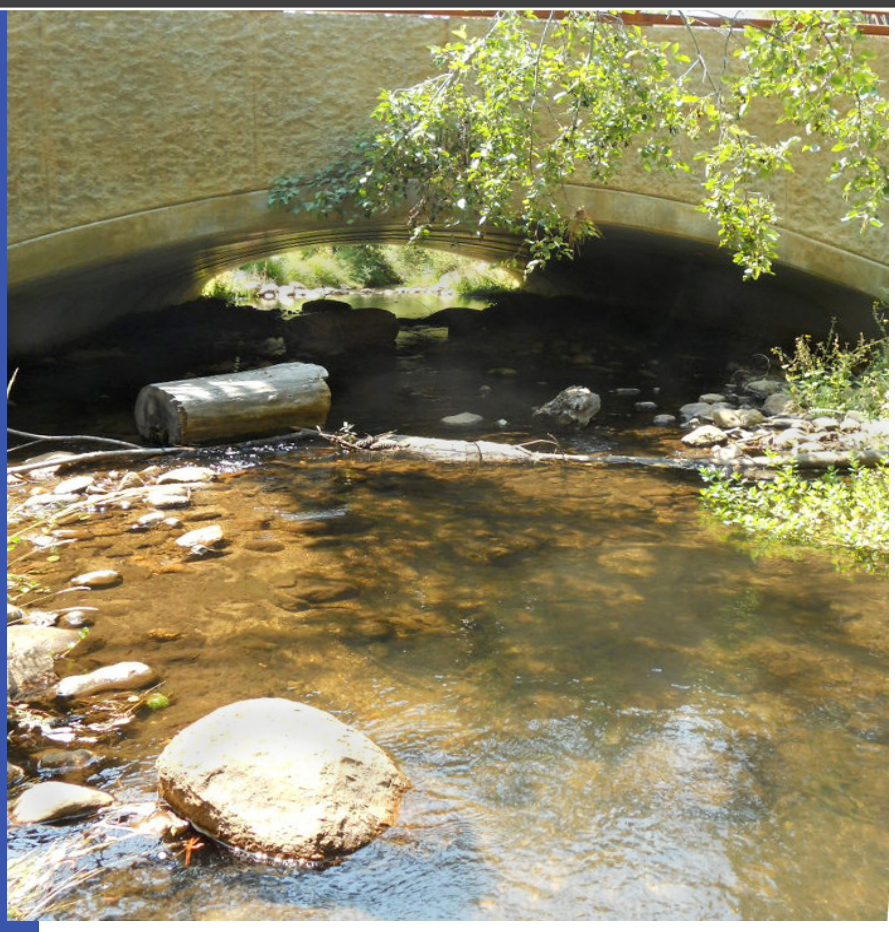
February 2015

Lower Country Club Community Stormwater Summary



Prepared for:

Washoe County

Incline Village General Improvement District

Prepared by:

Nevada Tahoe Conservation District

Lower Country Club Community Stormwater Summary
February 2015

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Contents

Executive Summary

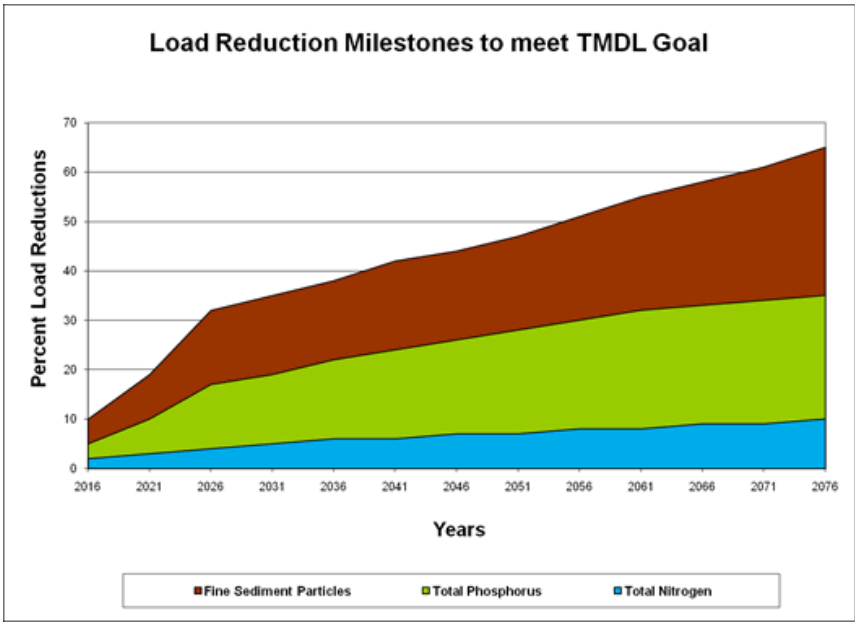
This document provides information regarding Community Watershed Partnerships in the Lower Country Club. It gives an inventory of the watershed and describes water quality issues and stormwater treatment options

Introduction and Background

Lake Tahoe was designated as an impaired waterbody by the Environmental Protection Agency (EPA) in 1988. One of the requirements after designation is the creation of a Total Maximum Daily Load (TMDL) which set limits on the total amount of pollutants a waterbody can receive and still meet safe water standards. In 2011, after much research and development, a TMDL for Lake Tahoe was approved.

The goal of the Lake Tahoe TMDL is to restore the Lake to its historic water clarity level of 97.4 feet. It established thresholds of pollutants (namely fine sediment, nitrogen and phosphorus) and calculated the load reductions needed from the four largest sources (urban and forest stormwater runoff, stream channel erosion, and atmospheric deposition) to achieve the TMDL by 2076. The Clarity Challenge was created as an interim goal to the TMDL numeric target. This goal is to meet a target of 78 feet of lake clarity by 2026 and considers opportunities for achievable load reductions in all source categories.

Figure 1: Load Reduction Milestones for Lake Tahoe



State Water Resources Control Board in California and Nevada Division of Environmental Protection (NDEP) in Nevada oversee implementation of the TMDL. These agencies work with other basin groups to achieve the thresholds put forth by the TMDL through the Lake Clarity Crediting Program. It uses Lake Clarity Credits to track pollutant load reductions from urban stormwater through a comprehensive tracking system. The Crediting Program aligns policies with ongoing implementation which in turn improves accountability and effectiveness of efforts.

The Tahoe Regional Planning Agency (TRPA)'s Environmental Improvement Program (EIP) was launched in 1997. The program was created to protect and improve the extraordinary natural and recreational resources of Lake Tahoe. It is a cooperative effort that defines the

restoration needed to attain the environmental goals of increasing water clarity. Key to this strategy is reliance upon partnerships with all sectors of the community, including private, local, state and federal. Part of the new regional plan adopted by the TRPA is the option for jurisdictions to create Area Plans. These plans allow the jurisdictions to be more considerate of the unique properties of their local communities. They describe the implementation of land use goals, policies, and ordinances including how the area will reach the environmental thresholds set forth by the TRPA Regional Plan. Once a plan is found to conform with all TRPA regulations and is adopted by a jurisdiction, the jurisdiction can assume development review authority through a memorandum of understanding (MOU) with the TRPA.

A portion of the TMDL and the EIP is the implementation of Best Management Practices (BMPs). BMP's improve water quality by reducing soil erosion and capturing polluted water before it enters Lake Tahoe. Implementing BMPs on private parcels is a critical step toward improving Lake Tahoe's water quality.

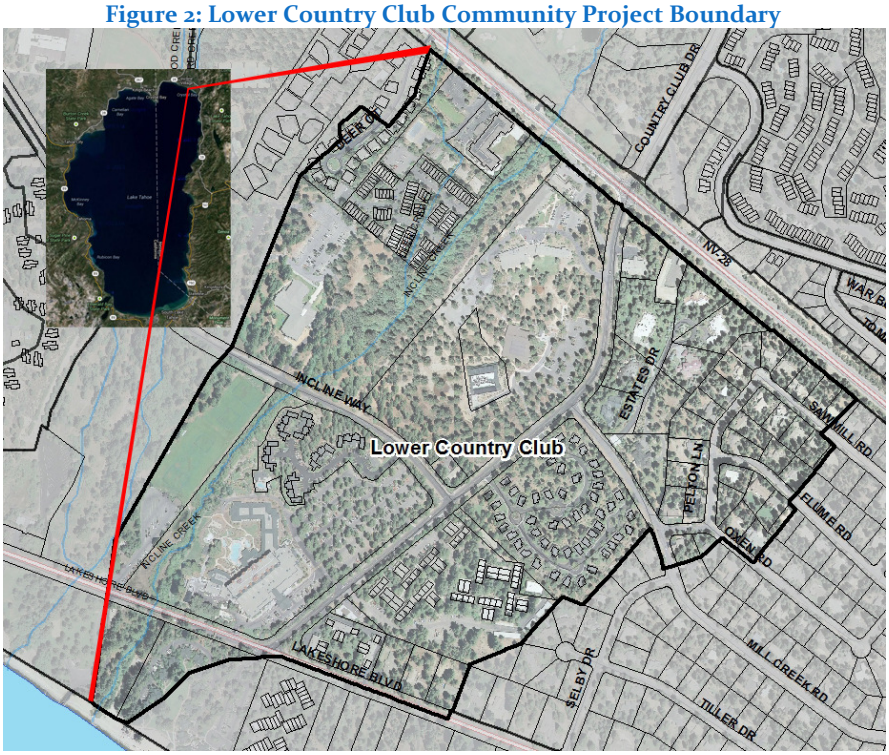
Community Watershed Partnerships (CWPs) work with jurisdictions and homeowners to create community-wide projects that achieve water quality improvement and help stabilize the declining clarity of Lake Tahoe. CWPs help watersheds achieve lake clarity goals by integrating the needs of the jurisdictions with the Best Management Practices (BMP) requirements of private parcels owners.

Lower Country Club is an area that is being targeted by Washoe County for stormwater treatment. The stormwater project that is now in the planning stage will benefit from increased developed parcel BMP participation. By increasing the number of BMP certified and maintained properties, future stormwater projects will function better and require less maintenance.

Inventory of the Watershed

The Lower Country Club Community is located on the north shore of Lake Tahoe in Washoe County. This area consists of 43 Single Family Residences, 243 Multi-Family Residences, and 48 Commercial/Industrial/Communication/Utilities properties. Washoe County is responsible for improvements and maintenance of roads, curbs, gutters, sidewalks, storm drains, storm drain system and street lighting. Washoe County maintains the roads by street sweeping, snow removal and abrasive application when and where applicable.

Figure 2: Lower Country Club Community Project Boundary



The Incline Village General Improvement District (IVGID) is responsible for public works including refuse and recycling, water treatment, production and availability, sewer water treatment and recreational areas for Incline Village and Crystal Bay.

The project area is hydrologically directly connected to Lake Tahoe via Incline Creek. Current EIPs in the project area treat runoff prior to discharging into Incline Creek.
The total acres in the Lower Country Club project area is 135.7. Of this, 34% is impervious and 66% is pervious. Below is the breakdown of pervious and impervious in SFR, MFR and CICU.

Figure 3: Land Use

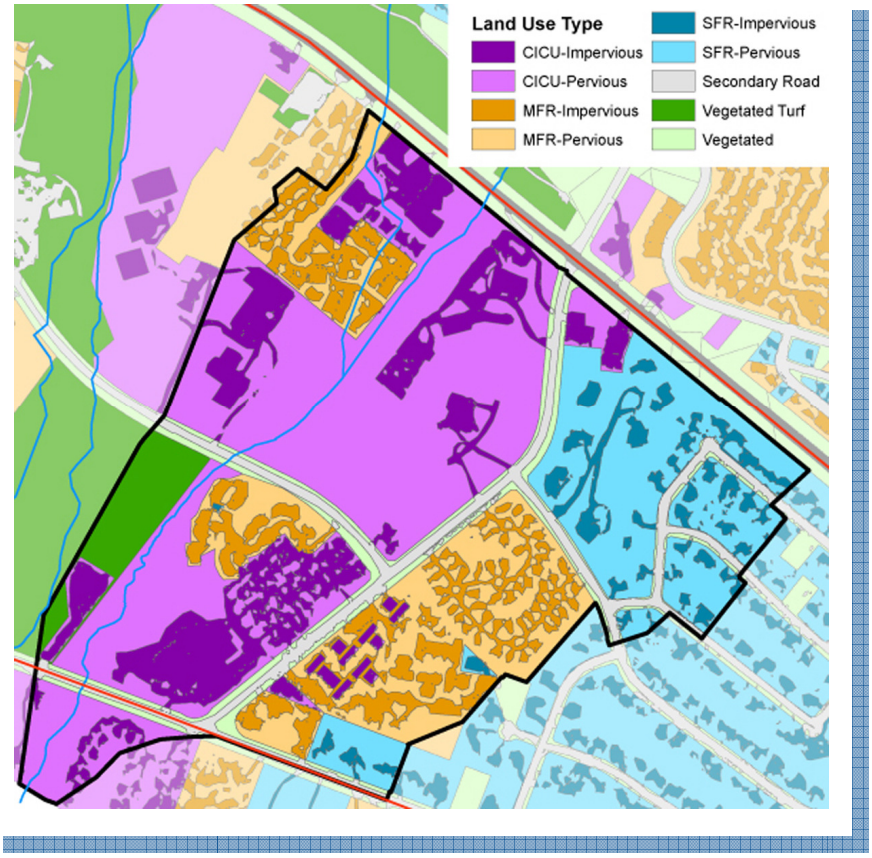
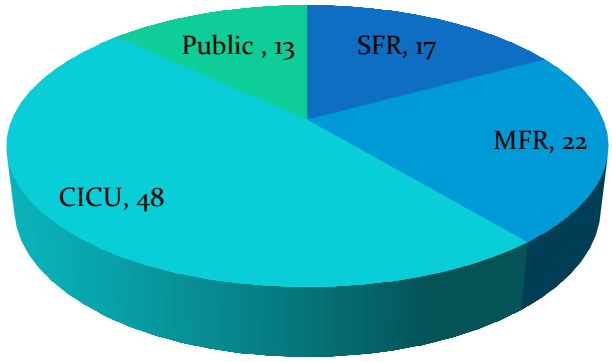
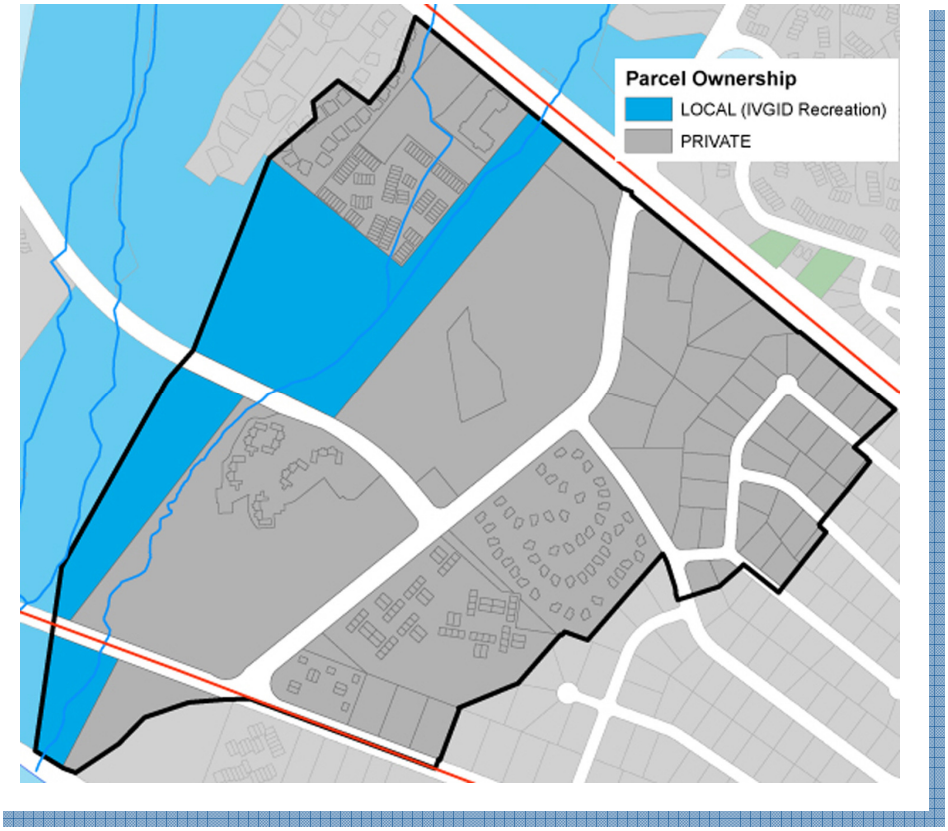


Figure 4: Percent Land Use



The ownership in Lower Country Club is divided into only local and private land. There is no federal or state owned land in the project area. IVGID owns 37% of the area with the rest being privately owned.

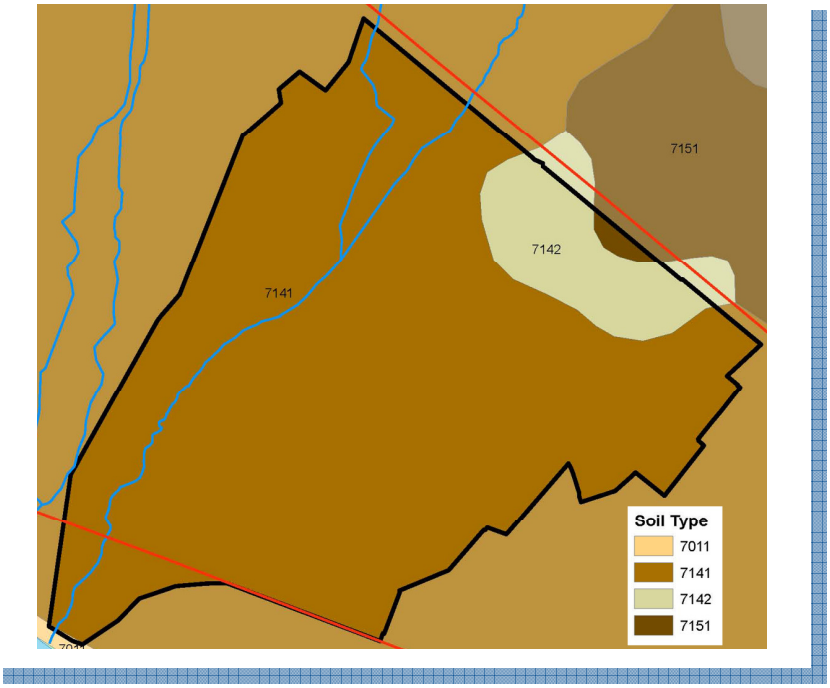
Figure 5: Parcel Ownership



Soils

Soil information helps explain hydrology, potential sources of pollutants, and past watershed conditions. The soils data that was completed in 2006 by the Natural Resources Conservation Service (NRCS) shows the soils in the area to be of 4 different types. Inville gravelly course sandy loam comprises the majority of the area. A summary of select characteristics of the soil types in the watershed are presented in below. Further descriptions of soil characteristics within the watershed can be found on pages A13-A19.

Figure 6: Soil Types



Soil Type	Description	% of Total Acreage	Permeability at 12"	Runoff Class
7011	Beaches, 0-5% slope	.04%	21.3	Negligible
7141	Inville gravelly course sandy loam, 2-9% slopes, stony	94%	5.7	Low
7142	Inville gravelly course sandy loam, 9-15% slopes, stony	8%	3.92	Low
7151	Jorge very cobbly fine sandy loam, 5-15% slopes, rubbly	1%	3.92	Low

Vegetation

Existing vegetation at the site is typical of a high, Eastern Sierra plant community. The south to west aspect, well drained soils, steep slopes and annual precipitation makes 'harsh site' species well adapted to this area.

Existing native vegetation:	
Ceanothus cordulatus	mountain whitethorn
Ceanothus prostratus	mahala mat
Ceanothus velutinus	Tobacco brush
Cercocarpos ledifolius	mountain mahogany
Artemesia tridentata	sagebrush
Arctostaphylos patula	greenleaf manzanita
Punus jeffreyi	Jeffrey pine
Purshia tridentata	antelope bitterbrush

Ericameria nauseosa	rabbitbrush

There are also additional "revegetation" type grasses. These species are scattered around the project area.

Figure 7: Rabbitbrush

Figure 8: Sagebrush

Invasive Weeds

The Lake Tahoe Basin is in the relatively early stages of infestation by invasive weeds, so early detection and rapid response (EDRR) is at the heart of efforts. By detecting and eradicating small populations early and quickly, land owners and managers can save money and time while protecting the area from damage by invasive plants. The plants listed below are the priority weeds of the Tahoe Basin. Report if encountered.

Class 1 Weeds: Present near or in the Tahoe Basin	
Cirsium arvense	Canada thistle
Centaurea diffusa	diffuse knapweed
Cardaria draba	hoary cress
Chondrilla juncea	rush skeletonweed
Acroptilon repens	Russian knapweed
Potentilla recta	sulfur cinquefoil
Dipsacus fullonum	teasel
Centaurea solstitialis	yellow starthistle
Carduus nutans	musk thistle
Onopordum acanthium	Scotch thistle

Class 2 Weeds: Managed Infestations	
Cirsium vulgare	bull thistle
Linaria dalmatica	dalmatian toadflax
Hypericum perforatum	klamathweed
Leucanthemum vulgare	oxeye daisy
Lepidium latifolium	perennial pepperweed
Cytisus scoparius	Scotch broom
Centaurea maculosa	Spotted knapweed
Linaria vulgaris	yellow toadflax

The 2013 Weed Data Collection Map for Douglas County can be found on page A20. For more information regarding invasive weeds of the Basin or to report a weed, visit TahoeInvasiveWeeds.org.

Wildlife

Wildlife is abundant in the Lake Tahoe Basin. While the Lower Country Club area is considered an urban area, it hosts many of the common species in the region.

Common Wildlife:	
Ursus americanus	black bear
Odocoileus hemionus	mule deer
Canis latrans	coyote
Tamiasciurus douglasii	Douglas squirrel
Callospermophilus lateralis	golden-mantled ground squirrel
Procyon lotor	raccoon
Cyanocitta stelleri	Stellar's jay
Poecile gambeli	mountain chickadee

Figure 9: Coyote

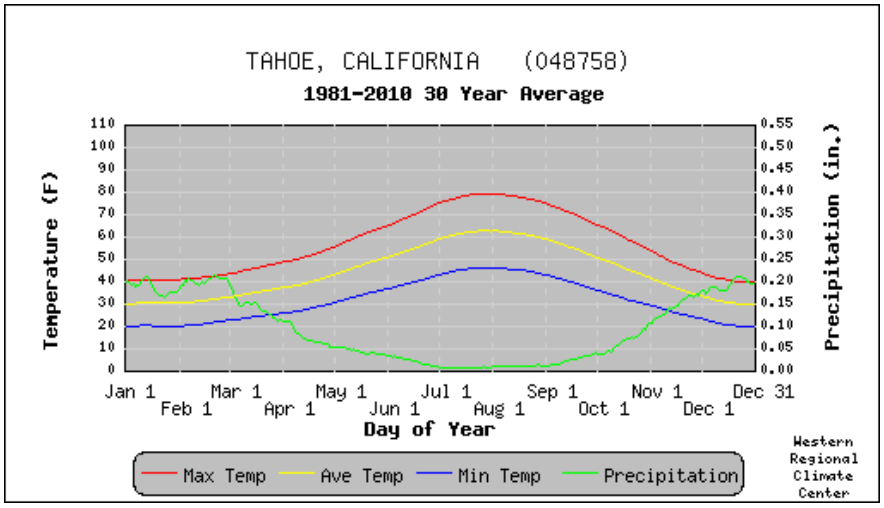
Figure 10: Black Bear

Refer to the *Lake Tahoe Watershed Assessment Volume II* for a full list of species in the Tahoe Basin: http://www.fs.fed.us/psw/publications/documents/gtr-175/

Precipitation and Climate

The average high temperatures in the Tahoe Basin are between 43° and 80° and low temperatures between 16° and 41°. The highest temperatures occur in July and August and the lowest in December and January. Precipitation is concentrated during the winter months, the highest precipitation in November with an average of 3.24".

Figure 11: Yearly Temperature and Precipitation Averages



(Desert Research Institute)

Recreation

Recreation around the Lower Country Club area includes hiking, biking, boating along with skiing, golfing, and much more a short distance away. IVGID owns multiple facilities in the project area including Aspen Grove Event Facility, Village Green Field and Inline Village Recreation Center. Ski Beach offers a boat launch, bocce ball court, volleyball court and canoe and kayak rental. The North Lake Tahoe Demonstration Garden is located on the grounds of Sierra Nevada College. The educational community garden promotes lake-friendly landscaping and conservation planning through demonstrations of using native and adaptive plants, water conservation, soil stabilization techniques, defensible space from wildfires, and Best Management Practices for storm water infiltration.

Figure 12: Village Green Field

Homeowner Survey

A survey was conducted of SFRs in the Lower Country Club Area to gauge the opinions and knowledge of residence of the area. Six surveys were completed out of 43 total residences. Below are a couple of graphs that represent the survey results. A complete list of responses can be found on pages A6-A12.

Figure 13: How much of a problem is Residential Stormwater Runoff in your area?

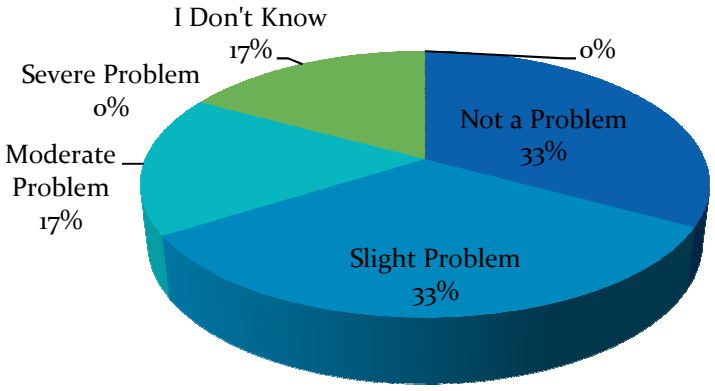
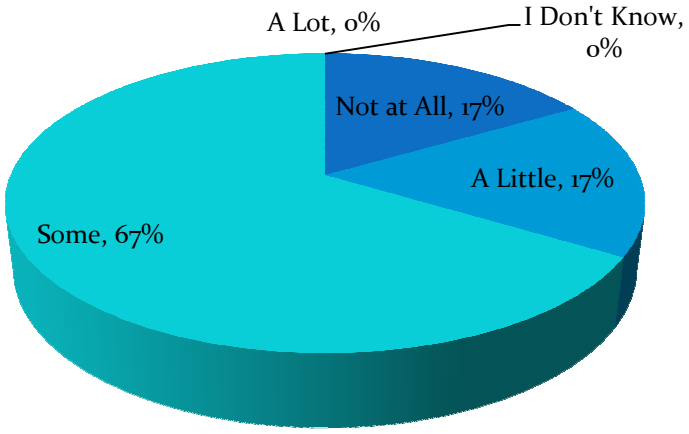


Figure 14: How much does Personal Out of Pocket Expense limit your ability to change your management practices?



Watershed Projects

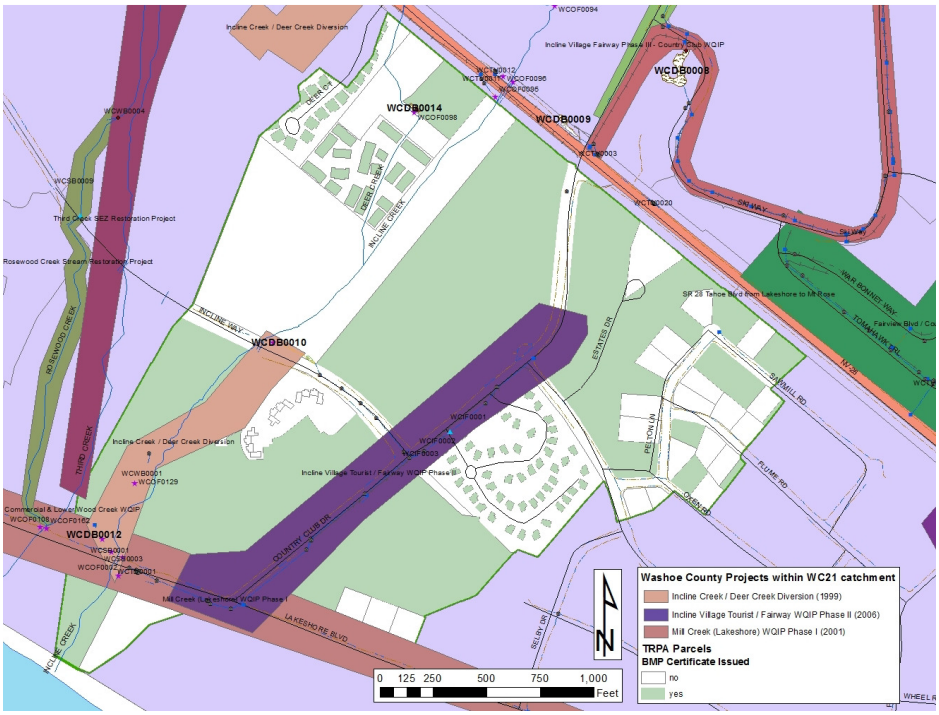


Figure 15: Environmental Improvement Projects in Lower Country Club Community

Being responsible for stormwater runoff management, Washoe County implemented three EIPs within the Lower Country Club area since 1999:

Project ID	Implementer's Project Name	Total:	Date Project Completed	Implemented:
107	Incline Creek, Deer Creek Diversion	$944,222	12/1/1999	Detention basin, wet basin with minimal conveyance pipes, sediment traps & manholes to finish project at Village Green Field
102	Mill Creek (Lakeshore) WQIP Phase I	$520,324	11/1/2001	Little water quality treatment; mostly revegetation, curb & gutter, & striping (original design vault not installed)
142	Incline Village Tourist/Fairway WQIP Phase II	$1,841,971	7/28/2006	Sediment traps, curb & gutter, revegetation, manhole, drop inlets, one treatment vault and 3 infiltration features along: Country Club Dr from Mill Creek Dr to Lakeshore Dr, Incline Way from Country Club Dr to Incline Creek, and Lakeshore Dr from Country Club Dr to Incline Creek (Also encompasses parts of EIP 231)

Each EIP improved stormwater management for a specific location, but with the new emphasis on fine sediment particle removal, the existing stormwater infrastructure does not adequately remove the sub 16µm sediment particles required by the TMDL.

In conjunction with Washoe County's stormwater treatments, single family residences (SFRs) will be working to complete their private parcel BMPs. Homeowners are required to treat all

impervious surfaces including drip lines, elevated structures, driveways along with stabilizing slopes and other bare soil areas. Maintenance of existing system will include refreshing these systems and ensure they are properly functioning.

Typical BMPs:

Figure 16: Armor under elevated

Figure 17: Armor under drip line

Water Quality Issues

The existing stormwater treatments in the Lower Country Club area do not treat all of the stormwater in the area. New systems need to address high priority zones.

The percent of developed parcels in Lower Country Club Community have completed their BMPs are: SFR, 38%; MFR 38%; CICU, 47%. The properties that have not completed their BMPs increases the amount of fine sediment that is exiting the watershed and puts a larger strain on any area wide system that is put in place to improve water quality.

Currently, developed property BMPs are considered fully functioning for the first 5 years after installation. Once a property reaches this 5 year threshold, the BMPs are considered working at 50% and the credits that can be gained by the jurisdiction through the Lake Clarity Crediting Program from that property are reduced by that percentage. Many of the BMPs that are installed are older than 5 years. To keep full credits on properties with BMP certificates that are over 5 years old, they must be maintained and recertified by the TRPA. This keeps the certification valid and allows properties to retain full credit in the Lake Clarity Crediting Program. This is done by the property owner by filling out a maintenance log. Maintenance logs are site specific plans that show what BMPs exist on the property and need to be maintained. These plans are developed by the TRPA or NTCD through existing BMP plans or on site evaluation. Using this plan to log maintenance activities and submit to TRPA will revalidate an existing certificate.

Encouraging property owners to complete and then maintain their BMPs has been a difficult task. In the past TRPA has worked with owners to encourage BMP completion. The TRPA is continuing their program, but through the Crediting Program and area wide plans, the

jurisdictions now need to take responsibility for ensuring private parcels complete their BMPs and keep them maintained.

Options for Improving Water Quality

There are many techniques for increasing private parcel BMP compliance. Below are different strategies that jurisdictions within the Tahoe Basin are using to encourage private parcel BMP implementation.

Creation of a Special Assessment District

Creating a Special Assessment District to help pay for communal BMP systems is one option to increase BMP compliance on private parcels. An Assessment District is created by a sponsoring local government agency, such as a city or county. Depending on the type of assessment district, some begin with a petition signed by owners of the property who want to be included in the district, others only by notice of a public hearing regarding the assessment. The proposed district includes all properties that will directly benefit from the improvements to be constructed. A public hearing is held, at which time property owners have the opportunity to vote on the assessment district. If the assessment district passes, a lien is then recorded against each property with an unpaid assessment. These parcels will pay their total assessment through annual installments on the county property tax bill.

The Nevada Revised Statutes (NRS) that allows for Special Assessment Districts is NRS 271. Below is a document developed by University of Nevada Cooperative Extension with more information on Nevada Special Assessment Districts:
NRS 271 - http://www.unce.unr.edu/publications/files/cd/2013/fs1333.pdf

Harrison Avenue Assessment District

The Harrison Avenue Assessment District in South Lake Tahoe was created to pay for transportation, landscaping and water quality improvements as put forth by the Harrison Avenue Streetscape Improvement Project. Before construction of the project, a vote took place within the proposed assessment district and was passed by simple majority by the property owners that voted. All properties within the project boundary are included in the assessment district.

The projects within the plan that provide direct benefit were analyzed and it was determined that 41.3% of the improvements directly benefit the property owners in the district. This breaks down to $720,552 of the total $1,745,050 that will be paid for by the assessment. The remainder will be paid by the City of South Lake Tahoe and other funds.

The BMP portion of the assessment is $250,597. Three of the properties that are included in the District have completed their BMPs and are not responsible for this portion. The remaining properties will pay $1.63 per square foot of potential impervious surface to construct the communal systems that will be placed in public right of ways and parking lots. These properties are still required to install and maintain on-site source control such as paving on-site parking, and revegetation. Once constructed, the City of South Lake Tahoe will pay for

maintenance of the communal facilities. The district is proposed to exist until June 30, 2034 when the full amount of the assessment will be paid in full.
More information on the Harrison Avenue Assessment district can be found here:
http://slt.granicus.com/MetaViewer.php?view_id=4&clip_id=550&meta_id=52993

Bijou Community Facility District

A Community Facility District (CFD) is being created for the Bijou area Erosion Control Project, Phase 1 that will cover the cost of future maintenance of the system. The City of South Lake Tahoe was able to secure funds for all of the capital improvements for phase 1 through grants and other funds provided by Caltrans, United States Forest Service (USFS), California Tahoe Conservancy (CTC), State Water Resources Control Board, and TRPA. The fee being assessed by the CFD is for operation and maintenance of the system once installed. The property owners that are part of the District are not responsible for any of the initial capital improvement costs. By being a part of the CFD, properties received a BMP retrofit certification (as long as other source control measures such as paving or restoring compacted areas are in place on the property).

The Bijou Area Erosion Control Project, Phase 1 is being designed to accept all runoff from public and private parcels which flow into the project area regardless of what properties become part of the district. Properties are allowed to choose whether they want to opt into the CFD and it will be comprised of only the property owners that decide to join. This means the CFD may be as small as one property or may include every property in the project area. Regardless of how many properties join the District, the fee that is assessed will not change. This fee will be determined by lot size and amount of impervious surface on the parcel. The per-year cost of operations and maintenance was based on a 20 year estimate. The CFD's assessment will cover about half of the costs to maintain the system with the remainder being paid for by the City and other funds. Properties will have the option to join the district after it is formed, but this will incur additional administration and surveying fees that at the creation of the district are being paid for by the City.

More information on the Bijou Community Facility District can be found here:
http://www.cityofslt.us/index.aspx?NID=610
Contact: Trevor Coolidge: tcoolidge@cityofslt.us

Kings Beach Benefit Assessment District

This is another example of an assessment district that was formed to pay for ongoing maintenance activities. This assessment has been created to pay for snow management, including the removal, hauling, and storage, the upkeep, repair, removal or replacement of all or any part of any sidewalk improvement, power-washing of the sidewalks, emptying of trash receptacles, and landscaping maintenance.

More information regarding this District can be found here:
http://www.kingsbeachcore.info/docs/BAD_KBEngRep101612.pdf

Public System Integration

Accepting private parcel stormwater runoff into existing or planned stormwater treatment systems is another option to increase BMP compliance. Regional stormwater treatment systems receive private party runoff from all non-BMPed parcels in the drainage area. These systems are sized large enough to be able to accept this additional stormwater runoff. By planning for the additional private property owner's stormwater runoff, these larger and more regional stormwater systems ensures this water gets treated without overwhelming the system.

Tahoe City Wetlands

The Tahoe City Wetland was constructed from 1999 to 2001. It was designed to accept all runoff from the drainage area, including private parcel runoff. Because of this, Tahoe City is able to allow developed properties to discharge pretreated water into the wetlands. Approximately 20-25 parcels are able to utilize this opportunity. Five are currently tied into the wetland system. This opportunity is available as an option to properties when the property goes under permit with the county where one of the bond stipulations is to complete their BMPs. The permitted property is required to install pretreatment measures for their runoff, including source control and filtration, but do not have to infiltrate the 1 inch per hour storm. The pretreated runoff is then allowed to be discharged into the storm drain that runs into the wetlands. Along with needing to pre-treat runoff, properties are assessed a yearly maintenance fee. This fee is based on the size of the property and whether the property is residential or commercial.

Cave Rock Community System

During the summer of 2014, the basin at the bottom of Cave Rock Estates was retrofitted to comply with current standards of filtering FSPs. Stormwater monitoring confirmed the detention basin is large enough to take on all road infrastructure and runoff from untreated driveways. Therefore, once the retrofit is complete, the system at the bottom of the catchment will capture all necessary runoff and will satisfy the TRPA BMP requirements for the General Improvement District (GID) and satisfy NDEP load reductions fine sediment requirement. In conjunction with the community-wide stormwater treatment system, single family residences (SFRs) will be working to complete their private parcel BMPs. The community based bed filter accepts and treats homeowner's driveway runoff that flows off property, but homeowners are still required to complete source control measures such as armoring drip lines and elevated structures and implementing slope stabilization measures. Additional credits will not be acquired by the GID from the private parcel BMP completion, but does make TRPA BMP compliance easier and less expensive for the homeowner.

TRPA BMP Program

In the past, jurisdictions and GIDs have accepted TRPA's BMP program as a way to earn credits without incurring any cost. TRPA is still committed to the BMP program and will continue to encourage completion and maintenance of private parcels. Some jurisdictions and GIDs are not incentivizing private parcels to complete their BMPs and are letting TRPA's efforts work towards continued BMP compliance.

TRPA is currently working on solidifying a maintenance program that can work in conjunction with the jurisdictions crediting needs. This may include the TRPA targeting areas in

catchments that are of a greater importance to jurisdictions' pollutant load reductions and sending maintenance letters to these properties.

Economy of Scale: Separation of Public Runoff versus Combination of Public-Private Runoff

Cave Rock Estates Community System Example

Stormwater projects in the Lake Tahoe basin often received funding from public agencies and these agencies prefer that the bulk of this work both occurs on public land and treats public runoff. Public and private properties share watersheds and stormwater runoff from the two is usually not separated unless 100 percent of private-parcel best management practices are in compliance and fully functional. Therefore, the question has arisen as to how much additional cost is incurred by treating private runoff in a public facility.

Civil engineers are responsible for designing most public stormwater treatment systems in the United States. As a responsible engineer, the engineer of record must ensure that designs do not endanger the public or their property. Because civil engineers working in water resources work within less than predictable natural systems, facilities are typically designed with a factor of safety. This factor of safety is integrated throughout the design process. For stormwater, an engineer may calculate the possible runoff from the entire watershed using a few different methods and choose the midpoint for the treatment criteria but the maximum point for the overflow criteria. Three different but common methods to calculate runoff (the Rational Method, the SCS Curve Number method, and the unit hydrograph method) have potential to yield considerably different results. This was the case for the Cave Rock Stormwater System (KB Foster 1991). The engineer may also simply round up at all steps to create a factor of safety. For example, the watershed size may be rounded up as well as the impervious surface and finally, the basin size. There are numerous ways a factor of safety can be applied throughout design, but it is rare that an engineer would disregard private runoff in the design process. The private runoff would have to be completely disconnected and therefore not a part of the design watershed to be ignored. Because of engineering ethics and responsibility code, there are not public stormwater projects in the ground that did not account for private runoff during the design process.

The next way to examine the differences between public and private costs would be to examine projects on a per-project basis. For the most recent Cave Rock Stormwater System Retrofit Project (2014), one could look at the construction costs by item and determine if a decrease in stormwater quantity would have led to a decrease in cost. The Cave Rock Stormwater System was originally designed to treat the 25 year storm from the entire watershed with the assumption that the entire subdivision would be developed. If private runoff were contained on the individual parcels, the system could have potentially been 25 to 30 percent smaller. This

estimate is based on the maximum allowable coverage by TRPA for residential lots of 25 to 30 percent so it may be a high estimate, but for discussion, this section will use a size reduction of 30 percent. Figure X shows the final costs for the Retrofit.

Figure 18: Cave Rock Stormwater System Retrofit actual construction costs

Item No.	Bid Item	Unit	Quantity	Cost/Unit	Total
1	Mobilization/Demobilization	LS	1	$4,000.00	$4,000.00
2	Temporary BMPS	LS	1	$2,100.00	$2,100.00
3	Rock Work	LS	1	$2,300.00	$2,300.00
4	Sand Filter Construction	LS	1	$22,600.00	$22,600.00
5	Settling Pond Construction	LS	1	$6,725.00	$6,725.00
6	Remove and Replace 12" Inlet Pipe and AC Pavement	LS	1	$3,800.00	$3,800.00
7	Inlet Sediment Trap and Headwall	EA	1	$5,000.00	$5,000.00
8	Repair Forebay	EA	3	$325.00	$975.00
9	Concrete Wall	LS	1	$9,675.00	$9,675.00
10	Perforated Riser	EA	1	$1,650.00	$1,650.00
11	Overflow Standpipe	EA	1	$1,950.00	$1,950.00
12	Emergency Overflow	LS	1	$2,200.00	$2,200.00
13	Retrofit Existing Outlets	LS	1	$575.00	$575.00
14	Vegetation Removal	LS	1	$1,500.00	$1,500.00
15	Clean Existing Inlets, Outlets, and Sediment Cans	LS	1	$1,850.00	$1,850.00
16	Revegetation	LS	1	$2,000.00	$2,000.00
17	Irrigation	LS	1	N/A	N/A
18	Pave Parking Bed Filter Maintenance Area	SF	2580	$6.95	$17,931.00
				Contracted Cost	**$86,831.00**
Note - Irrigation was not completed					
CCO1	Additional Rock Work	$11,500.00			
CCO2	Purchase and Import Compost	$400.00			
CCO3	Weep Holes	$ 500.00			
				Total Cost	**$99,231.00**

If the Retrofit were for a system 30 percent smaller, there would likely be a similar 30 percent cost reduction in the following bid items:

- Settling pond construction
- Vegetation removal

- Revegetation (Including import of compost)

In addition, there would likely be smaller reductions of perhaps 5 to 20 percent in the following bid items:

- Mobilization/Demobilization
- Sand Filter Construction

Little to no change in cost would occur for the remainder of the items. Therefore, by adding up the cost savings of the bid items discussed above, the cost reduction would be approximately $6,000 or 6 percent of the total project cost.

Examining the Retrofit would likely yield different results from examining costs of the original project. The original project costs are not available on a per item basis, but assumptions can be made based on knowledge of the project cost and the design plans. The total project cost was approximately $1.5 million and installed 2 basins, conveyance infrastructure, slope stabilization, and revegetation. Figure X has an engineering opinion on how these costs may have been separated and affected.

Figure 19: Engineering opinion of original project costs

Item	Percent of Project Cost	Cost	Potential Reduction	Savings
Conveyance	35%	$525,000	0%	$0
Slope Stabilization and Revegetation	25%	$375,000	0%	$0
Chukkar Infiltration Basin	5%	$75,000	10%	$7,500
Detention Pond	25%	$375,000	25%	$93,750
			Total Savings	$101,250
			Percent Savings	7%

Both the overall conveyance and slope stabilization/revegetation would not have any cost savings. As a steep watershed, the conveyance structures were relatively small because of the steep slopes (See Darcy-Weisbach or Hazen Williams equations). The watershed steepness also likely led to the slope stabilization being expensive in that numerous retaining walls and rip rap areas were installed as well as vegetation on steep slopes. Costs that would be reduced would be the cost of the infiltration basin on Chukkar. This basin was already small and so the cost savings of the actual basin compared to the costs of the inlet and outlet would've been much less than 30 percent. The large detention pond that was retrofit this past year would have seen the most savings from a reduction in size. Savings would include less grading and a smaller quantity of pond liner. A savings of 25 percent may be an overestimate, but overall, the cost of the original project would have saved 5 to 10 percent if it were designed to treat less water, i.e. the contribution of the public areas only.

In summary, we see a similar total savings for both the original project and the retrofit of 5 to 10 percent if engineers designed the system to be 30 percent smaller. Again, 30 percent less volume with public-private separation is an estimate for Cave Rock, but it serves to show that increasing a system size does not result in a proportional increase in cost.

Monitoring

Monitoring of public stormwater systems will be performed in accordance with the current BMP RAM protocols. Once this catchment is registered in accordance to the TMDL, annual monitoring for effectiveness will be required. Refer to the BMP RAM Technical Document (http://www.2ndnaturellc.com/wp-content/uploads/2012/08/BMP-RAM-Technical-Document1.pdf) and the BMP RAM User's Manual (http://www.2ndnaturellc.com/wp-content/uploads/2012/08/BMP-RAM-Users-Manual-V.1.pdf) for more detailed information regarding monitoring of public systems.

Monitoring private parcel BMP maintenance is handled through the TRPA. For multi-family and commercial residences, this includes submitting maintenance logs and potentially photographs of systems yearly and submittal maintenance work receipts to TRPA to prove maintenance. Maintenance logs need to be submitted to the TRPA to prove maintenance. Once these maintenance logs are created, they will be uploaded onto TRPA's BMP database and will be accessible for property owner's to complete and submit.

Inspection and Maintenance

Jurisdictions gain or lose TMDL credits based on the performance condition of BMPs. Actively inspecting and maintaining BMPs is an effective way to earn or maintain TMDL credits.

Public stormwater systems in the Lower Country Club area will need regular inspection to insure functionality. This should be scheduled based on observations, experiences, inspection findings, manufacturer's specifications and the changing conditions of the site. Maintenance should be performed when BMPs fall below their set thresholds (refer to BMP RAM Protocols and User's Manual for more information regarding setting thresholds).

Multi-family residences and commercial property maintenance includes ensure surface systems are clean and functioning and servicing of sub-surface systems. TRPA's BMP Handbook (http://tahoebmp.org/bmphandbook.aspx) has information on different systems and their maintenance needs.

Single family residences should inspect systems after major storms, in the spring, and just before winter to make sure they are functioning properly and to remove accumulated sediment. Additional information on SFR BMP maintenance can be found on ntcd.org.

Appendix

Soils

Brief Soil Descriptions (Tahoe)

Tahoe Basin Area, California and Nevada

[Absence of an entry indicates that the feature is not a concern or that data were not estimated. Data applies to the entire extent of the map unit within the survey area. Map unit and soil properties for a specific parcel of land may vary somewhat and should be determined by on-site investigation.]

7011 - Beaches

Composition

- Beaches: 64 percent of the unit
- Oxyaquic Xeropsamments and similar soils: 10 percent of the unit
- Watah and similar soils: 7 percent of the unit
- Gefo, Barrier beach and similar soils: 6 percent of the unit
- Marla and similar soils: 5 percent of the unit
- Cagwin and similar soils: 1 percent of the unit
- Cassenai, gravelly loamy coarse sand and similar soils: 1 percent of the unit
- Dunes: 1 percent of the unit
- Jorge, very gravelly sandy loam and similar soils: 1 percent of the unit
- Rock outcrop, Granitic: 1 percent of the unit
- Tahoe, silt loam and similar soils: 1 percent of the unit
- Tahoma and similar soils: 1 percent of the unit
- Toem and similar soils: 1 percent of the unit

Setting

Landform(s) beaches, mountains
Elevatio 6217 to 6250 feet
Precipitatio 21 to 27 inches
Slope 0 to 5 percent
Air temperature: 43 to 46 °F
Frost-free 25 to 75 days

Characteristics of Beaches

Average total avail. water in top five feet 2.4
Available water capacity Very low
Parent beach sand
Restrictive
Depth to Water
Drainage
Flooding
Ponding
Soil loss tolerance (T
Wind erodibility group
Wind erodibility index
Land capability class, irrigated:
Land capability class, non-
Hydric soil: no
Hydrologic
Runoff class: negligible
Potential frost low

Saturated hydraulic conductivity Very High

Representative soil profile:

Horizon --	Depth (inches)	Texture	Ksat	pH	Salinity (mmhos/cm)	SAR
C --	0 to 79	Gravelly coarse sand	21.3	6.8 to 7.1	0 - 0	0 - 0

Ecological class(es):

Brief Soil Descriptions (Tahoe)

Tahoe Basin Area, California and Nevada

[7141 - Inville gravelly coarse sandy loam, 2 to 9 percent slopes, stony]

7141 - Inville gravelly coarse sandy loam, 2 to 9 percent slopes, stony

Composition

°Inville and similar soils: 80 percent of the unit
°Christopher, Loamy coarse sand and similar soils: 10 percent of the unit
°Cassenai, gravelly loamy coarse sand and similar soils: 4 percent of the unit
°Jorge, very gravelly sandy loam and similar soils: 3 percent of the unit
°Kingsbeach and similar soils: 2 percent of the unit
°Aquic Xerorthents and similar soils: 1 percent of the unit

Setting

Landform(s) mountains, hillslopes on outwash terraces
Elevatio 6234 to 6955 feet
Precipitatio 19 to 33 inches
Slope 2 to 9 percent
Air temperature: 41 to 46 ºF
Frost-free 45 to 110 days

Characteristics of Inville and similar soils

Average total avail. water in top five feet 3.6
Available water capacity Low
Parent outwash derived from mixed
Restrictive none
Depth to Water none within the soil profile
Drainage well drained
Flooding none
Ponding none
Saturated hydraulic conductivity High
Soil loss tolerance (T 5
Wind erodibility group 7
Wind erodibility index 38
Land capability class, irrigated:
Land capability class, non- 4e
Hydric soil: no
Hydrologic B
Runoff class: low
Potential frost moderate

Representative soil profile:

Horizon	Depth (inches)	Texture	Ksat	pH	Salinity (mmhos/cm)	SAR
Oi	0 to 2	Slightly decomposed plant	56.7		0 - 0	0 - 0
A	2 to 12	Gravelly coarse sandy loam	4.0	5.6 to 6.5	0 - 0	0 - 0
Bt	12 to 37	Extremely cobbly sandy loam	4.0	5.6 to 6.5	0 - 0	0 - 0
C	37 to 56	Extremely gravelly loamy coarse sand	21.3	5.6 to 6.5	0 - 0	0 - 0

Ecological class(es): NRCS Forestland Site - Pinus jeffreyi-Abies concolor/Ceanothus cordulatus-Ceanothus prostratus/Pedicularis semibarbata-Kelloggia

7142 - Inville gravelly coarse sandy loam, 9 to 15 percent slopes, stony

Composition

- Inville and similar soils: 80 percent of the unit
- Cassenai, gravelly loamy coarse sand and similar soils: 10 percent of the unit
- Christopher, Gravelly Loamy Coarse Sand and similar soils: 4 percent of the unit
- Jorge, very gravelly sandy loam and similar soils: 3 percent of the unit
- Meeks, extremely bouldery and similar soils: 2 percent of the unit
- Aquic Xerorthents and similar soils: 1 percent of the unit

Setting

Landform(s): mountains, hillslopes on outwash terraces
Elevation: 6234 to 7251 feet
Precipitation: 21 to 37 inches
Slope gradient: 9 to 15 percent
Air temperature: 41 to 46 °F
Frost-free period: 45 to 110 days

Characteristics of Inville and similar soils

Average total avail. water in top five feet (in.): 3.6
Available water capacity class: Low
Parent material: outwash derived from mixed
Restrictive feature(s): none
Depth to Water table: none within the soil profile
Drainage class: well drained
Flooding hazard: none
Ponding hazard: none
Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 7
Wind erodibility index (WEI): 38
Land capability class, non-irrigated: 4e
Hydric soil: no
Runoff class: low
Potential frost action: moderate

Representative soil profile:

Horizon -- Depth (inches)	Texture	Ksat (inches per hour)	% cobbles	% stones and boulders	Excavation Difficulty
Oi -- 0 to 2	Slightly decomposed plant material	56	-	-	Low
A -- 2 to 12	Gravelly coarse sandy loam	3.92	0 - 0	0 - 0	
Bt -- 12 to 37	Extremely cobbly sandy loam	3.92	31 - 54	0 - 0	
C -- 37 to 56	Extremely gravelly loamy coarse sand	21	28 - 40	0 - 0	

Ecological class(es): NRCS Forestland Site - Pinus jeffreyi-Abies concolor/Ceanothus cordulatus-Ceanothus prostratus/Pedicularis semibarbata-Kelloggia galioides

7151 - Jorge very cobbly fine sandy loam, 5 to 15 percent slopes, rubbly

Composition

- Jorge, very cobbly fine sandy loam and similar soils: 80 percent of the unit
- Tahoma and similar soils: 5 percent of the unit
- Waca and similar soils: 5 percent of the unit
- Jorge, very cobbly loam and similar soils: 4 percent of the unit
- Ellispeak and similar soils: 2 percent of the unit
- Sky and similar soils: 2 percent of the unit
- Aquic Xerorthents and similar soils: 1 percent of the unit
- Rock outcrop, Volcanic: 1 percent of the unit

Setting

Landform(s): hillslopes, mountain slopes, mountains
Elevation: 6234 to 7972 feet
Precipitation: 23 to 41 inches
Slope gradient: 5 to 15 percent
Air temperature: 40 to 46 °F
Frost-free period: 40 to 90 days

Characteristics of Jorge, very cobbly fine sandy loam and similar soils

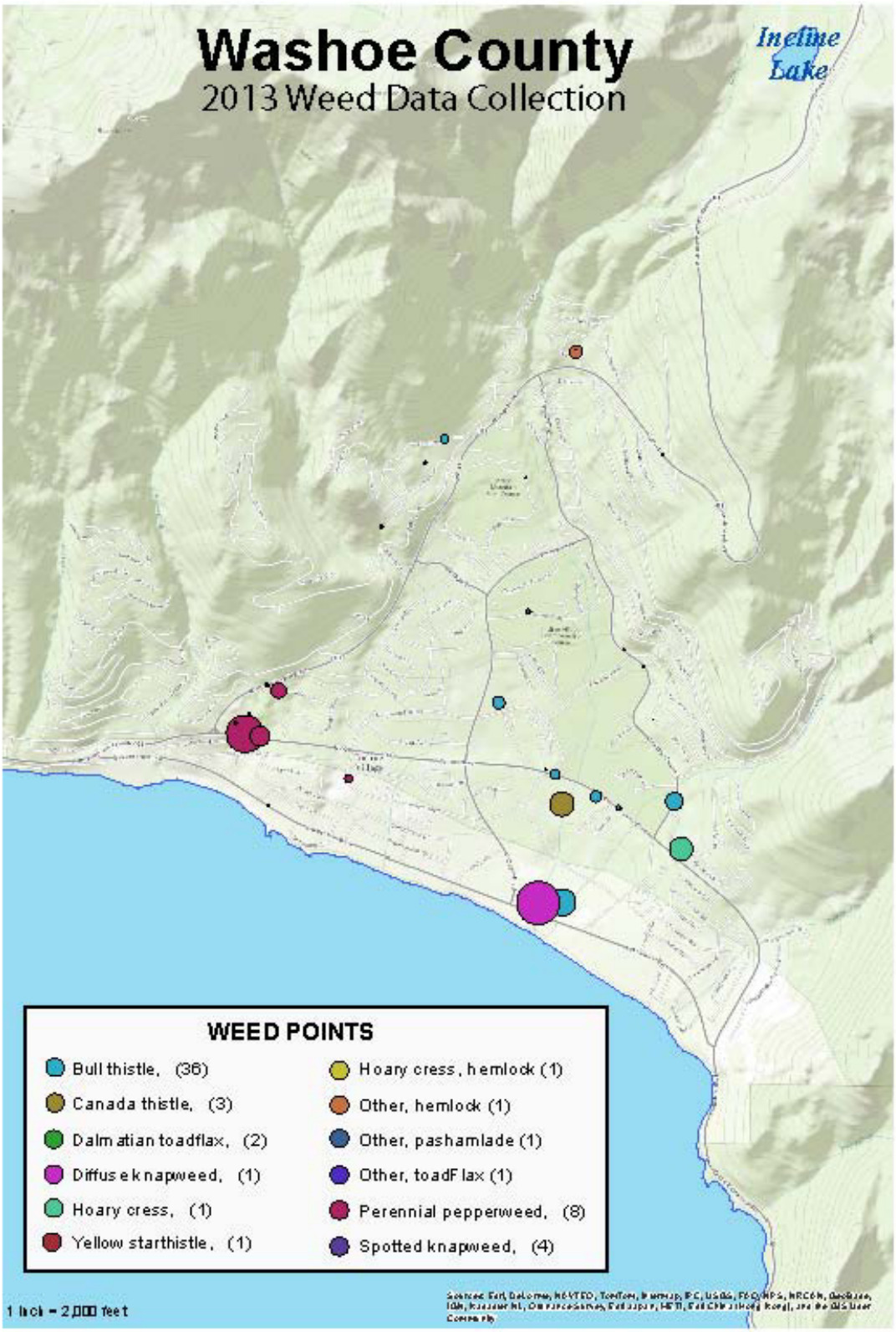
Average total avail. water in top five feet (in.): 5.7
Available water capacity class: Low
Parent material: colluvium derived from andesite
Restrictive feature(s): none
Depth to Water table: none within the soil profile
Drainage class: well drained
Flooding hazard: none
Ponding hazard: none
Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 7
Wind erodibility index (WEI): 38
Land capability class, non-irrigated: 4e
Hydric soil: no
Runoff class: low
Potential frost action: moderate

Representative soil profile:

Horizon -- Depth (inches)	Texture	Ksat (inches per hour)	% cobbles	% stones and boulders	Excavation Difficulty
Oi -- 0 to 2	Slightly decomposed plant material	56	-	-	Low
A -- 2 to 9	Very cobbly fine sandy loam	3.92	24 - 55	24 - 55	
Bw1 -- 9 to 28	Very cobbly fine sandy loam	3.92	24 - 55	24 - 55	
Bw2 -- 28 to 34	Very cobbly fine sandy loam	3.92	24 - 55	24 - 55	
2Bt -- 34 to 59	Very cobbly loam	1.26	35 - 59	0 - 30	

Ecological class(es): NRCS Forestland Site - Abies concolor-Pinus lambertiana/Quercus vacciniifolia-Amelanchier utahensis/Pyrola picta

2013 Weed Collection Data



Lower Country Club, Incline Village Homeowner Survey

Rating of Water Quality

Overall, how would you rate the quality of the water in your area?

Question #	Poor (1)	Okay (2)	Good (3)	Don't Know (9)	Mean (SD)	Valid Responses / Total Responses
1. For canoeing / kayaking / other boating	0	0	100	0	3 (0)	8 / 8
2. For eating locally caught fish	0	0	66.7	33.3	3 (0)	4 / 6
3. For swimming	0	0	100	0	3 (0)	6 / 6
4. For picnicking and family activities	0	0	100	0	3 (0)	6 / 6
5. For fish habitat	0	0	66.7	33.3	3 (0)	4 / 6
6. For scenic beauty	0	0	100	0	3 (0)	6 / 6
7. For drinking water	0	33.3	66.7	0	2.67 (0.52)	6 / 6

Your Water Resources

1. Of these activities, which is the most important to you? **(Responses: 4)**

25% For canoeing / kayaking / other boating
0% For eating locally caught fish
75% For swimming
0% For picnicking and family activities
0% For fish habitat
0% For scenic beauty

2. Do you know where the rain water goes when it runs off of your property? **(Responses: 6)**

50% No
50% Yes

3. If you answered 'Yes' above, where does your rain water drain to?

Your Opinions

Please indicate your level of agreement or disagreement with the statements below.

Question #	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)	Mean (SD)	Valid Responses / Total Responses
1. The way that I care for my lawn and yard can influence water quality in local streams and lakes.	16.7	0	16.7	33.3	33.3	3.67 (1.51)	6 / 6
2. It is my personal responsibility to help protect water quality.	0	0	16.7	50	33.3	4.17 (0.75)	6 / 6
3. It is important to protect water quality even if it slows economic development.	0	0	33.3	33.3	33.3	4 (0.89)	6 / 6
4. My actions have an impact on water quality.	0	0	16.7	50	33.3	4.17 (0.75)	6 / 6
5. I would be willing to pay more to improve water quality (for example: though local taxes or fees)	0	33.3	33.3	33.3	0	3 (0.89)	6 / 6
6. I would be willing to change the way I care for my lawn and yard to improve water quality.	0	0	33.3	66.7	0	3.67 (0.52)	6 / 6
7. The quality of life in my community depends on good water quality in local streams, rivers and lakes.	0	0	33.3	33.3	33.3	4 (0.89)	6 / 6

Water Impairments

Below is a list of water pollutants and conditions that are generally present in water bodies to some extent. The pollutants and conditions become a problem when present in excessive amounts. In your opinion, how much of a problem are the following water impairments in your area?

Question #	Not a Problem (1)	Slight Problem (2)	Moderate Problem (3)	Severe Problem (4)	Don't Know (9)	Mean (SD)	Valid Responses / Total Responses
1. Sedimentation (dirt and soil) in the water	16.7	33.3	16.7	16.7	16.7	2.4 (1.14)	5 / 6
2. Nitrogen	0	0	33.3	0	66.7	3 (0)	2 / 6
3. Phosphorus	0	0	33.3	0	66.7	3 (0)	2 / 6
4. Cloudiness of the water	33.3	16.7	33.3	0	16.7	2 (1)	5 / 6
5. Algae in the water	16.7	16.7	16.7	16.7	33.3	2.5 (1.29)	4 / 6
6. Invasive aquatic plants and animals	33.3	16.7	0	16.7	33.3	2 (1.41)	4 / 6
7. Pesticides	33.3	16.7	16.7	0	33.3	1.75 (0.96)	4 / 6

Sources of Water Pollution

The items listed below are sources of water quality pollution across the country. In your opinion, how much of a problem are the following sources in your area?

Question #	Not a Problem (1)	Slight Problem (2)	Moderate Problem (3)	Severe Problem (4)	Don't Know (9)	Mean (SD)	Valid Responses / Total Responses
1. Soil erosion from construction sites	33.3	50	0	0	16.7	1.6 (0.55)	5 / 6
2. Excessive use of lawn fertilizers and/or pesticides	33.3	33.3	16.7	0	16.7	1.8 (0.84)	5 / 6
3. Street salt and sand	33.3	16.7	16.7	16.7	16.7	2.2 (1.3)	5 / 6
4. Waste material from pets	33.3	16.7	16.7	16.7	16.7	2.2 (1.3)	5 / 6
5. Residential stormwater runoff	33.3	33.3	16.7	0	16.7	1.8 (0.84)	5 / 6
6. Highway/road/bridge runoff	16.7	33.3	16.7	16.7	16.7	2.4 (1.14)	5 / 6
7. Removal of riparian vegetation	16.7	33.3	16.7	0	33.3	2 (0.82)	4 / 6
8. Drainage/filling of wetlands	33.3	16.7	16.7	0	33.3	1.75 (0.96)	4 / 6
9. Outputs from marinas and/or	16.7	16.7	33.3	16.7	16.7	2.6 (1.14)	5 / 6

recreational boats							
10. Yard maintenance	33.3	33.3	16.7	0	16.7	1.8 (0.84)	5 / 6
11. Turf management (golf courses, sports fields)	33.3	33.3	16.7	0	16.7	1.8 (0.84)	5 / 6

Consequences of Poor Water Quality

Poor water quality can lead to a variety of consequences for communities. In your opinion, how much of a problem are the following issues in your area?

Question #	Not a Problem (1)	Slight Problem (2)	Moderate Problem (3)	Severe Problem (4)	Don't Know (9)	Mean (SD)	Valid Responses / Total Responses
1. Reduced beauty of lakes or streams	50	33.3	0	16.7	0	1.83 (1.17)	6 / 6
2. Reduced opportunities for water recreation	66.7	16.7	16.7	0	0	1.5 (0.84)	6 / 6
3. Reduced quality of water recreation activities	66.7	16.7	16.7	0	0	1.5 (0.84)	6 / 6
4. Excessive aquatic plants or algae	33.3	16.7	16.7	16.7	16.7	2.2 (1.3)	5 / 6
5. Lower property values	50	33.3	0	16.7	0	1.83 (1.17)	6 / 6

Practices to Improve Water Quality

Please indicate which statement most accurately describes your level of experience with each practice listed below.

Question #	Not relevant for my property (9)	Never heard of it (1)	Somewhat familiar with it (2)	Know how to use it; not using it (3)	Currently use it (4)	Mean (SD)	Valid Responses / Total Responses
1. Following the manufacturer's instructions when fertilizing lawn or garden	0	0	16.7	33.3	50	3.33 (0.82)	6 / 6
2. Use a mulching lawn mower	33.3	0	16.7	16.7	33.3	3.25 (0.96)	4 / 6
3. Follow pesticide application instructions for lawn and garden	33.3	0	0	16.7	50	3.75 (0.5)	4 / 6
4. Properly dispose of pet waste	33.3	0	0	16.7	50	3.75 (0.5)	4 / 6

Specific Constraints of Practices

Phosphate-Free Fertilizer: Fertilizer without phosphates designed to reduce phosphorus runoff and water pollution.

1. How familiar are you with this practice? **(Responses: 6)**

0% Not relevant
50% Never heard of it
33.3% Somewhat familiar with it
0% Know how to use it; not using it
16.7% Currently use it

2. If the practice is not relevant, please explain why.

3. Are you willing to try this practice? **(Responses: 6)**

66.7% Yes or already do
33.3% Maybe
0% No

How much do the following factors limit your ability to implement this practice?

Question #	Not at all (4)	A little (3)	Some (2)	A lot (1)	Don't Know (9)	Mean (SD)	Valid Responses / Total Responses
4. Don't know how to do it	20	20	20	20	20	2.5 (1.29)	4 / 5
5. Time required	60	0	20	0	20	3.5 (1)	4 / 5
6. Cost	60	0	20	0	20	3.5 (1)	4 / 5
7. The features of my property make it difficult	60	0	20	0	20	3.5 (1)	4 / 5
8. Insufficient proof of water quality benefit	40	20	20	0	20	3.25 (0.96)	4 / 5
9. Desire to keep things the way they are	40	20	20	0	20	3.25 (0.96)	4 / 5
10. Physical or health limitations	60	0	20	0	20	3.5 (1)	4 / 5
11. Hard to use with my farming system	60	0	20	0	20	3.5 (1)	4 / 5
12. Lack of equipment	40	20	20	0	20	3.25 (0.96)	4 / 5

Making Decisions for my Property

In general, how much does each issue limit your ability to change your management practices?

Question #	Not at all (4)	A little (3)	Some (2)	A lot (1)	Don't Know (9)	Mean (SD)	Valid Responses / Total Responses
1. Personal out-of-pocket expense	16.7	66.7	16.7	0	0	3 (0.63)	6 / 6
2. My own physical abilities	83.3	16.7	0	0	0	3.83 (0.41)	6 / 6
3. Not having access to the equipment that I need	50	50	0	0	0	3.5 (0.55)	6 / 6
4. Lack of available information about a practice	33.3	33.3	16.7	16.7	0	2.83 (1.17)	6 / 6
5. No one else I know is implementing the practice	50	16.7	0	0	33.3	3.75 (0.5)	4 / 6
6. Approval of my neighbors	50	16.7	0	0	33.3	3.75 (0.5)	4 / 6
7. Don't know where to get information and/or assistance about those practices	16.7	66.7	0	16.7	0	2.83 (0.98)	6 / 6
8. Environmental damage caused by practice	50	33.3	0	0	16.7	3.6 (0.55)	5 / 6
9. Legal restrictions on my property	50	16.7	0	0	33.3	3.75 (0.5)	4 / 6
10. Concerns about resale value	66.7	16.7	0	0	16.7	3.8 (0.45)	5 / 6
11. Not being able to see a demonstration of the practice before I decide	66.7	16.7	0	0	16.7	3.8 (0.45)	5 / 6
12. The need to learn new skills or techniques	60	20	20	0	0	3.4 (0.89)	5 / 5

Best Management Practices {BMPs}

13. If you have installed your BMPs, what have you done to maintain them?

14. Do you think maintaining your BMPs helps their effectiveness? **(Responses: 6)**

66.7% yes

33.3% no

About You

1. Do you make the home and lawn care decisions in your household? **(Responses: 5)**

100% Yes

0% No

2. What is your gender? **(Responses: 6)**

66.7% Male

33.3% Female

3. What is your age? (Mean=52.17; SD = 9.75; Min = 40; Max = 69; Range = 29; n = 6)

4. What is your occupation?

5. What is the approximate size of your residential lot? **(Responses: 6)**

0% 1/4 acre or less

83.3% More than 1/4 acre but less than 1 acre

16.7% 1 acre to less than 5 acres

0% 5 acres or more

6. Do you own or rent your home? **(Responses: 6)**

100% Own

0% Rent

7. How long have you lived at your current residence (years)? (Mean=10.67; SD = 9.03; Min = 3; Max = 26; Range = 23; n = 6)

8. Do you use a professional lawn care service? **(Responses: 6)**

0% Yes, just for mowing

0% Yes, for mowing and fertilizing

0% Yes, just for fertilizing and pest control

50% Yes, for mowing, fertilizing, and pest control

50% No

9. Where are you likely to seek information about water quality issues? **(Responses: 6)**

50% Newsletters/brochure/fact sheet

50% Internet

0% Radio

33.3% Newspapers/magazines

16.7% Workshops/demonstrations/meetings

16.7% Conversations with others

16.7% None of the above