City of South Lake Tahoe

Pollutant Load Reduction Plan

2011 to 2016

and

Long Term Pollutant Load Reduction Strategy (2016-2021)

January 2013

Prepared for:

Lahontan Regional
Water Quality Control Board

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LIST OF ACRONYMS

BMP	Best management practices, e.g. stormwater control measures
CICU	Commercial/institutional/communications/utilities
CRC	Characteristic Runoff Concentration
CSLT	City of South Lake Tahoe
DCIA	Directly connected impervious area
DN	Dissolved nitrogen
DP	Dissolved phosphorus
FSP	Fine sediment particles
GIS	Geographic information system
HSC	Hydrologic source control
ICIA	Indirectly connected impervious area
Lahontan	Lahontan Region Water Quality Control Board
MFR	Multi-family residential
NDEP	Nevada Division of Environmental Protection
NRCS	Natural Resources Conservation Service
PLRP	Pollutant load reduction plan
PSC	Pollutant source control
SEZ	Stream environment zone
SFR	Single family residential
SWT	Storm water treatment
TMDL	Total maximum daily load
TN	Total nitrogen
TP	Total phosphorus
TRPA	Tahoe Regional Planning Agency
UPC	Urban planning catchment
WQIP	Water quality improvement project

1.0 BACKGROUND

The California Regional Water Quality Control Board-Lahontan Region (Lahontan) incorporated the Lake Tahoe Total Maximum Daily Load (TMDL) pollutant load reduction requirements into the updated Tahoe Municipal National Pollutant Discharge Elimination System (NPDES) Permit (Lahontan 2011a). This permit (Board Order R6T-2011-0101) regulates stormwater discharges from each California municipalities' stormwater management infrastructure in the Tahoe Basin. The municipal separate storm sewer system (MS4) infrastructure consists of collection, conveyance, and treatment facilities. Federal rules require operators of MS4 systems to implement programs to control polluted runoff. California regulates MS4s through municipal NPDES permits, and for this document, Lahontan Board Order R6T-2011-0101 is referred to as the MS4 permit.

The MS4 permit requires the City of South Lake Tahoe (City) to prepare a Pollutant Load Reduction Plan (PLRP) by March 15, 2013 detailing the City's approach for meeting pollutant load reduction requirements. Section 2 of this document presents the City's PLRP, which describes the: 1) selected approach for achieving required load reductions; 2) associated performance and cost estimates; 3) urban planning catchment (UPC) registration schedule; 4) annual timeline for load reductions; and, 5) annual adaptive management process.

Section 1 provides background information describing the City's baseline load estimate, specific load reduction requirements specified in the MS4 permit, and previous City planning efforts that have directly informed the development of this PLRP.

1.1 BASELINE LOAD ESTIMATE

In 2011, Lahontan issued an *Order to Submit Technical Reports in Accordance with California Water Code – Lake Tahoe Urban Stormwater Implementation* (13267 Order) to the City and the other Tahoe Basin MS4 permitees (El Dorado County and Placer County). The 13267 Order required the City to estimate a baseline pollutant load discharged to Lake Tahoe for fine sediment particles (FSP), total phosphorus (TP), and total nitrogen (TN). The period of time from October 1, 2003 to May 1, 2004 is defined by the 13267 Order, and the MS4 permit, as the baseline condition and the point of reference for estimating baseline pollutant loading. The City's *Lake Tahoe TMDL Baseline Pollutant Load Estimate Report (CSLT 2011)* was submitted to Lahontan in September of 2011. The City's baseline load estimate (Table 1.1) was subsequently reported in section IV.A of the MS4 Permit (Lahontan 2011b: p. 26).

Table 1.1 – City Baseline Pollutant Load Estimate

Urban Area (acres)	Surface Runoff (acre-feet/year)	Pollutant Loading			
		FSP	TP	TN	Units
5,500	1,200	389,000	1,740	7,410	lb/year
		176,450	789	3,361	kg/year
		1.94E+19	n/a	n/a	# particles/year[1]

[1] One kg FSP = 1.1×10^{14} particles FSP (Lahontan and NDEP 2011, Equation: 0.3)

1.2 LOAD REDUCTION REQUIREMENTS

Through the Lake Tahoe TMDL, Lahontan established five-year load reduction targets to assess a jurisdiction's progress towards meeting overall load reduction goals (Lahontan 2010: p. 10-4). Load reduction targets for FSP, TP, and TN have been established based on attainment of California's Lake Tahoe transparency standard (roughly 97 feet) over an estimated 65-year implementation period. The MS4 permit requires a 10 percent FSP reduction, 7 percent TP reduction, and an 8 percent TN reduction from baseline pollutant loading by September 30, 2016.

Lahontan has developed the Lake Clarity Crediting Program to support the Lake Tahoe TMDL, which specifies the process to link implementation of water quality improvement actions to estimated pollutant load reductions (Lahontan and NDEP 2011). Through this program, Lake Clarity Credits have been defined as a mechanism to provide flexibility for regulated jurisdictions to achieve required load reductions. Lahontan intends to use the Lake Clarity Crediting Program and an accounting system for Lake Clarity Credits to track compliance with stormwater regulatory measures. Table 1.2 displays the City's load reduction requirements and associated Lake Clarity Credits that need to be obtained during the MS4 permit term. Note that the MS4 permit identifies the City's required Lake Clarity Credits as 190, which resulting from rounding the baseline load of FSP particles and associated Lake Clarity Credits to two significant figures.

Table 1.2 – 2016 Load Reduction Requirements

Parameter	Baseline Load (kg/year)	Required Percent Reduction	Required Load Reduction (kg/year)	Allowable Load (kg/year)
Fine Sediment Particles (mass)	176,450	10%	17,650	158,800
Fine Sediment Particles (# of particles)	1.94E+19	10%	1.94E+18	1.75E+19
Total Phosphorus	789	7%	55	734
Total Nitrogen	3,361	8%	269	3,092
Lake Clarity Credits[1]	n/a	n/a	190	n/a

[1] One Lake Clarity Credit = 1.0 x10^{16} particles FSP (Lahontan and NDEP 2011, Equation: 0.2)

1.3 SUPPORTING INFORMATION AND REPORTS

The City authorized development of a *Pollutant Load Reduction Strategy Report* (CSLT 2012) to assess potential approaches for reducing pollutant loading to Lake Tahoe from urban stormwater runoff. The goal of the Strategy Report was to identify feasible and cost effective actions to meet anticipated targets to inform the City's load reduction planning process.

The Strategy Report categorized and analyzed water quality improvement actions as three primary load reduction methodologies:

1. Road maintenance operations for water quality;
2. Public water quality improvement projects (WQIPs); and
3. Private parcel BMPs implemented through retrofit or redevelopment.

Using this framework, the Strategy Report completed an existing conditions assessment that estimated load reductions the City could register from completed water quality improvement actions. Following the existing conditions assessment, each of the three load reduction methodologies was assessed under various assumptions, which included varying levels of implementation. The results identify potential load reduction approaches and associated costs to achieve anticipated load reduction targets.

In addition to the Strategy Report, the City's *Lake Tahoe TMDL Baseline Pollutant Load Estimate Report* (CSLT 2011) provides useful information to help prioritize water quality improvement actions. This report separately identifies urban planning catchments (UPCs) that drain directly to Lake Tahoe and UPCs that drain to a meadow or other natural filtration system prior to reaching Lake Tahoe. The term *catchment connectivity* is used to specify this distinction, which classifies the portion of surface runoff and associated pollutant load discharged from a discrete UPC that reaches Lake Tahoe. Catchment connectivity is expressed as a percentage and termed a *connectivity factor*, where a connectivity factor of 100 percent denotes a directly connected UPC that discharges stormwater directly to Lake Tahoe or a stream flowing to Lake Tahoe. Distinguishing between UPCs based on catchment connectivity is particularly important to the City because much of the City's urban drainage area discharges to meadows prior to reaching Lake Tahoe. For these UPCs, only a fraction of the total pollutant load generated by the urban land uses within the City reaches Lake Tahoe.

1.4 PRESENTATION OF PERFORMANCE AND COST ESTIMATES

Pollutant load reduction performance estimates were developed using the Pollutant Load Reduction Model (PLRM), which is the same modeling tool used to estimate the City's baseline pollutant load. The PLRM is a publicly available long-term continuous simulation model used to evaluate and compare alternatives for storm water quality improvement projects in the Tahoe Basin. The PLRM links urban stormwater hydrology and site specific land use conditions to estimate average annual pollutant loading from urban drainage catchments under varying scenarios (NHC et al. 2009).

The City's PLRP is intended to be a concise and targeted document that communicates to Lahontan the City's approach and timeline for meeting the 2016 load reduction targets set forth in the MS4 permit. For brevity, the PLRP does not include a detailed narrative of the assumptions used to generate the performance and cost estimates presented herein. That information can be found in the City's Strategy Report (NHC 2012), which contains the supporting analysis that informed development of this PLRP.

For each UPC identified within this PLRP for catchment registration during the MS4 permit term, Appendix A summarizes the: 1) approach for load reduction within the UPC; 2) status of the supporting PLRM model; 3) quality assurance steps completed on the supporting PLRM model; and 4) primary and secondary water quality improvements within that UPC providing the majority of the estimated load reductions.

2.0 POLLUTANT LOAD REDUCTION PLAN

This following section summarizes the City's: 1) selected approach for meeting the load reduction requirements; 2) performance and cost estimates; 3) UPCs identified for catchment registration during the MS4 permit term; 4) annual timeline for achieving load reductions; and, 5) adaptive management process.

2.1 LOAD REDUCTION APPROACH

The City's selected approach to meet load reduction requirements combines the registration of WQIPs completed from 2004-2016 with the implementation of a pilot program to improve road operations for water quality. Specific actions include the following:

Register Completed WQIPs (2004-2012): Since the baseline period, the City has completed seven WQIPs. The UPCs that encompass the seven completed project areas will be registered with the Lake Clarity Crediting Program (see Section 2.1.1).

Construct and Register Active WQIPs (2013-2016): Three WQIPs are in active stages of planning and design, and construction should be completed by the load reduction deadline (September 2016). The UPCs that encompasses the three active project areas will be registered with the Lake Clarity Crediting Program (see Section 2.1.2).

Implement Pilot Program for Improved Road Operations: Through a pilot program, the City will implement the following:

- Switch to a road abrasive source with less FSP to reduce the average annual mass of FSP generated by City roads from sanding practices.
- Improve FSP recovery on a subset of City roads that generate high amounts of pollutants through frequent street sweeping.

The UPCs that bound the roads targeted for frequent street sweeping will be registered with the Lake Clarity Crediting Program (see Section 2.1.3). The City may also decide to explore with Lahontan the appropriate methods for registering the change in road abrasive supply as a jurisdiction-wide action. Findings and results from the pilot program will be used to assess the feasibility of expanding City road operations for water quality as a more prominent load reduction strategy in future PLRPs.

The following sections summarize performance estimates for each of the City's selected actions to meet the required load reductions in the MS4 permit.

2.1.1 REGISTER COMPLETED WQIPS (2004-2012)

To date, the City's approach for reducing stormwater pollutant loads has focused on implementation of public WQIPs in accordance with TRPA's Environmental Improvement Program. Since the Lake Tahoe TMDL baseline period, the City has constructed seven WQIPs. Performance estimates for the seven completed WQIPs are presented in Table 2.1. Pollutant reduction estimates are derived from PLRM models developed by the City, or consultants to the City. The following are standard assumptions used for each PLRM model:

- Street sweeping is conducted on a regular basis using one mechanical broom sweeper and two dustless regenerative air sweepers. Street sweeping is performed citywide one to two times during the year in the summer and fall months, and more frequently on specific roads during the winter to recover road abrasives applied during snow events.
- Each PLRM simulation for the expected condition assumes the City uses the "High-efficiency" PLRM sweeper type, and a sweeping frequency of 1-2 times per year for all secondary roads.
- Estimates of private property BMP implementation for the expected condition are based on BMP data supplied to the City by TRPA.

Each PLRM model has gone through a peer review process, which is documented in Appendix A. In some cases, additional model refinement and quality assurance may be necessary before registering a WQIP with the Lake Clarity Crediting Program. Where additional quality assurance steps are needed, this information is noted in Appendix A. Final load reduction numbers registered by the City may be different than shown in Table 2.1.

Table 2.1 – Completed WQIP Performance Estimates

City UPC	Water Quality Improvement Project	Year Completed	Load Reduction Estimates (kg/year)			Lake Clarity Credits	% of City's Baseline Load		
			FSP	TP	TN		FSP	TP	TN
B11	Glorene and 8th	2004	2,660	9	31	29	1.5%	1.2%	0.9%
M3	Rocky Point 1 and 2	2004	3,510	13	43	39	2.0%	1.7%	1.3%
J4, J8	Rocky Point 3 and 4	2012	1,100	5	20	12	0.6%	0.6%	0.6%
F1	Sierra Tract Phase 1	2010	150	2	9	2	0.1%	0.2%	0.3%
F1	Sierra Tract Phase 2	2005	200	1	4	2	0.1%	0.1%	0.1%
G12	Al Tahoe Phase 1	2010	900	6	16	10	0.5%	0.8%	0.5%
G11	Al Tahoe Phase 2	2012	1,810	10	33	20	1.0%	1.2%	1.0%
	Totals:	n/a	10,330	45	155	114	5.9%	5.7%	4.6%

For some completed WQIPs the load reduction achieved is a relatively small proportion of the City's baseline load. In these cases, the WQIPs were implemented in UPCs that discharge stormwater to meadows which subsequently were found to have low connectivity factors. Consequently, the load reduction benefit was diminished because much of the stormwater and pollutant loads generated in the pre-project condition would be filtered or infiltrated in meadows and marshes downstream of City storm drain outfalls. The City incorporated the concept of

catchment connectivity into the project prioritization process, and all active WQIPs are within UPCs that discharge stormwater directly to Lake Tahoe or streams flowing to Lake Tahoe.

Of the 29 Lake Clarity Credits attributed to the Glorene and 8th WQIP, 10 Credits result from improvements constructed by the City that treat Caltrans runoff. Previous discussions between City staff and Caltrans staff have indicated that Caltrans may allow the City to take credit for the total load reduction realized by the Glorene and 8th WQIP. However, a formal agreement between the City and Caltrans has not been negotiated.

2.1.2 CONSTRUCT ACTIVE WQIPS (2013-2016)

The City anticipates at least three WQIPs in various stages of planning and design will be constructed by the pollutant load reduction deadline (September 2016). The three WQIPs include:

- Bijou Commercial Core
- Harrison Avenue
- Sierra Tract Phase 3 & 4

These projects highlight a new City strategy to maximize load reductions by selecting project areas that treat runoff from land uses expected to generate high pollutant loads. These projects treat runoff from dense commercial land uses and city streets, as well as Caltrans runoff where feasible. Additionally, these WQIPs are within UPCs that discharge stormwater directly to Lake Tahoe or streams flowing to Lake Tahoe. Consequently, the WQIPs are forecasted to provide greater load reductions relative to most past City WQIPs on a unit area basis.

Pollutant reduction estimates in Table 2.2 are derived from preliminary PLRM models that typically reflect the preferred alternative for project design. These models have gone through a peer review process, and the status of each model is documented in Appendix A. Additional refinement and quality assurance of these PLRM models will be necessary after project construction to ensure the models appropriately represent the functions of the constructed water quality improvements. Final load reduction numbers registered with the Lake Clarity Crediting Program will likely differ from the estimates presented in Table 2.2.

Table 2.2 – Active WQIP Performance Estimates

City UPC	Water Quality Improvement Project	Estimated Construction Year	Load Reduction Estimates (kg/year)			Lake Clarity Credits	% of City's Baseline Load		
			FSP	TP	TN		FSP	TP	TN
I8	Bijou Commercial Core	2013/2014	4,570	17	61	50	2.6%	2.1%	1.8%
G12	Harrison Avenue	2013	2,300	7	25	25	1.3%	0.9%	0.7%
E1	Sierra Tract Phase 3 and 4	2015	3,370	11	19	37	1.9%	1.4%	0.6%
	Totals:	n/a	10,240	35	105	113	5.8%	4.5%	3.1%

The Bijou Commercial Core WQIP is a joint effort with Caltrans. The load reduction estimate presented in Table 2.2 is the City's initial negotiated share (50 percent) of the credited load reduction for the project with Caltrans. Total load reductions for the project, when including

Caltrans negotiated share, is twice the estimate shown in Table 2.2. The City is bearing the maintenance and operational costs of the Bijou Commercial Core WQIP. Dependent upon future negotiations with Caltrans, the City's share of the load reduction achieved from the project may increase dependent upon the City's cumulative costs for long-term operation of the Bijou WQIP.

Performance estimates for the Sierra Tract Phase 3&4 WQIP represent the preferred alternative. These estimates exclude Caltrans stormwater runoff, which currently commingles with City stormwater runoff in the project area. Depending upon the City's potential future coordination with Caltrans on the final project design, the load reductions achieved from the Sierra Tract Phase 3&4 project could be greater than what is shown in Table 2.2 when including treatment of Caltrans runoff.

2.1.3 IMPLEMENT PILOT PROGRAM FOR ROAD OPERATIONS

Approaches for reducing FSP loads generated from roads are categorized as follows: 1) minimizing the amount of FSP generated from application of road abrasives; and 2) maximizing the recovery of FSP on targeted roads, through activities such as frequent street sweeping. As a pilot program, the City will implement the following two actions:

- Switch to an abrasive supply with negligible FSP in the source material
- Test improved FSP recovery through frequent street sweeping on a subset of City roads

Switch to Abrasive Supplies with Negligible FSP in the Source Material

Preliminary Caltrans results (2010) indicate that the volcanic cinders used by the City through the 2011-2012 winter season (#004 in Caltrans study) has comparably high amounts of FSP relative to other available sources. For example, El Dorado County recently switched to a deicing sand (#022 in Caltrans study) with approximately 0.01 percent FSP, compared to the 0.3 percent FSP contained in volcanic cinders (Table 2.3).

The small percentages of FSP within an abrasive supply can become a relatively significant load when calculating total abrasives applied citywide. For example, switching to the abrasive supply used by El Dorado County is estimated to reduce the amount of FSP applied on City roads by 1,470 kilograms per year (Table 2.3). The actual load reduction in the City's baseline load from this action, however, would be less than 1,470 kilograms of FSP because the calculations in Table 2.3 do not consider fate and transport of material applied to City roads.

Table 2.3 – Estimated FSP Applied to City Roads from Road Abrasives

Abrasive Supply	FSP Count (particle count / kg abrasive)[1]	FSP Mass (kg FSP / kg abrasive)[2]	FSP Percentage by Mass in Abrasive Supply	Average Annual City Abrasives Applied (kg)	FSP Applied (kg/year)
Volcanic Cinders - Existing Source	3.29E+11	0.0030	0.30%	503,000	1,500
Deicing Sand - Current El Dorado County Source	6.94E+09	0.0001	0.01%	503,000	30

[1] Caltrans 2010: p. 4-1

[2] One kg FSP = 1.1×10^{14} particles FSP (Lahontan and NDEP 2011: Equation 0.3)

For the 2012-2013 winter season, the City has changed its abrasive supply to the deicing sand used by El Dorado County (Table 2.3). The load reduction benefit that may be realized from this action is not proposed for registration with this PLRP, unless future circumstances require the City to take credit for this action to meet load reduction requirements. The City intends to take credit for this action as part of a future PLRP once the following programmatic steps are completed:

- The methods and associated level of effort for registering and tracking the performance of jurisdictional actions with the Lake Clarity Crediting Program are better defined.
- Updates to the PLRM Road Methodology and Road Rapid Assessment Methodology (Road RAM) are completed.
- Additional research is completed, which is currently being conducted by Caltrans and El Dorado County, to assess the load reduction benefit of various road abrasive materials in terms of resistance to pulverization into FSP.

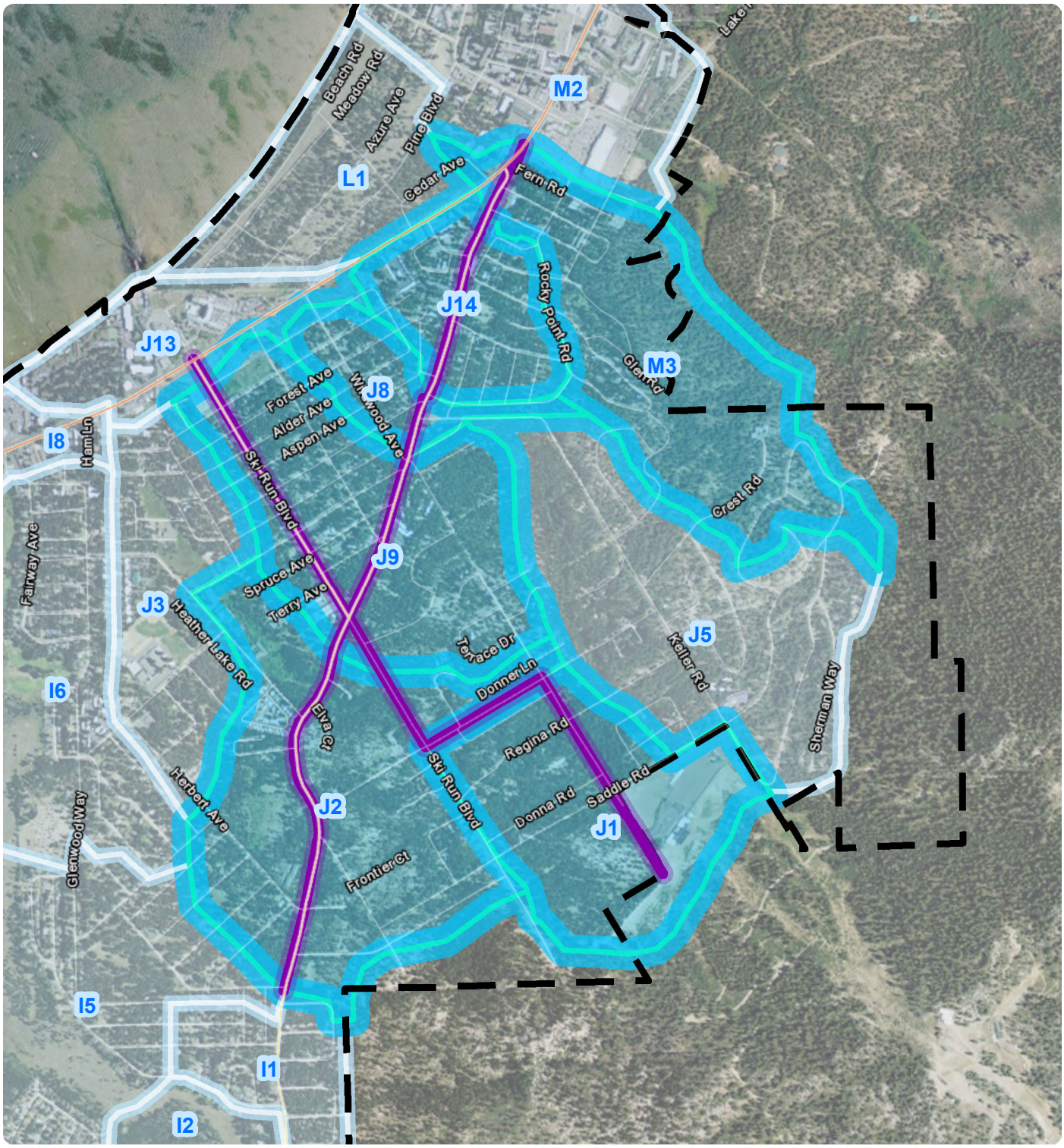
Frequent Street Sweeping on a Subset of City Roads

Various sweeping scenarios evaluated within the City's Strategy Report (CSLT 2012: p. 22-25) suggest refinement and augmentation of current sweeping operations could be a viable pollutant load reduction action. Evaluating more frequent and targeted sweeping activities during the current MS4 permit term will help the City assess options for achieving future pollutant load reductions, which must be estimated and submitted as part of the updated Pollutant Load Reduction Plan due on June 9, 2016. As a pilot program, the City will begin frequent street sweeping on a subset of City roads to assess the feasibility of expanding road operations as part of future PLRPs. The pilot program will target frequent sweeping on Primary Roads within UPCs that are directly connected to Lake Tahoe. Specifically, these roads include Ski Run Boulevard, Pioneer Trail, and the portion of Needle Peak Road and Wildwood Avenue used to access the Heavenly Mountain Resort California Base Area. The UPCs that bound the targeted roads will be registered with the Lake Clarity Crediting Program as part of this PLRP (Figure 2.1).

The targeted streets will be swept with the City's dustless regenerative air sweepers after each winter abrasive application, as road conditions allow, and once a month otherwise. This frequency equates to the most frequent sweeping interval in PLRM. The City has modeled sweeper performance in PLRM from this action using the "High-Efficiency Vacuum-Assisted Dry Sweeper" option. The City's regenerative air sweepers employ a dust separation and filtration system, which meets the definition of a high-efficiency sweeper (Sutherland 2011: p. 4). Table 2.4 displays load reduction estimates from PLRM simulations for the pilot program sweeping activities.

Table 2.4 – Pilot Street Sweeping Performance Estimate

City UPCs	Parameter	Pollutant of Concern			Lake Tahoe TMDL Credits
		FSP	TP	TN	
J1, J2, J8, J9, J14, and M3	Load Reduction Estimate (kg/year)	1,850	1.9	6.1	20
	Percent Load Reduction Compared to Baseline	1.0%	0.2%	0.2%	n/a



Data Sources: ArcGIS Online Basemaps, 2012.

City Limits

Targeted Roads for Frequent Street Sweeping

UPCs Included in Pilot Sweeping Program

Other UPCs

City of South Lake Tahoe

Pollutant Load Reduction Plan

Scale - 1:18,000 1 inch = 1,500 feet

0 750 1,500 3,000 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	January 2013

Figure 2.1 - Pilot Street Sweeping Program

2.1.4 PERFORMANCE SUMMARY

Using Lake Clarity Credits as the defining performance metric, the PLRM analysis estimates that the City can obtain 114 Credits by registering WQIPs completed since the baseline period (Table 2.1). If the three active WQIPs currently in various planning and design stages are completed by 2016, an additional 113 Credits will be available (see Table 2.2). Based on this estimate, it may be possible for the City to obtain the required amount of Credits (190) through the implementation and registration of WQIPs. However, this overall performance estimate contains some uncertainty as a number of individual WQIP performance estimates are based on preliminary PLRM models, which in some cases reflect the preferred alternative for project design. Additionally, Lake Clarity Credits could be reduced if City operations and maintenance activities are unable to sustain load reductions at the levels estimated by the stormwater modeling and supporting assumptions. To address these uncertainties the City has selected a diversified approach that includes registration of all WQIPs completed by 2016 with the registration of the pilot street sweeping effort. The selected approach will ensure that a flexible and adaptable load reduction program will be in place by 2016 to meet the MS4 permit requirements. Table 2.5 summarizes the estimated load reductions and associated Lake Clarity Credits the City anticipates achieving with the selected approach.

Table 2.5 – Load Reduction Performance Summary

Action	Load Reduction Estimates (kg/year)			Lake Clarity Credits	% of City's Baseline Load		
	FSP	TP	TN		FSP	TP	TN
Register Completed WQIPs (2004-2012)	10,330	45	155	114	6%	6%	5%
Construct and Register Active WQIPs (2013-2016)	10,240	35	105	113	6%	4%	3%
Implement Pilot Program for Improved Road Operations	1,850	2	6	20	1%	0%	0%
Totals:	**22,420**	**82**	**267**	**247**	**13%**	**10%**	**8%**
Minimum MS4 Permit Requirements:				**190**	**10%**	**7%**	**8%**

2.1.5 ESTIMATED COST

Table 2.6 presents the estimated costs to achieve the load reduction requirements specified in the MS4 permit. Estimated costs are segmented into categories of project delivery, water quality operations and maintenance, and Lake Clarity Crediting program reporting tasks.

- Project delivery costs include planning, environmental documentation, permitting, design, acquisition, and construction.
- Operation and maintenance costs are annualized based on the estimated time and resources necessary to maintain stormwater treatment infrastructure and supporting drainage infrastructure; operate street sweepers; and maintain street sweepers.
- Lake Clarity Crediting Program costs are annualized and include City staff time to:
    - Complete the initial catchment registration process for each UPC

- Perform BMP Rapid Assessment Methodology (RAM) observations and complete annual reporting
- Perform Road RAM observations and complete annual reporting
- Update catchment registration schedules for UPCs, when necessary

The total project delivery cost to meet load reduction requirements is estimated to be roughly $48 million. Of this amount, approximately $34 million has been expended on completed WQIPs and the planning and design of active WQIPs. The cost estimate includes annual operation and maintenance and Lake Tahoe TMDL reporting costs from 2012-2016, which average roughly $300,000 per year during that time period. Details regarding the assumptions and methods used to calculate costs shown in Table 2.6 can be found in the City's Strategy Report (CSLT 2012: Appendix B).

Table 2.6 – Cost Estimate for Achieving Load Reduction Targets

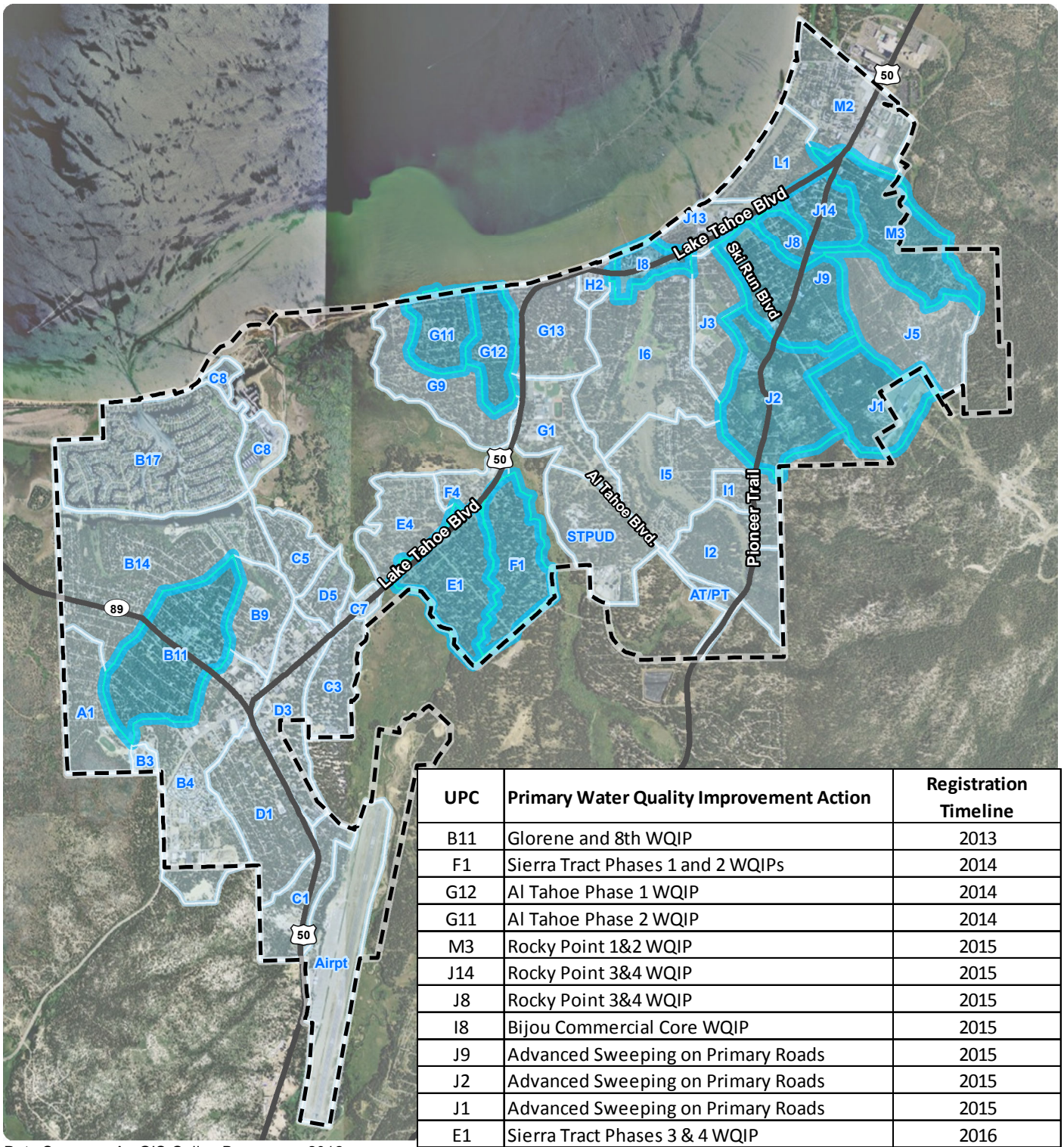
Action	Project Delivery Cost	Operations and Maintenance ($/year)	Lake Clarity Crediting Program ($/year)
Register Completed WQIPs (2004-2012)	$31,010,000	$58,000	$41,000
Construct and Register Active WQIPs (2013-2016)	$17,070,000	$140,000	$25,000
Implement Pilot Program for Improved Road Operations	$300,000	$23,000	$19,000
Total Project Delivery Costs:	**$48,380,000**		
Average Annual Costs of Maintaining Actions ($/year):		**$221,000**	**$85,000**

2.2 CATCHMENT REGISTRATION SCHEDULE

The City intends to register 12 of the 45 UPCs delineated in the *Baseline Pollutant Load Estimate Report* (CSLT 2011) to document achievement of the required load reductions with the Lake Clarity Crediting program. Table 2.7 identifies the: 1) UPCs proposed for registration as part of this PLRP; 2) calendar year each UPC will be registered; 3) water quality improvement action(s) taken within each UPC to reduce pollutant loading; 4) and timeline for completion of water quality improvement actions. For each UPC planned for registration, Appendix A documents that status of the PLRM models used to estimate pollutant load reductions, as well as the baseline pollutant loading and expected pollutant loading. Figure 2.2 identifies the UPCs planned for registration.

Table 2.7 – Catchment Registration Schedule

City UPC	Planned Registration Year	Primary Water Quality Improvement Actions	Status of Improvements
B11	2013	Glorene and 8th WQIP	Completed
G12	2014	Al Tahoe Phase 1 WQIP; Harrison Avenue WQIP	Al Tahoe completed; Harrison construction planned for 2013
G11	2014	Al Tahoe Phase 2 WQIP	Completed
F1	2014	Sierra Tract Phases 1 and 2 WQIPs	Completed
I8	2015	Bijou Commercial Core WQIP	Construction planned for 2013-2014
M3	2015	Rocky Point 1&2 WQIP; Frequent Street Sweeping on Primary Roads	WQIP Completed; Sweeping initiated in 2014-2015
J14	2015	Rocky Point 3&4 WQIP; Frequent Street Sweeping on Primary Roads	WQIP Completed; Sweeping initiated in 2014-2015
J18	2015	Rocky Point 3&4 WQIP; Frequent Street Sweeping on Primary Roads	WQIP Completed; Sweeping initiated in 2014-2015
J1	2015	Frequent Street Sweeping on Primary Roads	Initiated in 2014-2015
J2	2015	Frequent Street Sweeping on Primary Roads	Initiated in 2014-2015
J9	2015	Frequent Street Sweeping on Primary Roads	Initiated in 2014-2015
E1	2016	Sierra Tract Phases 3 & 4 WQIP	Construction planned for 2015



UPC	Primary Water Quality Improvement Action	Registration Timeline
B11	Glorene and 8th WQIP	2013
F1	Sierra Tract Phases 1 and 2 WQIPs	2014
G12	Al Tahoe Phase 1 WQIP	2014
G11	Al Tahoe Phase 2 WQIP	2014
M3	Rocky Point 1&2 WQIP	2015
J14	Rocky Point 3&4 WQIP	2015
J8	Rocky Point 3&4 WQIP	2015
I8	Bijou Commercial Core WQIP	2015
J9	Advanced Sweeping on Primary Roads	2015
J2	Advanced Sweeping on Primary Roads	2015
J1	Advanced Sweeping on Primary Roads	2015
E1	Sierra Tract Phases 3 & 4 WQIP	2016

Data Sources: ArcGIS Online Basemaps, 2012.

City Limits

City UPCs Planned for Registration

Other City UPCs

UPC - Urban Planning Catchment

City of South Lake Tahoe

Pollutant Load Reduction Plan

Scale - 1:48,000 1 inch = 4,000 feet

0 2,000 4,000 8,000 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	January 2013

Figure 2.2 - UPCs Proposed for Registration with Lake Clarity Crediting Program

2.3 LOAD REDUCTION SCHEDULE

Figure 2.3 presents the City's catchment registration schedule to attain at least 190 Lake Clarity Credits by the end of the MS4 permit term in 2016. Load reduction performance estimates, which are used to estimate anticipated Lake Clarity Credits, are based on the PLRM results presented in Section 2.1. The UPC registration schedule presented in Section 2.2 is used to estimate Lake Clarity Credits projected for obtainment during each calendar year of the MS4 permit term (Figure 2.3).

Figure 2.3 – Load Reduction Catchment Registration Schedule

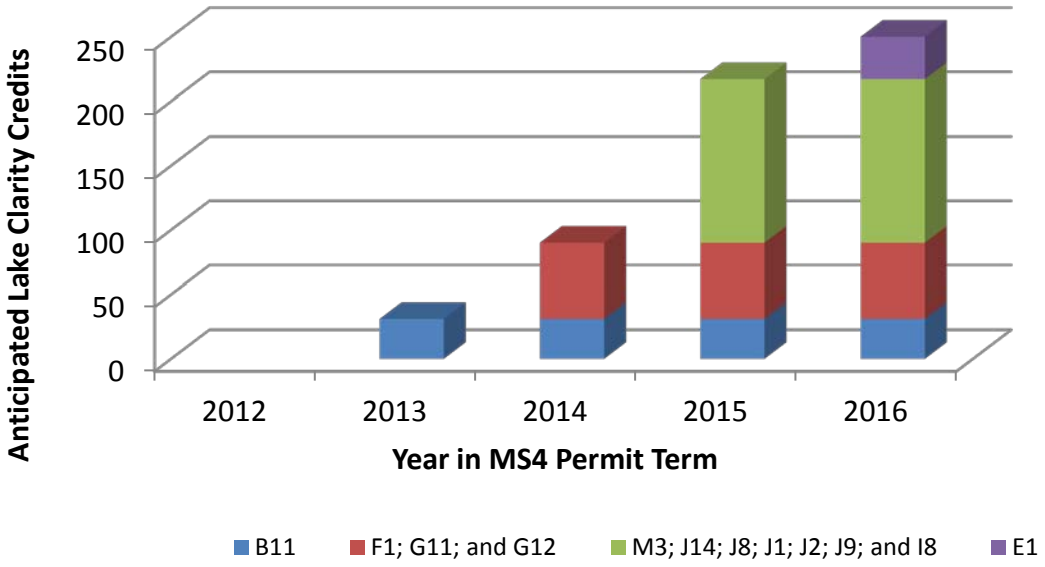
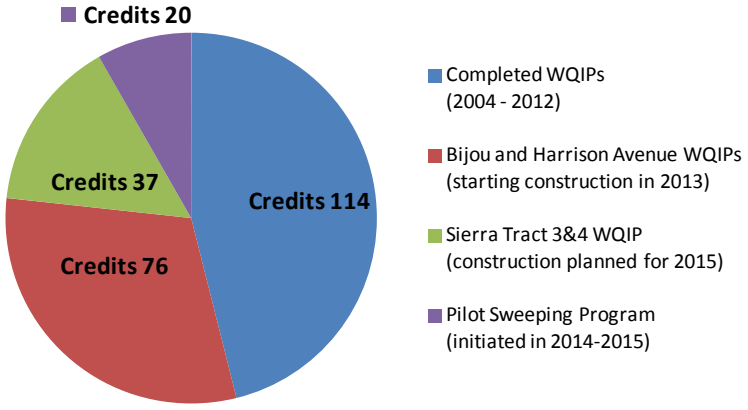


Figure 2.4 presents estimated Lake Clarity Credits categorized based on the timing of water quality improvement actions. As shown in Figure 2.4, the majority of Lake Clarity Credits the City plans to register during the MS4 permit term are associated with completed WQIPs and WQIPs that will begin construction in the summer of 2013.

Figure 2.4 – Estimated Credits Categorized by Action



2.4 ADAPTIVE MANAGEMENT PROCESS

Since 2009, the City has been developing an Asset Information System, which is a web-based geographic information system (GIS) tool that allows City staff to review and assess its stormwater infrastructure and treatment systems citywide. The City will also continue to track abrasive applications and materials recovered by sweeping and vactoring, which helps identify areas with high pollutant loading. City staff and consultants will continue to inspect facilities during large runoff events, to determine whether constructed source control, conveyance, and treatment measures are functioning as designed. City staff will also complete annual storm water system, construction and commercial, industrial, and municipal site inspections required in the MS4 permit. With a new stormwater ordinance in place, the City has additional tools to control pollutant and fine sediment discharges generated within our jurisdiction.

These existing tools and processes form the foundation of the City's internal approach to assess its stormwater management activities. The tools can also support assessments and reporting of load reduction progress during the implementation of this PLRP. For example, Appendix A of this PLRP indentifies the water quality improvements that provide the majority of credited load reductions within each UPC planned for registration. This information (identified by the Lake Clarity Crediting Program as primary and secondary load reduction components) will be integrated and highlighted in the Asset Information System. This process will allow City staff to identify and track the performance of stormwater treatment systems and water quality improvements that produce the majority of the City's credited load reduction. Using this system, City staff can efficiently direct inspection resources to ensure that BMP RAM and Road RAM observations are conducted on the most important stormwater treatment and conveyance infrastructure. Information obtained from the RAM observations will be used to identify necessary maintenance actions, and the frequency of maintenance actions, to ensure that key stormwater infrastructure functions as intended.

As mentioned in previous sections of this PLRP, a number of the estimated load reductions are based on preliminary PLRM models that will require additional refinement and quality assurance prior to registration with the Lake Clarity Crediting Program. In addition, if water quality maintenance activities in response to field inspection assessments are not sufficient to maintain the Lake Clarity Credits estimated by the stormwater modeling, awarded Lake Clarity Credits may be reduced. Recognizing this uncertainty, the City has developed a PLRP that is projected to obtain as much as 250 Lake Clarity Credits, which is in excess of the 190 required by the MS4 permit. If Lake Clarity Credits exceed the minimum required under the current MS4 permit they can be applied to meet future load reduction requirements. The City will update its load reduction schedule annually (Figure 2.3), after catchment registration activities are completed, to track and assess progress towards obtainment of the required load reductions by 2016.

3.0 REFERENCES

Caltrans. 2010. Particle Analysis of Abrasives Study. Technical Memorandum. CTSW-TM-10-209.41.1. October 2010.

CSLT - City of South Lake Tahoe. 2012. Pollutant Load Reduction Strategy. Prepared by Northwest Hydraulic Consultants. South Lake Tahoe, CA. November 2012.

CSLT. 2011. Lake Tahoe TMDL Baseline Pollutant Load Estimate. Prepared by Northwest Hydraulic Consultants. South Lake Tahoe, CA. September 2011.

Lahontan Regional Water Quality Control Board (Lahontan). 2011a. Updated Waste Discharge Requirements and National Pollutant Discharge Elimination System (NPDES) Permit for Storm Water/Urban Runoff Discharges from El Dorado County, Placer County, and the City of South Lake Tahoe Within the Lake Tahoe Hydrologic Unit. Order Number: R6T-2011-0101. NPDES Number: CAG61600.

Lahontan. 2011b. Order to Submit Technical Reports in Accordance with Section 13267 of the California Water Code – The Lake Tahoe Urban Stormwater Implementation. February 2011.

Lahontan and Nevada Division of Environmental Protection (NDEP). 2011. Lake Clarity Crediting Program Handbook: for Lake Tahoe TMDL Implementation v1.0. Prepared by Environmental Incentives, LLC. South Lake Tahoe, CA. September 2011.

Lahontan 2010. Final Lake Tahoe Total Maximum Daily Load. November 2010. http://www.swrcb.ca.gov/rwqcb6/water_issues/programs/tmdl/lake_tahoe/docs/tmdl_rpt_nov2010.pdf

NHC, Geosyntec Consultants, and 2NDNATURE. 2009. PLRM Model Development Document. Prepared for Lake Tahoe Basin Storm Water Quality Improvement Committee. South Lake Tahoe, CA. http://www.tiims.org/TIIMS-Sub-Sites/PLRM/docs-downloads.aspx

Sutherland. 2011. Street Sweeping 101 – Using Street Sweepers to Improve Water and Air Quality. January-February 2011. http://files.stillwater.org/files/waste/StreetSweeping-101.pdf

APPENDIX A – PLRM QUALITY ASSURANCE DOCUMENTATION BY UPC

Quality assurance documentation last updated on January 24, 2013.

In some cases, additional model refinement and quality assurance may be necessary before registering a WQIP with the Lake Clarity Crediting Program. Where additional quality assurance steps are needed, this information is highlighted within Appendix A. As part of the City's Adaptive Management Process, additional quality assurance checks will be completed prior to catchment registration.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate

Date: 24-Jan-13

UPC ID: B11 **PLRM Project Name:** Glorene_8th **Date PLRM Project Last Revised:** 23-Jan-13

Background Information

Baseline Scenario Name: BaselineCondition **Expected Scenario Name:** ExpectedCondition
Model Built By: CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City Provide

UPC Connectivity Factors

Surface Runoff: 19% **FSP:** 19% **TP:** 19% **TN:** 19%

Narrative of Water Quality Improvements Represented in PLRM

The Glorene and 8th ECP is located in the Gardner Mountain neighborhood, which is one of the steeper areas of the City. Runoff eventually drains to Tallac Lagoon and flows out to Pope Marsh before discharging to Lake Tahoe. Due to a barrier beach in Pope Marsh, the estimated connectivity to Lake Tahoe is roughly 20%. Source controls consist of curb and gutter on most streets that route storm water runoff to many drain inlets. Drain inlets convey the storm water to several treatment basins. Treatment controls consist of two infiltration basins and two dry basins adjacent State Highway 89. There are also several small infiltration basins in the upper watershed as well as rock lined channels that provide further infiltration and conveyance.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	Yes
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	No, see Comment 1
5. Is the total impervious area the same between the baseline and expected condition scenarios?	No, see Comment 1

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	Yes
2. Are road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 2
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	Not present
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	No, see Comment 3
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	Yes

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	Expected
PLRM Name	InfiltrationBasin1	InfiltrationBasin2	DryBasin1
Type	Infiltration Basin	Infiltration Basin	Dry Basin
Physical Location	2 parcels between Tenth and Eight Streets	833 Emerald Bay Rd	825 Emerald Bat Rd between Hwy 89 and
Scenario	Expected		
PLRM Name	DryBasin2		
Type	Dry Basin		
Physical Location	829 James Ave between James and Eloise		

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)	FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
Baseline	69.9	38,239	142.2	528.2	17,345	64.5	239.6	1.91E+18
Expected	33.0	7,459	35.6	164.7	3,383	16.1	74.7	3.72E+17
Load Reduction	36.8	30,780	106.7	363.5	13,961	48.4	164.9	1.54E+18
% Load Reduction	53%	80%	75%	69%				

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr): 7.0 **FSP (kg/yr):** 2,653 **TP (kg/yr):** 9.2 **TN (kg/yr):** 31.3 **Credits:** 29.2

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	69.9	38,294	142.4	528.9

Catchment Notes

Need to rectify land use distribution between the

Expected Load	49.2	21,251	88.4	354.5
Load Reduction	20.7	17,043	54.0	174.3

Baseline Condition and Expected Condition before finalizing load reduction diagnostics.

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
InfiltrationBasin1	7.0	2,342	10.5	47.2
InfiltrationBasin2	1.6	1,469	4.6	15.9
DryBasin1	2.7	6,407	23.3	77.8
DryBasin2	4.8	3,563	14.4	48.7

SWT Notes

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	56%	55%	51%	48%
InfiltrationBasin1	19%	8%	10%	13%
InfiltrationBasin2	4%	5%	4%	4%
DryBasin1	7%	21%	22%	21%
DryBasin2	13%	12%	14%	13%
Check on Percentages	100%	100%	100%	100%

Summary Notes

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

Need to rectify land use distribution between the Baseline Condition and Expected Condition before finalizing assessment.

Secondary Components

Tertiary Components

None noted

Comments

1. The baseline condition has roughly 5 acres more Secondary Roads in total area and 4 more acres of impervious area associated with Secondary Roads. This discrepancy should be resolved.
2. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads.
3. Infiltration facilities are sized to PLRM defaults to store 1-inch of runoff from tributary impervious areas. This input does not appear to have been assessed.

Model Status

1. Load reduction estimate includes approximately 5 acres of Caltrans runoff, which is treated by the Glorene and 8th project. The entity that received credit for this portion of the project's load reduction has not been finalized between the City and Caltrans.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate **Date:** 7-Jan-13

UPC ID: I8 **PLRM Project Name:** Bijou_CommercialCore **Date PLRM Project Last Revised:** 7-Jan-13

Background Information

Baseline Scenario Name:	BaselineCondition	**Expected Scenario Name:**	ExpectedCondition
Model Built By:	CSLT and NHC	**QA/QC Review By:**	B. Wolfe, NHC

GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff:	100%	**FSP:**	100%	**TP:**	100%	**TN:**	100%

Narrative of Water Quality Improvements Represented in PLRM

The Bijou Area Erosion Control Project, Phase 1 (Project) is a water quality improvement project for one of the highest pollutant load outfalls to Lake Tahoe. The purpose of the Project is to treat high pollutant load stormwater runoff generated in the Bijou commercial area, adjacent to Lake Tahoe (Commercial Core). The Bijou Commercial Core is comprised of 47 acres of nearly 100% impervious area (pavement and dense urban development), which includes US Highway 50, commercial development, and City roads immediately adjacent to and hydraulically connected to Lake Tahoe. Project construction focuses on two key elements: (1) Construction of a comprehensive regional treatment system for runoff generated in the Commercial Core. The regional treatment system is designed to collect and treat co-mingled urban stormwater runoff from the City right-of-way (ROW), California Department of Transportation (Caltrans) ROW, and private property. Urban storm water runoff from the Commercial Core watershed will be collected in a separate drainage system from that of the upper watershed (i.e., a double box culvert) and directed through a series of underground sediment vaults to remove oil/grease and larger-sized sediment. Stormwater would then be pumped and conveyed through an underground force main to infiltration basins in the upper watershed; and (2) Replacement of the existing Bijou Creek storm drain system that conveys storm water runoff from the 1,300-acre Bijou Creek watershed, through the Commercial Core, to Lake Tahoe. This work includes replacing the 50-year-old drainage, that is failing and undersized, with an underground double box culvert. The replacement will allow the cleaner storm water runoff from Bijou Meadow to be separated and conveyed to Lake Tahoe without co-mingling with high pollutant load runoff from the Commercial Core (current configuration). This will allow for greater water quality treatment of the highest pollutant load runoff to Lake Tahoe.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	No, see Comment 1
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	Yes
5. Is the total impervious area the same between the baseline and expected condition scenarios?	Yes

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	No, see Comment 2
2. Are road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 3
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	Not present
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	Not present
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	No, see Comment 4

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	
PLRM Name	Vaults	USFSBasin	
Type	Dry Basin	Infiltration Basin	
Physical Location	Bijou Commercial Core near Bal Bijou Rd	West side of Walkup Rd	

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)	FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
Baseline	39.6	21,293	78.5	285.6	9,658	35.6	129.5	1.06E+18
Expected	2.3	1,175	4.4	15.9	533	2.0	7.2	5.86E+16
Load Reduction	37.3	20,118	74.1	269.7	9,125	33.6	122.3	1.00E+18
% Load Reduction	94%	94%	94%	94%				

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr):	37.3	**FSP (kg/yr):**	9,125	**TP (kg/yr):**	33.6	**TN (kg/yr):**	122.3	**Credits:**	100.4

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	39.6	21,302	78.5	285.8
Expected Load	41.4	22,516	83.4	301.7
Load Reduction	-1.8	-1,214	-4.9	-16.0

Catchment Notes

Increased catchment runoff and loading results by reducing private BMP implementation to zero. See comment 2.

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Vaults	0.1	903	3.0	11.0
USFSBasin	39.0	19,290	71.7	259.8

SWT Notes

The Vaults are used to regulate flow to the pumping system. Based on the drain time and associated pumping rate, they are simulated with minimal ability to remove FSP, TP, and TN.

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	-5%	-6%	-7%	-6%
Vaults	0%	4%	4%	4%
USFSBasin	105%	96%	97%	96%
Check on Percentages	100%	94%	94%	94%

Summary Notes

The current simulation has some water quality continuity problems, see Comment #5.

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

1. Maintaining infiltration capacity and function of the USFSBasin.
2. Ensuring that the pumping system effectively transports stormwater to the USFSBasin.

Secondary Components

1. Maintaining conveyance to the vaults and pumping system.
2. Removing trash and debris from the vaults.

Tertiary Components

Comments

1. Project area was extended west past Takela Drive toward Freemont Ave. Entire project area = 54 acres including Caltrans (5.1 acres). The current UPC delineation for I8 is roughly 45 acres.
2. Proposed project improvements address private runoff through a regional treatment system. To avoid double-counting, private property BMP implementation is set to zero for private land uses.
3. The City's regenerative air sweeper is used (change from baseline) with the same sweeping frequency of twice per year (same as baseline). Caltrans sweeping on Highway 50 is not adjusted from baseline assumptions.
4. The Pre-treatment vault named "Vaults" has CECs adjusted upwards to reflect that this facility has minimal ability to remove FSP, TP, and TN.
5. The current representation of the Bijou pump and treat system is producing reasonable results. However, there area some continuity errors with the calculations of pollutant loads. The issue is caused by a number of factors associated with PLRM version 1 (simplicity of algorithms, simulation time step, constraints associated with the use of dividers to represent stormwater pumping). Given that there are no continuity errors with the water balance, the load reduction estimate appears reasonable and could be registered.

Model Status

1. Pollutant load numbers include Caltrans runoff. The City's initial share of the project is 50%. Load reductions estimates registered by the City should be 50% of the estimates shown herein.
2. Need to rectify the UPC delineation after project completion since the project changes the current drainage boundaries.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate **Date:** 22-Jan-13

UPC ID: J8 & J14 **PLRM Project Name:** Rocky_Point_3_4 **Date PLRM Project Last Revised:** 14-Jan-13

Background Information

Baseline Scenario Name: BaselineCondition **Expected Scenario Name:** ExpectedCondition
Model Built By: CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff: 100% **FSP:** 100% **TP:** 100% **TN:** 100%

Narrative of Water Quality Improvements Represented in PLRM

The Rocky Point ECP, Phases 3 and 4 was completed in 2012, although the majority of project improvements were constructed in 2008. Improvements include curb and gutter, storm drain pipes, drainage swales, infiltration features/channels and numerous storm water treatment basins in the upper catchment. Runoff in the lower catchment is collected at the Wildwood Wet Basin where significant treatment takes place. A connection to the Marriot Wet Basin on the west side of Highway 50 was does not function as designed. The junction box could be redesigned reconstructed in the future to add additional downstream treatment prior to discharge to Lake Tahoe.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	No, see Comment 1
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	Yes
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	No see Comment 2
5. Is the total impervious area the same between the baseline and expected condition scenarios?	No see Comment 2

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	Yes
2. Are road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 3
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	Not present
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	No, see Comment 4
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	No, see Comment 5-6

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	Expected
PLRM Name	PentagonBasin	CelladorGallery	ShepherdsBasins
Type	Dry Basin	Infiltration Basin	Infiltration Basin
Physical Location	Between Pentagon and Hwy 50.	West end of Cellador Rd.	1049 Shepherds Dr
Scenario	Expected	Expected	Expected
PLRM Name	LowerPioneerBasin	UpperPioneerBasin	AspenwaldBasin
Type	Dry Basin	Dry Basin	Dry Basin
Physical Location	3833 Pioneer Trail	3802 Pioneer Trail	3830 Aspenwald
Scenario	Expected	Expected	Baseline and Expected
PLRM Name	LostSheepBasins	KellerBasin	WildwoodBasin
Type	Dry Basin	Dry Basin	Wet Basin
Physical Location	Corner of Larch Dr Lost Sheep Ln (4 Basins)	Corner of Keller and Steven	Wildwood Ave and Hwy 50
Scenario	Baseline and Expected		
PLRM Name	MarriotWetBasin		
Type	Wet Basin		
Physical Location	Ski Run Marina behind Marriot Vacation Resort		

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)	FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
Baseline	26.7	4,040	19.8	107.1	1,833	9.0	48.6	2.02E+17
Expected	19.0	1,623	9.8	63.8	736	4.4	28.9	8.10E+16
Load Reduction	7.7	2,417	10.0	43.3	1,096	4.5	19.6	1.21E+17

% Load Reduction	29%	60%	51%	40%

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr):	7.7	FSP (kg/yr):	1,096	TP (kg/yr):	4.5	TN (kg/yr):	19.6	Credits:	12.1

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load				
Expected Load				
Load Reduction	0.0	0	0.0	0.0

Catchment Notes

Need to rectify land use distribution between the Baseline Condition and Expected Condition before checking load reduction diagnostics.

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
PentagonBasin				
CelladorGallery				
ShepherdsBasins				
LowerPioneerBasin				
UpperPioneerBasin				
AspenwaldBasin				
LostSheepBasins				
KellerBasin				
WildwoodBasin				
MarriotWetBasin				

SWT Notes

The WildwoodBasin and MarriotWetBasin facilities exist in the baseline condition. The load reduction/increase for these facilities is the difference in pollutant removal from the baseline to expected condition. A hydraulic issue is causing runoff to bypass the MarriotWetBasin. This issue is simulated in both the baseline and expected condition using a Diversion in PLRM.

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	0%	0%	0%	0%
PentagonBasin	0%	0%	0%	0%
CelladorGallery	0%	0%	0%	0%
ShepherdsBasins	0%	0%	0%	0%
LowerPioneerBasin	0%	0%	0%	0%
UpperPioneerBasin	0%	0%	0%	0%
AspenwaldBasin	0%	0%	0%	0%
LostSheepBasins	0%	0%	0%	0%
KellerBasin	0%	0%	0%	0%
WildwoodBasin	0%	0%	0%	0%
MarriotWetBasin	0%	0%	0%	0%
Check on Percentages	0%	0%	0%	0%

Summary Notes

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

Secondary Components

Tertiary Components

Comments

1. Assumptions for Primary Roads does not match; need to note that Wildwood submitted as a dry basin in baseline load estimate but City feels is more appropriate to represent as a wet basin the baseline. Assumptions for Primary Roads adjusted. Sweeping still set to 1-2 times per year, needs to be 1-2 times per season on Primary Roads.
2. Land use distribution for secondary roads and primary roads does not match. Suspect its an issue with the Expected Condition tabulation because the

land use layer hasn't been updated to reflect the City's designation of Pioneer Trail and Ski Run Blvd. as Primary Roads.
3. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads; need to adjust City Primary Roads to sweeping 20 times per year (PLRM maximum) to represent PLRP approach. Rocky Point ECP's (phases 1/2, 3/4) will be registered later in the registration process so as to allow for the Pilot Sweeping Program to be established. Once this occurs, PLRM will be updated.
4. Infiltration facilities are sized to PLRM defaults to store 1-inch of runoff from tributary impervious areas. This input does not appear to have been assessed. Adjusted to 0.50 in. Are these basins or something else, still seems a little high for an assumption?
5. Drain times for dry basins are low. To compensate for this issue, CECs are adjusted upwards to reflect less treatment.
6. Infiltration rate selected for all infiltration basins (2.5 inches/hour) may be difficult to maintain at that rate based on estimated load inputs - should standardize these assumptions across models. Originally designed to infiltrate at a 7-8 in/hr. Adjustment to 2.5 in/hr is a big downgrade. Still probably too high, could be quite burdensome to maintain at a rate of 2.5 inch/hour.

Model Status

1. Address issues mentioned above in the Comments section.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate

Date: 24-Jan-13

UPC ID: M3 **PLRM Project Name:** Rocky_Point_1_2 **Date PLRM Project Last Revised:** 11-Dec-12

Background Information

Baseline Scenario Name: Baseline_Conditions **Expected Scenario Name:** ExpectedCondition
Model Built By: CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff: 100% **FSP:** 100% **TP:** 100% **TN:** 100%

Narrative of Water Quality Improvements Represented in PLRM

The objective of the project was to reduce erosion and protect water quality through a combination of erosion control, drainage and water quality treatment measures. The project included stabilization of road shoulders and roadside ditches on Rocky Point. Source control was achieved through the construction of concrete curb and gutter. Concrete curb and gutter as well as adjoining asphalt paving were constructed on existing road shoulders or drainage swales. Concentrated stormwater flow is routed to dry basin sites for treatment and infiltration. Stormwater is routed to several basins in the upper catchment before joining the Park Avenue basin system in the lower catchment. Flows eventually discharge at the North Ditch outfall.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	Yes
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	Yes
5. Is the total impervious area the same between the baseline and expected condition scenarios?	Yes

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	Yes
2. Are road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 1
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	Not present
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	Not present
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	No, see Comment 2

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Baseline	Baseline	Baseline
PLRM Name	Shepards	RockyPoint	FernBasins
Type	Dry Basin	Dry Basin	Dry Basin
Physical Location	Shepards & Rocky Pt.	Glen Rd.	Hwy 50 & Pioneer Tr.

Scenario	Baseline and Expected	Baseline and Expected	Baseline and Expected
PLRM Name	UpperPark	LowerPark2a	LowerPark2b
Type	Wet Basin	Infiltration Basin	Dry Basin
Physical Location	End of Pine Blvd.	Park Ave.	Park Ave.

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)	FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
Baseline	59.6	26,631	100.8	407.2	12,080	45.7	184.7	1.33E+18
Expected	54.9	18,904	72.0	313.7	8,575	32.7	142.3	9.43E+17
Load Reduction	4.7	7,727	28.8	93.5	3,505	13.1	42.4	3.86E+17
% Load Reduction	8%	29%	29%	23%				

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr): 4.7 **FSP (kg/yr):** 3,505 **TP (kg/yr):** 13.1 **TN (kg/yr):** 42.4 **Credits:** 38.6

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	77.5	40,032	152.2	577.5
Expected Load	79.7	37,924	150.0	577.2
Load Reduction	-2.2	2,108	2.2	0.3

Catchment Notes

Catchment improvements are primarily curb and gutter, which slightly increases road DCIA and surface runoff relative to baseline condition.

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Shepards	0.2	294	2.1	5.8
RockyPoint	0.6	1,163	6.3	21.6
FernBasins	1.7	3,419	16.8	52.7
UpperPark	-0.1	-623	-3.1	-8.8
LowerPark2a	1.1	137	0.1	3.2
LowerPark2b	3.4	1,191	4.2	18.0

SWT Notes

The UpperPark, LowerPark2a, and LowerPark2b facilities exist in the baseline condition. The load reduction/increase for these facilities is the difference in pollutant removal from the baseline to expected condition after Rocky Point runoff is routed to them.

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	-48%	27%	8%	0%
Shepards	5%	4%	7%	6%
RockyPoint	13%	15%	22%	23%
FernBasins	36%	44%	58%	56%
UpperPark	-1%	-8%	-11%	-9%
LowerPark2a	23%	2%	0%	3%
LowerPark2b	73%	15%	14%	19%
Check on Percentages	100%	100%	99%	99%

Summary Notes

Load and runoff reductions primarily result from the FernBasins, RockyPoint basin, and LowerPark system. Loads from the UpperPark wet basin slightly increase relative to the baseline condition, which indicates the basin is at capacity and additional stormwater runoff routed through is not treated. The UpperPark basin routes runoff to the LowerPark system, so overall there is a net load reduction from diverting Rocky Point runoff to the UpperPark and LowerPark treatment system.

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

1. Maintaining infiltration capacity and function of the Fern Basins, Rocky Point basin, and Lower Park basins.
2. Ensuring that conveyance systems effectively transport stormwater to these treatment facilities.

Secondary Components

1. Maintaining the infiltration and treatment capacity of the Shepards basin.
2. Maintaining the conveyance of runoff from the Rocky Point drainage to the UpperPark basin, and from the UpperPark basin to the LowerPark basins.

Tertiary Components

None noted

Comments

1. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads; 20 times per year (PLRM maximum) on City Primary Roads. Will be adjusted once Pilot Sweeping Program is established
2. Drain times for dry basins (based on built outlet structures) are below PLRM recommended values. To compensate for this issue, CECs are adjusted upwards to reflect less treatment for FSP, TP, and TN.

Model Status

1. Rocky Point ECP's (phases 1/2, 3/4) will be registered later in the registration process so as to allow for the Pilot Sweeping Program to be established. Once this occurs, PLRM will be updated.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate **Date:** 24-Jan-13

UPC ID: G11 **PLRM Project Name:** AlTahoe_Phase2 **Date PLRM Project Last Revised:** 14-Dec-12

Background Information

Baseline Scenario Name: BaselineCondition **Expected Scenario Name:** ExpectedCondition
Model Built By: Wood Rodgers and CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff: 100% **FSP:** 100% **TP:** 100% **TN:** 100%

Narrative of Water Quality Improvements Represented in PLRM

The Al Tahoe ECP, Phase 2 includes installation of an in-line pretreatment vault at the terminus of the Regan Beach storm drain upstream and connected to a media filter treatment vault (Stormfilter). The stormfilter has two chambers. The first chamber to receive runoff is designed for low-flow with cartridges specified to remove FSP, and the second chamber is designed for bypass flow during larger storms. The project also includes rehabilitation of approximately 0.8 miles of unpaved compacted shoulder. Improvements along Lakeview Avenue will include curb and gutter, soil stabilization, soil amendment/revegetation and permanent parking deterrents. Improvements along Fresno, Nevada, Sacramento and Oakland Avenues from Lakeview to Merced will include installation of pervious concrete. Removal and replacement of drain inlets and additional 7 inlets, and replacement of storm drain pipes will improve conveyance to the treatment system at Reagan beach.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	Yes, see Comment 1
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	Yes
5. Is the total impervious area the same between the baseline and expected condition scenarios?	Yes

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	Yes
2. Are the road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 2
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	Not present
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	Yes, see Comment 3
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	No, see Comment 4

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	Expected
PLRM Name	TreatmentVault1	CartridgeFilter1	CartridgeFilter2
Type	Treatment Vault	Cartridge Filter	Cartridge Filter
Physical Location	Reagan Beach Parking Lot	Reagan Beach Parking Lot	Reagan Beach Parking Lot

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)	FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
Baseline	19.5	4,584	28.1	127.9	2,079	12.7	58.0	2.29E+17
Expected	13.0	604	6.6	55.8	274	3.0	25.3	3.02E+16
Load Reduction	6.5	3,980	21.5	72.1	1,805	9.8	32.7	1.99E+17
% Load Reduction	33%	87%	77%	56%				

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr): 6.5 **FSP (kg/yr):** 1,805 **TP (kg/yr):** 9.8 **TN (kg/yr):** 32.7 **Credits:** 19.9

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	19.52	4,591	28.2	128.1
Expected Load	13.0	2,131	17.2	81.2
Load Reduction	6.5	2,460	10.9	46.9

Catchment Notes

Catchment runoff reductions result from routing runoff to distributed infiltration facilities (e.g., pervious pavement road shoulders).

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)

SWT Notes

The treatment vault default CECs were modified

TreatmentVault1	0.0	6	0.2	0.2
CartridgeFilter1	0.0	802	5.1	12.5
CartridgeFilter2	0.0	712	5.3	12.4

(upwards) to represent TreatmentVault1 as a pre-treatment system having minimal ability to remove FSP, TP, and TN.

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	100%	62%	51%	65%
TreatmentVault1	0%	0%	1%	0%
CartridgeFilter1	0%	20%	24%	17%
CartridgeFilter2	0%	18%	25%	17%
Check on Percentages	100%	100%	100%	100%

Summary Notes

The majority of project load reductions result from 1) runoff volume reductions within the catchments; and 2) the performance of the cartridge filters.

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

1. Maintaining infiltration capacity of distributed infiltration systems within the catchments (e.g., ensuring pervious pavement road shoulders do not clog).
2. Ensuring that conveyance systems effectively transport stormwater to distributed infiltration systems within the catchments.
3. Maintaining the treatment capacity of CartridgeFilter1 and Cartridge Filter2.

Secondary Components

1. Ensuring that conveyance systems (curb and gutter and storm drain) effectively transport stormwater to the cartridge filters.

Tertiary Components

1. Removing trash and debris in the pre-treatment vault.

Comments

1. Upon detailed inspection, UPC delineation required a slight modification. This change should be noted when registering the catchment.
2. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads.
3. Infiltration facilities (which are used to represent the pervious pavement) are sized to store 0.84 inches of runoff. This sizing is likely appropriate, however, Catch1 is sized to store 0.084 inches. Was this a data entry error?
4. Pre-treatment vault named TreatmentVault1 has CECs adjusted upwards to reflect that this facility has minimal ability to remove FSP, TP, and TN.

Model Status

1. Note any modifications to UPC boundary when registering catchment.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate **Date:** 24-Jan-13

UPC ID: G12 **PLRM Project Name:** Harrison_Ave **Date PLRM Project Last Revised:** 4-Jan-13

Background Information

Baseline Scenario Name: BaselineCondition **Expected Scenario Name:** ExpectedCondition
Model Built By: R.O. Anderson and CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff: 100% **FSP:** 100% **TP:** 100% **TN:** 100%

Narrative of Water Quality Improvements Represented in PLRM

The reconfigured drainage system of the Harrison Avenue project redirects flows to a new storm drain system beneath Riverside Avenue, which will discharge into an expanded treatment basin located adjacent to merced Avenue in the northern portion of the boat parking lot. The drainage system incorporates a series of drain inlets, drainage pipes and infiltration pipes to direct storm water flows along Riverside Avenue to the expanded infiltration basin in the boat parking lot.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	No, see Comment 1
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	yes
5. Is the total impervious area the same between the baseline and expected condition scenarios?	Yes

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	No, see Comment 2
2. Are the road abrasive application and sweeping strategies the same as baseline assumptions?	No, see comment 3
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	Not present
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	Not present
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	Yes

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	Expected
PLRM Name	PerfPipe1	PerfPipe2	InfiltrationBasin1
Type	Infiltration Basin	Infiltration Basin	Infiltration Basin
Physical Location	Beneath Riverside Ave between Tallac and Merced	Beneath Riverside Ave between Tallac and Alameda	Beneath Riverside Ave between Alameda and San Jose

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)	FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
Baseline	7.1	5,206	16.5	57.0	2,361	7.5	25.9	2.60E+17
Expected	0.3	140	0.5	2.1	64	0.2	1.0	6.99E+15
Load Reduction	6.8	5,066	16.0	54.9	2,298	7.3	24.9	2.53E+17
% Load Reduction	96%	97%	97%	96%				

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr): 6.8 **FSP (kg/yr):** 2,298 **TP (kg/yr):** 7.3 **TN (kg/yr):** 24.9 **Credits:** 25.3

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	7.1	5,210	16.5	57.0
Expected Load	7.4	3,694	14.3	54.4
Load Reduction	-0.2	1,516	2.2	2.6

Catchment Notes

Pollutant loading decreases primarily from road shoulder improvements.

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
PerfPipe1	1.4	736	2.8	10.6
PerfPipe2	2.3	1,132	4.4	16.9

SWT Notes

InfiltrationBasin1	3.4	1,660	6.4	24.4

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	-3%	29%	13%	5%
PerfPipe1	20%	14%	17%	19%
PerfPipe2	32%	22%	27%	30%
InfiltrationBasin1	47%	32%	39%	43%
Check on Percentages	96%	97%	96%	96%

Summary Notes

The stormwater treatment facilities provide all the runoff reductions and the majority of the load reductions (70%-95%). Maintaining the infiltration rates in the stormwater treatment facilities is key to continued performance.

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

1. Maintaining infiltration capacity the stormwater treatment system (infiltration basin and infiltration pipes).
2. Ensuring that conveyance systems effectively transports stormwater to the stormwater treatment system.

Secondary Components

1. Removing material accumulated in the pre-treatment vaults to reduce loading discharged to the infiltration systems.
2. Pollutant source controls (e.g., sweeping) to reduce loading discharged to the infiltration systems.

Tertiary Components

None noted.

Comments

1. This PLRM model represents a portion of UPC = G12. The Al Tahoe Phase 1 model should be registered with this model to provide complete registration of the UPC = G12.
2. Proposed project improvements address private runoff through a regional treatment system. To avoid double-counting in PLRM, private property BMP implementation is set to zero for private land uses in the expected condition.
3. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads.

Model Status

1. The expected condition scenario represents the preliminary project design. The PLRM scenario should be reviewed and revised after project construction and prior to catchment registration.
2. Catchment registration of UPC = G12 should include both the Al Tahoe Phase 1 PLRM model and the Harrison Avenue PLRM model.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate **Date:** 24-Jan-13

UPC ID: G12 **PLRM Project Name:** AlTahoe_Phase1 **Date PLRM Project Last Revised:** 14-Dec-12

Background Information

Baseline Scenario Name: BaselineCondition **Expected Scenario Name:** ExpectedCondition
Model Built By: Wood Rodgers and CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff: 100% **FSP:** 100% **TP:** 100% **TN:** 100%

Narrative of Water Quality Improvements Represented in PLRM

The Al Tahoe Erosion Control Project 1 (Project) installed a proprietary media filter with a pretreatment vault at the terminus of the existing Pasadena storm drain. The Project reconstructed and/or rehabilitated the entire Pasadena storm drain system, i.e. replaced existing damaged and/or deteriorated storm drain pipes with perforated storm drain pipes to encourage infiltration. The Project replaced approximately 24 existing drainage inlets (DI) along the storm drain with DIs which include sediment collection sumps for pre-treatment and repaired two dry wells. To provide source control, the Project installed curb and gutter along one major street and revegetated the right-of-way (ROW) area behind the curb. Trench drains connected to infiltration galleries were installed periodically behind the curb and gutter to remove runoff from the road and distribute it, sub-surface, to the vegetated shoulder area. Finally, road shoulders throughout the Project area were rehabilitated. Rehabilitation included construction of a porous surface with revegetation and the installation of parking deterrents to encourage drivers to park on the pavement to allow for the re-establishment of shoulder vegetation.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	No, see Comment 1
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	Yes
5. Is the total impervious area the same between the baseline and expected condition scenarios?	Yes

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	Yes
2. Are the road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 2
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	Not present
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	Yes
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	No, see Comment 3

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	Expected
PLRM Name	TreatmentVault1	CartridgeFilter1	CartridgeFilter2
Type	Treatment Vault	Cartridge Filter	Cartridge Filter
Physical Location	End of Pasadena Ave.	End of Pasadena Ave.	End of Pasadena Ave.

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)	FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
Baseline	12.4	2,328	17.3	77.3	1,056	7.8	35.1	1.16E+17
Expected	10.0	330	4.1	41.0	150	1.9	18.6	1.65E+16
Load Reduction	2.4	1,998	13.2	36.3	906	6.0	16.5	9.97E+16
% Load Reduction	19%	86%	76%	47%				

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr): 2.4 **FSP (kg/yr):** 906 **TP (kg/yr):** 6.0 **TN (kg/yr):** 16.5 **Credits:** 10.0

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	12.4	2,328	17.3	77.3
Expected Load	10.0	1,431	13.2	60.1
Load Reduction	2.4	897	4.1	17.2

Catchment Notes

Catchment runoff reductions result from routing runoff to distributed infiltration facilities (e.g., pervious pavement road shoulders).

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
TreatmentVault1	0.0	5	0.1	0.2
CartridgeFilter1	0.0	882	7.4	14.8
CartridgeFilter2	0.0	158	1.5	2.9

SWT Notes

The treatment vault default CECs were modified (upwards) to represent TreatmentVault1 as a pre-treatment system having minimal ability to remove FSP, TP, and TN.

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	99%	45%	31%	47%
TreatmentVault1	0%	0%	1%	0%
CartridgeFilter1	0%	44%	56%	41%
CartridgeFilter2	0%	8%	11%	8%
Check on Percentages	99%	97%	98%	97%

Summary Notes

The majority of project load reductions result from 1) runoff volume reductions within the catchments; and 2) the performance of the cartridge filters.

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

1. Ensuring that the conveyance and storm drain system distributes stormwater to the cartridge filters as designed.
2. Maintaining the treatment capacity of CartridgeFilter1.
3. Maintaining infiltration capacity of distributed infiltration systems within the catchments (e.g., ensuring pervious pavement road shoulders do not clog).

Secondary Components

1. Ensuring that conveyance systems (curb and gutter and storm drain) effectively transport stormwater to the cartridge filters.
2. Maintaining the treatment capacity of CartridgeFilter2. Note that this treatment system by design gets significantly less runoff and pollutant loading relative to CartridgeFilter1. The maintenance interval for activities such as cartridge replacement should be less frequent relative to CartridgerFilter1.

Tertiary Components

1. Removing trash and debris in the pre-treatment vault.

Comments

1. This PLRM model represents a portion of UPC = G12. The Harrison Avenue model should be registered with this model to provide complete registration of the UPC = G12.
2. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads.
3. Pre-treatment vault named TreatmentVault1 has CECs adjusted upwards to reflect that this facility doesn't target pollutants simulated by PLRM.

Model Status

1. Catchment registration of UPC = G12 should include both the Al Tahoe Phase 1 PLRM model and the Harrison Avenue PLRM model.

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate

Date: 24-Jan-13

UPC ID: F1 **PLRM Project Name:** SierraTract_Phase1 **Date PLRM Project Last Revised:** 21-Dec-12

Background Information

Baseline Scenario Name: Baseline_Conditions **Expected Scenario Name:** ExpectedCondition
Model Built By: CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff: 46% **FSP:** 20% **TP:** 19% **TN:** 26%

Narrative of Water Quality Improvements Represented in PLRM

The Sierra Tract Phase 1 Erosion Control Project is represented through this model. The project consists of road shoulder stabilization (curb and gutter) on a number of roads in the project area. While this improvement increases DCIA of roads in the expected condition, a number of curb and gutter sections have been designed with curb cuts to allow water to flow into the pervious area behind the curb. This project feature is represented in the PLRM Drainage Conditions Editor using the "Area Routed to Pervious Drainage Area" option. Stormwater runoff from the project area is routed to a number of Infiltration Basins that are connected in series. The treatment capacity within individual Infiltration Basins varies greatly, from a few hundred cubic feet to roughly 10,000 cubic feet.

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	No, see Comment 1
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	Yes
5. Is the total impervious area the same between the baseline and expected condition scenarios?	Yes

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	Yes
2. Are the road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 2
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	No, see Comment 3
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	Not present
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	Yes

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	Expected
PLRM Name	BasinA	BasinC	BasinD
Type	Dry	Infiltration	Infiltration
Physical Location	1191 O'Malley	Corner of Charles, Osbourne and O'Malley	2696 Osbourne

Scenario	Expected	Expected	Expected
PLRM Name	BasinE	BasinF	BasinG
Type	Infiltration	Infiltration	Infiltration
Physical Location	NW Corner of Kubel and Martin	1313 and 1309 O'Malley	Adjacent to 1245 O'Malley

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline	14.9	1,893	19.7	82.5
Expected	1.6	275	2.0	9.8
Load Reduction	13.3	1,618	17.7	72.7
% Load Reduction	89%	85%	90%	88%

Conversion to Metric Units

FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
859	8.9	37.4	9.45E+16
125	0.9	4.4	1.37E+16
734	8.0	33.0	8.07E+16

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr): 6.1 **FSP (kg/yr):** 147 **TP (kg/yr):** 1.5 **TN (kg/yr):** 8.6 **Credits:** 1.6

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	14.9	1,893	19.7	82.5
Expected Load	12.2	2,293	16.2	75.6

Catchment Notes

Why so much change in runoff between this version of the model and the older version for the expected

Load Reduction	2.7	-400	3.5	7.0

condition? Need to check what caused change.

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Basin A	0.1	14	0.1	0.5
Basin C	2.8	473	3.7	17.0
Basin D	0.2	28	0.3	1.3
Basin E	1.0	131	1.2	5.9
Basin F	1.6	268	1.9	9.6
Basin G	4.9	1,101	7.1	31.4

SWT Notes

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	20%	-25%	20%	10%
Basin A	1%	1%	1%	1%
Basin C	21%	29%	21%	23%
Basin D	2%	2%	1%	2%
Basin E	8%	8%	7%	8%
Basin F	12%	17%	11%	13%
Basin G	37%	68%	40%	43%
Check on Percentages	100%	100%	100%	100%

Summary Notes

The infiltration basins appear to be highly effective at reducing runoff volumes, and associated pollutant loads leaving the project area, well below the baseline condition. Three of the infiltration basins (C, F, and G) are providing roughly 90% of the volume and load reduction.

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

1. Maintaining the infiltration capacity and overall function of Infiltration Basins C, F, and G.
2. Ensuring that conveyance systems (curb and gutter and storm drain) transport stormwater to key infiltration basins.

Secondary Components

1. Maintaining infiltration capacity and the function of Infiltration Basins A, D, and E
2. Ensuring that conveyance systems (curb and gutter and storm drain) transport stormwater to these infiltration basins.

Tertiary Components

None noted

Comments

1. This PLRM model only represents a portion of UPC = F1. The Sierra Tract Phase 2 PLRM model should be registered with this model to provide complete registration of the UPC = F1.
2. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads.
3. Pervious dispersion areas are using PLRM defaults. The physical characteristics of these area should be reviewed in the field to make sure estimates are reasonable. These would be curb-cuts. Would like some guidance as to how I should interpret these features. NHC will set up a meeting with City staff to work on representation of these.

Model Status

Quality Assurance Documentation for PLRM Project Supporting Pollutant Load Reduction Estimate

Date: 7-Jan-13

UPC ID: F1 **PLRM Project Name:** SierraTract_Phase2 **Date PLRM Project Last Revised:** 21-Dec-12

Background Information

Baseline Scenario Name: Baseline_Conditions **Expected Scenario Name:** ExpectedCondition
Model Built By: CSLT **QA/QC Review By:** B. Wolfe, NHC
GIS shapefile(s) showing catchment delineations (Baseline and Expected): City to provide

UPC Connectivity Factors

Surface Runoff: 46% **FSP:** 20% **TP:** 19% **TN:** 26%

Narrative of Water Quality Improvements Represented in PLRM

City to provide

Standard Checks ***"No" answers require an explanation in the Comments Section***

1. Do the baseline scenario assumptions match the baseline submittal to Lahontan for this UPC?	Yes
2. Does the modeled area for baseline scenario match the delineated area for this UPC?	No, see Comment 1
3. Are the total areas modeled in the baseline and expected condition scenarios the same?	Yes
4. Is the distribution of land uses the same between the baseline and expected condition scenarios?	Yes
5. Is the total impervious area the same between the baseline and expected condition scenarios?	Yes

Expected Condition Scenario Checks ***"No" answers require an explanation in the Comments Section***

1. Is an estimate of the existing levels of private property BMP implementation used?	Yes
2. Are the road abrasive application and sweeping strategies the same as baseline assumptions?	No, see Comment 2
3. Do estimates of DCIA appear to be assessed and adjusted from the PLRM default of 50%?	Yes
4. Where present, do pervious dispersion areas draining roads appear to be adjusted from defaults?	No, see Comment 3
5. Where present, do infiltration facilities draining roads appear to be assessed and adjusted from defaults?	Not present
6. Do the sizing/function inputs for SWT facilities appear reasonable; are default CECs used?	No, see Comment 4

Identification of Stormwater Treatment (SWT) Facilities

Scenario	Expected	Expected	Expected
PLRM Name	YoungStA	YoungStB	OmalleyB
Type	Infiltration	Infiltration	Infiltration
Physical Location	NW corner of Young St and William	NW corner of Young St and Marjorie	1135 O'Malley

Scenario	Expected	Expected	
PLRM Name	OmalleyA	BlueLakeBasin	
Type	Infiltration	Dry Basin	
Physical Location	1114 O'Malley, corner of O'Malley and Blue Lake	1067 Blue Lake	

PLRM Estimates (no UPC connectivity factors applied)

Scenario	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline	7.0	2,693	12.1	48.1
Expected	4.3	424	2.6	15.4
Load Reduction	2.7	2,269	9.5	32.7
% Load Reduction	39%	84%	79%	68%

Conversion to Metric Units

FSP (kg/yr)	TP (kg/yr)	TN (kg/yr)	FSP (# part)
1,222	5.5	21.8	1.34E+17
192	1.2	7.0	2.12E+16
1,029	4.3	14.8	1.13E+17

Effective Load Reductions for Catchment Registration (after UPC connectivity factors applied)

Surface Runoff (af/yr): 1.2 **FSP (kg/yr):** 206 **TP (kg/yr):** 0.8 **TN (kg/yr):** 3.9 **Credits:** 2.3

Catchment Load Reduction Diagnostics

Sum all Catchments	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
Baseline Load	7.0	2,696	12.1	48.1

Catchment Notes

Improvements (e.g., curb and gutter) are increasing

Expected Load	9.1	2,356	13.4	60.2
Load Reduction	-2.1	341	-1.3	-12.1

runoff volumes. Quality of runoff is improved, with net effect being minimal change in loading from catchment improvements.

Stormwater Treatment Load Reduction Diagnostics

SWT Facilities	Volume and Load Reductions			
	Vol (af/yr)	FSP (lb/yr)	TP (lb/yr)	TN (lb/yr)
YoungStA	1.4	441	2.2	9.8
YoungStB	0.5	162	0.8	3.5
OmalleyB	1.0	218	1.5	6.7
OmalleyA	0.6	117	0.8	3.8
BlueLakeBasin	1.2	988	5.5	21.1

SWT Notes

Summary of Load Reduction Diagnostics

Project Component	% of Project Reduction			
	Vol	FSP	TP	TN
Catchment Changes	-76%	15%	-14%	-37%
YoungStA	52%	19%	23%	30%
YoungStB	19%	7%	8%	11%
OmalleyB	38%	10%	15%	20%
OmalleyA	22%	5%	9%	12%
BlueLakeBasin	45%	44%	58%	64%
Check on Percentages	100%	100%	100%	100%

Summary Notes

While the road shoulder improvements have increased runoff transported within the drainage catchments, the infiltration basins are effective at reducing runoff volumes, and associated pollutant loads leaving the project area below the baseline condition. The Blue Lakes dry basin provides roughly 50% of the load reduction.

Importance of Project Components Related to Estimated Load Reductions and Ongoing Maintenance

Primary Components

1. Maintaining the infiltration capacity and overall function of the Blue Lakes dry basin, YoungStA infiltration basin, and OmalleyB infiltration basin.
2. Ensuring that conveyance systems (curb and gutter and storm drain) transport stormwater to these facilities.

Secondary Components

1. Maintaining the infiltration capacity and overall function of the YoungStB infiltration basin and OmalleyA infiltration basin.
2. Ensuring that conveyance systems (curb and gutter and storm drain) transport stormwater to these facilities.

Tertiary Components

None noted

Comments

1. This PLRM model only represents a portion of UPC = F1. The Sierra Tract Phase 1 PLRM model should be registered with this model to provide complete registration of the UPC = F1.
2. High-Efficiency sweeper option selected in PLRM for all roads (City has two dustless regenerative air sweepers). 1-2 times per year sweeping on all Secondary Roads.
3. Pervious dispersion areas are using PLRM defaults. The physical characteristics of these area should be reviewed in the field to make sure estimates are reasonable. These inputs are small (10-20%) and insignificant. Especially for a modeled catchment that is only 20% connected. Willing to revisit, but may decide to simply exclude them from the model. Agree the effect is minor, suggest deleting pervious dispersion areas from this model.
4. Blue Lakes inputs for water quality volume, footprint, and draw down needs additional assessment. On hold until Spring due to snow in basin

Model Status

1. After edits and final qa/qc, will need to update final loading numbers in this worksheet.
2. Catchment registration of UPC = F1 should include both the Sierra Tract Phase 1 and Phase 2 PLRM models.

City of South Lake Tahoe

Long Term Pollutant Load Reduction Strategy

(2016-2021)

Prepared For:

Lahontan Regional
Water Quality Control Board

Submitted by:

Conceptual Project Layouts for Potential Near-Term Water Quality Improvements

June 2012

Prepared for:

Prepared by:

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LIST OF ACRONYMS USED

CICU	Commercial/institutional/communications/utilities
CRC	Characteristic Runoff Concentration
CSLT	City of South Lake Tahoe
CTC	California Tahoe Conservancy
DCIA	Directly connected impervious area
DN	Dissolved nitrogen
DP	Dissolved phosphorus
ECAM	Existing conditions analysis memorandum
FSP	Fine sediment particles
GIS	Geographic information system
HSC	Hydrologic source control
ICIA	Indirectly connected impervious area
LRWQCB	Lahontan Region Water Quality Control Board
MFR	Multi-family residential
NDEP	Nevada Division of Environmental Protection
NRCS	Natural Resources Conservation Service
PSC	Pollutant source control
SEZ	Stream environment zone
SFR	Single family residential
SWT	Storm water treatment
TMDL	Total maximum daily load
TN	Total nitrogen
TP	Total phosphorus
TRPA	Tahoe Regional Planning Agency
TSS	Total suspended sediment
UPC	Urban planning catchment
USFS	United States Forest Service
WQIP	Water quality improvement project

1.0 BACKGROUND AND APPROACH

In connection with the Lake Tahoe TMDL process, the City of South Lake Tahoe (City) developed a baseline pollutant load estimate for City stormwater runoff. Table 1.1 displays the City's estimated baseline load of fine sediment particles (FSP) and the Lake Tahoe TMDL load reduction milestones up to the Clarity Challenge milestone (CSLT 2011).

Table 1.1 – City FSP Load Reduction Milestones

Load	% Reduction	Year of measure	FSP Loading (lb/year)	FSP Reduction (lb/year)
City Baseline	-	2004	389,000	-
First Load Reduction Milestone	10%	2016	350,000	39,000
Second Load Reduction Milestone	21%	2021	307,000	82,000
Clarity Challenge Milestone	34%	2026	257,000	132,000

The primary objectives for the City to attain the first Lake Tahoe TMDL load reduction milestone are to: 1) identify near-term water quality improvements that may be feasible to implement by 2016; and 2) initiate project development activities for the most promising and feasible opportunities for pollutant load reduction to streamline planning, environmental review, and design activities.

Using information developed in the City's *Baseline Pollutant Load Estimate Report* (2011) and reconnaissance level field assessments of stormwater runoff conditions, the City assessed and produced a memorandum identifying opportunities for stormwater quality improvements (CSLT, 2012a).

Among the near-term water quality improvement opportunities identified, the Tahoe Valley drainage area was prioritized for the most extensive project development activities. A separate document (CSLT, 2012b) was developed as part of this work effort to initiate the Stormwater Quality Improvement Committee (SWQIC) planning process for the Tahoe Valley Water Quality Improvement Project by developing conceptual layouts of alternatives. This document explores potential near-term pollutant load reduction opportunities for the City identified outside of the Tahoe Valley drainage area.

2.0 CONCEPUTAL PROJECT LAYOUTS

The following sections summarize: 1) conceptual layouts of potential improvements; 2) design considerations; 3) feasibility assessments and key information needs; and 4) planning level estimates of pollutant load reduction.

2.1 LLOYD AVENUE WET BASIN

There are five adjoining CTC parcels on the south side of Lloyd Avenue at the intersection with Herbert Avenue that could be used for stormwater treatment (Figure 2.1). The site appears to have undergone a restoration effort to restore it to a mesic meadow. There are no mature trees on the parcels. Soils are mapped as Marla loamy coarse sand, which has a clay loam water restricting horizon around a depth of 47 inches and a water table at 12-30 inches. The parcels gently slope from the east up several feet to meet the shoulder of Herbert Avenue.

Adjacent to the CTC parcels is a drop inlet which collects runoff from Lloyd and discharges into the Bijou Park Drainage. From Bill Avenue to the Ski Run Marina, runoff from this major drainage is conveyed in a storm drain whose alignment and capacity is unknown. On the west side of Herbert Avenue, runoff travels north along the shoulder flow line and is discharged onto Highway 50. On the east side of Herbert Avenue runoff travels north but then turns east to flow down the various side streets (Bill Avenue, Shirley Avenue, Betty Rae Lane, and Vanda Lee Way) toward the Bijou Park drainage. On Betty Rae Lane and Vanda Lee Way, runoff is discharged into a wet meadow SEZ and has considerable distance to travel to reach the Bijou Park creek. However, runoff flowing down both Bill Avenue and Shirley Avenue is directly discharged into the creek.

Design Considerations

Currently, there is virtually no drainage area tributary to the CTC parcels. Only runoff from the east side of Herbert Avenue between Lloyd Avenue and Bill Avenue reaches the CTC parcels. In order to utilize the CTC parcels as a stormwater treatment basin, runoff tributary to Herbert Avenue would have to be routed to it.

The accompanying schematic (Figure 2.1) illustrates the potential drainage area for one concept where runoff would be collected in drop inlets along the west side of Herbert Avenue, which would be routed to a new storm drain in Herbert Avenue. Drop inlets would be located on the southeast corner of Bill Avenue and Shirley Avenue. Runoff upslope of Shirley Avenue would continue along existing flow paths to the Bijou Park SEZ, where it appears to receive a high degree of treatment in the SEZ. North of Lloyd Avenue, runoff on both sides of Herbert drains to Highway 50. However, it appears feasible to route some of this flow back to the potential stormwater treatment basin since there is a sufficient elevation difference between the shoulder flow line and the existing ground surface. Similarly, it might be possible to route some local runoff from the north side of Lloyd through the use of a cross drain or through regrading the street to install a swale spanning the crowned centerline. Along the east side of Herbert Avenue,

the prevailing topography slopes away from the road such that little of the adjacent area could be routed to the potential stormwater treatment basin.
While the soils on the CTC parcels have a water restricting horizon, the small tributary area of 5 acres in comparison to the gross available area of 0.5 acres on the CTC lots suggests that available basin volume would be adequate to retain runoff. For example, 52 percent of the potential drainage area (Figure 2.1) is estimated to be impervious (2.6 acres). This impervious area produces roughly 9,500 cubic feet of runoff for the standard design storm of one inch of precipitation. Given the gross lot size of 21,800 square feet for the CTC parcels, even a shallow basin with a depth of just 0.5 feet appears to be compatible on the site and would provide adequate storage volume consistent with design standards. A shallow basin would also allow for the wetland processes to remove nutrients and metals. The basin could discharge into the Bijou Park storm drain.

Feasibility Assessment and Key Information Needs

1. To date, the CTC has not confirmed the feasibility of using the five parcels identified (Figure 2.1) for the Lloyd Wet Basin.

2. If the parcels are available for use, a minimum of two soil pits should be excavated to assess the possible presence of a water-restricting horizon, depth to the seasonal high water table, and confirm the characteristics of the soils on the parcels.

3. If the parcels are available for use, a topographic survey of the parcels will need to be performed.

Planning Level Estimate of Pollutant Load Reduction

A planning level PLRM scenario was developed to estimate reductions in pollutant loading that may be achieved from implementation of the Lloyd Wet Basin. The PLRM scenario is provided digitally in Appendix A. Key design attributes assumed for the Lloyd Wet Basin were the following:

- Wet Pool Volume = 6,000 cubic feet
- Wet Pool Footprint = 12,000 square feet
- Surcharge Basin Volume = 6,000 cubic feet

Based on the planning level PLRM scenario, the Lloyd Wet Basin is estimated to produce a load reduction of 600 lb/year of FSP, which equates to a 0.15% reduction in the City's baseline load.

Legend

Existing Infrastructure

- Drainage Pipe
- Curb and Gutter
- Paved Flow Line
- Proposed Drainage

Reference Map

City of South Lake Tahoe

Conceptual Project Layouts

Scale - 1:2,400 1 inch = 200 feet

0 200 400 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 2.1 – Conceptual Layout of Lloyd Avenue Wet Basin

2.2 RUBY WAY DRY BASIN

The existing Osgood Basin on Ski Run Boulevard is undersized relatively to its tributary drainage area. A large portion of the drainage area is associated with Keller Canyon (aka Little Heavenly Creek), which contributes a base flow in the late spring and through the summer in wet years to the Osgood Basin. The Keller Canyon drainage does not appear to contribute large volumes of runoff during fall storms or thunderstorms because a large portion of that area is forested undeveloped open space. In contrast, exposed bedrock and adjacent shallow soils over a lithic contact in the vicinity of Lucida Court, Overlook Court, and Terrace Drive appear to contribute large stormwater volumes and high flow rates to the existing Osgood Basin.

Reducing or delaying runoff from this responsive part of the Osgood Basin watershed could improve the performance of the wet basin and reduce the influent sediment load. This could be accomplished through the construction of a dry basin downslope from Lucinda Court and Overview Court in the vicinity of the undeveloped Ruby Way extension east of the unpaved Wildwood alignment on a collection of CTC lots (see Figure 2.2). Two channels flow down the steep hillside on the northwest part of Overview Court. Both channels cross underneath the unpaved extension of David Lane within close proximity of each other. The channel farthest to the west has been rock lined and flows down to a vacant lot on Ruby Way, and thence into a drop inlet on Ruby Way. The other channel lies slightly to the northeast and has been recently improved with cobble lining, rock check dams, and straw wattles to catch sediment within the channel.

The two channels appear to convey the majority of runoff from the Overview Court area. Runoff from Lucinda Court is conveyed in rocked ditches on each side of the unpaved portion of Wildwood. Placement of any type of basin between Ruby Way and David Lane appears infeasible because of the relatively steep slopes (15% - 20%). However, the area on the east side of Wildwood, within the graded right-of-way for the Ruby Way extension does present an opportunity for construction of a basin. The slopes are slightly less steep and there is some nearly level ground associated with the abandoned roadway.

Design Considerations

The proposed concept would route the west channel crossing David Lane to the east channel by locally regrading the intervening ditch on David Lane. At the second channel, approximately 700 feet of storm drain would be installed to route flow in the two channels and convey it to a constructed basin on the east side of Wildwood, within the abandoned Ruby Way alignment. Where the storm drain crosses Wildwood Avenue, drop inlets would be installed to capture the flow in the roadside ditches. There is adequate elevation drop to attain a one percent grade or steeper for the storm drain. The size of the basin would dictate the length and steepness of the cut slope required to form the basin on the southeastern boundary.

The principal potential design constraints with this concept are the STPUD sewer line running down the Wildwood alignment, and the difficulty of installing a storm drain along an alignment

which has a cross slope of 17 percent. Because of potential gradeline conflicts between the existing sewer line and a new storm drain which must pass over or under it, it may be necessary to place fill over a portion of the storm drain alignment to raise it above the sewer line.

The basin would discharge onto the east or west side of Wildwood Avenue. If discharged to the east side of Wildwood Avenue, the outflow could be routed to the Wildwood Basins, thereby reducing runoff to the undersized Osgood Basin. If the runoff is routed to the west side of Wildwood Avenue, then it would remain in the Osgood Basin's watershed. Under either scenario, it would be desirable to route the flow via new storm drains rather than routing it along the curb down Wildwood Avenue.

Feasibility Assessment and Key Information Needs

1. To date, the CTC has not confirmed the feasibility of using the collection of parcels identified (Figure 2.2) for the Ruby Way Dry Basin.

2. If the parcels are available for use, a minimum of two soil pits should be excavated to confirm the characteristics of the soils on the parcels.

3. Further topographic work assessment is needed to determine a reasonable basin size and volume in comparison to the length and steepness of the cut slope that would be created as a result of basin construction. However, it does appear feasible to create a basin of more than 100 feet long and less than 100 feet wide.

4. The approximate drainage area associated with the two channels crossing David Lane and the Wildwood ditch lines is 11 acres. This drainage area is estimated to be 23% impervious, which equates to an impervious area of 2.5 acres. A design storm of one inch of runoff from this impervious area yields a volume of approximately 9,000 cubic feet. Based on the preliminary estimate of available basin area, it would be feasible to retain the runoff volume generated by the design storm in the basin.

5. Potential conflicts with the sewer gradeline, difficulties in installing a storm drain perpendicular to a sloped surface, and the need to create a substantial cut slope to construct the basin would need to be further investigated and may limit basin feasibility.

Planning Level Estimate of Pollutant Load Reduction

A planning level PLRM scenario was developed to estimate reductions in pollutant loading that may be achieved from implementation of the Ruby Way Dry Basin. The PLRM scenario is provided digitally in Appendix A. Key design attributes assumed in the PLRM scenario for the Ruby Way Dry Basin were the following:

- Water Quality Volume = 14,000 cubic feet
- Footprint = 7,000 square feet
- Average Infiltration Rate = 0.1 inch/hour
- Brim Full Draw Down Time = 72 hours

Based on the planning level PLRM scenario, the Ruby Way Basin is estimated to provide a load reduction of 450 lb/year of FSP, which equates to a 0.12% reduction in the City's baseline load.

Legend

Existing Infrastructure

- Drainage Pipe
- Curb and Gutter
- Paved Flow Line
- Proposed Drainage

Reference Map

City of South Lake Tahoe

Conceptual Project Layouts

Scale - 1:2,400 1 inch = 200 feet

0 200 400 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 2.2 – Conceptual Layout of Ruby Way Dry Basin

2.3 EXISTING OSGOOD BASIN RETROFIT ALTERNATIVES

The existing Osgood Basin, aka, the Ski Run Basin, is located on the east side of Ski Run Boulevard, a short distance above Highway 50 (Figure 2.3). The basin receives runoff from the dense residential area on both sides of Ski Run Boulevard extending to above Pioneer Trail. The approximate drainage area with relatively dense development is 110 acres. Additionally, the predominantly forested Keller Canyon drainage (aka Little Heavenly Creek), contributes a base flow in the late spring and through the summer in wet years to the Osgood Basin. The existing Osgood Basin is significantly undersized relatively to its drainage area. Runoff from the basin is discharged into the Ski Run Marina.

Immediately adjacent to the Osgood basin is an SEZ that receives local runoff, principally from Sonora Avenue and streets tributary to it. The estimated drainage area is approximately 18 acres to this SEZ. As-built drawings obtained from the City show storm drain from this SEZ routing runoff north under private property to storm drain under Highway 50, which then discharges into the Ski Run Marina.

The Osgood Basin was constructed a number of years prior to restoration of the adjacent SEZ parcels, which are owned by the City and CTC. Once the adjacent parcels were acquired for restoration, consideration was given to expanding the Osgood Basin. However, the primary intent of the land acquisition was to restore the parcels to SEZ. These parcels have a shallow water table, which would make expansion of the Osgood Basin problematic. Additionally, the surface slopes to the east, which is the reason that a berm surrounds the Osgood Basin on its eastern boundary. Expansion of the Osgood Basin to the east would require a higher berm, with a proportionally larger footprint. Given these considerations, a past project elected to restore these parcels to SEZ while incorporating some shallow depressions in the SEZ parcels to promote treatment of local runoff from the 18 acre drainage area.

Design Considerations

The water quality improvement strategy for the Osgood Basin is to provide additional treatment capacity for runoff generated by the developed area tributary to the existing basin. The following lists potential alternatives for modifying the current configuration of the Osgood Basin to accomplish this strategy.

1. Alternative 1 - Install a new low flow drain located in the eastern portion of the Osgood Basin that discharges to the Wildwood Basins, either south or north Highway 50.
2. Alternative 2 - Expand the storage volume and surface area of the Osgood Basin by expanding the basin into the eastern SEZ parcels.
3. Alternative 3 - Combine expansion of the Osgood Basin with a low flow drain to the Wildwood Basins.

The following design considerations are noted regarding the proposed alternatives:

- Installation of a low volume gravity drain from Osgood to Wildwood appears possible based on limited field assessments. However, a detailed topographic survey and site plan would be necessary to confirm the feasibility of a gravity drain vs. the need to pump water in the Osgood Basin to the Wildwood Basins.
- Expanding the Osgood Basin to the east would modify the existing SEZ, and probably convert some portion of it to open water.
- A higher berm, with a proportionally larger footprint would be required to contain the runoff from spilling to the east onto Sonora Avenue.

Feasibility Assessment and Key Information Needs

1. To date, the CTC has not confirmed the feasibility of using the identified parcels (Figure 2.3) for potential expansion of the Osgood Basin.

2. The parcels proposed for potential basin expansion were acquired for SEZ restoration. Additional research would be necessary to determine if the conversion of these parcels for use as a stormwater treatment basin would be an allowable use.

3. A TRPA land capability verification will be required to support the environmental review process and to determine permitting requirements.

4. Topographic surveying would be required to determine the: 1) feasibility of a low flow gravity drain from the Osgood Basin to the Wildwood Basin; and 2) the maximum size of basin expansion.

5. Obtain and review as-built drawings for the Osgood Basin and Wildwood Basins.

6. Review and analyze influent and effluent water quality data from the Osgood and Wildwood Basins to assess their current performance with respect to retention of FSP and hydraulic residence times. Note that the treatment performance of the Osgood Basin is currently being monitored and studied through the 2013 water year. A preliminary report on Osgood Basin performance was recently published in June 2012: *Pilot Catchment Validation Study: Lake Tahoe Basin (2NDNATURE 2012).*

Planning Level Estimate of Pollutant Load Reduction

Planning level PLRM scenarios were developed to estimate reductions in pollutant loading that may be achieved from implementation of the proposed alternatives. The PLRM scenarios are provided digitally in Appendix A. PLRM scenarios developed to support the City's baseline load estimate (CSLT 2011) for the Osgood Basin and Wildwood Basins were combined to evaluate the alternatives. The following describes the modeling assumptions for each PLRM scenario.

Scenario 1 - Reconnection of Southern and Northern Wildwood Basins

- In the existing condition, stormwater runoff from the southern Wildwood Basins bypasses the northern Wildwood Basins (Figure 2.3), which are adjacent to the Embassy Suites.
- The City intends to repair this connection to reduce the volume of runoff that bypasses the northern Wildwood Basins. Scenario 1 assumes that this repair has occurred. Additionally, Alternative 1 through Alternative 3 assumed that this repair has occurred.

Scenario 2 - Alternative 1: Low Flow Diversion to Wildwood Basins

- A low flow diversion routing stormwater from the Osgood Basin to the northern Wildwood Basins was modeled (Figure 2.3).
- The diversion was modeled with a maximum flow rate of 0.5 cfs.

Scenario 3 - Alternative 2: Expanded Osgood Basin

- The size of the existing Osgood Basin was roughly doubled, assuming the basin is expanded into the SEZ parcels to the east.
- The following input parameters for the expanded Osgood Basin were used:
    - Wet Pool Volume = 14,000 cubic feet
    - Wet Pool Footprint = 24,000 square feet
    - Surcharge Basin Volume = 22,000 cubic feet

Scenario 4 - Alternative 3: Expanded Osgood Basin plus Low Flow Diversion

- The low flow diversion of 0.5 cfs from Alternative 1 was included in this scenario.
- The expanded Osgood Basin with the input assumptions for Alternative 2 was included in this scenario.

Table 3.1 provides an estimate of potential load reductions for the formulated Osgood Basin alternatives based on the planning level PLRM scenarios described above. As shown in Table 3.1, each alternative would provide a significant pollutant load reduction.

Table 3.1 – Load Reduction Estimates for Osgood Basin Alternatives

Scenario Description	Planning Level Estimate of FSP Load Reduction (lb/year)	Percentage of the City's FSP Baseline Load
Reconnection of Southern and Northern Wildwood Basins	1,300	0.3%
Alternative 1: Low Flow Diversion to Wildwood Basins	6,500	1.7%
Alternative 2: Expanded Osgood Basin	5,700	1.5%
Alternative 3: Expanded Osgood Basin plus Low Flow Diversion	8,000	2.1%

Legend

Existing Infrastructure

- Drainage Pipe
- Curb and Gutter
- Paved Flow Line
- Proposed Drainage

Reference Map

City of South Lake Tahoe

Conceptual Project Layouts

Scale - 1:2,400 1 inch = 200 feet

0 200 400 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 2.3 – Conceptual Layout of Osgood Basin Alternatives

2.4 NORTH ELOISE INFILTRATION BASIN

A 0.75 acre CTC parcel near the northern terminus of Eloise Avenue could be used as a site for a stormwater treatment basin (Figure 2.4). The site is located on level ground with Jeffry Pine vegetation. Soil is mapped as Christopher loamy coarse sand, which lacks a water restricting horizon. Although the site is upland of delineated SEZ boundaries, it is only about 6 feet higher than the adjacent Upper Truckee River meadow.

Design Considerations

The site appears to be highly feasible for the installation of an off-line infiltration basin. Soils are highly permeable and there is sufficient slope along the flow line down slope of the lot.

The basin could consist of an inlet comprised of an open grate located on the roadside flow line that would collect runoff running down the shoulder. Once the basin was full, the water surface in the basin would match that of the grate and then flows would simply continue their normal route down to the end of Eloise Avenue. A cross drain would need to be installed to convey runoff from the south side of Eloise Avenue to the basin. The potential drainage area with the cross drain would be roughly 2.6 acres, as defined by a local high spot on the flow line on the north side of Eloise Avenue. However, this high spot may just represent a small depressional area and it is possible that the drainage area could extend closer to Tahoe Keys Blvd, which would need to be confirmed with additional topographic survey.

Feasibility Assessment and Key Information Needs

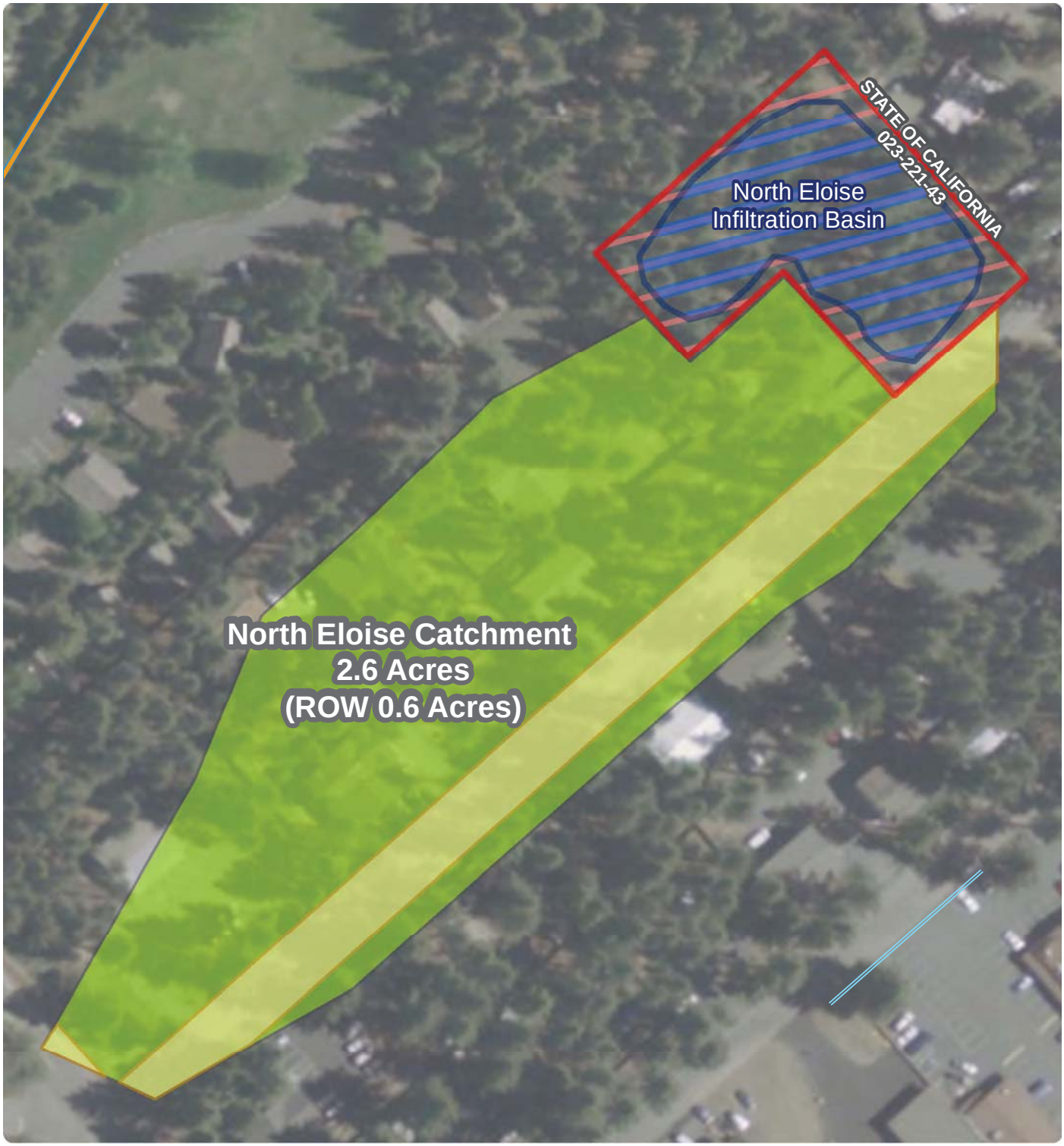
1. The treatable area is relatively small (2.6 acres) and therefore the achievable load reduction is likely quite small.
2. The flat existing topography might require that the grade of the road be raised on each side of the cross drain to attain acceptable cover over the new culvert.
3. Runoff delivered to the end of Eloise Avenue flows into a dense SEZ, which does not appear to be frequently inundated such that a relatively high level of treatment may already occur in the SEZ. Connectivity estimates to surface waters should be revisited prior to proceeding with this treatment opportunity.

Planning Level Estimate of Pollutant Load Reduction

A planning level PLRM scenario was developed to estimate reductions in pollutant loading that may be achieved from implementation of the North Eloise Infiltration Basin. The PLRM scenario is provided digitally in Appendix A. Key design attributes assumed for the North Eloise Infiltration Basin were the following:

- Water Quality Volume = 7,500 cubic feet
- Footprint = 7,500 square feet
- Average Infiltration Rate = 0.1 inch/hour

Based on the planning level PLRM scenario, the North Eloise Infiltration Basin is estimated to provide a load reduction of 500 lb/year of FSP, which equates to a 0.12% reduction in the City's baseline load.



Legend

Existing Infrastructure

- Drainage Pipe
- Curb and Gutter
- Open Channel

Reference Map

City of South Lake Tahoe

Conceptual Project Layouts

Scale - 1:1,200 1 inch = 100 feet

0 100 200 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 2.4 – Conceptual Layout of North Eloise Infiltration Basin

3.0 ADDITIONAL FEASIBILITY ASSESSMENTS

Section 3 summarizes results from additional assessments of stormwater quality improvement opportunities explored in this work effort. The identified opportunities summarized in this section were found to have a low feasibility for near-term implementation. To conserve resources for higher priority opportunities, the information developed herein was limited to a description of each assessment and the key findings.

3.1 RIVERSIDE AVENUE BASIN

The City's 2012 storm drain database identifies a number of drop inlets between Alameda Avenue and San Francisco Avenue, either on Riverside Avenue or on the above-named streets. (No storm drain routing of the drop inlets is shown in the 2012 database). One concept investigated was to route stormwater from this area to CTC parcels on the west side of Riverside Avenue between San Jose Avenue and Alameda Avenue, or possibly to the City parcel currently used for boat trailer parking. Storm drain manholes in the area of interest were removed and it was determined that all of the drop inlets in question are routed to the intersection of Riverside Avenue and Tallac Avenue. From there, a storm drain carries the runoff east to Pasadena Avenue and ties into the recent storm water drain installed there. Storm drain inverts were between 4-5 feet below the street surface. At that depth, it is infeasible to route any of the storm water over to the lots on Riverside Avenue since any reasonably sized basin would have to be 6-8 feet below the surface of the lot. Using 3:1 side slopes, the lots are too small to obtain that depth for basin construction.

Regarding the boat trailer parking parcel, the only surface runoff that could be routed to the parcel is from the centerline of the surrounding streets, except that runoff from Harrison Avenue already enters an existing basin constructed on the northeast corner of the parcel. Based on the reconnaissance assessment, the available treatment area would be too small to warrant a basin.

3.2 DON CHEAPOS DIVERSION TO BIJOU MEADOW

The drainage area between the *Inn By The Lake* to Safeway is discharged directly to Lake Tahoe through the "Don Cheapos" outfall. The catchment includes the Highway 50 frontage between Fremont Avenue and Takela Drive but also extends to the south to drain the western portions of Sandy Way, Mono Lane, and Tree Haven Drive. The eastern portions of those streets drain to Johnson Boulevard. The City's stormwater database (2012) incorrectly designates flow lines in the vicinity of Johnson Boulevard and Tree Haven Lane. Although confirmation is needed, runoff from the eastern portions of the above-referenced streets enters a storm drain on Johnson Boulevard that is discharged near Fairway Avenue. Also, the destination of water entering the drop inlet shown at the intersection of Sandy Way and Takela Drive is not known.

Based on the significant elevation difference between the intersection of Sandy Way and Takela Drive relative to Johnson Boulevard and Tree Haven Drive, it appears possible that some portion of the runoff discharged through the Don Cheapos outfall could be diverted to the storm drain on Johnson Boulevard and Bijou Meadow. The diverted runoff would become part of the area treated by the planned Bijou Commercial Core Water Quality Improvement Project.

Any diversion would be accomplished by installing storm drain in the City streets described above and routed in Tree Haven Drive to Johnson Boulevard. Since the proposed storm drain will essentially reverse the existing surface flow direction, the storm drain would be progressively deeper as it moves to Johnson Boulevard. A topographic and utility survey would be necessary to assess overall engineering feasibility of this option.

Based on discussions with City staff, the opportunity for diverting additional runoff towards Bijou Meadow for stormwater treatment was deemed to have a low level of feasibility due to concerns over the ability of existing culverts to pass flood flows downstream of Bijou Meadow.

3.3 STATELINE AVENUE BASIN

Runoff beginning at Highway 50 and Stateline Avenue runs down Stateline Avenue and enters a storm drain at the intersection with Manzanita Avenue. Drop inlets along this path accept additional runoff, which is discharged directly into Lake Tahoe.

This runoff could potentially be treated on a vacant private parcel at the intersection of Pine Boulevard and Stateline Avenue owned by Edgewood Companies. The willingness of Edgewood Companies to grant a drainage easement for use of the identified parcel for stormwater treatment is currently being explored by the City. Until the availability of the identified parcel for stormwater treatment is known, this opportunity is deemed to have low feasibility for implementation.

3.4 LAKESHORE BOULEVARD UNPAVED ROADSIDE PARKING

Approximately 1,000 lineal feet of roadside parking exists on the lake side of Lakeshore Boulevard. The average width from the edge of pavement to the private beach fence is 40 feet. On average it appears that approximately 30 feet consists of compacted soils which produce runoff while the remaining 10 feet is beach sand. The total area of disturbed soil is approximately 0.7 acres. The parking area slopes back to the road and all runoff from this area is discharged directly into Lake Tahoe through a drop inlet and storm drain at the corner of Stateline Avenue and Lakeshore Boulevard. This area receives heavy parking use during the summer and remains in a disturbed state year-long. The area could be paved with the stormwater runoff routed to an infiltration facility.

3.5 EXISTING SOUTH AVENUE BASIN RETROFIT

The basin at the terminus of South Avenue near Barton hospital was inspected to assess if some type of retrofit could improve water quality. There was still some snow cover on the ground when the basin was inspected. The basin appears to act primarily as an infiltration facility. No discharge pipe was located either in the basin or downslope of it. Also, no spillway was evident. Snowmelt runoff was entering the basin and there was some standing water on the south edge of the basin (March 2012). No retrofit action is recommended because the basin, which would discharge to the Upper Truckee Meadow, appears to have low connectivity to the Upper Truckee River.

4.0 REFERENCES

2NDNATURE. 2012. Pilot Catchment Validation Study: Lake Tahoe Basin. Final Report June 2012. Prepared for U.S. Army Corps of Engineers Sacramento District.

City of South Lake Tahoe (CSLT). 2012a. Pollutant Load Reduction Strategy and Plan – Identification of Stormwater Improvement Opportunities. Prepared by Northwest Hydraulic Consultants. South Lake Tahoe, CA. April 2012.

City of South Lake Tahoe (CSLT). 2012b. Tahoe Valley Water Quality Improvement Project: Streamlined Existing Conditions Analysis and Conceptual Layout of Alternatives. Prepared by Northwest Hydraulic Consultants. South Lake Tahoe, CA. May 2012.

City of South Lake Tahoe (CSLT). 2011. Lake Tahoe TMDL Baseline Pollutant Load Estimate. Prepared by Northwest Hydraulic Consultants. South Lake Tahoe, CA. September 2011.

Lahontan Regional Water Quality Control Board (LRWQCB) and Nevada Division of Environmental Protection (NDEP). 2010. Final Lake Tahoe Total Maximum Daily Load. November 2010. http://www.swrcb.ca.gov/rwqcb6/water_issues/programs/tmdl/lake_tahoe/docs/tmdl_rpt_nov2010.pdf

Northwest Hydraulic Consultants (NHC), Geosyntec Consultants, and 2NDNATURE. 2009. PLRM Model Development Document. Prepared for Lake Tahoe Basin Storm Water Quality Improvement Committee. South Lake Tahoe, CA. http://www.tiims.org/TIIMS-Sub-Sites/PLRM/docs-downloads.aspx

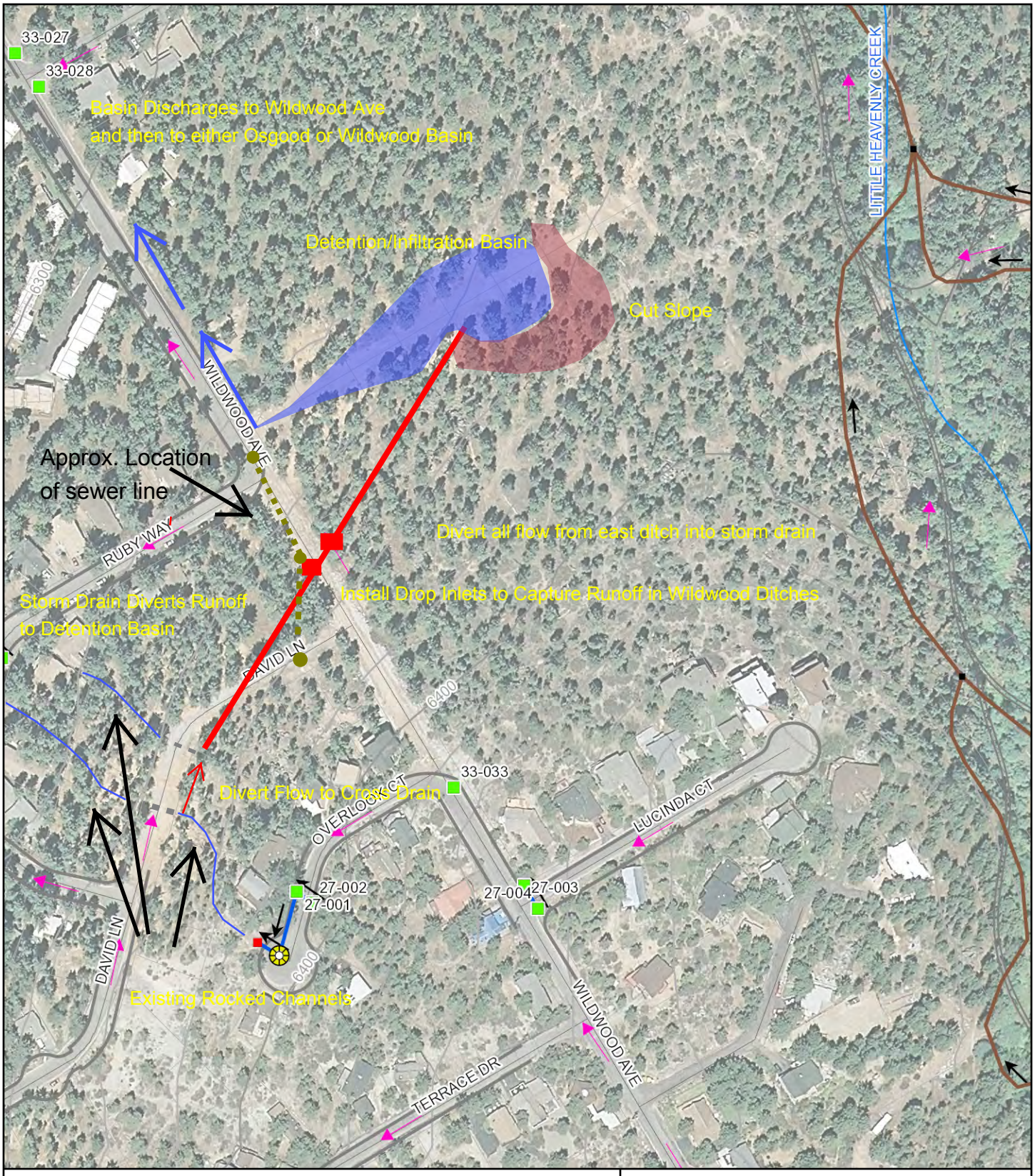
Northwest Hydraulic Consultants (NHC). 2010. PLRM Applications Guide. Prepared for Lake Tahoe Basin Storm Water Quality Improvement Committee. South Lake Tahoe. CA. http://www.tiims.org/TIIMS-Sub-Sites/PLRM/docs-downloads.aspx

Natural Resources Conservation Service (NRCS) - U.S. Department of Agriculture. 2006. Soil Survey of Tahoe Basin Area, CA and NV. U.S. Department of Agriculture, South Lake Tahoe, CA

Appendix A – PLRM Models

All files provided digitally.

Appendix B –
Gradeline Feasibility Assessments



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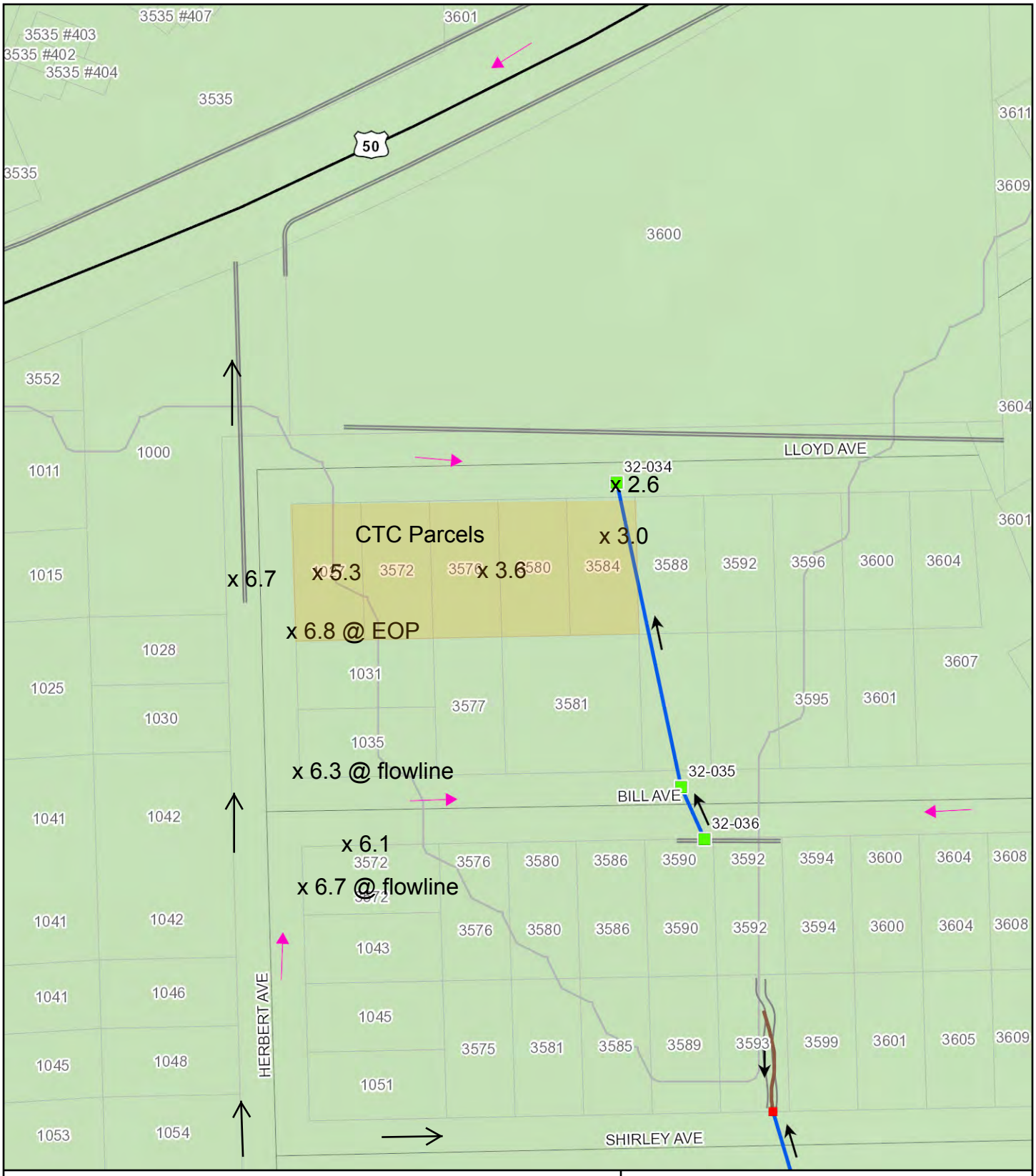
Storm Water System
South Lake Tahoe, California

Ruby Way Detention Basin

5/4/2012



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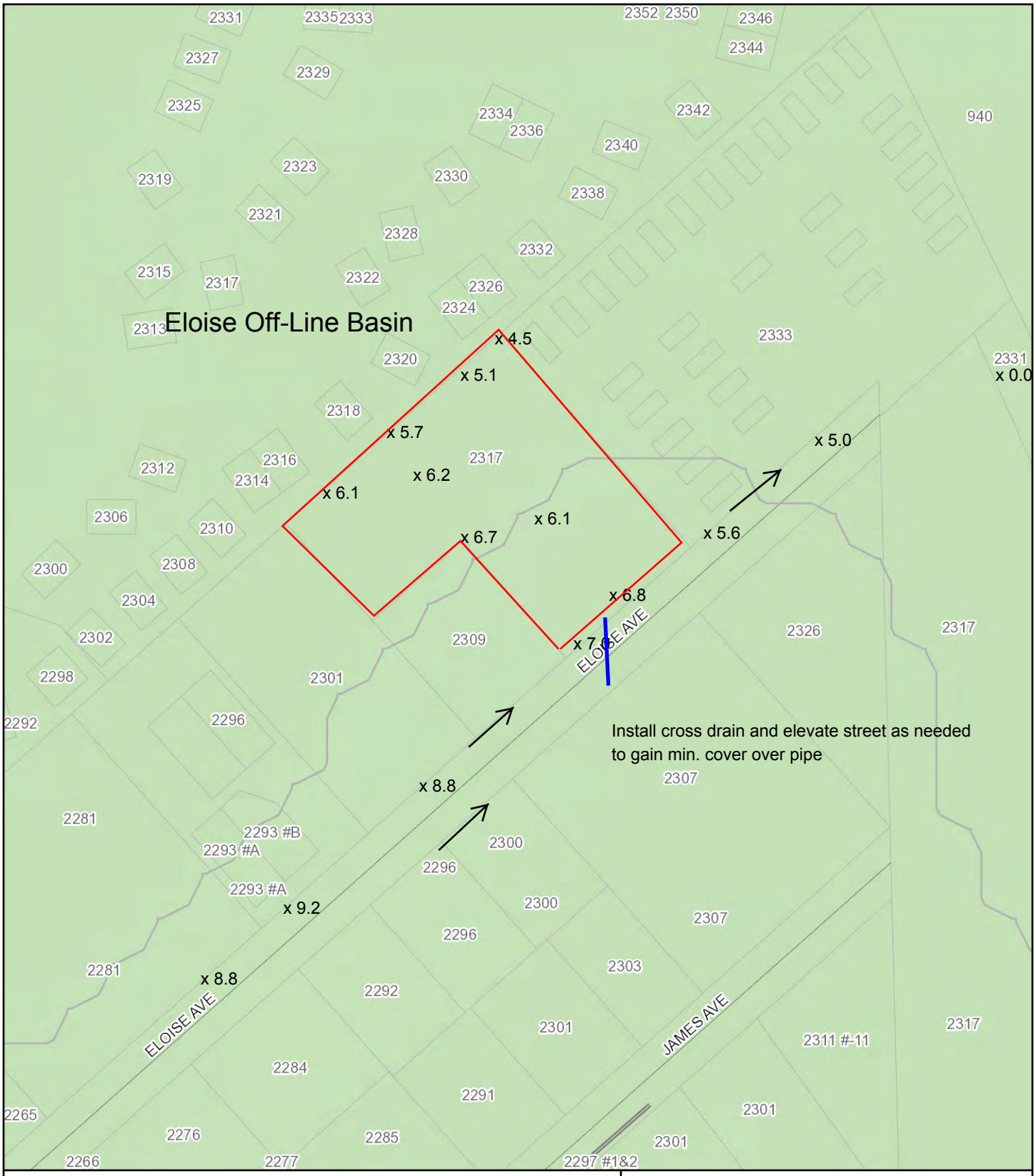
Arbitrary Datum

Storm Water System
South Lake Tahoe, California

LLoyd Ave. Basin

4/19/2012



Storm Water System
South Lake Tahoe, California

End of Eloise Basin Site

1 : 1,200

0 100 Ft

Arbitrary Datum

4/19/2012

Tahoe Valley Water Quality Improvement Project

Streamlined Existing Conditions Analysis
and
Conceptual Layout of Alternatives

June 2012

Prepared for:

Prepared by:

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LIST OF ACRONYMS USED

CICU	Commercial/institutional/communications/utilities
CRC	Characteristic Runoff Concentration
CSLT	City of South Lake Tahoe
CTC	California Tahoe Conservancy
DCIA	Directly connected impervious area
DN	Dissolved nitrogen
DP	Dissolved phosphorus
ECAM	Existing conditions analysis memorandum
FSP	Fine sediment particles
GIS	Geographic information system
HSC	Hydrologic source control
ICIA	Indirectly connected impervious area
LRWQCB	Lahontan Region Water Quality Control Board
MFR	Multi-family residential
NDEP	Nevada Division of Environmental Protection
NRCS	Natural Resources Conservation Service
PSC	Pollutant source control
SEZ	Stream environment zone
SFR	Single family residential
SWT	Storm water treatment
TMDL	Total maximum daily load
TN	Total nitrogen
TP	Total phosphorus
TRPA	Tahoe Regional Planning Agency
TSS	Total suspended sediment
UPC	Urban planning catchment
USFS	United States Forest Service
WQIP	Water quality improvement project

1.0 BACKGROUND AND APPROACH

In connection with the Lake Tahoe TMDL process, the City of South Lake Tahoe (City) developed a baseline pollutant load estimate for City stormwater runoff. Table 1.1 displays the City's estimated baseline load of fine sediment particles (FSP) and the Lake Tahoe TMDL load reduction milestones up to the Clarity Challenge milestone (CSLT 2011).

Table 1.1 – City FSP Load Reduction Milestones

Load	% Reduction	Year of measure	FSP Loading (lb/year)	FSP Reduction (lb/year)
City Baseline	-	2004	389,000	-
First Load Reduction Milestone	10%	2016	350,000	39,000
Second Load Reduction Milestone	21%	2021	307,000	82,000
Clarity Challenge Milestone	34%	2026	257,000	132,000

The primary objectives for the City to attain the first Lake Tahoe TMDL load reduction milestone are to: 1) identify near-term water quality improvements that may be feasible to implement by 2016; and 2) initiate project development activities for the most promising and feasible opportunities for pollutant load reduction to streamline planning, environmental review, and design activities.

Using information developed in the City's *Baseline Pollutant Load Estimate Report* (2011) and reconnaissance level field assessments of stormwater runoff conditions, the City assessed and produced a memorandum identifying opportunities for stormwater quality improvements (CSLT, 2012). Among the near-term water quality improvement opportunities identified, the Tahoe Valley drainage area was prioritized for project development activities. The decision to prioritize the Tahoe Valley drainage area was based on the following factors:

- Among the urban planning catchments (UPCs) analyzed in the City's *Baseline Pollutant Load Estimate Report* (2011), the Tahoe Valley drainage area has one of the highest loading rates of pollutants of concern to Lake Tahoe from stormwater runoff.
- The Tahoe Valley drainage area is directly connected to the Upper Truckee River; therefore, pollutants generated within the drainage area are directly discharged to receiving waters connected to Lake Tahoe.
- Since completion of the D Street erosion control projects in the late 1980s, no water quality improvements have been built in the Tahoe Valley drainage area. The City was awarded a planning grant from the USFS to initiate the Tahoe Valley Water Quality Improvement Project (WQIP) in 2010. The City is intending to use the USFS grant to further planning and design activities for the Tahoe Valley WQIP based on the information developed in this work effort.

The work described herein initiates a planning process consistent with Stormwater Quality Improvement Committee (SWQIC) guidelines by developing conceptual layouts of alternatives and identifying information needs to inform future planning and design tasks.

2.0 TAHOE VALLEY DRAINAGE CONDITIONS

The 320 acre drainage area for the Tahoe Valley WQIP is shown in Figure 2.1. The upper portion of the drainage area (TV1 through TV3) is composed of roads that predominantly run perpendicular to the contour in a north-south direction and exhibit a high amount of unprotected and eroding road shoulders. Land uses in the upper portion of the drainage area are predominantly composed of high density residential lots. Land uses in drainage catchments located to the west of Highway 50 (TV5 and TV5), below the upper portions of the drainage area, transition from high density residential lots to moderate density commercial uses adjacent to Highway 50. The lower portion of the drainage area is composed of moderate density commercial uses on the east side of Highway 50 south of the "Y" (TV4 and most of TV7), and dense commercial uses along both sides of Highway 50 east of the "Y" and north of Highway 50 along James and Eloise in the vicinity of Third Street (TV8 and TV9).

Runoff from the upper portion of the drainage area concentrates into a storm drain pipe at Highway 50 at B Street. From this point flow is conveyed under Highway 50 to an SEZ that routes runoff to an existing stormwater treatment basin near the intersection of Fourth and Barton (referred to in this report as the Helen Dry Basin). Discharge from Helen Dry Basin commingles with runoff from Highway 50 and commercial land uses east of the "Y", and continues to flow through a storm drain until the runoff discharges into a ditch on a California Tahoe Conservancy (CTC) parcel on James Street. The ditch runs along property boundaries eventually entering a City-owned SEZ parcel on the north side of Eloise (referred to in this report as the Linda Wet Basin). From the Linda Wet Basin, the ditch accepts additional drainage from the TV9 catchment (Figure 2.1) before discharging into a constructed channel which runs along the north property boundary of the Sky Meadows subdivision to the Upper Truckee River.

Stormwater Quality Problems Identified

The following summarizes the most significant water quality problems identified in the Tahoe Valley drainage area.

- In the upper portion of the drainage area, unprotected roadside flow paths are sufficiently steep that, during larger storms, they appear to become a large source of sediment both associated with the road shoulders, but also with the connected unpaved compacted surfaces on the adjacent residential lots. The larger flows from the upper drainage areas are capable of conveying concentrated runoff and pollutants to the lower, flatter sections.
- Commercial land uses occupy up to 60% of the lower portions of the drainage area. These land uses have relatively high amounts of impervious area and are typically directly connected to the drainage systems that discharge to the SEZ extending downstream from the Linda Wet Basin, which discharges to the Upper Truckee River. Very few commercial properties in the drainage area have private property BMP certificates from TRPA.
- Untreated Caltrans stormwater runoff discharges to the SEZ and City storm drainage systems, which then discharges to the Upper Truckee River. Planned Caltrans projects appear to have enough available area to retain flows from their roadway south of the "Y" within Caltrans right-of-way, but opportunities are limited for Caltrans to retain or infiltrate road runoff within their right-of-way near and east of the "Y".

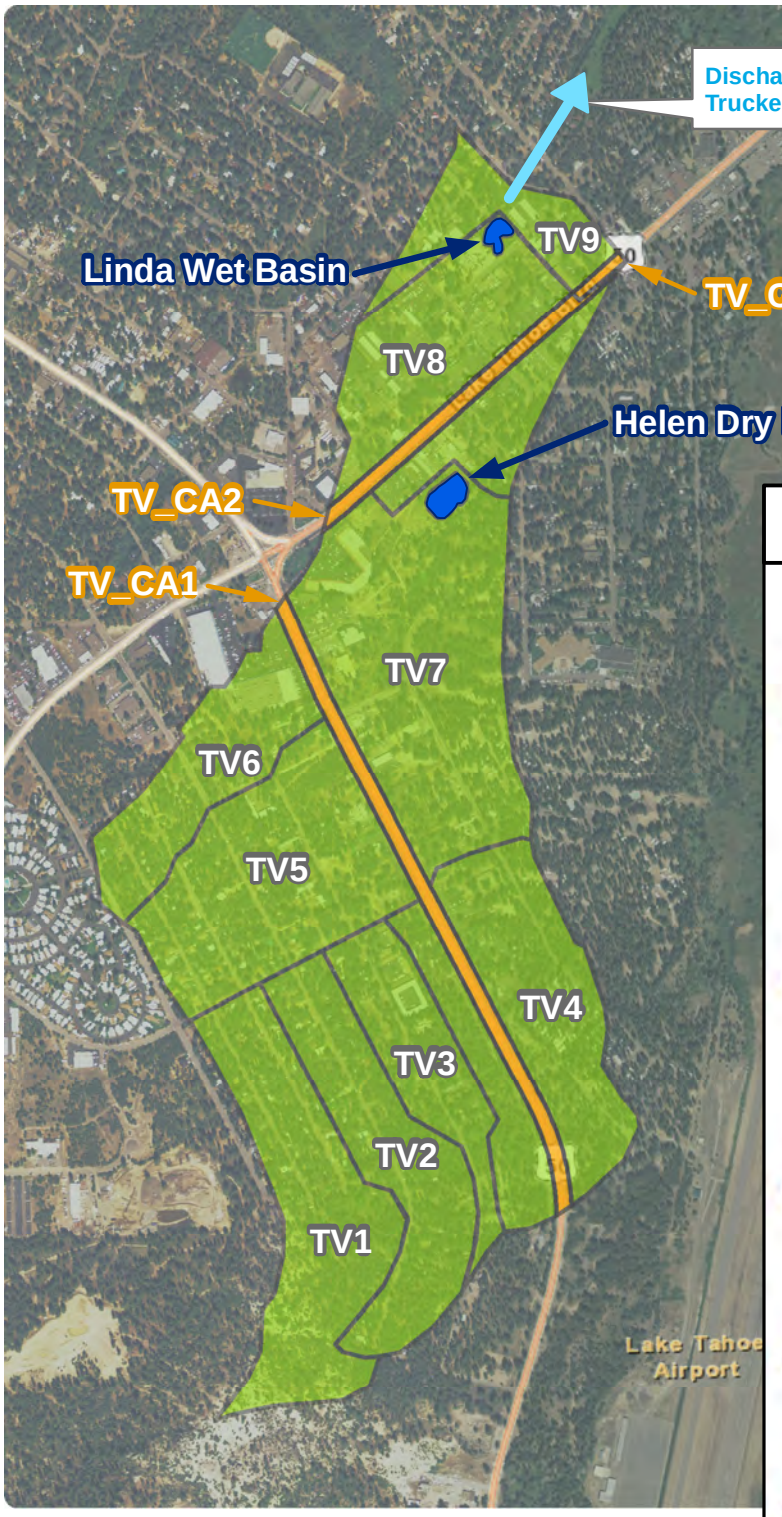
- There are essentially no stormwater treatment facilities within the drainage area except for the Helen Dry Basin, which is significantly undersized relative to the size of the contributing drainage area and is likely ineffective at removing fine sediment from runoff.

Estimated Baseline Pollutant Load

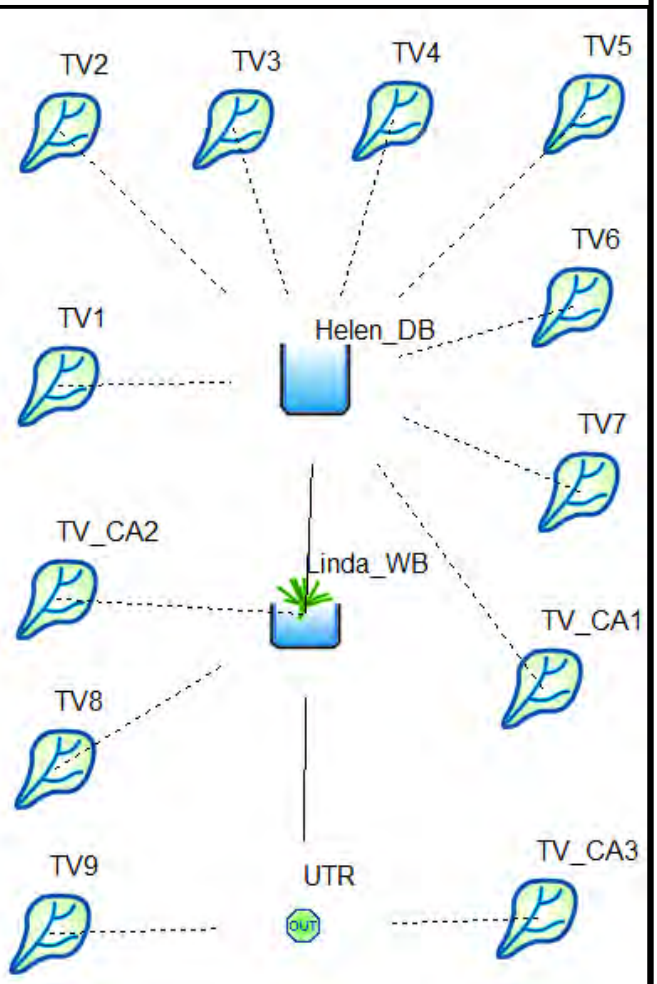
The baseline condition Pollutant Load Reduction Model (PLRM) scenario for the Tahoe Valley drainage area, which was developed to inform the City's *Baseline Pollutant Load Estimate Report*, was refined in this work effort based on additional field assessments of drainage conditions. The field review of drainage conditions identified that an additional 14 acres of City urban area, which was delineated in the City's *Baseline Pollutant Load Estimate Report* to be in the adjacent UPC identified as C1, is actually tributary to the Tahoe Valley drainage area. The refined drainage boundary delineations for the Tahoe Valley WQIP and the modeled PLRM routing of the baseline condition are shown in Figure 2.1.

Also shown in Figure 2.1 are three Caltrans drainage catchments totaling 8.4 acres. The Caltrans drainage catchments have been modeled separately in PLRM for both the baseline condition scenario and each modeled stormwater quality improvement alternative. Because City and Caltrans stormwater runoff commingles in the Tahoe Valley drainage area, the modeled PLRM baseline scenario represents this commingling and total pollutant loading from both City and Caltrans stormwater runoff is reported. Under the baseline PLRM scenario the 320 acre Tahoe Valley drainage area, which includes 8.4 acres of Caltrans drainage, is estimated to generate 56,000 lbs/year of FSP. Based on PLRM output on pollutant load generation and surface runoff, which excludes load reduction estimates from stormwater treatment facilities, City stormwater runoff is estimated to generate 80% of the FSP load in the Tahoe Valley drainage area with Caltrans stormwater runoff estimated to generate 20% of the FSP load. In regard to the distribution of surface runoff, City stormwater is estimated to generate 91% of total surface runoff with Caltrans stormwater estimated to generate 9% of total surface runoff.

The total urban area within the City limits is 5,500 acres (CSLT 2011). Therefore, the Tahoe Valley drainage area (with Caltrans drainage area subtracted) comprises roughly 6% of the City's urbanized area but generates 14% of the baseline FSP load, when Caltrans runoff is included.



PLRM Drainage Routing



Legend

- City Catchment
- CalTrans Catchment

Reference Map

City of South Lake Tahoe

Tahoe Valley WQIP
Conceptual Layout of Alternatives

Scale - 1:15,000 1 inch = 1,250 feet

0 1,250 2,500 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 2.1 - Existing Drainage Conditions

Stormwater Quality Improvement Opportunities

The following summarizes the most significant water quality opportunities identified based on field assessments of the Tahoe Valley drainage area and review of readily available information.

1. The lower portion of the Tahoe Valley drainage area is adjacent to, but not connected with, UPCs that drain to Tallac Lagoon and then to Pope Marsh. Some of the stormwater runoff in the Tahoe Valley drainage area, which is directly discharged to the Upper Truckee River, could potentially be diverted to the adjacent UPCs for discharge to Tallac Lagoon.

2. A number of publicly owned lots are located along the primary drainage courses within the Tahoe Valley WQIP. These lots might provide cost-effective opportunities to construct storm water treatment facilities at the following locations:

    a. Four CTC parcels at the intersection of Margaret Avenue and D Street.
    b. Two USFS parcels at the intersection of Dedi Avenue and D Street.
    c. A large CTC parcel in the vicinity of Highway 50 and Bonanza Avenue.
    d. Two large CTC parcels on James Street.
    e. A collection of CTC and City parcels southeast of the “Y” in the vicinity of the existing Helen Dry Basin. However, at the time of this work effort the CTC owned lots may not be available for use due to potential sale of those parcels.

3. The stormwater treatment performance of the existing Helen Dry Basin could be enhanced to improve fine sediment capture by creating additional water quality storage and increasing the hydraulic residence time of the stormwater runoff in the basin.

4. The level of private property BMP implementation and BMP maintenance within the Tahoe Valley drainage area could be increased. In particular, private property BMP installation and requirements for BMP maintenance could be prioritized for commercial properties, as well as specific residential properties in the upper portion of the drainage area that appear to be significant sources of sediment.

5. The amount of road shoulder stabilization could be increased to provide better pollutant source controls for streets in the upper portion of the drainage area.

3.0 CONCEPTUAL ALTERNATIVE LAYOUTS

Three alternatives have been formulated for the Tahoe Valley WQIP from the identified opportunities with strategies targeting stormwater quality improvements that may be feasible for the City to implement to support the first Lake Tahoe TMDL pollutant load reduction milestone. Given the relatively short time frame to plan and implement water quality improvements, as well as limitations on near-term grant funding, water quality improvement strategies were developed with the following considerations:

- Implementation of extensive road shoulder and storm drainage improvements was not considered to be a viable near-term strategy for water quality improvement as the cost of designing and constructing a large amount of drainage improvements would exceed forecasts of available grant resources.
- Increased private property BMP compliance is not a strong focus of near-term strategies for water quality improvement because this strategy has not yet been presented to or adopted by City Council. If adopting this strategy, the City may need to commit City staff resources to coordinate and/or enforce BMP compliance with numerous individual private property owners. The water quality benefit of targeted BMP compliance for commercial properties in the Tahoe Valley drainage area is evaluated in one proposed strategy for water quality improvement.
- Stormwater treatment facilities and storm drainage facilities were sited on public parcels and within public rights-of-way to avoid increases in cost and potential schedule delays associated with acquiring private land and/or drainage easements.

The following sections summarize for each alternative the: 1) strategy for stormwater quality improvement; 2) conceptual layouts of potential improvements; 3) planning level estimate of pollutant load reduction; 4) design considerations; 5) results of feasibility assessments and key information needs; and 6) planning level cost estimates.

3.1 ALTERNATIVE 1 – LOW FLOW DIVERSION TO TALLAC LAGOON

Strategy for Water Quality Improvement

As noted above in the discussion of drainage conditions, stormwater runoff from the Tahoe Valley drainage area discharges directly into the Upper Truckee River. In the City's *Baseline Pollutant Load Estimate Report* (2011) the Tahoe Valley drainage area (UPCs D1 and D3 in Figure D-1 of the Baseline Loading Report) is estimated to have a connectivity factor of 100%, which means that 100% of surface runoff and associated pollutant load discharged from the Tahoe Valley drainage area reaches Lake Tahoe.

In contrast to stormwater routing in the Tahoe Valley drainage area, the UPCs immediately to the north of the Tahoe Valley drainage area discharge stormwater runoff to Pope Marsh. The majority of the City's urban stormwater runoff that reaches Pope Marsh flows across a stream environment zone (SEZ) then enters Tallac Lagoon, where a weir on the western edge of Tallac Lagoon controls discharge to the marsh. When the water level rises high enough in Tallac

Lagoon, water discharges over the weir into Pope Marsh were it distributes through the 165 acre marsh. A natural barrier beach frequently retains surface water in the marsh. For portions of some water years, surface water in Pope Marsh breaks through the barrier beach next to the Lighthouse Shores development within the Tahoe Keys and discharges to Lake Tahoe. At other times surface runoff is retained in Pope Marsh. Based on modeling analysis documented in City's *Baseline Pollutant Load Estimate Report* (2011), UPCs connected to Pope Marsh are estimated to have a connectivity factor of 19%, which means that 19% of surface runoff and associated pollutant load discharged from these UPCs reaches Lake Tahoe.

Given that the Tahoe Valley drainage area is adjacent to, but currently unconnected with UPCs with low connectivity to Lake Tahoe, the strategy for Alternative 1 proposes to divert a portion of stormwater runoff from the Tahoe Valley drainage area into the principal southern SEZ tributary to the Tallac Lagoon and Pope Marsh, thereby reducing pollutant loading discharged to Lake Tahoe.

Conceptual Layout of Potential Improvements

Figure 3.1 provides an overview of the overall strategy for Alternative 1 and potential options for creating a low flow diversion of stormwater runoff. The diversion would be accomplished through a low-lift pump which would route stormwater from the Tahoe Valley drainage area through a pipe to an SEZ draining to Tallac Lagoon. Two options for storm drain routing and provided additional treatment of runoff prior to discharge to the SEZ are shown on Figure 3.1.

- Routing Option #1 - connect storm drain to the existing Linda Wet Basin and route runoff in Linda Avenue to a USFS parcel (APN 023-686-12) for treatment of runoff prior to discharge to the SEZ adjacent to the Tahoe Valley Elementary School. The total distance of new storm drain would be roughly 1,000 feet. The SEZ wraps behind the Tahoe Valley Elementary School and then discharges into the head of the long north-south "feeder" canal that leads to the Tallac Lagoon. The first 500 lineal feet of this SEZ is characterized by a well incised and confined channel that is not expected to provide any treatment capacity. The remaining 1,000 feet of SEZ is characterized by the lack of a continuous channel where water spreads laterally and there are scattered shallow zones of inundation. The nearly level topography of the SEZ in this area allows high flows to spread laterally over a 200 foot width, equating to an SEZ area of 4.5 acres. However, low flows still take a preferred path consisting of linked ponds up to 8 inches deep. During the winter and spring, there is little emergent vegetation in this preferred flow path. Because the length of the SEZ that is in good condition for providing stormwater treatment is relatively short, enhancing treatment could be accomplished by constructing a "high line" ditch that would wrap around the school boundary. At the point where the ditch turns to the west, a series of turnouts could be constructed to allow small portions of the flow out of the ditch into the SEZ. This runoff would flow over portions of the SEZ that are not exposed to flow except during floods, which would increase opportunities for treatment and fine sediment deposition.

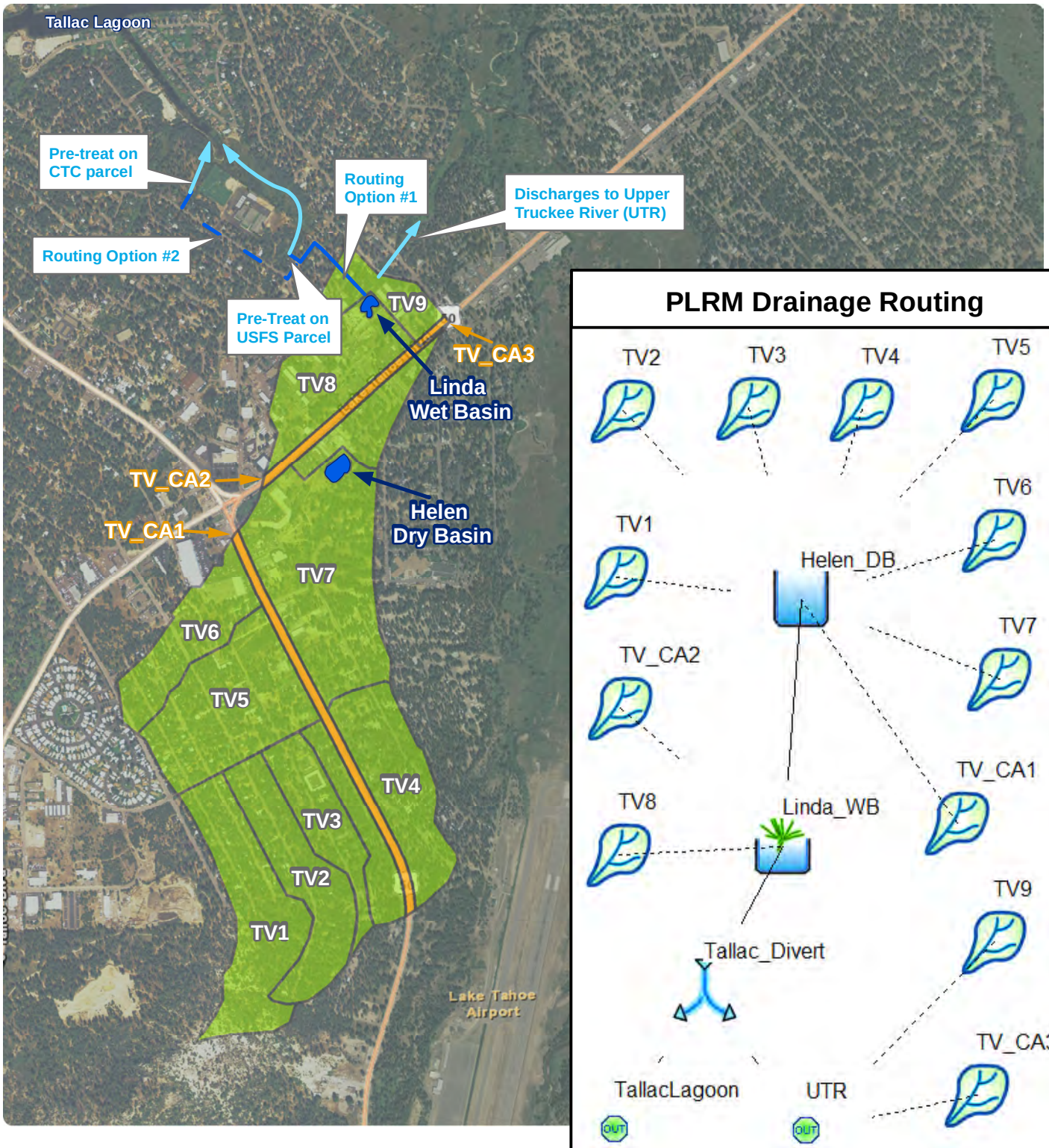
Routing Option #2 - connect storm drain to the existing Linda Wet Basin and route runoff in Linda Avenue. Instead of discharging to the USFS parcel, extend storm drain pipe to near the intersection of Tahoe Island and Tahoe Vista Drives and discharge runoff on a large CTC parcel (APN 023-700-10) for treatment prior to discharge to the SEZ north of the Tahoe Valley Elementary School. The total distance of new storm drain would be roughly 2,500 feet. The diverted stormwater could be routed into constructed wet basins on the large CTC parcel to remove fine sediments and nutrients prior to discharge into Tallac Lagoon.

Planning Level Estimate of Pollutant Load Reduction

In addition to illustrating the conceptual layout of Alternative 1, Figure 3.1 illustrates how Alternative 1 was modeled using PLRM to estimate reductions in pollutant loading that may be achieved from the low flow diversion. The overall load reduction in the City's baseline load from implementation of Alternative 1 would depend on the amount of stormwater runoff diverted to Tallac Lagoon.

To illustrate how load reductions may vary based on the maximum diversion flow rate, the PLRM scenario shown in Figure 3.1 was run for multiple maximum rates of diversion to produce Figure 3.2. The results of the modeling analysis show that a relatively minor diversion in flow could significantly reduce the City's baseline load. For example, a diversion with a maximum flow rate of 4 cfs is estimated to route roughly 30,000 lb/year of FSP that is currently discharged to the Upper Truckee River to Pope Marsh. Applying the 19% connectivity factor for stormwater runoff discharged to Pope Marsh (described above) produces a load reduction estimate of 24,000 lb/year of FSP for City and Caltrans stormwater (Figure 3.2).

The estimates in Figure 3.2 include an analysis of total reductions in pollutant loading and reductions attributed to City stormwater with Caltrans stormwater excluded. The estimate that excludes Caltrans stormwater assumes the City coordinated with Caltrans on a joint project for Alternative 1 that proportionally distributed project and maintenance costs based on the proportion of FSP generated by each jurisdiction in the Tahoe Valley drainage area (where the baseline loading estimates are: City = 80%; Caltrans = 20%). Under this joint project scenario the City's credited load reduction would be roughly 19,200 lb/year of FSP from a 4 cfs diversion (24,000 x 80% = 19,200 lb/year). A 19,200 lb/year load reduction equates to a 5% reduction in the City's baseline load.



Legend

- Potential Storm Drain Routing
- City Catchment
- CalTrans Catchment

Reference Map

City of South Lake Tahoe

Tahoe Valley WQIP
Conceptual Layout of Alternatives

Scale - 1:18,000 1 inch = 1,500 feet

0 1,500 3,000 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 3.1 - Alternative 1: Low Flow Diversion to Tallac Lagoon

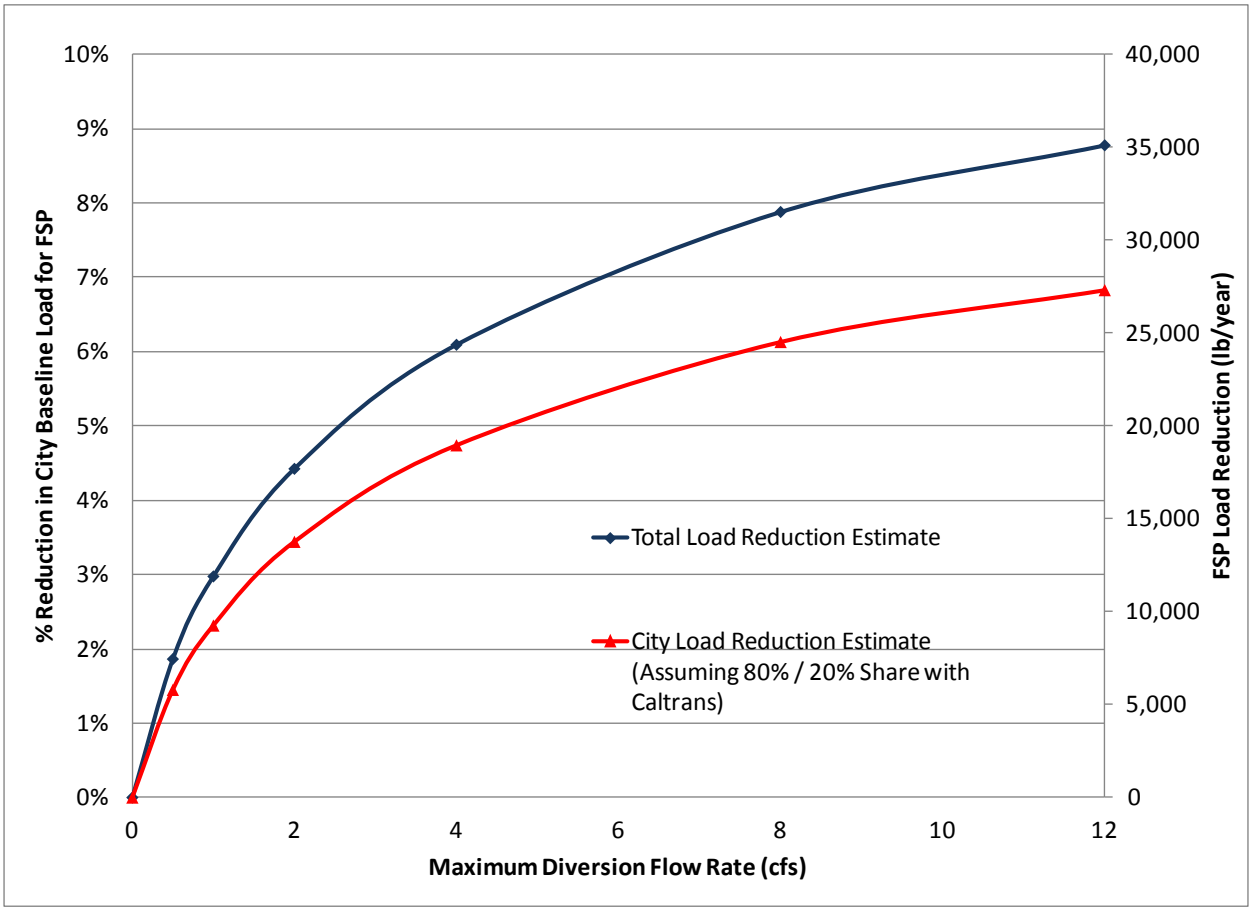


Figure 3.2 – Alt 1 Estimated Load Reduction Based on Diversion Flow Rate

Design Considerations

Design considerations for Alternative 1 primarily relate to evaluating the feasibility of routing stormwater runoff and providing an acceptable level of water quality for discharge to the SEZ adjacent to the Tahoe Valley Elementary School, Tallac Lagoon, and Pope Marsh. The preliminary assessment below focuses on these points:

<u>Gravity Flow vs. Stormwater Pumping for Diversion</u>

A topographic field survey was performed in March 2012 to assess the feasibility of a gravity flow diversion from the existing storm drain invert at the intersection of Third and James Streets to the channel in the SEZ at Tahoe Island Drive south of the Tahoe Valley Elementary School. The length of storm drain necessary for this option is roughly 1,400 feet. The topographic field survey indicated that the invert of the existing storm drain pipe was roughly 0.75 feet above the invert of the channel in the SEZ at the potential discharge location. Therefore, a storm drain pipe connecting these two locations would have a slope of roughly 0.05%.

An estimate of the minimum slope necessary to convey stormwater by gravity was made based on: 1) assumptions noted below, 2) Equation 1, and 3) estimates of headloss associated with friction, bends, and exit and entrance losses.

$Equation\ 1\ (Mays\ 2005)$: $$Headloss(z_1 - z_2) = H_f + H_b + H_{ex} + H_{en}$$

$Equation\ 2$: $$H_b\ or\ H_{ex}\ or\ H_{en} = \mathrm{K}\frac{\mathrm{V}^2}{2\mathrm{g}}$$

$Equation\ 3$: $$H_f = \mathrm{f}\frac{\mathrm{L}}{\mathrm{D}}\frac{\mathrm{V}^2}{2\mathrm{g}}$$

The following assumptions were used to estimate headloss and the minimum slope of the pipe for gravity flow.

- V = Minimum scour velocity necessary (full pipe): 3 ft/s
- Q = Maximum Discharge Rate: 4 cfs
- D = Pipe diameter to pass roughly 4 cfs: 18 inches
- L = Pipe Length: 1400 feet
- Friction coefficients (Mays 2005):
  - f = friction factor of 18 inch pipe: 0.035
  - K_b (45° elbow): 0.2
  - K_{ex} (square edge): 0.5
  - K_{en} (slightly taunted): 0.23

Using the above assumptions, the calculated headloss is roughly 4 feet to achieve the desired minimum scour velocity of 3 feet per second with the pipe flowing full. Given the 1,400 foot pipe length with this equates to a minimum pipe slope of roughly 0.25%.

Based on the results of the above analysis, a gravity flow diversion was deemed infeasible for Alternative 1 and stormwater pumping would be necessary to accomplish the low flow diversion (unless a location for a diversion further upstream in the Tahoe Valley drainage area could be identified). Note that Alternative 1 currently proposes to divert stormwater from the Linda Wet Basin to the SEZ adjacent to the Tahoe Valley Elementary School, which is a slightly different alignment relative to the topographic field survey conducted. However, the Linda Wet Basin is downstream from the intersection of Third and James; therefore a gravity diversion would also be infeasible from this location.

<u>SEZ Discharge Location</u>

Both of the routing options described above propose to discharge stormwater to pre-treatment facilities on either USFS or CTC parcels prior to discharge to the SEZ. This approach is intended to reduce potential impacts to the SEZ and Tallac Lagoon that may

be caused from a diversion of Tahoe Valley stormwater runoff and associated pollutant loading.

A detailed topographic survey would be necessary to assess the feasibility of the Routing Option #1 because it would require a certain amount of elevation drop over the length of the proposed highline ditch in order to function. There is also some beaver activity at the transition between the SEZ and the lagoon canal, which could pose a potential problem if beavers dam the outlets within the highline ditch. However, the ephemeral nature of the flow may limit that potential.

Because of the larger available surface area for wet basin construction on the CTC parcel, Routing Option #2 may better mitigate any potential water quality impacts on Tallac Lagoon and Pope Marsh associated with a Tahoe Valley stormwater diversion.

Feasibility Assessments and Key Information Needs

While Alternative 1 would require pumping to successfully route stormwater from the Tahoe Valley drainage area to Tallac Lagoon, the design and construction of the proposed facilities would be relatively straightforward. The primary information need for Alternative 1 is associated with additional assessment of potential adverse impacts to the SEZ adjacent to the Tahoe Valley Elementary School, Tallac Lagoon, and Pope Marsh from the discharge of additional stormwater runoff and the identification of any mitigation measures that would be necessary to avoid unacceptable impacts.

The environmental review and permitting process for Alternative 1 would likely require a number of additional environmental studies and public outreach initiatives. The time and resources necessary to perform the environmental review process and obtain applicable permits may conflict with the City's objective to construct near-term water quality improvements in the Tahoe Valley drainage area with limited available funding. However, Alternative 1 should be considered in longer range planning given the significant pollutant load reductions that might be achieved from the low flow diversion (Figure 3.2).

The following summarizes key information needs to support environmental review and the potential permitting processes that might be required for Alternative 1:

- Tallac Lagoon is mapped as a Special Flood Hazard Area (Zone AE) with a Base Flood Elevation of 6232 feet (FEMA 2012). Potential flooding effects from the discharge of additional stormwater runoff to Tallac Lagoon would require some additional hydrologic and hydraulic study.
- Potential effects on the Upper Truckee River from the low flow diversion might require some additional study to ensure the there are no conflicts with existing water rights or other environmental considerations.
- The parcels identified for potential pre-treatment of stormwater runoff (CTC parcel 023-700-10 and USFS APN 023-686-12) are upland of the primary SEZ flow paths, but these parcels are mapped to be within the SEZ. The feasibility of using these parcels for

stormwater treatment would need to be confirmed with regulatory agencies as well as the CTC and/or USFS.

- The required level of stormwater treatment prior to discharge to the SEZ adjacent to the Tahoe Valley Elementary school would require consultations with permitting agencies and additional study.
- Tallac Lagoon is a backyard water feature for a number of homes adjacent to the lagoon. Potential impacts to the aesthetics of Tallac Lagoon from the discharge of additional stormwater runoff may need to be studied.
- The Tahoe Keys Water Company would need to be consulted to determine if their operations would be effected.
- Pope Marsh is owned and managed by the USFS to support multiple resource objectives. Potential impacts from discharge of additional stormwater runoff on other resources, such as wildlife habitat in the marsh, would need to be studied.
- TRPA, NEPA and CEQA permitting processes would need to be completed.
- LRWQCB would require a Section 401 Water Quality Certification.
- USACE would require a Section 404 permit; additionally, a Nationwide Permit might be applicable.
- An assessment of the feasibility of water quality improvements within adjacent UPCs (B4 and B9) to reduce surface runoff and pollutants loads already discharged to Tallac Lagoon and Pope Marsh may be worthwhile to explore as a means to mitigate any potential impacts that might be created from the proposed diversion.

Planning Level Cost Estimate

Table 3.1 provides a planning level cost estimate to implement Alternative 1 organized into categories of work related to: 1) environmental studies, documents, and permitting; 2) planning, design, and preparation of construction documents; 3) and construction of improvements. Given the preliminary nature of the formulated alternative, a lower and upper bound on probable costs has been estimated. As shown in Table 3.1, there is significant range in probable costs associated with Alternative 1. This range in cost is predominantly due to uncertainties associated with the level of environmental analysis and permitting that would be required to implement a stormwater diversion to Tallac Lagoon, as well as uncertainties associated with costs for constructing a piped diversion, stormwater pumping system, and potential SEZ improvements that may be required.

Table 3.1 – Alternative 1 Planning Level Cost Estimate

Category of Work Effort	Planning Level Cost Estimate	
	Low Estimate	High Estimate
Environmental Studies, Documents, and Permitting	$380,000	$1,110,000
Planning, Design, and Preparation of Construction Documents	$300,000	$500,000
Construction of Improvements	$990,000	$2,070,000
Total	$1,670,000	$3,680,000

3.2 ALTERNATIVE 2 – INCREASED STORMWATER TREATMENT

Strategy for Water Quality Improvement

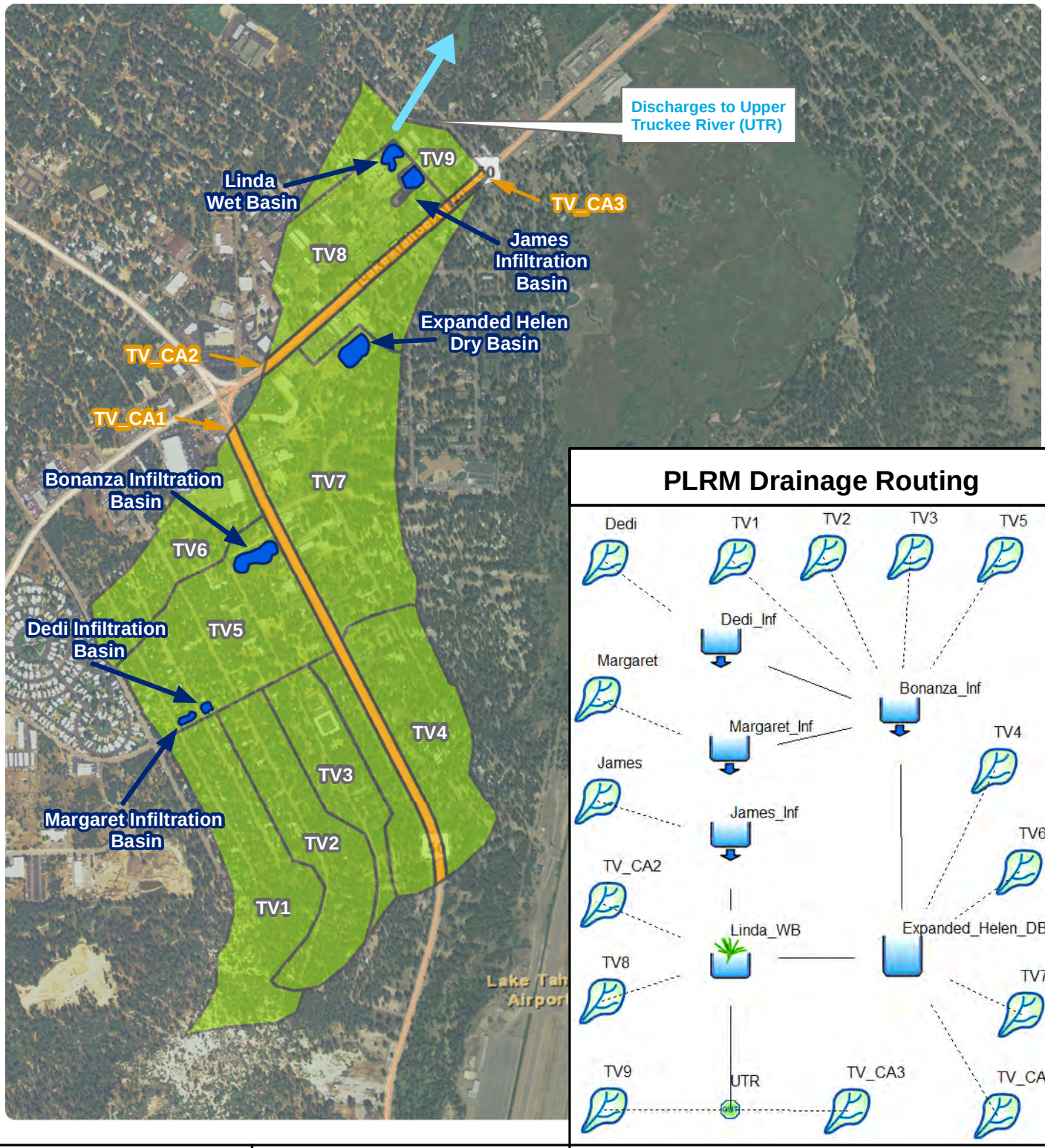
A number of parcels located along the primary drainage courses within the Tahoe Valley WQIP are owned by the CTC, City, and USFS. The strategy for Alternative 2 proposes to construct new and expanded stormwater treatment facilities on publicly owned lots near or adjacent to the primary Tahoe Valley drainage courses as a potentially cost-effective opportunity to reduce pollutant loading.

Conceptual Layout of Potential Improvements

Figure 3.3 provides an overview of proposed locations for new and expanded stormwater treatment facilities in the Tahoe Valley drainage area. Individual conceptual layouts describing potential improvements for each stormwater treatment location are provided in the subsections below as follows:

- Section 3.2.1 – Proposed Margaret Infiltration Basin
- Section 3.2.2 – Proposed Dedi Infiltration Basin
- Section 3.2.3 – Proposed Bonanza Infiltration Basin
- Section 3.2.4 – Expanded Helen Dry Basin
- Section 3.2.5 – Proposed James Infiltration Basin

Individual conceptual layouts summarize the stormwater treatment opportunity; identify design considerations; and summarize preliminary feasibility assessment and key information needs. Estimates of potential pollutant load reductions and costs for Alternative 2 are summarized collectively after the description of stormwater treatment opportunities.



Legend

City Catchment

CalTrans Catchment

Reference Map

City of South Lake Tahoe

Tahoe Valley WQIP
Conceptual Layout of Alternatives

Scale - 1:15,000 1 inch = 1,250 feet

0 1,250 2,500 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 3.3 - Alternative 2: Increased Stormwater Treatment

3.2.1 MARGARET INFILTRATION BASIN

Four CTC parcels along D Street between Margaret Avenue and Dedi Avenue could potentially be developed into a stormwater treatment basin. Figure 3.4 illustrates the 5 acre drainage area and the location of the CTC parcels. The total size of the four CTC lots is 0.45 acres. Vegetation on the lots appears to be primarily upland species with Jeffrey pines and white fir, and some lodgepole. The north easterly portion of the parcels is mapped as SEZ. Based on review of the 2007 NRCS Soils Survey, the CTC lots are on the boundary between two different soil types. Christopher-Gefo complex is mapped on the southern portion of the parcels. Christopher-Gefo soil is coarse sandy loam to a depth of over 61 inches and is a highly suitable soil for infiltration. Ubaj sandy loam is mapped on the northern portion of the parcels. This soil has finer textured horizons beginning at a depth of 17 inches with clay present at a depth of 42 inches. The existence of the Ubaj soil might restrict the efficiency of an infiltration basin on the CTC parcels.

In the existing condition, runoff flows north down Margaret Avenue and then discharges into an open channel which flows eastward toward Highway 50 between residential lots. Flows on Margaret are conveyed under D Street on both sides of Margaret. The road shoulders on Margaret are unpaved and appear to be a chronic source of sediment, especially since the prevailing slope is down the street, such that the roadsides are subject to erosion during larger storms.

Design Considerations

1. The proposed configuration would route runoff from the east side of Margaret into an off-line infiltration basin. Water would flow into the basin until the water surface elevation in the basin is the same as in the roadside ditch, at which point runoff would continue in its existing flow path down Margaret. Off-line basins capture and retain first-flush runoff and the entire pollutant load contained within the volumetric capacity of the basin at the time runoff commences, plus whatever additional capacity is regained through infiltration of stormwater.

2. Two soil pits were excavated on the site on May 7, 2012, with each pit located approximately 40 feet off the edge of pavement from Margaret and Dedi along an east-west centerline. Both pits were representative of the Christopher-Gefo soil in that there were no horizons encountered with finer textured material. Groundwater was exposed at a depth of approximately 5.5 feet in the pit closest to Margaret. No groundwater was exposed to a depth of seven feet in the pit closest to Dedi. Both pits showed a mix of colors beginning at approximately 3.7 feet and extending to six feet. This color mix, although not definable as mottles, is indicative of a seasonal high water table. Design depth for the infiltration basin should take into consideration that the seasonal high water table could be within 3-4 feet of the existing ground surface.

3. To facilitate ease of sediment cleanout and prevent sedimentation within a pipe linking the drop inlet and the basin, a small open channel should be extended from the basin to

the ditch line itself. Water would exit the culvert under D Street and simply cascade through an open grate directly into the basin. Runoff would enter the basin until the elevation of the water surface in the basin reaches the elevation of the grate spanning the headwalls. Thereafter, the flow would simply shear across the basin inlet and continue down the existing ditch line.

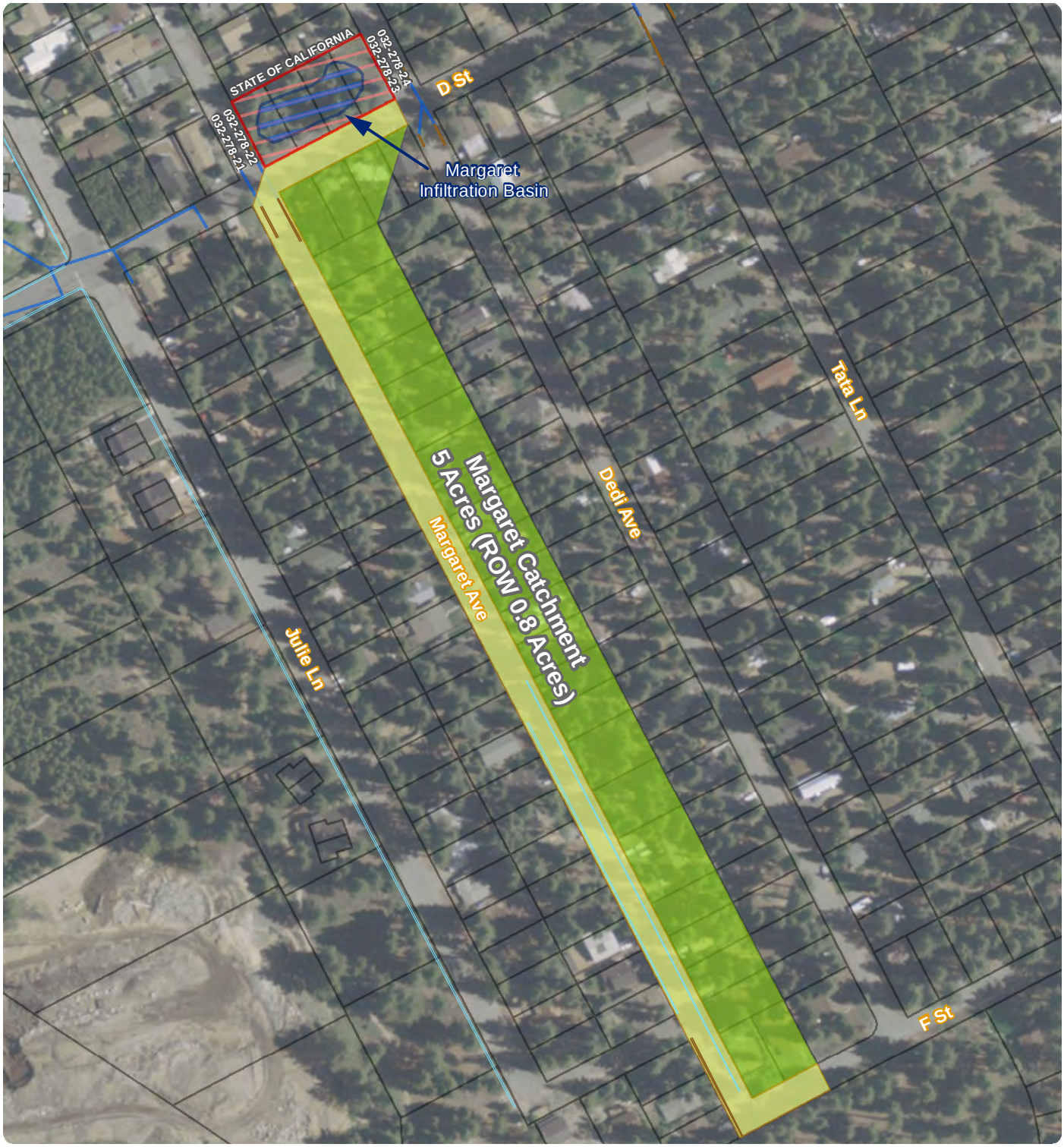
4. Basin design should incorporate an access point for heavy equipment to perform sediment removal and other measures such as periodically discing the basin bottom to prevent fine sediment from excessively reducing infiltration rates.

Feasibility Assessment and Key Information Needs

1. The CTC indicated in April 2012 that the four parcels identified (Figure 3.4) could potentially be used for the Margaret Infiltration Basin.

2. A topographic survey of the CTC parcels was completed in May of 2012. The survey data was collected in State Plane Coordinate System NAD83 and NAVD88. The point data from the topographic survey is provided in Appendix B along with a sketch showing the preliminary gradeline feasibility assessment of the parcels.

3. A portion of the CTC parcels is mapped as SEZ. A TRPA land capability verification will be required to support the environmental review process.



Legend

Existing Infrastructure

- Drainage Pipe
- Curb and Gutter
- Paved Flow Line

Reference Map

City of South Lake Tahoe

Tahoe Valley WQIP
Conceptual Layout of Alternatives

Scale - 1:2,400 1 inch = 200 feet

0 200 400 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 3.4 - Margaret Infiltration Basin

3.2.3 DEDI INFILTRATION BASIN

There are two adjacent U.S. Forest Service (USFS) lots on the northeast corner of Dedi Avenue and D Street. The combined size of the lots is approximately 0.23 acres. Figure 3.5 illustrates the 8 acre drainage area and the location of the USFS parcels. The lots are not mapped as SEZ. Vegetation consists largely of mature white fir and lodgepole pine. Soils are mapped as Christopher-Gefo loamy sands, which do not have a water-restricting horizon or a water table within six feet of the ground surface.

In the existing condition, runoff from the north side of D Street drains directly onto the parcel but the drainage area is very small area. The primary drainage area consists of both sides of Dedi Avenue, where runoff from the west side of Dedi is routed over to the east side of Dedi at the D Street intersection and then flows north and is discharged into an open channel. Road shoulders within the drainage area are unpaved and appear to be a chronic source of sediment, especially since the prevailing slope is down the street, such that the roadsides are subject to erosion during larger storms.

Design Considerations

1. Appendix B includes a sketch showing the preliminary gradeline feasibility assessment of the parcels. The USFS lots slope predominantly toward Dedi Avenue. Given the small size of the lots and the predominant sloping of the lots towards Dedi Avenue, the capacity of the potential basin will be limited. Therefore, a flow through design would either be subject to short cutting of flows since both the entrance and exit would have to be on Dedi Street, or the basin size would become extremely constrained in order to accomplish a horse shoe shape to prevent short cutting. In either case, a flow through design is estimated to have a very low efficiency at trapping and retaining fine sediment. An off-line infiltration basin is recommended for this location to retain first-flush runoff and the entire pollutant load contained within the volumetric capacity of the basin at the time runoff commences, plus whatever additional capacity is regained through infiltration of stormwater. The off-line basin could be constructed under various configurations as described for Margaret Basin above.

2. If soils perform as mapped, then runoff should readily infiltrate, although maintenance will be required. The basin design should incorporate an access point for heavy equipment to perform sediment removal and other measures such as periodically discing the basin bottom to prevent fine sediment from excessively reducing infiltration rates.

Feasibility Assessment and Key Information Needs

1. To date, the USFS has not been contacted to confirm the feasibility of using the two parcels identified (Figure 3.5) for the Dedi Infiltration Basin.

2. If the parcels are available for use, a minimum of two soil pits should be excavated to assess the possible presence of a water-restricting horizon, depth to the seasonal high water table, and confirm the characteristics of the soils on the parcels.

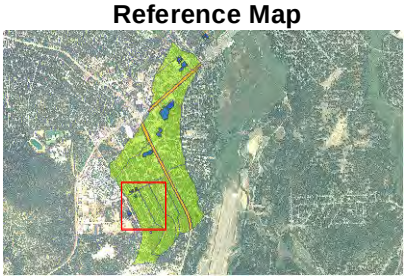
3. If the parcels are available for use, a topographic survey of the parcels will need to be performed.

Legend

Existing Infrastructure

- Drainage Pipe
- Curb and Gutter
- Paved Flow Line

Reference Map



City of South Lake Tahoe

Tahoe Valley Conceptual Alternative Layouts

Scale - 1:2,700 1 inch = 225 feet

0 200 400 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 3.5 - Dedi Infiltration Basin

3.2.3 BONANZA INFILTRATION BASIN

A 2.1 acre CTC parcel is located between Bonanza Avenue and Hwy 50 near B Street. Figure 3.6 illustrates the 111 acre drainage area and the location of the CTC parcel. The CTC parcel is nearly level, with most of the vegetation consisting of immature lodgepole pines with some immature Jeffery pines. The parcel is mapped as SEZ. Soils are mapped as Ubaj sandy loams. These soils become finer textured with depth, with a sandy clay loam horizon beginning at 17 inches below the surface and then becoming clay at 42 inches. The NRCS reports that the soil has a seasonal water table between 48-72 inches below the surface.

Surface channels and storm drain discharge from the 111 acre catchment upstream of the CTC parcel flows into a ditch that runs along the south property boundary of the parcel, which drains into a deep roadside ditch before entering a culvert crossing under Highway 50.

Design Considerations

1. Three soil pits were excavated on the parcel on May 7, 2012. None of the pits were representative of Ubaj soils, and were instead more indicative of Christopher-Gefo soils in that they were predominately sandy throughout with no evidence of a water restricting horizon. A water table was exposed in a pit dug within 100 feet of Hwy 50 at a depth of approximately 7 feet. No water was encountered in the other two pits, both excavated to depths below 6 feet. However, in all pits, a zone of mixed colors, believed to be indicative of the range of the seasonal high water table was found beginning at 2 to 2.7 feet below the surface. Design depth for the potential treatment basin should take into consideration that the seasonal high water table could be within 2-3 feet of the existing ground surface.

2. Given the large size of the watershed tributary to this parcel, a flow-through basin might have a very low efficiency at capturing fine sediment. Therefore, an off-line infiltration basin is proposed on this parcel. Runoff would continue to flow into the basin until the water surface in the ditch equals that in the basin, at which point runoff would simply continue to flow down the existing ditch line.

3. An off-line infiltration basin could be constructed similar to the one described for the Margaret Infiltration Basin. It will be necessary to improve the ditch that runs along the south edge of the property. Some consideration will need to be taken regarding the invert, slope, and hydraulic roughness of the ditch in comparison with the topography on the parcel to assess if the stage during flood events in the basin can be contained on the parcel, or if additional grading may be needed to form a berm around the basin.

4. The CTC has indicated that the informal trail system on the parcel would need to be preserved in some manner if a treatment basin was constructed on the parcel. Basin design will need to consider public access through the parcel.

Feasibility Assessment and Key Information Needs

1. The CTC indicated in April 2012 that the parcel (Figure 3.5) could potentially be used for the Bonanza Infiltration Basin.

2. A topographic survey of the CTC parcel was completed in May of 2012. The survey data was collected in State Plane Coordinate System NAD83 and NAVD88. The point data from the topographic survey is provided in Appendix B along with a sketch showing the preliminary gradeline feasibility assessment of the parcel.

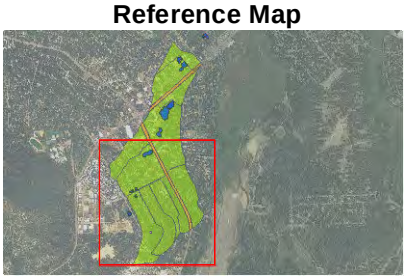
3. The CTC parcel is mapped as SEZ. A TRPA land capability verification will be required to support the environmental review process and to determine permitting requirements for this parcel in the SEZ.

Legend

Existing Infrastructure

- Drainage Pipe
- Open Channel
- Curb and Gutter
- Paved Flow Line

Reference Map



City of South Lake Tahoe

Tahoe Valley WQIP
Conceptual Layout of Alternatives

Scale - 1:7,200 1 inch = 600 feet

0 600 1,200 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 3.6 - Bonanza Infiltration Basin

3.2.4 EXPANSION OF HELEN DRY BASIN

The existing Helen Basin was constructed as part of the D Street Erosion Control Project. The existing basin is located on CTC and City parcels mapped as SEZ. Soils are mapped as Marla loamy coarse sand, which has a clay loam water restricting horizon at 47 inches and a depth to the water table of 12-30 inches. Based on the ephemeral nature of flow in the SEZ and the lack of a wet pool in the existing basin, the Helen Basin is estimated to function as a well vegetated dry basin rather than a wet basin in this analysis.

A number of additional City and CTC parcels, as well as City right-of-way are located immediately upstream and adjacent to the existing basin. Based on review of the current outlet structure, which includes numerous large weep holes, the current basin likely has a low hydraulic residence time and is likely very inefficient at trapping fine sediment particles.

An SEZ extends from the existing Helen Avenue basin location upstream to B Street. The size of the existing SEZ between B Street and the existing Barton Avenue Basin is approximately 3 acres over a distance of 1,500 feet. The SEZ slopes over that distance with an approximate 12 foot drop in elevation. The channel gradient of the SEZ is around one percent. The primary flow channel, which is ephemeral, is generally non-incised and willows and meadow vegetation grow throughout the channel bottom. The SEZ is confined to the channel bottom and floodplain and is typically between 50-100 feet wide. The ground then slopes upward, approximately 5-10 feet at a moderate gradient onto the surrounding uplands which are nearly level. Based on the existing riparian vegetation, it appears that the groundwater is at or very near the ground surface during the runoff season.

Figure 3.7 shows the publically owned parcels along the SEZ alignment, and a first approximation of the location and extent of potential SEZ expansion and basin expansion.

Design Considerations

1. Concurrent with an expansion of the SEZ would be the creation of steeper side slopes transitioning back to the upland. The potential for higher erosion rates into the SEZ by steepening these slopes would need to be considered in detailed design. Based on a reconnaissance of the site, it appears that only expansion to the north of the channel thalweg is possible. The ground rises more steeply to the south such that little new SEZ area could be created without excavating a large amount of soil and stabilizing a large area of cut slope.

2. Depending upon the results of further investigations, basin expansion might also be performed in conjunction with modification of the existing Helen Avenue basin outlet structure, which could be modified to either raise the outlet invert and/or modify the outlet structure to increase the hydraulic residence time, thereby increasing the efficiency of the basin to trap fine sediment.

3. An alternative for the lower SEZ expansion if the Helen basin outlet cannot be raised to backwater the lower zone and the basic treatment option for the upper SEZ expansion would be to excavate laterally outward from the channel thalweg or slightly higher on the City parcels thereby creating a wide thalweg area, but one which has a profile that has the same gradient as the existing thalweg. During storms, flows would spread over the expanded surface. In theory, there should be some increased capture of fine sediment because of the decreased flow depth and increased hydraulic roughness.

4. An enhancement of the thalweg expansion concept would be to create one of more stepped cattail wetlands on the City parcels. These could serve to enhance the treatment ability of the expanded SEZ to provide nutrient removal. The ephemeral nature of the drainage likely limits that possibility, and further knowledge about the flow regime of the channel would be needed to evaluate that option.

Feasibility Assessment Key Information Needs

1. During development of the Tahoe Valley alternatives, the CTC made known its intentions to sell the parcel(s) (APN 023-231-03 and 023-381-01) on which the SEZ would be expanded or which an expanded basin would partially inundate. Therefore, unless the future owners of the CTC parcel wish to only develop the highway frontage portion of the parcel, the SEZ expansion and the significant basin expansion proposed herein appears to have a low feasibility of implementation. The conceptual layout and assessment of this stormwater improvement opportunity for SEZ expansion was retained, but the assessment of potential pollutant load reductions that might be achieved from this treatment facility was scaled back in the PLRM to only estimate: 1) expanding the dry basin onto City parcels and City right-of-way; and 2) modifying the existing outlet structure to increase the hydraulic residence time in the basin to potentially capture more fine sediment; and 3) improved treated effluent quality from the treatment outlet of the Helen Dry Basin resulting from a combination of the improved outlet structure and the SEZ expansion upstream of the basin.

2. Obtain and review as-built drawings from the D Street Erosion Control Project.

3. Further evaluate land ownership and the feasibility of obtaining easements or acquisitions to facilitate SEZ expansion.

4. Assess the flow regime of the existing SEZ channel to evaluate the feasibility of sustaining an expanded SEZ. Potentially install shallow piezometers to assess seasonal depths to groundwater.

5. The parcels of interest are mapped as SEZ. A TRPA land capability verification will be required to support the environmental review process and to determine permitting requirements related to work in the SEZ.

Legend

Existing Infrastructure

- Drainage Pipe
- Open Channel
- Curb and Gutter
- Paved Flow Line

Reference Map

City of South Lake Tahoe

Tahoe Valley WQIP
Conceptual Layout of Alternatives

Scale - 1:2,400 1 inch = 200 feet

0 200 400 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 3.7 - Expansion of Helen Wet Basin

3.2.5 JAMES INFILTRATION BASIN

There are two adjoining CTC parcels on James Street between Third Street and Tahoe Keys Boulevard. The total area of the parcels is 1.45 acres. Figure 3.8 illustrates the 22 acre drainage area and the location of the two CTC parcels. Most of the area on the CTC lots is SEZ. The eastern CTC lot is a mix of SEZ and upland, with most of the upland occurring on the southern portion of the lot. The lots are predominantly mapped as Marla loamy coarse sand, which has a clay loam water restricting horizon at 47 inches and a depth to the water table of 12-30 inches. The upland portion of the eastern CTC lot is mapped as Christopher-Gefo complex, which does not have a water-restricting horizon or a water table within six feet of the ground surface.

All upstream runoff from the Tahoe Valley drainage area is discharged onto the western CTC lot in a drainage channel that runs along the boundary of a private parcel. There are a number of drop inlets located at the intersection of Third Street and James Street which convey runoff through the terminus of the storm drain system into the open channel. An additional drop inlet (City ID #02-01) routes water across Third Street at the Eloise Avenue intersection to a dry well, which was overflowing and discharging onto Eloise Avenue at the time of the field inspection in March 2012. Stormwater runoff in the open channel is passed from the CTC lots under Eloise Avenue and then flows to a fairly natural SEZ on a City lot directly across from Eloise Avenue, which is referred to as the Linda Wet Basin for this analysis.

Design Considerations

1. Three soil pits were excavated on the CTC lots on May 7, 2012. One was located on the smaller western lot, approximately 20 feet from an observation well installed by Caltrans. On the lot to the east, one pit was excavated 45 feet from Eloise Avenue at a location indicative of the lower portions of the lot, while the remaining pit was excavated 30 feet from James Street, on the upper, sloped portion of the lot. Groundwater was encountered at a depth of 5.8 feet on the western lot, which has had fill placed on it. At the pit, the depth of fill was 2.9 feet, indicating that the elevation of the water table relative to the original ground surface is 2.9 feet. Groundwater was encountered on the adjacent eastern lot at a depth of 2.6 feet at the lower elevation pit, while no groundwater was encountered at the pit on the sloped portion of the parcel next to James Street with the total depth of excavation of six feet. This latter pit had a profile indicative of the mapped Christopher-Gefo soil. For the other two pits, the shallow depth to the water table prevented excavation to a sufficient depth to determine if a clay loam horizon was present below a depth of 4 feet.

2. A significant restriction on the use of these parcels for water quality treatment is that the existing open channel, located on the western boundary of the parcels, is the topographic low point such that all runoff originating from the west flows directly into the channel (Figure 3.8). It might be possible to install a curb along James to pass some local runoff water over the low point and then onto the CTC lots (delineated as the 10-

acre Western James Catchment in Figure 3.8). However, it appears that a wet basin may be infeasible at the James Street CTC lots because of near-surface groundwater which would severely limit the storage capacity of any basin, thereby reducing the hydraulic residence time. Based on the apparent low feasibility of providing substantial treatment of the Western James Catchment on the City and CTC parcels, the drainage area has been shown on Figure 3.8 as an indentified opportunity but was not included in the pollutant load reduction analysis. A detailed feasibility assessment of this potential opportunity can be completed in future planning stages of the Tahoe Valley WQIP using the recently collected topographic data for the CTC and City lots. The pollutant load reduction analysis assessed opportunities to reduce loads from the Eastern James Catchment (Figure 3.8) as described below.

3. Use of these lots for infiltration of stormwater is possible, but limited because of the high water table over most of the area. All of the City lot and most of the CTC lots are defined as SEZ with a shallow depth to the water table, probably on the order of between 1-2 feet over approximately half of the available area. The elevation difference between the water surface in the open channel and the ground surface is approximately 4 feet on the western CTC lot. However, this drops to a difference of only 2 feet on the northern half of the larger eastern parcel. This shallow depth to water table restricts the ability to construct a basin with significant storage volume. The following design options may be possible to treat or infiltrate local runoff.

    a. The southern portion of the eastern CTC parcel has highly permeable soils with a depth to the water table in excess of 6 feet, and is capable of directly infiltrating runoff via several cross-drains which would route runoff generated along the south side of James under the street and discharge onto the parcel. Currently, this runoff enters the constructed channel and is then discharged to the river. The drainage area for James Street between Tahoe Keys Boulevard and Third Street extends to the south such that most of the highway frontage lots drain back to James Street (see boundaries of the 11-acre Eastern James Catchment on Figure 3.8).

    b. Runoff along the south side of Eloise Avenue east of the main channel appears to enter the CTC lot as dispersed flow, but some small lead-off ditches extending from the roadside flow line into the lots would ensure that runoff enters the CTC lot rather than being directly discharged into the channel. Very little runoff appears to enter the City lot because upslope runoff from the east is routed off the road to the east of the City lot and directly into the channel for runoff generated along Eloise west of the parcels. It may be possible to construct a low AC curb or berm along the shoulder could be installed to shunt this runoff east of the channel and onto the lots for treatment via a lead-off ditch and a very shallow basin. Care should be taken with this design option to avoid the possibility for

inundation of the road shoulder and possibly a portion of the roadway during very large storms.

Feasibility Assessment Key Information Needs

1. The CTC indicated in April 2012 that the two CTC parcels (Figure 3.8) could potentially be used for stormwater treatment.

2. A topographic survey of the two CTC parcels and City parcel occupied by the Linda Wet Basin was completed in May of 2012. The survey data was collected in State Plane Coordinate System NAD83 and NAVD88. The point data from the topographic survey is provided in Appendix B along with a sketch showing the preliminary gradeline feasibility assessment of the parcels.

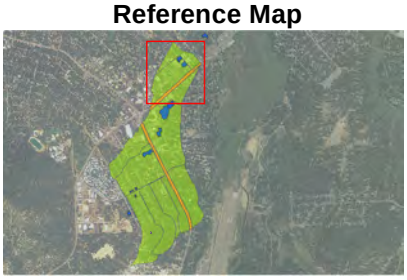
3. The parcels of interest are mapped as SEZ. A TRPA land capability verification will likely be required to support the environmental review process.

Legend

Existing Infrastructure

- Drainage Pipe
- Curb and Gutter
- Open Channel
- Paved Flow Line

Reference Map



City of South Lake Tahoe

Tahoe Valley WQIP
Conceptual Layout of Alternatives

Scale - 1:3,600 1 inch = 300 feet

0 295 590 Feet

CA State Plane, Zone II	NAD 83	horiz. units: feet
northwest hydraulic consultants	project no. 500019	May 2012

Figure 3.8 - James Infiltration Basin

Planning Level Estimate of Pollutant Load Reduction

In addition to illustrating the conceptual layout of Alternative 2, Figure 3.3 illustrates how Alternative 2 was modeled using PLRM to estimate reductions in pollutant loading that may be achieved from increased stormwater treatment on publicly owned parcels. Given the preliminary nature of this planning level analysis, the following assumptions were made to estimate the size and water quality storage capacity of the proposed treatment facilities.

- A reconnaissance level field survey estimated the maximum footprint of each stormwater treatment facility based on the topography of the parcel and the surrounding area.
- For infiltration basins, the water quality treatment volume was assumed to be 1 foot times the maximum footprint.
- For wet basins, the wet pool volume was assumed to be 0.5 feet times the maximum footprint. The surcharge storage volume was assumed to be 0.5 feet times the maximum footprint.

Table 3.2 summarizes the estimated performance of each proposed stormwater treatment facility for reducing pollutant loads of fine sediment and surface runoff. Additionally, Table 3.2 relates each estimate of stormwater treatment performance to the potential reduction in the City's baseline pollutant load of FSP. Caltrans runoff is tributary to the proposed expansion of the Helen Dry Basin, which is estimated to reduce FSP loading by 9,000 lb/year. To estimate the load reduction attributed to City stormwater, the same proportional share in FSP loading used for Alternative 1 was used (City = 80%; Caltrans = 20%). Therefore, the FSP load reduction attributed to City stormwater for the Expanded Helen Dry Basin is estimated to be 7,200 lb/year (9,000 x 80% = 7,200 lb/year). As shown in Table 3.2, the proposed Bonanza Infiltration Basin, Expanded Helen Dry Basin, and Proposed James Infiltration Basin are estimated to provide significant reductions in pollutant loading.

Table 3.2 – Alternative 2 Estimated Load Reduction

Stormwater Treatment Facility	Size of Drainage Area (Acres)	Estimated Water Quality Storage (CF)	Estimated FSP Load Reduction (lb/year)	Estimated Surface Runoff Reduction (AF/year)	% Reduction Relative to Total City Baseline Load
Proposed Margaret Infiltration Basin	5	10,000	100	0.5	0.03%
Proposed Dedi Infiltration Basin	8	5,000	200	1.0	0.05%
Proposed Bonanza Infiltration Basin	111	50,000	6,200	20.2	1.6%
Expanded Helen Dry Basin	252	25,000	7,200	0.8	1.9%
Proposed James Infiltration Basin	11	12,500	2,700	0.8	0.7%
Totals for Alternative 2:			**16,400**	**23**	**4.2%**

Planning Level Cost Estimate

Table 3.3 provides a planning level cost estimate to implement Alternative 2 organized into categories of work related to: 1) environmental studies, documents, and permitting; 2) planning, design, and preparation of construction documents; 3) and construction of improvements. Given the preliminary nature of the formulated alternative, a lower and upper bound on probable costs has been estimated. Relative to Alternative 1 and Alternative 3, the lower and upper estimates of probable costs have a narrower range, highlighting that Alternative 2 has the least amount of uncertainty associated with the implementation of proposed improvements among the formulated alternatives.

Table 3.3 – Alternative 2 Planning Level Cost Estimate

Category of Work Effort	Planning Level Cost Estimate	
	Low Estimate	High Estimate
Environmental Studies, Documents, and Permitting	$150,000	$310,000
Planning, Design, and Preparation of Construction Documents	$270,000	$450,000
Construction of Improvements	$480,000	$730,000
Total	$900,000	$1,490,000

3.3 ALTERNATIVE 3 – INCREASED STORMWATER TREATMENT COMBINED WITH LOW FLOW DIVERSION TO TALLAC LAGOON

Strategy for Water Quality Improvement

The strategy for Alternative 3 proposes to maximize the pollutant load reduction achieved by the Tahoe Valley WQIP by combining the key water quality improvements from Alternatives 1 and 2 to include the low flow diversion to Tallac Lagoon and construction of new and expanded stormwater treatment facilities on publicly owned lots. Additionally, the strategy for Alternative 3 includes a focus on private property BMP implementation for commercial properties within the Tahoe Valley drainage area. Finally, the strategy for Alternative 3 proposes to discharge treated stormwater from the expanded Helen Dry Basin via a closed pipe to the SEZ south of the Tahoe Valley Elementary School. Relative to Alternative 1, the approach for the low flow diversion in Alternative 3 is proposed to potentially: 1) reduce permitting issues and the level of environmental review necessary to discharge treated stormwater runoff to the SEZ adjacent to the Tahoe Valley Elementary School with subsequent discharge to Tallac Lagoon and Pope Marsh; and 2) avoid the need for stormwater pumping.

Conceptual Layout of Potential Improvements

Figure 3.9 provides an overview of the key water quality improvements proposed under Alternative 3, which include: 1) new and expanded stormwater treatment facilities; 2) low flow diversion to Tallac Lagoon of treated stormwater from the outlet of the expanded Helen Dry Basin; and 3) implementation of BMPs for all commercial properties in drainage catchments with the densest commercial area (TV5 through TV9 in Figure 3.9).

The low flow diversion to Tallac Lagoon would be accomplished by modifying the existing outlet of the expanded Helen Dry Basin to route low flows to a new pipe, which would be constructed in Barton Avenue, Third Avenue, and Tahoe Island Drive to convey treated runoff to the SEZ south of the Tahoe Valley Elementary School. This new pipe would be isolated from stormwater runoff flows in the downstream Tahoe Valley drainage area to avoid discharging untreated stormwater runoff to an SEZ. Flows discharged from the Helen Dry Basin that exceed the capacity of the low flow diversion pipe would be routed through the existing storm drainage system, which ultimately discharges to the Upper Truckee River.

Planning Level Estimate of Pollutant Load Reduction

In addition to illustrating the conceptual layout of Alternative 3, Figure 3.9 illustrates how Alternative 3 was modeled using PLRM to estimate reductions in pollutant loading that may be achieved. Similar to Alternative 1, the overall load reduction in the City's baseline load from implementation of the low flow diversion would be dependent upon the amount of stormwater runoff diverted. To illustrate how load reductions may vary based on the maximum diversion flow rate, the PLRM scenario shown in Figure 3.9 was run for multiple maximum rates of diversion to produce Figure 3.10.

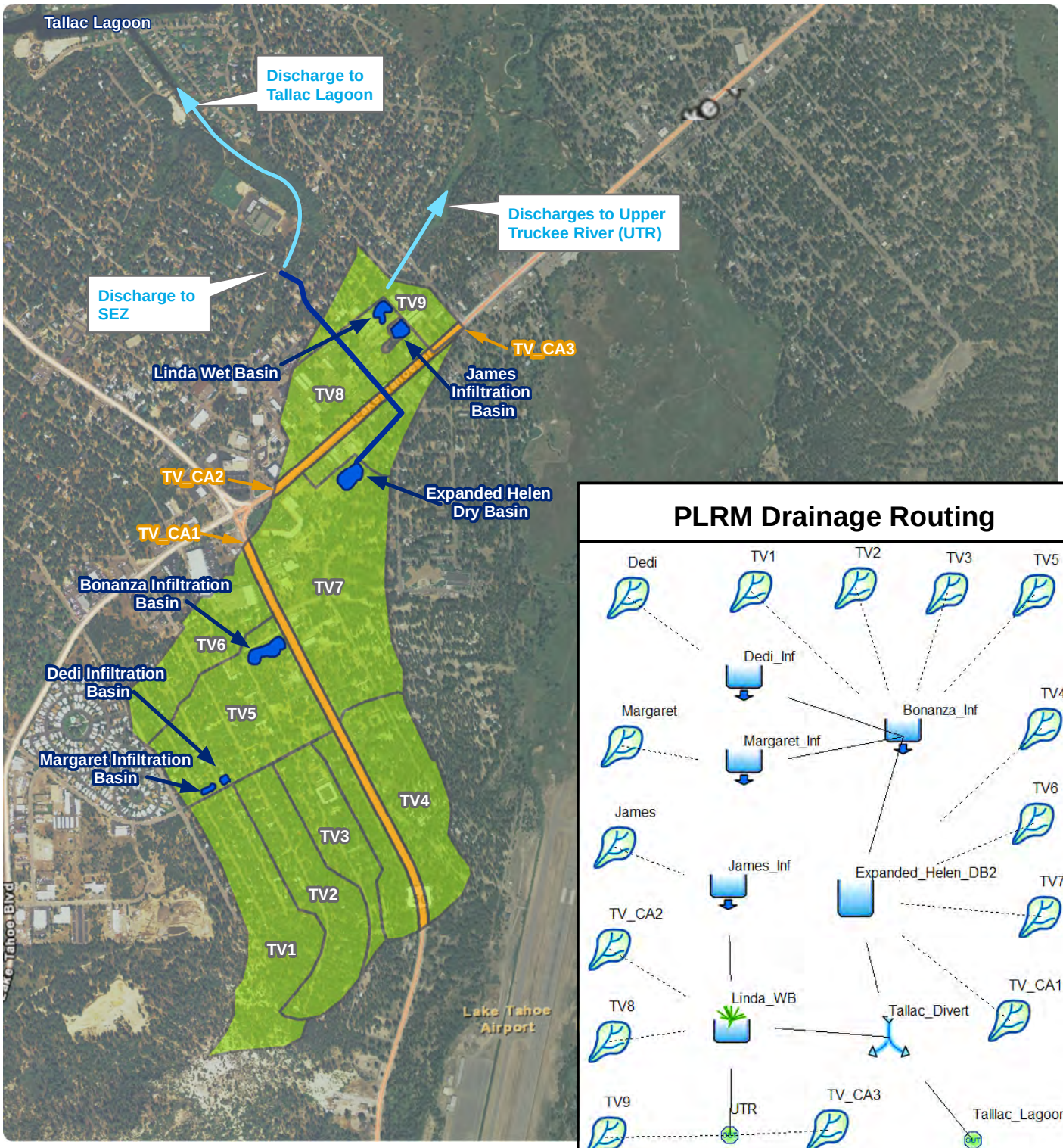


Figure 3.9 - Alternative 3: Low Flow Diversion and Increased Stormwater Treatment

Upstream of the diversion proposed at the Helen Dry Basin the following key modeling assumptions for Alternative 3 influence the estimate of the total pollutant load diverted (see Figure 3.9):

- The proposed Dedi, Margaret, and Bonanza Infiltration Basins are constructed
- Private property BMPs are implemented on all commercial land uses in catchments TV5, TV6, and TV7 to retain and infiltrate 1 inch or runoff
- Caltrans runoff from TV_CA1 generates pollutant loads in the baseline condition (i.e. Caltrans has not implemented planned water quality improvements to this section of their right-of-way).

The estimates in Figure 3.10 include an analysis of total reductions in pollutant loading and reductions attributed to City stormwater with Caltrans stormwater excluded. The estimate that excludes Caltrans stormwater assumes the same proportional share in FSP loading used for Alternative 1 (City = 80%; Caltrans = 20%). Using this proportional share for credited load reduction produces an estimated 8,600 lb/year load reduction of FSP for City stormwater from a 4 cfs diversion (10,800 x 80% = 8,600 lb/year). An 8,600 lb/year load reduction equates to a 2% reduction in the City's baseline load.

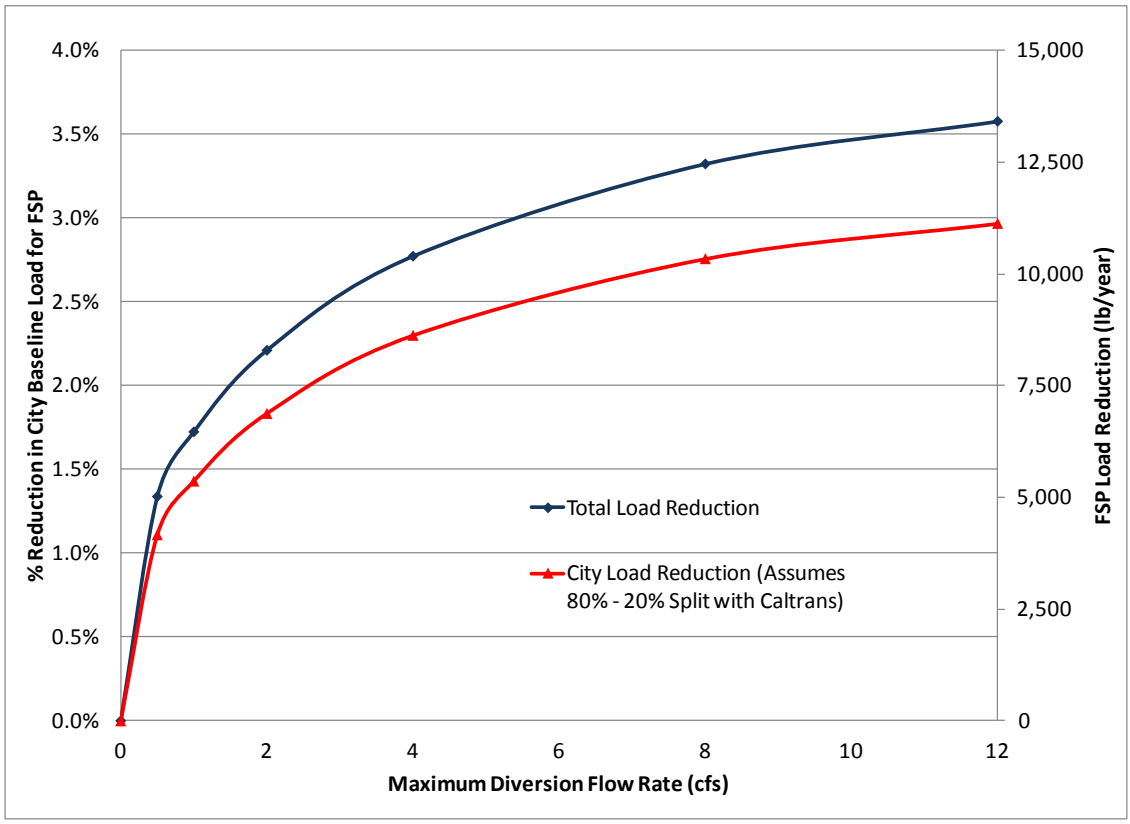


Figure 3.10 – Alt 3 Estimated Load Reduction of Diversion Only

In addition to the pollutant load reduction achieved from the stormwater diversion, the implementation of the proposed stormwater treatment facilities and commercial BMPs for all commercial properties in drainage catchments with the densest commercial area (TV5 through TV9 in Figure 3.9) would provide an estimated total pollutant load reduction of 30,000 lb/year of FSP. Of this total, proposed stormwater treatment facilities are estimated to provide an 18,000 lb/year reduction in FSP, and implementation of commercial BMPs is estimated to provide a 12,000 lb/year reduction in FSP.

Therefore, combining a diversion of 4 cfs with stormwater treatment improvements and commercial BMPs in the Tahoe Valley drainage area under Alternative 3 is estimated to provide a reduction of 41,000 lb/year of FSP. (This estimate includes load reductions from Caltrans runoff that is tributary to stormwater treatment facilities and the low flow diversion). Assuming the same proportional share in FSP loading used for Alternative 1 (City = 80%; Caltrans = 20%), the FSP load reduction attributed to City stormwater under Alternative 3 is estimated to be 32,800 lb/year (41,000 x 80% = 32,800 lb/year). This load reduction equates to an 8.5% reduction in the City's total baseline load, which is close to the 10% reduction in the baseline load required to meet the first Lake Tahoe TMDL milestone.

Design Considerations

Design considerations for Alternative 3 primarily relate to routing of storm drain piping for the low flow diversion. A potential option for routing storm drain from the Helen Dry Basin to the SEZ crossing Tahoe Island Drive is shown in Figure 3.9. This route would construct storm drain in Barton Avenue, Third Avenue, and Tahoe Island Drive to convey treated runoff to the SEZ south of the Tahoe Valley Elementary School. The following design considerations would require further assessment for this routing option.

- Topographic surveying and detailed hydraulic calculations to assess the feasibility of gravity flow storm drain from the outlet of the Helen Dry Basin to the SEZ has not been conducted. While additional data collection and analysis would be necessary, a preliminary evaluation using the 2010 Tahoe Basin LiDAR data for the Tahoe Basin indicates that gravity flow may be possible. The LiDAR data indicated an elevation difference of roughly 10 feet from the Helen Basin outlet to the SEZ. The proposed routing of storm drain would span a distance of 2,700 feet, equating to a pipe slope of roughly 0.3%. Based on the analysis conducted for Alternative 1, a minimum pipe slope of 0.25% is necessary to achieve the desired minimum scour velocity of 3 feet per second with a pipe flowing full.
- The proposed storm drain route extends from the existing outlet of the Helen Dry Basin in Barton Avenue to Third Street. This route was selected to minimize construction in Caltrans right-of-way and the number of potential conflicts with other underground utilities. However, the localized topography along the proposed route would require an excavation of at least 10 feet in Barton Avenue between Fourth Street and Third Street to place the storm drain at the necessary grade.

- Potential conflicts with underground utilities, especially conflicts at the intersection of Highway 50 and Third Street have not been assessed.

Feasibility Assessment Key Information Needs

Similar to Alternative 1, the primary information needed for Alternative 3 is associated with additional environmental assessment of potential adverse impacts from the discharge of treated stormwater runoff to the SEZ adjacent to the Tahoe Valley Elementary School, with subsequent discharge to Tallac Lagoon and Pope Marsh. The environmental review and permitting process for Alternative 3 may be less extensive compared to Alternative 1 based on the quality of stormwater diverted. However, Alternative 3 would still likely require a number of additional environmental studies and public outreach initiatives. The time and resources necessary to perform the environmental review process and obtain applicable permits may conflict with the City's objective to construct near-term water quality improvements in the Tahoe Valley drainage area with limited available funding.

The following information related to the proposed storm drain routing for the low flow diversion would also need to be assessed.

- Topographic survey to confirm feasibility of gravity storm drain for the low flow diversion.
- Locations of underground utilities in Barton Avenue, Third Street, intersection of Highway 50 and Third Street, and Tahoe Island Drive.
- Obtain and review as-built drawings from the D Street Erosion Control Project.

Planning Level Cost Estimate

Table 3.4 provides a planning level cost estimate to implement Alternative 3 organized into categories of work related to: 1) environmental studies, documents, and permitting; 2) planning, design, and preparation of construction documents; 3) and construction of improvements. Given the preliminary nature of the formulated alternative, a lower and upper bound on probable costs has been estimated. Alternative 3 includes an estimate of construction costs for BMP retrofit of all commercial properties in drainage catchments with the densest commercial area (TV5 through TV9 in Figure 3.9).

Table 3.4 – Alternative 2 Planning Level Cost Estimate

Category of Work Effort	Planning Level Cost Estimate	
	Low Estimate	High Estimate
Environmental Studies, Documents, and Permitting	$340,000	$560,000
Planning, Design, and Preparation of Construction Documents	$470,000	$760,000
Construction of Improvements	$1,490,000	$2,250,000
Commercial Private Property BMPs (50 Acres)	$2,000,000	$3,000,000
Total	$4,300,000	$6,570,000

4.0 ESTIMATED LOAD REDUCTION BY ALTERNATIVE

Assuming a maximum diversion flow rate of 4 cfs, Table 3.5 compares estimated load reductions of FSP based on the results of PLRM simulations for each alternative. (Estimates of load reductions in Table 3.5 include Caltrans runoff that is tributary to stormwater treatment facilities and/or the low flow diversion). As shown in Table 3.5, Alternative 3 is estimated to create the largest pollutant load reduction. While load reduction estimates are less for Alternatives 1 and 2 when compared to Alternative 3, the water quality benefit from these alternatives would still be significant. For example, Alternative 2 is estimated to reduce the City's baseline load of FSP by almost 5%, which is half of the targeted 10% load reduction necessary to meet the first Lake Tahoe TMDL milestone.

Table 3.5 – Alternative Load Reduction Comparison with 4 cfs Diversion

Alternative	Total FSP Load Reduction (lb/year)	City FSP Load Reduction (lb/year) - 80%/20% Split with Caltrans	% Reduction in City Baseline Load for FSP
Alternative 1 - Assuming Maximum 4 cfs Diversion to Tallac Lagoon	24,000	19,200	4.9%
Alternative 2 - Stormwater Treatment Facilities and No Diversion	18,000	16,400	4.2%
Alternative 3 - Stormwater Treatment Facilities plus Maximum 4 cfs Diversion to Tallac Lagoon	41,000	32,800	8.4%

As noted previously, the total load reduction that might be achieved from either Alternative 1 or Alternative 3 would be dependent upon the amount of stormwater runoff diverted to Tallac Lagoon. Figure 3.10 displays how load reductions would vary for the alternatives with maximum rate of stormwater diversion to Tallac Lagoon. The following bullet points summarize how to interpret Figure 3.10 and the results of the modeling analysis:

- Alternative 2 does not include the low flow diversion. Therefore, the load reduction estimate does not vary based on the diversion flow rate and is constant at 18,000 lb/year of FSP.
- Alternative 3 assumes that public stormwater treatment facilities and commercial BMPs in the Tahoe Valley drainage area are constructed prior to implementing the low flow diversion. Therefore, the load reduction for Alternative 3 at a diversion flow rate of 0 cfs equals the estimated load reduction from these actions (roughly 30,000 lb/year of FSP)
- Estimates of load reduction resulting from the same rate of low flow diversion are higher for Alternative 1 relative to Alternative 3. This difference in loading results from the following differences proposed under Alternative 3: 1) the location of the diversion would be farther upstream in the Tahoe Valley drainage area, which reduces the amount of

highway runoff and commercial runoff that would be tributary to the diversion; and 2) stormwater treatment facilities in the upper drainage area would be implemented to infiltrate runoff and reduce loading. In addition to differences in load reduction, the differences between the formulated alternatives would result in more pollutant loading being diverted in Alternative 1 to the SEZ adjacent to the Tahoe Valley Elementary School with subsequent discharge to Tallac Lagoon and Pope Marsh relative to Alternative 3.

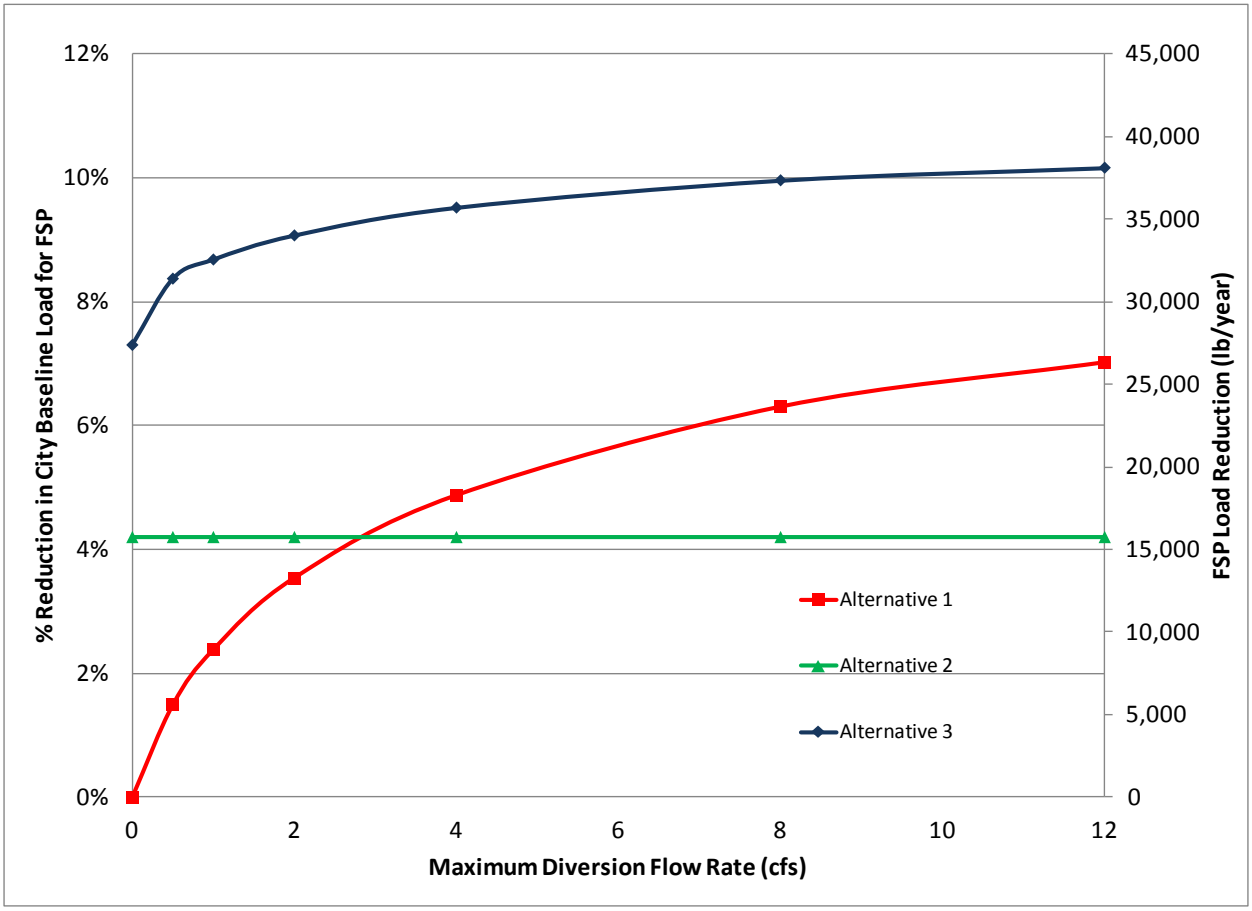


Figure 3.11 – Alternatives Load Reduction Comparison

5.0 REFERENCES

City of South Lake Tahoe (CSLT). 2012. Pollutant Load Reduction Strategy and Plan – Identification of Stormwater Improvement Opportunities. Prepared by Northwest Hydraulic Consultants. South Lake Tahoe, CA. April 2012.

City of South Lake Tahoe (CSLT). 2011. Lake Tahoe TMDL Baseline Pollutant Load Estimate. Prepared by Northwest Hydraulic Consultants. South Lake Tahoe, CA. September 2011.

FEMA. 2012. Flood Insurance Rate Map. El Dorado County and Unincorporated Areas. Map Number 06017C0367F. Panel 367 of 1125. Map Revised April 3, 2012.

Lahontan Regional Water Quality Control Board (LRWQCB) and Nevada Division of Environmental Protection (NDEP). 2010. Final Lake Tahoe Total Maximum Daily Load. November 2010. http://www.swrcb.ca.gov/rwqcb6/water_issues/programs/tmdl/lake_tahoe/docs/tmdl_rpt_nov2010.pdf

Mays, L. W. 2005. Water Resources Engineering. ISBN: 978-0-471-70524-6. Publisher: John Wiley & Sons, Inc.

Northwest Hydraulic Consultants (NHC), Geosyntec Consultants, and 2NDNATURE. 2009. PLRM Model Development Document. Prepared for Lake Tahoe Basin Storm Water Quality Improvement Committee. South Lake Tahoe, CA. http://www.tiims.org/TIIMS-Sub-Sites/PLRM/docs-downloads.aspx

Northwest Hydraulic Consultants (NHC). 2010. PLRM Applications Guide. Prepared for Lake Tahoe Basin Storm Water Quality Improvement Committee. South Lake Tahoe. CA. http://www.tiims.org/TIIMS-Sub-Sites/PLRM/docs-downloads.aspx

Natural Resources Conservation Service (NRCS) - U.S. Department of Agriculture. 2006. Soil Survey of Tahoe Basin Area, CA and NV. U.S. Department of Agriculture, South Lake Tahoe, CA.

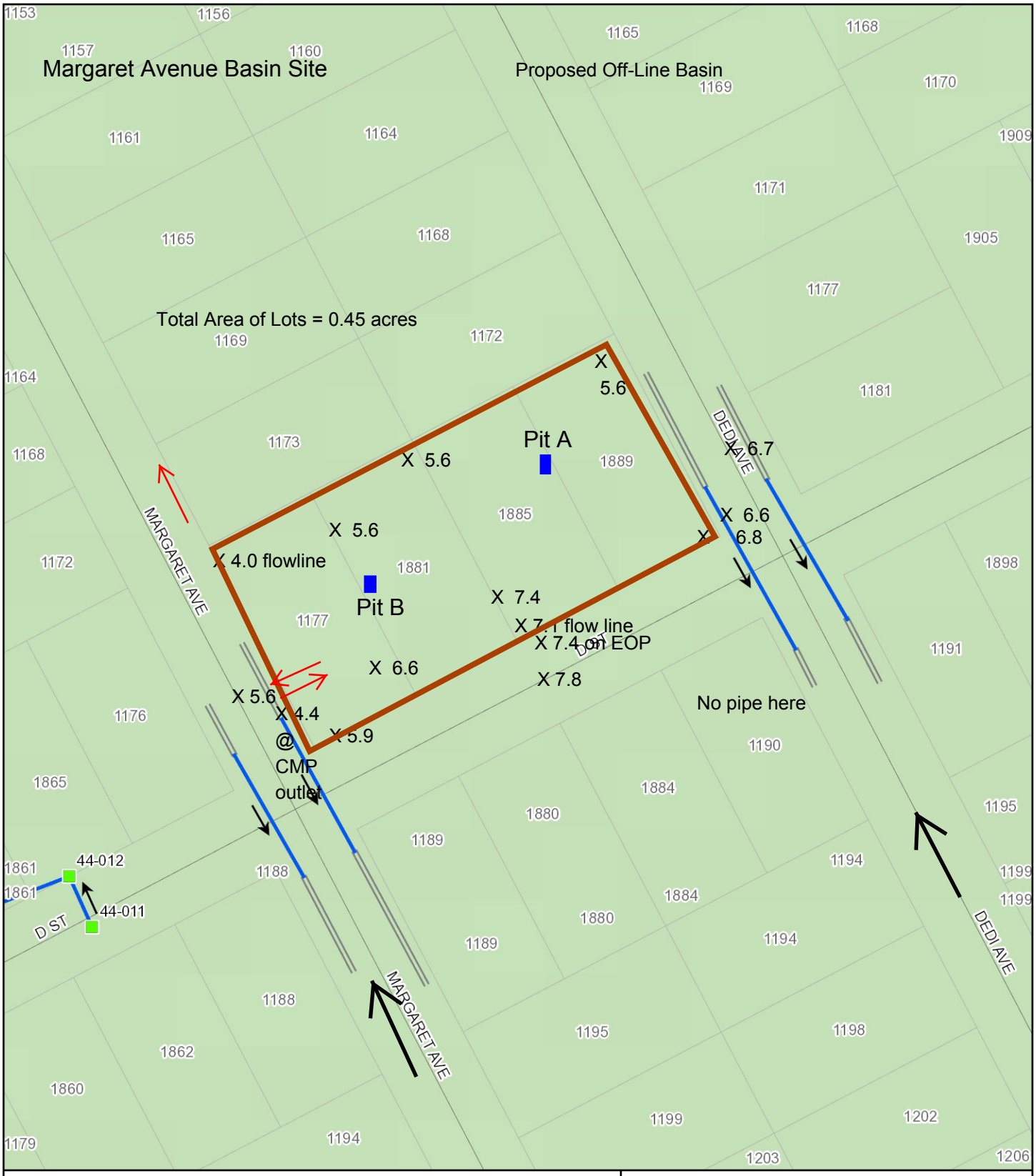
Appendix A – PLRM Models

All files provided digitally.

Appendix B – Topographic Surveys and Gradeline Feasibility Assessments

Point files of survey data provided digitally.

Margaret Infiltration Basin



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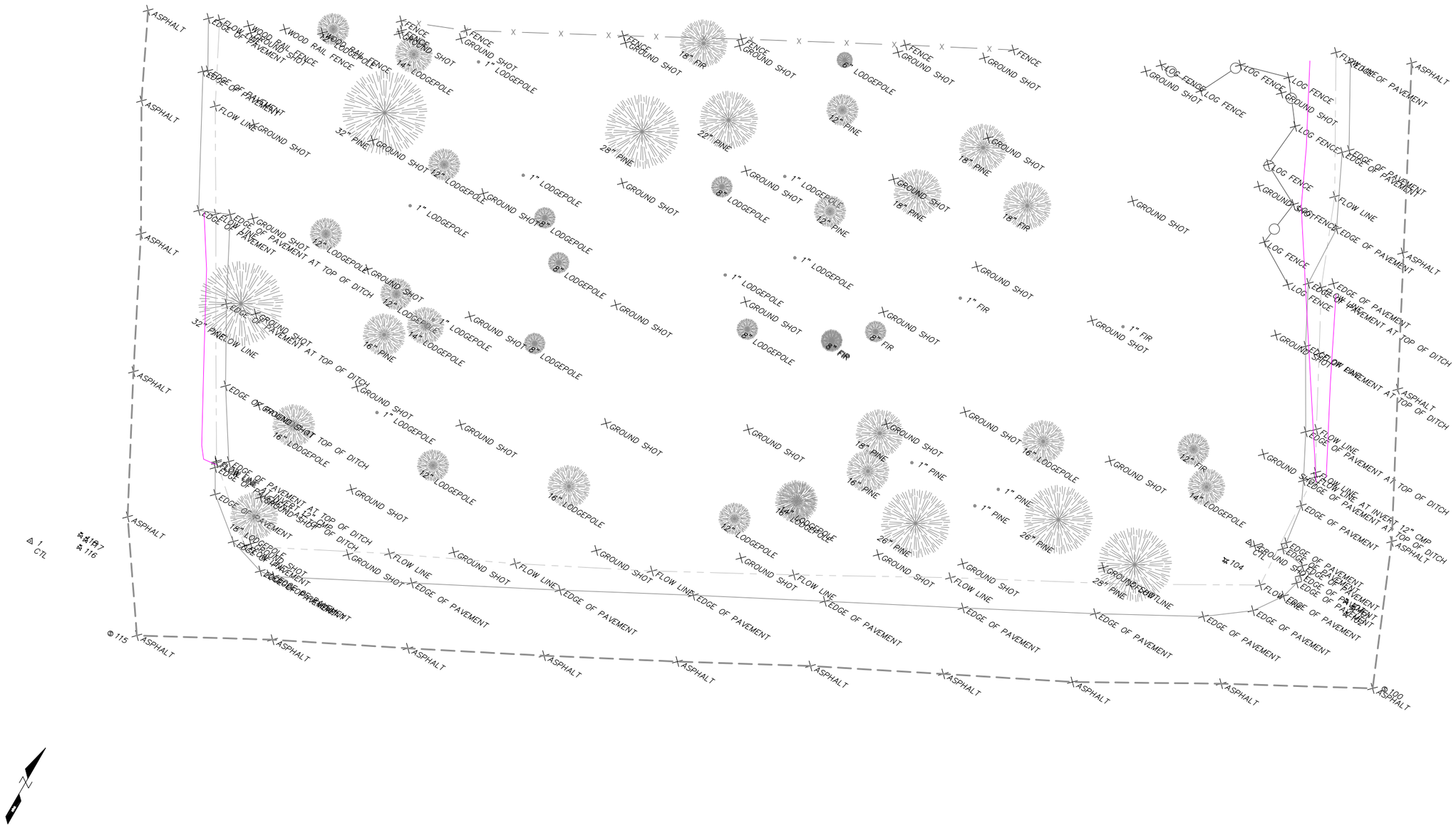
Storm Water System
South Lake Tahoe, California

Margaret and D St. Basin Gradeline Feasibility

4/5/2012



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PRELIMINARY
NOT FOR CONSTRUCTION

Revisions		
No.	Date	Description

Drawing Information	
Date	29 May 2012
Status	30% Submittal
Designer	
Drafter	
Checked	
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Plotted Scale	0 ½ 1

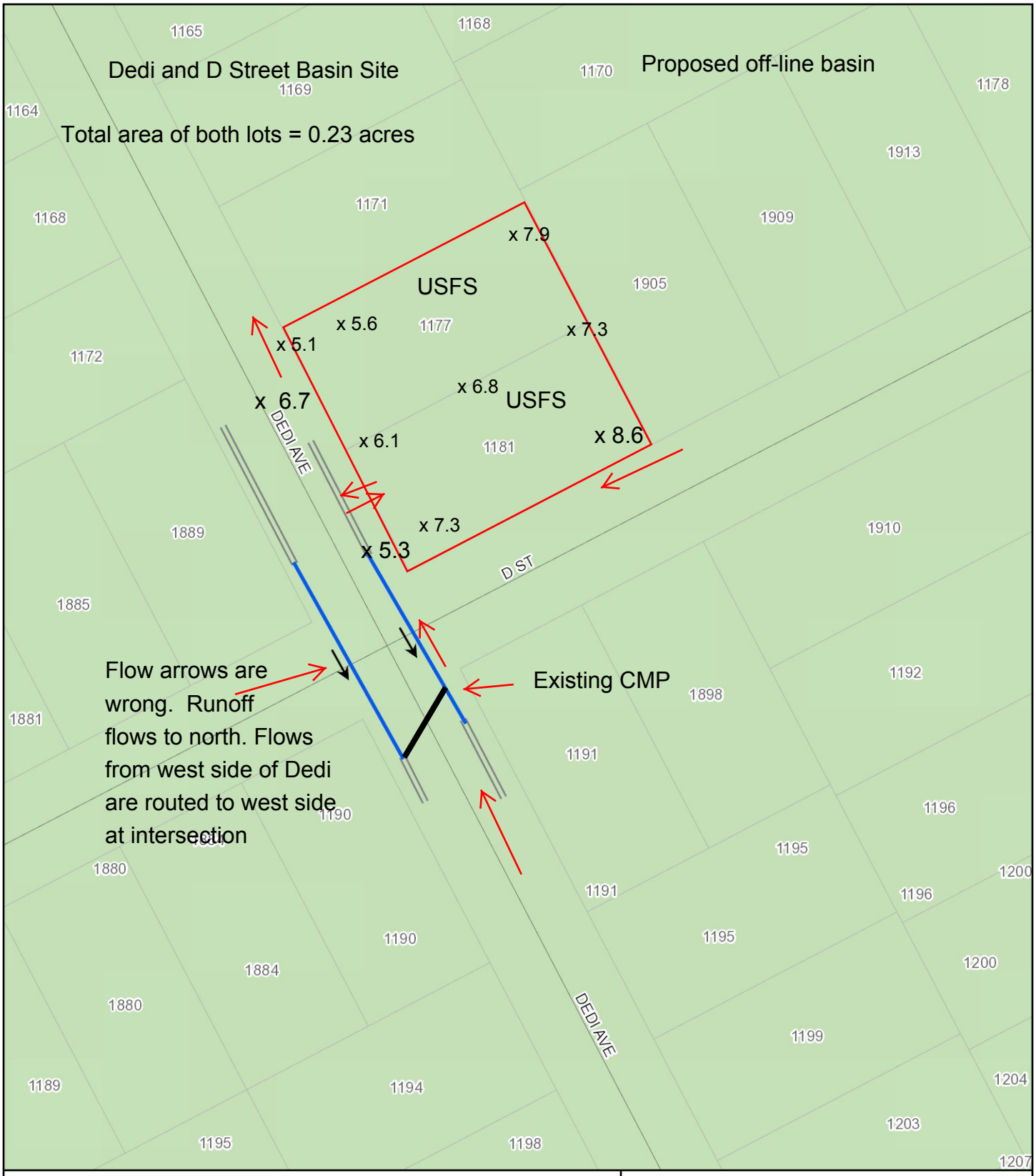
Margaret Survey

Job Number

Sheet Number

Sheet 1 of

Dedi Infiltration Basin



Storm Water System
South Lake Tahoe, California

Dedi Ave. and D St. Basin Site

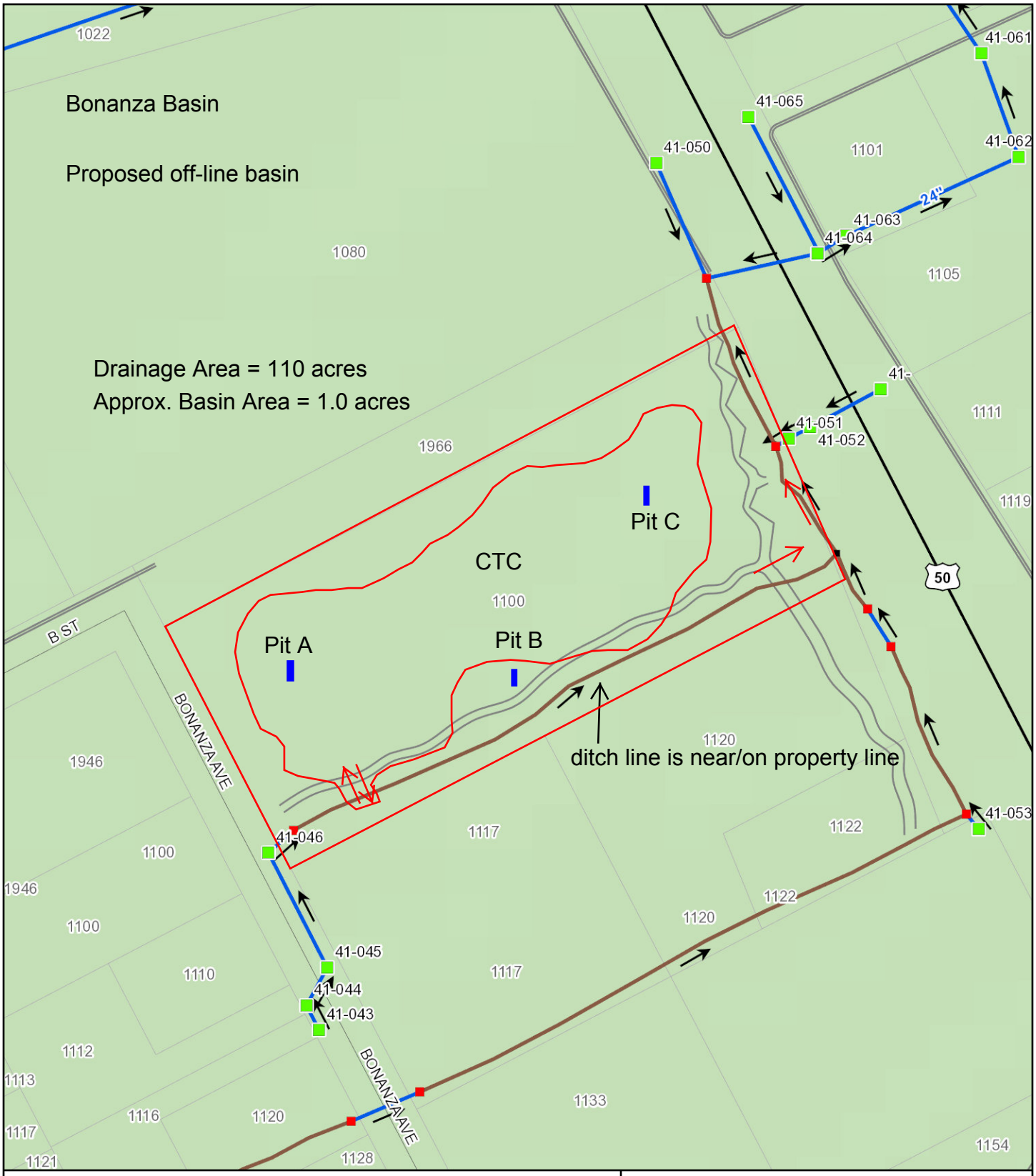
N

1 : 600

0 50 Ft

4/20/2012

Bonanza Infiltration Basin



N

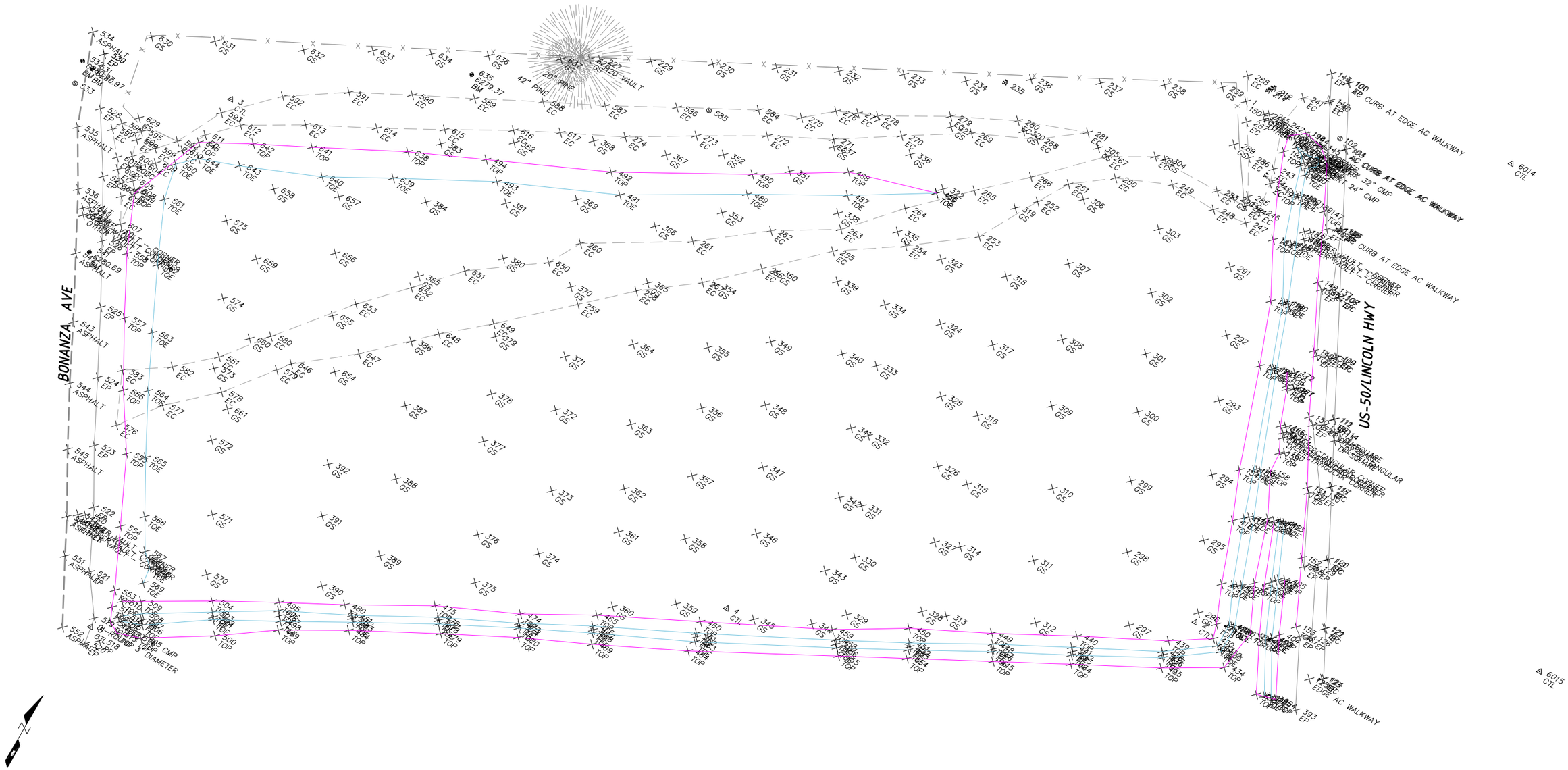
1 : 1,200

0 100 Ft

Storm Water System
South Lake Tahoe, California

Bonanza Basin Site

4/20/2012



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Revisions		
No.	Date	Description

Drawing Information	
Date	29 May 2012
Status	30% Submittal
Designer	
Drafter	
Checked	
File Name	XREF BONANZA.dwg
Plotted Scale	0 ½ 1

Bonanza Survey

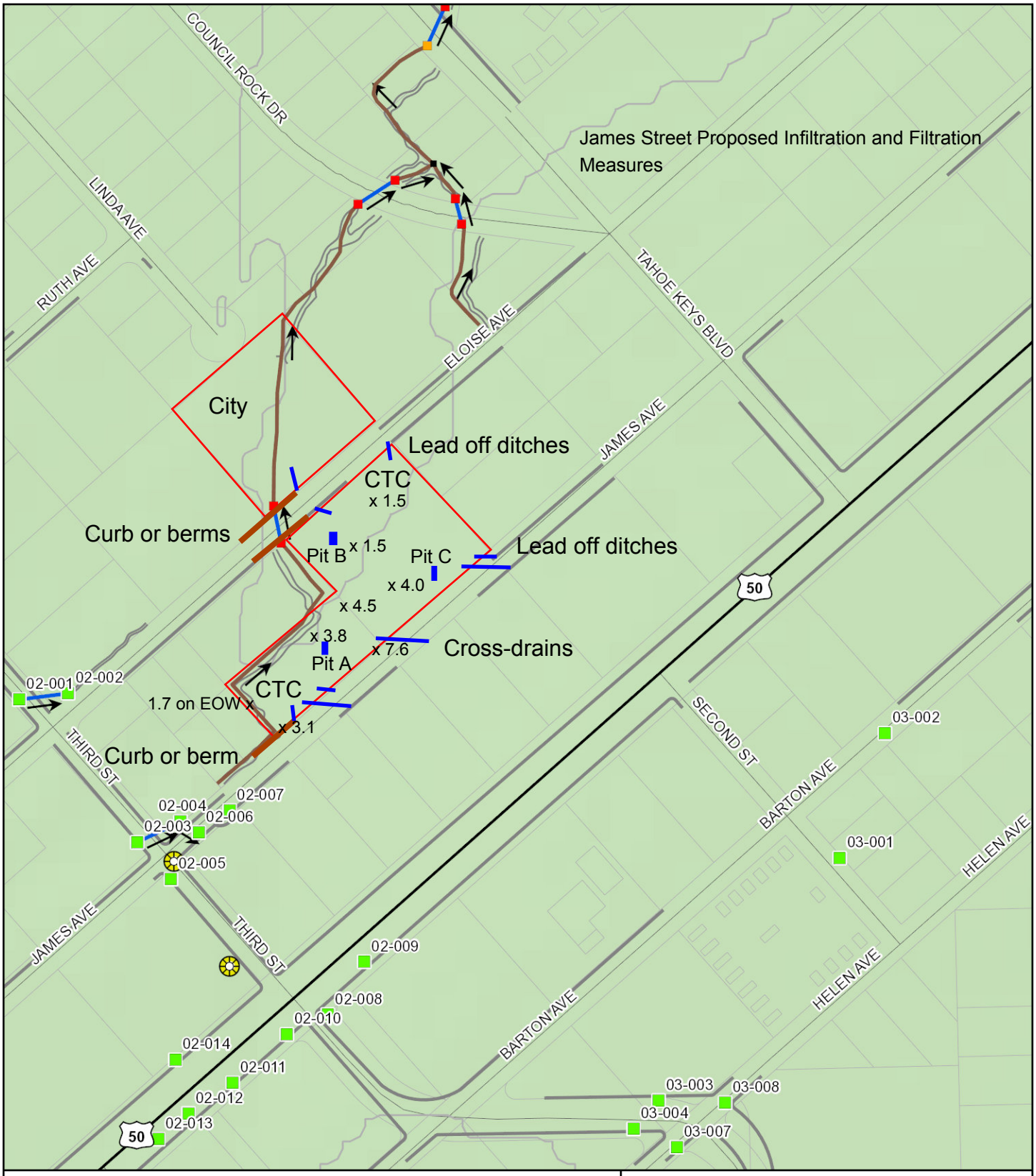
Job Number

Sheet Number

Sheet 1 of

James Infiltration Basin and

Existing Helen Wet Basin



Arbitrary Datum

N

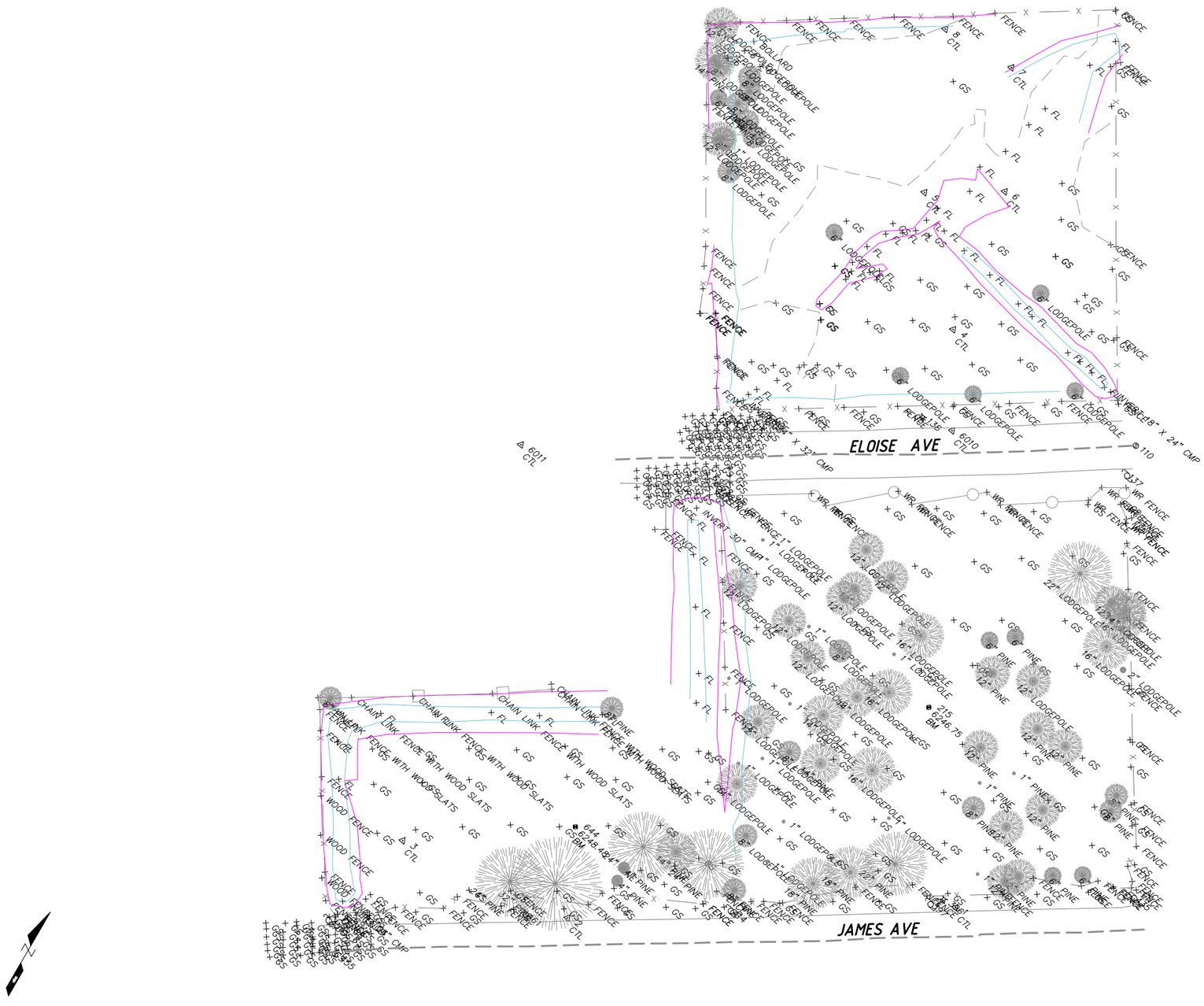
1 : 2,400

0 200 Ft

Storm Water System
South Lake Tahoe, California

James Street Basin Site

4/18/2012



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Revisions		
No.	Date	Description

Drawing Information	
Date	29 May 2012
Status	30% Submittal
Designer	
Drafter	
Checked	
File Name	XREF JAMES_LINDA.dwg
Plotted Scale	0 ½ 1

James/Linda Survey

Job Number

Sheet Number

Sheet 1 of