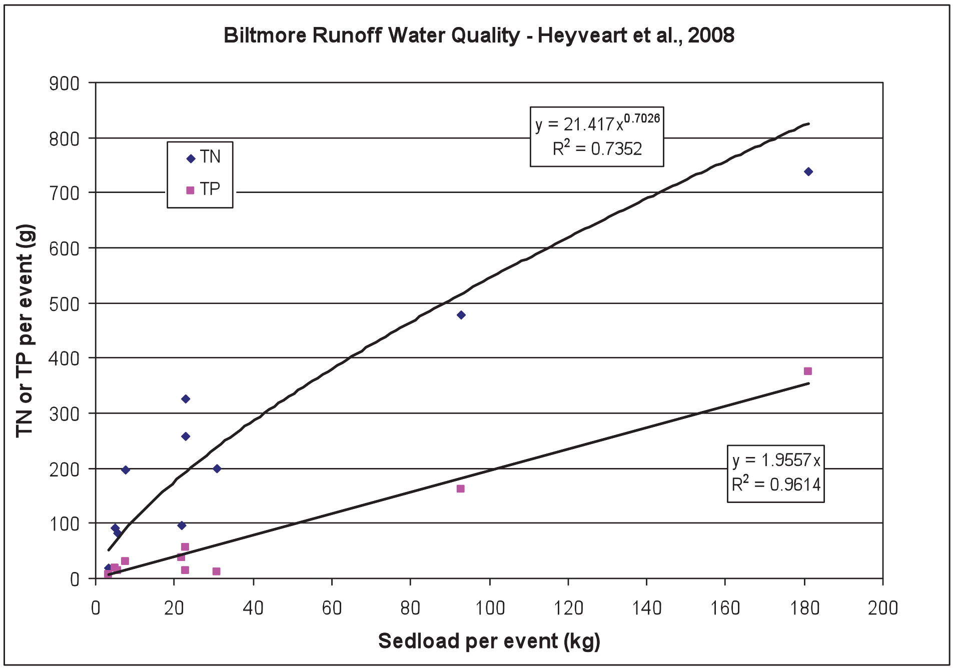


Figure 2. Relationship between nutrient and sediment loads in runoff per event in 2007-08 WY.

Annual stormwater infiltration, storage and runoff quantities are obviously affected by daily changes in rainfall, snowmelt and available facility capacities throughout the year, with generally less "capacity" available during spring snowmelt periods due to nearly saturated soils and/or during sequential storm periods. We examined the rainfall records used in the previous TMDL analyses (1993-2004) and identified the 1993-94 and 1994-95 WYs as "dry" and "very-wet" years, as well as 2007-08 and 2005-06 as more recent similarly "dry" and "wet" WYs, respectively. We also included 1997-98 WY as a representation of the most recent El Nino year as requested by the League. Net annual precipitation for these WYs are 15.9 and 61 inches, 13.4 and 47.4 inches, and 44.6 inches, respectively, as compared to a long-term average annual precipitation at Tahoe City of approximately 31 inches[3]. Additionally, the storm distributions during each of these WYs vary, which in turn affects the amount of runoff and sediment loading generated. To provide a graphical sense of this variation, Figure 3 illustrates the cumulative rainfall for these four WYs as well as 2008-09; steeper step-wise increases are associated with repeated storm events. Note that the rainfall of recent "dry" WYs is similar to the 1993-94, though more rapid accumulations of precipitation occur early, mid and later in the WY. Similarly, though the Thanksgiving to New Years rains of 2005 were substantial and resulted in significant stormwater contamination and slope failures in and around the Lake Tahoe and Truckee region, the net accumulation is less than that of the 1995 WY.

[3] These data illustrate that simply using an average annualized data set over a number of WYs could be misleading since a low precipitation year will usually produce a much smaller potential to move and deliver sediment while a very wet WYs tends toward much higher sediment movement, which is not captured in the 'average' value.

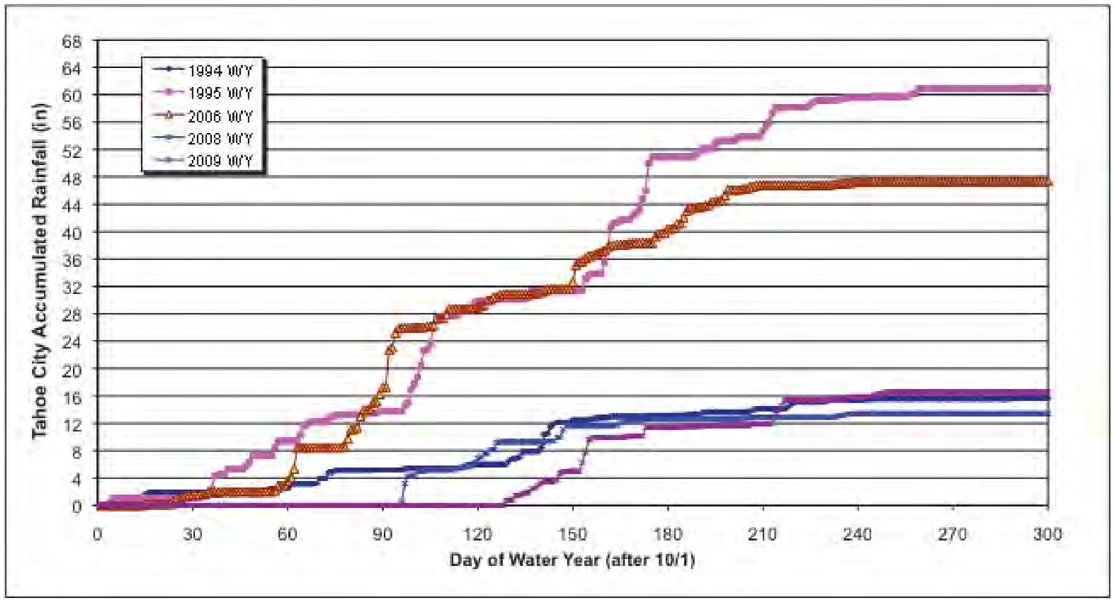
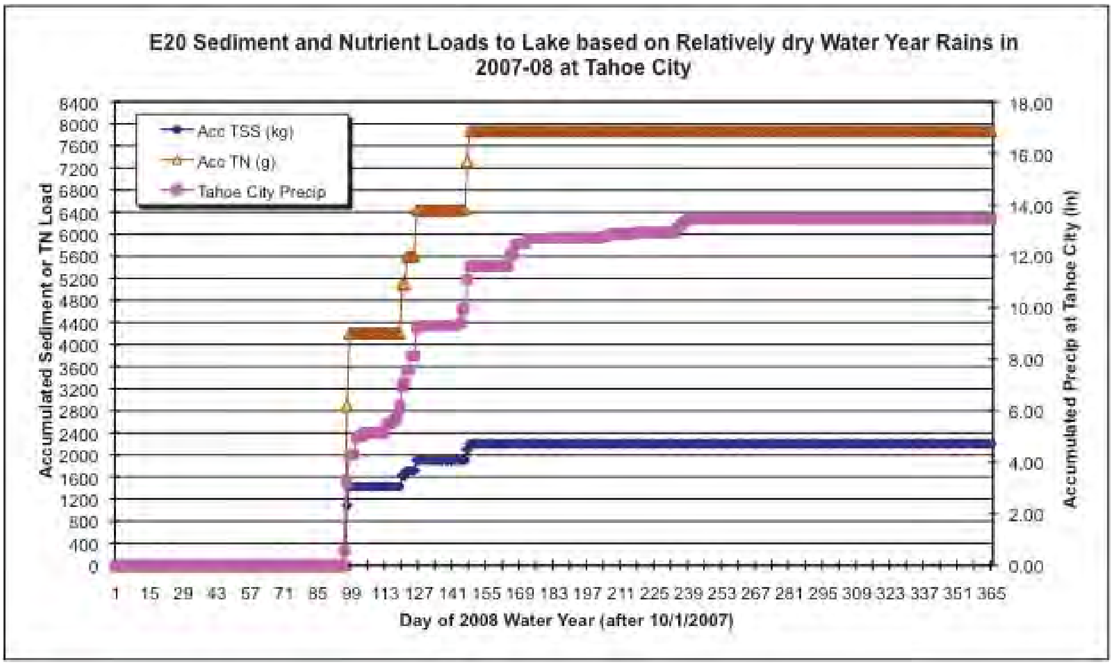


Figure 3. Accumulated rainfall at Tahoe City NWS gage for wet and dry WYs used in analysis.

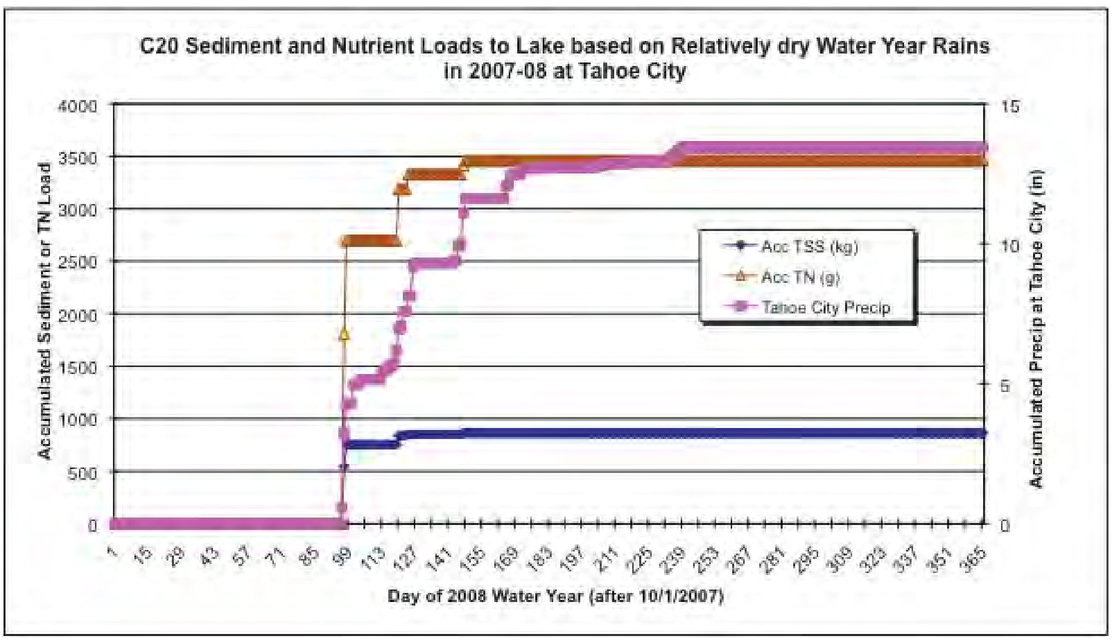
IERS modeled the capture and possible runoff from a daily time-step for the 1994, 1995, 1998 2006 and 2008 WYs to determine sediment and nutrient loadings from the project area for: 1) Existing Condition; 2) before re-development with only 'standard' 20yr/1hr BMPs installed (E20); and 3) after implementation of Alternative C (C20 and C100). The LSPC model quantified the effects of the different SWMP and related sediment loadings to down-gradient drainage and stormwater systems and ultimately to Lake Tahoe for each WY. The modeling included soil storage of stormwater volumes associated with pervious pavers, stormwater catchments, biological treatment swales, green roofs and restored soils of the former Tahoe Mariner "park" site as well as storage capacities summarized above for the three different scenarios considered. Infiltration and soil storage capacities were taken from our measured field data of similar soils, while those for the green roof, pervious pavers, biological treatment swales and stormwater catchments were taken from soils data and available literature on "LID strategies". Results of these modeling efforts are summarized in Tables 2 and 3 below.

Dry Water Years

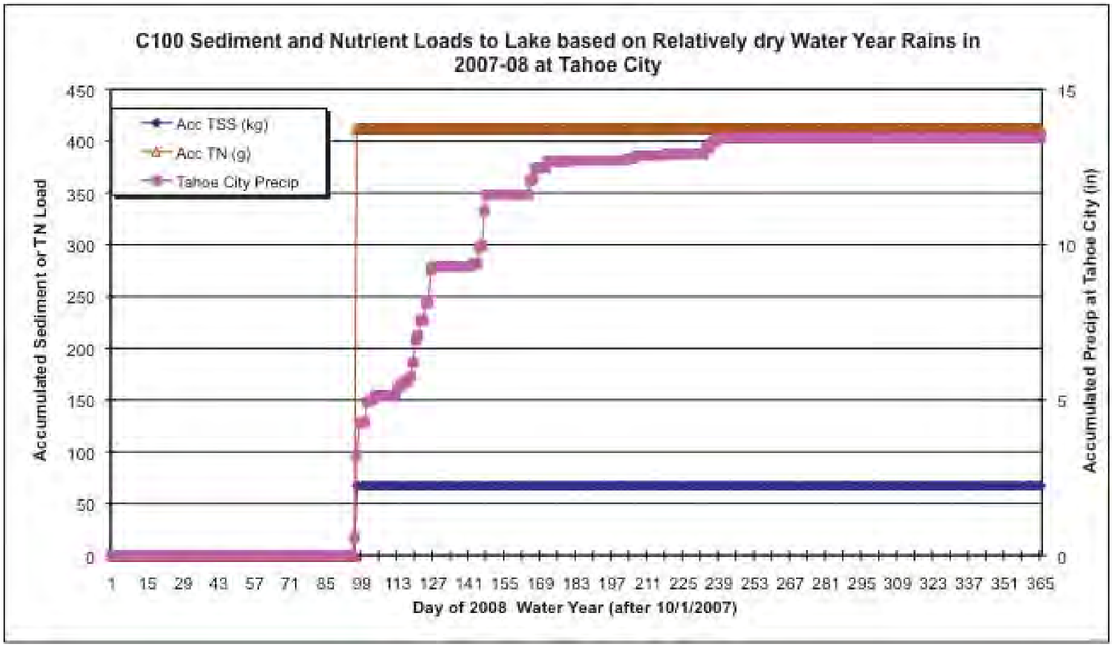
First considering dry WYs and despite a smaller annual precipitation in the 2008 as compared to 1994 WY, sediment and nutrient loadings under E20 are nearly twice as great due to the storm sequencing in 2007-08. Implementation of interim C20 SWMP reduces the loading compared to Existing Conditions in both dry years by roughly half. Implementation of the C100 contains the stormwater runoff completely such that there is minimal to no discharges to down-gradient drainage and stormwater systems and ultimately to Lake Tahoe. That is, ***97-100% of the TSS and FSP removed as compared to E20***. Stormwater runoff from the site occurs on 6-7 days under E20 conditions and 2-6 days for the C20 conditions each dry year. To illustrate the daily variations in loadings see Figure 4 as an example of the accumulated daily loadings for the 2008 dry WY. For E20, C20 and C100, a dry year is forecasted contribute 4,374 lbs, 1,714 lbs and 134 lbs of FSP respectively (ranges are provided in Table 2 and 3).


E20 Sediment and Nutrient Loads to Lake based on Relatively dry Water Year Rains in 2007-08 at Tahoe City
Acc TSS (kg)
Acc TN (g)
Tahoe City Precip
Accumulated Sediment or TN Load
Accumulated Precip at Tahoe City (in)
Day of 2008 Water Year (after 10/1/2007)

(4a)


C20 Sediment and Nutrient Loads to Lake based on Relatively dry Water Year Rains in 2007-08 at Tahoe City
Acc TSS (kg)
Acc TN (g)
Tahoe City Precip
Accumulated Sediment or TN Load
Accumulated Precip at Tahoe City (in)
Day of 2008 Water Year (after 10/1/2007)

(4b)



(4c)

Figure 4. Accumulated possible sediment and nitrogen loading to the Lake for E20, C20 and C100 under dry year conditions as encountered in the 2007-08 WY.

Water Balance Model	Existing Conditions	E20 Existing Conditions (20yr/1hr Design)	C20 Alternative C (20yr/1hr Design)	C100 Alternative C (100yr/1hr Design)
Possible Loads to Lake for Wet Water Year (1994-95) - Annual ppt = 61 inches (EL NINO)**				
Total Sediment captured relative to E20 (lb)	NA	NA	12,743	28,365
Total Fines* captured relative to E20 (lb)	NA	NA	11,468	25,528
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	24.9	55.5
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	40.7	94.9
Total Sediment in Runoff (lb)	52,825	32,267	19,524 (-40%)	3,902 (-88%)
Fine Sediment* in Runoff (lb)	31,695 – 47,542	19,360 – 29,040	11,715 – 17,572	23,41 – 35,12
Total Phosphorous in Runoff (lb)	103.3	63.1	38.2	7.6
Total Nitrogen in Runoff (lb)	192.1	108.9	68.3	14.0
Possible Loads to Lake for Wet Water Year (1997-98) - Annual ppt = 44.6 inches (EL NINO)**				
Total Sediment captured relative to E20 (lb)	NA	NA	3,935	16,060
Total Fines* captured relative to E20 (lb)	NA	NA	3,541	14,453
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	7.7	31.4
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	15.0	56.9
Total Sediment in Runoff (lb)	40,271	17,430	13,496 (-22%)	1,371 (-92%)
Fine Sediment* in Runoff (lb)	24,163 – 36,244	10,458 – 15,687	8,097 – 12,146	823 – 1,234
Total Phosphorous in Runoff (lb)	78.8	34.1	26.4	2.7
Total Nitrogen in Runoff (lb)	152.8	63.3	48.3	6.4
Possible Loads to Lake for Dry Water Year (1993-94) - Annual ppt. = 15.9 inches**				
Total Sediment captured relative to E20 (lb)	NA	NA	1,126	2,695
Total Fines* captured relative to E20 (lb)	NA	NA	1,014	2,426
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	2.2	5.3
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	4.9	10.6
Total Sediment in Runoff (lb)	12,245	2,695	1,569 (-41%)	0 (-100%)
Fine Sediment* in Runoff (lb)	7,347 – 11,021	1,617 – 2,426	942 – 1,412	0 - 0
Total Phosphorous in Runoff (lb)	23.9	5.3	3.1	0.0
Total Nitrogen in Runoff (lb)	56.7	10.6	5.7	0.0

Table 2. Comparisons of sediment and nutrient loadings possible to Lake from project area before and after re-development for dry (1993-94), very-wet (1994-95) and El Nino (1997*1998) years. Existing Conditions without 20yr/1hr BMP Design provide for reference.

Water Balance Model	Existing Conditions	E20 Existing Conditions (20yr/1hr Design)	C20 Alternative C (20yr/1hr Design)	C100 Alternative C (100yr/1hr Design)
Possible Loads to Lake for Wet Water Year (2005-06) - Annual ppt. = 47.4 inches**				
Total Sediment captured relative to E20 (lb)	NA	NA	9,902	20,921
Total Fines* captured relative to E20 (lb)	NA	NA	8,912	18,829
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	19.4	40.9
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	33.7	69.0
Total Sediment in Runoff (lb)	40,569	22,883	12,981 (-43%)	1,962 (-91%)
Fine Sediment* in Runoff (lb)	24,341 – 36,512	13,730 – 20,595	7,789 – 11,683	1,177 – 1,766
Total Phosphorous in Runoff (lb)	79.3	44.8	25.4	3.8
Total Nitrogen in Runoff (lb)	151.6	76.0	42.3	6.9
Possible Loads to Lake for Dry Water Year (2007-08) - Annual ppt. = 13.4 inches**				
Total Sediment captured relative to E20 (lb)	NA	NA	2,956	4,712
Total Fines* captured relative to E20 (lb)	NA	NA	2,660	4,240
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	5.8	9.2
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	9.7	16.4
Total Sediment in Runoff (lb)	11,091	4,860	1,904 (-61%)	148 (-97%)
Fine Sediment* in Runoff (lb)	6,655 – 9,982	2,916 – 4,374	1,142 – 1,714	89 - 134
Total Phosphorous in Runoff (lb)	21.7	9.5	3.7	0.3
Total Nitrogen in Runoff (lb)	45.7	17.3	7.6	0.9

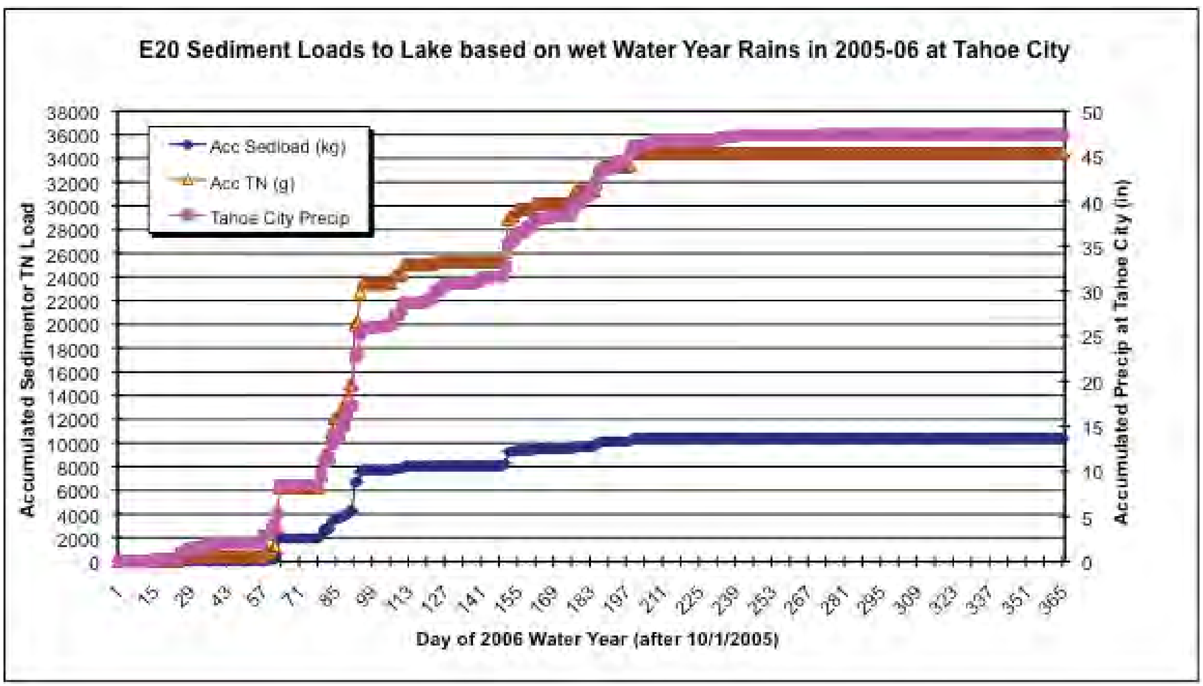
* Assuming fine sediment particles (FSP) <20 microns are 60-90% of total sediment load.
Field monitoring of disturbed soils runoff indicates FSP load is >50% of total sediment load for granitic soils.

** Based on Tahoe City daily rainfall that is greater than that at Crystal Bay

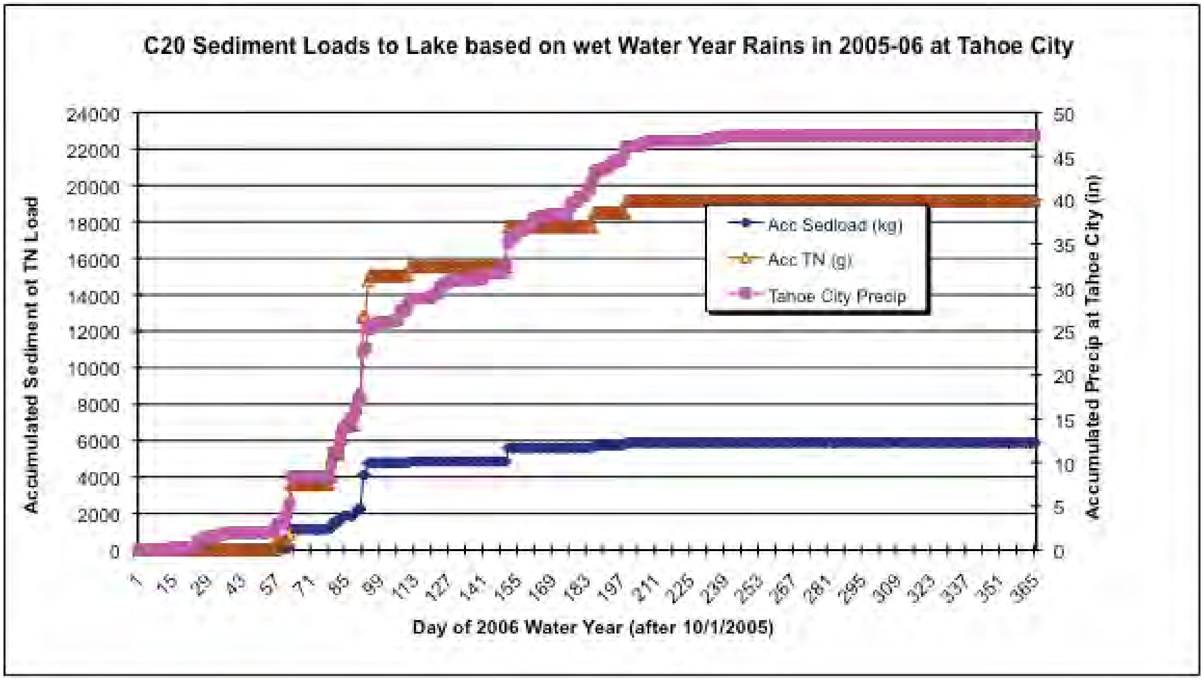
Table 3. Comparisons of sediment and nutrient loadings possible to Lake from project area before and after re-development for dry (2007-08) and wet (2005-06) WYs. Existing Conditions without 20yr/1hr BMP Design provide for reference.

Wet Water Years

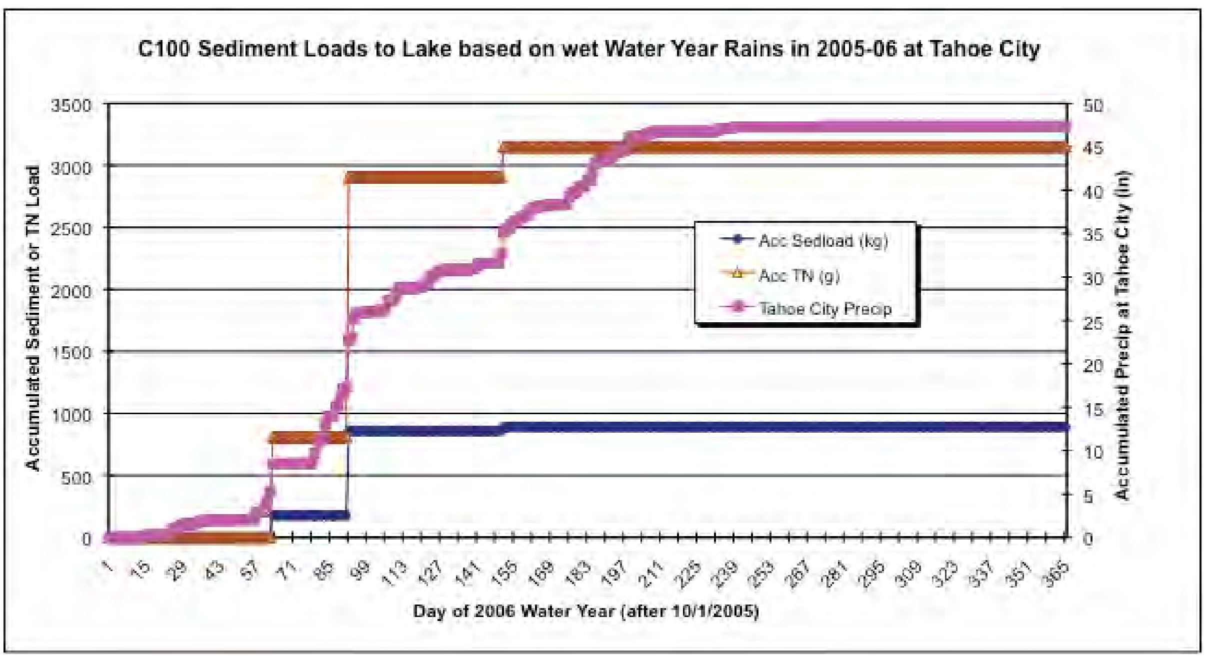
During the wet WYs; E20 conditions result in possible discharge of approximately 17,000 to 32,000 lbs of total sediment, 14,000 to 29,000 lbs of fine sediment, 34 to 63 lbs of total phosphorous and 63 to 109 lbs of total nitrogen leaving the project area. The intermediate strategy of C20 only reduces the loading compared to E20 by roughly 23-43% to ranges of 13,000 – 19,000 lbs total sediment, 8,000 to 18,000 lbs of fine sediment, 25 – 38 lbs total phosphorous and 42 – 68 lbs total nitrogen. C100 implementation reduces loadings compared to existing conditions by roughly 88% to 92% to ranges of 1,400-3,900 lbs total sediment, 800 to 3,500 lbs of fine sediment, 3 – 8 lbs total phosphorous and 6 – 14 lbs total nitrogen. Stormwater runoff from the project area occurs on 34-42 days under E20, 16-27 days for C20 and 3-5 days for C100 each wet WY. Stormwater runoff from the project area occurs under C100 conditions only for a substantial rain-on-snow event of 5.37 inches on New Year's eve of 2005 and after sequential ~ 2 inch rain-on-snow days in January 1995. For comparison purposes, recall that the 20yr/1hr design storm event is 1.0 inch while the 100yr/1hr storm event is estimated at 1.55 inches. Analogous to Figure 4, Figure 5 illustrates the accumulated daily variation in possible loadings for the three scenarios considered for the 2005-06 WY. Similar such figures can be generated for the 1994-95 and 1997-98 WYs as well.



(5a)



(5b)

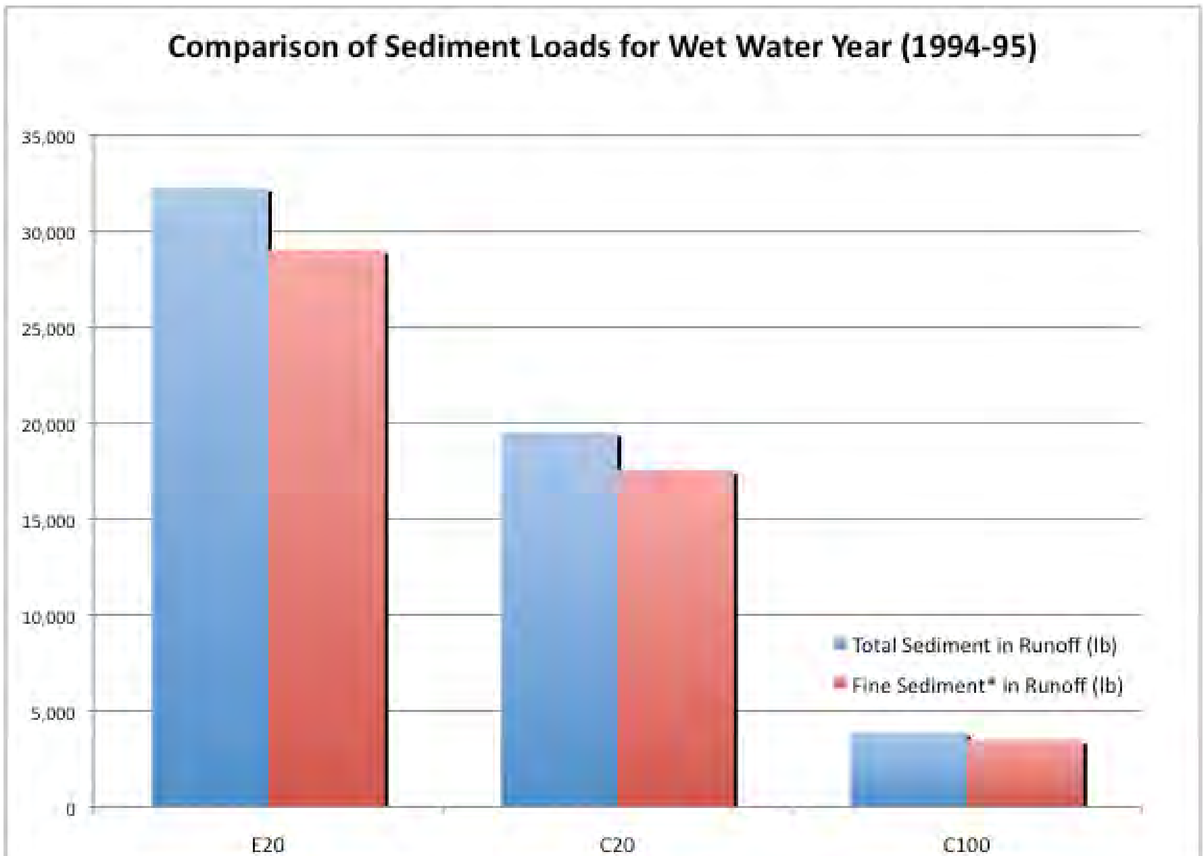


(5c)

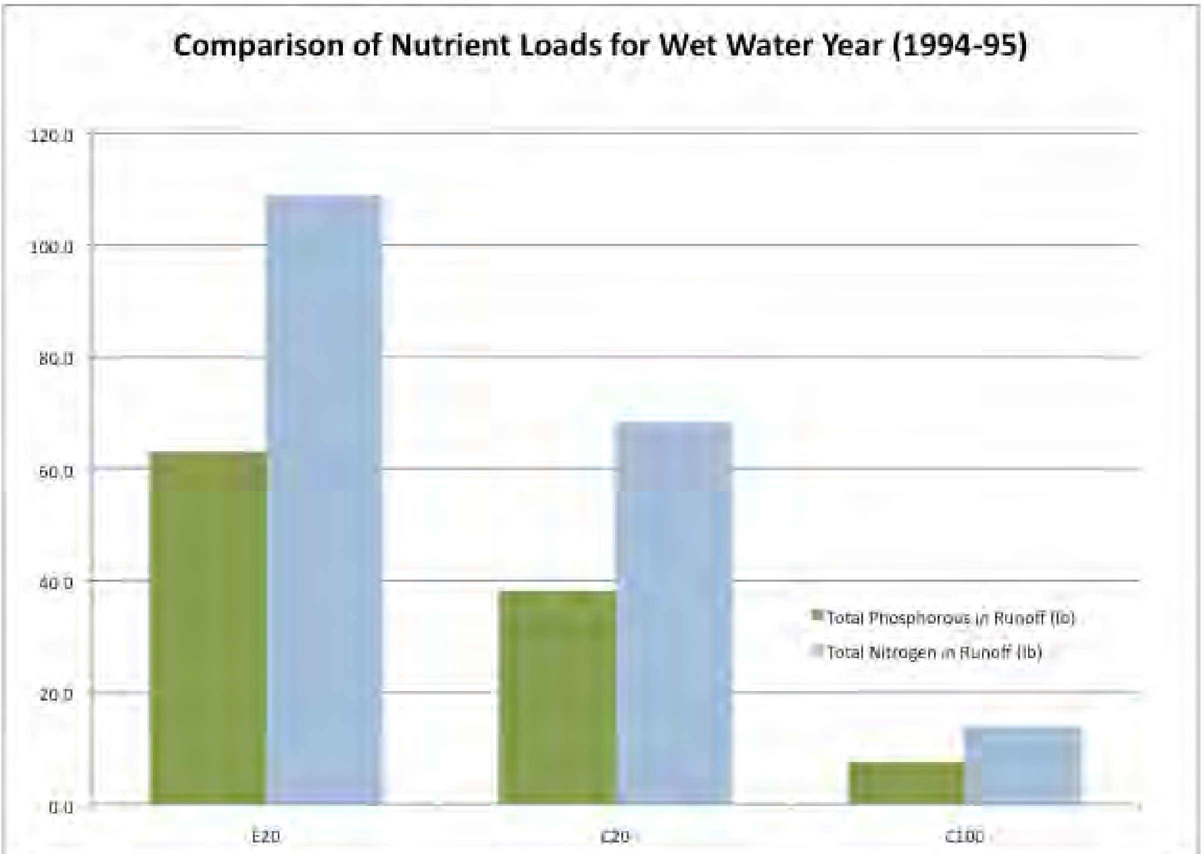
Figures 5. Accumulated sediment and nitrogen loading to the Lake under wet year conditions as encountered in the 2005-06 WY for E20, C20 and C100.

Summary

The runoff and treatment efficiency that can be expected from Alternative C is presented here in a manner that has not been done previously. Using real time, measured runoff data from 12 storms, and actual climate data for a range of years and conditions, we have calculated runoff from existing conditions and compared that to other treatment levels and storm events. While simple summary statements are difficult to make, given the complexity of storms, antecedent soil moisture conditions and other variables, the data shows that in wetter years, which represent worst-case scenarios, both total sediment and total nitrogen output for C100 is over an order of magnitude (10x +) less than those produced by E20 .



(6a)



(6b)

Figures 6. Comparison of Annual Loading for E20, C20 and C100 Scenarios, Wet WY 1994-1995.

Attachment A

Brockway Project Area Stormwater Runoff and Characterization Study
Desert Research Institute
Heyveart et al., March 28, 2008

(Selected Tables)

Table 4. Primary runoff events at Brockway ECP sampled for water quality.

Site	Runoff Event #	Runoff Start (Date Time)	Runoff End (Date Time)	Runoff Duration (hh:mm)	Type of Runoff	Runoff Volume (cf)	Peak Flow (cfs)	Sample Pacing	Samples Collected	Singles Analyzed	Composites Analyzed	Sampling Quality
Biltmore	01	12/26/06 19:05	12/27/06 1:50	6:45	event snowmelt	2,869	0.34	250cf	12	0	3	good
Speedboat	01	12/26/06 20:55	12/27/06 1:45	4:50	event snowmelt	3,904	0.54	250cf	16	0	3	good
Beach Access	01	12/26/06 21:20	12/26/06 22:55	1:35	event snowmelt	84	0.03	25cf	4	0	1	good
Lake Street	01	12/26/06	na	na	event snowmelt	na	na	grabs	2	2	0	good
White Cap	01	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	02	1/3/07 21:40	1/4/07 10:15	12:35	rain on snow	4,561	0.25	250, 400cf	16	1	2	good
Speedboat	02	1/4/07 1:25	1/4/07 10:05	8:40	rain on snow	5,401	0.33	250cf, 400cf	18	0	2	good
Beach Access	02	--	--	--	no runoff at site	--	--	--	--	--	--	--
Lake Street	02	1/4/07	na	na	rain on snow	na	na	grabs	2	2	0	good
White Cap	02	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	03	2/8/07 19:30	2/10/07 19:35	48:05	rain on snow	11,615	0.82	250, 400cf	24	1	4	good
Speedboat	03	2/8/07 21:00	2/10/07 20:55	47:55	rain on snow	12,104	0.78	250cf	30	1	5	good
Beach Access	03	2/8/07 19:50	2/10/07 19:30	47:40	rain on snow	839	0.08	50cf	27	0	5	good
Lake Street	03	2/9/07	na	na	rain on snow	na	na	grabs	3	3	0	good
White Cap	03	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	04	2/11/07 9:10	2/11/07 17:25	8:15	post event snowmelt	3,665	0.47	250cf	14	1	2	good
Speedboat	04	2/11/07 0:15	2/11/07 19:35	19:20	post event snowmelt	10,028	0.63	250cf	22	0	3	good
Beach Access	04	2/11/07 10:00	2/11/07 16:30	6:30	post event snowmelt	215	0.03	25cf	10	1	2	good
Lake Street	04	2/11/07	na	na	post event snowmelt	na	na	grabs	1	1	0	good
White Cap	04	2/11/07	na	na	post event snowmelt	na	na	grabs	2	2	0	good
Biltmore	05	3/6/07 10:05	3/6/07 17:00	6:55	post event snowmelt	626	0.05	100cf	7	0	3	good
Speedboat	05	3/6/07 11:50	3/6/07 19:25	7:35	post event snowmelt	1,264	0.09	100cf	10	0	3	good
Beach Access	05	3/6/07 11:20	3/6/07 17:20	6:00	post event snowmelt	254	0.02	15cf	4	2	1	good
Lake Street	05	3/6/07	na	na	post event snowmelt	na	na	grabs	3	3	0	good
White Cap	05	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	06	4/22/07 8:20	4/22/07 16:05	7:45	post event snowmelt	4,664	0.45	250cf	11	0	1	good
Speedboat	06	4/22/07 10:05	4/22/07 16:55	6:50	post event snowmelt	5,360	0.64	250cf	12	0	1	good
Beach Access	06	4/22/07 9:40	4/22/07 13:15	3:35	post event snowmelt	215	0.03	20cf	11	0	1	good
Lake Street	06	4/22/07	na	na	post event snowmelt	na	na	grabs	3	3	0	good
White Cap	06	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	07	8/31/07 8:45	8/31/07 11:35	2:50	thunderstorm	711	0.95	250cf	4	1	1	moderate
Speedboat	07	8/31/07 8:45	8/31/07 11:10	2:25	thunderstorm	209	0.20	250cf	1	1	0	moderate
Beach Access	07	8/31/07 8:45	8/31/07 10:35	1:50	thunderstorm	40	0.05	100cf	1	1	0	moderate
Lake Street	07	--	--	--	no runoff at site	--	--	--	--	--	--	--
White Cap	07	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	08	9/22/07 7:50	9/22/07 9:45	1:55	thunderstorm	1,574	0.47	250cf, 105cf	7	0	3	good
Speedboat	08	9/22/07 7:45	9/22/07 10:10	2:25	thunderstorm	1,470	0.41	250cf, 150cf	9	0	3	good
Beach Access	08	9/22/07 7:50	9/22/07 9:20	1:30	thunderstorm	123	0.05	50cf, 25cf	3	3	0	moderate
Lake Street	08	9/22/07	na	na	thunderstorm	na	na	grabs	3	3	0	good
White Cap	08	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	09	10/10/07 4:40	10/10/07 8:15	3:35	event snowmelt	889	0.24	250 cf	5	5	0	good
Speedboat	09	10/10/07 5:40	10/10/07 8:05	2:25	event snowmelt	304	0.08	250cf	2	2	0	poor
Beach Access	09	10/10/07 5:45	10/10/07 6:45	1:00	event snowmelt	73	0.04	25cf	3	3	0	moderate
Lake Street	09	--	--	--	no runoff at site	--	--	--	--	--	--	--
White Cap	09	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	10	10/19/07 19:35	10/19/07 23:45	4:10	rain	1,730	0.40	250cf, 500cf	6	1	2	good
Speedboat	10	10/19/07 20:40	10/20/07 0:25	3:45	rain	1,702	0.34	250cf	7	1	2	good
Beach Access	10	10/19/07 20:40	10/19/07 22:40	2:00	rain	71	0.04	25cf	3	3	0	good
Lake Street	10	--	--	--	no runoff at site	--	--	--	--	--	--	--
White Cap	10	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	11	10/29/07 15:30	10/29/07 17:00	1:30	thunderstorm	1,175	0.77	250cf	5	1	2	good
Speedboat	11	10/29/07 15:35	10/29/07 18:10	2:35	thunderstorm	1,306	0.88	250cf	6	0	3	good
Beach Access	11	10/29/07 15:30	10/29/07 16:35	1:05	thunderstorm	92	0.09	25cf	4	2	1	good
Lake Street	11	--	--	--	no runoff at site	--	--	--	--	--	--	--
White Cap	11	--	--	--	no runoff at site	--	--	--	--	--	--	--
Biltmore	12	1/4/08 3:30	1/4/08 15:50	12:20	rain on snow	18,514	1.42	1200cf	28	0	4	good
Speedboat	12	1/4/08 6:00	1/4/08 17:25	11:25	rain on snow	24,694	1.93	1500cf	25	0	4	good
Beach Access	12	1/4/08 5:00	1/4/08 16:35	11:35	rain on snow	3,977	0.31	200cf	21	0	4	good
Lake Street	12	1/4/08	na	na	rain on snow	na	na	grabs	4	4	0	good
White Cap	12	1/4/08	na	na	rain on snow	na	na	grabs	2	2	0	good

Table 5. Analytical results for sampled runoff events during the monitoring period.

Site	Runoff Event #	Sampling Start (Date Time)	Average or EMC	Sampling End (Date Time)	TN (µg/L)	TKN (µg/L)	NO3-N + NO2-N (µg/L)	NH3-N (µg/L)	TP (µg/L)	TDP (µg/L)	PO4-P (µg/L)	TSS (mg/L)	Turbidity (NTU)	Conductivity (µS/cm)
Biltmore	01	12/26/06 19:59	EMC	12/27/06 0:00	2,455	2,412	47	<50	152	120	75	387	373	na
Speedboat	01	12/26/06 20:58	EMC	12/27/06 0:29	2,047	1,903	144	38	727	112	78	363	415	na
Beach Access	01	12/26/06 21:22	EMC	12/26/06 22:34	2,145	2,100	45	<50	360	330	320	180	168	na
Lake Street	01	12/26/06 21:32	average	12/26/06 22:05	9,770	9,750	39	<50	150	78	34	2,459	987	na
White Cap	01	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	02	1/3/07 22:48	EMC	1/4/07 8:36	1,997	1,992	6	14	115	111	77	180	165	na
Speedboat	02	1/4/07 1:29	EMC	1/4/07 9:13	992	952	40	8	388	113	72	143	185	na
Beach Access	02	--	--	--	--	--	--	--	--	--	--	--	--	--
Lake Street	02	1/4/07 5:30	average	1/4/07 6:40	2,414	2,400	18	<50	165	135	81	104	124	na
White Cap	02	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	03	2/8/07 19:37	EMC	2/10/07 19:09	1,450	1,430	20	8	490	58	33	281	205	381
Speedboat	03	2/8/07 21:06	EMC	2/10/07 19:29	1,196	1,129	67	7	445	82	53	215	200	285
Beach Access	03	2/8/07 19:46	EMC	2/10/07 19:26	1,014	1,011	3	4	387	107	97	127	85	27
Lake Street	03	2/9/07 2:20	average	2/10/07 13:25	7,748	7,677	72	7	3,978	86	64	2,732	1,354	277
White Cap	03	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	04	2/11/07 10:58	EMC	2/11/07 15:09	929	915	14	5	371	55	33	208	144	120
Speedboat	04	2/11/07 3:31	EMC	2/11/07 16:22	923	893	30	5	410	59	42	210	202	214
Beach Access	04	2/11/07 10:55	EMC	2/11/07 15:28	320	316	4	2	165	70	63	38	49	26
Lake Street	04	2/11/07 14:45	average	2/11/07 14:45	798	790	8	4	369	61	44	165	147	90
White Cap	04	2/11/07 12:35	average	2/11/07 14:47	1,138	1,030	108	9	453	152	120	182	154	185
Biltmore	05	3/6/07 10:50	EMC	3/6/07 16:36	1,021	972	49	3	420	72	52	193	210	225
Speedboat	05	3/6/07 12:02	EMC	3/6/07 19:05	565	523	43	3	223	46	30	80	98	364
Beach Access	05	3/6/07 11:49	EMC	3/6/07 16:40	344	318	26	8	237	113	90	58	62	33
Lake Street	05	3/6/07 14:33	average	3/6/07 16:45	691	647	44	3	292	56	38	118	108	310
White Cap	05	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	06	4/22/07 8:47	EMC	4/22/07 14:20	na	na	na	na	na	na	na	369	194	370
Speedboat	06	4/22/07 10:11	EMC	4/22/07 15:00	na	na	na	na	na	na	na	385	283	369
Beach Access	06	4/22/07 10:03	EMC	4/22/07 12:54	na	na	na	na	na	na	na	90	68	12
Lake Street	06	4/22/07 13:28	average	4/22/07 13:28	na	na	na	na	na	na	na	186	153	186
White Cap	06	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	07	8/31/07 10:16	EMC	8/31/07 10:33	16,184	16,167	17	71	2,772	200	82	1,141	450	203
Speedboat	07	8/31/07 8:45	EMC	8/31/07 8:45	42,324	42,300	24	50	5,230	127	78	2,770	2,280	335
Beach Access	07	8/31/07 8:46	EMC	8/31/07 8:46	50,281	49,800	481	3,890	5,800	1,420	1,190	1,722	1,349	375
Lake Street	07	--	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	07	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	08	9/22/07 7:51	EMC	9/22/07 9:15	4,409	4,390	19	20	706	65	52	171	92	114
Speedboat	08	9/22/07 7:54	EMC	9/22/07 9:42	4,757	4,735	22	23	896	115	55	160	99	106
Beach Access	08	9/22/07 7:52	EMC	9/22/07 8:47	9,178	8,508	670	511	4,118	2,029	1,701	145	138	128
Lake Street	08	9/22/07 8:40	average	9/22/07 9:25	4,789	4,767	22	24	1,179	190	75	301	149	116
White Cap	08	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	09	10/10/07 4:43	EMC	10/10/07 7:55	na	na	na	na	na	na	na	na	69	na
Speedboat	09	10/10/07 5:52	EMC	10/10/07 7:22	na	na	na	na	na	na	na	na	50	na
Beach Access	09	10/10/07 5:46	EMC	10/10/07 6:12	na	na	na	na	na	na	na	na	67	na
Lake Street	09	--	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	09	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	10	10/19/07 19:42	EMC	10/19/07 22:02	1,878	1,874	3	22	360	61	32	101	63	40
Speedboat	10	10/19/07 21:10	EMC	10/19/07 23:15	2,157	2,155	3	22	482	99	68	149	109	45
Beach Access	10	10/19/07 20:41	EMC	10/19/07 21:21	1,719	1,716	3	19	766	478	415	35	60	26
Lake Street	10	--	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	10	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	11	10/29/07 15:37	EMC	10/29/07 16:22	2,465	2,107	358	268	444	124	101	164	104	57
Speedboat	11	10/29/07 16:03	EMC	10/29/07 16:53	3,142	2,751	390	19	732	94	75	279	220	68
Beach Access	11	10/29/07 15:33	EMC	10/29/07 16:15	3,009	2,993	16	15	679	226	193	136	76	25
Lake Street	11	--	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	11	--	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	12	1/4/08 3:51	EMC	1/4/08 15:04	1,409	1,300	109	9	715	64	45	344	281	233
Speedboat	12	1/4/08 6:06	EMC	1/4/08 15:33	1,330	1,197	133	77	696	99	79	299	284	187
Beach Access	12	1/4/08 5:45	EMC	1/4/08 16:22	954	942	12	6	464	110	83	161	143	31
Lake Street	12	1/4/08 7:31	average	1/4/08 14:48	2,087	1,960	127	13	920	99	70	384	391	379
White Cap	12	1/4/08 13:23	average	1/4/08 15:00	677	585	92	18	326	255	218	37	47	106

Table 6. Constituent loads for sampled runoff events during the monitoring period.

Site	Runoff Event #	Runoff Start (Date Time)	Runoff End (Date Time)	Runoff Volume (cf)	Sampling Quality	TN (g)	TKN (g)	NO3-N + NO2-N (g)	NH3-N (g)	TP (g)	TDP (g)	PO4-P (g)	TSS (kg)
Biltmore	01	12/26/06 19:05	12/27/06 1:50	2,869	good	199	196	3.8	2.9	12	9.7	6.1	31
Speedboat	01	12/26/06 20:55	12/27/06 1:45	3,904	good	226	210	16	4.2	80	12	8.7	40
Beach Access	01	12/26/06 21:20	12/26/06 22:55	84	good	5.1	5.0	0.1	0.1	0.9	0.8	0.8	0.4
Lake Street	01	12/26/06	na	na	good	--	--	--	--	--	--	--	--
White Cap	01	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	02	1/3/07 21:40	1/4/07 10:15	4,561	good	258	257	0.8	1.8	15	14	9.9	23
Speedboat	02	1/4/07 1:25	1/4/07 10:05	5,401	good	152	146	6.0	1.2	59	17	11	22
Beach Access	02	--	--	--	--	--	--	--	--	--	--	--	--
Lake Street	02	1/4/07	na	na	good	--	--	--	--	--	--	--	--
White Cap	02	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	03	2/8/07 19:30	2/10/07 19:35	11,615	good	477	470	6.7	2.6	161	19	11	93
Speedboat	03	2/8/07 21:00	2/10/07 20:55	12,104	good	410	387	23	2.3	153	28	18	74
Beach Access	03	2/8/07 19:50	2/10/07 19:30	839	good	24	24	0.1	0.1	9.2	2.5	2.3	3.0
Lake Street	03	2/9/07	na	na	good	--	--	--	--	--	--	--	--
White Cap	03	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	04	2/11/07 9:10	2/11/07 17:25	3,665	good	96	95	1.4	0.5	38	5.7	3.4	22
Speedboat	04	2/11/07 0:15	2/11/07 19:35	10,028	good	262	254	8.6	1.5	116	17	12	60
Beach Access	04	2/11/07 10:00	2/11/07 16:30	215	good	1.9	1.9	0.02	0.01	1.0	0.4	0.4	0.2
Lake Street	04	2/11/07	na	na	good	--	--	--	--	--	--	--	--
White Cap	04	2/11/07	na	na	good	--	--	--	--	--	--	--	--
Biltmore	05	3/6/07 10:05	3/6/07 17:00	626	good	18	17	0.9	0.1	7.4	1.3	0.9	3.4
Speedboat	05	3/6/07 11:50	3/6/07 19:25	1,264	good	20	19	1.5	0.1	8.0	1.7	1.1	2.9
Beach Access	05	3/6/07 11:20	3/6/07 17:20	254	good	2.5	2.3	0.2	0.1	1.7	0.8	0.6	0.4
Lake Street	05	3/6/07	na	na	good	--	--	--	--	--	--	--	--
White Cap	05	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	06	4/22/07 8:20	4/22/07 16:05	4,664	good	na	na	na	na	na	na	na	na
Speedboat	06	4/22/07 10:05	4/22/07 16:55	5,360	good	na	na	na	na	na	na	na	na
Beach Access	06	4/22/07 9:40	4/22/07 13:15	215	good	na	na	na	na	na	na	na	na
Lake Street	06	4/22/07	na	na	good	--	--	--	--	--	--	--	--
White Cap	06	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	07	8/31/07 8:45	8/31/07 11:35	711	moderate	326	325	0.3	1.4	56	4.0	1.6	23
Speedboat	07	8/31/07 8:45	8/31/07 11:10	209	moderate	250	250	0.1	0.3	31	0.8	0.5	16
Beach Access	07	8/31/07 8:45	8/31/07 10:35	40	moderate	57	56	0.5	4.4	6.6	1.6	1.3	2.0
Lake Street	07	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	07	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	08	9/22/07 7:50	9/22/07 9:45	1,574	good	196	196	0.9	0.9	31	2.9	2.3	7.6
Speedboat	08	9/22/07 7:45	9/22/07 10:10	1,470	good	198	197	0.9	0.9	37	4.8	2.3	6.7
Beach Access	08	9/22/07 7:50	9/22/07 9:20	123	moderate	32	30	2.3	1.8	14	7.1	5.9	0.5
Lake Street	08	9/22/07	na	na	good	--	--	--	--	--	--	--	--
White Cap	08	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	09	10/10/07 4:40	10/10/07 8:15	889	good	na	na	na	na	na	na	na	na
Speedboat	09	10/10/07 5:40	10/10/07 8:05	304	poor	na	na	na	na	na	na	na	na
Beach Access	09	10/10/07 5:45	10/10/07 6:45	73	moderate	na	na	na	na	na	na	na	na
Lake Street	09	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	09	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	10	10/19/07 19:35	10/19/07 23:45	1,730	good	92	92	0.2	1.1	18	3.0	1.6	4.9
Speedboat	10	10/19/07 20:40	10/20/07 0:25	1,702	good	104	104	0.1	1.1	23	4.8	3.3	7.2
Beach Access	10	10/19/07 20:40	10/19/07 22:40	71	good	3.5	3.5	0.01	0.04	1.5	1.0	0.8	0.1
Lake Street	10	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	10	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	11	10/29/07 15:30	10/29/07 17:00	1,175	good	82	70	12	8.9	15	4.1	3.4	5.5
Speedboat	11	10/29/07 15:35	10/29/07 18:10	1,306	good	116	102	14	0.7	27	3.5	2.8	10
Beach Access	11	10/29/07 15:30	10/29/07 16:35	92	good	7.8	7.8	0.04	0.04	1.8	0.6	0.5	0.4
Lake Street	11	--	--	--	--	--	--	--	--	--	--	--	--
White Cap	11	--	--	--	--	--	--	--	--	--	--	--	--
Biltmore	12	1/4/08 3:30	1/4/08 15:50	18,514	good	739	681	57	4.9	375	33	23	181
Speedboat	12	1/4/08 6:00	1/4/08 17:25	24,694	good	930	837	93	54	486	69	55	209
Beach Access	12	1/4/08 5:00	1/4/08 16:35	3,977	good	107	106	1.4	0.7	52	12	9.3	18
Lake Street	12	1/4/08	na	na	good	--	--	--	--	--	--	--	--
White Cap	12	1/4/08	na	na	good	--	--	--	--	--	--	--	--

APPENDIX B. Speedboat (SB) site event runoff data from Water Years 2003–2008.

Water Year	WY Event	Station	Precipitation Event Start	Precipitation Event End	Event Duration (hr:mm)	Total Event Precipitation (inches)	Event Type	SB Event Volume (cf)	SB Peak Flow (cfs)
03	1	USCG	10/26/02 17:40	10/26/02 17:50	0:20	0.05	rain	--	--
03	2	USCG	11/7/02 4:20	11/11/02 7:50	99:40	4.74	rain	102,953	2.36
03	3	USCG	12/9/02 15:40	12/10/02 5:40	14:10	0.04	rain	--	--
03	4	USCG	12/13/02 3:30	12/14/02 18:00	38:40	1.20	rain	21,975	0.93
03	5	USCG	12/15/02 23:20	12/16/02 11:10	12:00	0.10	rain	--	--
03	6	USCG	12/19/02 10:30	12/19/02 11:50	1:30	0.03	rain	--	--
03	7	USCG	12/26/02 14:30	12/27/02 13:30	23:10	0.21	rain	14,524	0.72
03	8	USCG	12/29/02 11:10	12/30/02 23:00	36:00	0.23	rain	--	--
03	9	USCG	1/9/03 11:20	1/11/03 22:00	58:50	0.44	rain	39,991	0.88
03	10	USCG	1/21/03 9:10	1/23/03 18:30	57:30	0.65	rain	35,059	1.73
03	11	USCG	1/27/03 2:20	1/28/03 9:10	31:00	0.25	rain	--	--
03	12	USCG	2/1/03 13:00	2/2/03 11:00	22:10	0.12	rain	--	--
03	13	USCG	2/12/03 20:50	2/13/03 13:10	16:30	0.26	rain	6,947	0.94
03	14	USCG	2/16/03 0:50	2/16/03 11:10	10:30	0.03	rain	--	--
03	15	USCG	2/24/03 19:00	2/25/03 13:20	18:30	0.04	rain	--	--
03	16	USCG	2/27/03 8:00	2/27/03 12:40	4:50	0.07	rain	--	--
03	17	USCG	3/1/03 9:20	3/1/03 11:30	2:20	0.02	rain	--	--
03	18	USCG	3/13/03 20:00	3/15/03 10:40	38:50	0.62	rain	26,975	1.55
03	19	USCG	3/20/03 8:30	3/20/03 9:00	0:40	0.07	rain	--	--
03	20	USCG	3/22/03 22:30	3/24/03 0:00	25:40	0.25	rain	2,364	0.40
03	21	USCG	3/26/03 4:40	3/26/03 10:40	6:10	0.37	rain	6,744	0.71
03	22	USCG	4/5/03 8:10	4/5/03 9:40	1:40	0.05	rain	--	--
03	23	USCG	4/12/03 4:50	4/12/03 17:00	12:20	0.04	rain	35,140	0.66
03	24	USCG	4/14/03 11:10	4/14/03 11:50	0:50	0.17	rain	--	--
03	25	USCG	4/16/03 16:50	4/17/03 8:30	15:50	0.07	rain	--	--
03	26	USCG	4/20/03 21:30	4/21/03 9:10	11:50	0.07	rain	--	--
03	27	USCG	4/24/03 9:00	4/24/03 14:10	5:20	0.05	rain	132	0.03
03	28	USCG	4/26/03 7:30	4/26/03 10:50	3:30	0.02	rain	--	--
03	29	USCG	4/28/03 8:30	4/28/03 10:30	2:10	0.03	rain	3,688	0.39
03	30	USCG	5/2/03 8:50	5/4/03 5:40	45:00	0.31	rain	5,729	0.52
03	31	USCG	5/7/03 22:00	5/8/03 13:20	15:30	0.05	rain	50	0.03
03	32	USCG	5/10/03 8:00	5/10/03 9:20	1:30	0.06	rain	--	--
03	33	USCG	6/23/03 12:20	6/23/03 16:10	4:00	0.22	thunderstorm	7,736	1.28
03	34	USCG	7/22/03 17:00	7/23/03 18:10	25:20	0.23	thunderstorm	14	0.02
03	35	USCG	8/21/03 7:40	8/22/03 13:10	29:40	0.83	thunderstorm	19,962	1.68
03	36	USCG	8/26/03 7:00	8/26/03 18:20	11:30	0.12	thunderstorm	--	--
03	37	USCG	9/4/03 15:30	9/4/03 16:40	1:20	0.26	thunderstorm	--	--
04	1	NTM	11/1/03 11:10	11/1/03 13:50	2:40	0.14	snow	--	--
04	2	NTM	11/3/03 8:40	11/3/03 8:50	0:10	0.03	snow	--	--
04	3	NTM	11/7/03 8:20	11/7/03 9:30	1:10	0.07	snow	--	--
04	4	NTM	11/8/03 13:30	11/9/03 7:40	18:10	0.31	snow	--	--
04	5	NTM	11/14/03 17:50	11/14/03 23:00	5:10	0.11	snow	--	--
04	6	NTM	11/30/03 13:50	11/30/03 14:40	0:50	0.05	snow	--	--
04	7	NTM	12/1/03 18:30	12/2/03 1:20	6:50	0.16	rain	--	--
04	8	NTM	12/4/03 23:10	12/7/03 2:20	51:10	1.64	rain	46,237	1.88
04	9	NTM	12/9/03 16:40	12/11/03 12:00	43:20	0.24	snow	--	--
04	10	NTM	12/12/03 22:10	12/15/03 12:00	61:50	0.56	snow	1,777	0.08
04	11	NTM	12/19/03 21:30	12/20/03 15:30	18:00	0.20	rain	7,496	1.04
04	12	NTM	12/23/03 14:30	12/24/03 20:00	29:30	1.17	snow	42,459	1.81
04	13	NTM	12/27/03 12:10	12/31/03 10:40	94:30	0.52	snow	--	--
04	14	NTM	1/3/04 10:40	1/4/04 10:30	23:50	0.04	snow	--	--
04	15	NTM	1/7/04 6:10	1/7/04 22:40	16:30	0.07	snow	2,773	0.36
04	16	NTM	1/27/04 8:20	1/28/04 9:30	25:10	0.08	snow	1,945	0.50
04	17	NTM	2/2/04 10:30	2/5/04 11:40	73:10	0.36	snow	302	0.04
04	18	NTM	2/16/04 5:00	2/18/04 9:10	52:10	1.61	rain, snow	36,703	2.02
04	19	NTM	2/25/04 5:40	2/25/04 16:20	10:40	0.76	rain, snow	14,404	1.61
04	20	NTM	2/27/04 11:20	2/28/04 11:00	23:40	0.23	snow	2,825	0.35
04	21	NTM	3/1/04 11:30	3/2/04 11:00	23:30	0.16	snow	4,459	0.37

Water Year	WY Event	Station	Precipitation Event Start	Precipitation Event End	Event Duration (hr:mm)	Total Event Precipitation (inches)	Event Type	SB Event Volume (cf)	SB Peak Flow (cfs)
04	22	NTM	3/25/04 15:10	3/26/04 10:40	19:30	0.43	snow	--	--
04	23	NTM	4/19/04 19:10	4/22/04 10:40	63:30	0.33	rain	1,933	0.61
04	24	NTM	5/1/04 21:10	5/2/04 1:00	3:50	0.28	rain	--	--
04	25	NTM	5/10/04 9:30	5/11/04 7:40	22:10	0.27	snow	2,117	0.45
04	26	NTM	5/27/04 21:00	5/28/04 4:10	7:10	0.09	rain	--	--
04	27	NTM	6/9/04 5:00	6/9/04 8:20	3:20	0.20	rain, snow	644	0.21
05	1	NTM	10/17/04 7:00	10/17/04 22:10	15:10	0.51	rain	5,462	1.50
05	2	NTM	10/19/04 8:10	10/21/04 10:50	50:40	1.93	snow, rain	--	--
05	3	NTM	10/26/04 3:30	10/26/04 14:40	11:10	0.68	snow	--	--
05	4	NTM	10/28/04 12:10	10/28/04 12:10	0:00	0.01	snow	--	--
05	5	NTM	11/3/04 12:30	11/4/04 3:40	15:10	0.25	rain/snow, snow	--	--
05	6	NTM	11/10/04 16:30	11/10/04 19:50	3:20	0.19	snow	--	--
05	7	NTM	11/25/04 13:00	11/25/04 13:30	0:30	0.04	snow	--	--
05	8	NTM	11/27/04 0:10	11/27/04 6:00	5:50	0.21	snow	--	--
05	9	NTM	11/29/04 13:10	11/30/04 13:20	24:10	0.40	snow	--	--
05	10	NTM	12/6/04 20:40	12/8/04 23:30	50:50	0.16	snow, rain	--	--
05	11	NTM	12/31/04 12:40	12/31/04 13:10	0:30	0.02	snow	--	--
05	12	NTM	1/4/05 10:40	1/4/05 11:20	0:40	0.02	snow	--	--
05	13	NTM	1/7/05 9:50	1/7/05 17:30	7:40	0.31	snow	--	--
05	14	NTM	1/9/05 8:10	1/12/05 10:00	73:50	0.30	rain/snow	--	--
05	15	NTM	1/16/05 10:30	1/16/05 10:30	0:00	0.01	rain	--	--
05	16	NTM	1/25/05 4:10	1/26/05 16:30	36:20	0.45	rain, snow, rain	--	--
05	17	NTM	1/28/05 2:20	1/29/05 13:20	35:00	0.09	snow	--	--
05	18	NTM	2/7/05 9:00	2/7/05 9:40	0:40	0.05	rain, snow	--	--
05	19	NTM	2/11/05 18:50	2/12/05 2:10	7:20	0.08	rain	--	--
05	20	NTM	2/13/05 19:40	2/14/05 0:10	4:30	0.06	rain/snow	--	--
05	21	NTM	2/15/05 14:50	2/16/05 12:50	22:00	0.27	snow	--	--
05	22	NTM	2/18/05 12:00	2/18/05 13:10	1:10	0.09	snow	--	--
05	23	NTM	2/19/05 19:10	2/20/05 8:40	13:30	0.11	snow	--	--
05	24	NTM	2/21/05 21:50	2/22/05 11:40	13:50	0.17	snow	--	--
05	25	NTM	2/27/05 23:00	2/28/05 10:00	11:00	0.21	snow	--	--
05	26	NTM	3/2/05 9:40	3/2/05 11:00	1:20	0.21	snow	--	--
05	27	NTM	3/19/05 2:30	3/23/05 15:50	109:20	2.10	snow	--	--
05	28	NTM	3/25/05 15:20	3/25/05 15:20	0:00	0.01	snow	--	--
05	29	NTM	3/27/05 18:50	3/29/05 11:00	40:10	0.82	snow	--	--
05	30	NTM	4/4/05 8:10	4/4/05 9:00	0:50	0.05	snow	--	--
05	31	NTM	4/7/05 3:20	4/7/05 3:20	0:00	0.01	snow	--	--
05	32	NTM	4/8/05 12:40	4/9/05 9:10	20:30	0.17	snow	--	--
05	33	NTM	4/19/05 9:40	4/20/05 7:10	21:30	0.10	snow	--	--
05	34	NTM	4/23/05 2:40	4/23/05 14:10	11:30	0.06	rain	--	--
05	35	NTM	4/26/05 20:10	4/28/05 14:30	42:20	0.32	rain	--	--
05	36	NTM	4/30/05 18:20	5/1/05 6:10	11:50	0.26	rain	--	--
05	37	NTM	5/8/05 8:00	5/9/05 7:50	23:50	0.58	rain	--	--
05	38	NTM	5/10/05 16:30	5/11/05 6:30	14:00	0.09	rain	--	--
05	39	NTM	5/15/05 14:20	5/16/05 15:50	25:30	0.46	rain	--	--
05	40	NTM	5/17/05 20:30	5/19/05 5:50	33:20	0.21	rain	--	--
05	41	NTM	6/7/05 6:20	6/10/05 17:00	82:40	0.56	snow	--	--
05	42	NTM	6/16/05 18:10	6/17/05 1:50	7:40	0.19	thunderstorm	--	--
05	43	NTM	8/15/05 15:20	8/16/05 12:10	20:50	0.20	thunderstorm	--	--
05	44	NTM	9/26/05 16:50	9/27/05 3:10	10:20	0.33	thunderstorm	5,917	1.50
06	1	KBE	10/15/05 7:00	10/15/05 11:00	4:00	0.19	thunderstorm	--	--
06	2	KBE	10/24/05 18:00	10/25/05 3:00	9:00	0.99	thunderstorm	--	--
06	3	KBE	10/26/05 11:00	10/27/05 9:30	22:30	0.09	rain	--	--
06	4	KBE	10/29/05 2:30	10/29/05 6:00	3:30	0.05	rain	--	--
06	5	KBE	11/2/05 15:30	11/2/05 16:30	1:00	0.06	rain	--	--
06	6	KBE	11/4/05 1:30	11/4/05 4:00	2:30	0.02	snow	--	--
06	7	KBE	11/25/05 7:30	11/25/05 20:30	13:00	0.50	rain, snow	--	--
06	8	KBE	11/28/05 13:00	12/2/05 2:00	85:00	2.82	snow, rain	123,473	2.98

Water Year	WY Event	Station	Precipitation Event Start	Precipitation Event End	Event Duration (hr:mm)	Total Event Precipitation (inches)	Event Type	SB Event Volume (cf)	SB Peak Flow (cfs)
06	9	KBE	12/8/05 10:00	12/8/05 10:00	0:00	0.01	rain	--	--
06	10	KBE	12/17/05 23:30	12/19/05 6:30	31:00	1.70	snow, rain	49,633	1.96
06	11	KBE	12/21/05 8:00	12/22/05 17:30	33:30	1.63	rain	--	--
06	12	KBE	12/25/05 17:30	12/26/05 11:30	18:00	0.58	snow	--	--
06	13	KBE	12/27/05 13:00	12/28/05 23:00	34:00	0.95	rain, snow	--	--
06	14	KBE	12/30/05 8:00	1/2/06 21:00	85:00	5.36	rain, snow	218,476	6.52
06	15	KBE	1/7/06 6:30	1/7/06 6:30	0:00	0.02	rain	--	--
06	16	KBE	1/11/06 12:30	1/11/06 13:00	0:30	0.07	rain	--	--
06	17	KBE	1/14/06 9:30	1/16/06 10:30	49:00	0.69	snow	--	--
06	18	KBE	1/17/06 21:30	1/19/06 10:00	36:30	0.78	snow	--	--
06	19	KBE	1/26/06 10:00	1/26/06 10:00	0:00	0.01	snow	--	--
06	20	KBE	1/28/06 17:30	1/28/06 22:30	5:00	0.06	snow	--	--
06	21	KBE	1/30/06 4:30	1/30/06 22:00	17:30	0.47	rain, snow	12,556	1.04
06	22	KBE	2/2/06 5:00	2/2/06 11:00	6:00	0.04	rain	--	--
06	23	KBE	2/4/06 7:30	2/4/06 11:00	3:30	0.16	rain	--	--
06	24	KBE	2/14/06 23:00	2/15/06 6:30	7:30	0.06	snow	--	--
06	25	KBE	2/17/06 22:30	2/19/06 10:00	35:30	0.41	snow	--	--
06	26	KBE	2/26/06 17:00	2/28/06 15:30	46:30	2.78	snow, rain	136,926	3.22
06	27	KBE	3/2/06 8:30	3/3/06 23:00	38:30	0.27	snow	--	--
06	28	KBE	3/5/06 17:00	3/7/06 11:00	42:00	0.32	snow	--	--
06	29	KBE	3/8/06 19:00	3/9/06 0:30	5:30	0.04	snow	--	--
06	30	KBE	3/10/06 3:30	3/11/06 14:30	35:00	0.1	snow	--	--
06	31	KBE	3/12/06 15:30	3/14/06 17:00	49:30	0.67	snow	--	--
06	32	KBE	3/17/06 5:00	3/17/06 20:30	15:30	0.07	snow	--	--
06	33	KBE	3/20/06 16:00	3/20/06 16:30	0:30	0.02	snow	--	--
06	34	KBE	3/25/06 4:00	3/25/06 19:30	15:30	0.92	snow	--	--
06	35	KBE	3/27/06 21:00	3/29/06 15:30	42:30	0.46	snow	11,049	0.85
06	36	KBE	3/31/06 20:30	4/1/06 11:30	15:00	0.39	snow	15,048	1.58
06	37	KBE	4/2/06 22:00	4/4/06 19:00	45:00	1.11	rain	100,631	2.41
06	38	KBE	4/7/06 21:30	4/8/06 0:30	3:00	0.09	snow	--	--
06	39	KBE	4/10/06 1:30	4/12/06 7:30	54:00	0.39	snow	--	--
06	40	KBE	4/14/06 15:00	4/14/06 21:30	6:30	0.03	rain	--	--
06	41	KBE	4/16/06 5:00	4/17/06 7:30	26:30	0.81	rain/snow	--	--
06	42	KBE	4/21/06 16:00	4/24/06 2:00	58:00	0.45	thunderstorm	--	--
06	43	KBE	4/25/06 17:00	4/25/06 19:30	2:30	0.30	thunderstorm	13,854	2.08
06	44	KBE	5/19/06 8:30	5/19/06 16:00	7:30	0.05	thunderstorm	--	--
06	45	KBE	5/21/06 14:00	5/22/06 14:30	24:30	0.06	thunderstorm	--	--
06	46	KBE	5/27/06 2:00	5/27/06 16:30	14:30	0.29	thunderstorm	--	--
06	47	KBE	6/13/06 11:00	6/13/06 11:30	0:30	0.04	thunderstorm	--	--
06	48	KBE	6/27/06 18:30	6/28/06 14:00	19:30	0.37	thunderstorm	6,293	1.85
06	49	KBE	7/21/06 19:00	7/21/06 19:30	0:30	0.11	thunderstorm	3,036	1.50
06	50	KBE	8/2/06 23:00	8/2/06 23:00	0:00	0.02	thunderstorm	--	--
07	1	SBM	10/1/06 20:15	10/2/06 5:15	9:00	0.09	rain	--	--
07	2	SBM	10/5/06 10:20	10/7/06 1:35	39:15	0.70	rain	9,256	1.94
07	3	KBE	10/16/06 22:00	10/16/06 23:00	1:00	0.08	rain/snow	--	--
07	4	KBE	11/2/06 4:30	11/3/06 16:00	35:30	0.60	rain	24,675	2.65
07	5	KBE	11/8/06 7:30	11/8/06 11:00	3:30	0.07	rain	--	--
07	6	KBE	11/11/06 7:00	11/11/06 9:00	2:00	0.02	snow	--	--
07	7	KBE	11/12/06 21:00	11/14/06 2:30	29:30	0.38	snow, rain	9,321	0.84
07	8	KBE	11/23/06 2:00	11/23/06 3:00	1:00	0.05	snow	--	--
07	9	KBE	11/26/06 15:30	11/28/06 1:00	33:30	0.21	snow	--	--
07	10	KBE	12/9/06 1:30	12/10/06 13:00	35:30	0.13	rain, snow	--	--
07	11	KBE	12/12/06 9:00	12/12/06 11:00	2:00	0.02	rain	--	--
07	12	KBE	12/15/06 6:00	12/15/06 10:30	4:30	0.06	rain	--	--
07	13	KBE	12/16/06 18:30	12/16/06 20:30	2:00	0.02	rain	--	--
07	14	KBE	12/21/06 15:00	12/21/06 23:00	8:00	0.45	rain, snow	--	--
07	15	KBE	12/26/06 19:00	12/27/06 15:30	20:30	0.51	snow	3,904	0.54
07	16	KBE	1/3/07 21:30	1/4/07 20:30	23:00	0.50	rain, snow	5,401	0.33

Water Year	WY Event	Station	Precipitation Event Start	Precipitation Event End	Event Duration (hr:mm)	Total Event Precipitation (inches)	Event Type	SB Event Volume (cf)	SB Peak Flow (cfs)
07	17	NG	2/8/07 1:00	2/11/07 6:40	77:40	2.15	rain/snow	12,104	0.78
07	18	NG	2/22/07 6:30	2/23/07 2:40	20:10	0.25	snow	--	--
07	19	NG	2/24/07 21:50	2/27/07 9:10	59:20	1.35	snow	--	--
07	20	SBM	3/20/07 16:05	3/20/07 20:10	4:05	0.02	rain/snow	--	--
07	21	NG	3/26/07 16:10	3/28/07 0:50	32:40	0.47	rain, snow	--	--
07	22	NG	4/11/07 10:00	4/12/07 8:10	22:10	0.19	snow	--	--
07	23	NG	4/14/07 11:10	4/14/07 14:50	3:40	0.03	snow	--	--
07	24	NG	4/17/07 18:40	4/18/07 8:00	13:20	0.11	snow	--	--
07	25	NG	4/21/07 23:10	4/22/07 8:30	9:20	0.70	snow	--	--
07	26	NG	5/2/07 10:50	5/2/07 21:50	11:00	0.08	thunderstorm	--	--
07	27	NG	5/3/07 22:50	5/4/07 17:00	18:10	0.09	thunderstorm	--	--
07	28	NG	6/5/07 19:40	6/6/07 15:10	19:30	0.14	rain	--	--
07	29	NG	8/30/07 16:00	8/31/07 11:20	19:20	0.17	thunderstorm	209	0.20
07	30	NG	9/19/07 21:00	9/20/07 3:10	6:10	0.05	thunderstorm	--	--
07	31	NG	9/22/07 7:40	9/22/07 9:10	1:30	0.21	thunderstorm	1,470	0.41
07	32	NG	9/28/07 21:20	9/28/07 23:30	2:10	0.04	snow	--	--
08	1	NG	10/5/07 2:00	10/5/07 12:50	10:50	0.11	snow	--	--
08	2	NG	10/10/07 4:30	10/10/07 7:30	3:00	0.15	snow	304	0.08
08	3	NG	10/12/07 14:50	10/12/07 15:20	0:30	0.03	rain	--	--
08	4	NG	10/16/07 17:10	10/16/07 17:50	0:40	0.04	rain/snow	--	--
08	5	NG	10/19/07 18:50	10/19/07 23:00	4:10	0.21	rain	1,702	0.34
08	6	NG	10/29/07 0:50	10/29/07 16:10	15:20	0.23	thunderstorm	1,306	0.88
08	7	NG	11/10/07 21:40	11/11/07 6:20	8:40	0.19	rain	--	--
08	8	NG	12/6/07 12:00	12/7/07 10:30	22:30	1.22	snow	--	--
08	9	NG	12/18/07 9:30	12/18/07 19:40	10:10	0.23	snow	--	--
08	10	NG	12/19/07 21:40	12/20/07 12:10	14:30	0.76	snow	--	--
08	11	NG	12/27/07 18:50	12/27/07 19:50	1:00	0.03	snow	--	--
08	12	NG	1/4/08 2:00	1/6/08 14:20	60:20	2.88	rain, snow	24,694	1.93
08	13	NG	1/8/08 9:50	1/9/08 19:30	33:40	0.44	snow	--	--
08	14	NG	1/12/08 6:40	1/12/08 10:00	3:20	0.16	snow	--	--
08	15	NG	1/21/08 9:10	1/21/08 17:50	8:40	0.04	snow	--	--
08	16	NG	1/24/08 3:10	1/24/08 21:20	18:10	0.03	snow	--	--
08	17	NG	1/27/08 2:20	1/28/08 12:20	34:00	0.78	snow	--	--
08	18	NG	1/29/08 13:50	1/30/08 4:30	14:40	0.2	snow	--	--
08	19	NG	1/31/08 14:40	1/31/08 23:30	8:50	0.26	snow	--	--
08	20	NG	2/2/08 15:30	2/3/08 18:40	27:10	0.84	snow	--	--
08	21	NG	2/20/08 2:30	2/20/08 10:20	7:50	0.26	snow	--	--
08	22	NG	2/21/08 13:20	2/24/08 20:30	79:10	1.39	snow	2,673	0.16
08	23	NG	3/13/08 0:00	3/15/08 21:20	69:20	0.25	snow	835	0.21
08	24	NG	3/19/08 20:10	3/19/08 23:50	3:40	0.22	rain	--	--

Boulder Bay, LLC
Summary of Storm Volume Reduction
February 25, 2010

Project Area BMP Designs	Existing Conditions	E20 Existing Conditions (20 yr Design)	C20 Alternative C (20 yr Design)	C100 Alternative C (100 yr Design)
BMP Capacity (CF)	500	22,647	39,079	66,518
Pervious area infiltration*, or Infiltration trenches (Alt. C) (CF)	0	17,139	17,139	2,282
LID elements (green roofs, pervious pavers, cisterns) (CF)	0	0	0	13,125
Total Capacity	**500**	**39,786**	**56,218**	**81,926**
20 yr - 1 hr storm Volume (CF)	39,075	39,075	39,075	39,075
Storm Volume Runoff (CF)	**38,575**	**-710**	**-17,142**	**-42,851**
50 yr - 1 hr storm Volume (CF)	48,844	48,844	48,844	48,844
Storm Volume Runoff (CF)	**48,344**	**9,058**	**-7,374**	**-33,082**
100 yr - 1 hr Storm Volume (CF)	60,567	60,567	60,567	60,567
Storm Volume Runoff (CF)	**60,067**	**20,781**	**4,349**	**-21,359**

* Necessary to equalize areas between comparisons

Public BMP Designs	Existing Conditions	E20 Existing Conditions (20 yr Design)	C20 Alternative C (20 yr Design)	C100 Alternative C (100 yr Design)
Washoe County BMP Capacity (CF)	0	0	1,653	7,040
NDOT BMP Capacity (CF)	0	0	0	7,637
Total Public BMP Capacity (CF)	**0**	**0**	**1,653**	**14,677**
20 yr - 1 hr storm Volume (CF)	10,089	10,089	10,089	10,089
Storm Volume Runoff (CF)	**10,089**	**10,089**	**8,436**	**-4,588**
50 yr - 1 hr storm Volume (CF)	12,611	12,611	12,611	12,611
Storm Volume Runoff (CF)	**12,611**	**12,611**	**10,959**	**-2,066**
100 yr - 1 hr Storm Volume (CF)	15,638	15,638	15,638	15,638
Storm Volume Runoff (CF)	**15,638**	**15,638**	**13,985**	**961**
Total 20yr - 1 hr Storm Volume Runoff (CF)	**10,088**	**10,089**	**8,436**	**0**
Total 50yr - 1 hr Storm Volume Runoff (CF)	**60,955**	**21,670**	**10,959**	**0**
Total 100yr - 1 hr Storm Volume Runoff (CF)	**75,704**	**36,419**	**18,334**	**961**

Project Area BMP Designs	Existing Conditions	E20 Existing Conditions (20 yr Design)	C20 Alternative C (20 yr Design)	C100 Alternative C (100 yr Design)
20 yr - 1 hr Storm Volume Runoff (CF)	**48,664**	**10,089**	**8,436**	**0**
Project Area	38,575	0	0	0
Washoe County/NDOT	10,089	10,089	8,436	0
50 yr - 1 hr Storm Volume Runoff (CF)	**60,955**	**21,670**	**10,959**	**0**
Project Area	48,344	9,058	0	0
Washoe County/NDOT	12,611	12,611	10,959	0
100 yr - 1 hr Storm Volume Runoff (CF)	**75,704**	**36,419**	**18,334**	**961**
Project Area	60,067	20,781	4,349	0
Washoe County/NDOT	15,638	15,638	13,985	961

*A negative storm volume runoff represents excess design capacity for the storm event.
**For purposes of calculating Total storm runoff, excess capacity is not assumed to be additive.
***For the Public BMP Design, the capcity allocated to the contributing area is equal to the storm volume

Water Balance (LSPC) Model	Existing Conditions	E20 Existing Conditions (20 yr Design)	C20 Alternative C (20 yr Design)	C100 Alternative C (100 yr Design)	Removal Fraction C20 vs. E20	Removal Fraction C100 vs. E20	Removal Fraction E20 vs. Existing	Removal Fraction C20 vs. Existing	Removal Fraction C100 vs. Existing
Possible Loads to Lake for Wet Water Year (1994-95) - Annual ppt = 61 inches (EL NINO)**									
Total Sediment captured relative to E20 (lb)	NA	NA	12,743	28,365					
Total Fines* captured relative to E20 (lb)	NA	NA	11,468	25,528					
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	24.9	55.5					
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	40.7	94.9					
Total Sediment in Runoff (lb)	52,825	32,267	19,524	3,902	39.5%	87.9%	38.9%	63.0%	92.6%
Fine Sediment* in Runoff (lb)	31695 - 47542	19360 - 29040	11715 - 17572	2341 - 3512	39.5%	87.9%	38.9%	63.0%	92.6%
60%	31,695	19,360	11,715	2,341					
90%	47,542	29,040	17,572	3,512					
Total Phosphorous in Runoff (lb)	103.3	63.1	38.2	7.6	39.5%	87.9%	38.9%	63.0%	92.6%
Total Nitrogen in Runoff (lb)	192.1	108.9	68.3	14.0	37.3%	87.1%	43.3%	64.5%	92.7%
Possible Loads to Lake for Wet Water Year (1997-98) - Annual ppt = 44.6 inches (EL NINO)**									
Total Sediment captured relative to existing conditions (lb)	NA	NA	3,935	16,060					
Total Fines* captured relative to existing conditions (lb)	NA	NA	3,541	14,453					
Total Phosphorous (TP) captured relative to existing (lb)	NA	NA	7.7	31.4					
Total Nitrogen (TN) captured relative to existing conditions (lb)	NA	NA	15.0	56.9					
Total Sediment in Runoff (lb)	40,271	17,430	13,496	1,371	22.6%	92.1%	56.7%	66.5%	96.6%
Fine Sediment* in Runoff (lb)	24163 - 36244	10458 - 15687	8097 - 12146	823 - 1234	22.6%	92.1%	56.7%	66.5%	96.6%
60%	24,163	10,458	8,097	823					
90%	36,244	15,687	12,146	1,234					
Total Phosphorous in Runoff (lb)	78.8	34.1	26.4	2.7	22.6%	92.1%	56.7%	66.5%	96.6%
Total Nitrogen in Runoff (lb)	152.8	63.3	48.3	6.4	23.7%	89.9%	58.6%	68.4%	95.8%
Possible Loads to Lake for Dry Water Year (1993-94) - Annual ppt. = 15.9 inches**									
Total Sediment captured relative to E20 (lb)	NA	NA	1,126	2,695					
Total Fines* captured relative to E20 (lb)	NA	NA	1,014	2,426					
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	2.2	5.3					
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	4.9	10.6					
Total Sediment in Runoff (lb)	12,245	2,695	1,569	0	41.8%	100.0%	78.0%	87.2%	100.0%
Fine Sediment* in Runoff (lb)	7347 - 11021	1617 - 2426	942 - 1412	0 - 0	41.8%	100.0%	78.0%	87.2%	100.0%
Total Phosphorous in Runoff (lb)	23.9	5.3	3.1	0.0	41.8%	100.0%	77.9%	87.2%	100.0%
Total Nitrogen in Runoff (lb)	56.7	10.6	5.7	0.0	46.5%	100.0%	81.3%	90.0%	100.0%

Water Balance (LSPC) Model	Existing Conditions	E20 Existing Conditions (20 yr Design)	C20 Alternative C (20 yr Design)	C100 Alternative C (100 yr Design)	Removal Fraction C20 vs. E20	Removal Fraction C100 vs. E20	Removal Fraction C20 vs. E19	Removal Fraction C20 vs. E20	Removal Fraction C100 vs. E20
Possible Loads to Lake for Wet Water Year (2005-06) - Annual ppt. = 47.4 inches**									
Total Sediment captured relative to E20 (lb)	NA	NA	9,902	20,921					
Total Fines* captured relative to E20 (lb)	NA	NA	8,912	18,829					
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	19.4	40.9					
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	33.7	69.0					
Total Sediment in Runoff (lb)	40,569	22,883	12,981	1,962	43.3%	91.4%	43.6%	68.0%	95.2%
Fine Sediment* in Runoff (lb)	24341 - 36512	13730 - 20595	7789 - 11683	1177 - 1766	43.3%	91.4%	43.6%	68.0%	95.2%
Total Phosphorous in Runoff (lb)	79.3	44.8	25.4	3.8	43.3%	91.4%	43.6%	68.0%	95.2%
Total Nitrogen in Runoff (lb)	151.6	76.0	42.3	6.9	44.4%	90.9%	49.9%	72.1%	95.4%
Possible Loads to Lake for Dry Water Year (2007-08) - Annual ppt. = 13.4 inches**									
Total Sediment captured relative to E20 (lb)	NA	NA	2,956	4,712					
Total Fines* captured relative to E20 (lb)	NA	NA	2,660	4,240					
Total Phosphorous (TP) captured relative to E20 (lb)	NA	NA	5.8	9.2					
Total Nitrogen (TN) captured relative to E20 (lb)	NA	NA	9.7	16.4					
Total Sediment in Runoff (lb)	11,091	4,860	1,904	148	60.8%	96.9%	56.2%	82.8%	98.7%
Fine Sediment* in Runoff (lb)	6655 - 9982	2916 - 4374	1142 - 1714	89 - 134	60.8%	96.9%	56.2%	82.8%	98.7%
Total Phosphorous in Runoff (lb)	21.7	9.5	3.7	0.3	60.8%	96.9%	56.2%	82.8%	98.7%
Total Nitrogen in Runoff (lb)	45.7	17.3	7.6	0.9	56.0%	94.8%	62.0%	83.3%	98.0%

* Assuming fine sediment particles (FSP) <20 microns are 60-90% of total sediment load.
Field monitoring of disturbed soils runoff indicates FSP load is >50% of total sedload for granitic soils.

** Based on Tahoe City daily rainfall that is greater than that at Crystal Bay

DEIS APPENDIX G
SUPPLEMENTAL INFORMATION

Boulder Bay LLC
Alternative C
BMP Contributing Areas - With TMDL Reduction Implementations
April 20, 2009

Buildings A and B (Gallery 2)

		Area	TMDL Strategy	TMDL SF	Factor	TMDL Reduction
Contributing Areas (SF)	12,134	Building A	Green Roof	15,167	20%	3,033
	0	Building B	SW Catchment	21,151	100%	21,151
	1,359	ADA Ramp at Park Entrance	Pervious Paver	658	50%	329
	19,833	Lakeview and Wassau (Washoe County)				
Total Contributing Area (SF)	33,326					

North Entrance (Gallery 3)

Contributing Areas (SF)	9,525	Entrance and Wellness Drive	Pervious Paver	15,140	50%	7,570
Total Contributing Area (SF)	9,525					

50yr/1hr Storm Accumulation (in)****

Building C (Gallery 4)

Contributing Areas (SF)	21,533	Building C	SW Catchment	15,987	100%	15,987
	972	Porte Cochere				
	4,496	North Portion of Boulder Way	Pervious Paver	4,948	50%	2,474
Total Contributing Area (SF)	27,001					

Building G (Infiltration Galleries 5, 6 & 7)

Contributing Areas (SF)	13,824	Building G	Green Roof	17,280	20%	3,456
	162	Building G Patio				
Total Contributing Area (SF)	13,986					

Crystal Bay Motel (Basin 3)

Contributing Areas (SF)	18,868	Hwy 28 (NDOT)				
	12,621	Crystal Bay Motel Site				
Total Contributing Area (SF)	31,489					

100yr/1hr Storm Accumulation (in)****

Nugget Parking Lot (Basin 4 and Gallery 10)

Contributing Areas (SF)	18,100	Nugget Parking Lot				
	1,443	Entrance to Nugget Parking Lot				
Total Contributing Area (SF)	19,543					

Southwest Project Site (Basins in southwest corner/Gallery 8)

Contributing Areas (SF)	7,486	Building D	SW Catchment	17,689	100%	17,689
	11,556	Building E	SW Catchment	6,456	100%	6,456
	12,679	Building F				
	17,833	Building H	Green Roof	18,256	20%	3,651
	10,272	Interior Road Portion	Pervious Paver	8,434	50%	4,217
	19,067	Interior Road Portion	Pervious Paver	12,093	50%	6,047
	24,638	Patio between Bldgs D&F				
	9,594	Patio below Building F				
	107	Driveway Entrance to Building D	Pervious Paver	498	50%	249
	1,467	Building H Patio				
Total Contributing Area (SF)	114,698					

Infiltration Trench 1 (Behind Bldg A)

Contributing Areas (SF)	1,660	Path behind Bldg A	Pervious Paver	3,317	50%	1,659
Total Contributing Area (SF)	1,660					

Infiltration Trench 2 (In front of Bldg C & G)

Contributing Areas (SF)	6,113	Sidewalk in front of Bldg C & G	Pervious Paver	5,066	50%	2,533
	271	Entrance Walkway to Bldg G				
Total Contributing Area (SF)	6,384					

Infiltration Trench 3 (In Front of Bldg H)

Contributing Areas (SF)	2,998	Sidewalk in front of Bldg H	Pervious Paver	2,521	50%	1,261
Total Contributing Area (SF)	2,998					

Infiltration Trench 4 (Southwest Corner of Site)

Boulder Bay LLC
Alternative C
BMP Contributing Areas - With TMDL Reduction Implementations
April 20, 2009

Contributing Areas (SF)	2,205	Sidewalk at southwest corner of site	Pervious Paver	3,261	50%	1,631
Total Contributing Area (SF)	2,205					

Infiltration Trench 5 (Park - Trails)

Contributing Areas (SF)	4,498	Park - Trails and Ammenities				
Total Contributing Area (SF)	4,498					

Gallery 9 (California Site)

Contributing Areas (SF)	54,450	NDOT Contribution from Brockway Existing Conditions Analysis by Placer County				
	32,386	Washoe County above 28				
	15,363	Washoe County below 28				
Total Contributing Area (SF)	102,199					

DEIS APPENDIX P
SUPPLEMENTAL INFORMATION

STORMWATER - ANNUAL LOADING ESTIMATES

North Basin
Area (Basin 6) 9.20
Coverage 3.59

	Annual Rainfall P	Fraction Pj	Impervious Ia	Runoff Rv	Annual Runoff R	Concentration C4	C9	C14	C(Avg)	Area A	Annual Load L
Ammonia, as Nitrogen (NH3)	31.49	0.90	0.39	0.40	11.365	0.44	0.29	0.05	0.26	9.20	6
Total Suspended Solids (TSS)	31.49	0.90	0.39	0.40	11.365	241.17	848.00	566.67	551.94	9.20	13,042
Dissolved Phosphorus as P (DP-P)	31.49	0.90	0.39	0.40	11.365	0.16	0.23	0.10	0.16	9.20	4
Total Phosphorus as P (TP-P)	31.49	0.90	0.39	0.40	11.365	0.68	0.98	0.56	0.74	9.20	17
Nitrate Nitrogen (NO3-N)	31.49	0.90	0.39	0.40	11.365	0.20	0.34	0.08	0.21	9.20	5
Nitrite Nitrogen (NO2-N)	31.49	0.90	0.39	0.40	11.365	0.02	0.04	0.02	0.03	9.20	1
Total Kjeldahl Nitrogen (TKN)	31.49	0.90	0.39	0.40	11.365	1.41	2.06	0.41	1.29	9.20	31
Total Nitrogen (TN)	31.49	0.90	0.39	0.40	11.365	1.62	2.45	0.50	1.52	9.20	36
Turbidity (Nephelometric)	31.49	0.90	0.39	0.40	11.365	344.83	702.00	330.00	458.94	9.20	NA
Oil & Grease (Gravimetric)	31.49	0.90	0.39	0.40	11.365	6.05	9.82	5.33	7.07	9.20	167
Total Iron (Fe)	31.49	0.90	0.39	0.40	11.365	4.80	8.36	9.30	7.49	9.20	177
TSS .25um	31.49	0.90	0.39	0.40	11.365	93.67	264.00	454.00	270.56	9.20	6,393

South Basin
Area (Basin 3,4,5) 6.10 (Basin 3, 4, 5)
Coverage 5.49

	Annual Rainfall P	Fraction Pj	Impervious Ia	Runoff Rv	Annual Runoff R	Concentration C3	C5	C6	C(Avg)	Area A	Annual Load L	Annual Load Total B1 +B2
Ammonia, as Nitrogen (NH3)	31.49	0.90	0.90	0.86	24.37	0.45	0.49	0.80	0.58	6.10	19	26
Total Suspended Solids (TSS)	31.49	0.90	0.90	0.86	24.37	313.33	1,205.33	444.00	654.22	6.10	21,983	35,025
Dissolved Phosphorus as P (DP-P)	31.49	0.90	0.90	0.86	24.37	0.18	0.23	0.49	0.30	6.10	10	14
Total Phosphorus as P (TP-P)	31.49	0.90	0.90	0.86	24.37	0.78	0.59	1.23	0.87	6.10	29	47
Nitrate Nitrogen (NO3-N)	31.49	0.90	0.90	0.86	24.37	0.34	0.40	0.65	0.46	6.10	16	21
Nitrite Nitrogen (NO2-N)	31.49	0.90	0.90	0.86	24.37	0.04	0.04	0.04	0.04	6.10	1	2
Total Kjeldahl Nitrogen (TKN)	31.49	0.90	0.90	0.86	24.37	1.43	2.46	3.11	2.34	6.10	78	109
Total Nitrogen (TN)	31.49	0.90	0.90	0.86	24.37	1.81	2.91	3.81	2.84	6.10	96	132
Turbidity (Nephelometric)	31.49	0.90	0.90	0.86	24.37	239.17	376.17	217.00	277.44	6.10	NA	NA
Oil & Grease (Gravimetric)	31.49	0.90	0.90	0.86	24.37	9.00	13.80	9.25	10.68	6.10	359	526
Total Iron (Fe)	31.49	0.90	0.90	0.86	24.37	4.73	5.31	5.32	5.12	6.10	172	349
TSS >25um	31.49	0.90	0.90	0.86	24.37	235.33	312.83	328.83	292.33	6.10	9,823	16,216

3-Oct-08	C3	C4	C5	C6	C9	C14
Ammonia, as Nitrogen (NH3)	1.60	1.80	1.50	3.10	0.82	
Total Suspended Solids (TSS)	92.00	460.00	110.00	200.00	1,400.00	
Dissolved Phosphorus as P (DP-P)	0.48	0.45	0.44	1.30	0.25	
Total Phosphorus as P (TP-P)	0.12	1.10	1.00	2.00	0.66	
Nitrate Nitrogen (NO3-N)	1.40	0.51	1.10	2.30	1.30	
Nitrite Nitrogen (NO2-N)	0.11	0.01	0.12	0.13	0.17	
Total Kjeldahl Nitrogen (TKN)	4.10	5.10	4.00	9.50	6.50	
Total Nitrogen (TN)	5.60	5.60	5.30	12.00	8.00	
Turbidity (Nephelometric)	93.00	310.00	86.00	140.00	1,300.00	
Oil & Grease (Gravimetric)	2.00	2.30	2.40	2.00	2.10	
Total Iron (Fe)						
TSS >25um						
% TSS <25 um						
Estimate Q	0.23	0.14	0.15	0.02	0.06	

Boulder Bay - Annual Laoding Estimates based on Stormwater Monitoring (2008-2009)

1-Nov-08	C3	C4	C5	C6	C9	C14
Ammonia, as Nitrogen (NH3)	0.71	0.53	1.00	1.10	0.44	
Total Suspended Solids (TSS)	36.00	37.00	38.00	45.00	610.00	
Dissolved Phosphorus as P (DP-P)	0.17	0.16	0.71	0.97	0.43	
Total Phosphorus as P (TP-P)	2.90	1.60	1.20	1.80	2.20	
Nitrate Nitrogen (NO3-N)	0.26	0.11	0.87	0.75	0.22	
Nitrite Nitrogen (NO2-N)	0.01	0.01	0.01	0.01	0.01	
Total Kjeldahl Nitrogen (TKN)	2.50	0.93	7.90	6.10	2.20	
Total Nitrogen (TN)	2.80	1.00	8.70	6.90	2.40	
Turbidity (Nephelometric)	35.00	39.00	59.00	64.00	330.00	
Oil & Grease (Gravimetric)	4.30	3.00	4.00	3.40	7.00	
Total Iron (Fe)						
TSS >25um						
% TSS <25 um						
Estimate Q	0.21	0.12	0.13	0.02	0.05	

2-Jan-09	C3	C4	C5	C6	C9	C14
Ammonia, as Nitrogen (NH3)	0.09	0.14	0.14	0.14		
Total Suspended Solids (TSS)	240.00	320.00	230.00	220.00		
Dissolved Phosphorus as P (DP-P)	0.10	0.07	0.06	0.27		
Total Phosphorus as P (TP-P)	0.17	0.19	0.08	0.33		
Nitrate Nitrogen (NO3-N)	0.08	0.26	0.20	0.39		
Nitrite Nitrogen (NO2-N)	0.03	0.04	0.04	0.03		
Total Kjeldahl Nitrogen (TKN)	0.55	0.75	1.50	1.10		
Total Nitrogen (TN)	0.66	1.10	1.80	1.50		
Turbidity (Nephelometric)	520.00	580.00	250.00	250.00		
Oil & Grease (Gravimetric)	23.00	16.00	28.00	16.00		
Total Iron (Fe)	2.60	4.40	1.10	1.30		
TSS >25um	40.00	76.00	60.00	120.00		
% TSS <25 um	83%	76%	74%	45%		
Estimate Q	0.233	0.14	0.145	0.022		

22-Jan-09	C3	C4	C5	C6	C9	C14
Ammonia, as Nitrogen (NH3)	0.18	0.06	0.22	0.12	0.08	0.05
Total Suspended Solids (TSS)	1,300.00	380.00	6,700.00	2,000.00	1,300.00	760.00
Dissolved Phosphorus as P (DP-P)	0.12	0.12	0.11	0.14	0.31	0.22
Total Phosphorus as P (TP-P)	0.87	0.44	0.89	2.30	1.00	0.61
Nitrate Nitrogen (NO3-N)	0.18	0.17	0.15	0.14	0.12	0.20
Nitrite Nitrogen (NO2-N)	0.05	0.06	0.06	0.01	0.01	0.05
Total Kjeldahl Nitrogen (TKN)	0.56	0.20	0.54	0.47	0.51	0.34
Total Nitrogen (TN)	0.79	0.42	0.74	0.60	0.63	0.58
Turbidity (Nephelometric)	580.00	700.00	1,700.00	680.00	1,100.00	600.00
Oil & Grease (Gravimetric)	16.00	4.90	39.00	23.00	7.00	5.70
Total Iron (Fe)	18.00	14.00	29.00	27.00	30.00	20.00
TSS >25um	1,200.00	270.00	1,700.00	1,700.00	840.00	550.00
% TSS <25 um	8%	29%	75%	15%	35%	28%
Estimate Q	0.233	0.14	0.145	0.022	0.06	0.133

22-Feb-09	C3	C4	C5	C6	C9	C14
Ammonia, as Nitrogen (NH3)	0.054	0.080	0.054	0.16	0.05	0.05
Total Suspended Solids (TSS)	52	150	130	79	610	140
Dissolved Phosphorus as P (DP-P)	0.12	0.064	0.030	0.01	0.050	0.021
Total Phosphorus as P (TP-P)	0.29	0.46	0.27	0.52	0.42	0.15
Nitrate Nitrogen (NO3-N)	0.096	0.10	0.023	0.19	0.015	0.033
Nitrite Nitrogen (NO2-N)	0.01	0.01	0.01	0.01	0.017	0.01
Total Kjeldahl Nitrogen (TKN)	0.84	1.4	0.75	1.2	1.0	0.47
Total Nitrogen (TN)	0.94	1.5	0.78	1.4	1.1	0.50
Turbidity (Nephelometric)	150	360	150	120	610	190
Oil & Grease (Gravimetric)	2.8	4.8	7.1	7.2	28	5.9
Total Iron (Fe)	3.6	6.3	1.3	1.4	7.7	3.4
TSS >25um	12.00	150.00	93.00	53.00	200.00	82.00
% TSS <25 um	77%	0%	28%	33%	67%	41%
Estimate Q						

2-Mar-09	C3	C4	C5	C6	C9	C14
Ammonia, as Nitrogen (NH3)	0.05	0.05	0.05	0.16	0.058	0.05
Total Suspended Solids (TSS)	160	100	24	120	320	800
Dissolved Phosphorus as P (DP-P)	0.066	0.083	0.040	0.23	0.13	0.055
Total Phosphorus as P (TP-P)	0.31	0.28	0.075	0.45	0.63	0.91
Nitrate Nitrogen (NO3-N)	0.054	0.066	0.054	0.12	0.041	0.01
Nitrite Nitrogen (NO2-N)	0.01	0.01	0.01	0.050	0.01	0.01
Total Kjeldahl Nitrogen (TKN)	0.05	0.05	0.083	0.30	0.092	0.42
Total Nitrogen (TN)	0.07	0.07	0.14	0.47	0.13	0.42
Turbidity (Nephelometric)	57	80	12	48	170	200
Oil & Grease (Gravimetric)	5.9	5.3	2.3	3.9	5.0	4.4
Total Iron (Fe)	4.2	4.1	0.48	2.2	4.1	4.5
TSS >25um	160.00	66.00	24.00	100.00	280.00	730.00
% TSS <25 um	0%	34%	0%	17%	13%	9%
Estimate Q						

Average	C3	C4	C5	C6	C9	C14
Ammonia, as Nitrogen (NH3)	0.45	0.44	0.49	0.80	0.29	0.05
Total Suspended Solids (TSS)	313.33	241.17	1,205.33	444.00	848.00	566.67
Dissolved Phosphorus as P (DP-P)	0.18	0.16	0.23	0.49	0.23	0.10
Total Phosphorus as P (TP-P)	0.78	0.68	0.59	1.23	0.98	0.56
Nitrate Nitrogen (NO3-N)	0.34	0.20	0.40	0.65	0.34	0.08
Nitrite Nitrogen (NO2-N)	0.04	0.02	0.04	0.04	0.04	0.02
Total Kjeldahl Nitrogen (TKN)	1.43	1.41	2.46	3.11	2.06	0.41
Total Nitrogen (TN)	1.81	1.62	2.91	3.81	2.45	0.50
Turbidity (Nephelometric)	239.17	344.83	376.17	217.00	702.00	330.00
Oil & Grease (Gravimetric)	9.00	6.05	13.80	9.25	9.82	5.33
Total Iron (Fe)	4.73	4.80	5.31	5.32	8.36	9.30
TSS >25um	235.33	93.67	312.83	328.83	264.00	454.00
% TSS <25 um	25%	61%	74%	26%	69%	20%

Boulder Bay LLC
BMP Calculations - Existing Conditions
PN: 7139.000
December 18, 2009

	BILTMORE SITE	WASSOU & LAKEVIEW	CB MOTEL	BILTMORE OFFICES	BILTMORE SITE	BILTMORE SITE	MARINER SITE	
Biltmore Site 123-052-02, 123-052-03, 123-052-04, 123-053-02	**BASIN #1**	**BASINS #2 & #3**	**BASINS #4 & #5**	**GALLERY #1**	**GALLERY #2**	**GALLERY #3**	**INFIL TRENCH**	**Totals**
Coverage Type		**Area (SF)**						
Building	43,160	0	0	0	9,069			52,229
Paving	57,022	0	0	0	25,187	54,499		136,708
Deck	217	0	0	0	2,425			2,642
Total Contributing Area (SF)	**100,399**	**0**	**0**	**0**	**36,681**	**54,499**	**0**	**191,579**
20yr 1hr Storm Volume (CF)	**8,367**	**0**	**0**	**0**	**3,057**	**4,542**	**0**	**15,965**

Biltmore Offices (Below Water Tank) 123-053-04	**BASIN #1**	**BASINS #2 & #3**	**BASINS #4 & #5**	**GALLERY #1**	**GALLERY #2**	**GALLERY #3**	**INFIL TRENCH**	**Totals**
Coverage Type		**Area (SF)**						
Building	0	0	0	1428	0	0		1,428
Paving	0	0	0	4010	0	0		4,010
Deck	0	0	0	323	0	0		323
Total Contributing Area (SF)	**0**	**0**	**0**	**5,761**	**0**	**0**	**0**	**5,761**
20yr 1hr Storm Volume (CF)	**0**	**0**	**0**	**480**	**0**	**0**	**0**	**480**

Corner of Reservoir and Wassou 123-054-01	**BASIN #1**	**BASINS #2 & #3**	**BASINS #4 & #5**	**GALLERY #1**	**GALLERY #2**	**GALLERY #3**	**INFIL TRENCH**	**Totals**
Coverage Type		**Area (SF)**						
Building	0	2,478	0	0				2,478
Paving	0	20,363	0	0				20,363
Deck	0	78	0	0				78
Total Contributing Area (SF)	**0**	**22,919**	**0**	**0**	**0**	**0**	**0**	**22,919**
20yr 1hr Storm Volume (CF)	**0**	**1,910**	**0**	**0**	**0**	**0**	**0**	**1,910**

Mariner Site 123-071-34	**BASIN #1**	**BASINS #2 & #3**	**BASINS #4 & #5**	**GALLERY #1**	**GALLERY #2**	**GALLERY #3**	**INFIL TRENCH**	**Totals**
Coverage Type		**Area (SF)**						
Building	0	0	0	0	0	0	0	0
Paving	0	0	0	0	0	0	2,790	2,790
Deck	0	0	0	0	0	0	0	0
Total Contributing Area (SF)	**0**	**0**	**0**	**0**	**0**	**0**	**2,790**	**2,790**
20yr 1hr Storm Volume (CF)	**0**	**0**	**0**	**0**	**0**	**0**	**233**	**233**

Crystal Bay Motel
123-042-01, 123-042-02

Coverage Type	**BASIN #1**	**BASINS #2 & #3**	**BASINS #4 & #5**	**GALLERY #1**	**GALLERY #2**	**GALLERY #3**	**INFIL TRENCH**	**Totals**
	Area (SF)							
Building	0	0	5,964	0	0	0	0	5,964
Paving	0	0	14,935	0	0	0	0	14,935
Deck	0	0	1,135	0	0	0	0	1,135
Parking Lot	0	0	18,157	0	0	0	0	18,157
Total Contributing Area (SF)	**0**	**0**	**40,191**	**0**	**0**	**0**	**0**	**40,191**
20yr 1hr Storm Volume (CF)	**0**	**0**	**3,349**	**0**	**0**	**0**	**0**	**3,349**
Total 20yr Storm Volume (CF)	**8,367**	**1,910**	**3,349**	**480**	**3,057**	**4,542**	**233**	**21,937**

DETENTION BASIN CAPACITIES

Basin	BASIN #1 SW COR BILTMORE	BASIN # 2 APN 123-054-01 (Upper)	BASIN #3 APN 123-054-01 (Lower)	BASIN #4 Crystal Bay Hotel 1	BASIN #5 Crystal Bay Hotel 2
Rim Elev.	6408	6469	6460	6401	6399
Bottom Elev.	6406	6466.5	6458	6400	6397
Depth (ft)	2.0	2.5	2.0	1.0	2.0
Rim Area (sf)	4,579	920	269	840	1,900
Bottom Area (sf)	2,611	185	46	350	525
Average Area (sf)	3,595	553	158	595	1,213
Ksat (in/hr)	4	4	4	4	4
Volume (CF)	7,190	1,381	315	595	2,425
Inf. Capacity (CF)	1,198	184	53	198	404
Total Capacity (CF)	**8,388**	1,565	368	793	2,829
		Combined #2+#3	**1,933**	**Combined#4+#5**	**3,623**

Infiltration Gallery Capacity Calculations

Gallery #	**1**	**2**	**3**	**INFIL TRENCH**
Length, L (ft)	12.00	18.00	48.00	30.00
Width, W (ft)	9.00	24.00	21.00	3.00
Depth, H (ft)	4.50	7.50	4.50	6.00
Void Ratio	0.95	0.95	0.95	0.33
Storage Capacity (CF)	462	3,078	4,309	178
Infiltration Capacity (CF)	48	174	384	70
Total Capacity (CF)	**510**	**3,252**	**4,693**	**248**

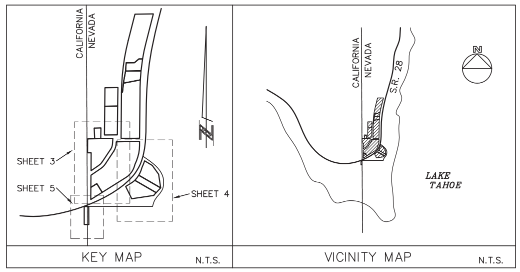
Notes:

- Gallery dimensions based on StormTank unit dimensions.
- StormTank literature quotes a Void Ratio of 0.97. 0.95 is used in the calculations to be conservative.

BOULDER BAY MASTER PLAN

BMP RETROFIT for EXISTING CONDITIONS

DECEMBER, 2009



OWNER/DEVELOPER:

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ENGINEER:

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LEGEND

EXISTING / PROPOSED

- HYDRANT
- UTILITY POLE
- SPOT ELEV. (+99.28)
- A.C. PAVEMENT
- P.C.C. SIDEWALK or GUTTER
- TO BE REMOVED
- AGG. BASE
- RIP-RAP
- CONTOUR
- UNDERGROUND UTILITY LINES
- FENCE
- PROPERTY LINE OR R/W LINE
- SECTION LINE
- CENTER LINE
- EASEMENT LINE
- FLOW LINE
- CONTROL POINT
- SOIL TEST PIT
- WATER VALVE
- GAS VALVE
- SANITARY SEWER MANHOLE
- TELEPHONE MANHOLE
- TELEPHONE BOX
- WATER METER
- GAS METER
- POWER VAULT
- CATCH BASIN
- EXISTING TREE
- EXISTING TREE TO BE REMOVED
- GRADEBREAK
- ORANGE CONSTRUCTION FENCE
- SILT FENCE / SEDIMENT ROLL
- CHAIN LINK CONST. FENCE
- DETAIL REFERENCE
- FOUND AS NOTED
- NOTHING FOUND OR SET
- TELEPHONE MANHOLE
- STORM MANHOLE
- D.I. DRAIN INLET
- C/O CLEAN OUT
- LIGHT
- SIGN
- UTILITY AS NOTED
- BENCH W/ TRASH ENCLOSURES (T.E.)
- TREE, DIAMETER & TYPE (o12"P) P=PINE, F=FIR, C=CEDAR
- SPOT ELEVATION (104.9 GR) FL=FLOWLINE, GR=GRATE, TW=TOP WALL, BW=BOTTOM WALL

BASIS OF BEARING:

-

BASIS OF ELEVATION:

THE DATUM OF THIS SURVEY IS NAVD 88 AND IS BASED ON A 2" BRASS DISC (NDOT 925002A), ELEV.=6426.55', LOCATED ON THE SOUTH R/W OF STATE ROUTE 28 IN FRONT OF "THE BEARS DEN". THE ACCURACY OF THIS SURVEY IS ONE-HALF CONTOUR INTERVAL.

GENERAL NOTES:

1. THE CONTRACTOR SHALL OBTAIN A PERMIT FOR PUBLIC WORKS CONSTRUCTION FROM WASHOE COUNTY PUBLIC WORKS DEPARTMENT PRIOR TO THE START OF CONSTRUCTION.
2. THE OWNER/CONTRACTOR SHALL CALL THE WASHOE COUNTY PUBLIC WORKS DEPARTMENT (887-2300) FORTY-EIGHT (48) HOURS PRIOR TO THE START OF CONSTRUCTION. THE OWNER/CONTRACTOR SHALL CALL TWENTY-FOUR (24) HOURS PRIOR TO REQUIRED INSPECTIONS AND TESTING. THE REQUIRED INSPECTIONS AND TESTING ARE LISTED ON THE INSPECTION RECORD ISSUED WITH EACH PERMIT. THE CONTRACTOR MUST HAVE THE PERMIT NUMBER AND THE DESCRIPTION LISTED ON THE INSPECTION RECORD TO SCHEDULE REQUIRED INSPECTIONS AND TESTING.
3. ALL WORK SHALL CONFORM TO THE STANDARD SPECIFICATIONS AND DETAILS FOR PUBLIC WORKS CONSTRUCTION AS ADOPTED BY WASHOE COUNTY. THE OWNER/CONTRACTOR SHALL OBTAIN A PERMIT FOR PUBLIC WORKS CONSTRUCTION FROM THE WASHOE COUNTY PUBLIC WORKS DEPARTMENT, ENGINEERING DIVISION PRIOR TO THE START OF CONSTRUCTION.
4. DETAILS NOT SHOWN ON THESE DRAWINGS SHALL BE AS CONTAINED IN THE BOOK OF STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION AS ADOPTED BY WASHOE COUNTY, OR THE CURRENT EDITION OF STANDARD SPECIFICATIONS AND DETAILS FOR ROAD AND BRIDGE CONSTRUCTION AS PUBLISHED BY NDOT FOR WORK WITHIN THE NDOT RIGHT-OF-WAY.
5. THE LOCATION OF EXISTING UTILITIES SHOWN ON THESE DRAWINGS IS BASED ON THE BEST INFORMATION AVAILABLE TO THE ENGINEER. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO VERIFY THESE LOCATIONS AT THE PROPOSED POINTS OF CONNECTIONS AND IN AREAS OF POSSIBLE CONFLICT WITH NEW UTILITY INSTALLATION, PRIOR TO BEGINNING CONSTRUCTION. SHOULD THE CONTRACTOR FIND ANY DISCREPANCIES BETWEEN THE CONDITIONS EXISTING IN THE FIELD AND THE INFORMATION SHOWN ON THESE DRAWINGS, HE SHALL NOTIFY THE ENGINEER BEFORE PROCEEDING WITH CONSTRUCTION.
6. IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES THE CONTRACTOR WILL BE SOLELY AND COMPLETELY RESPONSIBLE FOR THE CONDITIONS OF THE JOB SITE, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK. THIS REQUIREMENT WILL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN AND CONSTRUCTION OF PROPER SHORING OF TRENCHES IN ACCORDANCE WITH OCCUPATIONAL SAFETY LAWS. THE DUTIES OF THE PROJECT CIVIL ENGINEER DO NOT INCLUDE REVIEW OF THE ADEQUACY OF THE CONTRACTORS SAFETY IN, ON OR NEAR THE CONSTRUCTION SITE.
7. SHOULD IT APPEAR THAT THE WORK TO BE DONE, OR ANY MATTER RELATIVE THERETO, IS NOT SUFFICIENTLY DETAILED OR EXPLAINED ON THESE PLANS, THE CONTRACTOR SHALL CONTACT THE PROJECT ENGINEER FOR SUCH FURTHER EXPLANATIONS AS MAY BE NECESSARY PRIOR TO COMMENCING WORK.
8. THE OWNER/CONTRACTOR SHALL CALL UNDERGROUND SERVICE ALERT "CALL BEFORE YOU DIG" (1-800-227-2600) FORTY-EIGHT (48) HOURS PRIOR TO THE START OF CONSTRUCTION.
9. ALL CLEARING, GRADING OR FILLING OF LAND IS SUBJECT TO CHAPTER 33, OF THE UNIFORM BUILDING CODE AS ADOPTED BY WASHOE COUNTY. ANY CLEARING, GRADING OR FILLING OF LAND OF ONE ACRE OR MORE WILL ALSO REQUIRE A PERMIT FROM THE NEVADA DEPARTMENT OF ENVIRONMENTAL PROTECTION FOR AIR QUALITY AND STORM DISCHARGE PURPOSES.

14. ALL TRAFFIC CONTROL AND BARRICADING WITHIN THE WASHOE COUNTY RIGHT-OF-WAY SHALL CONFORM TO SECTION 330 OF THE STANDARD SPECIFICATIONS, PART VI OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, LATEST EDITION AND THE NEVADA WORK ZONE TRAFFIC CONTROL HANDBOOK, 1986 EDITION. NO STREET CLOSURES WILL BE ALLOWED WITHOUT APPROVAL OF A TRAFFIC CONTROL PLAN BY THE WASHOE COUNTY ENGINEER.

ABBREVIATION

AC	ASPHALT CONCRETE	GD	GROUND	REF	REFERENCE
ACP	ASBESTOS CEMENT PIPE	GV	GATE VALVE	RET	CURB RETURN
AGG	AGGREGATE	H	HANDICAPPED	RP	RADIUS POINT
BC	BEGIN CURVE (HORIZONTAL)	HGL	HYDRAULIC GRADE LINE	RT	RIGHT
BOW	BACK OF WALK	HORIZ	HORIZONTAL	R/W, ROW	RIGHT-OF-WAY
BF, BOF	BOTTOM OF FOOTING	HP	HIGH POINT	S=	SLOPE (FT./FT.)
BV	BUTTERFLY VALVE	ID	INSIDE DIAMETER	S	SOUTH
BVC	BEGIN VERTICAL CURVE	IE	INVERT ELEVATION	SD	STORM DRAIN
BW	BOTH WAYS	INT	INTERSECTION	SDMH	STORM DRAIN MANHOLE
CB	CATCH BASIN	IRR	IRRIGATION	SL	STREET LIGHT
cfs	CUBIC FEET PER SECOND	LAT	LATERAL	SS	SANITARY SEWER
C&G	CURB AND GUTTER	LF	LINEAR FEET	SSCO	SANITARY SEWER CLEAN OUT
℄	CENTER LINE	LT	LEFT	SSMH	SANITARY SEWER MANHOLE
CL	CLASS	MAX	MAXIMUM	SSPWC	STANDARD SPEC. for PUBLIC WORKS CONST.
CMP	CORRUGATED METAL PIPE	MDD	MAXIMUM DRY DENSITY	STA	STATION
COMP	COMPACTION	MH	MANHOLE	SW	SIDEWALK
CONC	CONCRETE	MIN	MINIMUM	TELE	TELEPHONE
CP	CONCRETE PAD	MMD	MAXIMUM MARSHALL DENSITY	TBO	TEMPORARY BLOW OFF VALVE
CTV	CABLE TELEVISION	MUTCD	MANUAL FOR TRAFFIC CONTROL DEVICES	TC	TOP OF CURB
D.E.	DRAINAGE EASEMENT	N	NORTH	TG	TO GRADE
DI	DROP INLET	NAP	NOT A PART	TOB	TOP OF BERM
DIA	DIAMETER	NIP	NOT IN PROJECT	TF, TOF	TOP OF FOOTING
DWY	DRIVEWAY	NTS	NOT TO SCALE	TW, TOW	TOP OF WALL
E	EAST	OC	ON CENTER	TS	TRAFFIC SIGNAL
EA	EACH	OD	OUTSIDE DIAMETER	TSCB	TRAFFIC SIGNAL CONTROL BOX
EC	END CURVE (HORIZONTAL)	OH	OVERHEAD	TRANS	TRANSITION
ELL	ELBOW	PCC	PORTLAND CEMENT CONCRETE	TYP	TYPICAL
ELEC	ELECTRICAL	PG	PAD GRADE	UG/P	UNDER GROUND POWER
ELEV	ELEVATION	PI	POINT OF INTERSECTION	U.N.O.	UNLESS NOTED OTHERWISE
EVC	END VERTICAL CURVE	PIVC	POINT OF INTERSECTION VERTICAL CURVE	V_5	VELOCITY AT 5 YEAR PEAK
EX, EXIST	EXISTING	PL	PROPERTY LINE	VC	VERTICAL CURVE
EXT	EXTERIOR	POCC	POINT OF COMPOUND CURVATURE	VEL	VELOCITY
FE	FINISH ELEVATION	POT	POINT OF TANGENCY	VERT	VERTICAL
FF	FINISH FLOOR	PP	POWER POLE	VG	VALLEY GUTTER
FFC	FRONT FACE OF CURB	PRC	POINT OF REVERSE CURVE	W	WEST
FG	FINISH GRADE	PRVC	POINT OF REVERSE VERTICAL CURVE	W/G	WATER AND GAS
FH	FIRE HYDRANT	PVC	POLYVINYL CHLORIDE	WL	WATER LINE
FL	FLOW LINE	PVMT	PAVEMENT	WM	WATER METER
fps	FEET PER SECOND	P.U.E.	PUBLIC UTILITY EASEMENT	WS	WATER SURFACE
FTG	FOOTING	Q_5	5 YEAR PEAK FLOW	WV	WATER VALVE
G	GAS	Q_{100}	100 YEAR PEAK FLOW	WWF	WELDED WIRE FABRIC
GALV	GALVANIZED	R	RADIUS		
GB	GRADE BREAK	RCP	REINFORCED CONCRETE PIPE		

APPROVED BY:

WASHOE COUNTY PUBLIC WORKS DEPARTMENT DATE

PLACER COUNTY PUBLIC WORKS DEPARTMENT DATE

SHEET INDEX:

REGISTERED PROFESSIONAL ENGINEER BRIAN E. McRAE No. C 59100 CIVIL STATE OF CALIFORNIA

PROFESSIONAL ENGINEER STATE OF NEVADA BRIAN E. McRAE EXP. 12/31/07 CIVIL No. 14393

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BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
TITLE SHEET

CRYSTAL BAY | WASHOE COUNTY | NEVADA

REV	DATE	DESCRIPTION	BY

C1

DATE: DECEMBER 2009
DRAWN BY: SJR
DESIGNED BY: BM
CHECKED BY: BM
JOB NO.: 7139.000

T:\lapro\7139-000 BOULDER BAY MASTER PLAN\dwg\7139BMP_XCond BEM.dwg,C2 Index Map,
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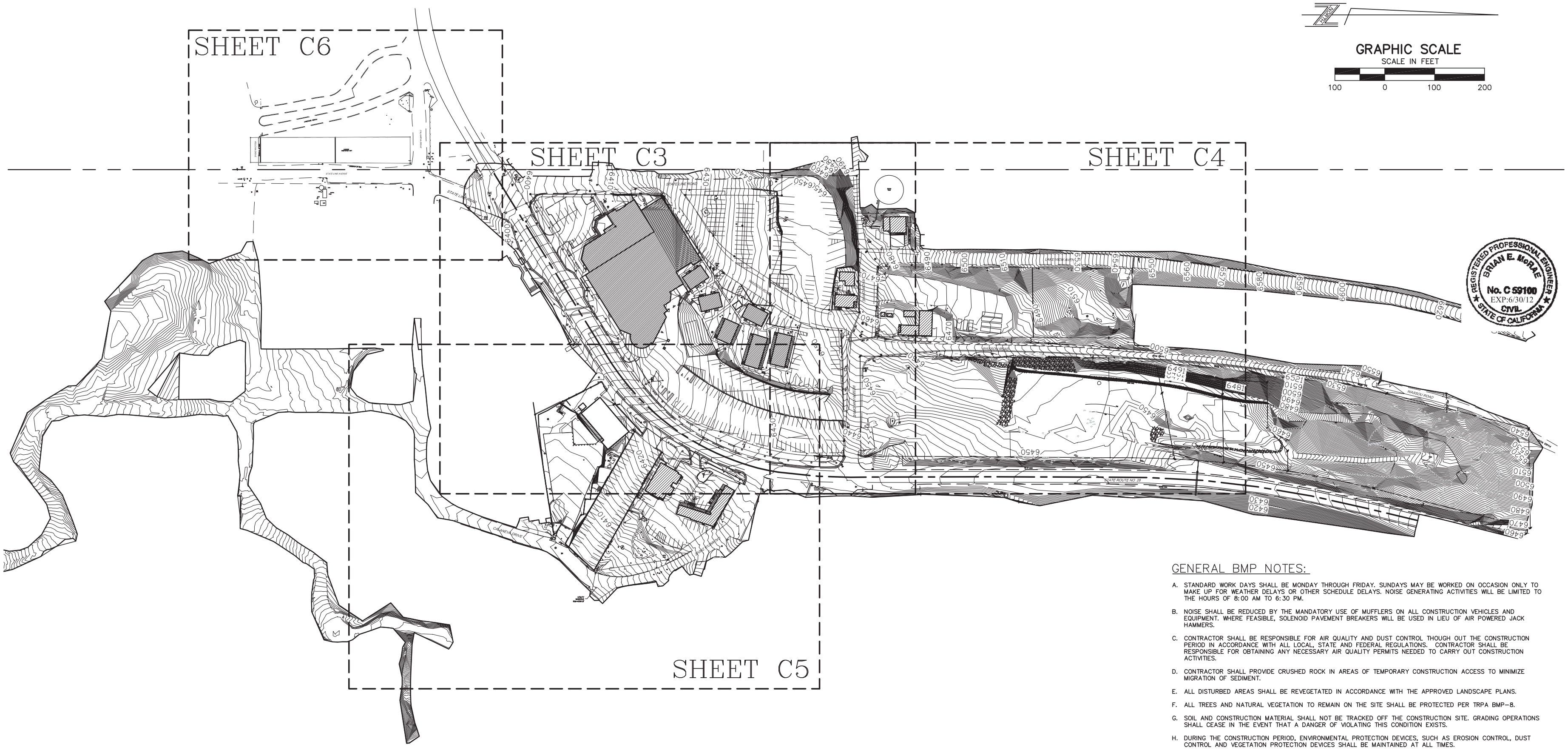

GENERAL BMP NOTES:

A. STANDARD WORK DAYS SHALL BE MONDAY THROUGH FRIDAY. SUNDAYS MAY BE WORKED ON OCCASION ONLY TO MAKE UP FOR WEATHER DELAYS OR OTHER SCHEDULE DELAYS. NOISE GENERATING ACTIVITIES WILL BE LIMITED TO THE HOURS OF 8:00 AM TO 6:30 PM.

B. NOISE SHALL BE REDUCED BY THE MANDATORY USE OF MUFFLERS ON ALL CONSTRUCTION VEHICLES AND EQUIPMENT. WHERE FEASIBLE, SOLENOID PAVEMENT BREAKERS WILL BE USED IN LIEU OF AIR POWERED JACK HAMMERS.

C. CONTRACTOR SHALL BE RESPONSIBLE FOR AIR QUALITY AND DUST CONTROL THOUGH OUT THE CONSTRUCTION PERIOD IN ACCORDANCE WITH ALL LOCAL, STATE AND FEDERAL REGULATIONS. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY NECESSARY AIR QUALITY PERMITS NEEDED TO CARRY OUT CONSTRUCTION ACTIVITIES.

D. CONTRACTOR SHALL PROVIDE CRUSHED ROCK IN AREAS OF TEMPORARY CONSTRUCTION ACCESS TO MINIMIZE MIGRATION OF SEDIMENT.

E. ALL DISTURBED AREAS SHALL BE REVEGETATED IN ACCORDANCE WITH THE APPROVED LANDSCAPE PLANS.

F. ALL TREES AND NATURAL VEGETATION TO REMAIN ON THE SITE SHALL BE PROTECTED PER TRPA BMP-8.

G. SOIL AND CONSTRUCTION MATERIAL SHALL NOT BE TRACKED OFF THE CONSTRUCTION SITE. GRADING OPERATIONS SHALL CEASE IN THE EVENT THAT A DANGER OF VIOLATING THIS CONDITION EXISTS.

H. DURING THE CONSTRUCTION PERIOD, ENVIRONMENTAL PROTECTION DEVICES, SUCH AS EROSION CONTROL, DUST CONTROL AND VEGETATION PROTECTION DEVICES SHALL BE MAINTAINED AT ALL TIMES.

I. LOOSE SOIL MOUNDS OR SURFACES SHALL BE PROTECTED FROM WIND OR WATER EROSION BY BEING APPROPRIATELY COVERED WHEN CONSTRUCTION IS NOT IN ACTIVE PROGRESS OR WHEN REQUIRED BY TRPA.

J. EXCAVATED MATERIAL SHALL BE STORED UPGRADE FROM THE EXCAVATED AREA WHENEVER POSSIBLE. NO MATERIAL SHALL BE STORED IN ANY STREAM ENVIRONMENT ZONE (SEZ) OR WET AREA.

K. ONLY EQUIPMENT OF A SIZE AND TYPE THAT WILL DO THE LEAST AMOUNT OF DAMAGE, UNDER PREVAILING SITE CONDITIONS, AND CONSIDERING THE NATURE OF THE WORK TO BE PERFORMED, WILL BE USED.

L. NO WASHING OF VEHICLES OR HEAVY EQUIPMENT SHALL BE PERMITTED ANYWHERE ON THE SUBJECT PROPERTY UNLESS AUTHORIZED BY TRPA IN WRITING.

M. NO VEHICLE OR HEAVY EQUIPMENT SHALL BE ALLOWED IN A STREAM ENVIRONMENT ZONE OR WET AREA EXCEPT AS AUTHORIZED BY TRPA.

N. ALL CONSTRUCTION SHALL BE WINTERIZED BY OCTOBER 15 TO REDUCE THE WATER QUALITY IMPACTS ASSOCIATED WITH WINTER WEATHER AS FOLLOWS:

   1. FOR THE SITES THAT WILL BE INACTIVE BETWEEN OCTOBER 15 AND MAY 1:

      a. TEMPORARY EROSION CONTROLS SHALL BE INSTALLED
      b. TEMPORARY VEGETATION PROTECTION FENCING SHALL BE INSTALLED
      c. DISTURBED AREAS SHALL BE STABILIZED
      d. ONSITE CONSTRUCTION SLASH AND DEBRIS SHALL BE CLEANED UP AND REMOVED
      e. WHERE FEASIBLE, MECHANICAL STABILIZATION AND DRAINAGE IMPROVEMENTS SHALL BE INSTALLED
      f. SPOIL PILES SHALL BE REMOVED FROM THE SITE

   2. FOR THE SITES THAT WILL BE ACTIVE BETWEEN OCTOBER 15 AND MAY 1, IN ADDITION TO THE ABOVE REQUIREMENTS:

      a. PERMANENT MECHANICAL EROSION CONTROL DEVICES SHALL BE INSTALLED, INCLUDING PAVING OF THE DRIVEWAYS AND PARKING AREAS.
      b. PARKING OF VEHICLES AND STORAGE OF BUILDING MATERIALS SHALL BE RESTRICTED TO PAVED AREAS.

O. CONSTRUCTION STAGING AND MATERIAL STORAGE SHALL BE LOCATED ONSITE ON PAVED SURFACES OR PREVIOUSLY DISTURBED AREAS AND SHALL BE FITTED WITH TEMPORARY BMPS, INCLUDING CONSTRUCTION LIMIT FENCING. STORAGE AREAS WILL BE POSITIONED WHERE THEY WILL HAVE THE LEAST AMOUNT OF IMPACT ON THE SOILS. ANY MATERIAL NOT STORED ONSITE SHALL BE HAULED OUT OF THE BASIN TO A TRPA APPROVED DISPOSAL SITE.

P. CONSTRUCT SILT-FENCES TO PREVENT MIGRATION OF SEDIMENT. APPLIES TO ALL AREAS DOWN GRADIENT FROM CONSTRUCTION ACTIVITIES.

Q. CONSTRUCT TREE PROTECTION FENCING PER TRPA, APPLIES TO ALL TREES NEAR CONSTRUCTION.

R. EXISTING TREES ONSITE WILL BE PROTECTED IN PLACE THROUGHOUT CONSTRUCTION. NO TREES WILL BE REMOVED.

S. A 1"-2" LAYER OF GRAVEL SHALL BE PLACED BENEATH ALL DECKS.

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PROFESSIONAL ENGINEER STATE OF NEVADA
BRIAN E. McRAE
EXP. 12/31/09
CIVIL
14393

DECEMBER 2009

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
INDEX MAP

CRYSTAL BAY | WASHOE COUNTY | NEVADA

REV	DATE	DESCRIPTION	BY

C2

DATE: DECEMBER 2009
DRAWN BY: SJR
DESIGNED BY: BM
CHECKED BY: BM
JOB NO.: 7139.000

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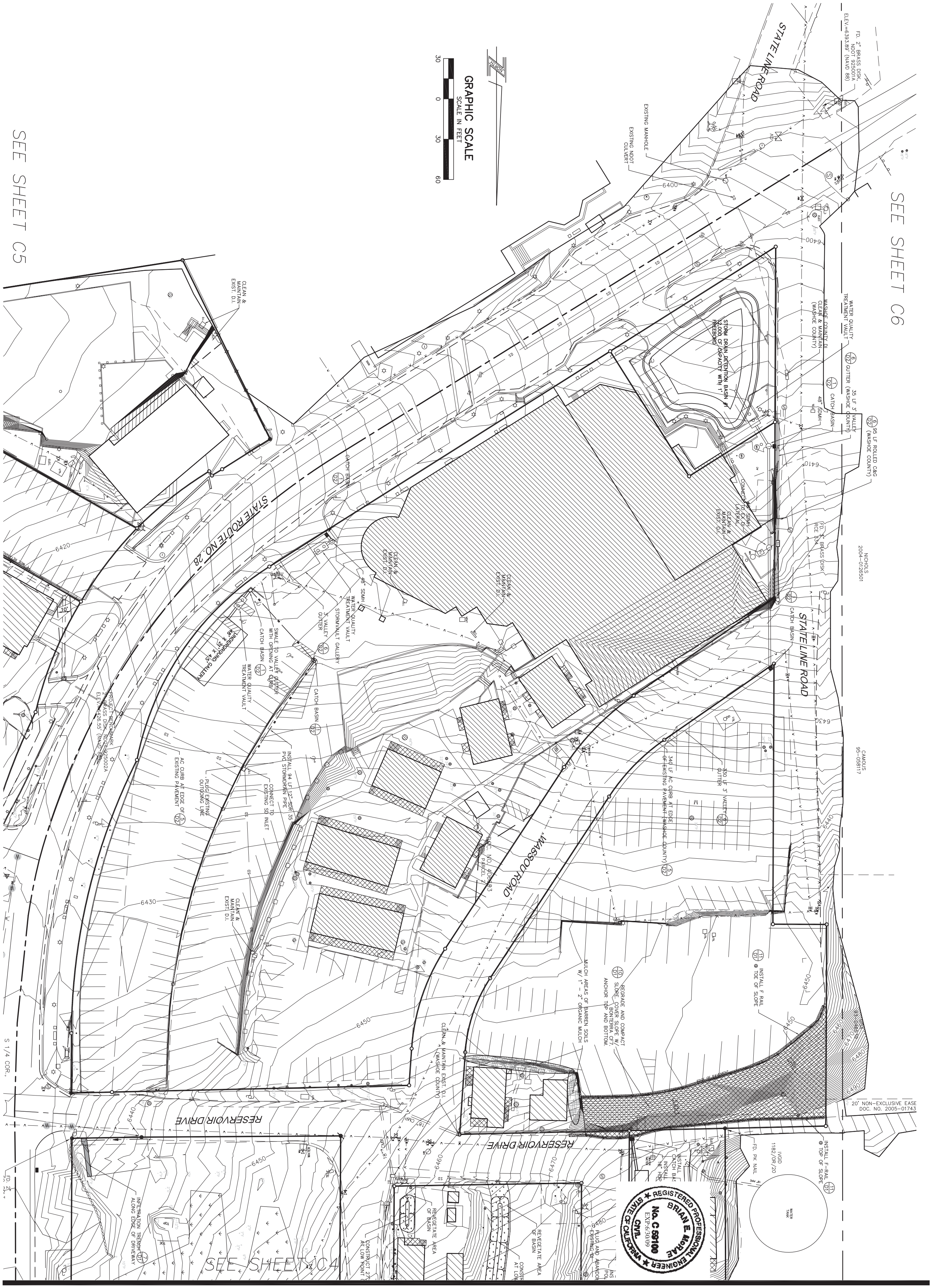

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No. 14391
STATE OF NEVADA

BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
SITE PLAN TAHOE BILTMORE

CRYSTAL BAY | WASHOE COUNTY | NEVADA

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C3

SEE SHEET C3

CALIFORNIA

NEVADA

REVEGETATION NOTES

1. All areas disturbed by construction activities shall be revegetated. Additional revegetation may be required beyond what is shown on plans.

2. A minimum of two inches (2") of topsoil shall be placed on all disturbed areas. Topsoil shall include all of the organic–rich layer of soil immediately under duff layer. Topsoil shall be stored with a minimal handling and no compaction, and it should not be mixed with spoil material.

3. Disturbed areas that are compacted or have experienced heavy vehicle and equipment use shall be plowed with a ripper or other deep tillage implement where feasible to a depth of 6"–12". Soil may be loosened with a backhoe bucket equipped with cutting teeth if loosening is done such that clods remain and soil is not pulverized or inverted. Following soil loosening, all further equipment traffic shall be eliminated from the planting area.

4. Areas should be irrigated by a low–flow irrigation system approximately three (3) times per week. The goal for all revegetated areas is to minimize irrigation needs and discontinue the need for irrigation after a maximum of three (3) growing seasons.

5. Following seeding and planting, all revegetation areas shall be mulched with pine needles. Pine needles shall be applied evenly to the entire area to a depth of one inch (1") if applied by blower or two inches (2") if applied by hand.

LANDSCAPE PLANTING NOTES

1. Refer to Civil Engineer's utility and precise grading plans for utility location and final grading.

2. Verify locations of pertinent site improvements installed under other sections. If any part of this landscape plan cannot be followed due to site conditions, contact Landscape Architect for instructions prior to commencing work.

3. Verify plant counts and square footages: Quantities are provided as Owner information only. If quantities on plant list differ from graphic indications, then graphics shall prevail.

4. All vegetation shall be consistent with the requirements of Chapter 30, Chapter 55.8, and Chapter 74.2 of the TRPA Code of Ordinances, see plant list for sizing and spacing, all plants specified are from the TRPA approved plant lists as described in Table 1 and Table 2 of the Home Landscaping Guide for Lake Tahoe and Vicinity.

5. No non–native soil or fertilizer to be used in the SEZ and SEZ setback areas.

6. No lawn shall be placed in the SEZ and SEZ setback areas.

IRRIGATION & MANAGEMENT PLAN

1. Landscape maintenance and management shall be consistent with Chapter 12 of the TRPA Home Landscaping Guide for Lake Tahoe and Vicinity.

2. Temporary spray irrigation is required to establish all revegetation areas. Irrigation will be required for an establishment period of 3 years, after which the irrigation can be removed at the owner's discretion. Apply 1/2" of water per day 3 days a week only on weekdays during the growing season during the morning hours of the day, no later than 10 am.

3. Use phosphorus free slow release fertilizer only for shrubs. Use phosphorus free fertilizer such as SummerSet 10–0–3 or approved equal at a rate 1/2 to 3/4 pounds per 1000sf during each application.

4. Fertilizer shall be applied twice per year; once during early June or late May depending on weather, when plants have come out of dormancy, and once late in September or early October depending on weather, but before the first frost. Avoid using weedkiller/fertilizer combinations that can damage vegetation.

5. All proposed shrubs, perennials, and trees are native or adaptive native plants to the Tahoe Basin as outlined in Table 1 of the TRPA Home Landscaping Guide. Therefor these plants will require very little fertilizer long term to sustain their health. The plants will require regular fertilizer applications during their establishment period (5 years).

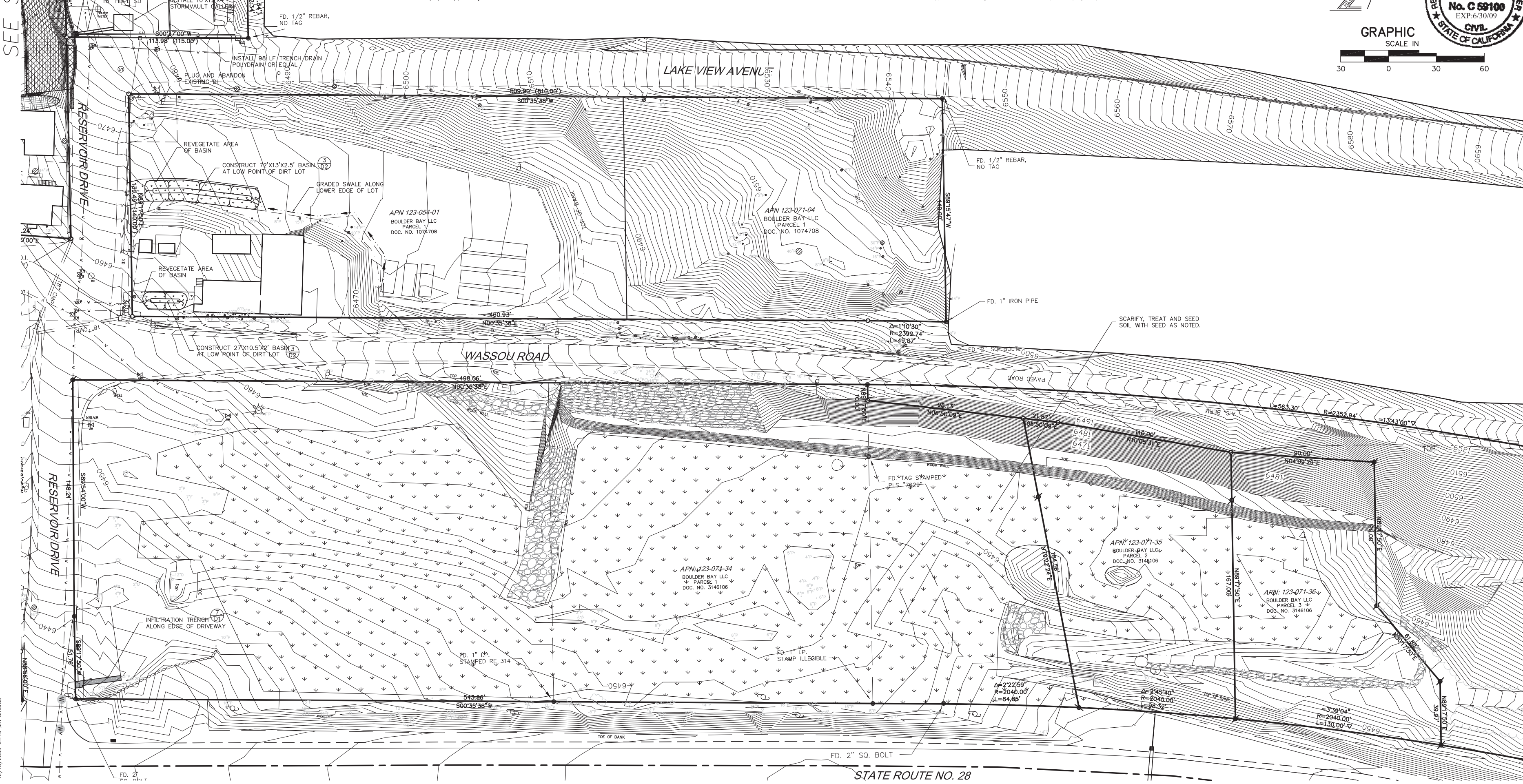
REVEGETATION SEED MIX

BOTANICAL NAME	COMMON NAME	QUANTITY
Elymus glaucus (Stan 5000)	Blue Wildrye (Stanislaus 5000 or high elevation collection)	30 PLS
Bromus carinatus (Mokelumne)	Mokelumne or El Dorado Brome (or other high elevation collection)	30 PLS
Elymus elymoides ssp. elymoides (Sierra)	Squirreltail, High elevation collection	30 PLS
Purshia tridentata	Antelope Bitterbrush (+5500 ft Sierra Collection)	5 PLS
Artemesia tridentata	Mountain Sagebrush (+5500 ft Sierra Collection)	1 PLS
Chrysothamnus nauseosus	Rubber Rabbitbrush (+5500 ft Sierra Collection)	4 PLS
	100 TOTAL PLS PER ACRE RATE	

Revegetation (see specifications above)
Revegetation Area:10,055 sy

GRAPHIC SCALE IN
30 0 30 60

REGISTERED PROFESSIONAL ENGINEER BRIAN E. McRAE No. C 59100 EXP:6/30/09 CIVIL STATE OF CALIFORNIA



BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
SITE PLAN TAHOE BILTMORE

CRYSTAL BAY | WASHOE COUNTY | NEVADA

REV	DATE	DESCRIPTION	BY

C4

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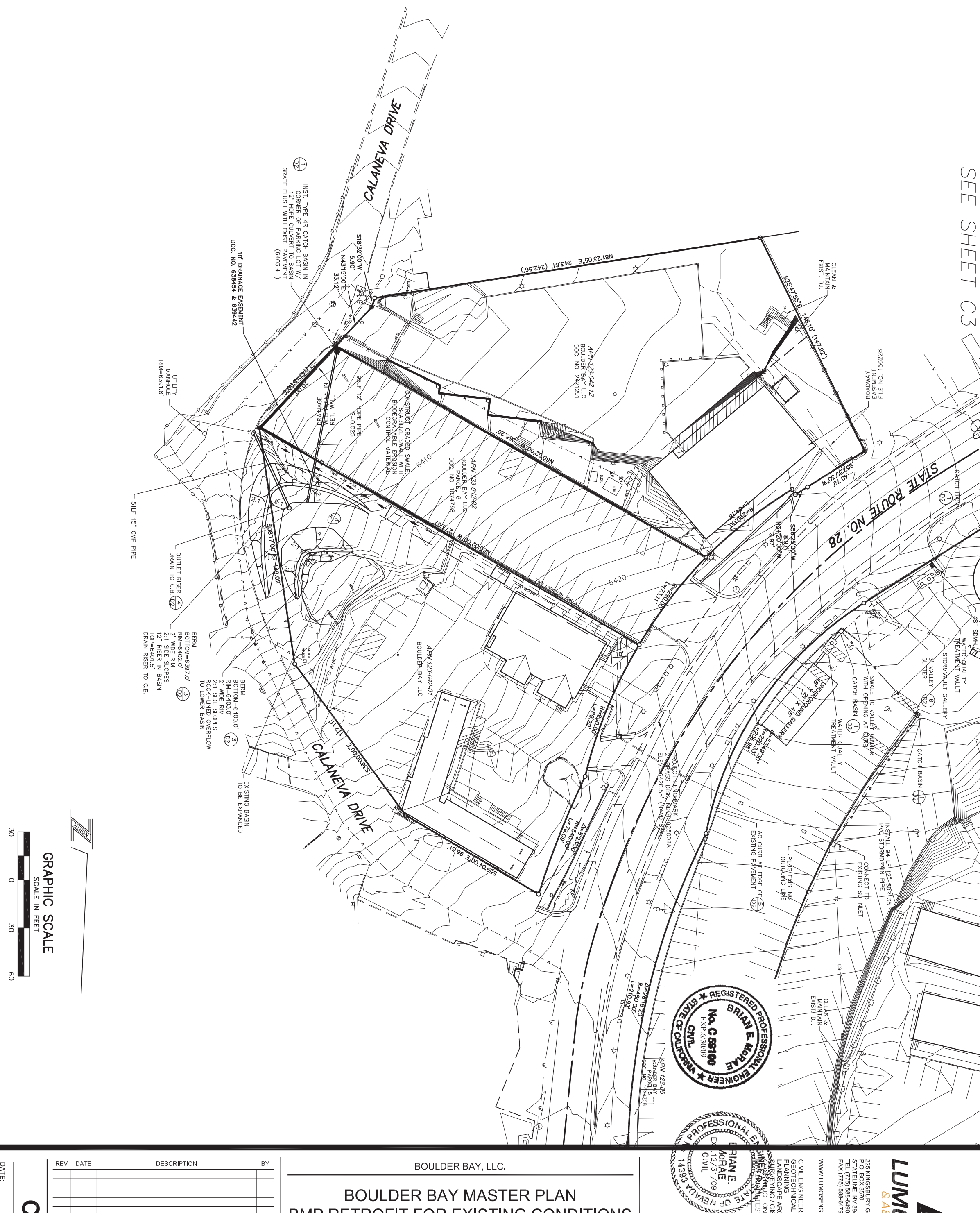

BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
SITE PLAN CRYSTAL BAY HOTEL

CRYSTAL BAY | WASHOE COUNTY | NEVADA

REV	DATE	DESCRIPTION	BY

C5

DATE: DECEMBER 2009
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CHECKED BY: BM
JOB NO.: 7139.000

LUMOS & ASSOCIATES
225 KINGSBURY GRADE, SUITE A
P.O. BOX 3570
STATELINE, NV 89449
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WWW.LUMOSENGINEERING.COM
CIVIL ENGINEERING
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CONSTRUCTION SERVICES
MATERIALS TESTING

REVEGETATION NOTES

1. All areas disturbed by construction activities shall be revegetated. Additional revegetation may be required beyond what is shown on plans.

2. A minimum of two inches (2") of topsoil shall be placed on all disturbed areas. Topsoil shall include all of the organic–rich layer of soil immediately under duff layer. Topsoil shall be stored with a minimal handling and no compaction, and it should not be mixed with spoil material.

3. Disturbed areas that are compacted or have experienced heavy vehicle and equipment use shall be plowed with a ripper or other deep tillage implement where feasible to a depth of 6"–12". Soil may be loosened with a backhoe bucket equipped with cutting teeth if loosening is done such that clods remain and soil is not pulverized or inverted. Following soil loosening, all further equipment traffic shall be eliminated from the planting area.

4. Areas should be irrigated by a low–flow irrigation system approximately three (3) times per week. The goal for all revegetated areas is to minimize irrigation needs and discontinue the need for irrigation after a maximum of three (3) growing seasons.

5. Following seeding and planting, all revegetation areas shall be mulched with pine needles. Pine needles shall be applied evenly to the entire area to a depth of one inch (1") if applied by blower or two inches (2") if applied by hand.

LANDSCAPE PLANTING NOTES

1. Refer to Civil Engineer's utility and precise grading plans for utility location and final grading.

2. Verify locations of pertinent site improvements installed under other sections. If any part of this landscape plan cannot be followed due to site conditions, contact Landscape Architect for instructions prior to commencing work.

3. Verify plant counts and square footages: Quantities are provided as Owner information only. If quantities on plant list differ from graphic indications, then graphics shall prevail.

4. All vegetation shall be consistent with the requirements of Chapter 30, Chapter 55.8, and Chapter 74.2 of the TRPA Code of Ordinances, see plant list for sizing and spacing, all plants specified are from the TRPA approved plant lists as described in Table 1 and Table 2 of the Home Landscaping Guide for Lake Tahoe and Vicinity.

5. No non–native soil or fertilizer to be used in the SEZ and SEZ setback areas.

6. No lawn shall be placed in the SEZ and SEZ setback areas.

IRRIGATION & MANAGEMENT PLAN

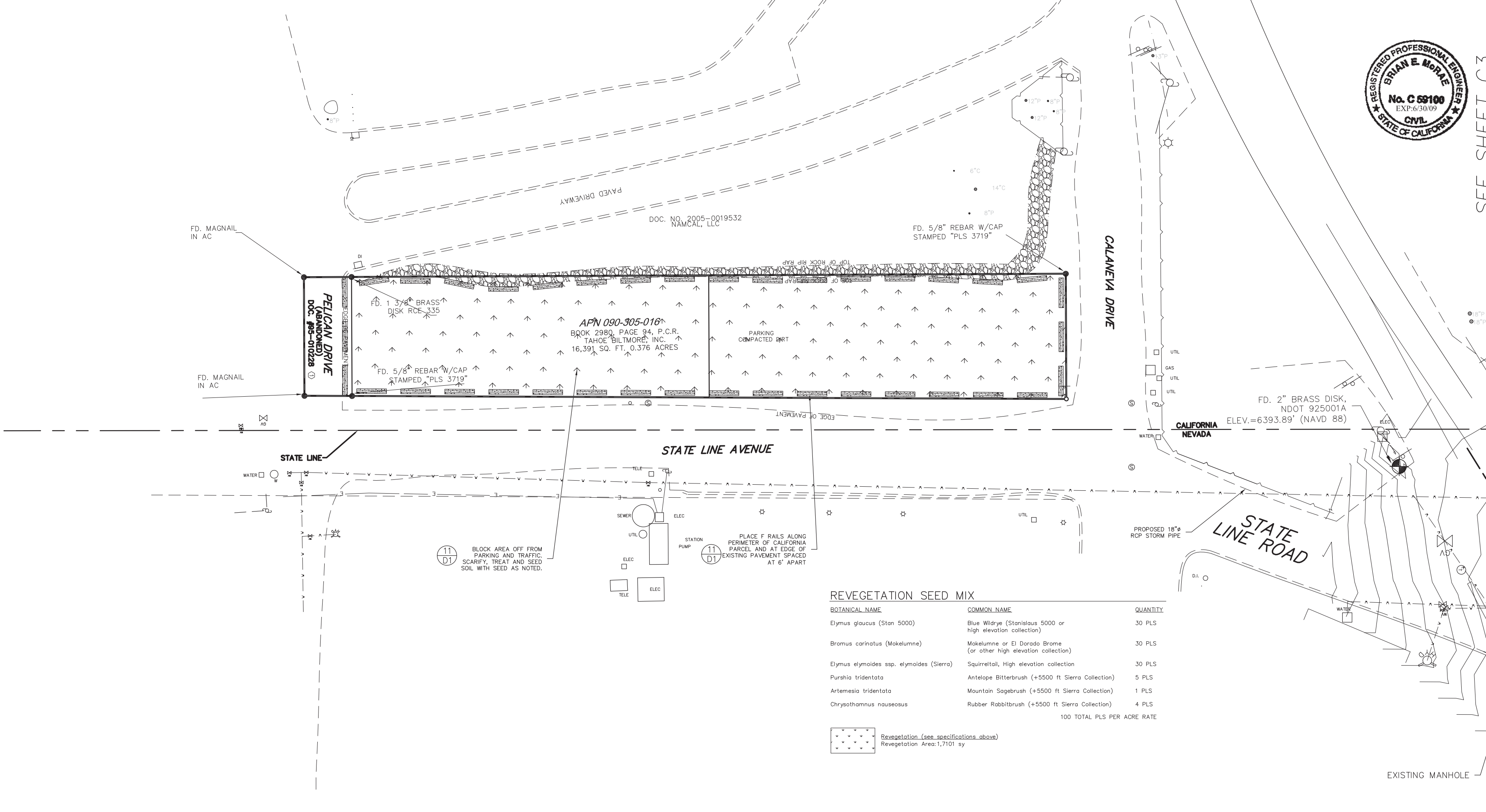
1. Landscape maintenance and management shall be consistent with Chapter 12 of the TRPA Home Landscaping Guide for Lake Tahoe and Vicinity.

2. Temporary spray irrigation is required to establish all revegetation areas. Irrigation will be required for an establishment period of 3 years, after which the irrigation can be removed at the owner's discretion. Apply 1/2" of water per day 3 days a week only on weekdays during the growing season during the morning hours of the day, no later than 10 am.

3. Use phosphorus free slow release fertilizer only for shrubs. Use phosphorus free fertilizer such as SummerSet 10–0–3 or approved equal at a rate 1/2 to 3/4 pounds per 1000sf during each application.

4. Fertilizer shall be applied twice per year; once during early June or late May depending on weather, when plants have come out of dormancy, and once late in September or early October depending on weather, but before the first frost. Avoid using weedkiller/fertilizer combinations that can damage vegetation.

5. All proposed shrubs, perennials, and trees are native or adaptive native plants to the Tahoe Basin as outlined in Table 1 of the TRPA Home Landscaping Guide. Therefor these plants will require very little fertilizer long term to sustain their health. The plants will require regular fertilizer applications during their establishment period (5 years).



REVEGETATION SEED MIX

BOTANICAL NAME	COMMON NAME	QUANTITY
Elymus glaucus (Stan 5000)	Blue Wildrye (Stanislaus 5000 or high elevation collection)	30 PLS
Bromus carinatus (Mokelumne)	Mokelumne or El Dorado Brome (or other high elevation collection)	30 PLS
Elymus elymoides ssp. elymoides (Sierra)	Squirreltail, High elevation collection	30 PLS
Purshia tridentata	Antelope Bitterbrush (+5500 ft Sierra Collection)	5 PLS
Artemesia tridentata	Mountain Sagebrush (+5500 ft Sierra Collection)	1 PLS
Chrysothamnus nauseosus	Rubber Rabbitbrush (+5500 ft Sierra Collection)	4 PLS

100 TOTAL PLS PER ACRE RATE

Revegetation (see specifications above)
Revegetation Area: 1,7101 sy

SEE SHEET C3

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REGISTERED PROFESSIONAL ENGINEER BRIAN E. McRAE No. C 59100 EXP.6/30/09 CIVIL STATE OF CALIFORNIA

PROFESSIONAL ENGINEER STATE OF NEVADA BRIAN E. McRAE EXP.12/31/09 CIVIL No. 14393

BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
SITE PLAN BILTMORE CALIFORNIA PARCEL

CRYSTAL BAY — PLACER COUNTY — CALIFORNIA

REV	DATE	DESCRIPTION	BY

C6

DATE: DECEMBER 2009
DRAWN BY: SJR
DESIGNED BY: BM
CHECKED BY: BM
JOB NO.: 7139.000

T:\lapro\7139-000 BOULDER BAY MASTER PLAN\dwg\7139OBMP_XCond BEM.dwg,C6 N CAL, 12/18/2009 01:13 pm bmcrae

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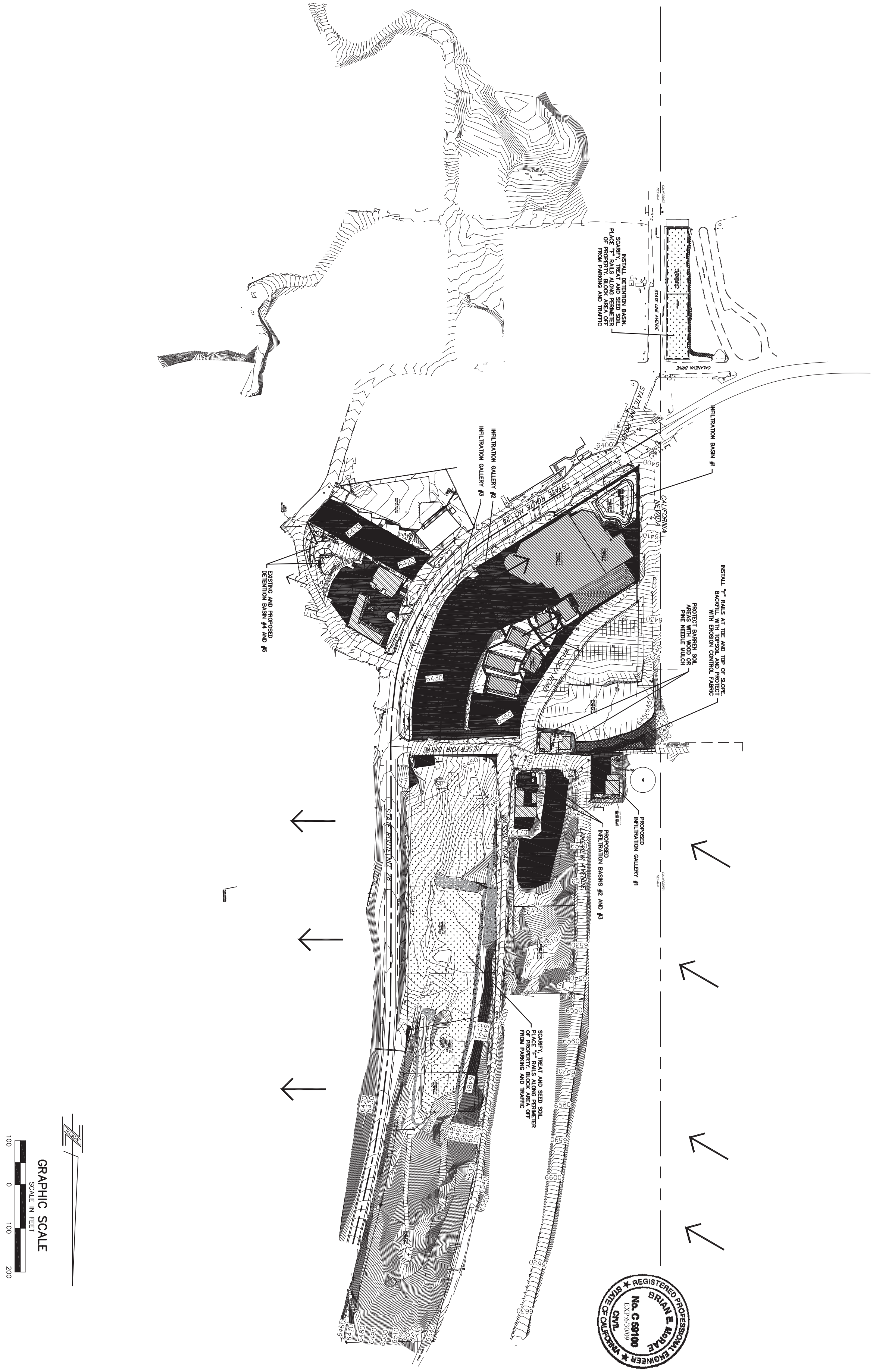
12/18/2009 01:14 pm bmcroe



REV	DATE	DESCRIPTION	BY

BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
OVERALL EXHIBIT

CRYSTAL BAY — WASHOE COUNTY — NEVADA

PROFESSIONAL ENGINEER STATE OF NEVADA
BRIAN E. McRAE
EXP 12/31/09
CIVIL
14339

LUMOS & ASSOCIATES
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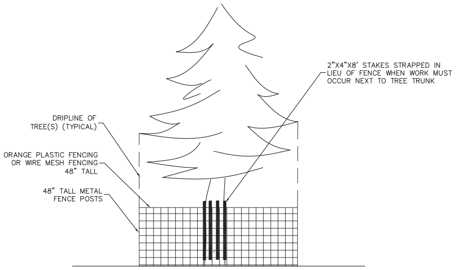
CONSTRUCTION SERVICES
MATERIALS TESTING

DATE: DECEMBER 2009
DRAWN BY: SJR
DESIGNED BY: BM
CHECKED BY: BM
JOB NO.: 7139.000

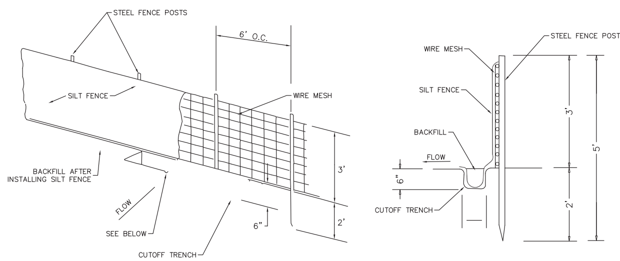
C7



NOTES:
1. PLACING ANY MATERIAL–TEMPORARY OR OTHERWISE–WITHIN PROTECTIVE FENCING OR ENTERING PROTECTION AREAS MAY RESULT IN UP TO A $5,000 PENALTY PER VIOLATION PER DAY. (SECT 65.2 I AND J)
2. THESE CONDITIONS ARE PART OF ALL PROJECTS AS CONDITIONS OF ATTACHMENTS R,S, AND Q.
3. METAL OR WIRE MESH FENCING MAY BE REQUIRED.
4. TREE PROTECTION SHALL CONFORM TO THE REQUIREMENTS OF ATTACHMENT A OF THIS PERMIT.

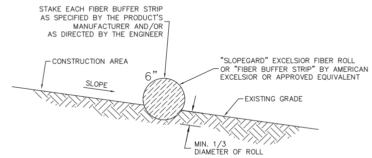
ADDITIONAL NOTES:
1. TO MINIMIZE ANY IMPACTS TO THE PROTECTED TREES ON SITE, TREES SHALL BE PROTECTED PER CHAPTER 65 AND 71 OF THE TRPA CODE OF ORDINANCES.
2. TECHNIQUES WILL BE USED TO MINIMIZE COMPACTION WITHIN THE TREE DRIPLINE OF ANY TREES IMPACTED BY CONSTRUCTION. THESE TECHNIQUES INCLUDE BRIDGING OF STRUCTURES OVER TREE ROOTS WARPING OF STRUCTURES TO AVOID IMPACTS AND CONSTRUCTION OF TREE WELLS.
3. EXCAVATION WITHIN THE DRIPLINE OF TREES SHALL BE HAND DUG. ANY ROOTS ENCOUNTERED SHOULD BE CUT CLEANLY USING APPROPRIATE STERILIZED ROOT PRUNING EQUIPMENT. CUT ROOTS SHALL NOT BE LEFT EXPOSED AND SHALL BE COVERED WITH SOIL AS SOON AS POSSIBLE.

TREE PROTECTION FENCING (1/D1)
SCALE: N.T.S.

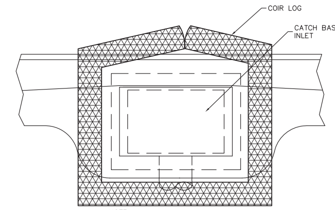


THE CONTRACTOR MAY USE MANUFACTURED SILT FENCING IN LIEU OF THE ABOVE, SUBJECT TO SUBMITTAL OF MANUFACTURER'S DATA SHEETS TO THE ENGINEER FOR APPROVAL.

SILT FENCE (2/D1)
SCALE: N.T.S.

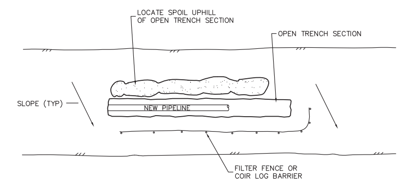


COIR LOG (3/D1)
SCALE: N.T.S.



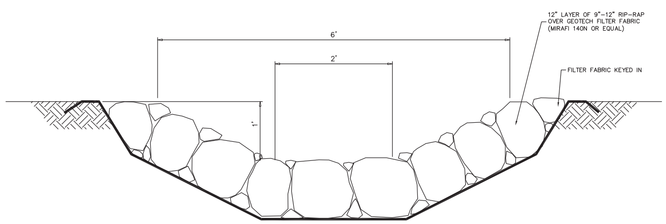
NOTE:
WEIGHT COIR LOG WITH GRAVEL BAGS

COIR LOGS AROUND CATCH BASINS (4/D1)
SCALE: N.T.S.

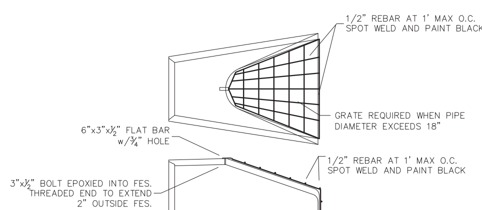


NOTES:
1. RELOCATE FILTER FENCE/COIR LOG SEDIMENT BARRIER AS NECESSARY.
2. SPOILS TO BE LOADED DIRECTLY INTO DUMP TRUCK TO BE HAULED OFF SITE. NO SPOILS TO BE STORED ON SITE.

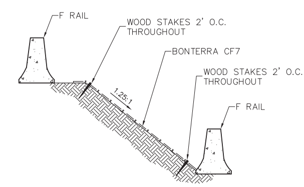
TYPICAL OPEN TRENCH SECTION (5/D1)
SCALE: N.T.S.



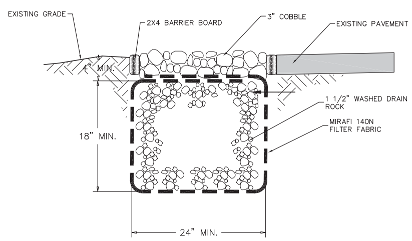
ROCK–LINED CHANNEL (6/D1)
SCALE: N.T.S.



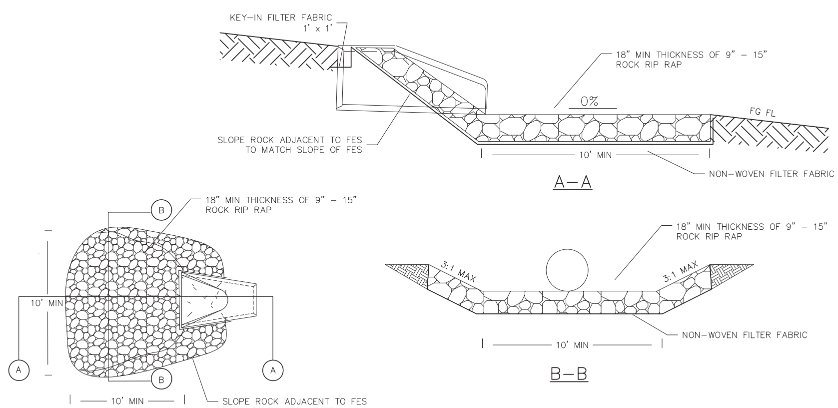
FLARED END SECTION (8/D1)
SCALE: N.T.S.



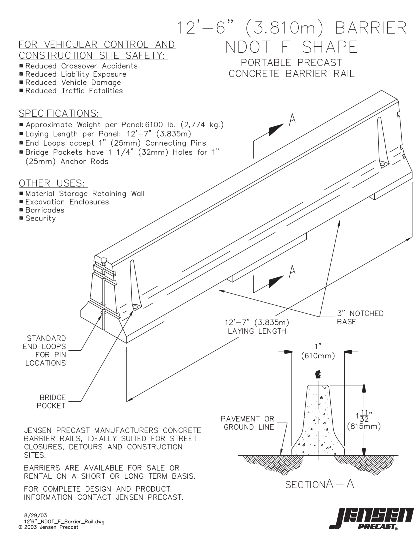
SLOPE PROTECTION DETAIL (10/D1)
SCALE: N.T.S.



INFILTRATION TRENCH (7/D1)
SCALE: N.T.S.



ENERGY DISSIPATER (9/D1)
SCALE: N.T.S.



FOR VEHICULAR CONTROL AND CONSTRUCTION SITE SAFETY:
- Reduced Crossover Accidents
- Reduced Liability Exposure
- Reduced Vehicle Damage
- Reduced Traffic Fatalities

SPECIFICATIONS:
- Approximate Weight per Panel: 6100 lb. (2,774 kg.)
- Laying Length per Panel: 12'-7" (3.835m)
- End Loops accept 1" (25mm) Connecting Pins
- Bridge Pockets have 1 1/4" (32mm) Holes for 1" (25mm) Anchor Rods

OTHER USES:
- Material Storage Retaining Wall
- Excavation Enclosures
- Barricades
- Security

JENSEN PRECAST MANUFACTURERS CONCRETE BARRIER RAILS, IDEALLY SUITED FOR STREET CLOSURES, DETOURS AND CONSTRUCTION SITES.

BARRIERS ARE AVAILABLE FOR SALE OR RENTAL ON A SHORT OR LONG TERM BASIS.

FOR COMPLETE DESIGN AND PRODUCT INFORMATION CONTACT JENSEN PRECAST.

8/29/03
12'6"_NDOT_F_Barrier_Rail.dwg
© 2003 Jensen Precast

"F" – RAIL DETAIL (10/D1)
SCALE: N.T.S.

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BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
DETAIL SHEET

CRYSTAL BAY | WASHOE COUNTY | NEVADA

REV	DATE	DESCRIPTION	BY

D1

DATE:	DECEMBER 2009
DRAWN BY:	SJR
DESIGNED BY:	BM
CHECKED BY:	BM
JOB NO.:	7139.000

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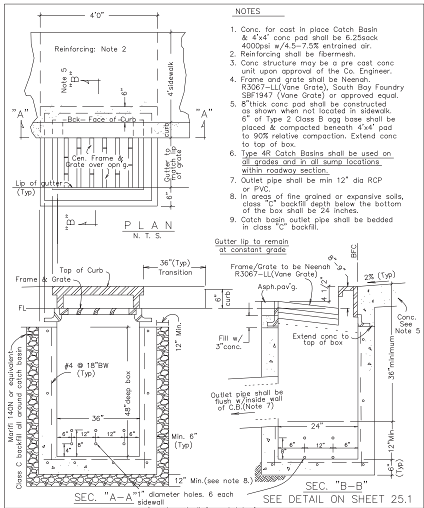
12/18/2009 01:15 pm bmcrae

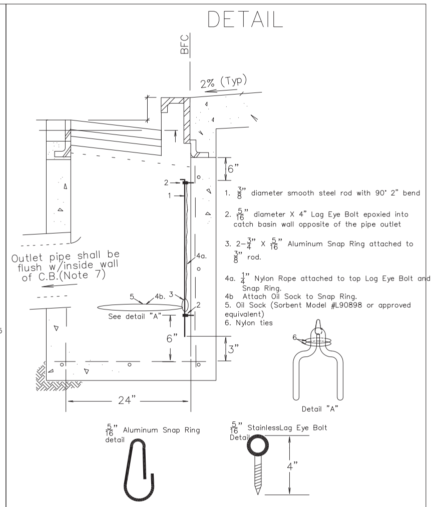
Rinker Materials — Concrete Pipe Division



NOTES

1. Conc. for cast in place Catch Basin & 4'x4' conc pad shall be 6.25sack 4000psi w/4.5–7.5% entrained air.
2. Reinforcing shall be fibermesh.
3. Conc structure may be a pre cast conc unit upon approval of the Co. Engineer.
4. Frame and grate shall be Neenah. R3067–LL(Vane Grate), South Bay Foundry SBF1947 (Vane Grate) or approved equal.
5. 8"thick conc pad shall be constructed as shown when not located in sidewalk. 6" of Type 2 Class B agg base shall be placed & compacted beneath 4'x4' pad to 90% relative compaction. Extend conc to top of box.
6. Type 4R Catch Basins shall be used on all grades and in all sump locations within roadway section.
7. Outlet pipe shall be min 12" dia RCP or PVC.
8. In areas of fine grained or expansive soils, class "C" backfill depth below the bottom of the box shall be 24 inches.
9. Catch basin outlet pipe shall be bedded in class "C" backfill.

NO.	REVISED	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION: WASHOE
9	Note 8 & 9	6-07	CATCH BASIN TYPE 4-R	DRAWING NO: W-12
6	Grate type	5-99		DATE: 6/07sw PAGE: 25
7	Note 4	8-99		
8	Note 6&7	10-99		

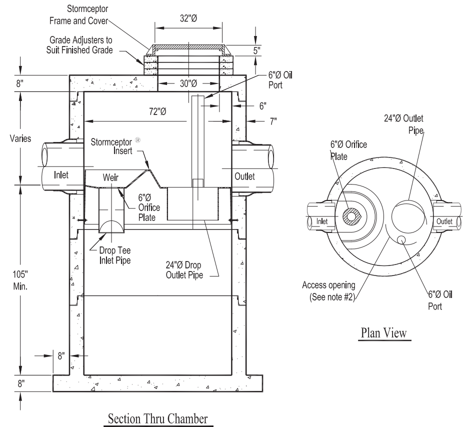


1. 3/8" diameter smooth steel rod with 90° 2" bend
2. 5/16" diameter X 4" Lag Eye Bolt epoxied into catch basin wall opposite of the pipe outlet
3. 2–3/4" X 5/16" Aluminum Snap Ring attached to 3/8" rod.
4a. 1/4" Nylon Rope attached to top Log Eye Bolt and Snap Ring.
4b Attach Oil Sock to Snap Ring.
5. Oil Sock (Sorbent Model #L90898 or approved equivalent)
6. Nylon ties

NO.	REVISED	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION: WASHOE
			CATCH BASIN TYPE 4-R	DRAWING NO: W-12
				DATE: 06/07sw PAGE: 25.1

CATCH BASIN (1/D2)
SCALE: N.T.S.

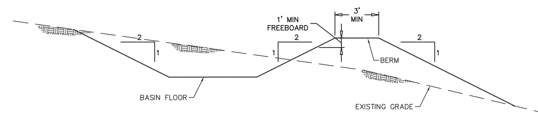
STC 1800 Precast Concrete Stormceptor®
(1800 U.S. Gallon Capacity)



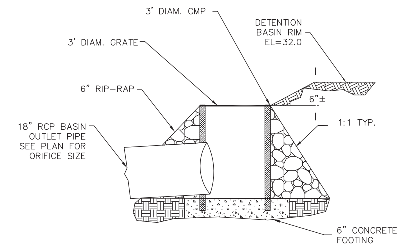
Notes:
1. The Use Of Flexible Connection is Recommended at The Inlet and Outlet Where Applicable.
2. The Cover Should be Positioned Over The Outlet Drop Pipe and The Oil Port.
3. The Stormceptor System is protected by one or more of the following U.S. Patents: #4985148, #5498331, #5725760, #5753115, #5849181, #6068765, #6371690.
4. Contact a Concrete Pipe Division representative for further details not listed on this drawing.

Rinker 030

STORM WATER TREATMENT VAULT (2/D2)
SCALE: N.T.S.

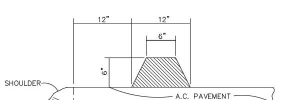


DETENTION BASIN SECTION (3/D2)
SCALE: N.T.S.



*ALL CMP SHALL BE "HOT DIP" GALVANIZED

BASIN OUTLET DETAIL (4/D2)
SCALE: N.T.S.

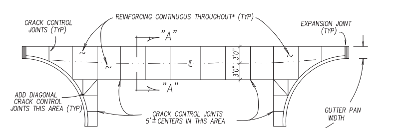


A.C. CURB

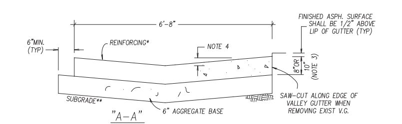
NOTES:

1. ALL P.C.C. CURB, GUTTER AND SIDEWALK SHALL BE MIN 6sack OF CEMENT PER CU.YD. OF CONC. UNLESS OTHERWISE SPECIFIED (4000psi) W/4.5–7.5% AIR. MAX SLUMP SHALL BE 4." MAX WATER/CEMENT RATIO SHALL BE .45.
2. (a) ALL CONC CURB, GUTTER, AND SIDEWALK SHALL HAVE WEAKENED PLANE JOINTS EVERY 10 FEET.
   (b) EXPANSION JOINTS 1/2" WIDE SHALL BE LOCATED IN CURBS & GUTTERS @ EA. SIDE OF STRUCTURES @ ENDS OF ALL CURB RETURNS, & ABUTTING HARDENED IN-PLACE CURB & GUTTER, EXCEPT THAT EXPANSION JTS. SHALL NOT BE INSTALLED WITHIN 20' OF AN ISLAND NOSE. EXPANSION JOINTS SHALL BE 1/2" THICK, SHAPED TO THE CROSS-SECTION OF THE CURB & GUTTER, & SHALL BE CONSTRUCTED @ RIGHT ANGLES TO THE CURB & GUTTER. JOINT FILLER MATERIAL SHALL CONFORM TO SECTION 202.10.
3. AGGREGATE BASE MATERIAL SHALL CONFORM TO THE SPECIFICATIONS FOR TYPE 2 CLASS B AGG. BASE AND BE COMP. TO A MIN. 95% MAX. DRY DENSITY.
4. ALL A.C. CURB INSTALLED IN WASHOE CO. TO BE MFD w/ ASPHALTIC CEMENT, GRADE AC-20.

AC CURB (5/D2)
SCALE: N.T.S.



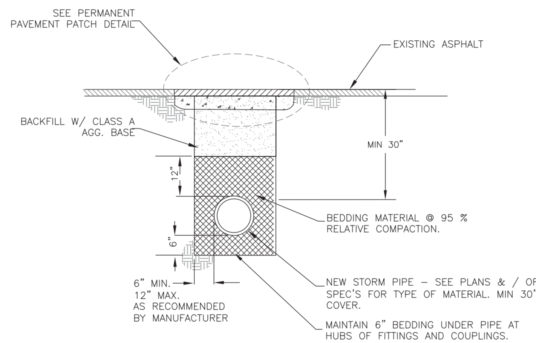
NOTES:
* REINFORCING SHALL CONSIST OF COLLATED, FIBRILLATED, POLYPROPYLENE FIBERS AS MANUFACTURED BY FIBERMESH OR APPROVED EQUAL. USE 1-1/2 LBS PER CU.YD. OF CONC.
** SUBGRADE SHALL BE OVEREXCAVATED IN AREAS OF UNSTABLE OR FINE GRAINED, EXPANSIVE SOILS. DEPTH OF OVEREXCAVATION SHALL BE DETERMINED BY SOILS ENGINEER OR AGENCY.



NOTES
1. AGG. BASE SHALL BE TYPE 2, CLASS B AND SHALL BE COMPACTED TO 95% OF MAX. DENSITY.
2. AN APPROVED MIX DESIGN SHALL BE SUBMITTED BEFORE PLACING CONCRETE.
3. 8" PORTLAND CEMENT CONC. TO BE USED IN RESIDENTIAL AREAS WHERE TRUCK OR BUS TRAFFIC IS LESS THAN 5% OF TOTAL TRAFFIC. 10" PORTLAND CEMENT CONC TO BE USED FOR COMMERICAL DRIVEWAYS, ROADS OR STREETS WHERE TRUCK OR BUS TRAFFIC EXCEEDS 5% OF TOTAL TRAFFIC.
4. FLOWLINE VARIES TO MATCH GUTTER.
5. PORTLAND CEMENT CONC. SHALL HAVE A MIN. COMPRESSIVE STRENGTH OF 4000psi @ 28 DAYS W/ A MIN OF 6.25 SACKS OF CEMENT PER CU.YD. OF CONC., AIR ENTRAINMENT TO BE 4.5–7.5%. MAX. SLUMP SHALL BE 4".
6. EVAPORATION REDUCERS & CURING AGENTS SHALL CONFORM TO THE REQUIREMENTS OF DWG.W-16.1)
7. ALL CONCRETE SHALL BE MECHANICALLY VIBRATED.
8. NO EQUIPMENT SHALL BE PERMITTED ADJACENT TO OR ACROSS V.G. UNTIL THE FOURTH DAY FOLLOWING PLACEMENT OF CONC OR UNTIL THE CONC HAS REACHED A MIN. COMPRESSIVE STRENGTH OF 3000psi.
9. VALLEY GUTTER NOT PERMITTED ACROSS COLLECTOR OR ARTERIAL STREETS.

NO.	REVISED	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION: WASHOE
1	REDRAW	11/92 vp	P.C.C. VALLEY GUTTER	DRAWING NO: W-11
2	MISC NOTES	2/94 vp		DATE: 11/92 vp PAGE: 24

VALLEY GUTTER (6/D2)
SCALE: N.T.S.



NOTES
1. FOR PAVEMENT REPLACEMENT SEE PERMANENT PAVEMENT PATCH DETAIL
2. PERMANENT PAVEMENT PATCH WILL BE PLACED IN LIFTS WITH A 2" MINIMUM LIFT THICKNESS AND 3" MAXIMUM LIFT THICKNESS
3. ALL ROAD SHOULDERS TO BE COMPACTED TO 95% RELATIVE COMPACTION (NO REVEGETATION REQUIRED)
4. ALL PROTRUDING ROCKS WILL BE REMOVED PRIOR TO PIPE INSTALLATION.

TRENCHING DETAIL (7/D2)
SCALE: N.T.S.

LUMOS & ASSOCIATES
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STATELINE, NV 89449
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BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
DETAIL SHEET

CRYSTAL BAY — WASHOE COUNTY — NEVADA

REV	DATE	DESCRIPTION	BY

D2

DATE: DECEMBER 2009
DRAWN BY: SJR
DESIGNED BY: BM
CHECKED BY: BM
JOB NO.: 7139.000

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PATHWAY

A VISION FOR TAHOE'S FUTURE

PO Box 5310
Stateline, NV
89449

Prepared by:
Regional Planning Partners and
Tahoe Regional Planning Agency

Tahoe Regional Planning Agency
Community Enhancement Program

A collaboration between TRPA and local government jurisdictions

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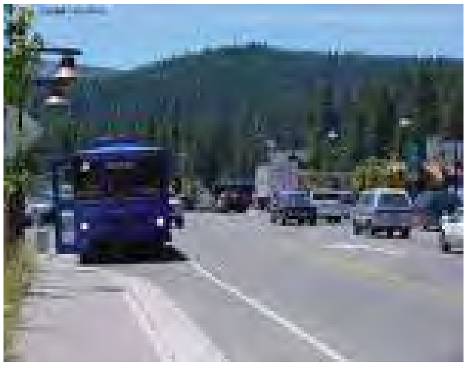
www.regionalplanningpartners.com



Implementing a sustainable vision for Lake Tahoe communities.

The Community Enhancement Program is seeking net gain solutions for the Lake Tahoe Basin which implement environmental improvements, enhance the quality of life for residents, improve the visitor experience and contribute to the long-term economic vitality of the region.

- Goals and Objectives
- Pre-application Criteria
- Incentives
- Selection Criteria
- Schedule

LAKE TAHOE COMMUNITY ENHANCEMENT PROGRAM

A collaboration between
the Tahoe Regional Planning Agency
and its local government jurisdiction partners

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