

APPENDIX P

Burke Creek Monitoring Workplan

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1.0 Project Background and Objective

Sierra Colina is located on approximately 18 acres in Stateline, Nevada. The project is in the planning phase, with environmental analysis and review currently initiated. Burke Creek flows through the southern portion of the property and this area is designated as a Stream Environment Zone (SEZ). SEZs are thought to provide functional values in protecting and restoring water quality in the Lake Tahoe Basin.

This monitoring workplan was developed by Northwest Hydraulic Consultants (**nhc**) and the Nevada Tahoe Conservation District (NTCD). The monitoring workplan is designed to provide baseline data and assess the current function of the Burke Creek SEZ with respect to water quality on the Sierra Colina property. The monitoring program will continue for approximately one year after initiation of this workplan. The collected water quality data will be used during the planning process for environmental analysis of baseline conditions.

Two previous monitoring efforts to characterize Burke Creek water quality are known at this time:

1. The Burke Creek Stream Channel Restoration Monitoring Report (August 1999), describes monitoring conducted downstream of the property from 1990 to 1998. The monitoring report indicates that some of the data collected may be questionable. The water quality data from the channel restoration study will be reviewed to determine if it can be used to complement this effort.
2. For the previous two years, TRPA has collected continuous flow data and intermittent water quality data from the downstream side of the NDOT culvert that conveys Burke Creek underneath Highway 50. The quality of data collected is unknown at this time. The data has not been compiled or reviewed by TRPA and the agency currently lacks the resources to complete this task.

1.1 Description of Monitoring Plan Revisions

The monitoring plan was adopted by Sierra Colina, NTCD, and **nhc** in February 2006. Minor revisions to the monitoring effort have occurred since the adoption of the plan to improve the data collection effort. This monitoring plan was revised in August 2006 to provide the reader with a more accurate description of the monitoring work occurring. The following revisions to the February 2006 plan were made in this document:

- Flow monitoring was originally envisioned downstream of the Highway 50 culvert because of previous TRPA monitoring at this location and the potential use of the existing equipment. However, NTCD inspected the downstream location and recommended that a more accurate stage-discharge relationship could be developed upstream of the Highway 50 culvert. Consequently, the flow monitoring location was moved upstream of Highway 50 to the location shown as F1 on Figure 1.
- The February 2006 monitoring plan recommended NTCD use a multi-parameter water quality probe to collect field parameters at each sample location during grab sampling for pH, conductivity, turbidity, temperature, and oxidation-reduction potential (ORP).



After review of initial data collected from the multi-parameter probe, NTCD and **nhc** recommended reducing the parameters measured and reported to pH, conductivity, and temperature. These parameters were found to be the most useful and accurate during initial data collection.

2.0 Scope of Work

Grab sampling and flow monitoring will be conducted under this monitoring workplan, recognizing that definitive conclusions regarding the overall function of Burke Creek may not be reached from the limited initial sampling. The compiled data will be reviewed at the conclusion of the monitoring period and recommendations regarding continuation or revision of the program will be made at that time.

NTCD will conduct all field work, data collection, data compilation, and quality assurance. **nhc** will provide oversight of the monitoring effort. NTCD and **nhc** will jointly provide quarterly status updates, and at the end of data collection will provide a joint set of recommendations and findings.

2.1 Water Quality Sampling Locations

NTCD personnel will collect synoptic grab samples from Burke Creek at various locations on and above the property. A total of six sampling locations are identified to characterize the function of the Burke Creek SEZ on and above the property (Figure 1). The six water quality sampling locations, as shown in Figure 1, are located just downstream of Chimney Rock Road (WQ-1 and WQ-2), just upstream of the property line (WQ-3), roughly 100 meters upstream of the confluence of Burke Creek with the Kahle Park drainage channel (WQ-4), just downstream of the property line (WQ-6), and as runoff conditions dictate, at the Kahle Park drainage channel prior to the confluence with Burke Creek (WQ-5). Below is a brief rationale for selection of each water quality sampling location.



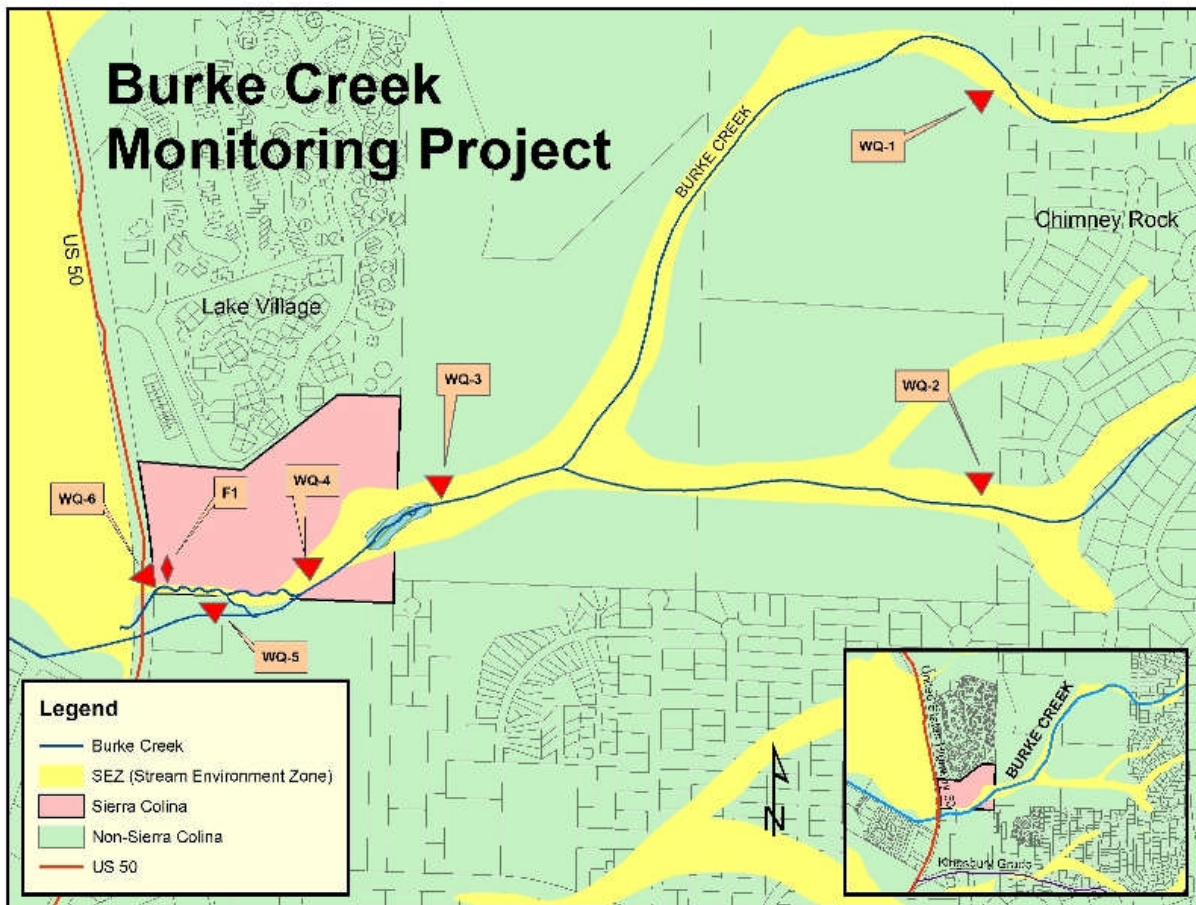


Figure 1. Burke Creek Sampling Locations

2.1.2 Sampling Locations WQ-1 and WQ-2

Above the Sierra Colina property, Burke Creek flows through the Lower Kingsbury residential development. The residential development is likely impacting the water quality of Burke Creek. Sampling below Chimney Rock Road on the two tributaries flowing through the Lower Kingsbury residential development will provide data to analyze this hypothesis. While these two sampling locations are well above Sierra Colina, they represent the final major urban influence to Burke Creek before flow enters Sierra Colina. Sampling the two tributaries of Burke Creek below Chimney Rock Road (WQ-1 and WQ-2) and just upstream of the property (WQ-3) may provide an indication of how well the Burke Creek SEZ is mitigating potentially poor quality runoff from the urban development. Additionally, a portion of the Burke Creek SEZ on Sierra Colina appears to be in a similar condition (between WQ-3 and WQ-4 on Figure 1) relative to the upstream SEZ. Sampling WQ-1 and WQ-2 in conjunction with sampling locations at WQ-3 and WQ-4 may provide an indication of the connection between the SEZ on Sierra Colina relative to the SEZ above the property, and its overall water quality.

2.1.2 Sampling Location WQ-3

Sampling just upstream of the property line will provide an indication of the quality of water entering the property. This sampling location will provide background data to determine if water



quality improves, declines, or remains relatively stable as Burke Creek travels through the property.

2.1.3 Sampling Location WQ-4

The Burke Creek channel within the property is composed of two distinct reaches. The channel upstream of WQ-4 appears relatively undisturbed and is characterized by braided and distributed flow. The channel downstream of WQ-4 is heavily man-modified, primarily due to the construction of the Burger King parking lot, which confined the reach to a narrow and steep corridor. Sampling at WQ-4 will provide a data point to compare the two distinct reaches of Burke Creek on the property.

2.1.4 Sampling Location WQ-5

As shown on Figure 1, an ephemeral drainage channel from Kahle Park inflows to Burke Creek at the southern property line just downstream of WQ-4. Characterizing the quality of water inflowing to Burke Creek from the drainage channel will help determine the influence of Kahle Park operations on the quality of water in Burke Creek. The Kahle Park drainage channel receives runoff from a portion of the large lawn associated with the park, and when the drainage channel flows to Burke Creek, it may contain elevated levels of phosphorous and nitrogen.

2.1.5 Sampling Location WQ-6

Sampling just downstream of the property line will provide an indication of the quality of water discharging from the property. Sampling this location along with WQ-3 and WQ-4 may indicate how well the Burke Creek SEZ is functioning within the property

2.2 Water Quality Sampling Parameters

The monitoring study will focus on the priority pollutants contributing to Lake Tahoe clarity decline, standard water quality field parameters, and a limited assessment of grease and oil and dissolved iron. Priority pollutants for Lake Tahoe are fine sediment, dissolved and particulate nitrogen, and dissolved and particulate phosphorous. Table 1 lists the specific water quality parameters to be analyzed.

NTCD will use a multi-parameter water quality probe to collect field parameters at the sample points during grab sampling. Collection of field parameters will provide a quick and relatively inexpensive overview of the general function of the creek at the time of grab sampling. The multi-parameter water quality probe provides in-situ sampling capability, meaning that field parameters are analyzed directly on site at the time of sampling. As shown in Table 1, NTCD's probe will measure pH, conductivity, and temperature.

Grease and oil, along with dissolved iron are not considered priority pollutants to Lake Tahoe but are subject to TRPA standards and will be analyzed on a limited basis to provide baseline information. A total of four samples will be analyzed for grease and oil and dissolved iron at WQ-6. A single sample will be collected and analyzed for grease and oil and dissolved iron for each runoff condition described below. If the presence of grease and oil is detected, additional sampling needs will be evaluated by NTCD and **nhc**.



Table 1. Water Quality Parameter Analysis

Water Quality Constituent	Symbol	Type of Analysis
Nitrate + Nitrite	NO3+NO2	Lab
Total Kjeldahl Nitrogen	TKN	Lab
Ammonia	NH3	Lab
Dissolved Phosphorous	DP	Lab
Total Phosphorous	TP	Lab
Total Suspended Sediment	TSS	Lab
Particle Size Distribution	PSD	Lab
Grease and Oil	G&O	Lab
Dissolved Iron	Fe	Lab
pH	pH	In-situ
Conductivity	Cond	In-situ
Temperature	Temp	In-situ

Water quality analysis will be conducted in accordance with Lake Tahoe Interagency Monitoring Program (LTIMP) standards for minimum detection levels, holding times and lab procedures. NTCD will contract with a federally certified lab (currently High Sierra Water Lab) for all water quality analysis of grab samples.

2.3 Water Quality Sampling Frequency

The monitoring program will continue for approximately one year after initiation of this workplan. Water quality sampling will be conducted throughout the year to characterize the complete range of seasonal runoff conditions and precipitation events found in the Burke Creek watershed. NTCD will conduct grab samples and in-situ monitoring of field parameters during the following runoff conditions: 1) the peak of spring runoff from snowmelt, 2) significant summer thunderstorms and fall rains, 3) rain-on-snow, and 4) typical baseflow.

Each of these runoff conditions can cause varying concentrations of sediment and nutrients to enter Burke Creek. Sampling data from a variety of events will assist in evaluation of Burke Creek SEZ functions for water quality. Table 2 displays a summary of runoff conditions and the water quality sampling frequency for each sample location and runoff condition. Event sampling may require NTCD personnel to be available outside of typical work hours. Typically, storm events occurring after 10 p.m. will be sampled as early as possible the next morning.

Table 2. Sampling Frequency for Runoff Conditions

Runoff Condition	Description of Sampling Frequency	Total Number of Samples at Each Location					
		WQ-1	WQ-2	WQ-3	WQ-4	WQ-5	WQ-6
Spring Snowmelt	Consecutive daily	4	4	4	4	0	4
Summer and Fall Rain ¹	Event	3	3	3	3	3	3
Rain on Snow ¹	Event	2	2	2	2	2	2
Baseflow	Bi-monthly	6	6	6	6	0	6
Quality Control	Field duplicates	0	0	4	0	0	0
	Total:	15	15	19	15	5	15

¹ NTCD previously collected samples for two rain-on-snow events and two fall rain events (Dec. 05) at WQ-3, WQ-5, and WQ-6



2.3.1 Spring Snowmelt

Intermittent samples will be taken on days as close to the seasonal runoff peak as possible. Due to the difficulty in accurately predicting when the actual peak of spring runoff will occur, up to four days of peak daily runoff sampling may need to be collected. Spring snowmelt runoff will be collected at sampling locations WQ-1, WQ-2, WQ-3, WQ-4, and WQ-6.

2.3.2 Summer and Fall Rain

Up to three samples will be collected from a combination of summer thunder storms and fall rain events. Samples will be collected during the event as close to maximum flow as possible.

Summer thunderstorm and fall rain event samples will be collected at sampling locations WQ-1, WQ-2, WQ-3, WQ-4, and WQ-6, and when significant runoff exists in the Kahle Park drainage channel, at WQ-5.

2.3.3 Rain on Snow

Up to two samples will be collected during rain-on-snow events. The sampling will be conducted as close to maximum flow as possible. NTC previously collected and analyzed two rain-on-snow events on December 18, 2005 and December 31, 2005 for sampling locations WQ-3, WQ-5, and WQ-6. Rain-on-snow event samples will be collected at sampling locations WQ-1, WQ-2, WQ-3, WQ-4, and WQ-6, and when significant runoff exists in the Kahle Park drainage channel, at WQ-5.

2.3.4 Baseflow

Up to six baseflow samples will be collected during the course of the one year monitoring program. Baseflow sampling will commence on the 1st of the month, beginning with March 1st, 2006 and will proceed on a bi-monthly basis after initial sampling. Collection of baseflow samples throughout the entire year will be used to evaluate potential seasonal variations in water quality concentrations. In the event baseflow sample collection is not possible on the 1st of the month due to storm events, the baseflow sample will be collected as soon as Burke Creek returns to baseflow runoff conditions. Baseflow samples will be collected at sampling locations WQ-1, WQ-2, WQ-3, WQ-4, and WQ-6.

2.3.5 Quality Control

Up to four quality control samples will be collected during the one year monitoring program. Quality control samples will be field duplicates sent to the lab to ensure accurate reporting of water quality data. One duplicate quality control sample will be collected and analyzed during four of the events at sampling location WQ-3.

2.4 Flow Monitoring

Combining water quality sampling analysis with flow measurements can provide an estimate of the total pollutant loads a stream is transporting. The current regulatory environment is transitioning to this type of analysis for the Lake Tahoe Basin through the Total Maximum Daily Load (TMDL) program. To collect data in a manner commensurate with the future regulatory environment, flow monitoring will be conducted as part of this monitoring workplan. An additional advantage to including flow monitoring, is that it may provide insight into correlation between the magnitudes of runoff events and water quality.



NTCD installed a pressure transducer to continuously record stage (Van Essen Instruments Diver and Baro Diver) at the flow monitoring location upstream of Highway 50 in Burke Creek, shown on Figure 1 as F1. NTCD will record periodic discharge measurements using a Swoffer Portable Flowmeter. These measurements will be used to create an accurate stage-discharge relationship in order to estimate discharge by measuring stage. The final water quality analysis from this monitoring effort will estimate constituent loads by comparing nutrient and sediment concentrations with average discharge.

3.0 Data Compilation and Reporting

Water quality and flow data will be compiled and quality assured by NTCD into a single database structure that facilitates review and analysis. This database structure will use readily available software (either Microsoft Excel or Access). NTCD will provide quarterly reporting of sampling activity and data collection by transmitting the most recent populated database to **nhc**. Along with transmittal of the database, NTCD will provide a 1-page summary of water quality observations regarding apparent function of the Burke Creek SEZ. The quarterly reporting will compare collected data to relevant Nevada and TRPA standards. **nhc** will review each quarterly report and discuss preliminary findings with NTCD and Sierra Colina. Preliminary findings may lead to a revision of this monitoring workplan.

At the completion of monitoring, NTCD will transmit the following to **nhc** within 30 days:

- Quality assured database containing all records of sampling activity and data collected
- Graphical analysis of water quality data evaluating potential trends and anomalies
- Brief narrative highlighting water quality observations regarding the function of the Burke Creek SEZ; a description of any unexpected results; a comparison of Burke Creek's data relative to similar watersheds in the Lake Tahoe Basin; and a brief review of data collected for this study relative to prior monitoring studies of Burke Creek.

nhc will review data results as compiled by NTCD and incorporate NTCD observations along with **nhc** observations into a set of findings and recommendations to Sierra Colina regarding the continuation or revision of the program.

Deliverables:

NTCD – Quarterly and final data compilation; including graphical analysis and findings
nhc – Brief memorandum of recommendations at the conclusion of monitoring

