CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

BOARD ORDER NO. R6T-2016-0066
WDID 6A310023700

WASTE DISCHARGE REQUIREMENTS

FOR

HOMEWOOD VILLAGE RESORT

Placer County

The California Regional Water Quality Control Board, Lahontan Region (Water Board) finds:

1. Discharger
   JMA Ventures, LLC (Discharger) owns and operates Homewood Village Resort (Facility), a 1,200-acre skiing and resort development located on privately owned lands in Placer County. The Discharger also operates over-snow skiing/riding on an adjacent parcel, the 204-acre Quail Lake parcel, which is owned by the United States Department of Agriculture Forest Service – Lake Tahoe Basin Management Unit (LTBMU). The Discharger operates on the Quail Lake parcel under a 20-year lease with the LTBMU that expires on December 12, 2034. JMA is the sole Discharger on its property and a co-discharger with the LTBMU for discharges associated with operations on the Quail Lake parcel. Under the lease, JMA is responsible for ensuring compliance with this Order for operations conducted on the Quail Lake parcel. For the purpose of this Order, JMA Ventures and the LTBMU are "Dischargers."

2. Facility Location
   The Facility is an approximately 1,400-acre site located along the west shore of Lake Tahoe in the vicinity of the Tahoma and Homewood communities (Figure 1). There are two discrete base areas, one located at the end of Tahoe Ski Bowl Way (South Base) and one located between Fawn Street and Silver Street (North Base).

3. History of Previous Regulation by the Water Board
   The Water Board has regulated storm water and authorized non-storm water discharges from the Facility in a series of Orders since 1979. The most recent Waste Discharge Requirements (WDRs) were established under Board Order No. 6-95-86 and included storm water runoff effluent and receiving water limitations, requirements to implement erosion control best management practices (BMPs), and a time schedule order to implement storm water runoff controls from impervious surfaces (parking lot and rooftops) and mitigate ski area erosion features. The Order was amended twice; in 1997 to extend requirement due dates to coordinate with comprehensive master planning work in association with other responsible agencies; and in 2002 to change a compliance schedule for a new owner (the Discharger) to complete the parking lot storm water control requirements that were not implemented by the previous owner. The Facility was subsequently brought into

compliance in accordance with Amended Board Order No. 6-95-86A2. This Order supercedes and rescinds Board Order No. 6-95-86, as amended, upon the effective date of this Order, except for enforcement purposes.

4. Reason for Action
The Water Board is updating the WDRs because they are outdated and the Discharger plans to redevelop the Facilty in accordance with the Homewood Mountain Resort Ski Area Master Plan (Master Plan). The Master Plan includes upgrading/expanding ski facilities and adding amenities to the base areas such as covered parking, lodging, restaurants, and commercial space. The WDRs are also being updated to reflect current ski area water quality control requirements implemented in the Lake Tahoe Basin and to align with the current *Water Quality Control Plan for the Lahontan Region* (Basin Plan), which has been amended several times since the last WDRs for the Facility were adopted.

5. Homewood Mountain Resort Ski Area Master Plan
Due to the age and deterioration of the Facility infrastructure, the Facility is planned to be redeveloped. The Discharger purchased the Facility in 2006 for redevelopment and undertook and completed a comprehensive land use planning process with Placer County staff and others pursuant to the California Environmental Quality Act (CEQA, Public Resources Code section 21000, et seq.).

   The Discharger plans to demolish and redevelop numerous existing structures at the Facility that include mixed uses at the North Base area, residential uses in the South Base area, a lodge at the Mid-Mountain Base area, and upgraded support facilities in the ski area. As such, the Discharger prepared the Master Plan in accordance with guidelines set forth in the August 2007 Tahoe Regional Planning Agency (TRPA) Community Enhancement Program (CEP). Projects implemented through the CEP are intended to be consistent with TRPA's regional vision and planning concepts for the Lake Tahoe Basin.

6. Facility and Discharge Area
The existing Facility covers approximately 1,400 acres for downhill skiing and snowboard riding and includes two base lodges (South Base and North Base), ski lifts and slopes, summer access roads, and maintenance facilities. The Facility boundaries, including discharge areas, are shown on Figure 2. Runoff from the site flows within three subwatersheds: Madden Creek, Homewood Creek (aka Ellis Creek), and Quail Creek. Madden Creek flows along the northern boundary of the Facility and the watershed is influenced by residential and LTBMU land uses on the north side of Madden Creek. The Homewood Creek watershed is almost entirely within the boundaries of the Facility and is potentially influenced by ski area operations. Only a small portion of the Quail Creek watershed is within the Facility boundaries and is not significantly influenced by ski area operations. Two areas, the North Base and areas south of South Base, flow overland to Lake Tahoe and are influenced by vehicle parking.

One maintenance shop is used to maintain and repair snow cats and other large equipment and is located at the South Base. A smaller general maintenance shop is located at the North Base. There are underground storm water collection and treatment facilities installed to control runoff from impervious surfaces at each base area. Layouts of the North and South Bases are presented in Figures 3 and 4, respectively.

Redevelopment of the Facility is anticipated to start in 2017, although some preliminary pilot projects may begin in 2016. An overview of the redevelopment areas and layout of the proposed Mid-Mountain Lodge are presented in Figure 5. Layouts of the proposed redeveloped North and South Bases are presented in Figures 6 and 7, respectively. Final designs are subject to change as the project proceeds.

At the North Base area, the Discharger plans to remove: four existing ski lifts and associated pads, footings and utilities; buildings and concrete foundations; storm water treatment systems; asphalt parking surfaces; overhead transmission lines; and a pumphouse. The redeveloped 17-acre North Base area will include six new mixed-use buildings and eight new townhouse buildings to provide 36 residential condominiums, 16 townhouses, 20 fractional ownership units, 75 traditional hotel rooms, 40 two-bedroom homes for sale as condominium/hotel units, 30 penthouse condominium units, 25,000 square feet of commercial floor area, 13 affordable housing units, a four-story 272-space day-skier parking structure, and a 30,000-square foot skier-services lodge.

At the South Base area, the Discharger plans to remove: one existing ski lift and associated pads, footings and utilities; buildings and concrete footings; concrete parking surfaces; and overhead transmission lines. The six-acre South Base area will be converted to a 95-unit neighborhood condominium complex. Day-skier access and skier amenities will be relocated to the North Base area. The South Base area condominiums will be in three, three-story buildings.

The Mid-Mountain Base area will include a new 15,000-square foot day-use lodge with a detached gondola terminal linked to the lodge by a covered passage, a new learn-to-ski lift, an outdoor swimming facility for use during the summer months by West Shore residents, a new snow-based vehicle (e.g., grooming equipment) maintenance facility, and two water storage tanks.

Proposed water quality management elements for the Facility will include, but are not limited, to the following:

a. Treating the runoff from a minimum of a 50-year, 1-hour storm event for redevelopment areas through a planned series of basins, vaults, and infiltration galleries;
b. Low-impact design (LID) practices for developed areas (e.g., pervious pavement and pavers, cisterns, heated walk ways, bioretention areas, slope revegetation, and landscaping);

c. Installing groundwater interception and re-infiltration facilities associated with an underground parking structure that will maintain the existing groundwater/surface water hydrology;
d. Improved snow and fuel storage areas;
e. Removing culvert and fill from the stream environment zone (SEZ) at the South Base area to restore a portion of the Homewood Creek channel;
f. Land coverage reduction and restoration on the upper mountain areas;
g. Removing fill from SEZ in the gravel parking lot at the North Base area;
h. Use of non-mowed or slow-growing turf grass species, locally native or adapted species with annual fertilizer requirements that do not exceed 1.5 pounds per 1,000 square feet;
i. Implementing a Fertilizer Management Plan that meets the requirements of TRPA's Code of Ordinances;
j. Prohibiting fertilizer use on bioretention areas for storm water treatment after initial establishment; and
k. Installing a highly-controlled spray-irrigation system to avoid over-irrigation and overspray onto hardscape.

7. Scope of Activities Covered and Excluded Under This Order
This Order covers waste discharges in storm water/snowmelt runoff from activities conducted to operate and maintain the Facility. This Order does not authorize excavation/dredge and fill activities in waters of the United States. This Order does not authorize storm water discharges associated with construction activities that disturb one acre or more of land, or construction activities that disturb less than one acre of land, but are part of a larger common plan of development, including the construction activities identified in the Master Plan. Such discharges are prohibited except in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. This Order does not authorize discharges from construction and development of new groundwater supply wells.

8. Potential Pollutants
Chemicals used in the operations of the Facility include diesel fuel, lube oils, hydraulic oil, gasoline, anti-freeze, paints, solvents, propane, cleansers, snow conditioning and deicing chemicals (salt), and traction abrasives. Explosives are used for snow safety and avalanche control. Fertilizers and/or other soil amendments are used on revegetation and restoration sites. Potential pollutant discharges are related to hill-slope erosion, snow conditioning, road sanding and de-icing, and vehicle and equipment use. Fine sediment, nitrogen, phosphorus, and vehicular/equipment fluids are the primary pollutants of concern for discharges to Lake Tahoe and its tributaries.

9. Site Geology and Soils[1]
The basement geology of the Lake Tahoe Basin is divided into three categories: granitic, metamorphic, and volcanic (Hyne et al. 1972). The majority of the Facility area is underlain by Quaternary (2.6 million years to present) glacial moraines and

[1] Findings are excerpted and/or paraphrased from Chapter 14 of the Homewood Mountain Resort Ski Area Master Plan EIR/EIS, Hauge Brueck Associates, January 20, 2011

Miocene (23 to 5.3 million years) volcanic rocks (Kleinfelder 2007). Surface geology of the Facility area consists primarily of andesite lahars/flows and breccias and glacial till and moraines. Other minor geologic map units include alluvium, granitic rocks, metasedimentary rocks, and older lake sediments.

Volcanic-derived soils comprise the majority of the Facility area with some areas along the northwest boundary and below Quail Lake determined as a mix of volcanic and glacial. Soils in the vicinity of existing and/or proposed development in the Facility area have been reviewed as part of various geotechnical, hydrologic, and TRPA land capability analyses (See Davis 2006; Kleinfelder 2007; Holdredge and Kull 2010a, 2010b; and Appendix D of the Master Plan EIR/EIS for soil investigation locations and results). Generally speaking, results of these reports found that the soils within the Facility area are suitable for development with implementation of standard site-specific geotechnical recommendations.

Soil investigations determined that across the North Base area, soils are generally very deep and well drained, derived from colluvium of reworked andesitic materials in the upper layers. These soils are members of Soil Hydrologic Groups A and B. One isolated area displayed finer grained sediments within about 30 inches of the natural surface in a small isolated area just south of the North Lodge site, which places the soil within Soil Hydrologic Group C. None of the soil profiles in the base areas examined displayed restrictive subsurface layering.

10. Site Hydrology[2]

As shown in Figure 2, surface runoff flows to Lake Tahoe via one of three subwatersheds across the site, Madden Creek, Homewood Creek, and Quail Creek watersheds. There are also two intervening zones that flow overland to Lake Tahoe.

Madden Creek - The Madden Creek watershed contains the perennial Madden Creek and Lake Louise and establishes the northern and western boundaries of the Facility. A weir structure spills water from Lake Louise into Madden Creek and the headwaters are located in a broader valley area. Madden Creek watershed has an area of approximately 2.5 square miles or over 1,300 acres. The headwaters begin at Ellis Peak at an elevation of about 8,700 feet mean sea level (msl), flow over three miles and discharge into McKinney Bay of Lake Tahoe. Lake Louise is the only lake in this watershed and is located at approximately 7,700 feet msl. LTBMU land is located adjacent to the north side of the drainage. The Facility area covers the majority of the lower portion of the watershed and 27 percent, or 351 acres, of the total watershed.

Homewood Creek - The Homewood Creek watershed contains: an unnamed ephemeral creek that flows through the Facility north of the terminus of Tahoe Ski Bowl Way; the perennial Homewood Creek; and several tributaries to Homewood Creek. Homewood Creek flows through the South Base area. Homewood Creek watershed has an area of approximately 1.3 square miles or 645 acres, the majority

[2] Findings are excerpted from Chapter 15 of the Homewood Mountain Resort Ski Area Master Plan EIR/EIS, Hauge Brueck Associates, January 20, 2011

of which, 81 percent or 524 acres, is located within the Facility. The headwaters begin at Knee Ridge, flow over two miles through the Facility and then through residential areas before discharging into McKinney Bay of Lake Tahoe.

Quail Creek - The Quail Creek watershed contains several tributaries that discharge to Quail Lake and the perennial Quail Creek that flows south out of the Facility. The Quail Creek watershed has an area of approximately 1.7 square miles or 947 acres, of which 26 percent of the total watershed area is located within the Facility. The headwaters flow from an elevation of 8,400 feet msl at Knee Ridge and discharge into McKinney Bay of Lake Tahoe near Lagoon Road. The upper portion of this creek does not have water year-round. Quail Lake is located in the lower half of the watershed. Less than half of the runoff from this watershed actually flows through this lake.

11. Groundwater[3]
The Facility lies within the Tahoe Valley Groundwater Basin (TVGB) and the Sierra Glacial Till Basin (SGTB). The TVGB and SGTB are located within the larger structural feature referred to as the Lake Tahoe Basin. The basins are bounded on the east by the western shore of Lake Tahoe and on the west by the Sierra Nevada. The approximate north-south running boundary is one-half mile west of Dollar Point and two miles west of Meeks Bay (Nichols 2009). Within this subbasin, elevations range from 6,225 feet msl at lake level to above 6,400 feet msl in the west (California Department of Water Resources 2003).

Groundwater recharge in the Facility area is primarily from infiltration of precipitation into faults and fractures in bedrock, into soils and decomposed granite that overlies much of the bedrock, and into unconsolidated basin-fill deposits (Nichols 2010). Except where the land surface is impermeable or where the groundwater table coincides with land surface, groundwater is recharged over the extent of the flow path (Thodal 1997).

North Base Area - The North Base paved parking lots contain seasonal high groundwater at depths ranging from 5.44 to 10.45 feet below ground surface (bgs) in an interlayered colluvial and lake sediment depositional environment. The gravel parking lot south of the North Base parking lot contains seasonal high groundwater at depths ranging from 0.89 to 5.95 feet bgs in a lake depositional environment. The slopes above the North Base and between the North and South Base contain groundwater at depths ranging from 9 to 18 feet bgs. Groundwater flow in the North Base area generally follows topography and is to the north and east towards Lake Tahoe.

South Base - Shallow groundwater measured at the north end of Tahoe Ski Bowl Way and above the north portion of the South Base area ranged between 1 and 4 feet bgs. The southern portion of the slopes above the South Base area contained groundwater at depths of approximately 9 feet bgs.

[3] Findings are excerpted and/or paraphrased from Chapter 15 of the Homewood Mountain Resort Ski Area Master Plan EIR/EIS, Hauge Brueck Associates, January 20, 2011

During spring 2007 or 2008 evaluations, the borings drilled in the South Base parking lots did not encounter groundwater to drilling depths of 18 feet bgs. Mottled soils indicative of seasonal groundwater were noted at depths of four to five feet bgs in the South Base parking lot area. Additionally, nearby monitoring wells contained groundwater at depths of approximately 15 to 17 feet from 1997 through 2001. Based on these data, the seasonal high groundwater levels are at depths of approximately 15 to 19 feet bgs in this area. Groundwater flow in the South Base area generally follows the topography and is to the east towards Lake Tahoe.

Mid-Mountain Area - The geotechnical investigation (Holdrege and Kull 2010b) encountered no groundwater during ten test pit excavations at the Mid-Mountain Lodge and water tank locations. Groundwater depths are expected to be substantial based on topography (e.g., site location is along a ridge) and soils (e.g., indicative of a colluvial depositional environment).

12. Water Quality Control Plan
The Water Board adopted the *Water Quality Control Plan for the Lahontan Region* (Basin Plan), which took effect on March 31, 1995. This Order implements the Basin Plan, as amended.

13. Impaired Waters and Total Maximum Daily Loads (TMDLs)
Storm water runoff from the Facility discharges to Lake Tahoe, either by tributaries to Lake Tahoe or by overland flow from intervening areas. Since 2002, Lake Tahoe has been listed as impaired pursuant to section 303(d) of the Clean Water Act for the pollutants nitrogen, phosphorus, and sedimentation/siltation. In accordance with federal requirements, a TMDL was prepared and subsequently adopted by the Water Board in 2010 to ensure attainment of water quality standards. Basin Plan amendments (Chapter 5.18) establishing the TMDL and implementation plan for Lake Tahoe received final approval from the U.S. Environmental Protection Agency (EPA) on August 16, 2011, and are now in effect. The Lake Tahoe TMDL includes pollutant loading estimates for forested lands and urbanized areas, such as the lands occupied by the Facility.

This Order does not include waste or load allocations (e.g., on a daily or annual basis) to implement the Lake Tahoe TMDL as no TMDL wasteload allocations are assigned other than to the local municipal jurisdictions (Placer County and the California Department of Transportation in this case) in accordance with adopted municipal storm water NPDES permits. However, an analysis of the sediment loading potential associated with the redeveloped Facility was completed as part of the Master Plan environmental document (see section below on CEQA compliance). Using the same modeling approach that was used to develop the Lake Tahoe TMDL, the sediment loading potential was analyzed for existing conditions and proposed redeveloped conditions over two dry (1994 and 2003) and two wet (1995 and 2006) water years. The analysis showed that sediment loading would decrease for the redeveloped Facility compared with existing conditions by approximately 83 percent at the North Base, 80 percent at the South Base, and 60 percent at the Mid-

Mountain location.[4] Based on the reduction in sediment loading, it is also expected that the redeveloped Facility would also reduce nitrogen and phosphorus loading to Lake Tahoe. Therefore, this Order and redevelopment of the Facility is consistent with, and implements, the types of load reductions associated with requirements of the Lake Tahoe TMDL.

14. Receiving Waters
The receiving waters are surface waters within the Lake Tahoe Hydrologic Unit - North Lake Tahoe Hydrologic Area (Department of Water Resources (DWR) HA No. 634.20), and ground waters in the Tahoe Valley – North Basin (DWR No. 6-5.02) and the Sierra Glacial Till Basin (DWR No. 6-345).

15. Beneficial Uses
The designated beneficial uses of Madden Creek, Lake Tahoe, and minor surface waters and wetlands in the North Lake Tahoe Hydrologic Area are MUN, AGR, GWR, FRSH, REC-1, REC-2, COMM, COLD, WILD, MGR, SPWN, WQE, and FLD. Beneficial uses of ground waters for the Tahoe Valley – North Basin are MUN and AGR and for the Sierra Glacial Till Basin are MUN.

16. Policy for Maintaining High Quality Waters
State Water Board Resolution No. 68-16 requires the Water Board, in regulating activity that may produce or increase the discharge of waste, to maintain existing high quality waters of the state. Changes in water quality are allowed only if: (1) the change is consistent with maximum benefit to the people of the state, does not unreasonably affect present and anticipated beneficial uses, and does not result in water quality less than that described in water quality control plans or policies; and (2) the activity that produces the waste is required to meet WDRs to prevent pollution and nuisance, and best practicable treatment or control measures necessary to assure the highest water quality consistent with the maximum benefit to the people of the state will be maintained.

Activities that may affect water quality include continued long-term operation of the ski slopes and support facilities, and new land disturbance associated with Facility redevelopment and occupancy, including short-term effects due to construction activity. To assess potential effects from existing operations, a constituent-based Facility monitoring program has been conducted over many years, which includes collecting samples of storm water runoff from parking lot discharges and samples from receiving waters (Madden and Homewood Creeks), and analyzing these for selected chemical constituents. Effluent limitations (instantaneous maximum) are set for parking lot discharges and water quality objectives (as annual averages) are set for receiving waters.

Starting in 2010, an alternative sampling approach (in addition to the requirements established by the WDRs) was initiated by the Discharger to better evaluate the results of landscape restoration and erosion control activities on actual total

[4] Table 15-7 of Homewood Mountain Resort Ski Area Master Plan EIR/EIS, Hauge Brueck Associates, January 19, 2011

suspended sediment (TSS) loading of creeks tributary to Lake Tahoe. In snowmelt driven watersheds such as Lake Tahoe, it is estimated that over 90 percent of the total annual sediment loading occurs during a three- to four-month snowmelt period. To estimate this loading, the sampling involved collecting near-continuous turbidity samples from Homewood Creek during the rising limb of its hydrograph (snow melt period typically between April 1 and June 30). Total suspended solids (TSS) samples were also collected periodically during the sampling period to correlate with turbidity readings. The data were then plotted against streamflow rates to obtain a TSS loading curve relative to flow rates observed in the stream. The approach is considered to be a more direct measure of land management effects on sediment loading from the Facility. The results were presented to the Water Board and, as a result, the Facility monitoring program was revised in May 2013 to incorporate the rising-limb sampling approach. A discussion of the available data from both monitoring approaches is presented below.

Constituent-Based Monitoring

Receiving Waters

Constituent-based data collected from Madden and Homewood Creek locations upstream and downstream from the Facility from 1989 through 2012 has been compiled and analyzed. In 2013, rising limb (see below) sampling was initiated in lieu of constituent-based sampling. The receiving water data are difficult to compare to water quality objectives (WQOs) in the Basin Plan, which are expressed as annual averages that represent the entire yearly flow regime, because samples were collected during the highest flows of the snow-melt period. This skews the dataset to the highest concentrations found during the hydrologic cycle (as a goal of the effectiveness study). Therefore, the data are not directly comparable to WQOs in the Basin Plan. Additionally, the data are difficult to interpret due to variability in water years, seasonal fluctuations, inputs from other development on Madden Creek, and inability to collect samples from certain locations during winter. A summary of the data for three main constituents, total phosphorus (TP), total nitrogen (TN), and TSS is presented below.

Total Phosphorus (WQO - Annual Average)				
Location	**WQO (mg/L)**	**Minimum Value (mg/L)**	**Maximum Value (mg/L)**	**Average of Annual Averages (mg/L)**
Madden Upstream (n=15)	0.015	<0.01	0.032	0.015
Madden Downstream (n=16)	0.015	<0.01	0.037	0.022
Homewood Upstream (n=15)	0.008	<0.01	0.083	0.023
Homewood Downstream (n=16)	0.008	<0.01	0.083	0.034

Total Nitrogen (WQO – Annual Average)				
Location	**WQO (mg/L)**	**Minimum Value (mg/L)**	**Maximum Value (mg/L)**	**Average of Annual Averages (mg/L)**
Madden Upstream (n=15)	0.18	0.025	0.22	0.11
Madden Downstream (n=16)	0.18	0.02	0.97	0.16
Homewood Upstream (n=15)	0.15	0.25	0.2	0.09
Homewood Downstream (n=16)	0.15	0.05	0.27	0.13

Total Suspended Solids (WQO – 90th Percentile)				
Location	**WQO (mg/L)**	**Minimum Value (mg/L)**	**Maximum Value (mg/L)**	**Average of Annual 90th Percentiles (mg/L)**
Madden Upstream (n=15)	60	0.5	14.6	3.6
Madden Downstream (n=16)	60	2.0	37.6	14.5
Homewood Upstream (n=15)	60	0.5	22.0	7.0
Homewood Downstream (n=16)	60	4.2	77.6	28.1

These data are not representative of complete hydrologic cycles and are therefore are not directly comparable to the WQOs. It is expected that the results would be lower if samples were collected throughout the complete water year. Data from the headwaters of the creeks suggest that natural levels of TP are higher than the WQOs, possibly influenced by volcanic soils in the area. However, these data also indicate that constituent levels in surface waters increase as they move lower in the watersheds. This is typical of natural systems, but also indicates that constituent levels may be influenced by the Facility and/or other sources (adjacent recreational and residential areas), particularly in the Madden Creek watershed. The degree that the Facility influences constituent levels in the lower portions of the watershed cannot be determined from these data, which is one reason why the monitoring program was revised to incorporate the rising-limb sampling approach discussed in the following section.

Parking Lot Effluent

Storm water infiltration and treatment facilities have been in place in the parking lots at the North and South Base areas since late 2003. The facilities collect storm water runoff from the paved parking areas and building roofs. Inspections/observations are conducted during snow melt and rain events, and storm water effluent samples are required to be collected whenever the infiltration facilities reach their capacity and effluent bypasses to the Caltrans municipal storm drain system in Highway 89. Most of the sample collection events were during the spring snow melt periods of 2004, 2005, and 2006, when the snow years were larger than in recent years. A summary of the sample results from late 2003 to the present is presented below.

North Parking Lot Effluent Samples				
Constituent (limit)	Number of Sample Events	Min/Max Values	Number of Exceedances	Average/Median Values
TP (0.1 mg/L)	17	0.1/0.88 mg/L	14	0.28/0.22 mg/L
TN (0.5 mg/L)	23	0.06/0.69 mg/L	2	0.18/0.07 mg/L
Turbidty (20 NTU)	22	7.5/120 NTU	14	32/25 NTU

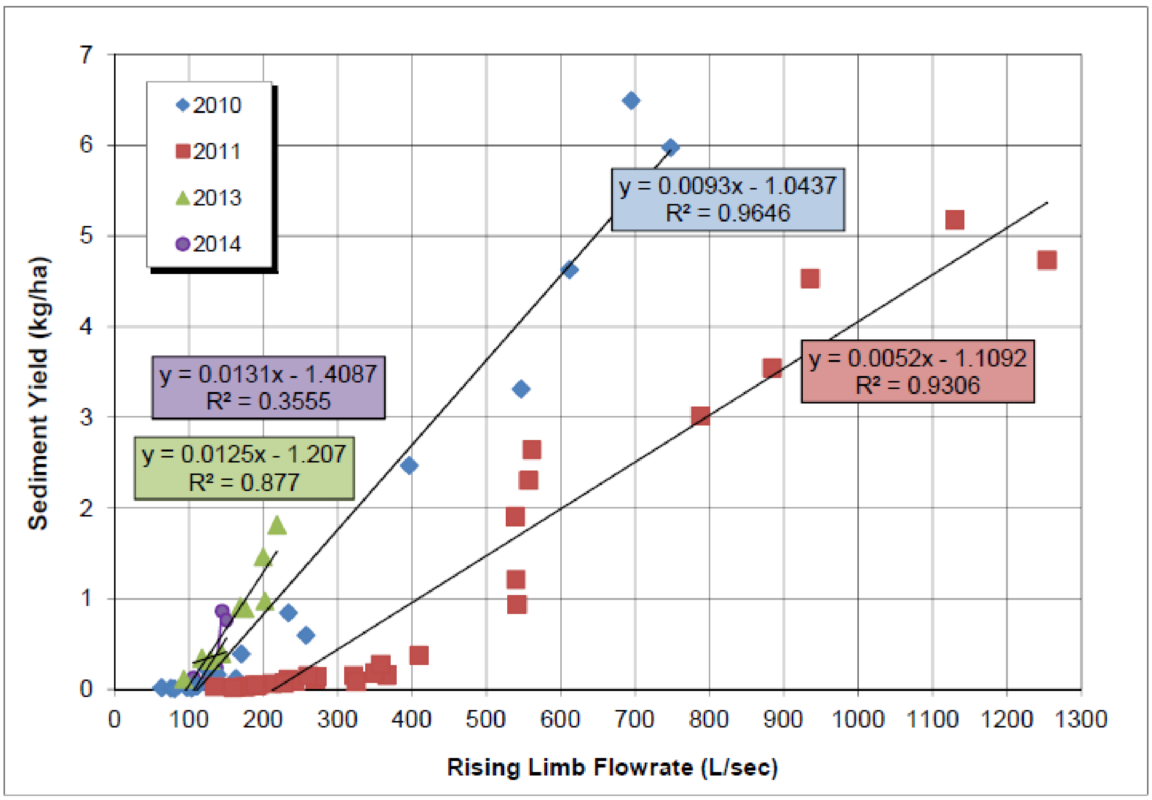
South Parking Lot Effluent Samples				
Constituent (limit)	Number of Sample Events	Min/Max Values	Number of Exceedances	Average/Median Values
TP (0.1 mg/L)	32	0.005/0.87 mg/L	6	0.09/0.04 mg/L
TN (0.5 mg/L)	32	0.004/320 mg/L	13	22.0/0.32 mg/L
Turbidty (20 NTU)	21	0.5/390 NTU	3	29/5.3 NTU

The bulk of the sampling (bypass) events occurred during the spring snowmelt periods from 2003 through 2007 or during a few high intensity rain events. The record indicates that the infiltration facilities, designed to infiltrate runoff from a 20-year, 1-hour storm (one inch of rainfall), are generally effective at capturing all runoff during the majority of the storm water runoff events. For the North Parking Lot, average sample values are influenced by a few high results, but median values are generally close to the effluent limits. TP exceeds the effluent limitations by the greatest amount and may be influenced by high natural levels and/or traction sand carried by vehicles from the roadway onto the parking lot. Cinders were used in the past by Caltrans for traction sand, which are typically high in phosphorus. Caltrans no longer uses cinders for traction sand and results from more recent sampling events show much lower concentrations of TP.

Except for TN, results from the South Parking Lot show average and median values generally close to or below the effluent limits. TN values are highly influenced by samples collected from 2003 through 2006, which showed several values one to over two orders of magnitude above the effluent limit. There is only one exceedance of the effluent limits after 2006. The reason for this is unknown.

Rising Limb Monitoring

Results of rising limb monitoring from 2010 through 2014 is presented in the graph below.



Water years 2013 and 2014 were drought years that did not provide sufficient runoff to accurately evaluate. However, water years 2010 and 2011 were relatively normal runoff years and the data indicate a reduction in sediment yield relative to flow from 2010 to 2011. The results indicate that road decommissioning and erosion control work on the mountain had a significant beneficial effect in reducing sediment loading to Homewood Creek.

Conclusions

Available information indicates that the existing operation of the Facility has not adversely impacted receiving water quality. Concentrations of TN and TP increase as flows move downstream in the watershed, but appear to be consistent with natural stream systems. The data also indicate that concentrations of TP are naturally higher than established WQOs. Concentrations of TSS appear to increase most in downstream flows, but are still less than half the WQO. There is no evidence that beneficial uses of water have been adversely impacted. Runoff from the two base areas periodically exceeds effluent limitations set in the Basin Plan when the infiltration facilities reach capacity. These bypass discharges may receive further treatment in the municipal storm drain facilities located along Highway 89. However, redevelopment of the Facility is expected to reduce runoff volume and improve runoff quality leaving the site through the use of LID practices and improved infiltration facilities. Additionally, modeling as described in Finding No.13 shows that redevelopment of the Facility will significantly reduce sediment loading from the two base areas as compared with existing conditions. Therefore, no degradation of water quality from existing conditions is anticipated or authorized in this Order. The Discharger is required to meet WDRs to prevent pollution and nuisance, and use of best practicable treatment or control measures will assure the highest water quality consistent with the maximum benefit to the people of the state will be maintained.

17. Evaluation of Water Code Section 13241
Pursuant to Water Code section 13263, the requirements of this Order take into consideration the provisions of section 13241:

a. Past, present, and probable future beneficial uses of water.
As described above in Finding Nos. 15 and 16, past, present, and probable future beneficial uses of water will be maintained at the Facility under both current and future redeveloped conditions. The Order requires the Discharger to maintain and protect water quality to serve the designated beneficial uses.

b. Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.
Refer to Finding Nos. 10, 11, 13, 15, and 16, above. The environmental characteristics of the hydrographic units have been extensively studied and this Order continues requirements to implement controls necessary to protect water quality. This Order continues and improves the monitoring program established under previous Orders.

c. Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.
Lake Tahoe is the ultimate receiving water for discharges from the Facility. Water quality conditions beyond the Facility boundaries are controlled under the Lake Tahoe TMDL program, which is implemented on a watershed-wide basis

and coordinated through the jurisdiction of municipalities and the LTBMU in the area. Controls placed on the Facility's discharges, which enter tributaries to Lake Tahoe or municipal separate storm sewer systems, are part of the overall effort to meet the objectives of the Lake Tahoe TMDL, and the more site-specific requirements to maintain high quality water of tributaries flowing through the Facility. Other than the Facility, there are no other significant factors that may affect water quality in the area in which the Facility is located.

d. Economic considerations
The Facility is a significant economic asset for the Lake Tahoe area. The current deteriorated condition of the Facility is not economically sustainable in the long term. Therefore, redevelopment and improvement of the Facility will enhance economic conditions of the West Shore area, including for other support businesses. The requirements include upgraded amenities and storm water runoff controls, which are integrated into the overall redevelopment plan to benefit both economic and water quality interests.

e. The need for developing housing within the region.
The Master Plan includes construction of new residential, tourist, and worker housing facilities. The Facility will enhance housing opportunities in the area.

f. The need to develop and use recycled water
There is no need to develop and recycle wastewater from the Facility, nor legal ability to do so. Wastewater generated from the Facility is currently treated and disposed of outside the Lake Tahoe Basin by the Tahoe-Truckee Sanitation Agency.

18. Consideration of California Water Code Section 106.3
Water Code section 106.3 establishes a state policy that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes, and directs state agencies to consider this policy when adopting regulations pertinent to water uses described in the section, including the use of water for domestic purposes.

These WDRs implement effluent limitations and other requirements to meet established receiving water objectives that will maintain all designated beneficial uses of water, including Municipal and Domestic Supply. Therefore, the requirement to consider access to safe, clean and affordable water has been met in this Order.

19. California Environmental Quality Act
The CEQA Lead Agency is Placer County. A Final EIR/EIS was certified by the Placer County Board of Supervisors in a public meeting on December 6, 2011 and a Notice of Determination, including a Statement of Overriding Considerations was filed with the State Clearinghouse on December 7, 2011 (SCH# 2008092008). The Statement of Overriding Considerations did not identify any water quality-related impacts associated with the project alternative covered by this Order. The Lahontan Water Board, acting as a CEQA Responsible Agency in compliance with California Code of Regulations, title 14, section 15096, has exercised its independent

judgment when considering the EIR/EIS for the Facility and has incorporated into this Order the specified mitigation measures from the EIR/EIS to reduce potential impacts to hydrology and water quality to a less than significant level. Those mitigation measures are:

a. Requiring a Landscape/Revegetation Plan and Fertilizer Management Plan to be developed and ready for implemention before the end of the first phase of Facility redevelopment;
b. Requiring storm drain and catch basin stenciling to prevent dumping of waste to storm water control facilities;
c. Requiring refuse and other solid waste to be protected from contacting storm water and requiring leak-proof trash containers with appropriate covering;
d. Preventing increases in storm water runoff volume by requiring LID practices defined in the Master Plan and requiring that the 50-year, 1-hour storm volume from impervious surfaces to be infiltrated or treated on site;
e. Requiring coverage under the appropriate construction general NPDES permit for grading activities disturbing one acre or more and requiring coverage under Clean Water Act sections 404 and 401 for dredge/excavation and fill activities within waters of the U.S.;
f. Requiring intercepted groundwater to be re-infiltrated for the purposes of groundwater recharge and maintaining existing surface and groundwater conditions; and
g. Including requirements for monitoring and maintenance of all storm water control and groundwater interception and re-infiltration facilities.

The Lahontan Water Board finds that, with the above mitigation measures, and additional requirements, specifications, prohibitions, and monitoring incorporated into this Order, the Project will not have a significant effect on the environment.

20. <u>Notification and Consideration of Comments</u>
The Water Board has notified the Discharger and interested parties of its intent to issue WDRs for the Facility and its discharges. A notice of the availability of a draft Order was also provided by posting a copy of the tentative WDRs to the Water Board's internet website and distributing to interested parties through direct electronic mailing and Lyris lists on August 31, 2016. The Water Board has considered comments provided in accordance with applicable time limits, and adopted this Order at a public meeting following opportunity to comment.

IT IS HEREBY ORDERED, pursuant to Water Code sections 13260, 13263, and 13267 this Order is effective as of **December 1, 2016,** and the Dischargers must comply with the following:

I. DISCHARGE SPECIFICATIONS

A. Infiltration Requirements and Effluent Limitations - Lake Tahoe Hydrologic Unit and/or Master Plan EIR

1. At a minimum, permanent stormwater infiltration/treatment facilities must be designed and constructed for runoff generated by the 50-year, 1-hour storm which equates to approximately 1.35 inches of runoff over all impervious surfaces during a 1-hour period.

   In the event that site conditions do not provide opportunities to infiltrate the runoff volume generated by a 50 year, 1-hour storm, project proponents must either (1) meet the numeric effluent limits below, or (2) document coordination with the local municipality or state highway department to demonstrate that shared stormwater treatment facilities treating private property discharges and public right-of-way stormwater are sufficient to meet the municipality’s average annual fine sediment and nutrient load reduction requirements.

2. All waste discharges generated as a result of operations or development of the Facility, which are discharged to surface waters, lands with underlying ground water, or land-based treatment or disposal systems within the Lake Tahoe Hydrologic Unit, must not contain constituents in excess of the following concentrations:

Table 1
Lake Tahoe Hydrologic Unit
Surface Water Runoff Effluent Limits*

Constituent	To Land	To Surface Waters
Total Nitrogen (mg/l as N)	5.0	0.5
Total Phosphorus (mg/l as P)	1.0	0.1
Total Iron (mg/l)	4.0	0.5
Turbidity (NTU)	200	20
Grease & Oil (mg/l)	40	2.0
* Calculated as the daily average of all effluent samples collected from a single discharge point.		

3. If constituent concentrations of runoff waters entering the subject property exceed the numerical standards specified above, there must be no statistically significant increase (at a 90% confidence level) in the constituent concentrations of the waters as the waters are discharged from the Facility.

B. Receiving Water Limits for Surface Waters – Regionwide

The discharge of waste must not violate the following water quality objectives. Unless otherwise specified, the following objectives (listed alphabetically) apply to all surface waters of the Lahontan Region, including the Lake Tahoe HU:

Ammonia
The neutral, unionized ammonia species (NH_3°) is highly toxic to freshwater fish. The fraction of toxic NH_3° to total ammonia species ($NH_4^+ + NH_3^{\circ}$) is a function of temperature and pH. Basin Plan Tables 5.1-5 and 5.1-6 were derived from USEPA ammonia criteria for freshwater. Ammonia concentrations shall not exceed the values listed for the corresponding conditions in these tables. For temperature and pH values not explicitly in these tables, the most conservative value neighboring the actual value may be used or criteria can be calculated from numerical formulas developed by the USEPA.

Bacteria, Coliform
Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes.

The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 ml, nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 ml. *The log mean shall ideally be based on a minimum of not less than five samples collected as evenly spaced as practicable during any 30-day period. However, a log mean concentration exceeding 20/100 ml for any 30-day period shall indicate violation of this objective even if fewer than five samples were collected.*

Biostimulatory Substances
Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect the water for beneficial uses.

Chemical Constituents
Waters designated as MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) based upon drinking water standards specified in the following provisions of Title 22 of the California Code of Regulations which are incorporated by reference into this plan: Table 64431-A of section 64431 (Inorganic Chemicals), Table 64431-B of section 64431 (Fluoride), Table 64444-A of section 64444 (Organic Chemicals), Table 64449-A of section 64449 (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits), and Table 64449-B of section 64449 (Secondary Maximum Contaminant Levels-Ranges). This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

Waters designated as AGR shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses (i.e., agricultural purposes).

Waters shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses.

Chlorine, Total Residual
For the protection of aquatic life, total chlorine residual shall not exceed either a median value of 0.002 mg/L or a maximum value of 0.003 mg/L. Median values shall be based on daily measurements taken within any six-month period.

Color
Waters shall be free of coloration that causes nuisance or adversely affects the water for beneficial uses.

Dissolved Oxygen
The dissolved oxygen concentration, as percent saturation, shall not be depressed by more than 10 percent, nor shall the minimum dissolved oxygen concentration be less than 80 percent of saturation.

For waters with the beneficial uses of COLD, COLD with SPWN, WARM, and WARM with SPWN, the minimum dissolved oxygen concentration shall not be less than that specified in Table 5.1-8.

Floating Materials
Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water for beneficial uses.

For natural high quality waters, the concentrations of floating material shall not be altered to the extent that such alterations are discernable at the 10 percent significance level.

Oil and Grease
Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect the water for beneficial uses.

For natural high quality waters, the concentration of oils, greases, or other film or coat generating substances shall not be altered.

Nondegradation of Aquatic Communities and Populations
All wetlands shall be free from substances attributable to wastewater or other discharges that produce adverse physiological responses in humans, animals, or plants; or which lead to the presence of undesirable or nuisance aquatic life.

All wetlands shall be free from activities that would substantially impair the biological community as it naturally occurs due to physical, chemical and hydrologic processes.

pH
In fresh waters with designated beneficial uses of COLD, changes in normal ambient pH levels shall not exceed 0.5 pH units. For all other waters, the pH shall not be depressed below 6.5 nor raised above 8.5.

The Regional Board recognizes that some waters of the Region may have natural pH levels outside of the 6.5 to 8.5 range. Compliance with the pH objective for these waters will be determined on a case-by-case basis.

Radioactivity
Radionuclides shall not be present in concentrations which are deleterious to human, plant, animal, or aquatic life nor which result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal, or aquatic life.

Waters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified in Table 4 of section 64443 (Radioactivity) of Title 22 of the California Code of Regulations which is incorporated by reference into this plan. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

Sediment
The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect the water for beneficial uses.

Settleable Materials
Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or that adversely affects the water for beneficial uses. For natural high quality waters, the concentration of settleable materials shall not be raised by more than 0.1 milliliter per liter.

Suspended Materials
Waters shall not contain suspended materials in concentrations that cause nuisance or that adversely affects the water for beneficial uses.

For natural high quality waters, the concentration of total suspended materials shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.

Suspended Sediment
Suspended sediment concentrations in streams tributary to Lake Tahoe shall not exceed a 90^{th} percentile value of 60 mg/L. (This objective is equivalent to the Tahoe Regional Planning Agency's regional "environmental threshold carrying capacity" standard for suspended sediment in tributaries.) *The Regional Board will consider revision of this objective in the future if it proves not to be protective of beneficial uses or if review of monitoring data indicates that other numbers would be more appropriate for some or all streams tributary to Lake Tahoe.*

Taste and Odor
Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance, or that adversely affect the water for beneficial uses. For naturally high quality waters, the taste and odor shall not be altered.

Temperature
The natural receiving water temperature of all waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such an alteration in temperature does not adversely affect the water for beneficial uses.

For waters designated COLD, the temperature shall not be altered.

Temperature objectives for COLD interstate waters and WARM interstate waters are as specified in the "Water Quality Control Plan for Control of Temperature in The Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" including any revisions. This plan is summarized in Chapter 6 (Plans and Policies) and included in Appendix B.

Toxicity
All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. *Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration and/or other appropriate methods as specified by the Regional Board.*

The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or when necessary, for other control water that is consistent with the requirements for "experimental water" as defined in *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, et al. 1998).

Turbidity
Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent.

C. Receiving Water Limits for Surface Waters - Certain Water Bodies

The discharge of waste must not violate the following water quality objectives. The following objectives (listed alphabetically) are in addition to the regionwide objectives specified above and supersede the regionwide objectives in the event of any conflict. These objectives apply to all surface waters of the Lake Tahoe Hydrologic Unit (HU).

Algal Growth Potential
For Lake Tahoe, the mean algal growth potential at any point in the Lake shall not be greater than twice the mean annual algal growth potential at the limnetic

reference station. *The limnetic reference station is located in the north central portion of Lake Tahoe. It is shown on maps in annual reports of the Lake Tahoe Interagency Monitoring Program. Exact coordinates can be obtained from the U.C. Davis Tahoe Research Group.*

Biological Indicators
For Lake Tahoe, algal productivity and the biomass of phytoplankton, zooplankton, and periphyton shall not be increased beyond the levels recorded in 1967-71, based on statistical comparison of seasonal and annual means. *The "1967-71 levels" are reported in the annual summary reports of the "California-Nevada-Federal Joint Water Quality Investigation of Lake Tahoe" published by the California Department of Water Resources.*

Clarity
For Lake Tahoe, the vertical extinction coefficient shall be less than 0.08 per meter when measured below the first meter. When water is too shallow to determine a reliable extinction coefficient, the turbidity shall not exceed 3 Nephelometric Turbidity Units (NTU). In addition, turbidity shall not exceed 1 NTU in shallow waters not directly influenced by stream discharges. *The Regional Board will determine when water is too shallow to determine a reliable vertical extinction coefficient based upon its review of standard limnological methods and on advice from the U.C. Davis Tahoe Research Group.*

Conductivity, Electrical
In Lake Tahoe, the mean annual electrical conductivity shall not exceed 95 umhos/cm at 25°C at any location in the Lake.

pH
In Lake Tahoe, the pH shall not be depressed below 7.0 nor raised above 8.4.

Plankton Counts
For Lake Tahoe, the mean seasonal concentration of plankton organisms shall not be greater than 100 per ml and the maximum concentration shall not be greater than 500 per ml at any point in the Lake.

Suspended Sediment
Suspended sediment concentrations in streams tributary to Lake Tahoe shall not exceed a 90th percentile value of 60 mg/L. (This objective is equivalent to the Tahoe Regional Planning Agency's regional "environmental threshold carrying capacity" standard for suspended sediment in tributaries.) *The Regional Board will consider revision of this objective in the future if it proves not to be protective of beneficial uses or if review of monitoring data indicates that other numbers would be more appropriate for some or all streams tributary to Lake Tahoe.*

Transparency
For Lake Tahoe, the annual average Secchi disk deep water transparency shall not be decreased below 29.7 meters, the levels recorded in 1967-71.

Table 2

Additional Receiving Water Limits for Lake Tahoe and Madden Creek

Surface Waters	Objective (mg/L except as noted) [1,2]						
	TDS	Cl	SO_4	B	N	P	Fe
Lake Tahoe	60 65	3.0 4.0	1.0 2.0	0.01 -	0.15 -	0.008 -	--
Madden Creek	60 -	0.10 0.20	--	--	0.18 -	0.015 -	0.015 -

[1] Annual average value/90th percentile value.
[2] Objectives are as mg/L and are defined as follows:
B - Boron
Cl - Chloride
SO_4 - Sulfate
Fe - Iron, Total
N - Nitrogen, Total
P- Phosphorus, Total
TDS - Total Dissolved Solids (Total Filterable Residues)

D. Receiving Water Limits for Ground Waters – Regionwide

The discharge of waste must not violate the following water quality objectives. The following water quality objectives apply to all ground waters of the Lahontan Region:

Bacteria, Coliform
In ground waters designated as MUN, the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 milliliters.

Chemical Constituents
Ground waters designated as MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) based upon drinking water standards specified in the following provisions of Title 22 of the California Code of Regulations which are incorporated by reference into this plan: Table 64431-A of section 64431 (Inorganic Chemicals), Table 64431-B of section 64431 (Fluoride), Table 64444-A of section 64444 (Organic Chemicals), Table 64449-A of section 64449 (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits), and Table 64449-B of section 64449 (Secondary Maximum Contaminant Levels-Ranges). This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

Waters designated as AGR shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses (i.e., agricultural purposes).

Ground waters shall not contain concentrations of chemical constituents that adversely affect the water for beneficial uses.

Radioactivity
Ground waters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified in Table 4 of section 64443 (Radioactivity) of Title 22 of the California Code of Regulations which is incorporated by reference into this plan. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

Taste and Odor
Ground waters shall not contain taste or odor-producing substances in concentrations that cause nuisance or that adversely affect beneficial uses. For ground waters designated as MUN, at a minimum, concentrations shall not exceed adopted secondary maximum contaminant levels specified in Table 64449-A of section 64449 (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits), and Table 64449-B of section 64449 (Secondary Maximum Contaminant Levels-Ranges) of Title 22 of the California Code of Regulations which is incorporated by reference into this plan. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

E. Waste Discharge Prohibitions

The discharge of waste must not violate the following prohibitions. The following discharge prohibitions apply to the Facility except for discharges of storm water when wastes in the storm water discharge are controlled through the application of management practices or other means and the discharge does not cause a violation of water quality objectives. Certain exemptions to the waste discharge prohibitions below may apply as set forth in chapters 4.1 and 5.2 of the Basin Plan.

1. The discharge of waste that causes violation of any narrative or numeric water quality objective contained in this Plan is prohibited.

2. Where any numeric or narrative water quality objective contained in this Plan is already being violated, the discharge of waste that causes further degradation or pollution is prohibited.

3. The discharge of waste that could affect the quality of waters of the state that is not authorized by the State or Regional Board through waste discharge requirements, waiver of waste discharge requirements, NPDES permit, cease and desist order, certification of water quality compliance pursuant to Clean Water Act section 401, or other appropriate regulatory mechanism is prohibited.

4. The discharge of untreated sewage, garbage, or other solid wastes into surface waters of the Region is prohibited. (For the purposes of this prohibition, "untreated sewage" is that which exceeds secondary treatment standards of the Federal Water Pollution Control Act, which are incorporated in this plan in section 4.4 under "Surface Water Disposal of Sewage Effluent.")

5. The discharge of pesticides to surface or ground waters is prohibited[5].

6. The discharge attributable to human activities of any waste or deleterious material to surface waters of the Lake Tahoe HU is prohibited.

7. The discharge attributable to human activities of any waste or deleterious material to land below the highwater rim of Lake Tahoe or within the 100-year floodplain of any tributary to Lake Tahoe is prohibited.

8. The discharge attributable to human activities of any waste or deleterious material to Stream Environment Zones (SEZs) in the Lake Tahoe HU is prohibited.

9. The discharge of garbage or other solid waste to lands within the Lake Tahoe Basin is prohibited.

10. The discharge of industrial waste within the Lake Tahoe Basin is prohibited. Industrial waste is defined as any waste resulting from any process or activity of manufacturing or construction. Storm water discharges from industrial facilities are not prohibited when wastes in the discharge are controlled through the application of management practices or other means and the discharge does not cause a violation of water quality objectives.

II. REQUIREMENTS

A. Best Management Practices (BMPs)

1. Unless a variance has been granted by the Executive Officer, there must be no removal of vegetation nor disturbance of existing ground surface conditions between October 15 of any year and May 1 of the following year.

2. Prior to October 15 of each year, the Discharger must provide permanent or temporary (if project is incomplete) stabilization/cover of all disturbed or eroding areas.

3. Surplus or waste material and/or fill of earthen material must not be placed in drainage ways or within the 100-year flood plain of any surface water of the Lake Tahoe Hydrologic Unit.

[5] See chapter 4.1, footnote to Regionwide Prohibiton 5 for additional information regarding the applicability of this prohibition.

4. All loose piles of soil, silt, clay, sand, debris, or other earthen materials must be protected in a reasonable manner to prevent the discharge of these materials to waters of the state. All trash containers must not be allowed to leak and must be covered when not in use.

5. Prior to any disturbance of existing soil conditions, the Discharger must install temporary erosion control facilities to prevent transport of eroded earthen materials and other wastes off of the property.

6. During construction activities, all non-construction areas in the vicinity must be protected to prevent unauthorized disturbance.

7. All disturbed areas must be adequately restabilized and revegetated, and be continually maintained until vegetation becomes established.

8. Surplus waste earthen materials must be removed from the Facility and deposited at a legal point of disposal, or restabilized on site in accordance with erosion control plans submitted by the Discharger. At no time must waste earthen materials be placed in surface water drainage courses, or in such a manner or location as to allow the discharge of such materials to adjacent undisturbed land or to any surface water drainage course.

9. LID practices included in Master Plan EIR must be followed and, at a minimum, runoff from impervious surfaces must be treated and/or contained on site for a 50-year, 1-hour storm. A 50-year, 1-hour storm would produce approximately 1.35 inches of rain. Storm water runoff in excess of the design storm that leaves the site must only be discharged to a storm drain or to a stabilized drainage. The Executive Officer can accept alternate treatment methods where site limitations prevent onsite treatment, containment, and infiltration.

10. Surface flows from the Facility site must be controlled so that they do not cause downstream erosion at any point.

11. There must be no significant modification of existing drainage ways or existing stream channels except for those modifications designed to improve water quality and beneficial uses. All modifications of the bed, channel, or bank of a stream require prior written acceptance by the Water Board, the California Department of Fish and Wildlife, and the United States Army Corps of Engineers.

12. Drainage swales that are disturbed by construction activities must be stabilized by appropriate soil stabilization measures to prevent erosion.

13. Snow storage and disposal must be managed to avoid, reduce and/or minimize the discharge of pollutants, including sand and de-icing materials, to receiving waters.

14. Use of best available source reduction measures for de-icing materials (salts) is required to avoid and minimize pollutant discharges from paved parking areas, roads, and ski areas.

15. The amount of abrasives applied on paved parking areas and roads must be minimized to the extent practicable.

16. Abrasives applied to paved parking areas and roads must minimize the amount of fine sediment and soluble N and P in runoff from the Facility with respect to available sources.

17. Sweeping must be conducted to effectively maximize the recovery of solid pollutants.

B. Landscape/Revegetation Plan and Fertilizer Management Plan

The Discharger must prepare and implement a final Landscape/Revegetation Plan and Fertilizer Management Plan in accordance with the BIO-9 mitigation measure included in the Master Plan EIR MMP.[6] The plans must be prepared before the end of the first phase of Facility redevelopment and made available to the Water Board upon request.

C. Storm Drain Stenciling

All newly constructed storm drain inlets and catch basins within the Facility must be permanently marked/embossed with prohibitive language such as “No Dumping! Flows to Lake” or similar language.

D. Groundwater Interception

Groundwater intercepted as part of the drainage collection and conveyance systems for the underground parking structures must include methods to infiltrate all collected groundwater for the purposes of groundwater recharge. The reinjection galleries for intercepted groundwater must be separate from the storm water treatment infiltration galleries and the distance between the groundwater and storm water infiltration galleries must be maximized to minimize potential for mixing. Collected groundwater must be infiltrated locally in the general area where collected from. Systems must be adequately sized to infiltrate no less than 100 percent of the collected volume. Discharging intercepted groundwater flow on the land surface is prohibited.

[6] Homewood Mountain Resort Ski Area Master Plan EIR/EIS, Chapter 21, Mitigation and Monitoring Program, Huage Brueck Associates, September 30, 2011.

E. Snow Conditioning

Snow conditioning materials applied to terrain parks and other ski areas have the potential, if applied in excess quantities, to contribute to increased concentrations of chloride in runoff and receiving waters. Snow conditioning materials, if used on terrain parks or other ski areas, must be applied by appropriate methods and in quantities that minimize the discharge of pollutants to receiving waters.

F. Facilities and Watershed Awareness

The Discharger must annually inform ski area employees of the locations and purposes of ski area erosion control improvements and encourage employees to report possible maintenance needs to Facility supervisors and managers.

III. PROVISIONS

A. Standard Provisions

The Discharger must comply with the "Standard Provisions for Waste Discharge Requirements," dated September 1, 1994, in Attachment 1 which is made part of this Order.

B. Monitoring and Reporting Program

A monitoring and reporting program (MRP) is necessary to verify compliance with requirements. Pursuant to Water Code section 13267, subdivision (b), the Discharger must comply with MRP No. 95-86A2 through November 30, 2016, and thereafter comply with MRP No. 2016-PROP, as specified by the Water Board Executive Officer, including reporting data obtained from October 1, 2016 through November 30, 2016, with the Annnual Report for 2017.

C. Rescission of WDRs

Board Order No. 6-95-86, as amended, is hereby rescinded on November 30, 2016, except for reporting and enforcement purposes.

I, Patty Z. Kouyoumdjian, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on November 9, 2016.

Patty Z. Kouyoumdjian

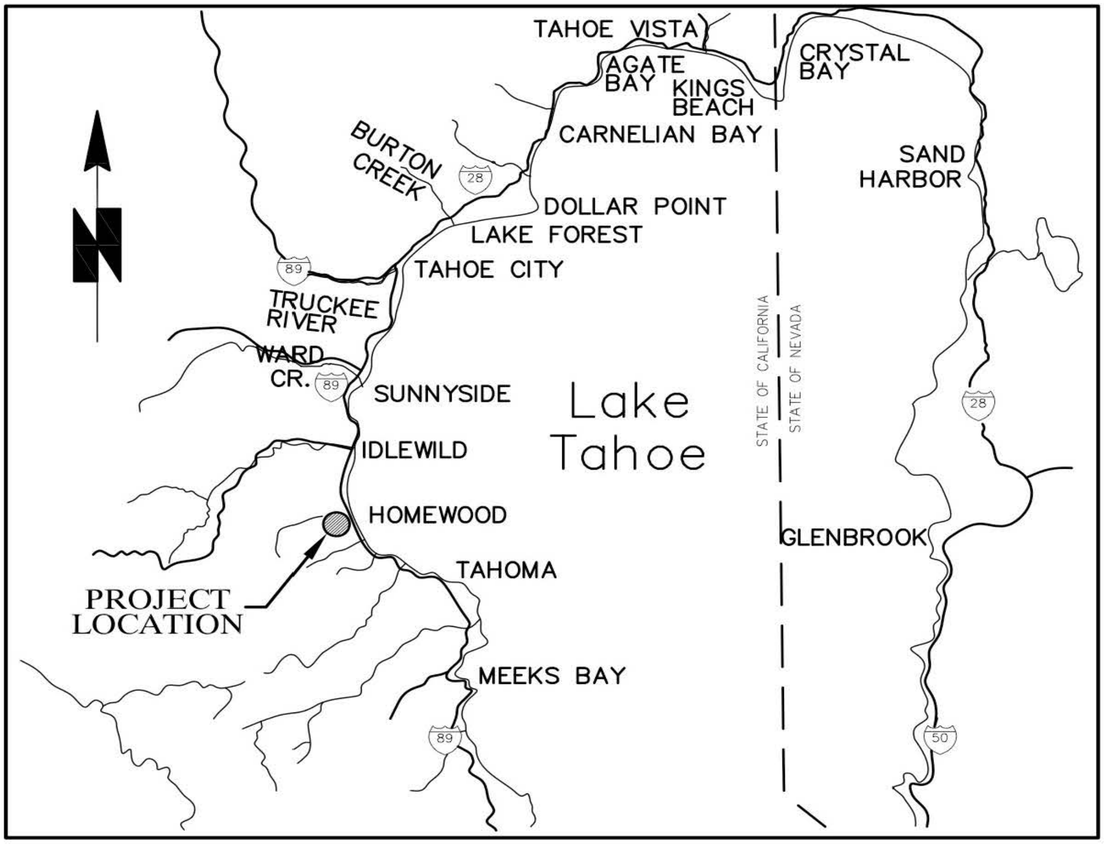
PATTY Z. KOUYOUMDJIAN
EXECUTIVE OFFICER

Figures: 1 – Location Map
2 – Facility Boundaries
3 – North Base Layout

4 – South Base Layout
5 – Facility Develoment/Redeveloment Areas
6 – Proposed North Base Development
7 – Proposed South Base Development

Attachment: 1 - Standard Provisions for Waste Discharge Requirements

Figure 1 – Facility Location Map



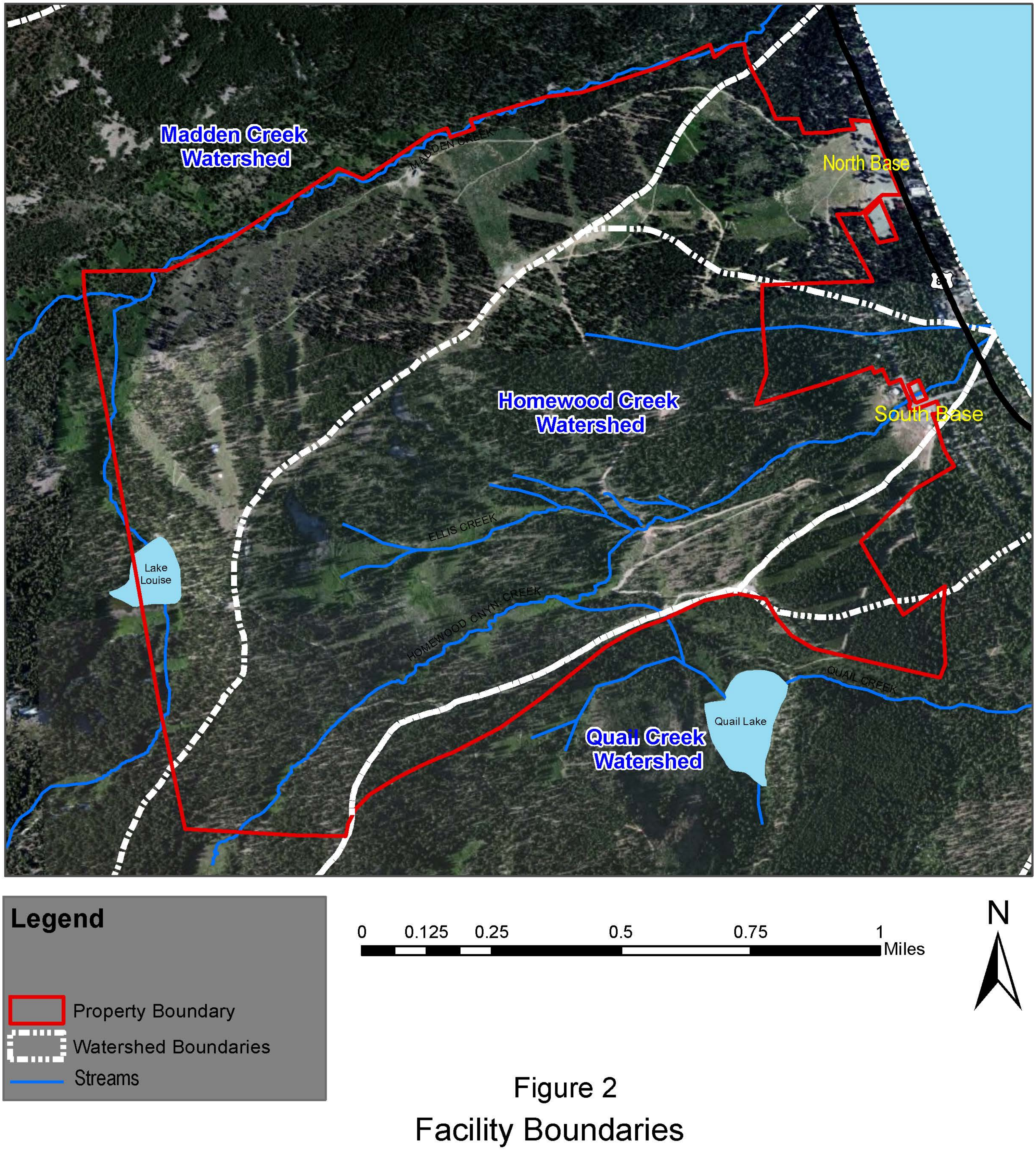
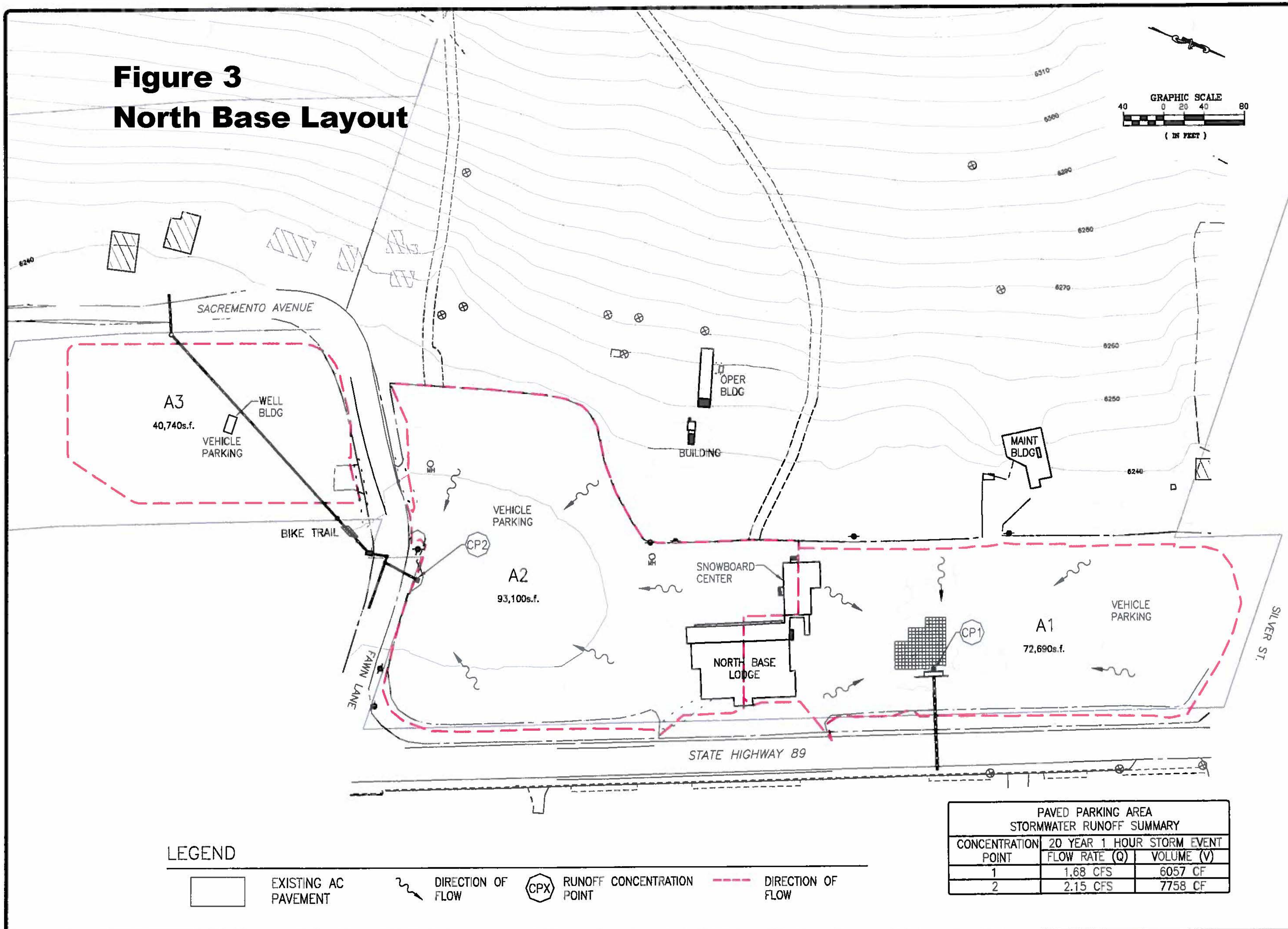


Figure 2
Facility Boundaries

Map prepared by
Kevin Drake - IERS, Inc.
3/28/13

INTEGRATED ENVIRONMENTAL RESTORATION SERVICES, INC

Figure 3
North Base Layout



PAVED PARKING AREA
STORMWATER RUNOFF SUMMARY

CONCENTRATION POINT	20 YEAR 1 HOUR STORM EVENT FLOW RATE (Q)	VOLUME (V)
1	1.68 CFS	6057 CF
2	2.15 CFS	7758 CF

REVISIONS

No.	DESCRIPTION	DATE	BY

SHAW ENGINEERING
20 Vine Street
Reno, NV 89503
(775) 329-5559
(888) 329-5559
Fax 329-5406
E-mail
General@shawengineering.com

COMPREHENSIVE SITE PLAN REPORT

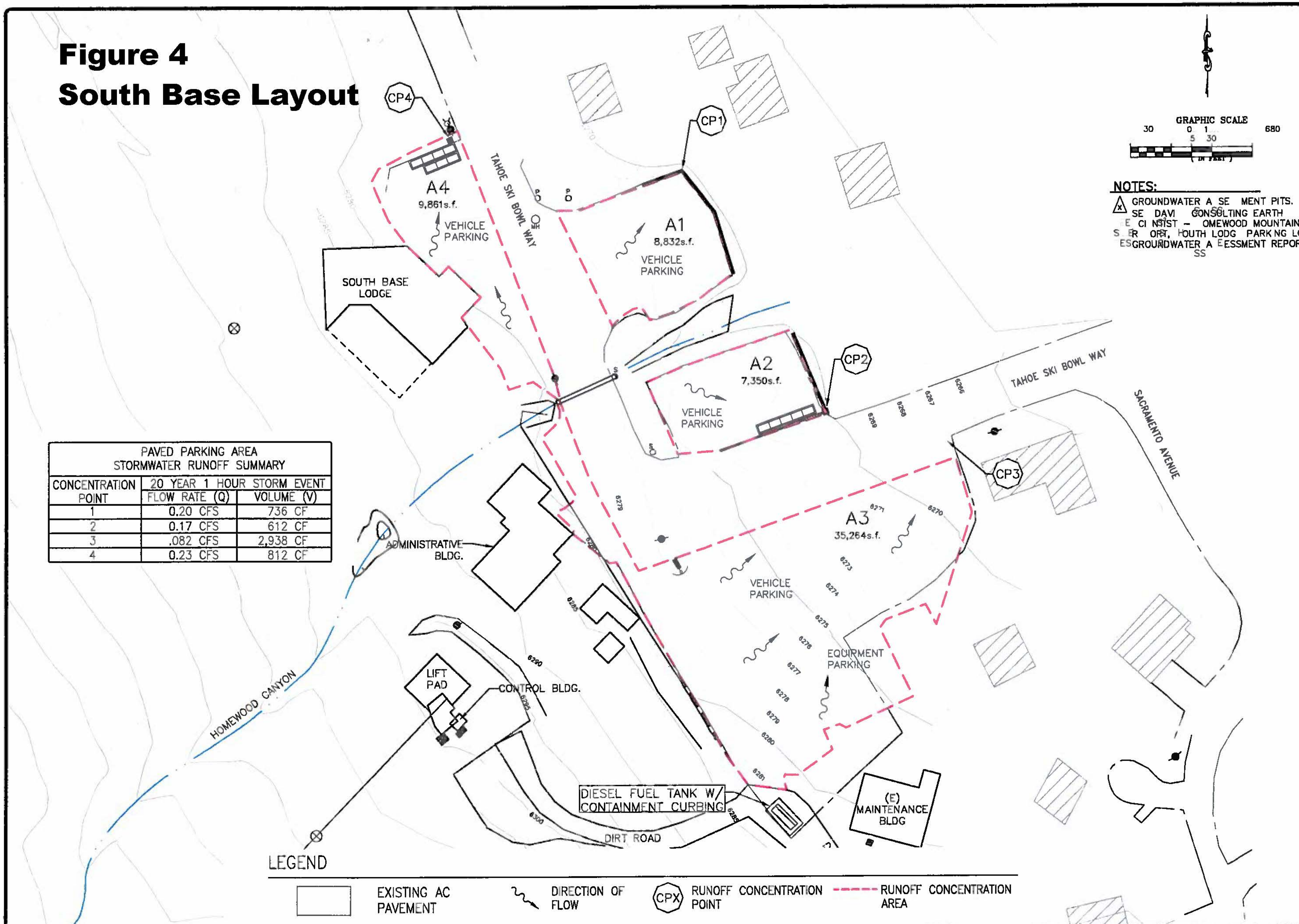
HOMEWOOD MOUNTAIN RESORT NORTH BASE DRAINAGE MAP

DRAWN BY: GRG
DESIGNED BY: SB
CHECKED: SB
DATE: APRIL, 2006
JOB NO.: 04025.000

SHEET NUMBER
FIG.5

Figure 4
South Base Layout

PAVED PARKING AREA STORMWATER RUNOFF SUMMARY		
CONCENTRATION POINT	20 YEAR 1 HOUR STORM EVENT	
	FLOW RATE (Q)	VOLUME (V)
1	0.20 CFS	736 CF
2	0.17 CFS	612 CF
3	.082 CFS	2,938 CF
4	0.23 CFS	812 CF



NOTES:
GROUNDWATER A SE MENT PITS. SE DAVI CONSULTING EARTH E CI NTIST – OMEWOOD MOUNTAIN S R ORT, OUTH LODG PARKING LOT ES GROUNDWATER A ESSMENT REPORT

REVISIONS

No.	DESCRIPTION	DATE	BY
	D		

SHAW ENGINEERING
20 Vine Street
Reno, NV
(775) 329-5559
Fax: 329-5406
General@shawengineering.com

COMPREHENSIVE PLAN REPORT SITE
HOMEWOOD MOUNTAIN RESORT
SOUTH BASE DRAINAGE MAP

DRAWN BY: GRG
DESIGNED BY: SB
CHECKED: SB
DATE: APRIL-2008

SHEET NUMBER
FIG.6

Figure 5

Facility Development/Redevelopment Areas

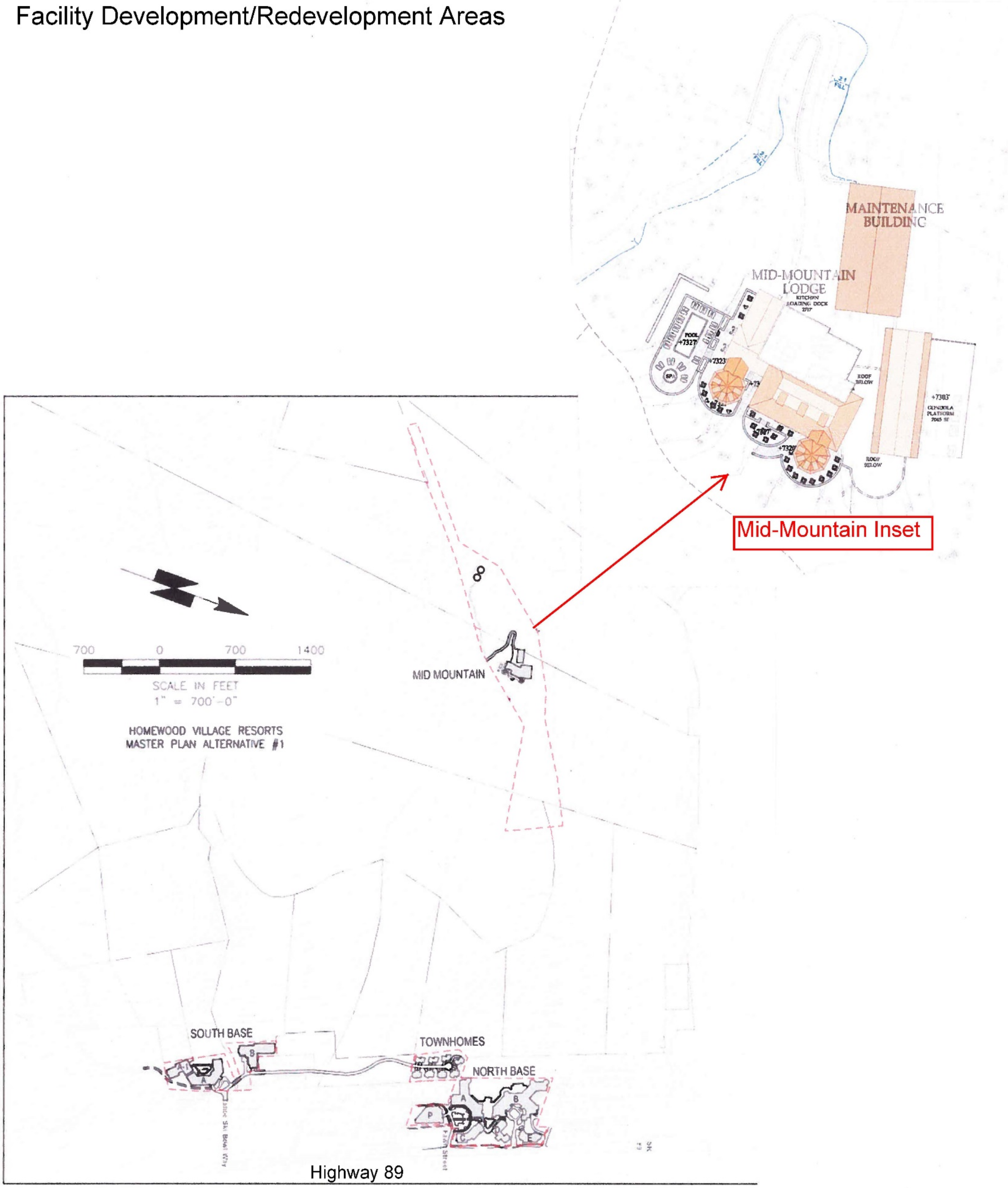


Figure 6

Proposed North Base Development

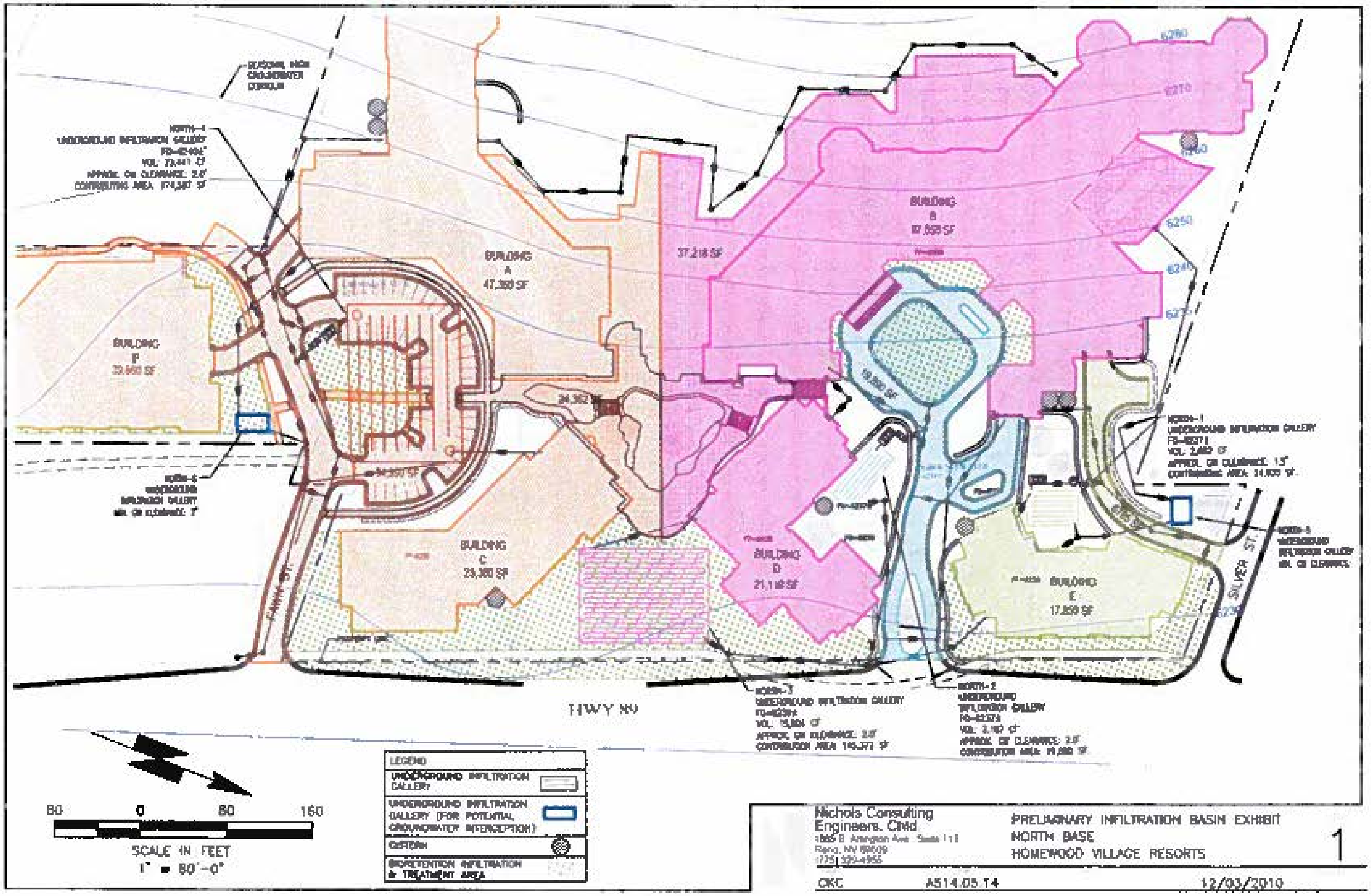
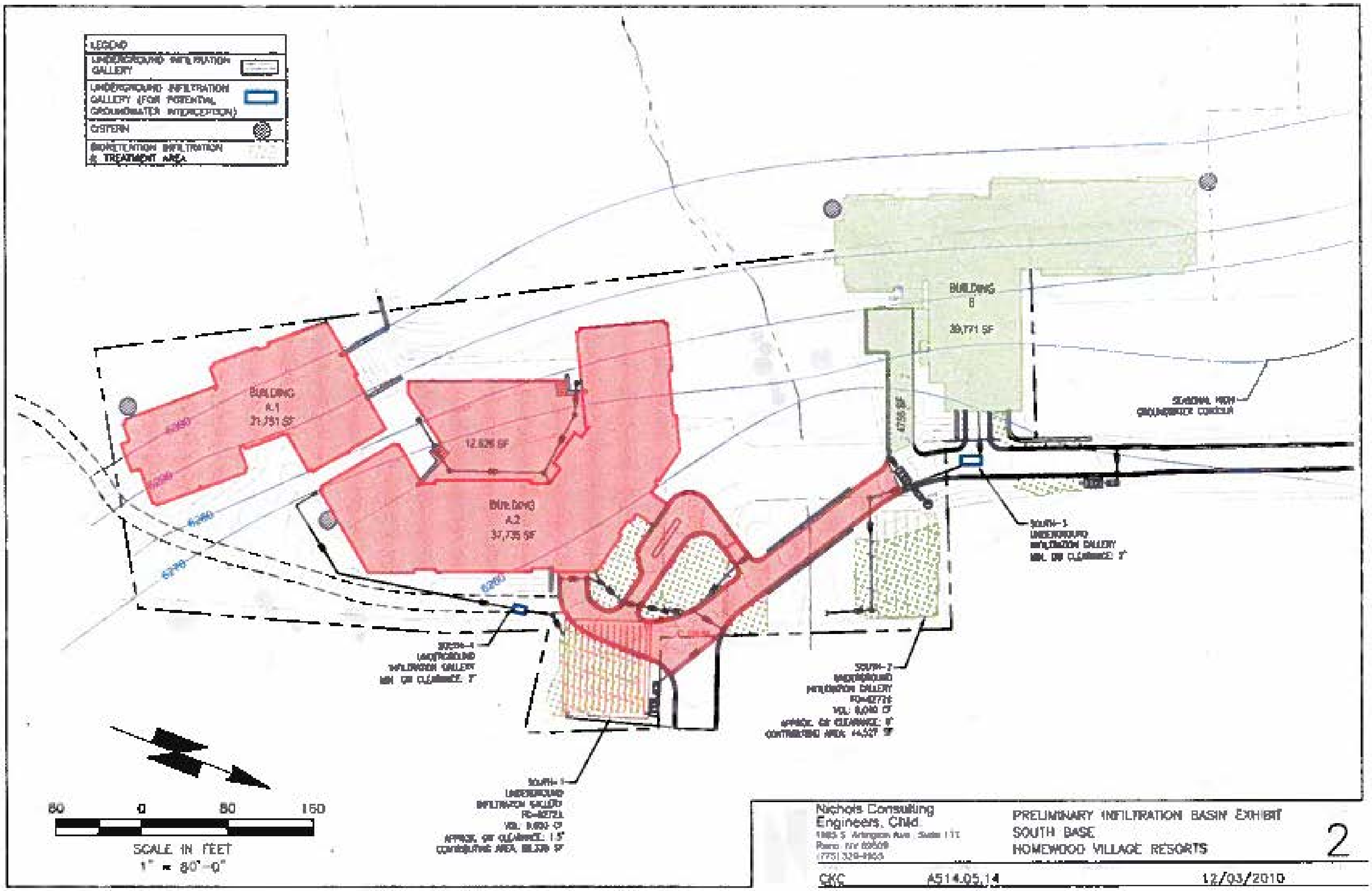


Figure 7
Proposed South Base Development



Attachment 1

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

STANDARD PROVISIONS
FOR WASTE DISCHARGE REQUIREMENTS

1. Inspection and Entry

   The Discharger shall permit Regional Board staff:

   a. to enter upon premises in which an effluent source is located or in which any required records are kept;

   b. to copy any records relating to the discharge or relating to compliance with the Waste Discharge Requirements (WDRs);

   c. to inspect monitoring equipment or records; and

   d. to sample any discharge.

2. Reporting Requirements

   a. Pursuant to California Water Code 13267(b), the Discharger shall immediately notify the Regional Board by telephone whenever an adverse condition occurred as a result of this discharge; written confirmation shall follow within two weeks. An adverse condition includes, but is not limited to, spills of petroleum products or toxic chemicals, or damage to control facilities that could affect compliance.

   b. Pursuant to California Water Code Section 13260 (c), any proposed material change in the character of the waste, manner or method of treatment or disposal, increase of discharge, or location of discharge, shall be reported to the Regional Board at least 120 days in advance of implementation of any such proposal. This shall include, but not be limited to, all significant soil disturbances.

   c. The Owners/Discharger of property subject to WDRs shall be considered to have a continuing responsibility for ensuring compliance with applicable WDRs in the operations or use of the owned property. Pursuant to California Water Code Section 13260(c), any change in the ownership and/or operation of property subject to the WDRs shall be reported to the Regional Board. Notification of applicable WDRs shall be furnished in writing to the new owners and/or operators and a copy of such notification shall be sent to the Regional Board.

   d. If a Discharger becomes aware that any information submitted to the Regional Board is incorrect, the Discharger shall immediately notify the Regional Board, in writing, and correct that information.

   e. Reports required by the WDRs, and other information requested by the Regional Board, must be signed by a duly authorized representative of the Discharger. Under Section 13268 of the California Water Code, any person failing or refusing to furnish technical or monitoring reports, or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation.

f. If the Discharger becomes aware that their WDRs (or permit) are no longer needed (because the project will not be built or the discharge will cease) the Discharger shall notify the Regional Board in writing and request that their WDRs (or permit) be rescinded.

3. Right to Revise WDRs

The Regional Board reserves the privilege of changing all or any portion of the WDRs upon legal notice to and after opportunity to be heard is given to all concerned parties.

4. Duty to Comply

Failure to comply with the WDRs may constitute a violation of the California Water Code and is grounds for enforcement action or for permit termination, revocation and re-issuance, or modification.

5. Duty to Mitigate

The Discharger shall take all reasonable steps to minimize or prevent any discharge in violation of the WDRs which has a reasonable likelihood of adversely affecting human health or the environment.

6. Proper Operation and Maintenance

The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Discharger to achieve compliance with the WDRs. Proper operation and maintenance includes adequate laboratory control, where appropriate, and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by the Discharger, when necessary to achieve compliance with the conditions of the WDRs.

7. Waste Discharge Requirement Actions

The WDRs may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Discharger for waste discharge requirement modification, revocation and re-issuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any of the WDRs conditions.

8. Property Rights

The WDRs do not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

9. Enforcement

The California Water Code provides for civil liability and criminal penalties for violations or threatened violations of the WDRs including imposition of civil liability or referral to the Attorney General.

10. Availability

A copy of the WDRs shall be kept and maintained by the Discharger and be available at all times to operating personnel.

11. Severability

Provisions of the WDRs are severable. If any provision of the requirements is found invalid, the remainder of the requirements shall not be affected.

12. Public Access

General public access shall be effectively excluded from treatment and disposal facilities.

13. Transfers

Providing there is no material change in the operation of the facility, this Order may be transferred to a new owner or operation. The owner/operator must request the transfer in writing and receive written approval from the Regional Board’s Executive Officer.

14. Definitions

a. "Surface waters" as used in this Order, include, but are not limited to, live streams, either perennial or ephemeral, which flow in natural or artificial water courses and natural lakes and artificial impoundments of waters. "Surface waters" does not include artificial water courses or impoundments used exclusively for wastewater disposal.

b. "Ground waters" as used in this Order, include, but are not limited to, all subsurface waters being above atmospheric pressure and the capillary fringe of these waters.

15. Storm Protection

All facilities used for collection, transport, treatment, storage, or disposal of waste shall be adequately protected against overflow, washout, inundation, structural damage or a significant reduction in efficiency resulting from a storm or flood having a recurrence interval of once in 100 years.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MONITORING AND REPORTING PROGRAM NO. 2016-0066
WDID NO. 6A310023700

FOR

HOMEWOOD VILLAGE RESORT

______________________________Placer County______________________________

I. GENERAL PROVSIONS

A. The Monitoring and Reporting Program (MRP) shall be conducted in accordance with the "General Provisions for Monitoring and Reporting" dated September 1, 1994 (Attachment 1).

B. Homewood Village Resort (Discharger) shall provide a certified cover letter (Attachment 2) with each MRP submittal to the Water Board.

II. MONITORING

The monitoring period is the water year (October 1 through September 30 of the following year).

A. Sampling Stations

Sampling stations shall be established for stream condition assessment, receiving waters, and effluent discharges at the following locations (Figures 1 and 2).

1. Station H-1 – Homewood Creek, segment above where creek enters culvert passing under South Base paved area.
2. Station H-2 - Homewood Creek, segment where the creek exits the Discharger's property.
3. Station P-1 – North Parking Lot – Effluent Discharge Point.
4. Station P-2 – South Parking Lot – Effluent Discharge Point.

B. Receiving Water Monitoring of Homewood Creek – Station H-2

Receiving water monitoring shall be conducted in accordance with the Discharger's proposal submitted March 26, 2013 titled "Results-Focused Watershed Management at Homewood Mountain Resort, Integrated Restoration Services, March 2013" (Attachment 3). The purpose of this monitoring approach is to better capture responses in stream conditions from land management activities at the resort. The following monitoring shall be conducted:

1. Collect near-continuous (15-minute intervals) turbidity and stage sensor readings during the rising limb of the daily hydrograph during peak-period runoff (typically between April 1 and June 30). Turbidity and stage sensors shall be set in Homewood Creek as soon as the stream channel is safely accessible in early spring. Turbidity and stage sensors must be installed, calibrated and actively logging by the time five days have passed with night time low temperatures above 33 degrees Fahrenheit (°F) and daytime high temperatures above 50°F (based on the Ward Creek SNOTEL station - http://www.wcc.nrcs.usda.gov/nwcc/site?sitenum=848&state=ca). Stage and turbidity sensor readings shall be collected until after the average daily flow rate peaks for the season.

2. Collect a minimum of 15 grab samples at different times/flow rates along the rising limb of the daily hydrograph during the time that near-continuous turbidity readings are collected. Grab samples shall be depth-width integrated samples to the extent practicable based on stream characteristics. The first grab sample shall be collected within one week of the start of the warming pattern and subsequent grab samples will be collected at different times/flow rates along the rising limb of the daily hydrograph until the average daily flow rate peaks for the season. Analyze grab samples for total suspended sediment (TSS).

C. Effluent Monitoring of Parking Lot – Stations P1 and P2

1. Sampling Frequency

Grab samples of effluent shall be collected from Stations P1 and P2 for each day that overflow from the infiltration vault system occurs, not to exceed 10 runoff events per water year. Samples are not required to be collected if dangerous weather or site conditions would unreasonably endanger sampling staff.

2. Constituents to be Analyzed

a. Turbidity
b. Total Phosphorus
c. Total Nitrogen
d. Oil and Grease

D. Stream Condition Assessments

Conditions in Homewood Creek must be assessed twice before initiation of Facility redevelopment activities at the South Base area. The assessments must be completed once by **September 1, 2017**, and once by **September 1, 2022** or before initiation of the South Base redevelopment activities, whichever comes first. The assessments must be completed at the segments encompassing the H-1 and H-2 stations. The H-2 segment must include the culverted section and open channel of the creek. The assessment must be conducted using the California Rapid Assessment Methodology (CRAM) in accordance with the most recent update of the CRAM Riverine Field Books. CRAM methodologies may be accessed from the following website: http://www.cramwetlands.org/.

E. Erosion Control Inspections of Ski Area

Areas subject to erosion at the Facility shall be monitored on an ongoing basis and necessary corrective actions implemented as soon as feasible. A minimum of two comprehensive, Facility-wide inspections per year shall be conducted and recorded, once during June and once after September 15, but before snow cover is present. The inspections shall identify any erosion control or drainage problems that require corrective actions associated with resort facilities including, ski runs, roads, drainage maintenance facilities, and service areas. Results of the inspections shall include a map and photographs of identified erosion control and drainage facilities, and document the corrective measures implemented at such areas. The purpose of the June inspection is to identify erosion features that may have developed over the winter operating months. The purpose of the September inspection is to verify that all necessary corrective actions were completed for erosion issues identified in the June inspection, identify any additional actions needed to address impacts from construction or other resort operations conducted during the summer months, and ensure that the resort property is adequately prepared for fall and winter precipitation and runoff.

F. Parking Lot Inspections

Parking lots and associated drainage structures shall be visually monitored to ensure that parking lot runoff is being treated as designed prior to discharge from the Facility. Necessary corrective actions shall be implemented as soon as feasible. At a minimum, weekly inspections must be conducted and documented during the ski resort operating period. Parking lots and associated drainage structures must also be inspected and results documented during each storm event that produces storm water runoff to drainage facilities. A rain gauge must be installed at a representative location to track the depth of each precipitation event that produces storm water runoff. The Discharger must record the precipitation amount at the time of inspection and include observations of whether runoff is bypassing the drainage/infiltration facilities.

The Discharger shall develop and maintain an inspection checklist and current map of the drainage facilities. The inspection checklist shall identify each significant drainage feature, including but not limited to, drop inlets, drainage swales and ditches, culverts, treatment vaults and basins, and outfall points. Potential pollutant source areas (e.g., oil and grease spills, paints, and stockpiles of earthen materials) shall also be identified. The date and time of inspection, rain gauge reading, and the inspection results shall be recorded on the checklist with a description of the corrective actions needed to be implemented. The date corrective actions are completed shall also be recorded on the inspection checklist. When frozen conditions exist, inspection reports shall document whether runoff is leaving the site.

G. Snow Conditioning Chemical Monitoring

The Discharger shall report whether snow conditioning chemicals are used and, if so, report: 1) the locations and dates of application; 2) amounts applied; and 3) the chemical composition and source of the materials.

H. Snowmaking Enhancement Chemical Monitoring

The Discharger shall report whether snow making enhancement chemicals are used and, if so, report: 1) the location and dates of application; 2) amounts and source of applications; and 3) the chemical composition of the materials.

III. REPORTING

An Annual Report must be submitted to the Water Board by **December 15** of each year and cover the preceding water year (October 1 through September 30 of the following year – hereafter referred to as the "reporting period"). The first Annual Report, due **December 15, 2017**, must include the information obtained during October 2016 and November 2016. The Annual Report must include the results of the requirements set forth in Section II as follows:

A. Homewood Creek Receiving Water Monitoring

1. Summary of reporting period hydrologic characteristics, sampling timing and overview of monitoring activities.
2. Annual snow-melt sediment load based on the "flow-frequency distribution" approach (Attachment 4 - Grismer, 2012) and discussion of changes from prior reporting period(s).
3. Rising limb rating curves (stage-discharge, TSS-discharge, and turbidity-TSS).
4. Summary of grab sampling analytical results and associated laboratory data sheets.
5. Interpretation of monitoring results with management recommendations.

B. Parking Lot Effluent Monitoring and Inspections

1. Summary of sampling analytical results for Stations P1 and P2 and associated laboratory data sheets with comparison of each value to the limitations specified in section I.A.2. of Board Order No. R6T-2016-PROP.
2. Summary of parking lot inspections and any corrective actions required or taken, with dates of actions.
3. Discussion of effectiveness of storm water controls.

C. Stream Condition Assessment

Results of stream condition assessments must be reported in the Annual Reports, as applicable to the respective reporting periods. Data sheets required as part of the CRAM assessments must be included. Results of the assessment must also be uploaded into EcoAtlas (http://www.ecoatlas.org/).

D. Ski Area Erosion Control Inspections

1. Prioritized list of erosion and drainage areas and issues identified from inspections with corresponding map, description of corrective actions for each area, and schedule for completion.
2. Discussion of effectiveness monitoring results from erosion treatment areas.
3. Photos documenting corrective actions taken (cross-referenced with erosion area list and map).

E. Snow Conditioning and Snow Making Enhancement Chemical Records

Report information as required under Section II.G and II.H. or, if no chemicals were applied during the reporting period, provide a certification stating so.

F. Redevelopment Status Report

The Discharger must summarize the Facility redevelopment activities completed during the previous reporting period and activities planned for the subsequent reporting period. The Discharger must identify any changes in waste treatment and discharge facilities or activities that would affect monitoring locations set in this Monitoring and Reporting Program.

IV. Effective Date

This Monitoring and Reporting Program shall become effective on December 1, 2016, and Monitoring and Reporting Program No. 95-86A2 is rescinded, effective November 30, 2016.

Ordered by: [signature] PATTY Z. KOUYOUMDJIAN
EXECUTIVE OFFICER

Dated: November 9, 2016

Figures: Figure 1 – Homewood Water Quality Sampling Locations
Figure 2 – Homewood Creek Monitoring Locations

Attachments:

Attachment 1 - General Provisions for Monitoring and Reporting, September 1, 1994

Attachment 2 – Certified Cover Letter Template

Attachment 3 - Results-Focused Watershed Management at Homewood Mountain Resort, Integrated Restoration Services, March 2013"

Attachment 4 - Grismer, M.E. (2012). Soil Disturbance/Restoration effects on Stream Sediment Loading in the Tahoe Basin – Detection Monitoring. Environmental Monitoring & Assessment.

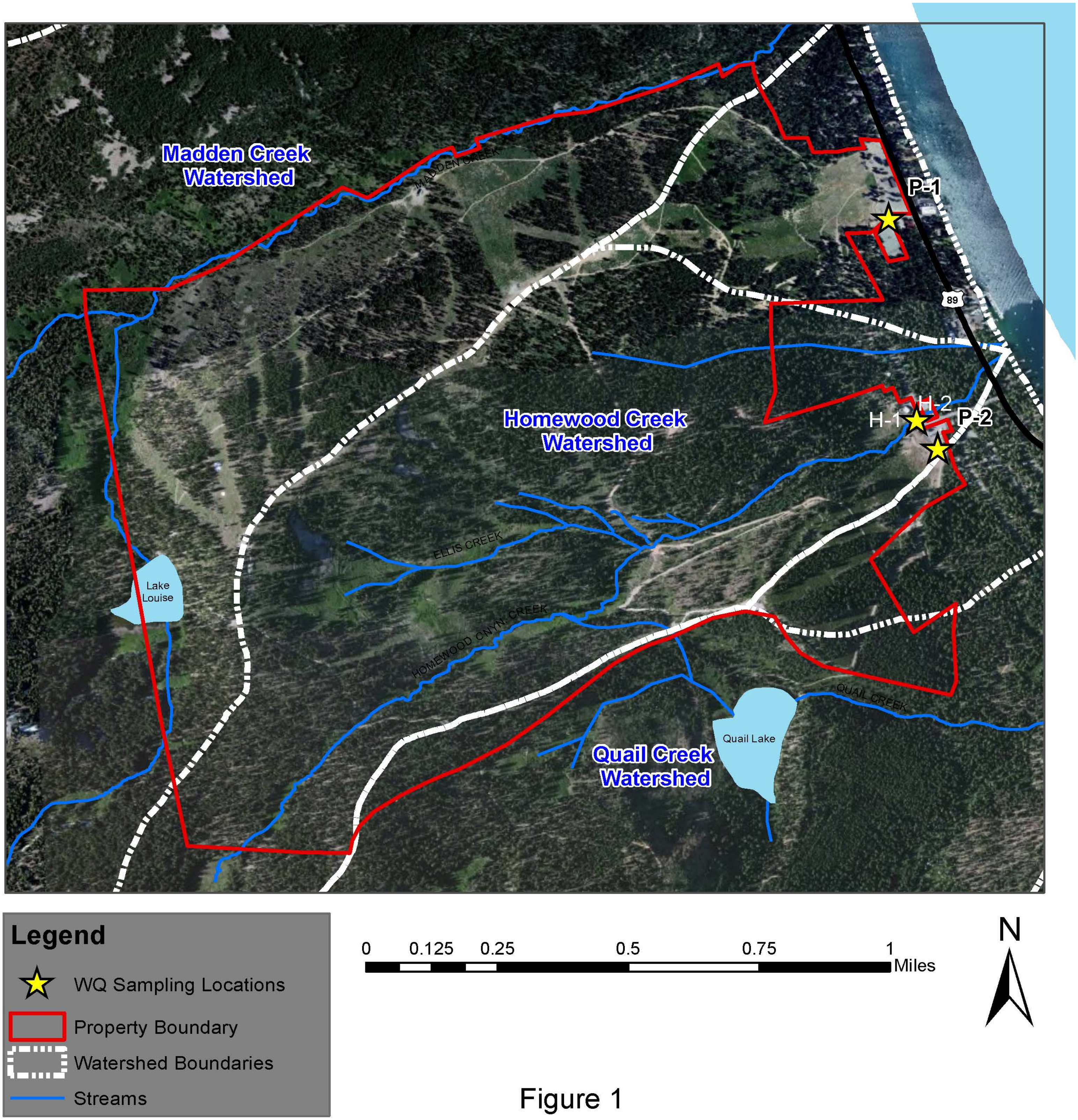


Figure 1

Water quality grab sampling locations for Waste Discharge monitoring at Homewood Mountain Resort

Map prepared by
Kevin Drake - IERS, Inc.
3/28/13

INTEGRATED ENVIRONMENTAL RESTORATION SERVICES, INC

Google Maps

Figure 2 - Homewood Creek Monitoring Locations

Imagery ©2016 Google, Map data ©2016 Google 100 ft

ATTACHMENT 1

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

GENERAL PROVISIONS
FOR MONITORING AND REPORTING

1. SAMPLING AND ANALYSIS

   a. All analyses shall be performed in accordance with the current edition(s) of the following documents:

      i. Standard Methods for the Examination of Water and Wastewater

      ii. Methods for Chemical Analysis of Water and Wastes, EPA

   b. All analyses shall be performed in a laboratory certified to perform such analyses by the California State Department of Health Services or a laboratory approved by the Regional Board Executive Officer. Specific methods of analysis must be identified on each laboratory report.

   c. Any modifications to the above methods to eliminate known interferences shall be reported with the sample results. The methods used shall also be reported. If methods other than EPA-approved methods or Standard Methods are used, the exact methodology must be submitted for review and must be approved by the Regional Board prior to use.

   d. The Discharger shall establish chain-of-custody procedures to insure that specific individuals are responsible for sample integrity from commencement of sample collection through delivery to an approved laboratory. Sample collection, storage, and analysis shall be conducted in accordance with an approved Sampling and Analysis Plan (SAP). The most recent version of the approved SAP shall be kept at the facility.

   e. The Discharger shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to ensure accuracy of measurements, or shall insure that both activities will be conducted. The calibration of any wastewater flow measuring device shall be recorded and maintained in the permanent log book described in 2.b, below.

   f. A grab sample is defined as an individual sample collected in fewer than 15 minutes.

   g. A composite sample is defined as a combination of no fewer than eight individual samples obtained over the specified sampling period at equal intervals. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever period is shorter.

2. OPERATIONAL REQUIREMENTS

a. Sample Results

Pursuant to California Water Code Section 13267(b), the Discharger shall maintain all sampling and analytical results including: strip charts; date, exact place, and time of sampling; date analyses were performed; sample collector's name; analyst's name; analytical techniques used; and results of all analyses. Such records shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

b. Operational Log

Pursuant to California Water Code Section 13267(b), an operation and maintenance log shall be maintained at the facility. All monitoring and reporting data shall be recorded in a permanent log book.

3. REPORTING

a. For every item where the requirements are not met, the Discharger shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time, and shall submit a timetable for correction.

b. Pursuant to California Water Code Section 13267(b), all sampling and analytical results shall be made available to the Regional Board upon request. Results shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

c. The Discharger shall provide a brief summary of any operational problems and maintenance activities to the Board with each monitoring report. Any modifications or additions to, or any major maintenance conducted on, or any major problems occurring to the wastewater conveyance system, treatment facilities, or disposal facilities shall be included in this summary.

d. Monitoring reports shall be signed by:

i. In the case of a corporation, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge originates;

ii. In the case of a partnership, by a general partner;

iii. In the case of a sole proprietorship, by the proprietor; or

iv. In the case of a municipal, state or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

e. Monitoring reports are to include the following:

i. Name and telephone number of individual who can answer questions about the report.

ii. The Monitoring and Reporting Program Number.

iii. WDID Number.

f. Modifications

This Monitoring and Reporting Program may be modified at the discretion of the Regional Board Executive Officer.

4. NONCOMPLIANCE

Under Section 13268 of the Water Code, any person failing or refusing to furnish technical or monitoring reports, or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation under Section 13268 of the Water Code.

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ATTACHMENT 2
Monitoring Report Cover Page

Date ____________

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

Facility Name: ____

____

Address: ____

____

____

____

Contact Person: ____

Job Title: ____

Phone: ____

Email: ____

WDR/NPDES Order Number: ____

WDID Number: ____

Type of Report (circle one)**:** **Monthly Quarterly Semi-Annual Annual Other**

Month(s) (circle applicable month(s)*)**:**

JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**
JUL	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**

***annual Reports** (circle the first month of the reporting period)

Year: ____

Violation(s)? (Please check one):__________**NO** ________ **YES***

***If YES is marked complete a-g (Attach Additional information as necessary)**

a) Brief Description of Violation:____

____

____

____

____

b) Section(s) of WDRs/NPDES Permit Violated: ______________________________
____
____

c) Reported Value(s) or Volume: ______________________________
____
____

d) WDRs/NPDES Limit/Condition: ______________________________
____
____

e) Date(s) and Duration of Violation(s): ______________________________
____
____

f) Explanation of Cause(s): ______________________________
____
____
____

g) Corrective Action(s)
(Specify actions taken and a schedule for actions to be taken) ______________________________
____
____
____
____

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision following a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my knowledge of the person(s) who manage the system, or those directly responsible for data gathering, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

If you have any questions or require additional information, please contact ___________________________at the number provided above.

Sincerely,

Signature:____________________________________

Name: __________________________________

Title: ___________________________________

INTEGRATED ENVIRONMENTAL
RESTORATION SERVICES, INC

Attachment 3

RESULTS-FOCUSED WATERSHED MANAGEMENT AT HOMEWOOD MOUNTAIN RESORT

Proposed Changes to the Homewood WDR Monitoring and Reporting Program

WDID# 6A310023700

Prepared by

Kevin Drake, *Integrated Environmental Restoration Services, Inc.*
on behalf of
Kevin Mitchell*, General Manager, Homewood Mountain Resort*

Prepared for

Bud Amorfini, *Lahontan Regional Water Quality Control Board*

March 2013

PROBLEM STATEMENT AND NEED FOR A SHIFT

Water quality monitoring has been used in California and throughout the US for decades in an attempt to determine compliance with water quality standards. Based on the Clean Water Act, these requirements have been assumed to be an indicator of watershed stability or unacceptable inflows of pollutants to waters of the US. However, clear linkages between upland erosion control (and other pollutant source reduction) efforts and changes in stream water quality are less than obvious. These efforts are constrained by the inherent complexity and heterogeneity of watersheds and the need for long-term water quality monitoring datasets to distinguish natural variability from the effects of on-the-ground actions. Further, weekly monitoring has been shown to be inadequate to capture the actual 'signature' of watershed processes and thus is difficult to use as either a guide to management or as an indicator of the effectiveness of management activities. Thus, the 'discharger' is left in a position of either being in or out of compliance with little information as to what can be done to attain compliance when needed. JMA Ventures, owner/operator of Homewood Mountain Resort (Homewood), is proposing to shift the watershed monitoring program in several ways, all of which are aimed at gaining a better understanding of the extent to which their investments in watershed protection are producing actual watershed improvements and developing useful tools with which to plan future watershed protection efforts.

The current Monitoring and Reporting Program (MRP) at Homewood is producing very little information that can be used to assess or improve watershed management practices. The proposed changes described below will improve the "signal" in typically "noisy" water quality monitoring data and allow us to assess changes in watershed sediment loading from year to year, which will help to guide Homewood's watershed management program as well as provide valuable information for the Lake Tahoe TMDL implementation program. The monitoring approaches described below were developed and rigorously tested in the Ellis Creek watershed from 2008-2011 with partial funding support from a 319(h) grant.

PROGRAM GOALS

Homewood has developed a flexible, dynamic watershed management program, whose overall goal is to improve conditions in the watershed and to demonstrate measureable watershed improvement through targeted and effective watershed management and monitoring at Homewood Mountain Resort.

Specific goals are to:

- Identify, prioritize and address erosion source areas within the context of watershed drainage
- Conduct stream and source monitoring/assessment in a manner that provides clear, defensible information about the watershed and within the water quality portion, a "signature" of the watershed's condition and trajectory
- Minimize ongoing maintenance needs wherever possible

PROPOSED CHANGES TO HOMEWOOD MONITORING AND REPORTING PROGRAM

1. **Madden Creek watershed: Replace stream monitoring with upland runoff assessment and targeted repair and maintenance of erosion hot spots.**
   Justification: More than 70% of the contributing land area to Madden Creek is owned by the US Forest Service – Lake Tahoe Basin Management Unit. Therefore, in-stream water quality measurements in Madden Creek cannot be directly attributed to Homewood watershed management practices. In place of

stream monitoring, we propose to identify erosion and drainage issues on the Homewood portion of the Madden Creek watershed (during spring and fall erosion assessments), prioritize erosion "hot spots" for treatment based on magnitude of erosion and connectivity to the creek, and develop an annual work plan to implement targeted erosion control treatments and drainage improvements. Each treatment will have an accompanying monitoring component to ensure that treatments are effective at reducing sediment transport and that maintenance is conducted where appropriate.

2. **Ellis Creek watershed:**
    a. **Eliminate upper sampling station (E-1) and conduct all sampling at lower station (E-2).** *Justification: sampling upstream and downstream of the resort is not necessary to assess changes in sediment loading from year to year. Rather, targeted rising limb sampling near the watershed outlet (as described in 2.c below) can be used to defensibly assess changes in watershed sediment loading from year to year. Further, the upper station is often inaccessible due to snow and thus provides inconsistent data during the spring snowmelt period, which makes analysis less reliable.*
    b. **Eliminate nutrient (TN and TP) sampling requirement and focus on sediment for in-stream monitoring (nutrients will continue to be included in parking lot monitoring).**
    Justification:
    1) Background levels of phosphorous in Ellis Creek often exceed Basin standards at the point where the creek enters Homewood property suggesting that a) some Basin standards need revision since upslope areas are relatively undisturbed and b) since P is often lower at the base measuring station, usefulness of the data for regulation or management is negligible.
    2) Fine sediment particles have been identified as the primary pollutant of concern in the Lake Tahoe TMDL and nutrient (TN and TP) loading has been shown to be closely correlated with fine sediment loading in Ellis Creek (Grismer 2012b).
    3) Changes in sediment loading are likely to be more directly linked to resort operations than changes in nutrient loading.
    c. **Replace routine (weekly) grab sampling with near-continuous turbidity and stage sensors and targeted grab sampling on the rising limb of the daily hydrograph during spring runoff.** *Justification: Routine sampling tends to miss the daily and seasonal fluctuations in sediment and flow that are necessary to develop defensible sediment-discharge relationships and assess changes in sediment loading. In contrast, focusing grab sampling on the rising limb of the daily and seasonal snowmelt hydrograph (when sediment loads tend to be greatest), coupled with near-continuous turbidity and stage measurement, enables the development of load-flow relationships that can be used to reliably calculate sediment loads and assess changes in sediment loading from year-to-year.*

WATER QUALITY MONITORING AND ANALYSIS METHODS TO BE USED

- Minimum of 15 grab samples collected at different times/flow rates along the rising limb of the daily hydrograph during spring snowmelt until the average daily flow rate peaks for the season. Each grab sample will be analyzed for total suspended sediment (TSS) and a minimum of 5 samples will be analyzed for fine sediment particles (FSP).
- Near-continuous (15-minute) sensors will be installed and maintained to measure stream stage and turbidity in accordance with USGS standard methods described by Wagner et al. (2006).
- Rating curves (stage-discharge, TSS-discharge, FSP-discharge and turbidity-TSS) will be developed and used to calculate daily sediment loads.

- Annual sediment loads will be calculated using the "flow frequency distribution" approach described in Grismer (2012a).

ANNUAL REPORTING

An Annual Report will be prepared each year by December 15th that provides the following information:

- Stream Monitoring
    - Summary of water year hydrologic characteristics, sampling timing and overview of monitoring results
    - Annual sediment load and discussion of changes from prior water year(s)
    - Rising limb rating curves (stage-discharge, TSS-discharge, FSP-discharge and turbidity-TSS) and discussion
    - Interpretation of monitoring results with management recommendations

- Erosion Control Inspections and Maintenance
    - Prioritized list of erosion and drainage "hot spots" with corresponding map
    - Description of corrective actions for each hot spot and schedule for completion
    - Discussion of effectiveness monitoring results from treatment areas
    - Photos documenting corrective actions taken (cross-referenced with hot spot list and map)

No changes are proposed for parking lot monitoring and inspections, snow conditioning chemical monitoring, or snowmaking enhancement chemical monitoring.

REFERENCES CITED

Grismer, M.E. (2012a). Soil Disturbance/Restoration effects on Stream Sediment Loading in the Tahoe Basin – Detection Monitoring. Environmental Monitoring & Assessment. Submitted.

Grismer, M.E. (2012b). Stream Sediment and Nutrient Loads in the Tahoe Basin – Estimated versus Monitored Loads for TMDL "Crediting". Environmental Monitoring & Assessment. Submitted.

Wagner, Richard J.; Boulger, Robert W., Jr.; Oblinger, Carolyn J.; Smith, Brett A. (2006). Guidelines and standard procedures for continuous water-quality monitors: Station operation, record computation, and data reporting. USGS Techniques & Methods 1-D3. http://pubs.er.usgs.gov/

Attachment 4

Soil Disturbance/Restoration effects on Stream Sediment Loading in the Tahoe Basin – Detection Monitoring

M. E. Grismer
Dept. of LAWR-Hydrology, UC Davis
1 Shields Ave., Davis, CA 95616
megrismer@ucdavis.edu
(530) 304-5797
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Abstract

Quantifying the relative impacts of soil restoration or disturbance on watershed daily sediment and nutrients loads is essential towards assessing the actual costs/benefits of the land management. Such quantification requires stream monitoring programs capable of detecting changes in land-use or soil functional and erosive area "connectivity" conditions across the watershed. Previously, use of a local-scale, field-data based runoff and erosion model for three Lake Tahoe west-shore watersheds as a detection monitoring "proof of concept" suggested that analyses of mid-range average daily flows can reveal sediment load reductions of relatively small watershed fractional areas (~5%) of restored soil function within a few years of treatment. Developing such an effective stream monitoring program is considered for tributaries on the west shore of the Lake Tahoe Basin using continuous (15-min) stream monitoring information from Ward (2521 ha), Blackwood (2886 ha) and the Homewood (260 ha, HMR) Creek watersheds, The continuous total suspended sediment (TSS) and discharge monitoring confirmed the hysteretic TSS concentration – flowrate relationship associated with the daily and seasonal spring snowmelt hydrographs at all three creeks. Using the complete dataset, daily loads estimated from one-hour sampling periods during the day indicated that the optimal sampling hours were in the afternoon during the rising limb of the spring snowmelt hydrograph; an observation likely to apply across the Sierra Nevada and other snowmelt driven watersheds. Measured rising limb sediment loads were used to determine if soils restoration efforts (e.g. dirt road removal, skirun rehabilitation) at the HMR creek watershed reduced sediment loads between 2010 and 2011. A nearly 1.5-fold decrease in sediment yields (kg/ha per m^3/s flow) was found suggesting that this focused monitoring approach may be useful towards development of TMDL "crediting" tools. Further monitoring is needed to verify these observations and confirm the value of this approach.

Keywords: water quality, turbidimeters, forest soils, monitoring, soils restoration, sediment yields

1. INTRODUCTION

The inability to quantitatively assess the impacts of land-use changes on catchment water quality due to hydrologic variability has typically resulted in use of hydrologic models employing landscape and channel erosion process subroutines to predict daily sediment loads. On the other hand, development of daily stream flowrate – pollutant load relationships from limited, or possibly continuous stream sampling data capable of detecting such impacts is hampered by hysteresis in the discharge-concentration relationship (Stubblefield, 2007; Grismer, 2012c). In the 840 km^2 Lake Tahoe Basin (between the states of California and Nevada, USA) accurate assessment of the landscape management impacts on suspended particle and nutrient loading to the Lake has remained elusive. Famed Lake clarity continues to decline during the summers when tourism is greatest (State of the Lake, 2012) despite considerable expense and effort to the contrary. That is, predicted or anticipated reductions in sediment and nutrient loadings associated with various projects in the Basin have not apparently materialized in improved Lake clarity. The apparent failures or limited success of such projects underscore the need to develop real-time or stream monitoring programs capable of detecting those changes or management strategies in the Lake tributary watersheds that result in smaller loadings. Moreover, such monitoring programs are also essential towards verification of hydrologic model predictions. Building on the previous papers (Grismer 2012a, 2012b & 2012c) considering erosion model upscaling, hydrologic variability and use of estimated load-flow relationships in the Tahoe Basin, respectively; this paper focuses on extraction of the most relevant sampling data from stream monitoring programs so as to more readily assess impacts of land management or restoration on stream pollutant loading to Lake Tahoe as well as other alpine waterbodies.

Stream water quality monitoring programs typically rely on grab sampling and subsequent laboratory analyses for determination of instantaneous pollutant concentrations associated with the flowrate measured at the time of sampling. Ideally, tributary pollutant mass loads are calculated through integration of the product of flowrate and concentration across the time period of interest (e.g. hourly, daily); however, while nearly continuous flowrate data may be available, pollutant concentration information is not. Thus, hourly or daily stream loads based on "estimated" concentrations or loads determined from averaging or statistical regressions such as rating curves may dramatically over-predict actual loads (Grismer 2012c) and mask possible changes in loads associated with land management projects within the catchment. Such discrepancies or lack of detection may then result in mistaken "crediting" associated with TMDL programs. For example, significant errors may be introduced for constituents that naturally vary widely during the day since mean daily concentration must be estimated from instantaneous concentrations determined at different times and days associated with the sampling program. Thomas (1985) and Thomas and Lewis (1993) noted that sampling conducted at a particular time each day or periodically is proportional to the estimated total suspended sediment (TSS) or nutrient discharge and that time- and flow-stratified sampling designs may allow for unbiased estimates of total load, as well as estimation of sampling error. Coats et al. (2002) provides a concise review of these different approaches and suggests that continuous stream water quality monitoring using multi-probe or turbidimeters be deployed so as to avoid the need for estimation.

Here, data developed from continuous flow and turbidity measurements combined with grab sampling for water quality constituents at Ward, Blackwood and Homewood (HMR) Creeks along the Lake Tahoe west shore are used to determine daily loading to the Lake. As with many Sierra Nevada watersheds, in these west-shore catchments spring snowmelt flows account for more than 90% of the total volumes and loads to the Lake with occasional late summer thunderstorms making up the bulk of the remainder.

2. HYPOTHESIS & RESEARCH OBJECTIVES

Building from the modeling "proof of concept" paper (Grismer, 2012b) from which watershed modeling results on the Tahoe west shore suggested the possibility of detecting soils restoration efforts within a reasonable time frame of several years (e.g. ~5 years), the basic research hypothesis considered here is that there exists a stream monitoring program capable of quantifying the possible changes in stream loading associated with watershed soils disturbance or restoration. Building on the work of Stubblefield et al. (2007) indicating the daily and seasonal hysteresis in stream sediment concentrations as a function of flowrate, the secondary hypothesis is that focused stream flow and sediment sampling during the daily and seasonal rising limb of the hydrograph provides the clearest information about changing conditions in Tahoe west shore catchments. The research objectives associated with these hypotheses included:

a) Determine which hourly period(s) if sampled alone best represent the daily sediment loading from Ward and HMR Creeks based on hourly estimates of mean daily flows and total daily sediment loads.

b) Determine the change in HMR Creek sediment yield (kg/ha) per unit flowrate and annual sediment loads following soils restoration and erosion pathway disconnection work completed during summers of 2006-2010 in the catchment.

As noted in the previous papers, the overall goal of this work is development of an efficient stream water quality monitoring program capable of detecting relative impacts of land-use management on sediment loading as a guide towards creating an effective realistic TMDL "credits" for land managers and policy makers in the Basin and across the Sierra Nevada.

3. METHODOLOGIES and STATISTICAL ANALYSES

3.1 Monitoring & Lab Analyses

This study focuses on the HMR Creek watershed described previously (Grismer, 2012a and 2012b), but also considers the data from Blackwood and Ward Creek watersheds to the north developed by Stubblefield (2002). To facilitate later discussion, Table 1 of Grismer (2012b) summarizing the watershed land-uses, areas and dominant soil types of the three watersheds is reproduced here. The stream monitoring occurred near the basin outlet of HMR creek at the Highway 89 crossing at the station located at 39° 04' 44" N120° 09' 33" W and an elevation of 1899 m (see Figure 1 of Grismer, 2012c). Multi-probe sensors were placed in-channel to measure stream stage and turbidity combined with regular grab sampling to determine TSS, fines and nutrient concentrations in the laboratory following standard methods summarized by Grismer (2012c). Here, the focus is only on the sediment loading as the remaining parameters are closely linked to TSS loads. The monitoring stations were installed following USGS standard methods described by Rantz et al. (2005), Wagner et al. (2006) and Wilde (2011) and are similar to those used by Stubblefield (2002). Probes were re-calibrated monthly when downloading data and factory re-calibrated annually prior to the spring snowmelt season. A simple stage-discharge relationship was developed for HMR Creek that included incremental offsets for different flow widths from the surveyed channel cross-sections. The nearly continuous stream flow and turbidity monitoring for HMR included the spring snowmelt periods of 2009 (flow only) through that of 2012, while monitored snowmelt periods for Blackwood and Ward Creeks by Stubblefield (2002) included the years 1999-2001.

3.2 Computational Methods & Statistical Analyses

Daily mean flows and sediment loads were determined from the 15-min data generated by the stage and turbidity probes following conversion to TSS concentrations using the linear regressions between turbidity and TSS outlined previously (Grismer (2012c). The mean daily flowrate was simply determined as the average of all the 15-min flowrates for the day. Daily total sediment loads were determined from the 24-hour sum of the 15-min interval products of flowrate and TSS concentration. Later, in the rising limb analyses, only 6-8 hour periods associated with the daily rising limb of the hydrograph are considered, but computed in the same fashion as that for the 24-hr totals using only the abbreviated periods instead.

Following simple bar graph comparisons of snowmelt season and annual sediment loads as measured and calculated from sampling data only at individual day hours; three statistical measures are applied to determine the relative merits of each sampling hour during the day. One useful statistic (Dolan et al., 1981) for expressing both the bias and imprecision of an estimate is the root mean squared error [$RMSE = (B^2 + S^2)^{0.5}$] where B is the deviation from the measured daily load, and S is the standard deviation of the estimated loads for each "sampling" hour. The second method uses t-test comparisons considering two-tailed distributions and non-equal variances to determine relative confidence levels of "overlapping" estimated and measured daily TSS load distributions for load-stratified data. The third method employs linear regressions between hourly estimated and measured daily TSS loads to provide insight into relative over- and under-estimation by each sampling hour of estimated and measured daily sediment loads. These analyses are directed at the practical problems that may be associated with programs having limited resources rather than continuous stream sampling programs.

Finally, focused analysis of the catchment daily hydrograph rising limb sediment yields (kg/ha) as they depend on rising limb average flowrate during the seasonal rising limb hydrograph are determined in an effort to reduce uncertainty in load-flow relationships associated with daily and seasonal hysteresis in the sediment concentration versus discharge relationships (Stubblefield et al., 2007). This approach relies on calculation of the sediment load during the afternoon periods (sum of 15-min flow-concentration products for 8 hour periods) of each day during the snowmelt season until the average daily flow peaks for the season.

4. MONITORING RESULTS and DISCUSSION

First, simple comparisons between estimated and actual measured snowmelt season and annual loads from different sampling hours at HMR creek are described to set the stage for subsequent analyses and provide the reader an insight into streamflow – sediment load characteristics of west shore watersheds. Then comparisons between estimated daily loads from different sampling hours and measured daily loads are considered following the statistical methods outlined above. Next, the hydrograph rising limb analyses of sediment yields (kg/ha) as they depend on discharge are considered to set the stage for a possible monitoring strategy capable of detecting watershed soils restoration or disturbance. Finally, comparable annual sediment loads from HMR creek are computed using the flow-frequency analysis described previously (Grismer, 2012c).

4.1 Optimal Sampling Times when Sampling Resources are Limited

Figures 1 and 2 illustrate the dependence of estimated sediment loads on sampling period of the day as compared to measured loads as well as the dominance of the snowmelt period of runoff on the annual sediment loads from HMR creek. Note that the greater snowpack and cooler spring associated with the 2011 water year (WY) results in a roughly 50% greater annual load and a 2-hour later shift (from 1 to 3 PM) in sampling hour best representing the annual load. In both WYs, consistent morning sampling based estimates of load would under-predict that measured, while regular later afternoon sampling would over-estimate actual loads.

When only limited daily sampling is possible, the results shown in Figures 1 and 2 suggest that focused daily sampling during the daily afternoon period (between 1 and 3 PM) of the spring snowmelt season (April-June) would likely best estimate the annual loadings from HMR creek. Considering daily data, the relative merits of daily one-hour flow and constituent concentration sampling based daily loading estimates are evaluated using the statistical metrics of RMSEs, t-tests and linear regressions as described above. Using log-transformed daily loads (to obtain normal distributions) calculated from the 24-hr sum of 15-min flow-concentration products or estimated by the 1-hr flow-concentration product multiplied by 24, the population means, standard deviations, coefficients of variation (*CoV*) and RMSEs were determined. These values are summarized in Table 2 for Blackwood, Ward and HMR creeks. While actual daily load statistics from Ward and Blackwood creeks are similar (2^{nd} column of Table 2), those from HMR creek are of much smaller magnitude, but exhibit more than ten times greater variability (i.e. greater *CoV*). In terms of the least RMSE together with means and standard deviations nearest the actual daily load mean and deviation, based on the 2001 spring snowmelt, sampling Blackwood Creek in the later afternoon (5-6 PM) would provide the best prediction of daily loads. Similarly, based on the same criteria, sampling Ward creek at 3-4 PM and HMR creek at 4-5 PM would result in the best estimates of daily sediment loading. This latter sampling time period for HMR creek is 1-2 hours later than that indicated by Figures 1 and 2 that consider annual loads suggesting that the annual load analysis approach may not offer the best indication of optimal sampling period when sampling is limited to one hour per day.

Comparison of basic log-transformed statistics does not provide information about the relative confidence of load estimates from different sampling periods during the day. The second approach for determining optimal daily sampling periods is based on t-test analyses and comparisons of "binned" loads; that is, computation of t-test p-values for ranges of actual daily loads. These results are summarized for Ward and HMR creeks in Table 3 (there was insufficient data for Blackwood creek). For this analyses, values of $p>0.80$ were assumed to indicate near complete overlapping of actual and estimated daily sediment loads for the given load range since two-tailed t-test comparisons were used. With the exception of the greatest two load ranges for HMR creek in the 2010 WY, none of the high load ranges were well estimated from the hourly sampling at HMR creek in 2011 and Ward creek in 1999-2000. In terms of estimating several different load ranges, daily sampling at 1-2 PM from Ward creek was the best estimator followed by that at 3-4 PM, the same optimal sampling period based on the RMSE analysis. For HMR creek, the optimal sampling is about noon for high loads, but otherwise between 3-5 PM for mid-range loads, the latter values roughly consistent with the RMSE analysis above. That the noon-hour sampling best represents the high load ranges is also reflected in that suggested by Figures 1 and 2. Comparing the various sediment load ranges from each creek provides some insight into the dependence of optimal sampling times on flows/loads.

Finally, comparison of estimated and actual daily sediment loads based on regression analyses provides insight into the relative under- or over-prediction of actual loads from estimated values determined from particular sampling hours in the day. For example, Figure 3 illustrates the linear regressions between hourly estimated and actual daily sediment loads at Ward creek from the two spring monitoring periods. Based on this graph, the optimal sampling time at Ward creek is at 3 PM when the linear slope is ~1.0 and R^2~0.9. Similarly, Figures 4 and 5 show the hourly estimated versus actual load linear regressions for the spring –summer period of 2010 and 2011, respectively, at HMR creek. Actual daily loads from the lighter snowpack spring melt of 2010 were best estimated by noon sampling, whereas in 2011 with the deeper snowpack and cooler spring period temperatures, the optimal sampling hour was 2 PM. Not surprisingly, combining the estimated and actual daily loads for both years as shown in Figure 6 indicates an optimal sampling time at HMR creek of about 1 PM.

Table 4 summarizes the optimal flow and concentration sampling hours for Ward and HMR creeks based on the different approaches described above. Overall, the different approaches suggest that sampling at Ward Creek between 1 and 4 PM daily during the spring snowmelt would best represent actual daily sediment loads. Similarly, sampling at HMR creek between 1 and 5 PM would best represent daily sediment loads. From the limited data at Blackwood, it appears that even later afternoon sampling is best. The optimal sampling times likely vary in part on the relative snowpack depths and average spring temperatures from year-to-year. That the different methods suggest there are a range of optimal afternoon sampling times implies that from a practical perspective, the sampling program shouuld capture the entire afternoon period on Lake Tahoe west-shore tributaries to best estimate actual daily sediment loading.

4.2 Detecting Changes in Watershed Soils Function (Infiltration & Erosion rates)

From analyses of both the continuous flow-turbidity data above and a conceptual understanding of the spring snowmelt processes within the watersheds, it appears that daily afternoon sampling is most closely linked to actual daily sediment loads. Conceptually, the daily hydrograph rising limb flows represent the accumulated surface erosion and runoff generated by snowmelt that afternoon and “pushed” into the stream channel and out in the evening, while the recession limb flows during the night and morning represents the residual sediment swept from the channel after surface runoff to the stream channel has ceased. This daily conceptualization of flow and sediment loading would also apply at the seasonal time scale; that is, increasingly greater daily surface erosion and runoff carrying material to the stream channel occurs during the seasonal hydrograph rising limb of typically April and May, while the seasonal recession limb flows are reflecting channel processes and final sweeping of residual sediment during June and July. As a result of this conceptual model to account for sediment concentration-discharge hysteresis, there are at least four different periods to consider in developing the stream sediment sampling program. Specifically, these include sampling during (a) the daily hydrograph rising limb of the seasonal hydrograph rising limb, (b) the daily hydrograph rising limb of the seasonal hydrograph recession limb, (c) the daily hydrograph recession limb of the seasonal hydrograph rising limb, and (d) the daily hydrograph recession limb of the seasonal hydrograph recession limb. Thus overall, the greatest sediment yields (kg/ha) per unit flowrate and greatest relative information about surface runoff processes would be expected from (a) and the least from (d). Stream sampling from these two extreme periods would then envelope the values from (b) and (c) as well as much of the uncertainty associated with the discharge-load relationship.

Figures 7 and 8 illustrate the recession limb (types b, c, & d above) and rising limb (type a) load – discharge data from Homewood Creek for the 2010 and 2011 spring snowmelt periods based on equal 8-hr sampling periods each day (i.e. morning recession, afternoon rising and night recession hydrograph limb periods) for comparison purposes,. Note the wide variability of sediment loads for any particular flowrate in Figure 7 and that data from 2010 is indistinguishable from that of 2011 with the exception perhaps of the 2-3 high load points of 2010 from the daily recession limb of the seasonal rising limb hydrographs. Figure 8 includes the base load-discharge relationship associated with sampling in the latest period (morning) of the daily recession hydrograph limb from 2010-2011 for comparison with the hydrograph rising limb data. These two figures show that the both the daily and seasonal recession limb sampling information is of limited value in distinguishing load-discharge relationships from one year to the next and that the only load-discharge information that can be distinguished from one year to the next is that from the daily and seasonal hydrograph rising limbs (type a).

Expanding the single-hour sampling to ~8 hours corresponding to the rising limb of the daily hydrograph during the rising limb of the seasonal spring snowmelt hydrograph should provide the greatest opportunity to detect changes in watershed (WS) soils or stream channel conditions. Analogous to load-flow relationships (Grismer 2012c), though plotted in Figure 9 on linear- rather than log-axes to better illustrate the data variability, are catchment sediment yields (kg/ha) as they depend on mean flow rate from the rising limb of the daily and seasonal hydrographs from Homewood (2011), Blackwood and Ward Creeks (1999-2001). There is only limited data for Blackwood creek and it appears to have greater sediment yields then its sister watershed Ward Canyon of similar size to the north. For the three years of spring snowmelt data at Ward creek, there appears to be little change from year-to-year (1999-2001) and all of the data can be represented by a single curve. Somewhat surprisingly, the much smaller HMR creek watershed has roughly equivalent sediment yields though at discharges an order of magnitude less than that from Blackwood or Ward creeks.

Considerable watershed soils restoration work has been underway in the HMR Creek watershed during the past several years in an effort to limit erosion and sediment discharge to Lake Tahoe. This work has included site-specific soils rehabilitation to improve hydrologic function (infiltration rate & capacity) as well as longer-term plant sustainability and the land areas affected are summarized in Table 5. Following a watershed assessment as part of that work, effort was directed at "disconnecting" adjoining runoff flowpaths so as to further limit sediment transport to the creek. Examining the HMR creek rising limb sediment yields for 2010 and 2011 shown in Figure 8 suggests that there has been a dramatic decrease in stream sediment loading. Linear rather than power curve regressions are shown to better compare the dependence of WS sediment yield on flowrate for each year. Despite the much greater snowpack, sediment yields from the 2011spring are obviously much smaller, or about 2/3^{rds} of that from 2010.

4.3 Crediting for Sediment/Nutrient Load Reductions following Restoration

TMDL "crediting" likely requires some assessment of the net decrease in comparable annual sediment loading that may be ascribable to various watershed management practices similar to that outlined in the previous paper (Grismer 2012c). In the case of Homewood Creek, it is only possible to discern the changes in the rising limb load-discharge relationship from year-to-year. However, use of that relationship alone would greatly exaggerate annual loads because it describes the maximum loads per unit discharge as it represents the upper limits of the load-discharge hysteresis envelope (rising limb data in Fig. 8). Averaging that maximum relationship with that describing the minimum loads per unit discharge, or lower limit of the load-discharge hysteresis envelope (recession limb data in Fig. 8) enables determination of a load-discharge relationship for each year and calculation of comparable annual loads as summarized in Table 6. Based on the TSS loads in Table 6, the various soil restoration and "disconnection" work would appear to have reduced the annual load by a factor of 2.9 from 2010 to 2011. An additional spring snowmelt monitoring period in 2012 and perhaps 2013 will be required to confirm the decreased sediment yields resulting from the soils restoration work.

5. SUMMARY and CONCLUSIONS

Regulatory staff and watershed resource managers in the Lake Tahoe Basin as in alpine watersheds across the Sierra Nevada and elsewhere struggle with developing quantifiable and measurable pollutant load crediting programs for meeting mandated TMDL targets. Few, detailed pre- and post-project quantitative assessments associated with watershed urbanization, forest management or soils restoration exist of how such changes within a watershed affect daily stream outlet sediment, fine particle or nutrient loads. Here, nearly continuous discharge and pollutant concentration monitoring of three Lake Tahoe west-shore tributaries is used to examine issues associated with limited sampling, to determine optimal sampling times and the ability to quantify effects of restoration efforts in the HMR creek watershed.

Based on hourly "sampling" from the continuous datasets to estimate measured daily loading confirmed that sampling in the afternoon during the rising limb of the daily hydrograph during the rising limb of the spring snowmelt seasonal hydrograph provided the best estimates of actual daily loads from all three creeks. Applying this latter observation about sampling towards quantifying soils restoration efforts from 2006-2010 in the HMR creek watershed, daily rising limb sediment yields (kg/ha) as they depend on rising limb mean discharge were computed and compared from year-to-year at Ward and HMR creeks. For comparison, at Ward creek no discernible change in the sediment yield – discharge relationship was found for the period 1999-2001; relatively dry years when no substantial soils restoration, or disturbance work was reported. In contrast, a significant decrease, by nearly a factor of 1.5, in sediment yield per unit discharge was found at HMR creek from spring 2010 to spring 2011, and confirmed in 2012, presumably the result of previous soils restoration and "disconnection" of adjoining eroding areas in the upper watershed. These results are quite encouraging and suggest that focused monitoring programs may be successful in detecting changes in watershed soils functionality within a few years on the Tahoe west shore. Nonetheless, additional spring snowmelt period monitoring in the next couple years should be directed at confirming the nearly three-fold decrease in sediment loading from HMR creek for comparable water years (Table 6) and the ability of this method to "quantify" the decreased sediment loading of watershed management practices across the Tahoe Basin in the future.

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Table 1. Land-use characteristics of Ward, Blackwood and HMR Creek watersheds.

Land-use	**Ward Area (ha)**	**Blackwood Area (ha)**	**HMR Area (ha)**
Dirt Roads	4.39	3.98	8.4
Ski-run areas	58.8	0	43.9
Forested areas	2400	2862	202.7
Residential	42.9	8.29	0.31
CICU*	0.36	0	1.18
Water body	2.91	2.85	0
Roads - paved	14.7	11.8	1.50
Total Pervious Area (ha)	2502	2873	258.8
Total Impervious Area (ha)	19.3	12.5	1.98
Volcanic fraction of basin	0.97	0.96	0.89
Granitic fraction of basin	0.03	0.04	0.11

*CICU are utility (e.g. powerline, sewer, etc.) access areas.

Table 2. Summary of statistics for log-transformed calculated and estimated daily suspended sediment loads from Ward, Blackwood and HMR Creeks on the Lake Tahoe west shore.

Blackwood April-May, 2001	**Daily Load (kg)**	**Log-Transformed Estimated Daily Sediment Load from Hourly Sampling (kg)**									
		9-10 am	**10-11 am**	**11-12 am**	**12-1 PM**	**1-2 PM**	**2-3 PM**	**3-4 PM**	**4-5 PM**	**5-6 PM**	**6-7 PM**
Mean	3.001	2.506	2.407	2.353	2.289	2.251	2.402	2.591	2.761	3.055	3.160
Std Deviation	0.949	0.966	0.965	1.000	1.055	1.159	1.134	1.104	1.217	1.149	1.156
CoV (%)	*31.62*	*38.56*	*40.08*	*42.48*	*46.09*	*51.48*	*47.23*	*42.60*	*44.07*	*37.62*	*36.58*
	RMSE	***3.86***	***4.30***	***5.26***	***5.40***	***5.96***	***4.93***	***3.59***	***3.54***	***2.73***	***2.95***
Ward April-June 1999 & 2000	**Load (kg)**	**9-10 am**	**10-11 am**	**11-12 am**	**12-1 PM**	**1-2 PM**	**2-3 PM**	**3-4 PM**	**4-5 PM**	**5-6 PM**	**6-7 PM**
Mean	3.355	3.166	3.177	3.184	3.189	3.214	3.281	3.364	3.425	3.466	3.472
Std Deviation	0.492	0.426	0.429	0.447	0.452	0.483	0.511	0.545	0.585	0.617	0.620
CoV (%)	*14.65*	*13.46*	*13.51*	*14.06*	*14.17*	*15.02*	*15.58*	*16.19*	*17.08*	*17.81*	*17.87*
	RMSE	***3.30***	***3.28***	***3.40***	***3.34***	***3.00***	***2.27***	***1.78***	***1.99***	***2.36***	***2.51***
HMR Oct., 2009 - Sept., 2011	**Load (kg)**	**9-10 am**	**10-11 am**	**11-12 am**	**12-1 PM**	**1-2 PM**	**2-3 PM**	**3-4 PM**	**4-5 PM**	**5-6 PM**	**6-7 PM**
Mean	0.499	0.357	0.353	0.345	0.356	0.389	0.408	0.448	0.485	0.518	0.521
Std Deviation	1.397	1.324	1.312	1.333	1.330	1.344	1.416	1.439	1.491	1.517	1.533
CoV (%)	*279.70*	*370.8*	*372.2*	*386.5*	*373.4*	*345.3*	*347.2*	*321.6*	*307.4*	*292.8*	*294.2*
	RMSE	***7.03***	***7.77***	***7.18***	***6.79***	***6.17***	***5.69***	***5.49***	***5.29***	***5.52***	***5.56***

Table 3. Summary of t-test p-values for ranges of calculated and estimated daily suspended sediment loads from Ward and HMR Creeks on the Lake Tahoe west shore.

Ward April-June 1999-2000 Load Range (kg)	**Mean Load (kg)**	**n**	**t-test p-values**									
			9-10 am	**10-11 am**	**11-12 am**	**12-1 PM**	**1-2 PM**	**2-3 PM**	**3-4 PM**	**4-5 PM**	**5-6 PM**	**6-7 PM**
400-600	524.7	8	0.076	0.105	0.626	0.614	0.490	0.303	0.135	0.062	0.528	0.192
600-800	722.0	8	0.118	0.067	0.022	0.509	0.021	0.064	0.574	0.480	0.225	0.223
800-1000	890.8	11	0.435	0.234	0.632	0.117	0.057	0.102	**0.987**	0.534	0.397	0.365
1000-1300	1105	9	0.044	0.170	**0.948**	**0.908**	**0.987**	**0.810**	**0.923**	0.742	0.525	0.524
1300-2000	1679	9	0.765	0.359	0.261	0.367	0.456	0.404	0.083	0.127	0.197	0.321
2000-2500	2260	7	0.355	0.679	0.753	0.749	**0.924**	0.607	0.232	0.098	0.065	0.077
2500-3400	2885	9	0.003	0.004	0.064	0.342	0.745	0.757	0.220	0.006	0.005	0.022
3400-4500	4099	10	0.761	0.790	**0.923**	0.646	**0.996**	0.771	0.411	0.171	0.072	0.129
5000-10000	6414	8	0.002	0.004	0.008	0.013	0.026	0.113	0.628	0.064	0.044	0.076
10000-20000	15202	5	0.001	0.001	0.001	0.001	0.005	0.257	0.581	0.105	0.029	0.014
>20000	32397	6	0.001	0.001	0.002	0.002	0.004	0.291	0.369	0.046	0.012	0.002
Frequency of p>0.80			0	0	***2***	0	***3***	***1***	***2***	0	0	0
HMR 2010 WY Load Range (kg)	**Load (kg)**	**n**	**9-10 am**	**10-11 am**	**11-12 am**	**12-1 PM**	**1-2 PM**	**2-3 PM**	**3-4 PM**	**4-5 PM**	**5-6 PM**	**6-7 PM**
0.01-0.03	0.02	22	**0.97**	0.40	0.28	0.28	0.29	0.02	**0.97**	0.37	0.71	0.38
0.03-0.05	0.04	21	0.71	0.51	0.32	0.08	0.02	0.44	0.07	0.09	**0.85**	0.01
0.05-0.08	0.06	24	0.26	**0.89**	0.34	0.11	0.26	0.16	0.76	0.04	0.57	0.08
0.08-0.15	0.11	17	0.71	0.51	0.32	0.08	0.02	0.44	0.07	0.09	**0.85**	0.01
0.15-0.20	0.17	23	0.55	0.08	0.70	0.36	0.03	0.79	0.67	**0.97**	**0.96**	0.54
0.20-0.30	0.25	11	0.50	0.50	**0.87**	0.50	0.62	0.37	0.65	**0.98**	0.56	**0.93**
0.30-0.40	0.34	9	0.54	0.81	0.09	0.02	0.58	0.74	**1.00**	0.53	0.51	**0.95**
0.40-0.60	0.49	9	0.47	0.41	0.46	0.02	0.11	0.03	0.14	**0.82**	0.68	0.49
0.60-1.00	0.76	14	0.06	0.01	0.01	0.17	0.01	**0.99**	0.51	0.67	**0.84**	0.24
1.00-3.00	2.11	14	0.38	0.18	0.07	0.01	0.06	0.43	**0.95**	0.25	0.27	0.20
3.00-6.00	4.13	6	0.66	0.59	**0.87**	0.48	0.32	0.61	0.63	**0.86**	0.65	0.31
6.00-8.00	6.71	9	0.03	0.02	0.01	0.00	0.03	**0.90**	**0.93**	0.78	0.04	0.01
8.00-11.00	9.49	7	0.20	0.12	0.77	0.13	0.17	0.08	0.01	0.00	0.02	0.05
11.00-20.00	14.2	8	0.18	0.14	0.07	0.00	0.03	0.02	0.07	0.76	0.28	0.16
20.00-30.00	24.5	9	0.27	0.31	0.24	0.06	0.04	0.09	**0.95**	0.63	0.33	0.25

30.00-40.00	36.2	8	0.02	0.00	0.00	0.01	0.06	0.30	0.15	0.07	0.04	0.01
40.00-60.00	47.5	10	0.11	0.08	0.04	0.01	0.00	0.09	0.78	0.05	0.00	0.00
60.00-100.0	81.5	9	0.10	0.11	0.06	0.01	0.05	0.30	0.47	0.06	0.04	0.06
100.0-200.0	133.4	5	0.07	0.04	0.08	0.07	0.07	0.73	0.67	0.20	0.05	0.05
200.0-1000	446.0	6	0.03	0.05	0.06	**0.88**	0.42	0.57	0.35	0.23	0.13	0.07
>1000	2291	5	0.32	0.37	**0.96**	**0.98**	0.49	0.20	0.10	0.12	0.17	0.32
Frequency of p>0.80			***1***	***1***	***3***	***2***	0	***2***	***5***	***4***	***4***	***2***
HMR 2011 WY Load Range (kg)	**Load (kg)**	**n**	**9-10 am**	**10-11 am**	**11-12 am**	**12-1 PM**	**1-2 PM**	**2-3 PM**	**3-4 PM**	**4-5 PM**	**5-6 PM**	**6-7 PM**
0.09-0.40	0.22	8	0.42	0.52	0.70	**0.88**	0.70	0.79	0.70	0.57	**0.87**	0.51
0.40-0.60	0.49	10	0.35	0.07	0.26	0.02	0.23	**0.92**	**0.98**	0.29	0.46	0.69
0.60-1.00	0.75	11	0.47	0.52	0.46	0.15	0.35	0.57	0.50	0.69	**0.84**	0.69
1.00-2.00	1.41	18	**0.91**	0.12	0.06	0.28	0.06	0.28	**0.86**	**0.96**	0.61	0.41
2.00-4.00	3.07	16	0.55	0.69	0.19	0.33	0.30	0.62	0.49	0.77	0.68	0.41
4.00-7.00	5.19	9	0.06	0.74	0.10	0.03	0.07	0.64	0.78	**0.83**	0.76	0.34
7.00-16.00	10.69	7	0.55	0.25	**0.94**	0.08	0.43	**0.98**	0.64	**0.82**	**1.00**	**0.89**
16.00-30.00	22.55	9	**0.77**	0.27	**0.77**	0.19	0.15	0.17	0.56	0.47	0.30	**0.85**
30.00-60.00	36.72	9	0.42	0.06	0.27	0.17	0.20	0.53	0.35	0.41	0.46	0.29
60.00-100.0	71.54	11	0.27	0.02	**0.99**	0.37	0.08	0.79	0.20	**0.86**	0.40	0.30
100.0-150.0	125.8	10	0.002	0.410	0.000	0.531	0.736	**0.942**	0.042	0.619	**0.890**	0.219
150.0-200.0	165.0	13	0.100	0.021	0.042	0.084	0.002	0.026	0.200	0.237	0.067	0.003
200.0-300.0	240.3	9	0.155	0.031	0.001	**0.878**	0.095	0.269	0.283	0.167	0.089	0.204
300.0-400.0	339.1	12	0.001	0.149	0.000	0.100	0.002	0.080	0.385	0.386	0.029	0.017
400.0-1000	612.2	12	0.042	0.003	0.001	0.001	0.092	0.204	0.654	0.073	0.013	0.003
>1000	1906	7	0.004	0.004	0.004	0.006	0.115	0.792	0.221	0.012	0.017	0.016
Frequency of p>0.80			***1***	0	***2***	***2***	0	***3***	***2***	***4***	***4***	***2***
HMR overall *Frequency of p>0.80*			***2***	***1***	***5***	***4***	0	***5***	***7***	***8***	***8***	***4***

Table 4. Summary of optimal hourly sampling period at Ward and HMR creeks based on the different statistical methods described above.

Analysis Method	Creek	Data Period	Optimal sampling	Associated Figs or Tables
Annual Load	HMR	2010 WY	1 PM	Fig. 1
	HMR	2011 WY	3 PM	Fig. 2
RMSE	Blackwood	4-5/2001	5-6 PM	Table 2
	Ward	4-6/1999-00	3-4 PM	
	HMR	2009-11	4-5 PM	
t-test	Ward	4-6/1999-00	1-2 PM	Table 3
	HMR	2010 WY	3-4 PM	
	HMR	2011 WY	4-5 PM	
Regressions	Ward	4-6/1999-00	3 PM	Fig. 3
	HMR	2010 WY	noon	Fig. 4
	HMR	2011 WY	2-3 PM	Fig. 5
	HMR	2010-11 WY	1-2 PM	Fig. 6

Table 5. Summary of soils restoration work in the HMR Creek watershed (WS).

Summer-Year	Type	Area (m^2)	Roaded area Fraction (%)	Ski-run area Fraction (%)	Net WS Fraction (%)
2006	Road	2234	2.6	--	0.09
2007	Road	7483	8.9	--	0.37
2008	Road	4515	5.3	--	0.55
2009	Road	4145	4.9	--	0.70
	Ski-run	3143	--	0.7	0.82
2010	Road	5603	6.6		1.04
	Totals	**27,123**	**28.4**	**0.7**	**1.04**

Table 6. Calculated annual pollutant loads based on 11-yr average flow frequency (Grismer (2012c) and averaged load-flow relationships between greatest rising limb and least recession limb data from Homewood Creek.

Flow Freq. Days/yr	Flow (Lps)	2010 TSS Load (kg)	2011 TSS Load (kg)
13	3.87	0.39	0.57
10	7.68	1.18	1.41
28	18.6	19.4	17.9
19	40.9	63.6	46.7
10	70.6	99.7	62.5
11	99.6	342.6	123.8
16	137	1259.6	310.8
15	223	2821.9	670.4
10	346	3445.9	947.5
7	505	3828.0	1266.3
4	626	2803.1	1044.9
2	786	1808.6	771.1
1	1338	1606.5	957.8
146	**Totals**	**18,100**	**6,222**

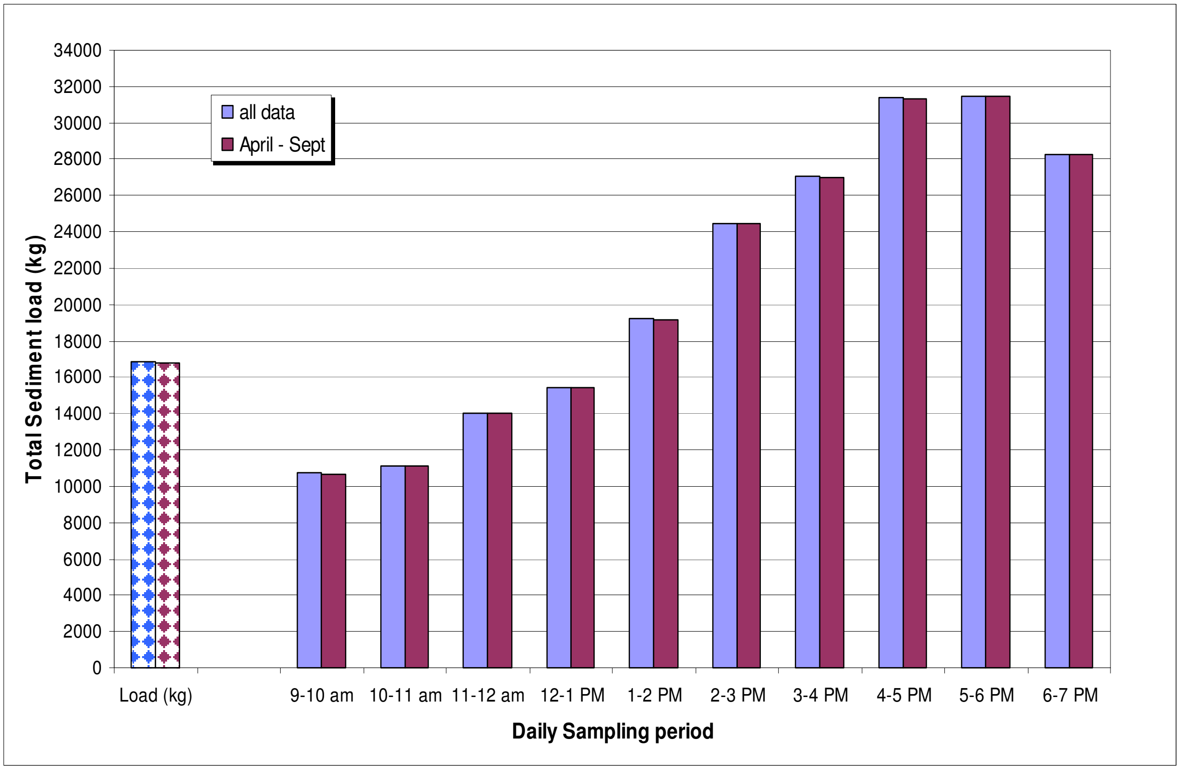

Figure 1. Total annual and spring-summer sediment load from Homewood Creek in 2010 WY as measured ("Load") and would be estimated by different sampling periods.

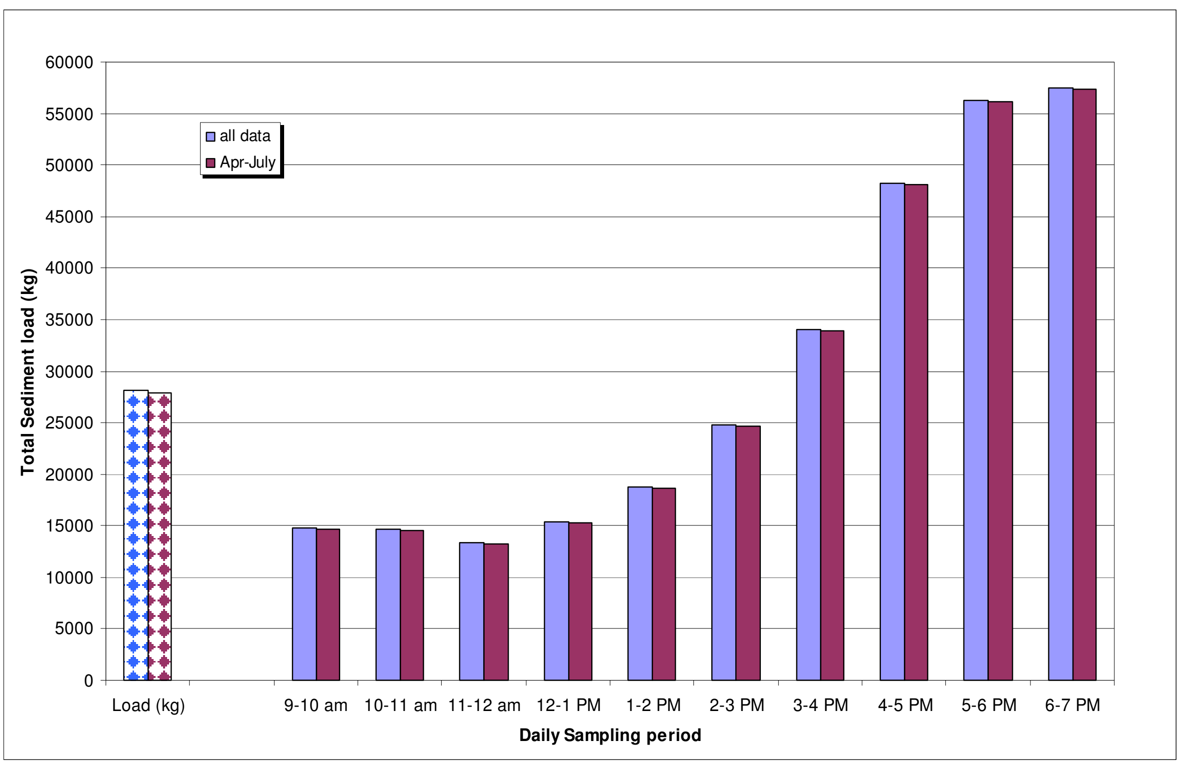

Figure 2. Total annual and spring-summer sediment load from Homewood Creek in 2011 WY as measured ("Load") and would be estimated by different sampling periods.

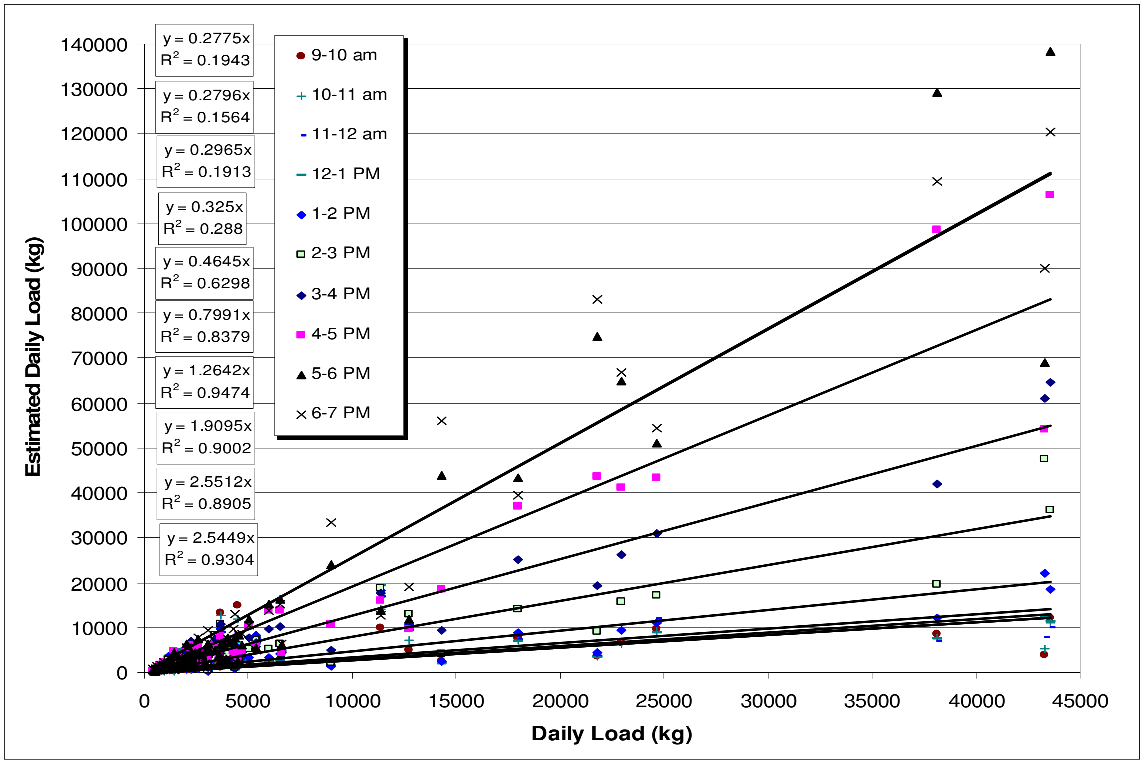

Figure 3. Linear regressions of hourly estimated versus actual daily sediment loads at Ward Creek for April- June of 1999 & 2000 (less rain-on-snow event of 5/8/2000).

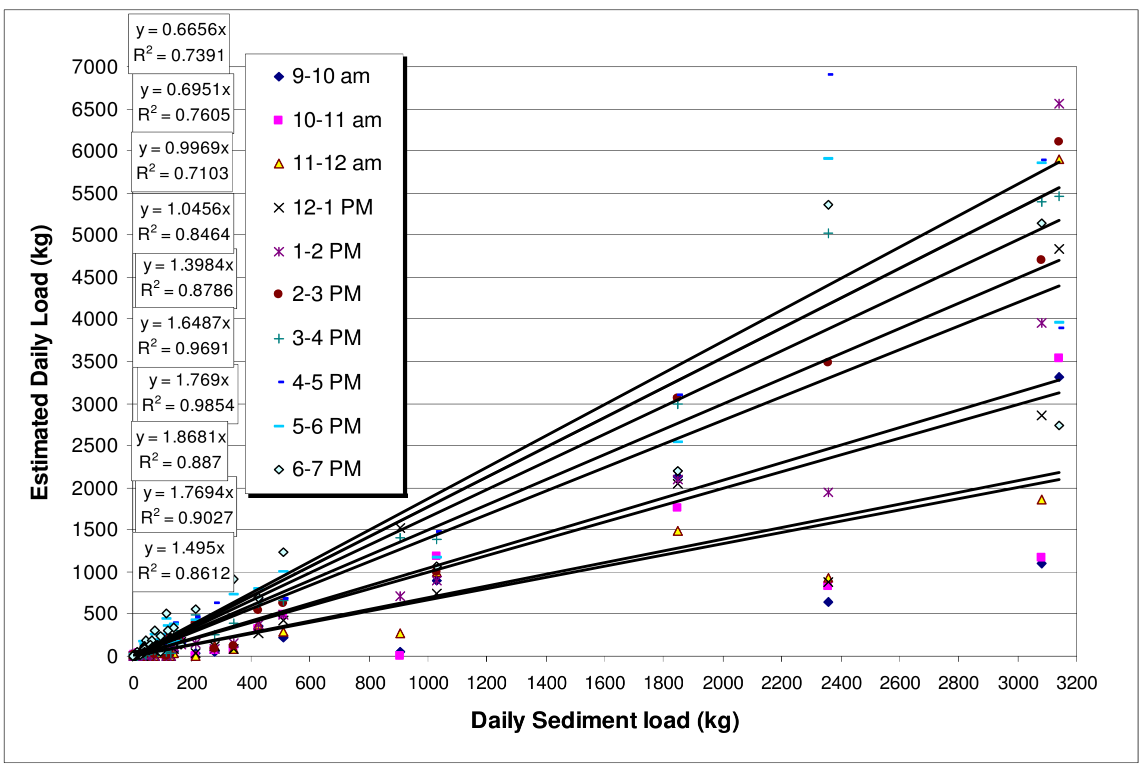

Figure 4. Linear regressions of hourly estimated versus actual daily sediment loads at HMR Creek for April- September of 2010.

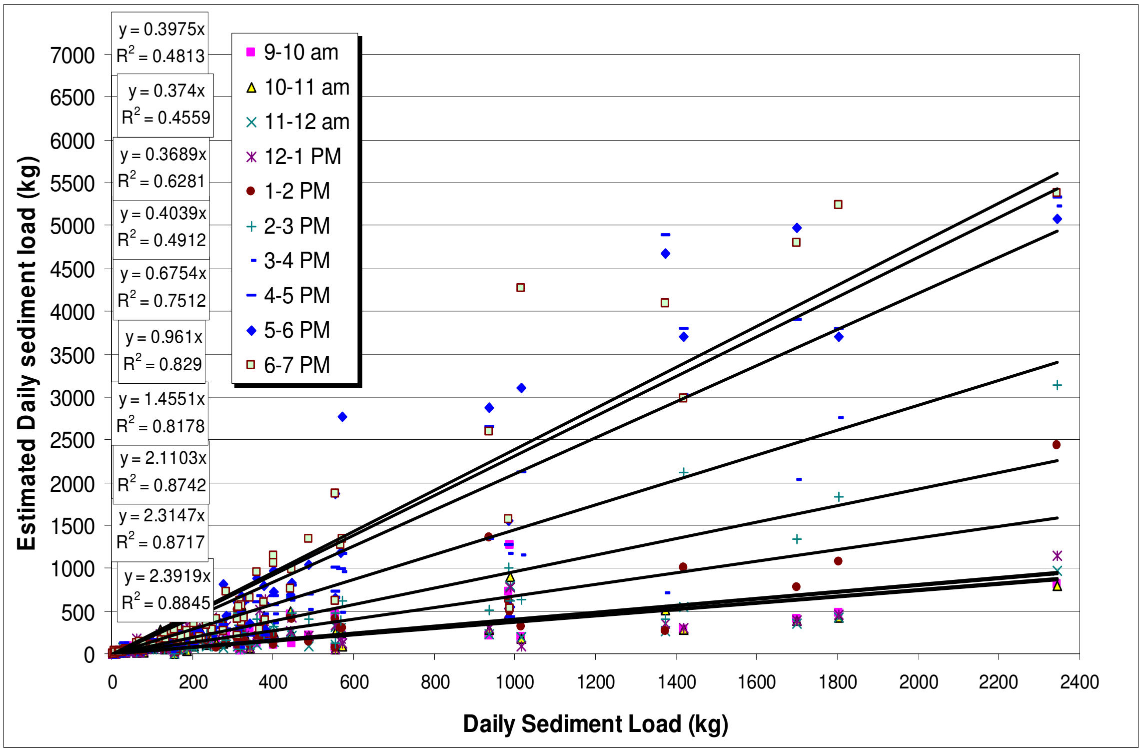

Figure 5. Linear regressions of hourly estimated versus actual daily sediment loads at HMR Creek for April- July of 2011.

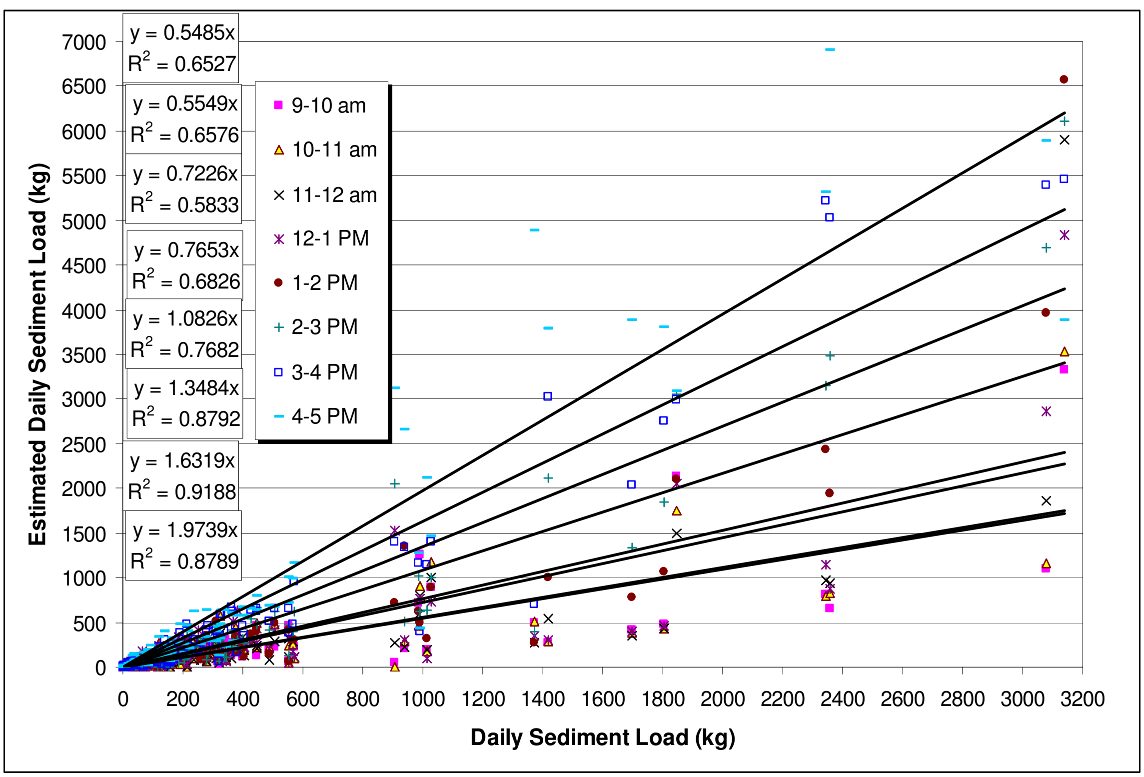

Figure 6. Linear regressions of hourly estimated versus actual daily sediment loads at HMR Creek for April- September of 2010 and 2011.

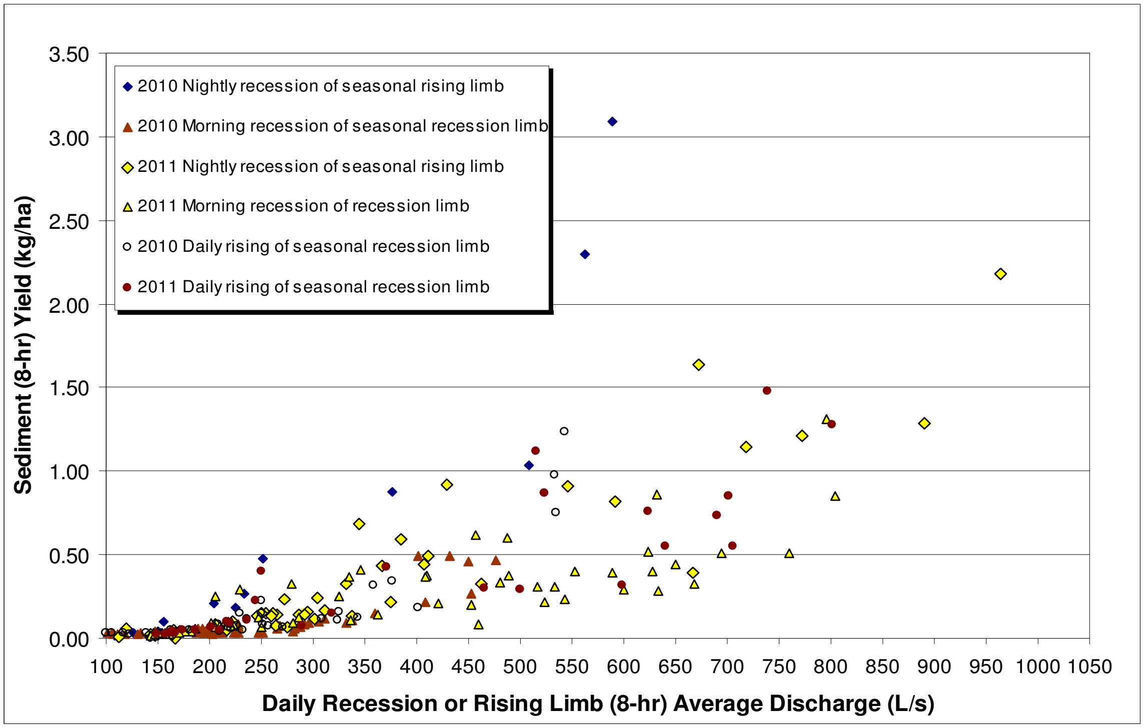

Figure 7. Daily and seasonal hydrograph recession limb sediment loads from HMR Creek as they depend on discharge during spring snowmelt of 2010 and 2011.

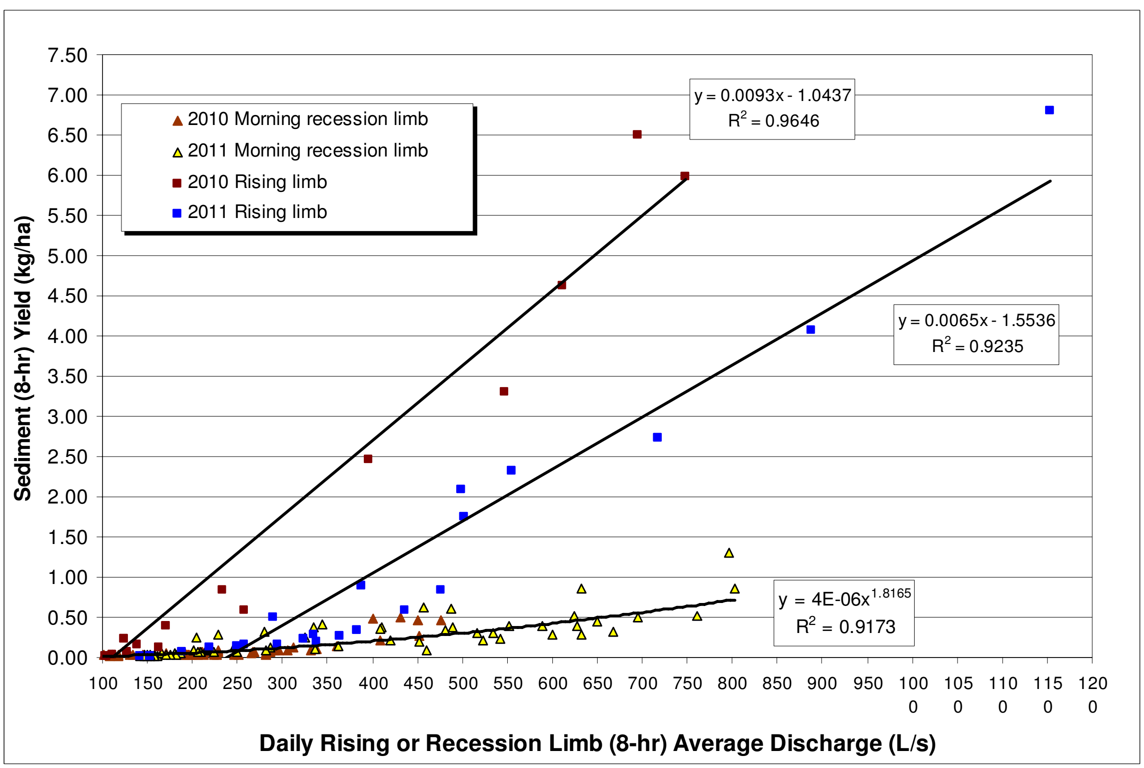

Figure 8. Daily and seasonal hydrograph rising limb sediment loads from HMR Creek as they depend on discharge and compare to daily and seasonal recession loads during spring snowmelt of 2010 and 2011.

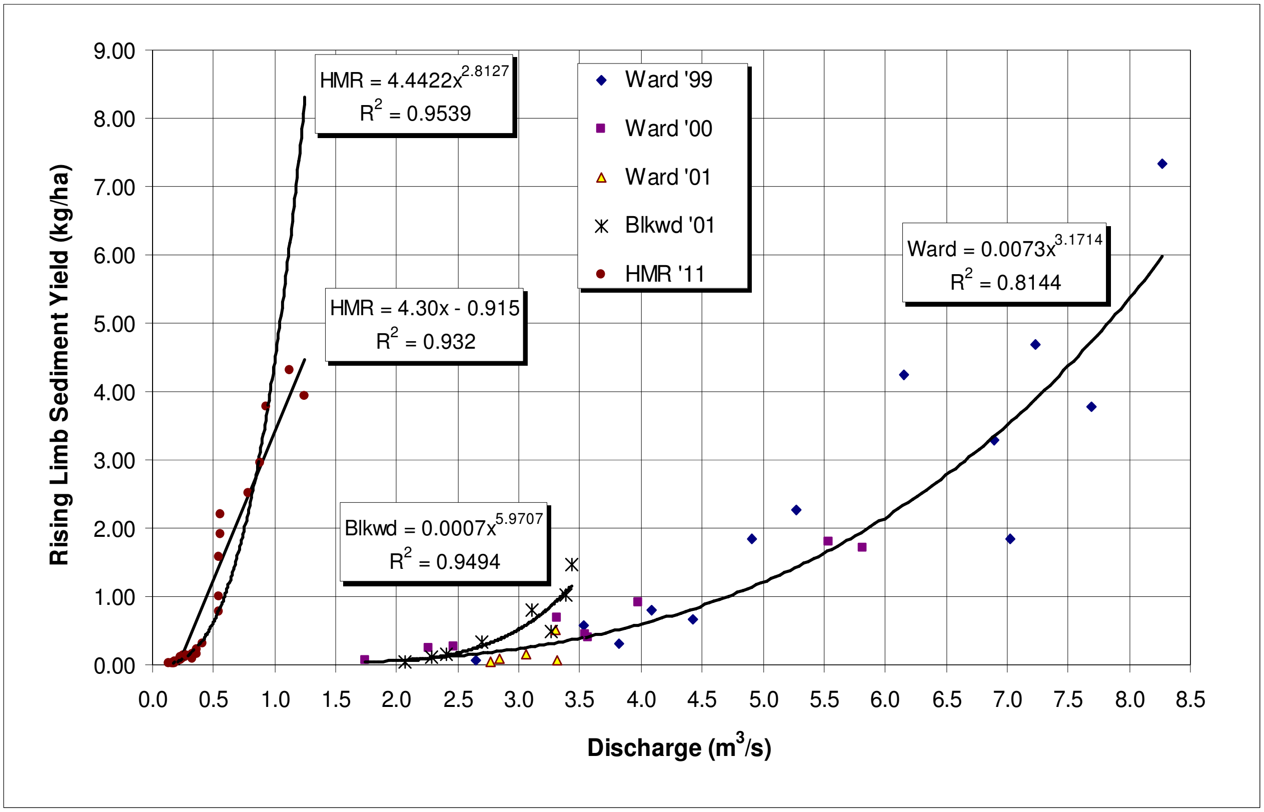

Figure 9. Hydrograph rising limb sediment yields (8-hr) as they depend on average flowrate at HMR, Blackwood and Ward Creeks during spring snowmelt periods.