GROUP A ELEMENTS: PROJECT MANAGEMENT

1. TITLE AND APPROVAL SHEETS

Quality Assurance Project Plan

FINAL
VERSON 1.0

For

PROJECT NAME: Truckee River Monitoring Plan

Proposal Identification Number: 06-156-556-0

Date: June 15, 2007

NAME OF RESPONSIBLE ORGANIZATION : Truckee River Watershed Council

APPROVAL SIGNATURES

GRANT ORGANIZATION:

Title:	Name:	Signature:	Date*:
TRWC Project Manager	Lisa Wallace		
TRWC QA Officer	Beth Christman		
SNA Watershed Program Associate	Shasta Ferranto		

REGIONAL BOARD (SWRCB**):

Title:	Name:	Signature:	Date*:
Contract Manager	Bruce Warden		
QA Officer	William Ray		

* This is a contractual document. The signature dates indicate the earliest date when the project can start.

** If the QAPP is being prepared under the jurisdiction of the State Water Resources Control Board (SWRCB) rather than a Regional Board, substitute the appropriate SWRCB information for the RWQCB information.

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3. DISTRIBUTION LIST

Title:	Name (Affiliation):	Tel. No.:	QAPP No*:
Contractor Grant Contact – SNA Watershed Program Associate	Shasta Ferranto (SNA)	530-542-4546	1
Subcontractor Project Manager	Lisa Wallace (TRWC)	530-550-8760	1
Subcontractor QA Officer	Beth Christman (TRWC)	530-550-8760	1
Regional Board Contract Manager	Bruce Warden (LRWQCB)	530-542-5426	ORIGINAL
Regional Board QA Officer	William Ray (SWRCB)	(925) 352-5205	1

4. PROJECT/TASK ORGANIZATION

4.1 Involved parties and roles.

The Sierra Nevada Alliance (SNA) is a non-profit organization that works to build capacity of environmental groups throughout the Sierra Nevada. They have received grant funding to help member organizations establish monitoring programs. The Truckee River Watershed Council (TRWC) has received a re-grant from SNA to establish such a program. The activities outlined in this QAPP relate only to the monitoring activities that will be conducted by TRWC. Shasta Ferranto of SNA is the grant contact for organizations receiving regrants from SNA.

The Truckee River Watershed Council is a non-profit organization that works to improve the water quality and habitat of the Truckee River. TRWC will oversee the activities of volunteers related to collecting physical, chemical, and biological monitoring data.

Beth Christman (TRWC) is the QA Officer and will oversee the different aspects of monitoring outlined here. Lisa Wallace (TRWC) will oversee the program management.

Sierra Nevada Alliance (SNA) will conduct training activities related to ambient monitoring and stream walk surveys. Megan Suarez-Brand of SNA will coordinate the training activities.

High Sierra Water Lab (HSWL) will be the contract laboratory for nutrient analyses. HSWL will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP. HSWL will act as a technical resource to TRWC staff and management.

The Aquatic Bioassessment Laboratory of California Department of Fish & Game (ABL) will be the contract laboratory for bioassessment sample analyses that are not analyzed by TRWC's in-house laboratory. ABL will follow all method and quality assurance requirements found in this QAPP.

Table 1. (Element 4) Personnel responsibilities.

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
Beth Christman	TRWC	Program Manager	Phone:(530) 550-8760 Fax: (530) 550-8761 e-mail: bchristman@truckeeriverwc.org

Lisa Wallace	TRWC	Executive Director	Phone:(530) 550-8760 Fax: (530) 550-8761 e-mail: lwallace@truckeeriverwc.org
Megan Suarez-Brand	SNA	Watersheds Program Director	Phone: (530) 542-4546 Fax: (530) 542-4570 e-mail: *megan@sierranevadaalliance.org*
Mark Palmer	HSWL	Owner	Phone: (530) 582-8150 Fax: (530) 550-7262 e-mail: *HSWaterLab@aol.com*
Gina Hall	ABL	Environmental Projects Manager	Phone: (530) 898-5496 Fax: (530) 898-4363 e-mail: ghall@exchange.csuchico.edu

4.2 Quality Assurance Officer role
Beth Christman is TRWC's QA Officer. Beth's role is to ensure that QA and QC procedures outlined in the QAPP are followed. Beth will also review and assess all procedures during the life of the contract against QAPP requirements. She will report findings to Lisa Wallace, including all requests for corrective action. Beth Christman may stop all actions, if there are significant deviations from required practices or if there is evidence of a systematic failure.

4.3 Persons responsible for QAPP update and maintenance.
Changes and updates to this QAPP may be made by TRWC's Project Manager or QA Officer, with agreement from the State Board Contract Manager and QA Officer. TRWC's QA Officer will be responsible for making the changes and getting the changes approved.

4.4 Organizational chart and responsibilities

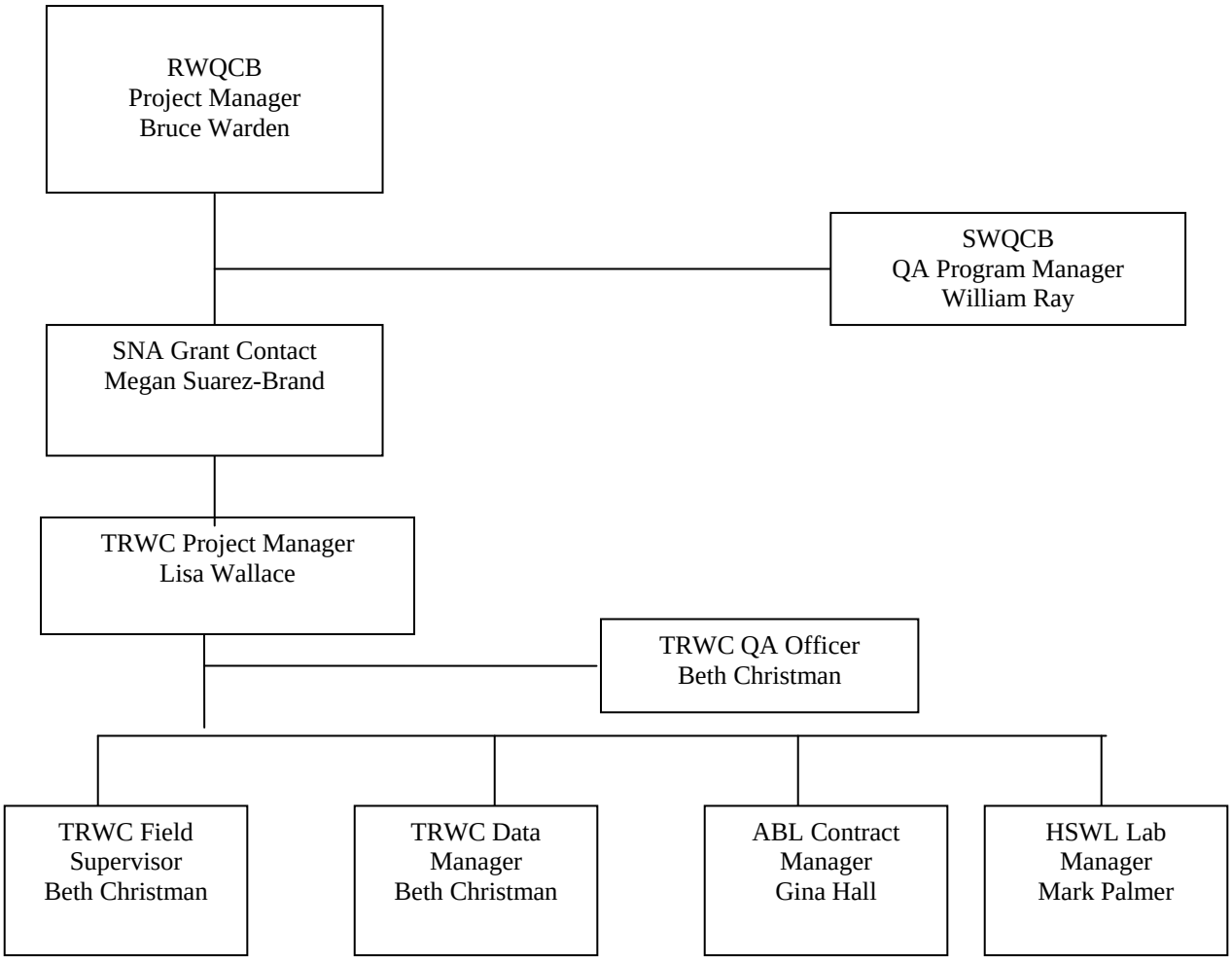

Figure 1. Organizational chart.

5. PROBLEM DEFINITION/BACKGROUND

5.1 Problem statement.

The watershed area to be covered under the Truckee River QAPP is the Middle Truckee River. This includes all drainages to the Truckee River, from below the dam at Lake Tahoe to the California/Nevada state line. The watershed includes 26 major sub-basins (or sub-watersheds). A map of the geography covered is posted on the TRWC website: www.truckeeriverwc.org and is included as Appendix A.

The Truckee River watershed has a 170-year history of significant human disturbance. Timber harvests (including multiple clear cuts) began early to support silver mining and the transcontinental railroad; railroad construction and operation were (and still are) the source of many watershed problems; the native trout fishery (Lahontan cutthroat trout) was fished to extinction as a food source for California expansion by 1930; gravel mining to support large scale road construction including Interstate 80 have left behind degraded areas; and the largest subdivision in the United States – Tahoe Donner - was built in the 1960s and 1970s before stormwater and erosion regulation. A series of dams in the Truckee River system were established for water supply and flood control.

More recent impacts of concern in the Truckee River watershed include extensive construction particularly in the Town of Truckee and Martis Valley, which is predicted to last another 6-10 years. Ski resorts are expanding to year-round resorts with an increase in golf course use and residential development. Additionally, the flow regime in the Truckee River may see significant changes as the Truckee River Operating Agreement is implemented.

The Truckee River and three tributaries (Bronco Creek, Gray Creek, and Squaw Creek) are listed as impaired for excessive sediment under the Clean Water Act. The primary pollutant of concern in the watershed is excessive sediment. Sediment sources include road and highway salting and sanding, construction, ski runs, and natural sediment sources including landslides and debris flows.

5.2 Decisions or outcomes.

This project will provide information about watershed condition and response to land use changes by monitoring various physical, chemical, and biological parameters. Different areas of the watershed are expected to experience different kinds of changes in land use, which will affect the types of monitoring that are conducted at each site. For details on monitoring locations and activities, please refer to the Truckee River Monitoring Plan (Appendix B).

5.3 Water quality or regulatory criteria

The Truckee River and three of its tributaries (Gray Creek, Bronco Creek, and Squaw Creek) are 303(d) listed for sediment. The TMDLs for the Truckee River, Gray Creek, and Bronco Creek are under development. A TMDL for Squaw Creek has recently been adopted.

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6. PROJECT/TASK DESCRIPTION

6.1 Work statement and produced products.

The project will monitor temperature, pH, dissolved oxygen, electrical conductivity, and turbidity at a minimum of six locations in the Truckee River watershed four times per year. Additionally, nutrient data will be collected from a minimum of six sites two times per year. The project will also collect bioassessment samples from a minimum of eight sites during the summer sampling season (May – September). See Item 10 for site locations.

The project will provide quarterly progress reports, including collected data, for the length of the contract. Additionally, a final report with all data and analyses will be completed by June 1, 2008.

6.2. Constituents to be monitored and measurement techniques.

The monitoring activities to take place and methods used are described in the Monitoring Plan (Appendix B) developed for this grant.

6.3 Project schedule
A project schedule follows.

Table 2. (Element 6) Project schedule timeline.

Activity	Date (MM/DD/YY)		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Start Project	2/1/07	2/1/07	None	None
Orientation for volunteer monitors	4/17/07	4/17/07	Quarterly Progress Report	By the 1st of the month following the end of the quarter
Field Training for volunteer monitors	4/21/07	6/2/07	Quarterly Progress Report	By the 1st of the month following the end of the quarter
Ambient monitoring	4/21/07	6/1/08	Quarterly Progress Report	By the 1st of the month following the end of the quarter
Bioassessment monitoring	6/1/07	9/15/07	Quarterly Progress Report	By the 1st of the month following the end of the quarter
Final Report	6/1/08	6/1/08	Final Report	6/1/08

6.4 Geographical setting

The Middle Truckee River watershed starts at the outflow of Lake Tahoe and continues to approximately the California/Nevada state line. The watershed includes 26 major sub-basins. Significant bodies of water in the watershed include the Truckee River, Donner Lake, Prosser Creek Lake, Boca Reservoir, and Stampede Reservoir. Elevations in the watershed range from 5,050 to 10,778 feet. A map of the watershed is included as Appendix A.

6.5 Constraints

Bioassessment monitoring will only take place during the regular field season which lasts from June to mid-September. Earlier in the year, flows are typically too high, or temperatures are too low for volunteers to safely conduct monitoring. Later in the year, low flows bias the stream community composition. For comparability purposes, sampling is limited to these months.

Ambient monitoring sites will be selected with safety concerns and access in mind. Some sampling is likely to take place during very high flows. Additionally, many sites within the watershed are not easily accessed during winter months when seasonal roads are buried under snow.

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7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Field Measurements –accuracy, precision, completeness
Turbidity Measurements – accuracy, precision, completeness
Benthic Macroinvertebrates – accuracy, precision, completeness
Nutrient Analyses (Laboratory Analyses, conventional constituents) – accuracy, precision, recovery, completeness

Accuracy will be determined by measuring against a solution of known concentration (other than that used for calibration). Accuracy for benthic macroinvertebrate identification will be performed by the QA Officer or by a professional laboratory.

Precision will be determined by taking replicate measurements. All field measurements will be taken three times.

Completeness is the number of measurements generating useable data for each monitored parameter divided by the number of measurements collected for that analysis.

Recovery measurements will be determined by laboratory spiking of a replicate sample with a known concentration of the analyte. The target level of addition is at least twice the original sample concentration.

See attached HSWL QA procedures (Appendix F) for more details regarding nutrient analyses.

Data Quality Objectives

Measurement or Analyses Type	Applicable Data Quality Objective
e.g. Field Testing, Dissolved Oxygen	*e.g. Accuracy, Precision, Completeness*
Field Testing, Temperature	Accuracy, Precision, Completeness
Field Testing, pH	Accuracy, Precision, Completeness
Field Testing, Electrical Conductivity	Accuracy, Precision, Completeness
Field Testing, Dissolved Oxygen	Accuracy, Precision, Completeness
Laboratory Analyses, Turbidity	Accuracy, Precision, Completeness
Laboratory Analyses, Benthic Macroinvertebrates	Accuracy, Precision, Completeness
Laboratory Analyses, (conventional constituents)	Accuracy, Precision, Recovery, Completeness

Table 3. (Element 7) Data quality objectives for field measurements.

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Completeness
Field Testing	Temperature	± 0.5ºC	± 0.5 ºC	NA		90%
	pH	±0.5 units	± 0.5 units	NA		90%
	Electrical Conductivity	±5%	±5%	NA		90%
	Dissolved Oxygen	±0.5 mg/L	±0.5 mg/L	NA		90%
	Turbidity	±10%	±10%	NA		90%

Table 4. (Element 7) Data quality objectives for laboratory measurements.

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Laboratory analyses	Conventional Constituents in Water (forms of N&P)	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then within 80% to 120% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD 25% RPD laboratory duplicate minimum	Matrix spike 80% - 120% or control limits at ± 3 standard deviations based on actual lab data	1 ppb	90%
Laboratory analyses	Benthic Macroinvertebrates	≤5% difference	≤5% difference	NA	NA	100%

8. Special Training Needs/Certification

8.1 Specialized training or certifications.

Volunteer monitors will attend an orientation session, and two days of field training for ambient monitoring. Volunteers involved in benthic macroinvertebrate field collection or lab processing will be supervised by the TRWC QA Officer.

8.2 Training and certification documentation.

Records of training with QAPP requirements will be held at the TRWC office.

8.3 Training personnel.

The TRWC QA Officer will ensure that all entities performing monitoring will be familiar with the procedures outlined in the QAPP.

9. Documents And Records

TRWC will collect records from field testing, sample collection, and bioassessment monitoring. Samples sent to either ABL or HSWL will include a Chain of Custody form. Hard copies and electronic copies of the data will be housed at TRWC. ABL and HSWL transmit data to TRWC electronically.

TRWC will develop an electronic database and all records will be incorporated into that database. All electronic records housed at TRWC are backed up on an offsite server.

The TRWC QA Officer or TRWC Project Manager will ensure that copies of the QAPP are distributed to all project partners and any subcontractors working on the monitoring aspect of this project.

Persons responsible for maintaining records for this project are as follows: Beth Christman, QA Officer (TRWC) will maintain all field analyses, sample collection, bioassessment, chain of custody, and all in-house laboratory analysis (bioassessment and turbidity) forms. Mark Palmer, Laboratory Manager at HSWL will maintain records for nutrient analyses. Dan Pickard, Freshwater Invertebrate Taxonomist at ABL will maintain laboratory records. Lisa Wallace, TRWC Project Manager, will oversee the actions of everyone involved in the project and will have the final determination on record retention.

A final monitoring report will summarize all the data collected and will be submitted to the Grant Contact at Sierra Nevada Alliance, Megan Suarez-Brand. SNA will submit all records to the Project Manager at LRWQCB, Bruce Warden.

All records at TRWC will be maintained for a minimum of 5 years.

GROUP B: DATA GENERATION AND ACQUISITION

10. SAMPLING PROCESS DESIGN

Sample design is outlined in the Monitoring Plan (Appendix A). All sampling sites meet at least 4 of the following 12 criteria:

- Presence of flow gauging station
- Present or historic major land use with potential to affect water quality at site
- Designation as critical habitat for listed species
- Easy and safe access for sampling
- Potential water quality impairment
- Previously collected data from site
- Part of existing watershed restoration program
- Listed as impaired under the Clean Water Act
- Non-impacted reference site for comparison
- Presence of dams or weirs that affect flow
- Variation among sites selected in watershed characteristics
- Site potentially affect by reservoir operations under the Truckee River Operating Agreement

11. SAMPLING METHODS

Nutrient and turbidity samples will be collected as grab samples from the main channel, approximately 6 inches below the surface of the water. Plastic containers will be used for sample collection and will be acid rinsed prior to use.

Bioassessment samples will be collected in plastic jars and preserved with alcohol in the field.

12. SAMPLE HANDLING AND CUSTODY

Nutrient and turbidity sample containers are labeled prior to taking the sample, except for the time the sample was taken. Time will be filled in immediately prior to taking the grab sample. Once samples are taken the containers are placed on ice or blue ice and kept cold until transported to the laboratory.

A field tag is filled out and placed within the BMI sample jar prior to putting the materials in the jar. The outside of the jar is then labeled and sealed with chain of custody tape. Alcohol is added to the sample for a preservative.

Plastic bottles are used for collecting grab samples. 500 ml bottles will be used for nutrient samples and 250 or 500 ml bottles will be used for turbidity samples. Wide mouth 500 ml (16 oz.) jars will be used for collecting BMI samples.

Samples will be delivered to the TRWC laboratory. Turbidity samples will be kept at approximately 4°C in a refrigerator until they are processed at TRWC, within 2 days of collection. A field turbidity meter is used, and protocols for the meter are followed. Nutrient samples will be kept cold and delivered to HSWL immediately for processing. BMI samples will be kept at the TRWC laboratory until they are processed at TRWC or delivered to ABL.

Table 5. (Element 12). Sample handling and custody.

Parameter	Container	Volume	Initial Preservation	Holding Time
Orthophosphate (OPO_4)	Polyethylene bottle	500 ml	Chill to 4°C, delivered to lab immediately for processing.	48 hours at 4°C, dark
Nitrate + Nitrite ($NO_3 + NO_2$)	Polyethylene bottle	500 ml	Chill to 4°C, delivered to lab immediately for processing	48 hours at 4°C, dark
Total Keldjahl Nitrogen (TKN)	Polyethylene bottle	500 ml	Chill to 4°C, delivered to lab immediately for processing	7 days, 48 days maximum, both at 4°C, dark
Ammonia (NH_3)	Polyethylene bottle	500 ml	Chill to 4°C, delivered to lab immediately for processing	28 days at 4°C, dark
Total Phosphorus (TP)	Polyethylene bottle	500 ml	Chill to 4°C, delivered to lab immediately for processing	28 days at 4°C, dark
Benthic Macroinvertebrates	Plastic jar	500 ml	70 % ethyl alcohol, store in dark	5 years
Turbidity	Polyethylene bottle	250 ml	Chill to 4°C, store in dark	28 days at 4°C, dark

A Chain of custody form will be used to track sample delivery.

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13. ANALYTICAL METHODS

Field data collected using meters will be conducted according to the manufacturer's instructions for each instrument. Volunteers will be trained in the proper use of field analytical equipment during a series of training dates conducted by SNA in April. SOPs are included as Appendices C, D, & E.

HSWL Analytical methods are described in the attached HSWL QA plan (Appendix F).

Table 6. (Element 13) Field and Laboratory analytical methods.

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
pH	Field monitoring by citizen volunteers	6 - 9 pH units	NA	Standard Methods 4500H+B TRWC Field SOP 1	None		
Conductivity	Field monitoring by citizen volunteers	> 1500 micromhos	10 micromhos	Standard Methods 2510B TRWC Field SOP 3	None		
Dissolved Oxygen	Field monitoring by citizen volunteers	< 5 mg/L	0.1 mg/L	Standard Methods 4500OG TRWC Field SOP 2	None		
Temperature	Field monitoring by citizen volunteers	None	-5 ^{o} C	Standard Methods 2550B FOI Field SOP 1	None		
Turbidity	In-house laboratory	NTU	0.1 NTU	TRWC SOP 4	None	NA	
Orthophosphate	HSWL	µg/L	1 µg/L	SM 4500-PE	No	0.40 µg/L	1 µg/L
Total Phosphorus/ Dissolved TP	HSWL	µg/L	1 µg/L	EPA 365.3	No	0.62 µg/L	1 µg/L
Nitrate-Nitrogen + Nitrite-Nitrogen	HSWL	µg/L	1 µg/L	EPA 353.1	No	0.44 µg/L	1 µg/L
Nitrite-Nitrogen	HSWL	µg/L	1 µg/L	EPA 354.1	No	0.45 µg/L	1 µg/L
Ammonia-Nitrogen	HSWL	µg/L	1 µg/L	EPA 350.1	No	0.49 µg/L	1 µg/L
Total Kjelhdal Nitrogen/ Dissolved TKN	HSWL	µg/L	1 µg/L	EPA 351.2	No	23.5 µg/L	35 mg/L

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14. Quality Control

Sampling:

Quality assurance and quality control activities for sampling processes include the collection of field replicates for chemical testing. Blanks are tested in the lab for nutrient analysis. One replicate sample per sampling event will be collected.

In order to monitor the sampling process, the TRWC QA Officer will randomly observe volunteer teams during field collection events.

Field Measurements:

All field measurements will be taken in triplicate, including digital photographs taken at each photo-point.

Percent difference = 100*(largest-smallest)/average

The difference or percent difference, as appropriate, will be compared against the Precision criteria established for field measurements in section 7.

Laboratory work

HSWL laboratory quality control procedures are described in the attached HSWL QA document.

TRWC in-house Macroinvertebrate lab work is supervised by the TRWC QA officer. All subsampling grids are re-checked for count accuracy. Identification is checked by the QA Officer or other steering committee member, taxonomic verification is conducted by professional taxonomists at the Desert Research Institute before data are considered final.

15. Instrument/Equipment Testing, Inspection, and Maintenance

Field equipment will be inspected and tested prior to each sampling event. All necessary maintenance will be taken care of by the TRWC QA Officer, including replacement of batteries, cleaning of electrodes, and replacement of membranes. Equipment will also be inspected when brought back from the field.

HSWL equipment testing and maintenance procedures are described in Appendix F.

16. Instrument/Equipment Calibration and Frequency

Before equipment is sent out in the field it will be checked to ensure that it is operational. Conductivity meters, pH meters, DO meters and turbidity meters will be calibrated prior to use with standards. Calibration will occur according to the manufacturer's standards.

Calibration techniques used by HSWL are described in Appendix F. No equipment requiring calibration is used by ABL.

17. Inspection/Acceptance of supplies and Consumables

All standards used for calibration of TRWC field equipment will be checked for expiration dates. No expired standards will be used.

See attached HSWL QA plan (Appendix F) for description of their protocols. This element is non-applicable to ABL procedures.

18. NON-DIRECT MEASUREMENTS (EXISTING DATA)

The only non-direct measurements that will be used are from previous studies conducted by TRWC, and collected under a SWRCB approved QAPP. Therefore SWAMP data quality objectives have been met for previously collected data. It will be noted in the database where different methods have been used for data collection.

19. DATA MANAGEMENT

Data will be maintained as described in element 9 above. TRWC will maintain an inventory of data and will check inventory against records quarterly. TRWC backs up all records, including files transmitted from HSWL and ABL weekly to an off-site server. HSWL data management protocols are described in Appendix F.

GROUP C: ASSESSMENT AND OVERSIGHT

20. ASSESSMENTS & RESPONSE ACTIONS

Reviews will be made by the TRWC QA Officer. TRWC will conduct reviews of data collection on a quarterly schedule to ensure that objectives of the QAPP are being met.

If a review discovers any discrepancies, TRWC's QA Officer will discuss the problems with the appropriate person responsible for that activity (see organization chart). The discussion will cover the accuracy of the collected data, why the deviation from procedures occurred, how the deviation may affect data quality, and how future problems could be avoided.

The TRWC QA Officer may stop any and all monitoring work carried out under this QAPP if any problems are encountered that may impact data quality.

Assessment information will be reported to Megan Suarez-Brand at Sierra Nevada Alliance, the grant contact for this project in quarterly progress reports.

21. REPORTS TO MANAGEMENT

Table 7. (Element 21) QA management reports.

Table 7. (Element 21) QA management reports.

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Quarterly Progress Reports	Quarterly	By the 1st of the month following the quarter	Beth Christman, TRWC Lisa Wallace, TRWC	Megan Suarez, SNA or Joan Clayburgh, SNA
Final Report	Single report	June 1, 2008	Beth Christman, TRWC Lisa Wallace, TRWC	Megan Suarez, SNA or Joan Clayburgh, SNA

GROUP D: DATA VALIDATION AND USABILITY

22. DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

Data generated by project activities will be reviewed against the data quality objectives cited in Element 7 and the Quality Assurance/Quality Control practices cited in Elements 14-17. Data meeting all data quality objectives will be considered usable by the project. Data that meets data quality objectives, but that does not meet all quality assurance/quality control practices will be set aside for later investigation. Data that fails to meet basic accuracy criteria will be considered unusable by the project.

Data that have been set aside for later investigation will be carefully considered to establish their validity. If it is decided that the observed failures in quality assurance/quality control practices are not significant, the data will be considered usable for the project, but will be flagged with a "J" as per EPA specifications.

23. VERIFICATION AND VALIDATION METHODS

All TRWC data records will be checked by the TRWC QA Officer. Data sheets will be verified and initialed as volunteers return from field sampling. All data entered electronically (100%) is cross checked by the TRWC QA Officer, the number of records entered are relatively few so 100% verification is reasonable. HSWL data verification procedures are described in the HSWL QA document included in the Appendices.

Any issues noted in field collected data will be addressed with volunteers when they are handing in field data sheets. Other data verification issues will be noted and addressed as they appear.

24. RECONCILIATION WITH USER REQUIREMENTS

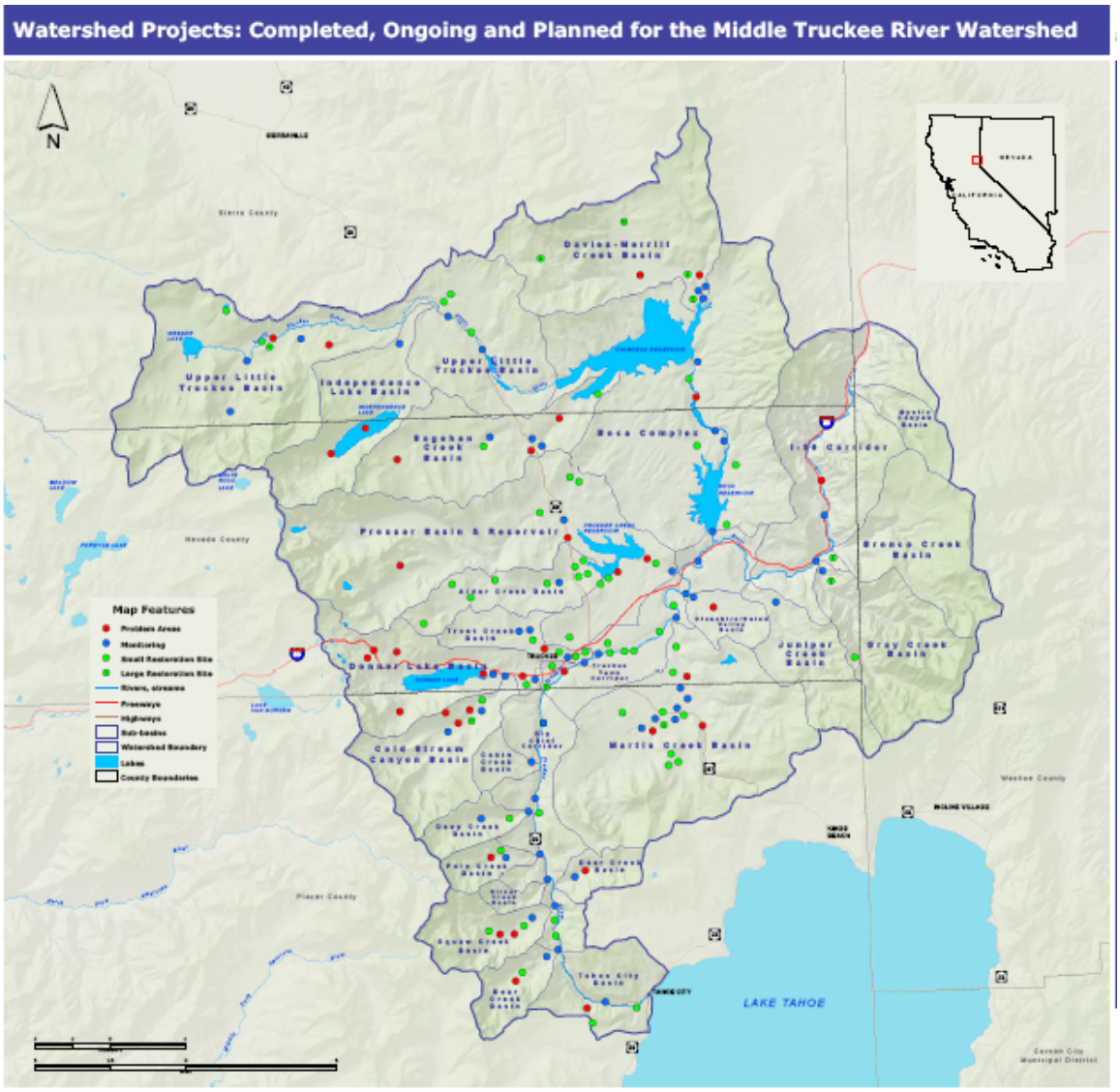
The number of ambient monitoring data points to be collected under this contract will be too few for statistical analyses. However, graphical presentation and discussion of trends may be possible for sites where data have been collected previously. For bioassessment data, standard metrics will be calculated. Once the Eastern Sierra Index of Biological Integrity (IBI) becomes available, IBI scores will be calculated as possible.

The goal of this project is to begin to establish baseline data, therefore as long as data quality objectives are met, this goal should be realized.

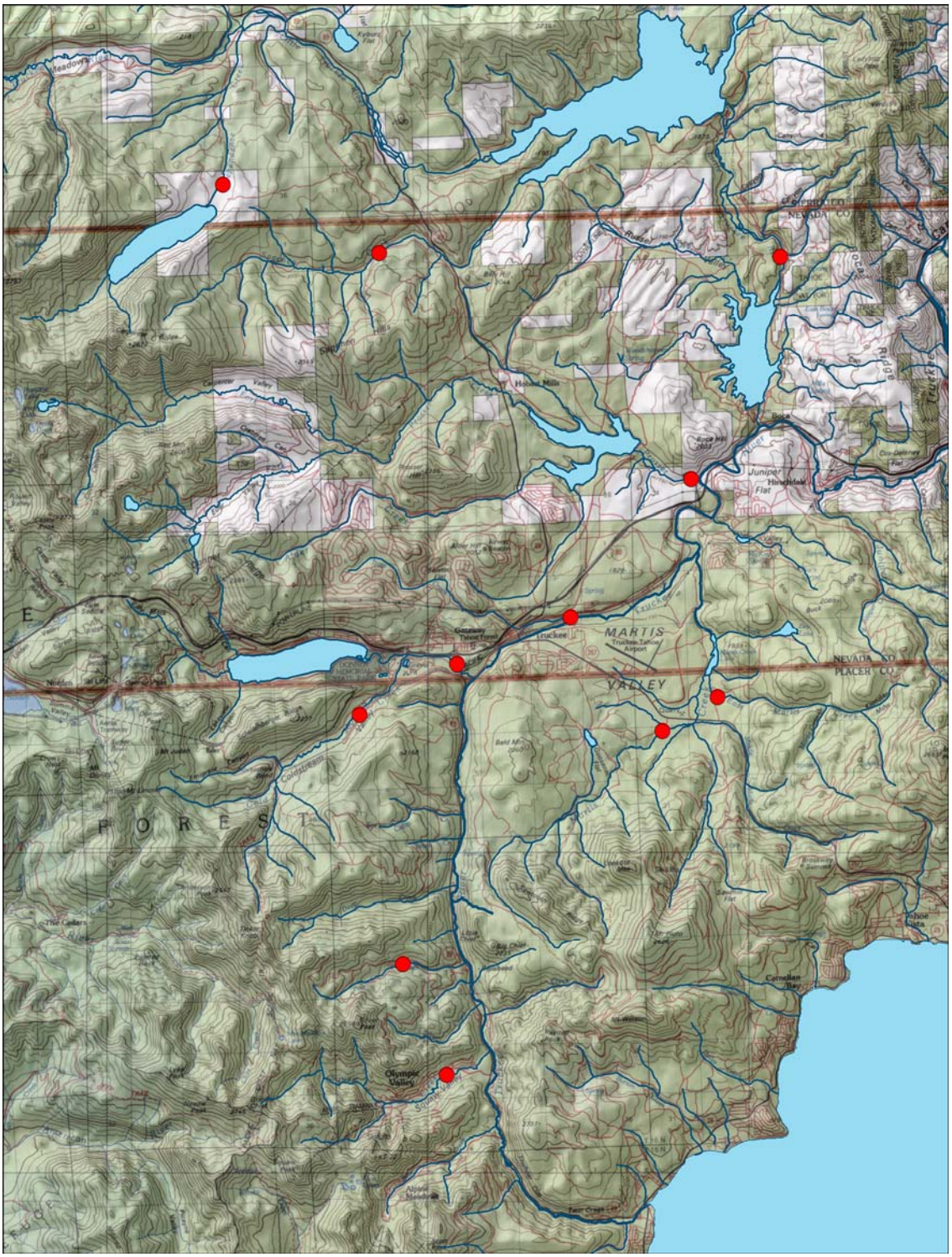
Any reports produced will acknowledge limitations regarding statistical analysis.

Appendix A. Map of Watershed and Monitoring Sites

Middle Truckee River watershed



Monitoring Locations



Appendix B. Monitoring Work Plan

Truckee River Monitoring Program Work Plan Year One

April, 2007

Submitted by:
Truckee River Watershed Council
P.O. Box 8568
Truckee, CA 96162

Truckee River Watershed Monitoring Program

Year One

1. Introduction

The intent of this plan is to outline the monitoring responsibilities required in the coordinated watershed plan for the Truckee River watershed, as funded under Proposition 40 through the Sierra Nevada Alliance and the California Department of Water Resources. This document is a work plan for Year One of the Truckee River Monitoring Program. The Truckee River Watershed Council (TRWC) is responsible for all tasks outlined in this document, which fall under Activity 1 of the grant agreement between the State Water Resources Control Board and the Sierra Nevada Alliance and subcontracted with TRWC.

The Truckee River watershed is composed of several interacting landscapes and river systems. This plan describes procedures for assessing land use/land cover and impacts of particular water quality stressors. By monitoring conditions in both aquatic and terrestrial environments, the "health" of the watershed can be periodically determined relative to standards for water quality and land cover disturbance. "Watershed health" in this case refers to the relative state of the combined landscape and river systems in terms of maintenance of natural ecological, geological, and hydrological processes.

2. Organizational Structure

A. Program Advisors

The staff (paid and unpaid) and Board Members of TRWC directly involved with the Truckee River Monitoring Program (TRMP) are:

1. Beth Christman, staff – Program Manager
2. Lisa Wallace, staff – Oversight
3. John Eaton, Board Member and Chair of Monitoring Committee
4. Jeff Brown, Board Member and member of Monitoring Committee

B. Technical Advisors

The technical advisors of the Truckee River Monitoring Program include the participants of the Truckee River Monitoring and/or Technical Advisory Committee.

Committee members that are directly involved include:

1. John Hiscox, Staff Environmental Scientist, California Department of Fish and Game

2. Mike Cooney, Staff Environmental Scientist, California Department of Water Resources
3. Lisa Heki, U.S. Fish and Wildlife Service
4. Gerald Rockwell, U.S. Geologic Survey

3. Goals

The primary goals of the TRMP for Year One are:

- To determine how common land use practices in the Truckee River watershed affect water quality and habitat function.
- To screen for water quality problems typically associated with common land use practices in the Truckee River watershed.
- To empower citizens to be responsible stewards and decision-makers.
- To design and execute scientifically credible studies that assess the condition of the Truckee River ecosystem.
- To support the Truckee River sediment TMDL monitoring program.
- To support the Biological Resources Monitoring Plan for the Truckee River Operating Agreement (TROA).

This program will supplement existing agency information by monitoring streams in the Truckee River watershed. The focus of the project is on measuring chemical, habitat and biological parameters in order to assess land use impacts on water quality and watershed health.

4. Objectives

The primary objectives of the TRMP for Year One are:

- To better understand and document the relationship between water quality, hydrologic function, river system management, and land use.
- To identify land use practices that negatively impact the Truckee River watershed, the extent of impact, and the geographic locations of concern.
- To engage and educate residents about local watershed processes and strengthen their understanding of watershed stewardship.
- To enhance the quality and quantity of data available for resource managers and decision makers in the Truckee River watershed.
- To provide documentation linking water quality problems to land use practices in the Truckee River watershed.

- To provide data that can be used to help monitor the implementation of the Truckee River sediment TMDL.

- To collect data to help provide pre-TROA implementation data, and to establish a program that will help to track changes in the condition of biological resources in the Truckee River watershed once TROA is implemented.

5. Outreach

Through outreach meetings, mailings, use of free media, and the Internet the TRMP will compile a list of volunteers for the next year. A pool of existing volunteers exists, and volunteers for the TRMP will be recruited heavily from this pool. Each volunteer understands that they are responsible for sampling at their assigned site on the assigned monitoring dates. The volunteers have been/will be recruited and trained on the following dates:

- April 17th, 2007 – Orientation meeting
- April 21st, 2007 – First ambient monitoring training day
- April 28th, 2007 – Second ambient monitoring training day
- June 2nd, 2007 – streamwalk training day
- June through August, 2007 – bioassessment training and collection

5. Monitoring Program Description

A. Narrative

The watershed area to be covered under the TRMP is the Middle Truckee River. This includes all drainages to the Truckee River, from below the dam at Lake Tahoe to the California/Nevada state line. The watershed includes 26 major sub-basins (or sub-watersheds). A map of the geography covered is posted on the TRWC website: www.truckeeriverwc.org.

The Truckee River watershed has a 170-year history of significant human disturbance. Timber harvests (including multiple clear cuts) began early to support silver mining and the transcontinental railroad; railroad construction and operation were (and still are) the source of many watershed problems; the native trout fishery (Lahontan cutthroat trout) was fished to extinction as a food source for California expansion by 1930; gravel mining to support large scale road construction including Interstate 80 have left behind degraded areas; and the largest subdivision in the United States – Tahoe Donner - was built in the 1960s and 1970s before stormwater and erosion regulation. A series of dams in the Truckee River system were established for water supply and flood control.

More recent impacts of concern in the Truckee River watershed include extensive construction particularly in the Town of Truckee and Martis Valley, which is predicted to last another 6-10 years. Ski resorts are expanding to year-round resorts with an increase in golf course use and residential development. Additionally, the flow regime in the Truckee River may see significant changes as the Truckee River Operating Agreement is implemented.

The Truckee River and three tributaries (Bronco Creek, Gray Creek, and Squaw Creek) are listed as impaired for excessive sediment under the Clean Water Act. The primary pollutant of concern in the watershed is excessive sediment. Sediment sources include road and highway salting and sanding, construction, ski runs, and natural sediment sources including landslides and debris flows.

B. Criteria for Site Selection

Criteria were developed to establish the monitoring locations for Year one of the TRMP. Criterion for initial selection of sites included the following:

1.) Is there an existing flow gauging station?
2.) Is there or has there historically been a major land use (agriculture, municipal, industrial, mining, recreational, etc.) that may affect water quality in the area?
3.) Is the site included in the designated critical habitat for listed species?
4.) Does the site have easy and safe access for sampling?
5.) Is there a potential water quality impairment?
6.) Is there previous water quality data that could be used?
7.) Is the site part of an existing watershed restoration program?
8.) Has the state identified the waterbody as an impaired watershed under the Clean Water Act?
9.) Is the site a non-impacted reference site to be used for comparison?
10.) Does the site represent variable flow patterns caused by artificial structures such as dams and weirs?
11.) Does the site incorporate different water conditions than other sites (for example: different land uses, different stream/river size, tributary junctions, different altitudes, areas receiving point-source discharge, areas receiving NPS discharge)?
12.) Is the site potentially affected by reservoir operations under TROA?

All sites fall within the area designated within the original proposal and subsequent contract with the Sierra Nevada Alliance. All sites chosen for water quality sampling fit at least 4 of the criterion for monitoring described in this section.

C. Sites

Year one of the TRMP includes collecting water quality data at up to 39 locations in the Truckee River watershed. Table 1 is a list of each sampling site selected for the TRMP.

Twenty-eight of the sites are only scheduled to be monitored annually during a watershed wide monitoring event. These sites are collectively called “Snapshot Day” (SSD) sites. The GPS locations and brief site descriptions for these sites are included in Attachment 1. Narrative descriptions of SSD sites can be provided upon request.

Table 1. Sampling Sites for Truckee River Monitoring Program

Site #	Site Name	Site Description	GPS* Coordinates	Criteria **
Snapshot Day	See Attached	See Attached	See Attached	See Attached
MTR-BOCA-01	Little Truckee River between Boca & Stampede	At Boyington Mill	750456 E 4369109 N NAD 27, 10S	1, 2, 4, 5, 6, 10, 12
MTR-BOCA-03	Little Truckee River between Boca & Stampede	Just DS of gage, near Rock Shelf	750931 E 4368566 N NAD 27, 10S	1, 2, 4, 5, 6, 10, 12
MTR-COLD-00	Cold Creek	Just above confluence with Donner Creek	739370 E 4362189 N NAD 27, 10S	2, 3, 4, 5, 6, 7, 11
MTR-DONN-01	Donner Creek	At Hwy 89	740844 E 4355845 N NAD 27, 10S	1, 2, 4, 5, 6, 10, 12
MTR-EMAR-00	East Martis Creek	Near COE boundary	748982 E 4354815 N NAD 27, 10S	2, 3, 4, 6, 7, 9, 11
MTR-INDE	Independence Creek	Near road crossing	733774 E 4373864 N NAD 27, 10S	1, 2, 3, 4, 5, 6, 10, 12
MTR-MART-00	Middle Martis Creek	At Mouth	748637 E 4355466 N NAD 27, 10S	2, 3, 4, 5, 6, 7, 11
MTR-MMAR	Middle Martis Creek	In Wildlife Area	747253 E 4353745 N NAD 27, 10S	2, 3, 4, 5, 6, 7, 11
MTR-PROS-00	Prosser Creek	Near confluence with Truckee River	748151 E 4361613 N NAD 27, 10S	1, 2, 4, 5, 6, 10, 12
MTR-PROS-01	Prosser Creek	Immediately below dam	746829 E 4362189 N NAD 27, 10S	1, 2, 4, 5, 6, 10, 12
MTR-SAGE-01	Sagehen Creek	At Field Station	738420 E 4368682 N NAD 27, 10S	2, 3, 4, 6, 9
MTR-SAGE-02	Sagehen Creek	DS of research station – BMI site	738420 E 4368682 N NAD 27, 10S	2, 3, 4, 6, 9
MTR-SQCR-00	Squaw Creek	At mouth	741889 E 4343775 N NAD 27, 10S	2, 4, 5, 6, 7, 8, 11

MTR-SQCR-01	Squaw Creek	In meadow, just upstream of Poulsen's	740534 E 4343031 N NAD 27, 10S	2, 4, 5, 6, 7, 8, 11
MTR-TROU-00	Trout Creek	Near confluence with Truckee River	744385 E 4357321 N NAD 27, 10S	2, 4, 5, 6, 7, 11

*** Please give all GPS locations as UTM coordinates. Make sure to include the datum and projection information used (for example: NAD 83, Zone 11S)**

****Please reference all the criteria numbers listed above (in section 5B) that your site meets**

D. Narrative Description for Sites

Snapshot Day Sites – These sites are monitored annually and include the main tributaries to the Truckee River. Attachment 1 includes sites that are only monitored on Snapshot Day. Sites that will be monitored more than once a year are described separately. If volunteer interest is significant, the ambient monitoring program will be expanded to include sites from the Snapshot Day list. Site criteria are listed for each site in Attachment 1.

MTR-BOCA-01 - this site is located along the Little Truckee River between Boca and Stampede. This stream reach will be affected by changes in reservoir operations once TROA is in effect. This site is a very important recreational fishery. This site is slightly upstream from MTR-BOCA-03, but has easier access. (Fits site selection criteria 1, 2, 4, 5, 6, 10, 12)

MTR-BOCA-03 – this site is located along the Little Truckee River between Boca and Stampede. This stream reach will be affected by changes in reservoir operations once TROA is in effect. This site is a very important recreational fishery. This site is just slightly downstream of MTR-BOCA-01, but has better habitat for macroinvertebrate monitoring. (Fits site selection criteria 1, 2, 4, 5, 6, 10, 12)

MTR-COLD-00 – Cold Creek has been severely degraded from past land use practices. Several restoration actions are likely to take place over the course of the next 10-15 years. Pre-project data will help to assess the effectiveness of restoration work. Additionally, development is planned for the downstream-most end of the canyon which may affect water quality. Although significant land disturbance will take place in conjunction with the development, several restoration measures are being considered for the development which may actually improve water quality. (Fits site selection criteria 2, 3, 4, 5, 6, 7, 11)

MTR-DONN-01 – Donner Creek is the receiving water for Cold Creek. In addition to the changes that are scheduled to occur in the Cold Creek watershed, development and potentially restoration work are scheduled to occur along Donner Creek. Donner Creek parallels Interstate 80 below the confluence with Cold Creek, so impacts from the road may also be significant for this stream. (Fits site selection criteria 1, 2, 4, 5, 6, 10, 12)

MTR-EMAR-00 – East Martis Creek is a tributary to Martis Lake. This drainage lies in the relatively undeveloped eastern portion of Martis Valley. It is likely that this portion of Martis Valley will remain undeveloped, while significant development is slated to take

place in the other portions of the watershed (Middle Martis, West Martis). This site has been used as a bioassessment reference site in the past, and may be used again. (Fits site selection criteria 2, 3, 4, 6, 7, 9, 11)

MTR-INDE – Independence Creek will be affected by changes in reservoir operations once TROA goes into effect. This site may be included as a bioassessment site to help to assess the biological effects of TROA implementation. (Fits site selection criteria 1, 2, 3, 4, 5, 6, 10, 12)

MTR-MART-00 –This site is located in the Martis Wildlife Area, at the mouth of Martis Lake. This site has been monitored periodically since 2002. Significant degradation due to overuse occurs in the Wildlife Area, additionally 2 golf courses and housing developments are located upstream. More development is slated to take place in the headwaters of this stream. A water quality monitoring plan is being developed for this watershed, which may eventually replace volunteer activities. (Fits site selection criteria 2, 3, 4, 5, 6, 7, 11)

MTR-MMAR – This site is located in the Martis Wildlife Area, downstream of the Lahontan development. This site has been monitored periodically since 2000. The habitat at MTR-MMAR is more appropriate for macroinvertebrate monitoring than at MTR-MART-00. Significant degradation due to overuse occurs in the Wildlife Area, additionally 2 golf courses and housing developments are located upstream. More development is slated to take place in the headwaters of this stream. A water quality monitoring plan is being developed for this watershed, which may eventually replace volunteer activities. (Fits site selection criteria 2, 3, 4, 5, 6, 7, 11)

MTR-PROS-00 - This site is located below Prosser Dam near the confluence with the Truckee River and this stream reach will be affected by changes in reservoir operations once TROA goes into effect. This site will be included as a bioassessment site to help assess the biological effects of TROA implementation. Prosser Creek is also an important spawning habitat for fish and is subjected to special fishing regulations. (Fits site selection criteria 1, 2, 4, 5, 6, 10, 12)

MTR-PROS-01 - This site is located immediately below Prosser Dam and this stream reach will be affected by changes in reservoir operations once TROA goes into effect. This site has easier access for volunteer monitors than MTR-PROS-00 so will be included as an ambient site. Prosser Creek is also an important spawning habitat for fish and is subjected to special fishing regulations. (Fits site selection criteria 1, 2, 4, 5, 6, 10, 12)

MTR-SAGE-01 – This site is located just below Sagehen Creek Field Station. It has been used in multiple studies as a bioassessment reference site. This site has more appropriate macroinvertebrate sampling habitat than MTR-SAGE-02. This watershed is relatively undisturbed, however significant fuel treatment work is scheduled to take place in the near future. For 2007, this site will probably still be considered a reference site, and beyond 2007, monitoring will likely continue to assess any water quality impacts of fuel treatments. (Fits site selection criteria 2, 3, 4, 6, 9)

MTR-SAGE-02 – This site is located at Sagehen Creek Field Station. Regular water quality data have been collected at this site over the years. This site has easier access than MTR-SAGE-01 so will be used for an ambient monitoring site. This watershed is

relatively undisturbed, however significant fuel treatment work is scheduled to take place in the near future. For 2007, this site will probably still be considered a reference site, and beyond 2007, monitoring will likely continue to assess any water quality impacts of fuel treatments. (Fits site selection criteria 2, 3, 4, 6, 9)

MTR-SQCR-00 – The Squaw Creek watershed is heavily developed – there are several commercial and residential developments, a ski resort, and a golf course. Squaw Creek is listed as impaired for sediment, and a TMDL has recently been adopted. This site is located at the mouth of the watershed. (Fits site selection criteria 2, 4, 5, 6, 7, 8, 11)

MTR-SQCR-01 – The Squaw Creek watershed is heavily developed – there are several commercial and residential developments, a ski resort, and a golf course. Squaw Creek is listed as impaired for sediment, and a TMDL has recently been adopted. Bioassessment monitoring is scheduled to take place as part of the TMDL monitoring plan, but will not be implemented until at least 2008. This site has more appropriate BMI habitat than MTR-SQCR-00. Once regular bioassessment is taking place, this site will probably be removed from our volunteer monitoring program. (Fits site selection criteria 2, 4, 5, 6, 7, 8, 11)

MTR-TROU-00 – Trout Creek is scheduled for both development and restoration. TRWC is cooperating with the Town of Truckee on a restoration project. The entire area at the confluence of Trout Creek and the Truckee River is currently a brownfield and is slated for development in the next 10-15 years. The development and restoration efforts are being coordinated. (Fits site selection criteria 2, 4, 5, 6, 7, 11)

Digital photos will be taken on the first sampling day.

E. Sampling Frequency and Sampling Dates

The type of parameter being investigated will determine the sampling frequency and regularity. For example, peak flow events are a critical time to collect a variety of water quality data, but also may reduce the number of parameters that can be measured. Certain parameters are unpredictable from month-to-month, but can be anticipated in advance of storms. Summer often brings reduced flows, increased temperature, increased recreational use, and a greater risk of fecal coliform contamination. Fecal coliform contamination may also be associated with peak flow events if waste water facilities and septic systems are impacted. The base frequency would be the following, and will vary slightly based on storm events and other concerns:

<u>Standard Set:</u>

1.) Temperature (T) (Air and Water)
2.) Dissolved Oxygen (DO)
3.) Conductivity
4.) pH
5.) Turbidity

<u>Additional Parameters:</u>

1.) Nutrients
2.) Benthic macroinvertebrates

Site #	Site Name	GPS Location	**Monitoring Parameter(s)***	**Sampling Frequency**	**Sampling Dates**
SSD	See Attached	See Attached	Standard set	Annually	5/12/07
MTR-BOCA-01	Little Truckee River between Boca & Stampede at Boyington Mill	750456 E 4369109 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-BOCA-01	Little Truckee River between Boca & Stampede at Boyington Mill	750456 E 4369109 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-BOCA-01	Little Truckee River between Boca & Stampede at Boyington Mill	750456 E 4369109 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-BOCA-03	Little Truckee River between Boca & Stampede at Rock Shelf	750931 E 4368566 N NAD 27, 10S	Macro-invertebrates	Annually	8/07
MTR-COLD-00	Cold Creek in Coldstream Canyon	739370 E 4362189 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-COLD-00	Cold Creek in Coldstream Canyon	739370 E 4362189 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-COLD-00	Cold Creek in Coldstream Canyon	739370 E 4362189 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-DONN-01	Donner Creek	740844 E 4355845 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-DONN-01	Donner Creek	740844 E 4355845 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07

MTR-DONN-01	Donner Creek	740844 E 4355845 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-DONN-01	Donner Creek	740844 E 4355845 N NAD 27, 10S	Macro-invertebrates	Annually	8/07
MTR-EMAR	East Martis Creek	748982 E 4354815 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-EMAR	East Martis Creek	748982 E 4354815 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-EMAR	East Martis Creek	748982 E 4354815 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-INDE	Independence Creek	733774 E 4373864 N NAD 27, 10S	Macro-invertebrates	Annually	7/07
MTR-MART-00	Middle Martis Creek at Mouth	748637 E 4355466 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-MART-00	Middle Martis Creek at Mouth	748637 E 4355466 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-MART-00	Middle Martis Creek at Mouth	748637 E 4355466 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-MMAR	Middle Martis Creek in WLA	747253 E 4353745 N NAD 27, 10S	Macro-invertebrates	Annually	6/07
MTR-PROS-00	Prosser Creek near Truckee River	748151 E 4361613 N NAD 27, 10S	Macro-invertebrates	Annually	7/07
MTR-PROS-01	Prosser Creek just below dam	746829 E 4362189 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-PROS-01	Prosser Creek just below dam	746829 E 4362189 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-PROS-01	Prosser Creek just below dam	746829 E 4362189 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07

MTR-SAGE-01	Sagehen Creek below Field Station	738420 E 4368682 N NAD 27, 10S	Macro-invertebrates	Annually	6/07
MTR-SAGE-02	Sagehen Creek at Field Station	737511 E 4368052 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-SAGE-02	Sagehen Creek at Field Station	737511 E 4368052 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-SAGE-02	Sagehen Creek at Field Station	737511 E 4368052 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-SQCR-00	Squaw Creek	741889 E 4343775 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-SQCR-00	Squaw Creek	741889 E 4343775 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-SQCR-00	Squaw Creek	741889 E 4343775 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-SQCR-01	Squaw Creek	740534 E 4343031 N NAD 27, 10S	Macro-invertebrates	Annually	6/07
MTR-TROU-00	Trout Creek	744385 E 4357321 N NAD 27, 10S	Standard Set	4 x per year	5/12/07 7/07 9/07 4/08
MTR-TROU-00	Trout Creek	744385 E 4357321 N NAD 27, 10S	Nutrients	Semi-annually	5/12/07 9/07
MTR-TROU-00	Trout Creek	744385 E 4357321 N NAD 27, 10S	Stream Walk Survey	3 x per year	7/07 9/07 4/07
MTR-TROU-00	Trout Creek	744385 E 4357321 N NAD 27, 10S	Macro-invertebrates	Annually	7/07

8. Use of Data

A. Specific Parameters

1.) Temperature: To identify areas of concern for thermal pollution.

2.) Dissolved Oxygen: To determine health of aquatic ecosystem. Dissolved oxygen availability affects photosynthesis, and the metabolic rates of organisms and their sensitivity to toxic wastes, parasites, and diseases in addition to their distribution. Also used to identify areas of concern for hypoxia/anoxia.
3.) Conductivity: To determine potential sources of dissolved solids or salts. High conductivity indicates impaired water quality. Common anthropogenic sources in the Truckee River watershed include wastewater discharge and road salt and sand.
4.) pH: To determine if stream will support aquatic life. pH can be affected by many types of sources, both natural and anthropogenic.
5.) Turbidity: To identify areas of increased erosion. Turbidity measures the amount of suspended particles in the water.
6.) Nutrients: Nitrogen and phosphorus are used to identify sources of nutrient loading. Excess nutrients, particularly phosphorus, can lead to algal blooms and eventual anoxic conditions.
7.) Benthic Macroinvertebrates: To determine the ability of the water body to support aquatic communities. Different types of benthic macroinvertebrates respond differently to pollution in aquatic ecosystems. By sampling the stream community directly, it is possible to determine water quality.

9. Field Procedures

Each Volunteer Monitor will be given a field procedures manual that includes the U.S Environmental Protection Agency (USEPA) and State Water Resources Control Board (SWRCB) monitoring protocols for each parameter. Each manual will contain:

a. Site location, including map and GPS locations
b. Site number
c. Schedule of sampling dates
d. Specific parameters to be measured for that site.
e. List of equipment necessary for each parameter for that site

f. EPA and SWRCB approved protocols for sample collection
g. Stream Walk forms
h. Data collection Sheets
i. Instructions for sample handling, labeling and transport
j. Safety Considerations including emergency contact information
k. Vegetation identification forms

10. Monitoring Methods

All samples will be taken and analyzed in accordance with the Quality Assurance Policy and Protocols as approved by the SWRCB, USEPA, and Technical Advisory Committee of the TRMP. Specific methodologies are listed below.

Parameter	**Method**	**Location (in field / lab)**	**Comments**
Dissolved Oxygen	Winkler Titration method, Chemet, or YSI meter	In Field	Winkler reagents and Chemet comparators will be checked for expiration date before being sent in the field. YSI meter will be calibrated in the field, prior to use.
pH	Meter or pH strips	In Field	Equipment will be calibrated against standards before use.
Conductivity	Conductivity Meter	In Field	Equipment will be calibrated against standards before use.
Turbidity	Turbidity Meter	Grab sample	All samples will be processed at TRWC when brought back from the field. Samples will be kept cold until processed. The TRWC turbidity meter will be calibrated before each use.
Temperature	Thermometer (-5 to 50° C)	In Field	Thermometers will be checked for accuracy before use.
Nutrients	NH_3-N, NO_3 & NO_2-N, SRP, TP	Grab sample	Samples will be kept cold until delivered to a lab.
Benthic Macroinvertebrates	CSBP	Grab sample	All samples will be preserved in alcohol until processed by TRWC or other laboratory.

10. Quality Assurance Policy and Protocols

The U.S. Environmental Protection Agency, State Water Resources Control Board, River Watch Network, and RiverKeeper programs nationwide all recommend the formation of

a Quality Assurance Project Plan (QAPP) for volunteer monitoring programs. In fact, U.S. Environmental Protection Agency-funded and State Water Resources Control Board-funded monitoring programs must have an approved QAPP before sample collection begins. A QAPP will be developed for the TRMP which outlines the procedures for Volunteer Monitors to collect and transport data.

The SWRCB Clean Water Team and the South Yuba River Citizens League provided a model QAPP that will be used as a basis for the TRMP. The QAPP will be submitted to USEPA and the SWRCB for approval.

11. Sample Analyses

Most parameters will be measured in the field (dissolved oxygen, conductivity, pH, temperature). Turbidity samples will be run through a turbidity meter at the TRWC office. Nutrient analyses will be performed by High Sierra Water Lab in Truckee. Benthic macroinvertebrate samples will be processed by volunteers at TRWC (QAPP is in place) or by professional laboratories. Professional labs to be used may include: California Department of Fish and Game, Aquatic Bioassessment laboratory; Desert Research Institute; or Tom King Bioassessment.

12. Data Management

Water quality data will be stored in a database that supports sorting and the use of the data in various types of models. This will be in Microsoft Excel which can support a variety of sorting and query types. This storage device will allow the development and updating of the information management system for the Truckee River watershed on a long-term basis.

The database management program and accompanying website will be created in Year 1 and will be based on the specific needs of the TRMP and TRWC.

- Data will be entered and stored at the TRWC office. All records are backed up weekly on an offsite server.
- Beth Christman, Program Manager will enter all data and maintain all records.
- Beth Christman, Program Manager will oversee the Quality Assurance of field collected data. Lisa Wallace, Executive Director will oversee the overall program.

13. Data Analysis

Protocols outlined by the Sierra Nevada Alliance will be used for some data analysis, particularly for the presentation of the ambient and stream walk monitoring data. A data analysis workshop is scheduled to be held in May.

In general, data will be presented graphically as much as possible. TRWC has committed to working on a GIS-based presentation system that would be hosted on the website (www.truckeeriverwc.org).

Standard metrics are calculated from the benthic macroinvertebrate data, outlined in the CSBP manual. Summary data will be posted on the TRWC website and raw data will be made available upon request.

14. Reporting

A summary of water quality data will be posted on line on the Truckee River Watershed Council website (www.truckeeriverwc.org). A summary report will be produced at the end of each year of the TRMP and posted on the website. Hard copies will be available to stakeholders upon request. A presentation of the results will be made and given to the Monitoring Committee of the TRWC.

Members of the TAC will receive copies of the final report, either electronically or hard copy, as will the Sierra Nevada Alliance and the Lahontan Regional Water Quality Control Board.

15. Landowner Notification

Most TRMP sampling locations will be located on public land. If any monitoring locations are selected on private property landowners will be contacted via phone or e-mail and written permission will be secured before any monitoring activities occur.

Appendix 1. Truckee River Snapshot Day Site

Site #	Site Name	Site Description	GPS coordinates NAD 27, 10 S mE	mN	Criteria
MTR-ALDR	Alder Creek	Off Alder Creek Rd. at Em Trail Xing	742126	4361011	2, 4, 5, 6
MTR-BEAR	Bear Creek	Across from Stables	741458	4341058	2, 4, 5, 6, 8
MTR-BIGC	Truckee River in Big Chief Corridor	Near Goose Meadows	740843	4349498	2, 3, 4, 5, 6, 7, 8, 10, 12
MTR-BOCA-00	Little Truckee Below Boca Dam	at dam outflow	750315	4363728	1, 2, 4, 5, 6, 10, 12
MTR-BOCA-02	Worn Mill Creek	Worn Mill Creek US of road	749527	4372781	2, 4, 6, 9
MTR-CABN	Cabin Creek subbasin	un-named tributary, at bend in road to land fill	740641	4351446	2, 4, 5, 6
MTR-DEEP	Deep Creek	At Hwy 89 (US)	741098	4346521	2, 4, 6, 9
MTR-DMCB	Davies Creek 1	DS of Henness Pass road	749530	4376782	2, 4, 5, 6, 7
MTR-DONN-03	Donner Creek 3	Donner Creek at Donner Lake outflow	738492	4356175	1, 2, 3, 4, 5, 6, 10, 12
MTR-GLEN	Union Creek below Glenshire	Union Creek near Teichert road Xing	748894	4360416	2, 4, 5, 6, 11
MTR-GLEN-01	Union Creek at outflow of Glenshire Pond	Below Glenshire pond outlet	749295	4360230	2, 4, 5, 6, 11
MTR-GRAY	Gray Creek	near mouth, at USGS gage	755838	4362160	1, 2, 3, 4, 6, 7, 8
MTR-I80C	Truckee River in I-80 Corridor	At Floriston	756294	4364601	2, 3, 4, 5, 6, 7, 8, 10, 12
MTR-MART-01	Martis at COE boundary	Middle Martis at US end of COE property	746531	4353244	2, 3, 4, 5, 6, 7, 11
MTR-POLE-00	Pole Creek	At Hwy 89 (US)	741098	4346521	2, 3, 4, 6, 9
MTR-PROS-02	Prosser Creek	At Emigrant Trail parking	742372	4364351	2, 4, 5, 6
MTR-SAGE-00	Sagehen Creek	At Hwy 89 (DS)	740669	4368479	2, 3, 4, 6, 9
MTR-SILVR	Silver Creek	At Hwy 89 (US)	741498	4345165	2, 4, 6, 9

MTR-TOWN	Truckee River in Town Corridor	At Regional Park	743430	4356836	2, 3, 4, 5, 6, 7, 8, 10, 12
MTR-TR01	Truckee River near Tahoe City	below Tahoe City	744587	4338639	2, 3, 4, 5, 6, 7, 8, 10, 12
MTR-TROU-01	Trout Creek in Town	At I-80 overpass	742727	4356977	2, 4, 5, 6, 7, 11
MTR-TROU-02	Trout Creek in Tahoe Donner	near Tahoe Donner clubhouse	739983	4358416	2, 4, 5, 6, 7, 11
MTR-ULTB	Upper Little Truckee	At Hwy 89 Xing (US)	738015	4373442	2, 4, 6, 7, 10, 11

Appendix C. SOP Sampling Methods

General Sampling Techniques

Always sample away from the stream bank in the main current and upstream from where you are standing, in or near the stream. Your behavior should never affect the water sample. The outside curve of the stream is often a good place to sample since the main current tends to hug this bank. Take measurements within the river/creek itself if high river flows are not a problem. This usually means a water depth of less than knee height at the deepest part of the site. If there is a high flow level in the river/creek, then collecting water using the sampling poles provided by the program may be advisable. Collect all your samples from the same location in the river.

Sampling Pole Techniques

Rinse out the sampling bottle attached to the pole 2-3 times with creek water. While standing with your body downstream of the sampling bottle, put sampling pole perpendicular to bottom of stream. Push it underwater so the sample comes from the middle of the water column. Tilt in upstream direction. Allow to fill with water and bring bottle to shore. Immediately measure for temperature, pH, and conductivity. Get a fresh water sample every time for each additional parameter: dissolved oxygen, turbidity, total suspended solids, fecal coliform, metals, hydrocarbons, and nitrites/nitrates.

Sample Collection Technique for Screw-Cap Bottles

This technique is used to collect water samples in screw-cap sample bottles for tests such as turbidity, total suspended solids, fecal coliform, heavy metals, hydrocarbons and nitrites/nitrates.

- Label the bottle with the site number, date, time and your name or initials. Use waterproof pen, if possible.
- Remove the cap from the bottle just before sampling. Avoid touching the inside of the bottle or the cap. In high flows, use a sampling pole. Rinse the sampling bottle on the pole 3 times prior to decanting water into sample bottle. If you accidentally touch the inside of the sampling bottle, use another one.
- Wading. Try to disturb as little bottom sediment as possible. In any case, be careful not to collect water that contains bottom sediment. Stand facing upstream. Collect the water sample in front of you (upstream).
- Hold the bottle near its base and plunge it (opening downward) below the water surface. Collect a water sample 6 to 12 inches beneath the surface or mid-way between the surface and the bottom if the stream reach is shallow.
- Turn the bottle underwater into the current and away from you (upcurrent).
- Leave a small air space, so that sample can be shaken before analysis.
- Check off the test on your appropriate field data sheet and record the time of sample collection. This is important because it helps the monitoring coordinator track the sample bottles to their collection sites.
- If the samples are to be analyzed in the lab (e.g. bacteria and metals), place them in the cooler for transport to the laboratory.

Appendix D. SOPs for Field Measurements

SOP 1 pH and Temperature

How to Measure pH (Hanna pHEP Waterproof Meter)
(Take 3 to 5 measurements)

The same meter is used to test both water temperature and pH. It is a red meter that reads both parameters on the LCD display. This meter reads more accurately when presoaked in 1" of water. Information about pH follows this section.

Presoak: First remove meter cap and presoak the pH meter/ thermometer in 1" of river water, in the shade upright in a container for at least 10 minutes, with the **power off** Be sure water level stays below the meter's buttons.

To turn the meter on and check the battery status
Press and hold the MODE button until the Liquid Crystal Display (LCD) lights up. All the used segments on the LCD will be visible for 1 second (or as long as the button is pressed), followed by the percent indication of the remaining battery life (e.g. % 100 BATT). The meters have been calibrated before monitoring day. This will be shown by the work CAL shown in the display.

Taking measurements
Submerge the electrode into river water or the sampling arm vessel while stirring it gently. Do not get it wet above the cap line. The measurements should be taken when the stability symbol (small clock) on the top left of the LCD disappears. The pH value automatically compensated for temperature is shown on the primary LCD (the larger readout) while the secondary LCD (the smaller readout in the lower right area of the LCD display) shows the temperature of the sample. Take the first water temperature reading simultaneously with the pH reading. Both will be displayed at the same time. Tell the recording partner your reading for each. Turn off the meter after each set of temperature and pH readings. Turn back on for each of the three readings. Record one time on the data sheet for your three readings of pH.

To freeze the display
While in measurement mode, press the SET/HOLD button. HOLD appears on the secondary display and the reading will be frozen on the LCD (e.g. pH 5.7 HOLD). Press any button to return to normal mode.

To turn the meter off
While in normal mode, press the MODE button. OFF will appear on the secondary display. Release the button. Store the meter upright with the electrode in a drop of water in the cap.

TWO-POINT PH CALIBRATION FOR HANNA PHEP WATERPROOF METERS

You will need:
newspaper
5 cups (use cut-off waste bottles)
4.0 pH Buffer Solution
7.0 pH Buffer Solution
deionized water
pH calibration sheet
pH meters
separate pH solution log sheet
2-3 yogurt containers

Record buffer solution bottle numbers on separate data sheet. Also record expiration dates of buffer solution on bottle. Re-order buffer solution as necessary

SET-UP

- ❑ Remove meter caps. Presoak meters in 1" tap water in a yogurt container 10 minutes. REMINDER: THESE METERS ARE NOT REALLY WATERPROOF. DON'T LET THEM GET WET ABOVE THE CAP LINE..
- ❑ Set up 6 cups on newspaper in front of you from left to right as follows: 1 cup deionized water, 1 cup of pH 7.0 buffer solution, 2 cups deionized water, 2 cups of pH 4.0 buffer solution.
- ❑ Record your name and date on pH calibration log.

CALIBRATION

- ❑ Dip meter probe into first deionized water. Remove from water and press MODE button until the display comes on. Watch to see that the battery is at 100% (display reads 100 BATT). If battery is low, replace batteries [(4) 1.5 volt alkaline batteries]. Record replaced batteries on log sheet under "Comments" column for meter.
- ❑ After displaying battery level, LCD display changes to pH and temperature reading.
- ❑ Press and hold MODE button. OFF will appear on LCD. **Keep holding down** on MODE button until CAL appears on LCD, then release button. Display should read 7.0 USE….then change to 7.0 REC.
- ❑ When reading changes to 7.0 USE, immerse meter tip in 7.0 buffer solution. CAL will flash in lower left corner of display until meter is calibrated. Hold meter in 7.0 buffer solution until CAL stops flashing. At this point, LCD readout changes to 4.0 USE.
- ❑ Dip meter in next two deionized water solutions, shaking off excess drop(s) into an empty yogurt container after each dip. Then dip meter into first 4.0 buffer solution. Shake off excess water in empty yogurt container. Immerse in second 4.0 buffer solution. Readout now reads 4.0 REC and CAL is flashing. Hold meter in 4.0 buffer solution until readout changes to OK2 and CAL stops flashing. Calibration is finished.
- ❑ Turn off meter and dip meter back into 4.0 buffer solution.
- ❑ Place meter in plastic case with meter cap down. Store vertically with meter cap down.
- ❑ Record "Yes" "Yes" in two columns on calibration sheet for the meter tested or record readings if they varied from 7.0 and 4.0.
- ❑ After calibrations, spot check three meters in 7.0 buffer solution to see if meters are operating correctly. Note spot check in "Comments" column for each meter spot-checked.
- ❑ Dispose of calibration solutions in sink and rinse sink thoroughly with tap water.

SOP 2 Dissolved Oxygen

How to Measure Dissolved Oxygen

(Follow each step precisely and take 3 measurements)

Set up your test bottles in a shady, flat area. Once you collect your samples, it is very important that you **immediately** proceed through step #6 of the instructions in the Lamotte kit . If you let your sample sit for any period of time, the amount of dissolved oxygen in the water can change, giving you inaccurate readings.

Fixing your samples:

- Rinse the DO sampling bottle with creek or river water.
- It is important not to introduce air into the sample. Face upstream in the main current where there is no whitewater. Uncap sampling bottle and plunge underwater into the vertical center of water column. Tip and fill completely.
- Tap the sides of the bottle to dislodge any air bubbles. Be sure that no air bubbles are trapped inside. Cap bottle underwater.
- If you are using a sampling arm, remove the cap at the moment just before filling the bottle. Tilt the bottle and fill the sample bottle using the water taken with the arm. Do this slowly and fill bottle to the top (by tilting bottle up). Tap sides of bottle to remove any bubbles that appear in the bottle and cap bottle.
- Put on gloves.
- Using the Winkler method with the LaMotte Dissolved Oxygen Test Kit, Code 5860, add 8 drops of **Manganous Sulfate Solution** AND
- Add 8 drops of **Alkaline Potassium Iodide Azide**; some liquid will overflow out of the bottle. Be sure to hold bottles vertically and press drops out slowly. Cap the two chemical solution bottles.
- Cap the sample bottle and mix by inverting several times. A precipitate will form.

- Set sample bottle down for a few minutes and allow the cloudy precipitate to settle below the shoulder of the bottle.
- Immediately add 8 drops **Sulfuric Acid 1:1**.
- Cap and gently invert the bottle to mix the contents until the solid precipitate and the reagent have totally dissolved. The solution will be clear yellow to orange if the sample contains dissolved oxygen.
- ***Note: At this point the sample has been "fixed" and may be stored for days or weeks. *** Triplicate samples may be run together until this point, adding each treatment to all 3 bottles consecutively. After this point, titrate the samples separately. This is also the point at which you record <u>for time of sample</u> collection for D.O. on your data sheet.***

<u>Titration:</u>

- Fill the titration tube so that the <u>meniscus</u> of the liquid is at the 20 mL line with the fixed sample. (See picture of meniscus on clipboard). To avoid spills, place the sample bottle so that both glass rings on the neck overhang the opening of the titration tube. Cap the tube with its flat lid.
- Depress plunger of the Titrator.
- Insert the Titrator firmly into the plug in the top of the **Sodium Thiosulfate, 0.025N** titrating solution. To avoid drips, clamp the titrator tip to the soldium thiosulfate bottle by gripping both firmly in one hand.
- Invert the bottle and slowly withdraw the plunger until the shoulder of the plunger (the end in contact with the solution) is opposite the zero mark on the scale. ***Note: If small air bubbles appear in the Titrator barrel, expel them by partially filling the barrel and pumping the titration solution back into the reagent container, or you can tap the side of the barrel to remove bubbles. Repeat until bubble disappears***.
- Turn the bottle upright and remove the Titrator. Insert the tip of the Titrator into the opening of the titration tube cap.
- Slowly depress the plunger to dispense the titrating solution. After every two drops, swirl the solution to mix in the sodium thiosulfate. Titrate until the yellow-brown color changes to a very pale yellow. Hold sample against a white sheet of paper to see color changes more accurately.
- Tap the Titrator to remove any drops of solution on the end, and then carefully remove the Titrator and cap. Do not disturb the Titrator plunger.
- Add 8 drops of **Starch Indicator Solution** into the titration tube**.** Gently swirl to mix in starch to sample solution. The sample should turn blue.
- Cap the titration tube. Insert the tip of the Titrator into the opening of the titration tube cap.
- Continue titrating one drop at a time until the blue color disappears and the solution becomes colorless. Swirl after each drop is added. It usually only takes one or two drops of sodium thiosulfate to turn the blue solution to clear. ***Note: If the plunger tip reaches the bottom line on the scale (10ppm) before the endpoint color change occurs, refill the Titrator until completely full and continue the titration. Add the value of the original amount of reagent dispensed (10ppm) to the second volume when recording the test result.***
- Record the test result where the Titrator tip (where the plunger meets the solution inside the barrel) meets the scale. Have you partners check your reading so you all agree. Record as ppm Dissolved Oxygen. Each minor division on the Titrator scale equals 0.2 ppm. When testing is complete, discard titrating solution in Titrator into waste bottle.
- **Between samples, rinse titration tube with a small amount of the next sample to be tested. This avoids leaving trace amounts of sodium thiosulfate in the titration tube which could skew subsequent sample readings.**
- All readings should be within 0.6 ppm of each other. If this is not the case, run a fourth titration from the sample which differs the most from the other two. Record the result in the column for "sample 4" and draw an arrow from that number back to the sample it came from. (In other words, if sample #1 is more than .6 ppm different from the results for sample #2 and #3, then run a fourth titration from sample #1, record it's result in the column marked "sample #4" and draw an arrow back to the result for "sample #1".

SOP 3 Conductivity

<u>Presoak:</u> First remove meter cap and presoak the TDS meter in 1" of river water, in the shade upright in a container for at least 10 minutes, with the **power off** Be sure water level stays below the meter's buttons.

Take the measurements: Turn the meter on and dip the electrode into river water or sampling arm vessel. Do not wet above the cap line! Stir gently every few seconds, until the readings stabilize. The probe automatically compensates for temperature, so it may take a couple of minutes for the values to stabilize. Be patient. Record value in microsiemen (μS). Record one time on the data sheet for your three readings.

Turn off meter. Repeat twice more, turning meter on and off for triplicate readings. Be sure meter is off when all three readings are recorded

TDS CALIBRATION PROTOCOL

You will need:

- 3 cut-off waste plastic bottles (cut them horizontally a little above the halfway mark)
- 1 waste bottle containing last month's TDS calibrating solution
- TDS Calibration solution bottle
- 1 small screwdriver from an eyeglass repair kit
- extra batteries for TDS meters
- tap water or de-ionized water
- paper towels
- TDS meters
- TDS calibration log sheet

SETUP
Lay out the newspaper and lay out the three cut-off waste bottles in a line in front of you. Fill the first bottle ½ - 2/3 with either tap water or de-ionized water. Fill the second bottle ½-2/3 with last month's TDS calibration solution. Fill the third cut-off bottle ½-2/3 with the new TDS calibration solution.

Record your name and date on top of calibration sheet. Record calibration solution bottle number and expiration date on bottle. If using a new calibration solution bottle, designate a number for it and write it on the bottle in permanent marker.

PROCEDURE
Take a meter to be tested, remove its cap, dip it into the water, turn it on and swirl for a few seconds. Remove it from the liquid and shake off remaining water droplets.

Dip it into second solution, swirl a few seconds, lift it out and again shake off droplets.

Dip into fresh calibration fluid, swirl a few seconds – being careful not touch sides or bottom of container with probe end --- and read value. Record this value under the meter number and the column "Old Value". If the number is a multiple of 10 as close to the value of the calibration fluid, the meter is correctly calibrated. (For example, a 450 reading is correct for 447 calibration fluid because the meter is only able to read by 10's). Place a check mark in the "New Value column of the calibration sheet.

Redip the meter in the water cup, shake off droplets and turn it off. Replace cap and put back in case.

CALIBRATION ADJUSTMENT
If the meter reading was incorrect you must adjust the value of the reading. To do this, remove top cover of meter (it pries up with a fingernail) and press one of the two white tables behind the batteries. First the tab will reset itself to a value in the 300's, then press the tab until you reach the desired calibration value.* THIS MUST BE DONE WHILE THE METER IS IN THE CALIBRATION SOLUTION. Replace top cap, rinse meter in water, turn off and replace cap. Record calibrated value in the "New Value column of calibration sheet.

Appendix E. SOP 4 Turbidity Measurement

Turbidity Meter Procedure: Hanna Portable Turbidity Meter – HI 93703
Samples must be read within 12 hours of collection. First, shake samples and allow to sit 20 minutes before taking readings. Samples should be at room temperature when read.

Wash hands before carrying out turbidity meter readings and wear at least one glove. When handling cuvettes, never touch glass with an ungloved hand, as oily fingerprints will affect readings. Try to handle cuvettes by cap only. If you must hold glass, make sure you do so with a glove.
Set out a clean towel to work on. Always set cuvettes down on a towel. Begin by wiping down cuvettes thoroughly with lint-free cloths (blue cloths in kit).
You will take three samples from each grab bottle (fill 3 cuvettes) and you will take one reading from each of the three samples. Record readings on turbidity reading log sheet.

- Begin by filling a clean cuvete up to one quarter inch (0.5 cm) from its rim with the thoroughly agitated sample. Hold the cuvete with your gloved hand when you pour. Allow sufficient time for bubbles to escape before securing the cap—**do not over tighten the cap.**
- Set the cuvettes down on the towel in front of the meter.
- Turn the meter on by pressing the ON/OFF key. The meter will carry out a self-test displaying a full set of figures. After the test, the LCD will change to the measurement mode.
- When the LCD displays "----" the meter is ready to measure.
- Wipe the cuvete thoroughly with a lint-free tissue before inserting into the measurement cell. The cuvete must be completely free of fingerprints and other oil or dirt, particularly in the area where the light goes through (approximately the bottom 2 cm/1 inch of the cuvete).
- Place the cuvete into the cell and check that the notch on the cap is positioned securely into the groove. The mark on the cuvete cap should point towards the LCD.
- Press the READ/↑ key and the LCD will display a blinking "SIP" (Sampling in Process). The turbidity value will appear after approximately 25 seconds.
- Even though **HI 93703** covers a very wide range of turbidity values, for very accurate measurements of samples exceeding 40 FTU, Standard Methods require dilution (see manual).
- If you are concerned with the accuracy of a reading, put the calibration solution cuvettes back into the meter to check meter accuracy. (If sample readings are <6.0, use 0.0 FTU calibration solution; if readings are higher, use 10.0 calibration solution.)
- To turn off meter, press the ON/OFF key.

Two-point turbidity meter calibration
Turbidity meters should be calibrated monthly. To check the date of the last calibraton, hold the DATE/ key down for a few seconds.
To calibrate:

- Fill a clean cuvette with ZERO FTU standard solution (NTU = FTU); fill a second cuvette with 10.0 calibration solution. If you have enough cuvettes, leave the calibration solution in these two cuvettes from month to month. (Calibration solution is probably accurate for one year). Mark top of cuvette cap with sticky label to indicate calibration level (0.0 or 10.0).
- Turn the meter on by pressing the ON/OFF key. Wait for the display to show "-----".
- Press the CAL key once and, while the "CAL" message is blinking, press CAL again to enter calibration mode. (CL appears in the lower part of the display).
- Edit the date of calibration by pressing the DATE/→ key. Scroll to the correct month by pressing the READ/ ↑ key to get to the month number. Press DATE/→ again to set the day of the month and again press READ/↑ to set the day. Then press CAL once to confirm the date and enter calibration mode again.
- When the blinking ZERO appears on the display, wipe the 0.0 FTU cuvette with the lint-free cloth and insert into the measurement cell. Make sure the notch on the cap is positioned securely into the groove. The mark on the cuvette cap should point towards the LCD. Press the CAL key.
- A blinking "SIP" (Sampling in Process) message indicates that the instrument is perfoming the measurement. This takes about 50 seconds.
- The first 0.0 calibration is complete when the display reads "10.0". The meter is now asking for the 10.0 FTU standard solution for the second calibration.
- Insert the 10.0 FTU calibration solution into the measurement cell and press the CAL key again
- After approximately 50 seconds, the LCD will display "500". This indicates that calibration of the 10.0 solution is complete.
- Once the meter is correctly calibrated, proceed to sample readings.
- To turn off meter, press the ON/OFF key.

Appendix F: HSWL QA plan

QUALITY ASSURANCE MANUAL
HIGH SIERRA WATER LAB

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Table of Contents

LABORATORY ORGANIZATION AND PERSONNEL RESPONSIBILITIES

High Sierra Water Lab is basically a one-person operation specializing in low level nutrient chemistry. The Lab Director, who is also the lab owner and Principal Analyst, is responsible for all aspects of the facility. There are no plans or desires to change this organization in its make-up or focus.

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

The principle objective is to ensure that routinely generated analytical data are scientifically valid and defensible, and are of known and acceptable precision and accuracy and are systematically documented as such throughout the processes.

SAMPLING PROCEDURES

High Sierra Water Lab does not routinely participate in the sample collection process.

CUSTODY, HOLDING, AND DISPOSAL OF SAMPLES

Samples should be kept chilled to 4 degrees C during delivery to the Lab, generally in coolers with appropriate coolant, and a Chain of Custody form completed by the sampler and any subsequent handler should be included. High Sierra Water Lab will provide blank Chain of Custody forms (see sample in Appendix A) or the client can provide their own, provided they include the following information:

Sample and/or Site Name
Identification Number
Sample Date
Sample Time
Name of Sampler
Assays to be Performed
Sample Pretreatment (if required)
Purpose of Assay:
Regulatory Compliance
Monitoring Only
Coolers will be unpacked upon arrival and labels verified against the Chain of Custody form. Client will be notified immediately if discrepancies are found.

Each sample will have its own High Sierra Water Lab ID number assigned to it and will be logged into the High Sierra Water Lab bound Log-In Book. Samples are then refrigerated where they will remain until assayed. Samples requiring filtering are filtered within 24 hours with a .45 micron nylon filter for the dissolved portions of the assay (NH3, NO3/NO2, SRP, DP). Assays are performed within the time limit designated in the Method for each constituent.
The samples is properly disposed of after it has passed all its Quality Control checks.

Hazardous waste is picked up and disposed of by a fully licensed and insured hazardous waste disposal company on an as needed basis.

CALIBRATION — PROCEDURES AND FREQUENCY

All calibrations are entered into the appropriate bound calibration notebook with date, time, calibration results and signature.

Shimatzu Spectrophotometer Model UV160, Dual Beam
Calibration: Once per assay

The instrument automatically initializes when the power is turned on. The initialization includes lighting of both lamps, optical alignment and energy check of both lamps, wavelength detection, and a baseline correction. Since the instrument is dual beam, both quartz cells are filled with distilled deionized water and placed in the cell holder. The instrument zeros and corrects for differences between cells. Any errors or abnormalities will appear as messages on the monitoring screen. The wave length setting is checked with a holmium crystal oxide.
The analyte standards are run first to measure the instrument response as a function of analyte concentration. A calibration curve is constructed.
Sample chamber and cells are cleaned monthly and documented in the spectrophotometer maintenance log.

Scales:
Metter AE 200 (0-200g) ñ calibrated each day of use
Metter Toploader (0-1,000g) ñ calibrated each day of use
ATI Cahn, Model CA-18 (0-250g) ñ calibrated each day of use

Zero the balance. Place one weight on the pan (handle only with forceps), take a reading. Repeat this procedure with the same weight for ten readings. Neither the precision nor the accuracy should exceed manufacturer tolerance limits. Repeat this procedure using seven weights: 10mg, 100mg, 1g, 10g, 50g, 100g and 200g.

Accuracy of all scales are certified annually by a professional service. They are

cleaned, lubricated and adjusted to the original manufacturerís specifications. Built-in weights are cleaned and tested for errors. Calibration, linearity and cornerload are checked. Certifications are kept permanently in a binder in the lab.

Pipettes:
Eppendorf Repeater Pipette
Eppendorf Reference Pipette
Oxford 1-5ml and 5-10ml Pipette
Volumetric Glass Pipettes

Pipettes are calibrated before each run. Pipette is set to desired volume. Scale is set to zero and a small beaker placed on pan and tared to zero. The specified volume of deionized water (20 degrees C) is pipetted into the beaker. 1 ml of water should weight 1 gram. The procedure is repeated until you get an accurate volume of that weight. Each pipette is periodically disassembled and checked for moisture, worn O-rings and is relubricated.

ANALYTICAL PROCEDURES

Glassware Management

All stored glassware is rinsed with deionized water 3-5 times after use and partially filled with 0.1 N HCl. The containers are covered with Parafilm and placed on the appropriate storage shelf. The glassware is rinsed 5 times with DI water before use. Glass volumetric pipettes and funnels are rinsed with 0.1 N HCl and DI water prior to storage.

Glass test tubes are rinsed with DI water and stored in plastic tubs containing 0.1 N HCl. There are separate storage containers for test tubes of each assay to reduce cross contamination between tests. The tubes are rinsed 5 times with DI water and air-dried before use.

Disposable plastic pipette tips are discarded after use.

Glassware Specifications

All glassware calibrated to contain (TC) or to deliver (TD) must meet the NBS specification for Class A volumetrics. The volume of solution and the internal volume of the glass container itself change with temperature. The temperature (usually 20°C) at which the volumetric glassware was calibrated is indicated on the glassware. Solutions should be ±1°C of the calibration temperature for accurate volume measurements.

Standard Management

Stock Standard Solutions - For all wet chemistry assays, a liquid stock standard is prepared as directed in the assay procedures. In most cases the stock is then stored refrigerated at 4°C. For most of the assays it is necessary to make an inter-

mediate stock solution that has a concentration value somewhere between the stock standard and the working standards. The entire set of working standards are prepared at the same time. Class A glass volumetric flasks and pipettes are used for the dilutions. Automatic micropipettes are not used. These working standards are stored in the same manner as the stock standard or remade fresh daily.

Reagent Preparation and Storage

Unless otherwise noted in a specific method, all chemicals used during analyses are reagent grade. Storage locations are assigned to the reagents according to manufacturer's directions. Reagents containers are never stacked on top of one another. Only original manufacturer containers are used for the storage of reagents.

Liquid reagent mixtures are stored in clean/new Nalgene plastic bottles or borosilicate glass bottles with ground glass stoppers. Strong basic solutions are never stored in the glass bottles because the stoppers are impossible to remove. Each reagent mixture is labeled with the reagent name.

The water used in preparing reagents is deionized. The deionization process is achieved by passing water through three resin columns that remove inorganic and organic contaminants. The resin columns are changed every 2 to 3 months or more frequently if needed.

Sample Preparation

Samples are removed from cold storage. Specific preparation is determined by Standard Operating Procedures for each specific assay. ***(See pages 6-27 for Standard Operating Procedures.)***

Datasheet Preparation

Raw data from each analysis is recorded on a run sheet. Each run sheet contains assay name, project name, sample site, sample date, sample time and date of analysis. The quality control information includes the standard curve calibration statistics (r coefficient, slope, y-intercept), the sample spike recoveries, the duplicate RPDs, DI spike recovery and the Standard Reference Material recovery.

ACQUISITION, REDUCTION, VALIDATION AND REPORTING OF DATA

Data acquisition and reduction consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. The complexity of the data reduction will be dependent on the specific analytical method and the

number of discrete operations (e.g., extractions, dilutions, or concentrations) involved in obtaining a sample that can be measured. The analyst will reduce or calculate all raw data into the final reportable values. Copies of all raw data and the laboratory notebooks and record files will be retained to allow reconstruction of the data reduction process at a later date if necessary.
System reviews are performed at all levels. The analyst constantly reviews the quality of data through calibration checks, QC sample results and performance evaluation samples. Data that fails to meet the criteria specified is noted and reanalysis may be necessary. Unusual or unexpected results are reviewed and a resolution is made as to whether the analysis should be repeated.
Reports will contain sample ID number, date/time collected, units, and final results. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. In addition, special analytical problems and/or modifications of reference methods will be noted. Data in these reports will be manually transferred from analyst's report into an Electronic Data Transfer file (e.g., Excel spreadsheet). These files are proofed three times: once on screen, once off of hard copy, and final hard copy proof by analyst.. A hard copy of the report is retained on file as well as a back-up electronic file on CD.

INTERNAL QUALITY CONTROL CHECKS

1. One important quality control check for all assays is the standard curve slope value. This value should remain consistent from one assay to the next. Slope values are tracked using control charts. An average standard curve slope is plotted on the chart, sandwiched between two levels of limitations. The warning limits are defined as ±1.5sx from the average slope. The control limits are defined as ±3sx from the average slope value. When assay slopes fall outside the control limits, the entire run is automatically done again. After each analysis, the standard curve slope is plotted one appropriate chart. Once every six months, the limits are updated to include data from analyses. of the previous six months. At least 10 new data points must be plotted in the six month period to initiate the update.

2. The statistics pertaining to the standard curve of each assay are recorded on a Standard Curve Statistical Summary Form. The structural curve slope, Y-intercept, correlation coefficient, and standard range are noted.

3. The concentrations of duplicates are recorded on the Relative Percent Difference Worksheet.

4. The reagent blank values for each assay are recorded on the Method Blank Absorbance Summary Form.

5. The spike concentrations are noted on the Matrix Recovery Worksheet and the percent recovery from each assay is calculated.

6. Calibration verification using either an independent source stock solution or a standard reference material are recorded. The percent difference between the actual value and the assay value is calculated.

For each chemical assay, a spike and a duplicate will be run with each 20 samples. Also, a Standard Reference Material (SRM) will be run with each assay. The duplicates are evaluated. The goal of our lab is to have the Relative Percent Difference (RPD) fall within 15% of 100%. If the 15% RPD criterion is exceeded in more than two individual runs, checks are made for contamination. The dups will be rerun.

Spike recoveries are used to monitor matrix interferences and method accuracy. The goal for our lab is to have spike recoveries fall within ±20% of 100% for SRP, TP, and NH3; and within ±25% NO3/NO2 and TKN. If the criterion is not met, the spike will be rerun and noted.

PERFORMANCE AND SYSTEM AUDITS

External quality control checks for accuracy provide information for laboratory evaluation. We routinely participate in interlaboratory proficiency checks on replicate samples (splits).

Biannual reference samples are received from the U.S. Geological Survey, Western Region. This Round Robin analysis of reference samples for ammonia, nitrate/nitrite, orthophosphate, total phosphorus, and Kjeldahl nitrogen test our laboratory’s ability to obtain accurate and acceptable results. The concentration of each analyte is unknown to the analyst.

PREVENTIVE MAINTENANCE

Preventive maintenance is performed on each piece of equipment as specified in that equipment's manufacturer's manual and as mentioned in the Calibration Procedures section of this Quality Assurance Manual on pages 4-5.

ASSESSMENT OF PRECISION AND ACCURACY

Precision and accuracy are determined from the results of the routine batch quality control (QC) samples. The samples are duplicates or matrix spike duplicates

and matrix spikes.

Precision is defined as the measure of the mutual agreement among individual measurements of the same chemical constituent in a sample (duplicates) secured under the same analytical protocols.

Laboratory precision will be expressed as relative percent difference (RPD) of the duplicate sample values.

$$RPD = \frac{|A - B|(2)}{A + B} \times 100$$

A = First sample value of duplicate analysis

B - Second sample value of duplicate analysis

The acceptance limits are set based on the nature of the material being analyzed (sample or standard) and are found in each SOP. Samples that fall outside the respective limits are reanalyzed.

Accuracy is defined as the degree of agreement of a measured value with the true value of the quantity of concern. Accuracy will be measured as percent recovery for lab control samples or matrix spikes as the primary criteria and percent recovery of the surrogate spikes as a secondary QC criteria for applicable analyses.

$$\text{Percent Recovery} = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR - Spike sample result

SR = Sample result

SA = Spike added from spiking standard

CORRECTIVE ACTION

Matrix Problems

The sample matrix will limit the analytical certainty. Matrix problems include chemical or physical interferences (particulates). Typically it is best to eliminate the interference form the matrix, if possible. Particulates, for example, might be

removed through filtration or lessened through dilution of the original matrix. Chemical interferences might be removed through precipitation of the interferences, pH changes, or lessened through dilution of the original matrix.

One indication of a matrix problem is poor spike recoveries and/or poor precision between duplicates. To confirm a suspected matrix problem, you can perform a standard addition where standards are made up in the matrix rather than DDW water. When the sample concentrations are calculated from the matrix-standard curve, the spike recoveries should be close to 100%.

Precision Problems

When numerous duplicate samples have poor replication this could be attributed to one or more potential problems. First, as mentioned above, check the sample homogeneity. Does the sample have particulates that limit the effectiveness of sub sampling duplicates? If so, try to remove the particulates or lessen the impact by diluting the original sample. Mix the sample continuously while pipetting to ensure homogeneity.

Second, poor replication may be diagnostic of changes that are occurring in your samples over time. If the duplicates are correctly set up in the assay, they should not be run one next to the other. Thus, if poor replication can be attributed to nothing other than time, take a careful look at the method instructions. Has the color been allowed to develop in the samples to full intensity before reading them? Have the reagents in the sample been completely mixed to enhance homogeneous color development?

Third, poor replication may also be an indication of spot contamination. The assay procedures may be prone to cross-contamination (such as TKN) where it is very difficult to control the source of contamination or the analyst may be causing contamination by careless habits.

Accuracy Problems

There are two QC tests for accuracy within a run that can indicate problems: spike recoveries and calibration verification (SRM). Poor spike recoveries can indicate matrix problems, incorrect or low spike additions relative to the sample concentration, inaccurate pipette calibrations, or method procedural inadequacies. If the calibration verification sample has poor agreement with the known value, this indicates method failure. Review the chemical principles of the method and try to diagnose what portion of the assay is suspect. One suggestion for a diagnostic tool is to spike sample replicates at different times in the assay to determine where the analyte is lost. This is an effective tool to monitor the procedural methods. Never alter the matrix (i.e. by dilution) when you are performing this test.

Contamination Problems

Laboratory contaminants, other than spot contamination, are introduced in a variety of ways. The contamination can affect all the samples and standards or only the method blanks. The most common suspect of contamination to all the samples *and* the standards is a reagent contamination. If all the standards have high absorbencies, you can assume that all the samples have similarly been contaminated.

Try to identify the suspect reagent and *replace only this reagent* in the next run. If the problem is not solved, select another reagent, replace, and rerun the assay. It is important to replace only one reagent at a time in order to diagnose the original source of contamination.

If only the method blanks have high absorbencies, this indicates possible DI contamination. However, the standards are also prepared form the same DI so all of the standard curve absorbances would be higher than usual.

Rerun Procedures:

Save all the sample bottles and insure that they are stored appropriately. It may be helpful to do a smaller run. Carefully consider the type(s) of problem with the initial run. If you can pinpoint the source of the error it will save time and effort. Fill out new data sheets, making a notation that this is a rerun. If possible, list any changes made to hopefully improve the performance of the next run. To monitor the performance of the run, try any or all of the following changes: increase the number of duplicates, increase the number of spikes, increase the number of standards. Check the results from this rerun carefully. Monitor the quality control samples. Check to make sure that the paired samples have appropriate values, i.e., totals>soluble.

QUALITY ASSURANCE REPORTS

QA reports include analysis date, lab duplicate relative percent difference, matrix spike recoveries, standard reference material relative percent difference and DI spike recovery percentage.