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

[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].

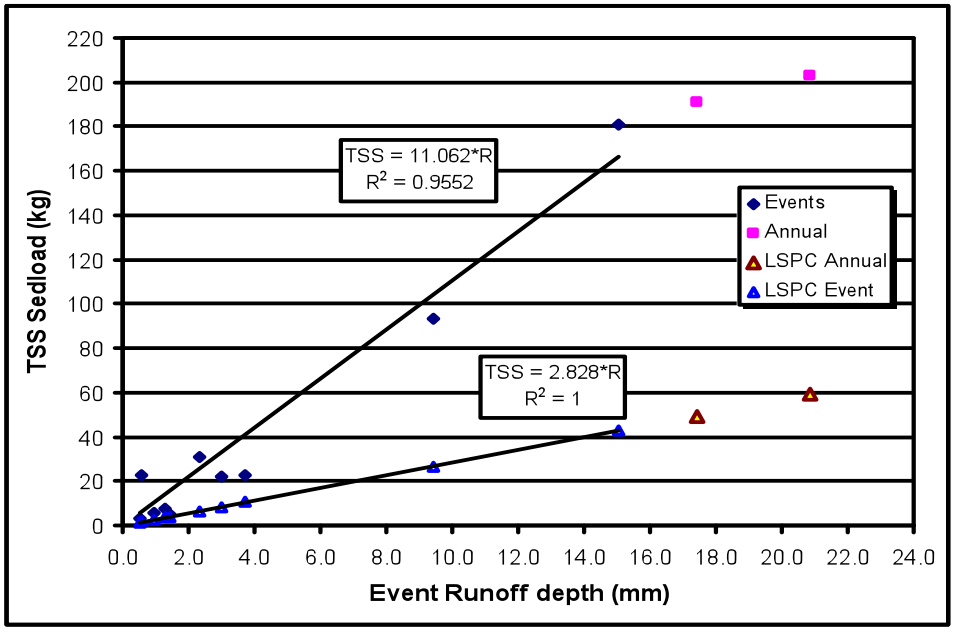


Figure 1. Relationship between event and annual sediment loading and runoff for LSPC based factors and that measured by DRI.

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.

[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.

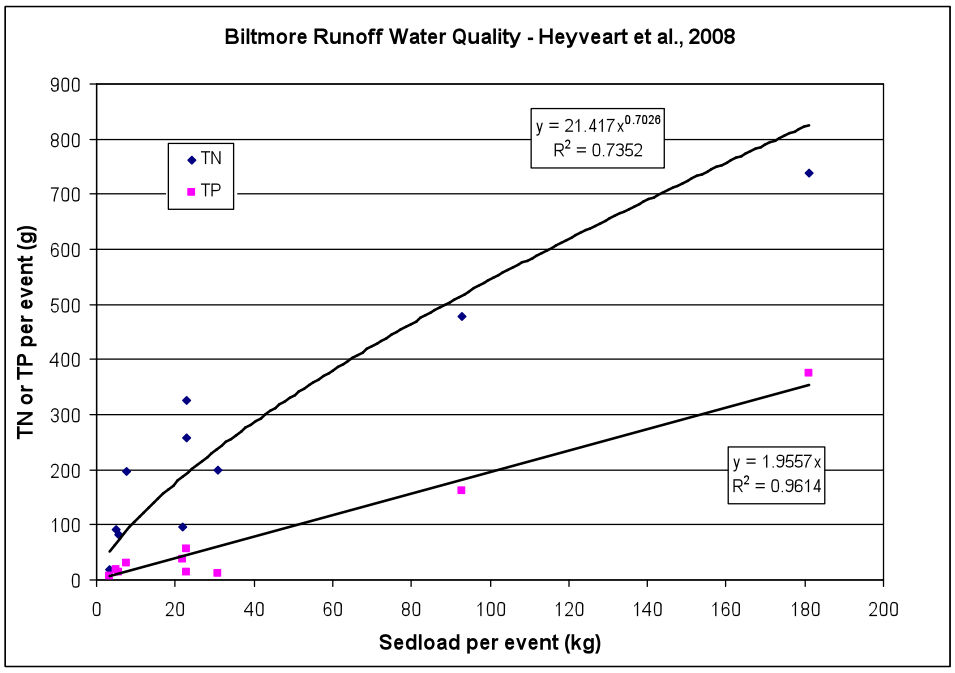


Figure 2. Relationship between nutrient and sediment loads in runoff per event in 2007-08 WY.

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.

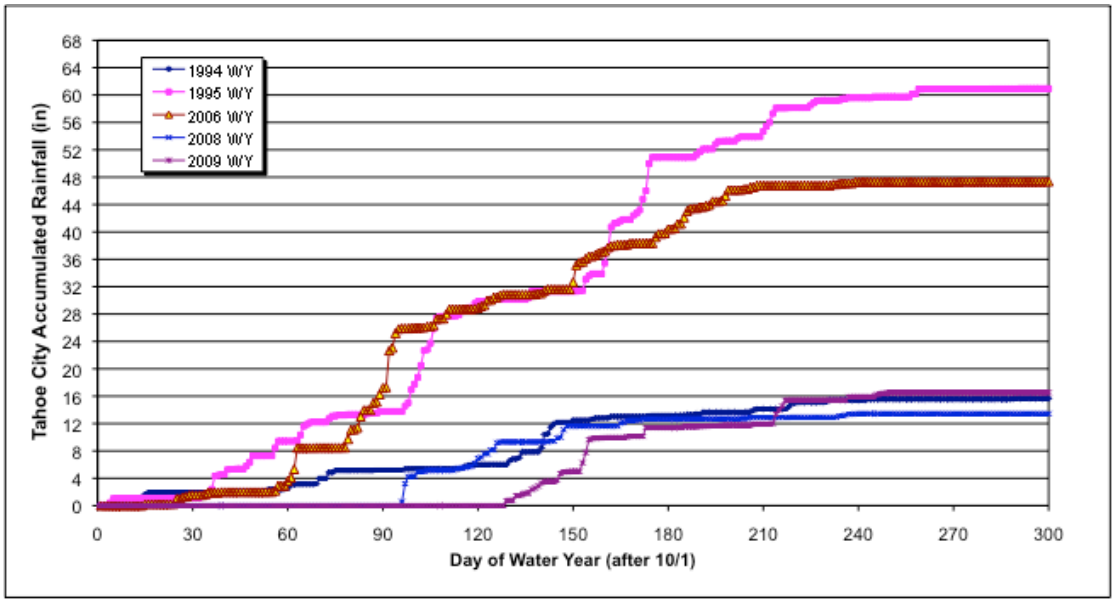
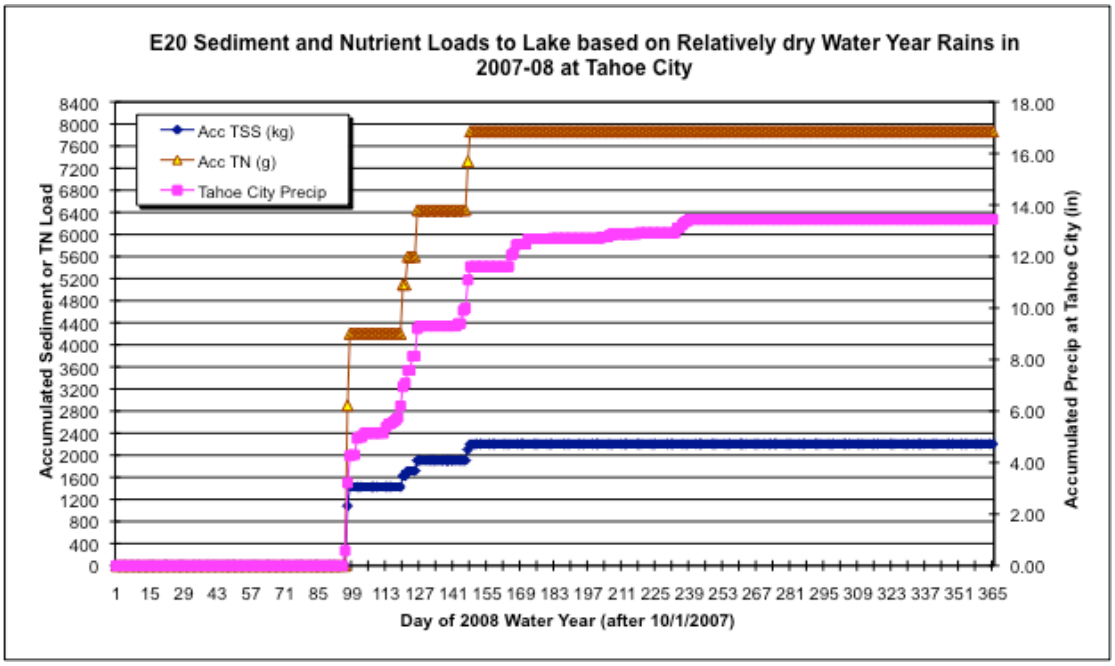


Figure 3. Accumulated rainfall at Tahoe City NWS gage for wet and dry WYs used in analysis.

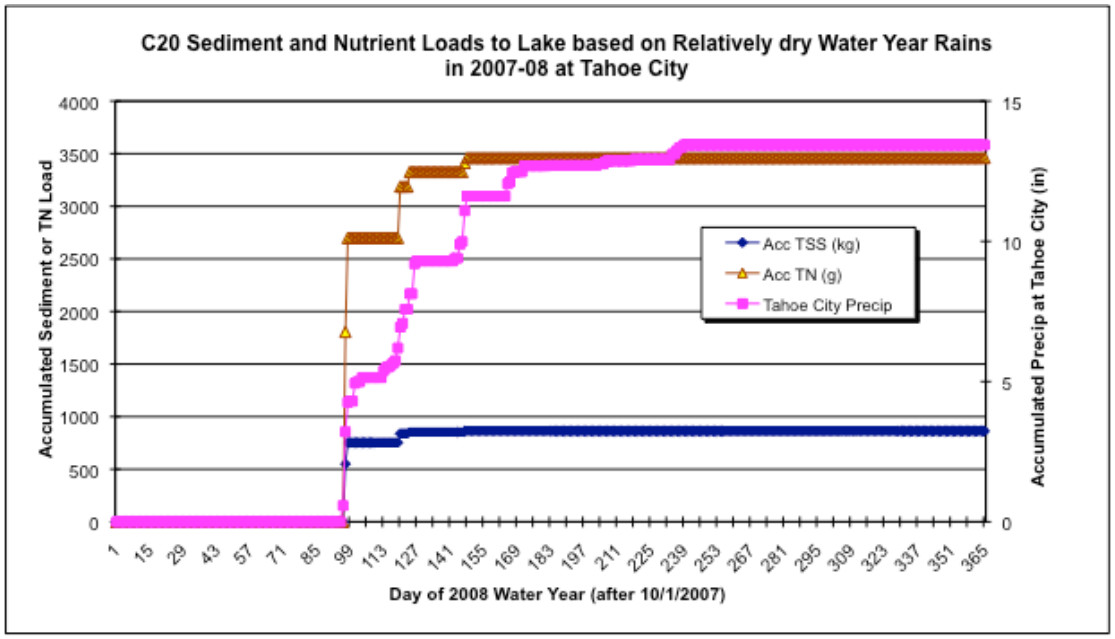
IERS modeled the capture and possible runoff from a daily time-step for the 1994, 1995, 1998 2006 and 2008 WYs to determine sediment and nutrient loadings from the project area for: 1) Existing Condition; 2) before re-development with only 'standard' 20yr/1hr BMPs installed (E20); and 3) after implementation 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)

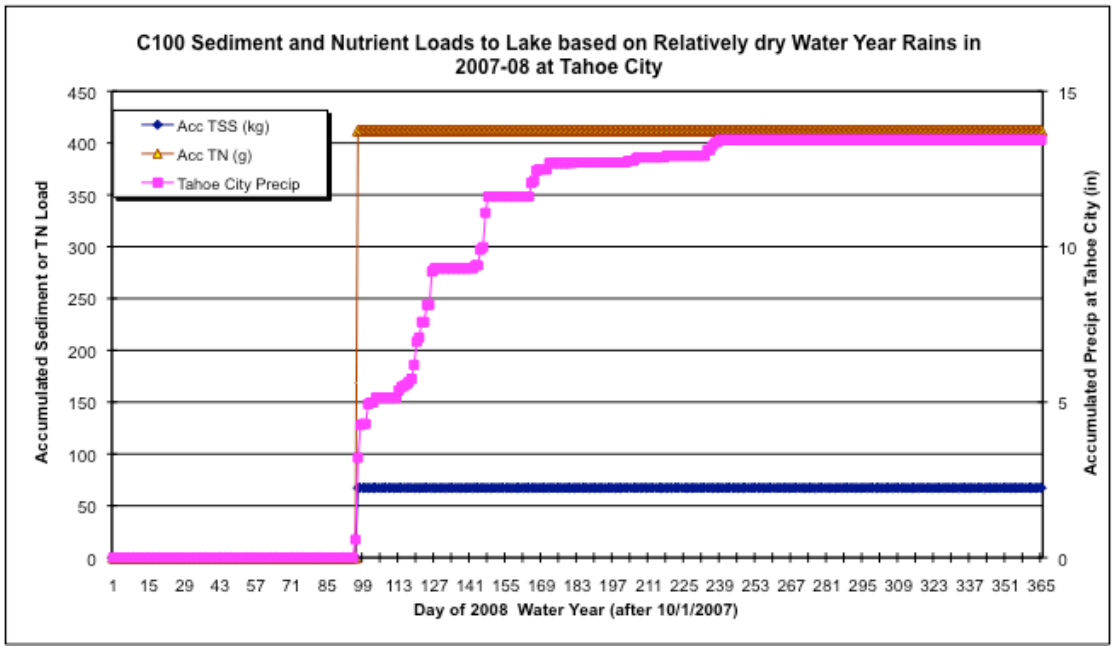


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Figure 4. Accumulated possible sediment and nitrogen loading to the Lake for E20, C20 and C100 under dry year conditions as encountered in the 2007-08 WY.

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

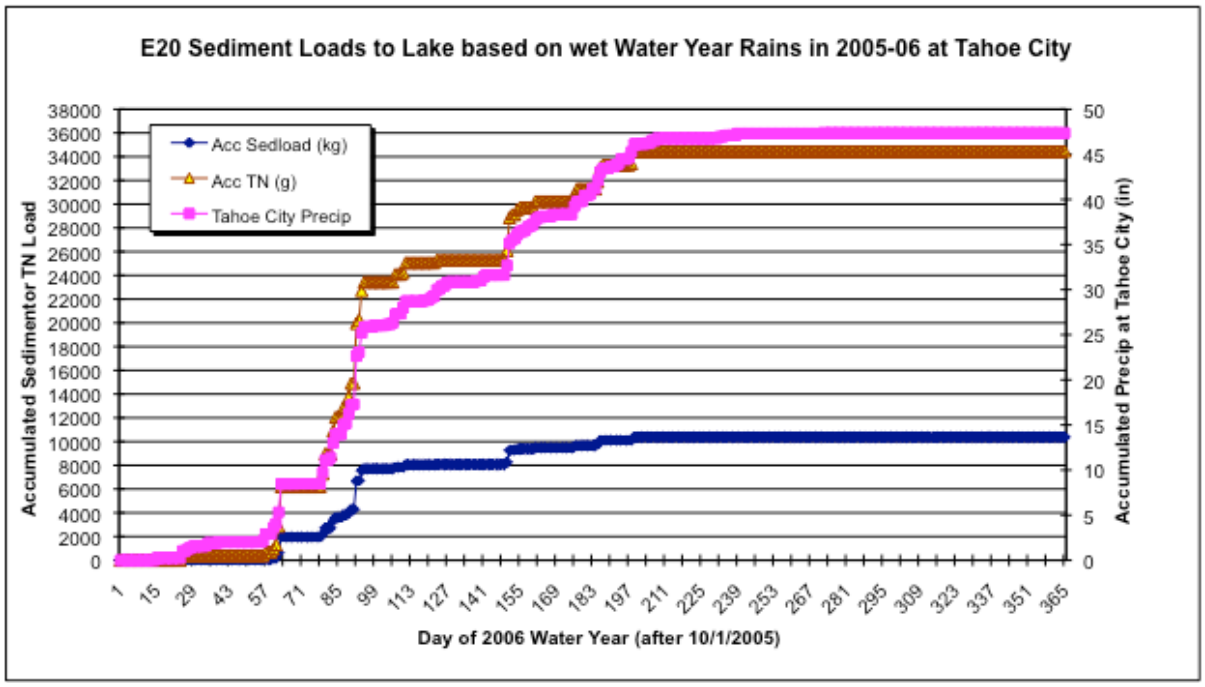
* Assuming fine sediment particles (FSP) <20 microns are 60-90% of total sediment load.
Field monitoring of disturbed soils runoff indicates FSP load is >50% of total sediment load for granitic soils.

** 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.



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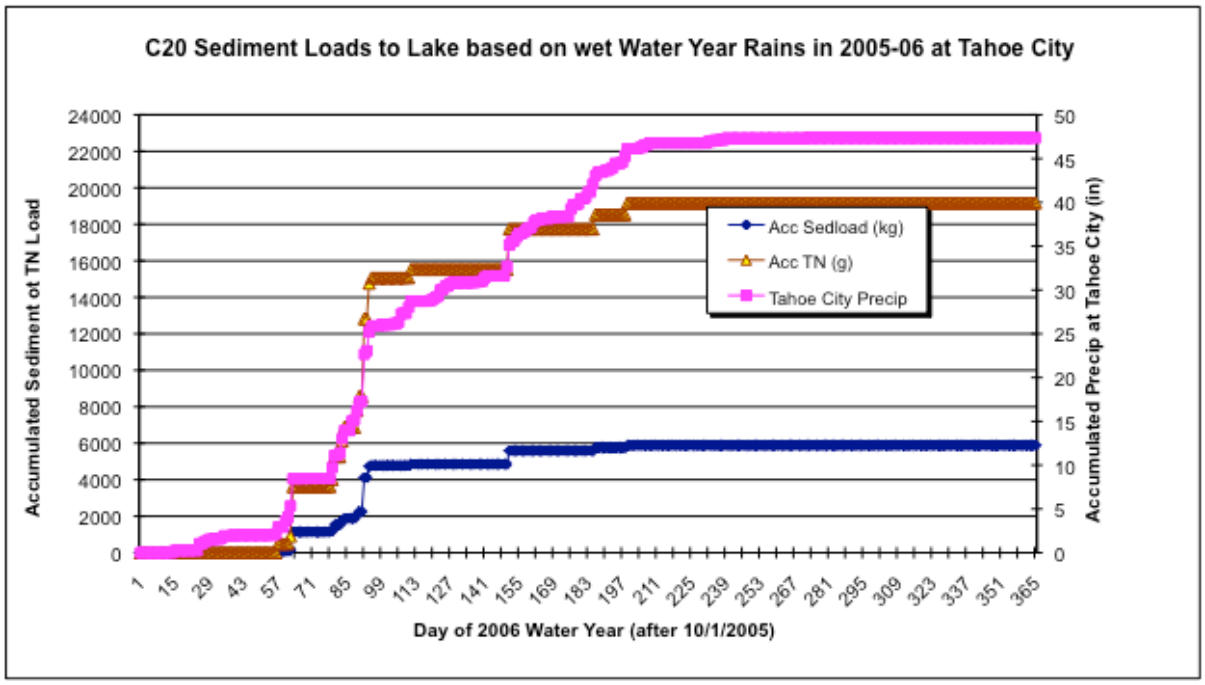

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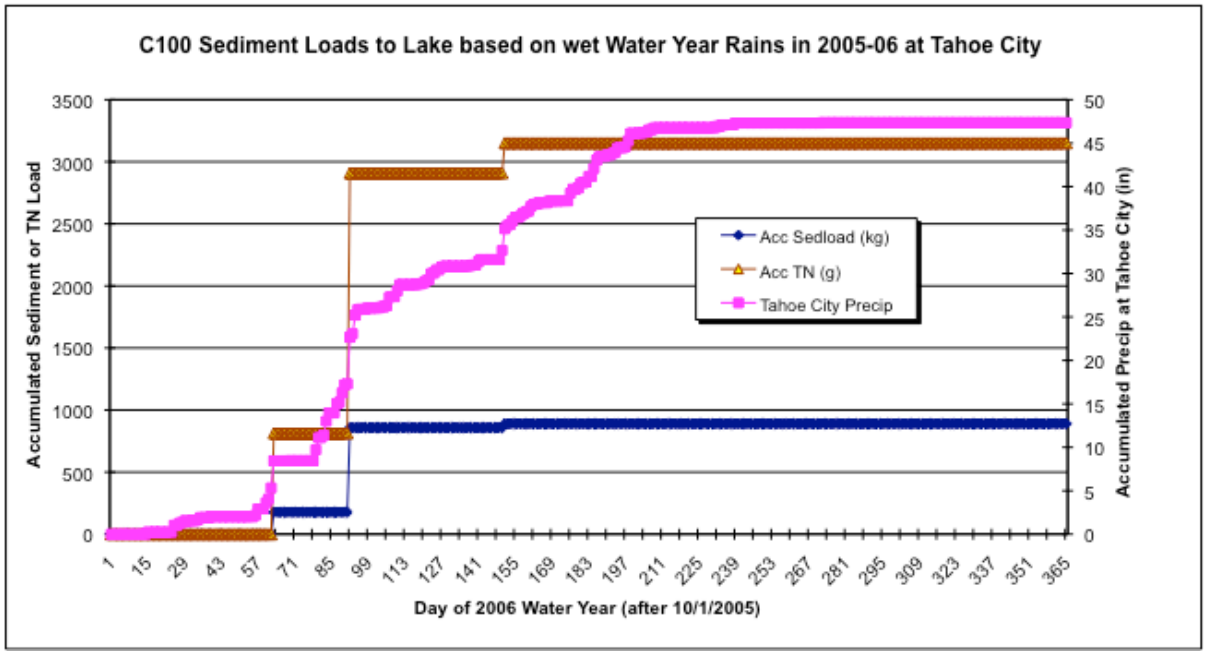

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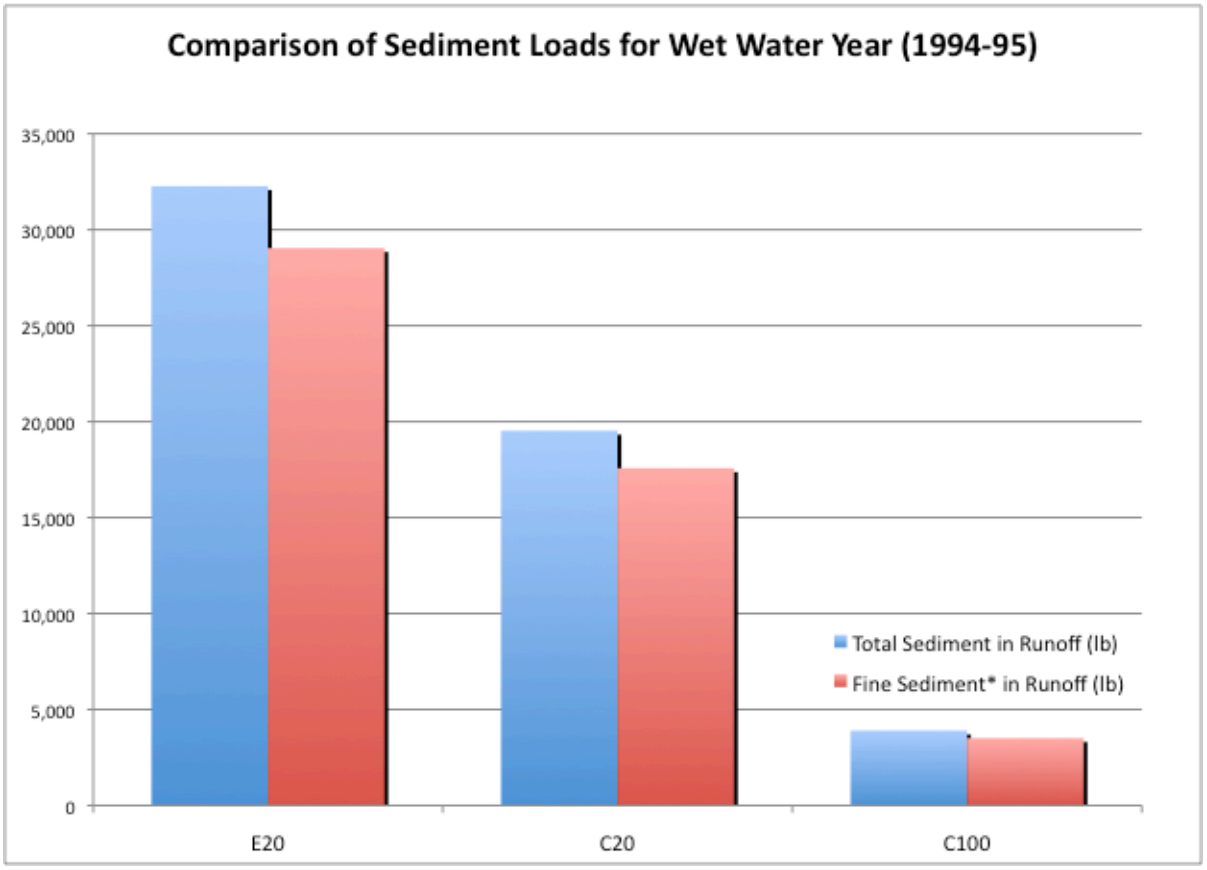
Figures 5. Accumulated sediment and nitrogen loading to the Lake under wet year conditions as encountered in the 2005-06 WY for E20, C20 and C100.

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 .



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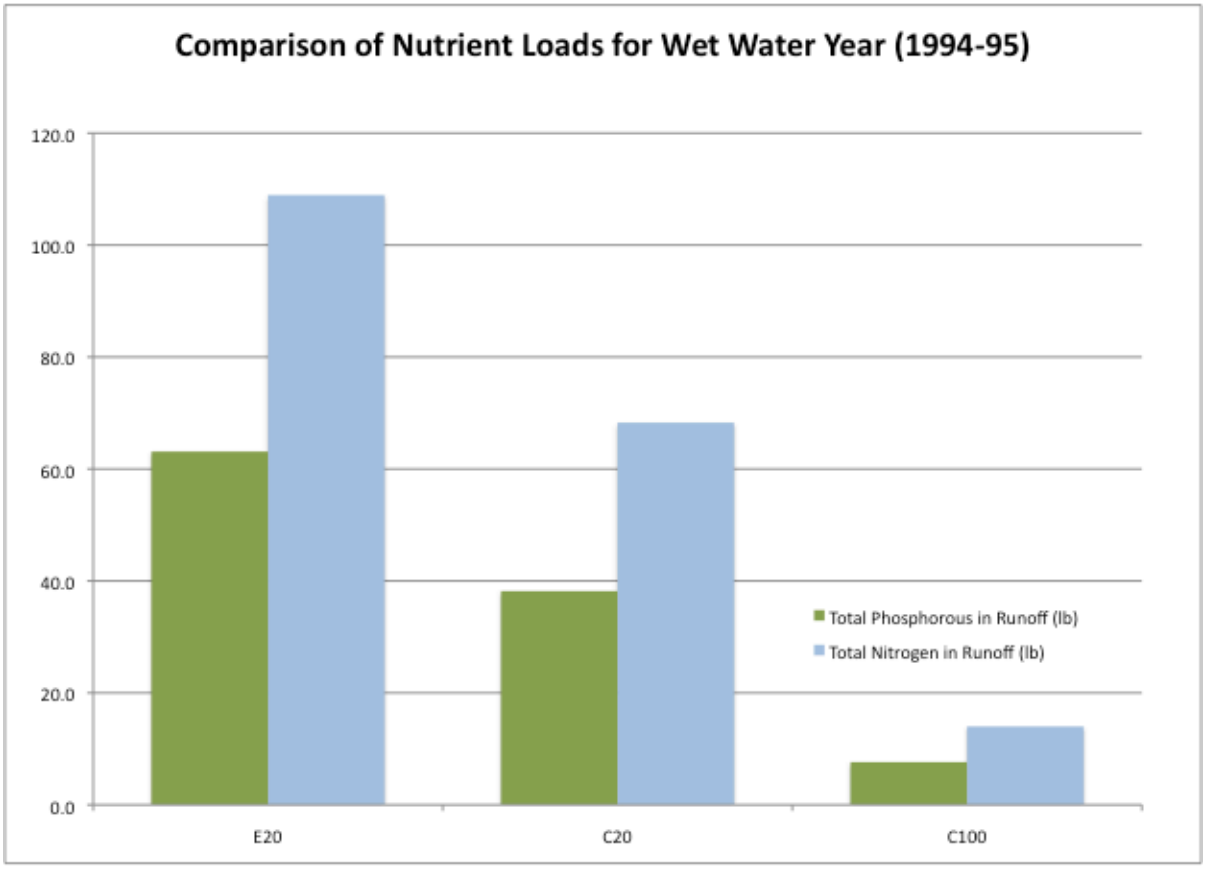

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Figures 6. Comparison of Annual Loading for E20, C20 and C100 Scenarios, Wet WY 1994-1995.

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

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

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	BASIN #1	BASINS #2 & #3	BASINS #4 & #5	GALLERY #1	GALLERY #2	GALLERY #3	INFIL TRENCH	Totals
Coverage Type			**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**

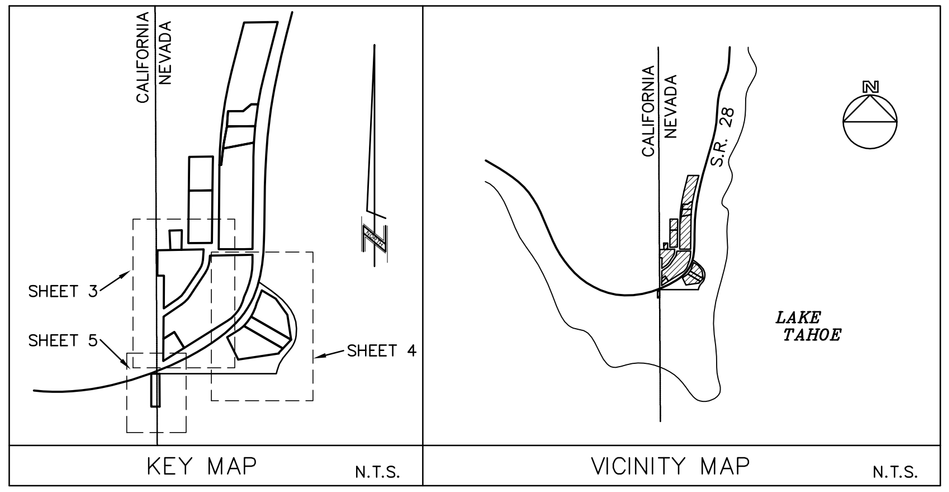
Notes:

- 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.

BOUDLER BAY MASTER PLAN

BMP RETROFIT
for
EXISTING CONDITIONS

DECEMBER, 2009



LEGEND

EXISTING		PROPOSED
	HYDRANT	
	UTILITY POLE	
+99.28	SPOT ELEV.	+99.28
	A.C. PAVEMENT	
	P.C.C. SIDEWALK or GUTTER	
	TO BE REMOVED	
	AGG. BASE	
	RIP-RAP	
95	CONTOUR	95
EX	UNDERGROUND UTILITY LINES	W
x	FENCE	x
	PROPERTY LINE OR R/W LINE	
	SECTION LINE	
	CENTER LINE	
	EASEMENT LINE	
	FLOW LINE	
	CONTROL POINT	
	SOIL TEST PIT	
WV	WATER VALVE	WV
GV	GAS VALVE	GV
S	SANITARY SEWER MANHOLE	
T	TELEPHONE MANHOLE	
T/S	TELEPHONE BOX	T/S
WM	WATER METER	
GM	GAS METER	
PV	POWER VAULT	
CB	CATCH BASIN	
	EXISTING TREE	
	EXISTING TREE TO BE REMOVED	
	GRADEBREAK	
	ORANGE CONSTRUCTION FENCE	
	SILT FENCE / SEDIMENT ROLL	
	CHAIN LINK CONST. FENCE	
	DETAIL REFERENCE	DETAIL # / PAGE #

- 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.)
- 12"P TREE, DIAMETER & TYPE P=PINE, F=FIR, C=CEDAR
- 104.9 GR SPOT ELEVATION FL=FLOWLINE, GR=GRATE, TW=TOP WALL, BW=BOTTOM WALL

OWNER/DEVELOPER:

BOULDER BAY, LLC.
590 LAKESHORE BLVD.
INCLINE VILLAGE, NV 89451
PH.: (775) 832-4900

ENGINEER:

LUMOS & ASSOCIATES
225 KINGSBURY GRADE, SUITE A
STATELINE, NV 89449
PH.: (775) 588-6490
FAX: (775) 588-6479

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

REGISTERED 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

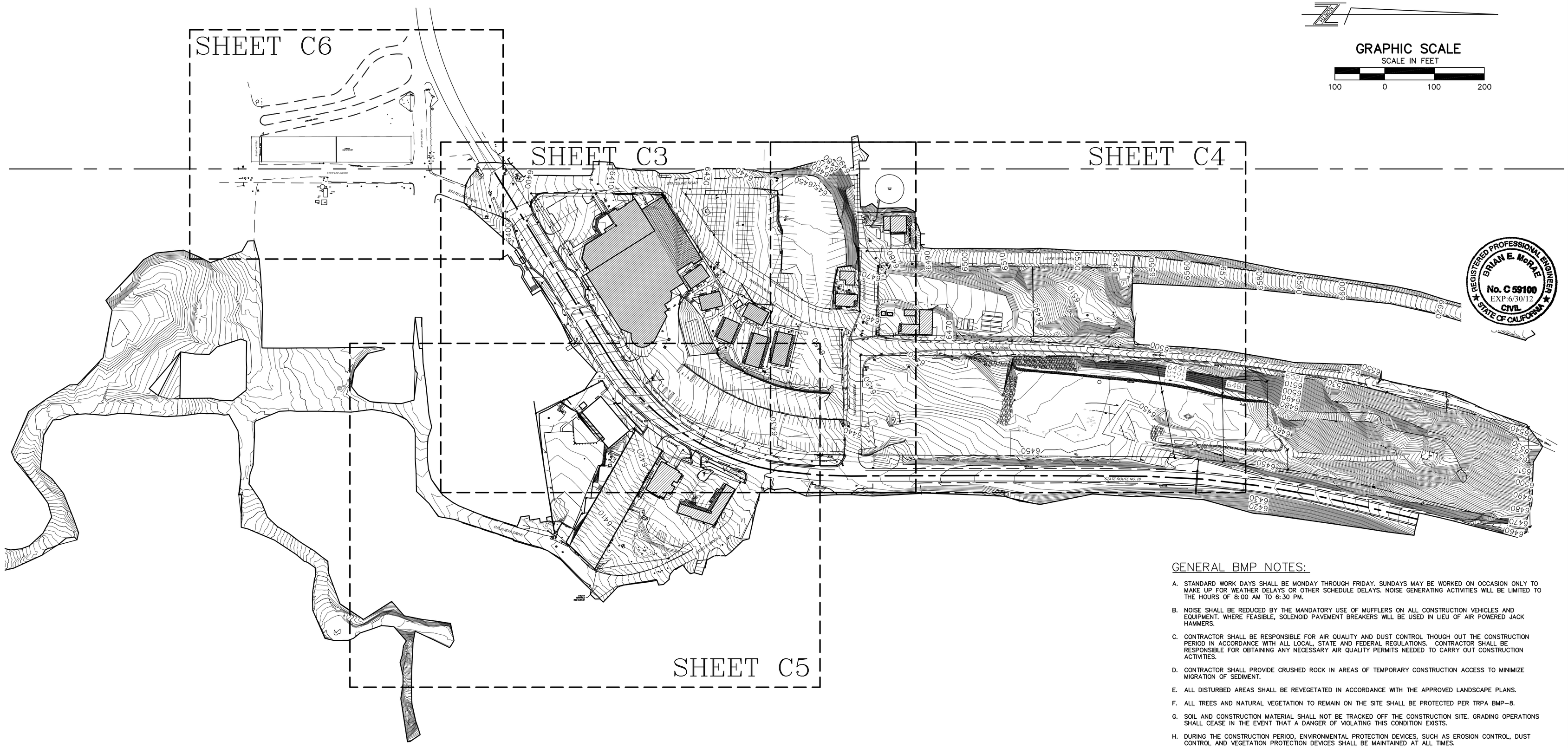
WASHOE COUNTY NEVADA
CRYSTAL BAY

REV	DATE	DESCRIPTION	BY

C1

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

T:\Vsproj\7139-000 BOULDER BAY MASTER PLAN\dwg\7139BMP_XCond BEM.dwg,C1 TITLE, 12/16/2009 12:58 pm mmoke



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

DECEMBER 2009

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
INDEX MAP

WASHOE COUNTY, NEVADA
CRYSTAL BAY

REV	DATE	DESCRIPTION	BY

C2

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

T:\laproj\7139-000 BOULDER BAY MASTER PLAN\dwg\71390BMP_XCond BEM.dwg,C3 BILTMORE,
12/18/2009 01:09 pm bmcrae

SEE SHEET C5

SEE SHEET C6

NORTH

GRAPHIC SCALE
SCALE IN FEET
30 0 30 60

STATE LINE ROAD

STATE ROUTE NO. 28

WASSOU ROAD

RESERVOIR DRIVE

FD. 2" BRASS DISK. NDOT 925001A ELEV.=6393.89' (NAVD 88)

EXISTING MANHOLE

EXISTING NDOT CULVERT

WATER QUALITY TREATMENT VAULT

(6/D2) GUTTER (WASHOE COUNTY)

35 LF 3' VALLEY (WASHOE COUNTY)

(1/D2) CATCH BASIN

48" SDMH

WASHOE COUNTY DI CLEAN & MAINTAIN (WASHOE COUNTY)

STORM DRAIN DETENTION BASIN #1 12,000 CF CAPACITY WITH 1' FREEBORD

(6/D2) 95 LF ROLLED C&G (WASHOE COUNTY)

CONNECT TO EX DI LATERAL

CLEAN & MAINTAIN EXIST. D.I.

FD. RCE 334 2" BRASS DISK

CATCH BASIN (1/D2)

CLEAN & MAINTAIN EXIST. D.I.

CATCH BASIN (1/D2)

48" SDMH

WATER QUALITY TREATMENT VAULT

STORMVAULT GALLERY

3' VALLEY GUTTER (6/D2)

SWALE TO VALLEY GUTTER WITH OPENING AT CURB

CATCH BASIN (1/D2)

WATER QUALITY TREATMENT VAULT

UNDERGROUND GALLERY 48' X 27.4' X 4.5'

CATCH BASIN (1/D2)

PROJECT BENCHMARK 2" BRASS DISK. NDOT 925002A ELEV.=6426.55' (NAVD 88)

AC CURB AT EDGE OF EXISTING PAVEMENT (5/D2)

PLUG EXISTING OUTGOING LINE

INSTALL 94 LF 12" SDR 35 PVC STORMDRAIN PIPE

CONNECT TO EXISTING SD INLET

CLEAN & MAINTAIN EXIST. D.I.

DOC. NO. 406693 PARCEL 2

340 LF AC CURB AT EDGE OF EXISTING PAVEMENT (WASHOE COUNTY) (5/D2)

330 LF 3' VALLEY GUTTER (6/D2)

MULCH AREAS OF BARREN SOILS W/ 1" – 2" ORGANIC MULCH

REGRADE AND COMPACT SLOPE. COVER SLOPE W/ BONTERRA CF7. ANCHOR TOP AND BOTTOM. (10/D1)

INSTALL F RAIL @ TOE OF SLOPE (11/D1)

EDGE OF PAVEMENT

INSTALL F-RAIL @ TOP OF SLOPE (11/D1)

20' NON-EXCLUSIVE EASE DOC. NO. 2005-01743

FD. PK NAIL

IVGID 1182/OR/20

WATER TANK

INSTALL CATCH BASIN

INSTALL 18" HDPE

CLEAN & MAINTAIN (WASHOE COUNTY)

INFILTRATION TRENCH ALONG EDGE OF DRIVEWAY (7/D1)

REVEGETATE AREA OF BASIN

CONSTRUCT 27"X AT LOW POINT

REVEGETATE AREA OF BASIN

PLUG AND ABANDON EXISTING DI

INS POL

FD. 2"

S 1/4 COR.,

SEE SHEET C4

6400 6410 6420 6430 6440 6450 6460 6470 6480 6490

NICHOLS 2004-0126501

CAMOUS 95-058117

BRIAN E. McRAE No. C 69100 EXP 6/30/09 CIVIL REGISTERED PROFESSIONAL ENGINEER STATE OF CALIFORNIA

BRIAN E. McRAE EXP 12/31/09 CIVIL STATE OF NEVADA No. 14993 PROFESSIONAL ENGINEER

C3

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

REV	DATE	DESCRIPTION	BY

BOULDER BAY, LLC.

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

CRYSTAL BAY WASHOE COUNTY NEVADA

LUMOS & ASSOCIATES

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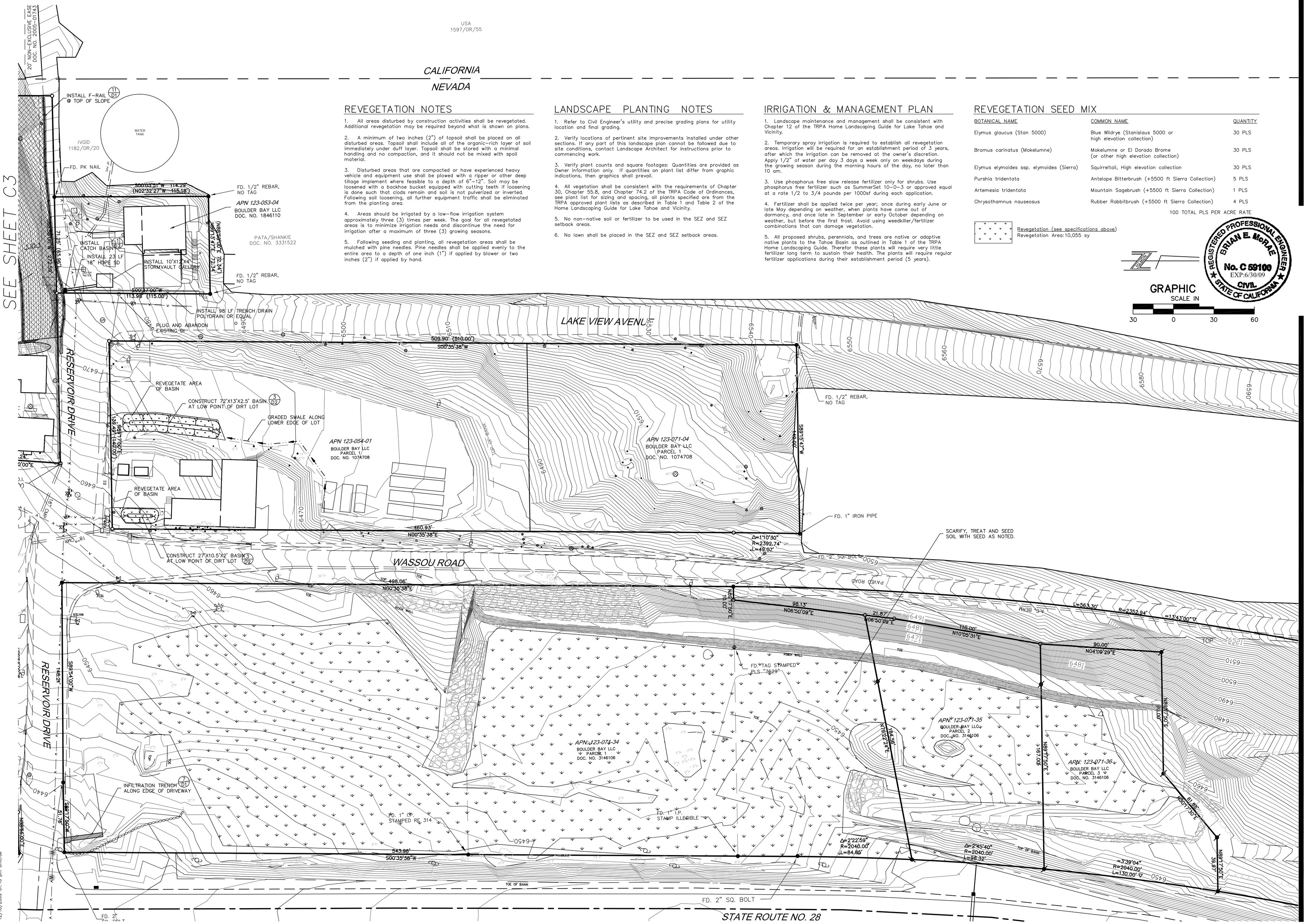

REVEGETATION NOTES

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 58100 EXP:6/30/09 CIVIL STATE OF CALIFORNIA

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

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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

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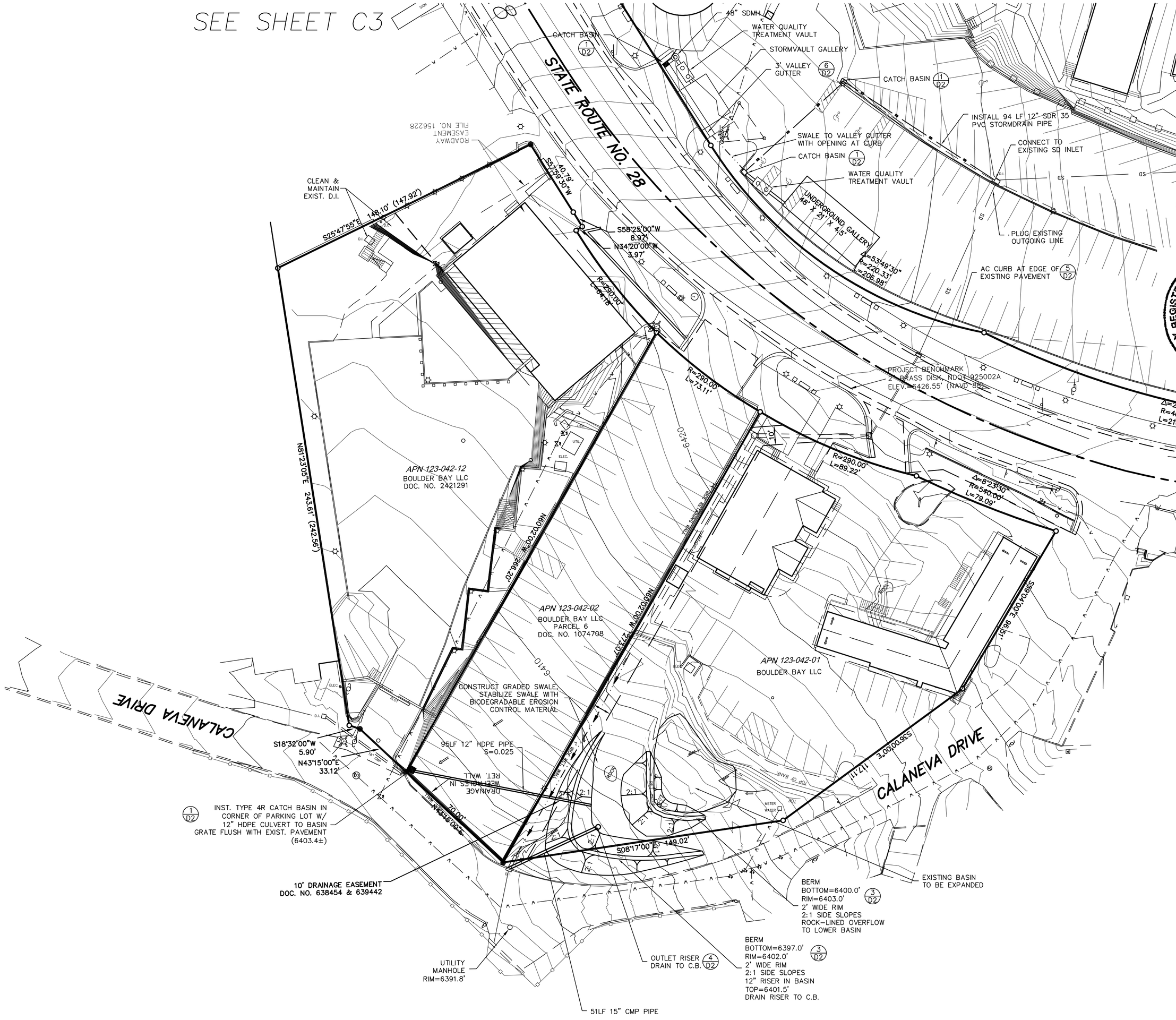
DESIGNED BY: BM
CHECKED BY: BM
JOB NO.: 7139.000

SEE SHEET C3



GRAPHIC SCALE
SCALE IN FEET
30 0 30 60

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

BOULDER BAY, LLC.

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

CRYSTAL BAY — WASHOE COUNTY — NEVADA

REV	DATE	DESCRIPTION	BY

C5

DATE: DECEMBER 2009
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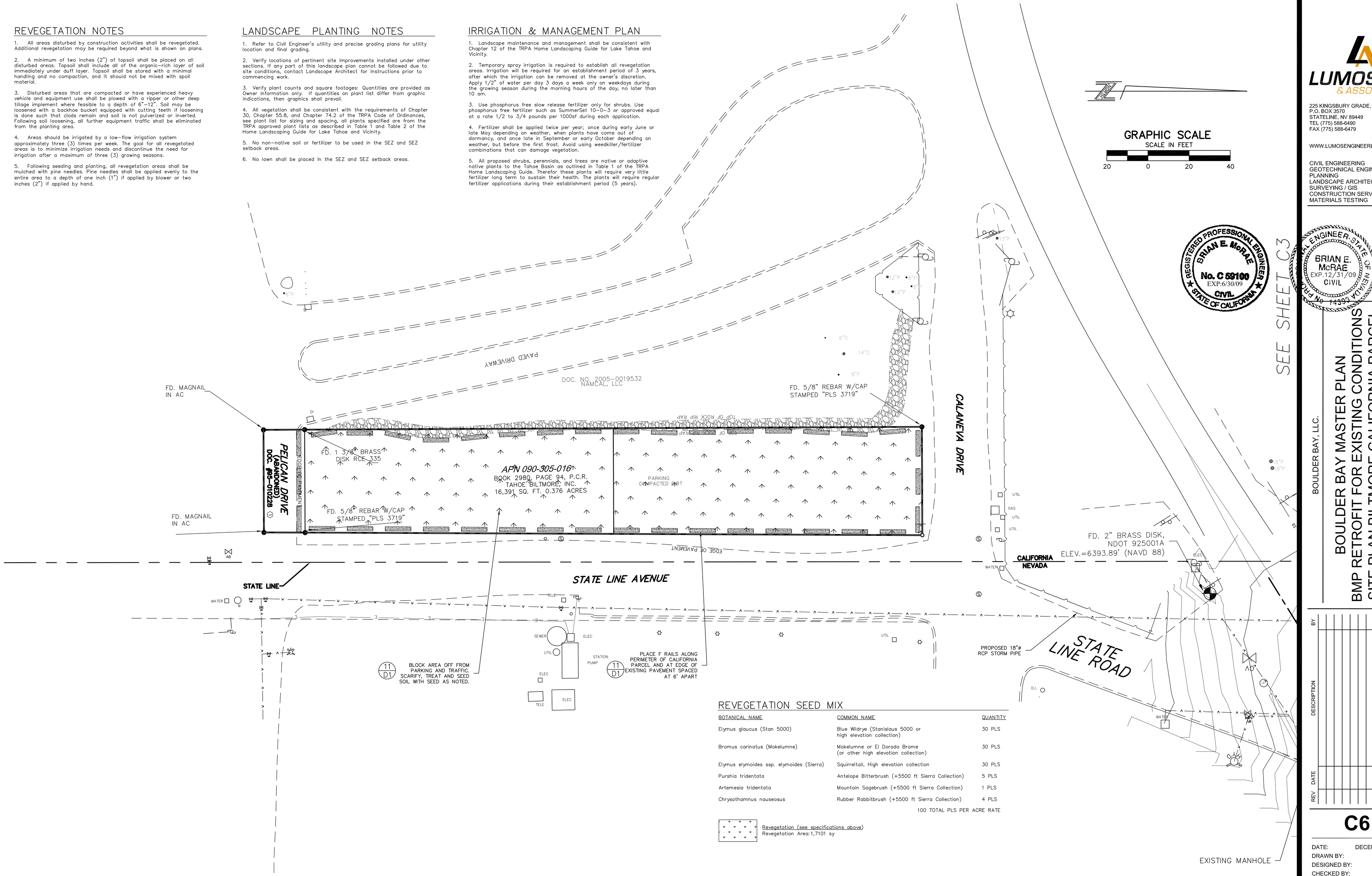

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	100 TOTAL PLS PER ACRE RATE	

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

GRAPHIC SCALE
SCALE IN FEET
20 0 20 40

SEE SHEET C3

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PROFESSIONAL ENGINEER STATE OF NEVADA BRIAN E. McRAE EXP.12/31/09 CIVIL No. 14398

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
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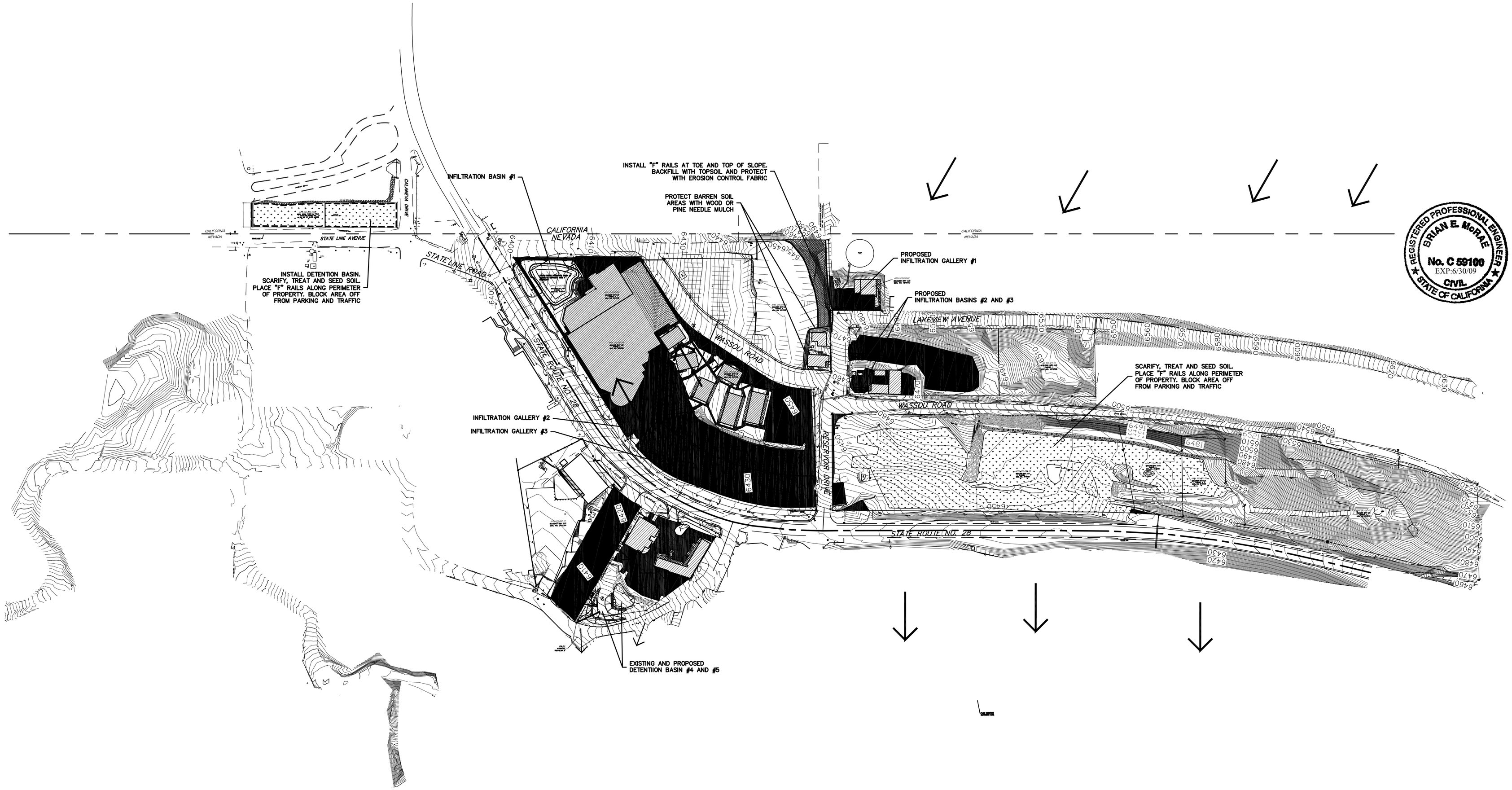

GRAPHIC SCALE
SCALE IN FEET
100 0 100 200

T:\Varro\7139-000 BOULDER BAY MASTER PLAN\dwg\7139BMP_XCond BEM.dwg,Overall Temp BMP Plan, 12/18/2009 01:14 pm tmcrae

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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
OVERALL EXHIBIT

CRYSTAL BAY — WASHOE COUNTY — NEVADA

REV	DATE	DESCRIPTION	BY

C7

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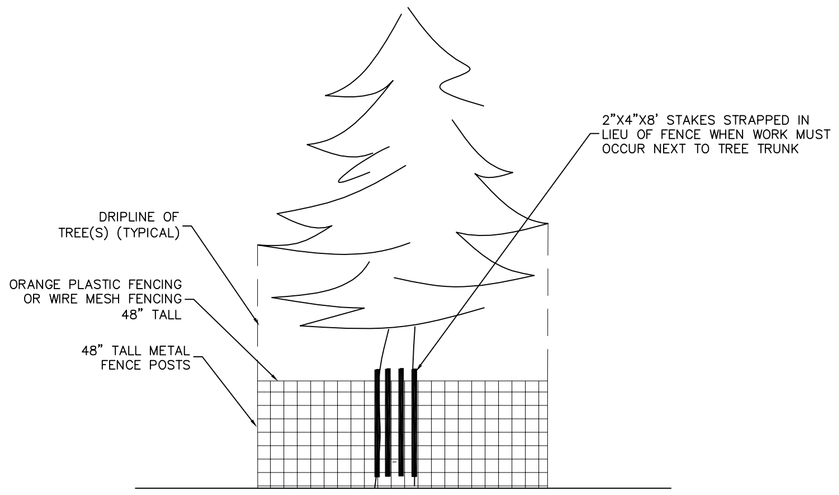
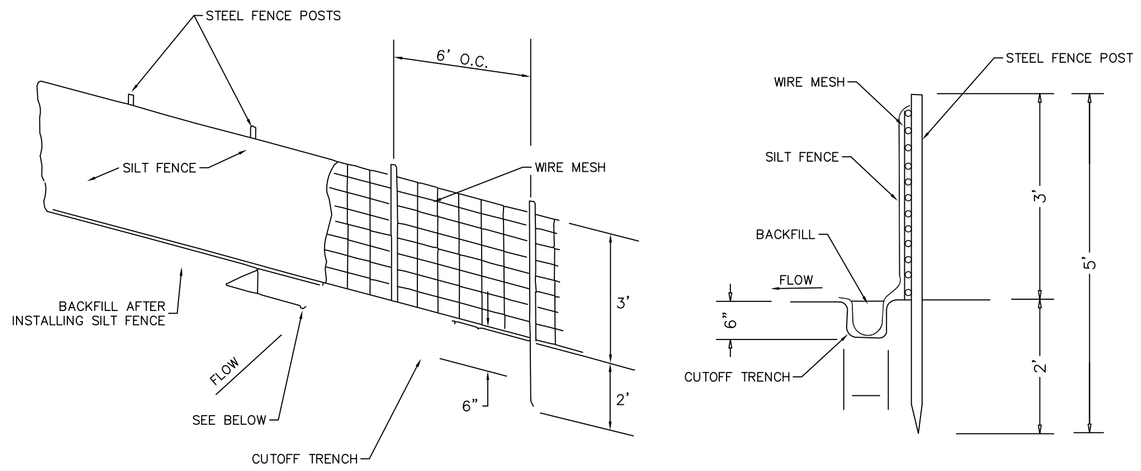


NOTES:
1. PLACING ANY MATERIAL–TEMPORARY OR OTHERWISE–WITHIN PROTECTIVE FENCING OR ENTERING PROTECTION AREAS MAY RESULT IN UP TO A $5,000 PENALTY PER VIOLATION PER DAY. (SECT 65.2 I AND J)
2. THESE CONDITIONS ARE PART OF ALL PROJECTS AS CONDITIONS OF ATTACHMENTS R,S, AND Q.
3. METAL OR WIRE MESH FENCING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

ADDIITIONAL NOTES:

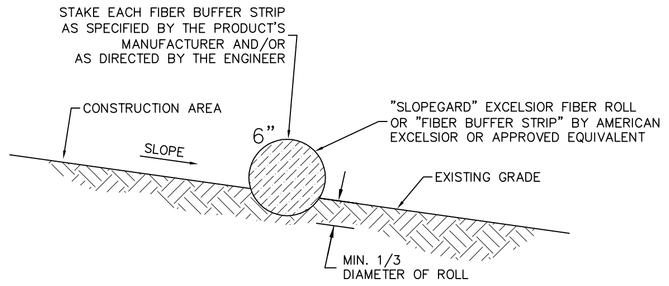
1. TO MINIMIZE ANY IMPACTS TO THE PROTECTED TREES ON SITE, TREES SHALL BE PROTECTED PER CHAPTER 65 AND 71 OF THE TRPA CODE OF ORDINANCES.
2. TECHNIQUES WILL BE USED TO MINIMIZE COMPACTION WITHIN THE TREE DRIPLINE OF ANY TREES IMPACTED BY CONSTRUCTION. THESE TECHNIQUES INCLUDE BRIDGING OF STRUCTURES OVER 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.

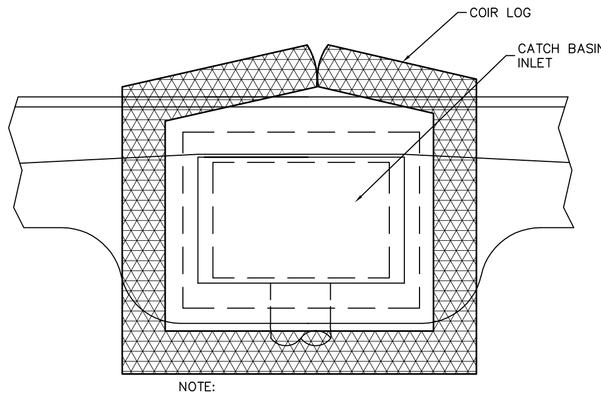


THE CONTRACTOR MAY USE MANUFACTURED SILT FENCING IN LIEU OF THE ABOVE, SUBJECT TO SUBMITTAL OF MANUFACTURER'S DATA SHEETS TO THE ENGINEER FOR APPROVAL.

SILT FENCE — 2/D1
SCALE: N.T.S.

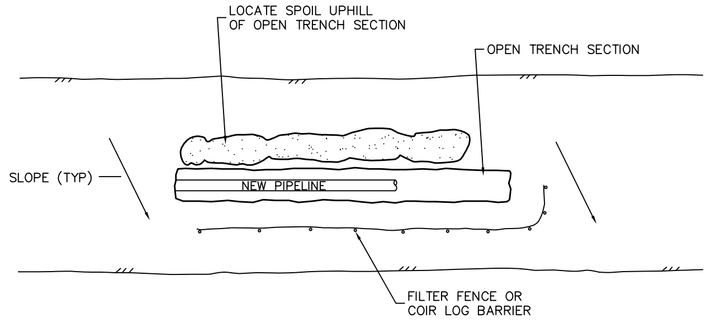


COIR LOG — 3/D1
SCALE: N.T.S.



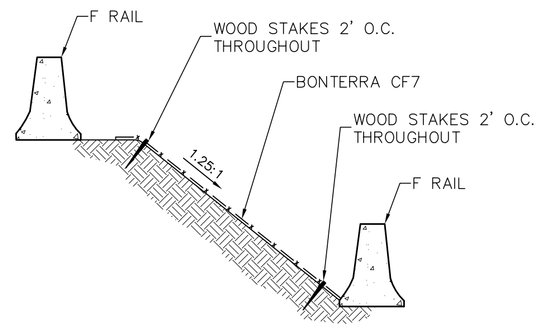
NOTE:
WEIGHT COIR LOG WITH GRAVEL BAGS

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.

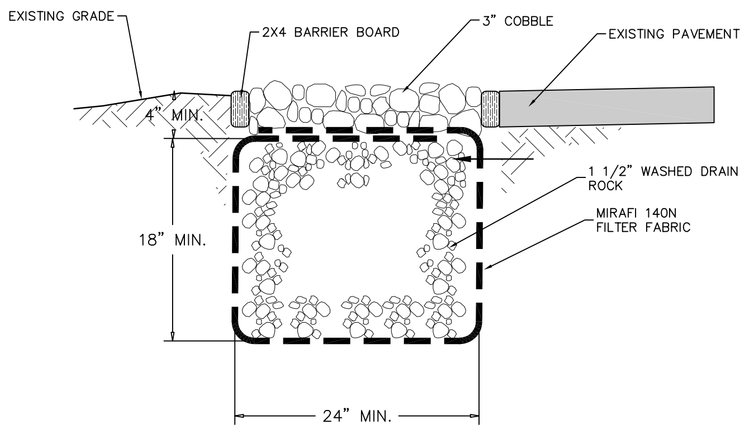
TYPICAL OPEN TRENCH SECTION — 5/D1
SCALE: N.T.S.



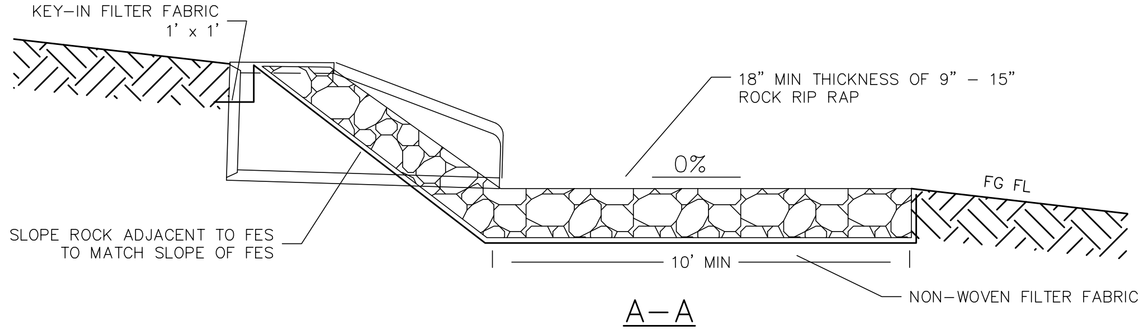
SLOPE PROTECTION DETAIL — 10/D1
SCALE: N.T.S.

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

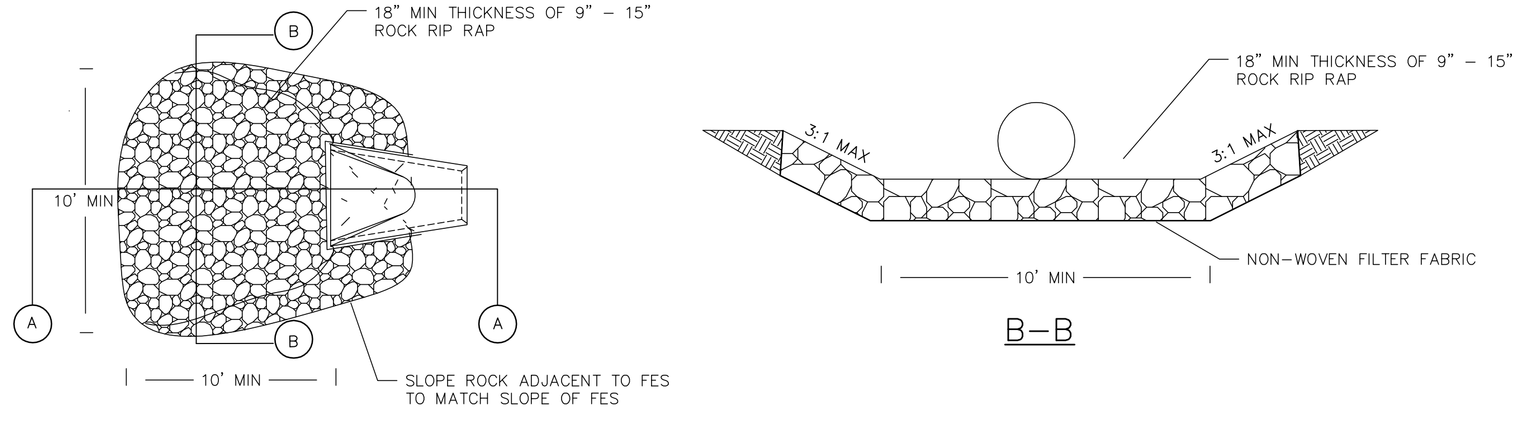
FLARED END SECTION — 8/D1
SCALE: N.T.S.



INFILTRATION TRENCH — 7/D1
SCALE: N.T.S.



A–A



B–B

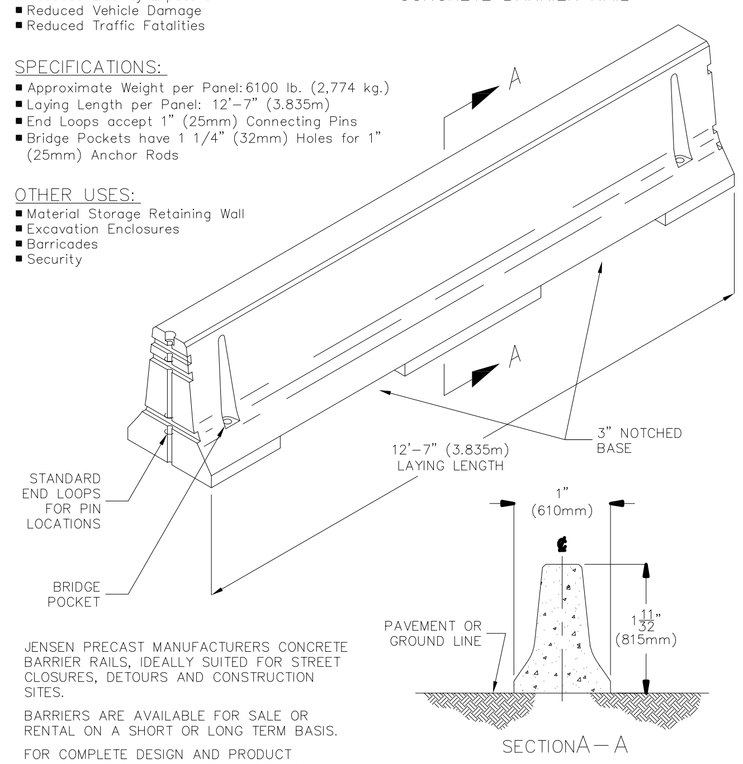
ENERGY DISSIPATER — 9/D1
SCALE: N.T.S.

12'–6" (3.810m) BARRIER
NDOT F SHAPE
PORTABLE PRECAST CONCRETE BARRIER RAIL

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

JENSEN PRECAST

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

LUMOS & ASSOCIATES
225 KINGSBURY GRADE, SUITE A
P.O. BOX 3570
STATELINE, NV 89449
TEL (775) 588-6490
FAX (775) 588-6479

WWW.LUMOSENGINEERING.COM

CIVIL ENGINEERING
GEOTECHNICAL ENGINEERING
PLANNING
LANDSCAPE ARCHITECTURE
SURVEYING / GIS
CONSTRUCTION SERVICES
MATERIALS TESTING

BOULDER BAY, LLC.

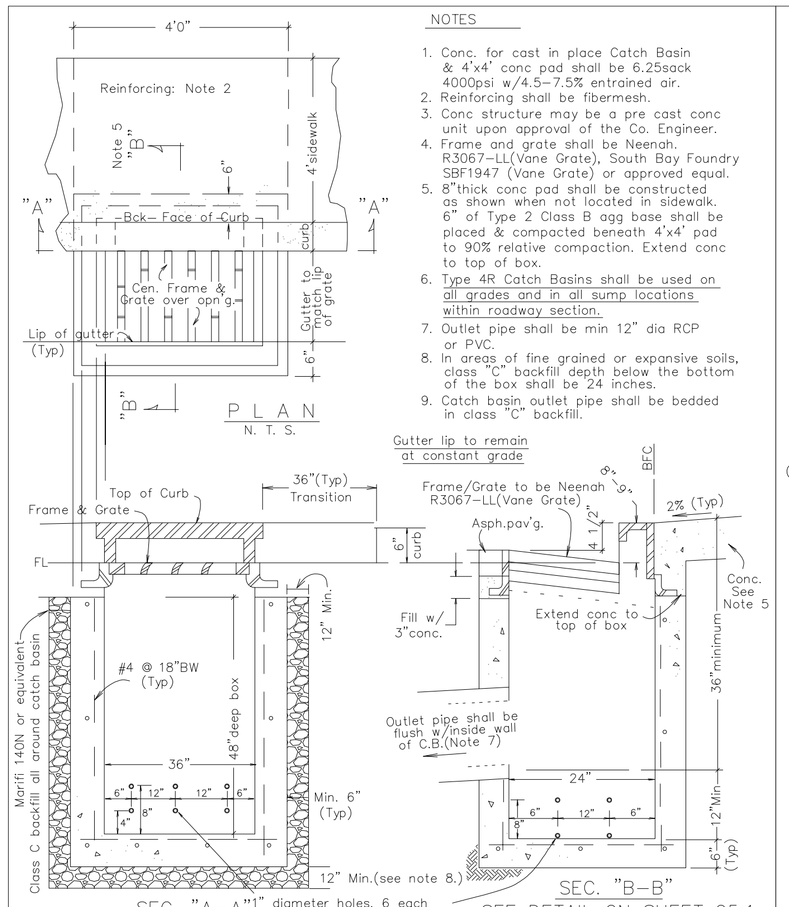
BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
DETAIL SHEET

CRYSTAL BAY — WASHOE COUNTY — NEVADA

REV	DATE	DESCRIPTION	BY

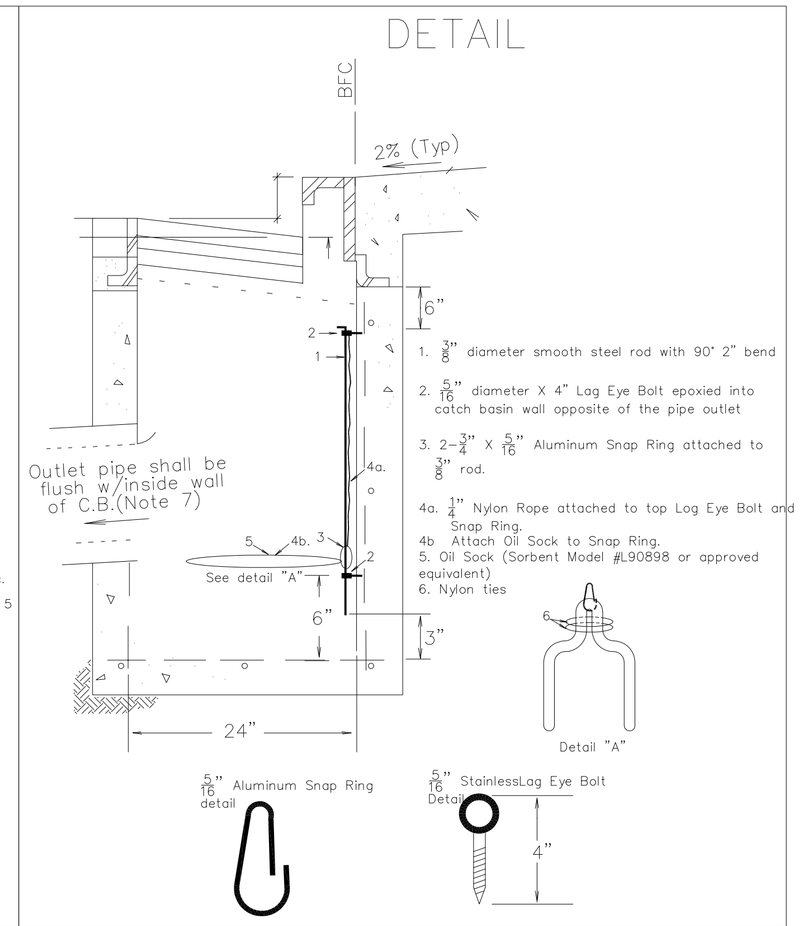
D1

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



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.



1. $\frac{3}{8}$" diameter smooth steel rod with 90° 2" bend
2. $\frac{5}{16}$" diameter X 4" Lag Eye Bolt epoxied into catch basin wall opposite of the pipe outlet
3. 2–$\frac{3}{4}$" X $\frac{5}{16}$" Aluminum Snap Ring attached to $\frac{3}{8}$" rod.
4a. $\frac{1}{4}$" 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
9	Note 8 & 9	6–07
6	Grate type	5–99
7	Note 4	8–99
8	Note 6&7	10–99

STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION

CATCH BASIN TYPE 4–R

SECTION: WASHOE
DRAWING NO: W–12
DATE: 6/07sw PAGE: 25

NO.	REVISED	DATE

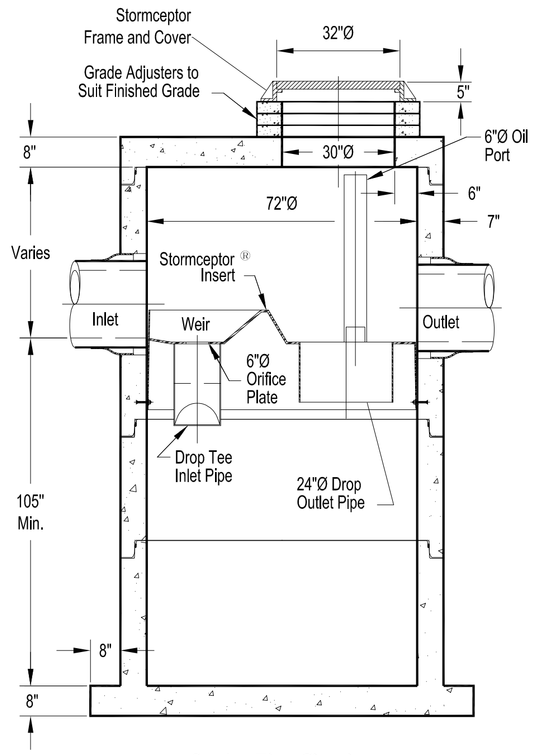
STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION

CATCH BASIN TYPE 4–R

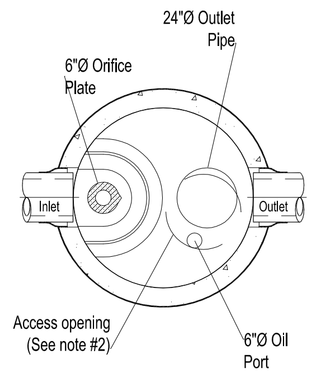
SECTION: WASHOE
DRAWING NO: W–12
DATE: 06/07sw PAGE: 25.1

CATCH BASIN SCALE: N.T.S. — 1 D2

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



Section Thru Chamber



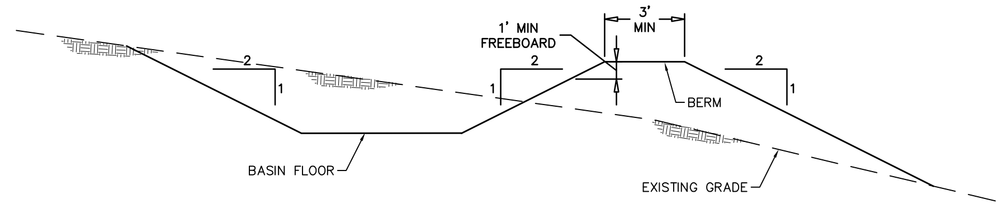
Plan View

Notes:

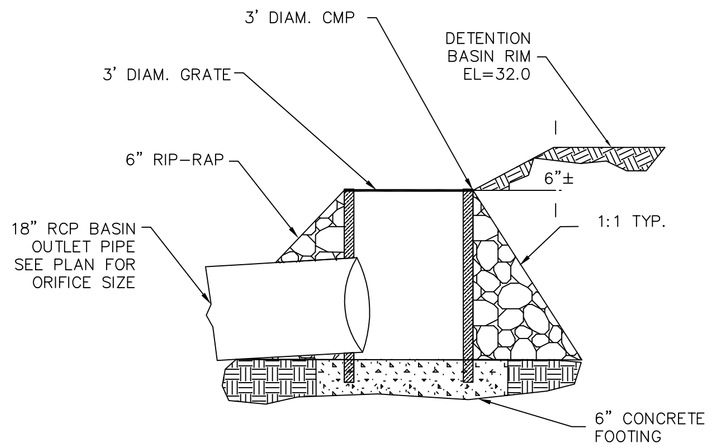
1. The Use Of Flexible Connection is Recommended at The Inlet and Outlet Where Applicable.
2. The Cover Should be Positioned Over The Outlet Drop Pipe and The Oil Port.
3. The Stormceptor System is protected by one or more of the following U.S. Patents: #4985148, #5498331, #5725760, #5753115, #5849181,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

Rinker 030

STORM WATER TREATMENT VAULT SCALE: N.T.S. — 2 D2

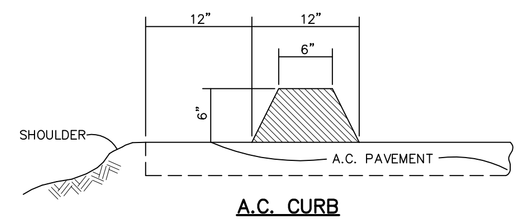


DETENTION BASIN SECTION SCALE: N.T.S. — 3 D2



*ALL CMP SHALL BE "HOT DIP" GALVANIZED

BASIN OUTLET DETAIL SCALE: N.T.S. — 4 D2

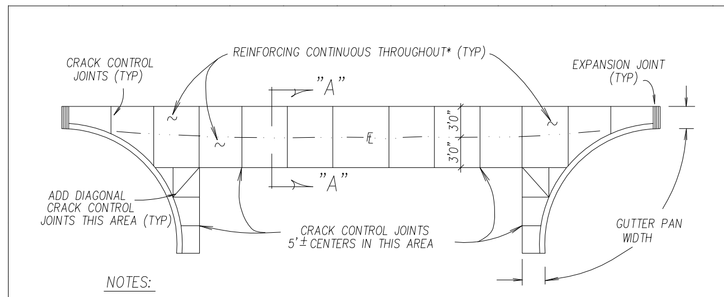


A.C. CURB

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.

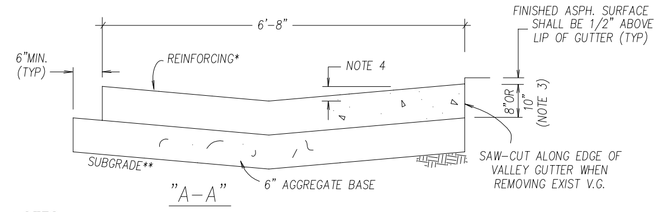
AC CURB SCALE: N.T.S. — 5 D2



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.

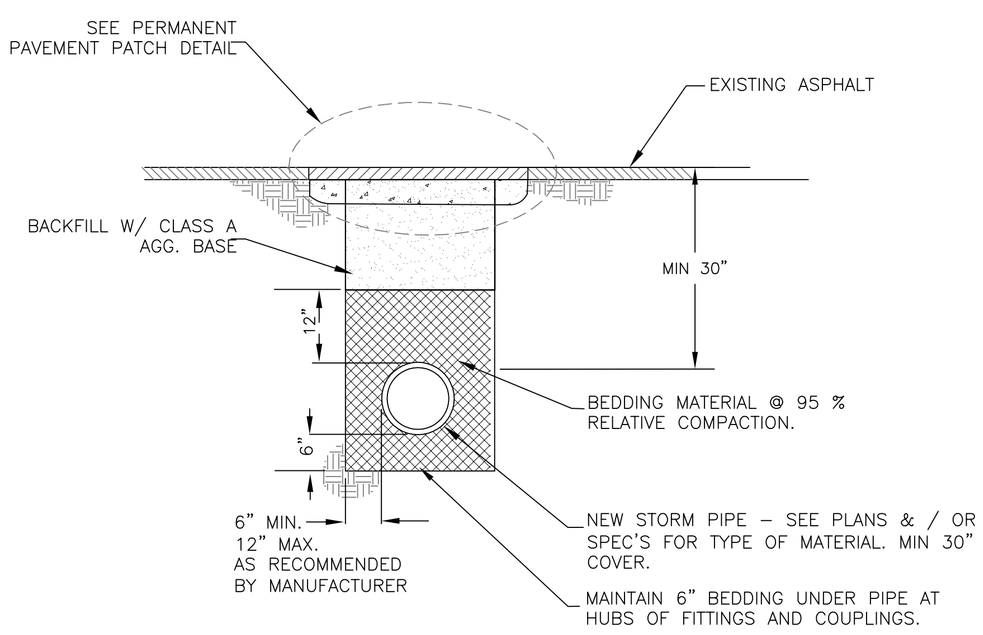
NO.	REVISED	DATE
1	REDRAW	11/92 vp
2	MISC NOTES	2/94 vp

STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION

P.C.C. VALLEY GUTTER

SECTION: WASHOE
DRAWING NO: W–11
DATE: 11/92 vp PAGE: 24

VALLEY GUTTER SCALE: N.T.S. — 6 D2



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 SCALE: N.T.S. — 7 D2

LUMOS & ASSOCIATES
225 KINGSBURY GRADE, SUITE A
P.O. BOX 3570
STATELINE, NV 89449
TEL (775) 588-6490
FAX (775) 588-6479
WWW.LUMOSENGINEERING.COM
CIVIL ENGINEERING
GEOTECHNICAL ENGINEERING
PLANNING
LANDSCAPE ARCHITECTURE
SURVEYING / GIS
CONSTRUCTION SERVICES
MATERIALS TESTING

BOULDER BAY, LLC.

BOULDER BAY MASTER PLAN
BMP RETROFIT FOR EXISTING CONDITIONS
DETAIL SHEET

WASHOE COUNTY NEVADA
CRYSTAL BAY

REV	DATE	DESCRIPTION	BY

D2

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