Quality Assurance Project Plan

Screening Investigation of Water and Sediment Quality in Creeks from Ten Washington Mining Districts

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October 2002

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Approvals:

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Abstract

This screening-level study is designed to characterize water and sediments in streams in the vicinity of selected inactive or abandoned metals mines or mining districts. Drainage from a few selected mines may also be opportunistically sampled to compare to the adjacent stream chemistry. The study will be conducted by staff from the Department of Ecology's Environmental Assessment and Water Quality Programs along with the Department of Natural Resources Division of Geology and Earth Resources. This study is similar in design to two previous studies conducted by the same staff in 1997 and 2000.

Candidate mining districts were screened based on information in a database of inactive and abandoned mines created and maintained by the Washington Department of Natural Resources. Districts were selected based on the size of the mines or dominant mine in the district, variations in geologic host rock among districts, presence of tailings in or adjacent to a stream, the primary and secondary minerals in the ore deposit, geographic distribution of districts around the state, and a consideration for including some high elevation sample sites.

The water quality emphasis for this study is the EPA ultra-clean sampling and low-level analysis methods for metals in surface water. General chemistry and field parameters will be obtained concurrently with the metals and sediment samples. Water and sediment samples will be collected upstream and downstream of each mining district during fall 2002 for low flow conditions and water samples will be collected during spring 2003. Results will be compared upstream to downstream, seasonally, and to state surface water quality standards and sediment quality guidelines.

Background

According to the Washington Department of Natural Resources (DNR), there are nearly four thousand inactive and abandoned metals mines in Washington State (Wolff et al., 2001). Discharges of water and sediment contaminated with metals from some mine adits, waste rock, and tailings piles have adversely impacted streams and rivers that drain metals mining districts. The purpose of this study is to do screening-level sampling of water and sediments in streams in the vicinity of selected inactive or abandoned metals mines or mining districts. Drainage from a few selected mines may also be sampled to compare to the adjacent stream chemistry.

This project is an extension of two similar studies jointly conducted by staff from the Washington State Department of Ecology (Ecology) Central Regional Office Water Quality Program, Ecology Environmental Assessment Program, and DNR Geology Division (Raforth et al., 2000; Raforth et al., 2002). Results from one of these earlier studies included discovery of water quality standards exceedences from a mine and mill that are now scheduled for cleanup by EPA and the Ecology Toxics Cleanup Program. Both studies identified sites that exceeded water quality and/or sediment quality standards and merit follow-up work.

Project Description

Ten mining districts have been selected for this study through review of information available in DNR's database of abandoned mines and consultation with DNR staff (Table 1). This study would characterize mining districts not previously investigated using the ultra-clean sampling procedure. Districts were selected based on the size of the mines or dominant mine in the district, variations in geologic host rock among districts, presence of tailings in or adjacent to a drainage, and the primary and secondary minerals in the ore deposit. Within those selection criteria, we also attempted to distribute districts around the state and include some high elevation samples (Figure 1).

Table 1. Sample Locations

Mining District	County
Mount Baker	Whatcom
Index	Snohomish
Money Creek	King
Blewett	Chelan
Wenatchee	Chelan
Chiwawa	Chelan
Republic	Ferry
Chewelah	Stevens
Metaline*	Pend Oreille
Metaline**	Pend Oreille

* Metaline Area
** Sullivan Area

Sampling will be conducted upstream and downstream at each mining district, during low flow in the fall of 2002 and high flow in the spring of 2003. Mine water draining to surface water from up to five individual mines may be sampled to compare to stream water quality. Results will be compared to state water quality standards for aquatic life (WAC 173-201A), EPA national water quality criteria (EPA, 1999), and to guidelines for freshwater sediments (Cubbage et al., 1997; MacDonald et al., 2000). This study will implement sampling recommendations from the previous work, including seasonality investigations and fingerprinting mine impacts through the use of the ratio of sulfate to total dissolved solids.

The emphasis for this study will be use of the EPA (1995) ultra-clean sampling procedure for metals in surface water. Metals to be analyzed in water are arsenic, cadmium, copper, lead, zinc, aluminum, iron, and mercury. General chemistry analyses for surface water samples will include hardness, sulfate, total suspended solids (TSS), total dissolved solids (TDS), and turbidity. Temperature, pH, and conductivity will be measured for each sampling event. Upstream and downstream sediment quality will be evaluated from samples obtained during the low flow sampling and analyzed for EPA priority pollutant metals (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn), iron, manganese, and aluminum. Fine-grain material will be preferentially sampled.

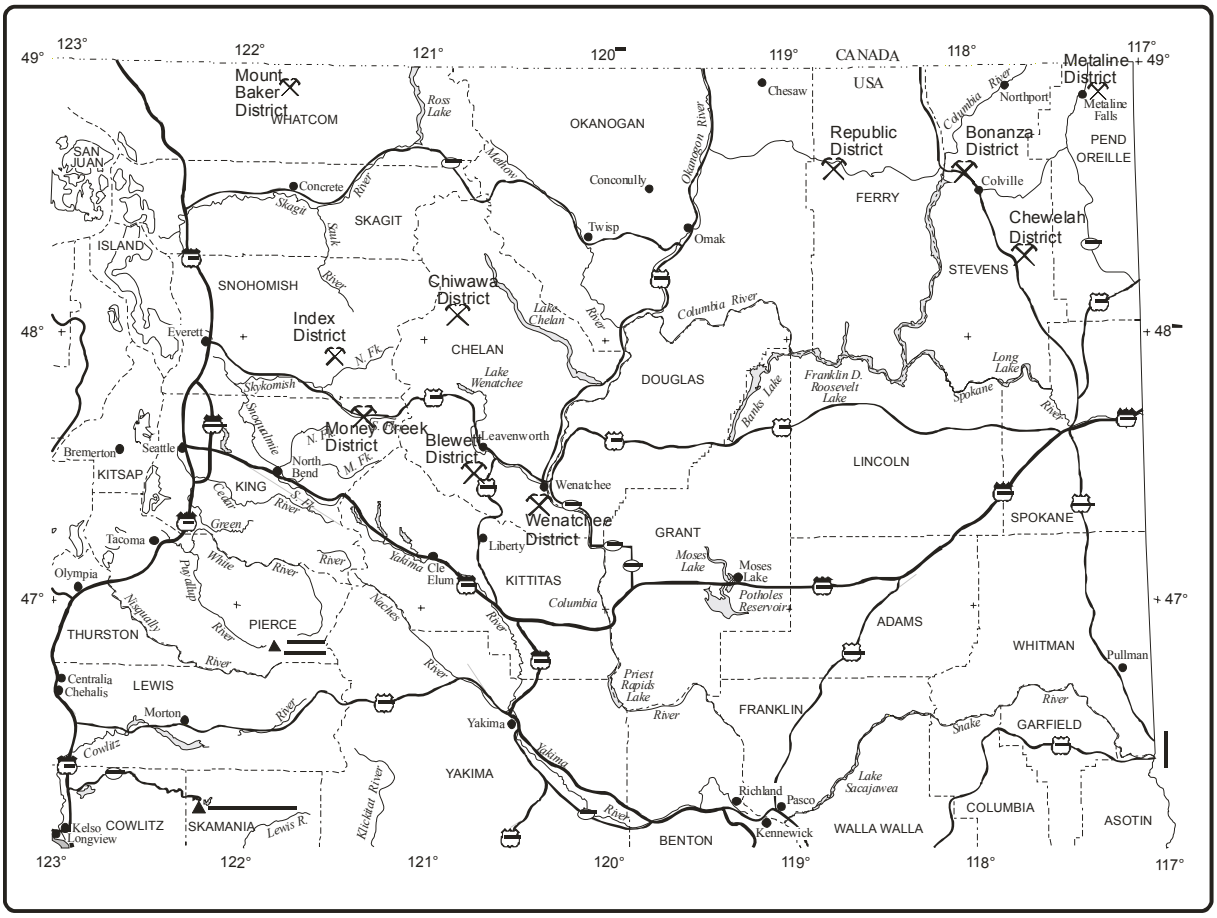

Figure 1

Note regarding Figure 1: During the course of conducting field work for this project, the Bonanza samples were dropped in favor of sampling the Metaline Area and the Sullivan Area in the Metaline District, Pend Orielle County, as indicated in Table 1.

Data obtained through this effort will be supplied to the Ecology regional offices for their use in permitting, watershed evaluation and planning, and to establish a baseline for TMDL studies. The data will also contribute to a database maintained by DNR that documents available information from state and federal agencies on abandoned mines in Washington.

Organization and Schedule

Project Lead - Bob Raforth (509-457-7113)
Technical Assistance - Art Johnson (360-407-6766)
DNR Cooperator - Dave Norman (360-902-1439)
Manchester Laboratory Director - Stuart Magoon (360-871-8801)
Manchester Inorganics Unit Leader- Dean Momohara (360-871-8808)
Quality Assurance Officer - Cliff Kirchmer (360-407-6455)
Watershed Ecology Section Manager - Will Kendra (360-407-6698)
Toxic Studies Unit Supervisor - Dale Norton (360-407-6765)
CRO WQP Section Manager - Tom Tebb (509-457-7107)

September 30 - October 8, 2002	Fall Sample Collection
November 25, 2002	Sample Analyses Completed and Data Reported
April - May 2003	Spring Sample Collection
July 2003	Sample Analyses Completed and Data Reported
November 2003	Draft Project Report
January 2004	Final Project Report
February 2004	Date Entered Into EIM

Data Quality Objectives

Table 2 shows the state water quality standards and EPA national criteria that the metals data will be compared to. The hardness-dependent standards for dissolved cadmium, copper, lead, and zinc are the lowest that might reasonably be encountered, based on results from the "Ten Mines Study" (Raforth et al., 2000). Results from the temperature, pH, and turbidity measurements will also be compared to state standards (Table 3).

Table 2. Applicable Water Quality Standards and Criteria for Metals
[dissolved standards calculated for a hardness of 10 mg/L]

Metal	Acute (ug/L)	Chronic (ug/L)
Washington State Surface Water Standards (WAC 173-201A)		
Arsenic - dissolved	360	190
Zinc - dissolved	16	15
Lead - dissolved	4.9	0.19
Copper - dissolved	1.9	1.6
Cadmium - dissolved	0.3	0.19
Mercury - total	no standard	0.012
Mercury - dissolved	2.1	no standard
EPA (1999) National Criteria		
Iron - total recoverable	no criterion	1,000
Aluminum - total recoverable*	750	87

*at pH of 6.5 - 9.0

Table 3. Applicable State Water Quality Standards for Temperature, pH, and Turbidity [WAC 173-201A]

Parameter	Class AA (Extraordinary)	Class A (Excellent)
Temperature	Shall not exceed 16.0°C due to human activities, When natural conditions exceed 18°C. no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C.	Shall not exceed 18.0°C due to human activities, When natural conditions exceed 18.0°C no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C.
pH	Shall be within the range of 6.5 - 8.5 with a human caused variation within the above range of less than 0.2 units	Shall be within the range of 6.5 - 8.5 with a human caused variation within the above range of less than 0.5 units
Turbidity	Shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.	Shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

The state standards do not address TSS, except indirectly by way of the turbidity standard. The National Academy of Sciences (1973) considers the level of protection afforded aquatic communities to vary with TSS as follows:

- <25 mg/L - high
- 25 to 80 mg/L - moderate
- 80 to 400 mg/L - low
- >400 mg/L - very low

There are no Washington State standards or EPA national criteria for chemical contaminants in freshwater sediments. Two sets of sediment quality guidelines (Table 4) will be used to assess the potential metals toxicity of stream sediments in mining districts: the lowest apparent effect thresholds of Cubbage et al. (1997) and the consensus-based effect concentrations of MacDonald et al. (2000). Cubbage's thresholds were developed from bioassay data on Washington State sediments. MacDonald's effect concentrations come from a national data set on sediment bioassays and alteration of the benthic invertebrate community.

Table 4. Guidelines on Metals in Freshwater Sediments (mg/Kg, dry)

Metal	Values Based on Wash. St. Data[a]	National Consensus-Based Values[b]	
	Lowest Apparent Effects Threshold	Threshold Effect Concentrations	Probable Effect Concentrations
Iron[c]	- -	- -	- -
Aluminum[d]	- -	- -	- -
Manganese	1800	- -	
Zinc	520	121	459
Lead	260	36	128
Copper	840	32	149
Chromium	280	43	111
Nickel	46	23	49
Cadmium	7.6	0.99	5.0
Arsenic	40	9.8	33
Silver	4.5	- -	- -
Antimony	3	- -	- -
Mercury	0.56	0.18	1.1
Selenium	- -	- -	- -
Beryllium	- -	- -	- -
Thallium	- -	- -	- -

-- None available

[a]Cubbage et al. (1997)

[b]MacDonald et al. (2000)

[c]Persaud et al. (1993) proposed a severe effect level of 40,000 mg/Kg for iron

[d]Ingersoll et al. (1996) proposed an effects range medium of 58,000 mg/Kg for aluminum

Tables 5 (water) and 6 (sediment) list project targets for accuracy, precision, bias, and required reporting limits. Sources of error from sampling collection, transportation, and storage will be minimized by adherence to EPA Method 1669 for water, and PSEP Protocols (EPA, 1996) and requirements of the Ecology Sediment Management Standards (Ecology, 1995a,b) for sediment.

Table 5. Measurement Quality Objectives - Water

Parameter	Accuracy (% deviation from true value)	Precision (RSD)	Bias (% of true value)	Required Reporting Limit
Aluminum	30%	10%	10%	20 ug/L
Iron	30%	10%	10%	50 ug/L
Arsenic	30%	10%	10%	0.1 ug/L
Zinc	30%	10%	10%	0.5 ug/L
Lead	30%	10%	10%	0.02 ug/L
Copper	30%	10%	10%	0.1 ug/L
Cadmium	30%	10%	10%	0.02 ug/L
Mercury	30%	10%	10%	0.002 ug/L
Hardness	15%	5%	5%	1 mg/L
TSS	15%	5%	5%	1 mg/L
TDS	15%	5%	5%	1 mg/L
Sulfate	15%	5%	5%	1 mg/L
Turbidity	15%	5%	5%	0.5 NTU

Table 6. Measurement Quality Objectives - Sediment

Parameter	Accuracy (% deviation from true value)	Precision (RSD)	Bias (% of true value)	Required Reporting Limit
Iron	50%	20%	10%	5 mg/Kg
Aluminum	50%	20%	10%	5 mg/Kg
Manganese	50%	20%	10%	5 mg/Kg
Zinc	50%	20%	10%	5 mg/Kg
Lead	50%	20%	10%	5 mg/Kg
Copper	50%	20%	10%	1 mg/Kg
Chromium	50%	20%	10%	1 mg/Kg
Nickel	50%	20%	10%	1 mg/Kg
Cadmium	50%	20%	10%	0.5 mg/Kg
Arsenic	50%	20%	10%	0.5 mg/Kg
Silver	50%	20%	10%	2 mg/Kg
Antimony	100%	40%	20%	5 mg/Kg
Mercury	50%	20%	10%	0.005 mg/Kg
Selenium	50%	20%	10%	0.3 mg/Kg
Beryllium	50%	20%	10%	0.5 mg/Kg
Thallium	100%	40%	20%	0.3 mg/Kg

The reporting limits are based on past performance by Manchester Laboratory, using the methods selected for this project. To minimize the effect of measurement imprecision when comparing the data to environmental criteria, detection limits should be 10 times lower than the criteria in question (Cliff Kirchmer, personal communication). This rule of thumb is generally met by these reporting limits, with the exception of the limits for mercury in water, and silver and antimony in sediment, which are the lowest currently available through Manchester.

Sampling Design

A conceptual water quality model for determining impacts to receiving waters from acid rock drainage (ARD) has been developed from interpreting the results of previous studies (Raforth et al., 2000; Raforth et al., 2002). This model for streams draining metals mining districts is based on seasonal variations in water quality caused by flushing mine workings, tailings, and waste rock during spring freshet.

This sampling program is designed to account for the anticipated seasonal effect of ARD. Water quality samples and field measurements will be obtained at each sample site twice during this study. The first samples and field data will be be collected during low stream flow conditions expected in September or October 2002. The same sample sites will be resampled during high stream flow conditions in May or June 2003. Sediment quality samples will only be collected during low stream flow conditions.

The conceptual water quality model also predicts that the ratio of sulfate to total dissolved solids is important for predicting impacts to receiving waters. This sampling program will continue to gather data toward confirming the utility of the ratio. Other parameters that will be analyzed in water samples and in sediments were recommended from the previous studies. These parameters were considered to be indicators of ARD or other impacts from mining operations.

Table 7 shows the number of samples to be collected and the estimated cost of laboratory analysis.

Table 7. Number of Samples and Laboratory Cost Estimate

Sample Type	Analysis	No. of Samples*	Sampling Periods**	Total Samples	Cost per Sample	Cost Subtotals
Water						
Field Samples	Diss. As,Cd,Cu,Pb,Zn	25	2	50	112	5600
"	Tot. Rec. Al, Fe	25	2	50	58	2900
"	Total Hg	25	2	50	70	3500
"	Hardness	25	2	50	14	700
"	TDS	25	2	50	10	500
"	TSS	25	2	50	10	500
"	Sulfate	25	2	50	12	600
"	Turbidity	25	2	50	7	350
Replicate Samples	Diss. As,Cd,Cu,Pb,Zn	4	2	8	112	996
"	Tot. Rec. Al, Fe	4	2	8	58	232
"	Total Hg	4	2	8	70	560
"	Hardness	4	2	8	14	112
"	TDS	4	2	8	10	80
"	TSS	4	2	8	10	80
"	Sulfate	4	2	8	12	96
"	Turbidity	4	2	8	7	56
Filter Blanks	Diss. As,Cd,Cu,Pb,Zn	2	2	4	112	448
Bottle Blanks	Tot. Rec. Al, Fe	2	2	4	58	232
"	Total Hg	2	2	4	70	280
Matrix Spikes	Metals	2	2	4	240	960
SRM	Diss Metals	2	2	4	112	448
					+0.45 um filters @$24 ea =	1706
					+500 mL Teflon bottles @$16 ea =	1856
					+Teflon acid vials @ $8 ea =	928
Sediment						
Field Samples	Priority Metals,Al,Fe,Mn	20	1	20	221	4420
Matrix Spikes	Priority Metals,Al,Fe,Mn	2	1	2	221	442
Replicates	Priority Metals,Al,Fe,Mn	4	1	4	221	884
					TOTAL LAB COST*** =	$29,466

*10 mining districts, 2 sampling sites/district, and 5 mine discharges (water only)

**low flow and high flow

***Costs include 50% price discount for Manchester Lab

Field Procedures

Recommended minimum sample sizes, containers, preservation procedures, and holding times for the parameters being analyzed in this study are shown in Table 8.

Table 8. Field Procedures

Parameter	Sample Size	Container	Preservation	Holding Time
Water				
Mercury	500 mL	500 mL Teflon bottle	HNO3 to pH<2, 4°C	28 days
Other metals	500 mL	500 mL Teflon bottle	HNO3 to pH<2, 4°C	6 months
Hardness	100 mL	125 mL poly bottle	HNO3 to pH<2, 4°C	6 months
TSS	1000 mL	1000 mL poly bottle	Cool to 4°C	7 days
TDS	250 mL	1000 mL poly bottle	Cool to 4°C	7 days
Sulfate	100 mL	1000 mL poly bottle	Cool to 4°C	28 days
Turbidity	100 mL	1000 mL poly bottle	Cool to 4°C	48 hours
Sediment				
Mercury	100 grams	8 oz. glass jar/Teflon lid	Cool to 4°C	28 days
Other metals	50 grams	8 oz. glass jar/Teflon lid	Cool to 4°C	6 months

Sampling methods for metals in water will follow the guidance in EPA Method 1669. Sampling methods for sediment will be consistent with Puget Sound Estuary Program Protocols (EPA, 1996) and requirements of the Ecology Sediment Management Standards (Ecology, 1995a,b). Chain of custody will be maintained.

All water samples will be collected as simple grab samples. Water samples for metals analyses will be collected directly into pre-cleaned 500 mL Teflon bottles. Samples for dissolved metals will be vacuum-filtered in the field through a disposable 0.45 um cellulose nitrate filter (#450-0045, type S). Non-talc, disposable gloves will be worn during the filtering procedure. The filtrate will be transferred to a clean Teflon bottle and preserved to pH <2 with sub-boiled 1:1 nitric acid, carried in small 5 mL Teflon vials, one per sample. Unfiltered water samples for aluminum, iron, and mercury will be preserved in the same manner.

Teflon sample bottles will be supplied by Manchester, cleaned as described in Kammin et al. (1995), and sealed in plastic bags. Each metals sample will be placed in double plastic bags and all samples will be held on ice for transport to Manchester Laboratory. General chemistry samples will be collected in 1-liter polyethylene bottles, also obtained from Manchester.

Sediment samples will be composites of multiple grabs taken with stainless steel scoops and homogenized in the field in stainless steel bowls. Sampling equipment will be cleaned by washing with Liquinox detergent and sequential rinses with tap water, dilute 10% nitric acid, and deionized (DI) water. The homogenate will be split into glass jars with Teflon lid liners and cleaned to EPA QA/QC specifications (EPA, 1990). Field observations will be recorded as to whether the sediment samples are predominantly gravel, sand, or silt.

Field measurements for pH, conductivity, and temperature will be obtained with a YSI Model 63 meter. The pH meter will be calibrated daily. Streamflow measurements will be made with a Marsh-McBirney flow meter and top-setting rod or estimated using best professional judgment or alternative measurement methods. Station positions will be recorded from a hand-held GPS and topographic maps.

Laboratory Procedures

Sample analysis will be conducted by Manchester Laboratory following the laboratory procedures listed in Tables 9 and 10. Methods other than those listed may be employed after consulting with the project lead.

Table 9. Laboratory Procedures - Water

Analyte	Sample Matrix	Number of Samples	Expected Range of Results	Sample Prep Method	Analytical Method
Arsenic	filtered water	29	<0.1 - 50 ug/L	analyze directly	EPA 200.8
Zinc	filtered water	29	1 - 10,000 ug/L	analyze directly	EPA 200.8
Lead	filtered water	29	<0.02 - 5 ug/L	analyze directly	EPA 200.8
Copper	filtered water	29	<0.05 - 10 ug/L	analyze directly	EPA 200.8
Cadmium	filtered water	29	<0.02 - 5 ug/L	analyze directly	EPA 200.8
Aluminum	whole water	29	<20 - 10,000 ug/L	EPA 200.7[a]	EPA 200.7[a]
Iron	whole water	29	<20 - 10,000 ug/L	EPA 200.7[a]	EPA 200.7[a]
Mercury	whole water	29	<0.002 - 0.1 ug/L	EPA 245.7[b]	EPA 245.7[b]
Hardness	whole water	29	10 - 1,000 mg/L	N/A	SM2340B
TSS	whole water	29	1 - 500 ug/L	N/A	EPA 160.2
TDS	whole water	29	1 - 1,000 ug/L	N/A	EPA 160.1
Sulfate	whole water	29	<0.5 - 1,000 mg/L	N/A	EPA 300.0
Turbidity	whole water	29	<1 - 100 NTU	N/A	EPA 180.1

[a]an ICP method modified by Manchester for ICP/MS
[b]aCVAF method modified by Manchester for CVAA

Table 10. Laboratory Procedures - Sediment

Analyte	Sample Matrix	Number of Samples	Expected Range of Results	Sample Prep Method	Analytical Method
Mercury	sediment	24	<0.005 - 100 mg/Kg	EPA 245.5	EPA 245.5
Arsenic	sediment	24	<0.3 - 1,000 mg/Kg	EPA SW3050	EPA SW6020
Lead	sediment	24	<5 - 500 mg/Kg	EPA SW3050	EPA SW6020
Selenium	sediment	24	<0.3 - 5 mg/Kg	EPA SW3050	EPA SW6020
Thallium	sediment	24	<0.3 - 1 mg/kg	EPA SW3050	EPA SW6020
Iron	sediment	24	5,000 - 50,000 mg/Kg	EPA SW3050	EPA SW6010
Aluminum	sediment	24	5,000 - 50,000 mg/Kg	EPA SW3050	EPA SW6010
Manganese	sediment	24	100 - 5,000 mg/Kg	EPA SW3050	EPA SW6010
Zinc	sediment	24	10 - 5,000 mg/Kg	EPA SW3050	EPA SW6010
Copper	sediment	24	5 - 5,000 mg/Kg	EPA SW3050	EPA SW6010
Chromium	sediment	24	5 - 100 mg/Kg	EPA SW3050	EPA SW6010
Nickel	sediment	24	5 - 50 mg/Kg	EPA SW3050	EPA SW6010
Cadmium	sediment	24	<0.5 - 100 mg/Kg	EPA SW3050	EPA SW6010
Silver	sediment	24	<2 - 10 mg/Kg	EPA SW3050	EPA SW6010
Antimony	sediment	24	<5 - 10 mg/Kg	EPA SW3050	EPA SW6010
Beryllium	sediment	24	<0.5 - 5 mg/Kg	EPA SW3050	EPA SW6010

Quality Control

The QC samples to be analyzed for this project are shown in Table 11.

Table 11. QC Procedures

Matrix / Parameter	Field QC Samples: Replicate	Bottle Blank	Filter Blank	Laboratory QC Samples: LCS	SRM	Check Standards	Method Blanks	Analytical Duplicates	MS/MSD
Water									
Metals	4	2	2	1/batch	1/batch	1/batch	1/batch	NA	1/batch
Hardness	4	NA	NA	1/batch	1/batch	1/batch	1/batch	1/batch	NA
SS	4	NA	NA	1/batch	1/batch	1/batch	1/batch	1/batch	NA
TDS	4	NA	NA	1/batch	1/batch	1/batch	1/batch	1/batch	NA
Sulfate	4	NA	NA	1/batch	1/batch	1/batch	1/batch	1/batch	NA
Turbidity	4	NA	NA	1/batch	1/batch	1/batch	1/batch	1/batch	NA
Sediment									
Metals	4	NA	NA	1/batch	1/batch	1/batch	NA	1/batch	1/batch

Field QC

Field QC samples for water will include bottle blanks, filter blanks, and replicate samples. Replicate samples will also be collected for sediment.

The blanks will be used to check for metals contamination arising from sample containers, preservative, or the filtration procedure. Bottle blanks will consist of 500 mL Teflon bottles cleaned and filled with DI water at Manchester, as previously described. Filter blanks will be prepared by filtering the contents of a DI-filled Teflon bottle. One pair of bottle and filter blanks each will be prepared for the low-flow and high-flow field work.

The total variability of the metals and conventional water quality data for this project (field + laboratory) will be assessed by collecting selected samples in replicate. The replicates will consist of four separate sets of samples collected five-to-ten minutes apart. For the fall (low flow) field work, replicate water and replicate sediment samples will be collected at two of the 20 sampling sites for a total of four samples each for water and sediment. The lab will analyze one of each of the eight replicate pairs in duplicate. One contaminated site and one upstream site

will be sampled in replicate. This procedure will be followed for the high flow sampling for water samples at different sites than the fall replicates.

Laboratory QC

Metals QC samples to be analyzed with each set of water samples will include a standard reference material (SRM) certified for low metals concentrations in river water (NRCC SLRS-4 and NIST 1641d (mercury), or equivalent SRMs), a laboratory control sample (LCS), a matrix spike and spike duplicate, and a method blank.

Laboratory QC samples for metals in sediment will use the Environmental Resource Associates "Trace Metals in Soil" QC Lot 247 as a SRM, a duplicate sample analysis (lab split), a matrix spike and spike duplicate, and a method blank.

Data Review, Verification, and Validation

Manchester lab will verify all data before reporting the results to the project lead. The project lead will review Manchester's data and case narratives for errors or omissions and to ensure that the narratives accurately describe compliance of QC results with acceptance criteria. Data validation will be done by the project lead using professional judgment as to whether Manchester followed the procedures in the Quality Assurance (QA) Project Plan and that the data requirements for this project have been met.

Data Quality Assessment

Once it has been determined that the data are satisfactory, the metals data will be screened for exceedences of environmental criteria. The water quality standards will be calculated with the most recent revision of Ecology's TSDCALC9.XLW spreadsheet, using the corresponding hardness value for dissolved metals.

Due to the screening-level nature of this investigation, with only one upstream and one downstream sample typically being collected for each site in the fall and again in the spring (water only), statistical testing for significant differences will not be possible. Identification of sites impacted by mining will be made by a simple comparison of upstream and downstream values, taking the estimates of field and laboratory variability from replicate and duplicate samples into account. If the difference between upstream and downstream samples is similar to or less than the difference in replicate/duplicate samples, we would caution the reader that the differences may not be significant.

Reporting

The project lead will prepare a draft report of the overall study by March 2004. The report will contain:

- a map of the study area showing sampling sites
- latitude/longitude and other location information for each sampling site
- descriptions of field and laboratory methods
- a discussion of data quality, estimates of precision and bias, and the significance of any problems encountered in the analyses
- summary tables of the metals and ancillary data
- an evaluation of significant findings with respect to exceedences of standards and guidelines, differences within and between mining districts, seasonality, sulfate:TDS ratios, comparison with previous mine studies, and additional data interpretation as appropriate
- recommendations for follow-up work if warranted

A final report will be prepared after receiving review comments from CRO, DNR, and Environmental Assessment (EA) Program. The goal is to have the revised, final report completed on or before January 2004. The data will be entered into Ecology's Environmental Information Management (EIM) system by February 2004.

References

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